

**NORTH CAROLINA
DEPARTMENT OF ENVIRONMENTAL QUALITY**

***TECHNICAL GUIDANCE
for
RISK-BASED ENVIRONMENTAL
REMEDiation OF SITES***

**For all applicable sites according to
NC General Statutes 130A-310.65 through 310.77**



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DEPARTMENT OF ENVIRONMENTAL QUALITY

TECHNICAL GUIDANCE FOR RISK-BASED ENVIRONMENTAL REMEDIATION OF SITES

The North Carolina Department of Environmental Quality (DEQ) *Technical Guidance for Risk-Based Environmental Remediation of Sites* describes how the provisions enacted in NC General Statutes 130A-310.65 through 310.77 are to be applied. These statutes establish a framework for developing and applying risk-based, site-specific remediation standards to groundwater and other contaminated media to ensure the sitewide risks meet acceptable levels.

A risk-based remedy relies on engineered and land-use controls to manage risks and carries with it a responsibility to ensure that such controls are protective, achievable, sustainable, and consistent with surrounding land uses. These controls must be maintained and enforced by the property owner in perpetuity.

The paradigm shift from compliance with state cleanup standards to a site-specific, risk-based approach presents an opportunity for state environmental cleanup programs to work with remediating parties to implement a remediation process whereby contaminated sites are cleaned up to a level that is sufficient to ensure protection of public health and the environment without excessive expenditure of public or private resources.

Remediating parties are encouraged to communicate with their oversight program early in the process to discuss site conditions and ensure that the requirements for risk-based closure are well understood.

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LIST OF ACRONYMS

DEQ	Department of Environmental Quality
DWM	Division of Waste Management
DWR	Division of Water Resources
EC	Engineered Control
HI	Hazard Index
HQ	Hazard Quotient
IC	Institutional Control
LUR	Land-Use Restrictions
NAPL	Non-Aqueous Phase Liquid
NCAC	North Carolina Administrative Code
NFA	No Further Action
NOIR	Notice Of Intent to Remediate
OSHA	Occupational Safety and Health Administration
PAH	Polynuclear Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyls
PQL	Practical Quantitation Limit
PSRG	Preliminary Soil Remediation Goal
POG PSRG	Protection of Groundwater Preliminary Soil Remediation Goal
QA/QC	Quality Assurance/Quality Control
RAP	Remedial Action Plan
RSL	Regional Screening Levels
SESD	Science and Ecosystem Support Division
SPLP	Synthetic Precipitation Leaching Procedure
SQL	Sample Quantitation Limit
TCLP	Toxicity Characterization Leaching Procedure
USEPA	United States Environmental Protection Agency
VI	Vapor Intrusion

1. PLANNING FOR RISK-BASED REMEDIATION

This guidance outlines key elements and procedures specified in [North Carolina General Statutes \(G.S.\) 130A-310.65 through 310.77](#) for implementing successful contaminant assessment and risk-based remediation strategies across applicable DEQ programs. Existing risk-based remediation programs in DEQ's Division of Waste Management (DWM), including those overseeing underground storage tank sites, dry-cleaning solvent sites, and pre-regulatory landfill sites have their own statutes and/or rules and guidance documents that provide the detailed technical requirements for risk-based remediation and do not qualify for remediation under these statutes [G.S. 130A-310.67(b)].

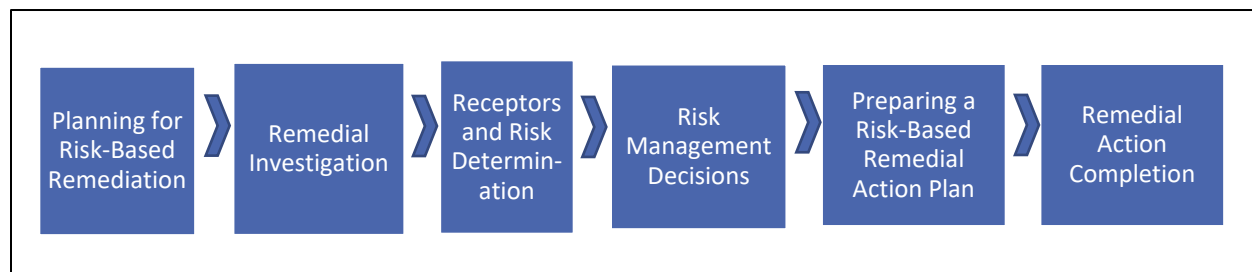
Remediating parties are encouraged to meet with their oversight program early in the process to discuss site conditions and ensure that the requirements are understood.

The types of sites best suited for risk-based remediation under these statutes are those where site closure is desired, contributing sources of contamination have been removed, contaminant concentrations in groundwater are stable and/or predictable, consent for site-specific remediation standards have been obtained from owners of all affected properties (including state-owned properties), and surface water standards are demonstrated to be met.

Risk-based remediation under these statutes is not recommended for sites where an active groundwater remedy is planned or ongoing because fees are collected at the outset, financial assurance will be required per G.S. 130A-310.72, and significant time may be required to achieve the site-specific remediation standards, or they may never be met. It is best to monitor groundwater conditions following an active remedy to ensure that groundwater conditions have stabilized and risk to receptors can be managed through land-use restrictions (LURs). At this point, a risk-based remedy could be implemented as the final stage of site-wide cleanup where multiple strategies over time have achieved conditions that are stable and predictable.

This guidance summarizes the procedures for initiating the risk-based remediation process according to G.S. 130A-310.65 through 310.77 (risk statutes) and describes how to develop site specific remediation standards that are protective of human health and environmental receptors. The [DEQ Risk-Based Remediation website](#) contains the risk statutes, required forms and worksheets, an Excel-based risk calculator, and other resources mentioned in this guidance. Figure 1-1 is a flow diagram of the main topics presented in this document.

Figure 1-1. Flow Diagram of Document Topics



Professional decision-making and judgment are necessary to weigh the cost of implementation and overall effectiveness of potential remedies. For this reason, and to protect public interests, licensed firms and professionals must oversee risk-based remedial actions per G.S. 130A-310.12 and G.S. 143-215.,

Due to the wide range of conditions encountered at contaminated sites, these guidelines cannot address every conceivable situation and every DEQ remediation program requirement. Please contact specific remediation program representatives to inquire about additional information or supplemental remediation guidance when planning a risk-based remedy under these risk statutes.

1.1 Legislative Background

In 2011, legislation was passed to allow remediation of contaminated sites based on risk and the calculation of site-specific groundwater remediation standards (G.S. 130A-310.66). These levels must be adequate to protect public health and the environment according to the current and anticipated future use of a property. The legislation is found in Part 8 of Article 9 of Chapter 130A of the G.S. 130A-310.65 through 310.77.

In 2015, amendments to the risk statutes expanded the risk-based remediation option across DEQ to include virtually all regulated sites, except those subject to remediation pursuant to the Coal Ash Management Act of 2014 and the requirements of animal waste management systems (G.S. 130A-310.67).

DEQ risk-based remediation programs (year established):

- Leaking Petroleum Underground Storage Tank Cleanup Program (1988)
- Dry-Cleaning Solvent Cleanup Program (1997)
- Pre-1983 Landfill Assessment and Remediation Program (2007)
- Hazardous Waste and RCRA Sites (2011)
- Inactive Hazardous Sites (2011)
- Petroleum Releases from Aboveground Storage Tanks and Other Sources (2015)
- Division of Water Resources Sites (2015)
- Permitted Solid Waste Sites (2015)

DEQ Programs with no risk-based alternative:

- Sites Regulated under the Coal Ash Management Act
- Permitted Animal Waste Management Systems

The term “site” in this document means the location and extent of known releases of hazardous substances. The site may encompass multiple properties, and a property may have multiple sites due to multiple distinct releases. As a result, terms such as “on-site” and “off-site” can become confusing. To avoid confusion, the risk statutes and this document use the term “source property” to refer to the property where the release occurred and “non-source property” to refer to the neighboring properties affected or potentially affected by the release. In general, the term “site” refers to the area where contamination has come to be located.

