

State Of Connecticut  
Department of Environmental Protection

**Recommended Reasonable Confidence Protocols**

**Quality Assurance and Quality Control Requirements**

**Extractable Petroleum Hydrocarbons**

**By The**

**Massachusetts DEP EPH Method**

Version 2.0

May 2009



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[www.ct.gov/dep/remediation](http://www.ct.gov/dep/remediation)

860/424-3705

<b>Revision</b>	<b>Comments</b>	<b>Date</b>
1.0	Draft for Public Comment	November 30, 2008
2.0	Final version following public comment period	May 1, 2009

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## 1.0 Method Overview

The Extractable Petroleum Hydrocarbons (EPH) Method (the EPH Method.) is based on a solvent extraction, silica gel solid-phase extraction (SPE)/fractionation process and gas chromatography (GC) analysis using a flame ionization detector (FID) to identify and quantify both Target Polynuclear Aromatic Hydrocarbons (PAH) analytes and method-defined aliphatic and aromatic hydrocarbon fractional ranges in water, soils and sediments. Extractable aliphatic hydrocarbons are collectively quantified within two specific ranges: C<sub>9</sub> through C<sub>18</sub>, and C<sub>19</sub> through C<sub>36</sub>. Extractable aromatic hydrocarbons are collectively quantified within the C<sub>11</sub> through C<sub>22</sub> range. These aliphatic and aromatic hydrocarbon ranges correspond to a boiling point range between approximately 150°C and 265°C. This method may also be used to identify and quantify specific Target PAH Analytes, including Diesel PAH analytes. All references to SW-846 Methods in this document refer to the United States Environmental Protection Agency's most recently published version.

The EPH Method is designed to complement and support the toxicological approach developed by the Connecticut Department of Environmental Protection (CTDEP) to evaluate human health hazards that may result from exposure to petroleum hydrocarbons. It is intended to produce data in a format suitable for evaluation by that approach.

Petroleum products suitable for evaluation by this method include kerosene, fuel oil #2, fuel oil #4, fuel oil #6, diesel fuel, jet fuels, and certain petroleum-based lubricating oils. The EPH Method, in and of itself, is not suitable for the evaluation of gasoline, mineral spirits, petroleum naphthas, or other petroleum products, that contain lower or higher boiling components or distillates of aliphatic and/or aromatic hydrocarbons that are outside the aforementioned analytical range (C<sub>9</sub> through C<sub>36</sub> aliphatic and aromatic ranges) of the EPH Method.

### 1.1 Reporting Limits for the EPH Method

The Reporting Limit (RL) for this method for each of the collective aliphatic and aromatic ranges is approximately 20 mg/kg in soil/sediment, and approximately 100 µg/L in water. The RL for this method when used to determine Total Petroleum Hydrocarbons (TPH) is approximately 10 mg/kg in soil and approximately 100 µg/L in water. The RL of this method for the Target PAH Analytes is compound-specific, and ranges from approximately 0.2 - 1.0 mg/kg in soil/sediment, and 2 - 5 µg/L in water. These RLs reflect the sampling procedures and prescriptive analytical conditions imposed by the EPH Method. The RLs are dependent upon the concentration of the lowest analytical standard in the initial calibration and/or the percent solids of the sample. Preservation, container and analytical holding time specifications for surface water, groundwater, soil, and sediment matrices for EPH samples analyzed in support of environmental decision-making are presented in Table 2.0 of this document.

### 1.2 Requirements for the EPH Method

Each laboratory that uses the EPH Method is required to operate a formal quality assurance program. The minimum requirements of this program consist of an initial demonstration of laboratory capability, ongoing analysis of standards and blanks to confirm acceptable continuing performance, and the analysis of laboratory control samples (LCSs) and ICV to assess analytical accuracy and precision. Matrix spikes (MS), matrix spike duplicates (MSD) or Matrix duplicates

may also be used to evaluate precision when such samples are analyzed either at discretion of the laboratory or at the request of the data-user.

Laboratories must document and have on file an Initial Demonstration of Laboratory Capability (IDLC) for each combination of sample preparation and determinative analytical method in use. An IDLC must be completed and documented when a method is initially started up, whenever a method is substantially modified or new laboratory staff is trained to perform the EPH Method. These data must meet or exceed the performance standards as presented in Section 10.3.1 through 10.3.5 of the EPH Method and Table 1A of this document. Procedural requirements for performing the IDLC can be found in SW-846 Method 8000 (Section 8.4), and Section 10.3 and Appendix 5 of the EPH Method. The data associated with the IDLC should be kept on file at the laboratory and made available to potential data-users on request.

Note: Because of the inherent difficulty in quantifying collective hydrocarbon ranges and the number of QC elements associated with the Initial Demonstration of Laboratory Capability, it should be expected that one or more of the ranges and/or optional target analytes may not meet the performance standard for one or more QC elements. Under these circumstances, the analyst should attempt to locate and correct the problem and repeat the analysis for all non-conformances. All non-conformances, along with the laboratory-specific acceptance criteria should be noted in the Initial Demonstration of Laboratory Capability data. This information should be kept on-file at the laboratory.

It is essential that laboratory-specific performance criteria for LCS, ICV, and surrogate recoveries also be calculated and documented as described in SW-846 Method 8000, Section 8.7. When experience indicates that the criteria recommended in specific methods are frequently not met for some analytes and/or matrices, the in-house performance criteria will be a means of documenting these repeated exceedances. Laboratories are encouraged to actively monitor pertinent quality control performance standards described in Table 1A to assess analytical trends (i.e., systematic bias, etc) and improve overall method performance by preempting potential non-conformances. For the EPH Method, laboratory-specific control limits must meet or exceed (demonstrate less variability than) the performance standards for each QC element listed in Table 1A. It should be noted that the performance standards listed in Table 1A are based on multiple-laboratory data, which are in most cases expected to demonstrate more variability than performance standards developed by a single laboratory. Laboratories are encouraged to continually strive to minimize variability and improve the accuracy and precision of their analytical results. A list of the required EPH Method performance standard elements and method references is presented in Table 1.0. In some cases, the standard laboratory acceptance criteria for the various QC elements may have to be modified to accommodate more rigorous project-specific data quality objectives prescribed by the data user. The laboratory may be required to modify routine sample introduction and/or analytical conditions to accommodate project-specific data quality objectives.

This method is restricted to use by, or under the supervision of, analysts experienced in the use of gas chromatography (GC), and skilled in the interpretation of gas chromatograms for individual Target PAH Analytes and petroleum hydrocarbon ranges in environmental matrices. Each analyst must demonstrate the ability to produce acceptable quantitative and qualitative results both for individual target analytes and petroleum hydrocarbon ranges with this method.

