Louisiana Department of Environmental Quality

Risk Evaluation/ Corrective Action Program

(RECAP)

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Louisiana Department of Environmental Quality

Corrective Action Group

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Preamble

The Louisiana Department of Environmental Quality (LDEQ) has developed a Risk Evaluation/Corrective Action Program (RECAP) to address risks to human health and the environment posed by the release of chemical constituents to the environment. This is LDEQ's primary statutory mandate for remediation activities. It is clear in Louisiana's Environmental Quality Act that risk to human health and the environment must be evaluated in the remedial decision-making process.

RECAP uses risk evaluation to: (1) determine if corrective action is necessary for the protection of human health and the environment, and (2) identify constituent levels in impacted media that do not pose unacceptable risks to human health or the environment, i.e., RECAP Standards.

RECAP consists of a tiered framework composed of a Screening Option and three Management Options. This tiered approach allows site evaluation and corrective action efforts to be tailored to site conditions and risks. As the Management Option level increases, the approach becomes more site-specific and, hence, the level of effort required to meet the objectives of the Option increases. Although the level of effort required for each Option varies, each Option achieves a common goal: protection of human health and the environment.

There are numerous reasons for establishing RECAP; chief among them is the necessity to ensure that risks are properly evaluated to protect human health and the environment. Absent the establishment of such a program, the Department will expend considerably more resources to ensure that risk is evaluated properly, the regulated community will not have a clear understanding of the Department's requirements, and the general public will be uncertain as to the criteria used by the Department for remedial decisions.

In addition, LDEQ finds it necessary to establish clear and consistent guidelines across media-based program lines for the remediation of releases to air, land, and water. RECAP will ensure that remediation standards are developed consistently, that all parties are treated equally, and that risk to human health and the environment is the primary consideration when remedial decisions are made.

RECAP is consistent with the Environmental Protection Agency's (EPA) guidance on risk assessment. However, RECAP establishes policy decisions for the State of Louisiana that are left open to interpretation in EPA guidance. These policy issues include appropriate risk level, exposure concentration, groundwater use, land use, points of exposure, and points of compliance. The written establishment of the Department's position on these issues will reduce transaction costs, not only for the regulated community, but also the Department. In addition, by clearly establishing the submittal requirements for a risk evaluation, LDEQ will be able to ensure that all documents received contain the information required for remedial decision making. The RECAP regulation serves as LDEQ's policy statement on the performance of risk evaluations to determine if corrective action is warranted and the level of remediation required.

Without the RECAP regulation, risk evaluation would not be performed consistently in Louisiana.

The Louisiana Legislature mandated in La. R.S. 30:2272 (Act 1092 of the 1995 Regular Session) that LDEQ develop Minimum Remediation Standards. The RECAP regulation is the Department's response to that mandate. RECAP's tiered approach to risk evaluation and corrective action establishes not only across the board numerical standards for most media, but also allows for the development of more site-specific numerical standards when warranted.

The difficulty in identifying appropriate remedial criteria has been an additional driving force behind the development of this program. Often, regardless of the resources spent, remediating to pristine conditions has been unachievable and risk is not reduced. The time and effort expended in making these sometimes futile efforts can be better spent on projects that provide greater reduction in risk to human health and the environment. RECAP regulation will assist the Department in prioritizing sites that require remediation. As a result, LDEQ remediation staff will better focus their efforts on sites posing the greatest risk.

The RECAP regulation was initially promulgated on December 20, 1998. The regulation was revised through rulemaking in June 2000. This is the third revision of RECAP. It is expected that the RECAP regulation will be revised through rulemaking on an as-needed basis to incorporate changes in the science of risk evaluation and revisions to toxicological data. Such revisions will also allow the Department to modify the regulation based on its work experience.

Additional regulations regarding issues such as scope and applicability of the RECAP regulation may be found in LAC 33:I.Chapter 13. We also encourage the use of our RECAP web site located at www.deq.state.la.us/technology/recap/ to assist you in the interpretation and application of the regulation. Technical questions regarding the RECAP regulation should be directed to LDEQ's Office of Environmental Assessment at (225) 219-3236 or may be directed to contact persons listed on our RECAP web site via email or telephone.

All requests for copies of this document should be directed to the Regulation Development Section (RDS) of the LDEQ. The RDS may be contacted as follows:

Office of Environmental Assessment
Environmental Planning Division
Regulation Development Section
Post Office Box 4314
Baton Rouge, Louisiana 70821-4314
(225) 219-3550

The document is also available on the Internet on LDEQ's home page at:

http://www.deq.state.la.us/technology/recap/

Thank you for your interest in LDEQ's Risk Evaluation/Corrective Action Program.

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1.0 INTRODUCTION

This document presents the LDEQ Risk Evaluation/Corrective Action Program (RECAP) for addressing present and past uncontrolled constituent releases. It does not replace or supersede the Department's enforcement or permitting authority, notification requirements, or other applicable regulations. It does not replace or supersede the Hazardous and Solid Waste Amendments (HSWA) reporting requirements pertaining to newly discovered hazardous waste, hazardous constituents, or releases from Solid Waste Management Units at sites regulated under the Resource Conservation and Recovery Act (RCRA). It does not replace or supersede the Louisiana Department of Health and Hospitals, Office of Public Health's (LDHH/OPH) enforcement authority or evaluation of environmental situations where public health may be at risk. When warranted, the LDEQ, LDHH/OPH, and/or other appropriate state or federal agencies will work together to arrive at risk management decisions that are protective of human health and the environment. When warranted for the implementation of the Voluntary Cleanup Program, a partial remedial action plan may be approved in accordance with La.R.S.30:2286. This program does not preclude emergency response or interim measures necessary to protect human health and the environment and/or to prevent significant migration of constituents. It does not authorize any injury to private or public property (refer to Section 2.20) or any invasion of personal rights, nor any infringement of federal, state, or local laws or regulations, and does not authorize the migration of COC offsite to adjacent property. It is the responsibility of the Submitter to ensure that all exposure conditions and risks to human health and the environment are addressed and that decisions concerning management of the release site are protective of human health and the environment. The RECAP is designed for the management of typical chemical release sites. Variance from the requirements set forth in this program may be required/granted if deemed necessary by the LDEQ to prevent risks to human health or the environment posed by unique site conditions. The RECAP regulation is revised through rulemaking on an as-needed basis to incorporate recent advances in environmental science and to improve the overall effectiveness of the program based on past implementation experiences of the Department and regulated community. It will be necessary for releases currently being regulated under RECAP (June 20, 2000) to transition to compliance with RECAP (2003). Unless otherwise approved by the Department, an Area of Concern (AOC) currently being regulated under RECAP (June 20, 2000) may continue to comply with RECAP (June 20, 2000) until the current task/phase of the assessment has been completed and approved by the Department. Further assessment of the AOC shall be conducted in accordance with the requirements set forth in RECAP (2003) unless otherwise approved by the Department to be conducted in accordance with a prior promulgated version of RECAP.

1.1 Overview of LDEQ's Risk Evaluation/Corrective Action Program

The LDEQ RECAP consists of a tiered framework comprised of a Screening Option (SO) and three Management Options (MO) (Figure 1). The SO may be used to: (1) manage an AOC expeditiously; or (2) determine if an AOC warrants further evaluation under the

RECAP and, if warranted, to identify the Area of Investigation (AOI) and the Constituent(s) of Concern (COC) for evaluation under the RECAP. The tiered Management Options allow site evaluation and corrective action efforts to be tailored to site conditions and risks. As the MO level increases, the approach becomes more site-specific and hence, the level of effort required to meet the objectives of the Option increases. Although the level of effort required for each Option varies, each Option achieves a common goal: protection of human health and the environment. The goal of RECAP is to reduce risks to human health and the environment associated with constituents present at or migrating from a current or historical uncontrolled release to acceptable levels (i.e., insignificant) as defined by EPA guidance. The provisions of each Option are briefly described below.

1.1.1 Screening Option

The Screening Option provides Department-derived Screening Standards (SS) for soil and groundwater for non-industrial (residential) and industrial land use scenarios. The SS represent constituent concentrations in media that are protective of human health and the environment. The SS may be used to: (1) demonstrate an AOC does not pose a threat to human health or the environment and, hence, does not require further action at this time; (2) identify the AOI and COC for management of an AOC under the SO; or (3) determine if an AOC warrants further evaluation under RECAP, and if further evaluation is warranted to identify the AOI and COC in accordance with Section 2.6. To screen an AOC, the maximum concentration detected for each constituent in soil and groundwater shall be compared to the limiting SS. The maximum concentration used in the screening process shall be representative of the most heavily impacted area(s) known or suspected to be present within the AOC. Identification of the most heavily impacted area(s) is subject to concurrence by the Department. If the maximum constituent concentration(s) detected at the AOC is less than or equal to the limiting SS, then typically, no further action at this time (NFA-ATT) is required. The screening step may be used to expeditiously document that an AOC does not pose a threat to human health or the environment and that it does not warrant further evaluation/action. The SS may also be used to screen out areas of a facility, media, or COC that do not warrant further evaluation so that the scope of the RECAP evaluation can be limited to those areas/media/constituents most likely to be of concern. If the maximum constituent concentration(s) detected in soil and/or groundwater at the AOC exceeds the SS, then: (1) the AOI shall be managed under the SO; or (2) the AOI shall be evaluated under MO-1, MO-2, or MO-3.

1.1.2 Management Option 1

Management Option 1 (MO-1) provides Department-derived RECAP Standards (RS) for soil and groundwater. The MO-1 RS represent constituent concentrations in media that are protective of human health and the environment. The MO-1 RS were derived for non-industrial (residential) and industrial land use scenarios using currently recommended default exposure parameters and toxicity criteria issued by the EPA. Management Option 1 may be used to: (1) document that an AOI does not pose a threat

to human health or the environment and hence, does not warrant further action at this time; (2) expeditiously manage an AOI defined by the presence of low constituent concentrations and standard exposure conditions; and/or (3) identify areas of a facility, media, or COC that warrant further evaluation so that the scope of the Management Option 2 (MO-2) or Management Option 3 (MO-3) evaluation can be limited to those areas/media/constituents most likely to pose risk. The soil AOI concentration (AOIC) and/or groundwater compliance concentration (CC) shall be compared to the MO-1 limiting RS. If the soil AOIC and groundwater CC for all COC are less than or equal to MO-1 limiting RS, then typically, NFA-ATT is required for soil or groundwater. If a constituent-specific soil AOIC or groundwater CC exceeds a MO-1 limiting RS, then the Submitter may: (1) remediate to the MO-1 limiting RS and comply with closure and/or post-closure requirements for MO-1; or (2) proceed with a MO-2 or MO-3 evaluation. The Submitter may elect to skip MO-1 and proceed directly to MO-2 or MO-3. If soil and/or groundwater do not meet the criteria for management under MO-1, the Submitter shall address these media under MO-2 or MO-3.

1.1.3 Management Option 2

Management Option 2 provides for the development of soil and groundwater RS using site-specific data with specified analytical models to evaluate constituent fate and transport at the AOI. The results of this site-specific evaluation shall be used in conjunction with currently recommended default exposure assumptions and toxicity criteria to identify site-specific MO-2 RS. The MO-2 RS represent constituent concentrations in media that are protective of human health and the environment under site-specific conditions. The soil AOIC and/or groundwater CC shall be compared to the site-specific MO-2 limiting RS. If the soil AOIC and groundwater CC for all COC are less than or equal to the site-specific MO-2 limiting RS, then typically, NFA-ATT is required for soil or groundwater. If a constituent-specific soil AOIC or groundwater CC exceeds a MO-2 limiting RS, the Submitter may: (1) remediate to the MO-2 limiting RS and comply with closure requirements for MO-2 (and post-closure requirements if warranted); or (2) proceed with a MO-3 evaluation. The Submitter may elect to skip MO-2 and proceed directly to MO-3. If soil or groundwater does not meet the criteria for management under MO-2, the Submitter shall address these media under MO-3.

1.1.4 Management Option 3

Management Option 3 provides for the development of site-specific RS for all impacted media using site-specific exposure and environmental fate and transport data. The site-specific MO-3 limiting RS represent constituent concentrations in media that are protective of human health and the environment under site-specific conditions. The AOIC and/or groundwater CC shall be compared to the site-specific MO-3 RS. If the AOIC and groundwater CC detected at the AOI are less than or equal to the MO-3 limiting RS, then typically, NFA-ATT is required. If a constituent-specific AOIC or groundwater CC for a COC exceeds a MO-3 limiting RS, then: (1) the AOI shall be remediated to the MO-3 RS; (2) confirmatory sampling shall be conducted; and (3) closure and/or post-closure requirements shall be met. In general, MO-3 requires

additional site evaluation, a more extensive exposure assessment, and the application of more sophisticated fate and transport models. However, it should be noted that the complexity and scope of MO-3 are dictated by the complexity of the AOI conditions and exposure scenarios.

The Submitter may choose which Option (SO, MO-1, MO-2, or MO-3) an AOC or an AOI is managed under as long as the conditions of the AOC or the AOI meet the criteria for the Option chosen. Non-contiguous AOI at a facility may be managed under different Options. For example, MO-1 may be used to manage areas of a facility that are minimally impacted while MO-2 or MO-3 may be used to manage the more heavily impacted areas. Different media within an AOI may also be managed under different Options. For example: (1) heavily impacted soils may be managed under MO-2 or MO-3, while minimally impacted groundwater may be managed under MO-1; and (2) surface soil may be managed under MO-1, while soil impacted with a volatile COC located beneath an enclosed structure may be managed under MO-2 or MO-3. Different COC within a medium may also be managed under different Options.

An overview of the LDEQ RECAP framework is illustrated in Figure 1. The relationship between the SS, MO-1 RS, MO-2 RS, and MO-3 RS is illustrated in Figure 2. Each of the Options is discussed in detail in the following sections.

1.2 Use of LDEQ's Risk Evaluation/Corrective Action Program

The LDEQ RECAP may be used by a Submitter as discussed in the following sections.

1.2.1 A Submitter Seeking a No Further Action At This Time Determination for an AOC or an AOI

Under the RECAP, a NFA-ATT determination may be granted at a site where: (1) the source of the release has been removed or mitigated; (2) it has been adequately demonstrated that the site does not pose a risk to human health or the environment, (i.e., AOIC and CC present at the site are less than or equal to the limiting SS, MO-1 RS, MO-2 RS, or MO-3 RS); (3) the property remains suitable for commerce and residual constituent concentrations are appropriate for the intended future use of the land; and (4) sufficient financial assurance and/or financial commitment is provided when deemed appropriate by the Department under MO-3.

1.2.2 A Submitter Seeking a Certification of Completion Under R.S. 30:2287.1 for an AOI

The Secretary shall certify completion of remedial actions taken under a voluntary remedial action plan, which has been approved under La. R.S. 30:2286 (and regulations promulgated pursuant thereto), when the Submitter has adequately demonstrated that the site does not pose a risk to human health or the environment for the proposed development/use of the land (i.e., constituent concentrations present at the AOI are less

than or equal to the limiting SS, MO-1 RS, MO-2 RS, or MO-3 RS which constitute the minimum remediation standards under R.S. 30:2272.1).

1.2.3 A Submitter Seeking Approval of a Corrective Action Plan for an AOI

Where it is warranted that risks to human health and the environment be evaluated, a site seeking approval of a corrective action plan (CAP) may use the RECAP to demonstrate that the corrective measures proposed at the AOI: (1) are adequate to protect human health and the environment (i.e., constituent concentrations reaching potential receptors and receiving media are less than or equal to the limiting SS, MO-1 RS, MO-2 RS, or MO-3 RS); and (2) will achieve acceptable constituent concentrations in a timeframe that is acceptable to the Department. Financial assurance and/or financial commitment shall be provided by the Submitter as deemed appropriate by the Department under MO-3.

1.2.4 A Submitter Seeking Approval of a Closure Plan for a Waste Management Unit for an AOI

RECAP may be used to support a closure plan for a Waste Management Unit where: (1) all applicable regulations are being addressed in the closure plan; and (2) it is warranted that risks to human health and the environment be evaluated. When deemed appropriate by the Department, a site seeking approval of a closure plan for a Waste Management Unit may use the RECAP in conjunction with applicable regulations to demonstrate that: (1) the proposed corrective measures are adequate to prevent a constituent from reaching potential receptors and/or receiving media at concentrations that are greater than the limiting SS, MO-1 RS, MO-2 RS, or MO-3 RS; and/or (2) residual constituent concentrations at or migrating from the site are less than or equal to the limiting SS, MO-1 RS, MO-2 RS, or MO-3 RS. Financial assurance and/or financial commitment shall be provided when deemed appropriate by the Department under MO-3. Clean closure of a Waste Management Unit (as defined in *Risk-Based Clean Closure*, EPA 1998) may be accomplished if: (1) all waste, waste residues, and containment system components have been removed from the Waste Management Unit; (2) the residual constituent concentrations in environmental media are less than or equal to the applicable SS, MO-1 RS, MO-2 RS, or MO-3 RS; and (3) the residual constituent concentrations in environmental media do not pose an unacceptable risk to ecological receptors.

1.3 Document Organization

Section 2.0, General Guidelines defines the terms used within the Program and provides guidance for key components of the Program including a site ranking system, site evaluation requirements, data quality assurance/quality control requirements, data evaluation and data usability, identification of the AOI and the COC, exposure assessment, estimation of the AOIC and groundwater CC, land use definitions, groundwater/aquifer use classifications, point of exposure/point of compliance for groundwater, descriptions of the Screening Standards and RECAP Standards, monitored natural attenuation, identification of background concentrations, acceptable risk levels, identification of toxicity values, institutional controls, self-implementation,

demonstration of compliance with RS, and notification requirements. These guidelines apply to the management of sites under all of the Options.

Section 3.0, Screening Option presents an overview of the screening process; a listing of data requirements for the SO, criteria for the management of soil and groundwater under the SO, and guidelines on the identification and application of the SS; and the submittal requirements for the Screening Option.

Section 4.0, Management Option 1 presents an overview of MO-1; a listing of data requirements for MO-1 and the criteria for the management of soil and groundwater under MO-1; guidance on the use of the MO-1 RS as action standards and corrective action standards; and the MO-1 submittal requirements.

Section 5.0, Management Option 2 presents an overview of MO-2; a listing of data requirements for MO-2 and the criteria for management of soil and groundwater under MO-2; guidance on the use of the MO-2 RS as action standards and corrective action standards; and the MO-2 submittal requirements.

Section 6.0, Management Option 3 presents an overview of MO-3. It includes a listing of the data requirements for MO-3 and the criteria for management of an AOI under MO-3; guidance on the development of a workplan; guidance on conducting a site-specific exposure assessment for the development of MO-3 RS; guidance on the application of MO-3 RS; guidance on the identification of alternate RS when it is technically/economically not feasible to meet MO-3 risk-based RECAP Standards; and submittal requirements for MO-3.

Section 7.0, Ecological Risk Assessment provides guidance on conducting ecological risk assessments under the RECAP.

Section 8.0, Soil Re-Use Under the LDEQ RECAP addresses issues related to the re-use of soil under the RECAP. Guidelines for the re-use of soil on-site and off-site are presented.

Appendix A, Site Ranking Example presents an example for ranking a site for the RECAP.

Appendix B, RECAP Site Investigation Requirements presents the site investigation requirements for the RECAP.

Appendix C, RECAP Forms contains Submittal Summary (RECAP Form 1), Analytical Data Summary (RECAP Form 2), Analytical Data Evaluation (RECAP Form 3), Sampling Information Summary (RECAP Form 4), Groundwater Monitoring Well Characteristics (RECAP Form 5), Groundwater Monitoring Well Sampling Event Summary (RECAP Form 6), Site-Specific Environmental Fate and Transport Data Summary (RECAP Form 7), Chemical-Specific Data Summary (Form 8), Management Option 3 Site-Specific Exposure Data Summary (Form 9), Screening Option Summary for Soil (RECAP Form 10), Management Option 1 Summary for Soil 0-15 ft bgs

(RECAP Form 11), Management Option 1 Summary for Soil >15 ft bgs (RECAP Form 12), Management Option 2 or 3 Summary for Soil 0-15 ft bgs (RECAP Form 13), Management Option 2 or 3 Summary for Soil >15 ft bgs (RECAP Form 14), Screening Option Summary for Groundwater (RECAP Form 15), Management Option 1 Summary for Groundwater (RECAP Form 16), Management Option 2 or 3 Summary for Groundwater (RECAP Form 17), and Ecological Checklist (RECAP Form 18).

Appendix D, Guidelines for Assessing: Petroleum Hydrocarbons, Polycyclic Aromatic Hydrocarbons, Lead, Polychlorinated Dibenzodoxins and Polychlorinated Dibenzofurans, and Non-Traditional and Parameters contains guidance on addressing Total Petroleum Hydrocarbons (TPH), Polycyclic Aromatic Hydrocarbons (PAH), lead, Polychlorinated Dibenzodioxins (PCDD) and Polychlorinated dibenzofurans (PCDF), and non-traditional constituents and parameters under the RECAP.

Appendix E, North American Industry Classification System presents the North American Industry Classification codes used in defining industrial and non-industrial land use under the RECAP.

Appendix F, Aquifer Tests presents methods for measuring or estimating maximum sustainable yield for aquifers under investigation.

Appendix G, Guidelines for Addressing Additive Health Effects Under the RECAP contains methods for addressing exposure to multiple constituents that elicit the same noncarcinogenic critical effects or affect the same target organ/system and includes a listing of the target organs/critical effects for the constituents presented in Tables 2 and 3.

Appendix H, Methods for the Development, Identification, and Application of Screening Standards and MO-1, MO-2, and MO-3 RECAP Standards presents the methods and assumptions for the development of the SS MO-1 RS, MO-2 RS, and MO-3 RS and guidelines for the identification and application of these Standards at the AOI.

Appendix I, A Site-Specific RECAP Evaluation for Typical UST Sites presents a site-specific RECAP evaluation for UST sites. It includes discussions on the types of sites that qualify for management under Appendix I; the identification and application of Appendix I RS; and Appendix I submittal requirements.

2.0 GENERAL GUIDELINES

This section includes RECAP terminology and provides guidance for key components of the RECAP. This guidance is applicable to the management of sites under the Screening Option and RECAP Management Options 1, 2, and 3.

2.1 Program Terminology

This section includes descriptions of terms that are **specific** to the RECAP.

10^{-6} - 10^{-6} is a shorthand description for an incremental or excess lifetime cancer risk of 0.000001 in 1 (i.e., 1 chance in a 1,000,000).

10^{-5} - 10^{-5} is a shorthand description for an incremental or excess lifetime cancer risk of 0.00001 in 1 (i.e., 1 chance in a 100,000).

10^{-4} - 10^{-4} is a shorthand description for an incremental or excess lifetime cancer risk of 0.0001 in 1 (i.e., 1 chance in a 10,000).

95 percent upper confidence limit - the upper limit of a 95 percent confidence interval for the mean; there is only a 5 percent probability that the true mean is greater than this value.

95%UCL-AM – **95** percent **u**pper **c**onfidence **l**imit on the **a**rithmetic **m**ean.

Acceptable risk - a cancer risk of 10^{-6} or less for the Screening Option, Management Option 1, and Management Option 2; a cancer risk less than or within the range of 10^{-6} to 10^{-4} for Management Option 3; a Hazard Index less than or equal to 0.1 for the Screening Option; a Hazard Index less than or equal to 1.0 for Management Option 1, Management Option 2, and Management Option 3 (refer to Section 2.14).

Action standard - the concentration of a specific COC that is defined as acceptable; COC concentrations less than or equal to the action standard do not typically require further action, COC concentrations above the action standard typically warrant further evaluation.

Acute - refers to an exposure of short duration, often refers to a single exposure event.

Additivity - the assumption that doses received from simultaneous exposure to several constituents from a variety of sources by more than one exposure pathway are additive. For carcinogens, simple dose additivity is assumed. For noncarcinogens, it is assumed that simultaneous subthreshold exposures to several constituents that elicit the same critical effect or affect the same target organ/system could result in an adverse health effect.

AOC - **a**rea **o**f **c**oncern.

AOI - **a**rea **o**f **i**nvestigation.

AOIC – **a**rea **o**f **i**nvestigation **c**oncentration.

Applicable or Relevant and Appropriate Requirements (ARAR) - applicable requirements are those clean-up standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a site. Relevant and appropriate requirements are those clean-up standards which, while not applicable, at a site, address problems or situations sufficiently similar to those encountered at the site that their use is well-suited to the particular site. ARAR can be action-specific, location-specific, or constituent-specific. Examples of ARAR that may be considered acceptable for use under the RECAP include a Safe Drinking Water Act maximum contaminant level (MCL), maximum contaminant level goal (MCLG), and secondary drinking water standard; a federal ambient water quality criterion; a national ambient air quality standard (NAAQS); a Louisiana Water Quality Standard; and a Louisiana Air Quality Standard. The use of an ARAR under the RECAP is subject to Department approval.

Aquifer - a geologic formation, group of formations, or part of a formation capable of yielding a significant amount of groundwater to wells or springs (LAC 33:V.109).

ARAR - **A**pplicable or **R**elevant and **A**ppropriate **R**equirements.

Area of concern (AOC) - an area where constituents have been released to the environment or a waste management unit.

Area of investigation (AOI) - a zone contiguous to and including impacted media defined vertically and horizontally by the presence of one or more constituents in concentrations exceeding the limiting SS, MO-1 RS, or MO-2 RS (depending on the Option being implemented).

Area of investigation concentration (AOIC) – (1) the concentration of the COC in the environmental or biological medium to which the receptor is exposed or may be exposed in the future; and/or (2) the concentration of the COC in an environmental medium that may serve as a source for constituent transport and/or transfer to another environmental medium (refer to Section 2.8).

Background concentration - concentration of constituents present in the environment that are distinguishable from an identifiable source concentration (refer to Section 2.13).

BCF - **b**io**c**oncentration **f**actor.

bgs - **b**elow **g**round **s**urface.

Bioconcentration factor (BCF) - a measure or an estimate of the extent of constituent partitioning at equilibrium between a biological medium such as fish tissue or plant tissue

and an external medium such as water. The higher the BCF, the greater the accumulation of a constituent in living tissue is likely to be.

Biota - animals and plants likely to be consumed by humans.

C_a – acceptable constituent concentration in air for the evaluation of the vapor emissions from soil to an enclosed structure pathway, the vapor emissions from groundwater to an enclosed structure pathway, and the vapor emissions from groundwater to ambient air pathway.

C_{ai} – acceptable constituent concentration in air for the evaluation of the vapor emissions from soil to an enclosed structure pathway, the vapor emissions from groundwater to an enclosed structure pathway, and the vapor emissions from groundwater to ambient air pathway for industrial/commercial land use.

C_{ani} – acceptable constituent concentration in air for the evaluation of the vapor emissions from soil to an enclosed structure pathway, the vapor emissions from groundwater to an enclosed structure pathway, and the vapor emissions from groundwater to ambient air pathway for non-industrial land use.

Cancer risk - the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen.

CAP - **C**orrective **A**ction **P**lan.

Carcinogen - a cancer-causing agent; see EPA's Weight-of-Evidence Classification System.

CC – **c**ompliance **c**oncentration.

Chronic - pertaining to an exposure duration of seven years to a lifetime (70 years).

Closure - the act of securing and rendering harmless a site that has been used to store, treat, or dispose of a hazardous or solid waste so that it will pose no significant threat to human health or the environment.

CLP - **C**ontract **L**aboratory **P**rogram.

COC - **C**onstituent(s) **o**f **C**oncern.

Compliance concentration (CC) - the COC concentration detected in groundwater at the point of compliance.

Conceptual site model (CSM) - a model of the site used to identify all potential or suspected sources of constituents, types and concentrations of COC detected at the site, potentially impacted media, and potential exposure pathways and receptors.

Constituents of concern (COC) - solid waste and hazardous waste, as defined in LAC 33:V.109; industrial solid waste as defined in LAC 33:VII.115; hazardous substance, as defined in La. R.S. 30:2272; regulated substance, as defined in LAC 33:XI.103; pollutant as defined in La. R.S. 30:2004; wastes as defined in La. R.S. 30:2073; and pollutant, priority pollutant, and toxic substances, as defined in LAC 33: IX.107.

Corrective action - activities conducted to protect human health and the environment.

Corrective action standard - term used within the meaning of the RECAP to prescribe concentrations of constituents in soil and groundwater above which remedial action shall take place or the concentrations to which impacted media shall be remedied.

Critical effect - the most sensitive health effect (the health effect observed at the Lowest Observable Adverse Effect Level) associated with exposure to the constituent of concern. The critical effect that serves as the basis of the RfD or RfC is the critical effect that should be identified for the purpose of adjusting RS to account for additive noncarcinogenic health effects.

CSM - **c**onceptual **s**ite **m**odel.

Cumulative risks - total cancer risks associated with exposure to multiple constituents and/or via multiple exposure pathways/media.

DAF - **d**ilution and **a**ttenuation **f**actor.

DAF2 – a MO-2 site-specific dilution and attenuation factor representative of the natural dilution and attenuation of constituent concentrations from the point of compliance to the point of exposure (nearest downgradient property boundary) (refer to Section 2.11 for guidance on establishing the POC and POE); applicable to $Soil_{GW2}$ and GW_2.

DAF3 – a MO-2 site-specific dilution and attenuation factor representative of natural dilution and attenuation of constituent concentrations from the point of compliance to the point of exposure (nearest downgradient surface water body) (refer to Section 2.11 for guidance on establishing the POC and POE); applicable to $Soil_{GW3}$ and GW_3.

Data evaluation - the assessment of the effect of quality control issues on data usability for risk assessment purposes.

Data quality objectives (DQO) - qualitative and quantitative statements established prior to data collection which specify the quality of data required to support decisions during remedial response activities.

Data validation - the evaluation of data generated in accordance with EPA's Contract Laboratory Program Statement of Work for organics and inorganics. The evaluation is conducted in accordance with EPA's laboratory data validation functional guidelines for organic and inorganic analyses and includes the identification of deviations from the Statement Of Work (SOW), poor Quality Control (QC) results, matrix interferences, and

other analytical problems that compromise the potential uses of the data. In the validation process, data may be flagged with qualifiers to alert data users of deviations from QC requirements.

Detection limit (DL) - the lowest amount of a constituent that can be seen above the normal noise of an analytical instrument or method.

DF - **d**ilution **f**actor.

DF2 - a MO-1 default dilution factor representative of natural dilution of constituent concentrations from the point of compliance to the point of exposure (nearest downgradient property boundary) (refer to Section 2.11 for guidance on establishing the POC and POE); applicable to $Soil_{GW2}$ and GW_2.

DF3 - a MO-1 default dilution factor representative of natural dilution of constituent concentrations from the point of compliance to the point of exposure (nearest downgradient surface water body) (refer to Section 2.11 for guidance on establishing the POC and POE); applicable to $Soil_{GW3}$ and GW_3.

Dilution and attenuation factor (DAF) - the ratio of the concentration of a constituent (dissolved in water or contained in soil) to the concentration of the same constituent after natural attenuation has occurred.

Dilution factor (DF) - the ratio of the concentration of a COC dissolved in water to the concentration of the same constituent after mixing with constituent free water or less concentrated constituent laden water. The measurements of concentrations usually occur at two different spatial points (e.g., at the POC and at the POE).

Dose - the mass of a chemical substance to which a receptor is exposed [i.e., in contact with an exchange boundary per unit body weight per unit time (mg/kg-day)].

DOTD - **L**ouisiana **D**epartment of **T**ransportation and **D**evelopment.

Downgradient - in the direction of groundwater flow. Groundwater flow is from areas of high hydraulic head to areas of low hydraulic head.

DQO - **D**ata **Q**uality **O**bjectives.

Ecological risk assessment - an assessment that evaluates the likelihood that adverse ecological effects may occur or are occurring as a result of exposure to one or more stressors. It is a process for organizing and analyzing data, information, assumptions, and uncertainties to evaluate the likelihood of adverse ecological effects.

Enclosed structure - an occupied (or potentially occupied) [i.e., one or more receptors spend a significant portion of the day (or workday) within the enclosed structure] structure on a slab foundation that has a roof and walls on all sides which prevent the free exchange of indoor air with outdoor (ambient) air.

Exposure - contact of an organism with a COC (chemical, metal etc.).

Exposure assessment - an appraisal of the magnitude of actual and/or potential human exposures, the frequency and duration of these exposures, and the pathways by which humans are potentially exposed.

Exposure medium - any environmental medium that may serve as a source of exposure of human or ecological receptors to one or more constituents of concern via current and/or future exposure pathways.

Exposure parameters - variables used in the calculation of intake (e.g., exposure duration, inhalation rate, body weight).

Exposure pathway - the course a constituent or physical agent takes from a source to an exposed organism. An exposure pathway describes a unique mechanism by which an individual or population is exposed to constituents or physical agents at or originating from a site. Each exposure pathway 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 (in cases of intermedia transfer) also is included.

Exposure point - a location of actual or potential contact between an organism and a constituent or physical agent.

Exposure route - the way a constituent or physical agent comes in contact with an organism (e.g., by ingestion, inhalation, and/or dermal contact).

