Getting the Most Out of *Your* Conceptual Site Model

RITS Fall 2009

Presentation Overview

- Introduction
- Components of a CSM
- Development of a CSM
- Case Study CSMs
- Summary/Take-Home Messages

Topic Objectives

- DISCUSS the basic components of a Conceptual Site Model (CSM) and its role at Navy environmental sites
- DESCRIBE different types of CSMs
- EXPLAIN how CSMs can help in the CERCLA process
- IDENTIFY useful analytical tools such as a GIS and NIRIS to help build, validate and refine your CSM
- DISCUSS case study CSMs dealing with soil, sediment and groundwater issues

Issues Facing Site Managers

- Environmental sites can be complex
  - Complex hydrogeology or transport mechanisms
  - Multiple constituents of potential concern (COPC)
  - Multiple receptors and related pathways
- Years of characterization data
- Revolving consultants/RPMs/ regulatory management
- Inconsistent regulatory oversight
- You have a full plate already

The Long Road of Site Management

- Information overload
- Minor site issues compete with major ones
- Road to site closure gets longer and bumpier

What is a Conceptual Site Model (CSM)?

Definitions

- **U.S. EPA, 1996**
  - The CSM is a **three-dimensional "picture"** of site conditions that illustrates contaminant distributions, release mechanisms, exposure pathways and migration routes, and potential receptors.
    - » USEPA, Soil Screening Guidance User's Guide, Second Edition, EPA/540/R-96/018, July 1996 (SSG, 1996).
- **NAVFAC 2009**
  - A CSM is a professional interpretation of site data that serves as a **systematic planning instrument**, a **communication device**, and an **optimization and decision support tool**. A CSM is the basis for all site planning and decision-making at an Environmental Restoration (ER) site.
    - » CSM Web Tool (DRAFT) – NAVFAC

Attention RPMs

Navy has a CSM Focus Group to Define and Evaluate Web Tool

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The CSM is a comprehensive representation of the site that documents current site conditions. It characterizes the distribution of contaminant concentrations across the site in three dimensions and identifies all potential exposure pathways, migration routes, and potential receptors. USEPA, SUPPLEMENTAL GUIDANCE FOR DEVELOPING SOIL SCREENING LEVELS FOR SUPERFUND SITES, OSWER 9355.4-24, December 2002

The CSM summarizes the site conditions, the distribution of constituents of potential concern (COPCs), potential receptors and exposure pathways, and land use data available for a given site.

Guidance For Optimizing Remedy Evaluation, Selection and Design; User's Guide UG-2060-ENV, April 2004, prepared for NAVFAC.

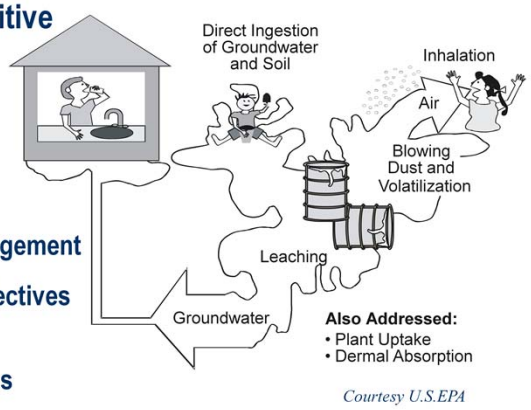
Others: The CSM is a description of a site and its environment that is based on existing knowledge. It describes sources and receptors, and the interactions that link these. It assists the team in planning, data, interpretation and communication (CONCEPTUAL SITE MODELS FOR ORDNANCE AND EXPLOSIVES (OE) AND HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE (HTRW) PROJECTS, EM 1110-1-1200 3 February 2003. U.S. Army Corps of Engineers)

A representation of site conditions developed using readily available (existing) data that illustrates the relationship between contaminants, retention/transport media, and receptors. EPA. November 2000. *Using the Conceptual Site Model to Select Performance Standards and Develop Data Quality Objectives in the CAS.*

A CSM is a three-dimensional "picture" of site conditions at a discrete point in time (a snapshot) that conveys what is known or suspected about the facility, releases, release mechanisms, contaminant fate and transport, exposure pathways, potential receptors, and risks. EPA Region 6, Corrective Action Strategy (CAS), November 2008

Usage of a CSM

- ***YOUR*** **View of potential releases to environment, fate & transport, and the proximity of receptors and sensitive environments**
  - Systematic planning process
  - Risk characterizations and risk management decisions
  - Performance-based project management
  - Development of Data Quality Objectives (DQOs)
  - Sound remedy selection decisions
  - Consensus building with stakeholders



Courtesy U.S.EPA

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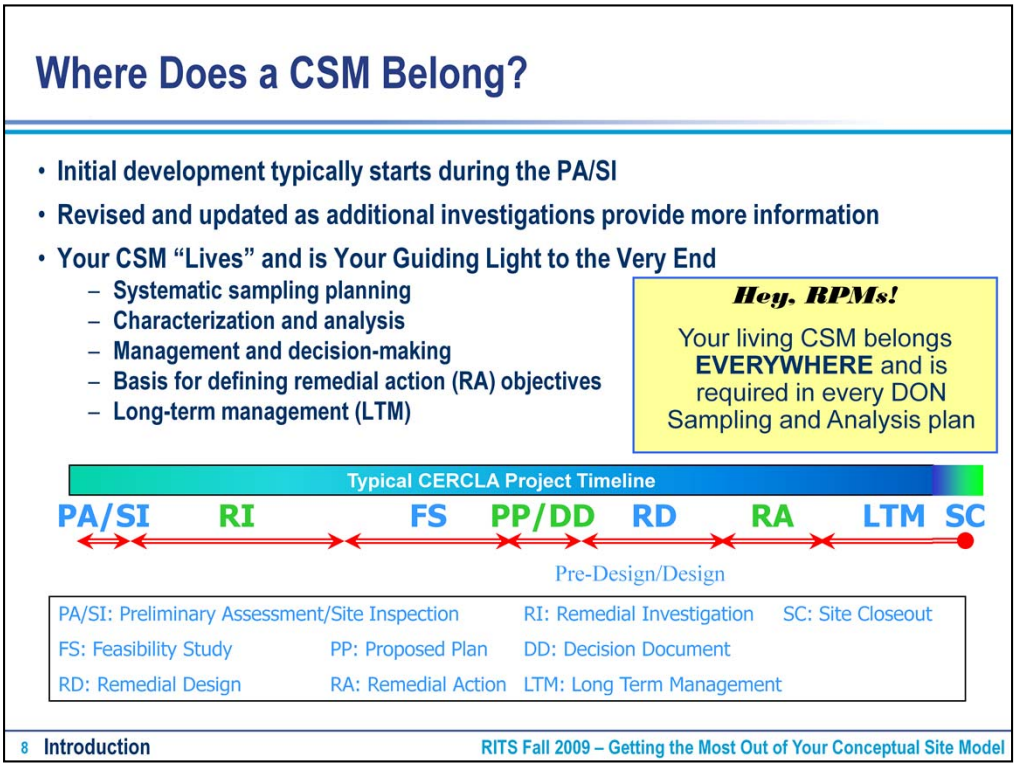


Because site conditions can change between the FS and RD phases, RPMs should consider the development of the CSM to be a continuous evolving process until site closeout is achieved.

