Inactive Hazardous Sites Branch

Guidelines for Assessment and Cleanup of Contaminated Sites

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Department of Environmental Quality
Division of Waste Management
Superfund Section
Inactive Hazardous Sites Branch

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Inactive Hazardous Sites Program website:
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Registered Environmental Consultant Program website:
https://deq.nc.gov/about/divisions/waste-management/superfund-section/registered-environment-consultant-program

Updates since September 2023 Version

1. Added an acronym section up front.
2. Added links up front.
3. Reorganized and expanded the information in former Section 1.0 which are now Sections 1 through 4.
    a. Outlined the reporting requirements in Section 3.0, including notification of new contamination, and submitting reports and lab data.
    b. Introduced the Electronic Data Delivery requirement that is being implemented across the DWM in Section 3.3.
    c. Expanded upon and clarified the site cleanup pathways in the Branch in Section 4.0.
4. Expanded the Remediation Goals and Standards section to include vapor and emphasize the use of calculating risk-based cleanup levels in Section 6.0.
5. Clarified the 20x rule calculation for leachability in Section 6.1.1.2.
6. Updated the DEQ IMACs and USEPA MCLs for PFAS in Section 6.3.
7. Added a section on RAP public notification as Section 7.1.
8. Emphasized the requirements for professional seals and signatures on technical documents submitted to the Branch (e.g., LG or PE) in several sections.
9. Added quarries as options for fill in Appendix B, Section B.10.
10. Moved the list of sensitive environments to Appendix C with the sensitive environment contacts.
11. Replaced the PFAS references with the links up front.

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List of Acronyms

AA	Administrative Agreement
ASTM	American Society for Testing and Materials
bgs	Below Ground Surface
Branch	Inactive Hazardous Sites Branch
BTV	Background Threshold Value
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Contract Laboratory Program
CSM	Conceptual Site Model
DEQ	Department of Environmental Quality
DWM	Division of Waste Management
EDD	Electronic Data Deliverable
EMC	Environmental Management Commission
GPS	Global Positioning System
HI	Hazard Index
HFPO-DA	Hexafluoropropylene Oxide Dimer Acid or GenX chemicals
HSL	Hazardous Substance List
ICP-MS	Inductively Coupled Plasma - Mass Spectrometry
IDW	Investigation Derived Waste
IHSB	Inactive Hazardous Sites Branch
IHSRA	Inactive Hazardous Sites Response Act of 1987
IMAC	Interim Maximum Allowable Concentration
ITRC	Interstate Technology & Regulatory Council
LG	Licensed Geologist
LSASD	USEPA Region IV, Laboratory Services and Applied Science Division
LUR	Land Use Restriction
MCL	Maximum Contaminant Level
MDLs	Method Detection Limits
ug/L	micrograms per liter
mg/kg	milligram per kilogram
mg/L	milligram per liter
ng/L	nanograms per liter
NCAC	North Carolina Administrative Codes
NCGS	North Carolina General Statutes
NFA	No Further Action
NIOSH	National Institute for Occupational Safety and Health
NTU	Nephelometric Turbidity Unit
PAHs	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PE	Professional Engineer
PFAS	Per-and Polyfluoroalkyl Substances
PFBS	Perfluorobutanesulfonic Acid
PFHxS	Perfluorohexanesulfonic Acid
PFNA	Perfluorononanoic Acid
PFOA	Perfluorooctanoic Acid

PFOS	Perfluorooctanesulfonic Acid
PID	Photoionization Detector
ppt	parts per trillion
PQL	Practical Quantitation Limit
RSL	Regional Screening Level
PSRG	Preliminary Soil Remediation Goal
QA/QC	Quality Assurance and Quality Control
RAP	Remedial Action Plan
RCRA	Resource Conservation and Recovery Act
REC	Registered Environmental Consultant
RI	Remedial Investigation
RSM	Registered Site Managers
SARA	Superfund Amendments and Reauthorization Act
SESD	Science and Ecosystem Support Division
SIM	Selected Ion Monitoring
SVOC	Semi-volatile Organic Compounds
SW-846	USEPA *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*
TCA	1,1,1-trichloroethane
TCE	Trichloroethylene
TICs	Tentatively Identified Compounds
TOP	Total Oxidizable Precursor
UCL	Upper Confidence Level
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VIMS	Vapor Intrusion Mitigation System
VOCs	Volatile Organic Compounds
WPC	Work Phase Completion

Related Links

Inactive Hazardous Sites Branch Information

Inactive Hazardous Sites Program | NC DEQ

Registered Environmental Consultant Program | NC DEQ

Division of Waste Management Resources

DEQ Risk-Based Remediation | NC DEQ

DWM Vapor Intrusion Guidance | NC DEQ

DWM Site Locator Tool | NC DEQ GIS Data (arcgis.com)

Waste Management Online Documents and Environmental Data | NC DEQ

Division of Water Resources

Groundwater Standards | NC DEQ

Surface Water Standards | NC DEQ

United States Environmental Protection Agency (always consult the most current versions)

Quality System and Technical Procedures for LSASD Field Branches | US EPA

Region 4 Human Health Risk Assessment Supplemental Guidance, January 2014 Draft Final.

USEPA Region 4 Eco Risk Assessment Supplemental Guidance - March 2018 Update

PFAS Resources (always consult the sources for the most current PFAS Resources)

PFAS Strategic Roadmap: EPA's Commitments to Action 2021-2024 | US EPA

USEPA Designation of PFOA and PFOS as Hazardous Substances - May 2024

ITRC PFAS Sampling and Analysis - September 2023

ITRC Sampling Precautions and Laboratory Analytical Methods for PFAS - July 2022

USEPA Multi-Industry PFAS Study - September 2021

1.0 Purpose

The purpose of this guidance document is to provide procedures for remediating parties and their environmental consultants to conduct assessments and remedial actions under the jurisdiction of the Inactive Hazardous Sites Branch (IHSB) or "Branch". Important information and additional information pertaining to the privatized Registered Environmental Consultant (REC) Program for voluntary cleanup of lower risk sites is provided in the text boxes. The information presented in this guidance is generally applicable to a wide variety of sites within the Branch's jurisdiction. However, because of site variability, unique aspects of some sites may not be addressed. In such cases, questions should be directed to Branch staff.

2.0 Statutory Authority and Jurisdiction

The Inactive Hazardous Sites Response Act of 1987 (IHSRA), through the North Carolina General Statutes (NCGS) 130A-310 *et. Seq*, was established by the North Carolina General Assembly to address releases to the environment of hazardous substances, as defined in the 1980 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the 1986 Superfund Amendments and Reauthorization Act (SARA). CERCLA has a list of about 800 hazardous substances that can be found at 40 CFR part 302.4. Note that in May 2024 the Environmental Protection Agency (USEPA) designated two per- and polyfluoroalkyl substances (PFAS), perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS), including their salts and structural isomers, as hazardous substances.

Parties responsible under law for unpermitted releases of hazardous substances must assess and remediate all environmental media comprising the contaminated site. A site is broadly defined under CERCLA as an area where a hazardous substance has been deposited, stored, disposed of, placed, or otherwise come to be located. These sites consist of historical and recent accidental (non-permitted) releases of hazardous substances to soil and/or groundwater and their migration to sediment, surface water, and/or indoor air. Excluded from the Branch's jurisdiction are discharges associated with North Carolina's Department of Environmental Quality (DEQ) permits, hazardous waste dumping, proper and routine application of agricultural chemicals, Federal remediation sites, petroleum releases, coal ash, animal waste systems, and sites undergoing remediation by the State's Drycleaning Solvent Cleanup Act and Pre-Regulatory Landfill Programs.

3.0 Reporting

Discoveries of recent or historic hazardous substance contamination must be reported to the Branch. The Branch, in turn, is required to catalogue all contamination sites and maintain records documenting the contamination and its extent in all environmental media. Site data should be submitted as remedial actions progress so the Branch can ascertain the potential risk the site poses to public health and the environment.

3.1 Notification Requirements

If a new or recent accidental release of a hazardous substance has occurred (i.e., train derailment, industrial equipment malfunction, etc.) a *24-Hour Notification of Non-Petroleum Spill/Discharge Form (IHSB-24)* is available on the Branch's website to provide the Branch related information as soon as possible.

The IHSRA (NCGS 130A-310.1(b)) requires that the Branch be notified within 90 days of the date on which any owner, operator or responsible party knows or should know of the existence of hazardous substance contamination. This notification requirement also applies to newly discovered contaminants at a site that were not previously identified as known or potential contaminants of concern.

Notification occurs when relevant site data are submitted to the Branch in an assessment report and/or on a *Notification of an Inactive Hazardous Substance or Waste Disposal Site* (Notification) form available on the Branch's website. If only the Notification form is submitted, site data and documentation that are known or readily available to the owner, operator, or responsible party should be attached. North Carolina regulations under 15A NCAC 02L also require immediate Branch notification of the discovery of a non-permitted activity that has resulted in groundwater contamination. Notification forms and assessment reports are reviewed to determine whether the reported contamination is regulated by the Branch.

3.2 Document Submittal and File Access

Sites with state-lead oversight (non-REC) currently need to submit both paper and electronic copies of work plans and reports. Documents may be e-mailed, but if they are large in size, contact the Branch for a file-sharing system or other delivery methods that may be used. DEQ is in the process of developing an online document submission solution whereby the submission of documents by members of the public is administered through the My Documents section of the AccessDEQ public portal. It is anticipated that the Branch may begin accepting documents electronically in this manner sometime in 2025.

REC Program documents must be submitted in electronic form only. Paper copies will not be accepted.

Until AccessDEQ is fully implemented, All REC certified documents must be submitted electronically through the existing portal on the REC Program website, unless otherwise requested by REC Program staff. All documents submitted electronically should be one PDF file that includes any cover letters, appendices, and signed and notarized certifications for work conducted under an AA. Extremely large documents may be split into more than one file.

All Branch files and online documents are stored electronically in the Division of Waste Management's (DWM) online document management system which can be accessed by the public. Instructions for accessing the system can be found in the Waste Management Online Documents and Environmental Data link provided at the front of this document.

3.3 Environmental Data Delivery

DEQ has procured an environmental data management system to streamline the submittal, organization, and presentation of environmental data collected across the State. A standardized Electronic Data Deliverable (EDD) format is being adopted by DEQ across all its divisions to regiment how analytical data is transmitted to the DEQ in order to achieve the above objectives, as well as to better facilitate data review and decision making.

Consultants will be notified by the Branch as to when they are expected to begin submitting site environmental data using the DWM EDD format. To assist remediating parties and their consultants with this new data reporting format, the Branch plans to hold routine training sessions on Equis. It is the expectation of the DEQ that all environmental analytical data will eventually be submitted using EDDs in addition to data being included in submitted reports.

To maintain the integrity of the DEQ's environmental data management system, it is critical that facilities, consultants, and laboratories work with their Branch contacts to ensure that environmental analytical data and the accepted EDD format is being used and data are transferred in an accurate manner.

4.0 Site Remediation Oversight

It is expected that the parties responsible for site contamination will voluntarily develop and implement a remedial action program in cooperation with the Branch rather than receive an order from the DEQ to do so. Where an inactive hazardous substance or waste disposal site endangers the public health or the environment, the Branch may order a responsible party to develop and implement a remedial action program according to NCGS 130A-310.3(c). Parties who knowingly purchase contaminated property without pursuing liability protection through a Brownfields Agreement may be considered a responsible party if activities conducted at the property cause exposure to, or migration of, the existing contamination. There is nothing in the IHSRA that precludes any party, property owner or operator from volunteering to serve as a "remediating party" whether they are responsible for the contamination or not.

In addition to the IHSRA, rules apply that govern the protection of groundwaters of the state. Pursuant to 15A NCAC 02L .0106(b), any person conducting or controlling an activity which results in the discharge of a waste or hazardous substance to the groundwaters of the State, or in proximity thereto, shall take immediate action to terminate and control the discharge, and mitigate any hazards resulting from exposure to the pollutants, such as vapor intrusion. Pursuant to 15A NCAC 02L .0106(c), if groundwater standards have been exceeded on a property, immediate actions must be taken to eliminate the source or sources of contamination.

If remedial action is not initiated voluntarily or through an order at a higher-risk site that poses or could pose an imminent hazard to human health and/or the environment, site action may be referred to the USEPA. USEPA will screen the site for Federal enforcement action under the Federal Superfund Program established under CERCLA and pursue cost recovery from the responsible party for the work completed.

4.1 State-Approved Voluntary Remedial Actions

The IHSRA provides site owners, operators, or responsible parties an opportunity to voluntarily clean up inactive hazardous sites with Branch approval in lieu of being ordered to do so. An owner, operator, or other responsible party volunteering for remedial action on a site is collectively referred to as the "remediating party". To participate in this voluntary cleanup program, the remediating party must sign an Administrative Agreement (AA) with the DWM specifying the agreed-upon terms of the remedial action program for the site.

The Branch must dedicate its staff resources toward overseeing assessment and remedial actions at the sites that pose the highest risk to human health and the environment. The lower-risk sites are directed to the Branch's privatized oversight program known as the REC Program for an approved cleanup (REC-lead). Higher-risk sites can also participate in the voluntary cleanup program, but actions are directly overseen and approved by Branch staff (State-lead). Whether a site is lower or higher risk is determined by the Branch.

The technical work conducted under state-lead or REC Program oversight is the same. However, the REC Program has additional administrative requirements for RECs and the work-phase completion deadlines to ensure work is progressing according to the REC rules.

4.1.1 The Registered Environmental Consultant Program

NCGS 130A-310.9(c) directs the adoption of rules to govern the REC Program. Those rules are found in 15A NCAC 13C .0300 titled "Voluntary Remedial Action Oversight by Registered Environmental Consultants."

Due to the large number of contaminated sites inventoried, many of which are orphaned with no identifiable responsible party, the Branch is unable to respond to all requests for remedial action oversight. To help address this problem, the North Carolina General Assembly amended the IHSRA in 1994 and 1995 to establish a program for parties to voluntarily pursue an approved cleanup at lower-risk sites. In the privatized REC Program, the remediating party hires a Branch-approved REC to direct, perform and certify a voluntary cleanup in place of state oversight. An AA is executed between the remediating party, the REC, and the DWM specifying the work to be conducted and the timeline to ensure progress is being made toward cleanup. A sample AA for REC-directed assessment and remedial action and list of approved RECs can be accessed on the REC Program website. All RECs are pre-approved by the Branch to do business and conduct work in NC.

Rules for implementing the REC Program (15A NCAC 13C .0300) specify the minimum qualification requirements for RECs and their Registered Site Managers (RSMs) and the administrative and technical requirements for conducting voluntary remedial actions in the program. The REC and its RSMs shall recognize their primary obligation is to protect public health, safety, and welfare and the environment in the performance of professional services as an REC and to comply with the standards of professional responsibility specified in REC rule 15A NCAC 13C .0305.

An RSM is responsible for the day-to-day oversight of the project and compliance with the REC rules. The technical requirements spelled out in the rules mimic the requirements for State-lead voluntary cleanups. However, the RSM approves the phases of work by certifying that the work was conducted according to the REC rules and ensures the work-phase completion milestones

specified therein are met. Only Branch-approved RSMs may manage site cleanups and make certifications on behalf of the REC. These responsibilities may not be delegated to anyone that is not an approved RSM in the same company. Similarly, site-related inquiries from the REC to the Branch should come from an RSM. When an REC learns that an RSM intends to change employment, the REC must notify the Branch within 30 days.

