Region 6

Corrective Action Strategy (CAS)

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Prepared by

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NOTICE

The policies and procedures set forth in the United States Environmental Protection Agency (EPA) Region 6 Corrective Action Strategy (CAS or Strategy) are provided as guidance for the implementation of Resource Conservation and Recovery Act (RCRA) corrective action at sites with releases of hazardous constituents. This strategy could also apply cross-programmatically to other cleanup programs (e.g. Brownfields, Superfund, LUST, Solid Waste, voluntary cleanup programs, TSCA). This updated version of the CAS incorporates more recent policy and guidance and focuses on the completion of corrective action, pursuant to *Beyond RCRA: Waste and Materials Management in the Year 2020*, EPA530-R-02-009, April 2003 at http://www.epa.gov/waste/inforesources/pubs/vision.pdf.

The CAS is based, in part, on policies referred to in the *Advanced Notice for Proposed Rulemaking (ANPR) Subpart S*, May 1996 (61 *Federal Register* 19432) at http://www.epa.gov/EPA-WASTE/1996/May/Day-01/pr-547.pdf and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), March 1990 (*55 Federal Register* 8666) at http://www.access.gpo.gov/nara/cfr/waisidx_03/40cfr300_03.html.

The CAS provides guidance to EPA Region 6 and the states in Region 6 as one potential method/process to implement and complete RCRA corrective action. It also provides guidance to the public and to the regulated community on how EPA Region 6 and states may exercise its discretion in implementing its regulations. The CAS is meant to supplement, not replace, previous guidance issued by EPA regarding RCRA corrective action and is not meant to supersede State legislated cleanup programs.

All decisions regarding corrective action at a particular facility should be based on the applicable statutes and regulations. This November 2008 CAS is intended to replace the November 2000 CAS.

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ACRONYMS

ACL	Alternate concentration limit
ANPR	Advanced Notice for Proposed Rulemaking
CAO	Corrective Action Objective
CAP	RCRA Corrective Action Plan
CAS	Corrective Action Strategy
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CMI	Corrective measures implementation
CMS	Corrective measures study
COC	Contaminants of concern
COPC	Contaminants of potential concern
CSGWPP	Comprehensive State Ground Water Protection Program
CSM	Conceptual site model
DQO	Data quality objective
EPA	U.S. Environmental Protection Agency
HI	Hazard index
HQ	Hazard quotient
ITRC	Interstate Technology & Regulatory Council
LUST	Leaking Underground Storage Tank
MCL	Maximum contaminant level
MCLG	Maximum contaminant level goal
MSSL	Media-specific screening level
NCP	National Oil and Hazardous Substances Contingency Plan
NFA	No further action
POC	Point of compliance
POE	Point of exposure
QA/QC	Quality Assurance/Quality Control
QAPP	Quality assurance project plan
RAGS	Risk assessment guidance for Superfund
RCRA	Resource Conservation and Recovery Act
RFA	RCRA facility assessment
RFI	RCRA facility investigation
SWMU	Solid waste management unit
TSCA	Toxic Substances Control Act
UCL95	95 percent upper confidence level

1.0 INTRODUCTION

This chapter describes . . .

the purpose and scope of the CAS
recent EPA policy and guidance changes
risk management using the CAS
organization of the document

1.1 PURPOSE AND SCOPE OF THE CORRECTIVE ACTION STRATEGY

The United States Environmental Protection Agency (EPA) Region 6 has developed a corrective action strategy (CAS) to expedite corrective action at Resource Conservation and Recovery Act (RCRA) facilities. This document was developed as guidance to help regulators and facilities make meaningful progress toward the completion of corrective action obligations. The primary objectives of this guide are to streamline corrective action administrative procedures, to provide tools that aid in the implementation and completion of corrective action, and to focus corrective action on releases that may require investigation/remediation versus historical releases that should be administratively closed, with the end result being the protection of human health and the environment.

Although the CAS was developed for the RCRA program, its purpose is consistent with EPA's long-standing goal for EPA's cleanup programs to yield similar remedies in similar circumstances. Therefore, this guide may be useful to those working with Brownfields, Superfund, LUST, Solid Waste, voluntary cleanup programs, and TSCA.

This guide describes a risk management approach that can be implemented during any phase of corrective action, to better focus time and money on releases that pose a significant and unacceptable risk. The CAS concepts are compatible with multiple regulatory frameworks (permits, orders, letter agreements, voluntary programs, facility-lead corrective action, etc.). Through implementation of the CAS, the main focus can be shifted away from process details and toward risk management activities.

The CAS is a performance-based approach that emphasizes results over process. Using the data quality objective process, investigations begin with the endpoint in mind. Use of existing and new site-specific information is encouraged. Performance standards (agreed upon site-specific remedial goals) are established at the beginning of this streamlined corrective action process, allowing for more focused implementation. Releases are screened to determine the priority of corrective action, and remedial alternatives are selected on the basis of their ability to achieve and maintain the established performance standards, resulting in protection of human health and the environment.

The CAS was designed as a tool for all stakeholders (EPA, states, facilities, and the public) involved in site remediation activities and was meant to complement, not supersede, existing Federal, state, and local regulations.

For states that have legislated or promulgated waste cleanup programs that apply to releases of contaminants into the environment and have established human-health and/or environmental cleanup criteria, those criteria should be used during the implementation of corrective action. Where appropriate and allowed by State regulation, however, EPA suggests that the philosophy and elements of the CAS (e.g., conceptual site models, data quality objectives, prioritization of corrective action, etc.) be applied to help expedite the decision-making process in corrective action.

The traditional RCRA corrective action process steps and reports such as RCRA facility investigations, (RFI), Corrective Measures Study (CMS), and various associated work plans are not elements of the CAS. Those process steps are not regulatory or statutory mandated, but use of any information available from those process steps which have been completed at a facility should be included to help further knowledge of the corrective action site. The intention of the CAS is to provide an alternative approach to corrective action by using the inherent flexibility in the RCRA statute, federal and State regulations, and remedial guidance.

1.2 RECENT EPA POLICY AND GUIDANCE CHANGES

EPA's authority to require facility-wide correction action comes from the RCRA, specifically RCRA statue sections §§3004(u)&(v), 3005(c)(3), 3008(h), 3013, and 7003. EPA's regulatory provisions for corrective action at permitted facilities are found primarily in 40 CFR Part 264 Subpart F.

Several recent policies have been adopted that can directly affect corrective action at sites. Streamlining cleanups has caused questions to be raised regarding the relationship of previous process elements to various new approaches and how to account, administratively, for the progress being achieved. The following topics are an overview of policy discussions which are ongoing.

1.2.1 Completion of Corrective Action Activities

EPA's *Final Guidance on Completion of Corrective Action Activities at RCRA Facilities*, February 2003, outlines significant issues related to completion of corrective action activities at RCRA facilities, provides guidance on when each type of completion determination is appropriate, and provides guidance on procedures for EPA and authorized states when making completion determinations. The guidance also discusses completion determinations for less than an entire facility (i.e., parceling).

EPA anticipates two (2) types of completion determinations: *Corrective Action Complete without Controls* and *Corrective Action Complete with Controls*. *Corrective Action Complete without Controls* is intended to indicate that either there was no need for corrective action or, where corrective action was necessary, the remedy has been implemented successfully and no further activity or controls (engineering and/or institutional) are necessary to protect human health and the environment. *Corrective Action Complete with Controls* is intended to indicate that (1) a full set of corrective measures has been defined; (2) the facility has completed construction and installation of all required remedies; (3) site-specific media cleanup objectives have been met; and (4) all that remains is performance of required operation and maintenance and monitoring actions, and/or compliance with and maintenance of any institutional controls. Refer to *Final Guidance on Completion of Corrective Action Activities at RCRA* Facilities, February 2003 at http://www.epa.gov/epawaste/hazard/correctiveaction/pdfs/compfedr.pdf.

1.2.2 Revitalization and Ready for Reuse

The intent of corrective action is to address releases that pose a threat to human health and the environment. When corrective action is complete, with or without controls, EPA encourages the productive use of property/facilities, but the use must be consistent with corrective action objectives. Since the CAS promotes the establishment of performance standards and site-specific corrective action objectives as early as possible in the corrective action process, revitalization (for human and/or ecological use) can be factored into the corrective action approach taken at a facility.

Ready for Reuse is a site-specific technical determination that encourages cleanups that will quickly support protective redevelopment opportunities. It is not intended to be a clean-closure approach; rather it encourages cleanups that will quickly support protective redevelopment opportunities. As part of this program, EPA and/or

states provide a technical determination that affirms that the conditions on the site are protective of human health and the environment based on the current and planned future use(s) of the property. EPA Region 6 believes that obtaining a determination that a property is Ready for Reuse will aid in returning previously used commercial/industrial property(ies) to productive use. By defining the environmental liability in terms of the intended reuse of the property, lending institutions and the public may be more willing to reuse previously owned/operated property rather than leasing/purchasing "green space." Additionally, the Ready for Reuse process may compel regulating authorities to make timely determinations on important site-specific issues that may hold up site progress (land use, groundwater use and protection, extent of remediation, etc.).

The Region 6 Ready for Reuse program has become an integral component of EPA's National Land Revitalization Action Agenda (http://www.epa.gov/oswer/landrevitalization/agenda.htm) and was instrumental in the development of the revitalization measure of "Ready for Anticipated Use" (RAU) as discussed in the *Guidance for Documenting and Reporting RCRA Subtitle C Corrective Action Land Revitalization Indicators and Performance Measures*, February 21, 2007 at http://www.epa.gov/reg3wcmd/ca/pdf/finalRCRA_CPRM_guidance2_21_07.pdf. The purpose of the land revitalization indicators and performance measures is to improve EPA's ability to promote revitalization accomplishments and the associated benefits to the economy and society. These new measures will communicate more clearly the environmental benefits and will enable the program to account for progress towards land revitalization goals.

1.2.3 Groundwater Policy Issues

Groundwater investigation, migration, and protection issues are always a major concern with respect to cleanup activities at remedial sites. Confusion over the appropriate level of detail in dealing with groundwater issues at sites can slow down progress if not dealt with clearly at the beginning stages of corrective action. States that

have promulgated corrective action programs clearly define such issues as groundwater classification, land use, point of compliance and appropriate groundwater cleanup standards, therefore, state programs should be consulted regarding groundwater policies.

EPA recently updated the *Handbook of Groundwater Protection and Cleanup Policies for RCRA Corrective Action for Facilities Subject to Corrective Action under Subtitle C of RCRA*, EPA/530/R-04/030, April 2004 at http://www.epa.gov/epawaste/hazard/correctiveaction/resources/guidance/gw/gwhandbk/gwhb041404.pdf. EPA issued this handbook to help regulators, the regulated community and/or the public find and understand EPA policies on protecting and cleaning up groundwater at RCRA corrective action facilities. The goal of the handbook is to help meet the corrective action objectives of the RCRA cleanup program by reducing time-consuming uncertainties and confusion about the EPA's policies concerning groundwater protection and cleanup at RCRA facilities. By clarifying EPA's groundwater policies, EPA believes this will promote faster, focused, and more flexible cleanups and foster creative solutions.

POE/POC

Under the CAS, the POC is equivalent to the POE for all groundwater designated as a drinking water source (current and in the reasonably expected future) and/or a beneficial resource. Therefore, groundwater restoration must be throughout-the-plume/unit boundary to drinking water standards or cleanup objectives to meet other uses or exposures. For instances where groundwater is not a drinking water source, is not a beneficial resource, or in instances in which restoration is not practical, the expectation is that human health and the environment must be protected at the POE. If a state does not consider groundwater beneath a facility to be a beneficial resource, the POE may be placed at the facility boundary. Protection of beneficial groundwater and receptors, both ecological and human, still would occur at the new POE.

1.2.4 Green Remediation

Green remediation is the practice of considering the environmental affects of a remedial strategy early in the process, and incorporating options to maximize the net environmental benefit of the cleanup while minimizing negative environmental impacts. Considerations include selection of a remedy and the associated energy requirements of remediation systems. Opportunities for incorporating green remediation, as well as utilizing emerging innovative technologies (e.g. bio-reactive permeable barriers, nanotechnology) should be considered in each phase of the remediation process. EPA published *Green Remediation: Incorporating Sustainable Environmental Practices into Remediation of Contaminated Sites*, April 2008. An electronic version of this document can be downloaded from Office of Superfund Remediation and Technology Innovation (OSRTI)'s and Brownfields and Land Revitalization Technology Support Center (BTSC)'s websites at http://cluin.org/greenremediation or http://www.brownfieldstsc.org.

1.3 RISK MANAGEMENT USING THE CAS

EPA Region 6 developed this strategy to expedite the implementation of corrective action based on risk management while protecting human health and the environment. The CAS is a performance-based approach that emphasizes results over process and recommends evaluating risks to receptors posed by contaminants from known releases. Using the data quality objective process, investigations begin with the endpoint in mind, focus data collection providing information for the development of a conceptual site model. The CAS allows and encourages the use of existing and new site-specific information throughout the process. The strategy establishes performance standards in three key areas that will govern corrective action at a facility. The performance standards are established at the beginning, rather than during the RFA/RFI/CMS phases under the more traditional approach, to allow earlier implementation of corrective action and to allow facilities to better plan response actions

and estimate costs. Remedial alternatives are selected on the basis of their ability to achieve and maintain the agreed upon performance standards.

1.4 ORGANIZATION OF THE DOCUMENT

The CAS is organized into six chapters. Chapter 2 describes the CAS in greater detail and identifies the steps for implementing the CAS, such as establishing performance standards and the deliverables necessary for documenting progress. Chapter 3 addresses data quality objectives for site characterization and the development and use of the conceptual site model (CSM) to define data needs. Chapter 4 is a brief description of screening techniques currently in use to prioritize releases, and Chapter 5 and 6 address the final stages of the CAS once the conceptual site model is developed.

