Town and Country Dry Cleaners

Trichloroethylene Risk Evaluation Report

Prepared for: Jennifer S. Cha LLC

June 2022

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Jennifer S. Cha LLC

6205 142nd Ave. SE
Bellevue, WA 98005

This document has been prepared by SLR International Corporation (SLR). The material and data in this work plan were prepared under the supervision and direction of the undersigned.

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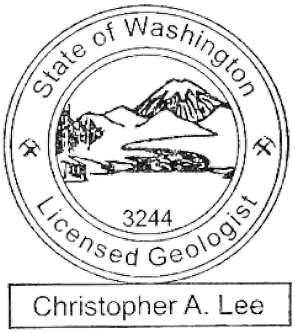


CONTENTS

ACRONYMS & ABBREVIATIONS

AESI	Associated Earth Sciences, Inc.
bgs	below ground surface
Ecology	Washington State Department of Ecology
F&B	Friedman & Bruya, Inc.
HVOCs	halogenated volatile organic compounds
in. Hg	inches of mercury
mg/kg	milligrams per kilogram
MTCA	Model Toxics Control Act
PCE	tetrachloroethylene
SLR	SLR International Corporation
Subject Property	Town and Country Dry Cleaners, 310 105th Avenue NE, Bellevue, Washington
TCE	trichloroethylene
VOC	volatile organic compound

1. INTRODUCTION

1.1 BACKGROUND

In a letter dated October 7, 2020, the Washington State Department of Ecology (Ecology) requested an evaluation of trichloroethylene (TCE) risks at the Town and Country Dry Cleaners facility located at 310 105th Avenue NE in Bellevue, Washington (the Subject Property; Figure 1). The letter indicated that this evaluation should be conducted in accordance with the guidelines set forth in Ecology's *Implementation Memorandum No. 22, Vapor Intrusion Investigations and Short-term TCE Toxicity* ("Implementation Memo 22", Ecology, 2019) and the Model Toxics Control Act ("MTCA", WAC 173-340) and should include the Subject Property and all buildings within 100 feet of the Subject Property, including:

- 308 105th Avenue NE;
- 345 106th Avenue NE;
- 239 106th Avenue NE; and
- 225 106th Avenue NE.

SLR understands that an extension to the deadlines detailed in that letter was requested by the Subject Property's owner and acknowledged by Ecology by e-mail on November 13, 2020. SLR subsequently submitted the *Town and Country Dry Cleaners, Work Plan to Evaluate Trichloroethylene Risks* (Work Plan; attached as Appendix C) to Ecology, detailing a proposed scope to complete this evaluation, on March 5, 2021. The Work Plan was approved by the agency on March 31, 2021.

At that time, SLR commenced making a good-faith effort to attain access to each of the properties referenced in the Work Plan, which included phone calls, certified mail, and in-person visits to the properties over the course of several months. Access to two properties, 225 106th Avenue NE and 345 106th Avenue NE, could not be obtained. In response, SLR proposed modifications to the Work Plan in an e-mail to Ecology on November 29, 2021:

- To assess for TCE risk at 345 106th Avenue NE, instead of sub-slab soil vapor samples in the building, SLR proposed installing a soil vapor probe in the City of Bellevue-owned right-of-way adjacent to the property.
- To assess for TCE risk at 225 106th Avenue NE, instead of sub-slab soil vapor samples in the building, SLR proposed evaluating the results of the sample collected at 239 106th Avenue NE, which is located directly between the subject property and the building at 225 106th Avenue NE.

Ecology approved of these changes in an e-mail dated November 30, 2021.

Access to 239 106th Avenue NE was finally obtained in May 2022. The following report presents the results of our Tier I and Tier II evaluation of the Subject Property building and the south-adjacent building at 308 105th Avenue NE, and our Tier I evaluation of the other three nearby buildings, shown on Figure 2.

1.2 SUBJECT PROPERTY DESCRIPTION & OPERATING HISTORY

The Subject Property consists of one generally rectangular-shaped parcel (King County parcel number 0679000055) totaling approximately 6,241 square feet (0.14 acre). The Subject Property is situated in downtown Bellevue and is developed with one commercial building surrounded by asphalt-paved parking spaces and driveways (Figure 2). Based on available records, the building appears to have been occupied by a dry cleaning business since approximately 1978. Interviews with the current operator at the Subject Property in 2020 indicate that tetrachloroethylene (PCE) was used as a dry cleaning solvent until approximately 2009 when they switched to a hydrocarbon solvent.

1.3 PREVIOUS INVESTIGATIONS AND REMEDIATION ACTIVITIES

SLR understands that investigations associated with other properties and sites have been conducted in the vicinity of the subject site in recent years. For the purposes of this summary, the information presented in this report only includes data that SLR understands were collected by entities associated with the current and past owners of the Subject Property.

In November 1989, Associated Earth Sciences, Inc. (AESI) of Kirkland, Washington visited the Subject Property and collected a soil sample from an area to the east of the building. The analytical results showed that the soil sample contained a PCE concentration [67 milligrams per kilogram (mg/kg)] that exceeded the MTCA Method A PCE cleanup level (0.5 mg/kg at the time of the sampling; in 2001 the cleanup level was updated to 0.05 mg/kg). In January 1990, AESI conducted a remedial excavation. Approximately three cubic yards of soil were excavated and placed into drums for offsite incineration. Confirmation samples collected at the limits of the excavation did not contain PCE above 0.5 mg/kg. Additional sampling was conducted in 1990. Soil samples contained PCE concentrations that were below the cleanup level at the time. No groundwater was encountered. On January 15, 1997, the Seattle-King County Department of Public Health, in consultation with Ecology, issued a letter concluding that no further action was necessary for the site.

In August 2019, SLR conducted a facility investigation within the Town and Country Dry Cleaners space. The inspection identified floor staining and the existence of potential pathways for solvent from dry cleaning operations to enter the subsurface, including a floor drain near the dry cleaning machine. In February 2020 SLR conducted a subsurface investigation beneath the floor inside the building. SLR cored two six-inch-diameter holes in the concrete slab and advanced two hand auger soil borings to depths of approximately two feet bgs. The borings were located in an area where staining was observed on the surface of the concrete floor near the dry cleaning machine and adjacent to the floor drain. The soil sample analytical results showed that the samples contained PCE concentrations that exceed the current MTCA Method A soil cleanup level. SLR also installed two soil vapor sampling ports in the concrete slab floor to allow for sampling the soil gas beneath the building. The sub-slab soil vapor sample analytical results indicated that the samples contained chemical concentrations that exceeded the MTCA Method B sub-slab soil vapor screening level, including concentrations of TCE that exceed screening levels for short-term risk detailed in Implementation Memo 22. These results are presented in greater detail in the Work Plan.

2. OBJECTIVES

The objectives of this risk evaluation were to:

- Conduct a Tier II indoor air sampling event at the Subject Property and at the 308 105th Avenue NE property to determine if the TCE contamination in soil and soil vapors has resulted in TCE concentrations in indoor air that exceed the non-residential short-term indoor air action level presented in Implementation Memo 22.
- Conduct a Tier I sub-slab soil vapor sampling event to determine if there are TCE concentrations in soil vapors beneath the four buildings that are within 100 feet of the Subject Property that exceed the non-residential sub-slab soil gas screening level presented in Implementation Memo 22.

This report is not intended to address any site characterization or source identification activities unrelated to an evaluation of vapor conditions. The work described herein was conducted in accordance with the approved Work Plan and subsequent approved modifications.

3. SCOPE OF WORK

3.1 BUILDING CONSTRUCTION AND DOCUMENTATION INQUIRY

Prior to conducting Tier I sub-slab soil vapor probe installation and sampling, SLR reviewed records of the construction details of the buildings at the four nearby properties to determine the foundation construction details; the presence of subsurface utilities including drains, sewer lines, water and gas supply lines, and electrical conduits; and the presence or absence of subsurface basements and/or crawl spaces.

- 308 105th Avenue NE is a single-story building of slab-on-grade construction;
- 345 106th Avenue NE is a single-story building of slab-on-grade construction;
- 239 106th Avenue NE is a two-story building of slab-on-grade construction; and
- 225 106th Avenue NE is a single-story building with a full basement.

All of the buildings are connected, via lateral sewers, to an 8" concrete gravity sanitary sewer main which is buried at a depth of approximately five feet below the grade of the alley separating the buildings. In addition, there is a 12" concrete gravity storm sewer line which is buried at a depth of approximately three feet below the grade of the alley. The storm sewer line originates at a catch basin located at the western edge of the alley at a location approximately 20 feet to the south of the southwestern Subject Property corner and continues south towards NE 2nd Street. Electrical and communications service to the buildings is via overhead wires, and there are no natural gas lines located beneath the alley. All five of the buildings considered in this Risk Evaluation are interconnected in the subsurface via the sanitary sewer main and each building's side sewer, and the storm sewer line may also represent a preferential pathway for TCE vapors to migrate along the orientation of the alley. A map of the subsurface utilities beneath the alley is presented in Appendix A.

3.2 VAPOR INTRUSION ASSESSMENT

3.2.1 INDOOR AIR SAMPLING

On July 11, 2021, SLR conducted a Tier II indoor air sampling event at the Subject Property and at the 308 105th Avenue NE property in accordance with Ecology's *Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action* (Ecology, 2016). SLR provided the owners of the Subject Property and the 308 105th Avenue NE property and their tenants with a list of volatile organic compound- (VOC-) emitting materials from the California Environmental Protection Agency's (California EPA's) *Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air* (California EPA, 2005) for removal from the areas of the buildings selected for sampling at least 48 hours prior to collecting indoor air samples. Examples of these materials include cleaners, glues, fingernail polish remover, aerosol sprays, paint, dry-cleaned clothes, and tap water. The presence of these interfering sources may bias indoor air sample results or preclude detection of vapors from the subsurface. Following the removal of these materials, we requested that the areas that were selected

for sampling be ventilated for 24 hours. The ventilation activities were discontinued at least 24 hours prior to the sampling event.

To conduct the Tier II sampling event, SLR deployed a total of five indoor air and one ambient air sampling six-liter Summa canisters in the most commonly occupied spaces within each of the two buildings (i.e. the areas where workers spend the greatest amount of time) in the portions of the buildings nearest the Subject Property (Figure 2):

- The Subject Property: Three air sampling canisters were deployed inside the building:

  IA-1 - At floor level with the intake valve facing down at the location of the floor drain in the Subject Property building to assess it for a potential vapor conduit and fate and transport associated with preferential vapor migration pathways;

  IA-2 - In the main working area of the building adjacent to the dry cleaning machine in the southeast portion of the building; and,

  IA-3 - At the front counter in the western portion of the building.

- 308 105th Avenue NE: Two air sampling canisters were deployed in the northernmost tenant space which is located adjacent to the Subject Property:

  IA-4 - Adjacent to a small break room and restroom in the northeast corner of the building; and,

  IA-5 - In the main working area in the central portion of the building.

- Ambient Air: A single air sampling canister (AA-1) was deployed on the northwest (upwind at the time of sampling and away from the likely source of subsurface contamination).

The sampling canisters were batch-certified as decontaminated and evacuated to a vacuum greater than 30 inches of mercury (in. Hg) by the laboratory. The canisters were equipped with eight-hour flow regulators to collect samples over the course of an eight-hour workday. The sampling event was conducted on a day when the businesses were closed, but during the normal opening hours of the businesses. The flow regulator intakes were set at a height of 4.5 feet above the floor, in the breathing zone of the workers.

To collect the samples, SLR opened the valves on the flow regulators at a time corresponding with the beginning of a typical workday. Canister vacuum levels were monitored during the sampling event to confirm that the flow regulators were working properly. Upon completion of the eight-hour period the valves on the flow regulators were closed. SLR submitted the indoor and ambient air samples to Friedman & Bruya, Inc. (F&B) in Seattle, Washington for analysis of select halogenated volatile organic compounds (HVOCs) by EPA Method TO-15, including TCE, tetrachloroethene (PCE), and vinyl chloride

3.2.2 SUB-SLAB SOIL VAPOR SAMPLING

SLR conducted Tier I sub-slab soil vapor sampling events at the 308 105th Avenue NE property on July 11, 2021 and at the 239 106th Ave. NE property on May 5, 2022. The sub-slab soil vapor sampling was conducted in accordance with Ecology's *Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action* (Ecology, 2009). SLR installed one soil vapor sampling port (Vapor Pin) in the concrete slab floor of the buildings at each of these properties to allow for sampling the soil vapors beneath the buildings. The Vapor Pins were installed at the locations in these buildings that are closest to the Subject Property (Figure 2):

- 308 105th Ave. NE: In the northeast corner of the building, directly to the south of location of the dry cleaning machine in the adjacent Subject Property building (SVP-3).
- 239 106th Ave. NE: In the northwest corner of the building (SVP-4).

SLR installed the Vapor Pins by drilling a small-diameter hole in the concrete floor with a rotary hammer drill. Vapor Pin installation was conducted in accordance with the manufacturer's instructions. Due to constraints in obtaining access to these properties, SLR was not able to install the Vapor Pins at least one day prior to the sampling event as planned in order to allow for equilibration of subsurface conditions; however, the process for Vapor Pin installation is minimally invasive to the subsurface, and we do not anticipate that collecting samples on the same day that the probes were installed had any significant effect on the results.

To collect the sub-slab soil vapor samples, a new, decontaminated, disposable three-way manifold was connected to each vapor pin and a peristaltic pump was attached to the purging valve on each manifold. A one-minute deadhead test was conducted by using the peristaltic pump to apply vacuum to the sampling port on each manifold. Following the successful completion of each deadhead test, a six-liter Summa canister was connected to the sample port on each manifold. The sampling canisters were batch-certified as decontaminated and evacuated to a vacuum greater than 30 in. Hg by the laboratory and were equipped with five-minute flow regulators to collect grab samples.

The soil vapors in each probe were purged for a minimum of five minutes. The peristaltic pump was used to extract soil vapors from the probes. While purging, each soil vapor probe was further tested for leaks by using a tracer gas box placed over the probe. A calibrated helium detector with a range of 0 parts per million to 100 percent was used to monitor the helium concentration within the box and in the purged soil vapors. Helium was introduced into the tracer gas box and maintained at a concentration of at least 75 percent while the helium concentrations in the purged soil vapors were monitored. Helium was detected in the purged vapors from SVP-3, so the purging was stopped and SLR reinstalled the Vapor Pin with a new silicone sleeve. The entire leak testing process was repeated beginning with the one-minute deadhead test of the manifold. After reinstallation, SVP-3 passed the tracer gas test, and SVP-4 passed the tracer gas test on the initial attempt.

After purging, the purging valves on the manifolds were closed, the peristaltic pump turned off, and then the sample valves and five-minute flow regulators were opened to allow the Summa canisters to extract a sample from each Vapor Pin. The valves on the canisters were closed when the residual vacuum in the Summa canister was not less than 5 in. Hg. The filled Summa canisters were submitted to F&B for analysis of select HVOCs by EPA Method TO-15, including TCE, PCE, and vinyl chloride.

3.2.3 DEEP SOIL VAPOR SAMPLING

SLR installed and sampled a deep soil vapor probe in the alley directly between the Subject Property and the 345 105th Ave. NE property during February 2022. The deep soil vapor probe installation and sampling was conducted in accordance with Ecology's *Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action* (Ecology, 2009). The location of the deep soil vapor probe is shown on Figure 2.

SLR subcontracted Cascade Drilling, L.P. (Cascade) of Woodinville, Washington to install the soil vapor probe on February 4, 2022. Cascade installed the probe, identified as VP-1, by excavating an 8-inch-diameter hole to a depth of 5.5 feet below ground surface (bgs) by using air knifing and vacuum excavation methods. Cascade constructed a soil vapor probe within the boring using one-inch-diameter flush-threaded PVC with a six-inch-long screen installed over the depth interval of 5.0 to 5.5 feet bgs. The screen was be backfilled with silica sand to a depth of 4.5 feet bgs, and the riser was backfilled and sealed with hydrated bentonite chips above the sand to a depth of 1.0 foot bgs. The soil vapor probe was completed at the surface with a flush-grade traffic-rated steel monument set in concrete. Following the completion of the soil vapor probe installation, SLR allowed the probe to equilibrate for six days prior to returning to collect a sample.

To collect the soil vapor sample, a new, decontaminated, disposable three-way manifold was connected to the soil vapor probe and a peristaltic pump was attached to the purging valve on the manifold. A one-minute deadhead test was conducted by using the peristaltic pump to apply vacuum to the sampling port on the manifold. Following the successful completion of the deadhead test, a six-liter Summa canister was connected to the sample port on the manifold. The sampling canister was batch-certified as decontaminated and evacuated to a vacuum greater than 30 in. Hg by the laboratory and was equipped with a five-minute flow regulator to collect a grab sample.

The soil vapors in the probe were purged for a minimum of five minutes. The peristaltic pump was used to extract soil vapors from the probe. While purging, the soil vapor probe was further tested for leaks by using a tracer gas box placed over the probe. A calibrated helium detector with a range of 0 parts per million to 100 percent was used to monitor the helium concentration within the box and in the purged soil vapors. Helium was introduced into the tracer gas box and maintained at a concentration of at least 75 percent while the helium concentration in the purged soil vapors was monitored. VP-1 passed the tracer gas test on the initial attempt.

After purging, the purging valve on the manifold was closed, the peristaltic pump turned off, and then the sample valve and five-minute flow regulator were opened to allow the Summa canister to extract a sample from the vapor probe. The valve on the canisters was closed when the residual vacuum in the Summa canister was 5 in. Hg. The filled Summa canister was submitted to F&B for analysis of select HVOCs by EPA Method TO-15, including TCE, PCE, and vinyl chloride

3.2.4 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

SLR followed applicable QA/QC procedures to ensure data quality and data integrity. Friedman & Bruya, a Washington State-accredited laboratory, was selected to analyze the samples. Laboratories

have robust QA/QC processes which include matrix spike samples and surrogate spikes, and a review of data to ensure compliance with standards and the integrity of the final results. This data and the field QA/QC processes outlined above were reviewed. However, for this limited work scope a formal plan or validation report was not required.

3.2.5 MODIFICATIONS TO WORK PLAN

Due to challenges obtaining access to the properties at 345 106th Avenue NE and 225 106th Avenue NE to install sub-slab soil vapor probes, SLR modified the March 2021 Work Plan as follows:

- 345 106th Avenue NE: SLR installed and sampled one soil vapor probe on the City of Bellevue-owned right-of-way between the Subject Property and this property and evaluated the results to determine if TCE vapor conditions at 345 106th Ave NE should be further evaluated.

- 225 106th Avenue NE – The building located at 239 106th Ave. NE is located directly between this building and the Subject Property (Figure 2). SLR evaluated the results of the sub-slab soil vapor sample collected from 239 106th Ave NE to determine if TCE vapor conditions at 225 106th Ave NE should be further evaluated.

4. SAMPLE ANALYTICAL RESULTS

4.1 INDOOR AIR SAMPLE ANALYTICAL RESULTS

The indoor air sample analytical results showed that the samples from IA-1, IA-2, and IA-4 contained TCE concentrations [0.22, 0.27, and 0.31 micrograms per cubic meter (µg/m^3), respectively] that are below the Model Toxics Control Act (MTCA) Method B unrestricted indoor air cleanup level (0.33 µg/m^3) and the short-term exposure level presented in Implementation Memo 22 (7.5 µg/ m^3). The samples from IA-3, IA-5, and AA-1 did not contain TCE above the laboratory's reporting limit, and none of the samples contained PCE, vinyl chloride, or any other HVOCs above the laboratory's reporting limits. The indoor air sample analytical results are presented in Table 1 and are shown on Figure 2, and the laboratory analytical report is presented in Appendix B.

4.2 SUB-SLAB SOIL VAPOR SAMPLE ANALYTICAL RESULTS

The sub-slab soil vapor sample analytical results showed that the samples from SVP-2 and SVP-3 contained a TCE concentration (43 µg/m^3) that was below the revised non-residential screening level for sub-slab soil gas as defined in Implementation Memo 22 (250 µg/m^3). The samples from SVP-3 and SVP-4 also contained PCE concentrations (850 µg/m^3 in both samples) that were below the MTCA Method B sub-slab soil vapor screening level for a commercial exposure scenario (1,685 µg/m^3). Neither of the samples contained vinyl chloride or any other HVOCs above the laboratory's reporting limits. The sub-slab soil vapor sample analytical results are presented in Table 2 and are shown on Figure 2, and the laboratory analytical reports are presented in Appendix B.

4.3 DEEP SOIL VAPOR SAMPLE ANALYTICAL RESULTS

The deep soil vapor sample analytical results showed that the sample from VP-1 contained a TCE concentration (1.4 µg/m^3) that was below the revised non-residential screening level for sub-slab soil gas as defined in Implementation Memo 22 (250 µg/m^3) as well as the MTCA Method B deep soil gas screening level based on cancer as the risk driver (33 µg/m^3). The sample from VP-1 also contained a PCE concentration (89 µg/m^3) that was below the MTCA Method B sub-slab soil vapor screening level for a commercial exposure scenario (1,685 µg/m^3) as well as the MTCA Method B dep soil gas screening level based on cancer as the risk driver (960 µg/m^3). The sample did not contain any other HVOCs above the laboratory's reporting limits. The deep soil vapor sample analytical results are presented in Table 2 and are shown on Figure 2, and the laboratory analytical report is presented in Appendix B.

5. RISK EVALUATION BASED ON CURRENT RESULTS

The human receptors currently present at the Subject Property and the four nearby properties include commercial workers that are assumed to be on the property five days a week for standard eight-hour workdays. Property visitors are also on the property for short periods of time and on an irregular basis; potential exposures to these receptors would be lower than those for commercial workers.

