Purchasing Divison
2019 Washington Street East
Post Office Box 50130
Charleston, WV 25305-0130

State of West Virginia
Request for Quotation
10 — Consulting

Proc Folder: 202807

Doc Description: Addendum 1 - Environmental Risk Assessment

Proc Type: Central Master Agreement

Date Issued	Solicitation Closes	Solicitation No	Version
2016-09-01	2016-09-14 13:30:00	CRFQ 0313 DEP1700000002	2

BID RECEIVING LOCATION

BID CLERK
DEPARTMENT OF ADMINISTRATION
PURCHASING DIVISION
2019 WASHINGTON ST E
CHARLESTON WV 25305
US

VENDOR

Vendor Name, Address and Telephone Number:

The Mahfood Group LLC
1061 Waterdam Plaza Drive, Suite 201
McMurray, PA 15317
724-260-5219

09/07/16 13:53:56
WV Purchasing Division

FOR INFORMATION CONTACT THE BUYER

Jessica S Chambers
(304) 558-0246
jessica.s.chambers@wv.gov

Signature X [signature] **FEIN #** 20-8745410 **DATE** 09/07/2016

All offers subject to all terms and conditions contained in this solicitation

FORM ID : WV-PRC-CRFQ-001

ADDITIONAL INFORMAITON:

Addendum

Addendum No. 1 issued to publish and distribute the attached information to the vendor community.
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The West Virginia Purchasing Division is soliciting bids on behalf of the West Virginia Department of Environmental Protection (WVDEP) to establish an open-end contract for an Environmental Risk Assessor to determine ecological and human health risks that may be associated with projects in the WVDEP Voluntary Remediation and Redevelopment Program.

INVOICE TO	SHIP TO
ENVIRONMENTAL PROTECTION OFFICE OF ENVIRONMENTAL REMEDIATION 601 57TH ST SE CHARLESTON WV25304 US	ENVIRONMENTAL PROTECTION 601 57TH ST CHARLESTON WV 25304 US

Line	Comm Ln Desc	Qty	Unit Issue	Unit Price	Total Price
1	Risk or hazard assessment	700.00000	HOUR	$ 72.00	$ 50,400

Comm Code	Manufacturer	Specification	Model #
77101501			

Extended Description :

Environmental Risk Assessor

DEP1700000002	**Document Phase** **Final**	**Document Description** Addendum 1 - Environmental Risk Assessment	**Page 3 of 3**

ADDITIONAL TERMS AND CONDITIONS

See attached document(s) for additional Terms and Conditions

SOLICITATION NUMBER: CRFQ DEP1700000002
Addendum Number: 01

The purpose of this addendum is to modify the solicitation identified as ("Solicitation") to reflect the change(s) identified and described below.

Applicable Addendum Category:

[ ] Modify bid opening date and time

[ ] Modify specifications of product or service being sought

[✓] Attachment of vendor questions and responses

[ ] Attachment of pre-bid sign-in sheet

[ ] Correction of error

[ ] Other

Description of Modification to Solicitation:

This addendum is issued to modify the solicitation per the attached documentation and the following:

1. To publish the vendor questions and agency answers.

No other changes.

Additional Documentation: Documentation related to this Addendum (if any) has been included herewith as Attachment A and is specifically incorporated herein by reference.

Terms and Conditions:

1. All provisions of the Solicitation and other addenda not modified herein shall remain in full force and effect.

2. Vendor should acknowledge receipt of all addenda issued for this Solicitation by completing an Addendum Acknowledgment, a copy of which is included herewith. Failure to acknowledge addenda may result in bid disqualification. The addendum acknowledgement should be submitted with the bid to expedite document processing.

ATTACHMENT A

Environmental Risk Assessment
CRFQ DEP1700000002
Vendor Questions and Agency Answers

Q1.) Regarding the referenced RFQ; (VENDOR) is interested in submitting a bid, but would need to subcontract portions of the work (LRS, for example). Is this acceptable?

Also, is more (site/project-specific) information available?

A1.) Yes, subcontracting portions of the work is acceptable. No, site-specific information is not available as reports to be reviewed by the contracted risk assessor will be for varied projects across the state.

INSTRUCTIONS TO VENDORS SUBMITTING BIDS

1. REVIEW DOCUMENTS THOROUGHLY: The attached documents contain a solicitation for bids. Please read these instructions and all documents attached in their entirety. These instructions provide critical information about requirements that if overlooked could lead to disqualification of a Vendor's bid. All bids must be submitted in accordance with the provisions contained in these instructions and the Solicitation. Failure to do so may result in disqualification of Vendor's bid.

2. MANDATORY TERMS: The Solicitation may contain mandatory provisions identified by the use of the words "must," "will," and "shall." Failure to comply with a mandatory term in the Solicitation will result in bid disqualification.

3. PREBID MEETING: The item identified below shall apply to this Solicitation.

☑ A pre-bid meeting will not be held prior to bid opening

☐ A **NON-MANDATORY PRE-BID** meeting will be held at the following place and time:

☐ A **MANDATORY PRE-BID** meeting will be held at the following place and time:

All Vendors submitting a bid must attend the mandatory pre-bid meeting. Failure to attend the mandatory pre-bid meeting shall result in disqualification of the Vendor's bid. No one person attending the pre-bid meeting may represent more than one Vendor.

An attendance sheet provided at the pre-bid meeting shall serve as the official document verifying attendance. The State will not accept any other form of proof or documentation to verify attendance. Any person attending the pre-bid meeting on behalf of a Vendor must list on the attendance sheet his or her name and the name of the Vendor he or she is representing.

Additionally, the person attending the pre-bid meeting should include the Vendor's E-Mail address, phone number, and Fax number on the attendance sheet. It is the Vendor's responsibility to locate the attendance sheet and provide the required information. Failure to complete the attendance sheet as required may result in disqualification of Vendor's bid.

All Vendors should arrive prior to the starting time for the pre-bid. Vendors who arrive after the starting time but prior to the end of the pre-bid will be permitted to sign in, but are charged with knowing all matters discussed at the pre-bid.

Questions submitted at least five business days prior to a scheduled pre-bid will be discussed at the pre-bid meeting if possible. Any discussions or answers to questions at the pre-bid meeting are preliminary in nature and are non-binding. Official and binding answers to questions will be published in a written addendum to the Solicitation prior to bid opening.

4. VENDOR QUESTION DEADLINE: Vendors may submit questions relating to this Solicitation to the Purchasing Division. Questions must be submitted in writing. All questions must be submitted on or before the date listed below and to the address listed below in order to be considered. A written response will be published in a Solicitation addendum if a response is possible and appropriate. Non-written discussions, conversations, or questions and answers regarding this Solicitation are preliminary in nature and are nonbinding.

Submitted e-mails should have solicitation number in the subject line.

Question Submission Deadline: August 31, 2016 at 9:00 AM EST.

Submit Questions to: Jessica Chambers
2019 Washington Street, East
Charleston, WV 25305
Fax: (304) 558-4115 (Vendors should not use this fax number for bid submission)
Email: Jessica.S.Chambers@wv.gov

5. VERBAL COMMUNICATION: Any verbal communication between the Vendor and any State personnel is not binding, including verbal communication at the mandatory pre-bid conference. Only information issued in writing and added to the Solicitation by an official written addendum by the Purchasing Division is binding.

6. BID SUBMISSION: All bids must be submitted electronically through wvOASIS or signed and delivered by the Vendor to the Purchasing Division at the address listed below on or before the date and time of the bid opening. Any bid received by the Purchasing Division staff is considered to be in the possession of the Purchasing Division and will not be returned for any reason. The Purchasing Division will not accept bids, modification of bids, or addendum acknowledgment forms via e-mail. Acceptable delivery methods include electronic submission via wvOASIS, hand delivery, delivery by courier, or facsimile.

The bid delivery address is:
Department of Administration, Purchasing Division
2019 Washington Street East
Charleston, WV 25305-0130

A bid that is not submitted electronically through wvOASIS should contain the information listed below on the face of the envelope or the bid may be rejected by the Purchasing Division.:

SEALED BID:
BUYER:
SOLICITATION NO.:
BID OPENING DATE:
BID OPENING TIME:
FAX NUMBER:

The Purchasing Division may prohibit the submission of bids electronically through wvOASIS at its sole discretion. Such a prohibition will be contained and communicated in the wvOASIS system resulting in the Vendor's inability to submit bids through wvOASIS. Submission of a response to an Expression or Interest or Request for Proposal is not permitted in wvOASIS.

For Request For Proposal ("RFP") Responses Only: In the event that Vendor is responding to a request for proposal, the Vendor shall submit one original technical and one original cost proposal plus ____N/A____ convenience copies of each to the Purchasing Division at the address shown above. Additionally, the Vendor should identify the bid type as either a technical or cost proposal on the face of each bid envelope submitted in response to a request for proposal as follows:

BID TYPE: (This only applies to CRFP)
☐ Technical
☐ Cost

7. BID OPENING: Bids submitted in response to this Solicitation will be opened at the location identified below on the date and time listed below. Delivery of a bid after the bid opening date and time will result in bid disqualification. For purposes of this Solicitation, a bid is considered delivered when confirmation of delivery is provided by wvOASIS (in the case of electronic submission) or when the bid is time stamped by the official Purchasing Division time clock (in the case of hand delivery).

Bid Opening Date and Time: September 14, 2016 at 1:30 PM EST.

Bid Opening Location: Department of Administration, Purchasing Division
2019 Washington Street East
Charleston, WV 25305-0130

8. ADDENDUM ACKNOWLEDGEMENT: Changes or revisions to this Solicitation will be made by an official written addendum issued by the Purchasing Division. Vendor should acknowledge receipt of all addenda issued with this Solicitation by completing an Addendum Acknowledgment Form, a copy of which is included herewith. Failure to acknowledge addenda may result in bid disqualification. The addendum acknowledgement should be submitted with the bid to expedite document processing.

9. BID FORMATTING: Vendor should type or electronically enter the information onto its bid to prevent errors in the evaluation. Failure to type or electronically enter the information may result in bid disqualification.

10. ALTERNATES: Any model, brand, or specification listed in this Solicitation establishes the acceptable level of quality only and is not intended to reflect a preference for, or in any way favor, a particular brand or vendor. Vendors may bid alternates to a listed model or brand provided that the alternate is at least equal to the model or brand and complies with the required specifications. The equality of any alternate being bid shall be determined by the State at its sole discretion. Any Vendor bidding an alternate model or brand should clearly identify the alternate items in its bid and should include manufacturer's specifications, industry literature, and/or any other relevant documentation demonstrating the equality of the alternate items. Failure to provide information for alternate items may be grounds for rejection of a Vendor's bid.

11. EXCEPTIONS AND CLARIFICATIONS: The Solicitation contains the specifications that shall form the basis of a contractual agreement. Vendor shall clearly mark any exceptions, clarifications, or other proposed modifications in its bid. Exceptions to, clarifications of, or modifications of a requirement or term and condition of the Solicitation may result in bid disqualification.

12. COMMUNICATION LIMITATIONS: In accordance with West Virginia Code of State Rules §148-1-6.6, communication with the State of West Virginia or any of its employees regarding this Solicitation during the solicitation, bid, evaluation or award periods, except through the Purchasing Division, is strictly prohibited without prior Purchasing Division approval. Purchasing Division approval for such communication is implied for all agency delegated and exempt purchases.

13. REGISTRATION: Prior to Contract award, the apparent successful Vendor must be properly registered with the West Virginia Purchasing Division and must have paid the $125 fee, if applicable.

14. UNIT PRICE: Unit prices shall prevail in cases of a discrepancy in the Vendor's bid.

15. PREFERENCE: Vendor Preference may only be granted upon written request and only in accordance with the West Virginia Code § 5A-3-37 and the West Virginia Code of State Rules. A Vendor Preference Certificate form has been attached hereto to allow Vendor to apply for the preference. Vendor's failure to submit the Vendor Preference Certificate form with its bid will result in denial of Vendor Preference. Vendor Preference does not apply to construction projects.

16. SMALL, WOMEN-OWNED, OR MINORITY-OWNED BUSINESSES: For any solicitations publicly advertised for bid, in accordance with West Virginia Code §5A-3-37(a)(7) and W. Va. CSR § 148-22-9, any non-resident vendor certified as a small, women-owned, or minority-owned business under W. Va. CSR § 148-22-9 shall be provided the same preference made available to any resident vendor. Any non-resident small, women-owned, or minority-owned business must identify itself as such in writing, must submit that writing to the Purchasing Division with its bid, and must be properly certified under W. Va. CSR § 148-22-9 prior to contract award to receive the preferences made available to resident vendors. Preference for a non-resident small, women-owned, or minority owned business shall be applied in accordance with W. Va. CSR § 148-22-9.

17. WAIVER OF MINOR IRREGULARITIES: The Director reserves the right to waive minor irregularities in bids or specifications in accordance with West Virginia Code of State Rules § 148-1-4.6.

18. ELECTRONIC FILE ACCESS RESTRICTIONS: Vendor must ensure that its submission in wvOASIS can be accessed by the Purchasing Division staff immediately upon bid opening. The Purchasing Division will consider any file that cannot be immediately opened and/or viewed at the time of the bid opening (such as, encrypted files, password protected files, or incompatible files) to be blank or incomplete as context requires, and are therefore unacceptable. A vendor will not be permitted to unencrypt files, remove password protections, or resubmit documents after bid opening if those documents are required with the bid.

19. NON-RESPONSIBLE: The Purchasing Division Director reserves the right to reject the bid of any vendor as Non-Responsible in accordance with W. Va. Code of State Rules § 148-1-5.3, when the Director determines that the vendor submitting the bid does not have the capability to fully perform, or lacks the integrity and reliability to assure good-faith performance."

20. ACCEPTANCE/REJECTION: The State may accept or reject any bid in whole, or in part in accordance with W. Va. Code of State Rules § 148-1-4.5. and § 148-1-6.4.b."

21. YOUR SUBMISSION IS A PUBLIC DOCUMENT: Vendor's entire response to the Solicitation and the resulting Contract are public documents. As public documents, they will be disclosed to the public following the bid/proposal opening or award of the contract, as required by the competitive bidding laws of West Virginia Code §§ 5A-3-1 et seq., 5-22-1 et seq., and 5G-1-1 et seq. and the Freedom of Information Act West Virginia Code §§ 29B-1-1 et seq.

DO NOT SUBMIT MATERIAL YOU CONSIDER TO BE CONFIDENTIAL, A TRADE SECRET, OR OTHERWISE NOT SUBJECT TO PUBLIC DISCLOSURE.

Submission of any bid, proposal, or other document to the Purchasing Division constitutes your explicit consent to the subsequent public disclosure of the bid, proposal, or document. The Purchasing Division will disclose any document labeled "confidential," "proprietary," "trade secret," "private," or labeled with any other claim against public disclosure of the documents, to include any "trade secrets" as defined by West Virginia Code § 47-22-1 et seq. All submissions are subject to public disclosure without notice.

GENERAL TERMS AND CONDITIONS:

1. CONTRACTUAL AGREEMENT: Issuance of a Award Document signed by the Purchasing Division Director, or his designee, and approved as to form by the Attorney General's office constitutes acceptance of this Contract made by and between the State of West Virginia and the Vendor. Vendor's signature on its bid signifies Vendor's agreement to be bound by and accept the terms and conditions contained in this Contract.

2. DEFINITIONS: As used in this Solicitation/Contract, the following terms shall have the meanings attributed to them below. Additional definitions may be found in the specifications included with this Solicitation/Contract.

2.1. "Agency" or **"Agencies"** means the agency, board, commission, or other entity of the State of West Virginia that is identified on the first page of the Solicitation or any other public entity seeking to procure goods or services under this Contract.

2.2. "Bid" or **"Proposal"** means the vendors submitted response to this solicitation.

2.3. "Contract" means the binding agreement that is entered into between the State and the Vendor to provide the goods or services requested in the Solicitation.

2.4. "Director" means the Director of the West Virginia Department of Administration, Purchasing Division.

2.5. "Purchasing Division" means the West Virginia Department of Administration, Purchasing Division.

2.6. "Award Document" means the document signed by the Agency and the Purchasing Division, and approved as to form by the Attorney General, that identifies the Vendor as the contract holder.

2.7. "Solicitation" means the official notice of an opportunity to supply the State with goods or services that is published by the Purchasing Division.

2.8. "State" means the State of West Virginia and/or any of its agencies, commissions, boards, etc. as context requires.

2.9. "Vendor" or **"Vendors"** means any entity submitting a bid in response to the Solicitation, the entity that has been selected as the lowest responsible bidder, or the entity that has been awarded the Contract as context requires.

3. CONTRACT TERM; RENEWAL; EXTENSION: The term of this Contract shall be determined in accordance with the category that has been identified as applicable to this Contract below:

☑ **Term Contract**

Initial Contract Term: This Contract becomes effective on upon award and extends for a period of one (1) year(s).
Renewal Term: This Contract may be renewed upon the mutual written consent of the Agency, and the Vendor, with approval of the Purchasing Division and the Attorney General's office (Attorney General approval is as to form only). Any request for renewal should be submitted to the Purchasing Division thirty (30) days prior to the expiration date of the initial contract term or appropriate renewal term. A Contract renewal shall be in accordance with the terms and conditions of the original contract. Renewal of this Contract is limited to three (3) successive one (1) year periods or multiple renewal periods of less than one year, provided that the multiple renewal periods do not exceed thirty-six (36) months in total. Automatic renewal of this Contract is prohibited. Notwithstanding the foregoing, Purchasing Division approval is not required on agency delegated or exempt purchases. Attorney General approval may be required for vendor terms and conditions.

Delivery Order Limitations: In the event that this contract permits delivery orders, a delivery order may only be issued during the time this Contract is in effect. Any delivery order issued within one year of the expiration of this Contract shall be effective for one year from the date the delivery order is issued. No delivery order may be extended beyond one year after this Contract has expired.

☐ **Fixed Period Contract:** This Contract becomes effective upon Vendor's receipt of the notice to proceed and must be completed within ______________________ days.

☐ **Fixed Period Contract with Renewals:** This Contract becomes effective upon Vendor's receipt of the notice to proceed and part of the Contract more fully described in the attached specifications must be completed within ______________________ days.

Upon completion, the vendor agrees that maintenance, monitoring, or warranty services will be provided for one year thereafter with an additional _______________ successive one year renewal periods or multiple renewal periods of less than one year provided that the multiple renewal periods do not exceed _______________ months in total. Automatic renewal of this Contract is prohibited.

☐ **One Time Purchase:** The term of this Contract shall run from the issuance of the Award Document until all of the goods contracted for have been delivered, but in no event will this Contract extend for more than one fiscal year.

☐ **Other:** See attached.

4. NOTICE TO PROCEED: Vendor shall begin performance of this Contract immediately upon receiving notice to proceed unless otherwise instructed by the Agency. Unless otherwise specified, the fully executed Award Document will be considered notice to proceed.

5. QUANTITIES: The quantities required under this Contract shall be determined in accordance with the category that has been identified as applicable to this Contract below.

☑ **Open End Contract:** Quantities listed in this Solicitation are approximations only, based on estimates supplied by the Agency. It is understood and agreed that the Contract shall cover the quantities actually ordered for delivery during the term of the Contract, whether more or less than the quantities shown.

☐ **Service:** The scope of the service to be provided will be more clearly defined in the specifications included herewith.

☐ **Combined Service and Goods:** The scope of the service and deliverable goods to be provided will be more clearly defined in the specifications included herewith.

☐ **One Time Purchase:** This Contract is for the purchase of a set quantity of goods that are identified in the specifications included herewith. Once those items have been delivered, no additional goods may be procured under this Contract without an appropriate change order approved by the Vendor, Agency, Purchasing Division, and Attorney General's office.

6. EMERGENCY PURCHASES: The Purchasing Division Director may authorize the Agency to purchase goods or services in the open market that Vendor would otherwise provide under this Contract if those goods or services are for immediate or expedited delivery in an emergency. Emergencies shall include, but are not limited to, delays in transportation or an unanticipated increase in the volume of work. An emergency purchase in the open market, approved by the Purchasing Division Director, shall not constitute of breach of this Contract and shall not entitle the Vendor to any form of compensation or damages. This provision does not excuse the State from fulfilling its obligations under a One Time Purchase contract.

7. REQUIRED DOCUMENTS: All of the items checked below must be provided to the Purchasing Division by the Vendor as specified below.

☐ **BID BOND (Construction Only):** Pursuant to the requirements contained in W. Va. Code § 5-22-1(c), All Vendors submitting a bid on a construction project shall furnish a valid bid bond in the amount of five percent (5%) of the total amount of the bid protecting the State of West Virginia. The bid bond must be submitted with the bid.

☐ **PERFORMANCE BOND:** The apparent successful Vendor shall provide a performance bond in the amount of ________________. The performance bond must be received by the Purchasing Division prior to Contract award. On construction contracts, the performance bond must be 100% of the Contract value.

☐ **LABOR/MATERIAL PAYMENT BOND:** The apparent successful Vendor shall provide a labor/material payment bond in the amount of 100% of the Contract value. The labor/material payment bond must be delivered to the Purchasing Division prior to Contract award.
In lieu of the Bid Bond, Performance Bond, and Labor/Material Payment Bond, the Vendor may provide certified checks, cashier's checks, or irrevocable letters of credit. Any certified check, cashier's check, or irrevocable letter of credit provided in lieu of a bond must be of the same amount and delivered on the same schedule as the bond it replaces. A letter of credit submitted in lieu of a performance and labor/material payment bond will only be allowed for projects under $100,000. Personal or business checks are not acceptable.

☐ **MAINTENANCE BOND:** The apparent successful Vendor shall provide a two (2) year maintenance bond covering the roofing system. The maintenance bond must be issued and delivered to the Purchasing Division prior to Contract award.

☐ **INSURANCE:** The apparent successful Vendor shall furnish proof of the following insurance prior to Contract award and shall list the state as a certificate holder:

☐ **Commercial General Liability Insurance:** In the amount of ____________________ ____________________________________ or more.

☐ **Builders Risk Insurance:** In an amount equal to 100% of the amount of the Contract.

☐

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The apparent successful Vendor shall also furnish proof of any additional insurance requirements contained in the specifications prior to Contract award regardless of whether or not that insurance requirement is listed above.

☐ **LICENSE(S) / CERTIFICATIONS / PERMITS:** In addition to anything required under the Section entitled Licensing, of the General Terms and Conditions, the apparent successful Vendor shall furnish proof of the following licenses, certifications, and/or permits prior to Contract award, in a form acceptable to the Purchasing Division.

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The apparent successful Vendor shall also furnish proof of any additional licenses or certifications contained in the specifications prior to Contract award regardless of whether or not that requirement is listed above.

8. WORKERS' COMPENSATION INSURANCE: The apparent successful Vendor shall comply with laws relating to workers compensation, shall maintain workers' compensation insurance when required, and shall furnish proof of workers' compensation insurance upon request.

9. LITIGATION BOND: The Director reserves the right to require any Vendor that files a protest of an award to submit a litigation bond in the amount equal to one percent of the lowest bid submitted or $5,000, whichever is greater. The entire amount of the bond shall be forfeited if the hearing officer determines that the protest was filed for frivolous or improper purpose, including but not limited to, the purpose of harassing, causing unnecessary delay, or needless expense for the Agency. All litigation bonds shall be made payable to the Purchasing Division. In lieu of a bond, the protester may submit a cashier's check or certified check payable to the Purchasing Division. Cashier's or certified checks will be deposited with and held by the State Treasurer's office. If it is determined that the protest has not been filed for frivolous or improper purpose, the bond or deposit shall be returned in its entirety.

10. LIQUIDATED DAMAGES: Vendor shall pay liquidated damages in the amount of

____

for ____.

This clause shall in no way be considered exclusive and shall not limit the State or Agency's right to pursue any other available remedy.

11. ACCEPTANCE: Vendor's signature on its bid, or on the certification and signature page, constitutes an offer to the State that cannot be unilaterally withdrawn, signifies that the product or service proposed by vendor meets the mandatory requirements contained in the Solicitation for that product or service, unless otherwise indicated, and signifies acceptance of the terms and conditions contained in the Solicitation unless otherwise indicated.

12. PRICING: The pricing set forth herein is firm for the life of the Contract, unless specified elsewhere within this Solicitation/Contract by the State. A Vendor's inclusion of price adjustment provisions in its bid, without an express authorization from the State in the Solicitation to do so, may result in bid disqualification.

13. PAYMENT: Payment in advance is prohibited under this Contract. Payment may only be made after the delivery and acceptance of goods or services. The Vendor shall submit invoices, in arrears.

14. PURCHASING CARD ACCEPTANCE: The State of West Virginia currently utilizes a Purchasing Card program, administered under contract by a banking institution, to process payment for goods and services. The Vendor must accept the State of West Virginia's Purchasing Card for payment of all orders under this Contract unless the box below is checked.

☐ Vendor is not required to accept the State of West Virginia's Purchasing Card as payment for all goods and services.

15. TAXES: The Vendor shall pay any applicable sales, use, personal property or any other taxes arising out of this Contract and the transactions contemplated thereby. The State of West Virginia is exempt from federal and state taxes and will not pay or reimburse such taxes.

16. ADDITIONAL FEES: Vendor is not permitted to charge additional fees or assess additional charges that were not either expressly provided for in the solicitation published by the State of West Virginia or included in the unit price or lump sum bid amount that Vendor is required by the solicitation to provide. Including such fees or charges as notes to the solicitation may result in rejection of vendor's bid. Requesting such fees or charges be paid after the contract has been awarded may result in cancellation of the contract.

17. FUNDING: This Contract shall continue for the term stated herein, contingent upon funds being appropriated by the Legislature or otherwise being made available. In the event funds are not appropriated or otherwise made available, this Contract becomes void and of no effect beginning on July 1 of the fiscal year for which funding has not been appropriated or otherwise made available.

18. CANCELLATION: The Purchasing Division Director reserves the right to cancel this Contract immediately upon written notice to the vendor if the materials or workmanship supplied do not conform to the specifications contained in the Contract. The Purchasing Division Director may also cancel any purchase or Contract upon 30 days written notice to the Vendor in accordance with West Virginia Code of State Rules § 148-1-6.1.e.

19. TIME: Time is of the essence with regard to all matters of time and performance in this Contract.

20. APPLICABLE LAW: This Contract is governed by and interpreted under West Virginia law without giving effect to its choice of law principles. Any information provided in specification manuals, or any other source, verbal or written, which contradicts or violates the West Virginia Constitution, West Virginia Code or West Virginia Code of State Rules is void and of no effect.

21. COMPLIANCE: Vendor shall comply with all applicable federal, state, and local laws, regulations and ordinances. By submitting a bid, Vendor acknowledges that it has reviewed, understands, and will comply with all applicable laws, regulations, and ordinances.

22. ARBITRATION: Any references made to arbitration contained in this Contract, Vendor's bid, or in any American Institute of Architects documents pertaining to this Contract are hereby deleted, void, and of no effect.

23. MODIFICATIONS: This writing is the parties' final expression of intent. Notwithstanding anything contained in this Contract to the contrary no modification of this Contract shall be binding without mutual written consent of the Agency, and the Vendor, with approval of the Purchasing Division and the Attorney General's office (Attorney General approval is as to form only). Any change to existing contracts that adds work or changes contract cost, and were not included in the original contract, must be approved by the Purchasing Division and the Attorney General's Office (as to form) prior to the implementation of the change or commencement of work affected by the change.

24. WAIVER: The failure of either party to insist upon a strict performance of any of the terms or provision of this Contract, or to exercise any option, right, or remedy herein contained, shall not be construed as a waiver or a relinquishment for the future of such term, provision, option, right, or remedy, but the same shall continue in full force and effect. Any waiver must be expressly stated in writing and signed by the waiving party.

25. SUBSEQUENT FORMS: The terms and conditions contained in this Contract shall supersede any and all subsequent terms and conditions which may appear on any form documents submitted by Vendor to the Agency or Purchasing Division such as price lists, order forms, invoices, sales agreements, or maintenance agreements, and includes internet websites or other electronic documents. Acceptance or use of Vendor's forms does not constitute acceptance of the terms and conditions contained thereon.

26. ASSIGNMENT: Neither this Contract nor any monies due, or to become due hereunder, may be assigned by the Vendor without the express written consent of the Agency, the Purchasing Division, the Attorney General's office (as to form only), and any other government agency or office that may be required to approve such assignments. Notwithstanding the foregoing, Purchasing Division approval may or may not be required on certain agency delegated or exempt purchases.

27. WARRANTY: The Vendor expressly warrants that the goods and/or services covered by this Contract will: (a) conform to the specifications, drawings, samples, or other description furnished or specified by the Agency; (b) be merchantable and fit for the purpose intended; and (c) be free from defect in material and workmanship.

28. STATE EMPLOYEES: State employees are not permitted to utilize this Contract for personal use and the Vendor is prohibited from permitting or facilitating the same.

29. BANKRUPTCY: In the event the Vendor files for bankruptcy protection, the State of West Virginia may deem this Contract null and void, and terminate this Contract without notice.

30. PRIVACY, SECURITY, AND CONFIDENTIALITY: The Vendor agrees that it will not disclose to anyone, directly or indirectly, any such personally identifiable information or other confidential information gained from the Agency, unless the individual who is the subject of the information consents to the disclosure in writing or the disclosure is made pursuant to the Agency's policies, procedures, and rules. Vendor further agrees to comply with the Confidentiality Policies and Information Security Accountability Requirements, set forth in http://www.state.wv.us/admin/purchase/privacy/default.html.

31. YOUR SUBMISSION IS A PUBLIC DOCUMENT: Vendor's entire response to the Solicitation and the resulting Contract are public documents. As public documents, they will be disclosed to the public following the bid/proposal opening or award of the contract, as required by the competitive bidding laws of West Virginia Code §§ 5A-3-1 et seq., 5-22-1 et seq., and 5G-1-1 et seq. and the Freedom of Information Act West Virginia Code §§ 29B-1-1 et seq.

DO NOT SUBMIT MATERIAL YOU CONSIDER TO BE CONFIDENTIAL, A TRADE SECRET, OR OTHERWISE NOT SUBJECT TO PUBLIC DISCLOSURE.

Submission of any bid, proposal, or other document to the Purchasing Division constitutes your explicit consent to the subsequent public disclosure of the bid, proposal, or document. The Purchasing Division will disclose any document labeled "confidential," "proprietary," "trade secret," "private," or labeled with any other claim against public disclosure of the documents, to include any "trade secrets" as defined by West Virginia Code § 47-22-1 et seq. All submissions are subject to public disclosure without notice.

32. LICENSING: In accordance with West Virginia Code of State Rules § 148-1-6.1.e, Vendor must be licensed and in good standing in accordance with any and all state and local laws and requirements by any state or local agency of West Virginia, including, but not limited to, the West Virginia Secretary of State's Office, the West Virginia Tax Department, West Virginia Insurance Commission, or any other state agency or political subdivision. Upon request, the Vendor must provide all necessary releases to obtain information to enable the Purchasing Division Director or the Agency to verify that the Vendor is licensed and in good standing with the above entities.

33. ANTITRUST: In submitting a bid to, signing a contract with, or accepting a Award Document from any agency of the State of West Virginia, the Vendor agrees to convey, sell, assign, or transfer to the State of West Virginia all rights, title, and interest in and to all causes of action it may now or hereafter acquire under the antitrust laws of the United States and the State of West Virginia for price fixing and/or unreasonable restraints of trade relating to the particular commodities or services purchased or acquired by the State of West Virginia. Such assignment shall be made and become effective at the time the purchasing agency tenders the initial payment to Vendor.

34. VENDOR CERTIFICATIONS: By signing its bid or entering into this Contract, Vendor certifies (1) that its bid or offer was made without prior understanding, agreement, or connection with any corporation, firm, limited liability company, partnership, person or entity submitting a bid or offer for the same material, supplies, equipment or services; (2) that its bid or offer is in all respects fair and without collusion or fraud; (3) that this Contract is accepted or entered into without any prior understanding, agreement, or connection to any other entity that could be considered a violation of law; and (4) that it has reviewed this Solicitation in its entirety; understands the requirements, terms and conditions, and other information contained herein.

Vendor's signature on its bid or offer also affirms that neither it nor its representatives have any interest, nor shall acquire any interest, direct or indirect, which would compromise the performance of its services hereunder. Any such interests shall be promptly presented in detail to the Agency. The individual signing this bid or offer on behalf of Vendor certifies that he or she is authorized by the Vendor to execute this bid or offer or any documents related thereto on Vendor's behalf; that he or she is authorized to bind the Vendor in a contractual relationship; and that, to the best of his or her knowledge, the Vendor has properly registered with any State agency that may require registration.

35. VENDOR RELATIONSHIP: The relationship of the Vendor to the State shall be that of an independent contractor and no principal-agent relationship or employer-employee relationship is contemplated or created by this Contract. The Vendor as an independent contractor is solely liable for the acts and omissions of its employees and agents. Vendor shall be responsible for selecting, supervising, and compensating any and all individuals employed pursuant to the terms of this Solicitation and resulting contract. Neither the Vendor, nor any employees or subcontractors of the Vendor, shall be deemed to be employees of the State for any purpose whatsoever. Vendor shall be exclusively responsible for payment of employees and contractors for all wages and salaries, taxes, withholding payments, penalties, fees, fringe benefits, professional liability insurance premiums, contributions to insurance and pension, or other deferred compensation plans, including but not limited to, Workers' Compensation and Social Security obligations, licensing fees, etc. and the filing of all necessary documents, forms, and returns pertinent to all of the foregoing.

Vendor shall hold harmless the State, and shall provide the State and Agency with a defense against any and all claims including, but not limited to, the foregoing payments, withholdings, contributions, taxes, Social Security taxes, and employer income tax returns.

36. INDEMNIFICATION: The Vendor agrees to indemnify, defend, and hold harmless the State and the Agency, their officers, and employees from and against: (1) Any claims or losses for services rendered by any subcontractor, person, or firm performing or supplying services, materials, or supplies in connection with the performance of the Contract; (2) Any claims or losses resulting to any person or entity injured or damaged by the Vendor, its officers, employees, or subcontractors by the publication, translation, reproduction, delivery, performance, use, or disposition of any data used under the Contract in a manner not authorized by the Contract, or by Federal or State statutes or regulations; and (3) Any failure of the Vendor, its officers, employees, or subcontractors to observe State and Federal laws including, but not limited to, labor and wage and hour laws.

37. PURCHASING AFFIDAVIT: In accordance with West Virginia Code § 5A-3-10a, all Vendors are required to sign, notarize, and submit the Purchasing Affidavit stating that neither the Vendor nor a related party owe a debt to the State in excess of $1,000. The affidavit must be submitted prior to award, but should be submitted with the Vendor's bid. A copy of the Purchasing Affidavit is included herewith.

38. ADDITIONAL AGENCY AND LOCAL GOVERNMENT USE: This Contract may be utilized by other agencies, spending units, and political subdivisions of the State of West Virginia; county, municipal, and other local government bodies; and school districts ("Other Government Entities"). Any extension of this Contract to the aforementioned Other Government Entities must be on the same prices, terms, and conditions as those offered and agreed to in this Contract, provided that such extension is in compliance with the applicable laws, rules, and ordinances of the Other Government Entity. If the Vendor does not wish to extend the prices, terms, and conditions of its bid and subsequent contract to the Other Government Entities, the Vendor must clearly indicate such refusal in its bid. A refusal to extend this Contract to the Other Government Entities shall not impact or influence the award of this Contract in any manner.

39. CONFLICT OF INTEREST: Vendor, its officers or members or employees, shall not presently have or acquire an interest, direct or indirect, which would conflict with or compromise the performance of its obligations hereunder. Vendor shall periodically inquire of its officers, members and employees to ensure that a conflict of interest does not arise. Any conflict of interest discovered shall be promptly presented in detail to the Agency.

40. REPORTS: Vendor shall provide the Agency and/or the Purchasing Division with the following reports identified by a checked box below:

☑ Such reports as the Agency and/or the Purchasing Division may request. Requested reports may include, but are not limited to, quantities purchased, agencies utilizing the contract, total contract expenditures by agency, etc.

☐ Quarterly reports detailing the total quantity of purchases in units and dollars, along with a listing of purchases by agency. Quarterly reports should be delivered to the Purchasing Division via email at purchasing.requisitions@wv.gov.

41. BACKGROUND CHECK: In accordance with W. Va. Code § 15-2D-3, the Director of the Division of Protective Services shall require any service provider whose employees are regularly employed on the grounds or in the buildings of the Capitol complex or who have access to sensitive or critical information to submit to a fingerprint-based state and federal background inquiry through the state repository. The service provider is responsible for any costs associated with the fingerprint-based state and federal background inquiry.

After the contract for such services has been approved, but before any such employees are permitted to be on the grounds or in the buildings of the Capitol complex or have access to sensitive or critical information, the service provider shall submit a list of all persons who will be physically present and working at the Capitol complex to the Director of the Division of Protective Services for purposes of verifying compliance with this provision. The State reserves the right to prohibit a service provider's employees from accessing sensitive or critical information or to be present at the Capitol complex based upon results addressed from a criminal background check.

Service providers should contact the West Virginia Division of Protective Services by phone at (304) 558-9911 for more information.

42. PREFERENCE FOR USE OF DOMESTIC STEEL PRODUCTS: Except when authorized by the Director of the Purchasing Division pursuant to W. Va. Code § 5A-3-56, no contractor may use or supply steel products for a State Contract Project other than those steel products made in the United States. A contractor who uses steel products in violation of this section may be subject to civil penalties pursuant to W. Va. Code § 5A-3-56. As used in this section:

a. "State Contract Project" means any erection or construction of, or any addition to, alteration of or other improvement to any building or structure, including, but not limited to, roads or highways, or the installation of any heating or cooling or ventilating plants or other equipment, or the supply of and materials for such projects, pursuant to a contract with the State of West Virginia for which bids were solicited on or after June 6, 2001.
b. "Steel Products" means products rolled, formed, shaped, drawn, extruded, forged, cast, fabricated or otherwise similarly processed, or processed by a combination of two or more or such operations, from steel made by the open heath, basic oxygen, electric furnace, Bessemer or other steel making process. The Purchasing Division Director may, in writing, authorize the use of foreign steel products if:
c. The cost for each contract item used does not exceed one tenth of one percent (.1%) of the total contract cost or two thousand five hundred dollars ($2,500.00), whichever is greater. For the purposes of this section, the cost is the value of the steel product as delivered to the project; or
d. The Director of the Purchasing Division determines that specified steel materials are not produced in the United States in sufficient quantity or otherwise are not reasonably available to meet contract requirements.

43. PREFERENCE FOR USE OF DOMESTIC ALUMINUM, GLASS, AND STEEL: In Accordance with W. Va. Code § 5-19-1 et seq., and W. Va. CSR § 148-10-1 et seq., for every contract or subcontract, subject to the limitations contained herein, for the construction, reconstruction, alteration, repair, improvement or maintenance of public works or for the purchase of any item of machinery or equipment to be used at sites of public works, only domestic aluminum, glass or steel products shall be supplied unless the spending officer determines, in writing, after the receipt of offers or bids, (1) that the cost of domestic aluminum, glass or steel products is unreasonable or inconsistent with the public interest of the State of West Virginia, (2) that domestic aluminum, glass or steel products are not produced in sufficient quantities to meet the contract requirements, or (3) the available domestic aluminum, glass, or steel do not meet the contract specifications. This provision only applies to public works contracts awarded in an amount more than fifty thousand dollars ($50,000) or public works contracts that require more than ten thousand pounds of steel products.

The cost of domestic aluminum, glass, or steel products may be unreasonable if the cost is more than twenty percent (20%) of the bid or offered price for foreign made aluminum, glass, or steel products. If the domestic aluminum, glass or steel products to be supplied or produced in a "substantial labor surplus area", as defined by the United States Department of Labor, the cost of domestic aluminum, glass, or steel products may be unreasonable if the cost is more than thirty percent (30%) of the bid or offered price for foreign made aluminum, glass, or steel products. This preference shall be applied to an item of machinery or equipment, as indicated above, when the item is a single unit of equipment or machinery manufactured primarily of aluminum, glass or steel, is part of a public works contract and has the sole purpose or of being a permanent part of a single public works project. This provision does not apply to equipment or machinery purchased by a spending unit for use by that spending unit and not as part of a single public works project.

All bids and offers including domestic aluminum, glass or steel products that exceed bid or offer prices including foreign aluminum, glass or steel products after application of the preferences provided in this provision may be reduced to a price equal to or lower than the lowest bid or offer price for foreign aluminum, glass or steel products plus the applicable preference. If the reduced bid or offer prices are made in writing and supersede the prior bid or offer prices, all bids or offers, including the reduced bid or offer prices, will be reevaluated in accordance with this rule.

REQUEST FOR QUOTATION
Environmental Risk Assessor

SPECIFICATIONS

1. **PURPOSE AND SCOPE:** The West Virginia Purchasing Division is soliciting bids on behalf of the West Virginia Department of Environmental Protection (WVDEP) to establish an open-end contract for an Environmental Risk Assessor to determine ecological and human health risks that may be associated with projects in the WVDEP Voluntary Remediation and Redevelopment Program.

   OPERATING ENVIRONMENT: The WVDEP Division of Land Restoration, Office of Environmental Remediation (OER) oversees the Voluntary Remediation and Redevelopment (VRRP) and Brownfield Programs. Within these programs, human health and ecological risks are assessed by use of one or more levels of evaluation in order to determine suitability of these sites for reuse and the need for applying controls to mitigate remaining site risks.

   The primary responsibility for providing an accurate assessment of site risks resides with the Licensed Remediation Specialist (LRS), who is retained by the property owner or interested party to oversee the site evaluation.
   In addition, an agency risk assessor is often consulted during the early stages of a site investigation to assist in developing a preliminary conceptual site model supported by an appropriate sampling and analysis plan.

   Currently, risk assessments are most often evaluated by agency toxicologists but the agency may experience a temporary need for additional capacity in order to meet required review deadlines for risk assessment and related documents.

2. **DEFINITIONS:** The terms listed below shall have the meanings assigned to them below. Additional definitions can be found in section 2 of the General Terms and Conditions.

   2.1 **"Contract Item"** or **"Contract Items"** means the list of items identified in Section 3.1 below and on the Pricing Pages.

   2.2 **"Pricing Pages"** means the schedule of prices, estimated order quantity, and totals contained in wvOASIS or attached hereto as Exhibit A, and used to evaluate the Solicitation responses.

   2.3 **"Solicitation"** means the official notice of an opportunity to supply the State with goods or services that is published by the Purchasing Division.

   2.4 **"WVDEP"** means the West Virginia Department of Environmental Protection.

   2.5 **"VRRP" means** the Voluntary Remediation and Redevelopment program.

2.6 **"OER" means** the Office of Environmental Remediation.

2.7 **"LRS" means** Licensed Remediation Specialist.

2.8 **Environmental Risk Assessor means:** a person who evaluates the exposure of human and ecological receptors to contaminants in environmental media (i.e. soil, groundwater, air, sediments and surface water) and determines the likelihood that such exposure would result in an adverse impact to the health of the receptor. Risk assessments are dependent upon mathematical constructs of interactions between living organisms and contaminants in their environment, risk assessors must possess knowledge of toxicology, statistics, biology and chemistry, as well as the ability to apply computer models simulate contaminant behavior in environmental media and /or contaminant uptake and distribution within a biological system.

3. **QUALIFICATIONS:** Vendor, or Vendor's staff if requirements are inherently limited to individuals rather than corporate entities, shall have the following minimum qualifications:

3.1. A doctoral degree in a relevant field of study from an accredited university and a minimum of three (3) years of relevant professional experience.

3.2. Or a Master's of Science degree in a relevant field of study from an accredited university and a minimum of five (5) years of relevant professional experience.

3.3 Relevant professional experience must consist of work related directly to risk assessment, risk characterization and risk management activities, including at least one year performed at the supervisory of project manager level.

3.4 Compliance with experience requirements will be determined prior to contract award by the State through references provided by the Vendor with its bid or upon request, through knowledge or documentation of the Vendor's past projects, or some other method that the State determines to be acceptable. Vendor should provide a current résumé which includes information regarding the number of years of qualification, experience and training, and relevant professional education for each individual that will be assigned to this project. Vendor must provide any documentation requested by the State to assist in confirmation of compliance with this provision. References, documentation, or other information to confirm compliance with this experience requirement are preferred with the bid submission, but may be requested after bid opening and prior to contract award.

4. **GENERAL REQUIREMENTS:**

4.1 **Contract Items and Mandatory Requirements:** Vendor shall provide Agency with the Contract Items listed below on an open-end and continuing basis. Contract Items must meet or exceed the mandatory requirements as shown below. Contracts will be awarded to all vendors who submit a bid and meet or exceed the mandatory requirements.

4.1.1 Environmental Risk Assessor:

4.1.1.1 Environmental Risk Assessor Information :

At the discretion of the vendor, an employee of the vendor with knowledge in the applicable disciplines of toxicology, statistics, biology, and chemistry may conduct the review. The final report however, must be prepared by, or under the direction of, an Environmental Risk Assessor possessing qualification as listed below.

An example risk assessment report or a risk assessment review prepared by the vendor demonstration evidence of relevant professional experience should also be provided with submitted bid or upon request. Redaction of confidential information regarding site/client names on the sample documents is acceptable.

The WVDEP reserves the right to request and approve the credentials of any person assigned to perform work under this contract.

4.1.1.2 Record Retention:
The Vendor shall maintain such records a minimum of five (5) years and make available all records to Agency personnel at the Vendor's location during normal business hours, 8:00AM EST to 5:00PM EST upon written request by the Agency within 10 calendar days after receipt of the request.

4.1.1.5 Confidentiality: The Vendor shall have access to private and confidential data maintained by the Agency to the extent required for the Vendor to carry out the duties and responsibilities defined in this contract.
Documents will be sent to the vendor through a secured server. Failure to maintain confidentiality will result in cancellation of contract.

The Vendor agrees to maintain confidentiality and security of the data made available and shall indemnify and hold harmless the State and Agency against any and all claims brought by any party attributed to actions of breach of confidentiality by the Vendor, subcontractors, or individuals permitted access by the Vendor.

4.1.1.6 **Testimony:** Should the Agency request additional assistance from the contractor for testimony in any state or federal court or before any board or other administrative body associated with a document prepared under this agreement, such assistance shall be considered to be within the scope of work for this contract and thus billed at the same hourly rate as the rest of the items in this contract. An estimated number of times this might occur is twice a year. Meetings/testimony would likely take place in Charleston, WV; however, other locations are possible.

5. CONTRACT AWARD:

5.1 **Contract Award:** The Contract is intended to provide Agencies with a purchase price on all Contract Items. The Contract will be awarded to the two (2) lowest bid vendors that provides the Contract Services meeting the required specifications for the lowest overall TOTAL BID AMOUNT as shown on the exhibit A Pricing Page. Selection will be based on the lowest bid vendor first. However, if the vendor has a conflict of interest on the job, the next vendor will be selected to avoid the conflict of interest.

5.2 **Pricing Pages:** Vendor should complete the Pricing Pages by bidding on the price per hour (x) multiplied by the Estimated Quantity of Hours needed (=) equals Extended Cost. Vendor should complete the Pricing Pages in their entirety as failure to do so may result in Vendor's bids being disqualified.

The Pricing Pages contain a list of the Contract Items and estimated purchase volume. The estimated purchase volume of each item represents the approximate volume of anticipated purchases only. No future use of the Contract of any individual item is guaranteed of implied.

Vendor should electronically enter the information into the Pricing Pages through wvOASIS, if available, or as an electronic document. In most cases, the Vendor can request an electronic copy of the Pricing Pages for bid purposes by sending an email request to the following address: Michelle.L.Childers@wv.gov.

6. **PERFORMANCE:** Vendor and Agency shall agree upon a schedule for performance of Contract Services and Contract Services Deliverables, unless such a schedule is already included herein by Agency. In the event that this Contract is designated as an open-end contract, Vendor shall perform in accordance with the release orders that may be issued against this Contract.

7. **Ordering Procedure / Payment:**

7.1. **Work Directives:** Work will be ordered by issuance of a Work Directive. The Work Directive will contain the location of the project site, the specific problem, the work to be performed, and the time frame during which the work must be completed.

7.1.1. The Work Directive may contain work directives for more than one site if the sites are in close proximity of each other.

7.1.2. Provided there is no conflict of interest in review of a specific project, the Work Directive shall be awarded in the following manner:

7.1.2.1. The Work Directive award will go to the first lowest successful vendor.

7.1.2.2. If the vendor accepts the Work Directive, a work plan and cost proposal will be required from the vendor as specified in the work directive. The vendor will have five (5) working days to accept or refuse the project. The work plan/cost proposal will consist of a brief description of the work to be performed, the number of hours, and the total dollar amount it will cost to perform each task included in the work directive. This can be provided in a simple email. Vendors will not be reimbursed for providing the work plan/cost estimate.

7.1.2.3. If the vendor refuses the Work Directive, it will be offered to the second lowest successful vendor and so on.

7.1.2.4. The vendor's submitted work plan and cost estimate, containing the quantity estimates, shall be in accordance with the unit prices provided in the response to this RFQ. If the work plan and cost estimate are approved, the WVDEP will issue a Notice to Proceed which will specify the cost of the project and the starting and ending dates. Electronic deliverables are acceptable.

9.4. Anyone performing under this Contract will be subject to Agency's security protocol and procedures.

9.5. Vendor shall inform all staff of Agency's security protocol and procedures.

10. VENDOR DEFAULT:

10.1 The following shall be considered a vendor default under this Contract.

10.1.1 Failure to provide Contract Items in accordance with the requirements contained herein.

10.1.2 Failure to comply with other specifications and requirements contained herein.

10.1.3 Failure to comply with any laws, rules, and ordinances applicable to the Contract Services provided under this Contract.

10.1.4 Failure to remedy deficient performance upon request.

10.2 The following remedies shall be available to Agency upon default.

10.2.1 Immediate cancellation of the Contract.

10.2.2 Immediate cancellation of one or more release orders issued under this Contract.

10.2.3 Any other remedies available in law or equity.

REQUEST FOR QUOTATION
Environmental Risk Assessor

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11. MISCELLANEOUS:

11.1 Reports: Vendor shall provide quarterly reports and annual summaries to the Agency showing the Agency's items purchased, quantities of items purchased, and total dollar value of the items purchased. Vendor shall also provide reports, upon request, showing the items purchased during the term of this Contract, the quantity purchased for each of those items, and the total value of purchases for each of those items. Failure to supply such reports may be grounds for cancellation of this Contract.

11.2 Contract Manager: During its performance of this Contract, Vendor must designate and maintain a primary contract manager responsible for overseeing Vendor's responsibilities under this Contract. The Contract manager must be available during normal business hours to address any customer service or other issues related to this Contract. Vendor should list its Contract manager and his or her contact information below.

Contract Manager: John J. Mahfood

Telephone Number: 724-260-5219

Fax Number: 724-260-5226

Email Address: vmahfood@themahfoodgroup.com

Exhibit A

Environmental Risk Assessor

Company Name: The Mahfood Group LLC

Address: 1061 Waterdam Plaza Dr. Ste 201

City, State, Zip: McMurray, PA 15317

Phone & Fax No.: 724-260-5219 / 724-260-5226

ITEM NO.	ESTIMATED QUANTITY	DESCRIPTION	UNIT PRICE PER HOUR	AMOUNT
1.0	700	Environmental Risk Assessor	$72	$ 50,400
		TOTAL BID AMOUNT		$ 50,400

The DEP reserves the right to request additional information and supporting documentation regarding unit prices when the unit price appears to be unreasonable

WV-10
Approved / Revised
12/16/15

State of West Virginia
VENDOR PREFERENCE CERTIFICATE

Certification and application is hereby made for Preference in accordance with ***West Virginia Code***, §5A-3-37. (Does not apply to construction contracts). ***West Virginia Code***, §5A-3-37, provides an opportunity for qualifying vendors to request (at the time of bid) preference for their residency status. Such preference is an evaluation method only and will be applied only to the cost bid in accordance with the ***West Virginia Code***. This certificate for application is to be used to request such preference. The Purchasing Division will make the determination of the Vendor Preference, if applicable.

1. Application is made for 2.5% vendor preference for the reason checked:

☐ Bidder is an individual resident vendor and has resided continuously in West Virginia for four (4) years immediately preceding the date of this certification; **or,**

☐ Bidder is a partnership, association or corporation resident vendor and has maintained its headquarters or principal place of business continuously in West Virginia for four (4) years immediately preceding the date of this certification;

☐ Bidder is a resident vendor partnership, association, or corporation with at least eighty percent of ownership interest of bidder held by another entity that meets the applicable four year residency requirement; **or,**

☐ Bidder is a nonresident vendor which has an affiliate or subsidiary which employs a minimum of one hundred state residents and which has maintained its headquarters or principal place of business within West Virginia continuously for the four (4) years immediately preceding the date of this certification; **or,**

2. Application is made for 2.5% vendor preference for the reason checked:

☐ Bidder is a resident vendor who certifies that, during the life of the contract, on average at least 75% of the employees working on the project being bid are residents of West Virginia who have resided in the state continuously for the two years immediately preceding submission of this bid; **or,**

3. Application is made for 2.5% vendor preference for the reason checked:

☐ Bidder is a nonresident vendor that employs a minimum of one hundred state residents, or a nonresident vendor which has an affiliate or subsidiary which maintains its headquarters or principal place of business within West Virginia and employs a minimum of one hundred state residents, and for purposes of producing or distributing the commodities or completing the project which is the subject of the bidder's bid and continuously over the entire term of the project, on average at least seventy-five percent of the bidder's employees or the bidder's affiliate's or subsidiary's employees are residents of West Virginia who have resided in the state continuously for the two immediately preceding years and the vendor's bid; **or,**

4. Application is made for 5% vendor preference for the reason checked:

☐ Bidder meets either the requirement of both subdivisions (1) and (2) or subdivision (1) and (3) as stated above; **or,**

5. Application is made for 3.5% vendor preference who is a veteran for the reason checked:

☐ Bidder is an individual resident vendor who is a veteran of the United States armed forces, the reserves or the National Guard and has resided in West Virginia continuously for the four years immediately preceding the date on which the bid is submitted; **or,**

6. Application is made for 3.5% vendor preference who is a veteran for the reason checked:

☐ Bidder is a resident vendor who is a veteran of the United States armed forces, the reserves or the National Guard, if, for purposes of producing or distributing the commodities or completing the project which is the subject of the vendor's bid and continuously over the entire term of the project, on average at least seventy-five percent of the vendor's employees are residents of West Virginia who have resided in the state continuously for the two immediately preceding years.

7. Application is made for preference as a non-resident small, women- and minority-owned business, in accordance with *West Virginia Code* §5A-3-59 and *West Virginia Code of State Rules*.

☐ Bidder has been or expects to be approved prior to contract award by the Purchasing Division as a certified small, women- and minority-owned business.

Bidder understands if the Secretary of Revenue determines that a Bidder receiving preference has failed to continue to meet the requirements for such preference, the Secretary may order the Director of Purchasing to: (a) rescind the contract or purchase order; or (b) assess a penalty against such Bidder in an amount not to exceed 5% of the bid amount and that such penalty will be paid to the contracting agency or deducted from any unpaid balance on the contract or purchase order.

By submission of this certificate, Bidder agrees to disclose any reasonably requested information to the Purchasing Division and authorizes the Department of Revenue to disclose to the Director of Purchasing appropriate information verifying that Bidder has paid the required business taxes, provided that such information does not contain the amounts of taxes paid nor any other information deemed by the Tax Commissioner to be confidential.

Bidder hereby certifies that this certificate is true and accurate in all respects; and that if a contract is issued to Bidder and if anything contained within this certificate changes during the term of the contract, Bidder will notify the Purchasing Division in writing immediately.

Bidder: ______________________ **Signed:** ______________________

Date: ______________________ **Title:** ______________________

**Check any combination of preference consideration(s) indicated above, which you are entitled to receive.*

ADDENDUM ACKNOWLEDGEMENT FORM
SOLICITATION NO.: ___________

Instructions: Please acknowledge receipt of all addenda issued with this solicitation by completing this addendum acknowledgment form. Check the box next to each addendum received and sign below. Failure to acknowledge addenda may result in bid disqualification.

Acknowledgment: I hereby acknowledge receipt of the following addenda and have made the necessary revisions to my proposal, plans and/or specification, etc.

Addendum Numbers Received:
(Check the box next to each addendum received)

[✓] Addendum No. 1	[ ] Addendum No. 6
[ ] Addendum No. 2	[ ] Addendum No. 7
[ ] Addendum No. 3	[ ] Addendum No. 8
[ ] Addendum No. 4	[ ] Addendum No. 9
[ ] Addendum No. 5	[ ] Addendum No. 10

I understand that failure to confirm the receipt of addenda may be cause for rejection of this bid. I further understand that any verbal representation made or assumed to be made during any oral discussion held between Vendor's representatives and any state personnel is not binding. Only the information issued in writing and added to the specifications by an official addendum is binding.

The Mahfood Group LLC
Company

[signature]
Authorized Signature

09-07-2016
Date

NOTE: This addendum acknowledgement should be submitted with the bid to expedite document processing.

Revised 6/8/2012

DESIGNATED CONTACT: Vendor appoints the individual identified in this Section as the Contract Administrator and the initial point of contact for matters relating to this Contract.

Vickie L. Mahfood, President
(Name, Title)

[signature]
(Printed Name and Title)

1061 Waterdam Plaza Dr. Ste 201 McMurray PA 15317
(Address)

724-260-5219 / 724-260-5226
(Phone Number) / (Fax Number)

vmahfood@themahfoodgroup.com
(email address)

CERTIFICATION AND SIGNATURE: By signing below, or submitting documentation through wvOASIS, I certify that I have reviewed this Solicitation in its entirety; that I understand the requirements, terms and conditions, and other information contained herein; that this bid, offer or proposal constitutes an offer to the State that cannot be unilaterally withdrawn; that the product or service proposed meets the mandatory requirements contained in the Solicitation for that product or service, unless otherwise stated herein; that the Vendor accepts the terms and conditions contained in the Solicitation, unless otherwise stated herein; that I am submitting this bid, offer or proposal for review and consideration; that I am authorized by the vendor to execute and submit this bid, offer, or proposal, or any documents related thereto on vendor's behalf; that I am authorized to bind the vendor in a contractual relationship; and that to the best of my knowledge, the vendor has properly registered with any State agency that may require registration.

The Mahfood Group LLC
(Company)

[signature], President
(Authorized Signature) (Representative Name, Title)

Vickie L. Mahfood, President
(Printed Name and Title of Authorized Representative)

09-07-2016
(Date)

724-260-5219 / 724-260-5226
(Phone Number) (Fax Number)

STATE OF WEST VIRGINIA
Purchasing Division

PURCHASING AFFIDAVIT

MANDATE: Under W. Va. Code §5A-3-10a, no contract or renewal of any contract may be awarded by the state or any of its political subdivisions to any vendor or prospective vendor when the vendor or prospective vendor or a related party to the vendor or prospective vendor is a debtor and: (1) the debt owed is an amount greater than one thousand dollars in the aggregate; or (2) the debtor is in employer default.

EXCEPTION: The prohibition listed above does not apply where a vendor has contested any tax administered pursuant to chapter eleven of the W. Va. Code, workers' compensation premium, permit fee or environmental fee or assessment and the matter has not become final or where the vendor has entered into a payment plan or agreement and the vendor is not in default of any of the provisions of such plan or agreement.

DEFINITIONS:

"Debt" means any assessment, premium, penalty, fine, tax or other amount of money owed to the state or any of its political subdivisions because of a judgment, fine, permit violation, license assessment, defaulted workers' compensation premium, penalty or other assessment presently delinquent or due and required to be paid to the state or any of its political subdivisions, including any interest or additional penalties accrued thereon.

"Employer default" means having an outstanding balance or liability to the old fund or to the uninsured employers' fund or being in policy default, as defined in W. Va. Code § 23-2c-2, failure to maintain mandatory workers' compensation coverage, or failure to fully meet its obligations as a workers' compensation self-insured employer. An employer is not in employer default if it has entered into a repayment agreement with the Insurance Commissioner and remains in compliance with the obligations under the repayment agreement.

"Related party" means a party, whether an individual, corporation, partnership, association, limited liability company or any other form or business association or other entity whatsoever, related to any vendor by blood, marriage, ownership or contract through which the party has a relationship of ownership or other interest with the vendor so that the party will actually or by effect receive or control a portion of the benefit, profit or other consideration from performance of a vendor contract with the party receiving an amount that meets or exceed five percent of the total contract amount.

AFFIRMATION: By signing this form, the vendor's authorized signer affirms and acknowledges under penalty of law for false swearing (*W. Va. Code* §61-5-3) that neither vendor nor any related party owe a debt as defined above and that neither vendor nor any related party are in employer default as defined above, unless the debt or employer default is permitted under the exception above.

WITNESS THE FOLLOWING SIGNATURE:

Vendor's Name: The Mahfood Group LLC

Authorized Signature: [signature] Date: 9-6-16

State of FL

County of Sumter, to-wit:

Taken, subscribed, and sworn to before me this 6th day of Sept, 2016.

My Commission expires June 5th, 2016.

AFFIX SEAL HERE NOTARY PUBLIC [signature]

MARY E GRAMS-KALLENBACH
MY COMMISSION #FF024545
EXPIRES June 5, 2017
(407) 398-0153 FloridaNotaryService.com

Resumes and

Copies of Diplomas

the MAHFOOD group LLC

JOHN J. MAHFOOD

Sr. Risk Assessment Specialist / Sr. Program Manager

EDUCATION

M.S. Health Aspects of Water Quality (1987)-University of Pittsburgh
B.S. Chemistry (1980)-University of Pittsburgh

FIELDS OF SPECIALIZATION

Public Health and Ecological Risk Assessments
Environmental Impact Assessments
Evaluation of Remedial Alternatives
Project Management
Analytical Chemistry
Indoor Air Quality and Vapor Intrusion
Environmental Education
PCB MegaRule
Residential Evaluations
Toxicological Assessments
Evaluation of Regulatory Criteria
Development of Alternative Criteria
Probabilistic Modeling

EXPERIENCE SUMMARY

Mr. Mahfood is principal and co-owner of The Mahfood Group LLC® (TMG) and has over 35 years of combined environmental experience in project management, human health risk assessment, and analytical chemistry. He has focused on the technical requirements under Pennsylvania's Land Recycling and Environmental Remediation Standards Act (Act 2) including the latest issues associated with potential vapor intrusion and indoor air quality. Mr. Mahfood has completed over 120 Act 2 risk assessments. Mr. Mahfood has also worked on a variety of state led voluntary remediation programs across the eastern United States including Ohio, North Carolina, South Carolina and West Virginia. He has also worked on various federal programs across the country, including Superfund and both Air Force and Navy programs. Mr. Mahfood has also worked as the lead risk assessment specialist on over 67 former manufactured gas plant sites in the United States. Mr. Mahfood has provided environmental health assessments to the natural gas and electric power industry for over twenty-six years. In addition, Mr. Mahfood has completed over 90 risk assessments under the PA Code 245 Storage Tank and Spill Prevention Program, including bulk storage terminal assessments.

Mr. Mahfood has worked on many sites where he has developed a variety of strategic approaches for site closure utilizing unique aspect and tools of quantitative risk assessment. Many of Mr. Mahfood's clients have relied on site specific data evaluation methods and procedures that reduce the need for further remediation. More recently, Mr. Mahfood has utilized various quantitative methods for deriving exposure point concentrations for the construction/utility worker scenarios, including segmentation of the utility corridor. Mr. Mahfood has also recently been utilizing refined fate and transport assessments to establish whether potential downgradient exposure to groundwater impacts exists. Recently, Mr. Mahfood has proposed alternative approaches to limiting exposure within a utility right-of-way in order to reduce the need for costly remediation.

The Mahfood Group LLC® currently holds a contract through the West Virginia Department of Environmental Protection (WVDEP), Division of Land Restoration, to assist in the review of human health and ecological risk assessments associated with the voluntary remediation and redevelopment program. Mr. Mahfood acts as the technical lead for this contract and focuses on the following:

- Review of public health and ecological risk assessments
- Assist and coordinate development of technical topics for use in the review of quantitative risk assessments under the program
- Interact with both WVDEP project managers and risk assessors to assist in project coordination including scope of work development and review for the site assessments
- Perform site visits in support of the technical review
- Perform quantitative reviews of all calculations, fate and transport assumptions and modeling
- Review of conceptual site model design
- Develop technical comments to be addressed by the entity submitting the risk assessment report
- Coordinate with the consulting firm submitting the risk assessment report to expedite and stream line technical responses

Mr. Mahfood has also conducted Phase I Environmental Site Assessments, Interim Remedial Measures, and Phase II Field Investigations at former manufactured gas plant (MGP) facilities. These projects included all aspects of agency negotiations to solicit a phased approach outlined in a decision flow diagram. He has coordinated all activities associated with the removal of coal tar material from above ground and below ground gas holders and associated MGP structures. Mr. Mahfood has also been responsible for conducting quantitative risk assessments at many different types of industrial/commercial facilities across the country, including both RCRA and Superfund sites.

SELECTED PROJECT EXPERIENCE

- Mr. Mahfood has developed and implemented a post remedial care program to monitor sites that have been closed under various regulatory programs. This post remedial care program consists of information/data collection to ensure that post remedial care obligations are being met. The information is archived into a data base and reports are submitted to the appropriate agency on a regular basis.

- Environmental covenants (EC) are a critical part of site closure under many state led remediation projects. Mr. Mahfood has developed and implemented the necessary institutional controls for site closure and has prepared many EC as part of post remedial care obligations.

- Mr. Mahfood has worked on a former manufacturing/plating facility where PCB sediment migration in drainage ditches was a potential issue. A historic review of the plant operations was completed to focus in on the potential sources of PCBs on the facility. With a refined strategic approach for sampling, PCBs were shown to attenuate to near acceptable levels, and biological issues associated with the sediment were of less concern when incorporating a biological assessment of the sediment. Therefore, the only remaining issue was to evaluate potential residual exposures to sediment for a trespasser.

- Mr. Mahfood is currently working on a bulk petroleum storage facility outside the United States, which presents a unique set of issues related to applicable guidance and criteria for completion of the quantitative risk assessment. An in depth analysis of potential exposure scenarios was completed for the local community and a preliminary conceptual site model was developed using numerous alternative guidance documents and methods for obtaining environmental field data to be used in the quantitative risk assessment.

- Mr. Mahfood regularly works within the electric power generation industry assisting his clients on the latest issues associated with coal fired power plants, including toxicological evaluations of coal fired power plant bi-products and ash material.

- Mr. Mahfood is currently working on various aspects associated with the gas industry and related impacts for development of natural gas compressor stations, including the development of site specific clean up criteria when Act 2 criteria are not available.

- A former industrial plant encompassing approximately 16 acres was evaluated by Mr. Mahfood utilizing the site specific standard under Pennsylvania's Act 2 program which affords a property owner the option to assess site specific risks using various current and potential future use scenarios. The site was divided into three future development parcels. Each parcel was addressed separately with site specific scenarios. One primary issue with the site was the diffuse groundwater discharge to surface water with impacts of chlorinated solvents and an identified preferential pathway also leading to the surface water via an historic catch basin system. Based on the results of the risk assessment a series of remedial action objectives were developed by Mr. Mahfood giving the property owner cost effective alternatives to address the surface water issues.

- Mr. Mahfood is responsible for developing and implementing a PCB monitoring program for a Pennsylvania utility under the federal PCB MegaRule Program Part 761. Responsibilities include developing sampling protocols, establishing a data base management system, working with the utility to update their natural gas pipeline system data base identifying PCB locations and developing system wide protocols for implementing mitigation measures.

- Mr. Mahfood has performed quantitative risk assessments on a variety of sites with mercury impacts. These evaluations focused on manometer repair buildings, compressor stations, and various other types of units where mercury impacts occurred (e.g. Superfund Sites). Of special interest for some of the projects was a complete understanding of how mercury may migrate within the structures (and external to the structures) where repairs took place (especially those facilities with wooden floors). Mercury migration as it is considered in quantitative risk assessments was very important in order to not underestimate the potential for receptors to be exposed outside the primary release area.

- Mr. Mahfood is currently working as lead risk assessor on numerous petroleum/underground storage tank sites located in both Pennsylvania and West Virginia under their respective voluntary programs. These assessments focus the use of risk assessment on addressing environmental impacts in order to place these sites back into use. Preliminary conceptual site modeling is paramount in converging the investigative activities to address those areas of the site that could create the most significant risk and then will help to develop specific remedial action objectives to mitigate any risk benchmark exceedances. Most of the site conceptual models addressed nonresidential use, however, several of the sites needed to address future residential use and recreational use as part of the risk assessment.

- Mr. Mahfood is focusing a considerable amount of time on vapor intrusion and indoor air quality. He has worked closing with a nationally recognized air laboratory to develop and refine soil gas sampling procedures and indoor air sampling methodologies utilizing his combined public health and chemistry background with specific focus on residential indoor air.

- Mr. Mahfood conducted a risk assessment on a former MGP located in Wilmington, NC. Investigative activities for this site were conducted under an Administrative Order on Consent (AOC). Current use of the site included a senior housing facility, a public boat ramp, and an abandoned industrial facility. The surrounding area includes residential properties. The site contained the typical MGP residual source areas. Because a portion of the MGP site is currently used and the other portion is being considered for future development, a variety of future use exposure scenarios were developed to focus the risk assessment. By incorporating reasonable future use scenarios at the beginning of the process and working together with the various interested parties, a significant cost savings can be realized for this site.

- One of Mr. Mahfood's latest projects involved the West Virginia Voluntary Remediation Program (VRP). The site is located in Kenova, West Virginia along the Ohio River. The site was a former industrial facility that housed a variety of industrial activities over the years. Mr. Mahfood was acting as both Sr. Project Manager and Sr. Risk Assessment Specialist on the project. The site has many unique characteristics including the involvement of multiple VRP's due to environmental impacts on adjacent properties, some of which have migrated and consequently impacted the site. Activities involving Mr. Mahfood's experience at the site have been ongoing for over three years. Beginning with a strategy meeting with the WVDEP, a unique approach was developed to address impacts at the site. This approach included addressing the soil and groundwater impacts (vapor intrusion from shallow perched zones) first. This approach enabled progression of the site investigation activities related to the soil independent of the deep groundwater issues which were a result of other entities and are being addressed under separate VRP's.

  A risk based approach was utilized at the beginning of the project to develop a conceptual site model (CSM) which focused the program on soil and the perched groundwater (vapor intrusion only). This process was helpful in centering the remedial investigation efforts on the end use and producing analytical data necessary for the site specific risk assessment. As part of the baseline risk assessment (BRA) for the site, Mr. Mahfood developed reasonable scenarios which addressed both current site situations and the future use based on knowledge of the surrounding area and the interest of adjacent property owners in the site. The BRA used both default and site specific inputs and assumptions which resulted in a conservative approach in order to develop potential remedial action objectives (RAOs). The BRA results indicated the need to address surface soil due to excess lead in two small areas of the site.

Therefore, Mr. Mahfood oversaw the preparation of a Remedial Action Plan (RAP) that was prepared and implemented to reduce the surface soil lead concentration to an acceptable level as demonstrated by the conduct of a residual risk assessment (RRA). Mr. Mahfood worked closely with the WVDEP project manager in order to delineate the remediation area and to collect post excavation samples necessary for use in the RRA.

In the conduct of this risk assessment process along with other risk assessments performed by Mr. Mahfood, he has utilized the most recent accepted methodologies in developing CSMs, fate and transport evaluation, receptor analysis, statistical analysis, quantitative assessment and uncertainty analysis. This project recently received a No Further Action Letter from the WVDEP.

- Mr. Mahfood is currently program manager for a multi-site MGP program being conducted under a Consent Order and Agreement (COA) in accordance with Pennsylvania's Land Recycling and Environmental Remediation Standards Act (commonly known as Act 2). Mr. Mahfood's responsibility includes managing 8-10 MGP sites on an annual basis under this program. Project activities have included Phase I activities, Remedial Investigations, Risk Assessments, Interim Remedial Activities, Cleanup Plans and Final Report documentation.

  As part of this program, generic documents (e.g., Generic Work Plan, Generic QAPP and Generic HASP) have been developed. These generic plans facilitate the use of generic procedures on a site-specific basis. The client realizes a significant cost savings by utilizing these types of generic documents.

  As an important element of the multi-site program, Mr. Mahfood participates in program meetings with the Pennsylvania Department of Environmental Protection (PADEP) once a year to discuss program and technical issues. These meetings include five of the six PADEP regions and PADEPs central office. These meetings act as the forum to discuss technical issues before they become problematic on a particular project (or program wide).

  Under this program, Mr. Mahfood completed management of a site investigation and cleanup where a detailed delineation of a basal confining unit was performed in order to determine the potential for coal tar migration. This activity enabled the placement of a product recovery system in an area where coal tar accumulation was most prominent. In addition, delineation of this unit also was useful for the placement of piezometers to monitor potential migration during recovery efforts and show that the coal tar was not migrating to the point of compliance (i.e., property boundary).

  The site activities have also included project objectives which have focused on reuse, including benefits for the site owner, local municipality and the local community. Mr. Mahfood has conducted a site-specific risk assessment for this property which incorporated very specific end use activities including a little league baseball field and supporting facilities (e.g. parking lot). Based on the risk assessment findings, it was determined that an engineered control along with deed restrictions on intrusive activities and an incomplete pathway for groundwater use would satisfy Act 2 requirements for closure and offer this site for reuse to the local community. This site has recently been closed under Act 2 and a relief of liability has been granted. The site was also designated as one of PADEP's "Showcase Sites" under the Land Recycling Program.

- Mr. Mahfood was project manager for the investigation and interim remedial action (IRA) phases and senior risk assessment specialist for a former manufactured gas plant site located in Pennsylvania. This site was also evaluated under the multi-site program. The site is adjacent to a recreational surface water body and a boat ramp to access the river. Based on the results of the IRA (which included the removal of approximately 700 tons of coal tar from a below grade gas holder) and the risk assessment, the final remedy for the site included an engineered cover and natural attenuation. The natural attenuation portion was supported by groundwater modeling activities to demonstrate that there was no direct impact to the adjacent surface water body. The results of these activities invited the local municipality to purchase the property and designate the site as "green space" to help encourage additional recreational use of the river. This site received a relief of liability under Act 2.

- Mr. Mahfood was project manager and lead risk assessor for an MGP site where purifier waste was identified as the primary MGP waste. This material was distributed along the surface of the site. He led the initial investigation activities to determine the vertical and horizontal extent of the purifier waste. Based on the site investigation Mr. Mahfood coordinated hot spot removal of certain areas exceeding applicable Act 2 medium-specific standards and performed a residual risk assessment demonstrating acceptable site-specific risks. Subsequent to the removal and risk assessment activities the area was returned to beneficial use as a parking lot for the local gas company. A relief of liability was granted for this site under Act 2.

- Mr. Mahfood was lead risk assessment specialist for two site-specific risk assessments utilizing both U.S. EPA Region 4 and State of North Carolina Guidance for a manufactured gas plant site located in North Carolina. The site consisted of two separate parcels where very different conceptual site models were developed to account for the distinct differences in current and potential future site use. The results of the risk assessment showed that for the one parcel only surgical soil removal would be necessary to meet site use and acceptable risk levels. While the other parcel met acceptable risk levels and no remedial alternative was necessary. A key element of both risk assessments was the development of a risk-based approach with consideration of potential current and future use and the use of reasonable exposure scenarios.

- Mr. Mahfood has completed the risk assessment on a former MGP site in North Carolina where the future development will be for recreational boating activities. Based on the planned future use, Mr. Mahfood was able to develop site-specific exposure scenarios which will limit removal of historic MGP materials to those contained in below grade structures (e.g. below grade holder and tar wells).

- Mr. Mahfood worked on a site-specific risk assessment in North Carolina where historic manufactured gas plant operations were conducted and more recently the site was used as a dry cleaner. The complicating factor with this site was the combined constituent list of manufactured gas plant residuals and dry cleaner chemicals. An office currently occupies a small portion of the site; however, the remainder of the site is unoccupied (with some vacant structures). The risk-based approach plays a very important role for redevelopment of the property. Redevelopment plans are incorporated into the risk-based approach therefore, enabling the refinement of a conceptual site model and the development of realistic potential exposure input parameters based on the future use, especially when considering potential exposure pathways such as vapor intrusion.

- As a Senior Environmental Risk Analyst, Mr. Mahfood has performed public health environmental assessments for industrial clients as part of remedial investigations and the development of various risk-based approaches. The types of sites include: coke plants, manufactured gas plants, wood treating plants, and coal tar refineries. He has provided expertise in the development of potential human exposure and environmental pathways and fate and transport analysis of site related chemicals in the environment.

- Mr. Mahfood has been involved in probabilistic cost modeling for various confidential clients. He has worked on and developed input parameters and methods for describing various probability distributions for use in the modeling.

- Mr. Mahfood was lead risk assessor for an industrial site where he compared the benefits of performing a deterministic risk assessment versus a probabilistic risk assessment and weighed the cost of each against a favorable outcome in order to show that implementation of a remedy was not necessary. This assessment was conducted under the Ohio VAP and saved the client approximately $500,000 dollars in remediation costs.

- Mr. Mahfood historically focused his efforts on evaluating the potential for reuse of "waste" material as a product for retail sale. He performed a risk assessment under Pennsylvania's Residual Waste Regulations to establish wood ash as a coproduct for various commercial uses (e.g., as a soil amendment, road base material). The activities associated with this risk assessment required a complete understanding of the manufacturing process which generated the wood ash, potential reuse markets, chemical breakdown of the material, potential use scenarios and a unique understanding of use specific exposure parameters.

- The following technical specialties support Mr. Mahfood's efforts acting as both project manager and risk assessment specialist for many of his projects. They include public health risk and environmental impact assessments, utilizing deterministic assessments and probabilistic analysis, chemical/ analytical program development, contaminant fate and transport and statistical analysis. Mr. Mahfood performed qualitative and quantitative health risk and environmental assessments for superfund remedial investigations and feasibility studies. One of his Superfund projects included a risk assessment for a car battery reclamation site where lead was the major environmental concern. This assessment not only included an evaluation of potential exposure to lead, but an assessment of how the lead would migrate in the environment based on the acidic conditions as a result of the battery acid.

- Mr. Mahfood has been responsible for the preparation of sampling and analysis plans, including budgeting and scheduling of associated analytical activities. Mr. Mahfood's background in analytical chemistry has assisted him in selecting the appropriate analytical methods necessary to accomplish project quality objectives and to assure attainment of chemical criteria.

- Mr. Mahfood has also completed public health and environmental assessments for uncontrolled waste sites and developed comprehensive validation procedures for the evaluation of analytical data on several remedial investigations for the U.S. Department of Defense. These sites included Air Force bases, with a focus on the risk associated with exposure to the various areas where training activities were completed (e.g., burn pits).

- As a Chemist, Mr. Mahfood coordinated the analysis and data review of water and soil samples under Superfund protocol for the analysis of pesticides, herbicides and PCBs. Mr. Mahfood has a complete analytical background in the analysis of industrial wastes by gas chromatography, including volatile compounds, PCBs, herbicides, base/neutral, and acids. He has also analyzed water samples for inorganic ions by ion chromatography and performed a variety of wet chemical analyses for inorganic constituents.

- Mr. Mahfood has developed quality control procedures, including routine quality control charts along with a complete statistical analysis to monitor and review test results on a daily basis. He has also performed analysis on other media such as acid mine drainage, industrial effluents, home drinking water and coal samples.

SELECTED PUBLICATIONS/PRESENTATIONS

Hale, J.R., J.J. Mahfood, and R.J. Hickman, 1999. *Evaluating Natural Attenuation of Dissolved Coal Gasification Derivatives in Shallow Unconfined Aquifers.* Presented at the IGT Twelfth International Symposium on Environmental Biotechnologies and Site Remediation Technologies & Utility Industry Environmental Issues, Challenges, and Solutions. December 1999.

Hasel, Michael, J.J. Mahfood, Anthony Mazzoni. A Case Study for Cost Effective Control of MGP Site Remediation Risks with a Fabric Structure in a Residential Setting. Presented at the Gas Technology Conference & Exhibition, Orlando, Florida. January 30-February 2, 2005.

Hayes, Heidi, J.J. Mahfood, B. Shamory. Comparison of EPA Compendium Methods TO-15 and TO-17 for the Measurement of Naphthalene in Soil Gas. Presented at Business of Brownfields Conference, April 17-18, 2008.

Hoff, Richard F., John J. Mahfood, Amanda L. McGuinness. Sustainable Benefits of Urban Farming as a Potential Brownfields Remedy. Business of Brownfields Conference, Pittsburgh, PA. April 2010.

Hoff, Richard F., Tammi Halapin, John J. Mahfood. Effects of Changing Regulatory Paradigms on Brownfield Viability and Sustainability. Business of Brownfields Conference, Pittsburgh, PA. April 2009.

Hoff, Richard F., Tammi Halapin, John J. Mahfood. Practical Considerations in Sustainability. Business of Brownfields Conference, Pittsburgh, PA. April 2009.

Kotun, RJ., and J.J. Mahfood, 1994. Deriving a Practical and Cost-Effective Soil Remedial Goal for Carcinogenic PAHs. Presented at Superfund 1994, December 1994.

Kupchella, L., A. Syty, and J.J. Mahfood, 1983. Improved Apparatus for Rapid Mercury Determination by Cold Vapor Atomic Absorption Spectroscopy. Journal of the Association of Official Analytical Chemists, September 1983, Volume 66, pp. 1117-1120.

Mahfood, J.J., Andrew Swales, 2011. Karst Geology, Vapor Intrusion and Human Health Risk Assessment – Fundamental Issues to Consider. Growing Communities on Karst 2011 and the Great Valley Water Resources Science Forum, September 2011.

Mahfood, J.J., Mary Washko, 2010. Risk Assessment and a Multi-Phased Approach to Investigating TCE Plume in Karst. Growing Communities on Karst 2010 and the Great Valley Water Resources Science Forum, September 2010.

Mahfood, J.J., B.D. Shamory, H. Hayes, 2007. Vapor Intrusion Pathways, Evaluating Naphthalene. Presented at the Business of Brownfields Conference, April, 2007.

Mahfood, J.J., M. Ferlin, R. Contrael, Dougherty, A. Lopez, D. Shier, 2006. Stratified Soil Gas Sampling at an MGP Site for Use in a Quantitative Risk Assessment, A Case Study. Presented at Gas Technology Conference and Exhibition, Orlando, Florida, October 2006.

Mahfood, J.J., Richard E. Baker, Jr., Jennifer M. Malle. Utilizing a Risk-Based Approach to Reduce Soil Excavation Costs. Presented at the Gas Technology Conference & Exhibition, Orlando, Florida. January 30-February 2, 2005.

Mahfood, J.J., D.J. Wingerd, and R.J. Kotun, 1994. A Decision Flow Chart for Cleanup of Multiple Manufactured Gas Plant Sites. Presented at HMCRI Federal Environmental Restoration III and Waste Minimization II Conference and Exhibition, New Orleans, LA, April 1994.

Malle, J.M., J.J. Mahfood, and A.C. Swales, 2001. Co-Product Determination-Applying State Residual Waste Regulations for Re-Use of Fly-Bottom Ash Material as a Retail Product. Presented at the Gas Technology Institute 14th Annual International Conference. December 2-6, 2001.

Shamory, Craig S., J.J. Mahfood, Andrew C. Swales. An Innovative Method for Presenting and Evaluating the Hydrogeologic and Exposure Aspects of a Risk-Based Site Closure. Presented at the Gas Technology Conference & Exhibition, Orlando, Florida. January 30-February 2, 2005.

Shamory, Brett, Smith, Lisa, 2015. Evaluation of Virginia DEQ Trench Model for Construction/Utility Worker Exposure Pathway Risk Assessment. Presented at the Pennsylvania Brownfields Conference. 2015. Co-contributor – John J. Mahfood.

Shosky Jr., D.J., J.J. Mahfood, R.A. Brown, and M. Jackson, Jr., 1995. Emerging Technologies for Recycling MGP Sites. Pollution Engineering, June 1995, Volume 27, Number 6, pp. 62-66.

Swales, A.C., J.J. Mahfood, J.R. Hale, E. Meyer, and M.J. Hasel, 2000. Remediation, Restoration, Re-Use: Accomplishing the Three R's of MGP Site Revitalization. Presented at the Gas Technology Institute Thirteenth International Symposium on Site Remediation Technologies & Environmental Management Practices in the Utility Industry. December 4-7, 2000.

Shaw, Bruce, L. Smith, and J. J. Mahfood, 2014. Risk Assessment to Support Multi-Phase Brownfields Redevelopment. Presented at the 2014 West Virginia Brownfields Conference. September 11 and 12, 2014.

Urbassik, Mark, Smith, Lisa, 2012. A Different Paradigm for Brownfield Assessments/Remediation. Presented at the Pennsylvania Brownfields Conference. 2012. Co-authored by John J. Mahfood.

University of Pittsburgh

Pittsburgh, Pennsylvania

To all persons to whom these presents may come, Greeting

Be it known that

John Jude Mahfoud

having satisfied the requirements for the degree of

Bachelor of Science

is now admitted to that degree with all the rights, privileges and immunities thereunto appertaining.

In Witness Whereof, we the Trustees of the University have caused our corporate seal and the proper signatures to be hereunto affixed. Given at Pittsburgh, Pennsylvania, on the thirteenth day of August in the year of our Lord one thousand nine hundred and eighty.

[illegible]
Chairman Board of Trustees

Wesley W. Posvar
Chancellor

UNIVERSITY OF PITTSBURGH · 1787 ·

[illegible]
Provost

[illegible]
Dean, College of Arts and Sciences

University of Pittsburgh

To all persons to whom these presents may come, Greeting
Be it known that

John Jude Mahfood

having satisfied the requirements for the degree of

Master of Science in Hygiene

and having been recommended by the Graduate Faculty in

The Graduate School of Public Health

is now admitted to that degree with all the rights, privileges and immunities thereunto appertaining.

In Witness Thereof, we the Trustees of the University have caused our corporate seal and the proper signatures to be hereunto affixed. Given at Pittsburgh, Pennsylvania on the twenty-second day of April in the year of our Lord one thousand nine hundred and eighty-seven.

University of Pittsburgh · 1787

J. Marous
Chairman, Board of Trustees

Wesley W. Posvar
President

Donald M. Henderson
Vice Provost

Raymond Seltser
Dean, Graduate School of Public Health

LISA M. POPPELREITER
Environmental Scientist/Risk Assessor

EDUCATION B.S. Environmental Science (2009) - Summa Cum Laude
California University of Pennsylvania

TRAINING HAZWOPER
ASTM E1527 Phase I Training

FIELDS OF SPECIALIZATION Public Health Assessments
Data Management
Statistical Evaluation of Analytical Data
Site Assessments

EXPERIENCE SUMMARY

Ms. Poppelreiter has over four years of environmental experience in areas including data management and review, statistical evaluation of analytical data, quantitative risk assessments, site assessments, and risk assessment review. She has focused on the technical requirements under Pennsylvania's Land Recycling and Environmental Remediation Standards Act (Act 2). Ms. Poppelreiter has completed a multitude of risk assessments under Act 2 ranging from simple, small UST sites to MGP sites to large, chlorinated sites with no comments from the PADEP. Her experience also extends beyond the baseline risk assessment, assisting with remedial action objectives, post-remedial care plans, and environmental covenants.

SELECTED WORK/PROJECT EXPERIENCE

Ms. Poppelreiter has sufficient experience in statistical evaluation of analytical data, screening of data against appropriate media specific criteria, toxicity assessments, quantitative risk assessments, and development of complex conceptual site models in order to efficiently and effectively close sites under various State standards. She has assisted in the development of Remedial Investigation Reports, Risk Assessments, Cleanup Plans, and Residual Risk Assessments for several manufactured gas plant (MGP) sites. In addition, she has completed the 40-hr online HAZWOPER training and a training course for ASTM E1527 Phase I ESA. Ms. Poppelreiter is proficient in Microsoft Word, Excel, Powerpoint, and Publisher.

Ms. Poppelreiter has taken the lead on many risk assessment reports. She has a solid understanding of the equations, parameters, and calculations necessary to complete a risk assessment using models from Pennsylvania as well as other states. She is familiar with the chemical properties and toxicity criteria available through a hierarchy of resources, as well as gathering background information. She is also familiar with using on-line search tools such as the PA Groundwater Information System (PaGWIS) online database and the Pennsylvania Natural Diversity Inventory (PNDI) environmental review tool. She is competent in utilizing ProUCL, a comprehensive statistical software package, in order to perform statistical analyses of analytical data to develop exposure point concentrations. She has performed numerous risk calculations and has written supporting text for a multitude of risk assessments. She has also created soil and groundwater tag maps, used to highlight exceedances of constituents in comparison to PA's Act 2 screening criteria and their location in relation to the site.

Ms. Poppelreiter has participated in a complex risk assessment for a site in which a catch basin served as a preferential pathway and discharged into a culvert, which then discharged into an adjacent stream. Assessment of a recreational user of the stream and the stream itself was strategically evaluated in two parts. One part was the direct discharge from the culvert and the other part was diffuse discharge of groundwater upstream of the culvert discharge point. A site-specific surface water concentration was back-calculated for the recreational user under several scenarios (varying dermal exposure) in order to determine an acceptable surface water concentration that would be below an acceptable risk benchmark.

Ms. Poppelreiter assisted in developing a model that represents a wet basement and a sump scenario in order to estimate indoor air concentrations in which groundwater conditions limited the use of the

Johnson and Ettinger (J&E) model. A model presented by the Virginia Department of Environmental Quality (VA DEQ) was creatively incorporated to this site-specific situation. In addition, she has utilized MS Publisher to create figures in support of a descriptive conceptual site model as well as to create schedule flow charts.

Ms. Poppelreiter has assisted in a residual risk assessment for a former MGP site. A residual risk assessment was conducted in order to derive remedial goals that would reduce the overall hazard index and cancer risk to acceptable levels for each receptor at the site. This required each receptor and exposure pathway to be evaluated in order to determine which pathway(s) contributed the most risk and as a result was chosen as the basis of the remedial action goals that were calculated. These remedial goals were calculated to be protective of all receptors evaluated at the site.

Ms. Poppelreiter has also assisted in third-party reviews of risk assessments from West Virginia. She is familiar with the West Virginia Voluntary Remediation and Redevelopment Act (VRRA) regulations and has assisted in commenting on site assessment reports and risk assessment reports.

Ms. Poppelreiter currently performs statistical analyses on quarterly groundwater data under a National Pollutant Discharge Elimination System (NPDES) Permit. This analysis utilizes the tolerance interval procedure to calculate tolerance limits based on the background well data and compares data from four compliance monitoring wells in order to determine if there is a statistically significant increase in concentration over the background well.

Ms. Poppelreiter has also had experience in the field participating in perimeter air monitoring during an interim response action excavation and assisting in collecting waste water disposal samples. She is familiar with the use of air monitoring equipment such as photoionization detector (PID) devices. She has also had a significant part of an on-going annual PCB (polychlorinated biphenyls) sampling program in which liquid samples were collected from accumulation in components from natural gas distribution pipeline systems across western Pennsylvania and tested for PCBs. Ms. Poppelreiter works closely with analytical laboratories to have samples from various media analyzed, starting from development of the analytical scope of work to management of the final lab results.

Ms. Poppelreiter has performed research on alternative methods for estimating trench air concentrations for a construction worker/utility worker scenario. This included site-specific modifications to existing trench air models (e.g. VADEQ model) based on USEPA Region 8 documents. Modifications to the trench dimensions and air exchange rate play a significant role in estimating trench air concentrations. This evaluation also included utilization of soil gas data and utilization of direct air measurements collected within a trench via Summa canisters. Alternative methods based on Andelman studies were also considered during this evaluation.

Ms. Poppelreiter has also been responsible for developing and updating generic work plan documents for a multi-site consent order and agreement in the state of Pennsylvania.

