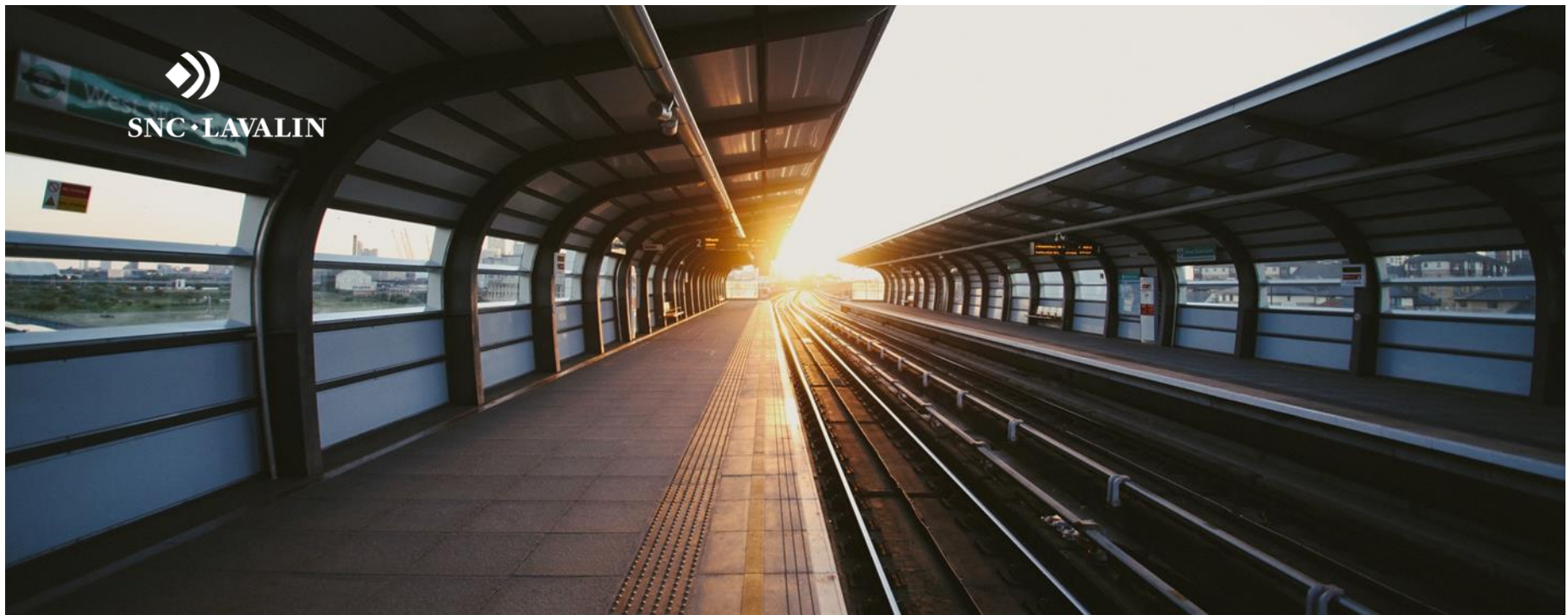




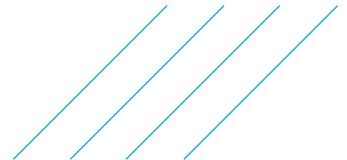
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Conceptual Site Models – Built for Purpose

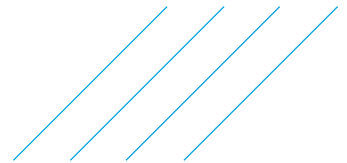
Ms. Sheila Duchek, M.Sc., P.Geol.

October 10, 2018



Our vision

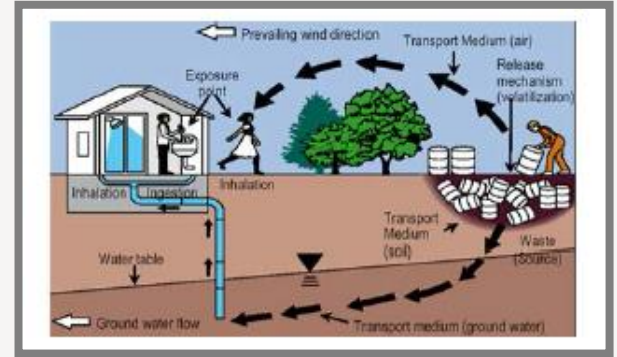
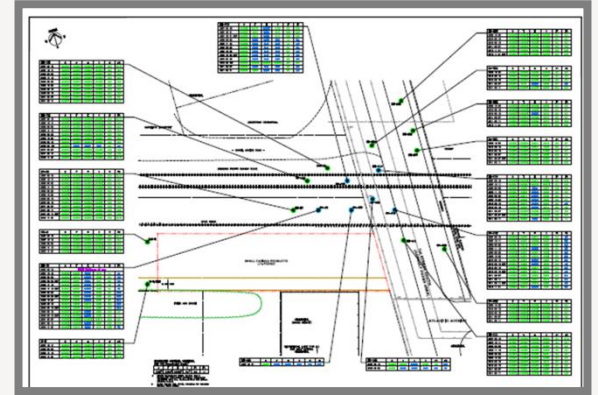
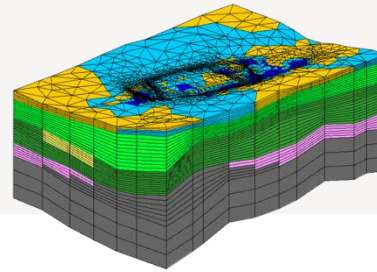
We strive to be the premier engineering solutions partner, committed to delivering complex projects from vision to reality for a sustainable lifespan.



Presentation Outline

- › Definition of a CSM
- › Published Examples
- › Developing a CSM
- › CSM Evolution
- › Key Components of Effective CSMs
- › Examples from Actual Project Work

Today's Theme:
Complex ≠ Complicated.



