

GEORGIA RISK-BASED CORRECTIVE ACTION

GRBCA WORKBOOK

Definition Reference Guide

The purpose of this document is to provide definitions for frequently used acronyms and terms and provide important reference tables to help guide users through the GRBCA model process.

I. Acronyms:

Acronym	Definition	Acronym	Definition
ACL	Alternate Concentration Limit	PAH	Polynuclear Aromatic Hydrocarbons
AOC	Area of Concern	PEL	Permissible Exposure Limits
AOPC	Area of Potential Concern	PVI	Petroleum Vapor Intrusion
AST	Above Ground Storage Tank	PID	Photo-Ionization Detector
ASTM	Amer. Soc. for Testing and Materials	POC	Point of Compliance
BaP TEQ	Benzo(a)pyrene Toxic Equivalent Quotient	POE	Point of Exposure
BTEX	Benzene, Toluene, Ethyl benzene, Xylenes	PPM	Parts per Million
CAP	Corrective Action Plan	PSH	Phase Separated Hydrocarbons
COC	Chemical of Concern	RAGS	Risk Assessment Guidance at Superfund Sites
CSF	Cancer Slope Factor		
CSM	Conceptual Site Model	RAR	Risk Analysis Report
DAF	Dilution Attenuation Factor	RBCA	Risk-based Corrective Action
DEP	Dept. of Environmental Protection (Mass.)	RBTL	Risk-based Threshold Level
DRO	Diesel Range Organics	RfC	Reference concentration
EDB	Ethylene Dibromide, 1, 2-Dibromoethane	RfD	Reference Dose
EDC	Ethylene Dichloride, 1, 2 Dichloroethane	RRO	Residual Range Organics
EPA	Environmental Protection Agency	RSL	Regional Screening Level
EPD	Environmental Protection Division	SF	Slope Factor
ExAR	Exposure Assessment Report	SISR	Site Investigation Summary Report
FID	Flame Ionization Detector	SSTL	Site Specific Threshold Level
FP	Free Product	TEF	Toxic Equivalent Factor
GALM	Georgia Adult Lead model	TEQ	Toxic Equivalents
GRBCA	Georgia Risk-based Corrective Action	TPH	Total Petroleum Hydrocarbon
GRO	Gasoline Range Organics	TGD	Technical Guidance Document
ELCR	Excess Lifetime Cancer Risk	THQ	Target Hazard Quotient
IEUBK	Integrated Expos. Uptake Biokinetic Model	TR	Target Cancer Risk
ISWQS	In Stream Water Quality Standard	USEPA	United States Env. Protect. Agency
ITRC	Interstate Technology Regulatory Council	USFWS	United States Fish & Wildlife Serv.
IUR	Inhalation Risk Unit	USGS	United States Geological Survey
LEL	Lower Explosive Limit	UST	Underground Storage Tanks
LPB	Land Protection Branch	USTMP	UST Management Program
LNAPL	Light Non-Aqueous Phase Liquids	VI	Vapor Intrusion
RAU	Risk Assessment Unit	VISL	Vapor Intrusion Screening Level
MCL	Maximum Contaminant Level	VPH	Volatile Petroleum Hydrocarbon
MTBE	Methyl tert-butyl ether	WPA	Wellhead Protection Area
NFA	No Further Action		
ORO	Oil Range Organics		
OSHA	Occupational Health and Safety Admin.		

II. Definitions

Area of Contamination (AOC) – The parcel of land containing the UST system where a petroleum release occurred and if applicable, beyond this parcel of land’s property boundary, the area **within** the known petroleum contaminated soil, groundwater and/or free product plume(s). The location of the soil, groundwater and/or free product plume is not dependent upon the location of property boundaries.

AOC Site Specific Threshold Level (AOC SSTL) - The risk-based threshold level calculated with site specific data for an individual chemicals of concern (COC) that will provide adequate protection of human health and/or the environment. The resident or nonresident groundwater to indoor air vapor intrusion threshold levels are determined by entering site specific data into the modified ASTM 1739-95 (Reapproved 2015) algorithms.