The default Method B screening levels available from Ecology are based on an assumed residential use of a property. As described in Ecology's Vapor Intrusion guidance, the assumptions used to calculate these default values are likely to be overly conservative for a building that is used commercially. To further evaluate the analytical results in the context of the commercial use of the Subject Property, SLR calculated soil vapor screening levels for a commercial building. This is because exposures are generally lower for workers compared to residential receptors. For example, workers are not likely to be present at the subject property 24 hours a day for seven days a week year-round, as is conservatively assumed for residential receptors. On this basis, the screening levels calculated using Equations 750-1 and 750-2 from WAC 173-340-750(3)(b)(ii) can be modified for protection of current on-property receptors by replacing relevant exposure assumptions to better reflect adult worker exposures. These equations result in indoor air screening levels that are then converted to soil vapor screening levels using an attenuation factor. The following exposure assumptions were modified consistent with Ecology and EPA (2014) guidance as described below:

- **Body Weight:** For commercial screening levels, the child body weight of 16 kilograms (kg) was replaced with the Ecology default adult body weight of 70 kg.

- **Exposure Duration**: The residential exposure duration of 30 years was replaced with the EPA standard default exposure duration for the commercial scenario of 25 years.

- **Exposure Frequency**: The residential exposure frequency of 365 days/year (expressed as a unitless value of 1 [365 days/365 days] in the MTCA equations) was replaced with the EPA standard default indoor worker exposure frequency of 250 days/year.

- **Exposure Time:** The EPA standard default worker air exposure time, which is based on an 8-hour work shift (8 hours / 24 hours), was incorporated to modify the residential assumption of 24 hours per 24-hour day spent indoors at the site.

The assumptions described above were substituted for the residential values included by default in Equations 750-1 and 750-2, and the lower of the noncancer- and cancer-based values was identified as the indoor air screening level for PCE, acrolein, and chloroform to be protective of current commercial receptors. The indoor air value was divided by an attenuation factor of 0.03, as described by Ecology in their summary of changes to the 2009 Draft Vapor Intrusion Guidance toxicity values and screening levels, to calculate commercial soil vapor screening levels for PCE (1,685 µg/m^3), 1,4-dichlorobenzene (39.8 µg/m^3), 1,4-dioxane (87.6 µg/m^3), acrolein (2.92 µg/m^3), and chloroform (19.0 µg/m^3).

The results of the Tier II indoor air sampling event conducted in July 2021 at the ***Subject Property*** and at the ***308 105th Avenue NE*** property has demonstrated that the TCE contamination previously detected in soil and soil vapors beneath these buildings has not resulted in TCE concentrations in indoor air that exceed the non-residential short-term indoor air action level presented in Implementation Memorandum No. 22 (7.5 µg/m^3).

The results of the Tier I sub-slab soil vapor sampling events conducted in July 2021 and May 2022 has demonstrated that the TCE concentrations in soil vapors beneath the buildings located at ***308 105th Avenue NE*** and ***239 106th Avenue NE*** do not exceed the non-residential sub-slab soil gas screening level presented in Implementation Memo 22. In addition, because the risks associated with TCE in soil vapors beneath the building located at 239 106th Avenue NE appear to be within acceptable limits, the risks associated with TCE in soil vapors beneath the building located at ***225 106th Avenue NE*** are likely also within acceptable limits at the time of this assessment.

The results of the deep soil vapor sampling event conducted in February 2022 has demonstrated that the TCE concentration in soil vapors beneath the alley between the Subject Property and the building located at ***345 106th Avenue NE*** does not exceed the non-residential sub-slab soil gas screening level presented in Implementation Memo 22, nor does it exceed the MTCA Method B deep soil gas screening level. Therefore, the risk associated with TCE in soil vapors beneath the building located at 345 106th Avenue NE are likely also within acceptable limits at the time of this assessment.

6. CONCLUSIONS

In 2021 and 2022 SLR conducted an evaluation of TCE risks at the Subject Property. This evaluation was based on the results of a Tier I (sub-slab soil gas) and Tier II (indoor air sampling) Vapor Intrusion Investigation and was conducted in accordance with the guidelines set forth in Implementation Memorandum No. 22, and in accordance with Ecology-approved work scopes. This evaluation included the Subject Property and all buildings within 100 feet of the Subject Property, including:

- 308 105th Avenue NE;
- 345 106th Avenue NE;
- 239 106th Avenue NE; and
- 225 106th Avenue NE.

Based on the results of this evaluation, risks associated with exposure to TCE via the vapor intrusion pathway at these properties appear to be below threshold limits as defined by the MTCA and in Implementation Memo 22.

7. REFERENCES

California Environmental Protection Agency, 2011. *Final Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air (Vapor Intrusion Guidance)*. October.

Washington State Department of Ecology (Ecology), 2016. *Draft Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action*, Publication no. 09-09-047. October 2009, Revised February 2016; Appendix Section C-1.

Ecology, 2020. *Request for Evaluation of Trichloroethene Risks at the following Site: Site Name: Town & Country Cleaners Bellevue*. October 7.

---------. 2019b. Implementation Memorandum No. 22, *Vapor Intrusion Investigations and Short-term TCE Toxicity*. October.

SLR, 2021. *Town and Country Dry Cleaners, Work Plan to Evaluate Trichloroethylene Risks.* March.

LIMITATIONS

The services described in this work product were performed in accordance with generally accepted professional consulting principles and practices. No other representations or warranties, expressed or implied, are made. These services were performed consistent with our agreement with our client. This work product is intended solely for the use and information of our client unless otherwise noted. Any reliance on this work product by a third party is at such party's sole risk.

Opinions and recommendations contained in this work product are based on conditions that existed at the time the services were performed and are intended only for the client, purposes, locations, time frames, and project parameters indicated. The data reported and the findings, observations, and conclusions expressed are limited by the scope of work. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, or the use of segregated portions of this work product.

The purpose of an environmental assessment is to reasonably evaluate the potential for, or actual impact of, past practices on a given site area. In performing an environmental assessment, it is understood that a balance must be struck between a reasonable inquiry into the environmental issues and an appropriate level of analysis for each conceivable issue of potential concern. The following paragraphs discuss the assumptions and parameters under which such an opinion is rendered.

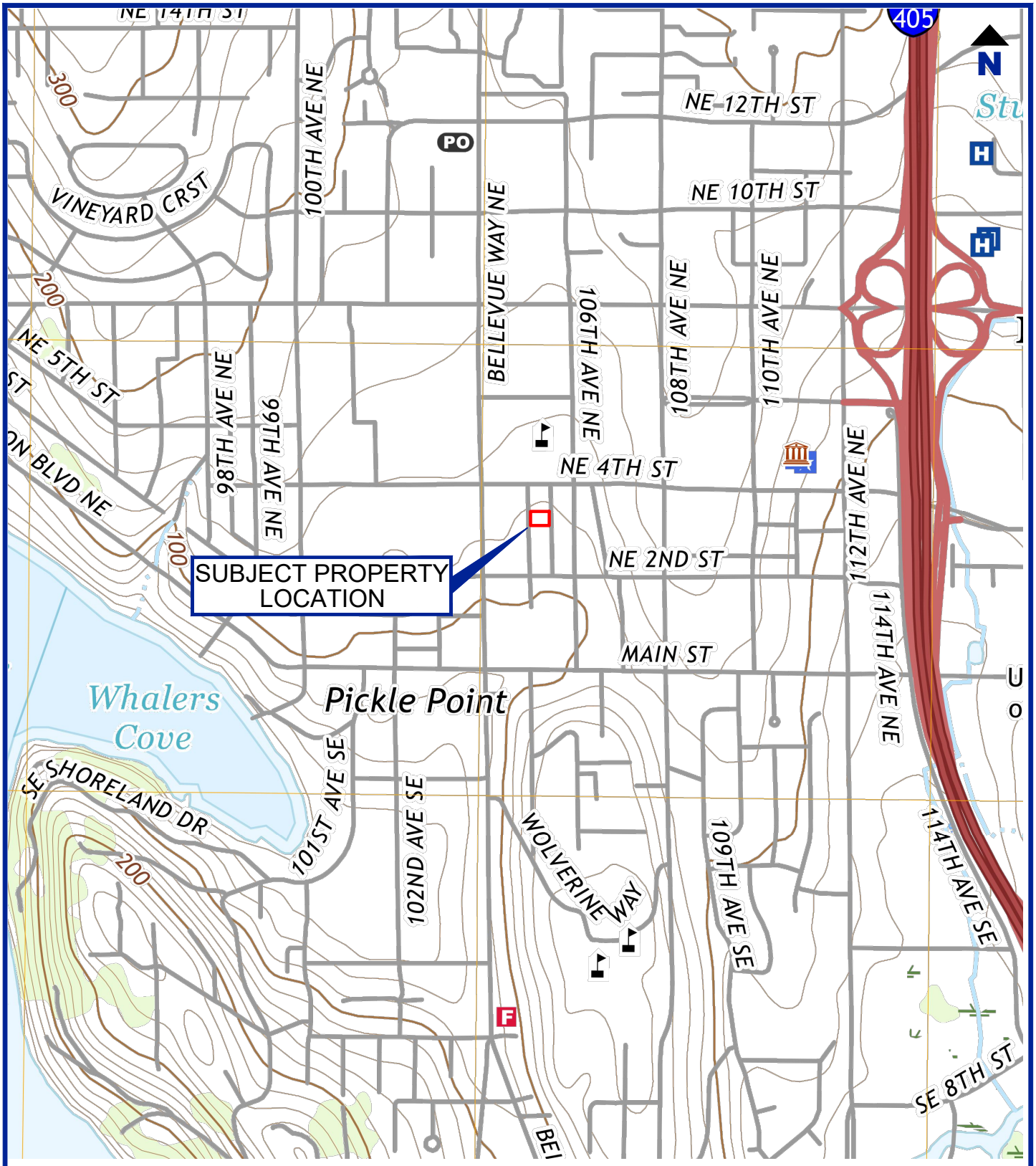
No investigation can be thorough enough to exclude the presence of hazardous materials at a given site. If hazardous conditions have not been identified during the assessment, such a finding should not therefore be construed as a guarantee of the absence of such materials on the site, but rather as the result of the services performed within the scope, practical limitations, and cost of the work performed.

Environmental conditions that are not apparent may exist at the site. Our professional opinions are based in part on interpretation of data from a limited number of discrete sampling locations and therefore may not be representative of the actual overall site environmental conditions.

The passage of time, manifestation of latent conditions, or occurrence of future events may require further study at the site, analysis of the data, and/or reevaluation of the findings, observations, and conclusions in the work product.

This work product presents professional opinions and findings of a scientific and technical nature. The work product shall not be construed to offer legal opinion or representations as to the requirements of, nor the compliance with, environmental laws rules, regulations, or policies of federal, state or local governmental agencies.

FIGURES



REFERENCED FROM : USGS 7.5 MINUTE QUARDRANGLE
<MERCER ISLAND, WA 2020>

LEGEND

LEGEND DESCRIPTION

0 1000 2000 3000'

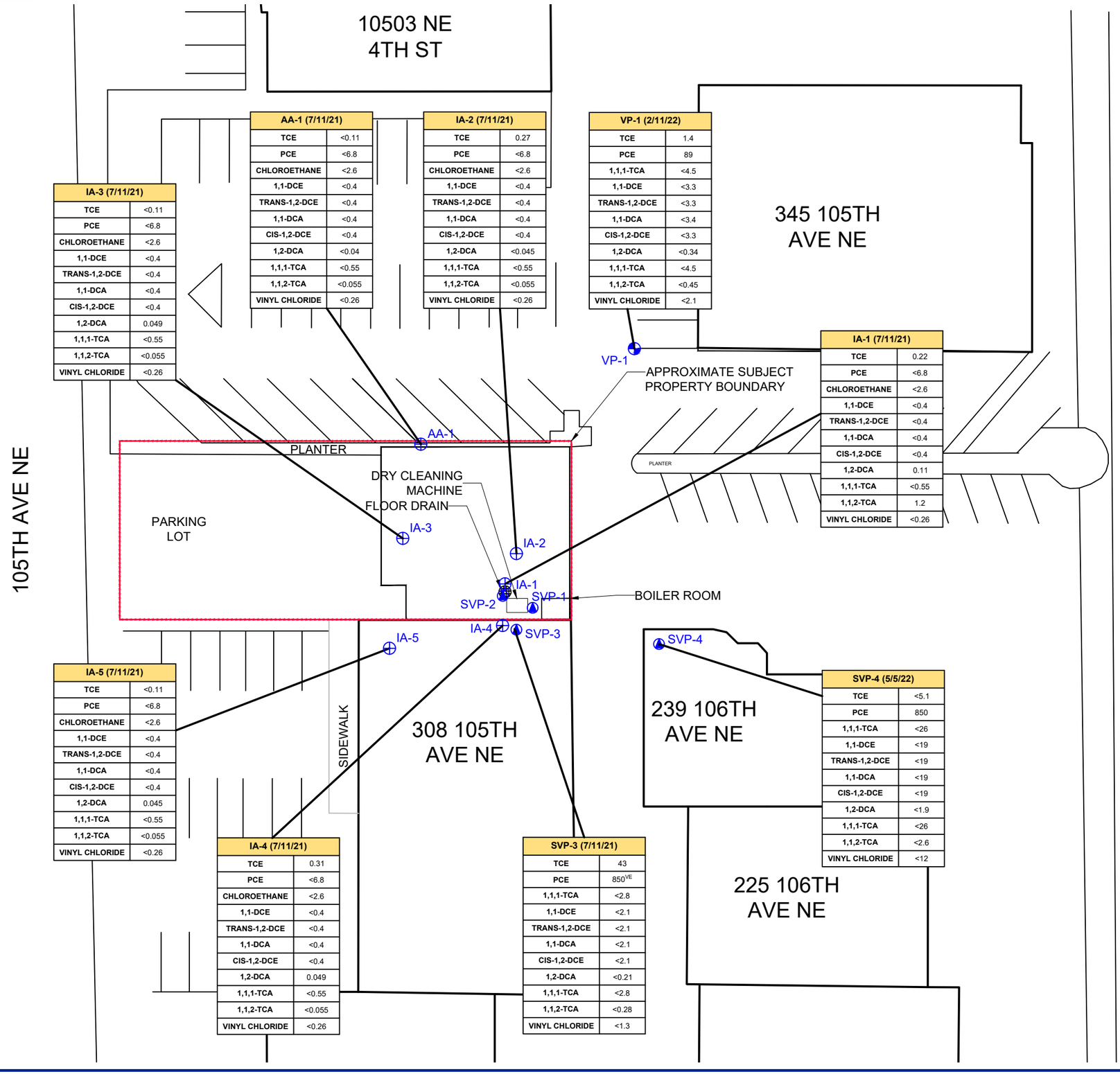
SLR

TOWN AND COUNTRY
CLEANERS 310 105TH AVE NE
BELLEVUE, WASHINGTON 98004

Drawing
SUBJECT PROPERTY LOCATION MAP

Date	February 11, 2021	Scale	AS SHOWN	Fig. No.	1
File Name	FIGURE 1	Project No.	101.02216.00001		

Drawing path: N:\Bothell\1 PROJECTS\Jennifer S. Cha LLC\Tier I and II Vapor Assessment Work Plan\DWG\FIGURE 1.dwg



AA-1 (7/11/21)	
TCE	<0.11
PCE	<6.8
CHLOROETHANE	<2.6
1,1-DCE	<0.4
TRANS-1,2-DCE	<0.4
1,1-DCA	<0.4
CIS-1,2-DCE	<0.4
1,2-DCA	<0.04
1,1,1-TCA	<0.55
1,1,2-TCA	<0.055
VINYL CHLORIDE	<0.26

IA-2 (7/11/21)	
TCE	0.27
PCE	<6.8
CHLOROETHANE	<2.6
1,1-DCE	<0.4
TRANS-1,2-DCE	<0.4
1,1-DCA	<0.4
CIS-1,2-DCE	<0.4
1,2-DCA	<0.045
1,1,1-TCA	<0.55
1,1,2-TCA	<0.055
VINYL CHLORIDE	<0.26

VP-1 (2/11/22)	
TCE	1.4
PCE	89
1,1,1-TCA	<4.5
1,1-DCE	<3.3
TRANS-1,2-DCE	<3.3
1,1-DCA	<3.4
CIS-1,2-DCE	<3.3
1,2-DCA	<0.34
1,1,1-TCA	<4.5
1,1,2-TCA	<0.45
VINYL CHLORIDE	<2.1

IA-3 (7/11/21)	
TCE	<0.11
PCE	<6.8
CHLOROETHANE	<2.6
1,1-DCE	<0.4
TRANS-1,2-DCE	<0.4
1,1-DCA	<0.4
CIS-1,2-DCE	<0.4
1,2-DCA	0.049
1,1,1-TCA	<0.55
1,1,2-TCA	<0.055
VINYL CHLORIDE	<0.26

IA-1 (7/11/21)	
TCE	0.22
PCE	<6.8
CHLOROETHANE	<2.6
1,1-DCE	<0.4
TRANS-1,2-DCE	<0.4
1,1-DCA	<0.4
CIS-1,2-DCE	<0.4
1,2-DCA	0.11
1,1,1-TCA	<0.55
1,1,2-TCA	1.2
VINYL CHLORIDE	<0.26

IA-5 (7/11/21)	
TCE	<0.11
PCE	<6.8
CHLOROETHANE	<2.6
1,1-DCE	<0.4
TRANS-1,2-DCE	<0.4
1,1-DCA	<0.4
CIS-1,2-DCE	<0.4
1,2-DCA	0.045
1,1,1-TCA	<0.55
1,1,2-TCA	<0.055
VINYL CHLORIDE	<0.26

IA-4 (7/11/21)	
TCE	0.31
PCE	<6.8
CHLOROETHANE	<2.6
1,1-DCE	<0.4
TRANS-1,2-DCE	<0.4
1,1-DCA	<0.4
CIS-1,2-DCE	<0.4
1,2-DCA	0.049
1,1,1-TCA	<0.55
1,1,2-TCA	<0.055
VINYL CHLORIDE	<0.26

SVP-3 (7/11/21)	
TCE	43
PCE	850[VE]
1,1,1-TCA	<2.8
1,1-DCE	<2.1
TRANS-1,2-DCE	<2.1
1,1-DCA	<2.1
CIS-1,2-DCE	<2.1
1,2-DCA	<0.21
1,1,1-TCA	<2.8
1,1,2-TCA	<0.28
VINYL CHLORIDE	<1.3

SVP-4 (5/5/22)	
TCE	<5.1
PCE	850
1,1,1-TCA	<26
1,1-DCE	<19
TRANS-1,2-DCE	<19
1,1-DCA	<19
CIS-1,2-DCE	<19
1,2-DCA	<1.9
1,1,1-TCA	<26
1,1,2-TCA	<2.6
VINYL CHLORIDE	<12

LEGEND

- SUBJECT PROPERTY BOUNDARY
- FLOOR DRAIN
- SVP-1 SUB-SLAB SOIL VAPOR PIN LOCATION AND DESIGNATION
- VP-1 SOIL VAPOR PROBE LOCATION AND DESIGNATION
- IA-1 INDOOR AIR SAMPLE LOCATION AND DESIGNATION

TCE	TRICHLOROETHENE
PCE	TETRACHLOROETHENE
TCA	TRICHLOROETHANE
DCE	DICHLOROMETHENE
DCA	DICHLOROMETHENE
MTCA	MODEL TOXICS CONTROL ACT
µg/m^3	MICROGRAMS PER CUBIC METER
E	ESTIMATED VALUE. THE AMOUNT EXCEEDS THE LINEAR WORKING RANGE OF THE INSTRUMENT
VE	THE ANALYTE RESPONSE EXCEEDED THE VALID INSTRUMENT CALIBRATION RANGE. THE VALUE REPORTED IS AN ESTIMATE.

IA-1 (7/11/21)	
TCE	0.22
PCE	<6.8
CHLOROETHANE	<2.6
1,1-DCE	<0.4
TRANS-1,2-DCE	<0.4
1,1-DCA	<0.4
CIS-1,2-DCE	<0.4
1,2-DCA	0.11
1,1,1-TCA	<0.55
1,1,2-TCA	1.2
VINYL CHLORIDE	<0.26

SAMPLE ID AND SAMPLE DATE

SAMPLE RESULTS (µg/m^3)

ANALYTE

848	CONCENTRATION **DOES NOT EXCEED** THE APPLICABLE MTCA CLEANUP LEVEL FOR RESPECTIVE CONTAMINANT
474	CONCENTRATION **EXCEEDS** THE APPLICABLE MTCA CLEANUP LEVEL FOR RESPECTIVE CONTAMINANT

NOTES

1. SITE MAP DEVELOPED AND REFERENCED FROM GOOGLE EARTH, 2019.
2. APPROXIMATE LOCATION OF FORMER INVESTIGATION LOCATIONS REFERENCED FROM EXPLORATION LOCATIONS AND ESTIMATED EXTENT OF PCE-IMPACTED SOIL, SOUND EARTH STRATEGIES (5/1/2019).
3. SOIL VAPOR RESULTS ARE IN µg/m^3.

N

SCALE: 1" = 30'
WHEN PLOTTED AT 11 x 17 PAGE SIZE

0 30' 60' 90'

THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. ACTUAL LOCATIONS MAY VARY AND NOT ALL STRUCTURES ARE SHOWN.