Choose Your Guide – DoD

- **Abundance of guidance documents – DoD**
  - **Navy**
    - Guidance for Optimizing Remedy Evaluation, Selection, And Design, April 2004
    - Guidance for Environmental Background Analysis, Volume III: Groundwater, April 2004
    - Final Implementation Guide for Assessing and Managing Contaminated Sediment at Navy Facilities, January 2005
    - Navy Guidance for Conducting Ecological Risk Assessments
    - Navy Guidance for Conducting Human Health Risk Assessments
    - U.S. Navy Range Sustainability Environmental Program Assessment (RSEPA) Policy Implementation Manual, Nov 2006 Appendix C: Models and Other Tools for Implementing RSEPA
    - NAVFAC ESC UG-2081-ENV: DON Guidance for Planning and Optimizing Monitoring Strategies. August 2008 Incorporating monitoring results into updated CSMs
    - NAVFAC ESC SR-2101-ENV: Guidance for Optimizing Remedial Action Operation (RA-O), Interim Final, April 2001
    - RPM Newsletter Fall 2007 Article: Case Study–Creating a Conceptual Site Model Using NIRIS

Choose Your Guide – DoD (cont.)

- **Abundance of guidance documents – DoD (cont.)**
  - **Army**
    - Conceptual Site Models for Ordnance And Explosives (OE) and Hazardous, Toxic, and Radioactive Waste (HTRW) Projects, February 2003
  - **Air Force**
    - Final: Performance-Based Management Remedial Objectives Assessment, June 2004
  - **DOE**
    - Guide for Developing Conceptual Models for Ecological Risk Assessments, May 1996

Choose Your Guide – Others

- **Guidance from regulatory authorities**
  - **U.S. EPA**
    - Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, October 1988
    - Guidance for Data Usability in Risk Assessment - Part A and Part B, May and April 1992
    - Soil Screening Guidance User's Guide, Second Edition, EPA/540/R-96/018, July 1996
    - Data Quality Objectives Process for Hazardous Waste Site Investigations, EPA QA/G-4HW, Final, January 2000
    - Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G-4, February 2006
    - Corrective Action Strategy (CAS), Region 6, November 2008
  - **ASTM**
    - Standard Guide for Developing Conceptual Site Models for Contaminated Sites, ASTM E1689 - 95(2008)

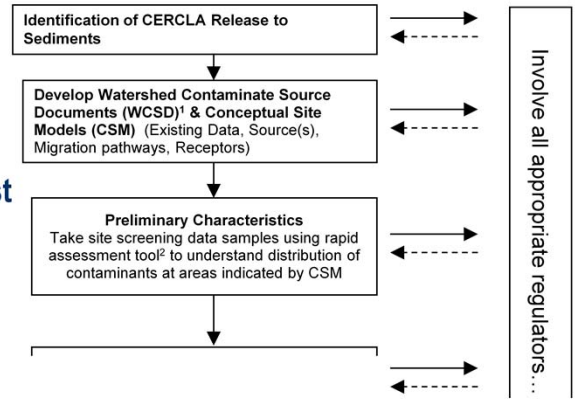
Navy Guidance Dictates use of CSM

- NERP Manual, 2006
  - "The CSM…is essential for successful management and decision making throughout the ER process."
  - "…the CSM should be updated as performance and monitoring data are collected and analyzed to optimize the remedy…"
  - "The CSM is the basis for defining RA Objectives…"

Navy Policy Requires CSM – Sediment

- **Navy/Marine Corps Policy on Sediment Site Investigation and Response Action – Feb 8, 2002**
  - **"…characterization must be conducted using planning tools and methods such as CSM, DQOs and problem formulation before any samples are collected."**

Navy IR Sediments Framework



Navy Policy Requires CSM – Vapor Intrusion

- Navy/Marine Corps Policy on Vapor Intrusion – April 29, 2008
  - "CSM and DQOs shall be used to determine proper sampling methodology."
  - "CSM shall be developed/updated to clearly outline the contamination location and types, the potential pathways, and the applicable receptors."
  - "When applicable, OSHA standards and workplace requirements will be considered and incorporated in the CSM…"

Presentation Overview

- Introduction
- Components of a CSM
- Development of a CSM
- Case Study CSMs
- Summary/Take-Home Messages

Components of a CSM

- Primary/potential sources (site history)
- Primary release mechanism
  - Past, current, and future releases
  - Impacted media
  - Secondary sources
- Transport pathways/mechanisms
  - Multi-media pathways
  - Fate processes (degradation/attenuation)
- Potential risk receptors and exposure routes
  - Human and ecological receptors, current and future
  - Inhalation, dermal, ingestion, consumption, and exposure routes

Key Requirements of CSM

- Chemical release scenario, source(s), and COPCs
- Spatial and temporal distribution of COPCs
- Description of physical setting
  - Topography
  - Hydrology
  - Hydrogeology
  - Stratigraphy
  - Meteorology
- Fate and transport (F&T) mechanisms
  - Geochemical conditions
  - Biological activity
  - Exposure to elements

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constituents of potential concern (COPC)

Key Requirements of CSM (cont.)

- Current and future land and groundwater use
- Description of any known existing or proposed land or water use restrictions
- Remedial activities conducted to date
- An exposure model that:
  - Identifies all potential receptors
  - Identifies exposure pathways to receptors
  - Evaluates current and future land use conditions with respect to risk

Different Levels of a CSM

- Comprehensive
  - Detailed evaluations of sources and releases
  - Environmental F&T
  - All receptors and exposure routes
- Targeted
  - May contain components of comprehensive CSM
  - Address pertinent issues such as sampling or focused remediation
  - Receptor or media specific
- Executive Summary CSM

Living CSM

- Keep feeding your CSM
  - New source information
  - Characterization data
  - Latest modeling results
  - Remediation activities
  - Land use changes
- A current and complete CSM is a happy CSM

CSM Visualization – Types and Formats

- Schematic
- Text
- Tables
- GIS Maps
- Photos
- 3D Physical Model
- Computer Model
- Receptor Flow Chart
- 2-D Cross Section
- Time Series Plots
- Treatment Train Conceptual Design