**Table 1.0 Performance Elements for EPH**

Performance Standard Element	Method Reference
Initial Calibration	Table 1A of this method
Continuing Calibration	Table 1A of this method
Laboratory Method Blanks	Table 1A of this method
Laboratory Control Samples	The EPH Method, Section 10.4.3.3
Fractionation Check Standard	The EPH Method, Section 10.4.3.7
Extraction Surrogate Recovery	Table 1A of this method
Fractionation Surrogate Recovery	Table 1A of this method
Potential Aromatic Breakthrough	The EPH Method, Section 10.4.2

### 1.3 Summary of Method

This method is suitable for the analysis of waters, soils, sediments and NAPL after appropriate sample concentration and cleanup. A sample submitted for EPH analysis is extracted with methylene chloride, dried over sodium sulfate, solvent exchanged into hexane, and concentrated in a Kuderna-Danish apparatus. Sample cleanup and separation into aliphatic and aromatic fractions is conducted using commercially available silica gel cartridges or self-packed silica gel columns. The two extracts produced (i.e., an aliphatic extract and an aromatic extract) are then re-concentrated to final volumes of 1 mL each. The extracts are then separately analyzed by a capillary column gas chromatograph equipped with a flame ionization detector. The resultant chromatogram of aliphatic compounds is collectively integrated within the C<sub>9</sub> through C<sub>18</sub> and C<sub>19</sub> through C<sub>36</sub> ranges. The resultant chromatogram of aromatic compounds is collectively integrated within the C<sub>11</sub> through C<sub>22</sub> range, and is (optionally) used to identify and quantify individual concentrations of Diesel and/or other Target PAH Analytes.

Average calibration factors or response factors determined using an aliphatic hydrocarbon standard mixture are used to calculate the collective concentrations of C<sub>9</sub> through C<sub>18</sub> and C<sub>19</sub> through C<sub>36</sub> aliphatic hydrocarbons. An average calibration factor or response factor determined using a PAH standard mixture is used to calculate a collective C<sub>11</sub> through C<sub>22</sub> aromatic hydrocarbon concentration. Calibration factors or response factors determined for individual components of the PAH standard mixture are also used to calculate individual concentrations of Diesel and Target PAH Analytes. The EPH Method marker compounds and retention time windows are summarized in Table 1.1. This method is based on the Massachusetts DEP *Method for the Determination of Extractable Petroleum Hydrocarbons (EPH)*, rev. 1.1, May 2004 or the most recent method.

**Table 1.1 EPH Method Marker Compounds**

RANGE/ MARKER	HYDROCARBON	BEGINNING COMPOUND	MAKER	ENDING COMPOUND	MARKER
C <sub>9</sub> - C <sub>18</sub>	Aliphatic Hydrocarbons	0.1 Minutes before n-Nonane		0.1 Minutes before n-Nonadecane	
C <sub>19</sub> - C <sub>36</sub>	Aliphatic Hydrocarbons	0.1 Minutes before n-Nonadecane		0.1 Minutes after n-Hexatriacontane	
C <sub>11</sub> - C <sub>22</sub>	Aromatic Hydrocarbons	0.1 Minutes before Naphthalene		0.1 minutes after Benzo(g,h,i)perylene	

### 1.3.1 Sample Analysis Procedure

The analytical procedure for both water and solid samples are described in detail in Section 9.0 of the EPH Method. Approved matrix-specific extraction procedures are also described in Section 9.0 and are presented in Table 1.2 below. In general, a measured volume or weight of sample, 1-L for liquids and 10 grams for solids, is extracted using the appropriate matrix-specific sample extraction technique. Samples are first extracted with methylene chloride, and then solvent exchanged into hexane. Alternative extraction procedures other than those listed in Table 1.2 are acceptable, provided that the laboratory can document acceptable performance. However, use of an alternative extraction procedure is considered a "significant modification" of the EPH method pursuant to Section 11.3.1.1 of the EPH Method and as such would preclude obtaining "Reasonable Confidence" for any analytical data produced using an alternative EPH extraction procedure.

**Table 1.2 Approved EPH Extraction Methods for Water, Soils and Sediments  
 SW-846 Method Matrix Description**

SW-846 Method	Matrix	Description
3510C	Aqueous	Separatory Funnel Liquid-Liquid Extraction
3520C	Aqueous	Continuous Liquid-Liquid Extraction
3511	Aqueous	Organic Compounds in Water by Microextraction
3540C	Soil/ Sediment	Soxhlet Extraction
3541	Soil/ Sediment	Automated Soxhlet Extraction
3545A	Soil/ Sediment	Pressurized Fluid Extraction (PFE)
3546	Soil/ Sediment	Microwave Extraction
3570	Soil/ Sediment	Microscale Solvent Extraction (MSE)
3550C	Contaminated Solids <sup>1</sup>	Ultrasonic Extraction
3580A	NAPL	Solvent Dilution

Note:

1. Sonication may only be used for the extraction of highly contaminated (free product) nonsoil/sediments (debris). Any other use of ultrasonic extraction is considered a "significant modification" of the EPH Method.

After solvent exchange with hexane, the extract is concentrated and subjected to a silica gel cleanup and fractionation step to isolate the aromatic and aliphatic components of the sample prior to GC analysis. It should be noted that the recommended hexane elution volume (20 mL) is critical and may need to be adjusted for each lot of silica gel/cartridges to optimize sample extraction and fractionation efficiencies. See Section 10.3.4 and Appendix 5 of the EPH Method for specifications on the use and evaluation of Fractionation Check Solutions.

Aliphatic and aromatic extracts are introduced into the gas chromatograph separately by directly injecting 1 to 4 µL of each extract using the solvent flush technique. Smaller volumes may be injected if automatic devices are employed. Samples are analyzed in a set referred to as an analysis sequence. The sequence begins with instrument calibration followed by sample extracts interspersed with blanks and laboratory QC samples. The sequence ends when the set of sample extracts has been injected or when qualitative and/or quantitative QC criteria are exceeded.

## 1.4 Method Interferences

Refer to SW-846 Methods 3500 (Sec. 3.0, in particular), 3600, and 8000 for a detailed discussion of interferences associated with GC methods. Analytical interferences will vary considerably from sample to sample depending on the matrix. While general cleanup techniques are referenced or provided as part of the EPH Method, unique samples may require additional cleanup approaches to achieve desired degrees of discrimination and quantitation. Sources of interference in this method can be grouped into three broad categories:

Contaminated solvents, reagents, or sample processing hardware, contaminated GC carrier gas, parts, column surfaces, or detector surfaces, and Compounds extracted from the sample matrix to which the detector will respond.

An in-depth discussion of the causes and corrective actions for all of these interferences is beyond the scope of this guidance document. A brief discussion of the more prevalent interferences for the EPH Method is presented below.

