New Jersey Department of Environmental Protection

Site Remediation Program

Technical Guidance for Preparation and Submission of a Conceptual Site Model

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Version 1.0

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1. INTENDED USE OF GUIDANCE DOCUMENT

This technical guidance is designed to help the person responsible for conducting remediation to comply with the New Jersey Department of Environmental Protection (Department) requirements established by the Technical Requirements for Site Remediation (Technical Rules), N.J.A.C. 7:26E. This guidance will be used by many different people involved in the remediation of a contaminated site; such as Licensed Site Remediation Professionals (LSRPs), Non-LSRP environmental consultants and other environmental professionals. Therefore, the generic term "investigator" will be used to refer to any person that uses this technical guidance to remediate a contaminated site on behalf of a remediating party, including the remediating party itself.

The procedures for a person to vary from the technical requirements in regulation are outlined in the Technical Rules at N.J.A.C. 7:26E-1.7. Variances from a technical requirement or departure from guidance must be documented and adequately supported with data or other information. In applying technical guidance, the Department recognizes that professional judgment may result in a range of interpretations on the application of the technical guidance to site conditions.

This technical guidance supersedes previous Department guidance issued on this topic, N.J.S.A. 26:10C-16.

This technical guidance was prepared with stakeholder input. The following people were on the committee who prepared this document:

Joseph Eaker, Bureau of Information Services and Program Support (BISPS), New Jersey Department of Environmental Protection

Rob Lux, Bureau of Enforcement and Investigation (BEI), New Jersey Department of Environmental Protection

Kimberly McEvoy, Bureau of Environmental Measurement and Site Assessment (BEMSA), New Jersey Department of Environmental Protection

Nick DeRose, LSRPA, Langan Engineering and Environmental Services

Richard Britton, Whitman

Brendan Lazar, TRC Environmental Corp.

Jaime Wuelfing, Groundwater & Environmental Services

William Gottobrio, Kleinfelder

Carrie McGowan, ISP Management Company, Inc.

2. PURPOSE

This Conceptual Site Model Technical Guidance has been developed to provide a framework that can be used to aid and document site characterization and remedial action decisions throughout the life of the remedial process. A conceptual site model is a written and/or illustrative representation of the conditions and the physical, chemical and biological processes that control the transport, migration and potential impacts of contamination (in soil, air, ground water, surface water and/or sediments) to human and/or ecological receptors.

This Conceptual Site Model Technical Guidance should be used in concert with the Administrative Requirements for the Remediation of Contaminated Sites, N.J.A.C. 7:26C, Remediation Standards N.J.A.C. 7:26D, and the Technical Requirements for Site Remediation, N.J.A.C. 7:26E. While the CSM can greatly assist in explaining results of an investigation, it is not a required deliverable for documents submitted to the NJDEP. The use of the conceptual site model does not replace the need for documenting procedures, or methodologies for proper site investigation or remediation in accordance with the Department's regulatory requirements.

The conceptual site model is a critical tool that should be used to identify sources, receptors and pathways associated with the area of concern and/or site. The conceptual site model should support scientific and technical decisions for the site. The conceptual site model can also assist the investigator to communicate effectively with interested parties about the critical issues, and/or processes identified at the site, and support the remedial decision-making process. Development and refinement of the conceptual site model will help identify data gaps in the characterization process and can ultimately support remedial decision making. The Department accepts the conceptual site model as a valid scientific approach to support professional judgment when applied in accordance with applicable regulatory requirements, remediation standards and technical guidance documents.

3. DOCUMENT OVERVIEW

This technical guidance in conjunction with other Department technical guidance reviews the definition, procedures and application of a conceptual site model. A conceptual site model allows the user to present a comprehensive and concise understanding of the site environmental system and the potential risks to human health and the environment associated with identified contaminants of concern (COCs). The conceptual site model can range from a simple illustration (see Figure C1-1) to a more sophisticated comprehensive document (See Figure B1-1) depending on the complexity of the site and the amount of data collected. The conceptual site model can be applied to all phases of the remedial process to understand the relationship between sources, migration pathways and receptors associated with the site or area of concern and identified COCs. The conceptual site model serves to identify currently complete or potentially complete pathways to receptors and the potential for future risks.

The use of the conceptual site model does not replace the need for documenting procedures, or methodologies for proper site investigation or remediation in accordance with the

Department's regulatory requirements. The conceptual site model should be used to enable investigators to communicate effectively with all interested parties, identify critical issues and/or processes and facilitate the remedial decision making process. The format and presentation of the conceptual site model may also vary from a stand-alone document to being incorporated into the body of a submittal.

Procedures for development of a conceptual site model are presented in this document in three main sections:

Section 5.1 Describes the conceptual site model in detail and identifies the key components of a conceptual site model. This section also provides a framework for the site characterization and presents options for relaying the information to the end user.

Section 5.2 utilizes the site specific information to describe the scope of the conceptual site model, determine the extent of the investigative area and summarize all of the available information. This section discusses the identification of all potential sources, pathways and receptors.

Section 5.3 describes how the conceptual site model should be continually revised to reflect the current understanding of the site and how it can be used during all phases of the investigation, remediation and support the remedial decision.

Specific examples are included in the document.

4. DEFINITIONS

Conceptual site model:
The conceptual site model is a written and/or illustrative representation of the physical, chemical and biological processes that control the transport, migration and actual/potential impacts of contamination (in soil, air, ground water, surface water and/or sediments) to human and/or ecological receptors. Development and refinement of the CSM will help identify investigative data gaps in the characterization process and can ultimately support remedial decision making.

Contaminant of Concern (COC) :
Site-specific compounds associated with a discharge(s) at or from a site that are detected in environmental media (soil, ground water, surface water, sediment, air) above regulatory criteria. It also includes the degradation byproducts from the COCs.

Smear Zone:
Thickness of contaminant distribution that results from fluctuations of the water table that is equal to or greater than the historical range of water table fluctuations,

Migration pathway, n:
The course through which contaminants in the environment may move away from the source(s) to potential environmental receptors.

Complete Pathway:
An exposure route with an impacted receptor that is associated with a confirmed source and migration pathway. An incomplete pathway is missing one of these three components.

Source – (ASTM 2008):
The location from which a contaminant(s) has entered or may enter a physical system. A primary source, such as a location at which drums have leaked onto surface soils, may produce a secondary source, such as contaminated soils; sources, may hence be primary or secondary.

5. PROCEDURES

5.1 What is a Conceptual Site Model?

The goal of a conceptual site model is to provide a description of relevant site features and the surface and subsurface conditions to understand the extent of identified contaminants of concern and the risk they pose to receptors. The conceptual site model is an iterative tool that should be developed and refined as information is obtained during review of the site history and continues throughout the site and/or remedial investigation. The level of detail of the conceptual site model should match the complexity of the site and available data. Development and refinement of the conceptual site model will help identify investigative data gaps in the characterization process and can ultimately support remedial decision making.

5.1.1 Description of Source, Pathways, and Receptors

Potential sources of contaminants are identified and investigated as described in the Tech Regs regulations and other Technical Guidance Documents. These sources may include tanks, material transport areas, drainage conveyance areas, production areas, waste disposal areas, and other areas of concern. Contaminants of Concern, as well as their concentrations in the various media on site should be fully characterized to understand the extent and potential for migration. Potential migration pathways for these contaminants to receptors are then identified and evaluated to assess exposure risks. Identify incomplete pathways.

Preparation and use of the conceptual site model is an iterative process throughout the lifecycle of the project. The conceptual site model should be modified to continually evaluate the relationship between sources of contaminants, migration pathways, and receptors as new data become available. Evaluation of these three components through the use of the conceptual site model, in conjunction with initial preparation and subsequent revisions to the Receptor Evaluation Form (N.J.A.C. 7:26E-1.15) will ensure receptors are identified and addressed.

5.1.2 Summary of Impacted Media

Investigate all environmental media (ground water, surface water, soils, sediment, and air) and incorporate into the conceptual site model. The conceptual site model should be used to document the presence or absence of contamination in a particular media. When data is available, the CSM could include basic information for all potentially impacted media, such

as classification and applicable remediation standards, and summary tables and/or other data summary methods for concisely describing data available for all media, collected throughout the history of the site.

5.1.3 A Tool for Remedial Decision Making

The conceptual site model will evolve as information is gathered throughout the life of a project. As the understanding of the source, nature and extent of contamination is realized, the information should be used to evaluate fate and transport of the contaminants to the receptors. By periodically evaluating the completeness of the conceptual site model, data gaps can be more readily identified and addressed to ensure there is a complete understanding of contaminant impacts. By developing the conceptual site model through this iterative process, remedial decisions can be made to effectively address and protect the impacted and/or potentially impacted receptors. Clearly identify uncertainties associated with the conceptual site model so that efforts can be taken to reduce these uncertainties to acceptable levels. Early versions of the conceptual site model, which are usually based on limited or incomplete information, will identify the uncertainties that should be addressed. Perform an assessment of data usability/data representativeness to ensure identification of data limitations affecting the use of the conceptual site model.

Discussion of applying data usability/representativeness concepts to the conceptual site model is presented in Sections 2.4.3 and 2.4.4 of "Technical and Regulatory Guidance for the Triad Approach: A New Paradigm for Environmental Project Management" (ITRC, December, 2003).

5.1.4 Form of the Model (diagram, text, and mapping**)**

The conceptual site model can be presented in a number of forms. Often the forms will be dictated by the complexity of the site or area of concern and the amount and type of available data. The conceptual site model may be narrative, text, pictorial, presented as a computer model, or some combination. It should represent the site or area of concern, contaminant sources, the environmental media that have been impacted, and the processes that determine transport of contaminants to potential receptors. Refine the CSM as information is collected throughout each phase of a project until implementation of a remedy. A CSM is also useful after the remedy has been implemented. For example, use post remediation monitoring data to validate the CSM and confirm selection of a proper remedy for the site and/or AOC.

Figures 1 and 2 present illustrations of generic conceptual site models and potential human health and ecological receptors, respectively. In addition, Figure 3 presents a generic U.S. Environmental Protection Agency schematic diagram of a conceptual site model exposure pathway evaluation. Examples of development and application of the conceptual site model are also presented in Section 5.5 of this document.