Area of Potential Contamination (AOPC) - Excluding the UST facility property footprint where the petroleum release occurred, the AOPC includes any location **outside** the area of the known petroleum contaminated soil, groundwater and/or free product plume(s). The location of the soil, groundwater and/or free product plume is not dependent upon the location of property boundaries.

AOPC Site Specific Threshold Level (AOPC SSTL) - The risk-based threshold level calculated with site specific data for an individual COC that will provide adequate protection of human health and/or the environment. The AOPC resident groundwater to indoor air vapor intrusion threshold levels are determined by entering site specific data into the modified ASTM 1739-95 (Reapproved 2015) algorithms. The drinking water or surface water threshold levels are determined using the Domenico (groundwater flow) Fate and Transport algorithms for ingestion of groundwater or exposure to surface water organisms from the petroleum release COCs.

Chemicals of Concern (COCs) - Specific constituents of petroleum product(s) and/or additives that have been identified for the evaluation in the risk assessment process by the USTMP (see REFERENCE 1).




Clean Soil - For the purpose of evaluating petroleum vapor intrusion (VI) inclusion screening, soil that contains < 0.1 mg/kg benzene concentration.

Contaminated Soil - For the purpose of evaluating petroleum VI inclusion screening, soil that contains ≥ 0.1 mg/kg benzene concentration.

Conceptual Site Model (CSM) Checklist - A visual checklist depicting results of the Receptor Field Survey located in the Receptor Field Survey Report appendices. The CSM captures the exposure pathways and receptors applicable to the site-specific UST release. The applicable exposure pathways and receptors from this checklist are entered in the GRBCA workbook.

Delineation Standards - The specific soil and groundwater concentration for each applicable COC used to define the extent of contamination during a petroleum release investigation. The USTMP delineation standards are the RBTLs listed in REFERENCE 3. An adequate number of soil and groundwater analytical results must be assembled for environmental professionals to confidently interpolate or extrapolate the applicable COC concentration isopleths on a scaled site map.

Drinking Water Status – The Receptor Field Survey, completed in accordance with the Receptor Field Survey Standard Operating Procedures (SOP), determines the groundwater usage within five hundred (500) feet of the release point or other applicable distance as directed by the USTMP Project Officer. A Drinking Water Status applies if any of the following groundwater use receptors are present:

-  public water supply withdrawal point,
-  non-public water supply withdrawal point(s); and/or,
-  public access spring.

Each receptor present is also hydraulically located in a down gradient or cross gradient direction from the release point and are not connected to a municipal water supply.

Ephemeral (stormwater) Stream* - A feature that carries only stormwater in direct response to precipitation, with water flowing only during and shortly after large precipitation events. An ephemeral stream may or may not have a well-defined channel, the stormwater is the primary source of water and the aquatic bed is always above the water table. An ephemeral stream typically lacks the biological, hydrological and physical characteristics commonly associated with the continuous or intermittent movement of water. *NOTE: “water table” refers to the seasonal high-water table in riparian zone soil adjacent to the stream.*

Excavation Worker - A worker operating heavy equipment or assisting in the operation of heavy equipment at a petroleum release site that may be acutely exposed to free product, contaminated soil and/or groundwater while performing UST system removal, petroleum contaminated soil removal, utility excavations/repairs or site redevelopment excavations. The term does not include a nonresident (commercial worker).

Exposure Assessment Report (ExAR) - This report template is used to publish results of a properly completed GRBCA Workbook process for the general public. It provides a non-technical assessment of the risks that are present and how these risks affect the current and/or future use of the release site.

Exposure Pathway (or Pathway) - The course a COC takes from the source area to an exposed organism. Each exposure pathway includes a release source, a point of exposure (or exposure point) and an exposure route.




Exposure Route - The contact mechanism (i.e., ingestion, inhalation, dermal absorption) by which COC enters an organism. More than one contact mechanism may transfer a COC to an organism.

Free Product (FP) - The measurable thickness of light, non-aqueous phase petroleum liquid (LNAPL) in a well or on the surface of a water body, or the USTMP target groundwater benzene concentration defining free product conditions.