### 1.4.1 Chemical Contaminants

The major contaminant source for the EPH Method is attributable to the leaching of plasticizers or other contaminants from silica gel SPE cartridges. Preferably, the silica gel cleanup and fractionation procedure described in Section 9.2 of the EPH Method should be used to minimize this source of interference.

As described in Section 11.2.6 of the EPH Method, peaks identified during the injection of laboratory method blanks, and determined to be attributable to the previously described silica gel SPE cartridge interference, may adversely affect the accurate integration of the C<sub>11</sub>-C<sub>22</sub> aromatic hydrocarbon range area. In general, blank correction, either by the manual or automatic subtraction of contaminant peaks, **is not permissible** unless the laboratory performs a GC/MS analysis of the Laboratory Method Blank extract to confirm that the encountered contaminant(s) is not a C<sub>11</sub> - C<sub>22</sub> aromatic hydrocarbon range compound. The laboratory must provide a discussion in the laboratory case narrative if this approach is used.

### 1.4.2 Cross-Contamination/Carryover

Cross-contamination may occur when any sample is analyzed immediately after a sample containing high concentrations of semi-volatile organic compounds. To reduce carryover, the sample syringe must be rinsed with solvent between sample injections. Whenever a sample with unusually high EPH Target PAH Analytes and/or range concentrations is encountered, it should be followed by the analysis of a method or solvent blank to check for unacceptable cross-contamination. Concentrations of any EPH target analyte or ranges that exceed the upper limit of calibration should prompt the analyst to check for potential cross-contamination/carryover. Laboratories should be aware that carryover from refractory compounds in particular may compromise a later sample analysis.

## **1.5 Quality Control Requirements for the EPH Method**

### **1.5.1 General Quality Control Requirements for Determinative Chromatographic Methods**

Refer to SW-846 Method 8000 for general quality control procedures for all chromatographic methods, including the EPH Method. These requirements ensure that each laboratory maintain a formal quality assurance program and records to document the quality of all chromatographic data. Quality Control procedures necessary to evaluate the GC system operation may be found in the EPH Method, Sec. 9.5, and include evaluation of calibrations and chromatographic performance of sample analyses. Instrument quality control and method performance requirements for the analytical system may be found in Section 10 of the EPH Method.

### **1.5.2 Specific QA/QC Requirements and Performance Standards for the EPH Method**

Specific QA/QC requirements and performance standards for the EPH Method are presented in Table 1A. Strict compliance with the QA/QC requirements and performance standards for this method, as well as satisfying other analytical and reporting requirements will provide an environmental professional with "Reasonable Confidence" regarding the usability of analytical data to support environmental decisions. The concept of "Reasonable Confidence" is explained on the CT DEP website at: <http://www.ct.gov/dep/cwp/view.asp?A=2715&Q=324958>

While optional, parties electing to utilize these protocols will be assured that agency reviewers will, generally accept "Reasonable Confidence" data. In order to achieve "Reasonable Confidence" parties must:

1. Comply with the applicable QC analytical requirements prescribed in Table 1A. for this test procedure;
2. Evaluate and narrate, as necessary, compliance with performance standards prescribed in Table 1A. for this test method; and,
3. Adopt the reporting formats and elements specified herein.

### **1.5.3 Additional QA/QC Requirements and Performance Standards Considerations for the EPH Method**

The complete list of QA/QC requirements and performance standards described in Table 1A are required only for samples analyzed for both EPH aliphatic and aromatic ranges and Target PAH Analytes. As described in Section 1.0 of the EPH Method, the analysis of Target PAH Analytes, including the diesel PAH analytes is optional. If these analytes are not reported for particular sample, then compliance with the applicable QA/QC requirements and performance standards pertaining to these individual analytes is optional. In addition, if fractionation is eliminated and the individual EPH Method aliphatic and aromatic ranges are not quantified then only compliance with the applicable QA/QC requirements and performance standards pertaining to Total Petroleum Hydrocarbon (TPH) analysis is required.

Strict compliance with the applicable QA/QC requirements and performance standards for EPH Method "range-only" or TPH analyses, as well as satisfying the previously described reporting requirements, will still provide an environmental professional with "Reasonable Confidence" regarding the usability of the analytical data to support environmental decisions for these options.



#### **1.5.4 Field Duplicates for EPH Analyses**

Submission of Field Duplicates is recommended for drinking water samples only. However, the Field Duplicates need only be analyzed if the concentration of one or more of the EPH Target PAH Analytes or ranges in the primary sample is above the Reporting Limit (RL). Drinking water samples should be identified and specific analytical instruction for the drinking water and associated field quality control samples provided when the samples are submitted to the laboratory for analysis

#### **1.6 Analyte List for the EPH Method**

As described in Section 1.1, the EPH Method is designed to complement and support the toxicological approach developed by the Connecticut Department of Environmental Protection to evaluate human health hazards that may result from exposure to petroleum hydrocarbons. It is intended to produce data in a format suitable for evaluation by that approach.

The Analyte List for the EPH Method is presented in Table 1.3. The list is comprised of seventeen (17) PAH Analytes, four (4) of which are required for the evaluation of diesel fuel releases, and three (3) collectively quantified extractable hydrocarbon ranges, as identified in Appendix 3 of the EPH Method, that are readily-analyzable using (1) the extraction methods described in Table 1.2, (2) the cleanup and fractionation procedure described in Section 9.2 of the EPH Method, and (3) conventional GC/FID separation and analysis. All the Target PAH Analytes and hydrocarbon ranges that comprise the RCP Analyte List for the EPH Method have hydrocarbon range (e.g., C<sub>11</sub> - C<sub>22</sub> aromatic hydrocarbons) or compound-specific water or soil criteria as described in the Remediation Standard Regulations. Use of the EPH Method to identify and quantify the listed Target PAH Analytes is optional at the discretion of the data user.

##### **1.6.1 Additional Reporting Requirements for the EPH Method**

While it is not necessary to request and report all the Target PAH Analytes listed in Table 2, it is required to quantify the EPH aliphatic and aromatic hydrocarbon ranges, described in the same table, to obtain "Reasonable Confidence" status. Such limitations must be documented for site characterization and data representativeness considerations. DEP strongly recommends use of the full analyte list during the initial stages of site investigations, and/or at sites with an unknown or complicated history of uses of oil or hazardous materials. It is also permissible to quantify EPH Target PAH Analytes, and aliphatic and/or aromatic range concentrations by GC/MS using a "modified" SW-846 Method 8270 as described in Section 9.10 of the EPH Method.

The Reporting Limit (based on the concentration of the lowest calibration standard) for each EPH hydrocarbon range or Target PAH Analyte must be less than or equal to the MCP standards or criteria that the contaminant concentrations are being compared to (e.g., Drinking Water MCLs, background, etc.). Meeting program reporting limits may require analytical modifications, such as increased sampling weight or volume, to increase sensitivity. All such modifications must be described in the Environmental Laboratory case narrative. Reporting limits above the regulatory criteria may be of limited use to the data user.

