

**DRAFT  
REMEDIAL INVESTIGATION AND  
FEASIBILITY STUDY**

FORMER BAYLINER MARINE  
17825 59TH AVENUE NE  
ARLINGTON, WASHINGTON 98223



August 10, 2010



**DRAFT REMEDIAL INVESTIGATION AND  
FEASIBILITY STUDY**

**FORMER BAYLINER MARINE  
17825 59<sup>TH</sup> AVENUE NE  
ARLINGTON, WASHINGTON 98223**

**STANTEC PN: 190402125**

**Submitted by:**

Stantec Consulting Corporation  
9400 SW Barnes Road Suite 200  
Portland, Oregon 97225

**Prepared for:**

Brunswick Corporation  
1 North Field Court  
Lake Forest, Illinois 60045

**Date**

**August 10, 2010**

**Prepared by:**

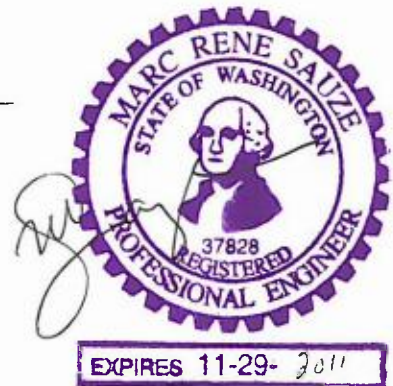
A handwritten signature in blue ink, appearing to read "Ross R. Simmons".

Ross R. Simmons  
Principal Consultant

**Reviewed by:**

A handwritten signature in blue ink, appearing to read "John McInnes".

John McInnes  
Managing Principal Geologist



Mark Sauze, PE.  
Senior Engineer

---

## **Table of Contents**

---

<b>1.0 INTRODUCTION .....</b>	<b>1</b>
1.1 SUBJECT PROPERTY DESCRIPTION .....	1
<hr/>	
<b>2.0 REMEDIAL INVESTIGATION.....</b>	<b>2</b>
2.1 OVERVIEW OF PRIOR INVESTIGATIONS .....	2
2.1.1 Phase I ESA – April 2009 .....	2
2.1.2 Phase II ESA – June 2009 .....	3
2.1.3 Environmental Site Investigation – December 2009 .....	4
2.1.4 Additional Site Characterization – February-March 2010.....	4
2.2 ONGOING GROUNDWATER MONITORING .....	4
2.3 VAPOR INTRUSION RISK SCREENING.....	6
2.4 PROPERTY DEVELOPMENT AND HISTORY .....	7
2.5 PHYSIOGRAPHIC SETTING OF PROPERTY.....	8
2.6 GEOLOGIC/HYDROGEOLOGIC SETTING .....	8
2.7 CONCEPTUAL SITE MODEL .....	10
2.7.1 Area of Concern .....	10
2.7.2 Contaminants of Concern.....	11
2.7.3 Potential Sources of Contamination.....	11
2.7.4 Affected Media .....	12
2.7.4.1 Groundwater .....	12
2.7.4.2 Surface Water .....	13
2.7.4.3 Air .....	13
2.7.4.4 Soil.....	13
2.7.4.5 Sediment.....	13
2.7.5 Environmental Receptors .....	14
2.7.5.1 Human Receptors .....	14
2.7.5.2 Ecological Receptors.....	14
2.7.6 Potential Exposure Pathways .....	14
2.7.6.1 Groundwater – Direct Exposure .....	15
2.7.6.2 Groundwater - Ingestion.....	15
2.7.6.3 Surface Water .....	15
2.7.6.4 Indoor Air – Inhalation of Vapors .....	15
2.7.6.5 Ambient Air – Inhalation of Vapors .....	16
2.7.6.6 Soil – Direct Exposure and Ingestion.....	16
2.8 CLEANUP STANDARDS .....	16
2.8.1 Cleanup Levels .....	17
2.8.2 Points of Compliance .....	18
2.8.3 Applicable State and Federal Laws .....	18
<hr/>	
<b>3.0 FEASIBILITY STUDY .....</b>	<b>19</b>
3.1 OVERVIEW OF CLEANUP ACTION ALTERNATIVES .....	19
3.2 EVALUATION CRITERIA.....	20

**Table of Contents**

3.3 SUMMARY OF CLEANUP ACTION COMPONENTS .....21

    3.3.1 In Situ Chemical Oxidation (ISCO) .....21

    3.3.2 Air Sparging and Soil Vapor Extraction (AS/SVE).....22

    3.3.3 Groundwater Extraction and Treatment (GWET) .....24

    3.3.4 Monitored Natural Attenuation (MNA).....25

    3.3.5 Institutional Controls (IC) .....26

    3.3.6 No Action.....28

3.4 DETAILED EVALUATION OF CLEANUP ACTION ALTERNATIVES.....28

    3.4.1 Alternative #1 – Site-Wide In Situ Chemical Oxidation and Monitored Natural Attenuation .....28

        3.4.1.1 Threshold Criteria.....28

        3.4.1.2 Other Evaluation Criteria .....29

    3.4.2 Alternative #2 – Monitored Natural Attenuation and Institutional Control .....31

        3.4.2.1 Threshold Criteria.....31

        3.4.2.2 Other Evaluation Criteria .....32

    3.4.3 Alternative #3 – Source-Area In Situ Chemical Oxidation, Monitored Natural Attenuation and Institutional Control.....34

        3.4.3.1 Threshold Criteria.....34

        3.4.3.2 Other Evaluation Criteria .....35

    3.4.4 Alternative #4 – Source Area Air Sparging/Soil Vapor Extraction, Monitored Natural Attenuation and Institutional Control.....37

        3.4.4.1 Threshold Criteria.....37

        3.4.4.2 Other Evaluation Criteria .....38

    3.4.5 Alternative #5 – Source-Area Groundwater Extraction and Treatment, Monitored Natural Attenuation and Institutional Control.....40

        3.4.5.1 Threshold Criteria.....40

        3.4.5.2 Other Evaluation Criteria .....41

            3.4.5.2.2 Restoration Time Frame.....41

    3.4.6 Alternative #6 – No Action .....43

        3.4.6.1 Threshold Criteria.....43

        3.4.6.2 Other Evaluation Criteria .....44

3.5 DISPROPORTIONATE COST ANALYSIS .....44

---

**4.0 SELECTION OF PREFERRED CLEANUP ACTION ALTERNATIVE.....46**

**APPENDICES**

Appendix A      Figures

                    Figure 1 – Site Location Map

                    Figure 2 – Site Plan With Sampling Locations

                    Figure 3 – Site Plan With Groundwater Elevations-May 26, 2010

                    Figure 4 – Site Plan With PCE Concentrations in Groundwater

                    Figure 5 - Disproportionate Cost Comparison

## **Table of Contents**

Appendix B	Tables
	Table 1 – Monitoring Well Data
	Table 2 – VOCs in Groundwater
	Table 3 – Evaluation of Remedial Alternatives
	Table 4 – Detailed Cost Estimate Worksheet
	Table 5 – Comparison of Benefits and Costs for Cleanup Action Alternatives
Appendix C	Groundwater Sampling Data Sheets – May 2010
Appendix D	Indoor Air Laboratory Analytical Report – April 2010

## **1.0 INTRODUCTION**

---

This report presents a Remedial Investigation (RI) and Feasibility Study (FS) for an area of shallow groundwater impacted with Tetrachloroethylene (PCE) beneath the former Bayliner Marine property located at 17825 59<sup>th</sup> Avenue NE, Arlington, Snohomish County, Washington 98223 (the “Site”). This RI describes the contamination known to be present, available information about the source of the contaminants, the previous investigations completed to define the extent of the impacted area, and the potential routes of exposure and human health risk resulting from the contamination. The FS describes several potential alternatives for cleanup actions, evaluates the technical feasibility, effectiveness, protectiveness and cost of each alternative, and identifies the most appropriate remedial alternative.

The RI and FS have been prepared to address requirements under the Washington Model Toxics Cleanup Act (MTCA), as outlined in Washington Administrative Code (WAC) Chapter 173-340-350.

Previous investigations conducted at the Site have identified the presence of PCE in shallow groundwater at concentrations ranging from 5 to 59 micrograms per liter (µg/L). Several of the detected concentrations exceed the Method A Groundwater Cleanup Level (CUL) of 5 µg/L established under the Washington Model Toxics Control Act (MTCA), but are relatively low when compared to concentrations frequently found in industrial settings where groundwater has been impacted by PCE. The area of groundwater exhibiting detectable levels of PCE is limited within the boundaries of the former Bayliner Marine property, and is also limited vertically to depths ranging between 15 and 22 feet below ground surface (bgs).

### **1.1 SUBJECT PROPERTY DESCRIPTION**

The former Bayliner Marine property is a 32.8-acre industrial site developed with three office buildings and 13 industrial buildings constructed between 1969 and 1996. The subject property also includes employee parking lots, boat storage areas, and three stormwater retention ponds. The Subject Property operated as a fiberglass boat manufacturing facility from 1968 until operations ceased in December 2008. Prior to 1968, the Site consisted of undeveloped land.

Figure 1 in Appendix A depicts the location of the subject property. Figure 2 presents a Site Plan of the subject property.

## **2.0 REMEDIAL INVESTIGATION**

---

Results of the Remedial Investigation are presented in detail in four reports previously prepared by Stantec and submitted to the Washington Department of Ecology (Ecology):

- Phase I Environmental Site Assessment Report, dated April 3, 2009
- Phase II Environmental Site Assessment Report, dated June 25, 2009
- Environmental Site Investigation Report, dated December 23, 2009
- Additional Site Characterization Report, dated April 9, 2010

The following presents a summary of the information in these reports. The full original reports are incorporated, by reference, into this RI.

### **2.1 OVERVIEW OF PRIOR INVESTIGATIONS**

#### **2.1.1 Phase I ESA – April 2009**

Brunswick Corporation, the property owner, retained Stantec to complete the Phase I Environmental Site Assessment (ESA) in anticipation of the potential sale of the property. Based on review of historical records about the property, the Phase I ESA Report identified the following Recognized Environmental Conditions (RECs) associated with the subject property:

- Wastewater discharges from the facility were originally directed to two septic systems with leach fields on the subject property. All wastewater from the facility went to the on-site septic systems from 1968 until at least 1987. Bayliner buildings were gradually connected to the municipal sanitary sewer system between 1987 and 2005. Chemical waste constituents that may have been present in the wastewater discharges had the potential to migrate from the leach fields to subsurface soil and groundwater beneath the subject property.
- All stormwater catch basins and trench drains on the property discharged the collected stormwater to a series of three retention ponds along the southern boundary of the subject property. As such, there was a potential that chemical or petroleum contaminants that may have become entrained in stormwater runoff could have accumulated in sediments within the ponds or leached to underlying soil or groundwater.
- Ecology's underground storage tank (UST) database indicated that two USTs had been present on the subject property from 1964 until 1996. No other details about the location or fate of the tanks were located in records at the property or in files researched at the City of Arlington Fire Department. There was a potential that petroleum leaks or spills

that may have resulted from the operation of the tank systems could potentially cause contamination of subsurface soil or groundwater.

### **2.1.2 Phase II ESA – June 2009**

In response to the results of the Phase I ESA, Brunswick Corporation directed Stantec to complete a Phase II ESA to further evaluate the potential presence or absence of impacted soil, sediment or groundwater associated with the RECs discussed above. Key findings of the Phase II ESA are summarized below:

Former Underground Storage Tanks. Mr. Tad Blankenbaker, site manager at the Bayliner Marine facility, reported that he had worked at the subject property for 20 years, and that the USTs had been formerly located in the area just north of Building #11. Stantec also reviewed files pertaining to the former USTs at the Northwest Region office of Ecology in Bellevue, Washington. Ecology's records indicated that one 5,000-gallon aviation gasoline UST and one 9,000-gallon Jet-A UST were removed from the ground in April 1989. No further documentation, such as results of soil sampling conducted at the time of the removal, was present in the Ecology files.

Sampling of Soil, Groundwater and Pond Sediment. In May 2009, soil borings were completed using a hollow-stem auger drilling rig at seven locations (B-1 through B-7) selected to evaluate potential impacts from the areas of concern identified as RECs in the Phase I report. Locations of the Phase II ESA borings are depicted on Figure 2 in Appendix A. Samples of soil and groundwater from each location were collected for laboratory analyses. To evaluate potential accumulations of contamination in the three on-site retention ponds, Stantec collected surface sediment samples from the bottom of each pond.

The Phase II ESA identified an area of shallow groundwater impacted with PCE at concentrations above the MTCA Method A Groundwater CUL. The highest reported concentration of PCE was 42 µg/L at B-4, located in the area of a former septic system leach field near the southeast corner of Building #11. At B-5, approximately 200 feet northwest in the presumed downgradient direction from B-4, the reported PCE concentration was 31 µg/L. At B-6, which is near the northern property boundary approximately 800 feet in the presumed downgradient direction from B-4, the PCE concentration was 18 µg/L. Based on the data generated in this preliminary investigation, the lateral extent of PCE impact to the east and west appeared to be limited. No other VOCs were detected in the collected groundwater samples. No Semi-Volatile Organic Compounds (SVOCs) were detected in any of the groundwater samples.

The analytical results did not identify any compounds in soil at concentrations exceeding Method A Soil CUL for Unrestricted Site Use. Based on results of the Phase II ESA, there is no evidence of impact from the former USTs, or from stormwater discharges to the on-site retention ponds. The presence of PCE in shallow groundwater was the only impact identified during the Phase II ESA that warranted further investigation.

### **2.1.3 Environmental Site Investigation – December 2009**

Five groundwater monitoring wells (MW-1 through MW-5) were constructed to further characterize and confirm the Phase II findings. PCE was detected in groundwater at concentrations exceeding the MTCA Method A Groundwater CUL at MW-1 (near Building 11 in the south-center of the site) and at MW-4 (near the north-central perimeter of the facility). TCE was also detected in groundwater at MW-4. No VOCs were detected in groundwater at the other three well locations.

PCE was detected in soil at MW-1 and MW-4, at concentrations below the MTCA Method A Cleanup Level for residential soils. Consequently, further evaluation of PCE in soils at these locations was not warranted.

### **2.1.4 Additional Site Characterization – February-March 2010**

To further delineate the extent of PCE impact in groundwater, the following additional investigations were conducted in February, March and April 2010, with results presented in the April 2010 Additional Site Characterization report:

- Groundwater monitoring wells MW-6 and MW-7 were constructed on February 17, 2010.
- Soil borings B-8 and B-9 were constructed on February 18, 2010 and temporary monitoring wells were installed to facilitate groundwater sampling.
- Groundwater samples were collected on February 18, 2010 from monitoring wells MW-1 through MW-7 and from the temporary wells at B-8 and B-9.
- Seven additional soil borings were completed as temporary wells on March 19, 2010, and groundwater samples were collected.

The results of the February-March 2010 groundwater sampling confirmed that the area of PCE-impacted groundwater was limited to a fairly narrow band between MW-1 and MW-4, with the highest PCE concentrations found in the area of Building 11 (MW-1) in the south-central portion of the property.

## **2.2 ONGOING GROUNDWATER MONITORING**

A quarterly groundwater monitoring program was initiated in May 2010 for the seven existing on-site monitoring wells. Gauging and sampling of the seven wells took place on May 26, 2010. Static water levels in each well were measured using an electronic water-level indicator and recorded to the nearest 0.01 foot. After gauging, each well was purged using a peristaltic pump and USEPA-approved low-flow techniques (removing less than 0.5 liter per minute) while monitoring parameters of color, pH, temperature and conductivity. Purged groundwater was placed into a DOT-approved 55-gallon steel drum for temporary on-site storage pending results

of laboratory sample analyses. Static water level measurements and purging parameters are included in the Groundwater Sampling Data Sheets in Appendix C.

Details of monitoring well construction (e.g., total depth and screened interval), static water level measurements for three consecutive quarterly monitoring events, and calculated potentiometric surface elevations are summarized in Table 1 in Appendix B. Figure 3 in Appendix A depicts the May 2010 potentiometric surface elevation contours and inferred groundwater flow direction. Measured groundwater surface elevations and flow direction in May 2010 were generally consistent with the findings of previous monitoring events.

Following purging, groundwater samples were collected from each well using a peristaltic pump fitted with dedicated polyethylene tubing. Samples were decanted directly into clean, laboratory-supplied sample containers. The containers were immediately closed and labeled with a unique sample ID number, and placed into a cooler with ice for shipment to the project laboratory. Samples were maintained under chain-of-custody documentation until delivery to the laboratory.

The samples were shipped to Environmental Science Corporation (ESC) laboratories in Mt. Juliet, Tennessee for analysis of volatile organic compounds (VOCs) by USEPA Method 8260B. One quality control duplicate sample and one trip blank sample were also submitted for analysis to facilitate QA/QC evaluation.

PCE was the only VOC detected in any of the groundwater samples. PCE was present in the sample from MW-1 at a concentration of 50 micrograms per liter ( $\mu\text{g/L}$ ). This is roughly consistent with the results of previous sampling events at MW-1, and exceeds the MTCA Method A Groundwater CUL of 5  $\mu\text{g/L}$ .

The PCE concentration at MW-4 of 5.0  $\mu\text{g/L}$  is lower than in previous sampling events, and equals the MTCA Method A Groundwater CUL. PCE was not detected above the laboratory's method reporting limit (MRL) in any of the other groundwater samples.

The laboratory reported a PCE concentration of 46  $\mu\text{g/L}$  in the duplicate sample collected from MW-1. VOCs were not detected above the laboratory MRLs in the trip blank. The samples were analyzed at the laboratory within the required holding time for the analytical method, and surrogate recovery and other QA/QC parameters appear to have been within appropriate limits.

The next groundwater monitoring event is scheduled for the Third Quarter in August 2010.

Groundwater VOC analytical results from the May 2010 event and previous sampling events are presented in Table 2 in Appendix B.

## **2.3 VAPOR INTRUSION RISK SCREENING**

Site soil and groundwater data were compared to vapor intrusion screening levels being considered by Ecology as identified in the draft “Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action” (SVI Guidance). The initial screening determined that the highest PCE concentrations in groundwater at the site exceeded generic groundwater screening levels for vapor intrusion risks for PCE.

To further assess the potential for vapor intrusion concerns, the USEPA Johnson & Ettinger model was used to predict maximum concentrations of PCE in indoor air. The results of the modeling showed that cumulative excess cancer risk (ECR) for PCE using a model-defined hypothetical residential building exceeded the lower bound of the discretionary risk range (an ECR of  $1 \times 10^{-6}$ ). The predicted indoor air concentration of 12.3 micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ) would exceed the Method B ( $0.42 \mu\text{g}/\text{m}^3$ ) and Method C ( $4.2 \mu\text{g}/\text{m}^3$ ) indoor air cleanup levels identified in the draft SVI Guidance. The draft SVI Guidance indicates Method B is intended for residential settings, and Method C is intended for industrial settings. Although these calculations suggest a potential for vapor intrusion, they employ numerous conservative assumptions and likely overestimate the potential vapor intrusion risk. For example the model uses a conservative assumption of residential property use, however, the current and anticipated future use of the property is industrial. Further, the risk evaluation is based upon an assumed continuous exposure to the maximum concentration of PCE over the entire exposure duration, without considering possible reductions in contaminant concentrations over time, or that much lower concentrations of PCE were detected throughout the property.

PCE was detected in a sub-slab soil vapor sample collected beneath the floor of Building 11 in March 2010 at a concentration of  $2,700 \mu\text{g}/\text{m}^3$ . Using conservative default factors to estimate attenuation of the vapor through the floor slab, this concentration suggested a need to sample indoor air to determine if a potential existed for PCE to exceed the Method B and Method C levels identified in the draft SVI Guidance. Details of this evaluation were provided in the April 2010 Additional Site Characterization report.

In April 2010, two indoor air samples were collected in Building 11, and one indoor air sample each was collected from Buildings #4, #8, #10, #14 and #17. The samples were submitted to Air Toxics, Ltd. Laboratory of Folsom, California for analysis of selected VOCs by USEPA Method TO-15 (GC/MS SIM). PCE was not detected above the laboratory MRL of  $0.21 \mu\text{g}/\text{m}^3$  in four of the seven samples. PCE was detected in the two samples from Building #11 at concentrations that were below the proposed CUL established under MTCA Method B ( $0.42 \mu\text{g}/\text{m}^3$ ). The highest PCE concentration ( $1.2 \mu\text{g}/\text{m}^3$ ), reported for the sample from Building #14, is above the proposed Method B CUL of  $0.42 \mu\text{g}/\text{m}^3$  for residential settings, but below the proposed Method C CUL of  $4.2 \mu\text{g}/\text{m}^3$  for industrial settings.

Laboratory analytical reports for the indoor air samples are provided in Appendix D.

## **2.4 PROPERTY DEVELOPMENT AND HISTORY**

Historic uses of the subject property and adjoining properties are described in detail in the March 2009 Phase I ESA report. The subject property was undeveloped land prior to 1968, when it was developed as a fiberglass boat manufacturing plant. Building #4, constructed in 1969, was the first manufacturing building on the site. Other buildings were added between 1971 and 1996. The facility operated continuously as a fiberglass boat manufacturing plant from 1968 to 2008.

According to the City of Arlington Development Services office, the property has a current zoning designation of GI (general industry). Potable water is supplied to the site by the City of Arlington, and electrical power is serviced by Snohomish Public Utility District.

Floor trench drains are present in Buildings #3, #4 and #10. According to Bayliner facility personnel, these drains discharge to the retention ponds on the south side of the property. Exterior stormwater drains from around the property also are routed to the retention ponds. Sanitary sewage from sinks and toilets within the buildings originally discharged to two on-site septic systems. Maps reviewed in the records of the Snohomish County Health Department depict the septic leach field locations to be as shown on Figure 2 in Appendix A. One of the leach fields was located between Building #6 and Building #12. The other was just outside the southeast corner of Building #11. According to a sewer permit technician with the City of Arlington, the septic systems were decommissioned and the subject property buildings were gradually connected to the municipal sanitary sewer between 1987 and 2005.

The subject property is located in an area of moderately dense industrial and commercial development. It is bordered on the north by 180<sup>th</sup> Street NE. Across 180<sup>th</sup> Street are three parcels:

- Across the street from the northwest portion of the property is Campbell and Neilson Auto Wrecking (18021 59<sup>th</sup> Avenue NE). According to reasonably ascertainable records, this area was undeveloped land prior to construction of the auto wrecking facility in the late 1990s.
- Land across the street from the north-central portion of the subject property is and has always been undeveloped.
- Across the street from the northeast portion of the subject property is undeveloped land that is part of the Stella-Jones wood preserving plant (6520 188<sup>th</sup> Street NE). The undeveloped land covers approximately 28 acres known as Parcel B. Portions of Parcel B have historically been used by Stella-Jones for storage of untreated wood and for pole peeling. No wood treating has ever occurred on Parcel B. The Stella-Jones facility treats telephone and power poles using a pressure-treating process with a solution of 5 percent pentachlorophenol (PCP) in a base oil carrier. An alternate treatment process using Copper Naphthanate was added to the facility in approximately 2002-2003. The

pole treatment operations are located in the northern part of the Stella-Jones facility, more than 1,500 feet north of the subject property. The wood treating facility began operation in the mid-1960s.

The subject property is bordered on the east by a currently vacant former manufacturing building (address and former tenants unknown). Further to the east are a Burlington Northern Railroad line, smaller commercial structures, and 67<sup>th</sup> Avenue NE. A residential neighborhood beyond 67<sup>th</sup> Avenue to the east was developed beginning in the late 1980s. The adjoining land to the south is and has always been undeveloped.

To the west of the subject property is 59<sup>th</sup> Avenue NE. The Arlington Municipal Airport has been present across the street to the west since the mid-1950s.

## **2.5 PHYSIOGRAPHIC SETTING OF PROPERTY**

According to the USGS 7.5-minute topographic map for the Smokey Point, Washington quadrangle (1981), the subject property is situated at an elevation of approximately 133 feet above mean sea level (MSL). The general topographic gradient in the vicinity is toward the northwest. The area to the north, south and west is relatively flat, sloping downward slightly toward the Stillaguamish River approximately 1.4 miles to the northwest. However, an area of low hills rise steeply just to the east of the subject property, reaching to ridges of up to 350 feet above MSL within less than one-half-mile.

