CONCEPTUAL SITE MODELS

What are they and why are they so important?

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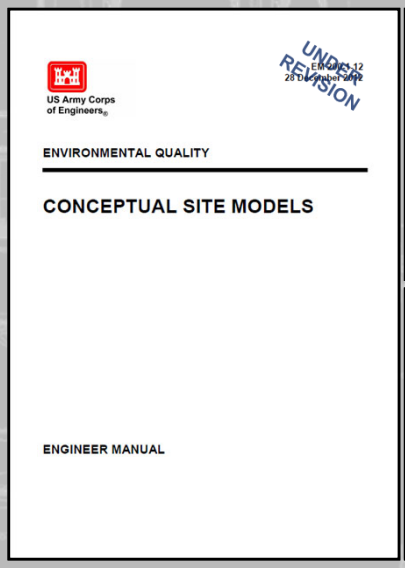
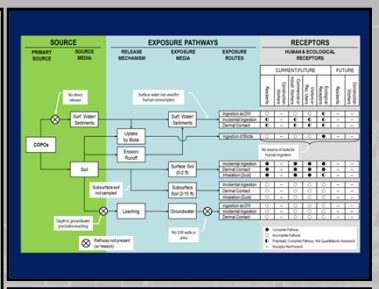
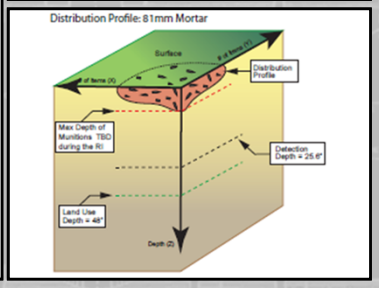
File Name







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THE CONCEPTUAL SITE MODEL (CSM)

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- First step in project planning is to ask
  - "What do we know about the site?"
- The answer to that question is
  - The Conceptual Site Model (CSM)
    - Basic understanding of site
    - Dynamic model
      - Updated throughout the project
    - Supports project planning and communication
      - At start and end of each restoration phase
- Without a sound preliminary CSM
  - We don't know our data gaps/needs
  - We can't plan our project effectively
- CSM is also how we present results
  - How has the CSM changed?
  - What data gaps have we filled?

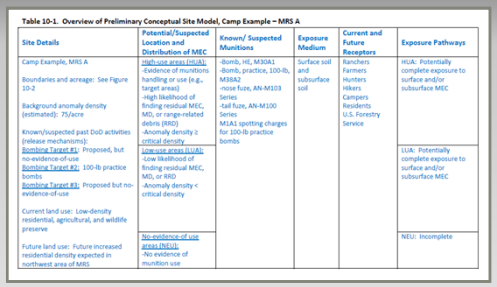
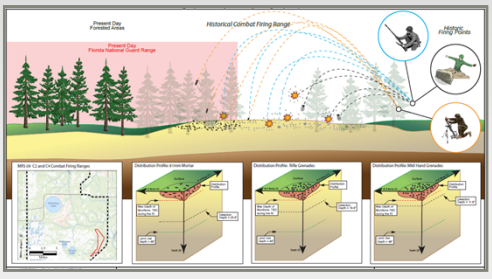


Table 10-1. Overview of Preliminary Conceptual Site Model, Camp Example – MRS A

Site Details	Potential/Suspected Location and Distribution of MEC	Known/ Suspected Munitions	Exposure Medium	Current and Future Receptors	Exposure Pathways
Camp Example, MRS A Boundaries and acreage: See Figure 10-2 Background anomaly density (estimated): 75/acre Known/suspected past DoD activities (release mechanisms): Bombing Target #1: Proposed, but no-evidence-of-use Bombing Target #2: 100-lb practice bomby Bombing Target #3: Proposed but no-evidence-of-use Current land use: Low-density residential, agricultural, and wildlife preserve Future land use: Future increased residential density expected in northwest area of MRS	High-use areas (HUA): -Evidence of munitions handling or use (e.g., target areas) -High likelihood of finding residual MEC, MD, or range-related debris (RRD) -Anomaly density ≥ critical density Low-use areas (LUA): -Low likelihood of finding residual MEC, MD, or RRD -Anomaly density < critical density No-evidence-of-use areas (NEU): -No evidence of munition use	-Bomb, HE, M30A1 -Bomb, practice, 100-lb, M38A2 -nose fuze, AN-M103 Series -tail fuze, AN-M100 Series M1A1 spotting charges for 100-lb practice bombs	Surface soil and subsurface soil	Ranchers Farmers Hunters Hikers Campers Residents U.S. Forestry Service	HUA: Potentially complete exposure to surface and/or subsurface MEC LUA: Potentially complete exposure to surface and/or subsurface MEC NEU: Incomplete