Chapter 1	Introduction
Chapter 2	Overview of the CAS
Chapter 3	Conceptual Site Model
Chapter 4	Risk-based Screening
Chapter 5	Remedy Evaluation
Chapter 6	Completing the CAS: Implementing A Performance-Based Remedy
Appendix A	Conceptual Site Model (CSM)/ Corrective Action Objectives
Appendix B	Ecological Exclusion Checklist/ Eco Reuse

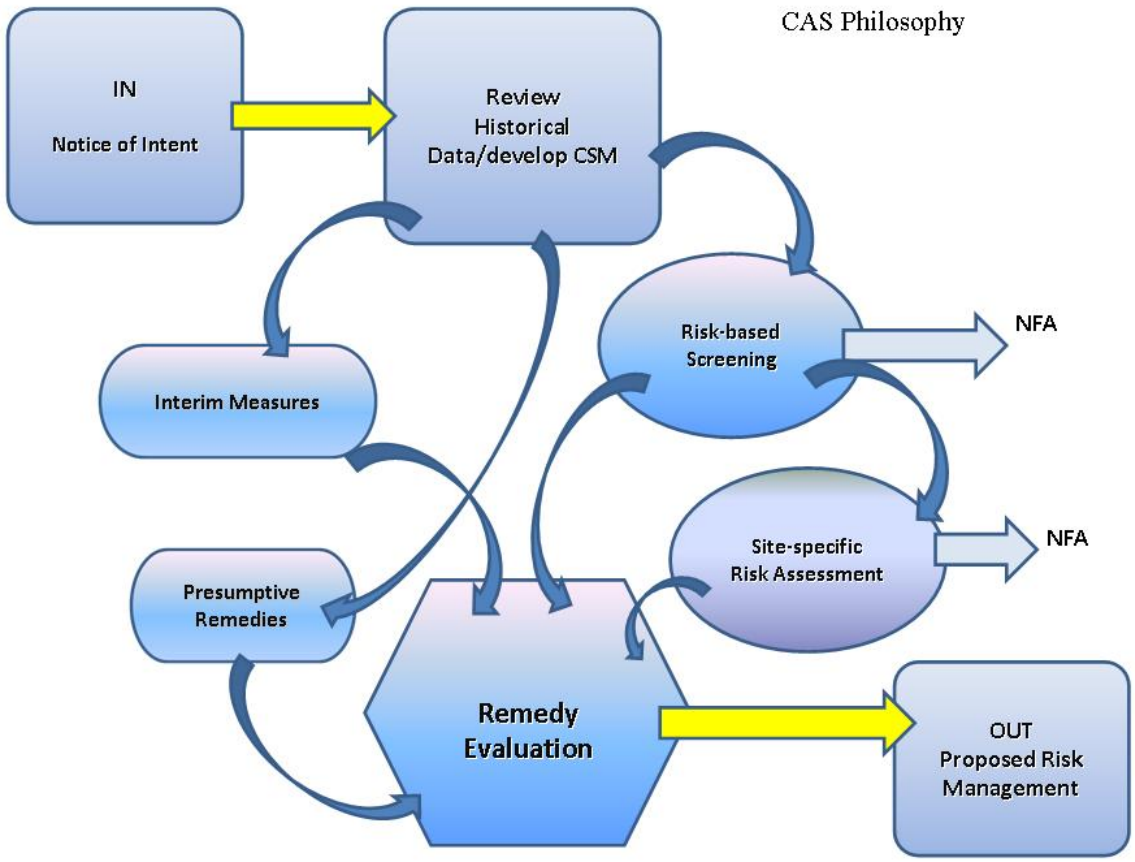

Figure 1

Figure 1 illustrates the philosophical concept of the CAS. There is no one specific path to proceed from investigation to cleanup. The administrative authority (i.e., the regulator) focuses on whether the established performance standards are met, ultimately achieving the primary goal of RCRA, to protect human health and the environment. The CAS philosophy emphasizes the options and flexibility available to evaluate and address risk at a site.

2.0 OVERVIEW OF THE CAS

This chapter describes . . .

key elements of the CAS
performance standards
responsibilities of the facility and administrative authority
steps for implementing the CAS
completing the CAS

2.1 KEY ELEMENTS OF THE CAS

The steps in this chapter describe a flexible approach to corrective action. The CAS is initiated by individual facilities or the administrative authority recognizing the need for and/or completion of correction action. Key elements in this approach are establishing performance standards at the beginning of the process; developing data quality objectives and data types (including the conceptual site model); screening releases to determine prioritization of corrective action or if corrective action is necessary; performing a site-specific risk assessment, when warranted; and evaluating, selecting, and monitoring performance of the remedy. The end result of the CAS process is a facility-specific prioritized risk management plan for releases that pose risk to human health and the environment.

There is an overriding goal of the CAS:

To protect human health and the environment

To accomplish this goal, performance standards should be established as close to the beginning of the corrective action process as possible. Through the application of the performance standards, the facility and administrative authority determine whether a release must be addressed through corrective action, and whether implemented

corrective actions are protective of human health and the environment warranting a finding of no further action.

2.2 PERFORMANCE STANDARDS

EPA's expectations for the outcome of corrective action at a facility are established in the CAS by three performance standards. The performance standards are not new, however, the CAS ensures that they are applied consistently at an early stage of the corrective action process. Fixed performance standards established at the beginning of the CAS should streamline the corrective action process more than other policy considerations by focusing activities toward a specific endpoints and allowing facilities to anticipate corrective action costs. These performance standards combine existing policy and regulatory requirements with a risk-based goal of protectiveness.

Source Control

EPA questions whether final remedies that fail to include source control would meet the overall RCRA statutory mandate to protect human health and the environment. The CAS, therefore, expects identification and prioritized corrective action on source material. EPA's continuing emphasis on source control reflects the Agency's strong preference for remedies that are protective in the long term. For groundwater, source control is critical to returning our nation's contaminated ground waters to their maximum beneficial uses in a reasonable time frame, and to ensuring that uncontaminated ground water is available for future generations.

The three CAS performance standards are:

1. **Source Control Performance Standard:** Source control refers to the control of materials that contain hazardous wastes or hazardous constituents and that act as a continuing reservoir for migration of contamination to soil, sediment, groundwater, surface water, air, or as a source for direct exposure. Sources are not always stationary, but can migrate from a landfill or surface impoundment where contamination originally was released. Contaminated groundwater plumes are not generally considered a source material, although non-aqueous phase liquids (NAPL) in the groundwater generally would be

viewed as source material (*Rules of Thumb for Superfund Remedy Selection*, August 1997, EPA/540/R-97/013 at http://www.epa.gov/superfund//policy/remedy/rules/rulesthm.pdf)

2. Statutory and Regulatory Performance Standard: Each facility will be subject to certain statutes and regulations, whether Federal or State which may dictate media-specific contaminant levels that must be achieved, such as maximum contaminant levels (MCLs) in drinking water, or human-health and /or environmental cleanup criteria established by state waste cleanup programs. These requirements may be specified in Federal, State, and local laws and regulations and should be identified for each corrective action site.

3. Final Risk Goal Performance Standard: The final risk goal is the standard of protection to be achieved and maintained by the facility. The final risk goal is agreed upon as early in the process as possible and established by the administrative authority based on land use, special sub-populations, contaminant concentrations associated with acceptable risk, location at which the concentrations are measured, and the remediation time frame required to achieve these goals.

It is paramount for the facility to determine if source material is present. While the strategy is primarily a risk-based approach, the CAS identifies source control as a priority performance standard. The CAS expects that facilities will make identification and prioritized corrective action on source materials a primary activity, while also prioritizing other releases, as discussed in Chapter 4. Removal, containment, treatment, or a combination of the three, should be evaluated on a case-by-case basis and balanced against factors such as effectiveness, implementability and cost. In some situations, treatment (in-situ or ex-situ) of source material may be the most appropriate way to achieve the performance standard. In other situations, removal of the source material may be appropriate, eliminating long-term costs associated with containment or monitoring. Containment coupled with institutional controls at a facility may be effective when the source material, once contained, no longer poses a continuing threat to human health or other environmental media. Combinations of approaches may likely be appropriate, with containment and/or monitoring warranted for treatment residuals to achieve the final risk goal performance standard.

Applicable statutory and regulatory requirements should be identified at the beginning of the CAS and may become part of the performance standards for the facility. These applicable requirements may be Federal, state, and/or local requirements (e.g., federally-established and/or state-endorsed maximum contaminant levels [MCLs] for groundwater). For states that have their own promulgated waste cleanup programs that apply to releases of contaminants into the environment and have established human-health and /or environmental cleanup standards, those criteria should be the performance standards for the corrective action implemented. When statutory or regulatory requirements are known at the beginning, it helps establish the appropriate level of data collection necessary at the site and affects setting of final risk goals.

Corrective Action Objectives (CAOs)

Once performance standards have been established and progress is made determining which releases require corrective action, CAOs should be determined. Whereas the performance standards represent existing policy and regulatory requirements with a risk-based goal of protectiveness, the CAOs are site-specific, media-specific, risk-based "endpoints" for corrective action for a facility. Remedies cannot be truly performance-based without establishing CAOs. The development of CAOs is described further in Chapter 5 and Appendix A.

The final risk goal is primarily based on site-specific issues, such as release and receptor characteristics, current or future land use, and beneficial resources. One final risk goal may apply to the entire facility, but it is more likely that different releases will require different final risk goals due to variations in location of releases, current or future land use, proximity of receptors, etc. Although regulatory programs (RCRA, Superfund, voluntary) may have different ways of evaluating the particular performance standards describe above, cleanup standards are typically in the $1x10^{-4}$ to $1x10^{-6}$ range excess lifetime cancer risk from exposure to carcinogenic hazardous constituents and a 1.0 hazard quotient for exposure to non-carcinogens. The final risk goal may vary, but should be developed on sound risk assessment methodologies, such as EPA's Superfund risk assessment guidance (*Risk Assessment*

Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part A), December 1989, EPA/540/1-89/002 at http://rais.ornl.gov/homepage/HHEMA.pdf).

The EPA expects that all applicable performance standards will be achieved and maintained by the facility. The objective of screening releases is to determine areas that require either immediate response or further evaluation from those that are a lower risk or long-term threat with the ultimate goal of completing all corrective action obligations and revitalizing the property, if and when appropriate. Remedial alternatives for corrective action are then selected on the basis of their ability to achieve and maintain the performance standards.

2.3 RESPONSIBILITIES OF THE FACILITY AND ADMINISTRATIVE AUTHORITY

For the CAS to be effective, the responsibilities of the facility and the administrative authority must be clear. The facility proposes performance standards to the administrative authority for approval. The facility should justify the proposed performance standards through evaluation and documentation of land use, groundwater designation (current and reasonably expected future use), types of receptors present, and exposure pathways, etc. The administrative authority will then approve the performance standards proposed by the facility or establish the final risk goals that it determines are adequate based on a technical evaluation of the information provided by the facility, as well as any legislated or promulgated waste cleanup programs that apply to releases of contaminants into the environment at the site.

The responsibilities of the facility and administrative authority are as follows:

- The facility must perform adequate investigation to develop a conceptual site model robust enough to propose performance standards for the site. The proposed standards must be justified by scientific, risk-based criteria, or regulatory requirements applicable to the site. The facility then has the responsibility to achieve and maintain the performance standards later established by the administrative authority. In doing so, the facility is encouraged to use any of the tools provided in the CAS.

- The administrative authority has the responsibility to ensure that the actions undertaken by the facility are protective of human health and the environment, by establishing performance standards consistent with their applicable statutes and regulations and consistent with the current and future uses at the site. The administrative authority should also provide technical assistance to the facility and the public.

2.4 STEPS FOR IMPLEMENTING THE CAS

The following sections provide the facility and the administrative authority with a suggested road map for implementing the CAS.

2.4.1 Beginning the CAS

To begin a CAS project, a facility should submit to the administrative authority a notice of its intent to conduct corrective action using the CAS. EPA and/or the state will review the notice of intent and respond whether a Federal and/or state project should be initiated. Preliminary discussions between a facility and the administrative authority will help determine whether the facility is a good candidate for using a streamlined approach, such as the CAS.

2.4.1.1 Notice of Intent

The notice of intent need not be longer than a few of pages and should state the following in a concise manner:

- commitment to conduct corrective action under a formal agreement
- request to conduct corrective action using the CAS
- general information regarding site location
- general information regarding the facility's operational history
- general discussion on how the facility will proceed through the CAS
- brief description of proposed performance standards for corrective action

- request for a scoping meeting between the facility and the administrative authority

For a facility currently conducting corrective action under an existing RCRA permit or an order, the CAS can be used as the means to expedite a facility's corrective action obligations. An agreement between the administrative authority and the facility that the CAS process will be used to complete a facility's corrective action obligations can be memorialized in a letter agreement, or a modification to the order or permit. The agreement or modification should be structured to note the new performance standards to be achieved by the facility, and the data quality requirements necessary to attain them. The agreement does not have to specify specific documents necessary to support the decision making, but should contain a proposed schedule of actions to take place. For a facility interested in implementing corrective action voluntarily, permission from the state voluntary cleanup program would be necessary before implementing the CAS approach.