The subject property is underlain by Lynnwood loamy sand soils. Lynnwood soils have generally high infiltration rates and are considered to be well-drained to excessively-drained sands and gravels. The nearest surface water bodies are the Middle Fork of Quilceda Creek, approximately 0.4 miles south of the subject property, and Portage Creek about 1.1 mile north of the subject property. According to the U.S. Fish & Wildlife Service National Wetlands Mapper (<http://www.fws.gov/wetlands/Data/Mapper.html>), the nearest identified wetland areas are approximately 0.75 miles southeast and 1.5 miles northwest of the subject property.

## **2.6 GEOLOGIC/HYDROGEOLOGIC SETTING**

Observed subsurface soils in the subject property borings consist of fine-to-coarse-grained sand with traces of gravel. Similar soil conditions were noted at all depth intervals in all of the borings, with the only noticeable difference being slight variation in the amount of gravel. Static water levels (SWL) recorded in well monitoring events in December 2009, February 2010 and May 2010 are provided in Table 1 in Appendix B. Measured SWL has ranged between 15 and 22 feet bgs. Variation in SWL over that time has been between 2 to 3 feet.

Top-of-casing elevations surveyed for each well have been used to determine the relative potentiometric surface elevation at each well location, the average gradient across the site, and the direction of groundwater flow. Groundwater flow direction has been toward the west-northwest, with the gradient ranging from 0.0034 feet per foot (ft/ft) in December 2009 to 0.0029

**DRAFT REMEDIAL INVESTIGATION AND FEASIBILITY STUDY  
Former Bayliner Marine – Arlington, Washington  
REMEDIAL INVESTIGATION**August 10, 2010

---

ft/ft in February and May 2010. Figure 3 in Appendix A presents potentiometric surface elevation contours and inferred groundwater flow direction from May 2010.

Water well logs reviewed at the Department of Ecology web site (<http://apps.ecy.wa.gov/welllog/scripts/mapresults3.asp>) identified approximately 136 wells within a 0.5 mile radius of the subject property. The majority of the wells were located upgradient (60) or cross-gradient (60) from the subject property. Of the 16 well logs from the downgradient quadrant, 15 are listed in the ¼ section directly northwest of the subject property (T31N, R03E, Section 22, SE ¼ of the NW ¼). Fourteen of those are listed as resource protection wells (monitoring wells). One well is listed as a City of Arlington municipal water supply well, located approximately 1,500 feet north-northwest from the northwest corner of the subject property. The City well is reported to be 185 feet deep, with a screened interval between 151 and 181 feet bgs. According to the web site for the City of Arlington Department of Public Works, (<http://www.ci.arlington.wa.us/documents/PW%20Utilities/annual%20water%20report%202007%20for%20web.pdf>), the well supplies 2 percent of the City's overall water supply.

The physiographic features and rock units of the Arlington area represent the end product of a complex geologic process. The glacially derived sands and gravels of Pleistocene age are the most recent deposits in the area, and various units of this group serve as the major aquifers in the area<sup>1</sup>.

The Stillaguamish sand member is an outwash deposit which accumulated to a thickness of about 200 feet at a time when the melting ice temporarily blocked the river at the north end of Getchell Hill and caused the Stillaguamish drainage to pass southward through a spillway now followed by the Pilchuck River<sup>2</sup>. The deposits are largely fine sand and clay but contain much coarser material towards the top and especially around the margin opposite points of tributary-stream debouchments. Review of well logs<sup>3</sup> in the region confirms the presence of significant, discontinuous layers of clay within the sand aquifers.

The well construction log for the City of Arlington water supply well does not indicate the presence of a confining layer in the stratigraphy at the site. However, a layer of fine sand with yellow clay was logged from 103 to 112 feet bgs. This layer of sand and clay is below the shallow water bearing zone and above the well screen interval and lower water bearing unit. The continuity of this lower permeability layer is unknown.

---

<sup>1</sup> Report On The Geology And Ground-Water Resources Of The Arlington Heights, Snohomish County, Washington, Paul A. Eddy, 1970. Open-File Technical Report 70-01

<sup>2</sup> Geology and Ore Deposits of the Sultan Basin, Snohomish County, Washington Bulletin No. 36 Ward Carithers and A. K. Guard, 1945

<sup>3</sup> Water well logs, Washington State Department of Ecology web site (<http://apps.ecy.wa.gov/welllog/scripts/mapresults3.asp>)

## **2.7 CONCEPTUAL SITE MODEL**

This Conceptual Site Model (CSM) summarizes technical information about impacted media at the site and evaluates potential exposure routes. The CSM identifies:

- Area of concern
- Contaminants of concern
- Potential sources of contamination
- Potential migration pathways for contaminants of concern
- Potential environmental receptors

This CSM has been prepared in general accordance with the American Society for Testing and Materials (ASTM) Standard Guide E1689-95 (2003) *Developing Conceptual Site Models for Contaminated Sites*. The model is based on the data obtained in site investigations to date, as described in Sections 2.1 through 2.3. The CSM is dynamic and will be updated with additional information as it is obtained.

### **2.7.1 Area of Concern**

The Area of Concern (AOC) is defined as the extent of shallow groundwater beneath the Bayliner property where PCE concentrations have been detected exceeding the MTCA Method A CUL of 5 µg/L. Site data indicates that the AOC is approximately 200 feet wide, extending south to north for approximately 800 feet between MW-1 and MW-4, and at depths ranging between 15 and 22 feet bgs.

PCE groundwater data is presented in Table 2 in Appendix B. The highest PCE concentrations have been found in the area of the septic system leach field immediately south of Building #11 (MW-1, B-14 and B-15). VOCs have not been detected at the upgradient well (MW-3) located near the property boundary southeast of MW-1.

The eastern extent of the VOC plume has been defined by the low PCE concentrations at B-2 (1.5 µg/L) and B-3 (3.3 µg/L) and the absence of VOCs in the groundwater samples collected from MW-6, B-1, B-12, B-9 and B-13. The western extent of the PCE impact is defined by the absence of PCE in samples from MW-2, MW-5, MW-7, B-7, B-8, B-10 and B-11.

The northern boundary of PCE impact extends to MW-4 where PCE in groundwater decreased from 13 µg/L in December 2009 to 5.0 µg/L in May 2010. PCE has not been detected at MW-7 located near the northern property boundary approximately 85 feet northwest of MW-4. Consequently, the data indicates that the downgradient reach of the VOC-impacted groundwater does not extend beyond the property line. In addition, PCE has not been detected

in MW-5 which is also located near the northern property boundary approximately XX feet west of MW-4, nor B-8 which was located approximately XX feet northwest of MW-4.

Depth discrete grab groundwater samples collected from borings (B-14 and B-16) placed downgradient of the proposed source area (former septic system leachfield) were reported to contain detectable concentrations of PCE extending to a depth of approximately 36 feet bgs. No VOCs were detected in groundwater samples collected at a depth of 44-48 feet from B-14, and 46-50 feet from B-16.

Soil samples have been collected for laboratory analyses from 23 boring locations across the site. No VOCs, SVOCs, or metals were identified in any of those samples at concentrations that exceed the most stringent MTCA Method A soil CUL. Based on this data, there are no known areas of contaminated soil for which a cleanup action is warranted.

### **2.7.2 Contaminants of Concern**

The initial rounds of investigation at the site analyzed soil, groundwater and retention pond sediment for the presence of VOCs, SVOCs, and RCRA metals. These were selected as parameters indicative of chemicals and waste products likely to have been present at the Bayliner facility. PCE in groundwater is the only compound identified at the site at concentrations exceeding Method A CUL. TCE was detected at a concentration of 13 µg/L in the December 2009 groundwater sample collected from MW-4. However, TCE has not been detected in the subsequent sampling events at MW-4, nor in any other site monitoring wells. No other VOCs, SVOCs or metals were found in groundwater at concentrations above the Method A Groundwater Cleanup Level. No VOCs, SVOCs or metals concentrations were found that exceeded the Method A Residential Soil cleanup levels.

Consequently, this RI/FS and any future investigations at the site will focus on PCE in groundwater as the sole Contaminant of Concern.

### **2.7.3 Potential Sources of Contamination**

The review of property history provided in the Phase I ESA report identified three potential sources of releases to the subsurface environment: the former underground fuel storage tanks, the three stormwater retention ponds, and the former two septic system leach fields. The soil and groundwater investigations did not find evidence of any releases from the fuel tanks. No VOCs, SVOCs, or metals were detected at concentrations above Method A residential soil cleanup levels in sediment samples collected from the retention ponds. However, PCE was identified in groundwater.

The highest concentrations of PCE in groundwater were found in the samples located near the former septic system leach field near Building #11 (MW-1 and B-4), with the next highest concentrations in the samples from the downgradient side of Building #11 (B-5, B-14, B-15). The location of underground utility lines through the area of the former septic system leach field

prevented the placement of soil borings directly into what is believed to be the exact location of the former septic system leach field. However, soil samples from the borings near the edge of the leach field (MW-1 and B-4) contained low concentrations of PCE (0.025 µg/L and 0.0049 µg/L, respectively) that appear more likely to represent capillary zone smearing of PCE from the groundwater than remnants of a historic subsurface PCE release to the leach field.

According to interviews with Bayliner facility personnel and representatives of Brunswick Corporation (owner of the Bayliner facility) there is no known history of PCE storage or use at the facility. PCE has not been an effective solvent for use with the fiberglass materials in the boat manufacturing process, and therefore is not typically present at such facilities. The relatively low detected concentrations of PCE in groundwater suggest that the quantity of PCE released was small, and probably not related to routine use at the facility.

Although the origin of the PCE impacts cannot be confirmed in the absence of an identifiable point source in the soil, it is assumed that small quantities of PCE were used for a brief time at the facility. It appears possible that a small quantity of PCE could have been disposed into sink drains at the facility which discharged to the septic system leach field near Building #11, resulting in leaching of the contaminant into the underlying shallow groundwater.

The Bayliner facility began operations in 1968, and decommissioning of the septic systems at the site started in 1986. Thus, it is quite possible that the releases(s) of PCE occurred 25 to 40 years ago, and that impacts to soil in the leach field area have naturally degraded over time.

For purposes of this RI, the source area of the PCE contamination is considered to be the septic system leach field near the southeast corner of Building #11. As evidenced by the absence of residual soil impact, it is likely that PCE present in soil, if any, has attenuated over time to the point that cleanup actions for soil are now not warranted.

## **2.7.4 Affected Media**

### **2.7.4.1 Groundwater**

Groundwater beneath the former Bayliner facility is impacted with low concentrations of PCE which exceed the Method A Groundwater CUL of 5 µg/L. The highest concentration of PCE in groundwater at the site was 59 µg/L, as was detected in the sample collected from MW-1 in December 2009. MW-1 is located immediately adjacent to the presumed source area. The contaminated groundwater is estimated to exist at depths ranging between 15 and 22 feet bgs, over an area approximately 200 feet wide and extending south to north for approximately 800 feet between MW-1 and MW-4. The area of PCE impact is limited within the property boundaries of the former Bayliner facility.

#### **2.7.4.2 Surface Water**

With the exception of the three on-site retention ponds, there are no surface water bodies within 2,000 feet of the site. No contaminated media has been identified at the ground surface where contact with stormwater runoff is possible, and all on-site runoff is contained within the on-site retention ponds, with no discharge to off-site water bodies. As such, there is no known impact to surface water resulting from the presence of PCE at the Bayliner property.

#### **2.7.4.3 Air**

Migration of PCE by the air pathway can occur due to the solvent's high potential for volatilization from liquid to gas. One sub-slab soil gas sample collected in March 2010 beneath Building #11 indicated that PCE vapors had accumulated beneath the slab of the building. However, indoor air samples collected in April 2010 in Buildings #4, #8, #10, #11, #14 and #17 found that PCE concentrations in the indoor air were below the applicable indoor air CUL. Consequently, there is no apparent impact to indoor air as a result of the PCE-contaminated groundwater.

The entire Bayliner property is covered by buildings or paved surfaces, minimizing the risk for migration of PCE vapors to ambient outdoor air. A sample of ambient air was collected in April 2010 concurrent with the indoor air samples discussed above. PCE was detected at a low concentration of 0.33  $\mu\text{g}/\text{m}^3$ . The presence of PCE in ambient air cannot be attributed to subsurface PCE contamination due to the presence in the ambient air sample of low concentrations of other VOCs that are not present in the subsurface. Based on the ambient air sample data and the impervious surfaces across the site, there is no apparent impact to ambient air as a result of the PCE-contaminated groundwater.

#### **2.7.4.4 Soil**

Soil sampling conducted at the site has not identified the presence of PCE in soil at concentrations above the Method A CUL for Residential Soils. Consequently, there is no apparent PCE impact to soil at the site.

#### **2.7.4.5 Sediment**

Sampling of sediment from the bottom of the three on-site retention ponds did not identify the existence of PCE at concentrations exceeding the laboratory MRL. Surface sediment and dust are covered by paved surfaces throughout the rest of the site. Therefore, there is no known impact to sediment stemming from the presence of PCE at the site.

## **2.7.5 Environmental Receptors**

### **2.7.5.1 Human Receptors**

The former Bayliner facility is located in an area of predominantly industrial and commercial property use. The nearest residences are east of 67<sup>th</sup> Avenue, about 1,800 feet away (cross-gradient or upgradient) of the area of groundwater impact. Potential on-site or downgradient human receptors in the vicinity include on-site workers and visitors, construction workers for any future excavation activity associated with site redevelopment, and workers at off-site business locations.

Exposure of any on-site or potential off-site human receptor groups to the contaminated groundwater is unlikely, based on the following factors:

- Impacted groundwater is contained within the property boundaries;
- The absence of impacted soil;
- The absence of indoor air concentrations above MTCA criteria;
- The depth of the affected groundwater; and,
- The absence of any nearby pumping wells.

### **2.7.5.2 Ecological Receptors**

The former Bayliner facility is located in an area of commercial/industrial land use. The subject property is covered entirely by buildings or paved surfaces except for a narrow strip of landscaping along the streets on the north and west perimeters. Plants on the subject property are limited to grass and shrubs or small trees used in landscaping. Similar conditions exist on neighboring developed properties, while undeveloped properties to the north and south feature grass, weeds and invasive undergrowth such as Himalayan Blackberry. No wildlife species are known to exist at the former Bayliner facility. Therefore, ecological receptors are not considered a factor at the former Bayliner facility.

## **2.7.6 Potential Exposure Pathways**

Migration or “exposure” pathways are routes potentially taken by contaminants as they migrate away from the contaminant source location through environmental media to potential environmental receptors. In order for an exposure pathway to be complete, each of the following elements must be present<sup>4</sup>:

- A mechanism of contaminant release from primary or secondary sources;

---

<sup>4</sup> ASTM Standard Guide E1689-95 *Developing Conceptual Site Models for Contaminated Sites*

- A transport medium, if potential environmental receptors are not located at the source; and,
- A point of potential contact between environmental receptors and the contaminated medium.

Possible migration pathways for a given site might include groundwater, surface water, air, sediment, and soils. Descriptions of each of the potential migration pathways are presented below.

#### **2.7.6.1 Groundwater – Direct Exposure**

Given the depth of groundwater (15 to 22 feet bgs), direct contact is unlikely. No groundwater supply wells exist on the site, and future installation of water supply wells is highly unlikely since adequate potable water is provided to the site by the City of Arlington's municipal water supply system. In addition, the property owner intends to implement an Institutional Control (restrictive covenant) prohibiting future extraction and use of on-site groundwater as long as PCE impacts are present.

Based on review of well logs filed with the state, the nearest existing potable water supply well is the City of Arlington's municipal supply well located approximately 1,500 feet northwest of the Bayliner property. Since PCE-contaminated groundwater does not extend beyond the Bayliner property boundary, there is no impact to the City well. Furthermore, the City well pumps from a depth of 150 to 180 feet bgs, while the PCE-impacted groundwater at the site is limited to depths between approximately 15 and 35 feet bgs.

#### **2.7.6.2 Groundwater - Ingestion**

As discussed above, no groundwater supply wells currently exist in or near the contaminated area, so there is no current complete pathway for ingestion of PCE-contaminated groundwater.

#### **2.7.6.3 Surface Water**

There are no surface water bodies within 2,000 feet of the site except for the on-site retention ponds, and no contaminated media present at the ground surface where contact with stormwater runoff is possible. As such, the surface water exposure pathway is incomplete.

#### **2.7.6.4 Indoor Air – Inhalation of Vapors**

There is a potential for vapors volatilized from PCE in the subsurface to accumulate beneath the concrete floor slabs of site buildings. One sub-slab vapor sample obtained beneath Building #11 indicates that such vapor accumulation may be occurring. This, in turn, creates a potential for such vapors to migrate through the slab, or to migrate via cracks and other penetrations in the slab, into the building. Vapor migration into the building envelope is affected by a variety of

factors such as thickness and integrity of the floor slab, ventilation and air temperature within the building, and operation of fans, HVAC systems and other equipment that affect air movement within the building.

PCE was detected in indoor air samples collected in April 2010 in Buildings #4, #8, #10, #11, #14 and #17, respectively. However, all detected concentrations were below the draft indoor air CUL<sup>5</sup>. Consequently, although data suggest that the vapor exposure pathway is complete, there is no evidence that PCE in indoor air may result in unacceptable health risks.

### **2.7.6.5 Ambient Air – Inhalation of Vapors**

A sample of ambient (outdoor) air was collected in April 2010 concurrent with the indoor air samples discussed above. PCE was detected, albeit at a very low concentration. Although the source of PCE in outdoor air is unknown since the entire Bayliner property is covered by buildings or paved surfaces, it is unlikely that the detection results from transport of PCE in the vapor phase from the subsurface. Therefore, the inhalation of vapors in ambient air pathways is considered to be incomplete.

### **2.7.6.6 Soil – Direct Exposure and Ingestion**

Soil sampling conducted at the site identified the presence of low concentrations of PCE (0.0036 to 0.025 milligrams per kilogram) in soil at depths of 15 to 20 feet bgs. As such, there is a potential, although unlikely, for direct contact with PCE-impacted soil. Consequently, this pathway is considered to be potentially complete. However, since all detected concentrations were below the Method A CUL for Residential Soils, there is no evidence that exposure would result in unacceptable human health risks.

## **2.8 CLEANUP STANDARDS**

Washington MTCA regulations address Cleanup Standards for contaminated groundwater in WAC 173-340-200 and 173-340-720. A Cleanup Standard, as defined in WAC 173-340-200 requires the specification of hazardous substance concentrations that protect human health and the environment (“Cleanup Levels”), and the identification of the location on the site where those Cleanup Levels must be attained. This location is defined as the Point of Compliance. A Cleanup Standard consists of the following three distinct elements:

1. A Cleanup Level (CUL), expressed as the concentrations of hazardous substances present in site groundwater that are protective of human health and the environment, as measured at the Point of Compliance;

---

<sup>5</sup> *Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action, Review Draft*, Washington Department of Ecology, October 2009

2. A Point of Compliance (POC) , i.e. the location(s) on the site where the CUL needs to be met and where groundwater quality is monitored to confirm the effectiveness of the cleanup action; and
3. Any other applicable state and federal laws.

### **2.8.1 Cleanup Levels**

WAC 173-340-720 identifies MTCA groundwater cleanup standards. In general, cleanup standards are established based on whether the groundwater at the site is considered potable or non-potable. Since information has not been developed to determine if the groundwater at the site is non-potable as described in WAC 173-340-720(2), for the purposes of this report groundwater at the site is being considered as potable.

Cleanup levels for potable groundwater may be established under MTCA regulations using one of three methods.

Method A CUL for Potable Groundwater is determined using lookup tables published by Ecology listing allowable concentrations of several common contaminants. These concentrations must be at least as stringent as concentrations specified in any applicable state or federal laws such as Maximum Contaminant Levels (MCLs) established under the federal Safe Drinking Water Act. In addition, Method A cleanup levels must not exceed natural background concentrations or the practical quantitation limit, whichever is higher.

Method B CUL for Potable Groundwater uses a universal method for determining cleanup levels for all media at all sites. For individual carcinogens, the Method B calculation of CUL is based on not exceeding the upper bound of estimated excess cancer risk (ECR) of one in a million ( $1 \times 10^{-6}$ ). For non-carcinogenic substances, CUL concentrations are calculated to result in no acute or chronic toxic effects on human health (that is, a hazard quotient  $\leq 1$ ), and no significant adverse effects on the propagation of aquatic and terrestrial species. Site-specific risk assessments may be used for the establishment of a Method B CUL.

Method C CUL for Potable Groundwater is established to be protective of human health and the environment for certain specified site uses and conditions, such as property use limited to industrial activities. Method C CUL may be established and used if 1) Method A and B CUL are below the naturally-occurring background concentrations, 2) Method A and B CUL have the potential for creating significantly higher health risks than a Method C level, or 3) Method A or B CUL are below technically possible concentrations.

At this time it is unknown whether it is technically possible to achieve the Method A Groundwater CUL at the site. However, for the purposes of this report, the Method A CUL of 5 µg/L will be evaluated as the presumptive CUL for the site.

### **2.8.2 Points of Compliance**

To develop a Cleanup Standard for the site, the POC must be determined. Two options exist for identifying the POC: a Standard POC and a Conditional POC. WAC 173-340-720(6) defines a Standard POC for groundwater as “established throughout the site from the uppermost level of the saturated zone extending vertically to the lowest depth which could potentially be affected by the site.”

When it is not practicable to achieve the CUL throughout the site within a reasonable restoration time frame, a Conditional POC may be used. Factors such as potential risks posed by contamination at the site, current and potential future uses of the site, likely effectiveness of institutional controls, toxicity of hazardous substances at the site, and the likely natural attenuation of hazardous substances at the site are all considered in assessing whether a cleanup action provides for a reasonable restoration time frame.

As further set forth in Section 3.1 of this Feasibility Study, it is not practicable at the former Bayliner Marine site to achieve the groundwater CUL of 5 µg/L throughout the site within a reasonable restoration time frame. Furthermore, it may not be technically possible, in any time frame, to reduce the concentrations of PCE to 5 µg/L in the source area. Accordingly, a Conditional POC should be established using monitoring wells MW-5 and MW-7, which are located on the site near the western and northern (downgradient) property boundaries.

### **2.8.3 Applicable State and Federal Laws**

As stated above, the federal Safe Drinking Water Act established a MCL for PCE in drinking water of 5 µg/L. This will be the presumptive CUL for PCE-contaminated groundwater at the former Bayliner Mariner facility.

### **3.0 FEASIBILITY STUDY**

---

#### **3.1 OVERVIEW OF CLEANUP ACTION ALTERNATIVES**

Based on available site characterization data and previous experience with remediation of PCE-impacted groundwater, a number of potential site cleanup action alternatives were identified for consideration. Several of the alternatives consist of combining more than one cleanup action component.

The contaminated groundwater at the site contains low concentrations of PCE which pose a low risk of on-site direct exposure in a fully developed industrial setting, and present no threat of exposure to off-site receptors. Although sufficient site data has been collected to fully delineate the nature, degree and extent of contamination, relatively little data is currently available about the geochemical characteristics of site soil and groundwater. There is evidence that PCE concentrations in groundwater have been declining, possibly as a result of natural degradation processes. Continuation of this natural degradation process has been evaluated as one long-term remedy that may be appropriate for the site. Several active groundwater remedies have also been evaluated for applicability to this site, such as *in situ* chemical oxidation, air sparging, soil vapor extraction, and groundwater extraction. Preliminary evidence indicates that these remedial approaches may be viable alternatives. However, to estimate accurate projections of the effectiveness and time frames for these cleanup actions are difficult, based on the low residual concentrations observed at the site and the limited empirical data currently available. The alternatives presented are commonly used technologies to achieve significant reductions in groundwater contaminant concentrations, but most typically at sites where chlorinated solvent concentrations are one or more orders of magnitude higher than the highest concentrations measured at the former Bayliner Marine site. The effectiveness of these remedial measures typically significantly declines as concentrations are reduced, and remedial measures are often unable to achieve cleanup down to the low concentrations used as drinking water criteria. Cleanup actions often utilize such active remedies to implement a sharp initial reduction of groundwater concentrations, then transition to Monitored Natural Attenuation when concentrations approach the levels present at the former Bayliner Marine site. It is uncertain whether these active remedies can be effective in significantly reducing already low concentrations and bringing the entire site into compliance with presumptive site-side CUL of 5 µg/L PCE.

