

SELECTING FIELD ANALYTICAL METHODS

A DECISION-TREE APPROACH

HEALTH AND ENVIRONMENTAL SCIENCES DEPARTMENT
PUBLICATION NUMBER 4670
AUGUST 1998



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Health and Environmental Sciences Department

API PUBLICATION NUMBER 4670

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ABSTRACT

A large number of portable instruments and techniques are available to perform on-site analyses of organic compounds in soil, groundwater, and soil gas samples at petroleum release sites. The appropriate selection and use of these methods can result in increased spatial site information in less time and with fewer phases of assessment than is typical using conventional sampling methods and off-site laboratories. There is some reluctance to using field analytical methods because of the lack of regulatory acceptance and the perception that field methods do not provide data of adequate quality for making decisions.

This report makes no recommendations, but presents a decision-tree approach for selecting and using field analytical methods. This approach will assist the user in the generation of higher-quality field analytical data by prompting selection of the appropriate method for the site's investigation goal. Quality assurance guidelines specific to the desired data quality level are also presented, to increase the credibility of the data by documenting method performance. The report also provides training suggestions and easy-to-use checklists for field quality control and formal documentation.

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EXECUTIVE SUMMARY

Throughout the environmental remediation industry, there has been a drive to reconcile the time constraints and regimentation of “phased” investigations that occur in discrete steps, with a more fluid process of continuous sampling, analysis, and real-time decision making. This has been the case for petroleum product release sites, where a great deal is now known about the hydrocarbons involved and the specific indicator constituents of concern. This publication presents a different approach, through a *Decision Tree*, for the selection of appropriate field methods for the on-site testing of petroleum compounds in both soil and groundwater, which would be a key part of accelerated site characterizations (ASCs).

The manual addresses the primary constituents of petroleum fuels [benzene, toluene, ethylbenzene, and xylenes (BTEX); total petroleum hydrocarbons (TPH); polynuclear aromatic hydrocarbons (PAHs)]. The methods selected for inclusion in the flow charts are mature, off-the-shelf technologies that measure these constituents. There are other technologies more recently available for these constituents and for constituents not included (e.g., metals). However, alternative methods and other non-petroleum constituents can also be considered within the context of the *Decision Tree* approach.

A unique decision process flow chart (Section 2) is designed with “decision steps,” to assist the site manager and regulatory remediation project managers with a tool to more efficiently manage the optimization of analytical data in the field, and to help determine the appropriate level of data quality (LDQ) needed for the job at hand. The analytical field method selection process is, therefore, job oriented and incorporates practical factors such as investigative goals, regulatory requirements, data quality needs, sampling media, and constituents of concern.

The *Decision Tree* charts are supported by quality control packages (Appendix D and Section 5). These packages contain 1) suggested quality controls in a checklist form, and 2) documentation

log sheets. This format is designed for ease-of-use in the field, and the forms can be attached to project reports.

An important part of the data optimization process, and a key advantage of on-site testing, is the opportunity for an iterative, or constant feedback approach, i.e., to repeat the sampling - evaluation process in the effort to get successively closer to desired results or goals. A version of an iterative sampling approach is illustrated in Section 3.

Finally, the minimum recommended training for personnel who will perform the testing in the field is described in Section 4.

Overall, the best approach to maximize the usefulness of the investigative data produced on site is to use this manual in combination with API's sister publication, *Compilation of Field Analytical Methods*, Publication No. 4635, and with other references noted in the Introduction of this manual. Additionally, the manufacturers are a worthwhile source of information on applications, background chemistry, and best practices for their products.

Section 1

INTRODUCTION

OBJECTIVE

This publication complements the API publication (December, 1996), *Compilation of Field Analytical Methods for Assessing Petroleum Product Releases*, in which operation, practical applications, and limitations of the most widely used field analytical methods are discussed. In this publication, a Decision Tree is developed to assist project or site managers with guidance for on-site investigations of suspected or confirmed hydrocarbon release sites, from an initial site assessment to site closure. The Decision Tree is complemented by method-specific quality assurance/quality control (QA/QC) protocols designed for the evaluation of quality, viability, and defensibility of field analytical data. Briefly, the objectives for this technology selection guidance document are:

1. To provide guidelines for field analytical technology selection and use on-site, through a Decision Tree or "Decision Flow" approach;
2. To assist in generating analytical data of known and consistent quality through method-specific QA/QC protocol packages;
3. To assure that the method sensitivity, accuracy, and precision meet the decision-making needs of the project or site manager, the client, and the regulatory agencies; and
4. To guide the regulated community in producing consistent and defensible field documentation and training for field personnel.

