Vapor Intrusion (VI) Assessment Work Plan & Report Checklist
NCDEQ Brownfields Redevelopment Section
May 2024

The purpose of this checklist is for consistency in the assessment and evaluation of risk at Brownfields Properties with potential for vapor intrusion (VI) concerns; it must be followed for all VI assessment work plans and reports. The completed checklist must be provided as an attachment with each of the submitted work plan and subsequent report documents, and confirm the following:

- The type of information detailed below has been included; and
- The format and tables provided below were used to complete the work plan.

The benefits of following this checklist include:

- Consistency and predictability in the assessment process;
- The most efficient process for preparing and reviewing work plans and reports prepared for Brownfields Properties;
- Maximize usability of the data by the Brownfields Redevelopment Section (BRS);
- Minimize DEQ review time; and
- Reduce costs and delays associated with additional mobilizations.

Assessment that is conducted without approval from the BRS is done at your own risk and may not be accepted by the BRS. The BRS will be using this checklist to conduct its reviews.

The VI assessment work plan and report must be signed and sealed by a NC licensed geologist or NC professional engineer.

Plan to allow sufficient review time for Work Plans and Reports. We are experiencing consistently high demand and your Brownfields Project Manager is managing multiple projects. The BRS has a vested interest in keeping all our projects on schedule, including yours, while ensuring a consistent and comprehensive risk management approach for the protection of public health, including the evaluation of site occupancy as it pertains to VI risk, and that comports with the Brownfields statute. To assist, you should maintain close coordination and consultation with your Brownfields Project Manager (whether it's with the Brownfields agreement production staff or with the Property Management Branch (PMB) staff) to plan sufficient time within the project schedule. The Prospective Developer, their technical, and legal team shall coordinate to ensure the validity of collected data that forms the basis for environmental risk decision-making regarding VI potential and mitigation measures at the Brownfields Property.

Note: Work plans that follow this checklist can be submitted either as a standalone document or as part of a work plan that encompasses other assessment activities (i.e. soil, groundwater, etc.) required by the BRS.

Title Page

The title page should include the following information.

- ☐ Title of work plan or report
- ☐ Brownfields Project Name (not the development name)
- ☐ Brownfields Project Number
- ☐ Date (updated with each revision)
- ☐ Revision Number
- ☐ Firm PE/PG License Number
- ☐ Individual PE/PG seal & signature
- ☐ Contact information for Developer, Consultant, and BF Project Manager (or BPMB Staff)

Section 1 – Introduction

Provide a ***BRIEF*** summary of the history of the property that contains the following:

- ☐ History in the BRS or involvement by another DEQ Section such as DSCA
- ☐ Provide a chronology of former and/or current uses
- ☐ List potential sources of VI (e.g. off-site migration of contaminants, on-site releases, chlorinated solvent use, especially the presence or suspected presence of trichloroethylene (TCE), groundwater contamination, and preferential pathways such as utility corridors)
- ☐ List RECs from a Phase I ESA and their location on the Brownfields Property
- ☐ Provide a conceptual site model for the Brownfields Property on which to base the data gap evaluation
- ☐ Indicate if the scope of work was negotiated during a Brownfields Data Gap Meeting, etc.
- ☐ Provide a summary of the redevelopment plans for the Brownfields Property that contains the following:
    - ☐ Type of proposed use (townhomes, apartments, mixed-use, retail, etc.)
    - ☐ New construction and/or reuse of existing structures
    - ☐ Foundation type
    - ☐ Presence of elevators & stairwells
    - ☐ How the new building configuration/parking areas relate to the location, if known, of contamination at the Brownfields Property
    - ☐ Proposed and existing building/unit square footage to be assessed.
- ☐ Indicate if the proposed use has been approved or is under evaluation by the BRS at the time of submittal.
- ☐ Include a discussion of the following and reference each appendix or attachment where located:
    - ☐ **Figure 1** - Site location map on USGS topographic map, north arrow, graphic scale, site outline
    - ☐ **Figure 2** – see format requirements in Section 8 below **-** Site redevelopment plans superimposed on a high-quality aerial photograph of the site, if available;(if unavailable, provide explanation as to why not)
    - ☐ **Table** 1 – see example Tables in Section 8 below: With property identifying information in a summary table format: Brownfield Project Number, Parcel Number(s), address, site acreage, former or current use, & proposed use

Section 2 – Scope of Work

☐ Provide a general description of proposed scope of work covered in this plan (e.g., 5 exterior soil gas sampling points, 6 sub-slab vapor points, 4 indoor air, 1 ambient air); **Note** for any Brownfields Property, baseline data for each applicable environmental medium as determined by DEQ is required.

