CLEANUP ACTION PLAN

Former Chevron Service Station #209335
1225 North 45th Street
Seattle, Washington

April 6, 2005

Prepared for:

ChevronTexaco

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1.0 INTRODUCTION

1.1 Purpose

The purpose of this Cleanup Action Plan (CAP) is to identify the cleanup actions selected by ChevronTexaco for the remediation of contaminated soils and groundwater at the Former Chevron Service Station # 209335 located at 1225 North 45th Street, Seattle, Washington. In accordance with WAC 173-340-360(2)(a), the selected cleanup actions meet the threshold requirements at the defined points of compliance; are protective of human health and the environment; comply with remedial action levels; comply with applicable state and federal laws; and provide for compliance monitoring.

2.0 BACKGROUND

2.1 Site Location and Description

The former Chevron Service Station # 209335 is located at 1225 North 45th Street, Seattle, Washington. The property is located in a commercial/mixed retail and residential neighborhood in northern Seattle. Located north of the site are single-family residences and a vacant lot that was formerly a McDonald's restaurant. Located east of the site is Stone Way. To the south is Big Wheel Auto Parts and an espresso stand; southwest is an asphalt parking lot and residences; and to the west are the former Wallingford Medical Building and the Seattle Housing Authority.

The subject property is currently owned by the Seattle Housing Authority and is an asphalt-paved parking lot. The property is scheduled for development as part of a mixed-use residential/commercial facility in early 2005.

A gasoline service station and a service building operated at this location beginning in approximately 1935. According to archive records, the Standard Oil Company (later Chevron USA) purchased the property in 1954. Chevron's tenure at the property covered the years 1954 to 1978. The original station was reported to contain two 1,000 gallon fuel USTs, one 550 gallon UST and one hydraulic lift. The 1935 service station was replaced in 1956 with one 3,000 gallon UST, one 2,000 gallon UST, and one 550 gallon UST. The gasoline service station building and service garage were removed in 1969 and the lot has remained undeveloped ever since. (Phase I ESA, August 20, 1999, by EA, Inc.)

In August 1999, four soil borings were drilled in the area of the 1935/1956 service station location. Gasoline- and diesel-range hydrocarbons along with xylenes were detected above the MTCA Method A cleanup level from 7.5-24 feet bgs. In November 2001, five soil borings were drilled and completed as monitoring wells MW-1 through MW-5. Depth to water has ranged between 34.0 and 38.5 feet below ground surface (bgs). Groundwater flow direction is south-southeast. Concentrations of gasoline-range hydrocarbons and BTEX constituents have exceeded MTCA Method A cleanup levels in wells MW-2, MW-4, and MW-5. Light non-aqueous phase liquid (LNAPL) has been detected in wells MW-2 (beginning in the first quarter 2002), MW-4 (beginning in the first quarter 2003), and MW-5 (beginning in the third quarter 2001).

An undocumented 1,000-gallon UST was removed in February 2001. No contamination was detected in the confirmation samples collected during the tank pull effort.

A supplemental soil investigation was completed in June 2004 and the results are presented in "*Supplemental Site Investigation Report*", SAIC September 2004. The monitoring wells on-site are currently checked for LNAPL weekly and bailed as needed.

2.2 Hydrogeology/Geology

The subsurface soils consist of dense to very dense, well-graded fine- to medium-grained sand with some silt and rounded gravel that extends to approximately 8.5 to 20 feet below ground surface. Underlying this is a thick layer of very dense, brown to light brown, poorly graded, fine- to medium-grained sand that is present from 8.5 to 45.5 feet bgs (to the bottom of all completed borings). Groundwater was encountered approximately 38 feet bgs across the site.

3.0 VAPOR MODELING

This section details the Johnson and Ettinger (J&E) vapor modeling information for the Site. The vapor model was completed to estimate the potential soil vapor intrusion impacts in the proposed sub-grade parking garage of the new building.