Therefore, this study has evaluated the use of a Conditional POC at two existing monitoring wells located near the downgradient property boundaries of the site. Monitoring data to date have shown that these locations are not affected by the PCE contamination. The proposed cleanup actions will focus on the ability to reduce the peak PCE concentrations in the presumed source area, while continuing to monitor at the Conditional POC to confirm that PCE-impacted groundwater is not leaving the site or posing risks to off-site receptors.

The primary potential route of exposure to site contamination would be through ingestion of contaminated groundwater. The on-site contaminated groundwater is not utilized as an irrigation, process or drinking water source. Furthermore, it is unlikely to be utilized for drinking water in the future due to the availability of plentiful municipal water supplies in the vicinity of the property. To maintain the current protectiveness into the future the Feasibility Study has also evaluated implementation of institutional controls through the implementation of a restrictive covenant on the property that would limit future use to industrial activities consistent with current and recent historic site uses, and prohibit the extraction and use of groundwater at the site. These Institutional Controls will supplement and enhance the protections afforded through the other cleanup action components.

Section 3.2 presents an overview of the criteria used to evaluate various cleanup action alternatives. Section 3.3 provides a general description of each of the cleanup action components under consideration, listing advantages and disadvantages typically associated with each technology. In Section 3.4, a number of cleanup action alternatives are identified. These alternatives utilize various combinations of the individual components described in Section 3.3. A site-specific evaluation of each of the proposed alternatives is presented and compared against the listed evaluation criteria.

### **3.2 EVALUATION CRITERIA**

Criteria for evaluation of cleanup action alternatives are listed in WAC 173-340-360. These criteria include four threshold criteria (WAC 173-340-360(2)(a):

- Protective of human health and the environment;
- Complies with cleanup standards;
- Complies with applicable state and federal laws; and
- Provides for compliance monitoring.

Any cleanup action alternative that fails to meet one or more of these threshold criteria was excluded from further detailed evaluation. Each of the alternatives that achieved these threshold requirements were then evaluated further on the following criteria (WAC 173-340-360(2)(b):

- Permanence
- Long-Term Effectiveness
- Management of Short-Term Risks
- Technical Implementability

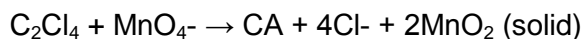
- Administrative Implementability
- Cost
- Consideration of Public Concerns

### **3.3 SUMMARY OF CLEANUP ACTION COMPONENTS**

#### **3.3.1 In Situ Chemical Oxidation (ISCO)**

In situ chemical oxidation (ISCO) is based on delivery of chemical oxidants directly to media affected by site contaminants (e.g., soil and/or groundwater) in order to chemically convert contaminants to non-hazardous or less toxic compounds that are more stable, less mobile, or inert. Although oxidizing agents can include ozone, hydrogen peroxide, permanganate and Fenton's Reagent (hydrogen peroxide mixed with an iron catalyst), this analysis will be restricted to the active oxidant permanganate which is available commercially as either potassium or sodium permanganate. The persistence of the oxidant in the subsurface is important since it affects the contact time for advective and diffusive transport and, ultimately, the delivery of the oxidant to the targeted zones in the subsurface.

For example, the oxidation of PCE using permanganate ( $MnO_4^-$ ), although dependent on pH, may yield a variety of intermediates such as dichloro, oxalic, formic, and glycolic acids (carboxylic acids [CA], all of which have lower toxicity) as the reaction proceeds to direct mineralization to  $CO_2$  and chloride ions. The basic stoichiometry for the oxidation of PCE by permanganate is as follows:



#### Advantages:

- Proven technology.
- Technology is appropriate for a variety of contaminants (e.g., VOCs and SVOCs).
- Contaminants reduced/destroyed in situ.
- Short treatment times under optimal conditions.
- No permanent or semi-permanent facilities required.
- Slow reaction rate of  $MnO_4^-$  allows for greater transport distances and thus extended treatment zones during injection.

**Disadvantages:**

- Concentration reductions >90 percent are likely to be difficult to achieve, so it is unlikely to be technically possible to achieve CUL throughout the site within a reasonable restoration time frame.
- A wide variety of naturally occurring reactants such as natural organic matter (NOM) react with  $MnO_4^-$  thus imposing a background oxidant demand. The effect increases the mass (and cost) of  $MnO_4^-$  necessary to achieve treatment objectives.
- Some grades of  $KMnO_4$  contain heavy metal impurities, which injected, could result in unacceptable groundwater concentrations (e.g., hexavalent state of chromium [ $Cr^{+6}$ ]). Further, in some cases naturally occurring trivalent chromium can be oxidized to hexavalent chromium.
- Additional health and safety concerns associated with handling of strong oxidants.

**3.3.2 Air Sparging and Soil Vapor Extraction (AS/SVE)**

Air sparging (AS) is an in situ remedial technology that reduces concentrations of VOCs that are adsorbed to soils and/or dissolved in groundwater. AS involves the injection of contaminant-free air into the saturated zone enabling partitioning of contaminants from the dissolved phase to the vapor phase. Injected air moves vertically and horizontally through the saturated zone, creating an underground air stripping process. Injected air migrates to the unsaturated zone where an SVE system creates a negative pressure to capture stripped VOCs.

An air sparging system is composed of four basic elements: air sparging wells, an air compressor or blower; a soil vapor extraction system; and, a monitoring system. These components are further described as follows:

Air Sparging Wells - An air sparging well is usually constructed of 2-inch diameter, Schedule 40 or higher, polyvinyl chloride (PVC) pipe. The bottom of the well consists of approximately two feet of a pervious section (well screen or porous pipe diffuser) connected to a pipe extending from the well screen to the surface. The sparge well is completed by placing a sand pack around the well screen. A 1- to 2-foot thick bentonite or cement seal is placed around the sand pack. The well bore is then grouted to the top of the water table.

Air Blower - Air would be injected into sparging wells under pressure with a mechanical blower. A pipe manifold constructed of small diameter PVC pipe is usually used to convey air from the blower to each well. Air injection pressure is governed by the static water head above the sparge point, the entry pressure of the saturated soils, and the injection flow rate. Working pressures are generally on the order of 15 psi and air flow

**DRAFT REMEDIAL INVESTIGATION AND FEASIBILITY STUDY  
Former Bayliner Marine – Arlington, Washington  
FEASIBILITY STUDY**

August 10, 2010

---

under field conditions varies between 3 and 10 scfm. In some cases, aquifer characteristics require that air flow be pulsed in order to improve transfer rates.

Soil Vapor Extraction System - Vapors mobilized by the AS system are controlled by application of an SVE system. The vapor extraction wells may be located in the same boring as the sparging well and are similarly constructed of small diameter PVC piping which extends to just above the water table.

Monitoring - A number of parameters may be used to monitor the performance of an air sparging system. The most common are dissolved oxygen (DO), water table elevation, soil gas vacuum from the SVE system, and VOC concentration.

The effectiveness of an AS/SVE system is dependent upon:

- Permeability of soil
- Soil structure and stratification
- Soil moisture
- Depth to groundwater

A pilot test would be necessary to evaluate SVE effectiveness and identify design parameters, and typically includes short term extraction of vapors from a single well (or existing monitoring well) at different extraction rates and wellhead vacuums.

Advantages:

- Proven technology; readily available equipment; easy installation.
- May be implemented without significant disruption to ongoing site operations.
- Short treatment times (6 months to 2 years).
- Requires no removal, treatment, storage, or discharge considerations for groundwater.

Disadvantages:

- Concentration reductions >90 percent are likely to be difficult to achieve, so it is unlikely to be technically possible to achieve CUL throughout the site within a reasonable restoration time frame.
- Potential for inducing migration of contaminants.
- Effectiveness may be reduced when applied to sites with low-permeable or stratified soil.

- May require treatment for discharge of extracted vapor to atmosphere; potentially resulting in minor degradation of air quality.

### **3.3.3 Groundwater Extraction and Treatment (GWET)**

In general, a GWET system is designed to remove groundwater through a series of extraction wells, pass extracted groundwater through a treatment device (e.g., granulated activated carbon), then re-inject or discharge the treated groundwater to surface water, storm sewer or publicly owned treatment works (POTW). The technology has three components: groundwater extraction, groundwater treatment, and treated groundwater discharge. These components are discussed individually in the following sections:

Groundwater Extraction - Most commonly, vertical wells screened in the contaminated zone are used for extraction and equipped with electric submersible pumps.

Groundwater Treatment - Removal of VOCs from groundwater is generally accomplished by partitioning them to air (air stripping), solids (granular activated carbon), or by destruction (UV oxidation).

Groundwater Discharge - Treated water effluent may potentially be discharged through piping directly to surface water, indirectly to a storm water system, to a POTW or re-injected to the subsurface through upgradient wells, galleries or basins.

#### Advantages:

- Established technology.
- Technology can be used for a variety of contaminants (VOCs, SVOCs and metals).
- May be used as a hydraulic barrier to prevent off-site migration of contaminant plumes

#### Disadvantages:

- Concentration reductions >90 percent are likely to be difficult to achieve, so it is unlikely to be technically possible to achieve CUL throughout the site within a reasonable restoration time frame.
- Attainment of cleanup levels may take a very long time. Sorbing compounds such as PCE are retarded relative to groundwater velocity which increases the time required for cleanup.
- Pumping depresses the groundwater level leaving residuals sorbed to soil. When groundwater level returns to normal level, contaminants sorbed to soil may become dissolved (resulting in a rebound of contaminant concentrations in groundwater).

- GWET technology may not be feasible for sites with low-permeable zones (less than about  $10^{-5}$  cm/sec) which restrict contaminant flow to extraction wells.
- Capital costs for installation and annual costs for O&M are high.

### **3.3.4 Monitored Natural Attenuation (MNA)**

The term “natural attenuation” refers to the reduction in mass or concentration of a compound in groundwater over time due to naturally-occurring physical, chemical, and/or biological processes. Physical processes include dispersion, dilution, sorption and volatilization of dissolved compounds to the vapor phase (e.g., atmosphere or soil gas). Typical chemical mechanisms include ion-exchange reactions (e.g., oxidation, reduction), hydrolysis and abiotic transformations. Biological degradation and/or transformation occur primarily by aerobic and anaerobic microbial processes, although plant uptake also occurs in some situations.

Monitored natural attenuation also involves sampling and analysis to verify that attenuation of the constituents is occurring. In some cases, natural attenuation processes can be modeled to predict long-term performance. However, regular groundwater monitoring is a more effective and reliable means of assessing natural attenuation.

WAC 173-340-370(7) states that natural attenuation is an appropriate remedy at sites where:

- a) Source control has been conducted to the maximum extent practicable;
- b) The presence of residual contamination during the restoration time frame does not pose an unacceptable threat to human health or the environment;
- c) There is evidence that natural biodegradation or chemical degradation is occurring and will continue to occur; and,
- d) Appropriate monitoring is performed

It is anticipated that all four of these conditions will be applicable at the site.

The USEPA OSWER directive regarding the use of MNA (OSWER Directive 9200.4-17P, April 21, 1999) directly addresses the suitability of MNA as a remedial alternative for chlorinated solvents. In the OSWER directive, the USEPA states that the most important considerations regarding the suitability of MNA as a remedy include: 1) whether the contaminants are likely to be effectively addressed by natural attenuation processes, 2) the stability of the groundwater contaminant plume and its potential for migration, and 3) the potential for unacceptable risks to human health or environmental resources by the contamination. Sites where the contaminant plumes are no longer increasing in extent, or are shrinking, would be the most appropriate candidates for MNA.

A conceptual MNA approach for the site would include collecting groundwater samples from existing monitoring wells MW-1 through MW-7 on a quarterly basis for VOC analysis.

Periodically, the VOC analysis would be supplemented by analyses for geochemical parameters such as dissolved oxygen (DO), oxidation-reduction potential (ORP), pH and others.

The groundwater monitoring data would be evaluated to confirm delineation of the plume, track concentration trends, and evaluate the progress of MNA in achieving the remedial objectives

Advantages:

- Generally lower cost than other active remedies.
- Does not result in byproducts or waste stream that cause secondary impacts to air or surface water
- Minimizes disruption to ongoing site activities

Disadvantages:

- May take somewhat longer to achieve CUL
- Concentration reductions >90 percent are likely to be difficult to achieve, so it is unlikely to be technically possible to achieve CUL throughout the site within a reasonable restoration time frame.

### **3.3.5 Institutional Controls (IC)**

Placement of an IC (e.g., deed restriction) on the property would be used as a component of several cleanup action alternatives to preclude consumption or other use of groundwater at the site. In this manner, protectiveness of human health and the environment would be enhanced through exposure prevention. WAC 173-340-440(4) identifies certain circumstances when Institutional Controls “shall be required to assure both the continued protection of human health and the environment, and the integrity of an interim action or cleanup action...” The cited circumstances include several that may be applicable to the former Bayliner Marine site:

- Sites where Method A or Method B CULs apply and where hazardous substances remain at the site at concentrations that exceed the applicable CUL.
- Sites where a groundwater CUL is established that exceeds the drinking water CUL based on a site-specific risk assessment
- Sites where a Conditional POC is established

ICs are administrative and/or legal controls that prevent exposure to constituents by limiting land use. Institutional controls, such as land use covenants, can be employed as part of remedial actions to prevent exposure to impacted media and thus ensure protectiveness of the remedy. Several of the Alternatives discussed herein assume the use of an IC as an additional exposure prevention measure. A restrictive covenant as applied to this site would include the following elements:

**DRAFT REMEDIAL INVESTIGATION AND FEASIBILITY STUDY  
Former Bayliner Marine – Arlington, Washington  
FEASIBILITY STUDY**August 10, 2010

---

- A restriction on installing drinking water wells in the shallow aquifer on-site while PCE concentrations in groundwater exceed the Federal MCL of 5 µg/L.
- A restriction on construction or relocation of buildings on site that would prevent proper monitoring of groundwater concentrations
- A requirement to limit property zoning and use to industrial activities consistent with the current zoning and uses.

While restrictive covenants have been used for many years, they have sometimes been rendered unenforceable under common law (e.g., waiver, abandonment, acquiescence, adverse possession, foreclosure of a tax lien, the rule against perpetuities, and requirements for privity or appurtenance, etc.). However, in 2007, Washington enacted the Uniform Environmental Covenants Act (UECA), which establishes environmental covenants for sites in Washington that are remediated under oversight of Ecology or USEPA. Environmental covenants created under the UECA contain activity or land use restrictions on real property that legally stay with the land, regardless of changes of property ownership. The covenants are based on traditional property law principles and are recorded in local land records, thereby binding successive owners of the property. The purpose of the UECA is to ensure that environmental covenants created for a particular site are not invalidated by conflicts or misunderstandings with other local, state, or federal regulations. The UECA provides clear rights for Ecology to create, record, monitor, enforce, modify and terminate environmental covenants, and thereby ensure with greater certainty the protection of human health and the environment throughout the life of the environmental covenant, including during real estate transactions or legal actions. Ecology has updated the language in its Model Restrictive (Environmental) Covenant to be consistent with the UECA.

**Advantages:**

- Protects all parties to the site cleanup by helping to ensure long-term integrity of the cleanup actions and prevents actions by future site owners that may result in inadvertent exposure risks or cause migration of site contamination to previously non-impacted areas
- Relatively low cost for extra measure of protection

**Disadvantages:**

- May not be utilized under MTCA rules as the primary remedy

### **3.3.6 No Action**

Inclusion of the no action alternative serves as a baseline for the alternatives evaluation. The No Action alternative would not require remedial activities beyond the investigation conducted to date. It is anticipated that PCE concentrations would continue to decline through natural biodegradation and chemical degradation processes. Groundwater monitoring to date indicates that contamination is not migrating beyond the property boundaries. Therefore, the No Action alternative is expected to be equally effective in achieve the CUL at the Conditional POC and equally protective of human health and the environment. However, the restoration time frame is uncertain and no long-term monitoring would be conducted. No institutional controls would be included to prevent future exposure to residual on-site PCE.

## **3.4 DETAILED EVALUATION OF CLEANUP ACTION ALTERNATIVES**

This Feasibility Study evaluates six cleanup action alternatives to address groundwater impact at the site. The following sections provide an evaluation of each of these alternatives. A summary of the evaluation is presented in Table 3 in Appendix B.

### **3.4.1 Alternative #1 – Site-Wide In Situ Chemical Oxidation and Monitored Natural Attenuation**

Alternative #1 would apply ISCO technology to achieve a rapid initial reduction of PCE concentrations. ISCO can in certain cases be effective in achieving concentration reductions of up to 90 percent. However, given the relatively low residual PCE concentrations observed at the site, this level of cleanup efficiency may not be feasible at this site.

#### **3.4.1.1 Threshold Criteria**

##### **3.4.1.1.1 Protection of Human Health and Environment**

Implementing ISCO throughout the impacted area is a protective alternative because it would rapidly reduce PCE concentrations throughout the plume. Monitoring would be performed to confirm long-term stability of the plume and residual concentration reduction.

##### **3.4.1.1.2 Compliance with Cleanup Standards**

Compliance with cleanup standards is defined by meeting the requirements of WAC 173-340-700 through WAC 173-340-760. Alternative #1 is anticipated to comply with cleanup standards by attaining cleanup levels at the points of compliance in accordance with WAC 173-340-700(7).

The ability of the ISCO technology to reduce PCE concentrations below the CUL throughout the site within a reasonable time frame is uncertain. Therefore, the effectiveness of this cleanup action would be determined by measurements of PCE concentrations at the conditional POC at MW-5 and MW-7. By using these locations for monitoring to confirm that PCE-impacted

groundwater does not migrate beyond the property boundary, this alternative will comply with the cleanup standard and ensure protectiveness.

#### **3.4.1.1.3 Compliance with Applicable State and Federal Laws**

This cleanup action alternative is designed to achieve the CUL of 5 µg/L at the Conditional POC which is compliant with the MCL established under the federal Safe Drinking Water Act.

#### **3.4.1.1.4 Opportunity for Compliance Monitoring**

Compliance monitoring would be performed to confirm long-term stability of the plume and residual concentration reduction.

#### **3.4.1.2 Other Evaluation Criteria**

##### **3.4.1.2.1 Permanence**

Alternative #1 is expected to provide a permanent reduction in toxicity, mobility and volume of PCE present in groundwater at the site. Chemical oxidation of PCE is not reversible and proceeds to direct mineralization to CO<sub>2</sub> and chloride ions.

##### **3.4.1.2.2 Restoration Time Frame**

The estimated restoration time frame for Alternative #1 is 2 years. Approximately 1 year would be required for pilot testing, design and construction, followed by application of ISCO over a period of up to one year. Monitoring of groundwater would be performed for up to 2 years during the design and application phases. As long as PCE concentrations at the Conditional POC remained below the CUL, throughout this process, monitoring would be discontinued and the cleanup action deemed complete at the end of this time period.

##### **3.4.1.2.3 Long-Term Effectiveness**

Alternative #1 permanently reduces PCE concentrations and monitors to confirm long-term stability of the plume and residual concentration reduction.

##### **3.4.1.2.4 Management of Short-Term Risks**

The impacted area is limited within the boundaries of the Bayliner property and there are no current groundwater receptors. Therefore, short-term risks associated with the presence of residual PCE in groundwater are minimal. Short-term risks associated with implementing ISCO would be addressed with a site-specific health and safety plan. Implementing ISCO as contemplated in Alternative #1 does not create excess short-term risks that could impact receptors at the site or adjacent property.

##### **3.4.1.2.5 Technical and Administrative Implementability**

**DRAFT REMEDIAL INVESTIGATION AND FEASIBILITY STUDY  
Former Bayliner Marine – Arlington, Washington  
FEASIBILITY STUDY**August 10, 2010

---

Based on limited existing information, site conditions appear to be generally favorable for implementation of an ISCO remedy. For example:

- The saturated zone is predominantly composed of sand and gravel. Therefore, the permeability should be sufficient to allow for effective delivery of the oxidant to the subsurface. Pilot testing would be required to evaluate effective radius of influence.
- The aquifer is unconfined and field measurements have documented elevated dissolved oxygen concentrations and oxidation reduction potential (ORP). These conditions suggest aerobic oxidizing conditions which favor ISCO over other remedial technologies that rely on reducing conditions (e.g., reductive dechlorination). However, pilot testing would be required to evaluate the natural oxidant demand.
- The targeted area of remediation is accessible and existing infrastructure does not preclude application of the technology.

Overall, the physical and chemical conditions in the subsurface suggest that ISCO may be a technically feasible alternative for the site.

There are no known administrative barriers to implementing the technology.

**3.4.1.2.6 Cost**

The following conceptual design has been developed for Alternative #1 as the basis for estimating the cost to remediate the impacted area described above:

- Installation of 154 injection points (assuming a treatment area of 160,000 square feet, treatment depth of 10 feet and radius of influence of 20 feet). Pilot testing will be required to determine the actual effective radius of treatment.
- Injection of approximately 160 tons of oxidant to overcome natural oxidant demand and degrade residual PCE (assuming a natural oxidant demand of 2 g/kg). Oxidant injection would occur twice. Pilot testing will be required to confirm natural oxidant demand.
- Installation and sampling of 16 monitoring points (assuming one confirmatory monitoring point per 10 injection points).

The estimated cost for Alternative #1 is \$1,715,000. Details of the calculation of this estimated cost are provided in Table 4 in Appendix B.

**3.4.1.2.7 Consideration of Public Concerns**

Community acceptance of the remedial alternative will be evaluated during any public comment period required pursuant to WAC 173-340-600 or WAC 197-11-970 (Determination of Non-

Significance) that may involve individuals, community groups, local governments, tribes, federal and state agencies, or other organizations that may have an interest in or knowledge of the site. There are no known public concerns with this alternative.

### **3.4.2 Alternative #2 – Monitored Natural Attenuation and Institutional Control**

Alternative #2 relies upon active monitoring of the natural attenuation of dissolved PCE in groundwater to achieve further reduction of PCE concentrations. Monitoring will be conducted to confirm the stability of the impacted area and the reduction of residual contaminant concentrations. Institutional controls would be placed in the property deed records to preclude exposure to residual PCE during the monitoring period.

#### **3.4.2.1 Threshold Criteria**

##### **3.4.2.1.1 Protection of Human Health and Environment**

Alternative #2 is protective of human health and the environment because it prevents exposure of receptors to impacted groundwater using an institutional control and actively monitors to confirm that concentrations are declining and not migrating beyond the area controlled by the IC. Existing groundwater monitoring data indicates that the area of impacted groundwater is confined to the site, is well defined with existing monitoring wells, and (based on initial data), appears to be declining in concentration. A groundwater monitoring program will be implemented to track concentration changes and confirm delineation. Protection of human health and the environment during the MNA period will be enhanced by placing a deed restriction on the property to preclude future activities that could result in exposure to residual PCE in groundwater (e.g., installation of supply wells).

##### **3.4.2.1.2 Compliance with Cleanup Standards**

Compliance with cleanup standards is defined by meeting the requirements of WAC 173-340-700 through WAC 173-340-760. Alternative #2 is anticipated to comply with cleanup standards by attaining cleanup levels at the points of compliance in accordance with WAC 173-340-700(7).

WAC 173-340-720(8) states that the standard point of compliance for all sites is established throughout the site except where it is not practicable to meet the CUL throughout the site within a reasonable restoration time frame. The natural attenuation process occurs gradually over time, and is not expected to reduce PCE concentrations below the CUL throughout the site for a number of years. Therefore, the effectiveness of this cleanup action will be monitored at the conditional POCs MW-5 and MW-7 located near the western and northern (downgradient) property boundaries. By using these locations for monitoring to confirm that PCE-impacted groundwater does not migrate beyond the property boundary, this alternative will comply with the cleanup standard and ensure protectiveness.