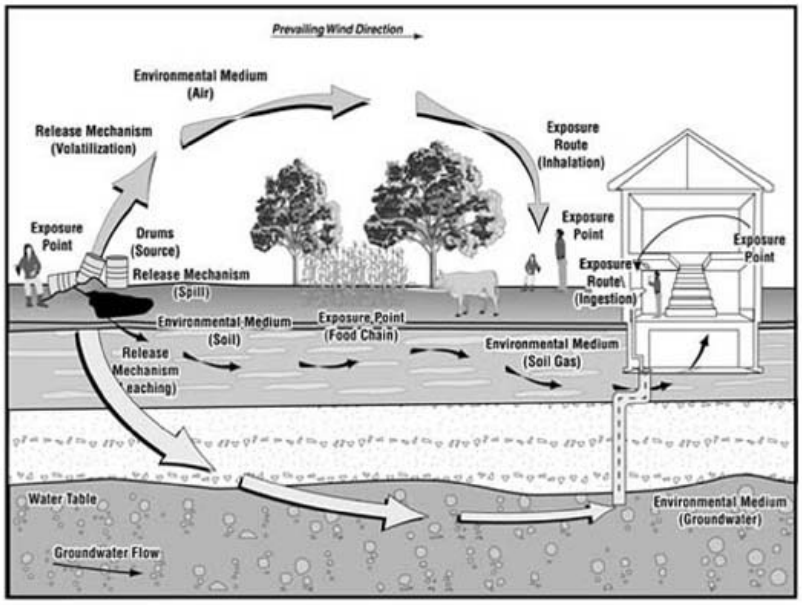

Figure 1: Conceptual Site Model – Exposure Pathway Schematic

Source: Agency for Toxic Substances and Disease Registry, Public Health Assessment Guidance Manual (2005 Update) (ATSDR, 2005)

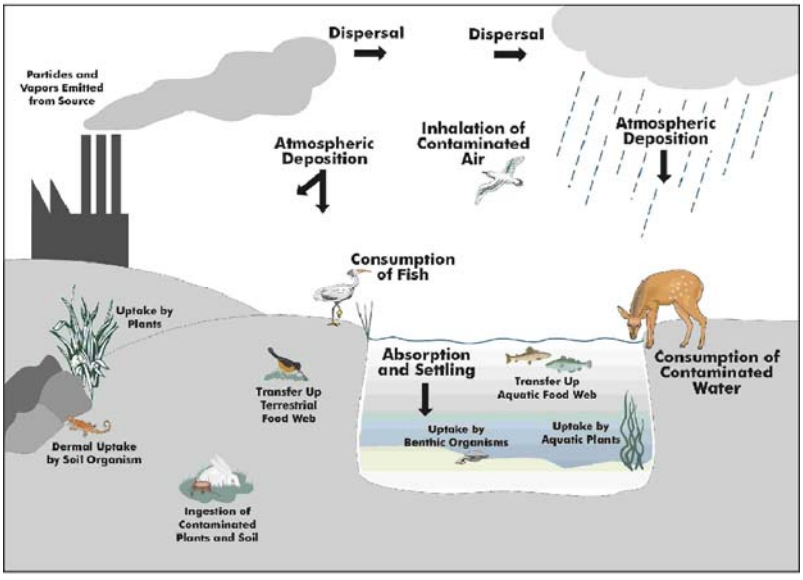

Figure 2: USEPA Generic ECO CSM Illustration
U.S. Environmental Protection Agency (USEPA) (2004)

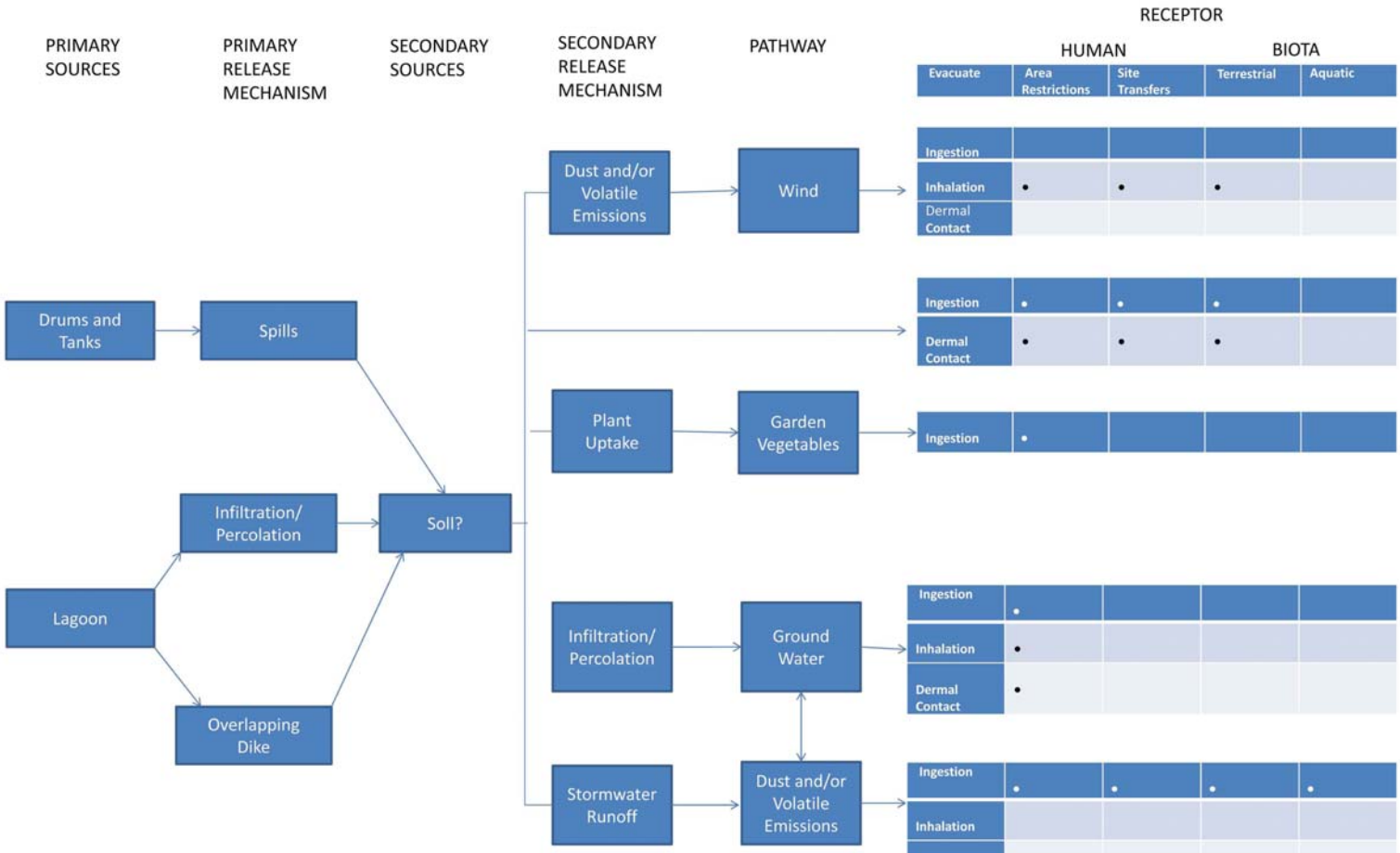

Figure 3: Schematic Illustration of conceptual site model for soil exposure pathway evaluation (Adopted from U.S. EPA, 1989)

5.2 Developing A Conceptual Site Model

The following sections describe the components that should be included in development and presentation of the conceptual site model in written submittals. The level of detail of the components should be consistent with the complexity of the site and available data. The format and presentation of the conceptual site model may also vary from a stand-alone document to being incorporated into the body of a submittal.

To assist the investigator in developing the conceptual site model, an optional checklist is provided in Appendix A to this guidance that identifies the types of information which could be collected during the remedial process. All items on this checklist may not apply to each site and depending upon the complexity of the site, there may be additional information required to complete the development of the conceptual site model. The investigator is also encouraged to conduct a site visit to assist in the development of a complete conceptual site model.

Components of the conceptual site model should clearly distinguish between background contamination and contamination associated with an area of concern or site to understand the receptor groups that may be associated with the exposure to contaminants of concern within a pathway.

5.2.1 Description of Conceptual Site Model Scope – Site-wide or Area of Concern

The scope of the conceptual site model should include establishing the extent of the investigative area to be characterized. Make clear if the conceptual site model will be limited to an area of concern or the entire site, and if it will extend off site to include regional features. It is also important to clarify if the conceptual site model is being developed to assess potential/actual impacts to human or ecological receptors or both. The description of the conceptual site model should include a complete site plan depicting the extent of the area addressed by the conceptual site model, a depiction of identified area of concerns/source areas, potential COCs, pertinent features affecting contaminant migration, identified potential receptors, and the applicable remediation criteria.

5.2.2 Summarizing Available Information

The investigator should evaluate information collected throughout the remedial process (Preliminary Assessment/Site Investigation (PA/SI), Remedial Investigation (RI), Remedial Action) in developing and refining the conceptual site model. This should include providing a summary of available site information and publications relevant to developing the conceptual site model.

The following information should be included in the summary:

- general description of current uses of the property and surrounding properties
- current zoning status for the property and surrounding properties

- available historical information on property use or activities that may be pertinent to its environmental status
- identification of the locations and depths of known subsurface utilities
- relevant off-site and regional information from aerial photographs, geographic information system data, and historical and current tax maps, etc.
- photographs, topographic maps, and geologic quadrangle maps
- historical discharges;
- historical contaminant concentrations in soil and ground water;
- aquifer classification and surface water body classification;
- applicable remediation standards for all potentially impacted media; and
- any applicable antidegradation policies.

5.2.3 Identification of Potential Sources

The investigator should conduct a diligent inquiry into the operational and ownership history of the area of concern or site to determine source(s) which may have contributed to the contamination. This may include information or data generated by a Preliminary Assessment conducted in accordance with N.C.A.C 7:26E-3 and the current versions of the Departments PA/SI/RI Ground Water Technical Guidance Document and PA Soils Technical Guidance Document. The source is then defined by specific area of concerns or may be a group of area of concerns. It is important to consider individual contributions when grouping area of concerns into a single source area.

Source areas and plumes that overlap are encouraged to be investigated together and included in the same CSM.

5.2.4 Characterization of the Source(s) of Contamination

The characterization of the source(s) provides the basis for completion of the site/remedial investigation. The investigator should identify the discharge date, discharge point, discharged material, and estimated volume of the discharge. Include a discussion of the affected media and initial mitigation and/or remediation efforts.

Initially, the source should be characterized and the extent of contaminants of concern estimated. As source characterization progresses, the conceptual site model should be refined using the site-specific sampling data and additional historical information that is discovered during the investigation/remediation.

The source characterization should discuss:

- location;
- content;
- dates of use;
- extent/volume/mass;
- maps;

- discharge maps;
- discharge information;
- prior remedial actions; and
- immediate environmental concerns conditions/mitigation.

