Evaluation of Extractable Petroleum Hydrocarbons in Soil Technical Guidance

July 23, 2019

Welcome

- In-Person Attendees
- Webinar Attendees

Continuing Education Credits (CECs)

SRP Licensing Board **has not yet approved 3 Technical CEC** for this Training Class

- Certificate process will occur after course has been approved by the SRPL Board
- **Attendance Requirements:**
  - In-person attendance: must sign-in / sign-out and may not miss more than 20 minutes of the training
  - Webinar participants: must be logged-in for entire session and answer 3 out of 4 test questions (randomly inserted in the presentation)

CECs: What's the Process?

Upon SRPL Board approval of CEC application:

- DEP compiles a list of "in-person" and "webinar" participants eligible for CECs
- DEP will email eligible participants a "Link" to a LSRPA webpage with certificate access instructions
- Certificates are issued by the LSRPA after paying $25 processing fee

Test Your Knowledge

Is the Lynne Mitchell the new Acting Assistant Director of the Remediation Review Element (BIR and BRAP)?

A. Yes

B. No

EXAMPLE WEBINAR QUIZ SLIDE

Test Your Knowledge

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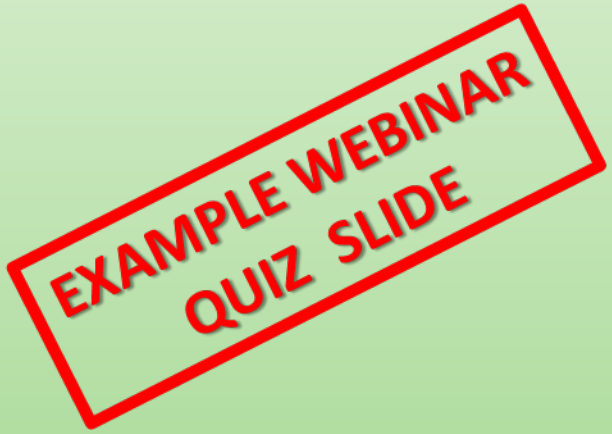
A. Yes



Important Reminders

- **Please mute cell phones**
- **Phone calls / conversations**
  - Please take outside of the meeting room
- **Question / Answers**
  - At times specified during the presentation
  - Please wait for the microphone
  - Webinar participants, wait for question period to "open up" and can then type in question

Remember!

Remember to sign **in <u>and</u> out** for credit

Please fill out the Course Evaluation Form

NJDEP Evaluation of Extractable Petroleum Hydrocarbons in Soil Technical Guidance Training
401 East State Street
Trenton, New Jersey
July 23, 2019

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Upcoming Events

August 1, 2019 - Trenton Thunder Baseball Game

September 17, 2019 - LSRPA Member Breakfast

October 7, 2019 - Professional Ethics 2018-082 MGP Conference, Philadelphia, PA

October 15, 2019 - LSRPA Member Breakfast

October 29, 2019 - Prevention of Adverse Community Exposure During Hazardous Waste Site Clean-ups 2018-062, Florham Park, NJ

October 30, 2019 - Due Diligence in New Jersey, Princeton, NJ

November 19, 2019 - LSRPA Member Breakfast

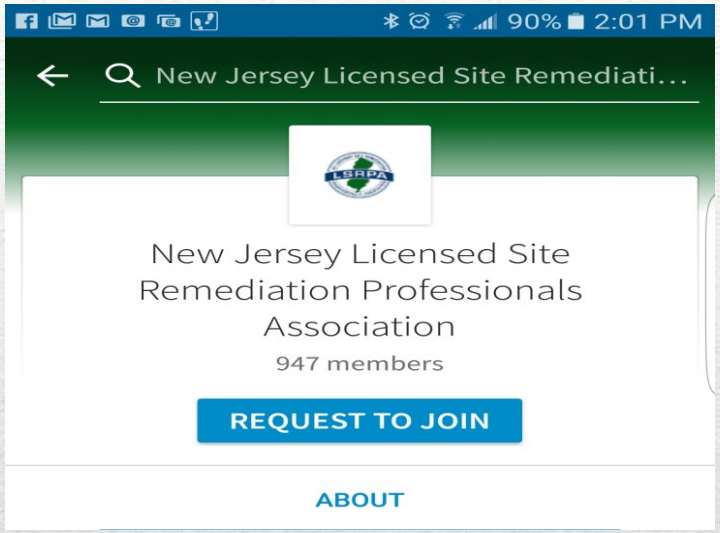
December 17, 2019 - LSRPA Member Breakfast

Click here to register:
https://www.lsrpa.org/events

LSRPA Initiatives

- **Member Breakfasts, held throughout the state: Check lsrpa.org for locations.**
- **LSRPA Participated in NRD and the Environmental Justice Task Force groups.**
- **LSRPA was a Stakeholder in the SRRA 2.0 revisions.**
- **LSRPA met with NJDEP Commissioner and NJEDA Chief Director on brownfield issues**
- **Dispute Resolution, LSRPA Sounding Board & CE Tracking Spreadsheet Tool**

LinkedIn



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SOCIAL MEDIA IS NOT JUST FOR KIDS…

It is an important way to connect our membership with the community

GET INVOLVED !

- **LSRPA Committees**

Governance (incl. Bylaws)
Continuing Education
Membership/Next Generation
Risk Management/Loss Prevention
Mentoring
Regulatory Outreach
Sponsorship
Sounding Board

Communications
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Nominating
SRRA 2.0
Conference

WANTED - VOLUNTEERS

NJ LICENSED SITE REMEDIATION
LSRPA
PROFESSIONALS ASSOCIATION

Thank You!

Evaluation of EPH in Soil Technical Guidance

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- Kathleen Kunze, Department Guidance Coordinator (retired)
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- Lynne Mitchell, NJDEP, SRWMP Training Chair
- Christina Page, NJDEP, SRWMP Ass't Training Chair
- Nicole Kozlowski, NJDEP, SRWMP Ass't Training Chair

List of Abbreviations

- AOC – Area of Concern
- Cat 1/Cat 2 – Category 1/Category 2
- Conc. - concentration
- EPH - Extractable Petroleum Hydrocarbons
- EPH Protocol - *Protocol For Addressing Extractable Petroleum Hydrocarbons* (August 2010)
- FAQs – Frequently Asked Questions in August 2010 EPH Protocol
- Ing-D Exp. Path. – Ingestion-Dermal Exposure Pathway
- NRDCSRC – Non-Residential Direct Contact Soil Remediation Criterion
- RDCSRC – Residential Direct Contact Soil Remediation Criterion
- SRC – Soil Remediation Criterion
- SRS – Soil Remediation Standards in REMEDIATION STANDARDS (N.J.A.C. 7:26D)
- Technical Rules - TECHNICAL REQUIREMENTS FOR SITE REMEDIATION (N.J.A.C. 7:26E)
- TPH - Total Petroleum Hydrocarbons

Petroleum Products in Table 2-1 of Technical Rules

Petroleum products this guidance applies to:

Cat 1 Defined (Section 4.1.1 of this guidance)

- No. 2 Heating Oil
- Diesel Fuel

Petroleum Products in Table 2-1 (cont'd)

Cat 2 Defined (section 4.1.2 of this guidance)

- Nos. 4 & 6 Heating Oil
- Hydraulic Oil, Cutting Oil, Lubricating Oil
- Crude Oil
- Waste Oil, *Unknown Petroleum Hydrocarbons
- Waste Vehicular Crankcase Oil
- *Mineral Oil
- *Dielectric Fluid, *Dielectric Mineral Oil, *Transformer Oil
- *Manufactured Gas Plant (MGP) Sites

* Petroleum products added to Table 2-1 that post-date the EPH Protocol

Stimulus For Developing EPH Technical Guidance

- Consider alternative EPH product limits for other soil textures
  - Medium sand-based EPH default product limits to all soil types (App. 3.1 of this guidance):
    - 8,000 mg/kg EPH for Cat 1
    - 17,000 mg/kg EPH for Cat 2
- Update EPH SRC with pending revisions to SRS

Main Differences Between 2010 and Now

- Addition of six EPH petroleum products in Table 2-1 of Technical Rule
- Allow for development EPH alternative product limits
- 8,000 mg/kg default product limit assigned to some Cat 2 petroleum products
- Establishment of 30,000 mg/kg EPH ceiling
- Compliance averaging for EPH Cat 1 SRC
- Petroleum product mixtures - clarification for EPH product limits and applicable SRC

Additional Changes

- Updated EPH evaluation steps (Sect. 5.0), plus
  - order rearranged to the investigator's perspective
  - streamlined
- Updated EPH Cat 2 SRC calculator
  - no longer compares EPH conc. to default product limit
  - displays equation and parameter default values for Ing-D Exp. Path.

Pertinent aspects of FAQs and EPH Protocol Implementation Phase-In (August 2010) retained in EPH Technical Guidance Appendix 3

Historical Perspective: TPH to EPH Freon/Method 418.1 Phase-Out

- TPH via EPA Method 418.1 used Freon extraction
  - Freon depletes ozone layer
- Freon phased-out
  - Method 418.1 unavailable
- Replacement method necessary
- Department employed several methods to bridge the gap
    - USEPA SW846 Methods 8015B and 8015B/C,
    - NJDEP OQA-QAM-025 and OQA-QAM-025 rev. 7, and
    - NJDEP EPH Method Revision 2

Historical Perspective: TPH Transition to EPH (Legislative Mandate)

- TPH based on "field capacity" and was not health-based
- Department legislatively mandated to establish human health-based remediation standards per Brownfield and Contaminated Site Remediation Act (N.J.S.A. 58:10B-12)
- EPH METHODOLOGY (Version 3.0) [August 2010] is health-based

Historical Perspective: TPH transition to EPH (NJDEP EPH Method Version 3.0)

- **RESULT:** Provides more accurate assessment of potential human health risk
- Determines collective concentrations for specific carbon number ranges of extractable aliphatic and aromatic petroleum hydrocarbons
- EPH method analyzes for 4 aromatic + 4 aliphatic fractions
- Representative toxicity factors assigned to each fraction range

EPH Category 1: Human Health-Based SRC Derivation

- 2007 EPH-TPH Field Study (No. 2 heating oil tank removals)
- EPH Direct Contact SRC based on Ing-D Exp. Path.
- Applying 95% Lower Confidence Limit of the mean and 2010 Remediation Standards Rule update:
  - **5,100** mg/kg EPH RDCSRC
  - **54,000** mg/kg EPH NRDCSRC

Appendix 3.3

EPH Cat 1 – Inhalation SRS and IGW Soil Screening Level

- How are the inhalation and impact to ground water exposure pathways evaluated?
- >1,000 mg/kg EPH triggers contingency analyses for:
  - Naphthalene: evaluates inhalation exposure pathway [FAQ#5]
  - 2-methylnaphthalene: evaluates impact to ground water exposure pathway [FAQ#9]

Petroleum Product Mixtures

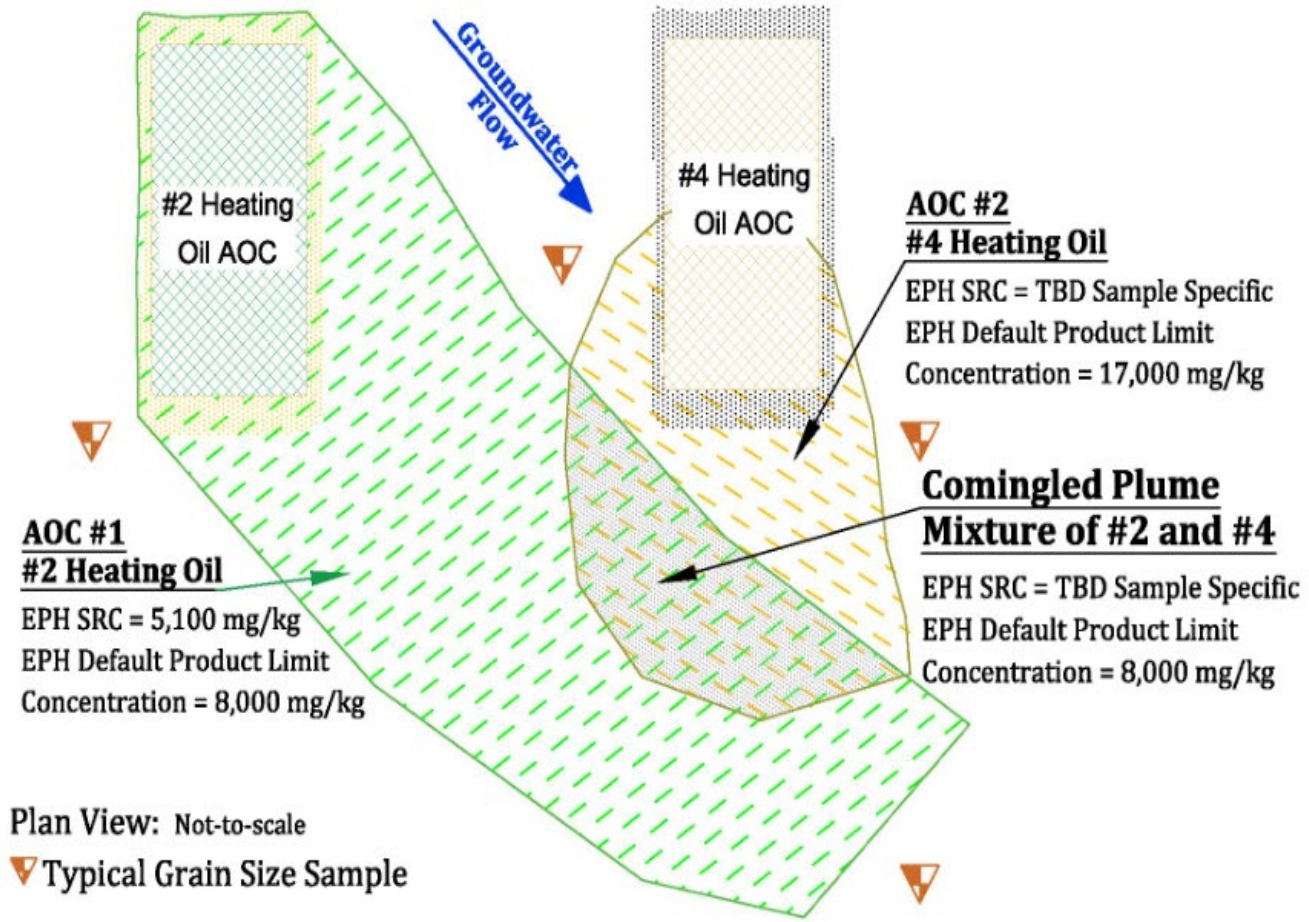
Mixtures of Table 2-1 Petroleum Products

Hand-Out: EPH Category, SRC, and
Default Product Limit by Petroleum Product

Section 4.1.3

N.J.A.C. 7:26E Table 2-1 Petroleum Product	EPH Category (1 or 2)	EPH SRC: Defined or Sample-specific	EPH default product limit (mg/kg)
No. 2 heating oil	1	Defined	8,000
Diesel fuel	1	Defined	8,000
No. 4 heating oil	2	Sample-specific	17,000
No. 6 heating oil	2	Sample-specific	17,000
Hydraulic oil	2	Sample-specific	17,000
Cutting oil	2	Sample-specific	8,000
Lubricating oil	2	Sample-specific	17,000
Crude oil	2	Sample-specific	8,000
Waste oil	2	Sample-specific	Parent product dependent
Unknown petroleum hydrocarbons	2	Sample-specific	8,000
Waste vehicular crankcase oil	2	Sample-specific	17,000
Mineral oil	2	Sample-specific	17,000
Dielectric fluid	2	Sample-specific	17,000
Dielectric mineral oil	2	Sample-specific	17,000
Transformer oil	2	Sample-specific	17,000
Manufactured Gas Plant	2	Sample-specific	8,000
Mixtures			
Mixture of Categories 1 and 2		Sample-specific	8,000
Waste Oil comprised of Categories 1 and 2		Sample-specific	8,000
Mixture of petroleum product with 8,000 mg/kg default product limit and petroleum product with 17,000 mg/kg default product limit		Sample-specific	8,000

Commingled NAPL Plumes Scenario



Two separate and unique NAPL plumes

- Each plume is investigated individually
- Any commingled area utilizes the **most conservative** remedial criteria

QUESTIONS?

Conceptual Approach for Petroleum Hydrocarbons in Soils

Ronald J. Baker
U.S. Geological Survey (retired)

Michel C. Boufadel, Ph.D., PE, BCEE, P.Hydro.
Professor, Department of Civil and Environmental Engineering
Professor, Department of Chemical and Materials Engineering
Director, Center for Natural Resources
New Jersey Institute of Technology, Newark NJ

Objectives for Presentation

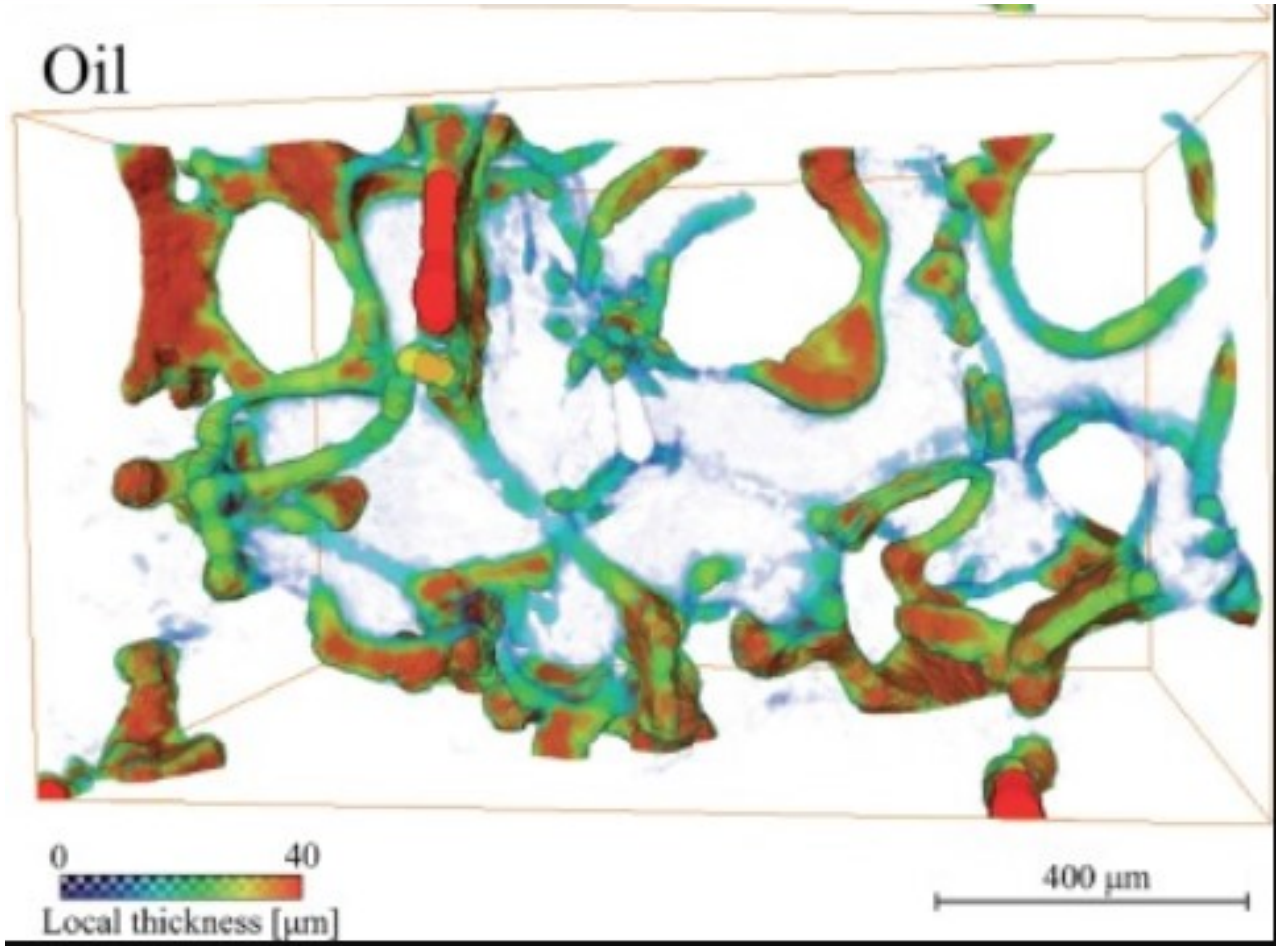
- Basic understanding of NAPL distribution in soils
- Complex system involving three phases
  - Hydrocarbons; water; air
- Movement of hydrocarbons is highly irregular
- Hysteresis
- Need for a simplification using

Hydrocarbon in Aquifers

Problem Statement

Three phases exist in the pore space:

- Hydrocarbon
- Water
- Air

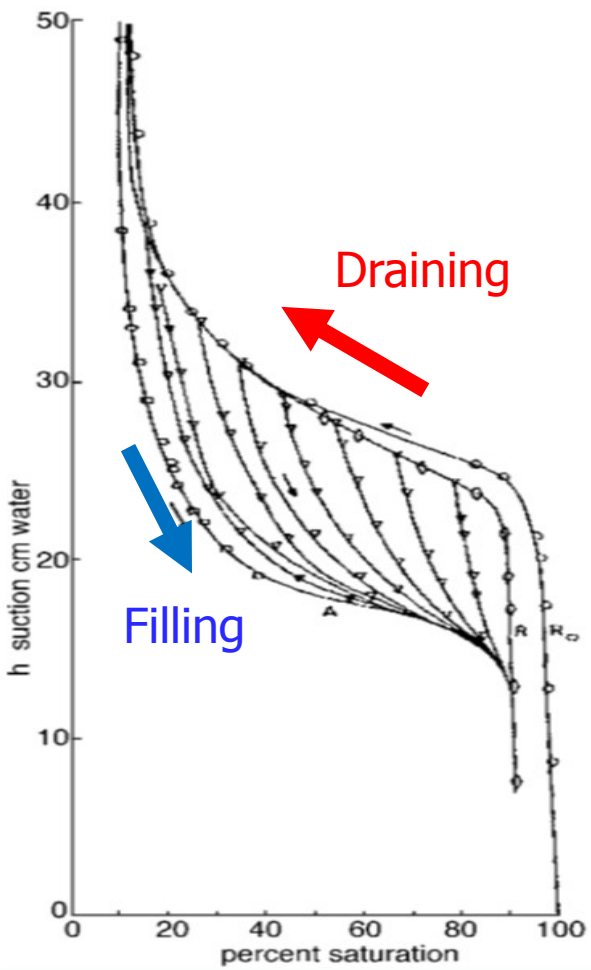


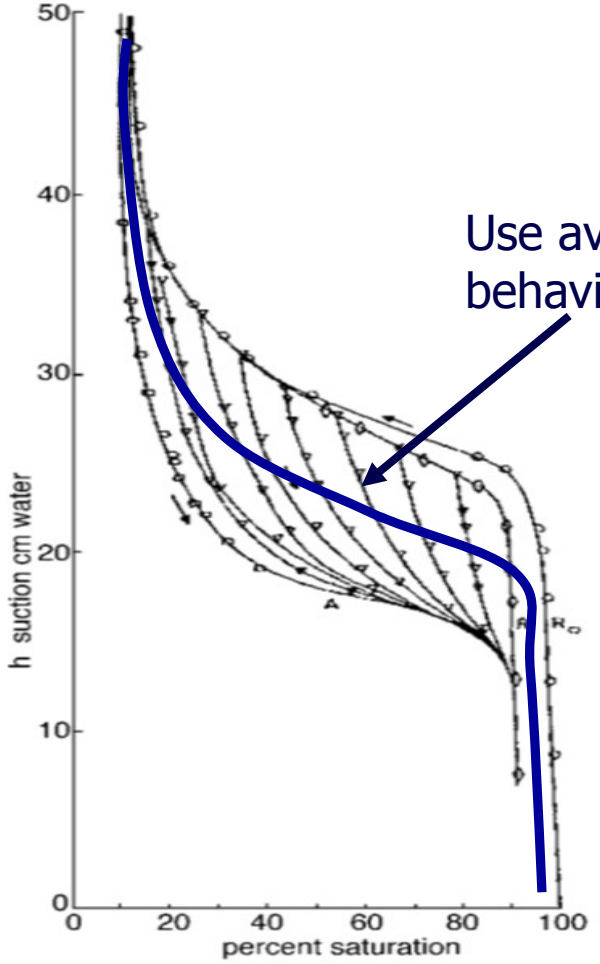
Red= Oil
Green= Air
Blue= Water
White= Soil

Scanziani et al. (2018), Advances in Water Resources

Hysteresis

The movement of hydrocarbons depends on the content and hydrodynamics of the three phases and the soil wettability





Morrow and Harris (1965), *Soc. Pet. Eng. Jour.* 15–24

EPH Committee Approach

- Accurately predicting the hydrocarbon content requires complicated models and a significant amount of soil and hydrocarbon data
- Adopt the approach used for unsaturated water flow in soils
- Conceptually, replace oil for water in the equations
  - Account for oil viscosity

EPH Committee Approach

Solve the Darcy equation for hydrocarbon flow in porous media (i.e., in soils)

Darcy flux= hydraulic conductivity*(Head drop)

$$q = \frac{g}{v} k_{\text{intrinsic}} * k_r * (\text{Head drop})$$

Where: v= oil viscosity.

$k_{intrinsic}$= Intrinsic soil permeability -Depends on porosity and d_{10}

(If you know porosity and d_{10}, you obtain $k_{intrinsic}$)

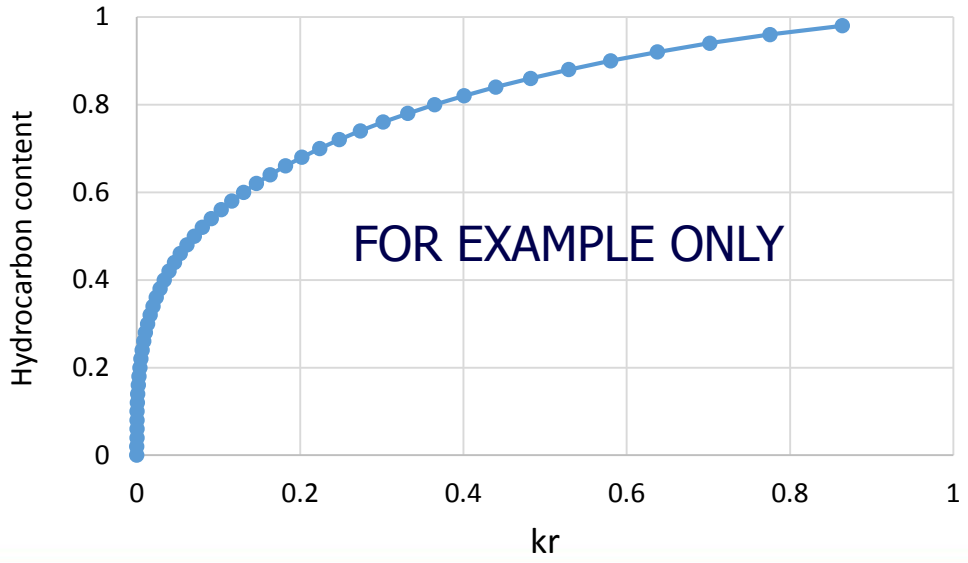
k_r= Relative permeability (0 to 1) **Depends on hydrocarbon content**

EPH Committee Approach

For vertical flow, (head drop)=1.0; Also let q= 1 foot/(100 years) per NJDEP

Thus, given oil viscosity, and k_{int}, one solves for k_r: $$k_r = \frac{V}{g.k_{intrinsic}}$$

After finding k_r, one finds the hydrocarbon content (i.e., volume fraction)



Questions?

Equation Variables used in the Calculator, Sensitivity Analysis, and Sample Collection for Particle-Size Distribution

Ronald J. Baker

U.S. Geological Survey (retired)

Factors that Determine Petroleum Hydrocarbon Product Mobility

- Site characteristics
  - Size, shape
  - Slope, structures, disturbance
- Product properties
  - Viscosity & density
    - Temperature, degree of weathering
- Soil properties
  - Porosity
  - Grain size distribution

Equations and Variables

- Appendix 2.3 describes derivation of the equation in detail
- Variable Names handout lists all variables used in the equation **(in red)**
- The following slides show the equations used in the calculator

Derivation of the Equation used to Calculate the Alternative EPH Product Limit in Soil

$$C = \frac{M_o}{M_s} = \frac{\theta_o * \rho_o}{(1-\emptyset) * \rho_s}$$

$S * \emptyset$

$$\frac{S * \emptyset * \rho_o}{(1-\emptyset)\,\rho_s}$$

$(1 - S_r)S_e + S_r$

$$\frac{[(1 - Sr)Se + Sr] * \emptyset * \rho_o}{(1-\emptyset)\,\rho_s}$$

$1.1349 * k_r^{0.3095}$

$$\frac{[(1 - Sr) * 1.1349\ k_r^{0.3095} + Sr] * \emptyset * \rho_o}{(1-\emptyset)\,\rho_s}$$

$\frac{K * \mu}{k_o * \rho_o * g}$

$$\frac{[(1 - Sr) * 1.1349 * (\frac{K * \mu}{k * \rho_o * g})\text{^}0.3095 + Sr] * \emptyset * \rho_o}{(1-\emptyset)\,\rho_s}$$

Final Equation used to Calculate the Alternative EPH Product Limit in Soil

Input the parameter default values and convert the units to mg/kg. The remaining parameters are specific to the type of petroleum product and the site's soil-specific properties.

$$C = \frac{[(1-0.02)1.1349*(\frac{10^{-9}*\mu}{k \quad *\rho_0*9.81})\text{^}0.3095 \ +0.02]*0.41*\rho_o}{(1-0.41)\ 2.54} * 10^6 \ \frac{mg}{kg}$$

Product Related Variables

- **μ** = Dynamic Viscosity
  - Lower viscosity → greater mobility
- **ρ_o** = Product Density
  - Lower density → lower mobility

Properties of Products Specified in the Calculator

Petroleum Product Name	Density (g/cm^3)	Dynamic Viscosity (poise)
Cutting Oil, Diesel Fuel No. 2 Heating Oil Unknown Petroleum Hydrocarbons	0.8245 @ 15°C	0.02 @ 15°C
Dielectric Fluid Mineral Oil Transformer Oil	0.8673	0.19
No. 4 Heating Oil	0.9250 @ 20°C	0.23@ 20°C
Hydraulic Oil	0.8727 @ 15°C	1.02 @ 15°C
Lubricating Oil	0.8498@ 15°C	1.4217 @ 15°C
Waste Vehicular Crankcase Oil	0.8848@ 15°C	1.75@ 15°C
No. 6 Heating Oil	0.9879 @ 15°C	403.4 @ 15°C

Soil Properties that Determine Product Mobility

- Φ =Total porosity of soil
- θ_o= Product-filled porosity
- i = Flow Gradient
  - Worst case: vertical gradient (1.0 feet/foot)
- D_{10} = grain effective diameter
  - Sieve size through which 10% passes

Values Determined by the Calculator

- **D_{10}**
- **C** = AOC-specific alternative product limit
  - Defined as the product concentration at which product moves at 0.01 ft/yr
- **Ceiling limit** = 30,000 mg/kg (Appendix 3.2)
- And is **C** greater than or less than the **ceiling limit?**
  - Only use **C** if it is less than the ceiling limit

Default Variables Imbedded in the Calculator

- **i** = Vertical Groundwater Gradient – dimensionless (1.0)
- **q** = Darcy Flux value – feet/year (0.01 feet/year)
- S_r = Residual petroleum HC saturation – percent (2%)
- ρ_s = Grain density of the soil - grams/cm^3 (2.54 g/cm^3)
- **Temperature** - of NAPL in soil (15 degrees C)
- **n** = Van Genuchten uniformity coefficient n (4)
- **τ** = tortuosity to flow (0.5)
- **F** = particle shape factor (2.5)
- **Φ** = porosity (0.41)

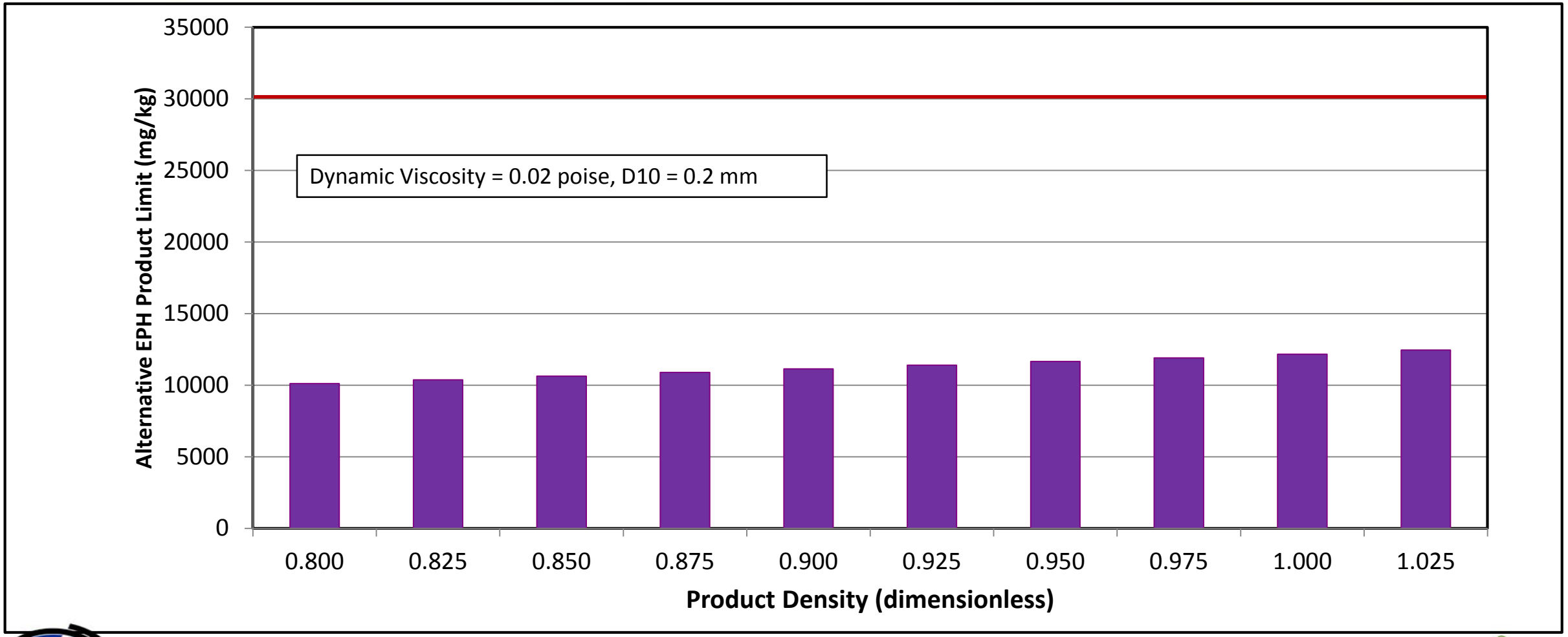
Variables Determined by the Calculator

- **K** = Hydraulic conductivity K=q/I = 0.01 ft/year
- **k** = Intrinsic permeability of the medium
- $\mathbf{k_r}$ = Relative permeability of the medium
- **S** = NAPL saturation ratio, the fraction of porosity occupied by product
- $\mathbf{S_e}$ = Effective saturation, the relative fraction of product available for flow
- θ_o = Product-filled porosity