Facility - all contiguous land and structures, other appurtenances, and improvements on the land used for the processing, treating, storing, or disposing of COC. A facility may consist of one or more treatment, storage, disposal operational units (e.g., one or more landfills, surface impoundments, etc.), and areas of investigation or sites.

f_{oc} - **f**ractional **o**rganic **c**arbon in soil or sediment.

Groundwater - water located beneath the ground surface or below a surface water body in a saturated zone or stratum.

Groundwater Classification 1 - ***Class 1A***: Groundwater within an aquifer or that has a direct hydraulic connection to an aquifer that currently supplies drinking water to a public water supply. A public water supply is defined as a water supply which provides water to the public and has a minimum of 15 service connections or regularly serves a minimum of 25 individuals daily at least 60 days out of the year (State of Louisiana Sanitary Code); or **Class 1B**: Groundwater within an aquifer that could potentially supply drinking water to a public water supply. The aquifer should be sufficiently permeable to transmit water to a well at a maximum sustainable yield of greater than or equal to 4,800 gallons per day (gpd) (6 households x 4 persons per household x 100 gpd x peaking factor of 2); **and** groundwater quality is such that it has a TDS concentration

less than or equal to 1,000 milligrams per liter (mg/l). **NOTE:** (1) An aquifer meeting the Groundwater Classification 1 criteria is considered an underground source of drinking water and shall be protected or restored to its maximum beneficial use (residential use). (2) A water supply that serves greater than six households is considered to be a public water supply as it is assumed that the average household has four occupants. Each person in the household is considered to use 100 gallons of water per day (Louisiana Department of Health and Hospitals). To ensure that water is available on an as-needed basis, a peaking factor of two has been applied to the daily water consumption rate. Therefore, a value of 4,800 gpd has been established as the minimum sustainable yield for a potential public water supply. Refer to Figure 3 for an illustration of the groundwater classifications.

Groundwater Classification 2 - ***Class 2A***: Groundwater within an aquifer that currently supplies water to a domestic water supply, agricultural supply, or any other supply. A domestic water supply is defined as one which provides water to an individual household or households but is not considered to be a public water supply as defined in Groundwater Classification 1; or ***Class 2B***: Groundwater within an aquifer that could potentially supply drinking water to a domestic water supply. The aquifer should be sufficiently permeable to transmit water to a well at a maximum sustainable yield of greater than or equal to 800 gpd and less than 4,800 gpd (4 persons per household x 100 gpd x peaking factor of 2); **and** groundwater quality is such that it has a TDS concentration less than or equal to 1,000 mg/l; or ***Class 2C***: Groundwater within an aquifer that could potentially supply drinking water to a domestic water supply. The aquifer should be sufficiently permeable to transmit water to a well at a maximum sustainable yield of greater than or equal to 800 gpd; **and** groundwater quality is such that it has a TDS concentration greater than 1,000 mg/l and less than or equal to 10,000 mg/l. **NOTE:** (1) If a public water supply well is located within one mile of the site property boundaries and is screened in the same stratum as the aquifer of concern or has a direct hydraulic connection, then the aquifer shall be classified as a Groundwater Classification 1 aquifer. (2) It is assumed that the average household has four occupants and that each person in the household uses 100 gallons of water per day (Louisiana Department of Health and Hospitals). To ensure that water is available on an as-needed basis, a peaking factor of two has been applied to the daily water consumption rate. Therefore, a value of 800 gpd has been established as the minimum sustainable yield for a potential domestic water supply. (3) A yield of 800 gpd is approximately the median yield for an underground source of drinking water as defined by EPA (150-1440 gpd) (*Assistance on Compliance of 40 CFR Part 191 with Groundwater Protection Standards*, Memorandum, EPA, Office of Water, June 1993). Refer to Figure 3 for an illustration of the groundwater classifications.

Groundwater Classification 3 - ***Class 3A***: Groundwater within an aquifer that is sufficiently permeable to transmit water to a well at a maximum sustainable yield of less than 800 gpd; or ***Class 3B***: Groundwater quality is such that it has a TDS concentration greater than 10,000 mg/l. **NOTE:** If a domestic or agricultural water supply well is located within one mile of the site property boundaries and is screened in the same stratum as the aquifer of concern or has a direct hydraulic connection, then the aquifer

shall be classified as a Groundwater Classification 2 aquifer. For groundwater in communication with a surface water body, groundwater shall be classified as surface water at the point of discharge to the surface water body. Refer to Figure 3 for an illustration of the groundwater classifications.

Groundwater plume - groundwater defined vertically and horizontally by the presence of a COC at concentrations greater than the limiting groundwater standard for the Option being implemented; the groundwater AOI.

GW_{air} - the RECAP standard for volatile emissions from **g**round**w**ater to the ambient **air**.

GW_1 - the RECAP standard for groundwater meeting the definition of **G**round**w**ater Classification **1**.

GW_2 - the RECAP standard for groundwater meeting the definition of **G**round**w**ater Classification **2**.

GW_3 - the RECAP standard for groundwater meeting the definition of **G**round**w**ater Classification **3**.

GW_{3DW} - the RECAP standard for groundwater meeting the definition of **G**round**w**ater Classification **3** that may potentially discharge to a downgradient surface water body (segment or subsegment) that is classified as a **d**rinking **w**ater source. The objective of the GW_{3DW} RECAP standard is to provide protection against the migration and discharge of a COC via groundwater to a surface water body. It is not the intent of this standard to allow the discharge of a COC to surface water.

GW_{3NDW} - the RECAP standard for groundwater meeting the definition of **G**round**w**ater Classification **3** that may potentially discharge to a downgradient surface water body (segment or subsegment) that is classified as a **n**on-**d**rinking **w**ater source. The objective of the GW_{3NDW} RECAP standard is to provide protection against the migration and discharge of a COC via groundwater to a surface water body. It is not the intent of this standard to allow the discharge of a COC to surface water.

GW_{es} - the RECAP standard for **g**round**w**ater impacted with volatile constituents located beneath an **e**nclosed **s**tructure, applies to Management Options 1, 2, and 3.

GW_{SS} - is the RECAP **s**creening **s**tandard for groundwater. The GW_{SS} is applicable to groundwater meeting the definitions of **G**round**w**ater Classifications 1, 2, and 3.

Hazard index (HI) - the sum of more than one hazard quotient for multiple noncarcinogens (that elicit the same critical effect or affect the same target organ/system) and/or multiple exposure pathways.

Hazard quotient (HQ) - the ratio of the AOIC for a single noncarcinogenic COC to the SS or RS for that COC.

HEAST - **H**ealth **E**ffects **A**ssessment **S**ummary **T**ables is a document published annually by the EPA that contains reference doses and cancer slope factors.

Henry's Law Constant - provides a measure of the extent of constituent partitioning between air and water at equilibrium. The higher the Henry's Law constant, the more likely a constituent is to volatilize to air than to remain in the water.

HI - **H**azard **I**ndex.

High fugitive dust emissions – the release of a high concentration of soil particulates to the ambient air due to the presence of dry soil (moisture content less than 8 percent), finely divided or dusty soils (high silt or clay content), high average annual wind speeds (greater than 5.3 m/sec), less than 50 percent vegetative cover, heavy traffic on unpaved roads, and/or soil intrusive activities.

HQ - **H**azard **Q**uotient.

Hydraulic conductivity - or "coefficient of permeability" is a measure of the capacity of a porous medium to transmit water. It is defined as the volume of water that will move in a unit time under a unit hydraulic gradient through a unit area measured at right angles to the direction of flow. The dimensions of hydraulic conductivity are length per time or velocity. Hydraulic conductivity is governed by the size and the shape of the pores, the effectiveness of the interconnection between pores, roughness of mineral particles, degree of soil saturation, and the physical properties of the fluid.

Impact - the presence of a constituent at a concentration which exceeds the limiting standard applicable at the AOC or the AOI for the Option being implemented.

Industrial/commercial - any property not currently used for human habitation on a permanent or temporary/intermittent basis having the following North American Industry Classification System (NAICS) (See Appendix E) major group numbers 11-21; 22 (except 22131); 23-56 inclusive; 61 (except 61111, 61121, 61131); 62 (except 62211, 62221, 62231, 62311, 62322, 623311, 623312, 62399, 62411, and 62441); 71 (except 71219); 72 (except 721191, 721211 and 72131); 81 (except 81411); and 92 (except 92214). Industrial property shall include any block(s) or lot(s) of land controlled by the same owner or operator that are vacant land(s) found within or beside developed land(s). For leased lands, industrial property includes the leasehold and any containers, vessels, tanks, or any other contrivances or units that provide for the management of COC to or from the leasehold.

Inhalation unit risk – toxicity value which represents the cancer risk per mg of chemical per kg of body weight per day of exposure.

Injury - a wrong or damage done to a person or his or her property or rights when caused by the wrongful act of another.

Institutional controls - actions taken or modifications to a site that prevent or minimize contact with impacted media.

Integrated Risk Information System (IRIS) - an EPA database (http://www.epa.gov/iris/) containing verified reference doses and cancer slope factors and up-to-date health risk and EPA regulatory information for numerous constituents.

IRIS - **I**ntegrated **R**isk **I**nformation **S**ystem.

K_d - distribution coefficient defined by the product of the fraction of organic carbon in soil multiplied by the K_{oc} for the hydrophobic organic constituents. Although comparable algorithms are not available for estimating equilibrium partition coefficients for inorganic constituents, published values are available for metals (e.g., EPA 1996).

K_{oc} - organic carbon/water partition coefficient - provides a measure of the extent of constituent partitioning between organic carbon and water at equilibrium. The higher the K_{oc}, the more likely a constituent is to bind to carbon in soil or sediment than to remain in the water column.

K_{ow} - octanol/water partition coefficient - provides a measure of the extent of constituent partitioning between water and octanol at equilibrium. The greater the K_{ow} the more likely a constituent is to partition to octanol than to remain in water. Octanol is used as a surrogate for lipids (fat), and K_{ow} can be used to predict bioconcentration in aquatic organisms.

Lifetime - the default average human lifetime which is assumed to be 70 years (EPA).

Limiting RECAP Standard (LRS) - the lowest standard of all the standards that are applicable to a given exposure or source medium.

LRS – **L**imiting **R**ECAP **S**tandard.

LSS – **L**imiting **S**creening **S**tandard.

Limiting Screening Standard (LSS) - the lowest screening standard of all the standards that are applicable to a given medium.

Management Option 1 (MO-1) - provides Department-derived RECAP Standards (RS) for soil and groundwater. MO-1 RS identify constituent concentrations in media that are protective of human health and the environment. MO-1 RS were derived for non-industrial (residential) and industrial exposure scenarios using currently recommended default exposure parameters and toxicity criteria.

Management Option 2 (MO-2) - provides the option of using site-specific data with specified analytical models to evaluate constituent fate and transport at the site. The results of this site-specific evaluation shall be used in conjunction with standard reasonable maximum exposure (RME) assumptions to identify site-specific MO-2 RS.

Management Option 3 (MO-3) - provides the option of using site-specific data for the evaluation of exposure and environmental fate and transport for the development of site-specific MO-3 RS.

Maximum Contaminant Level (MCL) - the maximum permissible concentration of a contaminant in water which is delivered to any user of a public water system. The MCL is contained in the National Primary Drinking Water Regulations (40 CFR 141).

MCL - **M**aximum **C**ontaminant **L**evel.

Media of concern - any currently impacted media to which individuals may be exposed or through which constituents may be transported to potential receptors.

MO-1 - **M**anagement **O**ption **1**.

MO-2 - **M**anagement **O**ption **2**.

MO-3 - **M**anagement **O**ption **3**.

Monitored natural attenuation (MNA) - the monitored biodegradation, dispersion, dilution, sorption, volatilization, and/or chemical and biochemical transformation/stabilization of constituents to effectively reduce constituent concentration, toxicity, mobility, mass or volume to levels that are protective of human health and the ecosystem. Also referred to as intrinsic remediation or passive remediation.

NAPL **- n**on-**a**queous **p**hase **l**iquid.

NFA-ATT - **n**o **f**urther **a**ction **a**t **t**his **t**ime.

Non-Aqueous Phase Liquid (NAPL) - a liquid not dissolved in water, commonly referred to as "free product."

Noncarcinogen - an agent that is known not to cause cancer.

Non-detect - a constituent that is not detected in a particular sample above a certain limit, usually the quantitation limit for the constituent in that sample.

Non-industrial - any property that does not meet the exclusive definition of an industrial property (see Appendix E). Such properties may be residential, farming (livestock or vegetative), or undeveloped lands that are not included in the industrial property description (privately-owned lands, wetlands, state and national parks). Non-industrial sites shall be managed through comparison with non-industrial standards and/or remediated to non-industrial standards.

Particulate emission factor (PEF) - relates the COC concentration in soil with the concentration of respirable particles in the air due to fugitive dust emissions from impacted surface soils at sites.

PAH - **p**olycyclic **a**romatic **h**ydrocarbon.

PCDD – **p**oly**c**hlorinated **d**ibenzo**d**ioxins.

PCDF – **p**oly**c**hlorinated **d**ibenzo**f**urans.

PEF - **p**articulate **e**mission **f**actor.

Permanent structure - a well established building or similar structure located in an area of established, controlled land use that is not anticipated to change in the future or the planned development of a well established building or similar structure in an area of established, controlled land use under the Voluntary Cleanup Program.

POC - **p**oint **o**f **c**ompliance.

POE - **p**oint **o**f **e**xposure.

Point of compliance (POC) - the point in groundwater where the RECAP standard must be met (refer to Section 2.11).

Point of exposure (POE) - a location of actual or potential contact between an organism and a chemical agent.

Post-remediation verification requirements - soil sampling and groundwater monitoring required to verify that remediated media meet the RS.

Post-closure requirements - monitoring, financial assurance, and/or institutional control requirements that shall be met after the closure of a site.

Preliminary evaluation - an initial investigation designed to determine if the release of a COC to the environment has occurred. This evaluation should include a review of any information available regarding the AOC, the results of an AOC inspection, and sample results from any media potentially impacted by a release. Preliminary evaluations may be conducted by a responsible party, an interested party, or by a regulatory agency. Examples of preliminary evaluations include Phase II real estate evaluations, State Site Assessments (SSA I and II) conducted by LDEQ under the Inactive and Abandoned Sites guidelines, or RCRA facility assessments (RFAs) conducted by LDEQ for the RCRA corrective action program.

QA/QC - **q**uality **a**ssurance/**q**uality **c**ontrol.

Quality assurance/quality control (QA/QC) - a system of procedures, checks, audits, and corrective actions used to ensure that field work and laboratory analysis meet certain established standards.

Quantitation limit (QL) - the lowest concentration at which a constituent can be accurately and reproducibly quantitated. Usually equal to the instrument detection limit

multiplied by a factor of three to five, but varies for different constituents and different samples.

Reasonable maximum exposure (RME) - the highest exposure that could reasonably be expected to occur for a given exposure pathway at an AOI and is intended to account for both uncertainty in the COC concentration and variability in exposure parameters. Reasonable maximum exposure is estimated by combining a mean (95 percent UCL on the arithmetic mean) AOIC with protective exposure assumptions.

RECAP - **R**isk **E**valuation/**C**orrective **A**ction **P**rogram.

RECAP standard (RS) - a concentration of a constituent of concern in an environmental medium that defines an action standard or remediation standard depending on the Management Option and the application chosen.

Receptor - potentially exposed individual/population.

Reference concentration (RfC) - an estimate of a daily exposure level (i.e., COC concentration in air) for a human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects during a lifetime; expressed in units of mg/m^3; may be converted to a corresponding inhalation RfD (mg/kg-day) by dividing by 70 kg and multiplying by 20 m^3/day; EPA toxicity value for constituents that elicit noncarcinogenic health effects.

Reference dose (RfD) - an estimate of a daily exposure level for a human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects during a lifetime; expressed in units of mg/kg-day; EPA toxicity value for constituents that elicit noncarcinogenic health effects.

Regulated site - area of investigation that is subject to the requirements of this program.

Remediation - action or series of actions taken at a site to reduce, destroy, or otherwise mitigate the constituents present at the site.

Residential - non-industrial.

RfC - **r**e**f**erence **c**oncentration.

RfD - **r**e**f**erence **d**ose.

Risk assessment - is an analysis of the potential adverse health or environmental effects (current or future) associated with the presence of a constituent in an environmental medium.

Risk characterization - the description of the nature and the magnitude of human or ecological risk, including associated uncertainty.

RME - **r**easonable **m**aximum **e**xposure.

RS - **R**ECAP **S**tandard.

Sample quantitation limit (SQL) - the method quantitation limit multiplied by the dilution factor for the sample (if any). A quantitation limit that takes into account adjustments in the preparation and analytical method for any given sample.

Sampling bias - the condition in which a sample data set is comprised of an inordinate number of source, perimeter, or other samples such that the data set is not representative of true constituent distribution at the AOI.

SAS - **s**pecial **a**nalytical **s**ervices.

Screening Option (SO) - provides Department-derived Screening Standards (SS) for soil and groundwater for non-industrial (residential) and industrial land use scenarios. Screening Standards may be used to: (1) document that an AOC does not pose a threat to human health or the environment and, hence, does not require further action at this time; (2) identify the AOI and COC for management of the AOC under the SO; or (3) determine if an AOC warrants further evaluation under MO-1, MO-2, or MO-3, and if further evaluation is warranted, to identify the AOI and the COC in accordance with Section 2.6.

Screening Standard (SS) - a constituent concentration in medium used to: (1) determine if an AOC requires further evaluation; (2) identify the AOI; and (3) identify the COC for further evaluation under a MO.

S_d - the thickness of the impacted groundwater within the permeable zone. Refer to Figure H-1 in Appendix H for guidance on determining the S_d.

Sediment - solid fragments of inorganic and/or organic material that come from the weathering of rock and are carried and deposited by wind, water, and ice and has come to rest on the earth's surface at, above, or below sea level.

Segment or subsegment of a surface water body - surface water bodies are identified by the drainage basin in which they are located. Each water body has an identification code. Refer to LAC 33:IX.1123.

Sensitive subpopulation - receptors at increased risk from chemical exposures due to increased sensitivity, behavior patterns that may result in high exposure, and/or current or past exposures from other sources. Subpopulations that may be more sensitive to chemical exposures include infants and children, elderly people, pregnant and nursing women, and people with chronic illness. Those potentially at higher risk due to behavior patterns include children, who are more likely to contact soil, and persons who may eat large amounts of locally caught fish or locally grown produce. Subpopulations at higher risk due to exposures from other sources include individuals exposed to chemicals during occupational activities and individuals living in industrial areas.

SF - **s**lope **f**actor.

Site - the physical location, including land area(s) and appurtenances, defined by the extent of migration of the COC, or any area where a COC has been or may have been deposited, stored, disposed of, placed, or otherwise come to be located.

Site investigation - an in-depth investigation for the purposes of defining site characteristics, determining the nature, horizontal and vertical extent of contamination, predicting fate and transport of contaminants, identifying potential exposure pathways and receptors, and determining the need for corrective action. A human health and/or ecological risk evaluation of the results of the remedial investigation will be required in all cases in accordance with RECAP.

Site location name - a location, including any appurtenances thereto, which encompasses one or more AOC or AOI.

Site ranking - a qualitative evaluation of a site based on known or readily available information to identify the urgency of response actions including interim remedial actions and further information gathering.

Site-specific - activities, information, and data unique to a particular site.

Slope factor (SF) - a plausible upper-bound estimate of the probability of a carcinogenic response per unit intake of a constituent over a lifetime; EPA toxicity value for a constituent that elicits carcinogenic health effects.

SO - **S**creening **O**ption.

$Soil_{es}$ – the RECAP Standard applicable to soil impacted with volatile constituents located beneath an **e**nclosed **s**tructure; applicable to Management Options 1, 2, and 3.

$Soil_{GW1}$ - the RECAP Standard for the soil concentration protective of groundwater meeting the definition of **G**round**w**ater Classification **1** (see Section 2.10); applicable to surface soil and subsurface soil.

$Soil_{GW2}$ - the RECAP Standard for the soil concentration protective of groundwater meeting the definition of **G**round**w**ater Classification **2** (see Section 2.10); applicable to surface soil and subsurface soil.

$Soil_{GW3}$ - the RECAP Standard for the soil concentration protective of groundwater meeting the definition of **G**round**w**ater Classification **3** (see Section 2.10); applicable to surface soil and subsurface soil.

$Soil_{GW3DW}$ – the RECAP Standard for the soil concentration protective of groundwater meeting the definition of **G**round**w**ater Classification **3** (see Section 2.10) that may potentially discharge to a downgradient surface water body (segment or subsegment) that is classified as a **d**rinking **w**ater source; applicable to surface soil and subsurface soil.

$Soil_{GW3NDW}$ – the RECAP Standard for the soil concentration protective of groundwater meeting the definition of **G**round**w**ater Classification **3** (see Section 2.10) that may potentially discharge to a downgradient surface water body (segment or subsegment) that is classified as a **n**on-**d**rinking **w**ater source; applicable to surface soil and subsurface soil.

$Soil_{ni}$ - the RECAP Standard for the protection of human health; applicable to surface soil located in an area meeting the definition of **n**on-**i**ndustrial land use.

$Soil_{ni}$-PEF - the RECAP Standard for the protection of human health; applicable to surface soil located in an area meeting the definition of **n**on-**i**ndustrial land use that is characterized by high fugitive dust emissions.

$Soil_{i}$ - the RECAP Standard for the protection of human health; applicable to surface soil located in an area meeting the definition of **i**ndustrial land use.

$Soil_{ni}$-PEF - the RECAP Standard for the protection of human health; applicable to surface soil located in an area meeting the definition of **i**ndustrial land use that is characterized by high fugitive dust emissions.

Soil re-use - the re-use of soil that meets, or has been treated to meet, applicable RS.

$Soil_{sat}$ - soil **sat**uration concentration.

Soil saturation concentration ($Soil_{sat}$) - the concentration at which the pore spaces in the soil medium are saturated with a constituent of concern. $Soil_{sat}$ is applicable to surface soil and subsurface soil. $Soil_{sat}$ is applicable only for constituents that are liquid at ambient soil temperatures (i.e., those having a melting point less than or equal to 20°C).

$Soil_{SSni}$ - is the risk-based soil **s**creening **s**tandard based on the protection of human health for **n**on-**i**ndustrial land use. The $Soil_{SSni}$ is applicable to surface soil.

$Soil_{SSi}$ - is the risk-based soil **s**creening **s**tandard based on the protection of human health for **i**ndustrial/commercial land use. The $Soil_{SSi}$ is applicable to surface soil.

$Soil_{SSGW}$ - **s**creening **s**tandard for the soil concentration protective of **g**round**w**ater meeting the definitions of Groundwater Classifications 1, 2 and 3 (based on compliance with GW_{SS}). The $Soil_{SSGW}$ is applicable to surface soil and subsurface soil.

Solubility - the amount of a substance that dissolves in a given amount of water to produce a saturated solution. Aqueous concentrations in excess of solubility may indicate sorption onto suspended solids/sediments, the presence of solubilizing constituents such as solvents, or the presence of a non-aqueous phase liquid (NAPL).

Source medium - any environmental medium that is serving or may serve as a source for the transfer of constituents to another medium (e.g., soil that may leach constituents to groundwater).

Special analytical services - Non-standardized analyses conducted to meet requirements that cannot be met using routine analytical services such as shorter analytical turnaround time, lower detection limits, and analysis of non-standard matrices or non-standard constituents.

SPLP - **S**ynthetic **P**recipitation **L**eaching **P**rocedure (EPA SW846 Method 1312).

SQL - **s**ample **q**uantitation **l**imit.

Standard industrial exposure scenario - a reasonable maximum exposure scenario for standard industrial land use based on an exposure time of 8 hours/day, an exposure frequency of 250 days/year, and an exposure duration of 25 years.

Standard non-industrial exposure scenario - a reasonable maximum exposure scenario for standard residential land use based on an exposure time of 24 hours/day, an exposure frequency of 350 days/year, and an exposure duration of 30 years.

SS - **s**creening **s**tandard.

Submitter - an individual or group of individuals involved in the RECAP process including owners, operators, etc.

Subsurface soil - the soil interval present from 15 feet bgs to the depth of impact.

Surface soil - the soil interval present from ground surface to a depth of 15 feet bgs. If the depth of impact is less than 15 feet bgs, then the surface soil shall be defined as the interval present between ground surface and the depth of impact. Soil present from ground surface to a depth of 15 feet bgs is considered potentially accessible and thus, a potential source of exposure, based on the fact that future intrusive soil activities at the site may result in deeper soils being brought to the surface. A depth of 15 feet was selected based on considerations of technical practicability. Based on site-specific conditions, the Department may require, or the Submitter may request to divide the surface soil interval into two intervals: (1) ground surface to 3 feet bgs; and (2) 3 feet bgs to depth of impact.

Surface water - all lakes, bays, rivers, streams, springs, ponds, impounding reservoirs, wetlands, swamps, marshes, water sources, drainage systems, and other surface waters, natural or artificial, public or private, within the state or under its jurisdiction that are not a part of the treatment system allowed by state law, regulation, or permit. Ditches that are part of a treatment system shall not be considered surface water provided that the treatment system is monitored downstream of the impacted area for the COC under the terms of an LPDES permit. It is not required that surface water in communication with groundwater be classified as groundwater for the purposes of determining yield and TDS for the selection of an aquifer classification.

Target hazard quotient (THQ) - an acceptable hazard quotient that is combined with exposure and toxicity information to calculate a corresponding acceptable constituent concentration in an environmental medium.

Target risk (TR) - an acceptable cancer risk level that is combined with exposure and toxicity information to calculate a corresponding acceptable constituent concentration in an environmental medium.

TDS - **T**otal **D**issolved **S**olids.

Tentatively identified compounds (TIC) - compounds detected in samples that are not target compounds, internal standards, system monitoring compounds, or surrogates.

Threshold effects - refers to noncarcinogenic health effects. For many noncarcinogens there is a range of exposures that exists from zero to some finite value that can be tolerated by the organism with essentially no chance of expression of adverse effects. The exposure level must exceed the upper bound of this tolerance range before effects are observed.

TIC - **T**entatively **I**dentified **C**ompounds.

Total carcinogenic risk - the incremental individual lifetime cancer risk for simultaneous exposure to more than one carcinogen and/or for more than one exposure pathway contributing to exposure of the same receptor (refer to Section 2.14).

Total dissolved solids (TDS) - the total concentration of dissolved solids in water that is determined by evaporating a quantity of filtered water at a low temperature (measured in mg/L).

Total hazard index – the sum of hazard quotients to assess simultaneous exposure to more than one noncarcinogen that elicits the same critical effect or affects the same target organ/system and/or for exposure via multiple exposure pathways.

Total petroleum hydrocarbons (TPH) - an estimate of the total amount of petroleum hydrocarbons in a sample that may represent sums of concentrations of a limited number of compounds, groups of compounds, or the entire range of petroleum hydrocarbons. It may contain compounds that are not derived from petroleum.

Toxicity assessment - an appraisal of the evidence regarding the potential for particular COC to cause adverse effects in exposed individuals and/or organisms. Toxicity assessment is generally accomplished in two steps: hazard identification and dose-response assessment.

Toxicity value - a numerical expression of a substance's dose-response relationship that is used in risk assessments. The most common toxicity values used are reference doses (for noncarcinogenic effects) and slope factors (for carcinogenic effects).

TPH - **t**otal **p**etroleum **h**ydrocarbons.

TPH fraction - the aliphatic and aromatic hydrocarbon fractions defined by the TPH Fraction and Indicator Approach (refer to Appendix D).

TPH-DRO - the range of extractable total petroleum hydrocarbon constituents used to represent the presence of diesel (C_{10}-C_{28}).

TPH-GRO - the range of purgeable total petroleum hydrocarbon constituents used to represent the presence of gasoline (C_6-C_{10}).

TPH mixture - the petroleum hydrocarbons comprising TPH-GRO, TPH-DRO, or TPH-ORO.

TPH-ORO - the range of extractable total petroleum hydrocarbon constituents used to represent the presence of oil (C_{28}-C_{35}).

UCL - **u**pper **c**onfidence **l**imit.

Upper confidence limit - the upper limit of an interval which has a certain probability of including the population mean.

Volatile - referring to a constituent that evaporates readily at normal temperature and pressure.

$Water_{sol}$ - water **sol**ubility.

Weight-of-evidence classification - EPA's Weight-of-Evidence Classification System for carcinogenicity is a classification system for characterizing the extent to which the available data indicate that an agent is a human carcinogen. Under this system, Group A carcinogens are described as human carcinogens; Group B1 carcinogens are described as probable human carcinogens, limited human data are available; B2 carcinogens are described as probable human carcinogens, sufficient evidence in animal and inadequate or no evidence in humans; Group C carcinogens are described as possible human carcinogens; Group D carcinogens are described as not classifiable as to human carcinogenicity; and Group E carcinogens are described as having evidence of noncarcinogenicity for humans.

Yield - rate of groundwater transmitted to a well; expressed in units of gal/day.

2.2 Site Ranking System

Site ranking shall serve to rank each AOI based upon the urgency of the response action required for the protection of human health and the environment. The RECAP submittal shall contain a site ranking section that includes a recommendation on the appropriate ranking for the AOI and a discussion on the site-specific factors and the criteria used to select the ranking. The ranking system is based on the system that is contained in *Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites* (ASTM E 1739-95). A site-ranking example (modified from ASTM E 1739-95) is

included in Appendix A. Each AOI shall be given a site classification ranking of 1, 2, 3, or 4 using the following criteria:

Ranking	Criteria
1	Immediate threat to human health, safety, or sensitive environmental receptors;
2	Short-term (0-2 years) threat to human health, safety, or sensitive environmental receptors;
3	Long-term (> 2 years) threat to human health, safety, or sensitive environmental receptors; or
4	No demonstrable long-term threat to human health, safety, or sensitive environmental receptors.

A thorough justification of the site ranking shall be included in the RECAP submittal and shall include consideration of all current and future receptors and exposure pathways. Recommendations for interim measures to raise the site ranking shall be included for any AOI with a ranking of 1 or 2.

2.3 Site Investigation Requirements

The site investigation requirements for the RECAP are presented in Appendix B. Deviations from these requirements may be granted by the Department if justified based on site-specific conditions. Any Department-approved deviation from the requirements presented in Appendix B shall be outlined and summarized in the cover letter attached to the site investigation report. It is strongly recommended that a site investigation workplan be submitted to the Department for approval prior to the implementation of site investigation activities. Refer to Section B.2.4 of Appendix B for guidelines on developing a RECAP site investigation workplan.

2.4 Data Quality Assurance/Quality Control Requirements

Data Quality Assurance/Quality Control (QA/QC) is critical to the acquisition of reliable data for quantitative risk assessment. Data on which risk-based decisions are made must meet minimum analytical requirements and be of known quality to allow for an evaluation of uncertainty in the data and the resulting impact on estimated risks. Therefore, data used in the RECAP shall be obtained from a laboratory accredited by the State of Louisiana (http://www.deq.state.la.us/laboratory/apps.asp) (or a laboratory exempt from accreditation) and shall meet the following requirements:

(1) The data were generated using rigorous analytical methods such as an approved EPA method;

(2) The data are analyte-specific and the identity and concentration are confirmed;

(3) The method produced tangible raw data (e.g. chromatograms, spectra, digital values) in the form of paper printouts or computer-generated electronic files; and

(4) QA/QC documentation includes:

(a) sample documentation,

(b) initial and continuing calibration,

(c) determination and documentation of detection limits,

(d) analyte identification and quantification,

(e) QC blanks (trip, method, rinsate),

(f) matrix spike recoveries,

(g) performance evaluation samples (external QA or laboratory control samples; performance evaluation samples are samples that are analyzed by the laboratory in which a known amount of chemical is present in the sample and the results of the analysis are compared to the known amount of chemical to evaluate the performance of the analysis by the laboratory),

(h) analytical error determination (measures precision of analytical method; analytical error can be determined with replicate samples), and

(i) total measurement error determination [measures overall precision of measurement system from sample acquisition through analysis; total measurement error can be determined with field duplicate, matrix spike (MS), and matrix spike duplicate (MSD) samples].

Data meeting these requirements are referred to as definitive data [*Data Quality Objectives Process for Superfund, Interim Final Guidance* (EPA 540-R-93-071)]. Definitive data were formerly referred to as Level III Data (data generated in an offsite analytical laboratory using standard, documented procedures) and Level IV Data (Contract Laboratory Program routine analytical services) [*Data Quality Objectives for Remedial Response Activities, Development Process* (EPA/540/G-87/003)]. Definitive data meet the Data Quality Objectives for quantitative risk assessment and are considered acceptable for use in the RECAP. In general, data generated using an EPA 500 Series, 600 Series, SW-846 methods, or Contract Laboratory Program (CLP) Statement of Work (SOW) methods meet the definition of definitive data. CLP SOW methods are not required under the RECAP but may be used if additional QA/QC documentation is desired by the Submitter. Documentation for the QA/QC requirements listed above for definitive data should be requested from the laboratory at the time the sample(s) is submitted for analysis. For an AOI impacted with petroleum constituents, fraction-specific TPH data shall be obtained in addition to indicator constituent data as specified in Appendix D. As an alternative to obtaining fraction-specific TPH data, mixture-

specific TPH data (TPH-GRO, TPH-DRO, and/or TPH-ORO) may be obtained as specified in Appendix D.

