



## \* Soil Basics


 Connecticut Department of Public Health  
 Keeping Connecticut Healthy



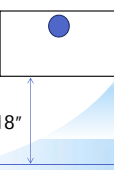
## \* Soils

- \* To determine systems placement and size, soils testing is needed.
- \* For residential buildings, size is based on number of bedrooms
- \* Utilize soil-based identification to determine restrictive conditions in the soil that could restrict the flow and treatment of effluent.
  - \* Groundwater
  - \* Ledge rock
  - \* Compact soils



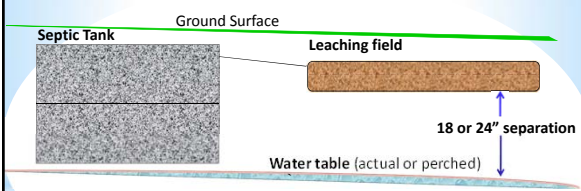


## Vertical Separation Distances

- \* Bottom of the Leaching
  - \* 18" above water, redox or compact layer (restrictive layer)
  - \* 24" if a large system over 2000 GPD, located in a tidally impacted groundwater table or perc quicker than 5.0 minutes per inch
  - \* 4' over ledge rock, 24" of which is naturally occurring soil.




Restrictive condition



## Deep Test Pits



<https://www.youtube.com/watch?v=oINAI0gmCos>



## Soil Profile



**DPH** **Soil Profile**

Horizons

- O: 0-12" Topsoil
- A: 12 - 30" Orange/Br Fine silt loam
- B: 30 - 48" Tan Fine Silt Loam
- C: 48 - 77" Gray Compact Sand w/ Gravel (Hardpan)

<https://www.youtube.com/watch?v=6ZibUOYUMbE>

**DPH** \* **Deep Test Pits**

\*Maximum Groundwater

\*the level to which groundwater rises for a duration of one month or longer during the wettest season of the year.

**DPH** \* **Groundwater** Credit: Peter Fletcher

\*Redoximorphic (redox) features

- \* redox- discoloration of the soil indicative of the seasonal high groundwater table
- \*Redox features form by the biogeochemical processes of reduction, movement, and oxidation of iron and manganese.

**DPH** \* **How Redox Features Form**

In well drained, upland soils the bright color in the subsoil is due to iron oxide stains coating the individual soil particles.

Credit: Peter Fletcher

FLUCTUATING WATER TABLE

$Fe^{3+}$

$Fe^{2+}$

DURING PERIODS OF SATURATION AND REDUCTION MIGRATING GROUNDWATER REDISTRIBUTES OR REMOVES IRON FROM THE SOIL.

Credit: Peter Fletcher

Bright mottles-high chroma  
Zone of accumulation

Gray mottles-low chroma  
Zone of depletion

Credit: Peter Fletcher

**DPH** Seasonal High Groundwater

A photograph of a soil profile with a black measuring tape on the right side. A red line is drawn across the soil, representing the water table. Two blue arrows point upwards from the water table line towards the surface. The soil is light brown and appears to be a loam or silt loam.

A photograph showing a person's hands holding a large, dark, clumpy soil sample. To the right, a black measuring tape is visible, showing markings at 20, 40, 60, and 80 cm. The soil sample is dark brown to black, indicating high organic matter or iron content.

A photograph of a soil profile showing various layers. A cyan arrow points to a light-colored, sandy layer. A blue arrow points to a darker, more textured layer. Several black arrows point to other features within the soil profile, such as roots and small stones.

A photograph showing several soil samples on a wooden boardwalk. A color chart with various color patches is placed next to the samples for comparison. The soil samples range from light brown to dark gray.

Generally speaking, the longer the period of soil saturation and reduction the greater the % gray colors

Credit: Peter Fletcher

**DPH** \* Ledge Rock

\* Ledge rock

A photograph of a soil profile with a red arrow pointing to a ledge rock. The ledge rock is a thin, light-colored layer of rock or mineral material that has formed at the surface of the soil.

**DPH**

A photograph showing a person in a purple shirt and a hat working on a soil profile. The person is standing on a ledge rock. The soil is dark and appears to be a loam or silt loam.

B103 a-e 18

**DPH** \* **Soil texture**

\* Various combination of different size of mineral particles form soil texture.

**Different textures based on their particle sizes.**

- Fine textured soil
- Moderately fine textured soil
- Medium textured soil
- Coarse textured soil

**DPH**

**USDA SOIL TEXTURING FIELD FLOW CHART**

Tools of the trade.

