Welcome to the CLU-IN Internet Seminar

Conducting Contamination Assessment at Drycleaning Sites

Sponsored by: State Coalition for Remediation of Drycleaners

Delivered: June 8, 2011, 1:00 PM - 3:30 PM, EDT (17:00-19:30 GMT)

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  - press *6 to mute #6 to unmute your lines at anytime
- Q&A
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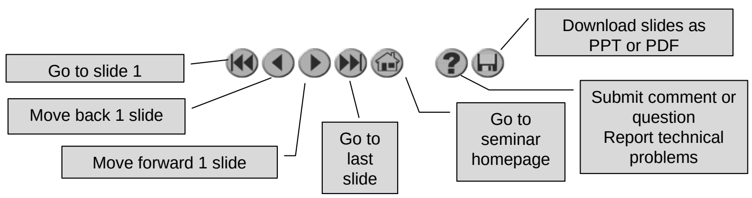
- Move through slides using # links on left or buttons



- This event is being recorded
- Archives accessed for free **http://cluin.org/live/archive/**

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Although I'm sure that some of you have these rules memorized from previous CLU-IN events, let's run through them quickly for our new participants.

Please mute your phone lines during the seminar to minimize disruption and background noise. If you do not have a mute button, press *6 to mute #6 to unmute your lines at anytime. Also, please do NOT put this call on hold as this may bring delightful, but unwanted background music over the lines and interupt the seminar.

You should note that throughout the seminar, we will ask for your feedback. You do not need to wait for Q&A breaks to ask questions or provide comments. To submit comments/questions and report technical problems, please use the ? Icon at the top of your screen. You can move forward/backward in the slides by using the single arrow buttons (left moves back 1 slide, right moves advances 1 slide). The double arrowed buttons will take you to 1st and last slides respectively. You may also advance to any slide using the numbered links that appear on the left side of your screen. The button with a house icon will take you back to main seminar page which displays our agenda, speaker information, links to the slides and additional resources. Lastly, the button with a computer disc can be used to download and save today's presentation materials.

With that, please move to slide 3.

Conducting Contamination Assessment at Drycleaning Sites

WWW.DRYCLEANCOALITION.ORG

State Coalition for Remediation of Drycleaners

- Founded in 1999.

- Sponsored by EPA Office of Superfund Remediation & Technology Innovation

- Twenty participating states

- Mission: To provide a forum for the exchange of information relating to the assessment and remediation of contaminated drycleaning sites.

- Website: WWW.DRYCLEANCOALITION.ORG

SCRD WEBSITE
WWW.DRYCLEANCOALITION.ORG

- **175 Drycleaning Site Profiles**
- **Conducting Contamination Assessment Work at Drycleaning Sites**
- **Chemicals Used in Drycleaning Operations**
- **Drycleaning Chemical Database**
- **Tour a Drycleaning Operation**
- **Regulatory Issues at PCE Drycleaners**
- **Glossary of Drycleaning Terms**
- **Numerous other publications & links**
- **Subscribe to the SCRD Newsletter!**

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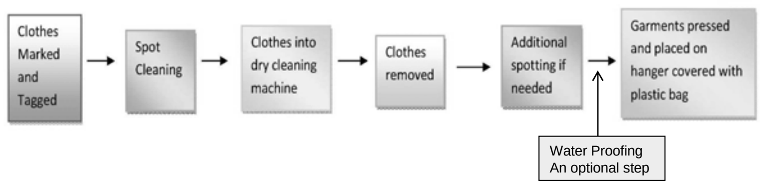
The Drycleaning Process

Part 1

By Don Hanson, Oregon DEQ

From Drop Off to Pick Up



For a virtual tour of a drycleaning facility
http://www.drycleancoalition.org/tour/

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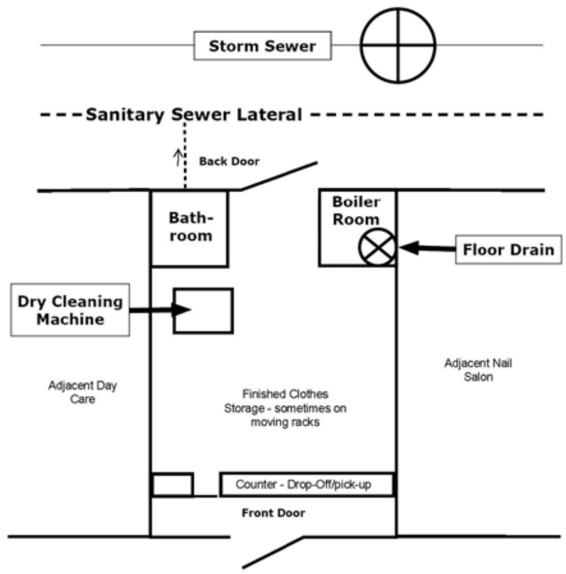
- Clothing is marked or tagged for ID
- Garments separated by weight, color, fabric
- Heavily soiled garments may be pre-cleaned or spot cleaned prior to drycleaning
- Clothing placed in drycleaning machine
- Clothing removed. If still stained, more spot cleaning
- Garments pressed and placed on hanger and covered with a plastic bag

TYPICAL DRYCLEANER LAYOUT



Drop-Off / Front Area

•Clothes can be dropped off by the customer in bags or just handed over the counter.

•Many drycleaners who have more than one store have one or more “drop-off” locations from which clothes are taken to a large central facility for drycleaning.

Pre-Cleaning (Spotting or Spot Cleaning)

- A Spotting Board is used
- Similar to an ironing board
- Chemicals are applied and captured in vacuum system
- TCE, PCE, 1,1,1-TCA (and others) used for spot cleaning

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•Spotting chemicals are captured in a vacuum and recovered

•Separate waste stream from DC machine

Solvents Historically Used For Drycleaning

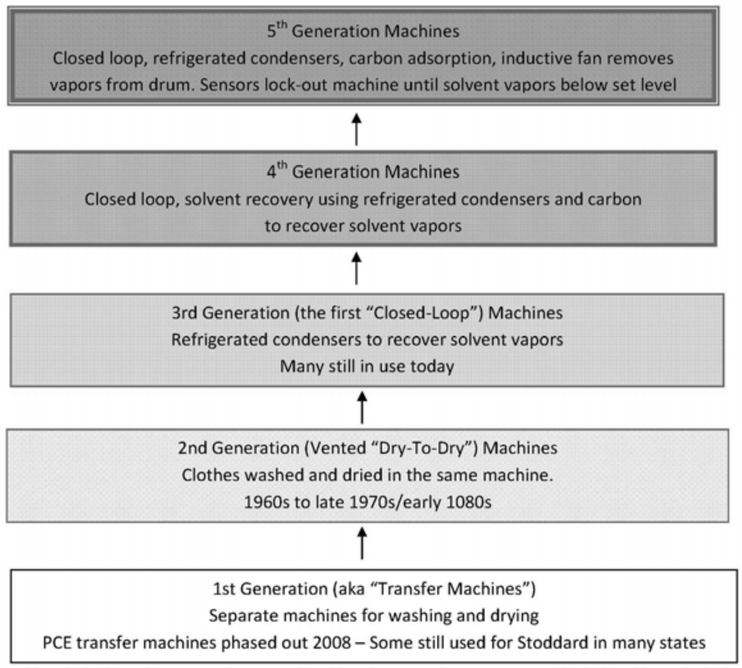
- Historic (you name it)
  - Turpentine, benzene, kerosene, white gas, chloroform, etc…
- Petroleum-based compounds (most widely used)
  - White gas
  - **Stoddard Solvent: Developed in 1924. Predominant solvent used in US until late 1950s**
  - A mixture of C_5 – C_{12} range hydrocarbons
- Carbon Tetrachloride
  - First chlorinated solvent used in drycleaning (mainly 1930s to 1950s)
  - Sometimes blended with other solvents
- Trichloroethylene (TCE)
  - Introduced into drycleaning industry in the US in 1930
  - More commonly used as a pre-cleaning or spotting agent and in water repellent agents.
- **Tetrachloroethylene (PCE)**
  - **First used in mid 1930s. Replaced most carbon tet. by the late 1940s**
  - **Safer than Stoddard (not flammable)**
  - **Superior cleaning qualities**
  - **Predominant drycleaning solvent in the US in 1962**
- 1,1,1-Trichloroethane (TCA)
  - Dow Chemical – 1980s
  - Very little general use
  - Was used as a pre-cleaning spotting agent (no longer)

More Info: Link to SCRD Website: Chemicals Used In Drycleaning Operations paper: http://www.drycleancoalition.org/chemicals/ChemicalsUsedInDrycleaningOperations.pdf

Drycleaning Machine Evolution

Drycleaning machines have evolved over time to:

- reduce solvent usage
- protect worker health
- protect the environment



More Info: SCRD Virtual Tour: http://www.drycleancoalition.org/tour/

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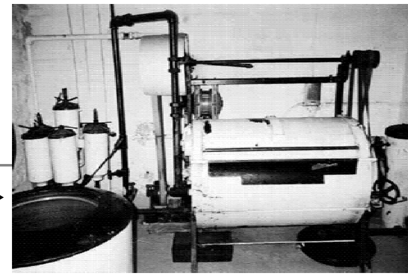
Transfer Machines



Dry to Dry Machines

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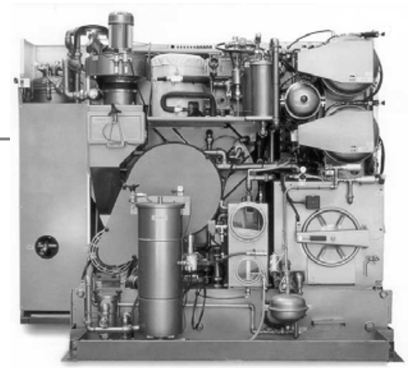
Green Machines

- Newer, non-chlorinated solvents are now used by some drycleaners
- Green Earth is an example of a proprietary chemical based on liquid silicone
- Typically more expensive than perchloroethene or petroleum machines
- Machines are more complex than perc machines
- As seen below, the front of a Green Earth machine looks similar to a perc dry-to-dry machine



Back

Front

PCE Drycleaning Process
What goes on in the machine?

Machine charged with solvent (98-99%) +
Detergent/surfactants (1-2%) + small amount of water

↓

Clothes tumbled for about 5 minutes
Clean solvent added while dirty solvent removed, filtered for re-use

↓

Solvent is drained and clothes spun to extract solvent
Drum is re-filled with solvent and clothes rinsed

↓

Solvent is drained – clothes are spun to extract solvent
Solvent clarified/filtered for re-use

↓

Clothes are dried at about 140°F for about 12 minutes
Solvent-laden air is sent to condenser to remove solvent

↓

Cool air is circulated in the drum for about 12 minutes
Air is routed to carbon adsorption to remove solvent

What goes on besides just washing?