1.2 Unrestricted Versus Restricted Land Use

For a property to have unrestricted use, the site must be cleaned up to state standards (15A NCAC 02L and 02B standards) or local background levels and meet acceptable risk for residential use. Residential use includes schools, daycare facilities, hospitals, single-family homes, townhouses, apartment buildings, and college/university dormitories. In some cases, it is not technically or economically feasible to achieve unrestricted-use standards, nor is it always possible to predict

whether a particular cleanup approach will ultimately meet the unrestricted-use standards, so a restricted-use cleanup option may be appropriate for a site when approved by the DEQ [G.S. 130A-310.68(a)(3)].

Risk-based, site-specific remediation standards must consider the present or probable future risk to human health and the environment based on the potential future use of the property [G.S. 130A-310.68(b)]. Site-specific remediation standards that rely on LURs will require annual property inspections and reporting to the appropriate DEQ program. A comparison of the cleanup requirements for unrestricted or restricted property use is presented in Table 1-1.

Table 1-1. Requirements for Site Cleanup to State Standards versus Restricted Use using Risk-Based Environmental Remediation of Sites under G.S. 130A-310.65 through 310.77.

Requirement	Unrestricted Property Use	Restricted Property Use
Administrative fees?	Program specific	Yes
DEQ approval of remediation standards?	No	Yes
Property owner permission?	No	Yes
Institutional controls?	No	Yes
Annual reporting to DEQ?	No	Yes
Soil cleanup target	Levels that meet risk for unrestricted/residential use and are demonstrated to not leach contaminants to groundwater above the 02L standards	Levels that do not pose unacceptable risk for the intended property use and are demonstrated to not leach contaminants to groundwater above the approved site-specific groundwater remediation standards [G.S. 130A-310.68(b)(5)]
Groundwater remediation standards	15A NCAC 02L Standards	Site-specific based on risk
Surface water remediation standards	15A NCAC 02B Standards	15A NCAC 02B Standards [G.S. 130A-310.68(b)(2)]
Indoor air vapor	Levels that meet risk for unrestricted/residential use	Levels that meet risk for non-residential use [G.S. 130A-310.68(b)(7)]

2. GETTING STARTED AND OBTAINING APPROVAL TO PROCEED

Prior to considering a risk-based remedy and preparing a risk-based remedial action plan (RAP), initial administrative steps are required by statute to determine if site-specific groundwater standards are a viable option for the site. The *Administrative Procedures for Risk-Based Environmental Remediation of Sites* can be found on the DEQ Risk-Based Remediation website under [Procedures and Forms](#). Here, remediating parties will find the eligibility requirements,

instructions, required forms, and fees that must be submitted to the appropriate remediation program for review and approval prior to proceeding with a risk-based RAP:

1. An approved remedial investigation (RI) report that contains the information in G.S. 130A-310.69(a) and any other information required by the appropriate remediation program.
2. The fee calculation worksheet showing the required administrative and oversight fees that are calculated based on the maximum predicted areal extent of contamination.
3. Signed consent forms from owners of contaminated property that provide written consent for site-specific cleanup levels that are accompanied by institutional controls (ICs).
4. A Notice of Intent to Remediate (NOIR) template and mailing list to serve as part of the public participation requirement.

Without these completed documents, a risk-based remedy cannot be considered, and time and cost need not be expended on preparing a risk-based RAP.

2.1 Remedial Investigation Report

A RI report must be completed, submitted, and approved by the appropriate oversight program prior to considering a risk-based remedy [G.S. 130A-310.69(a)]. The RI shall assess all contaminated areas of the site, and present the types, levels, and extent of contamination. The contents of the RI report shall include, at a minimum, the following information specified in G.S. 130A-310.69(a) and any additional information requested in any guidelines associated with the appropriate oversight program.

1. A map and legal description of the location of the site;
2. Identification of adjacent property owners, adjacent land uses and receptors;
3. A description of all source property releases of contamination and their concentration in the media of the site, including vapors in indoor air;
4. A description of groundwater monitoring well design and installation procedures;
5. A narrative description of the methodology used in the investigation, including a description of field quality control and quality assurance procedures and sampling procedures. Sample collection, preservation and container selection should follow the most current United States Environmental Protection Agency (USEPA) Region 4 Science and Ecosystem Support Division (SESD) [Quality System and Technical Procedures for LSASD Field Branches | US EPA](#)
6. A site map, drawn to scale, showing benchmarks, directional arrow, location of property boundaries, buildings, structures, all perennial and nonperennial surface water features, drainage ditches, dense vegetation, contaminant spill or disposal areas, underground utilities, storage vessels, and existing water supply wells on the source property;
7. Description of local geologic and hydrologic conditions, including a brief description of the major aquifers, confining units, groundwater flow direction, surface water features, and any structural features such as faults, fracture systems, geologic intrusions, and subsurface geologic or man-made features that could serve as preferential groundwater flow paths.;

8. A survey of water supply wells, public water intakes, environmentally sensitive areas, surface waters, and other receptors within 1,500 feet of the site.
9. Maps, drawn to scale showing all sample locations with isoconcentration contours of contaminant extent above unrestricted-use standards. Geologic cross-sections of the site should show topography, lithology, water-bearing zones, confining layers, and analytical results;
10. A description of procedures and the results of any special assessments;
11. A description of methods used to manage investigation-derived waste;
12. Tabulation of analytical results for all sampling. Contaminant analyses must have laboratory reporting limits that are lower than state standards or screening levels. Always confirm with the laboratory that reporting or practical quantitation limits (PQLs) allow comparison with the appropriate state screening or cleanup levels for every site contaminant, where possible;
13. Copies of all laboratory reports; and
14. Any other information required by the DEQ or considered relevant by the investigator.

2.1.1 Delineating the Extent of Subsurface Contamination

To properly manage risks, contamination in all media must be delineated laterally and vertically to the unrestricted use standards. Samples must be analyzed using approved methods that can attain PQLs equal to or less than the DEQ screening levels and regulatory standards, or the method with the lowest MDLs. The PQL incorporates laboratory operating conditions and is the lowest concentration of a chemical that the laboratory can be expected to reliably measure. The laboratory should be advised of the desired limits prior to requesting analysis.

Soil

The extent of soil contamination must be defined in all directions to the lower of (1) the residential health-based Preliminary Soil Remediation Goals (PSRGs) or residential cumulative risk of all contaminants using the DEQ risk calculator and (2) the protection of groundwater PSRGs or levels that will not leach from soil to groundwater above the 02L standards. Even when the property use is industrial/commercial, delineating to unrestricted-use remediation goals determines whether contamination extends beyond the property boundary and ensures appropriate placement of ICs. Delineating the vertical extent of soil contamination may help support whether there is a risk to groundwater through leaching.

Groundwater

The lateral and vertical extent of groundwater contamination should be defined to the 02L standards to determine which properties or receptors are or have the potential to become contaminated. Potential receptors include water supply wells, surface water bodies, sensitive environments, and existing and future occupied structures where volatilization of groundwater contaminants could be harmful.

Hazardous substances with a density greater than water often require a more complex assessment

and remediation strategy. If the vertical extent of dense contaminants proves technically difficult and costly to determine, contact the appropriate remediation program to discuss whether other lines of evidence may be considered. For example, assessment methods that show decreasing concentrations with depth or that identify hydrogeologic features that limit flow paths may satisfy an oversight program's vertical delineation requirements.

Where a plume's lateral extent is generally defined, but property access is not granted for final delineation, or ideal drilling locations are inaccessible due to physical constraints, computer modeling may be used to predict maximum extent provided sufficient delineation is demonstrated on accessible properties. Documentation of accessibility issues, property access requests, and any other relevant information should be presented and assistance from DEQ requested before models are considered. The remediating party must demonstrate that sufficient data have been collected, including site-specific aquifer test and geotechnical parameter data to allow for reliable model predictions. Computer models should consider all assessment and monitoring data, and input data should be clearly documented. Fate and transport modeling is discussed later in this guidance.

2.2 Consent Requirement

Analysis of the feasibility of implementing ICs should begin early in the remedial decision-making process. Consent from owners of source properties and other parties that may possess property interests in the land is necessary to ensure that a remedy involving LURs is possible. Non-financial encumbrance-holders on the property, including utility easements and rights-of-way, must be made aware of any proposed LURs to ensure that there are no conflicting interests.