##### **3.4.2.1.3 Compliance with Applicable State and Federal Laws**

This cleanup action alternative is designed to achieve the CUL of 5 µg/L at the Conditional POC, which would be compliant with the MCL established under the federal Safe Drinking Water Act.

#### **3.4.2.1.4 Opportunity for Compliance Monitoring**

Compliance monitoring through existing monitoring wells is an integral part of the remedy and therefore satisfies this criteria.

#### **3.4.2.2 Other Evaluation Criteria**

##### **3.4.2.2.1 Permanence**

Groundwater monitoring conducted as part of Alternative #2 is expected to track the natural and permanent reduction in toxicity, mobility and volume of PCE present in groundwater at the site. MNA does not actively destroy or remove contaminants, but the approach is regarded by USEPA as a proactive remedy.

##### **3.4.2.2.1 Restoration Time Frame**

The estimated restoration time frame for Alternative #2 is 2 years. Monitoring of groundwater would be performed until two full years of consecutive quarterly monitoring has been completed. As long as PCE concentrations at the Conditional POC remained below the CUL throughout this period, monitoring would be discontinued and the cleanup action deemed complete. Institutional controls would be implemented during this monitoring period to prevent use of site groundwater or changes in site use that might create a potential for exposure to the residual PCE in site groundwater.

##### **3.4.2.2.2 Long-Term Effectiveness**

Natural attenuation would reduce the mass of PCE in groundwater, although there is uncertainty that it would reduce concentrations to below the CUL. Existing groundwater monitoring data suggests that concentrations of PCE at the site may exhibit a declining trend. However, due to the recent discovery of impacted groundwater at the site, there has not been sufficient time to make a definitive determination about concentration trends. Concentrations of PCE (maximum of 59 µg/L in well MW-1 in December 2009) are low to moderate and potentially declining, the extent of impact is limited to within the boundary of the property, and potential exposure routes can be further limited with institutional controls. Therefore, Alternative #2, combining MNA with institutional controls, is a viable and effective approach.

##### **3.4.2.2.3 Management of Short-Term Risks**

The impacted area is limited within the boundaries of the Bayliner property and there are no current groundwater receptors. Therefore, short-term risks associated with the presence of

residual PCE in groundwater are minimal. Short-term risks would be additionally mitigated through implementation of the IC as an exposure prevention measure.

#### **3.4.2.2.4 Technical and Administrative Implementability**

MNA is readily implementable from a technical perspective. Quarterly groundwater monitoring has been conducted at the site since discovery of impacted groundwater. To date, three quarters of monitoring have been conducted. Although the existing data is insufficient to make a definitive determination of the effectiveness of natural attenuation, available monitoring data suggests potentially declining concentrations. For example, there are two monitoring wells on site that have at one time exhibited PCE concentrations above the Method A criteria (MW-1 and MW-4), and concentrations in both wells have declined since initial sampling. Since concentrations of PCE (maximum of 59 µg/L in well MW-1 in December 2009) are low to moderate and potential exposure routes are limited, MNA is a viable cleanup approach for the site.

There are no known administrative barriers to implementing the technology. The current owner of the property has indicated a willingness to consider establishing a restrictive covenant to protect human health and the environment.

#### **3.4.2.2.5 Cost**

The following conceptual plan has been developed for Alternative #2 as the basis for estimating the cost to remediate the impacted area described above:

- One-time up-front cost to obtain a restrictive covenant (IC) for the site.
- Development of a contingency source area remedy.
- Quarterly groundwater monitoring of existing monitoring wells and analysis for VOCs for 2 years.
- Supplemental sampling for geochemical parameters on a semi-annual basis.
- Quarterly reporting of groundwater monitoring results.

The estimated cost for Alternative #2 is \$105,000. Details of the calculation of this estimated cost are provided in Table 4 in Appendix B.

#### **3.4.2.2.6 Consideration of Public Concerns**

Community acceptance of the remedial alternative will be evaluated during any public comment period required pursuant to WAC 173-340-600 or WAC 197-11-970 (Determination of Non-Significance) that may involve individuals, community groups, local governments, tribes, federal

and state agencies, or other organizations that may have an interest in or knowledge of the site. There are no known public concerns with this alternative.

### **3.4.3 Alternative #3 – Source-Area In Situ Chemical Oxidation, Monitored Natural Attenuation and Institutional Control**

Alternative #3 would apply the same technology and approach as Alternative #1, except that ISCO technology would be focused in the source area near Building #11. ISCO can in certain cases be effective in achieving concentration reductions of up to 90 percent. However, given the relatively low residual PCE concentrations observed, this level of cleanup efficiency may not be feasible at this site.

MNA would be utilized to achieve reductions of PCE concentrations over the rest of the property. Monitoring would be performed to confirm the effectiveness of the alternative and the long-term stability of residual PCE concentrations. Institutional controls would be placed in the property deed records to provide additional long-term protection against exposure risks.

#### **3.4.3.1 Threshold Criteria**

##### **3.4.3.1.1 Protection of Human Health and Environment**

Alternative #3 is assessed to be protective of human health and the environment. Implementing ISCO in the area of highest observed PCE concentration would rapidly reduce PCE concentrations in the presumed source area. Monitoring would be performed to confirm long-term stability of the plume and reductions of residual PCE concentrations. Protection of human health and the environment during the remediation and MNA period will be enhanced by placing a deed restriction on the property to preclude future activities that could result in exposure to residual PCE in groundwater (e.g., installation of water supply wells).

##### **3.4.3.1.2 Compliance with Cleanup Standards**

Alternative #3 is anticipated to comply with cleanup standards by attaining cleanup levels at the points of compliance in accordance with WAC 173-340-700(7).

It may not be technically possible for the ISCO technology to reduce PCE concentrations below the CUL throughout the site within a reasonable time frame. Therefore, the effectiveness of this cleanup action would be determined by monitoring of PCE concentrations at the conditional POC MW-5 and MW-7. By using these locations for monitoring to confirm that PCE-impacted groundwater does not migrate beyond the property boundary this alternative will comply with the cleanup standard and ensure protectiveness.

##### **3.4.3.1.3 Compliance with Applicable State and Federal Laws**

This cleanup action alternative is designed to achieve the CUL of 5 µg/L at the Conditional POC, which is compliant with the MCL established under the federal Safe Drinking Water Act.

#### **3.4.3.1.4 Opportunity for Compliance Monitoring**

Compliance monitoring would be performed to confirm long-term stability of the plume and residual concentration reduction.

#### **3.4.3.2 Other Evaluation Criteria**

##### **3.4.3.2.1 Permanence**

Alternative #3 is expected to provide a permanent reduction in toxicity, mobility and volume of PCE present in groundwater at the site. Chemical oxidation of PCE is not reversible and proceeds to direct mineralization to CO<sub>2</sub> and chloride ions. MNA would further reduce residual contaminant mass, and monitoring is expected to track the stability or reduction of PCE concentrations in groundwater at the site. MNA does not actively destroy or remove contaminants, but the approach is regarded by USEPA as a proactive remedy.

##### **3.4.3.2.2 Restoration Time Frame**

The estimated restoration time frame for Alternative #3 is 2 years. Approximately 1 year would be required for pilot testing, design and construction, followed by application of ISCO in the source area during the second year. Monitoring of groundwater would be performed during the design and application phases. As long as PCE concentrations at the Conditional POC remained below the CUL throughout this process, monitoring would be discontinued and the cleanup action deemed complete at the end of the ISCO applications.

##### **3.4.3.2.3 Long-Term Effectiveness**

Alternative #3 permanently reduces PCE concentrations in the source area, while MNA results in the reduction of PCE concentrations over the remainder of the site. Monitoring would be performed to confirm long-term stability of the plume and residual concentration reduction.

##### **3.4.3.2.4 Management of Short-Term Risks**

The impacted area is limited within the boundaries of the Bayliner property and there are no current groundwater receptors. Therefore, short-term risks associated with the presence of residual PCE in groundwater are minimal. Short-term risks associated with the implementation of ISCO would be addressed with a site-specific health and safety plan. Implementing ISCO as contemplated in Alternative #3 does not create excess short-term risks that could impact receptors at the site or adjacent property. Short-term risks would be further reduced through implementation of IC to prevent exposure to on-site groundwater containing residual PCE.

#### **3.4.3.2.5 Technical and Administrative Implementability**

As discussed in Sections 3.3.1 and 3.4.1.2.5, site conditions appear to be generally favorable for implementation of an ISCO remedy and for implementation of MNA.

There are no known administrative barriers to implementing the technology.

#### **3.4.3.2.6 Cost**

The following conceptual design has been developed for Alternative #3 as the basis for estimating the cost to remediate the impacted area described above:

- Installation of 13 injection points (assuming a treatment area of 15,500 square feet, treatment depth of 10 feet and radius of influence of 20 feet). Pilot testing will be required to determine the actual effective radius of treatment.
- Injection of approximately 15.5 tons of oxidant to overcome natural oxidant demand and degrade residual PCE (assuming a natural oxidant demand of 2 g/kg). Pilot testing will be required to confirm natural oxidant demand.
- Installation and sampling of two monitoring points (assuming one confirmatory monitoring point per 10 injection points).
- One-time up-front cost to obtain a restrictive covenant (IC) for the site.
- Quarterly groundwater monitoring of existing monitoring wells and analysis for VOCs for two years.
- Quarterly reporting of groundwater monitoring results.

The estimated cost for Alternative #3 is \$290,000. Details of the calculation of this estimated cost are provided in Table 4 in Appendix B.

#### **3.4.3.2.7 Consideration of Public Concerns**

Community acceptance of the remedial alternative will be evaluated during any public comment period required pursuant to WAC 173-340-600 or WAC 197-11-970 (Determination of Non-Significance) that may involve individuals, community groups, local governments, tribes, federal and state agencies, or other organizations that may have an interest in or knowledge of the site. There are no known public concerns with this alternative.

### **3.4.4 Alternative #4 – Source Area Air Sparging/Soil Vapor Extraction, Monitored Natural Attenuation and Institutional Control**

Alternative #4 would utilize AS/SVE technology focused in the source area near Building #11. AS/SVE can be effective in achieving reductions of VOC concentrations. However, given the relatively low residual PCE concentrations observed at the property it may not be technically possible to achieve the CUL solely through application of this technology.

MNA would be utilized to achieve reductions of PCE concentrations over the rest of the site. Monitoring would be performed to confirm the effectiveness of the alternative and the long-term stability of residual PCE concentrations. Institutional controls would be placed in the property deed records to provide additional long-term protection against exposure risks.

#### **3.4.4.1 Threshold Criteria**

##### **3.4.4.1.1 Protection of Human Health and Environment**

Alternative #4 is assessed to be protective of human health and the environment. Implementing AS/SVE in the area of highest observed PCE concentration would rapidly reduce PCE concentrations in the presumed source area. Monitoring would be performed to confirm long-term stability of the plume and reductions of residual PCE concentrations. Protection of human health and the environment during the remediation and MNA period will be enhanced by placing a deed restriction on the property to preclude future activities that could result in exposure to residual PCE in groundwater (e.g., installation of water supply wells).

##### **3.4.4.1.2 Compliance with Cleanup Standards**

Alternative #4 is anticipated to comply with cleanup standards by attaining cleanup levels at the points of compliance in accordance with WAC 173-340-700(7).

It may not be technically possible for the AS/SVE technology to reduce PCE concentrations below the CUL throughout the site within a reasonable restoration time frame. Therefore, the effectiveness of this cleanup action would be determined by monitoring PCE concentrations at the conditional POC MW-5 and MW-7. By using these locations for monitoring to confirm that PCE-impacted groundwater does not migrate beyond the property boundary, this alternative will comply with the cleanup standard and ensure protectiveness.

##### **3.4.4.1.3 Compliance with Applicable State and Federal Laws**

This cleanup action alternative is designed to achieve the CUL of 5 µg/L at the Conditional POC, which is compliant with the MCL established under the federal Safe Drinking Water Act.

##### **3.4.4.1.4 Opportunity for Compliance Monitoring**

Compliance monitoring would be performed to confirm long-term stability of the plume and residual concentration reduction.

#### **3.4.4.2 Other Evaluation Criteria**

##### **3.4.4.2.1 Permanence**

Implementing AS/SVE would permanently remove VOCs from the saturated zone. Extracted VOCs would either be directly emitted to the atmosphere under permit or treated (polished) with granular activated carbon which is subsequently disposed of in a licensed disposal facility. MNA is expected to further reduce residual contaminant mass, and monitoring will track the natural and permanent reduction in toxicity, mobility and volume of PCE present in groundwater at the site. MNA does not actively destroy or remove contaminants, but the approach is regarded by USEPA as a proactive remedy.

##### **3.4.4.2.2 Restoration Time Frame**

The estimated restoration time frame for Alternative #4 is 3 years. Approximately 1 year would be required for pilot testing, design and construction, followed by operation of the AS/SVE system for a period of 2 years. Monitoring of groundwater would be performed during the design and operation phases. As long as PCE concentrations at the Conditional POC remained below the CUL throughout this process, monitoring would be discontinued and the cleanup action deemed complete at the end of the AS/SVE system operation period.

##### **3.4.4.2.3 Long-Term Effectiveness**

AS/SVE permanently reduces PCE concentrations in the source area, while MNA results in reduction of PCE concentrations over the remainder of the site. Monitoring would be performed to confirm long-term stability of the plume and residual concentration reduction.

##### **3.4.4.2.4 Management of Short-Term Risks**

The impacted area is limited within the boundaries of the property and there are no current groundwater receptors. Therefore, short-term risks associated with the presence of residual PCE in groundwater are minimal. Short-term risks associated with the implementation of AS/SVE (i.e., capture of sparge gas and prevention of vapor migration) would be addressed through engineering design of the AS/SVE system and routine operation and maintenance. Short-term risks would be further reduced through implementation of IC to prevent exposure to on-site groundwater containing residual PCE.

##### **3.4.4.2.5 Technical and Administrative Implementability**

Based on existing information, site conditions appear to be generally favorable for implementation of an AS/SVE remedy. For example:

**DRAFT REMEDIAL INVESTIGATION AND FEASIBILITY STUDY  
Former Bayliner Marine – Arlington, Washington  
FEASIBILITY STUDY**August 10, 2010

---

- The vadose zone and saturated zone are predominantly composed of sand and gravel. Therefore, the permeability should be sufficient to allow for effective sparge radius in the saturated zone and effective SVE radius in the vadose zone. Pilot testing would be required to evaluate effective radius of AS and SVE influence.
- The site stratigraphy is relatively uniform and does not exhibit significant stratification that would inhibit effective sparging or vapor extraction.
- AS/SVE is an appropriate remedial technology for VOCs like PCE.
- The targeted area of remediation is accessible and existing infrastructure does not preclude application of the technology.

Overall, the site stratigraphy and the chemical characteristics of the contaminant suggest that AS/SVE may be a technically feasible alternative for the site.

There are no known administrative barriers to implementing the technology.

**3.4.4.2.6 Cost**

The following conceptual plan has been developed for Alternative #4 as the basis for estimating the cost to remediate the impacted area described above:

- Feasibility of alternative confirmed through design and implementation of a pilot study.
- One-time, up-front cost to obtain a restrictive covenant (IC).
- Installation of four SVE wells, vacuum blower, GAC, system piping and equipment building.
- AS/SVE system would remain operational for two years.
- Quarterly groundwater monitoring of existing monitoring wells and analysis for VOCs for two years.
- Supplemental sampling for geochemical parameters on a semi-annual basis during groundwater monitoring.
- Quarterly reporting of groundwater monitoring results.

The estimated cost for Alternative #4 is \$500,000. Details of the calculation of this estimated cost are provided in Table 4 in Appendix B.

**3.4.4.2.7 Consideration of Public Concerns**

Community acceptance of the remedial alternative will be evaluated during any public comment period required pursuant to WAC 173-340-600 or WAC 197-11-970 (Determination of Non-Significance) that may involve individuals, community groups, local governments, tribes, federal and state agencies, or other organizations that may have an interest in or knowledge of the site.

Operation of remediation equipment creates potential noise concerns. There are no other known public concerns with this alternative.

### **3.4.5 Alternative #5 – Source-Area Groundwater Extraction and Treatment, Monitored Natural Attenuation and Institutional Control**

Alternative #5 would utilize GWET technology focused in the source area near Building #11. GWET can be effective in hydraulic containment of VOC concentrations, as well as removing some PCE mass from the subsurface. GWET would not be applied throughout the impacted area and therefore will not, by itself, achieve the cleanup standards.

MNA would be utilized to achieve reductions of PCE concentrations over the rest of the site. Monitoring would be performed to confirm the effectiveness of the alternative and the long-term stability of residual PCE concentrations. Institutional controls would be placed in the property deed records to provide additional long-term protection against exposure risks.

#### **3.4.5.1 Threshold Criteria**

##### **3.4.5.1.1 Protection of Human Health and Environment**

Alternative #5 is assessed to be protective of human health and the environment. Implementing groundwater extraction and treatment (GWET) in the area of highest observed PCE concentration would hydraulically contain PCE concentrations in the presumed source area and reduce the potential for downgradient migration. GWET will also contribute to the reduction of PCE mass in the subsurface. MNA would be utilized to continue reduction of concentrations throughout the plume, and monitoring would be performed to confirm the long-term stability of the plume and reductions of residual PCE concentrations. Protection of human health and the environment during the remediation and MNA period will be further enhanced by placing a deed restriction on the property to preclude future activities that could result in exposure to residual PCE in groundwater (e.g., installation of supply wells).

##### **3.4.5.1.2 Compliance with Cleanup Standards**

Alternative #5 is anticipated to comply with cleanup standards by attaining cleanup levels at the points of compliance in accordance with WAC 173-240-700(7).

It is not technically possible for the GWET technology to reduce PCE concentrations below the CUL throughout the site within a reasonable time frame. Therefore, the effectiveness of this cleanup action would be determined by monitoring of PCE concentrations at the conditional POC MW-5 and MW-7. By using these locations for monitoring to confirm that PCE-impacted groundwater does not migrate beyond the property boundary, this alternative will comply with the cleanup standard and ensure protectiveness.

##### **3.4.5.1.3 Compliance with Applicable State and Federal Laws**

This cleanup action alternative is designed to achieve the CUL of 5 µg/L at the Conditional POC, which is compliant with the MCL established under the federal Safe Drinking Water Act.

Washington's Underground Injection Control (UIC) program may apply to this alternative if post-treatment groundwater injection is used and therefore injection wells would need to be registered and authorized by Ecology. In addition, other Applicable, Relevant and Appropriate Requirements (ARARs) may apply including:

- National Pollutant Discharge Elimination System (NPDES) for discharge of treated water to stormwater collection system or surface water.
- Municipal Sanitary Sewer Discharge Permit.
- Puget Sound Air Pollution Control Agency air contaminant discharge permit.

Compliance with these possible ARARs is anticipated.

#### **3.4.5.1.4 Opportunity for Compliance Monitoring**

Compliance monitoring would be performed to confirm long-term stability of the plume and residual concentration reduction.

#### **3.4.5.2 Other Evaluation Criteria**

##### **3.4.5.2.1 Permanence**

Implementing GWET in the source area would temporarily contain the area of highest concentration and permanently remove some VOCs from the saturated zone. Extracted VOCs would be treated on site (using carbon or air stripping) and treated groundwater would be discharged under permit. MNA would continue the process of natural degradation of contaminants over the remainder of the site and achieve further reductions of residual PCE concentrations. Monitoring would be performed to track the natural and permanent reduction in toxicity, mobility and volume of PCE present in groundwater at the site. MNA does not actively destroy or remove contaminants, but the approach is regarded by USEPA as a proactive remedy.

##### **3.4.5.2.2 Restoration Time Frame**

The estimated restoration time frame for Alternative #5 is 6 years. Approximately 1 year would be required for pilot testing, design and construction, followed by operation of the GWET system for a projected period of 5 years. Monitoring of groundwater would be performed during the design and operations phases. As long as PCE concentrations at the Conditional POC remained below the CUL throughout the process, monitoring would be discontinued and the cleanup action deemed complete at the end of the GWET system period of operation.

### **3.4.5.2.3 Long-Term Effectiveness**

GWET does not provide long-term containment of the source area, but will contribute to long-term concentration reduction.

### **3.4.5.2.4 Management of Short-Term Risks**

The impacted area is limited within the boundaries of the property and there are no current groundwater receptors. Therefore, short-term risks associated with the presence of residual PCE in groundwater are minimal. Short-term risks associated with the implementation of GWET would be addressed through engineering design and a site-specific health and safety plan. Short-term risks would be further reduced through implementation of IC to prevent exposure to on-site groundwater containing residual PCE.

### **3.4.5.2.5 Technical and Administrative Implementability**

Based on existing information, site conditions appear to be generally favorable for implementation of a GWET remedy. For example:

- The saturated zone is predominantly composed of sand and gravel. Therefore, the permeability should be sufficient to allow for effective hydraulic capture of the source area. Aquifer testing would be required to evaluate hydrogeologic conditions and develop data necessary for design.
- The site stratigraphy is relatively uniform and does not exhibit significant stratification that would result in a heterogeneous flow field.
- The targeted area of remediation is accessible and existing infrastructure does not preclude application of the technology.

There are no known administrative barriers to implementing the technology.

### **3.4.5.2.6 Cost**

The following conceptual plan has been developed for Alternative #5 as the basis for estimating the cost to remediate the impacted area described above:

- One-time, up-front cost to obtain a restrictive covenant (IC).
- Following pilot testing, design and construction, the GWET system would operate for a period of five years.
- Quarterly groundwater monitoring of existing monitoring wells and analysis for VOCs for 6 years.
- Supplemental sampling for MNA geochemical parameters on a semi-annual basis for the first four years of monitoring.

- Quarterly reporting of groundwater monitoring results.

The estimated cost for Alternative #5 is \$1,130,000. Details of the calculation of this estimated cost are provided in Table 4 in Appendix B.

#### **3.4.5.2.7 Consideration of Public Concerns**

Community acceptance of the remedial alternative will be evaluated during any public comment period required pursuant to WAC 173-340-600 or WAC 197-11-970 (Determination of Non-Significance) that may involve individuals, community groups, local governments, tribes, federal and state agencies, or other organizations that may have an interest in or knowledge of the site.

Operation of remediation equipment creates potential noise concerns. There are no other known public concerns with this alternative.

#### **3.4.6 Alternative #6 – No Action**

Under Alternative #6, no cleanup actions beyond the investigations already conducted would occur. No long-term monitoring would be conducted. No institutional controls would be included. Inclusion of the No Action alternative serves as a baseline for the alternatives evaluation.

##### **3.4.6.1 Threshold Criteria**

###### **3.4.6.1.1 Protection of Human Health and Environment**

Alternative #6 may be protective of human health and the environment. Concentration decline due to natural biodegradation and chemical degradation is expected and it is unlikely that future use of the property would result in direct contact or consumption of on-site groundwater. Therefore, Alternative #6 is expected to be equally protective of human health and the environment as the other alternatives that are being evaluated. However, no controls would be in place to ensure exposure prevention and no monitoring would be conducted to confirm the extent and concentration of residual impacts.

###### **3.4.6.1.2 Compliance with Cleanup Standards**

As a result of the natural attenuation of PCE concentrations, it is likely that this alternative would, over time, achieve compliance with the CUL. However, no monitoring would be conducted to confirm compliance.

###### **3.4.6.1.3 Compliance with Applicable State and Federal Laws**

This cleanup action alternative is expected to achieve the CUL of 5 µg/L at the Conditional POC, which is compliant with the MCL established under the federal Safe Drinking Water Act.

#### **3.4.6.1.4 Opportunity for Compliance Monitoring**

No compliance monitoring would be performed as part of this cleanup action alternative. Therefore, Alternative #6 fails to comply with this threshold requirement.

#### **3.4.6.2 Other Evaluation Criteria**

Based on the fact that this alternative does not comply with the threshold requirements, further detailed evaluation of this alternative was not performed.