Additional resources to help with REC Program compliance can be found on the REC Program website (link provided at the front of this document). The website includes links to the REC Program rules, certification forms, document content checklists that can be used as a tool to guide the RSM through the REC Program planning and documentation requirements, and links to other guidance.

4.1.1.1 Document and Work-Phase Completion Certification

> Previously approved work does not need to be repeated in the REC Program, but a letter referencing the approval will need to be submitted to the REC Program with the appropriate work-phase completion form and certifications. Prior approvals must be in writing.

Work in the REC Program consists of four general phases: the remedial investigation (RI), the remedial action plan (RAP), the initiation of groundwater remedial action, and remedial action completion for individual or all media. Each of the work phases must be summarized in a report containing the information specified in the rules, and the report must contain the pertinent work-phase completion (WPC) statement and specific notarized certification statements from the RSM and the remediating party. The RSM must certify documents only when they have directly reviewed the work in question and only after the document has been certified by a representative of the remediating party.

WPC statements, schedules, work plans, data, calculations, and reports submitted to the Branch must be certified. Unless a certified document was submitted during the calendar year, the rules and AA require that a brief project status update report also be certified and submitted to the Branch for the public record to demonstrate progress is being made toward achieving the program deadlines. The Branch views certification of documents and WPC statements as a critical means of ensuring the integrity of the REC Program and that public health is being protected in the absence of state review.

4.1.1.2 Work-Phase Milestones

Work-phase milestones are established in rule that coincide with three of the four work phases to ensure that the REC makes remedial action progress. The following work-phase deadlines are specified in the REC Program rules based on the effective date of the AA:

- RI completion – 3 years.
- Groundwater remedial action initiation – 2 years from completion of the RI. Initiation is on the date the REC certifies (approves) the RAP for risk-based or monitored natural attenuation remedies and on the date remedial equipment has been installed and initial physical or chemical treatment actions have begun for active remedies.
- Non-groundwater (soil, sediment and surface water) remedial action completion – 8 years.

Work-phase milestones are considered met when the RSM submits the certified WPC form with the document that summarizes the phase of work. Failure to submit the WPC forms by their milestone deadlines are considered to be rule violations.

4.1.1.3 Audits

Because the work in the REC Program is independent from state oversight, the Branch conducts audits of any REC, RSM, or remediating party. Audits are performed to ensure that site cleanups under the REC Program are conducted in accordance with the REC rules, the site-specific AA, and applicable Federal and State statutes and regulations. Audits can be targeted but are most often random, and can consist of a document, phase of work, or full project. The audits also help maintain the integrity of the program and identify where procedures, guidance documents, and training for RSMs should be improved.

When potential REC rule violations are discovered during an audit, the Branch will first present the audit findings to the audited party and solicit comments or explanations for the identified issues or concerns. After considering the comments or explanations, one of the following audit results will be sent to the party audited depending on the severity of the deficiency or violation(s):

- Corrective education,
- Warning letter,
- Notice of deficiency,
- Notice of violation,
- Penalty order, or
- Other applicable enforcement action.

The Branch performs audits of the REC's work for compliance with the REC rules and protection of public health. The audits also help the Branch improve procedures, guidance documents, and training for RECs.

Education, warnings and deficiencies are given adequate time for corrections to avoid further enforcement. If the voluntary remedial action is not being properly implemented or there are repeat violations on more than one project, the Branch may do one of the following depending on the severity of the issue(s):

- Terminate a site's eligibility for voluntary remedial action under the REC Program and assume direct oversight;
- Disqualify an RSM or REC from work on a site;
- Revoke approval of a REC; or
- Take other applicable enforcement action.

4.1.2 State-Lead Oversight

At sites that staff consider to be ineligible for participation in the REC Program due to their elevated risk, a responsible party may still perform an *approved* voluntary cleanup under direct supervision by Branch staff (referred to as State-lead oversight). For these sites, the AA outlines the agreed-upon remedial action program for the site. Branch staff review, comment and approve

work plans and reports until the remedial action completion or the terms of the AA are met. The remedial action process for work conducted under state-lead or REC Program oversight is the same. However, the REC Program has the additional administrative requirements for RECs and work phase milestones to ensure work is progressing according to the REC rules.

4.1.3 Benefits of State-Approved Voluntary Remedial Action

Remediating parties benefit from entering into an AA in the following ways:

1. Branch oversight and approval (by a REC or Branch staff) occurs at each phase of work. Branch staff are available to provide guidance and assist with technical questions and unique situations to effectively move the site toward closure.
2. If the site has been ranked according to the danger it poses to human health and the environment, it is on the Inactive Hazardous Waste Site Priority List (SPL) published to the DWM's website each year. A signed AA automatically removes the site from the SPL.
3. Less conservative, risk-based cleanup levels with land-use restrictions may be used to achieve no-further-action status, since approval of alternate cleanup levels with land-use restrictions requires DWM approval. Most of the risk-based cleanups are directed to the REC Program, as this remedy is most appropriate for lower-risk, legacy sites where:
    - active sources contributing to groundwater contamination are removed,
    - groundwater monitoring indicates that plume migration is stable or predictable,
    - unacceptable risk can be mitigated through engineered and/or institutional controls, and
    - owners of all affected or potentially affected properties consent to the alternate, site-specific cleanup levels and institutional controls.

    The ability to employ land-use controls to manage risks carries with it a responsibility to ensure that such controls are protective, achievable, sustainable, consistent with surrounding land uses, maintained and enforced. Approved risk-based cleanup levels with restricted property use can be applied to soil, sediment and groundwater as described below. Surface waters must meet the 15A NCAC 02B standards.

    Soil. The Branch developed a process to allow for quick closure of sites that have only soil contamination, and the property owner consents to land-use restrictions in writing. Soil contamination must be limited in extent and/or concentration, and the final remedy consists of land-use restrictions with or without engineered controls (e.g., a physical barrier). Groundwater must meet the 02L standards. Refer to the *Methods to Quickly Close Soil-Only Sites* guidance document on the Branch's website for how to address soil-only contamination on a quick timeline under a modified AA created for this scenario.

    Groundwater. In 2015, amendments to NCGS 130A-310.65 through 310.77 expanded the risk-based remediation option for groundwater at sites regulated by the Branch. The statutes allow calculation of site-specific cleanup levels that are less stringent than the standards codified in 15A NCAC 02L (02L standards) with Branch approval. A groundwater-use restriction will be applied to the property with consent from the property

owner. Risk-based remediation procedures, guidance, and resources for groundwater can be found using the risk-based remediation link provided at the front of this document.

4. No one owner, operator, or other responsible party who voluntarily participates in the implementation of a remedial action program under NCGS 130A-310.3 or NCGS 130A-310.5 may be required to pay in excess of five million dollars ($5,000,000) for the cost of implementing a remedial action program at a single inactive hazardous substance or waste disposal site.

4.1.4 Procedures for Initiating a State-Approved Voluntary Remedial Action

General procedures for initiating state-approved remedial action at a site are as follows:

1. The remediating party, with the help of an environmental consultant, completes a Site Conditions Questionnaire (Questionnaire), available with instructions on the Branch website. The Questionnaire serves to provide information on the site conditions and the setting to help determine the level of risk the site poses to human health and the environment. The Questionnaire can be submitted along with all site data and reports not currently in the state's electronic files. If there is recent and sufficient site information already in the site file, a Questionnaire may not be necessary. Branch staff will review the information and notify the remediating party of the oversight needed (state oversight or oversight by an approved REC of their choice).
2. The Branch will prepare an AA between the DWM and the remediating party (and REC) to generally outline the work to be performed, reporting requirements, and document certification requirements.
3. The remediating party must pay a non-refundable fee to the Branch. For higher-risk sites performing state-lead voluntary remedial actions, the one-time fee is $1,000.

   For lower-risk sites performing REC-lead voluntary cleanups the initial fee to participate is currently $3,000. Remediating parties must also provide financial assurance by paying an annual fee to offset the cost of the Branch's administration and auditing of the program. The annual fee has never exceeded the initial participation fee.
4. At least 30 days prior to executing the AA, notification of the planned voluntary remedial action will be mailed to owners of property adjoining the site for their information. The AA is executed as soon as the 30-day public notification is completed.

4.2 Independent Remedial Action

Some remediating parties choose to perform remedial activities independently without approval by the Branch. As assessment and remedial action proceeds in these independent cleanups, documents containing property use information, historic and newly generated data, maps, and other site-related information should be submitted to the Branch as they are prepared, however, the document will not be reviewed or approved. The Branch is required to maintain records of contamination in the air, surface water, groundwater, surface or subsurface soils, or waste streams for inventoried sites to ascertain their risk. The Branch has the authority, upon reasonable notice,

to require submission of any information, document or record related to a site and may subpoena records, if needed, under 130A-310.1(h).

If a site is independently remediated to unrestricted use cleanup levels for all contaminated media, a party can submit to the Branch in writing a no-further-action (NFA) review request with a certified *Statement of Attainment of Cleanup Levels* form and non-refundable fee. Procedures for requesting NFA and the associated fees can be accessed using the link on the Branch's website.

As stated in **Section 4.1.3**, independent cleanups do not receive Branch approval and are not eligible for more lenient, risk-based cleanup levels or the cap on remedial expenses set out in the statute. Risk-based cleanups of soil and/or groundwater that rely on institutional controls as part of the remedy must be approved by the DWM and performed under a signed AA.

The importance of retaining a qualified and experienced environmental consultant cannot be overemphasized. Any work that would constitute the "practice of engineering" as defined by NCGS 89C shall be performed under the responsible charge of a professional engineer (PE) registered in the state of North Carolina. Any work that would constitute the "public practice of geology" as defined by NCGS 89E shall be performed under the responsible charge of a geologist licensed in the state of North Carolina (LG). Documents, or portions thereof, pertaining to such work will require the seal and signature of a licensed professional (e.g., a PE for engineering design work and/or a LG for geologic evaluations).

5.0 The Remedial Investigation

The RI involves planning the investigation, gathering information and analytical data, and reporting the findings in a RI report. At least two phases of work are generally necessary to complete the investigation. The purpose of the first phase is to identify known or suspected releases of hazardous substances to the environment, characterize the nature of such releases, and collect sufficient sampling data to compile a list of contaminants of concern. Additional phases are intended to delineate the extent of contamination in each medium, identify threatened and potential receptors, and assess the risk to receptors that may result from exposure to contaminated soil, water supplies and/or indoor air.

At any time during remedial activities, the Branch must be notified within 24-hours of discovery, or as soon as feasible, of the following:

1. Contamination that has migrated beyond the source property
2. Imminent Hazards
   a. uncontrolled access by children to the contaminated media
   b. contamination detected in water supply wells, or
   c. site contaminant vapors detected within occupiable structures
3. Threat to a sensitive environment

The notification can be by phone, email, or in a report. If notification is within a report, it should be expressed clearly up-front. For sites in the REC Program, the Branch should be notified by phone or email. Any notification delays should be shown to be unavoidable.

Per-and polyfluoroalkyl substances (PFAS) are now designated as hazardous substances by the USEPA, so these compounds should be considered as potential contaminants of concern at a site when conducting a RI. PFAS are a complex group of chemicals found in the environment worldwide due to their widespread use in in, but not limited to, aerospace,

automotive, construction, textile and waterproof fabrics, paper and packaging, metal plating and etching, semi-conductor and electronic industries, food packaging, and non-stick coatings, and in firefighting foams. Sampling and analytical methods, fate and transport properties and toxicity data are evolving rapidly. The RI of sites with known or potential PFAS should aim for a comprehensive characterization of ***all known and potential*** PFAS sources and analytes. The lack of documentation of PFAS use is not sufficient to rule out a site from further investigation, because PFAS chemicals are generally not listed on Safety Data Sheets or other product inserts. See the Interstate Technology & Regulatory Council (ITRC) PFAS sampling and analytical methods fact sheet and supplemental information on PFAS assessment from USEPA that can be accessed using the links provided at the front of this document.

5.1 Remedial Investigation Work Plans

Work plans should be prepared ahead of any data gathering at a site. They should describe the plans for gathering lithologic, hydrogeologic, and/or analytical data to build the conceptual site model (CSM). A work plan should be prepared for each phase of data gathering. The number of phases needed depends on the size and complexity of the contaminated site.

For REC sites, work plans for remedial investigations, additional site characterization, pilot studies or remedial action must be certified and submitted to the REC Program prior to implementation per 15A NCAC 13C.0306(b)(4).

Note: If part or all of the RI was completed and approved in writing by DWM prior to the execution of an AA for voluntary cleanup, a brief summary of the work and the results of the RI should be prepared and provided with a copy of the written approval to the Branch. Work does not have to be repeated unless the Branch or the consultant finds deficiencies or data gaps in the prior work. The summary should list all pre-existing RI work plans and reports for the site and ensure that they have been provided to the Branch.

Field procedures relating to sample collection techniques, sample containers, sample preservation, sample holding times equipment decontamination and field measurement procedures, should comply with the most current version of the USEPA Region IV, *Quality System and Technical Procedures for Laboratory Services and Applied Science Division (LSASD) Field Branches.* This information can be accessed using the link at the front of this document.

Field work must be overseen by, and documents must be prepared, submitted, and signed by, a LG and/or a PE licensed in North Carolina. In addition, documents must be properly certified according to the requirements in the AA (for work conducted under State oversight) or according to the AA and REC rules (for work conducted under REC oversight). Refer to **Appendix A** for the document certification requirements.

5.1.1 Identification of Contaminants and Areas of Concern (First Phase)

Each area known or suspected of being contaminated should be investigated during the initial phase of work. Known or suspected contaminated areas are those where material handling or storage occurred, or there is some indication of a release based on the following:

1. Existing laboratory data;

2. Observable conditions indicative of contamination, such as staining, odors, distressed vegetation, or evidence of damage to, or leakage from, a storage facility or vessel;
3. Records or statements of on-site spills or disposal; and
4. Other evidence known to the environmental consultant or the remediating party.

The following information should be documented in a RI work plan to guide sample collection and analyses according to the site's setting and environmental history.