Once significant contaminant data is available, summary tables, maps, graphs or other figures should be used to describe the nature and extent of contamination in all media and/or to concisely illustrate any temporal trends in the data. Historical monitoring/investigation data and past remedial actions taken should be included. Information that does, or may, explain any trends in the data could also be discussed. In addition, any important implications for receptor exposure that may be associated with changes in various contaminant levels over time in any media could be noted.

During the review of available site and surrounding property information, it is important to identify contamination in media on-site that may not be related to spills or site processes. Specifically, it is important to determine if fill was placed on-site at any point in time and the extent of the fill material. This material could meet the definition of historic fill and, if contaminants are detected in the fill, may influence the choice of remedial action for part of the site or area of concern. The presence of impacted fill does not preclude site investigation and remediation of impacts that are associated with site operations.

It may also become apparent that contaminants detected on-site may be due to diffuse anthropogenic contaminants, naturally occurring background concentrations, or impacts from discharges at near-by sites. The existence of contaminants not related to the site operations is important when determining site pathways and impacts to receptors. Source control or remediation of these constituents may not be possible or necessary but it is important to evaluate the impact to receptors and consider this when ultimately making remedial decisions.

5.2.5. Migration Pathways

The conceptual site model can identify all potential and confirmed migration pathways of the contaminants of concern for the area addressed by the conceptual site model. The purpose of this section of the conceptual site model is to document all current and future migration pathways for all contaminants of concern at the site. This section should also identify when the migration pathway(s) are not complete and therefore will not be evaluated.

The media that should be evaluated in the development of a conceptual site model are soil, ground water, surface water, sediment and air. The following sections provide information to consider when evaluating migration pathways for each media. The investigator should then evaluate which components are applicable based on the conditions and complexity of the site.

5.2.5.1 Soil

Soil sampling and characterization must be conducted in accordance with N.J.A.C. 7:26E-3.6. The investigator should also follow the Department's Guidance for Site Investigation of

Soil, Remedial Investigation of Soil, Remedial Action Verification Sampling for Soil, and NJDEP's Field Sampling Procedures Manual. If the investigator identifies constituents that exceed the appropriate Department remediation standards, the investigator can develop a conceptual site model to characterize the nature and extent of contamination. Include the evaluation of each potential exposure pathway and supporting fate and transport analysis as appropriate. In this analysis, the investigator must identify the boundaries that were used to define the site and/or area of concern, which should be supported by the sampling locations. Based upon the complexity of the site and site conditions, the conceptual site model should be able to provide the following information derived from field investigations:

- contaminants of concern that are present, their concentrations, spatial variation in concentration, and remediation standards;
- physical characteristics of the soil in which contaminants of concern are present and through which they may be moving
    - examples include soil type, dry bulk density, permeability, organic carbon content, porosity, field description from boring logs, and moisture content;
- heterogeneities within the soil column;
- existence of "smear zone"; and
- depth to ground water and/or bedrock.

Within the conceptual site model, identify site conditions that may represent potential exposure risks and/or migration pathways.. Examples of information to consider include:

- proximity to surface water and wetlands;
- surface and subsurface drainage features;
- subsurface storm water infiltration galleries;
- amount of soil cover;
- proximity to buildings;
- proximity to residential areas, schools, parks, etc.; and
- location of utilities/preferential migration pathways.

Documentation of above-mentioned properties and any significant variability over the site may be very important later in developing a fate and transport analysis and in identifying any potential secondary sources. Appendix C provides examples of conceptual site models for a single discharge, where soil is one of the media of concern

5.2.5.2 *Ground Water:*

If a release to ground water is suspected, ground water sampling must be conducted in accordance with N.J.A.C. 7:26E-3.7 and the current versions of the Departments PA/SI/RI Ground Water Technical Guidance Document and NJDEP Field Sampling Procedures Manual. A ground water conceptual site model can be used to aid in determining the extent of the migration of contamination in each aquifer unit. The ground water conceptual site model is based on knowledge of the site, ground water monitoring information, and the fate and transport analysis. The investigator should evaluate and include the following in the conceptual site model:

- types of contaminants of concern present, their concentrations and their spatial variation in concentration;
- aquifer characteristics (e.g., porosity and permeability) of the material(s) through which ground water moves;
- name and type (Class I, II, or III) of aquifer(s) that has(have) been impacted;
- direction of ground water flow;
- hydraulic gradient;
- location of recharge and discharge areas including infiltration galleries;
- location of any pumping influence;
- water use area (potable, irrigation, industrial, etc.);
- heterogeneities within the saturated geologic matrix
- bedrock structure information that may control contaminant migration; and
- preferential pathways (e.g. location of subsurface utilities).

Organic contaminants can migrate into low permeability formations of clay or rock where they remain at high concentrations. These may diffuse slowly into adjacent, aquifer formations. Therefore, the nature and extent of organic COCs sorbed within low permeability soil and rock matrices, both above and below the saturated zone, should also be characterized.

This information is not only necessary to describe and evaluate conditions at the site, but is often vital to fate and transport analysis, especially when it requires a quantitative approach. The conceptual site model should also identify if background contamination is migrating onto the site and/or area of concern. If an off-site source of contamination is identified, then collect the same information as if the ground water contamination was from the site and/or area of concern. The presence of an off-site source does not preclude site investigation and remediation of impacts that are associated with site operations.
The fate and transport evaluation of ground water in this section should identify the current and historical extent of ground water contamination and the related receptors. The investigator should also identify future receptors that may be impacted by the contamination stemming from the site and/or area of concern.

The investigator will also need to determine when there may be a need for specialized engineering and/or scientific expertise to support the characterization of the migration pathway. Many situations may result in complex interactions between contaminants and the environment. One common error than can invalidate the conceptual site model is the installation of monitoring wells at a consistent pre-determined depth without evaluating whether preferential pathways exist at the site. As illustrated by Figure 4, not accounting for a dipping transmissive zone that acts as a preferential pathway could lead the investigator to conclude that ground water contamination is delineated, when in fact contamination was simply missed due to inadequate site characterization, resulting in the development of an inaccurate conceptual site model.

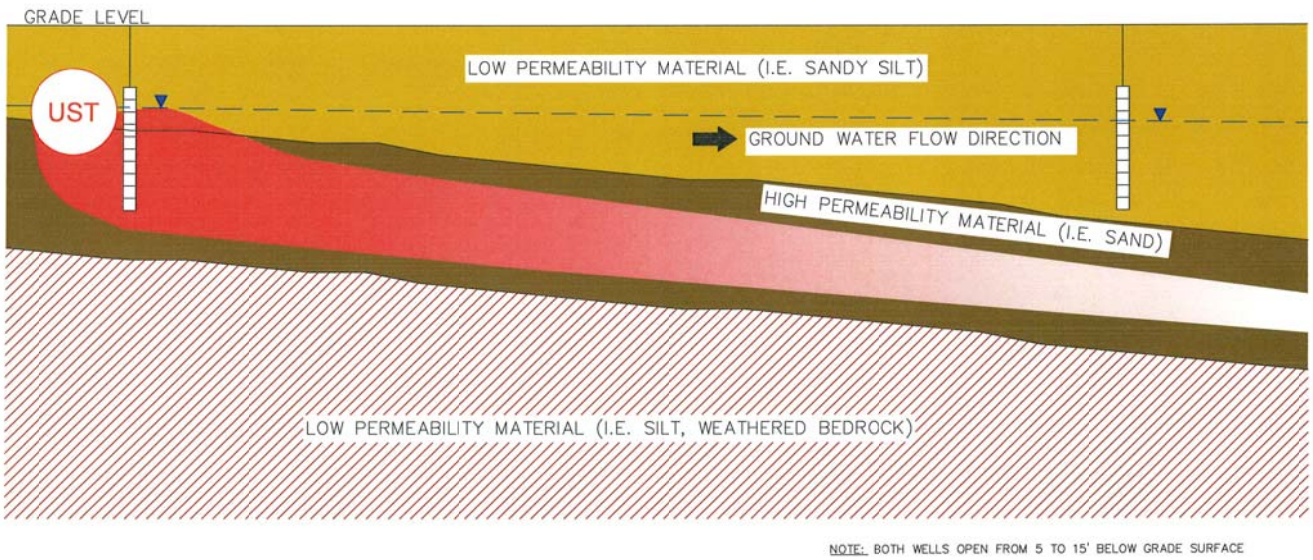

FIGURE 4 – IMPORTANCE OF PROPER SITE CHARACTERIZATION

5.2.5.3 *Surface Water*

If a discharge is suspected to have occurred into surface water or there is a migration pathway to surface water, then this pathway should be assessed as specified by N.J.A.C. 7:26E-3.8 and the Department Ecological Evaluation Technical Guidance. A surface water and sediment investigation is usually conducted if there is evidence of a direct discharge to surface water, contaminated surface water runoff or ground water discharges into the surface water body. This section will specifically address components that should be included when assessing the surface water migration pathway.

Provide the following information in the conceptual site model when addressing the surface water migration pathway:

- physical components associated with the surface water body such as identification of stressed vegetation, sheens, seeps, discolored soil or sediment along the shoreline or on the surface water body;
- documented historical discharges that may or may not be associated with the site and/or area of concern including historical ecological studies documenting differences in organism population density and diversity in areas potentially impacted by the site relative to areas not impacted by the site;
- identification of ground water contaminants of concern that exceed the Surface Water Quality Standards and migrate along the ground water path toward a surface water body;
- plume area, concentration and flow (Q) to estimate a mass loading to surface water;
- whether antidegradation policies apply,
- Seasonal surface water flow.

5.2.5.4. *Sediment*

In accordance with N.J.A.C. 7:26E-3.8 (b) and the Department's Ecological Evaluation Technical Guidance, the collection of sediment samples is required when it is evident that a discharge to a surface water body has occurred and there is reason to believe that sediments may have been impacted by contamination emanating from the site or area of concern. When evaluating the sediment migration pathway, the investigator should determine if there is potential exposure to human health and/or to the environment. Successful evaluation of contaminated sediments requires knowledge of the nature, concentration and areal extent of contamination, as well as site-specific variables that affect the expression of environmental impacts. When trying to understand the relationship between contaminant concentrations and exposure within the sediment migration pathway, the conceptual site model should identify:

- how site-related contaminants enter a system;
- how contaminants move in that system (including fate and partitioning); and
- mechanisms for exposure and uptake in human and/or ecological receptors.

