PART C
GUIDANCE SECTION 2: INVESTIGATION

C.1 TOPIC: General comments on Section 2 of the guidance

Comment C.1.1:

The guidance provides an excellent framework for developing a sampling regime to investigate the vapor intrusion pathway. It is especially helpful as it covers steps in the investigation that could be utilized for all of the different types of vapor intrusion scenarios that are available.

Response C.1.1:

Comment noted.

Comment C.1.2 (paraphrased, 1 commenter, 1 comment):

We concur with the sampling methods and protocols established in Section 2 of the guidance. Keeping in mind this guidance document is a generalized approach to the investigation of soil vapor intrusion pathways and each investigation must be conducted based on the specific characteristics of the individual site.

Response C.1.2:

Comment noted.

Comment C.1.3:

The first paragraph [of Section 2] states: *Therefore, guidance provided in this section is presented in terms of general steps and strategies that should be applied when approaching an investigation of soil vapor intrusion.* Since general steps and strategies can leave a lot of room for interpretation, the evaluation process will depend on individual interpretation and inconsistent application.

Response C.1.3:

The guidance recognizes that each site is unique and, therefore, the level of investigation necessary to evaluate the potential for soil vapor intrusion adequately is often site-specific as well. However, for sites being investigated under one of the state's environmental remediation programs, the soil vapor intrusion evaluation process generally follows a standard procedure including the submittal, review and approval of work plans. This process is intended to provide consistency. Additionally, training sessions on the State's approach to evaluating soil vapor intrusion were conducted throughout the State. Target audiences included State, local and regional DOH and DEC staff as well as the regulated public. Completion of training, with updated training sessions as needed, is intended to provide a uniform level of knowledge and practical application regarding soil vapor intrusion.

Comment C.1.4:

Section 2.0 is too prescriptive and onerous to be truly effective at all but the largest and most complicated sites. While it is recognized that some complicated sites may require the level of investigation specified in Section 2.0, this level of investigative effort is not warranted at most sites. While the introduction to this section states that specific site

conditions may warrant modifying the recommendations, many of the subsections are very prescriptive and suggest that data will not be usable for decision making if the specific procedures are not followed.

Response C.1.4:

The guidance is intended to provide general steps and strategies for the investigation of the soil vapor intrusion pathway, regardless of the size or complexity of the site. The guidance recognizes that each site is unique and, therefore, the level of investigation necessary to adequately evaluate the potential for soil vapor intrusion is often site-specific as well. At all types of sites, analytical data that do not meet site-specific data quality objectives may preclude adequate data evaluation.

Comment C.1.5:

Several statements in this section [Section 2] assume that the presence of vapors in the subsurface will cause on-going human exposures. Section 2.0 should be rewritten to state that subsurface vapors might cause human exposures but that the mere presence of subsurface vapors does not mean exposures are occurring. Further, exposures do not automatically result in any significant additional risk. Similar to the investigation approach for soil and groundwater, investigation of soil vapors is in an iterative process, and this process should be more thoroughly discussed in Section 2.0.

Response C.1.5:

Section 1.2 of the guidance defines both current and potential exposures and the State's consideration of both current and potential exposures in a soil vapor intrusion evaluation, which is typically an iterative process. Section 1.2 also states that exposure to a volatile chemical due to vapor intrusion does not necessarily mean that health effects will occur. Section 2 of the guidance provides general steps and strategies for a soil vapor intrusion investigation and does not state a causal link between the presence of vapors in the subsurface and on-going human exposures. As discussed in Section 2.5, we agree that the investigation of subsurface vapor contamination and exposures associated with it is an iterative process.

Comment C.1.6:

Soils vapors are a conduit for volatiles to enter a building, not an "exposure medium," as described.

Response C.1.6:

Section 2 of the guidance describes soil vapor as an *environmental* medium, not an *exposure* medium.

C.2 TOPIC: Sites at which an investigation is necessary

Comment C.2.1 (paraphrased, 8 commenters, 10 comments)

The NYSDOH should clarify what concentrations of volatile chemicals in groundwater and soil gas and/or contravention of what standards, criteria and guidelines (Section 2.1) would trigger the need for a soil vapor intrusion investigation, or conversely screen out sites to determine no further action is necessary. Furthermore, the NYSDOH should state what types of sites are affected.

Response C.2.1

Concentrations of volatile chemicals or identification of a site as a certain "type" should not be the only factor considered when determining whether or not there is a need for a soil vapor intrusion investigation. Data collected to date from the investigation of sites both within and outside of New York State demonstrate that soil vapor contamination may result from very low concentrations of volatile chemicals present in subsurface soil, soil vapor or groundwater at a variety of sites. Current exposures to subsurface contaminants, via the soil vapor intrusion pathway, have been demonstrated at sites where soil and/or groundwater concentrations have not contravened applicable standards, criteria and guidelines (such as TAGM 4046 soil values, TOGS 1.1.1 groundwater values, etc.). While the level of investigation may vary from site to site, investigation of the soil vapor intrusion pathway is generally recommended at sites with a subsurface source of volatile chemical contamination. Section 2.1 of the guidance has been revised to reflect this.

Comment C.2.2 (paraphrased, 4 commenters, 4 comments):

Section 2.1 should be expanded to define sites where investigation of vapor intrusion is not required based on the type of chemical of concern (COC) present and the distance between VOC source and vapor intrusion receptor (i.e., "near").

Response C.2.2:

While the level of investigation may vary from site to site, investigation of the soil vapor intrusion pathway is generally recommended at sites with a subsurface source of volatile chemical contamination, regardless of the type of volatile chemical. Section 2.1 of the guidance has been revised to reflect this. [See also Comment B.2.1 (definition of volatile chemical).]

Soil vapor intrusion data collected to date do not support the use of a generic distance criterion to screen-out sites for further evaluation. Therefore, the guidance continues to recommend a general approach for a soil vapor intrusion investigation that is similar to the investigation of other environmental media. Existing site data and a conceptual site model should be considered to scope the investigation. Similar to other types of site investigations, the investigation typically starts at a source and works outward, as necessary, until human exposures associated with soil vapor intrusion have been identified and addressed. [See also Comment A.8.1 (default distance criteria).]

Comment C.2.3 (paraphrased, 2 commenters, 1 comment):

Soil vapor intrusion investigations should be limited to sites with known existing sources of volatile contaminants.

Response C.2.3:

Soil and groundwater investigations are conducted at sites throughout New York State based on the potential for a subsurface source of contamination, often based on current and/or past use of a site. Soil vapor is an environmental medium of concern, like soil and groundwater, that should be characterized similarly.

Comment C.2.4 (paraphrased, 1 commenter, 1 comment):

The presence of a source alone should not spur investigation of the vapor intrusion pathway. The presence of existing or potential receptors should also be considered. For example, a remote landfill or spill site with no buildings and no known potential for

development should be investigated for environmental impacts, but not necessarily vapor intrusion.

Response C.2.4:

The level of evaluation necessary for soil vapor intrusion is determined on a site-by-site basis and with consideration of many factors, including current/future property use and current/potential receptors. Existing and potential receptors are considered in Section 2.1.b of the guidance.

Comment C.2.5:

The proposed vapor guidance requires investigation where there is the potential for volatile chemical contaminants to be present, whether it be from an on-site or off-site source.

Response C.2.5:

That is correct and the party responsible for conducting any investigation depends upon the source of the subsurface contamination (as mentioned in the comment) and the requirements of the specific environmental remediation program the site falls under. [See also Part A.11 (TOPIC: Party responsible for investigating and taking action(s) to address exposures).]

Comment C.2.6:

"Active" investigation of the pathway under the supposition that a building may be present in the future is extreme and may very well be misleading, depending on the time elapsed between investigation and construction, and other remedial actions (if any) undertaken at the site.

Response C.2.6:

As discussed in Section 2.3 of the guidance, there is flexibility in determining when to conduct a soil vapor intrusion investigation at a site. Many factors are considered when making this determination, including the current and future property use, completed and proposed remedial actions, and the estimated time between investigation or remediation and site development. For example, at many sites where new development is planned, parties have opted (with the State's approval) to incorporate a sub-slab depressurization system into the development plans (due to the relative costs of installing a system at the time of construction versus retrofitting a system post-construction) and to perform sampling after the site is developed to determine whether or not the system should be activated to address exposures related to soil vapor intrusion.

C.3 TOPIC: Types of samples needed

Comment C.3.1:

Since this is a risk-based evaluation, soil vapor and/or indoor air sampling should be focused on obtaining information related to current or potential exposures rather than on broader fate and transport issues.

Response C.3.1:

The primary purpose of a soil vapor intrusion investigation is to determine whether contaminated soil vapors are migrating or could migrate into occupied structures, resulting in exposure.

Comment C.3.2:

Soil vapor samples could also be collected to indirectly evaluate the effectiveness of ground water remediation if ground water is the source of the contamination. Consider an added sentence [Section 2.2.1].

Response C.3.2:

Agreed. The text in Section 2.2.1 of the guidance has been revised as follows: "Soil vapor sampling results are also used when evaluating the effectiveness of direct or indirect measures to remediate contaminated subsurface vapors. (Soil vapor extraction is an example of a direct remedial measure, and groundwater pumping and treating an indirect measure.)"

Comment C.3.3 (paraphrased, 1 commenter, 1 comment):

Section 2.2.1 of the guidance should be revised to include the use of soil vapor data to rule out the need for structure sampling, especially when the soil vapor data is consistent with the site conceptual model and demonstrates that subsurface conditions serve as a barrier to vapor migration.

Response C.3.3:

Soil vapor samples (as differentiated from sub-slab vapor samples) are useful tools to guide soil vapor intrusion evaluations. However, given the limitations associated with soil vapor samples (as discussed in Sections 2.2.1 and 3.3.1 of the guidance), soil vapor data alone cannot be accurately and reliably used to predict or model expected indoor air or sub-slab vapor volatile chemical concentrations. Therefore, soil vapor data are typically not sufficient as a single determinant for considering an investigation complete. To the extent that the existing site data are sufficient to meet the investigation objectives outlined in Section 1.5 of the guidance, no further sampling may be appropriate. These determinations are made on a site-specific basis.

Comment C.3.4 (paraphrased, 5 commenters, 7 comments):

Given the absence of screening values and standards, criteria or guidelines for soil vapor data and the fact that "there are no concentrations of volatile chemicals in soil vapor that automatically trigger action or no further action," we recommend that the utility of the soil gas data be more clearly explained and that the limitations of these data be discussed in detail.

Response C.3.4:

Soil vapor samples are collected to characterize the nature and extent of contamination in this medium and the results are useful tools for guiding the selection of structures to perform sampling (sub-slab vapor, indoor air, outdoor air) in. The types of samples collected should be selected to meet the stated objectives of the specific investigation, which may differ from site to site and may not necessarily include the collection of soil vapor samples. Soil vapor data are typically not sufficient as a single determinant for considering an investigation complete. However, to the

extent that the existing site data are sufficient to meet the investigation objectives outlined in Section 1.5 of the guidance, no further sampling may be appropriate. These determinations are made on a site-specific basis.

Comment C.3.5:

There are many potential scenarios in which soil vapor testing would not be a wise use of scarce resources.

Response C.3.5:

Comment noted.

Comment C.3.6 (paraphrased, 2 commenters, 2 comments):

Section 2.2.2 of the guidance states that sub-slab vapor samples are collected after soil and groundwater characterization "indicate a need." The guidance should provide clear criteria for determining when this need exists and how this need is defined in terms of human exposures. Additionally, clarification on how sub-slab vapor sample results are used for evaluating exposures is requested.

Response C.3.6:

Generally, if soil or groundwater samples contain volatile chemicals, soil vapor samples should be collected to determine whether this environmental medium is also affected. Depending upon site-specific conditions, sub-slab vapor sampling, rather than soil vapor sampling, may be more appropriate to yield more direct information about the potential for soil vapor intrusion. As discussed in Section 1.1 of the guidance, when contaminated vapors are present in the zone directly next to or under the foundation of a building, there is a possibility for soil vapor intrusion and associated exposures.

As discussed in Section 3, sub-slab vapor results are evaluated in conjunction with indoor air data and outdoor air data to determine whether current exposures are occurring, and, if so, whether they are a result of subsurface environmental contamination or of indoor or outdoor sources. Understanding the source is crucial for selecting the most appropriate method for addressing exposures. Sub-slab vapor results are also evaluated in conjunction with the conceptual site model, groundwater and soil concentrations, site-specific conditions, and structure-specific conditions to determine whether the potential exists for vapor intrusion to occur in the future should environmental, site or building conditions change.

Comment C.3.7:

This section [Section 2.2.2] is confusing since it appears to suggest that sub-slab vapor sampling results are used to evaluate current and potential exposures. Such suggestion is inconsistent with the discussion in Section 3.3.2 as in that section, it suggests that detection of chemicals in sub-slab vapor samples does not necessarily indicate soil vapor intrusion is occurring or actions are needed to address exposures. In Section 2.2.2, it should be made clear that to assess current and potential exposures, sub-slab vapor sampling results must be considered together with indoor air and ambient air sampling results.

Response C.3.7:

Agreed. Section 2.2.2 of the guidance has been revised as follows: "Sub-slab vapor sampling results are used in conjunction with indoor air and outdoor air sampling results when evaluating…."

Comment C.3.8:

Please clarify whether the potential for a change in the structural integrity or use of a building must be evaluated in a human exposure assessment for all sites or if the assessment of human exposure based on these changes is required only if such changes are likely to occur.

Response C.3.8:

The potential for structural integrity or building use to change does not need to be formally evaluated at every site. However, unless there are restrictions in place, the possibility that current conditions could change in the future should be assumed.

Comment C.3.9 (paraphrased, 2 commenters, 2 comments):

Basement probes may compromise the integrity of the foundation system (including possibly a vapor barrier), and therefore, create a preferential pathway for vapor migration and increase the risk of indoor exposure(s) in the distant future. The requirement to conduct sub-slab sampling should be flexible, especially for sites where impermeable membranes are present since such sampling may damage the integrity of the membrane and may draw contaminants toward the building and beneath the slab. Alternative methods for evaluating vapor intrusion (i.e., soil vapor probes adjacent to building foundations in lieu of sub-slab samples) should be provided.

Response C.3.9:

Installation of a sub-slab soil vapor probe involves a small diameter (typically one-inch) penetration through the slab. Sub-slab soil vapor implants are sealed to the surface and, for temporary installations, the implant hole is backfilled and the slab is restored after sampling has been completed. Thus, we believe the potential for sub-slab soil vapor probes to create preferential pathways in foundation systems where impermeable membranes are not currently present is unlikely. We acknowledge that penetrating an existing impermeable membrane could compromise the integrity of the membrane and potentially worsen site conditions. This is an example of a special consideration that should be discussed when determining the best approach for evaluating the potential for soil vapor intrusion in the building. As stated throughout the guidance, the types of samples collected in a soil vapor intrusion investigation are typically determined on a site-specific and, in some cases, a building-specific basis.

Comment C.3.10 (paraphrased, 1 commenter, 1 comment):

Investigation of the vapor intrusion pathway should focus on sub-slab sampling. For existing and future buildings in the vicinity of contaminated land or groundwater, this should focus on sub-slab monitoring over indoor air sampling. In general, we propose that no interior testing for soil vapor intrusion be done prior to the time a foundation venting system is required due to the potential for cross-contamination of interior samples.

Response C.3.10:

The types of samples collected in a soil vapor intrusion investigation are typically determined on a site-specific basis in consideration of many factors, including existing site data and the site-specific sampling objectives. Indoor air sampling, however, is a key component to determining whether soil vapor intrusion is actually occurring. We believe that if the sampling protocols provided in Section 2.7 of the guidance are followed, cross-contamination of interior samples is unlikely.