BACKGROUND

The use of field analytical methods for investigations of petroleum hydrocarbon release sites has gained broader attention in recent years as part of more cost-effective, single mobilization site assessments. This increasingly popular concept has been discussed as *Expedited Site Assessment* (ESA) by the U.S. Environmental Protection Agency's (EPA's) Office of Underground Storage Tanks (UST), as *Accelerated Site Characterization for Confirmed or Suspected Petroleum Releases* in the ASTM PS 3 guide, as *Expedited Site Characterization* by the Department of

Energy, or as *Expedited Site Closure Approach* (ESCA®) by Land Tech Remedial, Inc. All of these single mobilization site assessment concepts have in common the use of direct push technologies for rapid, minimally intrusive collection of soil and groundwater samples, and on-site data generation which permits the project or site manager to make crucial investigation decisions on-site.

In recent years technological developments and improvements of analytical instruments have led to a greater availability and affordability of "mobile" analytical equipment that can be used for on-site analysis. Particularly in the field of identification and quantification of petroleum hydrocarbons in environmental samples there is a wide range of field compatible tools at various degrees of sophistication (e.g., accuracy and precision) and analytical capabilities. Field analytical methods are currently reviewed and evaluated for use under the Resource Conservation and Recovery Act (RCRA), the Comprehensive Environmental Response Compensation and Liability Act (CERCLA), EPA's UST Office and Superfund Innovative Technologies Evaluation (SITE) Program, and by the Departments of Defense and Energy.

In spite of the apparent advancement of this technology, there still is some reluctance by the environmental community to use it to its full advantage. This conflict in attitudes arises partly from the lack of clear regulatory acceptance, and the perception that field-generated data may not be adequate for making regulatory or remedial decisions. A format for proper selection of field methods does not exist, nor does a framework for method selection that permits consistent validation and optimization of raw field data.

To help overcome reluctance, agencies and trade organizations have published technical information and guidance on the accelerated site characterization approach and the associated field technologies. Some of these publications are:

1. *EPA Expedited Site Assessment Guide* (March, 1997);
2. *New Jersey Guidelines for Field Analytical Technologies* (July, 1996);

3. *ASTM PS 3 Standard Guide for Accelerated Site Characterization* (January, 1996);
4. *ASTM E 1739 Guide for Risk-Based Corrective Action* (December, 1996); and
5. *API Compilation of Field Methods for Assessing Petroleum Product Releases* (December, 1996).

These publications provide technical information to characterize the available technologies in terms of their capabilities, advantages over non-field methods, and limitations, as well as provide general guidance on the accelerated site assessment approach.

This document is intended to fill information gaps by characterizing the decision-making process. The primary goal is to strengthen the users' and regulators' confidence in using field analytical data to make regulatory decisions. More specifically, the decision framework within this publication is designed to take the site or project manager through the sequence of questions that are critical to selecting field analytical methods appropriate for the particular monitoring objective at a petroleum release site. In that regard it is job oriented, using decision-making factors such as regulatory requirements, investigation goals, constituents of concern, and realistic data quality needs. Once the initial decisions are made, the document then provides information on optimizing data quality through unique field QC, and documenting those data through a rigorous documentation plan. To get the most out of this publication, it should be used in combination with the other publications mentioned above, and with equipment manufacturers' and engineering contractors' technical expertise on test procedures.

