WHAT WE’LL COVER

- What is a Conceptual Site Model
- Definitions:
  - Complete Exposure Pathways
  - Contaminant Sources
  - Release Mechanisms
  - Impacted Media
  - Transport Mechanisms
  - Exposure Media
  - Exposure Routes
  - Receptors
- Using the CSM Scoping Form to Complete a CSM for a site
A conceptual site model (CSM) is a way to describe and evaluate how people, animals, and plants might come in contact with contaminants at a location.

It shows the current and possible future spread of contamination in the environment (i.e. fate and transport).

Developing a CSM is a critical step in evaluating a contaminated site, and must be prepared during the site characterization phase.
CONCEPTUAL SITE MODEL

- Leaking fuel tanks
- Leaking barrels on the tundra
- Children playing in contaminated dirt
- Fish could become contaminated
- Silty sand
- Sandy gravel
- Plume of contaminant moving toward lake/river
- Migration to groundwater/surface water
- Wild foods ingestion
- Soil ingestion/Dermal contact
- Inhalation
Conceptual Site Models identify exposure pathways and outline the course a chemical takes from the source of contamination to a potentially exposed person, animal or plant (receptor).
Generalized Example Exposure Pathways

SOURCE

Release Mechanism
(spill, leak, emission)

IMPACTED MEDIA

Transport Mechanism
(runoff, leaching, precipitation)

EXPOSURE MEDIA

Exposure Route

RECEPTOR
All sources of contamination at the site need to be identified.

Many times the source is from a tank, drum, transformer, garage, shop, storage area, or landfill.

Other sources may include discarded batteries, deteriorating buildings, or pesticide application.
TYPICAL SOURCES OF CONTAMINATION FOUND IN VILLAGES:
Storage tanks: diesel, gasoline, and aviation fuel
Power plants: transformer oil, PCBs, and waste oil
Vehicle maintenance shops: waste oil, glycol, and chlorinated solvents
Mining activities: fuels and heavy metals
Former military activities: various contaminants
Abandoned dumps: various contaminants

Some contaminants are more hazardous than others due to their different toxicities.
The release mechanism describes how contaminants were released from the source into the environment.

Common release mechanisms include spills, leaks, direct discharge, and burning, etc.

In some instances the release mechanism is unknown and may need to be an educated guess based on the available information.
The impacted media at a site are the environmental substances to which a contaminant is directly released.

The impacted media may include soil, sediment, groundwater, surface water, or air.
Transport mechanisms show how contaminants in the impacted environmental media may be moved to other media.
Exposure media is the environmental substance an individual is exposed to.

Exposure media may include soil, sediment, groundwater, surface water, air, and biota (plants and animals).

Exposure media includes all impacted media that people may directly have contact with.
An exposure route is the way a contaminant comes in contact with a receptor and the way a chemical enters the body.

- Ingestion
- Inhalation
- Dermal contact
Main Routes of Exposure for Humans

- Eating/drinking (ingestion),
- Breathing (inhalation), and
- Skin (dermal) contact.
When determining human receptors for a site, it is important to keep in mind both current and future land use. This information should be included in the human health CSM. Potential receptors may include the following:

- Resident (adult and child);
- Commercial or industrial worker;
- Construction worker;
- Site visitor;
- Trespasser;
- Recreational user;
- Farmer;
- Subsistence harvester, or
- Subsistence consumer.
ANOTHER EXAMPLE: WHAT ARE THE POTENTIAL EXPOSURE ROUTES?

- Fuel leak
- Drinking
- Breathing
- Skin contact
- Eating contaminated food
- Contamination moving through groundwater

People exposed

Soil
BEFORE CLEANUP:

- People exposed
  - Breathing
  - Skin contact
- Soil
- Contamination moving through groundwater
- Eating contaminated food
HUMAN EXPOSURE AFTER CLEANUP:

People protected

Supply

Soil

Cleaned soil

Contamination slowly degrades underground
Environment after cleanup:

Environment protected

Food sources protected

Soil

Contamination slowly degrades underground

Cleaned soil
BEFORE CLEANUP:

Fuel leak

Contamination moving through groundwater

People exposed

Drinking

Breathing
HUMAN EXPOSURE AFTER CLEANUP:

- **People protected**

- **Cleaned soil**
  - Monitoring well
  - Impossible/Impractical to clean up

- **Alternate water supply**
  - Contamination slowly degrades underground

- **Soil**

- **Don’t drill water wells**
ENVIRONMENT AFTER CLEANUP:

Contamination sources removed, soil and groundwater cleaned

Environment protected

Cleaned soil

Impossible/ Impractical to clean up

Contamination slowly degrades underground
QUESTIONS?
CSM EXAMPLE:
HUGHES SCHOOL AND
COMMUNITY TANK FARM SITE
Former tanks
Public Drinking Water Well
Depth = 2 feet bgs
DRO = 37,700 mg/kg
RRO = 33,300 mg/kg
Benzene = 0.192 mg/kg

Depth = 3 feet bgs
DRO = 2,050 mg/kg

Depth = 6 feet bgs
DRO = 18,900 mg/kg
GRO = 485 mg/kg
Potential exposure routes: indoor and outdoor inhalation, ingestion soil and groundwater, and dermal contact.
Human Health Conceptual Site Model
Scoping Form

Site Name: Hughes Former Generator Building/Tank Farm
File Number: N/A
Completed by: SLR International Corp

Introduction
The form should be used to reach agreement with the Alaska Department of Environmental Conservation (DEC) about which exposure pathways should be further investigated during site characterization. From this information, a CSM graphic and text must be submitted with the site characterization work plan.