Comment C.3.11 (paraphrased, 1 commenter, 1 comment):

The current draft guidance requires concurrent sub-slab vapor sampling when performing indoor air sampling (except when evaluating immediate inhalation hazards). However, in the event that no indoor air hazards are found during indoor air sampling and analysis, we question the need for sub-slab vapor sampling.

Response C.3.11:

As discussed in Section 3.3.3 of the guidance, sub-slab vapor results and outdoor air results are important when evaluating indoor air results to determine whether current exposures are occurring via the soil vapor intrusion pathway. As discussed in Section 2.2.2, we also recommend sub-slab vapor samples be collected to evaluate the potential for future indoor air impacts and exposures to occur via soil vapor intrusion in the event that building or environmental conditions change.

Comment C.3.12:

The guidance should include that radon should also be measured as a tracer when conducting sub-slab sampling to confirm if vapor intrusion is occurring.

Response C.3.12:

The preface of the guidance document acknowledges that vapor intrusion may also occur with "naturally occurring" subsurface gases, such as radon. However, the intent of the guidance document is to provide strategies to address human exposures to contaminated subsurface vapors associated with known or suspected environmental contamination.

Comment C.3.13 (paraphrased, 1 commenter, 1 comment):

Section 2.2.3, Indoor air: How the evaluation of current human exposure and potential for future exposures is going to be used is not clear. Will this evaluation be based on Risk Assessment Guidance for Superfund or just a comparison with background and outdoor air?

Response C.3.13:

The evaluation will not be based on Risk Assessment Guidance for Superfund. Rather, as discussed in Section 3 of the guidance, the evaluation will be based on the consideration of many factors (including those mentioned in the comment). This evaluation of current and potential exposures will be used to guide the investigation and decision-making process.

Comment C.3.14 (paraphrased, 1 commenter, 2 comments):

Based on our experience, we do not recommend simply collecting indoor air samples in response to certain situations mentioned in Section 2.2.3 (including response to odor complaints and if a sump is present and overflowing/filled). For odor complaints, we recommend collecting information regarding potential releases and chemical usage in the area, then collecting appropriate subsurface samples, and then, as warranted, sampling indoor air. If an overflowing/filled sump is present, it would be prudent to first collect a water sample.

Response C.3.14:

Section 2.2.4 of the guidance (formerly Section 2.2.3 in the public comment draft) is intended to discuss situations in which the collection of indoor air samples might be

applicable, both concurrently with sub-slab soil vapor and outdoor air samples as well as without concurrent sub-slab/outdoor air sampling. This section is not intended to identify situations in which indoor air sampling is mandatory as a response measure. The type and number of samples is typically determined on a site-specific basis in consideration with particular site or building characteristics, such as sumps. Similarly, the time at which the samples are collected (such as when odors are identified or after releases in the area are identified first) will also depend upon site-specific circumstances. Section 2.2.4 of the guidance has been revised to indicate that collection of water samples from a sump may be appropriate.

Comment C.3.15 (paraphrased, 1 commenter, 1 comment):

How the collection of air samples from crawl spaces aids in the evaluation of potential health threats to building occupants is unclear given the exposure point of concern is the location where human contact with these release-related volatiles occurs, such as in the living space of a home or office building or school.

Response C.3.15:

The collection of crawl space samples may be applicable in situations where no basement area is present or a basement and separate crawl space area is present. Data provided from indoor air living space sampling alone typically are not adequate to evaluate the cause or source of exposure. Qualitative and quantitative comparisons between indoor air results obtained from different locations within a building (i.e., different floors, including crawl spaces) are used to determine the likely cause or source of the exposure so that appropriate actions can be taken to address the exposure.

Comment C.3.16:

It is unclear why it is necessary to sample outdoor air when confirming the effectiveness of a mitigation system. Outdoor air data is only likely to be informative if post mitigation indoor air results are unexpectedly high, and no discernable indoor sources are present.

Response C.3.16:

Outdoor air samples are collected concurrently with indoor air samples during post-mitigation sampling for the same reason they are collected pre-mitigation: to evaluate the extent outdoor air may be influencing indoor air quality. This information is used when interpreting indoor air results and identifying likely sources of volatile chemicals.

Comment C.3.17 (paraphrased, 1 commenter, 1 comment):

Why not allow the consultant to decide if outdoor air samples need to be collected at the same time as indoor air samples? To suggest this is one thing, to require it is another.

Response C.3.17:

The collection of outdoor air samples concurrently with indoor air samples and sub-slab soil vapor samples is recommended to identify likely source(s) of volatile chemicals in the indoor air. It is not required. However, data evaluation could be difficult or inconclusive without comparative data from the concurrent collection of indoor air samples, sub-slab soil vapor samples and outdoor air samples.

C.4 TOPIC: Phase of a site investigation in which to sample

Comment C.4.1:

What samples is this section [Section 2.3] referring to? Groundwater, soil vapor, sub-slab vapor, indoor air, or all of the above?

Response C.4.1:

This section refers to sampling as part of a soil vapor intrusion evaluation. The types of samples collected are typically determined on a site-specific basis, but may include soil vapor, sub-slab soil vapor, indoor air and outdoor air samples (as discussed in Section 2.2).

Comment C.4.2:

Section 2.3.a.1: Remove the word "adequately."

Response C.4.2:

Agreed. Section 2.3.a.1 of the guidance has been revised accordingly.

Comment C.4.3:

Section 2.3.b: An example of a typical measure that would "assure" the State the parcel will not be developed without addressing exposure concerns should be provided. Possibly institutional controls could be used to meet this criteria.

Response C.4.3:

Appropriate measures to assure the parcel will not be developed without addressing exposure concerns are typically made on a site-specific basis. In some cases, institutional controls may be appropriate. Examples of appropriate measures are discussed in Section 3.6 of the guidance. Section 3.6 is referenced in Section 2.3.b. Therefore, no additional revisions have been made to Section 2.3.b in response to this comment.

C.5 TOPIC: Time of year in which to sample

Comment C.5.1 (paraphrased, 11 commenters, 16 comments):

The heating season may not be the "worst-case scenario" for many industrial and commercial buildings. At some sites, other factors, such as seasonal variation in the water table, may play as great a role in affecting vapor intrusion as seasonal changes in building ventilation.

Response C.5.1:

Agreed. All available information about a site and potentially affected buildings (including HVAC operations and all of the other factors discussed in Section 1.3) should be considered in planning and timing an investigation. Section 2.4 of the guidance has been revised to emphasize the need to confirm results at the time of year when soil vapor intrusion is expected to have the greatest impact on air quality in a structure. Decisions to take no further action or to continue monitoring should be shown to be protective during worst case conditions.

Comment C.5.2:

There may be some merit in testing for vapor intrusion during the non-heating season by activating the furnace and closing up the building for a 24-hour period to simulate the heating season conditions. Has the Department considered this approach?

Response C.5.2:

Vapor intrusion evaluations should be conducted during what is thought to be the worst case scenario with respect to vapor intrusion. The State is open to any proposals that will show or simulate worst case conditions. Section 2.4 of the guidance has been revised to emphasize the need to confirm results at the time of year when soil vapor intrusion is expected to have the greatest impact on air quality in a structure.

Comment C.5.3 (paraphrased, 3 commenters, 3 comments):

Investigation should include the sampling of structures during all seasons of the year and under different weather conditions. This approach would account for variation in sub-slab and indoor air contaminant levels based on fluctuations in weather, barometric pressure, soil conditions, geology and the presence of preferential pathways and would be representative of potential human exposure resulting from vapor intrusion under a wider range of seasonal conditions and actual patterns of human occupancy. Site closure decisions should be based on more realistic exposure concentrations that are more representative of long term exposures.

Response C.5.3:

Section 2.4 of the guidance has been revised to clarify that a soil vapor intrusion investigation should be performed when the likelihood of soil vapor intrusion to occur is considered to be the greatest (i.e., worst-case conditions). Samples collected during this time are considered sufficient to speak to exposures and decisions made under these conditions are believed to be protective throughout the year. If there are concerns to the contrary, then additional sampling may be recommended.

The NYSDEC and NYSDOH intend to collect samples at several sites across the state over the course of a year to improve our understanding of how subsurface vapor concentrations and corresponding indoor air concentrations may or may not fluctuate with seasonal changes. If the results indicate that recommendations currently presented in the guidance (or the bases for those recommendations) are inappropriate, then the guidance will be revised or amended accordingly.

Comment C.5.4 (paraphrased, 4 commenters, 4 comments):

Sampling should not be biased toward a "worst-case scenario." Rather, decisions should be made based on a long-term exposure scenario.

Response C.5.4:

When environmental data suggest a need to take action to reduce exposures, it is preferable to do so, rather than to wait until additional, long-term data are collected.

Comment C.5.5 (paraphrased, 7 commenters, 7 comments):

Published data from various vapor intrusion sites show that indoor VOC concentrations vary seasonally by less than an order of magnitude. Given this, the guidance should allow decisions to be made based on data collected at any time of year.

Response C.5.5:

Decisions are not based on indoor air sample results alone. As discussed in Section 1.2 and throughout the guidance, when evaluating exposures related to soil vapor intrusion, both current and potential exposures are addressed. Generally, indoor air results represent current exposures and sub-slab vapor results represent the potential for future exposures or the source of current exposures.

As discussed in Section 1.3, soil vapor intrusion is affected by many factors, many of which vary from site to site and building to building. Some of these factors are well understood, and others are not. One such factor is how sub-slab vapor concentrations vary seasonally. The NYSDEC and NYSDOH intend to collect samples at several sites across the state over the course of a year to improve our understanding of how subsurface vapor concentrations and corresponding indoor air concentrations may or may not fluctuate with seasonal changes. If the results indicate that recommendations currently presented in the guidance (or the bases for those recommendations) are inappropriate, then the guidance will be revised or amended accordingly.

Comment C.5.6 (paraphrased, 5 commenters, 7 comments):

Requiring sampling during the heating season will discourage responsible parties from collecting samples at other times of the year and may delay real-estate transactions during the warmer months.

Response C.5.6:

Acknowledged. However, samples are typically collected during the heating season because soil vapor intrusion is more likely to occur when a building's heating system is in operation and doors and windows are closed. Samples may also be collected outside of the heating season, such as when exposures related to soil vapor intrusion appear likely or if the concern for vapor intrusion is greater during another time of the year. Section 2.4 of the guidance has been revised for clarification.

Comment C.5.7 (paraphrased, 1 commenter, 2 comments):

Specific dates (for the heating season) are misleading in a guidance document and should be deleted.

Response C.5.7:

The dates are intended as a general guide and are qualified by the following statement: "However, these dates are not absolute; the timeframe for sampling may vary depending on factors such as the location of the site (e.g., upstate versus downstate) and the weather conditions for a particular year."

Comment C.5.8:

The first full paragraph of Section 2.4 at page 9 should be modified as follows: "Sub-slab vapor samples and, unless there is an immediate need for sampling, indoor air samples are typically collected during the heating season because soil vapor intrusion potential may be

greater when a building's heating system is in operation and the building is sealed/winterized. In general, for discussion purposes, the heating season, is considered to be November 15th through March 31st throughout the State. However, this timeframe may vary depending on factors, such as the location of the site (e.g. upstate versus downstate) and the weather conditions for a particular year."

Response C.5.8:

The paragraph has been modified in a manner similar to that suggested.

C.6 TOPIC: Number of sampling rounds required

Comment C.6.1 (paraphrased, 9 commenters, 9 comments):

Commenters requested clarification on the number of sampling rounds required in a soil vapor intrusion evaluation (Section 2.5 of the guidance). Additionally, clarification on the identity of the individual or body that determines whether additional sampling is necessary was requested.

Response C.6.1:

Similar to investigations of soil and groundwater, there is no pre-determined number of sampling rounds required for the investigation of the soil vapor intrusion pathway. However, as stated in the guidance, investigating the soil vapor intrusion pathway usually involves more than one round of sampling. The number of sample rounds is based on a review of the site data, in consideration with multiple factors (see Section 3.2 of the guidance) and is determined on a site-specific basis. To the extent that site data and site conditions demonstrate that soil vapor intrusion is not occurring and the potential for soil vapor intrusion to occur is not likely, the soil vapor intrusion evaluation would be considered complete.

The NYSDOH and the NYSDEC (the Agencies) work cooperatively to review sampling proposals, to evaluate data collected during a soil vapor intrusion investigation, and to make appropriate recommendations on the need for additional sampling.

Comment C.6.2 (paraphrased, 2 commenters, 2 comments):

The guidance suggests that multiple sampling rounds are required to evaluate fluctuations in concentrations due to seasonal effects and changes in building conditions, such as HVAC operation. Because only heating season results are considered for decision making in Matrix 1 and Matrix 2 (Section 2.4) it appears unnecessary to characterize seasonal variations. Changes in building conditions, such as HVAC system operation, are also unlikely to occur during sampling if the sampling protocol in Section 2.11.1 of the guidance is followed.

Response C.6.2:

All available information about a site and potentially affected buildings (including HVAC operations and all of the other factors discussed in Section 1.3) should be considered in planning and timing an investigation. Section 2.4 of the guidance has been revised to emphasize that samples may be collected at any time of the year and that decisions to take no further action or to monitor should be shown to be protective when soil vapor intrusion is believed to be most likely.

Comment C.6.3:

A significant reason for conducting multiple sampling rounds is to aid in confirming sampling results in cases where either prior data indicate some lesser vapor intrusion potential relative to [NYS]DOH action guidelines or in recognition of possible temporal variations.

Response C.6.3:

Agreed. Confirming sampling results and evaluating temporal variations are given as examples in Section 2.5 of the guidance.

Comment C.6.4:

Multiple rounds of sampling will not be sufficient for the design of an [soil vapor extraction] SVE system. This inference seems like an apples/oranges comparison. Pre-design sampling may be necessary during pilot studies to evaluate design parameters such as the radius of influence of the system and its potential effectiveness.

Response C.6.4:

Acknowledged. Section 2.5 of the guidance discusses multiple rounds of sampling associated with the investigation phase to identify the nature and extent of subsurface vapor contamination that should be addressed by the remedy. However, samples may also be collected during the remedial design phase to evaluate the design parameters such as those mentioned in the comment.

C.7 TOPIC: Sampling locations and requirements – soil vapor

Comment C.7.1 (paraphrased, 1 commenter, 1 comment):

We recommend that Section 2.6.1 be clarified to suggest that, where appropriate, testing should be between the building and the location of the suspected contamination. While this may seem obvious, the clarification may prevent some misunderstanding.

Response C.7.1:

Agreed. This recommendation is provided in Section 2.6.1.a.1 of the guidance.

Comment C.7.2 (paraphrased, 2 commenters, 2 comments):

Section 2.6.1(b)(1): Please clarify what is meant by "samples should be collected…in areas of varying isoconcentrations of contamination in the upper groundwater…."

Response C.7.2:

Section 2.6.1.b.1 discusses examples of sample locations in particular areas of concern on an undeveloped parcel to characterize soil vapor, such as areas with either known or suspected subsurface sources of volatile chemicals, areas where elevated readings were obtained with field equipment during previous environmental investigations, and areas of varying shallow groundwater contaminant concentrations. The phrase "varying isoconcentrations" is contradictory. Therefore, Section 2.6.1.b.1 has been revised as follows: "…and in areas of varying concentrations of contamination in the upper groundwater…."

Comment C.7.3:

Section 2.6.1(b)(2): Please insert the word "contaminated" before "area" to clarify that grid sampling may be required within a contaminated area, not just an area.

Response C.7.3:

The word "contaminated" is provided in the first part of the paragraph (Section 2.6.1.b). However, the intent of Section 2.6.1.b is to provide examples of how locations may be selected to collect representative samples to characterize soil vapor on undeveloped parcels, which may or may not be "contaminated."