Free Product Condition (FPc) - The USTMP defines dissolved benzene concentration in groundwater or surface water that is $\geq 15,000 \mu\text{g/L}$ to be indicative of the presence of recent or newly released petroleum product(s). If no free product is identified and these benzene concentrations are present or higher, then un-manifested product is nearby and is to be treated equally as if free product is present. These conditions are actionable as a free product response and as directed by the USTMP Project Officer.

GRBCA Workbook – The Georgia Risk-based Corrective Action Process using an Excel® workbook program to evaluate each petroleum release site and compare maximum soil and groundwater concentrations to published applicable RBTLs and/or site specific, calculated groundwater SSTLs at all petroleum release sites. These results, when compared to any evaluated receptors, determines the receptor most at risk and on that basis, recommends the groundwater ACLs for approval.

Non-Drinking Water Status – The Receptor Field Survey, completed in accordance with its guidance document, determines the groundwater usage within five hundred (500) feet of the release point or other applicable distance as directed by the USTMP Project Officer. A Non-Drinking Water Status applies if **none** of the following groundwater use receptors are present:

-  public water supply withdrawal point,
-  non-public water supply withdrawal point(s); and/or,
-  public access spring.

Additionally, the Receptor Field Survey Report determines the presence or accessibility of a municipal water supply, within a reasonable distance (and cost) of the survey radius to determine if connection is possible to reduce risk of exposure. If applicable, identified groundwater withdrawal points may be provided public connection, thereby permitting reevaluation of the drinking water status.

Intermittent Stream* - A well-defined channel that contains water for only part of the year, typically during winter and spring when the aquatic bed is below the water table. The flow may be heavily supplemented by stormwater runoff. An intermittent stream often lacks the biological, hydrological and physical characteristics commonly associated with the continuous movement of water.

Municipal Water Supply - Public drinking water system where treated water is supplied by a local water authority and connected to a service address by a water meter (municipal tap). “City water” is a synonym for a public drinking water system.

Non-Public Water Supply Withdrawal Point – Private water well or spring that has fewer connections than the minimum Public Drinking Water System connections and usually supplies a single-family residence or farm.

Nonresident - The human receptor that is a commercial worker at a petroleum release site or an offsite structure. An onsite, nonresident is typically a retail gas station employee. An offsite nonresident is a commercial/industrial employee at an adjacent or nearby business. The term does not include excavation worker.

Offsite - Any properties located outside the legal property boundary of the parcel where the petroleum release occurred.

Onsite - The legally defined parcel of land where the petroleum release occurred.

Perennial Stream* - A well-defined channel that contains water year-round during a year of normal precipitation with the aquatic bed located below the water table for most of the year. Groundwater is the primary source of water for a perennial stream, but it also carries stormwater runoff. A perennial stream exhibits the typical biological, hydrological and physical characteristics commonly associated with the continuous movement of water.

Public Access Spring – A spring that supplies free, untreated water to patrons from a defined public location. Such springs are not common, and patrons typically use containers to fill and transport spring water for domestic consumption. Local utilities or municipalities may periodically monitor water quality from this type of spring.

Public Water Supply Withdrawal Point – Water well, surface water intake or spring that supplies water to a Public Drinking Water System.

Public Drinking Water System - As defined by the Georgia Rules for Safe Drinking Water (Chapter 391-3-5, as amended), provides piped water for human consumption to at least 15 service connections or regularly serves an average of at least 25 individuals daily at least 60 days out of the year.

Point of Exposure - The point(s) at which an individual or population has or may have come in contact with a COC originating from a petroleum release. The distance from the source to the AOC and/or AOPC receptor will be applied during fate and transport evaluation.

Receptor - Persons, structures, utilities, surface waters (water supply intake, organisms and recreation), water supply wells, and/or ecologically sensitive areas/habitats that are or may be adversely affected by a petroleum release. A receptor may be located within an AOC or AOPC.

Release Point - The identified and specific location responsible for the petroleum release investigation. This location will be a specific UST component that failed or had a spill or overflow. If the release point is unknown or cannot be identified (i.e., historical release lacking records, routine UST system closure, etc.), evaluate the UST system for how it is or was spatially located on the UST site.