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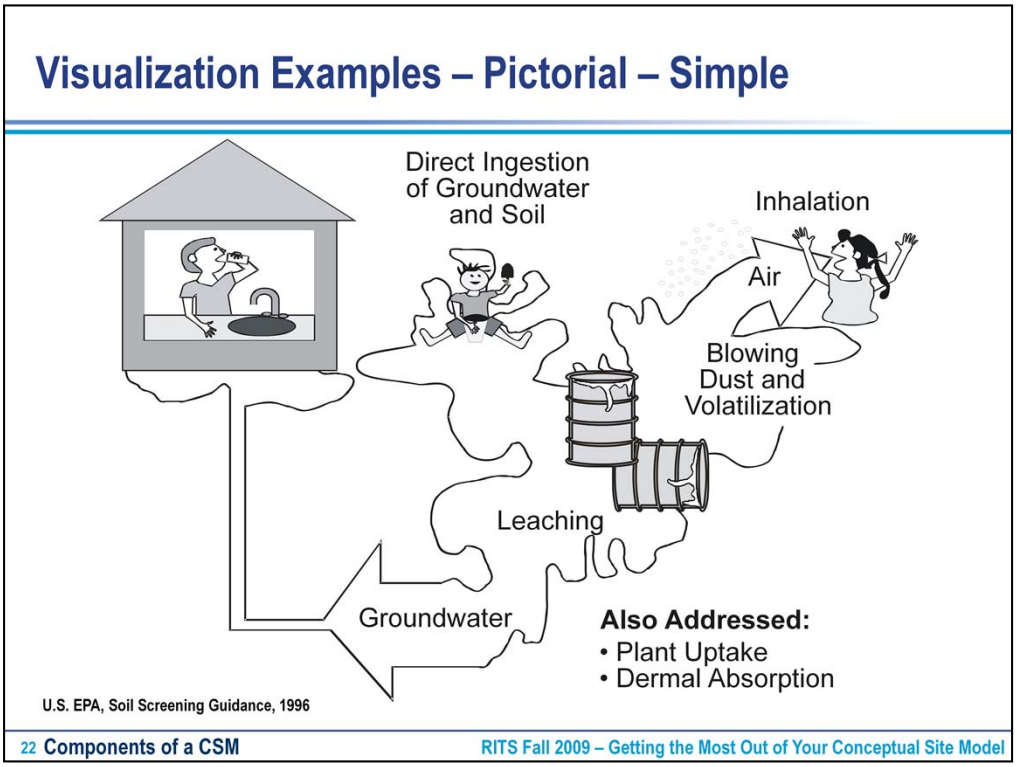
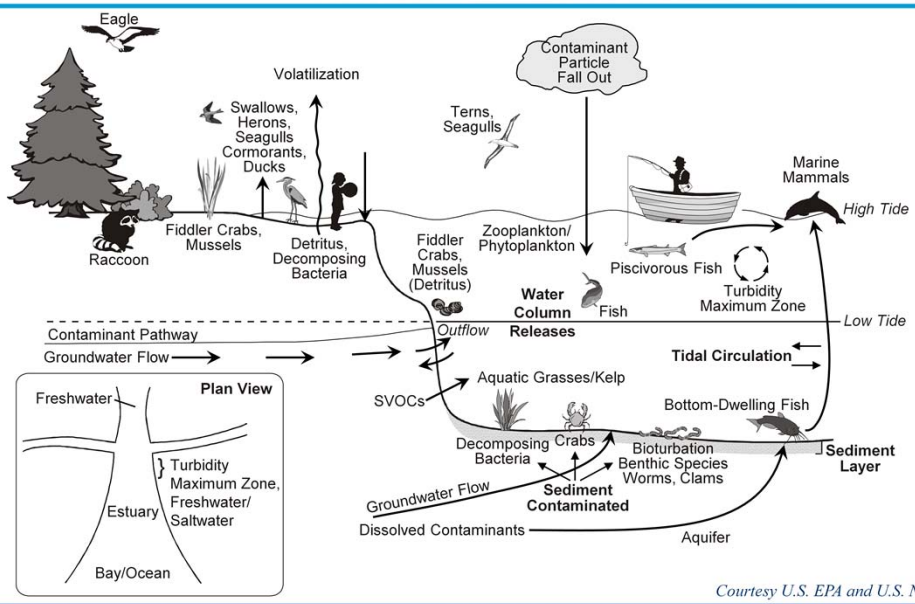
Don’t need all of these or maybe just a combination