General Instructions: Follow the italicized instructions in each section below.

1. General Information:
Sources (check potential sources at the site)
- USTs
- ASTs
- Dispensers/fuel loading racks
- Drums
- Vehicles
- Landfills
- Transformers
- Other: batteries, pipeline, generator system

Release Mechanisms (check potential release mechanisms at the site)
- Spills
- Leaks
- Direct discharge
- Burning
- Other: 

Impacted Media (check potentially-impacted media at the site)
- Surface soil (0-2 feet bgs*)
- Subsurface Soil (>2 feet bgs)
- Air
- Groundwater
- Surface water
- Other: 

Receptors (check receptors that could be affected by contamination at the site)
- Residents (adult or child)
- Commercial or industrial worker
- Construction worker
- Subsistence harvester (i.e., gathers wild foods)
- Subsistence consumer (i.e., eats wild foods)
- Site visitor
- Trespasser
- Recreational user
- Farmer
- Other: 

* bgs – below ground surface
2. **Exposure Pathways:** (The answers to the following questions will identify complete exposure pathways at the site. Check each box where the answer to the question is “yes”.)

a) **Direct Contact** –
   1. **Incidental Soil Ingestion**
      
      Is soil contaminated anywhere between 0 and 15 feet bgs?  
      
      ________________
      
      Do people use the site or is there a chance they will use the site in the future?  
      
      ________________
      
      **If both boxes are checked, label this pathway complete:**  
      
      Complete
      
      2. **Dermal Absorption of Contaminants from Soil**
      
      Is soil contaminated anywhere between 0 and 15 feet bgs?  
      
      ________________
      
      Do people use the site or is there a chance they will use the site in the future?  
      
      ________________
      
      Can the soil contaminants permeate the skin? (Contaminants listed below, or within the groups listed below, should be evaluated for dermal absorption).
      
      - Arsenic
      - Cadmium
      - Chlorophene
      - 2,4-dichlorophenoxacyclic acid
      - Lindane
      - PAHs
      - Pentachlorophenol
      - PCBs
      - SVOCs
      - DDT
      
      **If all of the boxes are checked, label this pathway complete:**  
      
      Complete
      

b) **Ingestion** –
   1. **Ingestion of Groundwater**
      
      Have contaminants been detected or are they expected to be detected in the groundwater, OR are contaminants expected to migrate to groundwater in the future?  
      
      ________________
      
      Could the potentially affected groundwater be used as a current or future drinking water source? Please note, only leave the box unchecked if ADEC has determined the groundwater is not a currently or reasonably expected future source of drinking water according to 18 AAC 75.350.  
      
      ________________
      
      **If both the boxes are checked, label this pathway complete:**  
      
      Complete
2 Ingestion of Surface Water

Have contaminants been detected or are they expected to be detected in surface water OR are contaminants expected to migrate to surface water in the future?  

Could potentially affected surface water bodies be used, currently or in the future, as a drinking water source? Consider both public water systems and private use (i.e., during residential, recreational or subsistence activities).

If both boxes are checked, label this pathway complete:  

3 Ingestion of Wild Foods

Is the site in an area that is used or reasonably could be used for hunting, fishing, or harvesting of wild food?  

Do the site contaminants have the potential to bioaccumulate (see Appendix A)?  

Are site contaminants located where they would have the potential to be taken up into biota? (i.e. the top 6 feet of soil, in groundwater that could be connected to surface water, etc.)  

If all of the boxes are checked, label this pathway complete:  

C) Inhalation

1 Inhalation of Outdoor Air

Is soil contaminated anywhere between 0 and 15 feet bgs?  

Do people use the site or is there a chance they will use the site in the future?  

Are the contaminants in soil volatile (See Appendix B)?  

If all of the boxes are checked, label this pathway complete:  

2 Inhalation of Indoor Air

Are occupied buildings on the site or reasonably expected to be placed on the site in an area that could be affected by contaminant vapors? (i.e., within 100 feet, horizontally or vertically, of the contaminated soil or groundwater, or subject to “preferential pathways” that promote easy airflow, like utility conduits or rock fractures)  

Are volatile compounds present in soil or groundwater (See Appendix C)?  

If both boxes are checked, label this pathway complete:  

Complete
Summary

Complete Pathways
- Incidental soil ingestion
- Skin contact with soil
- Outdoor or indoor inhalation
- Groundwater ingestion

Incomplete Pathways
- Surface water ingestion
- Wildfoods ingestion
Alaska Dept. of Environmental Conservation
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