**Table 1.3 Analyte List for the EPH Method**

<b>Range/ Optional Target Analyte</b>	<b>CAS No.</b>	<b>Comments</b>
EPH Ranges		
C9 - C18 Aliphatic Hydrocarbons	N/A	
C19 - C36 Aliphatic Hydrocarbons	N/A	
C11 - C22 Aromatic Hydrocarbons	N/A	
Diesel PAH Analytes		
Naphthalene	91-20-3	
2-Methylnaphthalene	91-57-6	
Phenanthrene	85-01-8	
Acenaphthene	83-32-9	
Other Target PAH Analytes		
Fluorene	86-73-7	
Acenaphthylene	208-96-8	
Anthracene	120-12-7	
Fluoranthene	206-44-0	
Pyrene	129-00-0	
Benzo(a)anthracene	56-55-3	
Chrysene	218-01-9	
Benzo(b)fluoranthene	205-99-2	
Benzo(k)fluoranthene	207-08-9	
Benzo(a)pyrene	50-32-8	
Indeno(1,2,3-cd)pyrene	193-39-5	
Dibenz(a,h)anthracene	53-70-3	
Benzo(g,h,i)perylene	191-24-2	

**Table 1A. QA/QC Requirements for the EPH Method**

Required QA/QC Parameter	Data Quality Objective	Required Performance Standard	Required Deliverable	Recommended Corrective Action	Analytical response Action
GC Performance	Inter-laboratory consistency and comparability	1) PAH resolution as per Section 10.1.3 of the method. 2) C <sub>9</sub> resolution from solvent front. 3) Response ratio of C28 to C20 should be $\geq 0.85$ . 4) Surrogate and internal stds must be resolved from all aromatic and aliphatic standards. 5) Naphthalene and n-dodecane in the aliphatic fraction must be adequately resolved (see Sect. 10.4.2 of EPH Method)	NO	Perform instrument/injection port maintenance as needed.	Suspend all analyses until performance criteria are achieved. Report exceedances in the report narrative.
Retention Time Windows	Laboratory Analytical Accuracy	1) Prior to initial calibration and when a new GC column is installed. 2) Calculated according to the method (Sect. 9.6). 3) Retention time windows must be updated with every CCAL.	NO	N/A	N/A
Initial Calibration (ICAL)	Laboratory Analytical Accuracy	1) Minimum of 5 stds. 2) Low std. must be $\leq$ reporting limit (RL). 3) % RSD should be $\leq 25$ or "r" should be $\geq 0.990$ for all compounds and ranges. 4) Must contain all aliphatic and aromatic hydrocarbon stds. listed in Tables 1 and 2 of the EPH Method. 5) If regression analysis is used, the curve must not be forced through the origin. 6) Must meet GC performance standards described in Sect. 10.2 of the EPH Method.	NO	Perform instrument maintenance. Recalibrate.	Sample analysis may not proceed without a valid initial calibration.  Report exceedances in narrative.

**Table 1A. QA/QC Requirements for the EPH Method (continued)**

Required QA/QC Parameter	Data Quality Objective	Required Performance Standard	Required Deliverable	Recommended Corrective Action	Analytical response Action
Continuing Calibration (CCAL)	Laboratory Analytical Accuracy	1) Every 24-hrs, prior to samples, and after no more than 20 samples. 2) Concentration near mid-point of curve. 3) Must contain all aliphatic and aromatic hydrocarbon stds. listed in Tables 1 and 2 of the EPH Method. 4) Opening CCAL % D or % drift must be $\leq 25$ for all target PAH analytes and ranges except for n-nonane, which must be $\leq 30$ . 5) Closing CCAL: Up to 4 analytes may exhibit % D or % drift $\geq 25$ , but must be $< 40$ . 6) Must meet GC performance standards.	NO	Recalibrate as required by the method. Any samples analyzed between the last CCAL that meets criteria and one that fails must be reanalyzed.	Report exceedances in narrative.
Method Blanks	Laboratory Method Sensitivity and Contamination Evaluation	1) Extracted with every batch or every 20 samples, whichever is more frequent. 2) Matrix specific (e.g. soil, water). 3) EPH hydrocarbon ranges must be $\leq 10\%$ of applicable RSR standard. 4) target PAH analytes must be $\leq RL$ . 5) EPA hydrocarbon ranges must be $\leq 10\%$ of any applicable clean up standard.	YES	Locate source of contamination; correct problem; re-extract associated samples	1) Report non-conformances in the narrative. 2) If contamination present all associated results above the RL must be "B" flagged. Document in narrative. 3) If re-extraction performed in holding time, report only compliant data. 4) If re-extraction performed outside of holding time, report both sets of data.

**Table 1A. QA/QC Requirements for the EPH Method (continued)**

Required QA/QC Parameter	Data Quality Objective	Required Performance Standard	Required Deliverable	Recommended Corrective Action	Analytical response Action
Laboratory Control Sample (LCS)	Laboratory Method Accuracy	1) Extracted with every batch or every 20 samples, whichever is more frequent. 2) Same source as ICAL. 3) Concentration between RL and mid-point. 4) Prepared using all aliphatic and aromatic hydrocarbon stds. listed in Tables 1 and 2 of the EPH Method. 5) Matrix specific (e.g. soil, water). 6) Percent recoveries between 40 and 140% for all EPH ranges and target PAH analytes, except for n-nonane which must be between 30-140%. 7) Individual concentrations of both naphthalene and 2-methylnaphthalene must be <5% in the aliphatic fraction (See calculation in Sect. 10.4.2 of EPH Method). 8) Laboratories should develop in-house control limits which must fall between limits listed above.	YES	1) Recalculate % recovery. 2) Re-extract samples if % recovery outside limits. 3) Re-fractionate archived extracts if either the concentration of naphthalene or 2-methylnaphthalene in aliphatic fraction is >5% of either of their respective total concentrations.	1) Report non-conformances in the narrative. 2) If re-extraction or re-fractionation performed in holding time, report only compliant data. 3) If re-extraction or re-fractionation performed outside of holding time, report both sets of data.
Initial Calibration Verification (ICV)	Laboratory Method Accuracy	1) Second source standard 2) Must be analyzed with each new ICAL 3) Percent recoveries must be between 80-120% for all EPA ranges and target PAH analytes.	NO	Perform new ICAL	1) Sample analysis may not proceed without a valid ICV. 2) Report non-conformances in the narrative.