Definition of a Conceptual Site Model

Canadian Council of Ministers of the Environment (CCME):

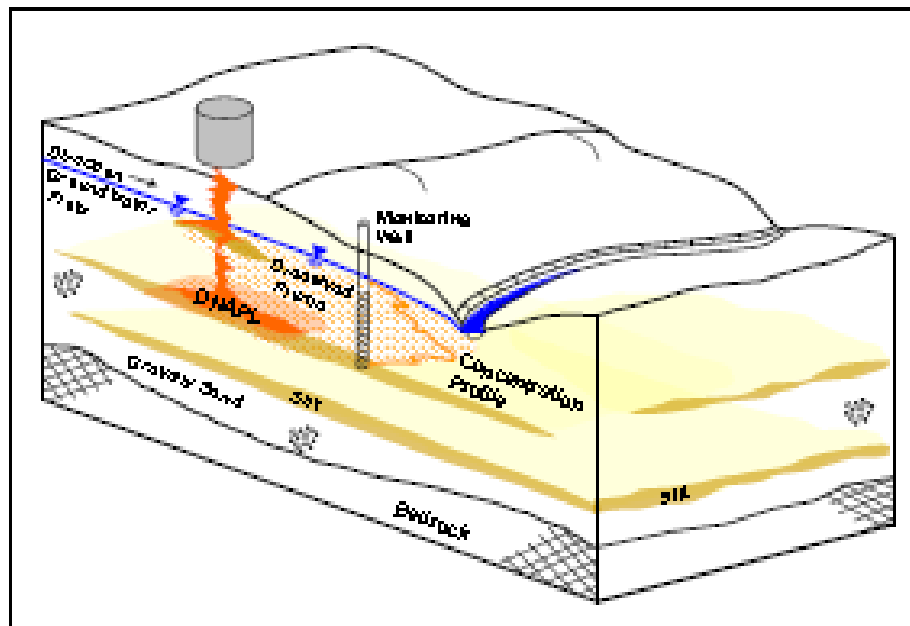
a visual representation and written description of the relationships between the physical, chemical, and biological processes of the site and the human and environmental receptors.

US Environmental Protection Agency (USEPA):

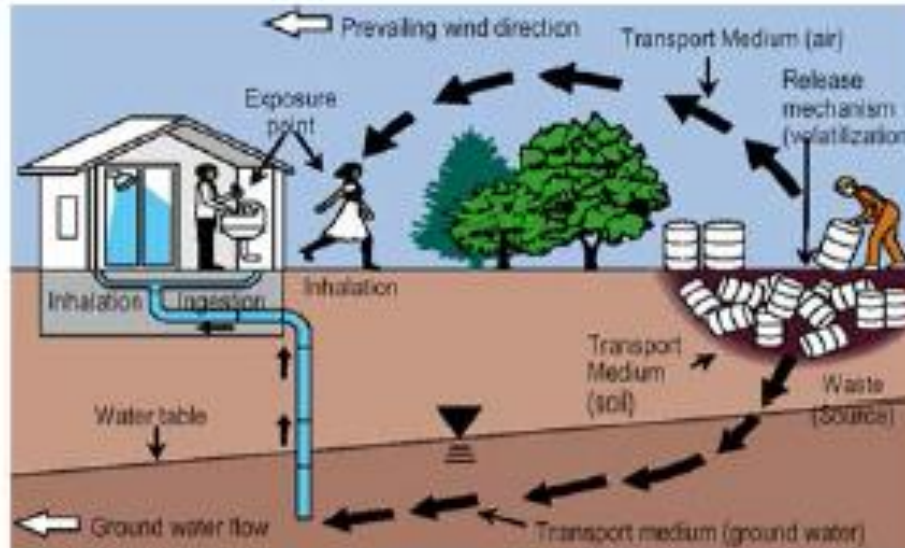
a summary of how the site became contaminated, how the contamination was and is transported, where the contamination will ultimately end up, and whom it may affect.



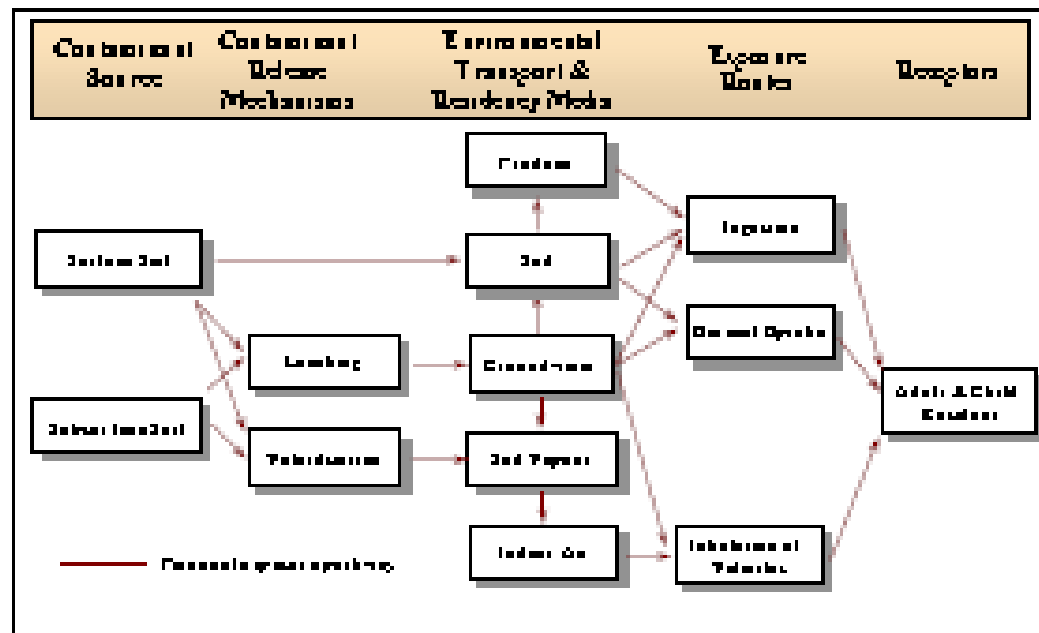
Published Examples: Hydrogeology Focus



Published Examples: Risk Focus



Published Examples: Risk Focus

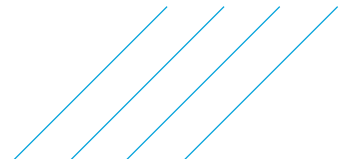


Taken from the CCME: Guidance Manual for Environmental Site Characterization in Support of Environmental and Human Health Risk Assessment

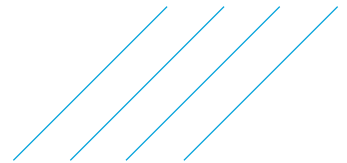
Definition of a Conceptual Site Model

SNC-Lavalin's Definition (in our Preferred Operating Practices):

- › an analytical tool for defining the site, comprehending physical properties and addressing site issues. It's a framework of the site and a description of source, receptors and pathways.
- › CSMs are scalable.
- › Depending on final closure plans, some CSMs will rely on risk assessment applied in conjunction with remediation.
- › Expressed as a figure or series of presentation slides or tables or text to facilitate communication.