Comment C.7.4 (paraphrased, 2 commenters, 2 comments):

The purpose of vapor sampling to characterize contamination in the vadose zone is unclear (Section 2.6.1.e). Soil contamination should be characterized by soil sampling and analysis. Additionally, it is unclear whether the preceding paragraphs apply to the vadose zone.

Response C.7.4:

The phrase "vadose zone" refers to the unsaturated, subsurface region between the water table and the land surface. Soil vapor is the air found in the pore spaces between soil particles. Section 2.6.1.e of the guidance and preceding paragraphs refer to soil vapor, and by definition, refer to the vapor present in the vadose zone.

Comment C.7.5:

Requirement for [soil vapor] sampling at multiple depths [Section 2.6.1.f]: While this type of study may be interesting for research regarding the mechanisms of influence, it may not be appropriate for site investigations focused on evaluation of vapor intrusion. The [responsible party] should only be required to do vertical profiling if there is a specific question regarding source or the nature and extent of contamination that needs to be addressed. Samples deeper than the foundation would not serve the purpose of most vapor intrusion evaluations.

Response C.7.5:

Acknowledged. The discussion of multiple soil vapor probe depths in Section 2.6.1.f of the guidance is an example of selecting sample locations to meet particular sampling objectives (i.e., to determine the influence of contaminated groundwater on soil vapor; to obtain a vertical profile of soil vapor, etc.). Sampling objectives vary from site to site. Vertical profiling of soil vapor may not meet the sampling objectives of a particular site. Section 2.6 has been revised to emphasize that the specific sampling approach will be dependent upon site-specific and building-specific conditions.

Comment C.7.6 (paraphrased, 3 commenters, 4 comments):

Several comments were received pertaining to vapor sampling along utility corridors, a site's perimeter or across the site in a grid pattern. Commenters questioned the justification for requiring such sampling, the need for such sampling if a portion of the site is bounded by vapor barriers (e.g., a large river), and the need for more than three soil vapor samples at a site.

Response C.7.6:

These types of samples are not automatically required at every site, they are provided as examples of locations designed to meet differing sampling objectives. As described

in Section 2.6.1 of the guidance, many factors are considered when planning the extent of vapor sampling and identifying the specific locations to collect samples, including site-specific characteristics and the objective(s) of the sampling. Examples of reasons why these types of samples are collected are given in Section 2.6.1. As with groundwater and soil, there is no prescribed number of soil vapor samples that are needed to characterize this environmental medium.

Comment C.7.7 (paraphrased, 1 commenter, 1 comment):

Section 2.6.1 indicates soil vapor samples collected at less than 5 feet may be prone to bias from surface air. The NYSDOH should provide more information to support this statement. Will data from areas where groundwater or natural conditions and bedrock prevent deeper samples from being collected be accepted? Using low-flow techniques and the surface sealing inert gas procedure, there should be no question regarding the depth of sampling.

Response C.7.7:

As discussed in Section 2.6.1, site–specific circumstances may warrant collection of soil vapor samples from depths less than 5 feet below ground surface. Under such circumstances, sample collection in accordance with the guidance (e.g., the use of low sample collection rates and tracer gas) should serve to verify that the samples are representative of the soil vapor concentration at the sampling interval of concern. These determinations will be made on a site-specific basis.

Comment C.7.8 (paraphrased, 3 commenters, 3 comments):

The requirement to sample [soil vapor] at least one foot above the water table in areas where the groundwater table is less than six feet below grade is not practicable for shallow groundwater. The height above the water table should be based on the type of soil and the corresponding height of the capillary fringe.

Response C.7.8:

The guidance specifies a minimum separation between the sample interval and the water table, but, at sites where is it not practicable to include a one foot separation above the water table, an alternate soil vapor collection configuration will be considered.

Comment C.7.9 (paraphrased, 4 commenters, 4 comments):

The guidance indicates that soil vapor samples should be collected 10 feet away from buildings when no confining layers are present (e.g., pavement) to avoid sampling areas affected by building operations (which might be pulling ambient air into the soil adjacent to the building). This is not supported by conceptual models of vapor intrusion (e.g., EPA 2002) and modeling studies (e.g., Abreu and Johnson, 2005) which indicate that sampling soil vapor adjacent to the building, at depths of 5 feet or more below the foundations, is preferred. If the purpose of sampling is to collect samples representative of soil vapor that could be entering a building via soil vapor intrusion, then soil vapor samples should be collected as close to the building as possible. There is no technical basis for indicating that the zone of a building influence is 10 feet. Also, what is the recommended procedure is there is a surface confining layer (asphalt or concrete).

Response C.7.9:

Under all conditions, samples should be collected from locations which are representative. The rationale behind collecting samples away from a structure is to

avoid sampling in fill materials or other non-native materials that may be present immediately surrounding the building, and thus may not be representative for the purposes of evaluating soil vapor contamination. The distance of 10-feet is provided in the guidance for the purposes of example and is not intended to be a set distance criteria. Surface confining layers, such as pavement, may temporarily or permanently retard the migration of subsurface vapors to the outdoor air and may indicate a need to collect samples closer to a structure. The extent to which a surface confining layer affects the location of soil vapor samples is determined on a site-specific basis.

Comment C.7.10 (paraphrased, 1 commenter, 1 comment):

The objective of the investigation should be to "identify" the extent of soil vapors, and not to "adequately address" them. Section 2.6 goes on to state that "[i]nvestigations of soil vapor contamination should proceed outward from known or suspected subsurface sources, as necessary, on an areal basis until potential and current exposures have been adequately addressed." (p.12). We recommend that the words "adequately addressed" should be replaced with "identified."

Response C.7.10:

Acknowledged. The word adequately has been removed from Section 2.6.1 of the guidance.

C.8 TOPIC: Sampling locations and requirements – sub-slab vapor and indoor air

Comment C.8.1 (paraphrased, 2 commenters, 2 comments):

The scope of testing described in this section of the guidance [Section 2.6.3] is needlessly burdensome. In many cases, limited indoor air testing in the lowest potential living space (i.e., the most likely space to be impacted by vapor intrusion) is sufficient for decision-making. Additionally, the locations of indoor air sampling should be tied to use of the area. The testing protocol described by this section should only be necessary when background sources are suspected and cannot readily be ruled out or confirmed by other lines of evidence.

Response C.8.1:

The type, number and location of samples included in a vapor intrusion evaluation is typically determined on a site-specific basis. In most cases, data provided from indoor air living space sampling alone typically are not adequate to evaluate the cause or source of exposure. Comparisons between sub-slab vapor, outdoor air, and indoor air results obtained from different locations within a building (i.e., different floors), as well as the information gathered in the building surveys, are used when determining the likely cause or source of the exposure. These steps are necessary so that appropriate actions can be identified to address exposures. While indoor air samples in the lowest level of a building, in conjunction with sub-slab vapor and outdoor air samples, may be adequate to determine whether soil vapor intrusion is occurring, the sample may not be representative of actual exposures occurring within the building. Therefore, we also recommend that an indoor air sample be collected from the lowest level living space. In some cases, such as a basement bedroom or finished living room, the lowest level may also represent the lowest level living space.

Comment C.8.2:

Although it is true that special consideration be given to [sampling] buildings that are used by sensitive populations, a child would be more likely to have a greater exposure in a residential dwelling. Guidelines "a" and "c" [in Section 2.6.2] should be combined.

Response C.8.2:

Section 2.6.2 identifies buildings that should be considered when selecting sub-slab vapor and indoor air sampling locations. The selection is not based on relative exposure duration. Furthermore, combining the guidelines as recommended would overlook the possibility that a child may be exposed at a facility (located within an area of subsurface vapor contamination), but not at home (located outside of the area of subsurface vapor contamination). The guidance has not been revised in response to this comment.

Comment C.8.3 (paraphrased, 1 commenter, 1 comment):

We request clarification and supporting data concerning the identity of "sensitive population groups."

Response C.8.3:

The identification of sensitive population or sensitive subgroups will vary with the nature of the exposure, the identity of the chemical and its effects, and the characteristics of various members of the exposed population (EPA 2006a,b). A sensitive subgroup for one type of exposure may not be the sensitive population for a different type of exposure. Typically, however, subgroups that might be more sensitive to chemical exposures than average healthy adults are pregnant women, infants and children, the sick, those nutritionally or immunologically compromised, and the elderly (ATSDR 1996; EPA 2001; 2006a,b).

Comment C.8.4 (paraphrased, 3 commenters, 4 comments):

The guidance states that buildings "located above or directly adjacent to known or suspected areas of subsurface volatile chemical contamination should be sampled." This is an overly broad statement that could be interpreted to require sub-slab vapor testing in all buildings over or adjacent to areas where contamination is merely suspected, or where concentrations are simply detected. This requirement is also contrary to the following statement: investigations of sub-slab vapor and/or indoor air contamination should radiate outward from the area of greatest concern until the potential for vapor intrusion exposures is adequately addressed. Clearly, testing should cease when test data and other lines of evidence indicate that vapor intrusion impacts, if any, have been adequately delineated, and should not be required in each and every building regardless of prior test results. Clarification is needed in the guidance as to whether the vagueness of the document will allow for elimination of buildings or areas from investigation.

Response C.8.4:

Every site is unique. The sampling approach that may be appropriate at one site may not be appropriate at another. The methodology discussed in the guidance is general in nature and is provided so that the applicant can develop an appropriate site-specific sampling plan. Elimination of buildings or areas from investigation is considered on a site-by-site basis in consultation with the Agencies. However, data collected to date do not support a universal distance criterion to screen-out sites or buildings from consideration. Typically, the relative relationship between sub-slab soil vapor, indoor

air and outdoor air concentrations are considered essential to evaluate exposures related to soil vapor intrusion.

Comment C.8.5 (paraphrased, 4 commenters, 4 comments):

The guidance states that indoor air samples should be taken in buildings "in which elevated concentrations of contaminants were measured in sub-slab vapor samples." The term "elevated" is too vague and should be explained further.

Response C.8.5:

Section 2.6.3 of the guidance provides a general discussion of various factors that should be considered when selecting buildings for indoor air sampling. The guidance recommends that indoor air samples be collected concurrently with sub-slab vapor and outdoor air samples. If only sub-slab vapor samples were collected during the heating season, we recommend indoor air samples be collected in those buildings with elevated concentrations of contaminants in sub-slab vapor samples. Section 3.3.2 of the guidance identifies factors that are considered when evaluating sub-slab vapor results, such as background concentrations in air, the NYSDOH's guidelines for volatile chemicals in air, human health risks associated with exposure, attenuation factors, and concentrations provided in the NYSDOH's decision matrices.

Comment C.8.6:

Buildings should be prioritized for sampling based on use and relative sub-slab concentrations.

Response C.8.6:

Acknowledged. As discussed in Section 2.6 of the guidance, the specific sampling approach will vary at each site depending upon site-specific and building-specific conditions. In many cases, prioritization of structure sampling (as recommended in the comment) has been considered when developing sampling work plans.

Comment C.8.7 (paraphrased, 5 commenters, 5 comments):

The guidance states that indoor air or sub-slab vapor sampling should be conducted in "buildings in which positive responses with field equipment (e.g., photoionization detector (PID)) were obtained." Commenters noted that PIDs are screening-level instruments and caution should be used in applying results. They also provided the following suggestions to clarify the intent of this statement:

- specify that the PID response triggering sampling should be above background and from unidentified sources,
- clarify the type and sensitivity of the screening device on which a positive reading leads to a presumption that indoor air testing is necessary,
- either add other field instrumentation as presented later in the guidance or qualify this statement to acknowledge that the utility of typical field screening instruments may be limited by instrument sensitivity, and
- indicate PID readings showing an increasing gradient from indoor air to obvious vapor intrusion points, such as cracks in a slab, may be more useful for determining the need for additional sampling.

Response C.8.7:

Acknowledged. The statement referenced in the comment has been revised as follows: "…buildings in which screening with field equipment (e.g., PID, ppbRAE, Jerome Mercury Vapor Analyzer, etc.) suggests a completed migration pathway, such as when readings are above background and from unidentified sources or when readings show increasing gradients, should be sampled…."

Comment C.8.8:

NYSDOH should define what constitutes a building. Clarification is needed to determine if this includes all building type structures (e.g., garden storage sheds, pole barns, lumber storage sheds) or just normally occupied structures.

Response C.8.8:

Building use and occupancy are considered in evaluating the potential for exposures via the soil vapor intrusion pathway. Structures which are not occupied and/or are not intended to be occupied, or structures which, based on their construction, do not present a potential for vapor intrusion (i.e., a pole-barn, storage sheds, etc.) are typically not included in a soil vapor intrusion evaluation. However, as both current and future exposures are considered in this evaluation, a structure that is currently unoccupied but may be occupied in the future may be included in the investigation. These determinations are made on a site-specific basis.

Comment C.8.9 (paraphrased, 2 commenters, 2 comments):

The guidance suggests collecting sub-slab vapor samples near the center of the slab, away from footings. However, it is generally believed that the majority of vapors enter the slabs around the edges and concentrations near perimeter construction joints may be more representative of sub-slab vapors with the potential to enter the building. Additionally, a one-point data set, such as a single sub-slab sample collected from the center of the slab of a small residence, may be difficult to interpret. More than one sample, and at locations around the slab edges, is encouraged.

Response C.8.9:

Samples collected near the edge of a building or near footings may not be representative of sub-slab soil vapor beneath that structure due to "short-circuiting" effects which may occur due to fill materials, conduits or other conditions near the building's periphery. Each site and building is unique. In some cases, sub-slab concentrations could be higher under one portion of the building than the other due to the location of the subsurface vapor source. As such, the number of samples and sampling locations should be determined based on the particular building, the slab conditions, and the objectives of the sampling. For example, in a small residence with a single slab, one sub-slab soil vapor sample (biased toward the source location) may be sufficient. For larger structures, or structures with more than one slab, additional samples may be recommended. Section 2.6.2 of the guidance has been revised to clarify that at least one sub-slab vapor sample should be collected.

Comment C.8.10:

The requirement to collect sub-slab vapor samples from each slab area is overly prescriptive. In some large buildings, subsurface sources may only exist below a portion of the building, and various data may adequately indicate that testing may be restricted to a

certain area. In other cases, samples collected in the worst case area may be sufficient to show no impact, or allow other risk management decisions.

Response C.8.10:

Acknowledged. While we generally recommend that at least one sub-slab vapor sample be collected from each representative area, and as discussed in the introduction to Section 2 of the guidance, site-specific or building-specific conditions may warrant modifying the recommendation. The comment contains examples of conditions that should be considered when determining the best approach for evaluating the potential for soil vapor intrusion in the building.

Comment C.8.11 (paraphrased, 1 commenter, 1 comment):

The guidance does not address sample number requirements with respect to large, slab-on-grade facilities, whose footprint is often measured in acres, not square feet. Buildings of this magnitude may actually be affected by more than one source of contamination, therefore, we recommend that a minimum sample number requirement be established (i.e., one indoor air sample per every 25,000 square feet of building floor for example).

Response C.8.11:

Indoor air and sub-slab soil vapor sampling needs are variable and are, therefore, addressed on a case-by-case basis in consideration of particular site conditions. The guidance has not been revised in response to this comment.

Comment C.8.12:

Section 2.6.3 discusses indoor air sampling and identifies areas likely to be impacted by vapor intrusion. We recommend specifically identifying basement areas near sump pumps or indoor wells, as these features provide a direct conduit from subsurface sources to indoor air.

Response C.8.12:

Agreed. Section 2.6.3.b of the guidance has been revised accordingly.

Comment C.8.13 (paraphrased, 2 commenters, 2 comments):

Why the draft guidance indicates that the samples should be taken at a height of three feet in the basement is not clear. People do not usually sit or sleep in the basement, particularly in commercial or industrial settings. Furthermore, indoor air sampling should include measurements of the lower airspace frequently occupied by children.

