Final

Feasibility Study Report

J.H. Baxter & Co.

Eugene, Oregon

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Prepared for

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Acronyms and Abbreviations

ACA	ammoniacal copper arsenate
ACQ	ammoniacal copper quat
ACZA	ammoniacal copper zinc arsenate
Baxter	J.H. Baxter & Co.
BHHRA	Baseline human health risk assessment
BTEX	benzene, toluene, ethylbenzene, and xylenes
BWUD	beneficial use determination
BWUS	beneficial use survey
Cascade	Cascade Plating & Machine
Chemonite®	registered trade name for ammoniacal copper zinc arsenate (ACZA)
COC	chemical of concern
COI	contaminants of interest
COPC	chemical of potential concern
CPEC	contaminants of potential ecological concern
CSM	conceptual site model
CZC	chromated zinc chloride
DCP	dichlorophenol
DEQ	Oregon Department of Environmental Quality
DNAPL	dense nonaqueous phase liquid
EarthCon	EarthCon Consultants, Inc. (formerly Premier Environmental Services)
EPA	U.S. Environmental Protection Agency
ERA	Ecological risk assessment
Eugene facility	J.H. Baxter & Co. wood treating facility in Eugene, Oregon
EWEB	Eugene Water and Electrical Board
FIFRA	Federal Insecticide Fungicide and Rodenticide Act
FS	feasibility study
HHRA	human health risk assessment
HSA	hot spot analysis
IC	institutional controls
IRAM	interim remedial action measures
IRM	interim remedial measures
LNAPL	light nonaqueous phase liquid
MNA	monitored natural attenuation
MSDS	material data safety sheets
MSL	mean sea level
NAPL	nonaqueous phase liquid
NPDES	National Pollution Discharge Elimination System
OAR	Oregon Administrative Rules
ORS	Oregon Revised Statues
PAH	polycyclic aromatic hydrocarbon
PCDD	polychlorinated dibenzo-*p*-dioxins
PCDF	polychlorinated dibenzofurans

PCP	pentachlorophenol
PHEA	public health and environmental assessment
POTW	public owned treatment works
PPE	personal protective equipment
Premier	Premier Environmental Services, Inc.
RA	risk assessment
RAO	remedial action objectives
RI	Remedial Investigation
RCRA	Resource Conservation and Recovery Act
RSL	risk screening levels
SVOC	semivolatile organic compound
TCDD	tetrachlorodibenzo-p-dioxin
TCP	trichlorophenol
TeCP	tetrachlorophenol
TEQ	toxic equivalent quotient
TSD	treatment, storage and disposal
VOC	volatile organic compounds

Appendices

Appendix A Cost Worksheets

1 Preface

In 2011, EarthCon Consultants (EarthCon) and J.H. Baxter & Co. (Baxter) prepared a Feasibility Study (FS) Report (Baxter, 2011a) on behalf of Baxter for their Eugene, Oregon wood-treating facility at 85 Baxter Street (Site) (Figure 1-1). The Feasibility Study was submitted to DEQ in 2011 but it was never approved. GSI Water Solutions, Inc. (GSI) was subsequently retained by Baxter in December 2014 to provide environmental services for the Baxter Eugene project. In the process of reviewing the groundwater monitoring program and performance of the pump and treat system, GSI determined that the pump and treat system was performing better than the original FS predicted and was containing groundwater from the source area from migrating offsite. This prompted a review of the recommended remedy in the FS and resulted in a new preferred remedial action alternative to DEQ. This approach was refined in numerous meetings with DEQ and documented in an Addendum to the FS. The addendum presented the new preferred remedy and was submitted to DEQ in June 2015 (GSI 2015). The Oregon Department of Environmental Quality (DEQ) provided comments on the FS Addendum in a letter dated January 21, 2015, and requested that relevant FS documents be combined into a single document for the final submittal.

This document merges the 2011 FS prepared by EarthCon (Baxter 2011a) with 2015 and 2016 FS-related work performed by GSI. It also incorporates comments from and discussions with DEQ regarding the 2015 and 2016 work. The 2011 FS outline and contents were preserved as much as possible to present the previous author's work in its original form, with changes and additions to reflect work subsequent to 2011.

In addition, figures extracted directly from the 2011 FS retain the EarthCon name in the title block, while newer figures produced by GSI show GSI in the title block. Tables are based on information in the 2011 FS with modifications by GSI to reflect post 2011 information.

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2 Introduction

This FS Report was prepared in accordance with an Oregon Department of Environmental Quality (DEQ) issued Consent Order (ECSR-WVR-88-06) dated August 7, 1989, as amended on October 26, 1990, and September 16, 1994. The original Consent Order required the completion of an FS for the facility. The October 26, 1990, addendum to the Consent Order required the submittal and implementation of a groundwater monitoring work plan at the facility. The second addendum, dated September 16, 1994, required the completion of a Remedial Investigation (RI)/FS in accordance with Oregon Administrative Rules (OAR) 340-122-080.

In August 1991, Baxter submitted the Phase I RI to DEQ (Keystone 1991), which included results of soil, sediment, groundwater and surface water investigations, as well as a Public Health and Environmental Assessment (PHEA). In October 1994, Baxter submitted the Phase II RI to DEQ (Keystone 1994). The Phase II RI included data from additional wells, boreholes, surface soils, sediment, and surface water, and used this data to refine the PHEA.

Since submittal of the Phase I RI and Phase II RI, several additional investigations have been conducted at the site, and an Ecological Risk Assessment (ERA) has been completed for the facility and approved by DEQ (Keystone 1999). Additional groundwater and surface water monitoring data have also been collected.

A draft RI report was submitted to DEQ in June 2002. In 2010, Baxter submitted a revised RI Summary Report (Revision 1), which incorporated DEQ written comments (DEQ 2002), suggestions from various meetings with DEQ, additional sediment and groundwater data collected between 2002 until 2008, as well as an evaluation of the stability of the existing groundwater plume (Baxter 2010a). The RI Summary Report, Revision 1, was approved by DEQ on March 15, 2011 (DEQ, 2011b).

A Revised Baseline Human Health Risk Assessment (BHHRA) was submitted to DEQ on July 28, 2006 (Baxter 2006a), which incorporated DEQ's comments on the 2002 Draft Human Health Risk Assessment (Baxter 2002c). An addendum to the 2006 BHHRA was subsequently submitted as a technical memorandum dated November 4, 2013 (AMEC 2013), and an updated technical memorandum was submitted February 19, 2014 (AMEC 2014). The BHHRA evaluates the potential effects of site-related contaminants on human receptors, and cleanup levels are developed in the FS based on the assumptions and findings of the BHHRA. As part of DEQ's review of the FS Addendum (GSI 2015), DEQ commented on the cleanup levels for exposure to PCP in off-site groundwater through industrial uses and residential irrigation (DEQ, 2016). DEQ required a revision of these two cleanup levels to reflect updated toxicity and exposure assumptions, which resulted in lower cleanup levels than were presented in the FS Addendum. A discussion of this evaluation is included in Section 5 of this FS. With these changes, DEQ's review of the risk assessment is considered complete.

In 2007, Baxter placed an engineered soil cap on approximately 11 acres on the eastern portion of the facility. Construction of the cap was preceded by an evaluation of four different remedial alternatives, participation in a public comment process, and DEQ approval of an Interim Action Work Plan. Following cap construction, Baxter prepared a Site Management Plan for the remediated parcel, and recorded an Easement and Equitable Servitudes agreement. On January 11, 2011, DEQ issued a No Further Action determination for the 11-acre parcel (DEQ, 2011a).

As mentioned in the Preface, Baxter submitted an Addendum to the FS in June 2015 and DEQ provided comments to the Addendum, along with a few specific comments regarding risk-based cleanup levels proposed in the Addendum to the FS that were based on work completed in the 2006 BHHRA and 2014 BHHRA Addendum.

The RI summary, BHHRA, draft FS (Baxter 2011a), FS Addendum (GSI 2015), and DEQ comments on the FS Addendum (DEQ, 2016) provide the basis for the final FS, which includes remedial action objectives and identification of areas that require remediation, and an evaluation of technologies that can meet the remedial action objectives.

2.1 Document Overview

This FS includes the following sections:

Preface (Section 1): The preface describes the history of the FS and the merging of the 2011 FS with the new information incorporated by GSI.

Introduction (Section 2): This section describes the purpose and objectives of the FS and provides an overview of the report contents and organization.

Site Background (Section 3): This section provides a brief description of the operations and history, environmental history, and current conditions of the Eugene facility.

Previous Investigation Findings (Section 4): This section summarizes the findings of the completed RI Summary.

Proposed Cleanup Levels (Section 5): This section evaluates the regulatory requirements applicable to the facility and develops proposed cleanup levels that are used to determine affected areas requiring remedial action.

Conceptual Site Model (Section 6): This section summarizes the Conceptual Site Model (CSM) developed from the RI Summary.

Remedial Action Considerations (Section 7): This section describes features of the facility operations and subsurface conditions that must be considered as part of the proposed remedial actions.

Remedial Action Objectives (Section 8): This section provides a discussion of applicable cleanup requirements, cleanup levels, qualitative and quantitative remedial action objectives, and special conditions at the Eugene facility that affect the selection of remedial technologies.

Technology Screening (Section 9): This section describes the screening of potentially applicable technologies to address soil and groundwater cleanup at the facility.

Remedial Action Alternatives (Section 10): This section describes the remedial action alternatives evaluated for the Eugene facility.

Detailed Evaluation of Alternatives (Section 11): This section provides a detailed analysis of each alternative for each balancing criterion.

Comparative Evaluation of Remedial Alternatives (Section 12): This section provides a comparison of each remedial alternative to each of the other alternatives.

Recommended Remedial Alternative (Section 13): This section documents the rationale for selection of the preferred remedial alternative for the facility.

References (Section 14): This section provides a list of references cited in this document.

In addition, the following appendices are included in this document:

Appendix A: Cost Worksheets: Detailed cost data are provided for each remedial action alternative in this appendix.

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3 Site Background

This section provides background information on the Eugene facility including its location, development and history, current wood treating operations, stormwater management, and hazardous waste management. Historical Eugene facility features are shown in Figure 3-1. The current features are shown in Figure 3-2.

3.1 Site Development History

The site is approximately 42.5 acres in size and is located within the city limits of Eugene, Oregon. The site was developed by Baxter as a wood treatment facility in 1943. Prior to 1943, the area was undeveloped farmland.

The site vicinity consists primarily of residential, commercial, and industrial properties. The site is bordered to the northwest by Roosevelt Boulevard. Additionally, commercial properties including Yale Transport, Armored Transport, and Lile of Oregon are located northeast of the facility along Roosevelt Boulevard. The site is bordered to the south by Southern Pacific Railroad; the west by Zip-O-Log Manufacturing, Cascade Plating and Machine, Heli-Jet; and Pacific Recycling on the east (Figure 3-2).

Baxter constructed the Eugene facility and began operations in 1943. The facility included an office building, a retort, working tanks for treating solution storage, and numerous buildings and sheds as generally shown in Figure 3-1. The earliest treating processes used creosote formulations in a single retort (Retort 82). In 1945, a second retort (Retort 83) was added for treating wood products with pentachlorophenol (PCP). In 1952, the Eugene facility starting using metals-based treating solutions, and in 1955 began treating wood products with fire retardants. Additional retorts were added in 1966 (Retort 84), 1967 (Retort 81), and 1970 (Retort 85). Figure 3-1 shows the location of the five retorts and other site features.

Between the years of 1945 to 1955, a burn pit was reportedly used to dispose of waste onsite (Keystone 1991) (Figure 3-1). The burn pit, which was approximately 40 square feet and was 4 feet deep, was located northeast of the former log pond (Figure 3-1). Oily materials were reportedly transferred to the burn pit by 55-gallon drum (Keystone 1991). In 1955, the pit was excavated and filled, and a dry shed was constructed over the former location of the burn pit (Keystone 1991). No records are available for remediation of the former burn pit.

Between approximately 1950 and 1961, two butt treating tanks were used at the facility (Keystone 1991). Prior to 1970, one of the two tanks was converted to a PCP mixing tank, and the other tank was removed (Keystone 1991).

A log pond was historically located on the southwestern portion of the facility (Figure 3-1). Raw logs were stored in this pond to prevent staining and to soften the wood prior to milling. During the mid-1970's, property including the log pond was purchased by Baxter, filled in, and a stormwater retention pond was constructed. At the time of the pond construction, bentonite was used to seal the pond by distributing the bentonite on top of the water allowing it to sink to form a loose seal (Keystone 1991). Bentonite was added again in the late 1990s to seal the pond. The current pond is approximately one acre in size and five feet deep.

In 1980 or 1981, the facility submitted an application for interim status as a treatment, storage, and disposal (TSD) facility as a precautionary measure due to uncertainties regarding Resource, Conservation and Recovery Act (RCRA) regulations. The application was subsequently withdrawn (Keystone 1991).

In 1982, a hazardous waste storage shed was constructed for the temporary accumulation of wastes (less than 90 days) (Figure 3-1). Historically, containerized wastes were accumulated in this same general area (Keystone 1991).

In 1992, a new Subpart W concrete, roofed drip pad was constructed on the east side of the retorts and treating plant. In 1994, a roof, drip pad, and sprinkler system were installed on the west side of Retort 85.

In late 2007, the eastern portion of the facility was capped with 12 inches of gravel fill, as part of an interim remedial action measure (IRAM) approved by DEQ. A boundary line adjustment was completed in 2009 and the IRAM capped area is now a separate tax parcel (Figure 3-2).

3.2 Current Operations

The Eugene facility imports untreated wood products and processes them into treated wood products. Processing includes framing, trimming, marking, seasoning, and treatment. The finished products, which include dimensional wood products, guardrails, crossarms, poles, and pilings, are shipped to utilities and other users by truck or rail. Current features at the facility are shown on Figure 3-2. Treatment processes and handling of treated products are summarized below.

Five retorts are currently in use onsite for pressure treatment of wood products using creosote, PCP, Chemonite® (ammoniacal copper zinc arsenate), and ACQ (ammoniacal copper quat). One area currently used for PCP treatment (Retort 85) includes one retort and several process and storage tanks. The main treatment area includes the remaining four retorts (Retorts 81, 82, 83, and 84), and multiple work, process, and storage tanks. The ground surface beneath all retorts and tanks is paved. As previously mentioned, all of the retorts have concrete drip pads. Approximately 80 percent of the remaining areas of the facility are unpaved.

3.2.1 Pressure Treating

Untreated wood products are placed in retorts and conditioned according to preservative type and customer specifications. Then, heated treating solution is applied to the retort under pressure. Following application of the pressurized treatment solution, the excess preservative is removed. Water and oil removed during the conditioning process is transferred to an oil/water separator where the oil is recovered and recycled in the system. In-process water leaving the oil/water separator is recovered or evaporated. Treated wood products are removed from the retort and kept on sealed drip pads until all drippage has ceased.

3.2.2 Product Storage

Pressure treated products are moved to the treated wood storage areas located throughout the facility and placed on skids for storage, and ultimately shipped offsite by truck. No treated wood products are stored in the eastern portion of the facility, where the IRAM cap was placed (Figure 3-2). Untreated wood products are stored throughout the facility.

3.3 Stormwater Management

Prior to 1976, stormwater falling on the Eugene facility primarily infiltrated into the ground, with some runoff into drainage ditches along the northern and southern portions of the facility (Figure 3-3).

In 1976, a one-acre stormwater retention pond was constructed with a bentonite liner in the southwestern portion of the facility (Keystone 1991). Overflow from the pond was discharged to the ditch along the southwestern portion of the facility. The ditch flows westerly beneath Bertelsen Road, then northerly to the Roosevelt Channel, which is a stormwater drainage system for the west Eugene area. Roosevelt Channel empties into Amazon Creek, approximately two miles west of the facility (Figure 3-3). In 1980, DEQ issued a National Pollutant Discharge Elimination System (NPDES) permit for the pond discharge.

In 1981, Baxter constructed a one-acre sprayfield immediately west of the retention pond to facilitate evaporation, which was used until 1982 (Keystone 1991). In 1984, an aerator was added to the pond to enhance aerobic biodegradation of organic constituents in the pond and increase the rate of evaporation. In November 1985, DEQ issued a revised NPDES permit to Baxter for discharge from the retention pond1.

1 NPDES permits are issued by the Oregon Department of Environmental Quality pursuant to ORS 468B.050 and The Federal Clean Water Act.

In 1997, Baxter installed a stormwater collection and treatment system, consisting of catch basins located around the facility to capture all site stormwater, aboveground piping to the stormwater collection tanks, flocculation and precipitation systems, and granulated activated carbon treatment. At this time, bentonite was also added to the stormwater retention pond. Several upgrades to the treatment system have been made since 1997, and treated water is discharged to Outfall 001 (Figure 3-3) under the current NPDES Permit. There is occasional overflow from the pond during extreme storm events. The overflows runs into the ditch at the southwest corner of the facility.

The current NPDES permit (No. 102432) was issued to Baxter on November 30, 2010. The sources covered by this permit include treated stormwater, boiler blowdown, and treated groundwater. These sources discharge through two outfalls, both of which are described in the permit as storm ditches. Treated stormwater and boiler blowdown is discharged through Outfall 001, and treated groundwater is discharged to Outfall 002 (Figure 3-3).

> Baxter is in the process of renewing its NPDES permit. Baxter submitted its permit renewal application in April 2015, and with DEQ's agreement has been collecting additional monitoring data that is required for the application. This supplemental data collection is for constituents that are not monitored under Baxter's NPDES permit. Results for this supplemental sampling are due to DEQ by February 29, 2016. At that time, the permit application will be complete and DEQ will begin reviewing the application.

3.4 Hazardous Waste Management

PCP, creosote, Chemonite®, and other metal-based treating solutions are registered pesticides under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), and have been used for treating wood products at the facility. Baxter recycles and reuses process residuals and wastewater in accordance with RCRA. In addition, under Baxter's *Incidental and Infrequent Drippage Plan* (Baxter 2006b), soil is inspected daily during operations and any liquid or stained soil is collected and disposed of as hazardous waste. Hazardous wastes generated at the Eugene facility are managed in accordance with federal, state, and local regulations. Hazardous wastes generated onsite are shipped offsite for disposal. Prior to shipment, the wastes are stored in the hazardous waste storage shed (Figure 3-2).

3.5 Previous Investigations and Interim Remedial Measures

Several environmental investigations and interim remedial measures have been performed at the Eugene facility since 1981. A brief listing of the previously completed investigations is provided below:

- Quarterly monitoring activities begin (1985)
- Surface geophysical survey and aquifer tests (1987) Offsite Water Well Survey (1990)

- Phase I Remedial Investigation (1989)
- Soil Pile Removal (1992)
- Groundwater Extraction and Treatment System (installed 1993)
- Phase II Remedial Investigation (1994)
- Feasibility Study Work Plan - Phase I (1995)
- Phase II Feasibility Study Supplemental Investigation (1996)
- Stormwater Treatment System (installed 1997)
- Onsite Soil and Sediment Sampling (1998)
- Offsite Tax Lot Sampling (1998)
- Capture Zone Analysis (1999)
- Ecological Risk Assessment (1999)
- Offsite Tax Lot Removal Action (1999)
- Supplemental Groundwater Investigation (2000)
- Private Well Investigation (2000)
- Former Guard Post Storage Area Investigation (2000)
- Phase II Supplemental Groundwater Investigation (2000)
- Supplemental Remedial Investigation (2001)
- Stormwater Tank Base Cap (installed 2001)
- NAPL pilot study (2002)
- Sediment Sampling (2003)
- Well Improvements (interim measures taken 2004)
- Installation of Odor Control System (2005)
- IRAM Cap (installed 2007)
- Submittal of RI Summary Report (2010)

The integrated results of these investigations and interim measures details are discussed in the RI Summary Report (Baxter 2010a). DEQ approved the RI Summary Report on March 15, 2011 (DEQ, 2011b). A Revised Baseline Human Health Risk Assessment (BHHRA) was submitted to DEQ on July 28, 2006 (Baxter 2006a), which incorporated DEQ's comments on the 2002 Draft Human Health Risk Assessment (Baxter 2002c). An addendum to the 2006 BHHRA was subsequently submitted as a technical memorandum dated February 19, 2014 (AMEC 2014). In 2011, Baxter submitted a Feasibility Study Report (Baxter 2011a) to DEQ; this report was not finalized. An addendum to the 2011 FS was submitted to DEQ in 2015 (GSI 2015) that presented an alternate recommended remedy. In 2015, Baxter proposed a revised sampling program (Baxter, 2015a) and based on DEQ's approval e-mail dated May 7, 2015 (DEQ, 2015). Baxter prepared the Revised Monitoring Program May 2015 (Baxter, 2015b).

3.6 Environmental Setting

This section describes the environmental setting including geology, hydrogeology, and other environmental conditions at the Eugene facility.

3.6.1 Topography

The topography at the facility is relatively flat, with elevations ranging from approximately 395 feet above mean sea level (msl) on the eastern boundary of the facility to 390 feet msl on the western boundary (USGS 1986). Topography in the vicinity slopes gently to the west toward Amazon Creek, located about 2 miles west of the facility. The site location and features at the facility are illustrated in Figures 3-1 and 3-2.

3.6.2 Soils

According to the U.S. Department of Agriculture, soils at the facility consist of Coburg and Awbrig Urban land complexes (USDA 1987). A majority of the facility consists of the Coburg Urban land complex, which is a deep, moderately well-drained, and low permeability soil. The soil along the southern site boundary consists of the Awbrig Urban land complex, which is a deep, poorly drained, and very low permeability soil. Both soils are typically located on stream terraces and have a percent slope of 0 to 3 percent. The Coburg and Awbrig Urban land complexes were formed in clayey and silty alluvium.

3.6.3 Geology

Eugene is located in the southern part of the Willamette Valley within the Pacific Border (Puget Trough section) physiographic province, which is characterized by diverse low lands. Eugene is situated between the Cascades to the east, the Coast Range to the west, and the Calapooya Range to the south.

The Eugene area is dominated by unconsolidated alluvial deposits of Quaternary age. The deposits are broken down into older and younger alluvial deposits, which are both composed of sands and gravels, with intermixed silt and clay materials.

The facility is situated on the older alluvium, which makes up the most extensive aquifer in the area. The alluvial deposits are estimated to be approximately 150 to 200 feet thick beneath the site (Keystone 1991).