Question: Is this a CSM?



Benefits of Using a CSM

- › The earlier the better! A CSM provides definition and logic to evaluation.
- › Early use of CSM can identify data issues before you get too far along...
- › Provides a format to focus data requirements.
- › Lays out problem: what is known and unknown?
- › Identifies sources, pathways and receptors.
- › Clarifies project goals.

WARNING: Don't get caught in details when starting out with your CSM! The details will work themselves out as work progresses.



Developing a CSM

Developing a CSM is a step-wise approach where data (available and needed) is reviewed, organized and presented in an accessible format:

- › Establish your framework
- › Know your impact
- › Understand your receptors
- › Assess data gaps to feed your CSM

Data is to a CSM as Cookies are to the Cookie-Monster; you have to keep feeding them both!



What makes a good CSM?

- › How complex do we need to be?
- › When is a CSM too complex?
- › What makes a CSM effective?
 - › *Organized*
 - › *Audience-focused*
 - › *Summary of interpretation for existing data*
 - › *Identifies areas where additional data needed*
- › An effective CSM should be dynamic and scalable, which means updating and adjusting and then, sharing as new information becomes available.

Complex does not mean complicated.
Effective CSMs are clear and focused on message delivery.



Feeding the CSM: Decoding Site Information into a CSM



Feeding the CSM: Decoding Site Information into a CSM

e r i H N n



Feeding the CSM: Decoding Site Information into a CSM

Le r i H N En



Feeding the CSM: Decoding Site Information into a CSM

Learning Has No End



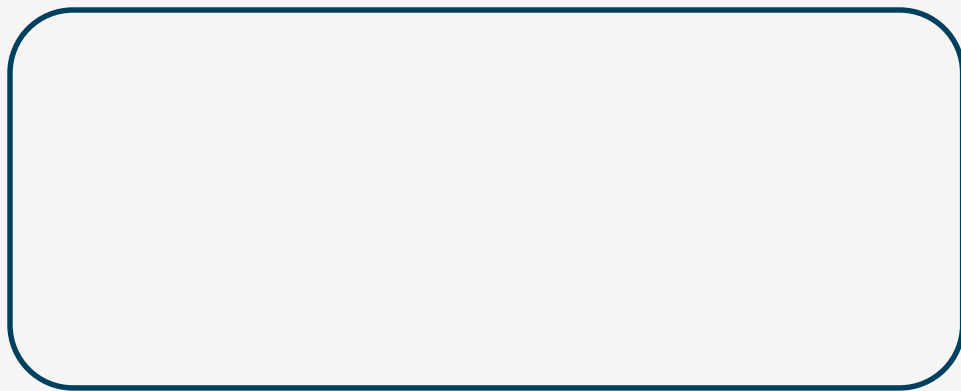
Feeding the CSM: Decoding Site Information into a CSM