Pic: Exhibit 2, EPA, Soil Screening Guidance, 1996

Visualization Examples – Pictorial – More Info

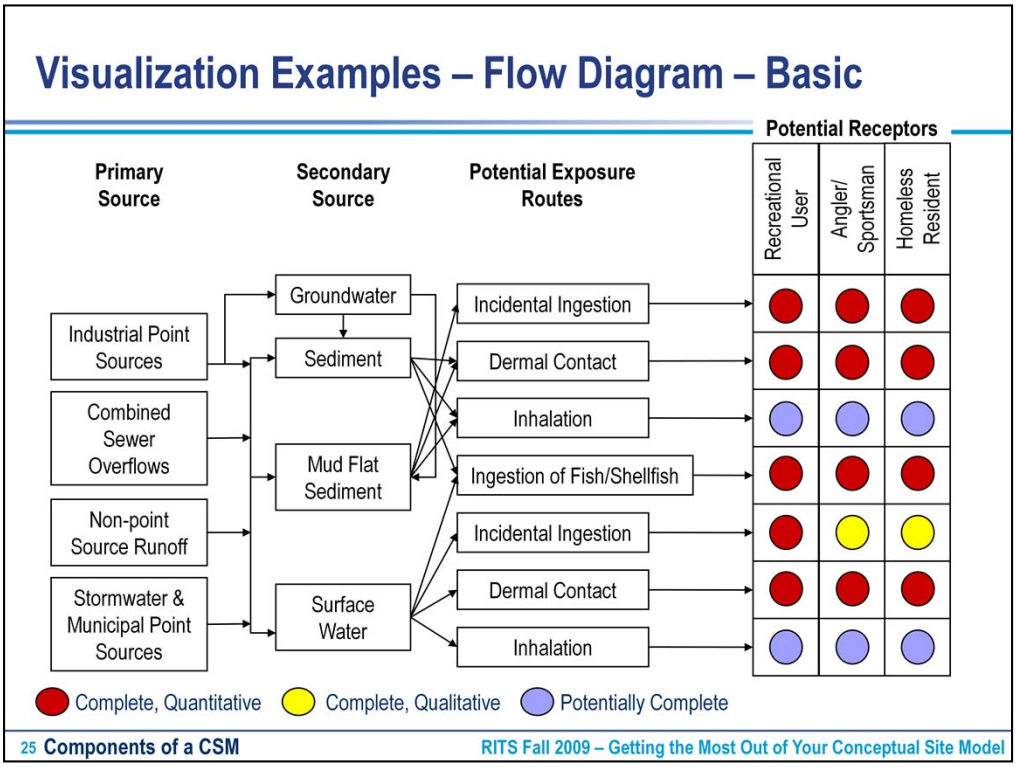


Courtesy U.S. EPA and U.S. Navy

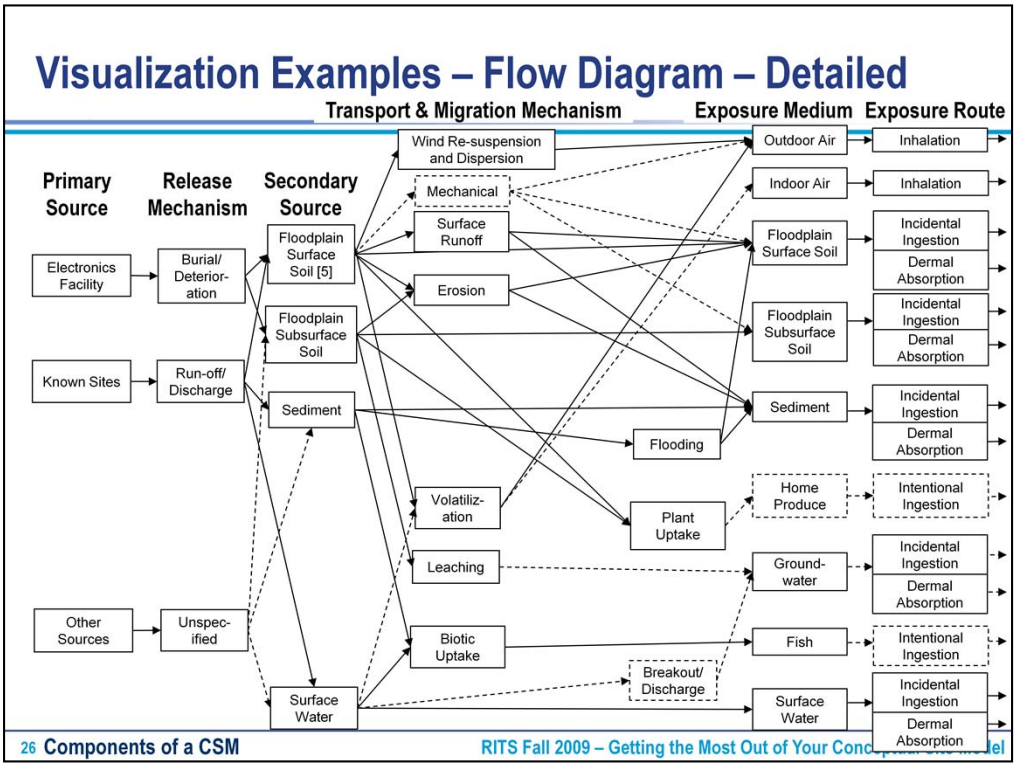
Visualization Examples – 3D GIS Data

Attention RPMs

3D GIS and other 3D models are **great** for **interactive presentations** and not so great as maps in reports



Flow diagrams are typically made for risk assessments


Visualization Examples – Flow Diagram – Detailed
Transport & Migration Mechanism
Exposure Medium
Exposure Route
Primary Source
Release Mechanism
Secondary Source
Electronics Facility
Burial/ Deterior-ation
Floodplain Surface Soil [5]
Known Sites
Run-off/ Discharge
Floodplain Subsurface Soil
Sediment
Other Sources
Unspec-ified
Surface Water
Wind Re-suspension and Dispersion
Mechanical
Surface Runoff
Erosion
Flooding
Volatiliz-ation
Plant Uptake
Leaching
Biotic Uptake
Breakout/ Discharge
Outdoor Air
Indoor Air
Floodplain Surface Soil
Floodplain Subsurface Soil
Sediment
Home Produce
Ground-water
Fish
Surface Water
Inhalation
Inhalation
Incidental Ingestion
Dermal Absorption
Incidental Ingestion
Dermal Absorption
Incidental Ingestion
Dermal Absorption
Intentional Ingestion
Incidental Ingestion
Dermal Absorption
Intentional Ingestion
Incidental Ingestion
Dermal Absorption
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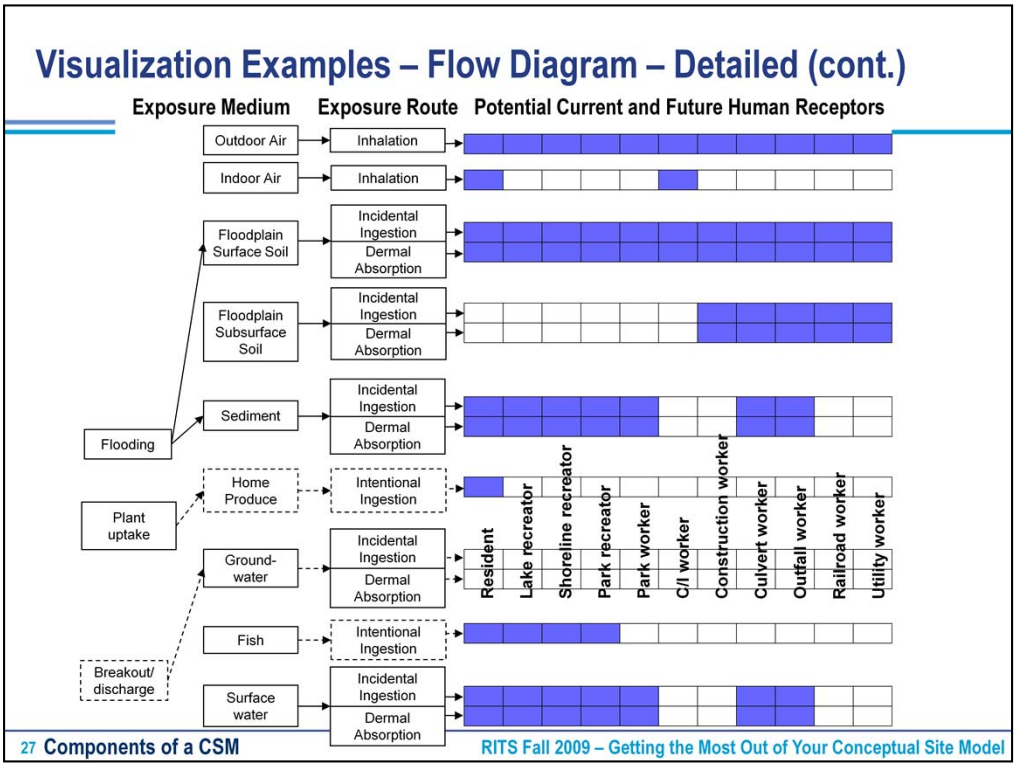
Visualization Examples – Flow Diagram – Detailed (cont.)
Exposure Medium
Exposure Route
Potential Current and Future Human Receptors
Outdoor Air
Inhalation
Indoor Air
Inhalation
Floodplain Surface Soil
Incidental Ingestion
Dermal Absorption
Floodplain Subsurface Soil
Incidental Ingestion
Dermal Absorption
Sediment
Incidental Ingestion
Dermal Absorption
Flooding
Home Produce
Intentional Ingestion
Plant uptake
Ground-water
Incidental Ingestion
Dermal Absorption
Fish
Intentional Ingestion
Breakout/ discharge
Surface water
Incidental Ingestion
Dermal Absorption
Resident
Lake recreator
Shoreline recreator
Park recreator
Park worker
C/I worker
Construction worker
Culvert worker
Outfall worker
Railroad worker
Utility worker
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Visualization Examples – Text

3.0 CONCEPTUAL SITE MODEL

Based on the data gathered from the previous work at the Site, a Conceptual Site Model (CSM) has been developed. The CSM includes identifying Site sources, exposure pathways, and potential receptors. A discussion of each of the CSM elements is presented below, followed by an evaluation of the risks the Site poses to human health and the environment.