For routine sampling events, it is required that field QA/QC samples be collected and analyzed. The following is an example of an acceptable QA/QC set:

- 1 rinsate sample per 20 field samples,
- 1 field blank per day,
- 1 trip blank per ice chest of samples for VOA analysis,
- 1 field duplicate sample per 20 field samples, and
- 1 matrix spike/matrix spike duplicate from the site per 20 field samples.

The QA/QC submittal requirements shall include sample documentation; initial and continuing calibration data; documentation of detection limits; analyte identification and quantification; quality control blanks such as trip blanks, method blanks, and rinsate blanks; matrix spike recovery results; performance evaluation sample data; analytical error determination; and total measurement error determination.

2.5 Data Evaluation and Data Usability

Analytical results shall not be accepted at face value. All data shall be reviewed by the analytical laboratory to ensure technical compliance with the analytical method. The data review shall be conducted in accordance with standard EPA protocols. All data shall also be reviewed by the Submitter to ensure that any limitations or uncertainties associated with the data are identified so that only data that are appropriate and reliable for use in quantitative risk assessment are carried through the RECAP process. Data shall be reviewed to identify reliable, accurate, and verifiable numbers that can be used to quantitate risks. Specifically, the data shall be evaluated to assess the effect of QC issues on data usability (*Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual, Part A,* EPA 540/1-89/002).

Data shall be evaluated with respect to:

(1) *Analytical Method* - In general, data generated using an EPA 500 Series, 600 Series, SW-846, or CLP SOW method will meet the definition of definitive data. Documentation for the aforementioned QA/QC requirements should be requested from the laboratory at the time the sample(s) is submitted for analysis. Analytical results that are: (a) not specific for a particular compound; (b) produced by insensitive analytical methods (e.g., analyses using portable field analytical instruments); or (c) associated with unknown, few, or no QA/QC procedures may be used in developing the conceptual site model but may not be used in determining the AOIC or the CC.

(2) *Sample Quantitation Limits* - The sample quantitation limits (SQL) should be less than the limiting SS or RS for the Option being implemented at the AOI. Prior to sample analysis, the Submitter should identify the limiting SS or RS applicable to the Option being implemented and compare those constituent concentrations to the

method detection limits (MDL) and the laboratory's practical quantitation limit (PQL) for the selected analytical method to ensure that the MDL and PQL are less than the applicable limiting standard. In the RECAP submittal, non-detected results shall be reported as less than the numerical value of the SQL (e.g., < 5 ug/l) and a comparison of the SQL to the limiting SS or RS shall be presented for all constituents reported as not detected to demonstrate that the SQL are less than or equal to the limiting SS or RS prior to eliminating a COC from further assessment. If the limiting SS or limiting RS is less than the laboratory's PQL, the Submitter shall select the most sensitive standard analytical method available (i.e., the analytical method with the lowest PQL) for the COC and the PQL shall serve as the limiting SS or limiting RS. A PQL selected by the Submitter to serve as the limiting standard is subject to Department approval. If a COC is reported as not detected (< SQL) and the SQL for the constituent is greater than the limiting SS or RS for a significant number of samples for that medium (e.g., greater than or equal to 5 to 10 percent), then the samples shall be reanalyzed. If a COC is reported as not detected (< SQL) for a key sampling location (e.g., drinking water well) and the SQL for the constituent is greater than the limiting SS or RS, then the sample shall be reanalyzed. If the SQL are elevated, the data may be considered acceptable by the Department if the following conditions are met: (a) the analytical method used is capable of achieving a PQL that is below the limiting standard; and (b) an analytical laboratory accredited by the State of Louisiana (http://www.deq.state.la.us/laboratory/apps.asp) (or an analytical laboratory that is exempt from accreditation) provides documentation to the Department that the PQL was not achievable due to site- or sample-specific considerations such as matrix interferences. Constituent concentrations detected below the PQL but above the MDL are flagged with a J qualifier (organics) or a B qualifier (inorganics) which indicates the reported concentration is estimated because the concentration falls below the calibration range, i.e., the concentration detected is below the lowest concentration on the calibration curve (PQL). Under the RECAP, the results reported as J-qualified (concentration estimated) shall be evaluated as positive data since there is certainty as to the presence and identity of the constituent.

(3) *Qualifiers and Codes* - Any anomalies in the data shall be noted in the laboratory report or by the data reviewer using qualifiers or codes to identify any potential problems in the data. Each qualifier or code shall be defined and include a statement on the useabililty of the data under the RECAP and the uncertainty in the data represented by the qualifier or code. All qualifiers and codes shall be addressed before the data are included in the RECAP process. For guidance on the use of qualified and coded data in quantitative risk assessment refer to *Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual, Part A,* (EPA 1989) and *Guidance for Data Useability in Risk Assessment, Part A*, (EPA 1992, 9285.7-09A). In general, all qualified data are considered suitable for inclusion in the quantitative risk assessment process with the exception of data flagged with the qualifier R (unusable organic and inorganic data). Results flagged with a J (organics) or a B (inorganics) (estimated concentration) qualifier shall be included as positive results. If an estimated concentration drives or contributes significantly to the risk at

the AOI, the uncertainty associated with the estimated concentration shall be clearly addressed in the data evaluation section of the submittal.

(4) *Blank Samples* - Blank samples provide a measure of contamination that has been introduced into a sample set either: (a) in the field while the samples were being collected or transported to the laboratory, or (b) in the laboratory during sample preparation or analysis. To prevent the inclusion of non-site-related constituents in the risk assessment, the concentrations of constituents detected in blanks shall be compared with concentrations of the same constituents detected in site samples. Acetone, 2-butanone, methylene chloride, toluene, cyclohexane, and the phthalates are considered by EPA to be common laboratory contaminants. If the blank contains detectable concentrations of common laboratory contaminants, then the sample results should be considered as positive results only if the concentration in the sample exceeds ten times the maximum amount detected in any blank. If the blank contains detectable concentrations of one or more organic or inorganic constituents that are not considered by EPA to be common laboratory contaminants, the site sample results should be considered as positive only if the concentration of the constituent in the site sample exceeds five times the maximum amount detected in any blank. For additional information on blank samples refer to *Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual, Part A* (EPA 1989); *Laboratory Data Validation Functional Guidelines for Evaluating Organics Analysis* (EPA 1999); *Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analysis* (EPA 2002); *National Functional Guidelines for Organic Data Review* (EPA 1991); and *Guidance on Environmental Data Verification and Data Validation* (EPA 2002).

(5) *Tentatively Identified Compounds (TIC)* - An effort to classify TIC into compound classes should be conducted and a qualitative judgment of the potential toxicity, at the class level, without definitive identification of each compound, should be made. If the chemical class contains carcinogenic or otherwise toxic constituents, then confirmation of the identity of the TIC may be indicated. When only a few TIC are present and no historical or other site information indicates that a particular TIC may indeed be present at the site, the TIC are generally not included in the risk assessment. A TIC may be eliminated from the list of COC if: (a) the Department concurs that the TIC is not known or suspected to be present at an AOI (i.e., the TIC is not associated with current or historical operations at the AOI and the TIC is not a transformation product of constituents present at the AOI); (b) no EPA toxicity values are available for the TIC; and (c) the TIC is not the primary COC at the AOI in terms of distribution and concentration. However, when a TIC is known or suspected to be present at an AOC or an AOI, the identities of the TIC shall be confirmed using SAS and/or the methods presented in *Guidance for Data Useability in Risk Assessment (Part A), Final* (EPA 1992) and the TIC shall be included as a COC. In addition, a TIC that has an EPA toxicity value shall be identified as a COC and included in the RECAP process. Note: The identification of TIC is not required at sites impacted with petroleum hydrocarbons.

The results of the **data evaluation** shall be presented in the RECAP submittal (RECAP Form 3) and shall address: (1) the appropriateness of the analytical method used and the sample quantitation limits; (2) the results of the blank analyses; (3) the TIC detected; (4) any calibration or matrix spike recoveries outside the acceptable range; (5) the results of the performance evaluation; and (6) the precision of the analyses. Based on the evaluation of the QA/QC data and the reported results, the Submitter shall make recommendations in the RECAP submittal concerning the usability of the data for RECAP purposes. Data determined not to be acceptable for RECAP shall be identified and justification for the determination shall be given. General guidelines on determining the usability of data for risk assessment purposes can be obtained in *Risk Assessment Guidance for Superfund, Human Health Evaluation Manual, Volume I, Part A* (EPA 1989). More detailed guidelines are available in *Guidance for Data Useability in Risk Assessment, Part A, Final* (EPA 1992).

If the Submitter opts to use **EPA Contract Laboratory Program (CLP) Statement Of Work (SOW) methods, data validation** shall be conducted in accordance with the guidelines presented in *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review* (EPA 1999); *Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analysis* (EPA 2002); *Guidance on Environmental Data Verification and Data Validation* (EPA 2002); and *Guidance for Data Useability in Risk Assessment, Part A* (EPA 1992). These guidelines may also be used to review non-CLP data where applicable.

The use of **historical data** in the RECAP process shall be in accordance with the following guidelines:

(1) The quality of historical data shall be determined prior to their use in the RECAP. Historical data shall be compared to current data with respect to analytical methods, QA/QC, and reported concentrations. Historical data may be combined with current data to determine the AOIC if: (a) the methods used to analyze the samples are similar in terms of the types of analyses conducted and the QA/QC procedures followed; and (b) the constituents and concentrations detected in the historical data are consistent with the current data (i.e., the historical data are similar to the current data).

(2) Historical data of **unknown** quality may be used in developing the conceptual model but may **not** be used in determining the AOIC.

(3) Sampling techniques, analytical methods, QA/QC procedures, and quantitation limits for the historical data shall be documented in the RECAP submittal.

(4) Historical data may **not** be combined with current data to determine the AOIC if: (a) the methods used to analyze historical data are dissimilar to those used to collect the current data; or (b) the methods and QA/QC are similar for the historical and current data sets, but the concentrations of a COC are significantly different for a defined AOI. For these situations, the most recent data set shall be used in determining the AOIC or CC.

(5) If the methods and QA/QC are similar for the historical and current data sets, the historical data may be used for a quantitative analysis of changes in constituent concentrations over time.

(6) The elimination of any data set shall be justified and fully described in the RECAP submittal (*Guidance for Data Useability in Risk Assessment*, EPA 1992; *Supplemental Region IV Risk Assessment Guidance*, EPA 1992).

Data Format: Data shall be submitted in a tabular format in accordance with the RECAP forms presented in Appendix C or similar format containing all the information contained in the Appendix C format. In addition, a summary table of data to be used in the RECAP assessment shall be provided in the submittal for each impacted medium and shall include the analyte, the number of samples, the frequency of detection, the sample quantitation limits, the minimum concentration detected, the maximum concentration detected, and if the maximum detected concentration is not used, the mean (95%UCL-AM) concentration detected for each medium. The data shall be presented in units of mg/kg (soil and sediment), mg/l (water), or $\mu g/m^3$ (air). The QA/QC data (sample documentation, initial and continuing calibration data, determination and documentation of quantitation limits, analyte identification and quantitation, QC blanks, matrix spike recoveries, performance evaluation samples, analytical error determination, and total measurement error) shall be included in the RECAP submittal. The raw analytical data including chromatograms and additional QA/QC information may be requested by the Department on an "as-needed" basis and shall be retained by the Submitter for a period of at least three years.

2.6 Identification of the Area of Investigation and the Constituents of Concern

2.6.1 Identification of the Area of Investigation

The Area of Investigation (AOI) is the zone contiguous to, and including, impacted media defined vertically and horizontally by the presence of one or more constituents in concentrations that exceed the limiting standard applicable for the Option being implemented. If an AOC is managed under more than one Option, the AOI (soil and groundwater) shall be identified using the limiting standard identified for the highest Option that has been completed to date for the AOI. An AOI shall be identified for each impacted medium including soil, groundwater, surface water, and sediment.

2.6.1.1 General Guidelines for Identification of the AOI

The AOI shall be identified for each Option in accordance with the guidelines presented below. For further guidance on identifying the AOI for unusual or complex site conditions, refer to Section 2.6.1.2.

(1) ***Screening Option.*** For a SO assessment, the limiting SS shall be used to identify the AOI. If the most heavily impacted area(s) known or suspected to be present within the AOC has been adequately investigated and the Department concurs that the

highest constituent concentrations within the AOC have been characterized, then the identification of an AOI may not be required under the SO.

(2) ***Management Option 1.*** For a MO-1 assessment, the limiting SS shall be used to identify the AOI.

(3) ***Management Option 2.*** For a MO-2 assessment, the limiting MO-1 RS shall be used to identify the AOI. If a MO-1 assessment has not been conducted and the soil and/or groundwater meets the criteria for management under the SO, the limiting SS (or site-specific SS, refer to Section 3.0) shall be used to identify the soil and groundwater AOI. Note: If the soil or groundwater does not meet the criteria for management under MO-1 or the AOI is based on an exposure pathway not addressed by the MO-1 RS, then the AOI shall be identified using an approved analytical quantitation limit or the applicable MO-2 RS.

(4) ***Management Option 3.*** For a MO-3 assessment, the limiting MO-2 RS shall be used to identify the soil and groundwater AOI. If a MO-2 assessment has not been conducted and the soil and groundwater meet the criteria for management under MO-1, then the MO-1 limiting RS shall be used to identify the AOI. If neither a MO-2 nor MO-1 assessment has been conducted and the soil and groundwater meet the criteria for management under the SO, then the limiting SS (or site-specific SS, refer to Section 3.0) shall be used to identify the AOI. Note: (1) An AOI for an environmental medium or an exposure pathway not addressed by the SS, MO-1 RS, or MO-2 RS; or (2) an AOI that does not meet the criteria for management under the SO, MO-1, or MO-2 shall be identified using a Department-approved background level, a Department-approved analytical quantitation limit, or the applicable MO-3 RS.

(5) ***All Options.*** The same limiting standard shall be used to identify the AOI and the COC (refer to Section 2.6.2).

(6) Any variance from these requirements is subject to Department approval prior to submission of the RECAP evaluation.

2.6.1.2 Site-Specific Considerations for the Identification of the AOI

For an AOC with site characteristics (e.g., land use, exposure pathways, COC distribution, multiple releases, or other unusual site conditions) that require special consideration when identifying the AOI, refer to the guidelines presented below.

(1) To determine if more than one AOI should be identified at an AOC, site-specific conditions such as the constituent type(s) and distribution, land use, receptor activity patterns, and exposure pathways at the AOC shall be taken into consideration. The identification of multiple AOI within an AOC is subject to Department approval. Multiple AOI within an AOC shall be identified as follows:

(a) If the AOC contains impacted areas (i.e., areas characterized by constituent concentrations above the limiting SS or RS) that are distinctly separated by non-impacted areas (i.e., areas characterized by constituent concentrations less than or equal to the limiting SS or RS), then multiple AOI shall be identified. In general, a limited area defined by one or two non-detect sampling locations will not be considered adequate to divide an AOC into two AOI unless the impacted areas are characterized by different constituents indicating the presence of two separate releases.

(b) If an AOC is comprised of multiple releases characterized by different constituents and distinct areas of impact can be delineated for each release, then an AOI shall be identified for each release.

(c) If multiple constituents are present at the AOC, the Submitter may: (i) identify one AOI that includes all of the COC (i.e., the boundaries of the AOI shall be defined by all sampling locations that have at least one constituent present at a concentration that exceeds the limiting standard for the Option being implemented); or (ii) identify an AOI for each constituent present within the AOC (i.e., the boundaries of an AOI for one constituent shall be defined by the sampling locations that have concentrations that exceed the limiting standard for that particular constituent). Note: Multiple AOI identified for each constituent will be superimposed on one another.

(d) If land use varies within the AOC (e.g., constituents have migrated from an industrial site to a residential area), then an AOI shall be identified for each type of land use within the AOC (refer to Figure 4). Where appropriate, site-specific factors such as property boundaries and receptor activity patterns shall be taken into consideration when delineating the boundaries of the AOI.

(e) If the pathways of exposure vary within the AOC, then pathway-specific AOI shall be identified based on site-specific conditions and constituent distribution in the area of exposure for the exposure pathway of concern [e.g., if a small portion of the AOC for a soil containing a volatile constituent is located beneath an enclosed structure, then two AOI shall be identified: 1) an AOI for direct contact exposure with soil (ingestion, dermal contact, inhalation of volatile emissions to ambient air) and/or environmental fate and transport pathways shall be identified as presented above; and 2) an AOI for the volatile emissions to an enclosed structure pathway ($Soil_{es}$ AOI) shall be delineated based on the boundaries of the enclosed structure and the sampling locations that best characterize the constituent concentrations in soil beneath the enclosed structure] (refer to Figures 5, 6 and 7).

(f) The Submitter may elect to divide the AOI for surface soil into two AOI: 1) ground surface to 3 feet bgs; and 2) 3 feet to 15 feet bgs. If warranted based on site-specific conditions, the Department may require that two AOI be identified for surface soil (ground surface to 3 ft bgs and 3-15 ft bgs).

(2) If only 1 or 2 sampling locations have a constituent concentration that exceeds the limiting SS or RS, it is not possible to identify an AOI as presented above. Therefore, the Submitter may: (a) evaluate the constituent under a higher tier; (b) conduct further site investigation to confirm the AOIC; (c) conduct further investigation to obtain additional data to evaluate a specific pathway of concern (e.g., SPLP data for the soil to groundwater pathway); or (d) remediate the area exceeding the limiting SS or RS.

(3) In lieu of using the limiting standard identified for the highest Option completed, the AOI may be identified using the limiting RS for the Option currently being implemented (i.e., for a MO-1 assessment, the limiting MO-1 RS may be used to identify the AOI; for a MO-2 assessment, the limiting MO-2 RS may be used to identify the AOI; and for a MO-3 assessment, the limiting MO-3 RS may be used to identify the AOI).

(4) Any variance from these requirements is subject to Department approval prior to submission of the RECAP evaluation.

2.6.1.3 Soil AOI

If the depth of impact is less than or equal to 15 ft bgs, then an AOI shall be delineated for surface soil (the soil interval extending from ground surface to the depth of impact). **If the depth of impact is greater than 15 ft bgs**, then two soil AOI shall be delineated: (1) a surface soil AOI (the soil interval extending from ground surface to a depth of 15 feet bgs); and (2) a subsurface soil AOI (the soil interval extending from 15 feet bgs to the depth of impact). If the Department determines that it is warranted based on site-specific conditions or if the Submitter elects, the 0-15 feet bgs interval may be divided into two AOI: (1) 0-3 feet bgs; and (2) 3 feet bgs - depth of impact. The AOI shall be delineated by comparing the constituent concentration detected at each sampling location with the appropriate limiting soil standard for Option being implemented. All sampling locations having a constituent concentration that exceeds the limiting soil standard shall be identified for inclusion in the AOI. Based on these identified sampling locations, the horizontal and vertical boundaries of the AOI shall be delineated. The soil AOI shall be a three-dimensional space which contains all data points with constituent concentrations above the limiting soil SS or the limiting soil RS and all points contained **within** that space whether the concentrations are less than, equal to, or greater than the limiting soil SS or the limiting soil RS. Sampling locations **outside** the delineated AOI with reported constituent concentrations less than the limiting soil SS or the limiting soil RS shall be eliminated from further consideration.

2.6.1.4 Groundwater AOI

The groundwater plume shall be delineated by comparing the constituent concentration detected at each sampling location with the groundwater SS or the limiting groundwater RS. All sampling locations having constituent concentrations that exceed the

groundwater SS or the limiting groundwater RS shall be identified. Based on these identified sampling locations, the horizontal and vertical boundaries of the groundwater plume shall be delineated. The delineated groundwater plume shall be a three-dimensional space which contains all data points with constituent concentrations above the groundwater SS or the limiting groundwater RS and all points contained **within** that space whether the concentrations are less than, equal to, or greater than the groundwater SS or the limiting groundwater RS. Sampling locations **outside** the delineated plume with reported constituent concentrations less than the groundwater SS or the limiting groundwater RS shall be eliminated from further consideration.

2.6.1.5 Sediment AOI

The AOI for sediment shall be delineated by comparing the constituent concentration detected at each sampling location with the Department-approved analytical quantitation limit, the Department-approved background concentration (refer to Section 2.13). All sampling locations having a constituent concentration that exceeds the analytical quantitation limit or the background concentration shall be identified. Based on these identified sampling locations, the horizontal and vertical boundaries of the AOI shall be delineated. The sediment AOI shall be a three dimensional space which contains all data points with constituent concentrations above the analytical quantitation limit or background concentration and all points contained **within** that space whether the concentrations are less than, equal to, or greater than the analytical quantitation limit or background concentration. Sampling locations **outside** the defined AOI with reported constituent concentrations less than the analytical quantitation limit or background concentration shall be eliminated from further consideration.

2.6.2 Identification of the Constituents of Concern

Constituents of Concern (COC) are the constituents that are site-related and the focus of the RECAP assessment. A COC list shall be developed for each impacted medium. Constituent speciation should be identified where appropriate, e.g., chromium, mercury, etc. Constituents that shall be identified as COC include: (1) constituents that are not considered by EPA as common laboratory contaminants (refer to Section 2.5) which were detected in at least one sample at a concentration that exceeds five times the maximum concentration detected in any blank sample; (2) constituents that are considered by EPA as common laboratory contaminants (refer to Section 2.5) which were detected in at least one sample at a concentration that exceeds ten times the maximum concentration detected in any blank sample; (3) a TIC known or suspected to be present at the AOI or which has been identified by SAS and EPA toxicity values are available (refer to Section 2.5); and (4) all constituents present within the AOI that exceed the limiting standard applicable for the Option being implemented. If an AOC is managed under more than one Option, the COC (soil and groundwater) for the Option currently being implemented shall be identified using the limiting standard identified for the highest Option that has been completed to date for the AOI. The Department reserves the right to alter the COC list due to site-specific considerations, such as an inordinately high number of constituents present (greater than 100) at the AOI. A reduced COC list may be approved

by the Department for environmental fate and transport modeling under MO-3 when sophisticated, three-dimensional models are being used to predict future AOIC. The COC on the reduced list shall be identified based on migration potential, frequency of detection, concentration, and toxicity. The RECAP submittal should present all constituents detected at the AOI, the COC identified for each medium, and the rationale for eliminating constituents from the COC list(s). Additional guidelines for the identification of COC for petroleum hydrocarbon releases are presented in Appendix D. Guidelines for identifying the constituents that shall be included on the list(s) of COC for each Option are presented below.

(1) ***Screening Option.*** For a SO assessment, all constituents detected in at least one sample shall be identified as COC.

(2) ***Management Option 1.*** For a MO-1 assessment, all constituents whose maximum detected concentrations exceed the limiting SS shall be identified as COC.

(3) ***Management Option 2.*** For a MO-2 assessment, all constituents whose AOIC or groundwater CC exceed the MO-1 limiting RS shall be identified as COC (if the soil and/or groundwater meet the criteria for management under MO-1). If a MO-1 assessment has not been conducted and the soil and/or groundwater meet the criteria for management under the SO, then all constituents whose maximum detected concentrations exceed the limiting SS (or site-specific SS, refer to Section 3.0) shall be identified as COC. If the soil and/or groundwater do not meet the criteria for the SO or MO-1, then the COC shall be identified using a Department-approved background level, Department-approved analytical quantitation limit, or the applicable MO-2 RS.

(4) ***Management Option 3.*** For a MO-3 assessment, all constituents whose soil AOIC or groundwater CC exceed the MO-2 limiting RS shall be identified as COC (if the soil and/or groundwater meet the criteria for management under MO-2. If a MO-2 assessment was not conducted and the AOI meets the criteria for management under MO-1, then all constituents whose AOIC or compliance concentrations exceed the MO-1 limiting RS shall be identified as COC. If neither a MO-1 nor MO-2 assessment was conducted and the AOI meets the criteria for management under the SO, then all constituents whose AOIC or compliance concentrations exceed the limiting SS shall be identified as COC. If the AOI does not meet the criteria for management under the SO, MO-1, or MO-2, then the COC shall be identified using a Department-approved background level or analytical quantitation limit or applicable MO-3 RS.

(5) ***Management Options 1, 2, and 3.*** In lieu of using the limiting RS identified for the highest Option completed, the COC may be identified using the limiting RS for the Option currently being implemented at the AOC or the AOI (i.e., for a MO-1 assessment, the limiting MO-1 RS may be used to identify the COC; for a MO-2 assessment, the limiting MO-2 RS may be used to identify the COC; and for a MO-3 assessment, the limiting MO-3 RS may be used to identify the COC).

(6) ***All Options.*** The same limiting standard shall be used to identify the AOI (refer to Section 2.6.1) and the COC.

(7) Any variance from these requirements is subject to Department approval prior to submission of the RECAP evaluation.

2.7 Exposure Assessment

The exposure assessment shall include: (1) characterization of the exposure setting including current and future land use at and in the vicinity of the AOI (refer to land use definitions in Section 2.9 and Appendix E); identification of current and future on-site and off-site receptor populations and sensitive subpopulations; identification of all potential current and future exposure pathways including an evaluation of constituent sources (primary, secondary, etc.), receiving media, fate and transport in release media, potential exposure points (within a one-mile radius of the AOI), and exposure routes; (2) quantification of the AOIC for all impacted media and groundwater CC (refer to Section 2.8); and (3) application of standard default RME assumptions under the SO, MO-1, and MO-2 (refer to Appendix H) or identification and documentation of site-specific exposure data representative of a RME scenario under MO-3 (in the absence of site-specific exposure data, default RME assumptions shall be used). When a standard default exposure parameter is revised by the EPA, the revised value may only be used under MO-3. Under the SO, MO-1, and MO-2, the default exposure parameters in Appendix H shall be applied. The exposure assessment shall be conducted in accordance with the guidelines presented in *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual, Part A,* Chapter 6 (EPA 1989), *Guidelines for Exposure Assessment Notice* (EPA 1992), *Soil Screening Guidance* (EPA 1996), *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites* (EPA 2001), *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment)* (EPA 2000), *Guidance on Risk Characterization for Risk Managers and Risk Assessors* (EPA 1992), *Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors* (EPA 1991), *Exposure Factors Handbook* (EPA 1997), and *Superfund Exposure Assessment Manual* (EPA 1988).

The exposure assessment shall include a Conceptual Site Model (CSM) for all Options implemented at the AOC unless otherwise approved by the Department. The CSM shall illustrate the known or potential constituent source(s) (primary as well as secondary and tertiary sources if applicable), routes of constituent migration, exposure media, exposure points and pathways, receptors, and source media to be evaluated under the RECAP. An example of a CSM is presented in Figure 8.

Components of the CSM shall be identified as follows: Constituent **sources** shall be identified based on site history and/or site investigation results. **Migration pathways** for the COC shall consider, where applicable, volatilization, fugitive dust generation/deposition, surface runoff, episodic overland flow, leaching, groundwater seepage, and biota uptake. **Exposure media** shall include currently impacted media to which receptors are being exposed or may be exposed or through which COC may be transported to potential receptors, and currently unimpacted media that may become

impacted in the future due to COC transport. **Source media** shall include currently impacted media that may result in the transfer of constituents to another medium. **Exposure points** and potential exposure points shall be identified by determining if and where the known or potential receptors may come in contact with an exposure medium. All current or potential points of contact between a receptor and an exposure medium shall be identified as exposure points in the CSM. The **exposure pathways** and potential exposure pathways shall be identified based on the anticipated receptor activities at the exposure point(s). The identification of **receptors** and potential receptors shall consider current and future land use at the AOI.

All current and potential exposure pathways shall be included in the CSM unless it is adequately demonstrated that an exposure pathway(s) is incomplete and the Department concurs with the finding. Exposure pathways that are determined to be incomplete shall be documented as incomplete. Where applicable, documentation shall include monitoring and/or modeling data. Documentation that a groundwater exposure pathway is incomplete shall include, but may not be limited to: (1) characterization of site geology/hydrology; (2) identification of potential exposure points for a COC present in or migrating from groundwater, i.e., surface discharge point such as surface water body, ambient air, enclosed structure, and water supply well [a DOTD listing within a one-mile radius (unless otherwise warranted) obtained within the last 12 months]; and (3) demonstration that constituent concentrations will not exceed acceptable concentrations at identified exposure points. For the identification of future POE (via a groundwater environmental fate and transport analysis), constituent migration shall be simulated until the maximum concentration is predicted at the point of compliance (POC) and the simulation period shall not be less than 70 years unless otherwise approved by the Department. If the analysis indicates that a groundwater plume containing volatile constituents may potentially migrate under an enclosed structure in the future, then the inhalation of volatile emissions pathway shall be addressed for the enclosed structure. Documentation that a soil exposure pathway is incomplete shall include, but may not be limited to, demonstration that: (1) a receptor will not come in direct contact with COC due to the presence of a permanent structure (i.e., a well established building or similar structure located in an area of established, controlled land use that is not anticipated to change in the future or the planned development of a well established building or similar structure in an area of established, controlled land use under the Voluntary Cleanup Program); and (2) receptors will not be exposed to COC migrating from the soil to other media such as air, groundwater, or surface water at unacceptable concentrations. If it is adequately demonstrated that exposure to constituents present in soil will not occur, the Department may allow the soil to be evaluated as a source medium only. It should be noted that: (1) if a permanent structure is removed, then the exposure pathways for soil shall be considered complete, and exposure to COC present in the soil shall be evaluated under RECAP based on the future use of the land; and (2) for most land use scenarios, fences and concrete (or asphalt) coverings shall not be considered permanent structures and shall not serve as adequate justification that soil exposure pathways are incomplete. Soil (0-15 ft bgs) containing constituent concentrations above the applicable RS shall not remain in place unless: (1) Department approval is granted based on site-specific conditions; (2) there is sufficient financial assurance/commitment to ensure that the

property will remain usable and in commerce; and (3) institutional controls are employed to ensure that unacceptable exposure does not occur (refer to Section 2.17).

The CSM shall be used throughout the RECAP process to:

(1) Identify exposure and source media;
(2) Identify current and future environmental transport pathways;
(3) Identify current and future exposure points and exposure pathways;
(4) Determine if the AOC or the AOI meets the criteria for management under the SO, MO-1 and/or MO-2;
(5) Verify that the SS, MO-1 RS, MO-2 RS, or MO-3 RS are appropriate for application at the AOC or the AOI (i.e., the exposure potential at the AOC or the AOI and the site characteristics that influence COC fate and transport are consistent with those assumed in the development of the SS and/or RS for the Option chosen); and
(6) Identify data gaps.

The CSM shall be revised as the AOI progresses through the tiers of the RECAP (SO, MO-1, MO-2, and/or MO-3) so that the model illustrates only those sources, migration pathways, exposure media, exposure points/pathways, receptors, and source media identified for evaluation under the Option currently being implemented (i.e., sources, source media, migration pathways, exposure media, exposure points, and exposure pathways eliminated (screened out) from further consideration at the conclusion of a given level of assessment shall be excluded from the CSM for the next level of assessment).

If a constituent is present in, or suspected to be present in, a medium regulated under the RECAP (soil, groundwater, air, surface water, sediment, and/or biota) and the exposure assessment/CSM indicate that exposure to the medium is possible, or likely, based on site-specific conditions (location, land use at or adjacent to the AOI, receptor accessibility, receptor activity patterns, etc.), then the medium shall be included in the RECAP assessment (i.e., RECAP Standards shall be developed for all applicable exposure pathways and/or cross-media transfer pathways identified for the medium of concern).

2.8 Area of Investigation Concentration and Groundwater Compliance Concentration

The **AOI concentration (AOIC)** is defined as: 1) the concentration of the COC in the environmental medium to which the receptor is exposed or may be exposed in the future; and/or 2) the concentration of the COC in an environmental medium that may serve as a source for constituent transport and/or transfer to another environmental medium. The AOIC is the concentration of the COC in the environmental medium that is compared to the limiting SS or the MO-1, MO-2, or MO-3 limiting RS to determine if the constituent concentrations present in the medium are acceptable (less than or equal to the limiting standard) or unacceptable (greater than the limiting standard) for the Option being implemented (with the exception of groundwater, refer to compliance concentration

below). An AOIC shall be determined for all impacted media or potentially impacted media identified in the CSM. The AOIC shall be presented in unit of parts per million (ppm) (mg/kg and mg/l) for all media except air which shall be presented in units of ppb (ug/m^3).

The AOIC shall be represented by:

(1) The **maximum** constituent concentration (SO, MO-1, MO-2, and MO-3) detected at the AOC/AOI. The maximum detected concentration shall be representative of the most heavily impacted area(s) known or suspected to be present within the AOC and is subject to concurrence by the Department;

or

(2) The 95 percent upper confidence limit on the arithmetic mean (**95%UCL-AM**) constituent concentration (MO-1, MO-2, and MO-3) detected at the AOI. Refer to Section 2.8.2 for further guidance on using the 95%UCL-AM concentration to represent the AOIC.

If the 95%UCL-AM constituent concentration is greater than the maximum detected concentration, then the maximum constituent concentration shall be identified as the AOIC. If the maximum detected constituent concentration is used as the AOIC, then calculation of the 95%UCL-AM concentration shall not be required.