Site
TOWN AND COUNTRY CLEANERS
310 105TH AVE NE
BELLEVUE, WASHINGTON 98004

Drawing
PLAN VIEW OF PROPERTIES DURING TCE RISK EVALUATION ASSESSED

Date	June 8, 2022	Scale	AS SHOWN
File Name	02-02	Project No.	101.02216.00003
		Fig. No.	2

SLR

Table 1
Sub-Slab Soil Vapor Sample Analytical Results
Town and Country Dry Cleaners Site
310 105th Avenue NE
Bellevue, Washington

Sample Probe ID	Sample Location Address	Sample Date	Analytical Results[(1)] (µg/m^3) PCE	TCE	1,1,1-TCA	1,1-Dichloroethene	trans-1,2-Dichloroethene	1,1-Dichloroethane	cis-1,2-DCE	1,2-Dichloroethane (EDC)	1,1,1-Trichloroethane	1,1,2-Trichloroethane	Vinyl Chloride
Previous Investigation Results													
Sub-Slab Soil Vapor Probes													
SVP-1	**310 105th Ave. NE**	02/16/20	571[E]	20.2	<0.546	NA	<0.198	NA	<0.198	NA	NA	NA	NA
SVP-2	**310 105th Ave. NE**	02/16/20	848[E]	**474[E]**	0.817	NA	1.40	NA	13.9	NA	NA	NA	NA
SVP-2	**310 105th Ave. NE**	04/26/20	**17,900[E]**	**537**	0.956	NA	1.18	NA	4.65	NA	NA	NA	NA
2022 TCE Risk Evaluation Results													
Sub-Slab Soil Vapor Probes													
SVP-3	**308 105th Ave. NE**	07/11/21	850[ve]	43	<2.8	<2.1	<2.1	<2.1	<2.1	<0.21	<2.8	<0.28	<1.3
SVP-4	**239 106th Ave. NE**	05/05/22	850	<5.1	<26	<19	<19	<19	<19	<1.9	<26	<2.6	<12
Deep Soil Vapor Probe													
VP-1	**345 106th Ave. NE**	02/11/22	89	1.4	<4.5	<3.3	<3.3	<3.4	<3.3	<0.34	<4.5	<0.45	<2.1
Short-Term Sub-Slab Soil Gas Screening Level, Implementation Memo. 22			**NE**	**250[(2)]**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
MTCA Method B Sub-Slab Soil Gas Screening Levels			**1,685[(3)]**	**107[(3)]**	**7,600[(4)]**	**3,000[(4)]**	**NE**	**52[(5)]**	**NE**	**3.2[(5)]**	**76,000[(4)]**	**3.0[(4)]**	**9.5[(5)]**

NOTES:

Only the compounds that were detected in at least one sample are included in this table.

Sample analysis in 2020 performed by Fremont Analytical, Inc. of Seattle, Washington.

Sample analysis in 2021 and 2022 performed by Friedman & Bruya, Inc. of Seattle, Washington.

Values in Red exceed the applicable Sub-Slab Soil Gas Screening Level.

[(1)]Analyzed by EPA Method TO-15.

[(2)]Non-residential short-term vapor intrusion Screening Level for sub-slab soil gas, Vapor Intrusion Investigations and Short-term TCE Toxicity, Implementation Memorandum No. 22, October 2019.

[(3)]MTCA Method B Sub-Slab Soil Gas Screening Levels for a commercial exposure scenario [calculated using equations 750-1 and 750-2 from WAC 173-340-750(3)(b)(ii)].

[(4)]MTCA Method B sub-slab soil gas screening levels, non-cancer risk driver, Washington State Department of Ecology's (Ecology's) Cleanup Levels and Risk Calculations (CLARC) Master Table, August 2020.

[(5)]MTCA Method B sub-slab soil gas screening levels, cancer risk driver, Ecology's CLARC Master Table, August 2020.

DATA QUALIFIERS:

[E]Estimated value. The amount exceeds the linear working range of the instrument.

[ve]The analyte response exceeded the valid instrument calibration range. The value reported is an estimate.

< = not detected at a concentration exceeding the laboratory reporting limit

µg/m^3 = micrograms per cubic meter

DCE = dichloroethene

EPA = U.S. Environmental Protection Agency

MTCA = Washington State Model Toxics Control Act

NE - none established

PCE = tetrachloroethene

TCE = trichloroethene

Table 2
Indoor Air Sample Analytical Results
Town and Country Dry Cleaners Site
310 105th Avenue NE
Bellevue, Washington

Sample Location ID	Sample Location Address	Sample Date	Analytical Results[(1)] (µg/m^3)										
			PCE	TCE	Chloroethane	1,1-Dichloroethene	trans-1,2-Dichloroethene	1,1-Dichloroethane	cis-1,2-DCE	1,2-Dichloroethane (EDC)	1,1,1-Trichloroethane	1,1,2-Trichloroethane	Vinyl Chloride
Indoor Air Sample Analytical Results													
IA-1	**310 105th Ave. NE**	07/11/21	<6.8	0.22	<2.6	<0.4	<0.4	<0.4	<0.4	0.11	<0.55	0.12	<0.26
IA-2	**310 105th Ave. NE**	07/11/21	<6.8	0.27	<2.6	<0.4	<0.4	<0.4	<0.4	<0.045	<0.55	<0.055	<0.26
IA-3	**310 105th Ave. NE**	07/11/21	<6.8	<0.11	<2.6	<0.4	<0.4	<0.4	<0.4	0.049	<0.55	<0.055	<0.26
IA-4	**308 105th Ave. NE**	07/11/21	<6.8	0.31	<2.6	<0.4	<0.4	<0.4	<0.4	0.049	<0.55	<0.055	<0.26
IA-5	**308 105th Ave. NE**	07/11/21	<6.8	<0.11	<2.6	<0.4	<0.4	<0.4	<0.4	0.045	<0.55	<0.055	<0.26
Ambient Air Sample Analtyical Results													
AA-1	**N/A**	07/11/21	<6.8	<0.11	<2.6	<0.4	<0.4	<0.4	<0.4	<0.04	<0.55	<0.055	<0.26
Short-Term Indoor Air Action Levels, Implementation Memo. No. 22			**NE**	**7.5[(2)]**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
MTCA Method B Indoor Air Cleanup Levels			**9.62[(3)]**	**0.334[(3)]**	**NE**	**91.4[(4)]**	**NE**	**1.56[(3)]**	**NE**	**0.51[(5)]**	**2,290[(4)]**	**0.156[(3)]**	**0.284[(3)]**

NOTES:

Only the compounds that were detected in at least one sample are included in this table.

Sample analysis performed by Friedman & Bruya, Inc. of Seattle, Washington.

[(1)]Analyzed by EPA Method TO-15.

[(2)]Short-term (maximum 3-week mean concentration for women of childbearing age) indoor air action level for a workplace scenario, Vapor Intrusion Investigations and Short-term TCE Toxicity, Implementation Memorandum No. 22, October 2019.

[(3)]MTCA Method B indoor air cleanup levels, cancer risk driver, Washington State Department of Ecology's (Ecology's) Cleanup Levels and Risk Calculations (CLARC) Master Table, August 2020.

[(4)]MTCA Method B indoor air cleanup levels, non-cancer risk driver, Ecology's CLARC Master Table, August 2020.

[(5)]MTCA Method B Indoor Air cleanup level for a commercial exposure scenario [calculated using equations 750-1 and 750-2 from WAC 173-340-750(3)(b)(ii). Cancer risk driver.

< = not detected at a concentration exceeding the laboratory reporting limit

µg/m^3 = micrograms per cubic meter

DCE = dichloroethene

EPA = U.S. Environmental Protection Agency

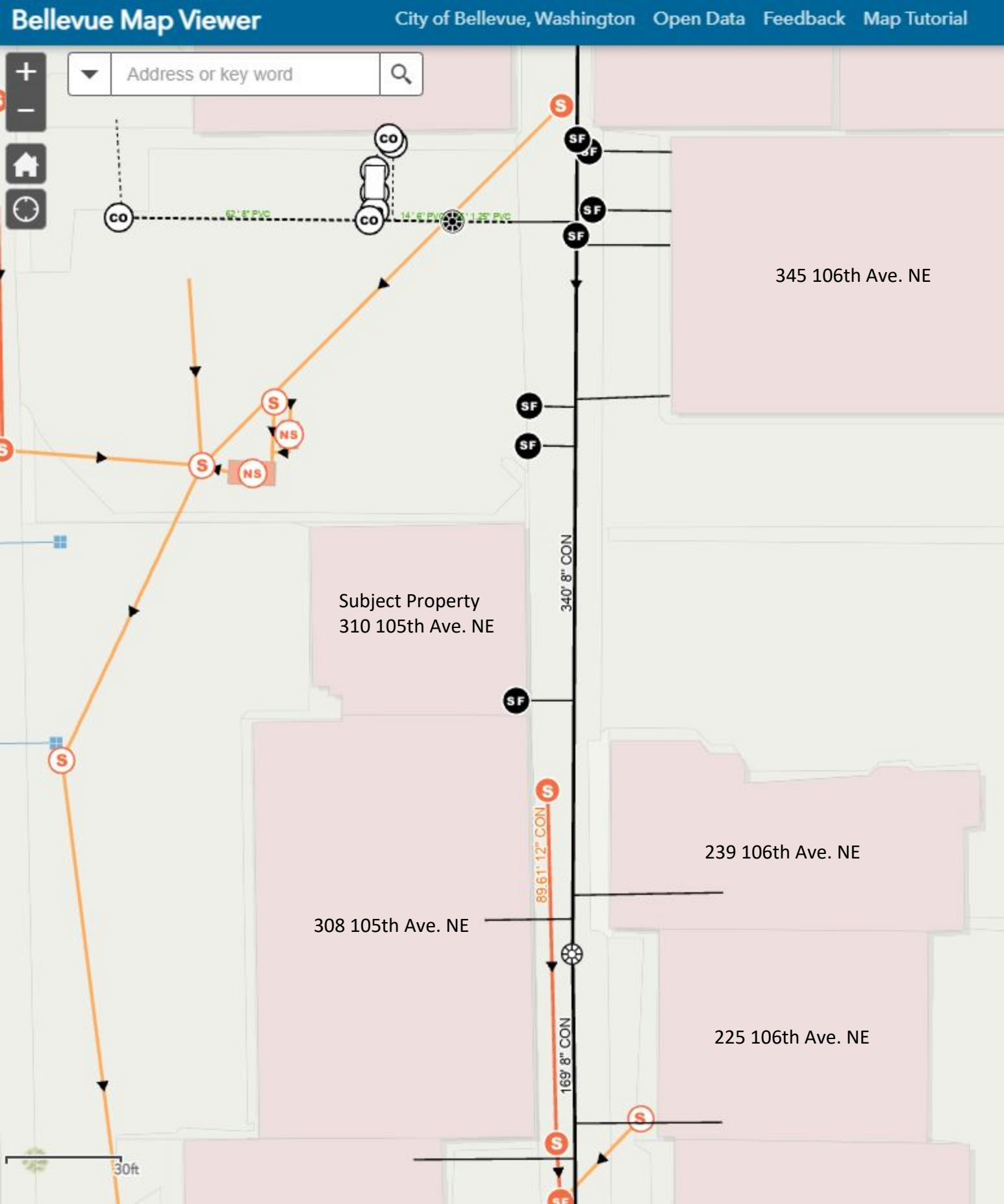
MTCA = Washington State Model Toxics Control Act

NE - none established

PCE = tetrachloroethene

TCE = trichloroethene

APPENDIX A – CITY OF BELLEVUE SUBSURFACE UTILITY MAP


Bellevue Map Viewer
City of Bellevue, Washington
Open Data
Feedback
Map Tutorial
Address or key word
345 106th Ave. NE
Subject Property
310 105th Ave. NE
239 106th Ave. NE
308 105th Ave. NE
225 106th Ave. NE
340' 8" CON
89.61' 12" CON
169' 8" CON
30ft

APPENDIX B – LABORATORY ANALYTICAL REPORTS

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

James E. Bruya, Ph.D.
Yelena Aravkina, M.S.
Michael Erdahl, B.S.
Arina Podnozova, B.S.
Eric Young, B.S.

3012 16th Avenue West
Seattle, WA 98119-2029
(206) 285-8282
fbi@isomedia.com
www.friedmanandbruya.com

July 15, 2021

John McCorkle, Project Manager
SLR International Corp.
22118 20th Ave. SE, G-202
Bothell, WA 98021

Dear Mr McCorkle:

Included are the results from the testing of material submitted on July 12, 2021 from the Town+Country Cleaners 101.02216.00001, F&BI 107147 project. There are 11 pages included in this report.

We appreciate this opportunity to be of service to you and hope you will call if you should have any questions.

Sincerely,

FRIEDMAN & BRUYA, INC.

Michael Erdahl
Project Manager

Enclosures
SLR0715R.DOC

CASE NARRATIVE

This case narrative encompasses samples received on July 12, 2020 by Friedman & Bruya, Inc. from the SLR International Corp. Town+Country Cleaners 101.02216.00001, F&BI 107147 project. Samples were logged in under the laboratory ID's listed below.

Laboratory ID	SLR International Corp.
107147 -01	IA-1-0721
107147 -02	IA-2-0721
107147 -03	IA-3-0721
107147 -04	IA-4-0721
107147 -05	IA-5-0721
107147 -06	AA-1-0721
107147 -07	SVP-3-0721

The tetrachloroethene concentration for sample SVP-3-0721 exceeded the calibration range. The data were flagged accordingly.

All other quality control requirements were acceptable.

Analysis For Volatile Compounds By Method TO-15

Client Sample ID:	IA-1-0721	Client:	SLR International Corp.
Date Received:	07/12/21	Project:	Town+Country Cleaners 101.02216.00001
Date Collected:	07/11/21	Lab ID:	107147-01
Date Analyzed:	07/12/21	Data File:	071217.D
Matrix:	Air	Instrument:	GCMS7
Units:	ug/m3	Operator:	bat

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
4-Bromofluorobenzene	89	70	130

Compounds:	Concentration ug/m3	ppbv
Vinyl chloride	<0.26	<0.1
Chloroethane	<2.6	<1
1,1-Dichloroethene	<0.4	<0.1
trans-1,2-Dichloroethene	<0.4	<0.1
1,1-Dichloroethane	<0.4	<0.1
cis-1,2-Dichloroethene	<0.4	<0.1
1,2-Dichloroethane (EDC)	0.11	0.027
1,1,1-Trichloroethane	<0.55	<0.1
Trichloroethene	0.22	0.041
1,1,2-Trichloroethane	0.12	0.022
Tetrachloroethene	<6.8	<1

Analysis For Volatile Compounds By Method TO-15

Client Sample ID:	IA-2-0721	Client:	SLR International Corp.
Date Received:	07/12/21	Project:	Town+Country Cleaners 101.02216.00001
Date Collected:	07/11/21	Lab ID:	107147-02
Date Analyzed:	07/12/21	Data File:	071218.D
Matrix:	Air	Instrument:	GCMS7
Units:	ug/m3	Operator:	bat

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
4-Bromofluorobenzene	94	70	130

Compounds:	Concentration ug/m3	ppbv
Vinyl chloride	<0.26	<0.1
Chloroethane	<2.6	<1
1,1-Dichloroethene	<0.4	<0.1
trans-1,2-Dichloroethene	<0.4	<0.1
1,1-Dichloroethane	<0.4	<0.1
cis-1,2-Dichloroethene	<0.4	<0.1
1,2-Dichloroethane (EDC)	0.045	0.011
1,1,1-Trichloroethane	<0.55	<0.1
Trichloroethene	0.27	0.051
1,1,2-Trichloroethane	<0.055	<0.01
Tetrachloroethene	<6.8	<1

Analysis For Volatile Compounds By Method TO-15

Client Sample ID:	IA-3-0721	Client:	SLR International Corp.
Date Received:	07/12/21	Project:	Town+Country Cleaners 101.02216.00001
Date Collected:	07/11/21	Lab ID:	107147-03
Date Analyzed:	07/12/21	Data File:	071219.D
Matrix:	Air	Instrument:	GCMS7
Units:	ug/m3	Operator:	bat

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
4-Bromofluorobenzene	88	70	130

Compounds:	Concentration ug/m3	ppbv
Vinyl chloride	<0.26	<0.1
Chloroethane	<2.6	<1
1,1-Dichloroethene	<0.4	<0.1
trans-1,2-Dichloroethene	<0.4	<0.1
1,1-Dichloroethane	<0.4	<0.1
cis-1,2-Dichloroethene	<0.4	<0.1
1,2-Dichloroethane (EDC)	0.049	0.012
1,1,1-Trichloroethane	<0.55	<0.1
Trichloroethene	<0.11	<0.02
1,1,2-Trichloroethane	<0.055	<0.01
Tetrachloroethene	<6.8	<1

Analysis For Volatile Compounds By Method TO-15

Client Sample ID:	IA-4-0721	Client:	SLR International Corp.
Date Received:	07/12/21	Project:	Town+Country Cleaners 101.02216.00001
Date Collected:	07/11/21	Lab ID:	107147-04
Date Analyzed:	07/12/21	Data File:	071220.D
Matrix:	Air	Instrument:	GCMS7
Units:	ug/m3	Operator:	bat

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
4-Bromofluorobenzene	95	70	130

Compounds:	Concentration ug/m3	ppbv
Vinyl chloride	<0.26	<0.1
Chloroethane	<2.6	<1
1,1-Dichloroethene	<0.4	<0.1
trans-1,2-Dichloroethene	<0.4	<0.1
1,1-Dichloroethane	<0.4	<0.1
cis-1,2-Dichloroethene	<0.4	<0.1
1,2-Dichloroethane (EDC)	0.049	0.012
1,1,1-Trichloroethane	<0.55	<0.1
Trichloroethene	0.31	0.058
1,1,2-Trichloroethane	<0.055	<0.01
Tetrachloroethene	<6.8	<1

Analysis For Volatile Compounds By Method TO-15

Client Sample ID:	IA-5-0721	Client:	SLR International Corp.
Date Received:	07/12/21	Project:	Town+Country Cleaners 101.02216.00001
Date Collected:	07/11/21	Lab ID:	107147-05
Date Analyzed:	07/12/21	Data File:	071221.D
Matrix:	Air	Instrument:	GCMS7
Units:	ug/m3	Operator:	bat

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
4-Bromofluorobenzene	93	70	130

Compounds:	Concentration ug/m3	ppbv
Vinyl chloride	<0.26	<0.1
Chloroethane	<2.6	<1
1,1-Dichloroethene	<0.4	<0.1
trans-1,2-Dichloroethene	<0.4	<0.1
1,1-Dichloroethane	<0.4	<0.1
cis-1,2-Dichloroethene	<0.4	<0.1
1,2-Dichloroethane (EDC)	0.045	0.011
1,1,1-Trichloroethane	<0.55	<0.1
Trichloroethene	<0.11	<0.02
1,1,2-Trichloroethane	<0.055	<0.01
Tetrachloroethene	<6.8	<1

Analysis For Volatile Compounds By Method TO-15

Client Sample ID:	AA-1-0721	Client:	SLR International Corp.
Date Received:	07/12/21	Project:	Town+Country Cleaners 101.02216.00001
Date Collected:	07/11/21	Lab ID:	107147-06
Date Analyzed:	07/12/21	Data File:	071222.D
Matrix:	Air	Instrument:	GCMS7
Units:	ug/m3	Operator:	bat

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
4-Bromofluorobenzene	89	70	130

Compounds:	Concentration ug/m3	ppbv
Vinyl chloride	<0.26	<0.1
Chloroethane	<2.6	<1
1,1-Dichloroethene	<0.4	<0.1
trans-1,2-Dichloroethene	<0.4	<0.1
1,1-Dichloroethane	<0.4	<0.1
cis-1,2-Dichloroethene	<0.4	<0.1
1,2-Dichloroethane (EDC)	<0.04	<0.01
1,1,1-Trichloroethane	<0.55	<0.1
Trichloroethene	<0.11	<0.02
1,1,2-Trichloroethane	<0.055	<0.01
Tetrachloroethene	<6.8	<1

Analysis For Volatile Compounds By Method TO-15

Client Sample ID:	SVP-3-0721	Client:	SLR International Corp.
Date Received:	07/12/21	Project:	Town+Country Cleaners 101.02216.00001
Date Collected:	07/11/21	Lab ID:	107147-07 1/5.2
Date Analyzed:	07/12/21	Data File:	071223.D
Matrix:	Air	Instrument:	GCMS7
Units:	ug/m3	Operator:	bat

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
4-Bromofluorobenzene	93	70	130

Compounds:	Concentration ug/m3	ppbv
Vinyl chloride	<1.3	<0.52
Chloroethane	<14	<5.2
1,1-Dichloroethene	<2.1	<0.52
trans-1,2-Dichloroethene	<2.1	<0.52
1,1-Dichloroethane	<2.1	<0.52
cis-1,2-Dichloroethene	<2.1	<0.52
1,2-Dichloroethane (EDC)	<0.21	<0.052
1,1,1-Trichloroethane	<2.8	<0.52
Trichloroethene	43	8.0
1,1,2-Trichloroethane	<0.28	<0.052
Tetrachloroethene	850 ve	130 ve

Analysis For Volatile Compounds By Method TO-15

Client Sample ID:	Method Blank	Client:	SLR International Corp.
Date Received:	Not Applicable	Project:	Town+Country Cleaners 101.02216.00001
Date Collected:	Not Applicable	Lab ID:	01-1570 MB
Date Analyzed:	07/12/21	Data File:	071212.D
Matrix:	Air	Instrument:	GCMS7
Units:	ug/m3	Operator:	bat

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
4-Bromofluorobenzene	88	70	130

Compounds:	Concentration ug/m3	ppbv
Vinyl chloride	<0.26	<0.1
Chloroethane	<2.6	<1
1,1-Dichloroethene	<0.4	<0.1
trans-1,2-Dichloroethene	<0.4	<0.1
1,1-Dichloroethane	<0.4	<0.1
cis-1,2-Dichloroethene	<0.4	<0.1
1,2-Dichloroethane (EDC)	<0.04	<0.01
1,1,1-Trichloroethane	<0.55	<0.1
Trichloroethene	<0.11	<0.02
1,1,2-Trichloroethane	<0.055	<0.01
Tetrachloroethene	<6.8	<1

Date of Report: 07/15/21
Date Received: 07/12/21
Project: Town+Country Cleaners 101.02216.00001, F&BI 107147

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF AIR SAMPLES FOR VOLATILES BY METHOD TO-15

Laboratory Code: 107147-07 1/5.2 (Duplicate)

Analyte	Reporting Units	Sample Result	Duplicate Result	RPD (Limit 30)
Vinyl chloride	ug/m3	<1.3	<1.3	nm
Chloroethane	ug/m3	<14	<14	nm
1,1-Dichloroethene	ug/m3	<2.1	<2.1	nm
trans-1,2-Dichloroethene	ug/m3	<2.1	<2.1	nm
1,1-Dichloroethane	ug/m3	<2.1	<2.1	nm
cis-1,2-Dichloroethene	ug/m3	<2.1	<2.1	nm
1,2-Dichloroethane (EDC)	ug/m3	<0.21	<0.21	nm
1,1,1-Trichloroethane	ug/m3	<2.8	<2.8	nm
Trichloroethene	ug/m3	43	43	0
1,1,2-Trichloroethane	ug/m3	<0.28	<0.28	nm
Tetrachloroethene	ug/m3	850	860	1

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Vinyl chloride	ug/m3	35	100	70-130
Chloroethane	ug/m3	36	95	70-130
1,1-Dichloroethene	ug/m3	54	97	70-130
trans-1,2-Dichloroethene	ug/m3	54	92	70-130
1,1-Dichloroethane	ug/m3	55	95	70-130
cis-1,2-Dichloroethene	ug/m3	54	90	70-130
1,2-Dichloroethane (EDC)	ug/m3	55	93	70-130
1,1,1-Trichloroethane	ug/m3	74	99	70-130
Trichloroethene	ug/m3	73	101	70-130
1,1,2-Trichloroethane	ug/m3	74	110	70-130
Tetrachloroethene	ug/m3	92	121	70-130

Data Qualifiers & Definitions

a - The analyte was detected at a level less than five times the reporting limit. The RPD results may not provide reliable information on the variability of the analysis.

b - The analyte was spiked at a level that was less than five times that present in the sample. Matrix spike recoveries may not be meaningful.

ca - The calibration results for the analyte were outside of acceptance criteria. The value reported is an estimate.

c - The presence of the analyte may be due to carryover from previous sample injections.

cf - The sample was centrifuged prior to analysis.

d - The sample was diluted. Detection limits were raised and surrogate recoveries may not be meaningful.

dv - Insufficient sample volume was available to achieve normal reporting limits.

f - The sample was laboratory filtered prior to analysis.

fb - The analyte was detected in the method blank.

fc - The analyte is a common laboratory and field contaminant.

hr - The sample and duplicate were reextracted and reanalyzed. RPD results were still outside of control limits. Variability is attributed to sample inhomogeneity.

hs - Headspace was present in the container used for analysis.

ht – The analysis was performed outside the method or client-specified holding time requirement.

ip - Recovery fell outside of control limits due to sample matrix effects.

j - The analyte concentration is reported below the lowest calibration standard. The value reported is an estimate.