Response C.8.13:

The State considered this comment and decided not to change the default indoor air sampling height at this time. We are not aware of any data indicating that chemicals entering homes via soil vapor intrusion have different concentrations at different heights above the floor. Indoor air near a source of intruding soil vapors, such as a wall outlet, foundation crack, perimeter drain, or sump pit, may contain higher levels of soil vapor contaminants than air at other places in a home. However, we would expect concentrations of soil vapor contaminants to rapidly equilibrate with increased distance from a source. However, the State will investigate the potential for higher levels of soil vapor contaminants at sampling heights below the default indoor air sampling height. The State anticipates implementing these investigations as soon as

feasible and will post any appropriate revisions or amendments to the guidance on the NYSDOH's soil vapor intrusion web page: http://www.health.state.ny.us/environmental/indoors/vapor_intrusion/.

Comment C.8.14:

Testing should ensure that contaminants are measured as accurately as possible, and citizens with legitimate concerns regarding the potential for vapor intrusion into their homes should have their homes tested.

Response C.8.14:

The guidance is intended to provide recommendations for sampling to ensure that high quality data are obtained and that all exposures associated with soil vapor intrusion at a site are identified and addressed. This involves sampling potentially affected homes until sufficient data are collected for appropriate decisions to be made. In some cases, sampling a representative number of homes may be sufficient for making decisions on an area-wide basis.

Comment C.8.15:

The guidance suggests that building testing would proceed "outward, as necessary, on an areal basis until potential and current human exposures have been adequately addressed" (Section 3.3.1); however, elsewhere it states: "[a]t a minimum… buildings, including residential dwellings, located above or directly adjacent to known or suspected subsurface sources of volatile chemicals or known soil vapor contamination should be sampled" (Section 2.6.3). This appears to indicate that building tests must proceed to the edges of a groundwater plume, even if testing on an areal basis indicates that the area of building impacts (if any) is smaller. Section 2.6.3 must be deleted or modified to the approach outlined in Section 3.3.1, which is more technically justifiable and cost-effective.

Response C.8.15:

Acknowledged. We generally recommend that "…buildings, including residential dwellings, located above or directly adjacent to known or suspected subsurface sources of volatile chemicals or known soil vapor contamination should be sampled" in Sections 2.6.2.a and 2.6.3.b of the guidance. However, as discussed in the introduction to Section 2, site-specific conditions may warrant modifying the recommendation. The comment contains an example of site-specific conditions that should be considered when determining the best sampling approach for evaluating the potential for soil vapor intrusion. In all cases, the investigation should proceed until the level of data is sufficient to evaluate what actions, if any, are necessary to address exposures related to soil vapor intrusion.

Comment C.8.16:

Section 2.6.2, third paragraph and Section 2.6.3, last paragraph: Confirmation sampling outside of known or suspected areas of subsurface contamination should be performed because unidentified migration pathways (e.g., due to soil heterogeneities) may affect the direction and extent of vapor migration.

Response C.8.16:

Acknowledged. The specific number and location of samples necessary to address human exposures associated with soil vapor intrusion should be determined on a site-

specific basis and with consideration of the site conceptual model and factors that may affect soil vapor migration and intrusion (as discussed in Section 1 of the guidance).

Comment C.8.17 (paraphrased, 1 commenter, 1 comment):

It is important not to rely blindly on existing contour maps for the purpose of selecting buildings for sampling based on the identification of known subsurface sources of volatile chemicals. Either field sampling should confirm the plume boundaries, or sub-slab and indoor sampling should be conducted within a larger "buffer zone" of potential contamination.

Response C.8.17:

Acknowledged. The guidance suggests a phased, iterative approach to investigation where existing site data and site information are used to guide subsequent phases of the investigation. We agree that the type and quality of the data should be sufficient to guide subsequent investigative phases.

C.9 TOPIC: Sampling locations and requirements – outdoor air

Comment C.9.1:

Consider rephrasing the first sentence [Section 2.6.4] because it is confusing. Indoor and outdoor samples cannot be collected "together," though they can be collected simultaneously.

Response C.9.1:

Acknowledged. Section 2.2.5 of the guidance states "Outdoor air samples should be collected simultaneously with indoor air samples…." In addition, Section 2.6.4 has been revised as follows: "Typically, an outdoor air sample is collected outside of each building where an indoor air sample is collected."

Comment C.9.2:

Outdoor air samples may not be necessary at each indoor air test location if sufficient data are available for the area to characterize ambient air levels, and these levels do not impact decision making (e.g., concentrations are consistently below background ambient air levels). The requirement for outdoor air sampling at every building where indoor air sampling is conducted is unnecessary except where gross differences in outdoor air concentrations are expected based on local sources. For non-industrial settings, outdoor air at a site would not be expected to be significantly variable from location to location or from day to day. This is especially the case with chlorinated VOCs. A statistically representative number of locations and samples should be more than sufficient to characterize background outdoor air. Location-specific outdoor air samples can always be collected during re-testing of buildings with anomalous results.

Response C.9.2:

Acknowledged. Outdoor air samples are necessary for each sampling event to characterize outdoor air quality during the specific time period. However, we agree that outdoor air sampling may not be necessary at every building and that representative locations are adequate when multiple locations are being testing during the same time period. Section 2.6.4 of the guidance has been revised to reflect this point. The specific number and locations of outdoor air samples are determined on a site-specific basis.

Comment C.9.3 (paraphrased, 4 commenters, 4 comments):

Outdoor background sampling locations should be based on actual conditions and not artificially created to minimize VOC levels. The draft guidance (p. 29) states that sampling locations should not be near known sources of VOCs. However, the background sample should be collected to reflect actual conditions, even if the subject building is near a source of VOCs.

Response C.9.3:

The State agrees that the outdoor air sample should be representative of actual outdoor air conditions to provide data to assist in determining the likely source(s) of volatile compounds in the indoor air so appropriate actions can be taken to address exposures. However, the collection of an outdoor air sample near an obvious source of contamination may bias the sample and prevent an evaluation of likely source(s) of volatile contaminants in the indoor air. The location should be a reasonable compromise that is an upwind location representative of outdoor conditions.

Comment C.9.4 (paraphrased, 3 commenters, 3 comments):

The discussion of outdoor air samples should be expanded to include collection of samples at exterior air intakes of buildings equipped with HVAC systems that draw outdoor air into a building. The indoor air quality in such a building would be more a function of the air quality at the intake, which may be on the rooftop or side of the building.

Response C.9.4:

Agreed. Section 2.6.4 of the guidance has been revised accordingly.

C.10 TOPIC: Sampling protocols, technologies and equipment in general

Comment C.10.1:

Section 2: Do you want to add some other possible vapor intrusion tools/tests here, such as:

- flux chambers,
- indoor ventilation rate determination (this is a good one to allow),
- determination of slab specific alpha using a conservative tracer (e.g. radon),
- documentation of bioattenuation, and
- pressure measurements?

Response C.10.1:

Section 2 of the guidance presents general approaches to investigating the soil vapor intrusion pathway. As discussed in the introduction to Section 2.7, the State will consider all proposed methods to evaluate soil vapor intrusion. Data from any investigative technique can be used as part of the conceptual site model process for hypothesis testing as long as the technique is appropriate and can be supported. However, we may request that chemical testing be used to verify that the objective of the proposed method has been met.

Comment C.10.2 (paraphrased, 2 commenters, 2 comments):

We believe it is prudent for the state of New York (and other states) to include an in-depth discussion on passive vapor sampling as it pertains to vapor intrusion investigations. While

there are limitations to these methods (e.g., results typically reported on a mass rather than concentration basis), they are simple to use and their efficacy in characterizing the extent of subsurface contamination is well documented. This technology should be considered, especially for identification of zones of contamination in which vapor intrusion sampling into buildings will then be conducted.

Response C.10.2:

As discussed in the introduction to Section 2.7, to the extent that proposed soil vapor intrusion methods meet the sampling objectives and the requirements for the sampling and analytical methods, they will be considered. In-depth discussions of alternate technologies and methodologies, such as passive vapor sampling, have not been added to the guidance. Passive vapor sampling devices may be appropriate in some situations, such as to delineate the general nature and extent of vapor contamination at a site. These determinations will be made on a site-specific basis.

Comment C.10.3 (paraphrased, 1 commenter, 1 comment):

The section on sampling protocols is too prescriptive. A performance based objective for each subsection (soil vapor, sub-slab vapor, etc.) should be presented. Details of sampling protocols in most cases will be provided in a sampling plan, which will require approval by the Agency overseeing the site investigation.

Response C.10.3:

As discussed in the introduction to Section 2.7 of the guidance, investigation procedures will vary from site to site and should be tailored to the site-specific sampling objectives. The objective of Section 2.7 is to provide a basis from which a sampling plan can be generated. The overall objectives of the sampling and data review processes are outlined in Section 1.5 of the guidance.

Comment C.10.4:

The sampling protocols are very detailed. Although proper and consistent sampling procedures are needed in order to ensure the integrity of the data collected, deviations from this protocol should be permitted without prior NYDOH approval provided that these deviations do not undermine the integrity of the data. This flexibility will ensure that minor deviations in sampling protocol do not result in unnecessary rejection of useful data.

Response C.10.4:

Acknowledged. Deviations from the standard protocol are common when faced with unforeseen events resulting from site-specific conditions. To the extent practicable an attempt should be made to incorporate any potential deviations in the work plan. As stated in the introduction to Section 2.7 of the guidance, "…the procedures that were implemented in the field should be documented and included in the final report of the sampling results." Deviations do not necessarily mean that the data collected will be rejected. However, it is critical that proper documentation be provided so that any changes can be considered during the data evaluation phase.

Comment C.10.5 (paraphrased, 2 commenters, 1 comment):

Throughout the discussion of sampling methods and strategies, the NYSDOH does not provide sufficient detail to ensure that implementation will meet NYSDOH goals and objectives. Examples include: (1) the minimum inside to outside temperature difference required to prevent questions later about whether it was "unseasonably" warm; (2) the

minimum time between sampling rounds; (3) the distance considered to be "in the vicinity" of a building foundation or "along the site's perimeter;" (4) concentrations considered to be elevated readings based on field equipment; and (5) distance considered to be appropriate in grid spacing intervals. Further clarification of these requirements is needed to ensure that sampling will be acceptable to NYSDOH and useful for evaluating the vapor intrusion pathway.

Response C.10.5:

Site-specific conditions will determine the details of the sampling approach. Prescribing many of the factors mentioned in the comment would not allow for the flexibility needed in investigating this complex exposure pathway and may not be appropriate for all sites. Concerns about whether the proposed sampling approach is acceptable will be addressed through the process of developing a site-specific sampling plan, in consultation with the NYSDEC and NYSDOH, and these Agencies' review and approval of the work plan.

Comment C.10.6 (paraphrased, 4 commenters, 4 comments):

The guidance does not provide specificity on sample time duration per sampling event, thereby allowing discrepancies between individual sites that may be similar in nature. The sample duration should be of long enough duration to reflect actual conditions accurately. A 24-hour sample is not adequate to measure long-term exposure. Additionally, one-hour samples do not appear to be compatible with any exposure scenario. However, if the objective is collection of indoor air quality under controlled conditions so that interference from indoor sources can be minimized and vapor intrusion can be more clearly evaluated, then a short duration (e.g., one hour) could be more appropriate.

Response C.10.6:

Sampling duration is generally discussed in Section 2.7 of the guidance. The duration should be selected to achieve the minimum reporting limits and to meet the particular sampling objectives. Indoor air sampling durations should reflect the exposure scenario being evaluated without compromising the minimum reporting limit or sample collection flow rate. These determinations are made on a site-specific basis.

Comment C.10.7 (paraphrased, 1 commenter, 1 comment):

Section 2.7.3.a implies that the NYSDOH guidance should be used in situations where workers may be exposed to subsurface vapors. If this is the case, then the NYSDOH's position should be clearly stated.

Response C.10.7:

Section 1.7.1 of the guidance discusses the applicability of the guidance to non-residential settings. [See also Part A.3 (TOPIC: Occupational Safety and Health Administration (OSHA) regulation).]

Comment C.10.8:

The Guidance does not specify that canisters (Summa®) are the only type of containers to be used for sampling; it is implied (or unclear) that other sample containers are authorized for use (e.g., Tedlar bags, sorption tubes, etc.). We are not aware of certification processes for Tedlar bags.

Response C.10.8:

As stated throughout Section 2.7, samples should be collected in an appropriate container. An appropriate container is one that meets the sampling objectives, meets the requirements of the sampling and analytical methods, and is certified clean by the laboratory. If these criteria cannot be achieved, such as certification of Tedlar® bags, then the container would not be considered appropriate.

Comment C.10.9:

We request clarification as to whether existing soil borings may be used to test for soil vapor intrusion.

Response C.10.9:

Soil borings are typically larger in diameter than soil vapor implants, increasing the amount of backfill material needed and possibly increasing the likelihood that short-circuiting will occur. In the event that existing soil borings are used, care should be taken to show that short-circuiting is not occurring. The decision to use existing soil borings should be made on a site-by-site basis.

Comment C.10.10 (paraphrased, 1 commenter, 1 comment):

I do not believe it is in NYSDOH's best interest to mention specific makes and models of vapor monitoring equipment (e.g., Jerome, RAE Systems). This implies preference by the State for specific corporations.

Response C.10.10:

Agreed. The Preface of the guidance has been revised to include a disclaimer to address this point.

C.11 TOPIC: Sampling protocol – soil vapor

Comment C.11.1:

Section 2.7 indicates cross sectional diagrams for soil gas point installation. Can commonly available probes also be used rather than the screen that is indicated? A number of companies have manufactured and tooled equipment that has been approved by [NYS]DEC for soil gas sampling for almost 20 years. These include points that are actually driven into the ground and the point is the widest part of the hole. The annulus is filled similarly to the diagram in the manual but it is not as large. This is the preferred and in many cases the only way to install gas sampling points indoors. They should also be approved for outside sampling as well.

Response C.11.1:

The purpose of Figure 2.2 is to illustrate the primary components of a soil vapor probe. For clarification, the title of Figure 2.2 has been revised as follows: "Schematics of a generic permanent soil vapor probe and permanent nested soil vapor probes. [Note: Many variations exist and may be proposed in a work plan. Proposed installations should meet the sampling objectives and requirements of the analytical methods.]"

Comment C.11.2 (paraphrased, 1 commenter, 1 comment):

Can multiple nested probes be installed in the same boring annulus with bentonite seals above and below sampling ports, in lieu of the construction detail shown in Figure 2.2?

Response C.11.2:

Multiple nested probes can be used. However, measures need to be taken to demonstrate that each probe is sampling from a discrete interval and that communication or short-circuiting within the system is not occurring. Such measures might include the use of a pump and micromanometer and/or tracer gas.

Comment C.11.3 (paraphrased, 3 commenters, 4 comments):

For soil vapor and sub-slab vapor sampling, nylon tubing may be superior to both polyethylene and Teflon. The guidance states that polyethylene or Teflon tubing must be used for sub-slab soil vapor samples. This section of the guidance does not allow inert tubing to be used, but the Figure 2.3 shows it. The guidance should specify the desired attributes of the tubing, rather than restricting material type.

Response C.11.3:

Acknowledged. Section 2.7.1.c and Section 2.7.2.b of the guidance have been revised to indicate that tubing should be inert, of laboratory or food grade quality, and of the appropriate size. Furthermore, in each of these sections, nylon has been added to the list of examples of inert tubing.

Comment C.11.4 (paraphrased, 2 commenters, 2 comments):

Figure 2.2 shows a stainless steel screen and backfill with "clean material." Are these requirements? The guidance should depict use of bentonite or bentonite grout to fill the annular space above the bentonite seal and allow for alternate screen types. It would seem to allow the use of soil removed from the borehole, filter sand, or other potentially highly air permeable material to backfill the borehole, creating the potential preferential vapor migration path across what may be stratified soils with limiting zones.