Ms. Poppelreiter has experience training entry level employees on the risk assessment process, including following appropriate regulatory guidance procedures, understanding the screening process for selection of constituents of interest, evaluation of applicable receptors and exposure pathways, etc.

Ms. Poppelreiter has taken part in public presentations that outreached to the general public as well as environmental professionals. For example, she gave a powerpoint presentation at the 2012 PA Brownfields Conference on the conservative nature of risk assessments based on conservative assumptions, parameters, and other factors that additively produce an overall conservative risk assessment. She has also presented at the 2014 WV Brownfields Conference on the complex nature of preferential pathways to surface water, and she has presented at the 2015 PA Brownfields Conference discussing an evaluation of the VADEQ trench model and exploring site-specific alternatives.

Ms. Poppelreiter has experience preparing environmental covenants (ECs) for a property based on the institutional and/or engineering controls required for the property. This includes summarizing the property's tax parcel information, description of contamination and remedy, and activity and use limitations.

SELECTED PRESENTATIONS

Urbassik, Mark, L. Smith, 2012. A Different Paradigm for Brownfield Assessments/Remediation. Presented at the 2012 Pennsylvania Brownfields Conference. Co-authored by John J. Mahfood.

Shaw, Bruce, L. Smith, and J. J. Mahfood, 2014. Risk Assessment to Support Multi-Phase Brownfields Redevelopment. Presented at the 2014 West Virginia Brownfields Conference. September 11 and 12, 2014.

Shamory, Brett, L. Smith, 2015. Evaluation of Virginia DEQ Trench Model for Construction/Utility Worker Exposure Pathway Risk Assessment. Presented at the 2015 Pennsylvania Brownfields Conference. Co-authored by John J. Mahfood and Chad Hunter.

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LISA MARIE SMITH

THE DEGREE OF

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GIVEN AT THE UNIVERSITY THIS SECOND DAY OF MAY, 2009

CHAIRPERSON, BOARD OF GOVERNORS

PRESIDENT

CHANCELLOR, STATE SYSTEM OF HIGHER EDUCATION

CHAIRPERSON, COUNCIL OF TRUSTEES

Lauren K. Tibbens
Environmental Scientist/Risk Assessor

EDUCATION

B.S. Environmental Health (2010) –
Indiana University of Pennsylvania
M.P.H Environmental and Occupational Health (2015)
University of Pittsburgh
Certificate in Environmental Health Risk Assessment (2015)
University of Pittsburgh

FIELDS OF SPECIALIZATION

Public Health Assessments
Data Management
Statistical Evaluation of Analytical Data
Site Assessments

EXPERIENCE SUMMARY

Ms. Tibbens has over one year of environmental experience in areas including data management and review, quantitative risk assessments, statistical evaluation of analytical data, site assessments, and risk assessment review. She has focused on the technical requirements under Pennsylvania's Land Recycling and Environmental Remediation Standards Act (Act 2).

SELECTED WORK/PROJECT EXPERIENCE

Ms. Tibbens has completed statistical evaluation of analytical data, screening of data against appropriate media specific criteria, toxicity assessments, quantitative risk assessments, and development of conceptual site models. She has also assisted in the development of Remedial Investigation Reports, Risk Assessments, and Residual Risk Assessments for multiple sites.

Ms. Tibbens has experience preparing environmental covenants (ECs) for several properties based on the institutional and/or environmental controls required for the property. This includes summarizing the property's tax parcel information, description of the contamination and remedy, and the activity and use limitations.

Ms. Tibbens has developed a solid understanding of equations, parameters, and calculations necessary to complete a risk assessment using models from Pennsylvania as well as other states. She is familiar with the chemical properties and toxicity criteria available through a hierarchy of resources, as well as gathering background information. She is also familiar with using on-line search tools such as the Pennsylvania Natural Diversity Inventory (PNDI) environmental review tool. She is competent in utilizing ProUCL, a comprehensive statistical software package, in order to perform statistical analyses of analytical data and to develop exposure point concentrations. Ms. Tibbens currently develops risk calculations and supporting text for multiple risk assessments.

Ms. Tibbens also created soil and groundwater tag maps which are used to highlight exceedances of constituents in comparison to PA's Act 2 screening criteria and their location in relation to the site.

Ms. Tibbens assisted in developing a model that required site-specific groundwater concentrations. This required her to use the Johnson and Ettinger (J&E) model to calculate indoor air concentrations. She was able to accomplish this by having strong understanding of the assumptions, parameters, and limitations of the model.

Ms. Tibbens has assisted in a residual risk assessment for a former MGP site. A residual risk assessment was conducted in order to calculate hazard index and cancer risk levels using post-remediation analytical data and to demonstrate attainment under the Site-Specific Standard (SSS). This required each receptor and exposure pathway to be evaluated in order to determine which pathway(s) contributed to the risk.

Ms. Tibbens currently performs statistical analyses on quarterly groundwater data under a National Pollutant Discharge Elimination System (NPDES)

Permit. This analysis utilizes the tolerance interval procedure to calculate tolerance limits based on the background well data and compares data from four compliance monitoring wells in order to determine if there is a statistically significant increase in concentration over the background well.

Indiana University of Pennsylvania

Upon recommendation of the Faculty
and by authority of the Council of Trustees
and of the Board of Governors of the State System of Higher Education

Lauren Kaye Tibbens

having successfully completed the required course of studies
is hereby awarded the degree of

Bachelor of Science

Magna Cum Laude

with all rights, honors, and privileges thereunto pertaining
Given at Indiana University of Pennsylvania
this seventh day of May, two thousand and ten.

Tony Atwater
President of the University

Chair, Council of Trustees

Chancellor
State System of Higher Education

Chair, Board of Governors
State System of Higher Education

The University of Pittsburgh

Graduate School of Public Health

Upon Recommendation Of The Faculty,
And By Authority Of The Board Of Trustees, Confers Upon

Lauren Kaye Tibbens

the degree of

Master of Public Health

With all the rights, privileges and responsibilities pertaining thereto.
In witness thereof, the seal of the University and the signatures
of the authorized officers are affixed at Pittsburgh, Pennsylvania.
April 25, 2015

Chairman, Board of Trustees

Chancellor

Provost

Dean, Graduate School of Public Health

THE UNIVERSITY OF PITTSBURGH

GRADUATE SCHOOL OF PUBLIC HEALTH

certifies that

Lauren Kaye Tibbens

having satisfied the requirements of this program

has been granted the Certificate in

Environmental Health Risk Assessment

In witness thereof, we have affixed our signatures.

April 25, 2015

James Peterson, PhD
Program Director

Donald S. Burke, MD
Dean, GSPH

Example Risk Assessment

Risk Assessment Report

Former Top's Diner Property
410 Central Avenue
Johnstown City, Cambria County, Pennsylvania

Prepared for:

P. Joseph Lehman, Inc.
Post Office Box 419
Hollidaysburg, PA 16648

Prepared by

The Mahfood Group LLC®
1061 Waterdam Plaza Drive
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McMurray, Pennsylvania 15317

PADEP Primary Facility ID No. 772457

Project No. 15030-001

August 2015

P. JOSEPH LEHMAN, INC.
CONSULTING ENGINEERS

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GEOLOGIST CERTIFICATION

I, Kaleb Kyler Hammond, a Registered Professional Geologist licensed in the Commonwealth of Pennsylvania (PG 005074), have participated in the preparation of the document titled, "Risk Assessment Report, Former Top's Diner Property, 410 Central Avenue, Johnstown City, Cambria County, Pennsylvania". I certify that the geologic and hydrogeologic content of this document, as prepared by the signing licensed Professional Geologist, are consistent with the applicable geologic and hydrogeologic standards of the Technical Guidance Manual for Pennsylvania's Land Recycling Program and Act 2.

Name: KALEB K. HAMMOND

Signature: [signature]

Date: 8/25/15

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
KALEB KYLER HAMMOND
GEOLOGIST
No. PG005074

1 Introduction

This document presents the Risk Assessment Report (RAR) for the former Top's Diner property (site) located at Johnstown City, Cambria County, Pennsylvania. This RAR has been prepared for Sheetz, Inc. (Sheetz) by The Mahfood Group LLC® (TMG) and by P. Joseph Lehman, Inc., Consulting Engineers (Lehman). This risk assessment was completed in accordance with the Land Recycling and Environmental Remediation Standards Act (Act 2) [LRERSA 1995], Chapter 250.409 and Subchapter F (Exposure and Risk Determination) of the regulations [PACODE 2011], Sections II.C.4, IV.G and IV.H of the Land Recycling Program Technical Guidance Manual (TGM) [PADEP 2002 and subsequent updates], and the vapor intrusion guidance [PADEP 2004]. Sheetz is seeking a release of liability under the Act 2 site-specific standard.

As per the requirements of the Pennsylvania Department of Environmental Protection (PADEP) Act 2 process, A Notice of Intent to Remediate (NIR) was submitted to the PADEP on January 7, 2014 that contained the proof of public notification, which was published in the Johnstown Tribune-Democrat, and the proof of municipal notification, which was provided to Johnstown City. No additional comments were received in response to either of the notifications. The risk assessment presented here is based on the investigative results and conceptual site model previously presented in the Remedial Investigation Report (RIR) [Lehman 2014].

The RAR is developed to characterize potential risks to human health and the environment, both now and in the future, associated with chemicals present on-site due to historical releases at the site. The RAR is organized into ten sections including this section (the Introduction). The subsequent sections include:

- Section 2: This section provides descriptions of the site, site history, site investigations, and groundwater use.
- Section 3: This section presents the analytical results and selection of constituents of concern.

- Section 4: This section presents the conceptual site model (CSM) for the site. The site CSM consists of a hydrogeologic CSM, human health CSM, and an ecological screening.

- Section 5: This section presents the procedures that were used to develop exposure point concentrations (EPCs) for the direct contact exposure pathways.

- Section 6: This section presents constituent-specific parameters used in the site-specific risk assessment including chemical properties, toxicological values, absorption adjustment factors, and permeability constants.

- Section 7: This section presents the intake or absorbed dose equations for the ingestion and dermal contact exposure pathways, exposure concentration equations for the inhalation exposure pathways, and assumptions used to calculate constituent exposure parameters.

- Section 8: This section presents the calculated risks and hazard indices.

- Section 9: This section presents an uncertainty analysis regarding the risk assessment.

- Section 10: This section presents the summary and conclusions.

- Section 11: This section contains the references cited in this document.

Various tables, figures, and attachments are also presented as part of this document and are referenced where appropriate in the text.

2 Site Background and Setting

This section provides descriptions of the site, site history, site investigations, and groundwater use. This site-specific information is used to select constituents of concern and to develop a conceptual site model for the site.

2.1 Site Location and Description

The former Top's Diner property is located at 410 Central Avenue, Johnstown City, Cambria County, Pennsylvania. Figure 2-1 presents the site location map. The property is approximately 0.5-acres in size. The site is currently inactive with no structures on-site. The majority of the site is covered with grass and gravel. The planned future use of the property is as a paved parking lot for an active Sheetz retail gasoline dispensing facility and convenience store located immediately south of and adjacent to the site. Figure 2-2 presents the site map.

The site is surrounded by commercial and residential properties. It is bounded to the northwest by Central Avenue, to the north by DuPont Street, to the east by residential properties, and to the south by the Sheetz convenience store. A Rite Aid Pharmacy is located to the northwest of the site across Central Avenue. A gasoline dispensing facility formerly branded as a CoGo's gas station and convenience store is located to the north/northeast of the site across DuPont Street. This gas station is currently inactive. Figure 2-3 presents the site area map.

A storm water line crosses the southeastern portion of the site at approximately 2 to 3 feet below ground surface (ft-bgs). Several underground utility lines are located adjacent to the site. These include a sanitary sewer line (approximately 4.5 to 8 ft-bgs) parallel to DuPont Street, several water lines parallel to DuPont Street and Central Avenue, storm water lines outside of the southwestern border of the site and parallel to DuPont Street, and gas lines outside of the southeastern border of the site. A main water line (36 inch pipeline) is located approximately 14 ft-bgs beneath Central Avenue. Electrical service is provided via overhead lines.

The site is fairly flat. Surface water run-off in the vicinity of the site flows via overland flow to the east/northeast. Groundwater generally flows toward the north/northeast. The nearest downgradient surface water body is Sam's Run, a channelized and buried stream located approximately 270 feet east of the site. In addition, Sandy Run is located approximately 230 feet west of the site.

2.2 Site History

Review of historical environmental investigations and aerial photographs indicates that the property historically was vacant before 1913. In 1913, the appearance of two structures that appear to be multi-family residences have been noted. Based on a review of Sanborn Maps, a gasoline filling station and three gasoline underground storage tanks (USTs) were present at the site in 1949. By 1965, the gasoline filling station was replaced with a small restaurant. The property was identified as Top's Diner and a Fox's Pizza Den prior to being acquired by Sheetz in 2012. The historical documents, photos, and Sanborn Maps were originally presented in the RIR [Lehman 2014].

2.3 Site Investigations

Several site investigations have been conducted previously. These investigations include the following:

- Phase I and Phase II Environmental Site Assessments (Mountain Research, LLC)
- Underground Storage Tank Excavation (Lehman)
- Remedial Investigation (Lehman)

A summary of each investigative phase is presented in following subsections. The basis for developing this risk assessment was based on these activities and findings discussed below.

2.3.1 Phase I and Phase II Environmental Site Assessments (Mountain Research, LLC)

Based on a Phase I Environmental Site Assessment (ESA) conducted by Mountain Research LLC (MRLLC) in June 2012, the site operated as a gasoline dispensing facility and three gasoline USTs were historically located at the site. A Phase II ESA conducted by MRLLC in June 2012 and reported to Sheetz in July 2012 consisted of a ground penetrating radar survey and eight soil borings (SB-1 through SB-8). Temporary groundwater wells were installed to collect qualitative groundwater samples from four of these soil borings. The locations of these soil borings are shown on Figure 2-4. The Phase II ESA results indicated that groundwater and soils were impacted by petroleum hydrocarbons at levels exceeding the Statewide Health Standards (SHSs).

2.3.2 Underground Storage Tank Excavation (Lehman)

On July 22, 2013, two USTs were discovered during the demolition of the site building and former site features. The tanks contained process waste water and what appeared to be used motor oil. Both tanks appeared to be 550-gallons in size. The location of these tanks is illustrated on Figure 2-4. During the removal of the tanks, small amounts of staining and discoloration were observed in the immediate vicinity of the USTs. Two feet of soil surrounding the tank (approximately 36 tons) were removed as part of the interim remedial actions in July 2013. Following the removal of the impacted soils, samples were collected beneath the USTs as part of the UST closure requirements. Samples collected as part of the confirmatory sampling associated with the UST closure did not yield exceedances of the SHSs for soil.

2.3.3 Remedial Investigation (Lehman)

P. Joseph Lehman, Inc., Consulting Engineers (Lehman) conducted site characterization investigations from December 2013 to March 2015 at the site. Investigations included collection of soil, groundwater, and soil gas data to support the remedial investigation and this risk assessment. Seventeen subsurface soil samples were collected from nine boring locations (SB-9 through SB-17) ranging from 4-5 ft-bgs to 14-15 ft-bgs intervals. The locations of these soil borings are shown on Figure 2-4. The soil samples were analyzed for the PADEP Short List of Petroleum Products for leaded gasoline.

Seven monitoring wells, including five on-site wells (i.e., MW-1 to MW-5) and two off-site wells (i.e., MW-6 and MW-7), were installed in the overburden groundwater to a maximum depth of 25 feet. The off-site wells MW-6 and MW-7 were installed on the Central Avenue right-of-way (ROW) adjacent to the Rite Aid Pharmacy. One monitoring well was installed on-site in the bedrock groundwater (MW-3D) to a total depth of 45 feet. Four rounds of groundwater samples were collected from each well between January 2014 and March 2015. The locations of these monitoring wells are shown on Figure 2-2. The samples were analyzed for the PADEP Short List of Petroleum Products for unleaded gasoline.

The Sheetz Store #21 building is within 100 from MW-3, which has exhibited the highest impacts to groundwater. Therefore, a soil vapor point (VP-1) was installed on the northwest side of the off-site Sheetz building to the south of the site in July 2014 in order to support vapor intrusion evaluation for the building. The location of the soil vapor point is shown on Figure 2-4. The vapor point was screened from 4.5 to 5 ft-bgs. Soil gas samples were collected from VP-1 in August and September 2014. The soil gas samples were analyzed for the volatile organic chemicals (VOCs) on the PADEP Shortlist of Petroleum products for unleaded gasoline.

Additional remedial investigation activities conducted by Lehman included a site survey, groundwater gauging, aquifer testing, and waste characterization, the details of which are summarized in the RIR [Lehman 2014]. The sampling results and preliminary conceptual site model of the remedial investigation were reported in an RIR [Lehman 2014], which was submitted to the PADEP on November 19, 2014. The RIR was approved by the PADEP on March 12, 2015. The analytical results that were utilized for this risk assessment are presented in Section 3 and an updated conceptual site model is presented in Section 4.

2.4 Groundwater Use

Groundwater is currently not used for any purposes on-site. The site and surrounding parcels are served by a public water supply owned by the Greater Johnstown Water Authority (GJWA). The main source of water is the North Fork Reservoir which is located approximately five miles to the east/southeast of the site. Based on a Pennsylvania Groundwater Information System (PaGWIS) search, there are 15 registered wells located within a one-mile radius of the site. Of the 15 wells that are present, four are monitoring wells associated with the site and 10 are monitoring wells associated with the former CoGo's gas station located northeast of the site. One well listed in the PAGWIS search is labeled as a being used for domestic/withdraw purposes. This well is located approximately 4,900 feet south/southwest of the site, which is upgradient of the site groundwater flow. No mandatory hook-up ordinance dictating the necessity of Johnstown City residents to connect to the municipal water supply is present. Additionally, no ordinance prohibiting the installation of potable drinking wells are currently in place in Johnstown City.

Since groundwater is currently not used for potable and/or non-potable purposes both on-site and within a one-mile radius downgradient of the site, exposure to site-related constituents in groundwater is currently incomplete for both on-site and off-site receptors.

However, Johnstown City currently does not have a mandatory public water connection ordinance or prohibit the installation of a well for groundwater use. There is the potential for a potable well to be installed on-site in the future that could potentially draw groundwater from the former source areas. Therefore, a restriction will be placed on the former Top's Diner property that will prohibit the use of groundwater for potable and agricultural purposes on the on-site property.

In addition, a potable or non-potable well may be installed on the immediate off-site properties in the future. Therefore, a post-remedial care plan will be put in place for the on-site property (former Top's Diner) to monitor the immediate off-site properties to verify if any wells are installed on those off-site properties.

3 Analytical Results and Selection of Constituents of Concern

This section presents the analytical results for soil (Table 3-1), groundwater (Tables 3-2 and 3-3), and soil gas (Table 3-4) and comparisons of the data to applicable screening values in order to identify constituents of concern (COCs) for the site.

3.1 Analytical Data

Soil

The soil analytical data were screened against United States Environmental Protection Agency (USEPA) Region 3 Regional Screening Levels (RSLs) [USEPA 2015a] in accordance with the TGM [PADEP 2002 and subsequent updates] Section IV.G.2.a.i under the site-specific standard (SSS). Since the site has been used for non-residential purposes and is expected to remain non-residential for the foreseeable future, direct contact soil COCs for on-site receptors were based on industrial soil RSLs and soil screening levels (SSLs) protective of groundwater. Table 3-1 presents the soil analytical data along with a comparison to USEPA industrial soil RSLs and SSLs protective of groundwater. In accordance with the TGM, the noncarcinogenic constituents were screened against applicable RSLs and SSLs based on a hazard quotient (HQ) of 0.1 rather than 1.

Subsurface soil samples were collected on-site at depths ranging from 3 to 15 ft-bgs. One subsurface soil sample [SB-3 (7')] was collected off-site at the DuPont Street ROW. Table 3-5 presents a summary of all the soil analytical data and indicates if the sample is retained or not retained for the risk evaluation. As indicated on Table 3-5, all soil samples were retained for use in the risk assessment except soil samples collected deeper than 10 feet [i.e., SB-9 (14-15'), SB-10 (11-12') and SB-11 (12-13')] at the center and southern portion of the site, which is considered unavailable for direct contact for on-site receptors.

The soil sample analytical results are subdivided by depth range based on site conditions, such as depth to groundwater and depth of utility lines, to support risk evaluations. Soil present from 3 ft-bgs to a maximum depth of 10 feet is considered available for direct contact for future on-site construction workers, and off-site utility workers at the Central Avenue ROW. Soil present from 3 ft-bgs to a maximum depth of 8 ft-bgs is considered available for direct contact for future off-site construction workers at the Central Avenue ROW. A subset of soil collected from 3 ft-bgs to a depth of 6 feet is considered available for direct contact for future on-site utility workers.

The site is currently inactive with no structures on-site. The planned future use of the site is a paved parking lot for the off-site Sheetz store just south of the site. As a result, vapor intrusion evaluation is not warranted for current and future on-site receptors.

A Sheetz convenience store building is located immediately south of the site. Soil samples SB-9 (9-10') and SB-11 (9-10') were collected in the unsaturated zone adjacent to the southwestern property boundary. None of the site-related volatile constituents were detected in SB-9 (9-10') and SB-11 (9-10'). Thus, vapor intrusion is not evaluated for soil for the current off-site Sheetz building.

Central Avenue is located to the northwest of the site. For evaluation of off-site receptors at the Central Avenue ROW, on-site soil samples SB-12 (7-8' and 9-10'), SB-14 (4-5' and 7-8'), and SB-15 (7-8' and 9-10') collected along the northwestern property boundary were utilized. DuPont Street is located to the north of the site. For evaluation of off-site receptors at the DuPont Street ROW, off-site soil sample SB-3 (7') collected at the DuPont Street ROW was utilized.

Groundwater

The groundwater analytical data were screened against USEPA Region 3 RSLs [USEPA 2015a] in accordance with the TGM [PADEP 2002 and subsequent updates] Section IV.G.2.a.i under the SSS. In accordance with the TGM, the noncarcinogenic constituents were screened against applicable RSLs based on a HQ of 0.1 rather than 1. In addition, groundwater analytical data were also screened against USEPA Office of Solid Waste and Emergency Response (OSWER) commercial vapor intrusion screening level (VISL) target groundwater concentrations based on a target risk of 1×10^{-6} and target HQ of 0.1 [USEPA 2014]. These target groundwater concentrations were calculated using the USEPA VISL Calculator, Version 3.4, (based on June 2015 RSLs) [USEPA 2015b]. All groundwater analytical data are presented in Table 3-2 along with a comparison to USEPA tapwater RSLs and VISL target groundwater concentrations. Table 3-5 presents a summary of all the groundwater analytical data and indicates if the sample is retained or not retained for the risk evaluation. As indicated on Table 3-5, all groundwater samples were retained for use in the risk assessment.

Groundwater samples collected between January 2014 and March 2015 in on-site monitoring wells (MW-1 to MW-5, and MW-3D) were utilized to select direct contact COCs for on-site receptors. As stated earlier, the site is currently inactive with no structures on-site. The planned future use of the property is a paved parking lot for the off-site Sheetz store just south of the site. Thus, vapor intrusion evaluation is not applicable to current and future on-site receptors.

The overburden groundwater at the site flows to the north/northeast. Several off-site properties/ROWs are located either adjacent to the site or downgradient of the on-site groundwater flow. These off-site properties/ROWs could be potentially impacted from site-related constituents. Evaluation of off-site receptors is described below.

- **Sheetz Store** – The Sheetz store is located immediately south of the site, hydraulically upgradient of the on-site groundwater flow. Due to the close proximity to the site, groundwater data collected from on-site monitoring well MW-1, located at the southern property boundary, were utilized to identify vapor intrusion COCs in conjunction with soil vapor data (discuss below) for off-site receptors at the Sheetz store.

- **Rite Aid Pharmacy** - The Rite Aid Pharmacy is located west of the site across Central Avenue. Groundwater data collected from off-site monitoring wells MW-6 and MW-7, located west of Central Avenue, were utilized to evaluate off-site receptors at the Rite Aid. There were no site-related constituents detected in groundwater samples from MW-6 and MW-7.

- **DuPont Street ROW and Former CoGo's Gas Station** - DuPont Street and the former CoGo's gas station are located north/northeast of the site, hydraulically downgradient of the on-site groundwater flow. The Quick Domenico (QD) model was utilized to predict constituent concentrations in groundwater at these downgradient locations. On-site monitoring well MW-3 was used as the source well in the modeling. Maximum concentrations from MW-3 were used as the initial source concentrations. Details on the QD modeling are provided in

Attachment 1. Predicted constituent concentrations in groundwater downgradient of the site were used to identify COCs for off-site receptors at the former CoGo's gas station and the DuPont Street ROW. Table 3-3 presents the modeled groundwater concentrations at the northern on-site property boundary and a comparison to USEPA Tapwater RSLs to support COC selection for the DuPont Street ROW. The distance from on-site monitoring well MW-3 to the northern property boundary line is approximately 20 feet. Based on the modeled distances available in the QD model, a conservative distance of 12 feet was chosen to represent the concentrations of site-related constituents at the northern property boundary line. For the CoGo's, the QD modeling results show that none of the site-related constituents would exceed direct contact or vapor intrusion groundwater screening criteria at the northernmost edge of the DuPont Street ROW. Specifically, direct contact and vapor intrusion groundwater exceedances do not migrate beyond 36 feet downgradient of the source area (MW-3). The distance from MW-3 to the former CoGo's property is over 70 feet.

- **Central Avenue ROW** – Central Avenue borders the site to the northwest. Groundwater data collected from on-site monitoring wells MW-3 and MW-5, located adjacent to northwestern property boundary and Central Avenue, were utilized to select direct contact COCs for off-site receptors at the Central Avenue ROW.

Residential properties are located east of the site, hydraulically sidegradient of the site. Thus, the residential properties were not evaluated in the risk assessment.

Soil Gas

Soil vapor point VP-1 is located off-site adjacent to the Sheetz convenience store just south of the site. Two rounds of soil gas samples were collected from the soil vapor point VP-1 in August and September 2014. For conservatism, the soil gas data were compared to USEPA OSWER residential VISLs for soil gas [USEPA 2014], as shown in Table 3-4. In accordance with the TGM, the noncarcinogenic constituents were screened against applicable VISLs based on a HQ of 0.1 rather than 1. These target soil gas concentrations were calculated using the USEPA VISL Calculator, Version 3.4, (based on June 2015 RSLs) [USEPA 2015b]. Table 3-5 presents a summary of all the soil gas analytical data and indicates if the sample is retained or not retained for the risk evaluation. As indicated on Table 3-5, all soil gas samples were retained for use in the risk assessment.

3.2 Selection of Constituents of Concern

Constituents of concern were selected for the direct contact ("direct contact COC") and vapor intrusion ("vapor intrusion COC") exposure pathways for the on-site and off-site receptors. The selection process was done using the analytical data and comparisons presented above.

Direct Contact COC

Direct contact COC were selected based on the comparisons described above for soil and groundwater. Table 3-6 presents a summary of the direct contact COCs in soil and groundwater for on-site and off-site receptors.

On-Site (Non-Residential):

- Soil: Any detected constituents that exceeded an industrial soil RSL or SSL for protection of groundwater in on-site soil samples were retained as a direct contact COC. As shown in Table 3-6, six COCs were identified in subsurface soil (3-6 ft-bgs) and nine COCs were identified in subsurface soil (3-10 ft-bgs).
- Groundwater: Any detected constituent that exceeded a tapwater RSL in groundwater samples collected between January 2014 and March 2015 from on-site monitoring wells (overburden and bedrock) was selected as a direct contact COC. As shown in Table 3-6, eight COCs were identified in the overburden groundwater. In addition, three COCs were identified in the bedrock groundwater.

Off-Site (Non-Residential):

- Soil: For evaluation of off-site receptors at the Central Avenue ROW, on-site soil samples SB-12 (7-8' and 9-10'), SB-14 (4-5' and 7-8'), and SB-15 (7-8' and 9-10') collected along the northwestern property boundary were utilized. For evaluation of off-site receptors at the DuPont Street ROW, off-site soil sample SB-3 (7') collected at the DuPont Street ROW was utilized. Any detected constituents that exceeded an industrial soil RSL or SSL for protection of groundwater were retained as a direct contact COC. As shown in Table 3-6, nine direct contact COCs were identified at the Central Avenue ROW and two direct contact COCs were identified at the DuPont Street ROW.

- Groundwater: Direct contact groundwater COCs were selected for the off-site properties/ROWs because these areas are located either downgradient of on-site groundwater flow or adjacent to the site. As summarized below, direct contact COCs were identified based on comparisons of groundwater data (collected between January 2014 and March 2015) to tapwater RSLs.

    - **Rite Aid Pharmacy** – Off-site monitoring wells MW-6 and MW-7 were utilized to identify direct contact groundwater COCs for off-site receptors at the Rite Aid. As shown in Table 3-2, none of the site-related constituents were detected in MW-6 and MW-7. Thus, no direct contact COCs were retained in the groundwater for the Rite Aid and no further evaluation of off-site receptors at the Rite Aid is required.

    - **DuPont Street ROW** – The QD model was utilized to predict constituent concentrations in groundwater downgradient of the on-site source area. The downgradient areas are the DuPont Street ROW and the former CoGo's gas station (across DuPont Street). Benzene, toluene, ethylbenzene, total xylenes, naphthalene, cumene, 1,3,5-TMB, and 1,2,4-TMB were identified as constituents to be carried through the QD modeling based on exceedances of the USEPA tapwater RSLs. The maximum groundwater concentrations from on-site monitoring well MW-3 were used in the QD model as source concentrations. Six constituents (i.e. 1,3,5-TMB, 1,2,4-TMB, ethylbenzene, toluene, total xylenes, and cumene) were modeled to their respective USEPA tapwater RSLs. The tapwater RSLs for benzene and naphthalene are 0.45 microgram per liter (µg/L) and 0.17 µg/L, respectively. These low screening levels are difficult to model to since the QD model is limited as to the level accuracy it can achieve at such low concentrations. As a result, these two constituents were modeled to a concentration of 1 µg/L, which is conservative and health protective since this concentration is well below the PADEP medium specific concentrations (MSCs) and maximum contaminant levels (MCLs)/lifetime health advisory levels (e.g. non-residential used aquifer groundwater MSCs for benzene and naphthalene are 5 µg/L and 100 µg/L, respectively).

Results of the QD model indicate that concentrations of site-related constituents in groundwater will exceed applicable standards (USEPA tapwater RSLs/MCLs) at the northernmost site property boundary, but will meet the applicable screening levels (USEPA tapwater RSLs) or drinking water standards (MCLs) at the northernmost edge of the Central Avenue/DuPont Street ROW within a 30 year timeframe. The QD groundwater modeling was utilized to predict the chemical concentration in groundwater at the northernmost site property boundary adjacent to the DuPont Street ROW. The distance from on-site monitoring well MW-3 to the northern property boundary line is approximately 20 feet. Based on the modeled distances available in the QD model, a conservative distance of 12 feet was chosen to represent the concentration of site-related constituents at the northern property boundary. These predicted concentrations were used to identify COCs in groundwater at the DuPont Street ROW (Table 3-3). As shown in Table 3-6, six direct contact COCs were retained in groundwater at the DuPont Street ROW.

- **The Former CoGo's Station** – According to the QD modeling, the predicted constituent concentrations in groundwater at the northernmost edge of the Central Avenue/DuPont Street ROW will meet USEPA tapwater RSLs and/or MCLs within a 30 year timeframe. Specifically, the RSLs/MCLs for all eight modeled constituents will be attained by 36 feet downgradient of the source area (MW-3). The distance from MW-3 to the former CoGo's property is over 70 feet. As a result, no direct contact COCs were retained for the former CoGo's gas station in groundwater and; thus, no further evaluation of groundwater for off-site receptors at the former CoGo's gas station is required.

- **Central Avenue ROW** – Groundwater data collected from on-site monitoring wells MW-3 and MW-5, located adjacent to northwestern property boundary and Central Avenue, were utilized to select direct contact COCs for off-site receptors at the Central Avenue ROW. As shown in Table 3-6, eight COCs were identified in the overburden groundwater at the Central Avenue ROW.

Vapor Intrusion COC

Vapor intrusion COCs were selected based on groundwater and soil gas data. Table 3-6 presents a summary of the off-site vapor intrusion COCs in groundwater and soil gas. The identification of vapor intrusion COCs is summarized below by properties.

Off-Site Sheetz Store (Non-Residential):

- Groundwater: For the Sheetz store south of the site, on-site groundwater monitoring well MW-1, located adjacent to the southern property boundary, was utilized to identify COCs for vapor intrusion in conjunction with soil vapor data. Any site-related constituents in groundwater samples collected between January 2014 and March 2015 from this monitoring well that exceeded USEPA OSWER commercial VISL target groundwater concentrations were retained as vapor intrusion COCs. As shown in Table 3-6, four constituents (i.e. benzene, ethylbenzene, 1,2,4-trimethylbenzene, and naphthalene) were identified as vapor intrusion COCs in groundwater for the Sheetz store.

- Soil Gas: Two rounds of soil gas samples were collected from one location (VP-1) adjacent to the Sheetz store building. These soil gas data were compared to USEPA OSWER residential target soil gas VISLs for conservatism. As shown in Table 3-4, BTEX were detected in the soil gas samples at concentrations below their respective residential VISLs. 1,2,4-trimethylbenzene was detected once in a duplicate sample at a concentration below its residential VISL. Naphthalene was not detected in any samples. Although benzene, ethylbenzene, 1,2,4-trimethylbenzene, and naphthalene were identified as vapor intrusion COCs in groundwater for the Sheetz building, the two rounds of soil gas data indicated that these VOCs were not present in soil gas adjacent to the Sheetz building at levels of concern. Soil gas is the preferred medium over groundwater for vapor intrusion evaluation. Thus, vapor intrusion is not further evaluated for the Sheetz store.

Off-Site Former CoGo's Station (Non-Residential):

- Groundwater: As mentioned earlier, the QD model predicted that the RSLs/MCLs for all eight site-related constituents that were included in the groundwater modeling will be attained by 36 feet downgradient of the source area (MW-3). The commercial VISL target groundwater concentrations for these eight constituents are equal to or greater than their respective RSLs/MCLs. Consequently, there are no vapor intrusion exceedances beyond 36 feet downgradient of MW-3. The distance from MW-3 to the former CoGo's property is over 70 feet. Thus, no vapor intrusion groundwater COCs are retained for the former CoGo's gas station and no further vapor intrusion evaluation of groundwater for off-site receptors at the former CoGo's station is required.

Off-Site Rite Aid (Non-Residential):

- Groundwater: Off-site monitoring wells MW-6 and MW-7 were utilized to identify vapor intrusion groundwater COCs for off-site receptors at the Rite Aid. As shown in Table 3-2, none of the site-related constituents were detected in MW-6 and MW-7. Thus, no vapor intrusion COCs were retained in groundwater for the Rite Aid and no further evaluation of off-site receptors at the Rite Aid is required.

4 Conceptual Site Model

This section presents the conceptual site model (CSM) developed for the site and includes a hydrogeologic CSM, human health CSM, and an ecological screening assessment.

4.1 Geologic and Hydrogeologic Conceptual Site Model

The following presents the site's geologic and hydrogeologic conceptual site model.

4.1.1 Site Geology

The site lies within the Allegheny Mountain Section of the Appalachian Plateaus Physiographic Province. The Allegheny Mountain Section of the Appalachian Plateaus Physiographic Province is described as consisting of broad, rounded ridges separated by broad valleys. The ridges decrease in elevation from south to north, and the ridges have no topographic expression at the north end of the section. Elevations in this section range from 775 feet above mean sea level (ft-amsl) to 3,213 ft-amsl.

According to the United States Geologic Service (USGS), the site is located on the Allegheny Formation. The Allegheny Formation is described as containing cyclic sequences of sandstone, shale, limestone, clay, and coal. A review of the United States Department of Agriculture Soil Survey of York County indicates the site lies within the Urban land-Udorthents complex, gently sloping (URB). According to the Soil Survey of Cambria County, the URB is described as consisting of areas that are covered by buildings, parking lots, and industrial facilities. These soils are approximately 60% urbanized areas; 30% udorthents, which are a mixture of soil and rock materials; and 10% other soils. The Pennsylvania Geologic Survey, Geologic Map of Pennsylvania 1980 indicates that there is a syncline axis less than one mile west of the site. Based on this position on the syncline, bedrock likely has a shallow dip to the west or is flat.

The topography of the site is generally flat lying. Overburden at the site is composed mostly of silt/clay mixtures with minor amounts of fill material at shallower depths. Trace amounts of weathered gravel and sandstone were present just above the bedrock interface. There were layers of fill material in the top few feet that appeared to be a result of the urbanized landscape in the vicinity of the site. Bedrock at the site is sandstone and occurs at depths of approximately 15 to 25 ft-bgs. Geologic cross-sections of the site are included as Figures 4-2 and 4-3.

4.1.2 Site Hydrogeology

Depths to groundwater at the site (based on on-site and off-site wells) range from approximately 7.4 feet (MW-7) to 11.2 feet (MW-1) in the overburden aquifer and approximately 16.0 feet to 19.8 feet in the bedrock aquifer (MW-3D). The depths to groundwater in the on-site overburden aquifer (based strictly on on-site wells) range from approximately 8.2 feet (MW-3) to 11.2 feet (MW-1). Average depth to groundwater at the site is approximately 10 feet in the overburden aquifer and 18.8 feet in the bedrock aquifer. Table 4-1 presents a summary of the groundwater elevation data.

Groundwater generally flows toward the north/northeast. Figure 4-1 shows the groundwater elevation contours for the overburden aquifer during the March 5, 2015 sampling event. The nearest downgradient surface water body is Sam's Run, a channelized and buried stream, located approximately 270 feet east of the site. In addition, Sandy Run is located approximately 230 feet west of the site. The groundwater gradient for the overburden is 0.0199 feet per foot.

4.2 Human Health Conceptual Site Model

The CSM is a comprehensive view of the site that integrates the various components of the overall environmental setting, including: site geology, hydrogeology, and hydrology; the current distribution and migration of site-related constituents; and potential receptors (both current and future) that may contact site-related constituents through potential exposure pathways associated with various on-site or off-site activities.

The CSM process was completed in accordance with Chapters 250.408 and 250.409 and Subchapter F (Exposure and Risk Determination) of the regulations [PACODE 2011] and Section II.C.3 and II.C.4, and IV.G and IV.H of the TGM [PADEP 2002 and subsequent updates]. The overall CSM can be broken down into a hydrogeologic component (e.g. evaluation of transport pathways) and a human health and ecological risk component (e.g. evaluation of exposure pathways). The CSM identifies those potentially complete transport and exposure pathways which must be either restricted by the implementation of engineering controls and/or institutional controls (e.g. environmental covenants) or further evaluated in a site-specific risk assessment to determine whether site-specific standard (SSS) benchmarks are met in accordance with Section 250.402.

Potential constituent migration routes and potential receptors are assessed in this section in order to determine whether potentially complete exposure pathways exist at the site. An exposure pathway is considered complete if all four of the following elements exist: 1) a potential source of COC; 2) a potential transport mechanism to an exposure medium (this is not needed if the source medium is the exposure medium); 3) contact between a potential receptor and the exposure medium; and, 4) an uptake mechanism associated with the potential receptor.

4.2.1 Potential Constituent Migration Routes

Constituent migration routes were evaluated for soil and groundwater based on the detection of constituents in the media and the potential for those detected constituents to migrate within the media or to another media. The evaluation of migration routes are based on the detection of constituents and is independent of whether those constituents exceed applicable screening criteria or not. The rationales for retaining or not retaining each migration route for receptor-specific evaluation are presented in Table 4-1 (Potential Constituent Migration Routes).

The potential constituent migration routes retained for receptor-specific evaluation include:

Subsurface Soil

- Volatilization of constituents from subsurface soil to outdoor air;

- Particulate emission of entrained constituents from subsurface soil (exposed during intrusive activities) to outdoor air; and,

- Leaching of constituents from subsurface soil to groundwater.

Groundwater

- Volatilization of constituents from on-site groundwater to outdoor air;

- Migration of constituents in on-site overburden groundwater to on-site bedrock groundwater;
- Migration of constituents in on-site overburden groundwater to off-site overburden groundwater;
- Migration of constituents in on-site overburden groundwater to off-site overburden groundwater to off-site surface water;
- Volatilization of constituents in off-site groundwater to outdoor air;
- Volatilization of constituents from off-site groundwater to soil gas and subsequent seepage of soil gas into a building (indoor air); and,
- Migration of constituents in off-site overburden groundwater to off-site surface water.

Note that the migration route of VOCs in on-site subsurface soil and overburden groundwater into indoor air of overlying on-site buildings via vapor intrusion was not retained. There are currently no buildings on-site. The planned future use of the property is as a paved parking lot for the Sheetz store south of the site. Thus, the vapor intrusion pathway is not applicable on-site under both current and future land use scenarios.

4.2.2 Potential Receptors and Exposure Pathways

This section identifies potential receptors and their associated exposure pathways. Potential receptors were selected to represent individuals who are most likely now or in the future to come into contact with COCs in soil and groundwater. As part of the exposure pathway analysis, all reasonable potential exposure pathways have been assessed.

Based on the retained potential constituent migration routes, the following most likely receptors were evaluated:

Current Land Use Scenario:

- On-Site Adolescent Trespasser (12 to 18 years old)

Future Land Use Scenario:

- On-Site Construction Worker
- On-Site Utility Worker
- Off-Site Construction Worker at the Central Avenue ROW
- Off-Site Utility Worker at the Central Avenue ROW
- Off-Site Construction Worker at the DuPont Street ROW
- Off-Site Utility Worker at the DuPont Street ROW

Based on the potential receptors listed above, descriptions of the retained receptors are provided below. Exposure pathways were retained based on the potential sources of COC, migration potential of COC, and the activities of the receptor. Table 4-2 (Potential Receptors and Exposure Pathways) presents a detailed listing of the exposure pathways considered for each receptor, whether or not pathways were retained, and the rationale for this decision.

On-Site Adolescent Trespasser (12 to 18 Years Old)

Currently, the site is inactive with no structures on-site. Thus, current trespassers could gain access to all areas of the site. Since the property is located at the intersection of two busy streets, the site is not expected to attract small children (less than 12 years of age) without adult supervision. However, older children may infrequently wander onto the site. Thus, adolescent trespassers (12 to 18 years old) are selected as potential receptors for quantitative evaluation.

When trespassing, these individuals may be exposed to constituents in surface soil through direct contact with surface soil. However, site-related COCs in soil at the site were identified at least 3 ft-bgs (i.e. in subsurface soil), which is considered inaccessible for trespassers. Thus, direct exposure to soil via incidental ingestion, dermal contact, and inhalation of particulates pathways is considered incomplete for this receptor.

The majority of the property is covered with grass and gravel. There were direct contact volatile COCs retained in on-site unsaturated subsurface soil. As a result, potential exposure to constituents in subsurface soil through inhalation of volatiles from unexposed unsaturated subsurface soil was considered a complete exposure pathway for the on-site trespasser. Additionally, trespassers may be potentially exposed to volatile COCs in unexposed groundwater without intrusive activities. There were direct contact volatile COCs retained in on-site groundwater. Therefore, potential exposure to volatile constituents in unexposed groundwater via the inhalation route was retained for the on-site trespasser. Note that the planned future use of the property is as a paved parking lot for the Sheetz store south of the site. Therefore, the potential for volatile COCs to migrate from subsurface soil or groundwater to outdoor air in the future will be eliminated.

The site is served by a public water supply owned by the GJWA. The source of water is the North Fork Reservoir which is located five miles to the east/southeast of the site. Groundwater is not currently used for any purposes on-site. Thus, exposure to site-related constituents in on-site groundwater via potable and non-potable water uses is currently incomplete for on-site trespassers.

The following exposure pathways were retained for quantitative evaluation for the current on-site adolescent trespasser (12 to 18 years old):

- Inhalation of volatiles emitted from unexposed subsurface soil to ambient air; and,
- Inhalation of volatiles emitted from unexposed groundwater to ambient air.

The rationale for retaining or not retaining each specific exposure pathway for the current on-site adolescent trespasser (12 to 18 years old) is provided in Table 4-2.

On-Site Construction Worker

The on-site construction worker is an individual who would be involved in construction and/or excavation activities on-site (e.g. constructing a new building). In addition, the construction worker may be responsible for any major repairs to existing utility lines or the installation of a new line which may result in exposure lasting more than one day.

The average depth to groundwater on-site is approximately 10 feet. Based on the work activities of the on-site construction worker, it is assumed that this receptor could be involved in excavation activities up to a maximum depth of approximately 10 feet or to the water table. As a result, potential exposures to constituents in subsurface soil and overburden groundwater are possible for this receptor. There were site-related constituents retained as direct contact COCs in on-site subsurface soil and groundwater. Therefore, potential exposures to constituents in soil and exposed groundwater within a trench were retained for this receptor.

The following exposure pathways were retained for the future on-site construction worker:

- Incidental ingestion of and dermal contact with subsurface soil, and inhalation of particulates and/or volatiles released from subsurface soil (maximum depth of 10 ft-bgs);
- Inhalation of volatiles emitted from exposed groundwater to trench air during intrusive activities; and,
- Dermal contact with groundwater during intrusive activities.

The rationale for retaining or not retaining each specific exposure pathway for the future on-site construction worker is provided in Table 4-2.

On-Site Utility Worker

The on-site utility worker is an individual who would be involved with repairing and maintaining utility lines on-site. The utility worker is not expected to be involved in the installation of new lines, as this is assumed to be performed by a construction worker.

Currently, a storm water line crosses the southeastern portion of the site at approximately 2 to 3 ft-bgs. In the future, additional underground utility lines may be installed on-site and may require maintenance, which are likely to be installed at a depth of approximately 6 feet or less. Based on the work activities of the on-site utility worker and based on the approximate depth to utility lines on-site (i.e. less than 6 ft-bgs), it is expected that this receptor could be involved in excavation activities up to a maximum depth of approximately 6 feet. As a result, potential direct exposures to constituents in subsurface soil to a depth of 6 feet are possible for this receptor.

The average depth to groundwater on-site is approximately 10 feet. Thus, on-site utility workers are unlikely encounter shallow groundwater when conducting intrusive activities at the site. However, there is the potential for the on-site utility worker to be indirectly exposed to volatile COCs in unexposed groundwater that migrate to trench air during intrusive activities. Therefore, potential exposures to volatile constituents in unexposed groundwater were retained for this receptor.

The following exposure pathways were retained for the future on-site utility worker:

- Incidental ingestion of and dermal contact with subsurface soil, and inhalation of particulates released from exposed subsurface soil (maximum depth of 6 ft-bgs);
- Inhalation of volatiles released from exposed and unexposed subsurface soil (maximum depth of 10 feet); and,
- Inhalation of volatiles emitted from unexposed groundwater to trench air during intrusive activities.

The rationale for retaining or not retaining each specific exposure pathway for the future on-site utility worker is provided in Table 4-2.

Off-Site Construction Worker at the Central Avenue ROW

This off-site construction worker is an individual who would be involved in construction and/or excavation activities at the Central Avenue ROW, located northwest of the site. In addition, the construction worker may be responsible for the installation of a new line which may result in exposure lasting more than one day.

The average depth to groundwater at the site is approximately 10 feet. There is a 36" underground water line beneath Central Avenue at approximately 14 ft-bgs. If a new water line were to be installed in Central Avenue, it is unlikely that the line would be installed at this depth, but more likely to be installed at a maximum depth of approximately 6-8 ft-bgs, above the water table. Therefore, based on the work activities of the off-site construction worker, it is assumed that this receptor could be involved in excavation activities up to a maximum depth of approximately 8 feet when installing a new underground utility line. As a result, potential exposures to constituents in subsurface soil and unexposed groundwater are possible for this receptor.

Any subsurface soil samples collected to a depth of 8 ft-bgs, located along the northwestern property boundary, were utilized to evaluate the off-site construction worker. This soil data set included SB-12 (7-8'), SB-14 (4-5' and 7-8'), and SB-15 (7-8'). Thus, soil data collected from the 4 ft-bgs to 8 ft-bgs interval along the northwestern property boundary were grouped together for evaluation of direct contact with soil for the off-site construction worker. There were site-related constituents retained as direct contact COCs in these subsurface soil samples. Therefore, potential exposures to constituents in subsurface soil were retained for the off-site construction worker via incidental ingestion, dermal contact, and inhalation of volatiles and particulates.

On-site monitoring wells MW-3 and MW-5 are located adjacent to the northwestern property boundary in close proximity to Central Avenue. There were direct contact exceedances in groundwater samples from MW-3 and MW-5. Off-site construction workers at the Central Avenue ROW may be potentially exposed to COCs in unexposed groundwater through inhalation of vapors in an excavation trench when installing a new underground utility line in the Central Avenue ROW based on the expected maximum excavation depth of this receptor (i.e. approximately 8 ft-bgs) and based on the average depth to groundwater at the site (i.e. approximately 10 ft-bgs).

The following exposure pathways were retained for the future off-site construction worker at the Central Avenue ROW:

- Incidental ingestion of and dermal contact with subsurface soil, and inhalation of particulates released from subsurface soil (maximum depth of 8 ft-bgs);

- Inhalation of volatiles released from subsurface soil (maximum depth of 10 ft-bgs); and,
- Inhalation of volatiles emitted from unexposed groundwater to trench air during intrusive activities.

The rationale for retaining or not retaining each specific exposure pathway for the future off-site construction worker at the Central Avenue ROW is provided in Table 4-2.

Off-Site Utility Worker at the Central Avenue ROW

This off-site utility worker is an individual who would be involved with repairing and maintaining utility lines at the Central Avenue ROW. The utility worker is not expected to be involved in the installation of new lines, as this is assumed to be performed by a construction worker.

Based on the work activities of the off-site utility worker and the presence of a 36" main underground water line in Central Avenue of approximately 14 ft-bgs, it is expected that this receptor could be involved in excavation activities up to a maximum depth of approximately 14 feet to repair the water line. As a result, potential direct exposures to constituents in subsurface soil to a depth of 14 feet are possible for this receptor. Any subsurface soil samples collected to depth of 14 ft-bgs, located along the northwestern property boundary, were utilized to evaluate the off-site utility worker. This soil data set included SB-12 (7-8' and 9-10'), SB-14 (4-5' and 7-8'), and SB-15 (7-8' and 9-10'). Thus, soil data collected from the 4 ft-bgs to 10 ft-bgs interval along the northwestern property boundary were grouped together for evaluation of direct contact with soil for the off-site utility worker. There were site-related constituents retained as direct contact COCs in these subsurface soil samples. Therefore, potential exposures to constituents in subsurface soil were retained for the off-site utility worker via incidental ingestion, dermal contact, and inhalation of volatiles and particulates.

The average depth to groundwater at the site is approximately 10 feet. Thus, off-site utility workers may encounter shallow groundwater when conducting intrusive activities at the Central Avenue ROW. On-site monitoring wells MW-3 and MW-5 are located adjacent to the northwestern property boundary, in close proximity to Central Avenue. There were direct contact exceedances in groundwater samples from MW-3 and MW-5.

Off-site utility workers at the Central Avenue ROW may be potentially exposed to COCs in exposed groundwater through inhalation of vapors in an excavation trench or dermal contact with groundwater when conducting maintenance activities on the underground water line in the Central Avenue ROW based on the expected maximum excavation depth of this receptor (i.e. approximately 14 ft-bgs) and based on the average depth to groundwater at the site (i.e. approximately 10 ft-bgs).

The following exposure pathways were retained for the future off-site utility worker at the Central Avenue ROW:

- Incidental ingestion of and dermal contact with subsurface soil, and inhalation of volatiles and particulates released from subsurface soil (maximum depth of 14 ft-bgs);
- Inhalation of volatiles emitted from exposed groundwater to trench air during intrusive activities; and,
- Dermal contact with groundwater during intrusive activities.

The rationale for retaining or not retaining each specific exposure pathway for the future off-site utility worker at the Central Avenue ROW is provided in Table 4-2.

Off-Site Construction Worker at the DuPont Street ROW

This off-site construction worker is an individual who would be involved in construction and/or excavation activities at the DuPont Street ROW, located just north of the site. In addition, the construction worker may be responsible for the installation of a new line which may result in exposure lasting more than one day.

Several underground utility lines are located adjacent to the site along DuPont Street including an 8" water line, storm water line, and a sanitary sewer line, which may be as deep at 8 ft-bgs. Based on the work activities of the off-site construction worker and the presence of underground utility lines at DuPont Street (approximately 8 ft-bgs or less), it is assumed that this receptor could be involved in excavation activities up to a maximum depth of approximately 8 feet. As a result, potential exposure to constituents in subsurface soil is possible for this receptor. There were site-related COCs retained as direct contact COCs in the off-site subsurface soil at the DuPont Street ROW at a depth of 7 feet. Therefore, potential exposures to constituents in soil were retained for this receptor via incidental ingestion, dermal contact, and inhalation of volatiles and particulates.

The average depth to groundwater at the site is approximately 10 feet. Based on the QD modeling results, site-related constituents were retained as direct contact COCs in groundwater at the DuPont Street ROW. Off-site construction workers at the DuPont Street ROW are not expected to be in direct contact with groundwater within a trench; however, this receptor may be potentially exposed to volatile COCs in unexposed groundwater through inhalation of vapors in an excavation trench.

In summary, potential exposures to constituents in subsurface soil and groundwater were retained for the off-site construction worker at the DuPont Street ROW. The off-site construction workers in the DuPont Street ROW and in the Central Avenue ROW have the same exposure pathways retained. However, off-site construction workers at the Central Avenue ROW are expected to have higher relative intake rates when compared to off-site construction workers at the DuPont Street ROW because of the additional COCs retained in soil (9 vs. 2) and groundwater (8 vs. 6) for off-site receptors at the Central Avenue ROW and the much higher COC concentrations they may encounter in soil and groundwater while working at the Central Avenue ROW. The off-site construction worker at the Central Avenue ROW exposure scenario provides a conservative basis for evaluating potential exposures to an off-site construction worker at the DuPont Street ROW. Thus, potential exposure to soil and groundwater for the off-site construction worker at the DuPont Street ROW was not quantitatively evaluated and was represented by the off-site construction worker at the Central Avenue ROW.

The rationale for retaining or not retaining each specific exposure pathway for the future off-site construction worker at the DuPont Street ROW is provided in Table 4-2.

Off-Site Utility Worker at the DuPont Street ROW

This off-site utility worker is an individual who would be involved with repairing and maintaining utility lines at the DuPont Street ROW. The utility worker is not expected to be involved in the installation of new lines, as this is assumed to be performed by a construction worker.

Several underground utility lines are located adjacent to the site along DuPont Street including an 8" water line, storm water line, and a sanitary sewer line, which may be as deep at 8 ft-bgs. Based on the work activities of the off-site utility worker and the presence of underground utility lines at DuPont Street (approximately 8 ft-bgs or less), it is assumed that this receptor could be involved in excavation activities up to a maximum depth of approximately 8 feet. As a result, potential exposure to constituents in subsurface soil is possible for this receptor. There were site-related COCs retained as direct contact COCs in the off-site subsurface soil at DuPont Street ROW at a depth of 7 feet. Therefore, potential exposures to constituents in subsurface soil were retained for this receptor via incidental ingestion, dermal contact, and inhalation of volatiles and particulates.

The average depth to groundwater at the site is approximately 10 feet. Based on the QD modeling results, site-related constituents were retained as direct contact COCs in groundwater at the DuPont Street ROW. Off-site utility workers at the DuPont Street ROW are not expected to be in direct contact with groundwater within a trench; however, this receptor may be potentially exposed to volatile COCs in unexposed groundwater through inhalation of vapors in an excavation trench.

In summary, potential exposures to constituents in subsurface soil and groundwater were retained for the off-site utility worker at the DuPont Street ROW. However, off-site utility workers at the Central Avenue ROW are expected to have higher relative intake rates when compared to off-site utility workers at the DuPont Street ROW because of the additional COCs retained in soil (9 vs. 2) and groundwater (8 vs. 6) for off-site receptors at the Central Avenue ROW and the much higher COC concentrations they may encounter in soil and groundwater while working at the Central Avenue ROW. In addition, the off-site utility worker in the Central Avenue ROW has an exposed groundwater scenario (i.e. dermal contact and inhalation of volatiles from exposed groundwater within a trench) whereas the off-site utility worker in the DuPont Street ROW has an unexposed groundwater scenario (i.e. inhalation of volatiles within a trench that migrate from unexposed groundwater). The off-site utility worker at the Central

Avenue ROW exposure scenario provides a conservative basis for evaluating potential exposures to an off-site utility worker at the DuPont Street ROW. Thus, potential exposure to soil and groundwater for the off-site utility worker at the DuPont Street ROW was not quantitatively evaluated and was represented by the off-site utility worker at the Central Avenue ROW.

The rationale for retaining or not retaining each specific exposure pathway for the future off-site utility worker at the DuPont Street ROW is provided in Table 4-2.

4.2.3 Summary of Incomplete Pathways via Institutional Controls

Based on the receptor and exposure pathway analysis above, a number of exposure pathways will be considered incomplete by means of implementing various institutional controls. The following is a summary of the receptors and pathways that will be considered incomplete via implementation of the various institutional controls:

- Ingestion, dermal contact, and inhalation of volatiles from groundwater via potable use for on-site receptors; and

- Inhalation of volatiles from groundwater to indoor air via vapor intrusion for a future on-site indoor worker.

In addition, potable use groundwater exposure pathways for off-site receptors will be addressed via a post-remedial care plan. These institutional controls shall be constituted via an environmental covenant and/or post-remedial care plan, which will be documented in the Final Report.

4.3 Ecological Assessment Summary

In order to comply with the site-specific requirements of the Act 2 regulations (Section 250.402) and the Federal Endangered Species Act, potential impacts to ecological receptors were evaluated. In particular, the following process was completed:

A. Assess direct impacts from site-related constituents for the following receptors [Section 250.402(c), which refers to Section 250.311(a)]: threatened or endangered species; exceptional value wetlands; habitats of concern; and, species of concern.

B. Complete an initial screening in order to evaluate site-specific ecological conditions and the exposure and risk to selected assessment endpoints (Steps 1 and 2 of the TGM, Section IV.H).

C. Determine which one of the three options available under the Site-Specific Standard apply:

- The initial screening is adequate to determine that no substantial ecological risk exists;
- The ecological risk assessment should be continued to develop a Site-specific cleanup goal, or to reduce uncertainty in the evaluation of risk and impact; or
- There is substantial impact and proceed to remediation that can eliminate or reduce exposure to an acceptable level.

Results of Steps A through B are summarized below.

Step A:

In order to assess direct impacts from site-related constituents for threatened or endangered species, exceptional value wetlands; habitats of concern, and species of concern, a Pennsylvania Natural Diversity Index (PNDI) review was conducted on July 9, 2015 to identify any potential records of threatened or endangered species and other species of concern near the site. The PNDI records indicated no known impacts to threatened and endangered species and/or special concern species and resources within the specified project area. The results of the PNDI search are presented in Attachment 2.

Step B:

Under Step 1 of the initial screening process, several site-specific conditions were evaluated to assess the potential for adverse effects.

- The site historically operated as a retail gasoline service station and later a restaurant. The site is currently inactive with no structures on-site. The historical use of the site has been non-residential and the anticipated future use of the site is to remain non-residential (i.e. a parking lot for the Sheetz store south of the site). The majority of the property is currently covered with grass and gravel. COCs in soil at the site are located at least three feet below ground surface. Since surface soil was not impacted, ecological receptors at the site would not be exposed to site-related constituents in surface soil. Based on this evaluation, current site conditions would not impact viable habitats.

- Groundwater generally flows toward the north/northeast. The nearest downgradient surface water body is Sam's Run, a channelized and buried stream, located approximately 270 feet east of the site. In addition, Sandy Run is located approximately 230 feet west of the site. Surface soil at the site was not impacted by site-related constituents from historical releases that occurred in the subsurface at the site. As a result, site-related constitutes in subsurface soil are not transported to the Sam's Run or Sandy Run via overland flow. Overburden groundwater flows to the north/northeast and may potentially discharge into Sam's Run. Using the QD model, on-site monitoring well MW-3 (located along the northwestern property boundary) was utilized to evaluate potential migration of dissolved-phase constituents in on-site groundwater to downgradient off-site areas. Benzene, toluene, ethylbenzene, total xylenes, naphthalene, cumene, 1,3,5-TMB, and 1,2,4-TMB were identified as COCs for the QD modeling based on exceedances of the USEPA RSLs for tapwater. The maximum groundwater concentrations from on-site monitoring well MW-3 were used in the QD model. The QD model results indicate that concentrations of site-related constituents in groundwater will meet the applicable screening levels (USEPA RSLs for tapwater) or drinking water standards (MCLs) at the northernmost edge of the Central Avenue/DuPont Street

ROW within a 30 year timeframe. Specifically, the RSLs/MCLs for all eight COCs will be attained by 36 feet downgradient of the source area (MW-3). Since the RSLs/MCLs used in the modeling are more conservative than the groundwater to surface water edge criteria [PADEP 2002 and subsequent updates], concentrations of site-related constituents in groundwater are expected to meet their respective edge criteria by 36 feet downgradient of the source area (MW-3).

Since the discharge of site-related constituents via diffuse groundwater flow is not expected to reach the nearest surface water body at concentrations above the fish and aquatic surface water quality criteria, a continuation onto Step 2 of the initial screening was not warranted.

Step C:

Based on the information presented above, it can be concluded that the initial screening was adequate to determine that no substantial ecological risk exists.

5 Exposure Point Concentrations

This section presents the procedures that were used to develop exposure point concentrations (EPCs) for the constituents of concern (COCs) identified at the site as previously presented in Table 3-6 in Section 2.

5.1 Exposure Point Concentrations for the Direct Contact Exposure Pathways

In theory, the concentrations in each medium are expected to decrease with time through biodegradation, volatilization, leaching, and other transformation processes. Therefore, the appropriate concentration for estimating exposure to a particular receptor is an average concentration over the exposure period. However, the change in source concentration with time is very difficult to assess. For this analysis, all source concentrations are treated as being constant (stable) for the foreseeable future, which is a conservative assumption.

5.1.1 Media-Specific Source Concentrations

Source concentrations for soil and groundwater were derived using the analytical data representative of current site conditions. Source concentrations were derived either by using the maximum detected concentration or using the following procedure, which is consistent with procedures presented in the USEPA ProUCL 5.0.00 Users Guide [USEPA 2013]:

- The distribution of each constituent in each dataset was determined by running the goodness-of-fit test in ProUCL. If a constituent could be represented by a normal distribution, it was classified as following a normal distribution. If a constituent could not be represented by a normal distribution, but could be represented by a gamma distribution, it was classified as following a gamma distribution. If a constituent could not be represented by a normal distribution or gamma distribution, but could be represented by a lognormal distribution, it was classified as following a lognormal distribution. If a constituent could not be represented by a normal distribution, gamma distribution or lognormal distribution, it was classified as nonparametric (i.e. not following any particular distribution).

- Depending on the distribution that a constituent was determined to follow, a 95 percent or higher upper confidence level (95%UCL) of the mean concentration was calculated using ProUCL.

- The source concentrations were determined to be the lesser of the recommended UCL or the maximum detected concentration.

Soil

Because different receptors may be exposed to soil at different depth intervals, four separate data groupings were used to evaluate trespasser, construction worker, and utility worker exposure to soil. Soil data collected from 3 ft-bgs to 6 ft-bgs were grouped together for evaluation of direct contact with soil for the on-site utility worker. Soil data collected from 3 ft-bgs to 10 ft-bgs were grouped together for evaluation of direct contact with soil for the on-site construction worker and inhalation of volatiles from subsurface soil for the on-site trespasser and on-site utility worker. Soil data collected from 4 ft-bgs to 10 ft-bgs at the northwestern property boundary were grouped together for evaluation of direct contact with soil for the off-site utility worker at the Central Avenue ROW. Soil data collected from 4 ft-bgs to 8 ft-bgs at the northwestern property boundary were grouped together for evaluation of direct contact with soil for the off-site construction worker at the Central Avenue ROW. A 95%UCL or higher of the mean concentration or the maximum concentration was derived for each soil COC. Attachment 3 presents the soil datasets and statistical analysis for development of the source concentrations in soil. Tables 5-1 and 5-2 present the source concentrations derived for on-site and off-site soil, respectively.

Exposures to lead are not evaluated using the same methods as those described for other COCs. The USEPA considers lead to be a special case because of the difficulty in identifying the threshold. However, the toxicokinetics of lead are well understood and indicate that lead is regulated based on the blood lead concentration (PbB). PbB can be correlated with both exposure and adverse health effects. In lieu of evaluating risk using typical intake calculations and toxicity criteria, USEPA developed models specifically to evaluate lead exposures. In accordance with the USEPA Adult Lead Model [USEPA 2003], the source concentrations for lead are based on arithmetic mean concentrations in environmental media, as shown in Tables 5-1 and 5-2.

Groundwater

Groundwater data collected between January 2014 and March 2015 were utilized to derive groundwater source concentrations. A 95%UCL or higher of the mean concentration or the maximum concentration was derived for each groundwater COC in groundwater. Attachment 3 presents the groundwater datasets and statistical analysis for development of the source concentrations in groundwater. Since excavation work is assumed to occur to a maximum depth of approximately 10 feet on-site and 14 feet off-site, construction worker and utility workers are expected only to come into contact with the overburden groundwater and not bedrock groundwater. Additionally, vapor-forming COCs in the uppermost overburden groundwater are likely to volatilize into the vadose zone with the potential to migrate to outdoor air. Thus, the overburden groundwater data are used for the evaluation of groundwater exposure to on-site trespassers, on-site construction workers, on-site utility workers, and off-site construction workers and off-site utility workers at the Central Avenue ROW. Tables 5-1 and 5-2 present the source concentrations selected for on-site and off-site groundwater, respectively.

5.1.2 Receptor-Specific Source Concentrations

The selection of source concentrations for each receptor is based on the potentially complete exposure pathways for that receptor.

Soil

As mentioned earlier, the selection of source concentrations in soil are based on the soil interval the receptor will contact based on the activities conducted while at the site.

For on-site receptors, the 3 to 10 ft-bgs soil interval was utilized for the incidental ingestion, dermal contact, and inhalation of volatiles and particulates exposure pathways for the on-site construction worker. A subset of subsurface soil at depths from 3 to 6 ft-bgs is considered available for contact for utility workers. The 3 to 6 ft-bgs soil interval was utilized for the incidental ingestion, dermal contact, and inhalation of particulates exposure pathways for the on-site utility worker; the 3 to 10 ft-bgs soil interval was utilized for the inhalation of volatiles exposure pathway since this receptor may be exposed to volatile COCs in soil less than and greater than 6 ft-bgs. The trespasser also may be exposed to volatile COCs in unexposed subsurface soil. The 3 to 10 ft-bgs soil interval was utilized for the inhalation of volatiles exposure pathways for the on-site trespasser.

For the off-site construction worker at the Central Avenue ROW, the 4 to 8 ft-bgs soil interval was utilized for the incidental ingestion, dermal contact, and inhalation of volatiles and particulates exposure pathways. For the off-site utility worker at the Central Avenue ROW, the 4 to 10 ft-bgs soil interval was utilized for the incidental ingestion, dermal contact, and inhalation of volatiles and particulates exposure pathways.

Table 5-1 presents the source concentrations for the current on-site trespasser and future on-site construction worker and on-site utility worker for the COCs in soil for the direct contact exposure pathways. Table 5-2 presents the source concentrations for the future off-site construction worker and utility worker at the Central Avenue ROW for the COCs in soil for the direct contact exposure pathways.

Groundwater

Similar to soil, the selection of groundwater concentrations are receptor specific and are based on the complete exposure pathways for each receptor. For on-site receptors, trespassers may be indirectly exposed to volatile constituents emitted from unexposed groundwater to outdoor air without intrusive activities. The on-site construction worker is expected to be in direct contact with exposed groundwater within a trench based on the depth to groundwater at the site (average of approximately 10 feet) and based on the expected maximum excavation depth of this receptor (approximately 10 feet or to the water table). The on-site utility worker is unlikely to be in direct contact with groundwater based on the depth to groundwater at the site (average of approximately 10 feet) and based on the expected maximum excavation depth of this receptor of 6 feet (underground utilities on-site are less than 6 ft-bgs). However, the on-site utility worker may be indirectly exposed to volatile COCs in unexposed groundwater that may migrate to trench air.

For off-site receptors at the Central Avenue ROW, the utility worker is expected to be in direct contact with exposed groundwater within a trench based on the depth to groundwater at the site (approximately 10 feet) and the presence of a 36" main water line at approximately 14 feet. The off-site construction worker is not expected to be in direct contact with groundwater within a trench based on the depth to groundwater at the site (approximately 10 feet) and the maximum excavation depth of this receptor (approximately 8 feet). However, the off-site construction worker may be indirectly exposed to volatile COCs in unexposed groundwater that may migrate to trench air.

Table 5-1 presents the source concentrations for the current on-site trespasser and future on-site construction worker and on-site utility worker for the COCs in groundwater for the direct contact exposure pathways. Table 5-2 presents the source concentrations for the future off-site construction worker and utility worker at the Central Avenue ROW for the COCs in groundwater for the direct contact exposure pathways.

5.2 Calculation of Exposure Point Concentrations for the Direct Contact Exposure Pathways

Exposure point concentrations (EPCs) are calculated for each direct contact COC by multiplying the selected source concentrations by a transfer factor. For the ingestion and dermal contact pathways, which involve actual contact with soil or groundwater, the transfer factor is 1.0 [USEPA 2004]. For the exposure pathways involving inhalation of constituents emitted from soil or groundwater to outdoor (ambient) air, the transfer factor relates measured concentrations in soil or groundwater to estimated concentrations in outdoor air. For volatilization of constituents from soil to outdoor air, transfer factors are calculated following USEPA's soil screening guidance [USEPA 1996] and are presented in Attachment 4 of this document. For volatilization of constituents from groundwater to outdoor air without intrusive activities, transfer factors are calculated using a model presented by the American Society for Testing and Materials (ASTM) Standard Guidance [ASTM 2015] and are presented in Attachment 4 of this document. For volatilization of constituents from exposed or unexposed groundwater to outdoor air within a trench (i.e. trench air), transfer factors were calculated following an approach suggested by the Virginia Department of Environmental Quality (VA DEQ) Voluntary Remediation Program [VA DEQ 2014] and are presented in Attachment 4 of this document. For inhalation of particulates emitted from soil to outdoor air, the transfer factor is 1×10^{-10} kilogram per cubic meter (kg/m^3) [PACODE 2011]. The exposure point concentrations for direct contact exposure pathways are presented in the risk calculation spreadsheets presented in Section 8 of this document.

6 Constituent-Specific Parameters

This section presents constituent-specific parameters used in the quantitative risk assessment including chemical properties, toxicological values, absorption adjustment factors, and permeability constants.

6.1 Chemical Properties

Table 6-1 presents the chemical properties required to complete the site-specific risk calculations for the direct contact exposure pathways. This table also references the source for each chemical property.

6.2 Toxicological Values

COCs are quantitatively evaluated on the basis of their cancer and/or noncancer potential. Cancer slope factors (CSFs) and inhalation unit risks (IURs) are the toxicity values used to evaluate cancer health effects in humans. The reference doses (RfDs) and reference concentrations (RfCs) are the toxicity values used to evaluate noncancer (e.g., systemic) health hazards in humans.

CSFs and IURs are presented in Table 6-2 for the direct contact COCs. RfDs and RfCs for chronic effects associated with long-term exposures are provided in Table 6-3 for the direct contact COCs. These values were obtained from Table 5 in Appendix A of the regulations for Act 2 [PACODE 2011] or the PADEP Land Recycling Program Toxicity Database (http://www.depreportingservices.state.pa.us/ReportServer/Pages/ReportViewer.aspx?/CPP/Toxicity) and verified following the USEPA's hierarchy:

- Tier 1: Integrated Risk Information System (IRIS), available through the USEPA website (http://www.epa.gov/IRIS/).
- Tier 2: Provisional Peer Reviewed Toxicity Values (PPRTVs). Information regarding the PPRTVs is available through the PPRTV online library (http://hhpprtv.ornl.gov/) and the Risk Assessment Information System (RAIS) website (http://rais.ornl.gov).
- Tier 3: Other Toxicity Values

Tier 3 of the hierarchy includes several sources of toxicity values that are commonly consulted by the USEPA when a relevant toxicity value is not available from either IRIS or the PPRTV database. They may include:

- The Agency for Toxic Substances and Disease Registry (ATSDR) Minimal Risk Levels (MRLs), available at http://www.atsdr.cdc.gov/mrls/index.html.
- The California Environmental Protection Agency (Cal/EPA) toxicity values, available at http://www.oehha.ca.gov/risk/chemicalDB/index.asp.
- PPRTV screening values from certain PPRTV assessment appendices. Information regarding the PPRTV Screening Values is available through the PPRTV online library (http://hhpprtv.ornl.gov/).
- The EPA Superfund Health Effects Assessment Summary Tables (HEAST).

RfDs and RfCs for subchronic effects associated with short-term exposures are provided in Table 6-4 for the direct contact COCs. These values were obtained from the PPRTVs (available through the RAIS website), the ATSDR MRLs, or HEAST tables. If values were not available from these sources, then the reference doses for chronic effects were used. The PPRTV value was selected first as the subchronic value (if available) since it is Tier 2 on the USEPA hierarchy. If PPRTV values were not available, then values from Tier 3 sources, ATSDR and HEAST, were reviewed and the most recent value presented in any of these sources was selected as the subchronic value. This subchronic value was then compared to the chronic value. If the subchronic value was higher than the chronic value, then the subchronic value was used. Otherwise the chronic value was used to estimate subchronic effects. Note that the only receptors assumed to have subchronic exposures were the on-site and off-site construction workers.

In accordance with USEPA Risk Assessment Guidance for Superfund (RAGS) Part E [USEPA 2004], oral-to-dermal conversion factors were used to convert oral slope factors and reference doses to dermal slope factors and reference doses. The conversion factors used are presented in Tables 6-2, 6-3, and 6-4.

Tumor type/critical effect and target organ information (when available) for several of the direct contact COCs are presented in Table 6-5 (CSFs and IURs) and Table 6-6 (chronic

RfDs and RfCs).

6.3 Absorption Adjustment Factors

Absorption adjustment factors are needed for the various direct contact exposure pathways and reflect desorption of a constituent from soil and subsequent absorption across the skin and into the blood stream [USEPA 1989]. For this evaluation, the absorption adjustment factor for ingestion of soil is 1.0 for all constituents, which implies all of the constituent is absorbed and is therefore conservative. The absorption adjustment factors for dermal contact with soil are constituent dependent. In accordance with RAGS-E, there are no default dermal absorption values for volatile organic compounds since they would tend to volatilize from the soil on skin and should be accounted for via inhalation routes. Table 6-7 presents the absorption adjustment factors for the various direct contact exposure pathways.

6.4 Permeability Constants

Permeability constants (*PC*) are used to evaluate dermal contact with water. These constants describe the rate at which constituents are absorbed through skin that is in contact with water. In this evaluation, organic constituent permeability constants are calculated from equations presented in RAGS Part E [USEPA 2004]. The permeability coefficients were obtained from RAGS Part E [USEPA 2004]. Parameters used to calculate permeability constants are presented in Table 6-8.

For organic constituents, the permeability constant depends on the exposure time (*ET*). As described in RAGS Part E [USEPA 2004], absorption of the constituent is faster for a shorter duration as the rate of absorption decreases as time goes by due to the skin becoming saturated with the constituent. The equations presented below to calculate permeability constants for organic constituents were developed from Equations 3.2 and 3.3 presented in RAGS Part E [USEPA 2004].

If the exposure time is less than or equal to the time to reach steady-state (*tstar*), then the permeability constant is calculated using the equation:

$$PC = \frac{2 * FA * K_p * \sqrt{\frac{6 * Tau-ev * ET}{\pi}}}{ET}$$

If the exposure time is greater than the time to reach steady-state, then the permeability constant is calculated using the equation:

$$PC = \frac{FA * K_p * \left[\frac{ET}{1+B} + 2 * Tau-ev * \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}{ET}$$

where:

PC	=	permeability constant (cm/hr)
FA	=	fraction of chemical absorbed from water (unitless) – used for highly lipophillic constituents
K_p	=	dermal permeability coefficient of constituent in water (cm/hr)
ET	=	exposure time per event (hr/event)
Tau-ev	=	lag time per event (hr/event)
B	=	dimensionless ratio of the permeability coefficient of a constituent through the stratum corneum relative to its permeability coefficient across the viable epidermis (unitless)

Permeability coefficients for several constituents are available in RAGS Part E [USEPA 2004]. For an organic constituent where a K_p value is not available, it can be calculated using the equation [USEPA 2004]:

$$\log K_p = -2.80 + 0.66 * \log K_{ow} - 0.0056 * MW$$

where:

K_p = dermal permeability coefficient of constituent in water (cm/hr)

K_{ow} = octanol-water partition coefficient (unitless)

MW = molecular weight (g/mole)

Values for the parameters *Tau-ev*, *B*, *tstar*, and *FA* for several organic constituents are available in RAGS Part E [USEPA 2004]. For organic constituents where values are not available, RAGS Part E [USEPA 2004] provides equations or procedures for calculating values for these parameters.

A value for the parameter *Tau-ev* can be calculated using the equation:

$$Tau-ev = 0.105 * 10^{(0.0056 * MW)}$$

where:

Tau-ev = lag time per event (hr/event)

MW = molecular weight (g/mole)

A value for the parameter *B* can be calculated using the equation:

$$B = K_p * \frac{\sqrt{MW}}{2.6}$$

where:

B = dimensionless ratio of the permeability coefficient of a constituent through the stratum corneum relative to its permeability coefficient across the viable epidermis (unitless)

K_p = dermal permeability coefficient of constituent in water (cm/hr)

MW = molecular weight (g/mole)

If the value for the parameter B is less than or equal to 0.6, then a value for *tstar* can be calculated using the equation:

$$tstar = 2.4 * Tau - ev$$

where:

tstar = time to reach steady-state (hr)

Tau-ev = lag time per event (hr/event)

If the value for the parameter B is greater than 0.6, then a value for *tstar* can be calculated using the equation:

$$tstar = 6 * Tau - ev * \left(b - \sqrt{b^2 - c^2}\right)$$

where:

$$b = \frac{2 * (1 + B)^2}{\pi} - c$$

$$c = \frac{1 + 3B + 3B^2}{3 * (1 + B)}$$

tstar = time to reach steady-state (hr)

Tau-ev = lag time per event (hr/event)

B = dimensionless ratio of the permeability coefficient of a constituent through the stratum corneum relative to its permeability coefficient across the viable epidermis (unitless)

The parameter *FA* is assumed to be 1.0 if there are no values for this parameter in RAGS Part E [USEPA 2004]. This is a conservative assumption.

The calculated permeability constants are presented in Table 6-9 for the on-site construction worker and the off-site utility worker.

7 Intake and Exposure Concentration Equations and Assumptions

This section presents the intake or absorbed dose equations and assumptions used to calculate constituent intakes for the incidental ingestion and dermal contact exposure pathways as well as the assumptions used to calculate exposure concentrations for the inhalation exposure pathways (volatiles and particulates) for the following receptors and exposure pathways:

- Direct contact (ingestion, dermal contact, and inhalation of volatiles and particulates) with subsurface soil for the on-site construction worker, on-site utility worker, off-site construction worker at the Central Avenue ROW, and off-site utility worker at the Central Avenue ROW during intrusive activities.
- Direct contact (inhalation of volatiles) with subsurface soil and unexposed groundwater for the on-site trespasser without intrusive activities.
- Direct contact (dermal contact and inhalation of volatiles) with exposed groundwater for the on-site construction worker and off-site utility worker at the Central Avenue ROW during intrusive activities; and
- Direct contact (inhalation of volatiles) with unexposed groundwater for the on-site utility worker and off-site construction worker at the Central Avenue ROW during intrusive activities.

These exposure pathways are the focus of this section, which is divided into three parts: the first part presents the intake equations for the incidental ingestion and dermal contact exposure pathways applicable to the receptors at this site; the second part presents the exposure concentration equations for the inhalation exposure pathways (volatiles and particulates); and the third part presents the receptor-specific assumptions used.

7.1 Intake Equations

This section presents the intake or absorbed dose equations for the exposure pathways identified above. General reference is made to RAGS Part A for all intake equations.

7.1.1 Incidental Ingestion of Soil

The intake from incidental ingestion of soil is estimated using the equation:

$$I_{ing-s} = CS_{src} * TF_s * AAF_{ing-s} * IF_{ing-s}$$

where:

$I_{ing\text{-}s}$ = intake from incidental ingestion of soil (mg/kg-day)

CS_{src} = constituent source concentration in soil (mg/kg)

TF_s = transfer factor that translates the source concentration in soil to an exposure point concentration in soil (unitless)

$AAF_{ing\text{-}s}$ = absorption adjustment factor for ingestion of soil (mg/mg)

$IF_{ing\text{-}s}$ = intake factor for ingestion of soil (kg/kg-day)

A constituent exposure point concentration in soil is calculated by multiplying a constituent source concentration in soil (CS_{src}) by a transfer factor (TF_s). Determination of the constituent source concentrations is presented in Section 5 of this document for each medium and receptor. The variable TF_s accounts for processes, such as biodegradation, that can reduce the source concentration over an extended period of time. In this evaluation, the value of TF_s for each constituent was conservatively set to 1.0, which implies that no biodegradation is occurring. Therefore, the exposure point concentration in soil equals the source concentration in soil for each constituent. The absorption adjustment factor ($AAF_{ing\text{-}s}$) is constituent-specific and accounts for the fraction of the constituent absorbed from soil relative to its absorption in the studies used to derive oral cancer slope factors or oral reference doses. In this evaluation, the value of $AAF_{ing\text{-}s}$ for each constituent was conservatively set to 1.0, which assumes all of the ingested constituent is absorbed.

Based on Exhibit 6-14 of RAGS Part A [USEPA 1989], the intake factor ($IF_{ing\text{-}s}$) accounts for all constituent-independent parameters and is estimated using the equation:

$$IF_{ing-s} = \frac{IR_{ing-s} * CF * FI * EF * ED}{BW * AT}$$

where:

$IF_{ing\text{-}s}$	=	intake factor for ingestion of soil (kg/kg-day)
$IR_{ing\text{-}s}$	=	incidental soil ingestion rate (mg-soil/day)
CF	=	conversion factor (1×10^{-6} kg/mg)
FI	=	fraction of daily incidental soil ingestion occurring on-site (unitless)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time (days)

The ingestion rate ($IR_{ing\text{-}s}$) is the amount of soil incidentally ingested per day or event, and is receptor-specific. The fraction ingested (*FI*) is the percent of the daily intake of soil that occurs at the site and is conservatively set to 1.0. The exposure frequency (*EF*), exposure duration (*ED*) and body weight (*BW*) are described in the intake assumptions for specific receptors. The averaging time (*AT*) for carcinogenic effects (AT_c) is 25,550 days (based on a lifetime of 70 years) and applies to all receptors [USEPA 1991]. The averaging time for noncarcinogenic effects (AT_{nc}) is exposure based and is described under the intake assumptions for specific receptors.

7.1.2 Dermal Contact with Soil

The absorbed dose from dermal contact with soil is estimated using the equation:

$$I_{derm-s} = CS_{src} * TF_s * AAF_{derm-s} * IF_{derm-s}$$

where:

I_{derm-s} = absorbed dose from dermal contact with soil (mg/kg-day)

CS_{src} = constituent source concentration in soil (mg/kg)

TF_s = transfer factor that translates the source concentration in soil to an exposure point concentration in soil (unitless)

AAF_{derm-s} = absorption adjustment factor for dermal contact with soil (mg/mg)

IF_{derm-s} = intake factor for dermal contact with soil (kg/kg-day)

A constituent exposure point concentration in soil is calculated as described above under the soil ingestion exposure pathway (Section 7.1.1). In calculating the absorbed dose from dermal contact with soil, the value of TF_s for each constituent was conservatively set to 1.0. The absorption adjustment factor (AAF_{derm-s}) is constituent-specific and accounts for the fraction of the constituent absorbed from soil through the skin. The value of AAF_{derm-s} for each constituent is presented in Table 6-7. As presented in Table 6-7, AAF_{derm-s} values are zero for all volatile COCs because in accordance with RAGS-E, there are no default dermal absorption values for volatile organic compounds since they would tend to volatilize from the soil on skin and should be accounted for via inhalation routes [USEPA 2004].

Based on Exhibit 6-15 of RAGS Part A [USEPA 1989], the intake factor (IF_{derm-s}) accounts for all constituent-independent parameters and is estimated using the equation:

$$IF_{derm-s} = \frac{SA * AF * CF * FC * EF * ED}{BW * AT}$$

where:

IF_{derm-s} = intake factor for dermal contact with soil (kg/kg-day)

SA = exposed skin surface area (cm^2/event)

AF = soil adherence factor (mg/cm^2)

CF = conversion factor (1×10^{-6} kg/mg)

FC = fraction of the day that contact with soil occurs at the site (unitless)

EF = exposure frequency (events/year)

ED = exposure duration (years)

BW = body weight (kg)

AT = averaging time (days)

The skin surface area (*SA*) exposed to soil is dependent upon activities performed by the receptor. Exposures via dermal contact are generally limited to certain parts of the body (i.e. hands, forearms, head, neck, etc.). The soil adherence factor (*AF*) is the density of soil adhering to the exposed fraction of the body. This value is correlated to the body parts exposed. The fraction of the day that contact with soil occurs at the site (*FC*) is conservatively set to 1.0. The exposure frequency (*EF*), exposure duration (*ED*) and body weight (*BW*) are receptor specific as defined in the intake assumptions for each receptor. The averaging time (*AT*) was discussed above in Section 7.1.1.

7.1.3 Dermal Contact with Groundwater

The absorbed dose from dermal contact with groundwater is estimated using the equation:

$$I_{derm-w} = CW_{src} * TF_w * PC * IF_{derm-w}$$

where:

I_{derm-w} = absorbed dose from dermal contact with groundwater (mg/kg-day)

CW_{src} = constituent source concentration in groundwater (mg/L)

TF_w = transfer factor that translates the source concentration to an exposure point concentration in groundwater (unitless)

PC = permeability constant (cm/hr)

$IF_{derm\text{-}w}$ = intake factor for dermal contact with groundwater (L-hr/cm-kg-day)

A constituent exposure point concentration in groundwater is calculated by multiplying a constituent source concentration in groundwater (CW_{src}) by a transfer factor (TF_w). The permeability constant (PC) is constituent-specific and describes the rate at which the constituent moves from water through the skin. The value of PC for each constituent is presented in Table 6-9.

Based on Exhibit 6-13 of RAGS Part A [USEPA 1989], the intake factor ($IF_{derm\text{-}w}$) accounts for all constituent-independent parameters and is estimated using the equation:

$$IF_{derm-w} = \frac{SA * ET * EF * ED * CF}{BW * AT}$$

where:

$IF_{derm\text{-}w}$ = intake factor for dermal contact with groundwater (L-hr/cm-kg-day)

SA = exposed skin surface area (cm^2)

ET = exposure time (hrs/day)

EF = exposure frequency (days/year)

ED = exposure duration (years)

CF = conversion factor (1.0×10^{-3} L/cm^3)

BW = body weight (kg)

AT = averaging time (days)

The skin surface area (*SA*) exposed to groundwater is the product of the total body surface area and the fraction of body exposed. The fraction of the body exposed is dependent on the nature of the activity being conducted and the age and type of the individuals involved. The exposure time (*ET*), exposure frequency (*EF*), exposure duration (*ED*), and body weight (*BW*) are receptor specific as defined in the intake assumptions for each receptor. The averaging time (*AT*) was discussed above in Section 7.1.1.

7.2 Exposure Concentration Equations

When estimating risk via inhalation, it is recommended that the concentration of the constituents in air be used as the exposure metric (e.g. μg/m^3) rather than the inhalation intake of a constituent in air based on inhalation rate and body weight [USEPA 2009a]. This section presents the exposure concentration equations for the inhalation exposure pathways (volatiles and particulates). The inhalation of volatiles (ambient air) is applicable for exposures to both soil and groundwater. The inhalation of particulates (fugitive dusts) emitted to outdoor air is applicable only to soil exposures.

Based on Equation 6 of RAGS Part F [USEPA 2009a], the exposure concentration for estimating inhalation of volatiles or particulates is estimated using the following equation:

$$EC = \frac{CA_a * ET * EF * ED}{AT}$$

where:

EC	=	exposure concentration ($\mu g/m^3$)
CA_a	=	constituent concentration in air ($\mu g/m^3$)
ET	=	exposure time (hours/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
AT	=	averaging time (hours)

The exposure time (ET), exposure frequency (EF), and exposure duration (ED) are described in the intake assumptions for specific receptors. The averaging time (AT) for carcinogenic effects (AT_c) is 613,200 hours (based on a lifetime of 70 years) and applies to all receptors [USEPA 2009a]. The averaging time for noncarcinogenic effects (AT_{nc}) is exposure based and is described under the intake assumptions for specific receptors.

The constituent concentration in air (CA_a) is calculated using the equation:

$$CA_a = C_{src} * TF_a$$

where:

CA_a	=	constituent concentration in air ($\mu g/m^3$)
C_{src}	=	constituent source concentration in soil ($\mu g/kg$) or groundwater (ug/L)
TF_a	=	transfer factor that translates the source concentration in soil or groundwater to an air concentration (kg/m^3 or L/m^3, respectively)

Determination of the constituent source concentrations (C_{src}) is presented in Section 5 of this document for each medium and receptor. The variable TF_a accounts for processes, such as volatilization or fugitive dust emission rate and air dispersion, which translate the source concentration into an air concentration. The transfer factors used for inhalation of volatiles in ambient air are chemical specific and are presented in Attachment 4. The transfer factor used for particulate emissions was 1×10^{-10} kg/m^3, which is the default value presented in Section 250.307 of the regulations [PACODE 2011].

7.3 Exposures to Lead

Exposures to lead are not evaluated using the same methods as those described for other COCs. The USEPA does not recommend quantifying cancer risks (or noncancer hazards) for lead using standard dose equations due to the many factors involved (e.g., receptor age, health, nutritional state, body burden and exposure duration). All of these factors influence the absorption, release and excretion of lead; therefore, using standard dose or exposure concentration equations would not provide an accurate characterization of potential risk/hazard [USEPA 2015a].

Instead, lead is regulated based on blood lead concentration (PbB). PbB is predicted with pharmacologically-based models that use a biokinetic slope factor that is correlated with both exposure and adverse health effects. In lieu of evaluating risk using typical intake calculations and toxicity criteria, USEPA developed models specifically to evaluate lead exposures. The USEPA recommends the use of the Adult Lead Methodology (ALM) to evaluate non-residential scenarios [USEPA 2003 and 2015c].

Lead is identified as a direct contact COC in soil for on-site construction workers, on-site utility workers, and off-site construction workers and utility workers at the Central Avenue Street ROW. The USEPA recommends the use of the ALM for non-residential scenarios to predict potential fetal PbB by relating lead intake to PbB in a woman of child-bearing age and in a fetus carried by that woman.

In accordance with the ALM, the EPCs for lead are based on arithmetic mean lead concentrations in environmental media. As shown in Table 5-1, the mean lead concentrations in on-site subsurface soil (3 to 6 ft-bgs) and subsurface soil (3 to 10 ft-bgs) are 132.3 and 42.02 milligrams per kilogram (mg/kg), respectively. Similarly, in Table 5-2, the mean lead concentration in subsurface soil (4 to 8 ft-bgs) and subsurface soil (4 to 10 ft-bgs) at the Central Avenue Street ROW are 136 and 96.2 mg/kg, respectively. These lead concentrations are well below the USEPA RSLs of 400 mg/kg for residential soil and 800 mg/kg for industrial soil [USEPA 2015a]. As a result, further evaluation of these receptors for potential lead exposure in soil is not required.