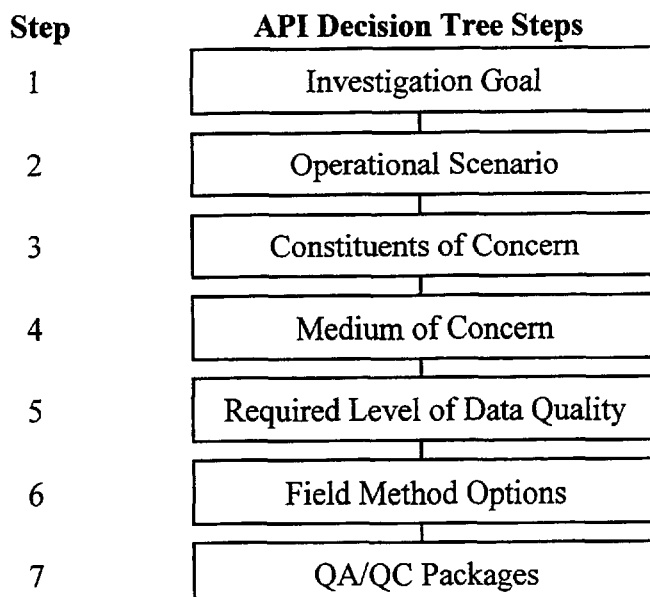
Section 2

HOW TO USE THE DECISION TREE APPROACH

This section is designed to guide the user through the Decision Tree flow charts (Appendix B), from the specification of investigation goals through the ultimate selection of a field analytical method or a group of methods to meet the goals specified. In this process, the user proceeds step-by-step through the following sequence of inquiries concerning the objectives of the monitoring effort:

- | | |
|--------|--|
| Step 1 | What is the regulatory or investigative goal? |
| Step 2 | What remedial activities may be required? |
| Step 3 | What contaminants are present, or required to be measured? |
| Step 4 | What media are to be sampled? |
| Step 5 | What data quality is acceptable, or required? |
| Step 6 | What are the field test options? |
| Step 7 | What are the recommended QC procedures for that test? |

The flow chart dealing with the above decision-making questions is illustrated below. Refer to Appendix B (Decision Tree Flow Charts) for the detailed flow charts associated with each step.



Step 1 Investigation Goal:

This step is the broad-based plan for site evaluation and might correspond to the Executive Summary or Objectives section of a site's Project Plan. The investigation goal is usually driven by an agency program, as with a UST replacement, a Spill Act investigation, or ECRA/ISRA property transfer.

Step 2 Operational Scenario:

This step specifies the type of field work actually needed at the site. This might correspond to the Scope of Work section of a Project Plan, with activities ranging from tank pulls, to monitoring well installations, to comprehensive site assessments.

Step 3 Constituents of Concern:

The contaminants for analysis are identified, based on the history of the site and agency requirements. For petroleum release sites, they may be individual target constituents, such as benzene or BTEX; and/or general product identifications, such as gasoline-range organics (GRO), diesel-range organics (DRO), etc.

Step 4 Medium of Concern:

The impacted media are air, water, and soil. Field tests (especially test kits) are highly specialized, with variable performance capabilities by environmental medium.

Step 5 Level of Data Quality:

This step requires knowledge of how the data are to be reported and used. Key issues are the requirements for qualitative or quantitative data, the reporting limit desired [percent, parts per million (ppm), parts per billion (ppb)], and the types of constituents being reported (e.g., benzene vs. gasoline hydrocarbons).

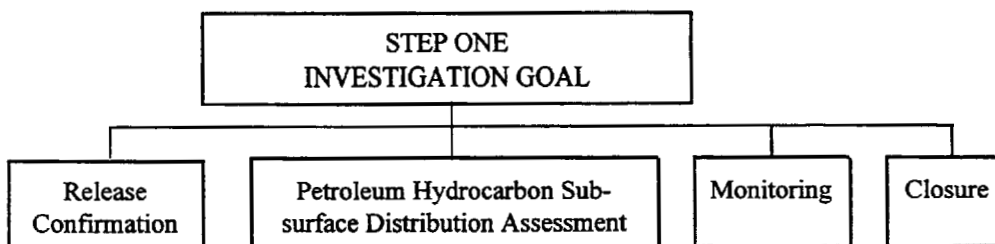
Step 6 Field Method Options:

The final test options are listed at this step. Flexibility is important, and one method, or several in combination, may be used to achieve the best results for each medium being investigated. One may also use this decision step to refine the field needs, gather more specific information from vendors, and review agency requirements.

Step 7 QA/QC Packages:

There are four packages, each related to the type of method employed. The QC packages contain 1) a QC protocol list containing the suggested minimum calibration and QC sampling in the field; and 2) a field log containing spaces for basic documentary evidence, a calibration schedule, and a QC sample data log section. These are in checklist form for easy use in the field and attachment to project reports. They may need expansion for some types of activities at the site.

FLOW CHART STEP ONE: WHAT IS THE INVESTIGATION GOAL?