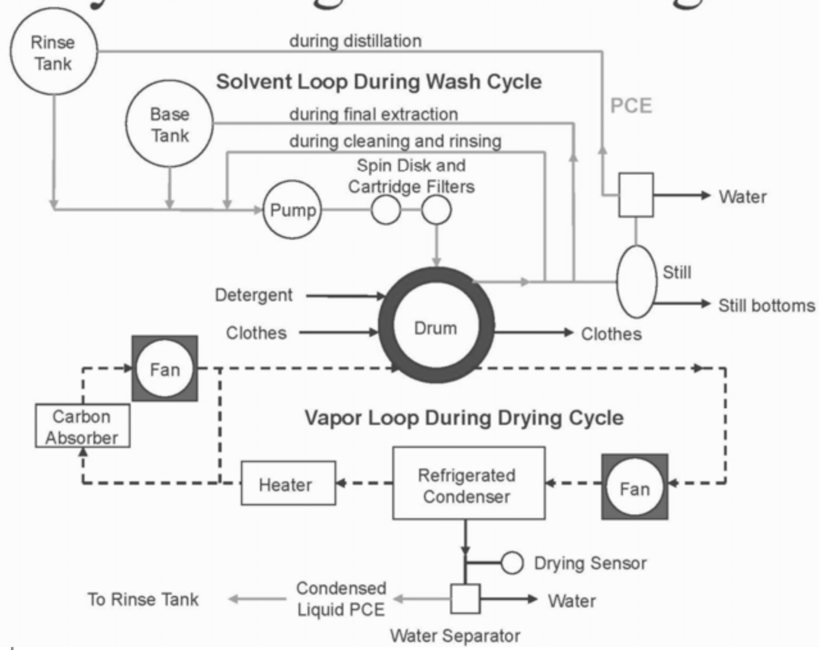
SOLVENT

- Solvent filtration (cartridge and spin-disk)
- Distillation/Separation to regenerate solvent

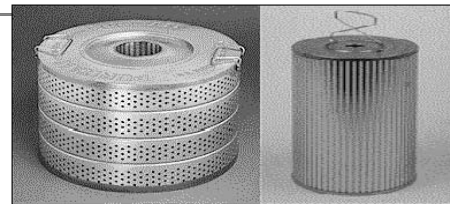
AIR

- Refrigerated condenser (removes solvent/water from air stream)
- Solvent/water separator – solvent returned to system
- Carbon absorber (used after drying cycle is over)

Drycleaning Process Diagram



Solvent Filtration



- •Cartridge filters
- •Spin disk filters (not pictured)
- •Some filters use filter substrate – diatomaceous earth, clay materials
- •Some use carbon

- •Remove dirt and lint
- •Some remove dyes
- •Some remove water, paraffins & more
- •Solvent filtered during cleaning and rinsing of wash cycle

Distillation to Separate Solvent and Water

• Soil/dirt (other junk) is removed from solvent after the washing process by distillation. Solvent/water is heated and vaporized leaving still bottoms behind.

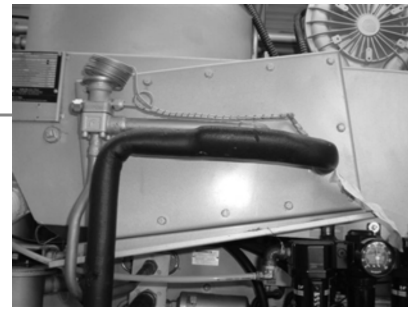
• After re-condensing, water is separated from the solvent. Solvent sent back to system for filtration and re-use. Water can still contain solvent if condenser not working properly

•Below: still bottoms in blue bucket, separator water in white bucket (note secondary containment)

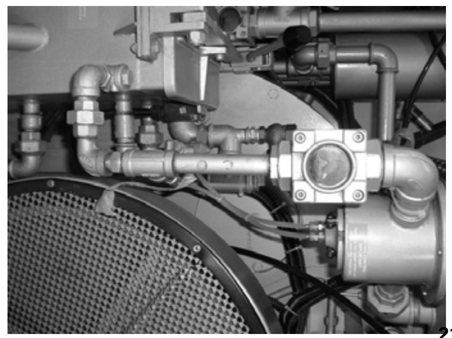
Water Treatment Unit (above)
Treats separator water

- Carbon adsorption
- Treated water often misted
- Run w/ compressed air

Condensation to Remove Solvent from Air



- A chiller or refrigerated condenser, above, condenses water and solvent vapors from the dryer to liquid form
- Solvent and water are separated physically in a separator unit
- Water is removed (separator water) from system.
- Solvent is re-routed to solvent system and re-used
- Air, after water and solvent removed, is routed back to machine (during drying) and through carbon absorber (after drying)



Cabinet Dryer

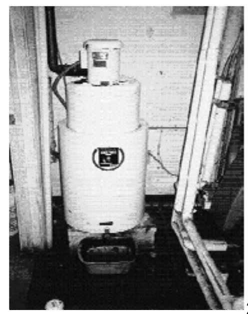
One specialized piece of equipment is a cabinet dryer. Cabinet dryers are used to dry items like sweaters that should not be tumbled.

Finishing

Pressing & waterproofing

- Steam Presses
- Starching
- Steam is collected by vacuum system

Vacuum Collects Steam from presses and spotting boards →



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Clothes are packaged and ready for pick-up or shipping back to drop store

Wastes Generated During Drycleaning Operations & Historical Waste Management Practices

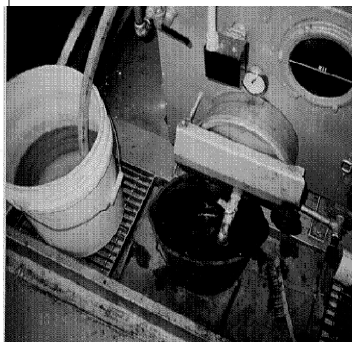
Part 2

Bill Linn
Florida Department of Environmental Protection

Types of Wastes Generated by Drycleaning Operations

- Distillation Residues/Cooked Powder Residues
- Spent Filters, Spent Filter Powder (Muck)
- Separator Water
- Mop Water
- Vacuum Water
- Lint
- Waste Solvent

Still Bottoms/Cooked Powder Residue



- Still bottoms are a waste product of the distillation process containing non-volatile residues, solvent, & water

- Muck is spent filter powder material (diatomite &/or activated carbon). The distillation by-product of muck is cooked powder residues

- In PCE drycleaning operations still bottoms can contain as much as 75% PCE by weight.

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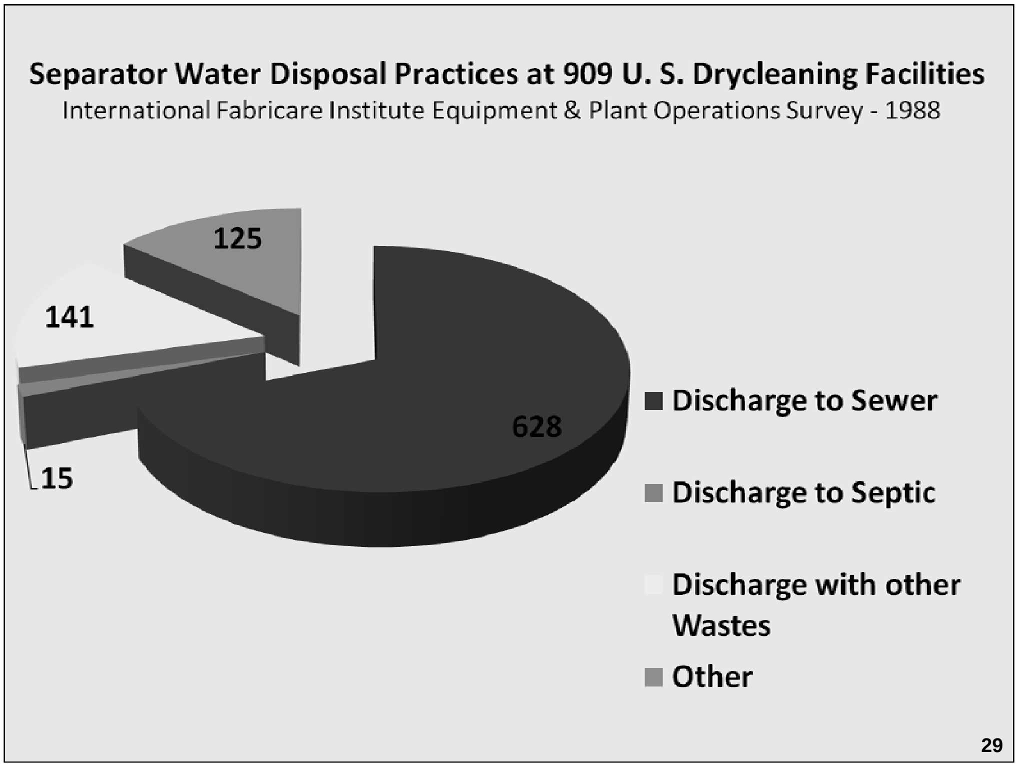
Separator Water

- Waste product of distillation process and of recovery of solvents from air (vapors).

- Separator water is generally saturated with drycleaning solvent. Free phase solvent may be present in separator water


Separator Water Disposal Practices at 909 U. S. Drycleaning Facilities
International Fabricare Institute Equipment & Plant Operations Survey - 1988
125
141
628
15
Discharge to Sewer
Discharge to Septic
Discharge with other Wastes
Other
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Separator Water Treatment Units

- Separator water has also been used in pre-cleaning & spotting operations.

- Separator water has been used to mop floors.

Separator Water Misting Discharge Point

Problems with Separator Water Treatment Units

- Operators fail to change filters

- Atomizers on misting units scale up resulting in water being sprayed from unit.

Spent Filters & Filter Powder

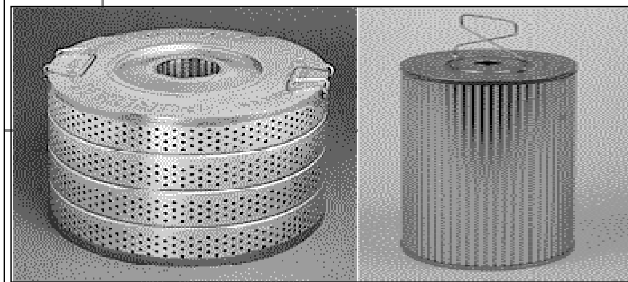
- Waste products of filtration process

- Cartridge filters – widely used, various sizes

- Filter powder (diatomite and/or granular activated carbon) widely used in past operations. Spent filter powder known as muck.