Learning Has No End

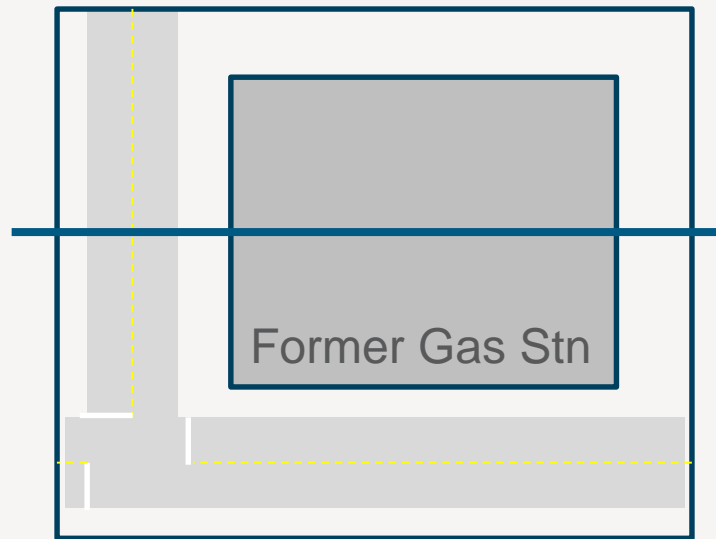


Feeding the CSM: Decoding Site Information into a CSM

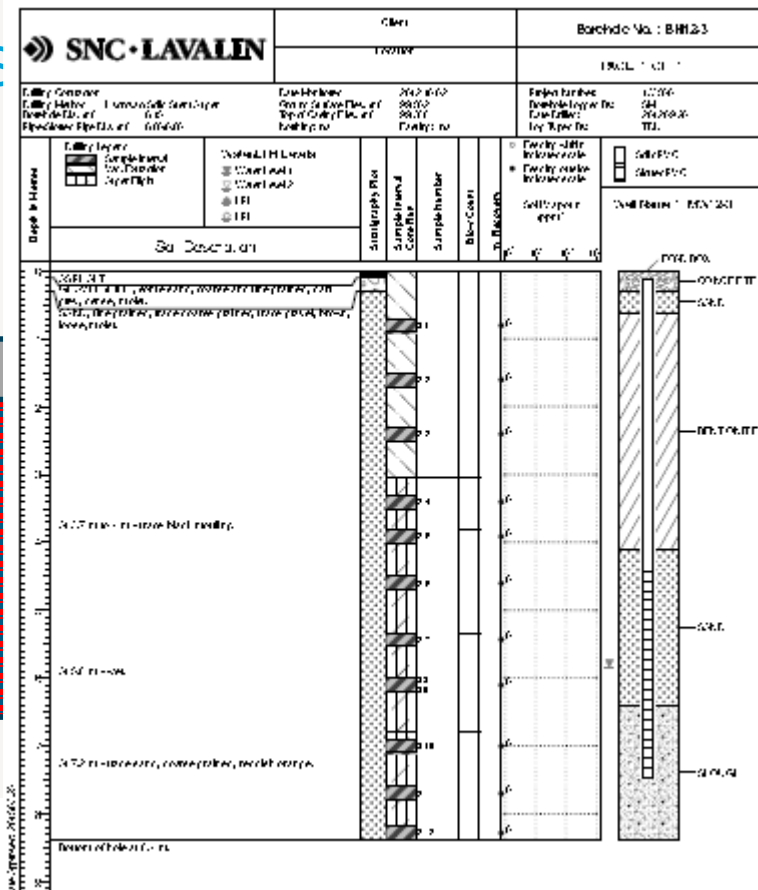
Cross-Section View



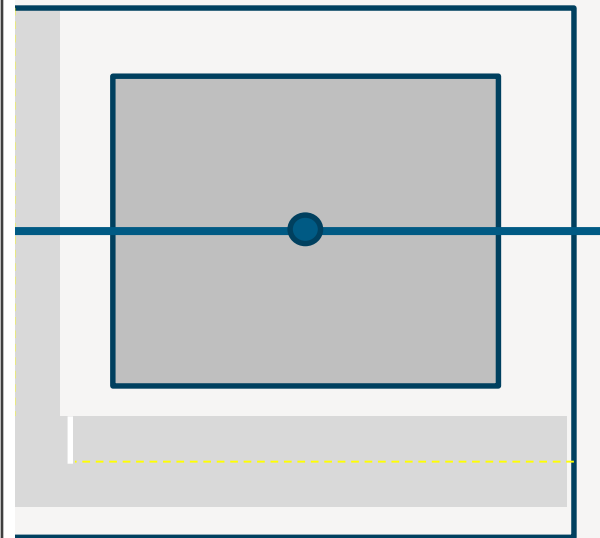
Plan View



A red book cover with a blue question mark on the left side. The cover has a dark red spine and a lighter red front cover. The question mark is a simple, stylized blue outline. The book is shown from a slightly angled perspective, showing the top and front edges.



to a CSM



Feeding the CSM: Decoding Site Information into a CSM

TABLE 1: Groundwater Analytical Results - Petroleum Hydrocarbons

Sample Location	Sample ID	Sample Date (yyyy/mm/dd)	Monocyclic Aromatic Hydrocarbons				Petroleum Hydrocarbon Fractions	
			Benzene mg/L	Toluene mg/L	Ethyl-benzene mg/L	Xylenes mg/L	F1-BTEX (C6-C10) mg/L	F2 (>C10-C16) mg/L
Reported Detection Limit			0.00040	0.00040	0.00040	0.00080	0.10	0.10
BH25 ^b	BH25	2016 05 25	<u>6.7</u>	0.015	<u>1.0</u>	<u>1.3</u>	<u>4.2</u>	<u>1.7</u>
	M/W/16-00A	Duplicate of BH25	<u>6.5</u>	0.014	<u>0.90</u>	<u>1.2</u>	<u>4.8</u>	<u>1.8</u>
	QA/QC RPD%		3	7	11	8	13	6
BH26 ^c	BH26	2016 05 26	0.0034	< 0.00040	< 0.00040	0.0016	< 0.10	< 0.10
BH51 ^b	BH51	2016 05 25	<u>0.66</u>	<u>0.27</u>	<u>0.19</u>	<u>6.6</u>	<u>0.94</u>	<u>1.8</u>
BH53 ^b	BH53	2016 05 25	<u>4.9</u>	<u>1.7</u>	<u>1.3</u>	<u>9.7</u>	<u>2.2</u>	<u>2.2</u>
BH54 ^c	BH54	2016 05 25	< 0.00040	< 0.00040	< 0.00040	< 0.00080	0.16	0.13
BH71 ^b	BH71	2016 05 25	<u>2.0</u>	<u>0.18</u>	<u>0.74</u>	<u>2.7</u>	<u>3.2</u>	<u>3.5</u>
BH77 ^b	BH77	2016 05 25	<u>1.6</u>	<u>0.038</u>	0.076	<u>0.78</u>	<u>2.6</u>	<u>3.7</u>
BH84 ^b	BH84	2016 05 25	0.0015	0.00069	< 0.00040	0.014	0.12	0.13
BH87 ^b	BH87	2016 05 25	0.0030	< 0.00040	< 0.00040	< 0.00080	< 0.10	< 0.10



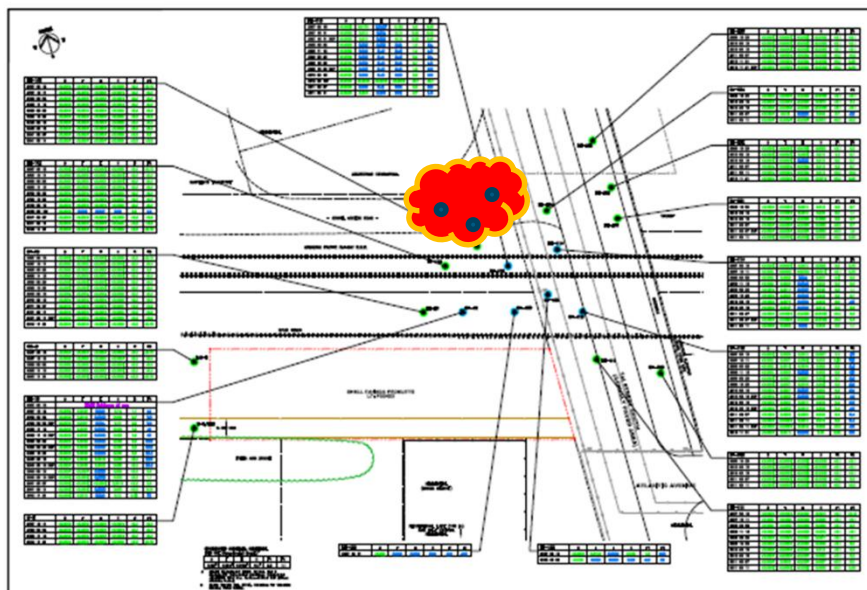
CSM Fundamentals: Communicating the 5 W's

- › Who?
 - › *Who are we preparing the CSM for?*
- › What?
 - › *What are the Site conditions? What are the CoCs?*
- › When?
 - › *When was the release? What time frame are we working with?*
- › Where?
 - › *Where are the problems? Where is the problem going?*
- › Why?
 - › *Why are we doing what we propose?*
 - › *Is more data needed?*

