

Tools Selection Process

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Orientation to the Tools Selection Matrix

- ▶ Contains over **100** tools
- ▶ Sorted by:
 - **Category**
 - Geology
 - Hydrogeology
 - Chemistry
 - **Effectiveness in media**
 - Unsaturated
 - Unconsolidated
 - Bedrock
- ▶ Ranked by data quality
 - Quantitative
 - Semi-quantitative
 - Qualitative



Tool	Soil			Water			Air			Sediment			Rock			Ranking
	Soil	Water	Air	Soil	Water	Air	Soil	Water	Air	Soil	Water	Air	Soil	Water	Air	
Soil Remediation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Soil Remediation (SR)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
High Precision Geosynthetics (HPS)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Geosynthetics	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Soil Remediation (SR)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Electrokinetic Remediation (ER)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Soil Remediation (SR)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Soil Remediation (SR)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Tools Matrix Functionality

Click any box for a description or definition

Click

C.5 Geology

Geologic data provide a means to describe the physical matrix and structure of the subsurface and to classify the sedimentary, igneous, or metamorphic environment. Data related to lithology and distribution of strata and facies changes are generated through a variety of qualitative and quantitative collection tools and methods.

Initial methods and tools used to characterize site geology include site walkovers to help gain a preliminary understanding of the site prior to a major field mobilization, which can involve the use of both intrusive and nonintrusive tools. Outcroppings offer insight into structural features of the bedrock, and much information can be obtained through basic geologic mapping techniques (for example, measuring strike and dip of planar features and plotting on a stereonet).

Following a surface investigation, the next step in site characterization commonly involves collecting a continuous core of sediments and bedrock. Data provided by this core sampling may include lithology, grain size, crystallinity, geologic contacts, bedding planes, fractures and faults,

Detailed Tool Descriptions (Appendix X?)

Click

- Click on any tool
- ▶ Description
 - ▶ Applicability
 - ▶ Limitations
 - ▶ Additional reference material

Tool	Description	Applicability/Advantages and Data Quality	Limitations/Difficulty	References
Ground Penetrating Radar	Ground penetrating radar (GPR) creates a cross-sectional mapping of the ground based on the reflection of an electromagnetic (EM) pulse from boundaries between layers of different electric properties. The quality depends on soil and water conditions as penetration is inhibited by clay, water, and salinity.	Data Quality <ul style="list-style-type: none"> • varies with antenna and subsurface EC • highly very sharp boundaries • qualitative to quantitative depending on field conditions, personnel, and knowledge of subsurface conditions • experimental quality, appropriate modeling Applicability/Advantages <ul style="list-style-type: none"> • relatively fast to acquire, and processing methodology well established • primarily used in materials with low EC (sand, gravel, or rock except shales) • can be run repeatedly 	Limitations/Difficulty <ul style="list-style-type: none"> • minimal penetration in electrically conductive soils and clay-rich or conductive zone water table • interpretation of features and depths semi-quantitative without independent reference well or core permeability (CPT) 	Jorner 2005 (Bayer et al. 2011, Dece et al. 1989) (Creswell, Santoni, and Knut 2006) (Quinn 2005) (USEPA 2004)

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Shaded Boxes Denote Tool Meets Objective

Tools collect these types of information

Tool	Data Quality	Bedrock	Unconsolidated	Unsaturated	Geology												
					Lithology	Lithology Contacts	Porosity	Permeability	Dual Permeability	Faults	Fractures	Fracture Density	Fracture sets	Rock Competence	Mineralogy		
Geophysics																	
Surface Geophysics																	
Ground Penetrating Radar (GPR)	DL-Q	✓	✓	✓													
High Resolution Seismic Reflection (2D or 3D)	DL-Q	✓	✓	✓													
Seismic Reflection	DL-Q	✓	✓	✓													
Multi-Channel Analyses of Surface Waves (MASW)	DL-Q	✓	✓	✓													
Electrical Resistivity Tomography (ERT)	DL-SQ	✓	✓	✓													
Very Low Frequency (VLF)	DL	✓	✓	✓													
ElectroMagnetic (EM) Conductivity	DL	✓	✓	✓													