- Field flow chart
- Tape measure
- Water bottle
- Filed book or soils form and pencil

Texture by feel

<https://www.youtube.com/watch?v=1QyaBx1767c>

Start: Place soil in palm of hand. Add water dropwise and knead the soil into a smooth and moist consistency. The moist soil should be a ball when squeezed?

Yes: Add more water. Is the soil too wet? Yes: Add dry soil. No: To the soil too wet? No: Sand.

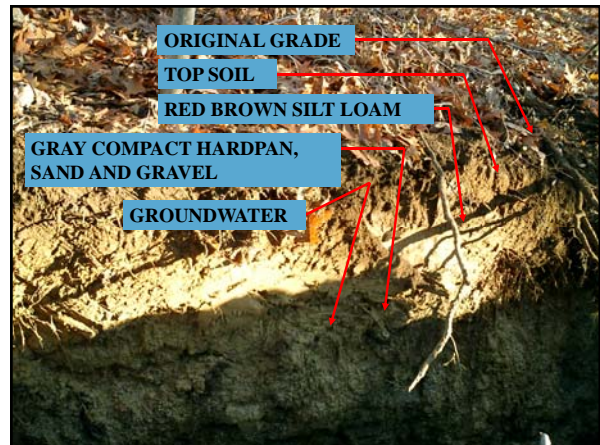
Place ball of soil between thumb and forefinger, gently pushing the soil between with the thumb, squeezing it upward into a ribbon. Form a ribbon 1/4 inch thick and 2 inches long. Allow ribbon to emerge and measure from the forefinger, measuring from its own weight. Does the soil form a ribbon?

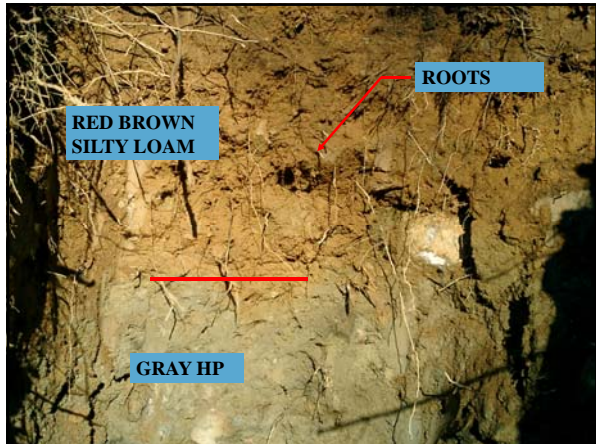
Yes: Loam. No: Loam Sand.

What kind of ribbon does it form?

Moisten a pinch of soil in palm and rub with forefinger	Forms a weak ribbon less than 1" before breaking	Forms a ribbon 1" or longer before breaking	Forms a ribbon 2" or longer before breaking
Does it feel very gritty?	Loam	Clay Loam	Clay
Does it feel equally gritty and smooth?	Sandy Loam	Sandy Clay Loam	Sandy Clay
Does it feel very smooth?	Lean	Clay Loam	Clay
	Silt Loam	Silty Clay Loam	Silty Clay

<http://www.ext.colostate.edu/mg/Gardennotes/images/214-4.jpg>





SAND & GRAVEL WITH COBBLES



**DPH** \* **Soil structure**  
Arrangement of soil particles is called soil structure.

**Types of aggregates-**

- \* Granular - small, spherical, non porous (< 0.5 cm), found in horizons, roots growth
- \* Platy - thin, flat plates that lie horizontally; usually found in compacted soil
- \* Blocky - irregular blocks, may be aggregated (1.5 - 5.0 cm)
- \* Columnar - vertical columns of soil having salt 'caps' at the top; found in soils of arid climates
- \* Prismatic - vertical columns of soil; usually found in lower horizons
- \* Single grained - soil is broken into individual particles that do not stick together; loose consistency; commonly found in sandy soil


**DPH** \* **Soil Coloring Agents**

- \* Organic matter: brown to black
- \* Iron: yellow, orange, and red
- \* Manganese: purplish black
- \* Saturated soils: gray and blue