The **compliance concentration (CC)** is defined as the COC concentration detected in groundwater at the POC (refer to Section 2.11 for identification of the POC and POE). The CC is the concentration of the COC in groundwater that is compared to the groundwater SS or the MO-1, MO-2 or MO-3 limiting RS to determine if the constituent concentrations present in the groundwater are acceptable (less than or equal to the limiting RS) or unacceptable (greater than the limiting RS) for the Option being implemented. Compliance concentrations shall be determined for all POC for groundwater meeting the definition of Groundwater Classification 1, 2, or 3. If a POE is present within the AOI for a groundwater Classification 1 or 2 aquifer, then the COC concentration detected at the POE shall be used to demonstrate compliance with the limiting SS or the limiting RS. The groundwater CC shall be presented in units of mg/l.

2.8.1 AOI Concentration for the Screening Option

For the SO, the maximum detected constituent concentration shall be used as the AOIC and shall be presented in units of mg/kg. The maximum concentration used in the screening process shall be representative of the most heavily impacted area(s) known or suspected to be present within the AOC. Identification of the most heavily impacted area(s) is subject to concurrence by the Department. Facilities with multiple AOI shall identify a separate AOIC for each AOI.

2.8.2 AOI Concentration for Management Options 1, 2, and 3

The AOIC is the constituent concentration that shall be compared to the limiting RS. For MO-1, MO-2, and MO-3, the lower of the 95%UCL-AM constituent concentration and the maximum detected concentration shall be used as the AOIC. **For small data sets (less than 10 samples) or data sets with high variability, it is likely that the 95%UCL-AM concentration will be greater than the maximum detected concentration. In these instances, the maximum detected constituent concentration shall serve as the AOIC. NOTE: If the maximum detected constituent concentration is used as the AOIC, calculation of the 95%UCL-AM concentration shall not be required.** For the evaluation of future exposure/risk under MO-3, the highest concentration predicted (via modeling) to reach an identified exposure point(s) shall be used as the AOIC.

The 95%UCL-AM constituent concentration is used to represent the AOIC because: (1) carcinogenic and chronic noncarcinogenic toxicity criteria are based on a lifetime average exposure; (2) the average concentration is most representative of the concentration that would be contacted over time; and (3) there is uncertainty associated with estimating the true average concentration at an AOI. (The 95%UCL provides reasonable confidence that the true AOI average will not be underestimated. The 95%UCL-AM is defined as a value that, when calculated repeatedly for randomly drawn subsets of data, equals or exceeds the true mean 95 percent of the time.) The 95%UCL-AM is considered appropriate to represent the AOIC regardless of the pattern of daily exposures over time or the type of statistical distribution that might best describe the sampling data.

The 95%UCL-AM shall be calculated in accordance with the methodology presented in *Supplemental Guidance to RAGS: Calculating the Concentration Term* (EPA 1992, 9285.7-081) using the LDEQ spreadsheet at http://www.state.la.us/technology/RECAP/ or a spreadsheet or computer program that generates an output that is consistent with the output of the LDEQ spreadsheet. Prior to the calculation of the 95%UCL-AM, the distribution of the constituent concentrations present within the AOI should be determined by plotting the data (constituent concentration detected versus the number of observations per concentration) or by using statistical methods such as the Wilk-Shapiro test (W-test). **Environmental data sets collected randomly are assumed to be log-normally distributed and transformation of the data to logarithmic equivalents is required. The H-statistic shall be used to estimate the 95%UCL-AM constituent concentration for data sets that are log-normally distributed.** If the data set is thought to be normally distributed, then a test of normality shall be conducted. For data sets that are normally distributed, the student t-statistic shall be used to estimate the 95%UCL-AM constituent concentration. If the data set is normally distributed, the sampling design used for data collection shall be evaluated to ensure that the most heavily impacted areas of the AOC have been adequately sampled/characterized and the submittal shall include a plot of the data demonstrating normal distribution. In general, the 95%UCL-AM concentration is representative of the AOIC where the COC is log-normally or normally distributed. At an AOI where the data set is not normally or log-

normally distributed (e.g., comprised of a large proportion of non-detect results), it may be more appropriate to use an alternate measure of central tendency or a 95%UCL-AM estimated using nonparametric statistical methods for the estimation of the AOIC. (*Data Quality Objectives Process for Superfund Interim Final Guidance*, EPA 1993). In the event the COC distribution at an AOI is such that standard statistical methods are not applicable or appropriate for the estimation of an upper bound mean constituent concentration, the Department may require that the limiting RS be met throughout the AOI. This approach serves to: (1) eliminate the uncertainty that may be associated with estimating an upper bound mean concentration at an AOI characterized by a unique COC distribution; and (2) ensure that the COC concentrations remaining at the AOI do not pose an unacceptable risk to human health or the environment.

In the calculation of the 95%UCL-AM constituent concentration for the AOI, all positively detected results (including estimated values flagged with a J qualifier) as well as non-detected results within or on the boundaries of the AOI shall be considered. All non-detect values shall be reported numerically as less than the SQL (e.g., < 0.005 ug/l) **not** as non-detect (ND). All SQL values shall be compared to the limiting RS to document that the SQL is less than or equal to the RS prior to eliminating a constituent from the RECAP assessment. All data points within the AOI shall be used in the calculation of the AOIC unless skewed due to sample bias. If only some of the samples in a medium within the AOI test positive for a constituent, the non-detected results shall not be omitted and zero shall not be substituted for the SQL. The non-detects for the AOI shall be addressed using simple substitution methods, distributional methods, or robust methods. Most commonly, substitution methods are used. This method involves the substitution of a single value as a proxy for each non-detected data value. Frequently used values include the SQL, one-half of the SQL, or the SQL divided by the square root of 2. For a non-detected result for a COC in a sample that is temporally/spatially related to samples containing detected results above the SQL, the value equal to the SQL (rather than one-half the SQL or the square root of the SQL) shall be used as the proxy concentration for the calculation of the 95%UCL-AM constituent concentration. When the SQL is not known and it is not possible or practical to obtain the SQL, the MDL or the value at which the data were censored shall be used as the proxy concentration for the calculation of the 95%UCL-AM concentration. For data sets used for screening purposes, the non-detects shall be assigned the value of the SQL for the COC. Distributional or robust methods shall be used if the non-detects exceed 10 to 15 percent of the data set or if the data set is highly skewed for the AOI. When a relatively large number of non-detect results are present within the AOI, the variability of the data set may be artificially reduced resulting in an artificially low 95%UCL-AM constituent concentration. For further information on simple substitution, distributional, or robust methods refer to *Guidelines for Exposure Assessment Notice* (EPA 1992). Justification shall be given for the method selected and the effect the method may have on summary statistics (95%UCL-AM) shall be discussed in the report. For other issues involving SQL refer to *Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual, Part A* (EPA 1989). The 95%UCL-AM calculations shall be included in the assessment report including a summary table of the data set used to calculate the 95%UCL-AM constituent concentration for each impacted medium and/or AOI. If the data are assumed

to be normally distributed, the submittal shall also contain a data plot demonstrating normal distribution of constituent concentrations at the AOI.

2.8.2.1 AOIC for Soil for MO-1, MO-2, and MO-3 Assessments

If the depth of impact is less than or equal to 15 feet bgs, the AOIC shall be based on the lower of the 95%UCL-AM constituent concentration and the maximum detected constituent concentration for the soil interval extending from ground surface to the depth of impact (surface soil interval). **All** data points (including data points with constituent concentrations less than, equal to, or greater than the limiting standard) located **on** or **within** the boundaries of the AOI from ground surface to the depth of impact shall be included in the calculation of the AOIC unless skewed due to sample bias. If the Department determines that it is warranted based on site-specific conditions (or if the Submitter elects) to divide the 0-15 feet bgs interval into two intervals (0-3 feet bgs and 3 feet bgs - depth of impact), then two AOIC shall be identified: 1) the 95%UCL-AM or the maximum detected constituent concentration for the soil interval extending from ground surface to 3 ft bgs; and 2) the 95%UCL-AM or the maximum detected constituent concentration for the soil interval extending from 3 ft bgs to the depth of impact.

If the depth of impact is greater than 15 feet bgs, two AOIC shall be determined: (1) an AOIC for surface soil (the soil interval extending from ground surface to 15 feet bgs); and (2) an AOIC for subsurface soil (the soil interval extending from 15 feet bgs to the depth of impact). The AOIC for the surface soil interval shall be the lower of the 95%UCL-AM constituent concentration and the maximum detected concentration for the soil interval extending from ground surface to 15 feet bgs. **All** data points (including data points with constituent concentrations less than, equal to, or greater than the limiting standard) located **on** or **within** the boundaries of the AOI from ground surface to a depth of 15 feet bgs shall be included in the calculation of the AOIC for the surface soil interval unless skewed due to sample bias. The AOIC for the subsurface soil interval shall be the lower of the 95%UCL-AM constituent concentration or the maximum detected concentration for the soil interval extending from 15 feet bgs to the depth of impact. **All** data points (including data points with constituent concentrations less than, equal to, or greater than the limiting standard) located **on** or **within** the boundaries of the AOI from 15 feet bgs to the depth of impact shall be included in the calculation of the AOIC for the subsurface soil interval unless skewed due to sample bias.

Dry Weight versus Wet Weight. In general, it is not necessary to adjust the reported constituent concentration in soil prior to calculation of the AOIC. Typically, exposure concentrations (and the risk-based SS and RS) are based on a wet-weight concentration whereas source concentrations (and environmental fate and transport SS and RS) are based on a dry-weight concentration. Analytical data for soil are routinely reported on a wet-weight basis. If requested, the analytical laboratory can report the percent moisture of the sample to allow for the conversion of the results to a dry-weight basis. In general, most soils have a relatively low percent of moisture and the difference between the wet-weight concentration and the dry-weight concentration is not usually significant. **Therefore, it is not necessary to adjust the reported constituent**

concentration prior to calculation of the AOIC for comparison with an environmental fate and transport SS or RS. For soils with a high moisture content (such as sediment), the wet-weight and dry-weight concentrations may differ significantly, therefore, the reported concentration should be adjusted to account for the percent moisture prior to calculation of the AOIC for comparison with a environmental fate and transport SS or RS. The wet-weight concentration may be converted to the dry-weight concentration as follows:

$$\text{Dry-weight concentration} = \frac{\text{Wet-weight concentration}}{\text{1 kg wet soil}} \times \frac{\text{1 kg wet soil}}{\text{1.0 - (\% moisture) kg dry soil}}$$

Facilities with multiple AOI shall develop a separate AOIC for each AOI. The soil AOIC shall be compared to the limiting standard for the Option being implemented.

2.8.2.2 AOIC for Soil Impacted with a Volatile Constituent Located Beneath an Enclosed Structure for MO-1, MO-2, and MO-3 Assessments

If the soil impacted with a volatile constituent is located beneath an enclosed structure, the AOIC shall be the lower of the 95%UCL-AM constituent concentration and the maximum detected concentration for the soil located beneath the enclosed structure. If it is technically infeasible to characterize the soil beneath the enclosed structure, then the AOIC shall be the lower of the 95%UCL-AM constituent concentration and the maximum detected concentration for the soil located immediately adjacent to the enclosed structure that is most likely to be representative of the COC concentration in soil beneath the structure. The AOIC for soil shall be presented in units of mg/kg.

2.8.2.3 AOIC for Groundwater Source Modeling for MO-3 Assessments

For the prediction of future constituent concentrations at the POC or potentially reaching a POE, the lower of the 95%UCL-AM constituent concentration and the maximum detected concentration shall be used as the AOIC for groundwater environmental fate and transport models which allow for the input of a single constituent concentration. **All** data points (including data points with constituent concentrations less than, equal to, or greater than the SS) located **on** or **within** the boundaries of the groundwater plume shall be included in the calculation of the AOIC unless skewed due to sample bias. For an environmental fate and transport model which allows for the input of multiple constituent concentrations, the constituent concentrations detected at individual sampling locations shall be used. Facilities with multiple groundwater plumes shall develop a separate AOIC for each plume. The AOIC for groundwater shall be presented in units of mg/l.

2.8.2.4 AOIC for Sediment for MO-3 Assessments

The AOIC for sediment shall be the lower of the 95%UCL-AM concentration and the maximum concentration for the AOI. The AOI shall be delineated by comparing the constituent concentration for each sampling location with the respective quantitation limit or Department-approved background concentration. **All** data points (including data points with constituent concentrations less than, equal to, or greater than the appropriate quantitation limit or Department-approved background concentration) located **on** or **within** the boundaries of the AOI shall be included in the calculation of the AOIC unless skewed due to sample bias. The AOIC for sediment shall be presented in units of mg/kg.

2.8.2.5 Exposure Concentration for Biota for MO-3 Assessments

The exposure concentration for biota shall be the lower of the 95%UCL-AM constituent concentration and the maximum detected constituent concentration for the edible portion of the samples collected. For estimated current and future biota concentrations, the highest modeled constituent concentration shall be used as the exposure concentration. An exposure concentration shall be established for each target species or group of species as appropriate based on species-specific and site-specific considerations. Tissue concentrations shall be presented in units of mg/kg.

2.8.3 Groundwater Compliance Concentration

The CC is the constituent concentration detected in **groundwater** at the POC (refer to Section 2.11 for guidelines on establishing the POC) that is compared to the groundwater SS or limiting RECAP Standard. If, based on site-specific conditions, it is determined that the COC concentration detected at the POC is not representative of the COC concentration present in the groundwater in the source area, the COC concentration detected at the POC shall be adjusted prior to being compared to the SS or limiting RS (e.g., if the distance from the source area to the POC is greater than 50 feet, then the COC concentration detected at the POC shall be multiplied by a DAF to account for dilution and attenuation of the COC concentration due to migration from the source area to the POC). Compliance concentrations shall be determined for all POC for groundwater meeting the definition of Groundwater Classification 1, 2, or 3 and shall be presented in units of mg/l. If a POE is present within the AOC or the AOI for a Groundwater Classification 1 or 2 aquifer, then the COC concentration detected at the POE shall be used to demonstrate compliance with the limiting RS. Facilities with multiple groundwater plumes or multiple POC shall develop a compliance concentration for each plume and/or POC. For the evaluation of future exposure/risk under MO-3, the highest concentration predicted via groundwater fate and transport modeling to reach the POC shall be used as the CC. Constituent migration shall be simulated until the maximum concentration is predicted at the POE and the simulation period shall not be less than 70 years unless otherwise approved by the Department. The compliance concentration shall be compared to the SS or the limiting MO-1, MO-2, or MO-3 groundwater RS.

2.9 Land Use

Current and future land use shall be determined in order to characterize the activities and activity patterns of the potentially exposed population. The current and future land use category assigned to the AOI is subject to Department approval. The following land use categories shall be used for the RECAP:

2.9.1 Industrial/Commercial

Industrial/Commerical land use refers to any property not currently used for human habitation on a permanent or temporary/intermittent basis having the following North American Industry Classification System (NAICS) major group numbers 11-21; 22 (except 22131); 23-56 inclusive; 61 (except 61111, 61121, 61131); 62 (except 62211, 62221, 62231, 62311, 62322, 623311, 623312, 62399, 62411, and 62441); 71 (except 71219); 72 (except 721191, 721211, and 72131); 81 (except 81411); and 92 (except 92214). The NAICS codes are defined in Appendix E. Industrial/Commerical property shall include any block(s) or lot(s) of land controlled by the same owner or operator that are vacant land(s) found within or beside developed land(s). For leased lands, industrial/commerical property includes the leasehold and any containers, vessels, tanks, or any other contrivances or units that provide for the management of COC to or from the leasehold. If the Submitter proposes to manage the AOC or AOI under an industrial/commerical land use scenario, the AOC or AOI shall meet the following additional criteria: the facility is zoned for industrial use (areas not zoned shall be considered as industrial if the property is currently used for industrial purposes and the use falls under one or more of the NAICS codes) and future use of the property remains industrial. If land use at an AOC or an AOI managed under the RECAP changes from industrial/commercial to non-industrial, the Submitter/responsible party shall notify the Department within 30 days and the AOI shall be re-evaluated. If a residential dwelling is located within the AOI (e.g., house trailer on industrial property), the land use shall be considered residential for the purpose of management of the AOI under the RECAP. If constituent migration from an industrial site has impacted an adjacent residential area, an industrial AOI and a residential AOI shall be identified. It should be noted that industrial dumping on rural land does not constitute industrial land use.

2.9.2 Non-industrial

Non-industrial land use refers to any property that does not meet the exclusive definition of an industrial property. Such properties may be residential, recreational, farming (livestock or vegetative), or undeveloped lands that are not included in the industrial property description (privately-owned lands, wetlands, state and national parks). For the SO, MO-1, and MO-2, a non-industrial land use scenario shall be represented by a residential scenario.

If future land use is unknown at the AOI, a future non-industrial scenario shall be assumed unless there is a strong reason to assume otherwise. Justification/documentation for not considering a non-industrial scenario shall be included in the RECAP submittal.

In some cases, an industrial facility may house a day care center within the boundaries of the facility or a person or persons reside at the facility in a designated housing unit. The Submitter, in order to retain and use the industrial scenario, shall demonstrate to the Department that acceptable exposure levels (RS) for a non-industrial scenario will not be exceeded at the day care center or housing unit.

If land use at an AOI managed under the RECAP changes (or is likely to change) from industrial/commercial to non-industrial, the Submitter/responsible party is required to notify the Department within 30 days.

For further guidance on land use issues refer to *Land Use in the CERCLA Remedy Selection Process* (EPA 1995).

2.10 Groundwater/Aquifer Use

For the purpose of implementing the RECAP, groundwater shall be classified into Groundwater Classification 1, 2, or 3, as determined by current or potential use, maximum sustainable yield, and/or Total Dissolved Solids (TDS) concentration. The Groundwater Classification assigned to the aquifer(s) of concern by the Submitter is subject to Department approval. The information required to classify the groundwater zone(s) of concern at the AOI shall be collected during the site investigation and shall include: (1) the current use of the aquifer determined by identifying all existing water wells and usage within one-mile radius of the AOI property boundaries (at a minimum, a DOTD well survey obtained within the past 12 months and a 500-foot radius walking receptor survey shall be performed); (2) the maximum sustainable yield determined by well yield estimation methods or by direct measurements which are outlined in Appendix F; and/or (3) the background total dissolved solids (TDS) concentration of the aquifer of concern determined by EPA Method 160.1. Note: Well yield measurements obtained from an aquifer that is hydraulically connected to a nearby surface water body may be influenced by the surface water body and not representative of the aquifer storativity. Therefore, the aquifer may be classified as a Groundwater Classification 3 zone after an adequate demonstration is made to the Department that the well yield measurements are influenced by pumpage from the surface water body. In lieu of classifying the groundwater zone of concern based on current or potential use, maximum sustainable yield, and/or TDS concentration, the Submitter may assume the zone is a Groundwater Classification 1 zone (Exception: If the AOI is eligible for reimbursement under the motor fuels trust fund, the Submitter may assume the zone is a Groundwater 1 zone only if approved by the Department).

All impacted underground waters of the state shall be evaluated using one of the groundwater classifications defined under RECAP.

The identifying criteria for the three Groundwater Classifications are defined as follows:

Groundwater Classification 1

Class 1A: Groundwater within an aquifer or that has a direct hydraulic connection to an aquifer that currently supplies drinking water to a public water supply. A public water supply is defined as a water supply which provides water to the public and has a minimum of 15 service connections or regularly serves a minimum of 25 individuals daily at least 60 days out of the year (State of Louisiana Sanitary Code);

or

***Class 1B*:** Groundwater within an aquifer that could potentially supply drinking water to a public water supply. The aquifer should be sufficiently permeable to transmit water to a well at a maximum sustainable yield of greater than or equal to 4,800 gallons per day (gpd) (6 households x 4 persons per household x 100 gpd x peaking factor of 2); **and**

Groundwater quality is such that it has a TDS concentration less than or equal to 1,000 milligrams per liter (mg/l).

NOTE:

(1) An aquifer meeting the Groundwater Classification 1 criteria is considered an underground source of drinking water and shall be protected or restored to its maximum beneficial use (residential use).

(2) A water supply that serves greater than six households is considered to be a public water supply as it is assumed that the average household has four occupants. Each person in the household is considered to use 100 gallons of water per day (Louisiana Department of Health and Hospitals). To ensure that water is available on an as-needed basis, a peaking factor of two has been applied to the daily water consumption rate. Therefore, a value of 4,800 gpd has been established as the minimum sustainable yield for a public water supply.

Groundwater Classification 2

Class 2A: Groundwater within an aquifer that currently supplies water to a domestic water supply, agricultural supply or any other supply. A domestic water supply is defined as one which provides water to an individual household or households but is not considered to be a public water supply as defined in Groundwater Classification 1;

or

Class 2B: Groundwater within an aquifer that could potentially supply drinking water to a domestic water supply. The aquifer should be sufficiently permeable to transmit water to a well at a maximum sustainable yield of greater than or equal to 800 gpd and less than 4,800 gpd (4 persons per household x 100 gpd x peaking factor of 2); **and**

Groundwater quality is such that it has a TDS concentration less than or equal to 1,000 mg/l;

or

Class 2C: Groundwater within an aquifer that could potentially supply drinking water to a domestic water supply. The aquifer should be sufficiently permeable to transmit water to a well at a maximum sustainable yield of greater than or equal to 800 gpd; **and**

Groundwater quality is such that it has a TDS concentration greater than 1,000 mg/l and less than or equal to 10,000 mg/l.

NOTE:

(1) If a public water supply well is located within one mile of the AOI property boundaries and is screened in the same stratum as the aquifer of concern or has a direct hydraulic connection, then the aquifer shall be classified as a Groundwater Classification 1 aquifer.

(2) It is assumed that the average household has four occupants and that each person in the household uses 100 gallons of water per day (Louisiana Department of Health and Hospitals). To ensure that water is available on an as needed basis, a peaking factor of two has been applied to the daily water consumption rate. Therefore, a value of 800 gpd has been established as the minimum yield for a potential domestic water supply.

(3) A yield of 800 gpd is approximately the median yield for an underground source of drinking water as defined by EPA (150-1440 gpd) (*Assistance on Compliance of 40 CFR Part 191 with Groundwater Protection Standards*, Memorandum, EPA, Office of Water, June 1993).

(4) If the limiting RS for the protection of an aquifer meeting the definition of Groundwater Classification 2 is less than the limiting RS for the protection of an aquifer meeting the definition of Groundwater Classification 1, then the aquifer shall be managed as a Groundwater Classification 1 aquifer.

Groundwater Classification 3

Class 3A: Groundwater within an aquifer that is sufficiently permeable to transmit water to a well at a maximum sustainable yield of less than 800 gpd;

or

Class 3B: Groundwater quality is such that it has a TDS concentration greater than 10,000 mg/l.

NOTE:

(1) If a domestic or agricultural water supply well is located within one mile of the AOI property boundaries and is screened in the same stratum as the aquifer of concern or has a direct hydraulic connection, then the aquifer shall be classified as a Groundwater Classification 2 aquifer.

(2) If the limiting RS for the protection of an aquifer meeting the definition of Groundwater Classification 3 is less than the limiting RS for the protection of an aquifer meeting the definition of Groundwater Classification 2, then the aquifer shall be managed as a Groundwater Classification 2 aquifer.

The Groundwater Classifications are illustrated in Figure 3.

2.11 Point of Exposure/Point of Compliance for Groundwater

The **point of exposure (POE)** for groundwater shall be the point in the aquifer where exposure to groundwater is occurring or may reasonably be expected to occur. The **point of compliance (POC)** for groundwater shall be the point in the aquifer where the groundwater RS is enforced and where groundwater monitoring takes place. A sampling location positioned as near to the source as feasible without causing an adverse impact to groundwater at which reproducible and representative samples can be withdrawn shall serve as the POC.

Based on site-specific conditions, the identification of more than one POC may be warranted. If the POE for one exposure pathway lies between the POC and POE for another exposure pathway, then the RS for both pathways shall be evaluated and if warranted, the RS and/or DF shall be adjusted such that the exposure levels are acceptable at the points of exposure for both pathways (e.g., if a POE for the inhalation of volatile emissions released from groundwater to the ambient air and/or a POE for the inhalation of volatile emissions released from groundwater to an enclosed structure lies between the POC and the POE for the application of a GW_3 RS, then the GW_3, DF3 or DAF3, GW_{es}, and GW_{air} RS shall be evaluated, and if warranted, adjusted so that the COC concentrations potentially reaching all identified POE are acceptable).

The POE and POC for GW_1 (and GW_{SS}), GW_2, and GW_3 are illustrated in Figure 9. The assumed points of exposure and the points of compliance for the groundwater classifications defined in Section 2.10 are as follows.

2.11.1 Groundwater Classification 1

The **POE** for an underground drinking water source meeting the criteria for Groundwater Classification 1 shall be assumed to be throughout the aquifer to be protected/restored.

The **POC** for the application of the groundwater SS (GW_{SS}) or limiting RS shall be a sampling location placed as near to the source as feasible without causing an adverse impact to groundwater at which reproducible and representative samples can be withdrawn. The groundwater SS or limiting RS shall be met throughout the aquifer to be protected/restored.

2.11.2 Groundwater Classification 2

In the absence of an on-site exposure point, the **POE** for an underground drinking water source meeting the criteria for Groundwater Classification 2 shall be assumed to be at the facility's property boundary (nearest to the source and/or downgradient of the source) or the nearest downgradient point off-site that could reasonably be considered for installation of a drinking water well within the aquifer to be protected/restored.

The **POC** for the application of the groundwater SS or limiting RS shall be a sampling location placed as near to the source as feasible without causing an adverse impact to groundwater at which reproducible and representative samples can be withdrawn. Appropriate and protective estimates of COC attenuation from the POC to the POE may be applied to the GW_2 RS prior to application at the POC.

2.11.3 Groundwater Classification 3

The **POE** for a groundwater source meeting the criteria for Groundwater Classification 3 shall be assumed to be at the potential point of discharge to the nearest downgradient surface water body within the aquifer to be protected/restored.

The **POC** for the application of the groundwater SS or limiting RS shall be a sampling location placed as near to the source as feasible without causing an adverse impact to groundwater at which reproducible and representative samples can be withdrawn. Appropriate and protective estimates of COC attenuation from the POC to the POE may be applied to the GW_3 RS prior to application at the POC. It should be noted that RECAP does not authorize the migration of COC offsite to adjacent property (but rather serves to evaluate the acceptability of constituent concentrations with respect to human health and the environment).

2.11.4 Groundwater Emissions to an Enclosed Structure

The **POE** for groundwater containing a volatile constituent located beneath an enclosed structure shall be assumed to be throughout the portion of the aquifer to be protected/restored that is located beneath, or expected to migrate beneath, the enclosed structure.

The **POC** for the application of the groundwater RS (GW_{es}) shall be a sampling location placed: 1) as near to the source as feasible without causing an adverse impact to

groundwater; and 2) as near to the enclosed structure as possible at which reproducible and representative samples of the maximum constituent concentration beneath the enclosed structure can be withdrawn.

2.11.5 Groundwater Emissions to Ambient Air

The **POE** for shallow groundwater containing a volatile constituent shall be assumed to be throughout the aquifer to be protected/restored.

The **POC** for the application of the groundwater RS (GW_{air}) shall be a sampling location placed as near to the source as feasible without causing an adverse impact to groundwater at which reproducible and representative samples can be withdrawn.

2.12 Screening Standards and RECAP Standards

The methodologies and exposure assumptions used for the development of the SS and RS are consistent with current EPA guidelines [*Risk Assessment Guidance for Superfund, Volume I Human Health Evaluation Manual, Part A (RAGS-A)* (EPA 1989); *Risk Assessment Guidance for Superfund, Volume I Human Health Evaluation Manual, Part B Development of Risk-Based Preliminary Remediation Goals (RAGS-B)* (EPA 1991)*; Soil Screening Guidance (SSG)* (EPA 1996)*; Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual Part E Supplemental Guidance Dermal Risk Assessment Interim Guidance* (EPA 1998); and *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites* (EPA 2001)]. For the development of the SS, MO-1 RS, and Appendix I RS, the toxicity values were obtained from the following hierarchy of references: (1) *Integrated Risk Information System (IRIS)* (EPA, http://www.epa.gov/iris/); (2) National Center for Environmental Assessment (NCEA) provisional values (http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm); (3) *Health Effects Assessment Summary Tables (HEAST)* (EPA); or (4) withdrawn from IRIS or HEAST.

Refer to Appendix H for detailed guidance on: (1) the identification and application of the limiting SS or RS; and (2) methods for the development of the SS and RS. Refer to Figures 10 through 15 for illustrations on the development of the SS and SS. Refer to Figures 16 and 17 for the illustration of identifying applicable soil standards for surface soil and subsurface soil, respectively. Refer to Figures 18 and 19 for an illustration of the application of the soil and groundwater RS.

2.12.1 Soil Screening Standards for the SO

$Soil_{SSni}$ The $Soil_{SSni}$ represents a constituent concentration in soil that is protective of human health for non-industrial land use. The $Soil_{SSni}$ shall be obtained from Table 1. For a constituent not listed in Table 1, a $Soil_{SSni}$ shall be calculated in accordance with Appendix H. The exposure pathways addressed by the $Soil_{SSni}$ include the ingestion of soil, the inhalation of volatile emissions released from soil to the ambient air, and dermal contact with soil. Exposure assumptions representative of a RME scenario for non-industrial (residential) land use were

applied. A risk-based standard was developed for both carcinogenic and noncarcinogenic health effects, and the lower of the two values was identified as the $Soil_{SSni}$. The $Soil_{SSni}$ is applicable to surface soil.

$Soil_{SSi}$ The $Soil_{SSi}$ represents a constituent concentration in soil that is protective of human health for industrial/commercial land use. The $Soil_{SSi}$ shall be obtained from Table 1. For a constituent not listed in Table 1, a $Soil_{SSi}$ shall be calculated in accordance with Appendix H. The exposure pathways addressed by the $Soil_{SSi}$ include the ingestion of soil, the inhalation of volatile emissions released from soil to the ambient air, and dermal contact with soil. Exposure assumptions representative of a RME scenario for industrial/commercial land use were applied. A risk-based standard was developed for both carcinogenic and noncarcinogenic health effects and the lower of the two values was identified as the $Soil_{SSi}$. The $Soil_{SSi}$ is applicable surface soil.

$Soil_{SSGW}$ The $Soil_{SSGW}$ represents a constituent concentration in soil that is not expected to result in the leaching of an unacceptable constituent concentration from soil to groundwater. The $Soil_{SSGW}$ serves to protect groundwater meeting the definition of Groundwater Classification 1 and is applicable to groundwater meeting the definition of Groundwater Classifications 1, 2, and 3. Thus, the $Soil_{SSGW}$ represents the constituent concentration in soil that will not result in a groundwater concentration that exceeds the GW_{SS}. As an alternative to applying the $Soil_{SSGW}$ at the AOI, the soil to groundwater pathway may be evaluated using the Synthetic Precipitation Leaching Procedure (SPLP) (refer to Appendix H). The soil to groundwater pathway shall be evaluated for surface soil and subsurface soil.

For the compilation of Table 1: (1) the noncarcinogenic $Soil_{SSi}$ and $Soil_{SSni}$ were based on a target hazard quotient of 0.1 and the carcinogenic $Soil_{SSi}$ and $Soil_{SSni}$ were based on a target risk level of 10^{-6}; (2) the $Soil_{SSni}$, $Soil_{SSi}$, and $Soil_{SSGW}$ were compared to the soil saturation concentration ($Soil_{sat}$) [for constituents that are in the liquid state at ambient temperature, i.e., those having a melting point less than or equal to 20°C (with the exception of the TPH fractions and mixtures)] and the lower of the two values was entered as the SS in Table 1. Therefore, $Soil_{sat}$ is not listed in Table 1 as a separate SS; and (3) if the $Soil_{SSni}$, $Soil_{SSi}$, or $Soil_{SSGW}$ was less than the analytical quantitation limit, the quantitation limit was entered in Table 1 as the SS.

2.12.2 Soil RECAP Standards for MO-1, MO-2, and MO-3

$Soil_{ni}$ The $Soil_{ni}$ represents a constituent concentration in soil that is protective of human health for non-industrial land use. The exposure pathways addressed by the $Soil_{ni}$ include the ingestion of soil, the inhalation of volatile emissions released from soil to the ambient air, and dermal contact with soil. Default exposure assumptions representative of a RME scenario for non-industrial (residential) land use shall be applied under MO-1 and MO-2. Site-specific RME assumptions approved by the Department shall be applied for non-industrial land uses under

MO-3. A risk-based standard shall be developed for both carcinogenic and noncarcinogenic health effects and the lower of the two values shall be identified as the $Soil_{ni}$. For MO-1, the $Soil_{ni}$ shall be obtained from Table 2. For a constituent not listed in Table 2, a $Soil_{ni}$ shall be calculated in accordance with Appendix H. Under MO-2 and MO-3, site-specific environmental fate and transport data may be used in the estimation of a site-specific volatilization factor (VF) (refer to Appendix H). The $Soil_{ni}$ is applicable to surface soil.