### **3.5 DISPROPORTIONATE COST ANALYSIS**

For the five alternatives that achieved the threshold requirements, a further evaluation was completed in accordance with the Disproportionate Cost Analysis procedure outlined in WAC 173-340-360(3)(e). This included an estimate of total costs and a qualitative evaluation of the benefits achieved by the cleanup action as compared to each of the six other evaluation criteria listed in WAC 173-340-360(3)(f). Table 3 in Appendix B provides a summary of the evaluation results for each alternative. Table 4 provides a breakdown of the estimated total costs shown in Table 3. A chart illustrating the relationship between estimated cost and assessed benefit is included as Figure 5 in Appendix A.

In order to compare the proportionality of benefits, the qualitative evaluation results listed in Table 3 were used to score each alternative on each of the evaluation criteria. The scoring was weighted to give the greatest weight to the criteria that are given the greatest emphasis in the MTCA regulations. Consequently, the Protectiveness criterion was given a weighted factor of 0.3 in the scoring. The Permanence and Long-Term Effectiveness criteria were each weighted with a factor of 0.2. The remaining three criteria were given a weight factor of 0.1. The scoring then used a 1-to-10 scale where a score of 10 indicates complete fulfillment of the criterion, a score of 1 indicates complete failure to meet the criterion, and scores of 2 to 9 indicate varying degrees of partial fulfillment of the criterion. The score for each criterion was multiplied by the weighted scoring factor, and the weighted scores were summed to give a total weighted score for each cleanup action alternative. The scoring is presented in Table 5 in Appendix B.

All five of the alternatives were judged to equally achieve the following criteria:

- Protectiveness
- Permanence
- Consideration of Public Concerns

The range of scores for the other three criteria was narrow. As a result, the range of total scores was also quite narrow and all alternatives (excluding No Action) fell between 8.3 and 9.3.

**DRAFT REMEDIAL INVESTIGATION AND FEASIBILITY STUDY  
Former Bayliner Marine – Arlington, Washington  
FEASIBILITY STUDY**August 10, 2010

---

The highest scoring alternative was Alternative #3 (Source Area ISCO with MNA and IC) with a score of 9.3 out of a possible 10 points.

The highest cost alternative is Alternative #1 (Site-Wide ISCO with MNA) at just over \$1.7 million. With a score of 9.2 out of 10, the “benefit” achieved by this alternative is 99 percent of the benefit achieved by Alternative #3, while the estimated cost is 591 percent of the cost of Alternative #3. Based on this analysis, the cost for Alternative #1 is deemed to be disproportionate to the benefit achieved.

The second-highest cost alternative was Alternative #5 (Source Area GWET with MNA & IC) with an estimated cost of just over \$1.1 million. With a score of 8.6 out of 10, the “benefit” achieved by this alternative is 92 percent of the benefit achieved by Alternative #3, while the estimated cost is 390 percent of the cost of Alternative #3. Based on this analysis, the cost for Alternative #5 is deemed to be disproportionate to the benefit achieved.

The third-highest cost alternative was Alternative #4 (Source Area AS/SVE with MNA & IC) with an estimated cost of \$500,000. With a score of 8.3 out of 10, the “benefit” achieved by this alternative was thus 89 percent as high as Alternative #3, while the estimated cost of Alternative #4 is 172 percent of the cost for Alternative #3. Based on this analysis, the cost for Alternative #4 is judged to be disproportionate to the benefit achieved.

A comparison of the remaining two alternatives found that Alternative #3 (Source Area ISCO with MNA and IC) achieved a “benefit” that is 4 percent higher than that of Alternative #2 (MNA with IC), while the cost differential is 74 percent. Based on this analysis, the cost of Alternative #3 may be disproportionate to the benefit achieved.

## **4.0 SELECTION OF PREFERRED CLEANUP ACTION ALTERNATIVE**

---

Based on the evaluation of on-site cleanup action alternatives and costs, this analysis has determined that Alternative #2 – MNA with Institutional controls and Alternative #3 – Source-Area *in situ* Chemical Oxidation (ISCO) with Monitored Natural Attenuation and Institutional Control provide nearly equivalent protectiveness. The cost of Alternative #3 is considerably higher than the cost for Alternative #2 for achieving approximately the equivalent outcome, although there is a differentiation in the timing of the spend. Alternative #3 requires higher near-term capital spending than Alternative #2 which has a lower even spend throughout implementation of the remedy.

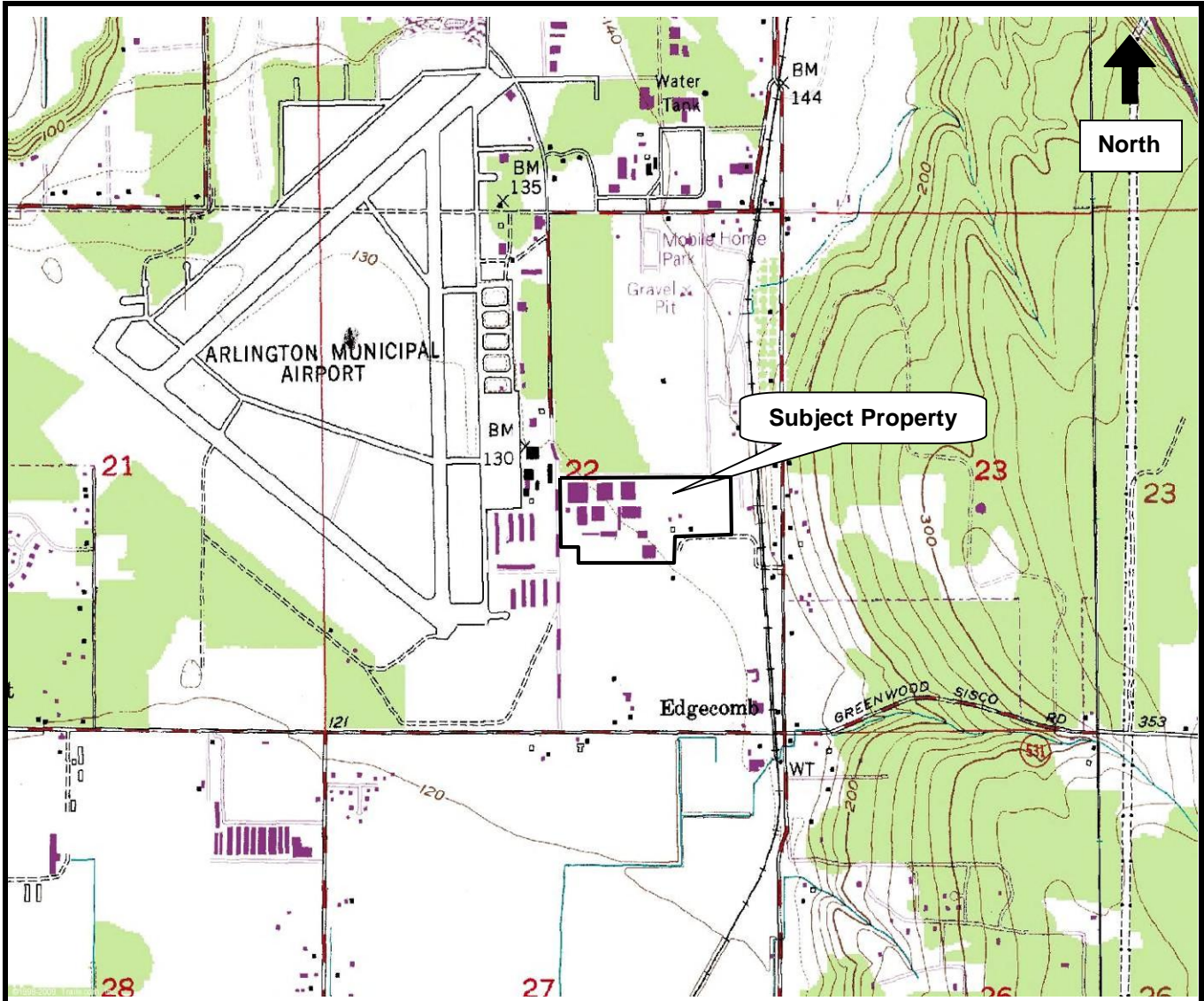
It is recognized that bench-scale and field pilot tests for the ISCO alternative would be required to confirm this evaluation prior to the implementation of cleanup activities. Similarly, additional groundwater monitoring is required to confirm the effectiveness of MNA.

It may not be technically possible for any of the evaluated cleanup technologies to achieve the CUL throughout the site within a reasonable time frame. Therefore, the effectiveness of the cleanup action will be determined by monitoring PCE concentrations at the conditional POC MW5 and MW7. WAC 173-340-720(8) states that when a Conditional POC is proposed it must be demonstrated that “all practicable methods of treatment are to be used in the site cleanup.” Consequently, Alternative #3 – Source-Area ISCO with MNA and IC is chosen as the preferred alternative, even though its cost is somewhat higher. Alternative #2 offers the best opportunity for rapid reduction of the highest concentrations of PCE, while also ensuring protectiveness by monitoring to confirm that PCE concentrations at the Conditional POC remain below the CUL. Implementation of an IC will further enhance protectiveness and permanence of the solution by preventing future on-site activities that pose a risk of exposure to on-site groundwater containing residual PCE.

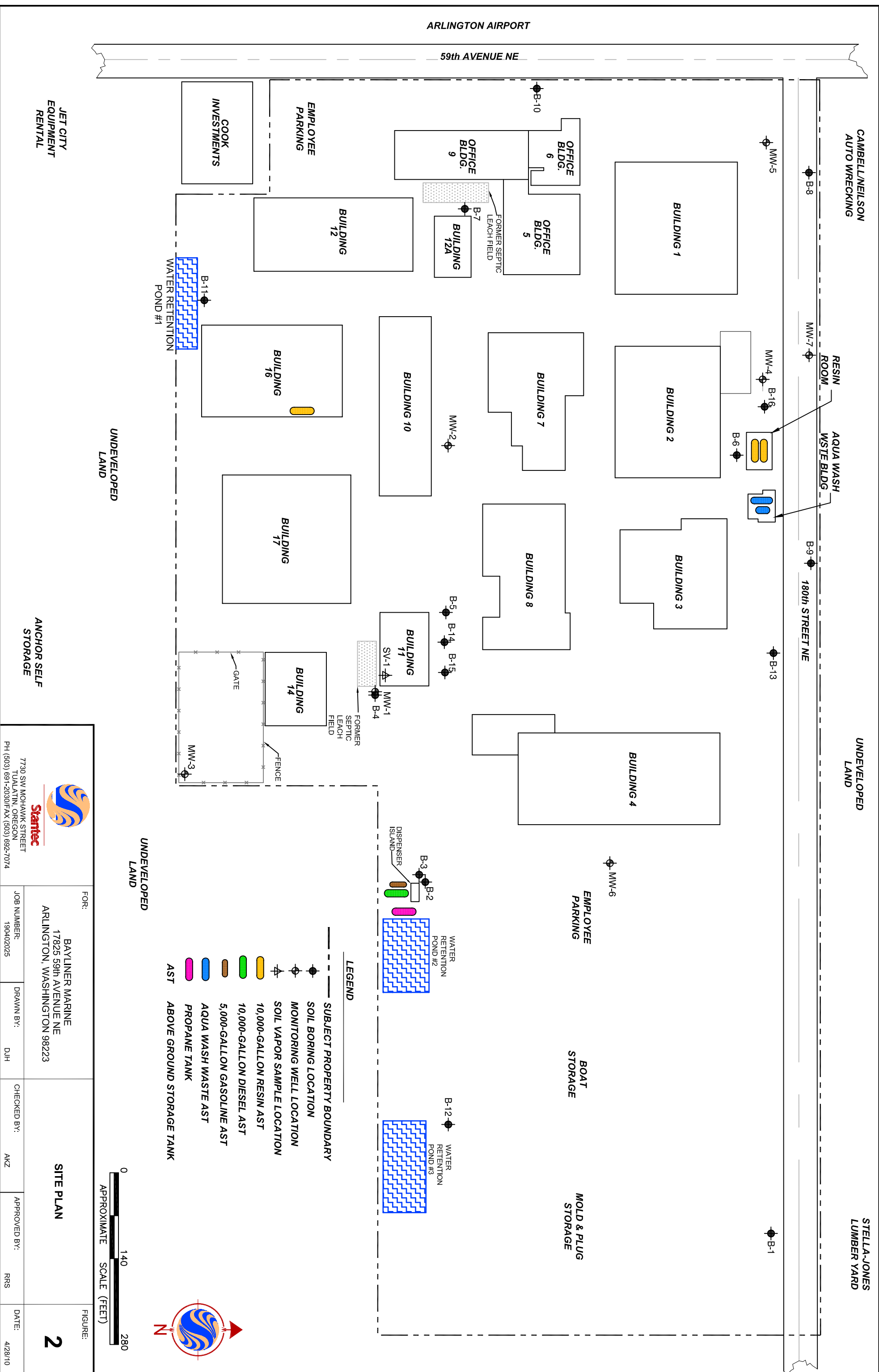
If pilot testing demonstrates that ISCO cannot be effectively implemented as a remedy in the source area, then Alternative #2 would be applied instead.

**APPENDIX A**  
**FIGURES**

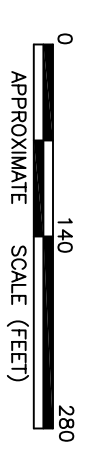
---



<p>Site</p> <p>Washington</p> <p>Quadrangle Location Map</p>	<p>Job #: 190402025</p> <p>Site Location Map</p> <p>US Marine 17825 59<sup>th</sup> Avenue Arlington, Washington 98223</p>	<p><b>Stantec</b></p> <p>7730 SW Mohawk St. Tualatin, Oregon 97062</p>	
<p>DATE: 03/04/09</p>	<p>Source: USGS Smokey Point, WA Quad 1981</p>	<p>Scale 1:25000</p>	<p>Figure: 1</p>
<p>DWN: Paula Fitzgerald</p>	<p>APPR: Amy Zach</p>	<p>Revision: 0</p>	



- LEGEND**
- SUBJECT PROPERTY BOUNDARY
  - SOIL BORING LOCATION
  - ⊕ MONITORING WELL LOCATION
  - ⚡ SOIL VAPOR SAMPLE LOCATION
  - 10,000-GALLON RESIN AST
  - 10,000-GALLON DIESEL AST
  - 5,000-GALLON GASOLINE AST
  - AQUA WASH WASTE AST
  - PROPANE TANK
  - AST ABOVE GROUND STORAGE TANK



<p>7730 SW MOHAWK STREET TUALATIN, OREGON PH (503) 691-2030/FAX (503) 692-7074</p>		<p>FOR: BAYLINER MARINE 17825 59th AVENUE NE ARLINGTON, WASHINGTON 98223</p>		<p><b>SITE PLAN</b></p>		<p>FIGURE: <b>2</b></p>	
<p>JOB NUMBER: 190402025</p>	<p>DRAWN BY: DJH</p>	<p>CHECKED BY: AKZ</p>	<p>APPROVED BY: RRS</p>	<p>DATE: 4/28/10</p>	<p>FILE PATH: \\K:\CLIENTS\BAYLINER MARINE-190402025\AR20101190402025-FIG 2,3 &amp; 4-BAYLINER MARINE.dwg\dwg\heller\pdr 28, 2010 at 2:11:10\layout SITE PLAN-FIG.2</p>		

UNDEVELOPED LAND

UNDEVELOPED LAND

UNDEVELOPED LAND

JET CITY  
EQUIPMENT  
RENTAL

ANCHOR SELF  
STORAGE

CAMBELL/NEILSON  
AUTO WRECKING

UNDEVELOPED  
LAND

STELLA-JONES  
LUMBER YARD

ARLINGTON AIRPORT

59th AVENUE NE

180th STREET NE

RESIN ROOM  
AQUA WASH  
WASTE BLDG

WATER RETENTION  
POND #1

WATER  
RETENTION  
POND #2

WATER  
RETENTION  
POND #3

FORMER  
SEPTIC  
LEACH  
FIELD

FORMER SEPTIC  
LEACH FIELD

OFFICE  
BLDG.  
6

OFFICE  
BLDG.  
5

BUILDING  
12A

BUILDING  
7

BUILDING  
8

BUILDING  
4

BUILDING  
10

BUILDING  
11

BUILDING  
14

BUILDING  
16

EMPLOYEE  
PARKING

COOK  
INVESTMENTS

EMPLOYEE  
PARKING

BOAT  
STORAGE

MOLD & PLUG  
STORAGE

MW-5

B-8

MW-7

MW-4

B-16

B-6

B-9

B-13

MW-2

B-5

B-14

B-15

BUILDING  
11

SV-1

MW-1

B-4

MW-3

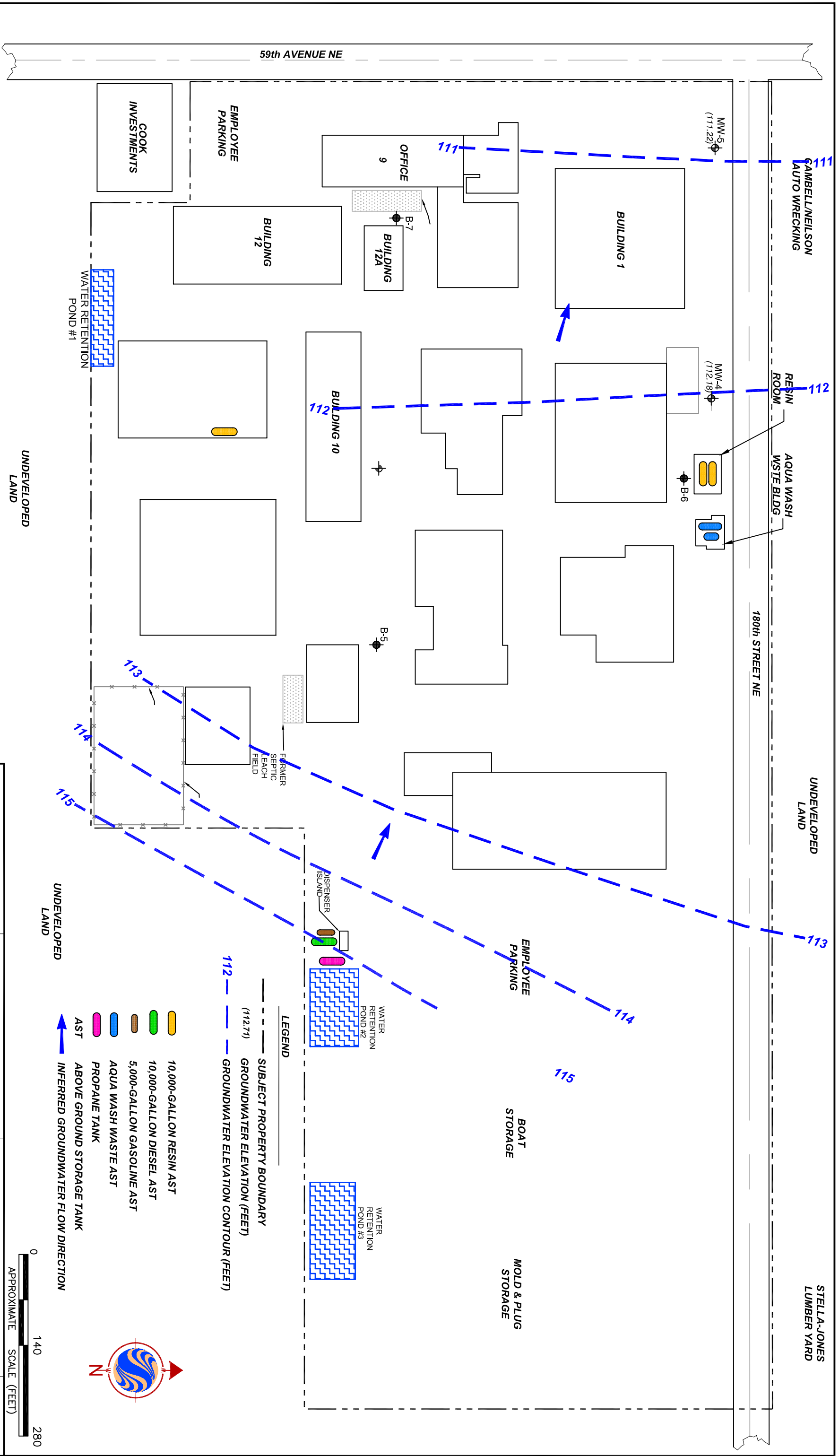
MW-6

B-3

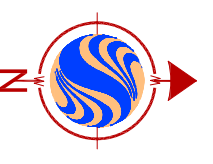
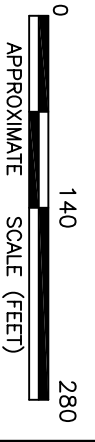
B-2

B-12

B-1



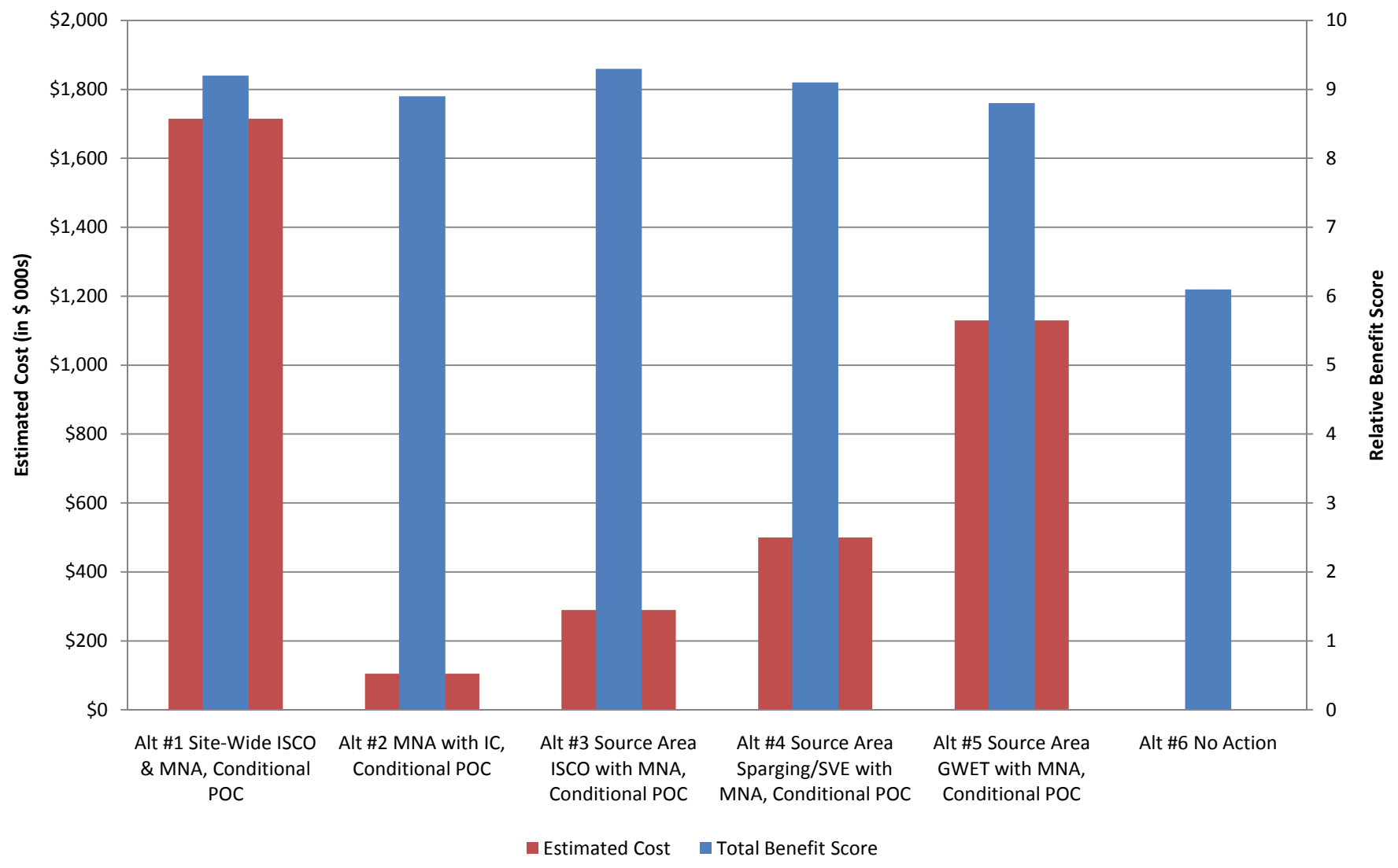
- LEGEND**
- SUBJECT PROPERTY BOUNDARY
  - (112.77) --- GROUNDWATER ELEVATION (FEET)
  - GROUNDWATER ELEVATION CONTOUR (FEET)
  - 10,000-GALLON RESIN AST
  - 10,000-GALLON DIESEL AST
  - 5,000-GALLON GASOLINE AST
  - AQUA WASH WASTE AST
  - PROPANE TANK
  - AST ABOVE GROUND STORAGE TANK
  - INFERRED GROUNDWATER FLOW DIRECTION



