Chapter 2
Description of a Conceptual Site Model

2-1. Introduction

This chapter presents an overview of what a CSM is and how it should be used, how it is depicted, when CSM development begins, and who is involved in the development process. It also discusses the refinement and iterative nature of the CSM.

2-2. Conceptual Site Model Defined

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.

a. The CSM is a description of a site and its environment that is based on existing knowledge. It describes sources of OE or HTRW at a site; actual, potentially complete, or incomplete exposure pathways; current or reasonable proposed use of property; and potential receptors. The source–receptor interaction is a descriptive output of a CSM. The CSM serves as a planning instrument, a modeling and data interpretation aid, and a communication device among the team (see Paragraph 2-3). It can be viewed as a tool that aids communication with the general public and also assists the team with integration of information and decisions. The CSM provides a standard means to summarize and display what is known about the site, and to identify what additional information must be known to develop technically sound DQOs.

CSM development is an ***iterative process*** that reflects the progress of activities at a site from initial assessment through site closeout. The CSM evolves over time to help focus objectives throughout the life of the project.

b. The CSM is a tool that evolves as site work progresses and data gaps are filled. CSM development should be viewed as a process that is used throughout the duration of project activities, from initial characterization to response action and recurring review to project closeout. Potential source areas, media of concern, and OE use areas are documented in the initial CSM. Later versions of the CSM may be used to evaluate the effectiveness of sampling or to help focus design efforts. The CSM can help focus general regulatory objectives to more site-specific project objectives. Data collection should be focused on complete or potentially complete exposure pathways, based on both current and reasonably anticipated future land use.

The threats presented by OE and HTRW are different, and in this document are differentiated by the terms "hazard" and "risk." OE presents a **hazard** of direct physical injury resulting from the blast, heat, fragmentation, or acute chemical effects of a munition or munition component. Environmental contaminants present a **risk** to human health and the environment through exposures. The degree of risk posed by HTRW is usually proportional to the toxicity of the contaminants, as well as the amount and duration of exposure. A single site may have threats of both OE hazards and HTRW risks that must be considered.

c. The basic process in the development of a CSM applies to both OE and HTRW sites. The CSM is developed through analysis of site profile information collected by the

team. The team integrates this information to illustrate relationships between the potential sources and receptors that may be affected. Through this illustration, the team conducts a pathway analysis to show how site conditions, including the exposure pathways, function as a system. As more data are generated, the understanding of this system becomes more refined. This understanding allows greater focus for subsequent investigations or for design and response activities.

2-3. Team Composition

> "The **Project Delivery Team** (PDT) will include the customer(s), the PM, technical experts within or outside the local USACE activity, specialists, consultants/contractors, stakeholders, representatives from other state or federal agencies, and vertical members from division and headquarters that are necessary to effectively develop and deliver the project." U.S. Army Corps of Engineers (ER 5-1-11)

Team composition will vary with the complexity of the site and the nature of the OE hazards or HTRW contaminants present. The PM leads a team that consists of technical experts, regulatory personnel, and other stakeholders. An effort should be made early in the process to identify special challenges or interests that require input from specific disciplines or groups. These personnel represent various planning perspectives, including decision-makers, data users, and data implementers, as described in the TPP Process manual (EM-200-1-2). Each group will have a set of data needs, and these may contain differences and overlaps. One aspect of developing a CSM for a site potentially having both OE and HTRW is the importance of early and ongoing coordination between technical experts on the team.

2-4. Profiles Needed to Develop a CSM

An effective CSM presents known or suspected conditions about sources and potential receptors, and the interactions between them. The team must be able to recognize those types of information relevant to developing the CSM. In most cases, the needed information may be categorized into five "profile types" that address specific yet overlapping types of information. These profile types include:

- Facility Profile—describes man-made features and potential sources at or near the site.
- Physical Profile—describes factors that may affect release, fate and transport, and access.
- Release Profile—describes the movement and extent of contaminants in the environment.
- Land Use and Exposure Profile—provides information used to identify and evaluate the applicable exposure scenarios, receptors, and receptor locations.
- Ecological Profile—describes the natural habitats of the site and ecological receptors in those areas.

