DRAFT

FEASIBILITY STUDY REPORT

FORMER SOUND MATTRESS AND FELT PROPERTY
1940 EAST 11TH STREET
TACOMA, WASHINGTON
FS ID 1232087

Submitted by:

Pacific Crest Environmental, LLC
1531 Bendigo Boulevard North
North Bend, Washington 98045

Pacific Crest PN: 110-001

For:

Mr. Robert Shea
Sound Mattress and Felt Company
7424 Bridgeport Way, Suite 206
Lakewood, Washington 98499-8134

April 12, 2013

Prepared by:

William Carroll, LHG
Principal Hydrogeologist

Peter LeDoux
Staff Geologist

Reviewed by:

Lauren Carroll, LHG
Principal Hydrogeologist

TABLE OF CONTENTS

FIGURES

TABLES

APPENDICES

1. INTRODUCTION

Pacific Crest Environmental, LLC (Pacific Crest) has prepared this Feasibility Study (FS) Report to evaluate cleanup alternatives for contaminated media affected by a release of chlorinated volatile organic compounds (CVOCs) that occurred at the former Sound Mattress and Felt Company (Sound Mattress) property located at 1940 East 11th Street in Tacoma, Washington (the former Sound Mattress Property) (Figure 1). The Sound Mattress Site (the Site) has been assigned Facility/Site No. 1232087 and Voluntary Cleanup Program (VCP) Project No. SW0857 by the Washington State Department of Ecology (Ecology), and is defined as the areal and vertical extent of the contaminants of concern (COCs) in the media of concern. This FS was conducted in accordance with the Model Toxics Cleanup Act (MTCA) Cleanup Regulation (Chapter 173-340 of the Washington Administrative Code [WAC 173-340] as amended November 2007) which specifies the requirements for completing a FS and selecting a cleanup action alternative.

1.1 PURPOSE

The purpose of this FS is to develop and evaluate cleanup action alternatives to facilitate selection of a final cleanup action for the Site in accordance with WAC 173-340-350(8) and WAC 173-340-360. The FS includes: an evaluation of regulatory requirements applicable to the cleanup action; an evaluation of remediation technologies; and selection of a cleanup action approach in accordance with the MTCA.

1.2 REMEDIAL ACTION RESPONSIBILITIES

The remedial action is being conducted under the direction of Sound Mattress:

Mr. Robert Shea
Sound Mattress and Felt Company
7424 Bridgeport Way, Suite 206
Lakewood, Washington 98499-8134

The environmental consultant for the remedial action is:

Ms. Lauren Carroll, Principal Hydrogeologist
Pacific Crest Environmental, LLC
P.O. Box 952
1531 Bendigo Boulevard North
North Bend, Washington 98045

2. BACKGROUND

2.1 FORMER SOUND MATTRESS PROPERTY

2.1.1 Description

The former Sound Mattress Property is a 5.77 acre irregular-shaped parcel that is bounded to the north by Thorne Road and beyond by commercial/industrial properties; to the west by East 11th Street and beyond by the Port of Tacoma Operations office; to the south and east by commercial/industrial properties (Schaub-Ellison and Castan Trucking). Improvements to the former Sound Mattress Property include a 112,280 square-foot masonry warehouse building (the Building) that was constructed between 1948 and 1953. The slab of the Building is between 6-inches and 12-inches thick and is located between 2 feet and 4 feet above surface grade. The parking areas surrounding the Building are unpaved. The Port of Tacoma has indicated that it plans to demolish the Building in the near future. The former Sound Mattress Property and improvements are illustrated on Figure 2.

2.1.2 Property Development and Uses

A chronologic summary of the development of the former Sound Mattress Property and the adjacent Shaub-Ellison Property is provided below:

- Prior to 1948, the former Sound Mattress Property was vacant and undeveloped.
- In 1948, Washington Steel Products (Washington Steel) constructed the northern portion of the existing Building. Washington Steel extended the Building with additions built in 1950 and 1953 (Tacoma Public Library - Tacoma-Pierce County Buildings Index).
- Between 1948 and 1959, Washington Steel conducted manufacturing operations in the Building that included the manufacturing of hardware including enameled metal drawers, knobs, pulls and hinges (Tacoma Library Photo Archive).
- In 1959, Ekco Products Company (Ekco) purchased Washington Steel and in 1965 American Home Products Corp (American Home Products) purchased Ekco.
- In 1964, Sound Mattress purchased the Property. Sound Mattress did not occupy or conduct manufacturing operations on the former Sound Mattress Property but, instead, continued to lease portions of the Building to Ekco and, later, American Home Products until at least 1967.
- In 1965, Sound Mattress leased a portion of the Building to Brown and Haley, Inc. (Brown and Haley) for commercial activities associated with the sales and distribution of Brown and Haley candy (Pacific Crest 2006).
- The Polk City Directory identifies the tenants of the former Sound Mattress Property as "Washington Steel Products" in 1960 and as Brown & Haley, Ekco Products Co., Dell's Copy Shop, Washington Line Federal Credit Union, and Washington Steel Products in 1967. From 1972 through the present, the former Sound Mattress Property tenants are listed as Brown & Haley (1972, 1977, 1982, 1987, 1992, 2001, and 2005) and/or Westlocknational (1997); Cardservice International (2001 and 2005), Northwest Cardservice (2001); Hoops Unlimited (2001) and Westpac Marketing (2001).

- In 1970, the Shaub-Ellison Property consisted of undeveloped land and was purchased by Mr. Sanford Shaub from Mr. Robert Shea Sr.
- In 1973, the Shaub-Ellison property was first developed with a 7,300 square-foot, split-level, concrete tilt-up building erected on approximately 0.78-acres. Additional improvements to the Shaub-Ellison Property include an asphalt-paved storage yard in the western portion of the parcel, and an asphalt-paved parking area on the eastern portion of the parcel.
- From 1974 through 1998, the property was operated by the Shaub-Ellison Company, an automotive retail tire service facility.
- Since 2000, the Shaub-Ellison Property has operated as RevChem Plastics, an industrial chemical and supply company.

2.2 NATURAL SETTING

2.2.1 Physiographic Setting

The former Sound Mattress Property is located in the near-shore tidal flats area of the Port of Tacoma near Commencement Bay of the Puget Sound. In the late 1800s, the southern and eastern shoreline of Commencement Bay consisted of tidal flats formed as part of the Puyallup River delta. Dredge and fill activities, conducted since the 1920s, have significantly changed the estuarine nature of this shoreline and the tidal flats. The historic meandering streams and rivers were dredged to form waterways and the intertidal areas between the waterways were filled with dredge material to create usable land. The newly created land has since been used for commercial and industrial operations including shipbuilding, chemical manufacturing, ore smelting, oil refining, food preservation, and transportation facilities.

2.2.2 Surface Water

The former Sound Mattress Property is located approximately 350 feet southeast of a large body of saline surface water (Sitcum Waterway and Commencement Bay). In 1983, the United States Environmental Protection Agency (EPA) placed portions of Commencement Bay, including the Sitcum Waterway, on the Superfund National Priorities List due to widespread contamination of the water, sediments, and upland areas.

2.2.3 Geologic Setting

The regional unconsolidated geology in the Puget Sound area consists primarily of interbedded Pleistocene Era clays, silts, and sands deposited as a result of glacial activity. Glacial outwash sediments in the region were deposited, eroded, and re-deposited by rivers and streams. The advance and retreat of glacial ice sheets also resulted in the compaction of underlying sediments into glacial till. Alluvial deposits in the region are present in the vicinity of streams in the major regional river valleys and typically consist of unconsolidated, stratified, clay, silt, and very fine to fine sand, with considerable organic matter. Medium to coarse sand and gravel units underlie much of the fine-grained floodplain sediment in the region and are common in small stream valley bottoms (Galster and Laprade 1991). As discussed in the previous section, anthropogenic activities in the Port of Tacoma tideflats (i.e. dredging and filling) have altered much of the shallow subsurface.

2.2.4 Hydrogeologic Setting

Groundwater aquifers in the Puget Sound area are generally confined to recent alluvial deposits of sands and gravel, which are stratigraphically delimited by aquitards (low permeability units) consisting of glacial till deposits. Discontinuous perched shallow groundwater zones may be seasonally or locally present above the glacial till deposits (Galster and Laprade 1991). The groundwater in aquifers that are located in close proximity to saline surface water generally meets the non-potability criteria of MTCA (WAC 173-340-720(2)(d)).

2.3 REMEDIAL INVESTIGATION

2.3.1 Historic Site Investigation Activities

In April 2004, during a preliminary due-diligence subsurface investigation performed by Environmental Associates, Inc. (EAI) at the neighboring Shaub-Ellison Property located at 1132 Thorne Road, laboratory analysis detected tetrachloroethene (PCE) in one groundwater sample (boring B2) (EAI 2004a). Further investigation on the former Sound Mattress and Shaub-Ellison properties identified apparent source areas on the former Sound Mattress Property where releases of PCE appear to have occurred and have resulted in PCE and associated daughter products generated by reductive dechlorination, including trichloroethene (TCE), cis-1,2-dichloroethene (c-DCE), trans-1,2-dichloroethene (t-DCE) and vinyl chloride (VC) in soil and groundwater.

The investigation activities conducted between 2004 and 2010 have been documented in reports previously submitted to Ecology and have included: advancing soil borings; installing groundwater monitoring wells; conducting tidal studies; collecting soil, groundwater and air samples for laboratory analysis; performing passive soil vapor surveys; and, assessing the results in accordance with industry practice. A chronologic summary of the investigation activities is provided below:

- In April 2004, EAI advanced 17 soil borings (Borings B1 through B17) during a preliminary due diligence subsurface investigation at the Shaub-Ellison Property. EAI collected soil and groundwater samples from the borings and submitted the samples to an independent laboratory for analysis (EAI 2004a).
- In April and May 2004, EAI advanced an additional 11 borings (Borings B18 through B28) and four test pits (TP1 through TP4) on the Shaub-Ellison Property. EAI collected soil samples from the borings and test pits, and groundwater samples from select borings, and submitted the samples to an independent laboratory for analysis (EAI 2004a).
- In July 2004, EAI advanced five borings (B29 through B32 and MW-4) and converted four of the borings into groundwater monitoring wells (MW-1 through MW-4). EAI collected groundwater samples from the borings and wells and submitted the samples to an independent laboratory for analysis (EAI 2004b).
- In January 2005, EAI advanced eight borings (B-33 through B-40) and converted four of the borings, located in the alley between the Sound Mattress Property and the Shaub-Ellison Property, into groundwater monitoring wells (MW-5 through MW-8). EAI collected groundwater samples from the borings and wells and submitted the samples to an independent laboratory for analysis (EAI 2005).

- In July 2005, LSI Adapt collected groundwater samples from monitoring wells MW-1 through MW-8 and submitted the samples to an independent laboratory for analysis. During the same groundwater monitoring event, Environmental Management Services (EMS) collected split samples from wells MW-5 through MW-8 (EMS 2005).
- In August 2005, LSI Adapt advanced five borings (SC-1 through SC-4, and MW-9) and converted one boring into a groundwater monitoring well (MW-9) (LSI Adapt 2005).
- In April 2006, Pacific Crest assessed the alley between the former Sound Mattress Property and the Shaub-Ellison Property for conductive and non-conductive underground utilities (Pacific Crest 2006).
- In May 2006, Pacific Crest conducted a soil gas survey to assess the concentrations of CVOCs in the Site vadose zone using W.L. Gore and Associates (Gore) soil vapor sorbent modules (Sorbers) and submitted the Sorbers to Gore for analysis of CVOCs by modified SW-846 Method 8260/8270 (Pacific Crest 2006).
- In October 2006, Pacific Crest advanced one soil boring (Boring MW-10) and converted it into a groundwater monitoring well (MW-10). Pacific Crest collected a soil sample from the boring and submitted the sample to an independent laboratory for analysis (Pacific Crest 2009).
- In February 2007, Pacific Crest measured groundwater elevations in all Site monitoring wells and collected groundwater samples from monitoring wells MW-1 through MW-8, and MW-10, and submitted these samples to a laboratory for analysis (Pacific Crest 2009).
- In November 2007, Pacific Crest advanced four reconnaissance soil borings (B-1 through B-4) and submitted soil and groundwater samples from these borings to an independent laboratory for analysis (Pacific Crest 2009).
- In November 2008, Pacific Crest advanced boring MW-11, converted the boring into monitoring well MW-11, collected a soil sample from the boring and submitted this sample to an independent laboratory for analysis (Pacific Crest 2009).
- In November 2008, Pacific Crest measured groundwater elevations in all Site monitoring wells and collected groundwater samples from monitoring wells MW-1 through MW-11 and submitted these samples to an independent laboratory for analysis (Pacific Crest 2009).
- In March 2009, Pacific Crest advanced three soil borings and converted them into groundwater monitoring wells MW-12, MW-13, and MW-14. Soil samples were collected from the borings and groundwater samples were collected from the wells and submitted to an independent laboratory for analysis (Pacific Crest 2009).
- In April 2009, Pacific Crest conducted a 72-hour tidal study by monitoring groundwater elevations in select Site monitoring wells using data logging pressure transducers (Pacific Crest 2009).

- In June 2009, the Port of Tacoma conducted an indoor air survey by collecting indoor air and ambient air samples and submitting these samples to an independent laboratory for analysis (Pacific Crest 2009).

- In August 2009, Pacific Crest conducted a soil vapor survey by installing and retrieving Gore-Sorber passive soil vapor sampling modules at 33 locations beneath the Building. Soil vapor modules were submitted to the Gore laboratory for analysis (Pacific Crest 2009).

- In May 2010, Pacific Crest advanced seven reconnaissance soil borings (borings B-5 through B-11) and submitted soil and groundwater samples from these borings to an independent laboratory for analysis (Pacific Crest 2010).

- In June 2010, Pacific Crest advanced three reconnaissance soil borings (borings B-12 through B-14) and submitted soil and groundwater samples from these borings to an independent laboratory for analysis (Pacific Crest 2010).

- In June 2010, Pacific Crest advanced boring MW-15, converted the boring into monitoring well MW-15, collected a soil sample from the boring and submitted this sample to an independent laboratory for analysis (Pacific Crest 2010).

- In June 2010, Pacific Crest measured groundwater elevations in all Site monitoring wells and collected a groundwater sample from monitoring well MW-15 and submitted the sample to an independent laboratory for analysis (Pacific Crest 2010).

2.3.2 Results

The results and conclusions of the investigations are summarized in the following sections.

- Unsaturated soil below the slab of the Building and above surface grade consists of sand, silt and gravel fill (Upper Fill). The unsaturated soil in the vicinity of the Site consists of sand and/or gravel fill (Upper Fill) to a depth of up to 10 feet below ground surface (bgs), overlying fine sand and silty sand with occasional minor silt and shell fragments to a depth of 8 ft bgs to 15 ft bgs (Upper Sand). The Upper Fill and Upper Sand consist of similar material and are nearly indistinguishable by visual inspection. The Upper Sand is underlain by a thin discontinuous silt (Upper Silt) that is up to 5 feet thick in places. The Upper Silt is present beneath the majority of the former Sound Mattress Property and the Port of Tacoma property located north of East 11th Street, but does not appear to be present in the immediate vicinity of East 11th Street along the northern boundary of the former Sound Mattress Property. The Upper Silt is underlain by sand (Lower Sand) to a depth of approximately 30 ft bgs. The Lower Sand is underlain by clayey silt (Lower Silt) that appears to be continuous across the Site. The unconsolidated geology in the Site vicinity is illustrated in cross section view on Figure 3 and Figure 4.

- Shallow groundwater in the vicinity of the Site is encountered in the Upper Sand between the depths of approximately 7.5 feet bgs to 11 feet bgs. Saturated conditions extend to the top of the Lower Silt, interpreted as an aquitard and the base of the shallow water-bearing zone, at approximately 30 feet bgs. Due to the discontinuous nature of the Upper Silt, the Upper Sand and Lower Sand are interpreted as a single hydrogeologic unit. The

Site groundwater is influenced by tidal fluctuations in the adjacent surface water body and meets the MTCA criteria for non-potability (WAC 173-340-720(2)(d)).

- The potentiometric surface calculated for the Site, based on the June 17, 2010 groundwater monitoring data, indicates a groundwater flow direction to the north-northwest under an average hydraulic gradient of 0.008 feet per feet (ft/ft). The groundwater elevation data are summarized in Table 1.
- Laboratory analysis of soil, groundwater and indoor air samples collected during the investigation activities detected one or more of the following CVOC compounds: PCE, TCE, c-DCE, t-DCE and VC. The analytical results for soil samples are summarized in Table 2. The analytical results for groundwater samples collected from monitoring wells and from reconnaissance borings are summarized in Table 3 and Table 4, respectively. Groundwater quality parameters measured during groundwater sampling are summarized in Table 5. The analytical results for indoor air are summarized in Table 6.
- The concentration of PCE in the groundwater samples collected from well MW-11 are considered to be potentially indicative of the presence of dense non-aqueous phase liquid (DNAPL). The vertical extent of DNAPL appears to be constrained by the Upper Silt in this location at approximately 12 feet below the Building slab.
- The distribution of the COCs in groundwater at the Site is affected by biologic, hydrogeologic, and geochemical variables. Concentrations of chlorinated ethenes adsorbed to soil and dissolved in groundwater are subject to biodegradation processes including reductive dechlorination, aerobic oxidation, anaerobic oxidation and anaerobic co-metabolism. Select bacteria that thrive in anaerobic environments are capable of utilizing PCE, TCE, and other CVOC constituents as energy sources and, through the process of biodegradation, transform the CVOCs into innocuous byproducts. The typical breakdown sequence for PCE and CVOCs under anaerobic conditions is summarized below:

  PCE ► TCE ► c-DCE (primarily) ► VC ► Ethene and Carbon Dioxide (CO2)

  The presence of all of the reductive dechlorination degradation compounds of PCE in groundwater indicates that the groundwater geochemistry is conducive to reductive dechlorination.

2.3.3 Conceptual Site Model

A CSM has been developed that is based on the data collected during the RI activities conducted at the Site by Pacific Crest and others. The CSM identifies plausible exposure pathways for human receptors. The CSM is illustrated on Figure 5 and the CSM elements are discussed below:

- The Site COCs include PCE and CVOC daughter products generated by the reductive dechlorination, including TCE, c DCE, t-DCE and VC. The primary sources of hazardous materials appear to be PCE-containing metal cleaning solvents used during former operations at the facility.
- The Site is characterized in the southeast by elevated concentrations of CVOCs (primarily PCE, TCE and c-DCE) in soil and groundwater in the Upper Fill and Upper Sand above the Upper Silt located near the suspected source areas – locations used by Washington Steel Products for metal degreasing and plating and a sewer line located in the alley

southeast of the Building. Concentrations of PCE indicative of DNAPL have been detected in one well (MW-11) located near the former metal plating areas. The northwestern portion of the Site is characterized by concentrations of the degradation products of PCE (c-DCE and VC) that have migrated in groundwater vertically downward into the Lower Sand below the Upper Silt and laterally to the northwest, away from the source areas, due to groundwater flow and the tidal influence of the Sitcum Waterway. In the southeastern portions of the Site, the soil and groundwater in the Lower Sand does not appear to be impacted and in the northwestern portions of the Site, the soil and groundwater in the Upper Sand does not appear to be impacted. This distribution of contaminants appears to be controlled by groundwater flow and the gap in Upper Silt located near East 11th Street.

- The media of concern where concentrations of COCs have been detected include: soil, groundwater, and indoor air. Elevated concentrations of c-DCE and VC have been detected in groundwater samples collected adjacent to the Sitcum Waterway.
- The applicable transport mechanisms for the migration of COCs include: direct release to soil; migration to subsurface soil; migration/leaching to groundwater; volatilization from soil and groundwater to air; groundwater migration to surface water; and uptake by plants or animals.
- Inhalation was identified as a potentially complete exposure pathway for commercial and industrial workers. Laboratory analysis of indoor air samples collected in the Building detected elevated concentrations of PCE; however, the Building is vacant and scheduled for demolition by the Port of Tacoma. Future receptors exposed to contaminants in air at the Site include: commercial and construction workers. The Site is located in a designated industrial zone; therefore, residents are not considered plausible future receptors under future land use.
- Future receptors exposed to contaminants in soil at the Site include commercial/industrial workers and construction workers for the ingestion and dermal exposure pathways.
- Future receptors exposed to contaminants in groundwater at the Site include construction workers for the dermal exposure pathway. Groundwater at the Site is not potable; therefore, ingestion of groundwater is not a complete exposure pathway.
- Potential future receptors exposed to contaminants in surface water and sediment include: commercial and industrial workers; construction workers; and recreational users for the dermal exposure pathway.
- Potential future receptors exposed to contaminants in marine biota resulting from uptake of contaminants in surface water or sediment include recreational users.

3. REGULATORY ELEMENTS

3.1 REGULATORY REQUIREMENTS

3.1.1 MTCA Status

Ecology is the state agency responsible for overseeing cleanup of the Site under the MTCA regulation. A chronologic summary of regulatory milestones is presented below:

- The release was discovered in 2004.
- In 2007, the Site was enrolled in Ecology's VCP.
- In 2009, the results of remedial investigation (RI) activities were submitted to Ecology in the RI Report dated December 9, 2009. Several RI data gaps were identified in the RI Report that required additional investigation to fully characterize the nature and extent of contamination.
- In 2010, the results of further characterization were submitted to Ecology in the Data Gap Investigation Report dated August 4, 2010 with a request for an Opinion Letter.
- Ecology issued an Opinion Letter dated November 8, 2010 that approved the RI activities and established cleanup levels for the COCs in soil, groundwater and air.

3.1.2 Applicable or Relevant and Appropriate Requirements

Although Ecology is the lead agency, the cleanup action effort will be conducted in accordance with all applicable local regulations and permitting requirements. The remedial alternatives presented in the FS will comply with all applicable or relevant and appropriate requirements (ARARs), including state and federal laws, in accordance with WAC 173-340-350 and WAC 173-340-710. Potential ARARs evaluated in the FS include:

- Ch. 173-204 WAC - Sediment Management Standards;
- Ch. 173-201A WAC - Aquatic Life – Marine (Acute and Chronic);
- Clean Water Act §304 – Human Health and Aquatic Life – Marine (Acute and Chronic);
- National Toxics Rule, 40 CFR 131 – Human Health and Aquatic Life – Marine (Acute and Chronic); and
- Washington State Dangerous Waste Regulations (WAC 173-303).

3.2 CLEANUP STANDARDS

As defined in WAC 173-340-700, cleanup standards for a site include establishing cleanup levels and points of compliance at which those cleanup levels will be attained. The cleanup standards for the Site have been established in accordance with WAC 173-340-700 through WAC 173-340-760, which are protective of human health and the environment, and also comply with the ARARs for the Site.

3.2.1 RI Cleanup Levels

As part of the RI, Pacific Crest developed cleanup levels for the COCs in the media of concern that were protective of human health and the environment under specified exposure conditions (WAC 173-340-200) and used those cleanup levels to define the areas of the Site that required cleanup. In the Opinion Letter dated November 8, 2010, Ecology approved final RI Cleanup Levels that were adjusted to reflect applicable ARARs. The Ecology approved RI Cleanup Levels for the media of concern are summarized below:

COC	Upland Soil (mg/kg)	Air (µg/m^3)	Groundwater (µg/L)
	MTCA Method C – Adjusted - Protective of Surface Water	MTCA Method C - Adjusted	National Recommended Water Quality Criteria (2009)
PCE	0.334	6.57	3.3
TCE	0.296	1.55	30
c-DCE	65	122.72	10,000
VC	0.057	0.99	2.4

3.2.1 Draft FS Cleanup Levels

In September 2012, Ecology revised several toxicological parameters that are used in the calculation of cleanup levels for PCE and TCE (Cleanup Levels and Risk Calculations [CLARC] 2012). As part of the FS, Pacific Crest re-calculated the site specific cleanup levels for PCE and TCE to account for the latest changes. Copies of the calculation worksheets are provided in Appendix A. The cleanup levels for c-DCE and VC remain unchanged. The draft FS Cleanup Levels for the Site are presented below:

COC	Upland Soil (mg/kg)	Air (µg/m^3)	Groundwater (µg/L)
	MTCA Method C Protective of National Recommended Water Quality Criteria (2009)	MTCA Method C - Adjusted	National Recommended Water Quality Criteria (2009)
PCE	0.04	23.28	3.3
TCE	0.2	2	30
c-DCE	65	122.72	10,000
VC	0.057	0.99	2.4

3.2.1 FS Remediation Levels

The draft FS Cleanup Levels for upland soil and groundwater are based on the protection of surface water and an ARAR: the National Recommended Water Quality Criteria (EPA 2009). Remediation levels for PCE and VC are proposed for the Site in this FS to facilitate the selection of cleanup alternatives. The FS Remediation Levels will be applied in selecting technologies for areas of the Site that are proportional to the concentrations of contaminants. The basis for the FS remediation levels are presented below:

- The ARAR based cleanup level for PCE is based on out-of-date toxicological parameters and the U.S. Environmental Protection Agency (EPA) has not recalculated the surface water quality criteria to reflect the latest scientific studies. Pacific Crest calculated a FS Remediation Level for PCE by substituting the out-of-date parameters used to calculate the National Recommended Water Quality Criteria with the latest values adopted by Ecology and EPA. The calculated FS Remediation Levels for PCE in soil and groundwater are 0.67 mg/kg and 62.2 µg/L, respectively. A copy of the calculation worksheet is provided in Appendix A.
- The FS Cleanup Level for VC is based on the surface water quality criteria ARAR. The proposed FS Remediation Level for VC in groundwater is the MTCA Method C Cleanup Level of 90 µg/L.

3.3 POINTS OF COMPLIANCE

The point of compliance is defined in WAC 173-340-200 as the point where cleanup levels, established in accordance with WAC 173-340-720 through WAC 173-340-760, shall be attained. Once the cleanup levels are attained at the point of compliance, the concentrations of COCs have achieved the regulatory requirements established under MTCA.

3.3.1 Point of Compliance for Groundwater

The standard point of compliance (SPOC) for groundwater is defined as all groundwater from the uppermost level of the saturated zone extending vertically to the lowest depth that is affected by any of the COCs. A conditional point of compliance (CPOC) for groundwater at sites abutting surface water is defined as a point in surface water located as close as technically possible to points where groundwater flows into surface water. A CPOC is subject to Ecology approval, in addition to the following regulatory conditions specified in WAC 173-340-720(8)(i):

- Demonstration that contaminated groundwater is entering surface water and will continue to enter surface water even after implementation of the selected cleanup action;
- Demonstration that it is not practicable to meet the cleanup level at a point within groundwater before entering the surface water within a reasonable restoration time frame;
- Implementation of all known available and reasonable methods of treatment for groundwater remediation prior to discharge into surface water;
- Demonstration that groundwater discharges shall not result in violations of sediment quality values published in WAC 173-204;
- Implementation of long-term groundwater and surface water monitoring; and

- Submittal of notice of, and invitation to comment on, the proposal for a CPOC to natural resource trustees, the Washington State Department of Natural Resources and United States Army Corps of Engineers.

For the purposes of this report, the SPOC will be used for evaluation of compliance with the cleanup standards. However, proposals to utilize a CPOC may be developed in the future.

3.3.2 Point of Compliance for Soil

The point of compliance for soil based on the protection of surface water is defined as all soil throughout the Site. The point of compliance for soil cleanup levels based on direct contact is soil between ground surface and 15-feet bgs.

3.3.3 Point of Compliance for Air

Air cleanup standards apply to ambient (outdoor) air and to air within any building or other structure large enough to fit a person. The point of compliance for air is defined as ambient air throughout the Site.