Response C.11.4:

The purpose of Figure 2.2 is to illustrate the primary components of a soil vapor probe. For clarification, the title of Figure 2.2 has been revised as follows: "Schematics of a generic permanent soil vapor probe and permanent nested soil vapor probes. [Note: Many variations exist and may be proposed in a work plan. Proposed installations should meet the sampling objectives and requirements of the analytical methods.]" Accordingly, alternate probe installations can be proposed; however, the materials used should be inert and appropriate for the sampling. These determinations will be made on a site-specific basis.

Comment C.11.5:

Grouting appears to be in conflict with the preference for using direct push technology. If grouting is necessary at a site, then an initial borehole can first be augered to a depth less than the sampling depth. The sampling probe can then be pushed to the sampling depth, and the grout can be placed in the annular space between the probe and the borehole. However, the problem of outdoor air infiltrating into soil gas samples has not been observed in practice using direct push probes. Tracer gas (helium) tests have confirmed this.

Response C.11.5:

The guidance document provides general recommendations. Alternate installations may be proposed. To the extent that other installations meet the sampling objectives and requirements of the analytical methods, they will be considered. Section 2.7 of the guidance has been revised to reflect this point.

Comment C.11.6 (paraphrased, 3 commenters, 3 comments):

The use of glass beads to create a sampling zone appears to be in conflict with the preference for using direct push technology. It is common to encounter significant void space beneath the slab due to settling of sub-grade fill material. In these instances it is not feasible to cover the probe tip with coarse sand or glass beads. Additionally, sand can act as a sink for volatiles. Introduction of additional materials is not recommended because it is unknown to what extent they may be a potential source of VOCs. Washed #1 crushed stone works well as a substitute.

Response C.11.6:

Acknowledged. Section 2.7.1.b and Section 2.7.2.d of the guidance have been revised as follows: "…porous, inert backfill material (e.g., glass beads, washed #1 crushed stone, etc.)…." Alternate backfill materials may be proposed and used; however, materials should be inert.

Comment C.11.7 (paraphrased, 1 commenter, 1 comment):

We recommend that a PRP should not be required to pay for permanent probes unless there is a documented, completed exposure pathway presenting a risk to human health.

Response C.11.7:

Section 2.7.1 of the guidance has been revised to reflect the fact that permanent soil vapor probes are not "required," but that "permanent or semi-permanent installations are preferred for data consistency reasons and to ensure outdoor air infiltration does not occur." We agree that permanent probes should be used when needed to meet the objectives of the sampling. For example, permanent probes are recommended when repeated soil vapor sampling from a particular location is needed (e.g., as part of a long-term soil vapor monitoring program).

Comment C.11.8:

For permanent installations, consider sloping the ground surface to direct water away from the borehole much like a monitoring well.

Response C.11.8:

Agreed. Section 2.7.1.f of the guidance has been revised to include this consideration.

Comment C.11.9:

The draft policy is heavily weighted toward permanent soil probe installations that are very similar in construction to groundwater monitoring wells. There are other vapor sampling methods such as installation of a temporary driven steel rod and membrane-tipped probes driven with a geoprobe. These techniques are less expensive and are not permanent

devices. Although the draft guidance (Section 2.7) states that temporary devices could be used, the draft language should revised to provide more sampling flexibility.

Response C.11.9:

Acknowledged. The examples provided in Section 2.7.1 are intended to provide guidance for collecting soil vapor samples from discrete zones with minimal ambient air infiltration. However, the section has been revised to acknowledge the use of temporary probes and to recommend their use only if "measures are taken to ensure that an adequate surface seal is created to prevent outdoor air infiltration and if tracer gas is used at every sampling location."

Comment C.11.10:

In this section the distinction between temporary, semi-permanent and permanent soil vapor probe installations is not clear. It appears the only difference between soil vapor implants would be the methods by which implants are completed at the ground surface (i.e., with or without a road box). It should be clarified that a temporary soil vapor point is one where probes are pushed to depth and the probe rods are bumped back to expose a small interval of the formation; once the sample is collected the probe rods are removed and no constructed material is left in the ground.

Response C.11.10:

The intent of the guidance is to provide general recommendations and strategies for conducting a soil vapor intrusion investigation. The probe installations described in the guidance are generally similar in construction. However, alternate installations may be proposed. To the extent that other installations meet the sampling objectives and requirements of the analytical methods they will be considered.

Comment C.11.11:

Provide acceptable procedures for temporary vapor sampling installations. For example, is a direct push vapor probe (e.g., Geoprobe) with a surface bentonite seal, which is commonly used for soil vapor sampling, acceptable?

Response C.11.11:

The guidance is intended to provide general strategies for a soil vapor intrusion evaluation and acknowledges that there are alternate methods for probe installation. To the extent that installations meet the sampling objectives and requirements of the analytical methods they will be considered. With respect to temporary soil vapor probes, Section 2.7.1 of the guidance has been revised as follows: "Temporary probes should only be used if measures are taken to ensure that an adequate surface seal is created to prevent outdoor air infiltration and if tracer gas is used at every sampling location."

Comment C.11.12:

The use of direct push for installation of soil-gas probes should be questioned, in particular, in fine-grained soils, because of the potential for smearing along the borehole walls during rod insertion. This practice could lead to an increased potential for vapors to short circuit, potentially with the atmosphere. The use of tracers and vacuum testing during sampling would be useful in helping determine whether short-circuiting occurs. Care should be taken both in using this type of approach in fine-grained soil settings.

Response C.11.12:

Acknowledged. Under certain circumstances, smearing could be a problem. The use of tracer gas as part of the sampling approach should be capable of identifying sample locations where short-circuiting is a problem. In some settings, such as those described in the comment, the use of hollow stem augers may be more likely to reduce smearing. Section 2.7.1.a of the guidance has been revised to incorporate the consideration of smearing when selecting the method of probe installation.

Comment C.11.13:

Section 2.7.1(a) references only augers or direct push technology. The Guidance should allow for other drilling methods as may be appropriate based on site conditions. Drilling for nested implants should include continuous sampling of soil in the deepest borehole to aid in characterizing vadose zone conditions. If possible, nested implants should target zones just above and below potential limiting soil zones (fine-grained high moisture content soils to aid in documenting potential vapor profiles and effects of limiting zones).

Response C.11.13:

We agree that drilling methods should be selected based on site conditions. Section 2.7.1.a of the guidance has been revised to clarify this point. The collection of soil samples should be considered on a case-by-case basis.

Comment C.11.14:

Describe procedures for soil and sub-slab vapor sampling in the presence of groundwater, especially due to seasonal fluctuations and affects on permanent probe installations.

Response C.11.14:

The use of semi-permanent probes may be more appropriate in areas exhibiting substantial fluctuations in the groundwater table. If groundwater is present immediately beneath a building's slab, then sub-slab vapor sampling would not be recommended. In these cases, indoor air sampling and a water sample from a sump may be more appropriate. These determinations should be made on a site-specific basis.

Comment C.11.15:

The guidance should stipulate requirements for when to sample based on weather conditions rather than just requiring the documentation of weather conditions. Precipitation can influence soil gas and indoor air sample results. Therefore, [NYS]DOH should provide guidance on weather conditions under which sampling is or is not recommended.

Response C.11.15:

While heavy rains can potentially produce a short-term surface confining layer, we have not observed significant limitations on subsurface vapor or indoor air sampling. Determinations regarding factors that may influence the quality of the sampling data (i.e., weather conditions) will be made on a site-specific basis. A discussion acknowledging the potential limitations of weather conditions on soil vapor sampling has been added to Section 2.7.1 of the guidance.

Comment C.11.16:

Some mention should be made of the difficulty associated with sampling during the winter. Condensation is a particular issue that should be mentioned.

Response C.11.16:

Acknowledged. A discussion acknowledging the potential limitations of weather conditions on soil vapor sampling has been added to Section 2.7.1 of the guidance. In the discussion, condensation is mentioned as an example.

Comment C.11.17:

Weather conditions such as outdoor temperature and barometric pressure have little effect on soil gas samples collected 5 feet or deeper. Why require this information?

Response C.11.17:

We agree that other factors, such as moisture content, would be more likely to affect concentrations of volatile chemicals in soil vapor collected from deeper locations than barometric pressure. Section 2.7.1 of the guidance has been revised to reflect that while information about the barometric pressure is not required, the information could be gathered to assist in the interpretation of the results. For example, this information is easily obtained and can be collected in a consistent fashion for all sampling events. Having consistent information corresponding with soil vapor concentrations can help to evaluate trends and demonstrate what effect these parameters might have on soil vapor concentrations at 5 feet or deeper.

Comment C.11.18:

The guidance does not recommend particular capping mechanisms for the sample tubes or the surface access covers. We have had problems with some capping mechanisms that have led to false readings (e.g. glues attaching the rubber gasket on the surface access cover released VOCs in warm weather, lubrication in valves that was used to cap the tube). Does [NYS]DOH have a recommendation for capping mechanisms that will not contaminate samples?

Response C.11.18:

No, the State does not have specific recommendations for capping mechanisms. However, care should be taken in specifying the materials that are used for capping the ends of probes to ensure that they do not interfere with the objectives of the sampling, such as lubricants used in valves and in the adhesives used in gaskets.

Comment C.11.19:

If you are going to recommend more than one sampling round in a different season, it may or may not be wise to leave the implants in the ground. Tampering becomes a concern.

Response C.11.19:

Acknowledged. We generally recommend permanent probes for data consistency reasons. However, as discussed in the introduction to Section 2 of the guidance, site-specific conditions may warrant modifying the recommendation. The comment contains an example of a concern that should be considered when selecting the appropriate probe type. The concern of tampering may be particularly relevant if there is a history of tampering at the site, such as with groundwater monitoring wells.

Comment C.11.20 (paraphrased, 2 commenters, 2 comments):

I recommend adding a reference to the necessity of contacting the Underground Facilities Protection Organization (Dig Safely New York) when collecting soil vapor samples along, above and adjacent to utility beddings, such as during an evaluation of preferential pathways.

Response C.11.20:

The party responsible for conducting subsurface sampling is responsible for ensuring that areas to be sampled are clear of underground utilities. The guidance has not been revised in response to the comment.

Comment C.11.21 (paraphrased, 1 commenter, 1 comment):

Is there a technical basis for the 24-hour wait time for permanent soil vapor probes? If the sand pack is purged out, then no wait time should be necessary.

Response C.11.21:

Based on past experience, the primary cause of outdoor air infiltration into soil vapor probes is an improperly set surface seal. The proper wait time is the length of time that it takes for the seal to fully set (typically 24 hours).

Comment C.11.22 (paraphrased, 2 commenters, 2 comments):

A restriction on the rate at which soil gas samples are collected should not be imposed for samples collected at depth. The rate at which deep samples are collected is limited only by the permeability of the soil. As long as it can be demonstrated that the flow rate does not exceed the rate at which soil gas moves through the soil, the flow rate should not be restricted for deep soil gas samples since air infiltration is not of concern. The guidance should allow for proposal of alternate rates of sampling based on site-specific soil conditions.

Response C.11.22:

A low flow rate is recommended to minimize the infiltration of outside air and to minimize disruptions to the natural equilibrium conditions in the sampling zone, which has been demonstrated to occur at high flow rates. When using low volume sampling techniques, this should not be overly restrictive.

C.12 TOPIC: Sampling protocol – sub-slab vapor

Comment C.12.1 (paraphrased, 1 commenter, 1 comment):

Given the schematic in Figure 2.3 and the accompanying discussion in the text, the Guidance does not address construction of sub-slab sample ports for relatively thin slabs (2 inches or less) that are commonly encountered in older structures, particularly residential structures. The Guidance should develop provisions for sub-slab samples at these "thinner slab" locations, perhaps considering a plugged port that is finished above floor grade.

Response C.12.1:

Figure 2.3 and the accompanying text provide general recommendations and approaches for sub-slab soil vapor sampling. The sub-slab probe should be installed in a manner that will provide representative data. If site circumstances indicate that a representative sub-slab soil vapor sample cannot be obtained, alternate approaches

should be discussed with the Agencies. These determinations are made on a site-specific basis.

Comment C.12.2:

As indicated in Figure 2.3, the sub-slab sample port is recessed below floor grade; presumably, the diameter of the hole drilled in the slab at the top of the port would need to be sufficiently large to allow for manipulating hand tools to remove the cap from the port fitting. The point itself would need to be anchored with a hand tool when unthreading the cap or plug on the port fitting; if not, the torque applied when attempting to remove the cap or plug from the port could eventually cause rotation of the entire point, thereby compromising the surface seal.

Response C.12.2:

Comment noted.

Comment C.12.3:

When a sub-slab vapor probe is installed in accordance with the depiction in Figure 2.3, the recessed sub-slab sample port should be capped at the floor slab grade, perhaps with a hollowed out plug.

Response C.12.3:

Comment noted.

Comment C.12.4:

Section 2.7.2 e.: Is bentonite acceptable for sealing the penetration? What about modeler's clay?

Response C.12.4:

We recommend that the material used for sealing should be inert and should allow for an adequate seal. Section 2.7.2.e of the guidance has been revised to clarify this point. Sealing materials that accomplish these objectives are considered appropriate.

Comment C.12.5:

If sub-slab samples are collected concurrently with indoor air samples, then they would need to be installed prior to the indoor air sampling. However, drilling through the concrete and creating a temporary open in the slab could temporarily impact indoor air quality in the immediate vicinity, which could cross-contaminate the indoor air samples. Instead, the indoor air samples should be collected first, and the sub-slab samples should be collected immediately after, on the same day if possible. The difference of a few hours will not change sub-slab VOC concentrations.

Response C.12.5:

Tight surface seals (such as with beeswax) can be installed immediately after the hole is drilled and the sub-slab vapor sampling tube (temporarily capped) is inserted. This procedure, combined with the effects of dilution processes, is not expected to substantially affect indoor air quality. Although a longer sampling duration (e.g., 24 hours) may not be necessary to collect representative sub-slab vapor samples, we

continue to recommend concurrent sampling of sub-slab vapor, indoor air and outdoor air because it

- is feasible,
- minimizes disruptions to the occupants (in terms of the number of visits to set-up and take-out), and
- facilitates direct comparisons of the data.

Comment C.12.6 (paraphrased, 2 commenters, 2 comments):

Based on experience at other sites, it is probably unnecessary to sample sub-slab soil vapor over the same time period as concurrent indoor air samples. Under most conditions, the subsurface vapor flux is unlikely to vary significantly over the course of 24 hours. A sub-slab "grab" sample of approximately 10 to 30 minutes duration is generally considered to be representative.

Response C.12.6:

Acknowledged. However, we recommend that concurrent samples be collected from multiple points (sub-slab, indoor, outdoor) to aid the data evaluation process by allowing for direct comparisons over the same time period and to minimizing the potential for discrepancies in the data and the need to resample. [See also Comment C.12.5.]

Comment C.12.7:

Under item a. at the top of page 18 (i.e., actions that should be taken to document conditions during sampling and ultimately to aid in the interpretation of sampling, when sub-slab vapor samples are collected) documentation of uses of volatile chemicals in residential buildings should be added.

Response C.12.7:

Acknowledged. Typically, knowing the indoor use of volatile chemicals is more relevant when sampling sub-slab vapor alone in commercial or industrial buildings, rather than residential buildings, due to the potential for large-scale use of the products and for complex HVAC systems that may operate under a positive pressure. Section 2.7.2.a of the guidance has been revised to reflect this point. As discussed in Sections 2.7.3 and 2.11, volatile chemical usage should be documented in all buildings (commercial, industrial, residential, etc.) when indoor air samples are collected.