<p>9400 SW BARNES ROAD PORTLAND, OREGON PH (503) 297-1631/FAX (503) 297-5429</p>	FOR:	BAYLINER MARINE 17825 59th AVENUE NE ARLINGTON, WASHINGTON 98223	<p><b>SITE PLAN WITH GROUNDWATER ELEVATIONS (MAY 26, 2010)</b></p>	FIGURE:	<b>3</b>				
	JOB NUMBER:	190402025		DRAWN BY:	DJH	CHECKED BY:	AKZ	APPROVED BY:	RRS



**Figure 5**  
**Comparison of Benefit and Costs**  
**For Cleanup Action Alternatives**



**APPENDIX B**  
**TABLES**

---

**Table 1**  
**Monitoring Well Data**  
**Bayliner Marine - Arlington, Washington**

Well No.	Measurement Date	Total Depth (feet)	Top of Casing Elevation (ft MSL)	Screened Interval (ft. bgs)		Screened Interval (ft. MSL)		Depth to Groundwater (Feet)	Groundwater Elevation (Ft. MSL)
				Top	Bottom	Top	Bottom		
MW-1	12/10/2009	29.95	129.42	15	30	114.42	99.42	18.89	110.53
	2/18/2010							16.71	112.71
	5/26/2010							16.51	112.91
MW-2	12/10/2009	27.25	129.68	15	30	114.68	99.68	20.02	109.66
	2/18/2010							17.64	112.04
	5/26/2010							17.41	112.27
MW-3	12/10/2009	24.3	129.90	10	25	119.9	104.9	16.89	113.01
	2/18/2010							15.02	114.88
	5/26/2010							14.85	115.05
MW-4	12/10/2009	28.4	130.42	15	30	115.42	100.42	21.20	109.22
	2/18/2010							18.55	111.87
	5/26/2010							18.24	112.18
MW-5	12/10/2009	33.95	130.39	20	35	110.39	95.39	21.96	108.43
	2/18/2010							19.45	110.94
	5/26/2010							19.17	111.22
MW-6	2/19/2010	25.00	129.59	15	25	114.59	104.59	16.68	112.91
	5/26/2010							16.51	113.08
MW-7	2/19/2010	30.00	131.27	15	30	116.27	101.27	19.90	111.37
	5/26/2010							19.61	111.66

**TABLE 2**  
**SUMMARY OF LABORATORY ANALYTICAL RESULTS**  
**VOCs IN GROUNDWATER**

**Bayliner Marine Property, Arlington, Washington**

Sample #	Sample Date	VOCs <sup>1</sup> (µg/L) <sup>2</sup>	MTCA Method A Cleanup Level <sup>3</sup> (µg/L)
B-1	5/20/09	All BDL <sup>4</sup>	N/A
B-2	5/21/09	PCE <sup>5</sup> 1.5 All Others BDL	PCE 5
B-3	5/21/09	PCE 3.3 All Others BDL	PCE 5
<b>B-4</b>	<b>5/21/09</b>	<b>PCE 42</b> All Others BDL	<b>PCE 5</b>
<b>B-5</b>	<b>5/21/09</b>	<b>PCE 31</b> All Others BDL	PCE 5
<b>B-6</b>	<b>5/21/09</b>	<b>PCE 18</b>	<b>PCE 5</b>
B-7	5/21/09	All BDL	N/A
<b>MW-1</b>	12/09/09	<b>PCE 59</b> All Others BDL	<b>PCE 5</b>
	2/18/10	<b>PCE 48</b> All Others BDL	
	5/26/10	<b>PCE 50</b> All Others BDL	
	5/26/10 - DUP	<b>PCE 46</b> All Others BDL	
MW-2	12/09/09	All BDL	N/A
	2/18/10	All BDL	
	5/26/10	All BDL	
MW-3	12/09/09	All BDL	N/A
	2/18/10	All BDL	
	5/26/10	All BDL	
MW-4	12/09/09	<b>PCE 13</b> <b>TCE<sup>6</sup> 16</b> All Others BDL	PCE 5 TCE 5
	2/18/10	<b>PCE 5.3</b> TCE BDL All Others BDL	
	5/26/10	PCE 5.0 All Others BDL	
MW-5	12/09/09	All BDL	N/A
	2/18/10	All BDL	
	5/26/10	All BDL	
MW-6	2/19/10	All BDL	N/A
	5/26/10	All BDL	
MW-7	2/19/10	All BDL	N/A
	5/26/10	All BDL	
B-8	2/18/10	All BDL	N/A
B-9	2/18/10	All BDL	N/A
B-10	3/19/10	All BDL	N/A

**TABLE 2  
SUMMARY OF LABORATORY ANALYTICAL RESULTS  
VOCs IN GROUNDWATER**

**Bayliner Marine Property, Arlington, Washington**

Sample #	Sample Date	VOCs <sup>1</sup> (µg/L) <sup>2</sup>	MTCA Method A Cleanup Level <sup>3</sup> (µg/L)
B-11	3/19/10	All BDL	N/A
B-12	3/19/10	All BDL	N/A
B-13	3/19/10	All BDL	N/A
<b>B-14 (16-20')</b>	<b>3/19/10</b>	<b>PCE 45</b> All Others BDL	<b>PCE 5</b>
<b>B-14 (30-34')</b>	<b>3/19/10</b>	<b>PCE 40</b> All Others BDL	<b>PCE 5</b>
B-14 (44-48')	3/19/10	All BDL	N/A
<b>B-15</b>	<b>3/19/10</b>	<b>PCE 40</b> All Others BDL	<b>PCE 5</b>
B-16 (18-22')	3/19/10	PCE 3.9 All Others BDL	N/A
<b>B-16 (32-36')</b>	<b>3/19/10</b>	<b>PCE 7.3</b> Ethylbenzene 3.4 All Others ND	<b>PCE 5</b> Ethylbenzene 700
B-16 (46-50')	3/19/10	All BDL	N/A

NOTES:

**Values in bold font exceed applicable cleanup guidelines**

- 1 VOCs = Volatile Organic Compounds by USEPA Method 8260B
- 2 µg/L = micrograms per liter
- 3 Method A Groundwater Cleanup Level established under Washington Model Toxics Cleanup Act (MTCA)
- 4 BDL = Below Detection Limit for the laboratory analytical method
- 5 PCE = Tetrachloroethylene (aka perchlorethylene)
- 6 TCE - Trichloroethylene

**TABLE 3  
EVALUATION OF CLEANUP ACTION ALTERNATIVES FOR DISPROPORTIONAL COST ANALYSIS  
BAYLINER MARINE PROPERTY, ARLINGTON, WASHINGTON**

	Alternative #1	Alternative #2	Alternative #3	Alternative #4	Alternative #5	Alternative #6
	Site-Wide In Situ Chemical Oxidation and MNA	Monitored Natural Attenuation and Institutional Control	Source Area In Situ Chemical Oxidation Combined With MNA and Institutional Control	Source Area Air Sparging and Soil Vapor Extraction with MNA and Institutional Controls	Source Area Groundwater Pump & Treat, MNA and Institutional Controls	No Action
<b>Compliance With MTCA Threshold Requirements [ WAC 173-340-360(2)(a) ]</b>						
Protective of Human Health & Environment	Yes – rapidly reduces PCE concentrations throughout plume and monitors to confirm long-term stability and residual concentration reduction.	Yes - reduces PCE concentrations over entire site; monitors to confirm long-term stability and concentration reduction, institutional control minimizes long-term risk of exposure to on-site groundwater.	Yes – rapidly reduces PCE concentrations in source area. MNA achieves further reductions over rest of site. Monitors to confirm long-term stability and concentration reduction. Institutional control minimizes long-term risk of exposure to on-site groundwater.	Yes – reduces PCE concentrations in source area. MNA achieves further reductions over rest of site. Monitors to confirm long-term stability and concentration reduction. Institutional control minimizes long-term risk of exposure to on-site groundwater.	Yes – hydraulically contains PCE concentrations in source area and reduces PCE mass in subsurface. MNA achieves further reduction over rest of site. Monitors to confirm long-term stability and concentration reduction. Institutional control minimizes long-term risk of exposure to on-site groundwater.	Yes – reduces PCE concentrations over entire site through natural attenuation of contaminants.
Complies with applicable cleanup standards	Yes –compliance at conditional property boundary POC.	Yes - compliance at conditional property boundary POC.	Yes –compliance at conditional property boundary POC.	Yes –compliance at conditional property boundary POC.	Yes –compliance at conditional property boundary POC.	Yes – compliance at conditional property boundary POC.
Complies with applicable state and federal laws	Yes – complies with applicable laws.	Yes – complies with applicable laws.	Yes – complies with applicable laws.	Yes – complies with applicable laws.	Yes – complies with applicable laws.	Yes – complies with applicable laws.
Provides For Compliance Monitoring	Yes	Yes	Yes	Yes	Yes	No

	Alternative #1	Alternative #2	Alternative #3	Alternative #4	Alternative #5	Alternative #6
	Site-Wide In Situ Chemical Oxidation and MNA	Monitored Natural Attenuation and Institutional Control	Source Area In Situ Chemical Oxidation Combined With MNA and Institutional Control	Source Area Air Sparging and Soil Vapor Extraction with MNA and Institutional Controls	Source Area Groundwater Pump & Treat, MNA and Institutional Controls	No Action
<b>Compliance With Other MTCA Requirements [ WAC 173-340-360(2)(b) ]</b>						
Permanence	Yes – results in permanent reduction in toxicity, mobility & volume of PCE throughout plume to the extent of technical feasibility.	Yes – results in permanent reduction in toxicity, mobility, and volume of PCE.	Yes – results in permanent reduction in toxicity, mobility and volume of PCE from source area. Further permanent concentration reduction is achieved through MNA across rest of site.	Yes – results in permanent removal of PCE from source area. Further permanent concentration reduction achieved through MNA across rest of site	Yes – results in permanent removal of PCE from source area. Further permanent concentration reduction is achieved through MNA across rest of site.	Not evaluated because alternative does not comply with threshold requirements.
Reasonable Restoration Time	Est. Restoration Time – 4 years: 1 year for pilot testing, design and construction; 1 year of periodic injection of chemical oxidizer.	Est. Restoration Time - 2 years.	Est. Restoration Time - 2 years: 1 year for pilot testing, design and construction; 1 year of periodic injection of chemical oxidizer.	Est. Restoration Time - 3 years: 1 year for pilot testing, design and construction; 2 years of system operation.	Est. Restoration Time - 6 years: 1 year for aquifer testing, design and construction; 5 years of system operation.	Not evaluated because alternative does not comply with threshold requirements.
Considers Pubic Concerns	No known public concerns.	No known public concerns	No known public concerns.	Potential noise issues associated with operating machinery.	Potential noise issues associated with operating machinery.	Not evaluated because alternative does not comply with threshold requirements.

	Alternative #1	Alternative #2	Alternative #3	Alternative #4	Alternative #5	Alternative #6
	Site-Wide In Situ Chemical Oxidation and MNA	Monitored Natural Attenuation and Institutional Control	Source Area In Situ Chemical Oxidation Combined With MNA and Institutional Control	Source Area Air Sparging and Soil Vapor Extraction with MNA and Institutional Controls	Source Area Groundwater Pump & Treat, MNA and Institutional Controls	No Action
<b>Other Evaluation Factors For Disproportionate Cost Analysis [ WAC 173-340-360(3)(f) ]</b>						
Long-Term Effectiveness	Yes – reduces PCE concentrations and monitors to confirm long-term stability and residual concentration reduction.	Yes – reduces PCE concentrations and monitors to confirm long-term stability and residual concentration reduction.	Yes – reduces PCE concentrations and monitors to confirm long-term stability and residual concentration reduction.	Yes – reduces PCE concentrations, and monitors to confirm long-term stability and residual concentration reduction.	Yes – reduces PCE concentrations and monitors to confirm long-term stability and residual concentration reduction.	Not evaluated because alternative does not comply with threshold requirements.
Management of Short-Term Risks During Implementation	Yes – No current groundwater receptors, so short-term risks are minimal. Does not create excess short-term risks that affect Site or adjoining properties.	Yes – No current groundwater receptors, so short-term risks are minimal. Does not create excess short-term risks that affect Site or adjoining properties.	Yes – No current groundwater receptors, so short-term risks are minimal. Does not create excess short-term risks that affect Site or adjoining properties.	Yes – No current groundwater receptors, so short-term risks are minimal. Does not create excess short-term risks that affect Site or adjoining properties.	Yes – hydraulically contains PCE concentrations in source area. Generates treated wastewater that must be discharged to sewer.	Not evaluated because alternative does not comply with threshold requirements.
Technical Implementability	Yes – can be implemented with established technology. Site conditions appear favorable for this technology.	Yes – requires no implementation other than continued monitoring. Site conditions appear favorable for this technology.	Yes – can be implemented with established technology. Site conditions appear favorable for this technology.	Utilizes established technology. Site conditions appear favorable for this technology.	Utilizes established technology. Site conditions appear favorable for this technology.	Not evaluated because alternative does not comply with threshold requirements.
Administrative Implementability	No administrative obstacles.	Requires implementation of Institutional Control.	Requires implementation of Institutional Control.	Requires implementation of Institutional Control.	Requires implementation of Institutional Control.	Not evaluated because alternative does not comply with threshold requirements.
<b>Total Cost</b>	<b>\$1,715,000</b>	<b>\$105,000</b>	<b>\$290,000</b>	<b>\$500,000</b>	<b>\$1,130,000</b>	<b>\$0</b>

**Table 4**  
**Cleanup Action Alternatives - Cost Estimate Summary**  
**(Cost in \$000s)**  
**Bayliner Marine - Arlington, Washington**

	Alternative #1	Alternative #2	Alternative #3	Alternative #4	Alternative #5
	Site-Wide ISCO/MNA	MNA/ Institutional Control	Source Area ISCO/MNA/ Institutional Control	Source Area AS/SVE, MNA, Institutional Control	Source Area GWET, MNA, Institutional Control
<b>Pre-Remediation</b>					
Pilot Testing and Design	\$ 25	\$ 5	\$ 25	\$ 25	\$ 25
Pre-Remediation Time Period (Yrs)	1	0.5	1	1	1
<b>Pre-Remediation Total</b>	<b>\$ 25</b>	<b>\$ 5</b>	<b>\$ 25</b>	<b>\$ 25</b>	<b>\$ 25</b>
<b>Remediation</b>					
Source Area ISCO			\$ 165		
Plume ISCO	\$ 1,600				
Source Area AS/SVE				\$ 240	
Source Area Pump and Treat					\$ 500
Remediation Time Period (Yrs)	1	2	1	2	5
<b>Remediation Total</b>	<b>\$ 1,600</b>	<b>\$ -</b>	<b>\$ 165</b>	<b>\$ 240</b>	<b>\$ 500</b>
<b>O&amp;M</b>					
O&M	\$ -	\$ -	\$ -	\$ 45	\$ 65
Duration (years)	0	0	0	2	5
<b>O&amp;M Total</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ 90</b>	<b>\$ 325</b>
<b>Monitoring</b>					
Groundwater Monitoring and reporting	\$ 45	\$ 45	\$ 45	\$ 45	\$ 45
Duration (years)	2	2	2	3	6
<b>Monitoring Total</b>	<b>\$ 90</b>	<b>\$ 90</b>	<b>\$ 90</b>	<b>\$ 135</b>	<b>\$ 270</b>
<b>Institutional Controls</b>	<b>\$ -</b>	<b>\$ 10</b>	<b>\$ 10</b>	<b>\$ 10</b>	<b>\$ 10</b>
<b>Grand Total</b>	<b>\$ 1,715</b>	<b>\$ 105</b>	<b>\$ 290</b>	<b>\$ 500</b>	<b>\$ 1,130</b>
<b>Total Restoration Time Frame (Yrs)</b>	<b>4</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>6</b>

**TABLE 5  
COMPARISON OF BENEFITS AND COSTS FOR CLEANUP ACTION ALTERNATIVES  
DISPROPORTIONATE COST ANALYSIS  
FORMER BAYLINER MARINE FACILITY, ARLINGTON, WASHINGTON**

Benefits Summary Factor	Weighting	Alt #1 Site-Wide ISCO and MNA		Alt #2 MNA with IC		Alt #3 Source Area ISCO with MNA and IC		Alt #4 Source Area Sparging & SVE with MNA & IC		Alt #5 Source Area Pump & Treat with MNA & IC		Alt #6 No Action	
		Conditional POC		Conditional POC		Conditional POC		Conditional POC		Conditional POC		Conditional POC	
		Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value
Protectiveness	0.3	10	3	10	3	10	3	10	3	10	3	4	1.2
Permanence	0.2	10	2	10	2	10	2	10	2	10	2	10	2
Long-Term Effectiveness	0.2	9	1.8	6	1.2	8	1.6	8	1.6	7	1.4	4	0.8
Mgmt of Short-Term Risks	0.1	10	1	10	1	10	1	7	0.7	8	0.8	1	0.1
Technical & Administrative Implementability	0.1	4	0.4	7	0.7	7	0.7	7	0	4	0.4	10	1
Considers Public Concerns	0.1	10	1	10	1	10	1	10	1	10	1	10	1
Total Benefits Score	1	9.2		8.9		9.3		8.3		8.6		6.1	
Benefits Score Comparison		99%		96%		100%		89%		92%		66%	
Estimated Cost		\$ 1,715,000		\$ 105,000		\$ 290,000		\$ 500,000		\$ 1,130,000		\$0	
Cost Comparison		591%		36%		100%		172%		390%			

**APPENDIX C**

**GROUNDWATER SAMPLING DATA SHEETS – MAY 2010**

---

**GROUNDWATER SAMPLING DATA SHEET**  
 Stantec Consulting  
 9400 SW Barnes Road, Suite 200, Portland, OR 97225

Stantec Project No.: 190402025.200.0001 Date: 05-26-10 Well No: MW-1  
 Facility Name: Brunswick - Bayliner Temperature: low SOs °F or °C  
 Field Personnel: ACE Weather: showers

**FIELD MEASUREMENTS:**

A. Total Depth (TD) of Well from TOC: 30.00 FT. or IN.  
 C. Static Water Level (SWL) Below Top of Casing (TOC): 16.51 FT. or IN.  
 D. Height of Water Column in Casing: (h = TD-SWL) 13.49 FT. or IN.  
 E. Useful approximate Purge Volumes (PV) per foot of water column

	<u>3 Well Vols.</u>	<u>5 Well Vols.</u>				
5/8" diameter =	21.8 mL/ft		X	feet of water	=	PV (milliliters)
2" diameter =	0.5 gal/ft	0.82 gal/ft	X	feet of water	=	PV (gallons)
4" diameter =	2.0 gal/ft	3.25 gal/ft	X	feet of water	=	PV (gallons)
6" diameter =	4.4 gal/ft	7.35 gal/ft	X	feet of water	=	PV (gallons)

Purge Method: low flow peristaltic pump Duration: 10 mins  
 disposable bailer / trash pump / pvc hand bail  
 in-line pump / single valve sampler / syringe

**OBSERVATIONS:**

	<u>Time</u>	<u>Turbidity</u>	<u>pH</u>	<u>Temp.</u>	<u>Conduct.</u>	<u>DO</u>	<u>ORP</u>	<u>SWL</u>
1038 start								
1st Volume:	<u>1039</u>	<u>LOW</u>	<u>5.47</u>	<u>52.09</u>	<u>157</u>	<u>4.49</u>	<u>197.2</u>	
2nd Volume:	<u>1042</u>	<u>CLR</u>	<u>4.87</u>	<u>51.52</u>	<u>126</u>	<u>3.51</u>	<u>141.2</u>	
3rd Volume:	<u>1045</u>	<u>CLR</u>	<u>4.89</u>	<u>51.49</u>	<u>122</u>	<u>3.45</u>	<u>139.1</u>	
4th Volume:	<u>1049</u>	<u>CLR</u>	<u>4.84</u>	<u>51.50</u>	<u>120</u>	<u>3.47</u>	<u>132.6</u>	
5th Volume:								

Total Volume of Water Purged From Well: < 1 gal

Purge Water Stored/Disposed of Where/How: On-Site 55-gallon drum

**SAMPLES COLLECTED:** Depth to Water at time of sample collection: 16.51 >80%

Sample Number(s):	Time:	Size/Number of Container(s):	Preservative:
<u>MW-1</u>	<u>10:55</u>	<u>(3) 40 ml VOA's</u>	<u>HCl</u>
<u>DUP-1</u>	<u>DUP-1</u>		

**COMMENTS:**

---



---

Casing Capacities:  
 2-inch hole ..... 0.16 gal/lin ft.  
 4-inch hole ..... 0.65 gal/lin ft.  
 6.5-inch hole ..... 1.70 gal/lin ft.  
 8-inch hole ..... 2.60 gal/lin ft.  
 10-inch hole ..... 4.10 gal/lin ft.

**Recharge Calculation at Time of Sample Collection:**  
 Total Depth of Well: \_\_\_\_\_  
 Original Water Column: \_\_\_\_\_ x 0.80 = -( \_\_\_\_\_ )  
 Collect sample when Depth to Water measures  
 Less than or equal to: \_\_\_\_\_

**GROUNDWATER SAMPLING DATA SHEET**  
 Stantec Consulting  
 9400 SW Barnes Road, Suite 200, Portland, OR 97225

Stantec Project No.: 190402025.200.0001 Date: 05-26-10 Well No: MW-2  
 Facility Name: Brunswick - Bayliner Temperature: low SOCs °F or °C  
 Field Personnel: ACT Weather: showers

**FIELD MEASUREMENTS:**

A. Total Depth (TD) of Well from TOC: 29.70 FT. or IN.  
 C. Static Water Level (SWL) Below Top of Casing (TOC): 17.41 FT. or IN.  
 D. Height of Water Column in Casing: (h = TD-SWL) 12.29 FT. or IN.

E. Useful approximate Purge Volumes (PV) per foot of water column

	3 Well Vols.	5 Well Vols.				
5/8" diameter =	21.8 mL/ft		X	feet of water	=	PV (milliliters)
2" diameter =	0.5 gal/ft	0.82 gal/ft	X	feet of water	=	PV (gallons)
4" diameter =	2.0 gal/ft	3.25 gal/ft	X	feet of water	=	PV (gallons)
6" diameter =	4.4 gal/ft	7.35 gal/ft	X	feet of water	=	PV (gallons)

Purge Method: low flow - peristaltic pump  
~~disposable bailer / trash pump / pvc hand bail~~  
~~in-line pump / single valve sampler / syringe~~ Duration: 10 mins

**OBSERVATIONS:**

1009 start

	Time	Turbidity	pH	Temp.	Conduct.	DO	ORP	SWL
1st Volume:	<u>1011</u>	<u>low</u>	<u>4.54</u>	<u>53.12</u>	<u>154</u>	<u>3.53</u>	<u>213.2</u>	
2nd Volume:	<u>1014</u>	<u>low</u>	<u>4.45</u>	<u>53.05</u>	<u>133</u>	<u>3.96</u>	<u>218.7</u>	
3rd Volume:	<u>1017</u>	<u>low</u>	<u>4.45</u>	<u>53.09</u>	<u>136</u>	<u>4.00</u>	<u>219.3</u>	
4th Volume:	<u>1021</u>	<u>low</u>	<u>4.49</u>	<u>53.00</u>	<u>141</u>	<u>3.92</u>	<u>219.8</u>	
5th Volume:								

Total Volume of Water Purged From Well: <1 gal

Purge Water Stored/Disposed of Where/How: On-Site 55-gallon drum

**SAMPLES COLLECTED:** Depth to Water at time of sample collection: 17.43 >80%

Sample Numbers(s): MW-2 Time: 1027 Size/Number of Container(s): (3) 40ml Vials Preservative: HCl

**COMMENTS:**

---



---



---

Casing Capacities:

2-inch hole.....	0.16 gal/lin ft.
4-inch hole.....	0.65 gal/lin ft.
6.5-inch hole.....	1.70 gal/lin ft.
8-inch hole.....	2.60 gal/lin ft.
10-inch hole.....	4.10 gal/lin ft.