J - The internal standard associated with the analyte is out of control limits. The reported concentration is an estimate.

jl - The laboratory control sample(s) percent recovery and/or RPD were out of control limits. The reported concentration should be considered an estimate.

js - The surrogate associated with the analyte is out of control limits. The reported concentration should be considered an estimate.

lc - The presence of the analyte is likely due to laboratory contamination.

L - The reported concentration was generated from a library search.

nm - The analyte was not detected in one or more of the duplicate analyses. Therefore, calculation of the RPD is not applicable.

pc - The sample was received with incorrect preservation or in a container not approved by the method. The value reported should be considered an estimate.

ve - The analyte response exceeded the valid instrument calibration range. The value reported is an estimate.

vo - The value reported fell outside the control limits established for this analyte.

x - The sample chromatographic pattern does not resemble the fuel standard used for quantitation.

SAMPLE CHAIN OF CUSTODY

107147

ME 7/12/21

Page # _____ of _____

Report To John McCorkle

Company SLR

Address 22118 20th Ave SE, Ste G202

City, State, ZIP Bothell, WA

Phone (425) 402-8800 Email jmccorkle@slrconsulting.com

SAMPLERS (*signature*): Steven Loskoben & Spencer Lo

PROJECT NAME & ADDRESS: Town + Country Cleaners

PO #: 101.0226.00001

NOTES:

INVOICE TO

TURNAROUND TIME
- ~~Standard~~
- ☐ RUSH
- Rush charges authorized by:

SAMPLE DISPOSAL
- ☐ Default: Clean after 3 days
- ☐ Archive (Fee may apply)

SAMPLE INFORMATION										ANALYSIS REQUESTED						
Sample Name	Lab ID	Canister ID	Flow Cont. ID	Reporting Level: IA=Indoor Air SG=Soil Gas (Circle One)	Date Sampled	Initial Vac. ("Hg)	Field Initial Time	Final Vac. ("Hg)	Field Final Time	TO15 Full Scan	TO15 BTEXN	TO15 cVOCs	APH	Helium	In-VOCs by TO	Notes
IA-1-0721	01	23227		(IA) / SG	7/11/21	30	0856	3	1642						X	
IA-2-0721	02	20543		(IA) / SG		31	0856	6	1656						X	
IA-3-0721	03	18563		(IA) / SG		31	0857	~~4~~ 7	1642						X	
IA-4-0721	04	18573		(IA) / SG		31	0937	6.5	1737						X	
IA-5-0721	05	21440		(IA) / SG		30	0938	6	1738						X	
AA-1-0721	06	20542		(IA) / SG		29	0859	6	1659						X	
SVP-3-0721	07	2300		IA / (SG)		31	0950	5	0957						X	
				IA / SG												Samples received at 22 °C

SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Relinquished by: Spencer Lo	Spencer Lo	SLR	7-12-21	830
Received by: Will Radford	Will Radford	F&BI	7/12/21	8:30a
Relinquished by:				
Received by:				

Friedman & Bruya, Inc.
3012 16th Avenue West
Seattle, WA 98119-2029
Ph. (206) 285-8282
Fax (206) 283-5044

FORMS\COC\COCTO-15.DOC

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

James E. Bruya, Ph.D.
Yelena Aravkina, M.S.
Michael Erdahl, B.S.
Vineta Mills, M.S.
Eric Young, B.S.

3012 16th Avenue West
Seattle, WA 98119-2029
(206) 285-8282
fbi@isomedia.com
www.friedmanandbruya.com

February 18, 2022

John McCorkle, Project Manager
SLR International Corp.
22118 20th Ave. SE, G-202
Bothell, WA 98021

Dear Mr McCorkle:

Included are the results from the testing of material submitted on February 11, 2022 from the Town and Country Cleaners 101.02216.00001, F&BI 202219 project. There are 5 pages included in this report.

We appreciate this opportunity to be of service to you and hope you will call if you should have any questions.

Sincerely,

FRIEDMAN & BRUYA, INC.

Michael Erdahl
Project Manager

Enclosures
SLR0218R.DOC

CASE NARRATIVE

This case narrative encompasses samples received on February 11, 2022 by Friedman & Bruya, Inc. from the SLR International Corp. Town and Country Cleaners 101.02216.00001, F&BI 202219 project. Samples were logged in under the laboratory ID's listed below.

Laboratory ID	SLR International Corp.
202219 -01	VP-1-0222

All quality control requirements were acceptable.

Analysis For Volatile Compounds By Method TO-15

Client Sample ID:	VP-1-0222	Client:	SLR International Corp.
Date Received:	02/11/22	Project:	101.02216.00001, F&BI 202219
Date Collected:	02/10/22	Lab ID:	202219-01 1/8.3
Date Analyzed:	02/16/22	Data File:	021516.D
Matrix:	Air	Instrument:	GCMS8
Units:	ug/m3	Operator:	bat

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
4-Bromofluorobenzene	93	70	130

Compounds:	Concentration ug/m3	ppbv
Vinyl chloride	<2.1	<0.83
Chloroethane	<22	<8.3
1,1-Dichloroethene	<3.3	<0.83
trans-1,2-Dichloroethene	<3.3	<0.83
1,1-Dichloroethane	<3.4	<0.83
cis-1,2-Dichloroethene	<3.3	<0.83
1,2-Dichloroethane (EDC)	<0.34	<0.083
1,1,1-Trichloroethane	<4.5	<0.83
Trichloroethene	1.4	0.27
1,1,2-Trichloroethane	<0.45	<0.083
Tetrachloroethene	89	13

Analysis For Volatile Compounds By Method TO-15

Client Sample ID:	Method Blank	Client:	SLR International Corp.
Date Received:	Not Applicable	Project:	101.02216.00001, F&BI 202219
Date Collected:	Not Applicable	Lab ID:	02-0398 MB
Date Analyzed:	02/15/22	Data File:	021512.D
Matrix:	Air	Instrument:	GCMS8
Units:	ug/m3	Operator:	bat

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
4-Bromofluorobenzene	97	70	130

Compounds:	Concentration ug/m3	ppbv
Vinyl chloride	<0.26	<0.1
Chloroethane	<2.6	<1
1,1-Dichloroethene	<0.4	<0.1
trans-1,2-Dichloroethene	<0.4	<0.1
1,1-Dichloroethane	<0.4	<0.1
cis-1,2-Dichloroethene	<0.4	<0.1
1,2-Dichloroethane (EDC)	<0.04	<0.01
1,1,1-Trichloroethane	<0.55	<0.1
Trichloroethene	<0.11	<0.02
1,1,2-Trichloroethane	<0.055	<0.01
Tetrachloroethene	<6.8	<1

Date of Report: 02/18/22
Date Received: 02/11/22
Project: Town and Country Cleaners 101.02216.00001, F&BI 202219

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF AIR SAMPLES FOR VOLATILES BY METHOD TO-15

Laboratory Code: 202165-01 1/5.5 (Duplicate)

Analyte	Reporting Units	Sample Result	Duplicate Result	RPD (Limit 30)
Vinyl chloride	ug/m3	<1.4	<1.4	nm
Chloroethane	ug/m3	<15	<15	nm
1,1-Dichloroethene	ug/m3	<2.2	<2.2	nm
trans-1,2-Dichloroethene	ug/m3	<2.2	<2.2	nm
1,1-Dichloroethane	ug/m3	<2.2	<2.2	nm
cis-1,2-Dichloroethene	ug/m3	<2.2	<2.2	nm
1,2-Dichloroethane (EDC)	ug/m3	<0.22	<0.22	nm
1,1,1-Trichloroethane	ug/m3	<3	<3	nm
Trichloroethene	ug/m3	<0.59	<0.59	nm
1,1,2-Trichloroethane	ug/m3	<0.3	<0.3	nm
Tetrachloroethene	ug/m3	<37	<37	nm

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Vinyl chloride	ug/m3	35	90	70-130
Chloroethane	ug/m3	36	99	70-130
1,1-Dichloroethene	ug/m3	54	93	70-130
trans-1,2-Dichloroethene	ug/m3	54	99	70-130
1,1-Dichloroethane	ug/m3	55	97	70-130
cis-1,2-Dichloroethene	ug/m3	54	95	70-130
1,2-Dichloroethane (EDC)	ug/m3	55	97	70-130
1,1,1-Trichloroethane	ug/m3	74	96	70-130
Trichloroethene	ug/m3	73	92	70-130
1,1,2-Trichloroethane	ug/m3	74	96	70-130
Tetrachloroethene	ug/m3	92	95	70-130

Data Qualifiers & Definitions

a - The analyte was detected at a level less than five times the reporting limit. The RPD results may not provide reliable information on the variability of the analysis.

b - The analyte was spiked at a level that was less than five times that present in the sample. Matrix spike recoveries may not be meaningful.

ca - The calibration results for the analyte were outside of acceptance criteria. The value reported is an estimate.

c - The presence of the analyte may be due to carryover from previous sample injections.

cf - The sample was centrifuged prior to analysis.

d - The sample was diluted. Detection limits were raised and surrogate recoveries may not be meaningful.

dv - Insufficient sample volume was available to achieve normal reporting limits.

f - The sample was laboratory filtered prior to analysis.

fb - The analyte was detected in the method blank.

fc - The analyte is a common laboratory and field contaminant.

hr - The sample and duplicate were reextracted and reanalyzed. RPD results were still outside of control limits. Variability is attributed to sample inhomogeneity.

hs - Headspace was present in the container used for analysis.

ht – The analysis was performed outside the method or client-specified holding time requirement.

ip - Recovery fell outside of control limits due to sample matrix effects.

j - The analyte concentration is reported below the lowest calibration standard. The value reported is an estimate.

J - The internal standard associated with the analyte is out of control limits. The reported concentration is an estimate.

jl - The laboratory control sample(s) percent recovery and/or RPD were out of control limits. The reported concentration should be considered an estimate.

js - The surrogate associated with the analyte is out of control limits. The reported concentration should be considered an estimate.

lc - The presence of the analyte is likely due to laboratory contamination.

L - The reported concentration was generated from a library search.

nm - The analyte was not detected in one or more of the duplicate analyses. Therefore, calculation of the RPD is not applicable.

pc - The sample was received with incorrect preservation or in a container not approved by the method. The value reported should be considered an estimate.

ve - The analyte response exceeded the valid instrument calibration range. The value reported is an estimate.

vo - The value reported fell outside the control limits established for this analyte.

x - The sample chromatographic pattern does not resemble the fuel standard used for quantitation.

202219

SAMPLE CHAIN OF CUSTODY

02.11.22

Page # 1 of 1

Report To ~~SLR~~ John McCorkle

Company SLR

Address 22118 20th Ave SE, Suite 020, Bothell WA

City, State, ZIP

Phone 425.402.8800 Email jmccorkle@slrconsulting.com

SAMPLERS (signature)	
PROJECT NAME & ADDRESS: Town and Country Cleaners	PO #: 101.02216.00001
NOTES:	INVOICE TO

TURNAROUND TIME
- ☑ Standard
- ☐ RUSH
- Rush charges authorized by:

SAMPLE DISPOSAL
- ☐ Default: Clean after 3 days
- ☐ Archive (Fee may apply)

SAMPLE INFORMATION										ANALYSIS REQUESTED						
Sample Name	Lab ID	Canister ID	Flow Cont. ID	Reporting Level: IA=Indoor Air SG=Soil Gas (Circle One)	Date Sampled	Initial Vac. ("Hg)	Field Initial Time	Final Vac. ("Hg)	Field Final Time	TO15 Full Scan	TO15 BTEXN	TO15 cVOCs	APH	Helium	4-VOCs by TO15	Notes
VP-1-0222	01	3258	12	IA / (SG)	2-10-22	30	1230	5	1235						X	Flow ID: 03
				IA / SG												
				IA / SG												
				IA / SG												
				IA / SG												
				IA / SG												
				IA / SG												
				IA / SG												

TW 2/11

Friedman & Bruya, Inc.
3012 16th Avenue West
Seattle, WA 98119-2029
Ph. (206) 285-8282
Fax (206) 283-5044

	SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Relinquished by:		Spencer Lo	SLR	2-11-22	1347
Received by:		Nhan Phan	FEBI	2-11-22	1347
Relinquished by:					
Received by:			Samples received at 18 °C		

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

James E. Bruya, Ph.D.
Yelena Aravkina, M.S.
Michael Erdahl, B.S.
Vineta Mills, M.S.
Eric Young, B.S.

3012 16th Avenue West
Seattle, WA 98119-2029
(206) 285-8282
fbi@isomedia.com
www.friedmanandbruya.com

May 16, 2022

John McCorkle, Project Manager
SLR International Corp.
22118 20th Ave. SE, G-202
Bothell, WA 98021

Dear Mr McCorkle:

Included are the results from the testing of material submitted on May 9, 2022 from the Town + Country Cleaners 101.02216.00001, F&BI 205129 project. There are 5 pages included in this report.

We appreciate this opportunity to be of service to you and hope you will call if you should have any questions.

Sincerely,

FRIEDMAN & BRUYA, INC.

Michael Erdahl
Project Manager

Enclosures
SLR0516R.DOC

CASE NARRATIVE

This case narrative encompasses samples received on May 9, 2022 by Friedman & Bruya, Inc. from the SLR International Corp. Town + Country Cleaners 101.02216.00001, F&BI 205129 project. Samples were logged in under the laboratory ID's listed below.

Laboratory ID	SLR International Corp.
205129 -01	SVP-4-0522

All quality control requirements were acceptable.

Analysis For Volatile Compounds By Method TO-15

Client Sample ID:	SVP-4-0522	Client:	SLR International Corp.
Date Received:	05/09/22	Project:	Town + Country Cleaners 101.02216.00001
Date Collected:	05/05/22	Lab ID:	205129-01 1/47
Date Analyzed:	05/10/22	Data File:	050929.D
Matrix:	Air	Instrument:	GCMS8
Units:	ug/m3	Operator:	bat

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
4-Bromofluorobenzene	96	70	130

Compounds:	Concentration ug/m3	ppbv
Vinyl chloride	<12	<4.7
Chloroethane	<120	<47
1,1-Dichloroethene	<19	<4.7
trans-1,2-Dichloroethene	<19	<4.7
1,1-Dichloroethane	<19	<4.7
cis-1,2-Dichloroethene	<19	<4.7
1,2-Dichloroethane (EDC)	<1.9	<0.47
1,1,1-Trichloroethane	<26	<4.7
Trichloroethene	<5.1	<0.94
1,1,2-Trichloroethane	<2.6	<0.47
Tetrachloroethene	850	130

Analysis For Volatile Compounds By Method TO-15

Client Sample ID:	Method Blank	Client:	SLR International Corp.
Date Received:	Not Applicable	Project:	Town + Country Cleaners 101.02216.00001
Date Collected:	Not Applicable	Lab ID:	02-0989 mb
Date Analyzed:	05/09/22	Data File:	050911.D
Matrix:	Air	Instrument:	GCMS8
Units:	ug/m3	Operator:	bat

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
4-Bromofluorobenzene	93	70	130

Compounds:	Concentration ug/m3	ppbv
Vinyl chloride	<0.26	<0.1
Chloroethane	<2.6	<1
1,1-Dichloroethene	<0.4	<0.1
trans-1,2-Dichloroethene	<0.4	<0.1
1,1-Dichloroethane	<0.4	<0.1
cis-1,2-Dichloroethene	<0.4	<0.1
1,2-Dichloroethane (EDC)	<0.04	<0.01
1,1,1-Trichloroethane	<0.55	<0.1
Trichloroethene	<0.11	<0.02
1,1,2-Trichloroethane	<0.055	<0.01
Tetrachloroethene	<6.8	<1

Date of Report: 05/16/22
Date Received: 05/09/22
Project: Town + Country Cleaners 101.02216.00001, F&BI 205129

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF AIR SAMPLES FOR VOLATILES BY METHOD TO-15

Laboratory Code: 205100-01 1/6.2 (Duplicate)

Analyte	Reporting Units	Sample Result	Duplicate Result	RPD (Limit 30)
Vinyl chloride	ug/m3	<1.6	<1.6	nm
Chloroethane	ug/m3	<16	<16	nm
1,1-Dichloroethene	ug/m3	<2.5	<2.5	nm
trans-1,2-Dichloroethene	ug/m3	<2.5	<2.5	nm
1,1-Dichloroethane	ug/m3	<2.5	<2.5	nm
cis-1,2-Dichloroethene	ug/m3	<2.5	<2.5	nm
1,2-Dichloroethane (EDC)	ug/m3	<0.25	<0.25	nm
1,1,1-Trichloroethane	ug/m3	<3.4	<3.4	nm
Trichloroethene	ug/m3	<0.67	<0.67	nm
1,1,2-Trichloroethane	ug/m3	<0.34	<0.34	nm
Tetrachloroethene	ug/m3	<42	<42	nm

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Vinyl chloride	ug/m3	35	103	70-130
Chloroethane	ug/m3	36	98	70-130
1,1-Dichloroethene	ug/m3	54	103	70-130
trans-1,2-Dichloroethene	ug/m3	54	106	70-130
1,1-Dichloroethane	ug/m3	55	105	70-130
cis-1,2-Dichloroethene	ug/m3	54	101	70-130
1,2-Dichloroethane (EDC)	ug/m3	55	97	70-130
1,1,1-Trichloroethane	ug/m3	74	105	70-130
Trichloroethene	ug/m3	73	98	70-130
1,1,2-Trichloroethane	ug/m3	74	99	70-130
Tetrachloroethene	ug/m3	92	105	70-130

Data Qualifiers & Definitions

a - The analyte was detected at a level less than five times the reporting limit. The RPD results may not provide reliable information on the variability of the analysis.

b - The analyte was spiked at a level that was less than five times that present in the sample. Matrix spike recoveries may not be meaningful.

ca - The calibration results for the analyte were outside of acceptance criteria. The value reported is an estimate.

c - The presence of the analyte may be due to carryover from previous sample injections.

cf - The sample was centrifuged prior to analysis.

d - The sample was diluted. Detection limits were raised and surrogate recoveries may not be meaningful.

dv - Insufficient sample volume was available to achieve normal reporting limits.

f - The sample was laboratory filtered prior to analysis.

fb - The analyte was detected in the method blank.

fc - The analyte is a common laboratory and field contaminant.

hr - The sample and duplicate were reextracted and reanalyzed. RPD results were still outside of control limits. Variability is attributed to sample inhomogeneity.

hs - Headspace was present in the container used for analysis.

ht – The analysis was performed outside the method or client-specified holding time requirement.

ip - Recovery fell outside of control limits due to sample matrix effects.

j - The analyte concentration is reported below the lowest calibration standard. The value reported is an estimate.

J - The internal standard associated with the analyte is out of control limits. The reported concentration is an estimate.

jl - The laboratory control sample(s) percent recovery and/or RPD were out of control limits. The reported concentration should be considered an estimate.

js - The surrogate associated with the analyte is out of control limits. The reported concentration should be considered an estimate.

lc - The presence of the analyte is likely due to laboratory contamination.

L - The reported concentration was generated from a library search.

nm - The analyte was not detected in one or more of the duplicate analyses. Therefore, calculation of the RPD is not applicable.

pc - The sample was received with incorrect preservation or in a container not approved by the method. The value reported should be considered an estimate.

ve - The analyte response exceeded the valid instrument calibration range. The value reported is an estimate.

vo - The value reported fell outside the control limits established for this analyte.

x - The sample chromatographic pattern does not resemble the fuel standard used for quantitation.

