GEORGIA
DEPARTMENT OF NATURAL RESOURCES

ENVIRONMENTAL PROTECTION DIVISION

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Georgia Risk Assessment Guidance

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Technical Guidance Document

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Acronyms

Acronym	Meaning
AALM	All Ages Lead Model
ADAF	Age-Dependent Adjustment Factor
ADD	Average Daily Dose
AF	Soil-skin Adherence Factor
ALM	Adult Lead Methodology
AT	Averaging Time
ATSDR	Agency for Toxic Substances and Disease Registry
BAF	Bioaccumulation Factor
BCF	Bioconcentration Factor
BERA	Baseline Ecological Risk Assessment
Bgs	Below ground surface
BRA	Baseline Risk Assessment
BTV	Background Threshold Values
BW	Body Weight
CalEPA	California Environmental Protection Agency
CAS	Chemical Abstracts Service
CG	Cleanup Goal
CGO	Cleanup Goal Option (same as RGO or Remedial Goal Option)
Cm	Centimeter
COC	Chemical of Concern
COPC	Chemical of Potential Concern
COPEC	Chemical of Potential Ecological Concern
CSM	Conceptual Site Model
DAF	Dilution Attenuation Factor
DL	Detection Limit
DNR	Georgia Department of Natural Resources
DQO	Data Quality Objectives
ELCR	Excess Lifetime Cancer Risk
USEPA	United States Environmental Protection Agency
ED	Exposure Duration
EF	Exposure Frequency
EPC	Exposure Point Concentration
EPD	Georgia Environmental Protection Division
ERA	Ecological Risk Assessment
ERAGS	USEPA's Ecological Risk Assessment Guidance for Superfund
Region 4 ERAGS	USEPA Region 4 Ecological Risk Assessment Supplemental Guidance
ESV	USEPA Region 4 Ecological Screening Value
ET	Exposure Time

Acronym	**Meaning**
FAQs	Frequently Asked Questions
G	Gram
GBA	Georgia Brownfield Act
GRAG	Georgia Risk Assessment Guidance
GISWQS	Georgia Instream Water Quality Standard)
GRBCA	Georgia Risk-Based Corrective Action
H	Henry's Law Constant
HEAST	Health Effects Assessment Summary Table
HI	Hazard Index
HQ	Hazard Quotient
HSRA	Georgia Hazardous Site Response Act
IEUBK	Integrated Exposure Uptake Biokinetic Model
IPaC	USFWS Information for Planning and Consultation
IR	Ingestion Rate
IRIS	Integrated Risk Information System
ITRC	Interstate Technology Regulatory Council
IUR	Inhalation Unit Risk
IVBA	In vitro bioaccessibility
Kg	Kilogram
K_{oc}	Organic Carbon partition coefficient
L	Liter
LOAEL	Lowest Observed Adverse Effect Level
LSASD	United States Environmental Protection Agency Laboratory Services and Applied Science Division
MaxDL	Maximum Detection Limit
MCL	USEPA Maximum Contaminant Level
MDC	Maximum Detected Concentration
MDL	Method Detection Limit
Mg	Milligram
mL	Milliliter
mm Hg	Millimeter of Mercury
NJDEP	New Jersey Department of Environmental Protection
NOAA	National Oceanic and Atmospheric Administration
NOAEL	No Observed Adverse Effect Level
NRWQC-HH (Organism Only)	National Recommended Water Quality Criteria – Human Health for the consumption of Organism Only
NRWQC-HH(Water+Organism)	National Recommended Water Quality Criteria - Human Health for the consumption of Water + Organism
NTU	Nephelometric Turbidity Units
O.C.G.A.	Official Code of Georgia Annotated

Acronym	**Meaning**
OLEM	Office of Land and Emergency Management (USEPA)
ORNL	Oak Ridge National Laboratory
PAH	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PCOPEC	Preliminary Chemical of Potential Ecological Concern
PPRTV	USEPA Provisional Peer-Reviewed Toxicity Value
PRG	Preliminary Remediation Goal
ProUCL	USEPA ProUCL Statistical Software
QA	Quality Assurance
QL	Quantitation Limit
RA	Risk Assessment
RAGS	USEPA's Risk Assessment Guidance for Superfund
RAIS	Risk Assessment Information System (ORNL)
RAP	Risk Assessment Program of Georgia EPD
RBA	Relative Bioavailability
RCRA	Resource Conservation and Recovery Act
RfC	Reference Concentration
RfD	Reference Dose
RL	Reporting Limit
RME	Reasonable Maximum Exposure
RPF	Relative Potency Factor
RRS	Risk Reduction Standards
RSL	USEPA Regional Screening Level
RSV	Refinement Screening Value
SA	Skin Surface Area
SESD	USEPA Region 4 Science and Ecosystem Support Division, now referred to as the USEPA Region 4 Laboratory Services and Applied Science Division (LSASD)
SF	Slope Factor
SL	Screening Level
SLERA	Screening Level Ecological Risk Assessment
SMDP	Scientific Management Decision Points
SSG	USEPA's 1996 Soil Screening Guidance
SSL	Soil Screening Level
SW-846	Hazardous Waste Test Methods
SWMU	Solid Waste Management Unit
TCE	Trichloroethylene
TEF	Toxicity Equivalence Factor
TEQ	Toxicity Equivalence Quotient
THQ	Target Hazard Quotient

Acronym	**Meaning**
TOSHI	Target Organ Specific Hazard Index
TR	Target Risk
TRV	Toxicity Reference Value
UCL	Upper Confidence Limit on the mean
UEC	Uniform Environmental Covenant
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Services
USGS	United States Geologic Survey
UST	Underground Storage Tank
UTL	Upper Tolerance Limit
VI	Vapor Intrusion
VOC	Volatile Organic Compound
VRPA	Voluntary Remediation Program Act

Contents

1.0 Introduction and Guidelines for Applicability and Use of this Guidance Document

Purpose

The purpose of the Georgia Risk Assessment Guidance (GRAG) is to provide regulated facilities and environmental professionals with a framework for developing human health and ecological risk assessments to support effective and efficient cleanups.

Applicability

This guidance document is applicable to sites in Georgia as follows:

- Both human health and ecological risk assessments conducted for Resource Conservation and Recovery Act (RCRA) and Georgia Hazardous Waste Management Act (HWMA) sites unless the guidance contradicts existing statutes and regulations.
- The ecological risk assessment (ERA) guidance herein is applicable to sites regulated under RCRA, HWMA, Hazardous Site Response Act (HSRA), Voluntary Remediation Program Act (VRPA), and Georgia Brownfield Act (GBA).

Limitations

- This document is not a statute or regulation. It serves as general guidance and does not supersede existing legal requirements.
- Risk-based screening levels developed by USEPA referenced in this guidance include multiple conservative assumptions and are not presumptive cleanup standards. Risk estimates are upper-bound, health protective estimates, not predictions of actual harm.
- This document is not intended to preclude the use of other methodologies which may be appropriate; however, such approaches should be discussed with EPD in advance to ensure they meet the regulatory requirements.
- This document is generic in nature and may not be appropriate for all sites. Site-specific considerations may necessitate alternative approaches.
- Guidance for evaluating the soil-to-groundwater and vapor intrusion exposure pathways may be found in EPD's 2019 *FAQs for Evaluating the Soil-to-Groundwater Pathway* and 2021 *Guidance for Evaluating the Vapor Intrusion Exposure Pathway*, respectively.
- Human health risk assessments for sites regulated under HSRA, VRPA, and GBA should be conducted in accordance with the respective Acts and the Rules for Risk Reduction Standards (RRS) 391-3-19-.07. Additional guidance on HSRA Cleanup Standards can be found on EPD's website.
- Responsible parties should evaluate releases from Underground Storage Tanks (USTs) containing fuel-related products using the Georgia Risk-Based Corrective Action (GRBCA) Model.
- This document replaces EPD's 1996 Guidance for Selecting Media Remediation Levels at RCRA Solid Waste Management Units (SWMU Guidance).

- In the event of differences, EPD gives precedence to this document over USEPA Region 4's 2018 *Human Health Risk Assessment Supplemental Guidance* and *Ecological Risk Assessment Supplemental Guidance* documents.
- This document is subject to future revisions based on feedback and new information.
- Trade names mentioned in this document do not constitute endorsement by EPD.

Benefits and Recommendations

- The methodologies presented in this guidance have been reviewed and are recommended by EPD and the Technical Advisory Committee (TAC).
- Following methods and recommendations in this document should streamline EPD's review process of human health and ecological risk assessments and facilitate approval.
- If alternative approaches or methodologies are being considered, please discuss in advance to ensure their appropriateness.
- Additional Resources are provided throughout the document in blue text boxes, and supplemental information and tips highlighted in orange boxes. Links to the resource documents can also be found in a *References, Resources, and Tools* document on EPD's website.

2.0 EPD's Overall Risk Assessment Approach

Risk assessment is not a one-size-fits-all process. Contaminants released into the environment may migrate through multiple media and exposure pathways, for example, from soil into groundwater, discharging to surface waters or volatilizing into indoor air. Along these pathways, contaminants may affect human health, wildlife and ecosystems.

The level of effort to conduct a risk assessment depends on site-specific factors including:

- The number and identity of the chemicals present.
- The complexity and completeness of potential exposure pathways.
- The degree of precision that is needed to support an informed risk management decision (USEPA, 1989).

EPD has previously published the following guidance documents addressing specific pathways:

- *FAQs for Evaluating the Soil-to-Groundwater Pathway (2019);*
- *Area Averaging Approach to Soil Compliance for Direct Contact Exposure Scenarios (2020);* and
- *Guidance for Evaluating the Vapor Intrusion Exposure Pathway (2021).*

These documents should be consulted when evaluating the soil-to-groundwater and vapor intrusion pathways or when applying the area averaging approach to develop EPCs.

This document focuses on evaluating risks to human health from direct contact with impacted media (RCRA, HWMA sites) and on ecological risks (RCRA, HWMA, HSRA, VRPA and GBA sites). In cases where risks to human health and the environment are evident, taking immediate action with EPD oversight to reduce risks takes precedence over documenting the need for such actions.

Risk and Hazard

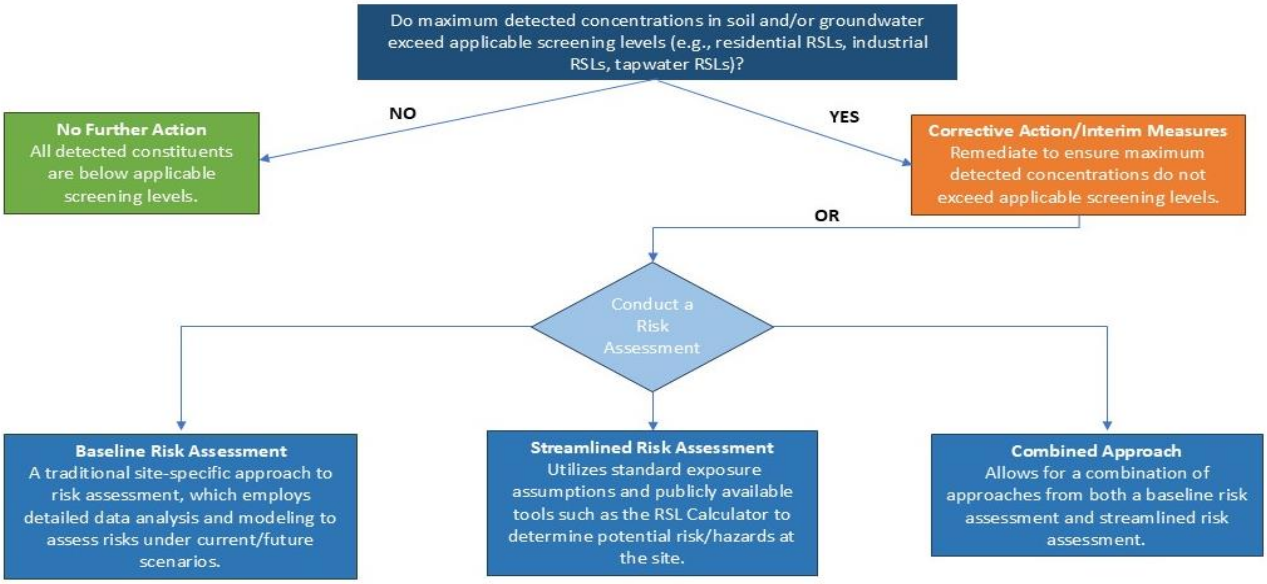
In the GRAG, *cancer risk* refers to the theoretical calculations of increased cancer cases that might occur if people were exposed to specific chemical contaminants in the environment over an extended period. These estimates are specifically related to the chemical exposures from the environment and do not include risks from other factors such as family history, lifestyle or diet. The estimated risk is described as an ELCR, which indicates the additional number of cancer cases that could occur in a defined population exposed to a chemical over a lifetime. For instance, an ELCR of one in a million (1E-06) would mean there might be one additional cancer case in one million people exposed to the chemical over a lifetime. Importantly, these calculated excess cancer risks do not predict individual cancer outcomes, nor do they reflect actual cancer cases within a population. The USEPA generally considers an ELCR between one in a million (1E-06) and one in ten thousand (1E-04) to be within an acceptable range. If multiple chemical contaminants are evaluated at a site, each chemical's risk is combined to determine a cumulative theoretical cancer risk.

In the GRAG, non-cancer hazard refers to the potential for adverse health effects, other than cancer, resulting from exposure to chemical contaminants at a site. This hazard is measured using a Hazard Quotient (HQ), which is the ratio of the chemical concentration in an environmental medium (e.g., soil, groundwater, air) to a chemical-specific reference dose or concentration, below which no adverse effects are expected. When exposure involves multiple chemicals, the individual HQs are summed to determine the Hazard Index (HI). In addition, when multiple chemicals may affect the same target organ or organ system, the Target Organ-Specific Hazard Index (TOSHI) approach is used. Under this approach, HQs are grouped by target organ (e.g., liver, kidney, nervous system) and summed separately for each organ system. This provides a more refined evaluation of potential noncancer health effects by identifying whether combined exposures may result in additive toxicity to a specific organ. An HQ, HI, or TOSHI greater than 1 indicates a potential concern for noncancer health effects.

2.1 Options for Human Health Risk Assessment

EPD provides multiple options for preparing a Human Health Risk Assessment (HHRA). Figure 1 presents a flowchart illustrating where each option fits in the overall risk assessment process. Table 1 provides a comparison of the principal differences between each option.

Figure 1: Risk Assessment Approach for Human Health Direct Contact



- **Baseline Risk Assessment:** This option is the traditional site-specific approach which employs detailed data analysis and modeling to assess risks under current conditions without considering potential corrective actions. Cleanup goals (CGs) are derived based on this assessment and applicable Regulatory Standard Based Goals (RSBGs). A baseline risk assessment (BRA) can be conducted upon delineation of the site's contamination, after a streamlined risk assessment shows unacceptable risk, or redone after corrective action to determine whether corrective action has been effective.

- **Streamlined Risk Assessment:** This option utilizes standard exposure assumptions and publicly available tools such as the USEPA RSL Calculator to determine risk and calculate cleanup levels based on human health, leaching, and direct contact considerations while factoring in RSBGs. This option is ideal for less complex sites.

- **Combined Approach:** Due to the complexity and long-term nature of many sites regulated under the Resource Conservation and Recovery Act (RCRA), a combination of a BRA and Streamlined Risk Assessment may be appropriate. This approach incorporates elements of both the BRA and Streamlined Risk Assessment methodologies while retaining flexibility to include additional

methods to assess site-specific conditions. It combines the quantitative consistency of a BRA with the efficiency of a streamlined framework, providing an adaptable method to address sites with variable data quality, exposure pathways, or risk drivers. If a combined approach is proposed, it should be discussed with EPD prior to conducting a risk assessment.

A combined approach may include elements such as the following:

Exposure Assumptions: Incorporates a mix of standard and site-specific exposure assumptions based on site-specific data and receptors.

Exposure Pathways: Refinement of exposure pathway evaluations based on the Conceptual Site Model (CSM), focusing on pathways that are complete or likely to be complete under current or future land use.

Focused COPC List: Evaluation of a refined list of COPCs that has been established through comprehensive site investigations and supported by history of analytical data.

Focused Receptor Evaluation: Under certain site-specific scenarios, the risk assessment may focus on an individual or key receptors.

Interim Measures to USEPA Regional Screening Levels (RSLs): This option is intended to support the cleanup of small, localized releases (e.g., leaking drum, line leaks, minor surface spill) originating from a single waste stream. Interim measures are designed for situations involving a limited number of exposure pathways and/or chemicals. Most sites utilizing this option will be permitted hazardous waste management facilities or facilities operating under a Hazardous Waste Management Act (HWMA) Order.

Cleaning up to industrial RSLs may be used as an interim measure if the release meets the following conditions:

- Single Waste Stream: The release originated from one defined waste source or waste stream.

- Limited Number of Chemicals: Up to ten (10) chemicals are present, which allows consideration of multiple contaminants while supporting the use of RSLs based on a hazard quotient (HQ) of 1 rather than 0.1. When more than ten chemicals are present, additive effects must be evaluated, as the cumulative cancer risk or noncancer Hazard Index (HI) may exceed acceptable thresholds.

- Land Use and Zoning: The site is zoned for non-residential (industrial/commercial) use. Facilities with a Uniform Environmental Covenant (UEC) or other mechanism restricting land use to industrial purposes may apply industrial RSLs. Residential RSLs may be applied as a more conservative option, particularly where future land use or exposure is uncertain.

- Limited Pathways: Contamination is confined to surface soils with no other complete exposure pathways (e.g., vapor intrusion, leaching to groundwater, or ecological receptors).

Interim corrective action measures should be based on the most current industrial RSLs set at a target cancer risk of 1E-06 and/or an HQ of 0.1 for individual contaminants. However, if the cumulative risk/hazard estimates for surface soil exceed the target cancer risk of 1E-05 and/or HI of 1, EPD should be consulted to determine whether Interim Measures will be acceptable or if a risk assessment will be warranted. Where appropriate, more conservative RSLs (e.g., residential RSLs) may be selected to ensure that cumulative risk and hazard remain below EPD's preferred thresholds of an ELCR of 1E-05 and HI of 1.

It is important to note that this approach is an interim measure, not a final remedy. While cleaning up to RSLs will generally reduce risks to acceptable levels under current site conditions, residual risk may remain and may need to be addressed in the future.

2.2 Steps of Conducting a Risk Assessment

The following steps outline the process for conducting a risk assessment. While the vapor intrusion pathway and the soil-to-groundwater pathway are important considerations in a risk assessment, they are beyond the scope of this guidance and not addressed in this section. For evaluation of these pathways, please refer to EPD's "*Guidance for Evaluating the Vapor Intrusion Exposure Pathway"* and "*FAQs for Evaluating the Soil-to-Groundwater Pathway*."

1. **Develop a Conceptual Site Model.** The first step in evaluating any site is to develop a Conceptual Site Model (CSM). Begin by identifying the source of the contamination and the receiving environmental media (e.g., a leaking 55-gallon drum releasing contaminants to surface soil). Next, describe the fate and transport of contaminants (e.g., migration from surface soil to subsurface soil, leaching to groundwater, or groundwater discharge to surface water). Then, determine exposure points and routes of exposure (e.g., a nearby resident could be exposed through direct contact with contaminated soil, inhalation of airborne dust, or ingestion of contaminated drinking water). If volatile contaminants are present, consider the potential for vapor intrusion from contaminated soil or groundwater. A CSM should be developed for every risk assessment and should be updated as new information becomes available. See Section 3 for more information on the CSM.

