What Do We Have HERE?

An Inspector's Guide to Site Assessment at Tank Closure

Companion Booklet to the Video

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NEIWPCC was established by an Act of Congress in 1947 and remains the oldest agency in the Northeast United States concerned with coordination of the multimedia environmental activities of the states of Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont.

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i. Preface

What Do We Have Here?

Across the country underground storage tanks (USTs) are being replaced or permanently taken out of service in response to federal and state UST requirements that call for replacement, upgrade, or removal of all unprotected UST systems. Because some of these tanks have caused serious drinking water contamination and other hazards, a site assessment must be conducted at tank closure to identify and correct environmental problems before they become bigger problems. These closure investigations are often overseen or conducted by state environmental agencies, fire inspectors, or other designated local officials.

What we have here is a companion booklet to the NEIWPCC video on site assessment at tank closure, **What Do We Have Here? An Inspector's Guide to Site Assessment at Tank Closure,** prepared with a variety of users in mind and focusing on tanks containing petroleum products. This material is presented primarily as a training guide for inspectors and can be used as supplementary training material by states and localities that have developed their own more specific site assessment regulations and procedures for tank closures. This booklet stops short of addressing a full-blown site assessment used to design a site cleanup or remediation plan.

Note:

Underground petroleum tank removal and closing in-place are potentially dangerous procedures because of the flammability and volatility of the products stored in the tanks.

Nationwide, UST inspectors are protecting public health, water supply, and public safety. Often UST inspectors are the only public officials present at a tank closure. UST inspectors can use this manual as a basis for identifying and documenting a release. This preliminary information can, in turn, be passed along to the appropriate response agencies.

The material in this booklet should also be useful to tank owners and contractors concerned with protecting their liability from environmental releases, as well as conducting efficient and cost-effective tank closures.

ii.
Planning and Decision Making Process

Tank owners, consultants, contractors, and inspectors need to take the time to gather appropriate tank and site information in order to put together a plan of action so that everyone involved is prepared to deal with conditions in the field. Lack of planning for tank closure is expensive and potentially dangerous for public health, public safety, and environmental protection. Unfortunately, many tank excavations have been the scene of upheaval or downtime because of poor planning. A few such scenes have even resulted in loss of life.

A. For Tank Owner

The tank owner is responsible for:

- Notifying the appropriate state or local implementing agency of intent to permanently close a UST system and obtaining any permits that are required.* Many states and communities have developed tank closure or permitting protocol, which provides the tank owner with a clear understanding of what to expect.
- Emptying the tank of product prior to excavation or removal.
- Removing the tank and piping; cleaning and disposing of the tank.
- Prompt assessment regarding the presence and extent of contamination. Many of the major oil companies routinely sample soil and groundwater ahead of time so they are better able to anticipate potential problems when the tank is removed.
- Handling, storing, and treating/disposing of contaminated soil on or off-site.

** The federal requirement is 30 days notifiction prior to closure.*

Site History

Tank/piping material
Number of tanks
Age of tanks
Capacity of tanks
Material stored in tank(past and present)
Inventory records
Precision test records
Repair records
Water pump-out records
Monitoring information
Neighborhood complaints
Current activities on-site
Previous ownership and uses
Results from any soil/water quality sampling completed
Construction planning maps of UST facility

B. For Inspector

The aforementioned Site History List can serve as a helpful checklist of information pertinent to conducting a site investigation. Each bit of site-specific information may provide a clue that can help the inspector make a more confident decision about when the closure is satisfactorily completed.

In order to be able to anticipate any problems and/or questions that need to be answered at the site, the information on the checklist on the previous page should be collected and reviewed prior to the closure inspection. Much of the site history information may be found in the state or local tank registration database. Many states and communities require the owner/operator to provide this data in their closure permit applications.

Other Critical Background Data

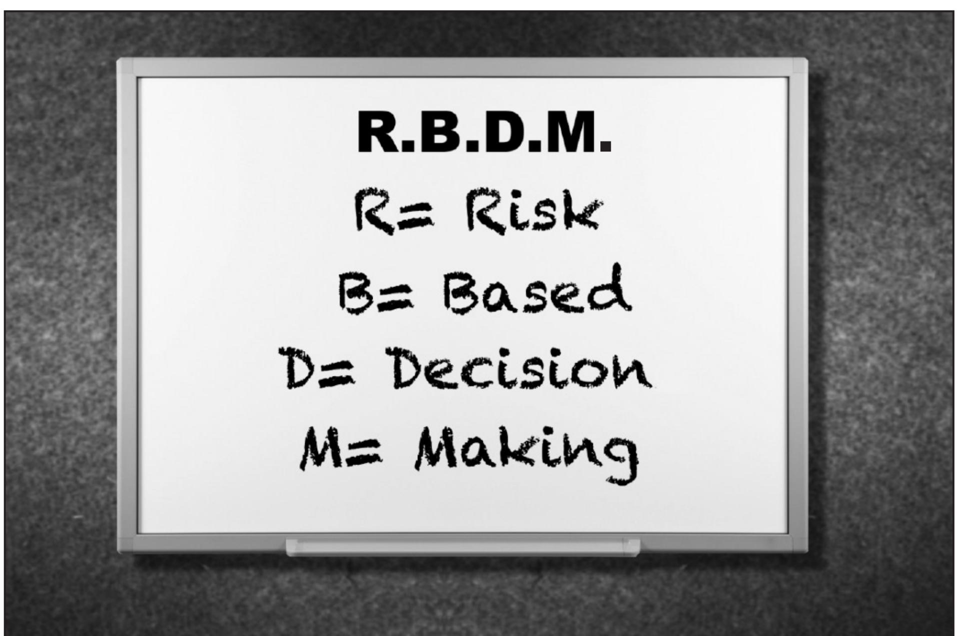
- Location of all underground utilities
- Storm sewer maps
- Water well locations
- Well records or boring logs
- Topographic and depth to bedrock maps
- Water table and hydrologic data
- Soil types