$Soil_i$ The $Soil_i$ represents a constituent concentration in soil that is protective of human health for industrial/commercial land use. The exposure pathways addressed by the $Soil_i$ include the ingestion of soil, the inhalation of volatile emissions released from soil to the ambient air, and dermal contact with soil. Default exposure assumptions representative of a RME scenario for industrial/commercial land use shall be applied under MO-1 and MO-2. Site-specific exposure data representative of a RME scenario and approved by the Department may be used under MO-3. A risk-based standard shall be developed for both carcinogenic and noncarcinogenic health effects, and the lower of the two values shall be identified as the $Soil_i$. For MO-1, the $Soil_i$ shall be obtained from Table 2. For a constituent not listed in Table 2, a $Soil_i$ shall be calculated in accordance with Appendix H. Under MO-2 and MO-3, site-specific environmental fate and transport data may be used in the estimation of a site-specific volatilization factor (VF) (refer to Appendix H). The $Soil_i$ is applicable to surface soil.

$Soil_{GW}$ The $Soil_{GW}$ represents a constituent concentration in soil that does not result in the leaching of an unacceptable constituent concentration from soil to groundwater. The $Soil_{GW}$ shall be based on the classification of the groundwater to be protected: **$Soil_{GW1}$** shall be based on the protection of groundwater meeting the definition of Groundwater Classification 1 (the $Soil_{GW1}$ shall not result in a groundwater concentration that exceeds the GW_1); **$Soil_{GW2}$** shall be based on the protection of groundwater meeting the definition of Groundwater Classification 2 (the $Soil_{GW2}$ shall not result in a groundwater concentration that exceeds the GW_2 at the POE); **$Soil_{GW3DW}$** shall be based on the protection of groundwater meeting the definition of Groundwater Classification 3 that may potentially discharge to a surface water body designated as a drinking water source (the $Soil_{GW3DW}$ shall not result in a groundwater concentration that exceeds the GW_{3DW} at the POE); and **$Soil_{GW3NDW}$** shall be based on the protection of groundwater meeting the definition of Groundwater Classification 3 that may potentially discharge to a surface water body designated as a non-drinking water source (the $Soil_{GW3NDW}$ shall not result in a groundwater concentration that exceeds the GW_{3NDW} at the POE). The $Soil_{GW2}$ shall be multiplied by a dilution and attenuation factor that accounts for the reduction in constituent concentration with groundwater migration from the source to the nearest downgradient property boundary. The $Soil_{GW3}$ shall be multiplied by a dilution and attenuation factor that accounts for the reduction in constituent concentration with groundwater migration from the source to the nearest downgradient surface water body. For MO-1, the $Soil_{GW}$

shall be obtained from Table 2 and the default dilution factor shall be obtained from Appendix H. For a constituent not listed in Table 2, a $Soil_{GW}$ shall be calculated in accordance with Appendix H. Under MO-2 and MO-3 site-specific environmental fate and transport data may be used to calculate a site-specific $Soil_{GW}$ RS and dilution and attenuation factor (refer to Appendix H). Refer to Section 2.10 for Groundwater Classification definitions, Section 2.11 for guidance on establishing the POC and POE, and Section 2.12.2 for GW_1, GW_2, GW_{3DW}, and GW_{3NDW} definitions. As an alternative to the $Soil_{GW}$ RS, the soil to groundwater pathway may be evaluated using a leach test (refer to Section H1.1 of Appendix H). The soil to groundwater pathway shall be evaluated for surface soil and subsurface soil.

$Soil_{es}$ The $Soil_{es}$ represents a constituent concentration in soil that does not result in an unacceptable constituent concentration in indoor air due to the actual or potential intrusion of volatile emissions from soil to indoor air within an enclosed structure. The $Soil_{es}$ shall be based on the protection of human health and shall be developed for the appropriate land use scenario (non-industrial or industrial/commercial). The exposure pathway addressed by the $Soil_{es}$ is the inhalation of volatile emissions released from soil to indoor air within an enclosed structure (refer to Section 2.1 for a definition of an enclosed structure). A risk-based $Soil_{es}$ standard shall be developed for both carcinogenic and noncarcinogenic health effects and the lower of the two values shall be identified as the $Soil_{es}$. The MO-1 $Soil_{es}$ RS are presented in Table 2. Under MO-2 and MO-3, site-specific environmental fate and transport data may be used in the development of the $Soil_{es}$. The $Soil_{es}$ shall be calculated in accordance with Appendix H. In general, the $Soil_{es}$ is applicable to soil present at a depth less than or equal to 15 feet bgs that is impacted with volatile constituents and located beneath an enclosed structure. The applicability of the $Soil_{es}$ at an AOI shall be determined by the Department based on site-specific conditions and the level of concern associated with the potential release of volatile emissions from soil to an enclosed structure. As an alternative to the $Soil_{es}$ RS, the soil to indoor air pathway may be evaluated under MO-2 and MO-3 using soil gas sampling or indoor air sampling if approved by the Department (for further guidance on the evaluation of indoor air COC concentrations refer to Section B.2.5.12 of Appendix B and Section H1.1.3.5 of Appendix H). The acceptable indoor air concentration for vapor inhalation (C_a) shall be determined in accordance with Section H2.3 of Appendix H.

$Soil_{sat}$ The $Soil_{sat}$ concentration represents a chemical-physical limit where saturation of the soil occurs. A constituent concentration in soil at or above the $Soil_{sat}$ indicates the potential for NAPL to be present in the soil. The $Soil_{sat}$ parameter is only applicable to constituents present in a liquid phase at ambient temperatures (constituents with melting points greater than 20^oC). For MO-1, the $Soil_{sat}$ shall be obtained from Table 2. For a constituent not listed in Table 2, a $Soil_{sat}$ shall be calculated in accordance with Appendix H. The $Soil_{sat}$ may be calculated using site-specific environmental fate and transport data under MO-2 and MO-3 in

accordance with Appendix H. The $Soil_{sat}$ is applicable to surface soil and subsurface soil.

For the compilation of Table 2: (1) the noncarcinogenic $Soil_i$ and $Soil_{ni}$ were based on a target hazard quotient of 1.0 and the carcinogenic $Soil_i$ and $Soil_{ni}$ were based on a target risk level of 10^{-6}; and (2) if the $Soil_{ni}$, $Soil_i$, or $Soil_{GW}$ was less than the analytical quantitation limit, the quantitation limit was entered in Table 2 as the RS.

2.12.3 Soil RECAP Standards for MO-2 and MO-3

$Soil_{ni}$-PEF The $Soil_{ni}$-PEF represents a constituent concentration in soil that is protective of human health for non-industrial land use. The exposure pathways addressed by the $Soil_{ni}$ include the ingestion of soil, the inhalation of volatile emissions released from soil to the ambient air, the inhalation of soil particulates, and dermal contact with soil. Default exposure assumptions representative of a RME scenario for non-industrial (residential) land use shall be applied. A risk-based standard shall be developed for both carcinogenic and noncarcinogenic health effects and the lower of the two values shall be identified as the $Soil_{ni}$-PEF. Site-specific environmental fate and transport data may be used in the calculation of the volatilization factor (VF) and the particulate emission factor (PEF) in accordance with Appendix H. The $Soil_{ni}$-PEF is applicable to surface soil at an AOI with unusually high fugitive dust emissions (an AOI that does not have ground cover, an AOI that includes uncovered soil piles, an AOI that includes heavily traveled unpaved roads, etc.).

$Soil_i$-PEF The $Soil_i$-PEF represents a constituent concentration in soil that is protective of human health for industrial/commercial land use. The exposure pathways addressed by the $Soil_i$-PEF include the ingestion of soil, the inhalation of volatile emissions released from soil to the ambient air, the inhalation of soil particulates, and dermal contact with soil. Default exposure assumptions representative of a RME scenario for industrial/commercial land use shall be applied. A risk-based standard shall be developed for both carcinogenic and noncarcinogenic health effects and the lower of the two values shall be identified as the $Soil_i$-PEF. Site-specific environmental fate and transport data may be used in the calculation of the volatilization factor (VF) and the particulate emission factor (PEF) in accordance with Appendix H. The $Soil_i$-PEF is applicable to surface soil at an AOI with unusually high fugitive dust emissions (an AOI that does not have ground cover, an AOI that includes uncovered soil piles, an AOI that includes heavily traveled unpaved roads, etc.).

2.12.4 Groundwater Screening Standard for the SO

GW_{SS} The GW_{SS} serves to protect groundwater meeting the definition of Groundwater Classifications 1, 2, and 3. The GW_{SS} represents a constituent concentration in groundwater that is protective of human health. The GW_{SS} shall be obtained from Table 1. For a constituent not listed in Table 1, the Safe

Drinking Water Act (SWDA) Maximum Contaminant Level (MCL) shall be identified as the GW_{SS}. If an MCL is not available, then a risk-based standard shall be developed in accordance with Appendix H. If an MCL listed in Table 1 is revised by the EPA, the revised value shall serve as the GW_{SS}. The exposure pathways addressed by the GW_{SS} include the ingestion of groundwater and the inhalation of volatile emissions associated with indoor groundwater use. Exposure assumptions representative of a non-industrial (residential) RME scenario shall be applied. A risk-based standard was developed for both carcinogenic and noncarcinogenic health effects and the lower of the two values was identified as the GW_{SS}. The GW_{SS} is applicable to groundwater meeting the definitions of Groundwater Classifications 1, 2, and 3. A dilution and attenuation factor shall **not** be applied to the GW_{SS}.

For the compilation of Table 1, the GW_{SS} was compared to the water solubility ($Water_{sol}$) and the lower of the two values was entered in Table 1 as the GW_{SS}. Therefore, $Water_{sol}$ is not listed as a separate SS in Table 1. If the GW_{SS} was less than the analytical quantitation limit, the quantitation limit was entered in Table 1 as the GW_{SS}.

2.12.5 Groundwater RECAP Standards for MO-1, MO-2, and MO-3

GW_1 The GW_1 serves to protect groundwater meeting the definition of Groundwater Classification 1. The GW_1 represents a constituent concentration in groundwater that is protective of human health. The GW_1 shall be obtained from Table 3. For a constituent not listed in Table 3, the SDWA MCL shall serve as the GW_1. If a MCL listed in Table 3 is revised by the EPA, the revised value shall serve as the GW_1 RS. If a MCL is not available, then a risk-based GW_1 shall be developed in accordance with Appendix H. The exposure pathways addressed by the GW_1 include the ingestion of groundwater and the inhalation of volatile emissions associated with indoor groundwater use. Default exposure assumptions representative of a non-industrial (residential) RME scenario shall be applied. A risk-based standard shall be developed for both carcinogenic and noncarcinogenic health effects and the lower of the two risk-based values shall be identified as the GW_1. The GW_1 RS is applicable to groundwater meeting the definition of Groundwater Classification 1 (refer to Section 2.10 for the Groundwater Classifications).

GW_2 The GW_2 serves to protect groundwater meeting the definition of Groundwater Classification 2. The GW_2 represents a constituent concentration that is protective of human health. The GW_2 shall be obtained from Table 3. For a constituent not listed in Table 3, the SDWA MCL shall serve as the GW_2 RS. If a MCL listed in Table 3 is revised by the EPA, the revised value shall serve as the GW_2 RS. If a MCL is not available, then a risk-based GW_2 shall be developed in accordance with Appendix H. The exposure pathways addressed by the risk-based GW_2 include the ingestion of groundwater and the inhalation of volatile emissions associated with indoor groundwater use. Exposure assumptions representative of a non-industrial (residential) RME scenario were

applied. A risk-based standard shall be developed for both carcinogenic and noncarcinogenic health effects, and the lower of the two values was identified as the GW_2. The GW_2 shall be multiplied by a dilution and attenuation factor that accounts for the reduction in constituent concentration with groundwater migration from the source to the nearest downgradient property boundary (POE). For MO-1, the default dilution factor (DF2) shall be obtained from Appendix H. Under MO-2 and MO-3, site-specific environmental fate and transport data may be used to calculate a site-specific dilution and attenuation factor (DAF2) (refer to Appendix H). A GW_2 standard shall not result in a constituent concentration in groundwater that poses unacceptable health risk for other pathways of exposure such as the inhalation of volatile emissions released from groundwater to ambient air or the inhalation of volatile emissions released from groundwater to an enclosed structure. This standard does not authorize the migration of COC offsite to adjacent property but rather serves to evaluate the acceptability of constituent concentrations with respect to human health and the environment. The GW_2 RS is applicable to groundwater meeting the definition of Groundwater Classification 2 (refer to Section 2.10 for the Groundwater Classifications and Section 2.11 for guidance on establishing the POC and POE).

GW_3 The GW_3 serves to protect groundwater meeting the definition of Groundwater Classification 3. The GW_3 represents a constituent concentration in groundwater that will not result in the cross-media transfer of a constituent from groundwater to a downgradient surface water body. The GW_3 shall be obtained from Table 3. For a constituent not listed in Table 3, the surface water criterion (LAC 33:IX.1113) for the protection of human health shall serve as the GW_3. The human health protection criterion shall be identified based on the use classification of the surface water body (segment or subsegment) to be protected. If a constituent is not listed in LAC 33:IX.1113, then a GW_3 shall be calculated in accordance with Appendix H. The **GW_{3DW}** shall be based on the protection of a downgradient surface water that is classified as a drinking water source. The **GW_{3NDW}** shall be based on the protection of a downgradient surface water that is classified as a non-drinking water source. The GW_{3DW} or the GW_{3NDW} shall be multiplied by a dilution and attenuation factor that accounts for the reduction in constituent concentration with groundwater migration from the source to the nearest downgradient surface water body (POE). For MO-1, the default dilution factor (DF3) shall be obtained from Appendix H. Under MO-2 and MO-3, site-specific environmental fate and transport data may be used to calculate a site-specific dilution and attenuation factor (DAF3) (refer to Appendix H). Refer to Section 2.11 for guidance on establishing the POC and POE). The objective of the GW_3 RECAP standard is to provide protection against the migration and discharge of a COC via groundwater to a surface water body. It is **not** the intent of this standard to allow the discharge of a COC to surface water. This standard does not authorize the migration of COC offsite to adjacent property but rather serves to evaluate the acceptability of constituent concentrations

with respect to human health and the environment. A GW_3 standard shall not result in a constituent concentration in groundwater that poses unacceptable health risk for other pathways of exposure such as the inhalation of volatile emissions released from groundwater to ambient air or the inhalation of volatile emissions released from groundwater to an enclosed structure.

$Water_{sol}$ The $Water_{sol}$ represents a chemical-physical limit where saturation of the water occurs. Constituent concentrations in water at or above the water solubility limit indicate a potential for NAPL to be present. The $Water_{sol}$ value shall be obtained from Table 3. For a constituent not listed in Table 3, the $Water_{sol}$ shall be obtained from EPA's *Superfund Chemical Data Matrix* or other published technical reference. Refer to Appendix H for the recommended hierarchy of sources for obtaining chemical-specific data.

GW_{es} The GW_{es} represents a constituent concentration in groundwater that does not result in an unacceptable constituent concentration in indoor air due to the actual or potential intrusion of volatile emissions from groundwater to an enclosed structure (refer to Section 2.1 for a definition of enclosed structure). The GW_{es} is protective of human health and shall be developed for the appropriate land use scenario (non-industrial or industrial/commercial). The exposure pathway addressed by the GW_{es} is the inhalation of volatile emissions released from groundwater to indoor air within an enclosed structure. The GW_{es} respresents the constituent concentration in groundwater that corresponds to an acceptable vapor concentration in the indoor air of the enclosed structure. The MO-1 GW_{es} RS are presented in Table 3. Under MO-2, default exposure assumptions representative of a RME scenario shall be applied. Under MO-3, Department-approved site-specific exposure data may be used in the development of the GW_{es}. Under MO-2 and MO-3, site-specific environmental fate and transport data may be used in the development of the GW_{es}. A risk-based standard shall be developed for both carcinogenic and noncarcinogenic health effects and the lower of the two values shall be identified as the GW_{es}. The GW_{es} shall be calculated in accordance with Appendix H. Refer to Section 2.11 for guidance on establishing the POE and POC for the groundwater to enclosed structure pathway. In general, the GW_{es} is applicable to groundwater present at a depth less than or equal to 15 feet bgs that is impacted with a volatile constituent and located beneath (or expected to migrate beneath) an enclosed structure. The applicability of the GW_{es} at an AOI shall be determined by the Department based on site-specific conditions and the level of concern associated with the potential release of volatile emissions from groundwater to an enclosed structure. As an alternative to applying a GW_{es} RS at the AOI, the groundwater to indoor air pathway may be evaluated under MO-2 and MO-3 using soil gas sampling or indoor air sampling if approved by the Department (for further guidance on the evaluation of indoor air COC concentrations refer to Section B.2.5.12 of Appendix B and Section H1.2.3.5 of Appendix H). The acceptable indoor air concentration for vapor inhalation (C_a) shall be determined in accordance with Section H2.3 of Appendix H.

GW_{air} The GW_{air} represents a constituent concentration in groundwater that does not result in an unacceptable constituent concentration in ambient air due to the actual or potential release of volatile emissions from groundwater to the ambient air. The exposure pathway addressed by the GW_{air} is the inhalation of volatile emissions released from groundwater to outdoor air. The MO-1 GW_{air} RS are presented in Table 3. Under MO-2, default exposure assumptions representative of a RME scenario shall be applied. For MO-3, Department-approved site-specific RME data may be used. Under MO-2 and MO-3, site-specific environmental fate and transport data may be used in the development of the GW_{air}. A risk-based standard shall be developed for both carcinogenic and noncarcinogenic health effects and the lower of the two values shall be identified as the GW_{air}. In general, the GW_{air} is applicable to groundwater present at a depth less than or equal to 15 feet bgs that is impacted with a volatile constituent. The applicability of the GW_{air} at an AOI shall be determined by the Department based on site-specific conditions and the level of concern associated with the potential release of volatile emissions from groundwater to ambient air. As an alternative to applying a GW_{air} RS at the AOI, the groundwater to ambient air pathway may be evaluated using air monitoring if approved by the Department. The acceptable ambient air concentration for vapor inhalation (C_a) shall be determined in accordance with Section H2.3 of Appendix H.

2.12.6 RECAP Standards for Other Media and/or Exposure Pathways for MO-3

Site-specific RS shall be developed for other media (air, surface water, sediments, biota, etc.) and/or exposure pathways as warranted by site conditions.

2.13 Identification of a Background Concentration

A background concentration is defined as the concentration of a constituent present in an environmental medium that is distinguishable from an identifiable source concentration. An evaluation of the background conditions at an AOI is warranted when a COC that is found to pose a risk to human health or the environment is thought to be attributable to naturally-occurring background concentrations of the COC. The background concentration may be used: (1) to distinguish site-related constituent concentrations from naturally-occurring constituent concentrations, i.e., in the identification of site-related COC; and (2) as a default SS or RS when the limiting SS or RS is less than the naturally-occurring background concentration. The background concentration applied at an AOC or an AOI for these purposes shall be: (1) a State-specific concentration established by the Department; or (2) a site-specific concentration based on sample collection/analysis by the Submitter and approved by the Department. State-specific background concentrations may be developed for frequently encountered constituents pursuant to this regulation. The State-specific background concentrations shall serve as SO SS and MO-1 RS and shall be listed in Tables 1-3. In the absence of a Department-derived, State-specific, background concentration, the background concentration shall be established via the collection and analysis of background samples obtained from an area within the vicinity of the AOC or the AOI that has not been impacted by site activities (or other

contaminant source) and that shares the same basic characteristics as the medium of concern. Background samples shall be collected for each medium of concern. The need, and required level of effort, for background characterization shall be determined on a site-specific basis. Sampling considerations for establishing background include the natural variability of metals, operational practices, source characteristics, constituent mobility, soil type, sample number, and sample locations. Soil background samples shall be collected from similar depths and soil types which shall be consistent with the depths and soil types in which the maximum levels of COC are found within the AOI. An insufficient number of background samples, inappropriate background sample locations, unknown or suspect data quality, alterations in the land (excavation, filling, new sources, etc.) since data collection, and gaps in the available data will result in the need for further background characterization. Regional or local background data from published sources may be used for qualitative analyses of site conditions but shall not be used in a quantitative manner to evaluate site-specific background conditions. If a COC is not naturally-occurring or the COC concentrations present at the AOI are not suspected to be greater than background concentrations, characterization of background conditions is not warranted.

A minimum dataset consisting of 4 discrete samples shall be required to establish a site-specific background concentration for soil. For a dataset consisting of 7 or fewer discrete samples, the arithmetic mean constituent concentration (unless skewed due to sample bias) shall be used to define the background concentration at the AOC or the AOI. For a dataset consisting of 8 or more discrete samples, the arithmetic mean constituent concentration (unless skewed due to sample bias) plus one standard deviation shall be used to define the background concentration at the AOC or AOI as presented below. (Note: the mean concentration plus one standard deviation shall be used to estimate background concentrations only and shall not be used for the estimation of the AOIC.)

1. Calculate the mean background concentration (BG_μ):

$$BG_\mu = (BG_1 + BG_2 + BG_3 \ldots BG_n)/n$$

2. Calculate the background variance (BG_s^2) by taking the sum of the squares of each reading minus the mean and dividing by the degrees of freedom (the total number of background samples minus 1):

$$BG_s^2 = [(BG_1 - BG_\mu)^2 + (BG_2 - BG_\mu)^2 + \ldots (BG_n - BG_\mu)^2]/n\text{-}1$$

3. Calculate the background standard deviation (BG_σ) by taking the square root of the variance:

$$BG_\sigma = (BG_s^2)^{1/2}$$

4. Evaluate the distribution of the background data using the Coefficient of Variation Test (CV) where:

$$CV = BG_{\sigma} / BG_{\mu}$$

The CV should not exceed 1. If the data distribution exceeds a CV of 1, then the data should be evaluated to determine the source of the variability. If the data evaluation indicates that a data point does not accurately represent background concentrations, the outlier data point may be excluded or additional background data points may be collected to ensure the dataset used to estimate the background concentration is truly representative of background conditions.

5. Calculate the upper limit of the background data as follows:

$$BG = BG_{u} + BG_{\sigma}$$

The site-specific background concentration (BG) is subject to Department approval prior to application at the AOI. A BG value based on a background data set characterized by high variability or skewed due to one or more outlier values shall not be approved by the Department if it is questionable that the data are truly representative of background conditions. Statistical methods used to establish background concentrations are subject to Department approval.

To determine if a constituent is site-related or attributable to natural background, compare the BG calculated in Step 5 to the arithmetic mean constituent concentration (**not** the 95%UCL-AM constituent concentration) detected within the AOI:

If the AOI arithmetic mean constituent concentration is less than or equal to the BG, then the presence of the constituent at the AOI shall be considered to be attributable to background and shall not be identified as a COC.

If the AOI arithmetic mean constituent concentration is greater than the BG, then the constituent shall be identified as a COC and included in the RECAP assessment.

In the event a limiting SS or limiting RS is less than the background concentration, the background concentration (determined as described above) shall be used as the default limiting SS or RS. A background concentration used as a default SS or RS shall receive Department approval prior to application at the AOC or the AOI. The background concentration shall not be used as a SS or RS in the event the Department determines that the background concentration for a COC poses an unacceptable acute or chronic risk to human health or the environment for current or future land use. The background concentration shall not be subtracted from the reported concentration(s) at the AOI.

2.14 Acceptable Risk Levels

Acceptable risk levels for site management decisions under the SO, MO-1, MO-2, and MO-3 shall be determined in accordance with the following guidelines.

2.14.1 Target Risk Levels

Carcinogenic Health Effects. The total cumulative cancer risk estimate for an AOI shall not exceed the target risk level (1E-06 to 1E-04) approved by the Department for the Option being implemented. The total cumulative cancer risk shall include all COC and exposure pathways identified for each receptor population and shall be estimated as follows: Total Risk = $[(AOIC_1/RS_1) + (AOIC_2/RS_2) + \ldots + (AOIC_i/RS_i)] \times 10^{-6}$. If the total cumulative cancer risk estimate exceeds the target risk, then typically, corrective action shall be warranted. Carcinogenic COC, exposure pathways, and media screened out under previously completed Options shall not be included in the calculation of the total cumulative cancer risk for the Option currently being implemented at the AOI.

Screening Standards and RECAP Standards shall be based on a target cancer risk of 10^{-6} in accordance with EPA guidelines and policy (*Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual Part B Development of Risk-Based Preliminary Remediation Goals,* EPA 1991*; Soil Screening Guidance,* EPA 1996*; Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites,* EPA 2001; *Role of Baseline Risk Assessment in Superfund Remedy Selection Decisions,* EPA 1991; NCP 40 CFR 300.430(e)(2); *Risk-based Concentration Tables,* EPA Region III; EPA Region IV; *Human Health Medium-Specific Screening Levels*, EPA Region VI; and *Preliminary Remediation Goals* EPA Region IX. For carcinogens, it is generally assumed that setting a 10^{-6} target risk level for individual constituents and pathways will result in a total cumulative cancer risk that is within the acceptable risk range of 10^{-6} to 10^{-4} (*Soil Screening Guidance*, EPA 1996). Under MO-3, an alternate target risk level may be approved by the Department for the development of site-specific MO-3 RS if warranted by site-specific conditions. An alternate target cancer risk level will only be considered acceptable for the development of site-specific MO-3 RS when it can be demonstrated that the total cumulative cancer risk for a RME scenario is less than or within the target range of 10^{-6} to 10^{-4}. The use of a target cancer risk level above 10^{-6} shall be justified based on site-specific conditions, the level of certainty in the nature and extent of impact (level of certainty in the site characterization and analytical data), the level of certainty in the nature and extent of exposure, the level of confidence in the risk assessment results, and technical factors. Other considerations include compliance with ARAR, cumulative effect of multiple COC, the potential for human exposure from other pathways at the AOC or the AOI, population sensitivities, potential impacts on environmental receptors, cross-media impacts, financial assurance/commitment, future site use, the reliability of alternatives, the weight-of-scientific evidence concerning exposures, quantitation limits for the COC, technical limitations to remediation, the ability to monitor and control movement of COC, and background levels of COC. The Department has a preference for site management decisions that meet the more protective end of the target range (i.e., 10^{-6}). For an AOI where a total cumulative risk level above 10^{-6} is deemed acceptable by the Department, the risks associated with all carcinogens detected on-site shall be considered in the estimation of: (a) cumulative cancer risks; and (b) cumulative risks associated with residual constituent concentrations following corrective action to document that the total cumulative cancer risk is at or below 10^{-4}. It should be noted that corrective action may be warranted even if the cancer risk is within

the target range if: (a) a chemical-specific standard that defines acceptable risk (ARAR) is exceeded; (b) the potential for noncarcinogenic adverse health effects is unacceptable (HI > 1.0); (c) an adverse environmental impact has occurred or may occur; and/or (d) ecological risks are unacceptable.

Noncarcinogenic Health Effects. The total hazard index (THI) for each critical effect/target organ shall not exceed a target hazard index of 1.0 in accordance with EPA guidelines (*Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual*, *Part B - Development of Risk-Based Preliminary Remediation Goals,* EPA 1991*; Soil Screening Guidance,* EPA 1996). A target hazard quotient of 1.0 corresponds to an acceptable exposure level for exposure to a single constituent via a single medium. Therefore, a RECAP Standard based on a target hazard quotient of 1.0 represents an acceptable exposure concentration for exposure to a single constituent via a single medium. If multiple COC or impacted media are present, the RECAP standards based on noncarcinogenic health effects must be evaluated for potential additive health effects and if warranted adjusted so that the total hazard index for each critical health effect/target organ is less than or equal to 1.0. Refer to Appendix G for guidance on adjusting RECAP standards to account for additive health effects. RECAP Screening Standards are based on a target hazard quotient of 0.1 and therefore do not require adjustment when multiple COC or impacted media are present. The hazard index (HI) for each critical health effect/target organ shall include all COC and exposure pathways identified for the Option being implemented and shall be determined as follows: $HI = [(AOIC_1/RS_1) + (AOIC_2/RS_2) + \ldots + (AOIC_i/RS_i)]$. To determine the total hazard index for each critical health effect/target organ (THI), the HI for all impacted media to which a receptor is simultaneously exposed shall be summed. If the HI for a given critical effect exceeds 1.0, then typically, corrective action shall be warranted. Media, COC, and exposure pathways screened out under Options previously completed shall not be included in the calculation of the total hazard index for the Option currently being implemented at the AOI. It should be noted that corrective action may be warranted even if the total hazard index for a critical health effect/target organ is less than or equal to 1.0 if: (a) a chemical-specific standard that defines acceptable risk is exceeded; (b) carcinogenic effects are unacceptable; (c) an adverse environmental impact has occurred or may occur; and/or (d) ecological risks are unacceptable.

2.14.2 Applicable or Relevant and Appropriate Requirements

When an Applicable or Relevant and Appropriate Requirement (ARAR) for a specific constituent defines an acceptable level of exposure, compliance with the ARAR shall typically be considered protective even if it is outside the risk range (unless there are extenuating circumstances such as exposure to multiple constituents, exposure via multiple pathways, or exposure to more than one medium) (*Memorandum: Role of Baseline Risk Assessment in Superfund Remedy Selection Decision*, EPA 1991). Examples of ARAR that may be considered acceptable for use under the RECAP include primary drinking water standards (MCL) (SDWA), secondary drinking water standards, federal ambient water quality criteria; national ambient air quality standards (NAAQS);

Louisiana Water Quality Standards, and Louisiana Air Quality Standards. The use of an ARAR under the RECAP is subject to Department approval.

2.14.3 Background Concentrations and Quantitation Limits

If deemed appropriate by the Department based on current and future land use, compliance with a Department-approved background concentration (refer to Section 2.13) or Department-approved analytical quantitation limit shall be considered to be acceptable even if the associated risk is outside the target cancer risk range or if the hazard index is greater than 1.0 for that COC. A RS based on a background concentration or quantitiative limit shall not be adjusted to account for additive health effects.

2.14.4 Acute Health Risks

It should be noted that for residential land use, acute toxicity may be a concern for a child receptor engaging in soil pica (25-60 gm/day) at COC (barium, cadmium, copper, cyanide, fluoride, nickel, phenol, vanadium, and lead) concentrations equal to the SS or RS which are based on the protection of chronic health effects (Calabrese, et. al.1997). If warranted, the SS and/or RS shall be adjusted downward to be protective of acute health effects potentially associated with soil pica for the child receptor.

2.14.5 Ecological Risks

An ecological checklist should be completed for each AOI. If an ecological risk assessment is determined to be warranted, it shall be conducted in accordance with Section 7.0. If the hazard quotient method is used for the assessment of ecological risks, acceptable risk shall be a defined as a hazard index of less than or equal to 1.0. If unacceptable environmental/ecological risks are determined to be associated with constituent concentrations at an AOI (refer to Section 7.0), corrective action shall be warranted even if there is no significant risk to human health.

2.15 Identification of Toxicity Values

Noncarcinogenic Health Effects. The toxicity values used to assess noncarcinogenic health effects under the RECAP include oral reference doses (RfD_o) and reference concentrations (RfC). For use in the calculation of soil and groundwater SS and RS, the RfC must be converted from units of mg/m^3 (acceptable concentration in air) to mg/kg-day (inhalation RfD) by dividing the RfC by 70 kg (an assumed body weight) and multiplying by 20 m^3/day (an assumed inhalation rate). The critical effect(s) identified by EPA as the basis for the development of the RfD and RfC shall be identified for each COC (that elicits noncarcinogenic health effects) included in the MO-1, MO-2, or MO-3 assessment.

Carcinogenic Health Effects. The toxicity values used to assess carcinogenic health effects under RECAP include slope factors (SF) and inhalation unit risk values. For use

in the calculation of SS and RS, the inhalation unit risk must be converted from units of risk per ug/m^3 to risk per mg/kg-day (inhalation SF) by multiplying the inhalation unit risk by 70 kg (an assumed body weight) and dividing by 20 m^3/day * 10^{-3} ug/mg (an assumed inhalation rate). The weight-of-evidence classification accompanying the oral slope factor and inhalation unit risk value shall be identified for each carcinogenic COC included in the MO-1, MO-2, or MO-3 assessment. The oral slope factor and inhalation unit risk value for continuous lifetime exposure during adulthood shall be used to develop SS and RS for industrial/commercial land use. The oral slope factor and inhalation unit risk value for continuous lifetime exposure from birth shall be used to develop SS and RS for nonindustrial (residential) land use. For polychlorinated biphenyls (PCB), the upper bound slope factor shall be selected based on the medium and exposure pathway under evaluation and the degree of chlorination of the PCB congeners of concern. For polycyclic aromatic hydrocarbons, slope factors shall be developed for the carcinogenic constituents using the SF for benzo(a)pyrene and the appropriate toxicity equivalent factor (TEF) (refer to Appendix D). Polychlorinated dibenzodioxins and dibenzofurans, shall be evaluated in accordance with the guidelines in Appendix D.

Identification of Toxicity Values. The RfD, RfC, SF, and inhalation unit risk value used under RECAP shall be obtained from the following hierarchy of sources: (1) EPA's *Integrated Risk Information System* (*IRIS*) (http://www.epa.gov/iris/); (2) EPA's National Center for Environmental Assessment (NCEA) provisional values (http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm); (3) EPA's *Health Effects Assessment Summary Tables* (EPA); (4) withdrawn from IRIS or HEAST; or (5) other EPA or EPA-recommended source. The RfD for the evaluation of total petroleum hydrocarbons shall be obtained from Appendix D. Surrogate RfD for select PAH constituents are presented in Appendix D. Toxicity values used in the development of SS or RS shall be presented in the RECAP submittal along with the critical effect for noncarcinogenic health effects, EPA carcinogenic classification for the carcinogenic health effects, and reference(s).