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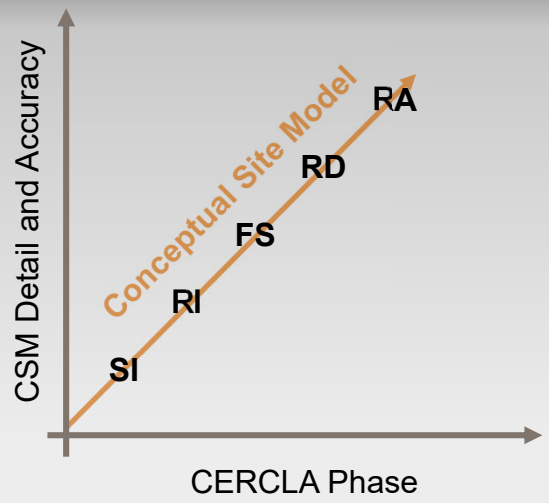
THE CSM – THE CORE OF THE PROJECT

- The CSM is THE common element that runs through all MMRP phases
  - It starts being pulled together during the SI…
  - And may be updated throughout every phase until Site Closeout
- Detail and accuracy increases as project advances through CERCLA phases



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CSM COMPONENTS – PROFILES

- Facility Profile
  - Site history, site boundaries, man-made features, and potential contaminant sources
- Physical Profile
  - Natural factors that may affect contaminant release, fate and transport, or accessibility
- Release Profile
  - Types of contaminants
  - Known/suspected locations of MEC or MC
- Land Use and Exposure Profile
  - Land uses and activities
  - Exposure scenarios
    - Receptors, receptor locations, and pathways
- Ecological and Cultural Resources Profile
  - Natural habitats and ecological receptors
  - Cultural resources
- Vertical Profile

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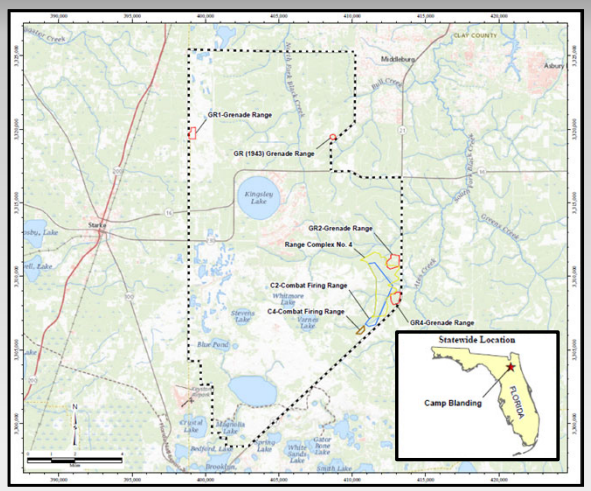
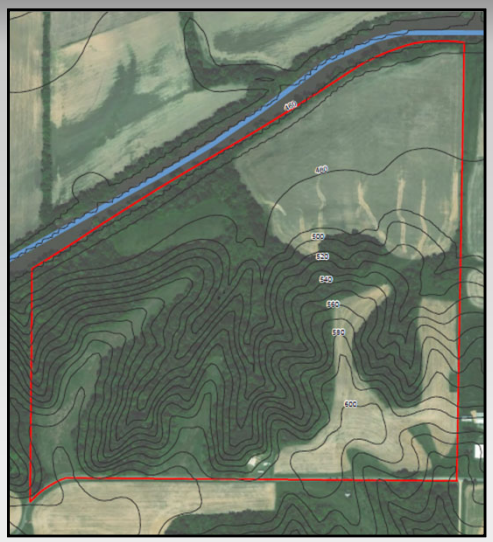
CSM – FACILITY PROFILE

- Site location, size and ownership
- Concise history of the use, storage, and disposal of munitions and other hazardous substances at the site
  - Before, during, and post-DoD use (to present)
- Identification of munitions and hazardous substances known or suspected to be present
  - MEC and MC
- Concise summary of relevant findings from previous investigations