2.4.1.2 Scoping Meeting

The scoping meeting should serve as the first CAS milestone where the facility and administrative authority identify expectations concerning the CAS implementation. The meeting may need to be scheduled over the course of a few days, depending on the complexity of the site. The purpose for the meeting is to bring the administrative authority and facility representatives together early in the process so that an agreement on land use, groundwater classification and expectations of corrective action can be discussed. At the scoping meeting, the facility should present the following:

- preliminary conceptual site model, including a very specific discussion about current and anticipated land use, and issues relating to points of exposure for human and ecological receptors *(see Appendix A)*

- discussions on history of corrective action at the facility, including investigations conducted, risk evaluations or risk assessments, interim measures/stabilization and final remedies implemented

- discussion on how the facility plans to use the CAS to meet its corrective action obligations, including permitting and compliance issues

- proposed performance standards for the facility with justification, both risk-based cleanup goals and regulatory requirements

- discussion of the design for a risk evaluation which will be used to meet the proposed performance standards, as well as potential risk management approaches for achieving them

- communication strategy (i.e., how the facility and administrative authority will share information about the site - progress reports, conference calls, routine meetings, etc.)

- site-specific concerns (i.e., sensitive environments or special sub-populations)

- need for interim measures or stabilization activities, if necessary

- schedule for submission of the CAS Work Plan and proposed schedule for conducting and completing CAS elements, including public participation

It is suggested that the scoping meeting be held at the facility for the following reasons:

- the facility can demonstrate the accuracy of the information contained in the preliminary conceptual site model in support of the proposed performance standards using all existing in-house data

- the administrative authority can confirm, firsthand, the information contained in the preliminary conceptual site model, aiding in the approval of the performance standards

Following the scoping meeting, the administrative authority may either approve the performance standards proposed by the facility or establish performance standards that the administrative authority deems necessary to protect human health and the

environment. At the completion of the conceptual site model, the facility and the administrative authority can agree upon specific CAOs that will be documented in the Risk Management Plan (Section 2.4.4). The administrative authority can include the CAOs in the final decision document that goes out for public review and comment. Should an impasse occur between the facility and the administrative authority regarding the performance standards, the administrative authority may consider mechanisms for implementing corrective action other than the CAS.

In the event the facility representatives and/or the administrative authority do not know enough about the facility (e.g. sufficient understanding of all of the elements of a conceptual site model) or the extent of corrective action obligations to propose or set performance standards, a pre-scoping meeting could be useful to serve as the first step in the implementation of corrective action using the CAS. At the pre-scoping meeting, many of the same issues that are outlined for discussion at the scoping meeting will be introduced and a set of action items will be developed. Once all action items from this pre-scoping meeting have been satisfied, the facility is prepared to continue using the CAS to expedite required corrective action.

2.4.2 CAS Work Plan

The facility should prepare a CAS Work Plan that describes the activities the facility intends to conduct during CAS implementation. The CAS Work Plan should be based on the conclusions of the scoping meeting as well as any significant input from public participation and should include, but not be limited to, the following:

- performance standards for each release area with supporting facility-specific information
- releases and potential releases listed and described (information regarding historical corrective action activities need only be included if final remedy approval is needed or if releases require further investigation)

- data quality objectives needed for achieving performance standards, including data quality project plans and sampling and analysis plans

- proposed or planned release characterization activities, including, but not limited to:

  - evaluating existing data and determining whether additional data are necessary

  - conducting any necessary investigation and data collection (sampling analysis plan and quality assurance project plan), including process for identifying additional data gaps and data collection until adequate data is available

  - implementing interim measures or stabilization of releases, if warranted

  - revising the conceptual site model to reflect the new or updated information

- describing how the facility intends to proceed through the CAS

- schedule of all facility activities for conducting and completing the CAS

The facility should submit the CAS Work Plan to the administrative authority to maintain the formal corrective action documentation record, but approval of the CAS Work Plan by the administrative authority may not be required. For larger facilities or facilities that have complex geology or site conditions, however, the administrative authority or the facility may request that the CAS Work Plan be approved. The CAS Work Plan should also provide any and all data necessary to demonstrate that the proposed performance standards will protect human health and the environment and that planned characterization activities are sufficient to support the performance

standards. Data collected using the work plan will be used to formulate the risk management plan for the site, including remedy evaluation and design, and, therefore, must be of high quality.

2.4.3 Evaluating and Prioritizing Impacts from Releases

Under the CAS, impacts to human health and the environment may be evaluated through the use of risk-based screening of releases to soil and groundwater. Exposure scenarios may be determined specific to commercial/industrial facilities, applicable (current or future) land uses, and/or through site-specific risk assessment. Ecological risk is addressed indirectly through an exclusion worksheet that allows a facility to exclude ecologically insignificant portions of a site from further evaluation and also provides an assessment checklist for areas that require further.

2.4.3.1 Risk-Based Screening

In order to quickly prioritize releases of contaminants that pose higher risk to human health and the environment, the CAS includes a discussion of risk-based screening. Information on screening criteria is described in greater detail in Chapter 4.

Screening is an integral component of the CAS. The primary objective of screening releases is to identify releases at the facility that pose the highest risk or threat from contaminants in soil and groundwater, and to allow the administrative authority and facilities to focus on achieving maximum risk reduction in a reasonable time frame. The degree of impact at the points of exposure then can be quickly evaluated. EPA Region 6 suggests that all facilities initially screen to evaluate their releases, using either state established criteria or EPA's screening tables, as this is the fastest and most cost-effective way to evaluate relative site risk. Use of EPA's screening tables may eliminate the need to carry each release through completion of a

site-specific risk assessment, though some sites or releases may wish to base their prioritization on site-specific evaluations. Another objective of screening is to allow facilities to identify releases that pose minimal risk from contaminants in soil and groundwater. However, for these de minimus releases to be considered for no further action, state concurrence is necessary.

2.4.3.2 Site-Specific Risk Assessment

The CAS includes a site-specific risk assessment component to further define impacts from releases where necessary. The site-specific risk assessment can aid in evaluating potential risks not considered in the screening of releases or more precisely define ecological risks. Specifically, facilities have greater flexibility to evaluate contaminant fate and transport, re-evaluate exposure scenarios that were not previously or adequately covered in the screening process, exclude certain pathways from consideration, and evaluate concentrations of contaminants of potential concern in background media. If a facility has already initiated or has completed a site-specific risk assessment, screening releases can still be done to quickly identify releases that need to be addressed, or the risk assessment process may be completed and the facility can move to the risk management evaluation process.

2.4.3.3 Ecological Exclusion Screening

EPA Region 6 is providing an Ecological Exclusion Criteria Worksheet and Ecological Assessment Checklist to help facilities and the administrative authority determine whether or not further ecological evaluation is necessary at an affected property where corrective action is being pursued.

Ecological screening under the CAS is a relatively simple process. Use of the exclusion criteria worksheet, general information about the facility, its operation,

physical site characteristics, ecological habitats and receptors will help identify incomplete or insignificant exposure pathways that exist at the affected property, thus eliminating the need for further ecological evaluation at these areas. If an area cannot be excluded from further ecological evaluation, additional information about ecological areas can be obtained using the assessment checklist to assist in further ecological risk evaluations, including a possible site-specific ecological risk assessment. If site-specific ecological risk data exists at the facility, it may be used to evaluate potential exposure scenarios at a site (*see Appendix B*).

2.4.3.4 Risk Evaluation Report

The facility should prepare a Risk Evaluation Report that describes the activities the facility conducted for release characterization, as described in the CAS Work Plan, and the evaluation of impacts and prioritization of these releases. The Risk Evaluation Report is submitted to the administrative authority as documentation of site risks but is not approved unless required by the administrative authority.

The Risk Evaluation Report should include, but not be limited to, the following:

- documentation of release characterization activities and results, including specific identification of media impacted
- documentation of the exposure scenario evaluation, including the identification of points of exposure
- documentation of the results of screening
- identification of release sites that will require further risk evaluation along with a schedule for implementation
- documentation of any interim measures/stabilization implemented during the course or as a result of the release characterization
- presentation of the results of any previously conducted risk assessments

- proposed revisions to performance standards, if warranted

The Risk Evaluation Report is a summary report that documents whether releases need additional response actions. The Risk Evaluation Report should concisely summarize the relevant data for risk decision making but should not be a compilation of all data collected during the course of all corrective action activities. For states with tiered risk screening, the Risk Evaluation Report should include a summary of the results for all identified release areas, including solid waste management units (SWMUs) and areas of concern (AOCs).

EPA Region 6 suggests that the Risk Evaluation Report be submitted to the administrative authority after the initial screening to document the differentiation between the releases that are a high risk or high threat from releases that are lower risk or long-term threats. When other releases (those that do not lend themselves to the screening process because of media impacted or when impacts need to be more precisely defined) are evaluated through a site-specific risk assessment, the Risk Evaluation Report and the conceptual site model, if warranted, should be updated to reflect the current information.

If data collection and release characterization reveal new information that may have an effect on the performance standards that were agreed upon with the administrative authority (e.g., change in land use, difference in expected receptors and/or exposure, or other differences in site conditions), the facility will need to notify and meet with the administrative authority to discuss making adjustments to the performance standards. Additional information useful in preparing a risk characterization report can be found in EPA's *Risk Characterization Handbook*, December 2000, EPA 100-B-00-002, December 2000 at http://www.epa.gov/OSA/spc/pdfs/rchandbk.pdf.

2.4.4 Risk Management Plan

After the facility has determined which releases do not meet the performance standards (i.e., source control, statutory/regulatory requirements, final risk goal) as established by the administrative authority, it should evaluate and propose appropriate risk management activity(ies). When the facility has developed a course of action to achieve and maintain the performance standard by establishing corrective action objectives, a Risk Management Plan should be prepared to describe and justify the facility's intended actions that will ensure protection of human health and the environment. Because the administrative authority is responsible for ensuring that the actions undertaken by the facility are protective of human health and the environment, as established by performance standards, the administrative authority should review and approve the Risk Management Plan.

The Risk Management Plan should describe and justify risk management activities for releases that failed the screening process, releases that failed to meet the performance standards, and other releases that the facility chooses to address in the near term. In addition, releases that pose a lower risk or a long-term threat should be identified in the Risk Management Plan along with a schedule for their evaluation.

The approval process for the Risk Management Plan likely will be similar to that used currently for approving corrective action reports and should be designed in accordance with all current and applicable laws and regulations, including public participation. The facility should begin implementation of the plan upon approval by the administrative authority.

The Risk Management Plan should include, but not be limited to, the following:

- Site-specific CAO's to support the performance standards

- Planned risk management activity (remedy proposal) - Describe and justify determinations that risk can be managed, and/or reduced to achieve performance standards. The risk management activity(ies) for each release should be specifically identified and described (i.e., remediation, engineering controls, and/or institutional controls) with corresponding CAO's.

- Performance monitoring, performance reviews and contingency plans - Identify specific criteria (such as land use changes, fate and transport model verification and constructed remedy performance) that will be evaluated to demonstrate that the risk management activity implemented will remain protective. Establish a schedule for periodic performance review (such as monitoring data summaries, possibly including graphical and statistical analyses) to demonstrate that the implemented activities are consistently achieving and maintaining desired results. Establish contingency plans in the event the implemented action does not achieve and maintain the CAOs and performance standards.

- Presentation of the final conceptual site model (CSM) supporting the Risk Management Plan - Identify the location of releases that did not meet the performance standards and that are addressed by a risk management activity. Identify the contaminant of concern concentrations in media after implementation of the risk management activity, including concentrations that are representative of the long-term fate and transport of residual contaminants of concern. Identify exposure pathways affected by a risk management activity and the performance monitoring locations.

- Schedule for implementation

- References

2.5 COMPLETING THE CAS

The Risk Management Plan, as approved by the administrative authority, should contain all elements and activities necessary to achieve compliance with the performance standards. Therefore, the CAS should be complete when all activities specified in the approved Risk Management Plan have been implemented, and the performance standards and supporting corrective action objectives have been achieved

and are being maintained, including appropriate monitoring and performance review activities.

For facilities being addressed under the RCRA statute (either under a permit or administrative order), it will be necessary for the administrative authority to write a decision document on the final site-wide remedy for public review and comment. EPA's term for the RCRA corrective action decision document is the "Statement of Basis". The Statement of Basis formalizes the remedy selection by the administrative authority. If corrective action is being conducted as part of the facility's RCRA permit, the public review and comment period can be concurrent to the permit renewal or permit modification process. The CAS supports close communication between the facility and the administrative authority further ensuring that all elements for the decision document are in the Risk Management Plan, making the final steps of corrective action a smooth process.

2.5.1 CAS Completion Report (Optional)

In cases where a certification of completion is needed or desired by a facility, say in the case where corrective action was completed through participation in a voluntary program, a CAS Completion Report could be prepared once all risk management activities have been implemented. For other sites, a CAS Completion Report might be the documentation presented to the administrative authority to demonstrate that all requirements of an enforcement action or permit modification have been met or completed. The administrative authority can then proceed with appropriate regulatory process/requirements regarding the corrective action status of the facility (e.g. permit or order closeout, no further action determinations).

The CAS Completion Report can be submitted under any one of the following scenarios:

- The CAS Completion Report can be prepared and submitted for a facility that has completed implementing all agreed upon risk management activities to achieve the performance standards, and the performance monitoring has demonstrated that the performance standards are being maintained but is still warranted. This determination recognizes when a facility has been characterized and remediated to the extent that the property conditions are protective based on current or planned land use, though risk management activities are ongoing to achieve and maintain performance standards. At this point a Ready for Reuse determination can be made (Section 1.2.2).

- The CAS Completion Report can be prepared for a facility that has completed all risk management activities to achieve the performance standards and the only performance monitoring requirement is the maintenance and monitoring of an institutional control. At this point a Corrective Action Complete with Controls determination can be made, pursuant to EPA's *Final Guidance on Completion of Corrective Action Activities at RCRA Facilities*, February 2003, and a Ready for Reuse determination can be made. The Corrective Action Complete with Controls determination provides the owner/operator with recognition that protection of human health and the environment has been achieved, and will continue as long as the necessary operation and maintenance actions are performed, and any institutional controls are complied with and maintained.