Each tank site is different, but by developing a sound approach, an inspector can control many of the variables that can lead to a poor site assessment. When inspecting a site, a good process to follow for evaluation and direction is Risk-Based Decision Making.

Risk – What types of risks exist that may affect people and places?

Based – It is the minimization of these risks that you should use as the basis for your...

Decision Making – You need to make decisions quickly and effectively in a way that is both beneficial to the environment and cost-effective to the site owner.



iii. Inspection Equipment

The following are lists of equipment necessary for conducting a thorough tank closure investigation, categorized by purpose:

Planning/Documentation

- Maps, site history information, any required permit forms, and copies of the tank removal regulations and/or guidance documents.
- Field notebook, pencils or pens, and camera.

* Optional: ASTM Conceptual Site Model Checklist.

Safety

- Hard hat, protective shoes, eye and ear protection.
- Combustible gas indicator for measuring vapors on the site to be sure you are not doing your inspection in an unsafe atmosphere.
- Respirator can be worn to avoid breathing vapors. OSHA provides occupational health and safety standards (OSHA 29 CFR 1910.12, Hazardous Waste Operations and Emergency Response Standards) that provide guidance as to when safety gear is necessary. It is always best to be cautious during a tank removal.

* It is recommended that all inspectors attend an authorized safety training course.

Tank and Piping Observation

- A pocket knife or wire brush to scrape soil and rust off tank and piping.

Environmental Evaluation

- Field testing equipment either recommended for use or required by regulations in your locality.
- Soil and water sampling equipment for field and lab analyses.
- Water level indicator if groundwater wells are on-site.

Field Testing Instruments

There is a wide range of field testing tools on the market to help determine the presence of volatile organic compounds, such as gasoline or fuel oils. Some tools simply detect the presence or absence of unspecified groups of volatile chemicals, while more sophisticated tools show exactly what constituents are present and in what quantities. We are focusing on instruments commonly in use for detecting volatile organics, but there are other instruments for detecting a broader spectrum of contaminants.

The keys to using and relying on field equipment for decision making at tank closure are to acknowledge the limitations of whatever instrument is used and to recognize the need for proper maintenance and use. Misleading or confusing data can be produced if tools are misused, misinterpreted, or not maintained and calibrated properly. For instance, results from an instrument designed only to indicate volatility should not be interpreted as an indicator of any other data.

Many states calibrate vapor detectors to a standard gas, such as benzene, and set action levels anywhere from 100 parts per million (ppm) to 500 ppm. However, field testing instruments are most often used to obtain relative values, that is, values which, relative to one another, serve as guides in determining the extent of contamination and how much additional investigation is necessary, and not to obtain absolute values of contaminant levels.

PID= Photo-Ionization Detector

The photo-ionization detector was one of the first field measurement tools on the market and one that is relatively easy to use in the field. PIDs are specifically sensitive to the aromatic constituents in gasoline. They use ionization to detect and measure the presence of organic vapors. An ultraviolet (UV) light in the instrument is used to ionize organic vapor molecules.

The air sample is drawn through the instrument probe and passes the lamp by an internal pump. If the ultraviolet light can excite the air sample and cause it to ionize, a signal registers on the instrument meter or digital display. The strength of the signal is a measure of the concentration.

Some PIDs have interchangeable UV lamps that are sensitive to different ranges of compounds. All of the PID lamps have a specific sensitivity to benzene, toluene, ethylbenzene, and xylene (BTEX). Different UV lamps can be used to detect different volatile constituents with a detection range from about 0.2 to 2,000 ppm. The accuracy varies with the concentration level being measured.

Because PIDs do not detect alkenes such as methane, they can be useful in detecting aromatic constituents released from USTs in areas where "natural" methane may exist.

Ideal conditions for conducting PID analyses are dry weather and temperatures at about 50° F. PIDs are less accurate in moist and high humidity conditions.

GC= Gas Chromatograph

An important step up in instrument sophistication is the portable gas chromatograph, which uses a separation column to isolate and analyze specific constituents in either a liquid or vapor phase in conjunction with a PID or FID detection system. A portable GC consists of a sample injection system, a separation column, an output detector, and a detection system. A GC/FID system contains a combustible gas supply for the flame; a GC/PID system contains a UV lamp. There are a number of different GCs with varying capabilities currently on the market.

A vapor sample containing a mixture of compounds is injected into the GC and carried through the sample column by an inert carrier gas. The vapors travel through the column at varying rates of speed and reach the detector at different times. Each component is separated when it gets to the detector. The lighter constituents elute or are extracted first, followed by those that are heavier and less volatile. This detection process is translated into a chart record, or chromatograph, which shows the length of time from injection to maximum peak height. The peak height from baseline to the top of the peak is proportional to the concentration of a constituent.