Based on boreholes and wells completed by Baxter, soils beneath the facility and surrounding area consist of a surficial silty clay horizon approximately 6 to 10 feet thick. Sandy gravels with varying amounts of silt and sand are present beneath the surficial material. Two aquitards are evident at the facility and adjacent areas based on borehole logs. The upper aquitard is composed of silty sandy gravel, and may be discontinuous west of the facility. The depth of the upper aquitard is 10 to 30 feet bgs and varies in thickness from approximately 10 to 30 feet. The deeper aquitard is present at a depth of approximately 70 to 80 feet bgs, and varies in thickness from a few feet to approximately 30 feet. The deeper aquitard appears to be discontinuous or absent west and northwest of the site. Generalized geologic cross sections are provided in Figures 3-5 and 3-6. Figure 3-4 shows the location of the cross sections in plan view.

3.6.4 Hydrogeology

Three informal water-bearing zones have been identified at the facility and in the surrounding area: a shallow water-bearing zone, an intermediate water-bearing zone, and a deeper water-bearing zone. Borehole data and pump test data indicate that the shallow and intermediate zones are semi-confined and leaky (Keystone 1991, 1994).

The shallow water-bearing zone is present in the sandy gravel beneath the surficial silty clay horizon, and is present at depths from approximately 10 to 30 feet bgs. Shallow groundwater may potentially discharge to Roosevelt Canal, depending on the time of year. The shallow water-bearing zone is separated from the intermediate water-bearing zone by discontinuous silty sandy gravel. The intermediate water-bearing zone is present beneath most of the facility, beginning at depths of approximately 20 feet bgs on the eastern portion of the facility to approximately 40 feet bgs west of the facility. The base of the intermediate zone is approximately 60 to 80 feet bgs. The intermediate and deeper zones are separated by an aquitard of silt, silty clay, or clay. The deeper water-bearing zone is present beneath the facility at a depth beginning at approximately 80 to 100 feet bgs, and is comprised of sandy gravel. Based on well and boring logs, pump test data, and the extent of PCP in groundwater, it appears that all three informal water-bearing zones are interconnected to some degree over the site and site vicinity.

Groundwater in the area is present at depths varying from approximately 4 to 22 feet bgs in the shallow water-bearing zone; approximately 6 to 28 feet bgs in the intermediate water-bearing zone; and approximately 12 to 22 feet bgs in the deeper water-bearing zone, depending on the location and time of year (Baxter 2009). Note that depths to groundwater can vary due to seasons, which water-bearing zone the well is screened in, and proximity to groundwater extraction wells. Groundwater flow in the shallow zone is north to northwesterly, and northwesterly in the intermediate zone. Groundwater gradients typically range from 0.007 to 0.02 feet/feet in the shallow zone, and 0.003 to 0.005 feet/feet in the intermediate zone. At the northern facility boundary, a groundwater capture zone has developed around the existing groundwater extraction wells in both the shallow and intermediate zones (Baxter 2010b). Inferred shallow zone groundwater flow directions for the spring of 2008 is provided in Figure 3-7. Inferred intermediate zone groundwater flow directions for the spring of 2008 is provided in Figure 3-8. Subsequent sampling has confirmed both flow direction and capture zones.

3.6.5 Surface Water Hydrology

Natural surface water drainage in the Eugene area is to the north-northwest toward the Willamette River. Drainage in the vicinity of the site had been modified by ditches and canals built in the 1950s by the Army Corps of Engineers and the Soil Conservation Service. The drainage system is included within the lower Amazon Creek Watershed. This watershed drains west and north through Fern Ridge Reservoir and the Long Tom River to the Willamette River, 40 miles north of Eugene (Keystone 1991). Any stormwater that collects on the facility in the pond is transferred to the stormwater treatment system. Treated stormwater is discharged through Outfall 001, described in the current NPDES permit as a storm ditch.

3.6.6 Demography and Land Use

The land near the facility was first developed in the mid-1920s for agricultural use, including farmhouses. Beginning in the 1950's, the farmland was developed for residential housing. The area was annexed as part of the City of Eugene in the early 1960's. The Eugene facility is zoned heavy industrial.

The area near the facility currently includes mixed industrial, commercial, and residential properties. Residential areas are located primarily north, northwest, and west of the facility, on the north side of Roosevelt Boulevard and west of the facility along Cross Street. Industrial areas are located south, west, and east of the facility. Reasonably likely future uses are generally the same as current uses. No changes in the current land use practices or zoning are expected. Land use for the immediate area is shown on Figure 3-9.

3.6.7 Groundwater and Surface Water Use

In June 2002, Baxter prepared a Revised Beneficial Water Use Determination (BWUD) for the Eugene facility (Baxter 2002a). Water use in the area was researched by contacting nearby property owners, conducting a field survey, and reviewing water well logs from the Water Resources Department that were within approximately one-mile of the facility. Baxter also connected the residents in the neighborhood north of the plant to City Water provided by EWEB.

The area has been primarily agricultural, residential, and industrial for the past 80 years. Based on the limited historical information obtained, municipal water was provided to the area by the Bethel Water District from sometime before 1939 to 1964. The Eugene Water and Electrical Board (EWEB) have provided water to the area since 1964. The main source of water provided by the EWEB is obtained from the McKenzie River. In addition, the EWEB relies on 24 covered reservoirs.

Twenty-seven water wells were initially identified in the locality of the facility (domestic, irrigation, or industrial wells, excluding monitoring wells). Water wells used for industrial use are located at properties in the site vicinity including Zip-O-Log, Camac Veneer (abandon according to the 2002 well survey), and Sanipot (abandoned in 2004). In addition, water wells used for irrigation purposes were identified in the site vicinity. Anticipated future uses of groundwater in the locality of the facility are expected to be for irrigation or industrial use, since Baxter connected the residents in the early 2000's, City water is readily available to the area provided by EWEB. Additional details on water use in the area is provided in the BWUD (Baxter 2002a), which was approved by DEQ in 2009 (DEQ, 2009a).

In 2015, as part of Baxter's request to revise the monitoring program, a review of new well installations in the vicinity of the Site was performed by GSI to determine whether there were new residential wells installed since the BWUD was completed in 2002. One new well was discovered within the Locality of Facility as defined in the 2002 BWUD based on a search of the Oregon Water Resources files. Results of the well search are provided in the technical memorandum dated April 2, 2015 entitled "Additional Information Requested Regarding the Reduction in Monitoring Request Dated February 9, 2015" (Baxter, 2015a). In DEQ's comment letter on the 2015 FS Addendum, they requested Baxter re-survey the adjacent neighborhood for information about well ownership and use. The BWUD will be updated as part of the recommended remedy, as discussed in Section 10, however, the beneficial uses identified are not expected to have changed.

3.6.8 Ecological Habitat

A small ecological habitat (approximately 3.5 acres) was identified in the Phase II RI, located in the southwest corner of the facility (the undeveloped area). This area included a small wetland, which was filled in 2001 during construction of the tank base cap for the stormwater treatment system. No other ecological habitat is present at the facility.

An Ecological Risk Assessment (ERA) was completed for the facility in 1999 (Keystone 1999) and approved by DEQ in a letter dated July 23, 1999.

4 Previous Investigation Findings

This section summarizes the distribution of Chemicals of Concern (COCs) throughout the different areas of the Eugene facility that will be used as the basis for the feasibility study. This summary is based on the findings of presented in the RI Summary (Baxter 2010a). For the purpose of this document, the "main treatment area" refers to the area containing the retorts and tank farm, where the treating solutions have historically and are currently handled and stored (Figure 4-1).

COCs discussed in this section include chemicals that have been detected during previous investigations and were found to chemicals of concern in the Revised BHHRA (Baxter 2006a). The COCs include PCP, PAHs, PCDD/PCDFs, and arsenic. In addition, the occurrence and distribution of observed non-aqueous phase liquid (NAPL) is discussed in this section. A detailed summary of analytical results is provided in Appendix C of the RI summary.

4.1 Surface Soil

Numerous surface soil (i.e., soils less than 2 feet bgs) samples have been collected at the facility. These samples have been analyzed for a wide variety of general chemistry parameters, metals, and organic compounds.

PCP was detected in 17 of 61 samples analyzed. The highest concentration of PCP was detected at B-11 near the main treatment area at a concentration 182 mg/kg. In general, PCP concentrations are highest in the main treatment area and near the former burn pit, where PCP treating solutions were handled. PCP concentrations away from the main treatment area and former burn pit are generally low or below method reporting limits.

Total PAHs were detected in 57 of 62 samples analyzed for PAHs. The highest total PAH concentration was from a soil pile removed from the drip pad area during construction of the new drip pads in 1992 (Baxter 2010a). The distribution of PAHs in surface soil is similar to that of PCP.

Metals, including arsenic, chromium, copper, and zinc was detected in nearly all of the samples analyzed. The maximum arsenic, chromium, copper, and zinc concentrations were 2,390 mg/kg, 468 mg/kg, 4,090 mg/kg, and 1,790 mg/kg, respectively. The highest concentrations of metals were present southeast of the main treating area. Metals concentrations in areas away from the main treatment area are considerably lower (Baxter 2010a).

Polychlorinated dibenzo-*p*-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) were analyzed in nine surface soil samples. PCDD/PCDF concentrations ranged from

7.23 pg/g near Retort 85 to 1,400 pg/g Toxic equivalent concentration (TEQ) in the soil pile (subsequently removed).

4.2 Subsurface Soil

Subsurface soil (i.e., soils greater than 2 feet bgs) samples were collected during the Phase I and Phase II RI. These samples were analyzed for general chemistry parameters, metals, and organic compounds. A detailed summary of analytical results is provided in the RI (Baxter 2010a). A statistical analysis of subsurface soil COIs and COPCs are presented in the Revised BHHRA (Baxter, 2006a).

PCP was detected in 18 of the 68 samples analyzed. The highest concentration of PCP was detected 7 to 9 feet bgs at B-36 near the main treatment area at a concentration of 163.9 mg/kg. In general, PCP concentrations are highest in the main treatment area where PCP treating solutions were handled. PCP concentrations away from the main treatment area are generally low or below method reporting limits.

PAHs were detected in 41 of 66 samples analyzed. The highest concentration of total PAHs was detected near the main treatment area. The distribution of PAHs in subsurface soil is similar to that of PCP.

Metals, including arsenic, chromium, copper, and zinc were detected in nearly all of the samples analyzed. The maximum arsenic, chromium, copper, and zinc concentrations were 1,650 mg/kg, 53.6 mg/kg, 154 mg/kg, and 1,180 mg/kg, respectively. The highest concentration of arsenic, chromium, and copper was detected 2.5 to 4 feet bgs near the main treatment area. Metals concentrations in areas away from the main treatment area are lower.

Residual nonaqueous phase liquid (NAPL) was observed in soil near the main treatment area, the stormwater retention pond, and the former burn pit during the installation of seven monitoring wells and 10 soil borings. In this report, residual NAPL refers to NAPL that is non-mobile, and held in soil by capillary forces. Areas with residual NAPL typically contain soils with the highest concentrations of COCs.

4.3 Groundwater

Groundwater data has been collected from facility monitoring wells since 1985. A summary of the number of samples, number of detections, and the minimum, median, and maximum concentrations for each analyte is presented in the RI, along with sample locations. A statistical analysis of groundwater contaminants of interest (COIs) and contaminants of potential concern (COPCs) are presented in the Revised BHHRA (Baxter 2006a). Figures 4-2 and 4-3 show groundwater concentrations from the August 2014, March 2015, and September 2015 sampling events for the shallow and intermediate water-bearing zones, respectively.

Small quantities of DNAPL and LNAPL have been reported in W-2S (located near the stormwater retention pond, and in W-8S located near the former burn pit (Figure 4-2). NAPL has not been observed in any other wells at or near the facility. In 2002, Baxter evaluated the possibility of extraction of mobile NAPL from W-2S and W-8S (Baxter 2002b). Based on the inability to extract measurable quantities of NAPL and the long period (8 weeks) for NAPL to return to the well, it was determined that there was insufficient mobile NAPL in the 2 wells to allow for recovery (Baxter 2010b).

4.4 Surface Water

Surface water from Roosevelt Channel and the ditch from the stormwater retention pond were sampled in 1990, 1993, 2000, and 2001. Samples have been analyzed for metals, PAHs, and PCP. A summary of the number of samples, number of detections, minimum, median, and maximum concentrations for each analyte is presented in the RI.

Since 1997 when the stormwater collection and treatment was installed, the stormwater discharged at outfall 001 has not been a significant source of site COCs.

4.5 Sediments

Sediment samples were collected in 1990, 1993, 1996, 1998, and 2003 from locations in and around the Baxter Facility. A summary of the number of samples, number of detections, minimum, median, and maximum concentrations for each analyte is presented in the RI.

4.6 Plume Stability Analysis

Baxter conducted a plume stability analysis using groundwater monitoring data from sampling events conducted between 1995 and 2008. The plume stability analysis included the development of PCP concentration isopleth maps for several sampling events, for both the shallow and intermediate water-bearing zones. A complete description of the plume stability analysis and results is included in the RI Summary (Baxter, 2010a).

Based on the plume stability analysis, analytical data collected for the site provide statistical evidence that the PCP plume emanating from the site is stable. As presented in the stability analysis, the area, average concentration, and mass of the PCP plume are stable or decreasing in both the shallow and intermediate aquifer zones. PCP concentrations in individual wells may be increasing or decreasing based on variation in groundwater flow, but overall, there is evidence that the PCP plume at the site is at dynamic equilibrium. Although PCP mass is still sourcing to the plume, the plume is not expanding.

In 2015, an evaluation of the plume between 2001 and 2014 for PCP in the shallow and intermediate water-bearing zones was conducted, coupled with a review of the concentration trends for PCP at individual wells. This evaluation showed that the plume footprint in the intermediate zone is shrinking. Figures 4-2 and 4-3 show the groundwater capture zones for the shallow and intermediate zones. The capture zone shows that the groundwater pump and treat system is containing the source area groundwater plume and preventing offsite groundwater migration. The 2011 FS suggested through groundwater modeling presented in Appendix A that the pump and treat system may not be able to capture the groundwater plume; however, empirical data has shown that source area groundwater capture is achieved by the system. Therefore, the containment of the source area has allowed the offsite intermediate plume to begin to shrink. This is further described and supported in the Technical Memorandum submitted to DEQ on April 2, 2015 entitled Additional Information Requested Regarding Reduction in Monitoring Requested Dated February 9, 2015 (Baxter 2015a).

4.7 Ecological Risk Assessment

As indicated in Section 3.6.8, an ecological risk assessment was performed for the Site (Keystone 1999), and approved by DEQ (DEQ 1999). The risk assessment evaluated potential risks to soil invertebrates, plants, avian species, and small mammals, and concluded that there are no unacceptable risks to ecological receptors at the Site (Keystone 1999).

4.8 Baseline Human Health Risk Assessment

Quantitative risk estimates were calculated for identified onsite and offsite receptor groups and presented in the BHHRA (Baxter, 2006a) and BHHRA Addendum (AMEC 2014). The risk estimates were the result of a deterministic BHHRA for current and hypothetical future receptors and exposure routes. A summary of human health risk assessment findings as presented in the BHHRA and BHHRA Addendum is provided as Table 4-1.

4.8.1 Risk Summary For Onsite Exposures

Risks were evaluated for industrial worker and trenchworker exposures to on-site soil and groundwater. As summarized in the 2011 FS (Baxter 2011), the BHHRA found that there were potentially unacceptable risks to industrial workers from direct contact with arsenic, benzo(a)pyrene, dibenzo(a)anthracene, and dioxins/furans in soil. There were no potentially unacceptable risks from trenchworker exposures to on-site soil.

The BHHRA (Baxter 2006) found that there were potentially unacceptable risks to trenchworkers from direct exposure to benzo(a)pyrene, dibenzo(a)anthracene, and pentachlorophenol in on-site groundwater. Industrial worker contact with groundwater was not evaluated for risk because it is not a complete exposure pathway.

4.8.2 Risk Summary For Off-Site Exposures

The BHHRA for Baxter (Baxter 2006a) evaluated the inhalation exposure pathway, and found there to be no potentially unacceptable risk from chemicals volatilizing from soil or groundwater, or from air dispersion of dust-borne particulates.

The BHHRA Addendum (AMEC 2014) concluded that there was no potentially unacceptable risk to off-site receptors from direct contact with soil, and no potentially unacceptable risk to recreational users of surface water or sediment in Roosevelt Channel.

However, in evaluating off-site residential exposure to groundwater through irrigation, the BHHRA Addendum (AMEC 2014) found that PCP concentrations in the groundwater could pose potentially unacceptable risk. There are currently no known uses of groundwater for domestic purposes (i.e. drinking water), as indicated in the BWUD (Baxter 2002). A drinking water exposure scenario is also unlikely in the future because the Eugene municipal water supply is available to the surrounding neighborhoods. In the BHHRA Addendum (AMEC 2014), Indeno(1,2,3-cd)pyrene and dioxins/furans were also retained as COCs for residential contact with off-site groundwater based on non-detect data, because when the maximum detection limit for these compounds was used in the risk calculations, resulting risk estimates exceeded target risk levels. Additionally, although the BHHRA Addendum showed no unacceptable risk from industrial use of off-site groundwater (i.e. log watering), PCP was retained as a COC for this scenario due to changes in DEQ toxicity factors since the BHHRA was conducted. Only the shallow and intermediate water-bearing zones were identified as posing potential human health risk from exposure to groundwater.

The BHHRA (Baxter 2006) states that there is no potentially unacceptable risk associated with consuming home-grown fruits and vegetables that are irrigated with water from impacted wells.

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5 Proposed Cleanup Levels

In establishing proposed cleanup levels, data from previous investigations were compared to proposed cleanup levels that are considered appropriate for the Eugene Facility. The proposed cleanup levels must be established for affected media and must be appropriate for the land use and related exposure pathways. The affected media identified in the RI are surface and subsurface soil, sediment, and groundwater. Stormwater is treated onsite prior to release to a permitted outfall under the NPDES program. Air discharges from active operations are regulated by an Air Contaminant Discharge Permit (ACDP) issued by the Lane Regional Air Protection Agency (LRAPA). Both the stormwater and air permits address ongoing operations, and permitted discharge limits are below levels that would endanger human health and the environment. In addition, a health consultation was performed by the United States Department of Health and Human Services (USDHHS) and Oregon Department of Human Services, based on air monitoring data from the Site (USDHHS 2007). The health consultation considered exposure of near-by residents to Site-related emissions. The report concluded that adverse health effects are not anticipated as a result of exposure to emissions from the Site (USDHHS 2007). Since 2007, an odor control system was installed at the Site to minimize treatment-related odors, further reducing air emissions from the facility. Therefore, cleanup levels are not needed for these media.

The Eugene facility is located in a mixed-use area of industrial, commercial and residential use. The reasonably likely future uses are generally the same as current uses. No changes in the current land use practices or zoning are expected. The facility has a long history of industrial use and is expected to remain in industrial use into the foreseeable future. Therefore, proposed cleanup levels for onsite media will reflect industrial scenarios. The risk calculations and pathways established in the Revised BHHRA (Baxter 2006a) and the BHHRA Addendum (AMEC 2014), as well as subsequent conversations with DEQ about exposure and toxicity factors, are utilized in determining the proposed cleanup levels.

Proposed cleanup levels are based on an estimated cancer risk of 1 in 1,000,000 (1E-06). Both EPA and DEQ use this level of risk as a target for protecting human health and the environment. Proposed "hot spot" cleanup levels are based on a 1 in 10,000 (1E-04) estimated cancer risk for soil. The findings of the BHHRA were used in setting the proposed cleanup and hot spot levels.

Cleanup levels for the Site are presented in Table 5-1 and described below.

5.1 Hot Spots

The 1995 amendments to Oregon Revised Statutes (ORS 465.315) require the Director of DEQ to select or approve a remedial action requiring treatment of hot spots to the extent treatment is feasible. The Oregon Administrative Rules for environmental cleanup (OAR 340-122) address requirements for hot spots and state the DEQ shall select or approve a remedial action that:

- Is protective of present and future public health, safety and welfare and of the environment, as specified in OAR 340-122-0040;
- Is based on balancing of remedy selection factors, as specified in OAR 340-122-0090(3); and
- Treats hot spots of contamination to the extent feasible, as specified in OAR 340-122-0090(4).

The Oregon environmental cleanup rules define hot spots of contamination in OAR 340-122-0115(31) as:

(a) For groundwater or surface water, hazardous substances having a significant adverse effect on beneficial uses of water or waters to which the hazardous substances would be reasonably likely to migrate and for which treatment is reasonably likely to restore or protect such beneficial uses within a reasonable time, as determined in the feasibility study; and

(b) For media other than groundwater or surface water, (e.g., contaminated soil, debris, sediments, and sludges; drummed wastes; "pools" of dense, non-aqueous phase liquids submerged beneath groundwater or in fractured bedrock; and non-aqueous phase liquids floating on groundwater), if hazardous substances present a risk to human health or the environment exceeding the acceptable risk level, the extent to which the hazardous substances:

(A) Are present in concentrations exceeding risk-based concentrations corresponding to:

(i) 100 times the acceptable risk level for human exposure to each individual carcinogen;

(ii) 10 times the acceptable risk level for human exposure to each individual noncarcinogen; or

(iii) 10 times the acceptable risk level for exposure of individual ecological receptors or populations of ecological receptors to each individual hazardous substance.

(B) Are reasonably likely to migrate to such an extent that the conditions specified in subsection (a) or paragraphs (b)(A) or (b)(C) would be created; or

(C) Are not reliably containable, as determined in the feasibility study.

5.2 Proposed Groundwater Cleanup Levels

Proposed cleanup levels for groundwater were developed using DEQ and EPA guidance, and incorporates the findings of the Beneficial Water Use Determination (Baxter 2002a). As found in the Beneficial Water Use Determination, groundwater uses in the vicinity of the facility are limited to irrigation and industrial purposes, both currently and in the future. Results of the BHHRA Addendum indicate that pentachlorophenol has an estimated cancer risks above the allowable level of 1E-06 only in a future offsite resident scenario. Because of changes in DEQ toxicity values for PCP since the BHHRA was conducted, the industrial use scenario is also considered in the development of groundwater cleanup levels for PCP. The future offsite groundwater scenario assumes that water will come from offsite wells, even though all residents are connected to the City water supply. The BWUD will be updated through a Beneficial Water Use Survey (BWUS) to confirm off-site uses. Response actions that may be required as a result of the findings will be implemented as part of the remedy for the Site.