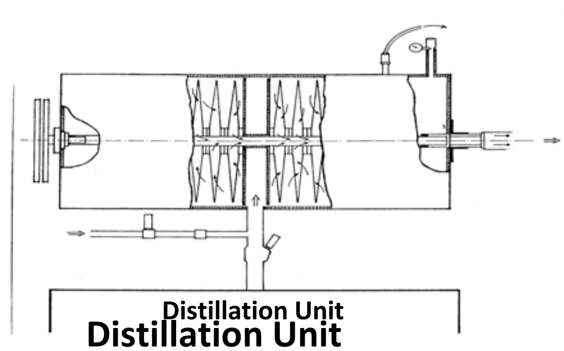
- Filter powder used in some spin disc filter operations.

Drycleaning Filter Systems



Cartridge Filters

Spin Disc Filter System



Distillation Unit

Leakage from Filter Housings

Mop Water

- Overlooked waste stream that often contains drycleaning solvent.

- Mopping the floor at a drycleaning facility can result in mop water that is saturated with solvent.


Still Bottom Spills Behind Drycleaning Machine
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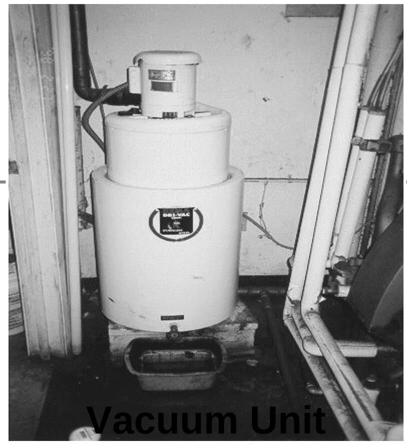
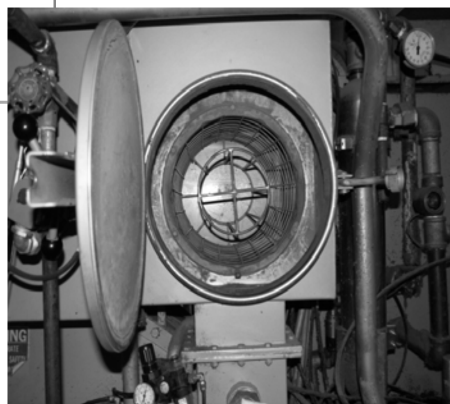


Vacuum Unit

- Vacuum water is spent (condensed)steam from clothing pressing and pre-cleaning/spotting operations.

- Vacuum water generally contains dissolved drycleaning solvent. Concentrations are generally in 10s of parts per billion.

Lint



- Lint is found in the dryer lint trap, the button trap & the pump strainer.

- Lint generated by drycleaning operations will contain solvent.

Spent Solvent

- Drycleaning solvent can be rendered unusable by failure to perform proper maintenance.

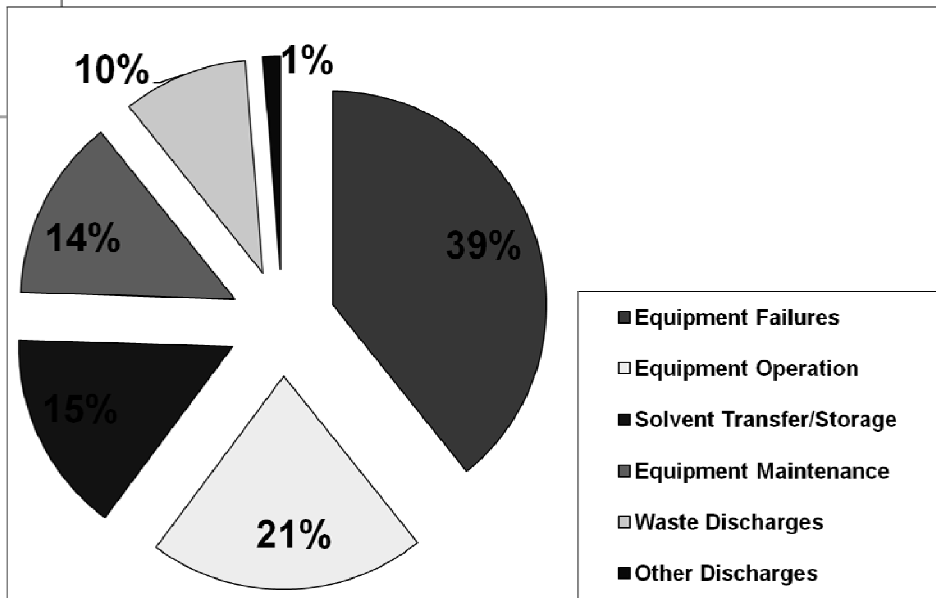
- Introduction of water into petroleum drycleaning solvent can result in biodegradation.

- Failure to regulate the pH of PCE can result in extreme high or low pH that will corrode machinery.

- Solvent used as a carrying agent in waterproofing operations eventually becomes spent and needs to be replaced.

Separator Water **(green color due to dissolved metals from drycleaning machine corrosion)**

Sources of Reported Drycleaning Solvent/Waste Discharges



Site Reconnaissance & Sampling

Part 3

Theresa Evanson
Wisconsin Department of Natural Resources

Now that you have an understanding of dry cleaner processes and equipment, we'll turn to site reconnaissance to scope areas of likely chemical release and focus on where environmental samples should be collected.

At the end of your site reconnaissance, you want to be able to mark the spots where the site investigation team will collect samples.

Site Reconnaissance

- Critical to scoping sampling locations & developing conceptual site model
- Appendix to SCRD document provides a thorough “Drycleaning Site Visit Checklist” to aid in site reconnaissance
- Typically based on file reviews, site inspection and interviews with employees

Conducting Contamination Assessment Work at Drycleaning Sites, 2010 SCRD document.

Receptors & History

- Sensitive receptors
- Facility operation dates, locations, solvents & chemicals used
- Historical information about the facility and nearby business activities & chemical use
- Historical waste management, leaks, spills, wastewater discharge practices

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•Indentifying possible receptors helps focus where samples may need to be collected.

•It is common for multiple owners to have owned & operated a dry cleaner location over decades. The operations, solvents, etc. may have varied with each owner.

•Nearby businesses help determine whether other chemicals may be co-located on the property.

•Historical waste management practices are one of the most important aspects of properly targeting sample collection.

Dry Cleaning Equipment Location

- dc machine
- distillation unit
- solvent storage tanks
- waste storage location
- spotting board
- vacuum unit
- boiler
- air compressor
- AST/UST
- floor drains
- dumpsters, etc.
- separator water mister

Easier to discern equipment location at operating or recently closed dry cleaners.

Identifying equipment location will be more difficult at operations that have been out of business a long time.

Solvent delivery, use & disposal

- Solvent delivery method to business & machine
- Location & use of all piping/vents on outside walls or through floor; joints & cracks in floor
- Underground & overhead utility locations
- Regulatory compliance information, violations, etc.
- Surface water drainage patterns

•Prior to today's closed loop, direct couple delivery equipment for delivering solvent directly to a dry cleaner machine, solvent may have been delivered in everything from 5 gallon pails to large trucks with hoses that filled up tanks the way you fill up your car with gas. Leaks of solvent along the hose, spills at the machines, leaks of the tanks, etc. all contribute to environmental contamination.

•Utility lines must be indentified not only for safety when conducting the investigation, but sewer lines, septic tanks, etc. were commonly used to dispose of separator water & other contaminants.

•Reports of past spills, violation of waste handling regulations, etc. are all pertinent to the site investigation.

•Surface water drainage patterns help identify possible contaminant migration away from the original release.

Conceptual Site Model

- Common elements: geology, surface & groundwater flow, preferential pathways, potential receptors, contaminant characteristics
- PCE and hydrocarbons are co-contaminants at many drycleaner facilities
  - Due to change over time in solvent use
  - Petroleum service station historically located at property

Dry cleaners: what solvents were used.

Gas stations & Dry Cleaner businesses often located on same parcel of land due to traffic patterns.

At long-time dry cleaners, not unusual that Stoddard's solvent was used at one point in a site's history & then a PCE machine was installed. We have a few sites in WI where the dry cleaner still runs an old Stoddard's machine, along with a more current PCE machine.

Where to Sample Drycleaner Solvent Source Areas

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•Delineate source areas based on site reconnaissance.

•Sampling within a dry cleaner building presents tight quarters & can be difficult.

Drycleaning Machine

- Solvent releases due to:
  - Equipment failure, overfilling, leaking gaskets, replacement of pump seals, filter changes, cleaning of equipment
- Overflow of separator water bucket, spillage of muck/still bottoms
- PCE readily moves through concrete

•Current dry cleaning machines have a number of spill prevention mechanisms, including delivery of solvent; secondary containment, recovery of solvent, etc. As well as practices required by the operator to inspect and detect spills.

•Most common source of solvent contamination

•Solvent releases due to overfilling, leaking gaskets, replacing pump seals, changing filters, cleaning equipment & equipment failure

•Overflow of separator water bucket behind machine

•PCE moves though concrete fairly readily

Sampling at Drycleaner Machine

- Collect soil and soil vapor samples beneath the floor slab at the front and back of the machine
- Sample near expansion joints or floor cracks
- Grab samples of groundwater may be possible where shallow groundwater is present

Distillation Units

- Built into newer machines, but were stand alone equipment with older machines. Were occasionally outdoors.
- ID by dark brown colored staining on floor or walls.
- Contamination from boil over of still bottoms or spillage from cleanout of unit

Storage near the Service Door

•Besides the dry cleaning machine, the back door may be the most likely place to find contamination.

Service or "Back" Door

- Solvents were delivered through and waste stored outside the service door
- If tank truck delivered solvent, where did it park? Leaks occurred along the hose line from the truck to the machine.
- In paved areas, sample where asphalt is deteriorated, dissolved or patched.
- Sample outside the service door, opposite where the door opens.

•If there are several back doors, the one located closest to the drycleaning machine is the most likely point of solvent release.

•Condensate water & mop water was commonly disposed out the back door. Spent filter cartridges were often stored outside the service door, along with used solvent.

Sewer Lines / Drains

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A good practice is to walk around the outside of the drycleaner building and identify anything that exits the building, then trace the pipe, hose, or drain back into & the building to understand its source.

Sanitary Sewer / Drainfield

- Historically, separator water was disposed into sewer lines.
- PCE-saturated water, solvent and solvent vapors can leach or leak from sewer lines.
- Collect wastewater & sludge samples from sewer laterals and septic tanks that service the facility.
- Sample near floor drains, often found in boiler room and adjacent to the dc machine.

•Perchloroethylene can dissolve PVC piping.   Elbow joints and low areas in the pipes are particularly susceptible to dissolution.

•Reductive dechlorination of PCE often takes place in sewer lines & drainfields. The presence of PCE daughter products in aerobic groundwater can be an indication of sewer line contamination.