Who What
When
Where
Why

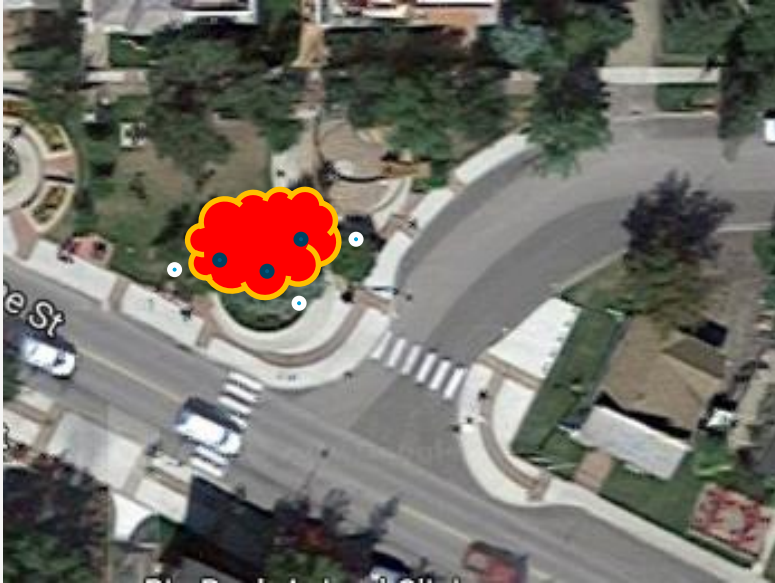


Same Site with Different Audiences: Project Team



- › Who?
 - › *Project team needs data shown spatially*
- › What?
 - › *Team confirms lateral delineation*
- › When?
 - › *Results shown with dates*
- › Where?
 - › *Red shows impact; green is 'clean'*
- › Why?
 - › *To show our SVE plan is sound*

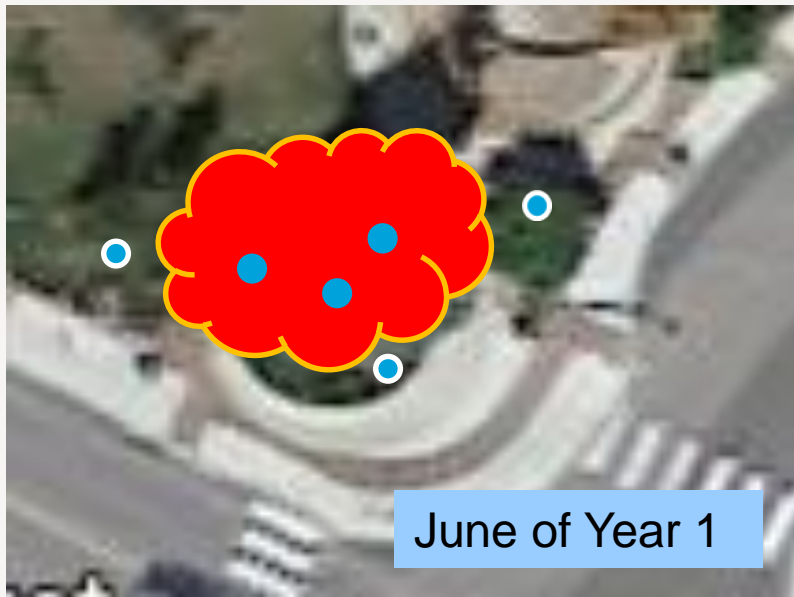
Same Site with Different Audiences: Public



- › Who?
 - › *Public and neighbours review RAP*
- › What?
 - › *SVE system placement with MWs*
- › When?
 - › *Predicted results shown with dates*
- › Where?
 - › *See SVE system in relation to neighbourhood*
- › Why?
 - › *Need buy-in from public and neighbours*

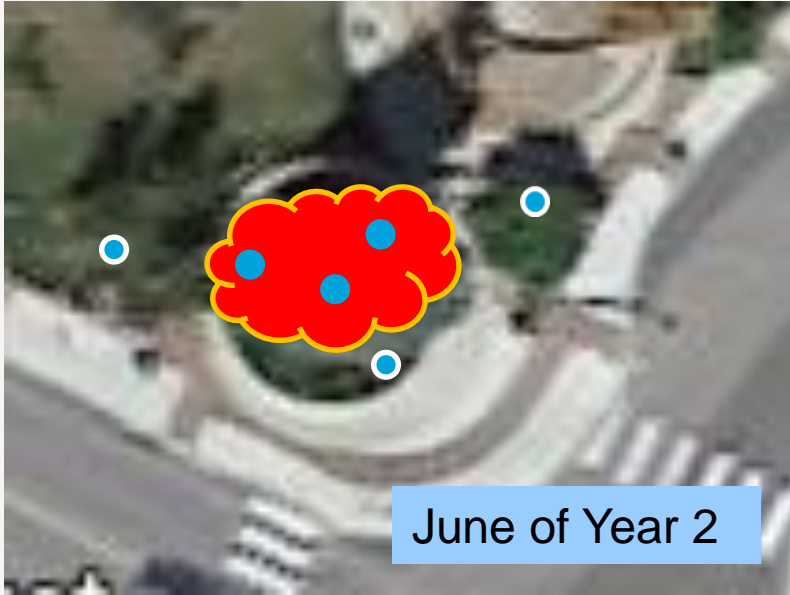


Same Site with Different Audiences: Public



- › Who?
 - › *Public and neighbours review RAP*
- › What?
 - › *SVE system placement with MWs*
- › When?
 - › *Predicted results shown with dates*
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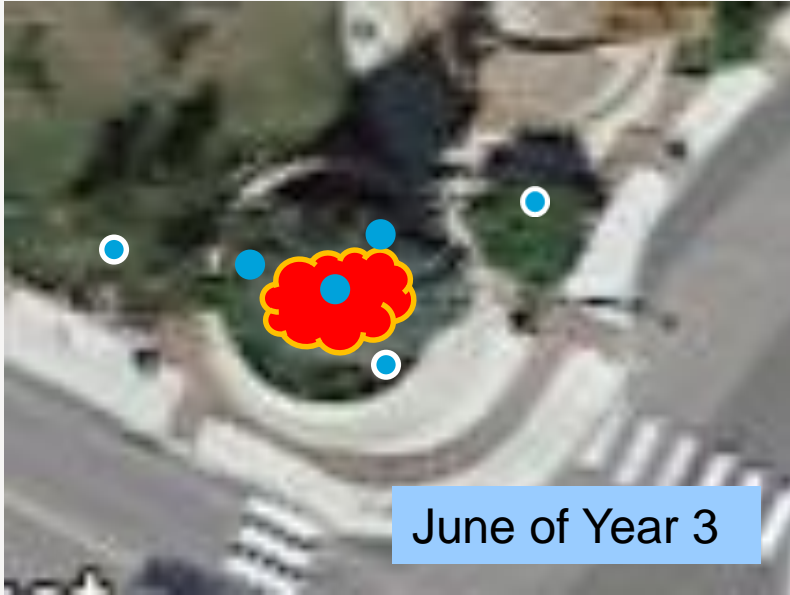
Same Site with Different Audiences: Public