In addition, the USEPA [2003] does not recommend the use of the ALM to evaluate lead exposures of less than 90 days. Estimates of first order elimination half-time for lead in blood are approximately 30 days for adults; therefore, a constant lead intake rate for 90 days would be required to achieve a PbB sufficiently close to quasi-steady state. It is anticipated that infrequent exposures (e.g., less than 1 day per week) and exposures of less than 90 days result in oscillations in blood lead, due to clearance of lead from the blood between exposures [USEPA 2003]. Exposures to subsurface soil for on-site and off-site construction workers are assumed to occur for only 25 days per year and for on-site and off-site and utility workers, only 1 day per year (as discussed in Section 7.4 below). Therefore, it is assumed that PbB in these receptors do not reach steady state because lead is cleared from the blood following brief exposure. Therefore, site-related lead concentrations in groundwater result in negligible exposure to these receptors.

7.4 Receptor-Specific Exposure Assumptions

This section presents receptor-specific exposure assumptions for each receptor. The receptor-specific exposure assumptions quantify activity patterns and body characteristics for each of the receptors such as the amount of time a receptor may spend at the site, the frequency the receptor visits the site, body weight of the receptor, and soil ingestion rates. The receptor-specific exposure assumptions were selected using PADEP recommended values, when available. Otherwise, alternative sources were used, such as recommended values from other state program guidance or USEPA guidance, or professional judgment (based on site-specific information) to select appropriate receptor-specific exposure assumptions.

7.4.1 On-Site Adolescent Trespasser (12 to18 years old)

The adolescent trespasser (12 to 18 years old) is an individual who may infrequently wander onto the site. While trespassing, this receptor may be exposed to constituents in surface soil through direct contact with surface soil. However, site-related COCs in soil at the site were identified at least 3 ft-bgs (i.e. in subsurface soil), which is considered not accessible for trespassers. Thus, direct exposure to soil via incidental ingestion, dermal contact, and inhalation of particulates pathways is considered incomplete for this receptor. However, the trespasser may be exposed to COCs in subsurface soil and groundwater through inhalation of outdoor vapor via volatilization of site-related constituents from unexposed subsurface soil and unexposed groundwater without intrusive activities.

The exposure duration (*ED*) was set to 6 years for the adolescent trespasser (12 to 18 years old) based on the range of years in the age group. The exposure frequency (*EF*) was set to 24 days per year (days/year) (assumes 6 days per month for 4 months) for the adolescent trespasser based on default values from the Virginia Department of Environmental Quality [VA DEQ 2014] for a trespasser scenario. The exposure time (*ET*) was set to 2 hours per day (hours/day) for this receptor based on default values from the VA DEQ [2014] for a trespasser scenario.

The averaging time for the inhalation exposure pathways was set at 613,200 hours [USEPA 2009a] for carcinogenic effects (AT_c) and 52,560 hours for noncarcinogenic effects (AT_{nc}) ($ED \times 365$ days/yr × 24 hrs/day) [USEPA 2009a]. Table 7-1 presents the exposure assumptions for the on-site adolescent trespasser (12 to 18 years old).

7.4.2 On-Site and Off-site Construction Worker

The construction worker is an individual who would be involved in construction and/or excavation activities on-site or off-site. In addition, the construction worker may be responsible for any major repairs to existing utility lines or the installation of a new line which may result in exposure lasting more than one day. The average depth to groundwater at the site is approximately 10 feet. Based on the work activities of the on-site construction worker (e.g. construction of a new building or installation of a new underground utility line), it is assumed that the on-site construction worker could be involved in excavation activities up to a maximum depth of approximately 10 feet or to the water table. As a result, potential exposures to subsurface soil and exposed groundwater within a trench are possible for the on-site construction worker.

For the off-site construction worker in the Central Avenue ROW, if a new utility line were to be installed in Central Avenue, it is likely it would be installed at a maximum depth of approximately 6-8 feet, which is above the water table (approximately 10 feet).

Based on these activities, it is assumed that the off-site construction worker at the Central Avenue ROW could be involved in excavation activities up to a maximum depth of approximately 8 feet. As a result, potential exposures to subsurface soil and unexposed groundwater beneath the bottom of a trench are possible for the off-site construction worker. There were site-related constituents retained as direct contact COCs in subsurface soil and groundwater for both the on-site and off-site construction workers. Tables 7-2 and 7-3 present the exposure assumptions for the on-site and off-site construction worker, respectively.

Since the regulations for Act 2 do not provide default assumptions for a construction worker for a few of the exposure parameters, regulations in other states were reviewed for guidance. The Illinois Environmental Protection Agency (Illinois EPA) has developed intake assumptions for a construction worker. The Illinois EPA assumes intensive subsurface excavation activity occurs for about 6 weeks during construction projects and therefore uses an exposure frequency (*EF*) of 30 days/year (5 days/week for 6 weeks) and exposure duration (*ED*) of one year to evaluate construction workers [IPCB 2007]. For the on-site construction worker, it is unlikely that this receptor would spend the full 30 days in direct contact with groundwater on-site (e.g. install utility lines for 5 days and place footers/construct buildings for the remaining 25 days). Therefore, the total exposure frequency (*EF*) has been apportioned to assume that the on-site construction worker will be in direct contact with soil for 25 days and exposed groundwater within a trench for the remaining 5 days. For the off-site construction worker, it is unlikely that this receptor would spend the full 30 days within the area of MW-5 and MW-3 while installing a new underground utility line along Central Avenue. Therefore, the total exposure frequency (*EF*) has also been apportioned to assume that the off-site construction worker will be in direct contact with soil for 25 days and unexposed groundwater beneath the bottom of a trench for the remaining 5 days. The Illinois EPA exposure duration (*ED*) of 1 year was used [IPCB 2007]. The default value for non-residential exposures of 8 hours/day was used as the exposure time (*ET*) for this receptor [PACODE 2011].

The soil ingestion rate (*IR*) was set to 330 mg/day for both construction workers, which is the default exposure assumption for a construction scenario presented in Exhibit 5-1 of the Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites [USEPA 2002]. The total daily soil ingestion fraction (*FI*) was conservatively set at 1.0

for both receptors, which assumes that 100% of the receptors' daily soil intake occurs at the site. The body weight (*BW*) was set at 70 kg for both receptors, and is based on the PADEP default values for an adult non-residential worker scenario [PACODE 2011].

The exposed surface area (*SA*) for dermal contact with soil was set at 3,300 cm^2/day for the construction workers and is the default value for a construction scenario and corresponds to the surface area for the face, forearms, and hands [USEPA 2002]. The soil adherence factor (*AF*) was set at 0.3 mg-soil/cm^2 for both receptors, corresponding to the 95^{th} percentile value that has been measured for construction workers [USEPA 2004]. The fraction of the day in contact with soil (*FC*) was conservatively set at 1.0 for both receptors, which assumes that 100% of the receptors' daily soil contact occurs from soil at the site.

The exposed surface area (*SA*) for dermal contact with groundwater for the on-site construction worker was estimated to be 2,550 cm^2 based on the values presented in the USEPA Exposure Factors Handbook: 2011 Edition [USEPA 2011] for mean body surface area exposed for an adult male, which corresponds to forearms and hands.

The averaging time for carcinogenic effects (AT_c) was set at 25,550 days [USEPA 1991] for the ingestion and dermal exposure pathways, and 613,200 hours [USEPA 2009a] for the inhalation pathways. The averaging time for noncarcinogenic effects (AT_{nc}) was set at 42 days [IPCB 2007] for the ingestion and dermal exposure pathways and 8,760 hours [USEPA 2009a] for the inhalation exposure pathways.

7.4.3 On-Site and Off-Site Utility Worker

The utility worker is an individual who would be involved with repairing and maintaining utility lines on-site or off-site. This receptor is not expected to be involved in the installation of new lines, as this is assumed to be performed by a construction worker. The average depth to groundwater at the site is approximately 10 feet. Based on the activities of the utility worker and based on the depth of the utility lines on-site (less than 6 feet), it is expected that the on-site utility worker could be involved in excavation activities up to approximately 6 feet. As a result of these activities, potential exposures to unsaturated soil to maximum depth of 6 feet are possible for the on-site utility worker. In addition, the on-site utility worker may be indirectly exposed to volatile constituents in unsaturated soil greater than 6 feet and unexposed groundwater that migrate to trench air.

Due to the presence of a 36" main water line beneath Central Avenue, it is assumed that the off-site utility worker at the Central Avenue ROW could be involved in excavation activities up to a maximum depth of approximately 14 feet in order to repair the water line. As a result of these activities, potential exposures to subsurface soil and exposed groundwater within a trench are possible for the off-site utility worker. Table 7-4 presents the exposure assumptions for the on-site utility worker. Table 7-5 presents the exposure assumptions for the off-site utility worker.

Since the regulations for Act 2 do not provide default assumptions for a utility worker for a few of the exposure parameters, regulations in other states were reviewed for guidance. The Massachusetts Department of Environmental Protection (MADEP) has determined that an exposure frequency (*EF*) of 1 day/year is reasonable for a utility worker where significant subsurface lines exist [MADEP 1995]. The exposure duration (*ED*) was set to 25 years, which is the PADEP default for an adult non-residential scenario [PACODE 2011]. An exposure time (*ET*) of 8 hours/day was selected to represent a typical work day [PACODE 2011]. These exposure assumptions apply to both the on-site and the off-site utility workers.

The soil ingestion rate (*IR*) for both the on-site and the off-site utility workers was set to 330 mg/day, which is the default exposure assumption for a construction scenario presented in Exhibit 5-1 of the Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites [USEPA 2002]. The total daily soil ingestion fraction (*FI*) was conservatively set at 1.0, which assumes that 100% of the receptors' daily soil intake occurs at the site. The body weight (*BW*) was set at 70 kg based on the PADEP default value for an adult non-residential worker scenario [PACODE 2011].

The exposed surface area (*SA*) for dermal contact with soil was set at 3,300 cm^2/day for both the on-site and the off-site utility workers. This is the recommended default value for a commercial/industrial scenario and corresponds to the surface area for the face, forearms, and hands [USEPA 2002]. The soil adherence factor (*AF*) for the on-site utility worker was set at 0.2 mg-soil/cm^2, which is the default value for commercial/industrial exposure [USEPA 2002]. The fraction of the day in contact with soil (*FC*) for both utility workers was conservatively set at 1.0, which assumes that 100% of the receptors' daily soil contact occurs from soil at the site.

The exposed surface area (*SA*) for dermal contact with groundwater for the off-site utility worker was estimated to be 2,550 cm^2 based on the values presented in the USEPA Exposure Factors Handbook: 2011 Edition [USEPA 2011] for mean body surface area exposed for an adult male, which corresponds to forearms and hands.

The averaging time for carcinogenic effects (AT_c) was set at 25,550 days [USEPA 1991] for the ingestion and dermal exposure pathways, and 613,200 hours [USEPA 2009a] for the inhalation exposure pathways. The averaging time for noncarcinogenic effects (AT_{nc}) was set at 9,125 days [USEPA 1989] for the ingestion and dermal contact exposure pathways and 219,000 hours [USEPA 2009a] for the inhalation exposure pathways. These exposure assumptions apply to both the on-site and the off-site utility workers.

8 Risk Characterization

In this section of the risk assessment, the potential human health risks for complete exposure pathways are assessed. Potential risks due to exposures to COC in soil and groundwater from the site are evaluated by integrating exposure assessments and toxicity data into quantitative expressions of cancer risk and noncancer health hazards. This section presents the risk calculation framework used to quantify risk for the direct contact exposure pathways.

8.1 Risk Calculation Framework

Two types of potential direct contact human health effects were calculated in this risk assessment: carcinogenic effects and noncarcinogenic effects. Carcinogenic effects are evaluated by calculating a cancer risk. Cancer risks are estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the potential carcinogen (i.e. incremental or excess individual lifetime cancer risk). Carcinogenic risks for the incidental ingestion and dermal contact exposure pathways are estimated using the equation [USEPA 1989]:

$$Risk = Intake * CSF$$

where:

$Intake$ = intake or absorbed dose of a constituent (mg/kg-day)

CSF = cancer slope factor of a constituent $(mg/kg\text{-}day)^{-1}$

Carcinogenic risks for the inhalation exposure pathways (volatiles and particulates) are estimated using the equation [USEPA 2009a]:

$$Risk = EC * IUR$$

where:

EC = exposure concentration ($\mu g/m^3$)

IUR = inhalation unit risk factor $(\mu g/m^3)^{-1}$

For each exposure pathway, this calculation is performed for each COC considered to be a potential carcinogen, and the risks are summed across all COC and exposure pathways to obtain the total risk for a specific receptor. The PADEP benchmark cancer risk level ranges between one in 1,000,000 (or 1×10^{-6}) and one in 10,000 (or 1×10^{-4}). The cumulative excess risk to exposed populations, including sensitive subgroups, may not be greater than 1 in 10,000 (or 1×10^{-4}) [PADEP 2002 and subsequent updates].

Potential noncarcinogenic effects are evaluated by calculating a hazard index (HI). For a single constituent and exposure route, a hazard quotient (HQ) for the incidental ingestion and dermal contact exposure pathways is calculated using the equation [USEPA 1989]:

$$HQ = \frac{Intake}{RfD}$$

where:

Intake = intake or absorbed dose of a constituent (mg/kg-day)

RfD = reference dose of a constituent (mg/kg-day)

A HQ for the inhalation exposure pathways (volatiles and particulates) is calculated using the equation [USEPA 2009a]:

$$HQ = \frac{EC}{RfC * CF}$$

where:

EC = exposure concentration $(\mu g/m^3)$

RfC = reference concentration (mg/m^3)

CF = conversion factor (1000 μg/mg)

For each exposure pathway, this calculation is performed for each COC and the hazard quotients are summed across all COC and exposure pathways to obtain the total HI for a specific receptor. The PADEP benchmark noncancer HI is 1. This value represents the level to which the human population could be exposed on a daily basis without appreciable risk of deleterious effect to the exposed population.

8.2 Risk Results

Calculations of cancer risks and noncancer HIs for the on-site adolescent trespasser (12 to 18 years old), on-site construction worker, on-site utility worker, off-site construction worker (Central Avenue ROW), and off-site utility worker (Central Avenue ROW) are presented in Tables 8-1 through 8-5, respectively. Table 8-6 presents a summary of the risk results for all receptors. As shown in Table 8-6, the estimated total cancer risks and noncancer HIs for all receptors are below the PADEP benchmark values of 1×10^{-4} and 1, respectively.

Note that if any of the exposure assumptions and/or assessment change in the future for this site, the results of this analysis do not apply.

9 Uncertainty Analysis

The risk assessment process presented in this document uses a considerable number of conservative assumptions regarding exposure and toxicity to ensure that potential risks are not underestimated. A qualitative review is presented in this section of the types of assumptions and how these assumptions result in a high degree of confidence that potential site-related risks are not underestimated.

During the risk assessment process, uncertainty and variability are inherent in the estimation of risks based on specific input parameters such as:

- Constituents of concern;
- Receptor and exposure routes;
- Exposure parameters;
- Exposure point concentrations; and,
- Toxicological values.

Selecting the correct COC, choosing values for the input parameters, and/or retaining receptors and exposure routes carries with it some degree of variability. This section describes some of the variables as applicable to the risk analysis and their potential effect on the final risk estimates.

Exposure is estimated through identification of COC, evaluation of transport mechanisms, identification of receptors, and identification of complete exposure pathways. Identification of COC relies, in part, on the information provided by the sampling and analytical program. Uncertainty in this regard is reduced as much as possible by following appropriate sample collection and analytical procedures.

9.1 Identification of COC

Identification of COCs for the risk assessment is through comparison of chemical concentrations to screening levels developed by the PADEP and/or USEPA. The derivation of MSCs is based on conservative exposure assumptions in Subchapter C of the regulations for Act 2 [PACODE 2011]. For example, the MSCs are based on a cancer risk of 1×10^{-5}, rather than the upper bound excess risk permitted by Act 2 of 1×10^{-4}. In addition, the soil-to-groundwater MSCs are modeled using conservative soil characteristics representative of soils throughout Pennsylvania, rather than modeling soil-to-groundwater MSCs based on site-specific soil characteristics. However, the selection of COCs was based on USEPA RSLs and SSLs for direct contact and VISLs for vapor intrusion, which were based on a target risk of 1×10^{-6} and a target HQ of 0.1. Therefore, the selection of COCs is considered a very conservative approach.

9.2 Exposure Assessment

There are three major areas of uncertainty associated with exposure assessment, including: 1) exposure pathways; 2) calculation of EPCs; and 3) exposure parameter values used to estimate chemical intake.

9.2.1 Exposure Pathways

Defining the probable current and future land use of the site carries with it some degree of uncertainty. Evaluating and understanding this uncertainty is important during the selection of potential receptors and exposure routes. For this evaluation, the potential receptors and exposure routes were based on current site conditions (non-residential) and the assumption that the site will continue to be used for non-residential use, limiting the uncertainty associated with these parameters. The planned future use of the property is as a paved parking lot for an active Sheetz retail gasoline dispensing facility and convenience store located immediately south of the site.

Two COCs were identified in the DuPont Street ROW subsurface soil (7 ft-bgs). Additionally, six COCs were identified in groundwater at the DuPont Street ROW based on the QD groundwater modeling. Thus, off-site construction workers and utility workers in the DuPont Street ROW could be potentially exposed to COCs in soil and groundwater while engaging in excavation activities. These off-site construction workers and utility workers in the DuPont Street ROW were not quantitatively evaluated in the risk assessment because the off-site construction worker and the off-site utility worker at the Central Avenue ROW scenarios provide a conservative basis for evaluating potential exposures to off-site construction workers and utility workers in the DuPont Street ROW. The off-site construction worker and the off-site utility worker at the Central Avenue ROW generally have higher relative intake rates when compared to the off-site construction worker in the DuPont Street ROW because they are potentially exposed to more retained COCs in soil (9 vs. 2) and groundwater (8 vs. 6) and at higher concentrations in soil and groundwater. The off-site construction workers in the DuPont Street ROW and in the Central Avenue ROW have the same exposure pathways retained. The off-site utility worker in the Central Avenue ROW has an exposed groundwater scenario (i.e. dermal contact and inhalation of volatiles from exposed groundwater within a trench) whereas the off-site utility worker in the DuPont Street ROW has an unexposed groundwater scenario (i.e. inhalation of volatiles within a trench that migrate from unexposed groundwater). Therefore, the retained exposure pathways for the Central Avenue receptors are either representative of or protective of receptors in DuPont Street. Since the estimated risks for the off-site construction worker and the off-site utility worker at the Central Avenue ROW are below the PADEP acceptable risk levels, potential risks for the off-site construction worker and utility worker in the DuPont Street ROW are likely well below levels of concern.

9.2.2 Exposure Point Concentrations

Using current media concentrations to reflect future concentrations adds another uncertainty to this risk assessment. Soil and groundwater concentrations of COCs are expected to decrease over time because there are no longer active sources at the site. Additionally, site-specific petroleum hydrocarbons tend to be biodegraded readily under aerobic conditions in unsaturated soil zones. Use of current data to assess the risks over chronic time periods is likely to overestimate risks.

The risk assessment evaluates mean concentrations over an exposure area, considering all exposures within that area as equally possible. Risks associated with exposures are then assessed by evaluating those mean concentrations with exposure factors and the appropriate exposure/toxicity values. The EPC for a specific chemical in a particular medium is based on the 95%UCL (or higher) on the mean concentrations for datasets containing eight or more samples. For datasets containing less than eight samples, the maximum detected concentrations are used as EPCs. The use of a 95%UCL is simply to ensure that the average concentration is not underestimated.

As shown in Tables 5-1 and 5-2, the maximum detected concentrations were used as EPCs for the on-site subsurface soil (3-6 ft-bgs), on-site subsurface soil (3-10 ft-bgs) for those constituents that had less than 4 detections, off-site subsurface soil (4-8 ft-bgs), off-site subsurface soil (4-10 ft-bgs), and off-site groundwater at the Central Avenue ROW since these media contained less than eight samples. The maximum concentration provides a highly biased representation of COC distribution, which often results in overestimates of exposure, and therefore, overestimates of individual and cumulative risk/hazard from potential exposure to COCs for site receptors. For example, The EPC for 1,2,4-TMB in off-site groundwater at the Central Avenue ROW was based on the maximum concentration of 2,220 μg/L from MW-3. 1,2,4-TMB was detected in 4 of 8 groundwater samples collected at on-site wells along the Central Avenue (i.e. MW-3 and MW-5) at concentrations ranging from 156 to 2,220 μg/L. Therefore, actual exposure to 1,2,4-TMB for the off-site construction workers and utility workers at the Central Avenue ROW may be much lower than the estimated EPC for this compound.

Measured data are not available to provide information on concentrations of chemicals in outdoor air. In the absence of measured values, outdoor air concentrations were estimated using fate and transport models. Uncertainties associated with the trench model are discussed below.

The trench model developed by the Virginia Department of Environmental Quality [VA DEQ 2014] is used to estimate chemical concentrations in outdoor air within a trench. The trench depth is assumed to be 10 feet for the on-site construction worker (equivalent to the average depth to groundwater at the site), 6 feet for the on-site utility worker, 8 feet for the off-site construction at the Central Avenue ROW, and 14 feet for the off-site utility worker at the Central Avenue ROW. The VA DEQ default width for an excavation trench is three feet. However, Occupational Safety and Health Administration (OSHA) regulation (29 Code of Federal Regulation [CFR] 1926 652[a]) requires adequate protective systems (i.e., sloping, benching, or trench shielding) for an excavation of five feet or deeper in order to protect workers from loose rock or soil falling or rolling from an excavation face. With the installation of protective systems, it is reasonable to assume that the trench width at the ground level is least 6 feet. Thus, a trench width of 6 feet is assumed.

According to the trench model, air exchange between the trench and above-ground atmosphere is restricted when the ratio of the trench width to the trench depth is less than one. The VA DEQ default air exchange rate for trenches with width less than or equal to depth is 2 exchanges per hour, based on measured ventilation rates of buildings [VA DEQ 2014]. The assumption that there is almost no air exchange between the open trench and above-ground atmosphere may be overly conservative. Based on a study conducted by the USEPA Region 8 [1999], the number of air exchanges in a trench depends on the wind speed and the dimension of the trench parallel to the wind direction. To estimate the air exchange rate in a worst case scenario, the USEPA Region 8 assumes that 1) a trench has a length up to 30 meters, 2) the wind direction is parallel to the long axis of trench (e.g., trench length), and 3) the wind is calm with a wind speed of 1 mile per hour (or 0.45 meters per second). This results in an air exchange rate of 0.015 per second or 54 exchanges per hour [USEPA 1999]. Since uniform mixing in the trench is not expected, a mixing factor of 0.5 is applied to account for deviation from complete mixing in an open trench. The resulting air exchange rate is 0.0075 per second or 27 exchanges per hour. Using the USEPA Region 8 recommended air exchange rate of 27 per hour in the VA DEQ trench model, the predicted volatilization factors (VFs) for transfer of VOCs from groundwater accumulating at the bottom of a trench to the air in the trench were approximately 0.3 to 0.6 liter per cubic meter (L/m^3). These predicted VFs are similar to the generic VF of 0.5 L/m^3 used by the USEPA and PADEP for volatilization of VOCs in typical indoor domestic water uses (e.g. showering, bathing, cooking, dishwashing, laundering, etc.) [USEPA 1991 and 2014b, and PADEP 2011]. Since the mechanism for volatilization in a flooded outdoor trench is considerably less vigorous than that responsible for volatilization in typical indoor water uses (e.g., showering) [USEPA 1999], the predicted VFs of 0.3 to 0.6 L/m^3 using the USEPA Region 8 recommended air exchange rate yields conservative yet more realistic trench air concentrations.

9.2.3 Exposure Parameters

Uncertainty is associated with the exposure parameter values used; however, assumptions are chosen to be conservative so not to underestimate risk. For example, assumptions are made for the exposure time, frequency, and duration of potential chemical exposures, as well as for the quantity of material ingested, inhaled, or absorbed. In general, assumptions are made based on reasonable maximum exposures and, in most cases, values are specified by PADEP, USEPA or other state guidance documents, or site-specific information. For the receptors evaluated in this risk assessment, the exposure frequency and exposure duration were chosen so as to overestimate potential exposures.

In 2011, USEPA issued *Exposure Factors Handbook – 2011 Edition* (EFH 2011) [USEPA 2011]. The EFH 2011 provides a substantive update to USEPA's exposure assessment recommendations and provides information and recommendations on various physiological and behavioral factors commonly used in risk assessments. Based upon recommendations from the EFH 2011, the USEPA Superfund program updated several default exposure factors for use in the human health risk assessment. These updates include, but are not limited to, adult body weight (from 70 kg to 80 kg), worker skin surface area (3,300 to 3,470 cm^2), worker soil adherence factor (from 0.2 to 0.12 mg/cm^2), and resident exposure duration (from 30 years to 26 years). The RSLs utilized as screening levels to identify COCs in this risk assessment are developed based on these updated exposure factors. Because PADEP has not adopted these changes in the Act 2 program, these USEPA recommended updates have not been incorporated into this risk assessment. The decision of not using the most up-to-date and scientifically sound exposure factors introduces uncertainty to the risk assessment.

9.3 Toxicity Values

A potentially large source of uncertainty is inherent in the derivation of the USEPA toxicity values (i.e., RfDs, RfCs, CSFs, and IURs). In many cases, data are extrapolated from animals to sensitive humans by the application of uncertainty factors to an estimated no-observed-adverse-effect level or lowest-observed-adverse-effect level for noncancer health effects. While designed to be protective, it is likely in many cases that uncertainty factors overestimate the magnitude of differences that may exist between humans and animals, and among humans.

In addition, derivation of CSFs and IURs often involves linear extrapolation of effects at high doses to potential effects at lower doses commonly seen in environmental exposure settings. Currently, it is not known whether linear extrapolation is appropriate. It is probable that the shape of the dose response curve for carcinogenesis varies with different chemicals and mechanisms of action. It is not possible at this time, however, to describe such differences in quantitative terms. It is likely that the assumption of linearity is conservative and yields CSFs and IURs that are unlikely to lead to underestimation of risks. Yet, for specific chemicals, current methodology could cause CSFs and IURs and, hence, risks to be underestimated.

The chronic RfD for 1,2,4-TMB, subchronic RfD for 1,3,5-TMB, and chronic RfC for 1,3,5-TMB are "archive" toxicity values. These "archive" values are older PPRTV toxicity values that "expired" and were removed from the USEPA PPRTV electronic library (http://hhpprtv.ornl.gov/pprtv_appendix.html). Based on evaluation of these chemicals, the USEPA concluded that databases for 1,2,4-TMB and 1,3,5-TMB were inadequate to derive a provisional RfD and RfC, respectively [USEPA 2007 and 2009b]. Per PADEP's direction, these archived PPRTV toxicity values were still used in the risk assessment. The use of these archived toxicity values no longer endorsed by the USEPA likely results in overestimates of noncancer HIs for the on-site and off-site receptors and introduce significant uncertainty to the risk assessment.

According to RAGS Part F [USEPA 2009a], exposures lasting 24 hours or less or intermittent exposures that occur at a series of short periods (e.g., 4 hours) separated by several days of no exposure can be characterized as acute exposures. For conservatism, utility workers with an exposure time of 8 hours per day for an exposure frequency of 1 day per year were analyzed using chronic, not acute, exposure algorithms and toxicity data in this risk assessment. Additionally, subchronic RfDs for ethylbenzene, 1,2,4-TMB, and subchronic RfCs for cumene and naphthalene were not available. In accordance with USEPA guidance [USEPA 2002 and 2009], the RfDs and RfCs based on chronic exposure duration were used as conservative estimates for the subchronic exposure duration. These sources of uncertainty may overestimate the potential hazard for site receptors.

9.4 Risk Characterization

There is also uncertainty in assessing risks associated with a mixture of chemicals. In this assessment, the effects of exposure to each contaminant present have initially been considered separately. However, these substances occur together at the site, and individuals may be exposed to mixtures of the chemicals. Predictions of how these mixtures of chemicals will interact must be based on an understanding of the mechanisms of such interactions. Individual chemicals may interact in the body, yielding a new toxic component or causing different effects at different target organs. Suitable data are not currently available to rigorously characterize the effects of chemical mixtures.

Consequently, as recommended by USEPA [1989], chemicals present at the site are assumed to act additively, and potential health risks are evaluated by summing excess lifetime cancer risks and calculating HIs for noncancer health effects.

This approach to assessing risk associated with mixtures of chemicals assumes that there are no synergistic or antagonistic interactions among the chemicals and that all chemicals have the same toxic endpoint and mechanisms of action. To the extent that these assumptions are correct, the actual risks could be underestimated or overestimated.

Thus, the risk assessment employed multiple conservative assumptions, which, when combined, produce an additive conservative effect throughout the process, resulting in an overestimation of the potential risk. As a result of the uncertainties described above, this risk assessment should not be construed as presenting absolute risks or hazards. Rather, it is a conservative analysis intended to indicate the potential for adverse impacts to occur based on reasonable maximum exposure that is well above the average but still within the range of possible exposures.

10 Summary and Conclusions

This document presents the RAR for the former Top's Diner property (site) located at 410 Central Avenue, Johnstown City, Cambria County, Pennsylvania. This RAR has been prepared for Sheetz by TMG and by Lehman. Sheetz is seeking a release of liability under the Act 2 site-specific standard. The risk assessment presented here is based on the investigative results and conceptual site model previously presented in the Remedial Investigation Report (RIR) [Lehman 2014].

Based on a review of Sanborn Maps, a gasoline filling station and three gasoline underground storage tanks (USTs) were present at the site in 1949. By 1965, the gasoline filling station was replaced with a small restaurant. The site is currently inactive with no structures on-site. The planned future use of the property is as a paved parking lot for an active Sheetz retail gasoline dispensing facility and convenience store located immediately south of and adjacent to the site. Subsurface soil, groundwater, and soil gas samples were previously collected as part of the remedial investigative activities. The analytical data were screened against USEPA Region 3 RSLs and/or VISLs. There were direct contact COCs retained in subsurface soil. There were direct contact and vapor intrusion COCs retained in groundwater. No vapor intrusion COCs were retained in soil gas.

Depths to groundwater at the site (based on on-site and off-site wells) range from approximately 7.4 feet (MW-7) to 11.2 feet (MW-1) in the overburden aquifer and approximately 16.0 feet to 19.8 feet in the bedrock aquifer (MW-3D). Average depth to groundwater at the site is approximately 10 feet in the overburden aquifer and 18.8 feet in the bedrock aquifer. Groundwater generally flows toward the north/northeast. Groundwater is currently not used for any purposes on-site. The site and surrounding parcels are served by a public water supply owned by the Greater Johnstown Water Authority (GJWA). Johnstown City currently does not have a mandatory public water connection ordinance or prohibit the installation of a well for groundwater use.

Based on the hydrogeologic and human health/ecological CSM, the receptors and exposure pathways retained for quantitative assessment were:

- **On-site adolescent trespasser (12 to 18 years old)** – inhalation of volatiles from unexposed subsurface soil and unexposed groundwater to ambient air.
- **On-site construction worker** – incidental ingestion of and dermal contact with subsurface soil, inhalation of particulates and/or volatiles released from subsurface soil (maximum depth of 10 ft-bgs), dermal contact with groundwater, and inhalation of volatiles emitted from exposed groundwater to trench air during intrusive activities.
- **On-site utility worker** – incidental ingestion of and dermal contact with subsurface soil, and inhalation of particulates released from exposed subsurface soil (maximum depth of 6 ft-bgs), inhalation of volatiles released from exposed and unexposed subsurface soil (maximum depth of 10 feet), and inhalation of volatiles emitted from unexposed groundwater to trench air during intrusive activities.
- **Off-site construction worker (Central Ave. ROW)** – incidental ingestion of and dermal contact with subsurface soil, and inhalation of particulates released from subsurface soil (maximum depth of 8 ft-bgs), inhalation of volatiles released from subsurface soil (maximum depth of 10 ft-bgs), and inhalation of volatiles emitted from unexposed groundwater to trench air during intrusive activities.
- **Off-site utility worker (Central Ave. ROW)** – incidental ingestion of and dermal contact with subsurface soil, and inhalation of volatiles and particulates released from subsurface soil (maximum depth of 14 ft-bgs), dermal contact with groundwater, and inhalation of volatiles emitted from exposed groundwater to trench air during intrusive activities.

The following is a summary of the receptors and exposure pathways that will be considered incomplete via implementation of various institutional controls:

- Ingestion, dermal contact, and inhalation of volatiles from groundwater via potable use for on-site receptors; and
- Inhalation of volatiles from groundwater to indoor air via vapor intrusion for a future on-site indoor worker.

In addition, potable use groundwater exposure pathways for off-site receptors will be addressed via a post-remedial care plan. These institutional controls shall be constituted via an environmental covenant and/or post-remedial care plan, which will be documented in the Cleanup Plan.

On-site and off-site source concentrations for soil and groundwater were derived either by using the maximum detected concentration or calculating a 95UCL. Toxicity values for the quantitative risk assessment were selected following the 3-tier USEPA hierarchy. The receptor-specific exposure assumptions were selected using PADEP recommended values, when available. Otherwise, alternative sources were used. Based on the results of the quantitative risk assessment, the estimated total cancer risks and noncancer HIs for all receptors are below the PADEP benchmark values of 1×10^{-4} and 1, respectively. Note that if any of the exposure assumptions and/or assessment change in the future for this site, the results of this analysis do not apply.

Statement of Limitations

This document is prepared solely for the former Top's Diner property located at 410 Central Avenue, Johnstown City, Cambria County, Pennsylvania. This report was prepared based on the information supplied by P. Joseph Lehman, Inc., Consulting Engineers (Lehman). The results of the risk assessment presented in this report apply to the existing and reasonably foreseeable site conditions at the time of this assessment. This risk assessment is based only on the current site conditions from the historic on-site release(s) defined by the analytical data and does not assess potential future releases. Changes in the conditions of the property may occur with time due to natural processes or works of man at the site or on adjacent properties. Changes in applicable standards and toxicity criteria may also occur as a result of legislation or the broadening of knowledge. As a result, if any of the exposure assumptions and/or assessment change in the future for this site (e.g. change in site use), the results of this risk assessment analysis do not apply. Based on the evolving nature of risk assessments, this risk assessment shall be submitted to the appropriate regulatory agency within a reasonable timeframe (e.g. approximately 3 months) to ensure that the most recent risk assessment methodologies and guidelines have been used at the time this risk assessment was completed. The Mahfood Group LLC® is not responsible for the misinterpretation or misuse of this risk assessment analysis.

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Tables

Table 3-1
Soil Analytical Data Comparison to Direct Contact Screening Values
Former Top's Diner Property
Johnstown City, Pennsylvania

Sample ID	Sample Date	Sample Depth	Saturated or Unsaturated	Post-March 2008 PA Short List of Petroleum Products for Unleaded Gasoline									
				Benzene	Toluene	Ethylbenzene	Xylenes (Total)	MTBE	Cumene	Naphthalene	1,2,4-Trimethylbenzene	1,3,5-Trimethylbenzene	Lead
USEPA Region 3 Industrial Soil RSL				**5.1**	**4,700**	**25**	**280**	**210**	**990**	**17**	**24**	**1,200**	**800**
USEPA Region 3 Risk-Based Soil SSL [1]				**0.00023**	**0.076**	**0.0017**	**0.019**	**0.0032**	**0.074**	**0.00054**	**0.0021**	**0.017**	**14**
SB-1 (8.5')	6/25/2012	8.50	U	**5.98**	**55.2**	**42.6**	**164**	-	**4.71**	**16.3**	**95.3**	**37.6**	**84.5**
SB-2 (7')	6/25/2012	7.00	U	< 0.223	< 0.223	< 0.223	< 0.446	-	< 0.223	< 0.677	**0.547**	< 0.223	**15**
SB-3 (7')	6/25/2012	7.00	U	< 0.245	< 0.245	< 0.245	< 0.489	-	< 0.245	< 0.245	**0.261**	< 0.245	**16.9**
SB-4 (6')	6/25/2012	6.00	U	< 0.232	< 0.232	< 0.232	< 0.4665	-	< 0.232	< 0.232	< 0.232	< 0.232	**12.7**
SB-5 (6.5')	6/25/2012	6.50	U	< 0.229	< 0.229	< 0.229	< 0.458	-	< 0.229	< 0.229	< 0.229	< 0.229	**5.18**
SB-6 (3.5')	6/25/2012	3.50	U	< 0.251	< 0.251	< 0.251	< 0.503	-	< 0.251	< 0.251	< 0.251	< 0.251	**18.6**
SB-7 (7')	6/25/2012	7.00	U	< 0.25	< 0.25	< 0.25	< 0.501	-	< 0.25	< 0.25	< 0.25	< 0.25	**37.4**
SB-8 (3')	6/25/2012	3.00	U	< 0.247	< 0.247	< 0.247	< 0.494	-	< 0.247	< 0.247	< 0.247	< 0.247	**30**
SB-9	12/26/2013	9-10'	U	< 0.0015	< 0.0037	< 0.0037	< 0.0074	< <0.0037	< 0.0037	< 0.0037	< 0.0037	< 0.0037	**16**
SB-9	12/26/2013	14-15'	S	< 0.0014	< 0.0035	< 0.0035	< 0.007	< <0.0035	< 0.0035	< 0.0035	< 0.0035	< 0.0035	**24.5**
SB-10	12/27/2013	9-10'	U	< 0.0014	< 0.0034	< 0.0034	< 0.0069	< <0.0034	< 0.0034	< 0.0034	< 0.0034	< 0.0034	**15.9**
SB-10	12/27/2013	11-12'	S	< 0.0013	< 0.0032	< 0.0032	< 0.0065	< <0.0032	< 0.0032	< 0.0032	< 0.0032	< 0.0032	**17.9**
SB-11	12/27/2013	9-10'	U	< 0.0015	< 0.0038	< 0.0038	< 0.0075	< <0.0038	< 0.0038	< 0.0038	< 0.0038	< 0.0038	**15.7**
SB-11	12/27/2013	12-13'	S	< 0.0015	< 0.0038	< 0.0038	< 0.0076	< <0.0038	< 0.0038	< 0.0038	< 0.0038	< 0.0038	**16.9**
SB-12	12/27/2013	7-8'	U	< 0.0015	< 0.0037	< 0.0037	< 0.0075	< <0.0037	< 0.0037	< 0.0037	< 0.0037	< 0.0037	**15**
SB-12	12/27/2013	9-10'	U	< 0.0015	< 0.0038	< 0.0038	< 0.0076	< <0.0038	< 0.0038	< 0.0038	< 0.0038	< 0.0038	**13.3**
SB-13	12/27/2013	7-8'	U	< 0.171	< 0.428	< 0.428	< 0.855	< <0.428	< 0.428	< 0.428	< 0.428	< 0.428	**25.1**
SB-13	12/27/2013	9-10'	U	< 0.0015	< 0.0036	< 0.0036	< 0.0073	< <0.0036	< 0.0036	< 0.0036	< 0.0036	< 0.0036	**13.6**
SB-14	12/27/2013	4-5'	U	**0.4**	**0.96**	< 0.769	**1.78**	< <0.769	< 0.769	**1.33**	**0.908**	< 0.769	**468**
SB-14	12/27/2013	7-8'	U	< 0.293	< 0.732	**15.3**	**6.66**	< <0.732	**2.36**	**12.3**	**4.19**	**4.43**	**35.6**
SB-15	12/27/2013	7-8'	U	< 0.307	< 0.766	**3.38**	< 1.53	< <0.766	**1.25**	**5.15**	< 0.766	< 0.766	**25.4**
SB-15	12/27/2013	9-10'	U	< 0.301	< 0.754	< 0.754	< 1.51	< <0.754	< 0.754	< 0.754	< 0.754	< 0.754	**20.1**
SB-16	12/27/2013	7-8'	U	< 0.285	< 0.711	< 0.711	< 1.42	< <0.711	< 0.711	< 0.761	**1.57**	**0.993**	**18.3**
SB-16	12/27/2013	9-10'	U	< 0.0013	< 0.0033	< 0.0033	< 0.0065	< <0.0033	< 0.0033	< 0.0033	< 0.0033	< 0.0033	**15.2**
SB-17	12/27/2013	7-8'	U	< 0.0015	< 0.0037	< 0.0037	< 0.0074	< <0.0037	< 0.0037	< 0.0037	< 0.0037	< 0.0037	**16.9**

Notes:
1. Indicates the applicable USEPA Risk Based SSL for each constituent. Note that since no Risk Based SSL was available for lead, the MCL Based SSL was utilized instead to screen the analytical data.
All results in milligrams per kilogram (mg/kg).
Depth measured in feet below ground surface.
Bold values indicate an exceedance of the laboratory reporting limit.
Bold and shaded values indicate exceedance of the RSL and/or protection of groundwater SSL.
NS indicates No Standard.
"-" = Not Analyzed
MTBE = Methyl Tertiary Butyl Ether

Table 3-2
Groundwater Analytical Data Comparison to Screening Values
Former Top's Diner Property
Johnstown City, Pennsylvania

Well ID	Sample Date	Post-March 2008 PA Short List of Petroleum Products for Unleaded Gasoline and Used Motor Oil including Lead																			
			1,3,5-Trimethylbenzene		1,2,4-Trimethylbenzene		Benzene		Toluene		Ethylbenzene		Xylenes (Total)		Cumene		MTBE		Naphthalene		Lead (dissolved)
USEPA Region 3 Tapwater RSLs			12		1.5		0.45		110		1.5		19		45		14		0.17		15
Non-Residential Vapor Intrusion Screening Levels [2]			12		12		6.9		8,100		15		210		370		2,000		20		Nav
MW-1	1/21/2014		4.20		9.48		2.57		1.29		16.60		16.60	<	1.00	<	1.00		1.30	<	0.004
	9/4/2014	<	1.00	<	1.00	<	1.00	<	1.00	<	1.00	<	2.00	<	1.00	<	1.00	<	1.00		-
	12/19/2014	<	1.00	<	1.00	<	1.00	<	1.00	<	1.00	<	2.00	<	1.00	<	1.00	<	1.00		-
	3/5/2015		5.36		13.70	<	1.00	<	1.00		3.75		3.56	<	1.00	<	1.00		2.20		-
MW-2	1/21/2014		1.53		2.82	<	1.00	<	1.00		4.95		4.92		1.11	<	1.00	<	1.00	<	0.004
	9/4/2014	<	1.00	<	1.00	<	1.00	<	1.00	<	1.00	<	2.00	<	1.00	<	1.00	<	1.00		-
	12/19/2014	<	1.00	<	1.00	<	1.00	<	1.00	<	1.00	<	2.00	<	1.00	<	1.00	<	1.00		-
	3/5/2015	<	1.00	<	1.00	<	1.00	<	1.00	<	1.00	<	2.00	<	1.00	<	1.00	<	1.00		-
MW-3	1/21/2014		247.00		382.00		418.00		157.00		944.00		898.00		70.00	<	5.00		398.00		0.00429
	9/4/2014		222.00		421.00		324.00		77.50		1,210.00		784.00		56.00	<	50.00		200.00		-
	12/19/2014		990.00		2,220.00		301.00		140.00		1,450.00		2,450.00		217.00	<	20.00		995		-
	3/5/2015		67.00		156.00		72.00		25.20		333.00		255.00	<	25.00	<	25.00		83.5		-
MW-3D	8/14/2014	<	1.00	<	1.00	<	1.00	<	1.00	<	1.00	<	2.00	<	1.00	<	1.00	<	1.00	<	0.004
	9/4/2014	<	1.00	<	1.00	<	1.00		1.71	<	1.00	<	2.00	<	1.00	<	1.00	<	1.00		-
	12/19/2014	<	1.00	<	1.00	<	1.00		1.21	<	1.00	<	2.00	<	1.00	<	1.00	<	1.00		-
	3/5/2015		1.99		3.85	<	1.00	<	1.00		3.03		2.30	<	1.00	<	1.00		1.04		-
MW-4	1/21/2014		5.52		4.63		6.72	<	1.00		6.75		5.22	<	1.00	<	1.00		1.02	<	0.004
	9/4/2014		2.99		10.80		9.38		1.37		24.80	<	2.00		4.72		1.00	<	1.00		-
	12/19/2014		13.40		66.00		91.00		14.80		553.00		37.40		65.90		1.00		35.90		-
	3/5/2015		9.40		44.50		23.20		5.30		89.00		24.40		11.40		5.00		10.70		-
MW-5	8/14/2014	<	1.00	<	1.00	<	1.00	<	1.00	<	1.00	<	2.00	<	1.00	<	1.00	<	1.00	<	0.004
	9/4/2014	<	1.00	<	1.00	<	1.00	<	1.00	<	1.00	<	2.00	<	1.00	<	1.00	<	1.00		-
	12/19/2014	<	1.00	<	1.00	<	1.00	<	1.00	<	1.00	<	2.00	<	1.00	<	1.00		1.20		-
	3/5/2015	<	1.00	<	1.00	<	1.00	<	1.00	<	1.00	<	2.00	<	1.00	<	1.00	<	1.00		-
MW-6	8/14/2014	<	1.00	<	1.00	<	1.00	<	1.00	<	1.00	<	2.00	<	1.00	<	1.00	<	1.00	<	0.004
	9/4/2014	<	1.00	<	1.00	<	1.00	<	1.00	<	1.00	<	2.00	<	1.00	<	1.00	<	1.00		-
	12/19/2014	<	1.00	<	1.00	<	1.00	<	1.00	<	1.00	<	2.00	<	1.00	<	1.00	<	1.00		-
	3/5/2015	<	1.00	<	1.00	<	1.00	<	1.00	<	1.00	<	2.00	<	1.00	<	1.00	<	1.00		-

Table 3-2
Groundwater Analytical Data Comparison to Screening Values
Former Top's Diner Property
Johnstown City, Pennsylvania

Well ID	Sample Date	Post-March 2008 PA Short List of Petroleum Products for Unleaded Gasoline and Used Motor Oil Including Lead																			
		1,3,5-Trimethylbenzene		1,2,4-Trimethylbenzene		Benzene		Toluene		Ethylbenzene		Xylenes (Total)		Cumene		MTBE		Naphthalene		Lead (dissolved)	
USEPA Region 3 Tapwater RSLs		12		1.5		0.45		110		1.5		19		45		14		0.17		15	
Non-Residential Vapor Intrusion Screening Levels [2]		12		12		6.9		8,100		15		210		370		2,000		20		Nav	
MW-7	8/14/2014	<	1.00	<	1.00	<	1.00	<	1.00	<	1.00	<	2.00	<	1.00	<	1.00	<	1.00	<	0.004
	9/4/2014	<	1.00	<	1.00	<	1.00	<	1.00	<	1.00	<	2.00	<	1.00	<	1.00	<	1.00		-
	12/19/2014	<	1.00	<	1.00	<	1.00	<	1.00	<	1.00	<	2.00	<	1.00	<	1.00	<	1.00		-
	3/5/2015	<	1.00	<	1.00	<	1.00	<	1.00	<	1.00	<	2.00	<	1.00	<	1.00	<	1.00		-
Trip Blank	1/21/2014	<	1.00	<	2.00	<	1.00	<	1	<	1.00		2.05	<	1.00	<	1.00	<	1.00		-
	8/14/2015	<	1.00	<	1.00	<	1.00	<	1.00	<	1.00	<	2.00	<	1.00	<	1.00	<	1.00		-
	9/4/2014	<	1.00	<	1.00	<	1.00	<	1.00	<	1.00	<	2.00	<	1.00	<	1.00	<	1.00		-
	12/19/2014	<	1.00	<	1.00	<	1.00	<	1.00	<	1.00	<	2.00	<	1.00	<	1.00	<	1.00		-
	3/5/2015	<	1.00	<	1.00	<	1.00	<	1.00	<	1.00	<	2.00	<	1.00	<	1.00	<	1.00		-

Notes:
2. In accordance with the PADEP approach for vapor intrusion, the 1,2,4-TMB target groundwater VISL was utilized as a surrogate VISL for 1,3,5-TMB.
All values in ug/l.
Bold values indicate exceedance of the lrl.
Bold and shaded values indicate exceedance of RSL.
MTBE = Methyl Tertiary Butyl Ether
"-" = not analyzed
Nav = not available

Table 3-3
Modeled Groundwater Concentrations from MW-3 to On-Site Northern Boundary and a Comparison to USEPA Tapwater RSLs
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Constituent	Modeled Groundwater Concentrations from On-Site Overburden Monitoring Well MW-3			
	Initial Maximum Groundwater Concentration from On-Site Monitoring Well MW-3 [1]	Modeled Groundwater Concentration at the Northern On-Site Property Boundary [2]	USEPA Tapwater RSL	Exceedance of RSL? (Yes/No)
	(µg/L)	(µg/L)	(µg/L)	
Volatile Organic Compounds				
Benzene	418	21	0.45	Yes
Toluene	157	16	110	No
Ethylbenzene	1480	68	1.5	Yes
Xylenes, Total	2450	135	19	Yes
Methyl tert-butyl ether (MTBE)	ND	---	14	No
Cumene	217	19	45	No
1,2,4-Trimethylbenzene	2220	167	1.5	Yes
1,3,5-Trimethylbenzene	990	54	12	Yes
Semivolatile Organic Compounds				
Naphthalene	995	51	0.17	Yes

Notes:

RSL - Regional Screening Level ND - non detect

µg/L - micrograms per liter

[1] The groundwater modeling was conducted using maximum concentrations from on-site monitoring well MW-3 (located near the northern property boundary line). This monitoring well is located in the source area in the downgradient direction of groundwater flow on-site and had detections of site-related constituents.

[2] The distance from on-site monitoring well MW-3 to the northern property boundary line is approximately 20 feet. Quick Domenico groundwater modeling was utilized to predict the chemical concentration in groundwater at the northernmost site property boundary adjacent to the DuPont Street right-of-way. Based on the modeled distances available in the Quick Domenico Model, a conservative distance of 12 feet was chosen to represent the concentration of site-related constituents at the northern property boundary line.

Table 3-4
Soil Vapor Analytical Data Comparison to Screening Values
Former Top's Diner Property
Johnstown City, Pennsylvania

Vapor Probe ID	Sample Date	1,3,5-Trimethylbenzene	1,2,4-Trimethylbenzene	Benzene	Toluene	Ethylbenzene	Xylenes (Total)	MTBE	Cumene	Naphthalene
Target Soil Gas - Residential [1]		24	24	12	17,000	37	350	360	1,400	2.8
VP-1	8/29/2014	<1.00	<1.00	<0.60	**5.00**	**4.00**	**28.00**	<0.70	<1.00	<1.00
	9/24/2014	<1.00	<1.00	**0.80**	**4.00**	**3.00**	**25.00**	<0.70	<1.00	<1.00
Duplicate	8/29/2014	<1.00	<1.00	<0.60	**4.00**	**3.00**	**21.00**	<0.70	<1.00	<1.00
	9/24/2014	<1.00	**2.00**	<0.60	**7.00**	**4.00**	**27.00**	<0.70	<1.00	<1.00

Notes:
All values are in microgram per cubic meter ($\mu g/m^3$)
MTBE = Methyl tert-butyl ether
Target Soil Gas is the Target Sub-Slab and Exterior Soil Gas Concentration at TCR= 1E-06 or THQ=0.1.
1. In accordance with the PADEP approach for vapor intrusion, the 1,2,4-TMB target soil gas VISL was utilized as a surrogate VISL for 1,3,5-TMB.
Bold = detection
Bold & Highlighted = exceedance of the screening level

Table 3-5
Analytical Sample Summary
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Sample Name	Sample Depth (ft-bgs)	Sample Date(s)	On-Site vs. Off-Site	Analytical Parameters										Sample Locations Retained for Risk Evaluation? (Yes or No)	Rationale
				Benzene	Toluene	Ethylbenzene	Total Xylenes	MTBE	Cumene	Naphthalene	1,2,4-Trimethylbenzne	1,3,5-Trimethylbenzene	Lead		
Unsaturated Subsurface Soil															
SB-1	8.5'	6/25/12	on-site	X	X	X	X		X	X	X	X	X	Yes	
SB-2	7.0'	6/25/12	on-site	X	X	X	X		X	X	X	X	X	Yes	
SB-3	7.0'	6/25/12	off-site	X	X	X	X		X	X	X	X	X	Yes	
SB-4	6.0'	6/25/12	on-site	X	X	X	X		X	X	X	X	X	Yes	
SB-5	6.5'	6/25/12	on-site	X	X	X	X		X	X	X	X	X	Yes	
SB-6	3.5'	6/25/12	on-site	X	X	X	X		X	X	X	X	X	Yes	
SB-7	7.0'	6/25/12	on-site	X	X	X	X		X	X	X	X	X	Yes	
SB-8	3.0'	6/25/12	on-site	X	X	X	X		X	X	X	X	X	Yes	
SB-9	9-10'	12/26/13	on-site	X	X	X	X	X	X	X	X	X	X	Yes	
SB-10	9-10'	12/27/13	on-site	X	X	X	X	X	X	X	X	X	X	Yes	
SB-11	9-10'	12/27/13	on-site	X	X	X	X	X	X	X	X	X	X	Yes	
SB-12	7-8'	12/27/13	on-site	X	X	X	X	X	X	X	X	X	X	Yes	
SB-12	9-10'	12/27/13	on-site	X	X	X	X	X	X	X	X	X	X	Yes	
SB-13	7-8'	12/27/13	on-site	X	X	X	X	X	X	X	X	X	X	Yes	
SB-13	9-10'	12/27/13	on-site	X	X	X	X	X	X	X	X	X	X	Yes	
SB-14	4-5'	12/27/13	on-site	X	X	X	X	X	X	X	X	X	X	Yes	
SB-14	7-8'	12/27/13	on-site	X	X	X	X	X	X	X	X	X	X	Yes	
SB-15	7-8'	12/27/13	on-site	X	X	X	X	X	X	X	X	X	X	Yes	
SB-15	9-10'	12/27/13	on-site	X	X	X	X	X	X	X	X	X	X	Yes	
SB-16	7-8'	12/27/13	on-site	X	X	X	X	X	X	X	X	X	X	Yes	
SB-16	9-10'	12/27/13	on-site	X	X	X	X	X	X	X	X	X	X	Yes	
SB-17	7-8'	12/27/13	on-site	X	X	X	X	X	X	X	X	X	X	Yes	
Saturated Subsurface Soil															
SB-9	14-15'	12/26/2013	on-site	X	X	X	X	X	X	X	X	X	X	No	These sample depths are greater than the maximum excavation depth of 10 feet for on-site receptors. Therefore, these samples are considered unavailable for direct contact for on-site receptors and were not utilized in this risk assessment.
SB-10	11-12'	12/27/2013	on-site	X	X	X	X	X	X	X	X	X	X	No	
SB-11	12-13'	12/27/2013	on-site	X	X	X	X	X	X	X	X	X	X	No	

Table 3-5
Analytical Sample Summary
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Sample Name	Sample Depth (ft-bgs)	Sample Date(s)	On-Site vs. Off-Site	Analytical Parameters: Benzene	Toluene	Ethylbenzene	Total Xylenes	MTBE	Cumene	Naphthalene	1,2,4-Trimethylbenzene	1,3,5-Trimethylbenzene	Lead	Sample Locations Retained for Risk Evaluation? (Yes or No)	Rationale
Overburden Groundwater															
MW-1	---	1/21/14	on-site	X	X	X	X	X	X	X	X	X	X	Yes	
		9/4/14; 12/19/14; 3/5/15		X	X	X	X	X	X	X	X	X		Yes	
MW-2	---	1/21/14	on-site	X	X	X	X	X	X	X	X	X	X	Yes	
		9/4/14; 12/19/14; 3/5/15		X	X	X	X	X	X	X	X	X		Yes	
MW-3	---	1/21/14	on-site	X	X	X	X	X	X	X	X	X	X	Yes	
		9/4/14; 12/19/14; 3/5/15		X	X	X	X	X	X	X	X	X		Yes	
MW-4	---	1/21/14	on-site	X	X	X	X	X	X	X	X	X	X	Yes	
		9/4/14; 12/19/14; 3/5/15		X	X	X	X	X	X	X	X	X		Yes	
MW-5	---	8/14/14	on-site	X	X	X	X	X	X	X	X	X	X	Yes	
		9/4/14; 12/19/14; 3/5/15		X	X	X	X	X	X	X	X	X		Yes	
MW-6	---	8/14/14	off-site	X	X	X	X	X	X	X	X	X	X	Yes	
		9/4/14; 12/19/14; 3/5/15		X	X	X	X	X	X	X	X	X		Yes	
MW-7	---	8/14/14	off-site	X	X	X	X	X	X	X	X	X	X	Yes	
		9/4/14; 12/19/14; 3/5/15		X	X	X	X	X	X	X	X	X		Yes	
Bedrock Groundwater															
MW-3D	---	8/14/14	on-site	X	X	X	X	X	X	X	X	X	X	Yes	
		9/4/14; 12/19/14; 3/5/15		X	X	X	X	X	X	X	X	X		Yes	
Soil Vapor [1]															
VP-1	4.5-5'	8/29/14	off-site	X	X	X	X	X	X	X	X	X		Yes	
		9/24/14													
Duplicate [1]	4.5-5'	8/29/14	off-site	X	X	X	X	X	X	X	X	X		Yes	
		9/24/14													

Notes:
ft-bgs - feet below ground surface
MTBE - methyl tert-butyl ether
[1] The "Duplicate" samples are a field duplicate soil vapor sample collected from VP-1 location.

Table 3-6
On-Site and Off-Site Constituents of Concern
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Constituent of Concern (COC)	On-Site				Off-Site					
	Direct Contact				Direct Contact				Vapor Intrusion	
	Subsurface Soil [1]		Groundwater [2]		DuPont Street ROW		Central Avenue ROW		Sheetz Store	
	3-6 ft-bgs	3-10 ft-bgs	Overburden	Bedrock	Overburden Groundwater [3]	Soil 7 ft-bgs [4]	Overburden Groundwater [5]	Soil 4-10 ft-bgs [6]	Soil Gas [7]	Groundwater [8]
Volatile Organic Compounds										
Benzene	X	X	X	---	X	---	X	X	---	X
Toluene	X	X	X	---	---	---	X	X	---	---
Ethylbenzene	---	X	X	X	X	---	X	X	---	X
Xylenes, Total	X	X	X	---	X	---	X	X	---	---
Methyl tert-butyl ether (MTBE)	---	---	---	---	---	---	---	---	---	---
Cumene	---	X	X	---	---	---	X	X	---	---
1,2,4-Trimethylbenzne	X	X	X	X	X	X	X	X	---	X
1,3,5-Trimethylbenzene	---	X	X	---	X	---	X	X	---	---
Semivolatile Organic Compounds										
Naphthalene	X	X	X	X	X	---	X	X	---	X [9]
Metals										
Lead	X	X	---	---	---	X	---	X	---	---

Notes:

"---" indicates constituent was not retained as a COC for the identified medium

ft-bgs - feet below ground surface

ROW - right-of-way

[1] Any site-related constituent in on-site unsaturated soil samples (i.e. 3-6 ft-bgs and 3-10 ft-bgs) that exceeded an Industrial Soil Regional Screening Level (RSL) or protection of groundwater Soil Screening Level (SSL) was retained as a direct contact COC.

[2] Any site-related constituent in groundwater samples from on-site overburden or bedrock monitoring wells that exceeded a Tapwater RSL was retained as a direct contact COC.

[3] Quick Domenico groundwater modeling was utilized to predict the chemical concentration at the northernmost site property boundary line adjacent to the DuPont Street right-of-way. Any predicted concentration (i.e. predicted at a conservative distance of approximately 12 ft) that exceeded a Tapwater RSL was retained as a direct contact COC for the DuPont Street ROW.

[4] Any site-related constituent in off-site unsaturated subsurface soil sample SB-3 (7') that exceeded an Industrial Soil RSL or protection of groundwater SSL was retained as direct contact COC for the DuPont St. ROW.

[5] Any site-related constituent in on-site monitoring wells MW-3 and MW-5 (located adjacent to the northwestern property boundary) that exceeded a USEPA tapwater RSL was retained as a direct contact COC for the Central Avenue ROW.

[6] Any site-related constituent in on-site unsaturated subsurface soil samples SB-12 (7-8' and 9-10'), SB-14 (4-5' and 7-8'), and SB-15 (7-8' and 9-10') (located along the northwestern property boundary) that exceeded a USEPA Industrial Soil RSL or protection of groundwater SSL was retained as a direct contact COC for the Central Avenue ROW.

[7] There were no site-related constituents in off-site soil gas samples from VP-01, located next to the off-site Sheetz convenience store (south of the site), that exceeded a USEPA residential VISL target exterior soil gas concentration. Therefore no vapor intrusion COCs were retained for the current off-site Sheetz store.

[8] Any site-related constituent in on-site monitoring well MW-1 (located closest to the southern boundary line) that exceeded a USEPA commercial VISL target groundwater concentration was retained as a vapor intrusion COC for the off-site Sheetz (i.e. south of the site).

[9] Defined as a volatile under the vapor intrusion pathway.

Table 4-1
Potential Constituent Migration Routes
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Media	Constituent Migration Route (Transport Mechanism)	Description	Retained/ Not Retained	Rationale
Subsurface Soil	Subsurface Soil to Outdoor Air (Volatilization)	Volatilization of constituents from subsurface soil to outdoor air	**Retained**	The site historically operated as a retail gasoline service station and later a restaurant. It is currently inactive with no structures on-site. The site is currently covered with grass and gravel. This migration route was retained because there were site-related volatile constituents that were detected in subsurface soil on-site and the potential exists for these constituents to volatilize to outdoor air.
	Subsurface Soil to Indoor Air (Volatilization)	Volatilization of constituents from subsurface soil to soil gas and subsequent seepage of soil gas into a building (indoor air)	Not Retained	The site historically operated as a retail gasoline service station and later a restaurant. It is currently inactive with no structures on-site. The site is currently covered with grass and gravel. The planned future use of the property is as a paved parking lot for a Sheetz retail gasoline dispensing facility and convenience store south of the site. This migration route was not retained because there are currently no structures on-site and no enclosed, occupied structures are anticipated on-site in the future.
	Subsurface Soil to Outdoor Air (Particulate Emission)	Particulate emission of entrained constituents from subsurface soil (exposed during intrusive activities) to outdoor air	**Retained**	The site historically operated as a retail gasoline service station and later a restaurant. It is currently inactive with no structures on-site. The site is currently covered with grass and gravel. If redevelopment occurs at the site in the future, subsurface soil may be exposed during excavation activities. Therefore, this migration route was retained because site-related semi-volatile and non-volatile constituents (i.e. naphthalene and lead) were detected in on-site unsaturated subsurface soil, which could be exposed during intrusive activities.
	Subsurface Soil to Groundwater	Leaching of constituents from subsurface soil to groundwater	**Retained**	This migration route was retained because site-related constituents were detected in on-site subsurface soil and the potential exists for constituents in on-site subsurface soil to leach to on-site groundwater. However, groundwater-related pathways are evaluated using groundwater analytical results rather than extrapolating from soil analytical results.
On-Site Groundwater	On-Site Groundwater to Outdoor Air (Volatilization)	Volatilization of constituents from on-site groundwater to outdoor air	**Retained**	The site historically operated as a retail gasoline service station and later a restaurant. It is currently inactive with no structures on-site. The site is currently covered with grass and gravel. This migration route was retained because site-related volatile constituents were detected in groundwater on-site and the potential exists for these constituents to volatilize to outdoor air as vapor.
	On-Site Groundwater to Indoor Air (Volatilization)	Volatilization of constituents from on-site groundwater to soil gas and subsequent seepage of soil gas into a building (indoor air)	Not Retained	The site historically operated as a retail gasoline service station and later a restaurant. It is currently inactive with no structures on-site. The site is currently covered with grass and gravel. The planned future use of the property is as a paved parking lot for a Sheetz retail gasoline dispensing facility and convenience store south of the site. This migration route was not retained because there are currently no structures on-site and no enclosed, occupied structures are anticipated on-site in the future.
	On-Site Overburden Groundwater to On-Site Bedrock Groundwater	Migration of constituents in on-site overburden groundwater to on-site bedrock groundwater.	**Retained**	This migration route was retained since site-related constituents were detected in both overburden and bedrock groundwater on-site.
	On-Site Groundwater to Off-Site Groundwater	Migration of constituents in on-site overburden groundwater to off-site overburden groundwater	**Retained**	Overburden groundwater on-site generally flows to the north/northeast. This migration route was retained because site-related constituents have been detected in monitoring wells located at the northern property boundary (MW-2) and have the potential to continue migrating off-site to the north/northeast.
	On-Site Overburden Groundwater to Off-Site Overburden Groundwater to Off-Site Surface Water	Migration of constituents in on-site overburden groundwater to off-site overburden groundwater to off-site surface water	**Retained**	Overburden groundwater on-site generally flows to the north/northeast. The nearest downgradient surface water body is Sam's Run, a channelized and buried stream, located approximately 270 feet east of the site. In addition, Sandy Run is located approximately 230 feet west of the site. There were site-related constituents detected in on-site monitoring wells located at the northern property boundary line. There is the potential for site-related constituents to continue to migrate off-site in the downgradient direction (north/northeast) towards the off-site surface water body (Sam's Run). Therefore, this migration route was retained.

Table 4-1
Potential Constituent Migration Routes
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Media	Constituent Migration Route (Transport Mechanism)	Description	Retained/ Not Retained	Rationale
Off-Site Groundwater	Off-Site Groundwater to Outdoor Air (Volatilization)	Volatilization of constituents from off-site groundwater to outdoor air.	**Retained**	Site-related volatile organic compounds are present in on-site groundwater along the northern property boundary (MW-2). The potential exists for these constituents to migrate to off-site groundwater and subsequently to outdoor air via volatilization Thus, this migration route was retained.
	Off-Site Groundwater to Indoor Air (Volatilization)	Volatilization of constituents from off-site groundwater to soil gas and subsequent seepage of soil gas into a building (indoor air)	**Retained**	Overburden groundwater on-site generally flows to the north/northeast. The former Cogo's Gas Station is located downgradient of site groundwater flow (north/northeast). Additionally, a Sheetz convenience store is located immediately south of and adjacent to the site. The potential exists for site-related volatile constituents detected in on-site groundwater to migrate off-site and volatilize to soil gas and subsequently into the off-site buildings. Therefore, this migration route was retained.
	Off-Site Overburden Groundwater to Off-Site Surface Water	Migration of constituents in off-site overburden groundwater to off-site surface water.	**Retained**	Overburden groundwater generally flows to the north/northeast. The nearest downgradient surface water body is Sam's Run, a channelized and buried stream, located approximately 270 feet east of the site. In addition, Sandy Run is located approximately 230 feet west of the site. There were site-related constituents detected in on-site monitoring wells located at the northern property boundary line. There is the potential for site-related constituents to continue to migrate off-site in the downgradient direction (north/northeast) towards the off-site surface water body (Sam's Run). Therefore, this migration route was retained.

Table 4-2
Potential Receptors and Exposure Pathways
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Scenario Timeframe	Potential Receptor	Medium	Potential Exposure Pathway	Retained/ Not Retained	Type of Analysis	Rationale
Current	**On-Site Adolescent Trespasser (12 to 18 years old)**	Subsurface Soil	Ingestion Inhalation of Particulates (Outdoor Air) Dermal Contact	Not Retained	NA	The site historically operated as a retail gasoline service station and later a restaurant. It is currently inactive with no structures on-site. The site is currently covered with grass and gravel. Direct contact COCs in at the site are located in the subsurface at least three feet below ground surface, which is not accessible to trespassers when trespassing the site. Thus, these exposure pathways were not retained for this receptor.
			Inhalation of Volatiles (Outdoor Air)	**Retained**	Quant	The site historically operated as a retail gasoline service station and later a restaurant. It is currently inactive with no structures on-site. The site is currently covered with grass and gravel. This exposure pathway retained for a current trespasser because there were site-related volatile constituents in on-site unsaturated subsurface soil retained as direct contact COCs and the potential exists for these constituents to migrate to outdoor air without intrusive activities.
			Inhalation of Volatiles (Indoor Air)	Not Retained	NA	This exposure pathway is not applicable to this receptor.
		Groundwater	Ingestion Dermal Contact Inhalation of Volatiles (Potable Use)	Not Retained	NA	The site is served by a public water supply owned by the Greater Johnstown Water Authority. The main source of water is the North Fork Reservoir which is located approximately five miles to the east/southeast of the site. Groundwater is not used for potable and/or nonpotable purposes on-site other than monitoring wells. Therefore, exposure to site-related constituents in on-site groundwater via potable and non-potable uses is currently incomplete for on-site trespassers. Thus, these exposure pathways were not retained for this receptor.
			Inhalation of Volatiles (Outdoor Air - Unexposed Groundwater)	**Retained**	Quant	The site historically operated as a retail gasoline service station and later a restaurant. It is currently inactive with no structures on-site. The site is currently covered with grass and gravel. This exposure pathway retained for a current trespassor because there were site-related volatile constituents in on-site overburden groundwater retained as direct contact COCs and the potential exists for these constituents to migrate to outdoor air without intrusive activities.
			Inhalation of Volatiles (Indoor Air)	Not Retained	NA	This exposure pathway is not applicable to this receptor.

otes:
uant = Quantitative risk analysis performed
ual = Qualitative risk analysis performed
A = Not applicable

Table 4-2
Potential Receptors and Exposure Pathways
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Scenario Timeframe	Potential Receptor	Medium	Potential Exposure Pathway	Retained/ Not Retained	Type of Analysis	Rationale
Future	**On-Site Construction Worker**	Subsurface Soil	Ingestion	**Retained**	Quant	The site historically operated as a retail gasoline service station and later a restaurant. The site is currently inactive with no structures on-site. If construction occurs in the future on-site, construction workers may encounter site-related constituents in subsurface soil while engaging in excavation activities. This receptor may be in direct contact with on-site subsurface soil to a maximum depth of approximately 10 feet or to the water table during intrusive activities. These exposure pathways were retained for the on-site construction worker because site-related constituents were retained in subsurface soil as direct contact COCs. Potential exposure pathways include incidental ingestion of and dermal contact with subsurface soil, and inhalation of particulates and/or volatiles released from subsurface soil.
			Inhalation of Volatiles (Outdoor Air - Exposed Subsurface Soil)			
			Inhalation of Particulates (Outdoor Air - Exposed Subsurface Soil)			
			Dermal Contact			
		Groundwater	Ingestion	Not Retained	NA	This exposure pathway was not retained because incidental ingestion of groundwater during intrusive activities is unlikely to occur.
			Inhalation of Volatiles (Outdoor Air - Exposed Groundwater)	**Retained**	Quant	The site historically operated as a retail gasoline service station and later a restaurant. The site is currently inactive with no structures on-site. The average depth to groundwater on-site is approximately 10 feet. If construction occurs in the future on-site, construction workers may encounter shallow groundwater while engaging in excavation activities (maximum excavation depth 10 feet). These exposure pathways were retained for the on-site construction worker because site-related constituents detected in on-site groundwater were retained as direct contact COCs. Construction workers may be potentially exposed to COCs in groundwater through inhalation of vapors in an excavation trench or dermal contact with groundwater.
			Dermal Contact			

Notes:
Quant = Quantitative risk analysis performed
Qual = Qualitative risk analysis performed
NA = Not applicable

Table 4-2
Potential Receptors and Exposure Pathways
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Johnstown City, Pennsylvania

Scenario Timeframe	Potential Receptor	Medium	Potential Exposure Pathway	Retained/ Not Retained	Type of Analysis	Rationale
Future	**On-Site Utility Worker**	Subsurface Soil	Ingestion	**Retained**	Quant	The site historically operated as a retail gasoline service station and later a restaurant. The site is currently inactive with no structures on-site. If underground utility maintenance activities occur in the future on-site, utility workers may encounter site-related constituents in subsurface soil while engaging in excavation activities. Currently, a storm water line crosses the southeastern portion of the site at approximately 2 to 3 ft-bgs. In the future, additional underground utility lines may be installed on-site and may require maintenance, which are likely to be installed at a depth of approximately 6 feet or less. Therefore, this receptor may be in direct contact with on-site subsurface soil to a maximum depth of approximately 6 feet based on the depth of the utility lines at the site (less than 6 ft-bgs). In addition, this receptor may be exposed to volatile constituents in exposed subsurface soil (less than 6 ft-bgs) and unexposed subsurface soil (greater than 6 ft-bgs). These exposure pathways were retained for the on-site utility worker because site-related constituents were retained in subsurface soil as direct contact COCs. Potential exposure pathways include incidental ingestion of and dermal contact with subsurface soil, and inhalation of particulates and/or volatiles released from subsurface soil.
			Inhalation of Volatiles (Outdoor Air - Exposed and Unexposed Subsurface Soil)			
			Inhalation of Particulates (Outdoor Air - Exposed Subsurface Soil)			
			Dermal Contact			
		Groundwater	Ingestion	Not Retained	NA	This exposure pathway was not retained because incidental ingestion of groundwater during intrusive activities is unlikely to occur.
			Inhalation of Volatiles (Outdoor Air - Unexposed Groundwater)	**Retained**	Quant	The site historically operated as a retail gasoline service station and later a restaurant. The site is currently inactive with no structures on-site. Currently, a storm water line crosses the southeastern portion of the site at approximately 2 to 3 ft-bgs. In the future, additional underground utility lines may be installed on-site and may require maintenance, which are likely to be installed at a depth of approximately 6 feet or less. Therefore, this receptor may conduct intrusive activities to a maximum depth of approximately 6 feet based on the depth of the utility lines at the site (less than 6 ft-bgs). The average depth to groundwater on-site is approximately 10 feet. Therefore, it is unlikely for this receptor to come into direct contact with groundwater. As a result, direct contact with COC in groundwater via dermal contact is considered an incomplete exposure pathway for the on-site utility worker. However, volatile constituents may migrate from unexposed groundwater below the bottom of the trench to trench air. The inhalation of volatiles from unexposed groundwater to trench air exposure pathway was retained for the on-site utility worker because site-related volatile constituents detected in on-site overburden groundwater were retained as direct contact COCs and these constituents may volatilize to trench air.
			Dermal Contact	Not Retained	NA	

Notes:
Quant = Quantitative risk analysis performed
Qual = Qualitative risk analysis performed
NA = Not applicable

Table 4-2
Potential Receptors and Exposure Pathways
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Scenario Timeframe	Potential Receptor	Medium	Potential Exposure Pathway	Retained/ Not Retained	Type of Analysis	Rationale
Future	**Off-Site Construction Worker (Central Avenue ROW)**	Subsurface Soil	Ingestion	Retained	Quant	There is a 36" underground water line beneath Central Avenue at approximately 14 ft-bgs. However, if a new water line were to be installed in Central Avenue, it is unlikely that the line would be installed at this depth. It is more likely that the new water line would be installed above the water table (approximately 10 ft-bgs) at a maximum depth of 6-8 feet. Therefore, based on the work activities of the off-site construction worker, it is assumed that this receptor could be involved in excavation activities up to a maximum depth of approximately 8 feet. As a result, potential exposures to constituents in subsurface soil are possible for this receptor. On-site soil samples SB-12 (7-8'), SB-14 (1-5' and 7-8'), and SB-15 (7-8') collected along the northwestern property boundary were utilized to evaluate off-site construction workers at the Central Avenue ROW. There were site-related constituents retained as direct contact COCs in these subsurface soil samples. Therefore, potential exposures to constituents in subsurface soil were retained for this receptor via incidental ingestion, dermal contact, and inhalation of volatiles and particulates.
			Inhalation of Volatiles (Outdoor Air - Exposed and Unexposed Subsurface Soil)			
			Dermal Contact			
			Inhalation of Particulates (Outdoor Air - Exposed Subsurface Soil)			
		Groundwater	Ingestion	Not Retained	NA	This exposure pathway was not retained because incidental ingestion of groundwater during intrusive activities is unlikely to occur.
			Inhalation of Volatiles (Outdoor Air - Unexposed Groundwater)	Retained	Quant	There is a 36" underground water line beneath Central Avenue at approximately 14 ft-bgs. However, if a new water line were to be installed in Central Avenue, it is unlikely that the line would be installed at this depth. It is more likely that the new water line would be installed above the water table (approximately 10 ft-bgs) at a maximum depth of 6-8 feet. Therefore, based on the work activities of the off-site construction worker, it is assumed that this receptor could be involved in excavation activities up to a maximum depth of approximately 8 feet. It is unlikely for this receptor to come into direct contact with groundwater while engaging in excavation activities within the Central Avenue ROW. As a result, direct contact with COCs in groundwater via dermal contact is considered an incomplete exposure pathway for the off-site construction worker. However, volatile constituents may migrate from unexposed groundwater below the bottom of the trench to trench air. On-site monitoring wells MW-3 and MW-5 are located adjacent to the northwestern property boundary in close proximity to Central Avenue. The inhalation of volatiles from unexposed groundwater to trench air exposure pathway was retained for the off-site contraction worker because site-related volatile constituents detected in on-site overburden groundwater from MW-3 and MW-5 were retained as direct contact COCs and these constituents may volatilize to trench air.
			Dermal Contact	Not Retained	NA	
Future	**Off-Site Construction Worker (DuPont Street ROW)**	Subsurface Soil	Ingestion	Retained	Qual	If construction occurs in the future at the DuPont Street ROW, construction workers may encounter site-related constituents in subsurface soil while engaging in excavation activities. Based on the work activities of the off-site construction worker and the presence of underground utility lines at DuPont Street (approximately 8 ft-bgs or less), it is assumed that off-site construction workers at the DuPont Street ROW could be involved in excavation activities up to a maximum depth of approximately 8 feet. As a result, potential exposures to constituents in subsurface soil are possible for this receptor. These exposure pathways were retained for the off-site construction worker because site-related constituents were retained in subsurface soil as direct contact COCs in an off-site subsurface soil sample [SB-3 (7')] collected in the ROW of DuPont Street. Potential exposure pathways include incidental ingestion of and dermal contact with subsurface soil, and inhalation of volatiles and particulates released from subsurface soil. The off-site construction workers in the DuPont Street ROW and in the Central Avenue ROW have the same exposure pathways retained. However, off-site construction workers at the Central Avenue ROW are expected to have higher relative intake rates when compared to off-site construction workers at the DuPont Street ROW because of the additional COCs retained in soil (9 vs. 2) and groundwater (8 vs. 6) for off-site receptors at the Central Avenue ROW and the much higher COC concentrations they may encounter in soil and unexposed groundwater while working at the Central Avenue ROW. The off-site construction worker at the Central Avenue ROW exposure scenario provides a conservative basis for evaluating potential exposures to an off-site construction worker at the DuPont Street ROW. Thus, potential exposure to soil for the off-site construction worker at the DuPont Street ROW was not quantitatively evaluated and was represented by the off-site construction worker at the Central Avenue ROW.
			Inhalation of Volatiles (Outdoor Air - Exposed Subsurface Soil)			
			Dermal Contact			
			Inhalation of Particulates (Outdoor Air - Exposed Subsurface Soil)			
		Groundwater	Ingestion	Not Retained	NA	This exposure pathway was not retained because incidental ingestion of groundwater during intrusive activities is unlikely to occur.
			Inhalation of Volatiles (Outdoor Air - Unexposed Groundwater)	Retained	Qual	Based on the average depth to groundwater at the site (approximately 10 ft-bgs) and based on the maximum excavation depth for this receptor (approximately 8 ft-bgs), it is unlikely a construction worker would be in direct contact with groundwater during intrusive activities. As a result, direct contact with COC in groundwater via dermal contact is considered an incomplete exposure pathway for the off-site construction worker. However, volatile constituents may migrate from unexposed groundwater below the bottom of the trench to trench air. This exposure pathway was retained for the off-site construction worker because direct contact COCs were retained in groundwater at the DuPont Street ROW based on the QD groundwater modeling. Therefore, construction workers may be potentially exposed to COCs in unexposed groundwater through inhalation of vapors in an excavation trench. The off-site construction workers in the DuPont Street ROW and in the Central Avenue ROW have the same exposure pathways retained. However, off-site construction workers at the Central Avenue ROW are expected to have higher relative intake rates when compared to off-site construction workers at the DuPont Street ROW because of the additional COCs retained in soil (9 vs. 2) and groundwater (8 vs. 6) for off-site receptors at the Central Avenue ROW and the much higher COC concentrations they may encounter in soil and unexposed groundwater while working at the Central Avenue ROW. The off-site construction worker at the Central Avenue ROW exposure scenario provides a conservative basis for evaluating potential exposures to an off-site construction worker at the DuPont Street ROW. Thus, potential exposure to unexposed groundwater for the off-site construction worker at the DuPont Street ROW was not quantitatively evaluated and was represented by the off-site construction worker at the Central Avenue ROW.
			Dermal Contact	Not Retained	NA	

Notes:
Quant = Quantitative risk analysis performed
Qual = Qualitative risk analysis performed
NA = Not applicable

Table 4-2
Potential Receptors and Exposure Pathways
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Scenario Timeframe	Potential Receptor	Medium	Potential Exposure Pathway	Retained/ Not Retained	Type of Analysis	Rationale
Future	Off-Site Utility Worker (Central Avenue ROW)	Subsurface Soil	Ingestion	Retained	Quant	Based on the work activities of this receptor and the presence of a 36" main underground water line in Central Avenue of approximately 14 ft-bgs, it is expected that this receptor could be involved in excavation activities up to a maximum depth of 14 feet to repair the water line. As a result, potential direct contact exposures to site-related constituents in subsurface soil to a depth of 14 feet are possible for this receptor. On-site soil samples SB-12 (7-8' and 9-10'), SB-14 (4-5' and 7-8'), and SB-15 (7-8' and 9-10') collected along the northwestern property boundary were utilized to evaluate off-site utility workers at the Central Avenue ROW. There were site-related constituents retained as direct contact COCs in these subsurface soil samples. Therefore, potential exposures to constituents in subsurface soil were retained for this receptor via incidental ingestion, dermal contact, and inhalation of volatiles and particulates.
			Dermal Contact			
			Inhalation of Volatiles (Outdoor Air - Exposed Subsurface Soil)			
			Inhalation of Particulates (Outdoor Air - Exposed Subsurface Soil)			
		Groundwater	Ingestion	Not Retained	NA	This exposure pathway was not retained because incidental ingestion of groundwater during intrusive activities is unlikely to occur.
			Inhalation of Volatiles (Outdoor Air - Exposed Groundwater)	Retained	Quant	Based on the work activities of this receptor and the presence of a 36" main underground water line in Central Avenue of approximately 14 ft-bgs, it is expected that this receptor could be involved in excavation activities up to a maximum depth of 14 feet to repair the water line. The average depth to groundwater at the site is approximately 10 feet. Therefore, this receptor may come into direct contact with groundwater. As a result, direct contact with COCs in groundwater via dermal contact and inhalation of volatiles from exposed groundwater to trench air exposure pathways were retained for the off-site utility worker because site-related constituents in overburden groundwater from on-site monitoring wells MW-3 and MW-5 (located along northwestern property boundary) were retained as direct contact COCs.
			Dermal Contact			
Future	Off-Site Utility Worker (DuPont Street ROW)	Subsurface Soil	Ingestion	Retained	Qual	If underground utility maintenance activities occur in the future at the DuPont Street ROW, utility workers may encounter site-related constituents in subsurface soil while engaging in excavation activities. Based on the work activities of the off-site utility worker and the presence of underground utility lines at DuPont Street (approximately 8 ft-bgs or less), it is assumed that off-site utility workers at the DuPont Street ROW could be involved in excavation activities up to a maximum depth of approximately 8 feet. As a result, potential exposures to constituents in subsurface soil are possible for this receptor. These exposure pathways were retained for the off-site utility worker because site-related constituents were retained in subsurface soil as direct contact COCs in an off-site subsurface soil sample [SB-3 (7')] collected in the ROW of DuPont Street. Potential exposure pathways include incidental ingestion of and dermal contact with subsurface soil, and inhalation of volatiles and particulates released from subsurface soil. However, off-site utility workers at the Central Avenue ROW are expected to have higher relative intake rates when compared to off-site utility workers at the DuPont Street ROW because of the additional COCs retained in soil (9 vs. 2) and groundwater (8 vs. 6) for off-site receptors at the Central Avenue ROW and the much higher COC concentrations they may encounter in soil and groundwater while working at the Central Avenue ROW. In addition, the off-site utility worker in the Central Avenue ROW has an exposed groundwater scenario (i.e. dermal contact and inhalation of volatiles from exposed groundwater within a trench) whereas the off-site utility worker in the DuPont Street ROW has an unexposed groundwater scenario (i.e. inhalation of volatiles within a trench that migrate from unexposed groundwater). The off-site utility worker at the Central Avenue ROW exposure scenario provides a conservative basis for evaluating potential exposures to an off-site utility worker at the DuPont Street ROW. Thus, potential exposure to soil for the off-site utility worker at the DuPont Street ROW was not quantitatively evaluated and was represented by the off-site utility worker at the Central Avenue ROW.
			Dermal Contact			
			Inhalation of Volatiles (Outdoor Air - Exposed Subsurface Soil)			
			Inhalation of Particulates (Outdoor Air - Exposed Subsurface Soil)			
		Groundwater	Ingestion	Not Retained	NA	This exposure pathway was not retained because incidental ingestion of groundwater during intrusive activities is unlikely to occur.
			Inhalation of Volatiles (Outdoor Air - Unexposed Groundwater)	Retained	Qual	Based on the average depth to groundwater at the site (approximately 10 ft-bgs) and based on the maximum excavation depth for this receptor (approximately 8 ft-bgs), it is unlikely a utility worker would be in direct contact with groundwater during intrusive activities. As a result, direct contact with COC in groundwater via dermal contact is considered an incomplete exposure pathway for the off-site utility worker. However, volatile constituents may migrate from unexposed groundwater below the bottom of the trench to trench air. This exposure pathway was retained for the off-site utility worker because direct contact COCs were retained in groundwater at the DuPont Street ROW based on the QD groundwater modeling. Therefore, utility workers may be potentially exposed to COCs in unexposed groundwater through inhalation of vapors in an excavation trench. However, off-site utility workers at the Central Avenue ROW are expected to have higher relative intake rates when compared to off-site utility workers at the DuPont Street ROW because of the additional COCs retained in soil (9 vs. 2) and groundwater (8 vs. 6) for off-site receptors at the Central Avenue ROW and the much higher COC concentrations they may encounter in soil and groundwater while working at the Central Avenue ROW. In addition, the off-site utility worker in the Central Avenue ROW has an exposed groundwater scenario (i.e. dermal contact and inhalation of volatiles from exposed groundwater within a trench) whereas the off-site utility worker in the DuPont Street ROW has an unexposed groundwater scenario (i.e. inhalation of volatiles within a trench that migrate from unexposed groundwater). The off-site utility worker at the Central Avenue ROW exposure scenario provides a conservative basis for evaluating potential exposures to an off-site utility worker at the DuPont Street ROW. Thus, potential exposure to groundwater for the off-site utility worker at the DuPont Street ROW was not quantitatively evaluated and was represented by the off-site utility worker at the Central Avenue ROW.
			Dermal Contact	Not Retained	NA	

Notes:
Quant = Quantitative risk analysis performed
Qual = Qualitative risk analysis performed
NA = Not applicable

Table 5-1
On-Site Source Concentrations for Constituents of Concern
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Constituent of Concern (COC)	On-Site												
	Source Concentration by Media						Source Concentration by Receptor and Exposure Pathway						
	Direct Contact						Trespasser		Construction Worker		Utility Worker		
							Soil 3-10 ft-bgs [4]	Groundwater [5]	Soil 3-10 ft-bgs [6]	Groundwater [7]	Soil 3-6 ft-bgs [8]	Soil 3-10 ft-bgs [8]	Groundwater [9]
	Unsaturated Subsurface Soil				Groundwater [3]		Inhalation of Volatiles	Inhalation of Volatiles	Ingestion, Dermal Contact, and Inhalation of Volatiles and Particulates	Dermal Contact and Inhalation of Volatiles	Ingestion, Dermal Contact, and Inhalation of Particulates	Inhalation of Volatiles	Inhalation of Volatiles
	3-6 ft-bgs [1]		3-10 ft-bgs [2]		Overburden								
	(mg/kg)		(mg/kg)		(mg/L)		(mg/kg)	(mg/L)	(mg/kg)	(mg/L)	(mg/kg)		(mg/L)
Volatile Organic Compounds													
Benzene	0.4	MAX [SB-14 (4-5')]	5.98	MAX [SB-1 (8.5')]	0.114	95% UCL	5.98	0.114	5.98	0.114	0.4	5.98	0.114
Toluene	0.96	MAX [SB-14 (4-5')]	55.2	MAX [SB-1 (8.5')]	0.041	95% UCL	55.2	0.041	55.2	0.041	0.96	55.2	0.041
Ethylbenzene	---		42.6	MAX [SB-1 (8.5')]	0.891	95% UCL	42.6	0.891	42.6	0.891	---	42.6	0.891
Xylenes, Total	1.78	MAX [SB-14 (4-5')]	164	MAX [SB-1 (8.5')]	0.915	95% UCL	164	0.915	164	0.915	1.78	164	0.915
Cumene	---		4.71	MAX [SB-1 (8.5')]	0.043	95% UCL	4.71	0.043	4.71	0.043	---	4.71	0.043
1,2,4-Trimethylbenzene	0.908	MAX [SB-14 (4-5')]	58.38	95% UCL	0.841	95 % UCL	58.38	0.841	58.38	0.841	0.908	58.38	0.841
1,3,5-Trimethylbenzene	---		37.6	MAX [SB-1 (8.5')]	0.593	99% UCL	37.6	0.593	37.6	0.593	---	37.6	0.593
Semivolatile Organic Compounds													
Naphthalene	1.33	MAX [SB-14 (4-5')]	3.38	95% UCL	0.368	95% UCL	NR [10]	NR [10]	3.38 [10]	0.368 [10]	1.33 [10]	NR [10]	NR [10]
Metals													
Lead	132.3	MEAN	42.02	MEAN	---		NR [10]	NR [10]	42.02 [10]	---	132.3 [10]	NR [10]	---

Notes:

"---" indicates COC not retained for the identified media or exposure pathway.

mg/kg - milligram per kilogram
NR - not required
ROW - right-of-way
mg/L - milligram per liter
MAX - maximum concentration
MEAN - arithmetic mean
ft-bgs - feet below ground surface
UCL - upper confidence limit of mean concentration

[1] Source concentrations for unsaturated subsurface soil (3-6 ft-bgs) are the maximum concentrations from soil borings SB-4 (6'), SB-6 (3.5'), SB-8 (3'), and SB-14 (4-5'). The source concentration for lead was based on the arithmetic mean from on-site soil samples SB-4 (6') SB-6 (3.5'), SB-8 (3'), and SB-14 (4-5').

[2] For those site-related constituents in on-site unsaturated subsurface soil (3-10 ft-bgs) with datasets containing at least 4 detected values, a 95%UCL (or higher) was derived utilizing Pro UCL 5.0.00. For those site-related constituents in on-site unsaturated subsurface (3-10 ft-bgs) with datasets containing fewer than 4 detected values, maximum concentrations were used as the source concentrations. The source concentration for lead was based on the arithmetic mean from on-site unsaturated soil (3-10 ft-bgs).

[3] Source concentrations for groundwater were derive using Pro UCL 5.0.00 form all on-site overburden monitoring wells (i.e. MW-1 through MW-5).

[4] This receptor is not expected to be in direct contact with unsaturated subsurface soil. However, volatile constituents have the potential to migrate to outdoor air. Therefore, the source concentration is the unsaturated subsurface soil 3-10 ft-bgs source concentrations for volatile COCs only.

[5] This receptor is not expected to be in direct contact with groundwater. However, volatile constituents have the potential to migrate to outdoor air. Therefore, the source concentration is the overburden groundwater source concentrations for volatile COCs only.