> Early involvement of team members and identification of project goals and objectives (culminating in site closeout) are important during the CSM development process.

Profile information may be collected from a variety of resources. The team should review all relevant historical and current documentation, conduct interviews, and perform a site visit, as needed, to gather profile informa-

tion. Typical information associated with each profile type is presented in Table 2-1. These information needs are not comprehensive, and each site may require different or additional information as determined by the team.

Table 2-1. Profile Types and Information Needs

Profile Type	Typical Information Needs
Facility Profile	• All structures, sewer systems, process lines, underground utilities • Physical boundaries (past and current), fencing, administrative controls, etc. • Current and historical process and manufacturing areas • Ordnance activity areas (firing points, impact areas, storage areas, munitions manufacturing, or disposal areas) • Storage and waste disposal • Historical features that indicate potential source areas (landfills or lagoons, ground scars, impact craters)
Physical Profile	• Topographic and vegetative features or other natural barriers • Surface water features and drainage pathways • Surface and subsurface geology, including soil type and properties • Meteorological data • Geophysical data • Hydrogeological data for depth to ground water and aquifer characteristics • Other physical site factors that affect site activities • Soil boring or monitoring well logs and locations
Release Profile	• Determination of contaminant movement from source areas • Contaminants and media of potential concern • Impact of chemical mixtures and co-located waste on transport mechanisms • Locations and delineation of confirmed releases with sampling locations • Migration routes and mechanisms (HTRW and OE constituents) • Modeling results
Land Use and Exposure Profile	• Receptors associated with current and reasonable future land use on and near the facility (residential, recreational, commercial, agricultural, industrial, public forest, etc.) • Zoning • Types of current or future activities at the facility, including frequency and nature of activity (intrusive or non-intrusive) • Beneficial resource determination (aquifer classification, natural resources, wetlands, cultural resources, etc.) • Resource use locations (water supply wells, recreational swimming, boating, or fishing areas, hiking trails, grazing lands, historical burial grounds, etc.) • Demographics, including subpopulation types and locations (schools, hospitals, day care centers, site workers, etc.)
Ecological Profile	• Description of the property at the facility, including habitat type (wetland, forest, desert, pond, etc.) • Primary use of the property and degree of disturbance, if any • Identification of any ecological receptors in relation to habitat type (endangered or threatened species, migratory animals, fish, etc.) • Relationship of any releases to potential habitat areas (locations, contaminants or hazards of concern, sampling data, migration pathways, etc.)

2-5. Pathway Analysis

Source–receptor interaction for an OE CSM requires two components: **Access** and **Activity**.

The team uses information from the profiles to identify all actual, potentially complete, or incomplete source–receptor interactions for the site, for both current and reasonably anticipated future land use. An exposure pathway is the course a chemical or physical agent takes from a source to a receptor. For OE projects, each pathway must include a source, access, activity, and a receptor. Each pathway for an HTRW project must include a source, an exposure medium, an exposure route, and a receptor. An HTRW pathway may also include a release mechanism (e.g., volatilization) and a transport medium (e.g., air), if the point of exposure is not at the same location as the source. The CSM will illustrate all complete exposure pathways, current and future. The pathway analysis, represented by the CSM, will guide data collection activities and can be used to inform stakeholders of site conditions.