205129

SAMPLE CHAIN OF CUSTODY

Report To John McCorkle

Company SLR

Address 2218 20th Ave SE, Suite G202

City, State, ZIP Bothell, WA 98021

Phone 425 402 9300 Email jmccorkle@slrconsulting.com

SAMPLERS (signature) Chris Lee 05.09.22

PROJECT NAME & ADDRESS: Town + Country Cleaners

PO # 101.02216.0003

NOTES:

INVOICE TO

Page # 1 of 1

TURNAROUND TIME
- ☑ Standard
- ☐ RUSH
- Rush charges authorized by:

SAMPLE DISPOSAL
- ☐ Default: Clean after 3 days
- ☐ Archive (Fee may apply)

SAMPLE INFORMATION / ANALYSIS REQUESTED

Sample Name	Lab ID	Canister ID	Flow Cont. ID	Reporting Level: IA=Indoor Air SG=Soil Gas (Circle One)	Date Sampled	Initial Vac. ("Hg)	Field Initial Time	Final Vac. ("Hg)	Field Final Time	TO15 Full Scan	TO15 BTEXN	TO15 cVOCs	APH	Helium	HVOCs by TO15	Notes
SVP-4-0522		20555	18	IA / (SG)	5.5.22	30	1230	6	1255						X	
				IA / SG												
				IA / SG												
				IA / SG												
				IA / SG												
				IA / SG												
				IA / SG												
				IA / SG												

Friedman & Bruya, Inc.
3012 16th Avenue West
Seattle, WA 98119-2029
Ph. (206) 285-8282
Fax (206) 283-5044

FORMS\COC\COCTO-15.DOC

SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Relinquished by:	Spencer Lo	SLR	5.9.22	940
Received by:	Tokeda Christensen	FTB	5/9/22	9:40
Relinquished by:				
Received by:		Samples received at 2°C		

APPENDIX C – WORK PLAN FOR TCE EVALUATION

Town and Country Dry Cleaners

Work Plan to Evaluate Trichloroethylene Risks

Prepared for: Jennifer S. Cha LLC

March 2021

Town and Country Dry Cleaners
Work Plan to Evaluate Trichloroethylene Risks

Prepared for:

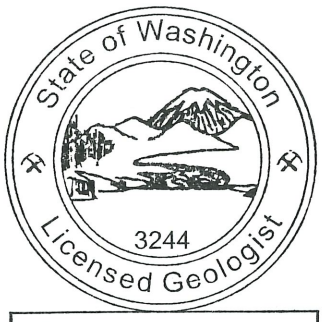
Jennifer S. Cha LLC

6205 142nd Ave. SE
Bellevue, WA 98005

This document has been prepared by SLR International Corporation (SLR). The material and data in this work plan were prepared under the supervision and direction of the undersigned.

Chris Lee, L.G.
Associate Geologist

John McCorkle, CEP
Principal



Christopher A. Lee

CONTENTS

FIGURES

ATTACHMENTS

ACRONYMS & ABBREVIATIONS

AESI	Associated Earth Sciences, Inc.
bgs	below ground surface
Ecology	Washington State Department of Ecology
F&B	Friedman & Bruya, Inc.
HVOCs	halogenated volatile organic compounds
in. Hg	inches of mercury
mg/kg	milligrams per kilogram
MTCA	Model Toxics Control Act
PCE	tetrachloroethylene
SLR	SLR International Corporation
Site	Town and Country Dry Cleaners, 310 105th Avenue NE, Bellevue, Washington
TCE	trichloroethylene
VOC	volatile organic compound

1. INTRODUCTION

This Work Plan has been prepared in response to an October 7, 2020 letter from the Washington State Department of Ecology (Ecology) that requested an evaluation of trichloroethylene (TCE) risks at the Town and Country Dry Cleaners facility located at 310 105th Avenue NE in Bellevue, Washington (the Subject Property; Figure 1). Ecology's letter requested an evaluation in accordance with the guidelines set forth in Implementation Memorandum No. 22, and is attached. The memorandum recommends a Tier 1 (sub-slab soil gas) and, if necessary, a Tier II (indoor air sampling) Vapor Intrusion Investigation to evaluate the risks associated with TCE exposure and to determine if further action is necessary. Ecology requested that the risk evaluation include the Subject Property and all buildings within 100 feet of the Subject Property, including:

- 308 105th Avenue NE;
- 345 106th Avenue NE;
- 239 106th Avenue NE; and
- 225 106th Avenue NE.

This work plan presents a proposed approach to conduct Tier II evaluation of the Subject Property building and Tier I evaluation of the four nearby buildings. All of the buildings to be assessed are shown on Figure 2.

1.1 SUBJECT PROPERTY DESCRIPTION & OPERATING HISTORY

The Subject Property consists of one generally rectangular-shaped parcel (King County parcel number 0679000055) totaling approximately 6,241 square feet (0.14 acre). The Subject Property is situated in downtown Bellevue and is developed with one commercial building surrounded by asphalt-paved parking spaces and driveways (Figure 2). Based on available records, the building appears to have been occupied by a dry cleaning business since approximately 1978. Tetrachloroethylene (PCE) was used as a dry cleaning solvent at the Subject Property until approximately 2009 when the current operator of the dry cleaning business reportedly switched to a hydrocarbon solvent.

1.2 PREVIOUS INVESTIGATIONS AND REMEDIATION ACTIVITIES

In November 1989, Associated Earth Sciences, Inc. (AESI) of Kirkland, Washington visited the Subject Property and collected a soil sample from an area to the east of the building. The analytical results showed that the soil sample contained a PCE concentration [67 milligrams per kilogram (mg/kg)] that exceeded the MTCA Method A PCE cleanup level (0.5 mg/kg at the time of the sampling). In January 1990, AESI conducted a remedial excavation. Approximately three cubic yards of soil were excavated and placed into drums for offsite incineration. Confirmation samples collected at the limits of the excavation did not contain PCE above 0.5 mg/kg. In March 1990, AESI drilled three soil borings and completed two of the borings as soil vapor probes, and in October 1990 Evergreen Environmental Consulting (Evergreen) of Seattle, Washington drilled three additional soil borings and completed them as soil vapor probes. The borings were advanced to depths ranging from 9 to 20 feet below ground surface (bgs), and groundwater was not encountered at these depths. Soil samples collected from the six soil borings contained PCE

concentrations (0.025 to 0.350 mg/kg) that were below 0.5 mg/kg. Documentation regarding sampling of the soil vapor has not been obtained by SLR. On January 15, 1997, the Seattle-King County Department of Public Health, in consultation with the Washington Department of Ecology, issued a letter concluding that no further action was necessary for the site.

In August 2019, SLR conducted a facility investigation within the Town and Country Dry Cleaners space. The inspection identified floor staining and the existence of potential pathways for solvent from dry cleaning operations to enter the subsurface, including a floor drain near the dry cleaning machine. In February 2020 SLR conducted a subsurface investigation beneath the floor inside the building. SLR cored two six-inch-diameter holes in the concrete slab and advanced two hand auger soil borings to depths of approximately two feet below ground surface (bgs). The borings were located in an area where staining was observed on the surface of the concrete floor near the dry cleaning machine (HA-1) and adjacent to the floor drain (HA-2). The soil sample analytical results showed that the samples from HA-1 and HA-2 contained PCE concentrations [0.206 and 0.186 milligrams per kilogram (mg/kg), respectively] that exceed that MTCA Method A soil cleanup level (0.05 mg/kg). SLR also installed two soil vapor sampling ports (Vapor Pins) in the concrete slab floor to allow for sampling the soil gas beneath the building. The Vapor Pins were installed to the east of the current dry cleaning machine, near an area where staining and cracks are present on the floor (SVP-1) and near the floor drain (SVP-2). The sub-slab soil vapor sample analytical results showed that the samples from SVP-1 and SVP-2 contained PCE concentrations [571 and 17,900 micrograms per cubic meter (µg/m^3), respectively] that exceed the Model Toxics Control Act (MTCA) Method B sub-slab soil vapor screening level (320 µg/m^3). The sample from SVP-1 and SVP-2 also contained trichloroethylene (TCE) concentrations (20.2 and 537 µg/m^3, respectively) that exceed the MTCA Method B sub-slab soil vapor screening level (12.3 µg/m^3). PCE and TCE are the most common halogenated VOCs associated with dry cleaning operations; however, other VOCs including naphthalene, 1,4-dichlorobenzene, 1,4-dioxane, acrolein, and chloroform were detected in the samples at concentrations that exceed the Method B screening levels.

1.3 RISK EVALUATION BASED ON CURRENT DATA

The human receptors currently present at the Subject Property include commercial workers that are assumed to be on the property five days a week for standard eight-hour workdays. Property visitors are also on the property for short periods of time and on an irregular basis; potential exposures to these receptors would be lower than those for commercial workers.

The default Method B screening levels available from Ecology are based on an assumed residential use of a property. As described in Ecology's Vapor Intrusion guidance, the assumptions used to calculate these default values are likely to be overly conservative for a building that is used commercially. To further evaluate the analytical results in the context of the commercial use of the Subject Property, SLR calculated soil vapor screening levels for a commercial building. This is because exposures are generally lower for workers compared to residential receptors. For example, workers are not likely to be present at the subject property 24 hours a day for seven days a week year-round, as is conservatively assumed for residential receptors. On this basis, the screening levels calculated using Equations 750-1 and 750-2 from WAC 173-340-750(3)(b)(ii) can be modified for protection of current on-property receptors by replacing relevant exposure assumptions to better reflect adult worker exposures. These equations result in indoor

air screening levels that are then converted to soil vapor screening levels using an attenuation factor. The following exposure assumptions were modified consistent with Ecology and EPA (2014) guidance as described below:

- **Body Weight:** For commercial screening levels, the child body weight of 16 kilograms (kg) was replaced with the Ecology default adult body weight of 70 kg.

- **Exposure Duration**: The residential exposure duration of 30 years was replaced with the EPA standard default exposure duration for the commercial scenario of 25 years.

- **Exposure Frequency**: The residential exposure frequency of 365 days/year (expressed as a unitless value of 1 [365 days/365 days] in the MTCA equations) was replaced with the EPA standard default indoor worker exposure frequency of 250 days/year.

- **Exposure Time:** The EPA standard default worker air exposure time, which is based on an 8-hour work shift (8 hours / 24 hours), was incorporated to modify the residential assumption of 24 hours per 24-hour day spent indoors at the site.

The assumptions described above were substituted for the residential values included by default in Equations 750-1 and 750-2, and the lower of the noncancer- and cancer-based values was identified as the indoor air screening level for PCE, acrolein, and chloroform to be protective of current commercial receptors. The indoor air value was divided by an attenuation factor of 0.03, as described by Ecology in their summary of changes to the 2009 Draft Vapor Intrusion Guidance toxicity values and screening levels, to calculate commercial soil vapor screening levels for PCE (1,685 µg/m^3), 1,4-dichlorobenzene (39.8 µg/m^3), 1,4-dioxane (87.6 µg/m^3), acrolein (2.92 µg/m^3), and chloroform (19.0 µg/m^3). The PCE concentration in the sample collected from SVP-2 exceeds this commercial screening level. The PCE concentration in the sample collected from SVP-1 and the 1,4-dichlorobenzene, 1,4-dioxane, acrolein, and chloroform concentrations in both sub-slab soil vapor samples do not exceed these commercial screening levels.

In October 2019, Ecology released *Implementation Memorandum No. 22, Vapor Intrusion Investigations and Short-term TCE Toxicity* (Ecology, 2019). This memorandum provides new guidance specific to TCE vapor intrusion. The guidance emphasizes the high risks associated with short-term exposure to TCE, particularly for a developing fetus. As a result, Ecology calculated revised sub-slab soil gas screening levels for short-term vapor intrusion using a woman of child-bearing age as the receptor of concern. The revised non-residential screening level for sub-slab soil gas is 250 µg/m^3. The TCE concentration in the sample collected from SVP-2 in February 2020 exceeds this screening level.

2. OBJECTIVES

The objectives of this risk evaluation are to:

- Conduct a Tier II indoor air sampling event at the Subject Property and at the 308 105th Avenue NE property to determine if the TCE contamination in soil and soil vapors has resulted in TCE concentrations in indoor air that exceed the non-residential short-term indoor air action level presented in Implementation Memorandum No. 22.
- Conduct a Tier 1 sub-slab soil vapor sampling event to determine if there are TCE concentrations in soil vapors beneath the four buildings that are within 100 feet of the Subject Property that exceed the non-residential sub-slab soil gas screening level presented in Implementation Memorandum No. 22.

This work plan is not intended to address any site characterization or source identification activities unrelated to an evaluation of vapor conditions. If required, other activities required by Ecology will addressed in other work scopes following consultation with the agency.

SLR will conduct four tasks described in the subsequent Scope of Work.

3. PROPOSED SCOPE OF WORK

3.1 TASK 1: WORK PLAN PREPARATION, PROJECT MANAGEMENT, AND TECHNICAL SUPPORT

The preparation of this detailed Work Plan that describes the sampling methods, locations, and analyses for the Vapor Intrusion Investigation for submittal to Ecology is included in Task 1. Prior to mobilizing to the Subject Property, we will also update the existing site-specific Health, Safety, and Environmental Plan (HSEP). Finally, Task 1 includes ongoing technical support provided to the site owner and counsel and discussions with Ecology.

3.2 TASK 2: COORDINATE ACCESS

SLR, the Subject Property owner, and counsel will request access from the Town and Country Dry Cleaners business owner to conduct Tier II indoor air sampling; enlisting Ecology's aid to gain access as appropriate. The nearby property owners and, if necessary, their tenants will also be contacted to request permission to conduct Tier II indoor air sampling (308 105th Avenue Northeast) and/or install sub-slab soil vapor probes and conduct sub-slab soil vapor sampling (all four of the nearby properties). Task 2 includes obtaining approval of this Work Plan from all involved parties prior to conducting any assessment activities.

3.2.1 BUILDING CONSTRUCTION AND DOCUMENTATION INQUIRY

Prior to conducting Tier I sub-slab soil vapor probe installation and sampling, SLR will request available records and/or will review online records of the construction details of the buildings at the four nearby properties:

- 308 105th Avenue NE;
- 345 106th Avenue NE;
- 239 106th Avenue NE; and
- 225 106th Avenue NE.

SLR will review these records to determine the foundation construction details; the presence of subsurface utilities including drains, sewer lines, water and gas supply lines, and electrical conduits; and the presence or absence of subsurface basements and/or crawl spaces. This information will be used to determine the ideal locations for sub-slab soil vapor probes in conjunction with a site reconnaissance

3.3 TASK 3: VAPOR INTRUSION ASSESSMENT

3.3.1 INDOOR AIR SAMPLING

SLR will conduct a Tier II indoor air sampling event at the Subject Property and at the 308 105th Avenue NE property in accordance with Ecology's *Guidance for Evaluating Soil Vapor Intrusion in Washington*

State: Investigation and Remedial Action (Ecology, 2016). SLR will provide the owners of the Subject Property and the 308 105th Avenue NE property and their tenants, as appropriate, with a list of volatile organic compound- (VOC-) emitting materials from the California Environmental Protection Agency's (California EPA's) *Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air* (California EPA, 2005) for removal from the areas of the buildings selected for sampling at least 48 hours prior to collecting indoor air samples. Examples of these materials include cleaners, glues, fingernail polish remover, aerosol sprays, paint, dry-cleaned clothes, and tap water. The presence of these interfering sources may bias indoor air sample results or preclude detection of vapors from the subsurface. If any of these materials are identified and removed, we will request that the areas that are selected for sampling be ventilated for 24 hours, with the cessation of any ventilation activities at least 24 hours prior to the sampling event.

To conduct the Tier II sampling event, SLR will deploy two indoor air sampling six-liter Summa canisters in the most commonly occupied spaces within each of the two buildings (i.e. the areas where workers spend the greatest amount of time) in the portions of the buildings nearest the Subject Property. The actual sample locations will be determined based on interior layout and accessibility. The sampling canisters will be batch-certified as decontaminated and evacuated to a vacuum of 25 to 30 inches of mercury (in. Hg) by the laboratory, and will be equipped with eight-hour flow regulators to collect samples over the course of an eight-hour workday. The sampling event will be conducted on a day when the businesses are closed, if possible, but during the normal opening hours of the businesses. The flow regulator intakes will be set at a height of 4.5 feet above the floor, in the breathing zone of the workers. SLR will also deploy one indoor air sampling Summa canister at floor level with the intake valve facing down at the location of the floor drain in the Subject Property building to assess it for a potential vapor conduit and fate and transport associated with preferential vapor migration pathways.

Concurrent with the indoor air sampling, SLR will deploy one ambient air sampling canister outdoors in an upwind direction, away from the potential source of the contamination.

To collect the samples, SLR will open the valves on the flow regulators at a time corresponding with the beginning of a typical workday. Canister vacuum levels will be monitored during the sampling event to ensure that the flow regulators are working properly; hourly pressure losses greater than ten percent of the initial pressure will be considered evidence of a malfunctioning flow regulator. Malfunctioning flow regulators will be replaced, and sampling will resume. Upon completion of the eight-hour period or when the residual vacuum in the canisters is not less than 3 in. Hg, whichever comes first, the valves on the flow regulators will be closed. SLR will submit the indoor and ambient air samples to Friedman & Bruya, Inc. (F&B) in Seattle, Washington for analysis of select halogenated volatile organic compounds (HVOCs) by EPA Method TO-15, including TCE, tetrachloroethene (PCE), and vinyl chloride

3.3.2 SUB-SLAB SOIL VAPOR SAMPLING

SLR will conduct a Tier I sub-slab soil vapor sampling event at the four nearby properties identified in Section 3.2.1 above in accordance with Ecology's *Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action* (Ecology, 2009). SLR will install one soil vapor

sampling port (Vapor Pin) in the concrete slab floor of each of the four nearby buildings to allow for sampling the soil vapors beneath the buildings. The actual sample locations will be determined based on interior layout and accessibility. SLR will install the Vapor Pins by drilling a small-diameter hole in the concrete floor with a rotary hammer drill. Vapor Pin installation will be conducted in accordance with the manufacturer's instructions. The Vapor Pins will be installed at least one day prior to the sampling event in order to allow for equilibration of subsurface conditions.

On the day of the sampling event, a new, decontaminated, disposable three-way manifold will be connected to each vapor pin and a peristaltic pump will be attached to the purging valve on each manifold. A one-minute deadhead test will be conducted by using an extra Summa canister to apply vacuum to the sampling port on each manifold. If there is a loss of vacuum from any manifold it will be replaced, and the deadhead test will be repeated. Following the successful completion of a deadhead test, a six-liter Summa canister will be connected to the sample port on each manifold. The sampling canisters will be batch-certified as decontaminated and evacuated to a vacuum of 25 to 30 in. Hg by the laboratory and will be equipped with five-minute flow regulators to collect grab samples.

The soil vapors in each probe will be purged for a minimum of five minutes. The peristaltic pump will be used to extract soil vapors from the probe. While purging, the soil vapor probe will be further tested for leaks by using a tracer gas box placed over the probe. A calibrated helium detector with a range of 0 parts per million to 100 percent will be used to monitor the helium concentration within the box and in the purged soil vapors. Helium will be introduced into the tracer gas box and maintained at a concentration of at least 75 percent while the helium concentrations in the purged soil vapors are monitored. If helium is detected at any concentration in the purged vapors, the purging will be stopped and SLR will attempt to determine the source of the leak. If the leak cannot be repaired, the Vapor Pin will be reinstalled and the entire leak testing process will be repeated beginning with the one-minute deadhead test of the manifold.

After purging, the purging valve on the manifold will be closed, the peristaltic pump turned off, and then the sample valve and five-minute flow regulator will be opened to allow the Summa canister to extract a sample from the Vapor Pin. The valve on the canister will be closed when the residual vacuum in the Summa canister is not less than 3 in. Hg. The filled Summa canisters will be submitted to F&B for analysis of select halogenated volatile organic compounds (HVOCs) by EPA Method TO-15, including TCE, tetrachloroethene (PCE), and vinyl chloride.

3.3.3 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

SLR will follow applicable QA/QC procedures to ensure data quality and data integrity. A Washington-certified laboratory will be selected to analyze collected samples. Laboratories have robust QA/QC processes which include matrix spike samples and surrogate spikes, and a review of data to ensure compliance with standards and the integrity of the final results. This data and the field QA/QC processes outlined above will be reviewed, however, for this limited work scope a formal plan or validation report will not be required.

3.4 TASK 4: PREPARE TECHNICAL MEMORANDUM

SLR will prepare a Technical Memorandum describing the field activities and the indoor air, ambient air, and sub-slab soil vapor sample analytical results. The sample analytical results will be compared to the short-term action levels presented in Implementation Memorandum No. 22 and to the MTCA Method B sub-slab soil vapor and indoor air screening levels for residential and commercial exposure scenarios, as appropriate. The Memorandum will include: a description of each of the buildings, including SLR's observations of the conditions near the sample collection locations; tables presenting summaries of the laboratory analytical results as well as the appropriate screening levels for comparison; figures showing the sample locations and sample analytical results associated with each sample location; and copies of the laboratory reports. The Technical Memorandum will also present an evaluation of the risks associated with TCE exposure at each of the five properties being assessed. Finally, the Memorandum will present our recommendations for further actions as necessary.

4. REFERENCES

California Environmental Protection Agency, 2011. *Final Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air (Vapor Intrusion Guidance)*. October.

Washington State Department of Ecology (Ecology), 2016. *Draft Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action*, Publication no. 09-09-047. October 2009, Revised February 2016; Appendix Section C-1.

Ecology, 2020. *Request for Evaluation of Trichloroethene Risks at the following Site: Site Name: Town & Country Cleaners Bellevue*. October 7.

---------. 2019b. Implementation Memorandum No. 22, *Vapor Intrusion Investigations and Short-term TCE Toxicity*. October.

LIMITATIONS

The services described in this work product were performed in accordance with generally accepted professional consulting principles and practices. No other representations or warranties, expressed or implied, are made. These services were performed consistent with our agreement with our client. This work product is intended solely for the use and information of our client unless otherwise noted. Any reliance on this work product by a third party is at such party's sole risk.

Opinions and recommendations contained in this work product are based on conditions that existed at the time the services were performed and are intended only for the client, purposes, locations, time frames, and project parameters indicated. The data reported and the findings, observations, and conclusions expressed are limited by the scope of work. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, or the use of segregated portions of this work product.

The purpose of an environmental assessment is to reasonably evaluate the potential for, or actual impact of, past practices on a given site area. In performing an environmental assessment, it is understood that a balance must be struck between a reasonable inquiry into the environmental issues and an appropriate level of analysis for each conceivable issue of potential concern. The following paragraphs discuss the assumptions and parameters under which such an opinion is rendered.