4. CLEANUP TECHNOLOGY SCREENING EVALUATION

4.1 IDENTIFICATION AND DESCRIPTION OF CLEANUP TECHNOLOGIES

Numerous remediation technologies have been developed, tested and utilized to remediate CVOC contaminated soil and groundwater at similar sites. CVOCs in soil and groundwater can be remediated using passive (e.g. monitored attenuation) or active (e.g. soil vapor extraction) technologies. In addition, some technologies focus on a single type of media (e.g. excavation of soil or air sparging for groundwater) while other technologies are capable of remediating several media at one time (e.g. dual phase extraction). Due to the unpredictability of DNAPL migration in the subsurface, achieving "full restoration" of affected media at sites where DNAPL has been present may be not be practicable regardless of the technology utilized (EPA 1992).

The potential technologies for Site remediation were selected from the Federal Remediation Technologies Roundtable Treatment Technologies Screening Matrix (http://www.frtr.gov/matrix2/section3/table3_2.pdf) and screened to identify those technologies best-suited to achieving the remediation objectives. The technologies selected in the initial screening are described below:

- **Excavation** – Excavation of shallow contaminated soil using readily available construction equipment is a rapid and effective, though costly, remediation method for soil. Excavation is the process of physically removing contaminated soil from a site and either treating the soil above ground or transporting the soil off-site for treatment and disposal. Following soil excavation, confirmation samples are collected and the excavation is backfilled with clean material.

  Current state and federal regulations governing waste disposal prohibit land disposal of any untreated hazardous waste. Under these regulations, soil that contains concentrations of a listed hazardous waste (e.g. PCE and other CVOCs) and is being excavated as a part of cleanup action must be handled as listed waste, regardless of the concentration of hazardous waste constituents present in the soil. In response to the unintended consequence of significantly increased cleanup costs without any observable improvement for human health or the environment that resulted from the strict interpretation of these regulations, EPA issued the "Contained-In" Policy to clarify the application of hazardous waste regulations to environmental media generated during a site cleanup. The "Contained-In" Policy allows soil from a cleanup action to be handled as a non-hazardous waste, provided that only minimal concentrations of hazardous waste constituents are present in the soil.

- **Soil Vapor Extraction (SVE) and Dual Phase Extraction (DPE)** – SVE and DPE operate by inducing a vacuum on wells to recover CVOCs from the subsurface. SVE recovers soil vapor only, while DPE recovers soil vapor and groundwater. SVE and DPE are effective for remediation of permeable material (sand and silty sand). DPE is primarily used for remediation of shallow contamination. The recovered media are typically treated before being discharged. During operation of a typical SVE or DPE system, the concentrations of CVOCs in soil gas decrease as the mass of contaminants present in the soil pore space is reduced. Over time, the CVOC recovery rate tends to become a function of the rate of desorption of contaminants from soil and recovery rates reach asymptotic levels.

- **Air Sparging (AS)** – AS operates by injecting compressed air into groundwater through wells installed below the static water table. The migration of injected air through the saturated soil pore spaces results in the partitioning of CVOCs dissolved in groundwater into air. Once the air reaches the un-saturated zone, SVE is used to physically extract the CVOCs as discussed above. Depending on the concentrations of the contaminants, treatment of the system effluent may be required. During operation of a typical AS system, the concentrations of CVOCs in recovered vapor decrease as the mass of contaminants dissolved in groundwater and present in the soil pore space is reduced.

- **Bioremediation** – Bioremediation is the process in which select bacteria that thrive in groundwater utilize CVOCs as energy sources and, eventually, transform the CVOCs into innocuous byproducts. The higher molecular weight compounds (PCE and TCE) are more readily degraded by reductive dechlorination, while the lower molecular weight degradation compounds (VC) can be degraded by reductive dechlorination or aerobic oxidation. Reductive dechlorination occurs under anaerobic conditions that are conducive to the growth of bacteria capable of consuming CVOCs. In aerobic zones of the subsurface (zones of the subsurface where dissolved oxygen is present), certain CVOCs can be oxidized to form carbon dioxide, water, and chloride by direct and co-metabolic mechanisms. The direct mechanisms are more likely to occur with the less chlorinated CVOCs (mono- and di-chlorinates). The byproducts of aerobic degradation are chlorine and CO_2.

  Monitored natural attenuation (MNA) is the process of periodic monitoring to verify that the natural degradation processes are occurring. MNA is typically implemented at sites where concentrations of contaminants are low and source removal has been conducted. MNA is the preferred alternative when concentrations of the COCs are below their respective FS Remediation Levels, but above the draft FS Cleanup Levels.

  Enhanced reductive dechlorination (ERD) or enhanced aerobic bioremediation (EAB) are technologies that add nutrients or other supplements to the subsurface to make the subsurface conditions more conducive to the rapid degradation of contaminants. The naturally occurring reductive dechlorination processes can be enhanced to accelerate degradation of CVOCs in groundwater by adding organic substrates to the subsurface. Numerous organic substrates are available which can be naturally degraded and fermented in the subsurface to result in the generation of hydrogen to enhance reductive dechlorination. Carbohydrates (e.g., sugars), alcohols, low-molecular-weight fatty acids (e.g., lactate), vegetable oils, and plant debris (e.g., mulch) are examples of easily fermentable organic substrates. Similarly, aerobic bioremediation can be enhanced by increasing the concentrations of dissolved oxygen in groundwater. Additional factors that influence the effectiveness of EAB include inorganic nutrients such as nitrogen and phosphate to support cell growth and sustain biodegradation processes.

- **In-Situ Chemical Oxidation (ISCO)** – Groundwater remediation using ISCO involves injecting oxidizing materials (e.g. hydrogen peroxide, potassium permanganate or sodium permanganate) and other amendments directly into the source zone and downgradient plume. The ISCO materials can be injected into the vadose zone, but is most effective in treating chemicals that are dissolved in groundwater. The oxidizing materials chemically react with the organic contaminant and any other organic material—including CVOC degrading bacteria—resulting in the breakdown of the contaminant into benign substances such as carbon dioxide and water.

- **Groundwater Recovery and Hydraulic Control (Pump-and-Treat)** – Pump-and-treat consists of pumping groundwater from recovery wells screened in the zone of contamination to both remove contaminant mass and to control groundwater migration (hydraulic control). The recovered groundwater is then treated before being discharged, typically to a sewer system under a permit with the local municipality. Pump-and-treat systems are capable of controlling the hydraulic gradient of groundwater, but they are not generally considered effective in achieving cleanup levels at sites impacted with CVOCs. In addition, groundwater treatment can be complicated by naturally high iron concentrations present in anaerobic groundwater and low treatment standards required by the treatment facility.
- **Electrical Resistance Heating (ERH)** – ERH uses multiphase electricity to resistively heat the soil to the boiling point of water. Heating the subsurface volatilizes the contaminants and, ultimately, causes the groundwater in the heating zone to boil. Steam that is generated from the boiling groundwater enhances contaminant extraction. The steam and volatilized contaminants are collected from the subsurface by a SVE process, and treated above ground to achieve applicable discharge permit limits.

4.2 FURTHER SITE CHARACTERIZATION AND CLEANUP TECHNOLOGY PILOT TESTING

Pacific Crest conducted field activities as part of the FS in order to further characterize the nature and extent of contamination on the former Sound Mattress Property and to evaluate the applicability of EAB, SVE and AS for cleanup of the Site. The field activities were conducted between January of 2011 and December of 2012 and are described in detail in the following sections.

4.2.1 Field Activities

4.2.1.1 Further Site Characterization

In 2011 and 2012, Pacific Crest conducted further Site characterization on the former Sound Mattress Property to assess the concentrations of CVOCs in shallow soil near the suspected source area and to assess concentrations of CVOCs in soil and groundwater at a location near the north side of the Building. The purpose of the additional characterization was to obtain more detailed data in the area of the Building to facilitate the evaluation of soil and groundwater cleanup alternatives.

On January 14, 2011, eight soil borings (borings B-15 through B-22) were advanced by Environmental Services Network Northwest (ESN) under the direction of a Pacific Crest geologist using direct-push hydraulic sampling methods. All borings were advanced inside the Building on the former Sound Mattress Property to a depth of approximately 4 ft below the Building slab. The boring locations are illustrated on Figure 2.

On November 8, 2012, two soil borings (borings B-23 and B-24) were advanced by ESN under the direction of a Pacific Crest geologist using direct-push hydraulic sampling methods. The borings were advanced inside the Building on the former Sound Mattress Property near the northern wall to provide data regarding the extent of CVOCs in soil and deeper groundwater to the northwest of the known extent of soil contamination. The boring locations are illustrated on Figure 2.

During both subsurface investigations, soil samples were collected using a four foot Geoprobe™ macro-core piston-type sampler. Samples collected from the borings were described in accordance with the Unified Soils Classification System (USCS), and inspected for visual and olfactory evidence of contamination. Soil vapor headspace analysis was conducted to field screen the samples for total volatile organic compound (TVOC) concentration using a photoionization detector (PID). The soil vapor headspace analysis was performed by placing a portion of soil from each sample interval into a re-sealable plastic bag, allowing the sample to warm for several minutes, and recording the highest TVOC concentration inside the bag measured over a 30-second span using the PID. The USCS descriptions, observations of contamination, and field screening data were recorded on boring logs. Copies of the boring logs are provided in Appendix B.

Pacific Crest collected soil samples from between 1 and 4 feet below the slab of the Building in borings B-15 through B-22; and from between 0 and 2 feet and 4 and 6 feet below the slab of the Building in boring B-24 for submittal to an analytical laboratory. Soil samples for laboratory analysis were not collected from boring B-23. Samples collected for laboratory analysis were prepared using SW-846 Method 5035A. The soil samples were submitted to OnSite Environmental, Inc. (OnSite) of Redmond, Washington, for analysis of CVOCs by SW-846 Method 8260B. Copies of the laboratory analytical reports are provided in Appendix C.

Reconnaissance groundwater samples were collected from borings B-23 at a depth immediately below first encountered groundwater (approximately 7.5 to 10 feet below the slab of the Building), and from the maximum depth of the boring (26 to 30 feet below the slab of the Building). Samples were collected through the screened section of a Geoprobe™ ScreenPoint 15 Water Sampler using a peristaltic pump and dedicated tubing. Prior to collecting each sample, approximately one gallon of groundwater was purged from the boring using a peristaltic pump and 0.25-inch dedicated polyethylene tubing. Groundwater samples were transferred directly from the tubing into laboratory-prepared 40-milliliter sample vials preserved with hydrochloric acid. The vials were filled completely with water to eliminate potential loss of volatiles to headspace and were checked to ensure that no air bubbles were present in the sample. Following collection, groundwater samples were labeled, placed in a cooler on ice, and transported to OnSite under standard chain-of-custody protocols. The samples were analyzed for CVOCs by SW-846 Method 8260B on a standard turnaround time. A copy of the laboratory analytical report is provided in Appendix C.

4.2.1.2 Groundwater Monitoring and Sampling

In April of 2012, Pacific Crest conducted groundwater monitoring in the existing monitoring wells. The monitoring event included measuring water levels and collecting groundwater samples for laboratory analysis.

Groundwater elevation monitoring was conducted at the Site by removing the monument and well cap from each of the existing wells and permitting the water level in each well to equilibrate with atmospheric pressure for a minimum of 15 minutes prior to collecting groundwater level data. Groundwater levels were measured relative to a surveyed mark located on the north side of each well casing to an accuracy of 0.01 foot using an electronic water level indicator.

Groundwater samples were collected using passive diffusion bag (PDB) samplers manufactured by Columbia Analytical Services (CAS). PDB samplers are long cylindrical tubes constructed of low density polyethylene (LDPE) that are filled with analyte-free distilled water and sealed to prevent cross-contamination. When the PDB samplers are installed in a well, the dissolved volatile organic compounds (VOCs) in groundwater diffuse through the membrane into the water in the sealed PDB sampler. Upon retrieval, usually 14 days after deployment, the PDB samplers are opened and water inside the PDB sampler is transferred into laboratory provided sample containers for submittal to an independent laboratory for analysis.

Pacific Crest installed PDB samplers in monitoring wells MW-1 through MW-15 on April 10, 2012. A PDB sampler was lowered into each well using a dedicated length of string sufficient to lower the PDB sampler into the well until the entire sampler was submerged. After each PDB sampler was lowered into the well, the line was secured and the well head locked. On April 25, 2012, Pacific Crest retrieved the PDB samplers from the wells and collected samples for laboratory analysis. The PDB samplers were cut open and water from inside the samplers was transferred directly into laboratory prepared 40-milliliter sample vials preserved with hydrochloric acid. Each vial was checked to ensure that there were no air bubbles present in the sample, labeled, placed on ice in a cooler, and transported to CAS under standard chain-of-custody protocols on a standard turnaround time. CAS analyzed the groundwater sample for CVOCs by SW-846 Method 8260B. A copy of the laboratory analytical report is provided in Appendix C.

4.2.1.3 EAB Pilot Test

Between September and December of 2012, Pacific Crest conducted an extended EAB pilot test. The purpose of the EAB pilot test was to assess the feasibility of enhancing aerobic bioremediation of VC in groundwater by increasing the concentrations of dissolved oxygen (DO) in groundwater. Oxygen Release Compound (ORC®) is a proprietary formulation of magnesium peroxide manufactured by Regenesis, Inc. (Regenesis) that releases oxygen when hydrated. The technology to increase DO in groundwater and facilitate EAB of VC consisted of injecting a slurry of ORC® and water through soil borings advanced into the saturated zone of the Lower Sand adjacent to the Sitcum Waterway. The EAB pilot test activities consisted of injecting 500 pounds (lbs) of ORC® into the subsurface through soil borings and monitoring changes in groundwater geochemistry and concentrations of CVOCs over time.

On September 8 and September 9, 2012, under the direction of Pacific Crest, ESN completed eleven soil borings, IP-1 through IP-11, in two rows (five borings in the first row and six in the second) (Figure 2) and advanced one boring (MW-17) which was completed as a monitoring well (MW-17). Prior to the initiating subgrade work, a public One-Call locating service and a private utility locate contractor were used to assess the proposed drilling locations for conductible utilities.

During the advancement of borings IP-1 through IP-11, a slurry of approximately 50 lbs of ORC® and 15 gallons of water was injected into the subsurface at depths between 30 and 20 feet bgs (Lower Sand) at each location. The slurry was injected into the Lower Sand saturated zone through direct push drilling rods using a high-pressure grout pump. Upon completion, each boring was filled to within 6 inches of surface grade with bentonite pellets which were hydrated with clean water and sealed with asphalt patching material.

In order to assess the effectiveness of EAB, Pacific Crest monitored the concentrations of DO and the concentrations of CVOCs in groundwater in two wells (MW-15 and MW-17) located on either side of the series of ORC® injection borings. Well MW-15 was an existing well in the Site monitoring network and well MW-17 was installed in September of 2012 as part of the EAB pilot test. On September 9, 2012, ESN advanced boring MW-17 up-gradient of IP-1 through IP-11 and completed the boring as monitoring well MW-17. The well boring was advanced to approximately 30 feet bgs using a hollow stem auger drilling rig. MW-17 was constructed in the annulus of the boring in accordance with the *Minimum Standards for Construction and Maintenance of Wells*, WAC 173-160, using 2-inch inner diameter (ID) Schedule 40 polyvinyl chloride (PVC) blank casing, flush-threaded to 10 feet of 2-inch ID Schedule 40, 0.010-inch slotted PVC well screen. The annulus of the well was filled with 2/12 silica sand pack from the total depth to a height of approximately one foot above the top of the screened interval, followed by a bentonite seal installed above the silica sand to within 6 inches of surface grade with a concrete surface seal, and completed at the surface with a flush-mount, traffic-rated monument set in a concrete pad. The casing was capped with a locking, compression-fit well cap. A copy of the boring log is provided in Appendix B. Due to the proximity of nearby wells and borings, soil samples were not collected for laboratory analysis from MW-17. Following installation, the monitoring well was developed by purging approximately 15 gallons of water, at which point the water was visually clear to the unaided eye.

Following completion and development of well MW-17, Pacific Crest collected a baseline groundwater sample for laboratory analysis. Groundwater sampling was performed using EPA low-flow (minimal drawdown) groundwater sampling procedures (EPA 1996). Prior to groundwater sample collection, the well was purged using a peristaltic pump and dedicated polyethylene tubing at a flow rate of approximately 300 milliliters per minute. During purging, groundwater geochemical parameters including temperature, specific conductivity, pH, DO, and oxidation/reduction potential (ORP) were measured and recorded approximately every three minutes using a YSI 556 multi-parameter water quality meter equipped with a flow-through cell. The groundwater sample was collected from upstream of the flow-through cell upon stabilization of the geochemical parameters.

The groundwater sample was transferred directly from dedicated tubing on the peristaltic pump into laboratory-prepared 40-milliliter sample vials preserved with hydrochloric acid. The vials were filled completely with water to eliminate potential loss of volatiles to headspace and were checked to ensure that no air bubbles were present in the sample. Following collection, the groundwater sample was labeled, placed in a cooler on ice, and transported to OnSite under standard chain-of-custody protocols. The sample was analyzed for CVOCs by SW-846 Method 8260B on a standard turnaround time. A copy of the laboratory analytical report is provided in Appendix C.

Following the injection of ORC® and the installation of well MW-17, performance groundwater monitoring and samples were collected from wells MW-15 and MW-17 to assess the effectiveness of the oxygen infusion to enhance aerobic oxidation of CVOCs in groundwater. On September 17 and 21, October 4, and November 27, 2012, Pacific Crest measured groundwater geochemical parameters including temperature, specific conductivity, pH, DO, and ORP using a YSI 556 multi-parameter water quality meter equipped with a flow-through cell. On October 4 and November 27, 2012, groundwater samples were collected from wells MW-15 and MW-17 for laboratory analysis. The groundwater samples were transferred directly from dedicated tubing on the peristaltic pump into laboratory-prepared 40-milliliter sample vials preserved with hydrochloric acid. The vials were filled completely with water to eliminate potential loss of volatiles to headspace and were checked to ensure that no air bubbles were present in the sample. Following collection, groundwater samples were labeled, placed into a cooler on ice and transported to OnSite for laboratory analysis of CVOCs by SW-846 Method 8260B under standard chain-of-custody protocol with a standard turn-around-time. Copies of the laboratory analytical reports are provided in Appendix C. The geochemical parameters and groundwater analytical data are presented in Table 7.

All investigation derived waste (soil and water) was sampled to determine the proper disposal method, and transported off-Site for treatment and/or disposal following waste profiling.

4.2.1.4 Soil Vapor Extraction and Air Sparging

In November and December of 2012, Pacific Crest conducted pilot test activities to assess the effectiveness of SVE and AS for remediation of soil and groundwater at the Site. During the pilot test activities, Pacific Crest monitored the vacuum response in the unsaturated vadose zone to an induced vacuum and measured the mass of recovered contaminants. The equipment used to conduct the pilot tests consisted of a Gast Model 2567 oil-less rotary vane compressor, a Gast Model EN656 regenerative blower, a 55-gallon moisture knock-out tank, magnehelic vacuum gauges, and appropriate manifolds and hoses. The scope of work for the pilot test activities consisted of: installing five wells (SVE-1, AS-1, VMW-1, VMW-2 and MW-16); conducting one SVE step test; one constant rate SVE pilot test; one AS/SVE pilot test; and evaluating the pilot test data.

On November 6, 2012, five soil borings (SVE-1, AS-1, VMW-1, VMW-2 and MW-16) were advanced by ESN under the direction of a Pacific Crest geologist using direct-push hydraulic sampling methods. The borings were advanced inside the Building on the former Sound Mattress Property. Wells SVE-1 and AS-1 were located near the suspected source area. The locations of wells VMW-1, VMW-2 and MW-16 were selected to facilitate the completion of SVE and AS pilot test activities. The borings for wells SVE-1, AS-1, VMW-1, VMW-2 and MW-16 were advanced to between 8 and 15 feet below the Building slab. Each well was constructed in accordance with the *Minimum Standards for Construction and Maintenance of Wells*, WAC 173-160, using 2-inch ID Schedule 40 PVC blank casing, flush-threaded to Schedule 40, 0.010-inch slotted 2-inch ID PVC well screen. The annulus of the well was filled with 2/12 silica sand pack from the total depth to a height of approximately one foot above the top of the screened interval, followed by a bentonite seal installed above the silica sand to 1 foot below the Building slab and completed at the surface with a flush-mount, traffic-rated monument set in a concrete pad. The casing was capped with a locking, compression-fit well cap. Due to the proximity of nearby wells and borings, soil samples were not collected for laboratory analysis. The well locations are illustrated on Figure 2.

On December 19 and 20, 2012, Pacific Crest conducted one SVE step test, one constant rate SVE pilot test, and one AS/SVE pilot test to collect the data necessary to assess the effectiveness of SVE and AS at the Site. The SVE step test was performed over a 3-hour period using a regenerative blower to apply incrementally increasing vacuums to well SVE-1 in order to induce air flow through the vadose zone. The constant rate SVE test was performed using the same regenerative blower to apply a constant vacuum to well SVE-1 in order to induce air flow through the vadose zone. The AS/SVE pilot test was performed using a rotary vane compressor to inject compressed air below the groundwater table in well AS-1 and a regenerative blower to extract air with from well SVE-1. The data collected during the SVE pilot tests included: air flow rates from the test well; CVOC concentrations of effluent vapors; and, vacuum/pressure conditions in MW-6, MW-11, VMW-1, VMW-2, and MW-16. Air effluent samples were collected during the constant rate SVE pilot test and AS/SVE pilot test in Tedlar® bags and analyzed at OnSite for CVOCs by SW-846 Method 8260B. The SVE data was collected in time intervals ranging from 5 to 15 minutes. The SVE data was then evaluated to assess the radius of influence (ROI) established from the applied vacuum; the air flow rate established at the applied vacuum; and the concentrations of CVOCs in the effluent air discharge. A copy of the laboratory analytical report is provided in Appendix C. The field data, mass recovery and ROI calculations are presented in Appendix D. Summaries of SVE pilot testing and air analytical data resulting from SVE testing are presented in Tables 8 and 9, respectively.

4.2.2 Results and Conclusions

The results of the field activities conducted in 2011 and 2012 are presented below:

- The soil types encountered in borings B-15 through B-24 consisted of gravel, silt, sand and silty sand. The materials encountered are consistent with results of previous investigations.
- Laboratory analysis of soil samples collected from borings B-15 through B-24 detected PCE at concentrations ranging from 0.029 mg/kg to 7.4 mg/kg; TCE at concentrations ranging from 0.0017 mg/kg to 0.0085 mg/kg; and c-DCE at concentrations ranging from 0.0014 mg/kg to 0.0023 mg/kg. Laboratory analysis did not detect VC in any of the soil samples. The analytical results for the soil samples are consistent with results of previous investigations. The analytical results are presented in Table 2.
- The laboratory analytical results for reconnaissance groundwater samples collected from boring B-23 detected PCE, TCE, c-DCE, t-DCE and VC. The concentrations of PCE and VC detected in the sample collected from between 8 feet below the Building slab and 12 feet below the Building slab exceed the draft FS Cleanup Levels. The concentrations of COCs detected in the sample collected from between 28 feet below the Building slab and 30 feet below the Building slab do not exceed the draft FS Cleanup Levels. The analytical results for groundwater samples are consistent with the results of previous investigations. The analytical results are presented in Table 4.
- The potentiometric surface calculated for the Site, based on the April 10, 2012 groundwater monitoring data, indicates a groundwater flow direction to the north-northwest. The groundwater elevation data are summarized in Table 1 and the groundwater elevation contours are illustrated on Figure 6.
- Laboratory analysis of groundwater samples collected from wells MW-1 through MW-15 in April of 2012 detected concentrations of the COCs that are consistent with previous investigation results. The laboratory analytical results for groundwater samples collected from wells MW-1 through MW-15 in April 2012 are presented in Table 3.
- The results of geochemical parameter monitoring in wells MW-15 and MW-17 following the ORC® injection event indicated a slight increase in DO compared to baseline measurements. Laboratory analysis of groundwater samples collected from monitoring wells MW-15 and MW-17 detected slight changes in concentrations of COCs (c-DCE and VC). The minimal changes indicate that ORC® was ineffective in enhancing aerobic bioremediation. The results of the EAB pilot test monitoring are presented in Table 7.
- The results of the SVE step test, and constant rate SVE pilot and AS/SVE pilot test for the Site conducted on December 19 and 20, 2012, are summarized below:
    - The SVE and AS/SVE pilot tests were conducted over a total of 7 hours. During the SVE step test, the initial vacuum applied to well SVE-1 was 10 inches of water

(in-H_2O) and the maximum vacuum applied to well SVE-1 was 60 in-H_2O. At 60 in-H_2O, groundwater was observed entering water knock-out drum. During the constant rate SVE pilot test, 30 in-H_2O was applied to well SVE-1 to prevent the accumulation of water in the knock-out drum. During the AS/SVE pilot test, 30 in-H_2O of vacuum was applied to well SVE-1 and 20 pounds per square inch (psi) was applied to well AS-1.

- o An effective ROI of 38 feet was calculated using data from the constant rate SVE pilot test. A copy of the calculation is provided in Appendix D.
- o Laboratory analysis of effluent vapor samples collected from well SVE-1 during the constant rate SVE pilot test and AS/SVE pilot test detected PCE at concentrations ranging from 230 µg/l (230,000 micrograms per cubic meter [$\mu g/m^3$]) to 81 µg/l (81,000 $\mu g/m^3$) and detected TCE at concentrations ranging from 3.1 µg/l to 1.6 µg/l. During the constant rate SVE and AS/SVE pilot tests, approximately 96 grams of PCE were extracted from the Site's subsurface. The mass recovery results are presented in Table 10 and illustrated on Figure 7.
- o The pilot test results indicate that SVE is effective in generating a large ROI and in recovering VOCs, but that application of AS reduces the ROI and does not increase VOC mass recovery.

4.3 CLEANUP TECHNOLOGY SELECTION

The criteria used for screening remedial technologies are as follows:

- Technology Development Status (bench, pilot, or full scale): the level of development for the technology. Technologies with full scale implementation and pilot test success were favored over less developed technologies. Technologies successfully implemented in a variety of environmental and geologic settings were favored over technologies with a more restricted application record.
- Performance Record: the record of successfully attaining the remediation objectives established for the technology in prior implementations. Technologies with a more successful performance record were favored over technologies with fewer successes or more failures.
- Constituents Addressed: the COCs the technology is capable of addressing. Only technologies which have been demonstrated capable of addressing the specific constituents in the specific media of interest (soil or groundwater) were retained for evaluation in the FS.
- The ability to implement within the constraints of the Site: the expected capability of successfully implementing the technology in the project area within a reasonable time frame. Technologies requiring minimal access and simpler permitting were favored over technologies requiring extensive permitting or access to numerous locations. Technologies that require significant infrastructure or would pose extensive administrative and logistical challenges and may ultimately be considered administratively not implementable were also not favored. Non-invasive technologies were favored over highly invasive technologies. Technologies that utilize existing infrastructure such as the Site monitoring well network are preferred.

The technology screening step is intended to produce a very short list of only the most applicable and promising technologies for further consideration. Technologies were either retained or rejected based upon their prior application history, ability to meet the remediation objectives, and an evaluation against the above screening criteria. The results of the technology screening are presented below and summarized in Table 11:

- Excavation is retained as a potentially feasible technology for remediation of shallow contaminated soil at the Site for the following reasons:
    - Contaminated soil at the Site is located inside the footprint of the Building beneath the area where PCE appears to have been used for metal part cleaning. The soil contamination extends from the bottom of the Building slab to the top of the water table (approximately 8 feet below the top of the Building slab). The contaminated soil is currently inaccessible; however, in order to redevelop the former Sound Mattress Property, the Port of Tacoma plans to demolish the Building. Removal of the Building and slab will allow access to the contaminated soil.
    - PCE and other CVOCs have been not been detected in soil at concentrations requiring handling as hazardous waste (greater than the MTCA Method B cleanup level for direct contact [476 mg/kg]). In order to manage soil with concentrations of CVOCs, Ecology would need to issue a "Contained-In" designation for soil with concentrations of CVOCs that do not exceed the applicable regulatory standard. Pursuant to approval of the "Contained-In" designation and the concentrations of CVOCs in the soil, CVOC contaminated soil would be transported to an authorized landfill for disposal under the "Contained-In" designation (LRI Landfill in Graham, Washington).