☐ Discuss samples to be collected by media and source area/location. Generally, the reasoning for the sample locations selected, including evaluating preferential pathways.

☐ Include a discussion of the following and reference each appendix or attachment where located:

☐ **Table 2** – see example Tables in Section 8 below - Briefly list and describe the VI data gaps the assessment is attempting to fill and note other pertinent information in a sampling summary, including background and QA/QC samples.

☐ **Figure 3** – see format requirements in Section 8 below - Proposed Sample Location Map - Provide a figure in the work plan noting the location of each of the proposed exterior soil gas, sub-slab vapor, or indoor air samples overlain with planned building layouts, historical areas of concern, and previously identified impacts.

Note that DEQ DWM VI Guidance states that "Due to spatial variability in sub-slab vapor concentrations over a slab, DWM generally recommends the collection of one sample per 1,000 square feet of first floor building area." Sampling density could vary due to site-specific considerations, and with prior approval from DEQ.

Section 3 – Sampling Methodology

For all air sampling planned, provide the following information in relevant section 3.a. or 3.b. discussed below:

☐ Reference the most current versions of DEQ DWM and ITRC guidance documents applicable to VI sampling, and any other applicable standard operating procedures. Note deviations or methodology planned that is not covered by such guidance.

☐ Discuss timing of sampling and whether indoor air and sub-slab vapor sampling will be occurring contemporaneously; if so plan to conduct indoor air sampling first so that the creation of the sub-slab vapor point does not influence the indoor air data.

☐ In accordance with Section 4 below, state the analytes for which each sample will be analyzed (briefly) and include the analytes that are specifically being requested for reporting. Reference Table 2.

☐ Indicate if mercury has previously been assessed for/detected in soil or groundwater and whether mercury VI concerns are present.

☐ Discuss how and when vacuum readings will be collected for Summa canisters

Note: Tedlar bags are **not** allowed for collection of samples for laboratory analysis). Field vacuum readings should be recorded on the chain of custody forms for ease in comparing to reported laboratory receipt vacuum readings.

Note: Per DEQ DWM VI Guidance, Summa canisters that have lost greater than 10% of the initial recorded lab vacuum when received in the field will not be used for sampling. It is assumed that Summa canisters are issued with a maximum achievable pressure of 30" Hg. If canisters are received in the field

with less than 27" Hg, initial lab pressure measurements should be documented to confirm less than a 10% volume loss or a replacement summa canister obtained. Otherwise, sample results may be rejected.

☐ Provide the sample collection time duration for all samples.
☐ State how duplicate sample(s) will be collected.
☐ Target a final vacuum reading of at least -5" Hg.

Note: A Summa canister must be received by the laboratory with some measurable amount of vacuum remaining. If a vacuum is not maintained in the canister when received by the laboratory, sample acceptance will be in jeopardy and DEQ Brownfields may request a resample. Field gauges are not as accurate as laboratory gauges; hence the 5" Hg provides tolerance levels that a canister should still retain at least 1" Hg when received at the laboratory and allow for analysis to proceed with confidence. In addition, per the DWM VI Guidance: *"residual vacuum of up to -5 inches mercury must exist in the canister upon completion of the sampling event and laboratories should report the received vacuum. Since the sample is designed to be collected over a specified period of time (i.e., 8 to 24 hours), the residual vacuum ensures that the sample was collected over that time period and ensures that the samples are not damaged or altered during transport. If no vacuum remains, the validity of the data is questionable."*

☐ Include planned flow rate for Summa canister sampling or time allotting for passive samplers.

Note: Per DEQ DWM VI Guidance, the maximum allowable flow rate is 200 mL/min.

Section 3.a. Exterior Soil Gas / Sub-Slab Vapor Sampling

☐ Describe depths of samples to be collected (Reference example Table 2 in Section 8 below) or how that decision will be made in the field, if needed. Refer to DEQ DWM Vapor Intrusion Guidance for reference to minimum depths of samples.
☐ Locate sub-slab vapor samples in areas of the slab that are near known or potential sources of volatile contaminants and in areas that could encourage vapor migration, such as sub-grade trenches, pits, and elevator shafts, but position them at least 5 feet from exterior walls or potential preferential pathways for vapors such as cracks/penetrations.
☐ Locate sub-slab vapor samples across the building(s) being assessed being mindful of any building features that could indicate the presence of sub-walls or footers that would restrict sub-slab vapor flow.
☐ Describe installation methodology construction details of the exterior soil gas and/or sub-slab vapor samples, including filter pack and sealants. Use of new and dedicated tubing is required.
☐ Discuss sample collection procedures. Include the following, at a minimum:
    ☐ Equipment to be used (Summa canisters & size, type of tubing, Vapor Pins, etc.).
    ☐ Indicate if sub-slab vapor/exterior soil gas sample points will be permanent or temporary.
    ☐ Whether Summa canisters are batch- or individually-certified.
    ☐ Discuss stabilization time of the sampling points prior to sampling.