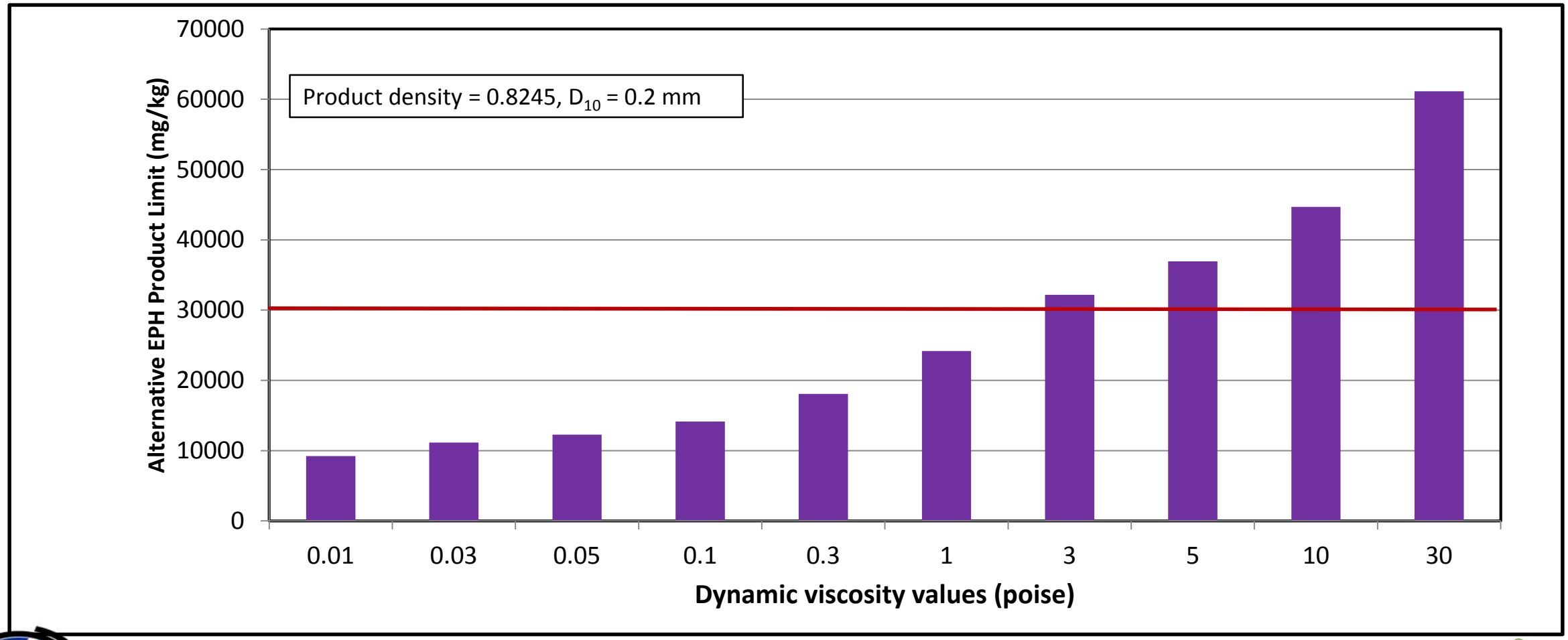
Sensitivity Analysis of Variables in the Calculator

- Alternative EPH Product Limit has different degrees of sensitivity to these variables:
  - **Product properties**
    - Density
    - Dynamic viscosity
  - **Soil properties**
    - Porosity
    - D_{10}

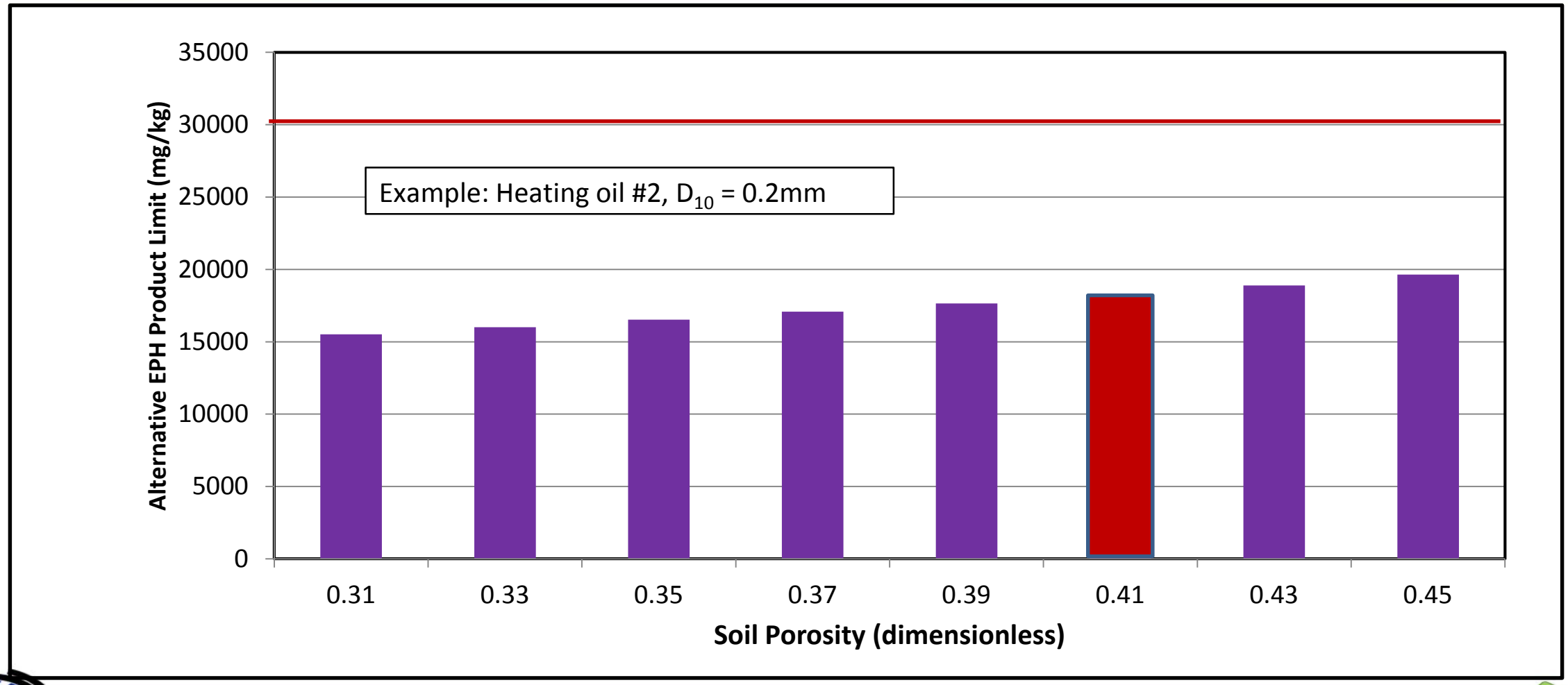
Minimal Effect of Product Density on C-Value



Substantial Effect of Product Viscosity on C-Value



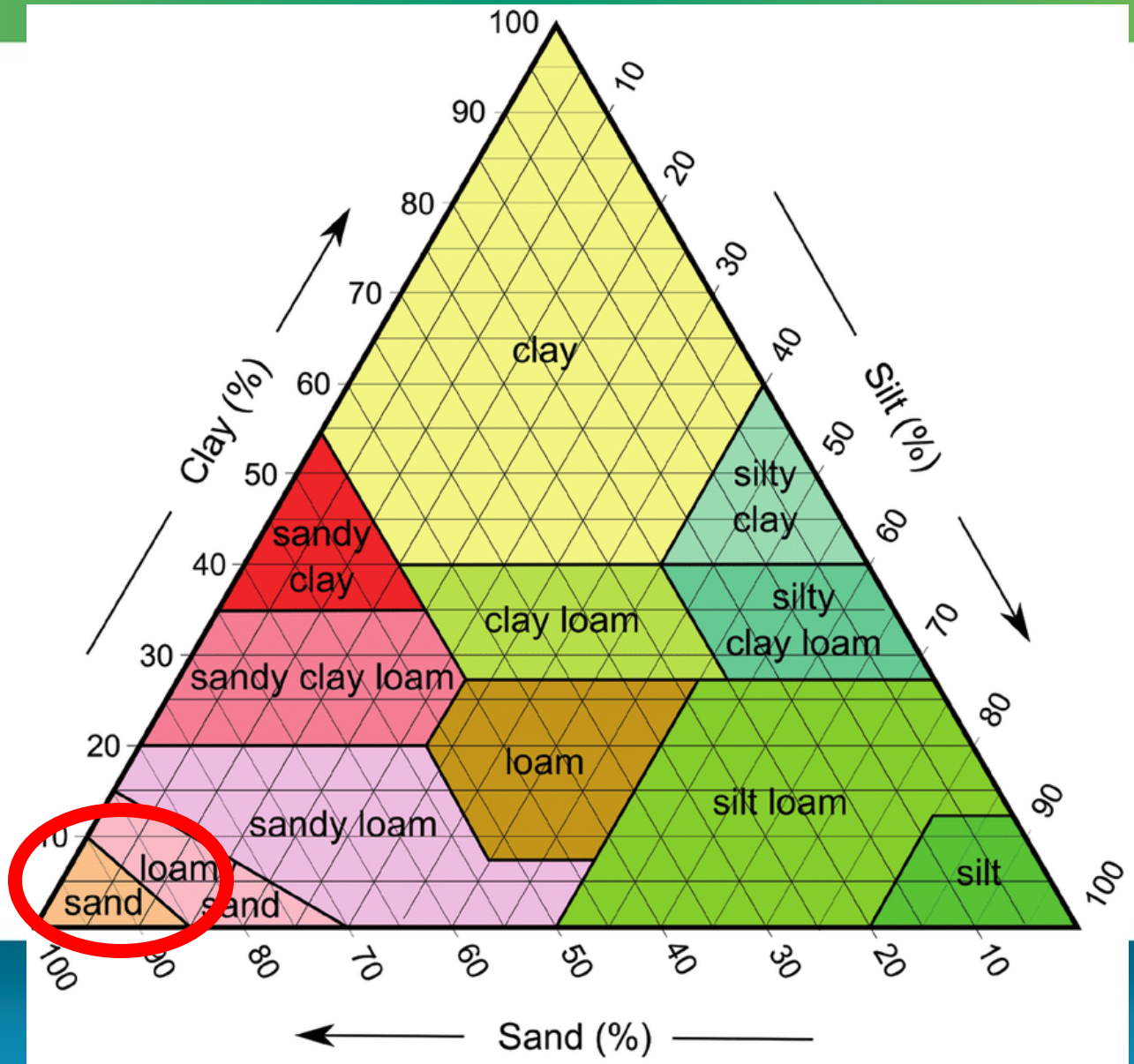
Minimal Effect of Porosity on C-Value



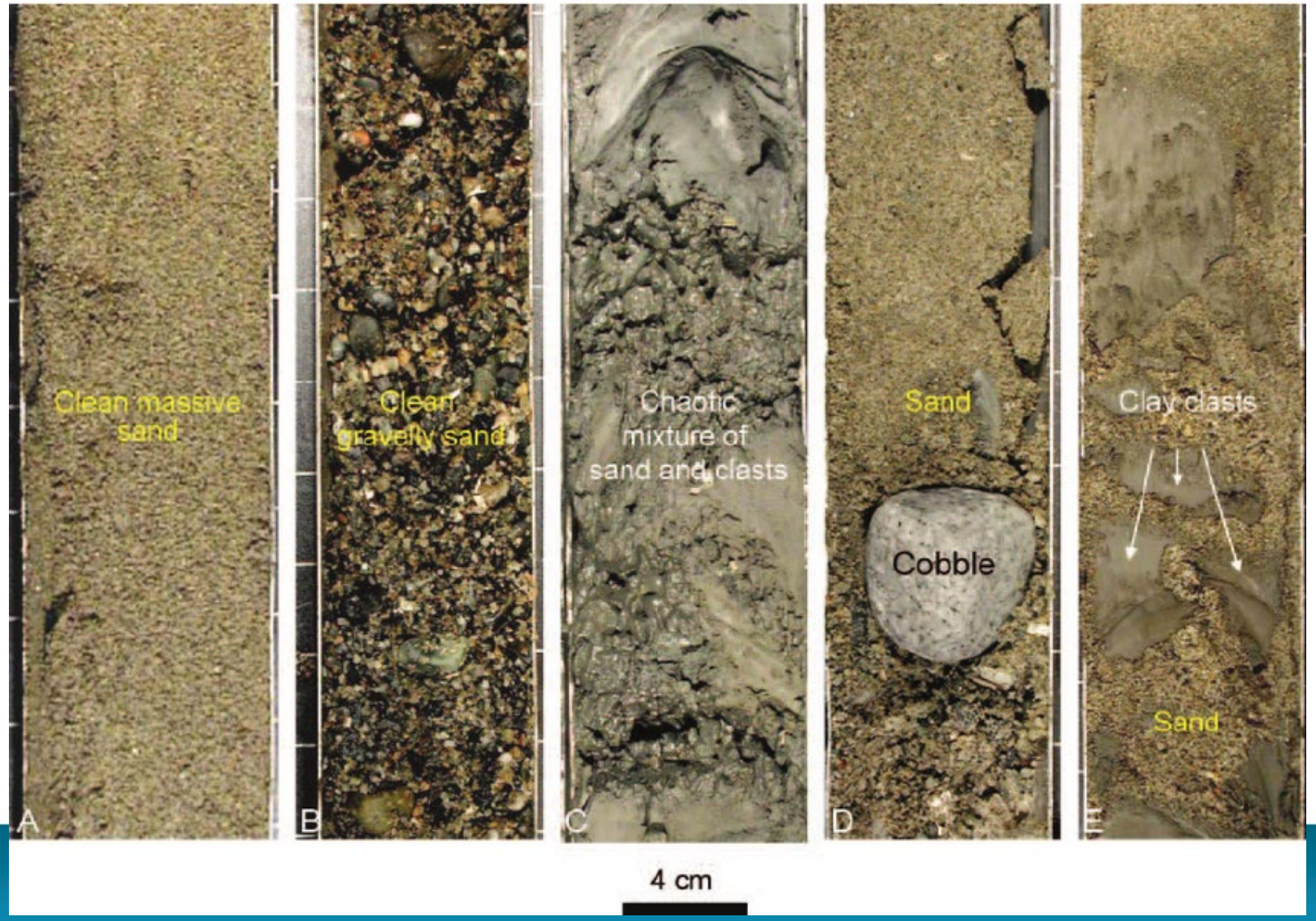
Why use D_{10}?

- **D_{10}** = measure of the finer particle fraction
  - Finer particles control permeability
- **D_{10}** is the basis of the Hazen formula used in geotechnical engineering and the Kozeny-Carmen equation (which we use in the calculator)
- **D_{20}** or **D_{60}/D_{10}** were rejected as alternatives
  - D_{20} gives less information about the finer particles
  - D_{60}/D_{10} informs about soil grading, but gives no additional information about the finer fraction

USDA Soil Classification System (SCS)



Soil Permeability



Sieves for Determining Particle (grain) Size Distribution

Sieves for Determining Particle (grain) Size Distribution

Additional Information about Sieve Analysis

- Chain of Custody must follow samples from collection through results reporting
- Specify method used
- Appropriate QA/QC measures must be applied
- If D_{10} is supplied by the lab, calculation method must be specified

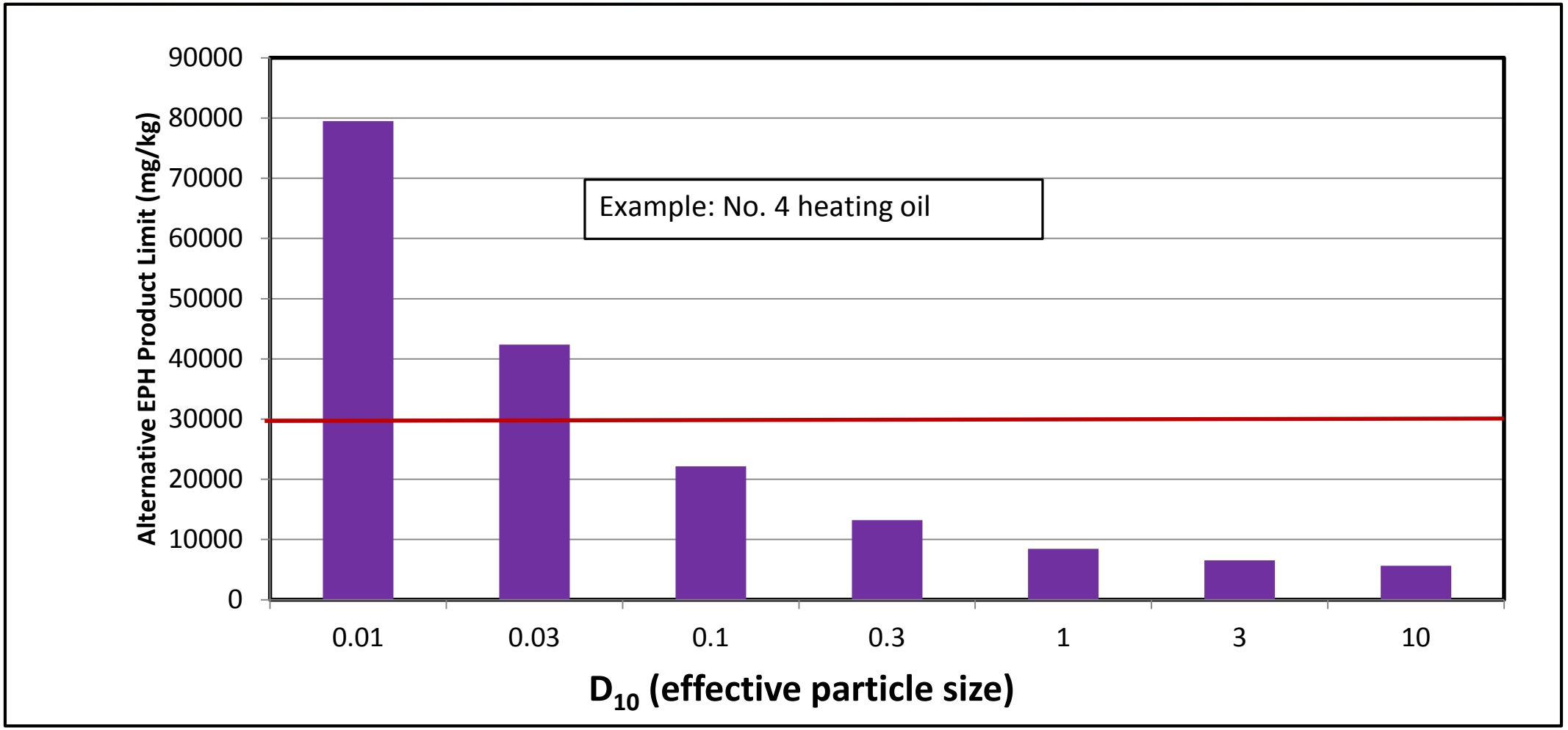
Example of Particle Size Distribution Data

Project: 493 North Arlington, NJ
Collected: 10/19/16
Lab Method: ASTM D422-63

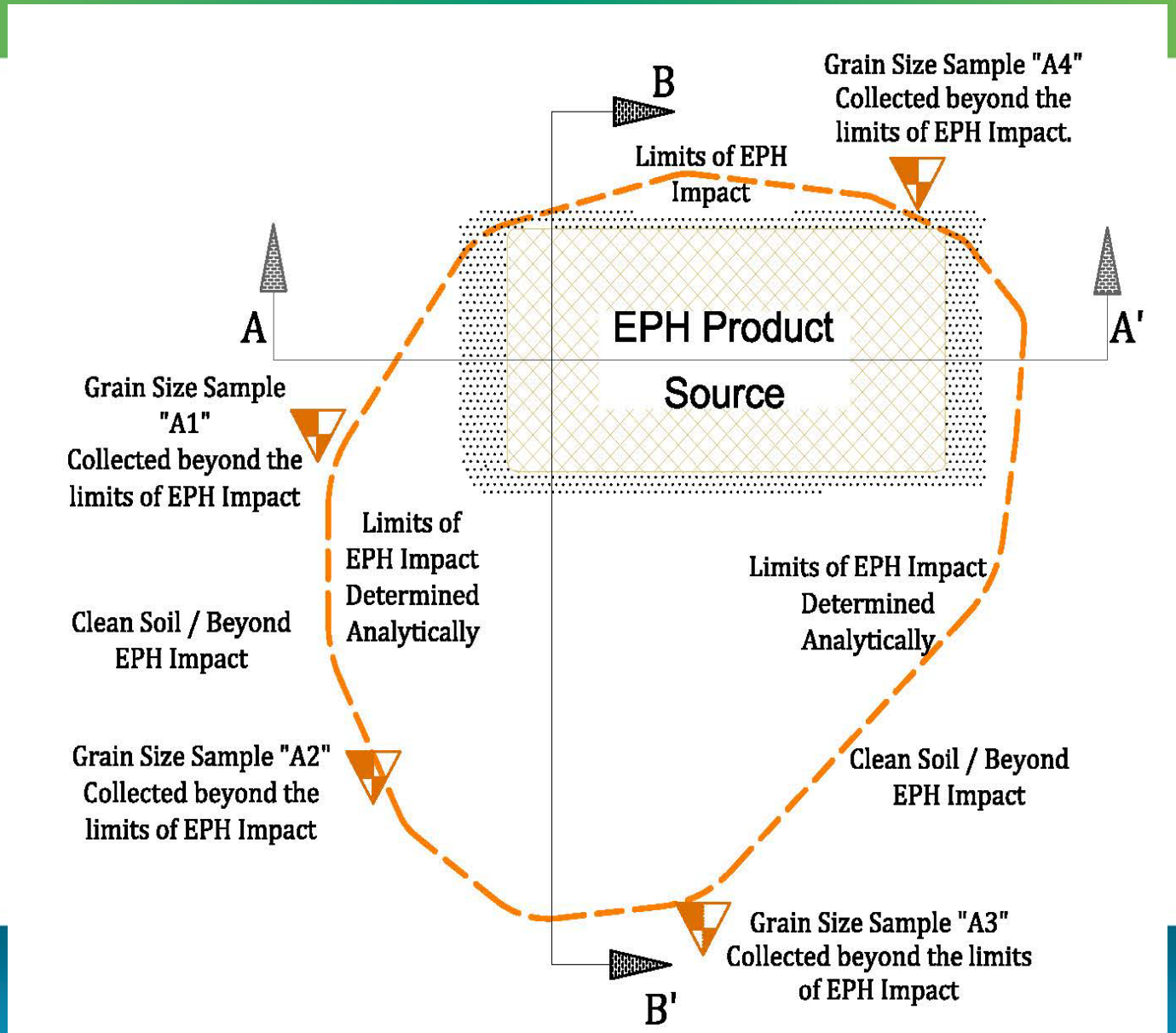
Sieve	size (mm)	Percent passed through
0.75 Inch	19.05	100.0
0.375 Inch	9.575	99.4
No.4 Sieve	4.75	96.2
No.10 Sieve	2.00	92.3
No.30 Sieve	0.60	87.1
No.50 Sieve	0.30	82.8
No.100 Sieve	0.15	74.3
No.200 Sieve	0.075	65.1
Hydrometer	0.030	50.0
Hydrometer	**0.005**	**10.0**
Hydrometer	0.0015	3.0

D_{10}

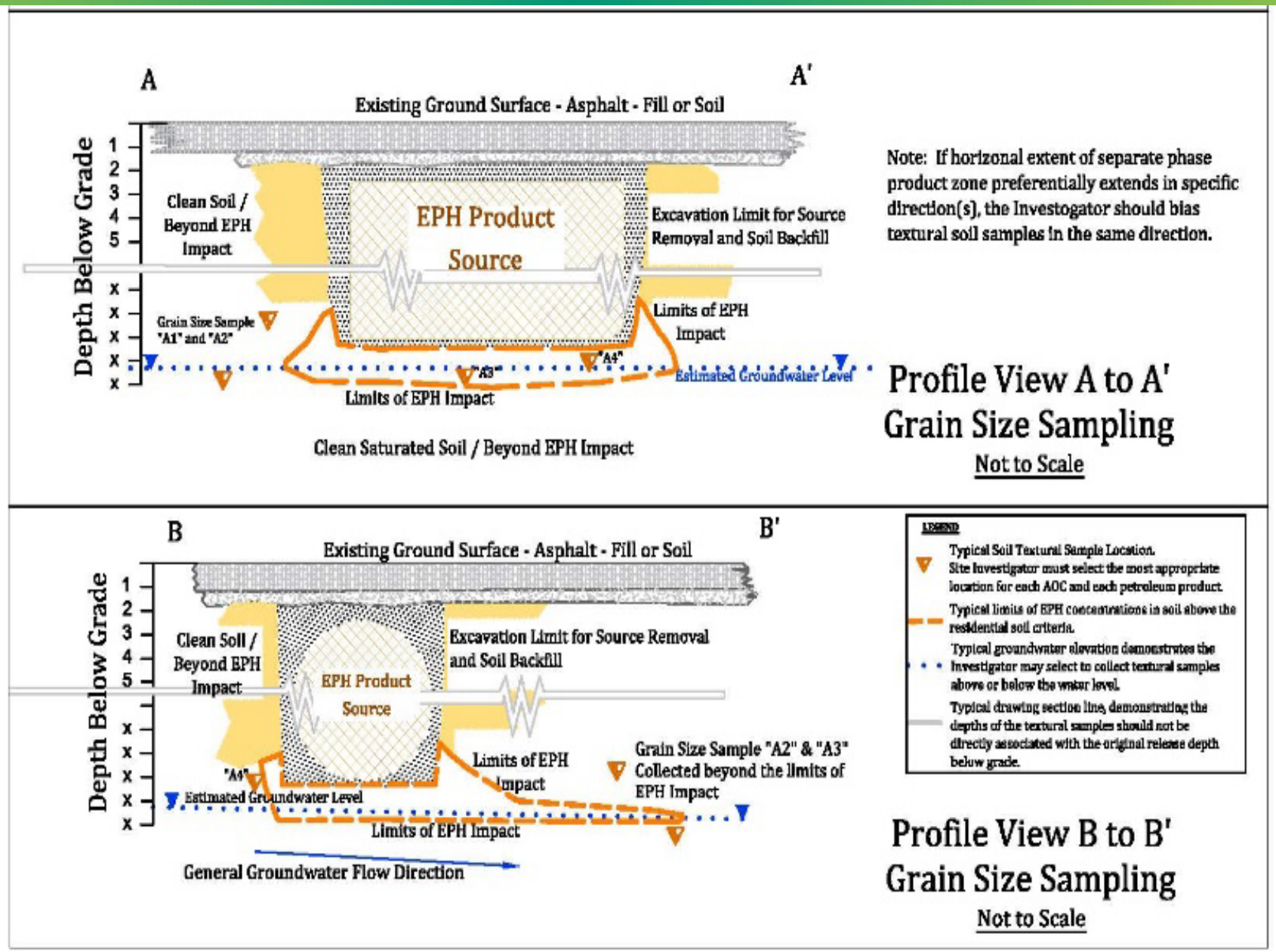
Substantial Effect of D_{10} on C value



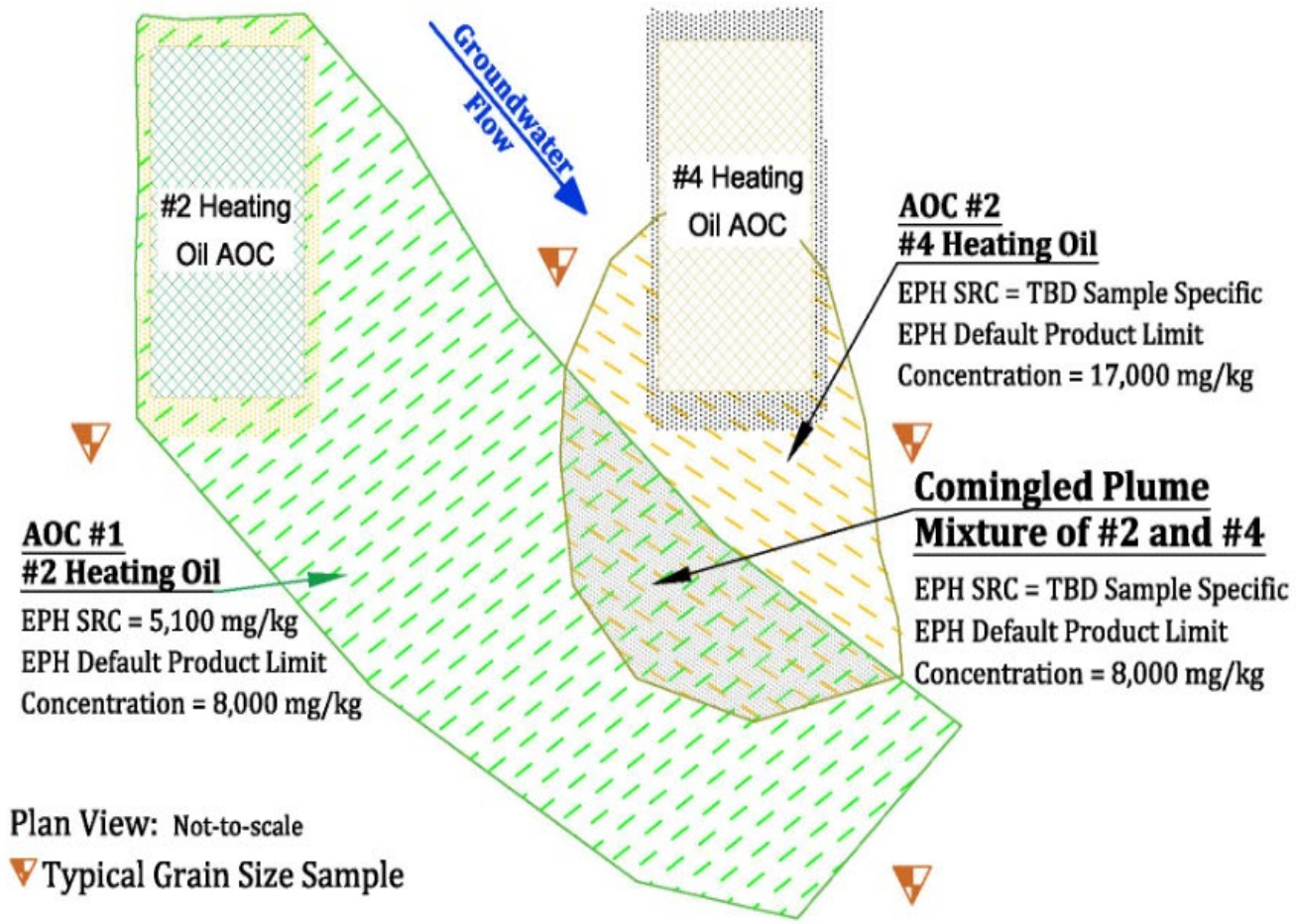
EPH Grain Size Sample Notes - Horizontal



Typical Cross Sections- Grain Size Sample Locations



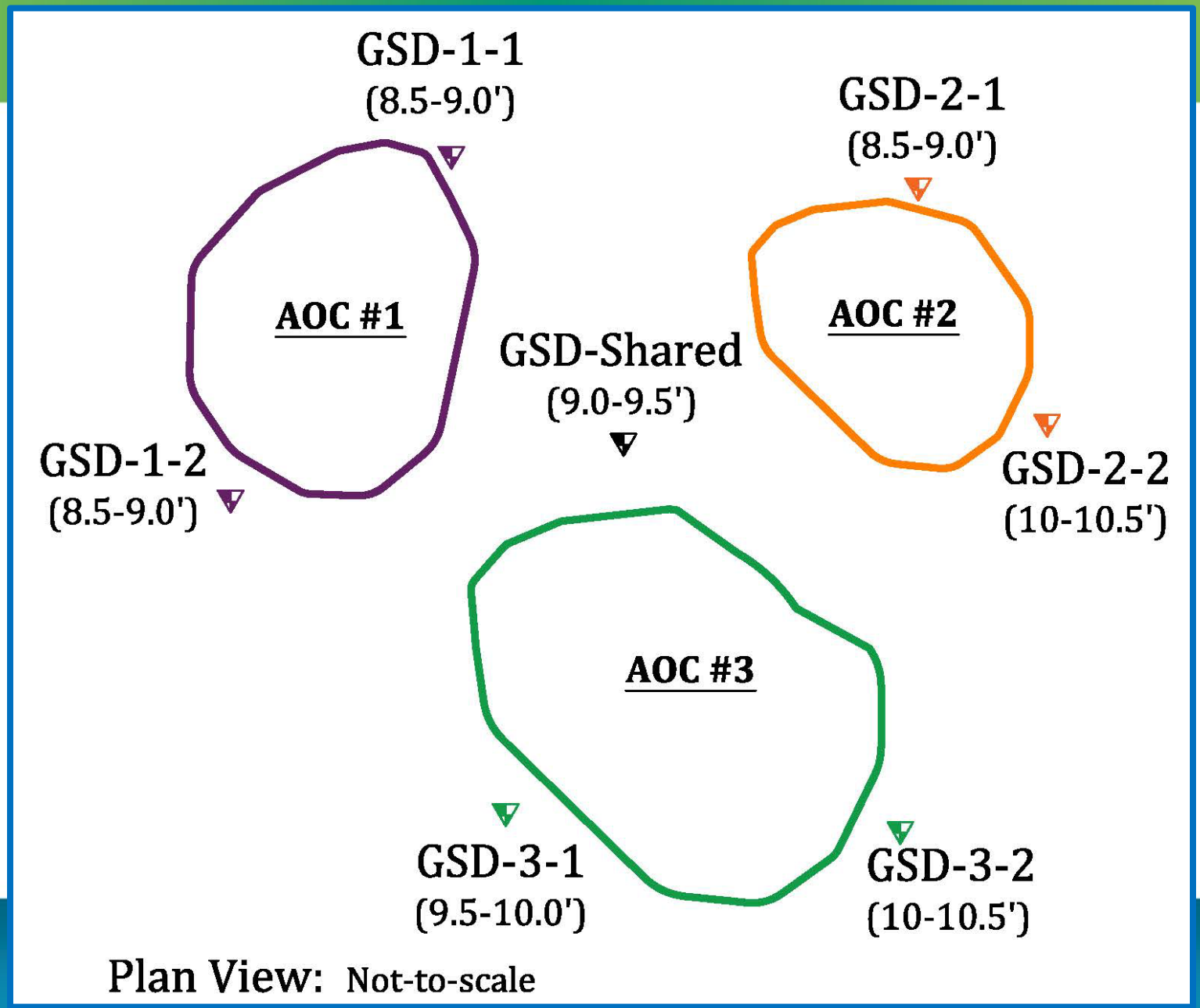
Commingled NAPL Plumes Scenario



Two separate and unique NAPL plumes

- Each plume is investigated individually
- Any commingled area utilizes the **most conservative** remedial criteria

Sharing of Grain Size Samples - 3 AOCs Scenario



Questions?