A Centralized UST system is where all system components (i.e., dispensers, lines and tanks) are or were located proximate to each other and where soil and/or groundwater analytical data cannot discern which component(s) leaked. The Release Point for a centralized UST system is the central location of the system or the maximum concentration boring and/or monitoring well located immediately adjacent to the UST system.

A Decentralized UST system is one where UST system components (i.e. tanks, piping and dispensers) are or were physically located away from each other. The Release Point for a decentralized UST system is the UST system component nearest the maximum concentration boring/monitoring well and the groundwater COC concentration gradient confirms the conclusion. The Release Point can be identified as the maximum concentration boring and/or monitoring well that is located immediately adjacent to a UST system component.

The COC hierarchy of COC importance in selecting the Maximum concentration COC MW is as follows: Benzene, MTBE, Ethyl benzene, Toluene, Xylenes and Naphthalene.

Resident - A human child or adult residing in an AOC or AOPC. A resident child is **always** included with a resident adult. Therefore, “Resident” in the GRBCA Process is inclusive of an adult and child.

Risk Analysis Report (RAR) - The GRBCA Workbook publishes the Risk Analysis Report, which is a very detailed, technical report to help guide consultants and staff to make informed decisions for

the impacted parcel. The report compares the published and applicable soil and groundwater RBTLs and/or groundwater SSTLs at all UST sites that have had a petroleum release or establishes determines if a risk of exposure does not exist because an exposure pathway is not complete.

Risk-based Threshold Level (RBTL) - Toxicological and chemical property specific, calculated concentration for an individual COC that provides adequate protection of human health and/or the environment. The RBTL for each COC is a conservative value that establishes safe exposure levels for a resident, nonresident, surface water organism, and/or recreation. Soil and groundwater RBTLs are listed in Section III, REFERENCES 3 through 4E.

REFERENCE 5 publishes Excavation Worker Advisory Levels for employers conducting excavation work on or near a known petroleum release site. Even if unexpected contamination is encountered, this advisory provides the work environment must be monitored for petroleum COC concentration levels where employees may be exposed. The advisory includes information regarding when employees should be using employer provided Personal Protective Equipment.

Site Specific Threshold Level (SSTL) - Using site specific data, the calculated concentration for an individual COC that provides adequate protection of human health and/or the environment. The SSTL for each COC is a conservative value that calculates safe exposure levels for a resident, non-resident and/or surface water organism, and/or recreation.

*Adapted from North Carolina Division of Water Quality - Methodology for Identification of Intermittent and Perennial Streams and Their Origins v. 4.11

III. GRBCA Report Reference Tables

Supporting documentation used in the GRBCA process, include, but are not limited to, algorithms to determine soil, groundwater (GW) and surface Water (SW) RBTLs and SSTLs, exposure factors, chemical and toxicological properties.

The table below provides a summary of each Reference Table that is applicable to the GRBCA process.

REFERENCE TABLES for COCs and RBTLs	
REFERENCE Table Title	Purpose
REFERENCE 1 - GW & SW COCs	Identify GW/SW COCs to sample by fuel type and water usage
REFERENCE 2 - Soil COCs	Identify Soil COCs to sample by fuel type
REFERENCE 3 - Soil and GW Delineation Standards	Soil and GW plume delineation standard <i>NOTE: this is not the cleanup standard</i>
REFERENCE 4A- Residential Land Use GW RBTLs	Residential RBTLs based on VI (GW to indoor air pathway) & Ingestion pathways
REFERENCE 4B - Nonresidential Land Use GW RBTLs	Nonresidential RBTLs based on VI (GW to indoor air pathway) & Ingestion pathways
REFERENCE 4C - UST System Closure & Soil to GW Leaching RBTLs	Soil & GW RBTLs during UST System Closure. No GW impact = leaching standard
REFERENCE 4D – Direct Exposure Soil RBTLs	Soil RBTLs when VI pathway not applicable
REFERENCE 4E – Surface Water RBTLs Direct Exposure Soil RBTLs	SW RBTLs for Public water withdrawal point & for perennial water bodies
REFERENCE 5 - Excavation Worker Advisory Levels	Excavation worker exposure RBTLs applicable during excavation activities

REFERENCE 1 – Groundwater & Surface Water Chemicals of Concern (COCs)