  Excavation is not applicable for remediation of groundwater, but excavation into the saturated zone of the Upper Sand in the area of suspected DNAPL may be feasible with limited dewatering.

- SVE and DPE are retained as potentially feasible technologies for remediation of shallow contaminated soil and groundwater at the Site for the following reasons:
    - Contaminated soil at the Site is shallow and located inside the footprint of the Building. The soil contamination extends from the bottom of the Building slab to the top of the water table (approximately 8 feet below the top of the Building slab).
    - The soil encountered in the shallow subsurface consists primarily of sand and silty sand which is conducive to the application of SVE and DPE. SVE is typically less effective in remediating low permeability silts. A potential drawback to implementation of SVE is the presence of a silt layer in the shallow Upper Fill.
    - Contaminated groundwater in the southeast portion of the Site is shallow and could be recovered by DPE.
    - The SVE pilot tests indicated that SVE creates a large ROI and is capable of recovering significant CVOC mass in soil vapor.

  SVE is not a feasible technology for remediation of contamination located in saturated material or below groundwater, and groundwater located in the northwest portion of the Site is too deep to be effectively addressed using DPE.

- Air sparging is not retained as a potentially feasible technology for remediation of contaminated groundwater at the Site for the following reasons:
  - While contaminated groundwater is present in sand and silty sand which is conducive to AS, the application of AS during the AS/SVE pilot test did not increase the recovered quantity of CVOCs in soil vapor. In addition, AS is not feasible to treat groundwater located in the Lower Sand because contaminants sparged from the deeper groundwater would be trapped by the Lower Silt and would not be recoverable using SVE.
- ERD and MNA are retained as potentially feasible technologies for remediation of contaminated groundwater at the Site, but EAB is not retained. The basis for retaining ERD, but not EAB, is presented below:
  - The investigation activities conducted to date indicate that the groundwater in the southeastern portion of the Site (near the source area) is anaerobic and the presence of degradation compounds of PCE indicates that reductive dechlorination is occurring. Groundwater throughout the Site is potentially conducive to the application of anaerobic bioremediation for the cleanup of CVOC contaminated groundwater.
  - The investigation activities conducted to date indicate that groundwater in the northwestern portion of the Site (near the Sitcum Waterway) are more aerobic. Groundwater in this area is potentially conducive to the application of aerobic oxidation for the cleanup of CVOC contaminated groundwater. However, pilot testing of EAB using ORC® did not result in reductions of CVOCs in groundwater. The lack of a measurable decrease in CVOCs and the minimal increase in DO is interpreted by Pacific Crest as indicating that aerobic bioremediation is unlikely to meet the remediation objectives for the Site.
- The effectiveness of ISCO is highly dependent on site conditions. The application of ISCO would eliminate the existing population of bacteria that are currently consuming CVOCs. The potential drawbacks of ISCO outweigh the possible advantages; therefore, ISCO is rejected as a potentially feasible technology for remediation of groundwater.
- Pump-and-treat is retained as a potentially feasible remediation technology for hydraulic control of groundwater at the Site, but it is unlikely to be effective in achieving cleanup levels in a reasonable timeframe.
- ERH is typically more costly to implement than other more conventional technologies. ERH is not retained as a potentially feasible remediation technology due to its high cost and the likely difficulties in recovering steam generated in the Lower Sand.

5. CLEANUP ACTION ALTERNATIVE SELECTION

The purpose of this FS is to develop and evaluate cleanup action alternatives to facilitate selection of a final cleanup action for the Site.

5.1 SITE BOUNDARIES

The Site is defined as the areal and vertical extent of the COCs in the media of concern at concentrations that exceed the applicable cleanup levels. In this FS, the cleanup levels used to define the Site are the draft FS Cleanup Levels for the media of concern. The Site extends from southeast to northwest: beginning on a portion of the adjacent former Shaub-Ellison property; extending across the former Sound Mattress property; underneath East 11th Street; beneath the parking lot for the Port of Tacoma Administrative Building; and, ultimately, terminating at the Sitcum Waterway. The Site is located within properties that are currently owned by the Port of Tacoma.

5.1.1 Soil

Soil with concentrations of CVOCs above the draft FS Cleanup Levels has been delineated and appears to be located only at locations beneath the footprint of the Building. The highest PCE concentration detected to date in soil was 16 mg/kg in a sample collected from boring B-10 from four feet bgs, which suggests that the primary source area is located in the vicinity of this boring. The latest analytical results and estimated areal extent of soil requiring remedial action is illustrated on Figure 8. The estimated vertical extent of soil requiring remedial action is illustrated in cross-section on Figure 3 and Figure 4.

5.1.1 Groundwater

The draft FS Cleanup Levels for the COCs in groundwater are identical to the Ecology approved RI Cleanup Levels. The extent of contamination in groundwater is delineated by samples collected to date. Groundwater with dissolved CVOC concentrations that exceed the draft FS Cleanup Levels extend from the alley southeast of the Building to the adjacent to the Sitcum Waterway north of the Port of Tacoma Administration Building. Contaminated groundwater in the southeast portion of the Site is characterized by elevated concentrations of PCE, TCE, c-DCE and VC in the Upper Sand above the Upper Silt. Contaminated groundwater in the northwestern portion of the Site is characterized by concentrations of PCE degradation products (c-DCE and VC) that have migrated downward in groundwater into the Lower Sand below the Upper Silt, and laterally to the northwest due to groundwater flow and tidal influence of the Sitcum Waterway. In the southeastern portion of the Site, soil and groundwater in the Lower Sand does not appear to be impacted; and in the northwestern portion of the Site, soil and groundwater in the Upper Sand does not appear to be impacted. The distribution of contaminants appears to be controlled by groundwater flow, as well as the discontinuity in the Upper Silt in the vicinity of East 11th Street.

For the purposes of evaluating remediation alternatives, the investigation area for the Site is divided into Zone A and Zone B to account for the varying subsurface characteristics of the two areas. Zone A includes areas of the Site located southeast of East 11^{th} Street; Zone B includes areas of the Site located between 11^{th} Street and the Sitcum Waterway. Zone A, Zone B and the lateral extent of CVOCs that exceed the draft FS Cleanup Levels and Remediation Levels are illustrated on Figure 9. The vertical extent of CVOCs that exceed the draft FS Cleanup Levels in groundwater is illustrated on Figures 3 and 4.

5.2 CLEANUP ACTION ALTERNATIVES

Cleanup action alternatives consist of combinations of remediation technologies that have the potential to achieve the remediation objectives. The technology screening process retained excavation, SVE, DPE, ERD, MNA and pump-and-treat as potentially feasible remediation technologies. Due to the variation in conditions across the Site, no single technology is likely to be capable of achieving the cleanup standards for soil and groundwater across the entire Site; therefore, a combination of technologies must be evaluated in the FS and implemented in areas where they are most likely to be effective. The cleanup action alternatives are presented in the following sections and summarized in Table 12.

5.2.1 Alternative No. 1 – MNA

The MNA alternative does not include active remediation but consists of monitoring the natural reductions of COCs in Zone A or Zone B. Decreasing COC concentrations as a result of reductive dechlorination is occurring and will likely continue to occur until contaminants are completely degraded. The MNA alternative can be implemented quickly; however, it would likely require a considerable amount of time (50 to 100 years) to reach cleanup standards without performing source remediation in Zone A.

5.2.2 Alternative No. 2 – Excavation, Pump-and-Treat, and MNA

Alternative No. 2 consists of demolition of the Building by the Port of Tacoma; excavation of soil in Zone A; implementation of pump-and-treat in Zone A and B; and MNA. The components of this alternative are described below:

- The Port of Tacoma would demolish the existing Building on the former Sound Mattress Property as part of property redevelopment.
- After demolition of the Building, soil remediation in Zone A would be conducted by excavation of approximately 19,000 cubic-yards (yd^3) of contaminated soil. All soil containing concentrations of contaminants exceeding the FS Cleanup Levels would be excavated and transported off-site to an approved treatment facility or local landfill (LRI Landfill). The excavated area would be backfilled with clean material suitable for building purposes.
- Hydraulic control and groundwater remediation would be implemented in Zone A and B using a pump-and-treat system consisting of a network of recovery wells connected to one or more centralized treatment systems. The purpose of the pump-and-treat system is hydraulic control of groundwater to prevent further migration. The pump-and-treat system would require the installation of treatment equipment and a connection to the sanitary or storm sewer system for disposal of treated water, and multiple groundwater recovery wells to ensure capture of the contaminant plume in groundwater. The recovery wells would be screened in the Upper Sand in Zone A and in the Lower Sand in Zone B. Iron fouling is anticipated to present a significant operation and maintenance issue. The pump-and-treat system would operate until either concentrations of PCE and VC are below their respective remediation levels in groundwater or system monitoring indicates that the system has recovered contaminants to the extent practicable. Due to the physical characteristics of the COCs, the pump-and-treat system is anticipated to

operate for 10 years or more.

- After the pump-and-treat component is turned off, remediation of residual concentrations of COCs in groundwater in Zone A and Zone B would be implemented by MNA. MNA would consist of performance monitoring to verify that conditions are conducive to reductive dechlorination and that naturally occurring bacteria are continuing to degrade the COCs.
- This alternative includes compliance groundwater monitoring consisting of performance monitoring during active remediation and confirmation groundwater monitoring to verify effectiveness of the remedial alternative.
- On the basis of experience at similar sites, the estimated remediation timeframe for this alternative is between 10 and 15 years.
- The estimated costs for implementation are between $3,000,000 and $4,000,000.
- Excavation and pump-and-treat have the advantage of being mature technologies that can be implemented quickly, with likely approval by Ecology.

5.2.3 Alternative No. 3 – DPE, Pump-and-Treat, and MNA

Alternative No. 3 consists of using DPE to address affected soil and groundwater in Zone A, pump-and-treat to hydraulically control groundwater in Zone B, and implementation of MNA. Demolition of the existing Building on the Former Sound Mattress Property is not assumed in this cleanup alternative. The components of this alternative are described below:

- Soil and groundwater remediation would be implemented in Zone A using a DPE system consisting of a network of recovery wells that are connected to a centralized recovery and treatment system to facilitate contaminant extraction. The DPE recovery wells would be screened in the Upper Fill and Upper Sand to remediate shallow contaminated soil and groundwater. The spacing of the recovery wells would be based on the ROI calculated during the SVE pilot test. DNAPL and low permeability silts in the Upper Fill may result in extended operation of the DPE system. The DPE system would operate until either concentrations of PCE and VC are below their respective remediation levels in groundwater or system monitoring indicates that the system has recovered contaminants to the extent practicable.
- Hydraulic control and groundwater remediation would be implemented in Zone B using a pump-and-treat system consisting of a network of recovery wells connected to a centralized treatment system. The purpose of the pump-and-treat system is hydraulic control of groundwater until concentrations of VC in Zone B groundwater decreases below its remediation level. The pump-and-treat system would require the installation of treatment equipment and a connection to the sanitary or storm sewer system for disposal of treated water, and multiple groundwater recovery wells to ensure containment of the contaminant plume in groundwater. The recovery wells would be screened in the Lower Sand in Zone B. Iron fouling is anticipated to present a significant operation and maintenance issue. Due to the physical characteristics of the COCs, the pump-and-treat system is anticipated to operate for 5 years or more. The pump-and-treat system would operate until concentrations of PCE and VC are below their respective remediation levels in groundwater.

- After the DPE and pump-and-treat components are turned off, remediation of residual concentrations of COCs in groundwater in Zone A and Zone B would be implemented by MNA. MNA would consist of performance monitoring to verify that conditions are conducive to reductive dechlorination and that naturally occurring bacteria are continuing to degrade the COCs.
- This alternative includes compliance groundwater monitoring consisting of performance monitoring during active remediation and confirmation groundwater monitoring to verify effectiveness of the remedial alternative.
- On the basis of experience at similar sites, the estimated remediation timeframe for this alternative is between 10 and 15 years. The extended timeframe for remediation is due to the slow desorption rate of CVOCs from soil.
- The estimated costs for implementation are between $1,000,000 and $1,500,000.
- DPE and pump-and-treat are mature technologies that can be implemented quickly, with likely approval by Ecology.

5.2.4 Alternative No. 4 – SVE, ERD, Pump-and-Treat and MNA

Alternative No. 4 consists of implementation of a SVE to remediate soil, anaerobic bioremediation to address COCs in groundwater, and pump-and-treat for hydraulic control in Zone B. Demolition of the existing Building on the Former Sound Mattress Property is not assumed in this cleanup alternative. The components of this alternative are described below:

- Soil remediation would be implemented in Zone A using a SVE system consisting of a network of vertical recovery wells that are connected to a centralized recovery and treatment system to facilitate contaminant extraction. The SVE recovery wells would be screened in the Upper Fill and Upper Sand to remediate shallow contaminated soil. The spacing of the recovery wells would be based on the ROI calculated during the SVE pilot test. The SVE system would operate until concentrations of the COCs in soil are below their respective cleanup levels.
- The groundwater monitoring data indicate that reductive dechlorination is occurring in groundwater and that ERD is an appropriate technology for implementation at the Site. Numerous organic substrates are available which can be naturally degraded and fermented in the subsurface to result in the generation of hydrogen to enhance reductive dechlorination. The commercially available substrates that can be added to the subsurface to enhance anaerobic bioremediation include sodium lactate, molasses, Hydrogen Release Compound (HRC™), and emulsified oil substrate (EOS). Implementation of ERD would be conducted in Zone A and Zone B by injecting a solution of water and a substrate compound into groundwater through vertical borings or wells and monitoring the resulting decreases in COCs. Periodic injection events to add substrate may be required to ensure continued effectiveness and rapid degradation of the COCs.
- Hydraulic control and groundwater remediation would be implemented in Zone B using a pump-and-treat system consisting of a network of recovery wells connected to a centralized treatment system. The purpose of the pump-and-treat system is hydraulic control of groundwater until concentrations of the VC in Zone B groundwater decreases below its remediation level. The pump-and-treat system would require the installation of treatment equipment and a connection to the sanitary or storm sewer system for disposal

of treated water, and multiple groundwater recovery wells to ensure containment of the contaminant plume in groundwater. The recovery wells would be screened in the Lower Sand in Zone B. Iron fouling is anticipated to present a significant operation and maintenance issue. Due to the physical characteristics of the COCs, the pump-and-treat system is anticipated to operate for 5 years or more. The pump-and-treat system would operate until concentrations of PCE and VC are below their respective remediation levels in groundwater.

- After the SVE and pump-and-treat components are turned off, remediation of residual concentrations of COCs in groundwater in Zone A and Zone B would be implemented by MNA. MNA would consist of performance monitoring to verify that conditions are conducive to reductive dechlorination and that naturally occurring bacteria are continuing to degrade the COCs.
- This alternative includes compliance groundwater monitoring consisting of performance monitoring during active remediation and confirmation groundwater monitoring to verify effectiveness of the remedial alternative.
- On the basis of experience at similar sites, the estimated remediation timeframe for this alternative is between 8 and 12 years.
- The estimated costs for implementation of this alternative are between $1,000,000 and $1,500,000.
- SVE and ERD are mature technologies that can be implemented quickly, with likely approval by Ecology.

5.2.5 Alternative No. 5 – Excavation, SVE, ERD, and MNA

Alternative No. 5 consists of the demolition of the existing Building on the former Sound Mattress Property by the Port of Tacoma; targeted excavation of contaminated soil; implementation of a SVE for residual soil remediation; and ERD for groundwater remediation. The components of this alternative are described below:

- The Port of Tacoma would demolish the existing Building on the former Sound Mattress Property as part of property redevelopment.
- After demolition of the Building, targeted soil remediation in Zone A would be conducted by excavation of approximately 9,000 yd^3 of contaminated soil from the source area located near well SVE-1 and MW-11. Excavated soil would be transported off-site to an authorized treatment facility or landfill. The excavation would be extended below groundwater but above the top of the Upper Silt in order to excavate areas where DNAPL may be present.
- Upon completion of excavation activities, but before backfilling, a commercially available substrate would be added to the subsurface to enhance anaerobic bioremediation of the COCs in groundwater. Implementation of ERD would be conducted by adding solution of water and a substrate to the excavation and allowing the solution to infiltrate into the subsurface. Addition of substrate to the excavation has the advantage of targeting the areas with the highest concentrations of COCs without the need to advance multiple soil borings.
- Remediation of residual contaminated soil not excavated would be implemented in Zone A using a SVE system consisting of a network of horizontal recovery wells that would be

connected to a centralized recovery and treatment system to facilitate contaminant extraction. After the addition of ERD substrate to the excavation, the excavated area would be backfilled with soil previously located under other portions of the Building. Prior to filling the excavated area, a series of horizontal SVE wells will be installed within the final limits of excavation, and covered by the soil remaining from the Building's elevated foundation containing residual concentrations of COCs. SVE will induce airflow in the subsurface through the vadose zone, extracting vapors from the recovery wells and dispersing them into the atmosphere. Due to the shallow groundwater, the use of horizontal recovery wells will minimize the potential for inadvertent water collection in the SVE system.

- Periodic supplementary injection events to add substrate in Zone A may be required to ensure continued effectiveness and rapid degradation of the COCs by ERD. Additionally, injection of substrate into the Lower Sand in Zone B would be conducted through the advancement of a series of borings across the width of the plume.
- This alternative includes compliance groundwater monitoring consisting of performance monitoring during active remediation and confirmation groundwater monitoring to verify effectiveness of the remedial alternative.
- On the basis of experience at similar sites, the estimated remediation timeframe for this alternative is between 3 and 5 years.
- The estimated costs for implementation are between $950,000 and $1,000,000.
- Excavation is a mature technology that can be implemented quickly. SVE and ERD are proven technologies with likely approval by Ecology.

5.3 SELECTION CRITERIA

The evaluation criteria used to select the cleanup action approach consists of the MTCA requirements (WAC 173-340-360). The evaluation criteria for this FS include the following:

Threshold Requirements:

- Protect human health and the environment;
- Comply with cleanup standards;
- Comply with applicable state and federal laws; and
- Provide for compliance monitoring of groundwater at the Site.

Other Requirements:

- Use permanent solutions to the maximum extent practicable;
- Provide for a reasonable restoration time frame; and
- Consider public concerns.

The evaluation criteria for this FS also include the following:

- Protectiveness and risk reduction;
- Permanence;

- Cost;
- Long-term effectiveness;
- Management of short-term risks;
- Technical and administrative implementability;
- Public concern; and
- Reasonable restoration time frame.

Each of the remedial alternatives presented in Section 5.1 was evaluated using the criteria presented above. The results of this evaluation indicate Alternative No. 3, Alternative No. 4 and Alternative No. 5 best address the regulatory requirements and, therefore, were retained for further evaluation of costs and practicability. A remediation alternative screening matrix developed in accordance with MTCA is provided as Table 13.

5.4 CLEANUP ACTION ALTERNATIVE SELECTED FOR THE SITE

The retained alternatives (Alternative No. 3, Alternative No. 4 and Alternative No. 5) were screened in accordance with the Ranked Pair Method (Jones 1998). Pair Ranking is conducted by selecting one preferred or superior alternative over another for each ranking criteria and assigning a rank (lower number indicates a higher rank) to each alternative and each criteria. The Ranked Pair results were further evaluated using a weighted ranking scheme that emphasized protectiveness (30%), permanence (20%) and long term effectiveness (20%) over management of short term risks (10%), implementability (10%) and public concern (10%) in order to select the preferred cleanup alternative. Under this selection methodology, the remedial alternative that achieves the highest ranking (i.e. lowest rank number) is selected as the preferred Cleanup Action Alternative for the Site. The ranking results indicate that the preferred Cleanup Action Alternative is Alternative No. 5 – Excavation, ERD, SVE and MNA. The weighted rank pair results for each alternative are summarized in Table 14.

The FS presented herein is intended to provide sufficient information to enable Ecology and Mr. Shea to reach concurrence on the selection of a final cleanup action alternative under the VCP and for Ecology to provide an opinion letter stating that this FS meets the substantive requirements of MTCA. After receipt of this letter from Ecology, design specifications and details regarding implementing the selected cleanup action alternative will be provided to Ecology via the Cleanup Action Plan for Site.

6. REFERENCES

CLARC. 2012. https://fortress.wa.gov/ecy/clarc/FocusSheets/updatesTable.htm. List of CLARC Toxicity Values Updated from EPA (December 2010) and Changes to CLARC Cleanup Levels (2011-04-13).

Environmental Associates, Inc. 2004a. *Preliminary Subsurface Exploration, RevChem Plastics, Inc., 1132 Thorne Road, Tacoma, Washington*. June 10

______, 2004b. *Groundwater Plume Delineation, Revchem Plastics Facility, 1132 Thorne Road, Tacoma, Washington.* July 23

______, 2005. *Offsite Groundwater Plume Delineation, Former Automotive Tire Service Facility, 1132 Thorne Road, Tacoma, Washington.* February 11

Environmental Management Services, LLC. 2005. *Groundwater Sampling Report.* July 20

Federal Remediation Technologies Roundtable Treatment Technologies Screening Matrix - http://www.frtr.gov/matrix2/section3/table3_2.pdf

Galster, R.W. and W.T. Laprade. 1991. *Geology of Seattle, Washington, United States of America.* Bulletin of the Association of Engineering Geologists Vol. XXVIII, No. 3: 235-302.

Jones, Morgan D. 1998. *The Thinker's Toolkit – 14 Powerful Techniques for Problem Solving.* Three Rivers Press

LSI Adapt. 2005. *Supplemental Characterization, Groundwater Monitoring Well Installation and July 2005 Groundwater Quality Monitoring Report, Former Automotive Tire Service Facility, 1132 Thorne Road, Tacoma, WA 98421*. November 10

Pacific Crest Environmental, LLC. 2006a. *Focused Site Investigation Report, Shaub-Ellison Company, 1132 Thorne Road, Tacoma, Washington, Pacific Crest No. 105-001. June 13*

______, 2009. *Remedial Investigation Report, Former Sound Mattress and Felt Property, 1940 East 11th Street, Tacoma, Washington*. December 9

______, 2010. *Data Gap Investigation Report, Former Sound Mattress and Felt Property, 1940 East 11th Street, Tacoma, Washington*. December 9

Washington State Department of Ecology. 2010. *Opinion Letter*. November 8

U.S. Environmental Protection Agency. 1992. Estimating Potential for Occurrence of DNAPL at Superfund Sites. Office of Solid Waste and Emergency Response: Publication 9355.4-07FS. January

______, 1993. Guidance for Evaluating the Technical Impracticability of Groundwater Restoration, EPA/540-R-93-060

_______, 1996. Low Flow (Minimal Drawdown) Ground-water Sampling Procedure, EPA/540/S-95/504, 12 pp.

_______, 2009. *National Recommended Water Quality Criteria.* Office of Water and Office of Science and Technology (4304T).

7. LIMITATIONS

The conclusions and recommendations contained in this report are based on professional opinions with regard to the subject matter. These opinions have been arrived at in accordance with currently accepted hydrogeologic and engineering standards and practices applicable to this location and are subject to the following inherent limitations:

- **Accuracy of Information**. Certain information used by Pacific Crest in this report has been obtained, reviewed, and evaluated from various sources believed to be reliable. Although the conclusions, opinions, and recommendations are based in part on such information, Pacific Crest's services did not include the verification of its accuracy or authenticity. Should such information prove to be inaccurate or unreliable, Pacific Crest reserves the right to amend or revise its conclusions, opinions, and/or recommendations.