5.2.5.5. *Vapor and Air*

If a vapor intrusion investigation is warranted in accordance with the VIG, the conceptual site model should identify all potential vapor migration pathways and processes through which a receptor can be exposed at a particular site. Vapor and liquid transport processes and their interactions with various geologic and physical site settings (i.e., variations in building design/construction, soil texture/profile, temporal variation in atmospheric pressure, precipitation/infiltration, soil moisture, and water table elevation) create a complex and dynamic system. Consider as follows the main vapor transport mechanisms that should be considered when evaluating vapor migration:

- diffusion of vapors from sources in the unsaturated zone;
- diffusion of vapors from sources in shallow ground water;
- advective/convective transport of vapors; and
- vapor migration through preferential pathways.

A vapor intrusion investigation must be initiated when any of the conditions outlined in N.J.A.C. 7:26 E-1.18 are met. The NJDEP Vapor Intrusion Guidance Document provides direction for such an investigation. The conceptual site model can be used for the following:

- determining presence/absence of current conditions that would trigger a vapor investigation;
- evaluating historical levels of ground water COCs which are not currently above screening levels to assess potential VI concerns;
- assessing identified risks;
- identifying actions necessary to mitigate the risks;
- documenting effectiveness of mitigation activities; and
- identifying and evaluating airborne release mechanisms (emissions from stacks, roof vents, dust collectors, fire and excavation/construction, etc.)

The conceptual site model should be used to document all sources, pathways, receptors and associated investigative/corrective actions conducted in accordance with the Vapor Intrusion Technical Guidance and N.J.A.C. 7:26E-1.18. A discussion of migration pathways for the vapor pathway is included in Appendix B of this document.

5.2.6 Identification of Human and Ecological Receptors

The identification of potential receptors is the key function of the conceptual site model and should take place upon the initial discovery of the discharge and continue to be refined as the investigation proceeds. Human and ecological receptors include those that are impacted or threatened by the contaminants of concern, located within the investigative area or present along an identified migration pathway. Future use of the site may affect the exposure scenario; therefore, the conceptual site model should identify, when possible, the future use of the site and take into consideration future exposures to all receptors.

Include the following in the human receptor evaluation:

- contaminants or suite of contaminants that are evaluated;

- pathway of exposure to each contaminant of concern (via direct contact (i.e., ingestion, inhalation or dermal contact) or bioaccumulation along food chain); and
- populations that are currently or potentially exposed.

The ecological risk evaluation is often separate from the human risk evaluation since humans are potentially exposed to contamination differently (e.g.., migration pathway or food source) than ecological receptors. The information that is required to be evaluated in the Receptor Evaluation Form, as required by N.J.A.C. 7:26E-1.15, will help with the identification of ecological receptors. See the Departments Ecological Evaluation Technical Guidance. Generally, the ecological receptor evaluation should address the following components:

- contaminants of potential ecological concern (including co-occurrence of contaminants) for soil, ground water, surface water and sediment;
- current and future exposed species: representative of major groups present at site, not necessarily all species on or adjacent to site;
- contaminant migration pathways to environmentally sensitive areas;
- environmentally sensitive areas as described in N.J.A.C. 7:1E-4.10 and
- map of exposed population along each migration pathway.

Submit the presentation of the ecological and the human receptor evaluations as two separate sections within the conceptual site model. As previously illustrated, Figures 1 and 2 present generic conceptual site models to highlight potential human health and ecological receptors, respectively.

5.2.7 Determination of the Extent of Investigative Area

The conceptual site model should not only characterize the source area and the extent of contamination associated with the source area as described above, but the conceptual site model should include a description of the extent of the investigative area. This would include identification of human populations that may be impacted by the contamination (i.e., private or public supply wells); any critical species that may live on or adjacent to the site, such as federally or state threatened or endangered species; or any environmentally sensitive natural resources. This should include identifying critical habitats within the area associated with identified migration pathways. The investigator should present this information in map form and update as the data is collected for all migration pathways related to the site.

5.2.8 Narrative Description

The narrative description puts all the pieces of the conceptual site model together in a summary fashion for the site as it is understood at that time. For a simple scenario, the narrative description may be notes or text boxes on a drawing. For a more complex site, it may be the section of a report. It should clearly describe the site, contaminants, pathways, and receptors. It also may include a discussion of data gaps or uncertainties.

5.3. Applying the conceptual site model

The conceptual site model can be applied to all phases of the Remedial Process to understand the relationship between sources (COCs), migration pathways and receptors associated with the Site or area of concern. The use of the conceptual site model does not replace the need for documenting procedures or methodologies for proper SI in accordance with the Technical Requirements for Site Remediation, N.J.AC. 7:26E. The conceptual site model allows the investigator to present a comprehensive and concise understanding of all impacted media including soil, ground water, air, surface water and sediment associated with the site or area of concern and the potential risks to human health and the environment associated with the contaminants of concern. Use the conceptual site model to enable the user to communicate effectively with all interested parties, identify critical issues and/or processes and facilitate the remedial decision making process.

Appendix C presents a series of graphical illustrations and schematic diagrams to illustrate the application of basic conceptual site models for Preliminary Assessment and Remedial Investigation phases.

A CSM is also useful after the remedy has been implemented. For example, post remediation monitoring data can be used to validate the CSM and confirm that a proper remedy has been selected for the site and/or AOC.

The conceptual site model can be applied in each phase of the remedial process as highlighted in the table below:

Table 5-1: Applying the conceptual site model in the Remedial Process	
Preliminary Assessment	• Allows the user to summarize collected information regarding area of concerns as to its relationship to source, pathway and potential receptor. • To eliminate need for further investigation (e.g., baseline ecological evaluation; building interiors. • Serves as basis for determining approach to the site investigation.
Site Investigation (SI)/ Remedial Investigation	• Characterize the physical, biological, and chemical systems existing at a site or area of concern. • Describe processes that affect discharges, contaminant migration, and exposure to contaminants. • Document non-site related contaminants (e.g., historic fill, naturally occurring background, diffuse anthropogenic contamination).
Remedy Selection	• Determine potential exposure routes (e.g., ingestion and inhalation) and identify potential risks to human health and the environment. • Identify potential remedial alternatives. • Facilitate the selection of remedial alternatives to eliminate the unacceptable exposure of environmental receptors to contaminants of concern and thereby ensure protection of human health and the environment. • Identify data gaps that may preclude a definitive determination of the remedial action selection and discussion of plans to address them. • Summarize the data collection/evaluation and feasibility testing completed to support the selected remedial approach (passive or active remediation). • Identify interim or active remedial approaches that have been applied or are planned for implementation at the site. • Discuss selected remedial action as it relates to protection of human health and the environment.
Post Remedial Action	• Document the effectiveness of remedial actions selected to mitigate or eliminate the exposure of all human and ecological receptors affected by the chemicals of concern; • Illustrate that sufficient investigative data were collected to support the selected remedial action; • Support that the appropriate engineering or institutional

	controls have been implemented; • Support a response action outcome • Document the completion of all phases of remediation in accordance with all applicable statutes, regulations, and guidance; • Support the appropriateness of a variance or deviation from an applicable regulation or guidance due to site-specific conditions; and • Summarize the post remedial monitoring plan, as appropriate.

5.4 Data Gaps and Revising the Conceptual Site Model – Iterative Process

It is recommended to develop a conceptual site model early in the investigative process (e.g., at the preliminary assessment phase). The integration of available site history into an initial conceptual site model assists in the identification of necessary information and/or data that may be required to be collected during the investigation to ensure understanding of impacts associated with an area of concern or site. The complexity of the conceptual site model should be consistent with the complexity of the site. The conceptual site model will increase in detail as the characterization of the site progresses. For example, a conceptual site model would be more complex when factoring in the evaluation of both ecological and human health receptors. For larger, more complex sites, the Site Investigation and Remedial Investigation phases will typically proceed in an iterative process, which will act to incrementally refine the CSM expands and builds as the information is gathered.

It should be noted that the conceptual site model can change significantly as the investigation proceeds and all data (soil, groundwater, surface water, air, sediment) must be continually and collectively evaluated over time. For example, changes in groundwater use, changes due to partial or evolving remedial actions over time can affect the understanding of site conditions and in turn the conceptual site model. New information should be utilized to modify or improve the conceptual site model even if it changes a previously "established" conceptual site model.

During the early development of the conceptual site model, assumptions may be useful. The conceptual site model should clearly identify the assumptions made about physical, chemical and biological processes associated with the site and/or area of concern throughout all phases. The assumptions employed in the conceptual site model are typically verified or adjusted based on further information from subsequent phases of investigation. This iterative process is essential to the development of a comprehensive conceptual site model.

When using the conceptual site model, the user should identify those components (e.g., source, migration pathway, receptor) that may represent data gaps that may need to be expanded. As previously identified in Section 5.1.3, development of the conceptual site model should also include an evaluation to identify potential data gaps based on sources of data uncertainty as described in “Technical and Regulatory Guidance for the Triad Approach: A New Paradigm for Environmental Project Management” (ITRC, December, 2003).

5.5 Examples of Development and Application of the Conceptual Site Model

Examples in Appendix B of this document will assist the investigator in understanding how to develop, apply and describe the conceptual site model. These examples include:

- Example B1: conceptual site model for complex site underlain by fill with potential multi-media pathways and receptors
- Example B2: Applying a Conceptual Site Model to Potential Indoor Air Migration

Examples in Appendix C of this document are illustrations of how to present case scenarios during different phases of an investigation.

- Figure C1-1 : Schematic of a site showing a single AOC and it's proximity to a building during a Preliminary Assessment.

- Figure C1-2: Flow chart showing the information known during the Preliminary Assessment.

- Figure C2-1: Schematic of a site showing sampling conducted and the site specific information collected for a single AOC during the Site Investigation.

- Figure C2-2:Flow chart showing sampling data and evaluation of potential pathways for the Site Investigation.

6. REFERENCES

ASTM CSM Guidance (ASTM E1689-95 (2008))

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Fairfax, Virginia, April 2004.

U.S. Environmental Protection Agency (USEPA). 2004. "User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings," Office of Emergency and Remedial Response, Washington, DC http://www.epa.gov/oswer/riskassessment/airmodel/johnson_ettinger.htm.

Appendix A

Conceptual Site Model Checklist

CONCEPTUAL SITE MODEL

This is an optional checklist that identifies the types of information which could be collected during the remedial process. All items on this checklist may not apply to each site and depending upon the complexity of the site, there may be additional information required to complete the development of the conceptual site model.