[6] This receptor is expected to be in direct contact with unsaturated subsurface soil to a maximum depth of 10 ft-bgs or to the water table (average depth to groundwater is approximately 10 ft-bgs). Therefore, the source concentration is the unsaturated subsurface soil 3-10 ft-bgs source concentrations. Note only volatile COCs were retained for the inhalation of volatiles exposure pathway.

[7] This receptor is expected to be in direct contact with groundwater during intrusive activities based on maximum excavation depth (10 ft-bgs) and depth to groundwater (average depth to groundwater approximately 10 ft-bgs). Therefore, the source concentration is the overburden groundwater source concentrations. Note only volatile COCs were retained for the inhalation pathway.

[8] This receptor is expected to be in direct contact with subsurface soil to a maximum depth of 6 ft-bgs. Therefore, the source concentration for the ingestion, dermal, and inhalation of particulates is the subsurface soil 3-6 ft-bgs source concentrations. The source concentration for the inhalation of volatiles pathway is the subsurface source concentration 3-10 ft-bgs for volatile COCs only.

[9] This receptor is not expected to be in direct contact with groundwater during intrusive activities based on the maximum excavation depth (6 ft-bgs) and depth to groundwater (average depth of groundwater is approximately 10 ft-bgs). Therefore, the source concentration is the overburden groundwater source concentrations for volatile COCs only.

[10] Source concentrations only required for volatile COC (as defined in Section 250.1 of the Act 2 regulations as a chemical compound with a boiling point less than 200 degrees centigrade at 1 atm) for the inhalation of volatiles exposure pathway.

Table 5-2
Off-Site Source Concentrations for Constituents of Concern
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Constituent of Concern (COC)	Off-Site										
	Source Concentration by Media						Source Concentration by Receptor and Exposure Pathway				
	Direct Contact						Construction Worker (Central Ave. ROW)			Utility Worker (Central Ave. ROW)	
							Soil 4-8 ft-bgs [4]	Soil 4-10 ft-bgs [4]	Overburden Groundwater [5]	Soil 4-10 ft-bgs [6]	Overburden Groundwater [7]
	Unsaturated Subsurface Soil				Groundwater		Ingestion, Dermal Contact, and Inhalation of Particulates	Inhalation of Volatiles	Inhalation of Volatiles	Ingestion, Dermal Contact, and Inhalation of Volatiles and Particulates	Dermal Contact and Inhalation of Volatiles
	4-8 ft-bgs [1]		4-10 ft-bgs [2]		Overburden [3]						
	(mg/kg)		(mg/kg)		(mg/L)		(mg/kg)	(mg/kg)	(mg/L)	(mg/kg)	(mg/L)
Volatile Organic Compounds											
Benzene	0.4	MAX [SB-14 (4-5')]	0.4	MAX [SB-14 (4-5')]	0.418	MAX [MW-3]	0.4	0.4	0.418	0.4	0.418
Toluene	0.96	MAX [SB-14 (4-5')]	0.96	MAX [SB-14 (4-5')]	0.157	MAX [MW-3]	0.96	0.96	0.157	0.96	0.157
Ethylbenzene	15.30	MAX [SB-14 (7-8')]	15.3	MAX [SB-14 (7-8')]	1.480	MAX [MW-3]	15.30	15.3	1.480	15.3	1.480
Xylenes, Total	6.66	MAX [SB-14 (7-8')]	6.66	MAX [SB-14 (7-8')]	2.45	MAX [MW-3]	6.66	6.66	2.450	6.66	2.450
Cumene	2.36	MAX [SB-14 (7-8')]	2.36	MAX [SB-14 (7-8')]	0.217	MAX [MW-3]	2.36	2.36	0.217	2.36	0.217
1,2,4-Trimethylbenzene	4.19	MAX [SB-14 (7-8')]	4.19	MAX [SB-14 (7-8')]	2.220	MAX [MW-3]	4.19	4.19	2.220	4.19	2.220
1,3,5-Trimethylbenzene	4.43	MAX [SB-14 (7-8')]	4.43	MAX [SB-14 (7-8')]	0.990	MAX [MW-3]	4.43	4.43	0.990	4.43	0.990
Semivolatile Organic Compounds											
Naphthalene	12.30	MAX [SB-14 (7-8')]	12.3	MAX [SB-14 (7-8')]	0.995	MAX [MW-3]	12.30	NR [8]	NR [8]	12.3 [8]	0.995 [8]
Metals											
Lead	136	MEAN	96.2	MEAN	—		136	NR [8]	—	96.23 [8]	—

Notes:

"—" indicates COC not retained for the identified media or exposure pathway.

mg/kg - milligram per kilogram

mg/L - milligram per liter

ft-bgs - feet below ground surface

MEAN - arithmetic mean

ROW - right-of-way

NR - not required

MAX - maximum concentration

Ave. - Avenue

[1] Off-site source concentrations for unsaturated subsurface soil 4-8 ft-bgs were the maximum concentrations from soil borings SB-12 (7-8'), SB-14 (4-5' and 7-8'), and SB-15 (7-8'). However, lead source concentration is the arithmetic mean from unsaturated subsurface soil samples SB-12 (7-8'), SB-14 (4-5' and 7-8'), and SB-15 (7-8').

[2] Off-site source concentrations for unsaturated subsurface soil 4-10 ft-bgs were the maximum concentrations from soil borings SB-12 (7-8' and 9-10'), SB-14 (4-5' and 7-8'), and SB-15 (7-8' and 9-10'). However, lead source concentration is the arithmetic mean from unsaturated subsurface soil samples SB-12 (7-8' and 9-10'), SB-14 (4-5' and 7-8'), and SB-15 (7-8' and 9-10').

[3] Source concentrations for overburden groundwater are the maximum concentrations from on-site monitoring wells MW-3 and MW-5.

[4] This receptor is expected to be in direct contact with subsurface soil during intrusive activities to a maximum depth of 8 ft-bgs. Therefore, the source concentration is the direct contact unsaturated subsurface soil 4-8 ft-bgs source concentrations for the ingestion, dermal contact, and inhalation of particulate pathway. The source concentration for the inhalation of volatiles pathway is direct contact unsaturated subsurface 4-10 ft-bgs source concentrations.

[5] This receptor is not expected to be in direct contact groundwater during intrusive activities based on the maximum excavation depth of 8 ft-bgs and depth to groundwater (average depth to groundwater 10 ft-bgs). Therefore, the source concentration is the overburden groundwater source concentrations for volatile COCs only.

[6] This receptor is expected to be in direct contact with subsurface soil to a maximum excavation depth of 14 ft-bgs. Therefore, the source concentration is the direct contact subsurface soil 4-10 ft-bgs source concentrations. Note only volatile COCs were retained for the inhalation of volatile pathway.

[7] This receptor may be in direct contact with groundwater during intrusive activities based on the maximum excavation depth of 14 ft-bgs and depth to groundwater (average depth to groundwater is 10 ft-bgs). Therefore, the source concentration is the overburden groundwater source concentrations. Note only volatile COCs were retained for the inhalation exposure pathway.

[8] Source concentrations only required for volatile COC (as defined in Section 250.1 of the Act 2 regulations as a chemical compound with a boiling point less than 200 degrees centigrade at 1 atm) for the inhalation of volatiles exposure pathway.

Table 6-1
Chemical Properties
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Chemical	CAS No.	Molecular Weight Value (g/mol)	Molecular Weight Source	Melting Point Value (°C)	Melting Point Source	Boiling Point Value (°C)	Boiling Point Source
Volatile Organic Compounds							
Benzene	71-43-2	78.1	RAIS	5.5	RAIS	81	Act 2
Toluene	108-88-3	92.1	RAIS	-94.9	RAIS	111	Act 2
Ethylbenzene	100-41-4	106	RAIS	-94.9	RAIS	136	Act 2
Xylenes, Total	1330-20-7	106	RAIS	-25.2	RAIS	140	Act 2
Cumene	98-82-8	120	RAIS	-96	RAIS	152	Act 2
1,2,4-Trimethylbenzene	95-63-6	120	RAIS	-43.8	RAIS	169	Act 2
1,3,5-Trimethylbenzene	108-67-8	120	RAIS	-44.7	RAIS	165	Act 2
Semi-Volatile Organic Compounds							
Naphthalene	91-20-3	128	RAIS	80.2	RAIS	218	Act 2

Notes:
g/mol - grams per mole
°C - degrees Celsius

Sources:

Act 2 - Pennsylvania Code, Title 25, Chapter 250, Administration of Land Recycling Program. Pennsylvania Department of Environmental Protection, January 8, 2011. (Chapter 250, Appendix A, Table 5)

RAIS - Risk Assessment Information System Website (http://www.rais.ornl.gov) (Accessed on May 11, 2015)

Table 6-1
Chemical Properties
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Chemical	CAS No.	Water Solubility Value (mg/L)	Water Solubility Source	Vapor Pressure Value (mm Hg)	Vapor Pressure Source	Octanol-Water Part. Coef. (K_{ow}) Value (L/L)	Octanol-Water Part. Coef. (K_{ow}) Source
Volatile Organic Compounds							
Benzene	71-43-2	1.8E+03	Act 2	9.5E+01	RAIS	1.3E+02	RAIS
Toluene	108-88-3	5.3E+02	Act 2	2.8E+01	RAIS	5.4E+02	RAIS
Ethylbenzene	100-41-4	1.6E+02	Act 2	9.6E+00	RAIS	1.4E+03	RAIS
Xylenes, Total	1330-20-7	1.8E+02	Act 2	8.0E+00	RAIS	1.4E+03	RAIS
Cumene	98-82-8	5.0E+01	Act 2	4.5E+00	RAIS	4.6E+03	RAIS
1,2,4-Trimethylbenzene	95-63-6	5.6E+01	Act 2	2.1E+00	RAIS	4.3E+03	RAIS
1,3,5-Trimethylbenzene	108-67-8	4.9E+01	Act 2	2.1E+00	RAIS	2.6E+03	RAIS
Semi-Volatile Organic Compounds							
Naphthalene	91-20-3	3.0E+01	Act 2	8.5E-02	RAIS	2.0E+03	RAIS

Notes:
mg/L - milligrams per liter
mm Hg - millimeters of mercury
L/L - liters per liter

Sources:

Act 2 - Pennsylvania Code, Title 25, Chapter 250, Administration of Land Recycling Program. Pennsylvania Department of Environmental Protection, January 8, 2011. (Chapter 250, Appendix A, Table 5)

RAIS - Risk Assessment Information System Website (http://www.rais.ornl.gov) (Accessed on May 11, 2015)

Table 6-1
Chemical Properties
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Chemical	CAS No.	Organic Carbon Part. Coef. (K_{oc}) Value (mg/Kg / mg/L)	Organic Carbon Part. Coef. (K_{oc}) Source	Henry's Law Constant Value (atm-m³/mol)	Henry's Law Constant Source
Volatile Organic Compounds					
Benzene	71-43-2	1.5E+02	RAIS	5.6E-03	USEPA 2015, ORNL
Toluene	108-88-3	2.3E+02	RAIS	6.6E-03	USEPA 2015, ORNL
Ethylbenzene	100-41-4	4.5E+02	RAIS	7.9E-03	USEPA 2015, ORNL
Xylenes, Total	1330-20-7	3.8E+02	RAIS	5.2E-03	USEPA 2015, ORNL
Cumene	98-82-8	7.0E+02	RAIS	1.2E-02	USEPA 2015, ORNL
1,2,4-Trimethylbenzene	95-63-6	6.1E+02	RAIS	6.2E-03	USEPA 2015, ORNL
1,3,5-Trimethylbenzene	108-67-8	6.0E+02	RAIS	8.8E-03	USEPA 2015, ORNL
Semi-Volatile Organic Compounds					
Naphthalene	91-20-3	1.5E+03	RAIS	4.4E-04	USEPA 2015, ORNL

Notes:

mg/Kg / mg/L - milligrams per kilogram per milligram per liter

atm - m³/mol - atmosphere cubic meter per mole

Sources:

RAIS - Risk Assessment Information System Website (http://www.rais.ornl.gov) (May 11, 2015)

USEPA 2015, ORNL - United States Environmental Protection Agency - Oak Ridge National Laboratory Chemical Properties Table, January 2015

Table 6-1
Chemical Properties
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Chemical	CAS No.	Vapor Phase Diffusivity Value (cm²/s)	Vapor Phase Diffusivity Source	Water Phase Diffusivity Value (cm²/s)	Water Phase Diffusivity Source
Volatile Organic Compounds					
Benzene	71-43-2	9.0E-02	RAIS	1.0E-05	RAIS
Toluene	108-88-3	7.8E-02	RAIS	9.2E-06	RAIS
Ethylbenzene	100-41-4	6.9E-02	RAIS	8.5E-06	RAIS
Xylenes, Total	1330-20-7	8.5E-02	RAIS	9.9E-06	RAIS
Cumene	98-82-8	6.0E-02	RAIS	7.9E-06	RAIS
1,2,4-Trimethylbenzene	95-63-6	6.1E-02	RAIS	7.9E-06	RAIS
1,3,5-Trimethylbenzene	108-67-8	6.0E-02	RAIS	7.8E-06	RAIS
Semi-Volatile Organic Compounds					
Naphthalene	91-20-3	6.1E-02	RAIS	8.4E-06	RAIS

Notes:
cm^2/s - centimeters squared per second

Sources:

RAIS - Risk Assessment Information System Website (http://www.rais.ornl.gov) (Accessed on May 11, 2015)

Table 6-2
Cancer Slope Factors and Inhalation Unit Risks
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

		Oral CSF		Dermal CSF			IUR	
		General		Gastrointestinal Adsorption Factor		CSF	General	
Chemical	CAS No.	(mg/kg-day)$^{-1}$	Source	(unitless)	Source	(mg/kg-day)$^{-1}$	(µg/m³)$^{-1}$	Source
Volatile Organic Compounds								
Benzene	71-43-2	5.5E-02	I	1	RAGS-E	5.5E-02	7.8E-06	I
Toluene	108-88-3	---		---		---	---	
Ethylbenzene	100-41-4	1.1E-02	C	1	RAGS-E	1.1E-02	2.5E-06	C
Xylenes, Total	1330-20-7	---		---		---	---	
Cumene	98-82-8	---		---		---	---	
1,2,4-Trimethylbenzene	95-63-6	---		---		---	---	
1,3,5-Trimethylbenzene	108-67-8	---		---		---	---	
Semi-Volatile Organic Compounds								
Naphthalene	91-20-3	1.2E-01	C	1	RAGS-E	1.2E-01	3.4E-05	C

Notes:
CSF - Cancer Slope Factor
IUR - Inhalation Unit Risk
(mg/kg-day)$^{-1}$ - per milligram per kilogram per day
(µg/m^3)$^{-1}$ - per microgram per cubic meter

Sources:
C - California EPA Cancer Potency Factor
I - Integrated Risk Information System (IRIS) Assessment)

Table 6-3
Chronic Reference Doses and Refrence Concentrations
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Chemical	CAS No.	Oral RfD General (mg/kg-day)	Oral RfD Source	Dermal RfD Gastrointestinal Adsorption Factor (unitless)	Dermal RfD Gastrointestinal Adsorption Factor Source	Dermal RfD (mg/kg-day)	Inhalation RfC (mg/m³)	Inhalation RfC Source
Volatile Organic Compounds								
Benzene	71-43-2	4.0E-03	I	1	RAGS-E	4.0E-03	3.0E-02	I
Toluene	108-88-3	8.0E-02	I	1	RAGS-E	8.0E-02	5.0E+00	I
Ethylbenzene	100-41-4	1.0E-01	I	1	RAGS-E	1.0E-01	1.0E+00	I
Xylenes, Total	1330-20-7	2.0E-01	I	1	RAGS-E	2.0E-01	1.0E-01	I
Cumene	98-82-8	1.0E-01	I	1	RAGS-E	1.0E-01	4.0E-01	I
1,2,4-Trimethylbenzene	95-63-6	5.0E-02	PPRTV Archive	1	RAGS-E	5.0E-02	7.0E-03	PPRTV
1,3,5-Trimethylbenzene	108-67-8	1.0E-02	PPRTV	1	RAGS-E	1.0E-02	6.0E-03	PPRTV Archive
Semi-Volatile Organic Compounds								
Naphthalene	91-20-3	2.0E-02	I	1	RAGS-E	2.0E-02	3.0E-03	I

Notes:
RfD - Reference Dose
RfC - Reference Concentration
mg/m³ - milligram per cubic meter

Sources:
I - Integrated Risk Information System (IRIS)
PPRTV - EPA Provisional Peer Reviewed Toxicity Valu
PPRTV Appendix - EPA Provisional Peer Reviewed Toxicity Value Appendix
PPRTV Archive - EPA Provisional Peer Reviewed Toxicity Value - Archived Value
RAGS-E - Risk Assessment Guidance for Superfund (RAGS) Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

Table 6-4
Subchronic Reference Doses and Reference Concentrations
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

		Oral RfD		Dermal RfD			Inhalation RfC	
		General		Gastrointestinal Adsorption Factor		RfD	RfC	
Chemical	CAS No.	(mg/kg-day)	Source	(unitless)	Source	(mg/kg-day)	(mg/m^3)	Source
Volatile Organic Compounds								
Benzene	71-43-2	1.0E-02	PPRTV	1	RAGS-E	1.0E-02	8.0E-02	PPRTV
Toluene	108-88-3	8.0E-01	PPRTV	1	RAGS-E	8.0E-01	5.0E+00	PPRTV
Ethylbenzene	100-41-4	1.0E-01	I (chronic)	1	RAGS-E	1.0E-01	9.0E+00	PPRTV
Xylenes, Total	1330-20-7	4.0E-01	PPRTV	1	RAGS-E	4.0E-01	4.0E-01	PPRTV
Cumene	98-82-8	4.0E-01	HEAST	1	RAGS-E	4.0E-01	4.0E-01	I (chronic)
1,2,4-Trimethylbenzene	95-63-6	5.0E-02	PPRTV Archive (chronic)	1	RAGS-E	5.0E-02	7.0E-02	PPRTV
1,3,5-Trimethylbenzene	108-67-8	5.0E-01	PPRTV Archive	1	RAGS-E	5.0E-01	1.0E-02	PPRTV
Semi-Volatile Organic Compounds								
Naphthalene	91-20-3	6.0E-01	ATSDR	1	RAGS-E	6.0E-01	3.0E-03	I (chronic)

Notes:

RfD - Reference Dose — mg/kg-day - milligram per kilogram per day

RfC - Reference Concentration — mg/m^3 - milligram per cubic meter

Sources:

ATSDR - Intermediate Minimal Risk Level (MRL) from the Agency for Toxic Substances and Disease Registry
chronic - chronic value used as subchronic value
I - Integrated Risk Information System (IRIS)
HEAST - Health Effects Assessment Summary Tables
PPRTV - EPA Provisional Peer Reviewed Toxicity Value
PPRTV Archive- EPA Provisional Peer Reviewed Toxicity Value - Archived Value
RAGS-E - Risk Assessment Guidance for Superfund (RAGS) Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

Table 6-5
Cancer Slope Factor/Inhalation Unit Risk - Tumor Type or Target Organ
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Chemical	CAS No.	Oral Tumor Type or Target Organ	Inhalation Tumor Type or Target Organ
Volatile Organic Compounds			
Benzene	71-43-2	leukemia; blood	leukemia; blood
Ethylbenzne	100-41-4	renal tubule carcinoma or adenoma incidence data in male rats	renal tubule carcinoma or adenoma incidence data in male rats
Semivolatile Organic Compounds			
Naphthalene	91-20-3	nasal respiratory epithelial adenoma and nasal olfactory epithelial neuroblastoma incidence data in male rats	nasal respiratory epithelial adenoma and nasal olfactory epithelial neuroblastoma incidence data in male rats

Notes:
Sources used include:
IRIS - Integrated Risk Information System (http://www.epa.gov/IRIS/)
RAIS - Risk Assessment Information System website (http://www.rais.ornl.gov) (Accessed on May 11, 2015)
California Environmental Protection Agency (http://www.oehha.ca/gov/risk)

Table 6-6
Chronic Reference Doses/Concentrations - Critical Effect or Target Organ
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Chemical	CAS No.	Oral Critical Effect or Target Organ	Inhalation Critical Effect or Target Organ
Volatile Organic Compounds			
Benzene	71-43-2	decreased lymphocyte count; blood	decreased lymphocyte count; blood
Toluene	108-88-3	increased kidney weight	neurological effects in occupationally-exposed workers
Ethylbenzene	100-41-4	liver and kidney toxicity	developmental toxicity
Xylenes, Total	1330-20-7	decreased body weight, increased mortality	impaired motor coordination (decreased rotarod performance)
Cumene	98-82-8	increased average kidney weight in female rats	increased kidney weights in female rats and adrenal weights in male and female rats
1,2,4-Trimethybenzene	95-63-6	decreased in body weight gain, clinical oobservations, and increased serum phosphorus levels, increased weights	decreased clotting time; blood
1,3,5-Trimethylbenzene	108-67-8	liver effects	respiratory, neurological,and hematological effects
Semi-Volatile Organic Compounds			
Naphthalene	91-20-3	decreased mean terminal body weight in males	nasal effects (hyperplasia in respiratory epithelium and metaplasia in olfactory epithelium)

Notes:
Sources used include:
IRIS - Integrated Risk Information System (http://www.epa.gov/IRIS/)
RAIS - Risk Assessment Information System website (http://www.rais.ornl.gov) (Accessed on May 11, 2015)
California Environmental Protection Agency (http://www.oehha.ca/gov/risk)

Table 6-7
Absorption Adjustment Factors for COCs in Soil
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Chemical	CAS No.	Ingestion of Soil Value	Ingestion of Soil Basis	Dermal Contact with Soil Value	Dermal Contact with Soil Basis
Volatile Organic Compounds					
Benzene	71-43-2	100%	conservative assumption	0% [1]	RAGS-E
Toluene	108-88-3	100%	conservative assumption	0% [1]	RAGS-E
Ethylbenzene	100-41-4	100%	conservative assumption	0% [1]	RAGS-E
Xylenes, Total	1330-20-7	100%	conservative assumption	0% [1]	RAGS-E
Cumene	98-82-8	100%	conservative assumption	0% [1]	RAGS-E
1,2,4-Trimethylbenzene	95-63-6	100%	conservative assumption	0% [1]	RAGS-E
1,3,5-Trimethylbenzene	108-67-8	100%	conservative assumption	0% [1]	RAGS-E
Semi-Volatile Organic Compounds					
Naphthalene	91-20-3	100%	conservative assumption	13%	RAGS-E

Notes:
RAGS-E - Risk Assessment Guidance for Superfund (RAGS) Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)
skin and should be accounted for via inhalation routes.

Table 6-8
Parameters Used to Calculate Permeability Constants for COCs in Groundwater
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Chemical	CAS No.	Molecular Weight (g/mol) Value	Molecular Weight Basis	Octanol-Water Partition Coefficient (K_{ow}) (unitless) Value	K_{ow} Basis	Kp (cm/hr) Value	Kp Basis
Volatile Organic Compounds							
Benzene	71-43-2	78.1	RAIS	1.3E+02	RAIS	1.5E-02	Est. RAGS-E
Toluene	108-88-3	92.1	RAIS	5.4E+02	RAIS	3.1E-02	Est. RAGS-E
Ethylbenzene	100-41-4	106	RAIS	1.4E+03	RAIS	4.9E-02	Est. RAGS-E
Xylenes, Total	1330-20-7	106	RAIS	1.4E+03	RAIS	4.9E-02	Calc. RAGS-E
Cumene	98-82-8	120	RAIS	4.6E+03	RAIS	8.8E-02	Calc. RAGS-E
1,2,4-Trimethylbenzene	95-63-6	120	RAIS	4.3E+03	RAIS	8.4E-02	Calc. RAGS-E
1,3,5-Trimethylbenzene	108-67-8	120	RAIS	2.6E+03	RAIS	6.1E-02	Calc. RAGS-E
Semi-Volatile Organic Compounds							
Naphthalene	91-20-3	128	RAIS	2.0E+03	RAIS	4.7E-02	Est. RAGS-E

Notes:
g/mol - grams per mole
cm/hr - centimeters per hour
Kp - Permeability coefficient

Sources:

Est. RAGS-E - Value is the estimated value presented in RAGS Part E.

Calc. RAGS-E - Value is calculated by using equations provided in RAGS Part E.

RAIS - Risk Assessment Information System Website (http://www.rais.ornl.gov) (Accessed on May 11, 2015)

Table 6-8
Parameters Used to Calculate Permeability Constants for COCs in Groundwater
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

		B		Tau-ev		tstar		FA	
		(unitless)		(hr)		(hr)		(unitless)	
Chemical	CAS No.	Value	Basis	Value	Basis	Value	Basis	Value	Basis
Volatile Organic Compounds									
Benzene	71-43-2	1.0E-01	Est. RAGS-E	2.9E-01	Est. RAGS-E	7.0E-01	Est. RAGS-E	1.0E+00	Est. RAGS-E
Toluene	108-88-3	1.0E-01	Est. RAGS-E	3.5E-01	Est. RAGS-E	8.4E-01	Est. RAGS-E	1.0E+00	Est. RAGS-E
Ethylbenzene	100-41-4	2.0E-01	Est. RAGS-E	4.2E-01	Est. RAGS-E	1.0E+00	Est. RAGS-E	1.0E+00	Est. RAGS-E
Xylenes, Total	1330-20-7	1.9E-01	Calc. RAGS-E	4.1E-01	Calc. RAGS-E	9.9E-01	Calc. RAGS-E	1.0E+00	Assumed
Cumene	98-82-8	3.7E-01	Calc. RAGS-E	4.9E-01	Calc. RAGS-E	1.2E+00	Calc. RAGS-E	1.0E+00	Assumed
1,2,4-Trimethylbenzene	95-63-6	3.5E-01	Calc. RAGS-E	4.9E-01	Calc. RAGS-E	1.2E+00	Calc. RAGS-E	1.0E+00	Assumed
1,3,5-Trimethylbenzene	108-67-8	2.6E-01	Calc. RAGS-E	4.9E-01	Calc. RAGS-E	1.2E+00	Calc. RAGS-E	1.0E+00	Assumed
Semi-Volatile Organic Compounds									
Naphthalene	91-20-3	2.0E-01	Est. RAGS-E	5.6E-01	Est. RAGS-E	1.3E+00	Est. RAGS-E	1.0E+00	Est. RAGS-E

Notes:
B - dimensionless ratio of the permeability coefficient of a constituent through the stratum corneum relative to its permeability coefficient across the viable epidermis
Tau-ev - lag time per event
tstar - time to reach stready state
FA - fraction absorbed
hr - hour

Sources:

Est. RAGS-E - Value is the estimated value presented in RAGS Part E.

Calc. RAGS-E - Value is calculated by using equations provided in RAGS Part E.

Assumed - Conservative assumption

Table 6-9
Calculation of Permeability Constants for On-Site Construction Worker and Off-Site Utility Worker
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Exposure Time per Event (ET) = 8 hrs/event

Chemical	Kp (cm/hr)	B (unitless)	Tau-ev (hr/event)	tstar (hr)	FA (unitless)	Organic? Enter "Y" or "N"	Permeability Constant ET <= tstar (cm/hr)	Permeability Constant ET > tstar (cm/hr)	Permeability Constant Selected (cm/hr)
Volatile Organic Compounds									
Benzene	1.5E-02	1.0E-01	2.9E-01	7.0E-01	1.0E+00	Y	7.9E-03	1.5E-02	1.5E-02
Toluene	3.1E-02	1.0E-01	3.5E-01	8.4E-01	1.0E+00	Y	1.8E-02	3.1E-02	3.1E-02
Ethylbenzene	4.9E-02	2.0E-01	4.2E-01	1.0E+00	1.0E+00	Y	3.1E-02	4.7E-02	4.7E-02
Xylenes, Total	4.9E-02	1.9E-01	4.1E-01	9.9E-01	1.0E+00	Y	3.1E-02	4.7E-02	4.7E-02
Cumene	8.8E-02	3.7E-01	4.9E-01	1.2E+00	1.0E+00	Y	6.0E-02	7.9E-02	7.9E-02
1,2,4-Trimethylbenzene	8.4E-02	3.5E-01	4.9E-01	1.2E+00	1.0E+00	Y	5.8E-02	7.6E-02	7.6E-02
1,3,5-Trimethylbenzene	6.1E-02	2.6E-01	4.9E-01	1.2E+00	1.0E+00	Y	4.2E-02	5.8E-02	5.8E-02
Semivolatile Organic Compounds									
Naphthalene	4.7E-02	2.0E-01	5.6E-01	1.3E+00	1.0E+00	Y	3.4E-02	4.7E-02	4.7E-02

Table 7-1
Summary of Exposure Assumptions for On-Site Trespasser (12 to 18 years old)
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Parameter			Value	Units	Comments/References		Intake Equation
Averaging Times							
Inhalation							
AT (c)	Carcinogenic Effects	=	613,200	hours	averaging time for a carcinogen based on lifetime of 70 years (lifetime in years x 365 days/year x 24 hours/day) (USEPA 2009)		
AT (nc)	Noncarcinogenic Effects	=	52,560	hours	averaging time for a noncarcinogen (ED in years x 365 days/year x 24 hours/day) (USEPA 2009)		
Exposure Assumptions Associated with Direct Contact with Soil							
Inhalation of Constituents Emitted from Soil (Volatiles)							
ET	Exposure Time	=	2	hours/day	average time expected to trespass on the site (VA DEQ 2014)		
EF	Exposure Frequency	=	24	days/year	default assumption for a trespasser scenario; assumes 6 days per month for 4 months (VA DEQ 2014)		$EC = \frac{CA_a * ET * EF * ED}{AT}$
ED	Exposure Duration	=	6	years	based on age range of exposure (12 to 18 years)		
EC_c	Exposure Concentration (Carcinogenic)	=	chem-spec.	$\mu g/m^3$	calculated		
EC_{nc}	Exposure Concentration (Noncarcinogenic)	=	chem-spec.	$\mu g/m^3$	calculated		
$TF_{a\text{-}vol}$	Transfer Factor (volatiles)	=	chem-spec.	kg/m^3	calculated using the soil volatilization model from the Soil Screening Guidance (USEPA 1996)		$CA_a = C_{src} * TF_a$
CA_a	Concentration in Outdoor Air	=	chem-spec.	$\mu g/m^3$	calculated value		
C_{src}	Source Concentration in Soil	=	chem-spec.	µg/kg	measured value		
CF	Conversion Factor	=	1.0E+03	µg/mg	---		
IUR	Inhalation Unit Risk	=	chem-spec.	$(\mu g/m^3)^{-1}$	chemical - specific	$Risk = EC_c * IUR$	$HI = \frac{EC_{nc}}{RfC * CF}$
RfC	Reference Concentration	=	chem-spec.	(mg/m^3)	chemical - specific		
Intake Assumptions Associated with Direct Contact with Groundwater							
Inhalation of Constituents Emitted from Groundwater to Outdoor Air							
ET	Exposure Time	=	2	hours/day	average time expected to trespass on the site (VA DEQ 2014)		
EF	Exposure Frequency	=	24	days/year	default assumption for a trespasser scenario; assumes 6 days per month for 4 months (VA DEQ 2014)		$EC = \frac{CA_a * ET * EF * ED}{AT}$
ED	Exposure Duration	=	6	years	based on age range of exposure (12 to 18 years)		
EC_c	Exposure Concentration (Carcinogenic)	=	chem-spec.	$\mu g/m^3$	calculated		
EC_{nc}	Exposure Concentration (Noncarcinogenic)	=	chem-spec.	$\mu g/m^3$	calculated		
$TF_{a\text{-}vol}$	Transfer Factor	=	chem-spec.	L/m^3	calculated using the groundwater volatilization model (ASTM 2015)		$CA_a = C_{src} * TF_a$
CA_a	Concentration in Outdoor Air	=	chem-spec.	$\mu g/m^3$	calculated value		
C_{src}	Source Concentration in Groundwater	=	chem-spec.	µg/L	measured value		
CF	Conversion Factor	=	1.0E+03	µg/mg	---		
IUR	Inhalation Unit Risk	=	chem-spec.	$(\mu g/m^3)^{-1}$	chemical - specific	$Risk = EC_c * IUR$	$HI = \frac{EC_{nc}}{RfC * CF}$
RfC	Reference Concentration	=	chem-spec.	(mg/m^3)	chemical - specific		

Table 7-2
Summary of Exposure Assumptions for On-Site Construction Worker
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Parameter			Value	Units	Comments/References	Intake Equation
Averaging Times						
Ingestion/Dermal						
$AT\ (c)$	Carcinogenic Effects	=	25,550	days	averaging time for a carcinogen based on lifetime of 70 years (lifetime in years x 365 days/year) (USEPA 1991)	
$AT\ (nc)$	Noncarcinogenic Effects	=	42	days	default assumption (IPCB 2007)	
Inhalation						
$AT\ (c)$	Carcinogenic Effects	=	613,200	hours	averaging time for a carcinogen based on lifetime of 70 years (lifetime in years x 365 days/year x 24 hours/day) (USEPA 2009)	
$AT\ (nc)$	Noncarcinogenic Effects	=	8,760	hours	averaging time for a noncarcinogen (ED in years x 365 days/year x 24 hours/day) (USEPA 2009)	
Exposure Assumptions Associated with Direct Contact with Soil						
Incidental Ingestion of Soil						
IR_{ing-s}	Incidental Soil Ingestion Rate	=	330	mg-soil/day	default exposure factor value for a construction senario (USEPA 2002)	
CF	Conversion Factor	=	1.0E-06	kg/mg	—	$I_{ing-s} = CS_{src} * TF_s * AAF_{ing-s} * IF_{ing-s}$
FI	Fraction of Daily Total	=	1	unitless	assumes 100% of daily soil ingestion occurs from soil at the site	
EF	Exposure Frequency	=	25	days/year	assumes 5 weeks of construction in soil at 5 days/week; where total construction period is 30 days (IPCB 2007)	
ED	Exposure Duration	=	1	years	construction occurs over a one year period (IPCB 2007)	
BW	Body Weight	=	70	kg	default assumption for an adult nonresidential exposure (PACODE 2011)	$IF_{ing-s} = \frac{IR_{ing-s} * CF * FI * EF * ED}{BW * AT}$
$IF_{ing-s}\ (c)$	Intake Factor (Carcinogenic)	=	4.61E-09	kg/kg-day	calculated	
$IF_{ing-s}\ (nc)$	Intake Factor (Noncarcinogenic)	=	2.41E-06	kg/kg-day	calculated	
CS_{src}	Source Concentration in Soil	=	chem-spec.	mg/kg	measured value	
TF_s	Transfer Factor	=	1	unitless	conservative assumption	
AAF_{ing-s}	Absorption Adjustment Factor	=	1	mg/mg	conservative assumption	$Risk = I_{ing-s\,(c)} * CSF_O$ $HI = \frac{I_{ing-s\,(nc)}}{RfD_O}$
I_{ing-s}	Intake for Ingestion of Soil	=	chem-spec.	mg/kg-day	chemical - specific	
CSF_O	Oral Cancer Slope Factor	=	chem-spec.	$(mg/kg\text{-}day)^{-1}$	chemical - specific	
RfD_O	Oral Reference Dose	=	chem-spec.	mg/kg-day	chemical - specific	
Dermal Contact with Soil						
SA	Exposed Surface Area	=	3,300	cm^2/day	recommended default value for a construction scenario (representative of face, forearms, and hands) (USEPA 2002)	
AF	Soil Adherence Rate	=	0.3	mg/cm^2	the 95[th] percentile value measured for construction workers (USEPA 2004)	
CF	Conversion Factor	=	1.0E-06	kg/mg	—	
FC	Fraction of day with contact to soil	=	1	unitless	assumes 100% of daily soil contact occurs from soil at the site	
EF	Exposure Frequency	=	25	days/year	assumes 5 weeks of construction in soil at 5 days/week; where total construction period is 30 days (IPCB 2007)	
ED	Exposure Duration	=	1	years	construction occurs over a one year period (IPCB 2007)	$I_{derm-s} = CS_{src} * TF_s * AAF_{derm-s} * IF_{derm-s}$
BW	Body Weight	=	70	kg	default assumption for an adult nonresidential exposure (PACODE 2011)	
$IF_{derm-s}\ (c)$	Absorbed Dose (Carcinogenic)	=	1.38E-08	kg/kg-day	calculated	
$IF_{derm-s}\ (nc)$	Absorbed Dose (Noncarcinogenic)	=	8.42E-06	kg/kg-day	calculated	$IF_{derm-s} = \frac{SA * AF * CF * FC * EF * ED}{BW * AT}$
CS_{src}	Source Concentration in Soil	=	chem-spec.	mg/kg	measured value	
TF_s	Transfer Factor	=	1	unitless	conservative assumption	
I_{derm-s}	Intake for Dermal Contact with Soil	=	chem-spec.	mg/kg-day	chemical - specific	
AAF_{derm-s}	Absorption Adjustment Factor	=	chem-spec.	mg/mg	chemical - specific	$Risk = I_{derm-s\,(c)} * CSF_D$ $HI = \frac{I_{derm-s\,(nc)}}{RfD_D}$
CSF_D	Dermal Cancer Slope Factor	=	chem-spec.	$(mg/kg\text{-}day)^{-1}$	chemical - specific	
RfD_D	Dermal Reference Dose	=	chem-spec.	mg/kg-day	chemical - specific	
Inhalation of Constituents Emitted from Soil (Volatiles and Particulates)						
ET	Exposure Time	=	8	hours/day	default assumption for an adult nonresidential exposure (PACODE 2011)	
EF	Exposure Frequency	=	25	days/year	assumes 5 weeks of construction in soil at 5 days/week; where total construction period is 30 days (IPCB 2007)	
ED	Exposure Duration	=	1	years	construction occurs over a one year period (IPCB 2007)	$EC = \frac{CA_a * ET * EF * ED}{AT}$
EC_c	Exposure Concentration (Carcinogenic)	=	chem-spec.	$\mu g/m^3$	calculated	
EC_{nc}	Exposure Concentration (Noncarcinogenic)	=	chem-spec.	$\mu g/m^3$	calculated	
TF_{a-vol}	Transfer Factor (volatiles)	=	chem-spec.	kg/m^3	calculated using the soil volatilization model from the Soil Screening Guidance (USEPA 1996)	$CA_a = C_{src} * TF_a$
TF_{a-part}	Transfer Factor (particulates)		1.00E-10	kg/m^3	default value (PACODE 2011)	
CA_a	Concentration in Outdoor Air	=	chem-spec.	$\mu g/m^3$	calculated value	
C_{src}	Source Concentration in Soil	=	chem-spec.	$\mu g/kg$	measured value	
CF	Conversion Factor	=	1.0E+03	$\mu g/mg$	—	$Risk = EC_c * IUR$ $HI = \frac{EC_{nc}}{RfC * CF}$
IUR	Inhalation Unit Risk	=	chem-spec.	$(\mu g/m^3)^{-1}$	chemical - specific	
RfC	Reference Concentration	=	chem-spec.	(mg/m^3)	chemical - specific	

Table 7-2
Summary of Exposure Assumptions for On-Site Construction Worker
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Parameter			Value	Units	Comments/References	Intake Equation
Averaging Times						
Ingestion/Dermal						
AT (c)	Carcinogenic Effects	=	25,550	days	averaging time for a carcinogen based on lifetime of 70 years (lifetime in years x 365 days/year) (USEPA 1991)	
AT (nc)	Noncarcinogenic Effects	=	42	days	default assumption (IPCB 2007)	
Inhalation						
AT (c)	Carcinogenic Effects	=	613,200	hours	averaging time for a carcinogen based on lifetime of 70 years (lifetime in years x 365 days/year x 24 hours/day) (USEPA 2009)	
AT (nc)	Noncarcinogenic Effects	=	8,760	hours	averaging time for a noncarcinogen (ED in years x 365 days/year x 24 hours/day) (USEPA 2009)	
Exposure Assumptions Associated with Direct Contact with Groundwater						
Dermal Contact with Groundwater						
SA	Exposed Surface Area	=	2,550	cm^2	mean body surface area exposed for adult male (corresponds to forearms and hands) (USEPA 2011)	
ET	Exposure Time	=	8	hours/day	default assumption for an adult nonresidential exposure (PACODE 2011)	
EF	Exposure Frequency	=	5	days/year	assumes 1 week of construction in contact with exposed groundwater at 5 days/week during the 30 days construction period (IPCB 2007)	
ED	Exposure Duration	=	1	years	construction occurs over a one year period (IPCB 2007)	
CF	Conversion Factor	=	1.0E-03	L/cm^3	---	$I_{derm-w} = CW_{src} * TF_{w} * PC * IF_{derm-w}$
BW	Body Weight	=	70	kg	default assumption for an adult nonresidential exposure (PACODE 2011)	
IF_{derm-w} *(c)*	Absorbed Dose (Carcinogenic)	=	5.70E-05	L-hr/cm-kg-day	calculated	
IF_{derm-w} *(nc)*	Absorbed Dose (Noncarcinogenic)	=	3.47E-02	L-hr/cm-kg-day	calculated	$IF_{derm-w} = \frac{SA * ET * EF * ED * CF}{BW * AT}$
CW_{src}	Source Concentration in GW	=	chem-spec.	mg/L	measured value	
TF_{w}	Transfer Factor	=	1	unitless	conservative assumption	
PC	Permeability Constant	=	chem-spec.	cm/hr	chemical - specific	$Risk = I_{derm-w} * CSF_D$ $HI = \frac{I_{derm-w}}{RfD_D}$
I_{derm-w}	Intake for Dermal Contact with Groundwater	=	chem-spec.	mg/kg-day	chemical - specific	
CSF_D	Dermal Cancer Slope Factor	=	chem-spec.	$(mg/kg\text{-}day)^{-1}$	chemical - specific	
RfD_D	Dermal Reference Dose	=	chem-spec.	mg/kg-day	chemical - specific	
Inhalation of Constituents Emitted from Groundwater to Outdoor Air						
ET	Exposure Time	=	8	hours/day	default assumption for an adult nonresidential exposure (PACODE 2011)	
EF	Exposure Frequency	=	5	days/year	assumes 1 week of construction in contact with exposed groundwater at 5 days/week during the 30 days construction period (IPCB 2007)	
ED	Exposure Duration	=	1	years	construction occurs over a one year period (IPCB 2007)	
EC_c	Exposure Concentration (Carcinogenic)	=	chem-spec.	$\mu g/m^3$	calculated	$EC = \frac{CA_a * ET * EF * ED}{AT}$
EC_{nc}	Exposure Concentration (Noncarcinogenic)	=	chem-spec.	$\mu g/m^3$	calculated	
$TF_{a\text{-}vol}$	Transfer Factor	=	chem-spec.	L/m^3	calculated using the groundwater volatilization model (VA DEQ 2014)	
CA_a	Concentration in Outdoor Air	=	chem-spec.	$\mu g/m^3$	calculated value	$CA_a = C_{src} * TF_a$
C_{src}	Source Concentration in Groundwater	=	chem-spec.	$\mu g/L$	measured value	
CF	Conversion Factor	=	1.0E+03	µg/mg	---	$Risk = EC_c * IUR$ $HI = \frac{EC_{nc}}{RfC * CF}$
IUR	Inhalation Unit Risk	=	chem-spec.	$(\mu g/m^3)^{-1}$	chemical - specific	
RfC	Reference Concentration	=	chem-spec.	(mg/m^3)	chemical - specific	

Table 7-3
Summary of Exposure Assumptions for Off-Site Construction Worker (Central Ave. ROW)
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Parameter			Value	Units	Comments/References	Intake Equation
Averaging Times						
Ingestion/Dermal						
AT (c)	Carcinogenic Effects	=	25,550	days	averaging time for a carcinogen based on lifetime of 70 years (lifetime in years x 365 days/year) (USEPA 1991)	
AT (nc)	Noncarcinogenic Effects	=	42	days	default assumption (IPCB 2007)	
Inhalation						
AT (c)	Carcinogenic Effects	=	613,200	hours	averaging time for a carcinogen based on lifetime of 70 years (lifetime in years x 365 days/year x 24 hours/day) (USEPA 2009)	
AT (nc)	Noncarcinogenic Effects	=	8,760	hours	averaging time for a noncarcinogen (ED in years x 365 days/year x 24 hours/day) (USEPA 2009)	
Exposure Assumptions Associated with Direct Contact with Soil						
Incidental Ingestion of Soil						
IR_{ing-s}	Incidental Soil Ingestion Rate	=	330	mg-soil/day	default exposure factor value for a construction scenario (USEPA 2002)	
CF	Conversion Factor	=	1.0E-06	kg/mg	—	$I_{ing-s} = CS_{src} * TF_s * AAF_{ing-s} * IF_{ing-s}$
FI	Fraction of Daily Total	=	1	unitless	assumes 100% of daily soil ingestion occurs from soil at the site	
EF	Exposure Frequency	=	25	days/year	assumes 5 weeks of construction in soil at 5 days/week; where total construction period is 30 days (IPCB 2007)	
ED	Exposure Duration	=	1	years	construction occurs over a one year period (IPCB 2007)	
BW	Body Weight	=	70	kg	default assumption for an adult nonresidential exposure (PACODE 2011)	$IF_{ing-s} = \frac{IR_{ing-s} * CF * FI * EF * ED}{BW * AT}$
IF_{ing-s} *(c)*	Intake Factor (Carcinogenic)	=	4.61E-09	kg/kg-day	calculated	
IF_{ing-s} *(nc)*	Intake Factor (Noncarcinogenic)	=	2.81E-06	kg/kg-day	calculated	
CS_{src}	Source Concentration in Soil	=	chem-spec.	mg/kg	measured value	
TF_s	Transfer Factor	=	1	unitless	conservative assumption	
AAF_{ing-s}	Absorption Adjustment Factor	=	1	mg/mg	conservative assumption	$Risk = I_{ing-s\,(c)} * CSF_O$ $HI = \frac{I_{ing-s\,(nc)}}{RfD_O}$
I_{ing-s}	Intake for Ingestion of Soil	=	chem-spec.	mg/kg-day	chemical - specific	
CSF_O	Oral Cancer Slope Factor	=	chem-spec.	$(mg/kg\text{-}day)^{-1}$	chemical - specific	
RfD_O	Oral Reference Dose	=	chem-spec.	mg/kg-day	chemical - specific	
Dermal Contact with Soil						
SA	Exposed Surface Area	=	3,300	cm^2/day	recommended default value for a construction scenario (representative of face, forearms, and hands) (USEPA 2002)	
AF	Soil Adherence Rate	=	0.3	mg/cm^2	the 95th percentile value measured for construction workers (USEPA 2004)	
CF	Conversion Factor	=	1.0E-06	kg/mg	—	
FC	Fraction of day with contact to soil	=	1	unitless	assumes 100% of daily soil contact occurs from soil at the site	
EF	Exposure Frequency	=	25	days/year	assumes 5 weeks of construction in soil at 5 days/week; where total construction period is 30 days (IPCB 2007)	$I_{derm-s} = CS_{src} * TF_s * AAF_{derm-s} * IF_{derm-s}$
ED	Exposure Duration	=	1	years	construction occurs over a one year period (IPCB 2007)	
BW	Body Weight	=	70	kg	default assumption for an adult nonresidential exposure (PACODE 2011)	
IF_{derm-s} *(c)*	Absorbed Dose (Carcinogenic)	=	1.38E-08	kg/kg-day	calculated	
IF_{derm-s} *(nc)*	Absorbed Dose (Noncarcinogenic)	=	8.42E-06	kg/kg-day	calculated	$IF_{derm-s} = \frac{SA * AF * CF * FC * EF * ED}{BW * AT}$
CS_{src}	Source Concentration in Soil	=	chem-spec.	mg/kg	measured value	
TF_s	Transfer Factor	=	1	unitless	conservative assumption	
I_{derm-s}	Intake for Dermal Contact with Soil	=	chem-spec.	mg/kg-day	chemical - specific	
AAF_{derm-s}	Absorption Adjustment Factor	=	chem-spec.	mg/mg	chemical - specific	$Risk = I_{derm-s\,(c)} * CSF_D$ $HI = \frac{I_{derm-s\,(nc)}}{RfD_D}$
CSF_D	Dermal Cancer Slope Factor	=	chem-spec.	$(mg/kg\text{-}day)^{-1}$	chemical - specific	
RfD_D	Dermal Reference Dose	=	chem-spec.	mg/kg-day	chemical - specific	
Inhalation of Constituents Emitted from Soil (Volatiles and Particulates)						
ET	Exposure Time	=	8	hours/day	default assumption for an adult nonresidential exposure (PACODE 2011)	
EF	Exposure Frequency	=	25	days/year	assumes 5 weeks of construction in soil at 5 days/week; where total construction period is 30 days (IPCB 2007)	$EC = \frac{CA_a * ET * EF * ED}{AT}$
ED	Exposure Duration	=	1	years	construction occurs over a one year period (IPCB 2007)	
EC_c	Exposure Concentration (Carcinogenic)	=	chem-spec.	$\mu g/m^3$	calculated	
EC_{nc}	Exposure Concentration (Noncarcinogenic)	=	chem-spec.	$\mu g/m^3$	calculated	
TF_{a-vol}	Transfer Factor (volatiles)	=	chem-spec.	kg/m^3	calculated using the soil volatilization model from the Soil Screening Guidance (USEPA 1996)	$CA_a = C_{src} * TF_a$
TF_{a-part}	Transfer Factor (particulates)		1.00E-10	kg/m^3	default value (PACODE 2011)	
CA_a	Concentration in Outdoor Air	=	chem-spec.	$\mu g/m^3$	calculated value	
C_{src}	Source Concentration in Soil	=	chem-spec.	µg/kg	measured value	
CF	Conversion Factor	=	1.0E+03	µg/mg	—	$Risk = EC_c * IUR$ $HI = \frac{EC_{nc}}{RfC * CF}$
IUR	Inhalation Unit Risk	=	chem-spec.	$(\mu g/m^3)^{-1}$	chemical - specific	
RfC	Reference Concentration	=	chem-spec.	(mg/m^3)	chemical - specific	

Table 7-3
Summary of Exposure Assumptions for Off-Site Construction Worker (Central Ave. ROW)
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Parameter			Value	Units	Comments/References	Intake Equation
Averaging Times						
Ingestion/Dermal						
AT (c)	Carcinogenic Effects	=	25,550	days	averaging time for a carcinogen based on lifetime of 70 years (lifetime in years x 365 days/year) (USEPA 1991)	
AT (nc)	Noncarcinogenic Effects	=	42	days	default assumption (IPCB 2007)	
Inhalation						
AT (c)	Carcinogenic Effects	=	613,200	hours	averaging time for a carcinogen based on lifetime of 70 years (lifetime in years x 365 days/year x 24 hours/day) (USEPA 2009)	
AT (nc)	Noncarcinogenic Effects	=	8,760	hours	averaging time for a noncarcinogen (ED in years x 365 days/year x 24 hours/day) (USEPA 2009)	
Exposure Assumptions Associated with Direct Contact with Groundwater						
Inhalation of Constituents Emitted from Groundwater to Outdoor Air						
ET	Exposure Time	=	8	hours/day	default assumption for an adult nonresidential exposure (PACODE 2011)	
EF	Exposure Frequency	=	5	days/year	assumes 1 week of construction in contact with unexposed groundwater at 5 days/week during the 30 day construction period (IPCB 2007)	
ED	Exposure Duration	=	1	years	construction occurs over a one year period (IPCB 2007)	
EC_c	Exposure Concentration (Carcinogenic)	=	chem-spec.	μg/m³	calculated	$EC = \frac{CA_o * ET * EF * ED}{AT}$
EC_{nc}	Exposure Concentration (Noncarcinogenic)	=	chem-spec.	μg/m³	calculated	
TF_{o}	Transfer Factor	=	chem-spec.	L/m³	calculated using the groundwater volatilization model (VA DEQ 2014)	
CA_o	Concentration in Outdoor Air	=	chem-spec.	μg/m³	calculated value	$CA_o = C_{sw} * TF_o$
C_{sw}	Source Concentration in Groundwater	=	chem-spec.	μg/L	measured value	
CF	Conversion Factor	=	1.0E+03	μg/mg	—	
IUR	Inhalation Unit Risk	=	chem-spec.	(μg/m³)⁻¹	chemical - specific	$Risk = EC_c * IUR$ $HI = \frac{EC_{nc}}{RfC * CF}$
RfC	Reference Concentration	=	chem-spec.	(mg/m³)	chemical - specific	

Table 7-4
Summary of Exposure Assumptions for On-Site Utility Worker
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Parameter			Value	Units	Comments/References	Intake Equation
Averaging Times						
Ingestion/Dermal						
AT (c)	Carcinogenic Effects	=	25,550	days	averaging time for a carcinogen based on lifetime of 70 years (lifetime in years x 365 days/year) (USEPA 1991)	
AT (nc)	Noncarcinogenic Effects	=	9,125	days	averaging time for a noncarcinogen (ED in years x 365 days/year) (USEPA 1989)	
Inhalation						
AT (c)	Carcinogenic Effects	=	613,200	hours	averaging time for a carcinogen based on lifetime of 70 years (lifetime in years x 365 days/year x 24 hours/day) (USEPA 2009)	
AT (nc)	Noncarcinogenic Effects	=	219,000	hours	averaging time for a noncarcinogen (ED in years x 365 days/year x 24 hours/day) (USEPA 2009)	
Exposure Assumptions Associated with Direct Contact with Soil						
Incidental Ingestion of Soil						
IR_{ing-s}	Incidental Soil Ingestion Rate	=	330	mg-soil/day	default exposure factor value for a construction senario (USEPA 2002)	
CF	Conversion Factor	=	1.0E-06	kg/mg	—	
FI	Fraction of Daily Total	=	1	unitless	assumes 100% of daily soil ingestion occurs from soil at the site	
EF	Exposure Frequency	=	1	days/year	assumes exposure to soil occurs one day per year (MADEP 1995)	$I_{ing-s} = CS_{src} * TF_s * AAF_{ing-s} * IF_{ing-s}$
ED	Exposure Duration	=	25	years	default assumption for an adult nonresidential exposure (PACODE 2011)	
BW	Body Weight	=	70	kg	default assumption for an adult nonresidential exposure (PACODE 2011)	
IF_{ing-s} *(c)*	Intake Factor (Carcinogenic)	=	4.61E-09	kg/kg-day	calculated	
IF_{ing-s} *(nc)*	Intake Factor (Noncarcinogenic)	=	1.29E-08	kg/kg-day	calculated	$IF_{ing-s} = \frac{IR_{ing-s} * CF * FI * EF * ED}{BW * AT}$
CS_{src}	Source Concentration in Soil	=	chem-spec.	mg/kg	measured value	
TF_s	Transfer Factor	=	1	unitless	conservative assumption	
I_{ing-s}	Intake for Ingestion of Soil	=	chem-spec.	mg/kg-day	chemical - specific	$Risk = I_{ing-s\,(c)} * CSF_O$ $HI = \frac{I_{ing-s\,(nc)}}{RfD_O}$
CSF_O	Oral Cancer Slope Factor	=	chem-spec.	(mg/kg-day)$^{-1}$	chemical - specific	
RfD_O	Oral Reference Dose	=	chem-spec.	mg/kg-day	chemical - specific	
AAF_{ing-s}	Absorption Adjustment Factor	=	1	mg/mg	conservative assumption	
Dermal Contact with Soil						
SA	Exposed Surface Area	=	3,300	cm²/day	recommended default value for a commercial/industrial scenario (representative of face, forearms, and hands) (USEPA 2002)	
AF	Soil Adherence Rate	=	0.2	mg/cm²	recommended default value for commercial/industrial exposure (USEPA 2002)	
CF	Conversion Factor	=	1.0E-06	kg/mg	—	
FC	Fraction of day with contact to soil	=	1	unitless	assumes 100% of daily soil contact occurs from soil at the site	
EF	Exposure Frequency	=	1	days/year	assumes exposure to soil occurs one day per year (MADEP 1995)	$I_{derm-s} = CS_{src} * TF_s * AAF_{derm-s} * IF_{derm-s}$
ED	Exposure Duration	=	25	years	default assumption for an adult nonresidential exposure (PACODE 2011)	
BW	Body Weight	=	70	kg	default assumption for an adult nonresidential exposure (PACODE 2011)	
IF_{derm-s} *(c)*	Absorbed Dose (Carcinogenic)	=	9.23E-09	kg/kg-day	calculated	
IF_{derm-s} *(nc)*	Absorbed Dose (Noncarcinogenic)	=	2.58E-08	kg/kg-day	calculated	$IF_{derm-s} = \frac{SA * AF * CF * FC * EF * ED}{BW * AT}$
CS_{src}	Source Concentration in Soil	=	chem-spec.	mg/kg	measured value	
TF_s	Transfer Factor	=	1	unitless	conservative assumption	
I_{derm-s}	Intake for Dermal Contact with Soil	=	chem-spec.	mg/kg-day	chemical - specific	
CSF_D	Dermal Cancer Slope Factor	=	chem-spec.	(mg/kg-day)$^{-1}$	chemical - specific	$Risk = I_{derm-s} * CSF_D$ $HI = \frac{I_{derm-s}}{RfD_D}$
RfD_D	Dermal Reference Dose	=	chem-spec.	mg/kg-day	chemical - specific	
AAF_{derm-s}	Absorption Adjustment Factor	=	chem-spec.	mg/mg	chemical - specific	
Inhalation of Constituents Emitted from Soil (Volatiles and Particulates)						
ET	Exposure Time	=	[illegible]	hours/day	default assumption for an adult nonresidential exposure (PACODE 2011)	
EF	Exposure Frequency	=	1	days/year	assumes exposure to soil occurs one day per year (MADEP 1995)	$EC = \frac{CA_a * ET * EF * ED}{AT}$
ED	Exposure Duration	=	25	years	default assumption for an adult nonresidential exposure (PACODE 2011)	
EC_c	Exposure Concentration (Carcinogenic)	=	chem-spec.	µg/m³	calculated	
EC_{nc}	Exposure Concentration (Noncarcinogenic)	=	chem-spec.	µg/m³	calculated	
TF_{a-vol}	Transfer Factor (volatiles)	=	chem-spec.	kg/m³	calculated using the soil volatilization model from the Soil Screening Guidance (USEPA 1996)	$CA_a = C_{src} * TF_a$
TF_{a-part}	Transfer Factor (particulates)		1.00E-10	kg/m³	default value (PACODE 2011)	
CA_a	Concentration in Outdoor Air	=	chem-spec.	µg/m³	calculated value	
CF	Conversion Factor	=	1.0E+03	µg/mg	—	
IUR	Inhalation Unit Risk	=	chem-spec.	(µg/m³)$^{-1}$	chemical - specific	$Risk = EC_c * IUR$ $HI = \frac{EC_{nc}}{RfC * CF}$
RfC	Reference Concentration	=	chem-spec.	(mg/m³)	chemical - specific	
C_{src}	Source Concentration in Soil	=	chem-spec.	µg/kg	measured value	

Table 7-4
Summary of Exposure Assumptions for On-Site Utility Worker
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Parameter			Value	Units	Comments/References	Intake Equation
Averaging Times						
Ingestion/Dermal						
AT (c)	Carcinogenic Effects	=	25,550	days	averaging time for a carcinogen based on lifetime of 70 years (lifetime in years x 365 days/year) (USEPA 1991)	
AT (nc)	Noncarcinogenic Effects	=	9,125	days	averaging time for a noncarcinogen (ED in years x 365 days/year) (USEPA 1989)	
Inhalation						
AT (c)	Carcinogenic Effects	=	613,200	hours	averaging time for a carcinogen based on lifetime of 70 years (lifetime in years x 365 days/year x 24 hours/day) (USEPA 2009)	
AT (nc)	Noncarcinogenic Effects	=	219,000	hours	averaging time for a noncarcinogen (ED in years x 365 days/year x 24 hours/day) (USEPA 2009)	
Exposure Assumptions Associated with Direct Contact with Groundwater						*ffFrr rr F TT F rr*
Inhalation of Constituents Emitted from Groundwater to Outdoor Air						
ET	Exposure Time	=	8	hours/day	default assumption for an adult nonresidential exposure (PACODE 2011)	
EF	Exposure Frequency	=	1	days/year	assumes exposure to groundwater occurs one day per year (MADEP 1995)	
ED	Exposure Duration	=	25	years	default assumption for an adult nonresidential exposure (PACODE 2011)	$EC = \frac{CA_a * ET * EF * ED}{AT}$
EC_c	Exposure Concentration (Carcinogenic)	=	chem-spec.	µg/m³	calculated	
EC_{nc}	Exposure Concentration (Noncarcinogenic)	=	chem-spec.	µg/m³	calculated	
$TF_{a\text{-}vol}$	Transfer Factor	=	chem-spec.	L/m³	calculated using the groundwater volatilization model (VA DEQ 2014)	$CA_a = C_{src} * TF_a$
CA_a	Concentration in Outdoor Air	=	chem-spec.	µg/m³	calculated value	
CF	Conversion Factor	=	1.0E+03	µg/mg	—	
IUR	Inhalation Unit Risk	=	chem-spec.	$(\mu g/m^3)^{-1}$	chemical - specific	$Risk = EC_c * IUR$ $HI = \frac{EC_{nc}}{RfC * CF}$
RfC	Reference Concentration	=	chem-spec.	(mg/m^3)	chemical - specific	
C_{src}	Source Concentration in Groundwater	=	chem-spec.	µg/L	measured value	

Table 7-5
Summary of Exposure Assumptions for Off-Site Utility Worker (Central Ave. ROW)
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Parameter			Value	Units	Comments/References	Intake Equation
Averaging Times						
Ingestion/Dermal						
AT (c)	Carcinogenic Effects	=	25,550	days	averaging time for a carcinogen based on lifetime of 70 years (lifetime in years x 365 days/year) (USEPA 1991)	
AT (nc)	Noncarcinogenic Effects	=	9,125	days	averaging time for a noncarcinogen (ED in years x 365 days/year) (USEPA 1989)	
Inhalation						
AT (c)	Carcinogenic Effects	=	613,200	hours	averaging time for a carcinogen based on lifetime of 70 years (lifetime in years x 365 days/year x 24 hours/day) (USEPA 2009)	
AT (nc)	Noncarcinogenic Effects	=	219,000	hours	averaging time for a noncarcinogen (ED in years x 365 days/year x 24 hours/day) (USEPA 2009)	
Exposure Assumptions Associated with Direct Contact with Soil						
Incidental Ingestion of Soil						
IR_{ing-s}	**Incidental Soil Ingestion Rate**	=	**330**	**mg-soil/day**	**default exposure factor value for a construction senario (USEPA 2002)**	
CF	Conversion Factor	=	1.0E-06	kg/mg	---	
FI	Fraction of Daily Total	=	1	unitless	assumes 100% of daily soil ingestion occurs from soil at the site	
EF	Exposure Frequency	=	1	days/year	assumes exposure to soil occurs one day per year (MADEP 1995)	$I_{ing-s} = CS_{src} * TF_s * AAF_{ing-s} * IF_{ing-s}$
ED	Exposure Duration	=	25	years	default assumption for an adult nonresidential exposure (PACODE 2011)	
BW	Body Weight	=	70	kg	default assumption for an adult nonresidential exposure (PACODE 2011)	
IF_{ing-s} *(c)*	Intake Factor (Carcinogenic)	=	4.61E-09	kg/kg-day	calculated	
IF_{ing-s} *(nc)*	Intake Factor (Noncarcinogenic)	=	1.29E-08	kg/kg-day	calculated	$IF_{ing-s} = \frac{IR_{ing-s} * CF * FI * EF * ED}{BW * AT}$
CS_{src}	Source Concentration in Soil	=	chem-spec.	mg/kg	measured value	
TF_s	Transfer Factor	=	1	unitless	conservative assumption	
I_{ing-s}	Intake for Ingestion of Soil	=	chem-spec.	mg/kg-day	chemical - specific	$Risk = I_{ing-s(c)} * CSF_O$; $HI = \frac{I_{ing-s(nc)}}{RfD_O}$
CSF_O	Oral Cancer Slope Factor	=	chem-spec.	$(mg/kg\text{-}day)^{-1}$	chemical - specific	
RfD_O	Oral Reference Dose	=	chem-spec.	mg/kg-day	chemical - specific	
AAF_{ing-s}	Absorption Adjustment Factor	=	1	mg/mg	conservative assumption	
Dermal Contact with Soil						
SA	Exposed Surface Area	=	3,300	cm²/day	recommended default value for a commercial/industrial scenario (representative of face, forearms, and hands) (USEPA 2002)	
AF	Soil Adherence Rate	=	0.2	mg/cm²	recommended default value for commercial/industrial exposure (USEPA 2002)	
CF	Conversion Factor	=	1.0E-06	kg/mg	---	
FC	Fraction of day with contact to soil	=	1	unitless	assumes 100% of daily soil contact occurs from soil at the site	
EF	Exposure Frequency	=	1	days/year	assumes exposure to soil occurs one day per year (MADEP 1995)	$I_{derm-s} = CS_{src} * TF_s * AAF_{derm-s} * IF_{derm-s}$
ED	Exposure Duration	=	25	years	default assumption for an adult nonresidential exposure (PACODE 2011)	
BW	Body Weight	=	70	kg	default assumption for an adult nonresidential exposure (PACODE 2011)	
IF_{derm-s} *(c)*	Absorbed Dose (Carcinogenic)	=	9.23E-09	kg/kg-day	calculated	
IF_{derm-s} *(nc)*	Absorbed Dose (Noncarcinogenic)	=	2.58E-08	kg/kg-day	calculated	$IF_{derm-s} = \frac{SA * AF * CF * FC * EF * ED}{BW * AT}$
CS_{src}	Source Concentration in Soil	=	chem-spec.	mg/kg	measured value	
TF_s	Transfer Factor	=	1	unitless	conservative assumption	
I_{derm-s}	Intake for Dermal Contact with Soil	=	chem-spec.	mg/kg-day	chemical - specific	
CSF_D	Dermal Cancer Slope Factor	=	chem-spec.	$(mg/kg\text{-}day)^{-1}$	chemical - specific	$Risk = I_{derm-s} * CSF_D$; $HI = \frac{I_{derm-s}}{RfD_D}$
RfD_D	Dermal Reference Dose	=	chem-spec.	mg/kg-day	chemical - specific	
AAF_{derm-s}	Absorption Adjustment Factor	=	chem-spec.	mg/mg	chemical - specific	
Inhalation of Constituents Emitted from Soil (Volatiles and Particulates)						
ET	Exposure Time	=	8	hours/day	default assumption for an adult nonresidential exposure (PACODE 2011)	
EF	Exposure Frequency	=	1	days/year	assumes exposure to soil occurs one day per year (MADEP 1995)	$EC = \frac{CA_a * ET * EF * ED}{AT}$
ED	Exposure Duration	=	25	years	default assumption for an adult nonresidential exposure (PACODE 2011)	
EC_c	Exposure Concentration (Carcinogenic)	=	chem-spec.	µg/m³	calculated	
EC_{nc}	Exposure Concentration (Noncarcinogenic)	=	chem-spec.	µg/m³	calculated	
TF_{a-vol}	Transfer Factor (volatiles)	=	chem-spec.	kg/m³	calculated using the soil volatilization model from the Soil Screening Guidance (USEPA 1996)	$CA_a = C_{src} * TF_a$
TF_{a-part}	Transfer Factor (particulates)		1.00E-10	kg/m³	default value (PACODE 2011)	
CA_a	Concentration in Outdoor Air	=	chem-spec.	µg/m³	calculated value	
CF	Conversion Factor	=	1.0E+03	µg/mg	---	
IUR	Inhalation Unit Risk	=	chem-spec.	$(\mu g/m^3)^{-1}$	chemical - specific	$Risk = EC_c * IUR$; $HI = \frac{EC_{nc}}{RfC * CF}$
RfC	Reference Concentration	=	chem-spec.	(mg/m³)	chemical - specific	
C_{src}	Source Concentration in Soil	=	chem-spec.	µg/kg	measured value	

Table 7-5
Summary of Exposure Assumptions for Off-Site Utility Worker (Central Ave. ROW)
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Parameter			Value	Units	Comments/References	Intake Equation
Averaging Times						
Ingestion/Dermal						
AT (c)	Carcinogenic Effects	=	25,550	days	averaging time for a carcinogen based on lifetime of 70 years (lifetime in years x 365 days/year) (USEPA 1991)	
AT (nc)	Noncarcinogenic Effects	=	9,125	days	averaging time for a noncarcinogen (ED in years x 365 days/year) (USEPA 1989)	
Inhalation						
AT (c)	Carcinogenic Effects	=	613,200	hours	averaging time for a carcinogen based on lifetime of 70 years (lifetime in years x 365 days/year x 24 hours/day) (USEPA 2009)	
AT (nc)	Noncarcinogenic Effects	=	219,000	hours	averaging time for a noncarcinogen (ED in years x 365 days/year x 24 hours/day) (USEPA 2009)	
Exposure Assumptions Associated with Direct Contact with Groundwater						
Dermal Contact with Groundwater						
SA	Exposed Surface Area	=	2,?50	cm^2	mean body surface area exposed for adult male (corresponds to forearms and hands) (USEPA 2011)	
ET	Exposure Time	=	8	hrs/day	default assumption for an adult nonresidential exposure (PACODE 2011)	
EF	Exposure Frequency	=	1	days/year	assumes exposure to groundwater occurs one day per year (MADEP 1995)	$I_{derm-w} = CW_{[illegible]} * TF_w * PC * IF_{derm-w}$
ED	Exposure Duration	=	25	years	default assumption for an adult nonresidential exposure (PACODE 2011)	
CF	Conversion Factor	=	1.0E-03	L/cm^3	---	
BW	Body Weight	=	70	kg	default assumption for an adult nonresidential exposure (PACODE 2011)	$IF_{derm-w} = \frac{SA * ET * EF * ED * CF}{BW * AT}$
IF_{derm-w} *(c)*	Absorbed Dose (Carcinogenic)	=	2.85E-04	L-hr/cm-kg-day	calculated	
IF_{derm-w} *(nc)*	Absorbed Dose (Noncarcinogenic)	=	7.98E-04	L-hr/cm-kg-day	calculated	
CW_{gw}	Source Concentration in GW	=	chem-spec.	mg/L	measured value	$HI = \frac{I_{derm-w}}{RfD_D}$ $Risk = I_{derm-w} * CSF_D$
TF_w	Transfer Factor	=	1	unitless	conservative assumption	
PC	Permeability Constant	=	chem-spec.	cm/hr	chemical - specific	
Inhalation of Constituents Emitted from Groundwater to Outdoor Air						
ET	Exposure Time	=	8	hours/day	default assumption for an adult nonresidential exposure (PACODE 2011)	
EF	Exposure Frequency	=	1	days/year	assumes exposure to groundwater occurs one day per year (MADEP 1995)	
ED	Exposure Duration	=	25	years	default assumption for an adult nonresidential exposure (PACODE 2011)	$EC = \frac{CA_a * ET * EF * ED}{AT}$
EC_c	Exposure Concentration (Carcinogenic)	=	chem-spec.	$\mu g/m^3$	calculated	
EC_{nc}	Exposure Concentration (Noncarcinogenic)	=	chem-spec.	$\mu g/m^3$	calculated	
$TF_{a\ wt}$	Transfer Factor	=	chem-spec.	L/m^3	calculated using the groundwater volatilization model (VA DEQ 2014)	$CA_a = C_{gw} * TF_a$
CA_a	Concentration in Outdoor Air	=	chem-spec.	$\mu g/m^3$	calculated value	
CF	Conversion Factor	=	1.0E+03	µg/mg	---	
IUR	Inhalation Unit Risk	=	chem-spec.	$(\mu g/m^3)^{-1}$	chemical - specific	$Risk = EC_c * IUR$ $HI = \frac{EC_{nc}}{RfC * CF}$
RfC	Reference Concentration	=	chem-spec.	(mg/m^3)	chemical - specific	
C_{gw}	Source Concentration in Groundwater	=	chem-spec.	µg/L	measured value	

Table 8-1
Calculation of Risks and Hazard Indices for On-Site Trespasser (12 to 18 years old)
Former Top's Diner Property
Johnstown City, Pennsylvania

Inhalation of Chemicals Volatilized to Outdoor Air from Soil

Constituent of Concern	Source Concentration for Soil C_{src} (ug/kg)	Adjusted Soil Saturation Limit $C_{sat-adj}$ (ug/kg)	Transfer Factor TF_{a-vol} (kg/m³)	Outdoor Air Concentration CA_a (ug/m³)	Calculation of Risk: Exposure Concentration (Cancer) EC_c (ug/m³)	Calculation of Risk: Inhalation Unit Risk Factor IUR (ug/m³)⁻¹	Calculation of Risk: Risk from Inhal. of Chem. Vol. from Soil $R_{inhal-v}$ (unitless)	Calculation of Hazard Index: Exposure Concentration (Noncancer) EC_{nc} (ug/m³)	Calculation of Hazard Index: Reference Concentration RfC_I (mg/m³)	Calculation of Hazard Index: Hazard Index from Inhal. of Chem. Vol. from Soil $HI_{inhal-v}$ (unitless)
Volatile Organic Compounds										
Benzene	5980	1.8E+06	1.9E-04	1.2E+00	5.4E-04	7.8E-06	4.3E-09	6.4E-03	3.0E-02	2.1E-04
Toluene	55200	8.3E+05	1.9E-04	1.1E+01	5.0E-03	---	---	5.9E-02	5.0E+00	1.2E-05
Ethylbenzene	42600	4.6E+05	1.9E-04	8.3E+00	3.9E-03	2.5E-06	9.7E-09	[illegible].5E-02	1.0E+00	4.5E-05
Xylenes, total	164	4.3E+05	1.9E-04	3.2E-02	1.5E-05	---	---	1.7E-04	1.0E-01	1.7E-06
Cumene	4710	2.2E+05	1.9E-04	9.1E-01	4.3E-04	---	---	5.0E-03	4.0E-01	1.3E-05
1,2,4-Trimethhylbenzene	58380	2.1E+05	1.9E-04	1.1E+01	5.3E-03	---	---	6.2E-02	7.0E-03	8.9E-03
1,3,5-Trimethylbenzene	37600	1.8E+05	1.9E-04	7.3E+00	3.4E-03	---	---	4.0E-02	6.0E-03	6.7E-03
Semivolatile Organic Compounds										
Naphthalene	---	---	---	---	---	---	---	---	---	---
							1.4E-08			1.6E-02

Note: EPC_a calculated using minimum of CA_{src} or $C_{sat-adj}$.

Table 8-1
Calculation of Risks and Hazard Indices for On-Site Trespasser (12 to 18 years old)
Former Top's Diner Property
Johnstown City, Pennsylvania

Inhalation of Chemicals Volatilized to Outdoor Air from Groundwater

Constituent of Concern	Source Concentration for Groundwater C_{src} (ug/L)	Transfer Factor TF_a (L/m³)	Outdoor Air Concentration CA_a (ug/m³)	Calculation of Risk: Exposure Concentration (Cancer) EC_c (ug/m³)	Calculation of Risk: Inhalation Unit Risk Factor IUR (ug/m³)⁻¹	Calculation of Risk: Risk from Inhal. of Chem. Vol. from Groundwater $R_{inhal\text{-}v}$ (unitless)	Calculation of Hazard Index: Exposure Concentration (Noncancer) EC_{nc} (ug/m³)	Calculation of Hazard Index: Reference Concentration RfC_I (mg/m³)	Calculation of Hazard Index: Hazard Index from Inhal. of Chem. Vol. from Groundwater $HI_{inhal\text{-}v}$ (unitless)
Volatile Organic Compounds									
Benzene	114	1.0E-04	1.2E-02	5.4E-06	7.8E-06	4.2E-11	6.3E-05	3.0E-02	2.1E-06
Toluene	41	1.0E-04	4.1E-03	1.9E-06	---	---	2.3E-05	5.0E+00	4.5E-09
Ethylbenzene	891	1.0E-04	8.9E-02	4.2E-05	2.5E-06	1.0E-10	4.9E-04	1.0E+00	4.9E-07
Xylenes, total	915	9.3E-05	8.5E-02	4.0E-05	---	---	4.6E-04	1.0E-01	4.6E-06
Cumene	43	1.2E-04	5.1E-03	2.4E-06	---	---	2.8E-05	4.0E-01	6.9E-08
1,2,4-Trimethhylbenzene	841	7.7E-05	6.5E-02	3.1E-05	---	---	3.6E-04	7.0E-03	5.1E-05
1,3,5-Trimethylbenzene	593	9.7E-05	5.7E-02	2.7E-05	---	---	3.1E-04	6.0E-03	5.2E-05
Semivolatile Organic Compounds									
Naphthalene	---	---	---	---	---	---	---	---	---
						1.5E-10			1.1E-04

Table 8-2
Calculation of Risks and Hazard Indices for On-Site Construction Worker
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Ingestion of Soil

Constituent of Concern	Source Concentration for Soil CS_{src} (mg/kg)	Transfer Factor TF_s (unitless)	Exposure Point Concentration for Soil EPC_s (mg/kg)	Absorption Adjustment Factor for Ingestion AAF_{ing-s} (mg/mg)	Calculation of Risk: IF_{ing-s} (c) = 4.61E-09 kg/kg-day — Ingestion Intake (Cancer) I_{ing-s} (c) (mg/kg-day)	Oral Cancer Slope Factor for Soil CSF_O (mg/kg-day)$^{-1}$	Risk from Ingestion of Soil R_{ing-s} (unitless)	Calculation of Hazard Index: IF_{ing-s} (nc) = 2.81E-06 kg/kg-day — Ingestion Intake (Noncancer) I_{ing-s} (nc) (mg/kg-day)	Oral Reference Dose for Soil RfD_O (mg/kg-day)	Hazard Index from Ingestion of Soil HI_{ing-s} (unitless)
Volatile Organic Compounds										
Benzene	5.980	1	6.0E+00	1	2.8E-08	5.5E-02	1.5E-09	1.7E-05	1.0E-02	1.7E-03
Toluene	55.200	1	5.5E+01	1	2.5E-07	—	—	1.5E-04	8.0E-01	1.9E-04
Ethylbenzene	42.600	1	4.3E+01	1	2.0E-07	1.1E-02	2.2E-09	1.2E-04	1.0E-01	1.2E-03
Xylenes, Total	164.000	1	1.6E+02	1	7.6E-07	—	—	4.6E-04	4.0E-01	1.2E-03
Cumene	4.710	1	4.7E+00	1	2.2E-08	—	—	1.3E-05	4.0E-01	3.3E-05
1,2,4-Trimethylbenzene	58.380	1	5.8E+01	1	2.7E-07	—	—	1.6E-04	5.0E-02	3.3E-03
1,3,5-Trimethylbenzene	37.600	1	3.8E+01	1	1.7E-07	—	—	1.1E-04	5.0E-01	2.1E-04
Semivolatile Organic Compounds										
Naphthalene	3.38	1	3.4E+00	1	1.6E-08	1.2E-01	1.9E-09	9.5E-06	6.0E-01	1.6E-05
							5.5E-09			7.8E-03

Table 8-2
Calculation of Risks and Hazard Indices for On-Site Construction Worker
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Dermal Contact with Soil

Constituent of Concern	Source Concentration for Soil CS_{src} (mg/kg)	Transfer Factor TF_s (unitless)	Exposure Point Concentration for Soil EPC_s (mg/kg)	Absorption Adjustment Factor for Dermal Contact AAF_{derm-s} (mg/mg)	Calculation of Risk: IF_{derm-s} (c) = 1.38E-08 kg/kg-day — Dermal Absorbed Dose (Cancer) I_{derm-s} (c) (mg/kg-day)	Dermal Cancer Slope Factor for Soil CSF_D (mg/kg-day)$^{-1}$	Risk from Dermal Contact with Soil R_{derm-s} (unitless)	Calculation of Hazard Index: IF_{derm-s} (nc) = 8.42E-06 kg/kg-day — Dermal Absorbed Dose (Noncancer) I_{derm-s} (nc) (mg/kg-day)	Dermal Reference Dose for Soil RfD_D (mg/kg-day)	Hazard Index from Dermal Contact with Soil HI_{derm-s} (unitless)
Volatile Organic Compounds										
Benzene	5.980	1	6.0E+00	0	0.0E+00	5.5E-02	—	0.0E+00	1.0E-02	—
Toluene	55.200	1	5.5E+01	0	0.0E+00	—	—	0.0E+00	8.0E-01	—
Ethylbenzene	42.600	1	4.3E+01	0	0.0E+00	1.1E-02	—	0.0E+00	1.0E-01	—
Xylenes, Total	164.000	1	1.6E+02	0	0.0E+00	—	—	0.0E+00	4.0E-01	—
Cumene	4.710	1	4.7E+00	0	0.0E+00	—	—	0.0E+00	4.0E-01	—
1,2,4-Trimethylbenzene	58.380	1	5.8E+01	0	0.0E+00	—	—	0.0E+00	5.0E-02	—
1,3,5-Trimethylbenzene	37.600	1	3.8E+01	0	0.0E+00	—	—	0.0E+00	5.0E-01	—
Semivolatile Organic Compounds										
Naphthalene	3.380	1	3.4E+00	0.13	6.1E-09	1.2E-01	7.3E-10	3.7E-06	6.0E-01	6.2E-06
							7.3E-10			6.2E-06

Table 8-2
Calculation of Risks and Hazard Indices for On-Site Construction Worker
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Inhalation of Chemicals Volatilized to Outdoor Air from Soil

Constituent of Concern					Calculation of Risk			Calculation of Hazard Index		
	Source Concentration for Soil C_{src} (µg/kg)	Adjusted Soil Saturation Limit $C_{sat-adj}$ (µg/kg)	Transfer Factor TF_{a-vol} (kg/m³)	Outdoor Air Concentration CA_a (µg/m³)	Exposure Concentration (Cancer) EC_c (µg/m³)	Inhalation Unit Risk Factor IUR (µg/m³)⁻¹	Risk from Inhal. of Chem. Vol. from Soil $R_{inhal-v}$ (unitless)	Exposure Concentration (Noncancer) EC_{nc} (µg/m³)	Reference Concentration RfC_I (mg/m³)	Hazard Index from Inhal. of Chem. Vol. from Soil $HI_{inhal-v}$ (unitless)
Volatile Organic Compounds										
Benzene	5980	1.8E+06	6.9E-03	4.1E+01	1.3E-02	7.8E-06	1.0E-07	9.4E-01	8.0E-02	1.2E-02
Toluene	55200	8.3E+05	5.7E-03	3.1E+02	1.0E-01	—	—	7.1E+00	5.0E+00	1.4E-03
Ethylbenzene	42600	4.6E+05	4.3E-03	1.8E+02	6.0E-02	2.5E-06	1.5E-07	4.2E+00	9.0E+00	4.6E-04
Xylenes, Total	164000	4.3E+05	4.2E-03	6.8E+02	2.2E-01	—	—	1.6E+01	4.0E-01	3.9E-02
Cumene	4710	2.2E+05	4.0E-03	1.9E+01	6.1E-03	—	—	4.3E-01	4.0E-01	1.1E-03
1,2,4-Trimethylbenzene	58380	2.1E+05	3.1E-03	1.8E+02	5.9E-02	—	—	4.1E+00	7.0E-02	5.9E-02
1,3,5-Trimethylbenzene	37600	1.8E+05	3.7E-03	1.4E+02	4.5E-02	—	—	3.2E+00	1.0E-02	3.2E-01
Semivolatile Organic Compounds										
Naphthalene	—	—	—	—	—	—	—	—	—	—
							2.5E-07			4.3E-01

Note: EPC_a calculated using minimum of CA_{src} or $C_{sat-adj}$.

Table 8-2
Calculation of Risks and Hazard Indices for On-Site Construction Worker
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Inhalation of Particulates Emitted to Outdoor Air from Soil

Constituent of Concern	Source Concentration for Soil C_{src} (µg/kg)	Transfer Factor $TF_{a\text{-}part}$ (kg/m³)	Outdoor Air Concentration CA_a (µg/m³)	Calculation of Risk: Exposure Concentration (Cancer) EC_c (µg/m³)	Calculation of Risk: Inhalation Unit Risk Factor IUR (µg/m³)⁻¹	Calculation of Risk: Risk from Inhal. of Part. Em. from Soil $R_{inhal\text{-}p}$ (unitless)	Calculation of Hazard Index: Exposure Concentration (Noncancer) EC_{nc} (µg/m³)	Calculation of Hazard Index: Reference Concentration RfC_I (mg/m³)	Calculation of Hazard Index: Hazard Index from Inhal. of Part. Em. from Soil $HI_{inhal\text{-}p}$ (unitless)
Volatile Organic Compounds									
Benzene	---	---	---	---	---	---	---	---	---
Toluene	---	---	---	---	---	---	---	---	---
Ethylbenzene	---	---	---	---	---	---	---	---	---
Xylenes, Total	---	---	---	---	---	---	---	---	---
Cumene	---	---	---	---	---	---	---	---	---
1,2,4-Trimethylbenzene	---	---	---	---	---	---	---	---	---
1,3,5-Trimethylbenzene	---	---	---	---	---	---	---	---	---
Semivolatile Organic Compounds									
Naphthalene	3379	1.0E-10	3.4E-07	1.1E-10	3.4E-05	3.7E-15	7.7E-09	3.0E-03	2.6E-09
						3.7E-15			2.6E-09

Table 8-2
Calculation of Risks and Hazard Indices for On-Site Construction Worker
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Dermal Contact with Groundwater

Constituent of Concern	Source Concentration for Groundwater CW_{src} (mg/L)	Transfer Factor TF_w (unitless)	Exposure Point Concentration for Groundwater EPC_w (mg/L)	Solubility in Water S (mg/L)	Adjusted Exposure Point Concentration for Groundwater $EPC_{w\text{-}adj}$ (mg/L)	Permeability Constant PC (cm/hr)	Calculation of Risk: $IF_{derm\text{-}w}$ (c) = 5.70E-05 L-hr/cm-kg-day — Dermal Absorbed Dose (Cancer) $I_{derm\text{-}w}$ (c) (mg/kg-day)	Dermal Cancer Slope Factor for Groundwater CSF_D $(mg/kg\text{-}day)^{-1}$	Risk from Dermal Contact with Groundwater $R_{derm\text{-}w}$ (unitless)	Calculation of Hazard Index: $IF_{derm\text{-}w}$ (nc) = 3.47E-02 L-hr/cm-kg-day — Dermal Absorbed Dose (Noncancer) $I_{derm\text{-}w}$ (nc) (mg/kg-day)	Dermal Reference Dose for Groundwater RfD_D (mg/kg-day)	Hazard Index from Dermal Contact with Groundwater $HI_{derm\text{-}w}$ (unitless)
Volatile Organic Compounds												
Benzene	0.114	1	1.1E-01	1.8E+03	1.1E-01	1.5E-02	9.6E-08	5.5E-02	5.3E-09	5.9E-05	1.0E-02	5.9E-03
Toluene	0.041	1	4.1E-02	5.3E+02	4.1E-02	3.1E-02	7.3E-08	---	---	4.4E-05	8.0E-01	5.5E-05
Ethylbenzene	0.891	1	8.9E-01	1.6E+02	8.9E-01	4.7E-02	2.4E-06	1.1E-02	2.6E-08	1.5E-03	1.0E-01	1.5E-02
Xylenes, Total	0.915	1	9.2E-01	1.8E+02	9.2E-01	4.7E-02	2.5E-06	---	---	1.5E-03	4.0E-01	3.7E-03
Cumene	0.043	1	4.3E-02	5.0E+01	4.3E-02	7.9E-02	1.9E-07	---	---	1.2E-04	4.0E-01	2.9E-04
1,2,4-Trimethylbenzene	0.841	1	8.4E-01	5.6E+01	8.4E-01	7.6E-02	3.6E-06	---	---	2.2E-03	5.0E-02	4.4E-02
1,3,5-Trimethylbenzene	0.593	1	5.9E-01	4.9E+01	5.9E-01	5.8E-02	2.0E-06	---	---	1.2E-03	5.0E-01	2.4E-03
Semivolatile Organic Compounds												
Naphthalene	0.368	1	3.7E-01	3.0E+01	3.7E-01	4.7E-02	9.9E-07	1.2E-01	1.2E-07	6.0E-04	6.0E-01	1.0E-03
									1.5E-07			7.2E-02

Table 8-2
Calculation of Risks and Hazard Indices for On-Site Construction Worker
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Inhalation of Chemicals Volatilized to Outdoor Air from Exposed Groundwater

Constituent of Concern	Source Concentration for Groundwater C_{src} (µg/L)	Transfer Factor TF_a (L/m³)	Outdoor Air Concentration CA_a (µg/m³)	Calculation of Risk: Exposure Concentration (Cancer) EC_c (µg/m³)	Calculation of Risk: Inhalation Unit Risk Factor IUR (µg/m³)⁻¹	Calculation of Risk: Risk from Inhal. of Chem. Vol. from Groundwater $R_{inhal-v}$ (unitless)	Calculation of Hazard Index: Exposure Concentration (Noncancer) EC_{nc} (µg/m³)	Calculation of Hazard Index: Reference Concentration RfC_I (mg/m³)	Calculation of Hazard Index: Hazard Index from Inhal. of Chem. Vol. from Groundwater $HI_{inhal-v}$ (unitless)
Volatile Organic Compounds									
Benzene	114	5.5E-01	6.3E+01	4.1E-03	7.8E-06	3.2E-08	2.9E-01	8.0E-02	3.6E-03
Toluene	41	5.1E-01	2.1E+01	1.4E-03	---	---	9.6E-02	5.0E+00	1.9E-05
Ethylbenzene	891	4.8E-01	4.3E+02	2.8E-02	2.5E-06	6.9E-08	1.9E+00	9.0E+00	2.2E-04
Xylenes, Total	915	4.8E-01	4.3E+02	2.8E-02	---	---	2.0E+00	4.0E-01	5.0E-03
Cumene	43	4.5E-01	1.9E+01	1.3E-03	---	---	8.8E-02	4.0E-01	2.2E-04
1,2,4-Trimethylbenzene	841	4.5E-01	3.8E+02	2.5E-02	---	---	1.7E+00	7.0E-02	2.5E-02
1,3,5-Trimethylbenzene	593	4.5E-01	2.7E+02	1.7E-02	---	---	1.2E+00	1.0E-02	1.2E-01
Semivolatile Organic Compounds									
Naphthalene	---	---	---	---	---	---	---	---	---
						1.0E-07			1.6E-01

Table 8-3
Calculation of Risks and Hazard Indices for On-Site Utility Worker
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Ingestion of Soil

Constituent of Concern	Source Concentration for Soil CS_{src} (mg/kg)	Transfer Factor TF_s (unitless)	Exposure Point Concentration for Soil EPC_s (mg/kg)	Absorption Adjustment Factor for Ingestion AAF_{ing-s} (mg/mg)	Calculation of Risk: IF_{ing-s} (c) = 4.61E-09 kg/kg-day — Ingestion Intake (Cancer) I_{ing-s} (c) (mg/kg-day)	Oral Cancer Slope Factor for Soil CSF_O (mg/kg-day)$^{-1}$	Risk from Ingestion of Soil R_{ing-s} (unitless)	Calculation of Hazard Index: IF_{ing-s} (nc) = 1.29E-08 kg/kg-day — Ingestion Intake (Noncancer) I_{ing-s} (nc) (mg/kg-day)	Oral Reference Dose for Soil RfD_O (mg/kg-day)	Hazard Index from Ingestion of Soil HI_{ing-s} (unitless)
Volatile Organic Compounds										
Benzene	0.400	1	4.0E-01	1	1.8E-09	5.5E-02	1.0E-10	5.2E-09	4.0E-03	1.3E-06
Toluene	0.960	1	9.6E-01	1	4.4E-09	---	---	1.2E-08	8.0E-02	1.5E-07
Ethylbenzene	---	---	---	---	---	---	---	---	---	---
Xylenes, Total	1.780	1	1.8E+00	1	8.2E-09	---	---	2.3E-08	2.0E-01	1.1E-07
Cumene	---	---	---	---	---	---	---	---	---	---
1,2,4-Trimethylbenzene	0.908	1	9.1E-01	1	4.2E-09	---	---	1.2E-08	5.0E-02	2.3E-07
1,3,5-Trimethylbenzene	---	---	---	---	---	---	---	---	---	---
Semivolatile Organic Compounds										
Naphthalene	1.330	1	1.3E+00	1	6.1E-09	1.2E-01	7.4E-10	1.7E-08	2.0E-02	8.6E-07
							8.4E-10			2.7E-06

Table 8-3
Calculation of Risks and Hazard Indices for On-Site Utility Worker
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Dermal Contact with Soil

Constituent of Concern	Source Concentration for Soil CS_{src} (mg/kg)	Transfer Factor TF_s (unitless)	Exposure Point Concentration for Soil EPC_s (mg/kg)	Absorption Adjustment Factor for Dermal Contact $AAF_{derm\text{-}s}$ (mg/mg)	Calculation of Risk: $IF_{derm\text{-}s}$ (c) = 9.23E-09 kg/kg-day — Dermal Absorbed Dose (Cancer) $I_{derm\text{-}s}$ (c) (mg/kg-day)	Dermal Cancer Slope Factor for Soil CSF_D (mg/kg-day)$^{-1}$	Risk from Dermal Contact with Soil $R_{derm\text{-}s}$ (unitless)	Calculation of Hazard Index: $IF_{derm\text{-}s}$ (nc) = 2.58E-08 kg/kg-day — Dermal Absorbed Dose (Noncancer) $I_{derm\text{-}s}$ (nc) (mg/kg-day)	Dermal Reference Dose for Soil RfD_D (mg/kg-day)	Hazard Index from Dermal Contact with Soil $HI_{derm\text{-}s}$ (unitless)
Volatile Organic Compounds										
Benzene	0.400	1	4.0E-01	0	0.0E+00	5.5E-02	—	0.0E+00	4.0E-03	—
Toluene	0.960	1	9.6E-01	0	0.0E+00	—	—	0.0E+00	8.0E-02	—
Ethylbenzene	—	—	—	—	—	—	—	—	—	—
Xylenes, Total	1.780	1	1.8E+00	0	0.0E+00	—	—	0.0E+00	2.0E-01	—
Cumene	—	—	—	—	—	—	—	—	—	—
1,2,4-Trimethylbenzene	0.908	1	9.1E-01	0	0.0E+00	—	—	0.0E+00	5.0E-02	—
1,3,5-Trimethylbenzene	—	—	—	—	—	—	—	—	—	—
Semivolatile Organic Compounds										
Naphthalene	1.330	1	1.33	0.13	1.6E-09	1.2E-01	1.9E-10	4.5E-09	2.0E-02	2.2E-07
							1.9E-10			2.2E-07

Table 8-3
Calculation of Risks and Hazard Indices for On-Site Utility Worker
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Inhalation of Chemicals Volatilized to Outdoor Air from Soil

Constituent of Concern	Source Concentration for Soil C_{src} (ug/kg)	Adjusted Soil Saturation Limit $C_{sat-adj}$ (ug/kg)	Transfer Factor TF_{a-vol} (kg/m^3)	Outdoor Air Concentration CA_a (ug/m^3)	Calculation of Risk: Exposure Concentration (Cancer) EC_c (ug/m^3)	Calculation of Risk: Inhalation Unit Risk Factor IUR (ug/m^3)$^{-1}$	Calculation of Risk: Risk from Inhal. of Chem. Vol. from Soil $R_{inhal-v}$ (unitless)	Calculation of Hazard Index: Exposure Concentration (Noncancer) EC_{nc} (ug/m^3)	Calculation of Hazard Index: Reference Concentration RfC_I (mg/m^3)	Calculation of Hazard Index: Hazard Index from Inhal. of Chem. Vol. from Soil $HI_{i,inhal-v}$ (unitless)
Volatile Organic Compounds										
Benzene	5980	1.8E+06	6.0E-05	3.6E-01	1.2E-04	7.8E-06	9.1E-10	3.3E-04	3.0E-02	1.1E-05
Toluene	55200	8.3E+05	6.0E-05	3.3E+00	1.1E-03	—	—	3.0E-03	5.0E+00	6.0E-07
Ethylbenzene	42600	4.6E+05	6.0E-05	2.5E+00	8.3E-04	2.5E-06	2.1E-09	2.3E-03	1.0E+00	2.3E-06
Xylenes, Total	164000	4.3E+05	6.0E-05	9.8E+00	3.2E-03	—	—	8.9E-03	1.0E-01	8.9E-05
Cumene	4710	2.2E+05	6.0E-05	2.8E-01	9.1E-05	—	—	2.6E-04	4.0E-01	6.4E-07
1,2,4-Trimethylbenzene	58380	2.1E+05	6.0E-05	3.5E+00	1.1E-03	—	—	3.2E-03	7.0E-03	4.5E-04
1,3,5-Trimethylbenzene	37600	1.8E+05	6.0E-05	2.2E+00	7.3E-04	—	—	2.0E-03	6.0E-03	3.4E-04
Semivolatile Organic Compounds										
Naphthalene	—	—	—	—	—	—	—	—	—	—
							3.0E-09			9.0E-04

Note: EPC_a calculated using minimum of CA_{src} or $C_{sat-adj}$.

