



5.5 Select Investigation Tools

Once the CSM is developed, data gaps are identified, and data collection planning is complete, the appropriate investigation tools and techniques can be selected. Often, several tools could be used to collect data for a specific data collection objective. Selecting the optimum tool relies on several factors to establish that it is appropriate for the task, including:

- availability and cost of the tool
- reliability of the tool
- familiarity with the tool
- required expertise to use the tool
- acceptability of data to stakeholders

Selection and proper use of any investigative tool is fundamental to a successful project and is ultimately the responsibility of the project team.

This guidance provides an interactive [which](#) offers over 100 investigation tools that can be used to collect the data needed to satisfy the data collection objectives. The Tool Selection Worksheet offers a rapid method of identifying the appropriate tools and information for collecting geologic, hydrologic, and chemical data. A well-designed characterization objective can be translated into a logical sequence of dropdown menus in the worksheet that narrows the list of tools to those that can be used to collect the needed data. Once a shortlist of tools has been identified, the project team can incorporate the tools as appropriate into an investigation work plan for review and approval by regulators and stakeholders.

5.5.1 Overview of the Tools Selection Worksheet

The Tools Selection Worksheet is organized in a spreadsheet format. The left column incorporates a comprehensive list of tools and the rows are subdivided by categories of tools. Parameters are listed across the top of the columns and are also separated into three categories: Geology, Hydrogeology, and Chemistry. The shaded boxes indicate that the tool listed in that row can be used to collect information about the parameter in that column. For example, packer testing can be used to collect data to calculate hydraulic conductivity. The worksheet also lists tools that are effective in unconsolidated, bedrock, saturated, or unsaturated environments, and whether the tools can be used to provide quantitative, semiquantitative, or qualitative data. Although many of the tools can provide data in all subsurface conditions, some are limited. For example, some tools cannot be used in screened or cased holes or in unsaturated conditions, and others may be able to penetrate relatively shallow depths in unconsolidated material but cannot penetrate bedrock and require a borehole.

In the [Tools Selection Worksheet](#), each tool name links to additional information such as descriptions and applicability of the tool, advantages and limitations, data quality capability, and challenges that may be encountered when using the tool. Additional information is provided in the citations at the end of each technology description. These citations are linked to the full reference information, and each parameter in the Worksheet links to a definition of that parameter.

5.5.2 Using the Tools Selection Worksheet

Figure 5-2 presents a screenshot of the dropdown menus in the worksheet that define the search functions for the tools selection. Using a well-formulated data collection objective, tools selection can be made from the dropdown menus and then *Search* selected to generate a shortlist of the appropriate tools. The five menus are used in a stepwise process as follows:

1. **Media Type:** What is the nature of media being investigated, and what category of data is being collected (geologic, hydraulic, or chemical)?
2. **Media Parameter:** What parameter is of interest?
3. **Subsurface Media:** Is media being investigated unconsolidated porous materials or bedrock?
4. **Media Zone:** Is the target zone saturated or unsaturated?
5. **Data Quality:** What is the data quality objective: quantitative, semiquantitative, or qualitative?

Clicking the search button after answering these questions with the dropdown menus will populate a new tab in the worksheet with a subset of tools to be further narrowed down after reviewing the information linked from the name of the

tool. The worksheet allows multiple searches, each populating a separate tab at the bottom.

The screenshot shows the 'Tool Selection Worksheet' interface. At the top, there are four dropdown menus with callouts:

- DROPDOWN**: Geology, Hydrology, Chemistry-all, Chemistry Soil Gas, Chemistry, Groundwater, Chemistry Solid, Media
- DROPDOWN**: All parameters listed in the headings
- DROPDOWN**: Bedrock, Unconsolidated
- DROPDOWN**: Q – Quantitative, SQ – Semiquantitative, QL - Qualitative

Below these is a 'Tool' table with columns for various parameters. A fifth dropdown menu is located on the right side of the table:

- DROPDOWN**: Unsaturated, Saturated

At the bottom left, there is a callout for 'Links to Tools Descriptions'. At the bottom center, there is an orange 'Download' button.

Tool	Zone					Geology										Hydrology										Chemistry										
	Unsaturated	Saturated	Bedrock	Unconsolidated	Saturated	Lithology	Lithology Correlate	Porosity	Dual Porosity	Permeability	Fracture	Fracture	Fracture Density	Fracture Orientation	Rock Competence	Mineralogy	Open Hole Flow	Ambient Flow	Groundwater Age	Fracture Aperture	Fracture Conductivity	Hydraulic Conductivity	Hydraulic Head	Bioactive Condition	Component Concentration	Geochemistry	Microbial Community	NAPL Presence	Dissolved Component Concentration	Geochemistry	Geochemistry/Biochar	Fe	NAPL Presence	Sorbed Component Concentration	Microbial Community	
Tool 1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Tool 2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Tool 3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Figure 5-2. Tool Selection Worksheet.

The tools descriptions should be reviewed to assess the best options for a particular site characterization or remediation. The extensive references make researching specific tools easier and quicker because some of the tools, originally classified as applicable, may be eliminated based on site conditions, access, cost, availability, deployment challenges, or DQOs described in the literature. Note that this [Tool Selection Worksheet](#) does not select individual tools, but rather narrows the choice of tools depending on the data needs and investigation plan. The worksheet may return multiple tools as options, so searches may need to be refined to reduce the number of applicable tools. Ultimately, the project team selects the appropriate tools from the shortlist.