

Source Water Protection Citizen Technical Advisory Committee (CTAC)
Source Water Assessment Plan Update - Subcommittee Meeting

February 20, 2020

Draft Meeting Minutes

Meeting Location: Tidewater Utilities Conference Room

WELCOME & INTRODUCTIONS – Douglas Rambo, P.G., DNREC, Division of Water, Source Water Protection Program

Mr. Rambo called the meeting to order at 10:10 a.m. and welcomed everyone. He asked for introductions around the table. The attendance list is included at the end of the meeting minutes.

REVIEW AND APPROVAL OF THE DECEMBER 12, 2019 DRAFT MEETING MINUTES

Mr. Rambo asked if anyone had any edits to the December draft meeting minutes. No edits were suggested.

The final meeting minutes are posted online at <https://publicmeetings.delaware.gov/Meeting/64203> .

Mr. Rambo spoke of recent updates to the Plan regarding Chapters 3-5. He stated the large update was to Table 3-1 in Chapter 3. He added that Tiers 1-3 have all been separated out. Tier 2, secondary drinking water contaminants and Tier 3, unregulated contaminants. Mr. Rambo said he will be adding more figures into Chapter 4 and there will be a discussion based upon today's presentation on how to use risk assessment for the Tier 3 unregulated contaminants. He added, "I've started putting some text into that section and based upon what we come up with today through discussion, we'll have a better idea of how we're going to proceed with that."

CONTAMINANT RISK EVALUATION APPLIED TO DRINKING WATER – SWAPP PLAN UPDATE-RISK ANALYSIS – Todd Keyser, P.G., DNREC, Division of Waste and Hazardous Substances, Remediation Section

Mr. Keyser introduced himself and stated that his Section implements regulations based upon, basically, Super Fund Law. He said, "It looks at the release of hazardous substances into the environment and the impact of those releases to human health as well as ecological health and then using multiple lines of evidence makes determinations on what should be done to be protective of the both of those." He stated this is a very simplistic way of what their Section does. He continued to discuss on what his recollection of a previous Subcommittee meeting conversation was on how do we bring in risk assessment.

Mr. Keyser presented a Power Point presentation (see attachment titled *SWAPP Plan Update-Risk Analysis*).

As stated in the presentation on the slide titled *What is Risk?*:

- "A hazard, danger or exposure to mischance or peril" – Oxford English Dictionary
- Voluntary – associated with activities we decide to undertake
- Involuntary – associated with an occurrence that happens to us without prior consent

Mr. Keyser gave examples on this definition and said there are risks every day but we can help minimize them. He then discussed the types of risks: voluntary and involuntary.

As stated in the presentation on the slide titled *What is the risk of common activities?:*

- Risk is a part of living
- We make decisions to accept risk every day
- We take precautions to limit the type and level of risk
- We also experience risk imposed upon us

Mr. Keyser discussed examples and said, “We are constantly making decisions about risks. We take the precautions and sometimes we’re not in control of whether or not we can dictate or determine the level of risk we have to accept.”

As stated in the presentation on the slide titled *How are Risks measured?:*

- Statistically verifiable – determined from direct observation, compared to each other
- Statistically Non-verifiable – only involuntary based upon limited data or equations

Mr. Keyser said, “You can measure risk. With involuntary risk, you can statistically verify, you can do the math, as to what that level of risk will be.” He discussed examples. He added, “Part of risk assessment is understanding the potential impact of a very broad world of contaminants. Some are regulated and some are not.”

As stated in the presentation on the slide titled *How is Risk expressed?:*

- Risk is expressed in terms of probability associated with a particular activity.

Actual Number	Scientific Notation	Read As
1/10	1×10^{-1}	One in ten
1/100	1×10^{-2}	One in a hundred
1/1,000	1×10^{-3}	One in a thousand
1/10,000	1×10^{-4}	One in ten thousand
1/100,000	1×10^{-5}	One in a hundred thousand
1/1,000,000	1×10^{-6}	One in a million
1/10,000,000	1×10^{-7}	One in ten million

Mr. Keyser stated, “These are sort of the threshold points. When we do an environmental clean-up, we typically look at 1/100,000 as the threshold not to exceed when we take into account all the things we know about a site, all of the potential exposures.” He continued to discuss the pathway. Mr. Andrew Homsey and Mr. Keyser discussed a cumulative risk assessment.

As stated in the presentation on the slide titled *What are the steps of environmental risk assessment?*:

- **Data Compilation and Evaluation** – gather what you have and sort by media – soil, air, water, sediment, fish tissue
 - Is it replicable and good quality data?
 - Develop a *Conceptual Site Model*
- **Exposure Assessment** – estimates type and magnitude of a pathway (physical)
- **Toxicity Assessment** –
 - Hazard Identification – determines if exposure increases adverse health effects
 - Dose response – the relationship between magnitude and adverse health effects
- **Risk Characterization** – synthesis of all information gathered above to estimate likelihood that a hypothetical exposure may adversely impact human health

Mr. Keyser stated he is a Hydrologist but there are staff within the Remediation Section who are experts in risk assessment and know how to gather the correct data, make the determination about the validity of the data, make sure the data gets into the software the proper way, run the software the proper way, get an output from that software and understand exactly what it's saying and then help everyone else make that decision. He stated, "There are people who are toxicologists, risk assessors, who use these processes on a daily basis to make decisions. So, in order to do this, we have to compile whatever data we have for a certain area of study and ask them questions about it."