**Table 1A. QA/QC Requirements for the EPH Method (continued)**

Required QA/QC Parameter	Data Quality Objective	Required Performance Standard	Required Deliverable	Recommended Corrective Action	Analytical response Action
Matrix Spike/ Matrix Spike Duplicate (MS/MSD)	Method Accuracy in Sample Matrix  Method Precision in Sample Matrix	1) Every 20 samples (Site specific MS/MSD's are strongly recommended). 2) Matrix Specific (e.g. soil/water) 3) Same source as LCS. 4) Spike near mid-point of ICAL. 5) Must contain all aliphatic and aromatic hydrocarbon stds. listed in Tables 1 and 2 of the EPH Method. 6) Percent recoveries between 40 and 140% for all EPH ranges and target PAH analytes, except for n-nonane which must be between 30-140%. 7) RPDs should be $\leq 50\%$ for waters and soils/sediments.	YES (when requested by data user)  Do not report "Batch" MS/MSDs	Check LCS, if recoveries acceptable in LCS no corrective action required.	Note exceedances in narrative.
Matrix Duplicate	Method Precision in Sample Matrix	1) Extracted with analytical batch (Optional site specific duplicates at request of data user). 2) Matrix Specific (e.g. soil/water) 3) RPDs should be $\leq 50\%$ for waters and soils/sediments for EPH ranges and target PAH analytes $>5x$ the RL.	YES (when requested by data user)  Do not report "Batch" matrix duplicates	Recheck RPD calculations	Note exceedances in narrative.

**Table 1A. QA/QC Requirements for the EPH Method (continued)**

Required QA/QC Parameter	Data Quality Objective	Required Performance Standard	Required Deliverable	Recommended Corrective Action	Analytical response Action
Surrogates	Accuracy in Sample Matrix	1) Minimum of 2 extraction and 1 fractionation surrogate. 2) Recommended extraction surrogates: chloro-octadecane and o-terphenyl. 3) Recommended fractionation surrogate: 2-bromonaphthalene and/or 2-fluorobiphenyl	YES	1) No corrective action if chromatogram indicates obvious interference. 2) If obvious interference absent, re-extraction and/or re-fractionation required unless: If surrogate recovery high, and the associated EPH range or PAH target analytes are not detected, re-extraction is not required.	1) Note exceedances in narrative. 2) If re-extraction or re-fractionation yields similar recoveries, report both sets of data and note in narrative. 3) If re-extraction or re-fractionation performed in holding time, report only compliant data. 4) If re-extraction or re-fractionation performed outside of holding time, and surrogate recoveries are acceptable, report both sets of data. 5) If sample is not reanalyzed due to obvious interference, laboratory must supply the chromatogram in the data report.
Internal Standards (only required for GC/MS analysis)	Laboratory Analytical Accuracy and Method Accuracy in Sample Matrix	1) Recommended internal std. For EPH analysis is 5-alpha-androstane. Alternatively, 1-Chloro-octadecane may also be used as an internal std. For GC/MS analysis. 2) Area counts in sample should be within 50-200% of area counts of associated CCAL .	NO	Reanalyze sample.	1) Note exceedances in narrative. 2) If re-extraction or re-fractionation yields similar recoveries, report both sets of data and note in narrative. 3) If re-extraction or re-fractionation performed in holding time, report only compliant data. 4) If re-extraction or re-fractionation performed outside of holding time, and surrogate recoveries are acceptable, report both sets of data.

**Table 1A. QA/QC Requirements for the EPH Method (continued)**

Required QA/QC Parameter	Data Quality Objective	Required Performance Standard	Required Deliverable	Recommended Corrective Action	Analytical response Action
Fractionation Check Standard	Laboratory Method Accuracy	1) Performed for each new lot of silica gel cartridges. 2) Must contain all aliphatic and aromatic hydrocarbon stds. listed in Tables 1 and 2 of the EPH Method. 3) Percent recoveries between 40 and 140% for all EPH ranges and target PAH analytes, except for n-nonane which must be between 30-140%.	YES	Re-fractionate using different volumes of hexane until recoveries are acceptable	Note exceedances in narrative.
General Reporting Issues	N/A	1) The laboratory should report only concentrations detected above the sample specific RL. 2) Concentrations below the reporting limit (RL) should be reported as "ND" with the sample specific RL also reported 3) Dilutions: If diluted and undiluted analyses are performed, the laboratory should report results for both sets of data. Compounds that exceed the linear range should be flagged ("E" flag). Do not report more than two sets of data per sample 4) If a dilution is performed, the highest detected analyte must be in the upper 60% of the calibration curve.	N/A	N/A	1) Performance of dilutions must be documented in the case narrative 2) All soil/sediment samples must be reported on dry weight basis.

Notes:

GC = Gas Chromatography  
 RSD = Relative Standard Deviation  
 N/A = Not Applicable  
 RL = Reporting Limit

"r" = Correlation Coefficient  
 RPD = Relative Percent Difference  
 PAH = Polynuclear Aromatic Hydrocarbon  
 std = standard



## 2.0 Data Usability Assessment for the EPH Method

Overall data usability is influenced by uncertainties associated with both sampling and analytical activities. This document provides detailed quality control requirements and performance standards for the EPH Method, which may be used to directly assess the analytical component of data usability. The sampling component of data usability, an independent assessment of the effectiveness of sampling activities to meet data quality objectives, is not substantively addressed in this document.

### 2.1 Specific Guidance Regarding the Interpretation and Use of EPH Data

The EPH Method produces both analyte-specific (Target PAH Analytes) and method defined (hydrocarbon fractions) data. An analyte-specific approach produces data by comparing the response of a known analyte with an unknown concentration to the response of a standard for the same analyte with a known concentration under the same analytical conditions. A method-defined approach produces data by prescriptively defining both analytical conditions and assumptions used to calibrate and interpret the data produced. Such an approach is particularly useful in determining average characteristics for a limited set of analytes with similar physical, chemical and toxicological properties (i.e., the collective concentration of a limited range of hydrocarbons). However, a clear understanding of the analytical limitations of the method and assumptions used to interpret data are required to maximize the potential of using this approach.

Both EPH Target PAH Analytes and ranges are subject to potential "false positive" bias associated with non-specific gas chromatographic analysis. That is (1) other compounds co-eluting at the specified retention time may be incorrectly identified and/or quantified (false positive) as a Diesel or Target PAH Analyte; (2) compounds not meeting the regulatory definition of the aromatic and/or aliphatic fractions as defined by this method in Sections 3.4, 3.5 and 3.6 of the EPH Method, respectively, that elute within the method-defined retention time window would be included in the Peak Area Count (PAC) and result in an overestimation of a fraction's concentration; (3) as described in Section 9.2.3.3 of the EPH Method, the lighter aromatic compounds may be stripped or may break through the silica gel cartridge/column because of mass overloading or excessive eluting solvent volume, resulting in an underestimation of the C<sub>11</sub> through C<sub>22</sub> aromatic fraction's concentration; or, (4) also as described in Section 9.2.3.3 of the EPH Method, insufficient eluting solvent volume may allow aliphatic hydrocarbons to be retained on the silica gel cartridge/column resulting in low recoveries of these fractions.

