

## Module 2: Evaluating Environmental and Health Risks

Estimated time: 2 – 3 hours

**Environmental Health and Land Reuse Certificate**  
**Module 2:**  
**Evaluating Environmental and Health Risks**

Agency for Toxic Substances and Disease Registry  
(Created in 2020)

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**Evaluating Environmental and Health Risks:**  
**Objectives**

- ❑ **Definitions**
  - Describe the basics of toxicology.
  - Describe the basics of epidemiology.
- ❑ **Best practices**
  - Describe Phase I and II environmental site assessments.
  - Describe the tiered approach to cleanup.
- ❑ **Evaluating the risk**
  - Describe 4 key steps in risk assessment.
  - Describe the ATSDR Public Health Assessment process.
- ❑ **Tools**

### Objectives

- Definitions helpful in connecting how Environmental Health is related to Land Reuse
  - Toxicology
  - Epidemiology
- Best practices for environmental site assessments and cleanup
  - Describe Phase I and Phase II environmental site assessments
  - Describe the tiered approach to cleanup
- Evaluate the risk
  - Describe the 4 key steps in Risk Assessment
  - Describe the ATSDR Public Health Assessment Process and how it is different from Risk Assessment

## Evaluating Environmental and Health Risks: Test Details

- ❑ Pre-test
- ❑ Post-test: 70% or higher to receive a certificate

### Create a 4-digit number to put on your pre-test and post-test

- Memorize the number or keep a written copy
- Use the same number on both the pre- and post-test



An ATSDR Regional Representative taking a test. ATSDR, 2019.

Some housekeeping. Everyone write down a 4-digit number that you can remember. You will use this number as your identifier on the pre- and post-test.

## Evaluating Environmental and Health Risks: Pre-test Module 2

- ❑ Pre-test Module 2
- ❑ Put your memorized 4-digit number on the top right-hand corner of your pre-test



Image of an environmental professional working in the field.  
[https://www.atsdr.cdc.gov/sites/brownfields/pdfs/Brownfields\\_Toolkit\\_Environmental\\_Professional-2016.pdf](https://www.atsdr.cdc.gov/sites/brownfields/pdfs/Brownfields_Toolkit_Environmental_Professional-2016.pdf)

Distribute pre-test. Collect all pre-tests when finished.


## Toxicology DEFINITIONS

If a land reuse site is being evaluated for contamination, you may work with environmental engineers/scientists, toxicologists, health assessors, planners, epidemiologists, and other environmental or health professionals.



Environmental or health professionals can use a basic understanding of toxicology to enhance their understanding of community concerns about potential exposures to contaminants. This knowledge can further guide understanding of environmental and health assessments related to contaminated or potentially contaminated sites. **Toxicology** is the study of the harmful effects of substances on humans or animals. The word “**toxicity**” describes the degree to which a substance is poisonous or can cause injury.

### Toxicity




**Toxicity** depends on:

- Dose
- Duration
- Route of Exposure
- Substance Shape and Structure
- Individual human factors
- **Health status**
- **Sex**
- **Genetics**


The word “**toxicity**” describes the degree to which a substance is poisonous or can cause injury. Toxicity depends on a variety of factors:

- Dose
- Duration
- Route of exposure
- Shape and Structure of the substance itself (the three-dimensional shape of a molecule)
- Individual human factors such as differences in health status, sex, genetics (and sensitivity)

### Dose and Duration



Dose



- Dose** – Amount of substance that enters the body; amount of substance per body weight (mg/kg)
- Duration** – Amount of time you are exposed to a substance

The **dose** is the amount of a substance that enters the body. It is often measured as a fraction of milligrams (or micrograms) per body weight in kilograms. The time that a person is exposed to a substance is often given as dose per day (e.g. amount/weight per measure of time). In general, the higher the dose or longer the time someone is exposed, the greater the probability that a health effect will occur. For example, one cigarette at one time will have minimal effect on your body. If you smoke one cigarette every hour for 30 years, then you could have a serious health effect such as decreases in lung function.


### Dose-Response

**Dose-response**

- Relationship between exposure and health effects


**Varies by:**

- pollutant
- individual sensitivity
- type of health effect



**“The dose makes the poison.”**

**Dose-response** is a relationship between exposure and health effects that can be established by measuring the effect (response) relative to an increasing dose. Usually the larger the dose (amount/weight), the greater the effect (response). Even substances we use all the time, like salt, can be a poison if the dose is high enough. This is the meaning behind the statement “the dose makes the poison.” This dose-response relationship varies with pollutant, individual sensitivity, and type of health effect.

 **Safe Level of Exposure**

**NOAEL:**

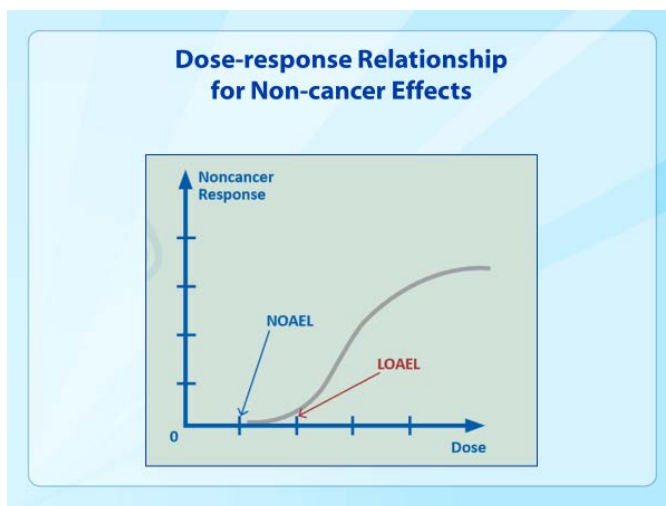
- The “**no observed adverse effect level**” (NOAEL)
- The dose below which harmful (adverse) effects are not seen.