Previous soil sampling and analytical testing reveal that subsurface contamination exists on the property above MTCA Method A cleanup levels. The area of contamination is restricted to one corner of the property (approximately 11% of the building footprint); however, as a very conservative estimate, the vapor intrusion modeling and human health risk calculations were performed assuming the contaminated layer underlies the entire building footprint. The highest concentrations of petroleum constituents detected onsite were used as model input (toluene = 48 mg/kg, ethylbenzene = 61 mg/kg, and total xylenes = 320 mg/kg). These values are from soil sample SB-8-37.5 collected 37.5 feet below ground surface (bgs). Benzene was not detected in any soil samples collected onsite. Based on historic sampling results, benzene is not present onsite and does not any risk to human health. However, to run the model in a conservative manner, the detection limit value of benzene (representative of site-wide analytical results, < 0.26 mg/kg) was input into the model.

The most current version of the US EPA Soil Johnson and Ettinger Model was used (SL-ADV Version 3.0; 02/03) for the human health hazard and risk estimations. However, US EPA has recent changes to reference dose concentrations that decrease the risk from benzene. These models were run using the more conservative values.

Soil physical parameters have not been analytically tested, so the pertinent model default values for observed soil types were used. Soils beneath the site have been described in previous investigations as sand, silty sand and gravelly sand. To be conservative, sand was used as soil type. Based on these previous investigations and on anticipated backfill material the onsite soils contain silts which if considered in the model would decrease the vapor intrusion risk.

The depths to top and bottom of the contaminated zone were based on historical analytical data and the proposed depth of remedial excavation. Risk calculations were performed assuming an excavation depth of 15 feet bgs and subsequent backfilling with clean fill, and a resultant contaminated zone extending from 15 to 45 feet bgs.

The depth below grade of the enclosed floor space and building dimensions were obtained from the architectural drawings of the proposed building. The building design drawings show the garage basement floor at six feet bgs. The garage will extend across the entire building footprint. The building width is shown as 94 feet, and the building length is shown as 322 feet. A basement ceiling height of 8 feet was assumed and input into the model.

MTCA standard exposure assumptions were used as model input for exposure duration and averaging times for carcinogens and noncarcinogens (WAC 173-340-750). Johnson and Ettinger default values were used for floor wall crack seam width, slab thickness, and differential pressure. A reasonable maximum exposure frequency was calculated assuming an individual spent one hour in the garage per day, for 365 days per year. It is unlikely that an individual will spend this much time in the parking garage, but it conservatively accounts for time spent in the laundry facilities located on the garage level, and walking to/from vehicles.

The final model input affecting the risk to human health is the indoor air exchange rate in the garage. The J&E default value for air exchange rate is 0.25, or all the air in the enclosed space is exchanged with outdoor air once every four hours. The J&E Model default is a residential default value.

The proposed new structure will have a parking garage in the basement which will cover the entire building footprint. Comparatively high air exchange rates are needed for enclosed indoor garages in order to quickly and efficiently flush the acutely toxic gasoline (and diesel) engine exhaust fumes out of the garage.

The J&E Model is sensitive to changes in the air exchange rate since it represents the rate at which indoor air impacted by vapor intrusion is exchanged with "clean" outdoor air (i.e., an increase in air exchange rate will decrease indoor vapor concentrations, and will therefore result in decreased exposures and decreases in estimated health hazards and risks).

The Washington Administrative Code (WAC), Chapter 51-13 (Ventilation and Indoor Air Quality) was consulted to obtain indoor ventilation rates, as presented in WAC 51-13-304. Table 3-4, of this section of the WAC presents the following:

- Enclosed Parking Garage: Outdoor Air Requirements = 1.50 cfm/ ft^2. (cfm = cubic feet per minute).

Assuming the garage complies with WAC 51-13-304, the following calculation can be used to estimate the air exchange rate of the garage portion of the building.

$(1.5\ cfm/ft^2)$ $(30{,}268\ ft^2$ building footprint$)$ = 45,402 cfm (rate for building)

Enclosed space volume = (30,268 ft2) x (8 ft garage ceiling height) = 242,144 ft^3

$(242{,}144ft^3)$ / $(45{,}402ft^3/min)$ = 5.3 minutes

Therefore the air in the garage should be exchanged every 5.3 minutes.

Thus, as an initial assumption, the ventilation rate (air exchange rate) of the enclosed garage in should be approximately 11 volumes per hour.