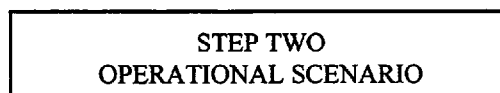


There are four options within Step One, each of which is a broad-based investigation goal frequently encountered during the investigation and management of confirmed or suspected petroleum hydrocarbon releases. The four options are:

1. **Release Confirmation**: The investigation of site media (generally soil and/or groundwater) to confirm that the subsurface has been impacted by the release of petroleum hydrocarbons from a primary source (i.e., a container used for the storage of petroleum hydrocarbons or its associated piping, pumps, or other appurtenances). The level of investigation is limited to the confirmation of such a release, and not its geometrical extent or magnitude.
2. **Petroleum Hydrocarbon Subsurface Distribution Assessment**: The investigation of site media (generally soil and/or groundwater) to determine the geometrical extent and magnitude of a petroleum hydrocarbon release.
3. **Monitoring**: Site analytical activities associated with one-time or routine periodic measurement of petroleum hydrocarbon concentrations within site media (generally water or air, but occasionally soil) to evaluate a specific process (remediation progress, compliance with discharge permits, etc.).
4. **Closure**: Site analytical activities associated with the measurement of petroleum hydrocarbon concentrations within site media (generally soil and/or groundwater) to document that environmental impact at the site does not warrant further action.

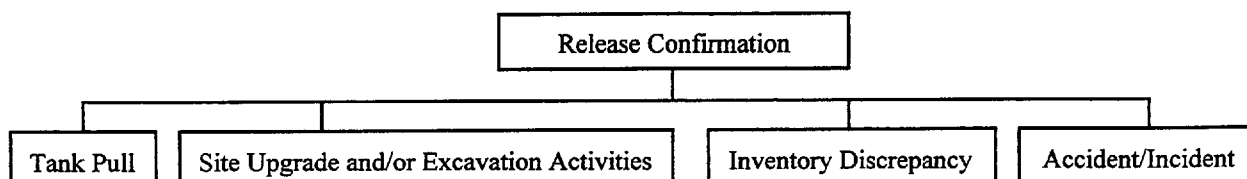
Generally, most site activities requiring field analyses of petroleum hydrocarbons can be classified as one of these four categories. Once the user has broadly categorized the subject investigation in Step One, the user narrows the scope of the subject investigation by specifying further detail in Step Two of the Decision Tree.

FLOW CHART STEP TWO: WHAT IS THE OPERATIONAL SCENARIO OF THE INVESTIGATION GOAL?



Within Step Two, the broad investigation goal identified in Step One is narrowed to more specifically determine the scope of the subject investigation. Each of the broad categories within Step One is broken down into two to four more detailed investigation sub-categories, called "Operational Scenarios." The user is required to match the details of the subject investigation with one of the Operational Scenarios listed below. While each investigation will be unique, and any specific investigation may not perfectly coincide with the listed Operational Scenarios, the user should attempt a "best fit" between the subject investigation and one of the Operational Scenarios, considering probable data quality requirements needed to meet the investigation goals.

Operational Scenarios for Investigation Goal 1, Release Confirmation

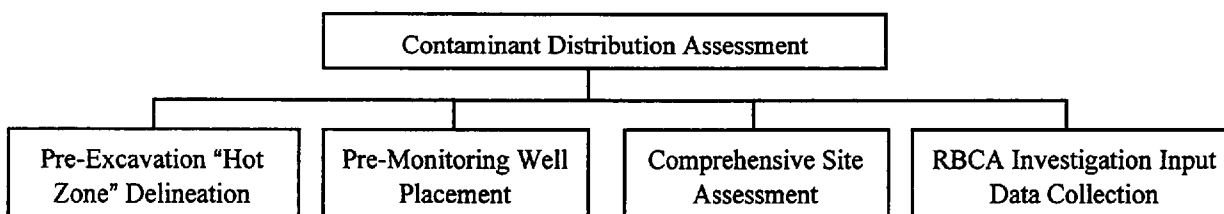


1. **Tank Pull:** Organoleptic analyses suggest petroleum hydrocarbon impact to soils and/or groundwater surrounding the UST, or below a UST in the excavated area. The goal of the investigation is to confirm the organoleptic analyses using field analytical techniques. Constituent-specific analyses generally will not be required.
2. **Site Upgrade and/or Excavation Activities:** During the excavation and/or upgrade, organoleptic analyses suggest petroleum hydrocarbon impact to soils and/or groundwater surrounding affected site features (footings, pumps, utility trenches, etc.). The goal of the investigation is to confirm the organoleptic analyses using field analytical techniques. Constituent-specific analyses generally will not be required.
3. **Inventory Discrepancy:** During the routine operation of a site used for petroleum hydrocarbon distribution, (e.g., petroleum retail service stations or bulk storage facilities), a