Data Compilation and Evaluation - Mr. Keyser stated that each of the media listed above (soil, air, water, sediment, fish tissue) has a different potential exposure unit. He continued to discuss. Mr. Keyser then discussed a Conceptual Site Model and said, "One of the big concepts and things we always try to do is develop a strong Conceptual Site Model. It has to be dynamic." He added that the more data you bring in, the more knowledge you bring in.

Exposure Assessment and Toxicity Assessment – Mr. Keyser said, "Once you've actually collected data, you know what the contaminants are, you know things about the contaminants, you know about how they can potentially enter the body, you know about how much actually needs to be present through an exposure assessment, through a completed pathway, for it to start to have an impact." He continued to discuss.

Risk Characterization – Mr. Keyser said, "We're taking all of these multiple lines of evidence, putting it together and determining whether or not there's actually going to be a risk to human health."

As stated in the presentation on the slide titled *Conceptual Site Model*:

1. All potential or suspected sources of contamination
2. Types and concentrations of contaminants detected at the site
3. Potentially contaminated media
4. Potential exposure routes and pathways
5. Potential receptors

Mr. Keyser said, "Try to have your model as simple as possible. The more things you add into it, the more complex it gets." He continued to discuss.

Mr. Keyser began to discuss the next slide titled *Which contaminants?* This information was pulled from the regulations detailing the meaning of **hazardous substance**. He said, "There are multiple

different ways that a chemical constituent can become a hazardous substance through the hazardous substance clean-up. It's on a list that is part of our standard set of hazardous waste materials." He continued to discuss.

As stated in the presentation on the slide titled *Which contaminants? HSCA Screening Level table*:

- Hazardous Substance Cleanup Act (HSCA) screening level table is primarily based on EPA's Regional Screening Level (RSL) table, which is updated semi-annually
- When EPA added chemicals to the RSL table, then DNREC added those chemicals to HSCA screening level/reporting level tables. Those chemicals became hazardous substances under HSCA.
- EPA does not consider all chemicals on the RSL table to be hazardous substances. They may be "pollutants or contaminants" instead
- RSL are typically lower than maximum contaminant levels (MCL)
This process is currently under review.

Mr. Keyser said, "This is the explanation slide for the regulations that we just looked at and what we're looking at now is something we've identified as a potential concern." He added, "If we use the EPA (RSL) table as our default and anytime EPA makes a change to the RSL within Region 3, we accept all of those contaminants. The issue is EPA isn't making the statement that all of those on that list are hazardous substances. EPA is saying some are hazardous substances, some are considered contaminants, some are considered pollutants. But DNREC, so far, has said we're going to call them all hazardous substances. Which means there are things on there that we will never test for because the potential for them showing up in the environment through release is so low and so unique we catch it another way but we have this very huge extensive list on our HSCA Screening table it's almost becoming cumbersome." He continued to discuss and added that regulations are usually updated very three years.

As stated in the presentation on the slide titled *Exceed Regional Screening Level?*:

- A detection over a regional screening level means that the chemical is retained for risk assessment.

Mr. Keyser said, "Just because you can find it doesn't mean it's a risk." He added that when something on site is detected it will be retained for an actual risk assessment. He continued, "Screening. The whole purpose of that is to say is it above this extremely conservative value or not. If it's not, we don't retain it. If it is, then we retain it and put it into the exposure assessment." He continued to discuss further.

As stated in the presentation on the slide titled *When does a property become a site?*:

- **Release** – means any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping or disposing of a hazardous substance, pollutant or contaminant into the environment (including the abandonment or discarding of barrels, containers, and other closed receptacles containing any hazardous substance or pollutant or contaminant), but excludes: (a) any release which results in exposure to a person solely within his or her workplace, with respect to a claim which such person may assert against his or her employer, provided, however, that this exclusion does not apply to any such release which also results in exposure to the environment; (b) emissions from the engine exhaust of a motor vehicle, rolling stock, aircraft, vessel or pipeline pumping station engine; (c) the appropriate

application of fertilizers and pesticides; and (d) any discharges in compliance with State permits issued in conformance with Title 7 of the Delaware Code and federally permitted releases under CERCLA.

Mr. Keyser summarized this and said, “A release is any number of different ways of a contaminant getting into the environment.” He continued to discuss.

As stated in the presentation on the slide titled *What can be a site?*:

- **Facility or site** – means any building, structure, installation, equipment, pipe or pipeline (including any pipe into a sewer or publicly owned treatment works), well, pit, pond, lagoon, impoundment, ditch, landfill, storage container, motor vehicle, rolling stock, vessel, aircraft or any site or area where a hazardous substance has been generated, manufactured, refined, transported, stored, treated, handled, recycled, disposed of, released, placed or otherwise come to be located. Where there is or has been a release or threat of release on real property, a portion of the real property may be considered a facility for the purpose of performing a remedy. A facility also includes all properties where hazardous substances may have migrated to or come to be located since being released.

Mr. Keyser discussed the meaning further with the Subcommittee.