- The CAS Completion Report can be prepared for a facility that has completed all corrective action where no performance monitoring is required. At this point a Corrective Action Complete without Controls determination can be made, pursuant to EPA's *Final Guidance on Completion of Corrective Action Activities at RCRA Facilities*, February 2003, at http://www.epa.gov/epawaste/hazard/correctiveaction/pdfs/compfedr.pdf

Depending under which scenario the CAS Completion Report is submitted, the report will include different information. The CAS Completion Report should in a concise manner include, but not be limited to:

- documentation that all risk management activities have been either been completed or implemented for those releases that did not meet performance standards, as established by the administrative authority
- summary of any necessary performance monitoring demonstrating that either the performance standards have been achieved and/or are being maintained, documentation of any institutional control data, or the implemented risk management activities are performing as expected to ultimately achieve and maintain the performance standards (Chapter 6).
- schedule for additional periodic performance review(s) and evaluation(s)
- references to supporting documentation.

3.0 CONCEPTUAL SITE MODEL

This chapter describes . . .

establishing data quality objectives (DQOs)
elements of a conceptual site model (CSM)
data quality considerations for the CAS

3.1 ESTABLISHING DATA QUALITY OBJECTIVES

This chapter provides general guidance for establishing data quality objectives (DQOs), building a conceptual site model (CSM), and using specific data quality considerations to implement the CAS. One of the key objectives of the CAS is the use of appropriate and relevant data to evaluate releases, and identify those releases that pose a threat to human health and the environment in order to design, construct, and implement remedies. Therefore, data should not be collected or compiled until the end use of the data is known. When the end use or quality is not considered, too much data can be as detrimental as too little, and the wrong kind of information can be as significant a problem as the lack of data.

DQOs are qualitative and quantitative statements that specify the data required supporting remedy decisions. The DQO approach is not limited to laboratory quality control criteria for sample analysis (precision, accuracy, representativeness, completeness, and comparability). DQOs are determined based on the end use of the data to be collected, and the DQO development process should be integrated into project planning and refined throughout the CAS implementation. The EPA has developed guidance regarding establishing DQOs:

- *Guidance for the Data Quality Assessment, Practical Methods for Data Analysis. QA00 Update: EPA QA/G-9*, July 2000, EPA/600/R-96/084 at http://www.clu-in.org/conf/tio/pasi_121603/g9-final.pdf

- *Guidance on Systematic Planning Using the Data Quality Objectives Process. EPA QA/G-4*, February 2006, EPA/240/B-06/001 at http://www.epa.gov/quality/qs-docs/g4-final.pdf

- *Data Quality Objectives Process for Hazardous Waste Sites. EPA QA/G-4HW*, January 2000, EPA/600/R-00/007 at http://www.epa.gov/quality/qs-docs/g4hw-final.pdf

DQOs should be used to ensure that environmental data are scientifically valid, defensible, and of an appropriate level of quality given the intended use of the data. Furthermore, site investigations can be expedited considerably when DQOs are carefully established during project planning. For example, if the objective of an initial investigation is to define an area of gross contamination, a DQO for this investigation may include a higher method detection limit provided by a cost-effective field screening technology for analysis of samples. In contrast, a very low method detection limit would be an appropriate DQO to determine if contamination is present in groundwater used as drinking water.

Traditionally, environmental investigations have used the development of quality assurance project plans (QAPP) to specify DQOs and quality control protocols. QAPPs are valuable tools for facilities and administrative authorities in providing direction and requirements to ensure that the data obtained is usable for the intended objectives. The EPA has developed extensive QAPP guidance under various programs, and the following guidance documents should be consulted in the DQO process:

- *Guidance EPA Requirements for Quality Assurance Project Plans. EPA QA/R-5*, May 2001, EPA/240/B-01/003 at http://www.epa.gov/quality/qs-docs/r5-final.pdf

- *Guidance on Quality Assurance Project Plans. EPA QA/G-5*, December 2002, EPA/240/R-02/009 at http://www.epa.gov/quality/qs-docs/g5-final.pdf

The CAS Work Plan (Section 2.4.2) is required to have DQOs that are developed to support the performance standard for each release, therefore, the QAPP should be included in the CAS Work Plan. DQOs will also be developed during performance monitoring (after remedy selection) to ensure data of adequate quality is obtained to assess progress toward achieving the CAOs.

3.2 ELEMENTS OF A CONCEPTUAL SITE MODEL (CSM)

Investigations and remedy implementation are often most successful when based on a CSM; therefore, the first critical step in implementing the CAS is the development of a CSM. A CSM is a three-dimensional "picture" of site conditions at a discrete point in time (a snapshot) that conveys what is known or suspected about the facility, releases, release mechanisms, contaminant fate and transport, exposure pathways, potential receptors, and risks. The CSM does not have to be based on a mathematical or computer model, although these tools often help to visualize current information and predict future conditions. The CSM should be documented by written descriptions of site conditions and supported by maps, geologic cross sections, analytical data, site diagrams that illustrate actual or potential receptors, and any other descriptive, graphical, or tabular illustrations necessary to present site conditions.

The preliminary CSM should be built based on existing site data and should be developed before initiating any field activities. It should also be used to aid in the scoping of future investigations. Facilities that have not conducted field investigations can develop a CSM by making use of process knowledge, current and historical waste management operations, aerial photographs, topographic maps, land use maps, and

published information on local and regional climate, soils, geology, hydrogeology and ecology (such as physical characterization of the facility).

The CSM, along with the DQO process, can be used to identify data gaps in current site knowledge and focus future investigative activities for making risk-based decisions. The CSM is dynamic and should be tested and refined from the initial stages of the CAS, to the point at which the site has been remediated and no longer presents unacceptable risks to human health and the environment. Additional information on the development and use of the CSM is available in the Interstate Technology & Regulatory Council (ITRC) *Technical and Regulatory Guidance for the Triad Approach: A New Paradigm for Environmental Project Management*, December 2003 at www.itrcweb.org/Documents/SCM-1.pdf

When preparing a CSM, the facility should decide the scope, quantity, and relevance of information to be included, balancing the need to present a complete model that documents site conditions and justifies risk management actions, with the need to focus the information on that necessary to perform risk-based screening. The facility may solicit advice from the administrative authority regarding the scope of information to be presented and how the CSM will be used to establish CAOs. The CSM should present all relevant aspects, or profiles, of site conditions. The CAS presents six profiles to be addressed in the CSM: facility profile, land use and exposure profile, physical profile, release profile, ecological profile and risk management profile. These profiles and their corresponding data elements are

The CSM

The CAS approach uses the CSM as a way to continually update documentation of site activities; such as new land acquisition, land use changes, and needed changes to remedy implementation when CAOs are not met. The CSM can be the "go to" document for site inspections, once a remedy is in place. The Risk Management Profile (Section 3.2.6) can document performance monitoring and performance reviews to show that risk is being reduced.

described in the following subsections. During initial development of the CSM, each profile serves as a placeholder in the preliminary CSM, as all relevant information may not be available for all profiles. However, as a facility progresses through the CAS, additional information will become available and should be used to update the CSM and complete each profile.

Appendix A contains additional information including examples that may be useful when developing and presenting a CSM and final CAOs to support the performance standards.

3.2.1 Facility Profile

The facility profile describes the various manmade features present on or near the site, including:

- facility structures
- process areas
- solid waste management units (SWMUs)
- property boundaries
- historical features that are no longer present but may have impacted actual or potential releases

The facility profile may provide information on potential source areas and identify buildings or process structures that may affect characterization or remedy implementation. The locations of facility structures and process areas relative to a release are important in identifying contaminants of potential concern for the screening of releases or site-specific risk assessment. The location of property boundaries also can be important in land use determinations.

3.2.2 Land Use and Exposure Profile

The land use and exposure profile consists of information used to identify and evaluate the applicable exposure scenarios and receptor locations, including:

- land use on the facility and adjacent properties, emphasizing specific uses (single-family homes, agriculture, etc.)
- beneficial resource determination (groundwater classification, natural resources, wetlands, etc.)
- resource use locations (water supply wells, surface water intakes, etc.)
- sub-population types and locations (schools, hospitals, daycare centers, etc.)
- applicable exposure scenarios (residential, industrial, recreational, farming, etc.)
- applicable exposure pathways identifying the specific sources, release and migration mechanisms, exposure media, exposure routes, and receptors

To develop the land use and exposure profile, the facility should begin by evaluating the types of land use and determining beneficial resources on and around the facility. In addition, information on potential receptors (such as surface water bodies, water wells, and residences) should be incorporated into the CSM for each release. For example, the location of a surface water body at the site may indicate the potential for exposure due to ingestion of fish or possible connection to drinking water aquifers. These types of possibilities should be evaluated. Receptor information also can be important in demonstrating potentially complete or incomplete exposure pathways for the screening of releases or site-specific risk assessment.

In the screening of releases, the land use information is evaluated to determine the applicable exposure scenarios for the facility and surrounding properties. The determinations of appropriate exposure scenarios also are addressed. After this evaluation is complete, the applicable exposure scenarios should be incorporated into the CSM. If onsite or offsite land use changes, the land use profile and CSM should be updated to reflect those changes.

3.2.3 Ecological Profile

The ecological profile consists of information concerning the physical relationship between the developed and undeveloped portions of the site, the use and level of disturbance of the undeveloped property, and the type of ecological receptors present in relation to completed exposure pathways. The following information should be included in the ecological exposure profile (some of this information already may be available from other CSM profiles):

- description of the developed property on the site, including but not limited to, structures, process areas, waste management units, property boundaries, and historical uses (reference to a facility map)

- description of the undeveloped property on the site, including but not limited to, sensitive environmental areas (Federal or state parks or protected areas) habitat type (wetland, grassy area, forested, pond, stream, etc.), primary use, degree and nature of disturbance, ornamental areas, drainage ditches, creeks, and landfill areas (reference to a facility map)

- description of site receptors in relation to habitat type, including but not limited to, endangered or protected species, mammals, birds, fish, etc.)

- description of relationship of releases to potential habitat areas, contaminants of potential concern present or suspected, media contaminated, sampling data summary, potential or likely routes of migration or exposure of potential receptors, etc.

The information captured in the ecological profile will be critical in completing the Ecological Exclusion Criteria Worksheet and Ecological Assessment Checklist (*see Appendix B*). The exclusion worksheet was developed to help facilities and the administrative authority identify incomplete or insignificant exposure pathways that exist at the affected property, thus eliminating the need for a formal Ecological Risk Assessment.

3.2.4 Physical Profile

The physical profile describes the factors that may affect releases, fate and transport, and receptors, including:

- topographical features, such as hills, gradients, surface vegetation or pavement
- surface water features such as drainage routes, surface water bodies, wetlands, and watershed parameters and characteristics
- surface geology including soil types and parameters, outcrops, and faulting
- subsurface geology including stratigraphy, continuity, and connectivity
- hydrogeologic information identifying the water-bearing zones, hydrologic parameters, and impermeable strata
- soil boring and monitoring well logs and locations

The physical profile should concentrate on the environmental setting information in the absence of a release. The physical profile information will generally be integrated

with information from the release profile to describe the behavior of contaminants in the environment. The initial development of the physical profile will begin with some preliminary understanding of the environmental setting. Data gaps can then be identified and used to design future investigations.

3.2.5 Release Profile

The release profile should describe the nature of contaminants in the environment, including the following:

- identification of source materials
- identification of contaminants of potential concern and contaminants of concern, as appropriate
- potential source locations
- source locations where a release has been confirmed
- soil sampling and monitoring well locations
- delineation of the area of contamination
- distribution and magnitude contaminants of potential concern and contaminants of concern in a release
- migration routes and mechanisms
- fate and transport modeling results

As with the other profiles, the release profile will be developed over time as information is obtained. At the beginning of the CAS, the release profile may consist of the potential source locations, but at the completion of the CAS, it should contain site-specific information on release characteristics. The contaminant migration and fate and transport aspects of the release profile should be integrated with the geologic and hydrogeologic information developed for the physical profile; this information can also

aid in the development of the performance monitoring for risk management activities implemented under the CAS.

3.2.6 Risk Management Profile

The risk management profile is used to illustrate the relationship between releases and risks. The profile also illustrates how implementing risk management activities can alter the release-risk relationship. The risk management profile can include:

- summary of risks
- impact of a risk management activity on release and exposure characteristics
- performance monitoring locations and media
- contingency plans in the event performance monitoring criteria are exceeded

The risk management profile will represent the risks and risk consequences of the selected risk management activity(ies). This profile also can provide a basis for determining appropriate performance monitoring locations and establishing contingency plans to ensure protectiveness. During the development of the preliminary CSM, the profile may serve as a placeholder. As the facility progresses through the CAS, the information contained in the risk management profile will be augmented and refined and will ultimately demonstrate how facility risk will be managed. Following remedy implementation, this profile serves as a place to update activities from the Risk Management Plan (Section 2.4.4).

3.3 DATA QUALITY CONSIDERATIONS FOR THE CAS

This section describes data quality considerations in developing DQOs for use in the CAS for the identification of contaminants of potential concern, data reporting limits, use of existing information, data collection, and release characterization techniques.

3.3.1 Identification of Contaminants of Potential Concern

Contaminants of potential concern (COPCs) are constituents (including transformation or daughter products and companion products) likely to be present in media affected by a release. The COPC evaluation process will involve screening the initial COPCs based on the findings of release characterization activities. COPCs should be identified through existing information regarding the process, product, or waste from which the release originated, and by characterization of the release. The two-step process listed below should be followed.

Step 1: Evaluate the types of product or waste handled at the source from which the release originated.