Another factor to consider is that the vapor risk calculations were performed based on existing soil contaminant concentration. This requires a model conversion from soil concentration to soil vapor concentration, then to indoor air. The added model iteration from soil to soil vapor adds another layer of conservative calculations to the risk determination. Furthermore, the model assumes a residential foundation structure with a 1-millimeter wide open seam along the entire perimeter of the building.

The Johnson and Ettinger Model results (attached as Attachment A) show that insignificant incremental risk to human health will be present in the proposed sub-grade parking garage of the Seattle Housing Authority building. This determination was reached with conservative assumptions, including that the soils beneath the proposed building are continuously contaminated from 15 to 45 feet bgs at the highest level of contamination detected onsite, across the entire footprint of the building. Please note that J&E Models were not run for the groundwater to vapor pathway. As detailed in Section 4.0, these deep soils impacted by LNAPL will be removed by bucket auger borings.

Based on the above assumptions and the resulting risk calculations, the potential soil vapor intrusion impacts in the proposed sub-grade parking garage of the new building appear to be insignificant. As such, we believe that no additional engineered controls beyond soil excavation to 15 feet bgs and bucket auger removal of residual non-aqueous phase liquids are necessary for the adequate protection of human health.

4.0 PROPOSED CLEANUP ACTIONS

The Site is scheduled for redevelopment in early 2005 as a multi-story apartment complex with ground floor retail and underground parking. Quarterly groundwater sampling and weekly LNAPL bailing will continue until the start of site development. The following proposed tasks are presented sequentially and will be implemented at the start of site development. The proposed cleanup action for the Site includes the following components:

- Monitoring Well Abandonment (completed)
- Deep Soil Hot Spot Removal
- Shallow Soil Excavation
- Monitoring Well Reinstallation (on-site)
- Delineation of Dissolved-phase Plume (off-site)
- LNAPL Removal (restarted if needed)
- Compliance/Natural Attenuation Monitoring

Monitoring Well Abandonment: Prior to the start of site development activities, monitoring wells located on the site will be abandoned and removed per 173-160-460 WAC.

Deep Soil Hot Spot Removal: Deep soil hot spots (those areas around MW-2 and MW-5 that contain LNAPL) will be removed by completing a number of 6-foot diameter bucket auger borings to a depth of approximately 40 feet below ground surface. The borings will be backfilled with a material that will allow for subsequent excavation of the shallow soils.

Shallow Soil Excavation**:** In conjunction with site development, shallow soils with contamination exceeding the Model Toxics Control Act (MTCA) Method A Cleanup Levels will be removed from the Site and transported to an approved treatment facility for disposal. The approximate extent of the proposed excavation is depicted in Figure 1 (as green hatching). This task will include the following measures to reduce and control immediate and long-term exposures to contaminants:

- Remove all accessible soils to a depth of approximately 18 feet bgs with contamination greater than the MTCA Method A cleanup levels;
- Soil will be removed to the property boundary with vertical cuts to a depth of 15 feet bgs (or as deep as possible near the shoring);
- Manage Incidental Excavated Soil (clean overburden);
- Excavate contaminated soil for off-site disposal; and
- Re-grade and compact backfill placed in the excavation up to the subgrade elevation for the parking garage.

The excavation will be completed so as not to endanger the stability of roads or sidewalks adjacent to the Site property. During soil removal, samples from the excavation limits and soil stockpiles will be taken in accordance with guidelines set forth in *Guidance for Remediation of Petroleum Contaminated Soils*, Washington State Department of Ecology Toxics Cleanup Program Publication 91-30, November, 1995.

Installation of Monitoring Wells: Replacement wells will be installed on-site following site redevelopment. The monitoring wells will be situated in locations that will not conflict with the operation of the underground parking garage, to maximize the removal of any remaining LNAPL, and to monitor groundwater conditions on-site.

Delineation of Dissolved-phase Groundwater Plume: Additional monitoring wells will be installed off-site to better delineate the dissolved-phase groundwater plume. The locations of these wells will be presented in the Work Plan.

Removal of LNAPL: After installation, the on-site monitoring wells will be checked regularly for the presence of LNAPL. If detected, the LNAPL will be removed by either hand bailing, pumping or using absorbent socks. The frequency of monitoring and removal will be adjusted according to measured LNAPL recovery rates. LNAPL removal will be deemed complete when measured thicknesses at all site-related wells are less than or equal to 0.01 feet throughout four consecutive seasonal measurements.