Table 8-3
Calculation of Risks and Hazard Indices for On-Site Utility Worker
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Inhalation of Particulates Emitted to Outdoor Air from Soil

Constituent of Concern	Source Concentration for Soil C_{src} (ug/kg)	Transfer Factor $TF_{a\text{-}part}$ (kg/m³)	Outdoor Air Concentration CA_a (ug/m³)	Calculation of Risk: Exposure Concentration (Cancer) EC_c (ug/m³)	Calculation of Risk: Inhalation Unit Risk Factor IUR (ug/m³)⁻¹	Calculation of Risk: Risk from Inhal. of Part. Em. from Soil $R_{inhal\text{-}p}$ (unitless)	Calculation of Hazard Index: Exposure Concentration (Noncancer) EC_{nc} (ug/m³)	Calculation of Hazard Index: Reference Concentration RfC_i (mg/m³)	Calculation of Hazard Index: Hazard Index from Inhal. of Part. Em. from Soil $HI_{inhal\text{-}p}$ (unitless)
Volatile Organic Compounds									
Benzene	---	---	---	---	---	---	---	---	---
Toluene	---	---	---	---	---	---	---	---	---
Ethylbenzene	---	---	---	---	---	---	---	---	---
Xylenes, Total	---	---	---	---	---	---	---	---	---
Cumene	---	---	---	---	---	---	---	---	---
1,2,4-Trimethylbenzene	---	---	---	---	---	---	---	---	---
1,3,5-Trimethylbenzene	---	---	---	---	---	---	---	---	---
Semivolatile Organic Compounds									
Naphthalene	1330	1.0E-10	1.3E-07	4.3E-11	3.4E-05	1.5E-15	1.2E-10	3.0E-03	4.0E-11
						1.5E-15			4.0E-11

Table 8-3
Calculation of Risks and Hazard Indices for On-Site Utility Worker
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Inhalation of Chemicals Volatilized to Outdoor Air from Unexposed Groundwater

Constituent of Concern	Source Concentration for Groundwater C_{src} (ug/L)	Transfer Factor TF_a (L/m³)	Outdoor Air Concentration CA_a (ug/m³)	Calculation of Risk: Exposure Concentration (Cancer) EC_c (ug/m³)	Calculation of Risk: Inhalation Unit Risk Factor IUR (ug/m³)⁻¹	Calculation of Risk: Risk from Inhal. of Chem. Vol. from Groundwater $R_{inhal-v}$ (unitless)	Calculation of Hazard Index: Exposure Concentration (Noncancer) EC_{nc} (ug/m³)	Calculation of Hazard Index: Reference Concentration RfC_I (mg/m³)	Calculation of Hazard Index: Hazard Index from Inhal. of Chem. Vol. from Groundwater $HI_{inhal-v}$ (unitless)
Volatile Organic Compounds									
Benzene	114	8.4E-02	9.5E+00	3.1E-03	7.8E-06	2.4E-08	8.7E-03	3.0E-02	2.9E-04
Toluene	41	8.7E-02	3.6E+00	1.2E-03	---	---	3.3E-03	5.0E+00	6.5E-07
Ethylbenzene	891	9.1E-02	8.1E+01	2.6E-02	2.5E-06	6.6E-08	7.4E-02	1.0E+00	7.4E-05
Xylenes, Total	915	7.4E-02	6.8E+01	2.2E-02	---	---	6.2E-02	1.0E-01	6.2E-04
Cumene	43	1.2E-01	5.0E+00	1.6E-03	---	---	4.6E-03	4.0E-01	1.1E-05
1,2,4-Trimethylbenzene	841	6.3E-02	5.3E+01	1.7E-02	---	---	4.9E-02	7.0E-03	7.0E-03
1,3,5-Trimethylbenzene	593	8.9E-02	5.3E+01	1.7E-02	---	---	4.8E-02	6.0E-03	8.0E-03
Semivolatile Organic Compounds									
Naphthalene	---	---	---	---	---	---	---	---	---
						9.0E-08			1.6E-02

Table 8-4
Calculation of Risks and Hazard Indices for Off-Site Construction Worker (Central Ave. ROW)
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsyvlania

Ingestion of Soil

Constituent of Concern	Source Concentration for Soil CS_{src} (mg/kg)	Transfer Factor TF_s (unitless)	Exposure Point Concentration for Soil EPC_s (mg/kg)	Absorption Adjustment Factor for Ingestion AAF_{ing-s} (mg/mg)	Calculation of Risk: IF_{ing-s} (c) = 4.61E-09 kg/kg-day — Ingestion Intake (Cancer) I_{ing-s} (c) (mg/kg-day)	Oral Cancer Slope Factor for Soil CSF_O (mg/kg-day)$^{-1}$	Risk from Ingestion of Soil R_{ing-s} (unitless)	Calculation of Hazard Index: IF_{ing-s} (nc) = 2.81E-06 kg/kg-day — Ingestion Intake (Noncancer) I_{ing-s} (nc) (mg/kg-day)	Oral Reference Dose for Soil RfD_O (mg/kg-day)	Hazard Index from Ingestion of Soil HI_{ing-s} (unitless)
Volatile Organic Compounds										
Benzene	0.4	1	4.0E-01	1	1.8E-09	5.5E-02	1.0E-10	1.1E-06	1.0E-02	1.1E-04
Toluene	0.96	1	9.6E-01	1	4.4E-09	—	—	2.7E-06	8.0E-01	3.4E-06
Ethylbenzene	15.3	1	1.5E+01	1	7.1E-08	1.1E-02	7.8E-10	4.3E-05	1.0E-01	4.3E-04
Xylenes, Total	6.66	1	6.7E+00	1	3.1E-08	—	—	1.9E-05	4.0E-01	4.7E-05
Cumene	2.36	1	2.4E+00	1	1.1E-08	—	—	6.6E-06	4.0E-01	1.7E-05
1,2,4-Trimethylbenzene	4.19	1	4.2E+00	1	1.9E-08	—	—	1.2E-05	5.0E-02	2.4E-04
1,3,5-Trimethylbenzene	4.43	1	4.4E+00	1	2.0E-08	—	—	1.2E-05	5.0E-01	2.5E-05
Semivolatile Organic Compounds										
Naphthalene	12.3	1	1.2E+01	1	5.7E-08	1.2E-01	6.8E-09	3.5E-05	6.0E-01	5.8E-05
							7.7E-09			9.3E-04

Table 8-4
Calculation of Risks and Hazard Indices for Off-Site Construction Worker (Central Ave. ROW)
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Dermal Contact with Soil

					Calculation of Risk			Calculation of Hazard Index		
					IF_{derm-s} (c) =	1.38E-08	kg/kg-day	IF_{derm-s} (nc) =	8.42E-06	kg/kg-day
Constituent of Concern	Source Concentration for Soil CS_{src} (mg/kg)	Transfer Factor TF_s (unitless)	Exposure Point Concentration for Soil EPC_s (mg/kg)	Absorption Adjustment Factor for Dermal Contact AAF_{derm-s} (mg/mg)	Dermal Absorbed Dose (Cancer) I_{derm-s} (c) (mg/kg-day)	Dermal Cancer Slope Factor for Soil CSF_D $(mg/kg\text{-}day)^{-1}$	Risk from Dermal Contact with Soil R_{derm-s} (unitless)	Dermal Absorbed Dose (Noncancer) I_{derm-s} (nc) (mg/kg-day)	Dermal Reference Dose for Soil RfD_D (mg/kg-day)	Hazard Index from Dermal Contact with Soil HI_{derm-s} (unitless)
Volatile Organic Compounds										
Benzene	0.4	1	4.0E-01	0	0.0E+00	5.5E-02	---	0.0E+00	1.0E-02	---
Toluene	0.96	1	9.6E-01	0	0.0E+00	---	---	0.0E+00	8.0E-01	---
Ethylbenzene	15.3	1	1.5E+01	0	0.0E+00	1.1E-02	---	0.0E+00	1.0E-01	---
Xylenes, Total	6.66	1	6.7E+00	0	0.0E+00	---	---	0.0E+00	4.0E-01	---
Cumene	2.36	1	2.4E+00	0	0.0E+00	---	---	0.0E+00	4.0E-01	---
1,2,4-Trimethylbenzene	4.19	1	4.2E+00	0	0.0E+00	---	---	0.0E+00	5.0E-02	---
1,3,5-Trimethylbenzene	4.43	1	4.4E+00	0	0.0E+00	---	---	0.0E+00	5.0E-01	---
Semivolatile Organic Compounds										
Naphthalene	12.3	1	1.2E+01	0.13	2.2E-08	1.2E-01	2.7E-09	1.3E-05	6.0E-01	2.2E-05
							2.7E-09			2.2E-05

Table 8-4

Calculation of Risks and Hazard Indices for Off-Site Construction Worker (Central Ave. ROW)

Risk Assessment Report

Former Top's Diner Property

Johnstown City, Pennsylvania

Inhalation of Chemicals Volatilized to Outdoor Air from Soil

Constituent of Concern	Source Concentration for Soil C_{src} (µg/kg)	Adjusted Soil Saturation Limit $C_{sat\text{-}adj}$ (µg/kg)	Transfer Factor $TF_{a\text{-}vol}$ (kg/m^3)	Outdoor Air Concentration CA_s (µg/m^3)	Calculation of Risk: Exposure Concentration (Cancer) EC_c (µg/m^3)	Calculation of Risk: Inhalation Unit Risk Factor IUR (µg/m^3)$^{-1}$	Calculation of Risk: Risk from Inhal. of Chem. Vol. from Soil $R_{inhal\text{-}v}$ (unitless)	Calculation of Hazard Index: Exposure Concentration (Noncancer) EC_{nc} (µg/m^3)	Calculation of Hazard Index: Reference Concentration RfC_I (mg/m^3)	Calculation of Hazard Index: Hazard Index from Inhal. of Chem. Vol. from Soil $HI_{inhal\text{-}v}$ (unitless)
Volatile Organic Compounds										
Benzene	400	1.8E+06	3.6E-03	1.4E+00	4.7E-04	7.8E-06	3.7E-09	3.3E-02	8.0E-02	4.1E-04
Toluene	960	8.3E+05	3.4E-03	3.2E+00	1.1E-03	—	—	7.4E-02	5.0E+00	1.5E-05
Ethylbenzene	15300	4.6E+05	2.5E-03	3.9E+01	1.3E-02	2.5E-06	3.2E-08	8.9E-01	9.0E+00	9.9E-05
Xylenes, Total	6660	4.3E+05	2.5E-03	1.7E+01	5.4E-03	—	—	3.8E-01	4.0E-01	9.4E-04
Cumene	2360	2.2E+05	2.4E-03	5.6E+00	1.8E-03	—	—	1.3E-01	4.0E-01	3.2E-04
1,2,4-Trimethylbenzene	4190	2.1E+05	1.8E-03	7.7E+00	2.5E-03	—	—	1.8E-01	7.0E-02	2.5E-03
1,3,5-Trimethylbenzene	4430	1.8E+05	2.2E-03	9.7E+00	3.2E-03	—	—	2.2E-01	1.0E-02	2.2E-02
Semivolatile Organic Compounds										
Naphthalene	—	—	—	—	—	—	—	—	—	—
							3.5E-08			2.6E-02

Note: FPC_a calculated using minimum of CA_{src} or $C_{sat\text{-}adj}$.

Table 8-4
Calculation of Risks and Hazard Indices for Off-Site Construction Worker (Central Ave. ROW)
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Inhalation of Particulates Emitted to Outdoor Air from Soil

Constituent of Concern	Source Concentration for Soil C_{src} (µg/kg)	Transfer Factor $TF_{a\text{-}part}$ (kg/m³)	Outdoor Air Concentration CA_a (µg/m³)	Calculation of Risk: Exposure Concentration (Cancer) EC_c (µg/m³)	Calculation of Risk: Inhalation Unit Risk Factor IUR (µg/m³)⁻¹	Calculation of Risk: Risk from Inhal. of Part. Em. from Soil $R_{inhal\text{-}p}$ (unitless)	Calculation of Hazard Index: Exposure Concentration (Noncancer) EC_{nc} (µg/m³)	Calculation of Hazard Index: Reference Concentration RfC_i (mg/m³)	Calculation of Hazard Index: Hazard Index from Inhal. of Part. Em. from Soil $HI_{inhal\text{-}p}$ (unitless)
Volatile Organic Compounds									
Benzene	---	---	---	---	---	---	---	---	---
Toluene	---	---	---	---	---	---	---	---	---
Ethylbenzene	---	---	---	---	---	---	---	---	---
Xylenes, Total	---	---	---	---	---	---	---	---	---
Cumene	---	---	---	---	---	---	---	---	---
1,2,4-Trimethylbenzene	---	---	---	---	---	---	---	---	---
1,3,5-Trimethylbenzene	---	---	---	---	---	---	---	---	---
Semivolatile Organic Compounds									
Naphthalene	12300	1.0E-10	1.2E-06	4.0E-10	3.4E-05	1.4E-14	2.8E-08	3.0E-03	9.4E-09
						1.4E-14			9.4E-09

Table 8-4
Calculation of Risks and Hazard Indices for Off-Site Construction Worker (Central Ave. ROW)
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Inhalation of Chemicals Volatilized to Outdoor Air from Unexposed Groundwater

Constituent of Concern	Source Concentration for Groundwater C_{gw} (µg/L)	Transfer Factor TF_a (L/m³)	Outdoor Air Concentration CA_a (µg/m³)	Calculation of Risk: Exposure Concentration (Cancer) EC_c (µg/m³)	Calculation of Risk: Inhalation Unit Risk Factor IUR (µg/m³)⁻¹	Calculation of Risk: Risk from Inhal. of Chem. Vol. from Groundwater $R_{inhal-v}$ (unitless)	Calculation of Hazard Index: Exposure Concentration (Noncancer) EC_{nc} (µg/m³)	Calculation of Hazard Index: Reference Concentration RfC_I (mg/m³)	Calculation of Hazard Index: Hazard Index from Inhal. of Chem. Vol. from Groundwater $HI_{inhal-v}$ (unitless)
Volatile Organic Compounds									
Benzene	418	9.3E-03	3.9E+00	2.5E-04	7.8E-06	2.0E-09	1.8E-02	8.0E-02	2.2E-04
Toluene	157	9.7E-03	1.5E+00	9.9E-05	---	---	6.9E-03	5.0E+00	1.4E-06
Ethylbenzene	1480	1.0E-02	1.5E+01	9.8E-04	2.5E-06	2.4E-09	6.8E-02	9.0E+00	7.6E-06
Xylenes, Total	2450	8.2E-03	2.0E+01	1.3E-03	---	---	9.2E-02	4.0E-01	2.3E-04
Cumene	217	1.3E-02	2.8E+00	1.8E-04	---	---	1.3E-02	4.0E-01	3.2E-05
1,2,4-Trimethylbenzene	2220	7.0E-03	1.6E+01	1.0E-03	---	---	7.1E-02	7.0E-02	1.0E-03
1,3,5-Trimethylbenzene	990	9.9E-03	9.8E+00	6.4E-04	---	---	4.5E-02	1.0E-02	4.5E-03
Semivolatile Organic Compounds									
Naphthalene	---	---	---	---	---	---	---	---	---
						4.4E-09			6.0E-03

Table 8-5
Calculation of Risks and Hazard Indices for Off-Site Utility Worker (Central Ave. ROW)
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Ingestion of Soil

Constituent of Concern	Source Concentration for Soil CS_{src} (mg/kg)	Transfer Factor TF_s (unitless)	Exposure Point Concentration for Soil EPC_s (mg/kg)	Absorption Adjustment Factor for Ingestion AAF_{ing-s} (mg/mg)	Calculation of Risk: IF_{ing-s} (c) = 4.61E-09 kg/kg-day — Ingestion Intake (Cancer) I_{ing-s} (c) (mg/kg-day)	Oral Cancer Slope Factor for Soil CSF_O (mg/kg-day)$^{-1}$	Risk from Ingestion of Soil R_{ing-s} (unitless)	Calculation of Hazard Index: IF_{ing-s} (nc) = 1.29E-08 kg/kg-day — Ingestion Intake (Noncancer) I_{ing-s} (nc) (mg/kg-day)	Oral Reference Dose for Soil RfD_O (mg/kg-day)	Hazard Index from Ingestion of Soil HI_{ing-s} (unitless)
Volatile Organic Compounds										
Benzene	0.4	1	4.0E-01	1	1.8E-09	5.5E-02	1.0E-10	5.2E-09	4.0E-03	1.3E-06
Toluene	0.96	1	9.6E-01	1	4.4E-09	—	—	1.2E-08	8.0E-02	1.5E-07
Ethylbenzene	15.3	1	1.5E+01	1	7.1E-08	1.1E-02	7.8E-10	2.0E-07	1.0E-01	2.0E-06
Xylenes, Total	6.66	1	6.7E+00	1	3.1E-08	—	—	8.6E-08	2.0E-01	4.3E-07
Cumene	2.36	1	2.4E+00	1	1.1E-08	—	—	3.0E-08	1.0E-01	3.0E-07
1,2,4-Trimethylbenzene	4.19	1	4.2E+00	1	1.9E-08	—	—	5.4E-08	5.0E-02	1.1E-06
1,3,5-Trimethylbenzene	4.43	1	4.4E+00	1	2.0E-08	—	—	5.7E-08	1.0E-02	5.7E-06
Semivolatile Organic Compounds										
Naphthalene	12.3	1	1.2E+01	1	5.7E-08	1.2E-01	6.8E-09	1.6E-07	2.0E-02	7.9E-06
							7.7E-09			1.9E-05

Table 8-5

Calculation of Risks and Hazard Indices for Off-Site Utility Worker (Central Ave. ROW)

Risk Assessment Report

Former Top's Diner Property

Johnstown City, Pennsylvania

Dermal Contact with Soil

					Calculation of Risk			Calculation of Hazard Index		
					$IF_{derm\text{-}s}$ (c) =	9.23E-09	kg/kg-day	$IF_{derm\text{-}s}$ (nc) =	2.58E-08	kg/kg-day
Constituent of Concern	Source Concentration for Soil CS_{ssc} (mg/kg)	Transfer Factor TF_s (unitless)	Exposure Point Concentration for Soil EPC_s (mg/kg)	Absorption Adjustment Factor for Dermal Contact $AAF_{derm\text{-}s}$ (mg/mg)	Dermal Absorbed Dose (Cancer) $I_{derm\text{-}s}$ (c) (mg/kg-day)	Dermal Cancer Slope Factor for Soil CSF_D $(mg/kg\text{-}day)^{-1}$	Risk from Dermal Contact with Soil $R_{derm\text{-}s}$ (unitless)	Dermal Absorbed Dose (Noncancer) $I_{derm\text{-}s}$ (nc) (mg/kg-day)	Dermal Reference Dose for Soil RfD_D (mg/kg-day)	Hazard Index from Dermal Contact with Soil $HI_{derm\text{-}s}$ (unitless)
Volatile Organic Compounds										
Benzene	0.4	1	4.0E-01	0	0.0E+00	5.5E-02	---	0.0E+00	4.0E-03	---
Toluene	0.96	1	9.6E-01	0	0.0E+00	---	---	0.0E+00	8.0E-02	---
Ethylbenzene	15.3	1	1.5E+01	0	0.0E+00	1.1E-02	---	0.0E+00	1.0E-01	---
Xylenes, Total	6.66	1	6.7E+00	0	0.0E+00	---	---	0.0E+00	2.0E-01	---
Cumene	2.36	1	2.4E+00	0	0.0E+00	---	---	0.0E+00	1.0E-01	---
1,2,4-Trimethylbenzene	4.19	1	4.2E+00	0	0.0E+00	---	---	0.0E+00	5.0E-02	---
1,3,5-Trimethylbenzene	4.43	1	4.4E+00	0	0.0E+00	---	---	0.0E+00	1.0E-02	---
Semivolatile Organic Compounds										
Naphthalene	12.3	1	1.2E+01	0.13	1.5E-08	1.2E-01	1.8E-09	4.1E-08	2.0E-02	2.1E-06
							1.8E-09			2.1E-06

Table 8-5
Calculation of Risks and Hazard Indices for Off-Site Utility Worker (Central Ave. ROW)
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Inhalation of Chemicals Volatilized to Outdoor Air from Soil

Constituent of Concern	Source Concentration for Soil C_{src} (ug/kg)	Adjusted Soil Saturation Limit $C_{sat-adj}$ (ug/kg)	Transfer Factor TF_{a-vol} (kg/m^3)	Outdoor Air Concentration CA_a (ug/m^3)	Calculation of Risk: Exposure Concentration (Cancer) EC_c (ug/m^3)	Calculation of Risk: Inhalation Unit Risk Factor IUR (ug/m^3)$^{-1}$	Calculation of Risk: Risk from Inhal. of Chem. Vol. from Soil $R_{inh,sl-v}$ (unitless)	Calculation of Hazard Index: Exposure Concentration (Noncancer) EC_{nc} (ug/m^3)	Calculation of Hazard Index: Reference Concentration RfC_I (mg/m^3)	Calculation of Hazard Index: Hazard Index from Inhal. of Chem. Vol. from Soil $HI_{inhal-v}$ (unitless)
Volatile Organic Compounds										
Benzene	400	1.8E+06	3.1E-05	1.2E-02	4.1E-06	7.8E-06	3.2E-11	1.1E-05	3.0E-02	3.8E-07
Toluene	960	8.3E+05	3.1E-05	3.0E-02	9.8E-06	---	---	2.7E-05	5.0E+00	5.5E-09
Ethylbenzene	15300	4.6E+05	3.1E-05	4.8E-01	1.6E-04	2.5E-06	3.9E-10	4.4E-04	1.0E+00	4.4E-07
Xylenes, Total	6660	4.3E+05	3.1E-05	2.1E-01	6.8E-05	---	---	1.9E-04	1.0E-01	1.9E-06
Cumene	2360	2.2E+05	3.1E-05	7.4E-02	2.4E-05	---	---	6.7E-05	4.0E-01	1.7E-07
1,2,4-Trimethylbenzene	4190	2.1E+05	3.1E-05	1.3E-01	4.3E-05	---	---	1.2E-04	7.0E-03	1.7E-05
1,3,5-Trimethylbenzene	4430	1.8E+05	3.1E-05	1.4E-01	4.5E-05	---	---	1.3E-04	6.0E-03	2.1E-05
Semivolatile Organic Compounds										
Naphthalene	---	---	---	---	---	---	---	---	---	---
							4.2E-10			4.1E-05

Note: EPC_a calculated using minimum of CA_{src} or $C_{sat-adj}$.

Table 8-5
Calculation of Risks and Hazard Indices for Off-Site Utility Worker (Central Ave. ROW)
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Inhalation of Particulates Emitted to Outdoor Air from Soil

Constituent of Concern	Source Concentration for Soil C_{src} (ug/kg)	Transfer Factor $TF_{a\text{-}part}$ (kg/m^3)	Outdoor Air Concentration CA_a (ug/m^3)	Calculation of Risk			Calculation of Hazard Index		
				Exposure Concentration (Cancer) EC_c (ug/m^3)	Inhalation Unit Risk Factor IUR (ug/m^3)$^{-1}$	Risk from Inhal. of Part. Em. from Soil $R_{inhal\text{-}p}$ (unitless)	Exposure Concentration (Noncancer) EC_{nc} (ug/m^3)	Reference Concentration RfC_i (mg/m^3)	Hazard Index from Inhal. of Part. Em. from Soil $HI_{inhal\text{-}p}$ (unitless)
Volatile Organic Compounds									
Benzene	---	---	---	---	---	---	---	---	---
Toluene	---	---	---	---	---	---	---	---	---
Ethylbenzene	---	---	---	---	---	---	---	---	---
Xylenes, Total	---	---	---	---	---	---	---	---	---
Cumene	---	---	---	---	---	---	---	---	---
1,2,4-Trimethylbenzene	---	---	---	---	---	---	---	---	---
1,3,5-Trimethylbenzene	---	---	---	---	---	---	---	---	---
Semivolatile Organic Compounds									
Naphthalene	12300	1.0E-10	1.2E-06	4.0E-10	3.4E-05	1.4E-14	1.1E-09	3.0E-03	3.7E-10
						1.4E-14			3.7E-10

Table 8-5
Calculation of Risks and Hazard Indices for Off-Site Utility Worker (Central Ave. ROW)
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Dermal Contact with Groundwater

Constituent of Concern	Source Concentration for Groundwater CW_{src} (mg/L)	Transfer Factor TF_w (unitless)	Exposure Point Concentration for Groundwater EPC_w (mg/L)	Solubility in Water S (mg/L)	Adjusted Exposure Point Concentration for Groundwater $EPC_{w\text{-}adj}$ (mg/L)	Permeability Constant PC (cm/hr)	Calculation of Risk: $IF_{derm\text{-}w}$ (c) = 2.85E-04 L-hr/cm-kg-day Dermal Absorbed Dose (Cancer) $I_{derm\text{-}w}$ (c) (mg/kg-day)	Dermal Cancer Slope Factor for Groundwater CSF_D (mg/kg-day)$^{-1}$	Risk from Dermal Contact with Groundwater $R_{derm\text{-}w}$ (unitless)	Calculation of Hazard Index: $IF_{derm\text{-}w}$ (nc) = 7.98E-04 L-hr/cm-kg-day Dermal Absorbed Dose (Noncancer) $I_{derm\text{-}w}$ (nc) (mg/kg-day)	Dermal Reference Dose for Groundwater RfD_D (mg/kg-day)	Hazard Index from Dermal Contact with Groundwater $HI_{derm\text{-}w}$ (unitless)
Volatile Organic Compounds												
Benzene	0.418	1	4.2E-01	1.8E+03	4.2E-01	1.5E-02	1.8E-06	5.5E-02	9.7E-08	5.0E-06	4.0E-03	1.2E-03
Toluene	0.157	1	1.6E-01	5.3E+02	1.6E-01	3.1E-02	1.4E-06	—	---	3.9E-06	8.0E-02	4.9E-05
Ethylbenzene	1.480	1	1.5E+00	1.6E+02	1.5E+00	4.7E-02	2.0E-05	1.1E-02	2.2E-07	5.6E-05	1.0E-01	5.6E-04
Xylenes, Total	2.450	1	2.5E+00	1.8E+02	2.5E+00	4.7E-02	3.3E-05	—	---	9.2E-05	2.0E-01	4.6E-04
Cumene	0.217	1	2.2E-01	5.0E+01	2.2E-01	7.9E-02	4.9E-06	—	---	1.4E-05	1.0E-01	1.4E-04
1,2,4-Trimethylbenzene	2.220	1	2.2E+00	5.6E+01	2.2E+00	7.6E-02	4.8E-05	---	—	1.3E-04	5.0E-02	2.7E-03
1,3,5-Trimethylbenzene	0.990	1	9.9E-01	4.9E+01	9.9E-01	5.8E-02	1.6E-05	---	---	4.6E-05	1.0E-02	4.6E-03
Semivolatile Organic Compounds												
Naphthalene	0.995	1	1.0E+00	3.0E+01	1.0E+00	4.7E-02	1.3E-05	1.2E-01	1.6E-06	3.7E-05	2.0E-02	1.9E-03
									1.9E-06			1.2E-02

Table 8-5
Calculation of Risks and Hazard Indices for Off-Site Utility Worker (Central Ave. ROW)
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Inhalation of Chemicals Volatilized to Outdoor Air from Exposed Groundwater

Constituent of Concern	Source Concentration for Groundwater C_{src} (ug/L)	Transfer Factor TF_a (L/m³)	Outdoor Air Concentration CA_a (ug/m³)	Calculation of Risk: Exposure Concentration (Cancer) EC_c (ug/m³)	Calculation of Risk: Inhalation Unit Risk Factor IUR (ug/m³)⁻¹	Calculation of Risk: Risk from Inhal. of Chem. Vol. from Groundwater $R_{inhal-v}$ (unitless)	Calculation of Hazard Index: Exposure Concentration (Noncancer) EC_{nc} (ug/m³)	Calculation of Hazard Index: Reference Concentration RfC_i (mg/m³)	Calculation of Hazard Index: Hazard Index from Inhal. of Chem. Vol. from Groundwater $HI_{inhal-v}$ (unitless)
Volatile Organic Compounds									
Benzene	418	4.0E-01	1.7E+02	5.4E-02	7.8E-06	4.2E-07	1.5E-01	3.0E-02	5.0E-03
Toluene	157	3.7E-01	5.7E+01	1.9E-02	---	---	5.2E-02	5.0E+00	1.0E-05
Ethylbenzene	1480	3.4E-01	5.0E+02	1.6E-01	2.5E-06	4.1E-07	4.6E-01	1.0E+00	4.6E-04
Xylenes, Total	2450	3.4E-01	8.3E+02	2.7E-01	---	---	7.6E-01	1.0E-01	7.6E-03
Cumene	217	3.2E-01	7.0E+01	2.3E-02	---	---	6.4E-02	4.0E-01	1.6E-04
1,2,4-Trimethylbenzene	2220	3.2E-01	7.1E+02	2.3E-01	---	---	6.5E-01	7.0E-03	9.3E-02
1,3,5-Trimethylbenzene	990	3.2E-01	3.2E+02	1.0E-01	---	---	2.9E-01	6.0E-03	4.8E-02
Semivolatile Organic Compounds									
Naphthalene	---	---	---	---	---	---	---	---	---
						8.3E-07			1.5E-01

Table 8-6
Summary of Risks and Hazard Indices for All Receptors
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Risks

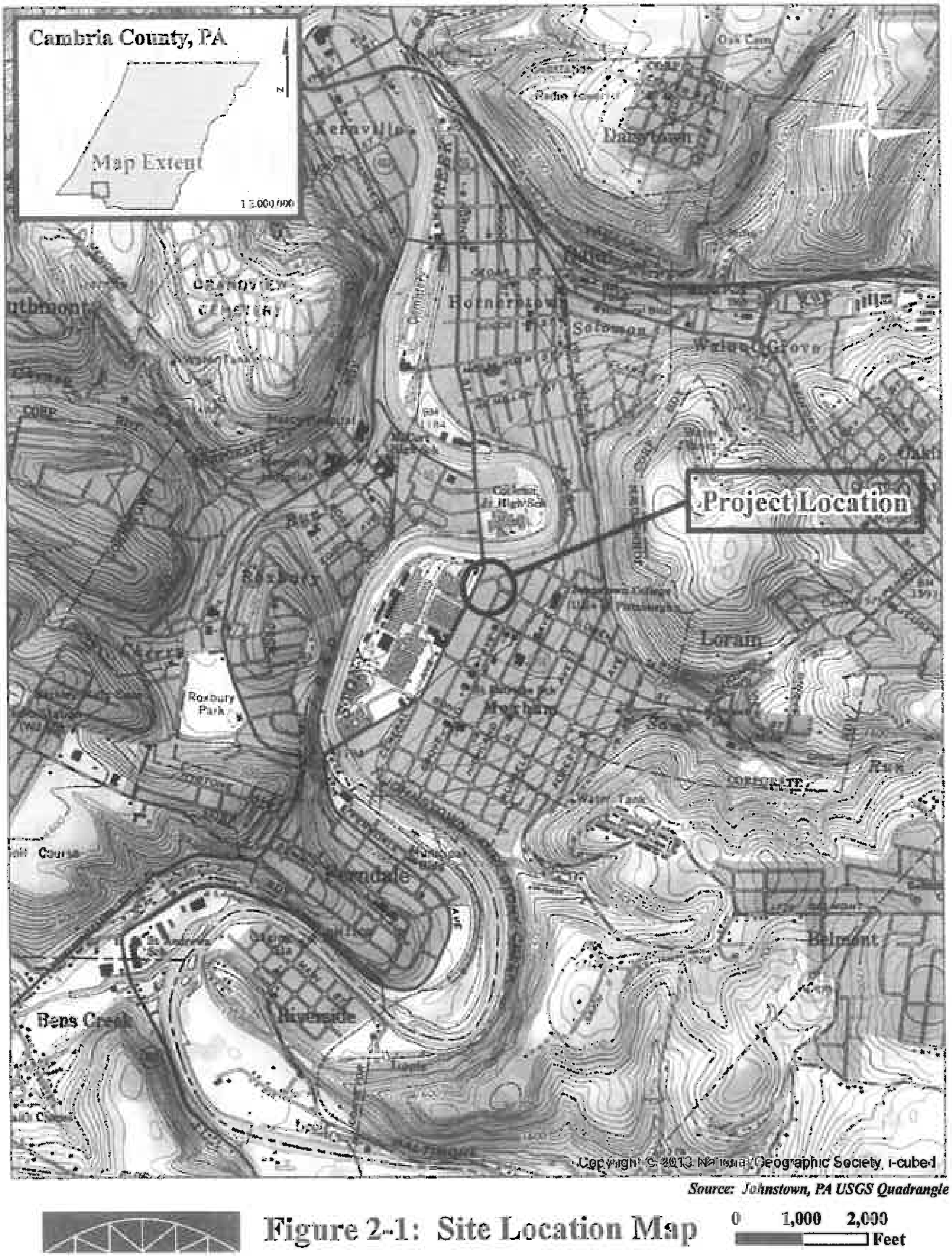
Receptor	Direct Contact									*Total Risk*
	Soil					Groundwater				
	Ingestion	Dermal Contact	Inhalation of Volatiles	Inhalation of Particulates	*Total Soil*	Dermal Contact	Inhalation of Volatiles - Unexposed Groundwater	Inhalation of Volatiles - Exposed Groundwater	*Total Groundwater*	
On-Site										
Trespasser	—	—	1.4E-08	—	*1.4E-08*	—	1.5E-10	—	*1.5E-10*	*1.4E-08*
Construction Worker	5.5E-09	7.3E-10	2.5E-07	3.7E-15	*2.6E-07*	1.5E-07	—	1.0E-07	*2.5E-07*	*5.1E-07*
Utility Worker	8.4E-10	1.9E-10	3.0E-09	1.5E-15	*4.0E-09*	—	9.0E-08	—	*9.0E-08*	*9.4E-08*
Off-Site										
Construction Worker (Central Ave. ROW)	7.7E-09	2.7E-09	3.5E-08	1.4E-14	*4.6E-08*	—	4.4E-09	—	*4.4E-09*	*5.0E-08*
Utility Worker (Central Ave. ROW)	7.7E-09	1.8E-09	4.2E-10	1.4E-14	*9.9E-09*	1.9E-06	—	8.3E-07	*2.7E-06*	*2.8E-06*

Hazard Indices

Receptor	Direct Contact									*Total Hazard Index*
	Soil					Groundwater				
	Ingestion	Dermal Contact	Inhalation of Volatiles	Inhalation of Particulates	*Total Soil*	Dermal Contact	Inhalation of Volatiles - Unexposed Groundwater	Inhalation of Volatiles - Exposed Groundwater	*Total Groundwater*	
On-Site										
Trespasser	—	—	1.6E-02	—	*1.6E-02*	—	1.1E-04	—	*1.1E-04*	*1.6E-02*
Construction Worker	7.8E-03	6.2E-06	4.3E-01	2.6E-09	*4.4E-01*	7.2E-02	—	1.6E-01	*2.3E-01*	*6.6E-01*
Utility Worker	2.7E-06	2.2E-07	9.0E-04	4.0E-11	*9.0E-04*	—	1.6E-02	—	*1.6E-02*	*1.7E-02*
Off-Site										
Construction Worker (Central Ave. ROW)	9.3E-04	2.2E-05	2.6E-02	9.4E-09	*2.7E-02*	—	6.0E-03	—	*6.0E-03*	*3.3E-02*
Utility Worker (Central Ave. ROW)	1.9E-05	2.1E-06	4.1E-05	3.7E-10	*6.2E-05*	1.2E-02	—	1.5E-01	*1.7E-01*	*1.7E-01*

Notes:
Bolded values indicate an exceedances of the upper risk benchmark of $1x10^{-4}$ or the hazard index benchmark of 1.0. As presented in this table, there were no exceedances of the risk/HI benchmark criteria.
"---" - Exposure pathway was not retained for this receptor.

Figures



Source: Johnstown, PA USGS Quadrangle

0 1,000 2,000 Feet

1 Inch = 2,000 Feet

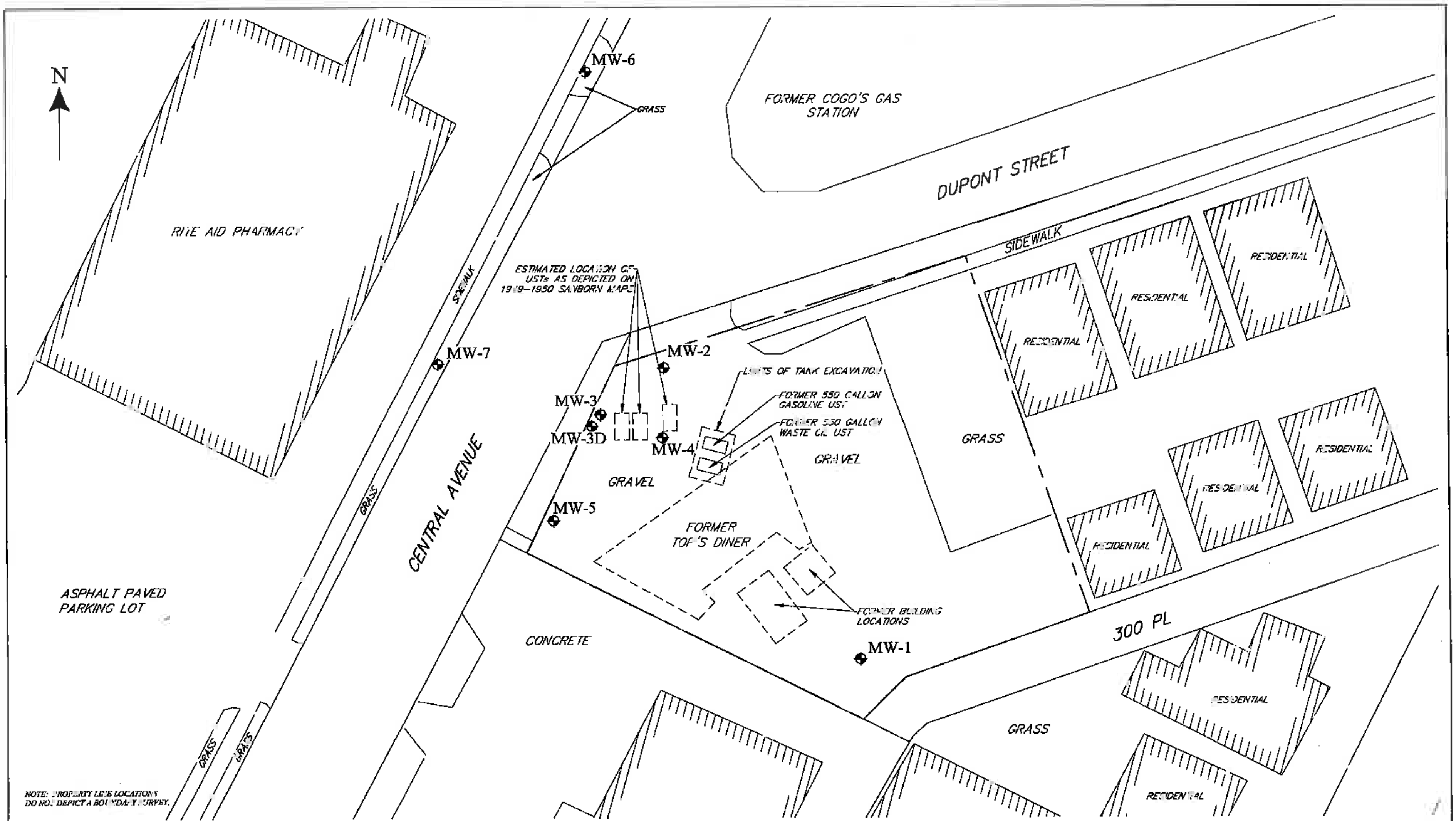
P. JOSEPH LEHMAN, INC.
CONSULTING ENGINEERS
P.O. Box 419
Hollidaysburg, PA 16648

Figure 2-1: Site Location Map

Former Top's Diner Property

410 Central Avenue
Johnstown City, Cambria County, PA

Project Number: 3787
Date: 10-2-2014



LEGEND		SCALE				
MW-6 - MONITORING WELL	- APPROXIMATE SITE BOUNDARY (SOURCE: MOUNTAIN RESEARCH PHASE II ESA, JULY 2012)	0 15 30 FEET 30 SCALE	PREPARED BY: P. JOSEPH LEHMAN, INC. CONSULTING ENGINEERS P.O. BOX 419 HOLLIDAYSBURG, PA 16648	FORMER TOP'S DINER PROPERTY 410 CENTRAL AVENUE JOHNSTOWN CITY, CAMBRIA COUNTY, PA	FIGURE: 2-2	SITE MAP
		PROJECT: 5787	DATE: 4-20-2015			

Imagery Date: 9-6-2013

0 75 150 Feet

1 Inch = 150 Feet

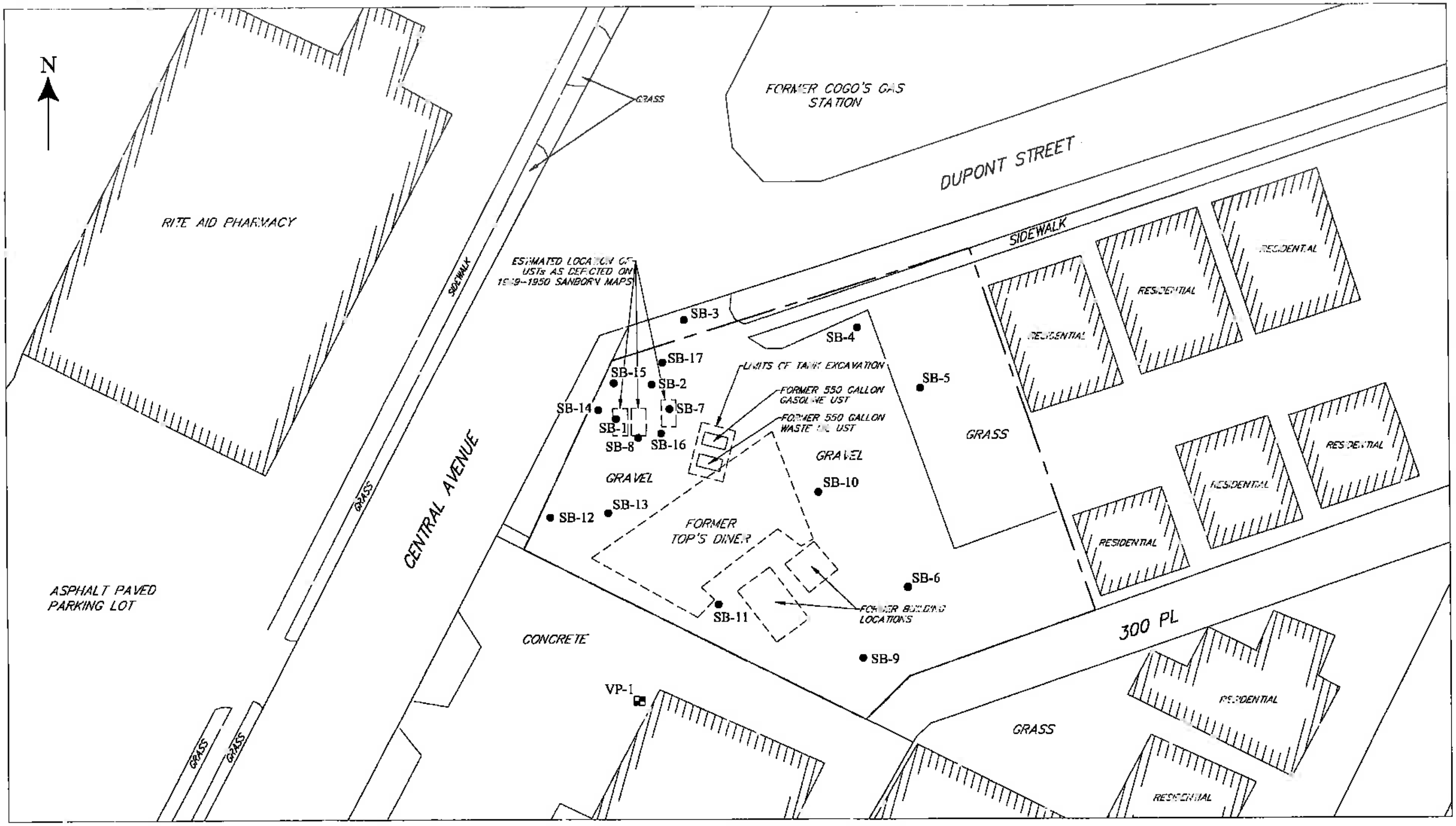
P. JOSEPH LEHMAN, INC.
CONSULTING ENGINEERS
P.O. Box 419
Hollidaysburg, PA 16648

Figure 2-3: Site Area Map

Former Top's Diner Property

410 Central Avenue
Johnstown City, Cambria County, PA

Project Number: 5787
Date: 8-24-2015



LEGEND

● SB-17 - SOIL BORING

▣ VP-1 - VAPOR POINT

— — - APPROXIMATE SITE BOUNDARY (SOURCE: MOUNTAIN RESEARCH PHASE II ESA, JULY 2012)

SCALE

0 15 30 FEET

30 SCALE

PROJECT: 5787

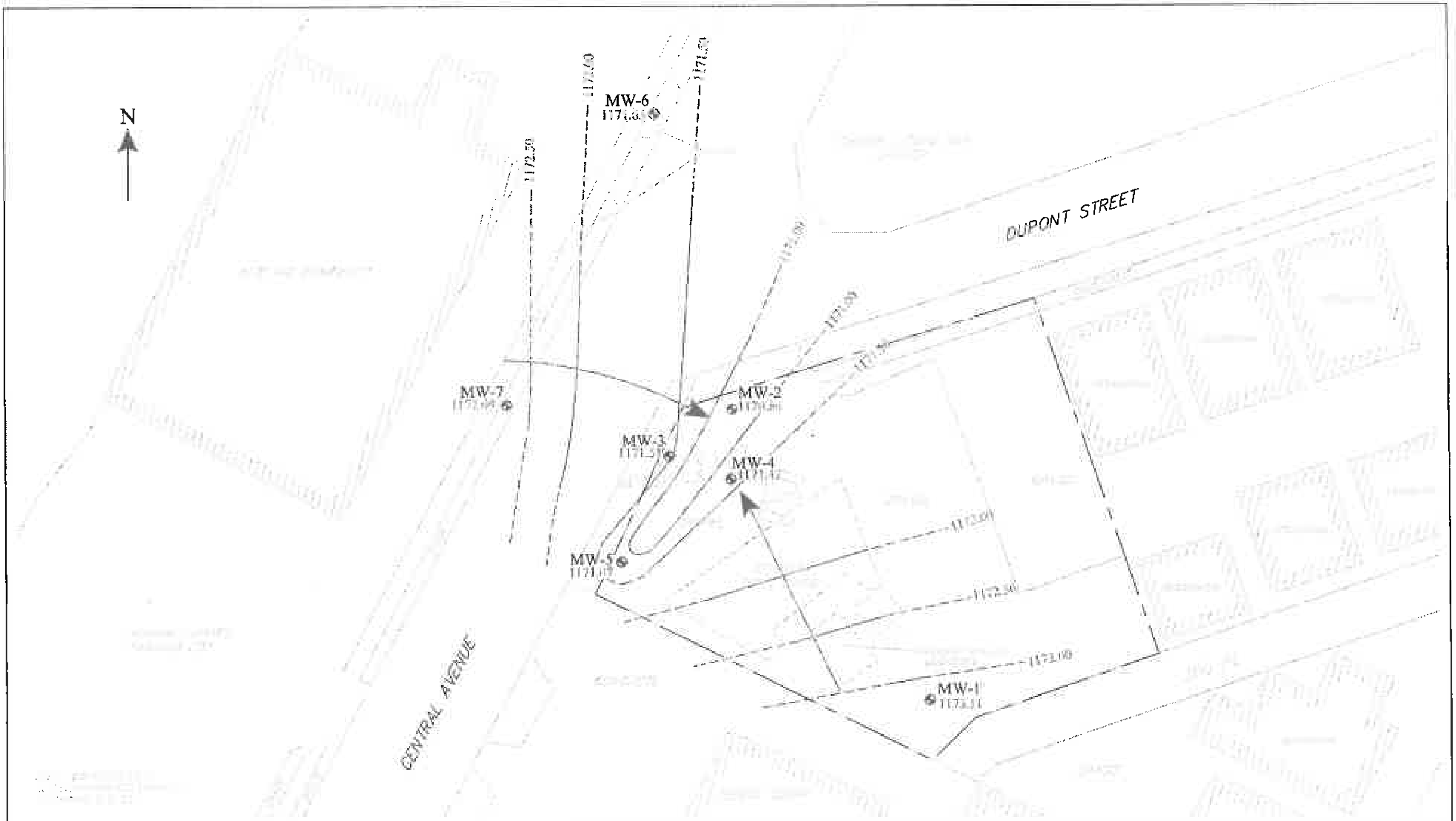
DATE: 4-20-2015

PREPARED BY:
P. JOSEPH LEHMAN, INC.
CONSULTING ENGINEERS
P.O. BOX 419
HOLLIDAYSBURG, PA 16648

FORMER TOP'S DINER PROPERTY
410 CENTRAL AVENUE
JOHNSTOWN CITY,
CAMBRIA COUNTY, PA

FIGURE: 2-4

SOIL BORING LOCATION MAP



LEGEND

MW-2 - MONITORING WELL

1171.07 - GROUNDWATER ELEVATION (FT-AMSL)

1172.00 - GROUNDWATER ELEVATION CONTOUR (FT-AMSL)

- GROUNDWATER FLOW DIRECTION

- APPROXIMATE SITE BOUNDARY

SCALE

0 15 30 FEET

30 SCALE

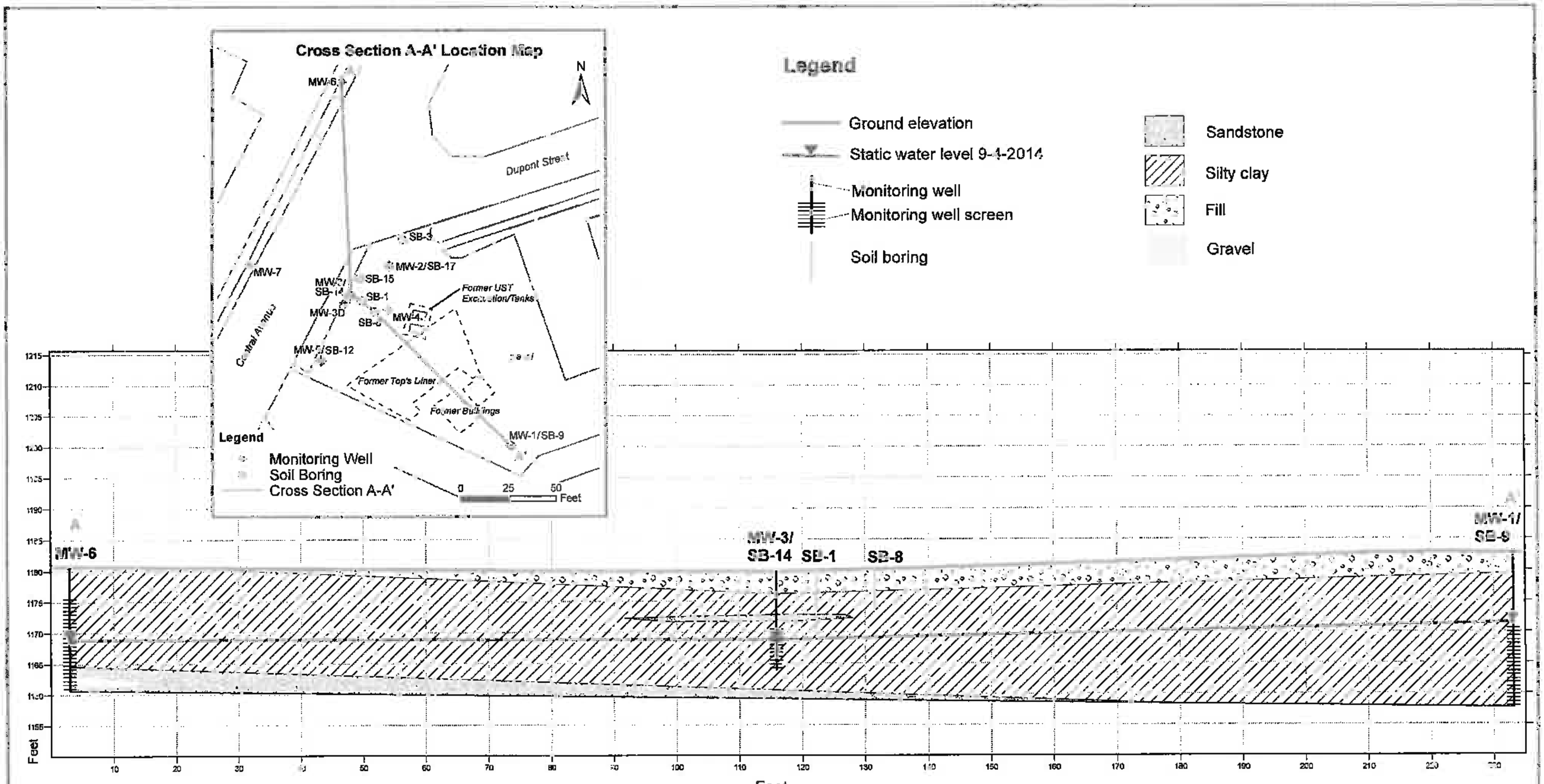
PROJECT: | DATE: 4-21-2015

PREPARED BY:
P. JOSEPH LEHMAN, INC.
CONSULTING ENGINEERS
P.O. BOX 419
HOLLIDAYSBURG, PA 16648

FORMER TOP'S DINER PROPERTY
410 CENTRAL AVENUE
JOHNSTOWN CITY
CAMBRIA COUNTY, PA

FIGURE: 4-1

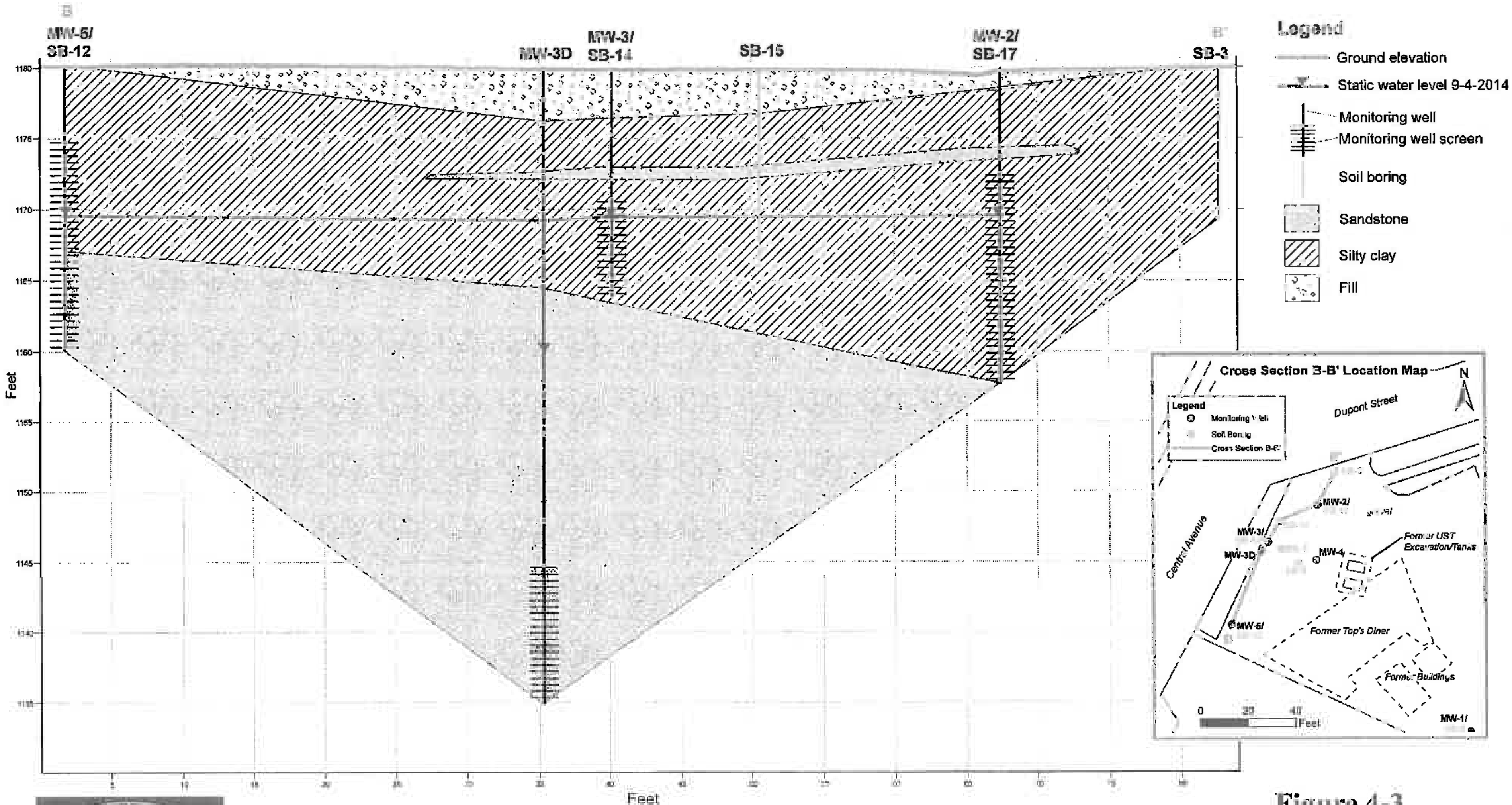
GROUNDWATER ELEVATION CONTOUR MAP
MARCH 5, 2015



Former Top's Diner Property
410 Central Avenue
Johnstown City, Cambria County, PA

Figure 4-2

Cross Section A-A'



P. JOSEPH LEHMAN, INC.

CONSULTING ENGINEERS

Former Top's Diner Property

410 Central Avenue

Johnstown City, Cambria County, PA

Figure 4-3

Cross Section B-B'

Attachment 1

Quick Domenico Modeling

GROUNDWATER FATE AND TRANSPORT CALCULATION BRIEF

MODELING CONTAMINANT DECAY AND PREDICTED CONCENTRATIONS OF DISSOLVED ORGANIC CONTAMINATS IN GROUNDWATER

FORMER TOP'S DINER PROPERTY
JOHNSTOWN, PENNSYLVANIA

INTRODUCTION TO THE QUICK DOMENICO MODEL

The Quick Domenico (QD) model was developed and updated by the Pennsylvania Department of Environmental Protection (PADEP) to calculate the concentration of contaminant species at any point and time downgradient of a source area of known width, thickness, and strength. The model is derived from the Domenico (1987) model and also accounts for retardation of contaminant movement based on compound-specific properties. The kinds of contaminants for which QD is intended are dissolved organic contaminants (unleaded gasoline and diesel fuel) whose fate and transport can be described or influenced by first order decay and reaction with organic carbon in the soil. The model allows for first order decay, retardation, and three-dimensional dispersion. In addition, QD calculates the concentrations in a two-dimensional 5x10 grid whose length and width are set by the user. The *QuickDomenico.xls* is a spreadsheet application developed by the PADEP to visually solve the Domenico equation.

However, the QD model has some limitations that are discussed below:

- QD is based on the Domenico analytical model referenced above. Only a single value of any one of the 20 or so flow and transport parameters required by the model is allowed at any one time. Therefore, the model should not be used where any of these parameters vary significantly in direction or magnitude over the model domain. Further, QD uses physical properties of the soil such as dry bulk density and fraction organic carbon which are difficult to relate to or determine for fractured bedrock aquifers. Therefore QD should be used with caution in these environments. QD is primarily intended for use in unconsolidated (soil) aquifers with reasonably uniform physical and hydrogeologic properties.

- QD is primarily intended for use with dissolved organic compounds and radioactive compounds that may react with organic carbon in the soil and/or may be subject to biodegradation or reaction that can be described by 1st order decay. The 1st order decay constant (lambda) should be set to zero where the biodegradability of the compound or its decay rate is questionable. QD is not appropriate for use with organic compounds that are undergoing transformation to daughter compounds (e.g. TCE to DCE). QD considers compounds individually and assumes no reaction between compounds.

Despite these limitations, the Domenico model has been successfully applied to actual data from contaminated sites as a screening model. In addition, the model has application as a "conceptual" model where hypothetical or "worst case" conditions are investigated.

PRELIMINARY SCREENING OF GROUNDWATER DATA

A preliminary data screening process was utilized to determine which constituents detected in groundwater at the Former Top's Diner Property in Johnstown, Pennsylvania (site) would require a fate and transport analysis using the QD model. The screening consists of a comparison of groundwater data to applicable screening values, including residential used aquifer (total dissolved solids <2,500 mg/L) MSCs, volatilization to indoor air screening values, and surface water loading criteria. In order to be extremely conservative and in order to accurately calibrate the model, the groundwater data collected from the most recent four quarters of sampling was utilized in the initial screening.

The constituents of potential concern were evaluated utilizing the procedures and limits established within the following documents:

- PA Code, Chapter 16, Section 102, Table 1, *Water Quality Criteria for Toxic Substances*
- PA Code, Chapter 250, Section 708, Table 5, *Physical and Toxicological Properties, A. Organic Regulated Substances*
- PA Technical Guidance Manual, Table IV-1, *Compounds excluded from Further Surface Water Evaluation on Attainment of SHS for GW <2500 TDS* (PADEP, 2002)
- PA Technical Guidance Manual, Table IV-2, *Compounds Requiring Additional Evaluation for Surface Water Compliance if PQL Exceeded** (PADEP, 2002)
- PA Technical Guidance Manual, Table IV-3, *Compounds Requiring Surface Water Compliance Analysis** (PADEP, 2002)
- USEPA, Regions 3, Regional Screening Level (RSL) Summary Table (TR=1E-6, HQ=0.1) January 2015 (USEPA, 2015)

The standard used in the screening process for each constituent was determined by using the most conservative (lowest) of the standards (groundwater MSC, soil vapor, or surface water). The following four types of screening criteria are utilized:

1. The Residential Used Aquifer MSC as defined in Table IV-1.
2. The SW846 Practical Quantitation Limit (PQL) as defined in Table IV-2.
3. The Lowest Surface Water Criterion (LSWC) or, if the LSWC is below the PQL, the higher of the LSWC and 3.18 times the Chapter 16 Method Detection Limit (MDL), as defined in Table IV-3.

4. The Region III United Stated Environmental Protection Agency (USEPA) Regional Screening Level (RSL) as specified in the table entitled "Regional Screening Level (RSL) Summary Table (TR=1E-6, HQ=0.1) January 2015".

As a result of this screening analysis, the following eight constituents-of-concern (COC) required a fate and transport analysis using the QD model:

- Benzene;
- Toluene;
- Ethylbenzene;
- Xylene(s) total;
- Naphthalene;
- Cumene;
- 1,3,5-TMB; and,
- 1,2,4-TMB.

SUMMARY OF QD MODEL PARAMETERS

Individual runs of the QD model were performed for the eight constituents listed above which failed the initial screening. The following input parameters and assumptions were used in the SWLOAD5B model runs.

Modeled Constituents – Benzene, toluene, ethylbenzene, xylene(s) total, naphthalene, cumene, 1,3,5-TMB, and 1,2,4-TMB are the chemical constituents which require further evaluation for the site. Further evaluation is required due to the exceedance of the applicable Act 2 groundwater MSC or the USEPA Region III RSL.

Source Concentration – A release of petroleum substances from the on-site UST system was confirmed. Groundwater characterization consisted of the installation groundwater monitoring wells. The highest concentration of petroleum short list constituents were reported in well MW-3 (herein referred to as the source area). The modeled source concentrations are conservatively represented by the maximum concentrations (in mg/L) detected during the historic quarterly sampling events for well MW-3.

A_x (longitudinal dispersivity) – Longitudinal dispersivity is a measure of plume dispersion that occurs parallel to the direction of groundwater flow. As per QD calculation guidance, the representative value for this parameter is one-tenth of the distance of contaminant travel (i.e., extent of the dissolved-phase plume for each constituent). However, this value was modified as part of the model calibration.

A_y (transverse dispersivity) – Transverse dispersivity is a measure of plume dispersion that occurs perpendicular to the direction of groundwater flow and parallel to the water table surface. As per QD guidance, the representative value for this parameter was one-tenth the longitudinal dispersivity. This value differs for each constituent. As with the longitudinal dispersivity, this value was modified as part of the model calibration.

A_z (vertical dispersivity) – Vertical dispersivity is a measure of plume dispersion that occurs parallel to the direction of groundwater flow and perpendicular to the water table surface. As per QD guidance, the representative value for this parameter is estimated from 1/20 to 1/100 of the transverse dispersivity. The value suggested by the QD guidance is **0.001** unless testing/ monitoring can justify a different value.

Lambda (days^{-1}) – Lambda is the first order decay constant which can be derived from the degradation rates published in §250.708 (Postremediation care attainment), Appendix A, Table 5 – Physiological and Toxicological Properties of Organic Substances (with the exception of 1,3,5-TMB for which there is no value established). As with the dispersivity, the lamda value of certain constituents may have been modified during model calibration.

Source Width – This value is the maximum width of the area of the known groundwater impacts at the site, measured perpendicular to groundwater flow. The groundwater plume as illustrated in the August 14, 2014 Benzene Groundwater Isoconcentration Map is **40 feet** wide.

Source Thickness – For sites where groundwater is impacted by light non-aqueous phase liquid (LNAPL), this value represents the maximum fluctuation in water elevation over the hydrologic cycle in addition to the thickness of impacted soil (potential smear zone). A review of historic data indicates a combined source thickness of **10.49 feet**.

Time (days) – The time in days after a contaminant has begun moving in groundwater. This value can be adjusted for the timeframe for which a solution is desired. Adjusting the time upward can be utilized to determine at what time steady state is reached. The exact date of the release is not known, but the release was discovered on July 22, 2103. Therefore, we utilized the number of days between the date of discovery and the date of the first groundwater sampling event (January 21, 2014). The time in days was calculated to be **182 days**.

Hydraulic Conductivity (K) – This value is a measure of a geologic material's ability to transmit water. The value was derived from an analysis of site-specific aquifer testing data and supported by the published values for the aquifer soil type (sandy loam). The results of aquifer testing indicated a hydraulic conductivity of **0.570 ft/day** in the shallow overburden aquifer.

Hydraulic Gradient (i) – The hydraulic gradient is the slope of the water table as measured parallel to groundwater flow. The input value was derived from field data generated during site investigations, by averaging straight-line gradients in the four historic groundwater gauging events. The average value calculated from the four most recent rounds of fluid-level monitoring was **0.0199 feet/foot**.

Porosity (n) – Porosity (total) is the ratio of volume of void space in a geologic material to the total volume of the material. In the Domenico (1987) model, the porosity input parameter is the effective porosity, which is generally less than or equal to the total porosity, and hence provides a more conservative model result. The effective porosity was estimated from published values for the soil composition encountered within the saturated zone. The saturated zone on-site consists predominantly of a sandy silty clay. Published values in McWorter and Sunada (1977) for the effective porosity of a clay range from 1% to 18%, with a median value of 6%. Therefore, to account for the sand and silt content of the soil (ranging from1% to 46%), a conservative average effective porosity is estimated to be **16% or 0.16.**

Soil Bulk Density (p_b) – The bulk density represents the dry weight of a soil sample divided by its total volume in an undisturbed state. This value was calculated using the site-specific porosity and the formula provided in the SWLOAD5B guidance $p_b = 2.65\ (1\text{-}n)$ where "n" is total porosity. Published values in McWorter and Sunada (1977) for total porosity range from 11% to 25% for a sandy silty clay (used 0.16 to account for various grain size content of soil). The formula, $p_b = 2.65\ (1\text{-}0.16)$, yields a soil bulk density estimate of **2.23 g/cm^3**.

K_{oc} – This is the organic carbon partition coefficient relative to the specific constituents being modeled. The values were taken from Appendix A, Table 5, of the Act 2 regulations if provided.

F_{oc} – This is the fraction of organic carbon (decimal fraction) content of the soil through which groundwater is moving. The QD guidance recommends a value between 0.0002 and 0.005 with a default value of **0.002**. However, this value was modified as part of the model calibration and a value of **0.0001** was utilized.

Retardation – This value is automatically calculated within the program using the equation $R = 1 + [(K_{oc} * F_{oc}) * (p_b)/n]$.

Velocity – The groundwater contaminant velocity value is automatically calculated using equation $V_c = (K * i/n)/R$

Point Concentration (x) (ft) – This value is the distance measured from the source, perpendicular to the water table contours, to the point where a concentration is desired.

Point Concentration (y) (ft) – This value is the 'y' coordinate for which a solution is desired. For a solution on the centerline of the plume downgradient from the source, y would be set equal to zero. Either positive or negative values may be entered; because QD provides a symmetrical solution, there is no difference in the values obtained. For the purposes of this model, y was set to zero to allow for a solution along the centerline of the plume and to accommodate site-specific groundwater data.

Point Concentration (z) (ft) – This value is the 'z' coordinate in the vertical axis. For most applications this should be left at zero since this value will yield the highest concentration which is at the water table.

Plume View Width and Depth – These cells are where the user sets the grid dimensions for the 5 by 10 grid that appears. By setting length at 500 ft and width at 50 feet, for example, the grid would cover a length of 500 feet and a width of 50 feet on either side of the source origin. Concentrations in the plume are calculated increments of length/10 or 50 feet, and for width/ 2 or 25 feet. By changing grid sizes, the grid dimensions can be increased or decreased.

A sensitivity analysis for each of the input parameters was conducted as part of the modeling process. The following variables were identified as "very sensitive": K, A_x, A_y, A_z, Lambda, and F_{oc}. Site-specific data or reasonably conservative estimates were used wherever possible for these model inputs. However, the QD model guidance recommends modifying K, A_x, and Lambda as part of your model calibration prior to modifying other parameters.

SUMMARY AND RESULTS OF THE QD MODEL RUNS

Direct contact groundwater COCs were retained in on-site groundwater based on exceedances of the USEPA Tapwater RSLs. These direct contact groundwater COCs were modeled using the Quick Domenico (QD) fate and transport model in order to define the downgradient extent of the groundwater plume off-site. The maximum groundwater concentrations from on-site monitoring well MW-3 were used in the QD model. Six COCs (i.e. 1,3,5-trimethylbenzene, 1,2,4-trimethylbenzene, ethylbenzene, toluene, total xylenes, and cumene) were modeled to their respective USEPA Tapwater RSLs. The other two retained direct contact COCs (i.e. benzene and naphthalene) were modeled to a concentration of 1 ug/L. The Tapwater RSLs for benzene and naphthalene are 0.45 ug/L and 0.17 ug/L, respectively. These low screening standards are difficult to model to in the QD model since the model is limited as to the level accuracy it can achieve at such low concentrations. Modeling to a concentration of 1 ug/L is conservative and health protective since this concentration is well below the PADEP medium specific concentrations (MSCs) and maximum contaminant levels (MCLs)/lifetime health advisory levels (e.g. non-residential used aquifer groundwater MSCs for benzene and naphthalene are 5 ug/L and 100 ug/L, respectively). Therefore, the groundwater fate and transport modeling is conservative and health protective.

For each COC, a model run was completed at a 30 year scenario. Based on a number of system-specific parameters and inputs for each constituent, the QD model estimated the average groundwater concentration, plume flow, and concentration at a point at a specific time downgradient of the source area. For the purposes of this model, the downgradeient point-of-compliance (POC) was assumed to be the northernmost property line. However, with the anticipated implementation of an EC waiver on the adjacent roadways, the point-of-exposure (POE) can be considered to be the northernmost (downgradient) property line of the Central Avenue/DuPont Street ROW. The QD model compared the modeled concentration for each constituent at the downgradient POE (northernmost edge of ROW) to the applicable USEPA Region 3 RSLs.

The QD model spreadsheet output results, provided as **Attachment 1**, indicate that concentrations of site constituents will ***exceed*** applicable standards (RSLs/MCLs) at the downgradient POC (the northernmost site property boundary), but ***will not exceed*** the applicable standards (RSLs/MCLs) at the northernmost edge of the Central Ave/DuPont Street ROW within a 30 year timeframe. Specifically, the RSLs/MCLs for all COC will be attained by 36 feet downgradient of the source area (MW-3). However, implementation of this scenario will require the request and approval of an EC waiver on the ROWs.

REFERENCES

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ATTACHMENT 1

Quick Domenico Model Spreadsheet Output Results

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project:	Sheetz #21 (former Top's Diner)		
Date:	6/4/2015	Prepared by:	KKH
		Contaminant:	124-TMB Calibration

NEW QUICK_DOMENICO.XLS

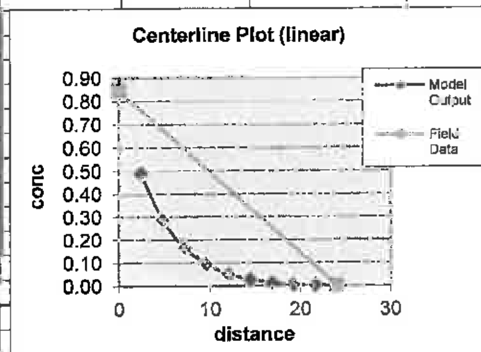
SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES"
P.A. Domenico (1987)
Modified to Include Retardation

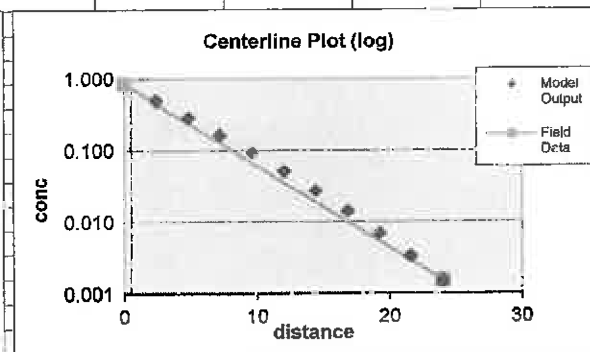
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.845	1.20E+01	1.20E+00	1.00E-03	0.0135	40	10.49	182

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)
5.70E-01	0.0199	0.16	2.23	2200	1.00E-04	4.06625	0.017434676

Point Concentration

x(ft)	y(ft)	z(ft)	
24		0	
	x(ft)	y(ft)	z(ft)
Conc. At	24	0	0
at	182	days =	0.001
			mg/l





AREAL MODEL CALCULATION DOMAIN

Length (ft)	24
Width (ft)	24

	2.4	4.8	7.2	9.6	12	14.4	16.8	19.2	21.6	24
24	0.023	0.034	0.028	0.019	0.012	0.007	0.004	0.002	0.001	0.000
12	0.491	0.284	0.160	0.089	0.048	0.025	0.013	0.006	0.003	0.001
0	0.491	0.287	0.165	0.093	0.051	0.027	0.014	0.007	0.003	0.001
-12	0.491	0.284	0.160	0.089	0.048	0.025	0.013	0.006	0.003	0.001
-24	0.023	0.034	0.028	0.019	0.012	0.007	0.004	0.002	0.001	0.000

Field Data:	Centerline C Concentration	0.845	0.0015
	Distance from Source	0	24

To RSL in 30 yrs

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project:	Sheetz #21 (former Top's Diner)		
Date:	6/4/2015	Prepared by:	KKH
		Contaminant:	124-TMB to RSL in 30 yrs

NEW QUICK_DOMENICO.XLS

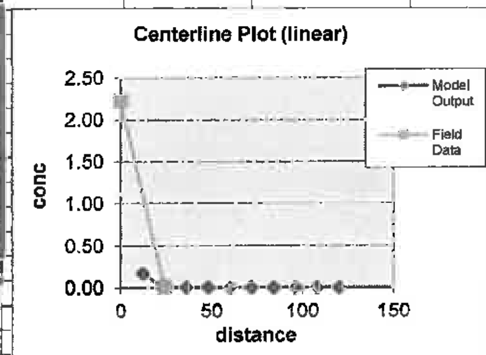
SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987) Modified to Include Retardation

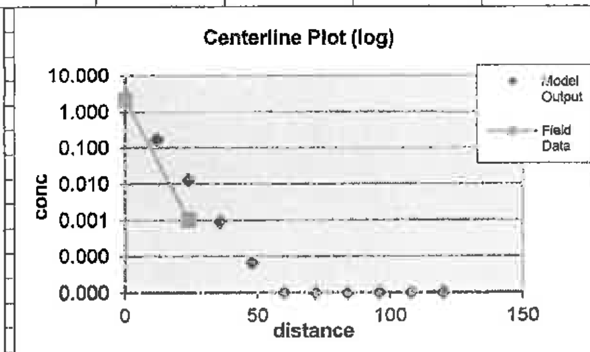
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
2.22	1.20E+01	1.20E+00	1.00E-03	0.0135	40	10.49	10950

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)
5.70E-01	0.0199	0.16	2.23	2200	1.00E-04	4.06625	0.017434076

Point Concentration

x(ft)	y(ft)	z(ft)	
120		0	
	x(ft)	y(ft)	z(ft)
Conc. At	120	0	0
at	10950	days =	0.000 mg/l





AREAL MODEL CALCULATION DOMAIN

Length (ft) 120

Width (ft) 120

	12	24	36	48	60	72	84	96	108	120
120	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	0.167	0.012	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-60	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-120	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Field Data:	Centerline C Concentration	2.22	0.001
	Distance from Source	0	24

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

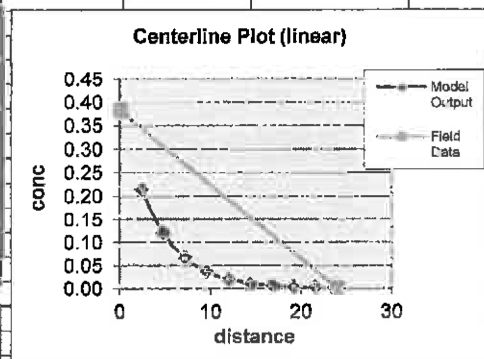
Project:	Sheetz #21 (former Top's Diner)						
Date:	6/4/2015	Prepared by:	KKH				
		Contaminant:	135-TMB Calibration				
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.382	1.20E+01	1.20E+00	1.00E-03	0.036	40	10.49	182
Hydraulic 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)
5.71E-01	0.0199	0.16	2.23	660	1.00E-04	1.919875	0.036981298

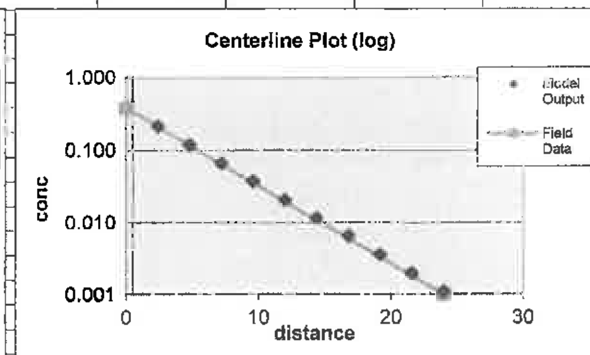
NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES"
P.A. Domenico (1987)
Modified to Include Retardation

Point Concentration

x(ft)	y(ft)	z(ft)	
24		0	
	x(ft)	y(ft)	z(ft)
Conc. At	24	0	0
at	182	days =	0.001
			mg/l





AREAL MODEL — CALCULATION DOMAIN

Length (ft) 24
Width (ft) 24

	2.4	4.8	7.2	9.6	12	14.4	16.8	19.2	21.6	24
24	0.010	0.014	0.011	0.008	0.005	0.003	0.002	0.001	0.001	0.000
12	0.213	0.118	0.065	0.035	0.019	0.011	0.006	0.003	0.002	0.001
0	0.214	0.119	0.067	0.037	0.021	0.012	0.006	0.004	0.002	0.001
-12	0.213	0.118	0.065	0.035	0.019	0.011	0.006	0.003	0.002	0.001
-24	0.010	0.014	0.011	0.008	0.005	0.003	0.002	0.001	0.001	0.000

Field Data:			
	Centerline C Concentration	0.382	0.001
	Distance from Source	0	24

To RSL in 30 yrs

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION, 1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

NEW QUICK_DOMENICO.XLS

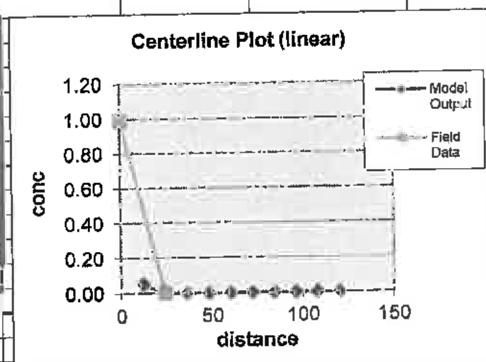
SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES"
P.A. Domenico (1987)
Modified to Include Retardation

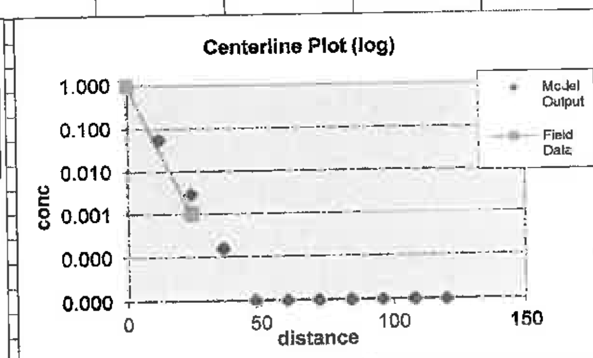
Project:	Sheetz #21 (former Top's Diner)						
Date:	6/4/2015	Prepared by:	KKH				
		Contaminant:	135-TMB to RSL in 30 yrs				
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.99	1.20E+01	1.20E+00	1.00E-03	0.035	40	10.49	10950
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)
5.71E-01	0.0199	0.16	2.23	660	1.00E-04	1.919875	0.036981298

Point Concentration

x(ft)	y(ft)	z(ft)
120		0

	x(ft)	y(ft)	z(ft)
Conc. At	120	0	0
at	10950	days =	0.000 mg/l





AREAL MODEL CALCULATION DOMAIN
Length (ft) 120
Width (ft) 120

	12	24	36	48	60	72	84	96	108	120
120	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	0.054	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-60	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-120	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Field Data:			
	Centerline C Concentration	0.99	0.001
	Distance from Source	0	24

Benzene Calibration

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project:	Sheetz #21 (former Top's Diner)		
Date:	6/4/2015	Prepared by:	KKH
		Contaminant:	Benzene Calibration

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.279	1.20E+01	1.20E+00	1.00E-03	0.06	40	10.49	182

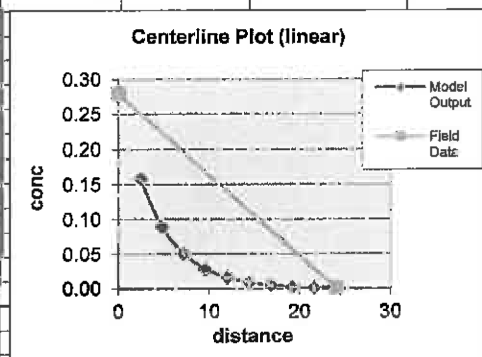
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm³)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
5.71E-01	0.0199	0.16	2.23	58	1.00E-04	1.0808375	0.065689309

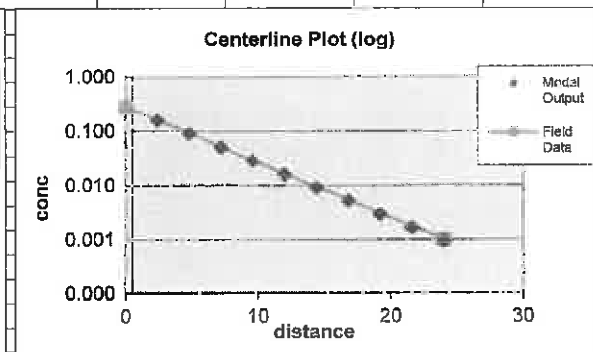
NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES"
P.A. Domenico (1987)
Modified to Include Retardation

Point Concentration

x(ft)	y(ft)	z(ft)	
24		0	
	x(ft)	y(ft)	z(ft)
Conc. At	24	0	0
at	182	days =	0.001
			mg/l





AREAL MODEL	CALCULATION DOMAIN
Length (ft)	24
Width (ft)	31

	2.4	4.8	7.2	9.6	12	14.4	16.8	19.2	21.6	24
31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15.5	0.153	0.081	0.043	0.024	0.013	0.007	0.004	0.002	0.001	0.001
0	0.158	0.089	0.051	0.029	0.016	0.009	0.005	0.003	0.002	0.001
-15.5	0.153	0.081	0.043	0.024	0.013	0.007	0.004	0.002	0.001	0.001
-31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Field Data:			
	Centerline Concentration	0.279	0.001
	Distance from Source	0	24

To 1 ugL in 30 yrs

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project:	Sheetz #21 (former Top's Diner)		
Date:	6/4/2015	Prepared by:	KKH
		Contaminant:	Benzene to 1 ug/L in 30 yrs

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.418	1.20E+01	1.20E+00	1.00E-03	0.06	40	10.49	10950

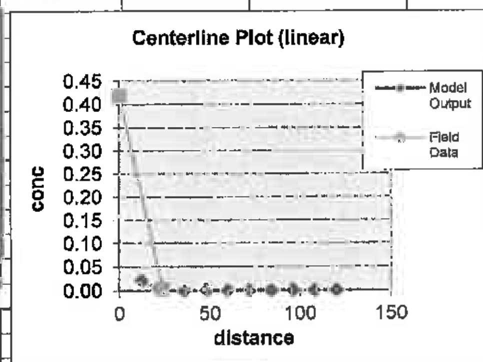
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
5.71E-01	0.0135	0.16	2.23	58	2.00E-04	1.161675	0.061118186

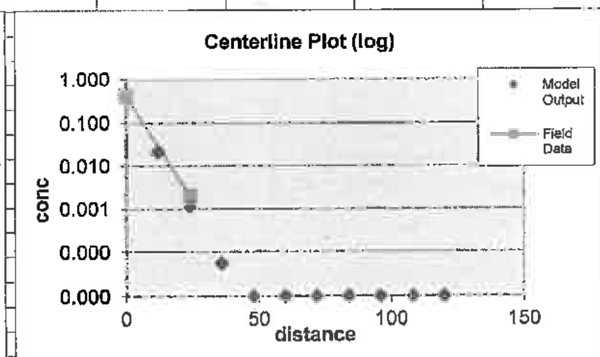
NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987) Modified to Include Retardation

Point Concentration

x(ft)	y(ft)	z(ft)	
120		0	
	x(ft)	y(ft)	z(ft)
Conc. At	120	0	0
at	10950	days =	0.000
			mg/l





AREAL MODEL CALCULATION DOMAIN

Length (ft) 120

Width (ft) 120

	12	24	36	48	60	72	84	96	108	120
120	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	0.021	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-60	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-120	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Field Data:		
Centerline C Concentration	0.418	0.002
Distance from Source	0	24