Prepared By:

Site Name:		
Site Address:		**NJDEP Case #:**
City, State:		**NJDEP PI #:**
Item	**Evaluation Criteria**	**Comments/Discussion:**
5.1	**Release Point/Material/Estimated Volume/Date of Discovery**	
	Description of Sources, Pathways, and Receptors	
	Initial Corrective Actions	
	Summary of Impacted Media	Soil: Ground water: Surface Water: Sediment Air:
	IEC Conditions / Corrective Actions Taken	Soil: Ground water: Surface Water: Air:
At a minimum, a Site Map, depicting site features and areas of concern (AOCs), should be included as part of Section 5.1.		
5.2	**Description of conceptual site model Scope**	DISCUSSION: Site Wide / area of concern only / Offsite Impact:

Contaminants of Concern (COC)	
COC in Soil	
COC in Ground water	
COC Vapor Phase	
Non Aqueous Phase Liquid	
Potential Migration Pathways and Regulatory Cleanup Goals (Human Health and Ecological)	
Soil	
Ground water	
Surface Water	
Vapor (Soil Gas / Indoor Air)	
Airborne	
Other (if applicable)	
Sensitive Receptors	
Local Ground Water Designation or Use	
# Residential Wells (distance/direction from site)	
# Municipal Wells (distance/direction from site)	
Surface Water Bodies (distance/direction from site)	
Public Community Water Supply -surface water intakes.	
Residential Buildings	
Identify all Public Use Areas w/in 200 feet	
Summarizing Available Information	
Historical and Current Site Use/Status	
<u>Site & Adjacent Properties Usage / Zoning</u>	
Site	
North Adjacent	
East Adjacent	
South Adjacent	
West Adjacent	
Subsurface Utilities / Depth to Invert	
<u>Soil</u>	
Lithology	

	Depth to ground water
	Smear zone
	Depth to bedrock
	Heterogeneities
	Proximity to surface water wetlands
	Soil cover
	Proximity to buildings
	Utilities / preferential pathways
	Ground Water
	Ground water flow
	Depth to water trends
	Hydraulic gradient
	Porosity / Permeability
	Hydraulic conductivity
	Hydraulic radius of influence
	Location of recharge and discharge areas
	Utilities / preferential pathways
	Location of any pumping influence
	Surface Water
	Stressed vegetation/seeps/sheen
	Discolored soil / sediment
	Historic ecological study conclusions
	Ground water flow
	Ground water COCs in excess of surface water Standards
	Presence of background contamination
	Note: Sediment sampling and assessment should be conducted when there is evidence of a discharge to surface water pursuant to N.J.A.C. 7:26E-3.8 (b).
	Air (Soil Gas/Indoor Air)
	Ground water in excess of Screening Levels within 30 feet from a building
	Free product present within 100 feet from a building (currently or historically)
	Non-petroleum compounds present within 100 feet from a building
	Could historical levels of ground water COCs which are not currently above

	screening levels result in a VI concern	
	Presence of a basement / sump	
	Current usage of the building	
	Condition of basement floor/walls or slab	
	Presence of ground water or free product in the basement or sump	
	Landfill located on or adjacent to the site	
	Soil gas or indoor air impact in excess of applicable screening levels	
	Methanogenic conditions are present	
	Other identified risks (ex: odor)	
	<u>Identification of Human and Ecological Receptors within the complete extent of the investigation area</u>	
	COCs in soil, surface water and sediment	
	Current and future exposed species	
	Environmentally Sensitive Areas (ESAs)	
	Exposed population along each migration pathway	
	Migration pathways leading to ESAs	
	Exposure Pathways (Human)	
	Human population currently or potentially exposed	
All relevant photographs, topographic maps, geologic quadrangle maps, etc. should be included as part of Section 5.2.		
5.3	**Remedial Selection**	
	Remedial actions taken	
	Area(s) remediated	
	Remediation effectiveness	
	Remediation Action Outcome (RAO)	
	RAO justification	
	Post RAO monitoring plan	
	Classification exception area length / duration (if applicable)	
	Variances	
	Attachments:	

Site Location Map, Local Area Map, Site Map, Soil Data Maps, Potentiometric Surface Map, Ground Water Chemical Data Maps, Soil Boring Logs, Well Construction schematics, Geologic Cross-Sections, Potable Well Radius Map, Soil Data Tables, Historic Ground Water Conditions Table, Hydrographs, and Ground Water Plume Model, and/or Remedial System Layout, and Process and Instrumentation Diagram

Appendix B

Examples of Development and Application of Conceptual Site Model

Example B1: Conceptual Site Model for Complex Site

An initial conceptual site model was developed and presented to understand the potential sources of contamination, contaminants of potential concern , potentially affected media (soil gas, soil, and ground water), and transport and exposure pathways that could potentially impact human or ecological receptors. The conceptual site model synthesizes what is known to date into a snapshot that communicates the site physical setting and contaminants of potential concern discharge or exposure mechanisms. Based on the findings of the SI, the initial conceptual site model was updated and the current conceptual site model is presented as described below.

Description of Sources, Pathways and Receptors

Results obtained from previous investigations indicated that there are contaminants of potential concern in soil in all parcels, and in ground water. Figure B1-1 illustrates their occurrence and associated potential exposure pathways. As illustrated, metals, Total Petroleum Hydrocarbons, Polycyclic Aromatic Hydrocarbons, and Polychlorinated Biphenyls have been detected in subsurface soil. Metals, Total Petroleum Hydrocarbons, Polycyclic Aromatic Hydrocarbons, and Volatile Organic Compounds (VOCs) have also been detected in ground water. Soil gas samples had not been collected previously. The likely sources of these contaminants of potential concern are the historic fill material, former fuel use and storage, and shipbuilding and other industrial operations located at the site. Chemicals may have been placed during bay infilling, spilled on the ground surface or released in the subsurface soil and leached into shallow ground water. Some contaminants of potential concern including arsenic, cadmium, copper, chromium, nickel, thallium, vanadium, and zinc are naturally occurring in the native rock and soil. Ground water contaminants may have spread following the direction of the shallow ground water gradient. VOCs in soil and ground water also may have volatilized into the soil pore space above the ground water table.

Based upon the types of chemicals present at the site and the media in which the chemicals are present, the following mechanisms for chemical transport have been identified for the site (Figure B1-1):

- volatilization of VOCs from soil and ground water into soil pore space (soil gas);
- leaching of contaminants of potential concern from soil into ground water; and
- transport of contaminants of potential concern in ground water via ground water flow.

The following potential human exposure routes for chemicals have been identified for the site (Figure B1-1):

- inhalation of VOCs volatized from soil gas;
- dermal contact inhalation and incidental ingestion of soil particulates; and
- dermal contact with ground water.

The site ground water is not currently used for or planned to be used for domestic purposes in the future.

The following ecological exposure routes for chemicals have been identified for the site (Figure B1-1):

- inhalation of VOCs volatized from soil gas in burrow air;
- incidental ingestion and dermal contact of soil particulates;
- plants' direct uptake of contaminated ground water and contaminated sediments; and
- ingestion and contact with contaminated surface water.

Exposure Assessment

In evaluating the potential human health risks posed by a site, it is necessary to identify the populations that may potentially be exposed to the chemicals present, and to determine the pathways by which these exposures may occur. Identification of the potentially exposed populations requires evaluating the human activity and anticipated land use at the site.

Once the potentially exposed populations are identified, the complete exposure pathways by which individuals in each of these potentially exposed populations may contact chemicals present in the soil gas, ground water, and soil at the site are determined. A complete exposure pathway requires the following three key elements:

- chemical contaminant source;
- migration route; and
- point for human exposure (e.g., soil, air, or water);

An exposure pathway is not complete unless all three elements are present.

Figure B1-2 is an example of a schematic diagram showing the relationship between a chemical source, exposure pathway, and potential receptor at this site.