1. Site location information including street address, longitude and latitude in decimal degrees, and source property and surrounding property land use;
2. A summary of the nature of all identified hazardous substance releases, including disposal or spills on the property;
3. Through written documentation and interviews with employees or occupants and review of records to provide:
    a. a summary of wastes that may have contained hazardous substances and hazardous wastes management practices employed at the property, including a list of types and amounts of waste generated, treatment and storage methods, and ultimate disposition of wastes;
    b. a description of the facility's past and current RCRA status; and
    c. the location and condition of all identified vessels currently or previously used to store any chemical products, hazardous substances or wastes;
4. United States Geological Survey topographic maps sufficient to display topography within a one-mile radius of the site;
5. An accurate and detailed site map(s) including:
    a. Scale, north arrow, date;
    b. Locations of property boundaries, buildings, subsurface utilities and structures, chemical handling and storage areas, and other areas identified where hazardous substances may have been handled or released;
    c. Perennial and non-perennial surface water features, storm water conduits, ponds/lagoons, drainage ditches, and dense vegetation;
    d. Known and suspected spill or disposal areas, dry wells, sumps chemical or waste, storage vessels, existing on-site wells, septic systems; and
    e. Proposed or previous sampling locations and data, if available.
6. A description of regional geologic and hydrogeologic conditions;
7. A chronological listing of all previous owners and each period of ownership since the property was originally developed from pristine land;
8. Operational history with aerial photographs and Sanborn Fire Insurance maps to support land-use history as needed;
9. A list of all hazardous substances which have been used or stored at the site, and approximate amounts and dates of use or storage as revealed by available written

documentation and interviews with a representative number of former and current employees or occupants possessing relevant information;

10. Environmental permit history, including copies of all Federal, State, and local environmental permits, past and present, issued to the remediating party or within its custody or control;
11. A summary of each previous and ongoing environmental investigation already documented in DWM's public records. Site-related reports within the custody or control of the remediating party and not in the DWM's public record to document prior work;
12. Proposed procedures to evaluate the risk of contaminant migration into structures via the vapor pathway and to wells, springs, surface water supply intakes and to sensitive environments if already known to be a concern;
13. Intended procedures for characterizing site geologic and hydrogeologic conditions and identifying the source(s) of contamination in each affected environmental medium, including plans for special assessments, such as a geophysical survey;
14. Intended field methods, locations, depths of, and justification for sample collection points for each medium sampled, including monitoring well locations and anticipated screened intervals;
15. Proposed field and laboratory procedures for quality assurance/quality control (QA/QC). PFAS sampling should be done carefully to prevent sample contamination and should always include the collection of blanks. The ITRC online document for PFAS sample collection is provided as a link at the front of this document;
16. Proposed analytical parameters and analytical methods for all samples (see **Appendix B**);
17. Equipment and personnel decontamination procedures, and investigation derived waste (IDW) management and disposal;
18. A description of measures that ensure the health and safety of nearby residential and business communities to demonstrate that they will not be adversely affected by activities related to the RI;
19. Signatures and seals from the appropriate professionals (e.g., LG or PE). A single document may require the signature and seal of more than one professional; and
20. Additional appropriate document certification statements or forms for all site-related documents submitted to the Branch See **Appendix A**); and
21. A schedule for completing site activities and submission of reports.

> The REC Program rules do not authorize an RSM to practice outside his/her area of professional expertise in any phase of work. If an RSM has relied on the advice of other professionals with relevant expertise, the document must be signed and sealed by the appropriate professionals: LG for hydrogeology and PE for engineering design.

5.1.2 Delineation of Extent of Contamination

Upon completion of the initial phase of the RI, the contaminants of concern for the site should generally be known. Subsequent phases of, and work plans for, the RI are generally designed to:

1. Delineate the lateral and vertical extent of contamination in each area of concern for all contaminated media (soil, groundwater, sediment, surface water, and vapor);
2. Identify potential exposure pathways and receptors that may currently be, or may become, exposed to the contamination;
3. Collect sufficient sampling data to support inclusion or elimination of chemicals at concentrations within naturally occurring or anthropogenic background levels, and to determine a cleanup-level; and
4. Characterize site conditions to address data gaps and refine the CSM so that a feasibility study can be conducted to support a proposed remedy. Appropriate document certification statements or forms (see **Appendix A**) should be included in all RI work plans.

The sampling and analysis procedures for delineating the extent of contamination should follow the specifications in **Appendix B**. The unrestricted-use remediation goals discussed in **Section 6.0** *must* be used as delineation endpoints for soil, groundwater, surface water and vapor during the RI. The DEQ Risk Calculator may also be used to calculate cumulative risk for residential/unrestricted use at perimeter soil sampling locations to satisfy delineation of soil contamination. However, at some sites, site-specific natural background concentrations (metals only) and anthropogenic background concentrations (PFAS, PAHs, PCB and/or Dioxins) or sample reporting limits (using the analytical methods specified in **Section B.8 in Appendix B**) may serve as delineation endpoints, provided that the laboratory's reporting limits are not elevated more than 10 times the laboratory's MDLs, and/or published average MDLs for the particular method/analyte.

Information contained in prior reports submitted to DEQ may be summarized or referenced. Any data or reports not already provided to DEQ should be attached. The following information should be included in subsequent RI work plans:

1. Items 12-21 from **Section 5.1.1**.
2. An inventory and map of all identified water supply wells, springs, and surface-water intakes used as sources of potable water within 1,500 feet of the contaminant perimeter as defined by the 02L standards or interim maximum allowable levels (IMACs) set by DEQ for groundwater, or if the extent of contamination is not yet defined, within 1,500 feet of the property boundary.

   As the RI and remedial action proceeds, groundwater conditions may change, so the potable water survey for a site should be updated approximately every five years, or more frequently depending on changes in plume extent and/or land use, to determine whether any threats to water supply wells or sensitive receptors exist. This information is required unless documentation is available to demonstrate that groundwater is not and will not become contaminated from site sources, or contaminant migration is stalled or retreating.

   Note: Contaminants such as 1,4-Dioxane and several short-chained PFAS are highly water soluble and tend to travel with minimal degradation in groundwater. Concentrations of these chemicals, time since the release, groundwater flow velocity, local topography, preferential groundwater flow pathways (such as geologic fractures and foliations or subsurface utilities) and likelihood of aerial deposition (e.g., previous presence of a smokestack or fume hood at facility)

should be considered when determining the distance from the property that may impact receptors.

3. A structural vapor intrusion evaluation of an occupied or potentially occupied building if that building is within 100 feet of volatile organic contamination in soil or groundwater. Refer to the *DWM Vapor Intrusion Guidance* document (link provided at the front of this document) for procedures. The DEQ Risk Calculator should be used to evaluate structural vapor intrusion risk at each phase of groundwater, soil gas, and indoor air data collection.
4. An evaluation of the source property and adjacent properties for the existence of environmentally sensitive areas listed in **Appendix C**. A visual evaluation of the source property and all adjacent properties within 1,500 feet of contamination should be conducted. In addition, the State and Federal agencies should be contacted to identify sensitive, protected, or recreational areas within 1,500 feet of contamination. Associated contact information is listed in **Appendix C**.

   The presence of any sensitive environments threatened by the site, including its migration, will require further review. *USEPA Region 4 Ecological Risk Assessment Supplemental Guidance (March 2018 Update)* contains screening levels for soil, sediment and surface water to determine whether an ecological risk assessment is warranted. These screening levels can be accessed using the link provided at the front of this document. The screening levels will help determine if any special sampling (such as aquatic toxicity testing) is necessary as part of an ecological risk assessment. Damage to these areas must be considered, as active remediation of a sensitive environment could do more harm to an ecosystem than leaving residual contamination in place. The Branch should be contacted for further instructions regarding full-scale ecological risk assessments and proposed mitigation measures.

Distance between the edge of contamination and known or potential receptors, including potable water supplies, structures within 100 feet of volatile contamination, surface waters, and sensitive ecological environments, should be reviewed periodically as the RI proceeds so that potential threats can be identified and the risk evaluated.

5.2 Remedial Investigation Reports

Following implementation of the RI Work Plan, the data should be compiled and documented in a RI report for submission to the Branch. RI reports should document the findings of the site investigation in sufficient detail to:

In the REC Program, RI reports must be completed within 3 years of the effective date of the AA and submitted to the Branch within 30 days of completion (i.e., certification of the work-phase completion form by the RSM).

1. Delineate the contamination in all media to unrestricted use levels;
2. Establish site-specific background levels;
3. Identify potential sensitive receptors;
4. Support the final cleanup-level determination; and
5. Assist with conducting a feasibility study of remedial alternatives.

Findings from special studies such as chemical fingerprinting, ecological evaluations, vapor intrusion studies, or geophysical surveys should be included. If a single investigative phase can complete contaminant delineation for a site, the report should state that it serves as a final RI report.

If the RI is complete and no cleanup levels have been exceeded for any of the media or cumulative risk for soil and vapor is acceptable for residential (unrestricted) use such that remedial action is not necessary, a combined RI and Remedial Action Completion Report could be submitted to the Branch. A NFA review must be requested in writing if work was conducted outside of an AA (**see Section 4.2**). These reports must be certified according to the document certification requirements in **Appendix A**.

RI reports should be organized in sections and, at a minimum, should include a summary of previous environmental investigations and the following information:

1. A narrative description of how the investigation was conducted, including a discussion of any variances from the approved work plan(s);
2. A description of groundwater monitoring well design and installation procedures (per 15 NCAC 02C Well Construction Standards), including drilling methods used, completed drilling logs, "as built" drawings of monitoring wells, well construction techniques and materials, geologic/boring logs, survey data, and copies of well installation permits obtained from DEQ's Division of Water Resources (DWR) for monitoring wells constructed on property not owned by the well owner;
3. Map(s), drawn to scale, showing each soil sample and monitoring well location in relation to known disposal areas or other sources of contamination. Monitoring well locations and top of casing elevations should be surveyed to an established benchmark and groundwater elevations to a known datum. Soil sample locations should be surveyed to a known benchmark or flagged with a secure marker until after the remedial action is completed;

   Note: As provided in G.S. 89C-2, it is unlawful for any person to practice land surveying in North Carolina, as defined in G.S. 89C, unless such person has been duly registered as a registered land surveyor.
4. A description of the field and laboratory QA/QC procedures followed during the RI (see **Sections B.5 and B.9 in Appendix B**). PFAS sampling protocol is provided in the links at the front of this guidance;
5. A description of procedures used to manage IDW (i.e., drill cuttings, purge water and decontamination water, etc.);
6. A summary of site geologic conditions, including a description of soil lithologies and vadose zone characteristics;
7. A description of site hydrogeologic conditions (if groundwater is, or may become, contaminated) including current uses of groundwater, notable aquifer characteristics, and preferential flow paths such as utilities. Also include the following:
   a. Tabulated well construction and groundwater elevation data; and

b. A water table elevation contour map and bedrock or other water-bearing unit potentiometric surface maps with groundwater and surface water flow patterns and discharge/recharge locations depicted;

8. Tabulated analytical results of the sampling data (including sampling dates and soil sampling depths) and copies of the laboratory reports with case narratives and QA/QC documentation;

   Note: Where a Gas Chromatograph/Mass Spectrometer (GC/MS) library search is conducted, a summary of the nature of any tentatively identified compounds (TICs) eliminated from further analyses and reporting should be provided in the report, including reasons for discounting the constituent as a site contaminant. Refer to **Section B.8.1 in Appendix B** for further information on evaluating TICs.

9. Where contaminants exceed cleanup levels for groundwater or surface water, or cumulative risk for residential use is exceeded for soil or sediment contaminants using the DEQ Risk Calculator, contaminant delineation maps for each primary contaminant of concern, including scale and sampling points with contaminant concentrations;

10. Cross sections depicting site features and sampling points with contaminant concentrations if contaminant concentrations exceed 02L standards in groundwater or risk is exceeded for residential use in soil at depths greater than five feet below ground surface;

11. A description of procedures and the results of any special assessments such as geophysical surveys, soil gas surveys, test pit excavations, or if volatile contaminants are present at the site, structural vapor intrusion evaluations;

12. Results of the water supply and sensitive environment receptor survey, unless provided in a previous document within the past five years;

13. Copies of field logs and notes, and color copies of site photographs, if collected, that provide documentation of the investigation;

14. The signature and seal of licensed professionals (e.g., LG or PE, as appropriate). A single document may require the signature and seal of more than one professional; and

15. Appropriate certification statements or forms (**Appendix A**).

6.0 Remediation Goals and Standards

The DWM provides both screening levels and State standards to assist with remedial action decisions. Preliminary remediation goals for **soil** and **vapor** are screening levels established in a manner consistent with CERCLA/SARA and are used to help identify areas, contaminants, and conditions that may warrant further investigation or site cleanup. They are conservative and generic and are calculated to be the average concentration of a chemical in an exposure area that will yield the specified target risk in an individual who is exposed at random within the exposure area.

The DEQ Risk Calculator was developed by DEQ in 2017 for calculating cumulative risk of site contaminants in each medium and is publicly available for download from the Risk Evaluation Resources page of the Risk-Based Remediation website. The companion DEQ Risk Calculator User Guide available alongside the calculator provides detailed instructions on its use.

Preliminary remediation goals are for screening and should not necessarily serve as final cleanup levels in all cases. Instead, they should guide the development of final remediation goals. Less conservative, final remediation goals or cleanup levels for soil and vapor can be based on cumulative risk of the site's contaminants using the DEQ Risk Calculator.

Groundwater and **surface** water do not have screening levels. Rather they have applicable State standards set by the Environmental Management Commission (EMC). The DWR can also establish IMACs for groundwater. In qualifying cases, an alternate, site-specific groundwater cleanup level may be approved by the Branch for restricted property use with property owner permission and according to the requirements set forth in NCGS 130A 310.65 through 310.77. There is no risk-based alternative for surface waters, so applicable 15A NCAC 02B standards must always be met for perennial and intermittent streams.

6.1 Soil Remediation Goals

The Branch provides preliminary soil remediation goals (PSRGs) as screening levels to help identify areas, contaminants, and conditions that may warrant further investigation. Methods to calculate final site-specific cleanup levels for soil that are protective of both human health and groundwater are described later in this section. **Soil must be remediated to levels that are both protective of human health and do not allow leaching of contaminants to groundwater.**

6.1.1 Preliminary Soil Remediation Goals (Screening Levels)

The PSRG table is provided under Guidance on the Branch's website. It is updated semiannually when USEPA updates their Regional Screening Levels (RSLs), so it should be consulted regularly since toxicity values may change or new chemicals may be added, particularly in the case of emerging compounds such as PFAS. If a chemical is reported at a site and is not listed on the PSRG table, contact the Branch. Often a DWM toxicologist can develop a screening level based on similar surrogate chemicals.

The PSRG Table includes screening levels that (1) are protective of human health through direct exposure to contaminated soils for both the residential and industrial/commercial scenarios, and (2) do not leach to groundwater and cause exceedance of the target groundwater concentration.

6.1.1.1 Human-Health-Based (Direct Contact) Preliminary Soil Remediation Goals

Human-health-Based PSRGs are provided on the PSRG Table for two land-use scenarios:

- The **residential** (unrestricted use) human health-based PSRGs are established for residential land use and are areas where both children and adults are expected to spend most of their time.

- The **industrial/commercial** (restricted use) human health-based PSRGs are for non-residential workers that routinely spend a significant part of their day on the property. Cleanup to industrial/commercial PSRGs will require a restriction barring residential land use on the property.

Note Always use the residential (unrestricted use) human health-based PSRGs as delineation endpoints.

6.1.1.2 Protection of Groundwater Preliminary Soil Remediation Goals

PSRGs are provided as a leachability screening level for the protection of groundwater. These values are based on a target groundwater concentration that meets the 02L standards or IMACs, Contaminants with levels in soil that exceed a Protection of Groundwater PSRG can be further evaluated for leachability using one of the methods below.

1. The 20x rule: If the soil contaminant concentrations (using totals analysis in mg/kg) for both metals and organics (totals analysis) are less than twenty times the corresponding groundwater remediation goals (in mg/L), then the leachability criterion is considered met. The 20 times multiplier represents the dilution factor used in EPA's leachability equation (shown in the PSRG Table notes) and the analytical laboratory's extraction methods.

   Example: 1,4-Dioxane's 02L standard is 3 ug/L, so the leachable threshold is calculated to be 0.003 mg/L x 20 = 0.06 mg/kg, which is slightly less conservative than the protection of groundwater PSRG of 0.012 mg/kg.

2. Age of release: If groundwater data from beneath the soil contamination show that the contaminants do not exceed (1) the target groundwater concentration, and (2) the release occurred fifteen or more years ago, the Branch considers the protection of groundwater criterium to have been met.