Comments?

Need coffee or other stimulants?

EPH Investigation Overview

John F. Donohue

Fuel Merchants Association of New Jersey

Determine EPH of Concern

- **Cat 1 EPH**
  - Number 2 (#2) fuel oil and/or diesel fuel
- **Cat 2 EPH**
  - Number 4 (#4) fuel oil, Number 6 fuel oil, hydraulic oils, cutting oils, crude oil, lubricating oil, waste oil, waste vehicular crankcase oil, and waste mineral oil
- **Both: Current #2 Fuel Oil, Former #4 Oil Use**
  - Mixtures: MGP, crude oil, cutting oil, unknown EPH

Determine Health Based Limits

- **Cat 1 EPH** = 5,100 mg/kg RDCSRC
  - 54,000 mg/kg NRDCSRC
- **Cat 2 EPH** → Site Specific
  - >2,300 mg/kg fractionated analysis needed
  - Use SRC calculator
- **Mixtures** → Most Stringent

Determine Contingency Driver Limits

- N.J.A.C. 7:26E, Table 2-1
- **Cat 1 EPH:** 1,000 mg/kg
  - Evaluate for naphthalene and 2-methylnaphthalene
- **Cat 2 EPH, Heating Oils:** 100 mg/kg
  - PAHs
- **Cat 2 EPH, Other:** >ND or Required
  - Product specific

Determine Default Product Limits

- **Cat 1 EPH:** 8,000 mg/kg
- **Cat 2 EPH:** 17,000 mg/kg
- **Mixtures:** 8,000 mg/kg

What if EPH concentrations are:

- Greater than default product limit?
  - Consider 'Alternative Product Limit'
- Greater than 30,000 mg/kg?

What's New?

- Guidance includes greater reference to Attainment Compliance Technical Guidance
- Guidance provides a method to develop a site-specific, alternative product limit
- Alternate product limit calculator
- Textural analysis of soil is needed to generate a value for use in the 'calculator'

What's New?
Depends on the Project Type

Residential HOT

-No substantive change

-Cat 1 EPH standard

-Cat 2 EPH calculated

Compliance Averaging (>5,100/<8,000 mg/kg)

Standard Industrial

-Small changes

-Cat 1 EPH standard

-Cat 2 EPH calculated

-Product ceiling limit

-Option for Alternative Product Limit Concentration

-Additional Grain Size analysis

Complex Industrial

-More changes

-Cat 1 EPH standard

-Cat 2 EPH calculated

-Product ceiling limit

-Option for Alternative Product Limit Concentration

-Grain Size analysis

-Added products and mixtures

-Technical Consultation

What is Not New

- Cat 1 Soil Remediation Criterion (RDCSRC)
  - Established in Remediation Standard, N.J.A.C. 7:26D
  - Established in Heating Oil Tank System Rule, N.J.A.C. 7:26 F (HOTSR Rule)
- Cat 2 Composition Specific EPH Soil Criterion Remediation Calculator (which has been updated)
- Contingency Analysis Requirements
- Default Product Limits
- Unrestricted Use Criterion/Institutional Control Requirements
- Product Indicator Concentrations require Single-Point Compliance

Residential Use Remediation Goal

- **Existing Residential Site with Unrestricted Use as goal**
  - EPH 2019 does not offer a 'silver bullet'
  - Compliance averaging or 75%/10X can be used for Cat 1 fuels and specific compounds of concern
  - Alternative product limit calculator, along with compliance averaging or 75%/10X can be used at sites regulated by N.J.A.C. 7:26F (HOTSR Rule) if EPH > 8,000 mg/kg is present
  - Cat 2 fuel AOC attainment compliance options do not include averaging

Non-Residential Use Remediation Goal

- **Non-Residential Site with an <u>Unrestricted</u> Use as goal**
  - EPH 2019 does not offer a 'silver bullet' for Cat 1 fuels due to RDCSRC
  - Alternative product limit calculator, along with compliance averaging or 75%/10X can be used at sites regulated by <u>N.J.A.C.</u> 7:26F (HOTSR Rule) if EPH > 8,000 mg/kg is present
  - Cat 2 fuels and use of alternative product limit can be quite effective for meeting remediation goal
  - Compliance averaging or 75%/10X can be used for Cat 1 fuels and specific compounds of concern

Restricted Use

- **Restricted Use is acceptable to the PRCR**
  - Institutional control required
  - Engineering control use may be reduced
  - Long term monitoring requirements can apply
  - Requires Remedial Action Permit (see HOTSR exclusions)

Why Default Product Limits?

- **7:26E-5.1 Remedial action requirements**
  - (e) The person responsible for conducting the remediation shall treat or remove free product and residual product to the extent practicable or contain **free product** and **residual product** when treatment or removal is not practicable. Monitored natural attenuation of free product and residual product is prohibited.
- **Question: How does the LSRP determine…**
  - What is 'Free product'? What is 'Residual product'?
  - What is 'Residual contamination'?
  - What is 'NAPL'?
- Answer: Department established 'Product Limits' for EPH

The Work of the Committee

- Evaluate the appropriateness of established default product limits
- Seek out methods to support development of 'site specific' limits
  - Centrifuge analysis
  - Testing of EPH impacted soils
- Consider a field classification of soil and use corresponding default limits from prior studies
- Provide the regulated community the option to calculate a product limit

Brost and DeVaull, 2000

- The Title: NAPL Mobility Limits in Soil
- The title may have been better stated as:
  - When is product in soil residual (or presumed to be immobile)?
  - When is product in soil NAPL (or potentially mobile)?
- Demonstrated **soil texture** is the predominant factor

What did Brost and DeVaull Say?

- "**Conservative** screening concentrations for NAPL that could be considered immobile in unsaturated soils."
- "Mobile NAPL deplete as immobile residual chemical is left behind through the soil column in which the NAPL is descending."
- "Our intent…is to determine **conservative** NAPL concentration below which NAPL will be immobile."
- "By '**conservative**' we mean underpredicting the concentration at which mobility would actually occur."
- "These screening values are intended to be worst-case estimates for mobility. **Higher values may be applicable on a site-specific basis.** For example, with an adequate distance in unsaturated soil between the lowest depth of a mobile NAPL and groundwater. ...account for potential NAPL redistribution in unsaturated soil layer. Redistribution decreases concentration…"

Brost and DeVaull: Table 2

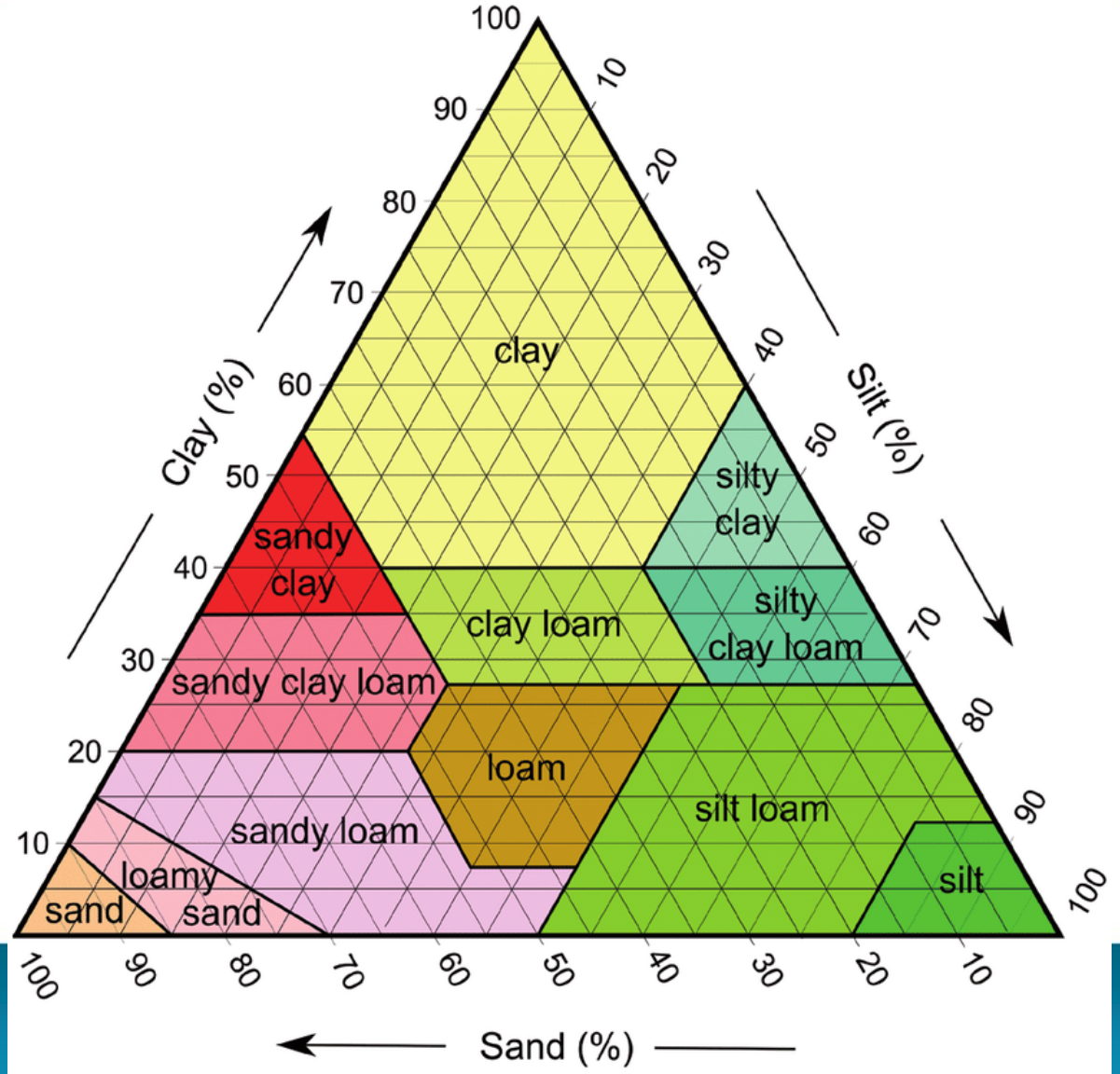
NAPL	Soil Type	Residual NAPL Concentration (mg/kg)
Middle Distillates	Coarse Gravel	2,286
Middle Distillates	Coarse Sand & Gravel	3,879
Middle Distillates **(Cat 1)**	Medium to Coarse Sand	7,742
Middle Distillates	Fine to Medium sand	13,333
Middle Distillates	Silt to Fine sand	22,856
Fuel Oils	Coarse Gravel	5,143
Fuel Oils	Coarse Sand & Gravel	8,727
Fuel Oils **(Cat 2)**	Medium to Coarse Sand	17,419
Fuel Oils	Fine to Medium sand	30,000
Fuel Oils	Silt to Fine sand	51,429

Existing default product limits

Challenges to Determining Soil Type

- Appendix 3.1 states: "Sand was selected by the NJDEP as a reasonably conservative soil texture for determination of a default upper limit concentration for No. 2 fuel oil and diesel based on the residual saturation point."
- Sand
  - Coarse, fine, sand with fines?
  - Silty sand? Sandy silt? Clay?
- Soil Classification
  - Could the investigator use USDA Soil Classification, as with VI?
  - How did Brost and DeVaull measure or classify soil type? Could the investigator go to their chart?

USDA Soil Classification System



Generic Soil Types Can Pose Issues

- Use of any generic soil classification is generally too broad
- Sieve analysis was conducted on samples submitted to EPH committee for use evaluating viability of centrifuge analysis
- For 7 of 11 sites, sand content 70% or less
  - Sites with 90% sand, EPH calculated to 22,000 mg/kg to 31,000 mg/kg
  - Sites with 70% sand, EPH calculated to 23,000 mg/kg to 88,000 mg/kg
  - Sites with 50% sand, EPH calculated to 83,000 mg/kg
  - Sites with 30% sand, EPH calculated to 23,000 mg/kg to 177,000 mg/kg

EPH Guidance-Criterion and Limits

- Health Based Criterion
  - N.J.A.C. 7:26D, N.J.A.C. 7:26F
- Contingency Analysis
  - N.J.A.C. 7:26E
  - Health Based Criterion
- Ecologic Assessment
  - ECO Guidance 1,700 mg/kg
- Product Limits
  - Default Product Limits- 8,000 mg/kg, 17,000 mg/kg
  - Site-specific Product Limits: established via soil testing up to Product Ceiling

Product Ceiling Limit

- Committee discussions:
  - When is a soil not a soil?
  - At what concentration of residual product do the characteristics of the soil change?
- Cat 1 Fuel NRDCSRC = 54,000 mg/kg
- Cat 2 Fuel criterion can range over 100,000 mg/kg
- Alternative product limit calculation can exceed 100,000 mg/kg

What is appropriate? 30,000 mg/kg

EPH Guidance 2019 - Effect

- EPH Product Limits for Cat 1 and Cat 2 Fuel can be up to 30,000 mg/kg
- Institutional Controls are required if EPH is to remain on-site at concentrations over RDCSRC (except for the limited provisions of the HOTSR Rule)
- Derivation of Alternative EPH Product Limit does not eliminate the need to remediate compounds of concern identified by contingency analysis
- Derivation of an Alternative Product Limit does not eliminate the need to evaluate ground water investigation requirements for compounds of concern identified by contingency analysis

Summary

- Define product type as soon as possible
- Product indicator concentrations are capped by the Default Ceiling Limit
- Product indicator compliance is determined on a point-by-point basis
- Soil samples for grain size analysis can be collected at any time
- A 'Calculator' is used to develop a Site-Specific Alternative Product Limit Concentration
- EPH samples are referenced to a free or residual product level, 'residual contamination' is not defined

Questions?

BREAK

Using The EPH Alternative Product Limit Calculator

Dave Puchalski, PE, LSRP
NewFields Princeton, LLC
dpuchalski@newfields.com

EPH Alternative Product Limit Concentration Calculator for Soil

Goals of this Section

- Introduce the calculator format
- Describe the data entry process
- Identify the input variables and calculator output
- Provide insight into the calculations
- Identify some eccentricities in the calculator
- Describe a recommended documentation and submittal process

Using the Product Limit Calculator

- **Read the instructions** & become comfortable with the calculator
- Preparing your data
- Working with the calculator
- Data submittal
- READ THE INSTRUCTIONS

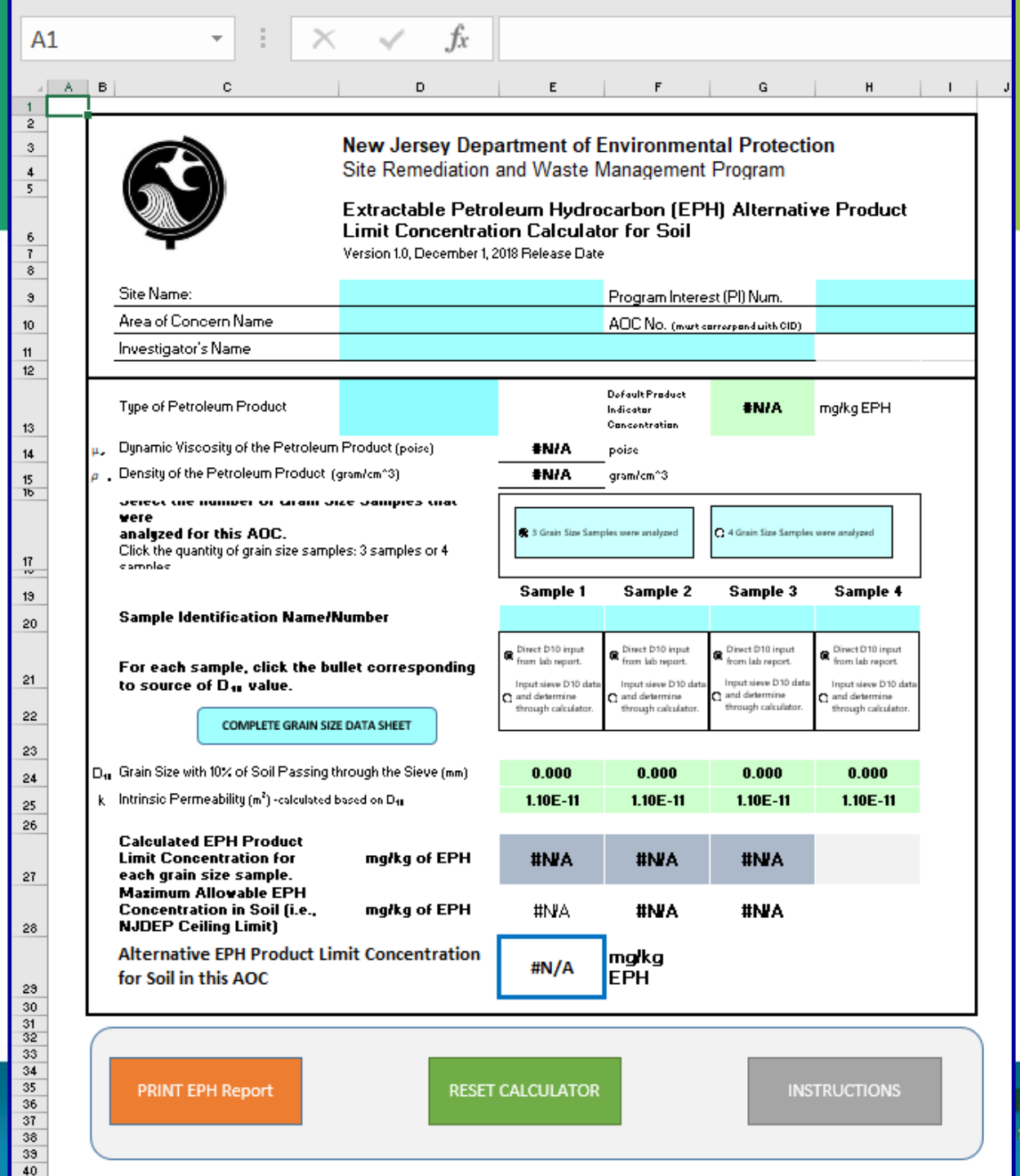
Preparing Your Data

Necessary information

1. Site specific information, including the PI# for the site and the AOC # for the investigation
   - **link to data miner**
2. Grain Size soil analysis laboratory reports
3. Definition of the Type of Petroleum Product discharged at the AOC
4. Site Plan of the AOC and sample locations
5. Download the NJDEP Excel Calculator

EPH Alternative Product Limit Concentration Calculator for Soil

Simple
One Page
No interpretation
Instruction guide follows the input process



New Jersey Department of Environmental Protection
Site Remediation and Waste Management Program

Extractable Petroleum Hydrocarbon (EPH) Alternative Product Limit Concentration Calculator for Soil

Version 1.0, December 1, 2018 Release Date

Site Name:
Program Interest (PI) Num.
Area of Concern Name
AOC No. (must correspond with CID)
Investigator's Name

Type of Petroleum Product
Default Product Indicator Concentration: #N/A mg/kg EPH

μ Dynamic Viscosity of the Petroleum Product (poise): #N/A poise

ρ Density of the Petroleum Product (gram/cm^3): #N/A gram/cm^3

Select the number of grain size samples that were analyzed for this AOC.
Click the quantity of grain size samples: 3 samples or 4 samples

3 Grain Size Samples were analyzed | 4 Grain Size Samples were analyzed

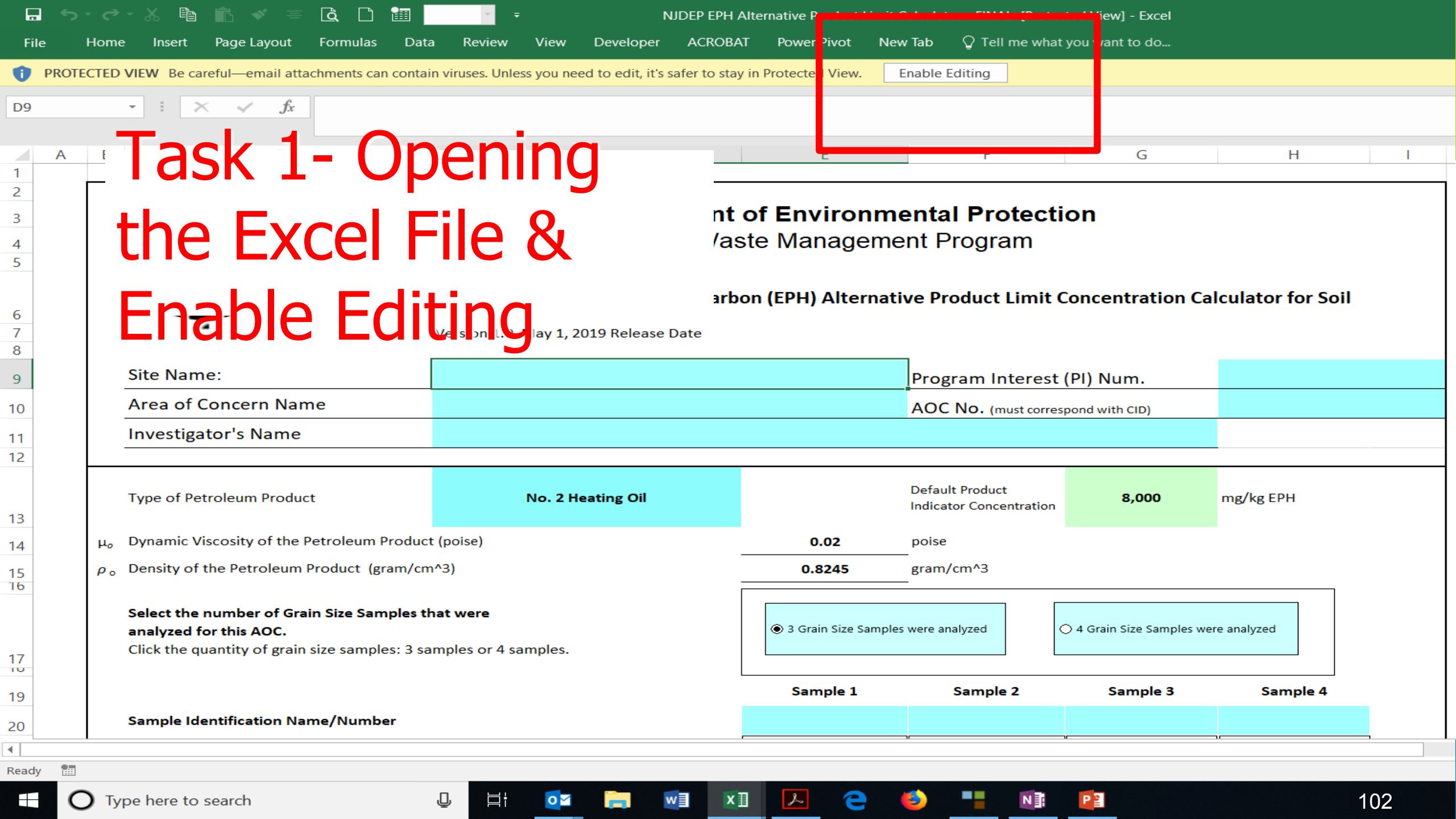
	Sample 1	Sample 2	Sample 3	Sample 4
Sample Identification Name/Number				
For each sample, click the bullet corresponding to source of D_{10} value.	Direct D10 input from lab report. / Input sieve D10 data and determine through calculator.			
D_{10} Grain Size with 10% of Soil Passing through the Sieve (mm)	0.000	0.000	0.000	0.000
k Intrinsic Permeability (m^2) -calculated based on D_{10}	1.10E-11	1.10E-11	1.10E-11	1.10E-11
Calculated EPH Product Limit Concentration for each grain size sample. mg/kg of EPH	#N/A	#N/A	#N/A	
Maximum Allowable EPH Concentration in Soil (i.e., NJDEP Ceiling Limit) mg/kg of EPH	#N/A	#N/A	#N/A	

COMPLETE GRAIN SIZE DATA SHEET

Alternative EPH Product Limit Concentration for Soil in this AOC: #N/A mg/kg EPH

PRINT EPH Report | RESET CALCULATOR | INSTRUCTIONS

Task 1- Opening the Excel File & Enable Editing



NJDEP EPH Alternative Product Limit Calculator - FINAL [Read-Only] - Excel

File Home Insert Page Layout Formulas Data Review View Developer ACROBAT Power Pivot New Tab Tell me what you want to do...

Cut Copy Format Painter Paste Clipboard | Calibri 13 Font | Wrap Text Merge & Center Alignment | Number | Conditional Formatting Format as Table Styles | Insert Delete Format Cells

SECURITY WARNING Macros have been disabled. Enable Content

D9

Formula Bar

New Jersey Department of Environmental Protection

Site Remediation and Waste Management Program

Extractable Petroleum Hydrocarbon (EPH) Alternative Product Limit Concentration Calculator for Soil

Version 1.0, May 1, 2019 Release Date

Site Name:		Program Interest (PI) Num.	
Area of Concern Name		AOC No. (must correspond with CID)	
Investigator's Name			

Type of Petroleum Product	**No. 2 Heating Oil**	Default Product Indicator Concentration	**8,000**	mg/kg EPH
μ_o Dynamic Viscosity of the Petroleum Product (poise)	**0.02**	poise		
ρ_o Density of the Petroleum Product (gram/cm^3)	**0.8245**	gram/cm^3		

Select the number of Grain Size Samples that were analyzed for this AOC.
Click the quantity of grain size samples: 3 samples or 4 samples.

(•) 3 Grain Size Samples were analyzed ( ) 4 Grain Size Samples were analyzed

Ready

Type here to search

New Jersey Department of Environmental Protection
Site Remediation and Waste Management Program

Extractable Petroleum Hydrocarbon (EPH) Alternative Product Limit Concentration Calculator for Soil

Version 1.0, May 1, 2019 Release Date

Site Name:	ABC Site	Program Interest (PI) Num.	0012345
Area of Concern Name	Former Oil Tank Area	AOC No. (must correspond with CID)	10
Investigator's Name	LSRP O'DeYear		

Type of Petroleum Product	**No. 2 Heating Oil**	Default Product Indicator Concentration	**8,000**	mg/kg EPH

μ_o	Dynamic Viscosity of the Petroleum Product (poise)	**0.02**	poise
ρ_o	Density of the Petroleum Product (gram/cm^3)	**0.8245**	gram/cm^3

Select the number of Grain Size Samples that were analyzed for this AOC.

(●) 3 Grain Size Samples were analyzed

( ) 4 Grain Size Samples were analyzed

New Jersey Department of Environmental Protection

Site Remediation and Waste Management Program

Extractable Petroleum Hydrocarbon (EPH) Alternative Product Limit Concentration Calculator for Soil

Version 1.0, May 1, 2019 Release Date

Site Name:	ABC Site	Program Interest (PI) Num.	0012345
Area of Concern Name	Former Oil Tank Area	AOC No. (must correspond with CID)	10
Investigator's Name	LSRP O'DeYear		

Type of Petroleum Product	**No. 2 Heating Oil**	Default Product Indicator Concentration	**8,000**	mg/kg EPH
μ_o Dynamic Viscosity of the Petroleum Product	**0.02**	poise		
ρ_o Density of the Petroleum Product (gram/cm	**0.8245**	gram/cm^3		

No. 2 Heating Oil
Diesel Fuel
No. 4 Heating Oil
No. 6 Heating Oil
Hydraulic Oil
Cutting Oil
Lubricating Oil
Waste Oil- Known Source Material

Select the number of Grain Size Samples th analyzed for this AOC.

Click the quantity of grain size samples: 3 samples or 4 samples.

(●) 3 Grain Size Samples were analyzed

( ) 4 Grain Size Samples were analyzed

Step 2
Type of Petroleum Product Pull Down Options List

Type of Petroleum Product Source Material
No. 2 Heating Oil
Diesel Fuel
No. 4 Heating Oil
No. 6 Heating Oil
Hydraulic Oil
Cutting Oil
Lubricating Oil
Waste Oil
Unknown Petroleum Hydrocarbon
Waste Vehicular Crankcase Oil
Mineral Oil
Dielectric Fluid, Dielectric Mineral Oil, Transformer Oil
Crude Oil
Manufactured Gas Plant (MGP)

Type of Petroleum Product	**No. 2 Heating Oil**	Default Product Indicator Concentration	**8,000**	mg/kg EPH
μ_o Dynamic Viscosity of the Petroleum Product (poise)	**0.02**	poise		
ρ_o Density of the Petroleum Product (gram/cm^3)	**0.8245**	gram/cm^3		

(●) 3 Grain Size Samples were analyzed ( ) 4 Grain Size Samples were analyzed

	Sample 1	Sample 2	Sample 3	Sample 4
Sample Identification Name/Number				
For each sample, click the bullet corresponding to source of D_{10} value.	(●) Direct D10 input from lab report. ( ) Input sieve D10 data and determine through calculator.	(●) Direct D10 input from lab report. ( ) Input sieve D10 data and determine through calculator.	(●) Direct D10 input from lab report. ( ) Input sieve D10 data and determine through calculator.	(●) Direct D10 input from lab report. ( ) Input sieve D10 data and determine through calculator.
COMPLETE GRAIN SIZE DATA SHEET				
D_{10} Grain Size with 10% of Soil Passing through the Sieve (mm)	**0.000**	**0.000**	**0.000**	**0.000**
k Intrinsic Permeability (m^2) -calculated based on D_{10}	**1.10E-11**	**1.10E-11**	**1.10E-11**	**1.10E-11**

Step 3 – Define the number of grain size samples (either 3 or 4 grain size samples)

Type of Petroleum Product	**No. 2 Heating Oil**	Default Product Indicator Concentration	**8,000**	mg/kg EPH
	0.02	poise		
	0.8245	gram/cm^3		

○ 3 Grain Size Samples were analyzed

◉ 4 Grain Size Samples were analyzed

	Sample 1	**Sample 2**	**Sample 3**	**Sample 4**
Sample Identification Name/Number				
For each sample, click the bullet corresponding to source of D_{10} value.	◉ Direct D10 input from lab report. ○ Input sieve D10 data and determine through calculator.	○ Direct D10 input from lab report. ◉ Input sieve D10 data and determine through calculator.	○ Direct D10 input from lab report. ◉ Input sieve D10 data and determine through calculator.	◉ Direct D10 input from lab report. ○ Input sieve D10 data and determine through calculator.
COMPLETE GRAIN SIZE DATA SHEET				
D_{10} Grain Size with 10% of Soil Passing through the Sieve (mm)	**0.000**	**0.000**	**0.000**	**0.000**
k Intrinsic Permeability (m^2) -calculated based on D_{10}	**1.10E-11**	**1.10E-11**	**1.10E-11**	**1.10E-11**

Step 5a –Define the Data Structure of your D10 Grain Size Samples & Input Sample Names

	Default Product Indicator Concentration	8,000	mg/kg EPH
0.02	poise		
0.8245	gram/cm^3		

Grain Size Samples were analyzed

(•) 4 Grain Size Samples were analyzed

	Sample 1	Sample 2	Sample 3	Sample 4
Sample Identification Name/Number				
For each sample, click the bullet corresponding to source of D_{10} value.	(•) Direct D10 input from lab report. ( ) Input sieve D10 data and determine through calculator.	( ) Direct D10 input from lab report. (•) Input sieve D10 data and determine through calculator.	( ) Direct D10 input from lab report. (•) Input sieve D10 data and determine through calculator.	(•) Direct D10 input from lab report. ( ) Input sieve D10 data and determine through calculator.
	COMPLETE GRAIN SIZE DATA SHEET			
D_{10} Grain Size with 10% of Soil Passing through the Sieve (mm)	0.000	0.000	0.000	0.000
k Intrinsic Permeability (m^2) -calculated based on D_{10}	1.10E-11	1.10E-11	1.10E-11	1.10E-11

Step 5b –Switch to Grain Size Data Sheet

Type of Petroleum Product	**No. 2 Heating Oil**	Default Product Indicator Concentration	**8,000**	mg/kg EPH
μ_o Dynamic Viscosity of the Petroleum Product (poise)	**0.02**	poise		
ρ_o Density of the Petroleum Product (gram/cm^3)	**0.8245**	gram/cm^3		

Select the number of Grain Size Samples that were

○ 3 Grain Size Samples were analyzed ◉ 4 Grain Size Samples were analyzed

For each sample, click the bullet corresponding to source of D_{10} value.

COMPLETE GRAIN SIZE DATA SHEET

	Sample 1	**Sample 2**	**Sample 3**	**Sample 4**
	◉ Direct D10 input from lab report. ○ Input sieve D10 data and determine through calculator.	○ Direct D10 input from lab report. ◉ Input sieve D10 data and determine through calculator.	○ Direct D10 input from lab report. ◉ Input sieve D10 data and determine through calculator.	◉ Direct D10 input from lab report. ○ Input sieve D10 data and determine through calculator.
D_{10} Grain Size with 10% of Soil Passing through the Sieve (mm)	**0.000**	**0.000**	**0.000**	**0.000**
k Intrinsic Permeability (m^2) -calculated based on D_{10}	**1.10E-11**	**1.10E-11**	**1.10E-11**	**1.10E-11**

New Jersey Department of Environmental Protection

Site Remediation and Waste Management Program

Extractable Petroleum Hydrocarbon (EPH) Alternative Product Limit Concentration Calculator for Soil

Version 1.0, May 1, 2019 Release Date

Return to Summary Sheet

Sample 1

Lab Sample Name: 0

Lab D_{10}= mm

Sample 2

Lab Sample Name: 0

Grain Size from Sieve (mm of Sieve)	Percent of soil mass passing through the sieve	Percent of material mass retained on the sieve
		100%
		100%
		100%
		100%
		100%
		100%
		100%
		100%
		100%
		100%
		100%
		100%
		100%
		100%
		100%
		100%
		100%
Calc. D_{10}=	0.0000	mm

Sample 3

Lab Sample Name: 0

Grain Size from Sieve (mm of Sieve)	Percent of soil mass passing through the sieve	Percent of material mass retained on the sieve
		100%
		100%
		100%
		100%
		100%
		100%
		100%
		100%
		100%
		100%
		100%
		100%
		100%
		100%
		100%
		100%
		100%
Calc. D_{10}=	0.0000	mm

Sample 4

Lab Sample Name: 0

Lab D_{10}= mm

New Jersey Department of Environmental Protection

Site Remediation and Waste Management Program

Extractable Petroleum Hydrocarbon (EPH) Alternative Product Limit Concentration Calculator for Soil

Version 1.0, May 1, 2019 Release Date

Return to Summary Sheet

Sample 1

Lab Sample Name	GS-A
Lab D_{10}=	0.4659 mm

Sample 2

Lab Sample Name	GS-B2

Grain Size from Sieve (mm of Sieve)	Percent of soil mass passing through the sieve	Percent of material mass retained on the sieve
75	100.0%	0%
37.5	100.0%	0%
19	100.0%	0%
9.5	100.0%	0%
4.75	98.0%	2%
2.36	94.0%	6%
2	92.5%	8%
1.18	80.0%	20%
0.6	30.0%	70%
0.3	7.8%	92%
0.15	5.5%	95%
0.075	2.5%	98%
0.03	2.5%	98%
0.005	2.0%	98%
0.0015	1.2%	99%
Calc. D_{10}=	0.3297	mm

Sample 3

Lab Sample Name	GS-03

Grain Size from Sieve (mm of Sieve)	Percent of soil mass passing through the sieve	Percent of material mass retained on the sieve
75	100.0%	0%
37.5	100.0%	0%
19	100.0%	0%
9.5	100.0%	0%
4.75	100.0%	0%
2.36	100.0%	0%
2	100.0%	0%
1.18	82.0%	18%
0.6	20.0%	80%
0.3	4.0%	96%
0.15	3.8%	96%
0.075	3.8%	96%
0.03	1.2%	99%
0.005	1.0%	99%
0.0015	0.0%	100%
Calc. D_{10}=	0.4125	mm

Sample 4

Lab Sample Name	GS-D
Lab D_{10}=	0.1100 mm

Close-up view of GS-03, sieve data input.