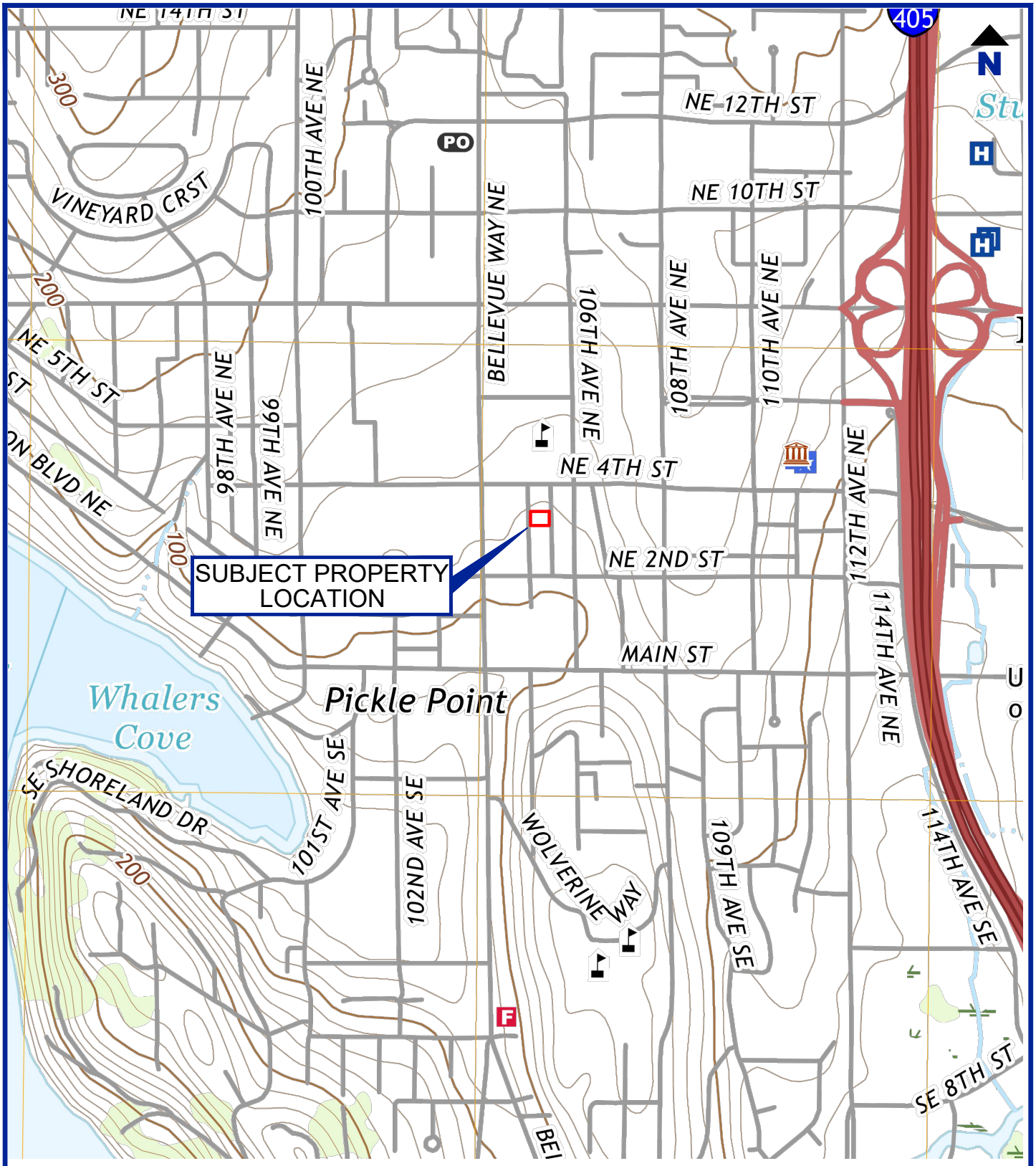
No investigation can be thorough enough to exclude the presence of hazardous materials at a given site. If hazardous conditions have not been identified during the assessment, such a finding should not therefore be construed as a guarantee of the absence of such materials on the site, but rather as the result of the services performed within the scope, practical limitations, and cost of the work performed.

Environmental conditions that are not apparent may exist at the site. Our professional opinions are based in part on interpretation of data from a limited number of discrete sampling locations and therefore may not be representative of the actual overall site environmental conditions.

The passage of time, manifestation of latent conditions, or occurrence of future events may require further study at the site, analysis of the data, and/or reevaluation of the findings, observations, and conclusions in the work product.

This work product presents professional opinions and findings of a scientific and technical nature. The work product shall not be construed to offer legal opinion or representations as to the requirements of, nor the compliance with, environmental laws rules, regulations, or policies of federal, state or local governmental agencies.

FIGURES



REFERENCED FROM : USGS 7.5 MINUTE QUARDRANGLE
<MERCER ISLAND, WA 2020>

LEGEND

LEGEND DESCRIPTION

0 1000 2000 3000'

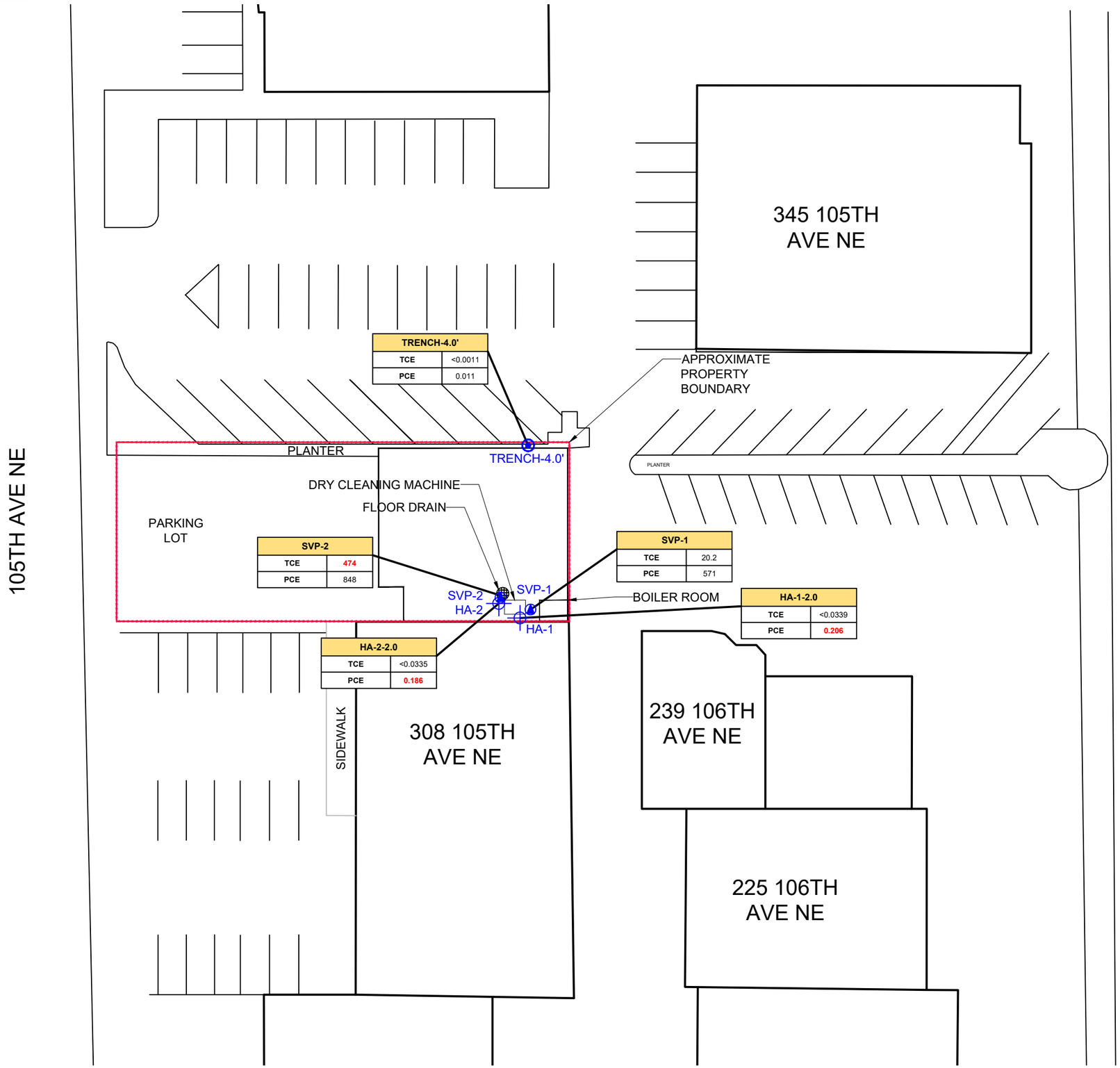
SLR

TOWN AND COUNTRY
CLEANERS 310 105TH AVE NE
BELLEVUE, WASHINGTON 98004

Drawing
SUBJECT PROPERTY LOCATION MAP

Date	February 11, 2021	Scale	AS SHOWN	Fig. No.	1
File Name	FIGURE 1	Project No.	101.02216.00001		

Drawing path: N:\Bothell\1 PROJECTS\Jennifer S. Cha LLC\Tier I and II Vapor Assessment Work Plan\DWG\FIGURE 1.dwg



LEGEND

- PROPERTY BOUNDARY
- FLOOR DRAIN
- SVP-1 — 2020 SLR SUB-SLAB SOIL VAPOR PIN LOCATION AND DESIGNATION
- HA-1 — 2020 SLR HAND AUGER BORING LOCATION AND DESIGNATION
- TRENCH-4.0' — 2020 SLR SOIL SAMPLE LOCATION AND DESIGNATION

TCE	TRICHLOROETHENE
PCE	TETRACHLOROETHENE
MTCA	MODEL TOXICS CONTROL ACT
mg/kg	MILLIGRAMS PER KILOGRAM
µg/m^3	MICROGRAMS PER CUBIC METER

SVP-2	
TCE	474
PCE	848

SAMPLE ID; SAMPLE RESULTS (µg/m^3 or mg/kg); ANALYTE

848 — SAMPLE **DOES NOT EXCEEDED** THE APPLICABLE MTCA CLEANUP LEVELS FOR RESPECTIVE CONTAMINANT

474 — SAMPLE HAS **EXCEEDED** THE APPLICABLE MTCA CLEANUP LEVELS FOR RESPECTIVE CONTAMINANT

NOTES

1. SITE MAP DEVELOPED AND REFERENCED FROM GOOGLE EARTH, 2019.
2. APPROXIMATE LOCATION OF FORMER INVESTIGATION LOCATIONS REFERENCED FROM EXPLORATION LOCATIONS AND ESTIMATED EXTENT OF PCE-IMPACTED SOIL, SOUND EARTH STRATEGIES (5/1/2019).
3. SOIL RESULTS ARE IN UNITS mg/kg. SOIL VAPOR RESULTS ARE IN µg/m^3.

N

SCALE: 1" = 30'
WHEN PLOTTED AT 11 x 17 PAGE SIZE
0 30' 60' 90'

THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. ACTUAL LOCATIONS MAY VARY AND NOT ALL STRUCTURES ARE SHOWN.

Site
TOWN AND COUNTRY CLEANERS
310 105TH AVE NE
BELLEVUE, WASHINGTON 98004

Drawing
PLAN VIEW OF PROPERTIES TO BE ASSESSED

Date February 10, 2021 | Scale AS SHOWN | Fig. No. 2
File Name 02-02 | Project No. 101.02216.00001

SLR

ATTACHMENTS

Electronic Copy

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
Northwest Regional Office • 3190 160th Ave SE • Bellevue, WA 98008-5452 • 425-649-7000
711 for Washington Relay Service • Persons with a speech disability can call 877-833-6341

October 7, 2020

Jennifer S. Cha
Town & Country Cleaners
310 105th Ave NE
Bellevue WA 98004
(jcharealty@gmail.com)

Re: Request for Evaluation of Trichloroethene Risks at the following Site:

- **Site Name:** Town & Country Cleaners Bellevue
- **Site Address:** 310 105th Ave NE, Bellevue WA 98004
- **Facility/Site No.:** 2319
- **CSID No.**: 1880

Dear Jennifer Cha:

Our records indicate that this Site is contaminated with trichloroethene (TCE), or with tetrachloroethylene (PCE) that can break down into TCE. TCE is a toxic organic chemical that can volatilize from contaminated soil or groundwater and potentially enter nearby buildings as a vapor. The presence of TCE in indoor air can result in health impacts to building occupants, the most urgent of which are to pregnant women. U.S. EPA has concluded that brief exposures to TCE in air may affect women in the first trimester of pregnancy by increasing the risk of heart malformations to a developing fetus.[1]

Ecology's Implementation Memo No. 22 titled "*Vapor Intrusion (VI) Investigations and Short-term Trichloroethene (TCE) Toxicity*" (attached) provides important information including indoor air action levels[2] (Section 4 – Table 1), as well as recommendations (Section 5) for determining whether environmental contamination is causing elevated levels of TCE in indoor air.

[1] See U.S. EPA, August 2014, Office of Solid Waste and Emergency Response Memorandum: Compilation of Information Relating to Early/Interim Actions at Superfund Sites and the TCE IRIS Assessment.

[2] The short-term indoor air action levels are higher than Ecology's long-term indoor air cleanup levels.

Based on concentrations of TCE in soil vapor at this Site reported to Ecology in August 2020, there is a possibility that concentrations of TCE in indoor air may exceed action levels. To protect human health, Ecology requests that:

1. Within 30 days from the date of this letter, you provide Ecology with any existing information regarding contamination at the Site that you have not already submitted.

2. Within 60 days from the date of this letter, you perform a vapor intrusion investigation and submit the results to Ecology, to determine whether environmental contamination at the site has resulted in TCE concentrations from vapor intrusion above the short-term indoor air action levels. Include recommendations on what actions, if any, are necessary to reduce TCE concentrations to below the appropriate short-term indoor air action level.

    - Your investigation is likely to include a combination of indoor air, outdoor air, and soil vapor sampling. In addition to the enclosed Implementation Memo, additional Ecology guidance on conducting vapor intrusion investigations is available online at https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Vapor-intrusion-overview .

    - Your soil vapor investigation should evaluate all buildings within 100 lateral feet of your property (parcel 0679000055), including:

        - 308 105th Ave NE (parcel 0679000060)
        - 345 106th Ave NE (parcel 0679000140)
        - 239 106th Ave NE (parcel 06790000125)
        - 225 106th Ave NE (parcel 06790000120)

    - If additional data has been collected that indicates a larger extent of subsurface contamination originating from your property, additional buildings may need to be added to this list.

Ecology's Next Steps

Depending on the site specific circumstances, Ecology may:

1. Continue to provide technical assistance as necessary for evaluating and/or remediating short-term TCE risks.

2. Notify appropriate local, state, or Federal health agencies to discuss possible health risks and any necessary public notifications.

3. Identify potentially liable parties and require additional remedial action pursuant to RCW 70.105D, such as: a) issuing an enforcement order or agreed order, b) pursuing an Ecology conducted cleanup with cost recovery, or c) seeking judicial review.

4. Pursue other options necessary to adequately clean up contamination at the site.

Contact Information

Ecology is committed to working with you to accomplish the prompt and effective actions necessary at the Site. If you have any questions about this request, please contact at me at 425-649-7257 (office), 425-324-1892 (mobile), or michael.warfel@ecy.wa.gov .

Sincerely,

Michael R. Warfel
Cleanup Project Manager
Toxics Cleanup Program, NWRO

Enclosure: Implementation Memo No. 22

cc: Kim Wooten, Ecology, (kim.wooten@ecy.wa.gov)

Vapor Intrusion (VI) Investigations and Short-term Trichloroethene (TCE) Toxicity

Implementation Memorandum No. 22

Date: October 1, 2019

To: Interested Persons

From: Jeff Johnston, Section Manager
Information & Policy Section
Toxics Cleanup Program

Contact: Policy & Technical Support Unit, Headquarters, Lacey, WA

Attachments: A - Response to comments on the November 21, 2018, review draft of this memo.

Accommodation Requests: To request ADA accommodation including materials in a format for the visually impaired, call Ecology at 800-826-7716. Persons with impaired hearing may call Washington Relay Service at 711. Persons with speech disability may call TTY at 877-833-6341.

Table of Contents

Acronyms and Abbreviations

Acronym or Abbreviation	Definitions
APU	air purification units
ATSDR	Agency for Toxic Substances and Disease Registry
CLARC	Ecology's Cleanup Levels and Risk Calculation data tables
COPC	contaminant of potential concern
CPF	carcinogenic potency factor
CSM	(vapor intrusion) Conceptual Site Model
DoD	United States Department of Defense
DTSC	California Department of Toxic Substances Control
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
HI	non-carcinogenic Hazard Index
HQ	non-carcinogenic Hazard Quotient
HVAC	heating, ventilation, and air conditioning
IRIS	EPA's Integrated Risk Information System
µg/l	micrograms per liter
µg/m³	micrograms per cubic meter
MTCA	Model Toxics Control Act
NAPL	non-aqueous phase liquids
QA	quality assurance
RCW	Revised Code of Washington
RfD	reference dose
RI	Remedial Investigation
RME	reasonable maximum exposure (RME) means the highest exposure that can be reasonably expected to occur for a human or other living organisms at a site under current and potential future site use
SAP	Sampling and Analysis Plan
SL	screening level
TCE	trichloroethene or trichloroethylene
TCP	Toxics Cleanup Program
Tier I	term used in Ecology's 2009 draft VI guidance to describe VI assessments employing subsurface (groundwater and soil gas) VOC measurements
Tier II	term used in Ecology's 2009 draft VI guidance to describe VI assessments employing indoor air VOC measurements
µg/l	micrograms per liter
µg/m^3	micrograms per cubic meter
VI	vapor intrusion
VOC	volatile organic compound
WAC	Washington Administrative Code

1.0 Purpose and Applicability

The purpose of this memorandum is to supplement the 2009 Draft Vapor Intrusion Guidance[1] produced by the Washington State Department of Ecology (Ecology) and provide recommendations pertaining to cleanup sites contaminated with trichloroethene (TCE).

Specifically, this memorandum:

1. Provides indoor air Action Levels that are protective of short-term exposures to TCE.

2. Provides the default (non-site-specific) subsurface vapor intrusion (VI) screening levels that are protective of the short-term indoor air TCE action levels.

3. Identifies options for effectively and rapidly responding to those situations where TCE concentrations caused by VI in indoor air are above action levels.

4. Establishes the goal to keep indoor air TCE concentrations (caused by VI) below short-term action levels at Model Toxics Cleanup Act (MTCA) cleanup sites in Washington state.

5. Provides guidance and recommendations for those scenarios where a) VI-caused TCE indoor air concentrations exceed, or may exceed, the short-term action levels, and b) the building being investigated is regularly occupied by female residents or workers of child-bearing age.

Unless otherwise specified, this document applies to any cleanup site where TCE is a subsurface contaminant of concern and a VI pathway is being, or should be, evaluated. This includes sites under direct Ecology oversight; sites where Ecology is responsible for the investigation and cleanup; and sites in the independent cleanup process. Although the memorandum refers in a number of instances to investigation and outreach activities that assume direct Ecology involvement at the site, when this is not the case (as noted in Section 5.2) the parties performing the site investigation and cleanup should independently complete the recommended steps outlined in the memorandum.[2]

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[1] *Draft Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action* (Ecology 2009): https://fortress.wa.gov/ecy/publications/SummaryPages/0909047.html.

[2] In later portions of the memorandum, we use the term "responsible party" to refer to the party who is conducting remedial actions at the site. In many cases the responsible party will be a person meeting the statutory definition of a "potentially liable person" (see RCW 70.105D.040).

WAC 173-340-200 of the MTCA rule defines the terms "cleanup," cleanup action," "interim action," and "remedial action." Remedial action (or "remedy") means "any action or expenditure consistent with the purposes of [MTCA statute] Chapter 7.0.105D RCW to identify, eliminate, or minimize any threat posed

NOTE: In some buildings, indoor workers are routinely exposed to elevated indoor air concentrations of volatile organic compounds (VOC) as part of a manufacturing or other business-related process. When the same VOCs are also present in subsurface contamination, these scenarios commonly pose difficulties to investigators who are attempting to quantify VI-only contributions to indoor air contamination. Another challenge: as long as manufacturing or other business-related processes result in indoor VOC levels much higher than those potentially caused by VI, the affected receptors will only minimally benefit from actions taken to curtail just the VI contributions.

Implementation Memorandum No. 22 does not provide guidance or recommendations for scenarios where business-related processes persistently contaminate the building's indoor air with TCE, and the resulting TCE concentrations significantly exceed any VI contributions. If this scenario is (or appears to be) present at the site, Ecology should be consulted before proceeding further with the VI evaluation.[3]

by hazardous substances to human health or the environment including any investigative and monitoring activities with respect to any release or threatened release of a hazardous substance and any health assessments or health effects studies conducted in order to determine the risk or potential risk to human health."

[3] See also Ecology's Implementation Memorandum No. 21: *Frequently Asked Questions (FAQs) Regarding Vapor Intrusion (VI) and Ecology's 2009 Draft VI Guidance* (Ecology 2018b), available at: https://fortress.wa.gov/ecy/publications/SummaryPages/1809046.html

2.0 How this Memo is Organized

When TCE is present in soils, groundwater, or soil gas, VI assessments should determine if indoor air concentrations exceed cleanup levels based on chronic exposure. Assessments should also, however, be designed to determine if indoor air concentrations are higher than action levels protective of toxic, non-cancer effects caused by short-term exposures to the chemical. This memorandum provides guidance and recommendations for such short-term exposure scenarios.

Section 3.0 provides background on the 2009 draft vapor intrusion guidance, and the major updates to the document since.

Section 4.0 identifies Ecology's short-term indoor air action levels. It also includes short-term TCE soil gas and groundwater screening levels, which are calculated to be protective of the indoor air action levels.

Section 5.0 discusses VI investigations at TCE sites, and outlines Ecology's expectations regarding assessments of possible short-term, indoor air TCE, action level exceedances.

Section 6.0 outlines Ecology's expectations regarding appropriate responses and response timeframes, when VI-caused indoor air TCE concentrations exceed action levels.

Section 7.0 describes notifications and other outreach-related tasks that responsible parties should perform at TCE sites where VI may be resulting in indoor air concentrations that exceed action levels.