For example, if a potential source area is a permitted waste pile that historically managed materials that included nitroaromatic compounds, the list of COPCs should include nitroaromatic compounds. If a storm water basin is a potential source area, the list of COPCs should include all known and potential compounds based on the industrial activity in the area that drains into the storm water basin (i.e., raw feed materials, finished products, waste by-products). In cases where the site history is incomplete or the quality of information is uncertain, laboratory analyses should include a broader spectrum of compounds to characterize the release. The range of COPCs may be reduced if available information indicates that certain compounds or classes of compounds (halogenated volatile organic compounds, polychlorinated biphenyls, etc.) consistently are absent from the source and release media.

Step 2: Evaluate any COPCs that may be of concern due to other site-specific factors such as community and regulatory issues.

The community or administrative authority may be concerned about specific chemicals or analytes not identified during Step 1.

If it can be determined that the chemical or analyte may not be present, documentation should reflect this fact. The process of identifying COPCs will provide the information necessary to conclude that the facility has not overlooked a chemical or analyte which may pose a risk at the point of exposure. The initial list of COPCs can be refined during and after release characterization to more accurately reflect any constituent(s) that may be present in the release.

3.3.2 Quality Considerations for Existing Data

When the potential use of existing data during implementation of the CAS is evaluated, the data quality should be characterized and its relevance established based on present objectives, DQOs and other applicable requirements for collection of new data. The use of historical or existing data should not be limited only to information collected under the direction and oversight of the administrative authority. Before this information can be considered useable for risk management activities, the following factors should be reviewed:

- Objectives: What were the objectives of the original data collection and are they consistent with the DQOs of the current characterization activities? Data needs likely would be significantly different if historical data were collected to establish that a release occurred versus the data needs for characterization of associated risk and hazard for a receptor population based on contact with impacted environmental media.
- Relevance: Are the historical data relevant given current site conditions? Data collected from a unit that has been remediated or has undergone an

interim measure (i.e., excavation, removal action and backfill) may not be relevant for establishing protective concentrations under current site conditions. What changes have occurred at the facility since historical data were collected? Will contaminant-specific factors, site conditions, and time impact the reliability of historical data to make it questionable for current assessment?

- Quality: Were adequate quality assurance/quality control (QA/QC) procedures in place at the time of sampling, and if so, did the program meet the objectives? Were QA/QC procedures consistent with current practices? Were the methods and analyses used to generate the data capable of achieving the DQOs required by the CAS? Is the documentation sufficient to adequately reconstruct the sampling procedures and associated information (locations, depths, and analytical detection limits)? Can the limitations which affect usability be adequately defined?

- Confirmation: Upon review, are the historical data valid or is confirmatory sampling necessary to establish relevance and data quality?

The historical data review should determine if the data is valid, if confirmatory sampling to validate historical data is needed, if the data are valid for limited purposes (such as confirmation of a release), and/or if the data is not usable.

General guidelines for the use of existing or historical data, based on data quality or limitations, are listed below:

- data of questionable or unknown quality
  - may be used to establish a release has occurred
  - may be useful in planning sampling location and analytical approaches for new data collection activities
  - may be used in the initial identification of COPCs and potential exposure pathways
  - may be used in developing a preliminary conceptual site model
  - should not be used to identify COPCs for use in a risk assessment

  - should not be used to eliminate a release from consideration
  - should not be used to eliminate or restrict new sampling activities
  - should not be used to support critical risk management decisions
  - should not be used in the determination of exposure concentrations

- data verified by confirmatory sampling at identical locations, using comparable sampling and analytical methods
  - may be used to establish representativeness, comparability, and completeness between historical and new data
  - may be used to provide information in evaluating contaminant fate and transport over time
  - may be used to establish the relevance of historical data to current site conditions
- data meeting quality criteria and relevance specific to the objectives and other requirements for collecting new data as proposed by the CAS
  - may be used in lieu of new data to support critical risk management decisions

3.3.3 Quality Considerations for New Data Collection

The facility should consider the following issues when developing DQOs for the collection of new data:

- Selected sampling and analytical methods should ensure analysis for, and detection of, COPCs at or below the contaminant-specific data reporting limits. If COPCs cannot be identified based on historical data, a broad suite of analytical methods (e.g., analysis of total metals, organic constituents, pesticides, etc.) should be used.
- Sampling locations should be selected within each medium at probable locations of a release to ensure that all media impacted by the release are identified. Media properties, conditions and contaminant behavior in the

media should be considered to ensure that the data collected are representative, reproducible, and complete.

3.3.4 Release Characterization Techniques

Release characterization techniques are those methods and activities used to collect current information about site conditions so that COPCs can be identified and impacts can be evaluated. Release characterization can include collection and analysis of environmental media samples; remote sensing and non-invasive procedures to estimate physical properties of the site or potential release areas predicated on historical land use (aerial photographs indicating historical operations); and other field measurements to obtain data for purposes such as groundwater modeling.

ITRC (http://www.itrcweb.org/), in collaboration with EPA's Technology Innovation Office, has been working on innovative approaches and new-generation technologies associated with sampling, characterization, and monitoring. ITRC documents may provide a valuable resource when developing project plans for corrective action sites. Another reference for acquiring technically defensible data using innovative characterization tools and strategies is the Triad approach found at www.triadcentral.org.

EPA's Superfund program supports the use of *Dynamic Field Activities for On-Site Decision Making: A Guide for Project Managers*, May 2003, EPA/540/R-03/002, May 2003 at http://epa.gov/superfund/programs/dfa/guidoc.htm which includes case study summaries. This document focuses on streamlining hazardous waste site activities with real-time data and real-time decisions.

4.0 RISK-BASED SCREENING

This chapter describes . . .

- background and purpose
- land use and receptors
- steps to conducting risk-based screening

4.1 BACKGROUND AND PURPOSE OF RISK-BASED PRIORITIZATION

The CAS presents a simplified approach to prioritize corrective action at a facility through the use of risk-based priority screening. The primary objective of screening releases is to quickly identify the highest risk releases at a facility and to focus limited corrective action resources (time and money) on these areas in order to obtain the maximum risk reduction in the shortest time frame. Another objective of screening is to allow facilities to identify releases that pose minimal risk from contaminants in soil and groundwater.

EPA Region 6 suggests that all facilities initially screen to evaluate their releases using either state established criteria or EPA's medium-specific screening levels (MSSLs), as this is the fastest and most cost-effective way to evaluate relative site risk. EPA Region 6 MSSLs are posted at http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm. This table was developed using information provided by Regions 3, 6, and 9, and provides the user with the best information available for human health screening. In addition to having developed a joint Regional table, a calculator was also developed that allows the user to define variables to compute a site-specific screening value. Values can be calculated for fish ingestion and other exposure scenarios, for example. The Regional table no longer includes both categories of industrial worker (indoor and outdoor), but

this value can be easily calculated for the more than 650 chemicals available in the calculator.

The result of screening should be the differentiation of releases that have the highest relative risk and warrant immediate expenditure of resources (to ensure the protection of human health) from releases the pose lower risk or long-term threat and can be considered a lower priority. For those releases that pose lower risk, additional evaluation may be warranted to determine if the release actually requires corrective action or if the risk is *de minimus*. For these *de minimus* releases to be considered for no further action (NFA), however, state concurrence is necessary.

Ecological Risks

The CAS prioritizes action first for all releases that present a risk to human health. This prioritization is not intended to ignore or dismiss any environmental risks which may be present at a site. In fact, failure to address environmental impacts in a timely fashion may result in the growth or compounding of possible ecological damage at the site. The CAS contains an Ecological Exclusion Criteria Worksheet and Ecological Assessment Checklist to help determine if significant habitat and/or receptors are present at a facility and assess the need for a more thorough ecological assessment. (Appendix B). These tools are simply aids and do not substitute for the judgment or requirements of the administrative authority or natural resource trustees who may be responsible for the site.

In order to further prioritize releases that may "Warrant Further Evaluation," it is necessary to evaluate them for potential cumulative contaminant risk that could exceed 1×10^{-4} for carcinogens and a hazard index of 10 for non-carcinogens. Sites that have multiple contaminants that exceed these risks or hazards should also be categorized as high-priority or "Address Now" sites for immediate consideration. Step 6 (Section 4.4) in conducting the screen below provides a simple algorithm for calculating the cumulative risk or hazard for these releases.

In the event that a facility does not have releases that are in the high-priority or "Address Now" category, their corrective action efforts should shift to evaluating the low-priority category releases to determine if they meet the performance standards for the facility.

4.2 LAND USE AND RECEPTORS

The accurate classification of current and future land use at a facility is essential in order to identify the kinds of human receptors that may be present and the types of activities in which they are likely to engage. This identification goes beyond simply designating a category of land use (e.g., residential, industrial or agricultural). Risk from contamination at a site is a function of the specific activities that receptors are assumed to undertake and the exposures to contaminants that are associated with those activities. The activities can vary considerably, even across sites that fall within the same land use category; thus, it is critical that the assumptions regarding receptor activities accurately reflect the land use and exposure profiles presented within the CSM.

Current land use conditions should be emphasized when evaluating exposures at commercial/industrial facilities because for most of these facilities, current land use is assumed to continue into the foreseeable future. If a different land use has been planned or may be reasonably anticipated for the facility (or a portion of the facility), then this future land use should be evaluated during the CAS screening process. The two primary land use categories in the CAS screening process are non-residential and residential. However, if other land use categories exist (e.g., agricultural or recreational), then any evaluation of risk from these exposure scenarios can be assessed or should be addressed through a site-specific risk assessment. Caution is recommended when screening using an evaluation of land uses other than those upon

which the screening values were based, because each of the land use categories is associated with a specific and potentially unique set of exposure assumptions.

- Non-residential land use - encompasses commercial/industrial site uses. Under the CAS screening process, the receptors for the commercial/industrial scenario are limited to generic on-site workers. There is no requirement under this land use category to evaluate exposure to members of the public. Access to industrial facilities is generally restricted (workers often being the only receptors), and even though the public may have access to commercial sites (e.g., customers, delivery people, etc.), screening values that are protective of workers are assumed be protective of a customer who visits the site on an infrequent basis.

- Residential land use - encompasses evaluation of adult and child receptors with regard to on-site contaminants associated with known or potential future residential use of the property or parts of the property. In addition, off-site residential receptors may be considered when construction activities at a site may impact off-site areas with fugitive dust and/or volatile emissions. Off-site receptors also should be evaluated when contamination from the site has migrated off-site to a residential land use setting from soil or groundwater.

If a future commercial/industrial land use is likely to involve substantial exposure to the public (i.e., where the current or future use involves housing, education, and/or care of children, the elderly, or other sensitive sub-populations), the exposure should be evaluated under the residential risk screening scenario.

4.3 EXPOSURE SCENARIOS AND EXPOSURE PATHWAYS

The exposure scenarios routinely associated with activities found at and around facilities undergoing corrective action should be evaluated. A facility is not required to evaluate environmental data against all exposure scenarios available in the screening table or calculator. This comparison should be limited to the receptors and pathways that exist or potentially exist at the facility based on current land use and reasonable future land use assumptions (e.g., ambient air or ingestion of groundwater or surface

water would not be evaluated where contaminants are not present or pathways are incomplete or not expected to be complete).

The focus for most facilities will be on current land use, because most cleanups at industrial facilities will be based on industrial exposure assumptions (assuming the current land use continues into the foreseeable future). Institutional controls may be required to ensure that environmental conditions are protective of human health and the environment over the long term, but should not be assumed to be in place at the time the CAS screening process. Exposure scenarios other than residential or industrial that are not sufficiently similar to either of these should be evaluated under a site-specific risk assessment.

Screening values for groundwater that is a current or reasonably expected future source of drinking water are included in the MSSLs table. If an aquifer is determined to be a current or reasonably expected future source of drinking water and concentrations of contaminants exceed the screening values at the $1x10^{-4}$ risk level or HQ of 10, maximum contaminant levels (MCLs), or other risk-based concentrations, then the release is considered to be a high priority for corrective action. Facilities should consult with state

Groundwater Use Designation

State regulatory programs have a primary responsibility to manage ground water resources under their control. EPA prefers to rely on states to develop ground water use designations and will generally defer to a states designation of ground water classification and use when developing cleanup objectives.

EPA has an expectation to return usable ground waters to their beneficial uses where practical, within a time frame that is reasonable given the particular circumstances of the facility. When restoration of ground water to beneficial use is not practical, EPA has an expectation that a facility will minimize further migration of existing plumes, prevent exposure to the contaminated water, and perform additional risk reduction as necessary.

and local authorities on the designated use and classification of underlying groundwater to determine whether the water bearing unit beneath or adjacent to the facility is a potential drinking water source or has another designated beneficial use.

The state will make the determination as to what level the aquifer is to be protected. If the state has not made a determination on the use of the aquifer, then the facility should consult with the state on using the EPA aquifer classification designation. EPA prefers to rely on states to develop groundwater use designations and will generally defer to a state's designation of groundwater classification and use. These designations may be part of an EPA-endorsed Comprehensive State Ground Water Protection Program (CSGWPP) that provides for facility-specific decisions or may rely on an alternate state groundwater use designation system and/or Federal groundwater guidelines.

Indoor Air

Where volatile contaminants are present in soil or ground water under or near an existing structure, consideration should be given to the inhalation of volatiles for indoor air exposure in a site-specific risk assessment. EPA has developed a document to present the "state of the science" regarding management and treatment of vapor intrusion into building structures. The document can be found at http://www.epa.gov/nrmrl/pubs/600r08115/600r08115.pdf

If an aquifer is not a drinking water resource, does not have any other beneficial resource attributes, does not impact indoor air, does not contaminate surface water, or does not contaminate a drinking water aquifer, then the level of protection (e.g., MCL or alternate concentration limit (ACL)) to be met at, within or beyond the facility boundary will be determined in consultation with the administrative authority.