The calculator interpolates between the two % passing values that bound 10%.

GS-03, D_{10} = 0.4125 mm

Direct read from the calculator.

Sample 3

Lab Sample Name	GS-03

	Grain Size from Sieve (mm of Sieve)	Percent of soil mass passing through the sieve	Percent of material mass retained on the sieve
	75	100.0%	0%
	37.5	100.0%	0%
	19	100.0%	0%
	9.5	100.0%	0%
	4.75	100.0%	0%
	2.36	100.0%	0%
	2	100.0%	0%
	1.18	82.0%	18%
	0.6	20.0%	80%
	0.3	4.0%	96%
	0.15	3.8%	96%
	0.075	3.8%	96%
	0.03	1.2%	99%
	0.005	1.0%	99%
	0.0015	0.0%	100%
	Calc. D_{10}=	0.4125	mm

New Jersey Department of Environmental Protection

Site Remediation and Waste Management Program

Extractable Petroleum Hydrocarbon (EPH) Alternative Product Limit Concentration Calculator for Soil

Version 1.0, May 1, 2019 Release Date

Return to Summary Sheet

Sample 1

Lab Sample Name	GS-A
Lab D_{10}=	0.4659 mm

Sample 2

Lab Sample Name	GS-B2

Grain Size from Sieve (mm of Sieve)	Percent of soil mass passing through the sieve	Percent of material mass retained on the sieve
75	100.0%	0%
37.5	100.0%	0%
19	100.0%	0%
9.5	100.0%	0%
4.75	98.0%	2%
2.36	94.0%	6%
2	92.5%	8%
1.18	80.0%	20%
0.6	30.0%	70%
0.3	7.8%	92%
0.15	5.5%	95%
0.075	2.5%	98%
0.03	2.5%	98%
0.005	2.0%	98%
0.0015	1.2%	99%
Calc. D_{10}=	0.3297	mm

Sample 3

Lab Sample Name	GS-03

Grain Size from Sieve (mm of Sieve)	Percent of soil mass passing through the sieve	Percent of material mass retained on the sieve
75	100.0%	0%
37.5	100.0%	0%
19	100.0%	0%
9.5	100.0%	0%
4.75	100.0%	0%
2.36	100.0%	0%
2	100.0%	0%
1.18	82.0%	18%
0.6	20.0%	80%
0.3	4.0%	96%
0.15	3.8%	96%
0.075	3.8%	96%
0.03	1.2%	99%
0.005	1.0%	99%
0.0015	0.0%	100%
Calc. D_{10}=	0.4125	mm

Sample 4

Lab Sample Name	GS-D
Lab D_{10}=	0.1100 mm

ρ_o Density of the Petroleum Product (gram/cm^3)	0.8245	gram/cm^3	

Select the number of Grain Size Samples that were analyzed for this AOC.
Click the quantity of grain size samples: 3 samples or 4 samples.

○ 3 Grain Size Samples were analyzed ◉ 4 Grain Size Samples were analyzed

	Sample 1	Sample 2	Sample 3	Sample 4
Sample Identification Name/Number				
For each sample, click the bullet corresponding to source of D_{10} value.	◉ Direct D10 input from lab report. ○ Input sieve D10 data and determine through calculator.	○ Direct D10 input from lab report. ◉ Input sieve D10 data and determine through calculator.	○ Direct D10 input from lab report. ◉ Input sieve D10 data and determine through calculator.	◉ Direct D10 input from lab report. ○ Input sieve D10 data and determine through calculator.
D_{10} Grain Size with 10% of Soil Passing through the Sieve (mm)	0.466	0.330	0.413	0.110
k Intrinsic Permeability (m^2) -calculated based on D_{10}	2.39E-10	1.20E-10	1.87E-10	1.33E-11

COMPLETE GRAIN SIZE DATA SHEET

Calculated EPH Product Limit Concentration for each grain size sample.	**mg/kg of EPH**	**8,000**	**8,832**	**8,273**	**13,036**
Maximum Allowable EPH Concentration in Soil (i.e., NJDEP Ceiling Limit)	**mg/kg of EPH**				

EPH Alternative Product Limit Concentration for Soil in this AOC **8,552** **mg/kg EPH**

ρ_o Density of the Petroleum Product (gram/cm^3)	0.8245	gram/cm^3	

Select the number of Grain Size Samples that were analyzed for this AOC.
Click the quantity of grain size samples: 3 samples or 4 samples.

○ 3 Grain Size Samples were analyzed	◉ 4 Grain Size Samples were analyzed

	Sample 1	Sample 2	Sample 3	Sample 4
Sample Identification Name/Number				
For each sample, click the bullet corresponding to source of D_{10} value.	◉ Direct D10 input from lab report. ○ Input sieve D10 data and determine through calculator.	○ Direct D10 input from lab report. ◉ Input sieve D10 data and determine through calculator.	○ Direct D10 input from lab report. ◉ Input sieve D10 data and determine through calculator.	◉ Direct D10 input from lab report. ○ Input sieve D10 data and determine through calculator.
D_{10} Grain Size with 10% of Soil Passing through the Sieve (mm)	0.466	0.330	0.413	0.110
k Intrinsic Permeability (m^2) -calculated based on D_{10}	2.39E-10	1.20E-10	1.87E-10	1.33E-11
Calculated EPH Product Limit Concentration for each grain size sample. mg/kg of EPH	8,000	8,832	8,273	13,036
Maximum Allowable EPH Concentration mg/kg of EPH				

COMPLETE GRAIN SIZE DATA SHEET

Step 7 – The calculated EPH Product Limit (the C value) for each grain size sample is shown.

ρ_o Density of the Petroleum Product (gram/cm^3)	0.8245	gram/cm^3	

Step 8 – The EPH Product Limit for this AOC is the median of the 4 Grain Size samples.

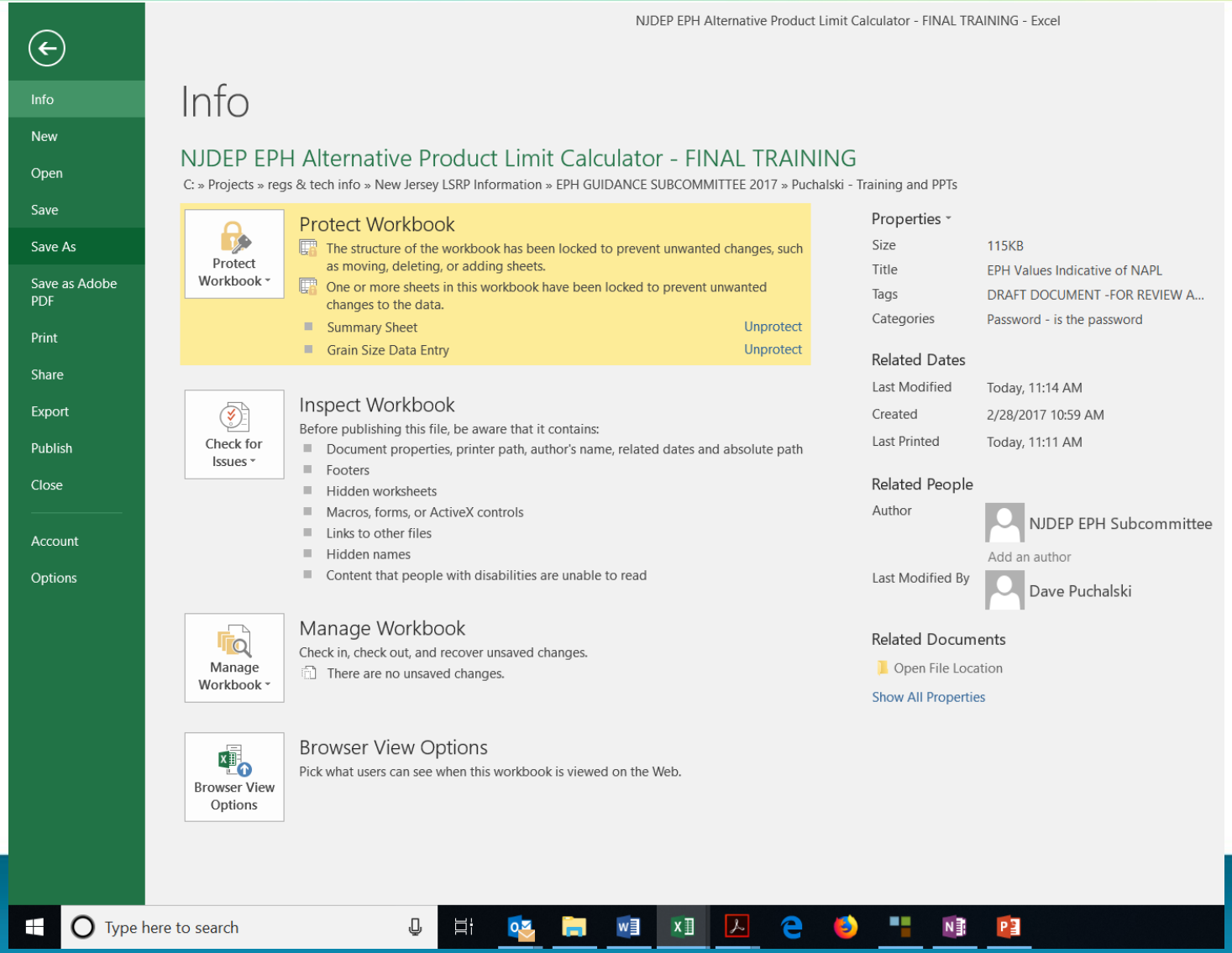
For this AOC, the EPH Alternative Product Limit is 8,552 mg/kg.

D_{10} Grain Size with 10% of Soil Passing through the Sieve (mm)		0.466	0.330	0.413	0.110
k Intrinsic Permeability (m^2) -calculated based on D_{10}		2.39E-10	1.20E-10	1.87E-10	1.33E-11
Calculated EPH Product Limit Concentration for each grain size sample.	**mg/kg of EPH**	**8,000**	**8,832**	**8,273**	**13,036**
Maximum Allowable EPH Concentration in Soil (i.e., NJDEP Ceiling Limit)	**mg/kg of EPH**				
EPH Alternative Product Limit Concentration for Soil in this AOC		**8,552**	**mg/kg EPH**		

Step 9 – Save Product Limit Calculator with a *Unique Name*

Reminder:

The calculator is a Macro Enabled file, with a *.xlsm extension.



Step 10a - Print the EPH Report

D_{10}	Grain Size with 10% of Soil Passing through the Sieve (mm)	0.466	0.330	0.413	0.110
k	Intrinsic Permeability (m^2) -calculated based on D_{10}	2.39E-10	1.20E-10	1.87E-10	1.33E-11
	Calculated EPH Product Limit Concentration for each grain size sample.	**mg/kg of EPH**	**8,000**	**8,832**	**8,273**	**13,036**
	Maximum Allowable EPH Concentration in Soil (i.e., NJDEP Ceiling Limit)	**mg/kg of EPH**			

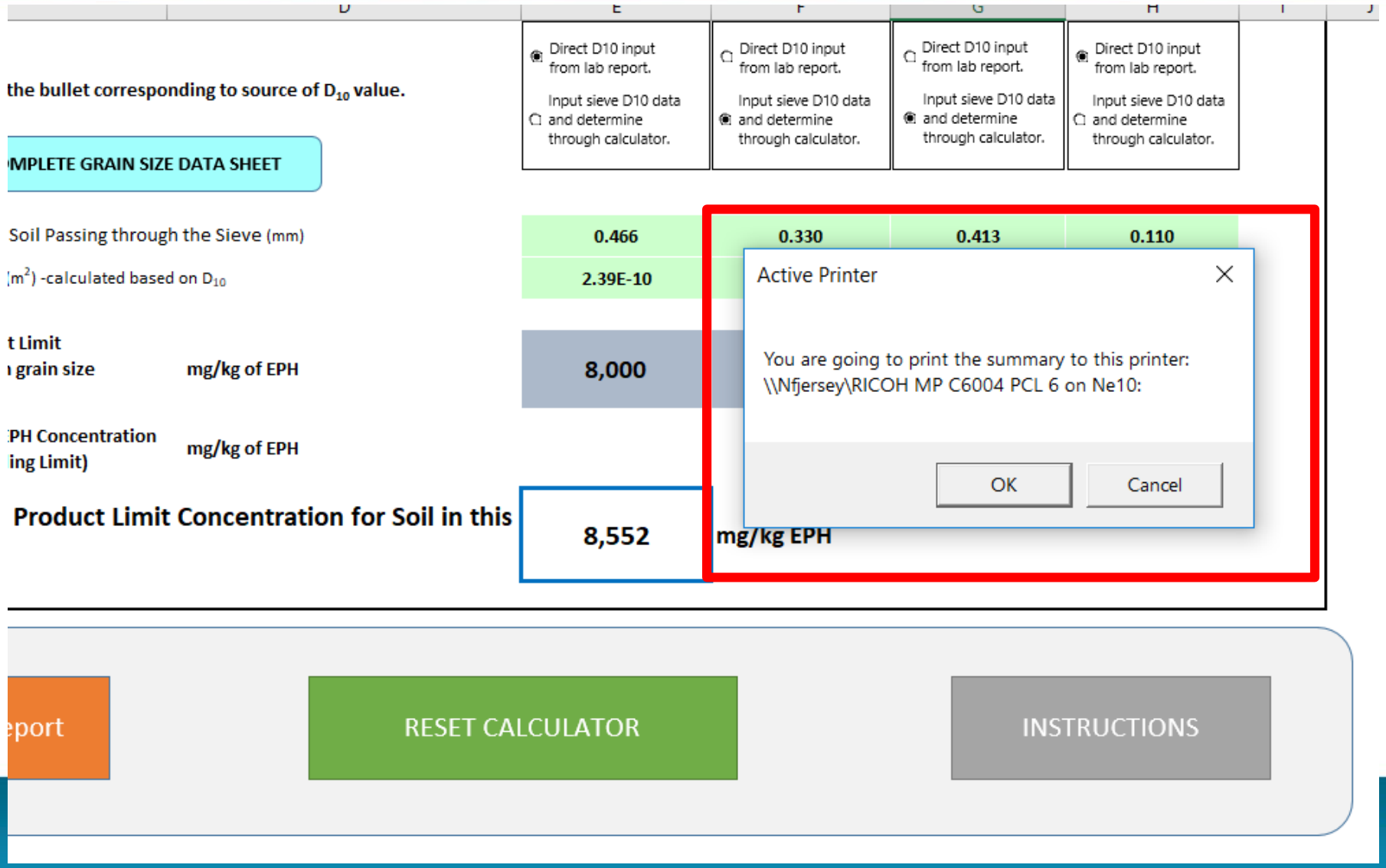
EPH Alternative Product Limit Concentration for Soil in this AOC **8,552** **mg/kg EPH**

PRINT EPH Report

RESET CALCULATOR

INSTRUCTIONS

Step 10b – Active Printer Screen Notice



Example Calculator Printout Sheet for this AOC

New Jersey Department of Environmental Protection
Site Remediation and Waste Management Program

Extractable Petroleum Hydrocarbon (EPH) Alternative Product Limit Concentration Calculator for Soil

Version 1.0, May 1, 2019 Release Date

Site Name:	ABC Site	Program Interest (PI) Num.	0012345
Area of Concern Name	Former Oil Tank Area	AOC No. (must correspond with CID)	10
Investigator's Name	LSRP O'DeYear		

Type of Petroleum Product	**No. 2 Heating Oil**	Default Product Indicator Concentration	**8,000**	mg/kg EPH
μ_o Dynamic Viscosity of the Petroleum Product (poise)	**0.02**	poise		
ρ_o Density of the Petroleum Product (gram/cm^3)	**0.8245**	gram/cm^3		

Select the number of Grain Size Samples that were analyzed for this AOC.
Click the quantity of grain size samples: 3 samples or 4 samples.

○ 3 Grain Size Samples were analyzed ● 4 Grain Size Samples were analyzed

	Sample 1	Sample 2	Sample 3	Sample 4
Sample Identification Name/Number				
For each sample, click the bullet corresponding to source of D_{10} value.	● Direct D10 input from lab report. ○ Input sieve D10 data and determine through calculator.	○ Direct D10 input from lab report. ● Input sieve D10 data and determine through calculator.	○ Direct D10 input from lab report. ● Input sieve D10 data and determine through calculator.	● Direct D10 input from lab report. ○ Input sieve D10 data and determine through calculator.
D_{10} Grain Size with 10% of Soil Passing through the Sieve (mm)	**0.466**	**0.330**	**0.413**	**0.110**
k Intrinsic Permeability (m^2) -calculated based on D_{10}	**2.39E-10**	**1.20E-10**	**1.87E-10**	**1.33E-11**
Calculated EPH Product Limit Concentration for each grain size sample. mg/kg of EPH	**8,000**	**8,832**	**8,273**	**13,036**

Maximum Allowable EPH Concentration in Soil (i.e., NJDEP Ceiling Limit) mg/kg of EPH

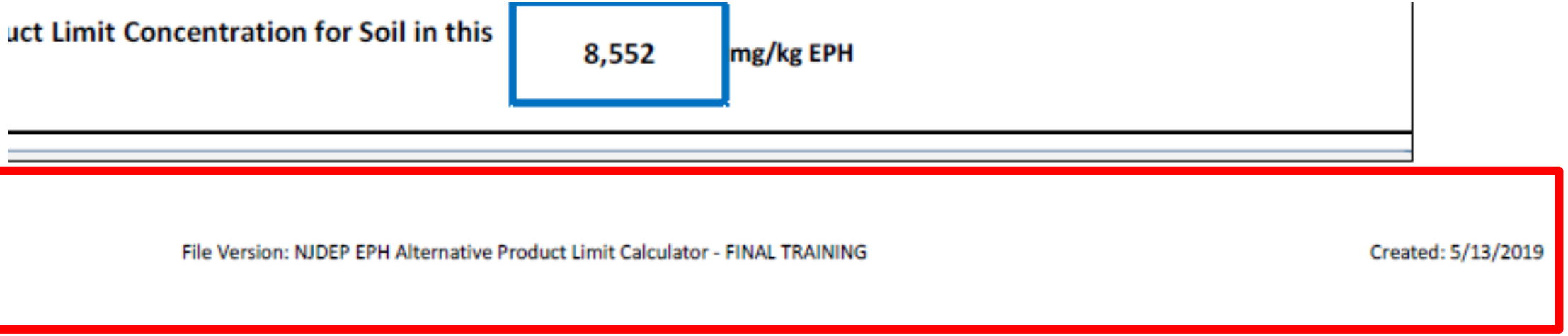
EPH Alternative Product Limit Concentration for Soil in this AOC **8,552** **mg/kg EPH**

COMPLETE GRAIN SIZE DATA SHEET

File Version: NJDEP EPH Alternative Product Limit Calculator - FINAL TRAINING

Created: 5/13/2019

Calculator Printout Reference



The calculator print setup includes the name of the calculator file in Excel format

and

The date the Calculator was printed

Step 11 – Reset Calculator for Next AOC

D_{10}	Grain Size with 10% of Soil Passing through the Sieve (mm)	0.466	0.330	0.413	0.110
k	Intrinsic Permeability (m^2) -calculated based on D_{10}	2.39E-10	1.20E-10	1.87E-10	1.33E-11
	Calculated EPH Product Limit Concentration for each grain size sample.	**mg/kg of EPH**	**8,000**	**8,832**	**8,273**	**13,036**
	Maximum Allowable EPH Concentration in Soil (i.e., NJDEP Ceiling Limit)	**mg/kg of EPH**				

EPH Alternative Product Limit Concentration for Soil in this AOC **8,552** **mg/kg EPH**

PRINT EPH Report

RESET CALCULATOR

INSTRUCTIONS

A Reset Calculator Screen

No site data
No Petroleum type
No D_{10} values
No EPH values
Identical Intrinsic Permeability values

Extractable Petroleum Hydrocarbon (EPH) Alternative Product Limit Concentration Calculator for Soil

Version 1.0, May 1, 2019 Release Date

Site Name:		Program Interest (PI) Num.	
Area of Concern Name		AOC No. (must correspond with CID)	
Investigator's Name			

Type of Petroleum Product		Default Product Indicator Concentration	#N/A	mg/kg EPH
μ_o Dynamic Viscosity of the Petroleum Product (poise)		#N/A	poise	
ρ_o Density of the Petroleum Product (gram/cm^3)		#N/A	gram/cm^3	

Select the number of Grain Size Samples that were analyzed for this AOC.
Click the quantity of grain size samples: 3 samples or 4 samples.

(•) 3 Grain Size Samples were analyzed ( ) 4 Grain Size Samples were analyzed

	Sample 1	Sample 2	Sample 3	Sample 4
Sample Identification Name/Number				
For each sample, click the bullet corresponding to source of D_{10} value.	(•) Direct D10 input from lab report. ( ) Input sieve D10 data and determine through calculator.	(•) Direct D10 input from lab report. ( ) Input sieve D10 data and determine through calculator.	(•) Direct D10 input from lab report. ( ) Input sieve D10 data and determine through calculator.	(•) Direct D10 input from lab report. ( ) Input sieve D10 data and determine through calculator.
D_{10} Grain Size with 10% of Soil Passing through the Sieve (mm)	0.000	0.000	0.000	0.000
k Intrinsic Permeability (m^2) -calculated based on D_{10}	1.10E-11	1.10E-11	1.10E-11	1.10E-11
Calculated EPH Product Limit Concentration for each grain size sample. mg/kg of EPH	#N/A	#N/A	#N/A	
Maximum Allowable EPH Concentration in Soil (i.e., NJDEP Ceiling Limit) mg/kg of EPH	#N/A	#N/A	#N/A	

EPH Alternative Product Limit Concentration for Soil in this AOC #N/A mg/kg EPH

COMPLETE GRAIN SIZE DATA SHEET

Instructions Fly-Out Sheet

D_{10}	Grain Size with 10% of Soil Passing through the Sieve (mm)	0.466	0.330	0.413	0.110
k	Intrinsic Permeability (m^2) -calculated based on D_{10}	2.39E-10	1.20E-10	1.87E-10	1.33E-11
	Calculated EPH Product Limit Concentration for each grain size sample. **mg/kg of EPH**	**8,000**	**8,832**	**8,273**	**13,036**
	Maximum Allowable EPH Concentration in Soil (i.e., NJDEP Ceiling Limit) **mg/kg of EPH**				

EPH Alternative Product Limit Concentration for Soil in this AOC **8,552** **mg/kg EPH**

PRINT EPH Report

RESET CALCULATOR

INSTRUCTIONS

Instructions Fly-Out Sheet

New Jersey Department of Environmental Protection
Site Remediation and Waste Management Program

Extractable Petroleum Hydrocarbon (EPH) Alternative Product Limit Concentration Calculator for Soil
Version 1.0, May 1, 2019 Release Date

Site Name:	ABC Site	Program Interest (PI) Num.	0012345
Area of Concern Name	Former Oil Tank Area	AOC No. (must correspond with CID)	10
Investigator's Name	LSRP O'DeYear		

Type of Petroleum Product	**No. 2 Heating Oil**	Default Product Indicator Concentration	**8,000**	mg/kg EPH
μ Dynamic Viscosity of the Petroleum Product (poise)	**0.02**	poise		
ρ Density of the Petroleum Product (gram/cm^3)	**0.8245**	gram/cm^3		

Select the number of Grain Size Samples that were analyzed for this AOC.
Click the quantity of grain size samples: 3 samples or 4 samples.

○ 3 Grain Size Samples were analyzed ◉ 4 Grain Size Samples were analyzed

	Sample 1	Sample 2	Sample 3	Sample 4
Sample Identification Name/Number				
For each sample, click the bullet corresponding to source of D_{10} value.	◉ Direct D10 input from lab report. ○ Input sieve D10 data and determine through calculator.	○ Direct D10 input from lab report. ◉ Input sieve D10 data and determine through calculator.	○ Direct D10 input from lab report. ◉ Input sieve D10 data and determine through calculator.	◉ Direct D10 input from lab report. ○ Input sieve D10 data and determine through calculator.
D_{10} Grain Size with 10% of Soil Passing through the Sieve (mm)	**0.466**	**0.330**	**0.413**	**0.110**
k Intrinsic Permeability (m^2) -calculated based on D_{10}	**2.39E-10**	**1.20E-10**	**1.87E-10**	**1.33E-11**
Calculated EPH Product Limit Concentration for each grain size sample. mg/kg of EPH	8,000	8,832	8,273	13,036
Maximum Allowable EPH Concentration in Soil (i.e., NJDEP Ceiling Limit) mg/kg of EPH				

COMPLETE GRAIN SIZE DATA SHEET

EPH Alternative Product Limit Concentration for Soil in this AOC 8,552 mg/kg EPH

PRINT EPH Report | RESET CALCULATOR | INSTRUCTIONS

Close Instructions

Instructions for using the EPH Alternative Product Limit Concentration Calculator.

Use this calculator in accordance with the Department's *Technical Guidance for Evaluation of Extractable Petroleum Hydrocarbons in Soil*. This calculator provides a tool for the investigator to calculate an AOC-specific alternative EPH product limit concentration. To use the calculator, the investigator must identity the petroleum product as listed in Table 2-1 at N.J.A.C. 7:26E-2.1(d) and have the laboratory report of the grain size distribution analyses. The investigator can input the effective diameter (D_{10}) reported by the laboratory, or the investigator can input the grain size distribution values and the calculator will generate the D_{10} value.

Complete the following actions:

1. Input the general information including the Site Name, PI number for the Site, AOC Name and AOC Number from the CID as applicable, and the investigator's name in the corresponding blue fields.
2. To the right of "Type of Petroleum Product", click in the blue field, and then select the applicable petroleum product from the dropdown list (identical to Table 2-1 at N.J.A.C. 7:26E-2.1(d)). If the petroleum product is Waste Oil with known source(s), select instead the source petroleum product from the dropdown list; or if the source petroleum product is not identified on the dropdown list or is unknown, select Unknown Petroleum Hydrocarbon. This ensures the correct dynamic viscosity and density values are incorporated into the calculation.

   Contact the Department if the petroleum product is MGP or Crude Oil.
3. Choose the selector button corresponding to the number of grain size samples that were analyzed. The selection options are 3 and 4 samples.
4. In the blue fields to the right of **Sample Identification Name/Number**, input the Sample ID for each sample analyzed for grain size.
5. For each sample, click the radio button corresponding to source of the D_{10} value.

   The default option is "Direct D_{10} input from lab report" when D_{10} has been calculated and reported by the laboratory. If this option is chosen, click on the blue box: **COMPLETE GRAIN SIZE DATA SHEET**, which opens the sheet **Grain Size Data Entry**. Click in the gray field to the right of **Lab D_{10}** and enter the D_{10} value. Do this for each sample. When finished, click **Return to Summary.**

   If D_{10} is not provided by the laboratory, the investigator selects "Input sieve D_{10} data and determine through this calculator". Next, click on the blue box: **COMPLETE GRAIN SIZE DATA SHEET**, which opens the sheet **Grain Size Data Entry**. In the column titled "Grain Size from Sieve (mm of Sieve)", starting at the bottom, enter the corresponding sieve size in mm from finest upward to coarsest for each sieve size reported by the laboratory. In the column directly to the right titled "Percent of soil mass passing through the sieve", enter the percent passing corresponding to each sieve size. The D_{10} value for the sample is displayed in the gray field to the right of "Calc D_{10}". Continue the data entry process for the remainder of the samples. When finished, click: **Return to Summary**
6. The **Summary Sheet** displays the D_{10} value for each sample and computes the intrinsic permeability (k), displaying both parameters below the corresponding sample in the green fields.
7. The **Calculated EPH Product Limit Concentration** for each sample is displayed on Line 27. If a displayed **Calculated EPH Product Limit Concentration** has a strikethrough, then the concentration for that sample exceeds the 30,000 mg/kg EPH Ceiling Limit.
8. Line 29 provides the **Alternative EPH Product Limit Concentration for Soil in this AOC** (cell E29). The concentration is the lesser of the median value for the **Calculated EPH Product Limit Concentrations** from Line 27 -OR- the 30,000 mg/kg EPH ceiling limit.
9. Save the spreadsheet with a unique file name and date within the project file.
10. Print the **Summary Sheet** by selecting "**PRINT EPH Report**". Return to the **Grain Size Data Entry** sheet and print it separately.
11. To run another set of samples or to calculate an Alternative EPH Product Limit Concentration for a second petroleum product stored/discharged at the AOC, click "RESET CALCULATOR" and return to Step 1.

Instructions –Intro & Action 1 to 4

Instructions for using the EPH Alternative Product Limit Concentration Calculator.

Use this calculator in accordance with the Department's *Technical Guidance for Evaluation of Extractable Petroleum Hydrocarbons in Soil*. This calculator provides a tool for the investigator to calculate an AOC-specific alternative EPH product limit concentration. To use the calculator, the investigator must identity the petroleum product as listed in Table 2-1 at N.J.A.C. 7:26E-2.1(d) and have the laboratory report of the grain size distribution analyses. The investigator can input the effective diameter (D_{10}) reported by the laboratory, or the investigator can input the grain size distribution values and the calculator will generate the D_{10} value.

Complete the following actions:

1. Input the general information including the Site Name, PI number for the Site, AOC Name and AOC Number from the CID as applicable, and the investigator's name in the corresponding blue fields.
2. To the right of "Type of Petroleum Product", click in the blue field, and then select the applicable petroleum product from the dropdown list (identical to Table 2-1 at N.J.A.C. 7:26E-2.1(d)). If the petroleum product is Waste Oil with known source(s), select instead the source petroleum product from the dropdown list; or if the source petroleum product is not identified on the dropdown list or is unknown, select Unknown Petroleum Hydrocarbon. This ensures the correct dynamic viscosity and density values are incorporated into the calculation.

   Contact the Department if the petroleum product is MGP or Crude Oil.
3. Choose the selector button corresponding to the number of grain size samples that were analyzed. The selection options are 3 and 4 samples.
4. In the blue fields to the right of **Sample Identification Name/Number**, input the Sample ID for each sample analyzed for grain size.

Instructions –Action 5 to 8

5. For each sample, click the radio button corresponding to source of the D_{10} value.

   The default option is "Direct D_{10} input from lab report" when D_{10} has been calculated and reported by the laboratory. If this option is chosen, click on the blue box: **COMPLETE GRAIN SIZE DATA SHEET**, which opens the sheet **Grain Size Data Entry**. Click in the gray field to the right of **Lab D_{10}** and enter the D_{10} value. Do this for each sample. When finished, click **Return to Summary.**

   If D_{10} is not provided by the laboratory, the investigator selects "Input sieve D_{10} data and determine through this calculator". Next, click on the blue box: **COMPLETE GRAIN SIZE DATA SHEET**, which opens the sheet **Grain Size Data Entry**. In the column titled "Grain Size from Sieve (mm of Sieve)", starting at the bottom, enter the corresponding sieve size in mm from finest upward to coarsest for each sieve size reported by the laboratory. In the column directly to the right titled "Percent of soil mass passing through the sieve", enter the percent passing corresponding to each sieve size. The D_{10} value for the sample is displayed in the gray field to the right of "Calc D_{10}". Continue the data entry process for the remainder of the samples. When finished, click: **Return to Summary**

6. The **Summary Sheet** displays the D_{10} value for each sample and computes the intrinsic permeability (k), displaying both parameters below the corresponding sample in the green fields.

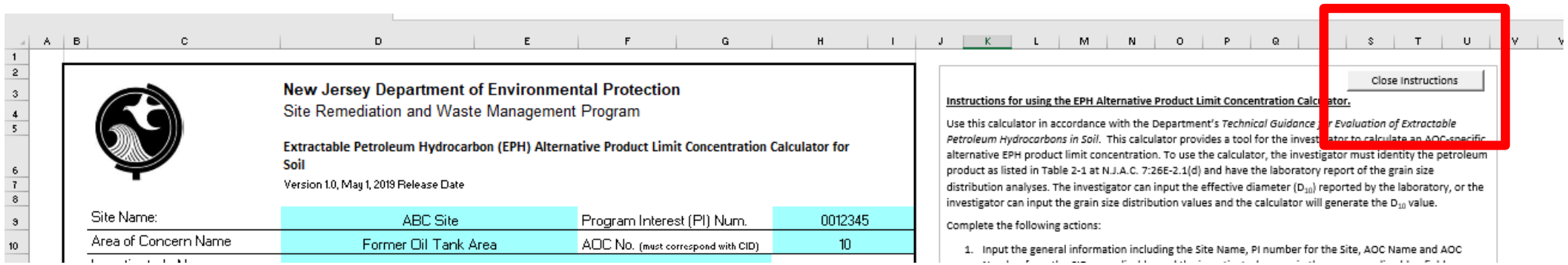
7. The **Calculated EPH Product Limit Concentration** for each sample is displayed on Line 27. If a displayed **Calculated EPH Product Limit Concentration** has a strikethrough, then the concentration for that sample exceeds the 30,000 mg/kg EPH Ceiling Limit.

8. Line 29 provides the **Alternative EPH Product Limit Concentration for Soil in this AOC** (cell E29). The concentration is the lesser of the median value for the **Calculated EPH Product Limit Concentrations** from Line 27 -OR- the 30,000 mg/kg EPH ceiling limit.

Instructions –Action 9 to 11

9. Save the spreadsheet with a unique file name and date within the project file.
10. Print the **Summary Sheet** by selecting "**PRINT EPH Report**". Return to the **Grain Size Data Entry** sheet and print it separately.
11. To run another set of samples or to calculate an Alternative EPH Product Limit Concentration for a second petroleum product stored/discharged at the AOC, click "RESET CALCULATOR" and return to Step 1.

Close Instructions – Selection button.