The groundwater cleanup levels for PCP based on the two off-site scenarios were calculated using the 2015 DEQ risk-based decision-making (RBDM) tool, which includes updated values for toxicity factors and dermal absorption. Exposure parameters provided by DEQ (via e-mail from Susan Turnblom dated 5/6/2015) were used to calculate the cleanup level for the irrigation scenario. These values are shown in Table 5-2. The cleanup level for industrial use of off-site groundwater was calculated using exposure parameter from the BHHRA (Baxter 2006a and AMEC 2014). The PCP cleanup level for the residential off-site irrigation scenario is 0.65 ug/l. The PCP cleanup level for the industrial worker off-site exposure scenario is 1.5 ug/l.

Groundwater hot spot evaluations involve an assessment of hazardous substances in groundwater that have a significant adverse effect on beneficial uses of water or waters to which the hazardous substances would be reasonably likely to migrate. The BWUD report states that future beneficial use of groundwater in the locality of the facility is anticipated for irrigation and industrial purposes. The BHHRA indicates that there is not a significant adverse effect to human health from exposure to PCP through irrigating with groundwater. However, updated toxicity and exposure information provided by DEQ have been incorporated into the proposed PCP cleanup level, and PCP concentrations in off-site groundwater exceed the cleanup level for an irrigation scenario. These exceedances indicate there is a groundwater hot spot that extends offsite, as discussed in Section 5.5.

As described in Section 4, NAPL present at the Site is in the form of residual (or non-mobile) NAPL; and therefore, there are no hot spots related to NAPL.

5.3 Proposed Soil Cleanup Levels

Proposed cleanup levels for soil were developed using DEQ guidance based on industrial land use assuming final remedial actions will include the use of institutional controls.

Results of the BHHRA indicate that arsenic, benzo(a)pyrene, dibenz(a,h)anthracene, and dioxins (as 2,3,7,8-TCDD toxicity equivalents) have estimated cancer risks above the allowable level of 1E-06. The proposed cleanup level selection process for each constituent is described below. Proposed cleanup levels are summarized in Table 5-1.

Arsenic – The Oregon DEQ RBC for soil ingestion, dermal contact, and inhalation of an occupational worker is 1.7 mg/kg (DEQ, 2011c). Based on the onsite worker scenario in the BHHRA, the 1E-06 excess cancer risk level is at 3.4 mg/kg. The background arsenic level in Oregon soils is 18 mg/kg (DEQ, 2013). Since the RBC and 1E-06 concentrations are less than the established background concentration, the proposed cleanup level is set at the background concentration of 18 mg/kg. The proposed hot spot level set at 340 mg/kg, which represents the 1E-04 excess cancer risk level as developed in the BHHRA.

Benzo(a)pyrene – The Oregon DEQ RBC for soil ingestion, dermal contact, and inhalation of an occupational worker is 0.27 mg/kg (DEQ, 2011c). To protect human health and the environment, the proposed cleanup level is set to the RBC of 0.27 mg/kg. The proposed hot spot level set at 27 mg/kg.

Dibenz(a,h)anthracene – The Oregon DEQ RBC for soil ingestion, dermal contact, and inhalation of an occupational worker is 0.27 mg/kg (DEQ, 2011c. To protect health and the environment, the proposed cleanup level is set to the RBC of 0.27 mg/kg. The proposed hot spot level set at 27 mg/kg.

Dioxins as 2,3,7,8-TCDD TEQ – The Oregon DEQ RBC for soil ingestion, dermal contact, and inhalation of an occupational worker is 2.0E-05 mg/kg (DEQ, 2011c To protect health and the environment, the proposed cleanup level is set to the RBC of 2.0E-05 mg/kg. The proposed hot spot level set at 2.0E-03 mg/kg.

Cleanup levels for other compounds are not included in the FS, as the BHHRA did not identify other compounds that posed risks above unacceptable levels.

These cleanup levels will be protective of onsite industrial workers and protective of groundwater under the site.

5.4 Proposed Sediment Cleanup Levels

For the purpose of this FS, no sediment cleanup levels are proposed. Material within the ditch near Outfall 001 at the southwest corner of the facility will be treated as soil, and subject to soil cleanup levels as appropriate.

5.5 Areas of Concern

The primary areas of concern for soil at the facility includes the Main Treatment Area and other areas where treated wood storage or other operations were conducted, as shown on Figure 5-1 and listed in Table 5-3. Areas of soil that exceed the hot spot criteria are also shown on Figure 5-1. Included with the onsite surface and subsurface soils is a narrow section of ditch material located at the southwestern corner of the facility (Figure 5-1) where elevated metals concentrations are present, but below hot spot levels. This area of ditch material is estimated to be approximately 600 feet long by 3 feet wide by 0.5 -1.0 feet deep

As stated earlier, the Beneficial Water Use Determination report states that future beneficial use of groundwater in the locality of the facility is anticipated to be irrigation and industrial purposes. As such, the existing groundwater plume is considered to be an area of concern. The proposed cleanup levels for PCP in groundwater are 0.65 ug/l (residential areas) and 1.5 ug/l (industrial areas). Because 0.65 ug/l is below historic detection limits for PCP, the approximate area delineated to 1 μg/L is shown in Figures 5-2 and 5-3 for the shallow and intermediate plumes, respectively. These figures also show the locations of water wells within the Locality of Facility. The Locality of Facility was originally indicated in the 2002 BWUD and accepted by DEQ. Since that report, the offsite groundwater plume has been shown to be shrinking, and as a result, a revised Locality of Facility is depicted on Figures 5-2 and 5-3.

Surface water and sediments located north of the facility in Roosevelt Channel are not considered an area of concern in this FS.

6 Conceptual Site Model

This section presents the conceptual site model (CSM) for the Eugene facility based on a synthesis of the existing physical and chemical data, and historical operations. The CSM presents a working hypothesis of the contaminant sources, distribution, and transport pathways.

A block diagram depicting the CSM is presented in Figure 6-1. The block diagram illustrates the current understanding of the potential sources and releases of COPCs, generalized hydrogeologic information, and COPC distribution and transport at the facility.

The Revised BHHRA (Baxter 2006a) identifies Chemicals of Interest (COIs) and Chemicals of Potential Concern (COPCs) in accordance with the Guidance for Conduct of Deterministic Human Health Risk Assessment (DEQ 2000). In the Revised BHHRA, COIs are defined as all chemicals that were detected at the facility prior to the BHHRA risk screening process. COPCs are defined as the COIs that exceed preliminary risk screening levels for each media. For a detailed discussion of COIs and COPCs, the reader is referred to the Revised BHHRA (Baxter 2006a).

For the purpose of this document, the COPCs identified in the BHHRA and BHHRA Addendum are described as Chemicals of Concern (COC). In addition, PCP is identified as a COC for an off-site industrial use scenario due to changes in toxicity factors since the BHHRA was conducted. Each of the COCs listed below will require remediation in select areas. Other chemicals present at the facility were not of a concern, and are not further discussed.

Potential human receptors and the potential pathways by which those receptors might be exposed to site-related COCs are briefly presented in this report, and are evaluated in detail as part of the BHHRA (Baxter 2006a) and BHHRA Addendum (AMEC 2014). The BHHRA also includes a CSM for human health pathways.

6.1 Chemicals of Potential Concern

The COCs listed below were developed from the BHHRA.

Pentachlorophenol. Petroleum hydrocarbon-based PCP solution is currently used at the facility to treat wood products. The PCP solution is primarily PCP dissolved in carrier oil. The PCP solution also contains tetrachlorophenols (TeCP) and trichlorophenols (TCP). Breakdown products of PCP include TeCP, TCP, dichlorophenol (DCP), pentachloroanisol (PCA), and other phenolic compounds. Contaminants in technical-grade PCP historically may have included PCDDs/PCDFs.

Dioxins/furans (PCDD/PCDFs). As discussed above, the PCP mixture historically used at the Site may have included PCDDs/PCDFs, and the BHHRA found potentially unacceptable risks from direct exposure to PCDDs/PCDFs in on-Site soils.

Petroleum hydrocarbons. Petroleum hydrocarbon mixtures such as diesel or other petroleum distillates have been used onsite as carriers for PCP and/or creosote treating solutions. The carrier historically used for PCP treating solutions is medium aromatic oil with the physical characteristics similar to No. 2 diesel oil.

Polycyclic Aromatic Hydrocarbons (PAHs). PAH compounds are the main components in creosote mixtures, and were historically used at the facility. Additional sources of PAHs may include the petroleum hydrocarbon-based carrier for creosote and PCP treating solutions.

Metals. Metals associated with wood treating chemicals and processes include arsenic, chromium, copper, and zinc. Metals are generally found as solids in soils and subsurface soils and have limited mobility. Variables that determine the ability of metals to move through soil include solubility of the metal, and pH and composition of the soils.

6.2 Treatment Solution Use and Source Areas

Current and historical wood treating processes and chemical use has occurred primarily in the central portion of the Eugene facility. All currently used treating equipment, including five pressure retorts and the tank farms, are located within concrete secondary containment structures. Annual inspection records at the facility indicate that these secondary containment structures remain in good structural condition. Concrete secondary containment structures have been present at the facility since at least the late 1960's.

Known, likely, or potential sources of releases of COCs to site media are summarized below:

- **Retorts 81 - 84**. This group of retorts lies southwest of the facility office. Retort 82 was installed in 1943, is currently in use, and has been used for treating wood with creosote, PCP, and ACZA formulations. Retort 83 was installed in 1945, is currently in use, and has been used for treating wood with fire retardants, creosote, PCP, ACA, and CZC formulations. Retort 84 was installed in 1966 and has been used to treat wood with fire retardants, ACA, ACQ, ACZA, and PCP formulations. Fire retardants used include D-blaze, NCX, and Flamescape, none of which are known to contain PCBs. Retort 81 was installed in 1967 and has been used to treat wood with ACA, creosote, and PCP formulations. No spills have been reported from these retorts and the retorts currently are housed in secondary containment structures. This group of retorts is a likely source area.

- **Retort 85**. Retort 85 is located northwest of Retorts 81 through 84. Retort 85 was installed in 1970 and has been used to treat wood with fire retardants, PCP formulations, and ACQ. No spills have been reported from Retort 85 and the retort is currently housed in secondary containment structures. Retort 85 is a potential source area.

- **Former Burn Pit and Associated Pipeline**. Between the years of 1945 to 1955, a burn pit was reportedly used to dispose of waste onsite. This former burn pit was reportedly located south of Retorts 81 through 85. Oil sludges were transferred to the burn pit by 55-gallon drum (Keystone 1991). NAPL has been observed in the subsurface in well W-8S located adjacent to the burn pit.

- **Stormwater Retention Pond**. The existing stormwater retention pond is approximately one acre in size, five feet deep and is located in the southwest corner of the facility (Figure 3-1). The stormwater retention pond is no longer in use (other than containing water from precipitation events), but received stormwater from ditches located along the southern property boundary. The ditches along the southern property boundary received stormwater by overland flow across the facility. In addition, bentonite clay was added to the stormwater retention pond in the late 1990s to limit the migration of COCs through infiltration to the subsurface. Small quantities of DNAPL and LNAPL have been reported in W-2S, which is located near the stormwater retention pond. The retention pond is a likely historical source of COCs to the subsurface through infiltration of affected stormwater.

- **Former Sprayfield**. The former one-acre sprayfield is located immediately west of the existing stormwater retention pond (Figure 3-1). This sprayfield was used between 1981 and 1982 to facilitate evaporation of stormwater (Keystone 1991). This former sprayfield is a potential historic source of COCs to soils and the subsurface through infiltration of affected stormwater.

- **Former Butt Tanks**. Two butt treating tanks were used at the facility between 1950 and 1961 (Figure 3-1). Prior to 1970, one of the two tanks was converted to a PCP mixing tank (since removed), and the other tank was removed (Keystone 1991)(Figure 3-1). No spills were reported from either butt tank.

- **Treated Products**. Treated products (historically and currently) are placed in piles on skids that are separated by access roads. De minimus drippage may occur from treated products, but soil stained with drippage is collected and disposed of in accordance with Baxter's Contingency Plan for Incidental and Infrequent Drippage (Baxter 2006b). Contingency plans for managing incidental drippage have been in place since promulgation of 40 C.F.R. § 264.570 (Subpart W) in 1990. Prior to 1990, de minimus drippage likely occurred in the storage yards, and is a source of COCs.

- **Ditches and Overland Flow**. Currently, stormwater at the facility is collected in catch basins and piped to the Stormwater Treatment System. Prior to construction of the stormwater treatment system and collection system, stormwater falling at the facility flowed across the facility (as overland flow) to ditches along the southern property boundary, then to the stormwater retention pond located at the southwest corner of the facility. These ditches and overland flow are likely sources of COCs to the subsurface via infiltration of affected stormwater.

6.3 Transport Pathways

Potential pathways for COC transport to human receptors include direct contact with soil, groundwater, NAPL, stormwater, and air transport. Of these, direct contact with affected soil, groundwater and NAPL, and stormwater and sediment transport are the primary pathways of interest, because of the ongoing potential for effects on human receptors. Because of the interrelationship between NAPL transport and groundwater transport, these pathways are discussed collectively. Similarly, the stormwater pathway and sediment pathway are also discussed collectively in the following sections. Other remaining potential pathways are addressed at the end of this section. Pathways and receptor are discussed in more detail in the BHHRA.

6.3.1 Soil Transport Pathways

The soil pathway involves the movement of a COC (such as PCP, creosote, or metals-based treating solution constituents) to surface or subsurface soils. COCs have been detected over much of the facility in surface and subsurface soils from releases from known, likely, or potential sources.

Onsite workers or trespassers could be potentially exposed to these COCs by incidental ingestion or dermal contact of affected soils, or inhalation of dust-borne particulates. In addition, onsite trench workers could be exposed to affected soils in the subsurface, and offsite residents could be exposed to COC-affected dust. Finally, COC-affected soil from the facility could be transported by winds to offsite areas.

6.3.2 Groundwater and NAPL Pathways

The groundwater and NAPL pathways involve the movement of a COC to groundwater and potential downgradient receptors. To be considered a complete pathway, the COC must be incorporated into groundwater in a dissolved (aqueous) phase, sorbed onto particulate or colloidal particles, or as NAPL, and must be transported to a point of contact with the end receptor. At the Eugene facility, groundwater transport of COCs occurs by the following mechanisms:

- Leaching of COC-affected soils or sediments in the vadose (unsaturated) zone and infiltration of the leachate to groundwater.

- Direct contact of COC-affected soils with groundwater.

- Direct contact of NAPL (containing COCs) with groundwater.

All of these processes have, and are currently occurring at the Baxter facility. For example, over the period of facility operations, gravity and the infiltration and percolation of rainfall at the facility carried the PCP, creosote, or metals-based treating solutions (as a NAPL or as a dissolved phase) downward vertically through the unsaturated soil zone to the unconfined shallow groundwater surface. Areas containing residual NAPL have been observed in the Main Treating Area, and small quantities of NAPL have been reported near the stormwater retention pond and near the former burn pit (Figure 3-2). Investigations conducted as part of the RI indicated that the quantity of NAPL that is present is insufficient for conventional removal technologies (Baxter 2010b).

Based on the results of the RI Summary, groundwater is in contact with soils affected by COCs and a dissolved phase plume is present beneath the facility. However, exposure is limited to the lack of receptors downgradient of the facility. All residents and users located downgradient have access to the City water system.

6.3.3 Surface Water and Sediment Pathways

The surface water and sediment pathways address the potential particulate or dissolved-phase transport of COC at or from the facility. To be considered a complete pathway, the COC-containing soil, groundwater, or NAPL must come into contact with surface water and must be physically or chemically transported into the surface water at, or in the vicinity of the facility. In addition, the infiltration of COC-affected surface water into vadose zone soils and groundwater is a potential pathway. Since 1997 all onsite stormwater has been collected and treated at the facility.

6.3.4 Air Transport Pathways

The potential pathways for emissions from wood treating operations at the Eugene facility include the following:

- Potential direct exposure to airborne vapors and contaminated windblown dust, potentially affecting onsite workers and offsite receptors including workers at adjacent industrial operations and nearby residents.

- Potential deposition of vapors onto the ground, where PCP could accumulate in surface soils where direct contact could occur or the chemicals could then migrate from surface soil into surface water or groundwater.

Baxter currently operates a carbon ventilation system at the facility, which collects emissions from the retorts, work tanks, and storage tanks. Emissions from these sources are captured and treated by activated carbon prior to discharge.

6.4 Potential Receptors

Potential current and future human receptors include onsite plant workers and trenchworkers, offsite area industrial workers, nearby residents, and trespassers. Onsite workers are likely to be the receptor population with the highest exposure potential. Onsite and offsite workers, residents, and trespassers could potentially contact COCs in site media via ingestion, dermal contact, or, to a lesser extent, inhalation. These potential receptors are evaluated in more detail in the BHHRA and BHHRA Addendum.

A complete exposure pathway for ecological receptors exists only when a receptor population, chemical contaminants, and a mechanism of exposure are all present. The ERA (Keystone 1999) concluded that chemicals of potential ecological concern in the undeveloped area are highly unlikely to present significant risk to soil invertebrates, plants, avian species, and small mammals. The ERA was approved by DEQ on July 23, 1999 (DEQ 1999).

7 Remedial Action Considerations

There are unique conditions associated with the Eugene facility that require consideration when developing and selecting remedial actions. These considerations include site conditions, contaminant characteristics, and technology limitations, as discussed in the following subsections.

7.1 Site Conditions

Large areas of the Eugene facility need to be addressed by remedial actions. The eastern portion of the facility (IRAM capped area) has been remediated and a No Further Action determination has been made by DEQ (DEQ, 2011a). This 11-acre parcel was sold to Pacific Recycling, and they are required to comply with the Soils Management Plan for that acreage. Offsite areas with affected groundwater have had no facility operations, but groundwater exceeds the proposed cleanup levels for PCP as a result of releases from the facility. As such, remedial actions developed for the facility in the following sections will address affected groundwater that extends downgradient from the Main Treatment Area, including offsite areas.

The Main Treating Area encompasses the majority of the industrial operations for the facility. It has served as the wood treatment area since the 1940's. COC-affected soils within the Main Treatment Area are the primary source of COCs in groundwater at the Eugene facility. However, all current operations have secondary containment so there are no further discharges. This area is central to facility operations, and any technologies proposed to address soils affected with COCs in the area must consider the effects of the remedial activities on facility operations and the facility operation's effects on the remedial activities. For example, excavation of soils in the Main Treatment Area would require shutting down the entire facility operations for a period of time. The costs of a facility shutdown, even for very short periods, could be severe particularly if a shutdown would require demolition of a portion of the existing facility and secondary containment structures, loss of income during the cleanup period of several months (referred to as opportunity losses, which could include long term loss of customers), and finally reconstruction of the facility after completion of the excavation work. Similarly, any measure planned in the area of the facility operations could be affected by the operations such as not being able to place components of the remedy in the ideal locations due to operational constraints. Proposed remedial alternatives will need to consider these effects in the evaluation process. Because the facility is currently operating, it is likely that the facility will remain industrial for the foreseeable future.

7.2 Contaminant Characteristics

Areas of COC-affected soil include the Main Treating Area (organics and metals), as well as low-level concentrations of metals across much of the site.

The area containing residual NAPL is considered the primary source of affected groundwater; however, the nature of the NAPL underlying the Main Treatment Area presents challenges to removal, as little free (mobile) NAPL has been observed during monitoring operations and during the NAPL pilot study. The residual NAPL is recoverable only through invasive and disruptive remediation technologies such as thermal processes (e.g., electrical resistance heating or steam injection) or excavation.

In addition, COC-affected soil, primarily surficial soils containing arsenic, is present over large areas of the facility. Removal of metals from soils is very difficult: containment technologies such as soil fixation or capping are typically used for these types of contaminants.

The existing groundwater plume beneath the Baxter facility extends westerly from the source area under the Main Treatment Area. PCP is the primary COC within the plume, with PAH compounds also present in groundwater near the source area (Figures 5-2 and 5-3). The presence of PCP in groundwater creates regulatory considerations in evaluating technologies. Any water generated by a technology such as pumping or above ground treatment would potentially be considered a RCRA listed waste due to the presence of PCP. RCRA has an exemption from this waste listing if the water is discharged to a Publicly Owned Treatment Works (POTW) or under a permitted NPDES discharge. Other options for disposal of treated groundwater include infiltration into the ground or discharge to the ditches located on the northern and southern margins of the facility. Groundwater reinjection back into the groundwater plume is exempted from the RCRA listed waste issue and can be done under a Class V injection permit.

7.3 Technology Limitations

The subsections above outline specific factors to be considered for technology selection based on site conditions and contaminant characteristics. In addition, for the types of COCs at the Baxter facility, technologies are limited in their application. DEQ guidance indicates a preference for COC destruction or removal for both the source area and any associated plume. For wood treating sites, the characteristics of the COCs are such that complete removal or destruction is unlikely even using very aggressive remediation technologies. At best, these technologies have been only partially effective in reducing source mass, and therefore long-term containment strategies are still necessary. For this reason, technologies will be screened out that have not been successfully implemented or that do not provide a risk benefit versus costs.

7.4 Regulatory Considerations

DEQ's environmental cleanup requirements (OAR 340-122-0010 et. seq.) favor permanent solutions. DEQ has the common goal to eliminate the potential risk that a hazardous substance can remobilize in the future if a nonpermanent remedy fails.

8 Remedial Action Objectives

Remedial Action Objectives (RAOs) are developed in this section as an initial step in the development of remedial actions for this facility. RAOs define the locations, media, constituents, and receptors that need to be addressed by the selected remedial actions in order to remediate potential adverse risks. The qualitative objectives are summarized in this section. Remedial actions are only needed to address potential human health risks, since there are no ecological habitats that could be affected by groundwater (see Section 6.4).

8.1 Applicable Requirements

The potentially applicable federal laws that will be considered for potential remedial actions and proposed cleanup levels include:

- Clean Water Act (including the National Toxics Rule and NPDES requirements);
- Safe Drinking Water Act (including Drinking Water Standards and Health Advisories);
- Resource Conservation and Recovery Act;
- Toxic Substances Control Act; and
- EPA Regional Screening Levels (RSLs).
- Potentially applicable state laws and regulations include:
- Water Resources Act of 1971;
- Drinking Water Act (including Drinking Water Regulations); and
- Hazardous Waste Management Act (including Dangerous Waste Regulations);
- Oregon cleanup requirements in OAR 340 122-0010 et. seq.