Confirmatory analysis by a GC/MS procedure or other suitable method is recommended in cases where a Target or Diesel PAH Analyte reported by this method exceeds an applicable reporting or cleanup standard, and/or where co-elution of a hydrocarbon compound not meeting the regulatory definition of a specific hydrocarbon fraction is suspected. ***Dual-column confirmation is suitable for confirmation of optional Target PAH Analytes only.***

The following definitions are provided to assist in the interpretation and evaluation of Extractable Petroleum Hydrocarbon data:

**Aliphatic Hydrocarbon:** Any organic compound comprised solely of carbon and hydrogen characterized by a straight, branched or cyclic chain of carbon atoms. This class of organic compounds includes alkanes, alkenes, alkynes, cycloalkanes or cycloalkenes.

**Aromatic Hydrocarbon:** Any cyclic and conjugated organic compound comprised solely of carbon and hydrogen. Aromatic compounds of environmental significance are benzoids that contain benzene or fused benzene rings.

**Extractable Petroleum Hydrocarbon:** Any hydrocarbon that elutes within the C<sub>9</sub> through C<sub>18</sub> and C<sub>19</sub> through C<sub>36</sub> aliphatic, or the C<sub>11</sub> through C<sub>22</sub> aromatic ranges defined by the method. The definition of Extractable Petroleum Hydrocarbon specifically **excludes** all substituted aliphatic or aromatic hydrocarbon derivatives (non-hydrocarbons as defined by the EPH Method), the individual EPH Method Target and Diesel PAH Analytes, surrogates, and/or internal standards that co-elute within these method-specific ranges. The EPH Method is suitable for the separation and quantification of the aliphatic and non-target aromatic components of kerosene, fuel oil #s 2, 4 and 6, diesel fuel, jet fuel (JP-4, 5 and 8) and certain hydrocarbon-based, low to medium viscosity lubricating oils contained within the aforementioned method-defined ranges (C<sub>9</sub> through C<sub>36</sub>). These aliphatic hydrocarbon ranges correspond to a boiling point range between approximately 150°C and 265°C. Consequently, the EPH Method, in and of itself, is not suitable for the evaluation of lower boiling petroleum products (gasoline, mineral spirits, or certain petroleum naphthas) or higher boiling petroleum products (asphalts, tars, etc) outside the dynamic range of this method.

**Total Petroleum Hydrocarbons (TPH):** The collective concentration associated with the PAC for all peaks corresponding to any fractionated or unfractionated aliphatic and/or aromatic compounds eluting between 0.1 minutes before the retention time for n-C<sub>9</sub> to 0.1 minutes after the Rt for n-C<sub>36</sub>, **excluding** the PAC for all substituted aliphatic or aromatic hydrocarbon derivatives, the individual EPH Method Target and Diesel PAH Analytes, surrogates, and/or internal standards that co-elute within this chromatographic range. The DEP recommends that the analysis of the unfractionated EPH extract be used as a conservative estimate of TPH when this parameter is used to support human health risk characterization or other assessments and evaluation decisions.

### **2.1.1 Interfering Peaks in Specified Aliphatic Hydrocarbon Ranges**

Hydrocarbons (and non-hydrocarbons), even with elution times within the defined chromatographic windows for the aliphatic hydrocarbon ranges specified by the EPH Method, need not be included in the PAC for these ranges unless they meet the definitions of aliphatic hydrocarbon and extractable petroleum hydrocarbon, as defined above. If the concentration of a hydrocarbon range is based on one (or just a few) peaks within the range and an indicative petroleum hydrocarbon peak pattern is not apparent, the laboratory should provide this information and alert the data user of the potential for a false positive result in the Environmental Laboratory case narrative. Sites with co-mingled non-petroleum hydrocarbons such as vegetable oils, synthetic oils and lubricants, and some naturally occurring humic materials are particularly susceptible to this type of interference.

### **2.1.2 Interfering Peaks in Specified Aromatic Hydrocarbon Range**

The EPH Method should be used with caution at sites with uncertain history and disposal practices, particularly at sites where other hazardous materials were used, stored and/or managed. Such contaminants, if encountered, may co-elute within the method-defined aliphatic and or aromatic ranges resulting in an overestimation of the concentration (i.e., positive interference).

### **2.1.3 Evaluation of Individual Hydrocarbons Not Associated with an Extractable Petroleum Hydrocarbon**

In general, it may be prudent to confirm all FID data using SW-846 Method 8270 (GC/MS) if critical environmental decision-making (notification, compliance with cleanup standards, risk assessment, etc.) is based solely on the EPH Method (or any other non-specific GC analysis). If a positive interference is suspected from hydrocarbons and/or non-hydrocarbons not associated with EPH in either aliphatic or the aromatic fraction or with a Target or Diesel PAH Analyte, and such interference would adversely effect decision-making, if confirmed, then SW-846 Method 8270, Semi-Volatile Organics by GC/MS, should be employed to accurately identify and quantify the components that comprise a fraction or to resolve any uncertainty regarding the identification of a specific Target or Diesel PAH Analyte.

It is recommended that the chromatographic conditions specified under SW-846 Method 8270 be modified for consistency with the conditions specified by the EPH Method to better allow for a direct comparison of the suspect FID peaks with the GC/MS system. This is particularly useful when comparing "suspect" aliphatic hydrocarbons. The electron impact mass spectra for aliphatic hydrocarbon homologues are not particularly unique and chromatographic relative retention time data may also be required to confirm suspect EPH data.

### **2.1.4 Ineffective Separation of Aromatic and Aliphatic Fractions During Silica Gel Cleanup and Fractionation Step**

The amount of hexane used to elute the aliphatic component of the EPH hydrocarbon mixture is critical. An excessive volume of hexane may cause the lighter aromatics to breakthrough and be captured in the aliphatic fraction; while an insufficient volume of hexane may allow some of the heavier aliphatic hydrocarbons to be retained on the silica gel cartridge/column resulting in a lower recovery for these aliphatic fractions. Depending on the analytical conditions, this could result in an underestimation of the C<sub>11</sub> through C<sub>22</sub> aromatic fraction's concentration for the excessive hexane condition or an overestimation of the aromatic fraction for the deficient hexane condition. It should be noted that acceptable recovery of the Fractionation Surrogate Standards, described in Section 7.5 of the EPH Method, may not always provide absolute confirmation that effective separation of the aliphatic fraction from the aromatic fraction of the sample extract has been accomplished.