Recharge Calculation at Time of Sample Collection:

Total Depth of Well: \_\_\_\_\_  
 Original Water Column: \_\_\_\_\_ x 0.80 = -( \_\_\_\_\_ )  
 Collect sample when Depth to Water measures  
 Less than or equal to: \_\_\_\_\_

**GROUNDWATER SAMPLING DATA SHEET**  
 Stantec Consulting  
 9400 SW Barnes Road, Suite 200, Portland, OR 97225

Stantec Project No.: 190402025.200.0001 Date: 05-26-10 Well No: MW-3  
 Facility Name: Brunswick - Bayliner Temperature: low SOs °F or °C  
 Field Personnel: ACE Weather: showers & cloudy

**FIELD MEASUREMENTS:**

A. Total Depth (TD) of Well from TOC: 23.91 FT. or IN.  
 C. Static Water Level (SWL) Below Top of Casing (TOC): 14.85 FT. or IN.  
 D. Height of Water Column in Casing: (h = TD-SWL) 9.06 FT. or IN.

E. Useful approximate Purge Volumes (PV) per foot of water column

	3 Well Vols.	5 Well Vols.				
5/8" diameter =	21.8 mL/ft		X	feet of water	=	PV (milliliters)
2" diameter =	0.5 gal/ft	0.82 gal/ft	X	feet of water	=	PV (gallons)
4" diameter =	2.0 gal/ft	3.25 gal/ft	X	feet of water	=	PV (gallons)
6" diameter =	4.4 gal/ft	7.35 gal/ft	X	feet of water	=	PV (gallons)

Purge Method: low flow - peristaltic pump Duration: 10 mins  
~~in-line pump / single valve sampler / syringe~~

**OBSERVATIONS:**

	Time	Turbidity	pH	Temp.	Conduct.	DO	ORP	SWL
start	<u>720</u>							
1st Volume:	<u>722</u>	<u>no filter</u>	<u>4.51</u>	<u>49.08</u>	<u>212</u>	<u>7.21</u>	<u>239.1</u>	
2nd Volume:	<u>725</u>	↓	<u>4.01</u>	<u>49.17</u>	<u>260</u>	<u>7.43</u>	<u>289.9</u>	
3rd Volume:	<u>728</u>	↓	<u>3.75</u>	<u>49.11</u>	<u>262</u>	<u>6.94</u>	<u>287.1</u>	
4th Volume:	<u>731</u>	↓	<u>3.86</u>	<u>49.15</u>	<u>249</u>	<u>6.90</u>	<u>279.9</u>	
5th Volume:								

Total Volume of Water Purged From Well: < 1 gal

Purge Water Stored/Disposed of Where/How: On-Site 55-gallon drum

**SAMPLES COLLECTED:**

Depth to Water at time of sample collection: 14.89 >80%

Sample Numbers(s): MW-3 Time: 0740 Size/Number of Container(s): (3) 40ml VOA's Preservative: HCl

**COMMENTS:**

Casing Capacities:

2-inch hole	0.16 gal/lin ft.
4-inch hole	0.65 gal/lin ft.
6.5-inch hole	1.70 gal/lin ft.
8-inch hole	2.60 gal/lin ft.
10-inch hole	4.10 gal/lin ft.

**Recharge Calculation at Time of Sample Collection:**

Total Depth of Well: \_\_\_\_\_  
 Original Water Column: \_\_\_\_\_ x 0.80 = -( \_\_\_\_\_ )  
 Collect sample when Depth to Water measures  
 Less than or equal to: \_\_\_\_\_

**GROUNDWATER SAMPLING DATA SHEET**  
 Stantec Consulting  
 9400 SW Barnes Road, Suite 200, Portland, OR 97225

Stantec Project No.: 190402025.200.0001 Date: 05-26-10 Well No: MW-4  
 Facility Name: Brunswick - Bayliner Temperature: low 50s °F or °C  
 Field Personnel: ACT Weather: showers

**FIELD MEASUREMENTS:**

A. Total Depth (TD) of Well from TOC: 28.40 FT. or IN.  
 C. Static Water Level (SWL) Below Top of Casing (TOC): 18.24 FT. or IN.  
 D. Height of Water Column in Casing: (h = TD-SWL) 10.16 FT. or IN.

E. Useful approximate Purge Volumes (PV) per foot of water column

	<u>3 Well Vols.</u>	<u>5 Well Vols.</u>				
5/8" diameter =	21.8 mL/ft		X	feet of water	=	PV (milliliters)
2" diameter =	0.5 gal/ft	0.82 gal/ft	X	feet of water	=	PV (gallons)
4" diameter =	2.0 gal/ft	3.25 gal/ft	X	feet of water	=	PV (gallons)
6" diameter =	4.4 gal/ft	7.35 gal/ft	X	feet of water	=	PV (gallons)

Purge Method: low flow - peristaltic pump  
disposable bailer / trash pump / pvc hand bail Duration: 10 mins  
in-line pump / single valve sampler / syringe

**OBSERVATIONS:**

0940 start

	Time	Turbidity	pH	Temp.	Conduct.	DO	ORP	SWL
1st Volume:	<u>0942</u>	<u>low</u>	<u>5.26</u>	<u>55.58</u>	<u>171</u>	<u>3.10</u>	<u>174.7</u>	
2nd Volume:	<u>0945</u>	<u>CR</u>	<u>5.19</u>	<u>55.50</u>	<u>134</u>	<u>2.82</u>	<u>162.6</u>	
3rd Volume:	<u>0948</u>	<u>CR</u>	<u>5.11</u>	<u>55.56</u>	<u>135</u>	<u>2.86</u>	<u>165.3</u>	
4th Volume:	<u>0951</u>	<u>CR</u>	<u>5.09</u>	<u>55.54</u>	<u>141</u>	<u>2.94</u>	<u>158.3</u>	
5th Volume:								

Total Volume of Water Purged From Well: < 1 gal

Purge Water Stored/Disposed of Where/How: On-Site 55-gallon drum

**SAMPLES COLLECTED:** Depth to Water at time of sample collection: 18.27 >80%

Sample Numbers(s): MW-4 Time: 0956 Size/Number of Container(s): (3) 40ml VOA's Preservative: HCl

**COMMENTS:**

---



---

Casing Capacities:  
 2-inch hole.....0.16 gal/in ft.  
 4-inch hole.....0.65 gal/in ft.  
 6.5-inch hole.....1.70 gal/in ft.  
 8-inch hole.....2.60 gal/in ft.  
 10-inch hole.....4.10 gal/in ft.

Recharge Calculation at Time of Sample Collection:  
 Total Depth of Well: \_\_\_\_\_  
 Original Water Column: \_\_\_\_\_ x 0.80 = -( \_\_\_\_\_ )  
 Collect sample when Depth to Water measures  
 Less than or equal to: \_\_\_\_\_

**GROUNDWATER SAMPLING DATA SHEET**  
 Stantec Consulting  
 9400 SW Barnes Road, Suite 200, Portland, OR 97225

Stantec Project No.: 190402025.200.0001 Date: 05-26-10 Well No.: MW-5  
 Facility Name: Brunswick - Bayliner Temperature: low SOs °F or °C  
 Field Personnel: ACE Weather: showers

**FIELD MEASUREMENTS:**

A. Total Depth (TD) of Well from TOC: 33.70 FT. or IN.  
 C. Static Water Level (SWL) Below Top of Casing (TOC): 19.17 FT. or IN.  
 D. Height of Water Column in Casing: (h = TD-SWL) 14.53 FT. or IN.  
 E. Useful approximate Purge Volumes (PV) per foot of water column

	3 Well Vols.	5 Well Vols.				
5/8" diameter =	21.8 mL/ft		X	feet of water	=	PV (milliliters)
2" diameter =	0.5 gal/ft	0.82 gal/ft	X	feet of water	=	PV (gallons)
4" diameter =	2.0 gal/ft	3.25 gal/ft	X	feet of water	=	PV (gallons)
6" diameter =	4.4 gal/ft	7.35 gal/ft	X	feet of water	=	PV (gallons)

Purge Method: low flow - resistive pump Duration: 10 mins  
disposable bailer / in-line pump / hand pump / electric pump

**OBSERVATIONS:**

	Time	Turbidity	pH	Temp. °F	Conduct.	DO	ORP	SWL
09 05 start								
1st Volume:	<u>0906</u>	<u>low</u>	<u>4.97</u>	<u>54.42</u>	<u>238</u>	<u>3.74</u>	<u>129.4</u>	
2nd Volume:	<u>0909</u>	<u>low</u>	<u>5.18</u>	<u>54.4</u>	<u>232</u>	<u>3.04</u>	<u>114.7</u>	
3rd Volume:	<u>0912</u>	<u>clr</u>	<u>5.24</u>	<u>54.43</u>	<u>246</u>	<u>2.96</u>	<u>108.9</u>	
4th Volume:	<u>0915</u>	<u>clr</u>	<u>5.26</u>	<u>54.44</u>	<u>227</u>	<u>2.85</u>	<u>105.9</u>	
5th Volume:								

Total Volume of Water Purged From Well: < 1 gal  
 Purge Water Stored/Disposed of Where/How: On-Site 55-gallon drum

**SAMPLES COLLECTED:** Depth to Water at time of sample collection: 19.13 >80%

Sample Numbers(s): MW-5 Time: 0920 Size/Number of Container(s): (3) 40ml VOLS Preservative: HCl

**COMMENTS:**

---



---



---

Casing Capacities:  
 2-inch hole.....0.16 gal/in ft.  
 4-inch hole.....0.65 gal/in ft.  
 6.5-inch hole.....1.70 gal/in ft.  
 8-inch hole.....2.60 gal/in ft.  
 10-inch hole.....4.10 gal/in ft.

Recharge Calculation at Time of Sample Collection:  
 Total Depth of Well: \_\_\_\_\_  
 Original Water Column: \_\_\_\_\_ x 0.80 = -( \_\_\_\_\_ )  
 Collect sample when Depth to Water measures  
 Less than or equal to: \_\_\_\_\_

**GROUNDWATER SAMPLING DATA SHEET**  
 Stantec Consulting  
 9400 SW Barnes Road, Suite 200, Portland, OR 97225

Stantec Project No.: 190402025.200.0001 Date: 05-26-10 Well No: MW-6  
 Facility Name: Brunswick - Bayliner Temperature: low 50s °F or °C  
 Field Personnel: ACZ Weather: showers

**FIELD MEASUREMENTS:**

A. Total Depth (TD) of Well from TOC: 25.00 FT. or IN.  
 C. Static Water Level (SWL) Below Top of Casing (TOC): 16.51 FT. or IN.  
 D. Height of Water Column in Casing: (h = TD-SWL) 8.49 FT. or IN.  
 E. Useful approximate Purge Volumes (PV) per foot of water column

	<u>3 Well Vols.</u>	<u>5 Well Vols.</u>				
5/8" diameter =	21.8 mL/ft		X	feet of water	=	PV (milliliters)
2" diameter =	0.5 gal/ft	0.82 gal/ft	X	feet of water	=	PV (gallons)
4" diameter =	2.0 gal/ft	3.25 gal/ft	X	feet of water	=	PV (gallons)
6" diameter =	4.4 gal/ft	7.35 gal/ft	X	feet of water	=	PV (gallons)

Purge Method: low flow w/ peristaltic pump Duration: 10 mins  
diaphragm pump / single valve pump / syringe

**OBSERVATIONS:**

	Time	Turbidity	pH	Temp.	Conduct. <sup>(µS/cm<sup>2</sup>)</sup>	DO <sup>(mg/L)</sup>	ORP	SWL
75+ start								
1st Volume:	<u>0800</u>	<u>clr</u>	<u>4.66</u>	<u>50.56</u>	<u>108</u>	<u>4.10</u>	<u>174.6</u>	
2nd Volume:	<u>0803</u>		<u>4.62</u>	<u>50.55</u>	<u>113</u>	<u>3.92</u>	<u>174.4</u>	
3rd Volume:	<u>0806</u>		<u>4.62</u>	<u>50.40</u>	<u>125</u>	<u>3.89</u>	<u>172.3</u>	
4th Volume:	<u>0809</u>	<u>↓</u>	<u>4.67</u>	<u>50.38</u>	<u>125</u>	<u>3.91</u>	<u>169.9</u>	<u>16.07</u>
5th Volume:								

Total Volume of Water Purged From Well: < 1 gal  
 Purge Water Stored/Disposed of Where/How: On-Site 55-gallon drum

**SAMPLES COLLECTED:**

Depth to Water at time of sample collection: 16.67 >80%  
 Sample Numbers(s): MW-6 Time: 0813 Size/Number of Container(s): (3) 40ml VOA's Preservative: HCl

COMMENTS: Well monument - small bolts (13mm)

Casing Capacities:

2-inch hole.....	0.16 gal/lin ft.
4-inch hole.....	0.65 gal/lin ft.
6.5-inch hole.....	1.70 gal/lin ft.
8-inch hole.....	2.60 gal/lin ft.
10-inch hole.....	4.10 gal/lin ft.

Recharge Calculation at Time of Sample Collection:  
 Total Depth of Well: \_\_\_\_\_  
 Original Water Column: \_\_\_\_\_ x 0.80 = -( \_\_\_\_\_ )  
 Collect sample when Depth to Water measures  
 Less than or equal to: \_\_\_\_\_

**GROUNDWATER SAMPLING DATA SHEET**  
 Stantec Consulting  
 9400 SW Barnes Road, Suite 200, Portland, OR 97225

Stantec Project No.: 190402025.200.0001 Date: 05-26-10 Well No: MW-7  
 Facility Name: Brunswick - Bayliner Temperature: low SOCs °F or °C  
 Field Personnel: ACE Weather: Showers

**FIELD MEASUREMENTS:**

A. Total Depth (TD) of Well from TOC: 30.00 FT. or IN.  
 C. Static Water Level (SWL) Below Top of Casing (TOC): 19.61 FT. or IN.  
 D. Height of Water Column in Casing: (h = TD-SWL) 10.39 FT. or IN.  
 E. Useful approximate Purge Volumes (PV) per foot of water column

	<u>3 Well Vols.</u>	<u>5 Well Vols.</u>				
5/8" diameter =	21.8 mL/ft		X	feet of water	=	PV (milliliters)
2" diameter =	0.5 gal/ft	0.82 gal/ft	X	feet of water	=	PV (gallons)
4" diameter =	2.0 gal/ft	3.25 gal/ft	X	feet of water	=	PV (gallons)
6" diameter =	4.4 gal/ft	7.35 gal/ft	X	feet of water	=	PV (gallons)

Purge Method: low flow - static Duration: 10 mins

**OBSERVATIONS:**

	Time	Turbidity	pH	Temp.	Conduct.	DO	ORP	SWL
0831 start								
1st Volume:	<u>0836</u>	<u>Clf</u>	<u>4.90</u>	<u>54.28</u>	<u>526</u>	<u>2.56</u>	<u>236.4</u>	
2nd Volume:	<u>0839</u>		<u>4.80</u>	<u>54.29</u>	<u>101</u>	<u>1.94</u>	<u>204.9</u>	
3rd Volume:	<u>0842</u>		<u>4.36</u>	<u>54.27</u>	<u>47</u>	<u>1.95</u>	<u>202.6</u>	
4th Volume:	<u>0845</u>	<u>V</u>	<u>4.71</u>	<u>54.17</u>	<u>104</u>	<u>2.10</u>	<u>233.1</u>	
5th Volume:								

Total Volume of Water Purged From Well: < 1 gal

Purge Water Stored/Disposed of Where/How: On-Site 55-gallon drum

**SAMPLES COLLECTED:**

Depth to Water at time of sample collection: >80%

Sample Numbers(s): MW-7 Time: 0850 Size/Number of Container(s): (3) 40ml VOA's Preservative: HCl

**COMMENTS:**

Casing Capacities:  
 2-inch hole.....0.16 gal/in ft.  
 4-inch hole.....0.65 gal/in ft.  
 6.5-inch hole.....1.70 gal/in ft.  
 8-inch hole.....2.60 gal/in ft.  
 10-inch hole.....4.10 gal/in ft.

**Recharge Calculation at Time of Sample Collection:**

Total Depth of Well: \_\_\_\_\_  
 Original Water Column: \_\_\_\_\_ x 0.80 = -( \_\_\_\_\_ )  
 Collect sample when Depth to Water measures  
 Less than or equal to: \_\_\_\_\_

**APPENDIX D**

**INDOOR AIR LABORATORY ANALYTICAL REPORT - APRIL 2010**

---

4/12/2010

Ms. Alyssa Johnson  
Landau Associates, Inc.  
130 2nd Avenue South

Edmonds WA 98020

Project Name: Bayliner Marine  
Project #: 786003.010.012  
Workorder #: 1004211

Dear Ms. Alyssa Johnson

The following report includes the data for the above referenced project for sample(s) received on 4/9/2010 at Air Toxics Ltd.

The data and associated QC analyzed by Modified TO-15 SIM are compliant with the project requirements or laboratory criteria with the exception of the deviations noted in the attached case narrative.

Thank you for choosing Air Toxics Ltd. for your air analysis needs. Air Toxics Ltd. is committed to providing accurate data of the highest quality. Please feel free to contact the Project Manager: Kelly Buettner at 916-985-1000 if you have any questions regarding the data in this report.

Regards,



Kelly Buettner  
Project Manager

**WORK ORDER #: 1004211**

Work Order Summary

<b>CLIENT:</b>	Ms. Alyssa Johnson Landau Associates, Inc. 130 2nd Avenue South Edmonds, WA 98020	<b>BILL TO:</b>	Ms. Alyssa Johnson Landau Associates, Inc. 130 2nd Avenue South Edmonds, WA 98020
<b>PHONE:</b>	425-329-0264	<b>P.O. #</b>	
<b>FAX:</b>	425-778-6409	<b>PROJECT #</b>	786003.010.012 Bayliner Marine
<b>DATE RECEIVED:</b>	04/09/2010	<b>CONTACT:</b>	Kelly Buettner
<b>DATE COMPLETED:</b>	04/12/2010		

<u>FRACTION #</u>	<u>NAME</u>	<u>TEST</u>	<u>RECEIPT VAC./PRES.</u>	<u>FINAL PRESSURE</u>
01A	Building 11A	Modified TO-15 SIM	3.5 "Hg	5 psi
02A	Building 11B	Modified TO-15 SIM	5.0 "Hg	5 psi
03A	Ambient Air	Modified TO-15 SIM	4.0 "Hg	5 psi
04A	Building 14	Modified TO-15 SIM	4.0 "Hg	5 psi
04AA	Building 14 Lab Duplicate	Modified TO-15 SIM	4.0 "Hg	5 psi
05A	Building 4	Modified TO-15 SIM	4.0 "Hg	5 psi
06A	Building 17	Modified TO-15 SIM	5.5 "Hg	5 psi
07A	Building 8	Modified TO-15 SIM	8.0 "Hg	5 psi
08A	Building 10	Modified TO-15 SIM	4.5 "Hg	5 psi
09A	Lab Blank	Modified TO-15 SIM	NA	NA
10A	CCV	Modified TO-15 SIM	NA	NA
11A	LCS	Modified TO-15 SIM	NA	NA

CERTIFIED BY: 

DATE: 04/12/10

Laboratory Director

Certification numbers: CA NELAP - 02110CA, LA NELAP/LELAP- AI 30763,  
NY NELAP - 11291, UT NELAP - 9166389892, AZ Licensure AZ0719

Name of Accrediting Agency: NELAP/Florida Department of Health, Scope of Application: Clean Air Act,  
Accreditation number: E87680, Effective date: 07/01/09, Expiration date: 06/30/10

Air Toxics Ltd. certifies that the test results contained in this report meet all requirements of the NELAC standards

This report shall not be reproduced, except in full, without the written approval of Air Toxics Ltd.

180 BLUE RAVINE ROAD, SUITE B FOLSOM, CA - 95630  
(916) 985-1000 . (800) 985-5955 . FAX (916) 985-1020

**LABORATORY NARRATIVE  
Modified TO-15 SIM  
Landau Associates, Inc.  
Workorder# 1004211**

Eight 6 Liter Summa Canister (SIM Certified) samples were received on April 09, 2010. The laboratory performed analysis via modified EPA Method TO-15 using GC/MS in the SIM acquisition mode.

This workorder was independently validated prior to submittal using 'USEPA National Functional Guidelines' as generally applied to the analysis of volatile organic compounds in air. A rules-based, logic driven, independent validation engine was employed to assess completeness, evaluate pass/fail of relevant project quality control requirements and verification of all quantified amounts.

Method modifications taken to run these samples are summarized in the table below. Specific project requirements may over-ride the ATL modifications.

<i>Requirement</i>	<i>TO-15</i>	<i>ATL Modifications</i>
ICAL %RSD acceptance criteria	<math>\leq 30\%</math> RSD with 2 compounds allowed out to <math>< 40\%</math> RSD	Project specific; default criteria is <math>\leq 30\%</math> RSD with 10% of compounds allowed out to <math>< 40\%</math> RSD
Daily Calibration	+/- 30% Difference	Project specific; default criteria is <math>\leq 30\%</math> Difference with 10% of compounds allowed out up to <math>\leq 40\%</math>.; flag and narrate outliers
Blank and standards	Zero air	Nitrogen
Method Detection Limit	Follow 40CFR Pt.136 App. B	The MDL met all relevant requirements in Method TO-15 (statistical MDL less than the LOQ). The concentration of the spiked replicate may have exceeded 10X the calculated MDL in some cases

**Receiving Notes**

There were no receiving discrepancies.

**Analytical Notes**

There were no analytical discrepancies.

**Definition of Data Qualifying Flags**

Eight qualifiers may have been used on the data analysis sheets and indicates as follows:

B - Compound present in laboratory blank greater than reporting limit (background subtraction not performed).

J - Estimated value.

E - Exceeds instrument calibration range.

S - Saturated peak.

Q - Exceeds quality control limits.

U - Compound analyzed for but not detected above the reporting limit.

UJ- Non-detected compound associated with low bias in the CCV

N - The identification is based on presumptive evidence.