Source–receptor interaction for an HTRW CSM requires two components: an **Exposure Medium** and an **Exposure Route**. A release mechanism and transport medium may also be present.

a. Source. Sources are those areas where OE or HTRW has entered (or may enter) the physical system. Information on sources and source areas is collected when the Facility, Physical, and Release Profiles are generated. Even though a source may be easily labeled, such as an impact range or a landfill, it is extremely important that the entire team completely understand as much about the source as possible, including probable munitions or contaminants. Early in the project, many of the details of the source may not be known. It is necessary for the team to determine what is known and what is assumed about the source.

b. Interaction. Interaction describes ways that receptors come into contact with a source. Information from all profiles will assist in identifying source–receptor interactions. Typically, movement of OE is not significant, and interaction will occur only at the source area, limited by access and activity. However, there can be some movement through natural processes, such as frost heave, tidal action, and erosion, or from human activity. Environmental contaminants often undergo various processes (e.g., volatilization, migration) such that media other than the source area can become contaminated. Therefore, the team must consider all potentially contaminated media (exposure media) as well as all exposure routes (ingestion, inhalation, and dermal contact) in evaluating the source–receptor interactions at HTRW sites.

c. Receptors. A receptor is an organism (human or ecological) that contacts a chemical or physical agent. The pathway evaluation must consider both current and reasonably anticipated future land use, as receptors are determined on that basis. Appropriate human and ecological receptors are identified in the Land Use and Exposure, and Ecological Profiles. Human receptor subcategories can include residents, site workers, construction workers, recreational users, and trespassers.

2-6. Representation of the CSM

The CSM can vary in content and detail, depending on complexity of the site as well as available or needed information. A simple figure or narrative may depict a CSM for a simple site. However, a CSM for most sites is more complex and typically documented by written narrative and supported by maps, cross-sections, diagrams, or other graphics to form the entire model. On HTRW sites, the risk exposure CSM focuses on the contaminant source, exposure routes through environmental media, and exposure of receptors. A hazard exposure CSM for an OE site is structured in a similar manner, depicting the OE source, access to the source by a receptor, and the activity performed by the receptor. Whatever format may be chosen to illustrate the model, all hazard exposure or risk exposure CSMs should provide an accurate representation of the source–receptor interactions present at the site.

> The CSM will illustrate the sources and receptors present at the site, and the interactions that may result in exposure. For OE projects, the CSM will aid in determining whether hazards from OE are present. Similarly, for HTRW projects, the CSM will help determine whether risk from chemical contamination exists.

a. Narrative Description. A narrative is a written description of the site conditions, based on profile information. Detail will vary with complexity and available information for the site. Narrative descriptions must include a summary of information on sources, receptors, and interactions. For very simple sites, a narrative may be all that is needed to document the CSM.

b. Pictorial Presentation. A pictorial presentation includes the necessary elements of a CSM, including the sources, receptors, and interactions between them. This format is useful for presenting the CSM to a wide range of stakeholders. An example of a pictorial CSM for an HTRW site is shown in Figure 2-1, and one for an OE site is shown in Figure 2-2.