Eccentricities in the Calculator

1. Quantity of Grain Size Samples – Radio selector buttons

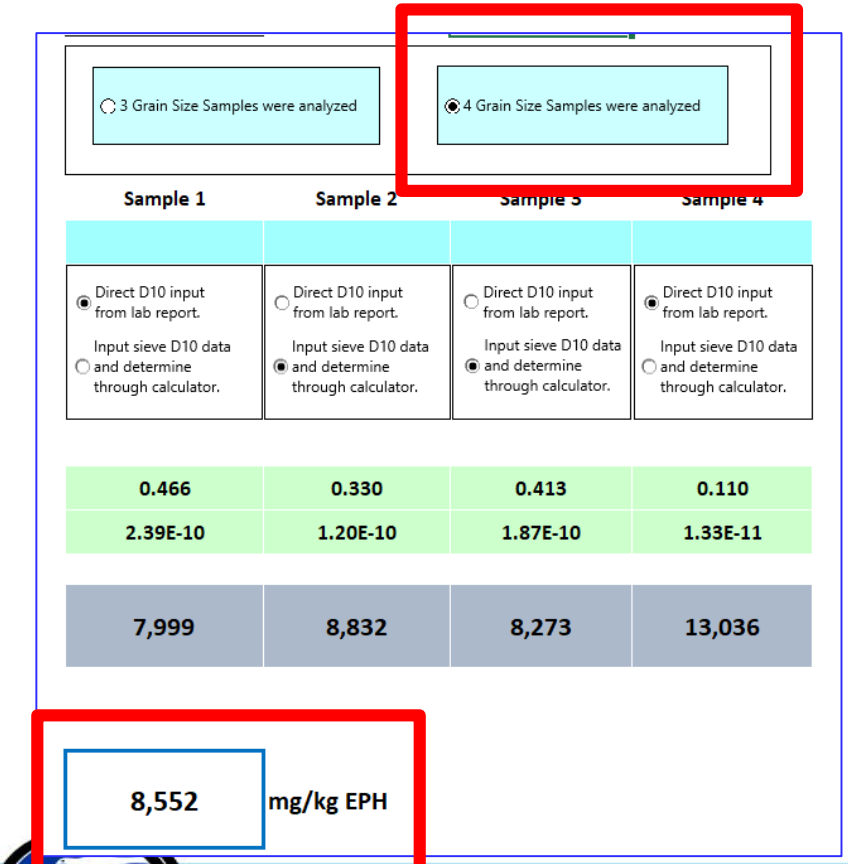
2. Same grain sizes – Different Petroleum Product Type

3. Grain Size Samples Yielding Alternate Product Limit Concentrations Above and Below the Ceiling Limit

4. Grain Size Samples are below the Default Product Limit Concentration

Quantity of Grain Size Samples Must be Confirmed See "Radio" Selector Buttons

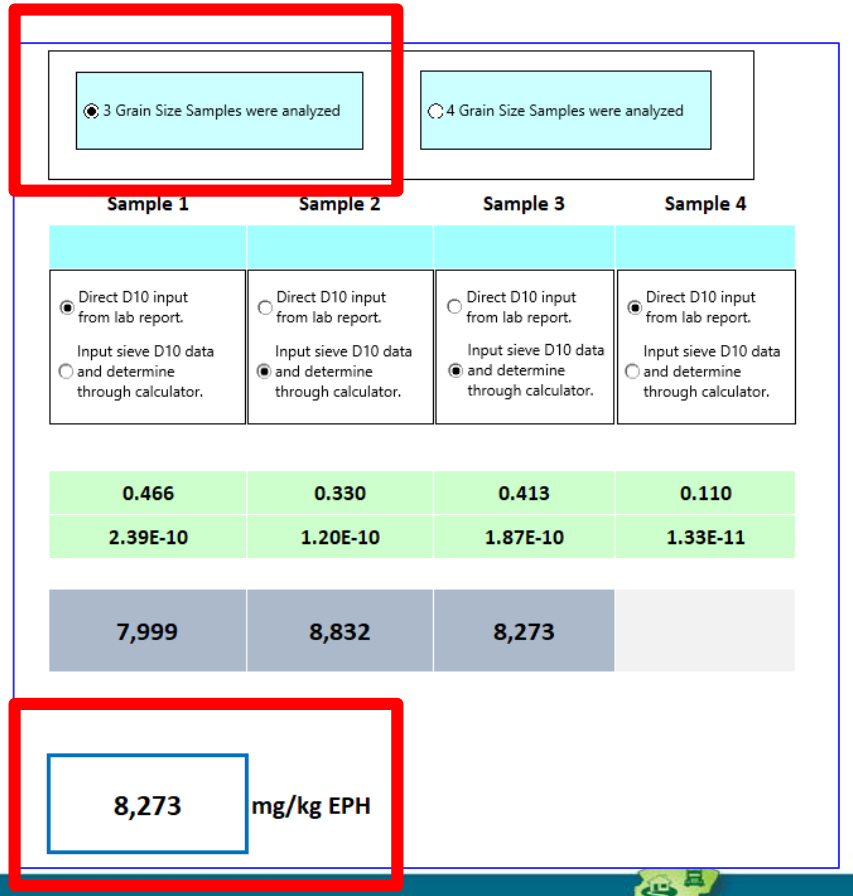
4 Grain Size Samples



4 samp = 8,552 mg/kg

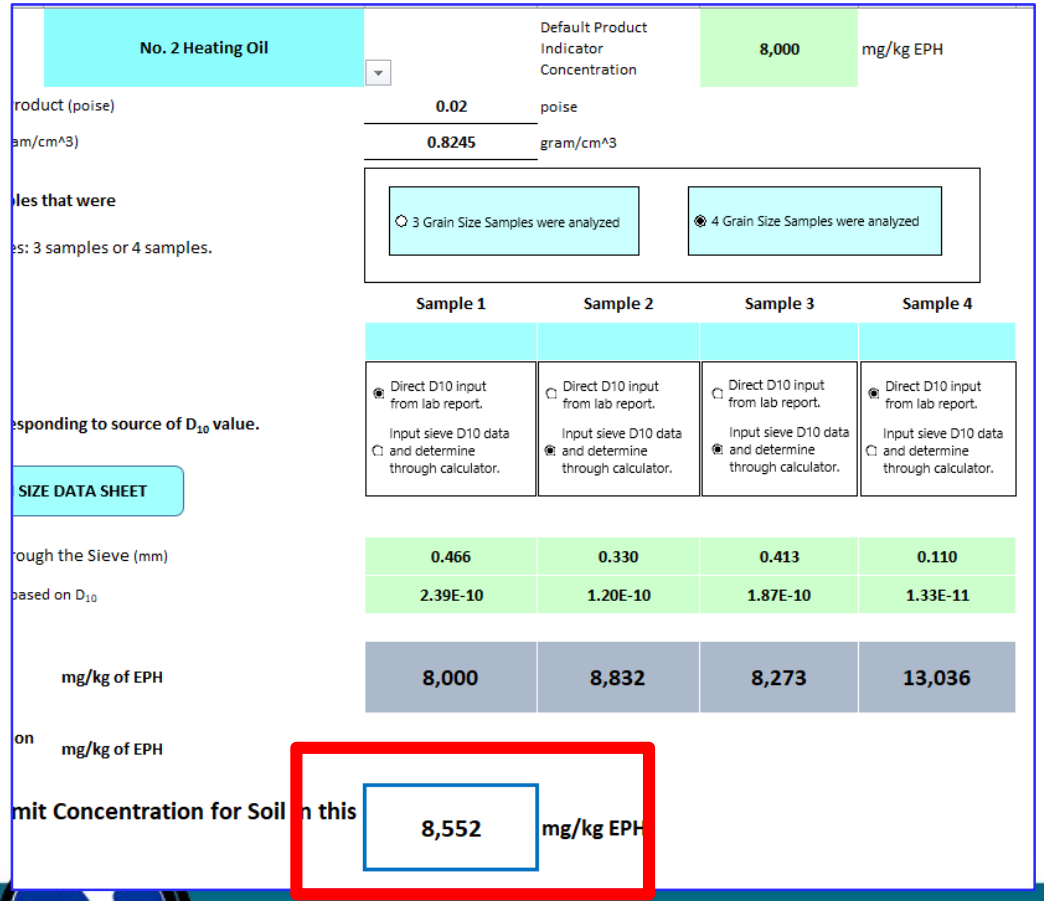
3 samp = 8,273 mg/kg

3 Grain Size Samples



Same Grain Sizes – Different Petroleum Product Type

#2 Fuel Oil = 8,552 mg/kg



No. 2 Heating Oil	Default Product Indicator Concentration	8,000	mg/kg EPH
roduct (poise)	0.02	poise	
am/cm^3)	0.8245	gram/cm^3	

les that were

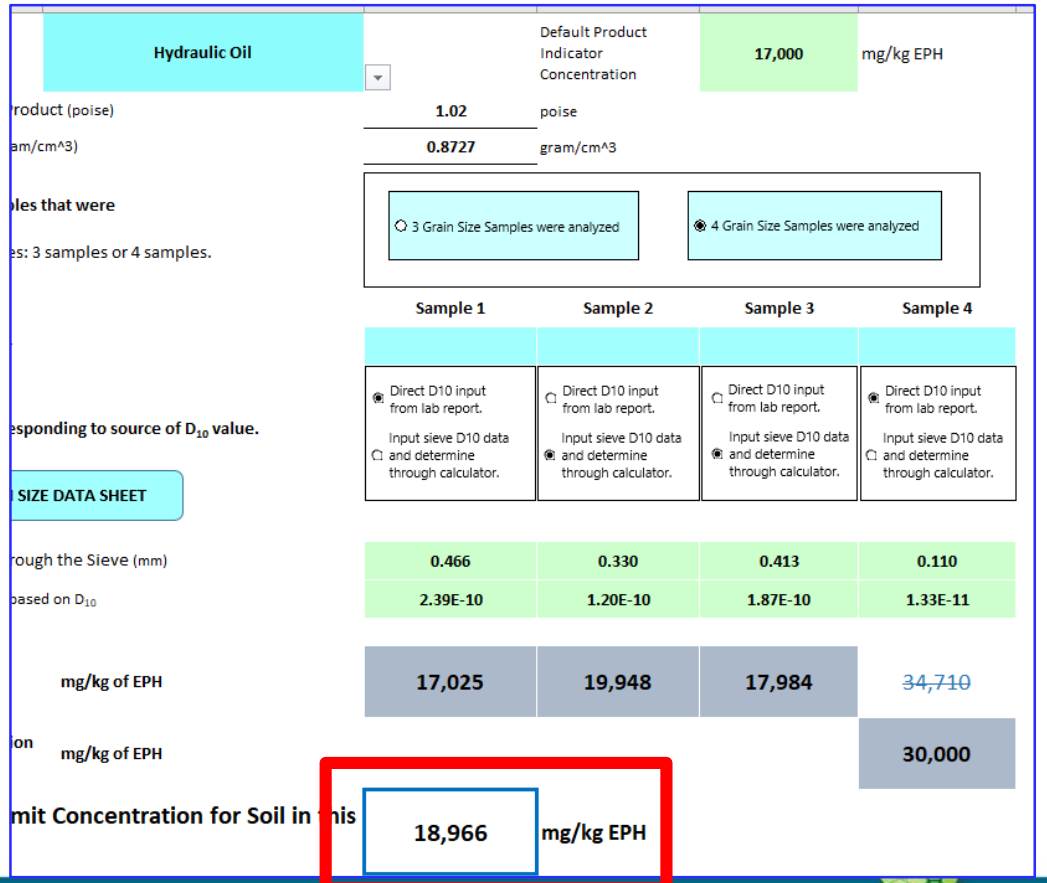
s: 3 samples or 4 samples.

○ 3 Grain Size Samples were analyzed ◉ 4 Grain Size Samples were analyzed

	Sample 1	Sample 2	Sample 3	Sample 4
sponding to source of D_{10} value.	◉ Direct D10 input from lab report. ○ Input sieve D10 data and determine through calculator.	○ Direct D10 input from lab report. ◉ Input sieve D10 data and determine through calculator.	○ Direct D10 input from lab report. ◉ Input sieve D10 data and determine through calculator.	◉ Direct D10 input from lab report. ○ Input sieve D10 data and determine through calculator.
SIZE DATA SHEET				
rough the Sieve (mm)	0.466	0.330	0.413	0.110
based on D_{10}	2.39E-10	1.20E-10	1.87E-10	1.33E-11
mg/kg of EPH	8,000	8,832	8,273	13,036
on mg/kg of EPH				

mit Concentration for Soil n this **8,552** mg/kg EPH

Hydraulic Oil = 18,966 mg/kg



Hydraulic Oil	Default Product Indicator Concentration	17,000	mg/kg EPH
roduct (poise)	1.02	poise	
am/cm^3)	0.8727	gram/cm^3	

les that were

s: 3 samples or 4 samples.

○ 3 Grain Size Samples were analyzed ◉ 4 Grain Size Samples were analyzed

	Sample 1	Sample 2	Sample 3	Sample 4
sponding to source of D_{10} value.	◉ Direct D10 input from lab report. ○ Input sieve D10 data and determine through calculator.	○ Direct D10 input from lab report. ◉ Input sieve D10 data and determine through calculator.	○ Direct D10 input from lab report. ◉ Input sieve D10 data and determine through calculator.	◉ Direct D10 input from lab report. ○ Input sieve D10 data and determine through calculator.
SIZE DATA SHEET				
rough the Sieve (mm)	0.466	0.330	0.413	0.110
based on D_{10}	2.39E-10	1.20E-10	1.87E-10	1.33E-11
mg/kg of EPH	17,025	19,948	17,984	~~34,710~~
on mg/kg of EPH				30,000

mit Concentration for Soil in this **18,966** mg/kg EPH

Grain Size Samples Yielding Alternate Product Limit Concentrations Above and Below the Ceiling Limit

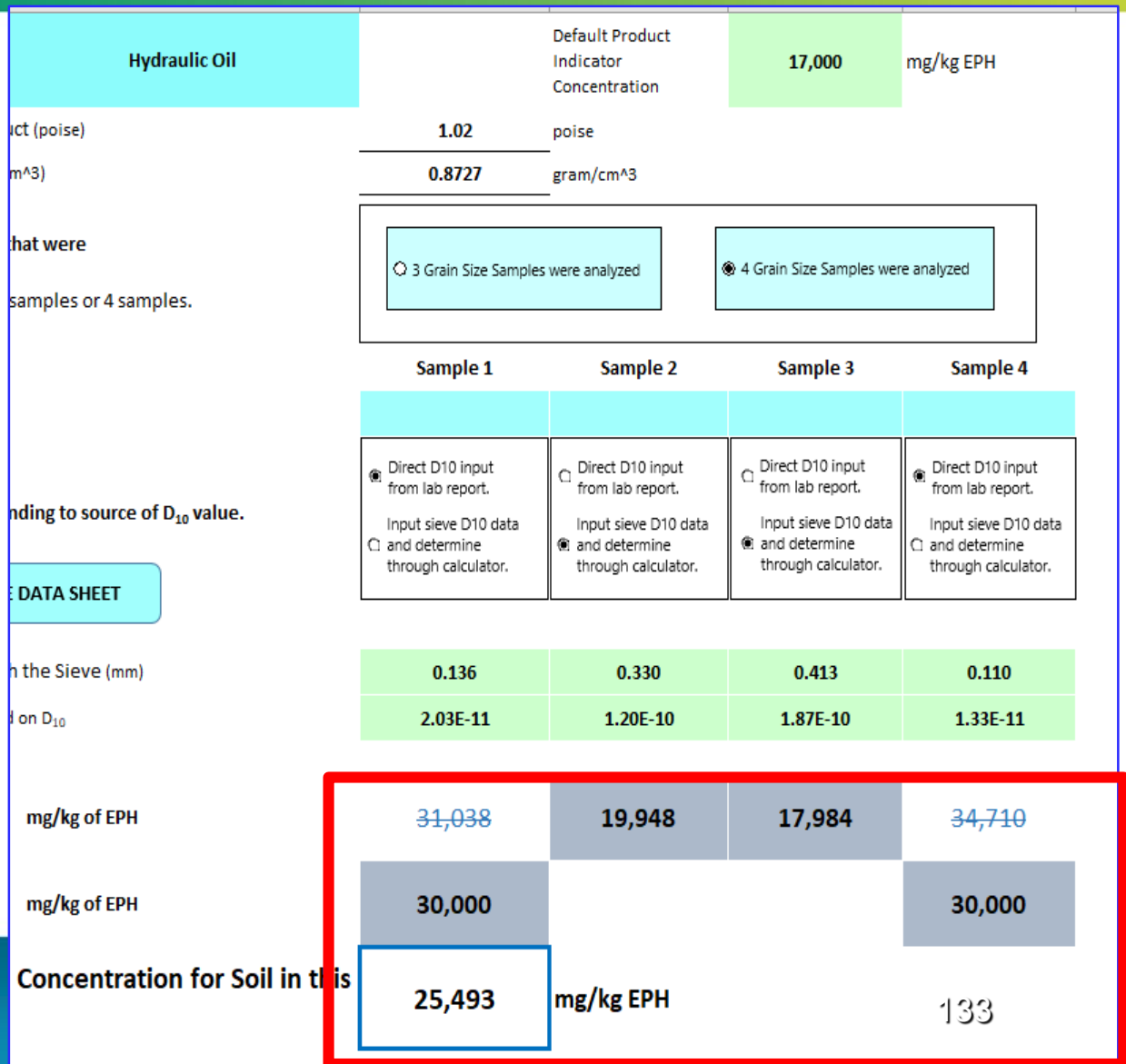
Hydraulic Oil example

2 Samples calculate > 30,000 mg/kg

2 Samples calculate < 30,000 mg/kg

Result = Median using the calculated values (31,038 and 34,710 mg/kg)

"C" Result = 25,493 mg/kg



Hydraulic Oil		Default Product Indicator Concentration	17,000	mg/kg EPH
ct (poise)	1.02	poise		
m^3)	0.8727	gram/cm^3		
hat were	○ 3 Grain Size Samples were analyzed		◉ 4 Grain Size Samples were analyzed	
samples or 4 samples.				
	Sample 1	Sample 2	Sample 3	Sample 4
nding to source of D_{10} value.	◉ Direct D10 input from lab report. ○ Input sieve D10 data and determine through calculator.	○ Direct D10 input from lab report. ◉ Input sieve D10 data and determine through calculator.	○ Direct D10 input from lab report. ◉ Input sieve D10 data and determine through calculator.	◉ Direct D10 input from lab report. ○ Input sieve D10 data and determine through calculator.
DATA SHEET				
h the Sieve (mm)	0.136	0.330	0.413	0.110
d on D_{10}	2.03E-11	1.20E-10	1.87E-10	1.33E-11
mg/kg of EPH	~~31,038~~	19,948	17,984	~~34,710~~
mg/kg of EPH	30,000			30,000
Concentration for Soil in this	25,493	mg/kg EPH		

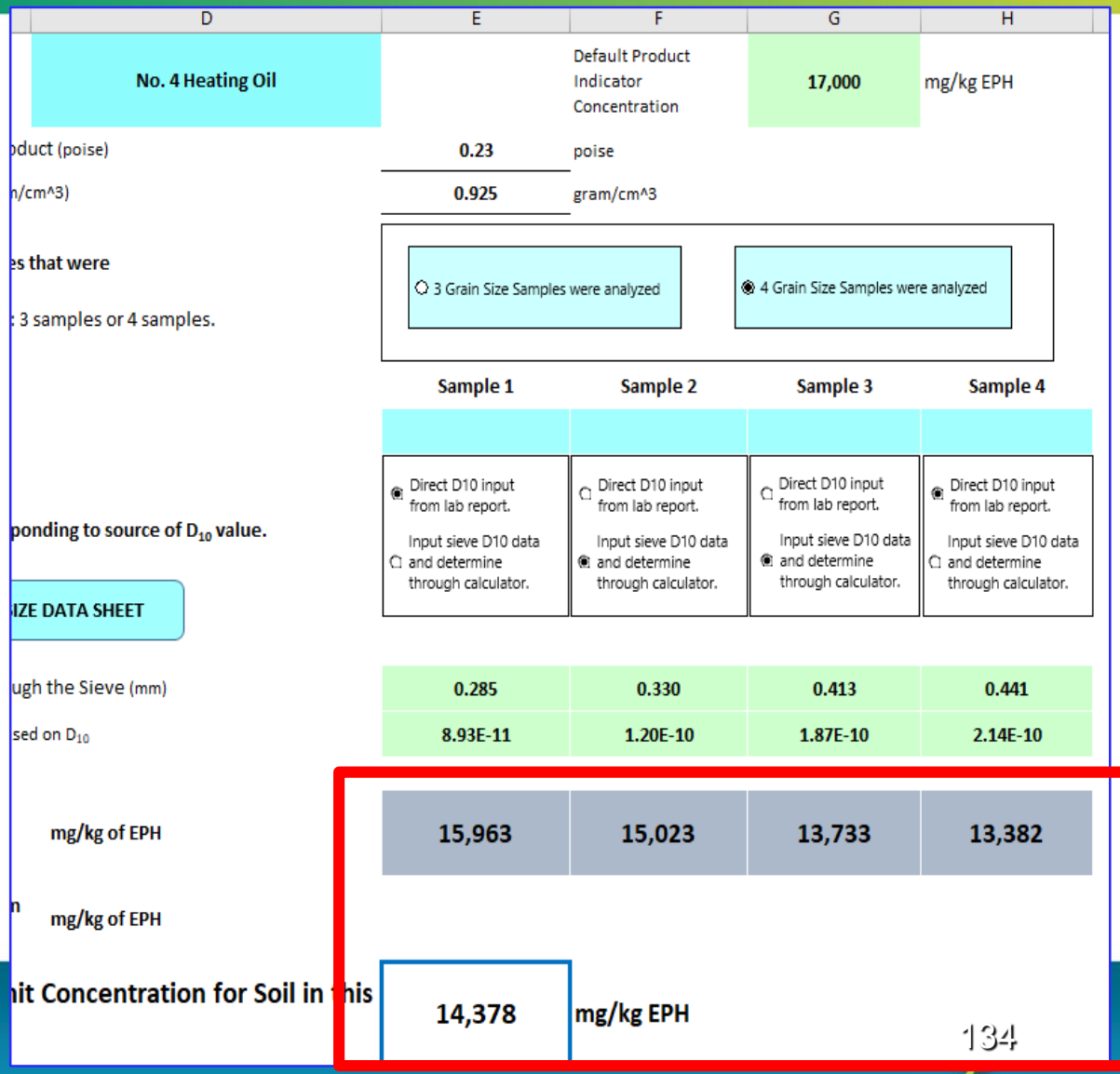
Grain Size Samples are below the Default Product Limit Concentration

#4 Fuel Oil Examples

4 Samples calculate > 17,000 mg/kg

"C" Result = 14,378 mg/kg

LSRP is allowed to use the Cat 2 Default Product Indicator Concentration = 17,000 mg/kg



D	E	F	G	H
No. 4 Heating Oil		Default Product Indicator Concentration	17,000	mg/kg EPH
oduct (poise)	0.23	poise		
n/cm^3)	0.925	gram/cm^3		
es that were	○ 3 Grain Size Samples were analyzed		◉ 4 Grain Size Samples were analyzed	
3 samples or 4 samples.				
	Sample 1	Sample 2	Sample 3	Sample 4
ponding to source of D_{10} value.	◉ Direct D10 input from lab report. ○ Input sieve D10 data and determine through calculator.	○ Direct D10 input from lab report. ◉ Input sieve D10 data and determine through calculator.	○ Direct D10 input from lab report. ◉ Input sieve D10 data and determine through calculator.	◉ Direct D10 input from lab report. ○ Input sieve D10 data and determine through calculator.
IZE DATA SHEET				
ugh the Sieve (mm)	0.285	0.330	0.413	0.441
sed on D_{10}	8.93E-11	1.20E-10	1.87E-10	2.14E-10
mg/kg of EPH	15,963	15,023	13,733	13,382
n mg/kg of EPH				
it Concentration for Soil in his	14,378	mg/kg EPH		

Questions?

What to Include in Report Submissions

John Ruhl, Technical Coordinator
Bureau of Environmental Evaluation
and Risk Assessment

Objectives

- EPH Alternative Product Limit Calculation - Report content
- Conclusions
- EPH Technical Questions / Dept. Contact

What to Submit - EPH Alternative Product Limit

Technical Rules

- Applicable phase documentation/discussion
- Information pursuant to N.J.A.C. 7:26E-1.6

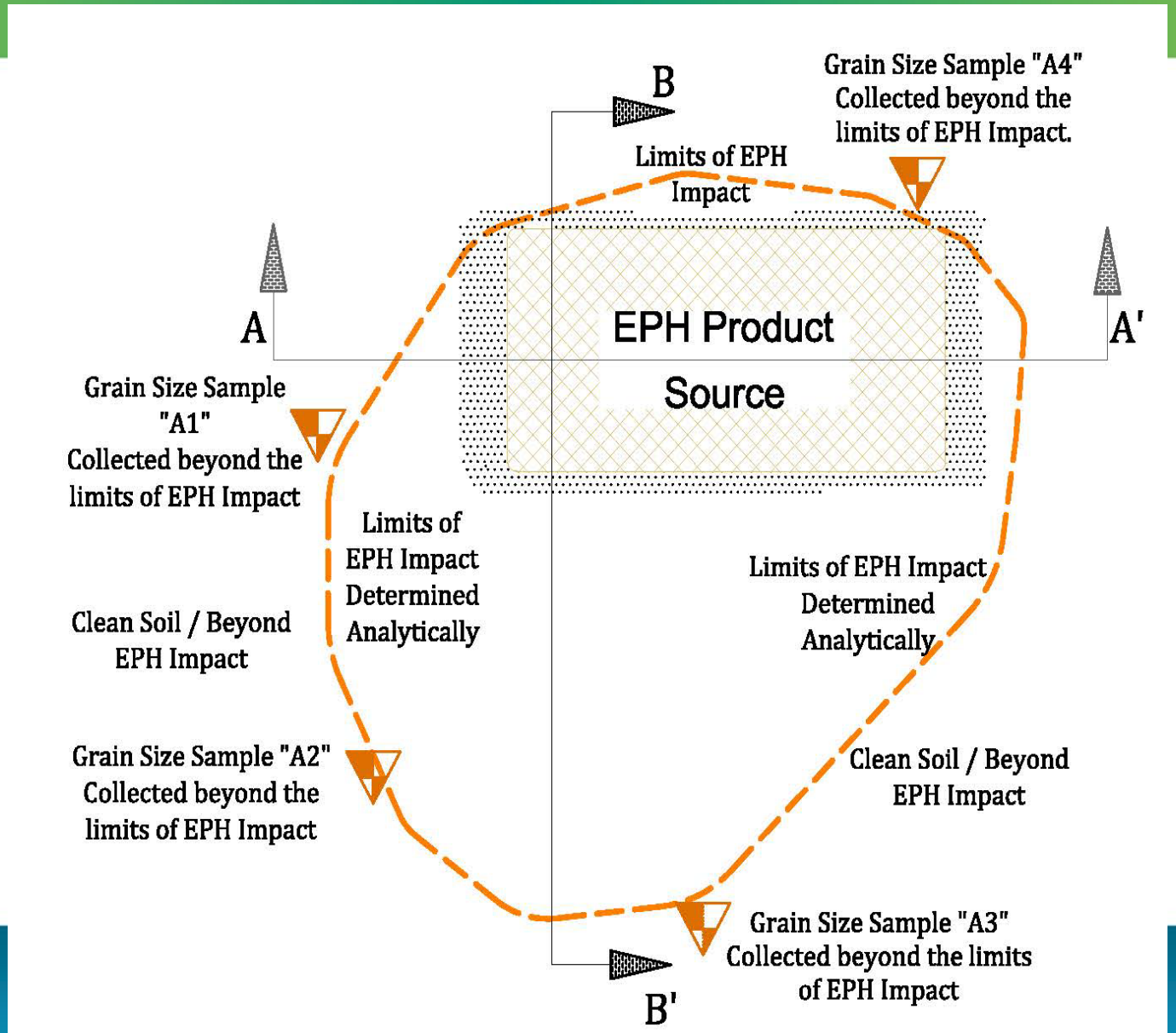
What to Submit - EPH Alternative Product Limit (cont'd)

AOC-specific info:

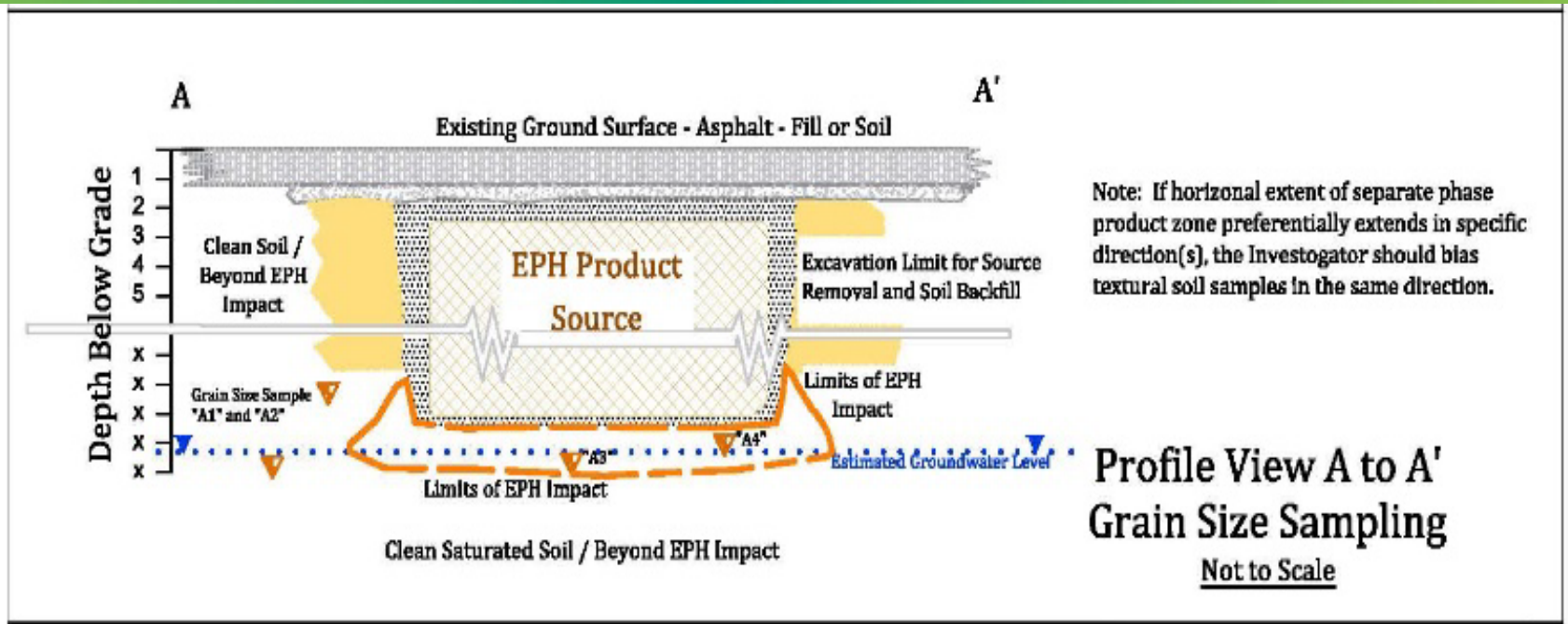
- Petroleum product identity
- Source Description (e.g., UST, AST, etc.)/Cause of discharge
- EPH product limits (defaults and alternative)
- Figures & vertical soil profiles across EPH product zone demonstrating delineation (include boring logs) [refer to Figure 2.1-1 in the guidance]
- All printouts from EPH Alternative Product Limit Calculator
- Complete lab data deliverables for all grain size distribution analysis(es): how D_{10} calculated

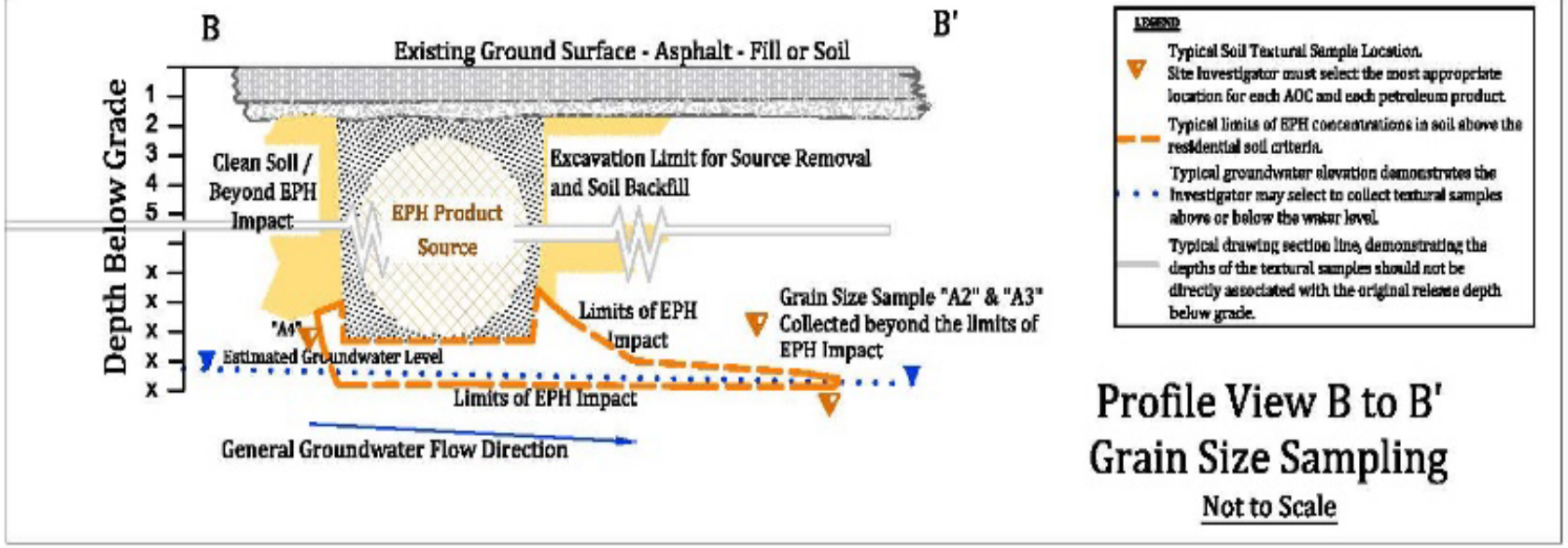
Appendix 2.2

EPH Grain Size Sample Notes - Horizontal



Typical Cross Sections- Grain Size Sample Locations





How to Use pre-September 2010 TPH Data

Cat 1 EPH only

- TPH data can be used
  - TPH/EPH data considered comparable (1:1 ratio)
- TPH or EPH > 1,000 mg/kg
  - Resample 25% for naphthalene & 2-methylnaphthalene
  - Bias locations to highest TPH/EPH detections
- Remediate TPH > 10,000 mg/kg

Appendix 3.5

How to Use pre-September 2010 TPH Data

Cat 2 EPH only

- TPH >2,300 mg/kg and ≤ 10,000 mg/kg
  - Resample 25% of TPH samples for EPH (determines health-based criteria)
  - Bias locations to highest TPH

    If EPH results are above health-based criteria, delineation required
- TPH results > 10,000 mg/kg:
  - Remediate, OR
  - Resample, analyze using EPH Method, and use SRC Calculator

Appendix 3.5

Conclusions

- Majority of the **Evaluation of EPH in Soil Technical Guidance** is not new information
- One new important tool - the EPH Alternative Product Limit Calculator

Helpful Links

Link to Evaluation of Extractable Petroleum Hydrocarbons (EPH) in Soil Technical Guidance: https://www.nj.gov/dep/srp/guidance/

Link to SRRA Contacts: https://www.nj.gov/dep/srp/srra/srra_contacts.htm

QUESTIONS?