2. **Evaluating Data for Inclusion into Risk Assessment.** Ideally, risk assessors should be involved early in the site investigation phase to gain a thorough understanding of site conditions and identify relevant exposure pathways. Early involvement and effective planning enhance the usability of environmental data. All environmental media samples (e.g., soil, groundwater, surface water, sediment) should be representative of the medium being sampled. Representativeness is achieved through the use of standardized sampling methods and analytical protocols (USEPA, 1992a). Additional guidance on data collection and data usability is provided in Section 4 of this document.

3. **Organizing and Screening Data.** After evaluating data for usability, the data should be organized by environmental medium. Contaminant concentrations in each medium are then compared to screening levels (e.g., risk-based, background) to identify chemicals of potential concern (COPCs). COPCs are those chemicals that will be quantitatively evaluated in the risk assessment. If no COPCs are identified for a given medium, no further risk evaluation or remedial action is necessary for that medium (USEPA Region 4, 2018b). See Section 5 for additional background information and Section 6 for additional information on data screening.

4. **Selection of COPCs.** Chemicals with concentrations exceeding applicable screening levels are designated as COPCs. COPCs require further evaluation through either a BRA or a streamlined risk assessment (see Sections 7 and 8).

5. **Selection of Chemicals of Concern.** Based on the results of the risk assessment, if the calculated cumulative cancer risk and/or noncancer hazard for any exposure pathway exceeds an excess lifetime cancer risk (ELCR) of 1E-05 and/or a HI of 1, either overall or target organ–specific, then chemicals that contribute significantly to the exceedance (e.g., exceeds ELCR of 1E-06 and HQ of 0.1) are identified as Chemicals of Concern (COCs). If the cumulative risk and/or noncancer hazard does not exceed 1E-05 and/or a HI of 1, no COCs should be identified. COCs represent the subset of COPCs that drive unacceptable risk and therefore may require corrective action to reduce risks to acceptable levels.

6. **Ecological Risk Assessment.** Each site should evaluate whether sufficient habitat is present either on-site or off-site. The presence or absence of a habitat may be evaluated through the Habitat Questionnaire in Appendix B. If no habitat is present or likely to be impacted, no further ecological risk evaluation is necessary. If a habitat is present and may be impacted by site contaminants, sampling of relevant media (e.g., soil, sediment, or surface water) may be warranted. Analytical results are then evaluated in a Screening Level Ecological Risk Assessment (SLERA) and, if indicated by the results of the SLERA, a Baseline Ecological Risk Assessment (BERA). See Section 9 for additional information on ecological risk assessment.

A pathway in the context of this document is defined as direct contact (including inhalation, incidental ingestion, and dermal contact) with any of the following media:

1. Surface Soil
2. Subsurface Soil
3. Combined Soil
4. Groundwater
5. Surface Water
6. Sediment
7. Ambient Air

The human food chain pathway includes human ingestion of vegetables, fruits, meat (deer, cows, fish, shellfish, etc.) and eggs. If the human food chain pathway is a potentially complete pathway at your site, please contact EPD to discuss.

7. **Calculation of Cleanup Goals Options and Selection of Final Cleanup Goals.** For each exposure pathway and receptor where risk or hazard threshold(s) are exceeded, risk-based human health direct contact and, if applicable, ecological CGs should be identified or calculated for COCs. All CGOs should be included in a corrective action plan. The selected CGO should be protective of all applicable receptors and comply with relevant regulatory standards. See Section 10 of this document for guidance on calculation and selection of CGOs.

Table 1: Comparisons Between Risk Assessment Approaches

Criteria	Baseline Risk Assessment	Streamlined Risk Assessment	Combined Approach	Interim Measure
Purpose	Comprehensive quantitative assessment supporting corrective measures and regulatory decision-making.	Standard assumption evaluation to determine whether the concentrations exceed risk-based thresholds and if additional assessment is warranted.	Combines elements of Streamlined and Baseline approaches to allow site-specific refinement where warranted by site-specific data, exposure pathways, and/or receptors.	Immediate, short-term cleanup or stabilization of small, localized releases from a single waste stream to reduce imminent or potential exposure.
Guidance Basis	Follows USEPA Region 4 Human Health Risk Assessment Supplemental Guidance and Section 7 of this guidance document.	Follows Section 8 of this guidance document. Uses standard exposure assumptions and publicly available tools to calculate risk.[1]	Incorporates applicable portions of Sections 7 and 8. Uses a combination of standard and site-specific exposure parameters with documented justification.	Based on current RSLs and limited to small-scale soil releases.
Conceptual Site Model (CSM)	Comprehensive and detailed evaluation using site-specific receptors and pathways. See Section 3.	Simplified and conservative evaluation using generic receptors and default exposure pathways. See Section 3.	Allows for pathway-specific refinement and site-specific exposure adjustments based. See Section 3.	CSM is limited to defining source area and direct exposure routes. Applies where contamination is confined to soils with no other complete pathways.
Screening	Use applicable USEPA Regional Screening Levels (RSLs) [5] and/or approved background. See Section 6.2 for additional details.			
Exposure Assessment	Use site-specific and/or standard exposure assumptions as appropriate. EPCs should be derived as either the maximum detected concentration (MDC) or the 95% UCL on the mean, calculated using USEPA's ProUCL software or an equivalent statistically appropriate method.[2]	Use standard exposure assumptions. EPCs should be derived as either the MDC or the 95% UCL on the mean, calculated using USEPA's ProUCL software or an equivalent statistically appropriate method.	Mix of standard and site-specific exposure assumptions. EPCs derived as MDC or the 95% UCL on the mean, calculated using USEPA's ProUCL software or an equivalent statistically appropriate method.	Use standard exposure assumptions based on industrial workers or on-site receptors. EPCs typically based on MDC.
Toxicity Assessment	Use USEPA's Toxicity Value Hierarchy.[3]	Use toxicity values from the RSL Calculator.	Use RSL Calculator and/or toxicity values based on USEPA's Toxicity Value Hierarchy.	Use toxicity values from the RSL Calculator.
Lead	Use of one or more of the following models for the evaluation of lead (e.g., IEUBK, ALM, or AALM).[4]	Use applicable USEPA Regional Screening Levels (RSLs) for lead as cleanup values.	May use lead RSLs or site-specific lead models (e.g., IEUBK, ALM, or AALM).	Use industrial RSL for lead for soil.
Risk Characterization	Quantitatively integrates exposure and toxicity data to estimate noncancer hazards and cancer risks for each receptor and exposure pathway. Calculates Hazard Quotients (HQs), Hazard Indices (HI), and Excess Lifetime Cancer Risk (ELCR).	Provides an estimate of risk using standard assumptions and exposure pathways using the RSL or RAIS calculators.	Quantifies risk using a combination of standard and site-specific exposure assumptions. If applicable, provides refined risk interpretation for selected pathways or receptors.	Compare detected concentrations directly to industrial RSLs (set at ELCR = 1E-06 and HQ = 1). Residual risk is deferred for evaluation under subsequent risk assessment.

1. USEPA (2024). *Regional Screening Level Calculator (RSL)* [Online] and Oak Ridge National Laboratory (ORNL) (2025). *Risk Assessment Information System (RAIS) Calculator* [Online].
2. USEPA (2022). *ProUCL: Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations.* Version 5.2.
3. USEPA (2003b). *Toxicity Value Hierarchy* (OSWER Directive 9285.7-53).
4. SRC, Inc. & USEPA (2021). *Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK)*. Version 2.0; (USEPA, 2003a). *Recommendations of the Technical Review Workgroup for Lead for an Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil – The Adult Lead Methodology* (ALM). EPA-540-R-03-001.; (USEPA, 2025d) *All Ages Lead Model (AALM) Version 3.1.* EPA/600/R-19/102
5. USEPA (2024). Regional Screening Levels (RSLs) Generic Tables [Online].

3.0 The Conceptual Site Model

A well-developed CSM lays the critical groundwork for an effective risk assessment. It serves as a dynamic roadmap that systematically outlines what is known and suspected about a site, ultimately driving the entire investigation and risk assessment process. The CSM facilitates a clear comprehension of potential contaminant sources, exposure pathways, and receptors and ensures that the environmental data collected are directly relevant to risk assessment needs (USEPA, 2011a).

The CSM should be developed through collaboration among risk assessors, site investigators, and EPD to ensure clarity, consistency, and defensibility. A team-based approach facilitates informed decision-making and improves communication throughout the risk assessment process (USEPA, 2011a).

Because the CSM is not static, it should be refined as new information becomes available. Site characterization results may add or eliminate exposure pathways, refine receptor definitions, or clarify contaminant migration processes. Maintaining open communication with EPD regarding updates ensures transparency and supports efficient reviews.

3.1 Purpose of the CSM

The CSM provides a structured, site-specific framework for evaluating the potential for human health risk assessment. Key elements include (ITRC, 2015; NJDEP, 2019):

- **Thorough source identification:** Pinpoint historical and current sources of contamination on and around the site.
- **Release mechanisms:** Explain how contaminants were released into the environment (e.g., leaks, spills, discharges, intentional disposal).
- **Environmental media affected:** Identify whether soil, groundwater, surface water, sediment, and/or air are impacted. See Table 2 below.
- **Fate and transport mechanisms:** Describe how contaminants migrate through and between media (e.g., infiltration, volatilization, runoff, leaching, sediment transport).
- **Current and future land use:** Define how the site is currently used and any planned future uses (residential, commercial, recreational, etc.).

Resources

Environmental Cleanup Best Management Practices: Effective Use of the Project Life Cycle Conceptual Site Model, USEPA, EPA542-F-11-011, July 2021.

Decision Making at Contaminated Sites: Issues and Options in Human Health Risk Assessment, ITRC, Section 3.2, January 2015.

Soil Screening Guidance: User's Guide, USEPA, Publication 9355.4-23, Attachment A, July 1996.

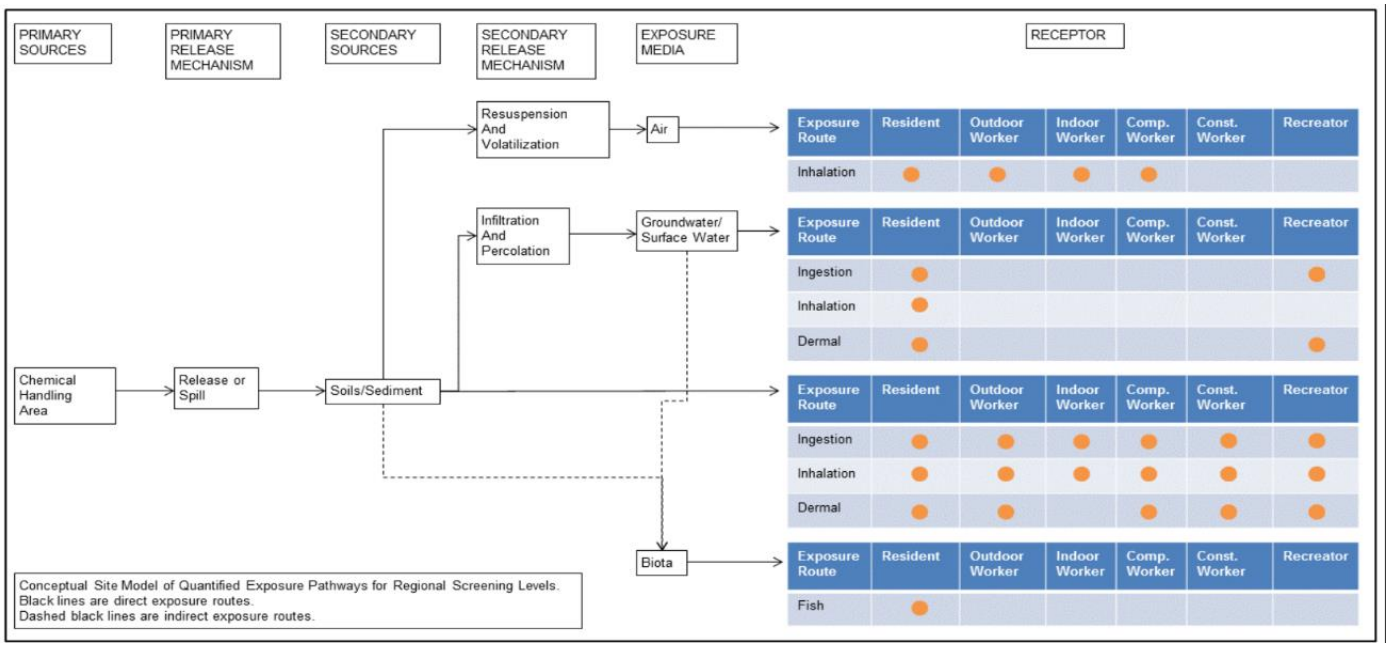
- **Receptors:** Identify populations and sensitive environments potentially at risk (e.g., residents, industrial workers, construction workers, trespassers, ecological receptors). See Table 3.

- **Exposure pathways:** Describe how receptors may be exposed (e.g., soil ingestion, dermal contact, inhalation of vapors or particulates, ingestion of groundwater).

By including these elements, the CSM provides a strong foundation for identifying potentially complete exposure pathways and evaluating risk.

The USEPA's *Soil Screening Guidance User's Guide* (USEPA, 1996b) presents CSM Summary Forms in Attachment A of that document, which serve as worksheets to document site-specific information used in the development of the CSM. These worksheets do not need to be included in a risk assessment report but are recommended for use as a checklist to ensure that all necessary information is included in the text of the CSM. However, the risk assessment report should include both a CSM diagram (See Figure 2) and supporting text describing the basis for identifying potentially complete exposure pathways. Where there are multiple zones, receptor populations, or site sub-units, separate CSM diagrams may be necessary to adequately represent the complexity of site conditions. Additional information on ecological CSMs is provided in Section 9.

Figure 2: Conceptual Site Model- Diagram Example



Source: USEPA (2025c). *Regional Screening Level (RSL) User's Guide*.

Table 2: Contaminated Environmental Media and Potential Receptors

This table includes the most common exposure pathways and receptors. Additional receptors may be applicable depending on site-specific conditions and land use.

Media	Adult and Child Resident	Industrial Worker	Construction Worker	Groundskeeper	Trespassers	Adult and Child Recreator	Hunter	Angler
Surface Soil	√	√	√	√	√	√	√	√
Subsurface Soil	(1)	(1)	√	(1)	(1)	(1)	(1)	(1)
Groundwater	√	√	(2)					
Surface Water						√		√
Sediment						(3)		(3)
Ingestion of Wild Game/Aquatic Life							√	√
Groundwater to Surface Water						(4)		(4)

√ - Complete pathway (Potential Current/Future)

Feet below ground surface- ft bgs

(1) Potentially complete pathway for future receptors if construction or excavation activities mixes subsurface soil into the surface soil horizon. Construction worker in this table encompasses the excavation worker and utility worker.

(2) Construction workers may be evaluated for direct contact with groundwater where routine activities (e.g., trenching, excavation, or utility line work) could result in incidental ingestion, dermal contact or inhalation of volatiles from exposed groundwater if groundwater table is less than 10 ft bgs.

(3) Potentially complete but insignificant pathway. Recreational receptors are not typically evaluated for direct contact with sediments. When sediments are submerged, incidental contact is minimal, and particles will typically wash off. Under these conditions, the pathway is incomplete. When sediments are not submerged the pathway should be considered complete.

(4) Potentially complete but insignificant pathway. Recreational (including anglers) receptors are not typically evaluated for direct contact with groundwater. When groundwater discharges to surface water (daylights), exposures are considered under the recreational surface water pathway (ingestion, dermal contact, inhalation), rather than the direct groundwater contact.

Table 3: Pathways to be Considered by Contaminated Environmental Media

Contaminated Environmental Media	Human Health	Ecological	Soil-to-Groundwater	Vapor Intrusion
Surface Soil	✓	✓[1]	✓[2]	✓[3]
Subsurface Soil	✓			
Groundwater	✓[4]	✓[5]		✓
Surface Water	✓	✓		
Sediment	✓	✓		
Biota	✓[6]	✓[7]		

✓ = Pathway applies under conditions described in footnotes.

1. **Ecological Soil Exposure:** Depth of soil to consider depends on habitat and burrowing animal species, which may extend to 6 ft below ground surface.
2. **Soil-to-Groundwater Pathway:** Evaluation should include the entire soil column down to the water table rather than limiting the evaluation to only the 0 to 10 foot interval for human receptor exposure. Please see EPD's Guidance *FAQs for Evaluating the Soil-to-Groundwater Pathway*.
3. **Vapor Intrusion (VI):** Volatile organic compounds (VOCs) present in soil can cause vapor intrusion. However, soil analytical data cannot be used to evaluate VI; soil gas data should be collected. Please see EPD's *Guidance for Evaluating the Vapor Intrusion Exposure Pathway.*
4. **Groundwater- Human Health:** The checkmark reflects direct contact exposure pathways (dermal and inhalation of volatiles for construction/utility workers). Potable use of groundwater (ingestion, dermal, inhalation) is evaluated separately under a drinking water pathway and is not fully captured by this "direct contact" designation.
5. **Groundwater- Ecological:** Ecological receptors may be exposed at groundwater discharge points (e.g., seeps, springs, or baseflow to surface water).
6. **Biota- Human Health:** The checkmark indicates that biota exposure applies to the ingestion of homegrown produce, fish, and wild game or livestock from uptake of contaminants in soils, surface water and/or sediment.
7. **Biota- Ecological:** The checkmark indicates that biota exposure applies when a food chain modeling scenario is relevant (e.g., fish consumption, wildlife foraging).

4.0 Data Collection Guidelines and Evaluation Before Conducting a Risk Assessment

Data collection and analysis should produce data of sufficient quality and with appropriate documentation to support risk assessment. Because site conditions vary, data collection and sampling strategies suitable for one site may not be appropriate for another. Early coordination with the EPD Risk Assessment Program (RAP) is strongly recommended to facilitate review of sampling and analysis plans and to ensure that the data generated is adequate for use in the risk assessment.

4.1 Environmental Sampling

Sampling Protocols. All sample collection and measurements should be conducted in accordance with the latest procedures outlined in USEPA Region 4 Laboratory Services and Applied Science Division's (LSASD) *Quality System and Technical Procedures for LSASD Field Branches* (2025). Other methodologies, such as an applicable ASTM Method for sampling a certain environmental medium, may be used with EPD approval.

Soils. Distinct sampling strategies should be applied for surface and subsurface soils. Surface soil is defined as the top 0 to 1 foot below ground surface (bgs), exclusive of grass, gravel, pavement, or other surface cover. Subsurface soil is defined as soil extending from 1 foot bgs to a depth of approximately 10 feet bgs or to the top of the groundwater table, whichever is shallower (USEPA Region 4, 2018b) samples should represent the depths that receptors are expected to contact. For example, an industrial worker may contact the upper foot of soil, whereas a construction worker may contact soils extending to approximately 10 feet bgs. The CSM should guide selection of appropriate sampling intervals to ensure that data reflect receptor-specific exposure scenarios. Because surface and subsurface soils are considered separate media, samples that span both horizons can make dataset classification unclear and complicate the risk assessment. Samples collected from 0 to 1 ft bgs represent surface soil for risk assessment purposes. Samples extending past 1 ft bgs include subsurface material and may dilute surface concentrations; therefore, they should be evaluated as subsurface soil**.** To minimize uncertainty and ensure appropriate dataset classification, consultation with EPD prior to soil sampling and risk assessment is recommended.