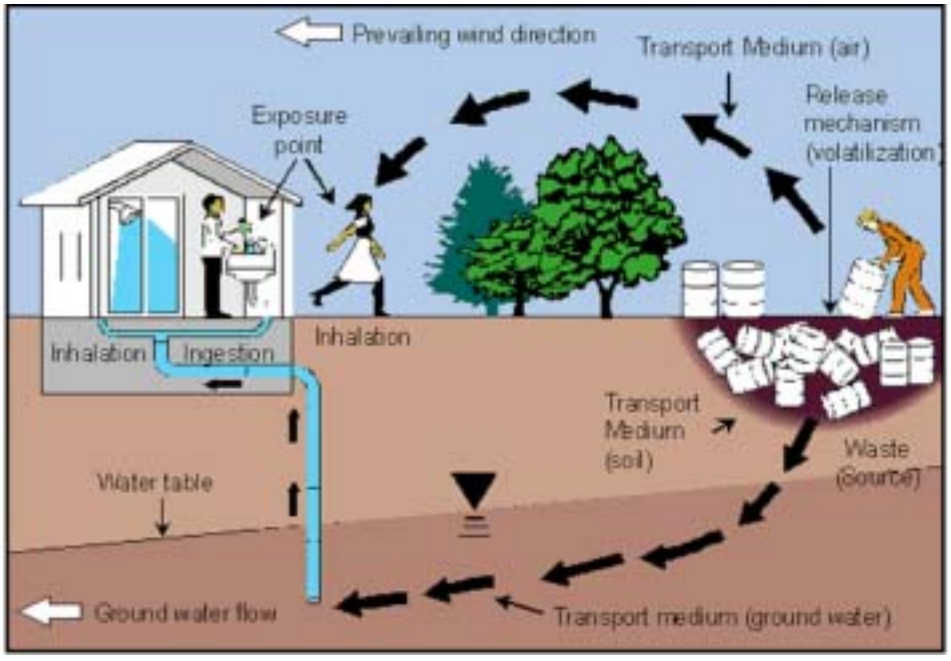

Figure 2-1. Pictorial Presentation of an HTRW CSM

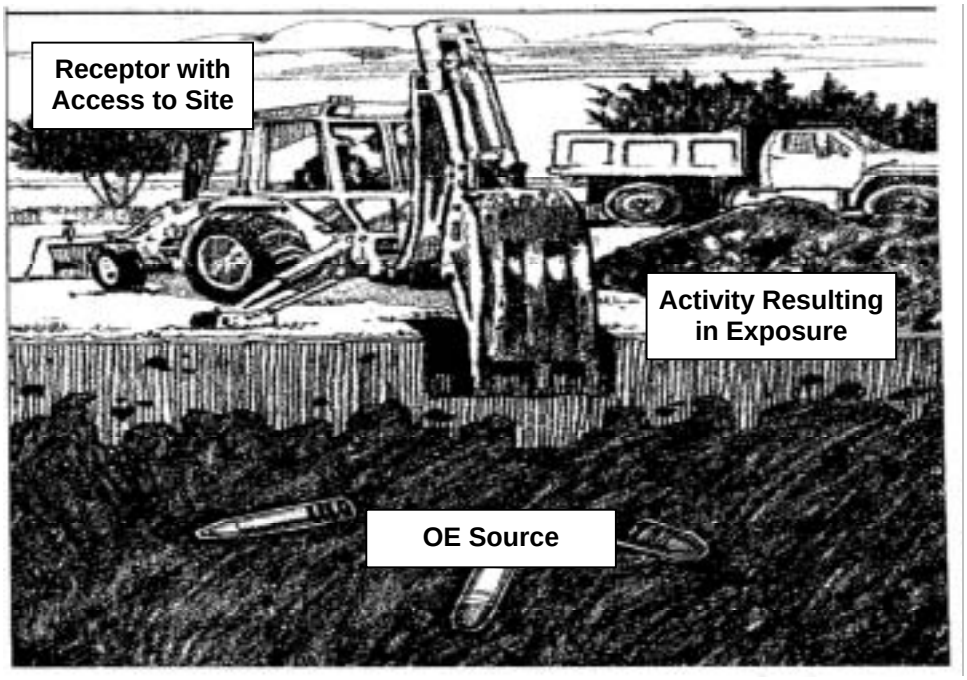

Figure 2-2. Pictorial Presentation of an OE CSM

c. Graphical Presentation. The graphical presentation provides a concise summary of complete or incomplete exposure pathways. It is commonly used for HTRW projects and may also be used for OE projects. However, the potential interactions between the source and receptors are assessed differently, as described below.

(1) A graphical presentation of a CSM for an HTRW project is shown in Figure 2-3. This example focuses on a single contamination source in soil. Secondary sources or secondary pathways may also be identified, and can be represented by the addition of these components to the diagram. Interaction between the source and receptors involves a release mechanism for the contaminant, an exposure medium that contains the contaminant, and an exposure route that places the receptor into contact with the contaminated medium. Additional pathways can be added to the model as necessary. For example, for sites with a radioactive source area, an exposure pathway could be added for external radiation for both the soil pathway and the inhalation pathway.