discrepancy between product volume delivered and product volume sold is noticed. The goal of the investigation is to determine whether the inventory discrepancy is due to a release of petroleum hydrocarbons to the subsurface. Constituent-specific analyses generally will not be required.

4. Accident/Incident: During the routine operation of a site used for petroleum hydrocarbon distribution, an accident or incident occurs (e.g., a vehicle collides with a petroleum dispenser). The goal of the investigation is to determine whether the accident/incident resulted in the release of hydrocarbons to the subsurface.

Operational Scenarios for Investigation Goal 2, Contaminant Distribution Assessment

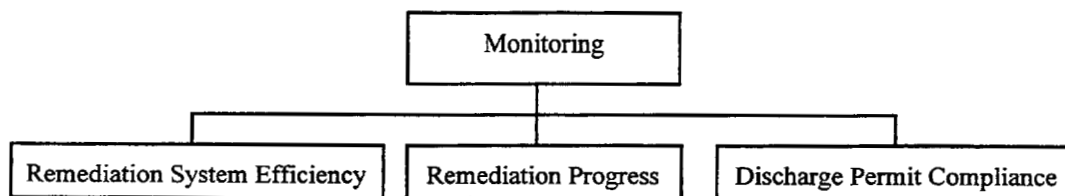


1. Pre-Excavation "Hot Zone" Delineation: A petroleum hydrocarbon release to subsurface soils has been confirmed, and the petroleum hydrocarbon impacted soils are to be excavated for *ex situ* treatment and/or disposal. In this case, the investigation goal is impact determination (hot/not hot) to ensure that all impacted soils are successfully excavated, and that unnecessary disposal is avoided. Constituent-specific data generally will not be required.
2. Pre-Monitoring Well Placement: A petroleum hydrocarbon release to site groundwater has been confirmed, and monitoring wells are to be installed for subsequent constituent-specific groundwater quality analyses. In this case, the investigation goal is impact determination (hot/not hot) to ensure that monitoring wells are installed in locations which will allow efficient monitoring. Constituent-specific data generally will not be required.
3. Comprehensive Site Assessment: A petroleum hydrocarbon release to subsurface soils and/or groundwater has been confirmed or is suspected, and the nature and extent of the subsurface impact is to be determined. The potential goals of a comprehensive site assessment include, but are not limited to:
 - The evaluation of site conditions for the efficient application of a range of remediation technologies.
 - Baseline evaluation of site conditions for property transfer purposes.
 - The evaluation of site conditions within a risk-based corrective action (RBCA) framework (see RBCA Investigation Input Data Collection, below).

In general these considerations as well as the individual physical characteristics (mobility, volatility, solubility, etc.) and health risks (carcinogenic or non-carcinogenic) associated with different petroleum hydrocarbon compounds, dictate the use of constituent-specific analytical methods.

4. **RBCA Investigation Input Data Collection:** This Operational Scenario involves the investigation of site media (generally soil and/or groundwater) specifically for the purpose of evaluating the site within an RBCA framework. The goal of the RBCA evaluation is the identification of exposure pathways. Therefore, high-level, constituent-specific data quality analyses will be focused on exposure pathway evaluations ("decision points") as opposed to broader, more arbitrary sampling strategies at sites where all site media are required to meet numerical maximum containment levels (MCLs).