Georgia Underground Storage Tank Management Program

Product Released	COCs to Sample			
	Groundwater		Surface Water ^{†††}	
	Drinking Water (Ingestion)	Non-Drinking Water (Vapor Inhalation)	Public Water Supply Withdrawal Point* (Ingestion)	Perennial Water Body** (Direct Exposure)
Gasoline	Benzene Ethyl benzene Toluene Total Xylenes MTBE Naphthalene	Benzene Ethyl benzene Toluene Total Xylenes MTBE Naphthalene	Benzene Ethyl benzene Toluene Total Xylenes	Benzene Ethyl benzene Toluene
Diesel/ Jet Fuel/ Kerosene	Benzene Ethyl benzene Toluene Total Xylenes MTBE Naphthalene 1-Methylnaphthalene 1,2,4-Trimethylbenzene Benzo(a)pyrene TEQ [†]	Benzene Ethyl benzene Toluene Total Xylenes MTBE Naphthalene	Benzene Ethyl benzene Toluene Total Xylenes Benzo(a)pyrene TEQ [†]	Benzene Ethyl benzene Toluene Naphthalene 1-Methylnaphthalene 1,2,4-Trimethylbenzene Benzo(a)pyrene TEQ [†]
Used Oil	D/JF/K (above) Lead, Total	D/JF/K (above)	D/JF/K (above) Lead, Total	D/JF/K (above) Lead, Total
Aviation Fuel/ Leaded Gasoline/ Unknown^{††}	Benzene Ethyl benzene Toluene Total Xylenes MTBE Naphthalene EDB ^{***†} EDC [†] 1-Methylnaphthalene 1,2,4-Trimethylbenzene Benzo(a)pyrene TEQ [†] Lead, Total	Benzene Ethyl benzene Toluene Total Xylenes MTBE Naphthalene EDB [†] EDC [†]	Benzene Ethyl benzene Toluene Total Xylenes Naphthalene EDB ^{***†} EDC [†] Benzo(a)pyrene TEQ [†] Lead, Total	Benzene Ethyl benzene Toluene Naphthalene EDC Benzo(a)pyrene TEQ [†] 1-Methylnaphthalene 1,2,4-Trimethylbenzene Lead, Total

[†]Benzo(a)pyrene Total Equivalent Quotient (TEQ). See Appendix B, Section 2.9 for TEQ determination details

^{††}COCs to sample for all leaded aviation fuels, all leaded racing fuels and sites with historical leaded gasoline storage

^{†††}COCs to be sampled **only** at surface water receptor

*GA EPD MCLs (Rule 391-3-5-.18);

**GA EPD In Stream Water Quality Standards (Rule 391-3-6-.03). See REFERENCE 4C for additional clarification of this category

***EDB drinking water samples are analyzed by EPA Method 8011

BTEX, MTBE, Naphthalene, 1,2,4-Trimethylbenzene (TMB) EDB (non-drinking water) and EDC are analyzed by EPA method 5030C/8260C

1- Methylnaphthalene are analyzed by EPA Method 8270C. Lead, Total are analyzed by EPA Method 200.8

REFERENCE 2 – Soil Chemicals of Concern (COCs)

Georgia Underground Storage Tank Management Program

COCs to Sample	
Product Released	Soil COCs to Sample
Gasoline	Benzene Ethyl benzene Toluene Total Xylenes MTBE Naphthalene
Diesel/ Jet Fuel/ Kerosene	Benzene Ethyl benzene Toluene Total Xylenes MTBE Naphthalene 1-Methylnaphthalene 1,2,4-Trimethylbenzene Benzo(a)pyrene TEQ TPH (Aliphatic Medium) *
Aviation Fuel/ Leaded Gasoline	Benzene Ethyl benzene Toluene Total Xylenes MTBE EDB, EDC Naphthalene 1-Methylnaphthalene 1,2,4-Trimethylbenzene Benzo(a)pyrene TEQ Lead, Total
Used Oil	Diesel/Kerosene Jet Fuel/ TPH (Aliphatic High) * Lead, Total
Unknown	Aviation Fuel TPH (Aliphatic Medium) * TPH (Aliphatic High) *