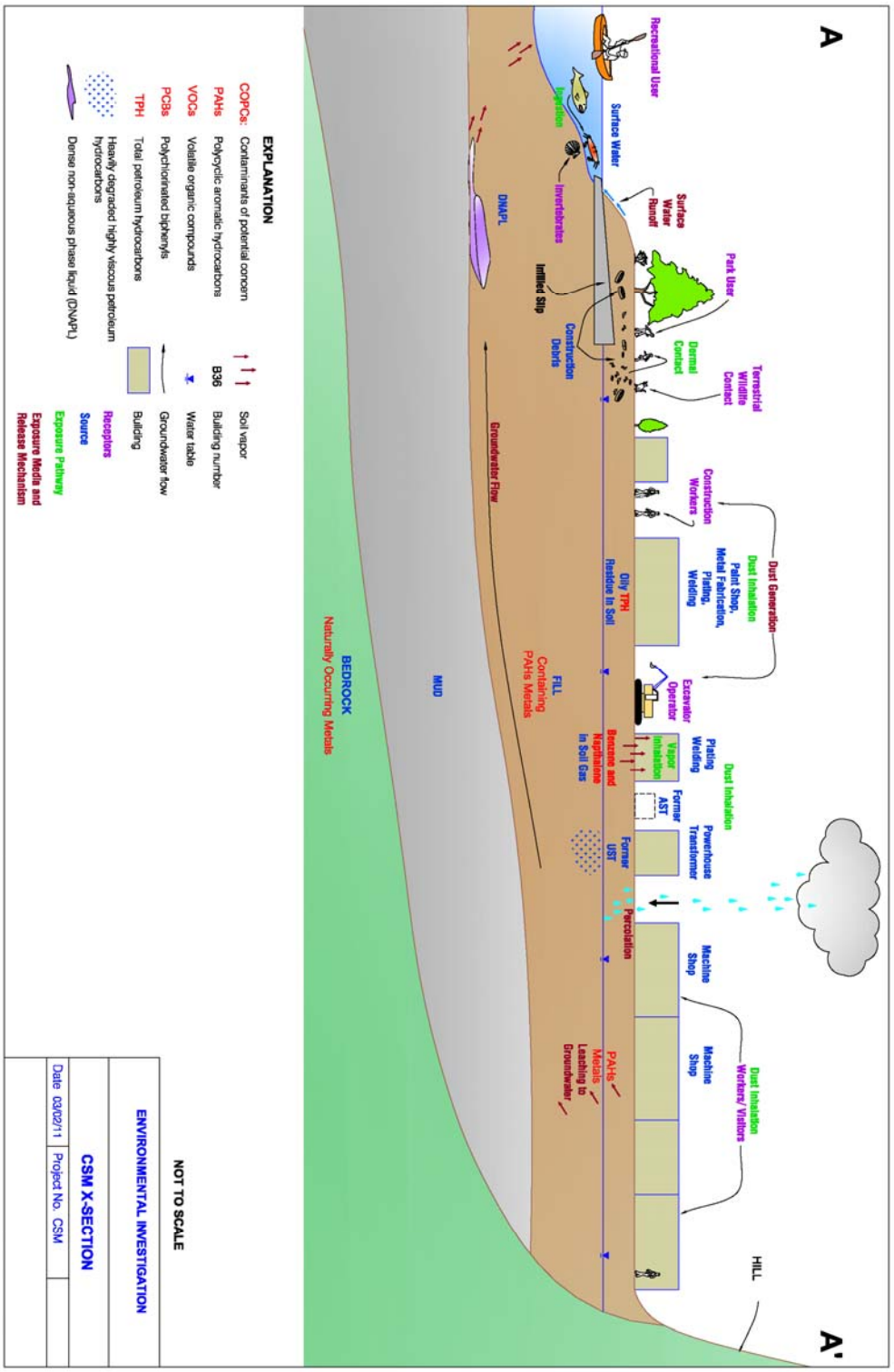

A
A'
Recreational User
Surface Water
Ingestion
Surface Water Runoff
Park User
Dermal Contact
Terrestrial Wildlife Contact
Invertebrates
Infilled Slip
Construction Debris
DNAPL
Groundwater Flow
Construction Workers
Dust Generation
Dust Inhalation
Paint Shop, Metal Fabrication, Plating, Welding
Oily TPH Residue in Soil
FILL
Containing PAHs Metals
Excavator Operator
Vapor Inhalation
Benzene and Naphthalene in Soil Gas
Plating Welding
Former AST
Dust Inhalation
Powerhouse Transformer
Former UST
Percolation
Machine Shop
PAHs Metals Leaching to Groundwater
Machine Shop
Dust Inhalation
Workers/ Visitors
HILL
MUD
BEDROCK
Naturally Occurring Metals
EXPLANATION
COPCs: Contaminants of potential concern
PAHs Polycyclic aromatic hydrocarbons
VOCs Volatile organic compounds
PCBs Polychlorinated biphenyls
TPH Total petroleum hydrocarbons
Heavily degraded highly viscous petroleum hydrocarbons
Dense non-aqueous phase liquid (DNAPL)
Soil vapor
B36 Building number
Water table
Groundwater flow
Building
Receptors
Source
Exposure Pathway
Exposure Media and Release Mechanism
NOT TO SCALE
ENVIRONMENTAL INVESTIGATION
CSM X-SECTION
Date 03/02/11
Project No. CSM

Figure B1-1

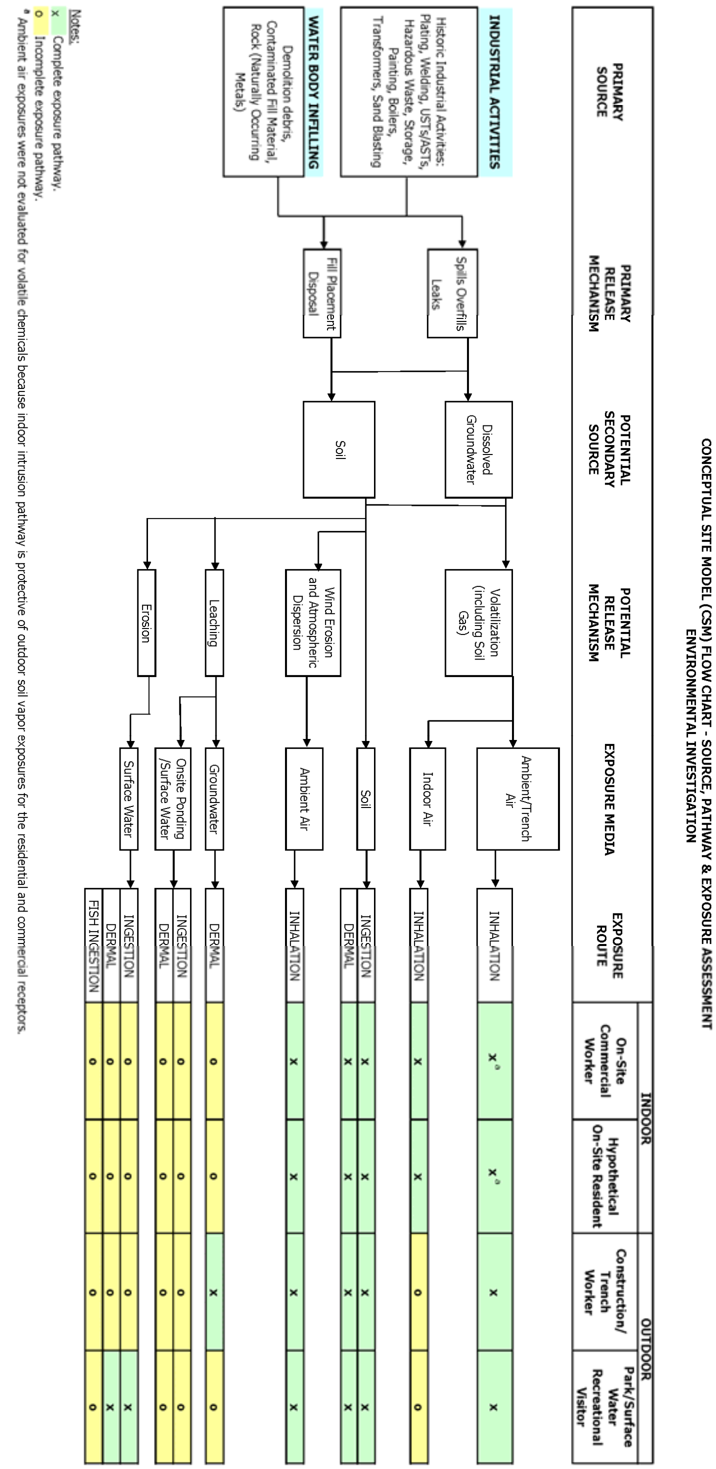


FIGURE 2-2
CONCEPTUAL SITE MODEL (CSM) FLOW CHART - SOURCE, PATHWAY & EXPOSURE ASSESSMENT
ENVIRONMENTAL INVESTIGATION
PRIMARY SOURCE
PRIMARY RELEASE MECHANISM
POTENTIAL SECONDARY SOURCE
POTENTIAL RELEASE MECHANISM
EXPOSURE MEDIA
EXPOSURE ROUTE
INDOOR
OUTDOOR
On-Site Commercial Worker
Hypothetical On-Site Resident
Construction/ Trench Worker
Park/Surface Water Recreational Visitor
INDUSTRIAL ACTIVITIES
Historic Industrial Activities: Plating, Welding, USTs/ASTs, Hazardous Waste, Storage, Painting, Boilers, Transformers, Sand Blasting
WATER BODY INFILLING
Demolition debris, Contaminated Fill Material, Rock (Naturally Occurring Metals)
Spills Overfills Leaks
Fill Placement Disposal
Dissolved Groundwater
Soil
Volatilization (Including Soil Gas)
Wind Erosion and Atmospheric Dispersion
Leaching
Erosion
Ambient/Trench Air
Indoor Air
Soil
Ambient Air
Groundwater
Onsite Ponding /Surface Water
Surface Water
INHALATION
INHALATION
INGESTION
DERMAL
INHALATION
DERMAL
INGESTION
DERMAL
INGESTION
DERMAL
FISH INGESTION
Notes:
x Complete exposure pathway.
o Incomplete exposure pathway.
a Ambient air exposures were not evaluated for volatile chemicals because indoor intrusion pathway is protective of outdoor soil vapor exposures for the residential and commercial receptors.

Figure B1-2

Example B2: Applying a Conceptual Site Model to Potential Indoor Air Migration

In order to construct a complete Conceptual Site Model (CSM) to assess potential impacts from volatile organic compounds (VOCs) in" the subsurface, "the investigator must evaluate" the four main vapor transport mechanisms; they are listed in section 5.2.5.5 and used as heading in the below discussion.

Diffusion of vapors from sources in the unsaturated zone

Diffusion occurs as a result of a concentration gradient between the source and the surrounding area; it can result in the upward, lateral or downward migration of vapors through the vadose zone. The location of the source is an important factor influencing the direction of vapor migration. Identifying soil gas concentration gradients may help determine the location of unidentified vapor sources. For recalcitrant VOCs that degrade slowly in the subsurface, limited case data and research studies suggest there may be a significant time lag (e.g., months to years) between source removal and significant dispersion of vapors that remain in the subsurface (Rivett 1995, Carr 2011); variable mass storage capacity of vapors in the vadose zone should be expected.

Diffusion of vapors from sources in shallow groundwater

Shallow ground water contamination and/or Non Aqueous Phase Liquid near the water table can act as a source for diffusion resulting in the upward or lateral migration of vapors through the vadose zone. Depending on the hydraulic conductivity, hydraulic gradient, aquifer heterogeneity, time since release of chemicals and natural attenuation processes, the distribution of volatile chemicals in ground water may extend considerable distances.

As discussed above, for recalcitrant VOCs investigators should consider whether ground water concentrations and their distribution have, or could have, recently decrease/changed. Such changes should impact the decision of whether a VI investigation is warranted for a potential receptor and influence the overall scope of the area to be investigated. Those decisions should be based on an accurate CSM and not solely on current ground water VOC concentrations because the vadose zone could have considerable storage capacity; it may continue to be a source for VOCs for some period after ground water concentrations have decreased significantly (Carr 2011).

Diffusion of vapors in the vadose zone from shallow ground water contamination is illustrated below.

Advective/convective transport of vapors *(Could insert the below at the end of this section, right before the figure.)*

The horizontal and vertical movement of vapors located near a building foundation is often affected within an area referred to as the "zone of influence" (see Figure Number ? below). Chemicals entering this zone are drawn into the building via soil gas advection and convection resulting from building interiors that exhibit a negative pressure relative to the outdoors and the surrounding soil. The reasons for this pressure differential include:

- factors relating to operation of heating, ventilating and air conditioning system including inadequate combustion or makeup air and unbalanced air supply and exhaust systems
- the use of fireplaces and other combustion sources, which results in venting of exhaust gases to the exterior
- the use of exhaust fans in bathrooms and kitchens
- higher temperatures indoors relative to outdoors during the heating season or as a result of solar radiation on rooftops
- pressure exerted on the wall of a building caused by wind movement over the building (Bernoulli's principle).

The combination of these actions/conditions results in a net convective flow of soil gas from the subsurface through the building foundation to the building interior. As would be expected from the above list, indoor air volatile concentrations are generally higher during the heating season in homes affected by vapor intrusion.

The CSM shown below suggests a permeable ground cover. If impermeable ground cover exists on either or both sides of a structure that condition could result in higher soil vapor concentrations near the building, a higher soil gas flow rate (Qsoil) and thus higher levels in indoor air than in the scenario with permeable ground cover.