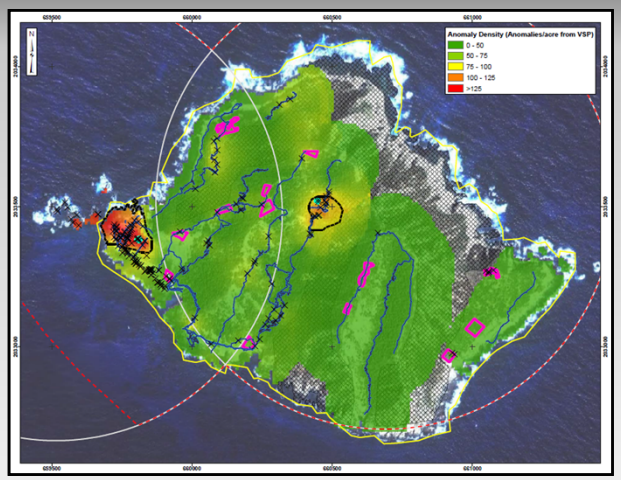
CSM – PHYSICAL PROFILE

- Topography and vegetation
- Geologic and hydrogeologic setting
  - Soil, bedrock, groundwater
- Climate
- Sensitive resources
  - Endangered species/sensitive habitats
  - Cultural resources
- Physical access limitations
  - Are there inaccessible areas that may impact the investigation?



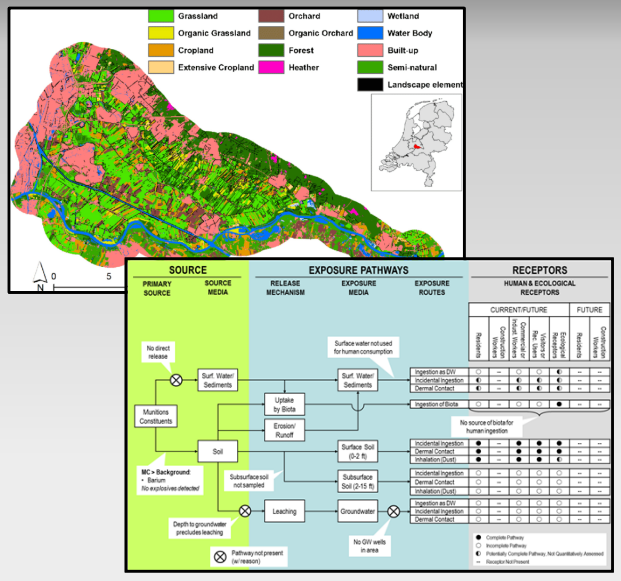
CSM – RELEASE PROFILE

- Description and locations of known or suspected areas where MEC were handled, used, stored, or disposed
  - e.g., targets, maneuver areas, storage facilities or OB/OD areas
- Current understanding of location and distribution of munitions and hazardous substances
  - Horizontal AND vertical
  - Affected environmental media
  - Anomaly densities?
- Evaluation of prior land-disturbing activities that may have redistributed MEC



CSM – LAND USE AND EXPOSURE PROFILE

- Current and reasonably anticipated future site uses
  - Include ownership and zoning
- Neighboring land uses
- Current and reasonably anticipated future receptors
  - *Including related activities and frequencies*
- Access and land use restrictions
- Potentially complete exposure pathways



CSM – ECOLOGICAL & CULTURAL RESOURCES PROFILE

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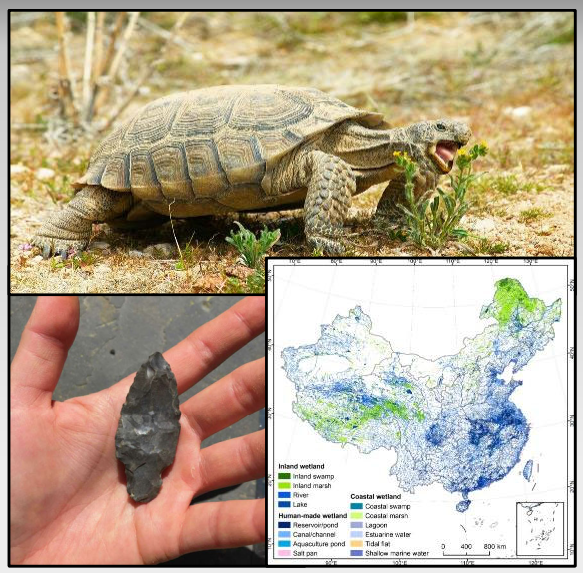
- Primary ecological or cultural use(s) of the area(s) and degree of disturbance
- Ecological receptors and habitat types
  - Endangered or threatened species
  - Migratory animals
  - Other species
- Sensitive environments
  - Habitat types (wetland, forest, desert, pond, etc.), size, and quality
- Cultural resource areas
- Relationship of releases to ecological or cultural areas