*TPH soil COC analyzed during UST system or component closures only

BTEX, MTBE, Naphthalene, 1, 2, 4-TMB, EDB and EDC are analyzed by EPA method 5030C/8260C

1 -Methylnaphthalene and Benzo(a)pyrene are analyzed by EPA Method 8270C

TPH Aliphatic Medium (C12-C18) and TPH Aliphatic High (C19-C32) are analyzed by EPA Method 8015C

Lead, Total is analyzed by EPA Method 6010C/3050B

REFERENCE 3 – Soil and Groundwater Delineation Standards

Georgia Underground Storage Tank Management Program Risk-based Threshold Levels (RBTLs)

SOIL AND GROUNDWATER DELINEATION STANDARDS

(NOTE: DELINEATION STANDARDS ARE NOT
THRESHOLD CLEANUP LEVELS OR ALTERNATE CLEANUP LEVELS)

CHEMICALS OF CONCERN	Sub-Surface Soil	Groundwater ^{††}
	Soil to Groundwater (Leaching) [†] (mg/kg)	Drinking Water (Ingestion) ^{††} (µg/L)
Benzene	0.10	5
Toluene	14	1000
Ethyl benzene	16	700
Xylenes (Total)	200	10,000
Naphthalene	400	6
1-Methylnaphthalene	0.12	11
1,2,4-Trimethylbenzene	2	56
Benzo(a)pyrene TEQ	4.80	0.2
MTBE	0.10	140
EDB	0.00028	0.05
EDC	0.028	5
Lead	270	15

[†]All soil leaching to groundwater values are based on a default dilution attenuation factor (DAF) of 20 and target cancer risk of 10^{-6} and non-cancer hazard quotient of 1.0 (where MCLs are not available).

^{††}GA EPD MCLs, Rule 391-3-5-.18, or, if not published, then risk-based concentrations

REFERENCE 4A – Residential Land Use Groundwater RBTLs

**Georgia Underground Storage Tank Management Program
Risk-based Threshold Levels (RBTLs)**

RESIDENTIAL LAND USE GROUNDWATER (GW) RBTLs

CHEMICALS OF CONCERN	Non-Drinking Water ($V_{I_{GW}}$) ($\mu\text{g/L}$)	Drinking Water (Ingestion of GW) ($\mu\text{g/L}$)
Benzene	16	5
Toluene	26,000	1000
Ethyl benzene	48	700
Xylenes (Total)	530	10,000
Naphthalene	172	6
1-Methylnaphthalene	N/A**	11
1,2,4-Trimethylbenzene	360	56
Benzo(a)pyrene TEQ	N/A	0.2
MTBE	5700	140
EDB	2.4	0.05
EDC	29	5
Lead	N/A	15

†When MCLs are unavailable, the target groundwater values are based on protection of a residential adult and child from consumptive use of groundwater. See Appendix B for additional details.

**N/A (Not Applicable) because the COC is not volatile

REFERENCE 4B – Nonresidential Land Use Groundwater RBTLs

**Georgia Underground Storage Tank Management Program
Risk-based Threshold Levels (RBTLs)**

NONRESIDENTIAL LAND USE GROUNDWATER (GW) RBTLs

CHEMICALS OF CONCERN	Non-Drinking Water ($V_{I_{GW}}$) ($\mu\text{g/L}$)	Drinking Water (Ingestion of GW) ($\mu\text{g/L}$)
Benzene	69	5
Toluene	110,000	1000
Ethyl benzene	210	700
Xylenes (Total)	2,200	10,000
Naphthalene	722	6
1-Methylnaphthalene	N/A*	11
1,2,4-Trimethylbenzene	1,500	56
Benzo(a)pyrene TEQ	N/A	0.2
MTBE	25,000	140
EDB	11	0.05
EDC	130	5
Lead	N/A	15

†When MCLs are unavailable, the target groundwater values are based on protection of a nonresidential worker from consumptive use of groundwater. See Appendix B for additional details.