- › Who?
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 - › *Predicted results shown with dates*
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Same Site with Different Audiences: Public



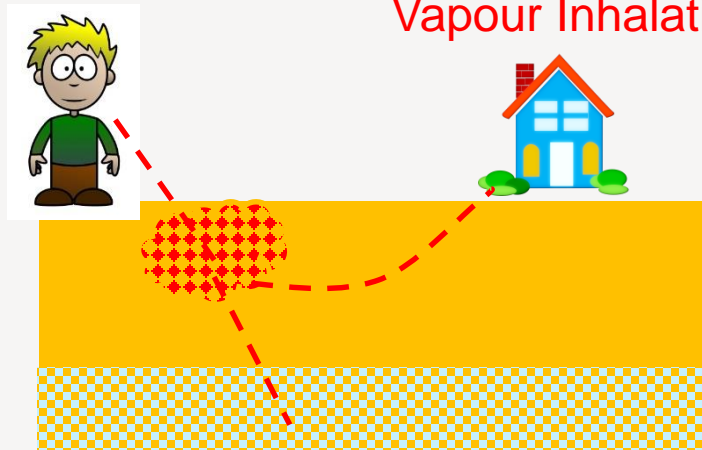
- › Who?
 - › *Public and neighbours review RAP*
- › What?
 - › *SVE system placement with MWs*
- › When?
 - › *Predicted results shown with dates*
- › Where?
 - › *See SVE system in relation to neighbourhood*
- › Why?
 - › *Need buy-in from public and neighbours*



Same Site with Different Audiences: Risk Assessor

Direct Soil Contact

Vapour Inhalation



Domestic Use Aquifer

- › Who?
 - › *Who is at risk?*
- › What?
 - › *Are the sources, receptors, pathways?*
- › When?
 - › *How will impacts move through media?*
- › Where?
 - › *Are sources, receptors, pathways?*
- › Why?
 - › *Protection of human health and environment*



Actual Project Examples

CSMs can be developed for a variety of environmental assessment and remediation work:

- › Estimating contaminant flux to receptors
- › Predicting maximum plume length, particularly in areas where monitoring well installation is difficult or impossible
- › Optimizing monitoring well locations
- › Investigating landfill stormwater runoff disposal options
- › Developing remedial system designs
- › Supporting risk assessment



Derailment

Project Budget:
\$5,000

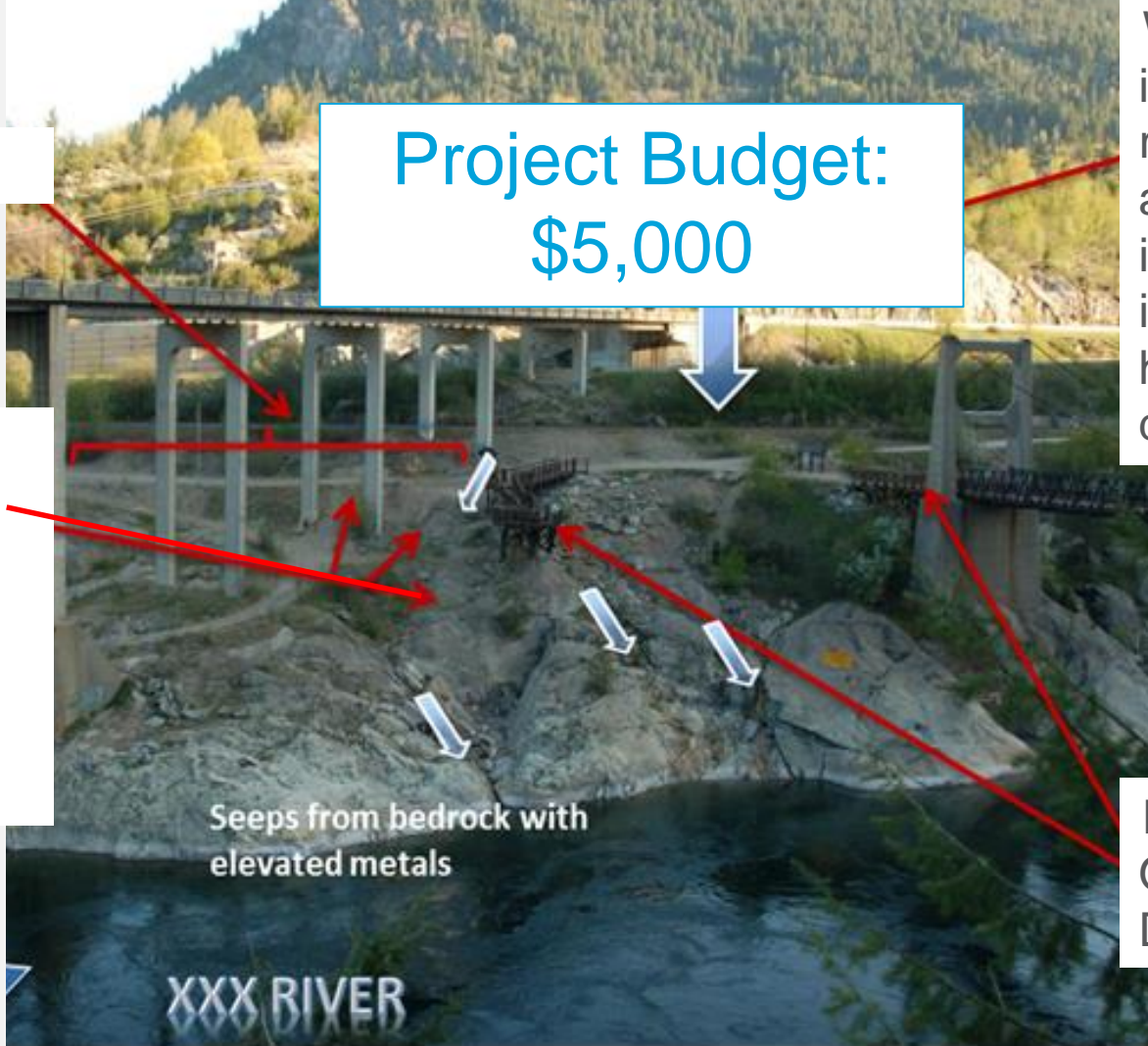
Water
input from
rock cut
and
infiltration
into
highway
ditch