8.2 Remedial Action Objectives

The remedial action objectives (RAOs) for the Site are as follows:

Soil:

- Prevent human exposure to on-site surface and subsurface soil containing chemicals of concern (COCs) at concentrations above industrial cleanup levels, including arsenic, benzo(a)pyrene, dibenzo(a,h)anthracene, and dioxins/furans.

- Prevent human exposure to arsenic in soil at concentrations above hot spot levels.

Groundwater:

- Prevent or minimize human exposure to COCs in on-site and off-site groundwater, including pentachlorophenol, PAHs, and dioxins/furans.

- Reduce the contaminant mass of COCs in groundwater to achieve cleanup levels and protect human health and the environment

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9 Technology Screening

Technologies that may potentially be used to address conditions at the facility will be identified and screened based on their applicability to the specific site conditions and COCs at the Baxter facility. Technology screening is a very coarse assessment, and technologies are either deemed potentially suitable, or are not appropriate or feasible and are rejected for further consideration.

9.1 General Response Actions

General response actions are medium-specific actions that will satisfy the RAOs. General response actions may include treatment, containment, excavation, extraction, disposal, institutional controls (ICs), or a combination of these.

9.1.1 Surface Soil, Subsurface Soil, and Sediments

General response actions for surface soil, subsurface soil, and sediments are:

- Monitored natural attenuation (MNA),
- Institutional Controls (ICs),
- Containment,
- Recovery/Removal,
- Ex situ treatment, and
- In situ treatment.

MNA is a general response action that relies on natural attenuation mechanisms to reduce contaminant concentrations to remedial action goals. No efforts would be taken under this general response to remove, treat, or otherwise control the release of contaminants in the subsurface.

IC are administrative measures undertaken to limit or prohibit activities that may interfere with a cleanup action or result in exposure to hazardous substances. They typically include legal restrictions, such as use limitations recorded on the property deed.

Containment technologies include the use of engineered barriers to isolate wastes. When properly constructed and maintained, these barriers often provide a reliable means of minimizing direct exposure and controlling the spread of contaminants from a waste source. Containment technologies include both horizontal (e.g., caps) and vertical (e.g., slurry wall) barriers.

Recovery/removal refers to the physical removal of wastes. The most common recovery/removal response action for contaminated soil or shallow sediment is excavation. Surface and shallow subsurface soil is typically easy to excavate, and deeper soils may be removed with appropriate equipment or by using terraced excavations.

Ex situ treatment involves the excavation of contaminated soil and subsequent offsite treatment or direct landfill disposal without treatment. In situ treatment treats contaminated soils in place without excavation. In situ treatment technologies for soil typically use some form of chemical and/or physical process to reduce contaminant concentrations, or otherwise render contaminants immobile.

9.1.2 Groundwater

General response actions for groundwater include the following:

- MNA;
- ICs;
- Containment;
- Recovery/Removal;
- Ex situ treatment; and
- In situ treatment.

MNA, ICs, and containment response actions would be the same as those described in Section 9.1.1. General response actions for recovery/removal of groundwater include the use of pumps to recover contaminated groundwater from the subsurface.

Ex situ treatment for contaminated groundwater typically involves the removal and/or destruction of contaminants via physical or chemical processes. Once treated, the water would then be disposed either onsite (e.g., direct discharge to ground surface) or offsite (e.g., discharge to a POTW or to a NPDES outfall).

In situ treatment technologies for contaminated groundwater typically use some form of chemical, physical, or biological process to reduce contaminant concentrations, or otherwise destroy contaminant mass.

9.2 Potentially Applicable Technologies

A range of proven and innovative technologies has been considered to identify those that have potential applicability to soils, sediment, and groundwater at the facility. Available technologies include ICs, engineering controls, and in situ and ex situ remediation technologies. This section describes the results of technology screening and identifies which technologies were retained.

Technology screening begins by identifying potentially applicable technologies. Retained technologies for each affected media are evaluated relative to one another on the basis of three criteria:

Effectiveness. The effectiveness criterion evaluates the technology for its protectiveness and reduction in contaminant toxicity, mobility, or volume. Both short-term and long-term effectiveness are evaluated. Short-term effectiveness addresses the construction and implementation periods. Long-term effectiveness evaluates the technology after the remedial action is in place.

Implementability. The implementability criterion evaluates the technology for technical and administrative feasibility. Technical feasibility refers to the ability to construct, operate, maintain, and monitor the action during and after construction and meet technology-specific regulations during construction. Administrative feasibility includes factors such as the ability to obtain permits for offsite actions and the availability of specific equipment and technical specialists.

Cost. The cost criterion represents the relative costs of different technologies so that the technologies can be compared in relative terms to each other. Typically, the full cost of a given technology cannot be determined at this screening level; however, knowledge of typical technology costs obtained from vendors, cost-estimating guides, EPA guidance documents, prior projects, and engineering judgment are used to determine the relative cost of a technology compared with similar technologies.

Technologies that pass the screening evaluation are assembled into remedial actions and evaluated in Section 10. Alternate process alternatives ultimately may be selected for a cleanup action during the design phase, based on design-level evaluation of similar options.

9.3 Technologies for All Media: Institutional Controls

Potentially applicable ICs include:

- Deed restrictions addressing land use and soil excavation;
- Use restrictions and monitoring requirements to prevent disturbance of caps or other engineered controls.

Institutional controls have the potential to address a number of the residential and onsite worker exposure-related remedial action objectives at the facility. A soil management plan requiring the use of personal protective equipment (PPE) during any subsurface soil excavation work can reliably prevent worker exposure to subsurface soil contaminants and shallow groundwater. A deed restriction can also be applied to the property to prevent any future residential uses of the property, , and to require a soil management plan with PPE during soil excavations. Controls such as management plans and deed restrictions are proven and reliable and were retained for detailed evaluation.

9.4 Technologies for Soil

Technologies for surface soil, subsurface soil, and sediments include both in situ and ex situ technologies, as well as soil removal. Each of the technologies screened is described below.

9.4.1 Engineered Caps

Capping commonly involves the construction of a surficial barrier to prevent or minimize infiltration of precipitation and to prevent human contact with COC-affected materials. Cap designs can employ the use of several different types of material, including synthetic fabrics, clay, soil, or asphalt. Impermeable caps, such as asphalt or concrete, can be effective in minimizing infiltration of precipitation through affected soil, thereby reducing contaminant mass loading to groundwater. Other caps, such as soil or gravel caps, are effective at preventing dermal exposure to effected media, but have less effect on minimizing infiltration.

Capping is an effective barrier technology that is considered to be a presumptive remedy at wood treated sites by EPA (EPA, 1995). While no contaminant mass is removed by capping, the technology remains effective for reducing site risk and is readily implemented at reasonable costs. This technology is retained for consideration.

9.4.2 Bioremediation

Bioremediation is the chemical degradation of organic contaminants using microorganisms, either naturally occurring or added to the affected media. Bioremediation can be either an in situ or ex situ process. Biological activity (i.e., biodegradation) can occur either in the presence or absence of oxygen. Aerobic biodegradation converts organic contaminants to various intermediate and final decomposition products, which may include various daughter compounds, carbon dioxide, water, humic materials, and microbial cell matter.

Bioremediation, while considered a presumptive remedy for wood treater sites by EPA, has not been shown to be effective for higher-weight PAH compounds associated with creosote. In addition, the presence of metals (e.g., arsenic) is toxic to the microorganisms that degrade organic compounds. For these reasons, bioremediation of soil was not retained for further evaluation.

9.4.3 Thermal Desorption

Thermal desorption is another presumptive remedy that physically separates, but does not destroy VOC and semivolatile organic compounds (SVOCs) from excavated soils and sediments. Thermal desorption uses heat and/or mechanical agitation to volatilize contaminants into a gas stream. Treatment is provided for the concentrated contaminants resulting from the use of this technology. Depending on the process selected, this technology heats contaminated media to varying temperatures, driving off water organic compounds. Off-gases may be condensed for disposal, captured by carbon adsorption beds, or treated with biofilters.

Case studies have indicated that thermal desorption can successfully treat halogenated phenols and cresols as well as volatile non-halogenated organic compounds at wood treater sites. If chlorine is present in the feed material (e.g., as a result of PCP), dioxin and furan formation may occur in the thermal desorber, stack, or air pollution control devices at higher temperatures. Because of the technology's inability to treat metals, and complications due to the presence of chlorinated hydrocarbons (e.g., PCP), this technology is not retained.

9.4.4 Excavation & Offsite Disposal

Excavation and offsite disposal of contaminated soil is a traditional heavy construction technique for removing contaminated soil from a site and disposing of it in an appropriately permitted landfill, thereby eliminating the potential for onsite worker exposures and future leaching of soil constituents to groundwater. This technique is best suited to small areas of shallow soil in readily accessible areas.

At the Eugene facility, the application of this technique is limited by the physical constraints of the ongoing facility operations and facility structures that overlay much of the affected soils in the Main Treatment Area. In order for this approach to be implemented, much of the main treatment system (retort, drip pads, sumps, tankage) would require either a temporary or permanent relocation, and revenue-generating operations would likely cease for an extended period of time. This approach is further limited by accessibility constraints imposed by the depths of soil contamination, the presence of affected soils below the water table, and the presence of structures. These site-specific conditions make complete soil excavation impractical at the Baxter facility. The presence of permanent structures makes the likelihood of removing all of the affected vadose-zone soils unlikely. In addition, soils excavated from the Main Treatment Area may be subject to land disposal restrictions. Despite these limitations, this traditional basic technology was retained for further evaluation as this technology will address all of the COCs in soil, and is also suitable to address hot spots.

9.4.5 Excavation & Onsite Consolidation

This technology is identical to excavation and offsite disposal, with the exception that excavated soils would be consolidated in selected areas. Other technologies such as capping may be used in conjunction with consolidation. This technology was retained for further evaluation.

9.4.6 Soil Stabilization

This technology involves processes that react with the soil or contaminant to stabilize contaminants in the affected soil such that their leaching and migration potential are reduced. Stabilization methods include both in situ and ex situ techniques using materials such as portland cement, asphalt, lime, polymers, resins, and sorbents to modify the physical and/or chemical properties of soil. Ex situ stabilization requires excavation of the soil to be treated. In situ treatment requires substantial disturbance to the soil in order to mix stabilization agents into the soil. These processes typically result in expansion of the soil volume due to the amount of material added and chemical reactions; the range of volume expansion typically encountered with this technology is in the range of 10-25%. This technology has been most successful for metals; limited success has been achieved in stabilizing organic contaminants.

The size of the affected area at the site, the depth of affected soils in the Main Treatment Area, and access constraints imposed by the ongoing operations at the facility reduce the applicability of both in situ and ex situ stabilization. Due to the depth of site contamination, volume expansion would create substantial elevation change to the site elevation, requiring either offsite disposal or site redevelopment. As in situ stabilization is typically used for soils contaminated with metals, this technology is expected to have limited effectiveness for organic contaminants. For these reasons, soil stabilization was not retained for further evaluation.

9.4.7 Six-Phase Heating

Six-phase soil heating is a remediation technology that enhances recovery of soils contaminated with volatile and SVOCs by applying electricity for soil heating. Soil heating splits conventional three-phase electricity into six separate phases, producing an improved subsurface heat distribution. Each phase is delivered to a single electrode which is placed in a hexagonal pattern with a central neutral electrode. The soil heating volatilizes contaminants which are then recovered by a central soil vapor extraction well and treated ex situ.

The effectiveness of this technique is limited by the soil permeability, shallow groundwater, and the rate of heating. Heating must be carefully controlled because once the soil is dried by heating the electrical conduction and heating stop. Other disadvantages of this technique are that it can mobilize contaminants into groundwater which would not be captured by the vapor recovery well, and it poses worker health risks due to the electrical voltages involved. This technique has not been generally proven for the COCs found at the Eugene facility (i.e., SVOCs and metals). For these reasons, six-phase heating was not retained for further evaluation.

9.4.8 Chemical Oxidation

Chemical oxidants have been able to cause the rapid and complete chemical destruction of many toxic organic chemicals, and other organics are amenable to partial degradation as an aid to subsequent bioremediation. Reduction/oxidation chemically converts hazardous contaminants to nonhazardous or less toxic compounds that are more stable, less mobile, and/or inert. Redox reactions involve the transfer of electrons from one compound to another. Specifically, one reactant is oxidized (loses electrons) and one is reduced (gains electrons). The oxidizing agents most commonly used are ozone, hydrogen peroxide, permanganate, hypochlorite, chlorine, and chlorine dioxide, and the most common application is in situ versus ex situ.

In general, the oxidants have been shown to be capable of achieving high treatment efficiencies for chlorinated ethenes (e.g., trichloroethylene) and saturated aromatic compounds (e.g., benzene), but use on SVOCs (e.g., PAHs) or highly chlorinated aromatic organics (e.g., PCP) is not as common. Field applications have clearly shown that matching the oxidant and in situ delivery system specifically to the COCs and the site conditions is the key to successful implementation and achieving performance goals. The presence of residual NAPL would undoubtedly require multiple applications and high volumes of reagents. The handling of large quantities of strong oxidizers is also a disadvantage of this method.

In general this technique is most effective on dissolved phase constituents, rather than COC-affected soils, due to the commensurately larger volumes of reagents and reduced soil permeability associated with areas containing residual NAPL. For these reasons, chemical oxidation was not retained for further evaluation.

9.4.9 Steam Enhanced Extraction

Steam enhanced extraction utilizes steam injection to vaporize organic contaminants in NAPL so they can be more readily collected in extraction wells. The use of steam typically requires the extraction of both groundwater and vapor for onsite treatment and disposal. A major concern with this technique is that the successful mobilization of constituents bound in the soil requires rigorous and complete capture of groundwater and vapor. Likewise, contaminants currently immobilized by capillary forces (i.e., residual NAPL in the vadose zone) and NAPL are mobilized by this technology (by increasing solubility). Unless groundwater recovery at a downgradient location is completely effective, the technology can significantly mobilize and further spread contamination. For these reasons, this technology was not retained for further evaluation.

9.4.10 Dynamic Underground Stripping

Dynamic underground stripping is an innovative remediation technology that accelerates the removal of organic compounds from the subsurface, including NAPL, soil contamination, and dissolved phase contamination in groundwater. Steam is injected into the contaminated zone, and heat energy volatilizes contaminants into the vapor phase and dissolves contaminants into the groundwater. Electrical heating of the subsurface may be required to augment steam heating. Pump and treat and dual-phase extraction technologies are required to remove and handle the contaminants within the LNAPL and groundwater that are removed.

This technique was developed primarily to address NAPL, which can be particularly difficult to remediate using traditional groundwater extraction and treatment techniques. This technique is innovative and has not been generally proven for the site-specific COCs. A significant concern associated with this technique is that contaminants currently immobilized by capillary forces (i.e., residual NAPL in the vadose zone) as well as NAPL are mobilized by this technology (by increasing solubility). Unless groundwater recovery at a downgradient location is completely effective, the technology can significantly mobilize and further spread contamination. For these reasons, dynamic underground stripping was not retained for further evaluation.

9.5 Technologies for Groundwater

Potentially applicable technologies for groundwater remediation are described and evaluated below. These technologies include groundwater monitoring, in situ treatment, and groundwater extraction and treatment.

9.5.1 Long-Term Monitoring

At the Eugene facility, long-term groundwater monitoring is a component of all groundwater corrective measures alternatives under consideration. Therefore, long-term groundwater sampling and analysis to monitor the plume over time is included in the remedial action alternatives to be evaluated further.

9.5.2 Monitored Natural Attenuation

Natural attenuation encompasses a variety of physical, chemical, and biological processes that, under favorable conditions, act without human intervention over time or distance to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in soil or groundwater. Natural attenuation is evaluated in the FS in accordance with the following EPA guidance documents.

- Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites, by U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response (OSWER) Directive Number 9200.4-17, December 1, 1997.
- Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater, by U.S. Environmental Protection Agency, Office of Research and Development, EPA/600/R-98/128, September 1998; and
- Performance Monitoring of Monitored Natural Attenuation Remedies for Volatile Organic Compounds (VOCs) in Ground Water, EPA/600/R-04/027, April 2004.

For the purpose of this document, the term natural attenuation will be used consistent with the EPA guidance on MNA. These in situ processes include biodegradation, dispersion, dilution, sorption, volatilization, and chemical or biological stabilization, transformation, or destruction of contaminants. Natural attenuation is retained as a remedial action technology for groundwater to be further evaluated.

9.5.3 Containment Wall

Physical containment technologies exist to restrict the flow of groundwater so that it cannot migrate off site or to a point where a potential human or ecological exposure may occur. This technology includes the installation of barriers or walls in the subsurface to restrict the natural flow of groundwater. The physical barriers can include slurry walls, grout curtains, or sheet pilings. Such installations typically address shallow groundwater plumes and are installed into an underlying confining or lower permeability layer to prevent underflow around the barrier. Additionally, groundwater extraction and treatment is necessary to manage the groundwater that builds up behind the barrier. Containment walls are a proven technology for containment of NAPL and source areas affected by COCs that leach into groundwater. Therefore, containment walls were retained for further evaluation.

9.5.4 Groundwater Extraction & Treatment

Groundwater extraction and treatment is a proven technique for hydraulic control of affected groundwater. This basic technology involves the installation of recovery wells in a pattern sufficient to capture the groundwater plume at its leading edge, or to fully capture groundwater throughout the plume area, depending on the size of the plume. The recovered groundwater is then treated on site or off site using treatment technologies appropriate for the specific contaminants in the plume. This is a proven technology for plume containment/control and is therefore retained for further evaluation.

Treated groundwater from an extraction and treatment system can potentially be disposed of at a POTW, reinjected into the groundwater plume, or discharged to the surface under an NPDES permit.

9.5.5 Funnel & Gate

A funnel and gate system is a passive remediation method that utilizes cutoff walls (the funnel) to modify flow patterns so that ground water flows primarily through high conductivity gaps (the gate). The funnel and gate system uses heterogeneous (surface-mediated) reactions on porous media to degrade dissolved contaminants. It is typically installed immediately down gradient of contaminant source zones to prevent plume formation. The impermeable funnel serves to modify the natural flow direction towards a permeable gate containing a reactive agent (e.g., iron granules, carbon) that reduces or eliminates contaminant mass. The funnel and gate technology is relatively new and reactive media have not been proven for all types of contaminants. Funnel and gate applications are typically applied to chlorinated hydrocarbons, but have also been applied to wood treating sites. Groundwater bypass around or under the funnel may be a potential problem given the wide plume width. Other technologies are more suitable for the Eugene facility, and the funnel and gate technology was not retained.

9.5.6 Surfactant Flushing

Surfactant flushing is a remediation technique whereby surfactants are used to increase the solubility and mobility of residual NAPL or adsorbed soil contamination so that the constituents can be biodegraded more easily in the aquifer or recovered for treatment above ground by a groundwater extraction and treatment system. The success of this technology requires use of the appropriate surfactant and effectively capturing dissolved phase constituents via a groundwater extraction system. Surfactant flushing is not commonly used for contaminants with relatively high solubility such as PCP. A significant concern associated with this technique is that contaminants currently immobilized by capillary forces (i.e., residual NAPL in the vadose zone) and NAPL are mobilized by this technology (by increasing solubility). Unless groundwater recovery at a downgradient location is completely effective, the technology can significantly mobilize and further spread contamination. For these reasons, this technology was not retained for further evaluation.

9.5.7 Air Sparging

Air sparging (aeration) is a groundwater remediation technology that involves the injection of air or oxygen into a contaminated aquifer. Injected air traverses horizontally and vertically in channels through the saturated aquifer matrix and the soil column, creating an underground biological reactor and stripper that can remove volatile and semivolatile organic contaminants by biodegradation and volatilization. Soil vapor extraction usually is implemented in conjunction with air sparging when substantial levels of volatile compounds are present to recover and treat the vapor-phase contamination from the vadose zone. In addition, oxygen added to the contaminated groundwater and vadose-zone soils by air sparging can enhance aerobic biodegradation of contaminants below and above the water table.

An alternate method of aeration is to extract groundwater and recirculate the water through an aeration trench and vadose zone to form an in situ biological treatment cell. Recirculating the water through the aeration trench would supply dissolved oxygen to the groundwater similar to the effects of air sparging. Aeration trenches can be designed to facilitate oxygenation of the groundwater and can be used to capture the entire groundwater plume and treat the captured groundwater within the aeration trench. Groundwater recirculation to an aeration trench has been retained as a potential remediation method for groundwater.

9.5.8 Enhanced Bioremediation

Enhanced bioremediation is a process in which indigenous or inoculated microorganisms (e.g., fungi, bacteria, and other microbes) degrade (metabolize) organic contaminants found in soil and/or groundwater, converting them to innocuous end products. Enhanced bioremediation stimulates the activity of naturally occurring microbes by circulating water-based solutions through contaminated soils to enhance in situ biological degradation of organic contaminants. Nutrients, oxygen, or other additives may be used to enhance bioremediation and contaminant desorption from subsurface materials if needed. An in situ application includes the delivery of one or more of the following to the subsurface zone: an electron acceptor (oxygen, nitrate); nutrients (nitrogen, phosphorus); and an energy source (carbon). In a typical in situ bioremediation system, bioremediation amendments are injected directly, or into extracted groundwater prior to reinjection upgradient or within the contaminant source.

Bioremediation can also be enhanced by recirculating groundwater to an aeration trench, which allows aerated groundwater to percolate to groundwater through native materials. These systems act as an aeration unit and a fixed-film biological reactor to increases the dissolved oxygen in the groundwater resulting in more rapid degradation of contaminants.

In situ groundwater bioremediation can be effective for the full range of hydrocarbons. Bioremediation techniques have been successfully used to remediate soils, sludges, and groundwater. In general, short-chain, low-molecular-weight, more water soluble constituents are degraded more rapidly and to lower residual levels than are long-chain, high-molecular-weight, chlorinated, and less soluble compounds.

This technology is potentially applicable to the Eugene facility and is therefore retained for further evaluation.

9.5.9 Ozone Oxidation

As discussed above under subsurface soil, this technology is potentially applicable, and is similar to air sparging. However, instead of injecting air, ozone would be sparged into the injection wells. Ozone is a strong oxidant that would add the oxidative breakdown of organic contaminants in groundwater (as well as in the saturated and unsaturated soil in the sparge zone) to delivering oxygen, thereby supporting aerobic biodegradation. Although potentially applicable at the Eugene facility, this technology was not retained in favor of other more suitable technologies.