3. Laboratory analysis of sample leachability: Collect and analyze soil samples in the areas of highest contaminant concentration using the lab's Synthetic Precipitation Leaching Procedure (SPLP), Toxicity Characterization Leaching Procedure (TCLP), or the USEPA's Leaching Environmental Assessment Framework (LEAF) methods. If contaminant concentrations in the soil leachate exceed their respective target groundwater remediation goals, those soils require remediation.

   Note: TCLP is the required test method for determining if a RCRA solid waste is a RCRA toxicity characteristic hazardous waste. Therefore, it is a procedure that uses organic acids to simulate typical landfill conditions. For this reason, SPLP may be a more appropriate procedure because it is more representative of leaching under natural rainfall conditions.

   A site-specific soil leaching goal can be determined by plotting sample pairs of total soil and leachate concentrations (from one of the lab leachate methods) and finding the total soil concentration that corresponds to a leachate concentration that meets the target groundwater concentration. Several soil samples need to be collected from various locations across the area of concern for correlation, not just the source area with the highest concentrations.

4. Using geotechnical data: If site-specific aquifer data (e.g., porosity, bulk density, and organic carbon content) are available, they can be used in place of the default values in Equations 1 and 2 in the PSRG table notes or in the DEQ Risk Calculator. Only the parameters noted should be modified and only site-specific data should be used. All calculations and data must be provided if site-specific Protection of Groundwater PSRGs are developed.

6.1.1.3 Using "Average" Soil Concentrations for Uniform Releases over Large Areas

Average contaminant concentrations in soil for sites that result from a generally uniform release of contaminants (e.g., former waste lagoons, spray fields, over-application to orchards, etc.) may be used to compare with the health based PSRGs for both unrestricted and restricted land use. Averaging cannot be used to demonstrate that soil concentrations are protective of groundwater. All of the following conditions apply to the use of such averaging in this scenario:

- Only sample points within 1/4-acre sectors may be averaged for comparison to unrestricted-use levels. For restricted industrial use (with LURs approved as part of the RAP), averaging over larger areas can be performed if the access and use across the area is consistent. Data from remote areas and areas of less frequent access may not be included in the industrial restricted-use averaging.
- No single sample point may exceed ten times the site-specific adjusted cleanup level for all contaminants except lead. For lead, no single sample point used in an average may exceed 500 ppm for unrestricted use and no more than three times the site-specific cleanup level for restricted use.
- The quarter-acre zone may be a circle or a square or triangle of generally equal sides. One dimension of the zone's perimeter may not be disproportionately longer than another. An exception would be a greenway corridor.
- Samples, whether they are composite or discrete, must generally be evenly spaced over the zone of averaging.
- Only samples of the same vertical horizon may be averaged (0-6 inches for surface samples and no more than 5-foot vertical spread for subsurface samples).
- Only actual sample data may be used for all points included in the average and not published averages for background concentrations.
- The laboratory PQL must be used for points where concentrations are at or below laboratory reporting limits. Sample data should not have elevated reporting limits.
- For characterizing soil concentrations over a 1/4-acre area, a sampling grid with generally uniform grid node spacing should be established. The average concentration for each compound within a 1/4-acre area is presumed to represent the entire 1/4-acre area. If the average concentration for any compound exceeds unrestricted-use remedial goals, the 1/4-acre area would require active cleanup or LURs. For very large areas, an alternative is to collect samples in multiple 1/4-acre sectors within the overall contaminated area that represents the range of environmental conditions (i.e., various geologic and geographic conditions such as slope vs. valley, wetter vs. drier, etc.). Grids with a uniform node

spacing should be established across these representative areas. The highest 1/4-acre average from all the areas tested would be presumed to reflect the overall area. This approach requires the area to be consistent in use and accessibility.

For unique circumstances, contact the Branch for further guidance.

6.1.2 Final Soil Remediation Goals (Cleanup Levels)

Conservative screening levels may be used as final soil remediation goals, but calculation of final, site-specific remediation goals based on the cumulative risk of all contaminants in soil is more appropriate (and most often cost effective) for making remedial action decisions. In all cases, soil contamination must be remediated to (1) levels that are protective of human health through direct contact and (2) levels that protect groundwater.

It is Division policy to base mitigation decisions on cumulative risk of all site contaminants rather than individual screening levels.

Final, site-specific soil remediation goals can be calculated using the DEQ Risk Calculator for both unrestricted (residential) property use and several restricted property use scenarios. In general, site data are entered into the risk calculator and the risk is calculated for the selected receptors: resident, non-residential worker, construction worker, recreator and trespasser. The risk calculator output can be used to (1) determine if the risk from site contaminants in soil is acceptable/unacceptable, (2) identify the contaminants that are driving the risk, (3) iterate final cleanup levels to meet acceptable risk, and (4) identify areas requiring excavation or active remediation.

6.1.2.1 Soil Cleanup Levels for Unrestricted Property Use

The residential (unrestricted) use scenario has no limit on property use and direct exposure to contaminated soils through dermal contact, ingestion and inhalation meet acceptable risk for a residence with children. However, the following scenarios may need to be considered when determining final soil cleanup levels for unrestricted use:

1. Could the property become agricultural (crops, livestock, etc.), with possible uptake of contaminants by plants and livestock?
2. Could surface waters, wetlands, or other sensitive ecological receptors be affected by contaminated soil?
3. Can volatile soil contamination cause a structural vapor intrusion risk to future structures?

6.1.2.2 Soil Cleanup Levels for Restricted Property Use

Restricted property-use scenarios may include any non-residential land-use: commercial/industrial, park use or open space and/or restricted uses in specific marked areas of the property. In these scenarios, the risk is calculated for a non-residential worker, construction worker, recreator, and/or trespasser. Land-use scenarios other than residential (unrestricted) will require Branch-approved land-use restrictions (LURs) as part of a soil RAP. Engineered controls,

such as permanent barriers, supported by LURs may allow higher concentrations to remain in place if contaminants do not leach to groundwater above the target groundwater concentration.

6.2 Sediment

For intermittent streams, the same procedures used to establish remedial goals for soil should be followed (see **Section 6.1**). Remediation goals for sediment in intermittent and perennial streams and other surface waters must meet the following:

1. The residential health-based soil remediation goals (or the upstream "background" concentrations if higher); and
2. Levels that ensure contaminated sediment will not cause exceedance of the remediation goals for groundwater or surface water.

If sediment could support benthic or other organisms, maximum sediment contaminant concentrations must meet levels that ensure protection of aquatic receptors. Sediment results can be compared to the ecological sediment screening levels provided in the *USEPA Region 4 Eco Risk Assessment Supplemental Guidance - March 2018 Update* document in the link provided at the front of this document. The laboratory must achieve sample quantitation limits less than or equal to the USEPA ecological sediment screening levels. If this is not possible, it needs to be stated in the laboratory report's case narrative that the quantitation limits are the lowest that can be achieved using USEPA-approved methods

If site ecological screening levels for sediment are exceeded, the remediating party should contact the Branch with a request for the Branch to determine the need for further ecological evaluation for determining cleanup levels. The request should provide the following information:

1. A statement that the contaminated surface water body is perennial or intermittent;
2. An estimate of the width and depth of the contaminated surface water body.
3. A topographic map with roads and surface water features clearly identified;
4. A map drawn to scale with locations of each sampling point;
5. A summary table containing maximum contaminant concentrations, upstream contaminant concentrations, USEPA aquatic screening levels and sample quantitation limits. Contaminant concentrations that exceed or have no screening levels should be clearly identified and highlighted;
6. A discussion of potential mobility of contaminated sediment and contaminant leachability to surface water or groundwater;
7. The names and classifications of all downstream surface water bodies *if* they could potentially be or become contaminated;
8. The identity of adjacent or downstream wetlands that could be affected; and

6.3 Groundwater

State-developed groundwater quality standards are the maximum allowable concentrations of contaminants in groundwater which may be tolerated without creating a threat to human health or which would otherwise render the groundwater unsuitable for use as a drinking water source.

With property-owner permission and Branch approval, less conservative, risk-based, site-specific groundwater cleanup levels may be calculated in certain cases. Cleanup levels other than State standards require a groundwater-use restriction on currently contaminated parcels and parcels that are predicted to become contaminated in the future. Groundwater cleanup levels are further described below.

6.3.1 State Groundwater Standards

The DWR's Classifications and Standards Branch is responsible for the development and maintenance of North Carolina's permanent and interim standards established under 15A NCAC 02L .0202. Interim standards known as IMACS are established by DWR upon request when a groundwater standard has not been established under the rule. Summary tables of the 02L standards and IMACs for groundwater can be found on DWR's website that can be accessed using the link provided at the front of this document.

6.3.1.1 PFAS Interim Maximum Allowable Concentrations

On October 15, 2024, the DWR established IMACs for eight PFAS in groundwater. They are provided here for reference since PFAS regulation is quickly developing. Units are in parts per trillion (ppt) or nanograms per liter (ng/L) when referring to PFAS in groundwater.

PFAS	IMAC	PQL*
Perfluorooctanoic acid (PFOA)	0.001 ppt	4 ppt
Perfluorooctanoic acid (PFOS)	0.7 ppt	4 ppt
Perfluorobutane sulfonic acid (PFBS)	2,000 ppt	NA
Perfluorononanoic acid (PFNA)	10 ppt	NA
Perfluorobutanoic acid (PFBA)	7,000 ppt	NA
Perfluorohexanoic acid (PFHxA)	4,000 ppt	NA
Perfluorohexanesulfonic acid (PFHxS)	10 ppt	NA
Hexafluoropropylene oxide dimer acid (HFPO-DA) also known as GenX Chemicals	10 ppt	NA

*PQL = A measurement above the lab's practical quantitation limit as reported in EPA Test Method 1633 would constitute an exceedance of the proposed IMAC for that chemical.

NA = not applicable, the lab PQL should be less than the IMAC value.

Even though IMACs currently exist for only eight PFAS, measuring for the full suite of analytes using USEPA Method 1633 for soil and/or groundwater is recommended to

(1) identify the specific PFAS present,

(2) acquire a more comprehensive set of data for discerning unique PFAS releases and their sources, and

(3) prepare for future regulatory standards for other PFAS.

The DWR Director will make a recommendation to the EMC as to whether the IMACs should either be replaced by a new groundwater standard or expired. For those PFAS with no permanent or interim standard, the PQL serves as the required cleanup level.

6.3.2 USEPA Maximum Contaminant Levels

USEPA sets legal limits on contaminants in drinking water known as maximum contaminant levels (MCLs). The legal limit for a contaminant reflects the level that protects human health and that water systems can achieve using the best available technology. The MCL is applied at any private drinking water well or public water system well that may be impacted. The MCL will also be applied as a cleanup level in rare cases where no 02L standard exists. MCLs for PFAS in potable water supplies are provided below.

6.2.2.1 PFAS Maximum Contaminant Levels

In April 2024, USEPA finalized MCLs for the following six PFAS in public drinking water supplies. The Branch also applies MCLs to private water supplies.

PFAS	MCL	MRL*
PFOA	4.0 ppt	4 ppt
PFOS	4.0 ppt	4 ppt
PFNA	10 ppt	4 ppt
PFHxS	10 ppt	3 ppt
HFPO-DA (GenX Chemicals)	10 ppt	5 ppt

*MRL = USEPA recommended laboratory minimum reporting limit (MRL) for reporting under Unregulated Contaminant Monitoring Rule 5 to ensure that labs are able to measure these PFAS at sufficiently low levels.

PFBS is included in the Hazard Index (HI) calculation for a mixture. The MCL is considered met when the HI is calculated to be less than 1.0.

$$HI\ MCL = \left(\frac{[HFPO\text{-}DA_{water}]}{[10\ ppt]}\right) + \left(\frac{[PFBS_{water}]}{[2000\ ppt]}\right) + \left(\frac{[PFNA_{water}]}{[10\ ppt]}\right) + \left(\frac{[PFHxS_{water}]}{[10\ ppt]}\right) = 1$$

The USEPA is currently conducting toxicity assessments for other legacy PFAS and has reserved the option to develop and adopt enforceable MCLs for them. USEPA also plans to fulfill additional health protective goals as outlined in the *USEPA PFAS Strategic Roadmap* that can be found on the USEPA website and the link at the front of this document.

6.3.3 Site-Specific, Risk-Based Groundwater Cleanup Levels for Restricted Property Use

In 2015, legislation was passed to allow calculation of alternate site-specific, risk-based groundwater cleanup levels as part of a Branch-approved RAP. NCGS 130A-310.65 through 310.77 specifies the fees and procedures for pursuing a risk-based remedy for groundwater. Cleanup to less conservative, site-specific, risk-based levels requires sufficient groundwater monitoring data to demonstrate stable or predictable plume conditions and a groundwater-use restriction on the property with property-owner permission.

Visit the DEQ Risk-Based Remediation website using the link provided at the front of this document for the *Administrative Procedures for Risk-Based Environmental Remediation of Sites*, risk evaluation resources including the DEQ Risk Calculator and companion *DEQ Risk Calculator User Guide*, and DEQ's current *Technical Guidance for Risk-Based Environmental Remediation of Sites* for preparing a risk-based RAP for groundwater.

6.4 Indoor Air

Always access the most current version of vapor intrusion screening tables using the DEQ Risk Calculator.

Vapor Intrusion Screening Levels (VISLs) for groundwater, soil gas and indoor air are updated semiannually when USEPA releases their RSLs. In 2020, VISLs became **accessible only from the DEQ Risk Calculator** because of the importance of using cumulative risk as the basis for indoor air mitigation decisions. Initiating mitigation measures based on a screening level exceedance alone can be unnecessary, costly and/or alarming to the public if cumulative risk is actually acceptable. Confirmation sampling and routine monitoring will be likely be necessary in these cases in lieu of immediate mitigation. On the other hand, if there are more than five contaminants with non-cancerous health effects reported in indoor air at levels less than their individual screening levels, their combined risk could be unacceptable and require mitigation.

Contact the Branch within 24 hours of receiving the analytical data indicating environmental contaminants are detected indoors, even if cumulative risk is determined to be acceptable.

The DEQ Risk Calculator can calculate cumulative risk to indoor air using groundwater, soil gas or indoor air data as the vapor intrusion evaluation progresses. Where a property is vacant or no structures exist to evaluate indoor air, soil gas data will be used to determine whether indoor air must be evaluated in future structures.

Note: The Federal Occupational Safety and Health Administration (OSHA) sets enforceable permissible exposure limits to protect workers against the health effects of exposure to hazardous substances. However, many of these limits are outdated and there are many substances for which OSHA does not have workplace exposure limits. For these reasons,

indoor air mitigation decisions are most often based on risk using the DEQ Risk Calculator.

6.4.1 TCE Indoor Air Immediate Action Levels

The DWM implemented Trichloroethylene (TCE) vapor intrusion indoor air action levels in 2019. The TCE-sensitive population at risk is women of child-bearing age (defined as age 15 to 50 years), and the action level for each scenario is as follows:

- Residential setting action level = **2.1 micrograms per cubic meter of air (µg/m^3)**.
- Non-residential setting action level = **8.8 µg/m^3**.

Based upon information from the USEPA and other scientific studies, the DWM has determined that when the inhalation action level concentration has been exceeded and the TCE-sensitive population may be exposed, immediate actions must be taken to report the concentrations to the DWM, notify the exposed population, and take response actions to reduce the exposure to below the action level concentration as quickly as possible (within 72-hours or less for women in their first trimester of pregnancy).