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

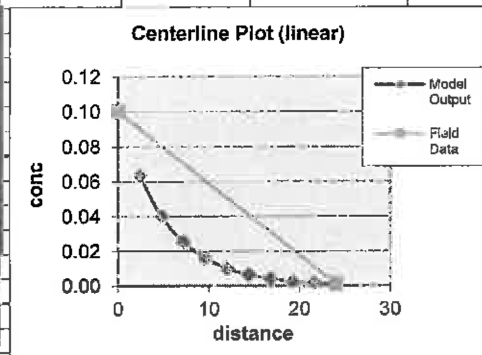
Project:	Sheetz #21 (former Top's Diner)						
Date:	6/1/2015	Prepared by:	KKH				
		Contaminant:	Toluene Calibration				
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.1	1.20E+01	1.20E+00	1.00E-03	0.038	40	10.49	132
Hydraulic 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)
5.71E-01	0.0199	0.18	2.23	130	1.00E-04	1.1811875	0.060108551

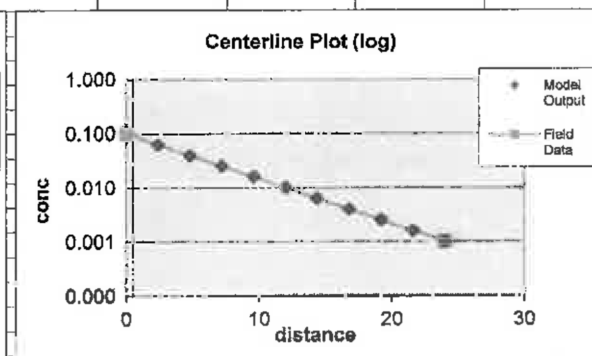
NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES"
P.A. Domenico (1987)
Modified to Include Retardation

Point Concentration

x(ft)	y(ft)	z(ft)	
24		0	
	x(ft)	y(ft)	z(ft)
Conc. At	24	0	0
at	182	days =	0.001 mg/l





AREAL MODEL CALCULATION DOMAIN

Length (ft) 24
Width (ft) 31

	2.4	4.8	7.2	9.6	12	14.4	16.8	19.2	21.6	24
31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15.5	0.061	0.036	0.022	0.013	0.008	0.005	0.003	0.002	0.001	0.001
0	0.063	0.040	0.025	0.016	0.010	0.006	0.004	0.003	0.002	0.001
-15.5	0.061	0.036	0.022	0.013	0.008	0.005	0.003	0.002	0.001	0.001
-31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Field Data:	Centerline C Concentration	0.1	0.001
	Distance from Source	0	24

To RSL in 30 years

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project:	Sheetz #21 (former Top's Diner)		
Date:	6/4/2015	Prepared by:	KKH
		Contaminant:	Toluene to RSL in 30 years

NEW QUICK_DOMENICO.XLS

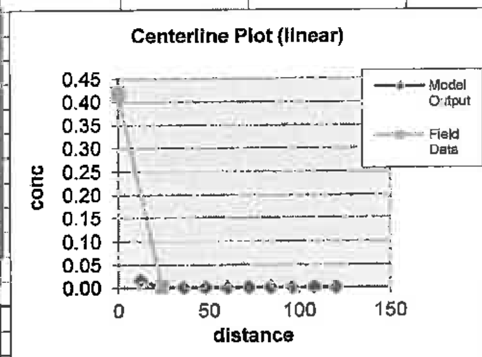
SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987) Modified to Include Retardation

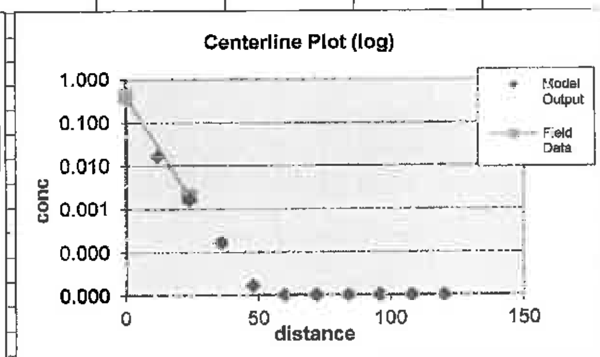
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.157	1.20E+01	1.20E+00	1.00E-03	0.038	40	10.49	10950

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)
5.71E-01	0.0199	0.16	2.23	58	2.00E-04	1.161675	0.061118186

Point Concentration

x(ft)	y(ft)	z(ft)	
120		0	
	x(ft)	y(ft)	z(ft)
Conc. At	120	0	0
at	10950	days =	0.000 mg/l





AREAL MODEL CALCULATION DOMAIN

Length (ft) 120
Width (ft) 120

	12	24	36	48	60	72	84	96	108	120
120	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	0.016	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-60	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-120	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Field Data:			
	Centerline C Concentration	0.418	0.002
	Distance from Source	0	24

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project: Sheetz #21 (former Top's Diner)
Date: 6/4/2015 Prepared by: KKH
Contaminant: Ethylbenzene Calibration

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

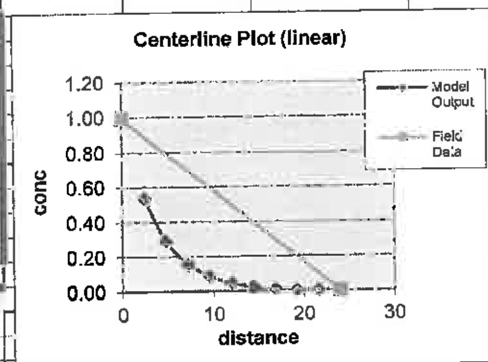
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.992	1.20E+01	1.20E+00	1.00E-03	0.067	40	10.49	182

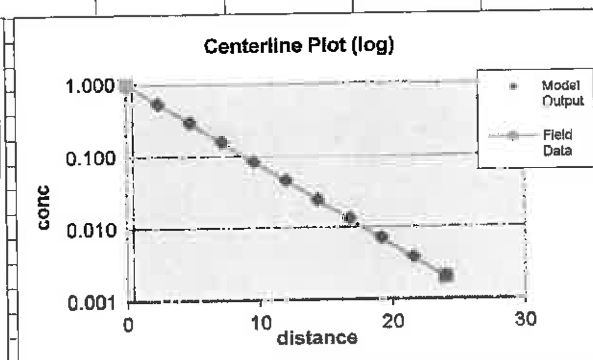
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm³)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
5.71E-01	0.0199	0.16	2.23	220	1.00E-04	1.306625	0.054338061

Point Concentration

x(ft)	y(ft)	z(ft)
24		0

	x(ft)	y(ft)	z(ft)
Conc. At	24	0	0
at	182	days =	0.002 mg/l





AREAL MODEL CALCULATION DOMAIN
Length (ft) 24
Width (ft) 24

	2.4	4.8	7.2	9.6	12	14.4	16.8	19.2	21.6	24
24	0.026	0.034	0.026	0.017	0.010	0.006	0.004	0.002	0.001	0.001
12	0.535	0.286	0.152	0.080	0.042	0.022	0.012	0.006	0.003	0.002
0	0.535	0.289	0.156	0.084	0.045	0.025	0.013	0.007	0.004	0.002
-12	0.535	0.286	0.152	0.080	0.042	0.022	0.012	0.006	0.003	0.002
-24	0.026	0.034	0.026	0.017	0.010	0.006	0.004	0.002	0.001	0.001

Field Data:			
	Centerline C Concentration	0.992	0.002
	Distance from Source	0	24

to RSL in 30 yrs

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project:	Sheetz #21 (former Top's Diner)		
Date:	6/4/2015	Prepared by:	KKH
		Contaminant:	Ethylbenzene to RSL in 30 yrs

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
1.48	1.20E+01	1.20E+00	1.00E-03	0.057	40	10.49	10950

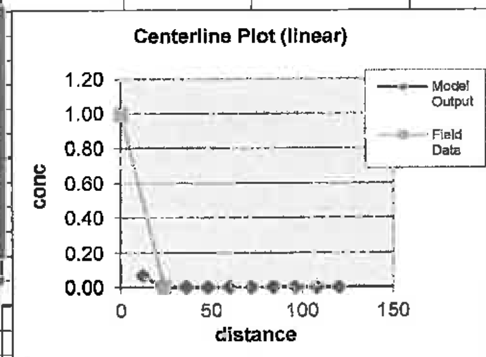
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm³)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
5.71E-01	0.0199	0.16	2.23	220	1.00E-04	1.306625	0.054338061

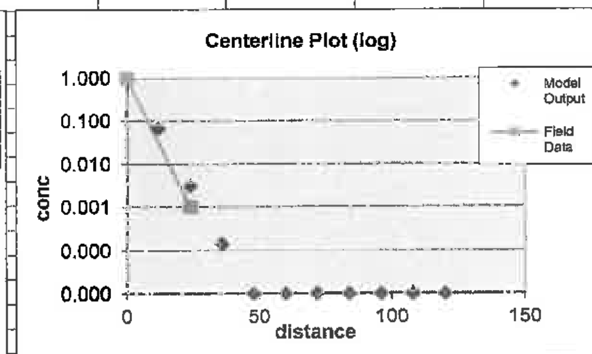
NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES" P.A. Domenico (1987) Modified to Include Retardation

Point Concentration

x(ft)	y(ft)	z(ft)	
120		0	
	x(ft)	y(ft)	z(ft)
Conc. At	120	0	0
at	10950	days =	0.000 mg/l





AREAL MODEL CALCULATION DOMAIN

Length (ft) 120

Width (ft) 120

	12	24	36	48	60	72	84	96	108	120
120	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	0.068	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-60	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-120	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Field Data:			
	Centerline C Concentration	0.992	0.001
	Distance from Source	0	24

Xylene Calibration

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

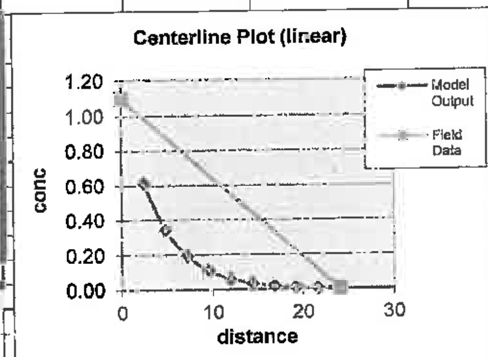
Project:	Sheetz #21 (former Top's Diner)						
Date:	6/4/2015	Prepared by:	KKH				
		Contaminant:	Xylene(s) Total Calibration				
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
1.097	1.20E+01	1.20E+00	1.00E-03	0.045	40	10.49	182
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)
5.71E-01	0.0199	0.15	2.23	350	1.00E-04	1.4878125	0.04772071

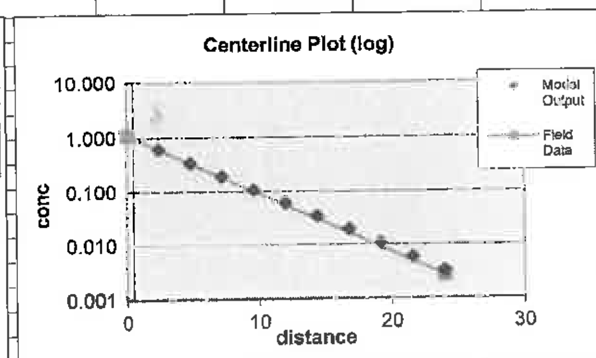
NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES"
P.A. Domenico (1987)
Modified to Include Retardation

Point Concentration

x(ft)	y(ft)	z(ft)	
24		0	
	x(ft)	y(ft)	z(ft)
Conc. At	24	0	0
at	182	days =	0.003
			mg/l





AREAL MODEL CALCULATION DOMAIN

Length (ft) 24
Width (ft) 24

	2.4	4.8	7.2	9.6	12	14.4	16.8	19.2	21.6	24
24	0.029	0.041	0.032	0.022	0.014	0.008	0.005	0.003	0.002	0.001
12	0.614	0.341	0.187	0.103	0.056	0.031	0.017	0.009	0.005	0.003
0	0.614	0.344	0.192	0.108	0.060	0.034	0.019	0.011	0.006	0.003
-12	0.614	0.341	0.187	0.103	0.056	0.031	0.017	0.009	0.005	0.003
-24	0.029	0.041	0.032	0.022	0.014	0.008	0.005	0.003	0.002	0.001

Field Data:		
Centerline C Concentration	1.097	0.0027
Distance from Source	0	24

to RSL in 30 yrs

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project:	Sheetz #21 (former Top's Diner)		
Date:	6/4/2015	Prepared by:	KKH
		Contaminant:	Xylene(s) Total to RSL in 30 yrs

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
2.45	1.20E+01	1.20E+00	1.00E-03	0.045	40	10.49	10950

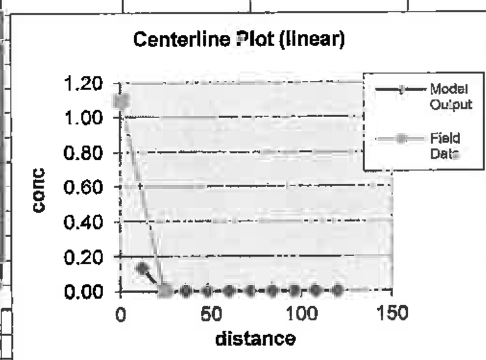
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
5.71E-01	0.0199	0.16	2.23	350	1.00E-04	1.4878125	0.04772071

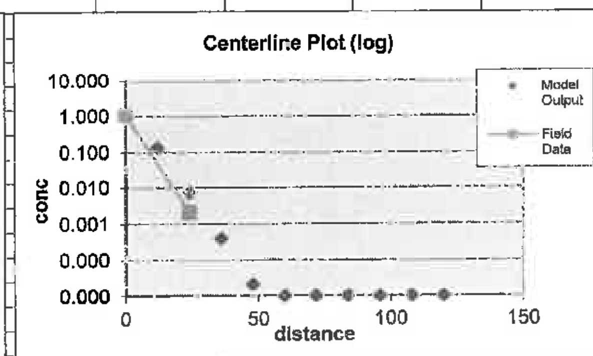
NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES"
P.A. Domenico (1987)
Modified to Include Retardation

Point Concentration

x(ft)	y(ft)	z(ft)	
120		0	
	x(ft)	y(ft)	z(ft)
Conc. At	120	0	0
at	10950	days =	0.000 mg/l





AREAL MODEL — CALCULATION DOMAIN

Length (ft)	120
Width (ft)	120

	12	24	36	48	60	72	84	96	108	120
120	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	0.135	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-60	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-120	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Field Data:			
	Centerline C Concentration	1.097	0.00207
	Distance from Source	0	24

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project:	Sheetz #21 (former Top's Diner)		
Date:	6/4/2015	Prepared by:	KKH
		Contaminant:	Cumene Calibration

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

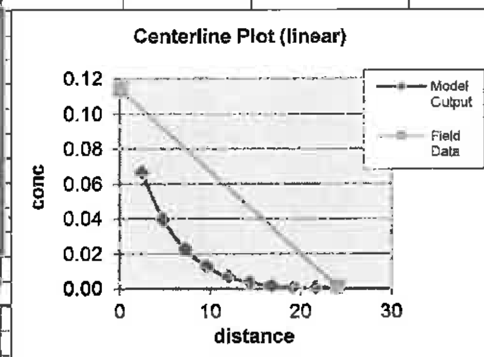
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.114	1.20E+01	1.20E+00	1.00E-03	0.01	40	10.49	182

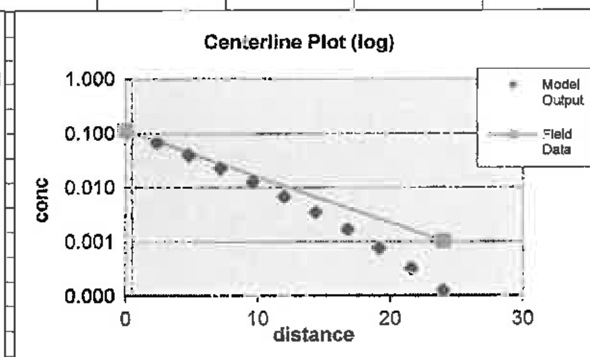
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retardation (R)	V (=K*i/n*R) (ft/day)
5.71E-01	0.0199	0.16	2.23	2800	1.00E-04	4.9025	0.014482299

Point Concentration

x(ft)	y(ft)	z(ft)
24		0

	x(ft)	y(ft)	z(ft)
Conc. At	24	0	0
at	182	days =	0.000 mg/l





AREAL MODEL CALCULATION DOMAIN

Length (ft)	24
Width (ft)	24

	2.4	4.8	7.2	9.6	12	14.4	16.8	19.2	21.6	24
24	0.003	0.005	0.004	0.003	0.002	0.001	0.000	0.000	0.000	0.000
12	0.067	0.039	0.022	0.012	0.006	0.003	0.001	0.001	0.000	0.000
0	0.067	0.039	0.023	0.013	0.007	0.003	0.002	0.001	0.000	0.000
-12	0.067	0.039	0.022	0.012	0.006	0.003	0.001	0.001	0.000	0.000
-24	0.003	0.005	0.004	0.003	0.002	0.001	0.000	0.000	0.000	0.000

Field Data:			
	Centerline C Concentration	0.114	0.001
	Distance from Source	0	24

to RSL in 30 yrs

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION, 1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

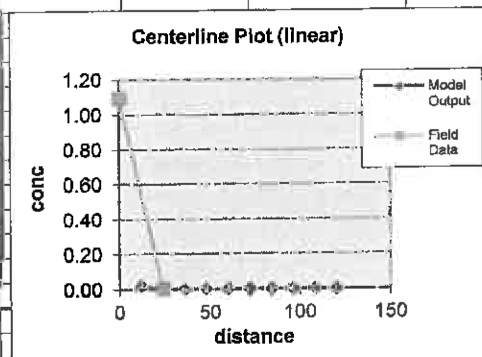
Project:	Sheetz #21 (former Top's Diner)						
Date:	6/4/2015	Prepared by:	KKH				
		Contaminant:	Cumene to RSL in 30 yrs				
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.217	1.20E+01	1.20E+00	1.00E-03	0.01	40	10.49	10950
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)
5.71E-01	0.0199	0.16	2.23	2800	1.00E-04	4.9025	0.014482299

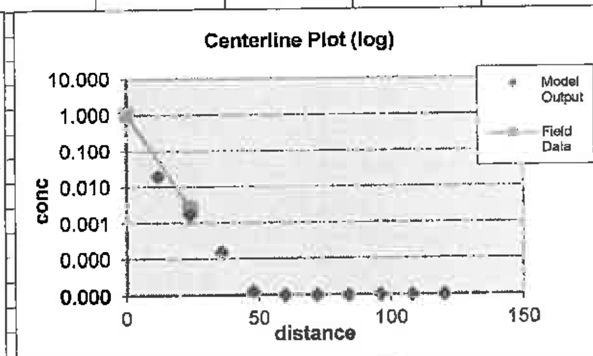
NEW QUICK_DOMENICO.XLS

SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES"
P.A. Domenico (1987)
Modified to Include Retardation

Point Concentration

x(ft)	y(ft)	z(ft)	
120		0	
	x(ft)	y(ft)	z(ft)
Conc. At	120	0	0
at	10950	days =	0.000
			mg/l





AREAL MODEL CALCULATION DOMAIN

Length (ft) 120
Width (ft) 120

	12	24	36	48	60	72	84	96	108	120
120	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	0.019	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-60	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-120	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Field Data:			
	Centerline C Concentration	1.097	0.0027
	Distance from Source	0	24

Naphthalene Calibration

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION,1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project:	Sheetz #21 (former Top's Diner)		
Date:	6/4/2015	Prepared by:	KKH
		Contaminant:	Naphthalene

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

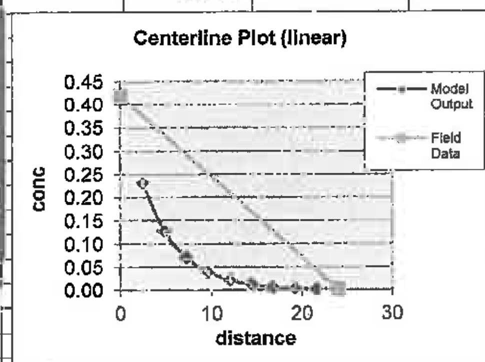
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.419	1.20E+01	1.20E+00	1.00E-03	0.03	40	10.49	182

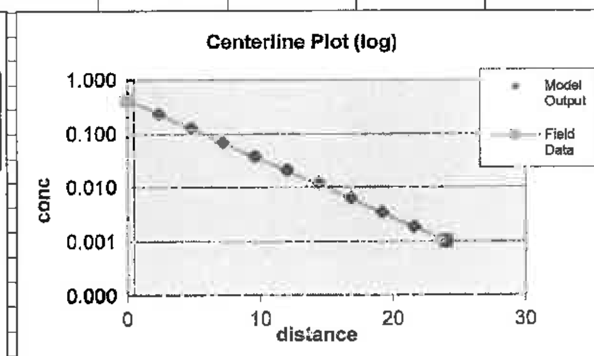
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm^3)	KOC	Frac. Org. Carb.	Retard-ation (R)	V (=K*i/n*R) (ft/day)
6.71E-01	0.0199	0.16	2.23	950	1.00E-04	2.3240625	0.030549724

Point Concentration

x(ft)	y(ft)	z(ft)
24		0

	x(ft)	y(ft)	z(ft)
Conc. At	24	0	0
at	182	days =	0.001 mg/l





AREAL MODEL **CALCULATION DOMAIN**

Length (ft) 24
Width (ft) 24

	2.4	4.8	7.2	9.6	12	14.4	16.8	19.2	21.6	24
24	0.011	0.016	0.012	0.008	0.005	0.003	0.002	0.001	0.001	0.000
12	0.231	0.126	0.068	0.037	0.020	0.011	0.006	0.003	0.002	0.001
0	0.231	0.128	0.070	0.039	0.021	0.012	0.006	0.003	0.002	0.001
-12	0.231	0.126	0.068	0.037	0.020	0.011	0.006	0.003	0.002	0.001
-24	0.011	0.015	0.012	0.008	0.005	0.003	0.002	0.001	0.001	0.000

Field Data:	Centerline C Concentration	0.419	0.001
	Distance from Source	0	24

To 1 ugl in 30 yrs

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION, 1ST ORDER DECAY and RETARDATION - WITH CALIBRATION TOOL

Project:	Sheetz #21 (former Top's Diner)		
Date:	6/4/2015	Prepared by:	KKH
		Contaminant:	Naphthalene to 1 ug/L in 30 yrs

NEW QUICK_DOMENICO.XLS

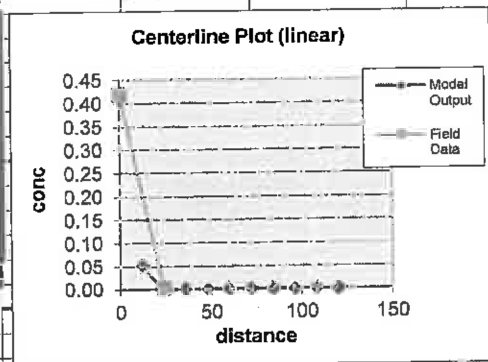
SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES"
P.A. Domenico (1987)
Modified to Include Retardation

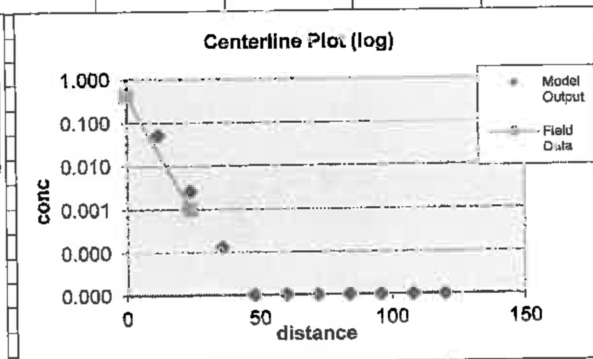
SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft) >=.001	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days) (days)
0.995	1.20E+01	1.20E+00	1.00E-03	0.03	40	10.49	10950

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)
5.71E-01	0.0199	0.16	2.23	950	1.00E-04	2.3240625	0.030549724

Point Concentration

x(ft)	y(ft)	z(ft)	
120		0	
	x(ft)	y(ft)	z(ft)
Conc. At	120	0	0
at	10950	days =	0.000
			mg/l





AREAL MODEL CALCULATION DOMAIN
Length (ft) 120
Width (ft) 120

	12	24	36	48	60	72	84	96	108	120
120	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	0.051	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-60	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-120	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

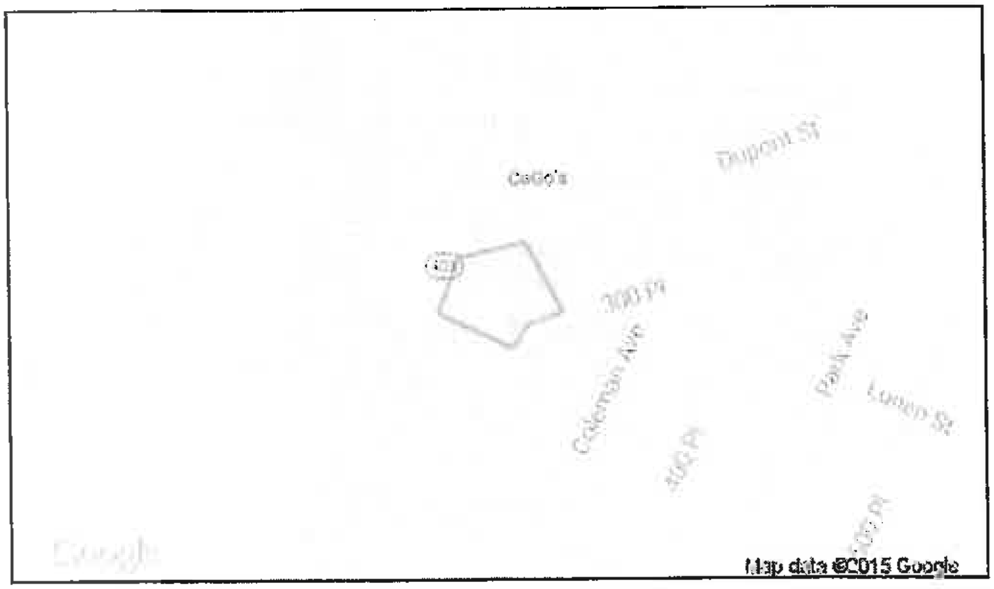
Field Data:				
	Centerline C Concentration		0.419	0.001
	Distance from Source		0	24

Attachment 2

Pennsylvania Natural Diversity Inventory Survey Results

1. PROJECT INFORMATION

Project Name: Sheetz 21
Date of review: 7/9/2015 11:49:10 AM
Project Category: Hazardous Waste Clean-up, Site Remediation, and Reclamation,Other
Project Area: 0.5 acres
County: Cambria Township/Municipality: Johnstown
Quadrangle Name: JOHNSTOWN ~ ZIP Code: 15902
Decimal Degrees: 40.300018 N, -78.911163 W
Degrees Minutes Seconds: 40° 18' 0 N, W



2. SEARCH RESULTS

Agency	Results	Response
PA Game Commission	No Known Impact	No Further Review Required
PA Department of Conservation and Natural Resources	No Known Impact	No Further Review Required
PA Fish and Boat Commission	No Known Impact	No Further Review Required
U.S. Fish and Wildlife Service	No Known Impact	No Further Review Required

As summarized above, Pennsylvania Natural Diversity Inventory (PNDI) records indicate no known impacts to threatened and endangered species and/or special concern species and resources within the project area. Therefore, based on the information you provided, no further coordination is required with the jurisdictional agencies. This response does not reflect potential agency concerns regarding impacts to other ecological resources, such as wetlands.

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: No Impact is anticipated to threatened and endangered species and/or special concern species and resources.

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: No Impact is anticipated to threatened and endangered species and/or special concern species and resources.

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.

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
Pennsylvania Field Office
110 Radnor Rd; Suite 101, State College, PA 16801
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:______________________________________
Company/Business Name:____________________________
Address:______________________________________
City, State, Zip:__________________________________
Phone:(_____)____________________Fax:(______)________________
Email:______________________________________

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 date

Attachment 3

Supporting Documentation for Derivation of Source Concentrations

On-Site Soil

Derivation of Source Concentrations for On-Site Subsurface Soil 3-6 ft-bgs
Former Top's Diner Property
Johnstown City, Pennsylvania

Sample ID	Sample Date	Sample Depth	Saturated or Unsaturated	Post-March 2008 PA Short List of Petroleum Products for Unleaded Gasoline									
				Benzene	Toluene	Ethylbenzene	Xylenes (Total)	MTBE	Cumene	Naphthalene	1,2,4-Trimethylbenzene	1,3,5-Trimethylbenzene	Lead
USEPA Region 3 Industrial Soil RSL				**5.1**	**4,700**	**25**	**250**	**210**	**990**	**17**	**24**	**1,200**	**800**
USEPA Region 3 Risk-Based Soil SSL [1]				**0.00023**	**0.076**	**0.0017**	**0.019**	**0.0032**	**0.074**	**0.00054**	**0.0021**	**0.017**	**14**
SB-4 (6')	6/25/2012	6.00	U	< 0.232	< 0.232	< 0.232	< 0.4665	-	< 0.232	< 0.232	< 0.232	< 0.232	**12.7**
SB-6 (3.5')	6/25/2012	3.50	U	< 0.251	< 0.251	< 0.251	< 0.503	-	< 0.251	< 0.251	< 0.251	< 0.251	**18.6**
SB-8 (3')	6/25/2012	3.00	U	< 0.247	< 0.247	< 0.247	< 0.494	-	< 0.247	< 0.247	< 0.247	< 0.247	**30**
SB-14	12/27/2013	4-5'	U	**0.4**	**0.96**	< 0.769	**1.78**	< <0.769	< 0.769	**1.33**	**0.908**	< 0.769	**468**
Maximum Concentration				0.4	0.96	---	1.78	---	---	1.33	0.908	---	468
Maximum Concentration Location				SB-14	SB-14		SB-14			SB-14	SB-14		SB-14 (4-5')

Notes:
1. Indicates the applcable USEPA Risk Based SSL for each constituent. Note that since no Risk Based SSL was available for lead. The MCL Based SSl was utilized instead to screen the analytical data.
All results in milligrams per kilogram (mg/kg).
Depth measured in feet below ground surface.
Bold values indicate an exceedance of the laboratory reporting limit.
Bold and shaded values indicate exceedance of the RSL.
NS indicates No Standard.
"-" = Not Analyzed
MTBE = Methyl Tertiary Butyl Ether

On-Site Soil Sample 3-6 ft-bgs Lead Database

Former Top's Diner Property

Johnstown City, Pennsylvania

Sample ID	Sample Date	Sample Depth	Saturated/Unsaturated	Lead (mg/kg)	d_Lead (mg/kg)
SB-4 (6')	6/25/2012	6.00	U	12.7	1
SB-6 (3.5')	6/25/2012	3.50	U	18.6	1
SB-8 (3')	6/25/2012	3.00	U	30	1
SB-14	12/27/2013	4-5'	U	468	1

On-Site Soil 3-6 ft-bgs Lead Stats
Former Top's Diner Property
Johnstown City, Pennsylvania

	General Statistics on Uncensored Data
Date/Time of Computation	6/22/2015 5:48:12 PM
User Selected Options	
From File	WorkSheet.xls
Full Precision	OFF

From File: WorkSheet.xls

General Statistics for Censored Datasets (with NDs) using Kaplan Meier Method

Variable	NumObs	# Missing	Num Ds	NumNDs	% NDs	Min ND	Max ND	KM Mean	KM Var	KM SD	KM CV
Lead (mg/kg)	4	0	4	0	0.00%	N/A	N/A	132.3	50131	223.9	1.692

General Statistics for Raw Dataset using Detected Data Only

Variable	NumObs	# Missing	Minimum	Maximum	Mean	Median	Var	SD	MAD/0.675	Skewness	CV
Lead (mg/kg)	4	0	12.7	468	132.3	24.3	50131	223.9	12.82	1.994	1.692

Percentiles using all Detects (Ds) and Non-Detects (NDs)

Variable	NumObs	# Missing	10%ile	20%ile	25%ile(Q1)	50%ile(Q2)	75%ile(Q3)	80%ile	90%ile	95%ile	99%ile
Lead (mg/kg)	4	0	14.47	16.24	17.13	24.3	139.5	205.2	336.6	402.3	454.9

On-Site Soil 3-10 ft-bgs Stats Database
Former Top's Diner Property
Johnston City, Pennsylvania

Sample ID	Sample Date	Sample Depth	Saturated or Unsaturated	Benzene (mg/kg)	d_Benzene (mg/kg)	NROS_Benzene (mg/kg)	GROS_Benzene (mg/kg)	LnROS_Benzene (mg/kg)
SB-1 (8.5')	6/25/2012	8.50	U	5.98	1	5.98	5.98	5.98
SB-2 (7')	6/25/2012	7.00	U	0.223	0	-28.02319678	0.01	4.15639E-07
SB-3 (7')	6/25/2012	7.00	U	0.245	0	-28.02319678	0.01	4.15639E-07
SB-4 (6')	6/25/2012	6.00	U	0.232	0	-28.02319678	0.01	4.15639E-07
SB-5 (6.5')	6/25/2012	6.50	U	0.229	0	-28.02319678	0.01	4.15639E-07
SB-6 (3.5')	6/25/2012	3.50	U	0.251	0	-28.02319678	0.01	4.15639E-07
SB-7 (7')	6/25/2012	7.00	U	0.25	0	-28.02319678	0.01	4.15639E-07
SB-8 (3')	6/25/2012	3.00	U	0.247	0	-28.02319678	0.01	4.15639E-07
SB-9	12/26/2013	9-10'	U	0.0015	0	-45.32455705	0.01	1E-10
SB-10	12/27/2013	9-10'	U	0.0014	0	-28.02319678	0.01	4.15639E-07
SB-11	12/27/2013	9-10'	U	0.0015	0	-37.07618545	0.01	5.16392E-09
SB-12	12/27/2013	7-8'	U	0.0015	0	-30.86142051	0.01	1.05013E-07
SB-12	12/27/2013	9-10'	U	0.0015	0	-25.23817106	0.01	1.60321E-06
SB-13	12/27/2013	7-8'	U	0.171	0	-28.02319678	0.01	4.15639E-07
SB-13	12/27/2013	9-10'	U	0.0015	0	-19.52039423	0.01	2.56233E-05
SB-14	12/27/2013	4-5'	U	0.4	1	0.4	0.4	0.4
SB-14	12/27/2013	7-8'	U	0.293	0	-28.02319678	0.01	4.15639E-07
SB-15	12/27/2013	7-8'	U	0.307	0	-28.02319678	0.01	4.15639E-07
SB-15	12/27/2013	9-10'	U	0.301	0	-28.02319678	0.01	4.15639E-07
SB-16	12/27/2013	7-8'	U	0.285	0	-28.02319678	0.01	4.15639E-07
SB-16	12/27/2013	9-10'	U	0.0013	0	-28.02319678	0.01	4.15639E-07
SB-17	12/27/2013	7-8'	U	0.0015	0	-12.92666513	0.01	0.000626145

On-Site Soil 3-10 ft-bgs Stats Database

Former Top's Diner Property

Johnston City, Pennsylvania

Sample ID	Sample Date	Sample Depth	Saturated or Umsaturated	Toluene (mg/kg)	d_Toluene (mg/kg)	NROS_Toluene (mg/kg)	GROS_Toluene (mg/kg)	LnROS_Toluene (mg/kg)
SB-1 (8.5')	6/25/2012	8.50	U	55.2	1	55.2	55.2	55.2
SB-2 (7')	6/25/2012	7.00	U	0.223	0	-275.3256978	0.01	1.04458E-09
SB-3 (7')	6/25/2012	7.00	U	0.245	0	-275.3256978	0.01	1.04458E-09
SB-4 (6')	6/25/2012	6.00	U	0.232	0	-275.3256978	0.01	1.04458E-09
SB-5 (6.5')	6/25/2012	6.50	U	0.229	0	-275.3256978	0.01	1.04458E-09
SB-6 (3.5')	6/25/2012	3.50	U	0.251	0	-275.3256978	0.01	1.04458E-09
SB-7 (7')	6/25/2012	7.00	U	0.25	0	-275.3256978	0.01	1.04458E-09
SB-8 (3')	6/25/2012	3.00	U	0.247	0	-275.3256978	0.01	1.04458E-09
SB-9	12/26/2013	9-10'	U	0.0037	0	-380.5458411	0.01	1E-10
SB-10	12/27/2013	9-10'	U	0.0034	0	-275.3256978	0.01	1.04458E-09
SB-11	12/27/2013	9-10'	U	0.0038	0	-341.9971817	0.01	1E-10
SB-12	12/27/2013	7-8'	U	0.0037	0	-275.3256978	0.01	1.04458E-09
SB-12	12/27/2013	9-10'	U	0.0038	0	-211.6875887	0.01	1.212E-07
SB-13	12/27/2013	7-8'	U	0.428	0	-275.3256978	0.01	1.04458E-09
SB-13	12/27/2013	9-10'	U	0.0036	0	-275.3256978	0.01	1.04458E-09
SB-14	12/27/2013	4-5'	U	0.96	1	0.96	0.96	0.96
SB-14	12/27/2013	7-8'	U	0.732	0	-275.3256978	0.01	1.04458E-09
SB-15	12/27/2013	7-8'	U	0.766	0	-275.3256978	0.01	1.04458E-09
SB-15	12/27/2013	9-10'	U	0.754	0	-275.3256978	0.01	1.04458E-09
SB-16	12/27/2013	7-8'	U	0.711	0	-275.3256978	0.01	1.04458E-09
SB-16	12/27/2013	9-10'	U	0.0033	0	-275.3256978	0.01	1.04458E-09
SB-17	12/27/2013	7-8'	U	0.0037	0	-177.8598079	0.01	1.51689E-06

On-Site Soil 3-10 ft-bgs Stats Database
Former Top's Diner Property
Johnston City, Pennsylvania

Sample ID	Sample Date	Sample Depth	Saturated or Unsaturated	Ethylbenzene (mg/kg)	d_Ethylbenzene (mg/kg)	NROS_Ethylbenzene (mg/kg)	GROS_Ethylbenzene (mg/kg)	LnROS_Ethylbenzene (mg/kg)
SB-1 (8.5')	6/25/2012	8.50	U	42.6	1	42.6	42.6	42.6
SB-2 (7')	6/25/2012	7.00	U	0.223	0	-101.1348413	0.01	0.006849891
SB-3 (7')	6/25/2012	7.00	U	0.245	0	-101.1348413	0.01	0.006849891
SB-4 (6')	6/25/2012	6.00	U	0.232	0	-101.1348413	0.01	0.006849891
SB-5 (6.5')	6/25/2012	6.50	U	0.229	0	-101.1348413	0.01	0.006849891
SB-6 (3.5')	6/25/2012	3.50	U	0.251	0	-101.1348413	0.01	0.006849891
SB-7 (7')	6/25/2012	7.00	U	0.25	0	-101.1348413	0.01	0.006849891
SB-8 (3')	6/25/2012	3.00	U	0.247	0	-101.1348413	0.01	0.006849891
SB-9	12/26/2013	9-10'	U	0.0037	0	-145.0880426	0.01	0.000446904
SB-10	12/27/2013	9-10'	U	0.0034	0	-101.1348413	0.01	0.006849891
SB-11	12/27/2013	9-10'	U	0.0038	0	-128.8835125	0.01	0.001222558
SB-12	12/27/2013	7-8'	U	0.0037	0	-101.1348413	0.01	0.006849891
SB-12	12/27/2013	9-10'	U	0.0038	0	-75.17811098	0.01	0.034337361
SB-13	12/27/2013	7-8'	U	0.428	0	-101.1348413	0.01	0.006849891
SB-13	12/27/2013	9-10'	U	0.0036	0	-101.1348413	0.01	0.006849891
SB-14	12/27/2013	4-5'	U	0.769	0	-101.1348413	0.01	0.006849891
SB-14	12/27/2013	7-8'	U	15.3	1	15.3	15.3	15.3
SB-15	12/27/2013	7-8'	U	3.38	1	3.38	3.38	3.38
SB-15	12/27/2013	9-10'	U	0.754	0	-101.1348413	0.01	0.006849891
SB-16	12/27/2013	7-8'	U	0.711	0	-101.1348413	0.01	0.006849891
SB-16	12/27/2013	9-10'	U	0.0033	0	-101.1348413	0.01	0.006849891
SB-17	12/27/2013	7-8'	U	0.0037	0	-61.71751131	0.01	0.079216379

On-Site Soil 3-10 ft-bgs Stats Database

Former Top's Diner Property
Johnston City, Pennsylvania

Sample ID	Sample Date	Sample Depth	Saturated or Unsaturated	Total Xylenes (mg/kg)	d_Total Xylenes (mg/kg)	NROS_Total Xylenes (mg/kg)	GROS_Total Xylenes (mg/kg)	LnROS_Total Xylenes (mg/kg)
SB-1 (8.5')	6/25/2012	8.50	U	164	1	164	164	164
SB-2 (7')	6/25/2012	7.00	U	0.446	0	-463.6083654	0.01	9.94677E-06
SB-3 (7')	6/25/2012	7.00	U	0.489	0	-463.6083654	0.01	9.94677E-06
SB-4 (6')	6/25/2012	6.00	U	0.4665	0	-463.6083654	0.01	9.94677E-06
SB-5 (6.5')	6/25/2012	6.50	U	0.458	0	-463.6083654	0.01	9.94677E-06
SB-6 (3.5')	6/25/2012	3.50	U	0.503	0	-463.6083654	0.01	9.94677E-06
SB-7 (7')	6/25/2012	7.00	U	0.501	0	-463.6083654	0.01	9.94677E-06
SB-8 (3')	6/25/2012	3.00	U	0.494	0	-463.6083654	0.01	9.94677E-06
SB-9	12/26/2013	9-10'	U	0.0074	0	-582.5564601	0.01	4.03247E-07
SB-10	12/27/2013	9-10'	U	0.0069	0	-463.6083654	0.01	9.94677E-06
SB-11	12/27/2013	9-10'	U	0.0075	0	-582.5564601	0.01	4.03247E-07
SB-12	12/27/2013	7-8'	U	0.0075	0	-352.3416463	0.01	0.000199477
SB-12	12/27/2013	9-10'	U	0.0076	0	-463.6083654	0.01	9.94677E-06
SB-13	12/27/2013	7-8'	U	0.855	0	-463.6083654	0.01	9.94677E-06
SB-13	12/27/2013	9-10'	U	0.0073	0	-463.6083654	0.01	9.94677E-06
SB-14	12/27/2013	4-5'	U	1.78	1	1.78	1.78	1.78
SB-14	12/27/2013	7-8'	U	6.66	1	6.66	6.66	6.66
SB-15	12/27/2013	7-8'	U	1.53	0	-463.6083654	0.01	9.94677E-06
SB-15	12/27/2013	9-10'	U	1.51	0	-463.6083654	0.01	9.94677E-06
SB-16	12/27/2013	7-8'	U	1.42	0	-463.6083654	0.01	9.94677E-06
SB-16	12/27/2013	9-10'	U	0.0065	0	-463.6083654	0.01	9.94677E-06
SB-17	12/27/2013	7-8'	U	0.0074	0	-352.3416463	0.01	0.000199477

On-Site Soil 3-10 ft-bgs Stats Database
Former Top's Diner Property
Johnston City, Pennsylvania

Sample ID	Sample Date	Sample Depth	Saturated or Umsaturated	Cumene (mg/kg)	d_Cumene (mg/kg)	NROS_Cumene (mg/kg)	GROS_Cumene (mg/kg)	LnROS_Cumene (mg/kg)
SB-1 (8.5')	6/25/2012	8.50	U	4.71	1	4.71	4.71	4.71
SB-2 (7')	6/25/2012	7.00	U	0.223	0	-7.926806899	0.01	0.043336426
SB-3 (7')	6/25/2012	7.00	U	0.245	0	-7.926806899	0.01	0.043336426
SB-4 (6')	6/25/2012	6.00	U	0.232	0	-7.926806899	0.01	0.043336426
SB-5 (6.5')	6/25/2012	6.50	U	0.229	0	-7.926806899	0.01	0.043336426
SB-6 (3.5')	6/25/2012	3.50	U	0.251	0	-7.926806899	0.01	0.043336426
SB-7 (7')	6/25/2012	7.00	U	0.25	0	-7.926806899	0.01	0.043336426
SB-8 (3')	6/25/2012	3.00	U	0.247	0	-7.926806899	0.01	0.043336426
SB-9	12/26/2013	9-10'	U	0.0037	0	-11.79567482	0.01	0.010144668
SB-10	12/27/2013	9-10'	U	0.0034	0	-7.926806899	0.01	0.043336426
SB-11	12/27/2013	9-10'	U	0.0038	0	-10.36931258	0.01	0.017327309
SB-12	12/27/2013	7-8'	U	0.0037	0	-7.926806899	0.01	0.043336426
SB-12	12/27/2013	9-10'	U	0.0038	0	-5.64203223	0.01	0.102156338
SB-13	12/27/2013	7-8'	U	0.428	0	-7.926806899	0.01	0.043336426
SB-13	12/27/2013	9-10'	U	0.0036	0	-7.926806899	0.01	0.043336426
SB-14	12/27/2013	4-5'	U	0.769	0	-7.926806899	0.01	0.043336426
SB-14	12/27/2013	7-8'	U	2.36	1	2.36	2.36	2.36
SB-15	12/27/2013	7-8'	U	1.25	1	1.25	1.25	1.25
SB-15	12/27/2013	9-10'	U	0.754	0	-7.926806899	0.01	0.043336426
SB-16	12/27/2013	7-8'	U	0.711	0	-7.926806899	0.01	0.043336426
SB-16	12/27/2013	9-10'	U	0.0033	0	-7.926806899	0.01	0.043336426
SB-17	12/27/2013	7-8'	U	0.0037	0	-4.457197437	0.01	0.159364012

On-Site Soil 3-10 ft-bgs Stats Database
Former Top's Diner Property
Johnston City, Pennsylvania

Sample ID	Sample Date	Sample Depth	Saturated or Unsaturated	Naphthalene (mg/kg)	d_Naphthalene (mg/kg)	NROS_Naphthalene (mg/kg)	GROS_Naphthalene (mg/kg)	LnROS_Naphthalene (mg/kg)
SB-1 (8.5')	6/25/2012	8.50	U	16.3	1	16.3	16.3	16.3
SB-2 (7')	6/25/2012	7.00	U	0.677	0	-24.82562233	0.01	0.033889285
SB-3 (7')	6/25/2012	7.00	U	0.245	0	-24.82562233	0.01	0.033889285
SB-4 (6')	6/25/2012	6.00	U	0.232	0	-24.82562233	0.01	0.033889285
SB-5 (6.5')	6/25/2012	6.50	U	0.229	0	-24.82562233	0.01	0.033889285
SB-6 (3.5')	6/25/2012	3.50	U	0.251	0	-24.82562233	0.01	0.033889285
SB-7 (7')	6/25/2012	7.00	U	0.25	0	-24.82562233	0.01	0.033889285
SB-8 (3')	6/25/2012	3.00	U	0.247	0	-24.82562233	0.01	0.033889285
SB-9	12/26/2013	9-10'	U	0.0037	0	-37.22072422	0.01	0.004992416
SB-10	12/27/2013	9-10'	U	0.0034	0	-24.82562233	0.01	0.033889285
SB-11	12/27/2013	9-10'	U	0.0038	0	-32.62343801	0.01	0.010157893
SB-12	12/27/2013	7-8'	U	0.0037	0	-24.82562233	0.01	0.033889285
SB-12	12/27/2013	9-10'	U	0.0038	0	-17.6652779	0.01	0.102457745
SB-13	12/27/2013	7-8'	U	0.428	0	-24.82562233	0.01	0.033889285
SB-13	12/27/2013	9-10'	U	0.0036	0	-24.82562233	0.01	0.033889285
SB-14	12/27/2013	4-5'	U	1.33	1	1.33	1.33	1.33
SB-14	12/27/2013	7-8'	U	12.3	1	12.3	12.3	12.3
SB-15	12/27/2013	7-8'	U	5.15	1	5.15	5.15	5.15
SB-15	12/27/2013	9-10'	U	0.754	0	-24.82562233	0.01	0.033889285
SB-16	12/27/2013	7-8'	U	0.761	0	-24.82562233	0.01	0.033889285
SB-16	12/27/2013	9-10'	U	0.0033	0	-24.82562233	0.01	0.033889285
SB-17	12/27/2013	7-8'	U	0.0037	0	-14.03121925	0.01	0.179639545

On-Site Soil 3-10 ft-bgs Stats Database
Former Top's Diner Property
Johnston City, Pennsylvania

Sample ID	Sample Date	Sample Depth	Saturated or Umsaturated	1,2,4-TMB (mg/kg)	d_1,2,4-TMB (mg/kg)	NROS_1,2,4-TMB (mg/kg)	GROS_1,2,4-TMB (mg/kg)	LnROS_1,2,4-TMB (mg/kg)
SB-1 (8.5')	6/25/2012	8.50	U	95.3	1	95.3	95.3	95.3
SB-2 (7')	6/25/2012	7.00	U	0.547	1	0.547	0.547	0.547
SB-3 (7')	6/25/2012	7.00	U	0.261	1	0.261	0.261	0.261
SB-4 (6')	6/25/2012	6.00	U	0.232	0	-87.42544201	0.01	0.001420779
SB-5 (6.5')	6/25/2012	6.50	U	0.229	0	-87.42544201	0.01	0.001420779
SB-6 (3.5')	6/25/2012	3.50	U	0.251	0	-87.42544201	0.01	0.001420779
SB-7 (7')	6/25/2012	7.00	U	0.25	0	-87.42544201	0.01	0.001420779
SB-8 (3')	6/25/2012	3.00	U	0.247	0	-87.42544201	0.01	0.001420779
SB-9	12/26/2013	9-10'	U	0.0037	0	-125.1502648	0.01	0.000103148
SB-10	12/27/2013	9-10'	U	0.0034	0	-87.42544201	0.01	0.001420779
SB-11	12/27/2013	9-10'	U	0.0038	0	-110.975534	0.01	0.000276346
SB-12	12/27/2013	7-8'	U	0.0037	0	-87.42544201	0.01	0.001420779
SB-12	12/27/2013	9-10'	U	0.0038	0	-66.60559065	0.01	0.006041755
SB-13	12/27/2013	7-8'	U	0.428	0	-82.48217757	0.01	0.002003475
SB-13	12/27/2013	9-10'	U	0.0036	0	-87.42544201	0.01	0.001420779
SB-14	12/27/2013	4-5'	U	0.908	1	0.908	0.908	0.908
SB-14	12/27/2013	7-8'	U	4.19	1	4.19	4.19	4.19
SB-15	12/27/2013	7-8'	U	0.766	0	-77.96304511	0.01	0.002743058
SB-15	12/27/2013	9-10'	U	0.754	0	-77.96304511	0.01	0.002743058
SB-16	12/27/2013	7-8'	U	1.37	1	1.37	1.37	1.37
SB-16	12/27/2013	9-10'	U	0.0033	0	-87.42544201	0.01	0.001420779
SB-17	12/27/2013	7-8'	U	0.0037	0	-56.46324738	0.01	0.012229311

On-Site Soil 3-10 ft-bgs Stats Database
Former Top's Diner Property
Johnston City, Pennsylvania

Sample ID	Sample Date	Sample Depth	Saturated or Unsaturated	1,3,5-TMB (mg/kg)	d_1,3,5-TMB (mg/kg)	NROS_1,3,5-TMB (mg/kg)	GROS_1,3,5-TMB (mg/kg)	LnROS_1,3,5-TMB (mg/kg)
SB-1 (8.5')	6/25/2012	8.50	U	37.6	1	37.6	37.6	37.6
SB-2 (7')	6/25/2012	7.00	U	0.223	0	-102.2874473	0.01	8.27385E-05
SB-3 (7')	6/25/2012	7.00	U	0.245	0	-102.2874473	0.01	8.27385E-05
SB-4 (6')	6/25/2012	6.00	U	0.232	0	-102.2874473	0.01	8.27385E-05
SB-5 (6.5')	6/25/2012	6.50	U	0.229	0	-102.2874473	0.01	8.27385E-05
SB-6 (3.5')	6/25/2012	3.50	U	0.251	0	-102.2874473	0.01	8.27385E-05
SB-7 (7')	6/25/2012	7.00	U	0.25	0	-102.2874473	0.01	8.27385E-05
SB-8 (3')	6/25/2012	3.00	U	0.247	0	-102.2874473	0.01	8.27385E-05
SB-9	12/26/2013	9-10'	U	0.0037	0	-144.4569935	0.01	1.49375E-06
SB-10	12/27/2013	9-10'	U	0.0034	0	-102.2874473	0.01	8.27385E-05
SB-11	12/27/2013	9-10'	U	0.0038	0	-128.9100559	0.01	6.56207E-06
SB-12	12/27/2013	7-8'	U	0.0037	0	-102.2874473	0.01	8.27385E-05
SB-12	12/27/2013	9-10'	U	0.0038	0	-77.38406131	0.01	0.000885719
SB-13	12/27/2013	7-8'	U	0.428	0	-102.2874473	0.01	8.27385E-05
SB-13	12/27/2013	9-10'	U	0.0036	0	-102.2874473	0.01	8.27385E-05
SB-14	12/27/2013	4-5'	U	0.769	0	-102.2874473	0.01	8.27385E-05
SB-14	12/27/2013	7-8'	U	4.43	1	4.43	4.43	4.43
SB-15	12/27/2013	7-8'	U	0.766	0	-102.2874473	0.01	8.27385E-05
SB-15	12/27/2013	9-10'	U	0.754	0	-102.2874473	0.01	8.27385E-05
SB-16	12/27/2013	7-8'	U	0.993	1	0.993	0.993	0.993
SB-16	12/27/2013	9-10'	U	0.0033	0	-102.2874473	0.01	8.27385E-05
SB-17	12/27/2013	7-8'	U	0.0037	0	-64.46970326	0.01	0.003028436

On-Site Soil 3-10 ft-bgs GOF
Former Top's Diner Property
Johnstown City, Pennsylvnaia

	Goodness-of-Fit Test Statistics for Data Sets with Non-Detects							
User Selected Options								
Date/Time of Computation	6/10/2015 3:54:50 PM							
From File	WorkSheet.xls							
Full Precision	OFF							
Confidence Coefficient	0.95							
Benzene (mg/kg)								
	Num Obs	Num Miss	Num Valid	Detects	NDs	% NDs		
Raw Statistics	22	0	22	2	20	90.91%		
	Number	Minimum	Maximum	Mean	Median	SD		
Statistics (Non-Detects Only)	20	N/A	N/A	N/A	N/A	N/A		
Statistics (Detects Only)	2	N/A	N/A	N/A	N/A	N/A		
Statistics (All: NDs treated as DL value)	22	N/A	N/A	N/A	N/A	N/A		
Statistics (All: NDs treated as DL/2 value)	22	N/A	N/A	N/A	N/A	N/A		
Statistics (Normal ROS Imputed Data)	22	N/A	N/A	N/A	N/A	N/A		
	Normal GOF Test Results							
	No NDs	NDs = DL	NDs = DL/2	Normal ROS				
Correlation Coefficient R	N/A	N/A	N/A	N/A				
	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)					
Shapiro-Wilk (Detects Only)	N/A	N/A						
Lilliefors (Detects Only)	N/A	N/A						
Shapiro-Wilk (NDs = DL)	N/A	N/A						
Lilliefors (NDs = DL)	N/A	N/A						
Shapiro-Wilk (NDs = DL/2)	N/A	N/A						
Lilliefors (NDs = DL/2)	N/A	N/A						
Shapiro-Wilk (Normal ROS Estimates)	N/A	N/A						
Lilliefors (Normal ROS Estimates)	N/A	N/A						
	Gamma GOF Test Results							
	No NDs	NDs = DL	NDs = DL/2	Gamma ROS				
Correlation Coefficient R	N/A	N/A	N/A	N/A				
	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)					
Anderson-Darling (Detects Only)	N/A	N/A						
Kolmogorov-Smirnov (Detects Only)	N/A	N/A						
Anderson-Darling (NDs = DL)	N/A	N/A						
Kolmogorov-Smirnov (NDs = DL)	N/A	N/A						
Anderson-Darling (NDs = DL/2)	N/A	N/A						
Kolmogorov-Smirnov (NDs = DL/2)	N/A	N/A						
Anderson-Darling (Gamma ROS Estimates)	N/A	N/A						
Kolmogorov-Smirnov (Gamma ROS Est.)	N/A	N/A						
Note: Substitution methods such as DL or DL/2 are not recommended.								

On-Site Soil 3-10 ft-bgs GOF
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Toluene (mg/kg)						
	Num Obs	Num Miss	Num Valid	Detects	NDs	% NDs
Raw Statistics	22	0	22	2	20	90.91%
	Number	Minimum	Maximum	Mean	Median	SD
Statistics (Non-Detects Only)	20	N/A	N/A	N/A	N/A	N/A
Statistics (Detects Only)	2	N/A	N/A	N/A	N/A	N/A
Statistics (All: NDs treated as DL value)	22	N/A	N/A	N/A	N/A	N/A
Statistics (All: NDs treated as DL/2 value)	22	N/A	N/A	N/A	N/A	N/A
Statistics (Normal ROS Imputed Data)	22	N/A	N/A	N/A	N/A	N/A

Normal GOF Test Results

	No NDs	NDs = DL	NDs = DL/2	Normal ROS
Correlation Coefficient R	N/A	N/A	N/A	N/A

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Shapiro-Wilk (Detects Only)	N/A	N/A	
Lilliefors (Detects Only)	N/A	N/A	
Shapiro-Wilk (NDs = DL)	N/A	N/A	
Lilliefors (NDs = DL)	N/A	N/A	
Shapiro-Wilk (NDs = DL/2)	N/A	N/A	
Lilliefors (NDs = DL/2)	N/A	N/A	
Shapiro-Wilk (Normal ROS Estimates)	N/A	N/A	
Lilliefors (Normal ROS Estimates)	N/A	N/A	

Gamma GOF Test Results

	No NDs	NDs = DL	NDs = DL/2	Gamma ROS
Correlation Coefficient R	N/A	N/A	N/A	N/A

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Anderson-Darling (Detects Only)	N/A	N/A	
Kolmogorov-Smirnov (Detects Only)	N/A	N/A	
Anderson-Darling (NDs = DL)	N/A	N/A	
Kolmogorov-Smirnov (NDs = DL)	N/A	N/A	
Anderson-Darling (NDs = DL/2)	N/A	N/A	
Kolmogorov-Smirnov (NDs = DL/2)	N/A	N/A	
Anderson-Darling (Gamma ROS Estimates)	N/A	N/A	
Kolmogorov-Smirnov (Gamma ROS Est.)	N/A	N/A	

Note: Substitution methods such as DL or DL/2 are not recommended.

On-Site Soil 3-10 ft-bgs GOF
Former Top's Diner Property
Johnstown City, Pennsylvnaia

Ethylbenzene (mg/kg)						
	Num Obs	Num Miss	Num Valid	Detects	NDs	% NDs
Raw Statistics	22	0	22	3	19	86.36%
	Number	Minimum	Maximum	Mean	Median	SD
Statistics (Non-Detects Only)	19	0.0033	0.769	0.23	0.229	0.263
Statistics (Detects Only)	3	3.38	42.6	20.43	15.3	20.11
Statistics (All: NDs treated as DL value)	22	0.0033	42.6	2.984	0.239	9.428
Statistics (All: NDs treated as DL/2 value)	22	0.00165	42.6	2.885	0.119	9.456
Statistics (Normal ROS Imputed Data)	22	-145.1	42.6	-84.85	-101.1	45.89
Statistics (Gamma ROS Imputed Data)	22	0.01	42.6	2.794	0.01	9.483
Statistics (Lognormal ROS Imputed Data)	22	4.4690E-4	42.6	2.795	0.00685	9.483
	K hat	K Star	Theta hat	Log Mean	Log Stdv	Log CV
Statistics (Detects Only)	N/A	N/A	N/A	N/A	N/A	N/A
Statistics (NDs = DL)	0.219	0.219	13.66	-2.228	2.943	-1.321
Statistics (NDs = DL/2)	0.191	0.195	15.12	-2.827	3.11	-1.1
Statistics (Gamma ROS Estimates)	0.163	0.171	17.13	--	--	--
Statistics (Lognormal ROS Estimates)	--	--	--	-3.972	2.851	-0.718

Normal GOF Test Results

	No NDs	NDs = DL	NDs = DL/2	Normal ROS
Correlation Coefficient R	0.975	0.574	0.567	0.569

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Shapiro-Wilk (Detects Only)	0.951	0.767	Data Appear Normal
Lilliefors (Detects Only)	0.267	0.512	Data Appear Normal
Shapiro-Wilk (NDs = DL)	0.354	0.911	Data Not Normal
Lilliefors (NDs = DL)	0.457	0.189	Data Not Normal
Shapiro-Wilk (NDs = DL/2)	0.346	0.911	Data Not Normal
Lilliefors (NDs = DL/2)	0.468	0.189	Data Not Normal
Shapiro-Wilk (Normal ROS Estimates)	0.665	0.911	Data Not Normal
Lilliefors (Normal ROS Estimates)	0.411	0.189	Data Not Normal

Gamma GOF Test Results

	No NDs	NDs = DL	NDs = DL/2	Gamma ROS
Correlation Coefficient R	N/A	0.938	0.945	0.953

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Anderson-Darling (Detects Only)	N/A	N/A	
Kolmogorov-Smirnov (Detects Only)	N/A	N/A	
Anderson-Darling (NDs = DL)	2.003	0.888	
Kolmogorov-Smirnov (NDs = DL)	0.286	0.205	Data Not Gamma Distributed
Anderson-Darling (NDs = DL/2)	2.371	0.905	
Kolmogorov-Smirnov (NDs = DL/2)	0.327	0.207	Data Not Gamma Distributed
Anderson-Darling (Gamma ROS Estimates)	6.541	0.931	
Kolmogorov-Smirnov (Gamma ROS Est.)	0.544	0.208	Data Not Gamma Distributed

Lognormal GOF Test Results

	No NDs	NDs = DL	NDs = DL/2	Log ROS
Correlation Coefficient R	0.994	0.934	0.934	0.807

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Shapiro-Wilk (Detects Only)	N/A	N/A	
Lilliefors (Detects Only)	N/A	N/A	
Shapiro-Wilk (NDs = DL)	0.861	0.911	Data Not Lognormal
Lilliefors (NDs = DL)	0.236	0.189	Data Not Lognormal
Shapiro-Wilk (NDs = DL/2)	0.862	0.911	Data Not Lognormal
Lilliefors (NDs = DL/2)	0.229	0.189	Data Not Lognormal
Shapiro-Wilk (Lognormal ROS Estimates)	0.663	0.911	Data Not Lognormal
Lilliefors (Lognormal ROS Estimates)	0.411	0.189	Data Not Lognormal

Note: Substitution methods such as DL or DL/2 are not recommended.

On-Site Soil 3-10 ft-bgs GOF
Former Top's Diner Property
Johnstown City, Pennsylvnaia

Total Xylenes (mg/kg)

	Num Obs	Num Miss	Num Valid	Detects	NDs	% NDs
Raw Statistics	22	0	22	3	19	86.36%

	Number	Minimum	Maximum	Mean	Median	SD
Statistics (Non-Detects Only)	19	0.0065	1.53	0.46	0.458	0.525
Statistics (Detects Only)	3	1.78	164	57.48	6.66	92.28
Statistics (All: NDs treated as DL value)	22	0.0065	164	8.236	0.478	34.82
Statistics (All: NDs treated as DL/2 value)	22	0.00325	164	8.037	0.239	34.86
Statistics (Normal ROS Imputed Data)	22	-582.6	164	-393.2	-463.6	192.2
Statistics (Gamma ROS Imputed Data)	22	0.01	164	7.847	0.01	34.91
Statistics (Lognormal ROS Imputed Data)	22	4.0325E-7	164	7.838	9.9468E-6	34.91

	K hat	K Star	Theta hat	Log Mean	Log Stdv	Log CV
Statistics (Detects Only)	N/A	N/A	N/A	N/A	N/A	N/A
Statistics (NDs = DL)	0.197	0.201	41.79	-1.634	2.842	-1.739
Statistics (NDs = DL/2)	0.174	0.181	46.15	-2.233	2.993	-1.341
Statistics (Gamma ROS Estimates)	0.137	0.148	57.36	--	--	--
Statistics (Lognormal ROS Estimates)	--	--	--	-9.622	5.172	-0.538

Normal GOF Test Results

	No NDs	NDs = DL	NDs = DL/2	Normal ROS
Correlation Coefficient R	0.879	0.466	0.463	0.459

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Shapiro-Wilk (Detects Only)	0.773	0.767	Data Appear Normal
Lilliefors (Detects Only)	0.376	0.512	Data Appear Normal
Shapiro-Wilk (NDs = DL)	0.244	0.911	Data Not Normal
Lilliefors (NDs = DL)	0.483	0.189	Data Not Normal
Shapiro-Wilk (NDs = DL/2)	0.24	0.911	Data Not Normal
Lilliefors (NDs = DL/2)	0.48	0.189	Data Not Normal
Shapiro-Wilk (Normal ROS Estimates)	0.617	0.911	Data Not Normal
Lilliefors (Normal ROS Estimates)	0.416	0.189	Data Not Normal

Gamma GOF Test Results

	No NDs	NDs = DL	NDs = DL/2	Gamma ROS
Correlation Coefficient R	N/A	0.849	0.859	0.88

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Anderson-Darling (Detects Only)	N/A	N/A	
Kolmogorov-Smirnov (Detects Only)	N/A	N/A	
Anderson-Darling (NDs = DL)	2.766	0.899	
Kolmogorov-Smirnov (NDs = DL)	0.329	0.206	Data Not Gamma Distributed
Anderson-Darling (NDs = DL/2)	3.024	0.921	
Kolmogorov-Smirnov (NDs = DL/2)	0.336	0.208	Data Not Gamma Distributed
Anderson-Darling (Gamma ROS Estimates)	6.819	0.956	
Kolmogorov-Smirnov (Gamma ROS Est.)	0.537	0.21	Data Not Gamma Distributed

Lognormal GOF Test Results

	No NDs	NDs = DL	NDs = DL/2	Log ROS
Correlation Coefficient R	0.972	0.923	0.928	0.779

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Shapiro-Wilk (Detects Only)	N/A	N/A	
Lilliefors (Detects Only)	N/A	N/A	
Shapiro-Wilk (NDs = DL)	0.847	0.911	Data Not Lognormal
Lilliefors (NDs = DL)	0.251	0.189	Data Not Lognormal
Shapiro-Wilk (NDs = DL/2)	0.858	0.911	Data Not Lognormal
Lilliefors (NDs = DL/2)	0.233	0.189	Data Not Lognormal
Shapiro-Wilk (Lognormal ROS Estimates)	0.617	0.911	Data Not Lognormal
Lilliefors (Lognormal ROS Estimates)	0.416	0.189	Data Not Lognormal

Note: Substitution methods such as DL or DL/2 are not recommended.

On-Site Soil 3-10 ft-bgs GOF
Former Top's Diner Property
Johnstown City, Pennsylvnaia

Cumene (mg/kg)

	Num Obs	Num Miss	Num Valid	Detects	NDs	% NDs
Raw Statistics	22	0	22	3	19	86.36%

	Number	Minimum	Maximum	Mean	Median	SD
Statistics (Non-Detects Only)	19	0.0033	0.769	0.23	0.229	0.263
Statistics (Detects Only)	3	1.25	4.71	2.773	2.36	1.767
Statistics (All: NDs treated as DL value)	22	0.0033	4.71	0.677	0.239	1.076
Statistics (All: NDs treated as DL/2 value)	22	0.00165	4.71	0.477	0.119	1.088
Statistics (Normal ROS Imputed Data)	22	-11.8	4.71	-6.493	-7.927	4.04
Statistics (Gamma ROS Imputed Data)	22	0.01	4.71	0.387	0.01	1.113
Statistics (Lognormal ROS Imputed Data)	22	0.0101	4.71	0.421	0.0433	1.102

	K hat	K Star	Theta hat	Log Mean	Log Stdv	Log CV
Statistics (Detects Only)	N/A	N/A	N/A	N/A	N/A	N/A
Statistics (NDs = DL)	0.352	0.334	1.638	-2.458	2.567	-1.044
Statistics (NDs = DL/2)	0.298	0.288	1.603	-3.057	2.703	-0.884
Statistics (Gamma ROS Estimates)	0.245	0.242	1.578	--	--	--
Statistics (Lognormal ROS Estimates)	--	--	--	-2.601	1.516	-0.583

Normal GOF Test Results

	No NDs	NDs = DL	NDs = DL/2	Normal ROS
Correlation Coefficient R	0.979	0.737	0.679	0.615

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Shapiro-Wilk (Detects Only)	0.959	0.767	Data Appear Normal
Lilliefors (Detects Only)	0.259	0.512	Data Appear Normal
Shapiro-Wilk (NDs = DL)	0.563	0.911	Data Not Normal
Lilliefors (NDs = DL)	0.301	0.189	Data Not Normal
Shapiro-Wilk (NDs = DL/2)	0.482	0.911	Data Not Normal
Lilliefors (NDs = DL/2)	0.398	0.189	Data Not Normal
Shapiro-Wilk (Normal ROS Estimates)	0.665	0.911	Data Not Normal
Lilliefors (Normal ROS Estimates)	0.411	0.189	Data Not Normal

Gamma GOF Test Results

	No NDs	NDs = DL	NDs = DL/2	Gamma ROS
Correlation Coefficient R	N/A	0.979	0.97	0.955

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Anderson-Darling (Detects Only)	N/A	N/A	
Kolmogorov-Smirnov (Detects Only)	N/A	N/A	
Anderson-Darling (NDs = DL)	1.125	0.836	
Kolmogorov-Smirnov (NDs = DL)	0.231	0.2	Data Not Gamma Distributed
Anderson-Darling (NDs = DL/2)	1.244	0.849	
Kolmogorov-Smirnov (NDs = DL/2)	0.214	0.201	Data Not Gamma Distributed
Anderson-Darling (Gamma ROS Estimates)	6.548	0.875	
Kolmogorov-Smirnov (Gamma ROS Est.)	0.545	0.204	Data Not Gamma Distributed

Lognormal GOF Test Results

	No NDs	NDs = DL	NDs = DL/2	Log ROS
Correlation Coefficient R	1	0.915	0.926	0.807

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Shapiro-Wilk (Detects Only)	N/A	N/A	
Lilliefors (Detects Only)	N/A	N/A	
Shapiro-Wilk (NDs = DL)	0.821	0.911	Data Not Lognormal
Lilliefors (NDs = DL)	0.282	0.189	Data Not Lognormal
Shapiro-Wilk (NDs = DL/2)	0.843	0.911	Data Not Lognormal
Lilliefors (NDs = DL/2)	0.262	0.189	Data Not Lognormal
Shapiro-Wilk (Lognormal ROS Estimates)	0.664	0.911	Data Not Lognormal
Lilliefors (Lognormal ROS Estimates)	0.411	0.189	Data Not Lognormal

Note: Substitution methods such as DL or DL/2 are not recommended.

On-Site Soil 3-10 ft-bgs GOF
Former Top's Diner Property
Johnstown City, Pennsylvnaia

Naphthalene (mg/kg)						
	Num Obs	Num Miss	Num Valid	Detects	NDs	% NDs
Raw Statistics	22	0	22	4	18	81.82%
	Number	Minimum	Maximum	Mean	Median	SD
Statistics (Non-Detects Only)	18	0.0033	0.761	0.228	0.231	0.286
Statistics (Detects Only)	4	1.33	16.3	8.77	8.725	6.773
Statistics (All: NDs treated as DL value)	22	0.0033	16.3	1.781	0.246	4.241
Statistics (All: NDs treated as DL/2 value)	22	0.00165	16.3	1.688	0.123	4.271
Statistics (Normal ROS Imputed Data)	22	-37.22	16.3	-18.82	-24.83	14.21
Statistics (Gamma ROS Imputed Data)	22	0.01	16.3	1.603	0.01	4.303
Statistics (Lognormal ROS Imputed Data)	22	0.00439	16.3	1.63	0.0339	4.292
	K hat	K Star	Theta hat	Log Mean	Log Stdv	Log CV
Statistics (Detects Only)	1.515	0.545	5.79	1.806	1.126	0.624
Statistics (NDs = DL)	0.256	0.252	6.951	-2.184	2.91	-1.332
Statistics (NDs = DL/2)	0.221	0.221	7.63	-2.751	3.098	-1.126
Statistics (Gamma ROS Estimates)	0.19	0.194	8.448	--	--	--
Statistics (Lognormal ROS Estimates)	--	--	--	-2.457	2.201	-0.896
Normal GOF Test Results						
	No NDs	NDs = DL	NDs = DL/2	Normal ROS		
Correlation Coefficient R	0.986	0.676	0.661	0.646		
	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)			
Shapiro-Wilk (Detects Only)	0.959	0.748	Data Appear Normal			
Lilliefors (Detects Only)	0.203	0.443	Data Appear Normal			
Shapiro-Wilk (NDs = DL)	0.47	0.911	Data Not Normal			
Lilliefors (NDs = DL)	0.413	0.189	Data Not Normal			
Shapiro-Wilk (NDs = DL/2)	0.451	0.911	Data Not Normal			
Lilliefors (NDs = DL/2)	0.438	0.189	Data Not Normal			
Shapiro-Wilk (Normal ROS Estimates)	0.712	0.911	Data Not Normal			
Lilliefors (Normal ROS Estimates)	0.391	0.189	Data Not Normal			
Gamma GOF Test Results						
	No NDs	NDs = DL	NDs = DL/2	Gamma ROS		
Correlation Coefficient R	0.917	0.962	0.962	0.962		
	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)			
Anderson-Darling (Detects Only)	0.283	0.662				
Kolmogorov-Smirnov (Detects Only)	0.26	0.399	Detected Data Appear Gamma Distributed			
Anderson-Darling (NDs = DL)	1.392	0.859				
Kolmogorov-Smirnov (NDs = DL)	0.205	0.203	Data Not Gamma Distributed			
Anderson-Darling (NDs = DL/2)	1.67	0.886				
Kolmogorov-Smirnov (NDs = DL/2)	0.259	0.205	Data Not Gamma Distributed			
Anderson-Darling (Gamma ROS Estimates)	5.689	0.906				
Kolmogorov-Smirnov (Gamma ROS Est.)	0.516	0.207	Data Not Gamma Distributed			
Lognormal GOF Test Results						
	No NDs	NDs = DL	NDs = DL/2	Log ROS		
Correlation Coefficient R	0.96	0.934	0.938	0.838		
	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)			
Shapiro-Wilk (Detects Only)	0.917	0.748	Data Appear Lognormal			
Lilliefors (Detects Only)	0.234	0.443	Data Appear Lognormal			
Shapiro-Wilk (NDs = DL)	0.856	0.911	Data Not Lognormal			
Lilliefors (NDs = DL)	0.242	0.189	Data Not Lognormal			
Shapiro-Wilk (NDs = DL/2)	0.865	0.911	Data Not Lognormal			
Lilliefors (NDs = DL/2)	0.235	0.189	Data Not Lognormal			
Shapiro-Wilk (Lognormal ROS Estimates)	0.707	0.911	Data Not Lognormal			
Lilliefors (Lognormal ROS Estimates)	0.391	0.189	Data Not Lognormal			
Note: Substitution methods such as DL or DL/2 are not recommended.						

On-Site Soil 3-10 ft-bgs GOF
Former Top's Diner Property
Johnstown City, Pennsylvnaia

1,2,4-TMB (mg/kg)						
	Num Obs	Num Miss	Num Valid	Detects	NDs	% NDs
Raw Statistics	22	0	22	6	16	72.73%
	Number	Minimum	Maximum	Mean	Median	SD
Statistics (Non-Detects Only)	16	0.0033	0.766	0.199	0.116	0.258
Statistics (Detects Only)	6	0.261	95.3	17.1	1.139	38.34
Statistics (All: NDs treated as DL value)	22	0.0033	95.3	4.807	0.249	20.23
Statistics (All: NDs treated as DL/2 value)	22	0.00165	95.3	4.736	0.124	20.25
Statistics (Normal ROS Imputed Data)	22	-125.2	95.3	-58.27	-84.95	52.45
Statistics (Gamma ROS Imputed Data)	22	0.01	95.3	4.67	0.01	20.26
Statistics (Lognormal ROS Imputed Data)	22	1.0315E-4	95.3	4.664	0.00171	20.27
	K hat	K Star	Theta hat	Log Mean	Log Stdv	Log CV
Statistics (Detects Only)	0.32	0.271	53.35	0.71	2.101	2.958
Statistics (NDs = DL)	0.194	0.198	24.75	-2.237	2.918	-1.306
Statistics (NDs = DL/2)	0.175	0.181	27.07	-2.741	3.127	-1.141
Statistics (Gamma ROS Estimates)	0.162	0.17	28.86	--	--	--
Statistics (Lognormal ROS Estimates)	--	--	--	-4.529	3.557	-0.785

Normal GOF Test Results

	No NDs	NDs = DL	NDs = DL/2	Normal ROS
Correlation Coefficient R	0.708	0.468	0.467	0.465

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Shapiro-Wilk (Detects Only)	0.526	0.788	Data Not Normal
Lilliefors (Detects Only)	0.465	0.362	Data Not Normal
Shapiro-Wilk (NDs = DL)	0.246	0.911	Data Not Normal
Lilliefors (NDs = DL)	0.477	0.189	Data Not Normal
Shapiro-Wilk (NDs = DL/2)	0.244	0.911	Data Not Normal
Lilliefors (NDs = DL/2)	0.475	0.189	Data Not Normal
Shapiro-Wilk (Normal ROS Estimates)	0.791	0.911	Data Not Normal
Lilliefors (Normal ROS Estimates)	0.253	0.189	Data Not Normal

Gamma GOF Test Results

	No NDs	NDs = DL	NDs = DL/2	Gamma ROS
Correlation Coefficient R	0.962	0.852	0.862	0.869

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Anderson-Darling (Detects Only)	0.872	0.764	
Kolmogorov-Smirnov (Detects Only)	0.348	0.356	Detected Data appear Approximate Gamma Distr
Anderson-Darling (NDs = DL)	2.617	0.902	
Kolmogorov-Smirnov (NDs = DL)	0.295	0.206	Data Not Gamma Distributed
Anderson-Darling (NDs = DL/2)	2.621	0.92	
Kolmogorov-Smirnov (NDs = DL/2)	0.274	0.208	Data Not Gamma Distributed
Anderson-Darling (Gamma ROS Estimates)	5.034	0.932	
Kolmogorov-Smirnov (Gamma ROS Est.)	0.431	0.208	Data Not Gamma Distributed

Lognormal GOF Test Results

	No NDs	NDs = DL	NDs = DL/2	Log ROS
Correlation Coefficient R	0.931	0.927	0.937	0.902

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Shapiro-Wilk (Detects Only)	0.878	0.788	Data Appear Lognormal
Lilliefors (Detects Only)	0.241	0.362	Data Appear Lognormal
Shapiro-Wilk (NDs = DL)	0.855	0.911	Data Not Lognormal
Lilliefors (NDs = DL)	0.239	0.189	Data Not Lognormal
Shapiro-Wilk (NDs = DL/2)	0.871	0.911	Data Not Lognormal
Lilliefors (NDs = DL/2)	0.234	0.189	Data Not Lognormal
Shapiro-Wilk (Lognormal ROS Estimates)	0.817	0.911	Data Not Lognormal
Lilliefors (Lognormal ROS Estimates)	0.286	0.189	Data Not Lognormal

Note: Substitution methods such as DL or DL/2 are not recommended.

On-Site Soil 3-10 ft-bgs GOF
Former Top's Diner Property
Johnstown City, Pennsylvnaia

1,3,5-TMB (mg/kg)

	Num Obs	Num Miss	Num Valid	Detects	NDs	% NDs
Raw Statistics	22	0	22	3	19	86.36%

	Number	Minimum	Maximum	Mean	Median	SD
Statistics (Non-Detects Only)	19	0.0033	0.769	0.233	0.229	0.269
Statistics (Detects Only)	3	0.993	37.6	14.34	4.43	20.22
Statistics (All: NDs treated as DL value)	22	0.0033	37.6	2.157	0.239	7.971
Statistics (All: NDs treated as DL/2 value)	22	0.00165	37.6	2.058	0.119	7.994
Statistics (Normal ROS Imputed Data)	22	-144.5	37.6	-86.66	-102.3	44.07
Statistics (Gamma ROS Imputed Data)	22	0.01	37.6	1.964	0.01	8.016
Statistics (Lognormal ROS Imputed Data)	22	1.4938E-6	37.6	1.956	8.2739E-5	8.018

	K hat	K Star	Theta hat	Log Mean	Log Stdv	Log CV
Statistics (Detects Only)	N/A	N/A	N/A	N/A	N/A	N/A
Statistics (NDs = DL)	0.231	0.23	9.328	-2.342	2.784	-1.188
Statistics (NDs = DL/2)	0.201	0.204	10.24	-2.941	2.934	-0.998
Statistics (Gamma ROS Estimates)	0.171	0.178	11.51	--	--	--
Statistics (Lognormal ROS Estimates)	--	--	--	-7.912	4.191	-0.53

Normal GOF Test Results

	No NDs	NDs = DL	NDs = DL/2	Normal ROS
Correlation Coefficient R	0.905	0.505	0.497	0.488

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Shapiro-Wilk (Detects Only)	0.82	0.767	Data Appear Normal
Lilliefors (Detects Only)	0.355	0.512	Data Appear Normal
Shapiro-Wilk (NDs = DL)	0.282	0.911	Data Not Normal
Lilliefors (NDs = DL)	0.467	0.189	Data Not Normal
Shapiro-Wilk (NDs = DL/2)	0.273	0.911	Data Not Normal
Lilliefors (NDs = DL/2)	0.462	0.189	Data Not Normal
Shapiro-Wilk (Normal ROS Estimates)	0.665	0.911	Data Not Normal
Lilliefors (Normal ROS Estimates)	0.411	0.189	Data Not Normal

Gamma GOF Test Results

	No NDs	NDs = DL	NDs = DL/2	Gamma ROS
Correlation Coefficient R	N/A	0.868	0.879	0.891

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Anderson-Darling (Detects Only)	N/A	N/A	
Kolmogorov-Smirnov (Detects Only)	N/A	N/A	
Anderson-Darling (NDs = DL)	2.064	0.881	
Kolmogorov-Smirnov (NDs = DL)	0.267	0.204	Data Not Gamma Distributed
Anderson-Darling (NDs = DL/2)	2.383	0.896	
Kolmogorov-Smirnov (NDs = DL/2)	0.304	0.206	Data Not Gamma Distributed
Anderson-Darling (Gamma ROS Estimates)	6.666	0.924	
Kolmogorov-Smirnov (Gamma ROS Est.)	0.539	0.208	Data Not Gamma Distributed

Lognormal GOF Test Results

	No NDs	NDs = DL	NDs = DL/2	Log ROS
Correlation Coefficient R	0.995	0.926	0.932	0.808

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Shapiro-Wilk (Detects Only)	N/A	N/A	
Lilliefors (Detects Only)	N/A	N/A	
Shapiro-Wilk (NDs = DL)	0.85	0.911	Data Not Lognormal
Lilliefors (NDs = DL)	0.255	0.189	Data Not Lognormal
Shapiro-Wilk (NDs = DL/2)	0.861	0.911	Data Not Lognormal
Lilliefors (NDs = DL/2)	0.237	0.189	Data Not Lognormal
Shapiro-Wilk (Lognormal ROS Estimates)	0.655	0.911	Data Not Lognormal
Lilliefors (Lognormal ROS Estimates)	0.411	0.189	Data Not Lognormal

Note: Substitution methods such as DL or DL/2 are not recommended.

On-Site Soil 3-10ft-bgs UCL
Former Top's Diner Property
Johnstown, Pennsylvania

UCL Statistics for Data Sets with Non-Detects	
User Selected Options	
Date/Time of Computation	6/10/2015 3:55:34 PM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Benzene (mg/kg)

General Statistics			
Total Number of Observations	22	Number of Distinct Observations	17
Number of Detects	2	Number of Non-Detects	20
Number of Distinct Detects	2	Number of Distinct Non-Detects	15
Minimum Detect	0.4	Minimum Non-Detect	0.0013
Maximum Detect	5.98	Maximum Non-Detect	0.307
Variance Detects	15.57	Percent Non-Detects	90.91%
Mean Detects	3.19	SD Detects	3.946
Median Detects	3.19	CV Detects	1.237
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	0.436	SD of Logged Detects	1.913

Warning: Data set has only 2 Detected Values.

This is not enough to compute meaningful or reliable statistics and estimates.