9.5.10 Disposal of Extracted Groundwater

Potential groundwater disposal methods are described and evaluated below. Some disposal methods may require pretreatment, depending on the quality of the extracted groundwater. Inclusion of these technologies in remedial action alternatives could occur if short-term groundwater dewatering is required as part of construction.

- **Discharge to Sanitary Sewer.** In this disposal option, groundwater is discharged to the local sanitary sewer system. Pretreatment of groundwater may not be required if concentrations of COCs meet discharge criteria. Fees for disposal of groundwater to the sanitary sewer are based on the volume discharged, and periodic chemical and physical monitoring of discharges are typically required. Allowable discharge volumes may be limited, particularly during the wet season.

This technology has not been retained because the City of Eugene prohibits Baxter from discharging to the sanitary sewer city.

- **Discharge to Surface Water.** Extracted groundwater may also be discharged to surface water, although this discharge option would require an NPDES permit. Water discharged to surface water would have to meet strict water quality requirements and would likely require treatment before discharge. This technology has been retained because the existing groundwater extraction system discharges to surface water, and the existing discharge facilities could be used, thereby simplifying implementation.
- **Reintroduction to Groundwater.** Extracted groundwater may also be discharged on site to groundwater via infiltration galleries or injection wells. Requirements for re-infiltration of contaminated groundwater must be evaluated to ensure regulatory requirements would be met. The most likely scenario would be reintroduction of actively treated groundwater through a Class V injection well. This technology has been retained for further consideration.

9.6 Summary of Retained Technologies

Based on the evaluation discussed in this section, the following technologies were retained for application to site-wide remedial action alternatives developed in Section 10.

All Media

- Institutional controls

Soil and Sediment

- Capping
- Excavation and onsite consolidation
- Excavation and offsite disposal

Groundwater

- Long-term monitoring
- Natural attenuation
- Containment wall
- Groundwater extraction and treatment
- Enhanced bioremediation
- Discharge to surface water
- Reintroduction to groundwater

10 Remedial Action Alternatives

Potentially applicable technology options for the Eugene facility are described and screened in Section 9. In this section, the retained technologies are combined to formulate a range of remedial alternatives. Each of these alternatives is evaluated with respect to the remedy selection balancing factors specified by DEQ.

The cleanup technologies suitable for the various areas of the facility that contain COCs in site media can be grouped in numerous combinations. However, the remedial alternatives are limited to compatible cleanup technologies that are combined to protect human health and the environment. The technologies applied to each media also need to be complementary when implemented in combination.

In this FS, a broad range of corrective measures alternatives representing a wide spectrum of potentially appropriate remedial technologies were developed. These alternatives include different combinations of natural attenuation, capping, removal, disposal, and treatment. When viewed together, the alternatives present a full range of potential remediation options available for the facility and highlight tradeoffs associated with implementation of different technologies, consistent with the objectives of a FS.

10.1 Elements Common to All Alternatives

Elements common to all alternatives include the use of ICs and long-term groundwater monitoring. These elements are discussed in more detail below.

10.1.1 Institutional Controls/Engineering Controls

ICs would be implemented for the Eugene facility to control future land use under all alternatives, in accordance with DEQ guidance (DEQ 1998b). Restrictions would be placed on land uses and on future use of groundwater in the location of the facility. An easement and equitable servitudes document would be recorded on title containing ICs for on-property controls and restrictions.

ICs would also be implemented to protect facility workers. A contaminated media management plan (“CMMP”) would be implemented instructing facility operators, contractors and workers how to manage activities that may disturb soil and groundwater contamination at the facility. ICs would also be required for offsite groundwater that exceeds cleanup levels protective of human health. ICs for offsite groundwater could be in the form of public awareness, communication or formal notices. Engineering controls could be in the form of connection to EWEB potable water or providing wellhead protection.

10.1.2 Monitored Natural Attenuation

MNA of COCs in the groundwater is included in all alternatives. For Alternatives 2 through Alternative 5, MNA wells would be selected from the existing monitoring well network to collect groundwater elevation data and groundwater samples. This includes groundwater wells located onsite and offsite, which would be used to ensure that natural attenuation is actively degrading COCs in the groundwater plume located in these areas. Systems for monitoring of natural attenuation would be designed in accordance with the following guidance documents, as applicable to site COCs:

- Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites, by U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response (OSWER) Directive Number 9200.4-17, December 1, 1997.
- Performance Monitoring of Monitored Natural Attenuation Remedies for VOCs in Ground Water, EPA/600/R-04/027, April 2004.

The above referenced documents are designed to be used during preparation and review of long-term monitoring plans for sites where MNA has been selected as part of the remedy. Performance monitoring system design depends on site conditions and site-specific remedial objectives; this document provides information on technical issues to consider during the design process.

Natural attenuation refers to reliance on natural processes to reduce contaminant concentrations and migration potential from a source in environmental media. Natural attenuation processes may reduce the potential risk posed by contaminants at the facility in three ways:

1. The contaminant may be converted to a less toxic form through destructive processes such as biodegradation or abiotic transformations;

2. Potential exposure levels may be reduced by the lowering of concentration levels (through destructive processes, or by nondestructive processes such as dilution or dispersion);

3. Contaminant mobility and bioavailability may be reduced by sorption to the soil or rock matrix.

Three types of evidence can be used to assess the effectiveness of natural attenuation of chlorinated organic compounds:

4. Observed reductions in contaminant concentrations along the flow path downgradient from the source of contamination.

5. Documented loss of contaminant mass at the field scale.

6. Data from field or microcosm studies that directly demonstrate the occurrence of a particular natural attenuation process at the site and its ability to degrade the contaminants of concern.

Long-term monitoring of a contaminant plume can provide empirical evidence of the effectiveness of natural attenuation as a remedy. The long-term monitoring program would include developing a sampling and analysis strategy that would allow for evaluating the effectiveness of the remedy with respect to the lines of evidence presented above.

Groundwater samples used for MNA would be collected using low-flow sampling methods and analyzed for PCPs and PAHs. Groundwater analytical samples collected during the routine monitoring have demonstrated a consistent reduction in plume contaminant mass and concentration (Baxter, 2010b).

A tiered approach to groundwater monitoring has been assumed for costing purposes for the corrective measures alternatives considered in this FS:

7. Monitoring would be conducted semiannually for the first five years following implementation of the remedial action alternative.

8. Monitoring would be conducted annually beginning in year six.

Groundwater elevation data would be collected from each well during each monitoring event. For monitoring events through year five, groundwater samples would be collected from annually from 24 existing wells, and a subset of these wells (ten wells) would be also be sampled in the spring using low-flow sampling methods. Beginning in year five, samples from up to 16 wells would be analyzed annually for PCP, four of which samples would also be analyzed for PAH compounds and metals. Quality assurance and quality control sampling would include one duplicate and one equipment rinsate sample collected and analyzed during each sampling event. Upon selection of a final remedial alternative, a detailed performance monitoring plan will be developed.

The results of the groundwater sampling and analysis would be evaluated for changes in the concentration of the COCs and the results reported to DEQ annually. The decisions to reduce the frequency of groundwater sampling would be made based on the concentrations of COCs in tested samples and after approval from DEQ.

10.2 Remedial Alternatives

In this section we describe five remedial action alternatives to address affected media. Maps showing application of different remedial technologies for each alternative are presented as Figures 10-1 through 10-3a, 10-8 and 10-9,

10.2.1 Alternative 1: No Action

The “no action” alternative serves as a baseline to compare other remedial alternatives. For this alternative, the only active remedial action is the existing groundwater extraction and treatment system (Figure 10-1).

The long-term monitoring program would involve the use of existing facility monitoring wells and would be conducted in accordance with the current monitoring program. The current monitoring program collects data annually from 24 existing wells, with a subset of these wells (ten wells) to be sampled in the spring using low-flow sampling methods. In addition, the three extraction wells are sampled on a quarterly basis.

As part of this alternative, ICs would be implemented at the facility. Institutional controls would also be required for offsite groundwater that exceeds cleanup levels protective of human health.

10.2.2 Alternative 2: Capping, Hot Spot Excavation and Consolidation, Enhanced Groundwater Extraction, MNA

Alternative 2 uses containment technology (e.g., a soil cap) to minimize the risk from site soils, consolidation of hot spot soils, enhanced groundwater extraction for treatment of groundwater, and MNA.

10.2.2.1 Capping

For the purpose of this alternative (as well as alternatives 3 and 4), an area of approximately 16 acres will be capped (Figure 10-2). Actual areas requiring a cap may be different than as presented in this FS. For example, additional sampling conducted as part of the final design may indicate that certain areas may not require capping due to low arsenic concentrations. Areas at the Eugene facility that are already paved would not require further remediation, as the asphalt cap effectively serve as a barrier to site soils. However, some areas of pavement may require repairs or resurfacing that can be conducted as part of ongoing operations.

Affected soils at the facility would be contained by 18 inches of soil cover, as shown in Figure 10-2. Final designed cap thickness after compaction would be approximately 12 inches. Installation of the cap will be preceded by placement of a geotextile fabric over all areas that will be capped. The geotextile fabric is used to provide a visual barrier between the existing surface and the clean cap material, and will also minimize the migration of fines upwards into the engineered cap.

Installation of the cap itself will utilize common construction methods. Delivered fill material will be rough graded in six-inch lifts using a bulldozer. Once each lift is graded, the surface will be smoothed, then compacted with a vibratory compactor to prepare the final surface. This final surface will be used to create the drainage patterns needed to allow precipitation to drain toward the existing catch basins.

In some areas, Baxter may elect to use asphalt or concrete instead of soil material for the cap. Use of asphalt or concrete has advantages of decreasing the infiltration of precipitation into the subsurface, and provides a better surface for heavy equipment. The areas that may receive asphalt or concrete covers will be determined based on operational requirements in the final design. As stated previously, areas that are already paved with asphalt will not require capping, however, some repairs or resealing may be required.

10.2.2.2 Consolidation

Soil material from the hot spot areas would be excavated to a depth of approximately 5 feet bgs and consolidated into the area presently occupied by the pond (Figure 10-2). In addition, ditch material located in the southwest corner of the site would also be placed into the pond. Prior to placement in the pond, the pond would be drained and lined with a synthetic liner to prevent infiltration and migration of COCs. The excavated soil would be placed into the pond, compacted, and covered with an engineered cap designed to minimize surface water infiltration. Detailed specifications for the consolidation area would be determined in the final design.

10.2.2.3 Enhanced Groundwater Extraction

Alternative 2 includes the removal of existing recovery wells W-20I and W-13I. Four new recovery wells would be installed just downgradient and in an arc around the Main Treatment Area at locations and depth configurations to optimize extraction of contaminants. The locations of the hypothetical new wells are shown in Figure 10-2. These new wells would be placed closer to the Main Treatment area in order to facilitate capture of the plume and to more aggressively reduce the COC mass in groundwater over the current groundwater extraction configuration. For this alternative, each of the new wells would operate at flows of 35 gpm each for a total flow of 140 gpm. Modeling results indicate that this alternative would be successful in good capture of the existing plume, and reduction in COC mass over a 30-year period.

Extracted groundwater would be conveyed to the existing stormwater treatment building via underground pipes, and treated using conventional granulated activated carbon methods. A new treatment system (pipes, valves, and carbon vessels) would be added to the existing stormwater system. Treated groundwater would be discharge to the surface ditch as part of the NPDES permit.

10.2.2.4 MNA

As described in Section 10.1.1, a long-term groundwater monitoring program would be conducted as part of the MNA component. The long-term monitoring program would involve the use of existing facility monitoring wells.

10.2.3 Alternative 3: Capping, Hot Spot Excavation and Disposal, Enhanced Biodegradation Recirculation System, MNA

Alternative 3 uses containment technology (e.g., a soil cap) to minimize the risk from site soils, offsite disposal of hot spot soils, enhanced biodegradation recirculation system for treatment of groundwater, and MNA.

10.2.3.1 Capping

The engineered cap for this alternative would be the same as in Alternative 2. Ditch material at the southwest portion of the facility would be excavated and spread as thin fill, prior to capping.

10.2.3.2 Hot Spot Soil Excavation and Disposal

Excavation of hot spot material would be similar to Alternative 2, but instead of placement into a consolidation area, affected soils would be transported and disposed of at an offsite facility.

10.2.3.3 Enhanced Biodegradation Recirculation System

Alternative 3 uses groundwater recovery wells to provide a hydraulic flow barrier and would effectively capture the plume; however, the water being pumped would not be brought to the surface and treated. Instead, the recovered water would be treated in situ by recirculating it through the vadose zone via an aeration trench to, in effect, form a large biological treatment cell. Currently, Baxter is successfully operating a similar system at their Arlington, Washington facility, and which was constructed and began operation in 2008 (Baxter, 2010b), and is still being successfully operated. Based on the results of the pilot test, Baxter included the recirculation system as the preferred corrective measures alternative in the final Corrective Measures Study presented to EPA in 2011 (Baxter, 2011b).

The in situ bioremediation system has been designed to address site-specific factors and to improve conditions supporting biodegradation of PCP within the groundwater plume. Therefore, it was deemed appropriate to utilize a groundwater recirculation system to enhance bioremediation of groundwater constituents. The key COC considered in designing the bioremediation system is PCP. An infiltration trench was selected for groundwater recharge, as this approach is considered promising for providing high reliability and requiring minimal maintenance. It was decided to implement the bioremediation system downgradient of the source area to remediate groundwater with minimal interference with ongoing facility activities.

Fate and transport modeling was used to support the design of the bioremediation system. The key factors for the design include:

- The physical layout of the extraction wells and trench;
- The groundwater recirculation rate;

- The distance between the extraction wells and infiltration trench; and
- The aqueous conditions supporting biodegradation of PCP.

Fate and transport modeling was also performed to support design of the bioremediation system. Several different extraction well and infiltration trench configurations were evaluated using the calibrated model (Baxter 2011b).

The well and trench layout shown on Figure 10-3 was established to accommodate constraints imposed by the configuration of the Eugene site. The design will allow pumping at different rates to provide for effective plume capture. Calibration of the fate and transport model to the existing PCP plume was achieved using a half-life of 9,902 days (first order rate constant of 0.00007 day-1), which is much slower than published half-lives averaging approximately 394 days (Howard, 1991).

Based on laboratory studies, it has been determined that the optimum pH for aerobic degradation of PCP is approximately 8.0 (Chang et. al., 1995). To increase the groundwater's pH to optimum levels for degradation, the bioremediation system design would include a layer of crushed limestone to be placed in the base of the infiltration trench to raise the pH. Thus, it is expected that the recirculation system will create a localized area with elevated pH that will significantly increase the degradation rate for PCP. In the event that it is necessary to implement other means to increase the degradation rate, such as addition of a carbon substrate, provisions will be included in the design to allow future addition of equipment to feed materials to the recirculated groundwater. In addition, the system could be design to transfer extracted groundwater to a conventional treatment system in the event that the recirculation system is not effective.

This alternative includes the use of six groundwater extraction wells that recirculate untreated water back into the aquifer through an infiltration gallery. This alternative assumes that water is pumped from the six extraction wells placed in an arc just downgradient of the Main Treating Area. Water is pumped from each well at flow rates of 10 gpm each for a total flow of 60 gpm. The pumped water is returned to the aquifer via an infiltration gallery located approximately 100 feet upgradient of the arc of extraction wells. This alternative assumes no treatment of extracted water; rather it is recirculated back into the plume at a reduced concentration resulting from exposure to oxygen and percolation through the infiltration gallery and unsaturated soil.

10.2.3.4 MNA

Long-term groundwater monitoring program would be conducted as part of the MNA component, as described for Alternative 2.

10.2.4 Alternative 3a: Capping, Groundwater Extraction and Treatment, Updated Beneficial Water Use Survey with Contingency Plan for Off-site Groundwater Use, MNA

Alternative 3a is a modified version of Alternative 3 that was first presented as an addendum to the 2011 FS (GSI 2015). Alternative 3a uses containment technology (e.g., a soil cap) to eliminate exposure to site soils containing arsenic, including hot spots, ex situ groundwater treatment using the existing groundwater treatment system, a contingency plan to prevent exposures to COCs from off-site groundwater use, and MNA.

10.2.4.1 Capping

The engineered cap for this alternative would be the same as in Alternative 3, but would cover hot spots instead of excavating them.

Low arsenic concentrations in the site groundwater indicate that there is not significant leaching to groundwater, so the soil hot spots are not considered to be mobile, and capping would provide the same protectiveness as excavation.

In addition to the capping of hot spots, Alternative 3a updates the cap area and thickness across the Site according to site use (see Figure 10-3a). In areas of limited industrial activity, cap thickness is reduced from 12” to 6” as compared to Alternative 3, and in areas where arsenic does not exceed cleanup levels, or there is already no exposure to soils, the cap is eliminated. This includes the tank area, beneath permanent structures, and currently paved areas. The gravel cap is 3” thick in the bottom of the pond where potential exposure is limited to a short period in the summer when the pond is dry.

10.2.4.1.1 Inclusion of southwest ditch in remedy

Ditch material at the southwest portion of the facility will be excavated, with soil placed in the Wood Storage area or around the perimeter of the pond. The placed ditch material will be spread in a thin lift and compacted before placement of the cap. Figure 10-3a shows the approximate placement area within the Wood Storage Area. The excavated bottom of the ditch will be backfilled with clean gravel to match the hydraulic grade of the ditch.

The data collected from the ditch is presented in the Remedial Investigation (RI) Report (Baxter 2010a). The RI Report indicates that two surface water samples and two sediment samples were collected from the ditch in 1993. These sediment samples were included in the soil data set for the purposes of the risk assessment conducted for the Site (Baxter 2016a). These sediment samples were analyzed for metals, PAHs, and PCP. Arsenic concentrations in both sediment samples (104 mg/kg and 26.2 mg/kg) exceeded the proposed cleanup level for onsite soil of 18 mg/kg. Benzo(a)pyrene concentrations did not exceed onsite cleanup levels in either sample, and dibenzo(a,h)anthracene concentrations exceeded the onsite soil cleanup level of 0.27 mg/kg only for sample SD-8 (0.362 mg/kg). PCP was not detected in either sample. Sample location SD-9 is located offsite, downgradient of sample SD-8. Concentrations of the analytes measured in the ditch samples are significantly lower in SD-9 than in SD-8, indicating that chemical gradients in the ditch sediment attenuate rapidly offsite and downgradient of the Site's stormwater outfall (Outfall 001). Between 1976 and 1997, there was limited treatment of stormwater including a settling pond, aeration, and spray field for evaporation. An NPDES permit was issued to Baxter by the State in 1980. Since 1997, stormwater has been collected though catch basins and associated piping and treated using holding tanks, flocculation and precipitation, and activated carbon treatment prior to discharge to the southern ditch under an updated NPDES permit. Therefore, the ditch has not been a conduit for chemicals to reach the ditch from the Site since 1997. However, given that this review of the historical ditch data and its use in the risk assessments indicates that there are point exceedances of site cleanup levels for chemicals of concern at the Site, this ditch area is included in Alternative 3a.

10.2.4.2 Ex situ groundwater treatment using existing groundwater treatment system

Alternative 3 proposes a recirculation groundwater treatment system with biotreatment, whereas the updated Alternative 3a proposes continuing with the current groundwater remedy of groundwater extraction, treatment, and disposal to a permitted outfall, coupled with MNA.

The facility has been operating extraction wells since 1993 as part of an interim remedial action measure (Baxter 2011b). The groundwater extraction and treatment system consists of three wells and a filtration system of granulated activated carbon, which removes both PAHs and PCPs from the groundwater. At a 2015 meeting with DEQ, it was demonstrated that the pump and treat system is effective and that installation of a recirculation system may not be as effective at containing the plume.

Analytical data collected between 2001 and 2014 indicate that the areal extent of the intermediate water-bearing zone PCP plume in groundwater is shrinking and concentrations in individual wells are generally decreasing. Figures 10-4 through 10-7 show maps of PCP iso-concentrations in groundwater in the shallow and intermediate water bearing zones for 2001 and 2014. The shallow water-bearing plume is limited to on-site wells within the source area. This plume is stable in size and concentrations in individual wells are either stable or decreasing in PCP concentration. Trend plots of groundwater concentrations through the second half of 2014 are provided in the Technical Memorandum submitted to DEQ on April 2, 2015 (GSI, 2015). The groundwater contour maps for both the shallow and intermediate zones show that the extraction system is achieving capture of the source area.

The groundwater extraction system and treatment facility will be evaluated for long term operations and maintenance, and will be updated as needed. The system is currently functioning, but will need upgrades for long term use, likely including the replacement of treatment tanks, new carbon filter media, miscellaneous plumbing upgrades and extraction well refurbishing.

10.2.4.3 Updated Beneficial Water Use Survey With Contingency Plan for Off-site Groundwater Use

Under Alternative 3a, the BWUD for the Site will be updated with a new BWUS, and a contingency plan will be developed and implemented in the case that off-site wells are used for purposes that could result in unacceptable risks from exposure to COCs groundwater (industrial or residential use). The contingency plan will consist of an annual review of new well installations in the area (based on Oregon Water Resources Department Records). If a well has been installed and is listed as having a domestic use, then a letter will be sent to the resident asking if and how they are using the well. If they are using the well for irrigation, a request will be made that they use the public water supply. If a well owner chooses to use their well for irrigation, then the well will be sampled, and if the groundwater contains PCP at levels above the cleanup levels, an offer will be made to provide wellhead treatment (a carbon filter at the tap) to protect the user from potentially unacceptable risks due to COCs in groundwater.

10.2.4.4 Institutional Controls.

As outlined above, institutional controls for Alternative 3a include maintenance of the cap over areas of concern, maintenance of existing paved areas in lieu of a cap, preparation and adherence to a contaminated media management plan, and installation of residential well-head treatment as needed, as part of an off-site groundwater use contingency plan.

10.2.4.5 MNA

Long-term groundwater monitoring program would be conducted as part of the MNA component, and long term monitoring would be conducted using existing facility monitoring wells.

A revised groundwater monitoring schedule was submitted to DEQ on May 1, 2015 and approved by DEQ on May 7, 2015. The monitoring reports will continue to evaluate whether the extraction system continues to maintain capture of the source area and verify that the PCP concentration trends are either stable or decreasing.

10.2.5 Alternative 4: Capping, Hot Spot Excavation and Disposal, Physical/Hydraulic Containment, MNA

Alternative 4 uses a soil cap, offsite disposal of hot spot soils, and MNA as described in Alternative 3. This alternative uses a hanging containment wall and groundwater extraction and treatment to control the groundwater plume.