Groundwater. When sampling groundwater, low flow purging techniques should be utilized so that the sample turbidity is below 10 nephelometric turbidity units (NTUs) (USEPA Region 4, 2018b). If the monitoring well consistently yields samples with turbidity greater than 10 NTUs, the cause of the elevated turbidity should be evaluated. High turbidity in groundwater can sometimes be resolved by calibrating the turbidity meter, utilizing low flow purging and sampling techniques, or by redeveloping the groundwater monitoring well. The use of groundwater samples where turbidity cannot be reduced to 10 NTUs or below is not recommended in risk assessments. A duplicate filtered sample may assist in determining the source of turbidity problems; however, filtered samples are not recommended for use in a human health risk assessment.

Aqueous Media. For aqueous media (e.g., groundwater, surface water) samples where both dissolved metals (samples filtered through a 0.45 µm filter) and total metals (unfiltered samples) are reported,

all data tables should clearly indicate whether each concentration represents the dissolved or total fractions. Dissolved metals results should be used for ERAs while total metals results should be used for human health risk assessments.

Background Sampling. Background can generally be defined as the presence of naturally occurring or anthropogenic chemicals not due to the site or source under evaluation. The decision to collect and analyze background concentrations may rely upon whether inorganic (metal) chemicals may have been released at the site. Background data may assist with delineation efforts, helping to estimate how much of the detected metal is attributable to background. Please see Section 5 for more information regarding background.

Volatile Organic Compounds. When sampling for Volatile Organic Compounds (VOCs), care should be taken not to composite or mix the environmental media, thus causing volatiles to escape into the air. For this reason, composite and incremental sampling for soils cannot be used for VOC analysis. Only discrete sampling of soils can be used when sampling for VOCs. Please refer to Georgia's *Guidance for Evaluating the Vapor Intrusion Exposure Pathway* for more information about sampling VOCs in soil gas and indoor air pertaining to vapor intrusion.

4.1.1 Sampling Considerations, Special Circumstances, and Speciation of Certain Chemicals

Certain chemicals pose unique considerations for risk assessment and sampling related to environmental fate and transport. Naturally occurring bacteria in soil and water may change the form of the chemical into forms that are more readily bioavailable and bioaccumulative. Chemicals may change to lipophilic forms which may have more toxic ionic forms that require additional assessment, may change to elemental salts, or may easily volatize or degrade into other chemicals requiring additional care in sampling or analyte analysis. Considerations are discussed below.

Mercury. Mercury analysis should be determined on a site- and medium-specific basis. While total mercury may be appropriate for characterizing sources and transport in soil and groundwater, methylmercury analysis is generally only warranted in media where bioaccumulation is a concern (USEPA, 2025g). Specifically, methylmercury analysis is most relevant for:

- **Surface water** – to assess potential formation and transport to aquatic receptors;
- **Sediment** – as the primary compartment where microbial conversion to methylmercury occurs; and
- **Fish tissue** – to evaluate bioaccumulation and risk to human and ecological receptors.

Groundwater analysis for methylmercury is typically not necessary, except in limited cases where groundwater discharges to surface water and could contribute to methylmercury loading in aquatic systems.

Chromium. When sampling for total chromium, analysis for hexavalent chromium may be needed. If the site used hexavalent chromium in its processes, was involved in chrome plating, or was a former wood treater using chromated copper arsenate, then samples should be analyzed for hexavalent

chromium. Failing to speciate chromium in samples at a site that managed or disposed of wastes containing hexavalent chromium could result in evaluating total chromium concentrations using hexavalent chromium toxicity values. Hexavalent chromium is covered by the total chromium MCL for drinking water, which is consistent with EPA standards as a preliminary remediation goal (PRG).

4.2 Laboratory Analysis

Sample analyses should follow the methods detailed in USEPA's *SW-846: Test Methods for Evaluating Solid Waste: Chemical/Physical Methods* (2025f) or an appropriate equivalent. Additionally, in accordance with Georgia Rule 391-3-26 of the Rules for Commercial Environmental Laboratories, data submitted to EPD for regulatory purposes by a commercial analytical laboratory or a customer of a commercial analytical laboratory, shall be accepted by the Division only if the commercial analytical laboratory has received (a) Accreditation or certification by another State acceptable to the Director, (b) Accreditation or certification by the U.S. Environmental Protection Agency (c) Accreditation or certification by an accreditation agency, acceptable to the Director, and which the Division has entered into a Memorandum of Understanding of these purposes, or (d) Certification by the Division pursuant to O.C.G.A. 12-5-174(a)(3) and DNR Rule 391-3-5-.29 for drinking water tests.

The regulated facility and/or laboratory should aim for reporting limits below media-specific screening levels (when feasible). When reporting limits are above media-specific screening levels, the regulated facility or laboratory may want to consider alternative approaches such as re-running samples without dilution or consulting the laboratory for further analysis justification, as recommended in USEPA's *Data Usability in Risk Assessment (Part A-1), Final* (USEPA 1992a). Additional coordination with the laboratory may be required as part of the data quality review process when reporting is unclear or the case narrative does not fully account for the report results. Situations that may require follow-up include, but are not limited to, insufficient justification for high dilutions, poor recoveries due to 'matrix', or substitution of a method. In many cases, more precise analytical information is beyond the technical capability of the laboratory or method.

Adequate documentation protects both the laboratory and the data user and may provide information to support future phases of work, such as using more sensitive analytical methods.

Uploading data directly from the analytical laboratory files and importing it into a database is highly recommended to avoid data entry errors. When using Excel files provided by the laboratory, Quality Assurance (QA) procedures should be implemented to verify that no errors have been made during manipulation. Manual data entry from lab reports should be avoided, if possible, due to the increased potential for transcription errors.

For Data Quality Objectives (DQOs), please refer to USEPA's *Guidance on Systematic Planning Using the Data Quality Objectives Process*.

4.3 Age of Data

Historical data should be evaluated carefully before inclusion in a risk assessment. Data from mobile media such as groundwater, surface water, or sediment may not accurately represent current (baseline) exposure conditions if site conditions, contaminant sources, or migration pathways have changed since sample collection. Similarly, surface soil data may become unrepresentative if site activities, erosion, volatilization, or natural processes have altered surface conditions. Older data may still be scientifically valid where site conditions have remained stable and undisturbed, and no changes in contaminant sources, migration pathways, or environmental setting are expected. Professional judgment should be applied to determine whether such data remains representative of current conditions. Historical data can also provide valuable information for identifying source areas, evaluating contaminant trends, and understanding migration patterns. Evaluation of historical data should be conducted on a case-by-case basis considering contaminant properties, media type, contaminant mobility, ongoing or historical source contributions, land disturbances, and concentration trends. The rationale for including historical data in a risk assessment should be clearly documented. For questions regarding the use of historical data in a risk assessment, contact your EPD project manager (USEPA, 1989).

Resources

RCRA Groundwater Monitoring: Draft Technical Guidance, USEPA Office of Solid Waste, EPA/530R-93/001, NTIS PB 93-139350. November 1992 (b).

Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures, EPA/540/S-95/504, April 1996.

USEPA's Lead at Superfund Sites: Guidance webpage.

USEPA's Hazardous Waste Test Methods/SW-846 webpage.

Guidance for Data Useability in Risk Assessment, USEPA OSWER, Publication 9285.7-09FS, April 1992 (a).

Georgia Rules for Commercial Environmental Laboratories, Rule 391-3-26.

5.0 Background

In terms of risk assessments conducted in Georgia, background refers to concentrations of naturally occurring or anthropogenic chemicals in environmental media that are not attributable to site-related releases**.** Background data are valuable for delineation purposes, as they help estimate how much of the detected concentration is attributable to background conditions versus site activities.

Background data sets should be used where possible to develop background threshold values (BTVs). These can be calculated using ProUCL, a free statistical program available from the USEPA. In most cases, a 95th percentile upper tolerance limit (UTL) with 95% coverage is a useful statistic for developing a BTV and should be selected based on the underlying data distribution. Consultation with a statistician may be helpful where the choice is unclear (e.g., if the data set fits multiple distributions). The UTL is specific to BTVs and should not be confused with upper confidence limits (UCLs) on the mean, which are separate calculations in ProUCL and represent a measure of central tendency. BTVs, such as UTLs, are generally compared to the highest detected concentrations and should not be compared with UCLs of site data or other estimates of the mean.

Types of Background. There are two primary types of background. Natural background refers to concentrations of inorganic chemicals (e.g., metals) present in environmental media due to natural weathering of geologic materials, soil-forming processes, and mineralogical composition. Anthropogenic background refers to chemicals introduced through human activities that are either ubiquitous or regional in nature rather than site-specific. Polycyclic aromatic hydrocarbons (PAHs) and pesticides are common anthropogenic organic chemicals. As stated in the USEPA document *Frequently Asked Questions About the Development and Use of Background Concentration at Superfund Sites: Part One, General Concepts* (OLEM Directive 9200.2-141 A, March 2018), anthropogenic background concentrations, whether site-specific or regional, should not be used to exclude these chemicals from the risk assessment process. However, background information and other lines of evidence may be considered during the risk management phase to help inform decisions regarding the necessity and extent of corrective action.

Background Soil Sampling Protocols

- Discrete or grab – a single soil sample from the specific location and depth interval
- Composite – a sample comprised of several subsamples of the same volume that are physically mixed to create a homogenous single sample
- Incremental – a structured sampling and processing protocol that reduces data variability to provide an estimate of mean contaminant concentration in a defined volume of soil

To learn about the pros and cons of each sampling method, see the ITRC document *Soil Background and Risk Assessment*, December 2021.

Determination of Background. Whenever possible, background data should be collected as part of the site investigation. While detailed methods of background investigations are beyond the scope of this guidance, background investigations should follow these basic principles:

- Representative Locations: Background samples should represent regional conditions but should be collected outside the influence of site releases or other point sources. Site-specific background refers to chemical concentrations measured in environmental media collected within a site, but in areas that are not impacted by site-related activities or releases. Reference area background refers to chemical concentrations measured in off-site locations with similar geologic, hydrologic, soil, and land-use characteristics, but that are not impacted by site releases or influenced by other site releases. Reference areas are used when site-specific background concentrations are not available, not well-documented, or not attainable (e.g., lack of spatial coverage, temporal representativeness, natural geochemical heterogeneity).
- Flowing Water Bodies: Select upstream locations as background, accounting for tidal influence where applicable.
- Air Sampling: Collect samples upwind at the time of collection. For longer duration (e.g., 24 hours or longer), multiple samples may be necessary to obtain an appropriate background concentration. Wind rose charts should be consulted to determine the optimal placement of upwind sampler(s). (See the resource box for more information on obtaining wind rose diagrams near your site).
- Comparable Media/Units: Substrate (soil, sediment) and/or hydrostratigraphic unit (groundwater) should be comparable between site and background. Each separate soil type or groundwater aquifer should have its own background concentration.
- Consistency in Methods: Collection methods, sampling design (incremental vs. grab), and analytical methods should be consistent between background and site samples.

Resources for Determining and Use of Background Levels

Establishing Background Levels, Quick Reference Fact Sheet, USEPA, Directive 9285.7-19FS, EPA/540/F-94/030, September 1995.

Frequently Asked Questions About the Development and Use of Background Concentration at Superfund Sites: Part One, General Concepts, USEPA, OLEM Directive 9200.2-141 A, March 2018.

Guidance for Comparing Background and Chemical Concentration in Soil for CERCLA Sites, OSWER 9285.7-41, EPA 540-R-01-003, September 2002.

Role of Background in the CERCLA Cleanup Program, USEPA OSWER 9285.6-07P, April 26, 2002.

Custom wind roses can be obtained from the link below. Zoom to the area of interest and select different networks to determine which weather stations are closest to the site and have data within the range of dates sampled or anticipated sampling date range.

- https://mesonet.agron.iastate.edu/sites/locate.php?network=GA_ASOS

Sample Size: The number of background samples is site-specific and should be sufficient to support statistically valid comparisons with site data. While there are alternative methodologies to determine background concentrations, EPD recommends the use of ProUCL to derive a site-specific 95% Upper Tolerance Level (UTL) for background. It is recommended that ProUCL User Guide be consulted to determine the number of sampling points needed to calculate a 95% UTL as adequate sample size is critical for defensible BTV. For background datasets, it is preferable to have a data set of a minimum

of 10 observations and 6 detections. Consultation with a statistician may be helpful where the choice is unclear (e.g., if the data set fits multiple distributions).

- Reference Area Selections: Reference areas should be carefully selected to ensure similarity to site conditions in terms of geology, soil type, and land use. For ERAs, reference areas should be comparable to the site in terms of cover type (e.g., forest, wetland), soil saturation, hydrology, habitat and other biological characteristics.

Various USEPA documents, such as *Frequently Asked Questions About the Development and Use of Background Concentration at Superfund Sites: Part One, General Concepts*, USEPA, OLEM Directive 9200.2-141 A, March 2018 and *Guidance for Comparing Background and Chemical Concentration in Soil for CERCLA Sites*, OSWER 9285.7-41, EPA 540-R-01-003, September 2002 are available to assist in developing background sampling programs. Background studies may have been conducted in support of investigations at other Georgia contaminated sites. Assessors are encouraged to search State public records and partner with their EPD representatives to identify potentially applicable data sets.

5.1 Georgia Specific Arsenic Screening Value

Soils in Georgia are known to contain naturally occurring background concentrations of arsenic that frequently exceed the USEPA residential soil RSL. As a result, arsenic is often automatically identified as a COPC and may disproportionately drive risk estimates. To avoid confounding the risk assessment, a site-specific background evaluation for arsenic may be conducted and incorporated into the screening process. Alternatively, a Georgia-specific surface soil background value for arsenic of 9 mg/kg may be applied. This concentration was derived using a data set of sample results from US Geological Survey (USGS) data *Geochemical and mineralogical data for soils of the conterminous United States*, collected in surficial soils (0-11.8 inches) in Georgia from 2007 to 2013. Additional information regarding the derivation of the Georgia specific arsenic screening value can be found on EPD's website.

6.0 Screening

6.1 Selection of Human Health Screening Levels

The purpose of screening is to eliminate chemicals that do not contribute significantly to risk so that risk assessment may focus on the COPCs that may be important for risk management. Data for each medium (soil, groundwater, etc.) should be summarized in individual tables displaying descriptive statistics for each detected chemical in comparison to the applicable screening criteria. See below for applicable screening criteria for each environmental media.

Where appropriate, surface soil, subsurface soil, and groundwater stratigraphic units should be presented individually. The tables should clearly identify the units of measure for each medium. Care is needed to ensure the screening criteria are presented in the same units as the data.

While alternative screening approaches may be used, EPD provides example template tables for screening data in Appendix A of this document and Excel versions of the spreadsheets are provided for your use on EPD's website. These templates ensure that all necessary information is included and will facilitate the review process.

For baseline and streamlined assessments, screening should use residential (unrestricted) benchmarks, which reflect the most conservative exposure assumptions. For a combined approach or focused risk assessment assessing a target or specific receptor and/or pathway, non-residential screening levels may be appropriate when the site has an alternative current or future planned use as indicated in a UEC or other land restriction mechanism. Risk-based screening levels should be set at a target cancer risk of one in a million (10^{-6} or 1E-06) or an HQ of 0.1. If a chemical has both target cancer risk and non-cancer (HQ) based screening levels, the lower of the two values should be used as the overall screening value. In USEPA's RSL tables and calculator, these values would typically be identified as TR=1E-06; HQ=0.1 values. Screening levels for individual chemicals are set an order of magnitude below EPD's preferred cumulative risk thresholds to avoid inadvertently excluding chemicals that could contribute additively to overall risk. In accordance with USEPA Region 4 guidance, any analyte with a maximum detected concentration (MDC) or maximum detection limit (MaxDL) above its respective risk-based screening level should be identified as a chemical of potential concern (COPC). Please see Section 6.3 for additional information regarding non-detect data with MaxDLs exceeding screening levels.

Applicable screening levels are summarized in Table 4, with additional contaminant-specific considerations provided in subsequent sections.

Soil: Soil in the vadose zone should be assumed to be unrestricted down to a depth of 10 feet or the water table, whichever is shallower. This provision allows for soil mixing during redevelopment whereby subsurface material may be brought to the surface.

Surface soil is generally considered to be the top 12 inches of soil (0-1 ft bgs) that is available for exposure. When considering historical data sets, it may be appropriate to consider the top 24 inches of soil (0-2 ft bgs) as surface soil. The surface soil horizon begins below any vegetative

cover (such as grass or ground cover), asphalt, gravel or concrete surfaces. For the initial screen of data, use the USEPA Regional Screening Levels (RSLs) for residential surface soil (TR=1E-06; HQ=0.1).

Subsurface soil is defined as the soil extending from the bottom of the surface soil interval to a depth of 10 feet bgs or to the groundwater table if groundwater is encountered within the 1-10 ft bgs interval (USEPA Region 4, 2018b). Subsurface soil data should be compared to the current RSLs for residential soil (TR=1E-06; HQ=0.1). This comparison ensures that subsurface soil potentially brought to the surface during construction activities is evaluated for potential direct exposure by future residents. If site-specific conditions demonstrate that subsurface soil will only be contacted by non-residential receptors (e.g., industrial, construction, utility workers) and not by future residents, comparison to industrial RSLs may be used, if justification is documented and exposure scenarios are consistent with the intended current and future land use. However, for sites where a UEC or other mechanism will restrict residential use, industrial screening levels are appropriate for evaluating both surface and subsurface soil. This distinction allows the screening process to reflect both potential future exposure pathways and the protections afforded by institutional controls.

Combined soil includes both surface and subsurface soils that may be excavated together and brought to the surface. Combined soil data should be compared to the current RSLs for residential soil (TR=1E-06; HQ=0.1). The combined soil should also be compared to the Soil Screening Levels (SSL) for the Protection of Groundwater at a target risk (TR) of 1E-06, HQ of 0.1 and a dilution attenuation factor (DAF) of 1, 20 or an approved site-specific DAF. A DAF of 20 may be used when the contamination source is less than half an acre; otherwise, for sources greater than half an acre, a DAF of 1 should be used. Additionally, a DAF of 1 should be used when there is shallow groundwater, fractured bedrock, or karst aquifers. Please note that the Protection of Groundwater SSLs in the RSL Table are set at a DAF of 1. The screening level is the lower of the cancer and non-cancer risk-based concentrations, or the MCL-based SSL. If a chemical exceeds the SSL, it is recommended that it be evaluated in accordance with GA EPD guidance *FAQs for Evaluating the Soil-to Groundwater Pathway*. Exceedance of SSLs does not automatically trigger remediation.

It is recommended to evaluate all three scenarios (e.g., surface soil, subsurface soil, and combined soil), especially when datasets include data from intervals that are not typical of surface or subsurface soil intervals (e.g., 0-3 feet bgs).

Non-Residential Land Use Considerations: In site-specific cases, involving non-residential current or planned land use, screening data using industrial soil RSLs to determine COPCs is acceptable if a UEC or other land use control mechanisms will be used to restrict residential land use.

The USEPA RSL Calculator can be used to develop screening levels for construction workers who could be exposed to the entire soil column or combined soil (surface and subsurface). In

some cases, construction worker screening levels can be more conservative than those for industrial workers due to the assumed higher-intensity exposure rates.

The residential receptor is considered the most conservative receptor with the highest potential for exposure to site media. If site data are screened in comparison to residential screening criteria, the resulting list of COPCs is considered applicable for evaluating other receptors with less exposure such as a recreational user, trespasser, or construction worker, if appropriate, based on site conditions and anticipated future use.

Groundwater: Each groundwater unit should be screened using the USEPA tapwater RSLs (TR=1E-06; HQ=0.1). Please note that, in accordance with Region 4 USEPA guidance, MCLs should not be used for screening purposes. However, if all contaminants in the groundwater have MCLs, a brief comparison of the contaminants' MDCs or MaxDLs to their respective MCLs is recommended. If no exceedances of the MCLs are identified, a risk assessment may not be warranted for the groundwater pathway (subject to EPD approval). Please note that when screening metal concentrations in groundwater data, total metals should be used and not dissolved metals.