* N/A (Not Applicable) because the COC is not volatile

REFERENCE 4C – UST System Closure & Soil to GW Leaching RBTLs
Georgia Underground Storage Tank Management Program
Risk-based Threshold Levels (RBTLs)

UST SYSTEM CLOSURE RBTLs*
AND
SOIL TO GROUNDWATER LEACHING
RBTLs^{†}**

CHEMICALS OF CONCERN	Subsurface Soil
	Soil to Groundwater (Leaching) (mg/kg)
Benzene	0.10
Toluene	14
Ethyl benzene	16
Xylenes (Total)	200
Naphthalene	400
1-Methylnaphthalene	0.12
1,2,4-Trimethylbenzene	2
Benzo(a)pyrene TEQ	4.80
MTBE	0.10
TPH (Aliphatic Medium) ^{††}	30
TPH (Aliphatic High) ^{††}	48,000
EDB	0.0003
EDC	0.03
Lead	270

*Applicable soil RBTLs for **All** UST System Closures. Refer to REFERENCE 2 for applicable COCs for type of fuel stored.

[†]All soil leaching to groundwater values are based on a default DAF of 20, a target cancer risk of 10⁻⁶ and a non-cancer hazard quotient of 1.0 (where MCLs are not available).

For release investigations, the soil to groundwater leaching RBTLs apply when **all the following site-specific criteria are met:

- The date of the confirmed release is less than twelve (12) months from the date the risk analysis report evaluation is completed.
- Groundwater at the site is determined to be drinking water.
- The depth to groundwater is less than fifteen (feet)
- The surficial aquifer is the same aquifer used for drinking water.
- A municipal water supply is not available for connection
- Groundwater COC concentrations at the site are below drinking water RBTLs; and
- Free product is not present on groundwater.

^{††}TPH soil COC analyzed during UST system or component closures only

REFERENCE 4C – UST System Closure & Soil to Groundwater Leaching Pathway

The COCs and RBTLs listed in REFERENCE 4C are applicable to **both** UST system closures **and** to soil leaching to groundwater. The closure RBTLs are part of the GRBCA Workbook process; however, the soil to groundwater leaching pathway for release investigations under CAP-Part A is applicable under the following site-specific conditions, and as determined during the Receptor Field Survey:

1. The date of the confirmed release is less than twelve (12) months from the date of the GRBCA Workbook evaluation.
2. Groundwater usage for the Receptor Field Survey area is determined to be drinking water.
3. The depth to groundwater is less than fifteen (15) feet.
4. The surficial aquifer is the same aquifer used for drinking water.
5. A municipal water supply is not available for connection by current groundwater users.
6. Groundwater COC concentrations at the site are below drinking water RBTLs (i.e., the groundwater at the site is **not** impacted by the petroleum release; and
7. Free product is not present on groundwater.

If the CAP-Part A and Receptor Field Survey establish that these site conditions exist, which at typical UST petroleum release sites is very unlikely, the soil to groundwater leaching RBTLs are applicable and the GRBCA workbook does not currently apply. Upon notification, the Project Officer will provide guidance regarding the future direction of the release investigation and/or cleanup. Likely outcomes may include a more comprehensive soil source investigation and/or preparation of a CAP-Part B, with options including, but not limited to, soil corrective action and/or groundwater monitoring.

REFERENCE 4D – Direct Exposure Soil RBTLs

Georgia Underground Storage Tank Management Program Risk-based Threshold Levels (RBTLs)

DIRECT EXPOSURE SOIL RBTLs**†

CHEMICALS OF CONCERN	Subsurface Soil
	Ingestion, Dermal Contact and Inhalation (Vapors and Particulates) (mg/kg)
Benzene	12
Toluene	4,900
Ethyl benzene	80
Xylenes (Total)	580
Naphthalene	129
1-Methylnaphthalene	180
1,2,4-Trimethylbenzene	300
Benzo(a)pyrene TEQ	1.23
MTBE	470
EDB	0.40
EDC	5
Lead	400

*Values listed are based on protection of a residential receptor and are established at a target cancer risk of 10^{-5} and a target hazard quotient of 1.0. For release investigations, the direct exposure soil RBTLs apply when the following criteria have been met:

- a. Delineation of soil COCs is complete
- b. Soil COC concentrations are located greater than or equal to thirty (30) feet from an existing structure; and
- c. Groundwater COCs at the site exceeds the drinking water MCLs