Comment C.12.8 (paraphrased, 2 commenters, 2 comments):

All of the steps you require on page 18 (a through h) for sub-slab vapor samples are not always necessary and are overkill that will drive up costs.

Response C.12.8:

We agree that not all of the items specified in the list need to be documented in every case. Therefore, Section 2.7.2 of the guidance has been revised to differentiate between the items that we recommend be documented every time and those that should be considered.

Comment C.12.9:

It would also be useful to measure the direction and magnitude of the differential pressure between the sub-slab and indoor air using a sensitive pressure gauge (e.g. an appropriately sensitive magnahelic or digital micromanometer). This measurement will provide quantitative data regarding the potential for vapor intrusion instead of relying simply on the observations made regarding the possible upward pressure differential due to use of HVAC systems, etc. The pressure differential value is used as an input to the [Johnson & Ettinger Model] JEM.

Response C.12.9:

Agreed. However, this information may not be needed in every case. As stated in Sections 2.7.2 and 2.7.3, "Additional documentation that could be gathered to assist in the interpretation of the results includes information about air flow patterns and pressure relationships obtained by using smoke tubes or other devices (especially between floor levels and between suspected contaminant sources and other areas)…"

Comment C.12.10:

Evaluation of flow patterns between floors is an extreme diagnostic step that should only be necessary if risk-management decisions cannot be made on the basis of indoor air test results. In general, the guidance appears to approach testing of each building as a research project, resulting in far more data collection than is necessary at most sites.

Response C.12.10:

We agree that an evaluation of airflow patterns may not be necessary to make decisions in all cases. Therefore, Sections 2.7.2 and 2.7.3 have been revised as follows: "Additional documentation that could be gathered to assist in the interpretation of the results includes information about air flow patterns and pressure relationships obtained by using smoke tubes or other devices (especially between floor levels and between suspected contaminant sources and other areas)…"

Comment C.12.11:

The requirement to operate the heating system prior to and during sub-slab sampling should be based on the design of the heating system, since systems that create a positive pressure inside the building will limit vapor intrusion during operation.

Response C.12.11:

Acknowledged. We generally recommend that heating systems be operational because this typically represents the conditions under which soil vapor intrusion is more likely to occur. However, as discussed in the introduction to Section 2 of the guidance, building-specific conditions may warrant modifying the recommendation. All available information about a site and potentially affected buildings (including HVAC operations and all of the other factors discussed in Section 1.3) should be considered in planning and timing an investigation. The comment contains an example of a building condition that should be considered when selecting the appropriate sampling approach.

C.13 TOPIC: Sampling protocol – indoor and outdoor air

Comment C.13.1 (paraphrased, 2 commenters, 2 comments):

While tetrachloroethene (PCE) badges are a less expensive alternative, the quality of the data that are generated from such badges is much less reliable than data generated from collecting air samples followed by laboratory analysis. They have higher detection limits and higher rates of laboratory contamination relative to Summa® canisters. We recommend that this section either be eliminated or that additional language be provided to explain why this type of technology is recommended.

Response C.13.1:

A minimum reporting limit appropriate for data evaluation can be achieved with PCE badges. The guidance includes a discussion of the passive air monitors in Section 2.7.3 because they are often used at sites with PCE contamination. At these sites, the use of badges is often appropriate for the sampling objectives (e.g., to evaluate the potential for intrusion of vapors containing PCE into a building) and is often a more cost-effective approach. Quality assurance/quality control measures in place at Environmental Laboratory Approval Program (ELAP)-certified laboratories ensure data obtained from passive air monitors are reliable.

Comment C.13.2 (paraphrased, 1 commenter, 2 comments):

All of the steps you require on page 19 (a through h) for indoor air samples and on page 20 (a through c) for outdoor air samples are not always necessary and are overkill that will drive up costs.

Response C.13.2:

We agree that not all of the items specified in the list need to be documented in every case. Therefore, Section 2.7.3 of the guidance has been revised to differentiate between the items that we recommend be documented every time and those that should be considered.

C.14 TOPIC: Use of tracer gas

Comment C.14.1 (paraphrased, 1 commenter, 2 comments):

Tracers should be required for all [soil vapor] samples to ensure no leaks in the sampling system, which can happen on any sample if fittings are not tightened. I recommend that tracers should be required on all samples or [non-detects] won't be legally defensible.

Response C.14.1:

If there are concerns about leaks in the sampling system (not just at the soil vapor probe/ground interface), then steps should be taken to ensure that the tracer gas is in contact with the entire sampling train. Field personnel may wish to use liquid tracers for this purpose. Section 2.7.5 of the guidance has been revised to include these considerations.

If the party conducting the investigation wants to use tracers at each soil vapor sampling location during each sampling event, they may do so. However, the guidance continues to recognize that the frequency of tracer gas use may be reconsidered after the results of initial soil vapor sampling (as differentiated from sub-slab vapor sampling) indicate that the tracer gas protocol being employed is adequate [Section 2.7.5].

Comment C.14.2 (paraphrased, 2 commenters, 1 comment):

The guidance recommends using a tracer gas for all initial soil vapor, sub-slab vapor or indoor air samples. As the NYSDOH is likely aware, the methodology presented for conducting the tracer gas study is complicated and time consuming. The NYSDOH should at most require 10% of initial samples undergo a tracer analysis. If these results show that there is no leakage, tracer gas analysis should no longer be required. As another alternative, the NYSDOH should consider allowing pressure testing as a method of leak detection. Using a micro-manometer and a simple hand operated pump, it is possible to measure the pressure drop over time in the sealed enclosure enveloping the sample port. These results can then be used to calculate a percent leakage.

Response C.14.2:

The use of tracer gas is recommended when collecting soil vapor samples, not sub-slab vapor or indoor air samples. Tracer gas should always be used as one element of the quality assurance/quality control elements in the soil vapor sampling program. The guidance provides the flexibility to reduce the percentage of soil vapor sampling points at which a tracer gas is used based on the demonstrated performance of the sampling technique. The pressure technique proposed in the comment would not allow the sampler to identify the source of the leakage.

Comment C.14.3:

The requirement for continued use of a tracer gas after a demonstration that air infiltration is not occurring seems contradictory with section 2.7.1 (e), where the guidance states that "continued use of the tracer gas may be reconsidered."

Response C.14.3:

Agreed. The statement has been removed from Section 2.7.1 (e). The guidance now refers the reader to Section 2.7.5, which describes the State's recommendations for using tracer gas when collecting soil vapor samples.

Comment C.14.4 (paraphrased, 3 commenters, 3 comments):

Commenters expressed the following concerns regarding the use of sulfur hexafluoride (SF_6) and "off-the-shelf" butane as tracer compounds:

- SF_6 is heavier than air and should not be used in situations where multiple samples will be collected from the same location,
- SF_6 can cost anywhere from $100-$400 to purchase depending on the cylinder size,
- SF_6 presents health and safety issues with transporting compressed gas into the field,
- recovery of SF_6 in SUMMA® canisters may be compromised since it is an extremely reactive compound which may react with stainless steel; therefore, this would require an additional separate analysis (either in the field or in the lab) for the SF_6 tracer, and
- "off-the-shelf" butane contains oil and should not be used.

Unless performing a real-time field analysis for the tracer compound, one commenter recommended the use of a more readily available and cost effective tracer, such as shaving cream (contains butane & isobutane), isopropyl alcohol, nail polish remover (contains acetone and/or ethyl acetate) or computer keyboard cleaners (contains Freons). All of these tracer compounds can easily be seen in a routine EPA Method TO-15 analysis, thus eliminating the need for additional field equipment/analyses.

One commenter recommended that liquid tracers be allowed also, such as isopropyl alcohol, pentane, etc. The logistics for using them are much easier, plus, most importantly, you can apply them to all locations that might be the source of a leak, including at the top of the rod or at all of the fittings on the collection train. It is too difficult logistically to have gaseous tracers such as helium, SF_6, etc. applied to all locations at once. Lastly, liquids are easier for soil gas collectors to handle and apply.

Response C.14.4:

As stated in Section 2.7.5 of the guidance, "Depending on the nature of the contaminants of concern, a number of different compounds can be used as a tracer." Several compounds that are commonly used are also provided as examples. The guidance does not require that any one particular compound be used as a tracer. Accordingly, use of any of the compounds mentioned in the comment may be appropriate, provided it meets project-specific data quality objectives. Section 2.7.5 has been revised to reflect this point.

Comment C.14.5 (paraphrased, 2 commenters, 1 comment):

The tracer gases recommended by NYSDOH are not included in the standard EPA Method TO-15 analyte list. As a result, either portable equipment must be used or other laboratory analytical methods must be used to detect the tracer thereby doubling the effort.

Response C.14.5:

The tracer gases mentioned in Section 2.7.5 of the guidance are provided as examples only. The guidance does not require that any one particular compound be used as a tracer. The selection of a tracer should be made on a site-by-site basis, taking into account the concerns mentioned in the comment.

Comment C.14.6:

If care is not taken when injecting tracer gas into a container such as a pail, then the zone around the probe could become pressurized, forcing soil vapors away from the probe and tracer into the soil. To avoid this, a pressure relief hole should be considered for the container. If the tracer gas is heavier than air, the relief hole should be near the top of the container to allow air to escape as the tracer fills the container from the bottom up. If a lighter-than-air tracer gas is used, it may accumulate at the top of the container and not remain in contact with the probe/ground interface. Therefore, sampling from the probe must be conducted quickly after injection of the tracer while it is still reasonably mixed with the air inside the container, before stratification can occur.

Response C.14.6:

Depending on the nature of the tracer gas apparatus, the use of a pressure relief valve may be warranted. Typically, the goal is to maintain an atmosphere of 100% tracer gas at the contact point between the probe and the ground surface. This can be accomplished with only a slight positive pressure in the tracer gas container.

Comment C.14.7 (paraphrased, 2 commenters, 3 comments):

The discussion of tracer gas appears to neglect potential leakage through sample apparatus fittings.

Response C.14.7:

We agree that leakage from fitting connections could bias the sampling results. Although the use of tracers at the fittings has merit, visual and manual inspection of the connections should typically suffice to ensure that they are functioning properly.

Comment C.14.8 (paraphrased, 3 commenters, 3 comments):

We recommend that the NYSDOH clarify the acceptance criteria for detection of tracer compounds (i.e., what percentage of tracer versus target compounds is considered acceptable and not indicative of a leak). Additionally, a 20% leak rate is very generous.

Response C.14.8:

Agreed. Based on public comment and experience in the field, the description of "high concentrations of tracer gas" in Section 2.7.5 of the guidance has been revised to 10%. This percentage refers to the concentration of tracer in the soil vapor sample. As discussed in Section 2.7.5, the probe seal should be enhanced to reduce the infiltration of outdoor air if high concentrations (> 10%) of tracer gas are observed in a sample.

Comment C.14.9:

The stated tracer gas criterion is 20%. However, in our experience, a bentonite or clay seal at the surface of soil vapor and sub-slab has always been capable of creating a seal allowing less than 2% of the tracer gas to be detected in the sample (helium was used). The Guidance should provide field data studies showing that the occurrence of greater than 20% leakage occurs and that this procedure is really warranted when appropriate procedures are followed.

Response C.14.9:

We agree that a bentonite clay seal is capable of functioning as described by the commenter – if it is installed properly and if it is allowed to hydrate adequately prior to sample collection. The guidance provides the flexibility to reduce the percentage of monitoring points at which a tracer gas is used based on the demonstrated performance of the sampling technique.

The State has sites at which 100% tracer gas has been observed. The guidance is intended to present general recommendations on steps and strategies that may be applied when evaluating soil vapor intrusion. Specific site data have not been incorporated into the guidance, as this is inconsistent with the general approach and intent of the guidance.

Comment C.14.10:

Please clarify what type of demonstration is required for [NYS]DOH to determine that the use of a tracer gas is no longer required.

Response C.14.10:

As discussed in Section 2.7.5 of the guidance, the use of tracer gas is recommended at all locations during the initial phase of the investigation. If the data collected during that phase indicate that the probe seals are functioning as intended, the continued use of a tracer gas on each probe may be re-evaluated. The frequency may be decreased after approval from the NYSDEC and NYSDOH is obtained, but we recommend that at

least 10% of the subsequent samples be supported with tracer gas analyses. If the results from the subsequent samples indicate problems with inadequate seals, resampling may be necessary and the frequency of tracer gas use may need to be increased.

C.15 TOPIC: Quality assurance/quality control (QA/QC)

Comment C.15.1:

We suggest that the reference to extreme care be removed and replaced with "an appropriate level of care" to limit potential biases. Unless the [NYS]DOH can precisely define "extreme care," it is a standard that cannot be understood.

Response C.15.1:

Acknowledged. Section 2.8 of the guidance has been revised as follows: "In general, appropriate QA/QC procedures should be followed during all aspects of sample collection and analysis to ensure that sampling error is minimized and high quality data are obtained."

Comment C.15.2 (paraphrased, 1 commenter, 3 comments):

You should not require certified-clean Summa® canisters. This should be left up to the judgment of the consultant based upon required detection levels. Recommending them for low target levels (< 10 mcg/m^3) is more appropriate.

Response C.15.2:

We generally recommend that canisters be certified clean, as defined in the EPA TO-15 method (www.epa.gov/ttnamti1/files/ambient/airtox/to-15r.pdf), to achieve data quality objectives. As discussed in Section 2.9 of the guidance, samples should be analyzed by methods that can achieve minimum reporting limits to allow comparison of the results to background levels. Background concentrations for most compounds are often much less than 10 mcg/m^3. If there is a reason to achieve different minimum reporting limits due to site-specific conditions, such as scoping out the extent of a source area where high concentrations are expected, then an alternate sampling and analysis approach may be appropriate.

Comment C.15.3 (paraphrased, 1 commenter, 1 comment):

The main quality assurance issue associated with the selective ion monitoring (SIM) technique is the proper cleaning and certification of all sample media (i.e., canisters and flow controllers). We strongly recommend that all media be certified as clean down to the lower SIM reporting limits prior to sampling. Selecting media based on past use, separating low level versus high level canisters, or individually certifying media may be desirable and/or necessary for programs looking to monitor very low concentrations of VOCs.

Response C.15.3:

Comment noted.

Comment C.15.4 (paraphrased, 2 commenters, 2 comments):

A regulatory preference between "individually" certified or "batch" certified canisters should be established. We believe that standard laboratory protocols call for batch-certification of containers, unless individual container certification is requested.

Response C.15.4:

Certification on either a batch or individual basis is currently recommended.

Comment C.15.5:

Discuss the applicability of field duplicate and split samples. I do not believe that it is appropriate to collect duplicates/splits for soil or sub-slab vapor samples due to inherent heterogeneities in the subsurface. Two sequential samples from a single location or two concurrent but competing samples from different locations are bound to yield different results due to even the smallest differences in subsurface flow paths and changes in pressure with time. Duplicates/splits may be collected for indoor and outdoor ambient air samples as long as the collection rate is low enough to minimize pressure gradients created at the sample vessel's intake.

Response C.15.5:

Agreed. As stated in Section 2.8 of the guidance, "Duplicate and/or split samples should be collected in accordance with the sampling and analytical methods being implemented." Field duplicate and split samples of soil vapor and sub-slab vapor samples may not be appropriate for the reasons stated in the comment, and are recommended if required by the sampling and analytical method being implemented.

Comment C.15.6:

The document states in Sections 2.8 and 3.1 that a [data usability summary report] DUSR must be prepared for soil gas samples. There should be guidance on how to perform trip blanks, field blanks, matrix spikes and matrix spikes duplicates on summa canister samples. If these are not required, a soil gas specific DUSR protocol should be prepared.