Surface Water: Surface water should be screened using the Georgia Instream Water Quality Standards (GISWQS) provided in Rule 391-3-6(5)(iv) of the Georgia Rules for Water Quality Control as the GISWQS applies to all waters of the State. If an GISWQS is not available for a specific chemical, screen using the USEPA National Recommended Water Quality Criteria (NRWQC) for human health-consumption of water plus organism consumption HH (Water+Organism). If there is not a NRWQC, a USEPA tapwater RSL may be used. If the water body supports fishing, but not potable use, use the NRWQC for organism ingestion only HH (Organism Only). For metals where the surface water screening value is based on the dissolved fraction, concentrations in dissolved (filtered) samples are acceptable for screening, but total (unfiltered) samples may also be used.

Sediment: Sediment is not soil, but where it presents a potential for direct contact (e.g., wading, etc.), residential soil RSLs (TR=1E-06; HQ=0.1) may be used. In accordance with USEPA guidance, it is unnecessary to evaluate human exposures to sediments that are submerged by surface water (USEPA Region 4, 2018b).

Table 4: Medium–Specific Screening Levels

Medium	Screening Levels
Surface Soil (0-1 ft) and Subsurface Soil (1-10 ft)	• Current USEPA Regional Screening Levels (RSLs) for residential soil • Current RSLs for industrial soil (may be used under certain circumstances (e.g., UEC) or with EPD approval) • EPD-approved background concentrations for inorganics
Entire Soil Column (0 ft to top of groundwater table)	• USEPA SSLs for the Protection of Groundwater**
Groundwater	• Tap Water RSLs*
Surface Water	1. Georgia Instream Water Quality Standards (Rule 391-3-6-.03) 2. National Recommended Water Quality Criteria for Human Health (Water + Organism) 3. Tap Water RSLs*
Sediment	• Current RSLs for Residential Soil • Use the RSL Calculator to develop recreator-specific RSLs

*RSLs should be set at a target excess lifetime cancer risk of 1E-06 and hazard quotient of 0.1. The screening level is the lower of the cancer and non-cancer screening level.
**Soil Screening Levels for the Protection of Groundwater should be set at a target risk of 1E-06, HQ of 0.1 and a DAF of 1 or 20 (or an approved site-specific DAF). If a chemical exceeds the screening level, it is recommended that it be evaluated in accordance with GA EPD guidance *FAQs for Evaluating the Soil-to Groundwater Pathway*.

6.2 Screening Process

Screening environmental data to determine if a risk assessment is necessary can be completed using one of the following:

(1) using an Excel template table on EPD's website and depicted in Appendix A of this document;

(2) using the EPD ScreenTool available on EPD's website, or

(3) using tables developed by the responsible party.

While alternative screening approaches may be used, including all required information provided in the templates will help streamline regulatory review and maintain consistency across submissions.

Chemicals should be identified as Chemicals of Potential Concern (COPCs) and evaluated further in the risk assessment if:

- The MDC exceeds the screening level (SL) for that medium, unless the concentration is below site-specific background values.
- A chemical is reported as non-detect where the MaxDL exceeds the screening level for that medium. EPD will consider requests to exclude non-detect COPCs from the risk assessment based on historical site activities on a case-by-case basis.
- A chemical does not have an established SL. For these chemicals, an appropriate surrogate's toxicity value(s) may be used to derive a screening level. If the chemical is detected above its calculated SL, it is carried forward as a COPC. Note that the appropriate surrogate's toxicity value(s) are also applicable for estimating risk. Any potential overestimation or underestimation of risk should be identified and discussed in the uncertainty section of the risk assessment. For a list of approved chemical surrogates, please see the Approved Chemical Surrogate List on the EPD's website.
- Frequency of detection should not be used during this phase of the risk assessment. However, in limited circumstances where non-detect data exceed screening levels, frequency of detection may be used as a line of evidence to support removing a chemical from further evaluation. Please see Section 6.3 below for additional information.

6.3 Alternative Approach for 100% Non-Detect Data

In consultation with EPD, chemicals with no detections in a given medium (0 percent frequency of detection) may be addressed qualitatively in the uncertainty section rather than being listed as COPCs if it can be demonstrated that the chemical was not historically used on the site, is not a breakdown product of another chemical used on the site, and has not been detected in other site media. If this approach is taken, the risk assessment should: (1) state clearly in the screening section which non-detect chemicals were excluded from the screening tables, and (2) identify where in the uncertainty section these chemicals are discussed. The level of detail expected in this qualitative discussion should be confirmed with EPD during planning.

6.4 Background Levels

The MDC of inorganic chemicals can be screened with approved background screening levels. Please note that if an inorganic is used in site processes, it should not be eliminated based on background, but should be evaluated further in the risk assessment, and discussed in the uncertainty section of the risk assessment. Please provide EPD with all background sampling locations, plans, reports, data sets and 95% UTLs based on the background data set for review prior to use as background screening

levels. Alternatively, a Georgia-specific surface soil background value for arsenic of 9 mg/kg may be applied. Please see Section 5 for additional information on background.

6.5 Individual Chemical Screening Considerations

Screening levels should be selected based on the context of the current CSM. Specific examples of additional considerations are provided below; however, these should not be considered the only chemicals requiring review. Where a chemical's speciation or form is unknown, the more conservative screening level should be applied.

Essential nutrients: Non-site-related essential nutrients, such as calcium, chloride, iodine, magnesium, phosphorus, potassium, sodium are not considered Chemicals of Potential Concern (COPCs) and do not require further evaluation in the risk assessment.

Arsenic: As previously discussed in Section 5.1, soils in Georgia are known to contain naturally occurring background concentrations of arsenic. A site-specific background evaluation for arsenic may be conducted and incorporated into the screening process or, a Georgia-specific surface soil background screening value of 9 mg/kg may be applied.

Chromium: As indicated in Section 4.1.1, certain industrial processes (such as chromium ore processing or plating operations) may have produced hexavalent chromium. Ideally, both total and hexavalent chromium data will be available. However, where hexavalent chromium data are not available and these processes have occurred at the site, use of hexavalent chromium screening values is recommended for total chromium until further speciation can be conducted. If site processes did not handle materials containing hexavalent chromium, this may be used as a line of evidence to support risk management decisions.

Mercury: USEPA publishes screening levels for mercuric chloride (mercury salts), elemental mercury, and methyl mercury. These are not interchangeable. In the absence of specific information that elemental mercury may be present (such as spills from meters, chlor alkali sites or visible sheens), presence of elemental mercury need not be assumed. Methylmercury is the predominant form of mercury found in animal tissue such as fish tissue. If elemental mercury and methylmercury are not known to be present, then the presence of mercuric chloride is assumed. Please see Section 4.2 regarding the analysis of mercury and its associated compounds.

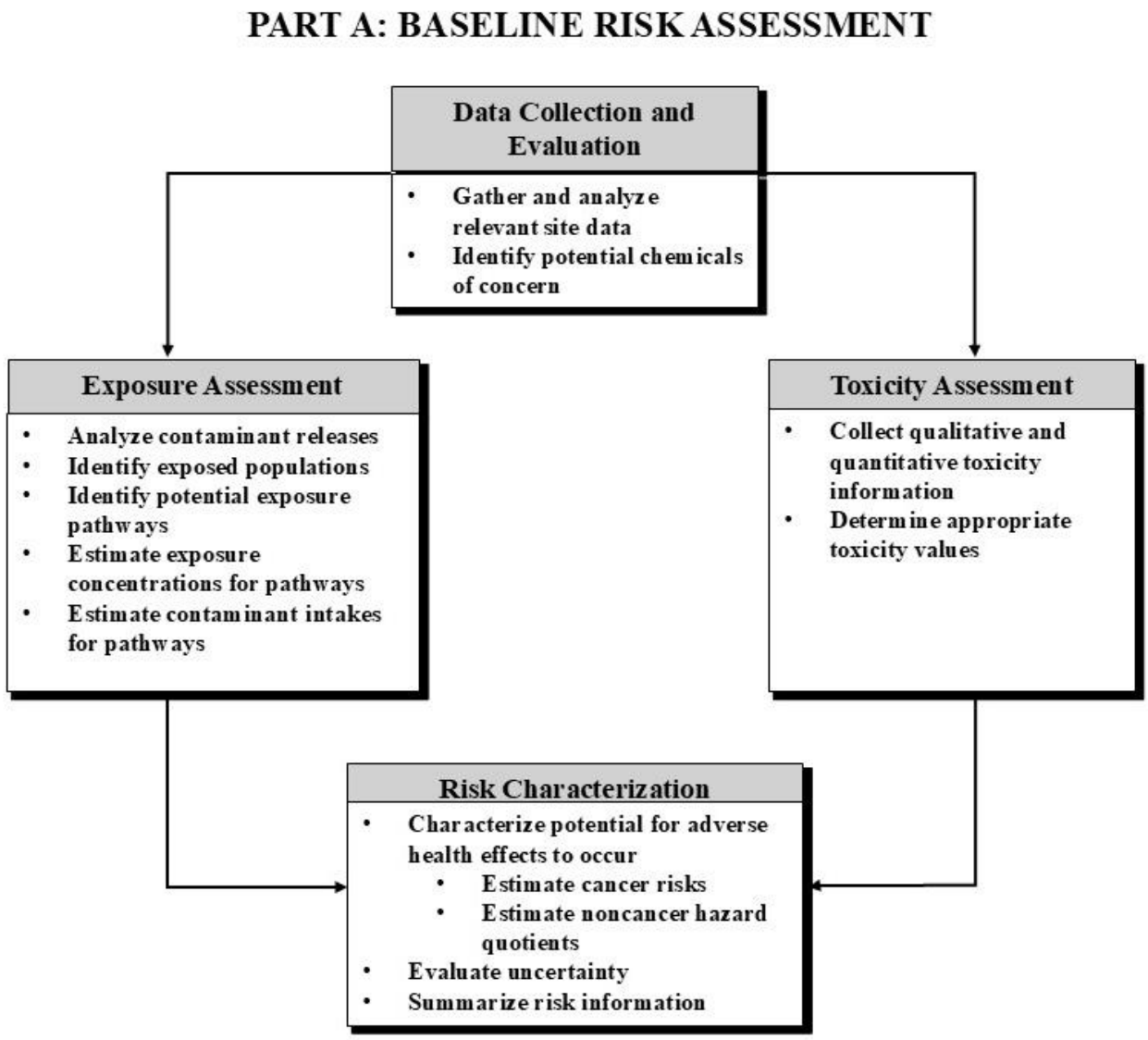
Nickel: Nickel is a naturally occurring element found in various forms in the environment, each with differing toxicological properties. The toxicity of nickel depends on its chemical form, concentration, route of exposure, and duration of contact. Determining the form of nickel present at a site is crucial for accurately assessing the associated risks to human health. USEPA publishes screening levels for various forms of nickel. Caution should be used in applying screening levels to total nickel in the absence of additional physicochemical information. Typically, screening levels for nickel soluble salts may be used at sites where nickel was not known to be part of the site process or a historical contaminant.

Lead: In accordance with USEPA's October 16, 2025 *Residential Lead Directive for CERCLA Sites and RCRA Hazardous Waste Cleanup Program Facilities*, a RSL of 200 mg/kg should be used when screening residential soils (USEPA, 2025e). Please note that the current Removal Management Level is 600 mg/kg.

7.0 Baseline Human Health Risk Assessment

A BRA characterizes conditions in the absence of remediation. It includes both current and reasonably foreseeable future receptor populations and exposures.

BRAs consist of four components as illustrated below:



Adapted from USEPA, 1989, Exhibit 1-2

The Data Collection and Evaluation Step has been described separately in Section 4 to emphasize integration with both the human health and ecological risk processes (Section 9). The remaining three steps of the human health risk process are described below.

7.1 Exposure Assessment

An exposure assessment is the process of evaluating site-related information to estimate the magnitude, frequency and duration of human exposure to COPCs in the environment. It describes qualitatively and quantitatively the contact between a COPC and a potential receptor. Complete exposure pathways should include all four elements:

1. A source and a mechanism of release to the environment;
2. An environmental transport medium;
3. A point of potential contact between a receptor and the environmental medium (referred to as the exposure point); and,
4. An exposure route or uptake mechanism.

An evaluation of the fate and transport of contamination in environmental media, a determination of the Exposure Point Concentration (EPC) for each COPC in each media, and exposure times (ET) and parameters for each receptor are crucial parts of the exposure assessment.

The first two elements of a complete exposure pathway, the source and mechanism of release to the environment and the environmental transport medium, represent the migration pathway, or how chemicals have been released at a site, and how those chemicals have migrated or could potentially migrate in site media. This information should be included as part of the CSM for the site.

7.1.1 Fate and Transport Analysis

The chemical screening or hazard identification step discussed previously in Section 6.2 identified the COPCs of interest in each medium at the site. A general fate and transport analysis should be completed to evaluate the potential for these COPCs to migrate in site media. The purpose of the fate and transport analysis is to evaluate whether the COPCs have the potential to migrate to a point of contact with a potential human receptor, and if so, in what environmental medium the contact will occur. Relevant physical and chemical properties of the COPCs should be summarized in a table and briefly discussed. The primary source of physical/chemical properties is the USEPA RSL Chemical-Specific Parameters Supporting Table. Additional sources of information based on peer-reviewed scientific research studies may be used on a case-by-case basis to obtain physical/chemical property information if a chemical is not included in the primary source document (USEPA, 1989).

The fate and transport analysis does not have to be extensive, but it should evaluate the physical and chemical properties of the COPCs in relation to the site environmental setting (e.g., soil property information, geologic setting, regional hydrogeology) to identify potential migration pathways at a site, including, but not limited to:

- ***Preferential pathways*** – If underground utility lines (e.g., utility corridors, storm sewers, etc.) are present, the potential for the utility to provide a preferential pathway for COPC migration should be evaluated. At a minimum, the depth of the utility line in relation to the source of

impact, material of construction and direction of flow should be evaluated.

- ***Volatilization*** - COPCs with Henry's Law Constants (H) greater than 1 x 10^{-5} atm-m^3/mol or vapor pressure greater than 1 millimeter mercury (mm Hg) are considered to have the potential to volatilize from soil or groundwater (USEPA, 2014c). The potential for COPCs to volatilize should be evaluated at each site with consideration given as to whether this potential migration pathway might be complete to ambient (outside) air, or indoor air. To evaluate the risk due to indoor air vapor intrusion, please use EPD's *Guidance for Evaluating the Vapor Intrusion Exposure Pathway*.

- ***Adsorption and/or Leaching*** – Low molecular weight compounds (generally below 200 grams per mole [g/mol] such as chlorinated VOCs) tend to have a relatively low affinity for soil as demonstrated by their organic carbon partition coefficients (K_{oc}) and would tend to migrate from soil to water. Other compounds, e.g., PAHs such as benzo(a)pyrene, with a high molecular weight tend to have a strong affinity to adsorb to soil as demonstrated by their K_{oc}. The following modified soil mobility classification scheme may be used to evaluate adsorption and potential for migration to groundwater.

Soil Mobility Classification Scheme*		
K_{oc} (mL/g or L/kg)	Log K_{oc} (mL/g or L/kg)	Mobility Class
<10 to 100	<1 to 2	Highly mobile to mobile
>100 to 10,000	2-4	Moderately mobile to slightly mobile
>10,000 to >100,000	4->5	Hardly mobile to immobile

*Modified from guidelines presented in *Guidance for Reporting on Environmental Fate and Transport of the Stressors of Concern in Problem Formulations for Registration Review*, USEPA (2009).

- ***Solubility*** - COPCs with moderate to high water solubility tend to dissolve readily in groundwater. These compounds also tend to have a relative low affinity for soil (based on Koc) and would therefore have the potential to migrate from soil to groundwater. COPCs that are soluble in groundwater could migrate through advection and dispersion to a secondary point of exposure including discharge to surface water. The following general classification scheme may be used to evaluate the potential for a COPC to be soluble in groundwater.

Water Solubility (mg/L)	**Classification***
<0.1	Negligible solubility
>0.1-100	Slightly soluble
>100-1,000	Moderate solubility
>1,000-10,000	Soluble
>10,000	Very soluble

* (USEPA, 2012)

- ***Erosion/Runoff*** – COPCs that bind to soil are considered to have the greatest potential to migrate by mechanical means through erosion/runoff during storm events. Evaluate potential erosion/runoff migration pathways based on chemical-specific K_{oc} values (discussed above), assessment of site cover (grass, pavement, etc.), surface elevation and slope, and site drainage and flow paths.

- ***Migration to Surface Water*** - The potential for migration to surface water should consider both overland drainage as well as the potential for groundwater to discharge to a surface water body. This potential migration pathway should be evaluated by identifying the distance to nearby surface water features, depth to impacted groundwater, direction of groundwater flow and potential for discharge to a nearby surface water body. In general, this migration pathway should be evaluated for surface water features located within 1,000 feet of the site, unless a site-specific feature (e.g., a preferential pathway) could lead to the migration of COPCs to a surface water body located at a greater distance.

- ***Wind Erosion/Dispersion*** - Soil particles have the potential to migrate through wind erosion and dispersion. Typically compounds that adhere to soil have the greatest potential to migrate through this pathway, especially if disturbance of soils will occur under current or future site development (i.e., construction).

7.1.2 Potential Receptors and Routes of Exposure

The exposure assessment should identify the potential receptors associated with the site as well as the routes of exposure (i.e., items 3 and 4 identified above for a complete exposure pathway). Each medium and exposure route needs to be assessed for potential exposures in the exposure assessment and CSM, although many of the exposure routes may be identified as incomplete and will not require further assessment. Other exposure routes may be secondary compared to receptors or routes already included.