Compliance/Monitored Natural Attenuation Monitoring: Following the re-installation of the monitoring wells a period of compliance and natural attenuation monitoring will take place until contaminant concentrations within the dissolved groundwater plume are below MTCA Method A Cleanup Levels.

5.0 EXPOSURE ASSESSMENT

5.1 Chemicals of Concern

Chemicals of concern in the groundwater and soil at the Site include gasoline-range hydrocarbons, diesel-range hydrocarbons, and BTEX.

5.2 Exposure Pathways

Exposure pathways related to this site include soil (dermal and ingestion), groundwater (dermal and ingestion) and soil/groundwater to indoor air. The following sections describe the site risk related to each of these pathways.

***Subsurface soil*:** Activities that involve soil excavation may lead to contaminant exposure to humans through inhalation, ingestion, and dermal contact. The most likely population to be affected by this exposure pathway is those participating in the installation of wells and remedial measures including installation of shoring, excavation of contaminated soils to 18 feet bgs and utility workers in Stone Way and North 45th Street.

***Groundwater*:** Due to the depth of groundwater (> 35 feet bgs) there is no potential for humans to come into contact with groundwater during excavations at the Site. The current exposure potential for groundwater ingestion is low. Drinking water is supplied by the municipal water system, which obtains its water from watersheds located east of the city. The City does not have any municipal wells within the city limits.

Vapors: There is potential for humans to come into contact with hazardous vapors that volatilize from soil and groundwater during excavation of soil at the Site and from residual soil and groundwater contamination left in place after construction of the building is completed . In addition, contaminant vapors can pose a threat to human health and the environment when they are present at concentrations in confined spaces that exceed NIOSH (National Institute for Occupational Safety and Health) and/or OSHA (Occupational Safety and Health Administration) permissible exposure limits, or at high enough concentrations to create conditions that may lead to explosions. The most likely population to be affected by this exposure pathway is utility workers and those participating in the installation of wells, construction of the building foundation and shoring, and remedial measures. Following redevelopment the Site will be overlain by a sub grade parking garage with placement. Given the size and the air exchange rate of the garage, the depth to contaminants, groundwater and LNAPL will not pose a risk to human health (as detailed in Section 3.0)

During any Site activities, steps will be taken to minimize the risk to workers and the public. These steps will be outlined in the Health and Safety Plan.

6.0 TERRESTRIAL ECOLOGICAL EVALUATION

Under WAC 173-340-7490, MTCA requires that one of the following actions be taken following the release of hazardous substances to the soil at a site to determine the potential impacts to terrestrial organisms at the site.

A site may be excluded from the requirement for a terrestrial ecological evaluation if any of the following criteria are met at the site. The Site meets all of these requirements, therefore is excluded from the requirement.

- All soil contaminated with hazardous substances is, or will be located below the point of compliance established under WAC 173-340-7490(4).
- All soil contaminated with hazardous substances is, or will be, covered by buildings, paved roads, pavement, or other physical barriers that will prevent plants or wildlife from being exposed to the soil contamination.
- There is less than 0.25 acres of contiguous undeveloped land on or within 500 feet of any area of the site contaminated with chlorinated dioxins or furans, PCB mixtures, DDT, DDE, DDD, aldrin, chlordane, dieldrin, endosulfan, endrin, heptachlor, heptachlor epoxide, benzene hexachloride, toxaphene, hexachlorobenzene, pentachlorophenol, or pentachlorobenzene.
- There is less than 1.5 acres of contiguous undeveloped land on the site or within 500 feet of any area of the site and the contamination at the site does not include any of the contaminants listed in the preceding bullet.

7.0 CLEANUP STANDARDS

7.1 Cleanup Level

Method A cleanup levels for groundwater and shallow soil as described in sections 720 and 740 of WAC 173-340, were selected for the Site. Table 1 lists the selected cleanup levels for groundwater and shallow soil for chemicals of concern at the Site.

Table 1: Site cleanup levels for groundwater and shallow soil.