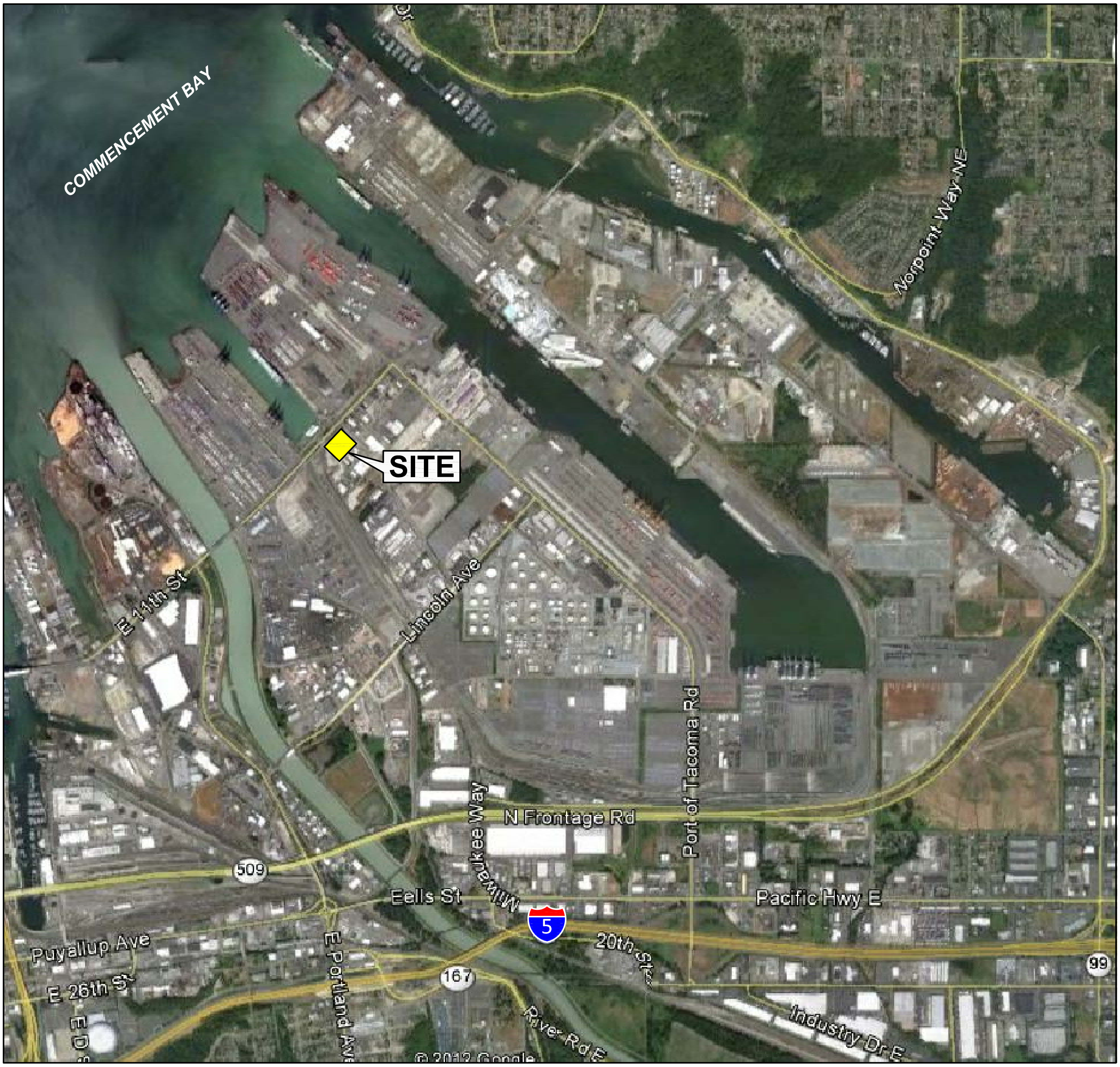
DRAFT

FIGURES

FEASIBILITY STUDY REPORT

Former Sound Mattress and Felt Property
1940 East 11th Street
Tacoma, Washington

Pacific Crest PN: 110-001



N

0 1/2
Approximate Scale in Miles

DRAFT

2/11/2013 8:34 AM Drafting \\PACIFIC-8E185AF\public\Project Files\110 Sound Mattress & Felt Co\Figures\110-001-003.dwg FIG 1

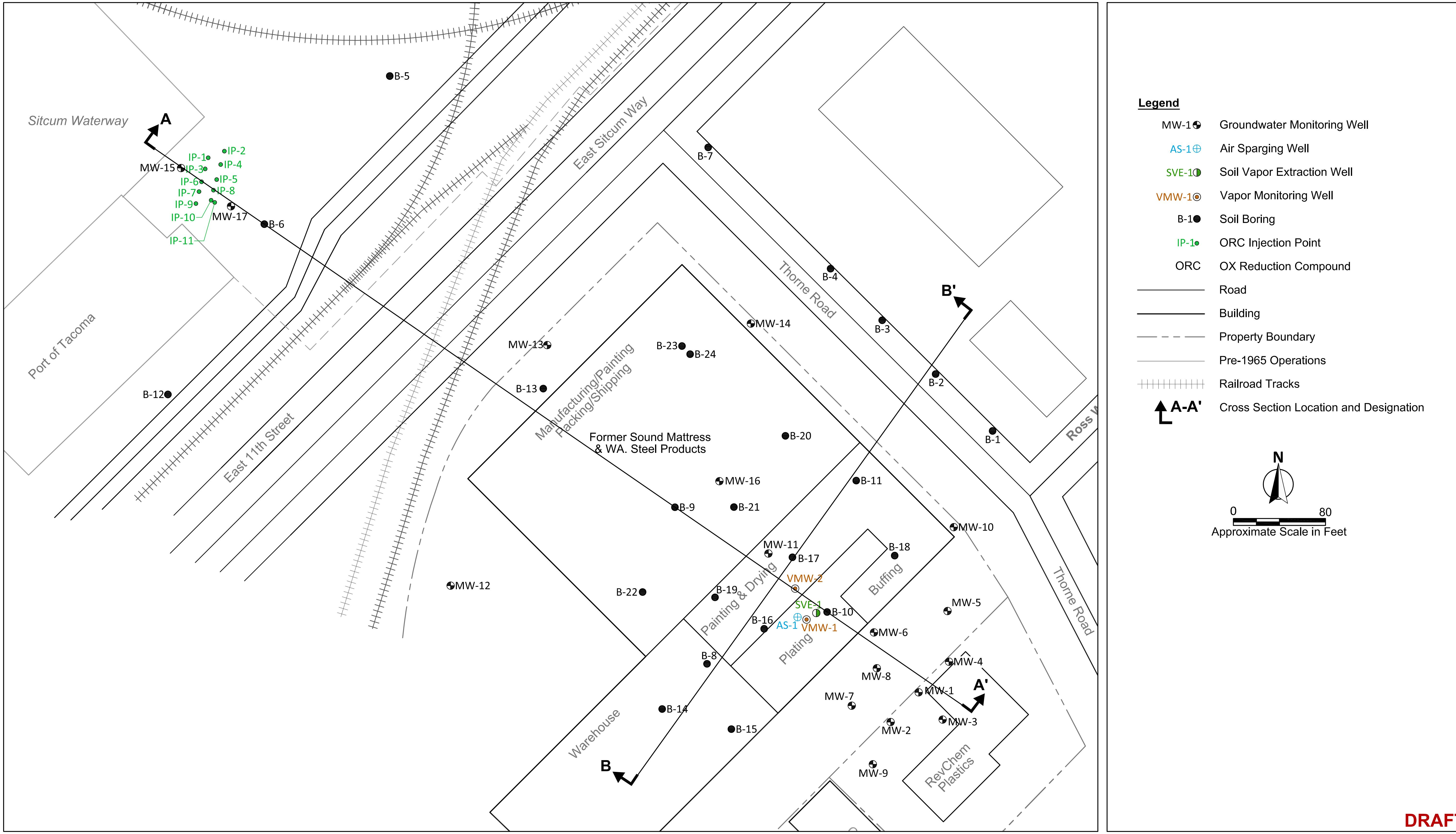
PACIFIC CREST ENVIRONMENTAL
WWW.PCENV.COM 425-888-4990

Former Sound Mattress & Felt Company
1940 East 11th Street
Tacoma, Washington

PN: 110-001

Figure 1

Site Location Map



4/9/2013 12:45 PM Drafting \\PACIFIC-8E185AF\public\Project Files\110 Sound Mattress & Felt Co\Figures\110-001-007.dwg FIG 2

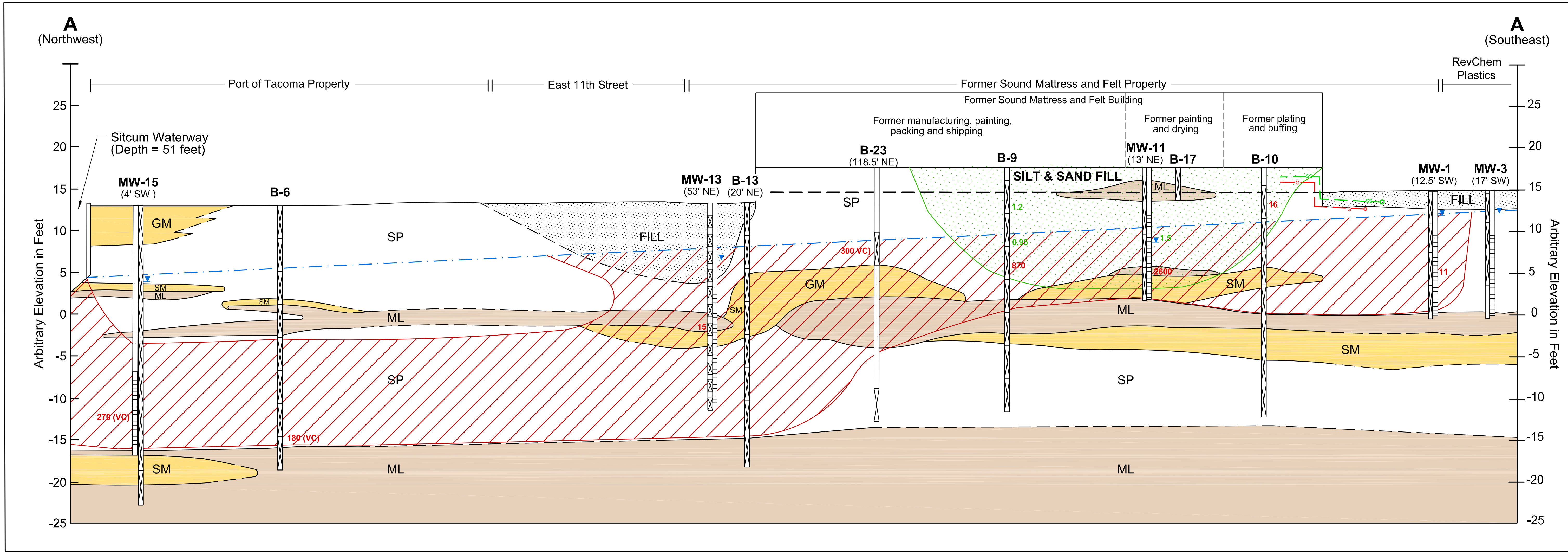
PACIFIC CREST ENVIRONMENTAL
WWW.PCENV.COM 425-888-4990

Former Sound Mattress & Felt Company
1940 East 11th Street
Tacoma, Washington

PN: 110-001

Figure 2

Site Plan with Cross Section Locations



Legend

- Fill
- SP, GP-SP = Sand, Gravel and Sand
- SM, GM, SM-GM = Sand Gravel or Sand and Gravel containing Silt
- ML = Silt
- Contact Between Sediment Types (Dashed Where Inferred)
- Estimated Groundwater Table (tidally influenced)
- Sanitary Sewer
- Gas Line

MW-13 (X' X) Boring ID Offset Distance & Direction

Soil Sample Interval

- Well Location
- Screened Interval
- Potentiometric Elevation in Well
- Bottom of Boring

- 16 Concentration of PCE in Groundwater Exceeds Cleanup Level of 3.3 µg/l
- 300 (VC) Concentration of VC in Groundwater in Exceeds Cleanup Level of 2.4 µg/l
- 1.2 Concentration of PCE in Soil Exceeds Cleanup Level of 0.142 mg/kg
- Estimated Extent of Groundwater with Concentrations of Site COCs Greater Than the Cleanup Level
- Estimated Extent of Soil with Concentrations of Site COCs Greater Than the Cleanup Level

Approximate Horizontal Scale in Feet
0 60
0 12
Approximate Vertical Scale in Feet
Vertical Exaggeration x 5

Notes:

Concentrations of VC and PCE are displayed if they exceed their respective Cleanup Levels.

PCE = tetrachloroethene

VC = vinyl chloride

µg/l = micrograms per liter

mg/kg = milligrams per kilogram

DRAFT

PACIFIC CREST ENVIRONMENTAL
WWW.PCENV.COM 425-888-4990

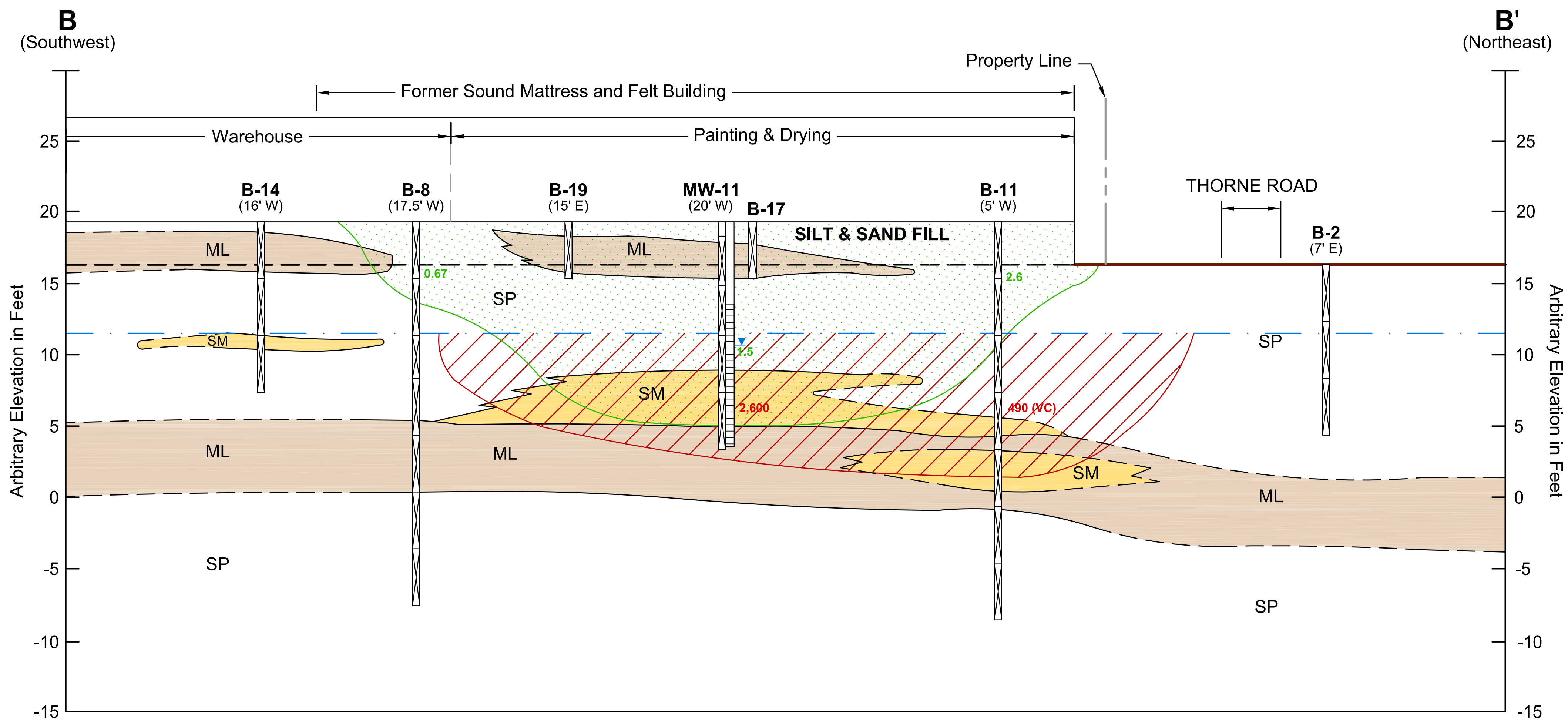
Former Sound Mattress & Felt Company
1940 East 11th Street
Tacoma, Washington

PN: 110-001

Figure 3

Cross Section A-A'

3/26/2013 Drafting \\PACIFIC-8E185AF\public\Project Files\110 Sound Mattress & Felt Co\Figures\110-001-010.dwg FIG 3



Legend

- Fill
- SP, GP-SP = Sand, Gravel and Sand
- SM, GM, SM-GM = Sand Gravel or Sand and Gravel containing Silt
- ML = Silt
- Contact Between Sediment Types (Dashed Where Inferred)
- Approximate Groundwater Table (tidally influenced)

MW-11 **(29' W)** Boring ID, Offset Distance & Direction

Soil Sample Interval

- Well Location
- Screened Interval
- Potentiometric Elevation in Well
- Bottom of Boring

16 Concentration of PCE in Groundwater Exceeds Cleanup Level of 3.3 µg/l

300 (VC) Concentration of VC in Groundwater in Exceeds Cleanup Level of 2.4 µg/l

1.2 Concentration of PCE in Soil Exceeds Cleanup Level of 0.142 mg/kg

Estimated Extent of Groundwater with Concentrations of Site COCs Greater Than the Cleanup Level

Estimated Extent of Soil with Concentrations of Site COCs Greater Than the Cleanup Level

Approximate Horizontal Scale in Feet
0 50
0 10
Approximate Vertical Scale in Feet
Vertical Exaggeration x 5

Notes:

Concentrations of VC and PCE are displayed if they exceed their respective Cleanup Levels.

PCE = tetrachloroethene

VC = vinyl chloride

µg/l = micrograms per liter

mg/kg = milligrams per kilogram

DRAFT

PACIFIC CREST ENVIRONMENTAL
WWW.PCENV.COM 425-888-4990

Former Sound Mattress & Felt Company
1940 East 11th Street
Tacoma, Washington

PN: 110-001

Figure 4

Cross Section B-B'

4/9/2013 12:50 PM Drafting \\PACIFIC-8E185AF\public\Project Files\110 Sound Mattress & Felt Co\Figures\110-001-009.dwg FIG 4

Primary Sources	Contaminant of Concern	Media of Concern	Transport Mechanism
Facility Operations PCE containing metal cleaning solvent	Chlorinated Volatile Organic Compounds (CVOCs) ☑ Adsorbed onto soil ☑ Dissolved in water ☑ Non-aqueous phase	☑ Surface Soil (0-2 ft bgs)	☑ Direct release to soil ☑ Migration to subsurface ☑ Migration to groundwater ☑ Volatilization ☐ Runoff or erosion ☐ Uptake by plant or animal ☐ Other (list) ___________
		☑ Soil (>2 ft bgs)	☑ Direct release to soil ☑ Migration to subsurface ☑ Volatilization ☐ Other (list) ___________
		☑ Groundwater	☑ Release to groundwater ☑ Volatilization ☑ Future Migration to surface water ☑ Future Migration to sediment ☐ Uptake by plant of animal ☐ Other (list) ___________
		☐ Surface Water	☐ Release to surface water ☐ Volatilization ☐ Sedimentation ☑ Uptake by plant of animal ☐ Other (list) ___________
		☐ Sediment	☐ Release to sediment ☐ Resuspension or erosion ☑ Uptake by plant of animal ☐ Other (list) ___________

Exposure Media	Exposure Pathway	Current (C) and Future (F) Human Receptors: Commercial/ Industrial	Construction Worker	Residential/ Recreant
☑ Soil →	☑ Ingestion	F	F	
	☑ Dermal Exposure	F	F	
☑ Groundwater →	☐ Ingestion			
	☑ Dermal Exposure	F	F	
☑ Air →	☑ Inhalation	C/F	F	
Potential Future Exposure Scenario				
☑ Surface Water →	☐ Ingestion			
	☑ Dermal Exposure	F	F	F
☑ Sediment →	☐ Ingestion			
	☑ Dermal Exposure	F	F	F
☑ Biota →	☑ Ingestion		F	F

DRAFT

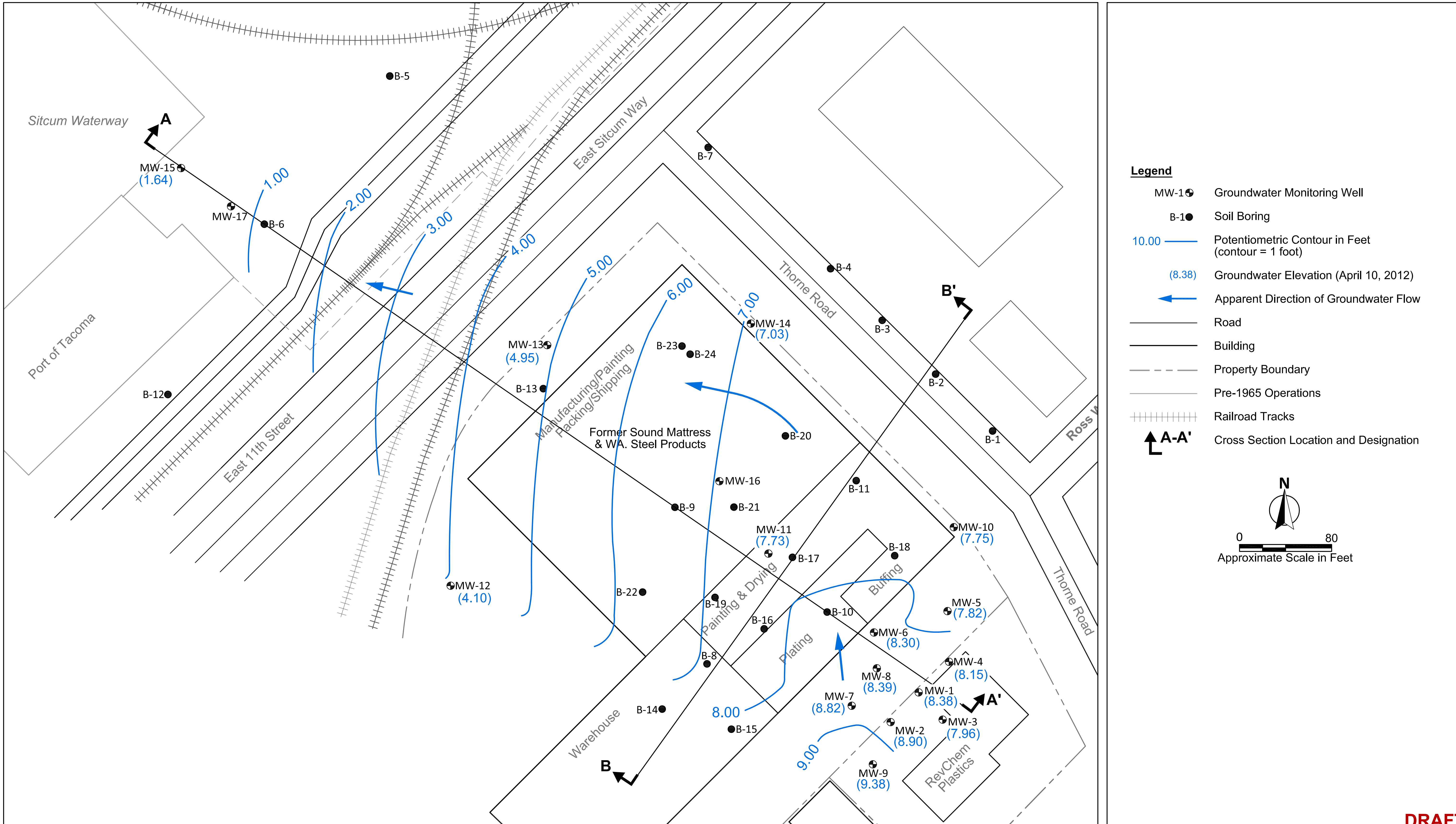
Pacific Crest Environmental
www.pcenv.com 425-888-4990

Former Sound Mattress & Felt Company
1940 East 11th Street
Tacoma, Washington

PN: 110-001

Figure 5

Conceptual Site Model



Pacific Crest Environmental
www.pcenv.com 425-888-4990

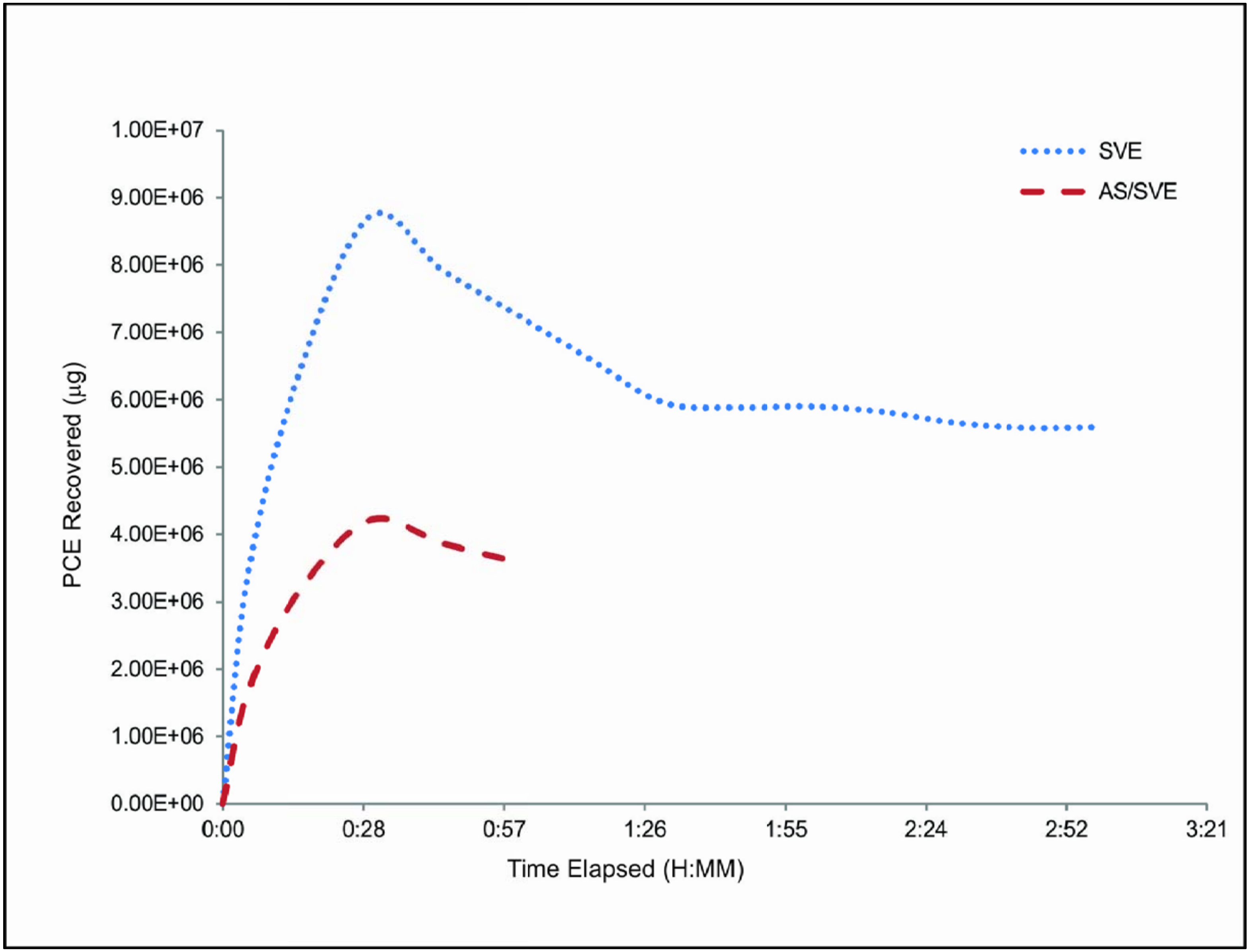
Former Sound Mattress & Felt Company
1940 East 11th Street
Tacoma, Washington

PN: 110-001

Figure 6

Site Plan with Potentiometric Surface Contours for April 10, 2012

4/9/2013 12:56 PM Drafting \\PACIFIC-8E185AF\public\Project Files\110 Sound Mattress & Felt Co\Figures\110-001-013.dwg FIG 6



DRAFT

PACIFIC CREST ENVIRONMENTAL
WWW.PCENV.COM 425-888-4990

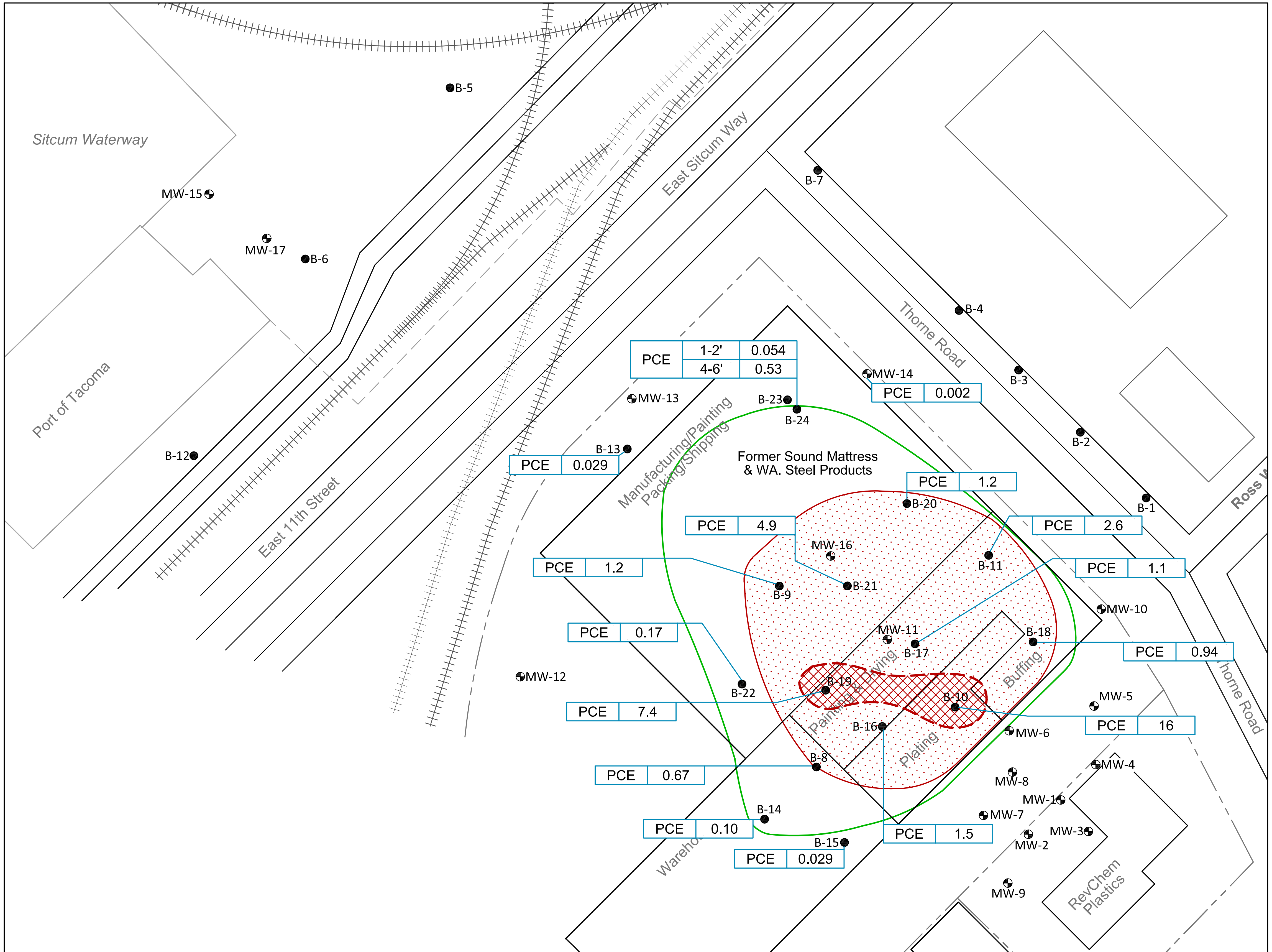
Former Sound Mattress & Felt Company
1940 East 11th Street
Tacoma, Washington