If ineffective fraction separation is suspected, even with acceptable recovery of the Fractionation Surrogate Standards, SW-846 Method 8270, Semi-Volatile Organics by GC/MS, may be employed to accurately identify and quantify the components that comprise a suspect fraction to resolve the uncertainty. Alternatively, if aromatic breakthrough is suspected, the aliphatic fraction may be analyzed to determine if naphthalene or any of the other more "mobile" aromatics are present. See Section 10.4.2 of the EPH Method.

If ineffective fraction separation is confirmed, the elution volume for optimal fractionation efficiency for the specific silica gel lot should be re-established as described in Section 10.4.3.7 of the EPH Method. *For particularly difficult separations, it may be required to resort to multiple cartridge or column cleanup/fractionation.*

## 2.2 Substitution of GC/MS for the Identification and Quantification of Ranges and Target Analytes

Consistent with Section 11.3.1.1 (Note 1) of the EPH Method, use of a GC/MS detector operated in the Total Ion Current mode to quantify the EPH Method's aliphatic and aromatic hydrocarbon ranges is not considered a "significant modification" provided that:

The sample extract has been **fractionated**;

The GC/MS system was also used to identify and quantify the Target PAH Analytes in the sample's aromatic fraction; and

The QC requirements and performance standards specified in Section 9.10 of the EPH Method are satisfied.

The EPH Method allows for "significant modifications", such as the use of a GC/MS detector to identify and quantify the EPH aliphatic and aromatic hydrocarbon ranges of an **un-fractionated** sample extract, provided that adequate documentation exists, or has been developed to demonstrate an equivalent or superior level of performance. Be advised, however, that any adaptation to the EPH Method that constitutes a "significant modification" pursuant to Section 11.3.1.1 will preclude obtaining "Reasonable Confidence" status for any analytical data produced using such modification and must be disclosed and documented on an attachment to the EPH Method analytical report form, as described in Section 11.3 of the EPH Method and Appendix 1 of this Method.

Any major modification to the EPH Method is deemed to satisfy the requirement "to demonstrate an equivalent or superior level of performance" for the determination of the collective concentrations of specified EPH aliphatic and aromatic ranges in water and soil/sediment matrices when:

1. The analytical data produced by the candidate method modification is in a format that is suitable for the evaluation using the toxicological approach developed by the Connecticut Department of Environmental Protection to evaluate human health hazards that may result from exposure to petroleum hydrocarbons;
2. The analytical data produced by the candidate method modification for both the EPH aliphatic and aromatic ranges and Target PAH Analytes must have the requisite accuracy and precision to be compared to reporting and cleanup standards;
3. The reported concentration for the C<sub>9</sub> - C<sub>18</sub> Aliphatic Hydrocarbon range includes the preponderance of the individual C<sub>9</sub> through C<sub>18</sub> aliphatic hydrocarbon compounds contained in the subject petroleum product in the matrix of interest associated with a release to the environment;
4. The reported concentration for the C<sub>19</sub> - C<sub>36</sub> Aliphatic Hydrocarbon range includes the preponderance of the individual C<sub>19</sub> through C<sub>36</sub> aliphatic hydrocarbon compounds contained in the subject petroleum product in the matrix of interest associated with a release to the environment; and,

5. The reported concentration for the C<sub>11</sub> - C<sub>22</sub> Aromatic Hydrocarbon range includes the preponderance of individual C<sub>11</sub> through C<sub>22</sub> aromatic hydrocarbon compounds contained in the subject petroleum product in the matrix of interest associated with a release to the environment.

### 3.0 Reporting Requirements for the EPH Method

Analytical reporting requirements for the EPH Method are presented in Table 1A and are summarized below in Table 1.4 as "Required Analytical Deliverables". These reporting requirements must be included as part of every analytical deliverable for the EPH Method. It should be noted that although certain items are not specified as "Required Analytical Deliverables", these data must be available for review during an audit. The required information and format for data reporting for EPH is presented in Appendix 1 of this method.

#### 3.1 Specific Reporting Requirements for the EPH Method

Specific Quality Control Requirements and Performance Standards for the EPH Method are presented in Table 1A. Specific reporting requirements for the EPH Method are summarized below in Table 1.4 as "Required Analytical Deliverables (YES)". These routine reporting requirements should always be included as part of the laboratory deliverable for this method. It should be noted that although certain items are not specified as "Required Analytical Deliverables (NO)", these data are to be available for review during an audit and may also be requested on a client-specific basis.

**Table 1.4 Analytical Reporting Requirements for the EPH Method**

Parameter	Method Section Reference	Required Analytical Deliverable
GC Performance	10.2 and 10.4	NO
Retention Time Windows	9.6	NO
Initial Calibration	9.7.2	NO
Calibration Check Standard	10.4.3.1	NO
Laboratory Method Blank	10.4.3.2	YES
Laboratory Control Sample (LCS)	10.4.3.3	YES
Initial Calibration Verification (ICV)	10.4.3.5	YES
Matrix Spike/ Matrix Spike Duplicate (MS/MSD)	10.4.4.2	YES (if requested by data user)
Matrix Duplicate	10.4.4.1	YES (if requested by data user)
Extraction Surrogates	10.4.1	YES
Fractionation Surrogates	10.4.1	YES
Fractionation Check Standard	10.4.3.7	YES
Aromatic Breakthrough Evaluation	10.4.2	YES
System Solvent Blank (for baseline correction only)	10.4.3.6	YES See the EPH Method, Section 11.2.5
GC/MS QC Parameters	9.10	YES (GC/MS only)
General Reporting Issues	11.3	Data Reporting Format is Presented in Section 11.3

#### 3.2.1 Sample Dilution

Under circumstances that sample dilution is required because either the concentration of one or more of the EPH target PAH analytes or hydrocarbon ranges exceed the concentration of their respective highest calibration standard, or any non-target peak exceeds the dynamic range of the detector (i.e., off scale.), the Reporting Limit (RL) for each EPH target PAH analyte or hydrocarbon range must be adjusted (increased) in direct proportion to the Dilution Factor (DF). Where the revised RL for the diluted sample extract is defined as RLd:

RLd = DF x Lowest Calibration Standard for Target PAH Analyte (or hydrocarbon range)

It should be understood that sample extracts with elevated RLs as a result of a dilution may not be able to satisfy DEP regulatory criteria in some cases if the RLd is greater than the applicable standard or criterion to which the concentration is being compared. Such increases in RLs are the unavoidable but acceptable consequence of sample extract dilution that enables quantification of target analytes or ranges, which exceed the calibration range. All dilutions must be fully documented in the Environmental Laboratory case narrative.