Normal GOF Test on Detects Only

Not Enough Data to Perform GOF Test

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.291	Standard Error of Mean	0.375
SD	1.244	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.937	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.908	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	1.417	95% KM Chebyshev UCL	1.926
97.5% KM Chebyshev UCL	2.634	99% KM Chebyshev UCL	4.024

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.817	k star (bias corrected MLE)	N/A
Theta hat (MLE)	3.902	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	3.27	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.0548	nu hat (KM)	2.41
		Adjusted Level of Significance (β)	0.0386
Approximate Chi Square Value (2.41, α)	0.221	Adjusted Chi Square Value (2.41, β)	0.189
95% Gamma Approximate KM-UCL (use when n>=50)	3.168	95% Gamma Adjusted KM-UCL (use when n<50)	3.711
Gamma (KM) may not be used when k hat (KM) is < 0.1			

On-Site Soil 3-10ft-bgs UCL

Former Top's Diner Property

Johnstown, Pennsylvania

Lognormal GOF Test on Detected Observations Only			
Not Enough Data to Perform GOF Test			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	0.29	Mean in Log Scale	-13.38
SD in Original Scale	1.274	SD in Log Scale	5.289
95% t UCL (assumes normality of ROS data)	0.757	95% Percentile Bootstrap UCL	0.834
95% BCA Bootstrap UCL	1.106	95% Bootstrap t UCL	2772
95% H-UCL (Log ROS)	248918		
DL/2 Statistics			
DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.359	Mean in Log Scale	-3.721
SD in Original Scale	1.259	SD in Log Scale	2.836
95% t UCL (Assumes normality)	0.821	95% H-Stat UCL	45.35
DL/2 is not a recommended method, provided for comparisons and historical reasons			
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution at 5% Significance Level			
Suggested UCL to Use			
97.5% KM (Chebyshev) UCL	2.634		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

On-Site Soil 3-10ft-bgs UCL
Former Top's Diner Property
Johnstown, Pennsylvania

Toluene (mg/kg)			
General Statistics			
Total Number of Observations	22	Number of Distinct Observations	19
Number of Detects	2	Number of Non-Detects	20
Number of Distinct Detects	2	Number of Distinct Non-Detects	17
Minimum Detect	0.96	Minimum Non-Detect	0.0033
Maximum Detect	55.2	Maximum Non-Detect	0.766
Variance Detects	1471	Percent Non-Detects	90.91%
Mean Detects	28.08	SD Detects	38.35
Median Detects	28.08	CV Detects	1.366
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	1.985	SD of Logged Detects	2.865
Warning: Data set has only 2 Detected Values.			
This is not enough to compute meaningful or reliable statistics and estimates.			
Normal GOF Test on Detects Only			
Not Enough Data to Perform GOF Test			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	2.556	Standard Error of Mean	3.464
SD	11.49	95% KM (BCA) UCL	N/A
95% KM (t) UCL	8.517	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	8.254	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	12.95	95% KM Chebyshev UCL	17.66
97.5% KM Chebyshev UCL	24.19	99% KM Chebyshev UCL	37.02
Gamma GOF Tests on Detected Observations Only			
Not Enough Data to Perform GOF Test			
Gamma Statistics on Detected Data Only			
k hat (MLE)	0.474	k star (bias corrected MLE)	N/A
Theta hat (MLE)	59.19	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	1.898	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.0495	nu hat (KM)	2.177
		Adjusted Level of Significance (β)	0.0386
Approximate Chi Square Value (2.18, α)	0.177	Adjusted Chi Square Value (2.18, β)	0.154
95% Gamma Approximate KM-UCL (use when n>=50)	31.39	95% Gamma Adjusted KM-UCL (use when n<50)	36.21
Gamma (KM) may not be used when k hat (KM) is < 0.1			
Lognormal GOF Test on Detected Observations Only			
Not Enough Data to Perform GOF Test			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	2.553	Mean in Log Scale	-18.66
SD in Original Scale	11.76	SD in Log Scale	7.263
95% t UCL (assumes normality of ROS data)	6.867	95% Percentile Bootstrap UCL	7.571
95% BCA Bootstrap UCL	10.12	95% Bootstrap t UCL	93034144
95% H-UCL (Log ROS)	1.203E+13		

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DL/2 Statistics			
DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2.669	Mean in Log Scale	-3.042
SD in Original Scale	11.74	SD in Log Scale	2.84
95% t UCL (Assumes normality)	6.974	95% H-Stat UCL	91.34
DL/2 is not a recommended method, provided for comparisons and historical reasons			
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution at 5% Significance Level			
Suggested UCL to Use			
99% KM (Chebyshev) UCL	37.02		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
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On-Site Soil 3-10ft-bgs UCL
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Ethylbenzene (mg/kg)			
General Statistics			
Total Number of Observations	22	Number of Distinct Observations	19
Number of Detects	3	Number of Non-Detects	19
Number of Distinct Detects	3	Number of Distinct Non-Detects	16
Minimum Detect	3.38	Minimum Non-Detect	0.0033
Maximum Detect	42.6	Maximum Non-Detect	0.769
Variance Detects	404.3	Percent Non-Detects	86.36%
Mean Detects	20.43	SD Detects	20.11
Median Detects	15.3	CV Detects	0.984
Skewness Detects	1.073	Kurtosis Detects	N/A
Mean of Logged Detects	2.566	SD of Logged Detects	1.275
Warning: Data set has only 3 Detected Values.			
This is not enough to compute meaningful or reliable statistics and estimates.			
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.951	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.267	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.512	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Normal at 5% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	2.788	Standard Error of Mean	2.42
SD	9.267	95% KM (BCA) UCL	N/A
95% KM (t) UCL	6.952	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	6.768	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	10.05	95% KM Chebyshev UCL	13.34
97.5% KM Chebyshev UCL	17.9	99% KM Chebyshev UCL	26.86
Gamma GOF Tests on Detected Observations Only			
Not Enough Data to Perform GOF Test			
Gamma Statistics on Detected Data Only			
k hat (MLE)	1.249	k star (bias corrected MLE)	N/A
Theta hat (MLE)	16.35	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	7.494	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.0905	nu hat (KM)	3.984
		Adjusted Level of Significance (β)	0.0386
Approximate Chi Square Value (3.98, α)	0.715	Adjusted Chi Square Value (3.98, β)	0.622
95% Gamma Approximate KM-UCL (use when n>=50)	15.53	95% Gamma Adjusted KM-UCL (use when n<50)	17.85
Gamma (KM) may not be used when k hat (KM) is < 0.1			
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.988	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.217	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.512	Detected Data appear Lognormal at 5% Significance Level	

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Detected Data appear Lognormal at 5% Significance Level			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	2.795	Mean in Log Scale	-3.972
SD in Original Scale	9.483	SD in Log Scale	2.851
95% t UCL (assumes normality of ROS data)	6.274	95% Percentile Bootstrap UCL	6.513
95% BCA Bootstrap UCL	9.14	95% Bootstrap t UCL	37.54
95% H-UCL (Log ROS)	38.21		
UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed			
KM Mean (logged)	-4.585	95% H-UCL (KM -Log)	22.51
KM SD (logged)	2.867	95% Critical H Value (KM-Log)	5.735
KM Standard Error of Mean (logged)	0.749		
DL/2 Statistics			
DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2.885	Mean in Log Scale	-2.827
SD in Original Scale	9.456	SD in Log Scale	3.11
95% t UCL (Assumes normality)	6.354	95% H-Stat UCL	493.4
DL/2 is not a recommended method, provided for comparisons and historical reasons			
Nonparametric Distribution Free UCL Statistics			
Detected Data appear Normal Distributed at 5% Significance Level			
Suggested UCL to Use			
95% KM (t) UCL	6.952	95% KM (Percentile Bootstrap) UCL	N/A
Warning: One or more Recommended UCL(s) not available!			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

On-Site Soil 3-10ft-bgs UCL
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Total Xylenes (mg/kg)			
General Statistics			
Total Number of Observations	22	Number of Distinct Observations	20
Number of Detects	3	Number of Non-Detects	19
Number of Distinct Detects	3	Number of Distinct Non-Detects	17
Minimum Detect	1.78	Minimum Non-Detect	0.0065
Maximum Detect	164	Maximum Non-Detect	1.53
Variance Detects	8516	Percent Non-Detects	86.36%
Mean Detects	57.48	SD Detects	92.28
Median Detects	6.66	CV Detects	1.605
Skewness Detects	1.727	Kurtosis Detects	N/A
Mean of Logged Detects	2.524	SD of Logged Detects	2.326
Warning: Data set has only 3 Detected Values.			
This is not enough to compute meaningful or reliable statistics and estimates.			
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.773	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.376	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.512	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Normal at 5% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	7.844	Standard Error of Mean	8.905
SD	34.11	95% KM (BCA) UCL	N/A
95% KM (t) UCL	23.17	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	22.49	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	34.56	95% KM Chebyshev UCL	46.66
97.5% KM Chebyshev UCL	63.46	99% KM Chebyshev UCL	96.45
Gamma GOF Tests on Detected Observations Only			
Not Enough Data to Perform GOF Test			
Gamma Statistics on Detected Data Only			
k hat (MLE)	0.426	k star (bias corrected MLE)	N/A
Theta hat (MLE)	134.8	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	2.559	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.0529	nu hat (KM)	2.327
		Adjusted Level of Significance (β)	0.0386
Approximate Chi Square Value (2.33, α)	0.205	Adjusted Chi Square Value (2.33, β)	0.175
95% Gamma Approximate KM-UCL (use when n>=50)	89.2	95% Gamma Adjusted KM-UCL (use when n<50)	104.1
Gamma (KM) may not be used when k hat (KM) is < 0.1			
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.945	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.273	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.512	Detected Data appear Lognormal at 5% Significance Level	

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Detected Data appear Lognormal at 5% Significance Level			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	7.838	Mean in Log Scale	-9.622
SD in Original Scale	34.91	SD in Log Scale	5.172
95% t UCL (assumes normality of ROS data)	20.65	95% Percentile Bootstrap UCL	22.61
95% BCA Bootstrap UCL	30.28	95% Bootstrap t UCL	721.4
95% H-UCL (Log ROS)	3503061		
UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed			
KM Mean (logged)	-4.005	95% H-UCL (KM -Log)	16.09
KM SD (logged)	2.688	95% Critical H Value (KM-Log)	5.408
KM Standard Error of Mean (logged)	0.702		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	8.037	Mean in Log Scale	-2.233
SD in Original Scale	34.86	SD in Log Scale	2.993
95% t UCL (Assumes normality)	20.83	95% H-Stat UCL	466
DL/2 is not a recommended method, provided for comparisons and historical reasons			
Nonparametric Distribution Free UCL Statistics			
Detected Data appear Normal Distributed at 5% Significance Level			
Suggested UCL to Use			
95% KM (t) UCL	23.17	95% KM (Percentile Bootstrap) UCL	N/A
Warning: One or more Recommended UCL(s) not available!			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

On-Site Soil 3-10ft-bgs UCL
Former Top's Diner Property
Johnstown, Pennsylvania

Cumene (mg/kg)			
General Statistics			
Total Number of Observations	22	Number of Distinct Observations	19
Number of Detects	3	Number of Non-Detects	19
Number of Distinct Detects	3	Number of Distinct Non-Detects	16
Minimum Detect	1.25	Minimum Non-Detect	0.0033
Maximum Detect	4.71	Maximum Non-Detect	0.769
Variance Detects	3.121	Percent Non-Detects	86.36%
Mean Detects	2.773	SD Detects	1.767
Median Detects	2.36	CV Detects	0.637
Skewness Detects	0.995	Kurtosis Detects	N/A
Mean of Logged Detects	0.877	SD of Logged Detects	0.663
Warning: Data set has only 3 Detected Values.			
This is not enough to compute meaningful or reliable statistics and estimates.			
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.959	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.259	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.512	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Normal at 5% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.381	Standard Error of Mean	0.285
SD	1.09	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.871	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.849	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	1.235	95% KM Chebyshev UCL	1.621
97.5% KM Chebyshev UCL	2.158	99% KM Chebyshev UCL	3.212
Gamma GOF Tests on Detected Observations Only			
Not Enough Data to Perform GOF Test			
Gamma Statistics on Detected Data Only			
k hat (MLE)	3.658	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.758	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	21.95	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.122	nu hat (KM)	5.38
		Adjusted Level of Significance (β)	0.0386
Approximate Chi Square Value (5.38, α)	1.332	Adjusted Chi Square Value (5.38, β)	1.189
95% Gamma Approximate KM-UCL (use when n>=50)	1.539	95% Gamma Adjusted KM-UCL (use when n<50)	1.724
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.999	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.178	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.512	Detected Data appear Lognormal at 5% Significance Level	
Detected Data appear Lognormal at 5% Significance Level			

On-Site Soil 3-10ft-bgs UCL
Former Top's Diner Property
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Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	0.421	Mean in Log Scale	-2.601
SD in Original Scale	1.102	SD in Log Scale	1.516
95% t UCL (assumes normality of ROS data)	0.825	95% Percentile Bootstrap UCL	0.838
95% BCA Bootstrap UCL	1.005	95% Bootstrap t UCL	1.797
95% H-UCL (Log ROS)	0.714		
UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed			
KM Mean (logged)	-4.815	95% H-UCL (KM -Log)	1.075
KM SD (logged)	2.271	95% Critical H Value (KM-Log)	4.66
KM Standard Error of Mean (logged)	0.593		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.477	Mean in Log Scale	-3.057
SD in Original Scale	1.088	SD in Log Scale	2.703
95% t UCL (Assumes normality)	0.877	95% H-Stat UCL	44.88
DL/2 is not a recommended method, provided for comparisons and historical reasons			
Nonparametric Distribution Free UCL Statistics			
Detected Data appear Normal Distributed at 5% Significance Level			
Suggested UCL to Use			
95% KM (t) UCL	0.871	95% KM (Percentile Bootstrap) UCL	N/A
Warning: One or more Recommended UCL(s) not available!			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

On-Site Soil 3-10ft-bgs UCL
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Johnstown, Pennsylvania

Naphthalene (mg/kg)			
General Statistics			
Total Number of Observations	22	Number of Distinct Observations	19
Number of Detects	4	Number of Non-Detects	18
Number of Distinct Detects	4	Number of Distinct Non-Detects	15
Minimum Detect	1.33	Minimum Non-Detect	0.0033
Maximum Detect	16.3	Maximum Non-Detect	0.761
Variance Detects	45.87	Percent Non-Detects	81.82%
Mean Detects	8.77	SD Detects	6.773
Median Detects	8.725	CV Detects	0.772
Skewness Detects	0.0251	Kurtosis Detects	-3.036
Mean of Logged Detects	1.806	SD of Logged Detects	1.126
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.959	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.203	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.443	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Normal at 5% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	1.597	Standard Error of Mean	1.035
SD	4.206	95% KM (BCA) UCL	N/A
95% KM (t) UCL	3.379	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	3.3	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	4.703	95% KM Chebyshev UCL	6.11
97.5% KM Chebyshev UCL	8.063	99% KM Chebyshev UCL	11.9
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.283	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.662	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.26	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.399	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics on Detected Data Only			
k hat (MLE)	1.515	k star (bias corrected MLE)	0.545
Theta hat (MLE)	5.79	Theta star (bias corrected MLE)	16.08
nu hat (MLE)	12.12	nu star (bias corrected)	4.363
MLE Mean (bias corrected)	8.77	MLE Sd (bias corrected)	11.88
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.144	nu hat (KM)	6.346
Approximate Chi Square Value (6.35, α)	1.819	Adjusted Chi Square Value (6.35, β)	1.645
95% Gamma Approximate KM-UCL (use when n>=50)	5.572	95% Gamma Adjusted KM-UCL (use when n<50)	6.163

On-Site Soil 3-10ft-bgs UCL

Former Top's Diner Property

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Gamma ROS Statistics using Imputed Non-Detects			
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
GROS may not be used when kstar of detected data is small such as < 0.1			
For such situations, GROS method tends to yield inflated values of UCLs and BTVs			
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
Minimum	0.01	Mean	1.603
Maximum	16.3	Median	0.01
SD	4.303	CV	2.685
k hat (MLE)	0.19	k star (bias corrected MLE)	0.194
Theta hat (MLE)	8.448	Theta star (bias corrected MLE)	8.255
nu hat (MLE)	8.347	nu star (bias corrected)	8.542
MLE Mean (bias corrected)	1.603	MLE Sd (bias corrected)	3.637
		Adjusted Level of Significance (β)	0.0386
Approximate Chi Square Value (8.54, α)	3.053	Adjusted Chi Square Value (8.54, β)	2.812
95% Gamma Approximate UCL (use when n>=50)	4.485	95% Gamma Adjusted UCL (use when n<50)	N/A
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.917	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.234	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.443	Detected Data appear Lognormal at 5% Significance Level	
Detected Data appear Lognormal at 5% Significance Level			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	1.63	Mean in Log Scale	-2.457
SD in Original Scale	4.292	SD in Log Scale	2.201
95% t UCL (assumes normality of ROS data)	3.204	95% Percentile Bootstrap UCL	3.262
95% BCA Bootstrap UCL	4.023	95% Bootstrap t UCL	6.932
95% H-UCL (Log ROS)	8.551		
UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed			
KM Mean (logged)	-4.347	95% H-UCL (KM -Log)	39.9
KM SD (logged)	2.93	95% Critical H Value (KM-Log)	5.849
KM Standard Error of Mean (logged)	0.721		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.688	Mean in Log Scale	-2.751
SD in Original Scale	4.271	SD in Log Scale	3.098
95% t UCL (Assumes normality)	3.255	95% H-Stat UCL	497
DL/2 is not a recommended method, provided for comparisons and historical reasons			
Nonparametric Distribution Free UCL Statistics			
Detected Data appear Normal Distributed at 5% Significance Level			
Suggested UCL to Use			
95% KM (t) UCL	3.379	95% KM (Percentile Bootstrap) UCL	N/A
Warning: One or more Recommended UCL(s) not available!			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

On-Site Soil 3-10ft-bgs UCL
Former Top's Diner Property
Johnstown, Pennsylvania

1,2,4-TMB (mg/kg)			
General Statistics			
Total Number of Observations	22	Number of Distinct Observations	19
Number of Detects	6	Number of Non-Detects	16
Number of Distinct Detects	6	Number of Distinct Non-Detects	13
Minimum Detect	0.261	Minimum Non-Detect	0.0033
Maximum Detect	95.3	Maximum Non-Detect	0.766
Variance Detects	1470	Percent Non-Detects	72.73%
Mean Detects	17.1	SD Detects	38.34
Median Detects	1.139	CV Detects	2.243
Skewness Detects	2.442	Kurtosis Detects	5.971
Mean of Logged Detects	0.71	SD of Logged Detects	2.101
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.526	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.788	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.465	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.362	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	4.67	Standard Error of Mean	4.624
SD	19.8	95% KM (BCA) UCL	13.28
95% KM (t) UCL	12.63	95% KM (Percentile Bootstrap) UCL	13.29
95% KM (z) UCL	12.28	95% KM Bootstrap t UCL	222.2
90% KM Chebyshev UCL	18.54	95% KM Chebyshev UCL	24.82
97.5% KM Chebyshev UCL	33.55	99% KM Chebyshev UCL	50.68
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.872	Anderson-Darling GOF Test	
5% A-D Critical Value	0.764	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.348	Kolmogrov-Smirnoff GOF	
5% K-S Critical Value	0.356	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data follow Appr. Gamma Distribution at 5% Significance Level			
Gamma Statistics on Detected Data Only			
k hat (MLE)	0.32	k star (bias corrected MLE)	0.271
Theta hat (MLE)	53.35	Theta star (bias corrected MLE)	63
nu hat (MLE)	3.846	nu star (bias corrected)	3.256
MLE Mean (bias corrected)	17.1	MLE Sd (bias corrected)	32.82
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.0557	nu hat (KM)	2.449
Approximate Chi Square Value (2.45, α)	0.23	Adjusted Chi Square Value (2.45, β)	0.196
95% Gamma Approximate KM-UCL (use when n>=50)	49.77	95% Gamma Adjusted KM-UCL (use when n<50)	58.38
Gamma (KM) may not be used when k hat (KM) is < 0.1			
Gamma ROS Statistics using Imputed Non-Detects			
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
GROS may not be used when kstar of detected data is small such as < 0.1			
For such situations, GROS method tends to yield inflated values of UCLs and BTVs			
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
Minimum	0.01	Mean	4.67

On-Site Soil 3-10ft-bgs UCL
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Maximum	95.3	Median	0.01
SD	20.26	CV	4.339
k hat (MLE)	0.162	k star (bias corrected MLE)	0.17
Theta hat (MLE)	28.86	Theta star (bias corrected MLE)	27.46
nu hat (MLE)	7.121	nu star (bias corrected)	7.483
MLE Mean (bias corrected)	4.67	MLE Sd (bias corrected)	11.32
		Adjusted Level of Significance (β)	0.0386
Approximate Chi Square Value (7.48, α)	2.439	Adjusted Chi Square Value (7.48, β)	2.23
95% Gamma Approximate UCL (use when n>=50)	14.33	95% Gamma Adjusted UCL (use when n<50)	15.67
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.878	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.241	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.362	Detected Data appear Lognormal at 5% Significance Level	
Detected Data appear Lognormal at 5% Significance Level			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	4.664	Mean in Log Scale	-4.529
SD in Original Scale	20.27	SD in Log Scale	3.557
95% t UCL (assumes normality of ROS data)	12.1	95% Percentile Bootstrap UCL	13.24
95% BCA Bootstrap UCL	17.75	95% Bootstrap t UCL	264
95% H-UCL (Log ROS)	1388		
UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed			
KM Mean (logged)	-3.892	95% H-UCL (KM -Log)	117.3
KM SD (logged)	3.044	95% Critical H Value (KM-Log)	6.058
KM Standard Error of Mean (logged)	0.724		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	4.735	Mean in Log Scale	-2.741
SD in Original Scale	20.25	SD in Log Scale	3.127
95% t UCL (Assumes normality)	12.16	95% H-Stat UCL	594.9
DL/2 is not a recommended method, provided for comparisons and historical reasons			
Nonparametric Distribution Free UCL Statistics			
Detected Data appear Approximate Gamma Distributed at 5% Significance Level			
Suggested UCL to Use			
95% KM (t) UCL	12.63	95% GROS Adjusted Gamma UCL	15.67
95% Adjusted Gamma KM-UCL	58.38		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

On-Site Soil 3-10ft-bgs UCL
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Johnstown, Pennsylvania

1,3,5-TMB (mg/kg)			
General Statistics			
Total Number of Observations	22	Number of Distinct Observations	19
Number of Detects	3	Number of Non-Detects	19
Number of Distinct Detects	3	Number of Distinct Non-Detects	16
Minimum Detect	0.993	Minimum Non-Detect	0.0033
Maximum Detect	37.6	Maximum Non-Detect	0.769
Variance Detects	408.7	Percent Non-Detects	86.36%
Mean Detects	14.34	SD Detects	20.22
Median Detects	4.43	CV Detects	1.41
Skewness Detects	1.676	Kurtosis Detects	N/A
Mean of Logged Detects	1.703	SD of Logged Detects	1.826
Warning: Data set has only 3 Detected Values.			
This is not enough to compute meaningful or reliable statistics and estimates.			
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.82	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.355	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.512	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Normal at 5% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	1.958	Standard Error of Mean	2.045
SD	7.833	95% KM (BCA) UCL	N/A
95% KM (t) UCL	5.478	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	5.323	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	8.095	95% KM Chebyshev UCL	10.87
97.5% KM Chebyshev UCL	14.73	99% KM Chebyshev UCL	22.31
Gamma GOF Tests on Detected Observations Only			
Not Enough Data to Perform GOF Test			
Gamma Statistics on Detected Data Only			
k hat (MLE)	0.638	k star (bias corrected MLE)	N/A
Theta hat (MLE)	22.49	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	3.826	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.0625	nu hat (KM)	2.75
		Adjusted Level of Significance (β)	0.0386
Approximate Chi Square Value (2.75, α)	0.302	Adjusted Chi Square Value (2.75, β)	0.257
95% Gamma Approximate KM-UCL (use when n>=50)	17.81	95% Gamma Adjusted KM-UCL (use when n<50)	20.97
Gamma (KM) may not be used when k hat (KM) is < 0.1			
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.99	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.213	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.512	Detected Data appear Lognormal at 5% Significance Level	

On-Site Soil 3-10ft-bgs UCL
Former Top's Diner Property
Johnstown, Pennsylvania

Detected Data appear Lognormal at 5% Significance Level			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	1.956	Mean in Log Scale	-7.912
SD in Original Scale	8.018	SD in Log Scale	4.191
95% t UCL (assumes normality of ROS data)	4.898	95% Percentile Bootstrap UCL	5.329
95% BCA Bootstrap UCL	7.128	95% Bootstrap t UCL	74.33
95% H-UCL (Log ROS)	4253		
UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed			
KM Mean (logged)	-4.702	95% H-UCL (KM -Log)	5.343
KM SD (logged)	2.604	95% Critical H Value (KM-Log)	5.258
KM Standard Error of Mean (logged)	0.68		
DL/2 Statistics			
DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2.056	Mean in Log Scale	-2.941
SD in Original Scale	7.994	SD in Log Scale	2.934
95% t UCL (Assumes normality)	4.989	95% H-Stat UCL	166.3
DL/2 is not a recommended method, provided for comparisons and historical reasons			
Nonparametric Distribution Free UCL Statistics			
Detected Data appear Normal Distributed at 5% Significance Level			
Suggested UCL to Use			
95% KM (t) UCL	5.478	95% KM (Percentile Bootstrap) UCL	N/A
Warning: One or more Recommended UCL(s) not available!			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

On-Site Soil 3-10 ft-bgs Lead Database

Former Top's Diner Property
Johnsonburg City, Pennsylvania

Sample ID	Sample Date	Sample Depth	Saturated or Unsaturated	Lead (mg/kg)	d_Lead (mg/kg)
SB-1 (8.5')	6/25/2012	8.50	U	84.5	1
SB-2 (7')	6/25/2012	7.00	U	15	1
SB-3 (7')	6/25/2012	7.00	U	16.9	1
SB-4 (6')	6/25/2012	6.00	U	12.7	1
SB-5 (6.5')	6/25/2012	6.50	U	5.18	1
SB-6 (3.5')	6/25/2012	3.50	U	18.6	1
SB-7 (7')	6/25/2012	7.00	U	27.4	1
SB-8 (3')	6/25/2012	3.00	U	30	1
SB-9	12/26/2013	9-10'	U	16	1
SB-10	12/27/2013	9-10'	U	15.9	1
SB-11	12/27/2013	9-10'	U	15.7	1
SB-12	12/27/2013	7-8'	U	15	1
SB-12	12/27/2013	9-10'	U	13.3	1
SB-13	12/27/2013	7-8'	U	25.1	1
SB-13	12/27/2013	9-10'	U	13.6	1
SB-14	12/27/2013	4-5'	U	468	1
SB-14	12/27/2013	7-8'	U	35.6	1
SB-15	12/27/2013	7-8'	U	25.4	1
SB-15	12/27/2013	9-10'	U	20.1	1
SB-16	12/27/2013	7-8'	U	18.3	1
SB-16	12/27/2013	9-10'	U	15.2	1
SB-17	12/27/2013	7-8'	U	16.9	1

On-Site Soil 3-10 ft-bgs Lead Stats

Former Top's Diner Property
Johnstown City, Pennsylvania

	General Statistics on Uncensored Full Data
Date/Time of Computation	6/11/2015 5:42:04 PM
User Selected Options	
From File	WorkSheet_a.xls
Full Precision	OFF

From File: WorkSheet_a.xls

General Statistics for Uncensored Dataset

Variable	NumObs	# Missing	Minimum	Maximum	Mean	SD	SEM	MAD/0.675	Skewness	Kurtosis	CV
Lead (mg/kg)	22	0	5.18	468	42.02	96.4	20.55	4.818	4.505	20.7	2.294

Percentiles for Uncensored Dataset

Variable	NumObs	# Missing	10%ile	20%ile	25%ile(Q1)	50%ile(Q2)	75%ile(Q3)	80%ile	90%ile	95%ile	99%ile
Lead (mg/kg)	22	0	13.33	15	15.05	16.9	25.33	27	35.04	82.06	387.5

Off-Site Soil

Derivation of Source Concentrations for Off-Site Soil 4-8 ft-bgs
Former Top's Diner Property
Johnstown City, Pennsylvania

Sample ID	Sample Date	Sample Depth	Saturated or Unsaturated	Post-March 2008 PA Short List of Petroleum Products for Unleaded Gasoline									
				Benzene	Toluene	Ethylbenzene	Xylenes (Total)	MTBE	Cumene	Naphthalene	1,2,4-Trimethylbenzene	1,3,5-Trimethylbenzene	Lead
USEPA Region 3 Industrial Soil RSL				**5.1**	**4,700**	**25**	**250**	**210**	**990**	**17**	**24**	**1,200**	**800**
USEPA Region 3 Risk-Based Soil SSL [1]				**0.00023**	**0.076**	**0.0017**	**0.019**	**0.0032**	**0.074**	**0.00054**	**0.0021**	**0.017**	**14**
SB-12	12/27/2013	7-8'	U	< 0.0015	< 0.0037	< 0.0037	< 0.0075	< <0.0037	< 0.0037	< 0.0037	< 0.0037	< 0.0037	**15**
SB-14	12/27/2013	4-5'	U	**0.4**	**0.96**	< 0.769	**1.78**	< <0.769	< 0.769	**1.33**	**0.908**	< 0.769	**468**
SB-14	12/27/2013	7-8'	U	< 0.293	< 0.732	**15.3**	**6.66**	< <0.732	**2.36**	**12.3**	**4.19**	**4.43**	**35.6**
SB-15	12/27/2013	7-8'	U	< 0.307	< 0.766	**3.38**	< 1.53	< <0.766	**1.25**	**5.15**	< 0.766	< 0.766	**25.4**
Maimum Concentration				0.4	0.96	15.3	6.66	---	2.36	12.3	4.19	4.43	468
Maximum Concentration Location				SB-14 (4-5')	SB-14 (4-5')	SB-14 (7-8')	SB-14 (7-8')		SB-14 (7-8')	SB-14 (7-8')	SB-14 (7-8')	SB-14 (7-8')	SB-14 (4-5')

Notes:
1. Indicates the applcable USEPA Risk Based SSL for each constituent. Note that since no Risk Based SSL was available for lead, the MCL Based SSL was utilized instead to screen the analytical data.
All results in milligrams per kilogram (mg/kg).
Depth measured in feet below ground surface.
Bold values indicate an exceedance of the laboratory reporting limit.
Bold and shaded values indicate exceedance of the RSL.
NS indicates No Standard.
"-" = Not Analyzed
MTBE = Methyl Tertiary Butyl Ether

On-Site Soil 4-8 ft-bgs Stats Database for Lead

Former Top's Diner Property
Johnstown City, Pennsylvania

Sample ID	Sample date	Sample Depth	Saturated or Unsaturated	Lead (mg/kg)	d_Lead (mg/kg)
SB-12	12/27/2013	7-8'	U	15	1
SB-14	12/27/2013	4-5'	U	468	1
SB-14	12/27/2013	7-8'	U	35.6	1
SB-15	12/27/2013	7-8'	U	25.4	1

Off-Site Soil 4-8 ft-bgs Lead Stats
Former Top's Diner Property
Johnstown City, Pennsylvania

	General Statistics on Uncensored Full Data
Date/Time of Computation	7/7/2015 5:17:15 PM
User Selected Options	
From File	WorkSheet.xls
Full Precision	OFF

From File: WorkSheet.xls

General Statistics for Uncensored Dataset

Variable	NumObs	# Missing	Minimum	Maximum	Mean	SD	SEM	MAD/0.675	Skewness	Kurtosis	CV
Lead (mg/kg)	4	0	15	468	136	221.5	110.7	15.27	1.991	3.971	1.629

Percentiles for Uncensored Dataset

Variable	NumObs	# Missing	10%ile	20%ile	25%ile(Q1)	50%ile(Q2)	75%ile(Q3)	80%ile	90%ile	95%ile	99%ile
Lead (mg/kg)	4	0	18.12	21.24	22.8	30.5	143.7	208.6	338.3	403.1	455

Derivation of Source Concentrations for Off-Site Soil 4-10 ft-bgs
Former Top's Diner Property
Johnstown City, Pennsylvania

Sample ID	Sample Date	Sample Depth	Saturated or Unsaturated	Post-March 2008 PA Short List of Petroleum Products for Unleaded Gasoline									
				Benzene	Toluene	Ethylbenzene	Xylenes (Total)	MTBE	Cumene	Naphthalene	1,2,4-Trimethylbenzene	1,3,5-Trimethylbenzene	Lead
USEPA Region 3 Industrial Soil RSL				5.1	4,700	25	250	210	990	17	24	1,200	800
USEPA Region 3 Risk-Based Soil SSL [1]				**0.00023**	**0.076**	**0.0017**	**0.019**	**0.0032**	**0.074**	**0.00054**	**0.0021**	**0.017**	**14**
SB-12	12/27/2013	7-8'	U	< 0.0015	< 0.0037	< 0.0037	< 0.0075	< <0.0037	< 0.0037	< 0.0037	< 0.0037	< 0.0037	**15**
SB-12	12/27/2013	9-10'	U	< 0.0015	< 0.0038	< 0.0038	< 0.0076	< <0.0038	< 0.0038	< 0.0038	< 0.0038	< 0.0038	**13.3**
SB-14	12/27/2013	4-5'	U	**0.4**	**0.96**	< 0.769	**1.78**	< <0.769	< 0.769	**1.53**	**0.908**	< 0.769	**468**
SB-14	12/27/2013	7-8'	U	< 0.293	< 0.732	**15.3**	**6.66**	< <0.732	**2.36**	**12.3**	**4.19**	**4.43**	**35.6**
SB-15	12/27/2013	7-8'	U	< 0.307	< 0.766	**3.38**	< 1.53	< <0.766	**1.25**	**5.15**	< 0.766	< 0.766	**25.4**
SB-15	12/27/2013	9-10'	U	< 0.301	< 0.754	< 0.754	< 1.51	< <0.754	< 0.754	< 0.754	< 0.754	< 0.754	**30.1**
Maimum Concentration				0.4	0.96	15.3	6.66	---	2.36	12.3	4.19	4.43	468
Maximum Concentration Location				SB-14 (4-5')	SB-14 (4-5')	SB-14 (7-8')	SB-14 (7-8')		SB-14 (7-8')	SB-14 (7-8')	SB-14 (7-8')	SB-14 (7-8')	SB-14 (4-5')

Notes:
1. Indicates the applcable USEPA Risk Based SSL for each constituent. Note that since no Risk Based SSL was available for lead, the MCL Based SSL was utilized instead to screen the analytical data.
All results in milligrams per kilogram (mg/kg).
Depth measured in feet below ground surface.
Bold values indicate an exceedance of the laboratory reporting limit.
Bold and shaded values indicate exceedance of the RSL.
NS indicates No Standard.
"-" = Not Analyzed
MTBE = Methyl Tertiary Butyl Ether

Off-Site Soil 4-10 ft-bgs Stats Database for Lead
Former Top's Diner Property
Johnstown City, Pennsylvania

Sample ID	Sample Date	Sample Depth	Saturated or Unsaturated	Lead (mg/kg)	d_Lead (mg/kg)
SB-12	12/27/2013	7-8'	U	15	1
SB-12	12/27/2013	9-10'	U	13.3	1
SB-14	12/27/2013	4-5'	U	468	1
SB-14	12/27/2013	7-8'	U	35.6	1
SB-15	12/27/2013	7-8'	U	25.4	1
SB-15	12/27/2013	9-10'	U	20.1	1

Off-Site Soil Lead Stats (4-10 ft-bgs)
Former Top's Diner Property
Johnstonwn City, Pennsylvania

	General Statistics on Uncensored Full Data
Date/Time of Computation	6/22/2015 6:05:48 PM
User Selected Options	
From File	WorkSheet.xls
Full Precision	OFF

'rom File: WorkSheet.xls

General Statistics for Uncensored Dataset

Variable	NumObs	# Missing	Minimum	Maximum	Mean	SD	SEM	MAD/0.675	Skewness	Kurtosis	CV
Lead (mg/kg)	6	0	13.3	468	96.23	182.3	74.43	12.75	2.439	5.959	1.894

Percentiles for Uncensored Dataset

Variable	NumObs	# Missing	10%ile	20%ile	25%ile(Q1)	50%ile(Q2)	75%ile(Q3)	80%ile	90%ile	95%ile	99%ile
Lead (mg/kg)	6	0	14.15	15	16.28	22.75	33.05	35.6	251.8	359.9	446.4

On-Site Groundwater

Former Top's Diner Property
Johnstown, Pennsylvania

Well ID	Sample Date	1,2,4-TMB (ug/L)	d_1,2,4-TMB (ug/L)	NROS_1,2,4-TMB (ug/L)	GROS_1,2,4-TMB (ug/L)	LnROS_1,2,4-TMB (ug/L)
MW-1	1/21/2014	9.48	1	9.48	9.48	9.48
	9/4/2014	1	0	-2022.86696	0.01	0.003412846
	12/19/2014	1	0	-1672.829754	0.01	0.014284216
	3/5/2015	13.7	1	13.7	13.7	13.7
MW-2	1/21/2014	2.82	1	2.82	2.82	2.82
	9/4/2014	1	0	-1438.224006	0.01	0.0372877
	12/19/2014	1	0	-1252.964019	0.01	0.07954746
	3/5/2015	1	0	-1095.091106	0.01	0.151719649
MW-3	1/21/2014	582	1	582	582	582
	9/4/2014	421	1	421	421	421
	12/19/2014	2220	1	2220	2220	2220
	3/5/2015	156	1	156	156	156
MW-4	1/21/2014	4.63	1	4.63	4.63	4.63
	9/4/2014	10.8	1	10.8	10.8	10.8
	12/19/2014	66	1	66	66	66
	3/5/2015	44.5	1	44.5	44.5	44.5
MW-5	8/14/2014	1	0	-954.3409332	0.01	0.269801123
	9/4/2014	1	0	-824.9571064	0.01	0.457990695
	12/19/2014	1	0	-703.2898372	0.01	0.75329195
	3/5/2015	1	0	-586.7898755	0.01	1.213086507

Former Top's Diner Property
Johnstown, Pennsylvania

Well ID	Sample Date	1,3,5-TMB (ug/L)	d_1,3,5-TMB (ug/L)	NROS_1,3,5-TMB (ug/L)	GROS_1,3,5-TMB (ug/L)	LnROS_1,3,5-TMB (ug/L)
MW-1	1/21/2014	4.2	1	4.2	4.2	4.2
	9/4/2014	1	0	-906.3849326	0.01	0.001832343
	12/19/2014	1	0	-749.7299716	0.01	0.007370058
	3/5/2015	5.36	1	5.36	5.36	5.36
MW-2	1/21/2014	1.53	1	1.53	1.53	1.53
	9/4/2014	1	0	-644.7349773	0.01	0.018732748
	12/19/2014	1	0	-561.8240883	0.01	0.039130826
	3/5/2015	1	0	-491.1699559	0.01	0.073306583
MW-3	1/21/2014	247	1	247	247	247
	9/4/2014	222	1	222	222	222
	12/19/2014	990	1	990	990	990
	3/5/2015	67	1	67	67	67
MW-4	1/21/2014	5.52	1	5.52	5.52	5.52
	9/4/2014	2.99	1	2.99	2.99	2.99
	12/19/2014	13.4	1	13.4	13.4	13.4
	3/5/2015	9.4	1	9.4	9.4	9.4
MW-5	8/14/2014	1	0	-428.178901	0.01	0.128291655
	9/4/2014	1	0	-370.2747182	0.01	0.214598057
	12/19/2014	1	0	-315.8239884	0.01	0.348119035
	3/5/2015	1	0	-263.6858252	0.01	0.553231061

Former Top's Diner Property
Johnstown, Pennsylvania

Well ID	Sample Date	Benzene (ug/L)	d_Benzene (ug/L)	NROS_Benzene (ug/L)	GROS_Benzene (ug/L)	LnROS_Benzene (ug/L)
MW-1	1/21/2014	2.37	1	2.37	2.37	2.37
	9/4/2014	1	0	-677.4966265	0.01	0.004012928
	12/19/2014	1	0	-562.1862971	0.01	0.015030002
	3/5/2015	1	0	-484.8157202	0.01	0.036455472
MW-2	1/21/2014	1	0	-423.6534373	0.01	0.073443648
	9/4/2014	1	0	-371.4750961	0.01	0.133494688
	12/19/2014	1	0	-324.9008104	0.01	0.22756312
	3/5/2015	1	0	-282.0320241	0.01	0.371800885
MW-3	1/21/2014	418	1	418	418	418
	9/4/2014	324	1	324	324	324
	12/19/2014	301	1	301	301	301
	3/5/2015	72	1	72	72	72
MW-4	1/21/2014	6.72	1	6.72	6.72	6.72
	9/4/2014	9.28	1	9.28	9.28	9.28
	12/19/2014	91	1	91	91	91
	3/5/2015	23.2	1	23.2	23.2	23.2
MW-5	8/14/2014	1	0	-241.6615239	0.01	0.590328424
	9/4/2014	1	0	-202.9420606	0.01	0.919740932
	12/19/2014	1	0	-165.2234353	0.01	1.416640496
	3/5/2015	1	0	-127.9605109	0.01	2.170637763

Former Top's Diner Property
Johnstown, Pennsylvania

Well ID	Sample Date	Ethylbenzene (ug/L)	d_Ethylbenzene (ug/L)	NROS_Ethylbenzene (ug/L)	GROS_Ethylbenzene (ug/L)	LnROS_Ethylbenzene (ug/L)
MW-1	1/21/2014	16.6	1	16.6	16.6	16.6
	9/4/2014	1	0	-1900.47817	0.01	0.004203563
	12/19/2014	1	0	-1553.310461	0.01	0.01843847
	3/5/2015	3.75	1	3.75	3.75	3.75
MW-2	1/21/2014	4.95	1	4.95	4.95	4.95
	9/4/2014	1	0	-1320.627938	0.01	0.049668954
	12/19/2014	1	0	-1136.886656	0.01	0.108623907
	3/5/2015	1	0	-980.3079357	0.01	0.211605548
MW-3	1/21/2014	944	1	944	944	944
	9/4/2014	1210	1	1210	1210	1210
	12/19/2014	1480	1	1480	1480	1480
	3/5/2015	333	1	333	333	333
MW-4	1/21/2014	6.75	1	6.75	6.75	6.75
	9/4/2014	24.8	1	24.8	24.8	24.8
	12/19/2014	553	1	553	553	553
	3/5/2015	89	1	89	89	89
MW-5	8/14/2014	1	0	-840.7115894	0.01	0.383458858
	9/4/2014	1	0	-712.3884112	0.01	0.662308159
	12/19/2014	1	0	-591.7185326	0.01	1.107251314
	3/5/2015	1	0	-476.1736016	0.01	1.811145783

Former Top's Diner Property
Johnstown, Pennsylvania

Well ID	Sample Date	Xylenes (ug/L)	d_Xylenes (ug/L)	NROS_Xylenes (ug/L)	GROS_Xylenes (ug/L)	LnROS_Xylenes (ug/L)
MW-1	1/21/2014	16.6	1	16.6	16.6	16.6
	9/4/2014	2	0	-2844.979952	0.01	0.000666805
	12/19/2014	2	0	-2366.377793	0.01	0.003500282
	3/5/2015	3.56	1	3.56	3.56	3.56
MW-2	1/21/2014	4.92	1	4.92	4.92	4.92
	9/4/2014	2	0	-2045.409009	0.01	0.010642218
	12/19/2014	2	0	-1791.803145	0.01	0.025621648
	3/5/2015	2	0	-1575.557598	0.01	0.05419631
MW-3	1/21/2014	898	1	898	898	898
	9/4/2014	784	1	784	784	784
	12/19/2014	2450	1	2450	2450	2450
	3/5/2015	255	1	255	255	255
MW-4	1/21/2014	5.22	1	5.22	5.22	5.22
	9/4/2014	2	0	-1382.641397	0.01	0.105737998
	12/19/2014	37.4	1	37.4	37.4	37.4
	3/5/2015	24.4	1	24.4	24.4	24.4
MW-5	8/14/2014	2	0	-1205.178907	0.01	0.195542346
	9/4/2014	2	0	-1038.168962	0.01	0.348757601
	12/19/2014	2	0	-878.1094003	0.01	0.607224109
	3/5/2015	2	0	-722.3219255	0.01	1.041709337

Former Top's Diner Property
Johnstown, Pennsylvania

Well ID	Sample Date	Cumene (ug/L)	d_Cumene (ug/L)	NROS_Cumene (ug/L)	GROS_Cumene (ug/L)	LnROS_Cumene (ug/L)
MW-1	1/21/2014	1	0	-331.4329708	0.01	0.001246874
	9/4/2014	1	0	-278.1267045	0.01	0.004735057
	12/19/2014	1	0	-242.1977496	0.01	0.011639004
	3/5/2015	1	0	-213.6709398	0.01	0.023770388
MW-2	1/21/2014	1.11	1	1.11	1.11	1.11
	9/4/2014	1	0	-189.2230496	0.01	0.043834292
	12/19/2014	1	0	-167.2930846	0.01	0.075895998
	3/5/2015	1	0	-146.9975348	0.01	0.126140837
MW-3	1/21/2014	70	1	70	70	70
	9/4/2014	56	1	56	56	56
	12/19/2014	217	1	217	217	217
	3/5/2015	25	0	-125.416472	0.01	0.216504836
MW-4	1/21/2014	1	0	-127.7669228	0.01	0.204134025
	9/4/2014	4.72	1	4.72	4.72	4.72
	12/19/2014	65.9	1	65.9	65.9	65.9
	3/5/2015	11.4	1	11.4	11.4	11.4
MW-5	8/14/2014	1	0	-109.1923273	0.01	0.324970101
	9/4/2014	1	0	-90.94850027	0.01	0.513068753
	12/19/2014	1	0	-72.74831956	0.01	0.809157824
	3/5/2015	1	0	-54.30949909	0.01	1.283764048

Former Top's Diner Property
Johnstown, Pennsylvania

Well ID	Sample Date	Naphthalene (ug/L)	d_Naphthalene (ug/L)	NROS_Naphthalene (ug/L)	GROS_Naphthalene (ug/L)	LnROS_Naphthalene (ug/L)
MW-1	1/21/2014	1.3	1	1.3	1.3	1.3
	9/4/2014	1	0	-1140.897718	0.01	8.92101E-05
	12/19/2014	1	0	-949.9475746	0.01	0.000533586
	3/5/2015	2.2	1	2.2	2.2	2.2
MW-2	1/21/2014	1	0	-821.8891564	0.01	0.001770718
	9/4/2014	1	0	-720.7068378	0.01	0.004568374
	12/19/2014	1	0	-634.4303397	0.01	0.010250305
	3/5/2015	1	0	-557.4616596	0.01	0.021078874
MW-3	1/21/2014	398	1	398	398	398
	9/4/2014	200	1	200	200	200
	12/19/2014	995	1	995	995	995
	3/5/2015	83.5	1	83.5	83.5	83.5
MW-4	1/21/2014	1.02	1	1.02	1.02	1.02
	9/4/2014	1	0	-486.6586196	0.01	0.040914388
	12/19/2014	35.9	1	35.9	35.9	35.9
	3/5/2015	10.7	1	10.7	10.7	10.7
MW-5	8/14/2014	1	0	-420.0258799	0.01	0.076372994
	9/4/2014	1	0	-356.1661673	0.01	0.138906582
	12/19/2014	1.2	1	1.2	1.2	1.2
	3/5/2015	1	0	-294.0109093	0.01	0.248640612

Former Top's Diner Property
Johnstown, Pennsylvania

Well ID	Sample Date	Toluene (ug/L)	d_Toluene (ug/L)	NROS_Toluene (ug/L)	GROS_Toluene (ug/L)	LnROS_Toluene (ug/L)
MW-1	1/21/2014	1.29	1	1.29	1.29	1.29
	9/4/2014	1	0	-300.0443372	0.01	0.000435427
	12/19/2014	1	0	-251.6421792	0.01	0.001851705
	3/5/2015	1	0	-219.1515687	0.01	0.004892897
MW-2	1/21/2014	1	0	-193.4568043	0.01	0.010551022
	9/4/2014	1	0	-171.5269066	0.01	0.020329384
	12/19/2014	1	0	-151.9433518	0.01	0.036515661
	3/5/2015	1	0	-133.90881	0.01	0.062620312
MW-3	1/21/2014	157	1	157	157	157
	9/4/2014	77.5	1	77.5	77.5	77.5
	12/19/2014	140	1	140	140	140
	3/5/2015	25.2	1	25.2	25.2	25.2
MW-4	1/21/2014	1	0	-116.9157097	0.01	0.104093797
	9/4/2014	1.37	1	1.37	1.37	1.37
	12/19/2014	14.8	1	14.8	14.8	14.8
	3/5/2015	5.3	1	5.3	5.3	5.3
MW-5	8/14/2014	1	0	-100.6071394	0.01	0.16952887
	9/4/2014	1	0	-84.70836766	0.01	0.272734415
	12/19/2014	1	0	-68.98803826	0.01	0.436433998
	3/5/2015	1	0	-53.23239581	0.01	0.699126654

On-Site Groundwater GOF
Former Top's Diner Property
Johnstown City, Pennsylvania

	Goodness-of-Fit Test Statistics for Data Sets with Non-Detects
User Selected Options	
Date/Time of Computation	7/9/2015 8:22:52 AM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	0.95

1,2,4-TMB (ug/L)

	Num Obs	Num Miss	Num Valid	Detects	NDs	% NDs
Raw Statistics	20	0	20	11	9	45.00%

	Number	Minimum	Maximum	Mean	Median	SD
Statistics (Non-Detects Only)	9	1	1	1	1	0
Statistics (Detects Only)	11	2.82	2220	321	44.5	658.9
Statistics (All: NDs treated as DL value)	20	1	2220	177	3.725	505.2
Statistics (All: NDs treated as DL/2 value)	20	0.5	2220	176.8	3.725	505.3
Statistics (Normal ROS Imputed Data)	20	-2023	2220	-351	3.725	950.6
Statistics (Gamma ROS Imputed Data)	20	0.01	2220	176.6	3.725	505.3
Statistics (Lognormal ROS Imputed Data)	20	0.00341	2220	176.7	3.725	505.3

	K hat	K Star	Theta hat	Log Mean	Log Stdv	Log CV
Statistics (Detects Only)	0.359	0.322	894.2	3.906	2.169	0.555
Statistics (NDs = DL)	0.237	0.234	747.9	2.148	2.54	1.182
Statistics (NDs = DL/2)	0.218	0.218	812.6	1.836	2.826	1.539
Statistics (Gamma ROS Estimates)	0.151	0.161	1172	--	--	--
Statistics (Lognormal ROS Estimates)	--	--	--	1.157	3.711	3.206

Normal GOF Test Results

	No NDs	NDs = DL	NDs = DL/2	Normal ROS
Correlation Coefficient R	0.727	0.612	0.613	0.613

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Shapiro-Wilk (Detects Only)	0.554	0.85	Data Not Normal
Lilliefors (Detects Only)	0.326	0.267	Data Not Normal
Shapiro-Wilk (NDs = DL)	0.402	0.905	Data Not Normal
Lilliefors (NDs = DL)	0.387	0.198	Data Not Normal
Shapiro-Wilk (NDs = DL/2)	0.402	0.905	Data Not Normal
Lilliefors (NDs = DL/2)	0.387	0.198	Data Not Normal
Shapiro-Wilk (Normal ROS Estimates)	0.929	0.905	Data Appear Normal
Lilliefors (Normal ROS Estimates)	0.195	0.198	Data Appear Normal

Gamma GOF Test Results

On-Site Groundwater GOF

Former Top's Diner Property

Johnstown City, Pennsylvania

	No NDs	NDs = DL	NDs = DL/2	Gamma ROS	
Correlation Coefficient R	0.974	0.951	0.956	0.974	
	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)		
Anderson-Darling (Detects Only)	0.605	0.809			
Kolmogorov-Smirnov (Detects Only)	0.205	0.274	Detected Data Appear Gamma Distributed		
Anderson-Darling (NDs = DL)	2.243	0.875			
Kolmogorov-Smirnov (NDs = DL)	0.275	0.213	Data Not Gamma Distributed		
Anderson-Darling (NDs = DL/2)	1.978	0.884			
Kolmogorov-Smirnov (NDs = DL/2)	0.251	0.214	Data Not Gamma Distributed		
Anderson-Darling (Gamma ROS Estimates)	1.327	0.938			
Kolmogorov-Smirnov (Gamma ROS Est.)	0.265	0.218	Data Not Gamma Distributed		
Lognormal GOF Test Results					
	No NDs	NDs = DL	NDs = DL/2	Log ROS	
Correlation Coefficient R	0.981	0.914	0.924	0.997	
	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)		
Shapiro-Wilk (Detects Only)	0.95	0.85	Data Appear Lognormal		
Lilliefors (Detects Only)	0.178	0.267	Data Appear Lognormal		
Shapiro-Wilk (NDs = DL)	0.823	0.905	Data Not Lognormal		
Lilliefors (NDs = DL)	0.251	0.198	Data Not Lognormal		
Shapiro-Wilk (NDs = DL/2)	0.838	0.905	Data Not Lognormal		
Lilliefors (NDs = DL/2)	0.265	0.198	Data Not Lognormal		
Shapiro-Wilk (Lognormal ROS Estimates)	0.985	0.905	Data Appear Lognormal		
Lilliefors (Lognormal ROS Estimates)	0.0657	0.198	Data Appear Lognormal		
Note: Substitution methods such as DL or DL/2 are not recommended.					

On-Site Groundwater GOF

Former Top's Diner Property
Johnstown City, Pennsylvania

1,3,5-TMB (ug/L)

	Num Obs	Num Miss	Num Valid	Detects	NDs	% NDs
Raw Statistics	20	0	20	11	9	45.00%

	Number	Minimum	Maximum	Mean	Median	SD
Statistics (Non-Detects Only)	9	1	1	1	1	0
Statistics (Detects Only)	11	1.53	990	142.6	9.4	295.2
Statistics (All: NDs treated as DL value)	20	1	990	78.87	2.26	226
Statistics (All: NDs treated as DL/2 value)	20	0.5	990	78.65	2.26	226.1
Statistics (Normal ROS Imputed Data)	20	-906.4	990	-158.2	2.26	425.6
Statistics (Gamma ROS Imputed Data)	20	0.01	990	78.42	2.26	226.2
Statistics (Lognormal ROS Imputed Data)	20	0.00183	990	78.49	2.26	226.2

	K hat	K Star	Theta hat	Log Mean	Log Stdv	Log CV
Statistics (Detects Only)	0.347	0.313	411.2	3.018	2.135	0.707
Statistics (NDs = DL)	0.261	0.255	302.7	1.66	2.184	1.316
Statistics (NDs = DL/2)	0.237	0.235	331.3	1.348	2.447	1.815
Statistics (Gamma ROS Estimates)	0.16	0.169	491.6	---	---	---
Statistics (Lognormal ROS Estimates)	---	---	---	0.345	3.616	10.47

Normal GOF Test Results

	No NDs	NDs = DL	NDs = DL/2	Normal ROS
Correlation Coefficient R	0.726	0.609	0.61	0.611

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Shapiro-Wilk (Detects Only)	0.551	0.85	Data Not Normal
Lilliefors (Detects Only)	0.328	0.267	Data Not Normal
Shapiro-Wilk (NDs = DL)	0.398	0.905	Data Not Normal
Lilliefors (NDs = DL)	0.414	0.198	Data Not Normal
Shapiro-Wilk (NDs = DL/2)	0.399	0.905	Data Not Normal
Lilliefors (NDs = DL/2)	0.414	0.198	Data Not Normal
Shapiro-Wilk (Normal ROS Estimates)	0.928	0.905	Data Appear Normal
Lilliefors (Normal ROS Estimates)	0.196	0.198	Data Appear Normal

Gamma GOF Test Results

	No NDs	NDs = DL	NDs = DL/2	Gamma ROS
Correlation Coefficient R	0.973	0.943	0.949	0.97

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Anderson-Darling (Detects Only)	0.918	0.811	
Kolmogorov-Smirnov (Detects Only)	0.297	0.274	Data Not Gamma Distributed
Anderson-Darling (NDs = DL)	2.919	0.864	

On-Site Groundwater GOF

Former Top's Diner Property
Johnstown City, Pennsylvania

Kolmogorov-Smirnov (NDs = DL)	0.314	0.212	Data Not Gamma Distributed			
Anderson-Darling (NDs = DL/2)	2.519	0.875				
Kolmogorov-Smirnov (NDs = DL/2)	0.29	0.213	Data Not Gamma Distributed			
Anderson-Darling (Gamma ROS Estimates)	1.52	0.93				
Kolmogorov-Smirnov (Gamma ROS Est.)	0.258	0.218	Data Not Gamma Distributed			
Lognormal GOF Test Results						
	No NDs	NDs = DL	NDs = DL/2	Log ROS		
Correlation Coefficient R	0.955	0.886	0.909	0.995		
	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)			
Shapiro-Wilk (Detects Only)	0.901	0.85	Data Appear Lognormal			
Lilliefors (Detects Only)	0.215	0.267	Data Appear Lognormal			
Shapiro-Wilk (NDs = DL)	0.778	0.905	Data Not Lognormal			
Lilliefors (NDs = DL)	0.226	0.198	Data Not Lognormal			
Shapiro-Wilk (NDs = DL/2)	0.815	0.905	Data Not Lognormal			
Lilliefors (NDs = DL/2)	0.248	0.198	Data Not Lognormal			
Shapiro-Wilk (Lognormal ROS Estimates)	0.983	0.905	Data Appear Lognormal			
Lilliefors (Lognormal ROS Estimates)	0.0821	0.198	Data Appear Lognormal			
Note: Substitution methods such as DL or DL/2 are not recommended.						

On-Site Groundwater GOF
Former Top's Diner Property
Johnstown City, Pennsylvania

Benzene (ug/L)						
	Num Obs	Num Miss	Num Valid	Detects	NDs	% NDs
Raw Statistics	20	0	20	9	11	55.00%
	Number	Minimum	Maximum	Mean	Median	SD
Statistics (Non-Detects Only)	11	1	1	1	1	0
Statistics (Detects Only)	9	2.37	418	138.6	72	162.6
Statistics (All: NDs treated as DL value)	20	1	418	62.93	1	126.8
Statistics (All: NDs treated as DL/2 value)	20	0.5	418	62.65	0.5	126.9
Statistics (Normal ROS Imputed Data)	20	-677.5	418	-130.8	-146.6	298.9
Statistics (Gamma ROS Imputed Data)	20	0.01	418	62.38	0.01	127
Statistics (Lognormal ROS Imputed Data)	20	0.00401	418	62.68	1.794	126.9
	K hat	K Star	Theta hat	Log Mean	Log Stdv	Log CV
Statistics (Detects Only)	0.565	0.451	245.4	3.828	1.884	0.492
Statistics (NDs = DL)	0.287	0.277	219.2	1.723	2.305	1.338
Statistics (NDs = DL/2)	0.253	0.249	247.2	1.341	2.611	1.947
Statistics (Gamma ROS Estimates)	0.155	0.165	403.1	--	--	--
Statistics (Lognormal ROS Estimates)	--	--	--	0.742	3.429	4.62

Normal GOF Test Results

	No NDs	NDs = DL	NDs = DL/2	Normal ROS
Correlation Coefficient R	0.905	0.744	0.744	0.745

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Shapiro-Wilk (Detects Only)	0.801	0.829	Data Not Normal
Lilliefors (Detects Only)	0.282	0.295	Data Appear Normal
Shapiro-Wilk (NDs = DL)	0.559	0.905	Data Not Normal
Lilliefors (NDs = DL)	0.373	0.198	Data Not Normal
Shapiro-Wilk (NDs = DL/2)	0.56	0.905	Data Not Normal
Lilliefors (NDs = DL/2)	0.372	0.198	Data Not Normal
Shapiro-Wilk (Normal ROS Estimates)	0.979	0.905	Data Appear Normal
Lilliefors (Normal ROS Estimates)	0.122	0.198	Data Appear Normal

Gamma GOF Test Results

	No NDs	NDs = DL	NDs = DL/2	Gamma ROS
Correlation Coefficient R	0.925	0.952	0.951	0.935

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Anderson-Darling (Detects Only)	0.377	0.766	
Kolmogorov-Smirnov (Detects Only)	0.196	0.293	Detected Data Appear Gamma Distributed
Anderson-Darling (NDs = DL)	2.624	0.851	

On-Site Groundwater GOF

Former Top's Diner Property
Johnstown City, Pennsylvania

Kolmogorov-Smirnov (NDs = DL)	0.314	0.211	Data Not Gamma Distributed			
Anderson-Darling (NDs = DL/2)	2.414	0.867				
Kolmogorov-Smirnov (NDs = DL/2)	0.321	0.212	Data Not Gamma Distributed			
Anderson-Darling (Gamma ROS Estimates)	2.015	0.935				
Kolmogorov-Smirnov (Gamma ROS Est.)	0.342	0.218	Data Not Gamma Distributed			
Lognormal GOF Test Results						
	No NDs	NDs = DL	NDs = DL/2	Log ROS		
Correlation Coefficient R	0.972	0.872	0.879	0.99		
	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)			
Shapiro-Wilk (Detects Only)	0.923	0.829	Data Appear Lognormal			
Lilliefors (Detects Only)	0.174	0.295	Data Appear Lognormal			
Shapiro-Wilk (NDs = DL)	0.742	0.905	Data Not Lognormal			
Lilliefors (NDs = DL)	0.323	0.198	Data Not Lognormal			
Shapiro-Wilk (NDs = DL/2)	0.754	0.905	Data Not Lognormal			
Lilliefors (NDs = DL/2)	0.332	0.198	Data Not Lognormal			
Shapiro-Wilk (Lognormal ROS Estimates)	0.967	0.905	Data Appear Lognormal			
Lilliefors (Lognormal ROS Estimates)	0.0987	0.198	Data Appear Lognormal			
Note: Substitution methods such as DL or DL/2 are not recommended.						

On-Site Groundwater GOF

Former Top's Diner Property
Johnstown City, Pennsylvania

Ethylbenzene (ug/L)

	Num Obs	Num Miss	Num Valid	Detects	NDs	% NDs
Raw Statistics	20	0	20	11	9	45.00%

	Number	Minimum	Maximum	Mean	Median	SD
Statistics (Non-Detects Only)	9	1	1	1	1	0
Statistics (Detects Only)	11	3.75	1480	424.2	89	547
Statistics (All: NDs treated as DL value)	20	1	1480	233.7	4.35	451.8
Statistics (All: NDs treated as DL/2 value)	20	0.5	1480	233.5	4.35	451.9
Statistics (Normal ROS Imputed Data)	20	-1900	1480	-242.3	4.35	906.4
Statistics (Gamma ROS Imputed Data)	20	0.01	1480	233.3	4.35	452.1
Statistics (Lognormal ROS Imputed Data)	20	0.0042	1480	233.5	4.35	451.9

	K hat	K Star	Theta hat	Log Mean	Log Stdv	Log CV
Statistics (Detects Only)	0.405	0.355	1047	4.428	2.341	0.529
Statistics (NDs = DL)	0.237	0.235	985.1	2.436	2.827	1.161
Statistics (NDs = DL/2)	0.218	0.219	1071	2.124	3.117	1.468
Statistics (Gamma ROS Estimates)	0.151	0.162	1546	--	--	--
Statistics (Lognormal ROS Estimates)	--	--	--	1.59	3.864	2.43

Normal GOF Test Results

	No NDs	NDs = DL	NDs = DL/2	Normal ROS
Correlation Coefficient R	0.896	0.767	0.768	0.768

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Shapiro-Wilk (Detects Only)	0.789	0.85	Data Not Normal
Lilliefors (Detects Only)	0.275	0.267	Data Not Normal
Shapiro-Wilk (NDs = DL)	0.593	0.905	Data Not Normal
Lilliefors (NDs = DL)	0.378	0.198	Data Not Normal
Shapiro-Wilk (NDs = DL/2)	0.594	0.905	Data Not Normal
Lilliefors (NDs = DL/2)	0.378	0.198	Data Not Normal
Shapiro-Wilk (Normal ROS Estimates)	0.977	0.905	Data Appear Normal
Lilliefors (Normal ROS Estimates)	0.157	0.198	Data Appear Normal

Gamma GOF Test Results

	No NDs	NDs = DL	NDs = DL/2	Gamma ROS
Correlation Coefficient R	0.937	0.958	0.955	0.938

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Anderson-Darling (Detects Only)	0.531	0.8	
Kolmogorov-Smirnov (Detects Only)	0.209	0.272	Detected Data Appear Gamma Distributed
Anderson-Darling (NDs = DL)	2.091	0.875	

On-Site Groundwater GOF
Former Top's Diner Property
Johnstown City, Pennsylvania

Kolmogorov-Smirnov (NDs = DL)	0.263	0.213	Data Not Gamma Distributed		
Anderson-Darling (NDs = DL/2)	1.875	0.884			
Kolmogorov-Smirnov (NDs = DL/2)	0.244	0.214	Data Not Gamma Distributed		
Anderson-Darling (Gamma ROS Estimates)	1.379	0.938			
Kolmogorov-Smirnov (Gamma ROS Est.)	0.273	0.218	Data Not Gamma Distributed		
Lognormal GOF Test Results					
	No NDs	NDs = DL	NDs = DL/2	Log ROS	
Correlation Coefficient R	0.957	0.904	0.912	0.987	
	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)		
Shapiro-Wilk (Detects Only)	0.886	0.85	Data Appear Lognormal		
Lilliefors (Detects Only)	0.177	0.267	Data Appear Lognormal		
Shapiro-Wilk (NDs = DL)	0.796	0.905	Data Not Lognormal		
Lilliefors (NDs = DL)	0.256	0.198	Data Not Lognormal		
Shapiro-Wilk (NDs = DL/2)	0.81	0.905	Data Not Lognormal		
Lilliefors (NDs = DL/2)	0.267	0.198	Data Not Lognormal		
Shapiro-Wilk (Lognormal ROS Estimates)	0.96	0.905	Data Appear Lognormal		
Lilliefors (Lognormal ROS Estimates)	0.113	0.198	Data Appear Lognormal		
Note: Substitution methods such as DL or DL/2 are not recommended.					

On-Site Groundwater GOF

Former Top's Diner Property
Johnstown City, Pennsylvania

Xylenes (ug/L)						
	Num Obs	Num Miss	Num Valid	Detects	NDs	% NDs
Raw Statistics	20	0	20	10	10	50.00%
	Number	Minimum	Maximum	Mean	Median	SD
Statistics (Non-Detects Only)	10	2	2	2	2	0
Statistics (Detects Only)	10	3.56	2450	447.9	30.9	780.6
Statistics (All: NDs treated as DL value)	20	2	2450	225	2.78	583.9
Statistics (All: NDs treated as DL/2 value)	20	1	2450	224.5	2.28	584.1
Statistics (Normal ROS Imputed Data)	20	-2845	2450	-568.6	-359.4	1263
Statistics (Gamma ROS Imputed Data)	20	0.01	2450	224	1.785	584.3
Statistics (Lognormal ROS Imputed Data)	20	6.6681E-4	2450	224.1	2.301	584.3
	K hat	K Star	Theta hat	Log Mean	Log Stdv	Log CV
Statistics (Detects Only)	0.337	0.302	1330	4.095	2.419	0.591
Statistics (NDs = DL)	0.237	0.235	948.9	2.394	2.412	1.007
Statistics (NDs = DL/2)	0.216	0.217	1039	2.048	2.68	1.309
Statistics (Gamma ROS Estimates)	0.137	0.15	1630	--	--	--
Statistics (Lognormal ROS Estimates)	--	--	--	0.574	4.297	7.493

Normal GOF Test Results

	No NDs	NDs = DL	NDs = DL/2	Normal ROS
Correlation Coefficient R	0.799	0.654	0.655	0.655

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Shapiro-Wilk (Detects Only)	0.654	0.842	Data Not Normal
Lilliefors (Detects Only)	0.301	0.28	Data Not Normal
Shapiro-Wilk (NDs = DL)	0.452	0.905	Data Not Normal
Lilliefors (NDs = DL)	0.426	0.198	Data Not Normal
Shapiro-Wilk (NDs = DL/2)	0.452	0.905	Data Not Normal
Lilliefors (NDs = DL/2)	0.426	0.198	Data Not Normal
Shapiro-Wilk (Normal ROS Estimates)	0.966	0.905	Data Appear Normal
Lilliefors (Normal ROS Estimates)	0.175	0.198	Data Appear Normal

Gamma GOF Test Results

	No NDs	NDs = DL	NDs = DL/2	Gamma ROS
Correlation Coefficient R	0.991	0.974	0.977	0.99

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Anderson-Darling (Detects Only)	0.621	0.807	
Kolmogorov-Smirnov (Detects Only)	0.266	0.287	Detected Data Appear Gamma Distributed
Anderson-Darling (NDs = DL)	3.104	0.875	

On-Site Groundwater GOF

Former Top's Diner Property
Johnstown City, Pennsylvania

Kolmogorov-Smirnov (NDs = DL)	0.33	0.213	Data Not Gamma Distributed				
Anderson-Darling (NDs = DL/2)	2.748	0.885					
Kolmogorov-Smirnov (NDs = DL/2)	0.302	0.214	Data Not Gamma Distributed				
Anderson-Darling (Gamma ROS Estimates)	1.754	0.951					
Kolmogorov-Smirnov (Gamma ROS Est.)	0.295	0.219	Data Not Gamma Distributed				
Lognormal GOF Test Results							
	No NDs	NDs = DL	NDs = DL/2	Log ROS			
Correlation Coefficient R	0.961	0.864	0.886	0.994			
	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)				
Shapiro-Wilk (Detects Only)	0.901	0.842	Data Appear Lognormal				
Lilliefors (Detects Only)	0.178	0.28	Data Appear Lognormal				
Shapiro-Wilk (NDs = DL)	0.737	0.905	Data Not Lognormal				
Lilliefors (NDs = DL)	0.271	0.198	Data Not Lognormal				
Shapiro-Wilk (NDs = DL/2)	0.772	0.905	Data Not Lognormal				
Lilliefors (NDs = DL/2)	0.278	0.198	Data Not Lognormal				
Shapiro-Wilk (Lognormal ROS Estimates)	0.978	0.905	Data Appear Lognormal				
Lilliefors (Lognormal ROS Estimates)	0.0762	0.198	Data Appear Lognormal				
Note: Substitution methods such as DL or DL/2 are not recommended.							

On-Site Groundwater GOF

Former Top's Diner Property
Johnstown City, Pennsylvania

Cumene (ug/L)

	Num Obs	Num Miss	Num Valid	Detects	NDs	% NDs
Raw Statistics	20	0	20	7	13	65.00%

	Number	Minimum	Maximum	Mean	Median	SD
Statistics (Non-Detects Only)	13	1	25	2.846	1	6.656
Statistics (Detects Only)	7	1.11	217	60.88	56	74.92
Statistics (All: NDs treated as DL value)	20	1	217	23.16	1	51.06
Statistics (All: NDs treated as DL/2 value)	20	0.5	217	22.23	0.5	51.25
Statistics (Normal ROS Imputed Data)	20	-331.4	217	-86.16	-100.1	135.4
Statistics (Gamma ROS Imputed Data)	20	0.01	217	21.31	0.01	51.57
Statistics (Lognormal ROS Imputed Data)	20	0.00125	217	21.49	0.419	51.5

	K hat	K Star	Theta hat	Log Mean	Log Stdv	Log CV
Statistics (Detects Only)	0.629	0.455	96.8	3.133	1.842	0.588
Statistics (NDs = DL)	0.356	0.336	65.08	1.258	1.889	1.502
Statistics (NDs = DL/2)	0.3	0.289	73.99	0.807	2.155	2.67
Statistics (Gamma ROS Estimates)	0.154	0.165	138	--	--	--
Statistics (Lognormal ROS Estimates)	--	--	--	-0.547	3.385	-6.182

Normal GOF Test Results

	No NDs	NDs = DL	NDs = DL/2	Normal ROS
Correlation Coefficient R	0.875	0.695	0.687	0.679

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Shapiro-Wilk (Detects Only)	0.779	0.803	Data Not Normal
Lilliefors (Detects Only)	0.309	0.335	Data Appear Normal
Shapiro-Wilk (NDs = DL)	0.506	0.905	Data Not Normal
Lilliefors (NDs = DL)	0.341	0.198	Data Not Normal
Shapiro-Wilk (NDs = DL/2)	0.495	0.905	Data Not Normal
Lilliefors (NDs = DL/2)	0.375	0.198	Data Not Normal
Shapiro-Wilk (Normal ROS Estimates)	0.986	0.905	Data Appear Normal
Lilliefors (Normal ROS Estimates)	0.0903	0.198	Data Appear Normal

Gamma GOF Test Results

	No NDs	NDs = DL	NDs = DL/2	Gamma ROS
Correlation Coefficient R	0.974	0.965	0.968	0.983

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Anderson-Darling (Detects Only)	0.285	0.744	
Kolmogorov-Smirnov (Detects Only)	0.213	0.325	Detected Data Appear Gamma Distributed
Anderson-Darling (NDs = DL)	3.054	0.833	

On-Site Groundwater GOF
Former Top's Diner Property
Johnstown City, Pennsylvania

Kolmogorov-Smirnov (NDs = DL)	0.387	0.209	Data Not Gamma Distributed				
Anderson-Darling (NDs = DL/2)	2.878	0.845					
Kolmogorov-Smirnov (NDs = DL/2)	0.352	0.21	Data Not Gamma Distributed				
Anderson-Darling (Gamma ROS Estimates)	2.968	0.935					
Kolmogorov-Smirnov (Gamma ROS Est.)	0.404	0.218	Data Not Gamma Distributed				
Lognormal GOF Test Results							
	No NDs	NDs = DL	NDs = DL/2	Log ROS			
Correlation Coefficient R	0.966	0.839	0.852	0.99			
	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)				
Shapiro-Wilk (Detects Only)	0.93	0.803	Data Appear Lognormal				
Lilliefors (Detects Only)	0.257	0.335	Data Appear Lognormal				
Shapiro-Wilk (NDs = DL)	0.693	0.905	Data Not Lognormal				
Lilliefors (NDs = DL)	0.379	0.198	Data Not Lognormal				
Shapiro-Wilk (NDs = DL/2)	0.715	0.905	Data Not Lognormal				
Lilliefors (NDs = DL/2)	0.357	0.198	Data Not Lognormal				
Shapiro-Wilk (Lognormal ROS Estimates)	0.971	0.905	Data Appear Lognormal				
Lilliefors (Lognormal ROS Estimates)	0.112	0.198	Data Appear Lognormal				
Note: Substitution methods such as DL or DL/2 are not recommended.							

On-Site Groundwater GOF
Former Top's Diner Property
Johnstown City, Pennsylvania

Naphthalene (ug/L)

	Num Obs	Num Miss	Num Valid	Detects	NDs	% NDs
Raw Statistics	20	0	20	10	10	50.00%

	Number	Minimum	Maximum	Mean	Median	SD
Statistics (Non-Detects Only)	10	1	1	1	1	0
Statistics (Detects Only)	10	1.02	995	172.9	23.3	315.9
Statistics (All: NDs treated as DL value)	20	1	995	86.94	1.01	234.6
Statistics (All: NDs treated as DL/2 value)	20	0.5	995	86.69	0.76	234.7
Statistics (Normal ROS Imputed Data)	20	-1141	995	-232.7	-146.5	505.4
Statistics (Gamma ROS Imputed Data)	20	0.01	995	86.45	0.515	234.8
Statistics (Lognormal ROS Imputed Data)	20	8.9210E-5	995	86.47	0.634	234.8

	K hat	K Star	Theta hat	Log Mean	Log Stdv	Log CV
Statistics (Detects Only)	0.315	0.287	548.7	2.982	2.612	0.876
Statistics (NDs = DL)	0.24	0.238	361.8	1.491	2.36	1.583
Statistics (NDs = DL/2)	0.219	0.219	396.4	1.144	2.605	2.276
Statistics (Gamma ROS Estimates)	0.146	0.158	590.8	--	--	--
Statistics (Lognormal ROS Estimates)	--	--	--	-0.817	4.636	-5.674

Normal GOF Test Results

	No NDs	NDs = DL	NDs = DL/2	Normal ROS
Correlation Coefficient R	0.785	0.64	0.64	0.641

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Shapiro-Wilk (Detects Only)	0.634	0.842	Data Not Normal
Lilliefors (Detects Only)	0.311	0.28	Data Not Normal
Shapiro-Wilk (NDs = DL)	0.434	0.905	Data Not Normal
Lilliefors (NDs = DL)	0.386	0.198	Data Not Normal
Shapiro-Wilk (NDs = DL/2)	0.435	0.905	Data Not Normal
Lilliefors (NDs = DL/2)	0.386	0.198	Data Not Normal
Shapiro-Wilk (Normal ROS Estimates)	0.963	0.905	Data Appear Normal
Lilliefors (Normal ROS Estimates)	0.178	0.198	Data Appear Normal

Gamma GOF Test Results

	No NDs	NDs = DL	NDs = DL/2	Gamma ROS
Correlation Coefficient R	0.998	0.971	0.976	0.991

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Anderson-Darling (Detects Only)	0.486	0.811	
Kolmogorov-Smirnov (Detects Only)	0.204	0.287	Detected Data Appear Gamma Distributed
Anderson-Darling (NDs = DL)	3.436	0.873	

On-Site Groundwater GOF

Former Top's Diner Property
Johnstown City, Pennsylvania

Kolmogorov-Smirnov (NDs = DL)	0.377	0.213	Data Not Gamma Distributed				
Anderson-Darling (NDs = DL/2)	3.013	0.884					
Kolmogorov-Smirnov (NDs = DL/2)	0.349	0.214	Data Not Gamma Distributed				
Anderson-Darling (Gamma ROS Estimates)	1.894	0.942					
Kolmogorov-Smirnov (Gamma ROS Est.)	0.286	0.219	Data Not Gamma Distributed				
Lognormal GOF Test Results							
	No NDs	NDs = DL	NDs = DL/2	Log ROS			
Correlation Coefficient R	0.962	0.83	0.864	0.994			
	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)				
Shapiro-Wilk (Detects Only)	0.9	0.842	Data Appear Lognormal				
Lilliefors (Detects Only)	0.199	0.28	Data Appear Lognormal				
Shapiro-Wilk (NDs = DL)	0.682	0.905	Data Not Lognormal				
Lilliefors (NDs = DL)	0.349	0.198	Data Not Lognormal				
Shapiro-Wilk (NDs = DL/2)	0.736	0.905	Data Not Lognormal				
Lilliefors (NDs = DL/2)	0.283	0.198	Data Not Lognormal				
Shapiro-Wilk (Lognormal ROS Estimates)	0.977	0.905	Data Appear Lognormal				
Lilliefors (Lognormal ROS Estimates)	0.0786	0.198	Data Appear Lognormal				
Note: Substitution methods such as DL or DL/2 are not recommended.							

On-Site Groundwater GOF

Former Top's Diner Property
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Toluene (ug/L)						
	Num Obs	Num Miss	Num Valid	Detects	NDs	% NDs
Raw Statistics	20	0	20	8	12	60.00%
	Number	Minimum	Maximum	Mean	Median	SD
Statistics (Non-Detects Only)	12	1	1	1	1	0
Statistics (Detects Only)	8	1.29	157	52.81	20	64.18
Statistics (All: NDs treated as DL value)	20	1	157	21.72	1	46.86
Statistics (All: NDs treated as DL/2 value)	20	0.5	157	21.42	0.5	47
Statistics (Normal ROS Imputed Data)	20	-300	157	-71.18	-76.85	125.2
Statistics (Gamma ROS Imputed Data)	20	0.01	157	21.13	0.01	47.13
Statistics (Lognormal ROS Imputed Data)	20	4.3543E-4	157	21.21	0.355	47.1
	K hat	K Star	Theta hat	Log Mean	Log Stdv	Log CV
Statistics (Detects Only)	0.544	0.423	97.12	2.813	1.935	0.688
Statistics (NDs = DL)	0.345	0.327	62.95	1.125	1.838	1.633
Statistics (NDs = DL/2)	0.294	0.283	72.92	0.709	2.118	2.985
Statistics (Gamma ROS Estimates)	0.162	0.171	130.4	---	---	---
Statistics (Lognormal ROS Estimates)	---	---	---	-0.895	3.746	-4.186

Normal GOF Test Results

	No NDs	NDs = DL	NDs = DL/2	Normal ROS
Correlation Coefficient R	0.902	0.709	0.711	0.713

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Shapiro-Wilk (Detects Only)	0.794	0.818	Data Not Normal
Lilliefors (Detects Only)	0.291	0.313	Data Appear Normal
Shapiro-Wilk (NDs = DL)	0.512	0.905	Data Not Normal
Lilliefors (NDs = DL)	0.387	0.198	Data Not Normal
Shapiro-Wilk (NDs = DL/2)	0.515	0.905	Data Not Normal
Lilliefors (NDs = DL/2)	0.384	0.198	Data Not Normal
Shapiro-Wilk (Normal ROS Estimates)	0.982	0.905	Data Appear Normal
Lilliefors (Normal ROS Estimates)	0.119	0.198	Data Appear Normal

Gamma GOF Test Results

	No NDs	NDs = DL	NDs = DL/2	Gamma ROS
Correlation Coefficient R	0.929	0.95	0.954	0.95

	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)
Anderson-Darling (Detects Only)	0.347	0.759	
Kolmogorov-Smirnov (Detects Only)	0.15	0.308	Detected Data Appear Gamma Distributed
Anderson-Darling (NDs = DL)	3.604	0.835	

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Kolmogorov-Smirnov (NDs = DL)	0.402	0.209	Data Not Gamma Distributed			
Anderson-Darling (NDs = DL/2)	3.226	0.848				
Kolmogorov-Smirnov (NDs = DL/2)	0.355	0.21	Data Not Gamma Distributed			
Anderson-Darling (Gamma ROS Estimates)	2.491	0.928				
Kolmogorov-Smirnov (Gamma ROS Est.)	0.368	0.218	Data Not Gamma Distributed			
Lognormal GOF Test Results						
	No NDs	NDs = DL	NDs = DL/2	Log ROS		
Correlation Coefficient R	0.966	0.816	0.841	0.992		
	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)			
Shapiro-Wilk (Detects Only)	0.904	0.818	Data Appear Lognormal			
Lilliefors (Detects Only)	0.161	0.313	Data Appear Lognormal			
Shapiro-Wilk (NDs = DL)	0.657	0.905	Data Not Lognormal			
Lilliefors (NDs = DL)	0.37	0.198	Data Not Lognormal			
Shapiro-Wilk (NDs = DL/2)	0.695	0.905	Data Not Lognormal			
Lilliefors (NDs = DL/2)	0.346	0.198	Data Not Lognormal			
Shapiro-Wilk (Lognormal ROS Estimates)	0.972	0.905	Data Appear Lognormal			
Lilliefors (Lognormal ROS Estimates)	0.081	0.198	Data Appear Lognormal			
Note: Substitution methods such as DL or DL/2 are not recommended.						

On-Site Groundwater UCLs
Former Top's Diner Property
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UCL Statistics for Data Sets with Non-Detects	
User Selected Options	
Date/Time of Computation	7/9/2015 8:23:48 AM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

1,2,4-TMB (ug/L)

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	12
Number of Detects	11	Number of Non-Detects	9
Number of Distinct Detects	11	Number of Distinct Non-Detects	1
Minimum Detect	2.82	Minimum Non-Detect	1
Maximum Detect	2220	Maximum Non-Detect	1
Variance Detects	434205	Percent Non-Detects	45%
Mean Detects	321	SD Detects	658.9
Median Detects	44.5	CV Detects	2.053
Skewness Detects	2.85	Kurtosis Detects	8.541
Mean of Logged Detects	3.906	SD of Logged Detects	2.169

Normal GOF Test on Detects Only		
Shapiro Wilk Test Statistic	0.554	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.85	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.326	Lilliefors GOF Test
5% Lilliefors Critical Value	0.267	Detected Data Not Normal at 5% Significance Level
Detected Data Not Normal at 5% Significance Level		

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	177	Standard Error of Mean	115.5
SD	492.4	95% KM (BCA) UCL	407.5
95% KM (t) UCL	376.7	95% KM (Percentile Bootstrap) UCL	390.8
95% KM (z) UCL	366.9	95% KM Bootstrap t UCL	935.7
90% KM Chebyshev UCL	523.4	95% KM Chebyshev UCL	680.3
97.5% KM Chebyshev UCL	898.1	99% KM Chebyshev UCL	1326

Gamma GOF Tests on Detected Observations Only		
A-D Test Statistic	0.605	Anderson-Darling GOF Test
5% A-D Critical Value	0.809	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.205	Kolmogrov-Smirnoff GOF
5% K-S Critical Value	0.274	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.359	k star (bias corrected MLE)	0.322
Theta hat (MLE)	894.2	Theta star (bias corrected MLE)	997.9
nu hat (MLE)	7.897	nu star (bias corrected)	7.077
MLE Mean (bias corrected)	321	MLE Sd (bias corrected)	566

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.129	nu hat (KM)	5.169
Approximate Chi Square Value (5.17, α)	1.231	Adjusted Chi Square Value (5.17, β)	1.088
95% Gamma Approximate KM-UCL (use when n>=50)	743.2	95% Gamma Adjusted KM-UCL (use when n<50)	841

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Gamma ROS Statistics using Imputed Non-Detects			
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
GROS may not be used when kstar of detected data is small such as < 0.1			
For such situations, GROS method tends to yield inflated values of UCLs and BTVs			
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
Minimum	0.01	Mean	176.6
Maximum	2220	Median	3.725
SD	505.3	CV	2.862
k hat (MLE)	0.151	k star (bias corrected MLE)	0.161
Theta hat (MLE)	1172	Theta star (bias corrected MLE)	1094
nu hat (MLE)	6.027	nu star (bias corrected)	6.456
MLE Mean (bias corrected)	176.6	MLE Sd (bias corrected)	439.5
		Adjusted Level of Significance (β)	0.038
Approximate Chi Square Value (6.46, α)	1.877	Adjusted Chi Square Value (6.46, β)	1.689
95% Gamma Approximate UCL (use when n>=50)	607.2	95% Gamma Adjusted UCL (use when n<50)	674.8
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.95	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.178	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.267	Detected Data appear Lognormal at 5% Significance Level	
Detected Data appear Lognormal at 5% Significance Level			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	176.7	Mean in Log Scale	1.157
SD in Original Scale	505.3	SD in Log Scale	3.711
95% t UCL (assumes normality of ROS data)	372.1	95% Percentile Bootstrap UCL	390.7
95% BCA Bootstrap UCL	507.9	95% Bootstrap t UCL	938.6
95% H-UCL (Log ROS)	1692128		
UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed			
KM Mean (logged)	2.148	95% H-UCL (KM -Log)	3474
KM SD (logged)	2.476	95% Critical H Value (KM-Log)	5.178
KM Standard Error of Mean (logged)	0.581		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	176.8	Mean in Log Scale	1.836
SD in Original Scale	505.3	SD in Log Scale	2.826
95% t UCL (Assumes normality)	372.1	95% H-Stat UCL	14947
DL/2 is not a recommended method, provided for comparisons and historical reasons			
Nonparametric Distribution Free UCL Statistics			
Detected Data appear Gamma Distributed at 5% Significance Level			
Suggested UCL to Use			
95% KM (BCA) UCL	407.5	95% GROS Adjusted Gamma UCL	674.8
95% Adjusted Gamma KM-UCL	841		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

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1,3,5-TMB (ug/L)			
General Statistics			
Total Number of Observations	20	Number of Distinct Observations	12
Number of Detects	11	Number of Non-Detects	9
Number of Distinct Detects	11	Number of Distinct Non-Detects	1
Minimum Detect	1.53	Minimum Non-Detect	1
Maximum Detect	990	Maximum Non-Detect	1
Variance Detects	87161	Percent Non-Detects	45%
Mean Detects	142.6	SD Detects	295.2
Median Detects	9.4	CV Detects	2.071
Skewness Detects	2.811	Kurtosis Detects	8.342
Mean of Logged Detects	3.018	SD of Logged Detects	2.135
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.551	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.328	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.267	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	78.87	Standard Error of Mean	51.67
SD	220.3	95% KM (BCA) UCL	173.4
95% KM (t) UCL	168.2	95% KM (Percentile Bootstrap) UCL	173.5
95% KM (z) UCL	163.9	95% KM Bootstrap t UCL	374.2
90% KM Chebyshev UCL	233.9	95% KM Chebyshev UCL	304.1
97.5% KM Chebyshev UCL	401.5	99% KM Chebyshev UCL	593
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.918	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.811	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.297	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.274	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics on Detected Data Only			
k hat (MLE)	0.347	k star (bias corrected MLE)	0.313
Theta hat (MLE)	411.2	Theta star (bias corrected MLE)	455.9
nu hat (MLE)	7.628	nu star (bias corrected)	6.881
MLE Mean (bias corrected)	142.6	MLE Sd (bias corrected)	254.9
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.128	nu hat (KM)	5.126
Approximate Chi Square Value (5.13, α)	1.211	Adjusted Chi Square Value (5.13, β)	1.069
95% Gamma Approximate KM-UCL (use when n>=50)	333.9	95% Gamma Adjusted KM-UCL (use when n<50)	378.1
Gamma ROS Statistics using Imputed Non-Detects			
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			

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GROS may not be used when kstar of detected data is small such as < 0.1			
For such situations, GROS method tends to yield inflated values of UCLs and BTVs			
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
Minimum	0.01	Mean	78.42
Maximum	990	Median	2.26
SD	226.2	CV	2.884
k hat (MLE)	0.16	k star (bias corrected MLE)	0.169
Theta hat (MLE)	491.6	Theta star (bias corrected MLE)	464.3
nu hat (MLE)	6.381	nu star (bias corrected)	6.757
MLE Mean (bias corrected)	78.42	MLE Sd (bias corrected)	190.8
		Adjusted Level of Significance (β)	0.038
Approximate Chi Square Value (6.76, α)	2.038	Adjusted Chi Square Value (6.76, β)	1.84
95% Gamma Approximate UCL (use when n>=50)	260	95% Gamma Adjusted UCL (use when n<50)	288
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.901	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.215	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.267	Detected Data appear Lognormal at 5% Significance Level	
Detected Data appear Lognormal at 5% Significance Level			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	78.49	Mean in Log Scale	0.345
SD in Original Scale	226.2	SD in Log Scale	3.616
95% t UCL (assumes normality of ROS data)	165.9	95% Percentile Bootstrap UCL	173.5
95% BCA Bootstrap UCL	226.6	95% Bootstrap t UCL	372.4
95% H-UCL (Log ROS)	408671		
UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed			
KM Mean (logged)	1.66	95% H-UCL (KM -Log)	465.4
KM SD (logged)	2.129	95% Critical H Value (KM-Log)	4.54
KM Standard Error of Mean (logged)	0.499		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	78.65	Mean in Log Scale	1.348
SD in Original Scale	226.1	SD in Log Scale	2.447
95% t UCL (Assumes normality)	166.1	95% H-Stat UCL	1362
DL/2 is not a recommended method, provided for comparisons and historical reasons			
Nonparametric Distribution Free UCL Statistics			
Detected Data appear Lognormal Distributed at 5% Significance Level			
Suggested UCL to Use			
99% KM (Chebyshev) UCL	593		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

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Benzene (ug/L)			
General Statistics			
Total Number of Observations	20	Number of Distinct Observations	10
Number of Detects	9	Number of Non-Detects	11
Number of Distinct Detects	9	Number of Distinct Non-Detects	1
Minimum Detect	2.37	Minimum Non-Detect	1
Maximum Detect	418	Maximum Non-Detect	1
Variance Detects	26438	Percent Non-Detects	55%
Mean Detects	138.6	SD Detects	162.6
Median Detects	72	CV Detects	1.173
Skewness Detects	0.88	Kurtosis Detects	-1.085
Mean of Logged Detects	3.828	SD of Logged Detects	1.884
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.801	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.282	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.295	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Approximate Normal at 5% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	62.93	Standard Error of Mean	29.3
SD	123.5	95% KM (BCA) UCL	110.2
95% KM (t) UCL	113.6	95% KM (Percentile Bootstrap) UCL	111
95% KM (z) UCL	111.1	95% KM Bootstrap t UCL	135.4
90% KM Chebyshev UCL	150.8	95% KM Chebyshev UCL	190.6
97.5% KM Chebyshev UCL	245.9	99% KM Chebyshev UCL	354.5
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.377	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.766	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.196	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.293	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics on Detected Data Only			
k hat (MLE)	0.565	k star (bias corrected MLE)	0.451
Theta hat (MLE)	245.4	Theta star (bias corrected MLE)	307.6
nu hat (MLE)	10.17	nu star (bias corrected)	8.111
MLE Mean (bias corrected)	138.6	MLE Sd (bias corrected)	206.5
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.259	nu hat (KM)	10.38
Approximate Chi Square Value (10.38, α)	4.18	Adjusted Chi Square Value (10.38, β)	3.873
95% Gamma Approximate KM-UCL (use when n>=50)	156.3	95% Gamma Adjusted KM-UCL (use when n<50)	168.6
Gamma ROS Statistics using Imputed Non-Detects			
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
GROS may not be used when kstar of detected data is small such as < 0.1			
For such situations, GROS method tends to yield inflated values of UCLs and BTVs			
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
Minimum	0.01	Mean	62.38
Maximum	418	Median	0.01
SD	127	CV	2.036
k hat (MLE)	0.155	k star (bias corrected MLE)	0.165

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Theta hat (MLE)	403.1	Theta star (bias corrected MLE)	378.4
nu hat (MLE)	6.19	nu star (bias corrected)	6.595
MLE Mean (bias corrected)	62.38	MLE Sd (bias corrected)	153.6
		Adjusted Level of Significance (β)	0.038
Approximate Chi Square Value (6.60, α)	1.951	Adjusted Chi Square Value (6.60, β)	1.758
95% Gamma Approximate UCL (use when n>=50)	210.9	95% Gamma Adjusted UCL (use when n<50)	234
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.923	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.174	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.295	Detected Data appear Lognormal at 5% Significance Level	
Detected Data appear Lognormal at 5% Significance Level			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	62.68	Mean in Log Scale	0.742
SD in Original Scale	126.9	SD in Log Scale	3.429
95% t UCL (assumes normality of ROS data)	111.7	95% Percentile Bootstrap UCL	112
95% BCA Bootstrap UCL	121.5	95% Bootstrap t UCL	138.1
95% H-UCL (Log ROS)	181643		
UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed			
KM Mean (logged)	1.723	95% H-UCL (KM -Log)	809.3
KM SD (logged)	2.246	95% Critical H Value (KM-Log)	4.754
KM Standard Error of Mean (logged)	0.533		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	62.65	Mean in Log Scale	1.341
SD in Original Scale	126.9	SD in Log Scale	2.611
95% t UCL (Assumes normality)	111.7	95% H-Stat UCL	2996
DL/2 is not a recommended method, provided for comparisons and historical reasons			
Nonparametric Distribution Free UCL Statistics			
Detected Data appear Approximate Normal Distributed at 5% Significance Level			
Suggested UCL to Use			
95% KM (t) UCL	113.6	95% KM (Percentile Bootstrap) UCL	111
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

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Ethylbenzene (ug/L)			
General Statistics			
Total Number of Observations	20	Number of Distinct Observations	12
Number of Detects	11	Number of Non-Detects	9
Number of Distinct Detects	11	Number of Distinct Non-Detects	1
Minimum Detect	3.75	Minimum Non-Detect	1
Maximum Detect	1480	Maximum Non-Detect	1
Variance Detects	299212	Percent Non-Detects	45%
Mean Detects	424.2	SD Detects	547
Median Detects	89	CV Detects	1.29
Skewness Detects	1.056	Kurtosis Detects	-0.367
Mean of Logged Detects	4.428	SD of Logged Detects	2.341
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.789	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.275	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.267	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	233.7	Standard Error of Mean	103.3
SD	440.4	95% KM (BCA) UCL	413.4
95% KM (t) UCL	412.3	95% KM (Percentile Bootstrap) UCL	405.5
95% KM (z) UCL	403.6	95% KM Bootstrap t UCL	517.6
90% KM Chebyshev UCL	543.6	95% KM Chebyshev UCL	683.9
97.5% KM Chebyshev UCL	878.7	99% KM Chebyshev UCL	1261
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.531	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.8	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.209	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.272	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics on Detected Data Only			
k hat (MLE)	0.405	k star (bias corrected MLE)	0.355
Theta hat (MLE)	1047	Theta star (bias corrected MLE)	1194
nu hat (MLE)	8.909	nu star (bias corrected)	7.812
MLE Mean (bias corrected)	424.2	MLE Sd (bias corrected)	711.8
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.282	nu hat (KM)	11.27
Approximate Chi Square Value (11.27, α)	4.75	Adjusted Chi Square Value (11.27, β)	4.419
95% Gamma Approximate KM-UCL (use when n>=50)	554.6	95% Gamma Adjusted KM-UCL (use when n<50)	596.1
Gamma ROS Statistics using Imputed Non-Detects			
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
GROS may not be used when kstar of detected data is small such as < 0.1			
For such situations, GROS method tends to yield inflated values of UCLs and BTVs			
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
Minimum	0.01	Mean	233.3
Maximum	1480	Median	4.35
SD	452.1	CV	1.938
k hat (MLE)	0.151	k star (bias corrected MLE)	0.162