**LOAEL:**

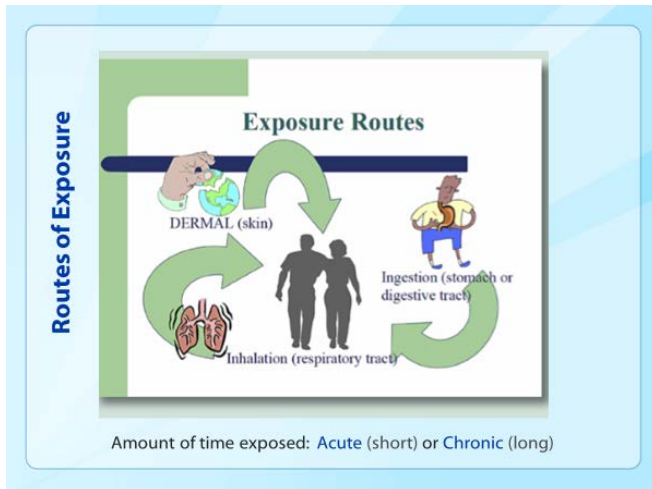
- The “**lowest observed adverse effect level**” (LOAEL)
- The lowest tested dose reported to cause harmful (adverse) effects.

*Carcinogens (substances that cause cancer) are assessed differently from non-carcinogens. While carcinogens are considered to have no safe level of exposure, they may have different cancer outcomes and levels of risk.*

The **no observed adverse effect level** (NOAEL) is the dose below which the harmful (adverse) effects of a substance are not seen in a population. The **lowest observed adverse effect level** (LOAEL) is the lowest tested dose of a substance that has been reported to cause adverse health effects. However, substances that can cause **cancer (carcinogens)**, are assessed differently than non-carcinogens. Carcinogens have no safe level of exposure because any exposure could result in cancer. That said, some carcinogenic contaminants can be removed from sites and thus pose minimal risk.



This is an example of a dose-response relationship for non-cancer health effects. The NOAEL is... the **no observed adverse effect level** (NOAEL) is the dose below which the harmful (adverse) effects of a substance are not seen in a population. The LOAEL is... the **lowest observed adverse effect level** (LOAEL) - is the lowest tested dose of a substance that has been reported to cause adverse health effects. The grey squiggle line shows the dose-response relationship.




**Environmental exposures** are often divided into two categories based on the amount of time exposed:

- Acute exposure is short-term (e.g., 24 hours)
- Chronic exposure is long-term (e.g., weeks, months, or years)

Routes of Exposure to substances occurs through three major routes:

- Ingestion (eating)
- Inhalation (breathing)
- Dermal (skin) contact

For example, when a person gardens, they have dermal contact with the dirt and substances in the dirt. If the substances stick to their skin, they will be exposed for the entire time they are gardening until they wash their hands and remove anything they have touched. They also may inadvertently inhale or ingest substances on their hands or under their fingernails. They should be careful to not eat until they have washed their hands. A person can lower their chance of dermal exposure by wearing gloves.



**Other Toxicology Resources**

- ATSDR Environmental Health Self Learning Module – Toxicology (<https://www.atsdr.cdc.gov/sites/brownfields/pdfs/toxicology-508.pdf>)
- ToxLearn: A Gateway to Toxicology (<https://toxlearn.nlm.nih.gov/Module1.htm>)
- Tox Tutor (<https://toxtutor.nlm.nih.gov/>)

- ATSDR Environmental Health Module – Toxicology ([www.atsdr.cdc.gov/sites/brownfields/pdfs/toxicology-508.pdf](http://www.atsdr.cdc.gov/sites/brownfields/pdfs/toxicology-508.pdf))
- ToxLearn: A Gateway to Toxicology (<https://toxlearn.nlm.nih.gov/Module1.htm>)
- Tox Tutor (<https://toxtutor.nlm.nih.gov/>)

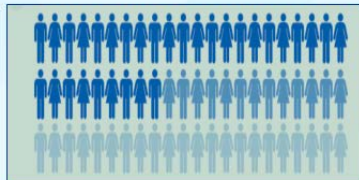
### Knowledge Check #1



Understanding the harmful effects of substances on humans or animals is important to land reuse and redevelopment because:

- The level of exposure to certain substances could determine whether a site is safe for reuse or not.
- Toxicology information should be withheld from the public.
- The chances of humans or animals being exposed to toxic substances on land reuse sites are so small.
- The media does not care about reporting this information.

**KC #1 Answer: a) The level of exposure to certain substances could determine whether a site is safe for reuse or not.**



### Epidemiology DEFINITIONS


Let's look at epidemiology and see how it is related to land reuse.



**Epidemiology**

**Epidemiology tries to determine:**

- Causes of illness in a population
- Causes of wellness in a population



**Epidemiology** is the study of the distribution and determinants of disease or health status in a population. Also, it is the study of the occurrence and causes of health effects in humans.


Stated simply, epidemiology tries to determine two things:

- a) Causes of illness in a population
- b) Causes of wellness in a population

**Environmental Epidemiology**

**Environmental Epidemiology:**

- Determines detailed disease information related to specific toxicant exposure.
- Evaluates environmental and health risks associated with contaminated sites.
- Determines if a local disease cluster is related to toxicant exposure.



**Environmental epidemiology** is concerned with environmental conditions or hazards that may pose a health risk to populations. For example, epidemiologists may investigate a cancer cluster in a particular community, or question whether people with a particular disease have higher levels of exposure than people without the disease.

Environmental Epidemiology:

- Determines detailed disease information related to specific toxicant exposure.
- Evaluates of environmental and health risks associated with contaminated sites.
- Determine if a local disease cluster is related to toxicant exposure.




Local health departments may receive calls from concerned residents when brownfields or land reuse sites lay idle or when redevelopment begins. People are often concerned about exposures to suspected contamination at these sites. Commonly, people worry about increased cancers and lead poisoning. A basic understanding of epidemiology and available resources may be useful to address community concerns and alleviate fears.