3.1 Sources

Releases related to the chromium plating operations conducted from the late 1970s through 2000 resulted in chromium VI concentrations that pose an environmental risk above ground, in soil, and in groundwater. The plating operation was housed mainly in one large building with five auxiliary buildings that were used to store products and waste. A storage tank housed inside a …

What a CSM Can Do For *You*

- Sampling plans
  - Focused plans
  - Data gap analysis
  - Assessment of background
- Data analysis
  - Perform analyses to test, validate and revise CSM
- Risk assessments
  - Define receptors and exposure pathways to evaluate
- Remedial decisions
  - Guided by risk and future use
- Communication/collaboration tool
- Liability assessment (allocation)

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Basic Steps to Developing a CSM

- **Compile site information**
  - **Environmental data**
  - **Physical setting**
  - **Hydrogeology**
  - **Site history and documentation**
    - Historic imagery
    - Characterization reports
    - Risk assessments
    - Facility profiles
- **Naval Installation Restoration Information Solution (NIRIS) can help!**

Basic Steps to Developing a CSM (cont.)

- **Outline exposure**
  - **Determine sources and receiving media**
  - **Fate and transport pathways**
  - **Primary, secondary, tertiary contact media**
  - **Exposure routes**
    - Ingestion, inhalation, dermal
  - **Assess receptor populations**
    - Human (adult, youth, child, worker, trespasser, etc.)
    - Ecological

Your CSM is a Living Interpretation of Site Data

- It lives
  - Each site must have a CSM
  - Developed during initial phases
  - Continually refined with new information
  - Must be repeatedly tested and validated
  - Changes with your site (which is never stagnant)
- It talks
  - Use your CSM to help organize and communicate information
- It can exist as many forms
  - Comprehensive, Targeted or Summary
  - Media-specific
  - Risk receptor-specific
  - Audience-specific

CSM Development Aids

- Use available forms
- Checklists
- Established procedures
  - Navy CSM Subgroup
  - Navy's Vapor Intrusion Checklist for CSM

NAVFAC

Vapor Intrusion Checklist

Please fill out this checklist form and click on 'submit' button below to download a printable form.

Conceptual Site Model Checklist – Vapor Intrusion

Site Name	
Site Description	Location:
	Size:
	Site Status: ☐ Active ☐ Inactive ☐ Unknown
Site Conditions	
Current Conditions (Request maps of site and adjacent areas)	Describe present site conditions using information from checklist as follows: conduct property inspection to identify on-site land use [e.g. residential vs. non-residential] and groundwater use [potable vs. non-potable] conditions as well as land and groundwater use on adjacent property, number and type of structures, number/type of people, distance from base boundary, distance to nearest off-base community [residential and non-residential]; site in investigation, cleanup, or post-cleanup phase.
Future Conditions	Describe potential future conditions (obtain from Base Master Plans or redevelopment plans for property transfers), consider including information as was identified under "current conditions" above
Geology and Hydrogeology	☐ Vadose zone lithology ☐ Depth to bedrock ☐ Characteristics of each stratigraphic unit ☐ Depth to groundwater ☐ Groundwater connection to surface water ☐ Aquifer characteristics (physical and chemical) ☐ Productivity of saturated zone

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Program-Specific Forms – Triad

Facility

CSM Requirement		Status	Required Action
Identify current and historical facility structures (buildings, drain systems, sewer systems, underground utilities, etc)			
Identify process areas, including historical processing areas (loading/unloading, storage, manufacturing, etc)			
Identify current and historical wastemanagement areas and activities			
Other			

Land Use And Exposure

CSM Requirement		Status	Required Action
Identify specific land use(s) on the facility and adjacent properties			
Identify beneficial resources (groundwater classification, wetlands, natural resources, etc)			
Identify resource use locations (water supply wells, surface water intakes, etc)			
Identify subpopulation types and locations (schools, hospitals, day care centers, etc)			
Identify applicable exposure scenarios (residential, industrial, recreational, farming, etc)			
Identify applicable exposure pathways (contaminant sources, releases, migration mechanisms, exposure media, exposure routes, receptors)			
Other			

Physical Features

CSM Requirement		Status	Required Action
Identify topographical features (hills, gradients, surface vegetation, or pavement)			
Identify surface water features (routes of drainage ditches, links to water bodies, etc)			
Identify surface geology (soil types, soil parameters, outcrops, faulting, etc)			
Identify subsurface geology (stratigraphy, continuity, connectivity, etc)			
Identify hydrogeology (water-bearing zones, hydrologic parameters, impermeable strata, direction of groundwater flow, etc)			
Identify existing soil boring and monitoring well logs and locations			
Other			

Program-Specific Forms – EPA CERCLA/RCRA

- **Soil Screening Guidance (SSG), 1996, Attachment A**

Soil Screening Guidance
Conceptual Site Model Summary Forms

Form 1: General Site Information **Site Name** _____

EPA Region_____ Date_____

Contractor Name and Address: _____

_____

_____

State Contact: _____

1. CERCLIS ID No. _____
   Address _____City _____
   County_____ State _____ Zip Code ____ Congressional District_____

2. Owner Name _____Operator Name_____
   Owner Address _____Operator Address_____
   City _____ State _____City _____ State _____

3. Type of ownership (check all that apply):
   ☐ Private ☐ Federal Agency_____ ☐ State ☐ County ☐ Municipal
   Other _____Ref. _____

4. Approximate size of property _____acres Ref. _____

5. Latitude ___ °___|___ . ___" Longitude ___ °___|___ . ___" Ref. _____

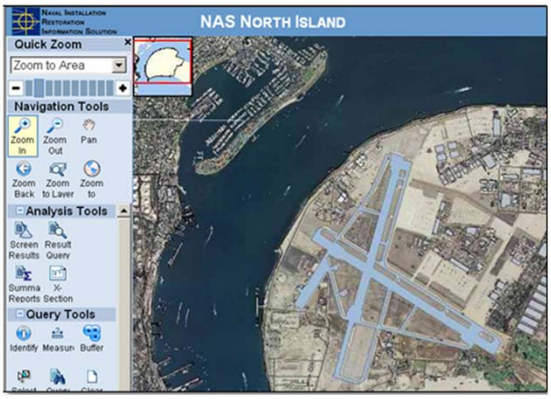
6. Site status ☐ Active ☐ Inactive ☐ Unknown Ref. _____

Advantages and Weaknesses

- **Checklists and forms offer:**
  - **Advantages**
    - Consistency
    - Step-by-step approach
    - Detailed and documented
  - **Weaknesses**
    - Not always one size fits all
    - Could limit your creativity
- **Don't go overboard with your CSM**
  - **Start simply and add detail and complexity if warranted**
  - **Remain clear and concise**