G.S. 130A-310.73A(a)(2) requires that remediating parties obtain consent from owners of contaminated non-source properties and uncontaminated properties where a contaminant plume could be expected to migrate, including state-owned property like roadways owned by NC Department of Transportation (DOT). Research into the ownership of some roadways has proven important to ensure consent is obtained from the appropriate party, which could be a city or county rather than NC DOT.

Consent for site-specific cleanup levels is required from the following property owners:

- Source property (though not specified in statute).
- All properties where a release has migrated, including publicly owned property (rights-of-way, roads, sidewalks)
- All properties where a release is predicted to migrate under natural conditions
- Non-source properties that are not predicted to become contaminated under natural conditions, but where a future water supply well could potentially draw the plume onto those properties

The request for consent provided to affected non-source property owners must be accompanied by the DEQ brochure [Contaminated Property: Issues and Liabilities](#) and a copy of the risk statutes (G.S. 130A-310.65 through 310.77). The brochure was prepared in consultation with the Consumer Protection Division of the North Carolina Department of Justice and the North Carolina Real Estate Commission to provide current/future owners and users of non-source contaminated properties with information about risk-based environmental cleanups, potential risks from residual contamination, and possible real estate issues regarding contaminated property. Remediators need

to provide a copy of this brochure to all owners of non-source property that will need to have the contamination addressed using site-specific cleanup levels and ICs.

Following RAP approval, property owners consenting to site-specific cleanup levels will be required to sign and record the IC documentation on their property deed restricting the use of groundwater and potentially other uses of their property.

2.3 Community Involvement

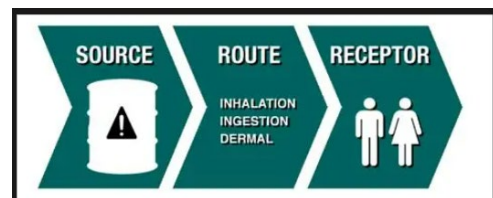
As part of the first phase of the risk-based remediation process, a draft NOIR and a mailing list must be prepared by the remediating party and submitted to the relevant DEQ remediation program for review as part of the public participation requirements (G.S. 130A-310.70). The mailing list shall, at a minimum, include all owners of contaminated property, all owners of property to which the contamination is expected to migrate, all owners of land adjoining contaminated parcels, and local governments having taxing or land-use jurisdiction over the contaminated property. Adjoining properties may need to include owners of property on the opposite side of a roadway.

The NOIR must direct the recipient to the RI report in the DEQ files and include a statement of intent to remediate groundwater at the site to site-specific cleanup levels. Proof of mailing must be submitted to DEQ. There is no comment period associated with the NOIR, but any comments received by the remediating party in response to the NOIR must be submitted to DEQ and addressed in the RAP as appropriate.

The NOIR requirement does not take the place of other public participation requirements associated with a proposed RAP. In most programs, a public notice and RAP comment period is issued once the proposed RAP is final. Adjoining property owners, the local health department, and any others who have expressed interest in the site cleanup activities are solicited for public comment on the RAP. The RAP notice documents the comment period and provides instructions for reviewing the RAP online and submitting comments. The final RAP is not approved by DEQ until all public comments are received and addressed by the remediating party.

3. IDENTIFYING RECEPTORS

Environmental contamination can pose a risk to human health and the environment if there is a complete exposure pathway, whereby people or other receptors can come in contact with the contamination. An exposure pathway requires a source/release of contamination, a contaminant transport mechanism, a point of exposure, an exposure route, and a receptor or receptor population. When all five parts are present, the exposure pathway is complete. Conversely, if an element in an exposure pathway is missing or removed (e.g., through remediation or institutional controls), the pathway is rendered incomplete. All current and potential future exposure pathways must be identified at a site considered for risk-based remediation.



Receptor surveys should be routinely reviewed and updated to account for contaminant migration, development of surrounding properties, and changes in land-use. Potential future receptors must be identified, controlled, or eliminated whether they are located on or off the source property [G.S. 130A-310.68(b)(3)]. Imminent hazards to public health or the environment must be addressed immediately.

3.1 Human Populations

The following receptor populations should be identified for the source and neighboring properties:

- **Residential** – Residential receptors are considered to be areas where both children and adults live or are expected to spend most of their time. Residential properties include single-family homes, townhouses, apartment buildings, college/university dormitories, schools through high school, child/daycare facilities, churches and hospitals.
- **Non-residential** – Non-residential properties are those where adults routinely spend 8 hours per day during a typical workday, including office buildings and commercial/industrial facilities. Colleges and universities (excluding dormitories) are considered non-residential.

Non-residential facilities with chemical exposures that fall under the purview of the Occupational Safety and Health Administration (OSHA) should have work-related risks evaluated separately. As stated in the *DWM Vapor Intrusion Guidance*, if OSHA standards currently govern the amount of chemical allowed in indoor air, future exposures from subsurface contamination should be evaluated using soil gas data to account for potential future changes in use of the building or changes in land use.

- **Construction Worker** – Adult construction/utility workers are a receptor population that can be exposed to soils through large-scale redevelopment activities that disturb at least ½ acre of contaminated soil or through work in excavations or trenches with volatile contamination. The associated exposure parameters assume a shorter exposure duration and higher exposure relative to residential and non-residential worker scenarios because of these assumptions.
- **Recreator** – Recreators include children and adults spending a portion of their time outside involved in recreational activities. This pathway is primarily used to assess surface water recreation or park-use exposures.
- **Trespasser** – Trespassers are unauthorized adults who trespassers at unsecured properties, undeveloped properties, or properties with open space.

3.2 Potable Water Supplies

Contaminated water supplies are a direct exposure route for all receptor populations. All sources of potable water, including active and inactive water supply wells, springs, surface water intakes and private, community and irrigation wells, should be identified within 1,500 feet from the edge of contamination. For solid waste landfill sites, the well-survey radius should extend 1,500 feet from the edge of the waste. If the site is greater than one hundred (100) acres in size, the inventory and map should cover a one-mile radius from the center of each source area. Wells used for industrial process water should also be identified if workers could be exposed to water from these sources, or if the water may be used in the consumer product manufacturing process.

A potable water supply area survey and data search should include one or more of the following activities:

- Visual inspection of properties to identify evidence of water supply wells, such as well houses and well heads.
- Review of city water and sewer billing records for nearby properties. Properties that have no water use record should be assumed to use water supply wells.
- Review of county environmental health departments records for private water supply wells, which may include drilling and construction logs, records of well samples collected by the county for bacteria analysis, and plats with wells located for properties under design. Some septic tank permits indicate water supply well locations.
- Water supply well surveys mailed to surrounding properties.
- Review of DWR maps of surface water intake locations.

The potential receptors should be tabulated and keyed to their locations on a receptor map, along with the level of threat from site contamination. The area(s) served by a municipal water supply should be shown on this map.

3.3 Surface Water

G.S. 130A-310.69(b)(7) states that the 02B standard cannot be violated if a site is known to, or has the potential to, discharge to surface water. Therefore, risk to neighboring surface waters must be understood. **There are no risk-based remediation standards allowed for surface water.**

All surface waters and wetlands within 1,500 feet from the edge of contamination should be identified. Wetlands are defined as those areas inundated or saturated by surface or groundwater for a portion of the year and support vegetation typically adapted for life in saturated soil conditions. Wetlands provide a habitat for numerous plants and animals and must comply with the 02B standards.

Surrounding stream types should be known to understand how they are regulated and whether they are classified:

- Ephemeral streams only carry stormwater in direct response to precipitation. They may have a well-defined channel but typically lack the biological, hydrological, and physical characteristics commonly associated with intermittent or continuous conveyances of water. These features are typically not regulated by the North Carolina Division of Water Resources (DWR) or the U.S. Army Corps of Engineers.
- Intermittent streams have a well-defined channel that contains water for only part of the year. The flow may be heavily supplemented by stormwater. When dry, they typically lack the biological and hydrological characteristics commonly associated with continuous conveyances of water. These features are regulated by DWR and may be regulated by the U.S. Army Corps of Engineers.
- Perennial streams have a well-defined channel and contain water year-round. Although groundwater is the primary source of water, they also carry storm water runoff. They exhibit the typical biological, hydrological, and physical characteristics commonly

associated with the continuous conveyance of water. These features are regulated by DWR and typically regulated by the U.S. Army Corps of Engineers.