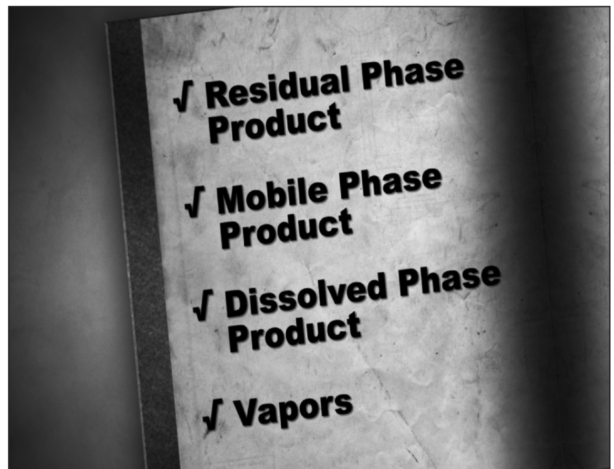
The portable GC is an extremely versatile and powerful tool for use in the field. However, performance of the GC is greatly dependent upon the operator's capabilities; the instruments require a substantial level of skill to operate and interpret the results.

IV. Site Inspection

A. THE NATURE OF PETROLEUM

In performing a site assessment for either tank removal or closure in-place, it is important to have some understanding of the characteristics of petroleum liquids and how different product types migrate through the subsurface environment. Liquid petroleum products are complex mixtures of hydrocarbons. They range from gasoline, which is comprised mainly of light molecular weight compounds, to diesel fuel and lubricating oils, which are comprised of heavier molecular weight hydrocarbons.

When released into the environment, petroleum liquids assume different phases: residual phase product, mobile phase product, dissolved phase product, and vapors. The product may be present in all four of the following phases at the same time, but not necessarily in the same place:



RESIDUAL PHASE PRODUCT

As a release spreads out from the point of origin, it fills the spaces between the soil particles. As it continues to drain through the soil, a certain amount of residual product is retained or trapped by the soil particles. Over time, rainwater may dissolve some of this residual material allowing continued leaching of the product through the soil toward the water table. Because of this movement, residual product in the soil is a major concern in any site assessment. As long as product remains in the soil, it is a potential source of groundwater contamination.

MOBILE PHASE PRODUCT

Product in the soil that is not dissolved remains free flowing, and where it is not residually trapped, it is called mobile phase product or free product. Free product tends to migrate both vertically and horizontally due to gravity and capillary action. The migration occurs by successive permeation of larger areas, depending on the quantity of product discharged.

When free product reaches the saturated soil zone or water table, it does not readily dissolve in water. Instead, it pools on top of the water table and continues to travel in the direction of groundwater flow. The rate of free product movement depends upon the subsurface soil structure, as well as the volume of the product released. Tighter soils such as various types of clay will tend to restrict the flow. Soil consisting of loose sand and gravel will allow relatively rapid subsurface transport. If bedrock is present, the product will flow along the bedrock surface until it finds a crack or crevice to penetrate.

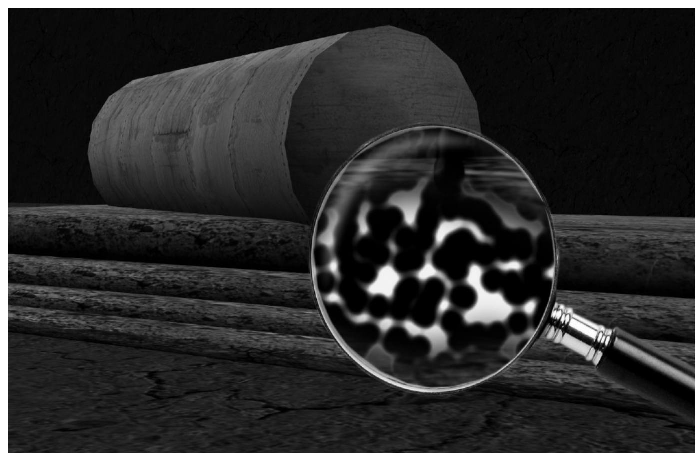
DISSOLVED PHASE PRODUCT

Some of the more soluble petroleum constituents will dissolve into both rainwater infiltrating through the unsaturated soil zone and into groundwater. Some highly toxic constituents (e.g., benzene) are colorless, odorless, and tasteless in drinking water.

The dissolved and free product phases provide important information when sampling groundwater, monitoring wells, and any water apparent within the excavation when a UST is removed. The appearance of a liquid sheen may be more indicative of dissolved product contamination. The presence of free product is readily apparent on the surface of the water. Where there is free product on water, there is most likely dissolved product as well.

VAPORS

Odor is generally the first tip-off that a spill or leak has occurred, particularly when gasoline is involved. The odor comes from the vapors that are transpiring as the volatile components of petroleum evaporate. Product vapors emanate upward and laterally through the pore spaces of the surrounding soil. When these vapors find their way to basements, storm sewers, or other nearby underground pathways, they pose serious health and safety threats.



There are many variables associated with the behavior and movement of residual, free product, dissolved phase hydrocarbons, and vapor. The downward and lateral migration of product through the subsurface depends primarily on the physical properties of the product, the quantity of product released, and the structure and physical properties of the soil and rock through which the product is moving.