NIRIS and CSM Development

- NIRIS can be used to
  - Compile site data and documents
  - Visualize your data
  - Analyze your data
  - Test and validate your CSM
  - Present your CSM



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Navy Graphic from NIRIS

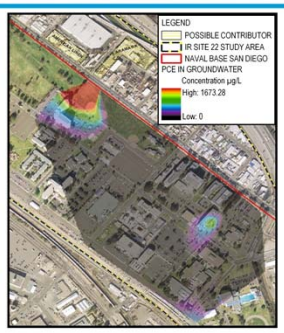
NIRIS and Input Data for CSMs

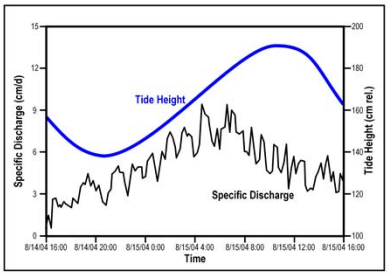
- ***Constituent distribution in soil and water***
- Potential release mechanisms
- Dispersal mechanisms
- Transport pathways
- ***Physical site characteristics***
- ***Potential source areas***
- Chemical & physical properties of constituents
- ***Geology***
- ***Hydrogeology***
- ***Surface water hydrology***
- Site history
- ***Site infrastructure***
- ***Current & future land use***
- Receptors
- Exposure pathways
- ***Site ownership and control***

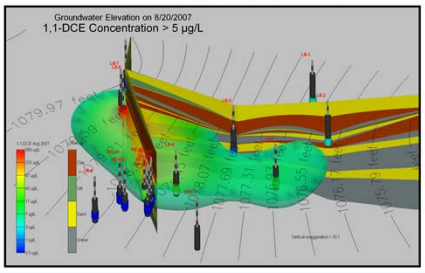
Underlined and *Italicized* text indicates NIRIS data

NIRIS Outputs for CSMs

- Post plots
- Plume maps
- Time series plots
- 3D data displays







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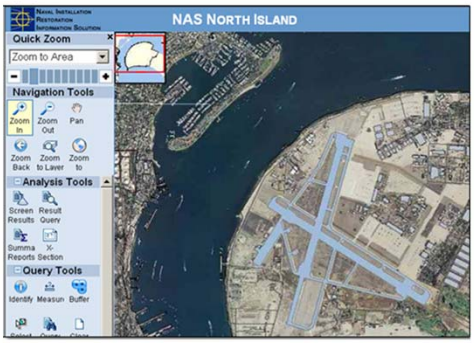
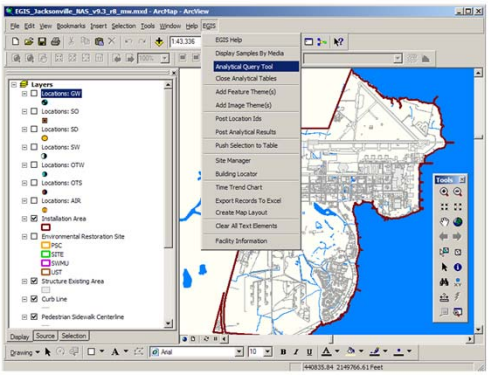
- It should be noted (or verbally explained) that some of these are easier than others - e.g., Time series is easy; contractor support would probably be needed to do 3D.

GIS and NIRIS

- Currently two solutions
  - Web-Based GIS linked to NIRIS database
  - ArcGIS via Citrix using data exported from NIRIS
    - Environmental GIS (EGIS)





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  - NAS JAX
  - Living CSMs
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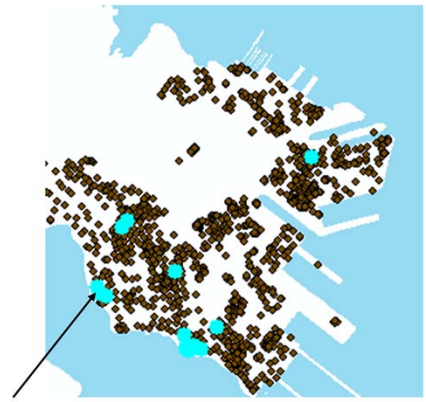
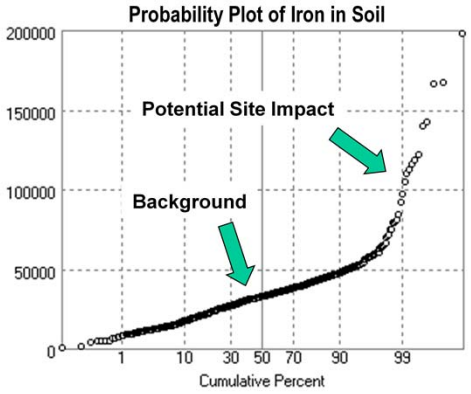
Hunters Point

- Natural/Anthropogenic soil, risk and remediation
  - Know your data when developing CSM

Use of Statistical Tools to Determine Background vs. Anthropogenic vs. Site Impact





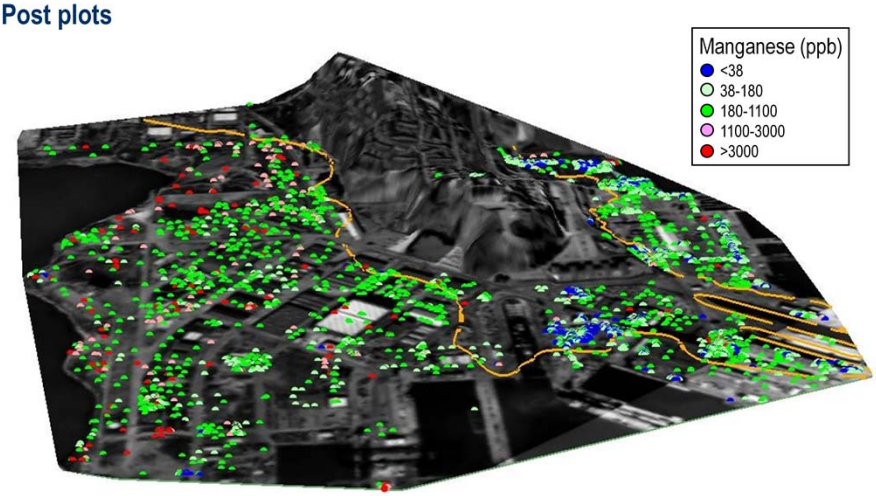
Tips for RPMs

- CECOS offers a 2-day course on "**Environmental Background Analysis**"

NewFields graphics

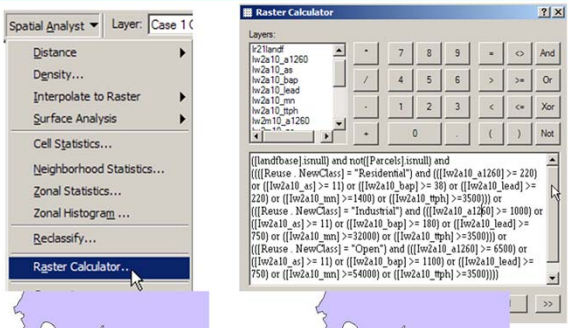
Use of GIS tools to Determine Impact of Risk/Cleanup Goals