Route-to-Route Extrapolation. EPA toxicity values for the **dermal** route of exposure are not available. The oral toxicity values shall be used for the dermal route of exposure with the exception of cadmium. For cadmium, the oral RfD shall be converted to a dermal RfD by multiplying the oral RfD by an oral absorption efficiency of 0.05 (Appendix A of *Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual*, EPA 1989; *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual Supplemental Guidance Dermal Risk Assessment Interim Guidance*, EPA 2000). For a constituent lacking an **inhalation** toxicity value: (1) for the SO and MO-1: the oral toxicity value may be used to evaluate the inhalation route; or (2) for MO-2 and MO-3: route-to-route extrapolation may be performed using EPA-approved methods. Route-to-route extrapolation methods shall account for the relationship between physical/chemical properties and absorption and distribution of the toxicant, the significance of portal-of-entry effects, and the potential differences in metabolic pathways associated with the intensity and duration of inhalation exposure. Toxicity values derived via a route-to-route extrapolation shall be identified in the RECAP submittal and are subject to Department approval. For the generation of Tables

1, 2, and 3: (1) the oral toxicity value was used to assess the dermal route of exposure; (2) the oral toxicity value was used to assess the inhalation route of exposure in the absence of an inhalation toxicity value.

Toxicity Values Not Available. If an EPA toxicity value is not available for a COC, the Submitter may: 1) refer to the Department for a surrogate toxicity value; 2) develop a toxicity value using current EPA methodology if adequate toxicological data are available; or 3) identify a surrogate toxicity value based on similarities in physical/chemical properties, critical effects, mechanism of action, and toxicokinetics. A toxicity value developed by the Submitter or a surrogate toxicity value identified by the Submitter shall receive approval from the Department **prior** to the use of the value in a RECAP assessment. To receive approval, the methods used for the development/identification of the toxicity value shall be documented, referenced, and consistent with current EPA guidelines. The supporting documentation shall contain a comprehensive toxicity profile including systems, critical effects and mechanisms of toxicity; the concentrations at which adverse effects are expected to occur in humans; absorption efficiency for relevant routes of exposure; and a brief description of the overall toxicological database available and the level of confidence associated with the database. References for toxicity values and toxicological data cited shall be included in the report. Toxicity values are not available for lead. Lead shall be evaluated in accordance with Appendix D.

If a toxicity value presented in the RECAP document is revised by the EPA: 1) the SS and MO-1 RS shall **not** be re-calculated using the revised toxicity value; and 2) the MO-2 and MO-3 RS shall be calculated using the revised toxicity value.

If the toxicity of a COC is dependent on the speciation/isomer present and speciation/isomer data is not available, then it shall be assumed that the most toxic speciation/isomer of the COC is present at the AOI.

2.16 Monitored Natural Attenuation

Monitored natural attenuation is defined as the biodegradation, dispersion, dilution, sorption, volatilization, and/or chemical and biochemical transformation/stabilization of constituents to effectively reduce constituent concentration, toxicity, mobility, mass, or volume to levels that are protective of human health and the ecosystem (USEPA ORD, OSWER). Monitored natural attenuation may be applied as a stand alone remedial process or included as a unit operation of a remedial process. It should be evaluated and compared to other remedial processes to determine which is the most appropriate process for a site. As with any remedial process, monitored natural attenuation should be selected only where it can meet all of the remedial goals for the site and where it can obtain those goals in an appropriate timeframe. An appropriate timeframe is one that is reasonable compared to that offered by other remedial methods. To ensure that the timeframe estimates are comparable, the assumptions used in each treatment proposal evaluated are to be consistent ["*Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites*" (OSWER Directive Number 9200.4-17P)]. Unless otherwise approved by the Department, the criteria

presented in Sections 2.16.1, 2.16.2, and 2.16.3 should be followed for monitored natural attenuation plans submitted to the Department.

2.16.1 Evidence to Support Monitored Natural Attenuation

Monitored natural attenuation of COC impacting soil and/or groundwater may be allowed as a remedial alternative when it has been demonstrated to the Department that the COC, under site-specific conditions, will naturally attenuate to the appropriate RS without causing adverse impacts. Department requirements for a monitored natural attenuation program shall include adequate evidence to support a determination that:

1) All sources of COC have been controlled and NAPL has been removed/controlled to the extent of technical practicability;

2) The plume has reached declining conditions and the area of constituent concentrations above SS is not expanding;

3) Constituents are susceptible to natural degradation processes;

4) Constituent concentrations reaching human or ecological receptors do not result in unacceptable risks (refer to Section 2.14); and

5) Conditions are favorable for degradation and/or natural attenuation of the COC (This shall include documentation of the constituent(s)' degradability and/or attenuation capacity and identification and discussion of site-specific characteristics which support natural attenuation. Monitoring results shall be submitted which demonstrate that site-specific conditions are conducive to the natural processes of degradability and/or attenuation).

2.16.2 Contingency Plan

A contingency remedial plan shall be included with the *Evidence to Support Monitored Natural Attenuation* in the event that the natural attenuation remedy fails to achieve the remedial goals. The contingency plan may be an assessment of the AOI under a higher tier (MO-1, MO-2, or MO-3) or actions that will be taken to develop and implement an active remediation program.

If the Department, at any time, determines that: (1) a COC being monitored under a natural attenuation compliance program has the potential to migrate to a human or ecological receptor above the applicable RS; (2) COC concentrations are not decreasing; (3) applicable RS will not be reached within a reasonable timeframe; or (4) in any way fails to achieve the remedial goals of the program within a reasonable timeframe, then the contingency plan shall be implemented. The Department may require the use of institutional controls as a condition to the approval of a natural attenuation compliance program when necessary to protect current or future use.

2.16.3 Documentation of the Effectiveness of Monitored Natural Attenuation

A plan to evaluate the progress of the remedy shall be included. This plan must provide specifics on sampling points, sampling methods, sampling frequency, analytical parameters, analytical methods, and Quality Assurance/Quality Control procedures.

The following specific requirements for groundwater are to be addressed in the plan:

1) The establishment of a sentinel monitoring well system for impacted groundwater designed to detect a COC in groundwater prior to reaching any potential human or ecological receptor. This system shall be located between the impacted plume and the human or ecological receptor at a point at least 2-years travel time upgradient of the exposure point(s) unless otherwise approved by the Department;

2) A POC monitoring well network sufficient to document reduction of contaminant concentrations at the source and for confirmation of attainment of RECAP standards at the POC; and

3) A network of monitoring wells extending from the source area down-gradient to the leading edge of the plume. These wells should be located near the mid-line of the plume in order to evaluate spatial and temporal variation of the plume and obtain geochemical data documenting that NA is occurring and to document specific processes occurring.

The plan is to state when reports shall be issued addressing the following items as deemed to be appropriate for site-specific conditions:

1) The treatment pathways and processes including potential byproducts of the COC;

2) The rate of treatment for each COC and for any byproducts;

3) The usage rate of electron acceptors and any related geochemical parameters that contribute to the natural attenuation process;

4) The treatment mass balance for each COC, any byproducts, and related electron acceptors;

5) Isopleths for each COC, electron acceptors, and byproducts; and

6) In some cases, microbiological laboratory data supporting degradation and decay rates.

2.16.4 Determination of the Biodegradation Rate and Retardation Factor

The biodegradation rate and retardation factor used in fate and transport modeling must be derived from site-specific monitored natural attenuation data. It is not the intent of

this sub-section to outline a step-by-step procedure of how to derive these parameters, but to provide a general overview of the type of basic information required to justify these parameters. Additional information on how to confirm and quantify biodegradation may be obtained from the "*Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water,*" EPA/600/R-98/128 or "*Technical Protocol for Implementing Intrinsic Remediation with Long-Term Monitoring for Natural Attenuation of Fuel Contamination Dissolved in Groundwater,*" Air Force Center for Environmental Excellence Technology Transfer Division 03/08/99.

The biodegradation rate can be derived using isopleths developed from site monitoring data. The isopleths are to include the COC, tracer, electron acceptors, and metabolic byproducts. The tracer is a chemical that is unaffected by biodegradation and may be inherent to the site. The contaminant concentration is to be normalized for advection, dispersion, dilution, and sorption. (Microcosms can be used to determine that biodegradation is occurring at a site but cannot be substituted for field data.)

The retardation factor by definition is the advective velocity of the groundwater divided by the advective velocity of the contaminant. The advective velocity of the groundwater can be derived from properties collected from pumping tests or slug tests and soil physical data obtained from the borehole. The advective velocity of the contaminant can be derived using contaminant iso-concentration drawings developed from site monitoring data. This method of deriving the retardation assumes that biodegradation is not occurring. If retardation and biodegradation are both occurring, then the retardation factor will have to be corrected to remove the biodegradation component.

2.17 Institutional Controls

It is the Department's preference that the RECAP objectives of protection of human health [target risk range of 10^{-6} to 10^{-4} (or less) and/or hazard index less than or equal 1.0], prevention of cross-media transfer, and the protection of resource aesthetics be met without the use of institutional controls. However, under site-specific conditions or when it is **not** technically or economically feasible (as determined by a corrective study) to attain these objectives, institutional controls may be used to supplement treatment and/or containment-based remedial action provided that Department approval is obtained. For an AOI with residual constituent concentrations that: (1) exceed the cumulative cancer risk level of 10^{-4}; (2) exceed a total hazard index of 1.0; (3) result in the exceedance of a limiting RS based on cross-media transfer; and/or (4) exceed a limiting RS based on the protection of resource aesthetics, institutional controls and/or financial assurance shall be required (as deemed appropriate by the Department). Institutional controls shall not be used in such a manner that a property or portion of a property is rendered unsuitable for commerce.

Institutional controls may be used by the Submitter to supplement treatment and/or containment-based remedial action provided that Department approval is obtained. Institutional Controls may not be used as stand-alone remedial measures to address the contamination present at the site. The post-closure care associated with institutional

controls will require the Submitter to notify the Department of any situation which may result if the institutional control becomes non-effective and corrective actions have to be taken.

Conveyance Notification. Institutional controls will usually require a legal instrument to be recorded in the parish conveyance records for the subject property. This legal instrument shall clearly state the notice or restriction imposed on the site; the description of the site; and a scaled site map showing the affected soil and groundwater zones. A conveyance notification shall be required under the following site conditions:

(1) A conveyance notification shall be placed on all properties having residual constituent concentrations in soil that are greater than the acceptable exposure concentration defined for non-industrial (residential) land use [i.e., constituent concentrations greater than the $Soil_{ni}$ (or $Soil_{esni}$ if applicable)]. Note: If land use at the AOI is industrial and the limiting soil RS applied at the AOI is a non-risk-based RS ($Soil_{GW}$, $Soil_{sat}$, quantitation limit, or background level) that is lower than the $Soil_{ni}$ (or $Soil_{esni}$) (if applicable), then a conveyance notification shall not be required.

(2) A Groundwater 2 Zone shall be required to have a conveyance notification on that portion of the plume within property boundaries that contains a residual constituent concentration that exceeds the GW_2 RS (without the application of a dilution and attenuation factor).

However, other legal controls may be implemented at the site such as a zoning ordinance by a local government which prevents the installation of groundwater wells and use of existing wells for potable or other purposes. If such a local ordinance is developed, the following must be submitted to the Department: (1) a copy of the ordinance restricting the stated actions at the site; and (2) a scaled map showing the horizontal and vertical extent of contamination of soils or groundwater and the legal boundaries of all properties on which soils or groundwater exceed the RECAP standard. If for any reason the ordinance that is being used as an institutional control changes, the Department reserves the right to evaluate the use of the changed ordinance as an institutional control. Changes or variances to the ordinance must be submitted by the owner/operator/responsible person of the affected site to the Department at least 30 days prior to the scheduled action date.

2.18 Self-Implementation of the RECAP

In some instances, the Submitter may wish to expeditiously remediate an impacted area that is discovered during routine operations or construction activities or that may be due to spill events. This type of activity is implemented by the Submitter without prior LDEQ approval in an effort to prevent migration of COC and/or impact to receptors. Although these actions are often termed interim measures, they are sometimes of sufficient scope and magnitude such that additional corrective action is not warranted. **Self-implementation of the RECAP shall be allowed for these types of activities provided that the following conditions are adhered to:**

(1) All reporting requirements to the Department shall be met;

(2) The Department shall be notified prior to samples being collected:

(a) Within five working days for planned sample events (e.g., a scheduled remediation event); or within two working days when non-time critical (non-emergency) events impact a remediation (e.g., severe rainfall event, unexpected changes to a planned remediation); or as soon as possible but prior to completion of remediation for time critical/unexpected events (e.g., real time spill remediation); and

(b) The sampling notification may be made in person, by telephone or, preferably, in writing to the appropriate LDEQ personnel. The sampling notification requirement has been satisfied if the appropriate LDEQ representative is present on-site during the sampling event and provided an opportunity to collect split samples or if a written waiver of the sampling notification requirement has been provided to the Submitter by the LDEQ prior to the sampling event. Written documentation of all personal and telephone sampling notifications required by this section shall be made to the Department within five (5) working days after the sampling notification. In the event that the five-day written sampling notification was not made, the Submitter shall provide, in the written documentation, a justification as to why such sampling notification was not made;

(3) Reimbursement shall not be sought from the state for remedial action costs that were not part of an emergency response action; and

(4) Engineering or institutional controls shall not be used as part of the final remedy unless installed during an emergency response.

For more extensive site characterization and/or remediation activities, the LDEQ recommends that the LDEQ and the Submitter reach an agreement about site management objectives and site characterization strategy prior to the Submitter expending extensive effort and resources on site activities. Performance of such activities without prior Department approval shall be conducted at the risk of the Submitter.

Investigation Self-Implementation. Preliminary evaluation investigations are conducted for the purpose of determining if a release of COC to the environment has occurred, i.e., screening of the site under the SO (refer to Section 3.0). Typically, these investigations (e.g. Phase II property transfer investigations) are of limited scope and are not sufficient to obtain a NFA-ATT decision from the Department if COC are detected. Site investigations may be self-implemented as preliminary evaluation tools to determine if a release has occurred provided that all laws, regulations, and permit conditions are followed. **Note: If COC are detected at an AOC, applicable LDEQ notification requirements shall be met.**

Self-implemented site investigations that are performed in accordance with Appendix B of this regulation may be considered as part of a more detailed RECAP submittal that includes additional investigation data provided that a sufficient number of samples have been collected and the areas most likely to have been impacted are sampled.

A workplan for a more detailed site investigation should be approved by the Department prior to being implemented. Self-implemented site investigations are performed at the risk of the Submitter. LDEQ may require confirmation sampling for any self-implemented site investigations where no further action is requested.

LDEQ may waive the requirement to submit a Site Investigation Workplan provided that all requirements of Appendix B are followed. The Submitter shall contact the LDEQ to establish the necessity of a Workplan. The requirement for a site investigation Workplan for a MO-1 or MO-2 evaluation shall be made by the Department based on site-specific conditions. A site investigation Workplan shall be submitted for Department approval for all MO-3 evaluations.

The Department may waive the requirement to submit a Site Investigation Workplan at sites determined to be eligible to participate in the Louisiana Motor Fuels Underground Storage Tank Trust Fund. The request for a waiver shall be submitted **prior** to the initiation of field activities and shall include a statement declaring that the investigation will be conducted in accordance with Appendix B. The request for a waiver shall also include a cost estimate to complete the proposed site investigation. The cost estimate shall include all costs related to the completion of the investigation and shall address unit costs should it become necessary to expand the proposed scope of the investigation (horizontally or vertically). Additionally, in order to ensure maximum potential eligibility under the Trust Fund, all site activities shall be conducted in accordance with the latest version of the Louisiana Motor Fuels *Underground Storage Tank Trust Fund Cost Control Guidance Document* and overseen or performed by a Response Action Contractor. Failure to follow these guidelines could result in some or all costs being ruled ineligible for Trust Fund reimbursements.

2.19 Demonstration of Compliance with RECAP Standards

Guidelines for identifying the AOI for remediation are presented below for each Option.

(1) ***Screening Option.*** If corrective action is conducted under the SO, the limiting SS shall serve as the corrective action standard for the identification of the boundaries of the AOI.

(2) ***Management Option 1.*** If corrective action is conducted under MO-1, the limiting MO-1 RS shall serve as the corrective action standard for the identification of the boundaries of the AOI.

(3) ***Management Option 2.*** If corrective action is conducted under MO-2, the limiting MO-2 RS shall serve as the corrective action standard for the identification of the boundaries of the AOI.

(4) ***Management Option 3.*** If corrective action is conducted under MO-3, the limiting MO-3 RS shall serve as the corrective action standard for the identification of the boundaries of the AOI.

Post-corrective action sampling shall be conducted for all media requiring corrective action. The number of data points to be collected shall be determined utilizing the methods presented in *SW846 Test Methods for Evaluating Solid Waste* (EPA) or other methods deemed appropriate by the Department for site-specific conditions. The QA/QC associated with the confirmatory data shall meet the requirements set forth in Sections 2.4 and 2.5.

To demonstrate compliance with the corrective action standards, the residual COC concentration remaining in the environmental medium of concern (soil, sediment, and surface water) following corrective action shall be represented by the lower of the 95%UCL-AM constituent concentration and the maximum detected concentration remaining within the boundaries of the AOI. If appropriate based on site-specific conditions, the use of a volume-weighted average may be approved by the Department for the purpose of demonstrating compliance with the corrective action standard. All confirmatory data points obtained within the boundaries of the AOI shall be used in the calculation of the residual concentration unless skewed due to sample bias. In the calculation of the 95%UCL-AM constituent concentration, all positively detected results (including estimated values flagged with a J qualifier) as well as non-detected results within the boundaries of the AOI shall be considered. Refer to Section 2.8.1 for further guidance on calculating the 95%UCL-AM constituent concentration. Compliance shall be demonstrated when: 1) the residual constituent concentration(s) (the lower of the 95%UCL-AM concentration and the maximum concentration) is less than or equal to the corrective action standard; or 2) the COC concentration detected at each confirmatory sampling location is less than or equal to the corrective action standard. For groundwater, compliance shall be demonstrated when the COC concentration detected at the POC(s) is less than or equal to the corrective action standard for a monitoring frequency and period to be determined by the Department based on site-specific conditions. If the groundwater corrective action standard is exceeded during the post-closure period, further corrective action may be required. For impacted biota, compliance shall be demonstrated when the lower of the 95%UCL-AM concentration and the maximum detected (or modeled) concentration for the edible portion of the samples collected is less than or equal to limiting RS (or predicted to be less than or equal to the limiting RS based on bioaccumulation modeling). The corrective action standard used to demonstrate compliance shall be the limiting RS identified for the medium of concern for the highest RECAP Option completed at the AOI. If it is adequately demonstrated that the residual constituent concentrations at the AOI or in the medium of concern are less than or equal to the corrective action standard, then no further corrective action shall

typically be required. Post-corrective action monitoring requirements shall be determined by the Department on a site-specific basis.

2.20 Identification of Landowners, Lessees, and Servitude Holders

The Submitter shall identify the name and mailing address (to the extent reasonably known and available) of all other landowners, lessees, and servitude holders whose property is within an AOI (reasonably known, for the purpose of this section, means the property interest holder of record as identified on the official parish tax assessor's records). This requirement shall not apply to landowners, lessees, and servitude holders that are owned or controlled by, or under common control of, the Submitter, such as parent and subsidiary corporations and partnerships. Where more than one responsible party exists, this duty is satisfied if any one of the responsible parties submits the information. This submission is due with any report required under RECAP that identifies one or more AOI. It must be updated in any subsequent report required under RECAP if there is any material change in information. A material change includes identification of a new AOI or a change in the boundaries of the AOI which affects a new landowner, new lessee, or new servitude holder not previously identified. A map depicting the AOI and identifying the property owners, lessees, and servitude holders within the AOI shall also be submitted.

This section applies only to RECAP submittals made after October 20, 2003.

3.0 SCREENING OPTION

For soil and groundwater meeting the criteria presented in Section 3.1, the Screening Option (SO) may be used to: (1) demonstrate that the COC concentration present in soil and/or groundwater does not pose a threat to human health or the environment and hence does not require further action at this time; (2) identify the AOI and the COC for corrective action of soil and/or groundwater under the SO; or (3) identify the AOI and the COC (in accordance with Section 2.6) for soil and groundwater for further evaluation under a MO. Department-derived Screening Standards (SS) for soil and groundwater are presented in **Table 1**. These SS were developed using protective assumptions with regard to the protection of human health and the prevention of cross-media transfer. The SS comply with Applicable or Relevant and Appropriate Requirements (ARAR) and consider the protection of resource aesthetics. Refer to Section 2.12 for a description of the SS and to Appendix H and Figures 10 – 12 for the methods and assumptions used in the development of the SS. If a constituent detected in soil or groundwater is not listed in Table 1 and the AOC meets the criteria listed in Section 3.1, a SS shall be calculated using the guidelines in Appendix H.

General data requirements for the Screening Option:

(1) Identification of impacted media;
(2) Identification of the constituents present;
(3) Identification of the maximum constituent concentration within the most heavily impacted area of the AOC/AOI (refer to Appendix B for site investigation requirements and Section 2.4 for data quality requirements);
(4) Identification of the SQL for non-detect results;
(5) SPLP data (optional);
(6) Horizontal and vertical boundaries of the AOI (unless otherwise approved by the Department);
(7) Area (acres) of impacted soil;
(8) Exposure pathways associated with current and future land use; and
(9) Environmental fate and transport pathways for constituent migration.

3.1 Criteria for the Management of Soil and Groundwater Under the Screening Option

In order to develop the Department-derived soil and groundwater SS, assumptions were made with regard to: (1) exposure potential at the AOC (receptors, exposure pathways, exposure frequency and duration, intake rates, cumulative exposures); and (2) site characteristics that influence constituent fate and transport (site size, soil characteristics, hydrogeological conditions, etc.). The application of risk-based and cross-media transfer standards is protective only if the AOI shares the same (or reasonably similar) characteristics as those assumed in the development of the standards. Therefore, the soil and groundwater SS presented in Table 1 (or calculated using the guidelines in Appendix H) are only applicable at an AOC or AOI that meets the management criteria listed below.

Application of the SO SS at an AOC that does meet all of the criteria presented below is subject to Department approval prior to submission of the SO assessment.

3.1.1 General Criteria

(1) A non-industrial or industrial exposure scenario is applicable at the AOC and there are no sensitive subpopulations on or near the site. [The SS only consider non-industrial (residential) and industrial exposure scenarios.]

(2) There are no other likely human exposure pathways at or adjacent to the AOC other than the ingestion of soil, the ingestion of groundwater, the inhalation of volatile emissions from soil, the inhalation of volatile emissions from groundwater during household water use, and dermal contact with soil. [The SS do not address the following pathways: inhalation of soil particulates, the inhalation of volatile emissions from soil to an enclosed structure, the inhalation of volatile emissions from groundwater to an enclosed structure, the ingestion of surface water, the inhalation of volatiles from surface water, dermal contact with surface water, the ingestion of sediment, dermal contact with sediment, the inhalation of volatiles from sediment, or the ingestion of biota (recreational or subsistence fishing and/or fish/shellfish propagation or production; meat or dairy production; agricultural crop production). If one or more of these pathways are of concern at an AOC, they shall be addressed under a MO].

3.1.2 Criteria for Impacted Soil

(1) The area of impacted soil under investigation is approximately 0.5 acre or less [The Q/C parameter for the calculation of the volatilization factor (VF) for $Soil_{SSi}$ and $Soil_{SSni}$ values presented in Table 1 are based upon an area of impacted soil that is 0.5 acre in size.];

Exceptions to this criterion:

(a) Soil impacted with inorganic constituents may be screened using the $Soil_{SSi}$ and $Soil_{SSni}$ regardless of the size of the area of impacted soil since the VF is not used in the development of the SS for inorganic constituents.
(b) If the area of impacted soil is greater than 0.5 acre **and** all other criteria for management under the SO are met, a site-specific $Soil_{SSi}$ or $Soil_{SSni}$ may be calculated using the site-specific area of impacted soil and the guidelines in Appendix H. The only site-specific input that may be incorporated into the development of the site-specific $Soil_{SSi}$ or $Soil_{SSni}$ is the Q/C value used in the calculation of a site-specific VF.
(c) If the area of impacted soil is not known, site-specific SS based on estimated areas of impacted soil shall be calculated and applied at the AOC in a re-iterative manner until the boundaries of the AOI have been defined.
(d) An area of soil that is greater than 0.5 acre may be screened under the SO if the limiting SS is based on a quantitation limit, the soil saturation concentration, the

ceiling concentration of 10,000 ppm for TPH, or an approved background concentration.

(2) The impacted soil under investigation is in declining conditions, i.e., the constituent mass is not increasing, the source of the release has been mitigated, and the area of constituent concentrations above the SS is not expanding. [The environmental fate and transport models used to develop the cross-media transfer SS assume steady-state concentrations over the AOC.]

(3) NAPL is not present (i.e., If NAPL was present at the site but has been, or will be, removed to the extent practicable, the adsorbed concentrations in soil may be addressed in the SO evaluation). [Note: The environmental fate and transport models used to develop the cross-media transfer SS assume that NAPL is not present.];

Exception to this criterion: The SO may be applied at a soil AOC or AOI where NAPL is present, if approved by the Department for the purpose of demonstrating that a CAP (refer to Section 1.2.3) is protective of human health and the environment (i.e., constituent concentrations at or reaching current or potential exposure points or cross-media transfer points are less than or equal to the SS).

(4) Soil impacted with volatile constituents is not present beneath an enclosed structure (the release of volatile emissions from soil to indoor air within an enclosed structure shall be addressed under MO-1, MO-2, or MO-3); and

(5) High fugitive dust emissions are not present [Examples of conditions that contribute to potentially high fugitive dust emissions include dry soil (moisture content less than 8 percent), finely divided or dusty soils (high silt or clay content), high average annual wind speeds (greater than 5.3 m/s), and less than 50 percent vegetative cover. Examples of activities that may generate high dust levels include heavy truck traffic on unpaved roads or other construction related activities. High fugitive dust emissions shall be addressed under MO-2 or MO-3.].

3.1.3 Criteria for Impacted Groundwater

(1) A COC is not discharging via groundwater to a surface water body. [The SS do not address exposure pathways associated with surface water, sediment, or biota. If a COC is discharging via groundwater to a surface water body, then the groundwater shall be addressed under MO-3];

(2) The impacted groundwater under investigation is in declining conditions, i.e., the constituent mass is not increasing, the source of the release has been mitigated, and the area of constituent concentrations above the SS is not expanding. [The environmental fate and transport models used to develop the cross-media transfer SS assume steady-state concentrations over the AOI.];

(3) NAPL is not present (i.e., If NAPL was present at the site but has been, or will be, removed to the extent practicable, the dissolved concentrations in groundwater may be addressed in the SO evaluation). [Note: The environmental fate and transport models used to develop the cross-media transfer SS assume that NAPL is not present.];

Exception to this criterion: The SO may be applied at a groundwater AOC or AOI where NAPL is present, if approved by the Department for the purpose of demonstrating that a CAP (refer to Section 1.2.3) (or current remedial measures) is protective of human health and the environment (i.e., constituent concentrations at or reaching current or potential exposure points or cross-media transfer points are less than or equal to the SS).

(4) Groundwater impacted with volatile constituents is not present (or anticipated to be present) beneath an enclosed structure (the release of volatile emissions from groundwater to indoor air within an enclosed structure shall be addressed under MO-1, MO-2, or MO-3); and

(5) Volatile emissions from groundwater to the ambient air do not represent a significant source of exposure via the inhalation pathway (the release of volatile emissions from groundwater to the ambient air shall be addressed under MO-1, MO-2, or MO-3).

For soil and groundwater screened under the SO, the Submitter shall demonstrate to the Department that the requirements of Section of 3.1 have been met if Department-derived SS are applied at the AOC.

3.2 The Screening Process: Identification and Application of the Soil and Groundwater Screening Standards

Refer to Appendix H for detailed guidance on identifying and applying the SO soil and groundwater SS.

The limiting SS may be used to: (1) document that an AOC does not pose a threat to human health or the environment and, hence, does not require further action at this time; (2) identify the AOI and the COC for management of the AOC under the SO; or (3) identify the AOI and the COC for further evaluation under MO-1, MO-2, or MO-3 in accordance with Section 2.6. To determine if the soil and/or groundwater at an AOC warrants further evaluation under RECAP (i.e., to screen soil and/or groundwater at an AOC), the SS presented in Table 1 (or calculated in accordance with the applicable guidelines) shall be compared to the maximum constituent concentration detected in each impacted medium. The maximum constituent concentration used in the screening process shall be representative of the most heavily impacted area(s) known or suspected to be present within the AOC. Identification of the most heavily impacted area(s) is subject to concurrence by the Department. If the maximum concentration of a COC exceeds the limiting SS for a medium, then the COC shall be managed under the SO or assessed further under a Management Option. If the maximum concentration of a COC is less

than the limiting SS, then the COC is dropped from consideration for that medium (i.e., the COC is screened out under the SO). If the maximum concentration of a COC does not exceed the limiting SS for any medium, then the COC is eliminated from further evaluation. If the maximum concentrations of all COC in a specific medium are less than or equal to their respective limiting SS for that medium, then the medium is dropped from further evaluation (i.e., the medium is screened out under the SO). If the maximum concentrations of all COC in all media are less than or equal to their respective limiting SS, then the AOC typically does not require further evaluation and the SO shall serve to expeditiously document that the AOC does not pose a risk to human health or the environment.

Prior to applying a soil or groundwater SS at an AOC, it is important to recognize that:

(1) The Department-derived SS (Table 1) are not available for all possible chemical forms of a constituent. In some site-specific situations, a constituent may exist in a particular chemical form such that the toxicity and/or fate and transport of the constituent is significantly different from that assumed for the development of the SS, thus making the application of the SS inappropriate under site-specific conditions. For example, the development of a soil SS for barium is based on the assumption that barium is present at the site in a mobile, ionic form. If barium is present at a site in a less mobile, inert, form such as barium sulfate, the SS would not be appropriate for screening the site. Another example is organic mercury. In general, the organic forms of mercury are more toxic than the inorganic forms and have not been addressed under the SO. If an EPA toxicity value is available for a specific chemical form of a constituent, then a SS may be developed by the Submitter. Refer to Section 2.15 for guidance on identifying the toxicity values.

(2) The soil and groundwater (Table 1) SS are based on the protection of human health and environmental resources, they do not address ecological risks. A screening level ecological risk assessment shall be required if the ecological checklist (Appendix C, RECAP Form18) indicates that ecological risks may be of concern. Areas of a facility, media, and constituents eliminated from consideration during the SO shall be included in the evaluation of ecological risks.

3.3 Screening Standards for Other Exposure Pathways and Media

Screening Standards are not available for all soil and groundwater exposure pathways or all environmental media. For exposure pathways not addressed by the soil and groundwater SS (e.g., volatile emissions from soil and groundwater to an enclosed structure, soil particulate emissions to the ambient air, and volatile emissions from shallow groundwater to the ambient air) and other environmental media (e.g., surface water, sediment and biota), the Department-approved analytical quantitation limit or background concentration for the medium of concern shall serve as the SS.

3.4 Screening Option Submittal Requirements

A SO Submittal Report shall be submitted to the Department for approval. This report shall, at a minimum, meet the submittal requirements listed below. Any variance from these requirements is subject to Department approval prior to submission of the SO report. Refer to Appendix C for the RECAP Forms.

(1) RECAP Form 1 Submittal Summary;
(2) RECAP Form 2 Analytical Data Summary;
(3) RECAP Form 3 Analytical Data Evaluation;
(4) RECAP Form 4 Sampling Information Summary;
(5) RECAP Form 5 Groundwater Monitoring Well Characteristics (if applicable);
(6) RECAP Form 6 Groundwater Monitoring Well Sampling Event Summary (if applicable);
(7) RECAP Form 10 Screening Option Summary for Soil (if applicable);
(8) RECAP Form 15 Screening Option Summary for Groundwater (if applicable);
(9) RECAP Form 18 Ecological Checklist;
(10) Site ranking and justification for the ranking;
(11) Site history and site setting;
(12) Topographic map with the AOC or the AOI labeled and name of quadrangle*;
(13) Vicinity map with adjoining properties, cross streets and land use*;
(14) Site map with all significant features;
(15) Detailed AOC or AOI map with identification of all sampling locations and the boundaries of the AOI*;
(16) Identification of current and future land use at and in the vicinity of the AOC;
(17) Documentation that the soil and/or groundwater meets the criteria for screening under the SO;
(18) Site investigation data with supporting QA/QC (see Section 2.4);
(19) Conceptual Site Model;
(20) For constituents not listed in Table 1, the calculations used in the development of the SS and RECAP Form 8 chemical-specific data summary;
(21) Identification of the groundwater POC;
(22) Identification of the AOI and COC requiring remediation under the SO or further assessment under a MO;
(23) Identification of areas/media where action has been taken (if applicable); and
(24) If applicable, landowners, lessees, and servitude holders (refer to Section 2.20).

*Note: All maps must have a bar scale, legend, north arrow, contour intervals (if contoured), date data was obtained, and map date. All maps, figures, diagrams, and cross sections submitted must be legible and, unless otherwise approved by the Department, not larger than 11 inches by 17 inches and must be folded to a standard report format (8.5 inches by 11 inches).