### Incidence vs Prevalence

- **Incidence rate**
  - Number of people **newly** diagnosed
  - Particular disease
  - Specific time period
- **Prevalence rate**
  - Number of people **who have the** particular disease
  - Defined point in time

$$\text{Incidence} = \frac{\text{\# of new cases}}{\text{Population at Risk}}$$


$$\text{Prevalence} = \frac{\text{\# of existing cases}}{\text{Population at Risk}}$$



The **incidence rate** quantifies how many people have been **newly** diagnosed during a specific time period. Incidence reflects the number of new cases in a certain period of time (e.g., the number of new HIV cases in 2015).

The **prevalence rate** quantifies the number of people who have a particular disease at a **defined point in time** (Gordis, 2009). Prevalence rate is the number of people who have the disease at a specified time (e.g., the number of people currently living with HIV/AIDS out of the total population).

### Knowledge Check #2



**Choose all that apply:**

Epidemiology can provide useful information to an environmental or health professional who is responsible for communicating with concerned citizens:

- a) Detailed disease information related to specific toxicant exposure.
- b) Evaluation of environmental and health risks associated with contaminated sites.
- c) Studies related to local disease clusters.
- d) Information on their neighbors' health status.

**KC #2 Answer: Bullets a), b), and c)**

**Detailed disease information related to specific toxicants exposure.**  
**Evaluation of environmental and health risks associated with contaminated sites.**  
**Studies related to local disease clusters.**

## Other Epidemiology Resources

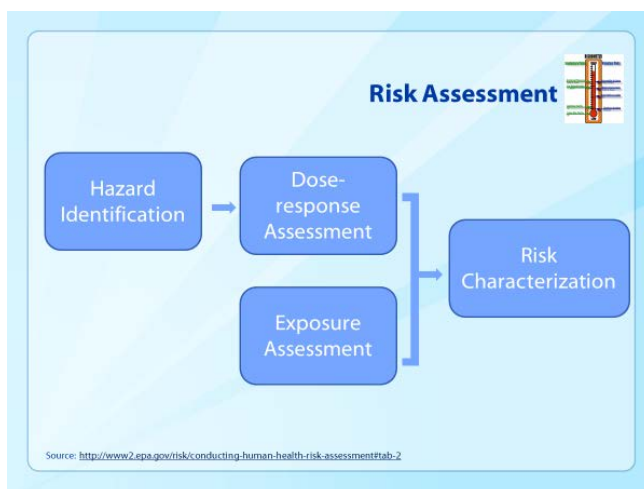
- ❑ ATSDR Environmental Health Self Learning Module – Epidemiology (<https://www.atsdr.cdc.gov/sites/brownfields/pdfs/epidemiology-508.pdf>)
- ❑ CDC's Principles of Epidemiology in Public Health Practice, 3<sup>rd</sup> Ed., An Introduction to Applied Epidemiology and Biostatistics (<https://www.cdc.gov/csels/dsepd/ss1978/>)
- ❑ Solve the Outbreak (<https://www.cdc.gov/mobile/applications/sto/web-app.html>)



Image of Improperly stored drums. Lloyd Degrane, 2019.

## Risk Assessment DEFINITIONS

Assessing risks of exposure to contamination is a big part of how we determine how dangerous a land reuse site may be.



**Risk** is defined as the possibility that something will cause harm. **Risk assessment** (baseline) is an analysis of the potential adverse health effects (current or future) caused by hazardous substance

releases from a site in the absence of any actions to control or mitigate these releases (i.e., under an assumption of no action).

The basic elements of risk assessment are:

- Hazard identification
- Dose-response assessment
- Exposure assessment
- Risk characterization



### Hazard Identification

- What is the hazard?
- What health problems are caused by the pollutant?
- Are any adverse health outcomes associated with the contaminant?



### Dose-Response Assessment:

What are the health problems at different exposures? Remember: increasing dose may be more harmful.

**Risk Assessment** 

Exposure Assessment

- How much of the pollutant are people exposed to during a specific event?
- How many people are exposed?

**Risk Assessment:**

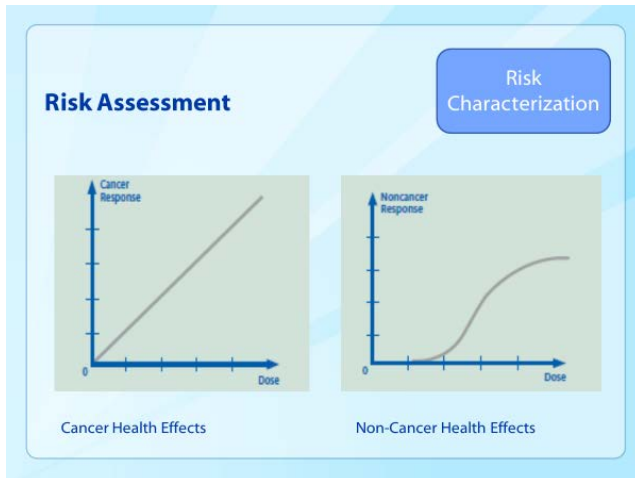
How much of the pollutant are people exposed to during a specific time period?

 **Risk Assessment**

What is the extra risk of health problems in the exposed population?

Risk Characterization

**Risk characterization:** What is the extra risk of health problems in the exposed population? It involves reviewing outputs from dose-response assessment and exposure assessments. What are the health problems from exposure? What is the impact? Quantifying the overall risks from individual and multiple chemicals. Consider the toxicity of each chemical and as a group. What are the cancerous and noncancerous health risks?



The health risks associated with cancer causing chemicals are evaluated differently than the health risks of non-cancer-causing chemicals. For **cancer** causing chemicals, the EPA assumes there is no dose of exposure that is considered safe, or without risk. Even a very low exposure to the chemical can increase the risk of cancer. The straight dose-response line assumes that for each unit increase in exposure (dose), there is an increase in cancer risk.

For **non-cancer**-causing chemicals, or the non-cancer effects of chemicals, there is a “no observable adverse effect level” (NOAEL) at which a person can be exposed to the chemical and experience no effects. At very low doses, the body can repair damage caused by the chemical. However, the dose at which there is an effect varies depending on the chemical, the individual, and the type of health effect.