10.2.5.1 Capping

The engineered cap for this alternative would be the same as in Alternative 2 and 3.

10.2.5.2 Hot Spot Soil Excavation and Disposal

Hot spot soil excavation and disposal would be the same as Alternative 3.

10.2.5.3 Physical/Hydraulic Containment

This alternative includes installation of a low-permeability barrier wall, groundwater extraction and treatment from within the containment wall, capping, hot spot removal and excavation, as well as ICs and MNA. This alternative is intended to contain the dissolved phase plume by a groundwater gradient such that groundwater flows toward the containment area. The containment approach would utilize a low-permeability barrier wall, such as a slurry wall, completely encircling the source area and groundwater extraction wells placed inside the barrier wall area to reduce the source concentration and induce inward flow to the containment area. The approximate location of the containment wall is shown in Figure 10-8.

A containment wall would ideally be installed into an aquitard to prevent contaminants from migrating underneath the barrier; however, a suitable aquitard is not present at the Baxter facility at a reasonable depth. The proposed containment wall under this alternative would be installed to a depth of approximately 40 feet and the upper portion of the affected groundwater. For this FS, it is assumed that a 2,070-foot-long slurry wall would be constructed around the Main Treatment Area. Use of a soil-bentonite slurry wall has been selected for this alternative over other potentially applicable technologies (sheet piling, etc.) because it is readily implemented, has a lower overall cost compared to other technologies, is compatible with site contaminants including NAPL, and is a proven technology for low permeability barriers.

Slurry walls are constructed by excavating a trench and then backfilling the trench with an engineered backfill, typically a low permeability soil or soil and bentonite mixture. Bentonite slurry is used for trench stability during excavation. This operation requires a large area for the use of heavy construction equipment, as well as sufficient space for staging of excavated soil and mixing the backfill.

Fluffing of the excavated soil as well as addition of admixture (water and bentonite) would generate some excess soil that would require disposal. It is estimated that approximately 25 percent of the excavated soil would have to be disposed off site.

To minimize the flow of groundwater under the barrier wall, groundwater extraction wells would be used to induce an inward flow gradient. Although groundwater modeling has not been conducted to establish inward gradients, relatively low flow rates of 5-10 gpm from approximately three wells would likely result in capture of the plume within the source area. The actual pumping rate required to maintain an inward gradient would be evaluated as part of a pilot study following barrier wall installation.

A typical hanging wall application and the probable location of the containment wall are shown on Figure 10-8. The extracted liquids would undergo the same treatment process and permitting considerations described for Alternative 2. Similar to Alternative 2, we have assumed that water would be treated on site under and discharged to surface water as part of the NPDES permit.

10.2.5.4 MNA

Long-term groundwater monitoring program would be conducted as part of the MNA component, as described for Alternative 2.

10.2.6 Alternative 5: Excavation, Offsite Disposal, and MNA

This alternative is the most intrusive remedial action alternative to be considered and is based on the excavation and offsite disposal of the affected surface and subsurface soil. ICs and MNA would also be employed as part of this alternative. This alternative meets DEQ's preference for an aggressive source removal as opposed to a containment approach described in the other alternatives.

10.2.6.1 Excavation and Offsite Disposal

The excavation would be designed to include the entire source area of soils affected by COCs above the proposed cleanup levels, as well as hot spots. This would result in a large excavation in the Main Treatment Area with a maximum depth of approximately 10 feet. The area of excavation is shown on Figure 10-9. This area currently includes a large portion of the Main Treatment Area and, therefore, would require (1) closure of the wood treatment facility; (2) demolition of several structures in this area, including the drip pads and aprons; (3) excavation of contaminated soil with offsite disposal; (4) backfilling of excavation with clean imported fill material; and (5) rebuilding of the wood treatment facility. All the affected soil down to the water table would be removed.

In addition, shallow soils across much of the site would also be excavated to a depth of approximately 2 feet (Figure 10-9). For the purpose of this FS, clean fill would be replaced over 50 percent of the excavated area and graded to facilitate ongoing operations.

Since this alternative removes much of affected source soils, the COCs in the groundwater would decrease more rapidly through monitored natural attenuation than for the alternatives that do not include source removal. However, affected soils beneath the water table would remain in place contributing to groundwater contamination.

It is estimated that approximately 193,000 tons of soil (based on a density of 1.6 ton/CY) of soil would be excavated and disposed offsite, based on the dimensions of the excavation stated above. Excavated soil from the deeper excavation would be considered listed RCRA waste (FO32/FO35), which would require disposal at an appropriate hazardous waste landfill after treatment to the Universal Treatment Standard (or alternatively; the soils may require incineration to achieve the UTS). Soils from the shallow excavation surrounding the Main Treatment Area would likely be considered non-hazardous, and could potentially be disposed of at a suitable Subtitle D landfill.

A consideration for this alternative is that the facility would need to be shut down, demolished, and then rebuilt following excavation. This would essentially put Baxter out of business for a number of months and result in the layoff of employees. The opportunity costs (e.g., loss of sales, continued asset costs during downtime), personnel costs (severance), and the potential for permanent loss of customers would affect the total cost. However, for the purposes of this FS, opportunity and personnel costs have not been estimated. On the other hand, this alternative would remove much of the source material on the Baxter site.

10.2.6.2 MNA

Long-term groundwater monitoring program would be conducted as part of the MNA component, as described for Alternative 2.

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11 Detailed Evaluation of Alternatives

Guidance from DEQ (DEQ, 2006) establishes an evaluation process for remedial action alternatives. The first phase is a screening to determine if alternatives meet the threshold criteria of protectiveness. Only those alternatives meeting the threshold criteria are then evaluated further against balancing factors in the second phase of evaluation. The threshold criteria are incorporated into the RAOs for this FS, thus all alternatives evaluated (other than the no action alternative) attain the threshold criteria.

Oregon's Environmental Cleanup Law requires the feasibility of the remedial action alternatives to be further assessed based on a balancing of five remedy selection factors after meeting the threshold criteria. The balancing factors include an assessment of effectiveness, long-term reliability, implementability, implementation risk, and reasonableness of cost.

The remedial action alternatives described in Section 10 are evaluated relative to the balancing factors in Sections 11.1 through 11.5. Summaries of the alternatives evaluation are presented in Table 11-1. Cost estimates for each of the alternatives are summarized in Table 11-2, and detailed cost estimates are included as Appendix A. A comparative analysis of the alternatives will be presented in Section 12.

11.1 Alternative 1: No Action

Alternative 1 is the "no action" alternative, which includes only the existing groundwater extraction and treatment system and groundwater monitoring. Groundwater monitoring would continue as presently conducted, which includes semiannual monitoring and reporting. The potential for direct exposure to affected groundwater and/or soil would be minimized through ICs under this alternative (i.e., fencing, soil management plans, and community awareness).

This alternative does not meet the threshold requirement of protectiveness, largely due to the potential exposure of arsenic in surface soils that would remain onsite above acceptable risk levels. Nevertheless, a discussion of balancing factors for this alternative is presented below.

11.1.1 Effectiveness

The effectiveness factor includes an assessment of the alternative's ability in achieving protection, including the magnitude of risk from untreated waste or residuals, as well as the long time-frame required for the alternative to meet the RAOs. Alternative 1 would involve only the existing groundwater extraction and treatment system, as well as natural processes to limit the toxicity and mobility of COCs within groundwater at the facility.

The natural attenuation processes, which include dilution, biodegradation, and immobilization due to adsorption to soil, have proven effective in reducing COC concentrations downgradient of the Main Treatment Area but have not prevented the groundwater plume from migrating offsite. For soils, only natural attenuation of COCs would occur with this alternative. This alternative would not be effective at meeting the RAOs in a reasonable time frame. This alternative is ranked low for effectiveness.

11.1.2 Long-term Reliability

Evaluation of the reliability of an alternative includes assessment of the reliability of the alternative to meet the treatment objectives and manage risks. While Alternative 1 relies on reliable groundwater extraction technologies and indigenous, natural processes for degradation of COCs, the alternative is ranked low in its ability to meet RAOs and manage site risks.

11.1.3 Implementability

The implementability of an alternative includes the constructability, the ability to monitor the effectiveness of the remedy, the consistency of the remedy with federal, state and local requirements, and the availability of necessary services and technologies. While this alternative is easy to implement and monitor, it is not consistent with state and federal requirements. Therefore, implementability for this alternative is ranked low.

11.1.4 Implementation Risk

Implementation risk addresses short-term potential impacts on the community, workers, and the environment, as well as the time until the remedial action is complete. As Alternative 1 has largely been implemented, and would be ranked moderately high for implementation risk (i.e., there is little risk). There is implementation risk in that current exposure to contamination would continue into the foreseeable future.

11.1.5 Reasonableness of Cost

The estimated total net present value for this alternative is approximately $1,041,000. First year costs associated with this alternative include implementation of ICs. Annual O&M costs include maintenance of ICs, operation and maintenance of the existing groundwater extraction and treatment system, and groundwater monitoring for a period of 30 years. A summary of total estimated costs for this alternative is included in Table 11-2. Detailed estimate worksheets are included as Appendix A. This alternative is ranked high for reasonableness of cost, since it is estimated to cost substantially less than the other alternatives.

11.2 Alternative 2: Capping, Hot Spot Excavation and Consolidation, Enhanced Groundwater Extraction, MNA

Alternative 2 uses containment technology (e.g., a soil cap) to minimize the risk from site soils, onsite consolidation and capping of hot spot soils, and enhanced groundwater extraction for treatment of groundwater. The potential for direct exposure to affected groundwater and/or soil would be implemented through ICs under this alternative, along with long-term groundwater monitoring to assess MNA.

11.2.1 Effectiveness

Capping of soils at wood treating site has proven to be an effective technology for reducing risks of dermal exposure at wood treating sites.

Excavation and onsite consolidation of highly contaminated soils will minimize the risk and mobility associated with these soils. Capping will not reduce the toxicity of the hot spot soils, but due to the low mobility of arsenic, the COC that defines the hot spots, capping is considered effective.

Groundwater extraction and treatment has been proven effective for wood treating sites. MNA will degrade COCs downgradient of the groundwater capture zone, but degradation rates will be slow and there is no offsite contingency plan to protect current water users within the plume.

Overall effectiveness of the alternative is ranked as moderate.

11.2.2 Long-term Reliability

The soil cap is considered highly reliable, as no mechanical equipment would be used for this alternative once the cap material was placed and graded. Periodic inspections would be required to monitor for erosion of the cap, which may require simple repairs. In addition, a soil management plan would be prepared to provide information and protocols for health and safety and soil management if excavations were required in the capped areas.

The excavation of hot spots is highly reliable as no mechanical equipment would be used for this alternative once excavated soils were removed. Onsite consolidation and capping is considered to be reliable.

The groundwater component of Alternative 2 will require long-term operation and maintenance to ensure reliability of the extraction and treatment. The only equipment expected to require routine checks and maintenance are the extraction pumps and components of the treatment system. Submersible well pumps have proven to be highly reliable, but they will require periodic maintenance and replacement after about 3-5 years of operation. Continued monitoring will be required to confirm the effectiveness of the alternative, but this element is common to all alternatives. Based on these considerations, this alternative is ranked moderately high for reliability.

11.2.3 Implementability

The implementation of the soil cap and excavation of hot spot soils is somewhat routine, although is slightly more complicated due to the presence of ongoing operations and the requirement to integrate the soil cap with existing infrastructure at the facility.

Implementability of the soil consolidation area (in the former pond) may be complex due removing water from the existing pond and allowing soils to dry sufficiently to facilitate construction of the containment cell. The design criteria would be determined in the final design.

Groundwater extraction and treatment systems are routinely installed at wood treating facilities, and are readily implemented.

For this alternative, the effectiveness of the remedy is relatively easy to measure though routine inspections of the soil cap, and groundwater monitoring and MNA, and is consistent with federal, state, and local requirements.

Overall implementability for this alternative is ranked moderately low due to soil management on an active facility.

11.2.4 Implementation Risk

Implementation of the soil cap and excavation and onsite consolidation of hot spots will be associated with some short-term risks to workers, due to increased truck traffic, the potential to generate dust during construction activities, the presence of workers in the immediate vicinity of the operating plant, and operation of heavy equipment.

The groundwater component of Alternative 2 could be implemented with moderate concerns for short-term risk. Safety concerns would result from operation of heavy equipment (i.e., drilling machines) in the vicinity of an operating plant, as well as construction and initial startup of a groundwater treatment system with contaminated groundwater.

Overall implementation risk for this alternative is ranked moderate.

11.2.5 Reasonableness of Cost

The estimated total net present value for this alternative is approximately $5,654,000. First year costs associated with this alternative include implementation of ICs, excavation and consolidation of hot spot soils, placement of the soil cap, construction of a new groundwater extraction and treatment system, and design and permitting costs. Annual

O&M costs include maintenance of ICs, operation and maintenance of the groundwater extraction and treatment system, and groundwater monitoring for a period of 30 years. A summary of total estimated costs for this alternative is included in Table 11-2. Detailed estimate worksheets are included as Appendix A. This alternative is ranked moderate for reasonableness of cost.

It should be noted that first year costs include construction costs for all necessary remedial action components. Actual costs would likely be spread over several years to facilitate ongoing operations, and lead times for design, permitting, and agency reviews. Combining all initial component costs into the first year allows costs for each remedial alternative to be evaluated against other alternatives.

11.3 Alternative 3: Capping, Hot Spot Excavation and Disposal, Enhanced Biodegradation Recirculation System, MNA

This alternative combines soil capping, excavation and offsite disposal of hotspot soils, in situ bioremediation through groundwater recirculation, and MNA to provide a comprehensive contaminant containment program in the vicinity of the source area. This system intercepts groundwater immediately downgradient of the main treatment area using groundwater extraction wells. The extraction wells recirculate the groundwater in situ to an aeration/infiltration trench, which mixes the collected groundwater and aerates it to promote in situ biological degradation of groundwater COCs. The water in the trench then re-infiltrates, creating a recirculation cell to enhance aerobic biodegradation of groundwater COCs. Groundwater flowing from the recirculation cell undergoes additional biodegradation and natural attenuation in the area downgradient from the recirculation cell.

11.3.1 Effectiveness

Capping of soils at wood treating sites has proven to be an effective technology for reducing risks of dermal exposure. Excavation and offsite treatment/disposal of highly contaminated soils meets DEQ's requirements for hot spots. The recirculation system would be designed to enhance aerobic bioremediation. Enhanced aerobic bioremediation has been proven effective for wood treating sites. Based on the data collected in three years of operation of a similar recirculation system at Baxter's Arlington facility, the proposed bioremediation approach has been effective. The potential effectiveness is less certain at Eugene for the following reasons: 1) the depth to groundwater is minimal at Eugene which does not provide an adequate unsaturated zone in which the infiltrated groundwater would entrain oxygen; and 2) the plume is located in the intermediate zone and it is uncertain whether the shallow recirculation system would deliver the required oxygen to the intermediate zone.

MNA will degrade COCs downgradient of the enhanced bioremediation system, but degradation rates will be slow, especially as distance from the bioremediation system increases.

Biodegradation of constituents due to the enhanced bioremediation system and due to MNA in the downgradient plume will permanently destroy the constituents, thereby reducing both the toxicity and volume of affected groundwater. The enhanced bioremediation system will also increase biodegradation rates downgradient of the extraction wells due to increased dissolved oxygen in groundwater exiting the recirculation zone. The mobility of COCs will decrease due to the hydraulic control and enhanced biodegradation created by the groundwater recirculation wells; however, complete capture will not be achieved with the recirculation system.

Based on these considerations, this alternative is ranked moderately low for effectiveness.

11.3.2 Long-term Reliability

The soil cap is considered highly reliable, as no mechanical equipment would be used for this alternative once the cap material was placed and graded. Periodic inspections would be required to monitor for erosion of the cap, which may require simple repairs. In addition, a soil management plan would be prepared to provide information and protocols for health and safety and soil management if excavations were required in the capped areas.

The excavation and offsite disposal of hotspots is highly reliable as no mechanical equipment would be used for this alternative once excavated soils were removed, and offsite treatment would be performed using facilities designed and permitted for waste materials and soil.

The groundwater component of Alternative 3 will require long-term operation and maintenance to ensure reliability of the enhanced bioremediation. However, operation and maintenance requirements at Baxter's Arlington facility have been shown to be nominal because the mechanical systems are simple and incorporate minimal rotating and electrical equipment. The only equipment expected to require routine checks and maintenance are the groundwater recirculation pumps. Submersible well pumps have proven to be highly reliable, but they will require periodic maintenance and replacement after about 3-5 years of operation. Continued monitoring will be required to confirm the effectiveness of the alternative, but this element is common to all alternatives.

The enhanced bioremediation system has been applied previously to wood treating sites; the actual configuration has varied in previous applications due to site-specific design requirements. Aerobic bioremediation of groundwater has been used widely and is known to be reliable at wood treating sites. Other components of this alternative have also been used reliably at wood treating sites.

No substantial adverse effects, other than reduction in the rate of biodegradation, will result from failure of the enhanced bioremediation recirculation system. If recirculation pumping fails or is stopped for short times, the effectiveness of the bioremediation system will not be significantly affected. If extraction wells stop operating, system warnings indicate the shutdown, thereby limiting the duration of shutdowns; however, because of the high hydraulic conductivity of the aquifer, groundwater containing elevated COC concentrations could migrate downgradient following a shutdown. Long-term failure of all recirculation wells would result in reduced treatment effectiveness.

In the event that the groundwater component of this alternative is not effective at controlling the PCP plume, the system could be readily modified to transfer extracted groundwater to a conventional treatment system.

Based on each of the main component's expected reliability, Alternative 3 is ranked as moderate.

11.3.3 Implementability

The implementability of the soil cap and excavation of hot spot soils is complicated due to the presence of ongoing operations and the requirement to integrate the soil cap with existing infrastructure at the facility. However, Baxter has experience with integrating facility operations as a soil cap was previously installed in the eastern portion of the facility during the IRAM work in 2007.

Implementability of the soil consolidation area (in the former pond) may be complex due removing water from the existing pond and allowing soils to dry sufficiently to facilitate construction of the containment cell. The design criteria would be determined in the final design.

Groundwater extraction and treatment systems are routinely installed at wood treating facilities, and is readily implemented.

For this alternative, the effectiveness of the remedy is relatively easy to measure though routine inspections of the soil cap, and groundwater monitoring and MNA, and is consistent with federal, state, and local requirements.

Overall implementability for this alternative is ranked moderately low.

11.3.4 Implementation Risk

Implementation of the soil cap and excavation and offsite disposal of hot spots will be associated with some short-term risks to workers and the community, due to increased truck traffic, the potential to generate dust during construction activities, and the presence of workers in the immediate vicinity of the operating plant, and operation of heavy equipment.

The groundwater component of Alternative 3 could be implemented with moderate concerns for short-term risk. Safety concerns would result from operation of heavy equipment (i.e., drilling machines) in the vicinity of an operating plant.

Overall implementation risk for this alternative is ranked moderate due to the management of soils on an active facility.

11.3.5 Reasonableness of Cost

The estimated total net present value for this alternative is approximately $5,640,000. First year costs associated with this alternative include implementation of ICs, excavation and offsite disposal of hot spot soils, placement of the soil cap, construction of the groundwater recirculation system, and design and permitting costs. Annual O&M costs include maintenance of ICs, operation and maintenance of the groundwater extraction and treatment system, and groundwater monitoring for a period of 30 years. A summary of total estimated costs for this alternative is included in Table 11-2. Detailed estimate worksheets are included as Appendix A. This alternative is ranked moderate for reasonableness of cost.

As noted for Alternative 2, actual costs would likely be spread over several years to facilitate ongoing operations, lead times for design, permitting, and agency reviews.

11.4 Alternative 3a: Capping, Groundwater Extraction and Treatment, Updated Beneficial Water Use Survey with Contingency Plan for Off-site Groundwater Use, MNA

Because Alternative 3a is a variation of Alternative 3, considerations in balancing factors are similar. However, the modifications to Alternative 3a result in a higher ranking for most criteria.

11.4.1 Effectiveness

As with Alternative 3, capping of soils at wood treating sites has proven to be an effective technology for reducing risks of dermal exposure at wood treating sites. Anticipated future use of the Site is the same as current use, so in terms of the effectiveness criteria, capping scores the same as excavation, since both remedies eliminate exposure to hot spot concentrations in soil.

The ex situ groundwater treatment and contingency plan for off-site uses will be more effective than the other alternatives, because while there may be exceedances of the PCP offsite groundwater cleanup level long after implementation of the remedial actions included in this alternative, the contingencies prevent direct exposure to the groundwater by receptor populations. In addition, the pump and treat system has been operating and proven to be effective at containing the source area groundwater.

Based on these considerations, this alternative is ranked moderately high for effectiveness.

11.4.2 Long-term Reliability

Also similar to Alternative 3, the soil cap is considered highly reliable, as no mechanical equipment would be used for this alternative once the cap material was placed and graded. Periodic inspections would be required to monitor for erosion of the cap, which may require simple repairs. In addition, a soil management plan would be prepared to provide information and protocols for health and safety and soil management if excavations were required in the capped areas.

The groundwater component of Alternative 3a will require long-term operation and maintenance to ensure reliability of the ex situ treatment and hydraulic containment. However, reliability is higher than for Alternative 3 because there will be no fouling of the recirculation system.

In the event that the groundwater component of this alternative is not effective at controlling the PCP plume, the contingency plan is already in place to prevent long-term exposures to groundwater off-site.

Based on each of the main component's expected reliability, Alternative 3a is ranked moderately high.

11.4.3 Implementability

Implementability of Alternative 3a is higher than Alternative 3 because capping instead of excavation of hot spots provides for less disruption of operations and less complicated planning. Also, Alternative 3a does not include infiltration of groundwater, and instead will discharge treated groundwater to a permitted-outfall, which improves its ranking. In other respects, the implementability of Alternative 3a is similar to Alternative 3.

Overall implementability for this alternative is ranked moderately high.

11.4.4 Implementation Risk

Implementation risk is similar for Alternative 3a as for Alternative 3, but capping the soil hot spots provides for lower implementation risk since there is no direct exposure to hot spots and there is little onsite soil management required.

Overall implementation risk for this alternative is ranked moderately low.