For example, different petroleum types behave differently, both physically and chemically, in the subsurface:

- Gasoline is composed of a complex mixture of hydrocarbons, additives, and blending agents, and contains aromatic constituents such as benzene, toluene, ethylbenzene, and xylene. These more volatile aromatic constituents tend to be more mobile, water soluble, and toxic. Since they are more water soluble, they tend to dissolve in rainwater, travel through the soil, and end up in the groundwater. *
- Middle distillate fuels such as diesel fuel, kerosene, jet fuel, and lighter fuel oils tend to be denser, less volatile, less mobile, and less water soluble. They also contain lower percentages of the more toxic aromatic compounds like BTEX.
- Heavier fuel oils and lubricants are even more dense and relatively insoluble and immobile in the subsurface environment compared to the middle distillate fuels.
- The middle distillate and heavier fuels may be less volatile and less mobile, but they still migrate and do have the potential to cause environmental contamination.

If the site you are inspecting has an older release:

Be aware that as gasoline ages, it tends to undergo both natural biodegradation and degradation through the loss of lighter, more volatile hydrocarbons while the heavier hydrocarbons are retained. Thus, over time, the gasoline begins to look and smell more like a fuel oil, which may affect the type of field detection equipment that needs to be used on a site. The aging process can be impeded by factors such as dense soils, barriers to vapor loss (e.g. asphalt paving), and/or high petroleum concentrations that inhibit bacterial breakdown.

**See API Publication 1628 for a thorough discussion of petroleum hydrocarbons.*

B. DOCUMENTATION OF PHYSICAL EVIDENCE

Setting up a workable system for tank closure recordkeeping and evidence gathering is important for the tank owner as well as the inspector. From the tank owner's perspective, liability, property value, and financing issues should be incentive enough to properly document the tank closure. Property transactions have been known to fall flat because of poor closure documentation, since lending institutions and prospective buyers are extremely wary of the potential liability from a buried tank problem.

The tank inspector should systematically document all inspection activities and field observations for each closure. These observations can be particularly valuable in the case of a site that will require further investigation and monitoring. Should any problems or litigation occur later on, the facts will be on record. Furthermore, the documentation should be thorough and clear to anyone else reviewing it. Individuals other than those licensed as environmental regulators often conduct many of the initial closure site visits. It is the regulator's job to make sense of the reported information and to determine whether additional investigation or corrective action is necessary.

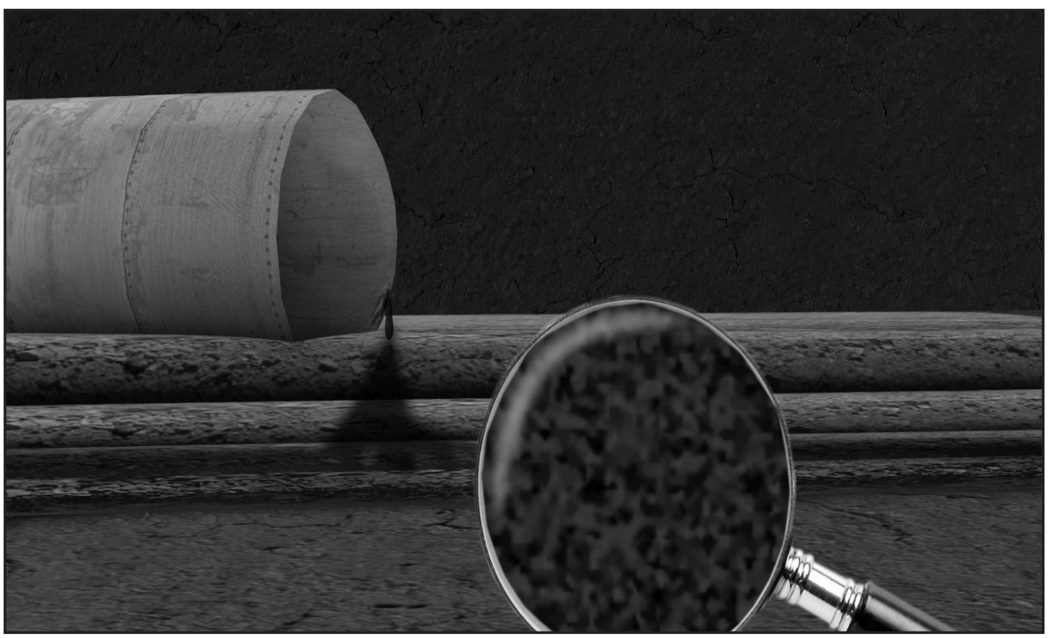
What, When, How:

The right gear is essential, but an inspector's eyes, ears, and nose can be the most important assessment tools.

Remember to inspect the entire site and surrounding area. Look carefully at the tank, piping, and fittings.

Inspectors should document the following information:

- Condition of tank and piping
- Groundwater conditions (depth, oil sheens, use of groundwater in area)
- Soil types encountered (including soil layering)
- Lab procedures
- On-site weather conditions
- Receptors (drinking water wells, surface waters)
- Field measurement procedures
- Sampling procedures, locations, and problems (no ice for storage, haphazard collection, “dirty” soil sampling, equipment, partially filled bottles, improper bottles)
- Presence of free product, odors, spills during removal, unexpected USTs
- Pertinent interviews with employees and neighbors



V. Soil and Water Sampling

Soil

The soil that has surrounded a tank during its tenure in the ground can hold within its pore spaces the free product, residue, and vapors of petroleum spills and leaks that occurred during the life of the system. Product in the soil is a potential source of groundwater contamination and the migration of vapors into confined spaces. The soil within tank and piping excavations can provide important clues to the presence and extent of contamination.