EPH Category 2 Ingestion/ Dermal Calculator Soil Remediation Criteria for Residential & Non-Residential Standards Training Section

Dave Puchalski, LSRP, PE
NewFields Princeton, LLC
dpuchalski@newfields.com

EPH Category 2 Health-based Soil Remediation Criterion Calculator

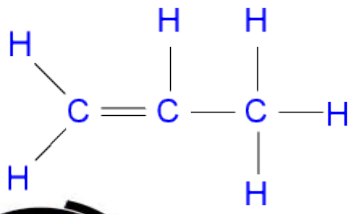
Goals of the Section

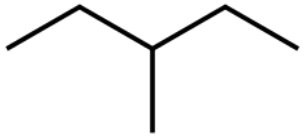
- Introduce the calculator format
- Describe the data entry process
- Identify the input variables and calculator output
  - Present Two Samples with the same EPH Concentration, but different chemical characteristics
  - Provide limited overview of the calculations

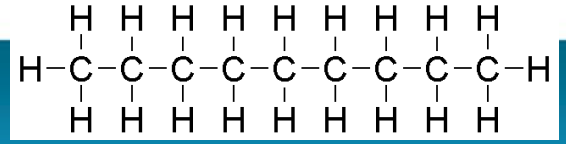
EPH Category 2 Chemical Speciation
What are Aliphatics and Aromatics?

Aliphatics

- Contains Carbon and Hydrogen joined together as straight chains, branched chains, or cyclic non-aromatic hydrocarbons
- May contain single, double, and triple bonds
- Include Petroleum Constituents
- Examples: Alkanes, Alkenes, Alkynes, Cycloalkanes

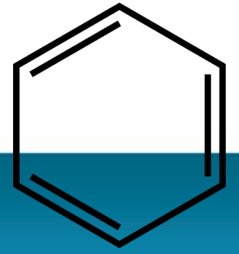


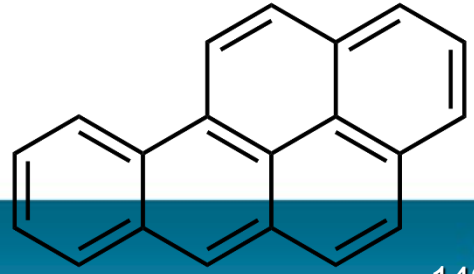




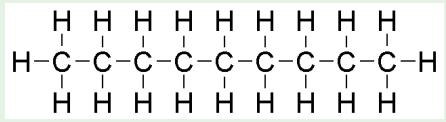
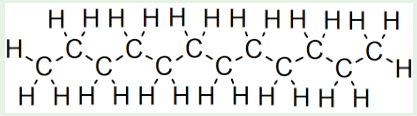
Aromatics

- Cyclic Compounds with Carbon joined together in alternating single and double bonds.
- Contains one or more aromatic rings (Benzene rings)
- Generally more volatile, more toxic, variable solubility
- Examples: Monoaromatics, Polyaromatic Hydrocarbons
- Benzene, Toluene, Phenol, Benzo(a)pyrene

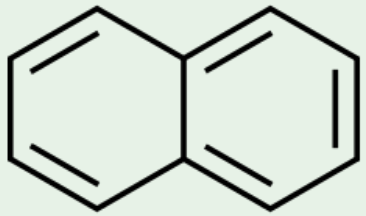
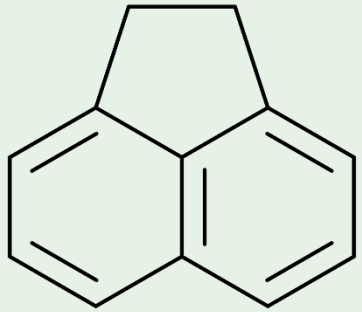
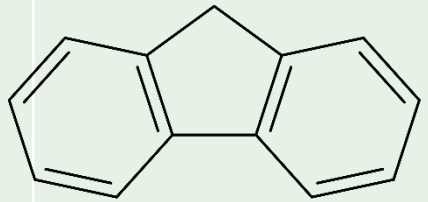
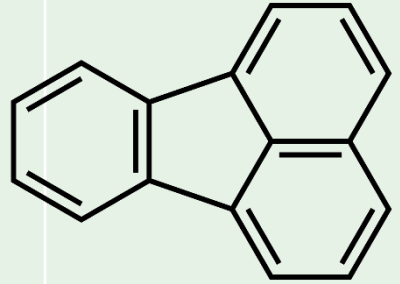




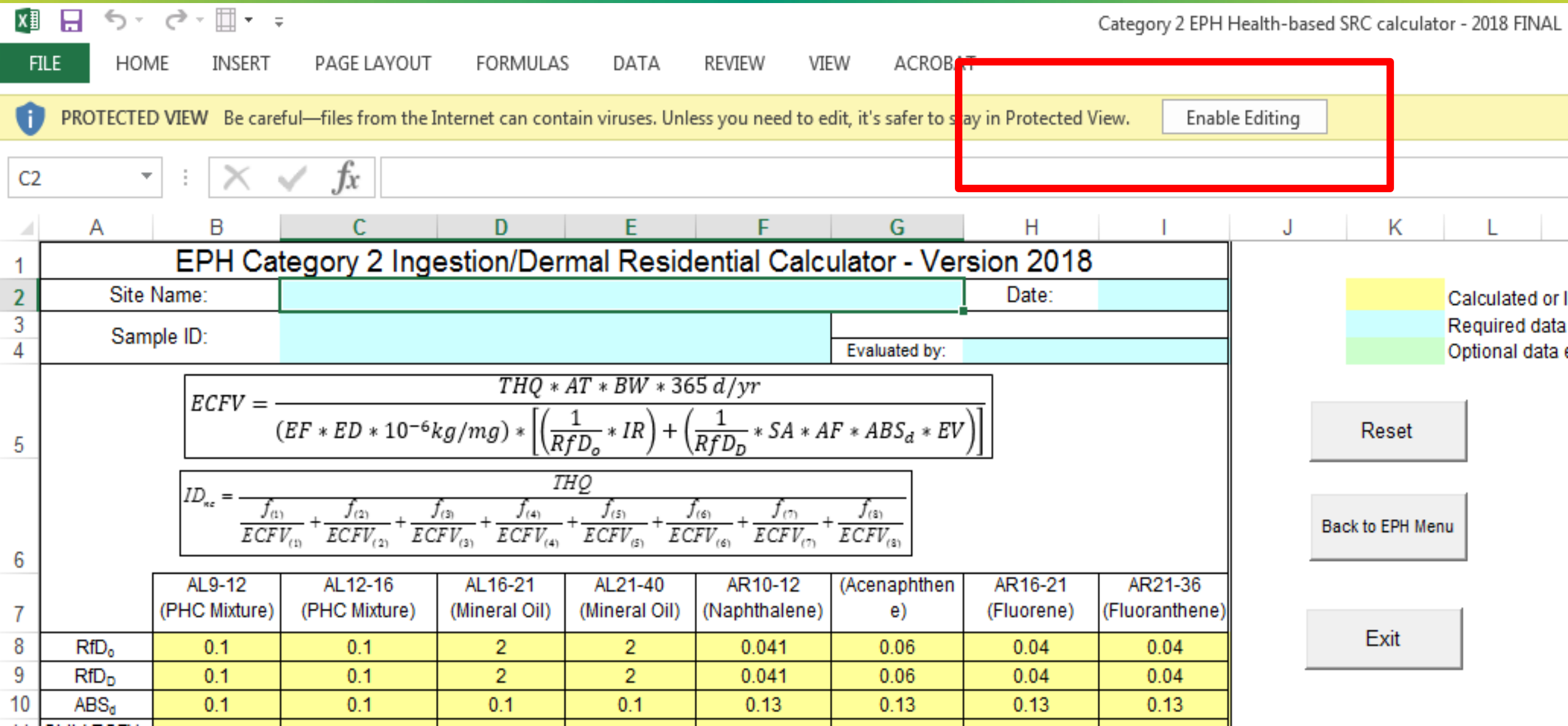
Aliphatic Ranges & Indicator Compounds

Carbon Range	AL 9-12	AL 12-16	AL 16-21	AL 21-40
Indicator Compound	Nonane	Dodecane	Hexadecane	Docosane
Chemical Formula	C9H20	C12H26	C16H34	C22H46
Molecular Weight, g/mol	128.3 g/mol	170.3 g/mol	226.4 g/mol	310.6 g/mol
Water Solubility, ug/L @25 deg C	220 ug/l	3.7 ug/l	0.021 ug/l	0.00078 ug/l
Vapor Pressure, Pa @25 deg C	593.3 Pa / 0.086 psi	18.0 Pa / 0.001 psi	0.20 Pa / 2.95 x10^{-5} psi	0.0002 Pa / 2.95 x10^{-8} psi
Structure			Straight Chain n-Alkane *Too large to present*	Straight Chain n-Alkane *Too large to present*

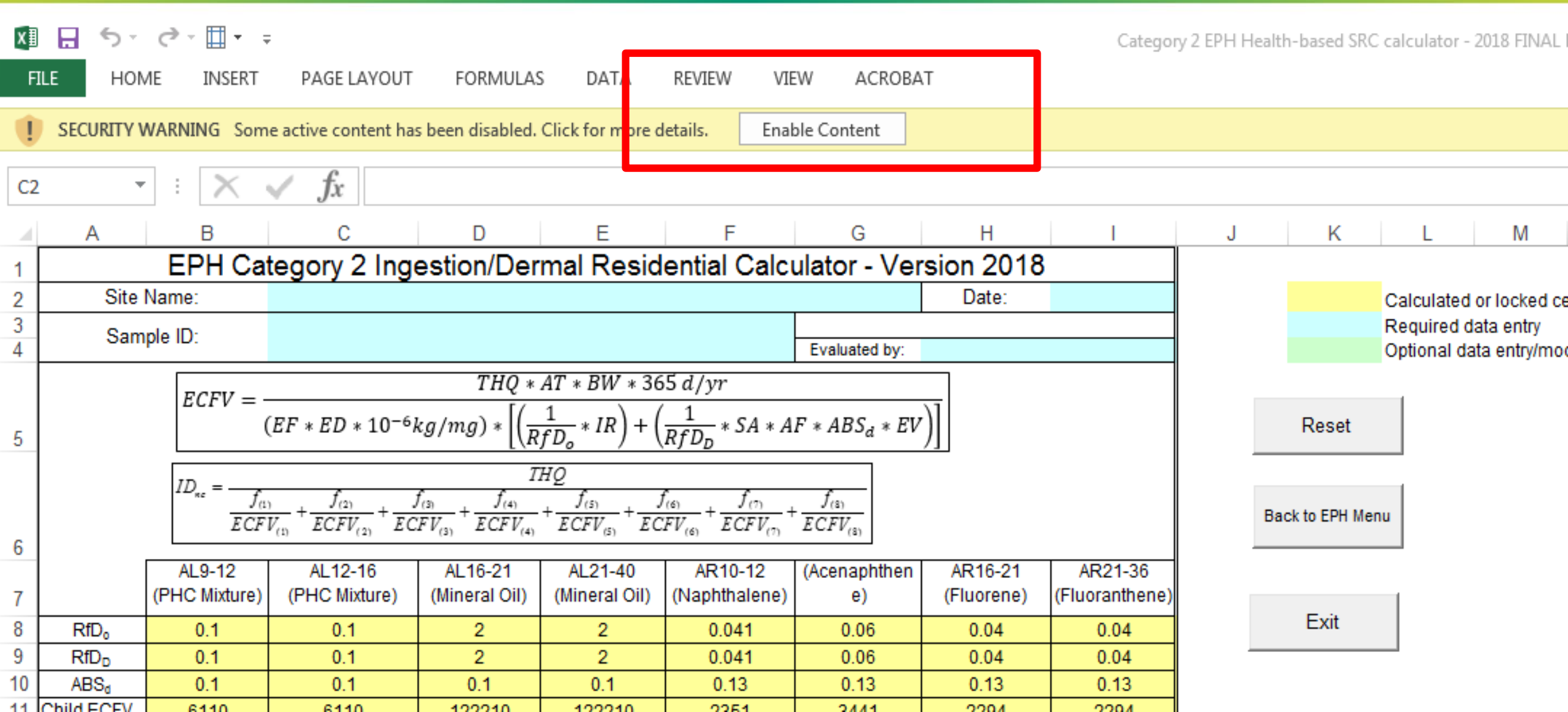
Aromatic Ranges & Indicator Compounds

Carbon Range	AR 10-12	AR 12-16	AR 16-21	AR 21-36
Indicator Compound	Naphthalene	Acenaphthene	Fluorene	Fluoranthene
Chemical Formula	C10H8	C12H10	C13H10	C16H10
Molecular Weight, g/mol	128.2 g/mol	154.2 g/mol	166.2 g/mol	202.3 g/mol
Water Solubility, ug/L @25 deg C	31,000 ug/l	3,900 ug/l	1,690 ug/l	230 ug/l
Vapor Pressure, Pa @25 deg C	11.3 Pa / 0.0016 psi	0.3 Pa / 4.3×10^{-5} psi	0.08 Pa / 1.16×10^{-5} psi	0.001 Pa / 1.45×10^{-7} psi
Structure				

Step 1- Opening the Excel File

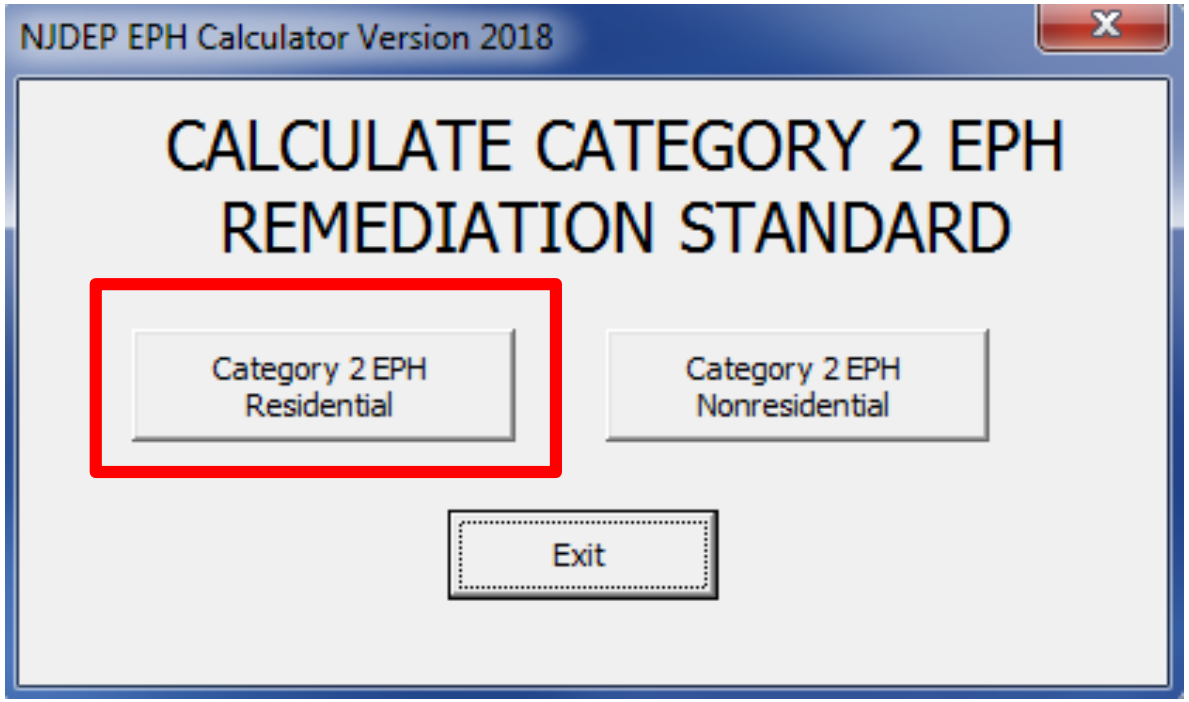


Step 2- Enable Macros & Enable Content



	AL9-12 (PHC Mixture)	AL12-16 (PHC Mixture)	AL16-21 (Mineral Oil)	AL21-40 (Mineral Oil)	AR10-12 (Naphthalene)	(Acenaphthene)	AR16-21 (Fluorene)	AR21-36 (Fluoranthene)
RfD_o	0.1	0.1	2	2	0.041	0.06	0.04	0.04
RfD_D	0.1	0.1	2	2	0.041	0.06	0.04	0.04
ABS_d	0.1	0.1	0.1	0.1	0.13	0.13	0.13	0.13
Child ECFV	6110	6110	122210	122210	2351	3441	2294	2294

Step 3 – Select Residential/ Nonresidential Standard for the Calculator



Step 4 – Define the Site and Sample Name

EPH Category 2 Ingestion/Dermal Residential Calculator - Version 2018

Site Name:	ABC Site	Date:	5/1/2019
Sample ID:	EPH-A		
		Evaluated by:	LSRP O'DeYear

Calculated or locked cell
Required data entry
Optional data entry/modifi

$$ECFV = \frac{THQ * AT * BW * 365\ d/yr}{(EF * ED * 10^{-6} kg/mg) * \left[\left(\frac{1}{RfD_o} * IR\right) + \left(\frac{1}{RfD_D} * SA * AF * ABS_d * EV\right)\right]}$$

$$ID_{nc} = \frac{THQ}{\frac{f_{(1)}}{ECFV_{(1)}} + \frac{f_{(2)}}{ECFV_{(2)}} + \frac{f_{(3)}}{ECFV_{(3)}} + \frac{f_{(4)}}{ECFV_{(4)}} + \frac{f_{(5)}}{ECFV_{(5)}} + \frac{f_{(6)}}{ECFV_{(6)}} + \frac{f_{(7)}}{ECFV_{(7)}} + \frac{f_{(8)}}{ECFV_{(8)}}}$$

	AL9-12 (PHC Mixture)	AL12-16 (PHC Mixture)	AL16-21 (Mineral Oil)	AL21-40 (Mineral Oil)	AR10-12 (Naphthalene)	(Acenaphthene)	AR16-21 (Fluorene)	AR21-36 (Fluoranthene)
RfD_o	0.1	0.1	2	2	0.041	0.06	0.04	0.04
RfD_D	0.1	0.1	2	2	0.041	0.06	0.04	0.04
ABS_d	0.1	0.1	0.1	0.1	0.13	0.13	0.13	0.13

Reset

Back to EPH Menu

Exit

Step 5 – Define EPH Fractionation
Total EPH = 16,900 mg/kg; Majority is Aliphatic

Sample ID:	EPH-A	Evaluated by:	LSRP O'DeYear

Required data entry
Optional data entry/modification

$$ECFV = \frac{THQ * AT * BW * 365\ d/yr}{(EF * ED * 10^{-6} kg/mg) * \left[\left(\frac{1}{RfD_o} * IR\right) + \left(\frac{1}{RfD_D} * SA * AF * ABS_d * EV\right)\right]}$$

$$ID_{nc} = \frac{THQ}{\frac{f_{(1)}}{ECFV_{(1)}} + \frac{f_{(2)}}{ECFV_{(2)}} + \frac{f_{(3)}}{ECFV_{(3)}} + \frac{f_{(4)}}{ECFV_{(4)}} + \frac{f_{(5)}}{ECFV_{(5)}} + \frac{f_{(6)}}{ECFV_{(6)}} + \frac{f_{(7)}}{ECFV_{(7)}} + \frac{f_{(8)}}{ECFV_{(8)}}}$$

	AL9-12 (PHC Mixture)	AL12-16 (PHC Mixture)	AL16-21 (Mineral Oil)	AL21-40 (Mineral Oil)	AR10-12 (Naphthalene)	(Acenaphthene)	AR16-21 (Fluorene)	AR21-36 (Fluoranthene)
RfD_o	0.1	0.1	2	2	0.041	0.06	0.04	0.04
RfD_D	0.1	0.1	2	2	0.041	0.06	0.04	0.04
ABS_d	0.1	0.1	0.1	0.1	0.13	0.13	0.13	0.13
Child ECFV	6110	6110	122210	122210	2351	3441	2294	2294
Concentration of fraction (mg/kg)	2000	1000	6500	6500	200	100	300	300
f								

Reset

Back to EPH Menu

Exit

Enter EPH Concentration for each fraction. ND=0

Parameter	*Definition*	*Units*	*Residential Scenario*
EV	Event Frequency	events/day	1
THQ	Target Hazard Quotient	unitless	1

Total EPH in sample:
16900 mg/kg

Step 6 – View Calculated Standard for Residential Use Evaluation

	A	B	C	D	E	F	G	H	I
10	ABS_d	0.1	0.1	0.1	0.1	0.13	0.13	0.13	0.13
11	Child ECFV	6110	6110	122210	122210	2351	3441	2294	2294
12	Concentration of fraction (mg/kg)	2000	1000	6500	6500	200	100	300	300
13	f	0.118343195	0.059171598	0.384615385	0.384615385	0.01183432	0.00591716	0.017751479	0.017751479

Enter EPH Concentration for each fraction. ND=0

Parameter	*Definition*	*Units*	*Residential Scenario*
EV	Event Frequency	events/day	1
THQ	Target Hazard Quotient	unitless	1
	Conversion Factor	days/year	365
EF_c	Exposure Frequency - child	days/year	350
ED_c and AT_c	Exposure Duration and Averaging Time - child	years	6
RfD_o	Oral Reference Dose	mg/kg-day	see above
RfD_D	Dermal Reference Dose	mg/kg-day	see above
ABS_d	Dermal Absorption Fraction	unitless	see above
BW_c	Body Weight - child	kg	15
IR_c	Soil Ingestion Rate - child	mg/day	200
SA_c	Skin Surface Area - child	cm^2/day	2800
AF_c	Soil Adherence Factor - child	mg/cm^2	0.2
ECFV	Equivalent carbon fraction value	mg/kg-day	see above
f	EC Weight fraction = fraction concentration/total concentration	unitless	see above
ID_{nc}	**Residential Non-carcinogenic Health-Based Soil Criterion (ingestion/dermal)**	mg/kg	17000

Total EPH in sample: 16900 mg/kg

Allowable EPH in sample: 17000 mg/kg

PASS

These parameters are fixed at the default residential values.

EPH Category 2 Ingestion/Dermal Residential Soil Remediation Standard:
17000 mg/kg

RESULT DOWN HERE

Step 7 – Compare Total EPH with Allowable
EPH Sample may PASS or FAIL ?

	A	B	C	D	E	F	G	H	I
10	ABS_d	0.1	0.1	0.1	0.1	0.13	0.13	0.13	0.13
11	Child ECFV	6110	6110	122210	122210	2351	3441	2294	2294
12	Concentration of fraction (mg/kg)	2000	1000	6500	6500	200	100	300	300
13	f	0.118343195	0.059171598	0.384615385	0.384615385	0.01183432	0.00591716	0.017751479	0.017751479

Enter EPH Concentration for each fraction. ND=0

15	*Parameter*	*Definition*	*Units*	*Residential Scenario*
16	EV	Event Frequency	events/day	1
17	THQ	Target Hazard Quotient	unitless	1
18		Conversion Factor	days/year	365
19	EF_c	Exposure Frequency - child	days/year	350
20	ED_c and AT_c	Exposure Duration and Averaging Time - child	years	6
21	RfD_o	Oral Reference Dose	mg/kg-day	see above
22	RfD_D	Dermal Reference Dose	mg/kg-day	see above
23	ABS_d	Dermal Absorption Fraction	unitless	see above
24	BW_c	Body Weight - child	kg	15
25	IR_c	Soil Ingestion Rate - child	mg/day	200
26	SA_c	Skin Surface Area - child	cm^2/day	2800
27	AF_c	Soil Adherence Factor - child	mg/cm^2	0.2
28	ECFV	Equivalent carbon fraction value	mg/kg-day	see above
29	f	EC Weight fraction = fraction concentration/total concentration	unitless	see above
30	ID_{nc}	**Residential Non-carcinogenic Health-Based Soil Criterion (ingestion/dermal)**	mg/kg	17000

Total EPH in sample: 16900 mg/kg

Allowable EPH in sample: 17000 mg/kg

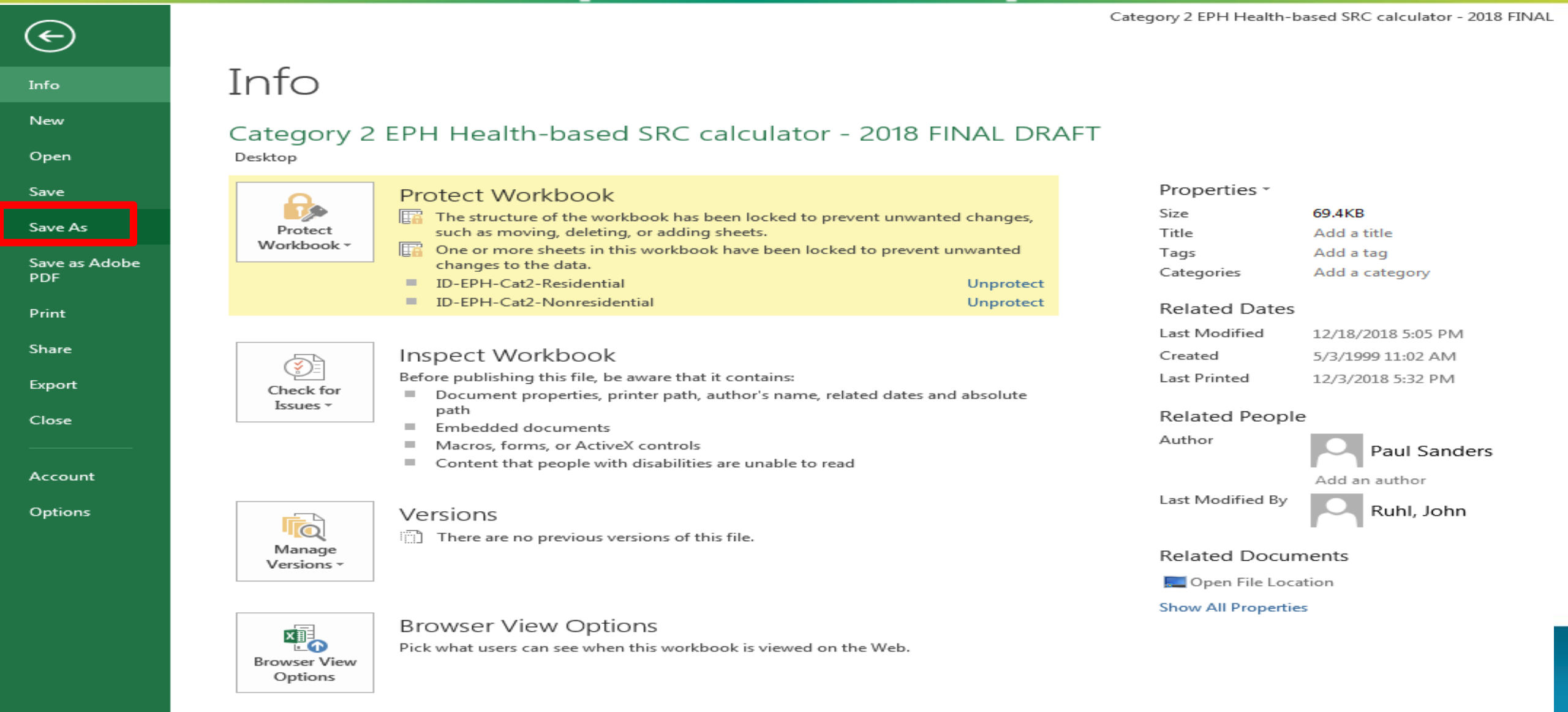
PASS

These parameters are fixed at the default residential values.

EPH Category 2 Ingestion/Dermal Residential Soil Remediation Standard:
17000 mg/kg

RESULT DOWN HERE

Step 8 – Save SRC Calculator Result for Each Sample with a Unique Name



Step 9 – Reset Inputs for Additional Samples (only resets concentrations)

EPH Category 2 Ingestion/Dermal Residential Calculator - Version 2018

Site Name:	ABC Site	Date:	5/1/2019
Sample ID:	EPH-A	Evaluated by:	LSRP O'DeYear

$$ECFV = \frac{THQ * AT * BW * 365\ d/yr}{(EF * ED * 10^{-6} kg/mg) * \left[\left(\frac{1}{RfD_o} * IR\right) + \left(\frac{1}{RfD_D} * SA * AF * ABS_d * EV\right)\right]}$$

$$ID_{nc} = \frac{THQ}{\frac{f_{(1)}}{ECFV_{(1)}} + \frac{f_{(2)}}{ECFV_{(2)}} + \frac{f_{(3)}}{ECFV_{(3)}} + \frac{f_{(4)}}{ECFV_{(4)}} + \frac{f_{(5)}}{ECFV_{(5)}} + \frac{f_{(6)}}{ECFV_{(6)}} + \frac{f_{(7)}}{ECFV_{(7)}} + \frac{f_{(8)}}{ECFV_{(8)}}}$$

	AL9-12 (PHC Mixture)	AL12-16 (PHC Mixture)	AL16-21 (Mineral Oil)	AL21-40 (Mineral Oil)	AR10-12 (Naphthalene)	(Acenaphthene)	AR16-21 (Fluorene)	AR21-36 (Fluoranthene)
RfD_o	0.1	0.1	2	2	0.041	0.06	0.04	0.04
RfD_D	0.1	0.1	2	2	0.041	0.06	0.04	0.04
ABS_d	0.1	0.1	0.1	0.1	0.13	0.13	0.13	0.13
Child ECFV	6110	6110	122210	122210	2351	3441	2294	2294
Concentration of fraction (mg/kg)	2000	1000	6500	6500	200	100	300	300
f	0.118343195	0.059171598	0.384615385	0.384615385	0.01183432	0.00591716	0.017751479	0.017751479

			Residential

Calculated or locked cell
Required data entry
Optional data entry/modification

Reset

Back to EPH Menu

Exit

Enter EPH Concentration for each fraction. ND=0

Step 4.b – Enter Data for Sample B

EPH Category 2 Ingestion/Dermal Residential Calculator - Version 2018

Site Name:	ABC Site	Date:	5/1/2019
Sample ID:	EPH-B	Evaluated by:	LSRP O'DeYear

Calculated or locked cell
Required data entry
Optional data entry/modifi

Reset

Back to EPH Menu

Exit

$$ECFV = \frac{THQ * AT * BW * 365\ d/yr}{(EF * ED * 10^{-6} kg/mg) * \left[\left(\frac{1}{RfD_o} * IR\right) + \left(\frac{1}{RfD_D} * SA * AF * ABS_d * EV\right)\right]}$$

$$ID_{sc} = \frac{THQ}{\frac{f_{(1)}}{ECFV_{(1)}} + \frac{f_{(2)}}{ECFV_{(2)}} + \frac{f_{(3)}}{ECFV_{(3)}} + \frac{f_{(4)}}{ECFV_{(4)}} + \frac{f_{(5)}}{ECFV_{(5)}} + \frac{f_{(6)}}{ECFV_{(6)}} + \frac{f_{(7)}}{ECFV_{(7)}} + \frac{f_{(8)}}{ECFV_{(8)}}}$$

	AL9-12 (PHC Mixture)	AL12-16 (PHC Mixture)	AL16-21 (Mineral Oil)	AL21-40 (Mineral Oil)	AR10-12 (Naphthalene)	(Acenaphthene)	AR16-21 (Fluorene)	AR21-36 (Fluoranthene)
RfD_o	0.1	0.1	2	2	0.041	0.06	0.04	0.04
RfD_D	0.1	0.1	2	2	0.041	0.06	0.04	0.04
ABS_d	0.1	0.1	0.1	0.1	0.13	0.13	0.13	0.13

Step 5.b. – Define EPH Fractionation
Total EPH = 16,900 mg/kg; Majority Aromatic

Sample ID:	EPH-B	Evaluated by:	LSRP O'DeYear

Required data entry
Optional data entry/modificati

$$ECFV = \frac{THQ * AT * BW * 365\ d/yr}{(EF * ED * 10^{-6} kg/mg) * \left[\left(\frac{1}{RfD_o} * IR\right) + \left(\frac{1}{RfD_D} * SA * AF * ABS_d * EV\right)\right]}$$

$$ID_{nc} = \frac{THQ}{\frac{f_{(1)}}{ECFV_{(1)}} + \frac{f_{(2)}}{ECFV_{(2)}} + \frac{f_{(3)}}{ECFV_{(3)}} + \frac{f_{(4)}}{ECFV_{(4)}} + \frac{f_{(5)}}{ECFV_{(5)}} + \frac{f_{(6)}}{ECFV_{(6)}} + \frac{f_{(7)}}{ECFV_{(7)}} + \frac{f_{(8)}}{ECFV_{(8)}}}$$

Reset

Back to EPH Menu

Exit

	AL9-12 (PHC Mixture)	AL12-16 (PHC Mixture)	AL16-21 (Mineral Oil)	AL21-40 (Mineral Oil)	AR10-12 (Naphthalene)	(Acenaphthene)	AR16-21 (Fluorene)	AR21-36 (Fluoranthene)
RfD_o	0.1	0.1	2	2	0.041	0.06	0.04	0.04
RfD_D	0.1	0.1	2	2	0.041	0.06	0.04	0.04
ABS_d	0.1	0.1	0.1	0.1	0.13	0.13	0.13	0.13
Child ECFV	6110	6110	122210	122210	2351	3441	2294	2294
Concentration of fraction (mg/kg)	200	100	300	300	2000	1000	6500	6500
f	0.01183432	0.00591716	0.017751479	0.017751479	0.118343195	0.059171598	0.384615385	0.384615385

Enter EPH Concentration for each fraction. ND=0

Parameter	*Definition*	*Units*	*Residential Scenario*
EV	Event Frequency	events/day	1
THQ	Target Hazard Quotient	unitless	1

Total EPH in sample:
16900 mg/kg

Step 6.b. – View Calculated Standard

	B	C	D	E	F	G	H	I
Concentration of fraction (mg/kg)	200	100	300	300	2000	1000	6500	6500
f	0.01183432	0.00591716	0.017751479	0.017751479	0.118343195	0.059171598	0.384615385	0.384615385

Enter EPH Concentration for each fraction. ND=0

Parameter	*Definition*	*Units*	*Residential Scenario*
EV	Event Frequency	events/day	1
THQ	Target Hazard Quotient	unitless	1
	Conversion Factor	days/year	365
EF_c	Exposure Frequency - child	days/year	350
ED_c and AT_c	Exposure Duration and Averaging Time - child	years	6
RfD_o	Oral Reference Dose	mg/kg-day	see above
RfD_D	Dermal Reference Dose	mg/kg-day	see above
ABS_d	Dermal Absorption Fraction	unitless	see above
BW_c	Body Weight - child	kg	15
IR_c	Soil Ingestion Rate - child	mg/day	200
SA_c	Skin Surface Area - child	cm^2/day	2800
AF_c	Soil Adherence Factor - child	mg/cm^2	0.2
ECFV	Equivalent carbon fraction value	mg/kg-day	see above
f	EC Weight fraction = fraction concentration/total concentration	unitless	see above
ID_{nc}	**Residential Non-carcinogenic Health-Based Soil Criterion (ingestion/dermal)**	mg/kg	2500

Total EPH in sample: 16900 mg/kg

Allowable EPH in sample: 2500 mg/kg

FAIL

These parameters are fixed at the default residential values.

EPH Category 2 Ingestion/Dermal Residential Soil Remediation Standard:
2500 mg/kg

RESULT DOWN HERE

Step 7.b. – Compare Total EPH with Allowable
EPH Sample may PASS or FAIL ?