PN: 110-001

Figure 7

PCE Mass Removal

4/8/2013 Drafting \\PACIFIC-8E185AF\public\Project Files\110 Sound Mattress & Felt Co\Figures\110-001-014.dwg FIG 7



Legend

MW-1	Groundwater Monitoring Well
B-1	Soil Boring
	Estimated Extent of Soil with PCE Concentrations Exceeding 0.67 mg/kg
	Estimated Extent of Soil with PCE Concentrations Exceeding 6 mg/kg
	Estimated Extent of Soil with PCE Concentrations Exceeding FS Cleanup Level
PCE 2.6	Concentration of tetrachloroethene (PCE) in milligrams per kilogram (mg/kg). Samples collected from 1-4 feet beneath building floor slab.
	Road
	Building
	Property Boundary
	Pre-1965 Operations
	Railroad Tracks

N

0 80
Approximate Scale in Feet

DRAFT

4/9/2013 1:48 PM Drafting \\PACIFIC-8E185AF\public\Project Files\110 Sound Mattress & Felt Co\Figures\110-001-015.dwg FIG 8 PCE

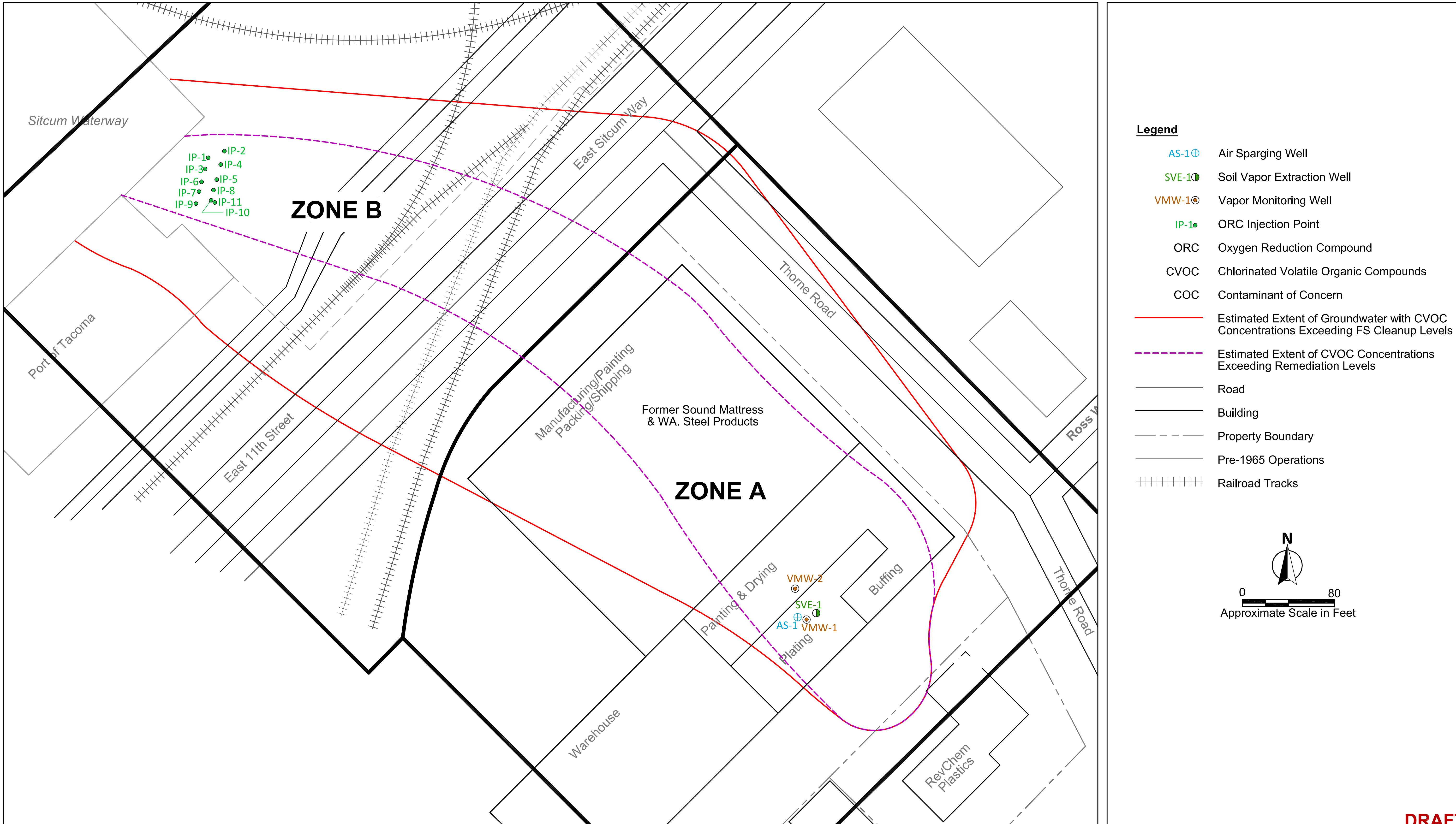
PACIFIC CREST ENVIRONMENTAL
WWW.PCENV.COM 425-888-4990

Former Sound Mattress & Felt Company
1940 East 11th Street
Tacoma, Washington

PN: 110-001

Figure 8

Site Plan with Soil Analytical Results and Extent of PCE



PACIFIC CREST ENVIRONMENTAL
WWW.PCENV.COM 425-888-4990

Former Sound Mattress & Felt Company
1940 East 11th Street
Tacoma, Washington

PN: 110-001

Figure 9

Feasibility Study Site Plan with Extent of COCs in Groundwater

DRAFT

TABLES

FEASIBILITY STUDY REPORT

Former Sound Mattress and Felt Property
1940 East 11th Street
Tacoma, Washington

Pacific Crest PN: 110-001

Table 1
Groundwater Elevation Data Summary
Sound Mattress and Felt Company
1940 E. 11th Street
Tacoma, Washington
Pacific Crest No: 110-001

Well Identification	Date Gauged	Collected By	Top of Casing Elevation (feet)[1]	Total Well Depth (feet)[2]	Depth to Groundwater (feet)[2]	Potentiometric Surface (feet)
MW-1	7/12/2004	EAI	15.00	14.6	7.76	7.24
	1/27/2005	EAI	15.00		7.43	7.57
	7/7/2005	LSI	15.00		7.54	7.46
	9/27/2005	LSI	14.94[3]		8.13	6.81
	2/6/2007	Pacific Crest	14.94		6.44	8.50
	11/20/2008	Pacific Crest	14.94		7.71	7.23
	3/10/2009	Pacific Crest	14.94		7.09	7.85
	6/17/2010	Pacific Crest	14.94		6.46	8.48
	4/10/2012	Pacific Crest	14.94		6.56	8.38
MW-2	7/12/2004	EAI	13.88	14.68	6.48	7.40
	1/27/2005	EAI	13.88		6.11	7.77
	7/7/2005	LSI	13.88		6.22	7.66
	9/27/2005	LSI	13.88		6.96	6.92
	2/6/2007	Pacific Crest	13.88		5.15	8.73
	11/20/2008	Pacific Crest	13.88		6.45	7.43
	3/10/2009	Pacific Crest	13.88		5.82	8.06
	6/17/2010	Pacific Crest	13.88		5.20	8.68
	4/10/2012	Pacific Crest	13.88		4.98	8.90
MW-3	7/12/2004	EAI	14.93	14.92	7.46	7.47
	1/27/2005	EAI	14.93		7.11	7.82
	7/7/2005	LSI	14.93		7.22	7.71
	9/27/2005	LSI	14.93		7.95	6.98
	2/6/2007	Pacific Crest	14.93		6.17	8.76
	11/20/2008	Pacific Crest	14.93		7.45	7.48
	3/10/2009	Pacific Crest	14.93		6.80	8.13
	6/17/2010	Pacific Crest	14.93		6.17	8.76
	4/10/2012	Pacific Crest	14.93		6.97	7.96
MW-4	7/12/2004	EAI	15.10	14.85	7.99	7.11
	1/27/2005	EAI	15.10		7.68	7.42
	7/7/2005	LSI	15.10		7.80	7.30
	9/27/2005	LSI	15.10		8.40	6.70
	2/6/2007	Pacific Crest	15.10		6.81	8.29
	11/20/2008	Pacific Crest	15.10		8.02	7.08
	3/10/2009	Pacific Crest	15.10		7.43	7.67
	6/17/2010	Pacific Crest	15.10		6.83	8.27
	4/10/2012	Pacific Crest	15.10		6.95	8.15

Table 2
Laboratory Analytical Results - Soil
Sound Mattress and Felt Company
1940 E. 11th Street
Tacoma, Washington
Pacific Crest No: 110-001

Location ID	Sample ID	Sampled By	Sample Date	Sample Depth[2]	Soil Analytical Results (milligrams per kilogram)[1]				
					Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Vinyl Chloride
B26	B26-1'-2'	EAI	5/14/2004	1-2	<0.05	<0.03	<0.05	<0.05	<0.5
B26	B26-5'-6'	EAI	5/14/2004	5-6	<0.05	<0.03	<0.05	<0.05	<0.5
SC-1	SC1-14.5	LSI	8/23/2005	14-14.5	<0.0012	<0.0012	<0.0012	<0.0012	<0.0012
SC-2	SC2-14.5	LSI	8/23/2005	14-14.5	<0.0012	<0.0012	<0.0012	<0.0012	<0.0012
SC-3	SC3-14.5	LSI	8/23/2005	14-14.5	<0.0012	<0.0012	<0.0012	<0.0012	<0.0012
SC-4	SC4-14.5	LSI	8/23/2005	14-14.5	<0.0012	<0.0012	<0.0012	<0.0012	<0.0012
MW-9	MW9/14.5	LSI	9/21/2005	14-14.5	<0.0012	<0.0012	<0.0012	<0.0012	<0.0012
MW-10	MW10-5-6.5	Pacific Crest	10/20/2006	5-6.5	0.024	0.0015	0.0035	<0.0012	<0.0012
B-1	B1-6-8	Pacific Crest	11/29/2007	6-8	<0.0012	<0.0012	<0.0012	<0.0012	<0.0012
B-2	B2-6-8	Pacific Crest	11/29/2007	6-8	<0.0011	<0.0011	<0.0011	<0.0011	<0.0011
B-3	B3-6-8	Pacific Crest	11/29/2007	6-8	<0.0012	<0.0012	<0.0012	<0.0012	<0.0012
B-4	B4-6-8	Pacific Crest	11/29/2007	6-8	<0.0011	<0.0011	<0.0011	<0.0011	<0.0011
MW-11	MW11-8-10-111908	Pacific Crest	11/19/2008	8-10	**1.5**	0.013	<0.0013	<0.0013	<0.0066
MW-12	MW12-18-22	Pacific Crest	3/4/2009	18-22	<0.00092	<0.00092	<0.00092	<0.00092	<0.0046
MW-13	MW13-18-19	Pacific Crest	3/4/2009	18-19	0.028	0.013	0.012	<0.0012	<0.0061
MW-14	MW14-7	Pacific Crest	3/6/2009	7	0.002	0.0025	<0.0012	<0.0012	<0.006
B-5	B5-7.0	Pacific Crest	5/25/2010	7	<0.0011	<0.0011	<0.0011	<0.0011	<0.0011
B-6	B6-10.0	Pacific Crest	5/25/2010	10	<0.00089	<0.00089	<0.00089	<0.00089	<0.00089
B-7	B7-6.0	Pacific Crest	5/25/2010	6	<0.0011	<0.0011	<0.0011	<0.0011	<0.0011
B-8	B8-4.0	Pacific Crest	5/26/2010	4	**0.67**	0.0071	<0.00088	<0.00088	<0.00088
	B8-10.0	Pacific Crest	5/26/2010	10	**0.065**	0.0012	<0.00096	<0.00096	<0.00096
B-9	B9-4.0	Pacific Crest	5/26/2010	4	**1.2**	0.013	0.0027	<0.0010	<0.0010
	B9-10.0	Pacific Crest	5/26/2010	10	**0.95**	0.020	0.043	<0.00087	<0.00087
B-10	B10-4.0	Pacific Crest	5/26/2010	4	**16**	0.042	<0.0092	<0.00092	<0.00096
	B10-10.0	Pacific Crest	5/26/2010	10	0.033	0.0046	0.063	0.0027	<0.00096
B-11	B11-4.0	Pacific Crest	5/26/2010	4	**2.6**	0.044	<0.00089	<0.00089	<0.00089
	B11-10.0	Pacific Crest	5/26/2010	10	0.099	0.0052	<0.00094	<0.00094	<0.00094
B-12	B12-4.0	Pacific Crest	6/16/2010	4	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
B-13	B13-4.0	Pacific Crest	6/16/2010	4	0.029	0.0032	<0.0010	<0.0010	<0.0010
	B13-10.0	Pacific Crest	6/16/2010	10	**0.045**	0.013	0.037	<0.00094	<0.00094
B-14	B14-4.0	Pacific Crest	6/16/2010	4	**0.10**	0.02	<0.00092	<0.00092	<0.00092
	B14-8.0	Pacific Crest	6/16/2010	8	0.027	0.0042	<0.00098	<0.00098	<0.00098
MW-15	MW15-8.0	Pacific Crest	6/15/2010	8	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
B-15	B15-4.0	Pacific Crest	1/14/2011	1-4	0.029	0.0037	<0.00088	<0.00088	<0.00088
B-16	B16-4.0	Pacific Crest	1/14/2011	1-4	**1.5**	0.012	<0.00088	<0.00088	<0.00088
B-17	B17-4.0	Pacific Crest	1/14/2011	1-4	**1.1**	0.0079	<0.00076	<0.00076	<0.00076
B-18	B18-4.0	Pacific Crest	1/14/2011	1-4	**0.94**	0.0077	<0.0051	<0.0051	<0.0051
B-19	B19-4.0	Pacific Crest	1/14/2011	1-4	**7.4**	0.064	<0.00084	<0.00084	<0.00084
B-20	B20-4.0	Pacific Crest	1/14/2011	1-4	**1.2**	0.035	<0.00090	<0.00090	<0.00090
B-21	B21-4.0	Pacific Crest	1/14/2011	1-4	**4.9**	0.085	0.0023	<0.00095	<0.00095

Table 2
Laboratory Analytical Results - Soil
Sound Mattress and Felt Company
1940 E. 11th Street
Tacoma, Washington
Pacific Crest No: 110-001

Location ID	Sample ID	Sampled By	Sample Date	Sample Depth[2]	Soil Analytical Results (milligrams per kilogram)[1]				
					Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Vinyl Chloride
B-22	B22-4.0	Pacific Crest	1/14/2011	1-4	**0.17**	0.0017	<0.0011	<0.0011	<0.0011
B-24	B24-0.0-2.0	Pacific Crest	11/8/2012	0-2	**0.054**	0.027	0.0014	<0.0012	<0.0016
	B24-4.0-6.0	Pacific Crest	11/8/2012	4-6	**0.053**	0.024	0.0014	<0.0012	<0.0017
MTCA Method A Cleanup Level[3]					**0.05**	**0.03**	**--**	**--**	**--**
MTCA Method B Cleanup Level - Carcinogen - Dermal Exposure[4]					**476.2**	**11**	**--**	**--**	**1**
MTCA Method B Cleanup Level - Non-Carcinogen - Dermal Exposure[4]					**--**	**--**	**800**	**1,600**	**--**
RI Cleanup Levels for Soil[5]					**0.334**	**6.57**	**65**	**--**	**0.057**
Draft FS Cleanup Level for Soil - 2012					**0.04**	**0.2**	**65**	**--**	**0.057**
Draft FS remediation Level for Soil - 2012					**0.67**	**--**	**--**	**--**	**--**

NOTE:

[1]Analyzed by U.S. Environmental Protection Agency (EPA) Method 8260B.
[2] Depth in feet below ground surface.
[3] Method A Cleanup Levels Model Toxics Control Act Cleanup Regulation Chapter 173-340 of the Washington Administrative Code, as amended November 2007.
[4]MTCA Method B Cleanup Level - Dermal Exposure
[5]Site Specific Cleanup Levels based on Ecology Opinion Letter dated 11/8/2010
Soil Samples collected from borings MW-1 through MW-8 were not submitted for laboratory analysis.
Results in **BOLD** denote concentrations above Draft FS Cleanup Levels.
Results in **Yellow** denote concentrations above Draft FS Remediation Level
< denotes result is less than laboratory practical quantitation limit listed or analyte not detected at or above the reporting limit.
- = not applicable
EAI = Environmental Associates, Inc.
LSI = LSI Adapt
Pacific Crest = Pacific Crest Environmental, LLC

Table 1
Groundwater Elevation Data Summary
Sound Mattress and Felt Company
1940 E. 11th Street
Tacoma, Washington
Pacific Crest No: 110-001

Well Identification	Date Gauged	Collected By	Top of Casing Elevation (feet)[1]	Total Well Depth (feet)[2]	Depth to Groundwater (feet)[2]	Potentiometric Surface (feet)
MW-5	1/27/2005	EAI	13.33	14.58	6.06	7.27
	7/7/2005	LSI	13.33		6.21	7.12
	9/27/2005	LSI	13.33		NM	--
	2/6/2007	Pacific Crest	13.33		5.45	7.88
	11/20/2008	Pacific Crest	13.33		NM	--
	3/10/2009	Pacific Crest	13.33		NM	--
	6/17/2010	Pacific Crest	13.33		5.36	7.97
	4/10/2012	Pacific Crest	13.33		5.51	7.82
MW-6	1/27/2005	EAI	13.51	14.03	6.18	7.33
	7/7/2005	LSI	13.51		6.29	7.22
	9/27/2005	LSI	13.51		NM	--
	2/6/2007	Pacific Crest	13.51		5.35	8.16
	11/20/2008	Pacific Crest	13.51		6.43	7.08
	3/10/2009	Pacific Crest	13.51		5.90	7.61
	6/17/2010	Pacific Crest	13.51		5.35	8.16
	4/10/2012	Pacific Crest	13.51		5.21	8.30
MW-7	1/27/2005	EAI	13.64	14.59	5.98	7.66
	7/7/2005	LSI	13.64		6.11	7.53
	9/27/2005	LSI	13.64		NM	--
	2/6/2007	Pacific Crest	13.64		5.05	8.59
	11/20/2008	Pacific Crest	13.64		6.23	7.41
	3/10/2009	Pacific Crest	13.64		4.62	9.02
	6/17/2010	Pacific Crest	13.64		5.09	8.55
	4/10/2012	Pacific Crest	13.64		4.82	8.82
MW-8	1/27/2005	EAI	13.68	14.44	6.18	7.50
	7/7/2005	LSI	13.68		6.27	7.41
	9/27/2005	LSI	13.68		NM	--
	2/6/2007	Pacific Crest	13.68		5.21	8.47
	11/20/2008	Pacific Crest	13.68		5.84	7.84
	3/10/2009	Pacific Crest	13.68		4.69	8.99
	6/17/2010	Pacific Crest	13.68		5.35	8.33
	4/10/2012	Pacific Crest	13.68		5.29	8.39
MW-9	9/27/2005	LSI	13.57	14.74	6.46	7.11
	2/6/2007	Pacific Crest	13.57		4.35	9.22
	11/20/2008	Pacific Crest	13.57		5.69	7.88
	3/10/2009	Pacific Crest	13.57		5.12	8.45
	6/17/2010	Pacific Crest	13.57		4.52	9.05
	4/10/2012	Pacific Crest	13.57		4.19	9.38

Table 1
Groundwater Elevation Data Summary
Sound Mattress and Felt Company
1940 E. 11th Street
Tacoma, Washington
Pacific Crest No: 110-001

Well Identification	Date Gauged	Collected By	Top of Casing Elevation (feet)[1]	Total Well Depth (feet)[2]	Depth to Groundwater (feet)[2]	Potentiometric Surface (feet)
MW-10	2/6/2007	Pacific Crest	12.81	14.79	5.19	7.62
	11/20/2008	Pacific Crest	12.81		5.89	6.92
	3/10/2009	Pacific Crest	12.81		5.60	7.21
	6/17/2010	Pacific Crest	12.81		5.28	7.53
	4/10/2012	Pacific Crest	12.81		5.06	7.75
MW-11	11/20/2008	Pacific Crest	15.42	15.8	8.79	6.63
	3/10/2009	Pacific Crest	15.42		8.30	7.12
	6/17/2010	Pacific Crest	15.42		7.81	7.61
	4/10/2012	Pacific Crest	15.42		7.79	7.63
MW-12	3/10/2009	Pacific Crest	12.01	20	8.09	3.92
	6/17/2010	Pacific Crest	12.01		7.23	4.78
	4/10/2012	Pacific Crest	12.01		7.91	4.10
MW-13	3/10/2009	Pacific Crest	12.90	20	9.22	3.68
	6/17/2010	Pacific Crest	12.90		7.70	5.2
	4/10/2012	Pacific Crest	12.90		7.95	4.95
MW-14	3/10/2009	Pacific Crest	12.34	11	5.80	6.54
	6/17/2010	Pacific Crest	12.34		5.52	6.82
	4.10/12	Pacific Crest	12.34		5.31	7.03
MW-15	6/15-6/16/2010[4]	Pacific Crest	12.76	30	10.11	2.65
	4/10/2012	Pacific Crest	12.76		14.40	-1.64

NOTES
[1]Elevations are relative to an arbitrary Site benchmark
[2]Depth below top of well casing.
[3]MW-1 casing was repaired and resurveyed.
[4]Depth to groundwater calculated by averaging depths to water measured with pressure transducer.
— = not available
NM = Not Measured
EAI = Environmental Associates, Inc.
LSI = LSI Adapt
Pacific Crest = Pacific Crest Environmental, LLC

Table 3
Laboratory Analytical Results - Groundwater
Sound Mattress and Felt Company
1940 E. 11th Street
Tacoma, Washington
Pacific Crest No: 110-001

Location ID	Sample ID	Sampled By	Sample Date	Groundwater Analytical Results (micrograms per liter)							
				HVOCs[1]					MEE[2]		
				Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Vinyl Chloride	Methane	Ethane	Ethene
MW-1	MW-1	EAI	7/12/2004	4.1	<1.0	<1.0	<1.0	*<1.0*	NA	NA	NA
	MW-1	EAI	1/24/2005	6.2	<1.0	<1.0	<1.0	*<5.0*	NA	NA	NA
	MW-1	LSI	7/7/2005	13	0.69	<0.20	<0.20	<0.20	NA	NA	NA
	MW-1	LSI	9/27/2005	6.6	0.48	<0.20	<0.20	<0.20	NA	NA	NA
	MW1-020707	Pacific Crest	2/7/2007	37	1.2	<0.20	<0.20	<0.20	NA	NA	NA
	MW1-112008	Pacific Crest	11/20/2008	11	2.1	0.35	<0.20	<0.20	NA	NA	NA
	MW1-042512	Pacific Crest	4/25/2012	**63**	1.2	<0.50	<0.50	<0.50	NA	NA	NA
MW-2	MW-2	EAI	7/12/2004	<1.0	<1.0	<1.0	<1.0	*<1.0*	NA	NA	NA
	MW-2	EAI	1/24/2005	9.9	3.5	3.2	<1.0	*<5.0*	NA	NA	NA
	MW-2	LSI	7/7/2005	29	4.5	1.3	0.26	<0.20	NA	NA	NA
	MW-2	LSI	9/27/2005	23	4.2	2.4	0.58	<0.20	NA	NA	NA
	MW2-020707	Pacific Crest	2/7/2007	**72**	4.4	0.75	<0.40	*<0.40*	NA	NA	NA
	MW2-112008	Pacific Crest	11/20/2008	30	3.8	1.6	0.33	<0.20	NA	NA	NA
	MW2-042512	Pacific Crest	4/25/2012	**89**	4.3	<0.50	<0.50	<0.50	NA	NA	NA
MW-3	MW-3	EAI	7/12/2004	<1.0	<1.0	<1.0	<1.0	*<1.0*	NA	NA	NA
	MW-3	EAI	1/24/2005	<1.0	<1.0	<1.0	<1.0	*<1.0*	NA	NA	NA
	MW-3	LSI	7/7/2005	1.9	<0.20	<0.20	<0.20	<0.20	NA	NA	NA
	MW-3	LSI	9/27/2005	NA	NA	NA	NA	NA	NA	NA	NA
	MW3-020707	Pacific Crest	2/7/2007	2.2	<0.20	<0.20	<0.20	<0.20	NA	NA	NA
	MW3-112108	Pacific Crest	11/21/2008	<0.20	<0.20	<0.20	<0.20	<0.20	NA	NA	NA
	MW3-042512	Pacific Crest	4/25/2012	2.1	<0.50	<0.50	<0.50	<0.50	NA	NA	NA
MW-4	B25 (MW-4)	EAI	5/14/2004	1	ND	ND	ND	ND	NA	NA	NA
	MW-4	EAI	1/24/2005	1.6	<1.0	<1.0	<1.0	*<5.0*	NA	NA	NA
	MW-4	LSI	7/7/2005	2.7	<0.20	<0.20	<0.20	<0.20	NA	NA	NA
	MW-4	LSI	9/27/2005	NA	NA	NA	NA	NA	NA	NA	NA
	MW4-020707	Pacific Crest	2/7/2007	4.9	0.36	<0.20	<0.20	<0.20	NA	NA	NA
	MW4-112008	Pacific Crest	11/20/2008	0.84	1.2	<0.20	<0.20	<0.20	NA	NA	NA
	MW4-042512	Pacific Crest	4/25/2012	3.4	2.6	0.58	<0.50	<0.50	NA	NA	NA
MW-5	MW-5	EAI	1/27/2005	1.9	0.57	0.29	0.20	<0.20	NA	NA	NA
	MW-5[3]	EMS	1/27/2005	1.8	<1.0	<1.0	<1.0	<0.2	NA	NA	NA
	MW-5	LSI	7/7/2005	6	0.82	<0.20	<0.20	<0.20	NA	NA	NA
	MW-5[3]	EMS	7/7/2005	5.9	1.0	<1.0	<1.0	<0.20	NA	NA	NA
	MW-5	LSI	9/27/2005	NA	NA	NA	NA	NA	NA	NA	NA
	MW5-020707	Pacific Crest	2/7/2007	9.8	1.6	0.22	<0.20	<0.20	2300	<500[4]	<500[4]
	MW5-112108	Pacific Crest	11/21/2008	3	0.46	<0.20	<0.20	<0.20	NA	NA	NA
	MW5-042512	Pacific Crest	4/25/2012	<0.50	6.1	6.7	<0.50	<0.50	NA	NA	NA
MW-6	MW-6	EAI	1/27/2005	53	12	75	6.9	0.63	NA	NA	NA
	MW-6	LSI	7/7/2005	11	2.3	91	9.1	1.3	NA	NA	NA
	MW-6[3]	EMS	7/7/2005	9.7	2.8	64	5.7	0.48	NA	NA	NA
	MW-6	LSI	9/27/2005	NA	NA	NA	NA	NA	NA	NA	NA
	MW6-020707	Pacific Crest	2/7/2007	**67**	7.0	110	7.5	**6**	1800	<500[4]	<500[4]
	MW6-112108	Pacific Crest	11/21/2008	45	6.5	91	4.2	1.2	NA	NA	NA
	MW6-042512	Pacific Crest	4/25/2012	**100**	9.6	13	<0.50	<0.50	NA	NA	NA
MW-7	MW-7	EAI	1/27/2005	3.3	0.93	3.8	0.95	<0.20	NA	NA	NA
	MW-7[3]	EMS	1/27/2005	2.7	<1.0	2.8	<1.0	<0.2	NA	NA	NA
	MW-7	LSI	7/7/2005	33	3.1	2.8	0.96	<0.20	NA	NA	NA
	MW-7[3]	EMS	7/7/2005	27	3.1	2.3	<1.0	<0.2	NA	NA	NA
	MW-7	LSI	9/27/2005	NA	NA	NA	NA	NA	NA	NA	NA
	MW7-020707	Pacific Crest	2/7/2007	**140**	12	3.3	<1.0	*<1.0*	360	<250[4]	<250[4]
	MW7-112008	Pacific Crest	11/20/2008	24	11	8.4	1.2	<0.20	NA	NA	NA
	MW7-042512	Pacific Crest	4/25/2012	**77**	7	2.8	<0.50	<0.50	NA	NA	NA