4.0 MANAGEMENT OPTION 1

Management Option 1 (MO-1) provides Department-derived RECAP Standards (RS) for the evaluation of soil and groundwater meeting the criteria presented in Section 4.1. The MO-1 RS represent constituent concentrations in soil and groundwater that are protective of human health and the environment. The comparison of the MO-1 RS with the soil AOIC and/or groundwater CC serves to provide predictable, consistent guidance regarding when further evaluation and/or corrective action is warranted at a site. The MO-1 RS were developed for non-industrial and industrial exposure scenarios using protective assumptions with regard to the protection of human health and the prevention of cross-media transfer. The MO-1 RS comply with ARAR and consider the protection of resource aesthetics. The MO-1 RS for soil and groundwater are presented in Tables 2 and 3 for constituents frequently encountered at AOC. If a constituent is not listed in these tables, then the Submitter shall calculate a MO-1 RS using the guidelines in Appendix H. Refer to Section 2.12 for a description of the MO-1 RS. Refer to Appendix H and Figures 10, 12, 13, 14, and 15 for the methods and assumptions used in the development of the soil and groundwater MO-1 RS.

In general, MO-1 functions as a tier 1 evaluation to determine if impacted soil and groundwater pose a risk to human health and/or the environment. The MO-1 limiting RS is compared to the soil AOIC and/or groundwater CC to determine whether or not further evaluation of the soil or groundwater is warranted. If the soil AOIC and groundwater CC for all COC are less than or equal to the respective MO-1 limiting RS, then typically, NFA-ATT is required for soil and groundwater. If the soil AOIC and/or groundwater CC for a COC exceeds the MO-1 limiting RS, then a more site-specific evaluation of that medium is warranted under MO-2 or MO-3. If the soil AOIC or groundwater CC exceeds the MO-1 limiting RS and the Submitter does not wish to manage the AOI under MO-2 or MO-3, then corrective action shall be implemented and the MO-1 limiting RS shall be used as the corrective action standard. Refer to Section 2.6 for the requirements for identifying the AOI and the COC and Section 2.8 for guidelines for estimating the AOIC and groundwater CC for a MO-1 assessment.

General data requirements for Management Option 1:

(1) Historical information related to the release (if known);
(2) Site investigation data and supporting QA/QC data;
(3) Geology, hydrology, and hydrogeology of the AOI;
(4) Identification of COC and media impacted;
(5) Maximum or 95%UCL-AM constituent concentration in soil;
(6) SQL for non-detect results;
(7) Horizontal and vertical boundaries of the AOI;
(8) Groundwater classification of the zone of concern based on aquifer yield or TDS; location, depth, and use of groundwater wells within a 1-mile radius; thickness of the groundwater plume (S_d); CC at the POC; POE; distance to the nearest downgradient property boundary (if applicable); designated use of, and distance to, the nearest downgradient surface water body (if applicable);

(9) Area (acres) of impacted soil;
(10) Distribution of the constituent concentrations present within the AOI (refer to Appendix B for site investigation requirements and Section 2.4 for data quality requirements);
(11) SPLP data (optional);
(12) Critical effects/target organs for each COC that elicits noncarcinogenic health effects;
(13) Receptors and exposure pathways associated with current and future land use; and
(14) Environmental fate and transport pathways for constituent migration.

4.1 Criteria for the Management of Soil and Groundwater Under Management Option 1

In order to develop MO-1 soil and groundwater RS, assumptions were made with regard to: (1) exposure potential at the AOC or the AOI (receptors, exposure pathways, exposure frequency and duration, intake rates, and cumulative exposures); and (2) site characteristics that influence constituent fate and transport (site size, soil characteristics, hydrogeological conditions, etc.). The application of risk-based and cross-media transfer standards are protective only if the AOI shares the same (or reasonably similar) characteristics as those assumed in the development of the standards. Therefore, the soil and groundwater RS are only applicable at an AOI that meets the management criteria listed below. Application of the MO-1 RS at an AOC or an AOI that does not meet all of the criteria for management under MO-1 shall receive Department approval prior to submission of the MO-1 assessment.

4.1.1 General Criteria

(1) A non-industrial or industrial exposure scenario is applicable at the AOC or the AOI and there are no sensitive subpopulations on or near the AOI. [The MO-1 RS only consider residential and industrial exposure scenarios.]; and

(2) There are no other likely human exposure pathways at or adjacent to the AOC or the AOI other than the ingestion of soil, the ingestion of groundwater, the inhalation of volatile emissions from soil to the ambient air, the inhalation of volatile emissions from groundwater to the ambient air, the inhalation of volatile emissions from groundwater to indoor air during household water use, the inhalation of volatile emissions from soil to an enclosed structure, the inhalation of volatile emissions from groundwater to an enclosed structure, and dermal contact with soil. [The MO-1 RS do not address the following pathways: inhalation of particulates, the ingestion of surface water, the inhalation of volatiles from surface water, dermal contact with surface water, the ingestion of sediment, dermal contact with sediment, the inhalation of volatiles from sediment, or the ingestion of biota (recreational or subsistence fishing and/or fish/shellfish propagation or production; meat or dairy production; agricultural crop production). If any of these pathways are of concern at an AOC, they shall be addressed under MO-2 or MO-3].

4.1.2 Criteria for Impacted Soil

(1) The area of impacted soil is approximately 0.5 acre or less. [The Q/C parameter for the calculation of the volatilization factor for $Soil_i$ and $Soil_{ni}$ and the S_w parameter for the calculation of the dilution factors (DF) for $Soil_{GW2}$ and $Soil_{GW3}$ are based on an area of impacted soil that is 0.5 acre in size.];

Exceptions to this criterion: The MO-1 $Soil_{es}$ may be applied regardless of the size of the area of impacted soil because the $Soil_{es}$ RS is not dependent on this parameter. The MO-1 $Soil_i$ and $Soil_{ni}$ may be applied to an area of impacted soil greater than 0.5 acre if:

(a) The COC is an inorganic constituent (the VF is not used in the development of RS for inorganic constituents);
(b) The limiting MO-1 RS is based on a quantitation limit, the soil saturation concentration ($Soil_{sat}$), $Soil_{es}$, the ceiling concentration of 10,000 ppm for TPH, or an approved background concentration (the VF and DF are not applicable); and
(c) The limiting MO-1 RS is based on the $Soil_{GW1}$ (a DF is not applicable).

(2) The impacted soil is in declining conditions, i.e., the constituent mass is not increasing; the source of the release has been mitigated. [The environmental fate and transport models used to develop the cross-media transfer RS assume steady-state concentrations over the AOI.];

(3) NAPL is not present (i.e., If NAPL was present at the site but has been, or will be, removed to the extent practicable, the adsorbed concentrations in soil may be addressed in the MO-1 evaluation). [Note: The environmental fate and transport models used to develop the cross-media transfer RS assume that NAPL is not present.];

Exception to this criterion: MO-1 may be applied at a soil AOC or AOI where NAPL is present, if approved by the Department for the purpose of demonstrating that a CAP (refer to Section 1.2.3) is protective of human health and the environment (i.e., constituent concentrations at or reaching current or potential exposure points or cross-media transfer points are less than or equal to the MO-1 limiting RS); and

(4) High fugitive dust emissions are not present [Examples of conditions that contribute to potentially high fugitive dust emissions include dry soil (moisture content less than 8 percent), finely divided or dusty soils (high silt or clay content), high average annual wind speeds (greater than 5.3 m/s), and less than 50 percent vegetative cover. Examples of activities that may generate high dust levels include heavy truck traffic on unpaved roads or other construction related activities. High fugitive dust emissions shall be addressed under MO-2 or MO-3.].

4.1.3 Criteria for Impacted Groundwater

(1) A COC(s) is not discharging via groundwater to a surface water body. [The MO-1 RS do not address exposure via surface water, sediment, or biota.];

(2) The area of impacted soil that is responsible for the impact to the groundwater zone is approximately 0.5 acre or less. [The MO-1 DF2 (GW_2 zone), DF3 (GW_3 zone), and GW_{air} (GW_1, GW_2, and GW_3 zones) are based on an area of impacted soil that is 0.5 acre in size (S_w parameter and W parameter, respectively).]

Exception to this criterion: The MO-1 GW_1 (GW_1 zone) and GW_{es} (GW_1, GW_2, and GW_3 zones) may be applied to a groundwater zone regardless of the size of the area of impacted soil because the GW_{es} RS is not dependent on this parameter and a DF is not applied to the GW_1 RS;

(3) The impacted groundwater is in declining conditions, i.e., the constituent mass is not increasing; the source of the release has been mitigated. [The environmental fate and transport models used to develop the cross-media transfer RS assume steady-state concentrations over the AOI.]; and

(4) NAPL is not present (i.e., If NAPL was present at the site but has been, or will be, removed to the extent practicable, the dissolved concentrations in groundwater may be addressed in the MO-1 evaluation). [Note: The environmental fate and transport models used to develop the cross-media transfer RS assume that NAPL is not present.].

Exception to this criterion: MO-1 may be applied at a groundwater AOC or AOI where NAPL is present, if approved by the Department for the purpose of demonstrating that a CAP (refer to Section 1.2.3) (or current remedial measures) is protective of human health and the environment (i.e., constituent concentrations at or reaching current or potential exposure points or cross-media transfer points are less than or equal to the MO-1 limiting RS).

The Submitter shall demonstrate to the Department that the AOC or the AOI for soil and groundwater meets the above criteria to qualify for management under MO-1 and that a site evaluation has been conducted in accordance with the guidelines in Appendix B. If the AOC or the AOI for soil and groundwater does not meet **all** of these criteria, then LDEQ considers the AOC or the AOI to be sufficiently complex to warrant a more detailed assessment of risk and the AOC or the AOI shall be addressed under MO-2 or MO-3 depending on site-specific exposure conditions.

Different AOC or AOI within a facility may be managed under different Management Options if the areas meet the criteria for management under the Options selected by the Submitter.

Exposure pathways and media not addressed by the soil and groundwater MO-1 RS shall be addressed under MO-2 or MO-3.

An ecological checklist shall be completed (refer to Appendix C, RECAP Form 18). If the ecological checklist indicates that an ecological assessment is warranted, then an ecological risk assessment shall be required in addition to the MO-1 human health assessment.

4.2 Identification and Application of the Management Option 1 Soil and Groundwater RECAP Standards

Refer to Appendix H for detailed guidance on the identification and application of the MO-1 limiting RECAP Standards at the AOI.

The MO-1 limiting RS (obtained from Tables 2 and 3) may be applied as an action standard or a corrective action standard (refer to Sections 4.2.1 and 4.2.2).

Prior to applying a MO-1 limiting RS at an AOI, it is important to recognize that:

(1) The RS developed under MO-1 are not available for all possible chemical forms of a constituent. In some site-specific situations, a COC may exist in a particular chemical form such that the toxicity and/or fate and transport of the constituent is significantly different from that assumed for the development of the MO-1 RS thus, making the application of the MO-1 RS inappropriate for site-specific conditions. For example, the development of a soil RS for barium is based on the assumption that barium is present at the AOI in a mobile, ionic form. If barium is present at an AOI in a less mobile, inert, form such as barium sulfate, the MO-1 RS would not be appropriate for making decisions concerning the management of the AOI. Another example is organic mercury. In general, the organic forms of mercury are more toxic than the inorganic forms and have not been addressed under MO-1. If an EPA toxicity value is available for a specific chemical form of a constituent, then a MO-1 RS may be developed by the Submitter in accordance with Appendix H.

(2) The MO-1 RS are based on the protection of human health and environmental resources; they do not address ecological risks. Further site evaluation may be required if the ecological checklist (refer to Appendix C, RECAP Form 18) indicates the AOI may pose a risk to ecological receptors.

4.2.1 Use of MO-1 Soil and Groundwater RECAP Standards to Screen an AOI or to Support a NFA-ATT Decision

The MO-1 limiting RS (as identified in accordance with the guidelines in Appendix H) may be used as an action standard to: (1) screen an AOI for further evaluation (i.e., identify areas, media, constituents, and/or pathways which warrant further evaluation under MO-2 or MO-3); or (2) support a NFA-ATT (i.e., document that the soil AOIC and/or groundwater CC are less than or equal to a constituent concentration that is

protective of human health and the environment. To screen an AOI or to demonstrate compliance under MO-1, the MO-1 limiting RS shall be compared to the soil AOIC and groundwater CC as defined in Section 2.8. If the soil AOIC and groundwater CC for all COC present in soil and groundwater at the AOI are less than or equal to the MO-1 limiting RS, then typically no further evaluation shall be required for soil and groundwater. Requests to the Department for a NFA-ATT determination under MO-1 shall demonstrate that: (1) the AOI meets the criteria for management under MO-1; (2) current site conditions meet the limiting RS set forth under MO-1 without the use of decontamination or control measures; (3) the MO-1 RS have been modified to account for additive effects due to exposure to multiple constituents which elicit noncarcinogenic effects on the same target organ/system **and/or** exposure to more than one impacted medium by the same receptor; and (4) the SQL for non-detected constituents are less than the limiting RS.

If the soil AOIC or groundwater CC for a COC is less than or equal to the MO-1 limiting RS, then the COC does not require further assessment at this time for that medium (i.e., the constituent is screened out under MO-1). If the soil AOIC is less than the MO-1 limiting RS for all COC, then the soil does not require further assessment at this time (i.e., the soil is screened out under MO-1). If the groundwater CC is less than the MO-1 RS for all COC, then the groundwater does not require further assessment at this time (i.e., the groundwater is screened out under MO-1).

If a soil AOIC or groundwater CC exceeds a MO-1 limiting RS, the Submitter shall: (1) conduct a more site-specific evaluation under MO-2 or MO-3; or (2) use the MO-1 RS to define the extent of corrective action required at the AOI for the protection of human health and the environment.

4.2.2 Use of MO-1 Soil and Groundwater RECAP Standards as Corrective Action Standards

If the soil AOIC and/or groundwater CC (as defined in Section 2.8) exceeds the MO-1 limiting RS (as identified in accordance with guidelines in Appendix H), and the Submitter does not wish to conduct a site-specific evaluation under MO-2 or MO-3, then the soil and/or groundwater shall be remediated to the MO-1 limiting RS (refer to Section 2.18).

4.3 Management Option 1 Submittal Requirements

A Management Option 1 Submittal Report shall be submitted to the Department for approval. This report shall include, at a minimum, the submittal requirements listed below. Any variance from these requirements is subject to Department approval prior to submission of the MO-1 report. Refer to Appendix C for the RECAP forms.

(1) RECAP Form 1 Submittal Summary;
(2) RECAP Form 2 Analytical Data Summary;
(3) RECAP Form 3 Analytical Data Evaluation;
(4) RECAP Form 4 Sampling Information Summary;

(5) RECAP Form 5 Groundwater Monitoring Well Characteristics (if applicable);
(6) RECAP Form 6 Groundwater Monitoring Well Sampling Event Summary (if applicable);
(7) RECAP Form 11 Management Option 1 Summary for Soil 0-15 ft bgs (if applicable);
(8) RECAP Form 12 Management Option 1 Summary for Soil > 15 ft bgs (if applicable);
(9) RECAP Form 16 Management Option 1 Summary for Groundwater (if applicable);
(10) RECAP Form 18 Ecological Checklist;
(11) Site ranking and justification for the ranking;
(12) Topographic map with the AOC or the AOI labeled and name of quadrangle*;
(13) Vicinity map with adjoining properties, cross streets and land use*;
(14) A site map with all significant features;
(15) Identification of the horizontal and vertical boundaries of the AOI for soil and groundwater and a detailed AOI map with longitude, latitude, and all sampling locations*;
(16) A description of the site including history, setting, size, geology, hydrology, and hydrogeology;
(17) A description of land use at and in the vicinity of the AOC or the AOI;
(18) A description of groundwater use at and in the vicinity (one-mile radius) of the AOC or the AOI including a DOTD well survey obtained within the last 12 months;
(19) The groundwater classifications of the zones under evaluation and information used to arrive at this determination and the location of the POC and POE;
(20) Identification of all known underground utilities (≤ 15 feet bgs) within or adjacent to the AOC or the AOI;
(21) Documentation that the soil and/or groundwater meets the criteria for management under MO-1;
(22) Site investigation data with supporting QA/QC (refer to Section 2.4) and data evaluation/data usability report;
(23) Identification of the COC;
(24) Identification of the AOIC for each COC in soil (including all calculations and identification of the sampling locations used in the calculations);
(25) Conceptual Site Model;
(26) For constituents not listed in Tables 2 and 3, the calculations used in the development of MO-1 RS and RECAP Form 8 Chemical-Specific Data Summary;
(27) Documentation of the methods used to determine the limiting MO-1 RS; identification of the critical effects/target organs for each noncarcinogenic COC and demonstration modifications of the MO-1 RS to account for additive effects (including calculations);
(28) The results of the SO (if conducted);
(29) Identification of areas/media where action has been taken (if applicable);
(30) Identification of the AOI and COC requiring corrective action under MO-1 or further assessment under MO-2 or MO-3; and

(31) If applicable, identification of landowners, lessees, and servitude holders (refer to Section 2.20).

*Note: All maps must have a bar scale, legend, north arrow, contour intervals (if contoured), date data was obtained, and map date. All maps, figures, diagrams and cross sections submitted must be legible and unless otherwise approved by the Department, not larger than 11 inches by 17 inches and must be folded to a standard report format (8.5 inches by 11 inches).

5.0 MANAGEMENT OPTION 2

Management Option 2 (MO-2) provides for the development of soil and groundwater RS using RME assumptions for the protection of human health and site-specific data for the evaluation of constituent fate and transport. The MO-2 RS represent constituent concentrations in media that are protective of human health and the environment under site-specific conditions. The MO-2 RS shall be developed in accordance with the risk assessment methodologies and analytical fate and transport models included in Appendix H. A description of the MO-2 soil and groundwater RECAP Standards is presented in Section 2.12. The methods for developing the soil and groundwater MO-2 RS are illustrated in Figures 10, 12, 13, 14, and 15.

The MO-2 risk-based RS for soil shall address exposure via the ingestion, inhalation, and dermal routes. The MO-2 risk-based RS for groundwater shall address exposure via the ingestion and inhalation routes. MO-2 RS shall only be developed for the receptors, exposure scenarios, exposure pathways, land uses, and environmental media included in Appendix H. Site-specific data shall be used for the evaluation of constituent fate and transport. In the absence of site-specific fate and transport data, protective default assumptions as specified under MO-2 shall be used. MO-2 RS based on site-specific data are only applicable at the AOI for which they were developed. MO-2 RS developed for one AOI shall not be applied at another AOI unless it is adequately documented that the RS are appropriate for the AOI and the Department concurs. The MO-2 RS shall comply with ARAR and shall consider the protection of resource aesthetics.

In general, MO-2 functions as a tier 2 evaluation to determine if site conditions pose a risk to human health or the environment. The Submitter may choose to evaluate the soil or groundwater under the SO and/or MO-1 prior to the MO-2 evaluation, or the Submitter may proceed directly to a MO-2 evaluation. The MO-2 limiting RS shall be compared to the soil AOIC and or groundwater CC to determine if site conditions warrant further evaluation. If the soil AOIC and/or groundwater CC for all COC are less than or equal to the MO-2 limiting RS, then typically no further evaluation of the soil and/or groundwater will be required at this time. If the soil AOIC and/or groundwater CC for a COC exceeds the MO-2 limiting RS for the appropriate use scenario, the Submitter may choose to conduct a more site-specific evaluation under MO-3. If the Submitter does not wish to manage the soil and or groundwater under MO-3, corrective action shall be implemented and the MO-2 limiting RS shall be used as corrective action standard. Refer to Section 2.6 for the requirements for identifying the AOI and the COC and to Section 2.8 for guidelines on estimating the AOIC and the groundwater CC for a MO-2 assessment.

Management Option 2 provides for the evaluation of soil and groundwater. Management Option 2 does not provide for the evaluation of other environmental media. Impacted surface water, sediment, and biota shall be addressed under MO-3.

General data requirements for Management Option 2:

(1) Historical information related to the release (if known);

(2) Site investigation data and supporting QA/QC data;
(3) Geology, hydrology, and hydrogeology of the AOI;
(4) Identification of COC and media impacted;
(5) Distribution of the constituent concentrations present within the AOI (refer to Appendix B for site investigation requirements and Section 2.4 for data quality requirements);
(6) Maximum or 95%UCL-AM constituent concentration in soil;
(7) SQL for non-detect results;
(8) Horizontal and vertical boundaries of the AOI;
(9) Site-specific environmental fate and transport data which may include area (acres) of impacted soil, dry soil bulk density, water-filled soil porosity, soil particle density, and fractional organic carbon in soil (refer to Appendix H for a complete listing of site-specific parameters for the exposure and environmental fate and transport pathways identified at the AOI); Not all of the fate and transport parameters identified in Appendix H as requiring site-specific data need to be determined on a site-specific basis. The Submitter may choose to collect partial site-specific data, however it is strongly recommended that at a minimum, f_{oc} and SPLP data be collected. Note: Site-specific data **requirements for Appendix I** assessments include, at a minimum, fractional organic carbon in soil, depth of the impacted groundwater zone, and dimensions of buildings present at the site;
(10) Groundwater classification of the zone of concern based on aquifer yield or TDS; location, depth, and use of groundwater wells within a 1-mile radius; thickness of the groundwater plume (S_d); CC at the POC; POE; distance to the nearest downgradient property boundary (if applicable); designated use of, and distance to, the nearest downgradient surface water body (if applicable);
(11) Area (acres) of impacted soil;
(12) Distribution of the constituent concentrations present within the AOI (refer to Appendix B for site investigation requirements and Section 2.4 for data quality requirements);
(13) SPLP data (optional);
(14) Critical effects/target organs for each COC that elicits noncarcinogenic health effects;
(15) Receptors and exposure pathways associated with current and future land use; and
(16) Environmental fate and transport pathways for constituent migration.

5.1 Criteria for Management of Soil and Groundwater Under Management Option 2

An AOI must meet the criteria listed below to be managed under MO-2. Application of the MO-2 RS at an AOC or an AOI that does meet all of the criteria for management under MO-2 shall receive Department approval prior to submission of the MO-2 assessment.

5.1.1 General Criteria

(1) A non-industrial or an industrial exposure scenario is applicable at the AOC or the AOI and there are no sensitive subpopulations on or near the AOI. [The MO-2 RS only consider residential and industrial exposure scenarios.]; and

(2) There are no other likely human exposure pathways at or adjacent to the AOC or the AOI other than the ingestion of soil, the ingestion of groundwater, the inhalation of volatile emissions from soil, the inhalation of particulates from soil, the inhalation of volatile emissions from groundwater, and dermal contact with soil. [The MO-2 RS do not address the ingestion of surface water, the inhalation of volatiles from surface water, dermal contact with surface water, the ingestion of sediment, dermal contact with sediment, the inhalation of volatiles from sediment, or the ingestion of biota (recreational or subsistence fishing and/or fish/shellfish propagation or production; meat or dairy production; agricultural crop production). If other pathways are of concern at the AOI, they shall be addressed under MO-3.].

5.1.2 Criteria for Impacted Soil

(1) The impacted soil is in declining conditions, i.e., the constituent mass is not increasing; the source of the release has been mitigated. [The environmental fate and transport models used to develop the cross-media transfer RS assume steady-state concentrations over the AOI.]; and

(2) NAPL is not present (i.e., If NAPL was present at the site but has been, or will be, removed to the extent practicable, the adsorbed concentrations in soil may be addressed in the MO-2 evaluation). [Note: The environmental fate and transport models used to develop the cross-media transfer RS assume that NAPL is not present.].

Exception to this criterion: MO-2 may be applied at a soil AOC or AOI where NAPL is present, if approved by the Department for the purpose of demonstrating that a CAP (refer to Section 1.2.3) is protective of human health and the environment (i.e., constituent concentrations at or reaching current or potential exposure points or cross-media transfer points are less than or equal to the MO-2 limiting RS).

5.1.3 Criteria for Impacted Groundwater

(1) A COC(s) is not discharging via groundwater to a surface water body. [The MO-2 RS do not address exposure via surface water, sediment, or biota.];

(2) The impacted groundwater is in declining conditions, i.e., the constituent mass is not increasing; the source of the release has been mitigated. [The environmental fate and transport models used to develop the cross-media transfer RS assume steady-state concentrations over the AOI and that NAPL is not present.]; and

(3) NAPL is not present. [Note: If NAPL was present at the site but has been, or will be, removed to the extent practicable, the dissolved concentrations in groundwater may be included in the MO-2 evaluation.].

Exception to this criterion: MO-2 may be applied at a groundwater AOC or AOI where NAPL is present, if approved by the Department for the purpose of demonstrating that a CAP (refer to Section 1.2.3) (or current remedial measures) is protective of human health and the environment (i.e., constituent concentrations at or reaching current or potential exposure points or cross-media transfer points are less than or equal to the MO-2 limiting RS).

The Submitter shall demonstrate to the Department that the AOC or the AOI meets the above criteria to qualify for management under MO-2 and that a site evaluation has been conducted in accordance with the guidelines in Appendix B. If an AOC or an AOI does not meet all of these criteria, then the LDEQ considers the AOC or the AOI to be sufficiently complex to warrant a more detailed assessment of risk and the AOC or the AOI shall be addressed under MO-3.

An ecological checklist (refer to Appendix C, RECAP Form 18) shall be completed. If the ecological checklist indicates that the AOC or the AOI may pose ecological risk, then an ecological risk assessment shall be required in addition to the MO-2 human health assessment.

Areas of investigation for soil and groundwater that qualify for management under MO-2 that do not qualify for management under MO-1 include:

(1) An area of impacted soil that is greater than 0.5 acre. [Site-specific data pertaining to the size of the AOI may be used for the Q/C parameter for the calculation of the volatilization factor for soil, the W parameter for the calculation of the GW_{air}, and the S_w parameter for the calculation of the dilution and attenuation factor for GW_2, GW_3, $Soil_{GW2}$, and $Soil_{GW3}$]; and

(2) An AOC or an AOI with unusually high fugitive dust emissions such as construction areas, areas with unpaved, heavily traveled roads, etc. [Soil RS which include exposure via the inhalation of soil particulates may be developed under MO-2.].

5.2 Development and Application of the Management Option 2 Soil and Groundwater RECAP Standards

Refer to Appendix H for detailed guidance on the development, identification, and application of the limiting MO-2 RECAP Standard.

The limiting MO-2 RS may be applied as an action standard or a corrective action standard. Guidelines on the application of the MO-2 limiting RS are presented in Sections 5.2.1 and 5.2.2 and Appendix H. Prior to applying a MO-2 soil or groundwater RS, it is important to recognize that MO-2 RS are based on the protection of human

health and environmental resources, they do not evaluate ecological risks. Therefore, compliance with MO-2 RS should not be interpreted to mean that **all** site risks are acceptable. Further site evaluation may be required if the ecological checklist indicates that there is potential for ecological risk at the AOI.

5.2.1 Application of MO-2 Soil and Groundwater RECAP Standards to Screen an AOI or to Support a NFA-ATT Decision

The Management Option 2 limiting RS (as identified in accordance with the guidelines in Appendix H) may be used to: (1) screen an AOI (i.e., identify areas, media, constituents, and/or pathways which warrant further evaluation under MO-3); or (2) support a NFA-ATT decision (i.e., document that the soil AOIC and/or groundwater CC are less than or equal to a constituent concentration that is protective of human health and the environment). The site-specific MO-2 RS shall be compared to the soil AOIC and groundwater CC as defined in Section 2.8. If the AOIC and groundwater CC for all COC present in soil and groundwater are less than or equal to the MO-2 limiting RS, then typically no further action is required. Requests to the Department for an NFA-ATT determination under MO-2 shall demonstrate that: (1) the AOI meets the criteria for management under MO-2; (2) current site conditions meet the RS set forth under MO-2 without the use of removal, decontamination, or control measures; (3) the MO-2 RS have been modified to account for additive effects due to exposure to multiple constituents which elicit noncarcinogenic effects on the same target organ/system **and/or** exposure to more than one impacted medium by the same receptor; and (4) the SQL for non-detected constituents are less than the limiting RS.

If the soil AOIC or groundwater CC for a COC is less than or equal to the MO-2 limiting RS, then the COC does not require further assessment at this time for that medium (i.e., the COC is screened out under MO-2). If the soil AOIC or groundwater CC is less than the MO-2 limiting RS for all COC, then that medium does not require further assessment at this time (i.e., the medium is screened out under MO-2).

If the soil AOIC and/or groundwater CC exceeds the MO-2 limiting RS, then corrective action shall be instituted **or** the soil and/or groundwater shall be evaluated further under MO-3.

5.2.2 Application of MO-2 Soil and Groundwater RECAP Standards as Corrective Action Standards

If a soil AOIC or groundwater CC (as defined in Section 2.8) exceeds the MO-2 limiting RS (as identified in accordance with the guidelines in Appendix H), and the Submitter does not wish to conduct a site-specific evaluation under MO-3, then the AOI shall be remediated to the MO-2 limiting RS (refer to Section 2.18).

5.3 Management Option 2 Underground Storage Tank (UST) Soil and Groundwater RECAP Standards

As an example of a MO-2 evaluation, a site-specific evaluation has been performed for typical UST sites. Relative to sites at large facilities (landfills, RCRA facilities, chemical plants, etc.), UST sites are unique because: (1) most sites are similar in size; (2) the COC are relatively limited and identical; (3) the sources of COC are generally limited (i.e. tank hold, pipe chase, and dispenser islands); and (4) the exposure conditions at the site are similar. Due to these factors and the abundance of information that has been obtained from numerous UST sites in Louisiana and across the country, a site-specific MO-2 RECAP example evaluation has been developed by the Department for typical UST sites (refer to Appendix I). The RS presented in the Appendix I example may be applied at typical UST sites which meet the criteria presented in Appendix I. Appendix I incorporates site-specific environmental fate and transport information that will be gathered during site investigation activities at UST sites. Sites are classified according to: (1) source length (L) (see Figure I-3); (2) source width (S_w) (see Figure I-3); and (3) fractional organic carbon present in soil that is unimpacted but representative of the impacted area.

Sites evaluated using Appendix I are required to meet all Appendix I submittal requirements. Although this MO-2 evaluation will be used at many UST sites that meet Appendix I management criteria, a more site-specific MO-2 analysis or a MO-3 analysis may be required by the Department on a site-specific basis dependent on site conditions. Exposure pathways not addressed in Appendix I may be addressed under a site-specific MO-2 conducted in conjunction with the Appendix I evaluation.

5.4 Management Option 2 Submittal Requirements

A Management Option 2 Submittal Report shall be submitted to the Department for approval. This report shall, at a minimum, meet the submittal requirements listed below. Any variance from these requirements is subject to Department approval prior to submission of the MO-2 report. Refer to Appendix C for the RECAP forms.

(1) RECAP Form 1 Submittal Summary;
(2) RECAP Form 2 Analytical Data Summary;
(3) RECAP Form 3 Analytical Data Evaluation;
(4) RECAP Form 4 Sampling Information Summary;
(5) RECAP Form 5 Groundwater Monitoring Well Characteristics (if applicable);
(6) RECAP Form 6 Groundwater Monitoring Well Sampling Event Summary (if applicable);
(7) RECAP Form 7 Site-Specific Environmental Fate and Transport Data Summary;
(8) RECAP Form 8 Chemical-specific Data Summary;
(9) RECAP Form 13 Management Option 2 Summary for Soil 0-15 ft bgs (if applicable);
(10) RECAP Form 14 Management Option 2 Summary for Soil > 15 ft bgs (if applicable);

(11) RECAP Form 17 Management Option 2 Summary for Groundwater (if applicable);
(12) RECAP Form 18 Ecological Checklist;
(13) A summary of the results of the SO evaluation (if conducted) and/or the results of the MO-1 assessment (if conducted);
(14) Site ranking and justification for the ranking;
(15) Topographic map with AOI labeled and name of quadrangle*;
(16) Vicinity map with adjoining properties, cross streets and land use*;
(17) Site map with all significant features;
(18) Identification of the horizontal and vertical boundaries of the AOI for each impacted medium and a detailed AOI map with all sampling locations*;
(19) A description of the site including history, setting, size, geology, hydrology, and hydrogeology;
(20) A description of land use at and in the vicinity of the AOI;
(21) A description of groundwater use at and in the vicinity (one-mile radius) of the AOC or the AOI including a DOTD well survey obtained within the last 12 months;
(22) The groundwater classifications of the zones under evaluation and information used to arrive at this determination, POC, and POE;
(23) Identification of all known underground utilities (≤ 15 feet bgs) within or adjacent to the AOI;
(24) Documentation that the soil and/or groundwater meets the criteria for management under MO-2;
(25) Site investigation data with supporting QA/QC (refer to Section 2.5) and data evaluation/data usability report;
(26) Identification of the COC and the methods used to identify the COC;
(27) Identification of the AOIC for each COC in soil (including all calculations and identification of the sampling locations used in the calculations);
(28) A conceptual site model (refer to Figure 8);
(29) If applicable, an environmental fate and transport analysis including identification of the model(s) used, a discussion on the appropriateness of the model(s) for site conditions, model outputs, and a discussion of uncertainties associated with the fate and transport analysis;
(30) Documentation of the methods and calculations used to determine the limiting MO-2 RS; identification of target organ/system for each noncarcinogenic COC and demonstration of the modifications to the MO-2 RS to account for additive effects (including calculations);
(31) Identification of areas/media where action has been taken (if applicable);
(32) Identification of the AOI and COC for the MO-3 assessment or for remediation under MO-2; and
(33) If applicable, the identification of landowners, lessees, and servitude holders (refer to Section 2.20).