11.4.5 Reasonableness of Cost

The estimated total net present value for this alternative is approximately $2,775,000. The large difference between Alternative 3a and Alternative 3 is reasonableness of cost. As shown in the tables in Appendix A, excavation of hot spots has a high cost, with an estimated cost of excavation, backfill, and disposal is over $1,310,000. Costs for capping of hot spots are low because the capping will be a small addition to site capping already proposed and excavation/disposal fees would be eliminated (see Appendix A). Also, the updates to the Alternative 3 cap in terms of location and thickness result in a change of estimated costs from $1,360,000 to $1,120,000 (see detailed cost estimates in Appendix A). Actual costs would likely be spread over several years to facilitate ongoing operations, lead times, permitting and agency reviews.

Finally, physical extraction, treatment, and discharge is lower cost than the recirculation system of Alternative 3.

Overall reasonableness of cost for Alternative 3a is ranked moderately high.

11.5 Alternative 4: Capping, Hot Spot Excavation and Disposal, Physical/Hydraulic Containment, MNA

Alternative 4 uses containment technology (e.g., a soil cap) to minimize the risk from site soils, excavation and offsite disposal of hot spot soils, and installation of a physical/hydraulic barrier for treatment of groundwater.

11.5.1 Effectiveness

Capping of soils at wood treating site has proven to be an effective technology for reducing risks of dermal exposure at wood treating sites. Excavation and offsite treatment/disposal of highly contaminated soils meets DEQ's requirements for hot spots.

Alternative 4 relies upon a hanging barrier wall and active groundwater pumping to provide hydraulic containment. MNA would limit the toxicity and mobility of site COCs within groundwater downgradient of the source area. The physical/hydraulic containment system could be effective, provided that active pumping is maintained. If pumping were to fail or stop, system warnings would indicate the malfunction; however, given the absence of an aquitard at depth, the system would become ineffective shortly after a shutdown and affected groundwater inside the barrier wall would likely migrate beyond the wall. However, the hanging barrier wall would limit contaminant flow from the source area during shutdown of the extraction system. MNA would remain active for degradation of many constituents in groundwater, but the rate of attenuation would be generally slow.

Biodegradation of constituents in the downgradient plume would permanently destroy the constituents, gradually reducing both the toxicity and volume of affected groundwater. COCs present in groundwater recovered at the facility would be removed from the groundwater and destroyed permanently; this would contribute to reduced toxicity and mobility within the source area. The mobility of COCs in the source area would be reduced due to the physical and hydraulic containment system. Even if the groundwater recovery component failed, the hanging barrier wall would reduce mobility of the groundwater plume somewhat by lengthening the flow path for affected groundwater and by limiting the flux of groundwater from the source area.

Based on these considerations, this alternative is ranked moderate for effectiveness.

11.5.2 Long-term Reliability

The soil cap and offsite disposal of hotspots is highly reliable, as discussed for Alternatives 2 and 3.

Alternative 4 incorporates a containment wall and groundwater extraction. The system requires long-term operation and maintenance for most reliable performance; however, the barrier wall alone would provide a nominal level of containment in the absence of the groundwater extraction component. Since both the groundwater recovery and treatment components include rotating and electronic equipment, regular maintenance is necessary. All components of this alternative have been proven appropriate and reliable for remediation of wood treating sites. Since the hanging barrier wall does not provide full physical containment, the alternative may provide only partial containment of the source area if the groundwater recovery and treatment system fails; such a failure would likely result in the loss of affected groundwater from the source area, potentially affecting downgradient groundwater. Given these considerations, Alternative 4 is ranked moderate for reliability.

11.5.3 Implementability

Implementability of the soil cap and hot spot excavation aspects of his alternative are the same as Alternatives 2 and 3.

The groundwater component of Alternative 4 would require extensive and highly invasive construction to install the barrier wall using either conventional slurry wall or other applicable barrier wall installation techniques (e.g., vibrated beam barrier wall). This alternative would be difficult to implement. Excavation and containment wall construction would be complicated by the presence of existing structures, including buildings, rail lines, any underground lines or utilities, and treated pole storage areas. The Eugene facility is also an active industrial facility, and ongoing facility operations would be disrupted by required construction work. Additionally, the groundwater collection piping, the groundwater treatment system, and the treated water discharge piping must be installed.

For this alternative, the effectiveness of the remedy is relatively easy to measure through groundwater monitoring and MNA, and is consistent with federal, state, and local requirements.

Based on the considerations presented above, Alternative 4 has been ranked moderately low for overall implementability due to the large amount of construction required on an active facility which would impact operations.

11.5.4 Implementation Risk

Implementation of the soil cap and excavation and offsite disposal of hot spots will be associated with some short-term risks to workers and the community, due to increased truck traffic, the potential to generate dust during construction activities, and the presence of workers in the immediate vicinity of the operating plant, and operation of heavy equipment.

Significant short-term risks are associated with implementation of the groundwater component in Alternative 4. Risks include potential exposure to affected soil during barrier wall construction or affected groundwater during excavation, and the normal construction safety concerns related to construction using heavy equipment. Additional safety concerns unique to slurry wall installation include potential trench failure due to the depth of the slurry trench and the potential effects of failure on adjacent structures, underground utilities, and rail lines.

Based on the considerations presented above, Alternative 3 has been ranked moderately high for implementation risk.

11.5.5 Reasonableness of Cost

The estimated total net present value for this alternative is approximately $9,639,000. First year costs associated with this alternative include implementation of ICs, excavation and offsite disposal of hot spot soils, placement of the soil cap, construction of the containment wall and groundwater extraction system, and design and permitting costs. Annual O&M costs include maintenance of ICs, operation and maintenance of the groundwater extraction and treatment system, and groundwater monitoring for a period of 30 years. A summary of total estimated costs for this alternative is included in Table 11-2. Detailed estimate worksheets are included as Appendix A. This alternative is ranked moderately low for reasonableness of cost.

As noted for Alternatives 2 and 3, actual costs would likely be spread over several years to facilitate ongoing operations, lead times for design, permitting, and agency reviews.

11.6 Alternative 5: Excavation, Offsite Disposal, and MNA

This alternative is the most intrusive remedial action alternative to be considered and is based on the excavation and offsite disposal of the affected surface and subsurface soil. ICs, groundwater monitoring, and MNA would also be employed as part of this alternative. Included with the alternative is the temporary closure of the facility, facility demolition, and facility reconstruction.

11.6.1 Effectiveness

Under Alternative 5, practically all affected soil would be removed for offsite treatment and disposal. MNA would continue to degrade COCs present in groundwater beneath and downgradient from the source area; since the source would be eliminated, it is expected that MNA would cause the plume to contract over time after source area removal. This approach would be highly effective in removing COCs from the facility and in reducing the contaminant loading to downgradient groundwater. Since this alternative does not rely on engineering controls to limit the mobility or toxicity of affected media and since it permanently removes most affected soil from the Eugene facility, the useful life of this alternative would be long.

Under applicable regulations, excavated soil would be treated at a permitted facility to permanently destroy COCs. Residuals remaining after treatment would be disposed in a secure, appropriately permitted landfill. This would substantially decrease the toxicity and mobility of the COCs present in soils at the facility. Biodegradation and immobilization of COCs in the plume beneath and downgradient from the source area would permanently destroy the constituents, gradually reducing both the toxicity and volume of affected groundwater. Based on these considerations, this alternative is ranked high for effectiveness and reduction in toxicity, mobility, and volume.

11.6.2 Long-term Reliability

Alternative 5 does not rely on engineering controls requiring active operation or maintenance. No mechanical equipment would be used for this alternative once excavated soils were removed, and offsite treatment would be performed using facilities designed and permitted for waste materials and soil. Alternative 5 is ranked high for expected reliability.

11.6.3 Implementability

This alternative would require complete demolition of the Main Treatment Area followed by extensive and highly invasive construction to excavate affected soil. For these reasons, excavation and disposal would be very difficult and extremely costly. The groundwater monitoring program described in Section 10 would be sufficient to provide groundwater quality monitoring for the MNA component. The ICs included in this alternative would apply to the Eugene facility and affected offsite groundwater and could be readily implemented.

Due to the complexities involved in demolishing existing facilities and excavating affected soil, it is expected that the implementation time for this alternative would be fairly long. However, beneficial results would be obtained immediately upon implementing the alternative and RAOs would be met within a short time frame

Although the effectiveness and ability of this remedy to meet federal and state criteria is high, the practical and technical aspects of this alternative result in a low implementability ranking.

11.6.4 Implementation Risk

Alternative 5 would create substantial safety concerns for demolition and remediation workers. These concerns include potential exposure to dust and other materials during demolition; potential exposure to affected soil and groundwater during excavation; and the normal construction safety concerns related to demolition and earthwork using heavy equipment. Transportation of large quantities of excavated soil to disposal facilities would also raise safety concerns along transportation routes for other traffic and for affected communities. In addition, closure of the facility and temporary loss of local jobs would affect the community in the short term. This alternative is ranked high for implementation risk.

11.6.5 Reasonableness of Cost

The estimated total net present value for this alternative is approximately $65,043,000. First year costs associated with this alternative include implementation of ICs, facility demolition, excavation and offsite disposal of COC-affected soils, backfill and grading, and reconstruction of the treating plant. Annual operations and maintenance costs include maintenance of ICs, operation and maintenance of the groundwater extraction and treatment system, and groundwater monitoring for a period of 30 years. A summary of total estimated costs for this alternative is included in Table 11-2. Detailed estimate worksheets are included as Appendix A. This alternative is ranked low for reasonableness of cost.

Due to the magnitude of activities associated with this remedial alternative, costs would likely be spread over a two or three year period.

12 Comparative Evaluation of Remedial Alternatives

This section compares the remedial action alternatives that have been developed and evaluated for the Eugene facility. This comparative analysis will then be used to select the preferred remedial action alternative for the facility.

DEQ guidance describes two sets of criteria for evaluating corrective measures alternatives: (1) threshold criteria that must be attained by the remedial action selected for implementation; and (2) balancing criteria that are used for detailed evaluation and screening of alternatives. Each alternative was evaluated for its performance relative to the Balancing Criteria in Section 11. All remedial actions, with the exception of Alternative 1, were designed to attain the threshold criteria; however, the alternatives may differ in how well they achieve these threshold criteria.

In this section we present a comparative evaluation of the alternatives described in Section 10. These comparative analyses will then be combined to develop a preferred remedial alternative.

12.1 Comparative Evaluation: Threshold Criteria

DEQ guidance has established the threshold criteria of protectiveness that must be attained by a selected remedy. The protectiveness criteria must be demonstrated by a quantitative assessment of the risk resulting from concentrations of untreated waste or residuals remaining onsite, and an assessment of the adequacy and reliability of any institutional controls to manage these remaining risks.

Alternatives 2 through 5 would attain the threshold criteria, however, some alternatives may require a longer time periods to attain the criteria while others, such as Alternative 5, may attain the criteria in a short time.

Alternative 5, including excavation and offsite disposal, would provide the most complete and rapid removal of COCs, eliminate the majority of the source area and future releases, and is ranked highest for the threshold criteria. This alternative would remove risks from dermal exposure to surface and near surface soil. However, some COCs would remain on site at deeper depths, and would require ongoing monitoring to assess whether or not natural attenuation processes could effectively manage risks from the groundwater plume.

Alternatives 3 and 4 are ranked the next highest for meeting the threshold criteria. Both of these alternatives manage residual risks of soil using proven containment technology to prevent dermal exposure (e.g., soil cap), and soil hot spots would be excavated and removed offsite for disposal. Groundwater is managed by either the enhanced bioremediation recirculation system or containment wall with groundwater extraction and treatment.

Alternative 2 and 3a are ranked slightly lower than alternatives 3 and 4, due to the fact that hot spot soils would be contained onsite, rather than excavated and disposed of offsite. Alternative 1 is ranked the lowest, as it does not meet the threshold criteria because risks associated with exposure to onsite soil is above acceptable levels.

12.2 Comparative Evaluation: Balancing Criteria

The six corrective measures alternatives are compared for the balancing criteria in this section. Each alternative was evaluated against the balancing criteria and assigned a numerical rating in Section 11 (Table 11-1). A total score was calculated from these numerical ratings and used to rank the five remedial alternatives against each other. In calculating the total score, each element of each criterion was weighted equally.

The relative ranking of the alternatives for the balancing criteria is based on the total score shown on Table 11-1. The highest ranked alternative is Alternative 3a and the lowest ranked alternative is Alternative 1. Thus, based on the balancing criteria presented in this FS, the recommended alternative is Alternative 3a.

13 Recommended Remedial Alternative

Based on the evaluation of alternatives presented in Sections 11 and 12 of this FS the recommended alternative for the Eugene facility is Alternative 3a. This alternative utilizes ICs, soil capping, groundwater extraction and treatment, a contingency plan for off-site groundwater use, and MNA.

The comprehensive remedial action addresses risks and potential exposure pathways associated with contaminated media at the Eugene facility. Placement of a soil cap on a large portion of the facility reduces the potential of dermal exposure of COC-affected soils and eliminates the possibility of airborne transport of COC-affected dust. It intercepts contaminated groundwater to minimize future COC migration from the source area. It includes an existing proven groundwater extraction and treatment system that results in hydraulic containment. It prevents exposure to off-site groundwater through a contingency plan with regular implementation. MNA is included for the downgradient plume to reduce the volume and toxicity of COCs in downgradient groundwater. It includes a groundwater monitoring program designed to detect future migration of COCs and to confirm the effectiveness of the system. Finally, the alternative includes a set of ICs to limit the potential for exposure to affected offsite groundwater and affected soil and groundwater present at the facility. Offsite water uses will be protected through the contingency plan.

The key components for this remedial action is the soil cap and the ex situ groundwater treatment system. The soil cap would be implemented over several years so as to not disrupt ongoing operations and facilitate other site improvements (such as removal of unused buildings and operations to increase production efficiency). Actual capping technologies may vary, as ongoing operations may be enhanced by asphaltic caps in select areas near the Main Treatment area, which would further reduce infiltration of stormwater into the subsurface.

The groundwater monitoring program will be implemented to confirm that the ex situ treatment system remains effective in achieving contaminant reduction and containment for the source area, and that MNA achieves contaminant reduction within the plume downgradient of the recovery wells, including offsite groundwater that has been affected by the facility and addressed via the contingency plan. The well network is designed properly to detect COCs downgradient of the source area. The parameters monitored for water quality and for MNA were selected to detect any migration of COCs and to assess the effectiveness of both the ex situ treatment system and natural attenuation. The frequency of monitoring planned is appropriate for the groundwater flow characteristics of the Site and the fate and transport characteristics of Site COCs.

The ICs included in this remedial action can be readily and effectively implemented to protect facility workers.

The recommended remedial action attains the threshold criteria established by DEQ in its FS guidance. This remedial alternative was the highest rated for the balancing criteria. This remedial alternative can be implemented in a reasonable time while allowing continued facility operations and it would achieve beneficial results in a reasonable time frame.

14 References

AMEC. 2013. Technical Memorandum. Subject: Revised Baseline Human Health Risk Assessment Addendum. To: Geoff Brown, Oregon DEQ. AMEC Environmental and Infrastructure, Inc. November 4, 2013.

AMEC. 2014. Technical Memorandum. Subject: Revised Baseline Human Health Risk Assessment Addendum. To: Geoff Brown, Oregon DEQ. AMEC Environmental and Infrastructure, Inc. February 19, 2014.

Baxter 2002a. Beneficial Water Use Determination, J.H. Baxter & Co. Eugene, Oregon Facility. Prepared by J.H. Baxter &Co. June 28, 2002.

Baxter 2002b. Draft RI Summary Report, J.H. Baxter & Co. Eugene, Oregon Facility. Prepared by J.H. Baxter &Co. June 28, 2002.

Baxter 2002c. Draft Human Health Risk Assessment. J.H. Baxter & Company, Eugene, Oregon Facility. Prepared for Oregon Department of Environmental Quality by J.H. Baxter. September 20, 2002.

Baxter 2006a. Revised Baseline Human Health Risk Assessment. Prepared for Oregon Department of Environmental Quality by J.H. Baxter. July 28, 2006.

Baxter 2006b. Contingency Plan for Incidental and Infrequent Drippage in the Treated Pole Storage Yard for J.H. Baxter & Company, Eugene, Oregon. Prepared by J.H. Baxter & Co. 2006.

Baxter 2009. Second Half 2008 Groundwater Monitoring Report, J.H. Baxter & Co., Eugene, Oregon Facility. Prepared by J. H. Baxter & Co. June 3, 2009.

Baxter, 2010a. Remedial Investigation Summary Report, Revision 1, J.H. Baxter & Co. Wood Treating Facility, Eugene, Oregon. Prepared by the J.H. Baxter Project Team, March 10, 2010.

Baxter, 2010b, Remedial Action Pilot Study Report Stella-Jones (formerly J.H. Baxter & Co.) Wood Treating Facility Arlington, Washington: Prepared by J.H. Baxter Project Team, October 2010.

Baxter 2011a. Feasibility Study Report, Revision 0, J.H. Baxter & Co. Eugene, Oregon Facility. Prepared by J.H. Baxter & Co. October 3, 2011.

Baxter, 2011b. Corrective Measures Study, Revision 2, Former J.H. Baxter Wood Treating Facility, Arlington, WA. Prepared by the J.H. Baxter Project Team. March 2011.

Baxter 2015a. Proposed revised Monitoring Program. J.H. Baxter & Co. Eugene, Oregon Facility. Prepared by J.H. Baxter & Co. February 9, 2015.

Baxter 2015b. Revised Monitoring Program, May 2015, J.H. Baxter Eugene Site, ECSI 55. Dated May 1, 2015.

Chang B.V.; Liou M.B; Yuan S.Y.; Pan T.M. (1995) Anaerobic degradation of chlorophenols by 2,4-dichlorophenol adapted microbial communities at different concentrations. Oceanoggra. Liter.Revi. 42: 1022-1030.

DEQ 1989. Order on Consent issued to J.H. Baxter & Co. by Oregon Department of Environmental Quality, ESCR-WVR-88-06. August 7, 1989.

DEQ 1998. Updated 2000. Guidance for Conduct of Deterministic Human Health Risk Assessment, Final. Oregon Department of Environmental Quality.

DEQ 1999. Approval of the revised Ecological Risk Assessment report. Memorandum from Max Rosenberg of Oregon Department of Environmental Quality to Georgia Baxter of J.H. Baxter & Co. July 23, 1999.

DEQ 2000. Guidance for Conduct of Deterministic Human Health Risk Assessments. Oregon Department of Environmental Quality. 1998. Rev. 2000.

DEQ 2002. Memorandum from Paul Rosenburg of DEQ to RueAnn Thomas of J.H. Baxter regarding DEQ comments on Draft RI Summary Report. August 23, 2002.

DEQ 2006. Guidance for Conducting Feasibility Studies. Final. Oregon Department of Environmental Quality. 1998, rev. 2006.

DEQ 2009a. Approval for Revised Beneficial Use Determination, June 28, 2002, JH Baxter, ECSI 55. Letter dated February 24, 2009.

DEQ 2009. Letter from Geoff Brown of DEQ to RueAnn Thomas of J.H. Baxter approving the Revised Beneficial Water Use Determination, June 28, 2002. February 24, 2009.

DEQ 2011a. Letter from Paul Rosenberg of DEQ to RueAnn Thomas of J.H. Baxter providing a Partial No Further Action Determination for the eastern portion of the Baxter site. January 11, 2011.

DEQ 2011b. Letter from Geoff Brown of DEQ to RueAnn Thomas of J.H. Baxter approving the Remedial Investigation Summary Report, Revision 1, March 2010. March 15, 2011.

DEQ 2011c. DEQ Risk-Based Decision Making Table. Oregon Department of Environmental Quality. 2011.

DEQ 2013. Development of Oregon Background Metals Concentrations in Soil. Technical Report. Oregon Department of Environmental Quality. March 2013.

DEQ 2015. E-mail Approval of Revised Monitoring Program, J.H. Baxter Eugene Site, ECSI 55. Dated May 7, 2015.

DEQ 2016. Letter from Greg Aitken of DEQ to Georgia Baxter of J.H.Baxter. *Re: Review of Feasilbity Study Addendum – JH Baxter & Co. Eugene Facility, DEQ File #0055*. January 21, 2016.

EPA, 1995. Presumptive Remedies for Soils, Sediments, and Sludges at Wood Treater Sites, EPA/540/R-95/148, December 1995.

EPA 2000. Institutional Controls: A Site Manager's Guide to Identifying, Evaluating and Selecting Institutional Controls at Superfund and RCRA Corrective Action Cleanups, EPA 540-F-00-055, OSWER 9355.0-74FS-P), September 2000.

GSI 2015. Feasibility Study Addendum, J.H.Baxter & Co., Eugene, OR Facility. Prepared for J.H.Baxter & Co. June 2015.

Howard, P.H., R.S. Boethling, W.F. Jarvis, W.M. Meylan and E.M. Michalenks. Handbook of Environmental Degradation Rates, Lewis Publishers Inc., Chelsea, Michigan, 725p, 1991.

Keystone 1991. Remedial Investigation Report (Phase I) of J.H. Baxter & Company Eugene, Oregon Site. Prepared by Keystone Environmental Resources, Inc. for J.H. Baxter & Company. August 1991.

Keystone 1994. Remedial Investigation Report (Phase II) of J.H. Baxter & Co. Eugene, Oregon Site. Prepared by Keystone Environmental Ltd. for J.H. Baxter & Company. October 1994.