If unacceptable TCE levels are reported in indoor air, procedures for notifying the Branch, implementing mitigation response actions, and communicating with building occupants must be followed. Fact sheets are available to communicate information to the public for both the residential and workplace scenarios. More information on procedures and resources can be accessed using the link to the *DWM Vapor Intrusion Guidance* webpage provided at the front of this document.

6.4.2 Indoor Air Mitigation Levels for Restricted Property Use

Indoor air levels that do not meet acceptable risk for the property's use will require active mitigation with engineered controls. If the building is occupied, temporary air purification units should be installed immediately with concurrent and ongoing monitoring until a permanent vapor intrusion mitigation system (VIMS) can be installed and tested for effectiveness. Plans for a permanent system should be provided in a sitewide or interim RAP and include the recordation of Branch-approved LURs that specify the monitoring and maintenance requirements of the VIMS.

6.5 Surface Water

IHSB is responsible for regulating hazardous substances that migrate from a contaminated site to surface water and cause an exceedance of a surface water standard through a non-permitted discharge. Surface waters include intermittent and perennial streams that flow continuously or seasonally; lakes, reservoirs and ponds; and wetlands that are adjacent to or within a certain distance of surface waters. If contaminated surface runoff or groundwater discharge is suspected, surface water samples should be collected, analyzed for the site contaminants and their daughter products, and compared with the results of samples collected from upstream. If upstream (background) sample results are lower than the samples collected from the discharge location, then applicable surface water standards developed by the DWR apply. The standards can be accessed on the 02B standards link provided at the front of this document. Contaminant levels

that are higher than upstream background levels in surface waters must meet the lower of the following:

- 15A NCAC 02B Water Quality Standards for Surface Waters (02B standards),
- USEPA National Recommended Water Quality Criteria for Aquatic Life & Human Health, or
- North Carolina In-Stream Target Values for Surface Waters.

If surface water contamination is causing sediment to exceed cleanup criteria, remediation of surface water will be necessary to eliminate this effect. In some cases, the number of surface water samples, frequency of sampling, and magnitude of contaminant concentrations detected will be used to determine whether a 02B standard is violated rather than considering just one sampling event. There are no alternate, risk-based cleanup levels allowed for surface water.

6.6 Background Levels

Naturally occurring or anthropogenic substances can be present in the environment and not associated with site conditions, actions, or activities. In North Carolina, several naturally occurring metals are prevalent in soil, sediment, groundwater and surface water. In addition, anthropogenic (human-made) background contaminants can include PFAS, dioxins, polycyclic aromatic hydrocarbons (PAHs), and/or polychlorinated biphenyls (PCBs). Indoor air may have non-site-related contaminants detected indoors or in outdoor ambient air, so establishing background conditions is important for all media.

Parties are not required to remediate contaminants that are less than naturally occurring or anthropogenic background concentrations, even if the background levels are higher than State or Federal standards. However, the Branch does not allow comparison with published regional background values alone. Sufficient sampling near the site should take place to quantify these potential contributions to the site in a legally defensible manner. Statistics play a major role in establishing background concentration levels, and methods vary widely in their degree of complexity, but in all cases, sample concentrations that are obvious outliers should not be used to establish background concentrations.

- If statistically significant background data sets are not available for naturally occurring inorganics, the *USEPA Region IV January 2014 Draft Final Human Health Risk Assessment Supplemental Guidance* (provided in a link at the front of this document) has recommended that two times the average site-specific background concentration can be used to eliminate them as contaminants.
- If there are at least 7 data points (as recommended in the *USEPA ProUCL Guidance Document (June 2008)*, the 95% background threshold value (BTV) calculation is preferred by the Branch for determining a background concentration.

In vapor-intrusion investigations, identifying background contamination is especially complicated, for several reasons:

- Some background contaminants are present in most structures;
- Background concentrations can vary by orders of magnitude over the course of a day; and

- Some commercial/industrial facilities may have Permissible Exposure Limits under OSHA that may be much higher than vapor-intrusion limits, making indoor sources potentially huge in occupational settings.

For these reasons, the list of analytes during indoor sampling should be restricted to those measured in soil gas, including their daughter products. Care should be taken to rule out indoor air contaminants that may not be attributed to the site. An occupant survey and site walkover should identify known and potential indoor sources. Lab, container and ambient air contaminants should be ruled out. Subslab soil gas samples should be collected concurrently with indoor air samples to identify inconsistent attenuation ratios.

When determining background levels for any media, the methodology used to eliminate background compounds or determine cleanup levels for site contaminants that are also present as background should be well-documented in reports submitted to the Branch. The risk of the background chemicals contributing to the site should be included in the initial risk calculation, and an unacceptable risk due to the contribution from background levels should be reported to the Branch for awareness.

6.7 Practical Quantitation Limits

The laboratory PQL is a scientific standard pursuant to G.S. 150B-2(8a)(h). Substances which are not naturally occurring and for which no standard is specified shall not be permitted in concentrations at or above the PQL. For contaminants with an existing standard that is less than the laboratory's PQL, the PQL is the State standard per 15A NCAC 02L .0202(b1) when the analytical methods specified in **Section B.8 in Appendix B** are used. In these cases, the laboratory's PQL cannot be elevated more than 10 times the Method Detection Limit (MDL) or published MDL for a contaminant.

7.0 Remedial Action

Once the RI has been completed, a RAP can be prepared and submitted to the Branch for addressing contamination that exceeds State standards or acceptable risk.

Note: Remedial actions that involve the emission or discharge of hazardous substances to the atmosphere or surface water should be conducted in a manner that provides for the protection of human health and the environment, and complies with any applicable permits, approvals, laws or other rules or regulations.

7.1 Remedial Action Plan

The RAP should inlcude the following information:

1. A discussion of the RI results and CSM, including media contaminated, contaminants of concern, and the areal and vertical extent of contamination;
2. A brief statement of objectives for the remedial action;

3. An evaluation of available remedial alternatives using the following feasibility study criteria:
    a. protection of human health and the environment, including attainment of cleanup levels;
    b. compliance with applicable Federal, State and local regulations;
    c. long-term effectiveness and permanence;
    d. reduction of toxicity, mobility and volume;
    e. short-term effectiveness, i.e., effectiveness at minimizing the impact of the site remedial action on the environment and the local community;
    f. implementability, i.e., technical and logistical feasibility, including an estimate of time required for completion;
    g. cost; and
    h. community acceptance.

> If the remedial action was already in progress prior to an REC Administrative Agreement and continuation of the same remedy is approved in writing by the Branch, any information previously prepared and submitted can instead be summarized and referenced in the RAP.

4. A detailed description and conceptual design of the proposed remedy, for each contaminated medium;
5. A demonstration that the proposed remedy is supported by the remedial alternative feasibility study conducted pursuant to item 3 above;
6. A description of the activities necessary to implement the proposed method(s) of remedial action in compliance with applicable laws and regulations and in a manner, such that cleanup standards are met. These activities include, but are not limited to, well installation and abandonment, sampling, run-on/run-off control, discharge of treated waste streams, and management of investigation and remedial action derived wastes;
7. A description of any proposed treatability studies, interim steps, and additional site characterization needed to support the final design;
8. A description of procedures for final design, construction, operation and maintenance, and system monitoring;
9. A sampling plan for monitoring and evaluating a groundwater remedy's performance and any changes to the extent of the contaminant and associated risk to receptors and sensitive environments;
10. A description of the criteria used for remedial action completion, including procedures for post-remediation confirmation sampling. Branch guidance on confirmation sampling and analysis is provided in **Section B.8 of Appendix B**;

11. A health and safety plan that assures that the health and safety of nearby residential and business communities (e.g., erecting physical barriers and/or signs, controlling foot and vehicular traffic, suppressing dust, etc.) potentially affected by activities related to the remedial action. The plan should conform to all local, State, and Federal regulations for health and safety;
12. Equipment and personnel decontamination procedures;

> Branch concurrence is required for any remedy proposed in the REC Program that would:
> 1) be conducted entirely on site and for which a permit waiver is desired under G.S. 130A-310.3(e);
> (2) include institutional controls for restricted use of contaminated areas or media; or
> (3) exceed the cost set forth in G.S. 130A-310.9(a)

13. A schedule for treatability studies, interim steps, and completion of the remedial design, remedial action construction and implementation and periodic sampling and reporting;
14. A description of the land-use restrictions if institutional controls serve as, or are part of, the remedy.
15. Professional work must be signed and sealed by the appropriate professionals (e.g., LG and/or PE). A single document may require the signature and seal of more than one professional; and
16. Appropriate certification statements or forms (see **Appendix A**).

7.1.1 Public Notification

> Branch staff prepare the public notice information for work done under a State-lead AA, and the REC prepares it for work conducted in the REC Program.

Prior to approval, the RAP will be made available for public comment for thirty days. A mailing list should be compiled, consisting of the owner of the site property, owners of property that adjoin the site, parties who have expressed interest in the site, the county health director and the local government authority, i.e., city manager. The public notice is mailed via certified mail to document proof of receipt. The Branch may request that the remediating party provide additional copies of the RAP for distribution to the local health director, register of deeds office, and the public library closest to the site as part of the public notice.

Any substantive comments from the public must be evaluated, and the RAP revised as necessary before the RAP is approved. If the Branch determines that there is significant public interest in a site, the Branch may hold a public meeting or public hearing. A RAP should not be implemented until the public notification process is completed, comments are addressed, and approval is received in writing from the Branch or by Branch receipt of the REC's certified Work-Phase Completion form.

7.2 Remedial Action Preconstruction Reports

A Preconstruction Report is needed for remedies involving capping, excavation, off-site disposal, construction, equipment installation, soil borings and/or well installation, *ex-* or *in-situ* treatments, or other active actions. These reports should include the following elements:

> To streamline the REC Program reporting requirements, contents of the Remedial Action Preconstruction and Construction Completion Reports are now included in the RAP or the first remedial action progress report, respectively..

1. The results of all treatability studies and additional site characterization work completed since the RI;
2. Final engineering design report, including a narrative description of process design, final plans and specifications, and an updated project schedule;
3. Copies of final registrations, permits and approvals; and
4. Appropriate certification statements or forms (see **Appendix A**).

7.3 Remedial Action Construction Completion Reports

If activities are described in a Preconstruction Report, a remedial action Construction Completion Report will be needed- once they are completed. The report should describe the final design and include the following:

1. "As-built" plans and specifications;
2. A summary of major variances from the final design plans;
3. A summary of any problems encountered or modifications during construction;
4. Disposal facility approvals, and disposal manifests for an excavation/offsite disposal remedy; and
5. Appropriate certification statements or forms (see **Appendix A**).

7.4 Remedial Action Progress Reports

Remedial Action Progress Reports are necessary for active remedial actions greater than three months in duration. Groundwater Remedial Action Progress Reports should initially be prepared and submitted to the Branch quarterly for the first year (four quarters) and may be prepared on an annual basis thereafter. Remedial Action Progress Reports should contain at least the following:

1. A summary of operation and maintenance activities, observations and a discussion of major problems encountered;
2. A map, drawn to scale, showing monitoring and/or sampling locations;
3. Performance evaluation results (i.e., tabulated and graphical presentations of monitoring data and a comparison of remedial action performance to design goals);
4. Full site monitoring history to present contaminant trends over time and to demonstrate the remedy's effectiveness;

5. A description of the field and laboratory QA/QC procedures followed during any sampling and analysis;
6. Copies of the complete laboratory reports with a case narrative and QA/QC documentation;
7. Appropriate certification statements or forms (see **Appendix A**).

7.5 Remedial Action Completion Report (Final Progress Report)

The Remedial Action Completion Report (final progress report) should include the information required under **Section 7.4**, above, and the following:

1. A summary of remedial action performance and effectiveness in meeting design goals, based on performance monitoring data and progress reporting to date;
2. A discussion of criteria for remedial action completion, and a demonstration, supported by confirmatory sampling data, that the criteria have been met;
3. Electronic copies of the institutional controls (Declaration of Perpetual Land Use Restriction document and/or Notice Plat) if they were part of the remedy showing proof of recordation at the Register of Deeds office.
3. Proof that each monitoring well has been properly abandoned, if abandonment is approved in writing by Branch staff.
4. Written request for a NFA letter if site closure is desired.
5. Appropriate certification statements or forms (see **Appendix A**).

8.0 No Further Action Determinations

After satisfactorily completing a voluntary remedial action, work required under the AA is complete, and the AA is terminated. The site will be assigned NFA status in the Inactive Hazardous Sites inventory. This change of inventory status does not preclude any future State action if new evidence of contamination is discovered later. In accordance with NCGS 130A-310.7(c), any party wishing to receive a written NFA determination from the Branch must provide the request in writing.

Remediating parties that have completed an independent cleanup that meets unrestricted use remedial goals can also request a NFA review in writing. In these cases, a certified *Statement of Attainment of Cleanup Levels* form and non-refundable fee must be received by the Branch to initiate the review. The fee schedule is generally based on the duration of remedial action, extent of contamination, and the type of remedial action completed. The instructions, form and fee schedule can be found on the Branch's website.

Following receipt of the NFA request, the Branch may request proper abandonment of existing monitoring wells per 15 NCAC 02C. If monitoring well abandonment is requested by the remediating party ahead of a NFA request, it must be approved by the Branch in writing. Once the Branch receives the documentation demonstrating the wells were properly abandoned, the NFA letter will be issued to the remediating party.

Owners of properties with LURs will be required to submit to the Branch annual inspection certifications affirming that the institutional controls remain recorded at the Register of Deeds office and activities and engineered controls (if applicable) at the property comply with the LURs. Current and future property owners, operators and other responsible parties are required under NCGS 130A-310.3(f) to enforce the LURs and are expected to act immediately upon discovery of a LUR violation. Failure to do so could cause an automatic revocation of Branch concurrence of the remedial action and the site's NFA status.

Appendix A: Document Certification Requirements

Any work that would constitute the "*practice of engineering*" per NCGS 89C, or "*public practice of geology*" per NCGS 89E, shall be performed under the responsible charge of a professional engineer, or geologist, in good standing with the respective licensing board, that represents a firm or entity also registered in the State of North Carolina, to conduct such work.

Per 15A NCAC 2L .0103(e), site assessment, interpretation of geologic conditions, preparation of corrective action plans, or any work requiring detailed technical knowledge of site conditions, shall be performed by persons, firms, or professional corporations who are licensed to offer geological or engineering services. Work which involves the design of remedial systems or specialized construction techniques shall be performed by people, firms, or professional corporations who are licensed to offer engineering services.

In addition to the professional seals on documents, reports summarizing site-related remedial actions must be certified by the person overseeing the work to assure the integrity of the work. The specific certification requirements for work conducted in the Branch are outlined in Tables A-1 and A-2 below.

REC Program

Unique REC Program certifications are specified in rule 15A NCAC 13C .0306(b). The RSM's document certification indicates that the document meets the requirements of the statute and the REC Program Rules. All certifications must also contain the notarized signature of the appropriate representative responsible for the remedial activities.

The RSM must include certified work-phase completion forms in the report that summarize the following work phases:

- Completion of the RI
- RAP approval (following a 30-day public comment period). The work-phase completion form may be submitted separately in this case.
- Initiation of groundwater remedial action
- Completion of all non-groundwater remedial actions
- Completion of all remedial action activities

REC Certification Forms

REC work plans and reports must include notarized document certification (DC) forms from the remediating party and the RSM.

The specific certification forms cannot be reproduced in any way.

Separate REC work phase completion (WPC) forms must be used to certify the completion of work phases in accordance with .0306(b)(5) and (b)(6).

The signatures must be properly notarized using only the notary text shown on the forms.