	Groundwater (µg/L)	**Soil** (mg/kg)
Benzene	5	0.03
Toluene	1000	7
Ethylbenzene	700	6
Xylenes	1000	9
TPH-G	800	30
TPH-D	500	2000
TPH-HO	500	2000

Reasons for using Method A levels for groundwater and soil at the Site are as follows:

WAC 173-340-720(1)(a) states, "Ground water cleanup levels shall be based on estimates of the highest beneficial use and the reasonable maximum exposure expected to occur under both current and potential future site conditions." Although there is no foreseeable potential for humans to be exposed to this groundwater, Method A cleanup levels were chosen for the Site.

WAC 173-340-704(1) states, "Method A may be used to establish cleanup levels at sites that have few hazardous substances and that meet one of the following criteria: (a) Sites undergoing a routine cleanup action as defined in WAC 173-340-200; or (b) Sites where numerical standards are available in this chapter or applicable state and federal laws for all indicator hazardous substances in the media for which Method A cleanup levels are used."

To ensure that soils and groundwater in the contaminant plume are reaching the established MTCA Method A cleanup levels, monitoring wells will be sampled quarterly (every 3 months).

8.0 INSTITUTIONAL CONTROLS

Institutional Controls are measures undertaken to limit or prohibit activities that may interfere with the integrity of a cleanup action or result in exposure to hazardous substances at the Site (WAC 173-340-440(1)). Since the cleanup action will leave residual contamination in soil and groundwater, institutional controls will be necessary to protect human health and the environment, and maintain the integrity of the cleanup action.

8.1 Types of Institutional Controls

Institutional controls that will be implemented for the Site include:

- Installation of physical measures such as locks to prevent tampering with on-site wells.
- Restrictive Covenants that prohibit the use of groundwater as a potable resource include notification to Ecology of the intent to convey any interest in the site, and provide long term maintenance of the basement floor slab, vapor, and LNAPL recovery and monitoring wells.

These controls will remain in place until the site meets the requirements of a no further action (NFA) determination from Ecology.

9.0 CLEANUP ACTIONS

9.1 Selected Cleanup Actions

The cleanup actions selected for the Site shall fulfill the threshold requirements put forth in WAC 173-340-360(2)(a), which include protecting human health and the environment, complying with cleanup standards, and complying with applicable state and federal laws. Other requirements in WAC 173-340-360(2)(b) state the selected action shall use permanent solutions to the maximum extent practicable, provide for a reasonable restoration time frame, and consider public concerns.

The cleanup action selected for the Site is the removal of shallow petroleum contaminated soils (PCS), the removal of LNAPL , deep soil hot spots and and monitored natural attention of dissolved-phase groundwater contamination.

9.2 Justification for Selected Cleanup Action

Justification for the selected cleanup actions is provided in the following sections that detail how the cleanup actions fulfill the requirements for a cleanup action set forth in WAC 173-340-360.

9.2.1 Threshold requirements – WAC 173-340-360(2)(a)

Protection of Human Health and the Environment

The selected cleanup actions address removal of contaminated soil to a depth of 18 feet bgs, removal of free product, natural attenuation of dissolved phased contaminants in groundwater. These actions will help to reduce the risk posed to humans and the environment at the Site.

Compliance with Cleanup Standards

The purpose of the selected cleanup actions is to reduce contaminant concentrations in the groundwater and soil at the Site to at or below Method A cleanup levels put forth in WAC 173-340-720 and WAC 173-340-740 or to provide containment of residual contamination left beneath the building that can not be exavated

Compliance with Applicable State and Federal Laws

The selected cleanup actions comply with all applicable state and federal laws.

Compliance Monitoring

A Site Health and Safety Plan will be used as guidance to protect workers and the public prior to, during, and after the proposed cleanup action. Groundwater samples will be taken and analyzed to monitor contaminant concentrations in the subsurface to confirm that the cleanup action is effective at reducing contaminant concentrations. Points of compliance for soil and groundwater will be defined based on the results of the off-site investigation and the final building design.

9.2.2 Other requirements – WAC 173-340-360(2)(b)

Permanent Solution

WAC 173-340-360(3) outlines the requirements and procedures for determining whether a cleanup action uses permanent solutions to the maximum extent practicable.