3.0 Background

In 2009, Ecology prepared the draft VI guidance titled *Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action.* A public comment period in the fall of 2009 provided an opportunity for the public to review and give us feedback on the draft document. Although a number of public comments were received, Ecology did not formally respond to the comments or revise and finalize the draft guidance. Nevertheless, the draft VI guidance has been relied on by Ecology staff, environmental consultants, and others who are responsible for assessing VI and ensuring that indoor receptors are protected from VI-related air contamination.

Since 2009, parts of the draft guidance have been updated or otherwise superseded by TCP Implementation Memoranda. Specifically:

1. **Updated and revised VI cleanup and screening levels.** Tables in Appendix B of the 2009 draft guidance contained VI indoor air cleanup levels and soil gas and groundwater screening levels. In 2009, the indoor air cleanup levels in Appendix B corresponded to standard, WAC 173-340-750 Method B and C air cleanup levels, calculated with reference doses (RfDs) and/or cancer potency factors (CPFs) obtained at that time from IRIS and other Environmental Protection Agency (EPA) toxicity databases. Soil gas and groundwater screening levels were calculated to be protective of these indoor air cleanup levels.

   As of 2016, the Appendix B tables in the 2009 draft guidance are outdated and should not be relied upon. The VI indoor air cleanup and groundwater and soil gas screening levels in Ecology's Cleanup Levels and Risk Calculation (CLARC) data tables[4] replace the 2009 tables and should be used instead. The CLARC table values are based on the most current Method B and C air cleanup levels and, for sub-slab soil gas screening levels, an attenuation factor different (that is, lower) than the value used to generate the Appendix B tables.

2. **Updated and revised Ecology guidance related to petroleum VI (PVI) screening.** TCP Implementation Memorandum No. 14 (Ecology 2016) embodies new EPA recommendations for assessing sites where the only volatile subsurface contaminants of concern are those petroleum hydrocarbons that are associated with a fuel release. Implementation Memo No. 18 (Ecology 2018) also primarily applies to releases of petroleum-containing fuels. It establishes generic TPH air cleanup levels and

[4] Available at: https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Contamination-clean-up-tools/CLARC (Ecology 2018a)

corresponding soil gas screening levels. It provides additional guidance for developing PVI sampling plans for Tier I and Tier II, and discusses potential PVI threats to buildings that will be constructed in the future. These memoranda were specifically developed for sites where PVI is a potential concern.

3. **Developed frequently asked questions (FAQs) on whether specific portions of the 2009 draft VI guidance are still applicable.** TCP Implementation Memo No. 21 (Ecology 2018) answers a number of questions regarding technical and policy changes that have occurred since the draft guidance was issued.

Since Ecology's 2009 draft VI guidance was prepared, EPA has concluded that brief exposures to TCE may cause serious health problems.[5] Short-term inhalation exposures to TCE in indoor air have the potential to cause serious heart defects in a developing fetus. The damage can occur early in a pregnancy, possibly before the pregnancy is recognized.

While much of the draft 2009 guidance document is applicable to sites where TCE vapor intrusion is a possibility, there are several issues that are not considered in the draft guidance but should be evaluated, due to the potential for harm from short-term exposure. These issues are:

1. Response speed. Actions to protect a fetus from unacceptable TCE exposures should occur as rapidly as possible after discovering the contamination—that is, within days or weeks, depending on the likelihood and degree of potential exposure.

2. Focus on women of childbearing age (which includes pregnant women). The developing fetus is sensitive to the effects of short-term TCE exposure, and preventing harm to the fetus relies on reducing the mother's exposure.

3. Public outreach. Promptly contacting people who live and work near TCE contamination is crucial for three reasons: 1) to identify women of childbearing age; 2) to explain the potential health hazards to building occupants and, 3) if warranted by site-specific conditions, to obtain permission to access buildings for property-specific investigation and exposure-reduction activities. Whenever possible, outreach activities should be conducted in collaboration with public health departments.

This degree of urgency, and the need for more intensive outreach to specific individuals, is not typically required at most MTCA sites. These issues are further discussed in Sections 5 through 7, following the discussion of Ecology's recommended short-term TCE action and screening levels.

[5] *Memorandum: Compilation of Information Relating to Early/Interim Actions at Superfund Sites and the TCE IRIS Assessment* (USEPA 2014).

4.0 VI Screening and Action Levels for TCE

4.1. Indoor air action levels for TCE

Indoor air cleanup levels—which are used during Tier I and Tier II vapor intrusion assessments to determine whether further sampling, interim actions, or cleanup actions are indicated—are provided in the CLARC data tables.[6] These concentrations are the same concentrations as the standard cancer and non-cancer Method B and C air cleanup levels in CLARC's *Air* data tables.

Air cleanup levels for TCE are lower than indoor air action levels for short-term indoor exposures. Cleanup levels apply to long-term (at least one year) average air concentrations for the entire population comprised of all genders and ages. Short-term indoor air action levels, on the other hand, only apply to three-week average concentrations for women of childbearing age. The average indoor air TCE concentration due to VI over **any** three-week interval should not exceed the applicable action level.

VI indoor air cleanup levels for long-term TCE exposures, and action levels for short-term exposures to women of childbearing age, are provided in Table 1 below. The table's Indoor Air Cleanup and Action Levels are compared to average indoor air TCE concentrations that result solely from site-contaminated soil gas (that is, vapor) intrusion. In some cases, this will mean that contributions to indoor air measurements from non-VI sources, such as outdoor or indoor sources, will need to be distinguished from those due solely to subsurface sources.

The short-term Action Levels for TCE in Table 1 are based on values recommended by EPA Region 10 (December 13, 2012, memorandum) and EPA Region 9 (July 9, 2014 memorandum).[7] Region 10's 2012 memorandum states that, pursuant to an IRIS toxicological review, exposure to TCE can cause fetal cardiac malformations during a 21-day gestation window. To protect against the possibility of this occurring, the average concentration of TCE in residential indoor air should not exceed 2.0 µg/m^3 during any 21-day period of time in a given year. For commercial / industrial settings, where the receptors of concern are workers, indoor air TCE should not exceed 8 µg/m^3. The Region 9 memorandum identifies "accelerated" and "urgent response action levels" for residents and workers. The "accelerated" levels range from 2 to 8 µg/m^3; the "urgent" levels vary from 6 to 24 µg/m^3. The range of levels for both categories accounts for the varied lengths of time that receptors are expected to be exposed.

[6] Cleanup Levels and Risk Calculation (CLARC). https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx

[7] For the Region 9 and 10 memoranda, see: https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Vapor-intrusion-overview

Table 1. Vapor intrusion indoor air cleanup and action levels for TCE

Level of Concern	Concentration ($\mu g/m^3$)	Risk Basis
TCE Indoor Air Cleanup Levels Chronic (mean long-term air concentration for RME receptor)*		
Method B (unrestricted land use)	**0.37**	Cancer risk 1E-6
	0.91	Hazard quotient 1
Method C (industrial land use)	**6.3**	Cancer risk 1E-5
	2.0	Hazard quotient 1
TCE Indoor Air Action Levels Short-term (maximum 3-week mean concentration for women of childbearing age)		
Unrestricted (residential) land use	**2.0**	Noncarcinogenic effect based on 24 hours/day, 7 days/week
Workplace scenario (commercial or industrial)	**7.5**	Noncarcinogenic effect based on 45-hour work week

* These values are available in CLARC (Ecology 2018a).

A number of other EPA Regions and states, including Massachusetts, New Jersey, New Hampshire, Minnesota, Ohio, Alaska, and Connecticut, have also adopted short-term TCE levels and recommended responses. These levels and response timeframes vary.

Consistent with EPA Region 10, TCE Action Levels in Table 1 are intended for comparison to the highest VI-caused indoor air levels averaged over any 21-day period. Ecology recognizes, however, that the fetal health effects that potentially arise from a short-term exposure to TCE could possibly result from an exposure to action level concentrations over a period less than three weeks. As of the date of this memo, we do not know how short this period could be, or whether shorter periods would only be harmful if TCE concentrations were significantly higher than Action Levels. Therefore, while this memorandum advocates comparing our Action Levels to measurements (or estimates) of average 21-day concentrations, Ecology also recommends that, if any 24-hour or 8-hour measurements of average indoor air TCE concentrations exceed Table 1's Action Levels (for residents or workers, respectively), prompt action should be taken to either reduce those concentrations, or reduce the degree to which women of childbearing age are exposed. Ecology will revisit this recommendation as more information becomes available about health effects attributable to short-term TCE exposures.

Table 1 is limited to providing a residential short-term TCE indoor air Action Level and a short-term Action Level for commercial/industrial workers. The residential concentration is intended to protect women of childbearing age who reside in the building and are continuously exposed to indoor air contaminated by VI. The commercial/industrial Action Level is protective of women

of childbearing age who work full-time shifts up to 45 hours per week.[8] However, other women of childbearing age who occupy a building where VI is occurring may also be receptors of concern. For example, visitors to a building, part-time workers in a building, or students within a school building could potentially be exposed to contaminated indoor air over extended periods of time.

Table 1's short-term Action Levels should be used to determine whether prompt and protective actions like interim actions should be implemented (see WAC 173-340-430). **These Action Levels are not MTCA Method B or C air Cleanup Levels**. Furthermore, the MTCA regulations require that cleanup levels be established for one of two specific land uses: *unrestricted* or *industrial* site use.

4.2. VI short-term screening levels for TCE in groundwater and soil gas

CLARC's data tables also provide groundwater and soil gas screening levels that can be used to assess the potential VI threat posed by a subsurface source. As for the VI indoor air cleanup levels, these concentrations are based on chronic exposures. CLARC's groundwater screening levels are intended to be protective of corresponding indoor air cleanup levels, and assume there will be 1,000-times attenuation between groundwater VOC concentrations (in equilibrium with vapor concentrations) and indoor air levels. CLARC's sub-slab soil gas screening levels are also expected to be protective of indoor air cleanup levels. They assume there will be 33-times attenuation between soil gas VOC concentrations just below a building's slab and indoor air levels. (For further discussion on this, see the note box following Table 2 in this section.)

VI groundwater and sub-slab soil gas screening levels protective of short-term TCE indoor air action levels are presented in Table 2 below. These screening levels embody the same attenuation assumptions used to calculate the chronic subsurface screening levels provided in CLARC (as discussed above). In summary:

- The short-term VI screening levels for groundwater and soil gas are higher than CLARC's VI TCE screening levels, which are calculated for chronic indoor exposures.

- For residential buildings, the short-term screening level for groundwater is about twice as high as CLARC's chronic-based non-carcinogenic screening level (8 µg/l versus 3.8 µg/l, respectively), and approximately five times higher than CLARC's carcinogenic screening level (8 µg/l versus 1.6 µg/l).

[8] The protection this paragraph refers to is the protection of the developing fetus. Exposures to TCE can also, of course, potentially affect the health of women themselves. Indoor "protection" for the women themselves should be assessed using the indoor air cleanup levels in the CLARC data tables, not the short-term action levels.

- Similarly, the short-term screening level for TCE in soil gas is about twice as high as CLARC's chronic-based non-carcinogenic sub-slab screening level (67 µg/m³ versus 31 µg/m³), and a little more than five times higher than CLARC's carcinogenic sub-slab screening level (67 µg/m³ versus 12 µg/m³).

Table 2. Vapor intrusion subsurface screening levels for short-term exposures to TCE

Short-term TCE Subsurface Screening Levels	Concentration	Basis
groundwater (in µg/l)		
residential short-term VI Screening Level for groundwater	**8**	• TCE as a non-carcinogen • receptor of concern: women of childbearing age • residential indoor scenarios
non-residential short-term VI Screening Level for groundwater	**31** **1.**	• TCE as a non-carcinogen • receptor of concern: women of childbearing age • commercial/industrial workplace scenarios
soil gas (in µg/m³)		
residential short-term VI Screening Level for sub-slab soil gas	**67**	• TCE as a non-carcinogen • receptor of concern: women of childbearing age • residential indoor scenarios
non-residential short-term VI Screening Level for sub-slab soil gas	**250**	• TCE as a non-carcinogen • receptor of concern: women of childbearing age • commercial/industrial workplace scenarios

NOTE: The 2009 draft guidance differentiates between the amount of soil gas-to-indoor air attenuation that should be assumed for soil gas VOC concentrations that are located immediately below the building (like sub-slab), versus those concentrations that are at significantly greater distances below ground surface (called "deep"). CLARC's VI data tables also make this distinction. "Deep" soil gas screening levels in CLARC assume 100-times attenuation between soil gas VOC concentrations and indoor air levels.

However, EPA's *Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air* (USEPA June 2015) does not recommend that soil gas levels be assumed to attenuate more than 33 times, regardless of depth. As a result, Ecology is re-evaluating the appropriateness of a deep soil gas VI screening level that assumes more than

33-times attenuation. At the time this memo was published, we are not withdrawing the recommended deep soil gas VI screening levels in CLARC, but:

1. These levels should not be used to assess the potential for an indoor air exceedance of the short-term TCE action level, and

2. For other assessment purposes (such as assessing the potential for an exceedance of a chronic-based indoor air cleanup level) the requisite 15-foot or greater separation distance should be applied to the depth of the vadose zone between the building foundation (not the ground surface) and the deep soil gas measurement. The short-term TCE Screening Levels identified in Table 2—referred to as "sub-slab" and calculated with an attenuation factor of 0.03—may also be compared to deeper soil gas sample measurements.

5.0 VI Investigation

Ecology's 2009 draft VI Guidance should generally be followed when investigating and addressing TCE vapor intrusion. But as noted in Section 3.0 above, the draft guidance does not discuss short-term inhalation exposures to TCE. The following investigation recommendations refer specifically to sites where TCE is a potential VI concern.

5.1. Identify any site buildings where VI may potentially result in indoor TCE concentrations above the short-term action level.

NOTE: The discussion in Section 5.1 assumes that indoor air sampling for TCE has not been conducted. If indoor air has already been sampled, and indoor TCE concentrations due to VI exceed the applicable short-term action level, appropriate responses are described and discussed in Section 6. If indoor air was sampled and TCE concentration measurements were below the short-term action level, the VI assessment team should determine whether those measurements represent the highest 3-week average indoor TCE concentration. Please see Section 5.4.

Determining which buildings are a potential concern is commonly accomplished by mapping site areas where TCE is, or may be, present in soils or shallow groundwater. Buildings above or close to these areas can then be identified. In parts of the site where soils are contaminated with TCE, soil gas samples are typically collected and analyzed.[9] Ecology's 2009 VI Guidance, CLARC's VI soil gas Screening Levels, and Table 2's short-term soil gas Screening Levels above, can then be used to determine if VI could potentially result in indoor air cleanup level or action level exceedances (respectively) at nearby buildings.

Regardless of whether the potential subsurface VI source is contaminated soils or shallow groundwater, soil gas samples can be collected below or near a building, and the measured TCE levels can be used to determine the potential for an indoor exceedance of indoor air cleanup levels and/or action levels. However, if TCE concentrations in shallow groundwater are above CLARC's VI Screening Levels, or if significant soil contamination or residual non-aqueous phase liquid (NAPL) is close to a building and likely to contain elevated TCE concentrations, investigators should not delay indoor air sampling (see section 5.3). When these conditions are

[9] *De minimis* levels of TCE in vadose zone soils (i.e., above the seasonal low water table) are unlikely to pose a VI threat. WAC 173-340-740(3)(b)(iii)(C)(III) defines such levels as concentrations no higher than concentrations "derived for protection of groundwater for drinking water beneficial use under WAC 173-340-747(4)." Concluding that TCE levels in soils are this low requires adequate characterization of vadose zone contamination.

present, the first indoor sampling event(s) should be a site priority and performed immediately, without waiting for a preliminary soil gas investigation.[10]

In areas where soils are not contaminated and shallow groundwater is the only potential VI source, the 2009 draft VI guidance, groundwater VI Screening Levels in CLARC, and short-term groundwater Screening Levels in Table 2 can be used to distinguish between buildings where VI could potentially result in exceedances of indoor air cleanup (chronic) or action (short-term) levels, and those where exceedances are highly unlikely.

In addition to the exceedance of subsurface VI screening levels, there may be other building- or site-specific reasons for suspecting that indoor air TCE concentrations could exceed the short-term action level. For instance, at some building locations, contaminated shallow groundwater may be the only potential VI source and TCE concentrations in this groundwater may be below the short-term screening level. However, the short-term groundwater screening levels assume a certain amount of attenuation and dilution of vapor-phase TCE between the groundwater surface and the indoor environment. While these are conservative assumptions for most buildings, they may not be if:

- There are preferential subsurface pathways that may result in higher soil gas VOC levels below the building than the short-term groundwater screening levels assume, or if

- There may be a higher soil gas flowrate into the building than the short-term groundwater (and soil gas) screening levels assume.[11]

[10] Ecology does not recommend that soil gas sampling be initiated at this point to determine if TCE concentrations exceed short-term soil gas screening levels. This is because it takes time to prepare (and approve) soil gas SAPs; obtain access; schedule and mobilize the related work; and, review the sampling results. Indoor air sampling should not be delayed while these activities are being performed. During or immediately following the first indoor air sampling event, however, it is prudent to obtain soil gas data.

[11] The short-term groundwater Screening Levels assume that vapor-phase TCE concentrations will attenuate by a factor of 1000 between soil gas levels immediately above (and in equilibrium with) contaminated groundwater and indoor air. This is generally a conservative assumption, but may over-predict the degree of subsurface attenuation in certain cases. Ecology's 2009 draft VI guidance describes the conditions where this may occur (e.g., sites with a very thin vadose zone (shallow water table); the presence of subsurface conduits capable of transporting elevated soil gas levels to areas directly below the building with minimal attenuation; etc.)

The short-term soil gas Screening Levels assume that vapor-phase TCE concentrations will attenuate by a factor of at least 33 times between soil gas levels immediately below the building and indoor air. Again, this is usually a conservative assumption. However, less attenuation is possible if the building or its foundation allows soil gas to enter interior spaces relatively unimpeded (which may occur, for example, when slab or basement wall penetrations or large cracks provide preferential conduits for entry).

5.2. Notify and involve Ecology

This memorandum presumes that Ecology will be involved throughout the VI evaluation process, including owner/tenant notifications, the initial building visit, indoor air sampling, data analysis, and post-sampling decision-making described in the rest of this section and in Sections 6 and 7. We have therefore identified certain recommended actions and decisions below as being responsibilities of both the party conducting the remedial actions (the responsible party) and Ecology.[12] However, in those cases where the responsible parties are acting independently and choose not to involve Ecology during some or all of these actions and decisions, they should complete the applicable and recommended steps in this memorandum themselves.

Regardless of whether Ecology oversees the site throughout the cleanup process, or whether another party independently conducts the remedial actions:

1. Ecology should be contacted as soon as the responsible party determines that women of childbearing age are current building occupants and indoor air sampling is needed to assess the potential for a short-term TCE action level exceedance (see Section 5.3 below).

2. If an Ecology staff person has already been assigned to the site, this is the individual who should be notified. Otherwise, the responsible party should contact their local Ecology regional office. They should not wait for Ecology's response before moving to the next steps of the investigation / response process. Find Ecology's contact information at https://ecology.wa.gov/About-us/Get-involved/Report-an-environmental-issue

5.3. Prepare for indoor air sampling

As soon as one or more site buildings have been identified as a location where VI may potentially result in indoor air TCE concentrations above the short-term action level, investigators should quickly plan for the next assessment steps—unless they already know that women of child-bearing age do not regularly occupy the buildings. At this point in the investigation, it is only *potentially possible* that indoor TCE concentrations actually exceed the Action Level, but several actions should occur without delay: notify building owners/tenants, determine if exceedances are occurring, and – if needed – take actions to protect the potential receptors.

1. **Contact building owner and/or tenant.** The owner/tenant of the building should be contacted to determine if women of childbearing age are current occupants, and to schedule a building and property visit. This initial contact should occur soon after the

[12] Please see footnote in Section 1.0 regarding use of the term "responsible party" in this memorandum.

building has been identified as potentially at risk. The owner and tenant(s) of these buildings should be notified that there is the *possibility* that VI-caused indoor air TCE concentrations exceed the acceptable chronic and/or short-term screening/action levels.

2. **Schedule a building visit.** If women of childbearing age are current building occupants, a building visit should be scheduled as soon as possible. During this visit Ecology and the responsible party will need to be prepared to discuss the potential TCE risk, explain how we would like to proceed, and answer exposure-related and other questions.[13] If the responsible party does not own the building, they should also be prepared at this time to request building access for the purpose of collecting indoor air samples. Interactions with building owners and tenants during the period preceding indoor air sampling are further discussed in Section 7.0 below.

3. **Prepare and finalize a SAP.** Following the visit to the building and property, an indoor air Sampling and Analysis Plan (SAP) should be expeditiously prepared, reviewed, and finalized.[14] The SAP should include a site/building-specific VI conceptual site model (CSM) that serves as the basis for the selection of data quality objectives and sampling design. The VI CSM, as discussed in our draft 2009 VI guidance document and in Section 5.4 of EPA's 2015 *Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air* (USEPA June 2015), is a combination of information, assumptions, and hypotheses that investigators use to support evaluations of the adequacy of available site-specific information, and guide the identification of critical data gaps.

4. **Schedule indoor air sampling.** After SAP finalization the first indoor air sampling event should be immediately scheduled. It should not be delayed to coincide with more desirable seasonal or meteorological conditions.[15]

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[13] Please see Section 7.1's discussion of VI-related risk communications.

[14] This assumes that: a) an exceedance of the short-term TCE indoor air action level has not yet been measured, and b) the responsible party has decided not to pursue a "preemptive" response action. If an exceedance of the action level has already been measured, no additional pre-mitigation sampling may be needed. See Section 6.0 for a description of appropriate response actions.

Preemptive mitigation is a term often used to describe VI mitigation efforts implemented without (or prior to) confirmation that VI-caused indoor air contamination exceeds acceptable levels. When preemptive mitigation has been chosen as the next step in Section 5.3, indoor air sampling is not typically conducted until after mitigation has been implemented. See Section 7.8 of EPA's OSWER VI guidance document (USEPA June 2015) for additional information about preemptive mitigation.