UST / AST PCE Tanks

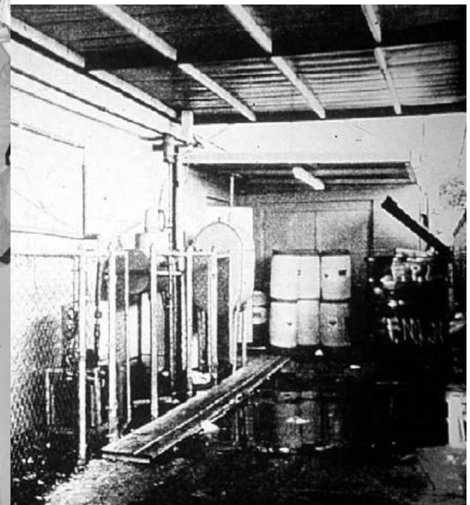


Photo of a Perc UST tank. Perc had been removed and contaminated ground leaked into the tank. A plywood board covers the tank.

In the 1960's coin operated dry cleaning machines were operated on the concrete slab above the UST.

- coin-operated machines resembled coin-operated tumble dryers; to be as small as they were, they simply filtered used perc, rather than distilling it like the commercial dc machines. Solvent had to be changed far more frequently as, without distillation, it quickly became discoloured and could cause yellowing of pale items being cleaned. People overfilled the machines with clothes & PCE wasn't effectively removed. Disposable filters & individual solvent tanks with each machine. (1977 – est. 18,000 coin operated dc machines in the US)

AST / UST

- Modern drycleaning machines store solvent in the base of the machine.
- Historically, solvent was stored in ASTs and USTs. PCE was more likely to be stored in ASTs.
- Drycleaners also stored fuel oil (for boilers) and gasoline (for trucks) in USTs.

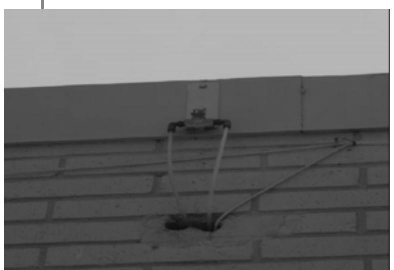
Identify the likely storage location of solvent tanks & sample soil/vapor/groundwater in these locations.

Poor storage / waste handling

Dumpsters / Trash Cans

- Historically, used PCE filters, muck and lint were disposed in waste containers
- Sample soil and groundwater at historical locations of dumpsters and waste containers

Separator Water Discharge



- Treated separator water may be misted to an external vent on building
- If filter not maintained, water may be saturated with PCE
- Sample soil and groundwater below vent or downspout

Vacuum and Press Water

- Contains low levels of PCE but historically discharged to the ground
- Follow piping from the vacuum unit to determine discharge point and collect samples there.

Pipes/hoses running from the dry cleaner may have their source with vacuum/press water.

Vapor Intrusion at Drycleaners

- Most historic and current drycleaning solvents are volatile organic compounds
- Most drycleaner facilities are located near residential properties and/or in strip malls, allowing migration of vapors into businesses, apartments and homes

•VI is a significant focus of SI occurring at dry cleaners.

•Chemicals include petroleum distillates, carbon tetrachloride, 1,1,1-TCA, TCE, 1,1,2-trichlorofluorethane, n-propyl bromide, and PCE.

•Sub-surface vapor assessment, such as Modified Active Gas Sampling (MAGS) used in FL can be very useful to identify VOC source zones

What if the equipment is gone?

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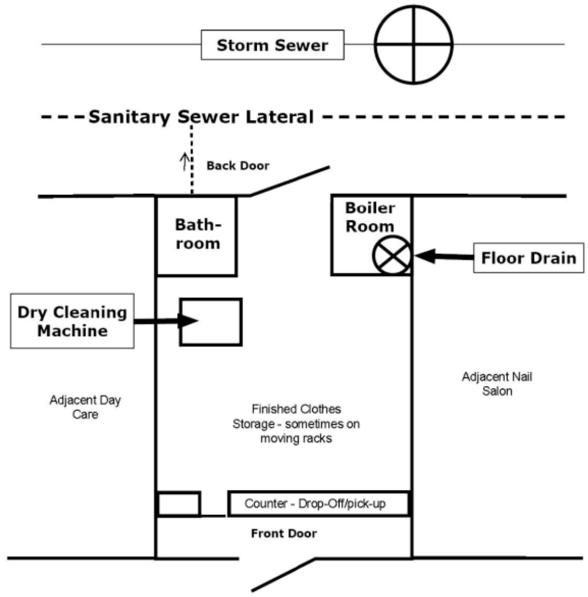
At an operating or recently closed dry cleaner, it will be fairly easy to identify the locations of the equipment, although you'll still need to find out where equipment may have been historically. In these situations, you'll feel confident about marking your sampling locations.

But what happens when the dry cleaner is a hair salon or a coffee shop?

Clues to Equipment Location – in a still standing building



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•Identify the building shape, the front & back of the facility.

•Interviews with owners, employees, etc. will be very helpful.

•Things to look for:

Strip malls & similar buildings – dry cleaning machine located in the back 1/3 of the bay

Machine floor bolts (or remains)

Staining on floor / walls / ground

Piping along walls, drains in floor

Redevelopment: Where to Sample if building no longer exists

- Aerial photography. Focus on the time period when the dry cleaner operated and indentify building layout & likely location of the dry cleaner machine.
- Sanborn maps sometimes show the location of the dry cleaning machine in the building.

These techniques are useful whether the property has a new building on it or is currently without a building.

Assessment Techniques and Equipment

Part 4

By Steve Hoke, New Jersey DEP

Assessment Techniques and Equipment

Soil Gas Surveys

Direct Push Technologies

Soil Conductivity Probe

Membrane Interface Probes

Mobile Laboratories

Assessing Sanitary Sewer Lines

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OK

There is a wide number of assessment techniques for evaluating Dry Cleaner Sites, but the most useful technologies for the initial assessment of dry cleaners include **Soil** gas surveys, which enable preliminary characterization of the subsurface prior to sample collection, **Direct** Push Technologies, which enable the convenient sampling of soil, ground water and soil gas. **Soil** Conductivity Probes and **Membrane** Interface Probes allow subsurface characterization without the collection and analysis of samples allowing large areas to be covered in a short time frame. **Mobile** Laboratories when combined with active soil gas surveys or direct push technologies provide real time data concerning contaminant concentrations and distribution. Finally, by **Assessing Sanitary** Sewer Lines, important sampling locations can be pre-determined.

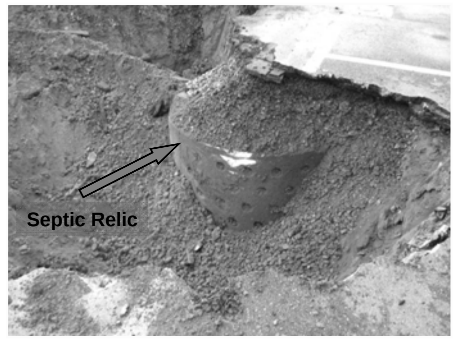
These techniques have been included in this presentation because they provide real-time information concerning contaminant concentration, contaminant distribution and the media impacted by contamination. Most of these techniques also allow cost savings by minimizing sample collection and limiting the number of mobilizations to a site.

The next slide begins a discussion about soil gas surveys

Soil Gas Surveys

Useful in locating contaminant source areas

- dry cleaner relics
- septic or sewer lines
- septic tanks
- areas of surface spills



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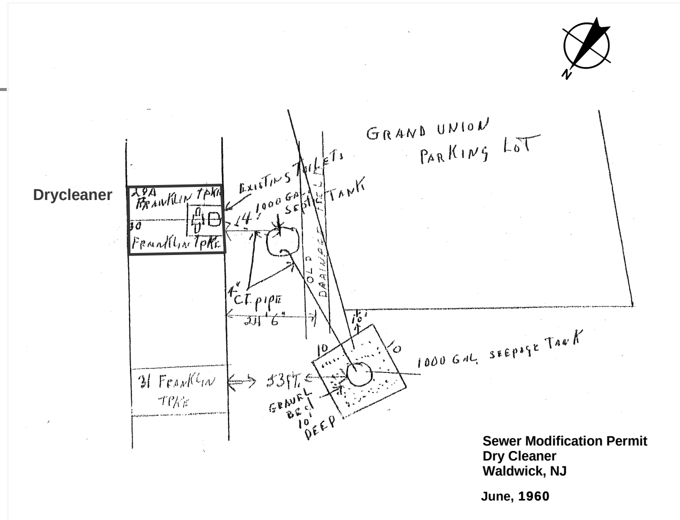
Soil gas surveys become useful when an on-site building has been removed or there is no information available concerning a site such as when an on on-site building has been removed and when any indication of subsurface relics has been obliterated.

Passive soil-gas methods consistently have proven to be reliable in identifying and even determining the extent of Organic Contamination **as well as** locating septic tanks, sewer lines and other drycleaner relics including underground storage tanks. The costs of soil gas surveys are usually lower than conventional sampling techniques.

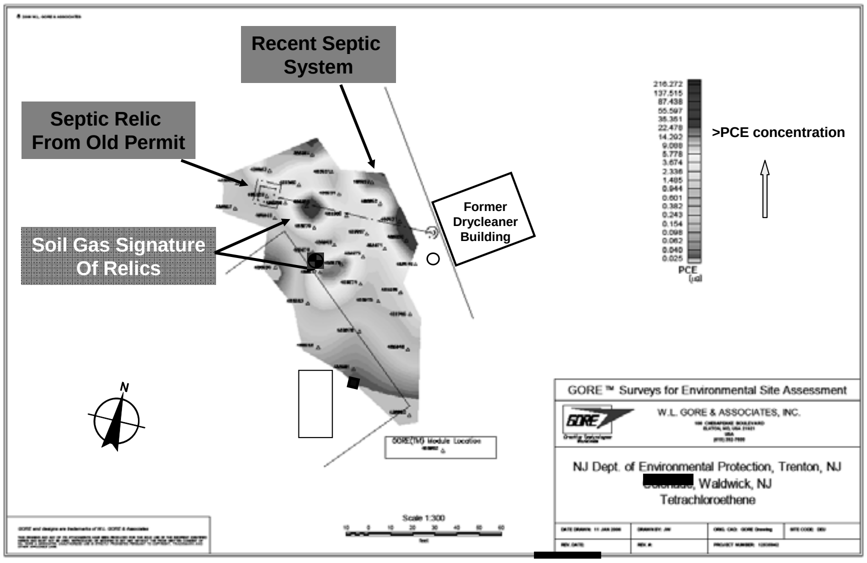
The next slide summarizes a subsurface investigation conducted by the NJDEP at former dry cleaner where a soil gas survey was instrumental in identifying areas of contamination.