**Other Risk Assessment Resources**

- ATSDR Environmental Health Self Learning Module – Risk Assessment ([https://www.atsdr.cdc.gov/sites/brownfields/pdfs/risk\\_assessment-508.pdf](https://www.atsdr.cdc.gov/sites/brownfields/pdfs/risk_assessment-508.pdf))
- EPA’s Risk Assessment Website (<https://www.epa.gov/risk>)
- EPA’s Integrated Risk Information System (IRIS) (<https://www.epa.gov/iris>)
- Risk Assessment Information System (RAIS) (<https://rais.ornl.gov/>)

[ATSDR Environmental Health Self Learning Module – Risk Assessment](#)

[EPA’s Risk Assessment Website](#)

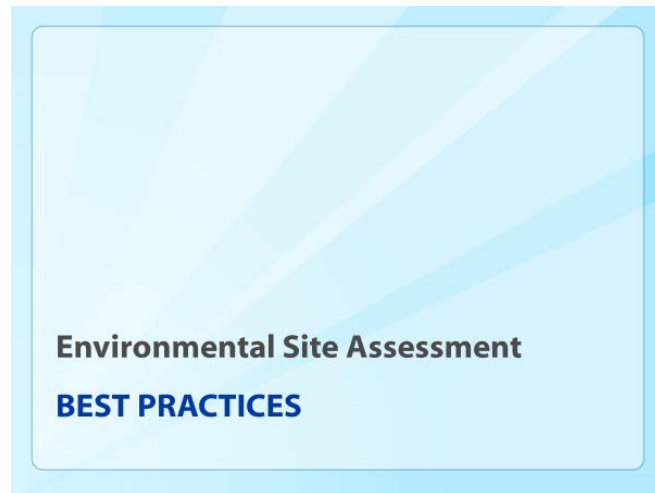
On EPA’s [risk assessment website](#) you can learn the basics about environmental risk assessments for the public. Additionally, this website also provides links to current EPA tools, as well as EPA guidance and guidelines.

[Integrated Risk Information System \(IRIS\)](#)

EPA's [IRIS](#) is a human health assessment program which explores the potential health effects of exposures to environmental contaminants, to support regulatory activities. Currently, the IRIS database contains information on over 550 chemicals.

### Risk Assessment Information System (RAIS)

The [RAIS](#) is a website that provides risk tools and information to conduct human health and ecological risk assessments. Included on this website are also several trainings including "What is Risk Assessment?," and the RAIS Main Tutorial. Additionally, there is a Powerpoint presentation available under "Training Coursework Powerpoint Presentation" which details how the RAIS website can be used effectively to conduct a risk assessment.



Before the redevelopment of land reuse sites, an **environmental site assessment (ESA)** is conducted to understand the potential for contamination. An environmental or health professional may already have experience with conducting an ESA. In addition, an environmental or health professional may need to determine the health risks associated with exposure to potential contamination to protect the health of people who live near to or who access the site. This could include identifying a release or threatened release of hazardous materials into structures on the property, into air, or into soil and groundwater or surface water on or near the property.

A presentation slide with a light blue background. The title "Environmental Site Assessments (ESA)" is in bold blue font. Below the title are two sections: "Phase I ESA" and "Phase II ESA", each with a list of bullet points. To the right of the text is a vertical photograph showing a person in an orange safety vest and blue pants working in a muddy area, possibly a construction site. The photo has a small caption at the top: "Conducting site assessment. Source: Getty Images, 2017."

**Environmental Site Assessments (ESA)**

- ☐ Phase I ESA
  - "Due Diligence"
  - "All appropriate inquiry"
  - Identifies potential environmental concerns
- ☐ Phase II ESA
  - Identifies actual contaminants
  - Sampling
  - Laboratory testing

The two primary phases of the ESA process are designed to increase the level of understanding of the site condition.

- ESA Phase I is sometimes referred to as “due diligence” or “all appropriate inquiry.” It identifies potential environmental concerns.
- ESA Phase II identifies actual contaminants through laboratory testing of soil, water, and air samples.

The Environmental Protection Agency (EPA) has established standards for conducting “all appropriate inquiry” – the requirements for assessing the environmental conditions of a property prior to its acquisition. An EPA fact sheet entitled, “All Appropriate Inquiry” is included in the Additional Resources section of this module. For properties purchased after May 31, 1997, the law requires the use of procedures developed by the ASTM, as they meet the “all appropriate inquiry” requirement for site characterizations and assessments.

**Phase 1 Environmental Site Assessment (ESA)**

□ **Phase I ESA**

- Records searches
  - Sanborn Fire Insurance maps
  - USGS topographical
  - Street directories
- Interviews
  - Owners
  - Tenants
  - Regulators
  - Health departments
- Site visit



Environmental Professionals engaged in a Phase I ESA. Lloyd DeGrane, 2019.

The EPA guidelines and standards for acquiring and assessing brownfields properties also provide property owners with a liability defense against the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as “Superfund.”

The EPA requires that only **licensed environmental professionals** conduct Phase I and Phase II ESAs following ASTM International Standards ASTM E1527-13 and ASTM 1903-11, respectively. Because ASTM E1527-13 does not address asbestos, lead paint, or controlled substances, assessment of these additional contaminants needs to be identified in the initial scope of work.

During the due diligence process, the property is evaluated to identify potential environmental contamination. The property is also assessed for potential liability for any contamination present at the property. As part of due diligence, a Phase I ESA identifies potential environmental concerns. It establishes historical and current uses of the site, as well as activities at the site and surrounding area.