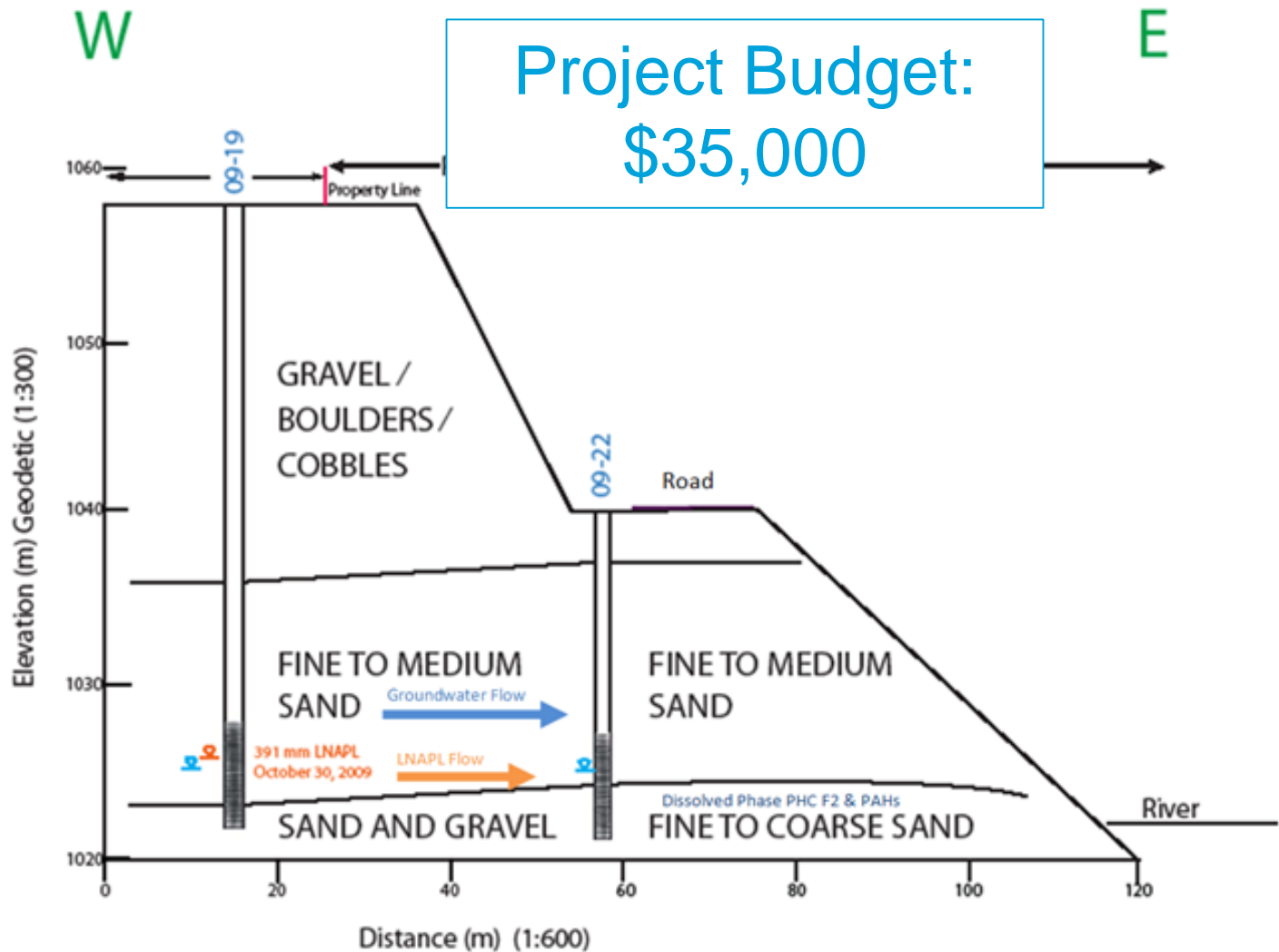
Soils
containing
metals
present in
undulating
bedrock
topography