CSM – VERTICAL PROFILE

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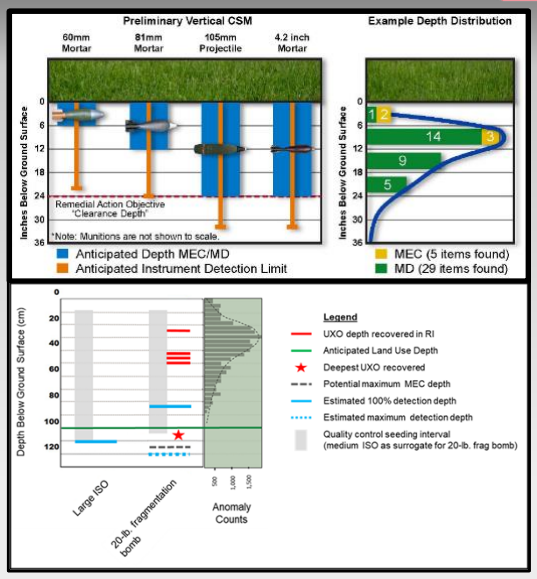
- The vertical profile is critical
  - MEC depths
    - Estimated and results-based
  - Seed depths
  - Instrument detection depths
    - Reliable and maximum
  - Land use depths
    - Current and future
  - RAO depths
    - For FSs and Remedial Actions
- Consider vertical profile data needs



CSM – DATA SOURCES

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- Starting point
  - PAs, SIs, and other reports provide useful initial data
    - *These should not be the only sources used*
    - *Imperative to verify old data*
- Additional sources
  - Other records searches, including online databases
  - Personnel and property owner interviews
  - Local safety officials
  - For military installations, contact base historian, real property and range managers
  - Historical ground and aerial photographs may be obtained from installations or military archives
  - Common Operations, Range Operations, and Installation Reports
  - Site visits
- Also use SPP meetings!

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CSM – EXPOSURE PATHWAYS

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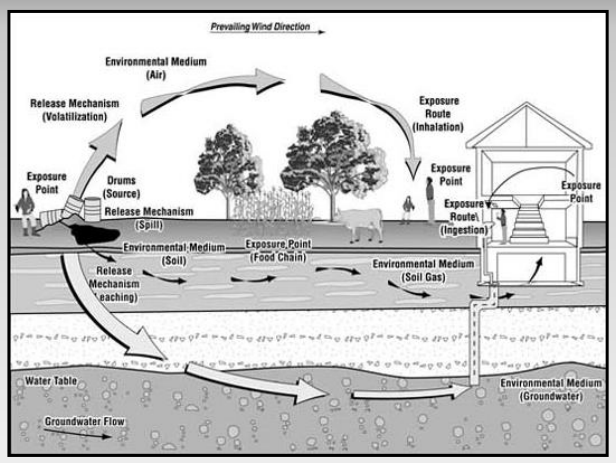
- CSM identifies ***exposure pathways***
- Exposure pathways have 4 elements
  - A source or release of contamination
  - An environmental transport mechanism and/or exposure medium
  - An exposure point
    - At which the receptor can come into contact with the contamination
  - A receptor and a likely route of exposure at the exposure point



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CSM – EXPOSURE PATHWAYS, CONT'D.

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Exposure Pathway Element	Example for MEC	Example for MC
Source or release of contamination	WWII range training resulted in MEC (UXO) being present at a former target area	WWII OB/OD area operations resulted in MC being present at a former disposal area
Environmental transport mechanism and/or exposure medium	The MEC are present in the soil at the former target area	The MC are initially in soil, but then migrate to groundwater
Exposure point at which the receptor can come into contact with the contamination	A recreational hiking trail passes through the former target area	The contaminated groundwater is used as drinking water by a local subdivision
Receptor and a likely route of exposure at the exposure point	A hiker encounters and then picks up a surface MEC item	A resident in the subdivision drinks the water

CSM – EXPOSURE PATHWAYS, CONT'D.