If petroleum product has contaminated the soil, the presence of odor, wetness, staining, or discoloration in the soil may indicate where a release or spill has occurred.

Look at soil color. Soil color can be a good indicator of petroleum contamination in many soil types. Many petroleum products leave a visible residue that can range from a very light-colored to dark-colored staining.

When a spill occurs, bacteria and other microorganisms begin to metabolize the product in the soil. During this process, the oxygen level in the soil is lowered, which promotes the leaching of iron and manganese from the soil. In fact, soil color is generally detected by the levels of iron and manganese present. Reduced iron, found where oxygen is deficient, causes soils and water to turn a gray-green color; reduced manganese is more apt to turn the soil a black-gray color.

Note: Always observe federal, state, and local safety guidelines when inspecting soil and removing soil samples. Know your OSHA regulations before you get to the site.

Through experience you learn that local soils develop a certain color when contaminated with petroleum products. While it is somewhat imprudent to generalize about soil color because of hydrogeologic variability throughout the country, there are certain characteristics you can look for and make note of in your own area.

For example, clays come in a variety of colors, depending on the regional geology. Red clay can indicate a tight particle structure, and most contamination may be contained within the excavation. Green clay can indicate that leaked gasoline is present; olive-colored clay can indicate weathering of shale, not contamination. Sand in the excavation area can be stained gray by leaked gasoline that has migrated along the asphalt or tar coating on the tank and leached into the soil.

Soils that are mottled or splotchy in color may indicate a seasonally high water table, which poses a greater risk of groundwater contact with contaminated soil. If a tank happens to be buried in dark organic soil, staining probably won't be visible.

Document the types of soil encountered. Determine or describe as best as you can: sandy soils, clay-like soils, any obvious clay lenses or sand lenses, and if the facility is built on fill material.

This information is important because different soil conditions affect the flow of product away from the source of a leak. Soils come in many complex arrangements of particle sizes, colors, textures, and structures that vary from locality to locality, from lowland to upland. It helps if an inspector can recognize how petroleum interacts with the soils in the area.

For example, in many areas of the country, particularly the southeastern United States, moist clay soils act as barriers to vertical and lateral product migration. Clays can create bathtubs that hold water and contaminants in the excavation. But when clay soil dries out, hydrocarbons can break down the bonding structure of the clay, allowing the contaminants to move through the soil very quickly.

Many southern areas have karst terrain, which is made up of soluble limestone. Solution channels evolve where limestone has dissolved, providing conduits that can direct leaked product a mile away before any problems are discovered. In the Southwest and other areas of the country, conditions vary greatly from deep alluvial basins, with poorly consolidated sediments and deep water tables, to zones of shallow groundwater where USTs may be buried in shallow surface deposits or in fractured bedrock.

In northern glaciated environments, layers and pockets of varying soil types (clay lenses, hardpan, rocks, sands, gravels) can cause petroleum to move along paths of least resistance. If a clay or sand lens has directed product away from the sampling point, detection efforts may miss significant contamination that has accumulated just ten feet below. Soil contamination is not always obvious, especially in the more porous, coarse-grained sands and gravels that drain quickly. In these instances, there may be no trace of product and the inspector must rely on tank observations and site background information for clues that a release might have occurred.

Sample Collection And Handling – In General

Selecting the appropriate number of samples and sample locations is important to a successful site assessment. Generally, the larger the tank and release potential, the more samples need to be collected. The best place to sample is one or two feet below the bottom of the excavation at suspected worst-case locations, such as areas that look stained or discolored.* Field instruments are useful for locating "hot spots" that will serve as representative sampling points for any samples going to the laboratory.

**Inspectors should not enter the tank excavation to take a soil sample. It is safest to direct the backhoe operator to bring soil up in the backhoe bucket from specified locations within the excavation. You can then use a clean trowel or auger to dig or bore into the soil in the backhoe bucket.*

A Macro-Core (MC) Sampler, or Geoprobe, is useful when removing soil samples because it allows inspectors to remove samples from various discreet depths around the site. This helps to determine whether a leak has reached the water table. An MC Sampler also allows inspectors to remove soil samples without disturbing the samples themselves, thus improving accuracy and decreasing the chances of contamination.

Many regulatory agencies provide guidelines that specify sampling locations within the excavation. However, if you are taking representative samples at discrete points in the excavation and piping trenches, common sense is still essential. You could diligently follow the guidelines and miss evidence of a significant release just a few feet away if you are not thorough and attentive in your assessments.

Sampling For Laboratory Analysis

Proper sample collection, preservation, and storage are essential if soil and water samples are being sent to a lab for analysis of volatile organic components (VOCs) or total petroleum hydrocarbons (TPHs). Every effort should be made to minimize vapor loss and biodegradation of a sample. Samples should be:

- Collected with minimal disturbance to the soil. A soil sample exposed to the air will lose some of its constituents, and air will encourage biodegradation.
- Preserved and sealed in a clean, vapor-tight jar as quickly and carefully as possible. Water samples should fill the jar completely, leaving no air bubbles. Ideally, samples should be collected in jars containing the appropriate chemical preservative provided by the lab doing the analysis.
- Collected to avoid any cross contamination. Sample collection equipment should be cleaned/decontaminated between sample locations.
- Labeled with a specific number that corresponds to the collection location at the site.