Seeps from bedrock with
elevated metals

Bridge and
Observation
Deck

XXX RIVER



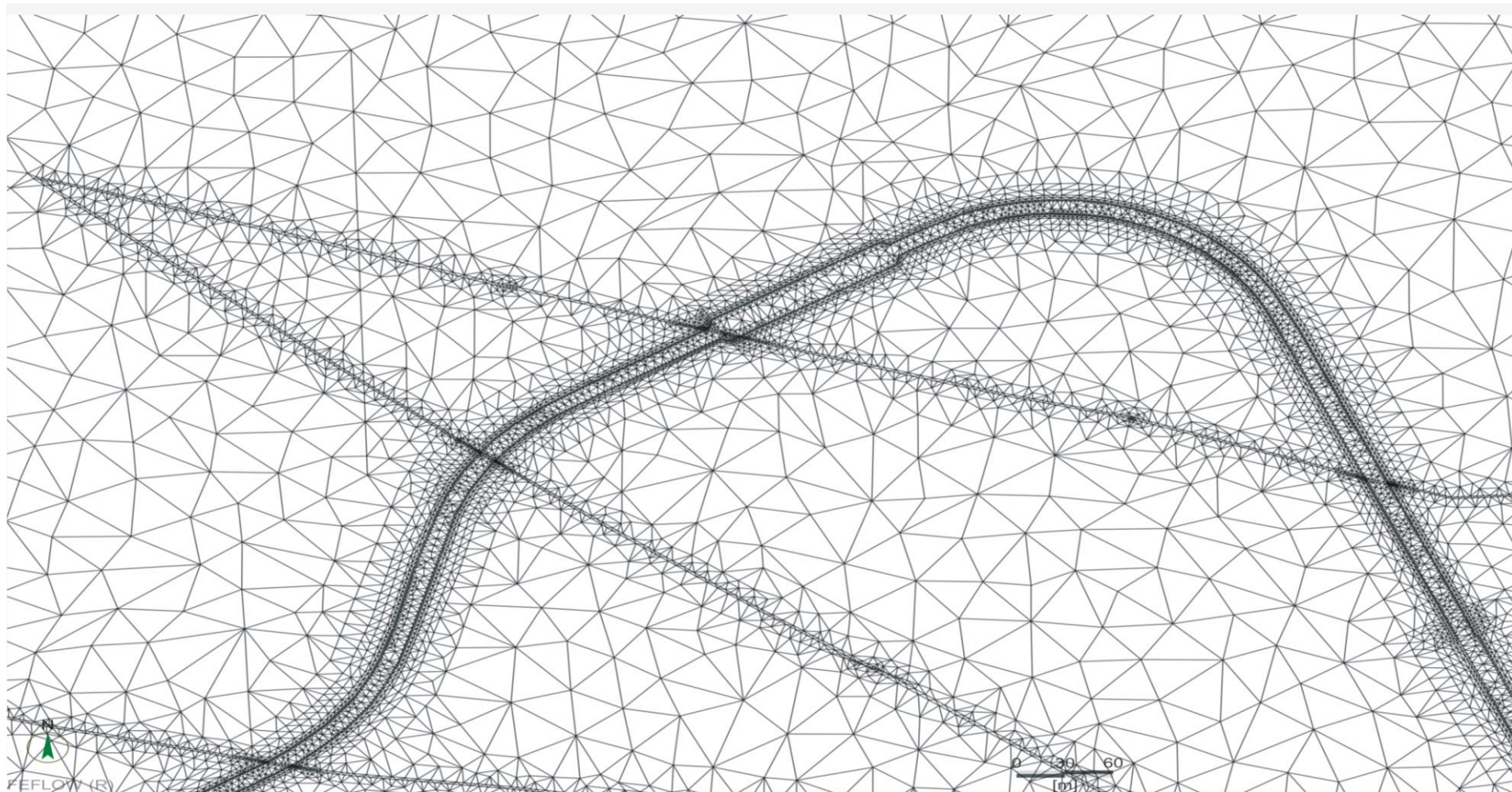


A 3D perspective rendering of a landscape model. The terrain is green with numerous small dark green dots representing trees. A blue body of water is visible in the foreground and middle ground. A road or path, shown in yellow and pink, runs along the shoreline. In the background, there are several grey rectangular structures representing buildings. A white rectangular box with a blue border is superimposed on the upper part of the model, containing blue text.

Project Budget:
\$125,000

Model Mesh Design with Tunnel Alignment and Bedrock Fractures





REFLOW (R)

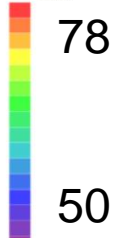
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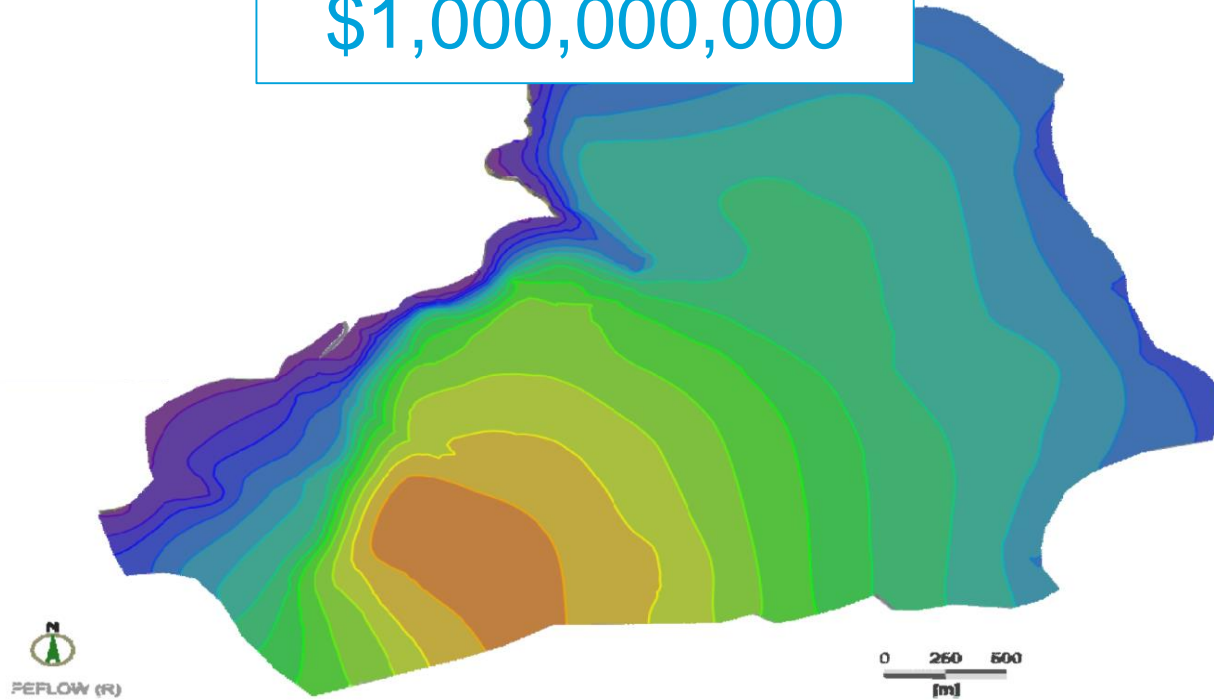
Sample Simulated Initial Hydraulic Heads in Model Domain

Legend

Hydraulic Head
(m)



Project Budget:
\$1,000,000,000



Good CSM's are Effective Communication Tools

CSMs are analytical tools for defining sites, comprehending physical properties and addressing site issues.

- › CSMs are as complex or as simple as needed. Effective CSMs are clear and focused on message delivery.
- › Effective communication can improve quality, resulting in better productivity.
- › Complex does not mean complicated.
- › CSM's should be dynamic and evolve as information is compiled.
- › CSM's can be used to guide site assessment, remediation and risk management.



*Our values are the essence of our company's identity.
They represent how we act, speak and behave together,
and how we engage with our clients and stakeholders.*

SAFETY

We put safety at the heart of everything we do, to safeguard people, assets and the environment.

INTEGRITY

We do the right thing, no matter what, and are accountable for our actions.

COLLABORATION

We work together and embrace each other's unique contribution to deliver amazing results for all.

INNOVATION

We redefine engineering by thinking boldly, proudly and differently.