Analytical Note: Over dilution is an unacceptable laboratory practice. The post-dilution concentration of the highest concentration target analyte in the sample extract must be at least 60 to 80% of its highest calibration standard. This will avoid unnecessarily high reporting limits for other target analytes, which did not require dilution.

If a sample analysis results in a saturated detector response for any target or non-target compound, the analysis must be followed by a System Solvent Blank analysis. If the solvent blank analysis is not free of interferences, the system must be decontaminated. Sample analysis may not resume until a solvent blank demonstrates the lack of system interferences.

**Table 2.0 Sample Collection, Preservation, and Holding Time Requirements for the EPH Method**

Matrix	Container Type (1)	Preservation	Holding Time
Aqueous	1-Liter amber glass with Teflon-lined screw cap	Add 1:1 HCl or H <sub>2</sub> SO <sub>4</sub> to pH <2 Cool to 4 ± 2° C	Samples must be extracted within 14-days of collection. Extracts must be analyzed within 40-days of extraction.
Soil/ Sediments	4-oz. (120 mL) wide mouth amber jar with Teflon-lined screw cap	Cool to 4 ± 2° C	Samples must be extracted within 14-days of collection. Extracts must be analyzed within 40-days of extraction.
	4-oz. (120 mL) wide mouth amber jar with Teflon-lined screw cap. Jar should be filled only 2/3 full to avoid breakage if expansion occurs during freezing.	Freeze at -12 ± 3° C (See note 2)	Samples must be extracted within 24-hours of thawing and extracts must be analyzed within 40-days of extraction.

1. Number and size of containers are optional. Sufficient sample volume/mass must be submitted to achieve required reporting limit.

2. Soil/sediment samples processed in the laboratory must be preserved at 4 ± 2° C and frozen within 48-hours of collection. Frozen samples may be held up to one year prior to analysis and must be extracted within 24-hours of thawing.

**APPENDIX 1: REQUIRED EPH DATA REPORT INFORMATION**

Exhibit 1 Page 1 of 2

**SAMPLE INFORMATION**

<b>Matrix</b>	<input type="checkbox"/> Aqueous <input type="checkbox"/> Soil <input type="checkbox"/> Sediment <input type="checkbox"/> Other:	
<b>Containers</b>	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Broken <input type="checkbox"/> Leaking:	
<b>Aqueous Preservatives</b>	<input type="checkbox"/> N/A <input type="checkbox"/> pH<2 <input type="checkbox"/> pH>2 <b>Comment:</b>	
<b>Temperature</b>	<input type="checkbox"/> Received on Ice <input type="checkbox"/> Received at 4 ± 2 °C <input type="checkbox"/> Other: °C	
<b>Extraction Method</b>	<b>Water:</b>	<b>Soil/Sediment:</b>

**EPH ANALYTICAL RESULTS**

<b>Method for Ranges:</b>		<b>Client ID</b>				
<b>Method for Target Analytes:</b>		<b>Lab ID</b>				
<b>EPH Surrogate Standards:</b>		<b>Date Collected</b>				
<b>Aliphatic:</b>		<b>Date Received</b>				
<b>Aromatic:</b>		<b>Date Thawed</b>				
		<b>Date Extracted</b>				
<b>EPH Fractionation Surrogates:</b>		<b>Date Analyzed</b>				
<b>(1)</b>		<b>Time Analyzed</b>				
<b>(2)</b>		<b>Dilution Factor</b>				
		<b>% Moisture (soil/sediment)</b>				
<b>RANGE/TARGET ANALYTE</b>		<b>RL</b>	<b>Units</b>			
<b>Unadjusted C11-C22 Aromatics<sup>1</sup></b>						
<b>Diesel PAH Analytes</b>	<b>Naphthalene</b>					
	<b>2-Methylnaphthalene</b>					
	<b>Phenanthrene</b>					
	<b>Acenaphthene</b>					
<b>Other Target PAH Analytes</b>						
<b>C9-C18 Aliphatic Hydrocarbons<sup>1</sup></b>						
<b>C19-C36 Aliphatic Hydrocarbons<sup>1</sup></b>						
<b>C11-C22 Aromatic Hydrocarbons<sup>1,2</sup></b>						
<b>Aliphatic Surrogate % Recovery</b>						
<b>Aromatic Surrogate % Recovery</b>						
<b>Sample Surrogate Acceptance Range</b>				<b>40-140%</b>	<b>40-140%</b>	<b>40-140%</b>
<b>Fractionation Surrogate (1) % Recovery</b>						
<b>Fractionation Surrogate (2) % Recovery</b>						
<b>Fractionation Surrogate Acceptance Range</b>				<b>40-140%</b>	<b>40-140%</b>	<b>40-140%</b>

<sup>1</sup>Hydrocarbon Range data exclude area counts of any surrogate(s) and/or internal standards eluting in that range  
<sup>2</sup> C<sub>11</sub>-C<sub>22</sub> Aromatic Hydrocarbons exclude the concentration of Target PAH Analytes



**APPENDIX 1: REQUIRED TPH DATA REPORT INFORMATION**

Exhibit 1 Page 2 of 2

**SAMPLE INFORMATION**

Matrix	<input type="checkbox"/> Aqueous <input type="checkbox"/> Soil <input type="checkbox"/> Sediment <input type="checkbox"/> Other:				
Containers	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Broken <input type="checkbox"/> Leaking:				
Aqueous Preservatives	<input type="checkbox"/> N/A <input type="checkbox"/> pH<2 <input type="checkbox"/> pH>2   Comment:				
Temperature	<input type="checkbox"/> Received on Ice <input type="checkbox"/> Received at 4 ± 2 °C <input type="checkbox"/> Other:   °C				
Extraction Method	Water:		Soil/Sediment:		

**TPH ANALYTICAL RESULTS**

Method for Ranges: MADEP EPH 03-1		Client ID					
Method for Target Analytes:		Lab ID					
TPH Surrogate Standards:		Date Collected					
		Date Received					
		Date Thawed					
		Date Extracted					
		Date Analyzed					
		Time Analyzed					
		Dilution Factor					
		% Moisture (soil/sediment)					
Range/Target Analyte		RL	Units				
Unadjusted Total Petroleum Hydrocarbons <sup>1</sup>							
Diesel PAH Analytes	Naphthalene						
	2-Methylnaphthalene						
	Phenanthrene						
	Acenaphthene						
Other PAH Target Analytes							
Total Petroleum Hydrocarbons <sup>2</sup>							
Sample Surrogate % Recovery							
Sample Surrogate % Recovery							
Sample Surrogate Acceptance Range				40-140%	40-140%	40-140%	40-140%
<sup>1</sup> Hydrocarbon Range data exclude area counts of any surrogate(s) and/or internal standards eluting in that range <sup>2</sup> Total Petroleum Hydrocarbons exclude the concentration of PAH Target Analytes only if determined by GC/MS							