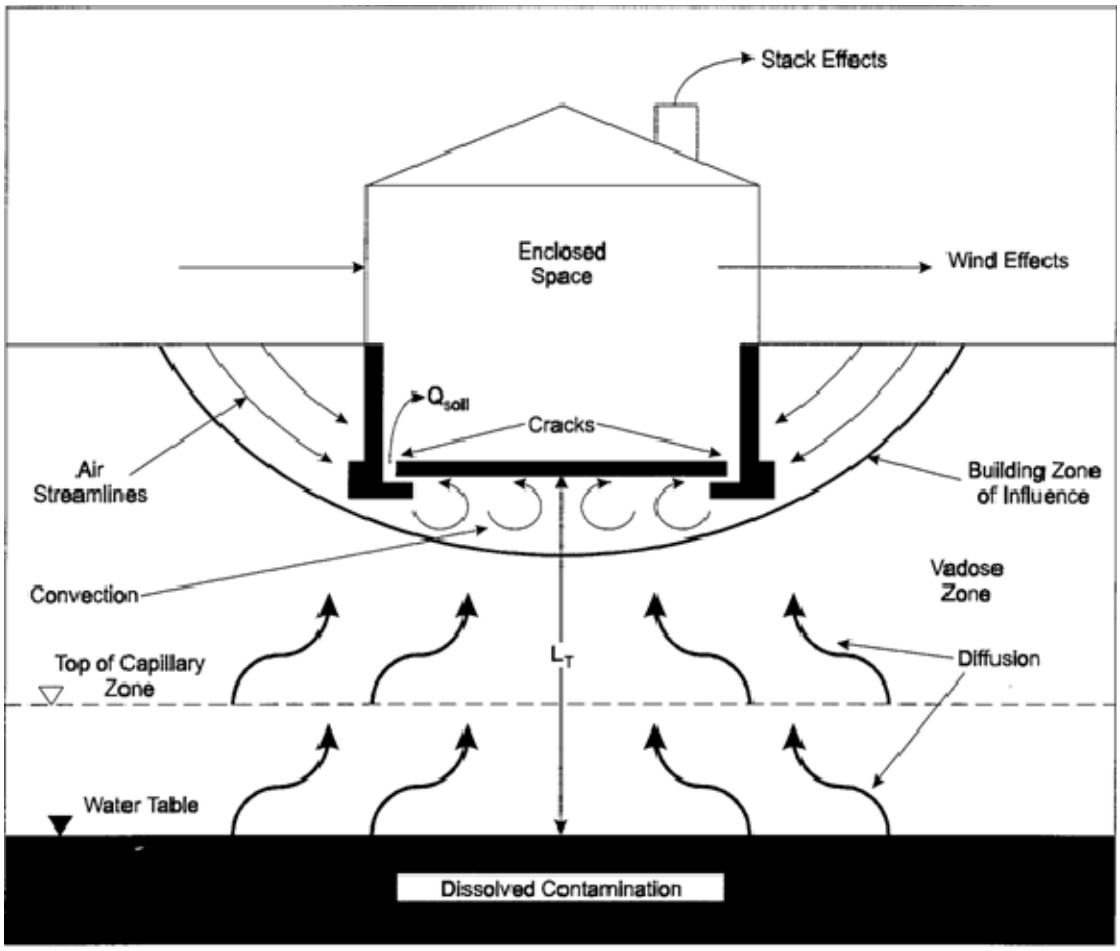


Figure B2-1
Advective and Convective Transport Near Buildings
Source: USEPA 2004d

Vapor Migration Through Preferential Pathways

In preparation of each conceptual site model, investigators should look for the presence and locations of natural and anthropogenic pathways in the subsurface with high gas permeability through which vapors can rapidly migrate. Naturally occurring fractures and macropores may facilitate vertical or horizontal vapor migration while anthropogenic features such as utility conduits would likely facilitate horizontal vapor migration due to their shallow depth (USEPA 2002b). Evaluate buildings that are, or may become, inhabited if they are associated with a preferential pathway that is within some reasonable distance of a source area (based on professional judgment).

Investigators should also evaluate the potential for vapor intrusion in situations where a preferential pathway leading to a structure runs near or through a source area. For sources

containing aerobically degradable contaminants, however, it is unlikely that sufficient vapors will reach the structure to result in a vapor intrusion problem unless the pathway and structure are both very close to the vapor source. Biodegradation of benzene, toluene, ethylbenzene and xylene vapors in the vadose zone has been shown to be a very efficient process as long as sufficient oxygen is available (DeVaull, et al. 1997). Thus, if a preferential pathway is not close to a source area, biodegradable vapors would likely degrade before reaching the pathway and/or within the pathway before reaching the structure.

Appendix C

Illustrations of Simple Conceptual Site Model

ILLUSTRATIONS OF SIMPLE CONCEPTUAL SITE MODEL

Examples in Appendix C of this document are illustrations of how to present case scenarios during different phases of an investigation.

- Figure C1-1 : Schematic of a site showing a single AOC and it's proximity to a building during a Preliminary Assessment.
- Figure C1-2: Flow chart showing the information known during the Preliminary Assessment.
- Figure C2-1: Schematic of a site showing sampling conducted and the site specific information collected for a single AOC during the Site Investigation.
- Figure C2-2Flow chart showing sampling data and evaluation of potential pathways for the Site Investigation.

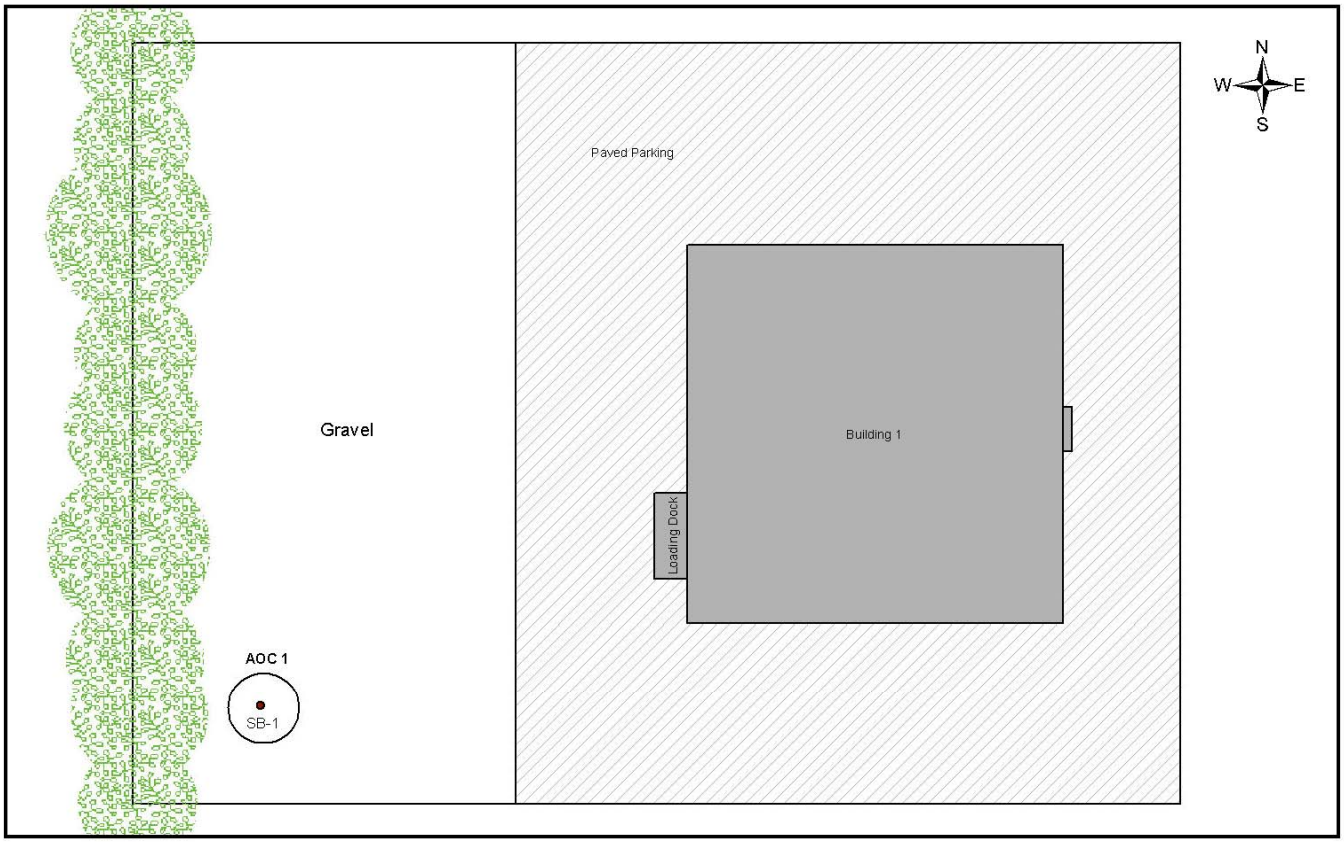
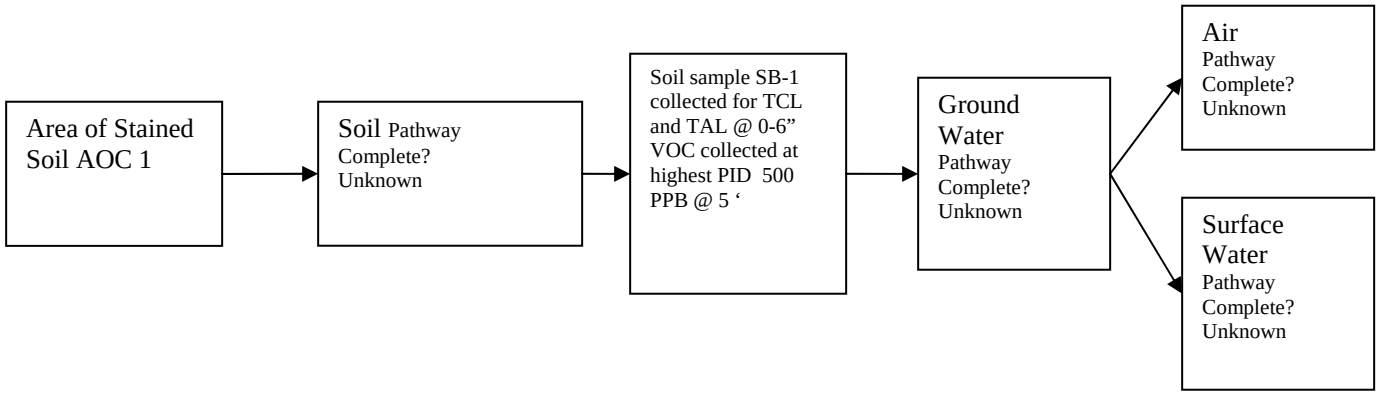


Figure C1-1 : Schematic of a site showing a single AOC and it's proximity to a building during a Preliminary Assessment.