Table 3
Laboratory Analytical Results - Groundwater
Sound Mattress and Felt Company
1940 E. 11th Street
Tacoma, Washington
Pacific Crest No: 110-001

Location ID	Sample ID	Sampled By	Sample Date	Groundwater Analytical Results (micrograms per liter)							
				HVOCs[1]					MEE[2]		
				Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Vinyl Chloride	Methane	Ethane	Ethene
MW-8	MW-8	EAI	1/27/2005	21	3.9	15	1.8	<0.20	NA	NA	NA
	MW-8	LSI	7/7/2005	**100**	6.6	10	1.4	<0.20	NA	NA	NA
	MW-8[3]	EMS	7/7/2005	**79**	7.4	7.5	1.2	<0.2	NA	NA	NA
	MW-8	LSI	9/27/2005	NA	NA	NA	NA	NA	NA	NA	NA
	MW8-020607	Pacific Crest	2/6/2007	**83**	15	24	1.6	*<0.40*	910	<500[4]	<500[4]
	MW8-112408-B	Pacific Crest	11/24/2008	<0.20	0.3	24	2.1	<0.20	NA	NA	NA
	MW8-042512	Pacific Crest	4/25/2012	<0.50	0.69	5.3	<0.50	<0.50	NA	NA	NA
MW-9	MW-9	LSI	9/27/2005	0.56	0.24	<0.20	<0.20	<0.20	NA	NA	NA
	MW9-112108	Pacific Crest	11/21/2008	0.91	0.31	<0.20	<0.20	<0.20	NA	NA	NA
	MW9-042512	Pacific Crest	4/25/2012	<0.50	<0.50	<0.50	<0.50	<0.50	NA	NA	NA
MW-10	MW10-020707	Pacific Crest	2/7/2007	26	2	19	0.23	**3.3**	NA	NA	NA
	MW10-112108	Pacific Crest	11/21/2008	2.7	2.3	58	0.65	**21**	NA	NA	NA
	MW10-042512	Pacific Crest	4/25/2012	23	1.3	2	<0.50	<0.50	NA	NA	NA
MW-11	MW11-112108	Pacific Crest	11/21/2008	**2600**	**1400**	4800	<30[4]	*<30*[4]	NA	NA	NA
	MW11-042512	Pacific Crest	4/25/2012	**470**	**160**	400	4.7	<0.50	NA	NA	NA
MW-12	MW12-031009	Pacific Crest	3/10/2009	<0.2	<0.2	<0.20	<0.20	<0.20	NA	NA	NA
	MW12-042512	Pacific Crest	4/25/2012	<0.50	<0.50	<0.50	<0.50	<0.50	NA	NA	NA
MW-13	MW13-031009	Pacific Crest	3/10/2009	15	17	35	0.21	0.39	NA	NA	NA
	MW13-042512	Pacific Crest	4/25/2012	2.8	3.2	6.2	<0.50	0.69	NA	NA	NA
MW-14	MW14-031009	Pacific Crest	3/10/2009	9	6.5	20	0.54	**28**	NA	NA	NA
	MW14-042512	Pacific Crest	4/25/2012	3.2	6.6	1.7	<0.50	<0.50	NA	NA	NA
MW-15	MW15-061710	Pacific Crest	6/17/2010	*<10*	<10	1400	12	**280**	NA	NA	NA
	MW15-042512	Pacific Crest	4/25/2012	*<0.50*	<0.50	1300	14	**290**	NA	NA	NA
	MW-15-110-001	Pacific Crest	10/5/2012	*<4*	<4	1400	12	**180**	NA	NA	NA
	MW-15-112712	Pacific Crest	11/27/2012	*<10*	<10	1400	15	**270**	NA	NA	NA
MW-17	MW17-090912	Pacific Crest	9/9/2012	*<4*	<4	460	6.3	**170**	NA	NA	NA
	MW-17-110-001	Pacific Crest	10/5/2012	*<4*	<4	600	7.1	**180**	NA	NA	NA
	MW-17-112712	Pacific Crest	11/27/2012	<20	<4	670	6.5	**130**	NA	NA	NA
Preliminary Screening Levels for Groundwater[5]				**5**	**5**	**80**	**60**	**0.2**	--	--	--
Cleanup Levels for Groundwater[6]				**3.3**	**30**	**10,000**	**--**	**2.4**	--	--	--
FS Remediation Level				**62.2**	**--**	**--**	**--**	**90**	--	--	--

NOTES:

[1]Analyzed by United States Environmental Protection Agency (EPA) Method 8260B.
[2]Analyzed by United States EPA Method 8015M.
[3] Split samples collected by EMS
[4]Practical Quantitation Limit raised due to the necessary dilution of the sample.

< denotes result is less than laboratory practical quantitation limit listed or analyte not detected at or above the reporting limit.
ITALICS denotes Practical Quantitation Limit higher than applicable MTCA Cleanup level.
BOLD indicates concentrations exceeding applicable draft FS Cleanup Levels

Table 4
Laboratory Analytical Results - Reconnaissance Groundwater
Sound Mattress and Felt Company
1940 E. 11th Street
Tacoma, Washington
Pacific Crest No: 110-001

Location ID	Sample ID	Sampled By	Sample Date	Sample Depth [2]	Analytical Results (micrograms per liter)[1]				
					Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Vinyl Chloride
B2	B2	EAI	4/6/2004	9-12	**5**	<1.0	<1.0	<1.0	<1.0
B6	B6	EAI	4/6/2004	9-12	<1.0	<1.0	<1.0	<1.0	<1.0
B7	B7	EAI	4/6/2004	9-12	<1.0	<1.0	<1.0	<1.0	<1.0
B8	B8	EAI	4/6/2004	9-12	<1.0	<1.0	<1.0	<1.0	<1.0
B13	B13	EAI	4/7/2004	9-12	<1.0	<1.0	<1.0	<1.0	<1.0
B14	B14	EAI	4/7/2004	9-12	<1.0	<1.0	<1.0	<1.0	<1.0
B21	B21	EAI	5/14/2004	9-12	<1.0	<1.0	<1.0	<1.0	<0.2j
B24	B24	EAI	5/14/2004	9-12	<1.0	<1.0	<1.0	<1.0	<0.2j
B25	B25	EAI	5/14/2004	9-12	1	<1.0	<1.0	<1.0	<0.2j
B26	B26	EAI	5/14/2004	9-12	<1.0	<1.0	<1.0	<1.0	<0.2j
B27	B27	EAI	5/14/2004	9-12	**13**	<1.0	<1.0	<1.0	<0.2j
B28	B28	EAI	5/14/2004	9-12	**20**	<1.0	<1.0	<1.0	<0.2j
B30	B30	EAI	7/12/2004	9-12	<1.0	<1.0	<1.0	<1.0	<5.0
B-33	B-33	EAI	1/24/2005	7-11	**5.9**	<1.0	4	1.3	<5.0
B-34	B-34	EAI	1/24/2005	7-11	2.2	<1.0	<1.0	<1.0	<5.0
B-35	B-35	EAI	1/24/2005	7-11	**4.6**	<1.0	11	<1.0	<5.0
B-36	B-36	EAI	1/24/2005	7-11	**19**	2.3	17	2.6	<5.0
B-37	B-37	EAI	1/24/2005	7-11	<1.0	<1.0	<1.0	<1.0	<5.0
B-38	B-38	EAI	1/24/2005	7-11	1.1	<1.0	52	6.2	<5.0
B-39	B-39	EAI	1/24/2005	7-11	**4.8**	1.4	170	14	<5.0
B-40	B-40	EAI	1/24/2005	7-11	2.4	<1.0	43	2.9	<5.0
SC-1	SC1-W	LSI	9/27/2005	11-14	0.26	<0.20	<0.20	<0.20	<0.20
SC-2	SC2-W	LSI	9/27/2005	11-14	0.23	<0.20	<0.20	<0.20	<0.20
SC-3	SC3-W	LSI	9/27/2005	11-13	<0.2	<0.20	<0.20	<0.20	<0.20
SC-4	SC4-W	LSI	9/27/2005	10-13	0.26	<0.20	<0.20	<0.20	<0.20
B-1	B1-RGW-12	Pacific Crest	11/29/2007	12	<0.20	<0.20	<0.20	<0.20	<0.20
B-2	B2-RGW-12	Pacific Crest	11/29/2007	12	<0.20	<0.20	<0.20	<0.20	<0.20
B-3	B3-RGW-12	Pacific Crest	11/29/2007	12	<0.20	<0.20	<0.20	<0.20	<0.20
B-4	B4-RGW-12	Pacific Crest	11/29/2007	12	<0.20	<0.20	<0.20	<0.20	<0.20
B-5	B5-12-052510	Pacific Crest	5/25/2010	8-12	<0.20	<0.20	<0.20	<0.20	<0.20
	B5-26-052510	Pacific Crest	5/25/2010	22-26	<0.20	<0.20	0.35	<0.20	<0.20
B-6	B6-12-052510	Pacific Crest	5/25/2010	8-12	<0.20	<0.20	<0.20	<0.20	<0.20
	B6-30-052510	Pacific Crest	5/25/2010	26-30	<0.20	<0.20	370	9.4	**180**
B-7	B7-12-052510	Pacific Crest	5/25/2010	8-12	<0.20	<0.20	<0.20	<0.20	<0.20
	B7-30-052510	Pacific Crest	5/25/2010	26-30	<0.20	<0.20	<0.20	<0.20	**6.7**
B-8	B8-15-052610	Pacific Crest	5/26/2010	11-15	0.21	<0.20	20	2	<0.20
	B8-27-052610	Pacific Crest	5/26/2010	23-27	0.29	<0.20	<0.20	<0.20	<0.20
B-9	B9-15-052610	Pacific Crest	5/26/2010	11-15	**870**	**1200**	**15,000**	110	<100
	B9-27-052610	Pacific Crest	5/26/2010	23-27	1.5	0.51	3.4	<2.0	<0.20
B-10	B10-16-052610	Pacific Crest	5/26/2010	12-16	*<10*	<10	1100	15	*<10*
	B10-28-052610	Pacific Crest	5/26/2010	24-28	1.9	0.36	7.5	<0.20	<0.20
B-11	B11-16-052610	Pacific Crest	5/26/2010	12-16	*<4.0*	<4.0	87	15	**490**
	B11-28-052610	Pacific Crest	5/26/2010	24-28	0.55	<0.20	0.62	<0.20	<0.20
B-12	B12-10-061610	Pacific Crest	6/16/2010	7-10	<0.20	<0.20	<0.20	<0.20	<0.20
	B12-28-061610	Pacific Crest	6/16/2010	25-28	<0.20	<0.20	11	2.1	**3**
B-13	B13-28-061610	Pacific Crest	6/16/2010	25-28	**3.3**	2.5	5.7	<0.20	1.7

Table 4
Laboratory Analytical Results - Reconnaissance Groundwater
Sound Mattress and Felt Company
1940 E. 11th Street
Tacoma, Washington
Pacific Crest No: 110-001

Location ID	Sample ID	Sampled By	Sample Date	Sample Depth [2]	Analytical Results (micrograms per liter)[1]				
					Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Vinyl Chloride
B-23	B23-8.0-12.0 RG	Pacific Crest	11/8/2012	8-12	**12**	12	600	12	**300**
	B23-28.0-30.0 RG	Pacific Crest	11/8/2012	28-30	0.3	<0.20	5.5	0.55	2.4
Preliminary Screening Levels for Groundwater[3]					**5**	**5**	**80**	**160**	**0.2**
RI Cleanup Levels for Groundwater[4]					**3.3**	**30**	**10,000**	**--**	**2.4**
Draft FS Cleanup Levels for Groundwater[5]					**3.3**	**30**	**10,000**	**--**	**2.4**
Draft FS Remediation Level[6]					**62.2**	**--**	**--**	**--**	**90**

NOTE:

[1]Analyzed by United States Environmental Protection Agency (EPA) Method 8260B.

[2] Depth in feet below ground surface.

[3] Method A or Method B in accordance with the Model Toxics Control Act Cleanup Regulation, Chapter 173-340 of the Washington Administrative Code, as amended November 2007.

[4] Site Specific RI Cleanup Levels presented in RI Report dated December 9, 2009.

[5] Site Specific Calculated Draft Cleanup Levels to be included in the Feasibility Study Report

[6]Site Specific Calculated Draft Remediation Levels to be included in the Feasibility Study Report

< denotes result is less than laboratory practical quantitation limit listed or analyte not detected at or above the reporting limit.

- indicates not applicable

Italics indicates laboratory pracitcal quanitation limit is greater than RI cleanup level.

BOLD indicates concentrations exceeding applicable Site Specific RI Cleanup Levels

Pacific Crest = Pacific Crest Environmental, LLC

Table 5
Groundwater Quality Parameter Data Summary
Sound Mattress and Felt Company
1940 E. 11th Street
Tacoma, Washington
Pacific Crest No: 110-001

				Groundwater Quality Parameters				
Location ID	Sample ID	Measured By	Sample Date	Temperature (°C)	Specific Conductivity (mS/cm)	Dissolved Oxygen (mg/L)	pH	Oxidation Reduction Potential (mV)
MW-1	MW-1	LSI	7/7/2005	17.6	-	1.73	7.37	-21.4
	MW-1	LSI	9/27/2005	18.2	-	-	7.36	-33.9
	MW1-020707[1]	Pacific Crest	2/7/2007	12.46	36.23	2.38	7.49	13.6
	MW1-112008[2]	Pacific Crest	11/20/2008	15.04	0.367	0.66	7.1	-151.2
	MW1-041012	Pacific Crest	4/10/2012	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]
MW-2	MW-2	LSI	7/7/2005	17.8	-	1.5	7.19	-11.2
	MW-2	LSI	9/27/2005	18.5	-	-	7.19	-24.2
	MW2-020707[1]	Pacific Crest	2/7/2007	12.4	29.09	2.52	7.25	53.9
	MW2-112008[2]	Pacific Crest	11/20/2008	14.88	0.287	0.99	6.82	-98.1
	MW2-041012	Pacific Crest	4/10/2012	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]
MW-3	MW-3	LSI	7/7/2005	16.7	-	1.54	7.12	-7.8
	MW3-020707[1]	Pacific Crest	2/7/2007	12.42	32.95	1.49	7.43	-40.6
	MW3-112108[2]	Pacific Crest	11/21/2008	15.25	0.341	0.17	7.25	-171.5
	MW3-041012	Pacific Crest	4/10/2012	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]
MW-4	MW-4	LSI	7/7/2005	15	-	1.53	7.25	-13.8
	MW4-020707[1]	Pacific Crest	2/7/2007	12.97	35.64	0.65	7.56	12.3
	MW4-112008[2]	Pacific Crest	11/20/2008	15.08	0.34	0.45	7.02	-153.2
	MW4-041012	Pacific Crest	4/10/2012	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]
MW-5	MW-5	LSI	7/7/2005	17.3	-	1.51	7.5	-28.9
	MW-5[3]	EMS	7/7/2005	17.1	-	1.48	7.53	-30.7
	MW5-020707[1]	Pacific Crest	2/7/2007	12.05	37.38	0.91	7.69	-71.4
	MW5-112108[2]	Pacific Crest	11/21/2008	14.38	0.391	5.43	7.88	-176.7
	MW5-041012	Pacific Crest	4/10/2012	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]
MW-6	MW-6	LSI	7/7/2005	17.2	-	1.21	7.68	-39.8
	MW-6[3]	EMS	7/7/2005	17.2	-	1.21	7.68	-39.8
	MW6-020707[1]	Pacific Crest	2/7/2007	12.09	33.79	0.51	7.77	-9.7
	MW6-112108[2]	Pacific Crest	11/21/2008	14.75	0.28	0.7	7.82	-138.4
	MW6-041012	Pacific Crest	4/10/2012	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]
MW-7	MW-7	LSI	7/7/2005	17.3	-	1.22	7.8	-45.6
	MW-7[3]	EMS	7/7/2005	17.3	-	1.22	7.8	-45.6
	MW7-020707[1]	Pacific Crest	2/7/2007	11.67	34.69	1.48	7.56	10.2
	MW7-112008[2]	Pacific Crest	11/20/2008	14.53	0.311	0.58	7.32	-121.3
	MW7-041012	Pacific Crest	4/10/2012	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]
MW-8	MW-8	LSI	7/7/2005	16.9	-	1.1	7.12	-7.7
	MW-8[3]	EMS	7/7/2005	16.9	-	1.1	7.12	-7.7
	MW8-020607[1]	Pacific Crest	2/6/2007	11.99	31.2	1.41	7.25	-89.8
	MW8-112408-B[2]	Pacific Crest	11/24/2008	14	0.391	1.35	7.24	-64.2
	MW8-041012	Pacific Crest	4/10/2012	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]
MW-9	MW-9	LSI	9/27/2005	17.5	--	-	6.92	-9.6
	MW9-112108	Pacific Crest	11/21/2008	14.63	0.26	0.35	6.77	-159.7
	MW9-041012	Pacific Crest	4/10/2012	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]
MW-10	MW10-020707[1]	Pacific Crest	2/7/2007	9.36	10.67	3.3	7.27	39.5
	MW10-112108[2]	Pacific Crest	11/21/2008	12.63	0.094	2.22	6.81	-69.1
	MW10-041012	Pacific Crest	4/10/2012	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]
MW-11	MW11-112108[2]	Pacific Crest	11/21/2008	12.9	0.457	0.2	7.12	-121.7
	MW11-041012	Pacific Crest	4/10/2012	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]
MW-12	MW12-031009[2]	Pacific Crest	3/10/2009	13.10	0.788	0.18	6.64	-75.3
	MW12-041012	Pacific Crest	4/10/2012	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]
MW-13	MW13-031009[2]	Pacific Crest	3/10/2009	11.05	3.478	0.72	6.19	113.4
MW-14	MW14-031009[2]	Pacific Crest	3/10/2009	8.50	0.750	3.46	7.44	36.9
	MW14-041012	Pacific Crest	4/10/2012	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]
MW-15	MW15-0617102	Pacific Crest	6/17/2010	13.1	5.083	0.48	7.22	-172.3
	MW15-041012	Pacific Crest	4/10/2012	NA4	NA4	NA4	NA4	NA4

Table 5
Groundwater Quality Parameter Data Summary
Sound Mattress and Felt Company
1940 E. 11th Street
Tacoma, Washington
Pacific Crest No: 110-001

Location ID	Sample ID	Measured By	Sample Date	Groundwater Quality Parameters: Temperature (°C)	Specific Conductivity (mS/cm)	Dissolved Oxygen (mg/L)	pH	Oxidation Reduction Potential (mV)
B-5	B5-12-052510[2]	Pacific Crest	5/25/2010	14.45	38.345	0.57	7.24	-131.7
	B5-26-052510[2]	Pacific Crest	5/25/2010	14.24	24.411	0.35	7.78	-271.1
B-6	B6-12-052510[2]	Pacific Crest	5/25/2010	13.15	21.788	1.77	7.60	-56.4
	B6-30-052510[2]	Pacific Crest	5/25/2010	14.79	6.264	0.44	7.36	-200.0
B-7	B7-12-052510[2]	Pacific Crest	5/25/2010	13.51	4.676	0.66	7.35	26.8
	B7-30-052510[2]	Pacific Crest	5/25/2010	13.87	5.294	0.70	7.93	-105.6
B-8	B8-15-052610[2]	Pacific Crest	5/26/2010	13.30	0.343	0.59	8.14	-109.8
	B8-27-052610[2]	Pacific Crest	5/26/2010	13.83	1.951	0.46	8.16	-208.4
B-9	B9-15-052610[2]	Pacific Crest	5/26/2010	13.60	0.561	0.40	7.47	-108.5
	B9-27-052610[2]	Pacific Crest	5/26/2010	13.85	2.381	0.39	8.27	-200.4
B-10	B10-16-052610[2]	Pacific Crest	5/26/2010	13.45	0.408	0.71	7.73	-77.5
	B10-28-052610[2]	Pacific Crest	5/26/2010	13.78	2.941	0.57	7.98	-190.2
B-11	B11-16-052610[2]	Pacific Crest	5/26/2010	13.98	0.548	0.58	8.08	-62.0
	B11-28-052610[2]	Pacific Crest	5/26/2010	14.29	2.898	0.54	7.88	-191.9
B-12	B12-10-061610[2]	Pacific Crest	6/16/2010	13.61	0.643	1.86	7.13	-7.4
	B12-28-061610[2]	Pacific Crest	6/16/2010	13.99	1.024	0.56	7.35	-134.2
B-13	B13-28-061610[2]	Pacific Crest	6/16/2010	14.85	3.148	0.44	8.26	-177.9

NOTE:
[1] Measurements by YSI 600 XL Water Analyzer
[2] Measurements by YSI 566 MPS
[3] Split samples collected by EMS
[4] Data Unavailable (Passive Diffusion Bags used)
C = celsius
mS/cm = millisiemen per centimeter
mg/L = milligrams per liter
mV = millivolts
- = not reported
EMS = Environmental Management Services
LSI = LSI Adapt
Pacific Crest = Pacific Crest Environmental, LLC

Table 6
Laboratory Analytical Results - Air
Sound Mattress and Felt Company
1940 E. 11th Street
Tacoma, Washington
Pacific Crest No: 110-001

Sample ID	Location	Sampled By	Sample Date	Summary of VOC Analytical Results in Air (micrograms per cubic meter)[1]									
				Tetrachloroethene	Trichloroethene	cis-1,2-dichloroethene	trans-1,2,-dichloroethene	Vinyl Chloride	1,1,1-trichloroethane	Benzene	Toluene	Ethylbenzene	Total Xylenes
BH6170901	Outside at SW-Side of Bldg	Port of Tacoma	6/17/2009	<0.16	<0.21	<0.16	<0.78	<0.050	<0.21	0.44	1.1	0.17	0.65
BH6170902	NW corner of office	Port of Tacoma	6/17/2009	6.2	0.56	0.16	<0.67	<0.43	3.8	0.51	2.7	0.42	1.67
BH6170903	SE Corner of Warehouse	Port of Tacoma	6/17/2009	25	1.2	<0.14	<0.69	<0.045	10	1.4	1.2	1.3	5.6
RI Cleanup Levels for Air				6.57	1.55	122.72	--	0.99	4800	0.32	2200	460	46
Draft FS Cleanup Levels for Air				23.28	2	122.72	--	0.99	--	--	--	--	--

NOTES:
VOCs = volatile organic compounds
< detected result is less than laboratory practical quantitation limit listed or analyte not detected at or above the reporting limit.
BOLD denotes analytical result above applicable MTCA cleanup level.
[1]Analyzed by TO-15
MTCA = Model Toxics Control Act
NA=Not applicable

Table 7
Aerobic Bioremediation Pilot Test Results
Sound Mattress and Felt Company
1940 E. 11th Street
Tacoma, Washington
Pacific Crest No: 110-001

Location ID	Sample ID	Measured By	Sample Date	Depth to Water (ft. btoc)	Groundwater Quality Parameters[1]					Groundwater Analytical Results[2] (micrograms per liter)				
					Temperature (°C)	Specific Conductivity (mS/cm)	Dissolved Oxygen (mg/L)	pH	Oxidation Reduction Potential (mV)	Chlorinated Volatile Organic Compounds				
										PCE	TCE	c-DCE	t-DCE	VC
MW-15	MW15-0617102	Pacific Crest	6/17/2010	10.11	13.1	5.083	0.48	7.22	-172.3	<10	<10	1400	12	280
	MW15-041012	Pacific Crest	4/10/2012	14.4	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	<0.50	<0.50	1300	14	290
	NA	Pacific Crest	9/17/2012	7.35	14.6	4.799	0.99	7.42	-122.2	--	--	--	--	--
	NA	Pacific Crest	9/21/2012	9.88	14.76	5.274	1.03	7.48	-129.8	--	--	--	--	--
	MW-15-110-001	Pacific Crest	10/4/2012	9.95	16.99	4.731	0.92	7.17	-117.4	<4	<4	1400	12	180
	MW-15-112712	Pacific Crest	11/27/2012	6.84	13.3	5.135	0.9	7.37	-110.8	<10	<10	1400	15	270
MW-17	MW17	Pacific Crest	9/9/2012	--	17.00	4.773	1.06	6.9	-107.1	<20	<4	460	6.3	170
	NA	Pacific Crest	9/17/2012	8.02	18.15	11.677	1.62	7.59	-91.4	--	--	--	--	--
	NA	Pacific Crest	9/21/2012	9.06	14.79	10.68	1.47	7.61	-98.5	--	--	--	--	--
	MW-17-110-001	Pacific Crest	10/4/2012	8.19	15.28	12.907	1.06	7.51	-100	<4	<4	600	7.1	180
	MW-17-112712	Pacific Crest	11/27/2012	6.97	13.7	12.399	0.87	7.91	-121.7	<20	<4	670	6.5	130

NOTE:
[1] Measurements by YSI 566 MPS
[2] SW-846 Method 8260
[3] Data Unavailable (Passive Diffusion Bags used)
C = celsius
mS/cm = millisiemen per centimeter
mg/L = milligrams per liter
mV = millivolts
- = not reported

Table 8
Soil Vapor Extraction and Air Sparging Pilot Test Operating Results
Sound Mattress and Felt Company
1940 E. 11th Street
Tacoma, Washington
Pacific Crest No: 110-001

Description	Date	Groundwater Zone	Duration Time (hr)	SVE					AS					Estimated Effective Radius Influence (ft)
				Extraction Well	Vacuum (in-H2O)		Flow Rate (cfm)		Sparging Well	Pressure (psi)		Flow Rate (cfm)		
					Beginning	End	Beginning	End		Beginning	End	Beginning	End	
SVE Step Test	12/19/2012	Shallow	3:00	SVE-1	10	60	131.27	85.06	N/A	N/A	N/A	N/A	N/A	--
SVE Test	12/20/2012	Shallow	3:00	SVE-1	40	30	100.26	107.99	N/A	N/A	N/A	N/A	N/A	38
SVE/AS Test	12/20/2012	Shallow	1:00	SVE-1	30	30	107.99	107.99	AS-1	10	20	4.75	7.50	--

Notes:
SVE = Soil Vapor Extraction
AS = Air Sparging
in-H2O = Inches of Water
cfm = Cubic Feet per Minute
psi = Pounds Per Square Inch
hr = Hour
ft = Feet

Table 9
Soil Vapor Extraction and Air Sparging Pilot Test - Analytical Results - Effluent Vapor
Sound Mattress and Felt Company
1940 E. 11th Street
Tacoma, Washington
Pacific Crest No: 110-001