Reasonable Restoration Time Frame

The cleanup actions described in this CAP provide for a reasonable restoration time frame, as is outlined in WAC 173-340-360 (4). PCS removal activities at the site are estimated to take no more than one month. Restoration of groundwater through monitored natural attenuation will have a longer time frame, however the groundwater in the vicinity of the site is not currently used for domestic purposes, nor will it be in the foreseeable future.

9.3 Expectations for Cleanup Action Alternatives

Expectations for cleanup actions are listed in WAC 173-340-370. These expectations include, but are not limited to, the following:

- Emphasis on treatment technologies;
- Destruction, detoxification, and/or removal of hazardous substances;
- Use of engineering controls;
- Minimization of migration of hazardous substances;
- Consolidation, to the maximum extent practicable, of hazardous substances remaining onsite;
- Taking active measures to prevent/minimize the release of contaminants to surface water.

9.4 Evaluation Criteria

WAC 173-340-360(3)(f) puts forth the criteria for determining whether a cleanup action is "permanent to the maximum extent practicable." Following is a list of these criteria and a discussion of how the selected cleanup actions fulfill each of them.

Protectiveness – WAC 173-340-360(3)(f)(i)

The selected cleanup actions serve to remove contaminants in shallow soil and LNAPL from the water table. This, in turn, will reduce the leaching of contaminants to groundwater and will help to reduce contaminant concentrations to Method A cleanup levels for groundwater defined in

WAC 173-340-720. These actions also serve to protect against the risk of contaminant exposure to human health and the environment. The implementation of appropriate safety measures and engineered controls will also protect human health and the environment from exposure to contaminants in the groundwater, soil, and in the vapor phase during PCS excavation, and installation of the monitoring wells. The selected alternative will improve the overall environmental quality of the Site by reducing contaminant concentrations in the soil and over the long-term in groundwater.

9.4.2 Permanence – WAC 173-340-360 (3)(f)(ii)

The selected cleanup alternative will serve to permanently remove contaminants in soil from the surface to a depth of 18 feet bgs, and to reduce the volume and mobility of any contaminants remaining in the subsurface. The cleanup alternative will be effective in destroying the shallow hazardous substances at the Site by removal from the subsurface and processing in the treatment facility. Removal of LNAPL will enhance the natural attenuation process for groundwater cleanup. However, residual soil contamination above the MTCA Method A cleanup level will remain on the site below 18 feet bgs. The residual soil contamination will be contained beneath a cap of compacted soil and building floor slab.

9.4.3 Cost – WAC 173-340-360 (3)(f)(iii)

The cost of the cleanup action selected is not considered to be substantial and disproportionate to the incremental degree of protection it would achieve over a lower preference cleanup action.

9.4.4 Effectiveness over the long-term – WAC 173-340-360(3)(f)(iv)

The cleanup alternatives selected involve the permanent and effective removal of contaminants from the soil to the extent practicable and LNAPL from groundwater for natural attenuation. Long term institutional controls will be in place to assure protection of human health and the environment.

9.4.5 Management of short-term risks – WAC 173-340-360(3)(f)(v)

Steps will be taken and engineered controls employed to minimize exposure to contaminated soil and groundwater during the remedial excavation. A Safety Health and Safety Plan describes these steps and controls and will be followed at the Site.

9.4.6 Technical and administrative implementability – WAC 173-340-360(3)(f)(vi)

The proposed cleanup alternative is technically possible to implement at the Site.