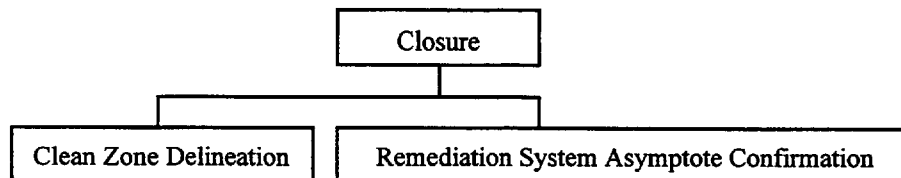
Operational Scenarios for Investigation Goal 3, Monitoring



1. **Remediation System Efficiency:** The periodic measurement of petroleum hydrocarbon concentrations in remediation system influent and effluent streams in order to assess treatment performance and the rate of removal of petroleum hydrocarbons from the subsurface as a function of time. These measurements generally are made to determine either the total removed mass of one or more petroleum hydrocarbon constituents, or the rate of TPH removed relative to previous monitoring events. In the case of the former, constituent-specific concentration data are required.
2. **Discharge Permit Compliance:** The regular, periodic determination of whether remediation system effluent streams, stormwater runoff, etc., are meeting regulatory discharge limits as specified in county, state or federally issued discharge permits. In these cases, relatively high levels of constituent-specific analytical data quality are required, since inaccurate discharge concentration data, and therefore permit non-compliance, may result in fines and other penalties.
3. **Remediation Progress:** The measurement of petroleum hydrocarbon concentrations in site media (usually groundwater) in order to show that petroleum hydrocarbon impact to the site is diminishing as a function of time. This can be accomplished through periodic measurement of petroleum hydrocarbon concentrations in site media during the remediation phase. Since the remediation of different petroleum hydrocarbon constituents proceed at different rates, these data should be constituent-specific. Additionally, since the progress of

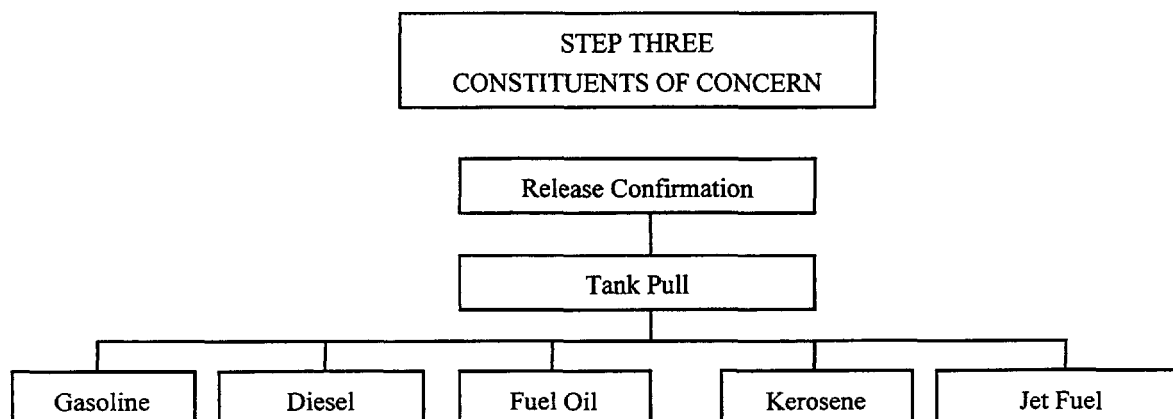
remediation at a site often will be subject to regulatory scrutiny, a percentage of the collected data should be of sufficiently high quality that trends observed in the monitoring data can be relied upon.

Operational Scenarios for Investigation Goal 4, Closure



1. Clean Zone Delineation: Following remediation activities, site media samples (generally soil and groundwater) are analyzed to determine if petroleum hydrocarbon concentrations have been reduced to meet maximum containment levels (MCLs), risk-based screening levels (RBSLs), or site-specific target levels (SSTLs). These data are necessarily constituent-specific, and of high quality due to the regulatory scrutiny of the analytical results, and the potential liabilities involved with inaccurate analyses.
2. Remediation System Asymptote Confirmation: Site closure is predicated upon a performance-based goal for a remediation system, and documentation of asymptotic petroleum hydrocarbon removal rates is required. Many regulatory agencies will require two or more monitoring rounds to obtain high-quality analytical data for asymptote confirmation. These data are necessarily constituent-specific, and of high quality due to the regulatory scrutiny of the analytical results, and the potential liabilities involved with inaccurate analyses.

FLOW CHART STEP THREE: WHAT ARE THE TYPES OF PETROLEUM HYDROCARBONS BEING INVESTIGATED?