Soil Gas Surveys



- The subsurface investigation was centered at the back of a former drycleaner in a strip mall. The fact that a dry cleaner had operated at the bank was confirmed by other dry cleaner operators in the town, eager to share their insights. The owner of the strip mall also provided information and offered that he had removed a septic system located at the rear of the building, **prior** to hooking up to a municipal sewer system.
- A file review in the municipal administration building produced a sewer modification permit from 1960 that featured this sketch. In the sketch, you will notice two 1,000-gallon seepage tanks connected to the former drycleaner building. Early attempts to assess ground water conditions using a Geoprobe were unsuccessful at this site because the ground water was too deep and the glacial sediments resisted advancement of the Geoprobe. NJDEP was reluctant to pepper the site with monitoring wells so we decided to conduct a Soil Gas Survey in an effort to locate contaminant hotspots where a monitoring well could be sited.
- **This sketch on the sewer modification permit was useful in designing the subsurface investigation detailed on the next slide.**

Soil Gas Surveys



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OK

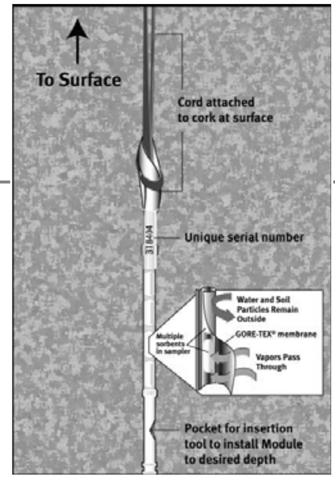
- The positioning of the soil gas points were based upon information obtained from the sewer modification permit and a grid system. The grid system was necessary to insure that there were no other septic relics and to see if contamination was localized. The soil gas survey identified 3 areas of elevated PCE concentrations. Two of the areas were the septic tanks identified on the permit and the third area showed residual contamination from the septic system located near the building.
- We installed a monitoring well adjacent to the elevated soil gas readings near the septic tanks and ground water sampling confirmed the presence of PCE at a concentration of 140 ppb at 26 feet below ground surface. Excavation of the rear of the former drycleaner confirmed the presence of 2 septic tanks including the one shown in slide 3.

The following slide shows components of the Gore Sorber System of Soil Gas Surveys.

Soil Gas Surveys

Passive Soil Gas Investigations

Gore Sorber System



www.drycleancoalition.org/docs/2002/attg.pdf

- There are several companies that have developed methodology for soil gas surveys. The New Jersey DEP has the most familiarity with the Gore Sorber system. The primary component of the Gore System is the Gore Sorber module, shown in the lower right hand corner. After a 2 – 4 foot boring is advanced, a module attached to a string is pushed into a boring using a steel rod. The string is secured to a cork which is used to plug the hole and the module is left suspended in the boring. While in the boring, the gore membrane allows contaminants to enter the module where they are absorbed on charcoal. The module can also be suspended in saturated zones because the goretex prevents water infiltration. **After approximately** 2 weeks, the modules are collected and sent to Gore for analysis. **After a typical** 4 week period, the results of the survey are delivered in tabular and then in mapped form as shown in the previous slide.

A detailed powerpoint presentation on Passive Soil Gas Surveys using Gore Sorber Modules was prepared by the Kansas Dry Cleaning Program of the Kansas Department of Health and the Environment. The web address for the presentation is on the lower left hand portion of this slide.

The next slide introduces active soil gas sampling.

Soil Gas Surveys

- Active Soil Gas Surveys - Soil gas is withdrawn from the subsurface using a portable vacuum pump.
- After purging, a soil gas sample is transferred into a gas-tight glass syringe or a tedlar bag for immediate analysis.

- During active Soil Gas Surveys soil gas is withdrawn from the subsurface through a screened point or through a vapor extraction well using a portable vacuum pump.

- After the screened point is sufficiently purged, a soil gas sample is collected into a gas tight glass syringe or a tedlar bag for immediate analysis in a portable GC.

- Active soil gas sampling enables rapid decisions concerning investigation strategies to be made based upon information from portable gas chromatograph, mobile laboratory or colorimetric tubes. - **Another advantage** is that soil gas data can be collected from discrete depths enabling the vertical profiling of contamination. Typically, 10 – 30 active soil gas samples can be collected and analyzed per day, given suitable subsurface conditions. - **Limiting factors** for active soil gas surveys are based primarily on the sites subsurface lithologies. Low permeability soils and shallow ground water tables may limit the effectiveness of active soil gas sampling.

The next slide discusses Modified Active Gas Sampling or MAGS

Soil Gas Surveys

Modified Active Gas Sampling (MAGS)

- a high rate of vacuum is applied to a network of vapor extraction wells
- soil gas samples are collected to determine contaminant mass
- by adjusting wellhead vacuums and measuring vacuum in surrounding monitoring points, the area affected by each sampling point can be estimated
- MAGS provides useful information for designing soil vapor extraction systems

HSA Engineers & Scientists

www.drycleancoalition.org/docs/2008_meeting/SCRD08.pdf

MAGS is a method of active soil gas sampling that utilizes a network of vapor extraction wells fitted with vacuum gauges. **By applying a** high pressure vacuum and testing soil vapor for contamination, MAGS is capable of assessing 20-feet of radius in sandy soils at a single extraction point. **Traditional assessment** techniques, involving the collection of a single soil or even gas sample from a boring, limits the amount of useful data obtained, to point data. **By sequentially** testing MAGS points and determining the areas where the 20 foot areas of influence intersect, areas where contamination is more likely to be found can be identified. **Although there** is a loss of resolution as compared to traditional soil sampling techniques, an entire assessment area can be tested in a shorter amount of time. **The resolution** of the testing results is on the order needed for a remedial action, **that is**, you do not need to know to the inch where the contamination is, you need to locate the contamination well enough to conduct further assessment or implement soil vapor extraction (SVE). **An additional benefit** to using MAGS is that it allows you to gather design information while you are performing your assessment. **As far as** SVE information, radius of influence information, flow versus pressure and emissions data, can be obtained during the site assessment.

An excellent power point summary of the MAGS technique is available through the SCRD website. The web address is located at the bottom right-hand portion of this slide.

This completes the section on Soil Gas Surveys. The next slide will introduce Direct Push Technologies

Direct Push Technologies

- Larger Machines with thicker drill rods can bore through most glacial tills and saprolites.

Photo Supplied by Geoprobe Systems

- Smaller Machines can work within buildings

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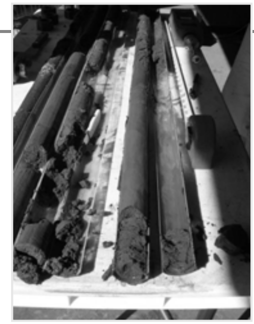
Direct push technologies may be the most important technology used in the assessment of dry cleaners and other sites. **It is from** a direct push platform that soil, ground water and soil vapor samples are easily and efficiently collected. **The New** Jersey DEP uses a Geoprobe machine to perform subsurface investigations. There are a number of different direct push technology machines that provide versatility as far as machine access, depth advancement capability and sampling capability. **The machine** in the upper right hand corner can advance a steel rod through anything but solid rock. **We have** discovered that it is worth the extra money to engage a larger machine when working in glacial tillsdue to its ability to power through a variety of sediments. **The machine** shown in the lower left hand photo is a portable Geoprobe that can be set up inside of buildings. **It is** particularly useful when soil samples beneath dry cleaner machines and other spill areas have to be collected. **Throughout this section**, I will be using the terms Direct Push Technology and Geoprobe interchangeably. It is not an endorsement of Geoprobe per se, but they are all that I have familiarity with.

The next slide introduces soil sampling with Geoprobes.

Direct Push Technologies



Collection of soil samples

- Continuous sampling with macrocore and acetate sleeves
- Document lithology
- Screening soil intervals
- Sampling should be conducted in the vadose zone

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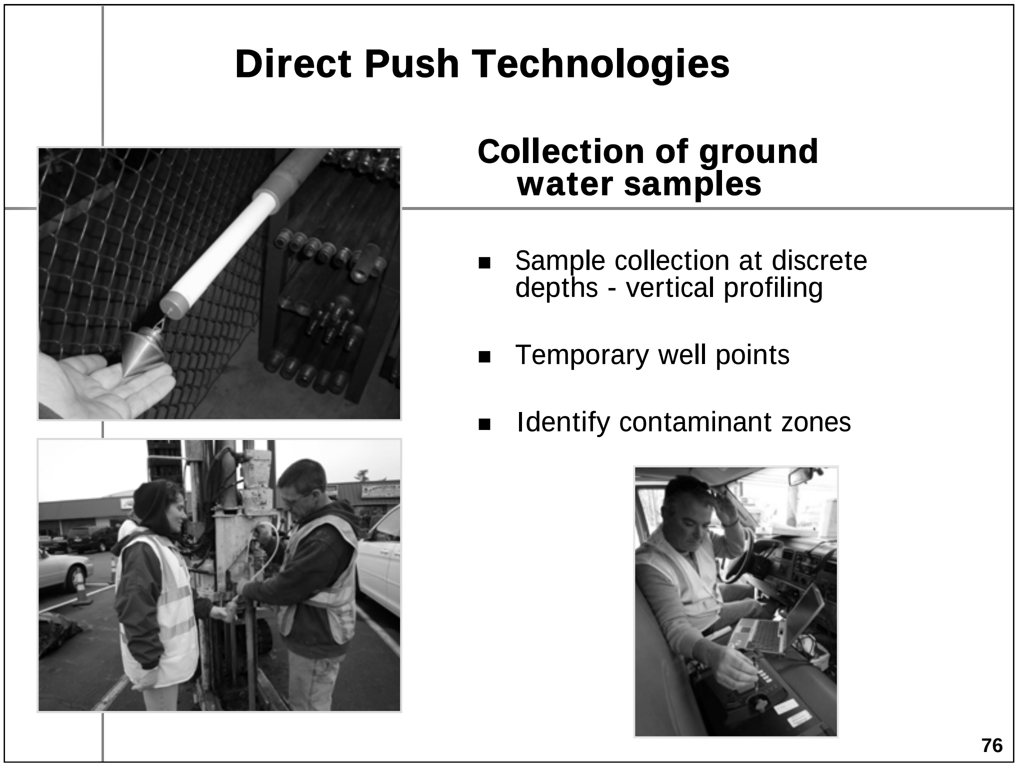
Direct push technology makes the collection of soil samples a rather simple affair .. especially compared with using split spoons and a drill rig. **Modern soil collection** with a Geoprobe utilizes an acetate macro-core that collects 4 or 5 foot core samples, 1½ inch in diameter. **The MacroCore system** is used to collect soil samples at depths typically less than 8 – 10 feet. **For depths greater** than 8 feet, Geoprobe developed a soil sampling technique called the Dual tube sampling system. **The primary feature** of Dual Core Sampling is that an inner steel rod advances with an outer steel rod. **Attached to the** end of the inner rod string is an acetate liner through which a soil sample can be retreived without pulling the outer rods. **Because the** outer rods do not have to be pulled out of the ground when each depth is achieved, they seal the boring and allow a discrete soil sample to be collected. Dual tube sampling is much faster than MacroCore boring.