4.4 STEPS TO CONDUCTING RISK-BASED SCREENING

There are six steps involved in evaluating releases against the risk-based screening values:

> Step 1. Compile risk relevant data from the site-specific CSM

Development of a site-specific CSM is the first step in the CAS screening process at a facility. The CSM is a comprehensive three-dimensional representation of the facility that documents current site conditions. It initially is developed from existing facility data, but should be revised continually as new site investigations produce updated and more accurate information. The CSM identifies and characterizes the distribution of contaminant concentrations across the facility, release mechanisms, fate and transport/migration routes, complete or potentially complete exposure pathways and receptors of concern.

Chapter 3 of the CAS describes the development of a CSM. There are six profiles used in the CAS to build a CSM, two of which are specific to the screening process: land use and exposure profile (Section 3.2.2), consisting of information used to identify and evaluate applicable exposure scenarios and receptor locations); and the release profile (Section 3.2.5), consisting of information used to confirm whether a release has occurred, defining the exposure area and identifying COPCs and their distribution and magnitude.

> Step 2. Verify that the exposure assumptions and scenarios in the CSM are consistent with (and comparable to) the assumptions upon which the screening values are based.

The next step in the CAS screening process is to compare the complete or potentially complete exposure scenarios presented in the CSM to the generic exposure assumptions used to develop screening values presented in the screening tables. The exposure scenarios included in the screening tables routinely are associated with the types of activities found at and around facilities. The facility is not required to evaluate all of the receptors, rather, this analysis is limited to the receptors that exist or may potentially exist at the facility based on current land use and reasonable future land use assumptions. This comparison is designed to determine whether the releases, exposure pathways, and receptors of concern outlined in the site-specific CSM are sufficiently similar to the generic exposure scenarios used in the calculation of the screening values to allow a defensible screening comparison. If the basic exposure pathways are not sufficiently similar (whether through omission of a complete exposure pathway, or receptor population, or whether an exposure parameter used in the screening table tends to underestimate exposure), screening is not appropriate and the facility should evaluate the release areas through a site-specific risk assessment.

Step 3. Evaluate existing data set to determine if it is adequate for use in the CAS screening process and then determine additional data collection needs, if necessary.

Areas that are unlikely to be contaminated based on historical documentation of the location, storage, handling, or disposal of hazardous materials at a facility may be eliminated from further evaluation at this stage after consultation with the administrative authority. The necessity for collecting confirmation samples in these areas will depend upon the level of confidence in historical information concerning the potential release site(s). In order to use the screening table, existing data should be sufficient to adequately characterize the release as described in Chapter 3 (Section 3.3.2) under the

DQO process. Existing data also may be used to identify data gaps and focus data collection needs.

A sampling and analysis plan should be developed (as part of the CAS Work Plan) before any new sampling activities are initiated to ensure that the data collected will fill data gaps and are of sufficient quality and quantity, based on the intended use of the data. The sampling approach should be designed to reflect the data needs specific to the complete or potentially complete exposure pathways identified in the CSM. The types of receptors identified in the CAS and the site-specific CSM vary in terms rate of contact and sources. For example, while indirect exposures associated with inhalation of volatiles from subsurface contamination may impact all receptors located on-site, direct contact to subsurface contamination may be limited to outdoor workers conducting excavation activities.

In addition, the facility also should consider the collection of information on site-specific soil characteristics (e.g., soil texture, dry bulk density, organic carbon content, pH, etc.) during sampling. The information may provide an additional level of accuracy at the site-specific risk assessment stage, if it becomes necessary. Chapter 3 (Section 3.3.3) under the DQO process provides more information on quality considerations for the collection of new data.

Step 4. Collect and analyze additional samples, if necessary.

Analytical results for individual chemicals, if the quality is sufficient, will be compared to screening values presented in the screening table. Analytical results help define the nature, extent, and rate of migration of contaminants from a release. Upon receipt of these data, the assumptions (e.g., exposure assumptions) outlined in the site-

specific CSM should be reviewed to ensure that they still are valid, and include any additional components indicated by the most recent results.

Collection and evaluation of soil characteristic data also should be considered. The information can assist in the assessment of inhalation of volatiles, and fate and transport considerations at the site-specific risk assessment stage, if necessary.

Step 5. Identify appropriate site receptors and exposure pathway(s) for comparison to the screening table.

Determine which, if any, of the receptors and exposure pathways presented in the screening table are appropriate for comparison against site chemical release results based on the presence or absence of contamination in a given media. Certain exposure pathways presented in the screening table may be eliminated from consideration when the pathway is not complete or reasonably expected to be complete. An example would be where the groundwater pathway would not be evaluated when groundwater is not considered a current or future drinking water source and does not create an impact at other relevant points of exposure (e.g. indoor air, surface water used as a drinking water source, connect to a drinking water aquifer).

Step 6. Compare release data against screening values for site-specific receptors.

After the appropriate screening values have been identified, they are compared to the measured concentrations of COPCs. At this point, it is important to again review the CSM to confirm the actual site data that were evaluated or collected during the CAS screening process ensuring that the screening values are applicable to the site.

Generally, for most new and existing data sets, the 95th percent upper confidence limit (UCL95) of the arithmetic mean concentration of each contaminant is compared directly to the corresponding screening value. For certain releases with small aerial distributions and low toxicity contaminants, it may be more advantageous and cost effective to collect a limited number of samples and compare the maximum contaminant concentration from the release area to the screening values. When this approach is used, it is essential to ensure that the samples collected from the release area will reasonably contain the highest contaminant concentrations to conservatively characterize risk. A facility may opt to collect additional samples from the release area and calculate a UCL95 for comparison to the screening values to more accurately characterize release concentrations. The EPA's *Supplemental Guidance to RAGS: Calculating the Concentration Term*, May 1992 (EPA Publication 9285.7-081) at http://rais.ornl.gov/homepage/UCLsEPASupGuidance.pdf, provides additional guidance on statistical methods for accurately determining exposure point concentrations.

First for each release area, individual contaminant concentrations are compared to the screening values. If a contaminant concentration exceeds $1x10^{-4}$ carcinogenic risk or a hazard quotient of 10, the release area is a high-priority, "Address Now," site. The calculator on the screening table website can be used to set the target at $1x10^{-4}$ and a hazard quotient of 10. Next, the individual contaminant concentrations for release areas that are not categorized as "Address Now" are compared to the screening values (i.e., 1×10^{-6} for carcinogens or exceed a hazard index of 1.0 for non-carcinogens). If an individual contaminant concentration for a release area does not exceed the screening values, then the site is considered *de minimus* risk, and therefore, designated as no further action (NFA). For releases that exceed the screening value for individual contaminants, but do not exceed the $1x10^{-4}$ carcinogenic risk or a hazard quotient of 10 screening values, these sites have risks or hazards within the National Oil and Hazardous Substances Contingency Plan risk range (i.e., 1×10^{-4} to 1×10^{-6} for

carcinogens or exceed a hazard quotient of 1.0 for non-carcinogens) but may warrant further evaluation.

For those releases with multiple contaminants which exceed the screening value, but no individual contaminant exceeds a $1x10^{-4}$ carcinogenic risk or a hazard quotient of 10 screening value, it is known that site risk is above $1x10^{-6}$ for carcinogens and hazard quotient of 1, but it is not known if cumulative risk or hazards exceed $1x10^{-4}$ or a hazard index of 10, respectively. Therefore, these sites should be evaluated for their cumulative risk or hazards using the algorithm presented in **Figure 2**. Sites that exceed a $1x10^{-4}$ cumulative risk or hazard index of 10 should also be considered as high-priority or "Address Now" sites.

Once releases are identified and comparisons made between site concentrations of COPCs and the screening table, the screening results should be used to help prioritize releases, so the most significant get early action. This, too, is where in the process the actual COCs are identified. Using the results of the comparison, categorize releases at the site as:

1. ***HIGH PRIORITY***
2. ***RELEASE THAT MAY WARRANT FURTHER EVALUATION***
3. ***NO FURTHER ACTION***

EPA Region 6 suggests that all facilities initially use screening tables to evaluate their releases as this is the most expeditious and cost-effective way to evaluate site risk thus categorizing releases as high priority, releases that may warrant further evaluation, or NFA for human health (ecological risks must be evaluated before making a final determination).

Figure 2

*Calculation of **cumulative carcinogenic risk** for releases with multiple contaminants that exceed the screening value.*

Background on risk calculations:

For the purposes of this calculation - Intake = Intake x Toxicity Criteria
Risk = Intake x Concentration
thus: Concentration = Risk/Intake

Example calculation:

The contaminant specific screening values are based on a target risk of 1×10^{-6}. Lets assume that the soil screening value for Contaminant Z is 50 mg/kg. Solving for Intake:

Intake = Risk/Concentration
Intake = $1 \times 10^{-6}/50$
Intake = 2×10^{-8}

Let's say the concentration of Contaminant Z in soil at Site A is 89 mg/kg. To determine the risk associated with the concentration detected in soil, substitute the 89 mg/kg for the value of 50 mg/kg and solve for the (target) risk.

Risk = Intake x Concentration
Risk = $2 \times 10^{-8} \times 89$
Risk = 1.78×10^{-6}

Do this for each of the contaminants which exceed the screening value, sum the risks and you have total cumulative carcinogenic risk for a particular release area.

*Calculation of **non-cancer risk (Hazard Index)** for releases with multiple contaminants that exceed the screening value.*

For the purposes of release prioritization under the CAS, the non-cancer hazards associated with multiple chemicals will be conservatively evaluated by summing the hazard quotient for all chemicals of concern, regardless of target organ or response, to obtain the hazard index. If the hazard index for the release area exceeds 10, the release is categorized as a high priority site.

Figure 2

5.0 REMEDY EVALUATION

This chapter describes . . .

- evaluating and proposing a remedy
- review of Interim Measures/Presumptive Remedies
- remediation
- use of institutional controls

5.1 EVALUATING AND PROPOSING A REMEDY

This chapter describes the process of evaluating and proposing risk management activities that will reduce risk to human health and the environment by addressing releases that do not meet the performance standards (i.e., source control, statutory/regulatory requirements, and final risk goal), as established by the administrative authority.

5.1.1 Risk Management Planning

The range of potential risk management activities evaluated will depend on the results of risk-based screening, any site-specific risk

Risk Management Activities

RCRA regulations provide great latitude to facility owners on how to meet the overall corrective action goal of protecting human health and the environment.

EPA has found through Superfund and other programs that removal and treatment, while initially expensive, is often best to permanently and dramatically reduce environmental liability.

Engineering controls may initially cost less, but also carry with them ongoing operations and maintenance costs and continuing liability. Institutional controls are often initially the lowest cost risk management activity, but the effectiveness over the long term is much less certain and does not

assessments conducted, and ecological risk assessments if warranted.

At this point in the process, all sites deemed “no further action” or NFA, are identified and summarized in the Risk Evaluation Report (Chapter 2.4.3.4). For remaining release sites that need to be addressed, the facility will evaluate and propose a risk management activity or combination of activities. The facility should consider many factors, including cost, in evaluating potential risk management activities; however, the primary criterion in proposing a risk management activity is the demonstration that the activity will achieve and maintain the performance standards.

In the Final *RCRA Corrective Action Plan*, May 1994, EPA-520-R-94-004 (Available to order via NCEPI; Order Number EPA-520-R-94-004; fax number 703/321-8547), five general decision factors are discussed for evaluating remedial alternatives (i.e., risk management activities) to factor into remedy selection. Along with the five general decision factors (long-term reliability and effectiveness, reduction in toxicity, mobility or volume of wastes, short-term effectiveness, implementability and cost), the administrative authority must also consider state and community acceptance of the final remedy. Additionally, opportunities for the evaluation of risk management activities that incorporate options to maximize the net environmental benefit of the corrective while minimizing negative environmental impacts (i.e., green remediation) and/or allow for revitalization should be explored.

For large complex sites, facilities need a strong communication strategy with the administrative authority. Face-to-face meetings and monthly conference calls through the evaluation of remedial alternatives process give the administrative authority a level of assurance that they are providing input into the final risk management activities proposed in the Risk Management Plan.

The completion of a comprehensive CSM (Chapter 3) is necessary before the risk management activities can truly be evaluated. Risk management planning may also require other activities such as field investigations to characterize hydrogeologic conditions and monitor meteorological conditions. Innovative technologies may need to be evaluated through bench-scale or pilot testing. A pilot test may be performed at any time during the corrective action process and may provide valuable information for risk management activity selection. Pilot testing of innovative in-situ treatments are particularly useful because of their potential to replace the conventional remedies, such as pump and treat remedies for contaminated groundwater.

When the facility has developed a course of action, the Risk Management Plan will be prepared to justify the facility's intended actions to ensure protection of human health and the environment. Because the administrative authority is responsible for making sure that actions undertaken by the facility are protective of human health and the environment, as established by performance standards, the administrative authority will review and approve the Risk Management Plan.

The approval process for the Risk Management Plan likely will be similar to that used currently for approving corrective action reports. The plan should be developed in accordance with all current and applicable laws and regulations, including public participation. Upon approval of the Risk Management Plan, the facility can begin its implementation.

5.1.2 Corrective Action Objectives

The ultimate performance of a remedy is defined as achieving and maintaining the performance standards of an implemented risk management activity, and is dependent upon the long-term reliability of established exposure scenarios and land use assumptions, the validity of fate and transport parameters used in modeling, and the

physical performance of the remedy or engineered control. The CAOs are established in support of the performance standards; CAOs can be refined through the corrective action process as the CSM is developed and updated. Therefore, whereas the performance standards represent existing policy and regulatory requirements with a risk-based goal of protectiveness, the CAOs are site-specific, media-specific, risk-based "endpoints" for corrective action for a facility.