**DPH** **Organic Matter**

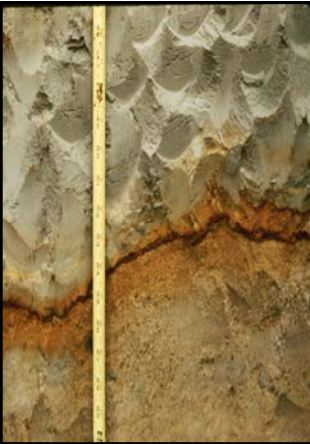
Credit: Peter Fletcher

**DPH** **Typical Colors of an Upland Soil**




- Topsoil, typically brown color, mix of organic and mineral
- Subsoil, dark yellowish brown color, iron oxide (rust) coatings on sand and silt particles
- Substratum, color of mineral soil particles (unweathered geologic sediments)

Credit: Peter Fletcher



There are several different forms of iron within the soil that range in color from yellow, orange, to brick red

Credit: Peter Fletcher



**Manganese**  
**Purplish black color**

Credit: Peter Fletcher

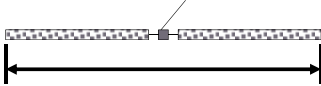
**DPH** \* **Site Hydraulics**

- \* Important factor when designing a septic system
- \* The naturally occurring soil surrounding leaching systems should be capable of dispersing the entire volume of sewage effluent discharged on a continuous basis
- \* Minimum Leaching System Spread (MLSS)
- \* Percolation Test (Perc) measures the rate at which water moves into a saturated soil.

**DPH** **Minimum Leaching System Spread**

\* **MLSS**

Calculation to determine how long a leaching system needs to be. (more to come...)



**DPH** **Soil Basics**

<https://www.youtube.com/watch?v=uimJY25uMR8>

stop at 4:31

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# \* NRCs Web Soil Survey

To start, go to  
<https://websoilsurvey.nrcs.usda.gov/app/HomePage.htm>


Connecticut Department of Public Health  
*Keeping Connecticut Healthy*



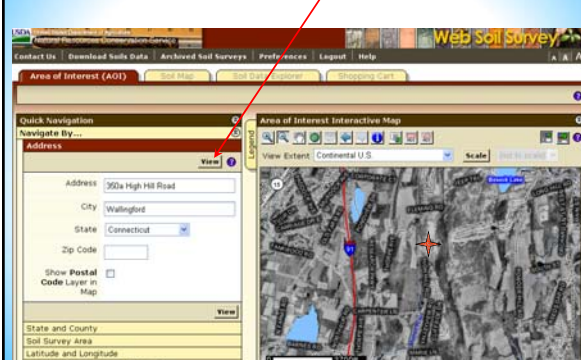
Click on the green "start" button to proceed



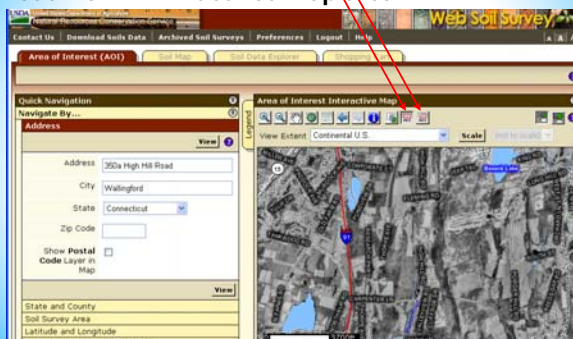
Step One: Area of Interest  
 Find your location



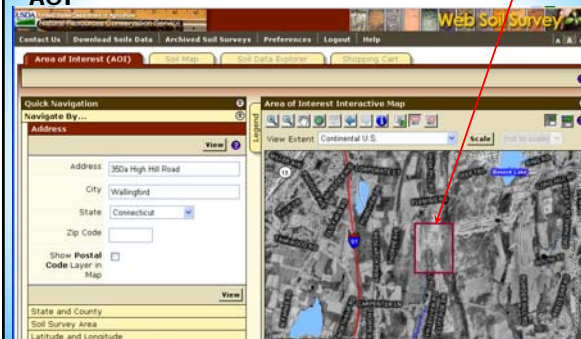
Step One: Area of Interest  
 Address Option



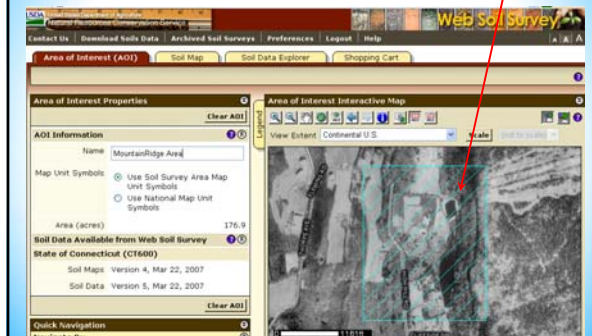
Step One: Area of Interest  
 Use one of the "AOI" buttons to outline desired map area.