DWR classifies surface water bodies according to their best uses, such as swimming, fishing, drinking water supply, and applies an associated set of water quality standards to protect those uses here: [Classifications & Standards | NC DEQ](#).

Surface water samples should be analyzed for the known contaminants in groundwater at various times of the year to determine whether site contaminants are discharging to a surface water body above the 02B standards. The frequency of occurrence, magnitude, and duration of detections over time in surface water should be evaluated since contaminant detections in surface water can be intermittent and inconsistent, which may not necessarily be interpreted as a violation of a 02B standard. The DEQ risk calculator can be used to help predict whether 02B standards could be exceeded from a soil or groundwater source. Always consult with DWR to confirm whether the data collected indicates that a 02B standard is violated.

3.4 Environmentally Sensitive Areas

Properties affected or predicted to be affected by the site should be evaluated for the existence of an environmentally sensitive area listed below. Governing agencies should be contacted to determine if any special sampling (such as aquatic toxicity testing or fish tissue sampling) is needed:

- State parks
- Areas important to maintenance of unique natural communities
- Sensitive areas identified under the National Estuary Program
- Designated state natural areas
- State seashore, lake and river recreation areas
- Rare species (state and federal threatened and endangered)
- Sensitive aquatic habitat
- State wild and scenic rivers
- National seashore, lake and river recreation areas
- National parks or monuments
- Federally designated scenic or wild rivers
- Designated and proposed federal wilderness and natural areas
- National preserves and forests
- Federal land designated for the protection of natural ecosystems
- State-designated areas for protection or maintenance of aquatic life
- State preserves and forests
- Terrestrial areas used for breeding by large or dense aggregations of animals
- National or state wildlife refuges
- Marine sanctuaries
- National and state historical sites
- Areas identified under coastal protection legislation
- Coastal barriers or units of a coastal barrier resources system

- Spawning areas critical for the maintenance of fish and shellfish species within rivers, lakes or coastal tidal waters
- Migratory pathways and feeding areas that are critical for maintenance of anadromous fish species. These can include river reaches or areas in lakes or coastal tidal waters in which such fish spend extended periods of time
- State lands designated for wildlife or game management

If any sensitive environments near the site warrant an ecological risk evaluation, contact the proper oversight agency for guidance on how to proceed.

3.5 Other Points of Compliance

Property boundaries often serve as points of compliance. Contaminant plumes that threaten to or migrate onto a neighboring property where consent for site-specific remediation standards has not been granted will need to be remediated to ensure 02L standards will never be exceeded beyond the property boundary. Consent from affected neighboring property owners is required under G.S. 130A-310.73A(a)(2)(b).

4. DETERMINING SITE-SPECIFIC REMEDIATION STANDARDS

Site-specific remediation standards must be developed for each medium according to G.S. 130A-310.68(b). They must be (1) protective of human health and the environment, (2) based on the present or currently planned future use of the property comprising the site, (3) compatible with surrounding land uses, (4) protective of other media (groundwater, surface water, and indoor air), and (5) demonstrated to be attainable and maintainable.

Site-specific remediation standards for a contaminated medium cannot allow discharge of contaminants into surface waters that violate applicable 02B standards nor can they potentially create an unacceptable current or future vapor intrusion risk in occupied structures.

4.1 Soil, Sediment and Vapor

Screening levels are provided for soil, sediment, soil gas and indoor air. The values for residential (unrestricted use) and industrial/commercial (also referred to as non-residential) are conservatively derived chemical concentration thresholds below which contaminants are unlikely to pose significant human health or ecological risks. They are calculated using the chemical database, toxicity values, default exposure parameters, and equations found in the [USEPA Regional Screening Level \(RSL\) tables](#). DEQ's screening levels are derived from the USEPA RSLs and are the concentration of a chemical that corresponds to the specified "target risk" of 1 in 1,000,000 (or 1E-06) for chemicals with cancerous effects and a hazard quotient (HQ) of 0.2 for contaminants with non-cancerous health effects. The lower of the cancerous or non-cancerous targets is used as the screening level. DEQ updates the screening levels following the release of USEPA's RSL updates.

Screening levels are not legally enforceable cleanup standards. Instead, they are *screening* benchmarks to identify chemicals of potential concern that may require further evaluation. They

should not drive remedial action decisions. Rather, RPs should base site-specific remediation standards and remedial action decisions on the cumulative risk of all contaminants that comprise a site, which can easily be determined using the DEQ risk calculator.

The DEQ risk calculator is a user-friendly, Excel-based, menu-driven program that can calculate cumulative risk of exposure to multiple receptors from multiple site contaminants in multiple media. All detected constituents must be included in the cumulative risk calculation even if some were not definitively quantified. See the *DEQ Risk Calculator User Guide* (User Guide) for the data entry requirements. The DEQ risk calculator and User Guide are located on the Risk Evaluation Resources page of the DEQ Risk Based Remediation website here: [Risk Evaluation Resources | NC DEQ](#)

An acceptable cumulative risk must be less than 10^{-4} for chemicals with cancerous effects and a Hazard Index (HI) of 1.0 for chemicals with non-carcinogenic toxicity [G.S. 130A-310.68(b)(9)]. If cumulative risk is within the targets for the receptor population, then site-specific remediation standards are considered met.

If site conditions do not meet acceptable risk, active remediation, engineered controls and/or institutional controls will be needed to reduce the risk to acceptable levels. If active remediation is necessary, numerical remediation standards that will meet acceptable risk can be calculated using the DEQ risk calculator. Where only one contaminant is present at a site, the user can easily iteratively enter concentrations until the calculated risk is within the acceptable targets (see the User Guide for more details). Calculating remediation standards when the site is made up of several contaminants becomes more difficult unless a single contaminant is clearly driving the risk. Remediating parties will be expected to demonstrate how the cleanup levels were calculated and may need to apply safety factors to the final remediation standards to account for any uncertainty.

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

A **hazard quotient (HQ)** is the ratio of the amount of a contaminant a person is exposed to versus the amount that may cause non-cancer harmful effects. The **hazard index (HI)** is the sum of the hazard quotients (at 0.2 each) for a given scenario.

It is anticipated that the risk calculator will be sufficient for evaluating risk of contaminated soil, sediment, or vapor at most sites. If an HI is exceeded at a site, a DEQ toxicologist may assist with further risk assessment consisting of a target organ evaluation. Contact your remediation program representative if further risk assessment is warranted. While a professional toxicological evaluation may be conducted at any site, it is usually only required for larger, more complex sites where the added cost of the risk assessment may result in a more cost-effective cleanup strategy.

Guidance for conducting a more detailed site-specific risk assessment is provided in [USEPA Superfund Guidance For Human Health Risk Assessments](#). Discussions with DEQ risk assessors or toxicologists prior to initiating such a detailed risk assessment are essential.

4.2 Groundwater

Unrestricted-use standards must be met on all contaminated properties unless the property owner

consents to site-specific remediation standards and ICs [G.S. 130A-310.73A(a)]. Unrestricted-use standards for groundwater include the following:

- The groundwater standards established under 15A NCAC 02L,
- Interim Maximum Allowable Concentrations (IMACs) set by DEQ where no formal standard 02L standard exists,
- The laboratory's practical quantitation limit where no standard exists or the standard is less than the PQL, or
- The demonstrated naturally occurring or background concentration in the site vicinity.

Site-specific remediation standards may be calculated for groundwater under G.S. 130A-310.68 and must consider the current and anticipated future uses of groundwater [G.S. 130A-310.68(b)(4)]. If the release is relatively old, sufficient groundwater monitoring shows that contaminant levels have stabilized, and the ICs are sufficient to mitigate all current and future risks to receptors and other media, then site-specific, risk-based remediation standards can be considered met since a stable plume will pose no future risks to neighboring properties. However, if the plume is not stable or current contaminant levels could pose a risk to indoor air, a distant receptor or future receptor, site-specific remediation standards will need to be calculated to protect those receptors.

The contaminant migration worksheets in the risk calculator, or a more sophisticated model such as Biochlor, can be used to back-calculate a site-specific, source-area remediation standard that will meet the 02L standards at a specified location, i.e., a downgradient receptor or property boundary. If fate and transport models other than the DEQ risk calculator are used to develop site-specific remediation standards, documentation pertaining to the model used, including input parameters, calibration, etc., must be provided.