Potential receptors should be evaluated for their presence both on-site and off-site as well as under current and future site conditions. A list of potential receptors evaluated in the exposure assessment would generally include:

- Residents (child and adult)
- Trespassers (adolescent age 7-16)
- Recreators (child, adolescent, adult)
- Indoor commercial/industrial workers (adult)
- Outdoor commercial/industrial workers (adult)
- Construction or Excavation Workers (exposed to soil from surface to 10 feet bgs) (adult)
- Utility Worker (exposed to soil from surface to 10 feet bgs) (adult)

Excavation/Construction Worker vs. Utility Worker Receptor Exposure Parameters

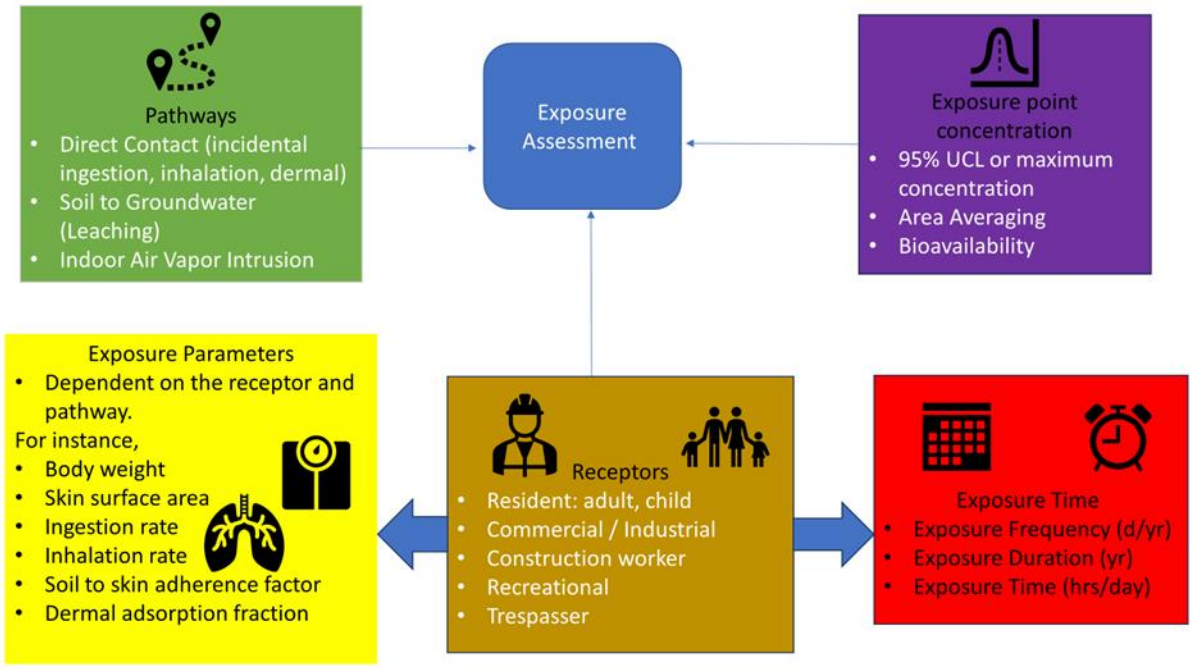
Excavation/Construction Worker

- Media: surface and subsurface soil (0-10 ft bgs)
- Exposure Type: acute or short-term
- Exposure Time: weeks to months (e.g., 26 weeks out of one year)
- Exposure Frequency: high (e.g., 8 hours a day)

Utility Worker

- Media: surface and possibly subsurface soil (0-10 ft bgs)
- Exposure Type: chronic but intermittent exposure throughout career
- Exposure Time: years (e.g., 25 years)
- Exposure Frequency: low (e.g., 1-2 hours a week)

Figure 3: Exposure Assessment



Although residents may not be present at a site under the current use scenario, it is standard practice to assume the potential for future residential use, unless a land use restriction (e.g., a UEC) has been implemented for the property. Including potential future residents in the risk assessment allows for

the identification of COCs at concentrations that exceed residential cleanup levels but fall below non-residential cleanup levels and provides support for implementing land use restriction, if necessary.

Assessment of a residential receptor under either a current or future site-use scenario, in the absence of remediation or institutional controls constitutes a BRA. Where a presumptive remedy such as land use controls (e.g., restricting use to industrial or limiting groundwater use) is anticipated, this approach should be discussed with EPD prior to incorporating it into the risk assessment report (USEPA Region 4, 2018b).

Depending on the environmental medium, it is often sufficient to identify the potential for exposure for receptors such as a recreator or trespasser (typically for soil). Exposure to these receptors may not need to be quantified if residential or worker receptors are evaluated, as the residential and worker receptors have increased rates of exposure (e.g., ingestion, dermal contact), as well as greater frequency and duration of exposure and will therefore drive risk management.

Media and potential exposure routes to be evaluated generally include those listed below. Site-specific conditions may warrant inclusion of additional media or pathways, and not all listed pathways will be applicable at every site (USEPA, 1989; USEPA Region 4 2018b)

- **Surface Soil** – incidental ingestion, dermal contact, and inhalation of particulates and volatiles.
- **Subsurface Soil** – incidental ingestion, dermal contact, and inhalation of particulates and volatiles during intrusive activities (e.g., excavation, drilling).
- **Groundwater** – ingestion, dermal contact, and inhalation of volatiles during use or exposure to vapors (e.g., showering, industrial use).
- **Surface Water** – incidental ingestion and dermal contact.
- **Sediment** – incidental ingestion and dermal contact.
- **Ambient Air (Trench Scenarios)** – inhalation of vapors or particulates originating from contaminated soil or groundwater.
- **Indoor Air** – inhalation of vapors or particulates migrating from subsurface soil or groundwater (vapor intrusion pathway).

Inhalation of vapors from subsurface sources in ambient (outdoor) air is typically not a medium of concern due to rapid volatilization.

7.1.3 Exposure Point Concentrations

Exposures are estimated using a combination of EPC and default or site-specific exposure parameters. An EPC represents the estimated arithmetic mean concentration of a contaminant that a receptor is expected to contact within a defined exposure unit over time. Because there are uncertainties in estimating the true average, statistical methods are used to calculate the EPC. EPD recommends using the most current version of USEPA ProUCL to calculate the 95% Upper Confidence Limit (UCL) of the mean for each dataset. Where supported by data distribution, ProUCL will recommend a 95%

UCL. If ProUCL does not recommend a UCL (e.g., due to small sample size, high variability, or non-normal distribution), the data and statistical outputs should be evaluated to select a defensible statistical value using best professional judgment, supported by rationale. When the 95% UCL exceeds the MDC, the MDC should be used as the EPC**.** Situations where the EPC is associated with bias or a higher-than-usual degree of uncertainty should be discussed in the Uncertainty Section of the BRA Report.

Tips for using ProUCL:

- The detection limit for non-detect data should not be halved.
- When ProUCL recommends more than one UCL, the most conservative or highest value should be used as the EPC.
- When using discrete sampling, if the number of samples is fewer than 10 and/or the number of detected concentrations is fewer than 6, it is recommended that that the MDC be used as the EPC.
- If the 95% UCL of the mean is greater than the MDC, the MDC should be used as the EPC.

For additional details and statistical considerations, please refer to the ProUCL User Guide for more instruction.

EPCs should be derived for all applicable environmental media; however, different approaches apply to specific media, as summarized below.

Surface Soil: EPCs for surface soil (0 to 1 ft bgs) should be calculated in accordance with EPD's *Area Averaging Approach to Soil Compliance for Direct Contact Exposure Scenarios* (December 2020). Area averaging may be used when soil contaminant concentrations are spatially representative and exposure units are defined consistently with receptor use areas.

Subsurface Soil: EPCs for subsurface soil should reflect the exposure depth applicable to the receptor (e.g., 0 to 10 ft bgs for construction workers). Use ProUCL to estimate the 95% UCL of the mean unless the data is limited or contains numerous non-detects.

For soils containing lead or arsenic, EPCs may be adjusted using the Relative Bioavailability (RBA) factor. The USEPA default RBA for both metals is 0.6, which is already incorporated in the RSL calculator (arsenic) and in USEPA's lead models (USEPA, 2021a). For lead, the arithmetic mean should be used as the EPC (not the 95% UCL). Site-specific RBA data may be incorporated into the risk assessment through adjustment of exposure dose or absorption fraction but should be applied only once (e.g., to the EPC, risk goal, or toxicity value) and submitted to EPD for approval.

Groundwater: Groundwater EPCs should be calculated using data from permanent monitoring wells located within the core of the contaminant plume. Use a minimum of three wells, and where possible, incorporate the most recent sampling events from each well.

EPD defines "aquifer" as any stratum or zone beneath the surface of the earth capable of containing or producing water from a well; therefore, the aquifer is usually defined based on the vertical stratum or layer transmitting the water. Therefore, deriving EPCs for groundwater should be based on the aquifer from the vertical perspective. (USEPA, 2014a). It is acknowledged that there are other scientifically supported approaches that may be used when justified by the CSM. If a different

approach is used than recommended, please discuss with EPD prior to implementation. All samples should be collected unfiltered using low-flow sampling techniques. Variability between aquifers or screened intervals should be noted and discussed in the risk assessment.

Surface Water: Surface water datasets often contain a limited number of samples. If ProUCL does not recommend a UCL (e.g., due to small sample size, high variability, or non-normal distribution), the data and statistical outputs should be evaluated to select a defensible statistical value using best professional judgment, supported by rationale. In such cases, consider the MDC as the EPC. Surface water data should consider representativeness based on hydrologic stability, flow regime, and proximity to source areas. Where long-term datasets exist (e.g., routine monitoring), age of data should be considered as well as temporal stratification (wet vs. dry season). Documentation of data selection criteria and statistical assumptions should be provided in the risk assessment.

Sediment: Sediment data, like surface water data, are often spatially limited and highly variable. If ProUCL does not recommend a UCL (e.g., due to small sample size, high variability, or non-normal distribution), the data and statistical outputs should be evaluated to select a defensible statistical value using best professional judgment, supported by rationale. In such cases, consider the MDC as the EPC. When a dataset includes multiple depositional zones or depth intervals, evaluate each as a separate exposure unit. EPC selection should be guided by depositional characteristics, receptor exposure frequency (EF) (e.g., wading humans), and representativeness of sampling locations. If sediment contamination is episodic or associated with storm events, EPCs should be based on samples that represent typical baseline conditions, not short-term peaks. Documentation of data selection criteria and statistical assumptions should be provided in the risk assessment.

7.1.4 Exposure Parameters

Exposure parameters such as body weight (BW), ingestion rate, inhalation rate, skin surface area, EF, exposure duration (ED) and ETs should be determined based on current and future scenarios for each receptor. The combination of these parameters should represent the reasonable maximum exposure (RME), which reflects the highest exposure reasonably expected at a site. USEPA default parameters provided in Table 5 may be utilized without justification. For recreators, default assumptions can be found in the Oak Ridge National Laboratory's Risk Assessment Information System (RAIS) User's Guide and can be used with appropriate documentation. See Figure 3 for an illustration of the factors considered in an exposure assessment.

Exposure Duration. Exposures may be acute, subchronic or chronic. Acute exposures are usually exposures that occur over a short period of time (hours to days). Subchronic exposures occur for weeks or months, typically up to 10 percent of a lifetime, or seven years, while chronic exposures occur over a significant part (greater than 10 percent) of a lifetime.

Exposure Frequency. The EF for a trespasser (adolescent adult) is site specific and based upon the distance, accessibility and attractiveness of the site to the trespasser.

The excavation/construction worker is usually considered in a future scenario, assuming intensive acute or short-term exposure to both surface and subsurface soils (generally to a depth of 10 ft bgs). This receptor has a relatively short ED (weeks to months), but a high EF during the active construction/excavation period. The excavation/construction worker incorporates potential dermal, inhalation, and incidental ingestion pathways related to direct exposure from contaminants in disturbed soils. The utility worker generally reflects a lower EF, but a longer ED over a career timeframe (i.e., 25 years). Utility workers may contact both surface and subsurface soils during maintenance and repair activities, though soil disturbance and frequency of contact are less intensive than a construction/excavation worker. Generally, utility workers' exposure is chronic, but intermittent.

For swimming, due to long warm seasons in Georgia, the EF of 45 days per year is recommended, except in coastal/lake environments when a frequency of 90 days/year is recommended.

Ingestion Rates. Fish ingestion rates are highly variable; therefore, site-specific values may be used with justification. Ingestion rates (IRs) for a variety of receptors are available from USEPA's *Exposure Factors Handbook* (2011b).

Because lead does not have traditional toxicity factors (e.g., oral slope factor or reference dose), USEPA uses blood lead modeling, which relies on central-tendency intake assumptions to predict the distribution of blood lead levels across a population. Therefore, when assessing lead, exposure parameters should be based on central tendency assumptions and not reasonable maximum exposure (USEPA 2003a). Please see Section 7.2.2.

When using site-specific exposure parameters, justification should be provided in the text of the BRA Report. All site-specific parameters are subject to EPD approval.

7.2 Toxicity Assessment

The toxicity assessment provides a description of the relationship between the intake (i.e., dose) of a chemical and the anticipated likelihood of an adverse health effect. The purpose of the toxicity assessment is to provide a quantitative estimate of the potential toxicity of COPCs for use in risk characterization. The human health risk assessment framework developed by USEPA, and utilized by EPD, separates the adverse health effects associated with chemicals into two broad categories: i) carcinogenic and ii) noncarcinogenic effects (also known as systemic health effects or hazard). Chemical carcinogens are also capable of producing systemic health effects at some dose (typically higher). These chemicals are generally evaluated for both carcinogenic and noncarcinogenic health effects.

Toxicity values should be selected based upon the hierarchy provided in USEPA's *Human Health Toxicity Values in Superfund Risk Assessments* (USEPA, 2003b) and *Tier 3 Toxicity Value White Paper* (USEPA, 2013a). The following toxicity value hierarchy should be used:

- *Tier 1 sources*: Integrated Risk Information System (IRIS)

- *Tier 2 sources:* USEPA Provisional Peer Reviewed Toxicity Values (PPRTVs)
- *Tier 3 sources*: Other Toxicity Values
    - Agency for Toxic Substances and Disease Registry (ATSDR)
    - The California Environmental Protection Agency (CalEPA)
    - Health Effects Assessment Summary Table (HEAST)

IRIS is the recommended primary source for human health toxicity values. Other sources listed in this section represent the main tiered references for obtaining toxicity factors. If additional credible and relevant sources are proposed, their use will be evaluated on a case-by-case basis, taking into account scientific validity, applicability to the site conditions, and regulatory acceptability.

Toxicity Values

Cancer toxicity factors:

For ingestion and dermal contact: Slope Factor or SF

For inhalation: Inhalation Unit Risk or IUR

Noncancer Hazard toxicity factors:

For ingestion and dermal contact: Reference Dose or RfD

For inhalation: Reference Concentration or RfC

When Tier 3 toxicity values are proposed, priority should be given to sources using similar methods and procedures to Tier 1 and Tier 2 sources. Additionally, sources should be peer reviewed and publicly accessible (USEPA, 2013a).

Based on the recommendations in the May 26, 2021, USEPA memorandum *Recommendations on the Use of Chronic or Subchronic Noncancer Values for Superfund Human Health Risk Assessments*, subchronic toxicity values should be used when evaluating human health rather than chronic toxicity values for 19 chemicals (see the hyperlink above for the list of chemicals) (USEPA, 2021c).

In some cases, toxicity values incorporated into the USEPA RSL tables are derived from Provisional Peer-Reviewed Toxicity Values (PPRTVs). For certain chemicals, only screening-level PPRTVs are available due to limitations in the toxicological database. These values are developed as interim estimates and carry greater uncertainty than other Tier III toxicity values. Screening-level PPRTVs may be used for initial screening and COPC identification when no higher-tier toxicity value exists. However, they should be applied with caution in the context of corrective action decisions, since they are not intended to serve as definitive regulatory criteria. Documentation in the risk assessment should note when screening-level PPRTVs are used, summarize their limitations, and explain how uncertainty was addressed in the risk management process.

7.2.1 Surrogate Toxicity Values

In some cases, a toxicity value may not be available from any of the sources discussed above. When a chemical lacks a toxicity value, it may be appropriate to use a surrogate based on a chemically and toxicologically related compound (i.e., structural similarity, toxicokinetic/metabolism, and/or toxicity similarity). A list of common surrogates is available on EPD's website.

7.2.2 Chemical-Specific Issues

Arsenic. Recent research suggests that the oral relative bioavailability (RBA) of arsenic in soil is less than 100%. Therefore, EPD follows the USEPA Technical Review Workgroup Bioavailability Committee's recommended RBA fraction of 0.6 (60%) in the absence of site-specific data. USEPA recommends that the in vitro bioaccessibility (IVBA) method for predicting oral RBA of arsenic in soil be used to estimate site-specific RBA, when site-specific RBA adjustments are warranted (USEPA, 2021a). For more information on bioavailability and bioacessibility, see USEPA's webpage "Soil Bioavailability at Superfund Sites: Guidance". Please note that any adjustment for RBA should be applied only once in the risk assessment process, either the EPC, toxicity factor, or CGO Site-specific RBA values should be supported by adequate data and submitted to EPD for approval.

Chlordane. When evaluating cis- and trans- chlordane, EPD follows the USEPA 2021 memorandum with the subject "Evaluation of the use of chlordane as a surrogate for cis- and trans-chlordane (STICS: ORD-041306)". USEPA's memo recommends using the technical chlordane (12789-03-6) reference dose as a surrogate toxicity value for oral, noncancer screening assessments of the cis- and trans- isomers (CAS Number 5103-71-9 and 5103-74-2, respectively) (USEPA, 2021b).

Vinyl Chloride. EPD accepts the use of the RSL Calculator approach for assessing vinyl chloride cancer risk, which incorporates age-specific toxicity factors reflecting exposure at birth. These factors account for increased susceptibility during early-life exposure. When evaluating a receptor exposed only during adulthood, the RSL Calculator's age-adjusted methodology is not required. In such cases, the unadjusted cancer slope factor or inhalation unit risk (IUR) without application of the twofold early-life uncertainty factor may be used to estimate cancer risk (USEPA, 2025c). For risk assessments involving multiple age scenarios, exposure should be partitioned by relevant life stages, applying the age-specific factors for exposures occurring at birth or during childhood, and the unadjusted adult factors for exposures occurring solely during adulthood. The RAIS PRG calculator can be utilized for assessing vinyl chloride in scenarios where receptors are exposed only in adulthood.

Vanadium PPRTV vs RSL Calculator assessment of Vanadium. EPD recognizes the availability of a Tier 2 vanadium reference dose (RfD). However, the RSL Calculator derived RfD (which uses the vanadium pentoxide IRIS RfD but factors out the molecular weight of the oxide ion) can be used for risk assessment to maintain consistency with USEPA Region 4's approach (USEPA 2025c)

Assessing Xylenes. It is acceptable to sum the concentrations of the individual isomers together to obtain total xylene and to assess the individual isomers as total xylenes in the risk assessment. Many labs cannot separate the m- and p- isomers from each other during analysis and report these results as "m,p-xylene".

Hexavalent Chromium. If a site handled materials containing hexavalent chromium, was involved in chrome plating, or was a wood treater using chromated copper arsenate, then samples should be analyzed for hexavalent chromium (See Section 4.1.1. regarding sampling for hexavalent chromium).

- If there are only total chromium sampling results, consult both the site history and CSM to decide if there are historical or current processes of chromium associated with the site. If so, assume all the total chromium is hexavalent chromium and discuss in the uncertainty section of the BRA Report. If it can be demonstrated that site processes did not use hexavalent chromium, then it may be possible to support evaluation as trivalent chromium. This should be discussed with EPD in advance of the risk assessment.

- Concerning the total chromium Maximum Contaminant Level (MCL) of 0.1 mg/L (100 µg/L), EPD is consistent with USEPA's current understanding that hexavalent chromium is covered under USEPA's total chromium MCL. Therefore, EPD accepts the total chromium MCL as a Regulatory Standard Based Goal (RSBG) for hexavalent chromium, meaning that the total chromium MCL can be selected as the hexavalent chromium groundwater and drinking water preliminary remediation goal (PRG) (USEPA, 2025a).

Lead. Lead risk assessments do not use traditional toxicity values, but rather evaluated based on blood lead levels. To evaluate lead in a risk assessment, the most current version of the Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK) for residential exposure scenarios or the Adult Lead Methodology (ALM) for non-residential lead scenarios should be used. In both models, a 95th percentile target blood lead level of 5 µg/dL should be used in accordance with the USEPA Directive (USEPA 2025e). Additionally, the EPC for lead should be the arithmetic mean of sample concentrations in a dataset.

USEPA Adult Lead Model, available on the RAIS website

Model Constraints:

- Minimum AT of 90 days (as 3 months of exposure are necessary to reach quasi-steady state blood lead levels).
- For excavation worker exposure to soil, use a default EF of 36 days (12 weeks, 3 days a week) with an ingestion rate of 75 mg per day for contact intensive exposure.

Lead soil PRGs should be derived using the IEUBK and/or ALM and should consider bioavailability, soil lead background concentrations, and technical limitations such as detection/quantification limits (SRC, Inc., 2021). The PRGs should also be derived using central tendency parameters (i.e., not the reasonable maximum exposure parameters).

USEPA has recently released the All Ages Lead Model (AALM). The AALM addresses the uncertainties associated with the other two models, specifically the age ranges between 7 years and adult and intermittent exposures. Because lead risk is based on total exposure, information from non-site-related sources such as ambient air, diet and tap water are required for the most reliable estimates (USEPA, 2025d).