The remediating party must sign and have notarized their document content certification **prior** to the RSM's certification.

Table A-1. Document Certification Statements and Forms.

Documents and Other Submissions	REC Document Certification Form	REC Work-Phase Completion Form*	Non-REC Document Certification Statements
Annual Progress Update Reports	DC-I and DC-II		The following statement individually signed and notarized by the remediating party and the consultant: "I certify that, to the best of my knowledge, after thorough investigation, the information contained in or accompanying this certification is true, accurate, and complete."
Remedial Investigation Work Plan	DC-I and DC-II		
Remedial Investigation Report	DC-I and DC-II	WPC-II	
Remedial Action Plan	DC-I and DC-II	WPC-III	
Groundwater Remedial Action Initiation	DC-I and DC-II	WPC-V	
Progress Monitoring Reports	DC-I and DC-II		
Remedial Action Completion Report	DC-I and DC-II	WPC-VI, WPC-VII, or WPC-VIII	
Project Schedules, Data Summaries, Interpretations, Calculations	DC-I and DC-II		Not applicable

* WPC-I and WPC-IV are no longer used according to the re-adopted REC rules effective July 1, 2020.

Table A-2. REC Program Work-Phase Completion (WPC) Form*

WPC Form	Title
II	Remedial Investigation Completion Certification
III	Proposed Remedial Action Plan Completion Certification
V	Groundwater Remedial Action Initiation
VI	Remedial Action Completion Certification
VII	Remedial Action Completion Certification "for Remedy with Land Use Restrictions"
VIII	Combined Remedial Investigation & Remedial Action Completion Certification "for No Action Remedy"

* WPC-I and WPC-IV are no longer used according to the re-adopted REC rules effective July 1, 2020.

Note: Phases of work are approved by the REC (and, therefore, the Branch) when the WPC forms are signed and received by the Branch.

Appendix B: Sampling and Analyses

Environmental sample collection and analyses should only be performed by persons who are qualified by education, training, and experience and under the supervision of a licensed professional. Procedures and methodologies employed for the collection and analysis of soil, sediment, water, vapor, air, and waste samples should follow the methods published by the United States Environmental Protection Agency (USEPA), the American Society for Testing and Materials (ASTM), the American Public Health Association (APHA), the National Institute for Occupational Safety and Health (NIOSH), the American Water Works Association (AWWA), or other organizations with expertise in the development of standardized analytical testing methods.

Note: Due to the extensive use of PFAS and their presence at trace levels in most environmental media, aspects of sampling and analysis require a unique protocol and high level of care to avoid cross-contamination with everyday packaging, body lotions, and biasing sampling equipment. Please follow the links provided at the front of this document for PFAS sampling protocols.

Known or suspected spills and disposal areas must be identified by researching waste management records, vintage maps, aerial photographs; and other information and by conducting employee interviews. All areas known, suspected or having been contaminated by hazardous substances must be investigated. Areas known or suspected of being contaminated are those areas where there is some evidence (such as, but not limited to, allegations or indications of spills, visual observations, field instrument readings, laboratory data, and chemical odor) of a release of hazardous substances or of materials that contain or may contain hazardous substances. The necessary sampling strategy depends on whether there is visible evidence of contamination.

B.1 Soil Sample Collection

Soil sampling methodologies shall be in accordance with USEPA Region IV *Quality System and Technical Procedures for LSASD Field Branches* and these Guidelines (link provided at the front of this document.

B.1.1 Phase I Sampling to Identify Contaminants

The purpose of the Phase I soil investigation is to identify releases of hazardous substances to site soils, to characterize the chemical nature of such releases, and to collect sufficient sampling data to establish remediation goals.

Sampling and boring locations should be documented using properly calibrated GPS equipment (in decimal degrees to 5 decimal places) or surveyed to a known benchmark and, to the extent possible, flagged with a secure marker until after the remedial action is completed.

B.1.1.1 Visible Evidence of Contamination

At least one grab soil sample should be collected centrally from the most visibly contaminated location and horizon in each area of hazardous substance release or possible release.

B.1.1.2 No Visible Evidence of Contamination

Surface Release

1. If no visible evidence exists in an area of a suspected *surface release* of contaminants, sampling should be conducted by first establishing a grid with grid line intersections (nodes) spaced no farther than 50 feet apart.

   Samples collected for all analyses except volatile organic compounds (VOCs) should be collected from the ground surface to a depth of 6 inches below ground surface (bgs) at each grid node. Compositing to reduce the total number of samples for non-VOC analyses may be conducted for qualitative purposes as follows:

   < 1 acre: No more than four adjacent grid node samples spaced no more than 50 feet apart may be composited.

   > 1 acre: A greater number of adjacent grid node samples may be composited, but a minimum of two composite samples per acre (minimum of five samples total) should be submitted for laboratory analysis.

   Split samples may be collected at each node and placed "on hold" with the analytical laboratory. If a composite sample exceeds a target concentration, individual node sample(s) could be analyzed.

   Samples for VOC analyses should be collected at a depth of 6 to 12 inches bgs at each node as unmixed grab samples without compositing. Field screening (e.g., PID or FID) methods may be used to select the locations of these unmixed samples.

   > 1/4 acre: A minimum of five unmixed, grab samples should be collected from locations that are evenly distributed across the area of suspected contamination.

   > 1 acre: At least five additional samples should be collected by compositing grab samples from at least 25% of the nodes which generally reflect an even distribution across the area. These composite samples will be used for qualitative purposes only.

2. In addition to grid sampling described above, if the actual contaminants released are unknown, mobile contaminants or contaminants have been detected in site groundwater, a soil boring should be advanced to the water table for depth interval sampling. The boring should be centrally located or biased to a suspected or known area of concern and adequately sampled at regular intervals from the ground surface to the water table.

   Sampling intervals should be every five feet beyond the initial ground surface sample and extend to just above the water table or capillary fringe. Additional sampling depths should also be chosen based on visual and field-screening evidence. Note that deeper saturated samples could be affected by groundwater contamination.

Subsurface Release

1. The results of the historical research should be used to plan initial field investigation activities such as geophysical surveys, test pits, or trenching. Geophysical surveys such as ground penetrating radar, seismic reflection/refraction, or electromagnetic surveys, should be conducted in areas of concern on parallel and perpendicular traverses spaced

no further than 30 feet apart. Closer spacing may be necessary when using a metal detector. Further spacing can be refined based on initial results.

Grids should be established in the areas that yield anomalous readings during the geophysical surveys. Grid nodes should be spaced no greater than 10 feet apart. If areas are excluded from the survey due to instrument interference, a written justification for exclusion along with a map delineating the features causing the interference should be documented.

2. Once the subsurface disposal area has been identified, it should be sampled in the anticipated worst-case areas that will identify the site contaminants.

   Note: Caution shall be exercised when assessing buried waste so as not to release additional contaminants.

3. If the suspected subsurface disposal area cannot be located using the methods described above, a soil boring should be advanced through the suspected disposal area in accordance with the procedures for surface releases above.

B.1.1.3 Waste Material Sampling

Waste materials (e.g., fly ash, sludge, concrete, wood, and asbestos and lead containing material that are known or suspected to contain hazardous substances) should be evaluated using the same procedures as if they were contaminated soil. Laboratory analyses are necessary to determine if the contaminants in the waste materials exceed the Branch's remedial goals.

B.1.2 Subsequent Sampling to Delineate Extent of Soil Contamination

Additional nodes, or step-off, sampling locations shall be planned to define the horizontal and vertical extent of contaminated soil. Delineating the extent of soil contamination includes sampling ditches, culverts, swales, slough, tidal channels, or other drainage features that may have received runoff from known-contaminated areas. Field screening methods, such as soil gas testing and immunoassay test kits, may be used to help define the extent of contamination. If these methods are used, soil samples should also be collected at the expected vertical and lateral boundaries of each contaminated area and sent to an analytical laboratory for confirmation.

Delineation of soil contamination is complete when contaminant concentrations at the perimeter of the soil source area meet either the residential PSRGs, cumulative risk for unrestricted (residential) property use, or representative background levels near the site.

B.2 Groundwater Sample Collection

Groundwater sampling may be conducted concurrently with the soil sampling or, if there is insufficient information on the nature of hazardous substance releases at the site, groundwater assessment may begin after the Phase I soil results are received and evaluated.

Permanent groundwater monitoring wells are required to accurately quantify contaminants in groundwater and to eventually monitor treatment, degradation, and attainment of remediation goals. Groundwater purging and sampling shall follow USEPA Region IV's *Quality System and Technical Procedures for LSASD Field Branches* methods provided in the link at the front of this

document. Low flow sampling methods are preferred by the Branch. When sampling for metals, groundwater turbidity should be less than 10 Nephelometric Turbidity Units (NTU).

B.2.1 Phase I Sampling to Identify Contaminants

If the water table is within five feet of the ground surface, the soil contaminants are known to extend to within a five-foot depth of the water table, or a soil leaching test (i.e., SPLP) suggests that soil contaminants could leach to groundwater, groundwater in the uppermost water-bearing unit should be sampled. At least one well should be installed centrally *within each area of an identified soil release*. Where contaminants are believed to be "floaters" due to their density and solubility in water, well screens should be positioned across the water table. Where contaminants are believed to be "sinkers," the well screen should be positioned at depth or just above the bedrock surface.

If the remediating party decides not to install a groundwater monitoring well within an area due to grossly contaminated conditions or concern for rupturing buried vessels, a minimum of three groundwater monitoring wells must be installed immediately surrounding the suspect area.

A professional land surveyor, registered in North Carolina, must survey each monitoring well location from a USGS known datum. Monitoring well depth and depth to water shall be measured at each well and the groundwater elevation calculated. At least one sample must be collected from each monitoring well and analyzed according to **Section B.8**.

B.2.2 Subsequent Sampling to Delineate Extent of Contamination

If hazardous substances are present in groundwater, additional groundwater assessment will be required to delineate their lateral and vertical extent to the 02L standards, IMACs, or PQLs. Sufficient data are needed to understand groundwater flow direction and pathways in the aquifer(s). Once groundwater flow patterns are clearly defined, a well will be necessary on the hydraulically down-gradient perimeter of the area of concern to serve as a sentinel well for future monitoring. Bedrock wells may be necessary to assess the presence, occurrence, and mobility of contaminants at depth and the presence of dense nonaqueous phase liquid for the protection of potentially threatened water-supply well receptors.

Water level data should be collected during each sampling event to calculate groundwater elevation at each monitoring point for creating potentiometric maps. If a significant change in the groundwater flow pattern or direction is indicated, additional monitoring wells will be necessary to adequately update the extent of groundwater contamination.

B.3 Surface Water and Sediment Sample Collection

If an identified IHSB site has the potential for contaminants to migrate to an intermittent or perennial stream or other regulated surface water body via surface runoff or through a discharge of contaminated groundwater, surface water and sediment assessment will be necessary. Ephemeral streams are not regulated by DEQ.

B.3.1 Phase I Sampling to Identify Contaminants

If a surface water body is threatened by a site regulated by the Branch, surface water and sediment samples should be collected at the probable surface discharge point or groundwater discharge area. In addition, at least one surface water and one sediment sample must be collected immediately upstream and downstream of the discharge for comparison.

For surface waters that are very shallow (less than six inches deep) or turbulent, samples may be collected in a separate collection container and then decanted into the sample container to minimize turbidity. Surface water samples for organic analysis must be decanted into the sample container immediately. Surface water samples for metals analysis may be allowed to settle for a few minutes prior to decanting. Collection containers must be made of the same materials as the sample container, pre-cleaned and handled with appropriate field QC.

Samples need only be analyzed for detected site contaminants and associated daughter products. If sample analysis indicates a non-permitted, direct discharge that is unrelated to a site regulated by the Branch, DWR should be notified.

B.3.2 Subsequent Sampling to Delineate Extent of Contamination

If contamination is detected in any downstream sample above concentrations detected in upstream samples, additional surface water/sediment assessment will be needed further downstream to define the downstream extent of contamination to concentrations less than or equal to the 15A NCAC 02B standards for surface water and the residential PSRGs for sediment. If 15A NCAC 02B standards are exceeded, and nearby populations include children or adults who could recreate in contaminated surface water, recreator risk should be evaluated using the DEQ Risk Calculator.

B.4 Background Sample Collection

Sampling for site-specific naturally occurring or anthropogenic background conditions is important in all media to confirm the extent of contamination sites.

B.4.1 Soil

The Branch recommends collecting a minimum of five background soil samples. Sample locations should not be near roadways, railways, parking areas and other potential sources of contamination. Background soil samples should be collected from depths and soil types that are representative of contaminated site soils but should not be collected from topsoil (typically 0-6 inches).

Soil samples with anthropogenic background contaminants should be collected at various distances from the site over a large area. If the results indicate no increase in concentration toward the site and after any obvious outliers are removed, the upper end of the range of concentrations detected (or preferably the 95% BTV if more than 7 samples were collected) can be used as the anthropogenic level.

If statistically significant background data sets are not available for naturally occurring inorganics, the *USEPA Region IV January 2014 Draft Final Human Health Risk Assessment Supplemental Guidance* (provided in a link at the front of this document) has recommended that two times the average site-specific background concentration can be used as a background level.

B.4.2 Groundwater

If metals exceed groundwater remediation goals for the site, groundwater samples should be collected upgradient of any on-site sources of contamination to established natural background conditions. Groundwater turbidity should be less than 10 NTU prior to collecting a sample for metals analysis.

B.4.3 Surface Water and Sediment

If surface water assessment is necessary, background (upstream) surface water and sediment samples should be collected to establish natural or anthropogenic background conditions. If contamination is found upstream of the site in concentrations greater than the downstream concentrations, downstream delineation may not be necessary.

B.5 Quality Assurance Sampling

1. Unless otherwise noted below, field procedures relating to sample collection techniques, sample containers, sample preservation, sample holding times equipment decontamination and field measurement procedures, should comply with the current version of the USEPA Region IV *Quality System and Technical Procedures for LSASD Field Branches.* This information is available by accessing the link provided at the front of this document.
2. The remediating party should employ analytical and environmental monitoring data, to support recommendations or conclusions with respect to assessment, removal, treatment, or containment actions, which are scientifically valid and of a level of precision and accuracy commensurate with their stated or intended use.
3. Field QC sampling recommendations are as follows:
   (i) Duplicate samples – minimum of one duplicate sample, per medium, per container type, per field day or per 20 samples collected;
   (ii) Equipment rinsate blanks – one per reusable, decontaminated, sampling device per field day; and
   (iii) Trip blanks – one per cooler containing VOC samples is strongly recommended.
   Note: If site conditions, sample frequency or number of samples warrant more limited QA/QC testing, present the information in the RI Work Plan, or RAP.
4. Other than composited samples, soil, sediment and waste samples for VOC analysis should be collected directly into sample containers without mixing.

B.6 Confirmation Sampling

When remedial action is considered to be complete, confirmation samples should be collected to demonstrate that the contaminants identified in each medium during the RI have been successfully remediated to meet applicable remedial goals, or acceptable risk for the designated land use. Confirmation samples should be analyzed for the contaminants identified during the RI using approved USEPA methods.

B.6.1 Soil

Soil contamination may be treated in place (*in situ*) or excavated and disposed (*ex situ*).

B.6.1.1 Post In-Situ Remediation

For in-situ soil remedies, a confirmation sampling plan should be designed to verify that the entire soil column has been remediated to below the established remediation goals. The remediating party should design a three-dimensional sampling grid over the area(s) of concern that meets the requirements below.