4.3 Accounting for Contaminant Migration

Understanding the migration of contaminants in the subsurface is important to ensure protection of future receptors and apply ICs. Soil contamination can be a continuing source of contamination to groundwater, and contaminants in groundwater can migrate laterally and threaten future receptors. Volatile contaminants in soil gas associated with soil and/or groundwater contamination can migrate into existing and future structures posing a risk to occupants. Understanding the potential for contaminant migration is essential to protect future receptors.

4.3.1 Soil to Groundwater Transport through Leaching

Soil must be remediated to levels that no longer constitute a source of groundwater contamination in excess of the approved site-specific groundwater remediation standards [G.S. 130A-310.68(a)(5)]. In general, if groundwater contaminant concentrations are demonstrated to be stable or decreasing over several years of monitoring, then soil contamination is not considered to be a continuing source of groundwater contamination. Additional, and more quantitative, methods can be used to rule out soil as a continuing source of contamination, and they are described below.

4.3.1.1 *Site-Specific Calculation*

The protection of groundwater PSRGs are based on the USEPA soil leachate equation (see the Risk Evaluation Equations and Calculations on the Risk-Based Remediation website [here](#)) with USEPA and DEQ-selected default fate and transport parameters and the groundwater target concentrations being the 02L standards.

Site-specific leachability of unsaturated soil contamination can be calculated by using site-specific aquifer properties and/or the site-specific groundwater target concentrations rather than the default aquifer properties and 02L standards.

4.3.1.2 *Analytical Leaching Procedures*

Site-specific soil leachability can be analyzed in a lab using the Synthetic Precipitation Leaching Procedure (SPLP) or Toxicity Characterization Leaching Procedure (TCLP). TCLP 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. The lab will measure the concentration of contaminants in the extraction fluid (leachate). If leachate concentrations are below the site-specific groundwater remediation goals, then soil contamination is not considered to be a continuing source of groundwater contamination provided the soil conditions are relatively uniform across the site.

If a laboratory model other than SPLP is proposed to determine leachability, its scientific validity must be demonstrated, and its precision and accuracy must be commensurate with its stated use.

4.3.2 Groundwater Transport

Sufficient water level data should be collected to calculate horizontal and vertical gradients and determine the groundwater flow pattern/direction across the property to understand contaminant migration. Aquifer and/or slug tests can approximate site-specific aquifer hydraulic conductivity, and geotechnical analyses of soil samples can provide site-specific porosity, bulk density, and other aquifer properties. These parameters are key when using the risk calculator or other fate and transport models to predict contaminant transport in groundwater. The following characteristics that could influence groundwater velocity, direction, and discharge across the property should be identified and considered:

- Local geology
 - groundwater flow system framework
 - groundwater flow horizons and their orientation, thickness, and properties
 - confining units, if present
 - bedrock fractures and other preferential flow zones
 - lithology
 - geologic structures
 - geologic heterogeneities or anomalies
- Site features
 - Man-made utility conduits
 - Impervious cover
 - Surface water impoundments

- Geomorphology
 - Recharge and discharge environments
 - Tidal influences on coastal surface waters
- Pumping wells: past, current, future

The monitoring well network should reflect the complexity of the subsurface conditions and define and track the spatial extent of contamination. Monitoring data should be gathered over a sufficient timeframe to understand seasonal fluctuations, effects of active remediation, and the mobility of contaminants in groundwater.

Groundwater plumes of persistent, higher-density chemicals, such as chlorinated solvents or the more common PFAS, can migrate to great depths or extend for long distances – sometimes more than a mile. Sentinel wells should exist at key locations and be screened at appropriate depths to define the plume's extent and detect advancing contamination ahead of a receptor or property boundary.

4.3.2.1 Predicting Maximum Extent of Contamination/GW migration

According to G.S. 130A-310.71(b), the person who proposes a risk-based RAP has the burden of demonstrating with reasonable assurance that contamination from the site will not migrate to off-site property above unrestricted-use levels unless written consent is obtained from the off-site property owner for cleanup to site-specific remediation standards with an IC barring any groundwater use. Therefore, predicting the maximum plume extent when stability cannot yet be demonstrated is critical for proper placement of ICs.

Although many fate and transport models are available, DEQ requires that numerical models be used only in support of site monitoring data. The remediating party should first make use of conservative, simplistic models and calculations, like the transport modules in the DEQ risk calculator. If more complex models are used, such as USEPA's Biochlor, it is expected that sufficient site-specific data are available as inputs to the model, and the model is calibrated to field measured observations. Use of literature-based parameters or undocumented site-specific parameters hold little value. If a model is used to support site-specific data, the process by which the model was selected, developed, calibrated, and used must be documented and include the following information.

1. Identify the type of model selected (e.g., analytical, numerical), model software, and version.
2. Describe its applicability and limitations as they relate simulating the site-specific hydraulic, geochemical, and contaminant conditions.
3. Provide a detailed description of the model fundamentals, assumptions, and limitations.
4. Specify the source of all input parameters.
5. Describe how the model was calibrated to field conditions.
6. Present the sensitivity analysis whereby various input parameters are used to determine ranges of uncertainty in values of a specific parameter.

7. Provide the simulation output sheets and a detailed description of the validity of the predictive simulation.

4.3.3 Evaluating Plume Stability

A risk-based groundwater remedy is most applicable to a groundwater contaminant plume that is predictable, stable, or shrinking over time. Further emphasizing the need to demonstrate plume stability and predictability in a risk-based RAP, G.S. 130A-310.73A(a)(2) states that "...site-specific remediation standards shall not allow concentrations of contaminants on the off-site property to increase above the levels present on the date the written consent is obtained," implying that the plume's behavior must be well-understood and predictable.

A plume is stable when monitoring data representative of the entirety of the plume demonstrates that the plume is not expanding, and that contaminant concentrations are not increasing over time. A stable plume indicates that groundwater contamination is contained in place and there is no unacceptable risk to future distant receptors. Stability does not imply lack of change, but rather, that change and variability are within predictable and manageable limits over the time of interest.

Plume stability should be supported by tabulated historic data, contaminant isoconcentration maps, concentration versus time graphs for select monitoring wells, and concentration versus distance graphs showing concentrations along the plume centerline over time. Displaying the data in multiple ways in visual form is the best way to support conclusions made regarding plume stability. For example, plume geometry could be consistent and not expand over time, while contaminant concentrations are increasing within the plume. An example of this could be a plume discharging to a surface water body.

Another approach for evaluating plume stability is using statistical analysis for single-well data. Meaningful statistical tests typically require eight or more consecutive sampling events. Determination of temporal trends at individual well locations using regression, Mann-Kendall, or Mann-Whitney methods are common approaches for assessing plume stability. However, chemical concentration trends at individual monitoring wells may not reflect overall plume trends.

Plume-based methods include evaluation plume area, plume mass, plume center of mass, and mass flux analyses over time to provide a more thorough understanding of plume stability than evaluation of isolated locations within the plume. However, reliable mass flux and mass discharge estimates often require more detailed characterization of hydraulic conductivity and groundwater flow than is typically available at most sites.

A demonstration of plume stability should include:

- Sufficient spatial coverage of sample points to define the plume's configuration and monitor its behavior.
- At least four (4) site-wide sampling events over time to understand contaminant trends.
- At least eight (8) sampling events for statistical evaluation of stability.
- Maps of plume's spatial extent over time.
- Graphs of individual well trends over time.
- Graph of concentration vs. distance over time.
- Calculations of plume area, plume mass, plume center of mass, and/or mass flux analyses.

4.3.4 Protecting Surface Water

Remedial actions need to be designed to ensure that the 02B standards are met, and the best uses of the surface waters are protected. In a wetland evaluation, soil, sediment, and standing water should be assessed if they are affected or threatened by the site contamination. A “multiple lines of evidence” approach will better demonstrate that proposed remedies will be protective of the surface water quality standards into the future.

At sites where groundwater contamination has been delineated, contaminant sources have been addressed, and sufficient data are available, one of the following determinations may be appropriate:

- If lines of evidence demonstrate that contamination from the site does not, and will not, extend to any surface water feature, surface water is considered protected.
- If lines of evidence demonstrate that contamination from the site does/may extend to a surface water feature but does not and will not exceed any applicable 02B standards, surface water is considered protected. If a standard is not available in the 02B table, contact DWR for the calculation of a provisional value.