The goal of a remedy is the attainment of the site-specific CAOs in order to protect human health and the environment; this allows the administrative authority to approve the proposed risk management activities in the Risk Management Plan as the final selected remedy without the worry that a chosen technology will prove itself over time. This performance-based approach uses contingency plans, which can include trying new technologies to meet the CAOs for remedy performance. In the event that contingency plans fail to achieve the site-specific CAOs, remedial alternatives will need to be evaluated again and a new approach will need to be proposed to the administrative authority.

CAOs are written narrative statements that are media-specific; they may have numeric cleanup goals, exposure prevention measures, or they may specify the performance standard it supports, such as removal, treatment or containment. The CAO may specify that a medium (such as surface water) will continue to be monitored for COCs. The ITRC Remediation Process Optimization Team authored a reference document that uses the term "remedial action objectives" which are equivalent to the CAS CAOs in *Exit Strategy-Seeing the Forest Beyond the Trees*, March 2006 at http://www.itrcweb.org/Documents/RPO-3.pdf.

Figure 3 illustrates how CAOs are developed and refined based on the development of the CSM. See Appendix A for more information on the development of the CSM and CAOs.

Figure 3

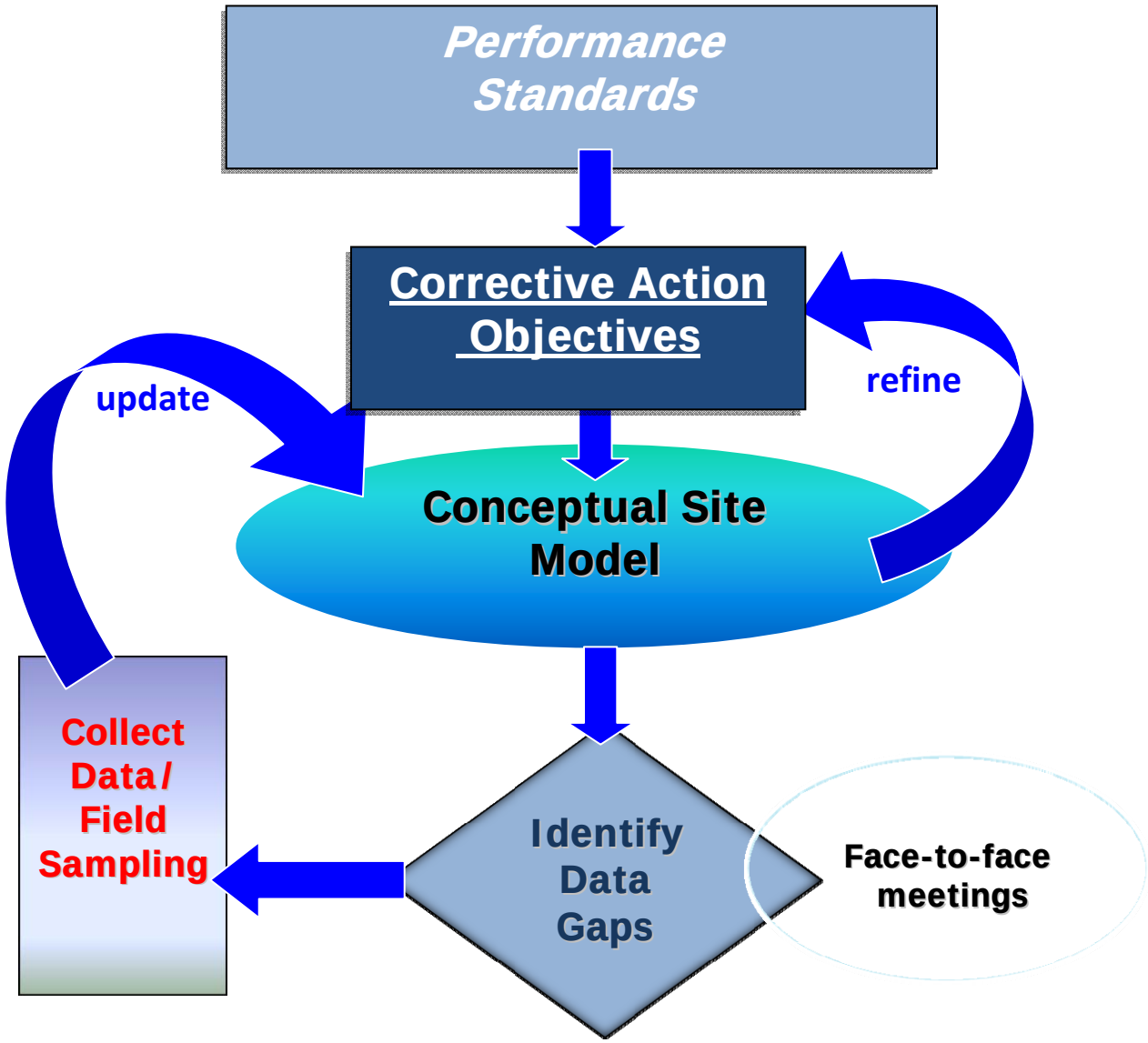

Figure 3: Corrective action objectives allow you to begin with the end use in mind. As the conceptual site model develops, the final corrective action objectives are refined and documented in the final Risk Management Plan. Ultimately, the performance-based goal is to develop risk management activities that will meet and maintain the final CAOs.

5.2 REMEDIATION

Remediation is the process of removing or reducing the concentrations of COCs, as determined from risk-based screening or site-specific risk assessment, to lessen or eliminate impacts at locations where unacceptable exposure exists (i.e., risk reduction). Remediation may be performed by excavation and removal of COCs, in-situ treatment of COCs, or ex-situ treatment of COCs. The facility will identify concentrations of COCs in media that can be reduced to meet performance standards and associated with site-specific CAOs, as established by the administrative authority. The use of a remedial alternative to meet a performance standard should include a mechanism to ensure that the remedy is protective over time. This can be accomplished by adequate design of operation, maintenance, and monitoring specifications.

To address source material, the priority of assessing remedial alternatives is removal, treatment, and containment. At most sites, the final remedy will include a combination of all three. Some ex-situ treatment systems are often criticized for poor energy efficiency. More innovative in-situ treatments are considered “green” technologies, and there are a variety of new applications for chlorinated solvents, as well as petroleum hydrocarbons.

Containment may be achieved through the use of engineered controls. Engineered controls can be used to prevent or minimize impacts at points of exposure. Engineered controls are risk management tools that are physical structures designed and constructed (such as caps, horizontal or vertical barriers, and hydraulic controls) to prevent migration of COCs to locations where unacceptable exposure may occur, or prevent exposure to a COC. Pump and treat systems for groundwater remediation are classified as both a removal and treatment approach with a measure of hydraulic containment if the extraction or recovery wells are engineered in a way to maximize the capture zone of contamination.

5.3 REVIEW OF INTERIM MEASURES/PRESUMPTIVE REMEDIES

Most facilities that have been in the corrective action process for some time are implementing/have implemented interim measures as a way to mitigate releases to the environment. The first remedy evaluation should include a review of the interim measures in place to see if performance standards have been attained or can be attained within a reasonable amount of time. Also, if the system(s) in place can be optimized with minimal effort, this might prove to be the best alternative for the final site-wide remedy.

Another evaluation that might be worthwhile is a review of available presumptive remedies. During development of the CSM, a facility may identify a release that could be addressed through a streamlined approach using presumptive remedies. The use of presumptive remedies for RCRA corrective action sites should be similar to those used for CERCLA sites, as noted in the ANPR. There are several EPA guidance documents outlining the use of presumptive remedies at CERCLA sites for specific contaminants in soils and sediments, and presumptive response strategies for the restoration of groundwater. While their use in not required for RCRA, they may be useful in remedy selection. Information regarding EPA's presumptive remedies can be found at the http://www.epa.gov/superfund/policy/remedy/presump/finalpdf/pol.pdf

5.4 USE OF INSTITUTIONAL CONTROLS

Institutional control refers to a non-engineering measure which restricts the use of land and other resources and which is often a key element of environmental cleanups. Institutional controls are legal or administrative tools intended to influence human activities in such a way as to prevent or reduce exposure to hazardous wastes or hazardous constituents. The types of institutional controls include governmental controls (e.g. zoning, ordinances), proprietary controls (e.g. legal instruments placed in

the chain of title for property), enforcement and permit tools with the proper components, and informational devices (e.g. state registries, deed notices). Institutional controls often are used in conjunction with, or as a supplement to, other measures such as remediation or engineering controls to prevent or reduce exposure. An institutional control or a group of institutional controls, under appropriate circumstances, though rare, may serve as the sole remedy at a facility. Institutional controls, however, are not intended to be used as secured abandonment (i.e., physically securing a site and preventing exposure while making little or no effort to ensure that COCs do not migrate to and beyond the property boundary). In fact, institutional controls can be an integral part of the risk management approach that allows property to be put back into productive use while being protective.

As with the evaluation of institutional controls for an onsite remedy, the evaluation of institutional controls for offsite property should include a determination of the appropriateness, feasibility, and long-term effectiveness in protecting human health and the environment afforded by the institutional control. An institutional control cannot be placed on neighboring property without first negotiating and receiving consent of the property owner. Although the administrative authority bears no responsibility in these negotiations, they need to ensure that the resulting agreement or settlements are protective of human health and the environment.

EPA has developed guidance on the use of institutional controls at Superfund and RCRA corrective action sites, and the guidance should be consulted for additional information concerning their applicability and use. *Institutional Controls: A Site Managers Guide to Identifying, Evaluating, and Selecting Institutional Controls at Superfund and RCRA Corrective Action Cleanups*, September 2000, EPA/540/F-00-005 at http://www.epa.gov/superfund/policy/ic/guide/guide.pdf

6.0 COMPLETING THE CAS: IMPLEMENTING A PERFORMANCE-BASED REMEDY

This chapter describes . . .

performance monitoring
performance reviews
contingency plans

6.1 PERFORMANCE MONITORING

The success of performance-based remedies relies on performance monitoring, periodic performance reviews and well-established contingency plans. Therefore, the facility should develop a program for monitoring the performance of the risk management activity including specific criteria demonstrating that the activity implemented will remain protective, details of which are included in the Risk Management Plan.

The performance criteria should be specific to concentrations and distributions of COCs, and identify points of exposure (POE) and other physical parameters directly relevant to monitoring and measuring the protectiveness of the selected risk management activity. All performance parameters should focus on demonstrating that the CAOs are maintained once achieved, they should be based on site-specific conditions and implemented risk management activities, and they should establish specific monitoring parameters that, if exceeded, would trigger contingency plans to ensure protectiveness.

The performance monitoring guidelines described in the following subsections are specific to the CAS, and are intended to complement, but not replace, monitoring requirements specified by statute, regulation, or other program components (e.g., permits required for the discharge of treated wastewater or air emissions). The performance monitoring plan will outline a clear definition of the monitoring frequency, sampling locations and data interpretation. The administrative authority is responsible for reviewing and approving the Risk Management Plan, and ensuring that the actions undertaken by the facility are protective of human health and the environment.

Analytical parameters selected for monitoring should be based on the COCs that are predicted to most significantly impact the POE of the media being monitored. While it may be convenient to monitor for all COCs, indicator compounds can be identified to provide a cost-effective validation of the model. At a minimum, the parameters to be monitored should include:

- COCs that are expected to travel the fastest
- COCs that are expected to travel the longest distance, including degradation and transformation products
- COCs that have the greatest impact (risk) at the POE being evaluated (including cases where contaminants may migrate from one media to another, e.g., the POE is determined from a groundwater to surface water pathways

DQOs for the sample analysis should be established to ensure that adequate quantification is achieved so that potential and actual impacts can be determined with respect to the CAOs. Performance monitoring may include measuring COC concentrations in various media or measuring physical parameters, such as aquifer gradients.

The rationale for selecting where and how the performance monitoring should be conducted is based solely on demonstrating that the selected risk management activity

(a remedy or an engineered control) meets the design criteria and objectives. Monitoring should adhere to the following:

- performance should be monitored along the COC transport route from the source area to the POE
- performance should be monitored at vertical locations within a media column where a particular COC would most likely occur and at the POE
- multiple monitoring points should be used as necessary
- performance should be monitored at the areas where the remedy or engineered structure is subject to greatest stress
- performance monitoring criteria should be based on appropriate COCs and other analytical and physical measurements specific to the system being monitored
- monitoring frequency should allow adequate time for correcting potential problems and maintaining protectiveness at the POE
- monitoring intervals should provide adequate time to identify, design, and implement a response action that would ensure protectiveness in the event that performance monitoring indicates a system failure

An optimization of monitoring well systems may be necessary in order to ensure effective monitoring. The optimization program will also make sure that monitoring wells are screened in proper intervals for the detection of COCs.

Performance monitoring for a risk management activity should continue until residual COCs no longer pose unacceptable risks at the POE, and no potential exists for off-site migration of, or cross-media contamination from, residual COCs. Each situation should be verified by field studies and actual measurements, rather than predictive modeling.

6.2 PERIODIC PERFORMANCE REVIEWS

6.2.1 Summarizing the Effectiveness of the Risk Management Activity

Even when risk management activities have been implemented and it can be demonstrated that the performance standards have been achieved and are being maintained, a periodic review is critical to assess the overall performance of the remedy. In the CERCLA program, this type of review occurs at 5-year intervals. There is no specific time frame used for RCRA sites, but performance reviews should be based on the complexities of risk management activities at the site. A performance review might take place annually or every three years. In its simplest form, a periodic review can consist of monitoring data summaries accompanied by graphical and statistical analyses, if necessary, to demonstrate whether the implemented activities are consistently achieving and maintaining desired results. For complicated remedial and engineering projects, a more thorough evaluation of overall performance may be warranted.