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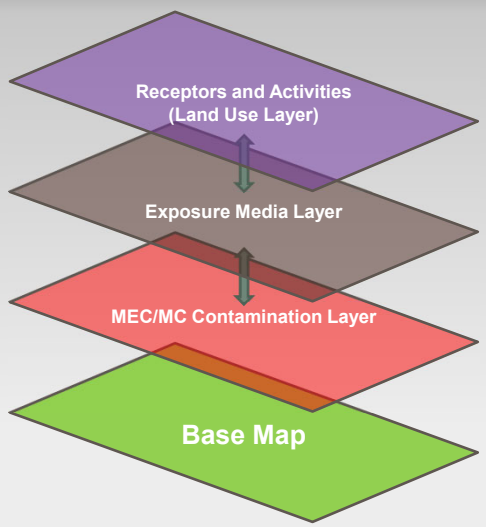
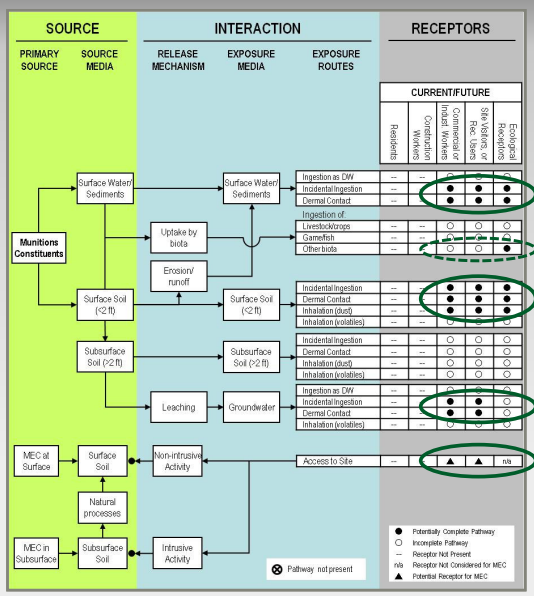
- To identify exposure pathways, you can think of the CSM as layers
  - Potential MEC/MC contamination
  - Exposure media
  - Receptors and activities
- Look at the receptors who might be exposed to contaminants in different media
  - Shows potential exposure pathways
- This helps to focus the investigation and, later in the project, the basis for the risk assessment
- Can also be presented in a GIS



CSM – EXPOSURE PATHWAYS, CONT'D.



- Exposure pathways can also identify which media need to be sampled
  - Which pathways should be evaluated for this site?

MC in surface water

Ecological exposures typically addressed under other media

MC in surface soil

MC in groundwater

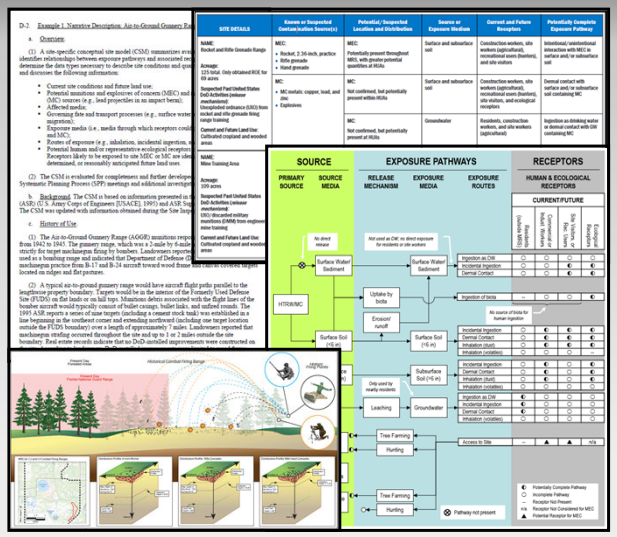
MEC in surface and subsurface soil

CSM – DATA GAP IDENTIFICATION

- Identifying what we know about a site also helps us to clarify what we DON'T know
  - i.e., data gaps
- Coupled with what we know about potential exposure pathways, this helps us focus on what we NEED to know
  - i.e., data needs
- And that supports the creation of data quality objectives, or DQOs

DEPICTING THE CONCEPTUAL SITE MODEL

- CSM contains a lot of information
  - Varies in content and level of detail
  - Depends on site complexity
- There are multiple ways to present the CSM information
  - A simple figure or narrative may be sufficient for a simple site
  - Most sites are more complex
    - Written narrative
    - Tables, maps, diagrams, & cross-sections
    - Other graphics
- What is the best way?
  - ***ALL OF THEM***



DEPICTING THE CONCEPTUAL SITE MODEL, CONT'D.