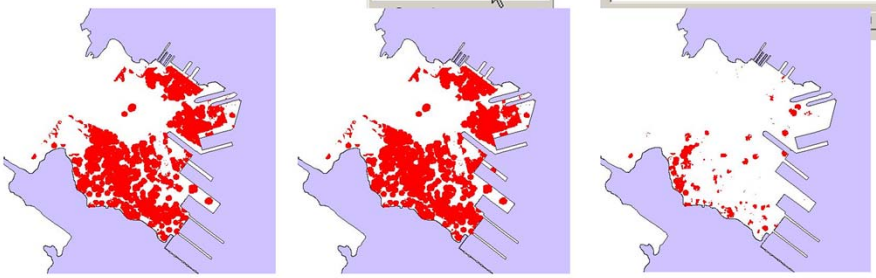
- Explore impact of risk- and background-based cleanup standards
  - Post plots



Use of GIS tools to Determine Impact of Risk/Cleanup Goals (cont.)

- Explore impact of risk- and background-based cleanup standards
  - Spatial Analyst





Lessons Learned

- Explore *Your* data before applying non-site-specific preliminary remediation goal (PRG) value
- Use tools such as probability plots to help understand data patterns and breakpoints
- Use GIS tools such as basic post plots and Spatial Analyst to determine consequence of COPC cleanup goals

Tips for RPMs

- Navy Guidance for Environmental Background Analysis: soil, sediment and groundwater

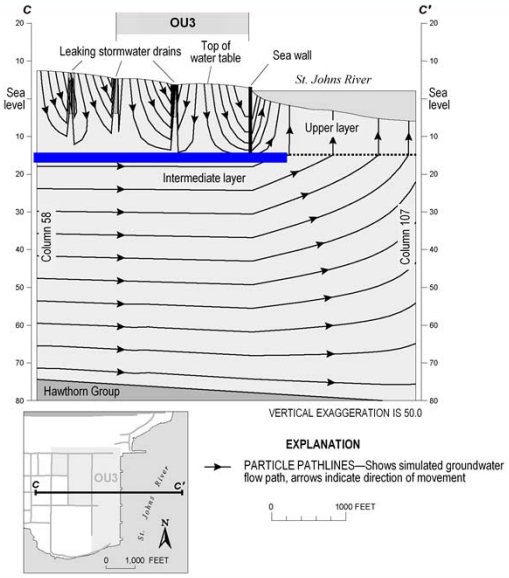
NAS Jacksonville, FL (JAX)

- Complex site with large dilute groundwater plume
- DNAPL likely present
- Multiple sources
- Groundwater discharges to river
- Tidally influenced
- Variable plume degradation

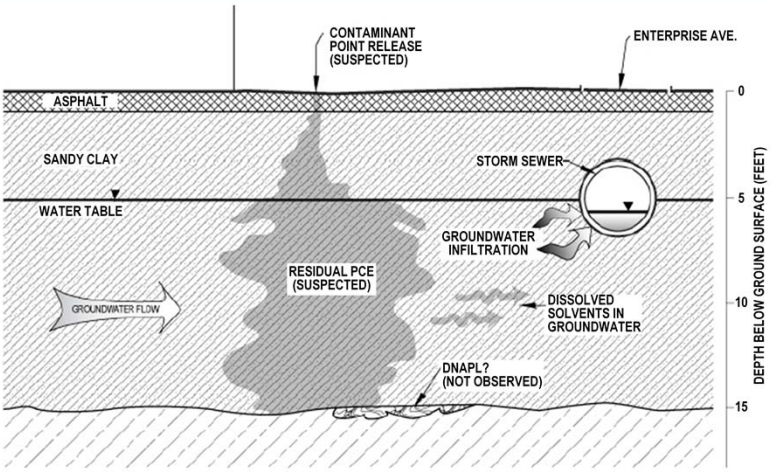
NIRIS EGIS

All NAS Jacksonville Case Study graphics courtesy U.S. Navy

Groundwater CSM – Start with F&T Model

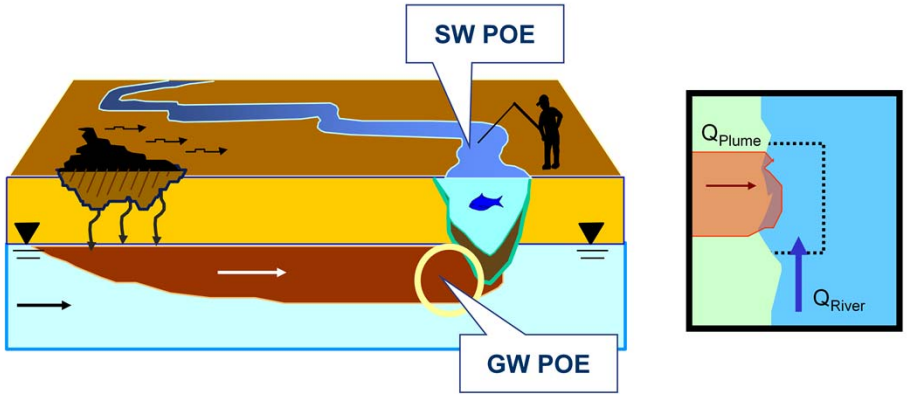


Groundwater CSM – Generate Conceptual Model of Fate & Transport



- Groundwater model simulated transport pathways, fate, timing of exposure and data gaps

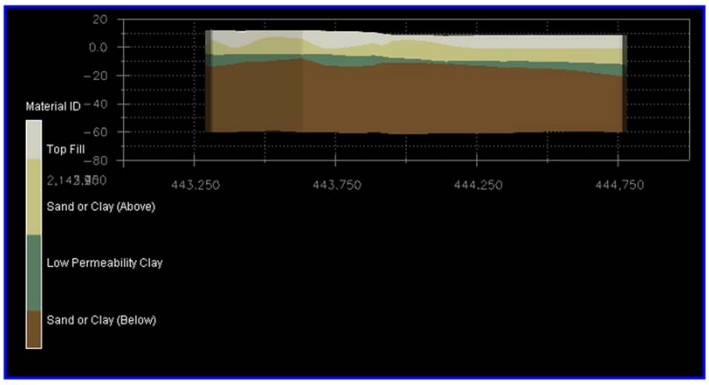
Groundwater CSM – Determine Point of Exposure (POE)



- Groundwater model simulated point of exposure to be in river while groundwater use is managed with institutional controls

CSM Data Requirements for DNAPL Sites

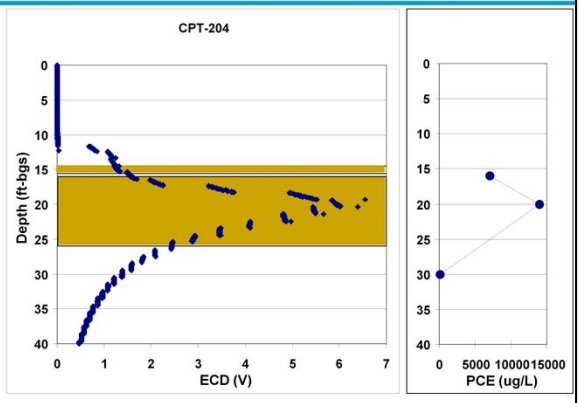
- Horizontal AND vertical delineation of COPCs
- Lithology data
- Stratigraphic model
- Groundwater flow and transport model