(2) A graphical presentation of a CSM for an OE project is shown in Figure 2-4. This example focuses on an impact area as the OE source. Interaction between the potential receptors and an OE source has two components. The receptor must have access to the source and must engage in some activity that results in contact with individual OE items within the source area.

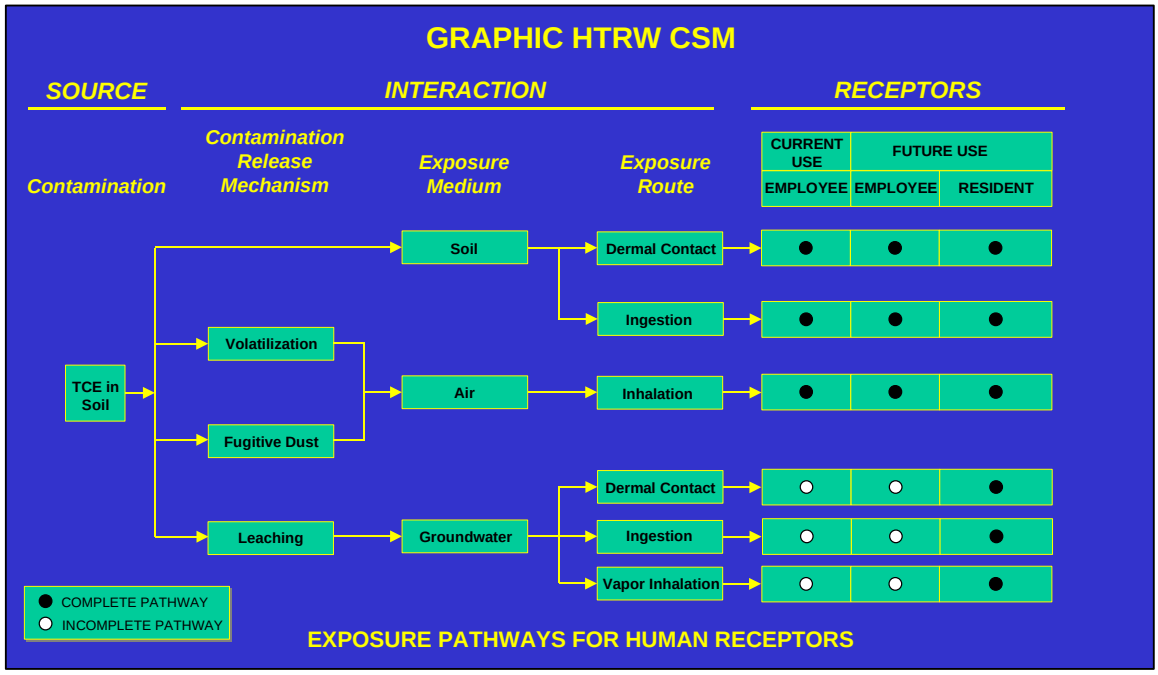

Figure 2-3. Graphic Presentation Component of an HTRW Conceptual Site Model

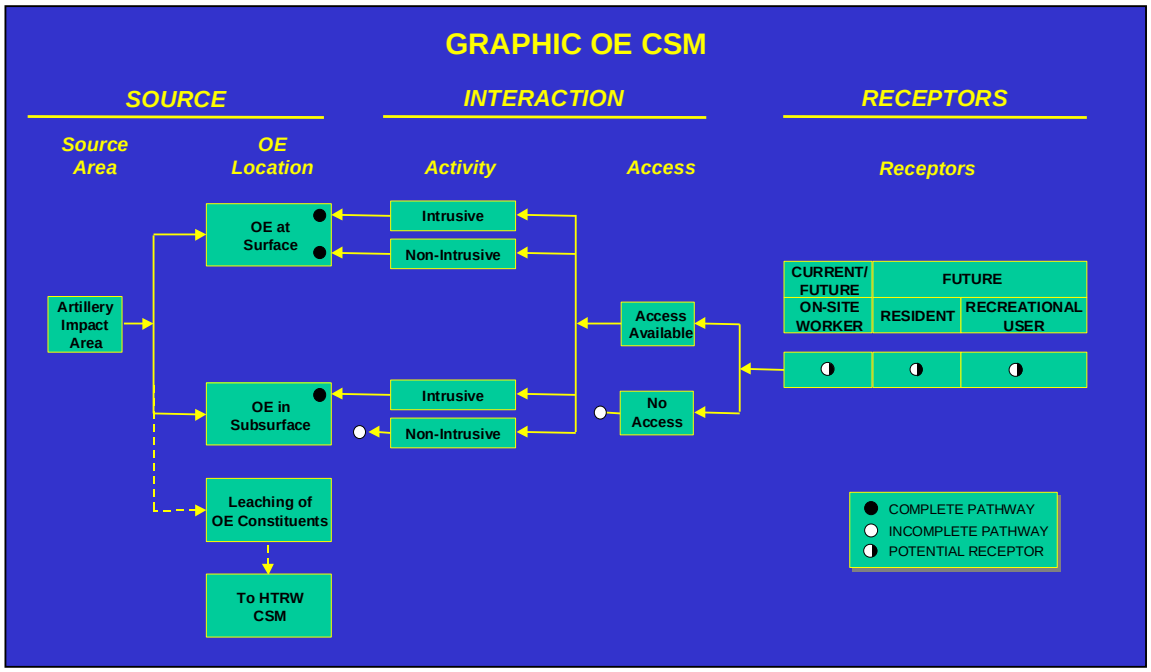

Figure 2-4. Graphic Presentation Component of an OE Conceptual Site Model

Additional detail regarding access and type of activity may be included. In this example, the OE in the subsurface would not present a hazard if left undisturbed. The concept of a secondary source does not apply to OE. However, a release of chemical constituents is possible and should be considered as a potential HTRW source in an integrated CSM.

d. Other Presentations. The CSM is a summary of the existing body of knowledge for a project presented in one or more illustrations or narratives. Specific data users may require this information to be presented in different formats. For instance, a hydrogeologist may prefer a cross-sectional subsurface diagram to conceptually view the source areas and possible ground water impacts. A risk assessor or land use planner may prefer the graphic representation to consider present or future risk issues. A person more interested in OE issues might opt for a range map depicting firing points and impact areas and the potential for human interaction with these.

e. Geographical Information Systems (GIS). The data collected and stored for a project may be complex and immense. The team is strongly encouraged to use GIS as a tool to store, manipulate, and present these data for the CSM.

2-7. Iterative Development of the CSM

a. A CSM requires continual refinement. Just as knowledge and understanding of a site will change as additional data are collected, the model used to represent that information should also change. The CSM helps the team to identify gaps in data in each phase of the project. In addition, completion of project phases will also be reflected in the CSM.

b. As shown in Figure 2-5, site profiles are developed from the existing data to document an initial CSM. The team must then create reasonable hypotheses regarding potential for exposure. For example, analysis of the ground water pathway will usually entail some hypotheses about ground water flow velocity or direction relative to potential receptors. If these parameters are not known, they can be measured through sampling or interpreted through modeling or professional judgement. If the results from data collection confirm the predicted model, the CSM is updated to show that the hypothesis is correct. However, if results do not support the predicted outcome, it may indicate the hypothesis was incorrect and should be restated. This will require revision to the existing CSM.

c. A CSM can be developed at any phase of a project, even if one had not been prepared previously. In addition, site characterization or response actions may reveal unanticipated contaminants or sources. As an example, OE may be discovered during investigation of an HTRW site. Although not expected during the initial phase of the investigation, an OE component to the CSM should now be developed, along with review or revision to the objectives for the project as needed.