As stated in the presentation on the slide titled *What is Risk Assessment/Baseline?*:

- HSCA Risk Guidance: A baseline human health risk assessment is an analysis of the nature and probability of adverse health effects in humans who may be exposed (currently or in the future) to hazardous substance releases from a site in the absence of any actions to control or mitigate these releases
- Details the steps needed to be taken to determine if the risk to the onsite contamination is acceptable
- Used to determine if a remedial action needs to be performed
- Risk Assessments are performed assuming both the current and future use of a property

Mr. Keyser said, “What are we doing when we do a risk assessment, when we determine a baseline? We’re looking at whether or not the current condition poses an unacceptable risk and whether or not we need to compel someone to take an action or take the action ourselves as the Department.” He continued to discuss.

As stated in the presentation on the slide titled *What is an acceptable risk per HSCA?*:

- Per the HSCA Regulations, an acceptable risk (i.e. no remedy is needed) is for a calculated cancer risk of **1 x 10⁻⁵ (one in a hundred thousand)** and a **Hazard Index of 1**.
- These values are calculated using the RAIS (Risk Assessment Information System) online model. Updated and maintained by the Oak Ridge National Laboratory and the University of Tennessee with funding through EPA and DOD.

Mr. Keyser said, “One in a hundred thousand. It’s a probability. It’s difficult to communicate, in general, that a risk is present but based upon the math, it is an acceptable risk.” He discussed further and Mr. Homsey asked Mr. Keyser if the one in a hundred thousand is the risk of somebody being exposed at the declared level or is it just that it’s going to be a problem? Mr. Keyser replied, “It’s the probability of a person who would live at this property for their entire life and would spend a certain

period of time outside in whatever it is and could become sick if all these things stayed exactly the same. So, when we do this risk assessment, we're saying if nothing changes, we can then calculate that risk." He continued to discuss.

As stated in the presentation on the slide titled *Exposure Scenarios and Receptors*:

- Definition: Exposure scenarios are tools to help develop estimates of exposure dose and risk
- Exposure scenarios typically include:
 - data,
 - assumptions,
 - inferences,
 - professional judgment.
- Difference between exposure scenario and receptor? A receptor is a person that could be exposed and an exposure scenario includes all the assumptions for that person's potential exposure.

Mr. Keyser said, "The idea is if you take a look at all of your data assumptions, inferences, and use your professional judgment you can make a determination of a lot of scenarios that there will not be an unacceptable risk."

As stated in the presentation on the slide titled *Exposure Scenarios/Receptors*:

- Residential
- Indoor Worker
- Outdoor Worker
- Composite Worker
- Excavation Worker
- Construction Worker
- Recreator (and Trespasser)
- Farmer

Receptors	Exposure Frequency (days per year)	Exposure Time (hours per day)	Exposure Duration (years)
Resident	350	24	Total: 26 Adult: 20 Child: 6
Indoor Worker	250	8	25
Outdoor Worker	225	8	25
Composite Worker	250	8	25
Excavation Worker	20	8	1
Recreator	75	1	Child: 6 Adult: 20
Trespasser	58	3.9	Adult (6-16): 10

Mr. Keyser discussed the list above and said, "The idea is we attempt to predict what the future use is going to be. We don't know what it's going to be. We use the most conservative value. We assume someone's going to live there and that the kids are going to play in the yard and that they're going to be avid gardeners and that's how we make that determination as to if we need to do something or not. So, when we make a determination about risk and we talk about that probability, there's a strong potential that we're being overprotective. But we are consistently "overprotective" in these situations." He continued to discuss.

As stated in the presentation on the slide titled *Exposure Media*:

- Each scenario evaluates certain media. Not all media are evaluated in each exposure scenario
- Typical exposure media is:
 1. Soil-shallow and deep (both separate and combined)
 2. Sediment-can be combined with soil
 3. Groundwater (RAIS uses the term tap water because of the ingestion pathway)

- 4.Surface water
- 5.Air-soil gas/vapor intrusion
- 6.Soil to Groundwater

Mr. Keyser discussed the above list.

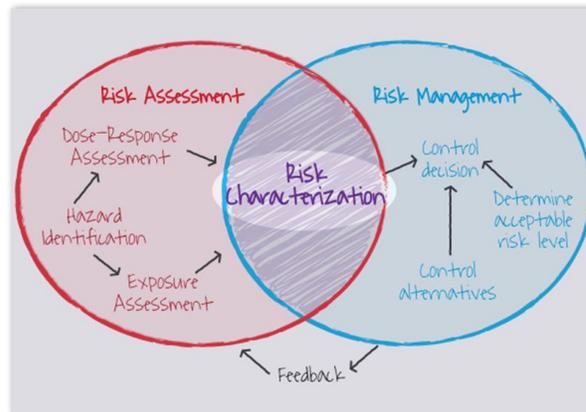
As stated in the presentation on the slide titled *Exposure Pathways*:

Receptor	Shallow Soil	Shallow & Deep Soil Combined	Sediment	Groundwater	Air	Tap Water	Surface Water	Fish
Residential	X	X		X	X	X		X
Indoor Worker	X	X		X	X	X		
Outdoor Worker	X	X			X			
Composite Worker	X	X			X			
Construction Worker	X	X			X			
Excavation Worker	X	X			X			
Recreator	X	X	X				X	
Trespasser	X	X	X				X	