†Direct Exposure Soil RBTLs are **not** applicable to **any** UST system closure. Refer to REFERENCE 4C for applicable UST system closure RBTLs

REFERENCE 4E – Surface Water RBTLs

Georgia Underground Storage Tank Management Program Risk-based Threshold Levels (RBTLs)

SURFACE WATER RBTLs[†]
--

CHEMICALS OF CONCERN	Public Water Supply Withdrawal Point (Ingestion) ^{††} (µg/L)	Perennial Water Body ^{†††} (Direct Exposure) (µg/L)
Benzene	5	51
Toluene	1,000	5,980
Ethyl benzene	700	2,100
Xylenes (Total)	10,000	193
Naphthalene	6	6
1-Methylnaphthalene	11	17
1,2,4-Trimethylbenzene	56	56
Benzo(a)pyrene TEQ	0.2	0.2
MTBE	140	195
EDB	0.05	0.05
EDC	5	37
Lead	15	1.2

[†]COCs to be sampled **only** at surface water receptor.

^{††}GA EPD MCLs, Rule 391-3-5-.18, or, if not published, risk-based concentrations.

^{*}Water exposure is based on recreation (i.e. swimming, wading, boating, incidental ingestion, etc.).

^{†††}The hierarchy for selecting surface water RBTLs is:

1. GA EPD In Stream Water Quality Standards, Rule 391-3-6-.03.
2. USEPA's National Recommended Water Quality Criteria for Human Health (consumption of water and organisms). Available at: <https://www.epa.gov/wqc/national-recommended-water-quality-criteria-human-health-criteria-table>.
3. MCLs: When unavailable, use USEPA's Tap Water RSLs (10⁻⁵ risk and THQ 1).
4. Values based on chronic freshwater criteria. If coastal and marine estuarine waters, the ISWQS for lead should become 8.1 µg/L.

REFERENCE 5A – Excavation Worker Advisory Levels
Georgia Underground Storage Tank Management Program
Excavation Worker Advisory Levels

**EXCAVATION WORKER ADVISORY LEVELS:
 THIRTY (30) DAY EXPOSURE**

CHEMICALS OF CONCERN	Sub-Surface Soil	Groundwater
	Ingestion, Dermal Contact and Inhalation (Vapors and Particulates) (mg/kg)	Ingestion, Vapor Inhalation and Dermal Contact (µg/L)
Benzene	941	620
Toluene	71,500	41,257
Ethyl benzene	9,230	2,467
Xylenes (Total)	7,990	3,625
Naphthalene	719,000	34
1-Methylnaphthalene	50,200	15,264
1,2,4-Trimethylbenzene	5,150	680
Benzo(a)pyrene TEQ	1,460	4
MTBE	40,100	24,227
EDB	58	4
EDC	729	59
Lead	1,050	15

Excavation Worker Advisory Levels

Consistent with the ASTM E1739-95 Standard (reapproved 2015), the USTMP has established a thirty (30) day, risk-based exposure advisory level for an excavation worker. This reference is provided to benefit employers and/or agencies and is an advisory for employees who may be exposed to residual or previously unidentified free product, soil and/or groundwater petroleum contamination. Exposure is possible during excavation activities for the purpose of UST system or component removal, contaminated soil excavation, subsurface utility work or site redevelopment involving subsurface soil removal.

REFERENCE 5 does not establish cleanup levels but provides exposure concentrations above which an employer or agency should implement mitigating steps (i.e., application of proper personal protection equipment) to address employee exposure or other site hazards consistent with the identified COC concentrations encountered. The advisory implies that an employer or agency understands an existing or former petroleum site has been identified within or near the planned excavation zone **prior** to commencement of any site work. The advisory also implies that an employer or agency has taken adequate steps:

1. To properly notify and inform site workers of potential petroleum contamination and related hazards.
2. To identify an action plan (including, but not limited to a Site Health & Safety Plan addressing the potential petroleum exposure pathway and employer plus employee response) to manage potentially contaminated material generated, and,
3. To monitor vapor emissions or other potential direct contact hazards affecting site workers during implementation of the scope of work.