Note: Inadequate stabilization times have been known to impact sample results through the inadvertent collection of vapors off-gassing from exterior soil gas/sub-slab installation materials, potentially creating

false positive results that would then require a resampling event. Required stabilization times are outlined below:

a. Sub-slab vapor with minimally invasive points (e.g. Vapor Pins): Manufacturer's guidelines generally suggest 20 minutes may be sufficient with an airtight cap installed; or
b. Sub-slab vapor points (other than minimally invasive points) or exterior soil gas points: at least 24 hours (to be purged at installation and at time of sampling with an air-tight cap in place in the interim).

Note: Equilibrium wait times to purge soil gas (after probe installation and prior to sampling) may be adjusted from those listed in a. or b. above if the Work Plan documents the approach(es) planned to be implemented to demonstrate samples will be reliable and representative of subsurface conditions, subject to prior BRS review and approval.

☐ Describe purging methods and volumes – must take into account not only the volume of the tubing but also of the annulus. Stagnant air inside soil gas probes and sampling trains must be purged prior to sample collection. A minimum of three system purge volumes are required. The investigator shall use a low purge rate with a maximum of 200 mL/min.

☐ Describe leak check procedures for sub-slab vapor and exterior soil gas samples. A helium check of the entire sample train is required; a shut-in test is also recommended as a best management practice.

☐ Describe how the helium meter will be connected to the sampling train. Directly connecting the helium meter to the sampling train without a backflow preventer is not allowed.

☐ Record the type of material found under the slab or in the soil gas borings.

☐ Record slab thickness for sub-slab vapor samples and provide soil boring logs for exterior soil gas samples.

☐ Discuss sample point abandonment and/or securement (if permanent points).

Note: Exterior soil-gas sampling may not necessarily be indicative of site conditions following redevelopment efforts. Except in extenuating circumstances, if a slab is present, sub-slab vapor samples are required to be collected even if the slab will be removed. Therefore, sub-slab vapor assessment of existing slabs should occur before any building demolition. This provides BRS with the most reliable data with which to evaluate the potential for VI occurring in that portion of the Brownfields Property. Confirmation sub-slab vapor sampling may be necessary following construction to confirm that a potential VI pathway is not present.

Section 3.b. Indoor Air / Crawl Space Sampling

☐ Include a chemical survey of any potential interference compounds stored or used inside the building (Refer to example Indoor Air Building Survey and Sampling Form that will be completed for each distinct area of the Brownfields Property under assessment. The Indoor Air Form is included within the DEQ DWM VI Guidance).

☐ Describe steps to remove any potential interference compounds from the sampling area sufficiently ahead of the sampling event (The DEQ DWM VI Guidance recommends removal within 24-72 hours, and typically within 48 hours of sampling as indicated on the Indoor Air Building Survey and Sampling Form; if materials are not able to be removed, documentation of the presence of suspected interfering building materials or products will need to be documented with a summary table of chemicals including volumes stored, SDS sheets, and photographic documentation).

☐ Schedule sampling to minimize any potential for interference from compounds used during construction or finishing of new buildings, etc. Describe any sampling constraints.

☐ Describe building conditions (including HVAC conditions) that will exist within 24 hours prior to and during the sampling. Site conditions should mimic normal operating conditions as closely as possible.

☐ Discuss sample collection procedures. Include the following, at a minimum:

- ☐ Equipment to be used (passive samplers, Summa canisters & size, etc.)
- ☐ Placement height of Summa canisters or passive samplers for indoor air and ambient air collection to account for site-specific breathing zone height of anticipated occupants.
- ☐ Description of the indoor air Summa canisters or passive samplers proposed placement location including use of space (e.g., ground floor garage, first floor living space, office, mechanical equipment room, etc.).
- ☐ Methods implemented to reduce or eliminate access to building where indoor air sampling is occurring.
- ☐ Per DEQ DWM VI Guidance, indoor air samples shall utilize individually certified Summa canisters.