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Theta hat (MLE)	1546	Theta star (bias corrected MLE)	1444
nu hat (MLE)	6.036	nu star (bias corrected)	6.464
MLE Mean (bias corrected)	233.3	MLE Sd (bias corrected)	580.4
		Adjusted Level of Significance (β)	0.038
Approximate Chi Square Value (6.46, α)	1.881	Adjusted Chi Square Value (6.46, β)	1.693
95% Gamma Approximate UCL (use when n>=50)	801.6	95% Gamma Adjusted UCL (use when n<50)	890.8
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.886	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.177	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.267	Detected Data appear Lognormal at 5% Significance Level	
Detected Data appear Lognormal at 5% Significance Level			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	233.5	Mean in Log Scale	1.59
SD in Original Scale	451.9	SD in Log Scale	3.864
95% t UCL (assumes normality of ROS data)	408.2	95% Percentile Bootstrap UCL	406
95% BCA Bootstrap UCL	445	95% Bootstrap t UCL	550.2
95% H-UCL (Log ROS)	6970905		
UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed			
KM Mean (logged)	2.436	95% H-UCL (KM -Log)	18709
KM SD (logged)	2.756	95% Critical H Value (KM-Log)	5.701
KM Standard Error of Mean (logged)	0.646		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	233.5	Mean in Log Scale	2.124
SD in Original Scale	451.9	SD in Log Scale	3.117
95% t UCL (Assumes normality)	408.3	95% H-Stat UCL	103769
DL/2 is not a recommended method, provided for comparisons and historical reasons			
Nonparametric Distribution Free UCL Statistics			
Detected Data appear Gamma Distributed at 5% Significance Level			
Suggested UCL to Use			
95% KM (BCA) UCL	413.4	95% GROS Adjusted Gamma UCL	890.8
95% Adjusted Gamma KM-UCL	596.1		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
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Xylenes (ug/L)			
General Statistics			
Total Number of Observations	20	Number of Distinct Observations	11
Number of Detects	10	Number of Non-Detects	10
Number of Distinct Detects	10	Number of Distinct Non-Detects	1
Minimum Detect	3.56	Minimum Non-Detect	2
Maximum Detect	2450	Maximum Non-Detect	2
Variance Detects	609409	Percent Non-Detects	50%
Mean Detects	447.9	SD Detects	780.6
Median Detects	30.9	CV Detects	1.743
Skewness Detects	2.236	Kurtosis Detects	5.259
Mean of Logged Detects	4.095	SD of Logged Detects	2.419
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.654	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.842	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.301	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.28	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	225	Standard Error of Mean	134.2
SD	569.2	95% KM (BCA) UCL	462.1
95% KM (t) UCL	456.9	95% KM (Percentile Bootstrap) UCL	462.7
95% KM (z) UCL	445.6	95% KM Bootstrap t UCL	813.4
90% KM Chebyshev UCL	627.4	95% KM Chebyshev UCL	809.7
97.5% KM Chebyshev UCL	1063	99% KM Chebyshev UCL	1560
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.621	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.807	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.266	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.287	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics on Detected Data Only			
k hat (MLE)	0.337	k star (bias corrected MLE)	0.302
Theta hat (MLE)	1330	Theta star (bias corrected MLE)	1481
nu hat (MLE)	6.735	nu star (bias corrected)	6.048
MLE Mean (bias corrected)	447.9	MLE Sd (bias corrected)	814.5
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.156	nu hat (KM)	6.249
Approximate Chi Square Value (6.25, α)	1.768	Adjusted Chi Square Value (6.25, β)	1.587
95% Gamma Approximate KM-UCL (use when n>=50)	795	95% Gamma Adjusted KM-UCL (use when n<50)	885.7
Gamma ROS Statistics using Imputed Non-Detects			
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
GROS may not be used when kstar of detected data is small such as < 0.1			
For such situations, GROS method tends to yield inflated values of UCLs and BTVs			
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
Minimum	0.01	Mean	224
Maximum	2450	Median	1.785
SD	584.3	CV	2.609
k hat (MLE)	0.137	k star (bias corrected MLE)	0.15

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Theta hat (MLE)	1630	Theta star (bias corrected MLE)	1492
nu hat (MLE)	5.494	nu star (bias corrected)	6.004
MLE Mean (bias corrected)	224	MLE Sd (bias corrected)	578.1
		Adjusted Level of Significance (β)	0.038
Approximate Chi Square Value (6.00, α)	1.642	Adjusted Chi Square Value (6.00, β)	1.469
95% Gamma Approximate UCL (use when n>=50)	819	95% Gamma Adjusted UCL (use when n<50)	915.3
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.901	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.842	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.178	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.28	Detected Data appear Lognormal at 5% Significance Level	
Detected Data appear Lognormal at 5% Significance Level			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	224.1	Mean in Log Scale	0.574
SD in Original Scale	584.3	SD in Log Scale	4.297
95% t UCL (assumes normality of ROS data)	450	95% Percentile Bootstrap UCL	467
95% BCA Bootstrap UCL	586	95% Bootstrap t UCL	776.2
95% H-UCL (Log ROS)	71208157		
UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed			
KM Mean (logged)	2.394	95% H-UCL (KM -Log)	2502
KM SD (logged)	2.351	95% Critical H Value (KM-Log)	4.946
KM Standard Error of Mean (logged)	0.554		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	224.5	Mean in Log Scale	2.048
SD in Original Scale	584.1	SD in Log Scale	2.68
95% t UCL (Assumes normality)	450.3	95% H-Stat UCL	8593
DL/2 is not a recommended method, provided for comparisons and historical reasons			
Nonparametric Distribution Free UCL Statistics			
Detected Data appear Gamma Distributed at 5% Significance Level			
Suggested UCL to Use			
95% KM (t) UCL	456.9	95% GROS Adjusted Gamma UCL	915.3
95% Adjusted Gamma KM-UCL	885.7		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

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Cumene (ug/L)			
General Statistics			
Total Number of Observations	20	Number of Distinct Observations	9
Number of Detects	7	Number of Non-Detects	13
Number of Distinct Detects	7	Number of Distinct Non-Detects	2
Minimum Detect	1.11	Minimum Non-Detect	1
Maximum Detect	217	Maximum Non-Detect	25
Variance Detects	5613	Percent Non-Detects	65%
Mean Detects	60.88	SD Detects	74.92
Median Detects	56	CV Detects	1.231
Skewness Detects	1.828	Kurtosis Detects	3.824
Mean of Logged Detects	3.133	SD of Logged Detects	1.842
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.779	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.803	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.309	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.335	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Approximate Normal at 5% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	22	Standard Error of Mean	12.07
SD	49.98	95% KM (BCA) UCL	45.6
95% KM (t) UCL	42.88	95% KM (Percentile Bootstrap) UCL	43.46
95% KM (z) UCL	41.86	95% KM Bootstrap t UCL	62.91
90% KM Chebyshev UCL	58.22	95% KM Chebyshev UCL	74.63
97.5% KM Chebyshev UCL	97.4	99% KM Chebyshev UCL	142.1
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.285	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.744	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.213	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.325	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics on Detected Data Only			
k hat (MLE)	0.629	k star (bias corrected MLE)	0.455
Theta hat (MLE)	96.8	Theta star (bias corrected MLE)	133.9
nu hat (MLE)	8.805	nu star (bias corrected)	6.364
MLE Mean (bias corrected)	60.88	MLE Sd (bias corrected)	90.29
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.194	nu hat (KM)	7.753
Approximate Chi Square Value (7.75, α)	2.593	Adjusted Chi Square Value (7.75, β)	2.363
95% Gamma Approximate KM-UCL (use when n>=50)	65.8	95% Gamma Adjusted KM-UCL (use when n<50)	72.2
Gamma ROS Statistics using Imputed Non-Detects			
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
GROS may not be used when kstar of detected data is small such as < 0.1			
For such situations, GROS method tends to yield inflated values of UCLs and BTVs			
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
Minimum	0.01	Mean	21.31
Maximum	217	Median	0.01
SD	51.57	CV	2.42
k hat (MLE)	0.154	k star (bias corrected MLE)	0.165

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Theta hat (MLE)	138	Theta star (bias corrected MLE)	129.5
nu hat (MLE)	6.177	nu star (bias corrected)	6.584
MLE Mean (bias corrected)	21.31	MLE Sd (bias corrected)	52.53
		Adjusted Level of Significance (β)	0.038
Approximate Chi Square Value (6.58, α)	1.945	Adjusted Chi Square Value (6.58, β)	1.753
95% Gamma Approximate UCL (use when n>=50)	72.14	95% Gamma Adjusted UCL (use when n<50)	80.06
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.93	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.257	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.335	Detected Data appear Lognormal at 5% Significance Level	
Detected Data appear Lognormal at 5% Significance Level			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	21.49	Mean in Log Scale	-0.547
SD in Original Scale	51.5	SD in Log Scale	3.385
95% t UCL (assumes normality of ROS data)	41.4	95% Percentile Bootstrap UCL	42.63
95% BCA Bootstrap UCL	53.12	95% Bootstrap t UCL	76.02
95% H-UCL (Log ROS)	37609		
UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed			
KM Mean (logged)	1.11	95% H-UCL (KM -Log)	78.95
KM SD (logged)	1.803	95% Critical H Value (KM-Log)	3.951
KM Standard Error of Mean (logged)	0.437		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	22.23	Mean in Log Scale	0.807
SD in Original Scale	51.25	SD in Log Scale	2.155
95% t UCL (Assumes normality)	42.05	95% H-Stat UCL	220.3
DL/2 is not a recommended method, provided for comparisons and historical reasons			
Nonparametric Distribution Free UCL Statistics			
Detected Data appear Approximate Normal Distributed at 5% Significance Level			
Suggested UCL to Use			
95% KM (t) UCL	42.88	95% KM (Percentile Bootstrap) UCL	43.46
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
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Naphthalene (ug/L)			
General Statistics			
Total Number of Observations	20	Number of Distinct Observations	11
Number of Detects	10	Number of Non-Detects	10
Number of Distinct Detects	10	Number of Distinct Non-Detects	1
Minimum Detect	1.02	Minimum Non-Detect	1
Maximum Detect	995	Maximum Non-Detect	1
Variance Detects	99770	Percent Non-Detects	50%
Mean Detects	172.9	SD Detects	315.9
Median Detects	23.3	CV Detects	1.827
Skewness Detects	2.377	Kurtosis Detects	5.833
Mean of Logged Detects	2.982	SD of Logged Detects	2.612
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.634	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.842	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.311	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.28	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	86.94	Standard Error of Mean	53.89
SD	228.7	95% KM (BCA) UCL	177.3
95% KM (t) UCL	180.1	95% KM (Percentile Bootstrap) UCL	174.2
95% KM (z) UCL	175.6	95% KM Bootstrap t UCL	453.2
90% KM Chebyshev UCL	248.6	95% KM Chebyshev UCL	321.9
97.5% KM Chebyshev UCL	423.5	99% KM Chebyshev UCL	623.2
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.486	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.811	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.204	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.287	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics on Detected Data Only			
k hat (MLE)	0.315	k star (bias corrected MLE)	0.287
Theta hat (MLE)	548.7	Theta star (bias corrected MLE)	601.9
nu hat (MLE)	6.302	nu star (bias corrected)	5.745
MLE Mean (bias corrected)	172.9	MLE Sd (bias corrected)	322.6
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.145	nu hat (KM)	5.783
Approximate Chi Square Value (5.78, α)	1.53	Adjusted Chi Square Value (5.78, β)	1.365
95% Gamma Approximate KM-UCL (use when n>=50)	328.6	95% Gamma Adjusted KM-UCL (use when n<50)	368.3
Gamma ROS Statistics using Imputed Non-Detects			
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
GROS may not be used when kstar of detected data is small such as < 0.1			
For such situations, GROS method tends to yield inflated values of UCLs and BTVs			
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
Minimum	0.01	Mean	86.45
Maximum	995	Median	0.515
SD	234.8	CV	2.716
k hat (MLE)	0.146	k star (bias corrected MLE)	0.158

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Theta hat (MLE)	590.8	Theta star (bias corrected MLE)	548.1
nu hat (MLE)	5.853	nu star (bias corrected)	6.309
MLE Mean (bias corrected)	86.45	MLE Sd (bias corrected)	217.7
		Adjusted Level of Significance (β)	0.038
Approximate Chi Square Value (6.31, α)	1.8	Adjusted Chi Square Value (6.31, β)	1.616
95% Gamma Approximate UCL (use when n>=50)	303.1	95% Gamma Adjusted UCL (use when n<50)	337.4
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.9	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.842	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.199	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.28	Detected Data appear Lognormal at 5% Significance Level	
Detected Data appear Lognormal at 5% Significance Level			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	86.47	Mean in Log Scale	-0.817
SD in Original Scale	234.8	SD in Log Scale	4.636
95% t UCL (assumes normality of ROS data)	177.2	95% Percentile Bootstrap UCL	177.7
95% BCA Bootstrap UCL	227.8	95% Bootstrap t UCL	463.6
95% H-UCL (Log ROS)	4.295E+8		
UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed			
KM Mean (logged)	1.491	95% H-UCL (KM -Log)	811.4
KM SD (logged)	2.301	95% Critical H Value (KM-Log)	4.854
KM Standard Error of Mean (logged)	0.542		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	86.69	Mean in Log Scale	1.144
SD in Original Scale	234.7	SD in Log Scale	2.605
95% t UCL (Assumes normality)	177.4	95% H-Stat UCL	2380
DL/2 is not a recommended method, provided for comparisons and historical reasons			
Nonparametric Distribution Free UCL Statistics			
Detected Data appear Gamma Distributed at 5% Significance Level			
Suggested UCL to Use			
95% KM (t) UCL	180.1	95% GROS Adjusted Gamma UCL	337.4
95% Adjusted Gamma KM-UCL	368.3		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
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Toluene (ug/L)			
General Statistics			
Total Number of Observations	20	Number of Distinct Observations	9
Number of Detects	8	Number of Non-Detects	12
Number of Distinct Detects	8	Number of Distinct Non-Detects	1
Minimum Detect	1.29	Minimum Non-Detect	1
Maximum Detect	157	Maximum Non-Detect	1
Variance Detects	4119	Percent Non-Detects	60%
Mean Detects	52.81	SD Detects	64.18
Median Detects	20	CV Detects	1.215
Skewness Detects	0.975	Kurtosis Detects	-0.902
Mean of Logged Detects	2.813	SD of Logged Detects	1.935
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.794	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.291	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.313	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Approximate Normal at 5% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	21.72	Standard Error of Mean	10.92
SD	45.67	95% KM (BCA) UCL	41.43
95% KM (t) UCL	40.6	95% KM (Percentile Bootstrap) UCL	40.23
95% KM (z) UCL	39.68	95% KM Bootstrap t UCL	62.64
90% KM Chebyshev UCL	54.47	95% KM Chebyshev UCL	69.31
97.5% KM Chebyshev UCL	89.9	99% KM Chebyshev UCL	130.3
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.347	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.759	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.15	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.308	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics on Detected Data Only			
k hat (MLE)	0.544	k star (bias corrected MLE)	0.423
Theta hat (MLE)	97.12	Theta star (bias corrected MLE)	124.8
nu hat (MLE)	8.699	nu star (bias corrected)	6.77
MLE Mean (bias corrected)	52.81	MLE Sd (bias corrected)	81.18
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.226	nu hat (KM)	9.05
Approximate Chi Square Value (9.05, α)	3.357	Adjusted Chi Square Value (9.05, β)	3.088
95% Gamma Approximate KM-UCL (use when n>=50)	58.56	95% Gamma Adjusted KM-UCL (use when n<50)	63.67
Gamma ROS Statistics using Imputed Non-Detects			
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
GROS may not be used when kstar of detected data is small such as < 0.1			
For such situations, GROS method tends to yield inflated values of UCLs and BTVs			
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
Minimum	0.01	Mean	21.13
Maximum	157	Median	0.01
SD	47.13	CV	2.231
k hat (MLE)	0.162	k star (bias corrected MLE)	0.171

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Theta hat (MLE)	130.4	Theta star (bias corrected MLE)	123.5
nu hat (MLE)	6.483	nu star (bias corrected)	6.844
MLE Mean (bias corrected)	21.13	MLE Sd (bias corrected)	51.08
		Adjusted Level of Significance (β)	0.038
Approximate Chi Square Value (6.84, α)	2.085	Adjusted Chi Square Value (6.84, β)	1.884
95% Gamma Approximate UCL (use when n>=50)	69.34	95% Gamma Adjusted UCL (use when n<50)	76.74
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.904	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.161	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.313	Detected Data appear Lognormal at 5% Significance Level	
Detected Data appear Lognormal at 5% Significance Level			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	21.21	Mean in Log Scale	-0.895
SD in Original Scale	47.1	SD in Log Scale	3.746
95% t UCL (assumes normality of ROS data)	39.42	95% Percentile Bootstrap UCL	39.42
95% BCA Bootstrap UCL	45.48	95% Bootstrap t UCL	62.32
95% H-UCL (Log ROS)	272278		
UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed			
KM Mean (logged)	1.125	95% H-UCL (KM -Log)	77.21
KM SD (logged)	1.792	95% Critical H Value (KM-Log)	3.932
KM Standard Error of Mean (logged)	0.428		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	21.42	Mean in Log Scale	0.709
SD in Original Scale	47	SD in Log Scale	2.118
95% t UCL (Assumes normality)	39.59	95% H-Stat UCL	172.1
DL/2 is not a recommended method, provided for comparisons and historical reasons			
Nonparametric Distribution Free UCL Statistics			
Detected Data appear Approximate Normal Distributed at 5% Significance Level			
Suggested UCL to Use			
95% KM (t) UCL	40.6	95% KM (Percentile Bootstrap) UCL	40.23
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

Off-Site Groundwater

Derivation of Source Concentrations for Off-Site Groundwater (Central Avenue ROW)

Former Top's Diner Property
Johnstown City, Pennsylvania

Well ID	Sample Date	Post-March 2008 PA Short List of Petroleum Products for Unleaded Gasoline and Used Motor Oil including Lead									
		1,3,5-Trimethylbenzene	1,2,4-Trimethylbenzene	Benzene	Toluene	Ethylbenzene	Xylenes (Total)	Cumene	MTBE	Naphthalene	Lead (Dissolved)
USEPA Region 3 Tapwater RSLs		12	1.5	0.45	110	1.5	19	45	14	0.17	15
Non-Residential Vapor Intrusion Screening Levels [2]		12	12	6.9	8,100	15	210	370	2,000	20	Nav
MW-3	1/21/2014	**247.00**	**552.00**	**418.00**	**157.00**	**944.00**	**898.00**	**70.00**	< 5.00	**398.00**	0.00429
	9/4/2014	**222.00**	**421.00**	**324.00**	77.50	**1,210.00**	**784.00**	**56.00**	< 50.00	**206.00**	-
	12/19/2014	**990.00**	**2,220.00**	**301.00**	**140.00**	**1,480.00**	**2,450.00**	**217.00**	< 20.00	**995**	-
	3/5/2015	**67.00**	**156.00**	**72.00**	25.20	**333.00**	**255.00**	< 25.00	< 25.00	**83.5**	-
MW-5	8/14/2014	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 2.00	< 1.00	< 1.00	< 1.00	< 0.004
	9/4/2014	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 2.00	< 1.00	< 1.00	< 1.00	-
	12/19/2014	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 2.00	< 1.00	< 1.00	**1.20**	-
	3/5/2015	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 2.00	< 1.00	< 1.00	< 1.00	-
Maximum Concentration		990.00	2,220.00	418.00	157.00	1,480.00	2,450.00	217.00	---	995.00	---
Maximum Concentration Location		MW-3	MW-3	MW-3	MW-3	MW-3	MW-3	MW-3		MW-3	

Notes:
2. In accordance with the PADEP approach for vapor intrusion, the 1,2,4-TMB target groundwater VISL was utilized as a surrogate VISL for 1,3,5-TMB.
All vlaues in ug/l.
Bold values indictae exceedance of the lrl.
Bold and shaded values indicate exceedance of RSL.
MTBE = Methyl Tertiary Butyl Ether
"-" = not analyzed
Nav = not available

Attachment 4

Fate and Transport Modeling

TABLE OF CONTENTS

LIST OF TABLES

1 Introduction

This attachment presents the mathematical models used in the quantitative risk assessment to estimate the concentrations of constituents in:

- ambient (outdoor) air due to volatilization from soil for the trespasser, on-site construction worker, on-site utility worker, off-site construction worker (Central Ave. ROW), and off-site utility worker (Central Ave. ROW);
- ambient (outdoor) air due to volatilization from unexposed groundwater (without intrusive activities) for the trespasser;
- ambient (outdoor) air due to volatilization from exposed groundwater (during intrusive activities) into a trench for the on-site construction worker and off-site utility worker (Central Ave. ROW);
- ambient (outdoor) air due to volatilization from unexposed groundwater (during intrusive activities) into a trench for the on-site utility worker and off-site construction worker (Central Ave. ROW).

The USEPA Soil Screening Guidance [USEPA 1996] was used to estimate concentrations of constituents in ambient air due to volatilization from soil. This model was used for intrusive activities and for non-intrusive activities for on-site and off-site receptors. It is specifically referenced in the Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites [USEPA 2002].

In order to estimate concentrations of constituents in ambient air due to volatilization from unexposed groundwater (without intrusive activities), the ASTM Standard Guidance [ASTM 2015] was used. For the excavation workers, models presented in the Virginia Department of Environmental Quality (VA DEQ) Voluntary Remediation Program [VA DEQ 2014] were used to estimate concentrations of constituents in ambient air due to volatilization from groundwater into a trench during intrusive activities. Two different methods are used to estimate volatilization into a trench. The selected method depends on whether groundwater is exposed or unexposed in the trench.

The ASTM approach is based on linear partitioning between dissolved chemicals in groundwater and chemical vapors at the groundwater table, steady-state vapor- and liquid-phase diffusion through the capillary fringe and vadose zones to ground surface, and steady well-mixed atmospheric dispersion of emanating vapors within the breathing zone as modeled by a box model for air dispersion.

The VA DEQ approach is based on a combination of a vadose zone model to estimate volatilization of gases from groundwater into a trench and a box model to estimate dispersion of the constituents from air inside the trench into the above-ground atmosphere in order to estimate the exposure point concentration (EPC) for air in a construction/utility trench.

2 Estimating Ambient (Outdoor) Air Concentrations from Volatile Emissions from Soil

USEPA Model

The USEPA Soil Screening Guidance [USEPA 1996] was used to model the volatile emissions from soil to ambient air during intrusive activities and during non-intrusive activities. This model is described below.

Ambient concentrations of constituents of potential concern in air resulting from volatile emissions from soil may be estimated as follows:

$$C_{ao\text{-}vs} = TF_{vol} * C_{sz}$$

where:

$C_{ao\text{-}vs}$	=	concentration of constituent in air averaged over the exposure period (mg/m^3)
TF_{vol}	=	transport factor that translates a soil concentration to an air concentration via volatile emissions (kg/m^3)
C_{sz}	=	initial concentration of constituent in soil (mg/kg)

The soil saturation limit (C_{sat}) is the constituent concentration at which soil pore air and pore water space are saturated with the constituent and the adsorptive limits of the soil particles have been reached. C_{sat} represents an upper bound on the applicability of the volatilization model. If the initial constituent soil concentration (C_{src}) is greater than the C_{sat}, then C_{sat} is utilized as the soil source concentration. If C_{src} is less than C_{sat}, then C_{src} is utilized as the soil source concentration. C_{sat} can be estimated by the following equation:

$$C_{sat} = \frac{S}{\rho_b} \left(K_d * \rho_b + n_w + H' * n_a\right)$$

where:

C_{sat}	=	soil saturation limit (mg/kg)
S	=	solubility in water (mg/L)
ρ_b	=	dry soil bulk density (kg/L or g/cm^3)
K_d	=	soil-water partition coefficient (cm^3/g or L/kg)
n_w	=	water-filled soil porosity (cm^3-water/cm^3-total or L-water/L-total)
H'	=	dimensionless Henry's Law constant {equal to 41*H}
H	=	Henry's Law Constant (atm-m^3/mol)
n_a	=	air-filled porosity (cm^3-air/cm^3-total or L-air/L-total)

Note that if the units g/cm^3 and cm^3/g are used for the variables above, the C_{sat} must be multiplied by the conversion factors 1 L/1000 cm^3 and 1000 g/1 kg.

The transport factor describes the relationship between the concentration in air to the concentration in soil and is given by the following expression:

$$TF_{vol} = DF * VF_{on}$$

where:

TF_{vol}	=	transport factor (kg/m^3)
DF	=	dilution factor which translates on-site air concentrations to off-site air concentrations (dimensionless) {DF equals 1 if on-site concentrations are required}
VF_{on}	=	volatilization factor for on-site air concentrations (kg/m^3)

The value for DF can be determined from on-site and off-site measurements or from use of an air dispersion model.

The volatilization factor describes the relationship between concentrations in air to concentrations in soil and is based on a volatilization model provided in the Soil Screening Guidance [USEPA 1996]. The volatilization factor is given by the following equation:

$$VF_{on} = \left(\frac{1}{Q/C}\right) * (FF)$$

where:

VF_{on}	=	volatilization factor (kg/m^3)
Q/C	=	inverse dispersion factor [(g/m^2-sec)/(kg/m^3)]
FF	=	flux factor (g/m^2-sec)

The flux factor (*FF*), when multiplied by the soil concentration, gives the average flux of chemical out of the soil surface over a specified period of time. This flux is translated into an on-site air concentration by use of a dispersion factor [$1/(Q/C)$], which represents the median air concentration for volatiles at the center of a square area based on analysis presented in the Soil Screening Guidance [USEPA 1996]. It should be noted that the volatilization factor (*VF*) defined by the Soil Screening Guidance [USEPA 1996] equals $1/VF_{on}$.

The following equation, derived from the Soil Screening Guidance [USEPA 1996], is used to calculate the average flux factor assuming volatilization is not limited by the available mass of a constituent in soil:

$$FF_a = \frac{2 * \rho_b * D_A * CF}{(\pi * D_A * T)^{0.5}}$$

where:

FF_a	=	average flux factor (g/m^2-sec)
ρ_b	=	dry bulk density (g/cm^3 or kg/L)

D_A	=	apparent diffusivity (cm^2/sec)
CF	=	conversion factor (1.0×10^4 cm^2/m^2)
T	=	exposure period (sec)

The following equation is used to calculate the maximum flux factor assuming volatilization is limited by the mass of a constituent in soil:

$$FF_m = \frac{\rho_b * d * CF}{T}$$

where:

FF_m	=	maximum flux factor (g/m^2-sec)
ρ_b	=	dry soil bulk density (g/cm^3 or kg/L)
d	=	thickness of affected soil (m)
CF	=	conversion factor (1.0×10^6 cm^3/m^3)
T	=	exposure period (sec)

In this evaluation, the flux factor (FF) is set to the minimum of the average flux factor (FF_a) and the maximum flux factor (FF_m).

The apparent diffusivity (D_A) is given by the following equation:

$$D_A = \frac{\left(n_a^{10/3} * D_v * H' + n_w^{10/3} * D_w\right) / n^2}{\rho_b * K_p + n_w + n_a * H'}$$

where:

D_A	=	apparent diffusivity (cm^2/sec)
n_a	=	air filled porosity (cm^3-air/cm^3-total or L-air/L-total)
n_w	=	water filled soil porosity (cm^3-water/cm^3-total or L-water/L-total)
n	=	total soil porosity (cm^3-pore/cm^3-total or L-pore/L-total) {equal to $1-(\rho_b/\rho_s)$}

ρ_s	=	soil particle density (g/cm^3 or kg/L)
ρ_b	=	dry soil bulk density (kg/L or g/cm^3)
H'	=	dimensionless Henry's Law constant {equal to 41*H}
H	=	Henry's Law constant (atm-m^3/mol)
D_v	=	diffusivity in air (cm^2/sec)
D_w	=	diffusivity in water (cm^2/sec)
K_p	=	soil water partition coefficient (cm^3/g or L/kg) {equal to f_{oc}*K_{oc}}
f_{oc}	=	fraction of organic carbon in soil (g-oc/g-soil)
K_{oc}	=	organic carbon to water partition coefficient (cm^3/g or L/kg)

The inverse dispersion factor (*Q/C*) for exposure to volatile emissions from soil was calculated using the following equation [USEPA 2002]:

$$Q/C = A * \exp\left[\frac{(\ln A_c - B)^2}{C}\right]$$

where:

A	=	constant [2.4538 for a construction worker (default from Equation E-15 of USEPA 2002); 11.911 for a maintenance worker and utility worker (default from Equation E-2 of USEPA 2002)]
B	=	constant [17.5660 for a construction worker (default from Equation E-15 of USEPA 2002); 18.4385 for a maintenance worker and utility worker (default from Equation E-2 of USEPA 2002)]
C	=	constant [189.0426 for a construction worker (default from Equation E-15 of USEPA 2002); 209.7845 for a maintenance worker and utility worker (default from Equation E-2 of USEPA 2002)]
A_c	=	Area extent of contamination (acres)

The results of running the model for the trespasser, on-site construction worker, on-site utility worker, off-site construction worker (Central Ave. ROW), and off-site utility worker (Central Ave. ROW) are presented in Tables 1 through 5, respectively. Individual constants used in the equations are presented and referenced for each receptor in Tables 1 through 5.

3 Estimating Ambient (Outdoor) Air Concentrations from Volatile Emissions from Groundwater

3.1 Unexposed Groundwater Equations Without Intrusive Activities

For this evaluation, the ASTM model assumes that groundwater will not be exposed. The receptor would then have exposure to volatile constituents emitted from unexposed groundwater to ambient air without intrusive activities. This evaluation was conducted for the trespasser.

Ambient concentrations of constituents of interest in air resulting from volatile emissions from groundwater may be estimated as follows:

$$C_A = VF_{wamb} * C_{gw}$$

where:

C_A	=	concentration of constituent in ambient air (ug/m^3)
VF_{wamb}	=	volatilization factor - groundwater to ambient air (L/m^3)
C_{gw}	=	concentration of constituent in groundwater (ug/L)

The volatilization factor is given by the following equation:

$$VF_{wamb} = \frac{H'}{1 + \left[\frac{DF_{amb} * L_{GW}}{D_{eff-ws}}\right]} * CF$$

where:

VF_{wamb}	=	volatilization factor (L/m^3)
H'	=	dimensionless Henry's Law Constant {equal to 41 * H}

H	=	Henry's Law Constant (atm-m^3-H_2O/mol)
DF_{amb}	=	dispersion factor for ambient air (cm/s)
L_{GW}	=	depth to groundwater (cm)
$D_{eff\text{-}ws}$	=	effective diffusion coefficient between groundwater and soil surface (cm^2/s)
CF	=	conversion factor (1x10^3 L/m^3)

The dispersion factor for ambient air is given by the following equation:

$$DF_{amb} = \frac{U_{air} * W * \delta_{air}}{A}$$

where:

DF_{amb}	=	dispersion factor for ambient air (cm/s)
U_{air}	=	wind speed above ground surface in ambient air mixing zone (cm/s)
W	=	width of source area parallel to wind, or groundwater flow direction (cm)
δ_{air}	=	ambient air mixing zone height (cm)
A	=	source-zone area (cm^2)

The effective diffusion coefficient between groundwater and soil surface is given by the following equation:

$$D_{eff-ws} = (h_{cap} + h_v) * \left[\frac{h_{cap}}{D_{eff-cap}} + \frac{h_v}{D_{eff-s}} \right]^{-1}$$

where:

$D_{eff\text{-}ws}$	=	diffusion coefficient between groundwater and soil (cm^2/s)

h_{cap}	=	thickness of capillary fringe (cm)
h_v	=	thickness of vadose zone (cm)
$D_{eff\text{-}cap}$	=	effective diffusion coefficient through capillary fringe (cm^2/s)
$D_{eff\text{-}s}$	=	effective diffusion coefficient in soil (cm^2/s)

The effective diffusion coefficient through the capillary fringe is given by the following equation:

$$D_{eff-cap} = D_{air} * \frac{\theta_{acap}^{3.33}}{\theta_T^2} + D_{wat} * \frac{1}{H'} * \frac{\theta_{wcap}^{3.33}}{\theta_T^2}$$

where:

$D_{eff\text{-}cap}$	=	diffusion coefficient through capillary fringe (cm^2/s)
D_{air}	=	diffusion coefficient in air (cm^2/s)
D_{wat}	=	diffusion coefficient in water (cm^2/s)
θ_{acap}	=	volumetric air content in capillary fringe soils (cm^3-air/cm^3-soil)
θ_{wcap}	=	volumetric water content in capillary fringe soils (cm^3-water/cm^3-soil)
θ_T	=	total soil porosity (cm^3/cm^3-soil)
H'	=	dimensionless Henry's Law Constant {equal to 41 * H}
H	=	Henry's Law Constant (atm-m^3-H_2O/mol)

The effective diffusion coefficient in soil is given by the following equation:

$$D_{eff-s} = D_{air} * \frac{\theta_{as}^{3.33}}{\theta_T^2} + D_{wat} * \frac{1}{H'} * \frac{\theta_{ws}^{3.33}}{\theta_T^2}$$

where:

$D_{eff\text{-}s}$	=	diffusion in soil (cm^2/s)

D_{air}	=	diffusion coefficient in air (cm^2/s)
D_{wat}	=	diffusion coefficient in water (cm^2/s)
θ_{as}	=	volumetric air content in vadose zone soils (cm^3-air/cm^3-soil)
θ_{ws}	=	volumetric water content in vadose zone soils (cm^3-water/cm^3-soil)
θ_T	=	total soil porosity (cm^3/cm^3-soil)
H'	=	dimensionless Henry's Law Constant {equal to 41 * H}
H	=	Henry's Law Constant (atm-m^3-H_2O/mol)

The results of the calculation of the volatilization transfer factors to predict air concentrations as a result of volatilization from unexposed groundwater (without intrusive activities) are presented in Table 6 for the trespasser. Individual constants used in the equations are presented and referenced in Table 6.

3.2 Exposed Groundwater Equations During Intrusive Activities

For this evaluation, the VA DEQ model assumes that the worker would encounter groundwater when digging an excavation or a trench. The worker would then have direct exposure to the groundwater. The worker would be exposed to constituents in the air inside the trench that would result from volatilization from the groundwater pooling at the bottom of the trench. This evaluation was conducted for the on-site construction worker and off-site utility worker (Central Ave. ROW).

Ambient concentrations of constituents of interest in air resulting from volatile emissions from groundwater may be estimated as follows:

$$C_{trench} = VF * C_{gw}$$

where:

C_{trench}	=	concentration of constituent in trench (ug/m^3)
VF	=	volatilization factor (L/m^3)
C_{gw}	=	concentration of constituent in groundwater (ug/L)

For shallow groundwater depths that result in exposed groundwater within the trench, the volatilization factor is given by the following equation:

$$VF = \frac{K_i * A * F * CF1 * CF2 * CF3}{ACH * V}$$

where:

VF	=	volatilization factor (L/m^3)
K_i	=	overall mass transfer coefficient of constituent (cm/sec)
A	=	area of the trench (m^2)
F	=	fraction of floor through which constituent can enter (unitless)
ACH	=	air changes per hour (1/hr)
V	=	volume of the trench (m^3)
CF1	=	conversion factor ($1x10^{-3}$ L/cm^3)
CF2	=	conversion factor ($1x10^4$ cm^2/m^2)
CF3	=	conversion factor (3600 sec/hr)

Studies of urban canyons suggest that if the ratio of trench width, relative to wind direction, to trench depth is less than or equal to one, a circulation cell or cells will be set up within the trench that limits the degree of gas exchange with the atmosphere. The *ACH* in this case is assumed to be 2/hr [VA DEQ 2014]. If the ratio of trench width to trench depth is greater than one, air exchange between the trench and above-ground atmosphere is not restricted. The *ACH* in this case is assumed to be 360/hr [VA DEQ 2014]. For this site-specific risk assessment, an *ACH* of 27/hr was assumed based on recommendations from USEPA Region 8 (see section 9 [Uncertainty Section] of the risk assessment report text).

The overall mass transfer coefficient of a constituent is given by the following equation:

$$K_i = \frac{1}{\frac{1}{k_{iL}} + \frac{R*T}{H_i * k_{iG}}}$$

where:

K_i	=	overall mass transfer coefficient (cm/sec)
k_{iL}	=	liquid-phase mass transfer coefficient of constituent i (cm/sec)
R	=	ideal gas constant (atm-m^3/mol-^{o}K)
T	=	average system absolute temperature (^{o}K)
H_i	=	Henry's Law constant of constituent i (atm-m^3/mol)
k_{iG}	=	gas-phase mass transfer coefficient of constituent i (cm/sec)

The liquid-phase mass transfer coefficient is given by the following equation:

$$k_{iL} = \left(\frac{MW_{O2}}{MW_i}\right)^{0.5} * \frac{T}{298} * k_{L,O2}$$

where:

k_{iL}	=	liquid-phase mass transfer coefficient (cm/sec)
MW_{O2}	=	molecular weight of oxygen (g/mol)
MW_i	=	molecular weight of constituent i (g/mol)
$k_{L,O2}$	=	liquid-phase mass transfer coefficient of oxygen at 25°C (0.002 cm/sec)
T	=	average system absolute temperature (^{o}K)

The gas-phase mass transfer coefficient is given by the following equation:

$$k_{iG} = \left(\frac{MW_{H2O}}{MW_i}\right)^{0.335} * \left(\frac{T}{298}\right)^{1.005} * k_{G,H2O}$$

where:

k_{iG}	=	gas-phase mass transfer coefficient (cm/sec)
MW_{H2O}	=	molecular weight of water (g/mol)
$k_{G,H2O}$	=	gas-phase mass transfer coefficient of water vapor at 25°C (0.833 cm/sec)

The results of the calculation of the volatilization transfer factors to predict air concentrations as a result of volatilization from exposed groundwater during intrusive activities for the on-site construction worker and off-site utility worker (Central Ave. ROW) are presented in Tables 7 and 8. Individual constants used in the equations are presented and referenced in Tables 7 and 8.

3.3 Unexposed Groundwater Equations During Intrusive Activities

For this evaluation, the VA DEQ model assumes that the worker would not encounter groundwater when digging an excavation or a trench. The worker would be exposed to constituents in the air inside the trench that would result from volatilization from the groundwater at some depth below the bottom of the trench. This evaluation was conducted for the on-site utility worker and off-site construction worker (Central Ave. ROW).

Ambient concentrations of constituents of interest in air resulting from volatile emissions from groundwater may be estimated as follows:

$$C_{trench} = VF * C_{gw}$$

where:

C_{trench}	=	concentration of constituent in trench (ug/m^3)
VF	=	volatilization factor (L/m^3)
C_{gw}	=	concentration of constituent in groundwater (ug/L)

For deeper groundwater depths where groundwater is not exposed within the trench, the volatilization factor (*VF*) is given by the following equation:

$$VF = \frac{\left(H_i * D_{air} * AC_{vad}^{3.33} * A * F * CF1 * CF2 * CF3 \right)}{\left(R * T * L_d * ACH * V * Por_{vad}^2 \right)}$$

where:

VF	=	volatilization factor (L/m^3)
H_i	=	Henry's Law constant of constituent i (atm-m^3/mol)
D_{air}	=	diffusion coefficient in air (cm^2/s)
AC_{vad}	=	volumetric air content in vadose zone soil (cm^3/cm^3)
A	=	area of trench (m^2)
F	=	fraction of floor through which constituent can enter (unitless)
R	=	ideal gas constant (atm-m^3/mol-^{o}K)
T	=	average system absolute temperature (^{o}K)
L_d	=	distance between trench bottom and groundwater (cm)
ACH	=	air changes per hour (1/hr)
V	=	volume of the trench (m^3)
Por_{vad}	=	total soil porosity in vadose zone (cm^3/cm^3)
$CF1$	=	conversion factor (1x10^{-3} L/cm^3)
$CF2$	=	conversion factor (1x10^4 cm^2/m^2)
$CF3$	=	conversion factor (3600 sec/hr)

Studies of urban canyons suggest that if the ratio of trench width, relative to wind direction, to trench depth is less than or equal to one, a circulation cell or cells will be set up within the trench that limits the degree of gas exchange with the atmosphere. The *ACH* in this case is assumed to be 2/hr [VA DEQ 2014]. If the ratio of trench width to trench depth is greater than one, air exchange between the trench and above-ground atmosphere is not restricted. The *ACH* in this case is assumed to be 360/hr [VA DEQ 2014].

The distance between the trench bottom and groundwater (L_d) is given by the following equation:

$$L_d = L_{gw} - D_{trench}$$

Where:

L_d = distance between the trench bottom and groundwater (cm)

L_{gw} = depth to groundwater (cm)

D_{trench} = depth of the trench (cm)

The results of the calculation of the volatilization transfer factors to predict air concentrations as a result of volatilization from unexposed groundwater into a trench during intrusive activities for the on-site utility worker and off-site construction worker (Central Ave. ROW) are presented in Tables 9 and 10. Individual constants used in the equations are presented and referenced in Tables 9 and 10.

4 References

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USEPA 1996. Soil Screening Guidance: User's Guide. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, EPA/540/R-96/018, OSWER 9355.4-23, April 1996.

USEPA 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, OSWER 9355.4-24, December 2002.

VA DEQ 2014. Voluntary Remediation Program Risk Assessment Guidance. Virginia Department of Environmental Quality, http://www.deq.state.va.us/Programs/LandProtectionRevitalization/RemediationProgram/VoluntaryRemediationProgram/VRPRiskAssessmentGuidance/Guidance.aspx, Section 3.2.2, updated August, 2014.

Tables

Table 1
Calculation of Soil Volatilization Transfer Factors for a Trespasser (12 to 18 years old)
Former Top's Diner Property
Johnstown City, Pennsylvania

System Parameters

Variable Name	Value	Units	Description
DF	1	unitless	dilution factor
Q/C control	1		0 indicates input value; 1 indicates calculate from area using SSG formula
Q/C (if Q/C control = 0)		(g/m²-sec) / (kg/m³)	
A_{site}	0.5	acres	assumes estimated area of site
A	15.5169	not specified	constant; value for Harrisburg, PA (USEPA 2002, Exhibit E-2)
B	18.4248	not specified	constant; value for Harrisburg, PA (USEPA 2002, Exhibit E-2)
C	211.7679	not specified	constant; value for Harrisburg, PA (USEPA 2002, Exhibit E-2)
Q/C	87.2	$(g/m^2\text{-sec}) / (kg/m^3)$	
ρ_b	1.5	g/cm^3	dry bulk density; default value from SSG (USEPA 1996; p. 24)
ρ_s	2.65	g/cm^3	soil particle density; default value from SSG (USEPA 1996; p. 24)
d	2.13	m	unsaturated thickness of affected soil; 7 ft based on depth of exceedances in on-site unsaturated subsurface soil (3-10 ft-bgs)
n	0.43	cm^3-pore/cm^3-total	total soil porosity; equal to $1-(\rho_b/\rho_s)$
n_w	0.15	cm^3-water/cm^3-total	water filled soil porosity; default value from SSG (USEPA 1996; p. 24)
n_a	0.28	cm^3-air/cm^3-total	air filled soil porosity; equal to $n-n_w$
f_{oc}	0.006	g-oc/g-soil	fraction organic carbon in soil; default value from SSG (USEPA 1996; p. 24)
T	6	yr	exposure period; set equal to the exposure duration for the receptor
	1.89E+08	sec	
CF1	1.0E+04	cm^2/m^2	conversion factor
CF2	1.0E+06	cm^3/m^3	conversion factor
CF3	41	mol/atm-m^3	conversion factor
MPcut	30	deg C	melting point cut-off for adjusted soil saturation limit determination
Volatilization Control	2	0 indicates no limits on volatilization	
		1 indicates volat. occurs if Hen law const. > limit and mol. wt. < limit	
		2 indicates volat. occurs if boiling point < limit	
Henry's law limit	1.0E-05	atm-m^3/mol	
molecular weight limit	200	g/g-mol	
boiling point limit	200	deg C	

Note: USEPA soil volatilization model [USEPA 1996]

Table 1
Calculation of Soil Volatilization Transfer Factors for a Trespasser (12 to 18 years old)
Former Top's Diner Property
Johnstown City, Pennsylvania

Chemical-Specific Variables

	Chemical Properties							
Chemical	Molecular Weight MW (g-mol)	Melting Point MP (°C)	Boiling Point BP (°C)	Solubility S (mg/L)	Organic Carbon Part. Coef. Koc (mg/kg / mg/L)	Henry's Law Constant H (atm-m³/mol)	Vapor Phase Diffusivity D_V (cm²/s)	Water Phase Diffusivity D_W (cm²/s)
Volatile Organic Compounds								
Benzene	78.1	5.5	81	1.8E+03	1.5E+02	5.6E-03	9.0E-02	1.0E-05
Toluene	92.1	-94.9	111	5.3E+02	2.3E+02	6.6E-03	7.8E-02	9.2E-06
Ethylbenzene	106	-94.9	136	1.6E+02	4.5E+02	7.9E-03	6.9E-02	8.5E-06
Xylenes, Total	106	-25.2	140	1.8E+02	3.8E+02	5.2E-03	8.5E-02	9.9E-06
Cumene	120	-96	152	5.0E+01	7.0E+02	1.2E-02	6.0E-02	7.9E-06
1,2,4-Trimethylbenzene	120	-43.8	169	5.6E+01	6.1E+02	6.2E-03	6.1E-02	7.9E-06
1,3,5-Trimethylbenzene	120	-44.7	165	4.9E+01	6.0E+02	8.8E-03	6.0E-02	7.8E-06
Semivolatile Organic Compounds								
Naphthalene	128	80.2	218	3.0E+01	1.5E+03	4.4E-04	6.1E-02	8.4E-06

Table 1
Calculation of Soil Volatilization Transfer Factors for a Trespasser (12 to 18 years old)
Former Top's Diner Property
Johnstown City, Pennsylvania

Chemical-Specific Variables

Chemical	Calculated Parameters									
	Dim. Henry's Law Constant H' (unitless)	Soil-Water Part. Coeff. K_p (cm^3/g)	Apparent Diffusivity D_A (cm^2/sec)	Average Flux Factor FFa (g/m^2-sec)	Maximum Flux Factor FFm (g/m^2-sec)	Volatilization Factor VFon (kg/m^3)	Volatilization Control (unitless)	Transport Factor TFvol (kg/m^3)	Calculated Soil Sat. Limit Csat (mg/kg)	Adjusted Soil Sat. Limit Csat-adj (mg/kg)
Volatile Organic Compounds										
Benzene	2.3E-01	8.8E-01	1.1E-03	4.0E-02	1.7E-02	1.9E-04	1	1.9E-04	1.8E+03	1.8E+03
Toluene	2.7E-01	1.4E+00	7.3E-04	3.3E-02	1.7E-02	1.9E-04	1	1.9E-04	8.3E+02	8.3E+02
Ethylbenzene	3.2E-01	2.7E+00	4.2E-04	2.5E-02	1.7E-02	1.9E-04	1	1.9E-04	4.6E+02	4.6E+02
Xylenes, Total	2.1E-01	2.3E+00	3.9E-04	2.4E-02	1.7E-02	1.9E-04	1	1.9E-04	4.3E+02	4.3E+02
Cumene	4.9E-01	4.2E+00	3.6E-04	2.3E-02	1.7E-02	1.9E-04	1	1.9E-04	2.2E+02	2.2E+02
1,2,4-Trimethylbenzene	2.5E-01	3.7E+00	2.1E-04	1.8E-02	1.7E-02	1.9E-04	1	1.9E-04	2.1E+02	2.1E+02
1,3,5-Trimethylbenzene	3.6E-01	3.6E+00	3.1E-04	2.2E-02	1.7E-02	1.9E-04	1	1.9E-04	1.8E+02	1.8E+02
Semivolatile Organic Compounds										
Naphthalene	1.8E-02	9.2E+00	6.2E-06	3.1E-03	1.7E-02	3.5E-05	0	---	2.8E+02	1.0E+06

Note: For the volatilization control column: "1" means the constituent is a volatile and a "0" means the constituent is not a volatile based on the selected definition of a volatile on page 1 of this table.

Table 2
Calculation of Soil Volatilization Transfer Factors for an On-Site Construction Worker
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

System Parameters

Variable Name	Value	Units	Description
DF	1	unitless	dilution factor
Q/C control	1		0 indicates input value; 1 indicates calculate from area using SSG formula
Q/C (if Q/C control = 0)		$(g/m^2\text{-sec}) / (kg/m^3)$	
A_{site}	0.5	acres	assumes estimated area of the site that was investigated
A	2.4538	not specified	constant; default for construction worker (USEPA 2002, Eq. E-15)
B	17.566	not specified	constant; default for construction worker (USEPA 2002, Eq. E-15)
C	189.0426	not specified	constant; default for construction worker (USEPA 2002, Eq. E-15)
Q/C	14.3	$(g/m^2\text{-sec}) / (kg/m^3)$	
ρ_b	1.5	g/cm^3 or kg/L	dry bulk density; default value from SSG (USEPA 1996; p. 24)
ρ_s	2.65	g/cm^3	soil particle density; default value from SSG (USEPA 1996; p. 24)
d	2.13	m	unsaturated thickness of affected soil; 7 ft based on exceedances of on-site unsaturated soil samples (3-10 ft-bgs)
n	0.43	cm^3-pore/cm^3-total or L-pore/L-total	total soil porosity; equal to $1-(\rho_b/\rho_s)$
n_w	0.15	cm^3-water/cm^3-total or L-water/L-total	water filled soil porosity; default value from SSG (USEPA 1996; p. 24)
n_a	0.28	cm^3-air/cm^3-total or L-air/L-total	air filled soil porosity; equal to $n-n_w$
f_{oc}	0.006	g-oc/g-soil	fraction organic carbon in soil; default value from SSG (USEPA 1996; p. 24)
T	1	yr	exposure period; set equal to the exposure duration for the receptor
	3.15E+07	sec	
CF1	1.0E+04	cm^2/m^2	conversion factor
CF2	1.0E+06	cm^3/m^3	conversion factor
CF3	41	mol/atm-m^3	conversion factor
MPcut	30	deg C	melting point cut-off for adjusted soil saturation limit determination
Volatilization Control	2	0 indicates no limits on volatilization 1 indicates volat. occurs if Hen law const. > limit and mol. wt. < limit 2 indicates volat. occurs if boiling point < limit	
Henry's law limit	1.0E-05	atm-m^3/mol	
molecular weight limit	200	g/g-mol	
boiling point limit	200	deg C	

Note: USEPA soil volatilization model [USEPA 1996]

Table 2
Calculation of Soil Volatilization Transfer Factors for an On-Site Construction Worker
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Chemical-Specific Variables

	Chemical Properties							
Chemical	**Molecular Weight MW (g/mol)**	**Melting Point MP (°C)**	**Boiling Point BP (°C)**	**Solubility S (mg/L)**	**Organic Carbon Part. Coef. Koc (L/kg / cm³/g)**	**Henry's Law Constant H (atm-m³/mol)**	**Vapor Phase Diffusivity D_V (cm²/s)**	**Water Phase Diffusivity D_W (cm²/s)**
Volatile Organic Compounds								
Benzene	78.1	5.5	81	1.8E+03	1.5E+02	5.6E-03	9.0E-02	1.0E-05
Toluene	92.1	-94.9	111	5.3E+02	2.3E+02	6.6E-03	7.8E-02	9.2E-06
Ethylbenzene	106	-94.9	136	1.6E+02	4.5E+02	7.9E-03	6.9E-02	8.5E-06
Xylenes, Total	106	-25.2	140	1.8E+02	3.8E+02	5.2E-03	8.5E-02	9.9E-06
Cumene	120	-96	152	5.0E+01	7.0E+02	1.2E-02	6.0E-02	7.9E-06
1,2,4-Trimethylbenzene	120	-43.8	169	5.6E+01	6.1E+02	6.2E-03	6.1E-02	7.9E-06
1,3,5-Trimethylbenzene	120	-44.7	165	4.9E+01	6.0E+02	8.8E-03	6.0E-02	7.8E-06
Semivolatile Organic Compounds								
Naphthalene	128	80.2	218	3.0E+01	1.5E+03	4.4E-04	6.1E-02	8.4E-06

Table 2
Calculation of Soil Volatilization Transfer Factors for an On-Site Construction Worker
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Chemical-Specific Variables

Chemical	Calculated Parameters									
	Dim. Henry's Law Constant H' (unitless)	Soil-Water Part. Coeff. K_d (cm^3/g) or (L/kg)	Apparent Diffusivity D_A (cm^2/sec)	Average Flux Factor FFa (g/m^2-sec)	Maximum Flux Factor FFm (g/m^2-sec)	Volatilization Factor VFon (kg/m^3)	Volatilization Control (unitless)	Transport Factor TFvol (kg/m^3)	Calculated Soil Sat. Limit Csat (mg/kg)	Adjusted Soil Sat. Limit Csat-adj (mg/kg)
Volatile Organic Compounds										
Benzene	2.3E-01	8.8E-01	1.1E-03	9.8E-02	1.0E-01	6.9E-03	1	6.9E-03	1.8E+03	1.8E+03
Toluene	2.7E-01	1.4E+00	7.3E-04	8.1E-02	1.0E-01	5.7E-03	1	5.7E-03	8.3E+02	8.3E+02
Ethylbenzene	3.2E-01	2.7E+00	4.2E-04	6.1E-02	1.0E-01	4.3E-03	1	4.3E-03	4.6E+02	4.6E+02
Xylenes, Total	2.1E-01	2.3E+00	3.9E-04	6.0E-02	1.0E-01	4.2E-03	1	4.2E-03	4.3E+02	4.3E+02
Cumene	4.9E-01	4.2E+00	3.6E-04	5.7E-02	1.0E-01	4.0E-03	1	4.0E-03	2.2E+02	2.2E+02
1,2,4-Trimethylbenzene	2.5E-01	3.7E+00	2.1E-04	4.4E-02	1.0E-01	3.1E-03	1	3.1E-03	2.1E+02	2.1E+02
1,3,5-Trimethylbenzene	3.6E-01	3.6E+00	3.1E-04	5.3E-02	1.0E-01	3.7E-03	1	3.7E-03	1.8E+02	1.8E+02
Semivolatile Organic Compounds										
Naphthalene	1.8E-02	9.2E+00	6.2E-06	7.5E-03	1.0E-01	5.3E-04	0	---	2.8E+02	1.0E+06

Note: For the volatilization control column: "1" means the constituent is a volatile and a "0" means the constituent is not a volatile based on the selected definition of a volatile on page 1 of this table.

Table 3
Calculation of Soil Volatilization Transfer Factors for an On-Site Utility Worker
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

System Parameters

Variable Name	Value	Units	Description
DF	1	unitless	dilution factor
Q/C control	1		0 indicates input value; 1 indicates calculate from area using SSG formula
Q/C (if Q/C control = 0)		$(g/m^2\text{-sec}) / (kg/m^3)$	
A_{site}	0.5	acres	assumes estimated area of the portion of the site that was investigated
A	11.911	not specified	constant; default for outdoor worker (USEPA 2002, Eq. E-2); applied to a utility worker
B	18.4385	not specified	constant; default for outdoor worker (USEPA 2002, Eq. E-2); applied to a utility worker
C	209.7845	not specified	constant; default for outdoor worker (USEPA 2002, Eq. E-2); applied to a utility worker
Q/C	68.2	$(g/m^2\text{-sec}) / (kg/m^3)$	
ρ_b	1.5	g/cm^3 or kg/L	dry bulk density; default value from SSG (USEPA 1996; p. 24)
ρ_s	2.65	g/cm^3	soil particle density; default value from SSG (USEPA 1996; p. 24)
d	2.13	m	unsaturated thickness of affected soil; 7 ft based on depth on exceedances in on-site unsaturated soil samples 3-10 ft-bgs)
n	0.43	cm^3-pore/cm^3-total or L-pore/L-total	total soil porosity; equal to $1-(\rho_b/\rho_s)$
n_w	0.15	cm^3-water/cm^3-total or L-water/L-total	water filled soil porosity; default value from SSG (USEPA 1996; p. 24)
n_a	0.28	cm^3-air/cm^3-total or L-air/L-total	air filled soil porosity; equal to $n-n_w$
f_{oc}	0.006	g-oc/g-soil	fraction organic carbon in soil; default value from SSG (USEPA 1996; p. 24)
T	25	yr	exposure period; set equal to the exposure duration for the receptor
	7.88E+08	sec	
CF1	1.0E+04	cm^2/m^2	conversion factor
CF2	1.0E+06	cm^3/m^3	conversion factor
CF3	41	$mol/atm\text{-}m^3$	conversion factor
MPcut	30	deg C	melting point cut-off for adjusted soil saturation limit determination
Volatilization Control	2	0 indicates no limits on volatilization 1 indicates volat. occurs if Hen law const. > limit and mol. wt. < limit 2 indicates volat. occurs if boiling point < limit	
Henry's law limit	1.0E-05	$atm\text{-}m^3/mol$	
molecular weight limit	200	g/g-mol	
boiling point limit	200	deg C	

Note: USEPA soil volatilization model [USEPA 1996]

Table 3
Calculation of Soil Volatilization Transfer Factors for an On-Site Utility Worker
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Chemical-Specific Variables

	Chemical Properties							
Chemical	Molecular Weight MW (g/mol)	Melting Point MP (°C)	Boiling Point BP (°C)	Solubility S (mg/L)	Organic Carbon Part. Coef. Koc (cm^3/g) or (L/kg)	Henry's Law Constant H (atm-m^3/mol)	Vapor Phase Diffusivity D_V (cm^2/s)	Water Phase Diffusivity D_W (cm^2/s)
Volatile Organic Compounds								
Benzene	78.1	5.5	81	1.8E+03	1.5E+02	5.6E-03	9.0E-02	1.0E-05
Toluene	92.1	-94.9	111	5.3E+02	2.3E+02	6.6E-03	7.8E-02	9.2E-06
Ethylbenzene	106	-94.9	136	1.6E+02	4.5E+02	7.9E-03	6.9E-02	8.5E-06
Xylenes, Total	106	-25.2	140	1.8E+02	3.8E+02	5.2E-03	8.5E-02	9.9E-06
Cumene	120	-96	152	5.0E+01	7.0E+02	1.2E-02	6.0E-02	7.9E-06
1,2,4-Trimethylbenzene	120	-43.8	169	5.6E+01	6.1E+02	6.2E-03	6.1E-02	7.9E-06
1,3,5-Trimethylbenzene	120	-44.7	165	4.9E+01	6.0E+02	8.8E-03	6.0E-02	7.8E-06
Semivolatile Organic Compounds								
Naphthalene	128	80.2	218	3.0E+01	1.5E+03	4.4E-04	6.1E-02	8.4E-06

Table 3
Calculation of Soil Volatilization Transfer Factors for an On-Site Utility Worker
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Chemical-Specific Variables

Chemical	Calculated Parameters									
	Dim. Henry's Law Constant H' (unitless)	Soil-Water Part. Coeff. K_d (cm^3/g) or (L/kg)	Apparent Diffusivity D_A (cm^2/sec)	Average Flux Factor FFa (g/m^2-sec)	Maximum Flux Factor FFm (g/m^2-sec)	Volatilization Factor VFon (kg/m^3)	Volatilization Control (unitless)	Transport Factor TFvol (kg/m^3)	Calculated Soil Sat. Limit Csat (mg/kg)	Adjusted Soil Sat. Limit Csat-adj (mg/kg)
Volatile Organic Compounds										
Benzene	2.3E-01	8.8E-01	1.1E-03	2.0E-02	4.1E-03	6.0E-05	1	6.0E-05	1.8E+03	1.8E+03
Toluene	2.7E-01	1.4E+00	7.3E-04	1.6E-02	4.1E-03	6.0E-05	1	6.0E-05	8.3E+02	8.3E+02
Ethylbenzene	3.2E-01	2.7E+00	4.2E-04	1.2E-02	4.1E-03	6.0E-05	1	6.0E-05	4.6E+02	4.6E+02
Xylenes, Total	2.1E-01	2.3E+00	3.9E-04	1.2E-02	4.1E-03	6.0E-05	1	6.0E-05	4.3E+02	4.3E+02
Cumene	4.9E-01	4.2E+00	3.6E-04	1.1E-02	4.1E-03	6.0E-05	1	6.0E-05	2.2E+02	2.2E+02
1,2,4-Trimethylbenzene	2.5E-01	3.7E+00	2.1E-04	8.8E-03	4.1E-03	6.0E-05	1	6.0E-05	2.1E+02	2.1E+02
1,3,5-Trimethylbenzene	3.6E-01	3.6E+00	3.1E-04	1.1E-02	4.1E-03	6.0E-05	1	6.0E-05	1.8E+02	1.8E+02
Semivolatile Organic Compounds										
Naphthalene	1.8E-02	9.2E+00	6.2E-06	1.5E-03	4.1E-03	2.2E-05	0	---	2.8E+02	1.0E+06

Note: For the volatilization control column: "1" means the constituent is a volatile and a "0" means the constituent is not a volatile based on the selected definition of a volatile on page 1 of this table.

Table 4
Calculation of Soil Volatilization Transfer Factors for an Off-Site Construction Worker (Central Ave. ROW)
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvlania

System Parameters

Variable Name	Value	Units	Description
DF	1	unitless	dilution factor
Q/C control	1		0 indicates input value; 1 indicates calculate from area using SSG formula
Q/C (if Q/C control = 0)		$(g/m^2\text{-sec}) / (kg/m^3)$	
A_{site}	0.04	acres	assumes estimated area of the Central Avenue ROW adjacent to the site
A	2.4538	not specified	constant; default for construction worker (USEPA 2002, Eq. E-15)
B	17.566	not specified	constant; default for construction worker (USEPA 2002, Eq. E-15)
C	189.0426	not specified	constant; default for construction worker (USEPA 2002, Eq. E-15)
Q/C	24.1	$(g/m^2\text{-sec}) / (kg/m^3)$	
ρ_b	1.5	g/cm^3 or kg/L	dry bulk density; default value from SSG (USEPA 1996; p. 24)
ρ_s	2.65	g/cm^3	soil particle density; default value from SSG (USEPA 1996; p. 24)
d	1.83	m	unsaturated thickness of affected soil; 6 ft based on exceedances of on-site unsaturated soil samples (4-10 ft-bgs) adjacent to Central Avenue
n	0.43	cm^3-pore/cm^3-total or L-pore/L-total	total soil porosity; equal to $1-(\rho_b/\rho_s)$
n_w	0.15	cm^3-water/cm^3-total or L-water/L-total	water filled soil porosity; default value from SSG (USEPA 1996; p. 24)
n_a	0.28	cm^3-air/cm^3-total or L-air/L-total	air filled soil porosity; equal to $n-n_w$
f_{oc}	0.006	g-oc/g-soil	fraction organic carbon in soil; default value from SSG (USEPA 1996; p. 24)
T	1	yr	exposure period; set equal to the exposure duration for the receptor
	3.15E+07	sec	
CF1	1.0E+04	cm^2/m^2	conversion factor
CF2	1.0E+06	cm^3/m^3	conversion factor
CF3	41	$mol/atm\text{-}m^3$	conversion factor
MPcut	30	deg C	melting point cut-off for adjusted soil saturation limit determination
Volatilization Control	2	0 indicates no limits on volatilization 1 indicates volat. occurs if Hen law const. > limit and mol. wt. < limit 2 indicates volat. occurs if boiling point < limit	
Henry's law limit	1.0E-05	$atm\text{-}m^3/mol$	
molecular weight limit	200	g/g-mol	
boiling point limit	200	deg C	

Note: USEPA soil volatilization model [USEPA 1996]

Table 4
Calculation of Soil Volatilization Transfer Factors for an Off-Site Construction Worker (Central Ave. ROW)
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Chemical-Specific Variables

	Chemical Properties							
Chemical	Molecular Weight MW (g/mol)	Melting Point MP (°C)	Boiling Point BP (°C)	Solubility S (mg/L)	Organic Carbon Part. Coef. Koc (L/kg / cm³/g)	Henry's Law Constant H (atm-m³/mol)	Vapor Phase Diffusivity D_V (cm²/s)	Water Phase Diffusivity D_W (cm²/s)
Volatile Organic Compounds								
Benzene	78.1	5.5	81	1.8E+03	1.5E+02	5.6E-03	9.0E-02	1.0E-05
Toluene	92.1	-94.9	111	5.3E+02	2.3E+02	6.6E-03	7.8E-02	9.2E-06
Ethylbenzene	106	-94.9	136	1.6E+02	4.5E+02	7.9E-03	6.9E-02	8.5E-06
Xylenes, Total	106	-25.2	140	1.8E+02	3.8E+02	5.2E-03	8.5E-02	9.9E-06
Cumene	120	-96	152	5.0E+01	7.0E+02	1.2E-02	6.0E-02	7.9E-06
1,2,4-Trimethylbenzene	120	-43.8	169	5.6E+01	6.1E+02	6.2E-03	6.1E-02	7.9E-06
1,3,5-Trimethylbenzene	120	-44.7	165	4.9E+01	6.0E+02	8.8E-03	6.0E-02	7.8E-06
Semivolatile Organic Compounds								
Naphthalene	128	80.2	218	3.0E+01	1.5E+03	4.4E-04	6.1E-02	8.4E-06

Table 4
Calculation of Soil Volatilization Transfer Factors for an Off-Site Construction Worker (Central Ave. ROW)
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsyvlania

Chemical-Specific Variables

Chemical	Calculated Parameters									
	Dim. Henry's Law Constant H' (unitless)	Soil-Water Part. Coeff. K_d (cm^3/g) or (L/kg)	Apparent Diffusivity D_A (cm^2/sec)	Average Flux Factor FFa (g/m^2-sec)	Maximum Flux Factor FFm (g/m^2-sec)	Volatilization Factor VFon (kg/m^3)	Volatilization Control (unitless)	Transport Factor TFvol (kg/m^3)	Calculated Soil Sat. Limit Csat (mg/kg)	Adjusted Soil Sat. Limit Csat-adj (mg/kg)
Volatile Organic Compounds										
Benzene	2.3E-01	8.8E-01	1.1E-03	9.8E-02	8.7E-02	3.6E-03	1	3.6E-03	1.8E+03	1.8E+03
Toluene	2.7E-01	1.4E+00	7.3E-04	8.1E-02	8.7E-02	3.[illegible]E-03	1	3.4E-03	8.3E+02	8.3E+02
Ethylbenzene	3.2E-01	2.7E+00	4.2E-04	6.1E-02	8.7E-02	2.5E-03	1	2.5E-03	4.6E+02	4.6E+02
Xylenes, Total	2.1E-01	2.3E+00	3.9E-04	6.0E-02	8.7E-02	2.5E-03	1	2.5E-03	4.3E+02	4.3E+02
Cumene	4.9E-01	4.2E+00	3.6E-04	5.7E-02	8.7E-02	2.4E-03	1	2.4E-03	2.2E+02	2.2E+02
1,2,4-Trimethylbenzene	2.5E-01	3.7E+00	2.1E-04	4.4E-02	8.7E-02	1.8E-03	1	1.8E-03	2.1E+02	2.1E+02
1,3,5-Trimethylbenzene	3.6E-01	3.6E+00	3.1E-04	5.3E-02	8.7E-02	2.2E-03	1	2.2E-03	1.8E+02	1.8E+02
Semivolatile Organic Compounds										
Naphthalene	1.8E-02	9.2E+00	6.2E-06	7.5E-03	8.7E-02	3.1E-04	0	—	2.8E+02	1.0E+06

Note: For the volatilization control column: "1" means the constituent is a volatile and a "0" means the constituent is not a volatile based on the selected definition of a volatile on page 1 of this table.

Table 5
Calculation of Soil Volatilization Transfer Factors for an Off-Site Utility Worker (Central Ave. ROW)
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

System Parameters

Variable Name	Value	Units	Description
DF	1	unitless	dilution factor
Q/C control	1		0 indicates input value; 1 indicates calculate from area using SSG formula
Q/C (if Q/C control = 0)		$(g/m^2\text{-sec}) / (kg/m^3)$	
A_{site}	0.04	acres	assumes estimated area of the Central Avenue ROW adjacent to the site
A	11.911	not specified	constant; default for outdoor worker (USEPA 2002, Eq. E-2); applied to a utility worker
B	18.4385	not specified	constant; default for outdoor worker (USEPA 2002, Eq. E-2); applied to a utility worker
C	209.7845	not specified	constant; default for outdoor worker (USEPA 2002, Eq. E-2); applied to a utility worker
Q/C	111.4	$(g/m^2\text{-sec}) / (kg/m^3)$	
ρ_b	1.5	g/cm^3 or kg/L	dry bulk density; default value from SSG (USEPA 1996; p. 24)
ρ_s	2.65	g/cm^3	soil particle density; default value from SSG (USEPA 1996; p. 24)
d	1.83	m	unsaturated thickness of affected soil; 6 ft based on depth on exceedances in on-site unsaturated soil samples (4-10 ft-bgs) adjacent to Central Avenue
n	0.43	cm^3-pore/cm^3-total or L-pore/L-total	total soil porosity; equal to $1-(\rho_b/\rho_s)$
n_w	0.15	cm^3-water/cm^3-total or L-water/L-total	water filled soil porosity; default value from SSG (USEPA 1996; p. 24)
n_a	0.28	cm^3-air/cm^3-total or L-air/L-total	air filled soil porosity; equal to $n-n_w$
f_{oc}	0.006	g-oc/g-soil	fraction organic carbon in soil; default value from SSG (USEPA 1996; p. 24)
T	25	yr	exposure period; set equal to the exposure duration for the receptor
	7.88E+08	sec	
CF1	1.0E+04	cm^2/m^2	conversion factor
CF2	1.0E+06	cm^3/m^3	conversion factor
CF3	41	$mol/atm\text{-}m^3$	conversion factor
MPcut	30	deg C	melting point cut-off for adjusted soil saturation limit determination
Volatilization Control	2	0 indicates no limits on volatilization	
		1 indicates volat. occurs if Hen law const. > limit and mol. wt. < limit	
		2 indicates volat. occurs if boiling point < limit	
Henry's law limit	1.0E-05	$atm\text{-}m^3/mol$	
molecular weight limit	200	g/g-mol	
boiling point limit	200	deg C	

Note: USEPA soil volatilization model [USEPA 1996]

Table 5
Calculation of Soil Volatilization Transfer Factors for an Off-Site Utility Worker (Central Ave. ROW)
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Chemical-Specific Variables

	Chemical Properties							
Chemical	Molecular Weight MW (g/mol)	Melting Point MP (°C)	Boiling Point BP (°C)	Solubility S (mg/L)	Organic Carbon Part. Coef. Koc (cm^3/g) or (L/kg)	Henry's Law Constant H (atm-m^3/mol)	Vapor Phase Diffusivity D_V (cm^2/s)	Water Phase Diffusivity D_W (cm^2/s)
Volatile Organic Compounds								
Benzene	78.1	5.5	81	1.8E+03	1.5E+02	5.6E-03	9.0E-02	1.0E-05
Toluene	92.1	-94.9	111	5.3E+02	2.3E+02	6.6E-03	7.8E-02	9.2E-06
Ethylbenzene	106	-94.9	136	1.6E+02	4.5E+02	7.9E-03	6.9E-02	8.5E-06
Xylenes, Total	106	-25.2	140	1.8E+02	3.8E+02	5.2E-03	8.5E-02	9.9E-06
Cumene	120	-96	152	5.0E+01	7.0E+02	1.2E-02	6.0E-02	7.9E-06
1,2,4-Trimethylbenzene	120	-43.8	169	5.6E+01	6.1E+02	6.2E-03	6.1E-02	7.9E-06
1,3,5-Trimethylbenzene	120	-44.7	165	4.9E+01	6.0E+02	8.8E-03	6.0E-02	7.8E-06
Semivolatile Organic Compounds								
Naphthalene	128	80.2	218	3.0E+01	1.5E+03	4.4E-04	6.1E-02	8.4E-06

Table 5
Calculation of Soil Volatilization Transfer Factors for an Off-Site Utility Worker (Central Ave. ROW)
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Chemical-Specific Variables

Chemical	Dim. Henry's Law Constant H' (unitless)	Soil-Water Part. Coeff. K_d (cm^3/g) or (L/kg)	Apparent Diffusivity D_A (cm^2/sec)	Average Flux Factor FFa (g/m^2-sec)	Maximum Flux Factor FFm (g/m^2-sec)	Volatilization Factor VFon (kg/m^3)	Volatilization Control (unitless)	Transport Factor TFvol (kg/m^3)	Calculated Soil Sat. Limit Csat (mg/kg)	Adjusted Soil Sat. Limit Csat-adj (mg/kg)
	Calculated Parameters									
Volatile Organic Compounds										
Benzene	2.3E-01	8.8E-01	1.1E-03	2.0E-02	3.5E-03	3.1E-05	1	3.1E-05	1.8E+03	1.8E+03
Toluene	2.7E-01	1.4E+00	7.3E-04	1.6E-02	3.5E-03	3.1E-05	1	3.1E-05	8.3E+02	8.3E+02
Ethylbenzene	3.2E-01	2.7E+00	4.2E-04	1.2E-02	3.5E-03	3.1E-05	1	3.1E-05	4.6E+02	4.6E+02
Xylenes, Total	2.1E-01	2.3E+00	3.9E-04	1.2E-02	3.5E-03	3.1E-05	1	3.1E-05	4.3E+02	4.3E+02
Cumene	4.9E-01	4.2E+00	3.6E-04	1.1E-02	3.5E-03	3.1E-05	1	3.1E-05	2.2E+02	2.2E+02
1,2,4-Trimethylbenzene	2.5E-01	3.7E+00	2.1E-04	8.8E-03	3.5E-03	3.1E-05	1	3.1E-05	2.1E+02	2.1E+02
1,3,5-Trimethylbenzene	3.6E-01	3.6E+00	3.1E-04	1.1E-02	3.5E-03	3.1E-05	1	3.1E-05	1.8E+02	1.8E+02
Semivolatile Organic Compounds										
Naphthalene	1.8E-02	9.2E+00	6.2E-06	1.5E-03	3.5E-03	1.4E-05	0	—	2.8E+02	1.0E+06

Note: For the volatilization control column: "1" means the constituent is a volatile and a "0" means the constituent is not a volatile based on the selected definition of a volatile on page 1 of this table.

Table 6

Calculation of Unexposed Groundwater Volatilization Transfer Factors for a Trespasser (12 to 18 years old)

Risk Assessment Report

Former Top's Diner Propety

Johnstown City, Pennsylvania

System Parameters — Unexposed Groundwater - Without Intrusive Activities

Variable Name	Value	Units	Description
θ_{as}	0.26	cm^3-air/cm^3-soil	ASTM default volumetric air content in vadose zone soils
θ_{ws}	0.12	cm^3-H2O/cm^3-soil	ASTM default volumetric water content in vadose zone soils
θ_{acap}	0.038	cm^3-air/cm^3-soil	ASTM default volumetric air content in capillary fringe soils
θ_{wcap}	0.342	cm^3-H2O/cm^3-soil	ASTM default volumetric water content in capillary fringe soils
θ_T	0.43	cm^3-pore/cm^3-soil	total soil porosity; default value from SSG (USEPA, 2002)
A	2.02E+07	cm^2	source-zone area (based on estimated area of site, approximately 0.5 acres)
L_{GW}	10	ft	depth to groundwater (based on average depth to groundwater on-site)
	304.8	cm	
h_v	9.836	ft	thickness of vadose zone (calculated as L_{GW} - h_{cap})
	299.8	cm	
h_{cap}	0.164	ft	thickness of capillary fringe (ASTM default value)
	5.0	cm	
U_{air}	9	mph	wind speed above ground surface (9 mph; Pittsburgh, PA annual average; NOAA)
	402.3	cm/sec	
δ_{air}	200	cm	ambient air mixing zone height (ASTM default value)
W	50	ft	ASTM default width of source area parallel to wind or groundwater flow direction
	1524	cm	
CF1	1.0E+03	L/m^3	conversion factor
CF2	41	mol/atm-m^3	conversion factor
Volatilization Control	2	0 indicates no limits on volatilization	
		1 indicates volat. occurs if Hen law const. > limit	
		2 indicates volat. occurs if boiling point < limit	
Henry's law limit	1.0E-05	atm-m^3/mol	
molecular weight limit	200	g/g-mol	
boiling point limit	200	°C	

Note: ASTM groundwater volatilization model [ASTM 2015]

Table 6
Calculation of Unexposed Groundwater Volatilization Transfer Factors for a Trespasser (12 to 18 years old)
Risk Assessment Report
Former Top's Diner Propety
Johnstown City, Pennsylvania

Chemical-Specific Variables

Chemical	Chemical Properties: Molecular Weight MW (g/g-mol)	Boiling Point BP (°C)	Henry's Law Constant H (atm-m³/mol)	Vapor Phase Diffusivity D_a (cm²/s)	Water Phase Diffusivity D_w (cm²/s)
Volatile Organic Compounds					
Benzene	78.1	81	5.6E-03	9.0E-02	1.0E-05
Toluene	92.1	111	6.6E-03	7.8E-02	9.2E-06
Ethylbenzene	106	136	7.9E-03	6.9E-02	8.5E-06
Xylenes, total	106	140	5.2E-03	8.5E-02	9.9E-06
Cumene	120	152	1.2E-02	6.0E-02	7.9E-06
1,2,4-Trimethylbenzene	120	169	6.2E-03	6.1E-02	7.9E-06
1,3,5-Trimethylbenzene	120	165	8.8E-03	6.0E-02	7.8E-06
Semivolatile Organic Compounds					
Naphthalene	128	218	4.4E-04	6.1E-02	8.4E-06

Table 6

Calculation of Unexposed Groundwater Volatilization Transfer Factors for a Trespasser (12 to 18 years old)

Risk Assessment Report
Former Top's Diner Propety
Johnstown City, Pennsylvania

Chemical-Specific Variables

Chemical	Calculated Parameters						
	Dim. Henry's Law Constant H' (unitless)	Dispersion Factor for Ambient Air DF_{amb} (cm/s)	Effective Diffusion Coefficient in Soil D_{eff-s} (cm²/s)	Effective Diffusion Coefficient Cap. Fringe $D_{eff-cap}$ (cm²/s)	Effective Diff. Coeff. between GW and Soil Surface D_{eff-ws} (cm²/s)	Volatilization Control (unitless)	GW to Outdoor Air Volatilization Factor VF_{wamb} (L/m³)
Volatile Organic Compounds							
Benzene	2.3E-01	6.1E+00	5.5E-03	1.6E-05	8.3E-04	1	1.0E-04
Toluene	2.7E-01	6.1E+00	4.7E-03	1.3E-05	6.8E-04	1	1.0E-04
Ethylbenzene	3.2E-01	6.1E+00	4.2E-03	1.1E-05	5.7E-04	1	1.0E-04
Xylenes, total	2.1E-01	6.1E+00	5.2E-03	1.6E-05	8.1E-04	1	9.3E-05
Cumene	4.7E-01	6.1E+00	3.7E-03	8.6E-06	4.6E-04	1	1.2E-04
1,2,4-Trimethylbenzene	2.5E-01	6.1E+00	3.7E-03	1.1E-05	5.6E-04	1	7.7E-05
1,3,5-Trimethylbenzene	3.6E-01	6.1E+00	3.7E-03	9.4E-06	4.9E-04	1	9.7E-05
Semivolatile Organic Compounds							
Naphthalene	1.8E-02	6.1E+00	3.7E-03	7.7E-05	2.1E-03	0	---

Note: For the volatilization control column: "1" means the constituent is a volatile and a "0" means the constituent is not a volatile based on the selected definition of a volatile on page 1 of this table.

Table 7

Calculation of Exposed Groundwater Volatilization Transfer Factors for an On-Site Construction Worker

Risk Assessment Report

Former Top's Diner Property

Johnstown City, Pennsyvlania

System Parameters — **Exposed Groundwater - During Intrusive Activities**

Variable	Value	Units	Description
Mass Transfer Coefficient Parameters			
$k_{G,H2O}$	0.833	cm/sec	gas-phase mass transfer coefficient of water vapor at 25 °C
MW_{H2O}	18	g/mol	molecular weight of water
$k_{L,O2}$	0.002	cm/sec	liquid-phase mass transfer coefficient of oxygen at 25°C
MW_{O2}	32	g/mol	molecular weight of oxygen
T	77	°F	average system absolute temperature
	298	°K	
R	8.21E-05	atm-m³/mol-°K	gas constant
Emission Flux and Concentration in Trench Parameters			
F	1	unitless	fraction of floor through which contaminant can enter
ACH	27	1/hr	air changes per hour
CF1	1.0E-03	L/cm³	converson factor
CF2	1.0E+04	cm²/m²	converson factor
CF3	3600	sec/hr	converson factor
Trench Dimensions			
L	8	ft	length; default assumption (VADEQ 2014)
	2.44	m	
W	6	ft	width; professional judgment
	1.83	m	
D	10	ft	depth; based on the maximum excavation depth
	3.05	m	
A	4.46	m²	area
V	13.59	m³	volume
W/D	0.60	unitless	
Volatilization Control			
Volatilization Control	2		0 indicates no limits on volatilization
			1 indicates volat. occurs if Hen law const. > limit and mol. wt. < limit
			2 indicates volat. occurs if boiling point < limit
Henry's law limit	1.0E-05	atm-m³/mol	
molecular weight limit	200	g/g-mol	
boiling point limit	200	°C	

Note: VADEQ groundwater volatilization model [VADEQ 2014]

Table 7
Calculation of Exposed Groundwater Volatilization Transfer Factors for an On-Site Construction Worker
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Chemical-Specific Variables

	Chemical Properties			Calculated Parameters				
Chemical	Molecular Weight MW_i (g/mol)	Boiling Point BP_i (°C)	Henry's Law Constant H_i (atm-m³/mol)	Gas-Phase Mass Transfer Coefficient k_{iG} (cm/sec)	Liquid-Phase Mass Transfer Coefficient k_{iL} (cm/sec)	Overall Mass Transfer Coefficient K_i (cm/sec)	Volatilization Control	Volatilization Factor VF (L/m³)
Volatile Organic Compounds								
Benzene	78.1	81	5.6E-03	5.09E-01	1.28E-03	1.27E-03	1	5.54E-01
Toluene	92.1	111	6.6E-03	4.82E-01	1.18E-03	1.17E-03	1	5.11E-01
Ethylbenzene	106	136	7.9E-03	4.60E-01	1.10E-03	1.09E-03	1	4.77E-01
Xylenes, Total	106	140	5.2E-03	4.60E-01	1.10E-03	1.09E-03	1	4.75E-01
Cumene	120	152	1.2E-02	4.41E-01	1.03E-03	1.03E-03	1	4.50E-01
1,2,4-Trimethylbenzene	120	169	6.2E-03	4.41E-01	1.03E-03	1.02E-03	1	4.48E-01
1,3,5-Trimethylbenzene	120	165	8.8E-03	4.41E-01	1.03E-03	1.03E-03	1	4.49E-01
Semivolatile Organic Compounds								
Naphthalene	128	218	4.4E-04	4.32E-01	1.00E-03	8.86E-04	0	---

Note: For the volatilization control column: "1" means the constituent is a volatile and a "0" means the constituent is not a volatile based on the selected definition of a volatile on page 1 of this table.

Table 8
Calculation of Exposed Groundwater Volatilization Transfer Factors for an Off-Site Utility Worker (Central St. ROW)
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvnaia

System Parameters

Variable	Value	Units	Description
Mass Transfer Coefficient Parameters			
$k_{G,H2O}$	0.833	cm/sec	gas-phase mass transfer coefficient of water vapor at 25 °C
MW_{H2O}	18	g/mol	molecular weight of water
$k_{L,O2}$	0.002	cm/sec	liquid-phase mass transfer coefficient of oxygen at 25°C
MW_{O2}	32	g/mol	molecular weight of oxygen
T	77	°F	average system absolute temperature
	298	°K	
R	8.21E-05	atm-m^3/mol-°K	gas constant
Emission Flux and Concentration in Trench Parameters			
F	1	unitless	fraction of floor through which contaminant can enter
ACH	27	1/hr	air changes per hour
CF1	1.0E-03	L/cm^3	converson factor
CF2	1.0E+04	cm^2/m^2	converson factor
CF3	3600	sec/hr	converson factor
Trench Dimensions			
L	8	ft	length; default assumption (VADEQ 2014)
	2.44	m	
W	6	ft	width; professional judgment
	1.83	m	
D	14	ft	depth; based on the maximum excavation depth of receptor
	4.27	m	
A	4.46	m^2	area
V	19.03	m^3	volume
W/D	0.43	unitless	
Volatilization Control			
Volatilization Control	2		0 indicates no limits on volatilization
			1 indicates volat. occurs if Hen law const. > limit and mol. wt. < limit
			2 indicates volat. occurs if boiling point < limit
Henry's law limit	1.0E-05	atm-m^3/mol	
molecular weight limit	200	g/g-mol	
boiling point limit	200	°C	

Note: VADEQ groundwater volatilization model [VADEQ 2014]

Table 8
Calculation of Exposed Groundwater Volatilization Transfer Factors for an Off-Site Utility Worker (Central St. ROW)
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvnaia

Chemical-Specific Variables

	Chemical Properties			Calculated Parameters				
Chemical	Molecular Weight MW_i (g/mol)	Boiling Point BP_i (°C)	Henry's Law Constant H_i (atm-m³/mol)	Gas-Phase Mass Transfer Coefficient k_{iG} (cm/sec)	Liquid-Phase Mass Transfer Coefficient k_{iL} (cm/sec)	Overall Mass Transfer Coefficient K_i (cm/sec)	Volatilization Control	Volatilization Factor VF (L/m³)
Volatile Organic Compounds								
Benzene	78.1	81	5.6E-03	5.09E-01	1.28E-03	1.27E-03	1	3.96E-01
Toluene	92.1	111	6.6E-03	4.82E-01	1.18E-03	1.17E-03	1	3.65E-01
Ethylbenzene	106	136	7.9E-03	4.60E-01	1.10E-03	1.09E-03	1	3.41E-01
Xylenes, Total	106	140	5.2E-03	4.60E-01	1.10E-03	1.09E-03	1	3.40E-01
Cumene	120	152	1.2E-02	4.41E-01	1.03E-03	1.03E-03	1	3.21E-01
1,2,4-Trimethylbenzene	120	169	6.2E-03	4.41E-01	1.03E-03	1.02E-03	1	3.20E-01
1,3,5-Trimethylbenzene	120	165	8.8E-03	4.41E-01	1.03E-03	1.03E-03	1	3.21E-01
Semivolatile Organic Compounds								
Naphthalene	128	218	4.4E-04	4.32E-01	1.00E-03	8.86E-04	0	---

Table 9
Calculation of Unexposed Groundwater Volatilization Transfer Factors for an On-Site Utility Worker
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

System Parameters — **Unexposed Groundwater - During Intrusive Activities**

Variable	Value	Units	Description
Effective Diffusion Coefficients			
AC_{vad}	0.25	cm^3/cm^3	volumetric air content in vadose zone soil; default
Por_{vad}	0.44	cm^3/cm^3	total soil porosity in vadose zone; default
T	77	°F	average system absolute temperature; default
	298	°K	
R	8.21E-05	atm-m^3/mol-°K	ideal gas constant; default
Emission Flux and Concentration in Trench Parameters			
F	1	unitless	fraction of floor through which contaminant can enter; default
L_{gw}	10	ft	depth to groundwater based on average depth to groundwater at the site
	304.8	cm	
ACH	2	1/hr	air changes per hour
CF1	1.0E-03	L/cm^3	converson factor
CF2	1.0E+04	cm^2/m^2	converson factor
CF3	3600	sec/hr	converson factor
Trench Dimensions			
L	8	ft	length; default assumption (VADEQ 2014)
	2.44	m	
W	6	ft	width; professional judgment
	1.83	m	
D	6	ft	depth; based on maximum excavation depth of receptor
	1.83	m	
	182.9	cm	
A	4.46	m^2	area
V	8.16	m^3	volume
W/D	1.00	unitless	
Volatilization Control	2		0 indicates no limits on volatilization
			1 indicates volat. occurs if Hen law const. > limit and mol. wt. < limit
			2 indicates volat. occurs if boiling point < limit
Henry's law limit	1.0E-05	atm-m^3/mol	
molecular weight limit	200	g/g-mol	
boiling point limit	200	deg C	

Note: VADEQ groundwater volatilization model [VADEQ 2014]

Table 9
Calculation of Unexposed Groundwater Volatilization Transfer Factors for an On-Site Utility Worker
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Chemical-Specific Variables

	Chemical Properties				Calculated Parameters				
Chemical	Molecular Weight MW (g/mol)	Henry's Law Constant H_i (atm-m^3/mol)	Boiling Point BP (°C)	Diffusivity in Air D_{air} (cm^2/s)	Distance Between Trench Bottom and Groundwater L_d (cm)	Area of Trench A (m^2)	Volume of Trench V (m^3)	Volatilization Control	Volatilization Factor VF (L/m^3)
Volatile Organic Compounds									
Benzene	78.1	5.6E-03	81	9.0E-02	1.22E+02	4.46E+00	8.16E+00	1	8.37E-02
Toluene	92.1	6.6E-03	111	7.8E-02	1.22E+02	4.46E+00	8.16E+00	1	8.71E-02
Ethylbenzene	106	7.9E-03	136	6.9E-02	1.22E+02	4.46E+00	8.16E+00	1	9.10E-02
Xylenes, Total	106	5.2E-03	140	8.5E-02	1.22E+02	4.46E+00	8.16E+00	1	7.39E-02
Cumene	120	1.2E-02	152	6.0E-02	1.22E+02	4.46E+00	8.16E+00	1	1.17E-01
1,2,4-Trimethylbenzene	120	6.2E-03	169	6.1E-02	1.22E+02	4.46E+00	8.16E+00	1	6.34E-02
1,3,5-Trimethylbenzene	120	8.8E-03	165	6.0E-02	1.22E+02	4.46E+00	8.16E+00	1	8.90E-02
Semivolatile Organic Compounds									
Naphthalene	128	4.4E-04	218	6.1E-02	1.22E+02	4.46E+00	8.16E+00	0	---

Note: For the volatilization control column: "1" means the constituent is a volatile and a "0" means the constituent is not a volatile based on the selected definition of a volatile on page 1 of this table.

Table 10
Calculation of Unexposed Groundwater Volatilization Transfer Factors for an Off-Site Construction Worker (Central Ave. ROW)
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

System Parameters

Variable	Value	Units	Description
Effective Diffusion Coefficients			
AC_{vad}	0.25	cm^3/cm^3	volumetric air content in vadose zone soil; default
Por_{vad}	0.44	cm^3/cm^3	total soil porosity in vadose zone; default
T	77	°F	average system absolute temperature; default
	298	°K	
R	8.21E-05	atm-m^3/mol-°K	ideal gas constant; default
Emission Flux and Concentration in Trench Parameters			
F	1	unitless	fraction of floor through which contaminant can enter; default
L_{gw}	10	ft	depth; based on the average depth to groundwater at the site
	304.8	cm	
ACH	27	1/hr	air changes per hour
CF1	1.0E-03	L/cm^3	converson factor
CF2	1.0E+04	cm^2/m^2	converson factor
CF3	3600	sec/hr	converson factor
Trench Dimensions			
L	8	ft	length; default assumption (VADEQ 2014)
	2.44	m	
W	6	ft	width; professional judgment
	1.83	m	
D	8	ft	depth; based on the maximum excavation depth
	2.44	m	
	243.8	cm	
W/D	0.75	unitless	

Note: VADEQ groundwater volatilization model [VADEQ 2014]

Table 10
Calculation of Unexposed Groundwater Volatilization Transfer Factors for an Off-Site Construction Worker (Central Ave. ROW)
Risk Assessment Report
Former Top's Diner Property
Johnstown City, Pennsylvania

Chemical-Specific Variables

	Chemical Properties		Calculated Parameters			
Chemical	Henry's Law Constant H_i (atm-m³/mol)	Diffusivity in Air D_{air} (cm^2/s)	Distance Between Trench Bottom and Groundwater L_d (cm)	Area of Trench A (m^2)	Volume of Trench V (m^3)	Volatilization Factor VF (L/m^3)
Volatile Organic Compounds						
Benzene	5.6E-03	9.0E-02	6.10E+01	4.46E+00	1.09E+01	9.30E-03
Toluene	6.6E-03	7.8E-02	6.10E+01	4.46E+00	1.09E+01	9.67E-03
Ethylbenzene	7.9E-03	6.9E-02	6.10E+01	4.46E+00	1.09E+01	1.01E-02
Xylenes, Total	5.2E-03	8.5E-02	6.10E+01	4.46E+00	1.09E+01	8.22E-03
Cumene	1.2E-02	6.0E-02	6.10E+01	4.46E+00	1.09E+01	1.30E-02
1,2,4-Trimethylbenzene	6.2E-03	6.1E-02	6.10E+01	4.46E+00	1.09E+01	7.05E-03
1,3,5-Trimethylbenzene	8.8E-03	6.0E-02	6.10E+01	4.46E+00	1.09E+01	9.92E-03
Semivolatile Organic Compounds						
Naphthalene	4.4E-04	6.1E-02	6.10E+01	4.46E+00	1.09E+01	4.99E-04