The Phase I ESA typically includes the following:

- Records searches
- Interviews with property owners
- Site visit



1. Historical and Environmental Records and Documentation Review:

- Geology & hydrogeology review, such as photographs, building permits, Sanborn Fire Insurance Maps, and USGS topographical maps

2. Historical Research:

- Historical aerial photographs
- Street directories
- Building permits
- Planning Department records
- USGS topographical maps
- Sanborn Fire Insurance maps
- Department of Oil and Gas maps
- Title information

3. Regulatory Records Review:

- Review federal, state, local, and tribal records regarding the subject property and/or neighboring sites

4. Site Visit:

- View present conditions and assess potential environmentally hazardous site history
- Inspect site along with experienced and knowledgeable inspector
- Document presence of hazardous materials or petroleum products

5. Interviews:

- Past owners
- Current tenants and owners
- State and local regulators
- Site managers
- Neighbors

6. Reporting:

- Review any reports you are provided
- Complete professional report, which offers conclusions and recommendations regarding the property based on judgment and findings of the environmental professional.

If required, a Phase II ESA may be conducted to sample or test for specific hazards that may have been identified in the Phase I ESA. The Phase II ESA evaluates recognized environmental concerns identified during the Phase I ESA and evaluates whether there has been a release of a hazardous substance at the site.

The American Society for Testing and Materials (ASTM) International is a worldwide standards organization, which has strict guidelines for both ESA I and II. Phase II of the ESA can be very technical, but there are plenty of environmental and health resources available. Besides the aforementioned

ATSDR and EPA, there are [state, tribal, and even local environmental and health agencies](#) that can also provide support.

**Site Visit: Recognized Environmental Conditions (RECs)**

- ❑ **During the site visit, note RECs**
  - E.g. oily spill
  - Possible PCB containing material
  - Possible lead based paint or asbestos
  - Odor
  - Drums
  - Other waste



Brownfields sites that may have recognized environmental conditions. Lloyd DeGrane, 2019.

**Phase II Environmental Site Assessment (ESA)**

- ❑ **Phase II ESA**
  - Sample/test for specific hazards identified in Phase I ESA
  - Evaluate environmental concerns
  - Evaluates if there was a hazardous substance release
- ❑ **Phase II ESA components**
  - Statement of Objectives
  - Conceptual Model (hypothesis of how contamination came and migrated)
  - Written Report (sampling plan, monitoring well tests, etc.)



If the first phase of an ESA indicates possible contamination from hazardous materials, a second phase may be necessary. Phase II is not required to satisfy the AAI. However, Phase I provides an introductory framework for evaluating a site's potential environmental contaminants, while Phase II provides a more complete understanding of the contamination that may be present on the site.

- ❑ Phase II ESA
  - Sample/test for specific hazards identified in Phase I ESA
  - Evaluate environmental concerns
  - Evaluates if there was a hazardous substance release

If a Phase II is necessary, the following requirements must be met before taking action:

#### Statement of Objectives

In order to minimize confusion of the scope of an ESA II, the goals of the assessment must be agreed upon by both the owner of a subject property and the certified environmental or health professional.

## Conceptual Model

The Conceptual Model is a key component of a site assessment performed using the scientific method. It requires the certified environmental or health professional to **hypothesize how “target analytes (a substance whose chemical constituents are being identified and measured) would have been released and migrated to the soil or groundwater.”** This process guarantees that the evaluation activities are appropriately performed. It also provides assurance that, if a substance is not detected, then it can be concluded that it is most likely not present.

## Written Report

Since the new Phase II standards are restructured to more closely reflect the scientific method, ASTM now requires a written report to detail the findings of the assessment in relation to the Statement of Objectives.

The ultimate goal of a Phase II ESA is to determine if environmental cleanup of the property will be necessary.

If cleanup is not necessary or already completed, many states will issue a “No Further Remediation Letter” to remediation applicants who have demonstrated, through proper investigation (e.g., Phase I and Phase II ESAs) and any necessary remedial action, that all environmental conditions at their site no longer present a significant risk to human health and the environment.

A light blue rectangular slide with a white border. The title "Knowledge Check #3" is centered at the top in bold blue text. Below the title, the question "Phase I ESA includes sampling soil and water on the site and testing the samples for contaminants." is written in bold black text. Underneath the question, two multiple-choice options are listed: "a) True" and "b) False", both in black text.

**Knowledge Check #3**

**Phase I ESA includes sampling soil and water on the site and testing the samples for contaminants.**

a) True  
b) False

**KC #3 Answer: b) False.** Phase 1 activities do not involve sampling.

### Knowledge Check #4

**Select all that apply:**

Phase I ESA typically includes the following (choose all that apply):

- a) Subsurface soil testing
- b) Records searches
- c) Site visit
- d) Contamination evaluation
- e) Underground storage tank (UST) sampling
- f) Interviews

**KC #4 Answer:** b), c), and f) are correct.

### Knowledge Check #5

**Select the best answer:**

In a Phase II ESA, the conceptual model is

- a) The same as a sampling plan
- b) The goals for the assessment
- c) The hypothesis for how target analytes may have arrived at and migrated through a site
- d) The explanation of findings from the assessment

**KC #5 Answer:** c). The Conceptual Model is the hypothesis...

### Phase 1 and Phase 2 ESA Activities

- Recognized Environmental Conditions – Dave Laney**



Environmental Professional discussing potential site contaminants. Lloyd DeGrane, 2014.

We will include some photographs of recognized environmental conditions (RECs). There will be some RECs placed throughout the room. Please make notes of these and be prepared to report out.

### Phase 1 and Phase 2 ESA

- ❑ There are piles of paper squares at your tables
- ❑ Sort the paper squares into Phase 1 ESA or Phase 2 ESA
- ❑ We will come and check to see how you are doing
- ❑ Be prepared to explain your answers



Students learning the importance of environmental site assessment. Lloyd DeGrane, 2014.

NOTE: cut your “ESA Game” into squares. We will play an interactive game. Squares of paper represent either Phase 1 ESA or Phase 2 ESA activities. Participants will sort the squares into the appropriate category of Phase 1 or Phase 2 ESA.

### Tiered Approach to Cleanup BEST PRACTICES

With support from the Comprehensive Environmental Response, Compensation, and Liability Act, also known as Superfund, CERCLA 128 (a) funding (i.e., funding to states, tribes, and territories from US EPA), state brownfields programs oversee assessment and cleanup activities at the majority of funded brownfields properties across the country. The Michigan Department of Environmental Quality provides a useful example of the tiered approach to clean up in Risk Based Corrective Action (RBCA).