10.0 ADDITIONAL REQUIREMENTS

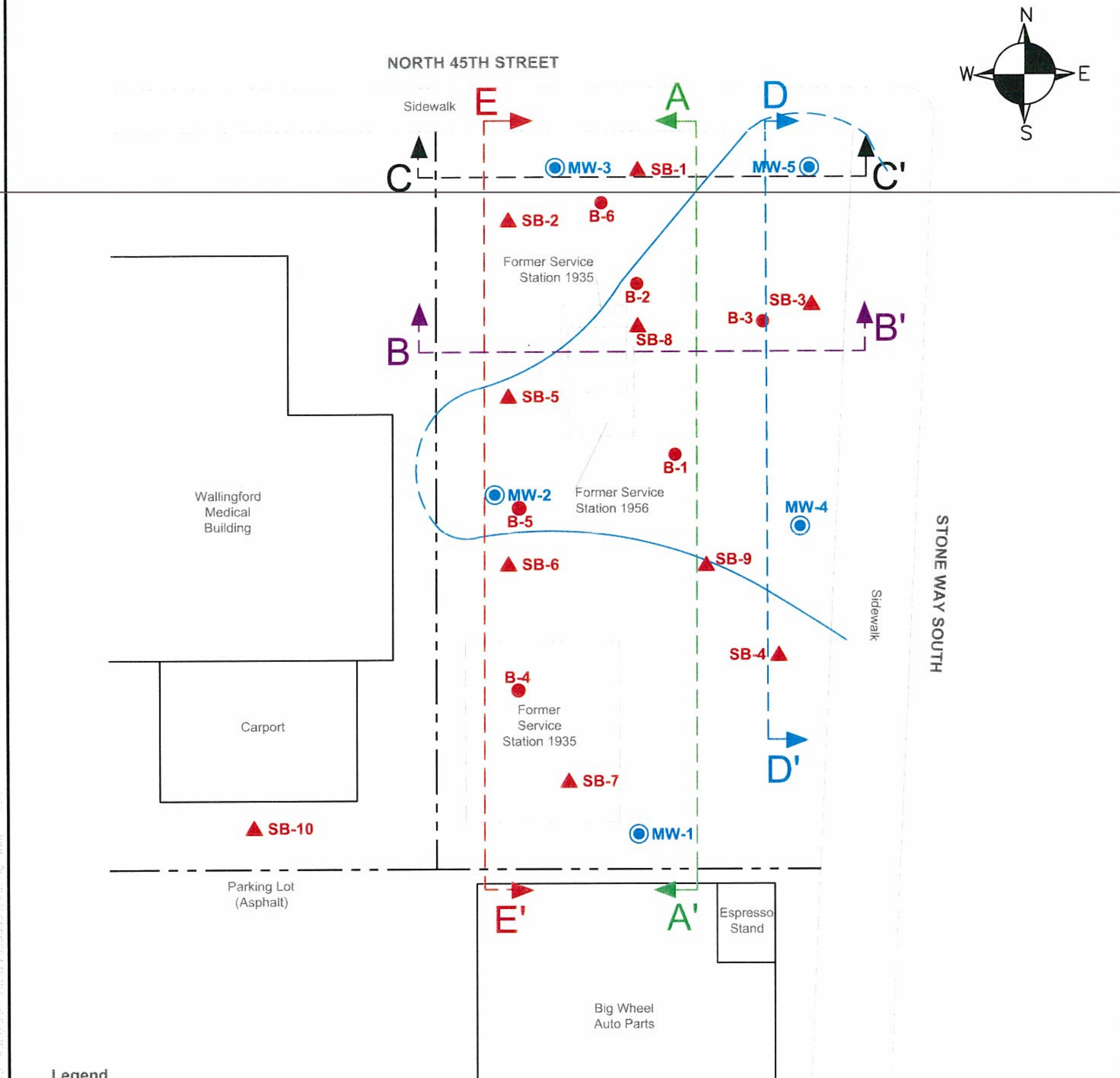
10.1 Compliance Monitoring

Requirements of Compliance Monitoring as stated in WAC 173-340-410 include:

a) Protection monitoring. Confirm that human health and the environment are adequately protected during construction and the operation and maintenance period of an interim action or cleanup action as described in the safety and health plan;
b) Performance monitoring. Confirm that the interim action or cleanup action has attained cleanup standards and, if appropriate, remediation levels or other performance standards such as construction quality control measurements or monitoring necessary to demonstrate compliance with a permit or, where a permit exemption applies, the substantive requirements of other laws;
c) Confirmational monitoring. Confirm the long-term effectiveness of the interim action or cleanup action once cleanup standards and, if appropriate, other performance standards have been attained.

10.2 Work Plan

A Remediation Work Plan will be submitted for review and comment prior to the start of remedial activities.