Alternate

Direct push technology is useful for collecting continuous soil borings. **One and one-half** inch diameter soil cores are collected in acetate tubes which can be kept sealed for future description or analysis or opened on site. **Typically, a geologist** will log the soil core and screen the entire core with a organic vapor analyzer, noting the areas where volatile organics are detected. **The number of** samples collected from each boring is determined by the needs of the investigation – such as the need to document the highest contaminant zones or collecting soil sample for vertical or horizontal contaminant delineation. **Logging the** soil cores allows you to determe the presence of confining layers, permeable intervals, saturated zones and other parameters specific to the needs of the investigation.

One thing that should be remembered about collecting soil samples when investigating a dry cleaner is that the purpose of collecting the sample is usually to document a surface spill or other release of contamination. **Therefore it** makes sense to only collect soil samples within the vadose zone which is loosely defined as the interval between the ground surface and the water table. **The reason** that this is important is that contaminated ground water can impact the soil horizon within the zone that the water table fluctuates and that an investigator could make the misplaced assumption that the soil contamination resulted from a surface release.

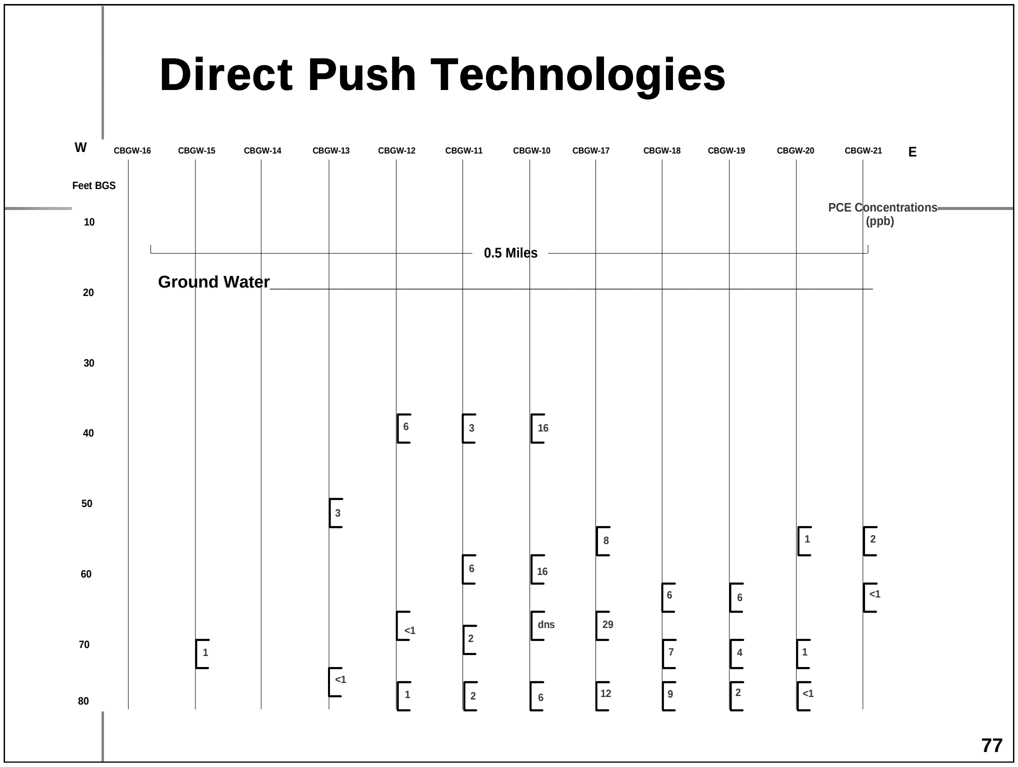
The next slide details some of the approaches that the New Jersey DEP takes in collecting ground water samples using direct push technology.



New Jersey uses direct push technologies extensively for ground water sampling, mainly for vertical profiling. **Geoprobe has** a number of ways in which to sample ground water, but a DEP employee came up with a unique system to collect ground water samples. **The upper left** photo shows a point-screen combination that is used to sample ground water. **The sacrificial** point is connected to a four foot screen that fits within the geoprobe rod. **After the rod** is advanced to depth, the rod string is pulled up 3-4 feet. **Because the** screen is attached to the point, it stays in place and the screen is exposed to the saturated zone. **The lower left** photo shows how water that accumulates within the screen is retrieved. **A check valve attached** to polyethylene tubing is lowered into the water column and brought ot the surface by a surging motion. **In this instance**, the ground water was particularly silty and was collected in a decant bottle to allow settling. **After the silt** settled, the cleared ground water is poured into sample bottles or a container for portable GC analysis.

By using a portable GC on site, decisions can be rapidly made concerning depths to focus on and the extent of contamination. **Some sampling** depths may be eliminated or sampling intervals increased or shortened based upon GC data.

The next slide shows a cross section that resulted from a vertical profiling subsurface investigation

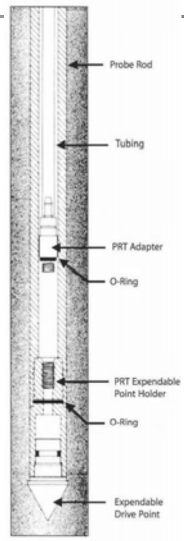


This figure is based upon a vertical profiling investigation conducted along a 1/2 mile street to a depth of 80 feet below ground surface using a field GC. **Ground water** was detected at 18 feet below ground surface and the areas where there is no data are areas where PCE was not detected.

When conducting a subsurface investigation at a dry cleaner site, vertical profiling is valuable for locating source areas, delineating contaminant plumes and collecting quality assured data when data is submitted to a certified lab.

The next slide shows how direct push technology is used to collect soil gas samples

Direct Push Technologies



Soil Gas Sampling

- collected at discrete intervals through the drive rods
- A vacuum pump on the surface purges the interval and soil vapor is directed to a sample collection device

Direct push technology simplifies the collection of soil gas samples. **Besides the** obvious of being able to penetrate resistant strata and going deeper than boring by hand, Direct push systems such as Geoprobe have adopted tooling methodology that enables the collection of quality soil gas samples. **Illustrated in the** left hand side of the slide is the The Geoprobe Post Run Tubing system or PRT which is a tool used to locate and delineate contaminant areas. **The primary** benefit of the system is its ability to collect soil vapor samples quickly and easily at the desired sampling depth WITHOUT the time-consuming complications associated with rod leakage and sample contamination. **Minimizing the** infiltration of soil gas through the drill rod connections is important in the collection of a representative soil gas sample. **In the PRT** system, the drill rod string is pulled up leaving the drive point in the ground and exposing a soil void. **A soil gas** sample is then drawn through the point holder, through the PRT adapter, and into the sample tubing. **Since the** tubing can be replaced after each sample, sample carryover problems and the need to decontaminate the probe rods is eliminated saving time and money.

Flow rate is an important consideration in soil gas sampling because if a powerful vacuum is applied to an installed system, volatiles sorbed into solids or liquids in the pore space of sediment may be stripped out and enter the gas stage for sampling, resulting in a strong positive bias in the sample. **A general** concensus of State and Federal guidance documents suggest that flow rates from soil gas sampling should not exceed 200 ml/min. **Three volumes** of gas in the sampling rods should be purged prior to sampling in order to get a representative sample. **Soil gas** samples are collected into tedlar bags for on-site analysis and in glass bottles or suma cannisters for laboratory analysis.

The next slide discusses the use of microwells for initial assessments

Direct Push Technologies

Microwell Installation

- minimizes investigation-derived wastes
- plume delineation becomes cost effective
- pneumatic slug testing possible in microwells
- microwell analytical data compares favorably with hollow-stem auger installed wells
- many cost advantages when compared to traditional monitoring wells

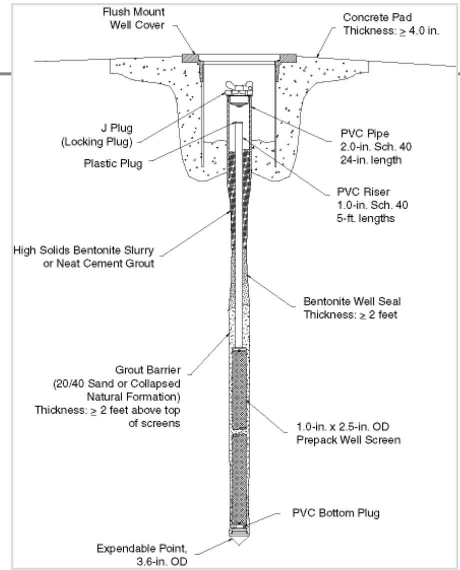


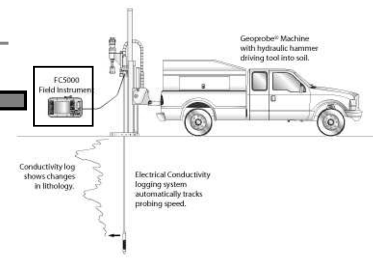
Figure Supplied by Geoprobe Systems

Microwells provide an inexpensive, yet effective method for obtaining overburden groundwater samples. **Microwells can** be installed for collection of groundwater samples on a temporary basis, or when placed in secured, out of the way locations, can be effective as long term monitoring points. **The primary** benefits of installing microwells is that they can be installed with direct push technology which minimizes the investigation derived wastes, such as drill cuttings and purge water. **Geoprobe supplies** a variety of tooling designed to install microwells from ¾ inch for a 1.1 inch boring to a 2 inch well diameter installed in a 3.6 inch boring, which is illustrated on the slide. **Each state** has its own guidelines in determining whether microwells may be installed temporarily or permanently. **A concern of** State regulators is the ability of well installers to properly install microwells in thin diameter borings. Placing an adequate well seal to restrict ground water and contaminant flow along the boring has its challenges in small diameter borings, but it can be done and Geoprobe manufactures the equipment and details the methodology. **Developmen**t of the microwell can be achieved using a peristaltic pump and ¼ inch polyethylene tubing.

Microwells enable the determination of ground water flow direction, may be used for pneumatic slug testing to determine aquifer characteristics **and** can be a long term solution for monitoring the effectiveness of a remedial strategy.