Land Use Changes

If the land use should change so that the remedy does not address exposures to new receptors, the administrative authority performing oversight will need to re-issue the remedy decision document for public review and comment. The new remedy decision document will propose viable risk management activities for the new land use that will be protective of human health and the environment.

The performance review plan is also part of the final Risk Management Plan. It provides a clear decision logic that defines alternate contingency plans to implement when CAOs are not being met, and a phase-out of performance monitoring as risk is reduced.

For facilities that are relying on land use controls (i.e., institutional controls) to ensure that exposures are not incurred, the CAS recommends a review of the land use

control plan as part of the performance review to document the effectiveness and adequacy of land use controls. Changes in the land use after a risk management activity has been implemented can influence both the types of receptors affected and the location of their exposure, thus, the exposure scenario evaluated under the previous land use may not adequately characterize the site risks. The performance review is the mechanism in place that checks to make sure the land use at the time of the remedy selection remains unchanged over time. It also identifies changes in land use and the re-evaluates the impacts.

Only certain types of institutional controls have mechanisms for limiting land use changes (i.e., easements, zoning, use restrictions). Institutional controls lacking such mechanisms should have alternative mechanisms for monitoring and maintaining land use put into place. Although the CAS does not recommend specific mechanisms for maintaining and monitoring land use changes, land use monitoring is critical and should be maintained until a potential change in land use would no longer result in unacceptable risk at the POE.

6.2.2 Verification of Fate and Transport Models as part of Performance Reviews

The fate and transport of COCs in groundwater, surface water, and air should be monitored to demonstrate the validity and representativeness of the groundwater model if conducted as part of a site-specific risk assessment. This is particularly critical in demonstrating the protectiveness of the selected risk management activity if it includes monitored natural attenuation (MNA) for groundwater contamination or if the POE is at the facility boundary (i.e., where the groundwater under a facility is determined not to be a beneficial resource).

Monitoring should be conducted at locations that will validate the performance of the predictive model, and the values of key fate and transport parameters. The

verification monitoring location should be along the route that a COC would most likely follow when being transported between the source area and the POE based on the site-specific risk evaluation. Consideration also should be given to the vertical pathways of likely migration. For example, a monitoring well intended to validate the predicted migration of groundwater contamination should be screened in the zone where preferential migration would occur based on the physical and chemical properties of the COCs.

The monitoring frequency should allow adequate time for making adjustments to the risk management activity implemented. If fate and transport parameters must be revised based on the monitoring results, it may be necessary to re-evaluate the risk at the POE and to develop, design, and implement changes to the risk management activity to maintain protection of human health and the environment.

The duration of verification monitoring for fate and transport of selected COCs should be based on establishing a high degree of confidence that the modeled performance has been validated by field conditions (i.e., the COC concentrations predicted by the model are representative of what is actually happening at the site).

6.3 CONTINGENCY PLANS

The periodic performance review process includes a decision logic diagram illustrating additional risk management activities in the event the implemented action does not maintain the established CAOs. The facility has the ongoing responsibility for maintaining protectiveness (in case of remedy failure) and should be prepared to implement contingency plans, as appropriate. Contingency plans are part of the final Risk Management Plan that will be reviewed and approved by the administrative authority. It describes response actions to address any new release or poor performance of the selected risk management activity. Failure to achieve the CAOs will trigger implementation of a contingency plan to correct the course of the remedy or to

re-assess performance measures. Examples of contingency measures might include: 1) additional treatment/removal of source areas to further reduce contaminant concentrations in soil or groundwater, 2) installation of filtrations systems at points of exposure, 3) changes in monitoring requirements, 4) implementation of wellhead protection programs, 5) changes to systems to divert groundwater gradients (irrigation wells, or golf course watering systems), or 6) installation of cut-off trenches to intercept shallow groundwater flow.

GLOSSARY

Administrative Authority
The approved state program or EPA.

Beneficial Resource
Beneficial resource describes natural resources that are useful to human and ecological receptors. Individual states may establish statutes or regulations that identify certain environmental components, such as specific groundwater or surface water sources, as beneficial resources, and as such these beneficial resources may be entitled to greater protection from contamination.

Cancer Risk
EPA expresses cancer risk in terms of the likelihood that a person might develop cancer from exposure to contaminants from a facility. For example, a risk assessment might say that a receptor has an upper bound cancer risk of 1×10^{-4}. The numerical estimate means that if 10,000 people received this level of exposure averaged over a 70-year lifetime, no more than one would have a probability of developing cancer from exposure to contaminants from a facility.

Chemical of Concern (COC)
After the application of a risk-based priority screen described in Chapter 4, the contaminants of potential concern (COPCs) that pose a significant risk are then labeled as COCs. Some COPCs may drop out from further evaluation. The remaining lists of COPCs are COCs.

Chemicals of Potential Concern (COPC)
Chemicals from hazardous waste and hazardous constituents that are potentially site related and have data are of sufficient quality for use in the screen process (Chapter 4) or a site-specific risk assessment. The facility should compile a list of COPCs for each release based on existing sampling data, waste analysis reports, etc.

Conceptual Site Model (CSM)
The CSM is part of the data quality objective (DQO) process that presents a three-dimensional picture of site conditions at a discrete point in time that conveys what is known about the facility, releases, release mechanisms, contaminant fate and transport, exposure pathways, potential receptors, and risks. The information for the CSM is documented into six profiles (Chapter 3 and Appendix B). The CSM evolves as data gaps in the profiles become more complete, and will be refined based upon results of site characterization data. The final CSM is documented in the CAS Risk Management Plan.

Corrective Action
Corrective action is the process of identifying, evaluating, and, if necessary, remediation releases of hazardous constituents from waste management units and releases to ensure protection of human health and the environment. Corrective action requirements apply to all solid waste management units (SWMUs) at a facility need a permit under RCRA.

Corrective Action Objectives (CAOs)
Corrective action objectives are site-specific objectives that support the performance standards. They are medium-specific and must be linked to a metric (cleanup standard) in order to measure remedy performance.

Cross-Media Transfer
The movement of contaminants from one environmental medium to a different environmental medium (e.g., the movement of contaminants from soil to groundwater).

Data Quality Objective (DQO)
DQOs are qualitative and quantitative statements derived from the output of each step of the DQO process. DQOs are used in the CAS to help clarify performance standards. The facility will use the DQO process as a guide to ensure quality data and defensible risk decisions.

Data Quality Objective (DQO) Process
A series of planning steps based on the scientific method that are designed to ensure that the type, quantity, and quality of environmental data used in decision making is appropriate for the intended application. With the CAS, the DQO Process involves evaluation of available data, developing a conceptual site model, identifying problems to be solved, identifying data quantity and quality needs, and evaluating the data collection approach.

Ecological Exclusion Criteria Worksheet and Ecological Assessment Checklist (ECO Screen)
This is a tool to help facilities and the administrative authority determine if an ecological risk assessment is necessary for a site or portion of a site where corrective action is being pursued. The exclusion criteria refer to those conditions at an affected property which preclude the need for a formal ecological risk assessment because there are incomplete or insignificant ecological exposure pathways due to the nature of the affected property setting and/or the condition of the affected property media.

Engineering Controls
Physical structures designed and constructed (such as caps, horizontal or vertical barriers, and hydraulic controls) to prevent migration of COCs to locations where unacceptable exposure may occur, or prevent exposure to a COC.

Environmental Medium
All materials, such as surface and subsurface soil, sediment, groundwater, surface water, and air.

Exposure Pathway
The course a chemical or physical agent takes from a source to an exposed receptor. A unique mechanism by which an individual or population is exposed to chemical or physical agents at, or originating from, a site. Each exposure pathway (e.g. groundwater, soil vapor) includes a source or release from a source, an exposure point, and an exposure route. If the exposure point differs from the source, a transport/exposure medium (e.g., air) or media also is included.

Exposure Route
The way a chemical or physical agent comes in contact with a receptor (i.e., by ingestion, inhalation, dermal contact).

Exposure Scenario
The setting of potential exposure, as described by exposure pathways and routes, that affects a particular receptor.

Fate and Transport Modeling
The use of scientific models derived from mathematical formulas that simulate the movement and distribution of contaminants in environmental media over a given period of time.

Facility
For purposes of defining the unit requiring a permit, the definition of facility includes all contiguous land, and structures, other appurtenances, and improvements on the land, used for treating, storing, or disposing of hazardous waste. A facility may consist of several treatment, storage, or disposal operation units (e.g. one or more landfills, surface impoundments, or some combination thereof). For the purpose of implementing corrective action under CFR 264.101, it includes all contiguous property under the control of the owner or operator seeking a permit under subtitle C of RCRA. This definition also applies to facilities implementing corrective action under RCRA Section 3008(h).

Final Risk Goal
A risk-based performance standard. The final risk goal is based on site-specific factors, such as land use, special sub-populations, contaminant concentrations based on acceptable risk, location at which the levels are to be measured and achieved, and the remediation time frame. This performance standard can be proposed by the facility, but is established by the administrative authority following the scoping meeting. Once the final risk goal has been evaluated and established, it becomes the level of protectiveness to be achieved and maintained by the facility.

Hazard Index (HI)
Assess potential for toxicity following exposure to multiple contaminants. It is equal to the sum of the hazard quotients. However, where information is available to identify the critical toxic effect from non-carcinogens, only hazard quotients with associated similar critical effects (target organs) are combined.

Hazard Quotient (HQ)
EPA expresses non-cancer health risk as a ratio, known as the HQ, which is defined as the calculated exposure from a single contaminant in a single medium divided by a reference dose. The reference dose is the level of exposure that EPA believes will be without adverse effect in human populations, including sensitive individuals. Note that some contaminants (chemicals) may be associated with both carcinogenic and non-carcinogenic effects (such as kidney or liver disease).

Institutional Control
A non-engineering measures intended to influence human activities in such a way as to prevent or reduce exposure to hazardous wastes or hazardous constituents. The types of institutional controls include governmental controls (e.g. zoning, ordinances), proprietary controls (e.g. legal instruments placed in the chain of title for property), enforcement and permit tools with the proper components, and informational devices (e.g. state registries, deed notices). Institutional controls should be rigorously evaluated during the remedy selection process to determine their appropriateness, feasibility, and long-term effectiveness in protecting human health and the environment.

Interim Measures
Actions undertaken by a facility or administrative authority to prevent or mitigate exposure, or in some instances, the migration of contaminants from a release. Generally, interim measures can be stabilization measures implemented before formal remedy evaluation is complete and after sufficient information is available to indicate that unacceptable risks and hazards are present.

Performance Standard
Performance standards describe EPA's expectation for the outcome of corrective action at a facility; the performance standards are to be achieved and maintained in order to protect human health and the environment. The three performance standards in the CAS (i.e., source control, statutory/regulatory requirements, and final risk goal) combine existing policy and regulatory requirements with a risk-based goal for protectiveness. Under the CAS, the performance standards applicable to releases at a facility are established early in the corrective action process.

Point of Compliance (POC)
For RCRA-regulated units, the point of compliance is described as the location closest to the waste management area (which can be one or more SWMUs) where the cleanup standard must be met. For risk-based corrective action, the POC is the point at which the risk-based cleanup standard must be met. In groundwater corrective action, the POC is often described as the point at which the facility must meet MCLs – which may be at the facility boundary or at another defined point of exposure. In these cases, an ACL (or other risk-based number) is met at the closest location to the waste management area.

Point of Exposure (POE)
The location within an environmental medium where a receptor is assumed to have a reasonable potential to come into contact with the COCs. EPA expects at the POE that protection of human health and the environment will be achieved.

Profile
A particular aspect, or view, of the conceptual site model that facilitates understanding of site conditions. The CAS describes several potential profiles, including the facility profile, land use and exposure profile, ecological profile, physical profile, release profile, and risk management profile.

Release and Release Area
EPA has interpreted the term *release* to mean, "any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping or disposing into the environment" (50 FR 2873, July 15, 1985). This definition also includes abandoned or discarded barrels, containers, and other closed receptacles containing hazardous wastes or constituents. In the CAS, the term *release area* refers to areas of concern, SWMUs, or groups of SWMUs at a facility where there has been a release or there is a potential for a release of hazardous waste constituents to the environment.

Release Characterization
The collection of current information and possible additional sampling data to identify COPCs, and the evaluation of potential adverse effects. Sampling and analytical techniques should be selected based on the ability to obtain the necessary data to meet DQOs for each release.

Risk Management Plan
The report a facility uses to document the work performed and risk management activities to be implemented.

Site-Specific Risk Assessment
The site-specific risk assessment is a risk management tool that allows facilities to take a closer look at release areas that pose a significant risk after the application of a risk-based screen. The facility should consider evaluating receptors under a site-specific risk assessment in order to adequately characterize their exposures, when appropriate. Facilities are allowed to input site-specific data into fate and transport models to more accurately predict the concentration of contaminants at points of exposure to evaluate risk.

Solid Waste Management Unit
Any discernible unit at which solid wastes have been placed at any time, irrespective of whether the unit was intended for the management of solid or hazardous waste. Such units include any area at a facility at which solid wastes have been routinely and systematically released.

Source Material
Source material is defined as material that includes or contains hazardous wastes or hazardous constituents that act as a reservoir for migration of contamination to soil, to groundwater, to surface water, to air, or act as a source for direct exposure. Sources are not always stationary, but can migrate from a location like a landfill or surface impoundment where contamination originally was released. Contaminated groundwater plumes are generally not considered a source material, although non-aqueous phase liquids (NAPL) in the groundwater generally would be viewed as source material (*Rules of Thumb for Superfund Remedy Selection*, August 1997, EPA/540/R-97/013)