The site-specific remediation standard for surface waters shall be the 02B standards [G.S. 130A-310.68(b)(2)]. There is no option to calculate a site-specific cleanup level for surface water. Therefore, if groundwater is discharging to a surface water body at levels that violate the 02B standards in magnitude, duration and frequency, groundwater must be remediated such that the 02B standards are met.

If the groundwater contaminant concentrations and surface water flow rate are known, the risk calculator can predict the future surface water contaminant concentration using simple advective transport and dispersion equations, but the collection of data may be needed to confirm the results.

5. RISK MANAGEMENT AND ENSURING REMEDY PROTECTIVENESS

Once the unacceptable risks are known, active remediation, ECs, and/or ICs must be planned to mitigate risks in a way that ensures protection of human health and the environment [G.S. 130A-310.71(a)(9)]. To effectively manage risk, the following factors should be considered:

- Scientific: The level of risk calculated from the risk evaluation, and the cleanup levels needed to achieve acceptable risks.
- Technical feasibility: Feasibility of implementing a risk management option.
- Economic: The cost of risk mitigation and the benefit of the outcome.
- Social: Land use, zoning, community input.
- Political: Local government entities, special interest groups, or concerned citizens.

All proposed risk-based remedies will rely on ECs and/or ICs that are demonstrated to be protective of existing receptors and potential future receptors if the property and its use could change.

5.1 Engineered Controls

Various ECs can be implemented to contain and/or prevent exposure to contamination, depending on the contaminants found and the type of media impacted. The following is a list of more commonly used ECs. Individual DEQ remediation programs may have a preference or specifications for certain technologies, so coordination with the oversight program is encouraged.

Contaminated Property:

- **Security Barriers and Fencing** – To restrict access to contaminated areas.

Contaminated Soil:

- **Capping in Place (Asphalt or Concrete)** – The use of paved areas and building slabs as surface barriers (caps) over contaminated soil reduces surface water infiltration, stabilizes contaminated soils, and prevents direct contact with the contamination.
- **Capping in Place (Clean Fill)** – Placement of a defined thickness of clean fill over contaminated soil prevents direct contact with the contamination. The clean fill thickness is typically 12-18 inches and may vary among DEQ remediation programs. A geotextile fabric marker beneath the clean fill is typically required, and erosion control measures must be in place.

Contaminated Vapor:

- **Passive Depressurization Systems** –A passive depressurization system installed beneath a building relies on natural convection to allow lateral air movement from beneath a building to the atmosphere, rather than through the floor, through a series of collection and discharge pipes. It is often used in conjunction with a vapor barrier installed beneath the building.
- **Active Depressurization Systems** –An active depressurization system consists of a powered fan or blower that actively draws air from beneath a building to the atmosphere through a series of collection and discharge pipes. It is often used in conjunction with a vapor barrier installed beneath the building.

5.2 Institutional Controls

Institutional controls cannot render use of a property as incompatible with the surrounding land use.

Restricted property use must comply with land-use and development controls adopted by a municipality or county.

ICs are required for all environmental media that do not meet residential (unrestricted use) remediation standards [G.S. 130A-310.69(b)(11)]. These administrative or legal instruments will limit the full use of contaminated property where unacceptable risk is present so current and future receptors are protected from exposure to contamination. ICs also identify the presence of ECs and specify their long-term inspection, maintenance, monitoring, and reporting requirements.

The DEQ IC documents typically consist of a LUR document (often referred to as a Declaration of Perpetual Land Use Restriction or DPLUR) and a

survey plat titled Notice of Residual Contamination (Notice) that describes the residual contamination remaining on a property. Confirm with the appropriate remediation program the document titles that should be used as they may slightly differ. Land-use restriction documents are required when property use is restricted due to risks from other contaminated media, like soil or indoor air, in addition to the risk associated with groundwater use. The LUR document content will initially be developed by DEQ for review and comment by the remediator. The land-use restriction document includes a requirement for the property owner to conduct an annual inspection and certify that any ECs are maintained and the LURs are still in place. The inspection report is due to DEQ each year.

In some programs, if just groundwater poses a risk because concentrations exceed a 02L standard (no vapor intrusion risk), only a Notice is required for recordation on the deed. Detailed instructions for how to prepare a survey plat notice will be provided by DEQ. Table 5-1 shows how the two IC documents are applied to contaminated property. Ultimately, the ICs will need to be approved and signed by the property owner when finalized as part of an approved RAP.

Table 5-1. Conditions and Type of Institutional Controls

Media Contaminated	Condition	Land-Use Restriction Document	Notice of Residual Contamination (Survey Plat)
Groundwater > 02L	Current extent of contamination poses a groundwater use risk only (no vapor intrusion risk) and there is no predicted contaminant migration beyond the source property		X
Potential Future Groundwater > 02L on adjoining property	A threat of groundwater contamination onto an adjacent property poses a future groundwater use risk (no vapor intrusion risk) if a water supply well is installed		X
Groundwater > 02L and Soil, Sediment or Vapor exceeds risk for unrestricted/ residential use	Contamination in groundwater poses a groundwater use risk and soil or vapor poses a risk to certain property uses (e.g., residents, trespassers, etc.)	X	X

2

LURs already recorded on a property as part of a Brownfields agreement may be relied upon in lieu of recording additional IC documents if they are sufficient to mitigate all identified risks. Adjoining properties that have unacceptable risk due to migration of the site but are not part of a recorded Brownfields agreement must have the appropriate ICs as part of a risk-based RAP prepared according to G.S. 130A.31065-77. The DEQ program that signed the LUR document will maintain responsibility for ensuring inspection and maintenance of the LURs.

Notices of Residual Petroleum (NORPs) recorded on properties cannot be relied upon as an IC because they do not cover hazardous substances. Therefore, NORPs must be accounted for in the for hazardous substances using the following language in a note:

The land-use restrictions specified in the Notice of Residual Petroleum, previously recorded pursuant to N.C. Gen. Stat. § 143B-279.9(b) and N.C. Gen. Stat. § 143B-279.11(g) in the _____ County Register of Deeds, Book _____, Page _____ on <date> , remain in full force and effect, and are incorporated herein.

5.2.1 Land-Use Restrictions

LURs are catered to the site-specific risks and are developed for each contaminated medium to meet acceptable sitewide risk. DEQ has a standard set of LURs to mitigate specific risks posed by environmental media, and others may be proposed by the property owner. Easements and non-financial encumbrances must be considered when planning LURs. All rights-to-use must not be hindered without written agreement from the easement or encumbrance holder(s). LURs that were previously recorded without DEQ's involvement will need to be subordinated or cancelled in some cases. In general, LURs typically follow the principles outlined in the following sections.

5.2.1.1 General Property-Use Restrictions

Each remedy that relies on LURs will need to consider the current and anticipated future land and groundwater uses and tailor the restrictions accordingly [G.S 130A-310.68(b)]. Restricting a property to “industrial use only” is not equivalent to “non-residential use only.” Industrial use in the zoning context generally allows for parks, recreational areas and day care facilities on industrial property. Similarly, “commercial use” can vary greatly and include schools. If the intent of the proposed restriction is to prohibit residential, day care, and school uses, the restriction should then list the specific uses for which the property may not be used.

For unsecured properties, risk to trespassers must be evaluated. Other uses of property may include recreational, park use, open space, and warehousing. If a property use cannot be evaluated using the DEQ risk calculator, contact the remediation program representative about providing the appropriate information so a DWM toxicologist can conduct a risk evaluation for a specific scenario.

5.2.1.2 Land Use Restrictions for Properties with Soil Contamination

Property Use: Soil contamination on residential or industrial/commercial property must be cleaned up to acceptable risk levels for the intended use. If acceptable risk is exceeded for residential use, ground level property uses must be nonresidential and potential exposure to contaminated soil must be eliminated [G.S 130A-310.68(a)(6)].

Soil removal: Remedies not meeting the acceptable residential risk levels throughout the soil column must include a restriction that bars removing soil from the property.