[15] The SAP should acknowledge the time-related considerations associated with determining if a short-term action level is being exceeded, and propose the respective timeframes and due dates for obtaining and reviewing data.

5.4. Determine if 3-week average indoor air TCE concentrations exceed the short-term action level.

For those buildings occupied by women of child-bearing age, the VI investigation should provide sufficient information to determine whether 3-week average indoor air TCE concentrations ever exceed the short-term action level. This is unlikely to be evident from a single indoor air sampling event unless that event coincides with a period when maximum VI impacts are occurring. Because VI impacts can vary significantly over time, and because this variability cannot be easily predicted, it is essentially impossible to schedule an indoor sampling event that can be confidently assumed to coincide with, or otherwise represent, the highest 3-week average VI impact on air quality, unless the sampling program is designed to intentionally create near-maximum VI conditions.[16] Unless TCE concentrations measured during the first sampling event exceed the short-term indoor air action level, often the investigation will require multiple sampling events.

This memorandum does not provide indoor sampling guidance. For recommendations related to sampling methodologies, please refer to:

- Ecology's Implementation Memorandum No. 21 (Ecology 2018)
- Relevant portions of the Tier II discussion in Ecology's 2009 draft VI guidance
- Section 6.4 of EPA's VI guidance (USEPA 2015)
- Recent state guidance documents, such as New Jersey's *VI Technical Guidance* (NJDEP 2018).

When the receptor of concern is a current occupant of the building, and air samples are being analyzed at an off-site laboratory, expedited turn-around times should be requested. For at least

[16] Generally, this is accomplished by inducing significant building depressurization just prior to the sampling event. Various degrees of depressurization, as well as positive pressurization, are typically induced to track indoor air concentration responses. (DOD 2017, McHugh 2017, and Johnson 2016.) The building depressurization methodologies that have utilized a blower-door approach, and have been subsequently described in the literature, can successfully meet project objectives. However, the methodology: a) is likely to be more successful at smaller and simpler buildings (architecturally, and in terms of interior design), and b) should not be assumed to result in higher, VI-caused, indoor air concentrations once significant depressurization has been achieved.

Even when conditions conducive to relatively extreme VI impacts are not intentionally created, they may fortuitously occur during a sampling event. That is, significant building depressurization may be "naturally" occurring during any given sampling event and this degree of depressurization may correspond to *worst case*-type VI-caused indoor air concentrations. At many sites and site buildings this often coincides with periods when indoor air temperatures are much higher than outdoor temperature. Continuously measuring pressure differentials of cross-slab or cross-first floor (for buildings with crawlspaces) throughout the indoor air sampling event can provide measurements that demonstrate the degree of building pressurization relative to the subsurface during the event. These measurements can be recorded regardless of the air sampling methodology used (such as canisters, passive diffusive samplers, or more real-time measuring devices).

the first sampling event, the goal should be to receive the laboratory's sampling data within three business days.

Immediately after the data have been received, they should be initially reviewed by the receiver and shared with other members of the decision-making team (such as the Ecology site manager,[17] if the responsible party's consultant receives the laboratory data). For at least the first indoor air sampling event the goal should be to share these results with the decision-making team within seven days from the time of sample collection. The objective of the decision-making team's review is to then determine, as soon as possible, if: 1) the relevant TCE short-term indoor air Action Levels listed in Table 1 are being exceeded, and 2) VI is the likely cause.

The immediate review, and the decisions arising from that review, will not have the benefit of a sampling-data quality assessment or validation. These activities will typically occur later, when the results of the sampling event are being integrated into some form of VI evaluation report. It is possible, then, that a later assessment of data quality will lead to a conclusion that VI is *not* causing short-term indoor air action level exceedances, and that the earlier determination was incorrect. However, if the receptors of concern are current occupants of the building, the importance of providing timely information to those receptors should outweigh the potential that the information provided might later need to be revised.

It should also be emphasized that this section (Section 5.0) is specifically devoted to recommendations related to the potential for short-term inhalation exposures to TCE. As discussed in Section 4.0, CLARC's VI Indoor Air Cleanup Levels for TCE are lower concentrations than action levels established to be protective of short-term indoor exposures. This is because the Indoor Air Cleanup Levels in CLARC are based on chronic VI-caused exposures. Remedial actions such as VI mitigation may therefore be needed to protect long-term indoor exposures, regardless of whether the short-term indoor air TCE action level is exceeded.

[17] If an Ecology site manager has not been assigned to the project, the results should be sent to the designated Regional contact.

6.0 Responding to Exceedances of the Short-term TCE Indoor Air Action Level

If VI is causing an exceedance of the TCE short-term indoor air action level, prompt action is needed. Such actions should be taken in consultation with the building's owner (and tenant, if applicable). Protecting people inside affected buildings is a high priority and any needed action should not be delayed. If additional, follow-up indoor air or other sampling is scheduled before the selected action is fully implemented, this sampling must be conducted in a manner that does not interfere with efforts to quickly and effectively reduce indoor exposures to TCE.

Systems for mitigating vapor intrusion

VI *mitigation* generally refers to actions whose purpose is to reduce VI-caused indoor air contamination, and these actions often focus on reducing the amount of contaminated soil gas entering the building.[18] Mitigation systems creating **depressurization** of the sub-slab zone or crawlspace will often be the most effective approach for reducing VI impacts (until subsurface cleanup permanently remediates the source of elevated soil gas concentrations). However, these types of mitigation, which are intended to minimize entry of contaminated soil gas into the building, can take weeks to design, construct, and fully implement. Additional time is then needed to demonstrate that target VOC concentrations in indoor air have actually been achieved.

Active VI mitigation systems such as sub-slab and sub-membrane depressurization are often able to reduce VI-caused TCE indoor air contamination to concentrations below the short-term action levels. But before the mitigation system has been successfully implemented, TCE concentrations will, or may, be above these levels. If a woman of childbearing age lives or works in an area of the building where elevated TCE concentrations are present, and does not re-locate, she will continue to be exposed to them. Mitigation should therefore be designed and implemented as quickly as possible,[19] and other actions should be considered that would effectively reduce exposures during the interim.

[18] Subsurface remediation, on the other hand, includes cleanup actions designed to reduce soil gas VOC levels. Although these actions will also reduce VI-caused indoor air contamination, they are not typically referred to as VI "mitigation" unless they can be implemented (and are successful) within a relatively short timeframe.

[19] The mitigator who will likely perform the work should be identified early (e.g., during the investigation's planning phase). His/her availability for constructing the mitigation system, if needed, should also be verified at this early stage.

EPA-recommended actions and MTCA cleanups

Prompt actions to reduce TCE exposures include the recommended responses described in EPA Region 9's 2014 TCE Memorandum under two headings: "Implementation of early or interim measures to mitigate TCE inhalation exposure," and "Tiered response action" (USEPA 2014). Many of the recommendations in these sections of the Memorandum are appropriate to use as a guide for selecting proper response actions in Washington state. However, three of Region 9's recommendations should be clarified in terms of their applicability at MTCA cleanup sites:

1. The recommendation to increase building pressurization/ventilation.

Positively pressurizing the building (with respect to the subsurface) can create a pressure barrier to advective flow of soil gas into the structure and mitigate VI impacts. However, it will not always be possible or sufficiently effective. Likewise, increasing ventilation can dilute VI impacts if the outdoor-to-indoor air exchange rate is increased. But it may not be practicable to increase the ventilation rate enough to reduce indoor air TCE below screening/action levels. Moreover, if the methods to increase the outdoor-to-indoor air exchange rate result in greater building depressurization, VI impacts may actually be exacerbated.

NOTE: At some buildings the owner/tenant may be able to quickly adjust HVAC settings to create these pressure or ventilation rate conditions. However, unless follow-up monitoring of indoor air quality is performed, there is no way to tell if TCE concentrations have been reduced to an acceptable level.

2. The recommendation to seal potential conduits.

It is possible that a single foundation or building feature is primarily responsible for the degree of vapor intrusion, leading to short-term indoor air TCE action level exceedances. For instance, there could be an uncovered earthen floor in part of the building. There could be an uncovered/unsealed basement, or a first floor sump or (disconnected) floor drain. There could be unsealed utility line penetrations at ground level or sub-grade. If the building has a crawlspace, there could be relatively large and unsealed first floor openings around pipes or wiring that run between the two levels. The crawlspace could also be walled-in, preventing any significant sub-floor ventilation and dilution of soil gas emissions.

Often, however, it won't be obvious where the most significant soil gas entry points are located. For this reason, conduit sealing measures are commonly combined with more effective mitigation actions.

In terms of the prompt action needed to respond to TCE action level exceedances, Ecology recommends that sealing efforts be:

a) Focused on any easily observable and obvious major routes by which soil gas is likely entering the building;
b) Only undertaken as the initial response if the sealing activity can be completed quickly; and
c) Promptly followed up with indoor air sampling to verify the sealing's effectiveness.

3. The recommendation to respond differently, based on whether the "urgent" response action level has been exceeded.

The EPA Region 9 Memorandum states that the response to exceeding an "accelerated" action level should be "completed and confirmed within a few weeks." If the higher "urgent" action level is also exceeded, the response time should be reduced to "a few days."

Ecology agrees that, all else being equal, there should be a greater sense of urgency when TCE concentrations are much higher than the short-term action level established for the site and building. It is also true that the types of responses likely to be effective will often partly depend on how high the indoor air TCE concentrations are. But Ecology believes any exceedance of the short-term action level merits prompt action. This means that once an exceedance is apparent, the site team should quickly decide on the preferred response action, and then immediately propose this action to the building's owner/tenant.

If VI is causing an exceedance of the TCE short-term indoor air action level, the action to be taken should be quickly determined in consultation with the building's owner (and, if applicable, the tenant). The goal should be to reduce TCE exposures for women of childbearing age as soon as possible. This may require that a "stop-gap" response be taken right away, while plans for long-term mitigation proceed on a parallel track. Stop-gap responses include actions such as temporarily relocating the receptor, and installing effective indoor air treatment.

Carbon-based indoor air VOC treatment devices (sometimes referred to as air purification units [APUs] or "air cleaners") can be installed relatively quickly. These devices can be used for extended periods, but their typical, or niche, VI application is temporary use. Often they are operated only while a more permanent form of mitigation is being designed/constructed. As discussed in EPA's 2017 *Engineering Issue*, which describes these devices, indoor air treatment can be accomplished with portable air cleaning units or HVAC in-duct systems (USEPA 2017).

The former usually employs a built-in air circulation fan and sorbent bed, with carbon serving as the sorbent.

Indoor air treatment devices may or may not be able to quickly reduce TCE concentrations to acceptable levels within certain airspaces. Regardless of the treatment device selected, it cannot be assumed that the installed units will *sustainably* reduce indoor air TCE to concentrations below the short-term action level. As noted in EPA's 2017 *Engineering Issue*, this must be confirmed with air sampling.[20]

[20] In the EPA 2017 *Engineering Issue* discussion of treatment systems, Attachment A lists a large number of VOC air cleaners by brand name. In 2014, California's DTSC reported use of Air Rhino and AirMedic Vocarb stand-alone air purifiers. The New Hampshire Department of Environmental Services and Massachusetts Department of Environmental Protection reported use of portable Austin HealthMate units in 2015 and 2016, respectively. (See "TCE Vapor Intrusion Case Study" presented at the 2015 NEWMOA conference, http://www.newmoa.org/events/event.cfm?m=157 and the October 2016 Field Assessment and Support Team (FAST): "An Expedited Approach to the Investigation and Mitigation of the Vapor Intrusion Pathway.").

Ecology does not endorse these particular products. We are including these references only to indicate that the products have been used in at least three states to reduce VI-caused indoor air contamination.

7.0 Working with people who are affected by vapor intrusion

This section, as well as Sections 5.0 and 6.0, discusses interactions with the owners and occupants of buildings where vapor intrusion is, or may be, contaminating indoor air with TCE. In the simplest case, the building is a single-family residence owned by the occupants. The responsible party and Ecology are then interacting primarily with a head of household. But various other scenarios are common, such as:

a. The building may be a single-family residence that is owned by someone who resides elsewhere.
b. The building may be occupied by a single business, which also owns the property.
c. The building may be occupied by a single business, which does not own the property or building.
d. The building may be occupied by multiple businesses, none, or only one, of which owns the property or building.

In some cases, the property where the building is located will be owned by the responsible party; in other cases, not.

Throughout this memorandum, we've used the term "building owners/tenants" when referring to notifications, access requests, information sharing, and other interactions with the affected public. We use this term for economy and simplicity, but recognize that owners are not always building occupants and receptors, and building occupants are not always owners or tenants. Women of childbearing age who occupy a building could be owners, tenants, employees or other workers, students, or visitors.

For communication purposes, it is helpful for the responsible party and Ecology to have no more than two designated "building contacts." Communications about scheduling building visits, obtaining access, sharing sampling data and data evaluations, and consultations concerning any response actions, can then be limited to a small number of individuals (who may or may not be potential "receptors"). It will be incumbent upon these building contacts to not only disseminate the information they receive from the responsible party and Ecology to (other) building occupants who are potentially being exposed, but to relay those occupants' concerns and questions back to us.

7.1. Outreach before indoor air sampling

As discussed in Section 5.1, any site buildings where VI may potentially result in indoor TCE concentrations above the short-term action level should be identified based on subsurface sampling and other site data. When such a building is identified and women of childbearing age are occupants, the planning, notification, and pre-sampling activities described in Section 5.3 should be performed. This includes a visit to the building itself.

In addition to obtaining the building and receptor-behavior information usually needed to prepare a VI indoor air SAP, during building visits Ecology and the responsible party should:[21]

1. Verify whether women of childbearing age regularly occupy the building. If they do (especially for non-residential buildings) the areas where these women spend most of their time, and the hours they are typically present in the building, should be ascertained.

2. Determine if women of childbearing age may be occupants in the foreseeable future, even if they're not currently present.

3. Discuss site contamination and how vapor intrusion can potentially contaminate indoor air; discuss what we propose to do next and the need for sampling access; answer their questions.

During the building visit, Ecology and the responsible party will need to be prepared for questions the occupants may have regarding potential short-term (and long-term) TCE health effects and how to reduce their exposures. Decisions should be made during the planning period (described in Section 5.3) about how and when this information should be provided, and who should communicate it.

Ecology staff are expected to only answer the most basic health-related VI questions. In general, the public should routinely be referred to local health departments or family physicians for the answers to questions that require toxicological or medical expertise.

Washington's state and local health departments are generally more familiar with local communities and their concerns than Ecology site management staff. Health departments also have more expertise at conveying health-related information. If women of childbearing age are potentially exposed to site-related TCE contamination, it is recommended that site managers and

[21] As noted in Section 5.2, this memorandum assumes Ecology will be involved throughout the VI evaluation process. When this is not the case, parties performing the site investigation and cleanup should independently complete the recommended steps outlined in this memorandum.

the responsible party rapidly coordinate with state/local health departments. These agencies can better explain potential health hazards to building occupants and/or help gain access to buildings for investigation and remediation if needed. If Ecology has assigned a Community Outreach and Environmental Education Specialist (COEES) to the site, the site manager should additionally confer with this individual during the pre-sampling period.[22]

Before any indoor air sampling can occur, the party performing that sampling must obtain the owner's/tenant's consent.[23] Typically during VI investigations, this consent is documented in an "access agreement," which also usually specifies the conditions under which access is granted. Finalizing an access agreement can occasionally be a lengthy process for various reasons. Sometimes it is difficult to make timely contact with the building owner or tenant. Sometimes the owner will elect to get the advice of legal counsel before entering into an agreement. There can be protracted negotiations regarding considerations such as access-related payment, or other site-specific issues. While securing access is normally the duty of the responsible party, Ecology may become involved with disputes or delays when the health threat relates to a short-term exposure to site contamination. The parties must realize that Ecology will make best efforts, including—if needed—exercising its legal authorities, to ensure access agreements are finalized as soon as possible.

7.2. Outreach after indoor air sampling

Indoor air sampling results, together with other lines of evidence, should indicate whether VI is causing an exceedance of the TCE short-term indoor air action level. Once the indoor air sampling data have been received from the laboratory (assuming no "real time" sampling was performed), the responsible party and Ecology should 1) discuss the results, 2) make a preliminary decision as to whether VI is likely to be resulting in a TCE short-term action level exceedance, 3) agree on next steps, and then 4) contact the building owner/tenant.

As discussed in Section 5.4, when women of childbearing age are current occupants of the building, this decision-making and outreach process should begin as soon as the data are initially received, without waiting for data quality assessment. In these cases the goal should be to quickly determine the likelihood of a TCE short-term indoor air action level exceedance and then inform building owners/tenants of the sampling results. Unless owners, tenants, and other

[22] Ecology's COEESs are typically not assigned to independent cleanup sites, including those in the Voluntary Cleanup Program (VCP). However, if a COEES has been assigned to a site where VI is causing, or may potentially result in, indoor TCE concentrations above the short-term action level, their assistance can improve communications with the owners, tenants, and occupants of the affected buildings (as well as other members of the concerned public).

[23] With limited exceptions, such as emergency situations.

concerned building occupants would prefer to wait until the quality of sampling data has been rigorously assessed and validated, they should be notified of sampling results soon after the results arrive from the laboratory.[24]

The responsible party and/or Ecology should tell the building owner/tenant what the sampling results indicate and what (at that time) the next steps should be. During this discussion, it is important to:

1. Explain how we have reached our conclusions.

2. Honestly differentiate between what is known (e.g., the results from this single sampling event), what we have inferred from the information we have collected, and what is not known, and

3. Urge the owner/tenant to share and explain these results–as well as plans for follow-up actions–with concerned building occupants. This includes all women of child-bearing age who live or work in affected portions of the building.

Coordinating with the site's assigned COEES and state/local health departments is critical at this stage and can improve the effectiveness of these communications.

If sampling data indicate that VI is likely to be causing an exceedance of the TCE short-term indoor air action level, and if a woman of childbearing age is a building occupant, the proper response should be quickly determined in consultation with the building's owner (and tenant, if applicable). Section 6.0 of this memo refers to various response actions that may apply. The selected action will depend on a number of building-specific factors, such as how high the indoor air TCE concentrations appear to be, and the preferences of the building's owner/tenant and receptors of concern. Promptly reaching, and carrying out, a mutually acceptable decision may require the involvement of state/local health departments.

If measured levels of indoor air TCE are below the action level, however, the next proposed step may simply be to schedule a re-sampling event for the future.[25]

[24] When the data are shared this quickly, the building occupants should be informed of the possibility that the implications of the sampling results could change following evaluation of the data quality. Should this occur, the owner/tenant would then be immediately notified by the responsible party and/or Ecology.

[25] Typically, a sampling report is prepared after the data have been quality assured (QA'ed) and validated. A copy of the report, and a copy of any Ecology response letter(s), should usually be provided to the building owner/tenant.

8.0 References

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Attachment A

Response to comments on the November 18, 2018, review draft of Implementation Memo No. 22: *Vapor Intrusion (VI) Investigations and Short-term Trichloroethene (TCE) Toxicity*

A public comment period was held from November 21, 2018, through January 7, 2019, for the review draft of this document. The comments received during that period helped inform modifications made to the final version of the document (dated October 1, 2019) and are summarized below. A number of editorial changes were also made to the review draft that are not reflected in this response to comments document.

1. Comments regarding the Environmental Protection Agency's (USEPA's) 2014 Memorandum: *Compilation of Information Relating to Early/Interim Actions at Superfund Sites and the TCE IRIS Assessment*, and the discussion of short-term inhalation exposures to TCE in Section 3 of Ecology's Implementation Memorandum 22. In particular, a commenter suggested clarifying in the third-to-last paragraph of this Section that the reference to EPA's 2014 Memorandum has limited applicability to certain statements made in later portions of the paragraph.

Response – To better distinguish the citation to EPA's 2014 Memorandum and that document's content from later statements in the paragraph, Ecology has made changes to the language in this part of Section 3.0, and removed the last sentence contained in the draft version of the third-to-last paragraph.

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2. Comments regarding Section 4 of Implementation Memorandum No. 22, and in particular:

a. The use of different default exposure assumptions–and different screening values–than used by EPA Region 9; and
b. Distinguishing between receptors of concern (women of child-bearing age versus the developing fetus).

Response – Implementation Memorandum No. 22's indoor air TCE action levels, listed in Table 1 of the document, are based the assumptions that a woman carrying a developing fetus could be exposed to indoor air TCE concentrations:

a) In a home for 24-hours per day, every day of the week throughout the year; and,
b) In the workplace for 45-hours per week, 260 days per year.

EPA Region 10's December 13, 2012, Memorandum, which served in part for the action levels we selected, recommends levels of 2 µg/m3 for residential settings and 8.4 µg/m3 for commercial/industrial settings. Ecology chose the same residential value for Implementation Memorandum 22. For the commercial/industrial action level, however, we opted to assume an additional five hours of weekly exposure. For this reason our commercial/industrial action level (7.5 µg/m3) is 12.5% lower than Region 10's corresponding level.

The commenter is correct that when Implementation Memorandum No. 22 refers in Section 4.1 to the protection of women of childbearing age against unacceptable short-term TCE exposures, our concern is for the developing fetus. The short-term action level concentrations cannot be assumed to be sufficiently protective of the woman herself. Ecology has therefore made changes to the third-to-last and second-to-last paragraphs of Section 4.1 to better clarify the action levels' applicability.

Since the close of the public comment period, other changes were made to Implementation Memorandum No. 22 based on comments received from Seattle & King County Public Health and Ecology's Toxics Cleanup Program. Among the substantive changes:

(1) Language was added to Section 3.0 to clarify that the "focus on women of childbearing age" includes pregnant women; and

(2) Language was added to Section 1.0 – similar to the statements in Section 5.2 – noting that when Ecology is not directly involved in the management of a cleanup site where TCE is a contaminant of concern, the parties performing the site investigation and cleanup should independently perform the Memorandum's recommended steps; and

(3) Language was added to Section 7.0 noting that Ecology's Community Outreach and Environmental Education Specialists (COEESs) are typically not assigned to independent cleanup sites, including those in the Voluntary Cleanup Program (VCP).