The next slide begins a section on the soil conductivity probe

Soil Conductivity Probe



Illustrations Supplied by Geoprobe Systems

- A soil conductivity profile provides a continuous reading of the electrical conductivity (EC) of the soil/sediment.
- The soil conductivity probe is advanced using a direct push unit
- Site specific core samples are used to verify the lithology represented by electrical conductivity values at a site

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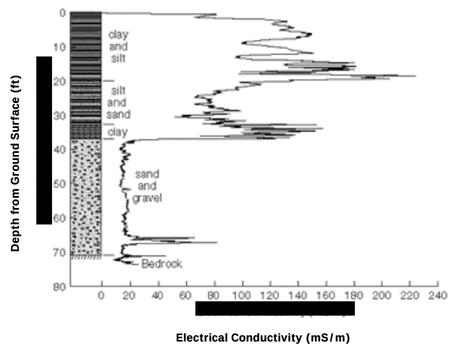
A soil conductivity probe is a device that measures the electrical conductivity of the soil. **The probe** is attached to drill rods and its cable is fed up through the drill rods to a field instrument that provides data acquisition and control interface for the probe. **The probe** is advanced through the soil using direct push technology and provides a continuous reading of the electrical conductivity of the soil/sediment. **The lithologic** information gathered with the soil conductivity probe can be used to assist the investigator in understanding the movement and location of contaminants in the subsurface. **This information** can also assist in the proper placement of monitoring or extraction wells. **Since site** conditions vary considerably, it is important to verify lithologic changes at a particular site by comparing a soil conductivity log to an actual soil boring.

The next slide continues the discussion on soil conductivity probes

Soil Conductivity Probe

A day or two of conductivity profiling will allow the development of a stratigraphic framework across the site and enable real time:

- characterization of subsurface lithology
- placement of groundwater sampling points
- selection of screen intervals in monitoring wells



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The conductivity of soils is different for each type of media. **Finer grained** sediments, such as silts or clays, have a higher electrical conductivity signal, while coarser grained sediments such as sands and gravel, have a lower electrical conductivity signal. **The coarser** grained sediments enable the migration of contaminants **and** the finer grained sediments tend to limit the migration of contaminants.

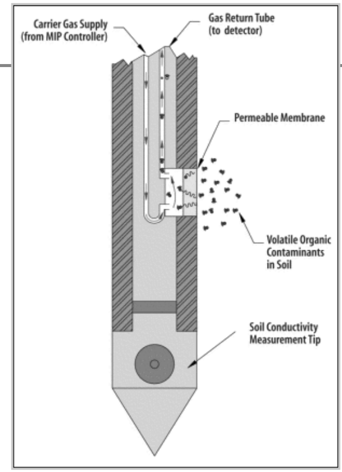
A day or two of conductivity profiling allows the development of a stratigraphic framework across the site by characterizing the subsurface lithology. **With this** information, decisions concerning the placement of groundwater sampling points, the selection of screen intervals in monitoring wells and the delineation of contaminant mass can be made.

The soil conductivity probe system is a powerful tool when used properly, giving the investigator real-time, on-screen soil lithologic logs, enabling onsite decisions to be made.

The next slide will begin a discussion about membrane interface probes

Membrane Interface Probe (MIP)

Photo and Figure Supplied by Geoprobe Systems

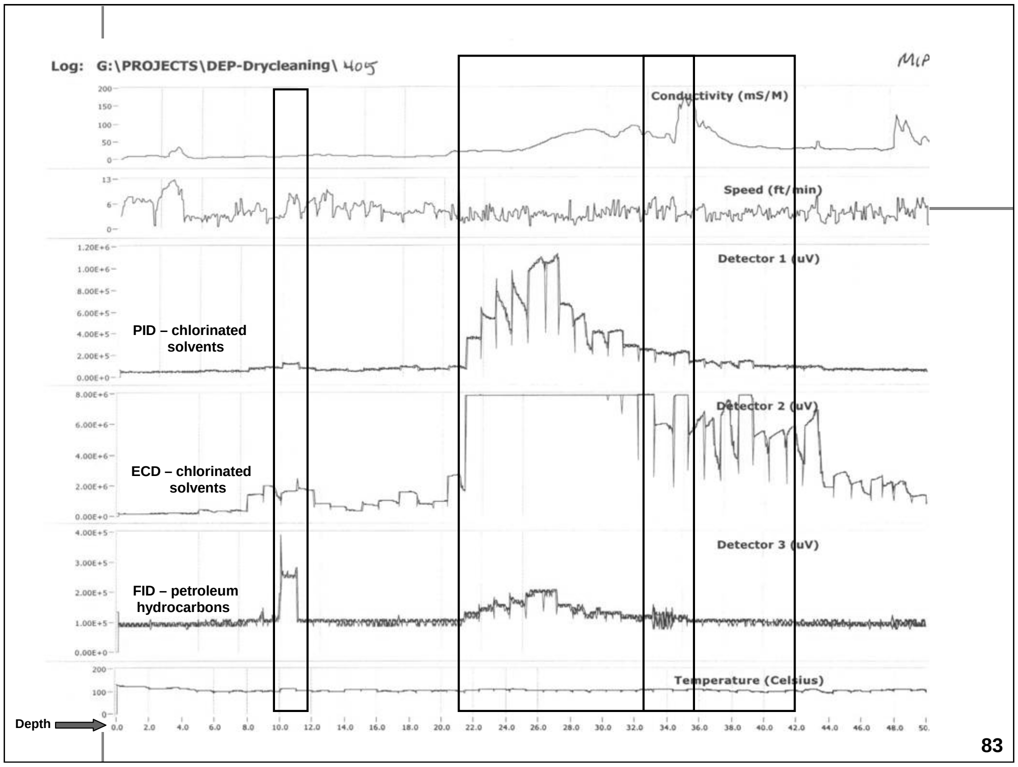


- The MIP is a subsurface screening device capable of detecting most VOC's and petroleum hydrocarbons
- A soil conductivity detector on the MIP also characterizes subsurface lithologies
- Due to high detection limits the MIP is mostly used for contaminant source delineation
- MIPS data will give an early indication on the type of data needed for the remedial design phase

The Membrane Interface Probe, or MIP, is a percussion tolerant VOC sensor that continuously logs volatile organics that diffuse through a semi-permeable membrane on the probe. **Using a carrier** gas, the VOCs are transported to the surface through tubing connected to a laboratory grade Electron capture device, photoionization detector and flame ionization detector for immediate analysis. **The MIP** is capable of detecting most Volatile Organic Compounds **and** petroleum hydrocarbons but due to high detection limits on the analytical equipment, the MIP is mostly used for contaminant source delineation - **a key** component of dry cleaner assessment.

The MIP also provides soil electrical conductivity data so that a consultant is able to read real time data showing changes in soil conductivity/resistivity. **These changes** can be used to identify lithology, contaminant plumes, salt water intrusion, or any other subsurface condition that displays a change in conductivity/resistivity. **This data** is an early indication as to the type of data that will be needed in subsequent remedial design phases.

The next slide is a schematic that provides a brief description how the MIP works



This log is from a drycleaning facility in Jacksonville Beach, Florida. The facility used both petroleum cleaning solvents and PCE. The FID response at 10 feet and within the purple zone, is a zone contaminated with petroleum solvent. The main contamination at the site occurs from approximately 21 feet below ground surface to approximately 42 feet below ground surface – highlighted by the red zone. Further investigation revealed that the bulk of the contaminant mass was situated in a silty, fine-grained sand overlying a silty clay (occurring from 33 - 36 ft BGS- as indicated by the green square

Beginning at the bottom of the MIP log and going up:

Depth Track: Feet below ground surface

Temperature: The temperature at the membrane. Critical because membrane needs to reach a temperature high enough to volatilize the VOCs. Advancing the tool cools the membrane and it is important to let it heat up to volatilize the VOCs.

FID (Flame ionization detector): Applicability - petroleum hydrocarbons

Electron Capture Detector (ECD): This is the chlorinated solvent sensitive detector.

PID (Photoionization Detectror): Not as sensitive as ECD. When ECE flatlines (detector saturates), the PID provides useful resolution in a zone contaminated with chlorinated solvents.

Logging Speed: Tool is normally advance one foot at a time.

Conductivity: Measures the conductivity of the formation (including the fluids): In general, the higher the porosity, the higher the conductivity. That generally means clays have a higher conductivity than silts and silts have a higher conductivity than sands. Conductivity can best be interpreted when an adjacent lithological boring is used to ground truth the data.

The membrane interface probe is a powerful tool when used properly, giving the investigator real-time data , on-screen logs enabling onsite decisions to be made.

The next slide is a summary of the detectors used during a MIPS investigation

Membrane Interface Probe (MIP)

Detectors

- Flame Ionization Detector (FID) detects petroleum compounds. Detection limit – approx. 200 ppb
- Photo Ionization Detector (PID) detects aromatic compounds (BTEX). Detection limit – 1 ppm. Chlorinated solvents – 5 ppm
- Electron Capture Device (ECD) – Gas chromatograph detects chlorinated compounds. Detection limit – as low as 250 ppb
- Halogen Specific Detector (XSD) – Detects only halogenated solvents including PCE. Detection limit – 250 ppb

Membrane Interface Probe can be configured in a number of ways, but the most common detectors are

Flame Ionization Detector (FID) which detects petroleum compounds. Detection limit – approx. 200 ppb

Photo Ionization Detector (PID) detects aromatic compounds (BTEX). Detection limit – 1 ppm Chlorinated solvents 5 ppm

Electron Capture Device (ECD) – Gas chromatograph detects chlorinated compounds. Detection limit – as low as 250 ppb.

Halogen Specific Detector (XSD) – Detects only halogenated solvents which are typically the compounds associated with dry cleaning. Detection limit – 250 ppb

With these detection limits, the MIP is most useful for source delineation and some plume delineation and because the data is semi-qualitative, it cannot be used to delineate contamination to regulatory standards for site closure. Classic sampling methods are still required for the characterization, confirmation and delineation of the entire contaminated area when using conventional MIP.

There are however, companies that offer services enabling the delineation of contaminant plumes and detection limits below ground water cleanup standards. These companies route the contaminant stream to a gas chromatograph / mass spectrometer.

The next slide summarizes the advantages for using MIPS technology

Membrane Interface Probe (MIP)

Advantages:

- Time and money are saved with the ability to delineate both source areas and contaminant plumes
- Chemical and physical logs are simultaneously graphed in real time
- MIP with ECD can log up to 300 feet per day in both vadose and saturated zones
- soil cuttings are not generated during the logging process
- Mapping of contaminant extent simplifies field decisions concerning:
  - Monitoring well placement
  - Sample collection depths
  - intervals for the injection of remediation materials.