☐ Provide how often and when exterior ambient air samples will be collected (typically, one sample per day per sampling event)

☐ If crawl space samples are proposed, include details on:

- ☐ Presence of moisture/VI barrier
- ☐ Ceiling structure of crawlspace
- ☐ Exterior openings or ventilation features
- ☐ Height across entire footprint of crawl space
- ☐ Walls/vertical structures separating crawl space areas
- ☐ Additional pertinent details of crawl space construction

Section 4 – Laboratory Analyses

☐ Include the proposed analyte list and EPA Method numbers prepared in consultation with your DEQ Brownfields Project Manager;

☐ Minimum analytical requirements are described as outlined below:

a. Full TO-15 list is required initially for exterior soil gas, sub-slab vapor, and indoor air analyses.

b. Modifications of the analyte list for subsequent sampling events must be pre-approved by DEQ and will be evaluated by your Brownfields Project Manager based on previous and current detections in other site media once sub-slab vapor results are known.

Note: Not all laboratories use the same standard analyte list. ***Ensure that naphthalene is included, but exclude acrolein unless it is a suspected site contaminant***. Because of the extremely limited analyte list for the TO-15 SIM method, discuss its use with your DEQ Brownfields Project Manager prior to implementation. When approved for use, this method should be used for both sub-slab vapor and indoor air samples for comparison purposes.

☐ Discuss any proposed limitations on the contaminants of concern, if any, and the reason for such limitation (sufficient previous data, indoor air interferences, etc.).

☐ Discuss laboratory certifications. Please note, NC does not certify laboratories for air samples. Please specify what certification the proposed air laboratory holds.

☐ Indicate that reporting limits/method detection limits will meet applicable screening criteria (to the extent feasible). Include reporting of J-flags to meet criteria.

☐ Indicate which Level QA/QC will be reported by the laboratory. Level II QA/QC is typically acceptable.

Section 5 – QA/QC

☐ Specify the duplicate sample frequency. Minimum requirement: 1 duplicate per 20 samples, per media, per method, per sampling event, with an event being a single day of sample collection.

☐ Discuss chain of custody and shipping.

Section 6 – Investigation-Derived Waste (IDW) Management

☐ Discuss what IDW will be generated and how it is proposed to be managed. Management recommendations should be in accordance with 15A NCAC 02T.1503 and 15A NCAC 02H. 0106. Generally, if the Brownfields Property has not previously been assessed, all IDW must be containerized and characterized prior to management. Previous assessment data that indicate no hazardous waste (listed or characteristic) is likely to be encountered in the area of proposed assessment will be required before thin spreading of IDW on-site is permitted.

Section 7 – Reporting

This section should discuss the components of the assessment report to be prepared as a result of the implementation of the work plan. At a minimum, the report shall include:

☐ Reporting/summary of site work conducted for all sections outlined above in this checklist;

☐ Summary of findings and possible recommendations;

☐ All applicable tables and figures outlined below with the addition of:

- ☐ Tables for tabulated analytical data per media sampled and analyzed, compared against applicable screening levels; any non-detectable levels should be reported as less than the applicable reporting limit, noting any reporting limits that exceed the respective screening level.
- ☐ Figure(s) depicting actual sample locations, with the results for each media depicted, graphic scale and north arrow. Modify the figures as appropriate in the report if there was variance from the approved work plan with these locations during the sampling event.

☐ Detail on building additions, slab types, and sub-grade features such as the locations of crawl spaces, tunnels, basements, sub-grade walls, and footer walls encountered during assessment.

☐ Attach copies of original, scanned, field notes;

☐ Firm PE/PG License Number; and

☐ Individual PE/PG seal & signature

Section 8 – Example Tables and Format for Figures

☐ Table 1 – Property Summary

Table 1: Property Summary

BF Project No.	Parcel No.	Address	Site Acreage	Former/ Current Use	REC	Proposed Use

☐ Table 2 – Sampling Summary

Table 2: Sampling Summary

Data Gap	Parcel/Bldg. No.	Sampling Objective	Type of Sample	Number of Samples	Depth of Samples	Analytical Program	Detection range for TCE (if applicable)

☐ **Figure 1** – Site Location Map (topographic map base) with north arrow, graphic scale, and site outline.

☐ **Figure 2** – Proposed Redevelopment to include the following details:

- ☐ All current and proposed structures (as-builts, building plans, etc. as available)
- ☐ Brownfields Property Boundary
- ☐ Which structures will be removed/renovated
- ☐ Proposed future use of each building

☐ **Figure 3** - Proposed Sample Location Map (work plan) or Sample Location Map to include the following details:

- ☐ High quality aerial and/or floor plan base (interior samples)
- ☐ Overlain planned or existing (to remain) building layout
- ☐ North arrow
- ☐ Graphic scale
- ☐ Historical sample locations (if applicable)
- ☐ RECs or other areas of concern
- ☐ Proposed sample locations for each medium proposed for sampling
- ☐ Sample identification labels

☐ **Appendix** – Tabular Summary of Historical Analytical Data

Describe any deviations from the work plan or report here, including justification(s) for such: