PNG ENVIRONMENTAL, INC.

MEMORANDUM

To:	Steve Teel, Department of Ecology
From:	Craig Hultgren and Paul McBeth
Date:	January 19, 2012
Subject:	Sampling and Analysis Plan for Expanded Area-Wide VIA - Former Milton's Dry Cleaners

PNG Environmental, Inc. (PNG) is conducting both area-wide and focused site specific vapor intrusion assessment (VIA) activities at selected properties in the broader study area as part of the ongoing Remedial Investigation/Risk Assessment/Feasibility Study (RI/RA/FS) at the Milton's Dry Cleaner (Milton's) site located in Vancouver, Washington (Figure 1). This work is documented in several previous sources (PNG 2009a, PNG 2009b, PNG 2010a, PNG 2010b, PNG 2011a, and PNG 2011b). Specific objectives for the RI/RA/FS are described in the Draft RI/RA/FS Work Plan (PNG 2007). Specific objectives of the VIA component of the RI are described in the Revised VIA Work Plan (PNG 2010c). Shallow groundwater plume characterization is summarized in Geosyntec Consultants, Inc.'s (Geosyntec) most recent groundwater report (Geosyntec 2011).

The Revised VIA Work Plan includes PNG's RI/RA/FS Sampling and Analysis Plan (SAP) and Quality Assurance Program Plan (QAPP). The supplemental VIA activities described below involve an expansion of the area-wide soil vapor investigation and will be performed in accordance with these plans. This work is being conducted under Agreed Order No. DE4239 07/4-TC-S between Ms. Lila Rears/Mr. Pat Milton and the Washington State Department of Ecology (Ecology). As agreed, PNG is performing VIA activities as Ms. Rear's consultant and Geosyntec is performing groundwater characterization and monitoring activities as Mr. Milton's consultant.

SAMPLING AND ANALYSIS PLAN

Previous investigation activities in the vicinity of the former Milton dry cleaner have identified a soil vapor plume consisting of tetrachloroethene (PCE) and trichloroethene (TCE) related to PCE releases from the facility. The source of these vapors includes PCE in soil in the immediate vicinity of the Milton property and a shallow water table aquifer plume that extends downgradient to the southwest. Water table plume and soil vapor concentrations for PCE and TCE in the study area are illustrated on Figure 2. The groundwater plume appears centered around the south end of the Milton's building and attenuates rapidly to below detection limits within 600 feet to the southwest (i.e., with the exception of low-concentration outlier data points along the groundwater flow path). The vapor plume correlates with the water table plume and attenuates to below 100 ug/m^3 within 1,000 feet to the southwest. There are no vapor data points to the east, north, or west of the Milton building to bound the vapor plume; however, water table plume data suggest the plume should attenuate rapidly in these directions unless another vapor source is present. To the west, Geosyntec has reported the shallow aquitard is not present to the extent necessary to support a perched, shallow aquifer. In this direction, the intermediate zone plume would represent a potential source for vapor intrusion. PNG expects the depth to groundwater combined with presence of fine grained horizons at the typical depth of the shallow aquitard will provide attenuation and a barrier for intrusion in this location.

The objective of the proposed VIA activities presented below is to attempt to characterize the bounds of the vapor plume in the Milton's site area through assessment of vapor concentrations overlying the shallow aquifer to the east and north and intermediate aquifer to the west A description of tasks included in this area-wide VIA SAP is provided in the following sections.

Access Agreements

As illustrated in Figure 2, PNG has negotiated access agreements with several private property owners during previous RI site investigation tasks. Several of the proposed temporary borings are located near private properties with which PNG has not negotiated formal access agreements. Due to the uncertainty of gaining formal access to these private properties, proposed borings in these areas will be situated in City of Vancouver Right-of-Ways (ROWs). As indicated below, PNG will acquire a ROW permit from the City of Vancouver, Washington to drill temporary borings on NE 66th Street, NE 62nd Street, NE 32nd Street, and NE Fourth Plain Boulevard.

Traffic Control Plan

PNG will contract with D&H Flagging to prepare a traffic control plan for drilling along the public ROWs along NE Fourth Plain Boulevard, NE 62nd Street, NE 66th Street, and NE 32nd Street in Vancouver, Washington. The plans will be submitted to the City of Vancouver, Washington for review and approval. The approved traffic control plans will be implemented by D&H flagging when temporary borings are being drilled along the public ROW.

Permitting

PNG will obtain a public ROW permit from the City of Vancouver to drill temporary borings in the ROWs of the above referenced streets. PNG will select boring locations in the ROW that offer the best opportunity for acquiring a good surface seal (i.e., away from a thick sequence of underlying structural fill), preferably in planter areas or unpaved surfaces.

Underground Utility Locating

PNG will review as-built underground utility diagrams provided by the City of Vancouver in order to determine placement of the temporary boring locations to insure they are not situated within or near underground utility corridors. PNG will request utility identification through the public Northwest Utility Notification Center (NUNC) as required before drilling. PNG will also contract with a qualified local geophysical locating firm to attempt to identify underground utility features and conduits located at each planned drilling location to clear the selected locations for drilling and sampling.

Soil Gas Sampling

Soil gas samples will be collected in one-liter SUMMA canisters in accordance with Ecology's draft guidance (Ecology 2009), the PNG SOP for soil gas sampling (SOP 22 in Attachment A) and the methodologies described in the Draft RI Work Plan (PNG 2007) and Revised VIA Work Plan (PNG 2010c).

In general, GeoProbe drilling equipment is used to advance a soil boring to the proposed target depth of five feet below ground surface (bgs). When the target depth is reached, soil gas sampling apparatus is attached to the tubing connected to the tip of the GeoProbe drilling rod. The sampling apparatus is leak-checked with helium tracer gas and if a tight seal is confirmed, the sampling apparatus is purged. Following purging, soil gas samples are collected into laboratory-prepared Summa canisters. All soil gas samples will be collected at a depth of at least five feet bgs.

Proposed sample locations are described below and illustrated on Figure 3.

- Sample GT-78-SG – The sample will be collected on the Hart Industrial Complex near monitoring wells MW-5s and MW-5i.
- Sample GT-79-SG – This sample will be collected on the southeastern end of the U-Lock-It property approximately mid-way between the southern fence line and the MW-8 well pair.
- Sample GT-80-SG – This sample will be collected in the public ROW of NE Fourth Plain Boulevard near the shared property line of SFI Holding Company and the Harry's Shell station.
- Sample GT-81-SG – This sample will be collected in the public ROW near the southeastern corner of the intersection of NE Fourth Plain Boulevard and 65th Avenue.
- Sample GT-82-SG – This sample will be collected in the public ROW of NE Fourth Plain Boulevard near the midpoint of the Goodwill Industries property.
- Sample GT-83-SG – This sample will be collected in the public ROW of NE Fourth Plain Boulevard northeast of the former Jiffy Lube.
- Sample GT-84-SG – This sample will be collected in the public ROW of NE 62nd Street near monitoring well MW-23i.
- Sample GT-85-SG – This sample will be collected in the public ROW of NE 32nd Street in the cul-de-sac.
- Sample GT-86-SG – This sample will be collected in the public ROW of NE 66th Street near monitoring well MW-16i.
- Sample GT-87-SG – This sample will be collected in the public ROW of NE 66th Street west of the Carr GMC/Cadillac dealership.
- Sample GT-88-SG – This sample will be collected on the Silver Star Plaza property north of monitoring well MW-11i.

At the conclusion of soil gas sampling, the temporary borings will be abandoned in accordance with methods described in Chapter 173-160 WAC: Ecology's Minimum Standards for Construction and Maintenance of Wells. The ground surface will be restored to match pre-existing conditions.

Laboratory Analytical Methods

Soil gas samples will be submitted to the CH2M Hill laboratory (Corvallis, Oregon) under chain-of-custody for VOC analysis by EPA Method TO-15 SIM. Table 1 summarizes the VOCs detected by the analytical method and the anticipated method reporting limits. Whereas this study will be limited to the target chlorinated solvents associated with the Milton site, the additional chemicals are included and therefore quantified in each laboratory analysis. Table 1 provides a comparison of laboratory reporting limits to MTCA Method B levels.

Management of Investigation Derived Waste

PNG will place investigation derived waste (IDW) (soil) into a labeled 55-gallon drum. A soil sample will be collected for volatile organic compound (VOC) analysis using EPA Method 8260B for profiling purposes. The contents of the drum will be properly disposed at an appropriate licensed facility (Subtitle C or D landfill).

PROPOSED SCHEDULE

The expanded soil gas investigation can be initiated within three weeks after receiving approval of this work plan by Ecology. Field activities are anticipated to be completed within one week including one day for utility locates, two days for drilling/soil gas sampling, and one day for management of IDW, and City inspection of ROW boring abandonment.

Attachments – Table 1 – TO-15 Low Level SIM List

Figure 1 – Site Location Map
Figure 2 – PCE/TCE in Water Table Groundwater and Soil Gas
Figure 3 – Proposed Soil Gas Boring Locations

Attachment A – PNG SOPs

REFERENCES

Ecology. 2009 (October). *Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action (Review Draft).* Washington Department of Ecology.

Geosyntec. 2011 (October 11). *Milton's Dry Cleaners Site - Monitoring Well Installation, April and August 2011 Groundwater Sampling Events.* Geosyntec Consultants, Inc.

PNG. 2007 (December 14). *Draft Remedial Investigation/Risk Assessment/Feasibility Study Work Plan – Milton's Dry Cleaners, Vancouver, Washington.* PNG Environmental Inc.

PNG. 2009a (February 19). *Soil Gas Sampling Results – Fort Vancouver High School* PNG Environmental Inc.

PNG. 2009b (November 9). *Soil Gas Sampling – Remedial Investigation Study Area Milton's Dry Cleaners* PNG Environmental Inc.

PNG. 2010a (July 19). *Fort Vancouver High School Vapor Intrusion Assessment Results* PNG Environmental Inc.

PNG. 2010b (October 12). *Rodeo Bingo Building Vapor Intrusion Assessment Results* PNG Environmental Inc.

PNG. 2010c (March 10). *Milton's RI – Revised Vapor Intrusion Assessment Work Plan* PNG Environmental Inc.

PNG. 2011a (May 13). *Markel Building Vapor Intrusion Assessment Results* PNG Environmental Inc.

PNG. 2011b (June 16). *Milton Building Vapor Intrusion Assessment Results (DRAFT)* PNG Environmental Inc.

TABLES

Table 1
TO-15 Low Level SIM List
Milton's Former Dry Cleaners
Vancouver, Washington

Compound Name	CH2M Hill Reporting Limits[a] (07/09)		MTCA Method B (Unrestricted) Indoor Air CUL (2007) [b]	MTCA Method B (Unrestricted) Indoor Air CUL (2009) [c]	MTCA Method B (Unrestricted) Soil Gas CUL (2009) [cd]	OR RBCs Air Inhalation Residential	MTCA Method C (Industrial) Indoor Air CUL	OR RBCs Air Inhalation Occupational	OSHA 8hr TWA[e]
	ppbv	ug/m^3	ug/m^3	ug/m^3	ug/m^3	ug/m^3	ug/m^3	ug/m^3	ug/m^3
1,1,1-Trichloroethane	0.010	0.055	4,800	4,800	48,000/480,000	5,200	11,000	22,000	1,900,000
1,1,2,2-Tetrachloroethane	0.010	0.070	0.043	0.043	0.43/4.3	-	0.43	-	35,000
1,1,2-Trichloro-1,2,2-trifluoroethane	0.020	0.156	14,000	14,000	140,000/1,400,000	31,000	30,000	130,000	7,600,000
1,1,2-Trichloroethane	0.010	0.055	0.16	0.16	1.6/16	0.15	1.6	0.77	45,000
1,1-Dichloroethane	0.010	0.041	320	320	3,200/32,000	1.5	700	7.7	400,000
1,1-Dichloroethene	0.010	0.040	91	91	910/9,100	210	200	880	-
1,2,4-Trichlorobenzene	0.010	0.075	91	91	910/9,100	-	200	-	-
1,2,4-Trimethylbenzene	0.010	0.050	2.7	2.7	27/270	7.3	6	31	-
1,2-Dibromoethane (EDB)	0.010	0.078	0.011	0.011	0.11/1.1	0.0041	0.11	0.02	154,000
1,2-Dichloro,1,1,2,2-tetrafluoroethane	0.010	0.071		-	-	-		-	-
1,2-Dichlorobenzene	0.010	0.061	64	64	640/6,400	210	140	880	-
1,2-Dichloroethane (EDC)	0.010	0.041	0.096	0.096	0.96/9.6	0.094	0.96	0.47	200,000
1,2-Dichloropropane	0.010	0.047	1.8	1.8	18/180	-	4	-	350,000
1,3,5-Trimethylbenzene	0.010	0.050	2.7	2.7	27/270	6.3	6	26	-
1,3-Butadiene	0.010	0.023	0.08	0.08	0.8/8	-	0.8	-	2,200
1,3-Dichlorobenzene	0.010	0.061		-	-	-		-	-
1,4-Dichlorobenzene	0.010	0.061	370	370	3,700/37,000	0.22	800	1.1	450,000
1,4-Dioxane	0.010	0.037	-	-	-	0.32	-	1.6	360,000
2-Hexanone	0.010	0.042	-	-	-	-	-	-	410,000
2-Methyl naphthalene	0.050	0.296	-	-	-	-	-	-	-
4-Ethyltoluene	0.010	0.050	-	-	-	-	-	-	-
Acetone	0.050	0.121	-	-	-	-	-	-	2,400,000
Acrylonitrile	0.010	0.022	0.037	0.037	0.37/3.7	0.036	0.37	0.18	4,300
Benzene	0.020	0.065	0.32	0.32	3.2/32	0.31	3.2	1.6	3,200
Benzyl Chloride	0.010	0.053	0.052	0.052	0.52/5.2	-	0.52	-	5,000
Bromodichloromethane	0.010	0.068	0.0033	0.0033	0.033/.33	0.066	0.033	0.33	-
Bromoform	0.010	0.105	2.3	2.3	23/230	2.2	23	11	5,000
Bromomethane	0.010	0.039	2.3	2.3	23/230	5.2	5	22	80,000
Carbon Disulfide	0.020	0.063	320	320	3,200/32,000	-	700	-	62,000
Carbon tetrachloride	0.010	0.064	0.17	0.17	1.7/17	0.16	1.7	0.82	63,000
Chlorobenzene	0.010	0.047	8	8	80/800	52	18	220	350,000
Chloroethane	0.010	0.027	-	-	-	10,000	-	44,000	2,600,000
Chloroform	0.010	0.050	0.11	0.11	1.1/11	0.11	1.1	0.53	240,000
Chloromethane	0.040	0.084	1.4	1.4	14/140	94	14	390	100,000
cis-1,2-Dichloroethene	0.010	0.040	16	16	160/1,600	>Pv	35	>Pv	790,000
cis-1,3-Dichloropropene	0.010	0.046	-	-	-	-	-	-	-
Cyclohexane	0.010	0.035	-	-	-	-	-	-	1,050,000
Dibromochloromethane	0.010	0.087	0.0045	0.0045	0.045/0.45	-	0.045		-
Dichlorodifluoromethane	0.010	0.050	80	80	800/8,000	-	180		4,950,000
Ethanol	0.100	0.192	-	-	-	-	-	-	1,900,000
Ethyl acetate	0.010	0.037	-	-	-	-	-	-	1,400,000
Ethylbenzene	0.010	0.044	460	460	4,600/46,000	0.97	1,000	4.9	435,000
Heptane	0.010	0.042	-	-	-	-	-	-	2,000,000
Hexachlorobutadiene	0.010	0.107	0.11	0.11	1.1/11	-	1.1		-
Hexane	0.200	0.717	-	320 [f]	3,200/32,000 [f]	-	-	-	1,800,000
Isopropyl alcohol	0.500	1.250	-	-	-	-	-	-	980,000
m,p-Xylenes	0.020	0.088	46	46 [g]	460/4,600 [g]	100[e]	100[e]	440	435,000
Methyl ethyl ketone	0.010	0.030	460	460	4,600/46,000	-	1,000	-	-
Methyl isobutyl ketone	0.010	0.042	32	32	320/3,200	-	70	-	410,000
Methylene chloride	1.000	3.534	5.3	5.3	53/530	-	53	-	86,750
Methyl-tert-butyl ether	0.020	0.073	9.6	9.6	96/960	9.4	96	47	-
Naphthalene	0.010	0.053	1.4	1.4	14/140	0.072	3	0.36	50,000
n-Butylbenzene	0.010	0.056	-	-	-	-	-	-	-
n-Propylbenzene	0.010	0.050	-	-	-	-	-	-	-
o-Xylene	0.010	0.044	46	46	460/4,600	100[e]	100[e]	440	435,000
Styrene	0.010	0.043	4.4	4.4	44/440	1,000	44	4,400	426,000
Tetrachloroethene (PCE)	0.010	0.069	0.42	0.42	4.2/42	0.41	4.2	2.1	678,000
Tetrahydrofuran	0.010	0.030	-	-	-	-	-	-	-
Toluene	0.010	0.038	2,200	2,200	22,000/220,000	5,200	4,900	22,000	750,000
trans-1,2-Dichloroethene	0.010	0.040	32	32	320/3,200	63	70	260	790,000
trans-1,3-Dichloropropene	0.010	0.046	-	-	-	-	-	-	-
Trichloroethene (TCE)	0.010	0.055	0.1	0.1	1/10	0.44	1	2.9	537,000
Trichlorofluoromethane	0.010	0.057	320	320	3,200/32,000	730	700	3,100	5,600,000
Vinyl Acetate	0.010	0.036	91	91	910/9,100	-	200	-	-
Vinyl chloride	0.010	0.026	0.28	0.28	2.8/28	0.17	2.8	2.8	2,600

Notes:

[a] These reporting limits are before inclusion of a typical canister dilution factor of 1.5

[b] MTCA = Model Toxics Control Act Method B and C clean-up level (CUL), Washington Department of Ecology (October 12, 2007)

[c] Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action, MTCA = Model Toxics Control Act Method B and C clean-up level (CUL), Washington Department of Ecology (Review DRAFT October 2009)

[d] Soil gas screening level concentration in the soil gas just beneath a building (first value) or at 15 foot depth or greater (second value)

[e] Time weighted averages (TWA) are recommended exposure limits for up to a ten hour work day in a 40 hour work week that are developed and periodically revised by NIOSH for hazardous substances or conditions in the work place.

[f] n-Hexane

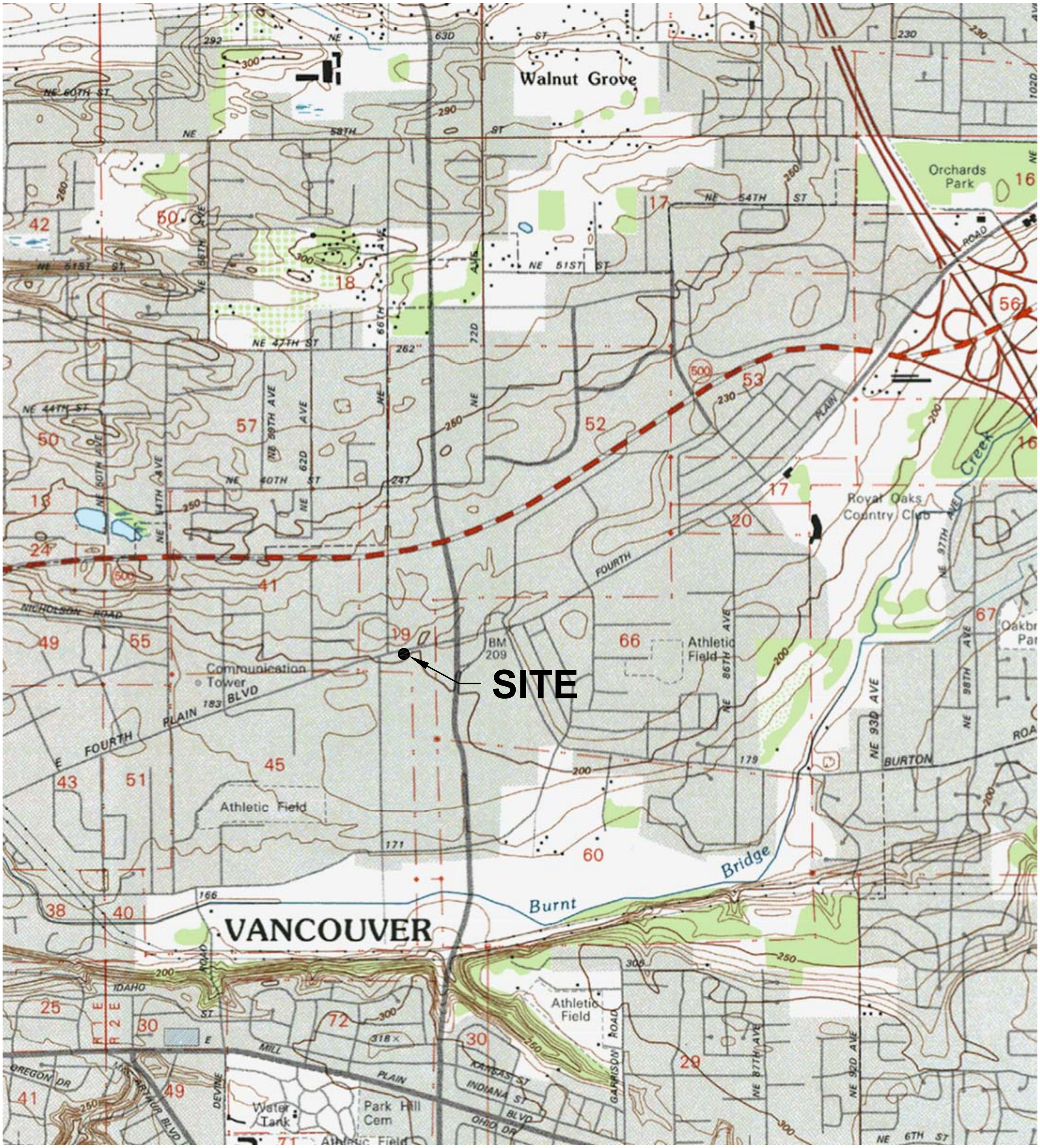
[g] m-Xylene

[h] Control limit is based on Total Xylenes

OR RBC = Risk-based concentrations for air inhalation in an occupational setting, Oregon Department of Environmental Quality (September, 2010)

>Pv = The air concentration reported for the risk-based concentration (RBC) exceeds the vapor pressure of the pure chemical. It can be assumed that this constituent cannot create an unacceptable risk by this pathway.

FIGURES



APPROXIMATE SCALE IN FEET

0 1000 2000 4000

NOTE: USGS, Orchards Quadrangle
Washington - Clark Co.
7.5 Minute Series (Topographic) 1990.
Base map provided by Map Tech.

PNG ENVIRONMENTAL, INC.
1339 Commerce Avenue, Suite 313 TEL (360) 414-0669
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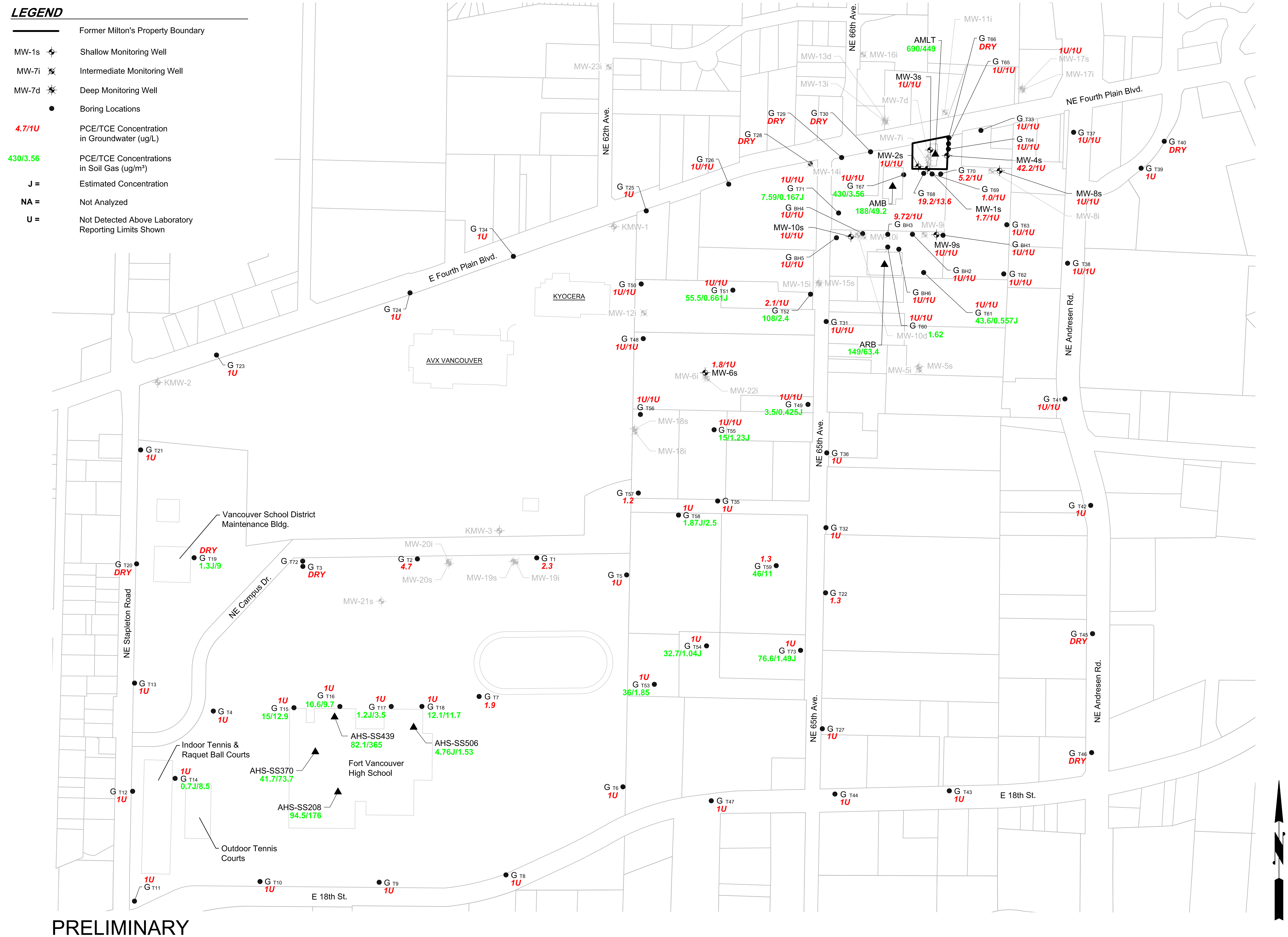
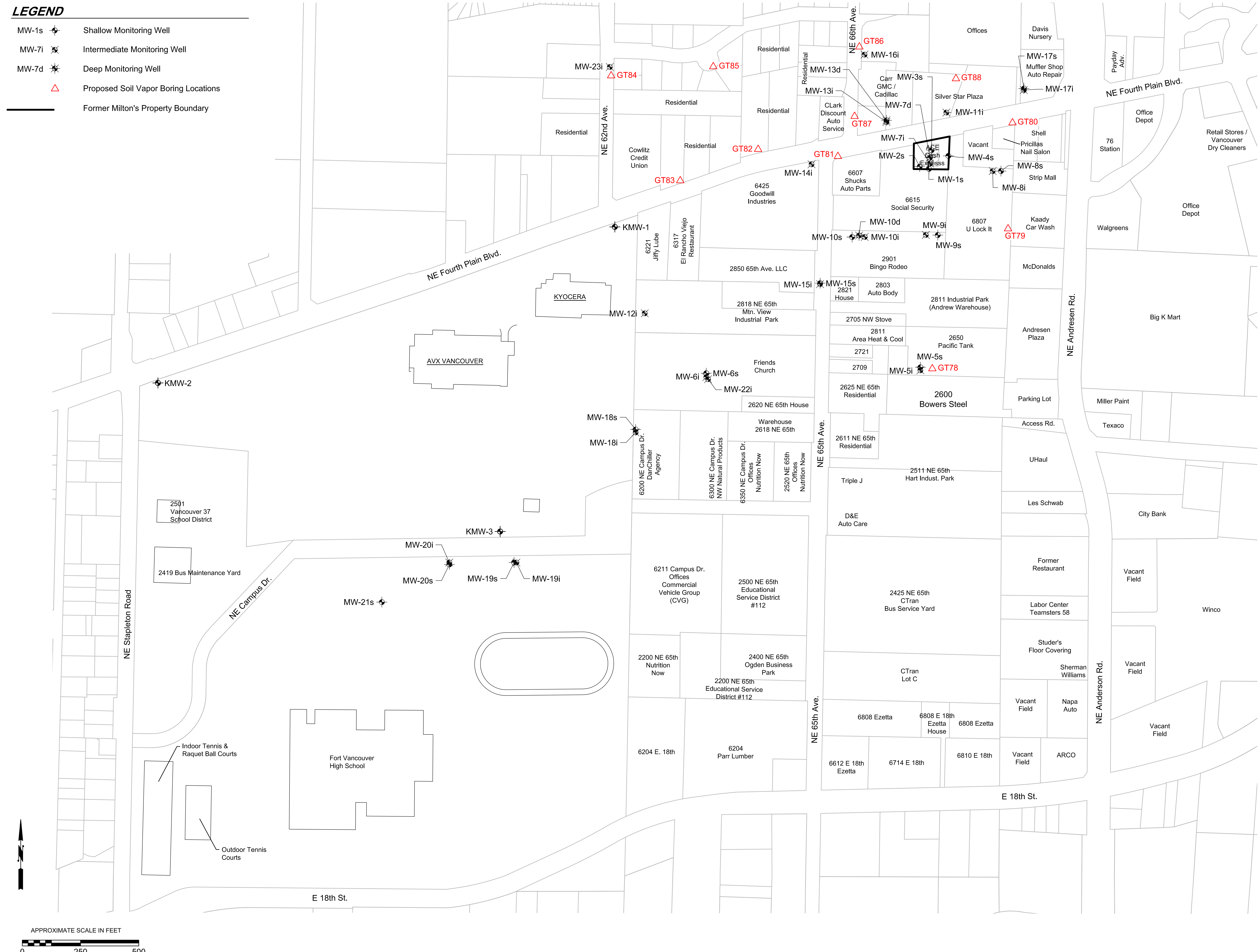
DATE: 12-13-07 FILE NAME: 987-03 DRAWN BY: JJT APPROVED BY:	MILTON'S DRY CLEANERS 6721 E. FOURTH PLAIN BLVD. VANCOUVER, WASHINGTON	SITE LOCATION MAP	Project No. 987-03	Figure No. 1



NOTE:
1. Base map provided by Clark County GIS.

APPROXIMATE SCALE IN FEET
0 250 500

PNG ENVIRONMENTAL, INC. 1339 Commerce Avenue Suite 313 TEL (360) 414-0669 Longview, Washington 98632 FAX (360) 414-0663	DATE: 10-11-11 FILE NAME: 987-03 DRAWN BY: JJT APPROVED BY: MA	MILTON'S DRY CLEANERS 6721 E. FOURTH PLAIN BLVD. VANCOUVER, WASHINGTON	PCE/TCE IN WATER TABLE GROUNDWATER AND SOIL GAS	Project No. 987-03 Figure No. 2



NOTE:
1. Base map provided by Clark County GIS.

PNG ENVIRONMENTAL, INC.
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DATE: 1-9-12 FILE NAME: 987-03 DRAWN BY: JJT APPROVED BY: MA	MILTON'S DRY CLEANERS 6721 E. FOURTH PLAIN BLVD. VANCOUVER, WASHINGTON	PROPOSED SOIL GAS BORING LOCATIONS	Project No. 987-03	Figure No. 3

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ATTACHMENT A

PNG SOPS

STANDARD OPERATING PROCEDURE
SOIL GAS (VAPOR) MONITORING AND SAMPLING
SOP 22

This standard operating procedure (SOP) describes procedures for performing soil gas (vapor) monitoring and sampling using direct-push drilling technology. Because each site is unique, these procedures should be viewed as guidelines and will likely require modification based on site and subsurface conditions present.

Personnel performing the soil gas monitoring and sampling will follow site safety procedures as specified in the site-specific Health and Safety Plan.

EQUIPMENT

Soil gas monitoring and sampling will be performed using direct push sampling equipment. The direct push probe will be advanced using either a truck- or track-mounted Geoprobe rig, or for limited access areas, using portable methods such as rotary hammer drill (rotohammer).

Coring/probe installation equipment which may be used includes the following: a rotohammer or truck-mounted Geoprobe rig, ½-inch to 2-inch diameter concrete coring drill bit, cloth (for dust suppression during drilling), Geoprobe drill rods, ¼-inch diameter tubing (nylon, stainless steel, or Teflon®), fine-grained (20-40) silica sand, granular bentonite grout or alternative, and possibly cement in cases where the formation has a very low permeability.

Leak check equipment using helium or other pre-approved non-reactive tracer gas may include: helium tank, piping, three-way valve, leak check enclosure (shroud), helium detector, paper towels or rags, and nitrile gloves.

Monitoring/sampling equipment which may be used includes the following: Summa canister (may be a one-liter or six-liter Summa canister with valve), certified flow controller, steel filter, three-way valve, extra miscellaneous valves, photo ionization detector (PID), low flow vacuum pump, vacuum gauge, barometer/thermometer/wind speed indicator.

CORING/PROBE INSTALLATION PROCEDURES

Prior to drilling or coring, an attempt will be made to locate utility lines and if inside a building, to determine whether or not the building has an existing vapor barrier or a tensioned slab.

When samples are collected beneath buildings, a minimum of one sample will be collected from beneath each building. In addition, one duplicate sample will be collected. If possible, the samples will be located in the central portion of the slab, away from the floor slab/perimeter foundation junction, where dilution is more likely to occur.

In each sample location, a small diameter (½-inch to one-inch) hole will be drilled in the foundation using a rotohammer, truck-mounted Geoprobe rig, or concrete corer. When drilling the hole, no water should be used and care should be taken not to puncture the surface of soil underneath. If dust prevention is necessary, cover the location with a cloth or towel and drill through a pre-cut small hole in the cloth.

The probes are typically advanced to a depth of five feet below ground surface (bgs), however, other site-specific depths or multiple depths for vertical soil gas profiling may be targeted by the work plan. At target depth, the probe rod will be withdrawn approximately three to six inches to disengage the expendable probe tip and minimize the terminal void space volume. New, dedicated disposable nylon or Teflon® tubing would then be fitted with a barbed steel end nut, pushed into the base of the probe rod, and threaded onto a downhole terminal fitting sealed with an o-ring to prevent vapor short-circuiting to the surface through the rod annulus.

The area immediately around the probe rods shall be grouted using hydrated bentonite grout (if temporary installation) or cement (if permanent installation). Wait 30 minutes prior to sampling for bentonite or cement to congeal. VOC-free modeling clay may also be used to seal around the probe rods to prevent vapor short-circuiting to the surface.

Procedures for leak checking, soil gas purging, and sampling are described in the section below.

Following the completion of sampling, the soil boreholes will be filled with hydrated granular or powdered bentonite grout. If a building slab or pavement is present, the hole(s) will be patched with cement and finished flush with the surface.

SYSTEM SETUP

Inspect the laboratory-provided Summa canister for damage prior to use. Do not use a canister that has visible damage.

Using a wrench, remove the brass cap above the valve on the top of the Summa canister. Measure and record the initial vacuum of Summa canister. If using an external vacuum gauge, cap the gauge and attach it to the canister using a wrench. Open the canister valve only after verifying the gauge is properly capped.

Verify that the vacuum pressure of the canister is equal to that indicated on the laboratory supplied tag. If the vacuum does not match, the canister has likely leaked and should not be used. Record the vacuum pressure on the sample collection form.

The canister will then be fitted with the laboratory-provided steel filter. The sampling train (steel-filter, flow-controller (if used), and Summa canister) will be attached to a T-connector with an in-line vacuum gauge and vacuum tight flow valves (Swagelok) at each end. All valves should be closed on the T-connector at this time. The valve connected to the sampling train is referred to as the sampling valve. The vacuum pump (truck-mounted or otherwise) is then attached to the second end of the T with the valve closed (referred to as the purge valve).

Lastly, the sample tubing is threaded through the leak-check shroud and connected to the soil gas sampling point and the third closed valve on the T-connector. The leak-check shroud should then be sealed against the surface (see "Leak Check – Probe Point Surface Seal" below).

LEAK CHECKING - APPARATUS

The method described below shall be used to check for leaks in the lines and fittings of the above-ground sampling apparatus:

After the sampling system is set up, make sure all valves are closed.

Open the purge valve (the valve connecting the purge pump to the apparatus, all other valves remain closed), turn on the purge pump, and apply approximately ten inches of vacuum into the T-connector and valves. Close the purge valve and check to verify that there is no loss of vacuum within the sampling apparatus (T-connector and valves) over a one minute period of time. If there is a loss of vacuum, this indicates a leak in the purge/sample system train that must be remedied.

If necessary, recheck the system to verify that there is no leakage as described above.

Document the date and time the leak check(s) were performed. Close all valves.

LEAK CHECKING – PROBE POINT SURFACE SEAL

In addition checking for leaks in the apparatus, the probe point surface seal also needs to be checked for leakage. The preferred method uses helium gas as a tracer and permits checking for and correcting potential leaks in the field prior to sampling. Other tracer gases may be used but approval of their use should be verified prior to the start of the work. The helium tracer gas method is listed in ITRC's "Technical and Regulatory Guidance, Vapor Intrusion Pathway: A Practical Guideline" dated January 2007 (ITRC 2007), and as described below. The ITRC guidance from which the text below is derived is consistent with California Environmental Protection Agency and Oregon Department of Environmental Quality guidance (CalEPA 2005 and 2010; DEQ 2010).

Helium Leak Check Method

- Insert sample tubing through the leak check enclosure (also referred to as a shroud) and complete sample tubing connections to the other apparatus (previously described above).
- Place the enclosure flush with the ground surface, placing hydrated bentonite around the shroud to seal the shroud around the sample point.
- Attach helium tubing from the helium tank regulator to the enclosure (the "helium in" tubing).
- Attach the exhaust tubing ("helium out") to the enclosure and locate the discharge end of the tubing as far as possible from the helium detector.
- Attach the helium detector on the exhaust line from the sample pump.
- Make sure the sample valve (from the sampling probe point) is closed.
- Open the helium tank valve and set the flow to approximately 200 milliliters/minute (ml/min); let it flow for about one minute to fill the leak check enclosure.
- Do an initial check to make sure the helium detector is not detecting any helium.
- Begin purging of soil gas as described in the section on purging below. During purging, continue monitoring helium detector, record readings. If helium is detected at over 5%, this indicates leakage; check/tighten all seals and fittings and repeat procedure. The helium exhaust line should also be monitored so that additional helium can be added to the shroud during sampling if needed.
- Close valves from the probe sampling point and purge pump lines, and turn pump off.
- If the helium detector reading is less than 5%, the system is considered leak free and sampling can be performed (see sampling section below).
- If the helium detector reading continues to be above 5%, leakage is indicated and the probe hole abandoned.
- Record helium monitoring measurements in field notes.

SOIL GAS PURGING PROCEDURES

Purging and sampling will be accomplished at a low flow rate (100 to 200 ml/min) to minimize the potential for inducing leakage. Flow rates should not exceed 200 ml/min.

Purge vapors will be monitored using a PID for the presence of volatile organic compounds.

Slowly open the vacuum pump purge valve and purge three tubing volumes of vapor from the line, then close the purge valve. Based on a volume of approximately 0.044 liters per foot of ¼-inch ID tubing, and assuming five feet of tubing above ground, this would yield a total purge volume of 1.32 liters for a five-foot probe depth (ten total feet of tubing), and a total purge volume of 1.98 liters for a ten-foot probe depth (15 total feet of tubing).

During purging, check for leaks as described in the section on leak checks above. Record PID measurements of purge vapors on the field form. Oxygen and carbon dioxide concentrations may be monitored in the soil gas stream if desired by the work plan. At the conclusion of purging, immediately close the purge valve and then shut off the purge pump.

SOIL GAS SAMPLING PROCEDURES

Atmospheric conditions (barometric pressure, temperature, wind speed and direction) will be recorded prior to and after sampling. A portable weather station equipped with a data logger is preferred to log site-specific conditions over the duration of sampling. However, if a weather station cannot be set-up on site, record atmospheric data from the closest weather station.

After leak testing and soil gas purging, soil gas sampling may be performed.

After purging, the purge valve will be closed prior to opening the sampling valve. The sample valve will then be opened followed by slowly opening the Summa canister valve. The canister's valve should be closed when the vacuum gauge shows a vacuum of 5 inches of mercury (in Hg) (pressure of -5 in Hg). The sample valve should then be closed.

Ensure the canister valve is tightly closed. The sample train should be immediately disassembled by removing the steel particulate filter, flow controller, and the Summa canister. Immediately cap the Summa canister fitting. The final vacuum reading from the canister should be recorded on the chain of custody, sample collection form, and canister identification tag. If the final canister vacuum is less than 0.1 in Hg (more than -0.1 in Hg of pressure, or is a positive pressure), then the sample should be disregarded and a new sample collected.

Soil vapor samples will be shipped to a certified laboratory for analysis.

FIELD RECORDS

The field technician maintains a log sheet summarizing:

- Sample Location.
- Sample Identification.
- Date and time of sample collection.
- Sampling depth.
- Tubing type, length, and volume.
- Purge Data (i.e. pump used, volume, PID screening information, purge start and stop time, purge vacuum reading).
- Weather conditions.
- Sampling methods and devices.

- Volume of sampling device.
- Sampling start and end date/time.
- Vacuum of canisters before and after samples collected.
- Apparent moisture content (dry, moist, or saturated, etc.) of the sampling zone.
- Chain of custody protocols and records used to track samples from sampling point to analysis.
- Other notes as applicable to site specific observations, sampling issues and mitigation of problems encountered..

REFERENCES

Cal EPA. *2005 (February 7 rev.). Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air.* Department of Toxic Substances Control, Interim Final. California Environmental Protection Agency.

Cal EPA. 2010 (March). *Advisory – Active Soil Gas Investigation (Draft).* California Environmental Protection Agency.

DEQ. 2010 (March 25). *Guidance for Assessing and Remediating Vapor Intrusion in Buildings.* Oregon Department of Environmental Quality.

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