1. Grid nodes should be no more than 50 feet apart laterally or 5 feet vertically to the known limits of contamination. Surface soil samples, 0 to 6 inches bgs for inorganics or 6-12 inches bgs for volatile contaminants, are required unless surficial soils were removed as part of the remedy.
2. Collect soil samples from each grid node to demonstrate conformance with site-specific remedial goals. Collected samples should be biased toward known "hot spots" or based on field screening methods at the time of collection, and/or from soil zones that are known to be less affected by *in-situ* remedial methods (e.g., clays).

B.6.1.2 Post Ex-Situ Remediation

Post-Excavation Sampling

Post-excavation sampling plans need to be designed to verify that all soils with concentrations above the established remediation goals have been removed. Excavations should be sampled using the requirements below.

1. Design a sampling grid over the base and sidewalls of the excavation. Grid nodes should be no more than 50 feet apart with at least one sample collected from each sidewall and base. At each location, collect a sample from 0-3 inches into the base or sidewall.
2. Sidewall samples should be biased toward formerly affected soil depths, based on field-screening, or no more than 1-foot from the excavation base

Treated Soil Stockpiles

Treated soils/wastes must meet the established remediation goals before they can be replaced on the property. Treated soil stockpiles should be sampled using the following procedures.

1. Stockpiles should be divided into equal segments of approximately 100 cubic yards each.
2. Within each segment, use either random or biased selection based on field screening to locate at least three hand-auger borings. Soil samples should be collected from two depths within each boring (minimum six samples per segment).

3. Use visible or field-screening evidence to collect additional biased samples as needed.
4. Only samples for non-volatile analysis within each segment may be composited.
5. For VOCs, two biased and unmixed grab samples per 100 cubic yard segment should be analyzed.

B.6.2 Groundwater

Groundwater confirmation sampling must demonstrate that site groundwater has been remediated to below the established remediation goals according to the following procedures.

B.6.2.1 Active Groundwater Remediation

1. A minimum of four quarters of monitoring following system implementation should demonstrate the remedy is effectively reducing contaminant concentrations.
2. Groundwater remediation systems may be shut down when two consecutive semi-annual (twice a year) sampling events demonstrate that *every* monitoring well (on- and off-property) has met the established remediation goals for the site. To account for the effects of seasonal fluctuations in the water table, semi-annual sampling events should be conducted in winter and summer.
3. Following system shutdown, data from two additional sampling events (spaced at least 3 months apart) should demonstrate that *each* monitoring well has met the remediation goals for the site, and contaminant concentrations are not increasing.

   Note: For remedial alternatives using injection technology, the first confirmation sampling event must occur after reagent is spent.

B.6.2.2 Passive Groundwater Remediation

For sites using passive groundwater remedial alternatives (e.g., monitored natural attenuation, phytoremediation, etc.), data from four consecutive sampling events (spaced at least three months apart) should demonstrate that (1) contaminant concentrations throughout the site meet the established remediation goals for the site, and (2) contaminant concentrations are not generally increasing over time.

B.6.3 Surface Water and Sediment

Four consecutive quarterly sampling events should be conducted to demonstrate that concentrations in downstream samples are less than or equal to concentrations in upstream samples or to established remediation goals.

B.7 Investigation-Derived Waste

IDW includes, but is not limited to, drill cuttings and muds, disposable sampling materials, laboratory containers, purge and decontamination water, and soil and residuals from testing generated as part of assessment activities. The Branch prefers that IDW be disposed of off-site at appropriate disposal or recycling facilities. In residential and public use areas, IDW will require

off-property management unless it meets unrestricted use levels and disposal permission has been granted by the property owner. IDW cannot be transferred and discharged to another area of the property.

With Branch concurrence drill cuttings, fluids, muds, soils, and sampling purge water may be discharged or stored in the area of contamination from which it was derived, and are not subject to RCRA permitting as long as the material:

1. stays on site and remains in the contaminated area,
2. is secured,
3. does not increase the spread of contamination or concentrations in a particular medium,
4. does not cause mobilization of contaminants,
5. does not introduce contamination to uncontaminated soil or groundwater, and
6. does not cause an increase in contaminant concentrations.

B.8 Sample Analyses

The remediating party should only use laboratories certified to analyze applicable certifiable parameters under 15A NCAC 02H .0800, or a contract laboratory under the USEPA Contract Laboratory Program (CLP) to analyze samples collected as part of an inactive hazardous waste site remedial action.

Environmental consultants should provide the laboratory with copies of **Sections B.8 and B.9** of this Guidance document to ensure that appropriate analyte lists are used in the analysis of samples.

B.8.1 Phase I Analyses to Identify Contaminants

Most sites managed by the Branch are pre-regulatory, non-permitted discharges where little information is available on the nature of the discharge, so the comprehensive list of parameters below must be included in the first phases of testing each contaminated medium. Where property history, activities and chemical usage at a property have already been documented, some of the analyses listed below can be excluded with supporting rationale in the RI report.

B.8.1.1 Analytical Parameters

Each Phase I sample should be analyzed for the following unless there is documentation indicating that a specific analysis is not necessary:

1. **Metals**: Hazardous substance list[1] (HSL) (totals analysis) including antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, selenium, silver, thallium, vanadium and zinc.

[1] USEPA, 2024. *List of Lists, Consolidated List of Chemicals Subject to the Emergency Planning and Community Right-To-Know Act (EPCRA), Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), and Section 112(r) of the Clean Air Act (CAA)*. May 2024.

Note: Analysis of chromium in soil should be speciated into trivalent and hexavalent chromium in most cases, since hexavalent chromium is more toxic than trivalent chromium. If only total chromium is analyzed, the results will require comparison with the more conservative hexavalent chromium PSRGs. For groundwater, hexavalent chromium analyses is not needed because the 02L groundwater standard for total chromium accounts for the toxicity of hexavalent chromium.

Note: If coal ash is known or suspected to have been discharged at the site, the following additional toxic, non-hazardous substance metals should be included in the testing of groundwater: boron, molybdenum, strontium.

Note: Total metals analysis should be used for groundwater samples. However, analysis of surface water for toxicity testing and hardness dependent metals (e.g., cadmium, chromium, copper, lead, nickel, silver, and zinc) requires analysis of dissolved metals according to DWR.

2. **VOCs/SVOCs**: Volatile and semi-volatile organic compounds listed on the most current USEPA CLP) Target Compound List[2] using analytical methods specified in **Section B.8.1.2** with a library search (using the National Institute of Standards and Technology mass spectral library) to produce a list of tentatively identified compounds (TICs). The library search should identify TICs for the largest 10 peaks in each analytical fraction of VOCs and SVOCs that have reasonable agreement with reference spectra (i.e., relative intensities of major ions agree within ± 20%). The list of identified TICs should not include laboratory control sample compounds, surrogates, matrix spike compounds, internal standards, system monitoring compounds or target compounds. The library search for TICs during the first assessment phase should be done on samples from the location with the highest contamination in each area of concern or if the "worst case" location is not known, then on a representative number of samples across the area.

   Any TICs that are hazardous substances, that have reasonable agreement with reference spectra and are detected in more than one sample in an area of concern should be included in all subsequent analytical work unless the compound is a laboratory contaminant, documented to be naturally occurring or from an anthropogenic background. Check with the laboratory on possible procedures to quantify the TICs so that cleanup levels can be determined. A summary of the nature of any TICs eliminated from future analysis and reporting should be provided in the RI Report, including reasons for eliminating the constituent.

3. **1,4-Dioxane**: If chlorinated solvents, including 1,1,1-trichloroethane (TCA) or trichloroethylene (TCE), are present, or if it is a suspected contaminant of concern. It is often associated with certain chlorinated solvents because of its widespread use as a stabilizer, but other uses are documented such as printing inks and paints, flame retardant production, rubber and plastics, deicing and antifreeze, among others. It is also a by-product present in many goods, including personal care products and herbicides (i.e.,

[2] USEPA, 1998. *Statement of Work for Organics Analysis Multi-Media, Multi Concentration*. September, 1998.

Round-up, and other herbicides) and is used as a purifying agent in the manufacture of pharmaceuticals.

4. **PFAS**: if suspected to have been discharged at the property with other contaminants, through aerial deposition (such as from a smokestack) or associated with a process that commonly involves PFAS. Information regarding the list of USEPA-industry sectors likely to have used PFAS and how to comprehensively characterize sites affected by PFAS can be found in the links available at the front of this document. Note that in May 2024, the USEPA designated PFOA and PFOS, including their salts and structural isomers, as CERCLA hazardous substances.
5. **Other Potential Contaminants**: Pesticides, PCBs, dioxins, cyanide, formaldehyde, nitrates, nitrites, ammonia, phosphorus, and any other CERCLA hazardous substances or pollutants not mentioned here if suspected of having been discharged at the property.
    a. If cyanide is a known or suspected contaminant of concern, cyanide should be analyzed using total cyanide methods.
    b. If PCBs are a known or suspected contaminant of concern in soils, Phase I soil samples should be collected in the area of highest concentration and analyzed using both total PCB analysis and congener-specific analysis. The congener analysis should specify the dioxin-like PCB congeners for comparison with their PSRGs. The sum of the dioxin-like PCB congener concentrations should be subtracted from the Total PCB analytical result. The resulting concentration are then compared to the Branch's allowable concentrations for non-dioxin-like PCBs, which are the PSRGs for "Polychlorinated Biphenyls (high risk)". If concentrations detected are less than soil remedial goals for both the individual dioxin-like congeners and for the total non-dioxin like congeners, no additional PCB sampling is required. If concentrations exceed applicable remedial goals, more gross delineation can be performed using total PCB analyses and then the perimeter of the extent of contamination samples run for the dioxin-like congeners found at the site. In areas where PCBs are detected, soil samples should also be collected and analyzed for VOCs because they are commonly present as carriers for PCBs. Final confirmation samples must also be analyzed using congener specific analyses. Aroclor analyses should not be used unless trying to fingerprint a manufacturer of PCB fluid.

       If soil in a fairly large area contains PCBs above the PSRGs, an evaluation of anthropogenic background concentrations may be warranted. If a protection of groundwater PSRG is exceeded, a groundwater samples should be collected at that location and analyzed for *Total* PCBs and the results compared to the current IMAC of 0.09 ugL.

B.8.1.2 Analytical Methods

The analytical methods used should be the *most recent* versions of the analytical methods tabulated below. For hazardous and solid waste test methods (SW-846 Method), the latest edition of SW-846, including any subsequent updates which have been incorporated into the edition, must be used. Sampling must be planned so that required holding times for analytical methods are met. The laboratory's reporting limits should be at or below remedial goals.

Soil and Sediment Samples

Volatile Organic Compounds[1]	SW-846 Method 8260
1,4-Dioxane[2]	SW-846 Method 8270
Semi-volatile Organic Compounds[1]	SW-846 Method 8270
Metals[3] (excluding hexavalent chromium), Pesticides, PCB congeners, total PCBs, Dioxins, Cyanide, Formaldehyde and any other analytes not covered by above methods	USEPA method or method published in *Standard Methods for the Examination of Water and Wastewater* having detection limits below unrestricted use remedial goals or having the lowest detection limit. For PCB congeners use USEPA Method 1668.
Hexavalent chromium (if total chromium exceeds the site-specific natural background concentrations and the remedial goal for hexavalent chromium)	SW-846 Method 3060A[4] alkaline digestion coupled with a USEPA method or method published in *Standard Methods for the Examination of Water and Wastewater* having detection limits below unrestricted use remedial goals or otherwise having the lowest detection limit.
PFAS compounds[8]	USEPA Method 1633 ASTM D7968-17a

Water Samples (including groundwater, surface water and TCLP/SPLP leachate)

Volatile Organic Compounds[1]	SW 846 Method 8260
1,4-Dioxane[2]	SW-846 Method 8270 SIM using d8 isotope analysis.
Semi-volatile Organic Compounds[1]	SW-846 Method 8270.
Metals[3, 5], Pesticides, PCBs, Dioxins, Cyanide, Formaldehyde and any other analytes not covered by above methods	USEPA method or method published in *Standard Methods for the Examination of Water and Wastewater* having the lowest detection limits or having detection limits below the 02L standards or IMACs.
Hexavalent chromium (if total Cr exceeds 2 times the site-specific natural background concentrations and the applicable remedial goal for hexavalent Cr, and Cr is a known or suspected contaminant at the site)[6, 7]	USEPA Method 218.7 or Method 218.6 as modified by USEPA Region IV.
PFAS compounds[8]	USEPA Method 1633 USEPA Method 537.1 Modified for drinking water.

1. *Analyses must include the USEPA Target Analyte List plus a library search as described in Section B.8.1.1(2).*

2. *Samples for 1,4-Dioxane analysis should not be collected with passive- or diffusive-bag samplers. Also, avoid use of Alconox and Liquinox for precleaning of sampling equipment and containers. Methods 8260 and 8260 SIM is not recommended due to interference issues between 1,4-dioxane and some chlorinated solvents, particularly TCE and 1,2-dichloroethene.*
3. *SW-846 Method 6010 does not have detection limits below the unrestricted use standards/02L standards for each of the hazardous substance list metals. Therefore, inductively coupled plasma mass spectrometry (ICP-MS) should be used when conducting first phase metals scans. For metals, ICP-MS has lower quantitation limits than ICP. However, ICP should be used for certain metals where interference issues exist.*
4. *SW-846 Method 3060A extraction for soil and sediment samples allows for a 30-day holding time prior to extraction.*
5. *Rapid analyses of samples are recommended to lessen the contact time with the acid preservative. Filtration of groundwater and surface water samples before digestion is not permitted. Highly turbid water samples for metals analysis should be collected when turbidity is less than 10 NTUs. Highly turbid samples may be collected in a separate collection container and then decanted into the sample container.*
6. *Hexavalent chromium analysis is not needed for groundwater samples as the 02L standard for total chromium is based on the more toxic hexavalent chromium species. The listed methods can be used for surface water and for ecological assessment purposes.*
7. *Samples collected for hexavalent chromium analyses must be field filtered within 15 minutes of collection. Each sample must be collected in a separate pre-preserved container from those for other metals analyses. Method 218.7 or Method 218.6 as modified by USEPA Region IV should be used. Method 218.7 requires low turbidity and allows for a 14-day holding time. USEPA Region IV has developed a modification to Method 218.6 that allows for a 28-day holding time. Bottles must be pre-preserved as specified in the modification to the Method. Laboratories should contact the USEPA in Region IV for the methodology modification. Otherwise, any USEPA Method or Standard Method may be used, however, other methods have a 24-hour holding time. Selection of methods and pre-preservation of bottles should be discussed with the laboratory prior to sample collection.*
8. *Analysis of a comprehensive list of PFAS analytes with a reporting limit of 4 ppt or less for PFOA and PFOS is required.*

The recommended analytical methods for PFAS are referred to as targeted methods because they provide concentrations of known and commonly detected PFAS. Additional analytical methods are available to characterize the total PFAS that may be present at a site. The total oxidizable precursor (TOP) method can identify PFAS precursors (or parent compounds) that degrade to PFOS and PFOA over time. Conversely the TOP assay can indicate which sites do not have such precursors present, so future occurrence of PFOS and PFOA as degradation products can be ruled out. Consult with DEQ chemists for more information on the uses and limitations of total PFAS methods such as TOP, Non-targeted Analysis, and total organic fluorine methods.