#### Risk Based Corrective Action helps you to:

- Categorize sites according to risk
- Allocate resources for maximum protection of human health and the environment
- Provide appropriate level of oversight
- Move all sites forward quickly

## You can use RBCA to:

- Identify exposure pathways and receptors at a site
- Determine the level and urgency of response required at a site
- Determine the level of oversight appropriate for a site
- Incorporate risk analysis into all phases of the corrective action process
- Select appropriate and cost-effective corrective action measures

(Source: [https://www.michigan.gov/egle/0,9429,7-135-3311\\_4109\\_4215-17592--,00.html](https://www.michigan.gov/egle/0,9429,7-135-3311_4109_4215-17592--,00.html))



**Tier 1** consists of a **qualitative risk-assessment** based on general site assessment information. At this stage, data identifies obvious environmental impacts:

- Sensitive receptors (e.g., schools, homes, water bodies)
- Significant exposure pathways (e.g., drinking water wells, vapor transport, other)

**Tier 2** uses **more site-specific data to determine the appropriate risk-based actions**, including:

- Characterization and monitoring
- Projections of expected levels of contamination after treatment
- Potential plume migration
- Reasonable maximum exposure scenarios

**Tier 3 focuses completely on the site-specific conditions, such as fate and transport phenomena** as well as descriptions of the range of possible exposures and risks. Site-specific risk assessment models may also be developed. Due to the costs involved, this analysis is suited to only large sites.

The goal of all tiers in the tiered approach to cleanup is to achieve similar levels of protection. The difference is that, in moving to higher tiers, more efficient and cost-effective corrective action results because the conservative assumptions of earlier tiers are replaced with more realistic site-specific assumptions.

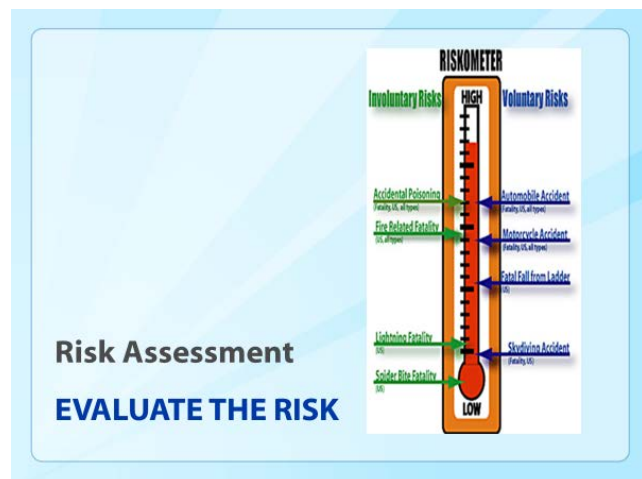
(Source: [https://www.michigan.gov/egle/0,9429,7-135-3311\\_4109\\_4215-17592--,00.html](https://www.michigan.gov/egle/0,9429,7-135-3311_4109_4215-17592--,00.html))

### Knowledge Check #6

The goal of all tiers in the **tiered approach** to cleanup is to achieve similar levels of protection. However, when moving to higher tiers, the assumptions of earlier tiers are replaced with more realistic site-specific assumptions resulting in more efficient and cost-effective actions

- a) True
- b) False

KC Answer: a) True



If a land reuse site has been evaluated for contamination, either through an ESA II or by a state or federal regulatory agency, the community members may have concerns about exposure to contamination. Through the [ATSDR Partnership to Promote Local Efforts to Reduce Environmental](#)



[Exposure](#) (APPLETREE), [ATSDR can fund state and tribal governments or organizations to conduct these activities at land reuse sites.](#)

As part of the public health assessment process, ATSDR and APPLETREE partners investigate and respond to harmful exposures in communities and educate the public on exposure protection. In 2017, for example, ATSDR funded 25 state health agencies. Since 1988, ATSDR and their partners have completed over 2,700 health assessments at land reuse sites across the country, of which 274 were brownfields. ATSDR discovered health hazards at 42% of these brownfield sites.



View the video at this link on your own.

During the health assessment process, either ATSDR or an APPLETREE partner may review environmental data to determine potential adverse health effects on people who may live near or access a land reuse site. Watch the following video ([https://www.atsdr.cdc.gov/videos/health\\_assessment\\_process.htm](https://www.atsdr.cdc.gov/videos/health_assessment_process.htm)) to understand how the health assessment process might work in a community.

**ATSDR and APPLETREE Partners:**

- ❑ **Identify** exposure pathways at specific sites
- ❑ **Evaluate** environmental and health data to identify potential health risks
- ❑ **Recommend** ways to prevent exposures
- ❑ **Educate** affected communities and local health professionals about site contamination and potential health effects

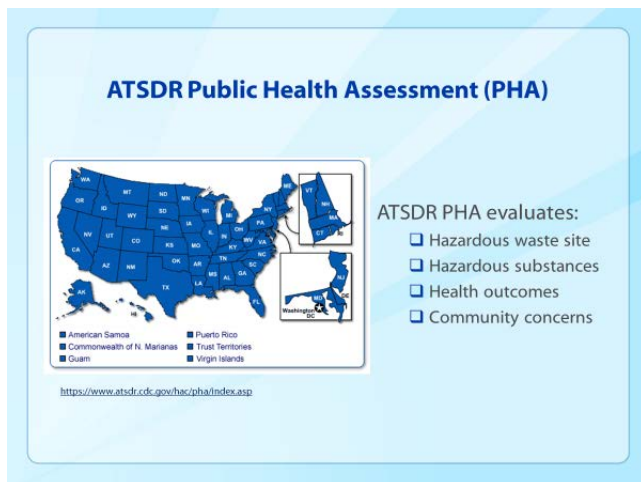
A small image showing a person in an orange protective suit and mask working at a site. A text box next to the image reads: "ATSDR and partners have completed over 2,700 health assessments at land reuse sites across the country, of which 274 were brownfields. ATSDR discovered health hazards at 42% of these brownfield sites."