Mutagens. Section 5.17 of the RSL User's Guide identifies specific chemicals considered to be carcinogenic by a mutagenic mode of action. Except for vinyl chloride, default age-dependent adjustment factors (ADAFs), as provided in USEPA's *Supplemental Guidance for Assessing Susceptibility from Early-Life Exposures to Carcinogens* (EPA/630/R-03/003F, March 2005), should be applied to cancer toxicity values before determining cancer risk. The default ADAFs do not need to be applied for residential or non-residential scenarios where no children (defined as individuals less than 16 years of age) are present (USEPA, 2025c).

For trichloroethylene (TCE), cancer toxicity values reflect a combined risk from kidney cancer, liver cancer, and non-Hodgkin lymphoma (NHL). TCE is considered mutagenic specifically for kidney cancer, while liver cancer and NHL are not considered to follow a mutagenic mode of action. Therefore, direct application of ADAFs to the composite cancer slope factor (CSF) or IUR is not appropriate. When evaluating TCE risk, ADAFs should only be applied to the kidney cancer component, while unadjusted toxicity factors should be used for liver cancer and NHL.

Dioxins & Furans (TEFs). In some cases, chemicals belonging to the same family exhibit similar toxicological properties, but their degree of toxicity differs. In the case of dioxins and furans, EPD follows USEPA's *"Use of Dioxin TEFs in Calculating Dioxin TEQ's at CERCLA and RCRA Sites"* recommendation to calculate a toxicity equivalence quotient (TEQ) by applying a toxicity equivalence factor (TEF) to the measured concentrations in environmental media. The TEQs are summed and assessed using appropriate toxicity values for 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD). Please note that when using the RSL Calculator, TEFs have already been applied to the toxicity values (USEPA, 2013b).

PCBs & Congeners. PCBs should be evaluated using the analytical and toxicity-value framework in the *USEPA Region 4 Technical Services Section Issue Paper for Polychlorinated Biphenyl Characterization at Region 4 Superfund and RCRA Sites, February 2013*. When Aroclor data are available, assess risk using Aroclor-specific toxicity values and exposure parameters, consistent with the current RSL User's Guide on selecting the appropriate tiered oral slope factor for human health risk assessment.

- Total PCB toxicity values should be used when samples are analyzed for individual congeners using USEPA Method 1668 and the full suite of 209 congeners is reported. In this case, total PCBs are defined as the sum of all detected congeners.
- Dioxin-like congeners should be assessed separately. See Section 2.3.5 of the RSL User's Guide.

Trihalomethanes. Please note that when using the RSL Calculator or referencing the RSL Summary Tables, the individual trihalomethanes (bromodichloromethane, bromoform, dibromochloromethane, and chloroform) each have a listed MCL of 80 µg/L. However, 80 µg/L is the MCL for the chemical group total trihalomethanes. Concentrations of trihalomethanes should be summed and compared to the cumulative MCL of 80 µg/L.

Table 5: Recommended Default Exposure Parameters (USEPA, 2014b)

Parameter	Receptor	Value
Body Weight (BW)	Child	15 kilograms (kg)
	Adult	80 kg
	Trespasser (Adolescent – Age 7-16)	45 kg
Skin Surface Area – Soil (SA)	Child	2,373 cm^2/day
	Adult	6,032 cm^2/day
	Worker	3,527 cm^2/day
Skin Surface Area – Water (SA)	Child	6,365 cm^2/day
	Adult	19,652 cm^2/day
Exposure Frequency (EF)	Resident	350 days/year
	Worker	250 days/year
	Indoor Worker	250 days/year
	Outdoor Worker	225 days/year
	Construction Worker	130 days/year
Exposure Duration (ED)	Resident	26 years
	Resident Adult	20 years
	Resident Child	6 years
	Worker	25 years
	Construction worker	1 year
Exposure Time (ET) – Air	Resident	24 hours/day
	Worker	8 hours/day
Exposure Time (ET) – Water	Resident	24 hours/day
	Resident Child	0.54 hours/event
	Resident Adult	0.71 hour/event
	Worker	0.54 hours/event
Exposure Time (ET) – Soil	Resident	24 hours/day
	Worker	8 hours/day
Averaging Time (AT)	Resident	365 days/year
	Indoor worker, composite worker, outdoor worker	365 days/year
Soil Adherence Factor (AF)	Child	0.2 mg/cm^2
	Adult	0.07 mg/cm^2
	Worker	0.12 mg/cm^2
	Construction Worker	0.3 mg/cm^2
Ingestion Rate – Water (IR_W)	Child	0.78 L/day
	Adult	2.5 L/day
Ingestion Rate – Soil (IR_S)	Child	200 mg/day
	Adult	100 mg/day
	Indoor Worker	50 mg/day
	Outdoor Worker	100 mg/day
	Construction Worker	330 mg/day
Lifetime		70 years

7.3 Risk Characterization

Once the Exposure Assessment and Toxicity Assessment are completed, the information gathered for both assessments is combined to calculate the cumulative risk and hazard for each receptor exposed to a pathway(s) of concern. It is recommended that the cumulative risk and hazard be calculated using the RSL or RAIS calculator for consistency. Additionally, cumulative risk and/or hazard may be calculated using the equations in USEPA's *Risk Assessment Guidance for Superfund* or RAGS (1989).

Using the RSL or RAIS calculator, select the appropriate receptor scenario, media, risk output, and COPCs. EPCs and any other site-specific parameters can be entered further. For more information on the RSL or RAIS calculator, please see their individual user guide. Please print out or save electronically the inputs and outputs from the calculator. Risk and hazard should be expressed as one significant figure in a table for each receptor/pathway scenario (e.g., resident child – surface soil pathway, or construction worker – combined soil, etc.). Any cumulative risk or HI exceeding 1E-05 (10^{-5}) and 1 ("thresholds") respectively, may need further action. Any receptor/pathway scenario below the cumulative thresholds does not require further action.

For HIs above 1, a target organ-specific hazard index (TOSHI) may be calculated for each receptor/pathway scenario. Calculate the TOSHI by adding the HQs for each chemical that has the same target organ or system. If any TOSHI exceeds 1, that receptor/pathway scenario may need further action. Target organ information can be obtained from reputable toxicological databases such as IRIS or ATSDR.

7.3.1 Selection of Chemicals of Concern

For each receptor/pathway combination, evaluate what chemicals contribute the most risk or hazard. Select the chemicals that contribute the most risk or hazard to a receptor/pathway scenario until the risk and hazard posed by remaining chemicals are below the thresholds (1E-05 or 1). Please submit the COC Worksheet available on EPD's website and in Appendix A of this document. Selected COCs for that receptor/pathway scenario should be addressed in a corrective action plan.

7.3.2 Uncertainty Section

Every risk assessment should include an uncertainty section that describes how the assumptions, input parameters, and data limitations influence the confidence in the quantitative risk and hazard estimates. Key site-specific assumptions that contribute most to overall uncertainty should be identified and discussed.

Uncertainties are most often associated with the exposure assessment, which relies on numerous assumptions and estimates such as contact rates, EF and duration, and BW. Depending on data quality and quantity, uncertainty may also arise in determining the EPC. For example, if ProUCL cannot calculate or recommend an EPC due to a high proportion of non-detects, the MDC may be used. Use

of the MDC can overestimate exposure potential and increase uncertainty in the resulting risk estimates.

The screening step in the risk assessment is conservative in design to ensure that all potentially relevant chemicals are initially retained for further evaluation. However, chemicals identified as chemicals of potential concern (COPCs) may later be excluded based on refined evaluations such as frequency of detection, trend analysis or other relevant lines of evidence.

Uncertainty is also inherent in toxicity values. Many toxicity reference values (TRVs) are derived from animal studies and extrapolated to humans through modeling, which introduces variability and uncertainty. These and other factors, such as analytical detection limits (DL), representativeness of samples, and model assumptions should be discussed in the Uncertainty Section of the report.

7.4 Baseline Risk Assessment Report

The following is a suggested outline for a BRA Report.

1. Introduction
    a. General problem at site
    b. Site-specific objectives of the risk assessment
2. Site Background and CSM
    a. Site description
    b. Map of site and photographs
    c. General history (Ownership, Operations and Contamination)
    d. Area(s) of Contamination and Sources (Include maps of source areas, extent of contamination, and sampling locations and tables of sampling depths and results)
    e. Surrounding land use
    f. Potential receptors
    g. CSM (pictorial and/or text)
3. Data Evaluation
    a. Evaluation of analytical methods
    b. Evaluation of quantification limits
    c. Evaluation of qualified data
    d. Chemicals in blanks
    e. Background for naturally occurring inorganics
    f. Data gaps
4. Screening to determine Chemicals of Potential Concern (include separate subsections for each contaminated area)
5. Exposure Assessment
    a. Description of exposure setting
    b. Fate and transport of contamination
    c. Potential receptors and routes of exposure
    d. EPC
    e. Exposure Parameters (for each receptor)
6. Toxicity Assessment (summarize in table)

   a. Source of toxicity values
   b. Surrogates
   c. Chemical-specific issues (such as bioavailability, lead model inputs and outputs, etc.)
7. Risk Characterization
   a. Risk and Hazard Calculations – present either calculations in a table or provide input and outputs from RSL or RAIS calculator
   b. Discussion of Risks and Hazards (separate section per contaminated area)
   c. Chemicals of Concern Selection
   d. Uncertainty Discussion

Attachments:

- Screening Tables (See Appendix A for examples. Excel spreadsheets are available on EPD website)
- Maps, Photographs, Aerials, Cross Sections – showing areas of releases, extent of contamination and locations of samples
- Table of Exposure Parameters used (if not using default parameters)
- Table of Toxicity Values used (if not using the RSL or RAIS calculator)
- Table of Risk Calculations (if not using the RSL or RAIS calculator)
- Summary of Risks, Hazards, and COCs for Each Pathway (See Risk Summary Table in Appendix A.)

8.0 Streamlined Human Health Risk Assessment

Another option for conducting a risk assessment in Georgia is a streamlined risk assessment. The Streamlined Risk Assessment utilizes standard exposure assumptions and publicly available tools such as the RSL Calculator to determine an estimated cumulative risk per pathway at a site for each receptor and calculate cleanup levels based on human health, leaching, and direct contact considerations while factoring in Regulatory Standard Based Goals (RSBGs). This option is ideal for less complex sites. The streamlined risk assessment can also be completed prior to a BRA (discussed in Section 7 of this document) to determine which pathways need further assessment in a BRA. It can also be used to determine where to prioritize remedial efforts.

The Streamlined Risk Assessment CSM should be a conservative, simplified version of site conditions based on generic receptors and default exposure pathways. As discussed in Section 6, the screening of COPCs follows the same approach as the BRA. Likewise, the EPC determination uses the same methodology as discussed in Section 7.1.3. Please refer to those sections for additional information. The following sections describe the components of the Streamlined Risk Assessment Process that differ from the BRA.

8.1 Risk and Hazard Calculations

To calculate cancer risk and non-cancer hazard in a Streamlined Risk Assessment, the RSL calculator (or RAIS Calculator) can be used to calculate the cumulative risk and hazard for each pathway and receptor scenarios. Receptor selection should be based on the exposure pathways identified in the CSM**.** For example, if the only receptor to on-site surface soils is the resident, risk/hazard should be calculated for that scenario using the standard exposure parameters embedded in the RAIS or RSL calculator.

8.2 Determining Chemicals of Concern

The final step of the Streamlined Risk Assessment is to determine the chemicals that require cleanup. Using the risk and hazard calculations from the RSL or RAIS calculator, determine the cumulative risks and hazards for each receptor/pathway. If the cumulative risk to a receptor in a pathway exceeds an ELCR of 1E-05 and/or a Non-carcinogenic HI of 1, the chemicals that contribute the most risk or hazard to a receptor/pathway scenario should be considered COC.

COC Worksheets are available in Appendix A of this document and may be used to assist in this selection process. Selected COCs for each receptor/pathway scenario should be addressed in a corrective action plan.

8.3 Streamlined Risk Assessment Report Contents

Below is a suggested outline for the Streamlined Risk Assessment:

1. CSM and Exposure Model
2. Human Health Risk and Hazard Summary
3. Screening worksheet/ScreenTool printout for each media
4. EPC Excel inputs and Pro UCL outputs and EPC Summary Table
5. RSL calculator output (pdf)
6. Uncertainty discussion

9.0 Ecological Risk Assessment

An ERA is performed to determine if there are unacceptable risks to ecological receptors exposed to chemicals at a site, identify levels of chemicals that would not pose unacceptable risks, and provide the risk information necessary to assist risk managers in making informed decisions regarding the need and extent of corrective action. This document provides supplemental guidance for sites to perform ERAs in addition to USEPA guidance, including USEPA's *Region 4 Ecological Risk Assessment Supplemental Guidance* (USEPA Region 4, 2018a) (Region 4 ERAGS) and *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessment* (USEPA, 1997) (ERAGS), and to streamline EPD's review.

Ecological Risk Assessment Guidance

Region 4 Ecological Risk Assessment Supplemental Guidance (March 2018 Update). USEPA Region 4.

Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments – Interim Final (June 1997), USEPA.

Eco Update: The Role of Screening-Level Risk Assessments and Refining Contaminants of Concern in Baseline Ecological Risk Assessments (June 2001), USEPA.

Framework for Application of the Toxicity Equivalence Methodology for Polychlorinated Dioxins, Furans, and Biphenyls in Ecological Risk Assessment (June 2008), USEPA.

The ERA process consists of eight steps, as detailed in ERAGS. Scientific Management Decision Points (SMDPs) are included throughout the process, allowing the risk manager, risk assessors, and other stakeholders to reach consensus on whether the next step is necessary. Depending on the outcome at each SMDP, not all steps may need to be completed. This framework provides flexibility to terminate or streamline the process once sufficient information is available to support risk management decisions.

EPD proposes the following phased approach for preparing an ERA to streamline the process while maintaining scientific defensibility.

1. ***Habitat Questionnaire* to Determine Presence of Ecological Pathways** This preliminary phase should be performed for sites where there is potential for a habitat, to determine if ecological receptors could potentially be exposed to site-related chemicals. The questionnaire (provided as Appendix B) is intended to determine the presence of a habitat at or near the site. If there are no potentially complete ecological exposure pathways, no further ecological assessment is warranted. This provides an off-ramp from the ERA process for sites (e.g., industrial, commercial) with no ecological habitat present or minimal habitat with fully landscaped areas (e.g., mowed lawns or ditches). If potentially complete ecological exposure pathways are identified, then continue to the next phase of the ERA process, the SLERA.

2. **Screening-Level Ecological Risk Assessment** This phase (ERAGS Steps 1, 2 and 3a) provides a quick determination as to whether releases at a site pose a threat to ecological receptors and identifies which chemicals and exposure pathways warrant further evaluation. The SLERA is conservative in design to produce a risk estimate to support risk management decisions. To streamline the process, EPD proposes incorporating ERAGS Step 3a of the ERA

into the SLERA report, allowing refinement screening to support retaining or eliminating a chemical for further evaluation. The SLERA conclusions may lead to: a) determination of negligible ecological risk and the completion of the ERA process; b) identification of chemicals or pathways warranting additional evaluation through additional steps in the ERA process (i.e., performing a Baseline Ecological Risk Assessment [BERA]); or c) a recommendation for corrective action based on the SLERA results and development of site-specific CGOs derived from the SLERA assumptions and/or Regulatory Standard Based Goals (RSBGs).

3. **Baseline Ecological Risk Assessment** – The BERA phase (ERAGS Steps 3b to 8) is conducted at a site if there are ecological risks that require risk management, data gaps critical to the ERA, or when the SLERA indicates the need for further evaluation to characterize the potential risk and/or develop CGOs. The BERA may include additional sampling at the site to address the identified data gaps and incorporate the site-specific data and exposure assumptions in the refined risk calculations.

The following sections provide a more detailed overview for guidance.

9.1 Questionnaire to Determine Presence of Ecological Pathways

This preliminary phase of the ERA includes a desktop analysis of site information and completion of the *Habitat Questionnaire* to determine if ecological receptors could potentially be exposed to site-related chemicals. Only sites with a potential habitat should complete the questionnaire to evaluate the presence of potentially complete ecological exposure pathways. Similar to human health risk assessments, an ecological exposure pathway is considered complete when a potential ecological receptor has a point of contact with a chemical either at or originating from a site. If there are no potential ecological exposure pathways associated with a site, then no further ecological evaluation is warranted. Depending on the extent of site development, the desktop analysis may need to be supplemented with information collected during a site reconnaissance conducted by an ecologist or other environmental professional with appropriate expertise. The questionnaire is provided as Appendix B.

Sufficient documentation should be provided to EPD to support responses to the questions, which may include:

- Completed *Ecological Habitat Questionnaire*
- Current aerial photograph(s) with site boundaries, known source areas, and potential migration pathways (e.g., drainage swales, stormwater discharge points, etc.)
- National Wetland Inventory map with an outline of the site boundaries, known source areas, and potential migration pathways (e.g., drainage swales, stormwater discharge points, etc.) (2019).
- List of federal and/or state protected species, critical habitats, or other sensitive resources from U.S. Fish & Wildlife Service (USFWS) Information for Planning and Consultation (IPaC),

Georgia Department of Natural Resources (GADNR) Biodiversity Portal, and National Oceanic and Atmospheric Administration (NOAA) Fisheries (as applicable)

- Site photographs, if site reconnaissance is performed.

If it can be documented that the responses to the first five questions in the Questionnaire are all "*No*", then no further ecological assessment is warranted, and the site can exit the ERA process. However, if any of the first five questions are answered "*Yes*", the remainder of the questionnaire should be completed as instructed. After EPD review, and site-visit verification if needed, proceed to the SLERA phase of the ERA if a complete exposure pathway is identified. A site-specific sampling plan should be developed in consultation with EPD, followed by completion of a SLERA for each potential habitat.

An exposure pathway in the context of the SLERA is defined as either direct contact (exposure to a chemical dissolved in or incorporated into an environmental medium through immediate contact with the medium) or indirect contact (i.e., through the food chain and includes prey ingestion, surface water ingestion, and/or incidental soil or sediment ingestion).

Impacted media can include:

- Surface soil (up to 2 feet bgs)
- Subsurface soil for burrowing mammals (depth dependent on receptor)
- Groundwater discharging to receiving surface water body
- Surface water
- Sediment

If there is a known groundwater discharge to a surface water body, contact EPD for discussion on how to incorporate into the ERA.

9.2 Screening-Level Ecological Risk Assessment

Under this guidance, the SLERA represents Steps 1 through 3a of the ERA process. This differs from the USEPA ERAGS which defines Step 3a ("Baseline Problem Formulation – Refinement of Preliminary Chemicals of Potential Ecological Concern") as the first step of the BERA. Georgia EPD includes Step 3a within the SLERA to streamline the process, allowing early refinement of screening results and reducing overall project duration.

The purpose of the SLERA is to provide a quick, conservative evaluation of potential ecological risk, identifying chemicals and pathways that warrant further evaluation. Consistent with EPA guidance, the SLERA produces intentionally conservative risk estimates to ensure that potential risks are not underestimated. Incorporating Step 3a within the SLERA allows the use of multiple lines of evidence and refinement of preliminary results before advancing to a full BERA, which can result in a time and cost-efficient assessment process.

Under this guidance, the SLERA includes the following ERAGS steps:

- Step 1: Screening-Level Problem Formulation and Ecological Effects Evaluation
- Step 2: Screening-Level Exposure Estimate and Risk Calculation
- Step 3a: Baseline Problem Formulation – Refinement of Preliminary Chemicals of Potential Ecological Concern (PCOPECs)

These steps should follow the EPA Region 4 ecological risk guidance, as summarized below.