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Time and money are saved with the ability to delineate both source areas and contaminant plumes. **But due to the** high detection limits on its detectors, MIP is most suited for the delineation of source areas which is normally a priority when assessing dry cleaners. **MIP can however**, delineate plumes out to 250 ppb depending on what detector is used. Also, there are limitations to the length of time that the MIP can remain in a source area zone. If a source area is encountered, the operator should try to push through the area to the next relatively clean zone. **If the operator** prolongs the MIP contact with source area sediments, the trunk line transporting the carrier gas will become contaminated and residual ***contamination present*** until the line is cleared.

The Chemical and physical logs generated by the MIP are simultaneously graphed in real time so there is instant feedback concerning lithologic change and the presence of contaminants. A MIP with ECD can log up to 300 feet per day in both vadose and saturated zones. Another benefit of MIPtechnology is that soil cuttings are not generated during the logging process.

With the proper software, MIP technology can generate 2D or 3D cross-sectional maps of the site as data is aquired. This is especially valuable toward monitoring well placement to both determine at what depth samples need to be collected and to identify the optimal intervals the injection of remediation materials.

Now, you may ask… Is MIP technology affordable compared to traditional sampling methods?

The cost may be justifiable. If you can quickly determine the location of a contaminant source area and the direction of plume migration, you should be able to reduce the number of samples that would be collected with traditional sampling methods. If you factor in savings of not only field time, but analytical costs and project management costs, the cost of MIPS may be justifiable.

The next slide begins a brief discussion on mobile labs

Mobile Laboratories

Simplify decisions regarding:

- Contaminant source location
- Contaminant mass delineation
- Confirmatory soil sampling at remedial phase

When coupled with direct push sampling, on-site Mobile Labs permit accurate real-time sampling and assist in decisions regarding:

Contaminant source location and establishing contaminant concentration gradients

Both vertical and horizontal contaminant mass delineation…

Contaminant source removal - confirmatory soil sampling at remedial phase to determine when you can stop excavating source material

Next slide

Mobile Laboratories

Advantages:

- Enhanced productivity
- Significant cost savings
- work plan may be adjusted in the field

Disadvantages:

- High cost needs to be compared to time savings and costs of standard analysis

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The advantages of using a mobile lab typically outweigh the disadvantages. **A mobile** lab stationed on site will enhance productivity and a subsurface investigation could realize significant cost savings. **Most mobile** labs can analyze soil, ground water and air samples generated during a direct push investigation. **The data** generated can immediately be compiled by a project manager and rapid decisions concerning the direction of the investigation can be made. **Cost savings** include the limiting of down-time on work crews, cutting down on the number of site mobilizations and decreased sample management time including transport to a fixed lab and compiling data reports. **Site work** plans can be adjusted in the field based upon real-time data and decisions regarding the placements of borings or monitoring wells made.

The use of a mobile lab is expensive but its high cost can usually be justified when time savings from on-site efficiencies and the cost of analysis and management of standard samples is considered. **The key** to a successful investigation is to have a thoroughly thought-out workplan and to develop a plan combing work efficiencies with sequences of events. Excess days of mobile lab use due to poor planning will quickly erode any cost savings gained by its use.

The next slide introduces the assessment of sanitary sewer lines.

Assessing Sanitary Sewer Lines

The investigation of sanitary sewer lines should be an integral part of all dry cleaner site assessments and conducted in the early stages.

The compilation and interpretation of dry cleaner assessment data over time, demonstrates that sanitary sewer lines are an important potential source of contamination

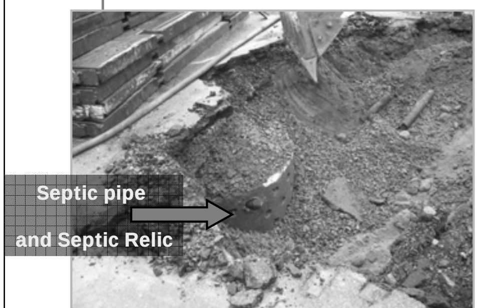
www.sewerhistory.org

OK

The compilation and interpretation of drycleaner assessment data demonstrates that Sanitary Sewer Lines are an important potential source of contamination.

The investigation of Sanitary Sewer Lines should be an integral part of all dry cleaner site assessments.

Assessing Sanitary Sewer Lines



Collect available information:

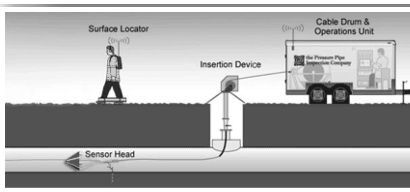
- Site/engineering plans
- Permits
- Site Inspections

The first task in assessing sanitary sewer lines is to collect available information. **Municipal or county** engineering departments are frequently a valuable source of information. **A file review** could yield engineering plans for sewer improvements or permitting information relative to septics. **It is also** important to determine when a dry cleaner was hooked up to a municipal water supply so you can estimate how long contaminants were discharged into the ground. Site visits are also important and *during* the visit one should try to note the locations of sanitary sewer laterals and mains, observe floor drains and manholes for directional clues for sewer lines and speak to the owner or the plummer for the facility for additional insights.

The two slides were taken during the excavation of a dry cleaner septic system. **The locations** of the septic main and relics were determined from a gore sorber study and confirmed during the excavation. **The upper** slide shows a cross section of the septic piping run and a monitoring well that had been installed adjacent to the piping run. **The monitoring** well was preserved during site restoration. **The lower slide** shows a septic tank prior to its removal. Records indicated that the septic system operated from the early 1960's to 1971.

The next series of slides describes several ways to identify the locations of septic lines.

Assessing Sanitary Sewer Lines



- Significant point-source contamination may result from sewer line leaks including cracked, broken or displaced mains and laterals
- Performing sewer line tightness tests are inexpensive and should be performed in the early stages of a subsurface investigation
- Sewer and drain lines as small as 1½ inches may be located remotely using radio technology

It must be remembered that significant point-source contamination may result from sewer line leaks including cracked, broken or displaced mains and laterals. It is easiest to determin if a sewer line is leaking by performing a line tightness test. These tests are inexpensive and should be performed at the early stage of an investigation.

If it is determined that there is a leak in the pipe, the location of sewer and drain lines may be determined by inserting a radio transmitter into lines as small as 1½ inches in diameter. **The transmitter** within the pipe is then located on the ground surface by using a hand-held receiver and the location of the pipes are marked on the ground surface. **In most** instances, a gore sorber study along the pipe will locate the source of the contaminant release.

However, the following slides outline methods to determine leak locations by inter pipe methods

Assessing Sanitary Sewer Lines

The three primary methods of assessing sewer lines are:

- Hydrostatic Pressure Testing
- Video Inspection
- Smoke Testing

Three ways of assessing sewer lines are hydrostatic testing, video inspections, and smoke testing

Assessing Sanitary Sewer Lines

Hydrostatic testing

- A section of sewer pipe is plugged near the outfall and water is added to the pipe. The water level in the pipe is observed for 20 minutes. If there is no change in the water level, the pipe is considered tight
- If the water level goes down, there is a leak and isolation tests are necessary to determine the location of the leak
- Isolation tests utilize inflatable test plugs which are placed with the aid of a camera. Small sections of pipe are assessed
- Even with the discovery of a leak, the entire pipe must be investigated for multiple leaks

One way to determine the likelihood of a release of contaminants from a sewer pipe is to perform a hydrostatic tightness test on the sewer pipe. **Sewer line** tightness tests cost in the neighborhood of $500 and should be performed in the early stages of a subsurface investigation. **The hydrostatic** test can be rather easy to perform. **After a sewer** pipe is plugged near its outfall, water is added to the pipe from its origin in the building. **If the water** level in the pipe goes down, then isolation tests are needed to locate the area of the leak.

Isolation Tests are done by installing an inflatable test plug that is maneuvered throughout the sewer lines with the help of a camera. **By isolating** and testing progressively smaller sections of the pipe, the area of the leak can be isolated. **Once a leak** location is found, it is documented and the rest of the system is then checked for additional leaks. **A good** leak detection company will continue to test all sewer line branches and all fixtures to locate all the leaks **and** once all the testing is completed, provide a sketch of the building indicating the layout of the drain lines, **and** the location of the leaks.

If the location of a leak is determined, direct push technology may be used to collect soil and or ground water samples near the leak. **If the** leak had occurred over several years, the amount of contamination could be substantial.

The next slide discusses video assessment of sewer lines

Assessing Sanitary Sewer Lines

Deteriorated pipe

Broken and displaced pipe

Video inspection

- Video cameras with diameters as small as 1-inch are inserted into sewer lines and both the mains and laterals can be inspected
- Video will show large cracks or separations in the pipe but may miss small cracks
- Video inspection is not a test
- Color video is preferable over black and white

There are situations where hydrostatic pressure testing is not possible. **An alternative** is performing a video inspection of a sewer line. Televising sewer lines has been an invaluable way of assessing the condition of a sewer line in real time. **It can** reveal blockages from debris to roots to grease **and** show cracks, breaks or deterioration of a pipe. **It allows** for detailed diagnosis without the need for excavation and save time and money.

Video cameras with diameters as small as 1-inch can be inserted into sewer lines and both mains and laterals can be inspected. **Color video** is preferable over black and white and the video will show large cracks or separations in the pipe but may miss small cracks. **It is important** to remember that video inspection is not a test and it cannot confirm leaks. After a suspected leak is discovered, it may be confirmed by performing a gore sorber investigation or by conducting sampling with direct push technology.

The next slide introduces smoke testing as another method of assessing sewer lines

Assessing Sanitary Sewer Lines

Smoke Testing

- Consists of blowing smoke with large volumes of air, into a sanitary sewer through a nearby manhole
- Smoke travels the path of least resistance to areas that allow surface water inflow
- Since most drycleaners are paved, the condition of the pavement will be a factor in the success of smoke testing

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Smoke testing is a relatively simple process that consists of blowing smoke mixed with large volumes of air into the sanitary sewer line usually induced through a manhole. **The smoke** travels the path of least resistance and quickly shows up at surface areas that allow surface water inflow. **Smoke can** identify broken manholes, uncapped lines and even cracked mains and laterals, providing there is a passageway for the smoke to travel to the surface. **Smoke testing** is a method of inspecting both the main lines and laterals. **Smoke travels** throughout the system, identifying problems in all connected lines—even sections of line that were not known to exist or thought to be independent or unconnected. Best results of smoke testing are obtained during dry weather, which allows smoke better opportunity to travel to the surface

The next slides are subtle safety reminders

Concluding Thoughts

Don’t forget your utility markouts

Don’t forget your utility markouts

And – next slide

Concluding Thoughts

You can never have too much information

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When it comes to underground utilities, you can never have too much information.

Resources & Feedback

- To view a complete list of resources for this seminar, please visit the **Additional Resources**
- Please complete the **Feedback Form** to help ensure events like this are offered in the future

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