Investigations and management of subsurface impact can involve the evaluation of many different types of petroleum hydrocarbons. Step Three allows the selection of the most common types of petroleum hydrocarbons:

1. Gasoline
2. Diesel
3. Fuel Oil
4. Kerosene
5. Jet Fuel.

If the petroleum hydrocarbon type is unknown, contaminant fingerprinting may become necessary before the investigation can proceed. While there are additional petroleum hydrocarbon types which may need to be evaluated during any specific investigation, the Decision Tree is limited to the most commonly encountered petroleum hydrocarbon types. Additional petroleum hydrocarbon types (e.g., waste oils) are beyond the scope of this manual.

The selection of more than one petroleum hydrocarbon type is also possible. At Step Three, if there is more than one type of petroleum hydrocarbon selected, the user potentially will be following two separate "branches" of the Decision Tree in parallel, possibly resulting in the selection of an individual field analytical method for each type of petroleum hydrocarbon selected, once the bottom of the Decision Tree is reached. Alternatively, within some Operational Scenarios, depending on the petroleum hydrocarbon types selected, two or more different types of

petroleum hydrocarbons can be analyzed by the same field analytical method, and the user may proceed along a single “branch” of the Decision Tree.

Product Types and Regulated Compounds

Although in the majority of spill scenarios a point source hydrocarbon product release represents the origin of contaminated soil or groundwater, it is the water-soluble hydrocarbon fraction transported in groundwater that poses the greatest risk to the environment and human health. Of the water-soluble fraction, those compounds with the highest confirmed or suspected toxicity require the highest degree of attention and more precise and sophisticated analytical tools. Standards for these compounds are in the ppb to sub-ppb range. In Table 2-1 commonly regulated constituents of several product types are summarized.

Gasoline

Chemically, gasoline is predominantly a mixture of hydrocarbons containing 4 to 10 carbon atoms. Gasoline has a boiling point range of 40° to 180°C. Analytically, the total gasoline range concentration of an environmental sample is most commonly determined by its content of hydrocarbons from C₆ to C₁₀ (GRO methods—Gasoline-Range Organics) inclusive. Constituents of concern in gasoline include benzene, toluene, ethylbenzene and xylenes, commonly reported as BTEX, and methyl-tertiary butyl ether (MTBE). Several field analytical instruments can be used to detect and quantify gasoline-derived hydrocarbons in environmental samples as summarized in Table 2-2.

Diesel/Fuel Oil

Chemically, the average composition of commercial diesel or No. 2 fuel oil consists of a mixture of petroleum hydrocarbons having 13 to 25 carbon atoms. Diesel fuel has a boiling point range of 220° to 350°C. Analytically, the total diesel-range organics (DRO) concentration of an environmental sample is most commonly determined by its content of hydrocarbons from C₁₀ to C₂₈, inclusive. Constituents of concern of diesel and fuel oil origin include naphthalene and lower molecular weight polynuclear aromatic hydrocarbons (PAHs). Several field analytical

instruments can be used to detect and quantify diesel- or fuel oil-derived hydrocarbons in environmental samples as summarized in Table 2-3.

Table 2-1. Commonly regulated compounds.

Chemical	Gasoline	Diesel	Jet Fuel	Kerosene	Fuel Oil	Used Oil
Volatiles						
Benzene	x	x	x	x	x	x
1,2-Dibromoethane	x					x
Ethylbenzene	x	x	x	x	x	x
MTBE	x					x
Toluene	x	x	x	x	x	x
1,2,4-Trimethylbenzene	x	x	x	x	x	x
m-Xylene	x	x	x	x	x	x
o-Xylene	x	x	x	x	x	x
p-Xylene	x	x	x	x	x	x
Xylenes (mixed)	x	x	x	x	x	x
PAHs						
Acenaphthylene						x
Anthracene						x
Benz(a)anthracene						x
Benzo(a)pyrene						x
Chrysene						x
Dibenz(a,h)anthracene						x
Fluorene	x			x	x	x
Naphthalene	x	x	x	x	x	x
Pyrene		x		x	x	x

Kerosene and Jet Fuel

Kerosene and jet fuel are petroleum hydrocarbon mixtures with a boiling point range of 160° to 250°C, slightly lower than diesel and fuel oil. Analytically, the total medium hydrocarbon range concentration of an environmental sample is most commonly determined by its content of hydrocarbons from C₁₀ to C₂₅, inclusive. Constituents of concern in kerosene include benzene, toluene, ethylbenzene and xylenes (BTEX), naphthalene, and other PAHs. Several field analytical instruments can be used to detect and quantify kerosene- and jet fuel-derived hydrocarbons in environmental samples as summarized in Table 2-4.