	A	B	C	D	E	F	G	H	I
2	Concentration of fraction (mg/kg)	200	100	300	300	2000	1000	6500	6500
3	f	0.01183432	0.00591716	0.017751479	0.017751479	0.118343195	0.059171598	0.384615385	0.384615385

Enter EPH Concentration for each fraction. ND=0

Parameter	Definition	Units	Residential Scenario
EV	Event Frequency	events/day	1
THQ	Target Hazard Quotient	unitless	1
	Conversion Factor	days/year	365
EF_c	Exposure Frequency - child	days/year	350
ED_c and AT_c	Exposure Duration and Averaging Time - child	years	6
RfD_o	Oral Reference Dose	mg/kg-day	see above
RfD_D	Dermal Reference Dose	mg/kg-day	see above
ABS_d	Dermal Absorption Fraction	unitless	see above
BW_c	Body Weight - child	kg	15
IR_c	Soil Ingestion Rate - child	mg/day	200
SA_c	Skin Surface Area - child	cm^2/day	2800
AF_c	Soil Adherence Factor - child	mg/cm^2	0.2
ECFV	Equivalent carbon fraction value	mg/kg-day	see above
f	EC Weight fraction = fraction concentration/total concentration	unitless	see above
ID_{nc}	**Residential Non-carcinogenic Health-Based Soil Criterion (ingestion/dermal)**	mg/kg	2500

These parameters are fixed at the default residential values.

Total EPH in sample: 16900 mg/kg

Allowable EPH in sample: 2500 mg/kg

FAIL

EPH Category 2 Ingestion/Dermal Residential Soil Remediation Standard:
2500 mg/kg

RESULT DOWN HERE

Step 8.b. – Back to Main Menu to Switch to Nonresidential Evaluation

EPH Category 2 Ingestion/Dermal Residential Calculator - Version 2018

Site Name:	ABC Site	Date:	5/1/2019
Sample ID:	EPH-B	Evaluated by:	LSRP O'DeYear

$$ECFV = \frac{THQ * AT * BW * 365\ d/yr}{(EF * ED * 10^{-6} kg/mg) * \left[\left(\frac{1}{RfD_o} * IR\right) + \left(\frac{1}{RfD_D} * SA * AF * ABS_d * EV\right)\right]}$$

$$ID_{nc} = \frac{THQ}{\frac{f_{(1)}}{ECFV_{(1)}} + \frac{f_{(2)}}{ECFV_{(2)}} + \frac{f_{(3)}}{ECFV_{(3)}} + \frac{f_{(4)}}{ECFV_{(4)}} + \frac{f_{(5)}}{ECFV_{(5)}} + \frac{f_{(6)}}{ECFV_{(6)}} + \frac{f_{(7)}}{ECFV_{(7)}} + \frac{f_{(8)}}{ECFV_{(8)}}}$$

	AL9-12 (PHC Mixture)	AL12-16 (PHC Mixture)	AL16-21 (Mineral Oil)	AL21-40 (Mineral Oil)	AR10-12 (Naphthalene)	(Acenaphthene)	AR16-21 (Fluorene)	AR21-36 (Fluoranthene)
RfD_o	0.1	0.1	2	2	0.041	0.06	0.04	0.04
RfD_D	0.1	0.1	2	2	0.041	0.06	0.04	0.04
ABS_d	0.1	0.1	0.1	0.1	0.13	0.13	0.13	0.13
Child ECFV	6110	6110	122210	122210	2351	3441	2294	2294
Concentration of fraction (mg/kg)	200	100	300	300	2000	1000	6500	6500
f	0.01183432	0.00591716	0.017751479	0.017751479	0.118343195	0.059171598	0.384615385	0.384615385

Parameter	*Definition*	*Units*	*Residential Scenario*

Calculated or locked cell
Required data entry
Optional data entry/modification

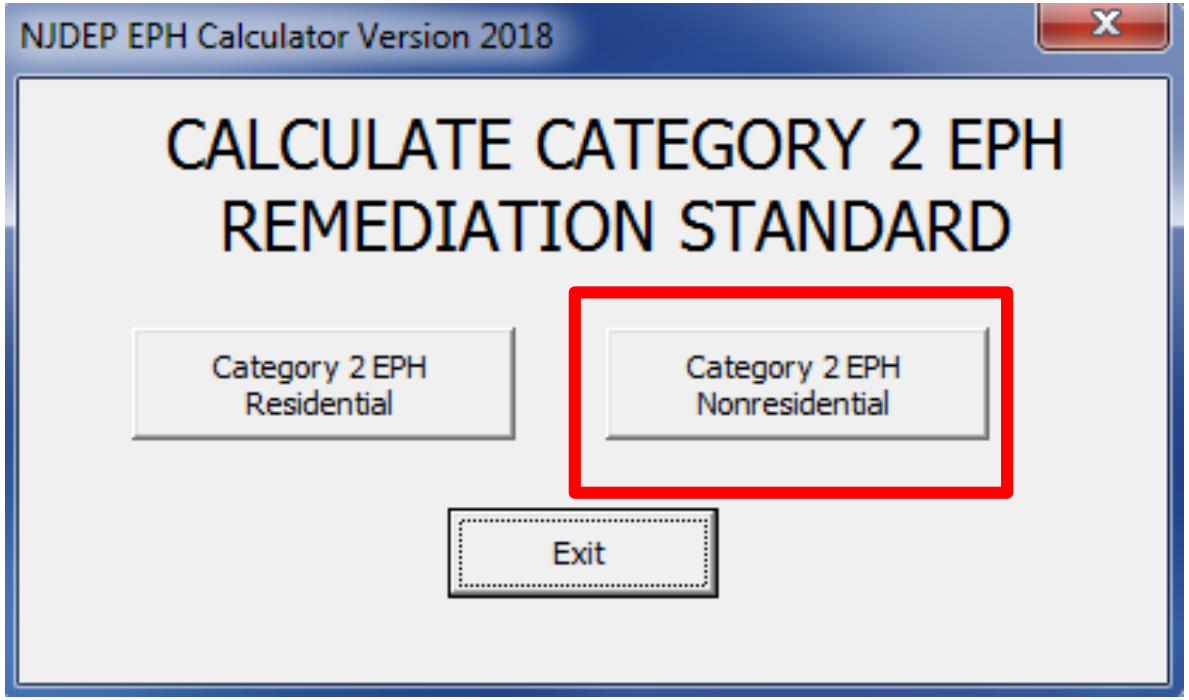
Reset

Back to EPH Menu

Exit

Enter EPH Concentration for each fraction. ND=0

Step 9.b. – Switch from Residential to Nonresidential Standard Calculation - Sample A



Step 10 – Re-Enter EPH Fractionation for Sample A

EPH Category 2 Ingestion/Dermal Nonresidential Calculator - Version 2018

Site Name:	ABC Site	Date:	5/1/2019
Sample ID:	EPH-A	Evaluated by:	LSRP O'DeYear

Calculated or locked cell
Required data entry
Optional data entry/modificat

$$ECFV = \frac{THQ * AT * BW * 365\ d/yr}{(EF * ED * 10^{-6} kg/mg) * \left[\left(\frac{1}{RfD_o} * IR\right) + \left(\frac{1}{RfD_D} * SA * AF * ABS_d * EV\right)\right]}$$

$$ID_{nc} = \frac{THQ}{\frac{f_{(1)}}{ECFV_{(1)}} + \frac{f_{(2)}}{ECFV_{(2)}} + \frac{f_{(3)}}{ECFV_{(3)}} + \frac{f_{(4)}}{ECFV_{(4)}} + \frac{f_{(5)}}{ECFV_{(5)}} + \frac{f_{(6)}}{ECFV_{(6)}} + \frac{f_{(7)}}{ECFV_{(7)}} + \frac{f_{(8)}}{ECFV_{(8)}}}$$

	AL9-12 (PHC Mixture)	AL12-16 (PHC Mixture)	AL16-21 (Mineral Oil)	AL21-40 (Mineral Oil)	AR10-12 (Naphthalene)	(Acenaphthene)	AR16-21 (Fluorene)	(Fluoranthene)
RfD_o	0.1	0.1	2	2	0.041	0.06	0.04	0.04
RfD_D	0.1	0.1	2	2	0.041	0.06	0.04	0.04
ABS_d	0.1	0.1	0.1	0.1	0.13	0.13	0.13	0.13
Adult ECFV	68407	68407	1368139	1368139	25058	36670	24447	24447
Concentration of fraction (mg/kg)	2000	1000	6500	6500	200	100	300	300
f	0.118343195	0.059171598	0.384615385	0.384615385	0.01183432	0.00591716	0.017751479	0.017751479

Reset

Back to EPH Menu

Exit

Enter EPH Concentration for each fraction. ND=0

Parameter	*Definition*	*Units*	*Nonresidential Scenario*
EV	Event Frequency	events/day	1
THQ	Target Hazard Quotient	unitless	1

Total EPH in sample:
16900 mg/kg

Step 11 – View Calculated Standard and Compare Total/Allowable EPH for Non-Red

ABS_d	0.1	0.1	0.1	0.1	0.13	0.13	0.13	0.13
Adult ECFV	68407	68407	1368139	1368139	25058	36670	24447	24447
Concentration of fraction (mg/kg)	2000	1000	6500	6500	200	100	300	300
f	0.118343195	0.059171598	0.384615385	0.384615385	0.01183432	0.00591716	0.017751479	0.017751479

Enter EPH Concentration for each fraction. ND=0

Parameter	*Definition*	*Units*	*Nonresidential Scenario*
EV	Event Frequency	events/day	1
THQ	Target Hazard Quotient	unitless	1
	Conversion Factor	days/year	365
EF_a	Exposure Frequency - adult	days/year	225
ED_a and AT_a	Exposure Duration and Averaging Time - adult	years	25
RfD_o	Oral Reference Dose	mg/kg-day	see above
RfD_D	Dermal Reference Dose	mg/kg-day	see above
ABS_d	Dermal Absorption Fraction	unitless	see above
BW_a	Body Weight - adult	kg	70
IR_a	Soil Ingestion Rate - adult	mg/day	100
SA_a	Skin Surface Area - adult	cm^2/day	3300
AF_a	Soil Adherence Factor - adult	mg/cm^2	0.2
ECFV	Equivalent carbon fraction value	mg/kg-day	see above
f	EC Weight fraction = fraction concentration/total concentration	unitless	see above
ID_{nc}	**Nonresidential Non-carcinogenic Health-Based Soil Criterion (ingestion/dermal)**	mg/kg	190000

Total EPH in sample: 16900 mg/kg

Allowable EPH in sample: 190000 mg/kg

PASS

These parameters are fixed at the default nonresidential values.

EPH Category 2 Ingestion/Dermal Nonresidential Soil Remediation Standard:
190000 mg/kg

RESULT DOWN HERE

Step 10.b. – Re-Enter EPH Fractionation for Sample B

EPH Category 2 Ingestion/Dermal Nonresidential Calculator - Version 2018

Site Name:	ABC Site	Date:	5/1/2019
Sample ID:	EPH-B	Evaluated by:	LSRP O'DeYear

Calculated or locked cell
Required data entry
Optional data entry/modification

Reset

Back to EPH Menu

Exit

$$ECFV = \frac{THQ * AT * BW * 365\ d/yr}{(EF * ED * 10^{-6} kg/mg) * \left[\left(\frac{1}{RfD_o} * IR\right) + \left(\frac{1}{RfD_D} * SA * AF * ABS_d * EV\right)\right]}$$

$$ID_{nc} = \frac{THQ}{\frac{f_{(1)}}{ECFV_{(1)}} + \frac{f_{(2)}}{ECFV_{(2)}} + \frac{f_{(3)}}{ECFV_{(3)}} + \frac{f_{(4)}}{ECFV_{(4)}} + \frac{f_{(5)}}{ECFV_{(5)}} + \frac{f_{(6)}}{ECFV_{(6)}} + \frac{f_{(7)}}{ECFV_{(7)}} + \frac{f_{(8)}}{ECFV_{(8)}}}$$

	AL9-12 (PHC Mixture)	AL12-16 (PHC Mixture)	AL16-21 (Mineral Oil)	AL21-40 (Mineral Oil)	AR10-12 (Naphthalene)	(Acenaphthene)	AR16-21 (Fluorene)	(Fluoranthene)
RfD_o	0.1	0.1	2	2	0.041	0.06	0.04	0.04
RfD_D	0.1	0.1	2	2	0.041	0.06	0.04	0.04
ABS_d	0.1	0.1	0.1	0.1	0.13	0.13	0.13	0.13
Adult ECFV	68407	68407	1368139	1368139	25058	36670	24447	24447
Concentration of fraction (mg/kg)	200	100	300	300	2000	1000	6500	6500
f	0.01183432	0.00591716	0.017751479	0.017751479	0.118343195	0.059171598	0.384615385	0.384615385

Enter EPH Concentration for each fraction. ND=0

Parameter	*Definition*	*Units*	*Nonresidential Scenario*
EV	Event Frequency	events/day	1
THQ	Target Hazard Quotient	unitless	1

Total EPH in sample:
16900 mg/kg

Step 11.b. – View Calculated Standard and Compare Total/Allowable EPH

	A	B	C	D	E	F	G	H	I
10	ABS_d	0.1	0.1	0.1	0.1	0.13	0.13	0.13	0.13
11	Adult ECFV	68407	68407	1368139	1368139	25058	36670	24447	24447
12	Concentration of fraction (mg/kg)	200	100	300	300	2000	1000	6500	6500
13	f	0.01183432	0.00591716	0.017751479	0.017751479	0.118343195	0.059171598	0.384615385	0.384615385

Enter EPH Concentration for each fraction. ND=0

Parameter	*Definition*	*Units*	*Nonresidential Scenario*
EV	Event Frequency	events/day	1
THQ	Target Hazard Quotient	unitless	1
	Conversion Factor	days/year	365
EF_a	Exposure Frequency - adult	days/year	225
ED_a and AT_a	Exposure Duration and Averaging Time - adult	years	25
RfD_o	Oral Reference Dose	mg/kg-day	see above
RfD_D	Dermal Reference Dose	mg/kg-day	see above
ABS_d	Dermal Absorption Fraction	unitless	see above
BW_a	Body Weight - adult	kg	70
IR_a	Soil Ingestion Rate - adult	mg/day	100
SA_a	Skin Surface Area - adult	cm^2/day	3300
AF_a	Soil Adherence Factor - adult	mg/cm^2	0.2
ECFV	Equivalent carbon fraction value	mg/kg-day	see above
f	EC Weight fraction = fraction concentration/total concentration	unitless	see above
ID_{nc}	**Nonresidential Non-carcinogenic Health-Based Soil Criterion (ingestion/dermal)**	mg/kg	26000

Total EPH in sample: 16900 mg/kg

Allowable EPH in sample: 26000 mg/kg

PASS

These parameters are fixed at the default nonresidential values.

EPH Category 2 Ingestion/Dermal Nonresidential Soil Remediation Standard:
26000 mg/kg

RESULT DOWN HERE

Step 12

1 Printout for EACH sample

Example Calculator Printout Sheet

EPH Category 2 Ingestion/Dermal Nonresidential Calculator - Version 2018

Site Name:	ABC Site	Date:	5/1/2019
Sample ID:	EPH-B	Evaluated by:	LSRP O'DeYear

$$ECFV = \frac{THQ * AT * BW * 365\ d/yr}{(EF * ED * 10^{-6} kg/mg) * \left[\left(\frac{1}{RfD_o} * IR\right) + \left(\frac{1}{RfD_D} * SA * AF * ABS_d * EV\right)\right]}$$

$$ID_{nc} = \frac{THQ}{\frac{f_{(1)}}{ECFV_{(1)}} + \frac{f_{(2)}}{ECFV_{(2)}} + \frac{f_{(3)}}{ECFV_{(3)}} + \frac{f_{(4)}}{ECFV_{(4)}} + \frac{f_{(5)}}{ECFV_{(5)}} + \frac{f_{(6)}}{ECFV_{(6)}} + \frac{f_{(7)}}{ECFV_{(7)}} + \frac{f_{(8)}}{ECFV_{(8)}}}$$

	AL9-12 (PHC Mixture)	AL12-16 (PHC Mixture)	AL16-21 (Mineral Oil)	AL21-40 (Mineral Oil)	AR10-12 (Naphthalene)	AR12-16 (Acenaphthene)	AR16-21 (Fluorene)	AR21-36 (Fluoranthene)
RfD_o	0.1	0.1	2	2	0.041	0.06	0.04	0.04
RfD_D	0.1	0.1	2	2	0.041	0.06	0.04	0.04
ABS_d	0.1	0.1	0.1	0.1	0.13	0.13	0.13	0.13
Adult ECFV	68407	68407	1368139	1368139	25058	36670	24447	24447
Concentration of fraction (mg/kg)	200	100	300	300	2000	1000	6500	6500
f	0.01183432	0.00591716	0.017751479	0.017751479	0.118343195	0.059171598	0.384615385	0.384615385

Parameter	Definition	Units	Nonresidential Scenario
EV	Event Frequency	events/day	1
THQ	Target Hazard Quotient	unitless	1
	Conversion Factor	days/year	365
EF_a	Exposure Frequency - adult	days/year	225
ED_a and AT_a	Exposure Duration and Averaging Time - adult	years	25
RfD_o	Oral Reference Dose	mg/kg-day	see above
RfD_D	Dermal Reference Dose	mg/kg-day	see above
ABS_d	Dermal Absorption Fraction	unitless	see above
BW_a	Body Weight - adult	kg	70
IR_a	Soil Ingestion Rate - adult	mg/day	100
SA_a	Skin Surface Area - adult	cm^2/day	3300
AF_a	Soil Adherence Factor - adult	mg/cm^2	0.2
ECFV	Equivalent carbon fraction value	mg/kg-day	see above
f	EC Weight fraction = fraction concentration/total concentration	unitless	see above
ID_{nc}	Nonresidential Non-carcinogenic Health-Based Soil Criterion (ingestion/dermal)	mg/kg	26000

Total EPH in sample: 16900 mg/kg

Allowable EPH in sample: 26000 mg/kg

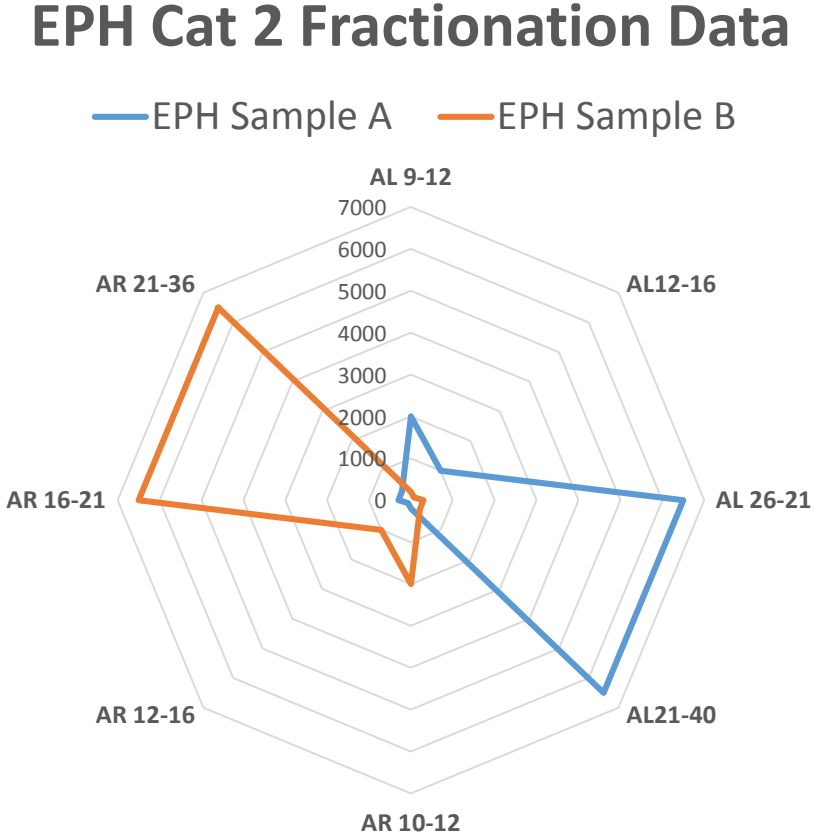
PASS

These parameters are fixed at the default nonresidential values.

EPH Category 2 Ingestion/Dermal Nonresidential Soil Remediation Standard:
26000 mg/kg

Comparison of Two EPH Data Sets

Sample	"A"	"B"
Total EPH	16,900 mg/kg	16,900 mg/kg
Sum of Aliphatics	16,000 mg/kg	900 mg/kg
Sum of Aromatics	900 mg/kg	16,000 mg/kg
Calculated Residential Standard	17,000 mg/kg **Pass Res.**	2,500 mg/kg **Fail Res.**
Calculated Non-Residential Standard	190,000 mg/kg **Pass NonRes**	26,000 mg/kg **Pass NonRes**



Questions?

EPH Guidance & Scenarios

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Baseline Characteristics for all Scenarios

- Each Scenario was developed to present specific points
  - All information is conceptual and may be abbreviated for training
  - Generally the same site, but different AOCs
  - Same surface covering & same surface water percolation rate
  - Same depth to water
  - Access is available for each of the AOCs unless indicated
- Variations exist in the mass of petroleum that was released
  - Variations in degradation characteristics

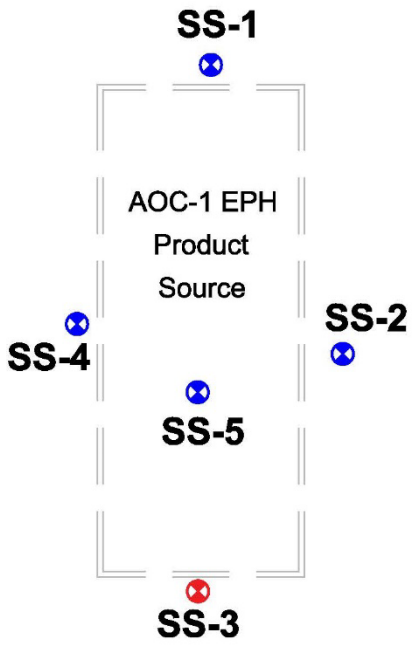
SCENARIO 1

#2 FUEL OIL WITH A PLANNED RESIDENTIAL/ UNRESTRICTED PROPERTY USE

Scenario 1 / #2 Fuel Oil Cat 1 –Residential Use

1. Are more samples required?
2. Is a ground water investigation required?

Sample Name	SS-1	SS-2	SS-3	SS-4	SS-5
EPH Concentration (mg/kg)	800	3,785	**7,675**	3,650	2,100
2 Methyl-Naphthalene **(8 mg/kg RDCSRS)**	NA	NA	7.85	NA	NA
Naphthalene **(6 mg/kg RDCSRS)**	NA	NA	4.25	NA	NA
EPH Product Limit Concentration	**8,000** mg/kg				
RAO Goal?	Residential – Unrestricted Use				
Remedial Action?	To Be Determined				

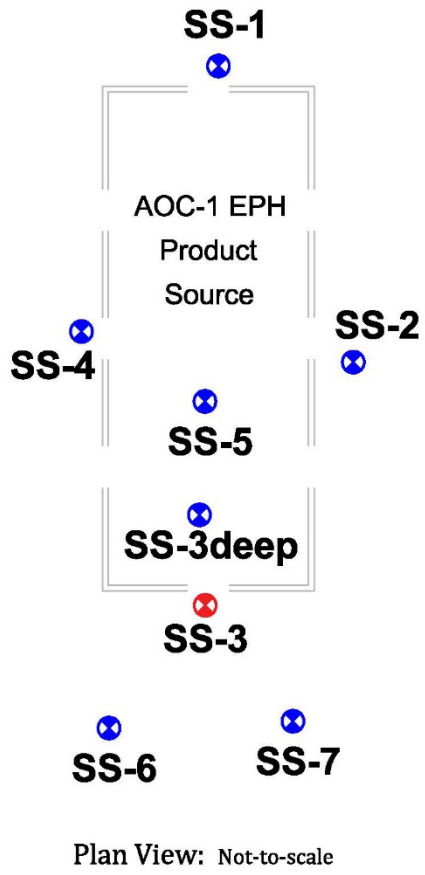


Plan View: Not-to-scale

Scenario 1 / #2 Fuel Oil Cat 1 –Residential Use

1. SS-6 & 7 are required to delineate the EPH exceedance
2. SS-3 deep is required for vertical delineation
3. No GW investigation is required
   - 2 MeN is below criteria

Sample Name	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6	SS-7	SS-3d
EPH Concentration (mg/kg)	800	3,785	**7,675**	3,650	2,100	4,150	2,105	650
2 Methyl-Naphthalene **(8 mg/kg RDCSRS)**	NA	NA	7.85	NA	NA	NA	NA	NA
Naphthalene **(6 mg/kg RDCSRS)**	NA	NA	4.25	NA	NA	NA	NA	NA
EPH Product Limit Concentration	**8,000** mg/kg							
Remedial Action?	**Compliance Average - EPH**							



Plan View: Not-to-scale

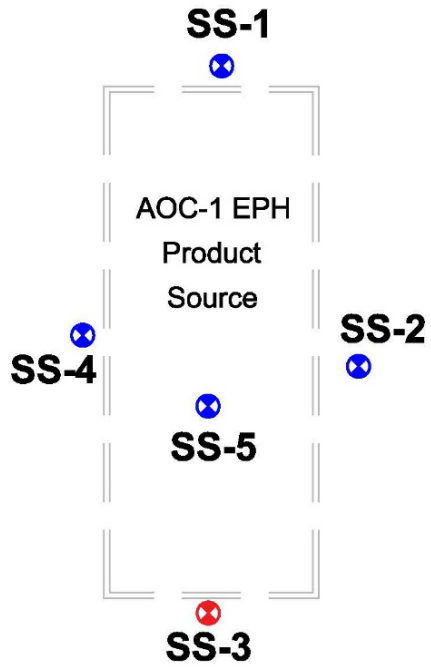
SCENARIO 2A AND 2B

3,000 GALLON #2 FUEL OIL WITH A PLANNED NON RESIDENTIAL PROPERTY USE

Scenario 2 / Cat 1, 3,000-gal Non-Residential Use

1. Are more samples required?
2. Is a ground water investigation required?
   - SPLP samples are collected by the field team
3. What remedial actions are available?

Sample Name	SS-1	SS-2	SS-3	SS-4	SS-5
EPH Concentration (mg/kg)	1,020	3,785	**8,551**	3,650	2,100
2 Methyl-Naphthalene **(8 mg/kg NRDCSRS)**	NA	4.10	**9.25**	NA	NA
Naphthalene **(17 mg/kg NRDCSRS)**	NA	0.85	5.15	NA	NA
EPH Product Limit Concentration	**8,000 mg/kg** (Default value)				
RAO Goal?	Non-Residential				

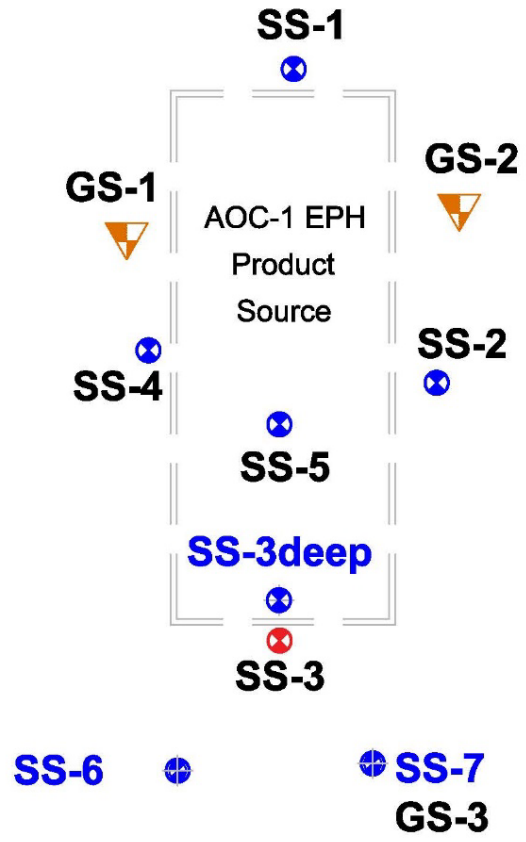


Plan View: Not-to-scale

Scenario 2A / Cat 1, 3,000-gal Non-Residential Use

1. 5 Borings Completed– 2 Horizontal, 1 Vertical, 2 Grain Size
2. SS-6 & 7 are required for horizontal delineation
3. 2MeN exceedance triggers further investigation
   a. SPLP is analyzed on SS-2, SS-3 and SS-6 & **PASSES**
4. SS-3 deep is required for vertical delineation EPH & 2MeN

Sample Name	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6	SS-7	SS-3d
EPH Concentration (mg/kg)	1,020	3,785	**8,551**	3,650	2,100	4,150	2,105	650
2 Methyl-Naphthalene **(8 mg/kg NRDCSRS)**	NA	4.10	**9.25**	NA	NA	4.15	NA	6.05
Naphthalene **(17 mg/kg NRDCSRS)**	NA	0.85	5.15	NA	NA	1.35	NA	NA
EPH Product Limit Concentration	**8,000 mg/kg** (Default value)							
RAO Goal?	Non-Residential – Limited-Restricted Use or Unrestricted							



Plan View: Not-to-scale

Scenario 2A / Cat 1, 3,000-gal Non-Residential Use

Grain size yields – D_{10} Larger than 0.110 mm

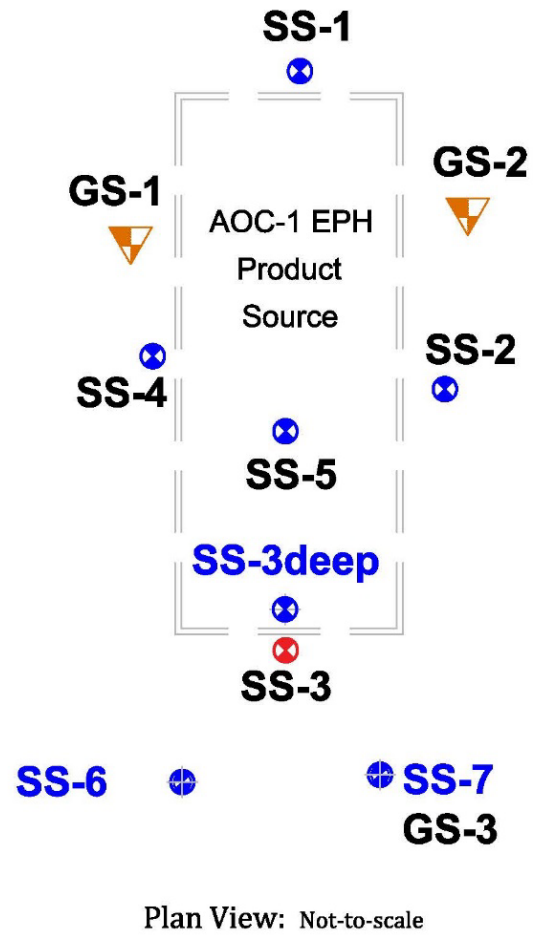
Alternate Product Indicator Concentration = **8,552 mg/kg**

Remedial Alternatives

Compliance Average EPH and 2MeN in soils

Alternate product indicator concentration for EPH

Sample Name	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6	SS-7	SS-3d
EPH Concentration (mg/kg)	1,020	3,785	**8,551**	3,650	2,100	4,150	2,105	650
2 Methyl-Naphthalene **(8 mg/kg NRDCSRS)**	NA	4.10	**9.25**	NA	NA	4.15	NA	6.05
Naphthalene **(17 mg/kg NRDCSRS)**	NA	0.85	5.15	NA	NA	1.35	NA	NA
EPH Product Limit Concentration	**8,552 mg/kg** (Site Specific "C" Value)							
RAO Goal?	Non-Residential – Limited-Restricted Use or Unrestricted							



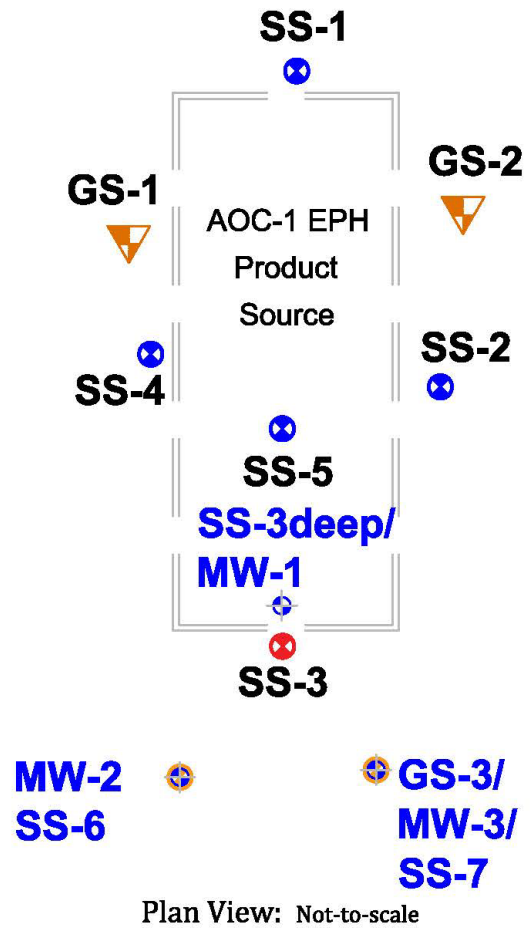
Plan View: Not-to-scale

Scenario 2B / Cat 1, 3,000-gal Non-Residential Use

WHAT IF, SPLP was not collected?

1. Site specific EPH product indicator concentration remains valid.
2. 2 Methyl-Naphthalene MUST be addressed.
   a. A groundwater investigation may be conducted for 2 MeN
   b. OR –Evaluate 2 MeN impact to GW with SPLP samples or F_{OC} Soil-Water Partition Equation

Sample Name	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6	SS-7	SS-3d
EPH Concentration (mg/kg)	1,020	3,785	**8,551**	3,650	2,100	4,150	2,105	650
2 Methyl-Naphthalene **(8 mg/kg RDCSRS)**	NA	4.10	**9.25**	2.15	1.15	4.15	NA	6.05
Naphthalene **(6 mg/kg RDCSRS)**	NA	0.85	5.15	0.6	<0.10	1.35	NA	NA
EPH Product Limit Concentration	**8,552 mg/kg (Site Specific "C" Value)**							
RAO Goal?	Unrestricted Residential Use is available							



Plan View: Not-to-scale

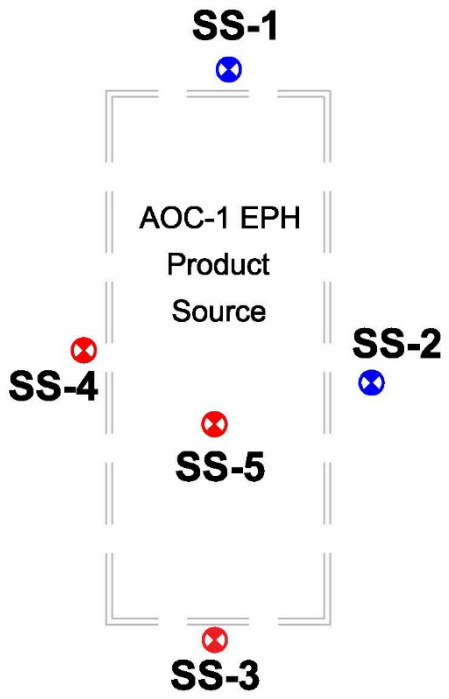
SCENARIO 3A AND 3B

8,000 GALLON #2 FUEL OIL WITH A PLANNED RESIDENTIAL PROPERTY USE

Scenario 3 / 8,000 gal. Cat 1 –Residential Use

1. Are more samples required?
   a. Where to take samples and how many?
2. Is a ground water investigation required?
3. What additional work is required?