Cross-section of 3D Stratigraphy generated using MVS

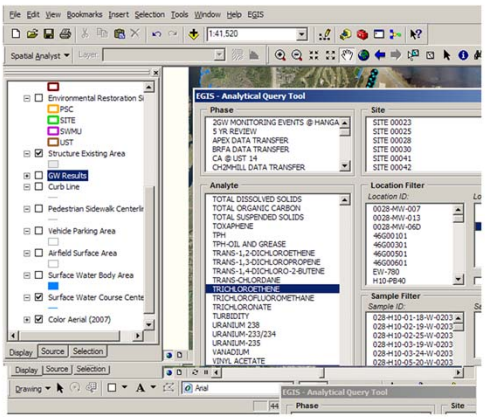
Use of GIS, 3D Modeling Tools and Semi-Quantitative Data

- All analytical data stored in NIRIS
- CPT/MIP data was used to supplement existing analytical data and boring log geologic classification
- Mining Visualization System (MVS) was used to analyze analytical and CPT/MIP data in 3D



Demo of NIRIS-Based EGIS

NIRIS EGIS



54 Case Study CSMs – NAS JAX RITS Fall 2009 – Getting the Most Out of Your Conceptual Site Model

NAS Jax Graphics from NIRIS and generated 4Dim model

Time Series Analysis of COCs demonstrate Most wells exhibit stable or decreasing trends in parent compounds (i.e. PCE and TCE)

Evidence for enhanced and natural reductive dechlorination

CPT data indicate clay layer thickness ranges from <1 to 10 feet

MIP/DPT data indicate CVOCs migrated through or around clay layer at Bldg 106

- Area with PCE ~1000s ppb at 50-70 ft bgs along upgradient edge of former Bldg. 106

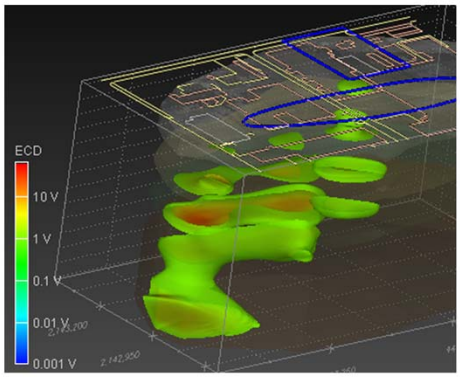
Much of the saturated zone contaminant mass resides in low permeability layers per CPT data

Back diffusion will limit impact of source treatment on downgradient plume and remediation timeframes.

- MNA and Long-term monitoring
  - Attenuation along GW flow path and occurring at groundwater/surface water interface (shown to be effective OU3)
- Transition zone (i.e., GW/SW interface)
  - Key element in site characterization
  - Need **cross-media data** (GW, SW, sediment) to verify model results

Demo of MVS 3D Model

3D Model generated using MVS



55 Case Study CSMs – NAS JAX RITS Fall 2009 – Getting the Most Out of Your Conceptual Site Model

NAS Jax Graphics - generated 4Dim model screen capture

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  - Key element in site characterization
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Lessons Learned

- Look at Your data using NIRIS
  - Ensure all pertinent data has been uploaded to NIRIS
- Qualitative or semi-quantitative data can enhance knowledge of site
- DNAPL sites can require extensive data
- 3D models are useful for more than plume maps
  - Determine feasibility of remedial actions
  - Build stakeholder consensus
- Don't stop validating *Your* CSM

Example of Living CSM

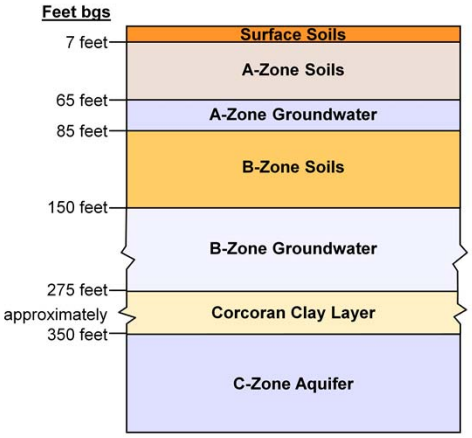
- A living CSM
  - Is dynamic and iterative
  - Will grow and shrink with the assessment and evaluation of risk pathways and exposure
  - Your site will change (plume migration, attenuation, new pumping wells, etc…) and so should your CSM
- Your CSM must be open to revision
  - Data will dictate CSM
  - Don't force information to fit a concept or project goal
  - Modify CSM when data becomes available

Empirical Data Driven vs. Desired Outcome Driven

Empirical Data Driven vs. Desired Outcome Driven (cont.)

- Preferred alternative – $15M
  - Relocate city well
  - Remediate shallow groundwater
  - On-site treatment
  - MNA in B-Zone

Source Reduction



Use of 3D Tools to Determine Appropriateness of CSM

- 3D Model of Stratigraphy and Cross-Sectional Slice of Model

Use of 3D Tools to Test Data Sensitivity

- Original cross-section of 3D stratigraphy

- Same cross-section with adjustment of only 3 of over 160 boring logs

Lessons Learned

- **Present ALL of *Your* data**
- **DO NOT limit data to create preferred outcome**
- **Use 3D tools with all available data**
  - **If end product does not match your CSM, determine why**
    - Revisit historical source information
    - Collect additional data
    - Independent modeling
  - **3D modeling does not replace sound science**

Presentation Overview

- Introduction
- Components of a CSM
- Development of a CSM
- Case Study CSMs
- Summary/Take-Home Messages

Summary/Take-Home Messages

- Guidance documents, forms, checklist and other aids are readily available to help create *Your* CSM
  - Navy, Army, EPA, ASTM, State agencies
  - Navy Web tools
- NIRIS can help
  - Analyze and display site data temporally and spatially
  - Test and validate CSM
  - Present your site data

Summary/Take-Home Messages (cont.)

- Start out simply
  - Create a CSM at the onset
  - Don't have one? – Never too late to start
- Let data and common sense build *Your* CSM
- Add detail and complexity when warranted
  - Comprehensive vs. Targeted
  - Know your audience

Navy policies dictate the creation and use of CSM

Summary/Take-Home Messages (cont.)

- *Your* CSM will be your guide for
  - Sampling and planning
  - Exposure assessments
  - Risk evaluation
  - Stakeholder communication
  - Remedy decisions
  - Remedial action performance monitoring and site closeout
- Keep *Your* CSM alive
  - Update your CSM with new data and changing site conditions
  - Validate your CSM with new information and modeling results

Navy policies dictate the creation and use of CSM