Legend

- MW-1 — Groundwater Monitoring Well Location
- SB-1 — Soil Boring Location
- B-1 — EA Soil Boring Location
- Contamination Above MTCA Method A
- Contamination Above MTCA Method A at depths <18 bgs
- Property Line
- A - A' — Profile A Location and Direction
- B - B' — Profile B Location and Direction
- C - C' — Profile C Location and Direction
- D - D' — Profile D Location and Direction
- E - E' — Profile E Location and Direction

0 10 20 40

1" = 20'

ChevronTexaco	Site Map	FIGURE
SAIC	Chevron Service Station 209335 1225 North 45th Street Seattle, Washington	1
	Date: August 11, 2004	

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (μg/kg)	Chemical
71432	2.60E+02	Benzene

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
15	183	457	1372	244	213	0	S		

Totals must add up to value of L_t (cell G28) (applies to h_A, h_B, h_C)

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
S	1.66	0.375	0.054	0.002	S	1.66	0.375	0.054	0.002					

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	9815	2865	244	0.1	11	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
75	6	30	15.2	1.0E-06	1

Used to calculate risk-based soil concentration.

END

RESULTS SHEET

RISK-BASED SOIL CONCENTRATION CALCULATIONS:

Indoor exposure soil conc., carcinogen (µg/kg)	Indoor exposure soil conc., noncarcinogen (µg/kg)	Risk-based indoor exposure soil conc., (µg/kg)	Soil saturation conc., C_{sat} (µg/kg)	Final indoor exposure soil conc., (µg/kg)
NA	NA	NA	3.20E+05	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
8.5E-08	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (μg/kg)	Chemical
108883	4.80E+04	Toluene

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
				Totals must add up to value of L_t (cell G28)					
15	183	457	1372	244	213	0	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
S	1.66	0.375	0.054	0.002	S	1.66	0.375	0.054	0.002					

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	9815	2865	244	0.1	11	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
75	6	6	15.2	1.0E-06	1

Used to calculate risk-based soil concentration.

END

RESULTS SHEET

RISK-BASED SOIL CONCENTRATION CALCULATIONS:

Indoor exposure soil conc., carcinogen (µg/kg)	Indoor exposure soil conc., noncarcinogen (µg/kg)	Risk-based indoor exposure soil conc., (µg/kg)	Soil saturation conc., C_{sat} (µg/kg)	Final indoor exposure soil conc., (µg/kg)
NA	NA	NA	2.25E+05	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	2.8E-02

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (μg/kg)	Chemical
100414	6.10E+04	Ethylbenzene

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
15	183	457	1372	244	213	0	S		

Totals must add up to value of L_t (cell G28)

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
S	1.66	0.375	0.054	0.002	S	1.66	0.375	0.054	0.002					

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	9815	2865	244	0.1	11	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
75	6	6	15.2	1.0E-06	1

Used to calculate risk-based soil concentration.

END

RESULTS SHEET

RISK-BASED SOIL CONCENTRATION CALCULATIONS:

Indoor exposure soil conc., carcinogen (µg/kg)	Indoor exposure soil conc., noncarcinogen (µg/kg)	Risk-based indoor exposure soil conc., (µg/kg)	Soil saturation conc., C_{sat} (µg/kg)	Final indoor exposure soil conc., (µg/kg)
NA	NA	NA	1.34E+05	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
7.5E-07	8.6E-03

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (μg/kg)	Chemical
106423	3.20E+05	p-Xylene

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Thickness of soil stratum A, h_A (cm) (Totals must add up to value of L_t (cell G28))	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
15	183	457	1372	244	213	0	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
S	1.66	0.375	0.054	0.002	S	1.66	0.375	0.054	0.002					

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	9815	2865	244	0.1	11	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
75	6	6	15.2	1.0E-06	1

Used to calculate risk-based soil concentration.

END

RESULTS SHEET

RISK-BASED SOIL CONCENTRATION CALCULATIONS:

Indoor exposure soil conc., carcinogen (µg/kg)	Indoor exposure soil conc., noncarcinogen (µg/kg)	Risk-based indoor exposure soil conc., (µg/kg)	Soil saturation conc., C_{sat} (µg/kg)	Final indoor exposure soil conc., (µg/kg)
NA	NA	NA	1.56E+05	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	2.9E-03

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: Risk/HQ or risk-based soil concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END