Sample Name	SS-1	SS-2	SS-3	SS-4	SS-5
EPH Concentration (mg/kg)	800	3,185	**8,675**	3,950	**16,875**
2 Methyl-Naphthalene **(8 mg/kg RDCSRS)**	NA	NA	**9.65**	2.15	**11.75**
Naphthalene **(6 mg/kg RDCSRS)**	NA	NA	4.25	**13.2**	<0.15
EPH Product Limit Concentration	**8,000 mg/kg** (Default value)				
RAO Goal?	Residential – Unrestricted Use				



Plan View: Not-to-scale

Scenario 3A / #2 Fuel Oil Cat 1 –Residential Use

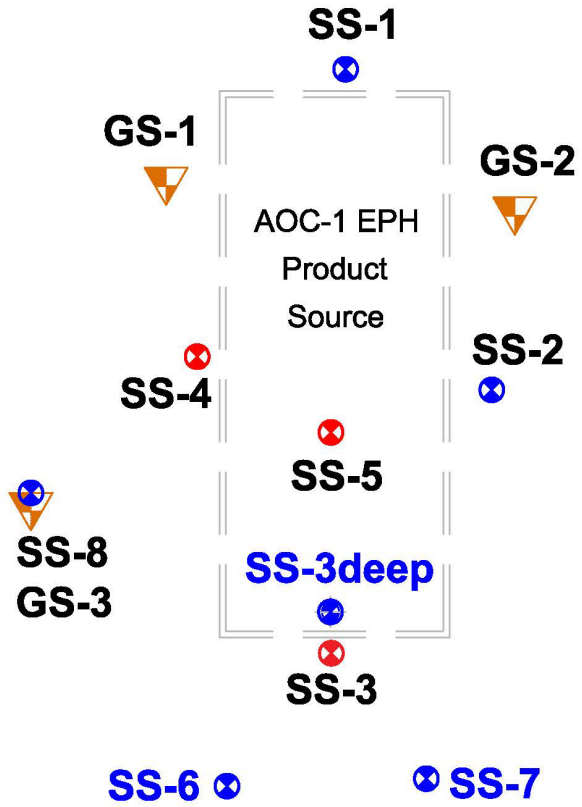
SPLP at SS-5 and SS-3 PASSES. No ground water trigger

SS-5 must be remediated in order to reach residential standards.

SS-4 Naphthalene may be compliance averaged after delineating

Do we need vertical delineation of SS-4? **YES**

Sample Name	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6	SS-7	SS-8	SS-3d
EPH Concentration (mg/kg)	400	3,185	**8,675**	3,950	**16,875**	4,150	2,105	2,005	650
2 Methyl-Naphthalene **(8 mg/kg RDCSRS)**	NA	NA	**9.65**	2.15	**11.75**	4.15	0.21	0.19	7.95
Naphthalene **(6 mg/kg RDCSRS)**	NA	NA	4.25	**13.2**	<0.15	1.35	0.21	<0.19	<0.22
EPH Product Limit Conc.	**9,160 mg/kg (Site Specific "C" Value)**								
RAO Goal?	Residential – Unrestricted Use								



Plan View: Not-to-scale

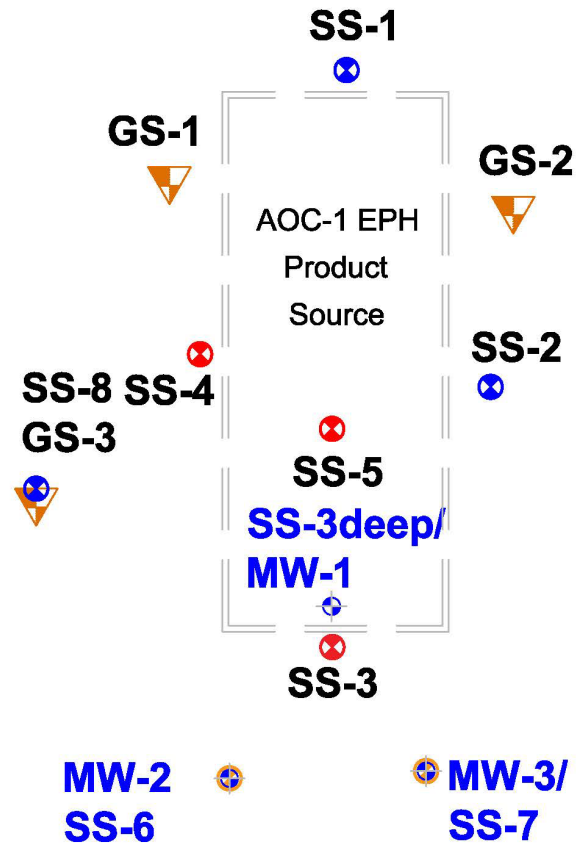
Scenario 3B / #2 Fuel Oil Cat 1 –Residential Use

SPLP SS-5 Fails. A ground water investigation is required

SS-5 must be remediated in order to reach residential standards

SS-4 Naphthalene may be compliance averaged after delineating

Sample Name	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6	SS-7	SS-8	SS-3d
EPH Concentration (mg/kg)	400	3,185	**8,675**	3,950	**16,875**	4,150	2,105	2,005	650
2 Methyl-Naphthalene **(8 mg/kg RDCSRS)**	NA	NA	**9.65**	2.15	**11.75**	4.15	0.21	0.19	7.95
Naphthalene **(6 mg/kg RDCSRS)**	NA	NA	4.25	**13.2**	<0.15	1.35	0.21	<0.19	<0.22
EPH Product Limit Conc.	**9,160 mg/kg (Site Specific "C" Value)**								
RAO Goal?	Residential – Unrestricted Use								



Plan View: Not-to-scale

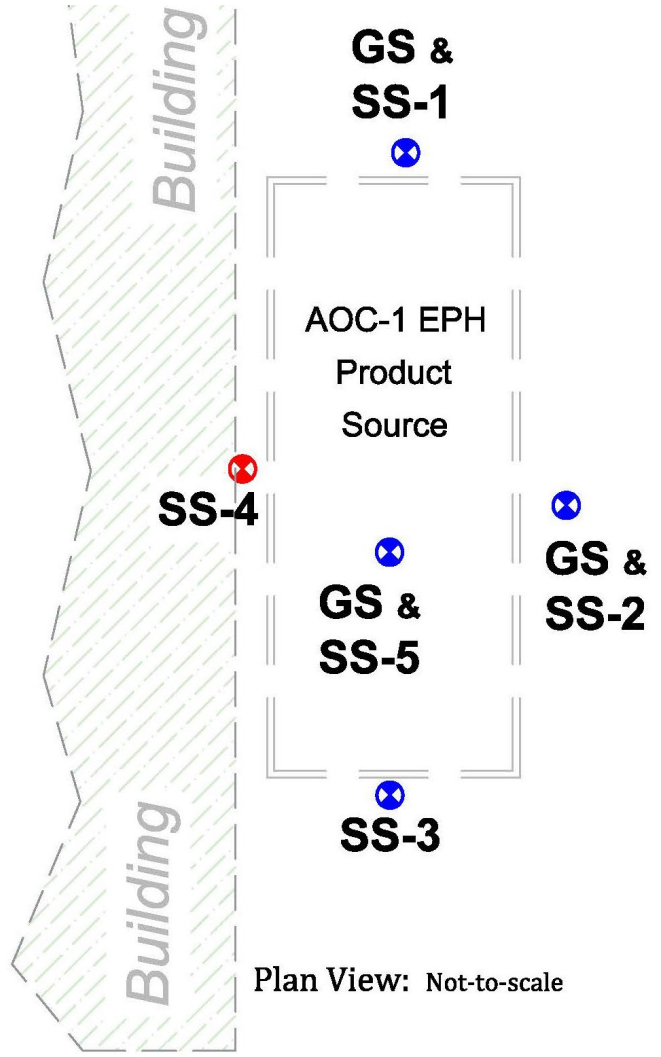
SCENARIO 4

2,000 GALLON DIESEL OIL WITH A PLANNED RESIDENTIAL PROPERTY USE

Scenario 4 / Diesel Fuel Oil 2000 gal. UST

1. The LSRP collected Grain Size samples during the investigation
2. What remedial actions are available? **SS-4 is at a footing**
3. Are more samples required?
   - Where to take samples and how many?

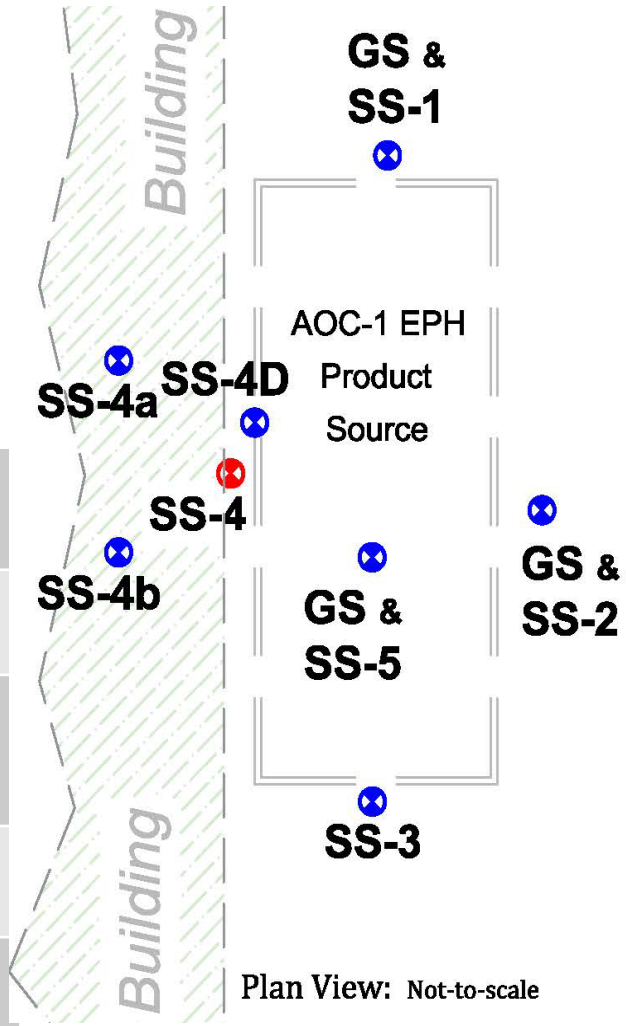
Sample Name	GS & SS-1	GS & SS-2	SS-3	SS-4	GS & SS-5
EPH Concentration (mg/kg)	ND	ND	ND	**17,000**	ND
2 Methyl-Naphthalene **(8 mg/kg RDCSRS)**	NA	NA	NA	5.15	NA
Naphthalene **(6 mg/kg RDCSRS)**	NA	NA	NA	**13.2**	NA
EPH Product Limit Conc.	**8,000 mg/kg** (Default Limit)				
RAO Goal?	Residential – Unrestricted Use				



Scenario 4 / Diesel Fuel Oil 2000 gal. UST

1. Site specific product indicator concentration = **22,000 mg/kg.**
2. What delineation is required?
3. How does Naphthalene in SS-4 affect the site?

Sample Name	SS-1	SS-2	SS-3	SS-4	SS-5	SS-4D	SS-4A	SS-4B
EPH Concentration (mg/kg)	ND	ND	ND	**17,000**	ND	5,050	4,100	3,800
2 Methyl-Naphthalene **(8 mg/kg RDCSRS)**	NA	NA	NA	5.15	NA	4.7	3.6	3.21
Naphthalene **(6 mg/kg RDCSRS)**	NA	NA	NA	**13.2**	NA	4.4	3.2	1.8
EPH Product Limit Conc.	**22,000 mg/kg (Site Specific "C" Value)**							
RAO Goal?	Residential – Unrestricted Use							



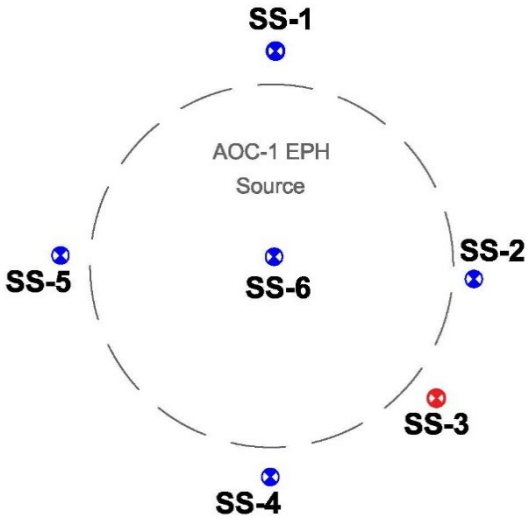
SCENARIO 5

LUBRICATING OIL WITH A PLANNED RESIDENTIAL PROPERTY USE

Scenario 5 / Lubricating Oil Cat 2 – Residential use

1. What remedial actions are available?
2. Are more samples required?
   - Where to take samples and how many?
3. Is a groundwater investigation required?
4. What additional work is required?

Sample Name	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6
EPH Concentration (mg/kg)	80	3,785	**22,000**	3,650	1,150	4,250
EPH Cat 2 Risk Calculator Results (mg/kg)	NA	Pass	Pass	Pass	Pass	Pass
Individual PAH Exceedances of Residential	NA	No exceed.	No exceed.	No exceed.	No exceed.	No exceed.
EPH Product Limit Conc.	**17,000 mg/kg** (Default Limit)					
RAO Goal?	Residential - Unrestricted Use					



Plan View: Not-to-scale

Scenario 5 / Lubricating Oil Cat 2 – Residential use

Alternate Product Indicator Concentration = **21,755 mg/kg**

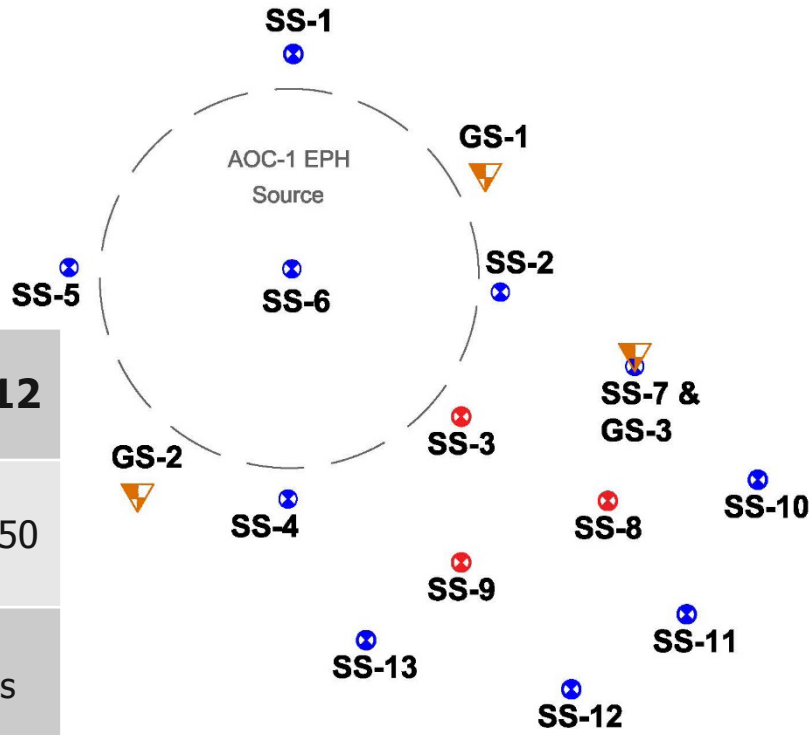
Remedial Alternatives

EPH Product Indicator Exceedances

EPH Cat 2 – Is not a chemical of concern

Individual PAH Compounds –Are not chemicals of concern

Sample Name	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6	SS-8	SS-9	SS-12
EPH Concentration (mg/kg)	80	3,785	**22,000**	3,650	1,150	4,250	**24,200**	**21,750**	13,150
EPH Cat 2 Risk Calculator Results (mg/kg)	NA	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Individual PAH Exceedances of Residential	NA	No exceed	No exceed	No exceed	No exceed	No exceed	No exceed	No exceed	No exceed
EPH Product Limit Conc.	**21,755 mg/kg (Site Specific "C" Value)**								
RAO Goal?	Residential - Unrestricted Use								

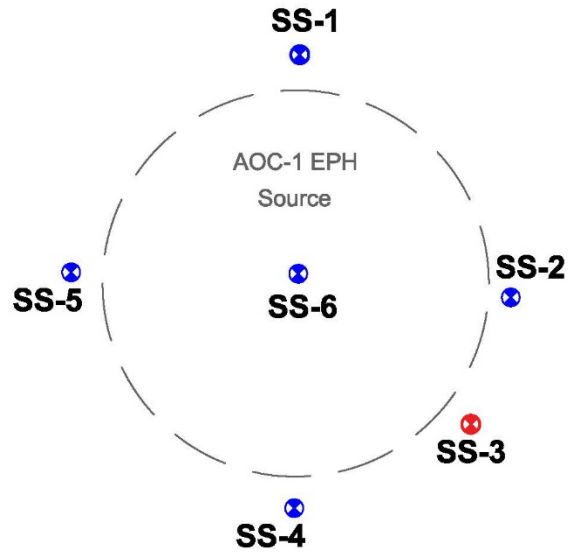


SCENARIO 6A & 6B

CUTTING OIL WITH AN INDUSTRIAL PROPERTY USE

Scenario 6A / Cutting Oil– Industrial Use

1. What remedial actions are available?
2. Are more samples required?
   - Where to take samples and how many?
3. Is a ground water investigation required?
4. What additional work is required?

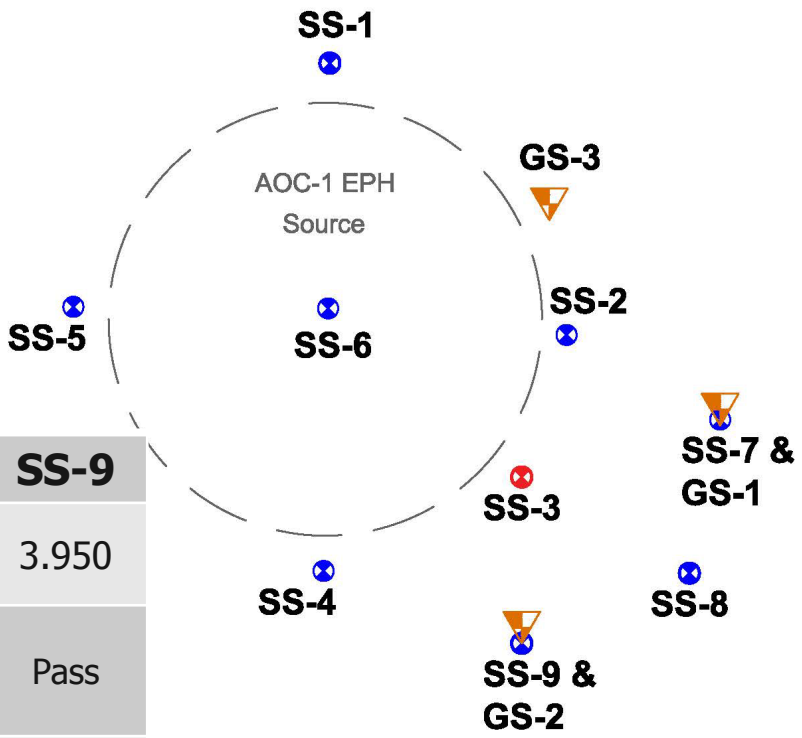


Plan View: Not-to-scale

Sample Name	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6
EPH Concentration (mg/kg)	85	4,785	**23,250**	3,650	1,150	4,250
EPH Cat 2 Risk Calculator Results	NA	Pass	Pass	Pass	Pass	Pass
Indivi. PAH Exceedance of Residential Criteria	NA	No exceed.	No exceed.	No exceed.	No exceed.	No exceed.
EPH Product Limit Concentration	**8,000 mg/kg (Unique Petroleum Product)**					
RAO Goal?	Industrial – Limited Restricted Use					

Scenario 6A / Cutting Oil– Industrial Use

1. Whys is the default Product Limit concentration = **8,000** mg/kg?
2. Alternate Product Indicator Concentration = **25,755 mg/kg**

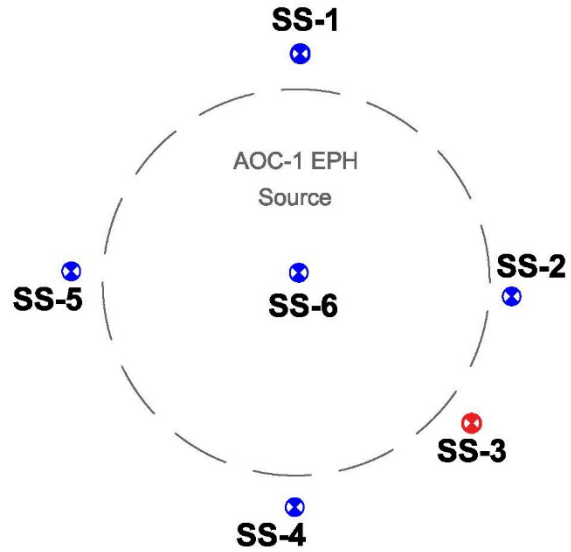


Sample Name	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6	SS-7	SS-8	SS-9
EPH Concentration (mg/kg)	85	4,785	**23,250**	3,650	1,150	4,250	1,020	5,010	3.950
EPH Cat 2 Risk Calculator Results	NA	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Indiv PAH Exceedance of Residential Criteria	NA	No exceed	No exceed	No exceed	No exceed	No exceed	No exceed	No exceed	No exceed
EPH Product Limit Concentration	**25,755 mg/kg (Site Specific "C" Value)**								
RAO Goal?	Unrestricted RAO								

Scenario 6B / Crude Oil– Industrial Use

1. EPH and Cat 2 concentrations are the same, however the petroleum product was a **CRUDE OIL** release
2. Why is the default Product Limit concentration = **UNKNOWN?**

Sample Name	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6
EPH Concentration (mg/kg)	85	4,785	**23,250**	3,650	1,150	4,250
EPH Cat 2 Risk Calculator Results	NA	Pass	Pass	Pass	Pass	Pass
Indivi. PAH Exceedance of Residential Criteria	NA	No exceed.	No exceed.	No exceed.	No exceed.	No exceed.
EPH Product Limit Concentration	**UNKNOWN**					
RAO Goal?	Industrial – Limited Restricted Use					



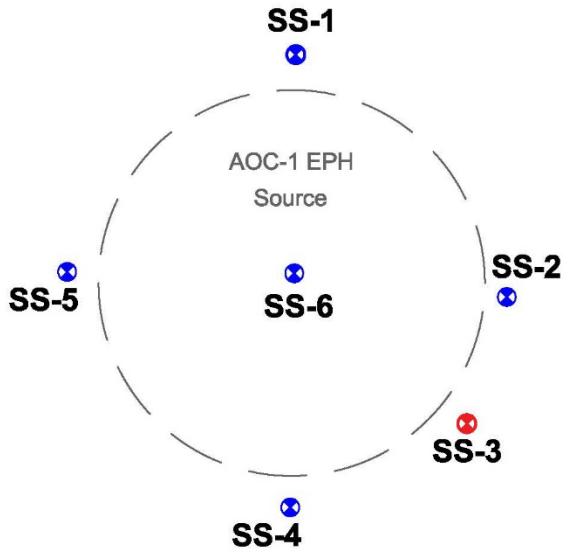
Plan View: Not-to-scale

Scenario 6B / Crude Oil– Industrial Use

Crude Oil & MGP & Waste Oil with an unknown source are considered unique mixtures of chemicals

The LSRP & PRCR can contact the NJDEP to evaluate the source material and determine a project specific EPH criteria for the product indicator concentration

Sample Name	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6
EPH Concentration (mg/kg)	85	4,785	**23,250**	3,650	1,150	4,250
EPH Cat 2 Risk Calculator Results	NA	Pass	Pass	Pass	Pass	Pass
Indivi. PAH Exceedance of Residential Criteria	NA	No exceed.	No exceed.	No exceed.	No exceed.	No exceed.
EPH Product Limit Concentration	**UNKNOWN**					
RAO Goal?	Industrial – Limited Restricted Use					



Plan View: Not-to-scale

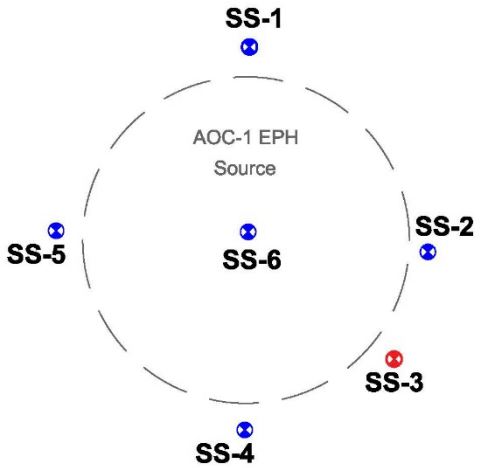
SCENARIO 7

#4 FUEL OIL WITH AN INDUSTRIAL PROPERTY USE

Scenario 7 / #4 Fuel Oil Cat 2 – Industrial Use

1. What remedial actions are available?
2. Are more samples required?
   - Where to take samples and how many?
3. Is a ground water investigation required?
4. What additional work is required?

Sample Name	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6
EPH Concentration (mg/kg)	80	3,785	**26,250**	3,650	1,150	4,250
EPH Cat 2 Risk Calculator Results (mg/kg)	NA	Pass	**Fail**	Pass	Pass	Pass
Individual PAH Exceedances of Residential D	NA	No exceed.	**YES**	No exceed.	No exceed.	No exceed.
EPH Product Limit Conc.	**17,000 mg/kg** (Default Limit)					
RAO Goal?	Industrial – Limited Restricted or Unrestricted Use					



Plan View: Not-to-scale

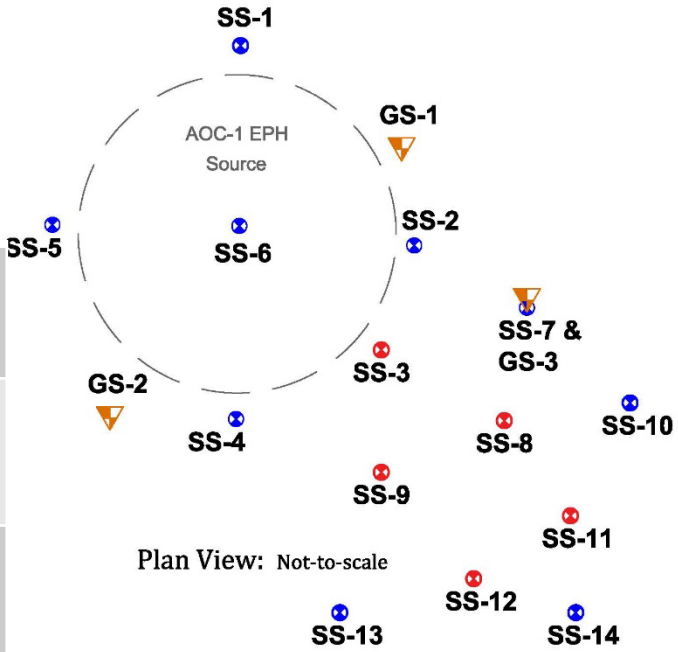
Scenario 7 / #4 Fuel Oil Cat 2 – Industrial Use

Alternate Product Indicator Concentration = 14,378 mg/kg

Remedial Alternatives

- EPH Product Indicator
- EPH Cat 2 Risk analysis
- Individual PAH Compounds

Sample Name	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6	SS-8	SS-9	SS-12
EPH Concentration (mg/kg)	80	3,785	**26,250**	3,650	1,150	4,250	**21,250**	16,200	13,150
EPH Cat 2 Risk Calculator Results (mg/kg)	NA	Pass	**Fail**	Pass	Pass	Pass	**Fail**	**Fail**	**Fail**
Individual PAH Exceedances of Residential D	NA	No exceed	**YES**	No exceed	No exceed	No exceed	**YES**	**YES**	No exceed
EPH Product Limit Conc.	**17,000 mg/kg** (Default Limit)								
RAO Goal?	Industrial – Limited Restricted or Unrestricted Use								



Not all results are presented.

Scenario 7 / #4 Fuel Oil Cat 2 – Industrial Use

Remedial Alternatives

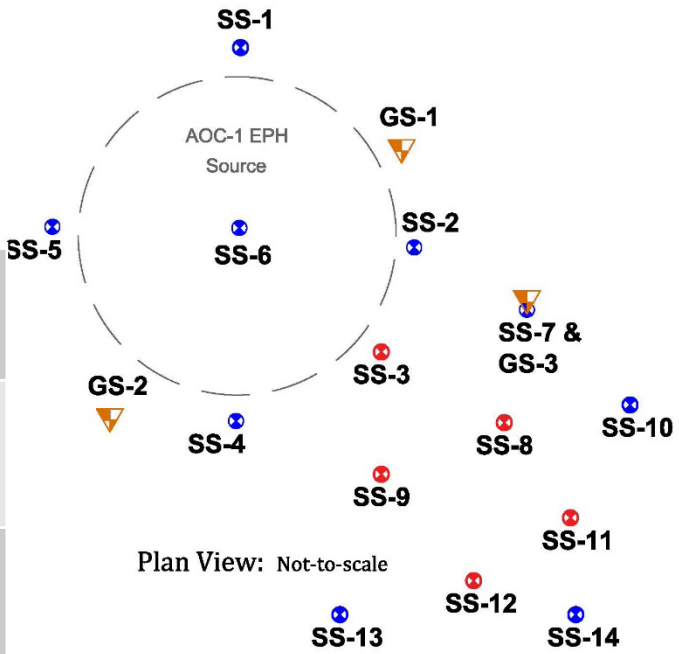
EPH Product Indicator - Active Remediation - No Compliance Avg

EPH Cat 2 Risk analysis - Active Remediation - No Compliance Avg

Individual PAH Compounds – Compliance Averaging is available

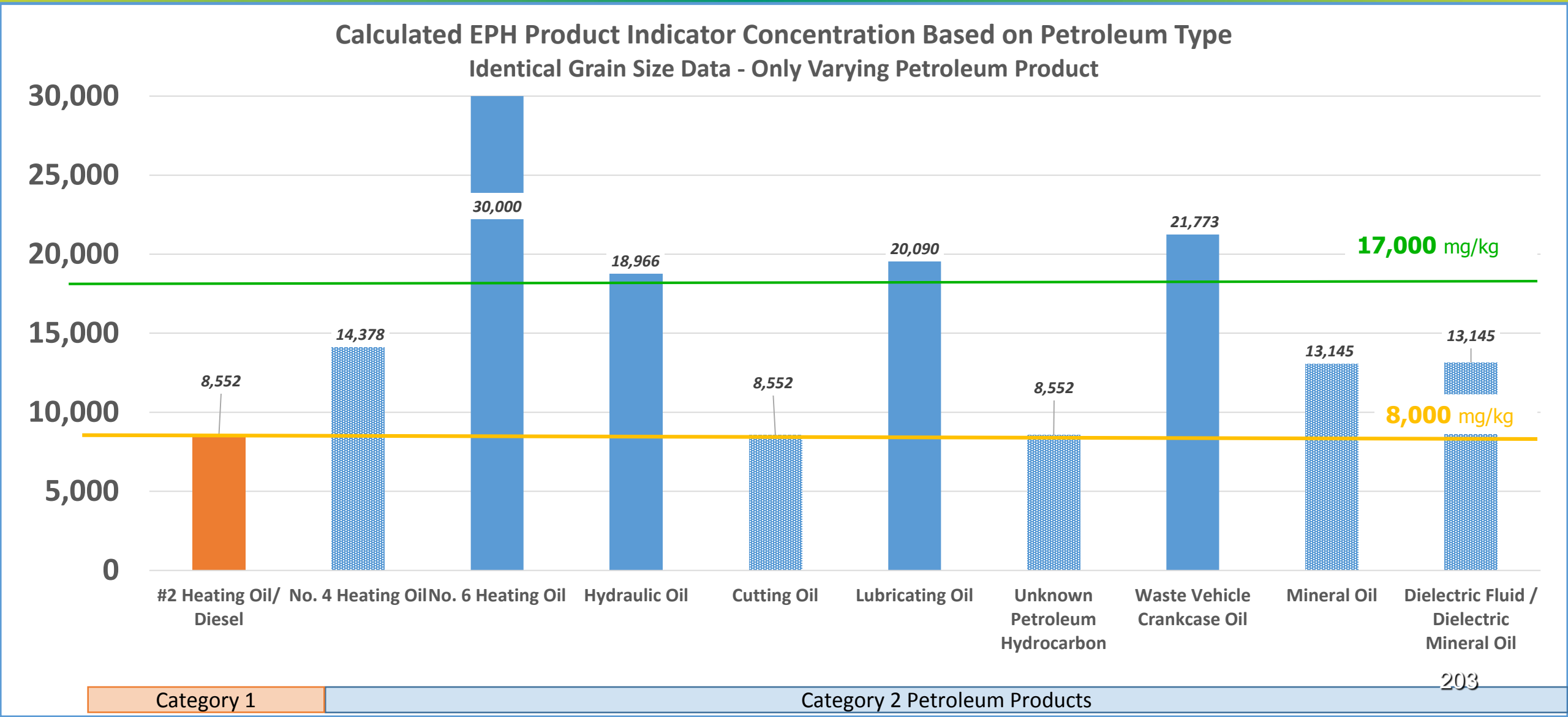
Consider 75%/10X & Spatially Weighted Average Technique

Sample Name	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6	SS-8	SS-9	SS-12
EPH Concentration (mg/kg)	80	3,785	**26,250**	3,650	1,150	4,250	**21,250**	16,200	13,150
EPH Cat 2 Risk Calculator Results (mg/kg)	NA	Pass	**Fail**	Pass	Pass	Pass	**Fail**	**Fail**	**Fail**
Individual PAH Exceedances of Residential D	NA	No exceed	**YES**	No exceed	No exceed	No exceed	**YES**	**YES**	No exceed
EPH Product Limit Conc.	**17,000 mg/kg** (Default Limit)								
RAO Goal?	Industrial – Limited Restricted or Unrestricted Use								



Not all results are presented

Comparison of Calculated Product Indicator Concentrations – Varying Petroleum Type



Summary

- EPH concentrations provide three pieces of data:
  1. Indication of the potential for free or residual petroleum product
  2. Indication of a direct contact human health exposure
  3. A screening point to determine if additional actions/analytical is required
- The LSRP must focus on compliance with all chemicals/ compounds in accordance with N.J.A.C. 7:26D and N.J.A.C. 7:26E
- The LSRP may use the Attainment & Compliance Technical Guidance

Questions?

Thank you!
Please sign out