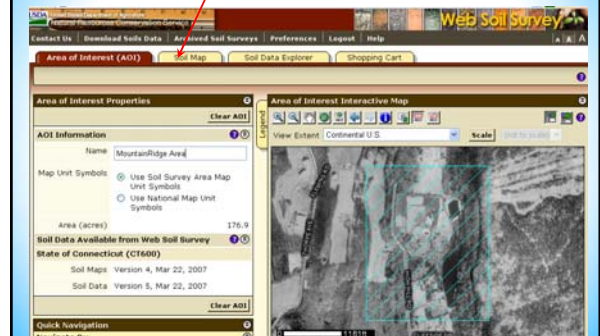
Step One: Area of Interest  
 Click and drag to form boundaries of "AOI"



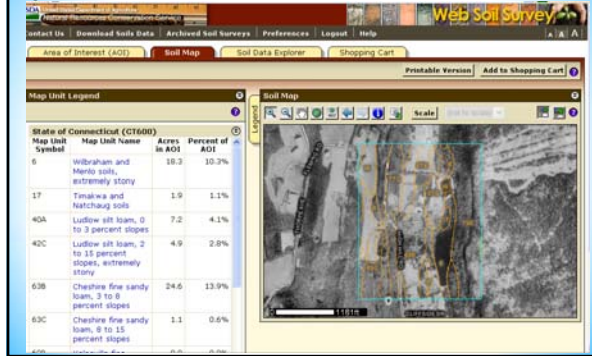
### Step One: Area of Interest "AOI"



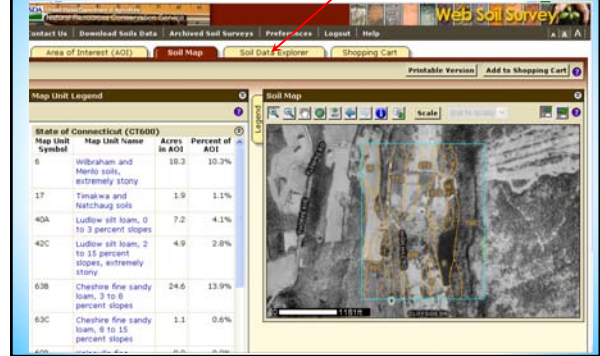
### Step Two: Create Soil Map Click on Soil Map Tab



### Step Two: Create Soil Map Web Soil Survey Creates a Soil Map for your Area Of Interest



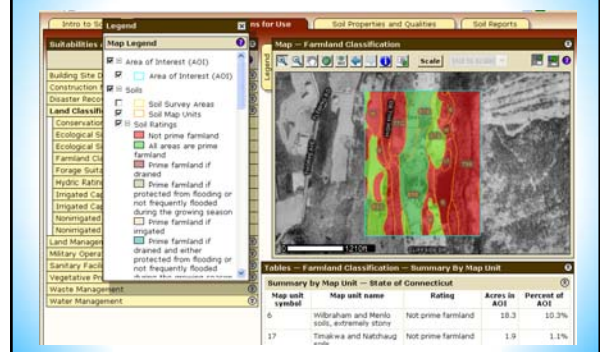
### Step Three: Explore Data Click on Soil Data Explorer Tab



### Intro to Soils Access Basic Soils Information

Table of Contents	Content
<input checked="" type="checkbox"/> All Users	<b>Introduction to Soils</b>
<input checked="" type="checkbox"/> Introduction to Soils	<b>Soils 101</b>
<input type="checkbox"/> What is soil? (less technical)	<b>How does soil form?</b>
<input type="checkbox"/> What is soil? (more technical)	Soils develop as a result of the interactions of climate, living organisms, and landscape position as they influence parent material decomposition over time. Differences in climate, parent material, landscape position, and living organisms from one location to another as well as the amount of time the material has been in place all influence the soil-forming process.
<input checked="" type="checkbox"/> How does soil form?	The five soil-forming factors are:
<input checked="" type="checkbox"/> Parent Material	- Parent material,
<input checked="" type="checkbox"/> Climate	- Climate,
<input checked="" type="checkbox"/> Living organisms	- Living organisms,
<input checked="" type="checkbox"/> Landscape position	- Landscape position, and
<input checked="" type="checkbox"/> Time	- Time.
<input type="checkbox"/> What are soil horizons?	
<input type="checkbox"/> What is a soil scientist?	
<input type="checkbox"/> What is a soil survey?	
<input type="checkbox"/> Who uses a map unit?	
<input type="checkbox"/> What is a connotation, complex, association, undifferentiated group, or miscellaneous area?	