- Narrative – Text
  - Written description of site conditions
    - Based on profile information
  - Summary of information
    - Contaminants
    - Receptors
    - Activities
    - Exposure routes
  - Advantages
    - Describes all details
  - Disadvantages
    - No spatial element
    - Not as easy to follow

D-2. Example 1, Narrative Description: Air-to-Ground Gunnery Range.

a. Overview.

(1) A site-specific conceptual site model (CSM) summarizes available site information and identifies relationships between exposure pathways and associated receptors. A CSM is used to determine the data types necessary to describe site conditions and quantify receptor exposure, and discusses the following information:

- Current site conditions and future land use;
- Potential munitions and explosives of concern (MEC) and munitions constituents (MC) sources (e.g., lead projectiles in an impact berm);
- Affected media;
- Governing fate and transport processes (e.g., surface water runoff and/or groundwater migration);
- Exposure media (i.e., media through which receptors could contact site-related MEC and MC);
- Routes of exposure (e.g., inhalation, incidental ingestion, and dermal contact); and
- Potential human and/or representative ecological receptors at the exposure point. Receptors likely to be exposed to site MEC or MC are identified based on current, determined, or reasonably anticipated future land uses.

(2) The CSM is evaluated for completeness and further developed as needed through Systematic Planning Process (SPP) meetings and additional investigation.

b. Background. The CSM is based on information presented in the Archives Search Report (ASR) (U.S. Army Corps of Engineers [USACE], 1995) and ASR Supplement (USACE, 2004). The CSM was updated with information obtained during the Site Inspection (SI).

c. History of Use.

(1) The Air-to-Ground Gunnery Range (AGGR) munitions response site (MRS) was in use from 1942 to 1945. The gunnery range, which was a 2-mile by 6-mile rectangle, was used strictly for target machinegun firing by bombers. Landowners reported that the site was never used as a bombing range and indicated that Department of Defense (DoD) personnel conducted machinegun practice from B-17 and B-24 aircraft toward wood frame and canvas covered targets located on ridges and flat pastures.

(2) A typical air-to-ground gunnery range would have aircraft flight paths parallel to the lengthwise property boundary. Targets would be in the interior of the Formerly Used Defense Site (FUDS) on flat lands or on hill tops. Munitions debris associated with the flight lines of the bomber aircraft would typically consist of bullet casings, bullet links, and unfired rounds. The 1995 ASR reports a series of nine targets (including a cement stock tank) was established in a line beginning in the southeast corner and extending northward (including one target location outside the FUDS boundary) over a length of approximately 7 miles. Landowners reported that machinegun strafing occurred throughout the site and up to 1 or 2 miles outside the site boundary. Real estate records indicate that no DoD-installed improvements were constructed on the site. According to landowners, DoD-installed improvements were limited to wood frame

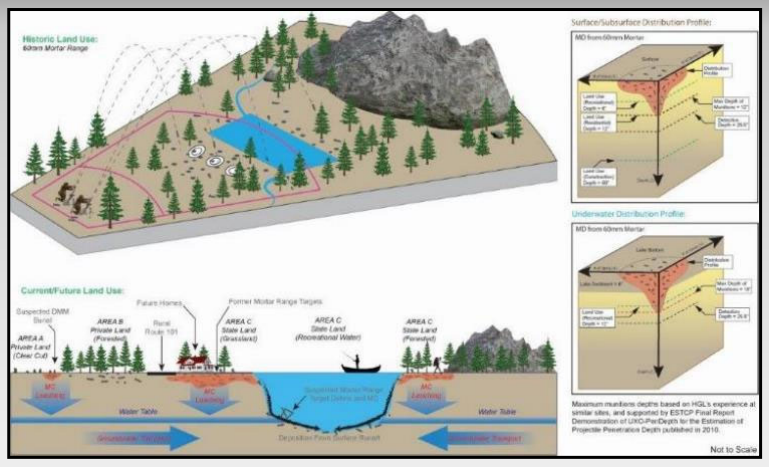
DEPICTING THE CONCEPTUAL SITE MODEL, CONT'D.