Table 2-2. Gasoline analytical instruments.

Analytical Instrument	Detected Gasoline Constituents	
	Range or Compound Groups	Constituent-Specific
TOV Detectors: PID/FID	Volatile organic vapors	
Immunoassay	Total BTEX, TPH	¹ Benzene
Infra-Red/Turbidimetric	TPH	
GC with PID and/or FID	TPH, gasoline-range organics	BTEX, MTBE

¹ Please consult manufacturers of immunoassay test kits for availability of other constituent-specific tests.

Table 2-3. Diesel and fuel oil analytical instruments.

Analytical Instrument	Detected Diesel or Fuel Oil Constituents	
	Range or Compound Groups	Constituent-Specific
TOV Detectors: PID/FID	¹ Volatile organic vapors	
Immunoassay	TPH, PAHs	
Infra-Red/Turbidimetric	TPH	
GC with PID and/or FID	TPH, diesel-range organics	BTEX, PAH

¹ It is important to note that even "fresh" diesel or fuel oil is primarily composed of semi-volatile organics, and only a small fraction of volatile organic compounds (VOCs). The presence of old and/or weathered diesel or fuel oil may not be detected using a total organic vapor (TOV) detector.

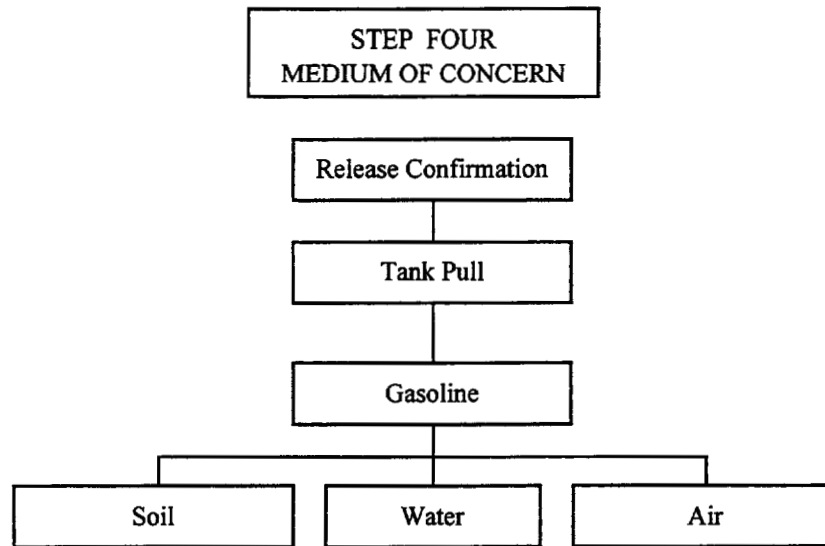
Table 2-4. Kerosene and jet fuel analytical instruments.

Analytical Instrument	Detected Kerosene or Jet Fuel Constituents	
	Range or Compound Groups	Constituent-Specific
TOV Detectors: PID/FID	¹ Volatile organic vapors	
Immunoassay	Total BTEX, TPH, PAH	² Benzene
Infra-Red/Turbidimetric	TPH	
GC with PID and/or FID	TPH, medium range organics	BTEX, PAH

¹ It is important to note that kerosene and jet fuel contain more semi-volatile than volatile organic compounds. The presence of old and/or weathered kerosene may not be detected using a TOV detector.

² Please consult manufacturers of immunoassay test kits for availability of other constituent-specific tests.

FLOW CHART STEP FOUR: WHAT MEDIA WILL BE ANALYZED DURING THE INVESTIGATION?



The majority of the field analytical methods described within the Decision Tree have their greatest applicability to a limited number of media. Subsurface impacts to soils, groundwater, or both, may be monitored. In some scenarios, air may also be monitored. Accordingly, Step Four allows the selection of the following media:

1. Soil
2. Water (e.g., groundwater, effluent waste streams)
3. Air.

The selection of more than one medium is possible. Depending on the selected Operational Scenario, this may result in the user proceeding along separate, parallel "branches" of the Decision Tree, leading to the selection of more than one field analytical method.