### Step Three: Explore Data Suitabilities and Limitations for use / Farmland Classification





### Step Three: Explore DataSoil Properties and Qualities / Drainage Class

The screenshot shows the 'Properties and Qualities Ratings' window in DataSoil. On the left, there are several expandable sections: 'Soil Chemical Properties', 'Soil Erosion Factors', 'Soil Physical Properties', 'Soil Qualities and Features', 'Landscape Group Classification (Surface)', 'Depth to a Selected Soil Restrictive Layer', and 'Depth to Any'. The 'Drainage Class' section is active, showing a 'Map Legend' with 'Area of Interest (AOI)' and 'Soils' checked. Below the legend is a 'View Options' section with various checkboxes for map symbols and ratings. The main window displays a map with a yellow highlighted area representing the drainage class. At the bottom, there is a 'Summary by Map Unit - State of Connecticut' table.

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
17	Wilbraham and Merio soils, extremely stony	Poorly drained	18.3	10.3%
9	Timakwa and Natshaug soils	Very poorly drained	1.9	1.1%

### Soil Reports Get Soil Ratings for your Map

The screenshot shows the 'Soil Reports' window. It includes a 'Component Legend', 'Map Unit Description (Brief)', and 'Selected Soil Interpretations'. There are 'View Description' and 'View Soil Report' buttons. Below this is an 'Options' section with checkboxes for various soil interpretations like 'Basements', 'ENG - Drawings With Basements', etc. The main part of the window is a 'Report - Selected Soil Interpretations' table.

Map symbol and soil name	Pct. of map unit	Eng - Infiltration systems (ct)	Rating class and limiting features	Value
6-Wilbraham and Merio soils, extremely stony	60	Very limited	Depth to saturated zone	1.00
Wilbraham			Thun layer	1.00

### Soil Potential Ratings of Subsurface Sewage Disposal Systems for Single Family Residences

The screenshot shows the 'Soil Potential Ratings of Subsurface Sewage Disposal Systems' window. It has an 'Options' section on the left with checkboxes for various soil potential ratings (e.g., 'ENG - Soil Potential Ratings of SSS (CT)', 'FOR - Conservation Tree/Brush Groups'). The main window displays a map and a 'Report - Selected Soil Interpretations' table.

Map symbol and soil name	Pct. of map unit	Eng - soil potential ratings of sss (ct)	Rating class and limiting features	Value
13-Walpole sandy loam	60	Extremely low potential		
Walpole				
20A-Ellington silt loam, 0 to 5 percent slopes	60	Low potential		
Ellington				
23A-Subury sandy loam, 0 to 5 percent slopes	60	Low potential		
Subury				
29B-Aqawam fine sandy loam, 3 to 8 percent slopes	80	High potential		
Aqawam				

### Get a printed copy of your map

The screenshot shows the 'Web Soil Survey' interface. It includes a 'Printable Version Options' window with a 'Report Options' section. The 'Report Options' section has a 'Printable Version Options' section with a 'Printable Version' button. The main window displays a map and a 'Map Unit Legend' table.

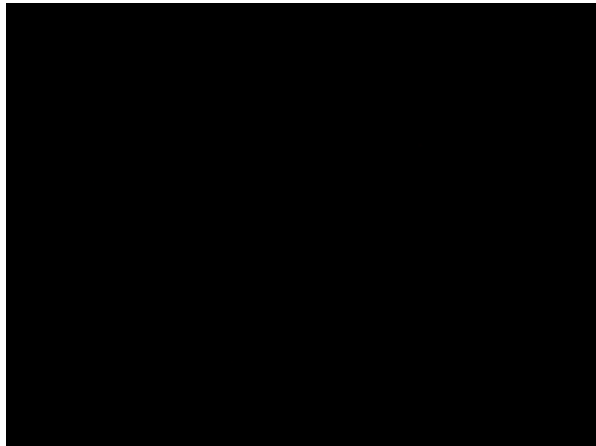
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
6	Wilbraham and Merio soils, extremely stony	18.3	10.3%
17	Timakwa and Natshaug soils	1.9	1.1%
40A	Ludlow silt loam, 0 to 3 percent slopes	7.2	4.1%
42C	Ludlow silt loam, 2 to 15 percent slopes, extremely stony	4.9	2.8%
63B	Cheshire fine sandy loam, 3 to 8 percent slopes	24.6	13.9%
63C	Cheshire fine sandy loam, 8 to 15 percent slopes	1.1	0.6%

### Web Soil Survey Generated Report

The screenshot shows a 'Web Soil Survey Generated Report'. It includes a map on the left and a detailed 'Map Unit Legend' table on the right. The table lists various soil units with their symbols, names, and other details.