- Placed in an ice-filled cooler immediately and transported to a certified or qualified lab as soon as possible.
- Properly stored at 4℃ until analyzed. Minimize sample holding-time, as specified in EPA analytical methodology.

Some states require all samples to be handled using a chain of custody procedure, which closely tracks samples from the moment they are collected to the time they are analyzed. This sampling protocol ensures the validity of the samples in the event of a legal challenge.

For gasoline contamination, soil samples are generally analyzed for BTEX because these toxic components are always present in gasoline and are relatively mobile in the environment. If a tank contained other petroleum products such as diesel, fuel, kerosene, used oil, or if the history of the tank is uncertain, then the soil is usually analyzed for both BTEX and TPH at closures. Some states require these analyses only on a case-by-case basis, depending on site sensitivity. One of the problems with lab analysis of contaminated soil is that the standard EPA methodologies for volatile organic compounds have been adapted for TPH and BTEX in soils. As labs have had to update these methods for soil analysis, modifications have been made in different ways by different labs. This has led to a situation of comparing apples to oranges when comparing one lab's analysis with another's; it is not always easy to interpret the results. Many states have tried to deal with this problem by getting labs to agree on standardized methods.

Field Measurement Procedures

The usefulness of the various types of field measurement equipment is contingent upon the use of good field measurement procedures for either soil or water analyses. There are a wide variety of field procedures currently being used. Each of the general types and some specific procedures are described in detail in *EPS's Field Measurements: Dependable Data When You Need It*.

Soil Vapor

Active soil vapor sampling and analysis measures the volatile hydrocarbon concentrations in a soil vapor sample that is collected in situ by pumping or withdrawing the sample into a field instrument for analysis. Soil vapor samples can be collected in the following ways: 1) drill or auger a borehole, insert instrument probe, and take a reading; 2) drive a hollow steel probe into the soil, collect a sample using a gas-tight syringe, and inject into a field instrument for analysis; 3) drive a hollow steel probe into the soil and collect sample in a tender bag for analysis with a portable field instrument; or 4) direct in-line sampling with a portable analytical field instrument from a driven probe. Skill levels needed depend on the type of analytical instrument being used.

Headspace Analysis

Headspace analysis of soil or water involves collecting a soil or water sample, placing it in an airtight container, and analyzing the headspace vapor above the soil or water sample using a portable analytical instrument.

Freezer Bag System

Dynamic headspace analysis of soil and water using a polyethylene freezer bag system involves collecting a soil or water sample, placing it in a resealable freezer bag, agitating the sample to release vapors in the bag, then measuring the vapor concentration using an analytical field instrument. The procedure includes generating a calibration curve using field standards to determine sample concentrations and to conduct a quality control check of analytical results.

Liquid Extraction

Liquid extraction and analysis of water uses a fixed volume of air that is passed through the water sample. The procedure extracts volatile contaminants and quantitatively measures the amount of contaminant with colorimetric indicator tubes. This is a procedure that is easy to use, gives rapid measurement, and requires only the equipment provided with the Draeger Liquid Extraction kit.

Hanby Procedure

The Hanby procedure for soil and water analysis involves the extraction of aromatic compounds from soil or water samples to yield a colorimetric indication of concentration and types of contaminants. Color indicates the type of compound, and color intensity indicates the concentration. Training and practice are necessary for performing the analysis and for interpreting results.

vi. Pathways and Receptors

Soil varies from county to county and state to state. Depending on where in the country the site assessment is taking place, assessing the direction leaked product has travelled can be challenging. The inspector should check the surrounding area for all possible contamination pathways and receptors. The extent of this effort depends, in part, on the level of concern generated by site background information and other factors gleaned during the investigation. The primary objective is to test for petroleum vapors, which are a clue to the presence of leaked product; water samples can also be taken. If a facility is located over or near public water supplies or private wells, there is likely to be more concern over the possibility that any amount of product loss could affect water quality. Regulators often refer to those sites where a product release would have a harmful impact on drinking water supplies as "environmentally sensitive areas." However, attention to UST sites located in industrialized areas or in areas that rely on remote water supplies should not be minimized. Vapors emanating from UST leaks have created serious indoor air quality problems in homes, businesses, and industrial buildings.

The paths that leaked product and vapors follow in the subsurface environment are prescribed by natural soil conditions, geologic barriers and conduits, and by man-made structures and infrastructures. For example, in a well-drained soil with neither geologic nor man-made obstacles, the product will most likely head straight down to the water table, be it 2 feet down or 200 feet down. In this case, the groundwater is the direct receptor of the contamination. When the free/dissolved product reaches the groundwater flow, the list of potential receptors is likely to grow as the free product spreads out horizontally.

Whether emanating from product trapped in soil or floating on or dissolved in the water table, vapors tend to migrate horizontally and upward along the paths of least resistance. Although the vapor migration can be blocked by buried structures, vapors will readily follow other more convenient pathways through backfill material surrounding structures such as water, sewer, and utility lines. Vapors can then accumulate in basements (especially ones under drains), sewers, and water wells. With the appropriate field testing instrument, it is sometimes possible for a trained inspector to get a quick sense of the pattern of product migration by taking readings from nearby storm drains, buildings, wells and by looking at water samples from wetlands, other surface waters, and wells.