ATSDR assesses and responds to site-specific issues involving exposure to hazardous substances in the environment. Through the cooperative agreement program, *ATSDR's Partnership to Promote Local*

*Efforts to Reduce Environmental Exposure (APPLETREE)*, ATSDR gives states resources and guidance to do this work as well.

ATSDR and our APPLETREE partners:

- Identify exposure pathways at specific sites
- Evaluate environmental and health data to identify potential health risks
- Recommend ways to prevent exposures
- Educate affected communities and local health professionals about site contamination and potential health effects



ATSDR incorporates elements of risk assessment into its public health assessment (PHA) process. Since 1986, ATSDR has been required by law to conduct a PHA at each of the sites on the [EPA National Priorities List](#). The aim of these evaluations is to find out if people are being exposed to hazardous substances and, if so, whether that exposure is harmful and should be stopped or reduced. ATSDR Public Health Assessments/Consultations are available online on our website (link on slide).

ATSDR PHA evaluates:

- Hazardous waste site
- Hazardous substances
- Health outcomes
- Community concerns



### ATSDR Petition Program

**Petition ATSDR to investigate:**

- Whether there are chemicals in your community
- If those chemicals could get into your body
- If they could affect your health


<https://www.atsdr.cdc.gov/hac/petitionatsdrdchi.html>

Residents, agencies, and others can petition ATSDR for a Public Health Assessment/Consultation to investigate

- 1) whether there are chemicals in your community,
- 2) if those chemicals could get into your body, and
- 3) if they could affect your health.

ATSDR can't

- change how a facility operates,
- clean up chemicals in your community,
- make medical diagnoses,
- tell you why there is a lot of illness in your community,
- make health conclusions without environmental data,
- change zoning codes, or
- make another organization treat you with fairness and respect.



### ATSDR Health Assessor Training

**ATSDR health assessor training topics:**

- Mission and Community
- Exposure Pathways and Toxicological Evaluation
- Evaluation of Health Data and Development of Conclusions and Recommendations

<https://www.atsdr.cdc.gov/training/public-health-assessment-overview/html/>

Environmental and health professionals in state or local health agencies may participate in the ATSDR's Public Health Assessment (PHA) program. ATSDR has created training for health assessors that may be useful for environmental or health professionals in routine site assessment.

The [Health Assessors Training](#) is divided into three modules:

Mission and Community

Exposure Pathways and Toxicologic Evaluation

Evaluating Health Effects Data and Determining Conclusions and Recommendations

Each section provides detailed step by step guidance through the topic area.

<b>Risk Assessment</b>	<b>Public Health Assessment</b>
Extent of contamination	Identify possible harmful exposures
Numeric estimate of risk without cleanup	Numeric estimate of risk
Current and potential future exposures	Past, current, and potential future exposure assessment
All contaminated media regardless of exposure	Toxicological assessment specific to community
Standard protective exposure assumptions	Review community health concerns
	Review of health outcome data
	Recommendations to reduce or prevent exposures

*The quantitative risk assessment* is used by regulators as part of site remedial investigations to determine the extent to which site remedial action (e.g., cleanup) is needed. The risk assessment provides a numeric estimate of theoretical risk or hazard, assuming no cleanup takes place. It focuses on current and potential future exposures and considers all contaminated media regardless if exposures are occurring or are likely to occur. By design, it generally uses standard (default) protective exposure assumptions when evaluating site risk.

**Risk Assessment:**

- Extent of contamination
- Numeric estimate of risk without cleanup
- Current and potential future exposures
- All contaminated media regardless of exposure
- Standard protective exposure assumptions

*The public health assessment* is used by ATSDR to identify possible harmful exposures and to recommend actions needed to protect public health. ATSDR considers the same environmental data as EPA, but focuses more closely on site-specific exposure conditions, specific community health concerns, and any available health outcome data to provide a more qualitative, less theoretical evaluation of

possible public health hazards. It considers past exposures in addition to current and potential future exposures.

#### Public Health Assessment:

- Identify possible harmful exposures
- Numeric estimate of risk
- Past, current, and potential future exposure assessment
- Toxicologic assessment specific to community
- Review community health concerns
- Review of health outcome data
- Recommendations to reduce or prevent exposures

The general steps in the two processes are similar (e.g., data gathering, exposure assessment, toxicologic evaluation), but the public health assessment provides additional public health perspective by integrating site-specific exposure conditions with health effects data and specific community health concerns. ATSDR's public health assessment also evaluates health outcome data, when available, to identify whether rates of disease or death are elevated in a site community, especially if the community expresses concern about a particular outcome (e.g., cancer).

Remedial plans based on a quantitative risk assessment represent a prudent public health approach— that of prevention. By design, however, quantitative risk assessments used for regulatory purposes do not provide perspective on what the risk estimates mean in the context of the site community. The public health assessment does. The process is more exposure driven. The process identifies and explains whether exposures are truly likely to be harmful under site-specific conditions and recommends actions to reduce or prevent such exposures.

**Knowledge Check #7**

A public health assessment (PHA) evaluates a hazardous waste site for hazardous substances, health outcomes, and community concerns.

- a) True
- b) False

**KC #7 Answer: a) True**

### Brownfields/Land Reuse Sites: Case Examples

- ❑ **Guest lecturers** can talk about some of their sites
- ❑ **Video examples** can be inserted (if available)

This slide can be used by guest lecturers to talk about some of their sites and experiences.

### Tools and Resources

- ❑ **ATSDR Brownfield and Land Reuse Site Tool**
  - ([https://www.atsdr.cdc.gov/sites/brownfields/site\\_inventory.html](https://www.atsdr.cdc.gov/sites/brownfields/site_inventory.html))
- ❑ **ATSDR Toxicological Profiles and ToxFAQs**
  - (<https://www.atsdr.cdc.gov/substances/index.asp>)
- ❑ **ATSDR Action Model**
  - (<https://www.atsdr.cdc.gov/sites/brownfields/model.html>)
- ❑ **Health Impact Assessment**
  - (<https://www.cdc.gov/healthyplaces/hia.htm>)
- ❑ **PACE EH**

There are a variety of useful tools and resources available to inform and assist your Environmental Site Assessments and Public Health Assessments.