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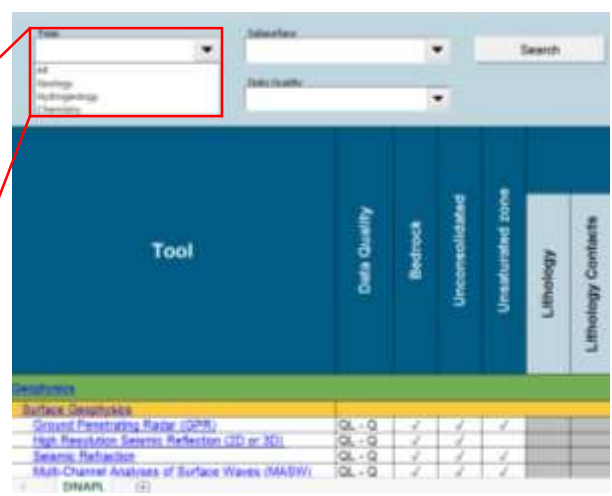
Using the Tools Matrix

- ▶ Down-selecting appropriate tools to meet your characterization objectives
- ▶ A systematic process
 1. Select your categories: geology, hydrogeology, chemistry
 2. Select parameters of interest
 3. Identify geologic media (e.g., unconsolidated, bedrock)
 4. Identify interval (e.g., unsaturated, saturated)
 5. Choose data quality
 6. Apply Filters, evaluate tools for effectiveness, availability, and cost

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1. Select Category

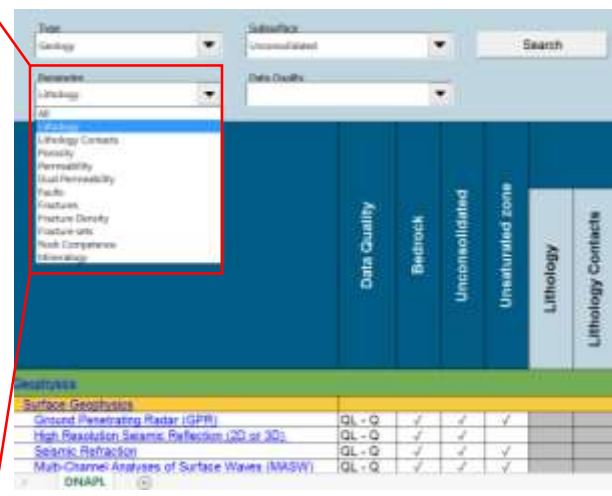
All
 Geology
 Hydrogeology
 Chemistry



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2. Select Parameters of Interest

All
 Lithology
 Contacts
 Porosity
 Permeability
 Dual Permeability
 Faults
 Fractures
 Fracture Density
 Fracture Sets
 Rock
 Competence
 Mineralogy



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3. Identify Geologic Media

All
 Bedrock
 Unconsolidated
 Unsaturated
 Zone

Tool	Data Quality	Bedrock	Unconsolidated	Unsaturated zone	Lithology	Lithology Contacts
Surface Geophysics						
Ground Penetrating Radar (GPR)	QL - Q	✓	✓	✓		
High Resolution Seismic Reflection (2D or 3D)	QL - Q	✓	✓	✓		
Seismic Reflection	QL - Q	✓	✓	✓		
Multi-Channel Analyses of Surface Waves (MASW)	QL - Q	✓	✓	✓		

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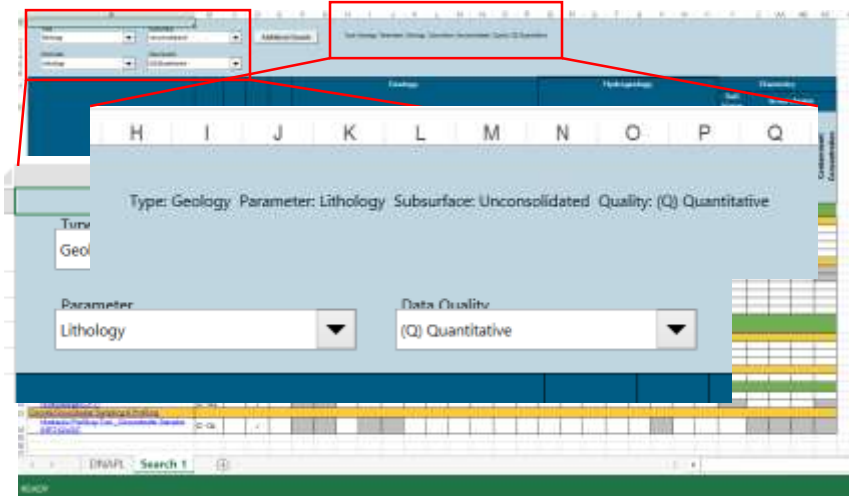
4. Choose Data Quality