Step 1. Screening-Level Problem Formulation and Ecological Effects Evaluation

A site reconnaissance or habitat assessment should be conducted (if not already completed) to support development of the ecological CSM. The ERAGS Appendix B "Checklist for Ecological Assessment/Sampling" is recommended during field reconnaissance. Documentation should include site photographs and relevant federal/state ecological resource data (e.g., USFWS IPaC, GADNR Biodiversity Portal, and NOAA Fisheries data, as applicable). This information supports identification of receptors, complete and incomplete exposure pathways, and habitats of interest. The CSM should be updated as additional information becomes available.

Ecological screening values (ESVs) should be obtained from the USEPA Region 4 ERAGS, except for surface water, where chronic Georgia In-Stream Water Quality Standards (GISWQS) should be used when available as first tier screening levels (Rule 391-3-6(5)(iv) of the Georgia Rules for Water Quality Control). According to the Region 4 ERAGS, chemical-specific requirements such as State water quality standards automatically become CGs. Chemicals that are detected at concentrations above the CG automatically become COCs and cannot screen out by less restrictive ESVs. Please note that dissolved metals concentrations should be screened against the GISWQS or Region 4 ESVs.

No Observed Adverse Effect Level (NOAEL) = The highest level of a stressor evaluated in a test that does not cause statistically significant differences from the controls.

Lowest Observed Adverse Effect Level (LOAEL) = The lowest level of a stressor evaluated in a test that causes statistically significant differences from the controls.

ESVs represent concentrations associated with a low likelihood of adverse ecological effects and are typically derived from chronic effect or No Observed Adverse Effect Level (NOAEL) data. Region 4 ESVs account for both direct toxicity and bioaccumulative potential; the lower, more protective value should be applied. For bioaccumulative chemicals, compare the MDC to both direct-toxicity and wildlife-based ESVs. The Region 4 ESVs consider direct toxicity as well as bioaccumulative effects on organisms, and the lowest protective value is chosen as the ESV. Therefore, some chemicals have wildlife-based ESVs (i.e., which account for bioaccumulative effects through the food web) in addition to the direct toxicity ESVs. Bioaccumulative chemicals are identified in the Region 4 guidance.

Step 2. Screening-Level Exposure Estimate and Risk Calculation

This step provides a conservative quantitative estimate of ecological risk. HQs are calculated by comparing the MDC (or one-half the MaxDL for non-detects) to the corresponding ESV for each medium (surface water, sediment, soil).

A chemical is identified as a PCOPEC if any of the following apply:

- HQ ≥ 1 (MDC ≥ ESV)
- The chemical was detected, but no ESV is available
- The chemical was not detected, but the surrogate concentration (½ MaxDL) ≥ ESV
- The chemical is bioaccumulative and lacks a wildlife-based ESV

After completing Step 2, an SMDP is held to determine whether additional steps are necessary:

- Scenario A: Ecological risk is negligible; no further evaluation is required.
- Scenario B: Data is insufficient; proceed with refinement (Step 3a).
- Scenario C: Evidence of potential ecological effects; consider early risk management or targeted investigation.

Step 3a. Baseline Problem Formulation – Refinement of PCOPECs

Under Georgia EPD's streamlined approach, Step 3a is completed as part of the SLERA, rather than as the first step in the BERA. Step 3a refines the conservative screening-level results to determine whether PCOPECs identified in Step 2 continue to indicate potential ecological concern when multiple lines of evidence are considered.

Refinement should incorporate several lines of evidence, including:

- Comparison to approved background concentrations
- Comparison of 95% UCL to Refinement Screening Values (RSVs)
- Evaluation of detection frequency, magnitude, and spatial pattern of detection
- Bioaccumulation potential, toxicity mode of action, or nutrient interactions
- Multiple contaminant effects (sum of toxic units for mixtures)
- Exposure potential and receptor occurrence

For surface water, chronic GISWQS values remain the appropriate screening values; however, when exposure is clearly short-term, acute GISWQS values may be used.

Where toxicity mode of action or bioaccumulation potential is relevant, additional lines of evidence may be applied. PCOPECs may be screened for direct toxicity to receptors (e.g., plants, terrestrial invertebrates, benthic macroinvertebrates) using 95% UCL concentrations and receptor-specific low-effect levels. Food-chain modeling may be used for chemicals with the potential to bioaccumulate, bioconcentrate, or biomagnify, using representative terrestrial and aquatic receptors. Region 4 default food-chain model assumptions and TRVs should be applied unless appropriate justification is provided for the use of alternative inputs (USEPA Region 4, 2024).

Risk estimates may be developed for one or more spatial exposure units defined on a site-specific basis. Lower-bound estimates may use the MDC (or one-half the MaxDL for non-detects) with NOAEL TRVs, while upper-bound estimates may use the 95% UCL with LOAEL TRVs.

The HQ method is used to estimate risk by dividing the chemical-specific calculated average daily dose (ADD) by the TRV and incorporating conservative assumptions for chemical bioavailability and exposure (i.e., 100% site use) and literature-based bioaccumulation factors (BAFs) or bioconcentration factors (BCFs) due to a lack of site-specific data at this step. A NOAEL HQ value greater than (>) 1.0 indicates potential for unacceptable risk. A NOAEL HQ less than or equal to (≤) 1.0 is considered unlikely to cause unacceptable risk or adverse ecological effects. A low effect or LOAEL HQ value ≥ 1.0 indicates concentrations are likely to pose an unacceptable risk. When the no effect or NOAEL HQs are > 1.0, but the low effect or LOAEL HQs are < 1.0, concentrations have

the possibility of an unacceptable risk as "the threshold for effects is assumed to be between the NOAEL and the LOAEL of a toxicity test" (ERAGS, 1997).

$$HQ = \frac{ADD}{TRV}$$

Where:

- *HQ = Hazard Quotient*
- *ADD = Average Daily Dose (mg/kg BW-day)*
- *TRV = Toxicity Reference Value*

Refinement should use multiple lines of evidence and produce a reduced, data-supported list of PCOPECs to be carried forward as Chemicals of Potential Ecological Concern (COPECs). All lines of evidence should be clearly documented for each chemical and medium, with recommended supporting tables and spatial figures showing the distribution of COPEC concentrations. Data gaps and uncertainties should also be identified to support risk conclusions.

Following completion of Step 3a and the associated SMDP, one of the following outcomes applies:

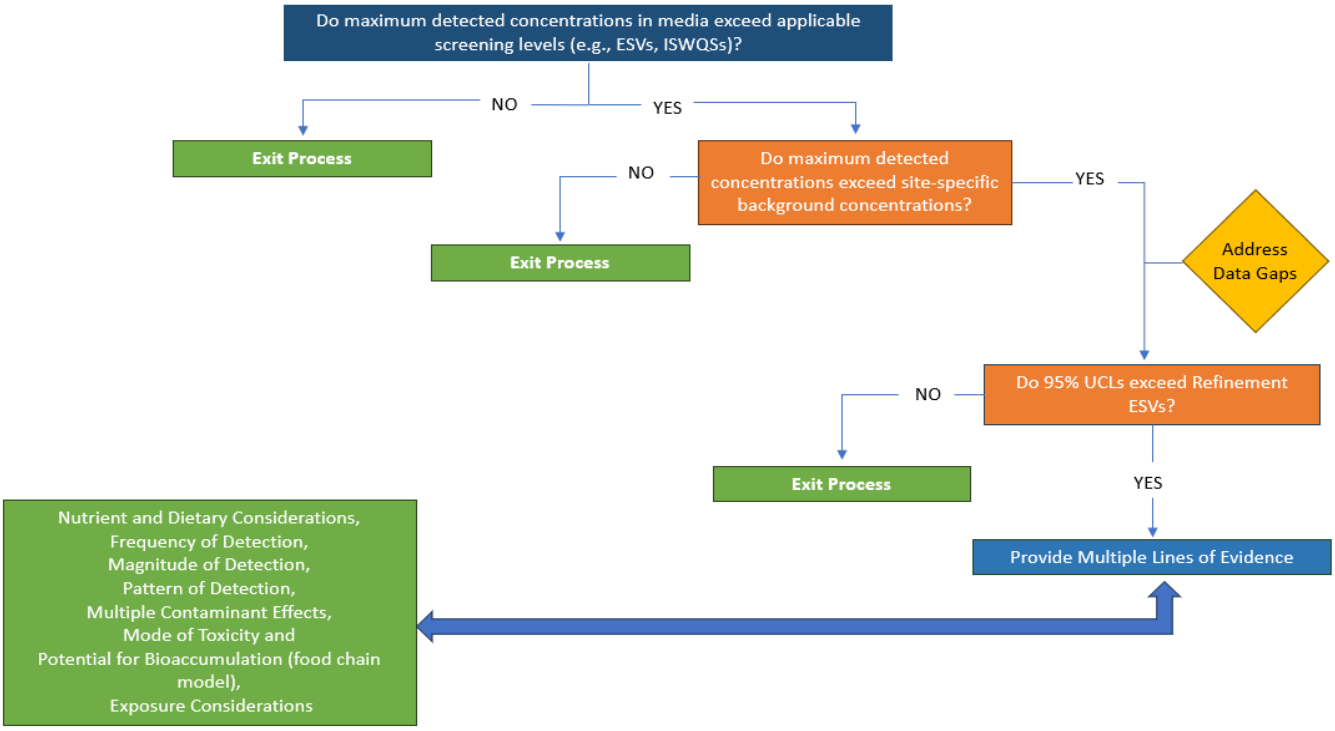
- Negligible risk: ERA process concludes at Step 3a.
- Further evaluation required for certain chemicals and exposure pathways: Proceed to the BERA (Step 3b – Step 8).
- Early risk management warranted: Focused investigation or interim corrective actions may be initiated.
- A recommendation for corrective action based on the SLERA results and development of site-specific CGs derived from the SLERA assumptions and applicable Regulatory Standard Based Goals (RSBGs). Refer to Section 10 for further discussion on CG development.

Please note, Step 3a has been incorporated into the SLERA process to ensure that refined evaluations can be conducted as part of the initial screening phase when appropriate. While this approach is recommended for streamlining, it is not mandatory; Step 3a may alternatively be conducted as part of the traditional BERA. Supporting tables "Step 3a SLERA Refinement Screening" (in Appendix C) provide a streamlined framework for determining which chemicals require further evaluation as a COPEC. Figure 4 provides a flowchart of the EPD's refined SLERA process.

Refer to USEPA Region 4 guidance and USEPA's *Eco Update: The Role of Screening-Level Risk Assessments and Refining Contaminants of Concern in Baseline Ecological Risk Assessments* (2001) for detailed information regarding these refinement steps.

Where needed, additional lines of evidence may be collected to support or address the remaining uncertainty in SLERAs due to the limited site-specific information available.

Figure 4: SLERA Refinement Process



9.3 Baseline Ecological Risk Assessment

The BERA corresponds to Steps 3b through 8 of the ERAGS process and begins after completion of Step 3a within the SLERA. The BERA involves **c**ollection of additional site-specific data to reduce uncertainty and refine exposure and risk estimates. Activities may include:

- Targeted ecological sampling (tissue residue, benthic or fish surveys, toxicity testing)
- Measurement of site-specific BAFs or BCFs
- Use of refined, receptor-specific exposure assumptions (e.g., home-range-based area use factors)

The BERA develops site-specific ecological goals and cleanup objectives (CGOs) consistent with the refined CSM and regulatory standards.

The BERA (Steps 3b through 8) includes additional sampling at the site to address the identified data gaps and incorporates the site-specific data and exposure assumptions in refined risk calculations. The BERA work plan will identify the specific data needed to refine the risk estimates, reduce uncertainties, and fill identified data gaps to ultimately refine the CGOs for Step 8 (risk management). Site-specific information collected for the BERA can include the following lines of evidence outlined in ERAGS Appendix B:

- Tissue residue studies or bioavailability/bioaccumulation studies

- Population or Community Studies
    - Terrestrial vertebrate surveys
    - Benthic macroinvertebrate surveys
    - Fish surveys
- Toxicity tests (surface soil or sediment)

Site-specific exposure assumptions (e.g., site-specific area use factor based on home range instead of assuming 100% site use) and data (e.g., tissue concentrations, calculated BAFs for dietary items, pH levels in media to assess bioavailability) are also used to refine risk calculations. CGOs are then derived from the BERA assumptions and applicable Regulatory Standard Based Goals (RSBGs) Refer to Section 10 for further discussion on CG development.

10.0 Determining Cleanup Goal Options

EPD recommends several methodologies for establishing cleanup goal options (CGOs). These methodologies incorporate a combination of scientific analysis, regulatory standards, and stakeholder input to ensure that CGOs are both protective and attainable. In some cases, permit requirements may dictate specific regulatory standards (e.g., groundwater concentrations limits) and should be considered when developing site-specific CGOs.

CGs are typically approved by programs within the Land Protection Branch. Although multiple approaches may be used, the following EPD recommendations are intended to assist the regulated community in developing CGOs for consideration in the corrective action plan. This list is not exhaustive and may not be applicable to every site.

Cleanup Goals for Human Health

- **Regulatory Standards and Regulatory Standard Based Goals (RSBGs)**
  Regulatory standards often serve as default CGs as they represent established, readily accepted cleanup standards.

  - Federal Standards:

    - *Groundwater:* MCLs under the Safe Drinking Water Act.

  - State Standards:

    - *Surface Water:* GISWQS under Rule 391-3-6(5)(iv) of the Georgia Rules for Water Quality Control.

      For surface water, if concentrations exceed ISWQS, it is EPD's expectation that the site will ultimately achieve compliance with the ISWQS.

- **Risk-Based Cleanup Goals**
  For risk-based CGs, EPD uses a cumulative cancer risk threshold of 1E-05 and an acceptable HI of 1.

  - USEPA Regional Screening Levels:

    RSLs may be used as default risk-based CGs as an initial reference point; RSLs are based on multiple conservative assumptions and are upper-bound, health-protective estimates, not predictions of actual harm. The selection of CGOs must also consider site-specific conditions, exposure pathways, and statutory requirements. Site-specific CGs can be developed by adjusting the RSLs to reflect site conditions, exposure pathways, and receptor scenarios.

- **Carcinogenic Risks**: CGs are set to maintain a cumulative TR of 1E-05
- **Non-carcinogenic Risks**: CGs are set to maintain a Hazard Index (HI) of 1.

$$Cleanup\ Goal\ (CG) = \frac{EPC\ x\ TR\ or\ THQ}{Cancer\ Risk\ or\ Non\ Cancer\ Hazard\ Quotient}$$

Where:

- *CG = Cleanup Goal*
- *EPC = Exposure Point Concentration*
- *TR = Target Risk (cancer)= 1E-05*
- *THQ = Target Hazard Quotient (noncancer)= 1*

Cleanup Goals for Ecological Habitats

Ecological CGOs are dependent on the assessment endpoints selected and the results of the SLERA/BERA. An acceptable level of adverse effects should be discussed with the Risk Assessment Program.

Regulatory Standards and Regulatory Standard Based Goals (RSBGs)

State Standards:
Surface Water: GISWQS under Rule 391-3-6(5)(ii & iii) of the Georgia Rules for Water Quality Control.

Risk-Based Cleanup Goals

Site-specific, risk-based CGs can be back-calculated from the food chain models using an HQ of 1 and the NOAEL and LOAEL TRVs for the chemicals and exposure pathways posing unacceptable risk. The back-calculations can be performed using the SLERA or BERA assumptions depending on the ERA step where the CGOs are calculated.

For Both Human Health and Ecological

When establishing CGs for both human health and ecological risks, it is essential to compare these goals to each other to determine which will guide the selection of CGs. In most cases, the more conservative CGO should be prioritized. However, it is equally important to consider the potential impacts on habitat and/or biotic communities, including its destruction or disturbance, when making a final decision.

Background Levels:

- Background Comparison: For naturally occurring inorganics (e.g., metals), CGOs can be based on approved site-specific background concentrations. Approved regional background concentrations can also be used as CGOs.

- Reference Area Comparison: If site-specific background concentrations are not well-documented or attainable, reference sites with similar characteristics can provide comparison data to set CGOs.

Additional Approaches to Corrective Action that may be Utilized:

- Iterative Truncation: This method is based on the identification and removal of soils or sediments with high contaminant concentrations to lower estimated post-remediation EPCs to levels at or below the acceptable risk/hazard levels. Iterative truncation process involves removing (truncating) high values from the dataset, and a hypothetical post-remediation EPC is calculated to demonstrate that the cumulative risk/hazard index will be at or below acceptable levels.

- Area-Averaging Approach: This method involves calculating the average concentration of discrete site-specific data. The average concentration of contaminants remaining in soil after remediation (if necessary) should be at or below the CGs. This method is primarily for surface soils. Please see EPD's *"Area Averaging Approach to Soil Compliance Direct Contact Exposure Scenarios."*

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APPENDIX A

Human Health Screening and Summary Tables

Directions for screening using the Screening Template Table in Appendix A:

To determine if a risk assessment is necessary and if so, the type of risk assessment that is appropriate, consider the following steps:

1. Data Organization: Organize environmental sampling data into separate media as listed below. Be sure to evaluate the useability of the data for the risk assessment (see Section 4.0 of the GRAG):

- Surface soil (0-1 ft below ground surface, excluding paved or graveled surfaces)
- Subsurface soil (1 ft – groundwater table)
- Groundwater
- Surface water
- Sediment

2. Data Screening:

a. For each medium, create a table containing the following information (an example table can be found in Appendix A and a copy of the excel spreadsheet is available on EPD's website):

- CAS number
- Constituent
- Frequency of detection presented as number of detections per number of observations
- Minimum and maximum detection limits
- Minimum and maximum detections
- Maximum detected concentration (MDC)
- Maximum method detection limit (MAX MDL)
- Concentration used for screening (greater of MDC and MAX MDL)
- Screening level: See Table 1 below for media specific screening levels. Sources of Screening Levels can be fou
- EPD-approved background concentration for inorganics
- Chemical of Potential Concern (COPC) designation (Yes/No)
- Rationale for COPC designation (e.g., MDC > screening level)

b. Compare the greater of the Contaminant MDC or MAX MDL to the EPD-approved background value, if available. If the greater of the Contaminant MDC or MAX MDL exceeds the EPD-approved background value, compare the greater of the Contaminant MDC or MAX MDL to the media-specific screening level. Any chemicals that exceed the media-specific screening levels and EPD-approved background levels are considered Chemical of Potential Concern (COPCs). If no COPCs are identified, no further action is required for that chemical in that media.

Surface Soil Screening Table

Units (i.e., mg/kg, ug/kg, etc.)	mg/kg

The first row (highlighted in grey) is an example. Please delete before submitting to EPD.

CAS Number	Constituent	Frequency of Detection	Minimum - Maximum Method Detection Limits	Minimum - Maximum Detected Concentrations	Maximum Method Detection Limit (MaxMDL)	Maximum Detected Concentration (MDC)	Concentration used for Screening (greater of the MDC and MaxMDL)	Approved Background Concentration	USEPA *Residential* Regional Screening Level (RSL) (TR1E-06/HQ=0.1)	COPC	Rationale
7440-38-2	Arsenic	7/28	0.0012 - 0.0015	0.81 - 42.33	0.0015	42.33	42.33	9	0.68	Y	MDC>RSL
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Subsurface Soil Screening Table

Units (i.e., mg/kg, ug/kg, etc.)	mg/kg

The first row (highlighted in grey) is an example. Please delete before submitting to EPD.