Mr. Homsey and Mr. Keyser discussed the public and the exposure pathway. Ms. Eul Lee asked Mr. Keyser if there was a map or anything that shows where and what kind of substances are in the soil. Ms. Lee gave Mr. Keyser an example and Mr. Keyser replied, “Everything that is done through the Hazardous Substance Clean-Up Act is public information in a file.” He also stated it would be impossible to create a single map. He stated, “We do keep site files that show every place that was sampled and then the data that we detected.” He discussed further and he stated that his Division communicates very well with the Division of Water. Mr. Keyser also told Ms. Lee the sites are listed through the Miss Utility Program for construction workers. He stated there are multiple levels of protection in place. Ms. Lee asked, “How do people trying to buy a house find that site is clear of dangerous substances or nearby?” Mr. Keyser directed Ms. Lee to the DNREC webpage. Mr. Keyser and Ms. Lee and Mr. Homsey continued to discuss and Ms. Lee stated this information should be disclosed to realtors, etc. Mr. Keyser told Ms. Lee that he could certainly speak with her at any time about any questions she has.

Mr. Rambo asked Mr. Keyser, “Why is surface water not considered a pathway for residential considering that surface water is one of the largest components of drinking water across the country and it’s one of the easiest resources for people to tap into?” Mr. Keyser said that it may fall into the realm of surface water and is considered a recreator or trespasser type of scenario. The Subcommittee continued to discuss.

As stated in the presentation on the slide titled *Risk Characterization*:



Mr. Keyser said, “It is a process and the concept of characterizing risk. We try to make it as dynamic as possible. We continue to inform the process as we get more data in and if we don’t have enough data we will often ask for more or more precise data in specific spots.” Mr. Keyser continued to discuss.

As stated in the presentation on the slide titled *So what could this mean for SWAPP?*:

- Apply risk assessment to contaminant that exceed a threshold value from sampling
- Require follow-up sampling before changing susceptibility
- Use multiple lines of evidence when rating susceptibility
- Develop a conceptual site model to help understand if detections could lead to exceeding a threshold
- Develop a tracking system for data received to share with other DNREC sections

Mr. Keyser stated there are more slides dealing with risk assessment and scenarios but he didn’t want to go into those because he didn’t think it was valuable for what the Subcommittee is doing because it’s so specific. He said, “I just scraped the top of this topic.”

Mr. Keyser asked if there were any questions. Mrs. Amber Bataille discussed source water assessments and if sites and sources of contamination can be included. She also asked about water quality data and land use. She and Mr. Keyser also discussed the Conceptual Site Model. Mr. Keyser, Mrs. Bataille, and Mr. Rambo discussed further.

Ms. Lee asked about the source water assessment and if it’s per well head and she and Mrs. Bataille discussed examples and they also discussed the purpose of risk assessment data. Ms. Lee, Mrs. Bataille, Mr. Rambo, and Mr. Keyser continued to discuss. Mrs. Bataille asked if the water providers that were present if having this information would be helpful to them in terms of having a risk analysis based on the water quality data. Mr. Jay Guyer asked, “What additional data would you want?” Mrs. Bataille said the unregulated contaminants. Mr. Keyser asked Mrs. Bataille which ones? Mrs. Bataille responded, “That would be up for discussion.” The Subcommittee continued to discuss and included using the UCMR list. Ms. Mary Neutz asked about the difference between finished drinking water results (which is UCMR) and source water and she continued to discuss with the Subcommittee. Mr. Homsey said it seems to be a coordination issue because DNREC has a lot of components. Mr. Keyser replied that there are communication mechanisms currently in place. He thinks some of the challenges

come from sharing the data in a fashion other than per project, per incident, etc. He stated they are working on that. Mr. Keyser and Mrs. Bataille continued to discuss.

The Subcommittee discussed the potential of possible government funding. Mr. Kenny Haggerty asked regarding the data if someone could get a proposed list of what should be tested and have information for and send it to the water providers in case the funding comes through they would be ready. Mr. Rambo and Mr. Haggerty discussed when putting in a new well and the standard evaluation of the water quality is done the types of methods that are used. The Subcommittee continued to discuss.

Ms. Lee, Mrs. Bataille and Subcommittee members discussed well head protection areas and travel time and risk assessments.

ADJOURN – Douglas Rambo, P.G., DNREC, Division of Water

Meeting adjourned at 11:54 a.m.

These minutes are not intended to be a detailed record. They are for the use of the Source Water Assessment and Protection Program, Source Water Assessment Plan Subcommittee members in supplementing their personal notes and recall of Committee discussions and presentations and to provide information to Committee members unable to attend. Minutes recorded and submitted by Kimberly Burris.

Attendees are listed below alphabetically, last name first:

Bataille, Amber – DNREC, Division of Water, Source Water Protection Program
Burris, Kimberly – DNREC, Division of Water, Administration
Guyer, Jay – Municipal Services Commission
Haggerty, Kenneth – Artesian Water Company
Homsey, Andrew – Water Resources Agency
Keyser, Todd – DNREC, Division of Waste & Hazardous Substances
Lee, Eul – Public Citizen
Mensch, Keith – Division of Public Health, Office of Drinking Water
Mills, Kate – City of Dover
Neutz, Mary – City of Wilmington
Rambo, Douglas – DNREC, Division of Water, Source Water Protection Program
Reyes, Betzy – USGS
Slabicki, Kelly – City of Wilmington
Walls, Brooke – Dept. of Agriculture
Yorston, Erin – Dept. of Agriculture

Source Water Assessment and Protection Citizen and Technical Advisory Committee

SWAPP Plan Update-Risk Analysis

Todd A. Keyser, P.G.