- Narrative – Table
  - CSM elements in columns
    - Contaminants
    - Receptors/activities
    - Exposure routes
  - Advantages
    - Describes key details
    - Easier to follow
  - Disadvantages
    - Not as detailed
    - No spatial element

SITE DETAILS	Known or Suspected Contamination Source(s)	Potential/Suspected Location and Distribution	Source or Exposure Medium	Current and Future Receptors	Potentially Complete Exposure Pathway
NAME: Rocket and Rifle Grenade Range Acreage: 125 total. Only obtained ROE for 69 acres Suspected Past United States DoD Activities (*release mechanisms*): Unexploded ordnance (UXO) from rocket and rifle grenade firing range training Current and Future Land Use: Cultivated cropland and wooded areas	MEC: • Rocket, 2.36-inch, practice • Rifle grenade • Hand grenade	MEC: Potentially present throughout MRS, with greater potential quantities at HUAs	Surface and subsurface soil	Construction workers, site workers (agricultural), recreational users (hunters), and site visitors	Intentional/unintentional interaction with MEC in surface and/or subsurface soil
	MC: • MC metals: copper, lead, and zinc • Explosives	MC: Not confirmed, but potentially present within HUAs	Surface and subsurface soil	Construction workers, site workers (agricultural), recreational users (hunters), site visitors, and ecological receptors	Dermal contact with surface and/or subsurface soil containing MC
		MC: Not confirmed, but potentially present at HUAs	Groundwater	Residents, construction workers, and site workers (agricultural)	Ingestion as drinking water or dermal contact with GW containing MC
NAME: Mine Training Area Acreage: 109 acres Suspected Past United States DoD Activities (*release mechanisms*): UXO/discarded military munitions (DMM) from engineer mine training Current and Future Land Use: Cultivated cropland and wooded areas	MEC: • Mine, Practice, M1 • Mine, Practice, M4 • Mine, Fuze, M1	MEC: Potentially present throughout MRS, with greater potential quantities at HUAs	Surface and subsurface soil (most likely subsurface)	Construction workers, site workers (agricultural), recreational users (hunters), and site visitors	Intentional/unintentional interaction with MEC in surface and/or subsurface soil
	MC: • MC metals: copper, lead, and zinc • Explosives	MC: Not confirmed, but potentially present within HUAs	Surface and subsurface soil	Construction workers, site workers (agricultural), recreational users (hunters), site visitors, and ecological receptors	Dermal contact with surface and/or subsurface soil containing MC
		MC: Not confirmed, but potentially present at HUAs	Groundwater	Potential future residents, construction workers, and site workers (agricultural)	Ingestion as drinking water or dermal contact with GW containing MC

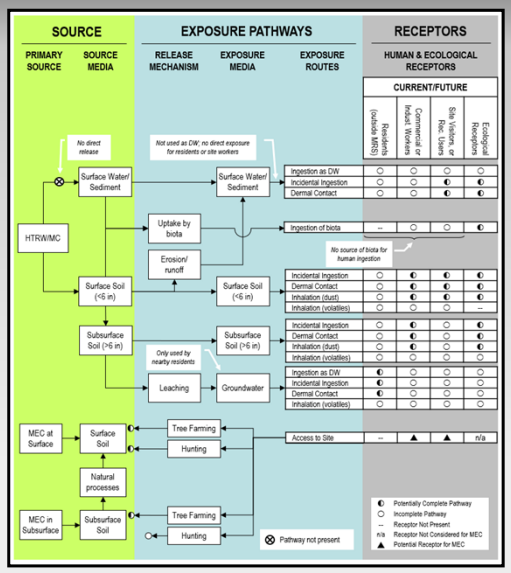
DEPICTING THE CONCEPTUAL SITE MODEL, CONT'D.

- Pictorial
  - Locations of
    - Contaminant locations
    - Receptors/activities
    - Exposure routes
  - Advantages
    - Easy to understand
    - Presents spatial data
    - Useful for presenting the CSM to stakeholders
  - Disadvantages
    - Limited details
    - Can be overly simplistic



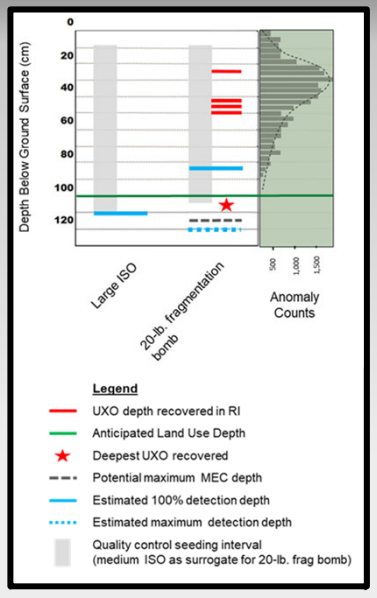
DEPICTING THE CONCEPTUAL SITE MODEL, CONT'D.