*Note: All maps must have a bar scale, legend, north arrow, contour intervals (if contoured), date data was obtained, and map date. All maps, figures, diagrams and cross sections submitted must be legible and unless otherwise approved by

the Department, not larger than 11 inches by 17 inches and must be folded to a standard report format (8.5 inches by 11 inches).

6.0 MANAGEMENT OPTION 3

Management Option 3 (MO-3) provides for: (1) the development of site-specific RS using site-specific exposure and environmental fate and transport data; and (2) the evaluation of all environmental media (i.e., soil, groundwater, air, surface water, sediment, and biota), fate and transport pathways, and exposure pathways. The MO-3 RS shall address the protection of human health, the prevention of cross-media transfer, and the protection of resource aesthetics.

Site-specific RS shall be developed for all exposure and media transfer pathways of concern at the AOI and the limiting RS shall be identified for comparison to the AOIC and groundwater CC (refer to Section 2.8) for the AOI. If the AOIC and groundwater CC for all COC are less than or equal to the MO-3 limiting RS for each impacted medium, then typically, NFA-ATT is required. If the AOIC or groundwater CC for a COC is greater than the MO-3 limiting RS, then the AOI for that medium shall be remediated to the site-specific MO-3 limiting RS and the Submitter shall comply with closure and post-closure requirements. In addition to the requirements presented this section, MO-3 evaluations shall comply with the guidelines presented in Section 2.0 and Appendices B, D, G, and H.

In general, a site-specific approach under MO-3 requires additional site evaluation, a more extensive exposure assessment and documentation of exposure conditions, and the application of more sophisticated fate and transport models. However, the scope of MO-3 is dependent on the complexity of exposure and cross-media transfer pathways at the AOI.

General data requirements for Management Option 3:

(1) Historical information related to the release (if known);
(2) Site investigation data and supporting QA/QC data;
(3) Geology, hydrology, and hydrogeology of the AOI;
(4) Identification of COC and media impacted;
(5) Distribution of the constituent concentrations present within the AOI (refer to Appendix B for site investigation requirements and Section 2.4 for data quality requirements);
(6) Maximum or 95%UCL-AM constituent concentration in soil;
(7) SQL for non-detect results;
(8) Horizontal and vertical boundaries of the AOI;
(9) Environmental fate and transport pathways for constituent migration and site-specific environmental fate and transport data;
(10) Groundwater classification of the zone of concern based on aquifer yield or TDS; location, depth, and use of groundwater wells within a 1-mile radius; thickness of the groundwater plume (S_d); CC at the POC; POE; distance to the nearest downgradient property boundary (if applicable); designated use of, and distance to, the nearest downgradient surface water body (if applicable);
(11) Area (acres) of impacted soil;

(12) Distribution of the constituent concentrations present within the AOI (refer to Appendix B for site investigation requirements and Section 2.4 for data quality requirements);
(13) SPLP data (optional);
(14) Site-specific exposure data and supporting documentation;
(15) Critical effects/target organs for each COC that elicits noncarcinogenic health effects; and
(16) Receptors and exposure pathways associated with current and future land use.

If there are public health concerns associated with exposure to constituents present at or migrating from the AOI, further evaluation and/or recommendations from LDHH/OPH may need to be incorporated into the decision-making process.

6.1 Management of an AOI Under MO-3

Any AOC or AOI may be managed under MO-3. A NFA-ATT determination shall only be considered for an AOC or an AOI where the source of the release has been removed or mitigated. The Submitter may choose to proceed through the SO, MO-1, and/or MO-2 prior to managing the AOI under MO-3, or the Submitter may proceed directly to MO-3.

6.2 Management Option 3 Workplan

Prior to conducting a MO-3 assessment, the Submitter shall submit a detailed workplan for Department approval. The work plan shall include:

(1) A description of the site including history, setting, size, geology, hydrology, and hydrogeology; the longitude and latitude of the primary facility entrance and location method;
(2) Topographic map with the AOC or the AOI labeled and name of quadrangle; vicinity map with adjoining properties, cross streets and land use;
(3) A site map with all significant features;
(4) Available site investigation data;
(5) Preliminary identification of the AOI and COC and a detailed AOI map with all sampling locations or proposed sampling locations;
(6) Identification of any known data QA/QC issues;
(7) A description of current and future land use at the AOC or the AOI and adjacent to the AOC or the AOI;
(8) Preliminary CSM which identifies the sources, media of concern, fate and transport pathways, exposure pathways, exposure points, and receptors;
(9) A description of groundwater use at and in the vicinity (one-mile radius) of the AOC or the AOI, groundwater classification of the aquifer of concern and supporting documentation;
(10) Preliminary identification of site-specific fate and transport data collected to date;
(11) Identification of site-specific and default exposure data to be used in the development of the RS;

(12) Identification of the model(s) to be used, a discussion on the appropriateness of the model(s) for site conditions, model inputs, and model documentation;
(13) Preliminary identification of COC for which EPA toxicity values are not available and the methods that will be used to assess these COC;
(14) Preliminary identification of chemical/physical parameters;
(15) Identification of the proposed use of background levels, ARAR, or quantitation limits as RS;
(16) Proposed target risk level that will be used in the development of the MO-3 RS;
(17) If further site characterization is proposed, data quality objectives; analytical methods, sample quantitation limits, data QA/QC, data evaluation/validation, and data usability;
(18) Summary of the SO, MO-1, and/or MO-2 if conducted; and
(19) RECAP Form 18 Ecological Checklist.

6.3 Exposure Assessment for Management Option 3

Site-specific exposure assumptions representative of a RME scenario for the identified receptor activity patterns at the AOI shall be used in the development of the MO-3 RS. The RME shall be estimated using protective assumptions regarding exposure (intake or contact rate, exposure frequency, exposure duration, body weight, etc.) at the AOI. Site-specific exposure data and environmental fate and transport data are subject to Department approval. In the absence of site-specific exposure data, protective default exposure assumptions consistent with current EPA recommendations shall be used.

Site-specific exposure data shall be used when available and shall be accompanied by supporting documentation. If the site-specific exposure time and/or exposure frequency is significantly less than the standard exposure frequency for an industrial scenario (8 hours/workday; 250 days/year), **financial assurance and institutional controls may be required** depending on site-specific considerations such as current and future land use and receptor activities at, and in the vicinity of, the AOI. Exposure time (hours/day) may be considered in the development of RS when exposure time is necessary for the estimation of contact rate, such as for the ingestion of chemicals in surface water while swimming pathway, the dermal contact with chemicals in water pathway, the inhalation of airborne (vapor phase) chemicals pathway (industrial land use only), and the inhalation of airborne particulates pathway (industrial land use only) (*Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual, Part A,* EPA 1989). Exposure time shall not be included in the estimation of exposure via the ingestion of water, ingestion of soil or sediment, inhalation of volatile emissions from groundwater to indoor air during household (residential) use of the water, dermal contact with soil or sediment, ingestion of biota, or other exposure pathways that do not require the consideration of exposure time to estimate contact rate for the calculation of chemical intake (*Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual, Part B, Development of Risk-based Preliminary Remediation Goals,* EPA 1991; *Soil Screening Guidance*, EPA 1997; *Risk-Based Concentration Table*, EPA Region III; *Preliminary Remediation Goals*, EPA Region IX). **The Submitter shall ensure that the**

property remains suitable for commerce and, at a minimum, suitable for industrial use.

All methods/models, input parameters, and calculations used in the estimation of exposure shall be clearly presented and fully documented and referenced in the MO-3 submittal.

6.4 Development of MO-3 Site-Specific RECAP Standards

The RS applicable under MO-3 are described in Section 2.12. The MO-3 RS shall be developed for each impacted medium, receptor population, exposure pathway, and environmental fate and transport pathway identified at the AOI in accordance with the guidelines in Appendix H. For media and/or pathways not included in Appendix H, the MO-3 RS shall be developed in accordance with current EPA methods and recommendations and shall be subject to Department approval.

The MO-3 RS shall consider the protection of human health, the prevention of cross-media transfer, compliance with ARAR, and the protection of resource aesthetics. The target risk (TR) and/or target hazard quotients (THQ) shall be determined in accordance with guidelines presented in Section 2.14. Site-specific and default exposure assumptions, target risk, target hazard quotient, and site-specific and default fate and transport assumptions used under MO-3 are subject to Department approval. **The MO-3 RS are subject to Department approval prior to application at the AOI.** The MO-3 RS are site-specific and therefore are only applicable at the AOI for which they were developed. The MO-3 RS developed for one AOI shall not be applied at another AOI unless it is adequately documented that the RS are appropriate for the AOI and the Department concurs with the decision. **A MO-3 RS submitted without the appropriate documentation will not be approved by the Department.** Refer to Section 6.9 for detailed guidance on the submittal requirements for a MO-3 assessment.

6.5 Application of the MO-3 RECAP Standards

The site-specific MO-3 RS shall be compared to the AOIC and groundwater CC as defined in Section 2.8. If: (1) the AOIC for all COC present in all impacted media; and (2) the groundwater CC for all COC present in groundwater are less than or equal to the MO-3 limiting RS, then typically no further action is required at this time. Requests to the Department for an NFA-ATT determination under MO-3 shall demonstrate that: (1) the MO-3 RS address all impacted media, constituents, receptor populations, exposure pathways, cross-media transfer pathways of concern at the AOI; (2) the MO-3 RS address the protection of resource aesthetics; (3) the MO-3 RS comply with ARAR; (4) the MO-3 RS address cumulative exposure for current and future land use; (5) the MO-3 were developed in accordance with RECAP and have been approved by the Department; (6) the SQL for non-detected constituents are less than the limiting RS; (7) application of the MO-3 RS allow for beneficial use of the land and residual constituent concentrations do not result in the removal of property from commerce; (8) ecological risks are not a

concern or ecological risks are acceptable; and (9) current site conditions meet the limiting MO-3 RS without the use of removal, decontamination, or control measures.

If an AOIC or groundwater CC (as defined in Section 2.8) exceeds the MO-3 limiting RS (as identified in accordance with the guidelines in Appendix H) for a COC, then the COC/AOI shall be remediated to the MO-3 limiting RS. Refer to Section 2.18 for guidance on demonstrating compliance with the MO-3 RS.

A COC migrating beyond an industrial property boundary to properties that meet the definition for non-industrial land use (refer to Section 2.9) shall be required to meet the non-industrial RS ($Soil_{ni}$) (refer to Section 2.20 for further requirements for addressing offsite migration).

6.6 Alternate MO-3 RECAP Standards

In the event it is **technically impracticable and/or economically infeasible** [as determined by a Corrective Action Study (CAS) and the concurrence of the Department] to meet the site-specific MO-3 RS, then the Submitter may develop alternate RS based on the results of a CAS. A CAS shall be required. The CAS shall include the development of the appropriate remedial alternatives for achieving the identified MO-3 RS and include a provision of performance and cost data for use in evaluating these alternatives and selecting a remedy. The CAS shall include where warranted:

(1) Identification of remedial alternatives;

(2) Screening of remedial alternatives;

(3) Performance of treatability studies; and

(4) Evaluation of alternatives.

Department approval is required for the development and application of alternate MO-3 RS. This approach requires more regulatory judgment to determine the required level of remediation dictated by site conditions and the best method to achieve that level of remediation. If warranted, a health risk assessment shall be conducted to determine if interim corrective measures are necessary for the protection of human health.

The description and evaluation of the remedial alternatives will vary with the scope and complexity of the AOI. All remedial alternatives under consideration shall be identified in the CAS. The remedial alternatives screening shall be based on the following criteria:

(1) ***Effectiveness.*** This criterion examines the effectiveness of the alternatives to achieve the MO-3 RS. Alternatives that have been proven to be successful in past use and are capable of achieving the RS shall be retained for evaluation. Alternatives that are innovative technologies may be retained if it is successfully demonstrated to the Department through treatability studies that the alternatives will achieve the RS. Alternatives that have demonstrated the capability of

achieving the RS shall be preferred to those only achieving partial clean-ups, unless other mitigating factors exist. Alternatives that have been proven incapable of achieving the RS may be used if it has been successfully proven to the Department that no known alternatives can achieve the RS;

(2) ***Implementability.*** This criterion examines the technical and administrative application of the alternatives. Factors such as use and readiness of equipment, processes, and services, and the obtaining of any required permits and waivers shall be considered;

(3) ***Costs.*** This criterion examines the relative cost of each alternative in relation to the attainment of the remedial goal; and

(4) ***Regulatory requirements.*** This criterion determines whether or not the alternatives will meet all state and federal ARAR for the location or remedy.

Treatability studies may be conducted to produce performance and cost data to determine if the alternatives will meet the alternate MO-3 RS. Quantitative analytical data shall be included in the treatability study to gauge effectiveness in meeting the RS. An analysis of the remedial alternatives shall present a detailed comparison of the relative performance of each alternative using:

(1) Ability of the alternative to achieve the RS;

(2) Long-term effectiveness and permanence considering engineering reliability and institutional controls;

(3) Reduction in toxicity, mobility, and volume;

(4) Treatment residuals that will be left at the AOI;

(5) Short-term effects, including protection to the community and workers during the implementation of remedial actions;

(6) Implementability of the alternative which considers availability of necessary equipment, specialists, technologies, off-site treatment, storage and disposal facilities; and coordination and approval from other agencies;

(7) Costs - capital costs and operating and maintenance costs; and

(8) Compliance with state and federal ARAR.

Corrective actions and closures shall be protective of human health and the environment. The Submitter shall have the responsibility of demonstrating to the Department that the remedial actions and/or control measures proposed or used, effectively abate present and future threats to human health and the environment, to the maximum extent practical. If warranted, a RECAP assessment may be required to quantitate residual risks to health

and the environment following remediation and to evaluate the need for institutional controls.

Alternate MO-3 RS shall be accompanied by post-closure care and financial assurance (in accordance with LDEQ guidelines) since conformance with these standards, although providing risk reduction, will result in a higher residual risk than MO-3 limiting RS.

6.7 Uncertainty Analysis

The objective of the uncertainty analysis is to identify the key site-related variables, assumptions, and scientific judgments that contribute most to the uncertainty in the RECAP assessment process. The uncertainty analysis serves to identify areas where additional data collection may significantly improve the basis for deciding how the AOI will be managed. Uncertainties associated with site data, the identification of the COC, toxicity values, and the exposure assessment shall be presented and the potential impact on the outcome of the assessment shall be discussed. For constituents not included in the RECAP assessment, the reason for exclusion and the possible consequences of exclusion on the assessment results shall be discussed. For current and future land uses, the sources and quality of information and the confidence level shall be provided. Justification shall be given for all pathways not included in the assessment. For cumulative effects, any qualifications regarding the selection of exposure pathways considered to contribute to exposure of the same receptor over the same time period shall be discussed. Key model assumptions shall be presented and the potential impact of each shall be discussed.

6.8 Probabilistic Risk Assessment

Probabilistic techniques may be used to analyze variability and uncertainty in risk assessments. Monte Carlo analysis is the most frequently used probabilistic tool for analyzing variability and uncertainty in risk assessments. Monte Carlo simulation is a statistical technique in which a quantity is calculated repeatedly, using randomly selected values from input probability distributions for each calculation. The results of the simulation approximate the full range of possible outcomes and the likelihood of each. Risk is presented as a frequency distribution graph rather than as a single point risk estimate. Such multiple descriptors of risk serve to provide more complete information on the uncertainty and variability surrounding the risk estimate. Typically, Monte Carlo analysis (and other probabilistic techniques) are used as part of a tiered approach which progresses from simpler deterministic risk estimates (single point estimates of risk) to more complex probabilistic analyses as the risk management situation requires.

Under the LDEQ RECAP, the use of probabilistic techniques is optional. Single-point risk estimates, prepared in accordance with current LDEQ and EPA guidelines, shall be required in conjunction with optional probabilistic techniques. When using probabilistic analysis techniques, the following guidelines* shall be applied:

(1) The purpose and scope of the analysis shall be clearly presented and the assessment endpoints shall be defined.

(2) The methods used for the analysis (including all models used, all data upon which the assessment is based, and all assumptions) shall be documented. This documentation shall include a discussion of the degree to which the data used are representative of the population under study. Also, this documentation is to include the names of the models and software used to generate the analysis. Sufficient information shall be provided to allow the results of the analysis to be independently reproduced.

(3) The application of Monte Carlo and other probabilistic techniques shall be limited to exposure assessment. Only exposure variables shall be used in the Monte Carlo simulation. Reference doses and cancer slope factors shall be entered as single numbers except for specific constituents for which the EPA Office of Research and Development has already approved frequency distributions.

(4) Only significant exposure scenarios and COC shall be included in the Monte Carlo simulation. Calculate single point RME risks for all exposure routes using current guidance. The analysis shall include: (1) those exposure routes for which the RME risk estimates exceed either a cancer risk of 1E-06 or a hazard index of 1.0; and (2) those constituents which contribute 1 percent or more to the total RME risk or hazard index.

(5) Monte Carlo simulation shall only be used to analyze uncertainty and variability.

(6) The report shall include graphs and tables that illustrate and describe each input distribution, distributions of risk for each exposure route, and distributions of total risk (summed across exposure pathways and age groups, as appropriate). The selection of distributions shall be explained and justified. For both the input and output distributions, variability and uncertainty shall be differentiated where possible.

(7) The results of sensitivity analyses shall be presented and discussed in the report.

(8) The presence or absence of moderate to strong correlations or dependencies between input variables shall be discussed and accounted for in the analysis along with the effects these have on the output distribution.

(9) The numerical stability of the central tendency and the higher end (i.e., tail) of the output distributions shall be presented and discussed.

**Region III Technical Guidance Manual Risk Assessment, Use of Monte Carlo Simulation in Risk Assessments*, United States Environmental Protection Agency, Region III, Hazardous Waste Management Division, Office of Superfund Programs, EPA 903-F-94-001; *Policy for Use of Probabilistic Analysis in Risk Assessment at the U.S. Environmental Protection Agency, Guiding Principles for Monte Carlo Analysis* (EPA/630/R-97/001)(EPA, Office of Research and Development, May, 1997); *Report on the Workshop Selecting Input Distributions for Probabilistic Assessments* (EPA/630/R-

98/004). Exposure data for Monte Carlo analyses are available in *Exposure Factors Handbook, Volumes I, II, and III* (EPA 1997).

6.9 Management Option 3 Submittal Requirements

A Management Option 3 Submittal Report shall be submitted to the Department for approval. This report shall, at a minimum, meet the submittal requirements listed below. Any variance from these requirements is subject to Department approval prior to submission of the MO-3 report.

(1) RECAP Form 1 Submittal Summary;
(2) RECAP Form 2 Analytical Data Summary;
(3) RECAP Form 3 Analytical Data Evaluation;
(4) RECAP Form 4 Sampling Information Summary;
(5) RECAP Form 5 Groundwater Monitoring Well Characteristics (if applicable);
(6) RECAP Form 6 Groundwater Monitoring Well Sampling Event Summary (if applicable);
(7) RECAP Form 7 Site-Specific Environmental Fate and Transport Data Summary;
(8) RECAP Form 8 Chemical-Specific Data Summary;
(9) RECAP Form 9 Management Option 3 Site-Specific Exposure Data Summary;
(10) RECAP Form 13 Management Option 3 Summary for Soil 0-15 ft bgs;
(11) RECAP Form 14 Management Option 3 Summary for Soil > 15 ft bgs;
(12) RECAP Form 17 Management Option 3 Summary for Groundwater;
(13) RECAP Form 18 Ecological Checklist;
(14) A summary of the SO, MO-1 and/or MO-2 evaluation (if performed);
(15) Site ranking and justification for the ranking;
(16) A topographic map with AOI labeled and name of quadrangle*;
(17) A vicinity map with adjoining properties, cross streets, and land use*;
(18) A site map with all significant features*;
(19) Identification of the horizontal and vertical boundaries of the AOI for each impacted medium and a detailed AOI map with all sampling locations identified*;
(20) A description of the site including history, setting, size, geology, hydrology, and hydrogeology;
(21) A description of land characteristics (such as surface water bodies) and current and future land use at and in the vicinity of the AOI including identification of receptors;
(22) The groundwater classifications of the zones under evaluation and information used to arrive at this determination and identification of the POC, POE, and CC;
(23) A description of groundwater use at and in the vicinity (one-mile radius) of the AOI including, at a minimum, a DOTD well survey obtained within the last 12 months;
(24) Identification of all known underground utilities (≤ 15 feet bgs) within or adjacent to the AOI;
(25) Conceptual site model (refer to Figure8);

(26) Identification of the AOIC for each COC in each medium (including all calculations and identification of the sampling locations/results used in the calculations) for the AOI;
(27) Documentation for site-specific exposure and fate and transport parameters used in the development of the site-specific MO-3 RS;
(28) Documentation of the methods and calculations used to determine the MO-3 limiting RS; identification of critical effect or target organ/system for each noncarcinogenic COC, and demonstration that the risk-based MO-3 RS have been modified to account for additive effects associated with exposure to multiple COC and/or via multiple pathways/media (including calculations);
(29) If applicable, an environmental fate and transport analysis including identification and justification of models used, a discussion on the appropriateness of the model(s) for site conditions, model outputs, boundary conditions, calibration data and sensitivity analyses, and model limitations and uncertainties;
(30) Identification of the corrective action standards and the areas/media/COC requiring corrective action; and
(31) Identification of landowners, lessees, and/or servitude holders (if applicable, refer to Section 2.20).

*Note: All maps must have a bar scale, legend, north arrow, contour intervals (if contoured), date data was obtained, and map date. All maps, figures, diagrams and cross sections submitted must be legible and, unless otherwise approved by the Department, not larger than 11 inches by 17 inches and must be folded to a standard report format (8.5 inches by 11 inches).

7.0 ECOLOGICAL RISK ASSESSMENT

Ecological risk assessment (ERA) is a process that evaluates the likelihood that adverse ecological effects may occur or are occurring as a result of exposure to one or more chemical stressors. It is a process for organizing and analyzing data, information, assumptions, and uncertainties to evaluate the likelihood of adverse ecological effects in a way that is useful for environmental decision-making. The objectives of the ERA process are to: (1) identify and characterize the current and potential threats to the environment due to the release of a constituent; and (2) identify constituent concentrations that are protective of ecological receptors and natural resources. The ERA functions to: (1) document whether actual or potential ecological risks exist at an AOI; (2) identify which constituents present at an AOI pose an ecological risk; and (3) generate data to be used in evaluating corrective alternatives. Ecological risk assessments performed under the RECAP shall be conducted in accordance with current EPA guidelines (*Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments*, EPA 1997). These guidelines shall be used in conjunction with the guidelines presented in RECAP when conducting an ERA.

Ecological risk assessments may range from very simple to complex and resource-demanding. Ecological risk assessments are frequently designed in sequential tiers that proceed from simple, relatively inexpensive, generic evaluations to more complex, site-specific assessments. The outcome of a given level of assessment (tier) shall be to: (1) make a management decision; or (2) continue to the next level of assessment. If the results of the ERA indicate there are no unacceptable risks to ecological receptors, then typically no further evaluation shall be warranted. If the results of the ERA indicate the potential for unacceptable risks to ecological receptors, then the Submitter shall: (1) conduct a more site-specific assessment; or (2) implement corrective action. When appropriate, ecological impacts associated remedial activities shall be evaluated and the results of the evaluation shall be considered in the management of ecological risk at the AOI. An ecological risk assessment shall be considered complete when the Department has sufficient information and confidence in the results of the risk assessment to make a scientifically defensible decision concerning management of the AOI.

Ecological checklist. An ecological checklist shall be used to determine if a tier 1 (screening level) ERA is warranted. The checklist is comprised of questions concerning on-site and off-site land uses, characteristics of the environmental setting, the extent of migration, and potential impacts to ecological receptors and/or their habitats. When completing the ecological checklist, current as well as potential future impacts to receptors and/or their habitats shall be considered. If it is determined from the checklist that no significant ecological impacts are occurring or could occur, then no further evaluation shall be required. If it is determined that ecological impacts are occurring or could occur in the future, then a tier 1 ERA shall be conducted. The ecological checklist is presented in Appendix C, Form 18.

Screening-level assessment. A tier 1 (screening level) ecological risk assessment shall be a simplified assessment conducted with limited site-specific data. Where data are lacking, protective default assumptions shall be used. At the screening level, it is important to minimize the chances of concluding that there is no risk when in fact a risk exists. Thus, for exposure and toxicity parameters for which site-specific data are lacking, assumed values shall be biased in the direction of overestimating risk. This ensures that an AOI that may pose an ecological risk is studied further. For screening methods based on the hazard quotient method, an acceptable hazard quotient (or hazard index) shall be defined as 1.0. Higher tier assessments shall incorporate site-specific data (as appropriate) for the assessment of exposure and potential ecological risks. All site-specific data shall be adequately documented. *Ecological Soil Screening Level Guidance* (EPA 2000) shall be used where determined to be applicable by the Department.

Data requirements. Refer to Sections 2.3, 2.4, and 2.5 for guidelines on site investigation, data QA/QC, and data evaluation/usability. For the collection of biological samples, guidelines may be obtained from *Superfund Program Representative Sampling Guidance Volume 3: Biological, Interim Final* (EPA 1997). For ecological assessments, surface soil shall be defined as soil present from the ground surface to a depth of 3 feet bgs. Subsurface soils shall be defined as soils present at depths greater than 3 feet bgs.

Conceptual site model. A CSM shall be developed for the ERA in accordance with current EPA guidelines (EPA 1998). The CSM shall address all current and potential future impacts to ecological receptors and/or their habitats. The CSM shall identify the known or potential constituent source(s) (primary as well as secondary and tertiary sources if applicable), routes of constituent migration, exposure media, exposure points, receptors (assessment endpoints), and measurement endpoints (where applicable) to be evaluated under the RECAP. The CSM shall be used throughout the RECAP ERA process to identify exposure and source media, current and future environmental transport pathways, current and future exposure points and receptors/habitats, and identify data gaps. The CSM shall be revised as the AOI progresses through the tiers of the ERA so that the model illustrates only those sources, migration pathways, exposure and/or source media, exposure points, receptors/habitats (assessment endpoints), and measurement endpoints identified for further evaluation under the tier currently being implemented (i.e., sources, exposure/source media, migration pathways, exposure points, and receptors eliminated from further consideration at the conclusion of a given level of assessment shall be excluded from the CSM for the next level of assessment).

Constituents of ecological concern (COEC). All constituents detected in at least one sample (refer to Section 2.6) shall be identified as COEC for the tier 1 (screening level) assessment. The results of the screening-level assessment shall be used to identify which constituents warrant further evaluation and which may be eliminated from consideration in the next level of assessment. Those constituents found to pose negligible ecological risk during a given level (tier) of assessment may be eliminated from the list of COEC for the next level of assessment. The rationale for eliminating a constituent shall be thoroughly documented in the assessment submittal. It is important to recognize that the COEC may be different from the COC identified in the health risk assessment because of

differing exposure pathways, receptor sensitivities, and receptor responses to constituents.

AOIC. For the estimation of the AOIC for screening-level ERAs, the maximum detected concentration shall be used. For other levels of assessment, the maximum detected concentration or the average concentration (unless skewed due to sampling bias) shall be used as the AOIC.

Ecological effects. NOAELs, LOAELs, exposure-response functions, and the mechanisms of toxic response shall be identified for each COEC. When evaluating the potential for adverse ecological effects using the hazard quotient approach, an acceptable total hazard index shall be defined as unity (1.0). Constituents for which toxicity information is limited or unavailable shall be addressed using best professional judgment and the impact of the data gap shall be discussed in the uncertainty analysis.

8.0 SOIL RE-USE UNDER THE LDEQ RECAP

The objective of the soil re-use plan is to allow the use of soils containing residual constituent concentrations that are protective of human health and the environment. It is the intent of the Department that soil be re-used for constructive purposes and **not** as a means of disposal. The Department may grant a one-time soil re-use under LAC 33:VII.303.K, 33:VII.303.L, or 33:VII.305.C. The Submitter shall be required to follow all applicable state and federal laws and regulations prior to re-using soils. Institutional controls shall be implemented as deemed necessary by the Department. In general, soils meeting the limiting soil SS, MO-1 RS, or MO-2 RS shall be considered for re-use. If deemed to be appropriate by the Department based on site-specific conditions, soils meeting the limiting MO-3 RS may be considered for re-use. The RS, DF2, DF3, DAF2, and DAF3 shall be based on the area (acres) of land on which the soil will be re-used (for organic constituents, the Q/C parameter for the calculation of the volatilization factor for $Soil_i$ and $Soil_{ni}$ and the S_w parameter for the calculation of the dilution factors/dilution and attenuation factors for $Soil_{GW2}$ and $Soil_{GW3}$ shall be based on a site-specific area of soil). The re-use of soils having constituent concentrations less than or equal to the limiting soil SS, MO-1 RS, MO-2 RS, or MO-3 RS shall receive Department approval **prior** to re-use of the soil. Re-used soil shall not contain COC concentrations that are unacceptable for the intended use of the property (e.g., soils re-used on agricultural land shall not contain COC concentrations that would result in adverse effects on the propagation of crops). A soil re-use plan meeting the requirements listed below shall be submitted to the Department unless these requirements are modified in writing by the Department:

(1) Demonstration that the proposal for re-use is for constructive purposes rather than disposal;

(2) Identification of the area where the soil will be re-used, including current and future land use of the area and, if warranted, an exposure assessment/conceptual site model;

(3) Manner in which the soil will be managed prior to re-use; and

(4) All submittal requirements for the RECAP Option that is being implemented.

Soil re-use under RECAP does not relieve the Submitter from any requirements of LAC 33:V.Chapter 22. Facilities that generate soils on a continuous basis that contain one or more constituents at concentrations that are less than or equal to applicable RS shall secure a re-use permit under LAC 33:VII. Chapter 11.

Unless otherwise approved by the Department, soil re-use shall be performed in accordance with the following requirements.

8.1 Re-Use of Soils On-Site

A soil re-use plan shall be submitted to the Department and the Submitter shall receive approval from the Department **prior** to re-using soil on-site. The soil re-use plan shall include, at a minimum: a) identification of the location(s) selected for the placement of soils; b) identification of the COC in accordance with Section 2.6; c) demonstration that the COC concentrations in the soil to be re-used comply with the limiting soil standard for the option being implemented; d) demonstration that the proposed location of soil placement will not result in unacceptable exposure to off-site receptors nor have adverse impacts to groundwater over time; and e) demonstration that the re-use of the soil is for constructive purposes rather than for disposal purposes.

In general, for soils to be re-used on-site, the following requirements shall be met:

(1) The limiting soil standard shall be identified in accordance with the guidelines presented in Appendix H for the appropriate land use scenario;

(2) Sampling shall be conducted on soils identified for re-use to demonstrate to the Department that the AOIC for the COC are less than or equal to the limiting soil standard. The AOIC shall be determined in accordance with the applicable guidelines in Section 2.8. The sampling data shall comply with the data requirements in Sections 2.4 and 2.5;

(3) If soil re-use results in higher COC concentrations at the surface than were present before soil re-use, then a six-inch layer of unimpacted soil shall be placed on top of the re-used soil;

(4) The submittal requirements for the option implemented shall be met; and

(5) A conveyance notification shall be placed on property where soils were re-used that contained residual constituent concentrations that exceed the non-industrial risk-based RECAP Standard ($Soil_{ni}$, refer to Table 2).

8.2 Re-Use of Soils Off-site

Approval for the off-site re-use of soils shall be obtained from the Department and will be determined on a case-by-case basis at the discretion of the Department. A soil re-use plan shall be submitted to the Department and the Submitter shall receive approval from the Department **prior** to re-using soil off-site. The soil re-use plan shall include, at a minimum: a) identification of the location(s) selected for the placement of soils and current and future land use at that location(s); b) identification of the COC in accordance with Section 2.6; c) demonstration that the COC concentrations in the soil to be re-used comply with the limiting soil standard for non-industrial land use; d) demonstration that the proposed location of soil placement will not result in unacceptable exposure to off-site receptors nor have adverse impacts to groundwater over time; and e) demonstration that the re-use of the soil is for constructive purposes rather than for disposal purposes.

In general, for soils to be re-used off-site, the following requirements shall be met:

(1) Soil placed off-site shall comply with the non-industrial soil limiting SS or RS identified in accordance with the guidelines presented in Appendix H;

(2) Sampling shall be conducted on soils identified for re-use to demonstrate to the Department that the AOIC for the COC are less than or equal to the limiting soil standard for the Option being implemented. The AOIC shall be determined in accordance with the applicable guidelines in Section 2.8. The sampling data shall comply with the data requirements in Sections 2.4 and 2.5;

(3) If soil re-use results in higher COC concentrations at the surface than were present before soil re-use, then a six-inch layer of unimpacted soil shall be placed on top of the re-used soil; and

(4) A RECAP submittal including all of the submittal requirements for the Option chosen shall be submitted to the Department.

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