



5.1 Review and Refine Existing CSM

The CSM is the primary vehicle used to organize and communicate technical information about site characteristics. As outlined in [Incremental Sampling Methodology \(ITRC 2012a\)](#), CSMs are essential elements of the systematic planning process. These models represent the relationship between contaminant sources and receptors by incorporating potential or actual migration and exposure pathways. They also provide a framework to collect and manage site data necessary to support project management decisions.

The CSM encompasses all significant components of contaminant fate and transport at a site. While this guidance focuses on fractured rock, an unconsolidated portion often exists and should be included in the same CSM. Guidance for preparing a CSM for unconsolidated environments is included in the IDSS-1 document ([ITRC 2011](#)). Contaminant transport often affects both unconsolidated and consolidated geology as well as different hydrogeologic flow regimes. Additionally, multiple separate or comingled contaminant plumes may be present. These individual components form a CSM only when they are combined into one comprehensive system that characterizes the relevant site conditions.

The CSM should reflect the best interpretation of available information at any point in time. Consequently, it is a living document that should be updated continuously as new data are collected at any stage of the investigation and remediation. If new data are inconsistent with the existing CSM, the data and CSM should be further evaluated and the CSM revised as needed.

To help visualize a basic CSM, the [21-Compartment Model](#) can be used to illustrate several concepts related to the fate and transport of contaminants in fractured bedrock settings. Using this model with site-specific information offers insight into the relationships among contaminant phases, bedrock geology, and bedrock hydrology. The results of the 21-Compartment Model evaluation are well-suited for developing or refining the CSM. For example, in Table 5-1, compartments in the 21-Compartment Model can be blocked out as the location and movement of the dissolved VOC mass. The compartments dealing with the vapor phase may still be relevant, however, depending on the site characteristics and potential receptors.

Unfortunately, some CSMs omit critical characteristics that greatly influence the quality of a CSM in fractured rock. [Section 1.2](#) describes these characteristics. [Terrane analysis](#) presents key elements that should be evaluated, from a physiographic province scale to finer site scale, to compile an initial CSM:

- regional physical setting (such as physiographic province)
- structural geology and tectonic setting
- lithology and stratigraphy/mechanical stratigraphy
- predicted anisotropy and heterogeneity

Many of these site characteristics are specific to fractured rock settings, and available literature and data should be carefully reviewed before undertaking a characterization study.

Likewise, [fluid flow](#) in fractured rock is influenced by the following:

- matrix (primary porosity) flow, which varies according to the lithology and micro-structures of the rock
- fracture (secondary porosity) flow, which is influenced by the [characteristics of the fractures](#)

[Figure 3-1](#) illustrates the degree of influence the various characteristics lend to a macro-, meso-, and micro-scale flow regime.

Finally, the [chemical characteristics](#) affect the fate and transport of contaminants and contaminant mixtures. These characteristics, which are often available in the literature, are essential for understanding the fate of contaminants in any setting, including fractured rock.

A range of tools and techniques for resolution of critical [physical, hydrologic and chemical relationships](#) are available. Some of these tools and techniques are specialized to address fractured rock settings, and others are commonly used in both fractured rock and unconsolidated settings. Some collect information from boreholes, and some collect information from the

surface, but most importantly note that desktops surveys of existing regional and local information can often describe the site geologically, hydrologically, and chemically.