Barriers: If it is technically impracticable to remediate soil to the appropriate property use levels, an engineered barrier (cap) must overlie the contaminated material and be marked and maintained

to prevent direct contact exposure. A building, asphalt, concrete, or earthen cover can serve as a barrier to soil contamination, and the ICs would describe the location and any required maintenance [G.S 130A-310.68(b)(6)]. The following general requirements for a barrier apply:

- The area should be generally rectangular in shape so the perimeter can be surveyed, and the boundary depicted on the survey plat/notice. The area should not be curved, irregular, or consist of multiple smaller patches of cover.
- The perimeter of the capped area must have a visible and physical boundary marked by bollards or fencing, or the entire property must be fenced. The use of paint alone to mark the boundary is not always acceptable.
- A restriction would be required to indicate that disturbance of the barrier or underlying soil is not allowed without DEQ approval. There may be circumstances that specific disturbances are allowed, and these should be noted in the restrictive covenants.
- As part of the annual certification, the owner must inspect barriers and document that they have been maintained in accordance with the specifications in the LUR.
- A vegetative cover is an acceptable barrier if the area is fenced with no regular access and the risk assessment indicates it is safe for a worker to maintain the vegetative cover and fence.
- High vehicular traffic areas, such as parking lots and other areas accessible by trucks and cars, should have durable barriers such as concrete or asphalt.
- Low or no vehicular traffic areas can have an earthen barrier. If soil contamination is present within 10 feet of the ground surface, a geotextile marker fabric must be used to identify the contaminated zone and reveal excessive erosion. Typically, contaminated soil is covered by a minimum of one foot of structural fill, geotextile fabric, and 6 inches of amended topsoil to promote a vegetative cover. If contaminated soil cannot be covered by a minimum of one foot of structural fill, the geotextile fabric can be placed directly on the contaminated surface and overlain by 12 inches of topsoil.
- High-use areas, such as ball fields, kennel yards, and horse-riding areas require earthen barriers of a thickness greater than 3 feet.
- If irrigation systems, lighting conduits, or other infrastructure are desired within the earthen barrier, the barrier must be of greater thickness or augmented with clean fill to accommodate their installation and maintenance.
- For earthen barriers, required maintenance may include measuring the depth and extent of the barrier and upkeep of erosion control measures to ensure compliance with the LURs.

5.2.1.3 Restrictions for Properties with Groundwater Contamination

In general, properties where groundwater contamination concentrations currently, and have future potential to, exceed the 02L standards will have restricted groundwater use [G.S 130A-310.68(b)(3)]. The groundwater-use restriction will encompass the entire parcel. Some large properties may be subdivided to avoid LURs on uncontaminated portions if most of the property is uncontaminated and a technical demonstration supports such.

Existing and potential future groundwater supply wells in the vicinity of a site must be considered in a risk evaluation to ensure that site contaminant levels are protective of all current and future receptors.

5.2.1.4 Restrictions for Properties with Vapor Intrusion Risks

When occupants of buildings are at risk from landfill gas or volatiles emanating from the site, mitigation measures must be implemented [G.S 130A-310.68(b)(7)]. Passive mitigation measures such as improved ventilation, sealing of conduits where vapors may be entering the building, and enclosing passively venting sumps may significantly reduce the VI risk. In other cases, ECs in the form of a vapor barrier and/or an active mitigation system may be required.

Property owners will be expected to satisfactorily demonstrate through sampling or other direct means, that the mitigation measures are operating and being maintained as designed. Requirements for the property owner's routine inspection, maintenance and reporting of the controls will be included in the LUR document.

Where there is no building, but soil gas concentrations indicate that an indoor air risk could be present in new construction, a LUR will be included that requires permission from DEQ for an owner to construct a building and a requirement to provide data to demonstrate that the building is safe prior to occupancy.

5.2.2 Reliance on State and Local Land-Use Controls

Properties with only groundwater contamination (soil meets unrestricted/residential use) that does not cause a vapor intrusion risk may rely on existing state or local land-use controls in lieu of recording a LUR document [G.S. 130A-310.71(a)(9)] provided the state or local land-use controls are reiterated on a Notice and the following are true:

1. There is no associated human health or environmental risk on the property from other contaminated media.
2. Permission for the Notice is obtained from the property owner(s).

The Notice may be filed by the property owner or the person who proposes to remediate the site. Rules 15A NCAC 02C .0107 (b)(1) and 15A NCAC 02C .0112(a) must be reiterated on the notice in the notes section to restrict future water-supply wells on the property using the wording shown below:

Pursuant to 15A North Carolina Administrative Code 02C .0107 (b)(1), "(t)he source of water for any water supply well shall not be from a water bearing zone or aquifer that is contaminated". Therefore, state law prohibits construction of a water supply well on this property. Further, pursuant to North Carolina General Statute 87-88(c) and 15A North Carolina Administrative Code 02C .0112(a), no well may be constructed or maintained in a manner whereby it could be a source or channel of contamination of the groundwater supply or any aquifer.

Local ordinances relating to water line connection requirements, or well-installation or groundwater-use restrictions, should also be added to the Notice in a note. Notices do not require property owners to annually report to DEQ, since that requirement is only specified in the LUR document.

6. PREPARING A RISK-BASED REMEDIAL ACTION PLAN

The risk-based RAP is a public document that should be written in a clear and concise manner in accordance with G.S. 130A-310.69(b) and program-specific requirements. The plan presents preliminary decisions and/or recommendations for sites that may require revision following DEQ review and public comment.

6.1 Content

A risk-based RAP should reference the remedial investigation report(s) on file, present the site conditions and risks, describe the methodology for developing site-specific remediation standards for each contaminated medium, and present the ECs and ICs that will mitigate all unacceptable risks to public health and the environment. In accordance with G.S. 130A-310.69(b), a risk-based RAP should include the key elements outlined below and the information required in the specific remediation program's guidelines, as applicable:

1. Identify the current and anticipated future uses of the contaminated site.
2. Identify the current and anticipated future use of groundwater at the contaminated site.
3. Present and describe the site conditions with current and potential future receptors and exposure pathways identified.
4. Address contamination that moves from one medium to another to prevent a violation of the remediation standards established under G.S. 130A-310.68. A more stringent remediation standard may be required for a particular medium to control impact to other media.
5. Present the risk assessment and mitigation measures for all unacceptable risks to human health and the environment.
6. Provide for attainment and maintenance of the remediation standards established in accordance with G.S. 130A-310.68.
7. Address any concerns raised in public comment on the proposed RAP as to the future use of the property and groundwater.
8. Provide for submission of an annual certification to DEQ by the property owner that land use at the site is in compliance with LURs and the LURs are still properly recorded in the chain of title for the property.

6.2 Risk-Based RAPs that Include Active Remediation

Although the statutes allow calculation of site-specific groundwater remediation standards with an active remedy, it is not recommended because fees are collected at the outset, financial assurance will be required per G.S. 130A-310.72, and significant time may be needed to achieve the approved site-specific remediation standards, or they may never be met. The remediating party must demonstrate with reasonable assurance that (a) site-specific cleanup levels are appropriate for the site [G.S. 130A-310.71(a)(1)], (b) the proposed RAP can be implemented within a reasonable timeframe without jeopardizing public health or the environment G.S. 130A-310.71(a)(8)], (c) contamination will not migrate to non-source property at levels above unrestricted use standards unless property owner consent is obtained for site-specific cleanup levels- [G.S. 130A-310.71(b)], and (d) the cleanup levels and objectives are achieved and maintained into the future.