ATSDR Brownfield and Land Reuse Site Tool: This Tool is a customizable, searchable site inventory and rapid site screening tool. Analytical sampling data is rapidly screened by the tool to highlight chemicals above comparison values used by ATSDR. This leads to a rapid assessment for site prioritization. The maximum concentration for each chemical and each media is compared against the relevant ATSDR comparison value.

ATSDR's Toxicological Profiles: Toxicological Profiles (Tox Profiles) are a unique compilation of toxicological information on a given hazardous substance. Each peer-reviewed Tox Profile reflects a comprehensive and extensive evaluation, summary, and interpretation of available toxicological and epidemiological information on a substance. ToxFAQs are summaries about hazardous substances and excerpted from the ATSDR Toxicological Profiles. Resources are available by audience: Community members, emergency responders, toxicological and health professionals, and health care providers.

**ATSDR Action Model:** The ATSDR Brownfields /Land Reuse Action Model helps the diverse members of the development community – officials, developers, community supporters, and residents, find ways to

make health part of the renewal process. Communities can use the action model to identify common goals to incorporate these goals in strategic planning.

A **Health Impact Assessment** (HIA) is an evidence-based approach to inform the decision-making of proposed policies, programs, or projects with the goal of maximizing the positive health impacts and minimizing the negative health impacts. This baseline research can help an environmental or health professional decide which aspects of the community's health can be addressed through the redevelopment of toxic sites.

The *Protocol for Assessing Community Excellence in Environmental Health (PACE EH)* was developed by the CDC's National Center for Environmental Health and the National Association for County and City Health Officials (NACCHO) to provide guidelines for local health officials. This methodology guides communities and local health officials in conducting community-centered environmental health assessments by relying on community collaboration to involve stakeholders



There are a variety of useful tools and resources available to inform and assist your Environmental Site Assessments and Public Health Assessments.

**Choose Safe Places for Early Care and Education:** ATSDR and APPLETREE are creating guidance to develop plans and act to protect children from environmental hazards through the safe siting of early care and education facilities.

**Community Mapping Tools**, such as EPA's **EnviroAtlas**: Interactive resources for exploring the benefits people receive from nature or "ecosystem goods and services" and **EJScreen**, a tool that combines environmental and demographic indicators in maps and reports

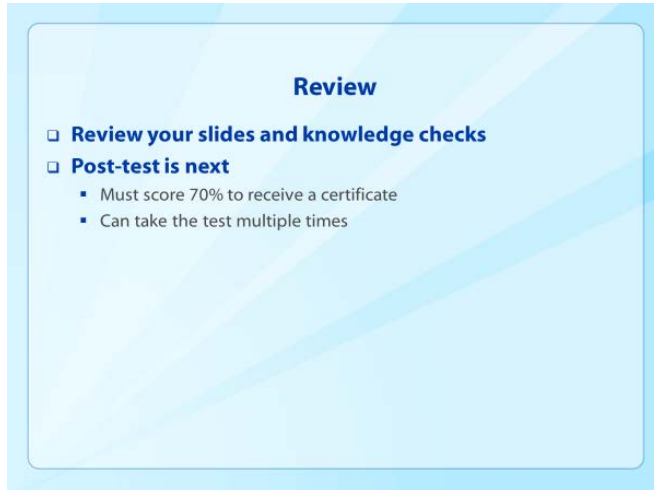
**Community Health Status Indicator:**

**NCEH Tracking Network** has data and information on the environment, exposures, health effects and population characteristics.

**County Health Rankings and Roadmaps** allow nationwide comparison of counties with similar populations based on key demographic, social, and economic indicators



Sources: <https://www.atsdr.cdc.gov/toxprofiledocs/index.html>;  
<https://www.atsdr.cdc.gov/substances/index.asp>;  
[https://www.atsdr.cdc.gov/sites/brownfields/site\\_inventory.html](https://www.atsdr.cdc.gov/sites/brownfields/site_inventory.html)

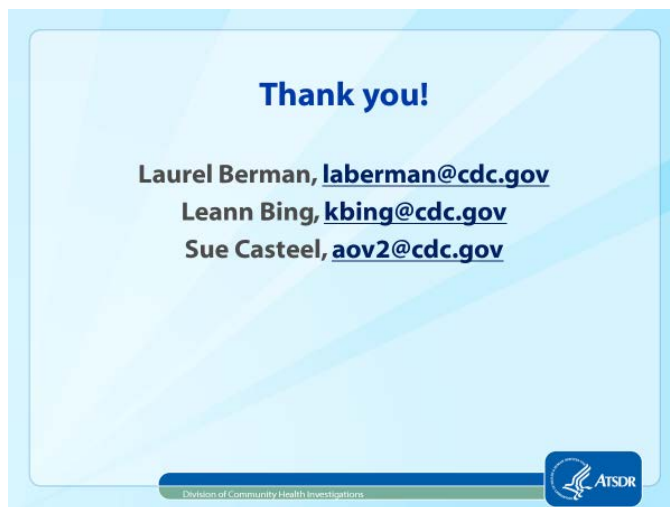


**Review**

- ❑ **Review your slides and knowledge checks**
- ❑ **Post-test is next**
  - Must score 70% to receive a certificate
  - Can take the test multiple times

## Summary

An Environmental or Health Professional can play a pivotal role in land reuse and redevelopment. Their technical expertise can be an asset in explaining the overall site and health assessment processes in plain language. Environmental or Health Professionals can work with the Community Champion and Municipal Agency to ensure that the community understands the site assessment results, or risk associated with contaminants on land reuse sites. In addition, Environmental or Health Professionals can partner with ATSDR and state or local health departments to help translate risks into common language.



**Thank you!**

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Division of Community Health Investigations 