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
6	Wilbraham and Merio soils, extremely stony	18.3	10.3%
17	Timakwa and Natshaug soils	1.9	1.1%
40A	Ludlow silt loam, 0 to 3 percent slopes	7.2	4.1%
42C	Ludlow silt loam, 2 to 15 percent slopes, extremely stony	4.9	2.8%
63B	Cheshire fine sandy loam, 3 to 8 percent slopes	24.6	13.9%
63C	Cheshire fine sandy loam, 8 to 15 percent slopes	1.1	0.6%

### VIDEO: Evaluating Soils For Onsite Septic Systems



**DPH** \* **Site Evaluation**

- \* gathering detailed information about the site
- \* topography
- \* physical properties
- \* depth to restrictive layers
- \* accurate assessment of site hydrology

**DPH** \* **Soil Testing Discussion**

- \* Natural soil vs fill. Note fill is fill regardless of how long its been there
- \* Fill is discounted in a soil profile.

Buried top soil with vegetation

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**DPH** \* **Natural soil vs fill**

**DPH** \* **Soil Testing Discussion**

- \* Down gradient soils: Where will the sewage go?
- \* Wet season testing
- \* Hydraulic analyses
- \* Plan info: Test locations, contours, wells, watercourses, drains, soil data, etc.
- \* Additional testing requests: sieve tests, permeability sampling, soil scientist assessments.

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**DPH** \* **Test Pit Safety**

- ⚠ Entering deep test pits above the waist can result in bodily harm or death in the event of a cave in
- ⚠ According to OSHA, the fatality rate for excavation work is 112% higher than the rate for general construction
- ⚠ Many of these fatalities occur due to soil collapses from excavations

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**DPH** \* **Always enter and exit any test pit safely!**

- ✓ Use care while descending the ramp into any test pit, especially if the soil is loose or wet
- ✓ Never jump down into a test pit
- ✓ Have a plan of escape in the event of a sudden collapse
- ✓ Avoid entering any test pit that is not ramped

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**DPH** \* **Never enter a test pit if:**

- ✓ You see any underground utility lines present
- ✓ There is heavy equipment or machinery within two feet of the pit's edge
- ✓ Heavy machinery is creating vibration near the pit. Wait until all equipment is finished running before entering pit.
- ✓ Any loose rocks or other hazards are visible
- ✓ It looks unsafe.

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**DPH** \* **Promptly backfill test pits after site evaluation is complete**


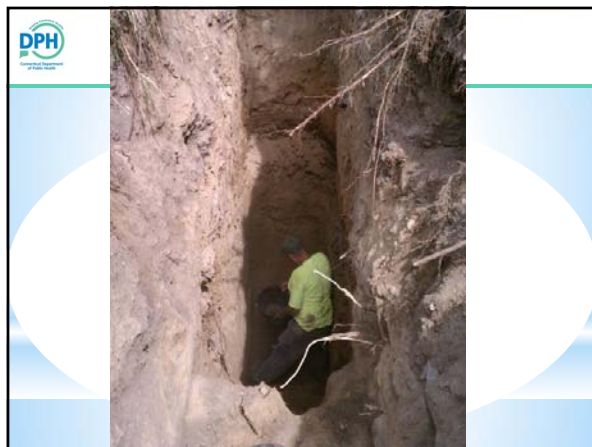
Open test pits can pose dangers

- \* Children Playing
- \* Pets
- \* Other workers on site

In addition, test pits may provide breeding grounds for mosquitoes when they contain standing water for long periods of time.

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What's wrong with this picture?



## Trenching and Excavation Resources

- \*MMWR Occupational Fatalities During Trenching and Excavation Work United States, 1992 - 2001.  
<http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5315a2.htm>
- \*Trenching and Excavation OSHA Standards  
<http://www.osha.gov/SLTC/trenchingexcavation/standards.html>
- \*OSHA Construction e-Tool; Trenching and Excavation  
<http://www.osha.gov/SLTC/etools/construction/trenching/mainpage.html>