DNREC – Remediation Section

February 20, 2020

What is Risk?

- “A hazard, danger or exposure to mischance or peril” - *Oxford English Dictionary*
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- Involuntary - associated with an occurrence that happens to us without prior consent

What is the risk of common activities?

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- We take precautions to limit the type and level of risk
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How are Risks measured?

- Statistically verifiable – determined from direct observation, compared to each other
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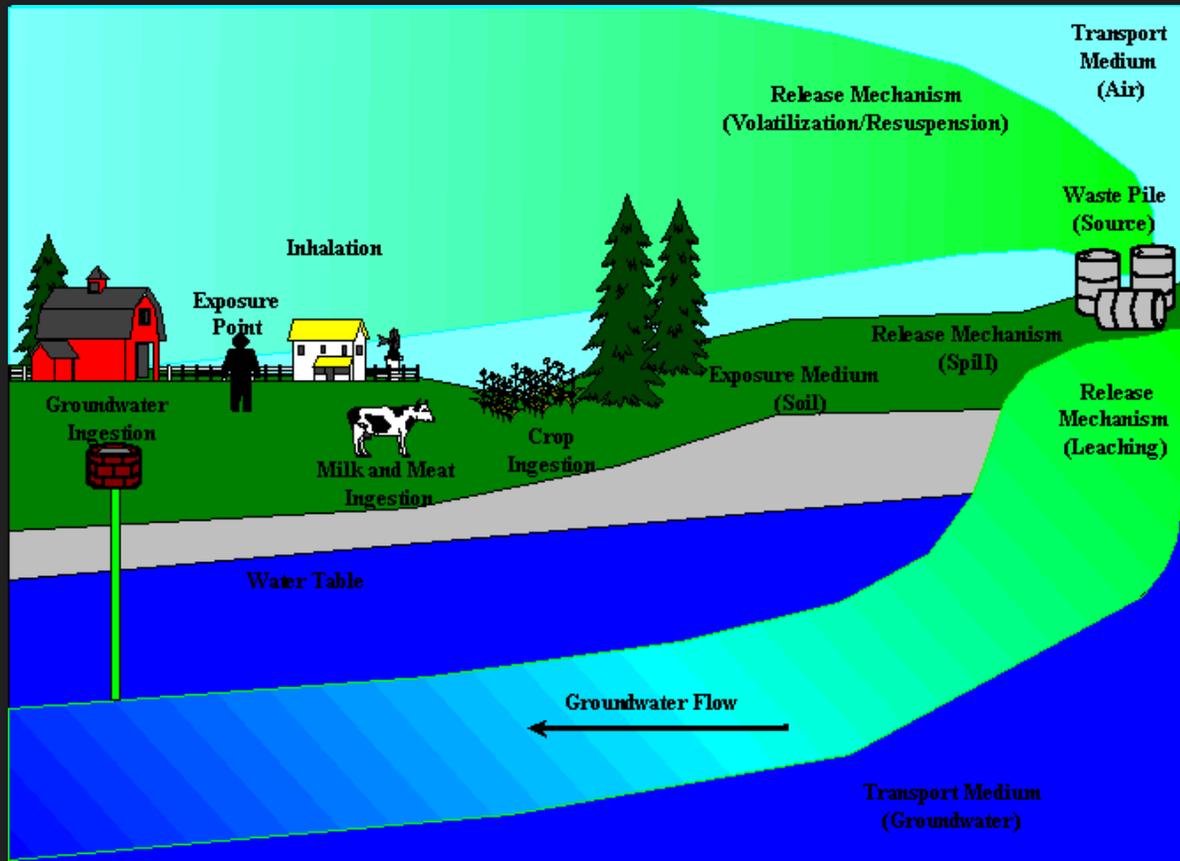
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What are the steps of environmental risk assessment ?

- **Data Compilation and Evaluation** – gather what you have and sort by media –soil, air water, sediment, fish tissue.
 - Is it replicable and good quality data?
 - Develop a **Conceptual Site Model**
- **Exposure Assessment**- estimates type and magnitude of a pathway (physical)
- **Toxicity Assessment** -
 - Hazard Identification – determines if exposure increases adverse health effects
 - Dose response - the relationship between magnitude and adverse health effects
- **Risk Characterization**- synthesis of all information gathered above to estimate likelihood that a hypothetical exposure may adversely impact human health

Conceptual Site Model



1. All potential or suspected sources of contamination
2. Types and concentrations of contaminants detected at the site
3. Potentially contaminated media
4. Potential exposure routes and pathways
5. Potential receptors

Which contaminants?

- **Hazardous substance**” means:
- (a) any hazardous waste as defined in 7 **Del.C.** Ch. 63 or any hazardous waste designated by regulation promulgated pursuant to 7 **Del.C.** Ch. 63;
- (b) any hazardous substance as defined in CERCLA or regulations promulgated pursuant thereto;
- (c) any substance determined by the Secretary through regulation to present a risk to the public health or welfare or the environment if released into the environment;
- (d) any substance included in the HSCA screening level table that will be updated semiannually; or
- (e) petroleum, including crude oil or any fraction thereof; however any release of hazardous substances from a storage tank which is regulated by 7 **Del.C.** Ch. 74 or 7 **Del.C.** Ch. 74A or regulations promulgated pursuant thereto is not subject to these Regulations except as provided for in Section 1.2. Notwithstanding the Department’s determination under Section 1.2 of these Regulations, any release of petroleum, including crude oil or any fraction thereof, is eligible for funding under the Act.