Response C.15.6:

As stated in Section 2.8 of the guidance, "For certain regulatory programs, a Data Usability Summary Report (DUSR) or equivalent report may be required to determine whether or not the data, as presented, meets the site or project specific criteria for data quality and data use. This requirement may dictate the level of QC and the category of data deliverable to request from the laboratory. Guidance on preparing these reports is available by contacting the NYSDEC's Division of Environmental Remediation." Questions on whether a DUSR is needed at a particular site should be directed to the NYSDEC's Division of Environmental Remediation.

Comment C.15.7 (paraphrased, 1 commenter, 1 comment):

We recommend that NYSDOH allow National Environmental Laboratory Accreditation Conference (NELAC) certified laboratories in addition to NYSDOH certified laboratories analyze environmental samples collected within New York State for the purposes of vapor intrusion evaluations.

Response C.15.7:

NELAC is a voluntary association of State and Federal agencies formed to adopt and promote mutually acceptable performance standards for the inspection and operation of environmental laboratories. The National Environmental Laboratory Accreditation Program (NELAP) is the program that implements the NELAC standards. States and Federal agencies serve as Accrediting Authorities with coordination facilitated by the EPA to assure uniformity. The ELAP standards conform to those standards adopted by NELAC, and ELAP is an approved accrediting authority under NELAP. Therefore, as required by NELAP and as authorized by the ELAP regulations, ELAP will recognize the accreditation of laboratories by other NELAP accrediting authorities as part of the ELAP accreditation process. Only laboratories approved by ELAP for the analytes of interest using ELAP-approved methods in the appropriate matrix categories are acceptable for use.

C.16 TOPIC: Analytical methods

Comment C.16.1 (paraphrased, 2 commenters, 2 comments):

We think you are doing yourself a disservice here. There are a number of analytical methods that are appropriate for soil gas samples besides the TO-15 method, such as 8260, 8021, 8015. These methods can yield results comparable to TO-15 and can meet QA/QC criteria and low detection limits.

Response C.16.1:

In Section 2.9 of the guidance, EPA Method TO-15 and NYSDOH Method 311-9 are provided as two examples of commonly used analytical methods. The guidance does not require that any one particular method be used. Accordingly, use of any of the methods mentioned in the comment may be appropriate, provided it meets project-specific data quality objectives.

Comment C.16.2:

It is agreed that a 1 mcg/m^3 level is a suitable detection limit for decision-making purposes. Lower limits are unnecessary unless some action will be taken at the lower level.

Response C.16.2:

The guidance does not indicate that a minimum reporting limit of 1 microgram per cubic meter (1 mcg/m^3) is suitable for decision-making purposes for all volatile chemicals or all types of samples (e.g., indoor air, sub-slab vapor, soil vapor, etc.). While a minimum reporting limit of 1 mcg/m^3 is typically sufficient for most analytes, a lower reporting limit may be necessary to meet data quality objectives (e.g., to make comparisons to background levels or to use the matrices as a decision-making tool). These determinations are made on a site-specific basis. Section 2.9 of the guidance has been revised to emphasize this point.

Comment C.16.3 (paraphrased, 1 commenter, 1 comment):

We recommend that NYSDOH address the issue of using SIM analysis in conjunction with the standard EPA TO-15 analysis in order to obtain lower reporting limits. NYSDOH states that the analytical laboratory should be able to obtain reporting limits in the range of "background;" these background levels are often slightly below a typical laboratory's normal reporting limit (reporting limits are equal to the lowest calibration standard, typically

0.50 ppbv for the TO-15 analysis). The SIM technique is used to obtain lower reporting limits.

Response C.16.3:

Acknowledged. A minimum reporting limit of 1 microgram per cubic meter or less is typically sufficient for most analytes. In some cases, a lower reporting limit may be necessary to meet data quality objectives. EPA Method TO-15 with SIM is often used to achieve lower limits (e.g., 0.25 micrograms per cubic meter TCE). Section 2.9 of the guidance has been revised to include EPA Method TO-15 with SIM in the list of examples of commonly used methods to reflect this point. However, the method is not the only method available or recommended for this purpose.

Comment C.16.4:

The minimum reporting limits of 1 microgram per cubic meter or less should be replaced with language that allows for establishment of reporting limits for individual compounds in consideration of benchmark values such as statistical measures of typical background, applicable air guidelines, and soil vapor to indoor air attenuation factors. The minimum reporting limit of 1 microgram per cubic meter may be insufficient for certain compounds while unnecessarily restrictive for others.

Response C.16.4:

While a minimum reporting limit of 1 microgram per cubic meter (1 mcg/m^3) is typically sufficient for most analytes, a lower or higher reporting limit may be appropriate for meeting data quality objectives. These determinations are made on chemical-specific and site-specific bases. Section 2.9 of the guidance has been revised to emphasize this point.

Comment C.16.5:

I suggest including a table of minimum required reporting limits for common analytes. Please differentiate or specify method/instrument detection limits and/or practical quantitation/reporting limits.

Response C.16.5:

When selecting appropriate minimum reporting limits, site-specific data quality objectives should be considered. Comparing sampling results for volatile chemicals with background concentrations and with indoor air/sub-slab vapor matrices are critical components of the data evaluation process. Therefore, samples should be analyzed by methods that can achieve minimum reporting limits to allow for comparison of the results with background levels and the levels presented in the matrices. Typically, a minimum reporting limit of 1 microgram per cubic meter or less is sufficient for most analytes. Section 2.9 of the guidance has been revised to reflect these points. The discussions of background concentrations for common analytes provided in Sections 3.2.4 and Appendix C, and the decision matrices provided in Section 3.4.2, can be used to guide the selection of appropriate minimum reporting limits. An additional table has not been added to the guidance.

Comment C.16.6 (paraphrased, 2 commenters, 1 comment):

The guidance indicates that samples should be analyzed by methods that can obtain reporting limits of 1 mcg/m^3 or less. It is unclear how these results will be used in conjunction with the comparison to background values. As shown in Section 3.2.4, the

majority of background levels are less than 1 mcg/m^3. As a result, it may be possible to get detection limits of 1 mcg/m^3, but still be above the background concentration. The guidance provides no information on how these results will be interpreted.

Response C.16.6:

When selecting appropriate minimum reporting limits, site-specific data quality objectives should be considered. As discussed in Section 3 of the guidance, comparing sampling results for volatile chemicals with background concentrations and with indoor air/sub-slab vapor matrices are critical components of the data evaluation process. Therefore, samples should be analyzed by methods that can achieve minimum reporting limits to allow for comparison of the results with background levels (given the background database(s) being used in the data evaluation process) and the levels presented in the matrices. The affect of higher minimum reporting limits (as suggested in the comment) on the data evaluation process will depend on several factors, such as how much higher the limit is above background levels and whether the volatile chemical is a chemical of concern. In some cases, conclusive interpretation of the data has not been feasible and resampling has been necessary to meet the sampling objectives.

Comment C.16.7 (2 commenters, 1 comment):

The guidance provides conflicting recommendations for indoor air analytical detection limits. Section 2.9 discusses the analytical detection limits needed for vapor samples. As presented in this section, samples should be analyzed by methods that can achieve a minimum reporting limit of 1 mcg/m^3. In contrast, the notes to Air Matrix 1 and Air Matrix 2 indicate that detection limits of 0.25 mcg/m^3 and 3 mcg/m^3 are needed, respectively. Although it appears that the Air Matrix notes are specific to TCE, tetrachloroethene (PCE), and 1,1,1-trichloroethane (1,1,1-TCA), the NYSDOH states that it intends to apply these matrices to other constituents. If and when this occurs, the current recommendations are likely to cause confusion among the regulated community.

Response C.16.7:

Acknowledged. When selecting appropriate minimum reporting limits, site-specific data quality objectives should be considered. Comparing sampling results for volatile chemicals with background concentrations and with indoor air/sub-slab vapor matrices are critical components of the data evaluation process. Therefore, samples should be analyzed by methods that can achieve minimum reporting limits to allow for comparison of the results with background levels and the levels presented in the matrices. Typically, a minimum reporting limit of 1 microgram per cubic meter or less is sufficient for most analytes. Section 2.9 of the guidance has been revised to reflect these points.

Comment C.16.8:

Is the TO-15 analyte list equivalent to a "wide range of volatiles?" If so, the guidance should state this understanding.

Response C.16.8:

Agreed. Section 2.9 of the guidance has been revised accordingly.

Comment C.16.9 (paraphrased, 5 commenters, 7 comments):

The NYSDOH should encourage the analysis of vapor intrusion samples for targeted analytes rather than for a wide range of chemicals since a wide range is likely to lead to the identification of many chemicals not related to the site. For example, the analyte list for vapor intrusion sampling should be limited to those found in previously collected subsurface vapor samples or to those that can be linked to subsurface source areas (soil, groundwater, etc.).

Response C.16.9:

As discussed in Section 2.9.1 and Section 2.9.2 of the guidance, we agree a targeted analyte list may be appropriate based on initial subsurface vapor sampling results. The approach discussed in these sections of the guidance is consistent with the phased, iterative approach taken when investigating other environmental media. When developing a targeted analyte list, the results of previous environmental investigations (e.g., subsurface vapors, groundwater, soil, etc.), site-specific sampling objectives, and the conceptual site model [Section 1.5] should be considered. Sections 2.9.1 and 2.9.2 have been revised for clarification.

Comment C.16.10 (paraphrased, 4 commenters, 3 comments):

Commenters expressed the following concerns regarding the examples of indicator compounds provided in Section 2.9.1 of the guidance:

- supporting information on analytical methods and background concentrations are needed in the guidance to supplement the examples, especially given that many of the indicator chemicals are not standard analytes;
- an explanation of how sampling these indicator compounds would be of benefit and how these lists were developed is needed;
- clarification that many of the constituents will not be applicable to all sites is needed;
- clarification on how the indicator compounds are to be used in evaluating human exposures given that many of the compounds listed do not have toxicity criteria; and
- justification should be provided for the recommendations given in the guidance (e.g., indicator compounds should only be included on the analyte list if specific data are available to suggest their presence and if accurate and precise analytical procedures are available).

Response C.16.10:

The first step in a soil vapor intrusion investigation is determining whether or not soil vapor intrusion is, in fact, occurring. Indicator compounds can be a useful tool during this process to help distinguish between site-related and non-site-related volatile chemicals. For petroleum products, laboratories may not have standards for every constituent compound, but the information obtained from the analytical chromatograms and tentatively identified compounds may be used to distinguish between sources of contamination. In some cases, indicator compounds have also been used to tailor site-specific analyte lists. Indicator compounds are provided in Section 2.9.1 of the guidance as examples (not requirements) based on our experience in collecting data at a variety of sites (e.g., gasoline spill, manufactured gas plant, etc.).

Once data is obtained from the investigation, they are evaluated to determine whether actions are needed to address current or potential exposures related to soil vapor intrusion. Whether or not a single compound of concern or multiple compounds of concern will drive these decisions at petroleum sites is uncertain given the data

currently available from the investigation of these sites to date. If one compound serves as the driver, the NYSDOH will determine whether to assign the chemical to one of the existing matrices or to develop a new matrix. If multiple compounds serve as the driver, the NYSDOH will determine whether a modified matrix or an alternate risk management tool should be developed. Absence of toxicity criteria for some chemicals is not expected to prevent the data evaluation process, as it is only one of many factors considered. [See also Comment D.12.4 (application of the matrices to other volatile chemicals).]

Comment C.16.11:

Please provide specific methods for evaluation vapor intrusion associated with petroleum compounds. It is unclear whether an evaluation of VOCs and SVOCs is sufficient, given the example compounds used as indicator compounds.

Response C.16.11:

Petroleum products are often a mixture of many individual compounds. Specific aromatic and aliphatic compounds can be good indicators for individual petroleum products (e.g., gasoline, diesel, fuel oil, and kerosene). The primary aromatic compounds benzene, toluene, ethylbenzene, xylenes (BTEX), and trimethylbenzenes should be included in all analyses. Analytical methods (e.g., EPA TO-15) using a mass spectrometer detector allow for the identification and quantitation of aromatic and aliphatic hydrocarbons and for oxygenated compounds such as ethanol and methyl tertiary butyl ether (MTBE). Analyzing for specific indicator compounds can aid in differentiating potential petroleum sources.

Indicator compounds for gasoline may include BTEX, trimethylbenzene isomers, the appropriate oxygenate additives (MTBE, ethanol, etc.), and the individual C-4 to C-8 aliphatics (e.g., hexane, cyclohexane, dimethylpentane, and 2,2,4-trimethylpentane [iso-octane]).

Indicator compounds for middle distillate fuels (#2 fuel oil, diesel, and kerosene) may include n-nonane, n-decane, n-undecane, n-dodecane, ethylbenzene, xylenes, trimethylbenzene isomers, tetramethylbenzene isomers, naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene.

Although tetramethylbenzene, naphthalene and methyl-naphthalene are listed as indicators for middle distillate fuels, we recognize that they may not be available as standard analytes on VOC analyses, but may be reported as tentatively identified compounds in some cases. We are not requiring additional semi-volatile analyses to obtain data for these compounds in these instances unless these SVOCs are the primary compounds of concern at a site.

Comment C.16.12 (paraphrased, 1 commenter, 1 comment):

Naturally occurring soil vapors are not properly the subject of investigation and/or remediation. Section 2.9.1 states that propane, propene, butane, iso-butane etc., are indicator compounds which indicate that natural gas has been used at sites. The presence of natural gas on a site is just that, natural. We recommend that the guidance be revised to state that PRPs cannot be required to conduct investigation or remediation due to naturally occurring compounds.

Response C.16.12:

In Section 2.9.1.d of the guidance, the term "natural gas" is the generic term that describes commercially supplied pipeline gas used for heating, etc. Although pipeline gas consists primarily of methane, it can include a number of other aromatic and aliphatic hydrocarbons. Testing for indicator compounds of pipeline gas helps to identify potential leaks and sources of petroleum compounds that might indicate a source other than site-related contaminants. As stated in the Preface to the guidance, the guidance discusses soil vapor intrusion in terms of environmental contamination only. If a substance is naturally occurring at a site (e.g., gas produced from decaying vegetation or gases from gas and petroleum producing areas of the state), the PRP is not required to investigate or remediate the naturally occurring compounds.

C.17 TOPIC: Field laboratories and mobile gas chromatographs

Comment C.17.1 (paraphrased, 2 commenters, 2 comments):

Section 2.10 unnecessarily downplays the usefulness of non-certified mobile laboratories (does NYSDOH ELAP certify mobile labs?). On-site data can be beneficial when used as part of a tiered sampling approach that also includes samples collected for analysis by an ELAP-certified laboratory.

Response C.17.1:

As discussed in Section 2.10 of the guidance, on-site laboratories or gas chromatographs can provide beneficial information when used appropriately. On-site data are very useful for screening purposes. However, in accordance with New York State's Public Health Law, samples collected for the purpose of evaluating exposures must be analyzed by an ELAP-certified laboratory. Therefore, field screening must be verified with ELAP-certified data for decision-making purposes.

As also discussed in Section 2.10, the NYSDOH ELAP does certify mobile laboratories. Mobile laboratory certification is a separate process from stationary laboratory certification and certification is not transferable from one to the other. Questions regarding a mobile laboratory's certification should be directed to the laboratory itself.

Comment C.17.2:

The last paragraph of Section 2.6.1 talks about step-outs. This is much more feasible and effective if real-time analysis is available. So, you should modify your section on mobile laboratories to encourage their use, not discourage as presently written.

Response C.17.2:

The use of mobile laboratories is not discouraged. As discussed in Section 2.10 of the guidance, the use of a mobile laboratory to screen samples and to help focus the investigation may be appropriate. These determinations should be made on a site-specific basis. However, in accordance with New York State's Public Health Law, any remedial decisions must be based on data from an ELAP-approved laboratory.