Storm Drains

If vapors are detected when checking nearby storm drains, it is worth testing storm drains upgradient and downgradient to try to determine a pattern of migration. If high levels of vapors are found upgradient, then the vapors are potentially coming from some other source. The "whose mess is this?" dilemma is not unusual in urban areas.

Buildings

In buildings, check for vapors, particularly in basement areas, that might have come in through cracks in the foundation or through sewer lines or drains coming into the house. Be aware that field testing instruments may misleadingly detect vapors from household residues or substances stored in the household, such as paint thinners. However, if real evidence of contamination is detected, it is time to recommend further site investigation and sampling. Checking out nearby buildings is usually unnecessary if no evidence of a leak is found and no one in the area has reported odors. However, in well-drained soils where there appears to be little or no evidence of a leak, it may well be worth investigating these receptors.

Wells
Wetlands
Surface Waters
Dead Vegetation

Nearby wells, wetlands, and surface waters should also be checked, at least visually, for signs of free product or sheen. Patches of dead vegetation can sometimes be a clue that something is wrong. Products such as gasoline or kerosene-based fuels have been associated with dead vegetation, particularly for continuous releases that have occurred over a long period of time. Again, how far afield you go with your investigation and sampling is a function of what the clues suggest.

Tank & Piping

An examination of tank and piping may provide a clue that a release occurred, even if it is not obvious from looking in the excavation. On the other hand, you may observe contamination in the excavation, but see nothing wrong with the tank itself. Try not to jump to premature conclusions: weigh your observations and wait to piece all your clues together. Each observation is just one part of your investigation.

- When the tank has been removed from the excavation and secured at ground surface to prevent any movement, the tank inspection can begin. Have the contractor clean soil clumps off the tank. Field instruments can be useful for locating small holes or contaminated soil stuck to the tank.
- Inspect steel tanks for corrosion pitting and signs of staining or discoloration, such as dissolved asphalt coating.
- Rust "plugs" sometimes form on the outside of buried steel tanks and can effectively prevent the release of product into the soil. These plugs may be dislodged during tank removal.
- Inspect fiberglass tanks for staining, indentations, and cracks. Generally, a problem with a fiberglass tank would have occurred shortly after installation as a result of improper installation or mechanical abuse. This means if you see a crack or hole it could well have existed from the beginning.
- Be aware that older fiberglass and steel tanks are vulnerable to failure at the bottom of the tank under the drop tube because of repeated filling and dipstick impacts. Newer tanks are manufactured with protective striker plates under the drop tube to prevent this type of tank failure.
- Steel and fiberglass tanks may be damaged during the removal process, so a hole or fracture does not necessarily mean that product leaked from the tank while it was buried.

- Contamination around the fill pipe is very common. It is typically the result of product spills, overfills, and/or loose fittings. Spills often occur at the fill pipe opening when the delivery truck's hose is disconnected. While contamination from spills is often minimal, years of accumulated spills can add up.

  Although overfills occur less frequently, they may release larger volumes of product into the environment. Any loose fittings on the fill pipe may leak in the event of an overfill. Ask owners, employees, neighbors, etc., about any major overfills, spills, and other site specific events.

  The importance of checking the product delivery system and piping cannot be stressed enough. The piping is an integral part of the UST system and the major source of releases. A significant number of piping failures occur at the joints because of loose fittings and corrosion.

- Take a good look at piping trenches, lines, and especially the fittings and unions. Ideally, piping should be inspected while in place in the exposed trench.
- Some localities will require soil samples at 10 or 20 foot intervals along the pipelines, but this is bit of a hit-or-miss approach. Soil vapor surveying along pipelines can be useful.

Groundwater and Excavation Pipe

The underlying reason for the various federal, state, and local UST regulatory programs is to protect groundwater and drinking water supplies from contamination caused by leaking USTs.

- If there is water in the tank excavation, look for either free product floating on top of the water or a sheen on the water. Free product is generally a red flag that significant contamination has occurred and further remedial action is necessary.

  Be aware that, in some instances, you may be looking at what is actually a small amount of free product that was released from the tank during the removal process perhaps because of a dislodged rust plug. This kind of contamination is generally confined to the excavation area. If the free product was not the result of a spill that occurred during removal, it will usually return when the groundwater seeps back into the excavation after initially pumping out the product/water mixture from the excavation.

Free product in the excavation poses health and safety risks, and it must be handled accordingly. Free product should be removed to the maximum extent practicable as soon as possible. Make sure that any free product and/or contaminated water removed from the excavation is managed or disposed of properly.

- A liquid sheen on the water table is a sign that some amount of product may be present. It could be from the tank, loose connections, or spills. Although sheen on the groundwater may not be an indication of major contamination, it indicates the need for further assessment as to the extent and degree of contamination, especially if drinking water supplies are in the area.

- To determine the degree of groundwater contamination, take a grab sample that is representative of the water in the excavation. Some investigators will not sample water in the excavation unless they are sure it is groundwater *(see below)*. The water sample can be tested in the field with a field measurement method (e .g., a portable gas chromatograph) or it can be properly preserved and labeled for transportation to a qualified or state-certified lab.