Which contaminants? HSCA Screening Level table

- Hazardous Substance Cleanup Act (HSCA) screening level table is primarily based on EPA's Regional Screening Level (RSL) table, which is updated semi-annually
- When EPA added chemicals to the RSL table, then DNREC added those chemical to HSCA screening level/reporting level tables. Those chemicals became hazardous substances under HSCA.
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This process is currently under review.

Exceed Regional Screening Level?

- A detection over a regional screening level means that the chemical is retained for risk assessment.

When does a property become a site?

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What can be a site?

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- Details the steps needed to be taken to determine if the risk to the onsite contamination is acceptable.
- Used to determine if a remedial action needs to be performed
- Risk Assessments are performed assuming both the current and future use of a property.

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- Per the HSCA Regulations, an acceptable risk (i.e. no remedy is needed) is for a calculated cancer risk of **1 x10⁻⁵ (one in a hundred thousand)** and a **Hazard Index of 1**.
- These values are calculated using the RAIS (Risk Assessment Information System) online model. Updated and maintained by the Oak Ridge National Laboratory and the University of Tennessee with funding through EPA and DOD.

Exposure Scenarios and Receptors

- Definition: Exposure scenarios are tools to help develop estimates of exposure dose and risk.
- Exposure scenarios typically include:
 - data,
 - assumptions,
 - inferences,
 - professional judgment.
- Difference between exposure scenario and receptor? A receptor is a person that could be exposed and an exposure scenario includes all the assumptions for that person's potential exposure.

Exposure Scenarios/Receptors

- Residential
- Indoor Worker
- Outdoor Worker
- Composite Worker
- Excavation Worker
- Construction Worker
- Recreator (and Trespasser)
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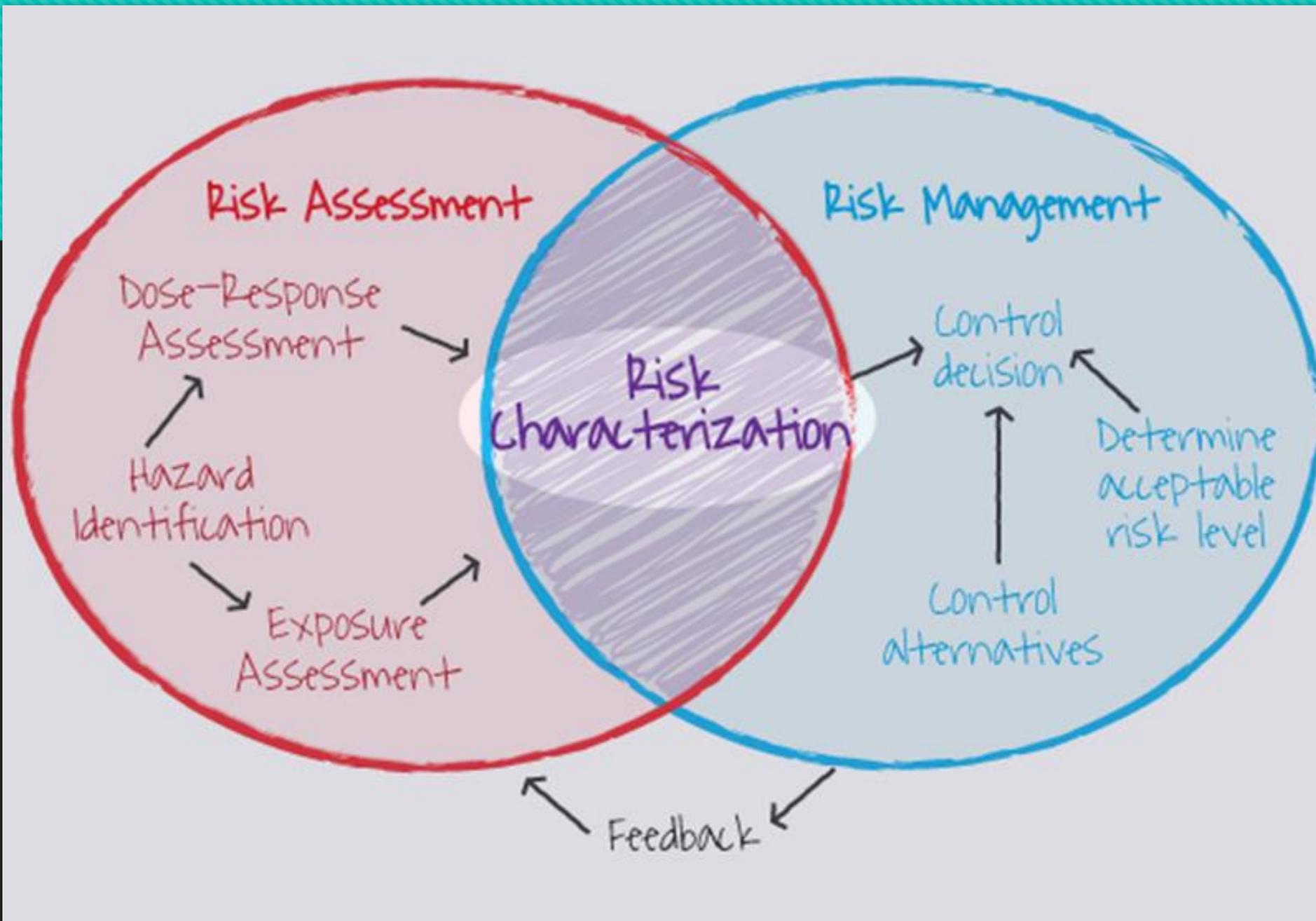
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Exposure Media