B.8.2 Analyses for Subsequent Phases of Assessment

If the Phase I analyses have sufficiently identified the site's contaminants of concern, and documentation has eliminated certain chemicals (such as naturally occurring or anthropogenic background, or a common laboratory contaminant detected in concentration below that detected

in the method blank) from further analysis, subsequent samples collected from the site need only be analyzed for the site-specific chemicals.

Note: If a compound that is not a common laboratory contaminant is detected in both the blank and a sample, another phase of sampling is necessary to demonstrate the absence or presence of the contaminant.

B.8.2.1 Analytical Parameters

1. All CERCLA hazardous substances detected in the first phase of sampling (including those with qualified estimated concentrations), and their potential degradation compounds.
2. TICs that meet the criteria in **Section B.8.1.** that are retained as site contaminants must be quantified in subsequent phase analyses using a USEPA Method or method published in *Standard Methods for the Examination of Water and Wastewater* (latest edition) having the lowest PQL or one that achieves the 02L standards or IMACs for water samples and the residential (unrestricted use) PSRGs for soil.
3. Hexavalent chromium analyses are required for soil if total chromium concentrations detected in the Phase I soil samples exceed 1) the site-specific natural background concentrations and 2) the hexavalent chromium residential PSRG.

Note: Sample dilutions raise analytical detection limits and can mask the presence of other constituents at lower concentrations. If laboratory sample dilutions were performed on Phase I samples, subsequent phase samples must be analyzed with PQLs that meet residential PSRGs for soil, 02L standards and IMACs for groundwater, and 02B standards for surface water.

B.8.2.2 Analytical Methods

Samples should be analyzed using the methods specified above for Phase I samples. Other USEPA-approved Methods or methods published in *Standard Methods for the Examination of Water and Wastewater* (latest edition) may be substituted if the substitute methods achieve equal or lower PQLs that meet residential PSRGs for soil, 02L standards and IMACs for groundwater, and 02B standards for surface water.

B.9 Laboratory Data Reporting

Analytical laboratory reports submitted to the Branch must include the following.

1. A statement that the laboratory is either 1) DWR Laboratory Certification Program certified for applicable parameters under 15A NCAC Subchapter 02H .0800 with its certification number, or 2) that it is a contract laboratory under the USEPA's CLP. Full CLP documentation packages are not required.
2. A signed statement from the laboratory that the samples were received in good condition, at the required temperature and that analysis of the samples complied with all procedures outlined in the analytical method used, unless otherwise specified in a narrative.

3. A report of the remaining vacuum of each Summa canister received. Summa canisters shall be identified as either being batch certified or individually certified as cleaned by the laboratory.
4. A case narrative justifying any deviations from the methods, additional sample preparation, sample dilution, and unrectified analytical problems, including details of any known conditions or findings which may affect the validity of analytical data, including but not limited to equipment blank, trip blank, method blank, surrogate, spiked sample, or other QC data;

Note: The laboratory must provide a written explanation for any sample having sample quantitation limits that exceed 10 times the laboratory or published MDLs.

5. Names of the individuals performing each analysis, the quality assurance officer reviewing the data and the laboratory manager.
6. Laboratory report of analytical results with consecutive page numbers, including:
    a. Date and time of sampling;
    b. Sample matrix description and identification number(s);
    c. Date samples were received, extracted and analyzed by the laboratory
    d. Sample preparation and analytical method name(s) and number(s), including filtration or preservation procedures used;
    e. Dilution factors and the sample PQL of each reported analyte based upon analytical conditions. Any PQL exceeding 10 times the published analytical MDL must be justified with supporting information.
    f. Reports of detected and estimated constituents even if they were not definitively quantified. All estimated concentrations and constituents not meeting method QA/QC requirements which have data qualifiers must be reported.
    g. The results of any library searches performed for TICs.
    h. Units reported as mass per unit volume for air, soil gas, vapor, and aqueous samples. Units reported as mass per unit mass for solid samples.
    i. Laboratory sheets for the laboratory QC samples, including results for bias and precision, continued calibration and control limits used. The following minimum laboratory quality control sample reporting information must be provided, and samples that exceed control limits/acceptance criteria must be flagged:
        i. At least one matrix spike and one matrix spike duplicate per sample delivery group or 14-day period, whichever is more frequent (control limits must be specified);
        ii. At least one method blank per sample delivery group or 12-hour period, whichever is less; and
        iii. System monitoring compounds, surrogate recovery required by the method and laboratory control sample analysis (acceptance criteria must be specified).

Note: Any quality control concerns, data qualifiers or flags should be evaluated and discussed in the associated report.

j. Completed chain-of-custody documentation with associated air bill (if applicable) attached.

B.10 Sampling and Analyses for Fill Imported from Another Property

The Branch must approve the import of fill material that originates from an off-site source. Imported fill must meet the acceptable risk for unrestricted property use and the leachability criterium. If metals are not present at leachable concentration, but they exceed levels suitable for unrestricted use, a demonstration must show that metals are within the receiving site's naturally occurring background levels before importation to the property. Note that any party accepting contaminated soil that exceeds levels suitable for unrestricted use may make themselves a responsible party under CERCLA.

B.10.1 Borrow Source

The history and location of the proposed borrow source must be established and documented. The borrow source property must either be undeveloped, or the historical usage of the property has no indication of a potential environmental concern. Borrow sources should not include the following:

1. locations on or within 1,000 feet of a site that the Division of Waste Management (DWM) manages, permits or has inventoried;
2. soil from a contaminant cleanup or removal;
3. commercial or industrial properties where hazardous materials were used, handled or stored;
4. dredged material from a marine environment; (unless it has dried to meet the moisture content of receiving site);
5. soil from below the groundwater table; (unless it has dried to meet the moisture content of receiving site);
6. soil containing construction or demolition debris or reclaimed asphalt or concrete;
7. soil from recycling operations that collect, sort, reprocess or manufacture products;
8. soil from transfer stations that collect, consolidate, temporarily store, sort, or recover refuse or used materials from off site; or
9. soil containing coal or wood ash.

B.10.2 Procedures

1. Document the location of the proposed borrow source.
2. Based on the volume of fill needed, visually divide up the total volume into sections according to the type of fill as described below.

3. Collect samples from the fill according to the type of fill. Sampling methodologies must be in accordance with U. S. Environmental Protection Agency (US EPA) Region IV *Field Branches Quality System and Technical Procedures* for soil sampling and these Guidelines.

In Situ Material

a. Divide the borrow source area into five approximately equal-sized sections (the number of sections is independent of the total acreage).

b. Collect a grab sample from each of the five sections at the following depths. Samples should not be composited for in-situ material.

- 0 to 0.5 ft below ground surface (bgs).
- 5 ft bgs (or a shallower depth if fill material will not extend beyond 5 ft bgs).

c. Analyze each grab sample for the following.

i. Volatile and Semi-Volatile Organic Compounds (USEPA Target Compound List plus 1,4-Dioxane): SW-846 Methods 8260 and 8270, respectively;

ii. Metals: SW-846 Method 6020 (Antimony, Arsenic, Beryllium, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Manganese, Nickel, Selenium, Silver, Thallium and Zinc);

iii. Mercury: Method 7471;

iv. Organochlorine Pesticides: Method 8081 (if the borrow source was used for agricultural purposes); and

v. PFAS analysis by Method 1633 may be required on a case-by-case basis depending on whether the soil's origin has the potential to be impacted by PFAS (e.g., near airports, fire training facilities, foam manufacturing facilities, etc.).

Stockpiles (including Quarries)

a. The owner of the stockpiled borrow source will be required to sign an affidavit, attesting that the stockpiled material originated from one source location and not from multiple source(s). The stockpiled material that is sampled and tested must be the same material that is purchased and imported for use as clean fill at the Site.

b. Visually divide the stockpile into 1,000 cubic yard sections.

c. Sample the stockpile according to the schedule in Table 1.

Table 1. Number of samples per volume of proposed import stockpiled material.

Volume of Material Needed	Number of Composite[1] Samples per Volume for Non-Volatile Contaminants	Number of Grab[2] Samples per Volume for Volatile and Semi-Volatile Contaminants
Up to 1,000 cubic yards (CY)	3 total	3 total
1,000 to 5,000 CY	2 for the first 1,000 CY, plus 1 for each additional 1,000 CY.	2 for the first 1,000 CY, plus 1 for each additional 1,000 CY.
>5,000 CY	5 for the first 5,000 CY, plus 1 for each additional 1,000 CY	5 for the first 5,000 CY, plus 1 for each additional 1,000 CY

[1]Composite sample should be comprised of 3 grab samples collected from different depths.

[2]All samples should be screened with a PID, and grab samples should be from the sample depth with the highest PID reading in the composite.

4. Analyze samples for the following parameters.
    a. Grab samples
        i. Volatile and Semi-Volatile Organic Compounds (USEPA Target Compound List plus 1,4-Dioxane): SW-846 Methods 8260 and 8270, respectively;
    b. Composite Samples
        i. Metals: SW-846 Method 6020 (Antimony, Arsenic, Beryllium, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Manganese, Nickel, Selenium, Silver, Thallium and Zinc);
        ii. Mercury: Method 7471;
        iii. Organochlorine Pesticides: Method 8081 (if the borrow source was used for agricultural purposes); and
        iv. PFAS analysis by Method 1633 may be required on a case-by-case basis depending on whether the soil's origin has the potential to be impacted by PFAS (e.g., near airports, fire training facilities, foam manufacturing facilities, etc.).
5. Tabulate and compare the soil analytical results to the direct contact unrestricted use and protection of groundwater Preliminary Soil Remedial Goals (PSRGs) and the site-specific background concentrations.
    a. If the soil analytical results are above unrestricted use direct contact PSRGs or exceed 2x the average site-specific background concentrations for naturally occurring contaminants, the data must be entered into the DEQ risk calculator to

confirm that concentrations are below unrestricted use risk targets, and/or a demonstration must show that metals are within the receiving site's naturally occurring background levels.

Note: When evaluating the quality of fill material, only the constituents that exceed a residential PSRG or 2x the background concentration need to be entered into the risk calculator.

b. If the soil analytical results are above the protection of groundwater PSRGs, TCLP or SPLP analysis is required to determine leachability.

6. Submit the borrowed fill evaluation, including the analytical data, risk calculator results and a summary cover letter signed by a PE/LG to Branch staff for review and approval prior to purchase and transport of fill material to the Site. For sites in the REC Program, the RSM must submit the fill evaluation as part of a report, or under separate cover, with appropriate certifications to indicate REC approval.

Appendix C: Sensitive Environments and Contacts

A list of sensitive environments is provided below, and their associated agency contacts follow. The presence of any sensitive environments on the contaminated property or threatened by the migration of contaminants off of the property should be reviewed and evaluated as indicated in **Section 5.1.2**).

- Wetlands
- Natural areas that could be attractive to terrestrial ecological receptors
- Areas of stressed vegetation or stressed wildlife
- Sensitive areas identified under the National Estuary Program
- Rare species (State and Federal threatened and endangered)
- Sensitive aquatic habitats
- Federal land designated for the protection of natural ecosystems
- State-designated areas for protection or maintenance of aquatic life (i.e., trout designated waters, etc.)
- Terrestrial areas utilized for breeding by large or dense aggregations of animals
- Spawning areas critical for the maintenance of fish/shellfish species within river, lake or coastal tidal waters
- Migratory pathways and feeding areas critical for maintenance of anadromous fish species within river reaches or areas in lakes or coastal tidal waters in which such fish spend extended periods of time
- Areas important to maintenance of unique natural communities
- National and State historical sites
- Areas identified under coastal protection legislation
- Coastal barriers or units of a coastal barrier resources system
- Designated State natural areas
- Federal or State designated wild and scenic rivers
- Designated and proposed Federal wilderness and natural areas
- National and State preserves and forests
- National or State wildlife refuges
- Marine sanctuaries
- State lands designated for wildlife or game management
- National and State seashore, lakeshore and river recreational areas
- National and State parks or monuments

AGENCY	NAME & CONTACT INFORMATION	SENSITIVE ENVIRONMENT
NC Division of Conservation, Planning, and Community Affairs Natural Heritage Program	Visit the Natural Heritage Program's interactive maps of Natural Heritage resources to search for records within 2 miles of your project area or the database search tool for record summaries by county and USGS 7.5-minute topo map. You can also download GIS shapefiles of our data; see the "GIS Download" page for details. Email inquiries to: natural.heritage@ncdcr.gov	State Parks Areas Important to Maintenance of Unique Natural Communities Sensitive Areas Identified Under the National Estuary Program Designated State Natural Areas State Seashore, Lakeshore and River Recreational Areas Rare species (State and Federal Threatened and Endangered) Sensitive Aquatic Habitat State Wild & Scenic Rivers
National Park Service Public Affairs Office	Anita Barnett, EEO Counselor & Environment Protection Specialist: Planning and Compliance Division Anita_Barnett@nps.gov (404) 507-5706 http://www.nps.gov/rivers	National Seashore, Lakeshore and River Recreational Areas National Parks or Monuments Federal Designated Wild & Scenic Rivers
US Forest Service	Heather Luczak, Forest NEPA Coordinator heather.luczak@usda.gov (828) 257- 4817	Designated and Proposed Federal Wilderness and Natural Areas National Preserves and Forests Federal Land Designated for the Protection of Natural Ecosystems
NC Division of Water Resources	Nora Deamer, Basin Planner Nora.Deamer@deq.nc.gov (919) 707-9116 General Basin Planning e-mail: DEQ.DWR.BasinPlanning@deq.nc.gov Michelle Raquet, Branch Supervisor michelle.raquet@deq.nc.gov (919) 707-9026 Ask for Clean Water Act 305b report	State-Designated Areas for Protection or Maintenance of Aquatic Life
NC Forest Service	Michael Foushee, Director, Safety, Planning & Analysis michael.foushee@ncagr.gov (919) 857-4820	State Preserves and Forests

US Fish & Wildlife Service	Pete Benjamin, Field Supervisor pete_benjamin@fws.gov (919) 856-4520 x 11	Endangered Species
NC Department of Natural and Cultural Resources	Renee Gledhill-Earley, Environmental Review Coordinator renee.gledhill-earley@dncr.nc.gov (919) 814–6579	National and State Historical Sites
NC Division of Coastal Management	Mike Lopazanski, Deputy Director Mike.lopazanski@deq.nc.gov (252) 515-5431 http://dcm2.enr.state.nc.us	Areas Identified Under Coastal Protection Legislation Coastal Barriers or Units of a Coastal Barrier Resources System
NC Wildlife Resources Commission	David Cox, Technical Guidance Supervisor David.Cox@ncwildlife.org (919) 707-4055	National or State Wildlife Refuges State lands designated for wildlife or game management Migratory pathways and feeding areas critical for maintenance of anadromous fish species within river reaches or lakes or coastal tidal waters Spawning areas critical for the maintenance of fish/shellfish species within river, lake or coastal tidal waters
US Army Corps of Engineers	Asheville Regulatory Field Office Dina Supple: (828) 271-7980 AshevilleNCREG@usace.army.mil Charlotte Regulatory Field Office Lisa Hreha: (704) 510-1441 CharlotteNCREG1@usace.army.mil Raleigh Regulatory Field Office Josephine Schaffer: (919) 554-4884 RaleighNCREG@usace.army.mil Washington Regulatory Field Office Nikki Dameron: (252) 975-1399 WashingtonNCREG@usace.army.mil Wilmington Regulatory Field Office Kasey Jones: (910) 251-4811 WilmingtonNCREG@usace.army.mil	Wetlands