Extraction Well	Date Sampled	Sampled By	Sample ID	Vapor Analytical Results (μg/L)			
				PCE	TCE	cis-1,2-DCE	VC
SVE-1	12/20/2012	Pacific Crest	SVE1-1	230	3.1	<1.0	<1.0
SVE-1	12/20/2012	Pacific Crest	SVE1-2	130	2.0	<1.0	<1.0
SVE-1	12/20/2012	Pacific Crest	SVE1-3	120	1.8	<1.0	<1.0
SVE-1	12/20/2012	Pacific Crest	AS-1-1	120	2.3	<1.0	<1.0
SVE-1	12/20/2012	Pacific Crest	AS-1-2	81	1.6	<1.0	<1.0

Notes:

< = Result is less than laboratory practical quantitation limit

μg/L = Micrograms per Liter

PCE = Tetrachloroethene

TCE = Trichloroethene

cis-1,2-DCE = cis-1,2-Dichloroethene

VC = Vinyl Chloride

Pacific Crest = Pacific Crest Environmental, LLC

Table 10
PCE Mass Recovery - Pilot Test
Sound Mattress and Felt Company
1940 E. 11th Street
Tacoma, Washington
Pacific Crest No: 110-001

SVE - Constant Rate

Date	Time	Elapsed Time	Extraction Point (SVE-1) Applied Vacuum (in. H_2O)	Flowrate (cfm)	Air Volume (cubic meters)	Soil Vapor Concentration PCE ($\mu g/m^3$)	Mass per Measured Interval PCE (µg)
12/20/2012	10:14	0:00	40	100.02	0.00	230,000	0
12/20/2012	10:19	0:05	30	109.71	15.52	215,714	3,348,893
12/20/2012	10:29	0:15	30	109.71	31.05	201,429	6,254,224
12/20/2012	10:44	0:30	30	109.71	46.57	187,143	8,715,994
12/20/2012	10:59	0:45	30	107.99	45.84	172,857	7,923,861
12/20/2012	11:14	1:00	30	107.99	45.84	158,571	7,268,996
12/20/2012	11:29	1:15	30	107.99	45.84	144,286	6,614,132
12/20/2012	11:44	1:30	30	107.99	45.84	130,000	5,959,267
12/20/2012	11:59	1:45	30	107.99	45.84	128,333	5,882,866
12/20/2012	12:14	2:00	30	109.71	46.57	126,667	5,899,375
12/20/2012	12:29	2:15	30	109.71	46.57	125,000	5,821,751
12/20/2012	12:44	2:30	30	107.99	45.84	123,333	5,653,664
12/20/2012	12:59	2:45	30	107.99	45.84	121,667	5,577,263
12/20/2012	13:14	3:00	30	109.71	46.57	120,000	5,588,881
						SVE Subtotal =	80,509,168
						Mass Removal Per Hour =	26,836,389

AS/SVE

Date	Time	Elapsed Time	Extraction Point (SVE-1) Applied Vacuum (in. H_2O)	Flowrate (cfm)	Air Volume (cubic meters)	Soil Vapor Concentration PCE ($\mu g/m^3$)	Mass per Measured Interval PCE (µg)
12/20/2012	13:56	0:00	30	102.63	0.00	120,000	0
12/20/2012	14:01	0:05	30	102.63	14.52	112,200	1,629,368
12/20/2012	14:11	0:15	30	104.45	29.56	104,400	3,085,865
12/20/2012	14:26	0:30	30	102.63	43.57	96,600	4,208,475
12/20/2012	14:41	0:45	30	102.63	43.57	88,800	3,868,661
12/20/2012	14:56	1:00	30	104.45	44.34	81,000	3,591,308
						AS/SVE Subtotal =	16,383,678
						Mass Removal Per Hour =	16,383,678

Total PCE Removal (µg) = 96,892,846

Table 11
Remediation Technology Screening
Sound Mattress and Felt Company
1940 E. 11th Street
Tacoma, Washington
Pacific Crest No: 110-001

Media	Technology	Description	Advantages	Disadvantages	Relative Cost	Selection Status
Soil Only	Excavation	Removal and off-site disposal of unsaturated soil using readily available construction equipment.	Highly effective and can be completed quickly relative to other technologies.	The source area is located beneath the Building. Due to shallow groundwater table at the site excavation could reach approximately 10 feet below ground surface. Any excavation beyond the groundwater table would require dewatering.	High	Retained
	Soil Vapor Extraction (SVE)	Mass removal technology for incremental remediation of soil by extraction of soil vapor.	Effective for remediation of volatile contaminants in permeable soil. Moderate capital equipment costs. Pilot testing indicates the technology is effective at the Site.	Less effective for remediation of low permeability silts and ineffective for contaminants located below groundwater.	Medium to High	Retained
Groundwater Only	Pump and Treat	Conventional technology for hydraulic control consisting of pumping and treating affected groundwater to minimize the potential for off-site migration.	Controls potential for further migration.	Unlikely to result in significant reductions of COC concentrations. High capital cost requiring long term operation, and only applicable to groundwater remediation.	High	Retained
	In-Situ Chemical Oxidation (ISCO)	In-situ chemical treatment of contaminants by the injection of oxidizing materials into the source zone and down-gradient plume. The oxidizing material reacts with the organic contaminant, resulting in the breakdown of that contaminant into carbon dioxide and water.	Highly effective if chemical oxidants can be brought into contact with CVOCs. May require less long term monitoring than other cleanup alternatives.	Disrupts natural attenuation by changing geo- and biochemical conditions. Possible long term solution requiring several injection events.	Medium	Rejected
	Enhanced Aerobic Bioremediation (EAB)	Select bacteria that thrive in aerobic groundwater can utilize VC as an energy source and, eventually, transform the VC into innocuous byproducts. The process is enhanced by the addition of nutrients and dissolved oxygen	Relatively inexpensive and does not alter existing geochemical or biological conditions of the site's subsurface.	Requires multiple injection events and monitoring of geochemical conditions. Pilot testing indicates the technology is not effective at the Site.	Low to Medium	Rejected
	Enhanced Reductive Dechlorination (ERD) and Monitored Natural Attenuation (MNA)	Select bacteria that thrive in anaerobic groundwater can utilize all PCE, TCE, c-DCE and VC as an energy source and, eventually, transform the CVOCs into innocuous byproducts. The process is enhanced by the addition of nutrients and substrates to enhance the anaerobic conditions.	A cost effective innocuous compound capable of remediating both source area and down-gradient plume. Site data indicate reductive dechlorination is occurring naturally.	Degradation of PCE requires sequential breakdown into TCE, c-DCE, and VC before remediation is complete. Requires anaerobic conditions.	Low	Retained
	Air Sparging	Mass removal technology that consists of injecting air below the groundwater to partition contaminants from groundwater into air. Usually combined with SVE to recover contaminants.	Effective for permeable saturated media.	Ineffective for impermeable saturated media. Cannot be implemented for confined or semi-confined groundwater.	Low to Medium	Rejected
Soil and Groundwater	Electric Resistive Heating (ERH)	Mass removal technology that uses multiphase electricity to resistively heat soil and boil groundwater. The steam and contaminant vapor is collected from the subsurface by SVE and treated aboveground.	Very effective, permanent mass reduction and rapid cleanup. Effective for soil and groundwater remediation with a short time frame to achieve cleanup standards.	High capital costs associated with resistive heating equipment and well installation.	High	Rejected
	Dual Phase Vapor Extraction (DPE)	Traditional Treatment technology consisting of extraction of soil vapor and groundwater to reduce concentrations of CVOCs.	Moderate capital equipment costs which can be used without significant disruption of business operations, and effective for both soil and groundwater remediation.	High vacuum required to be effective. Long-term operation and maintenance required to achieve cleanup standards.	Medium to High	Retained

Table 12
Cleanup Action Alternative Summary
Sound Mattress and Felt Company
1940 E. 11th Street
Tacoma, Washington
Pacific Crest No: 110-001

Cleanup Action Alternative	Description	General Performance Record	Site Specific Issues	Cost Range Low	Cost Range High
Alternative No. 1 - MNA	The MNA alternative does not include active remediation but consists of monitoring the natural reductions of COCs in Zone A or Zone B.	Decreasing concentrations of the COCs in groundwater due to reductive dechlorination are occurring and will likely continue to occur until the contaminants are completely degraded.	The MNA alternative can be implemented quickly, but, without source reduction in Zone A, would take a long time (50 to 100 years) before cleanup standards were reached	$ 300,000.00	$ 500,000.00
Alternative No. 2 - Excavation, Pump and Treat and MNA	Alternative No. 2 consists of demolition of the Building by the Port of Tacoma, excavation of contaminated soil in Zone A, implementation of pump-and-treat in Zone A and B, and MNA.	Excavation and pump-and-treat are mature technologies that can be implemented quickly. Pump-and-treat is effective for hydraulic control, but unlikely to be effective for significant mass reduction. MNA is effective at sites where the source area has been removed.	Dependent upon the Port of Tacoma for removal of the Building. Excavation below groundwater in the Upper Sand is feasible, but may require dewatering. Iron fouling of the pump-and-treat system is anticipated to present a significant operation and maintenance issue.	$ 3,000,000.00	$ 4,000,000.00
Alternative No. 3 - DPE, Pump and Treat and MNA	Alternative No. 3 consists of using DPE to address affected soil and groundwater in Zone A, pump-and-treat to hydraulically control groundwater in Zone B, and implementation of MNA.	DPE systems are used to remove contaminants from shallow low permeability or heterogeneous formations. DPE is proven in the removal of CVOCs in soil and groundwater.	Demolition of the Building is not assumed for this alternative. DNAPL and low permeability silts in the Upper Fill may result in extended operation of the DPE system.	$ 1,000,000.00	$ 1,500,000.00
Alternative No. 4 - SVE, Pump and Treat, ERD and MNA	Alternative No. 4 consists of using SVE to address affected soil in Zone A, ERD to address affected groundwater in Zone A, pump-and-treat to hydraulically control groundwater in Zone B, and implementation of MNA.	SVE pilot test results indicate a large radius of influence and mass recovery and monitoring results indicate groundwater conditions are conducive to reductive dechlorination.	Demolition of the Building is not assumed for this alternative. DNAPL and low permeability silts in the Upper Fill may result in extended operation of the SVE system.	$ 1,000,000.00	$ 1,500,000.00
Alternative No. 5 - Excavation, SVE, ERD and MNA	Alternative No. 5 consists of demolition of the Building by the Port of Tacoma, targeted excavation of contaminated soil in Zone A, implementation of SVE in Zone A, implementation of ERD in Zone A and B, and MNA.	SVE pilot test results indicate a large radius of influence and mass recovery and monitoring results indicate groundwater conditions are conducive to reductive dechlorination. Excavation is a mature technology and MNA is effective at sites where the source area has been removed.	Dependent upon the Port of Tacoma for removal of the Building. Excavation below groundwater in the Upper Sand is feasible, but may require dewatering. Assumes reuse of fill material on-site.	$ 950,000.00	$ 1,000,000.00

Table 13
Cleanup Action Alternative Screening Matrix - Compliance with MTCA Threshold Criteria
Sound Mattress and Felt Company
1940 E. 11th Street
Tacoma, Washington
Pacific Crest No: 110-001

Cleanup Action Alternative	Protection of Human Health and the Environment	Compliance with Cleanup Standards	Compliance with Applicable State and Federal Laws	Provisions for Compliance Monitoring	Management of Short Term Risk	Implementability	Public Concern	Reasonable Time Frame	Selection Rationale	Screening Result
Alternative No. 1 - MNA	No - Unlikely to result in permanent mass and risk reduction.	No - Unlikely to achieve cleanup standards due to persistence of CVOCs.	Yes - Alternative complies with applicable laws.	Yes - Alternative includes provisions for compliance monitoring (i.e., groundwater monitoring).	No - Unlikely to manage short term risks.	Yes - Easily implemented.	No - Unlikely to address public concerns.	No - Long time frame.	Does not meet MTCA threshold requirements.	Rejected
Alternative No. 2 - Excavation, Pump and Treat and MNA	Yes - Permanent mass and risk reduction through soil and groundwater remediation.	Yes - The combination of remediation technologies are proven to achieve cleanup standards.	Yes - Alternative complies with applicable laws.	Yes - Alternative includes provisions for compliance monitoring (i.e., groundwater monitoring).	Yes - Effective in managing short term risks.	Yes - Implementable if the Port of Tacoma demolishes the existing building.	Yes - Likely to address public concerns.	No - Likely to achieve cleanup standards in soil and groundwater in 10 to 15 years.	Does not meet MTCA threshold requirements.	Rejected
Alternative No. 3 - DPE, Pump and Treat and MNA	Yes - Permanent mass and risk reduction through soil and groundwater remediation.	Yes - The combination of remediation technologies are proven to achieve cleanup standards.	Yes - Alternative complies with applicable laws.	Yes - Alternative includes provisions for compliance monitoring (i.e., groundwater monitoring).	Yes - Effective in managing short term risks.	Yes - Easily implemented.	Yes - Likely to address public concerns.	Yes - Likely to achieve cleanup standards in soil and groundwater in 10 years.	Meets MTCA threshold criteria.	Retained
Alternative No. 4 - SVE, Pump and Treat, ERD and MNA	Yes - Permanent mass and risk reduction through soil and groundwater remediation.	Yes - The combination of remediation technologies are proven to achieve cleanup standards.	Yes - Alternative complies with applicable laws.	Yes - Alternative includes provisions for compliance monitoring (i.e., groundwater monitoring).	Yes - Effective in managing short term risks.	Yes - Easily implemented.	Yes - Likely to address public concerns.	Yes - Likely to achieve cleanup standards in soil and groundwater in 3-5 years.	Meets MTCA threshold criteria.	Retained
Alternative No. 5 - Excavation, SVE, ERD and MNA	Yes - Permanent mass and risk reduction through soil and groundwater remediation.	Yes - The combination of remediation technologies are proven to achieve cleanup standards.	Yes - Alternative complies with applicable laws.	Yes - Alternative includes provisions for compliance monitoring (i.e., groundwater monitoring).	Yes - Effective in managing short term risks.	Yes - Implementable if the Port of Tacoma demolishes the existing building.	Yes - Likely to address public concerns.	Yes - Likely to achieve cleanup standards in 3-5 years.	Meets MTCA threshold criteria	Retained

Table 14
Cleanup Action Alternative Screening Matrix - Weighted Pair Ranking
Sound Mattress and Felt Company
1940 E. 11th Street
Tacoma, Washington
Pacific Crest No: 110-001

Cleanup Action Alternative	Protectiveness (30%)	Permanence (20%)	Long Term Effectiveness (20%)	Management of Short Term Risk (10%)	Implementability (10%)	Public Concern (10%)	Screening Result
Alternative No. 3 - DPE, Pump and Treat and MNA	2	3	2	2	2	2	2.2
Alternative No. 4 - SVE, Pump and Treat, ERD and MNA	3	2	3	3	1	3	2.6
Alternative No. 5 - Excavation, SVE, ERD and MNA	1	1	1	1	3	1	1.2
Explanation	A5 is more protective source removal will be conducted faster than A3 or A4.	A5 is more permanent due to the removal of the source by excavation.	A5 is more effective because it is less susceptible to rebound.	A5 addresss short term risks by the excavation of the source area.	A4 easier to implement due to its relatively common use and does not required demolition of the Building by the Port	A5 addresses public concern by the excavation of the source area.	The screening results indicate A5 is the preferred alternative.

DRAFT

APPENDIX A
CLEANUP LEVEL CALCULATION WORKSHEETS AND EXCESS RISK CALCULATION

FEASIBILITY STUDY REPORT

Former Sound Mattress and Felt Property
1940 East 11th Street
Tacoma, Washington

Pacific Crest PN: 110-001

Appendix A - Table 1
Site Excess Cancer Risk Worksheet - Groundwater
Former Sound Mattress and Felt Company Property
Tacoma, Washington
Pacific Crest PN: 110-001

Groundwater

Contaminant of Concern	Method A Cleanup Level (ug/L)	Method B Cleanup Level (ug/L)	Method C Cleanup Level (ug/L)	ARAR (µg/L)	FS Cleanup Level (ug/L)	Excess Cancer Risk Values
Tetrachloroethene	5	100	9.7	3.3	3.3	1.00E-06
Trichloroethene	5	13	300	30	30	1.00E-06
Vinyl Chloride	0.2	3.7	90	2.4	2.4	1.00E-06

Total Site Excess Cancer Risk 3.00E-06

Appendix A - Table 2
Site Excess Cancer Risk Worksheet - Air
Former Sound Mattress and Felt Company Property
Tacoma, Washington
Pacific Crest PN: 110-001

Air

Contaminant of Concern	Method A Cleanup Level (ug/L)	Method B Cleanup Level (ug/m^3)	Method C Cleanup Level (ug/m^3)	Cleanup Level Adjusted for Site Excess Cancer Risk (ug/m^3)	Excess Cancer Risk Values
Tetrachloroethene	--	9.6	40	23.28	5.82E-06
Trichloroethene	--	0.37	6.3	2.00	3.18E-06
Vinyl Chloride	--	0.28	9.9	0.99	1.00E-06

Total Site Excess Cancer Risk **1.00E-05**

Appendix A - Table 3
MTCA Method B Cleanup Level and ARAR - Protection of Surface Water
Sound Mattress Site
Tacoma, Washington
Pacific Crest No. 110-001

COC	Exposure	Cleanup Standard	Cancer Risk (unitless)	AT (yr)	Bioconcentration Factor (liter/kg)	ABW (kg)	Fish Consumption Rate (gm/day)	ED (yr)	Fish Diet Fraction (unitless)	CPFo (kg-day/mg)	CUL.sw (ug/liter)	Comments
PCE	Protection of Surface Water -	Method B Cleanup Level - IRIS CPFo	1.00E-06	75	31	70	54	30	0.5	2.10E-03	**100**	Using 2012 EPA IRIS Database values for CPFo
PCE		ARAR - IRIS CPFo	1.00E-06	--	30.6	70	17.5	--	--	2.10E-03	**62.2**	EPA AWQC Using 2012 EPA IRIS Database values for CPFo
PCE		ARAR - Previous AWQC value	1.00E-06	--	30.6	70	17.5	--	--	3.98E-02	**3.3**	EPA AWQC Using 2012 EPA IRIS Database values for CPFo

Protection of Surface Water is based on standard MTCA parameters
Applicable or Relevant and Appropriate Requirement (ARAR) based on EPA Ambient Water Quality Criteria (AWQC) for ingestion of organisms
Cancer Risk - WAC 173-340-730 Eq. 730-2
Averaging Time (AT) WAC 173-340-730 Eq. 730-2
Bioconcentration Factor - WAC 173-340-730 Eq. 730-2 - CLARC Value
Average Body Weight (ABW) - WAC 173-340-730 Eq. 730-2
Fish Consumption Rate - WAC 173-340-730 Eq. 730-2
Exposure Duration (ED) - Residential - WAC 173-340-730 Eq. 730-2
Fish Diet Fraction (FDF) - WAC 173-340-730 Eq. 730-2
Carcinogenic Potency Factor (CPFo) - EPA IRIS or CLARC
MTCA Method B CUL (CUL.sw) - Protection of Surface Water - Human Ingestion of Biota - WAC 173-340-730 Eq. 730-2

Appendix A - Table 4
MTCA Method B Cleanup Levels - Soil Leaching to Groundwater - Protective of Surface Water
Sound Mattress Site
Tacoma, Washington
Pacific Crest No: 110-001

COC	Exposure	Cleanup Standard	CUL.gw (ug/l)	Dilution Factor	Koc	Foc	Kd	Th.water	Th.air	Hcc	Rho.drysoil	CUL.soil (mg/kg)	Comments
PCE	Surface Water	Cleanup Level	3.3	20	270	0.001	0.27	0.3	0.13	0.75	1.5	**0.04**	Using 2012 EPA IRIS Database values for CPF
PCE	Surface Water	Remediation Level	62.2	20	270	0.001	0.27	0.3	0.13	0.75	1.5	**0.67**	Using 2012 EPA IRIS Database values for CPF

Residential exposure is based on standard MTCA parameters
Non-residential exposure is based on revised parameters that are consistent with commercial worker (8 hrs per day, 250 days per yr for 25 yrs)
Cancer Risk - WAC 173-340-720 Eq. 720-2
Averaging Time (AT) WAC 173-340-720 Eq. 720-2
Drinking Water (DW) Ingestion Rate - WAC 173-340-720 Eq. 720-2
Average Body Weight (ABW) - WAC 173-340-720 Eq. 720-2
Inhalation Correction Factor (INH) - WAC 173-340-720 Eq. 720-2
Exposure Duration (ED) - Residential - WAC 173-340-720 Eq. 720-2
Exposure Frequency (EF) - WAC 173-340-720 Eq. 720-2
Carcinogenic Potency Factor (CPFo) - EPA IRIS or CLARC
MTCA Method B Drinking Water CUL (CUL.gw) WAC 173-340-720 Eq. 720-2

DRAFT

APPENDIX B
BORING LOGS AND WELL CONSTRUCTION DIAGRAMS

FEASIBILITY STUDY REPORT

Former Sound Mattress and Felt Property
1940 East 11th Street
Tacoma, Washington

Pacific Crest PN: 110-001

Log of Boring B-15

PACIFIC CREST ENVIRONMENTAL
WWW.PCENV.COM 425-888-4990

Site Name: Former Sound Mattress and Felt

Client: Robert Shea

Project Number: 110-001

Date/Time Started	: 1-14-11 / 0830
Date/Time Completed	: 1-14-11 / 0900
Total Boring Depth	: 4 ft
Depth to water ATD	: NA
Elevation (ft)	: NA
Drilling Method	: Direct Push
Sampler Type	: Macro-Core

Depth In Feet	Samples	Description	USCS	Graphic	% Recovery	PID (ppm)	Sample ID
0	X	0.0 - 0.5 Concrete	Concrete				
		0.5 - 4.0 SILT minor sand & gravel (80% silt, 10% fine sand, 10% fine gravel), dark brown, moist, no odor.	ML		10	8.4	B15-4.0
5							
10							

Drilling Company	: ESN
Drilling Foreman	: Chris
Equipment	: Strataprobe
Pacific Crest Rep.	: Monty Busbee

Log of Boring B-15

12-19-2012 \\PACIFIC-8E185AF\public\Project Files\110 Sound Mattress & Felt Co\Boring Logs\B-15.bo

Log of Boring B-16

(Page 1 of 1)

PACIFIC CREST ENVIRONMENTAL
WWW.PCENV.COM 425-888-4990

Site Name: Former Sound Mattress and Felt

Client: Robert Shea

Project Number: 110-001

Date/Time Started : 1-14-11 / 0913
Date/Time Completed : 1-14-11 / 1120
Total Boring Depth : 4 ft
Depth to water ATD : NA
Elevation (ft) : NA
Drilling Method : Direct Push
Sampler Type : Macro-Core

Depth In Feet	Samples	Description	USCS	Graphic	% Recovery	PID (ppm)	Sample ID
0		0.0 - 0.5 Concrete	Concrete				
		0.5 - 1.0 GRAVEL (100% coarse gravel), light gray, moist, no odor.	GP				
		1.0-4.0 SILT minor sand and gravel (80% silt, 10% fine sand, 10% fine gravel), medium brown, moist, no odor.	ML		80	29.1	B16-4.0
5							
10							

Drilling Company : ESN
Drilling Foreman : Chris
Equipment : Strataprobe
Pacific Crest Rep. : Monty Busbee

Log of Boring B-16

(Page 1 of 1)

Log of Boring B-17

(Page 1 of 1)

PACIFIC CREST ENVIRONMENTAL
WWW.PCENV.COM 425-888-4990

Site Name: Former Sound Mattress and Felt

Client: Robert Shea

Project Number: 110-001

Date/Time Started : 1-14-11 / 1134
Date/Time Completed : 1-14-11 / 1200
Total Boring Depth : 4 ft
Depth to water ATD : NA
Elevation (ft) : NA
Drilling Method : Direct Push
Sampler Type : Macro-Core

Depth In Feet	Samples	Description	USCS	Graphic	% Recovery	PID (ppm)	Sample ID
0	X	0.0 - 0.5 Concrete	Concrete		80	31.7	B17-4.0
		0.5 - 1.0 GRAVEL (100% coarse gravel), light gray, moist, no odor.	GP				
		1.0-2.0 SAND (100% fine sand), medium brown, dry, no odor.	SP				
		2.0-4.0 SILT minor sand and gravel (80% silt, 10% fine sand, 10% fine gravel), medium brown, moist, no odor.	ML				
5							
10							

Drilling Company : ESN
Drilling Foreman : Chris
Equipment : Strataprobe
Pacific Crest Rep. : Monty Busbee

Log of Boring B-17

(Page 1 of 1)

Log of Boring B-18

Date/Time Started	: 1-14-11 / 1207
Date/Time Completed	: 1-14-11 / 1226
Total Boring Depth	: 4 ft
Depth to water ATD	: NA
Elevation (ft)	: NA
Drilling Method	: Direct Push
Sampler Type	: Macro-Core

PACIFIC CREST ENVIRONMENTAL
WWW.PCENV.COM 425-888-4990

Site Name: Former Sound Mattress and Felt

Client: Robert Shea

Project Number: 110-001

Depth In Feet	Samples	Description	USCS	Graphic	% Recovery	PID (ppm)	Sample ID
0		0.0 - 0.5 Concrete	Concrete				
		0.5 - 1.0 GRAVEL (100% coarse gravel), light gray, moist, no odor.	GP				
		1.0-2.0 SAND (100% fine sand), medium brown, dry, no odor.	SP				
		2.0-3.0 SILT minor sand and gravel (80% silt, 10% fine sand, 10% fine gravel), medium brown, moist, no odor.	ML		70	20.1	B18-4.0
		3.0-4.0 SAND (100% fine sand), medium brown, dry, no odor.	SP				
5							
10							

Drilling Company	: ESN
Drilling Foreman	: Chris
Equipment	: Strataprobe
Pacific Crest Rep.	: Monty Busbee

Log of Boring B-18

Log of Boring B-19

(Page 1 of 1)

Date/Time Started	: 1-14-11 / 1251
Date/Time Completed	: 1-14-11 / 1315
Total Boring Depth	: 4 ft
Depth to water ATD	: NA
Elevation (ft)	: NA
Drilling Method	: Direct Push
Sampler Type	: Macro-Core

PACIFIC CREST ENVIRONMENTAL
WWW.PCENV.COM 425-888-4990

Site Name: Former Sound Mattress and Felt

Client: Robert Shea

Project Number: 110-001

Depth In Feet	Samples	Description	USCS	Graphic	% Recovery	PID (ppm)	Sample ID
0	X	0.0 - 0.5 Concrete	Concrete				
		0.5 - 1.0 GRAVEL (100% coarse gravel), light gray, moist, no odor.	GP				
		1.0-3.5 SILT minor sand and gravel (80% silt, 10% fine sand, 10% fine gravel), medium brown, moist, no odor.	ML		80	37.3	B19-4.0
		3.5-4.0 SAND (100% fine sand), medium brown, dry, no odor.	SP				
5							
10							

Drilling Company	: ESN
Drilling Foreman	: Chris
Equipment	: Strataprobe
Pacific Crest Rep.	: Monty Busbee

Log of Boring B-19

(Page 1 of 1)

Log of Boring B-20

(Page 1 of 1)

Date/Time Started	: 1-14-11 / 1322
Date/Time Completed	: 1-14-11 / 1353
Total Boring Depth	: 4 ft
Depth to water ATD	: NA
Elevation (ft)	: NA
Drilling Method	: Direct Push
Sampler Type	: Macro-Core