- Each scenario evaluates certain media. Not all media are evaluated in each exposure scenario
- Typical exposure media is:
 1. Soil- shallow and deep (both separate and combined)
 2. Sediment- can be combined with soil
 3. Groundwater (RAIS uses the term tap water because of the ingestion pathway)
 4. Surface water
 5. Air – soil gas/vapor intrusion
 6. Soil to Groundwater

Exposure Pathways

Receptor	Shallow Soil	Shallow & Deep Soil Combined	Sediment	Groundwater	Air	Tap Water	Surface Water	Fish
Residential	X	X		X	X	X		X
Indoor Worker	X	X		X	X	X		
Outdoor Worker	X	X			X			
Composite Worker	X	X			X			
Construction Worker	X	X			X			
Excavation Worker	X	X			X			
Recreator	X	X	X				X	
Trespasser	X	X	X				X	



So what could this mean for SWAPP?

- Apply risk assessment to contaminant that exceed a threshold value from sampling
- Require follow up sampling before changing susceptibility
- Use multiple lines of evidence when rating susceptibility
- Develop a conceptual site model to help understand if detections could lead to exceeding a threshold
- Develop a tracking system for data received to share with other DNREC sections

Exposure Pathways- more specifics

- Residential: should be used whenever there are or may be occupied residences on the site and are expected to be in frequent, repeated contact with the contaminated media. This contact is expected to be with the shallow soil, groundwater, and potentially combined shallow and deep soil if deep soil is brought to the surface from construction or excavation activities.
- Indoor Worker: adults who could potentially be exposed to the shallow soil and tap water during activities at the site and combined shallow and deep soil if deep soil is brought to the surface from construction or excavation activities.
- Outdoor Worker: adults who could potentially be exposed to the shallow soil during site activities and combined shallow and deep soil if deep soil is brought to the surface from construction or excavation activities.

Exposure Pathways- more specifics

- Composite Worker: adults who could potentially be exposed to shallow soil during activities at the site. These activities include a combination of general office activities and soil disturbing activities limited to the top 2 feet.
- Construction Worker: adults who could potentially be exposed to shallow and combined shallow and deep soil during activities on the site. This exposure scenario is site specific and can be estimated for both air and soil. The potential soil exposure can be further modified for either unpaved road traffic or other construction activities.

Exposure Scenarios- more specifics

- Excavation Worker: adults who could potentially be exposed to shallow and deep soil during infrequent excavation activities at the site. These activities could include placement or repair of utilities or other construction activities involving digging.
- Recreator: adults and children who spend a limited amount of time at the site while playing, fishing, hunting, hiking, or engaging in other outdoor activities for pleasure. This includes what is often described as the 'trespasser" or "site visitor" scenario.
- Trespasser: an unauthorized person accessing the site for a limited period of time. Trespassers could be exposed to any surface water bodies, sediment, the top two feet of soil, and potentially combined shallow and deep soil if deep soil is brought to the surface from construction or excavation activities.

Other Key Terms and Definitions

- Contaminant of Potential Concern (COPC): Contaminates that exceed the HSCA Screening Levels and need to be further considered.
- Contaminate of Concern (COC): Contaminates that are found to be a risk through the risk calculations.
- Exposure Point Concentration (EPC): The calculated 95% UCL or maximum observed concentration (MOC) of a contaminant that is used within the risk assessment calculations.