(Q) quantitative
 (SQ) semi-quantitative
 (QL) qualitative

Tool	Data Quality	Bedrock	Unconsolidated	Unsaturated zone	Lithology	Lithology Contacts
Surface Geophysics						
Ground Penetrating Radar (GPR)	QL - Q	✓	✓	✓		
High Resolution Seismic Reflection (2D or 3D)	QL - Q	✓	✓	✓		
Seismic Reflection	QL - Q	✓	✓	✓		
Multi-Channel Analyses of Surface Waves (MASW)	QL - Q	✓	✓	✓		

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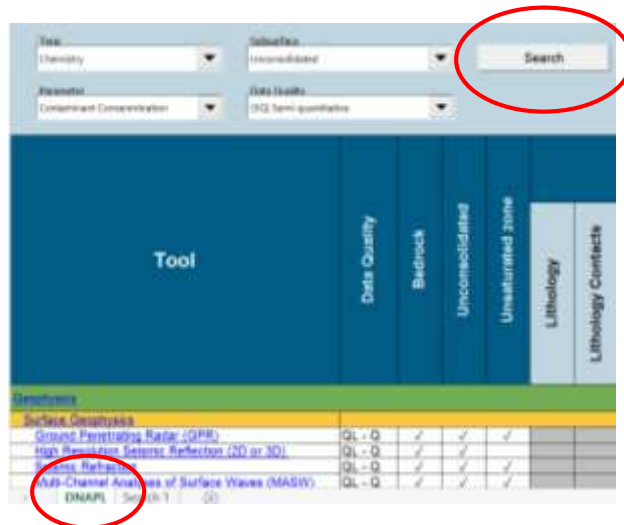
5. Apply Filters, Evaluate Tools



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Perform additional searches to find more tools for different objectives

Search 2 – creates new, separate tool list from first search



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Case Example – permeability distribution



Characterization Objective – Define the vertical and horizontal hydrogeologic flow regime and influence of utility corridors on VOC distribution.

- ▶ Category - Geology
- ▶ Parameter - Permeability
- ▶ Subsurface media - Unconsolidated
- ▶ Data Quality Objective – Semi-quantitative

Tools identified (13), Tools selected:

- ▶ HPT, Slug and Pumping Tests, tracer tests



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Case Example – presence of tarry DNAPL



Characterization Objective – Define the vertical and lateral extent of tarry DNAPL

- ▶ Category - Chemistry
- ▶ Parameter – NAPL Presence
- ▶ Subsurface media - Unconsolidated
- ▶ Data Quality Objective – All

Too many tools (30), refine search – SQ (16)

Project Team Selects:

- ▶ Colorimetric screening, UV fluorescence



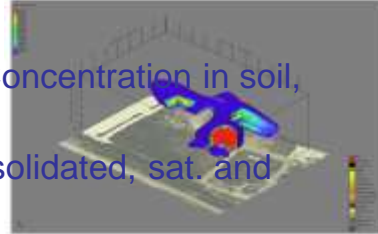
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Case Example – CVOC mass distribution



Characterization Objective – Define the three-dimensional cVOC mass distribution at three different dry cleaner sites.

- ▶ Category – Chemistry
- ▶ Parameter – Contaminant Concentration in soil, water, and soil vapor
- ▶ Subsurface media – Unconsolidated, sat. and unsat.



- ▶ Data Quality Objective - Quantitative

Tools Identified (22), tools selected:

- Active soil gas survey, FLUTE, Screen-point 22, dual tube sampler
- On-site analytics (GC/MS), GIS for mass

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Tools Matrix Summary



- ▶ Characterization Objectives guide selection of tools
- ▶ Interactive Tools Matrix - over 100 tools with links to detailed descriptions
- ▶ A systematic tools selection process
 - Tools Selection Framework
- ▶ Continual update of CSM and alignment of data gaps with characterization objectives
- ▶ Validation and consensus that objectives have been met

Q & A End of Tools Table