File extensions may have been used on the data analysis sheets and indicates as follows:

a-File was requantified

b-File was quantified by a second column and detector

r1-File was requantified for the purpose of reissue



**Summary of Detected Compounds  
MODIFIED EPA METHOD TO-15 GC/MS SIM**

**Client Sample ID: Building 11A**

**Lab ID#: 1004211-01A**

<b>Compound</b>	<b>Rpt. Limit (ppbv)</b>	<b>Amount (ppbv)</b>	<b>Rpt. Limit (ug/m3)</b>	<b>Amount (ug/m3)</b>
Benzene	0.076	0.089	0.24	0.28
Toluene	0.030	0.034	0.11	0.13
Tetrachloroethene	0.030	0.036	0.21	0.24

**Client Sample ID: Building 11B**

**Lab ID#: 1004211-02A**

<b>Compound</b>	<b>Rpt. Limit (ppbv)</b>	<b>Amount (ppbv)</b>	<b>Rpt. Limit (ug/m3)</b>	<b>Amount (ug/m3)</b>
Benzene	0.080	0.089	0.26	0.28
Toluene	0.032	0.038	0.12	0.14
Tetrachloroethene	0.032	0.034	0.22	0.23

**Client Sample ID: Ambient Air**

**Lab ID#: 1004211-03A**

<b>Compound</b>	<b>Rpt. Limit (ppbv)</b>	<b>Amount (ppbv)</b>	<b>Rpt. Limit (ug/m3)</b>	<b>Amount (ug/m3)</b>
Benzene	0.078	1.9	0.25	6.0
Toluene	0.031	1.3	0.12	5.0
Tetrachloroethene	0.031	0.049	0.21	0.33
Ethyl Benzene	0.031	0.26	0.13	1.1
m,p-Xylene	0.062	0.86	0.27	3.8
o-Xylene	0.031	0.29	0.13	1.3

**Client Sample ID: Building 14**

**Lab ID#: 1004211-04A**

<b>Compound</b>	<b>Rpt. Limit (ppbv)</b>	<b>Amount (ppbv)</b>	<b>Rpt. Limit (ug/m3)</b>	<b>Amount (ug/m3)</b>
Benzene	0.078	0.34	0.25	1.1
Toluene	0.031	0.040	0.12	0.15
Tetrachloroethene	0.031	0.18	0.21	1.2
Ethyl Benzene	0.031	0.030 J	0.13	0.13 J
m,p-Xylene	0.062	0.12	0.27	0.54
o-Xylene	0.031	0.082	0.13	0.35



**Summary of Detected Compounds  
MODIFIED EPA METHOD TO-15 GC/MS SIM**

**Client Sample ID: Building 14 Lab Duplicate**

**Lab ID#: 1004211-04AA**

<b>Compound</b>	<b>Rpt. Limit (ppbv)</b>	<b>Amount (ppbv)</b>	<b>Rpt. Limit (ug/m3)</b>	<b>Amount (ug/m3)</b>
Benzene	0.078	0.33	0.25	1.0
Toluene	0.031	0.040	0.12	0.15
Tetrachloroethene	0.031	0.18	0.21	1.2
m,p-Xylene	0.062	0.12	0.27	0.53
o-Xylene	0.031	0.080	0.13	0.35

**Client Sample ID: Building 4**

**Lab ID#: 1004211-05A**

<b>Compound</b>	<b>Rpt. Limit (ppbv)</b>	<b>Amount (ppbv)</b>	<b>Rpt. Limit (ug/m3)</b>	<b>Amount (ug/m3)</b>
Benzene	0.078	0.18	0.25	0.56
Toluene	0.031	0.11	0.12	0.43

**Client Sample ID: Building 17**

**Lab ID#: 1004211-06A**

<b>Compound</b>	<b>Rpt. Limit (ppbv)</b>	<b>Amount (ppbv)</b>	<b>Rpt. Limit (ug/m3)</b>	<b>Amount (ug/m3)</b>
Benzene	0.082	0.10	0.26	0.32
Toluene	0.033	0.092	0.12	0.35

**Client Sample ID: Building 8**

**Lab ID#: 1004211-07A**

<b>Compound</b>	<b>Rpt. Limit (ppbv)</b>	<b>Amount (ppbv)</b>	<b>Rpt. Limit (ug/m3)</b>	<b>Amount (ug/m3)</b>
Benzene	0.092	0.14	0.29	0.45
Toluene	0.037	0.066	0.14	0.25

**Client Sample ID: Building 10**

**Lab ID#: 1004211-08A**

<b>Compound</b>	<b>Rpt. Limit (ppbv)</b>	<b>Amount (ppbv)</b>	<b>Rpt. Limit (ug/m3)</b>	<b>Amount (ug/m3)</b>
Benzene	0.079	0.091	0.25	0.29
Toluene	0.032	0.051	0.12	0.19
m,p-Xylene	0.063	0.11	0.27	0.47



---

**Summary of Detected Compounds**  
**MODIFIED EPA METHOD TO-15 GC/MS SIM**

**Client Sample ID: Building 10**

**Lab ID#: 1004211-08A**

o-Xylene	0.032	0.063	0.14	0.28
----------	-------	-------	------	------

Client Sample ID: Building 11A

Lab ID#: 1004211-01A

**MODIFIED EPA METHOD TO-15 GC/MS SIM**

<b>File Name:</b>	<b>s040906sim</b>	<b>Date of Collection:</b> 4/8/10 2:40:00 PM
<b>Dil. Factor:</b>	<b>1.52</b>	<b>Date of Analysis:</b> 4/9/10 05:54 PM

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Vinyl Chloride	0.015	Not Detected	0.039	Not Detected
1,1-Dichloroethene	0.015	Not Detected	0.060	Not Detected
1,1-Dichloroethane	0.030	Not Detected	0.12	Not Detected
cis-1,2-Dichloroethene	0.030	Not Detected	0.12	Not Detected
1,1,1-Trichloroethane	0.030	Not Detected	0.16	Not Detected
Benzene	0.076	0.089	0.24	0.28
1,2-Dichloroethane	0.030	Not Detected	0.12	Not Detected
Trichloroethene	0.030	Not Detected	0.16	Not Detected
Toluene	0.030	0.034	0.11	0.13
1,1,2-Trichloroethane	0.030	Not Detected	0.16	Not Detected
Tetrachloroethene	0.030	0.036	0.21	0.24
Ethyl Benzene	0.030	Not Detected	0.13	Not Detected
m,p-Xylene	0.061	Not Detected	0.26	Not Detected
o-Xylene	0.030	Not Detected	0.13	Not Detected
1,1,2,2-Tetrachloroethane	0.030	Not Detected	0.21	Not Detected
trans-1,2-Dichloroethene	0.15	Not Detected	0.60	Not Detected
Methyl tert-butyl ether	0.15	Not Detected	0.55	Not Detected

**Container Type: 6 Liter Summa Canister (SIM Certified)**

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	116	70-130
Toluene-d8	101	70-130
4-Bromofluorobenzene	94	70-130

Client Sample ID: Building 11B

Lab ID#: 1004211-02A

**MODIFIED EPA METHOD TO-15 GC/MS SIM**

<b>File Name:</b>	<b>s040907sim</b>	<b>Date of Collection:</b> 4/8/10 2:42:00 PM
<b>Dil. Factor:</b>	<b>1.61</b>	<b>Date of Analysis:</b> 4/9/10 06:43 PM

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Vinyl Chloride	0.016	Not Detected	0.041	Not Detected
1,1-Dichloroethene	0.016	Not Detected	0.064	Not Detected
1,1-Dichloroethane	0.032	Not Detected	0.13	Not Detected
cis-1,2-Dichloroethene	0.032	Not Detected	0.13	Not Detected
1,1,1-Trichloroethane	0.032	Not Detected	0.18	Not Detected
Benzene	0.080	0.089	0.26	0.28
1,2-Dichloroethane	0.032	Not Detected	0.13	Not Detected
Trichloroethene	0.032	Not Detected	0.17	Not Detected
Toluene	0.032	0.038	0.12	0.14
1,1,2-Trichloroethane	0.032	Not Detected	0.18	Not Detected
Tetrachloroethene	0.032	0.034	0.22	0.23
Ethyl Benzene	0.032	Not Detected	0.14	Not Detected
m,p-Xylene	0.064	Not Detected	0.28	Not Detected
o-Xylene	0.032	Not Detected	0.14	Not Detected
1,1,2,2-Tetrachloroethane	0.032	Not Detected	0.22	Not Detected
trans-1,2-Dichloroethene	0.16	Not Detected	0.64	Not Detected
Methyl tert-butyl ether	0.16	Not Detected	0.58	Not Detected

**Container Type: 6 Liter Summa Canister (SIM Certified)**

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	121	70-130
Toluene-d8	115	70-130
4-Bromofluorobenzene	98	70-130

Client Sample ID: Ambient Air

Lab ID#: 1004211-03A

**MODIFIED EPA METHOD TO-15 GC/MS SIM**

<b>File Name:</b>	<b>s040908sim</b>	<b>Date of Collection:</b> 4/8/10 1:45:00 PM
<b>Dil. Factor:</b>	<b>1.55</b>	<b>Date of Analysis:</b> 4/9/10 07:25 PM

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Vinyl Chloride	0.016	Not Detected	0.040	Not Detected
1,1-Dichloroethene	0.016	Not Detected	0.061	Not Detected
1,1-Dichloroethane	0.031	Not Detected	0.12	Not Detected
cis-1,2-Dichloroethene	0.031	Not Detected	0.12	Not Detected
1,1,1-Trichloroethane	0.031	Not Detected	0.17	Not Detected
Benzene	0.078	1.9	0.25	6.0
1,2-Dichloroethane	0.031	Not Detected	0.12	Not Detected
Trichloroethene	0.031	Not Detected	0.17	Not Detected
Toluene	0.031	1.3	0.12	5.0
1,1,2-Trichloroethane	0.031	Not Detected	0.17	Not Detected
Tetrachloroethene	0.031	0.049	0.21	0.33
Ethyl Benzene	0.031	0.26	0.13	1.1
m,p-Xylene	0.062	0.86	0.27	3.8
o-Xylene	0.031	0.29	0.13	1.3
1,1,2,2-Tetrachloroethane	0.031	Not Detected	0.21	Not Detected
trans-1,2-Dichloroethene	0.16	Not Detected	0.61	Not Detected
Methyl tert-butyl ether	0.16	Not Detected	0.56	Not Detected

**Container Type: 6 Liter Summa Canister (SIM Certified)**

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	118	70-130
Toluene-d8	103	70-130
4-Bromofluorobenzene	100	70-130

Client Sample ID: Building 14

Lab ID#: 1004211-04A

**MODIFIED EPA METHOD TO-15 GC/MS SIM**

File Name:	s040909sim	Date of Collection: 4/8/10 2:53:00 PM
Dil. Factor:	1.55	Date of Analysis: 4/9/10 08:47 PM

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Vinyl Chloride	0.016	Not Detected	0.040	Not Detected
1,1-Dichloroethene	0.016	Not Detected	0.061	Not Detected
1,1-Dichloroethane	0.031	Not Detected	0.12	Not Detected
cis-1,2-Dichloroethene	0.031	Not Detected	0.12	Not Detected
1,1,1-Trichloroethane	0.031	Not Detected	0.17	Not Detected
Benzene	0.078	0.34	0.25	1.1
1,2-Dichloroethane	0.031	Not Detected	0.12	Not Detected
Trichloroethene	0.031	Not Detected	0.17	Not Detected
Toluene	0.031	0.040	0.12	0.15
1,1,2-Trichloroethane	0.031	Not Detected	0.17	Not Detected
Tetrachloroethene	0.031	0.18	0.21	1.2
Ethyl Benzene	0.031	0.030 J	0.13	0.13 J
m,p-Xylene	0.062	0.12	0.27	0.54
o-Xylene	0.031	0.082	0.13	0.35
1,1,2,2-Tetrachloroethane	0.031	Not Detected	0.21	Not Detected
trans-1,2-Dichloroethene	0.16	Not Detected	0.61	Not Detected
Methyl tert-butyl ether	0.16	Not Detected	0.56	Not Detected

J = Estimated value.

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	117	70-130
Toluene-d8	101	70-130
4-Bromofluorobenzene	94	70-130

Client Sample ID: Building 14 Lab Duplicate

Lab ID#: 1004211-04AA

**MODIFIED EPA METHOD TO-15 GC/MS SIM**

<b>File Name:</b>	<b>s040910sim</b>	<b>Date of Collection:</b> 4/8/10 2:53:00 PM
<b>Dil. Factor:</b>	<b>1.55</b>	<b>Date of Analysis:</b> 4/9/10 09:38 PM

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Vinyl Chloride	0.016	Not Detected	0.040	Not Detected
1,1-Dichloroethene	0.016	Not Detected	0.061	Not Detected
1,1-Dichloroethane	0.031	Not Detected	0.12	Not Detected
cis-1,2-Dichloroethene	0.031	Not Detected	0.12	Not Detected
1,1,1-Trichloroethane	0.031	Not Detected	0.17	Not Detected
Benzene	0.078	0.33	0.25	1.0
1,2-Dichloroethane	0.031	Not Detected	0.12	Not Detected
Trichloroethene	0.031	Not Detected	0.17	Not Detected
Toluene	0.031	0.040	0.12	0.15
1,1,2-Trichloroethane	0.031	Not Detected	0.17	Not Detected
Tetrachloroethene	0.031	0.18	0.21	1.2
Ethyl Benzene	0.031	Not Detected	0.13	Not Detected
m,p-Xylene	0.062	0.12	0.27	0.53
o-Xylene	0.031	0.080	0.13	0.35
1,1,2,2-Tetrachloroethane	0.031	Not Detected	0.21	Not Detected
trans-1,2-Dichloroethene	0.16	Not Detected	0.61	Not Detected
Methyl tert-butyl ether	0.16	Not Detected	0.56	Not Detected

**Container Type: 6 Liter Summa Canister (SIM Certified)**

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	118	70-130
Toluene-d8	101	70-130
4-Bromofluorobenzene	96	70-130

Client Sample ID: Building 4

Lab ID#: 1004211-05A

**MODIFIED EPA METHOD TO-15 GC/MS SIM**

<b>File Name:</b>	<b>s040911sim</b>	<b>Date of Collection:</b> 4/8/10 3:12:00 PM
<b>Dil. Factor:</b>	<b>1.55</b>	<b>Date of Analysis:</b> 4/9/10 10:14 PM

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Vinyl Chloride	0.016	Not Detected	0.040	Not Detected
1,1-Dichloroethene	0.016	Not Detected	0.061	Not Detected
1,1-Dichloroethane	0.031	Not Detected	0.12	Not Detected
cis-1,2-Dichloroethene	0.031	Not Detected	0.12	Not Detected
1,1,1-Trichloroethane	0.031	Not Detected	0.17	Not Detected
Benzene	0.078	0.18	0.25	0.56
1,2-Dichloroethane	0.031	Not Detected	0.12	Not Detected
Trichloroethene	0.031	Not Detected	0.17	Not Detected
Toluene	0.031	0.11	0.12	0.43
1,1,2-Trichloroethane	0.031	Not Detected	0.17	Not Detected
Tetrachloroethene	0.031	Not Detected	0.21	Not Detected
Ethyl Benzene	0.031	Not Detected	0.13	Not Detected
m,p-Xylene	0.062	Not Detected	0.27	Not Detected
o-Xylene	0.031	Not Detected	0.13	Not Detected
1,1,2,2-Tetrachloroethane	0.031	Not Detected	0.21	Not Detected
trans-1,2-Dichloroethene	0.16	Not Detected	0.61	Not Detected
Methyl tert-butyl ether	0.16	Not Detected	0.56	Not Detected

**Container Type: 6 Liter Summa Canister (SIM Certified)**

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	123	70-130
Toluene-d8	109	70-130
4-Bromofluorobenzene	96	70-130

Client Sample ID: Building 17

Lab ID#: 1004211-06A

**MODIFIED EPA METHOD TO-15 GC/MS SIM**

<b>File Name:</b>	<b>s040912sim</b>	<b>Date of Collection:</b> 4/8/10 3:00:00 PM
<b>Dil. Factor:</b>	<b>1.64</b>	<b>Date of Analysis:</b> 4/9/10 10:53 PM

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Vinyl Chloride	0.016	Not Detected	0.042	Not Detected
1,1-Dichloroethene	0.016	Not Detected	0.065	Not Detected
1,1-Dichloroethane	0.033	Not Detected	0.13	Not Detected
cis-1,2-Dichloroethene	0.033	Not Detected	0.13	Not Detected
1,1,1-Trichloroethane	0.033	Not Detected	0.18	Not Detected
Benzene	0.082	0.10	0.26	0.32
1,2-Dichloroethane	0.033	Not Detected	0.13	Not Detected
Trichloroethene	0.033	Not Detected	0.18	Not Detected
Toluene	0.033	0.092	0.12	0.35
1,1,2-Trichloroethane	0.033	Not Detected	0.18	Not Detected
Tetrachloroethene	0.033	Not Detected	0.22	Not Detected
Ethyl Benzene	0.033	Not Detected	0.14	Not Detected
m,p-Xylene	0.066	Not Detected	0.28	Not Detected
o-Xylene	0.033	Not Detected	0.14	Not Detected
1,1,2,2-Tetrachloroethane	0.033	Not Detected	0.22	Not Detected
trans-1,2-Dichloroethene	0.16	Not Detected	0.65	Not Detected
Methyl tert-butyl ether	0.16	Not Detected	0.59	Not Detected

**Container Type: 6 Liter Summa Canister (SIM Certified)**

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	118	70-130
Toluene-d8	103	70-130
4-Bromofluorobenzene	96	70-130

Client Sample ID: Building 8

Lab ID#: 1004211-07A

**MODIFIED EPA METHOD TO-15 GC/MS SIM**

<b>File Name:</b>	<b>s040913sim</b>	<b>Date of Collection:</b> 4/8/10 3:06:00 PM
<b>Dil. Factor:</b>	<b>1.83</b>	<b>Date of Analysis:</b> 4/10/10 12:16 AM

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Vinyl Chloride	0.018	Not Detected	0.047	Not Detected
1,1-Dichloroethene	0.018	Not Detected	0.072	Not Detected
1,1-Dichloroethane	0.037	Not Detected	0.15	Not Detected
cis-1,2-Dichloroethene	0.037	Not Detected	0.14	Not Detected
1,1,1-Trichloroethane	0.037	Not Detected	0.20	Not Detected
Benzene	0.092	0.14	0.29	0.45
1,2-Dichloroethane	0.037	Not Detected	0.15	Not Detected
Trichloroethene	0.037	Not Detected	0.20	Not Detected
Toluene	0.037	0.066	0.14	0.25
1,1,2-Trichloroethane	0.037	Not Detected	0.20	Not Detected
Tetrachloroethene	0.037	Not Detected	0.25	Not Detected
Ethyl Benzene	0.037	Not Detected	0.16	Not Detected
m,p-Xylene	0.073	Not Detected	0.32	Not Detected
o-Xylene	0.037	Not Detected	0.16	Not Detected
1,1,2,2-Tetrachloroethane	0.037	Not Detected	0.25	Not Detected
trans-1,2-Dichloroethene	0.18	Not Detected	0.72	Not Detected
Methyl tert-butyl ether	0.18	Not Detected	0.66	Not Detected

**Container Type: 6 Liter Summa Canister (SIM Certified)**

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	120	70-130
Toluene-d8	107	70-130
4-Bromofluorobenzene	95	70-130

Client Sample ID: Building 10

Lab ID#: 1004211-08A

**MODIFIED EPA METHOD TO-15 GC/MS SIM**

<b>File Name:</b>	<b>s040914sim</b>	<b>Date of Collection:</b> 4/8/10 3:17:00 PM
<b>Dil. Factor:</b>	<b>1.58</b>	<b>Date of Analysis:</b> 4/10/10 01:06 AM

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Vinyl Chloride	0.016	Not Detected	0.040	Not Detected
1,1-Dichloroethene	0.016	Not Detected	0.063	Not Detected
1,1-Dichloroethane	0.032	Not Detected	0.13	Not Detected
cis-1,2-Dichloroethene	0.032	Not Detected	0.12	Not Detected
1,1,1-Trichloroethane	0.032	Not Detected	0.17	Not Detected
Benzene	0.079	0.091	0.25	0.29
1,2-Dichloroethane	0.032	Not Detected	0.13	Not Detected
Trichloroethene	0.032	Not Detected	0.17	Not Detected
Toluene	0.032	0.051	0.12	0.19
1,1,2-Trichloroethane	0.032	Not Detected	0.17	Not Detected
Tetrachloroethene	0.032	Not Detected	0.21	Not Detected
Ethyl Benzene	0.032	Not Detected	0.14	Not Detected
m,p-Xylene	0.063	0.11	0.27	0.47
o-Xylene	0.032	0.063	0.14	0.28
1,1,2,2-Tetrachloroethane	0.032	Not Detected	0.22	Not Detected
trans-1,2-Dichloroethene	0.16	Not Detected	0.63	Not Detected
Methyl tert-butyl ether	0.16	Not Detected	0.57	Not Detected

**Container Type: 6 Liter Summa Canister (SIM Certified)**

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	125	70-130
Toluene-d8	114	70-130
4-Bromofluorobenzene	95	70-130

Client Sample ID: Lab Blank

Lab ID#: 1004211-09A

**MODIFIED EPA METHOD TO-15 GC/MS SIM**

<b>File Name:</b>	<b>s040905sim</b>	<b>Date of Collection:</b> NA
<b>Dil. Factor:</b>	<b>1.00</b>	<b>Date of Analysis:</b> 4/9/10 05:04 PM

<b>Compound</b>	<b>Rpt. Limit (ppbv)</b>	<b>Amount (ppbv)</b>	<b>Rpt. Limit (ug/m3)</b>	<b>Amount (ug/m3)</b>
Vinyl Chloride	0.010	Not Detected	0.026	Not Detected
1,1-Dichloroethene	0.010	Not Detected	0.040	Not Detected
1,1-Dichloroethane	0.020	Not Detected	0.081	Not Detected
cis-1,2-Dichloroethene	0.020	Not Detected	0.079	Not Detected
1,1,1-Trichloroethane	0.020	Not Detected	0.11	Not Detected
Benzene	0.050	Not Detected	0.16	Not Detected
1,2-Dichloroethane	0.020	Not Detected	0.081	Not Detected
Trichloroethene	0.020	Not Detected	0.11	Not Detected
Toluene	0.020	Not Detected	0.075	Not Detected
1,1,2-Trichloroethane	0.020	Not Detected	0.11	Not Detected
Tetrachloroethene	0.020	Not Detected	0.14	Not Detected
Ethyl Benzene	0.020	Not Detected	0.087	Not Detected
m,p-Xylene	0.040	Not Detected	0.17	Not Detected
o-Xylene	0.020	Not Detected	0.087	Not Detected
1,1,2,2-Tetrachloroethane	0.020	Not Detected	0.14	Not Detected
trans-1,2-Dichloroethene	0.10	Not Detected	0.40	Not Detected
Methyl tert-butyl ether	0.10	Not Detected	0.36	Not Detected

Container Type: NA - Not Applicable

<b>Surrogates</b>	<b>%Recovery</b>	<b>Method Limits</b>
1,2-Dichloroethane-d4	117	70-130
Toluene-d8	110	70-130
4-Bromofluorobenzene	96	70-130

Client Sample ID: CCV

Lab ID#: 1004211-10A

**MODIFIED EPA METHOD TO-15 GC/MS SIM**

<b>File Name:</b>	<b>s040902sim</b>	<b>Date of Collection: NA</b>
<b>Dil. Factor:</b>	<b>1.00</b>	<b>Date of Analysis: 4/9/10 01:24 PM</b>

<b>Compound</b>	<b>%Recovery</b>
Vinyl Chloride	89
1,1-Dichloroethene	87
1,1-Dichloroethane	91
cis-1,2-Dichloroethene	90
1,1,1-Trichloroethane	96
Benzene	85
1,2-Dichloroethane	88
Trichloroethene	81
Toluene	84
1,1,2-Trichloroethane	83
Tetrachloroethene	77
Ethyl Benzene	91
m,p-Xylene	92
o-Xylene	97
1,1,2,2-Tetrachloroethane	92
trans-1,2-Dichloroethene	92
Methyl tert-butyl ether	100

**Container Type: NA - Not Applicable**

<b>Surrogates</b>	<b>%Recovery</b>	<b>Method Limits</b>
1,2-Dichloroethane-d4	112	70-130
Toluene-d8	103	70-130
4-Bromofluorobenzene	104	70-130

Client Sample ID: LCS

Lab ID#: 1004211-11A

**MODIFIED EPA METHOD TO-15 GC/MS SIM**

<b>File Name:</b>	<b>s040903sim</b>	<b>Date of Collection: NA</b>
<b>Dil. Factor:</b>	<b>1.00</b>	<b>Date of Analysis: 4/9/10 03:00 PM</b>

<b>Compound</b>	<b>%Recovery</b>
Vinyl Chloride	102
1,1-Dichloroethene	91
1,1-Dichloroethane	103
cis-1,2-Dichloroethene	106
1,1,1-Trichloroethane	114
Benzene	100
1,2-Dichloroethane	102
Trichloroethene	95
Toluene	97
1,1,2-Trichloroethane	100
Tetrachloroethene	92
Ethyl Benzene	114
m,p-Xylene	120
o-Xylene	125
1,1,2,2-Tetrachloroethane	117
trans-1,2-Dichloroethene	106
Methyl tert-butyl ether	116

**Container Type: NA - Not Applicable**

<b>Surrogates</b>	<b>%Recovery</b>	<b>Method Limits</b>
1,2-Dichloroethane-d4	112	70-130
Toluene-d8	103	70-130
4-Bromofluorobenzene	109	70-130