Overall Background HHRA Information

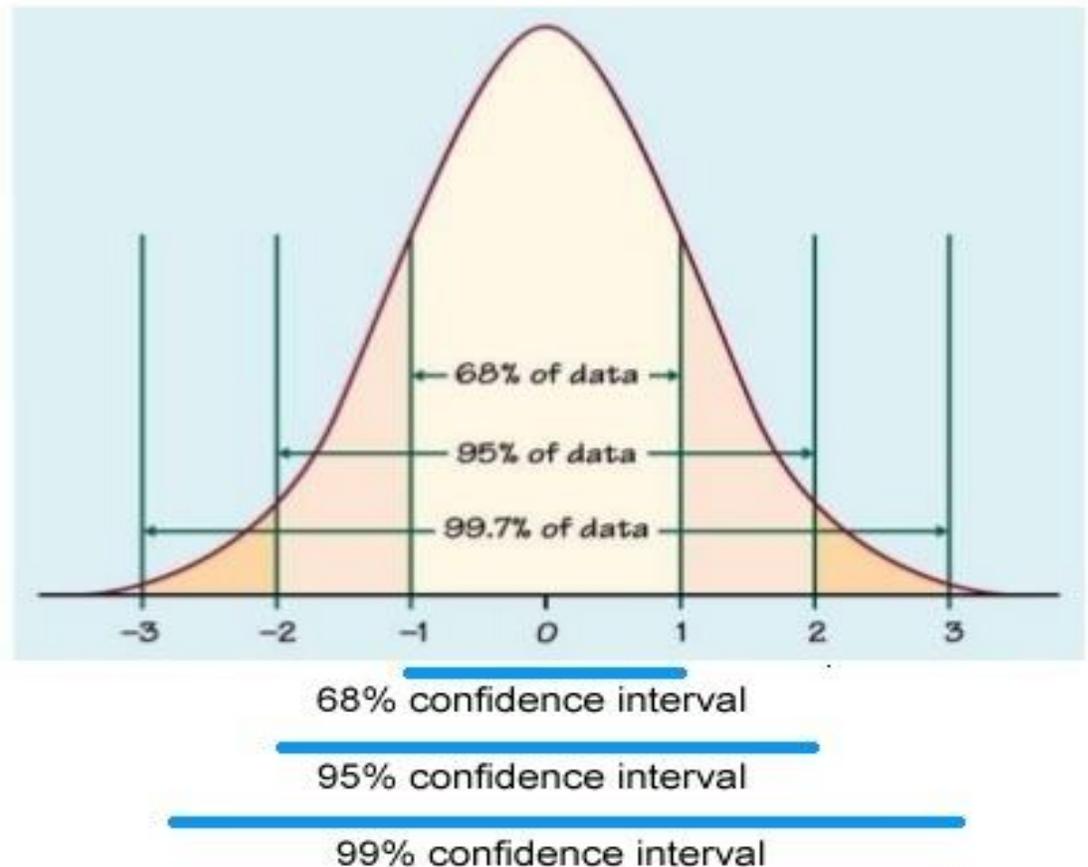
- HHRA is an evaluation of potential exposure.
- Assumes no additional remedial actions have taken place (ex: baseline conditions)
- This can change if a hot spot removal is done, then a HHRA can be performed on the remaining media.
- HHRA is broken into three main parts:
 1. Determination of the COPCs
 2. Exposure Assessment (this is where you calculate exposure point concentrations)
 3. Toxicity Assessment (this is where you perform calculations with RAIS)

How Do You Determine Your COPCs?

- The maximum observed concentration (MOC) of each constituent in the media is compared to the HSCA Screening Level Table for human health. If it exceeds it is retained for further evaluation. If it doesn't exceed, then it is not retained for further evaluation.
- If 10 or more samples are collected, a 95% UCL (upper confidence limit) can be calculated using PRO UCL; a software developed and maintained by EPA. If less than 10 samples are collected, the maximum must be used.

Upper Confidence Limits

- A UCL determines how close your observations are to the parametric or true mean of the observations.
- To put it in sampling terms: a 95% UCL value means that if we went back out to the site and took random samples (or in math terms a population) and calculated the mean and confidence limits of those samples (the high and low), you would have a confidence that the 95% of the samples would contain the mean and would be within the intervals.



Upper Confidence Limits- Why does this matter?

- Because in risk assessment, being representative is as important as being conservative. A person is not in one sample location (where the highest concentration is) for the entire length of time for that exposure scenario.
- 95% UCL are calculated within PRO UCL with a variety of statistics (see handout). PRO UCL recommends the statistic and 95% UCL to be used.
- On a site specific basis, the calculated 95% UCL can be compared to the HSCA Screening Level Table and if the calculated 95% UCL for that contaminant is below the Screening Level, it does not need to be further evaluated. If it is above, that contaminant needs to be further evaluated.
- Those calculated values or maximum values for each contaminant are your Exposure Point Concentrations (EPCs).
- The listing of each contaminant that exceeds for each media are your COPCs.

Human Health Risk Characterization- Background Information on Risk

- Risk is calculated by using toxicity factors (or reference doses and cancer slope factors) with the intake of the COPCs (the EPCs) to estimate non-carcinogenic and cancer risk.
- As previously stated the HSCA Regulatory acceptable risk for cancer risk is 1×10^{-5} for non-carcinogenic (or hazard Index) a value of 1.

Target Organ Analysis

- Hazard Quotients are summed across the same target organs and if their hazard index is above 1, then a remedial action must be performed. If the hazard index is below one for all of the target organs, then a remedial action does not need to be performed.
- Each contaminant can affect single or multiple organs/organ systems.
- Information on what affects what is found in RAIS on the Chemical Toxicity Metadata section.

Fictional Target Organ Analysis Table

Note: I did not research the actual organs affected by these contaminants. Purely made up.

Contaminant	Target Organ	HI
Cobalt	Thyroid	0.7
Benzo(a) pyrene	Thyroid	0.9
Arsenic	Brain	0.2
Benzo(a)pyrene	Nervous System	1.5
Benzo(b)fluoranthene	Heart/Cardiovascular	0.1
Acetone	NA	NA
Dioxane, 1-4	Lungs	0.8
Heptachlor Epoxide	Lungs	0.3
Styrene	Immune	0.6

Calculating Cancer Risk

- EPCs are compared to the chemical specific Cancer Slope Factors
- Equation:
Cancer Risk= Chemical Intake (mg/kg/day) x CSF (kg-day/mg)
- This is an incremental risk and is not a “true risk”
- DNREC acceptable cancer risk for a site is 1×10^{-5}