The remediator will need to balance the cost of paying the required fees and pursuing an engineered risk-based remedy with the level of certainty that the site-specific cleanup objectives will be met and maintained in perpetuity. In addition to the items listed above, the following should be included in a risk-based RAP proposing an active, engineered remedy per G.S. 130A-310.69(b):

1. Describe actions required to remove, treat, or otherwise appropriately mitigate or isolate the source of contamination to ensure that the source will not cause unrestricted use standards to be exceeded in any uncontaminated medium.
2. Provide a detailed description of (a) the proposed remedial action to be taken, (b) the results of any treatability studies and additional site characterization needed to support the proposed remedial action, (c) plans for post-remedial and confirmatory sampling, (d) a project schedule, (e) a schedule for progress reports to DEQ, and (f) any other information required by DEQ or considered relevant by the person who submits the proposed RAP.
3. Discuss the ease or difficulty of implementing the RAP, including (a) commercially available remedial measures, (b) expected operational reliability, (c) available capacity and location of needed treatment, storage, and disposal services for wastes, (d) time to initiate remediation, and (e) approvals necessary to implement the remediation.
4. Evaluate (a) the toxicity, mobility, and concentration of contaminants, including the volume of contaminated material that will be removed, contained, treated, or destroyed, (b) the degree of expected reduction in toxicity, mobility, and volume, and (c) the type, quantity, toxicity, and mobility of contaminants that will remain after implementation of the RAP.
5. Specify any measures that may be necessary to prevent adverse effects to the environment that may occur at contaminant concentrations below human health cleanup levels.
6. Specify measures necessary to prevent discharge into surface waters during implementation of the RAP that violate applicable surface water quality standards adopted by the NC Environmental Management Commission (Commission).
7. Specify measures necessary to prevent air emissions during implementation of the RAP that violate applicable air quality standards adopted by the Commission.
8. Provide for methods and procedures to verify that, at the conclusion of the contaminant-reduction phase of remediation, (a) the quantity, concentration, range, or other measure of each remaining contaminant meets the cleanup levels established for the site, (b) an acceptable level of risk has been achieved, and (c) no further remediation is required.
9. Evaluate the short-term risks and effectiveness of the remediation, including the short-term risks that may be posed to the community, workers, or the environment during implementation of the RAP, and the effectiveness and reliability of protective measures to address short-term risks.
9. Provide a description of measures that will be employed to ensure that the safety and health of people on property in the vicinity of the site and people visiting or doing business on the site will not be adversely affected by any remediation activity.
10. Discuss the long-term risks and effectiveness of the proposed remediation, including an evaluation of the following:
 - a. The magnitude of remaining risks after completion of the remediation.

- b. The type, degree, frequency, and duration of any post-remediation activity that may be required, including, but not limited to, operation and maintenance, monitoring, inspection, reports, and other activities necessary to protect public health and the environment.
 - c. Exposure potential for human and environmental receptors to contaminants remaining at the site.
 - d. Long-term reliability of any engineering and voluntary ICs, including repair, maintenance, or replacement of components.
 - e. Time required to achieve cleanup levels.
11. Provide a reasonable remedial action cost estimate sufficient for DEQ to determine an acceptable level of financial assurance.
12. Provide proof of financial assurance if required by G.S. 130A-310.72.

6.2.1 Financial Assurance Requirements

Financial assurance may be required to prove sufficient funds are available to implement and maintain long-term, active remediation systems, such as an injection and monitoring or a pump-and-treat system. To avoid the cost of financial assurance and risk of trying to meet site-specific remediation standards that may not be attainable, it is preferred by DEQ that a site-specific risk-based remedy is proposed only after an active remedy has achieved plume stability as demonstrated by sufficient monitoring.

DEQ does not require financial assurance for risk-based remedies where the mitigation measures involve low-cost activities, such as soil excavation and capping. Programs with significant financial assurance experience have found that long-term financial assurance for low-cost activities is unavailable or cost prohibitive, it may not always be possible to secure trusts and escrows for lower cost activities, and corporate guarantees may not be available to all remediating parties.

6.3 RAP Approval and Implementation

DEQ will review and approve proposed RAPs consistent with the procedures set out in G.S. 130A-310.71 and will determine whether site-specific cleanup levels are appropriate for the site. RAPs must identify all current and potential future risks, present the risk mitigation measures, and demonstrate with reasonable assurance that public health and the environment are protected.

RAP approval will be based on the information presented in the RAP as well as information provided by local governments and adjoining landowners in response to the NOIR. Supplemental submissions and revisions may be required based on DEQ's review comments. Once DEQ approves the proposed RAP, the notification of the public comment period required by applicable programs can be issued. All public comments must be reviewed and addressed by the remediating party or DEQ.

RAP implementation is considered to be when active remediation begins, proposed ECs are constructed, and/or ICs are recorded with the Register of Deeds.

6.4 Recordation of Documents

If both a LUR document and the Notice survey plat are required as part of the remedy, the survey plat must be recorded first with the Register of Deeds. The map book and page number provided by the Register of Deeds for the survey plat is then referenced in the LUR document. The LUR document is recorded last.

To confirm proper recordation of documents, the remediating party must provide electronic copies of the recorded documents to the appropriate program with the following Register of Deeds notations: the book and page number where the document was recorded, and the date of recordation. Confirm that the date of recordation noted on the grantor/grantee pages matches the date on the document. The remediation program may require confirmation that the documents are referenced to the appropriate property on the grantor/grantee pages by either providing proof of a Geographic Information System search or requesting a certification of recordation from the Register of Deeds.

7. REMEDIAL ACTION COMPLETION AND NO FURTHER ACTION

After the RAP has been fully implemented, the remediating party can submit a remedial action completion report. This final report should document that site remediation has achieved the approved cleanup levels, ICs are recorded, ECs are operational and effective, and monitoring wells are properly abandoned since they should no longer be needed.

The final report can be accompanied by a request that DEQ issue a determination that no further remediation is required. Once DEQ has issued a no further action (NFA) determination, DEQ could require additional remedial action by the remediating party if there is a material change in the facts known to DEQ at the time the NFA determination was issued, new facts cause DEQ to find that further remedial action is necessary to prevent unacceptable risk to human health or the environment, or one or more of the conditions, restrictions or limitations imposed on the site as part of the RAP have been violated [130A-310.73(c)].

7.1 Annual Certification of Land-Use Restrictions

If required in the recorded LUR document, each year by January 31st, current and future owners of properties must conduct an annual property inspection to confirm compliance with the LURs. After this inspection, a certification form confirming that the LURs are in place and maintained as specified in the LUR document must be submitted to DEQ. An example annual report form is included as Appendix A. In accordance with G.S. 130A-310.3(f) property owners must enforce the LURs and are expected to act immediately upon discovery of a violation of the LURs. Failure to do so could cause automatic revocation of DEQ's approval of the environmental cleanup activities, and the NFA status would be rescinded.

DEQ may periodically inspect restricted properties with ECs for compliance with the property's recorded LURs. Owners of restricted properties must allow DEQ access to the property for such inspections.

7.2 Cancellation of Land-Use Restrictions

If the owner demonstrates through sampling that all unacceptable risks associated with the site are mitigated, and hazardous substances are no longer present above unrestricted use standards, the owner may request that the DEQ Secretary cancel the LUR document. Canceling LURs without prior DEQ approval will cause automatic revocation of approval of the RAP and no-further-action status and will subject the party to enforcement.

8. REFERENCES

USEPA, 1989. Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual (Part A).

USEPA, 1996. Soil Screening Guidance: User's Guide.

USEPA, 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites.

USEPA, 2004. Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual (Part E).

USEPA, 2018. Region 4 Human Health Risk Assessment Supplemental Guidance.
https://www.epa.gov/sites/default/files/2018-03/documents/hhra_regional_supplemental_guidance_report-march-2018_update.pdf

USEPA, 2024. Regional Screening Levels (RSLs)
<https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables>

APPENDIX A

Annual Report Form for Perpetual Land-Use Restrictions



**Inactive Hazardous Sites Branch
Annual Report Form for Perpetual Land-Use Restrictions**

Site Name: _____

Site ID No.: _____

County in NC: _____

YES **NA** (*not applicable*). Check all that apply:

All restrictions in the recorded Declaration of Perpetual Land Use Restrictions (DPLUR) document are still in compliance.

All posted signs and demarcations required by the DPLUR that identify the restricted area(s) are visible and readable.

The contact information on the signs required by the DPLUR is current.

All physical markers and barriers (e.g., berms, fences, paved areas, etc.) required by the DPLUR are in place and intact.

The landfill cover system has been maintained according to the requirements outlined in the DPLUR.

The DPLUR and Notice are still recorded at the county register of deeds office.

The property has not been subdivided since the last certified annual report.

Comments:

Property Owner Certification Statement

I, _____, hereby state that: I am over the age of eighteen, I am competent to make this certification based upon my own personal knowledge and belief and, to the best of my knowledge and belief, after thorough investigation, the information contained herein is accurate and complete. I am aware that there are significant penalties for willfully submitting false, inaccurate or incomplete information.

(Signature of Property Owner)

(Date)

(Printed Name and Title of Property Owner)

(Printed Name of Company)