PACIFIC CREST ENVIRONMENTAL
WWW.PCENV.COM 425-888-4990

Site Name: Former Sound Mattress and Felt

Client: Robert Shea

Project Number: 110-001

Depth In Feet	Samples	Description	USCS	Graphic	% Recovery	PID (ppm)	Sample ID
0	X	0.0 - 0.5 Concrete	Concrete		80	15.1	B20-4.0
		0.5 - 1.5 GRAVEL (100% coarse gravel), light gray, moist, no odor.	GP				
		1.5-3.0 SILT minor sand and gravel (80% silt, 10% fine sand, 10% fine gravel), medium brown, moist, no odor.	ML				
		3.5-4.0 SAND (100% fine sand), medium brown, dry, no odor.	SP				
5							
10							

Drilling Company	: ESN
Drilling Foreman	: Chris
Equipment	: Strataprobe
Pacific Crest Rep.	: Monty Busbee

Log of Boring B-20

(Page 1 of 1)

Log of Boring B-21

(Page 1 of 1)

PACIFIC CREST ENVIRONMENTAL
WWW.PCENV.COM 425-888-4990

Site Name: Former Sound Mattress and Felt

Client: Robert Shea

Project Number: 110-001

Date/Time Started	: 1-14-11 / 1406
Date/Time Completed	: 1-14-11 / 1440
Total Boring Depth	: 4 ft
Depth to water ATD	: NA
Elevation (ft)	: NA
Drilling Method	: Direct Push
Sampler Type	: Macro-Core

Depth In Feet	Samples	Description	USCS	Graphic	% Recovery	PID (ppm)	Sample ID
0	X	0.0 - 0.5 Concrete	Concrete		80	8.2	B21-4.0
		SAND, 0.5 - 1.0 GRAVEL (100% coarse gravel), light gray, moist, no odor.	GP				
		1.0-1.5 SILT with sand (75% silt, 25% fine sand), medium brown, dry, no odor.	ML				
		1.5-2.5 Silty SAND (60% fine sand, 40% silt), medium brown , dry, no odor.	SM				
		2.5-3.0 SILT minor sand (90% silt, 10% fine sand), medium brown, moist, no odor.	ML				
		3.5-4.0 SAND with silt (75% fine sand, 25% silt), medium brown, moist, no odor, some shell fragments.	SM				
5							
10							

Drilling Company	: ESN
Drilling Foreman	: Chris
Equipment	: Strataprobe
Pacific Crest Rep.	: Monty Busbee

Log of Boring B-21

(Page 1 of 1)

Log of Boring B-22

(Page 1 of 1)

PACIFIC CREST ENVIRONMENTAL
WWW.PCENV.COM 425-888-4990

Site Name: Former Sound Mattress and Felt

Client: Robert Shea

Project Number: 110-001

Date/Time Started	: 1-14-11 / 1449
Date/Time Completed	: 1-14-11 / 1505
Total Boring Depth	: 4 ft
Depth to water ATD	: NA
Elevation (ft)	: NA
Drilling Method	: Direct Push
Sampler Type	: Macro-Core

Depth In Feet	Samples	Description	USCS	Graphic	% Recovery	PID (ppm)	Sample ID
0	X	0.0 - 0.5 Concrete	Concrete		70	10.1	B22-4.0
		0.5 - 1.0 GRAVEL (100% coarse gravel), light gray, moist, no odor.	GP				
		1.0 - 2.5 SAND with silt (75% fine sand, 25% silt), medium brown, dry, no odor.	SM				
		2.5 - 4.0 SAND trace silt (95% fine sand, 5% silt), medium brown, dry, no odor.	SP				
5							
10							

Drilling Company	: ESN
Drilling Foreman	: Chris
Equipment	: Strataprobe
Pacific Crest Rep.	: Monty Busbee

Log of Boring B-22

(Page 1 of 1)

LOG OF WELL MW-17

Date/Time Started	: 09-09-12/908
Date/Time Completed	: 09-09-12/1200
Total Boring Depth	: 28.8'
Total Well Depth	: 28.8'
Depth to water ATD	: NA
Elevation (ft)	: NA
Drilling Method	: HSA
Sampler Type	: ~2 inch GP macro core
Drive Hammer (lbs)	: -

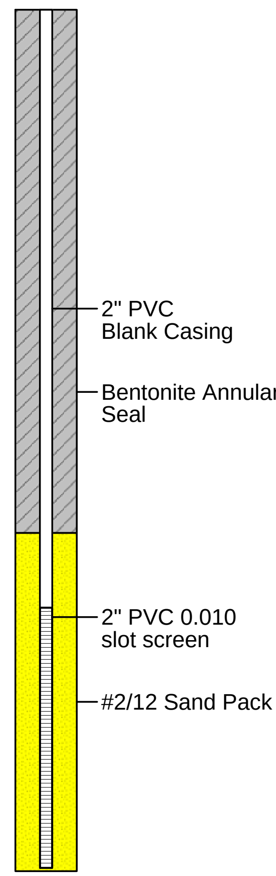
PACIFIC CREST ENVIRONMENTAL
WWW.PCENV.COM 425-888-4990

Site Name: Former Sound Mattress and Felt Company Property
Client: Mr. Robert Shea

Project #: 110-001

Depth In Feet	Samples	Description	USCS	Graphic	% Recovery	Blow Count	PID (ppm)	Sample ID
0								
5								
10								
15								
20								
25								
30		Bottom of boring at 28.8 feet bgs.						
35								
40								

Well: MW-15



Drilling Company	: ESN Northwest
Drilling Foreman	: Dan Hardin
Equipment	: -
Pacific Crest Rep.	: Monty Busbee

LOG OF WELL MW-17

LOG OF WELL AS-1

(Page 1 of 1)

PACIFIC CREST ENVIRONMENTAL
WWW.PCENV.COM 425-888-4990

Site Name: Former Sound Mattress and Felt Company Property
Client: Mr. Robert Shea

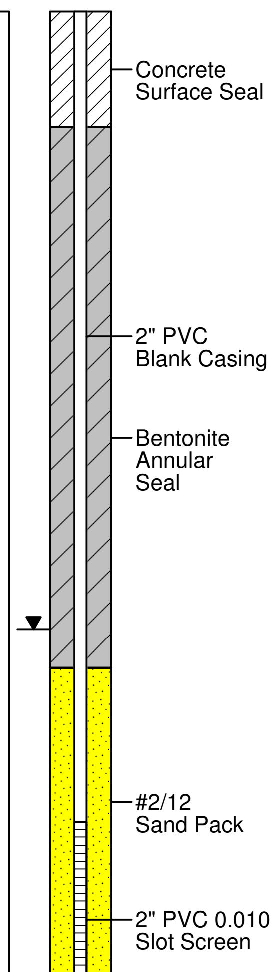
Project #: 110-001

Date/Time Started	: 11-6-12/1400
Date/Time Completed	: 11-6-12/1450
Total Boring Depth	: 15.0'
Total Well Depth	: 12.5'
Depth to water ATD	: ~8'
Elevation (ft)	: NA
Drilling Method	: Direct Push
Sampler Type	: -
Drive Hammer (lbs)	: -

Depth In Feet	Samples	Description	USCS	Graphic	% Recovery	PID (ppm)	Sample ID
0–1.5		0.0-1.5 Concrete					
1.5–10.0	X	1.5-10.0 SAND, trace silt (95% fine to medium sand, 5% silt), brown, moist to wet, no odor.	SP		50 (at ~3.3)	8.3	
					50 (at ~7.5)	0.0	
10.0–13.0	X	10.0-13.0 SAND, trace silt (95% fine to coarse sand, 5% sitl) dark brown, wet, no odor.	SP		100	15	
13.0–15.0	X	13.0-15.0 SILT, trace sand (95% silt 5% fine sand), brown, wet, no odor.	ML		15		

Bottom of boring at 15.0 feet below concrete slab.

Well: AS-1



Drilling Company	: ESN Northwest
Drilling Foreman	: Don
Equipment	: Geoprobe
Pacific Crest Rep.	: A Wiebenga/M. DeCaro

LOG OF WELL AS-1

(Page 1 of 1)

Log of Boring B-23

(Page 1 of 1)

Date/Time Started	: 11-8-12/1052
Date/Time Completed	: 11-8-12/1305
Total Boring Depth	: 30'
Depth to water ATD	: 8.0'
Elevation (ft)	: NA
Drilling Method	: Direct Push
Sampler Type	: -

PACIFIC CREST ENVIRONMENTAL
WWW.PCENV.COM 425-888-4990

Site Name: Former Sound Mattress and Felt Company Property
Client: Robert Shea

Project Number: 110-001

Depth In Feet	DESCRIPTION	USCS	PID (ppm)	% Recovery	Sample ID
0-0.5	0.0-0.5 Concrete				
0.5-5.0	0.5-5.0 SAND, trace silt, trace gravel (90% fine sand, <5% silt, <5% gravel), dark brown, moist, no odor.	SP	0.0	60	
5.0-10.0	5.0-10.0 SAND, minor silt, shell fragments (85% fine sand, 15% silt), dark brown, moist, no odor.	SP	0.0	85	B23-8.0-12.0 RG
10.0-15.0	10.0-15.0 Silty SAND (65% fine sand, 35% silt) dark brown, wet, moderate odor.	SM	13.9	70	
15.0-17.5	15.0-17.5 SILT, trace sand (95% silt, 5% fine sand), dark grey, wet, no odor.	ML	0.0	95	
17.5-20.0	17.5-20.0 Sandy SILT (60% silt, 40% coarse sand), dark grey, wet, no odor.	ML	0.0	80	
20.0-30.0	20.0-30.0 SAND, trace silt (95% fine to coarse sand, 5% silt), dark brown, wet, no odor.	SP	0.0	65	B23-28.0-30.0 RG

Bottom of boring at 30.0 feet below concrete slab.

Groundwater sample taken from 8.0 - 12.0 feet below concrete slab.
Groundwater sample taken from 28.0 - 30.0 feet below concrete slab.

Drilling Company	: ESN Northwest
Drilling Foreman	: Don
Equipment	: Geoprobe
Pacific Crest Rep.	: A. Wiebenga/M. DeCaro

Log of Boring B-23

(Page 1 of 1)

Log of Boring B-24

(Page 1 of 1)

PACIFIC CREST ENVIRONMENTAL
WWW.PCENV.COM 425-888-4990

Site Name: Former Sound Mattress and Felt Company Property
Client: Robert Shea

Project Number: 110-001

Date/Time Started : 11-8-12/1315
Date/Time Completed : 11-8-12/1345
Total Boring Depth : 10'
Depth to water ATD : -
Elevation (ft) : NA
Drilling Method : Direct Push
Sampler Type : -

Depth In Feet	Samples	Description	USCS	Graphic	% Recovery	PID (ppm)	Sample ID
0–0.5		0.0-0.5 Concrete					
0.5–5	X	0.5-5.0 SAND, trace silt, trace gravel (90% fine sand, <5% silt, <5% gravel), dark brown, moist, no odor.	SP		60	0.0	B24-0.0-2.0
5–10	X	5.0-10.0 SAND, minor silt, shell fragments (85% fine sand, 15% silt), dark brown, moist, no odor.	SP		85	0.0	B24-4.0-6.0
10		Bottom of boring at 10.0 feet below concrete slab.					

Drilling Company : ESN Northwest
Drilling Foreman : Don
Equipment : Geoprobe
Pacific Crest Rep. : A. Wiebenga/M. DeCaro

Log of Boring B-24

(Page 1 of 1)

LOG OF WELL MW-16

PACIFIC CREST ENVIRONMENTAL
WWW.PCENV.COM 425-888-4990

Site Name: Former Sound Mattress and Felt Company Property
Client: Mr. Robert Shea

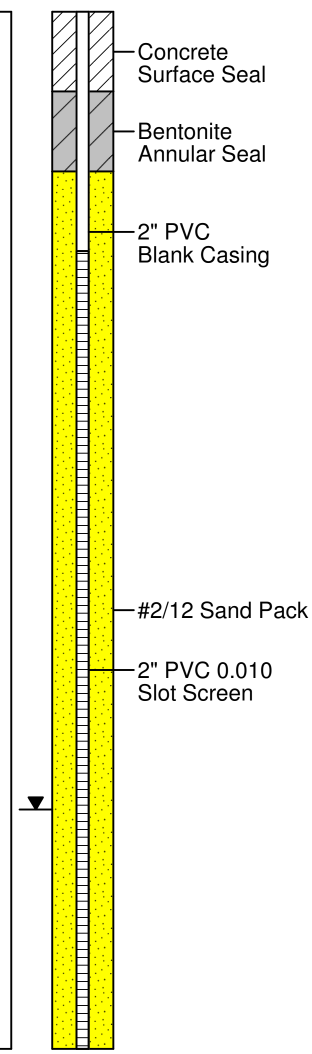
Project #: 110-001

Date/Time Started	: 11-6-12/1555
Date/Time Completed	: 11-6-12/1645
Total Boring Depth	: 13.0'
Total Well Depth	: 13.0'
Depth to water ATD	: ~10'
Elevation (ft)	: NA
Drilling Method	: Direct Push
Sampler Type	: -
Drive Hammer (lbs)	: -

Depth In Feet	Description	USCS	% Recovery	PID (ppm)	Sample ID
0.0-0.5	0.0-0.5 Concrete				
0.5-9.0	0.5-9.0 SAND, trace silt, trace gravel (90% fine sand, <5% silt, <5% gravel), brown, moist, no odor.	SP	65 (0-5); 80 (5-10)	42.6	
9.0-10.0	9.0-10.0 SAND, trace silt (95% fine to coarse sand, <5% silt), dark brown, very moist, no odor.	SP		39.4	
10.0-12.5	10.0-12.5 SAND, trace silt (95% fine to coarse sand, <5% silt), dark brown, wet, slight odor.	SP	90	45.0	
12.5-13.0	12.5-13.0 SILT with sand (75% silt, 25% fine sand), dark brown, wet, no odor.	ML			

Bottom of boring at 13.0 feet below concrete slab.

Well: MW-16



Drilling Company	: ESN Northwest
Drilling Foreman	: Don
Equipment	: Geoprobe
Pacific Crest Rep.	: A Wiebenga/M. DeCaro

LOG OF WELL MW-16

LOG OF WELL SVE-1

(Page 1 of 1)

Date/Time Started	: 11-6-12/1515
Date/Time Completed	: 11-6-12/1535
Total Boring Depth	: 8.0'
Total Well Depth	: 8.0'
Depth to water ATD	: -
Elevation (ft)	: NA
Drilling Method	: Direct Push
Sampler Type	: -
Drive Hammer (lbs)	: -

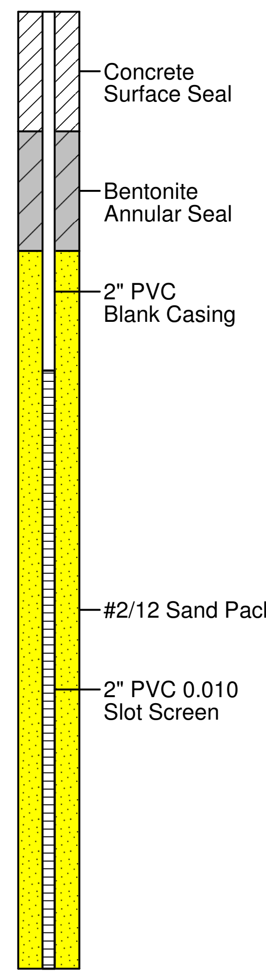
PACIFIC CREST ENVIRONMENTAL
WWW.PCENV.COM 425-888-4990

Site Name: Former Sound Mattress and Felt Company Property
Client: Mr. Robert Shea

Project #: 110-001

Depth In Feet	Samples	Description	USCS	Graphic	% Recovery	PID (ppm)	Sample ID
0		No samples collected.					
1							
2							
3							
4							
5							
6							
7							
8		Bottom of boring at 8.0 feet below concrete slab.					
9							
10							

Well: SVE-1



Drilling Company	: ESN Northwest
Drilling Foreman	: Don
Equipment	: Geoprobe
Pacific Crest Rep.	: A Wiebenga/M. DeCaro

LOG OF WELL SVE-1

(Page 1 of 1)

LOG OF WELL VMW-1

(Page 1 of 1)

PACIFIC CREST ENVIRONMENTAL
WWW.PCENV.COM 425-888-4990

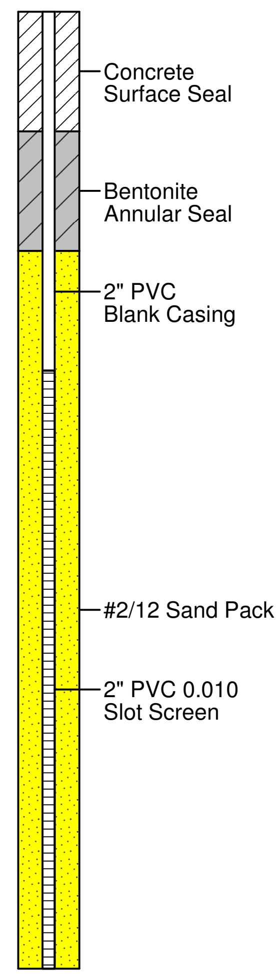
Site Name: Former Sound Mattress and Felt Company Property
Client: Mr. Robert Shea

Project #: 110-001

Date/Time Started	: 11-6-12/1700
Date/Time Completed	: 11-6-12/1730
Total Boring Depth	: 8.0'
Total Well Depth	: 8.0'
Depth to water ATD	: -
Elevation (ft)	: NA
Drilling Method	: Direct Push
Sampler Type	: -
Drive Hammer (lbs)	: -

Depth In Feet	Samples	Description	USCS	Graphic	% Recovery	PID (ppm)	Sample ID
0		No samples collected.					
1							
2							
3							
4							
5							
6							
7							
8		Bottom of boring at 8.0 feet below concrete slab.					
9							
10							

Well: VMW-1



Drilling Company	: ESN Northwest
Drilling Foreman	: Don
Equipment	: Geoprobe
Pacific Crest Rep.	: A Wiebenga/M. DeCaro

LOG OF WELL VMW-1

(Page 1 of 1)

LOG OF WELL VMW-2

Date/Time Started	: 11-8-12/0930
Date/Time Completed	: 11-8-12/1020
Total Boring Depth	: 8.0'
Total Well Depth	: 8.0'
Depth to water ATD	: -
Elevation (ft)	: NA
Drilling Method	: Direct Push
Sampler Type	: -
Drive Hammer (lbs)	: -

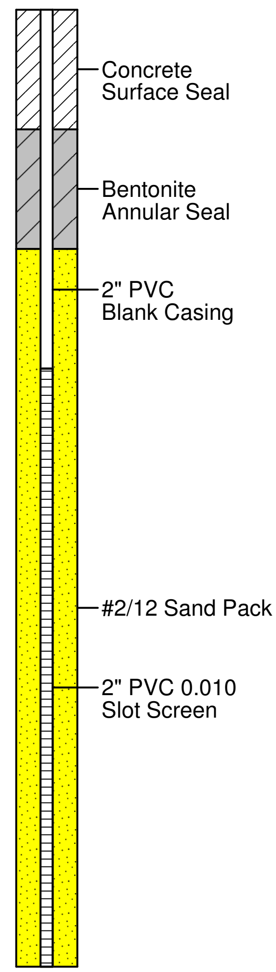
PACIFIC CREST ENVIRONMENTAL
WWW.PCENV.COM 425-888-4990

Site Name: Former Sound Mattress and Felt Company Property
Client: Mr. Robert Shea

Project #: 110-001

Depth In Feet	Samples	Description	USCS	Graphic	% Recovery	PID (ppm)	Sample ID
0		No samples collected.					
1							
2							
3							
4							
5							
6							
7							
8		Bottom of boring at 8.0 feet below concrete slab.					
9							
10							

Well: VMW-2



Drilling Company	: ESN Northwest
Drilling Foreman	: Don
Equipment	: Geoprobe
Pacific Crest Rep.	: A Wiebenga/M. DeCaro

LOG OF WELL VMW-2

(Page 1 of 1)

DRAFT

APPENDIX C
LABORATORY ANALYTICAL REPORTS

FEASIBILITY STUDY REPORT

Former Sound Mattress and Felt Property
1940 East 11th Street
Tacoma, Washington

Pacific Crest PN: 110-001

DRAFT

APPENDIX D
SOIL VAPOR EXTRACTION FIELD DATA AND ROI ANALYSIS

FEASIBILITY STUDY REPORT

Former Sound Mattress and Felt Property
1940 East 11th Street
Tacoma, Washington

Pacific Crest PN: 110-001

Appendix D - Table 1
Soil Vapor Extraction Pilot Study Step Test
Sound Mattress Site
Tacoma, Washington
Pacific Crest Project No.: 110-001

Date	Time	Elapsed Time	Extraction Point SVE-1		Monitoring Points VMW-1 Distance = 11 feet	VMW-2 Distance = 31 feet	MW-11 Distance = 67 feet	MW-6 Distance = 52 feet	MW-16 Distance = 142 feet	COC Vapor Concentration (ppmV)
			Applied Vacuum (in. H_2O)	Flowrate (cfm)	Vacuum (in. H_2O)	Vacuum (in. H_2O)	Vacuum (in. H_2O)	Vacuum (in. H_2O)	Vacuum (in. H_2O)	Total VOCs - PID
12/19/2012	12:39	0:00	10	--	0.00	0.00	0.00	0.00	0.00	--
12/19/2012	12:44	0:05	10	131.3	-1.10	0.14	0.02	--	--	17.1
12/19/2012	12:54	0:15	10	128.5	-1.40	-0.26	0.10	0.04	--	18
12/19/2012	13:09	0:30	10	128.5	-2.00	-0.26	-0.14	-0.16	--	18.3
12/19/2012	13:24	0:45	10	128.5	-2.00	-0.26	-0.05	-0.05	--	25
12/19/2012	13:39	1:00	10	128.5	-2.00	-0.26	-0.06	-0.10	0.00	24.4
12/19/2012	13:44	1:05	30	108.0	-4.00	-0.56	-0.10	-0.14	--	64.8
12/19/2012	13:54	1:15	30	108.0	-3.30	-0.42	-0.12	-0.32	--	63.2
12/19/2012	14:09	1:30	30	107.99	-3.60	-0.44	-0.10	-0.12	0.00	62.8
12/19/2012	14:24	1:45	30	107.99	-3.80	-0.60	-0.12	-0.22	--	59.6
12/19/2012	14:39	2:00	60	85.06	-5.60	-0.62	-0.16	-0.37	--	144
12/19/2012	14:49	2:10	60	85.06	-5.30	-0.62	-0.14	-0.22	--	125
12/19/2012	15:09	2:30	60	85.06	-5.00	-0.58	-0.14	-0.38	--	119
12/19/2012	15:24	2:45	60	85.06	-4.80	-0.62	-0.12	-0.17	--	124
12/19/2012	15:39	3:00	60	85.06	-4.80	-0.60	-0.17	-0.17	0.00	121

Notes:
cfm = cubic feet per minute
ppmV = parts per million vapor
TVOCs - Total Volatile Organic Compounds mesured with a photoionization detector
in. H_2O = inches of water column
- = not measured

Appendix D - Table 2
Soil Vapor Extraction Pilot Study Constant Rate Test
Sound Mattress Site
Tacoma, Washington
Pacific Crest Project No.: 110-001

Date	Time	Elapsed Time	Extraction Point SVE-1		Monitoring Points VMW-1 Distance = 11 feet	VMW-2 Distance = 31 feet	MW-11 Distance = 67 feet	MW-6 Distance = 52 feet	COC Vapor Concentration (ppmV)
			Applied Vacuum (in. H_2O)	Flowrate (cfm)	Vacuum (in. H_2O)	Vacuum (in. H_2O)	Vacuum (in. H_2O)	Vacuum (in. H_2O)	TVOCs
12/20/2012	10:15	0:00	40	100.0	-4.20	-0.42	-0.10	-0.14	79.5
12/20/2012	10:20	0:05	30	109.7	-2.80	-0.48	-0.13	-0.14	50.9
12/20/2012	10:30	0:15	30	109.7	-3.00	-0.40	-0.07	-0.20	49.4
12/20/2012	10:45	0:30	30	109.7	-2.80	-0.36	-0.13	-0.19	47.9
12/20/2012	11:00	0:45	30	108.0	-2.20	-0.35	0.00	-0.15	46.6
12/20/2012	11:15	1:00	30	108.0	-3.00	-0.37	0.00	-0.13	46.9
12/20/2012	11:30	1:15	30	108.0	-3.00	-0.34	-0.14	-0.28	47.3
12/20/2012	11:45	1:30	30	108.0	-3.00	-0.36	-0.16	-0.16	45.9
12/20/2012	12:00	1:45	30	107.99	-3.00	-0.55	-0.11	-0.21	44.6
12/20/2012	12:15	2:00	30	109.71	-3.00	-0.36	-0.08	-0.21	47.2
12/20/2012	12:30	2:15	30	109.71	-3.00	-0.40	-0.10	-0.16	48.6
12/20/2012	12:45	2:30	30	107.99	-3.00	-0.33	-0.08	-0.32	47.4
12/20/2012	13:00	2:45	30	107.99	-3.00	-0.33	-0.14	-0.13	48.5
12/20/2012	13:15	3:00	30	109.71	-3.00	-0.36	-0.04	-0.15	45.4

Notes:
cfm = cubic feet per minute
ppmV = parts per million vapor
TVOCs - Total Volatile Organic Compounds mesured with a photoionization detector
in. H_2O = inches of water column

Appendix D - Table 3
Air Sparging - Soil Vapor Extraction Pilot Study
Sound Mattress Site
Tacoma, Washington
Pacific Crest Project No.: 110-001

Date:	Time	Elapsed Time	Extraction Point SVE-1		Air Sparge Point AS-1		Monitoring Points VMW-1	VMW-2	MW-11	MW-6	COC Vapor Concentration (ppmV)
			Applied Vacuum (in. H_2O)	Flowrate (cfm)	Pressure (psi)	Flowrate (cfm)	Pressure (in. H_2O)	Pressure (in. H_2O)	Pressure (in. H_2O)	Pressure (in. H_2O)	TVOCs
10/21/2010	13:55	-	30	102.629	20	7.75	-2.4	-0.14	-0.02	-0.14	37.6
10/21/2010	14:00	0:05	30	102.629	20	7.75	-2.2	-0.11	-0.08	-0.34	34.2
10/21/2010	14:10	0:15	30	104.4456	20	7.75	-2	-0.1	-0.04	-0.08	32.5
10/21/2010	14:25	0:30	30	102.629	20	7.75	-1.8	-0.04	0.04	-0.2	30.4
10/21/2010	14:35	0:40	30	102.629	20	7.75	-2	-0.02	0.04	-0.22	29.3
10/21/2010	14:55	1:00	30	104.4456	29	7.75	-1.8	-0.02	0.02	-0.1	27.5

Notes:
cfm = cubic feet per minute
bgs = below ground surface
psi = pounds per square inch
ppmV = parts per million vapor
TVOCs - Total Volatile Organic Compounds mesured with a photoionization detector
in. H_2O = inches of water column

Appendix D - Table 4
Soil Vapor Extraction Pilot Study - Radius of Influence
Sound Mattress Site
Tacoma, Washington
Pacific Crest Project No.: 110-001

SVE Configuration (SVE Recovery Well)	Vacuum at Recovery Point In H2O	Normalized vacuum In H2O	Time	Vacuum Influence Measurement Location	Vacuum Influence (inches of water)	Distance (in feet) from Recovery Point to Measurement Location			
						VM-1	VM-2	MW-6	MW-11
SVE-1	30	0.1	13:14	VM-1	3.00	11		--	--
SVE-1	30	0.012	13:14	VM-2	0.36	--	31	--	--
SVE-1	30	0.005	13:14	MW-6	0.15	--	--	52	--
SVE-1	30	0.001333333	13:14	MW-11	0.04	--	--	--	67


Effective Radius of Influence
Vacuum (Inches of water)
1
0.1
0.01
0.001
0
10
20
30
40
50
60
70
80
Vacuum Data
Expon. (Vacuum Data)