Site Name: Vaste Warehousing Inc.
Address: 555 Vaste Lane
City/County: Forest City, Bergen Co.
NJDEP Case #: 000000
NJDEP PI #: G000000



Site Name: Vaste Warehousing Inc.
Address: 555 Vaste Lane
City/County: Forest City, Bergen Co.
NJDEP Case #:000000
NJDEP PI #:G000000
Facility History: Facility was constructed in 1985 as warehouse for paper products.

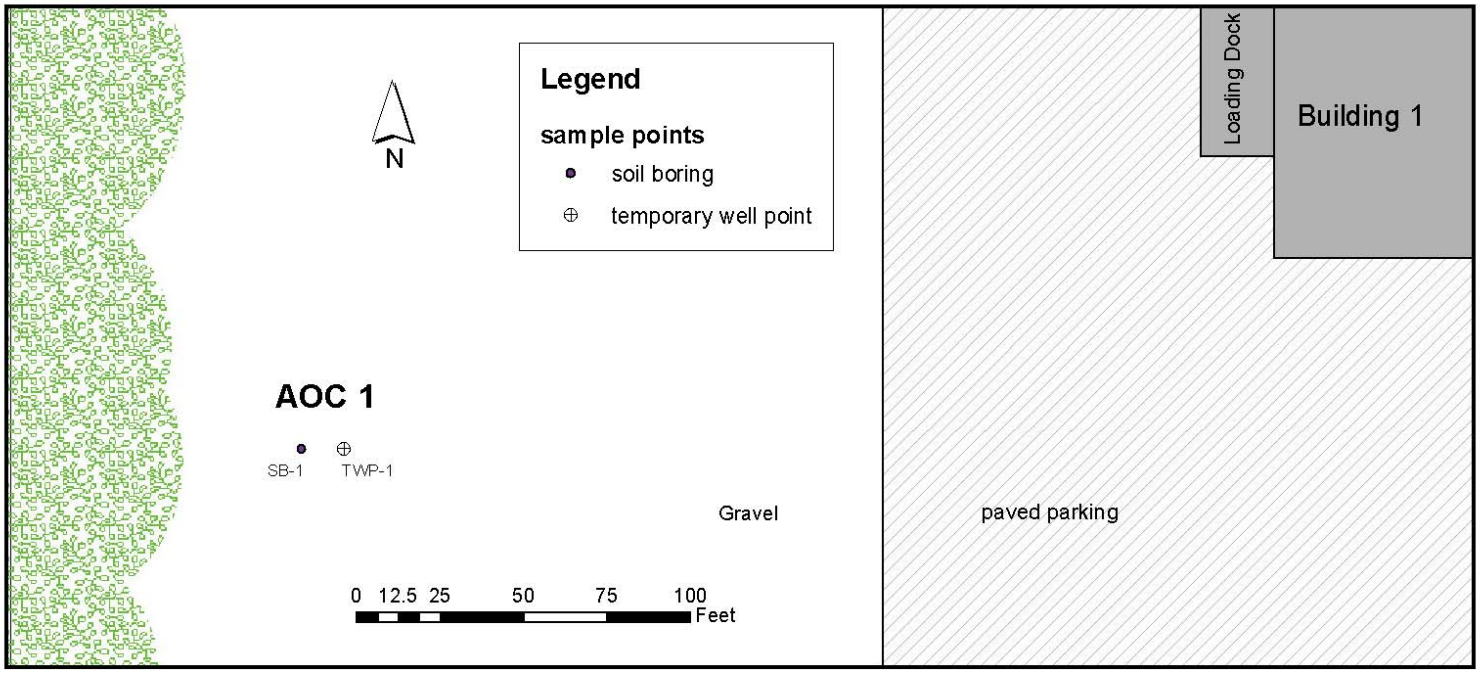
AOC 1 is an area of stained soil/gravel less than 25 sq ft. AOC 1 is the only AOC on-site. Review of Aerial photographs, Sanborn maps, and Staff interviews indicate no other potential Discharges. Surrounding properties are zoned commercial/industrial

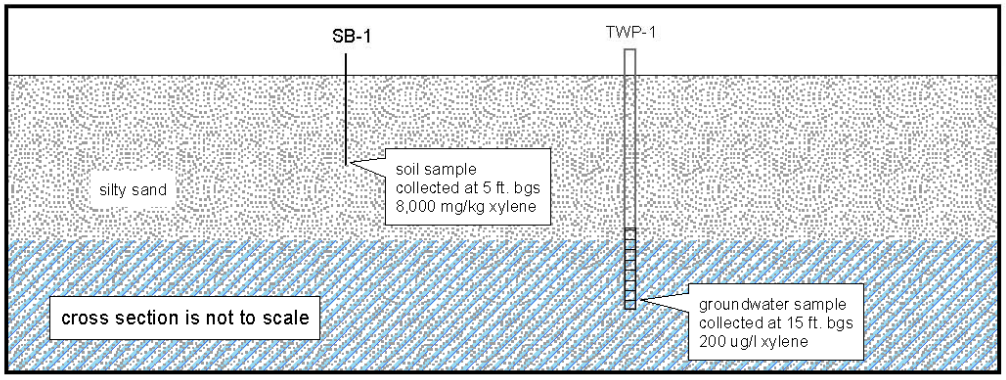
No IEC condition noted.

Actions Taken: Soil samples collected for Target Compound List plus TICs/Target Analyte List (TCL + TICs/TAL). VOC sample collected at 5 feet based on highest PID reading. All other parameters collected at 0-6 inches

Impacted media: Based on staining, soil is expected to be impacted. Ground water has a potential impact, while air (> 200 feet to structure) and surface water (> 200 feet to closest feature) are unlikely to be impacted.

Figure C1-2: Flow chart showing the information known during the Preliminary Assessment





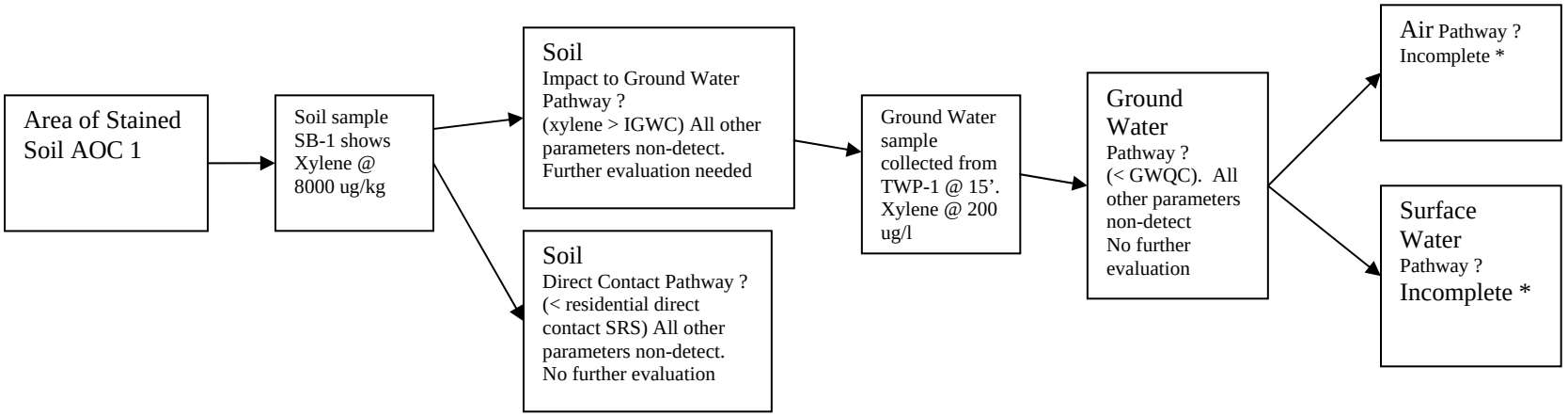
SB-1

Depth	PID reading
0-4 ft.	100 ppb
4-5 ft.	500 ppb
5-7 ft.	100 ppb
7-10 ft.	ND

SB-1 VO sample collected at 5 ft.
All other constituents collected at 0-6 inches

Site Name: Vaste Warehousing Inc.
Address: 555 Vaste Lane
City/County: Forest City, Bergen Co.
NJDEP Case #: 000000
NJDEP PI #: G000000

Figure C2-1: Schematic of a site showing sampling conducted and the site specific information collected for a single AOC during the Site Investigation.



Site Name: Vaste Warehousing Inc.
Address: 555 Vaste Lane
City/County: Forest City, Bergen Co.
NJDEP Case #: 000000
NJDEP PI #: G000000
Facility History: Facility was constructed in 1985 as warehouse for paper products.

AOC 1 is an area of stained soil/gravel less than 25 sq ft. AOC 1 is the only AOC on site. Review of Aerial photographs, Sanborn maps, and Staff interviews indicate no other potential Discharges. Surrounding properties are zoned commercial/industrial

No IEC condition noted.

Actions Taken: Soil sample SB-1 collected at 5' for VOCs showed 8,000 ug/kg of xylene. All other parameters non-detect. Ground water sample collected at 15' for VOCs. Sample contained 200 ug/l of xylene.

Impacted media/pathway:
Soil Direct Contact: All parameters below direct contact criteria.
Soil Impact to Ground Water: Xylene above Default Soil IGWC therefore ground water investigated
Ground Water: Xylene detected below GWQC.
Air: Pathway incomplete
Surface Water: Pathway incomplete.

* As determined in accordance with applicable Technical Guidance

Figure C2-2Flow chart showing sampling data and evaluation of potential pathways for the Site Investigation.

Appendix D

Acronyms

ACRONYMS

AOC	area of concern
COC	contaminants of concern
CSM	conceptual site model
ESA	environmentally sensitive areas
IEC	Immediate Environmental Concern
ITRC	Interstate Technology and Regulatory Council
LSRP	Licensed Site Remediation Professional
NAPL	nonaqueous phase liquid
N.J.A.C.	New Jersey Administrative Code
NJDEP	New Jersey Department of Environmental Protection
N.J.S.A.	New Jersey Statutes Annotated
PAH	polycyclic aromatic hydrocarbons
PA/SI	Preliminary Assessment/Site Investigation
RI	Remedial Investigation
RA	Remedial Action
RAO	Response Action Outcome
TPH	total petroleum hydrocarbons
USEPA	United States Environmental Protection Agency
VI	vapor intrusion
VOC	volatile organic compound