- Water in the excavation may not necessarily be groundwater. It may be surface drainage that has been held within the excavation by more compact native soils, creating a bathtub effect. As a rule of thumb, if water is pumped from the excavation and does not return over a 24-hour period, you're probably not dealing with groundwater (see the *California LUFT Field Manual*). Depth to groundwater varies tremendously from region to region, from one hydrogeologic setting to another. For example, many tanks in Florida are literally buried in groundwater. In parts of the Southwest, groundwater can be hundreds of feet below the surface. Mottled coloration in the soil profile may indicate that water is sometimes present where tanks are in contact with water seasonally, often during spring months.

- Some environmental inspectors will want more monitoring wells installed in an effort to determine the extent of contamination. While the placement of monitoring wells goes beyond this initial site assessment and into the next level of "further investigation" for remediation, this is a natural step for some environmental inspectors to take. On the other hand, a fire inspector would refer initial observations of groundwater contamination to the appropriate leak response agency.

vii. Review Steps Taken

- Do your leg work; access as much information as possible from state and local web sites, databases, and documents registered with state and local agencies. Be sure to interview anyone connected with the tank site, present and past. One option for organizing the approach to site inspection is by downloading the ASTM Conceptual Site Model Checklist.

- To help follow best practices methodology, use Risk-Based Decision Making. This helps in making decisions that are cost-effective and best for the environment surrounding the site.

- Make sure you have the appropriate safety gear for site inspection and know your OSHA safety regulations BEFORE visiting the site.

- Make sure you have the necessary equipment for site inspection and that your equipment has been calibrated and tested.

- Speak to on-site personnel, including the site owner and/or site contractors to get any up-to-date information.

- Inspect the site thoroughly including the tank, piping, pumps, and underground fill spouts for leaks, corrosion, and loose fittings.

- Collect soil samples surrounding the site and test any moist soil or standing water on the site. If necessary, use a Macro-Core Sampler to obtain soil samples from various depths around the site. Use a local topographic map to help determine the depth of the water table.

- If the possibility of a leak is determined, collect soil and water samples from neighboring homes and businesses. If local structures have basements, screen them for possible vapors.

Closure In-Place

The most difficult kind of UST closure is when a tank is to be abandoned in-place. Although EPA regulations allow tanks to be closed in-place, the stakes are higher. It's more difficult to perform a reliable site assessment when the tank and piping are still buried. Also, in real estate terms, a buried tank will always be a potential liability.

Many states allow closure in-place only when the structural integrity of a building would be threatened by a tank removal. Some states have extensive monitoring requirements for in-place closures. Soil vapor and/or groundwater monitoring in the area of the tank and piping are critical to getting a sense of whether a release has occurred. Soil sampling alone is like a shot in the dark; a problem just a foot or two away from the sample point may be missed.

Besides obtaining monitoring data and performing the usual closure inspection of a site, nearby receptors, and facility operation documentation, it can also be helpful to have the emptied, cleaned tank examined thoroughly from the inside by someone who is OSHA-trained and wearing the proper safety equipment.

The Decisions

Closure inspection is a fairly recent practice. In the past, people usually walked away from tank removals or closures in-place without assessing the condition of the site. Now, we know we don't want to bury these problems. Probably the most difficult part of a closure inspection is deciding whether you've looked enough to make a decision to end the site assessment or whether you need to look further for signs of contamination.

EPA has not prescribed how much effort should go into determining, at closure, whether a UST system has caused any environmental damage. However, many states and localities are getting more and more experience at evaluating these sites and are working to find ways to improve the decision making process so that sites can be handled more efficiently without environmental compromise.

Because site assessment involves judgment, there will often be some element of uncertainty in the final decision and pressure to hurry the whole process. Some calls are difficult to make. Even experienced inspectors can leave a job feeling that something might have been missed that could eventually cause a significant problem.

The inspector’s response to the discovery of contamination often depends on his or her background or affiliation. Fire inspectors are more familiar with sampling and analysis techniques. A fire inspector is more likely to perform limited field observations and call the state environmental agency to pursue any indications of a release. If the inspector is with the state environmental agency, instructions for minor cleanups are often issued on-site at the initial inspection. Examples of such minor cleanups include removing contaminated soil around the fill pipe, and monitoring groundwater observation wells.

The environmental inspector’s response to the discovery of minor contamination often depends on site-specific conditions. A small release in area of a sole source aquifer may be more significant than a larger release in a remote area where groundwater is 100 feet down or in an industrialized area where the groundwater is not used and land use practices have caused years of accumulated environmental abuse.

When a closure site assessment is complete, the inspector may call for further evaluation, corrective action, removal of any minor contamination, or some variation on these themes, or the site may look just fine. Many regulatory authorities will acknowledge that closure requirements have been met; however, they may point out that the owner is responsible for future liability associated with any residual contamination that may not have been detected or addressed during the closure or remedial activities. The owner/operator should be reminded that, according to EPA regulations, closure records must be maintained for at least three years after completion of the closure. States may have more specific or stringent recordkeeping requirements.

The key to successfully completing a UST closure is making sure you have enough evidence to make your final decision. Site assessment is a process of sorting out and evaluating the evidence. The challenge is in putting all the pieces together so you can make an informed decision as to whether the tank closure is complete or whether there is a need for further assessment or corrective action.