CAS Number	Constituent	Frequency of Detection	Minimum - Maximum Method Detection Limits	Minimum - Maximum Detected Concentrations	Maximum Method Detection Limit (MaxMDL)	Maximum Detected Concentration (MDC)	Concentration used for Screening (greater of the MDC and MaxMDL)	Approved Background Concentration	USEPA *Residential* Regional Screening Level (RSL) (TR1E-06/HQ=0.1)	COPC	Rationale
7440-38-2	Arsenic	3/28	0.0012-0.0016	0.7 - 2.45	0.0016	2.45	2.45		0.68	N	MDC<RSL
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Combined Soil Screening Table (Both Surface and Subsurface Soil)

Units (i.e., mg/kg, ug/kg, etc.)	mg/kg

The first row (highlighted in grey) is an example. Please delete before submitting to EPD.

CAS Number	Constituent	Frequency of Detection	Minimum - Maximum Method Detection Limits	Minimum - Maximum Detected Concentrations	Maximum Method Detection Limit (MaxMDL)	Maximum Detected Concentration (MDC)	Concentration used for Screening (greater of the MDC and MaxMDL)	Approved Background Concentration	USEPA *Residential* Regional Screening Level (RSL) (TR1E-06/HQ=0.1)	USEPA SSL for the *Protection of Groundwater* (TR1E-06/HQ=0.1)	COPC	Rationale
7440-38-2	Arsenic	2/28	0.0012-0.0016	0.7 - 2.45	0.0016	1.28	1.28		0.68	0.292	N	MDC<RSL
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Groundwater Screening Table

Units (i.e., mg/L, ug/L, etc.)	ug/L

The first row (highlighted in grey) is an example. Please delete before submitting to EPD.

CAS Number	Constituent	Frequency of Detection	Minimum - Maximum Method Detection Limits	Minimum - Maximum Detected Concentrations	Maximum Method Detection Limit (MaxMDL)	Maximum Detected Concentration (MDC)	Concentration used for Screening (greater of the MDC and MaxMDL)	Approved Background Concentration	USEPA *Tapwater* Regional Screening Level (RSL) (TR1E-06/HQ=0.1)	COPC	Rationale
7440-38-2	Arsenic	3/13	0.09 - 0.26	0.09 - 0.18	0.26	0.18	0.18		0.052	Y	MaxMDL>RSL
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Surface Water Screening Table

Units (i.e., mg/L, ug/L, etc.)	ug/L

The first row (highlighted in grey) is an example. Please delete before submitting to EPD.

CAS Number	Constituent	Frequency of Detection	Minimum - Maximum Method Detection Limits	Minimum - Maximum Detected Concentrations	Maximum Method Detection Limit (MaxMDL)	Maximum Detected Concentration (MDC)	Concentration used for Screening (greater of the MDC and MaxMDL)	Approved Background Concentration	1. Georgia Instream Water Quality Standard (Human Consumption of Fish and Drinking Water)	2. USEPA National Recommended Water Quality Criteria (Human Health and Organism)	3. USEPA Tapwater Regional Screening Level (TR=1E-06/HQ=0.1)	COPC	Rationale
7440-38-2	Arsenic	7/18	0.09 - 0.26	0.09 - 7.7	0.26	7.7	7.7		10			N	No screening levels
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Exposure Point Concentration (EPC) Summary Table

Media Type	CAS Number	Chemical Of Potential Concern	Units	Frequency of Detection (number of detections/number of samples)	Maximum Method Detection Limit (MaxMDL)	Maximum Detected Concentration (MDC)	95 % Upper Confidence Limit (UCL)	Exposure Point Concentration (EPC)	Basis
Ground Water	71-43-2	Benzene	(Select One)						Select One
Subsuface Soil	108-88-3	Toluene	(Select One)						Select One
Surface Soil	1330-20-7	Xylenes	(Select One)						Select One
			(Select One)						Select One
			(Select One)						Select One
			(Select One)						Select One
			(Select One)						Select One
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Human Health Risk and Hazard Summary

Please provide a Risk and Hazard Summary of the pathways and receptors evaluated in the Human Health Risk Assessment.

The first row (highlighted in gray) is an example. Please delete before submitting to EPD.

Pathway	Receptor	*Cumulative Excess Lifetime Cancer Risk Above 1E-5?*	*Hazard Index Above 1?*	*Need to be addressed in Corrective Action Plan?*	*Chemicals of Concern (Risk Drivers)*	*Notes*
Surface Soil	Child Resident	☐	☑	☑	1,1-Dichloroethylene	
(Select one)	(Select one)	☐	☐	☐		
(Select one)	(Select one)	☐	☐	☐		
(Select one)	(Select one)	☐	☐	☐		
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APPENDIX B

Ecological Habitat Questionnaire

GEORGIA
DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION

Ecological Habitat Questionnaire

Part 1: Key Questions

Please respond to the following questions regarding potential *habitats* located on or near the site. Supporting documentation should be provided to validate each response. (refer to the paragraph following the questions for examples of acceptable forms of documentation). Definitions for all *italicized* terms are provided on page 6 of this questionnaire.

1.1 Are there *undeveloped terrestrial areas* on or adjacent to the site (excluding landscaped areas and agricultural lands under cultivation)?

☐Yes (Provide information below.) ☐ No

Please describe the area and if any wildlife has been observed there. Click or tap here to enter text.

1.1.1 If the site will be redeveloped, will these terrestrial areas remain?

☐ Yes ☐ No

1.2 Are there potential wetlands, marshes, swamps or *vernal pools* on or adjacent to the site (do not include constructed surface water run-off controls)?

☐ Yes (Provide information below.) ☐ No

Please describe the area and if any wildlife has been observed there. Click or tap here to enter text.

1.3 Are there surface water bodies (e.g., rivers, *intermittent, ephemeral* and *perennial streams*, lakes, *seasonal ponds*; (do not include constructed surface water run-off controls) on or adjacent to the site?

☐ Yes (Provide information below.) ☐ No

Please describe the area and if any wildlife has been observed there. Click or tap here to enter text.

1.4 Are there off-site habitat*s* (e.g., terrestrial, wetland, aquatic) that are downstream, downwind, or downgradient, that could be affected by impacted media associated with a release from the site? This question does not apply to sites enrolled in the Georgia Brownfield Program.

☐ Yes ☐ No ☐ Not applicable (Brownfield site)

Please provide a description of the *habitat* and its distance from the facility boundary. Click or tap here to enter text.

1.5 Are there any planned future use(s) of the site, or current or future use(s) near the site, such as conservation areas or arboretums, etc., that would result in *undeveloped terrestrial areas*, wetlands, or aquatic *habitats*?

☐ Yes ☐ No

Sufficient information needs to be provided to the EPD to document site conditions in relation to these questions. If it can be documented that the answer to all of these questions is "no", then no further ecological assessment is warranted. Typical documentation includes the following:

- A current aerial photograph(s) showing 3 miles beyond the facility boundary. The map should illustrate site boundaries, known source areas, extent of contamination and potential migration pathways (e.g., drainage swales, stormwater discharge points, etc.).
- National Wetland Inventory map with an outline of the site boundaries, known source areas, extent of contamination, and potential migration pathways (e.g., drainage swales, stormwater discharge points, etc.).
- U.S. Fish & Wildlife Service (USFWS) Information for Planning and Consultation (IPaC)
- Site information from the Georgia Department of Natural Resources (GADNR) Biodiversity Portal

If the answer to any of the above questions is "yes", please complete the remainder of the questionnaire as instructed below.

Part 2: Harm to wildlife

2.1 Have there been any incidents where contaminants originating from the site evidently harmed wildlife?

☐ Yes ☐ No (Skip to Question 3.1 below)

Please describe the incident and what harm was caused to wildlife: Click or tap here to enter text.

2.1.1 Has the cause of such harm been eliminated?

☐ Yes (Briefly describe the actions taken below and complete the remainer of the questionnaire.)

☐ No (Implement actions necessary to eliminate the harm. Please complete the remainer of the questionnaire.)

Actions Taken: Click or tap here to enter text.

Part 3:
Contamination associated with Potential Ecological *Habitats*

3.1 Have environmental media (e.g., soil, surface water, sediments, biota) associated with the ecological *habitat* been sampled and analyzed for site-related contaminants?

☐ Yes (Provide comments below and proceed to the next question)

☐ No (A workplan for sampling environmental media within the potential *habitat* may be warranted to determine whether site-related contamination has impacted or could impact that *habitat*. Proceed to next question and also answer question 3.4. Submit questionnaire to EPD for verification.)

What media has been sampled? Click or tap here to enter text.

3.2 Have site-related releases been delineated, and has migration of contamination been controlled?

☐ Contamination has been delineated, but no measures to control migration are in place (Provide comment below and proceed to the next question. Actions to control migration of contamination may be necessary.)

☐ Migration has been controlled, but delineation is continuing. (Provide comments below and proceed to next question. Complete delineation efforts.)

☐ Yes (Provide comments below and proceed to the next question.)

☐ No (Provide comments below and take necessary actions to complete delineation and establish migration control.)

Information on delineation and migration control: Click or tap here to enter text.

3.3 Have any site-related contaminants been detected above approved background concentrations in environmental media collected from a terrestrial *habitat*?

☐ Yes (Provide additional information below, including the contaminants and the concentrations exceeding background values and proceed to the next question.)

☐ No (Proceed to the next question. No further action is required for the terrestrial habitat.)

☐ Site-related contaminants have been detected, but no background concentrations have been derived for comparison. (Provide additional information below and proceed to the next question.)

☐ Unknown (A workplan for sampling environmental media at the potential *habitat* may be required to determine if site-related contamination has impacted that *habitat*. Proceed to the next question.)

☐ N/A (No terrestrial habitat at site. Proceed to the next question.)

Comments: Click or tap here to enter text.

3.4 Are site-related contaminants currently or likely to migrate to aquatic *habitats*?

☐ Yes, an aquatic habitat has been impacted by site-related contaminants. (Provide information below and proceed to next question.)

☐ Yes, likely. (Provide information below. A workplan for sampling environmental media at the potential *habitat* may be required to determine if site-related contamination will impact that *habitat*. Additional actions may be required to prevent migration to the aquatic habitat. Submit questionnaire to EPD for verification.)

☐ No, there is no complete migration pathway or discharge to the aquatic *habitat.* (Submit questionnaire to EPD for verification.)

☐ Unknown. (A workplan for sampling environmental media at the potential *habitat* may be required to determine if site-related contamination could impact the *habitat*.)

☐ No aquatic *habitat* at site. (Submit questionnaire to EPD for verification.)

Type of aquatic *habitat*: Click or tap here to enter text.

3.5 Have any site-related contaminants been detected above approved background concentrations in environmental media collected from a wetland or aquatic *habitat*?

☐ Yes (Proceed to the next question.)

☐ No (Submit questionnaire to EPD for verification.)

☐ Site-related contaminants have been detected, but no background concentrations have been derived for comparison. (Proceed to next question.)

☐ No background concentrations have been derived, and no site-related contaminants have been detected. (Submit questionnaire to EPD for verification.)

☐ Unknown. (A workplan for sampling environmental media at the potential *habitat* may be required to determine if site-related contamination could impact the *habitat*.)

3.6 Is the site contamination causing exceedances of the Georgia Instream Water Quality Standards established for the protection of aquatic life?

☐ Yes (Provide information below regarding the location, contaminant and concentration of exceedances. Implement actions necessary to eliminate the discharge of contamination to the surface water body. Additional information/samples may need to be collected to evaluate risks to aquatic life.)

☐ No, but the potential for site-related contaminant migration to a surface water body exists. (Provide information regarding the potential for contaminant migration to the surface water below)

☐ No, contaminants have been detected, but those contaminants do not have Georgia Instream Water Quality Standards. (Provide information regarding the contaminants that have been detected below)

☐ No, contaminants have been detected, but not above Georgia Instream Water Quality Standards. (Provide information regarding the contaminants that have been detected below)

☐ Unknown (A workplan for sampling environmental media at the potential habitat may be required to determine if site-related contamination could impact or has impacted the habitat.)

Comments: Click or tap here to enter text.

Please submit questionnaire to EPD for verification. Thank you.

Definitions:

- *Habitat*: a place where an ecological receptor resides or forages. Per USEPA Region 5, habitat is defined as "the place where a population of plants or animals and its surroundings are located, including both living and non-living components."
- *Undeveloped Terrestrial Areas*: are parcels or portions of land that remain in a natural or semi-natural condition and have not been significantly altered by construction, grading, paving, or landscaping. These areas typically include forests, woodlands, grasslands, scrub-shrub habitats, meadows, and other naturally vegetated zones. Managed landscapes such as mowed lawns, ornamental plantings, maintained rights-of-way, or active agricultural fields under cultivation are not considered undeveloped areas.
- *Intermittent streams:* streams that flow during certain times of the year when smaller upstream waters are flowing and when groundwater provides enough water for stream flow.
- *Vernal pools* or *seasonal pond*: seasonally flooded depressional wetlands that hold water during portions of the year but not for the entire year, which also include ephemeral ponds which hold water in direct response to precipitation.
- *Ephemeral Stream*: a stream that typically has no well-defined channel, and which flows only in direct response to precipitation with runoff. (O.C.G.A. 12-7-6(b)(15))
- *Perennial Stream*: a stream that flows in a well-defined channel throughout most of the year under normal climatic conditions.

APPENDIX C

Ecological Screening Tables

Step 3a COPC Refinement Table - Soil

Refer to Section 9.2, "Screening-Level Ecological Risk Assessment" of EPD's Georgia Risk Assessment Guidance.

The first two rows row (highlighted in gray) are examples. Please delete before submitting to EPD.

Units	(Select one)

Chemical	CAS #	Frequency of Detection	1/2 Method Detection Limit (non-detected chemicals)	Maximum Detected Concentration (MDC)	Background Screening Value (BSV)	Frequency Exceeding BSV	Refinement Screening Value (RSV)	Frequency Exceeding RSV	RSV Source	Refinement Hazard Quotient	95% UCL	95% UCL Hazard Quotient	Refined PCOPEC?	Basis	Notes
1,2-Dichlorobenzene	95-50-1	2/10		100	NA	NA	920	0/10	R4 Mammalian	0.1	60	0.07	No	95% UCL hazard quotient was less than 1 and concentration was less than background screening value.	
Copper	7440-50-8	9/10		180	13	1/10	70	0/10	R4 Mammalian	3.0	140	2	Yes	Chemical was infrequently detected above RSV and 95% UCL HQ is less than 1	
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Step 3a COPC Refinement Table - Sediment

Refer to Section 9.2, "Screening-Level Ecological Risk Assessment" of EPD's Georgia Risk Assessment Guidance.

Units	(Select one)

Chemical	CAS #	Frequency of Detection	Maximum Detected Concentration (MDC)	1/2 Method Detection Limit for non-detected constituents	Background Screening Value (BSV)	Frequency Exceeding BSV	Refinement Screening Value (RSV)	Frequency Exceeding RSV	RSV Source	Refinement Hazard Quotient	95% UCL	95% UCL Hazard Quotient	Refined PCOPEC?	Basis	Notes
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Step 3a COPC Refinement Table - Surface Water

Refer to Section 9.2, "Screening-Level Ecological Risk Assessment" of EPD's Georgia Risk Assessment Guidance.

Units	(Select one)

Chemical	CAS #	Frequency of Detection	Maximum Detected Concentration (MDC)	1/2 Method Detection Limit (non-detected constituents)	Background Screening Value (BSV)	Frequency Exceeding BSV	Georgia Instream Water Quality Criteria (GIWQC)	Frequency Exceeding GIWQC	Refinement Screening Value (RSV)	Frequency Exceeding RSV	Refinement Hazard Quotient	95% UCL	95% UCL Hazard Quotient	Refined PCOPEC?	Basis	Notes
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Screening Level Ecological Risk Assessment (SLERA): Step 2 -- Screening-Level Preliminary Exposure Estimate and Risk

Refer to Table 3 of the EPA Region 4 Ecological Risk Assessment Supplemental Guidance for help filling out this table.

To determine the Hazard Quotient (HQ), divide the maximum detected concentration (MDC) by the EPA Region 4 Ecological Screening Value (ESV).

The first row (highlighted in grey) is an example. Please delete it before submitting your table to EPD.

Soil Screening

Units: mg/kg

CAS Number	Constituent	Frequency of Detection	Minimum - Maximum Method Detection Limit (MinMDL - MaxMDL)	1/2 MaxMDL	Minimum - Maximum Detected Concentration (MinDC - MaxDC)	Location(s) of MDC	Concentration used for Screening	EPA R4 Ecological Screening Value (ESV; mg/kg)	Hazard Quotient (HQ)	Frequency of ESV Exceedances	Bioaccumulative?	Contaminant of Potential Concern (PCOPEC; Y/N)	Basis	Notes
7440-38-2	Arsenic	2/30	0.0012 - 0.0012	0.0006	2.37 - 27.37	C-8	27.37	18	2.000	1/30	N	Y	MDC > ESV	
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Screening Level Ecological Risk Assessment (SLERA): Step 2 -- Screening-Level Preliminary Exposure Estimate and Risk

Refer to Tables 1a-e of the EPA Region 4 Ecological Risk Assessment Supplemental Guidance.

To determine the Hazard Quotient (HQ), divide the maximum detected concentration (MDC) by the appropriate screening value (e.g., GISWQS, ESV).

The first row (highlighted in grey) is an example. Please delete it before submitting your table to EPD.

Surface Water Screening

Units:	ug/L

CAS Number	Constituent	Freshwater or Marine/Estuarine	Frequency of Detection	Minimum - Maximum Method Detection Limit (MinMDL - MaxMDL)	1/2 MaxMDL	Minimum - Maximum Detected Concentration (MinDC - MaxDC)	Location(s) of MaxDC	Concentration used for Screening	Georgia Instream Water Quality Standard (GISWQC)	GIWQC Hazard Quotient	EPA Region 4 Ecological Screening Value (ESV)	ESV Hazard Quotient	Bioaccumulative ?	Contaminant of Potential Concern (PCOPEC; Y/N)	Basis	Notes
7440-38-2	Arsenic	Freshwater	8/30	0.112- 0.118	0.059	0.00188 - 0.208	A-2	0.208	150	0.00	150	0.0	N	N	MDC < ESV	
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Screening Level Ecological Risk Assessment (SLERA): Step 2 -- Screening-Level Preliminary Exposure Estimate and Risk

Refer to Tables 2a-c of the EPA Region 4 Ecological Risk Assessment Supplemental Guidance for help filling out this table.

To determine the Hazard Quotient (HQ), divide the maximum detected concentration (MDC) by the EPA Region 4 Ecological Screening Value (ESV).

The first row (highlighted in grey) is an example. Please delete it before submitting your table to EPD.

Sediment Screening

Units:	mg/kg

CAS Number	Constituent	Freshwater or Marine/Estuarine	Frequency of Detection	Minimum-Maximum Method Detection Limit (MinMDL - MaxMDL)	1/2 MaxMDL	Minimum - Maximum Detected Concentration (MinDC - MaxDC)	Location(s) of MaxDC	Concentration used for Screening	EPA Region 4 Ecological Screening Value (ESV)	Hazard Quotient (HQ)	Frequency of ESV Exceedances	Bioaccumulative?	Contaminant of Potential Concern (PCOPEC; Y/N)	Basis	Notes
7440-38-2	Arsenic	Freshwater	3/30	0.0072 - 0.0072		0.083 - 10.47	B-27	10.47	9.8	1.00	1/30	N	Y	MDC > ESV	
		(Select One)								#DIV/0!		(Select One)	(Select One)	(Select One)	
		(Select One)								#DIV/0!		(Select One)	(Select One)	(Select One)	
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