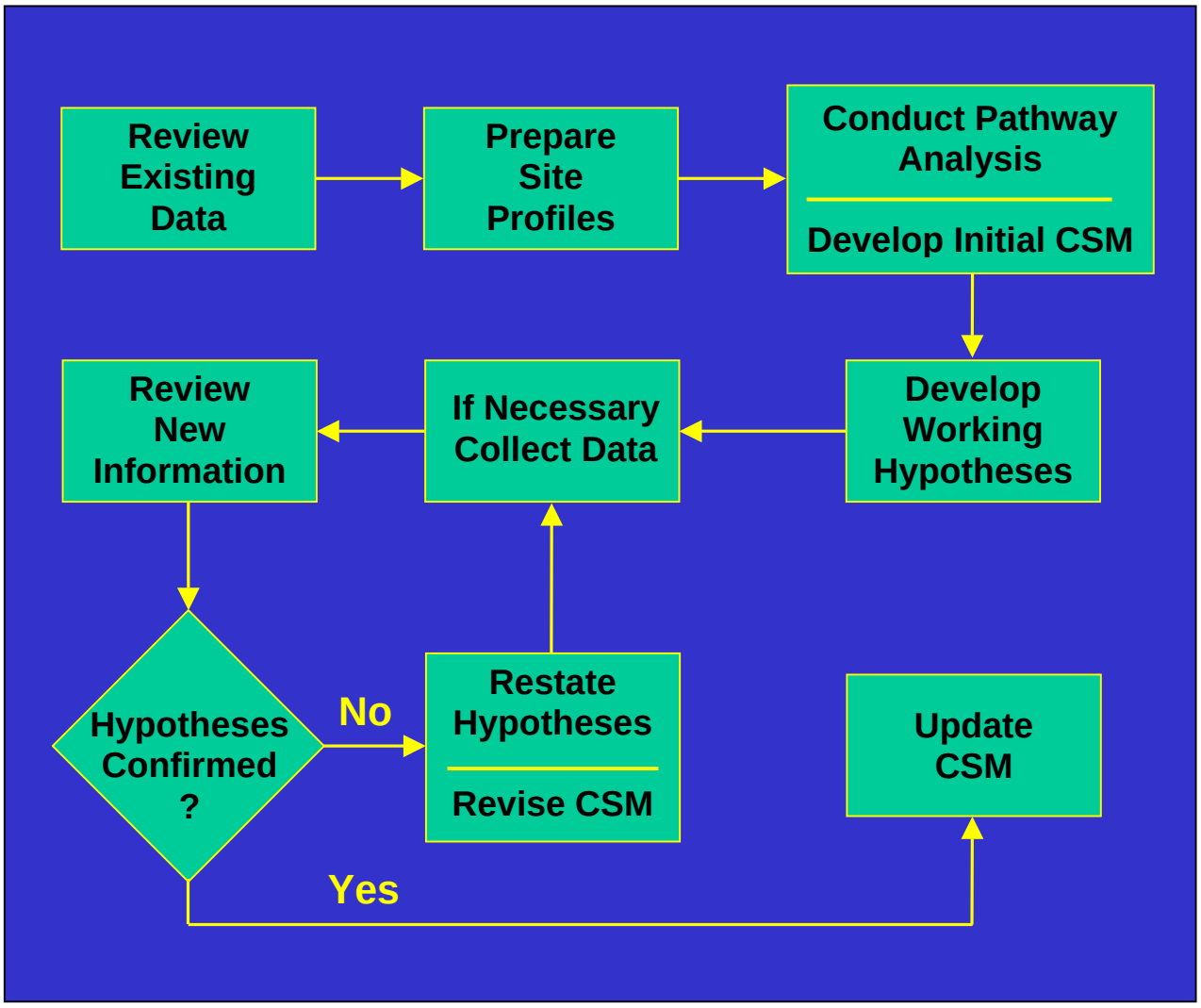

Figure 2-5. CSM Development Process