- Exposure Pathway Diagram
  - Summarizes
    - Contaminants
    - Release mechanisms
    - Exposure media
    - Receptors
    - Complete and incomplete exposure pathways
  - Advantages
    - Clearly shows complete and incomplete exposure pathways
    - Can display additional pathways as needed
  - Disadvantages
    - Not as detailed
    - No spatial element



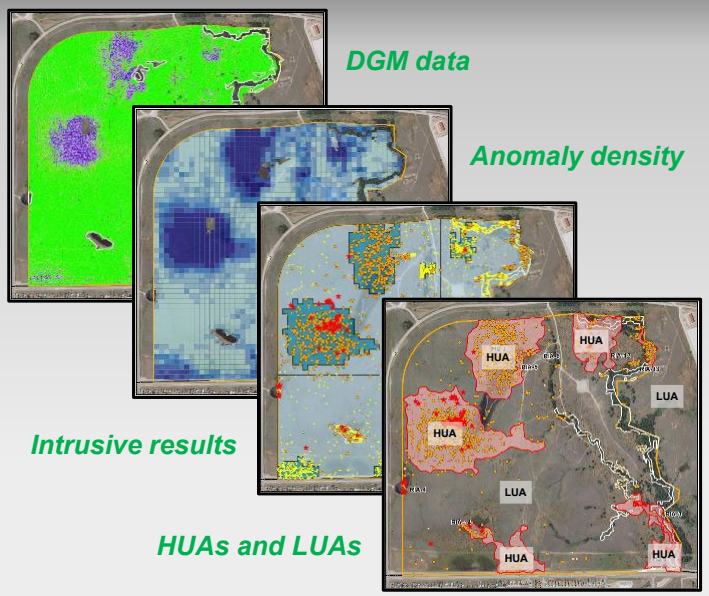
DEPICTING THE CONCEPTUAL SITE MODEL, CONT'D.

- Vertical profile
  - Shows
    - Estimated MEC depth distribution and max. depth
    - Seed depth intervals
    - MEC and seed detection depths
    - Vertical distribution of items
    - Land use interaction zone depths
    - Bedrock depth, if known
    - RA removal depth
  - Advantages
    - Can show all vertical data
    - Assists RAO development
  - Disadvantages
    - Only shows vertical data



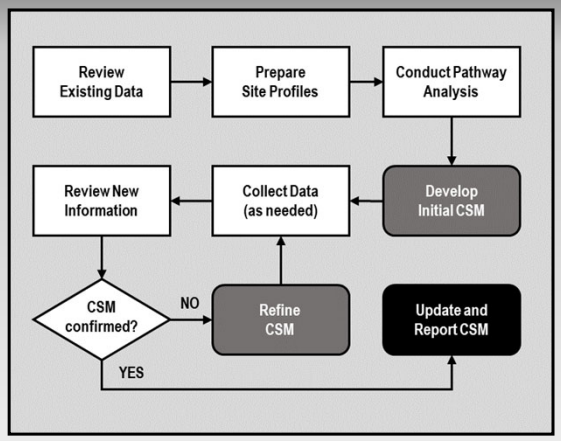
DEPICTING THE CONCEPTUAL SITE MODEL, CONT'D.

- Other methods
  - Project data maps
    - Geophysical data
    - Anomaly density
    - Intrusive results
    - High use and low use areas (HUAs and LUAs) and No Evidence of Use (NEU) areas
  - And whatever else you come up with



CLOSING THOUGHTS

- CSM describes what we currently know about the site
  - Also identifies data gaps
- CSM is dynamic
  - Requires continual refinement
  - Should be updated after completion of each project phase
- CSM data can, and should, be displayed in multiple ways
- CSM supports both DQO and RAO development



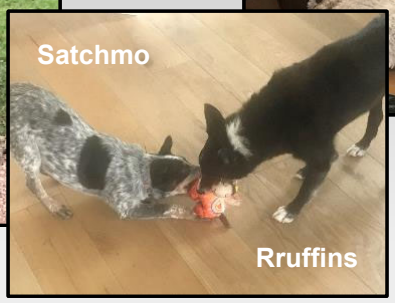
The CSM is *the core of the project*

QUESTIONS?

April 2021

May 2021

August 2021



June 2021