C.18 TOPIC: Surveys and pre-sampling building preparation

Comment C.18.1:

The section on identifying preferential pathways (page 31) is strong, but it could be strengthened more by expanding the discussion of real-time field sampling that may be

used to home in on such pathways. Real-time and near-real-time sampling devices, such as EPA's Trace Atmospheric Gas Analyzer (TAGA), have proven effective for this purpose. The TAGA—and presumably similar equipment—can be used to identify preferential pathways and confounding sources such as household products. It can also correlate concentrations with variable meteorological conditions such as wind, temperature, and atmospheric pressure.

Response C.18.1:

Although the results obtained from field instrumentation should not be used as the sole basis for determining appropriate actions to address exposures related to soil vapor intrusion, we agree that field instrumentation can be helpful in identifying preferential pathways for soil vapor intrusion. The EPA's TAGA is a fairly sophisticated example of such a device that can assist in a more detailed investigation of preferential pathways. Simpler handheld instruments (e.g., PIDs, mercury vapor analyzers, etc.) and even the detection of odors during a building inventory can also help identify such pathways. A recommendation that field instruments be used to help identify preferential pathways has been added to the discussion on the pre-sampling building inspection in Section 2.11.1 of the guidance.

Comment C.18.2:

The Guidance states that the pre-sampling inspection should be performed prior to each sampling event to identify and minimize conditions that may interfere with the proposed testing. We suggest that the wording be modified to read "limit to the extent practicable" given dependence on cooperation of property owners and tenants. In our experience, few tenants and property owners have fully cooperated with removal of indoor source materials.

Response C.18.2:

Acknowledged. Section 2.11.1 of the guidance has been revised as follows: "Potential interference from products or activities releasing volatile chemicals should be controlled to the extent practicable."

Comment C.18.3 (paraphrased, 2 commenters, 2 comments):

Tight sealing of containers is not guaranteed to eliminate vapors from these sources. In some cases, even unused product containers have been shown to be emitting VOC vapors and cannot be sealed further.

Response C.18.3:

Acknowledged. However, tight sealing may cut down on some of the volatilization and help to improve overall air quality and minimize the potential for interference with the sampling results.

Comment C.18.4:

We agree with [NYS]DOH that the inability to eliminate potential interferences is a justification for not testing indoor air.

Response C.18.4:

Comment noted.

Comment C.18.5:

Ventilation of a building for only 24 hours after removal of an indoor source is inadequate to guarantee complete dissipation of residual contaminants. Research on dissipation of PCE after dry cleaning is brought into a home suggests that several weeks may be necessary. This does not mean that testing should not be conducted if dry cleaning has been brought into a house over the past several weeks; it should simply be recognized that any number of sources may contribute to background levels of volatile chemicals in a building, some of which may no longer be present or identifiable. As a result, the guidance must allow a weight of evidence approach to background determinations, and not just rely on the overly conservative values in the table on page 31.

Response C.18.5:

Acknowledged. Section 2.11.1 of the guidance has been revised to emphasize that ventilation may be appropriate to minimize, not eliminate, residual contamination in the air. The intent of the discussion in Section 2.11 is to recommend ways to identify alternate sources of volatile chemicals in the indoor air and, where appropriate, to minimize potential sampling interferences. These steps are recommended to facilitate the data evaluation process. As discussed in Section 3, we agree that an understanding of background sources is a crucial part of the data evaluation process and recommend that a multiple-lines-of-evidence approach be used to identify sources of volatile chemicals to the indoor air and to select appropriate steps to address exposures.

Comment C.18.6:

Section 2.11.1, List of activities to avoid prior to sampling — Consider adding that dry cleaning should not be brought home for 24 to 48 hours prior to sampling.

Response C.18.6:

Agreed. The document has been revised accordingly.

Comment C.18.7 (paraphrased, 2 commenters, 2 comments):

The guidance recommends that efforts be made to avoid opening windows, fireplace damper, and vents for 24 hours prior to indoor sampling. Doing so may bias sampling results. When characterizing typical long-term exposure conditions, sampling should be conducted under "normal" building operating conditions rather than artificial conditions that may serve to either over or under-estimate typical exposure concentrations.

Response C.18.7:

In general, most people do not leave windows and/or vents open during the heating season, which in most cases, is when sampling occurs. We make this recommendation to facilitate conditions under which vapor intrusion is more likely to occur and to avoid collecting samples that are biased low.

Comment C.18.8:

If sources of VOCs are typically stored inside a building, an artificial sampling environment should not be created by removing these sources. Removal of such sources for a short time period (e.g., 24 hours) before sampling is not adequate, but gives the false impression that no indoor sources could remain. Furthermore, the removal of indoor sources of VOCs is often not feasible, especially in residential or third party settings. [NYS]DOH all but

acknowledges this by stating that no post-abatement samples should be collected for a period of at least 30 days.

Response C.18.8:

Collection of samples under "normal operating conditions" can be useful, but in most cases the goal of these investigations is to determine whether soil vapor intrusion is a concern. Therefore, the intent of the discussion in Section 2.11 is to recommend ways to identify alternate sources of volatile chemicals in the indoor air and, where appropriate, to minimize potential sampling interferences. These steps are recommended to facilitate the data evaluation process.

We acknowledge that removing indoor sources of volatile chemicals is not always feasible. Section 2.11.1 of the guidance has been revised as follows: "Potential interference from products or activities releasing volatile chemicals should be controlled to the extent practicable."

Comment C.18.9 (paraphrased, 3 commenters, 3 comments):

The protocol in section 2.11.1 listing activities that should be avoided for 24 hours prior to sampling is impractical, especially in multiple dwellings. Furthermore, these precautions may not be necessary in all cases, depending on the specific compounds of concern. For example, if chlorinated VOCs represent the target compounds, then smoking by building residents or using a wood stove would not affect the outcome of the analyses.

Response C.18.9:

Acknowledged. We recognize that avoiding the activities referenced in the comment is not always possible. Toward this end, Section 2.11.1 has been revised to state "To avoid potential interferences and dilution effects, occupants should make a reasonable effort to avoid the following for 24 hours prior to sampling..." The intent of the discussion is to provide general recommendations. However, as discussed in the introduction to Section 2, site-specific or building-specific conditions may warrant modifying the recommendations. The comment contains examples of such conditions (e.g., multiple tenant spaces, site-specific analyte lists, tenant activities, etc.) that should be considered when selecting an appropriate approach to minimize potential interfering sources of volatile chemicals to the indoor air and to meet the sampling objectives.

Comment C.18.10 (paraphrased, 1 commenter, 1 comment):

The form presented to perform a chemical inventory of a building (Appendix B) is based on a residential setting where it is possible to identify the number and types of chemicals being used. It is not practical to identify each and every chemical being used, including size and numbers, in an industrial facility that may employ 500 to 2,300 employees. To perform such an inventory would require several days. Also, to distinguish between manufacturing background levels and environmental levels during the inventory, as well as during the sampling event, manufacturing activities, such as painting, cleaning, operating powered industrial trucks, etc., would have to be terminated. As such, the vapor intrusion pathway should be focused on the known chemicals of concern.

Response C.18.10:

Acknowledged. We recommend that a product inventory be completed to "identify potential air sampling interference by characterizing the occurrence and use of chemicals and products throughout the building, keeping in mind the goal of the

investigation and site-specific contaminants of concern." However, as discussed in the introduction to Section 2 of the guidance, site-specific or building-specific conditions may warrant modifying the recommendation. The comment contains an example of building-specific conditions and operations that should be considered when selecting an appropriate approach to identify and minimize potential interfering sources of volatile chemicals to the indoor air and to meet the sampling objectives.

Comment C.18.11:

Sampling during the winter months can be performed and should be accompanied by a basic air flow diagram of the current heating system that indicates the locations of air supply for heating combustion and exhaust (not including an HVAC engineering diagram or flow and pressure measurements). Sampling during non-winter months can also be performed, and the same information needs to be provided to include air conditioning systems for the space under consideration. In addition, any heating equipment (water boilers) that remain on all year should be included again with the same general air diagram.

Response C.18.11:

As discussed in Section 2.7.3 and Section 2.11.1 of the guidance, we agree that an air flow diagram or any other information about a building's HVAC system would be a valuable addition to a vapor intrusion investigation. This information is particularly useful for larger industrial buildings.

C.19 TOPIC: Role of modeling

Comment C.19.1:

[NYS]DOH should explain its current assessment of the utility of the Johnson & Ettinger model to predict indoor soil gas vapor concentration from vapor levels in soil and to what extent the Johnson & Ettinger model failed to predict Endicott.

Response C.19.1:

Modeling may serve as a useful tool in the soil vapor evaluation process. However, conclusions drawn from modeling should be verified with actual field data. Based on our experience, the presence of relatively small stratigraphic and geographic heterogeneities in site geology can have a marked impact on the observed concentrations in shallow and sub-slab soil vapor. We have sub-slab vapor data from numerous locales in which the concentration of sub-slab soil vapor differs by more than two orders of magnitude from one structure to the next. The Johnson and Ettinger modeling that was performed for the Endicott investigations supported the decision to conduct a vapor intrusion investigation, but was not used to identify the areal extent of structures at which mitigation systems were needed. Overall, the State does not view the Johnson and Ettinger model as a substitute decision-making tool.

Comment C.19.2 (paraphrased, 1 commenter, 1 comment):

The NYSDOH guidance should allow modeling to be used in conjunction with soil vapor sampling to justify taking "no further action" without collection of sub-slab or indoor air samples. "No further action" should be acceptable when actual soil vapor concentrations are below those predicted by the model and are below EPA's screening values.

Response C.19.2:

The use of any model, in conjunction with soil vapor sampling, to justify taking "no further action" at sites without the collection of sub-slab vapor or indoor air samples is not recommended at this time. Rather, sub-slab vapor and/or indoor air data are the most reliable and appropriate samples to collect to evaluate the potential for human exposures related to soil vapor intrusion. Our experience to date has shown that soil vapor impacts to buildings vary considerably depending on site conditions and do not necessarily follow model predictions or correlate to soil vapor results. Therefore, the State does not believe that decisions based solely on modeling and/or soil vapor results are sufficiently protective of human health. The guidance has not been revised as suggested in the comment.

Comment C.19.3 (paraphrased, 6 commenters, 5 comments):

The guidance should allow modeling alone to justify taking "no further action" when predicted indoor air impacts from vapor intrusion are well below background levels (or levels of health concern). This is particularly relevant to undeveloped sites, where sub-slab and indoor air data cannot be collected.

Response C.19.3:

At this time, our experience with vapor intrusion does not allow us to be confident that decisions based on modeling alone are sufficiently predictive of current or potential sub-slab vapor and indoor air impacts. The guidance continues to state that actual field data should be collected and used for decision-making when there is a potential for human exposures. In the case of undeveloped sites, we recommend that an environmental easement be placed on affected parcels to ensure that evaluation of the potential for vapor intrusion will occur as properties are developed.

Comment C.19.4 (paraphrased, 8 commenters, 7 comments):

The guidance should allow for the use of the Johnson and Ettinger model, as incorporated into the EPA's vapor intrusion guidance, at any site, without prior approval by the state. The use of modeling as a screening step can reduce the amount of sampling required.

Response C.19.4:

The use of any model, including the Johnson and Ettinger model, to "screen out" sites without the collection of actual field data is not recommended at this time. Our experience to date has shown that soil vapor impacts to buildings vary considerably depending on site conditions and do not necessarily follow model predictions. Therefore, we do not believe that decisions based on modeling alone are sufficiently protective of human health. The guidance has not been revised as suggested in the comment.

There are situations in which modeling may be useful as a tool in a vapor intrusion investigation; some of these are discussed in Section 2.12 of the guidance. We strongly recommend that the use of any model be discussed with the Agencies beforehand to assure that all parties have the same expectations as to how the model's results will be used.

Comment C.19.5 (paraphrased, 1 commenter, 1 comment):

The guidance says that model results must be verified by "actual field data," but it then goes on to state that either indoor air or sub-slab sampling is required. This seems to

indicate that sub-slab vapor data is field data that are sufficient to support a decision, even though sub-slab vapor is not a medium to which people are exposed. In many cases, the best way to estimate the relationship between sub-slab vapor and indoor air is through modeling. The guidance should clarify that modeling may be appropriate under certain conditions to estimate indoor air impacts from subsurface media.

Response C.19.5:

The example given in Section 2.12 of the guidance (formerly Section 2.13 in the public comment draft) has been revised to indicate that indoor air, outdoor air and sub-slab vapor data should be collected. However, we acknowledge that sometimes the appropriate sampling is not possible or practical (due to access issues, interference from indoor sources, or other issues). In these situations, site-specific decisions are made. In some cases, modeling may be a part of the approach, but this decision would be made on a case-by-case basis.

Comment C.19.6 (paraphrased, 1 commenter, 1 comment):

I support the policy of requiring model predictions to be verified with data. However, the guidance suggests that sub-slab vapor data may be sufficient verification. People located near or above sources of volatile contamination are unlikely to be satisfied with sub-slab vapor data in the absence of indoor air data, even if the sub-slab vapor data indicate no further action is needed.

Response C.19.6:

Acknowledged. The example given in Section 2.12 of the guidance (formerly Section 2.13 in the public comment draft) has been revised to indicate that indoor air, outdoor air and sub-slab vapor data should be collected.

Comment C.19.7 (paraphrased, 2 commenters, 2 comments):

More clarification is needed as to why modeling would be used to estimate past exposures. This seems likely to be controversial and unreliable.

Response C.19.7:

Acknowledged. The discussion of the use of modeling to estimate past exposures has been removed from the guidance.

Comment C.19.8 (paraphrased, 1 commenter, 1 comment):

To improve the applicability of modeling results further, the guidance should discuss appropriate tests to characterize stratigraphy (porosity, moisture content, and other parameters).

Response C.19.8:

Specific recommendations regarding the use of models and the collection of field data to use as input parameters will vary depending on the objective of the modeling and should be made on a site-by-site basis. This information is beyond the scope of this guidance document.

Comment C.19.9 (paraphrased, 1 commenter, 1 comment):

The use of site-specific soil condition data, such as soil moisture content, may not be appropriate, as discussed in the EPA's modeling guidance. The EPA has established low moisture contents that should be used to evaluate long-term exposures, since one-time soil moisture sampling is not representative of long term site conditions and may underestimate indoor air concentrations.

Response C.19.9:

Acknowledged. Section 2.12 of the guidance (formerly Section 2.13 in the public comment draft) has been revised as follows: "If a model is used, it should incorporate appropriate site-specific parameters...."

Comment C.19.10 (paraphrased, 3 commenters, 4 comments):

The guidance should include the option of modeling the potential for vapor intrusion from environmental media, such as groundwater VOC concentrations. An allowance should also be made where there is an indoor (background) source of the subsurface volatile contaminant(s) of concern. Additionally, groundwater samples should be included in the discussion of types of samples needed since the Johnson and Ettinger model can predict contaminant concentrations in indoor air based on concentrations in groundwater.

Response C.19.10:

The use of any model to evaluate the potential for vapor intrusion at sites without the collection of actual field data is not recommended at this time. Rather, sub-slab vapor and/or indoor air data are the most reliable and appropriate samples to collect to evaluate the potential for human exposures related to soil vapor intrusion. Our experience to date has shown that soil vapor impacts to buildings vary considerably depending on site conditions and do not necessarily follow model predictions. Therefore, we do not believe that decisions based on modeling alone are sufficiently protective of human health. The guidance has not been revised as suggested in the comment.

As described in Section 2.12 of the guidance document, modeling may be a useful tool in the evaluation process. However, specific recommendations regarding the collection of field data (e.g., groundwater, porosity, etc.) to use as input parameters to a model will vary depending on the objective of the modeling and should be made on a site-by-site basis. This information is beyond the scope of this guidance document.