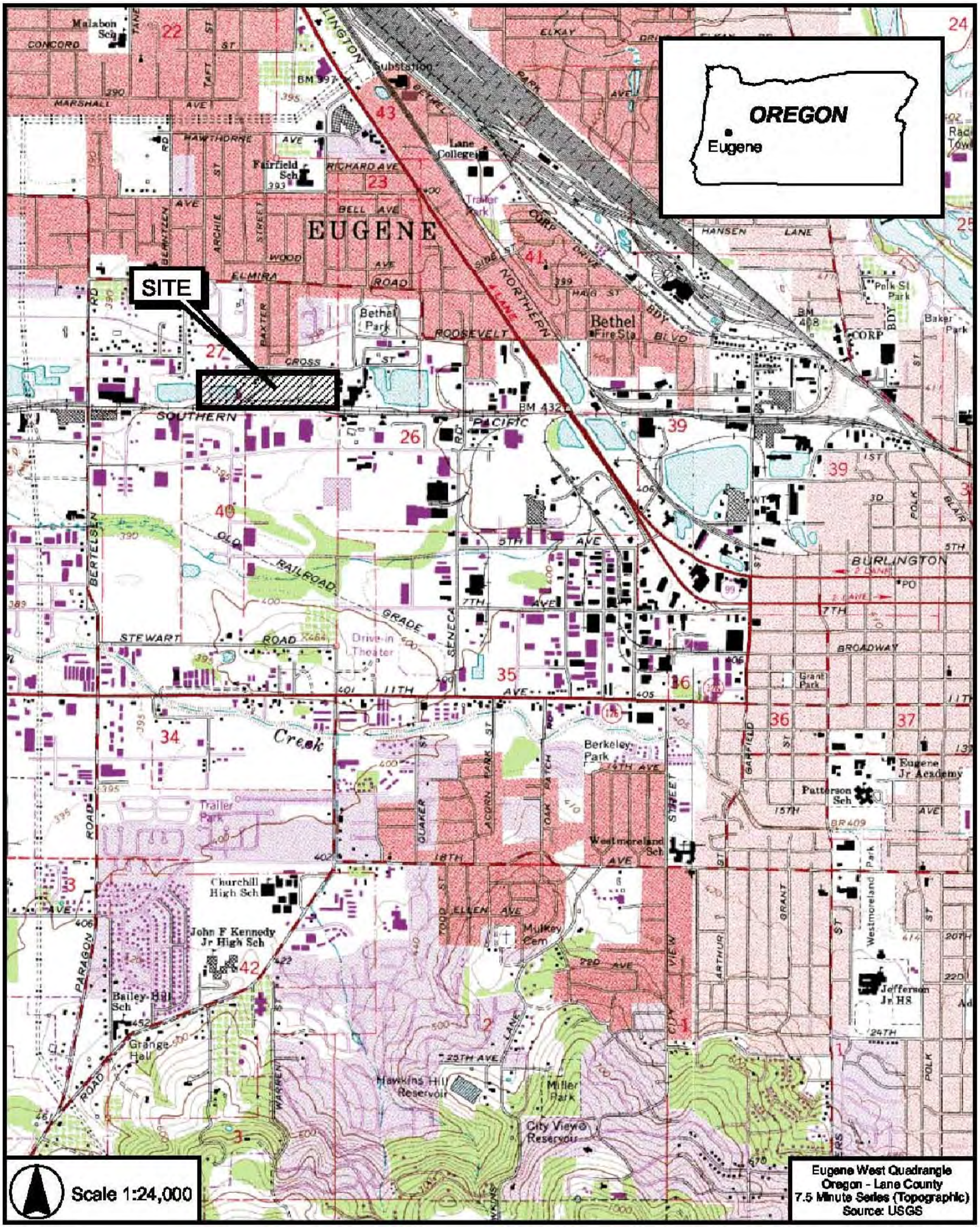
Keystone 1999. Ecological Risk Assessment of J.H. Baxter & Co., Eugene, Oregon Plant Site. Prepared by Keystone Environmental Consultants, Inc. for J.H. Baxter & Company. June 1999.

USDA 1987. Soil Survey of Lane County, Oregon. U.S. Department of Agriculture, Soil Conservation Service.

USDHHS. 2007. Agency for Toxic Substances and Disease Registry. *Health Consultation. Follow-Up J.H.Baxter Health Assessment Based on New Air Monitoring Data. Eugene,* Oregon. EPA Facility ID: ORD009032400. September 11, 2007.

USGS 1986. Eugene West, Oregon, 7.5 Minute Quadrangle. U.S. Geological Survey.

FIGURES



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SITE VICINITY MAP

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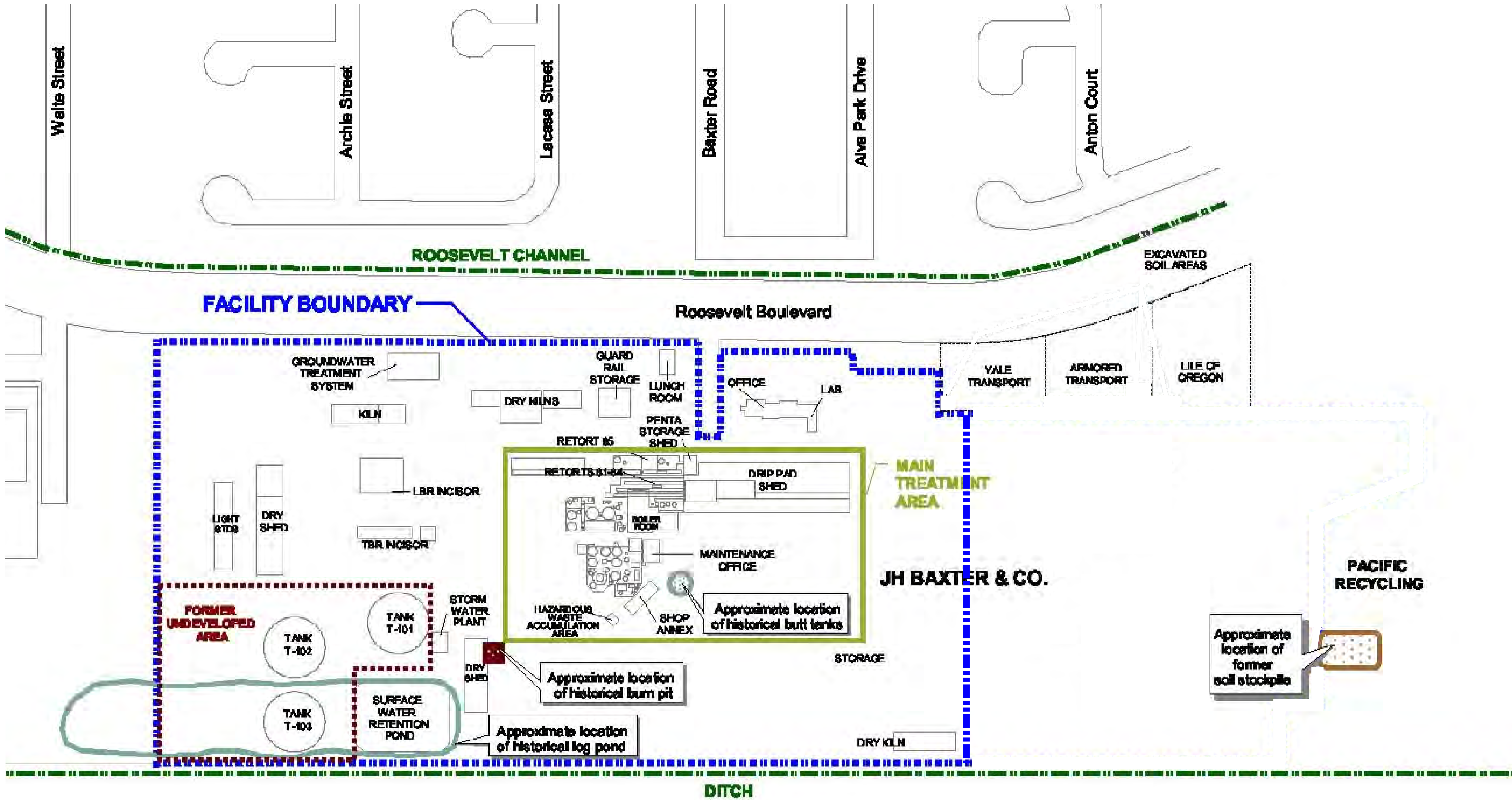

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HISTORICAL FEATURES

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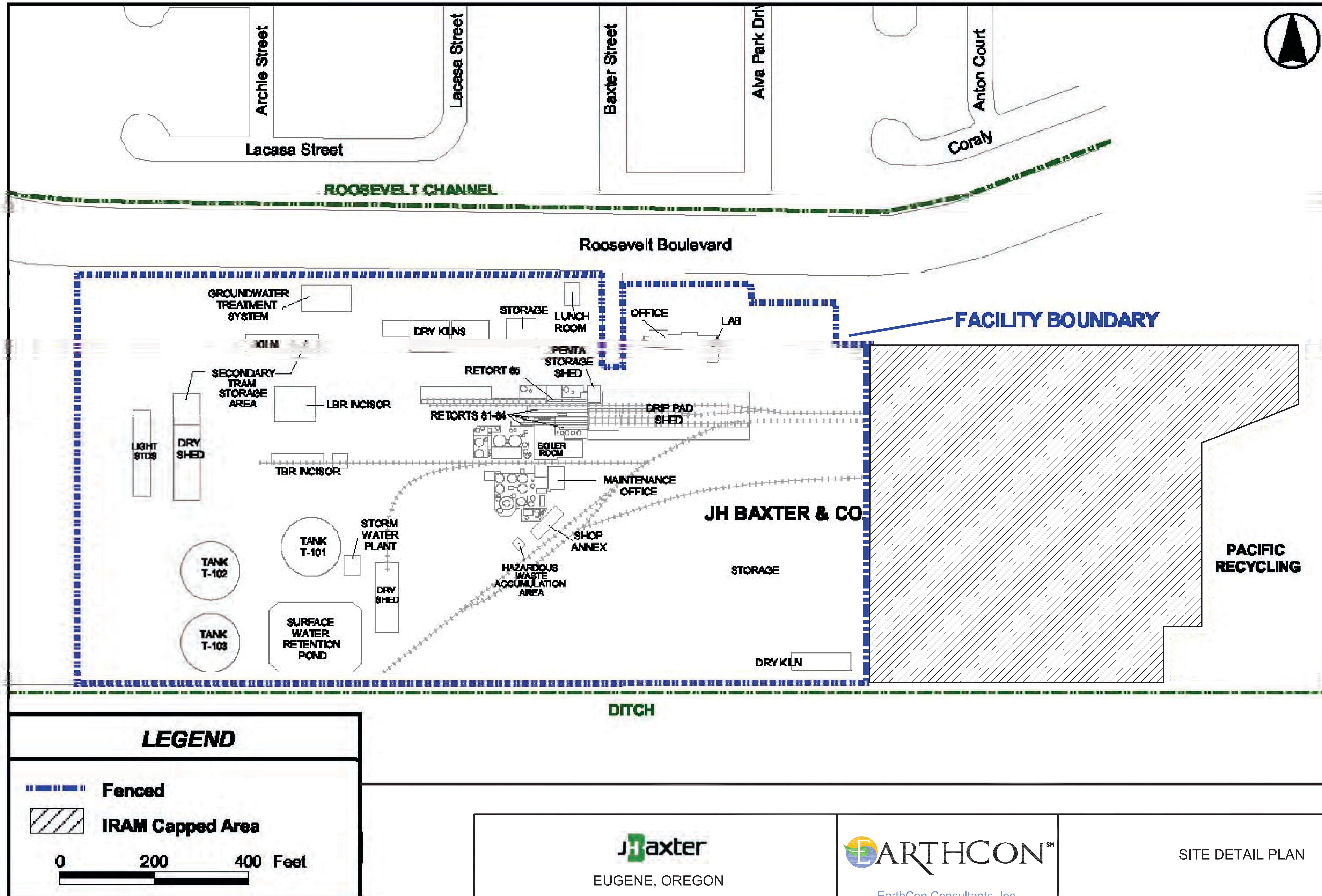

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SITE DETAIL PLAN

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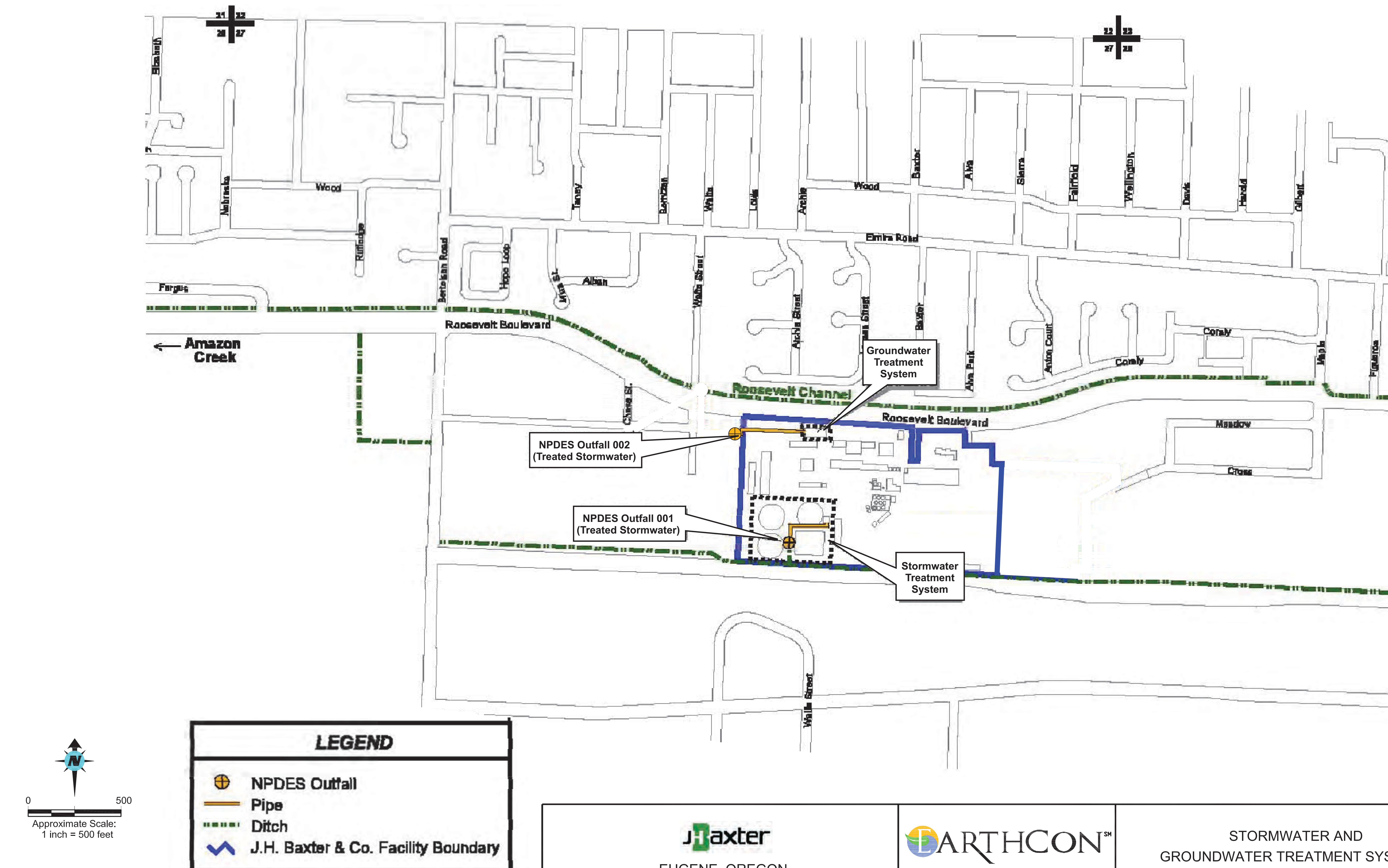

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STORMWATER AND
GROUNDWATER TREATMENT SYSTEMS

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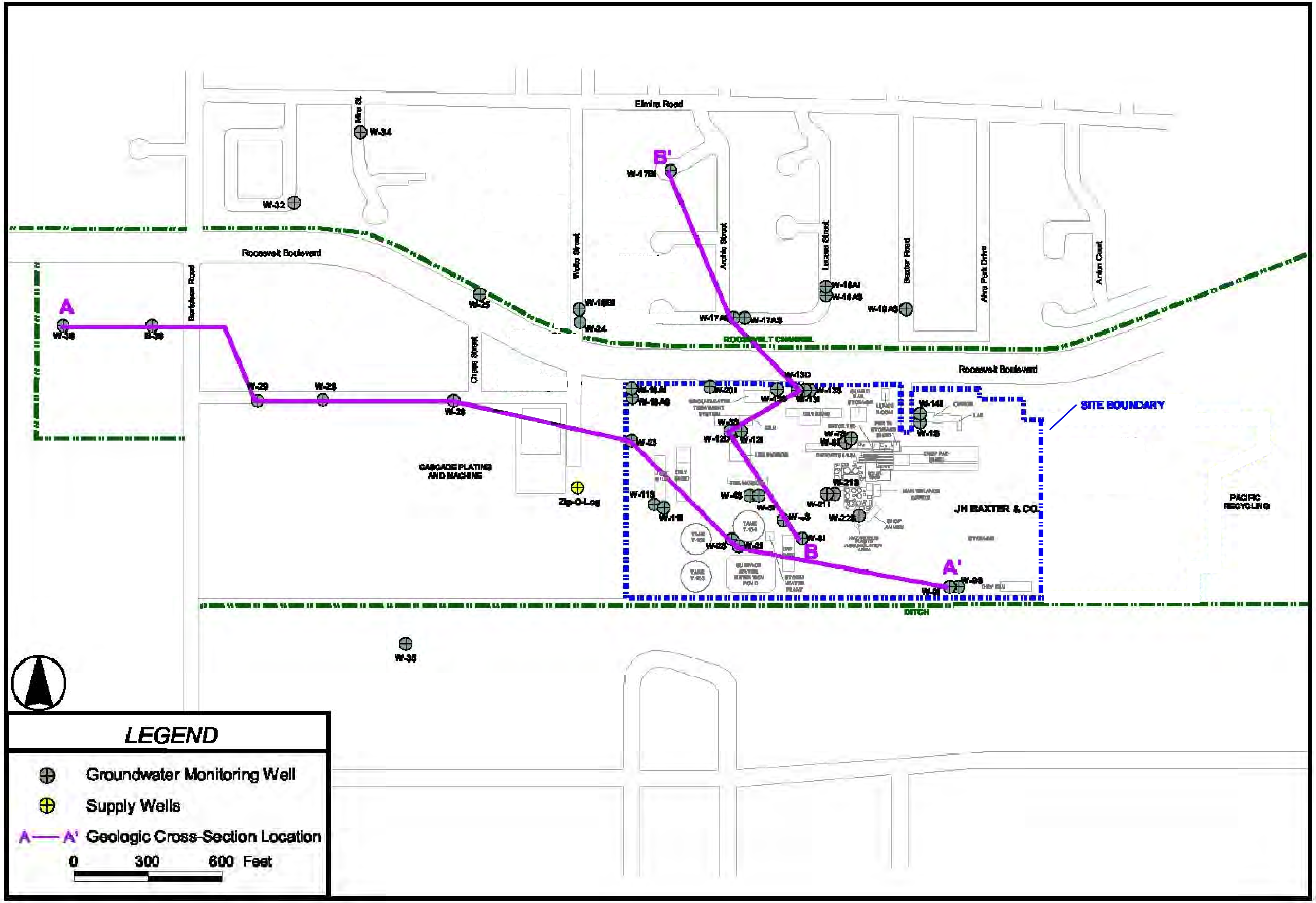

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GROUNDWATER MONITORING WELL LOCATIONS

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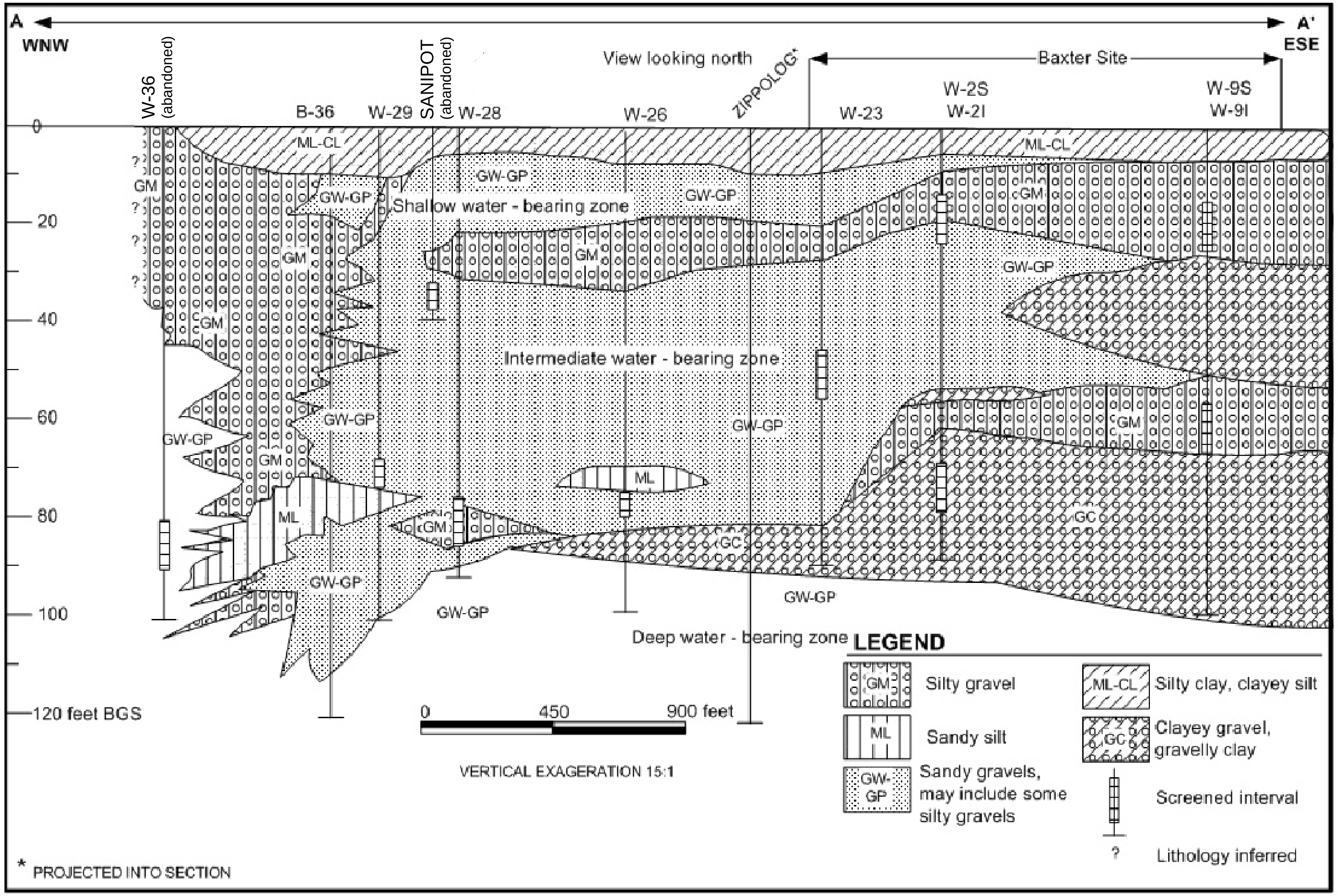

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GENERALIZED WEST - EAST
GEOLOGIC CROSS SECTION (A-A')

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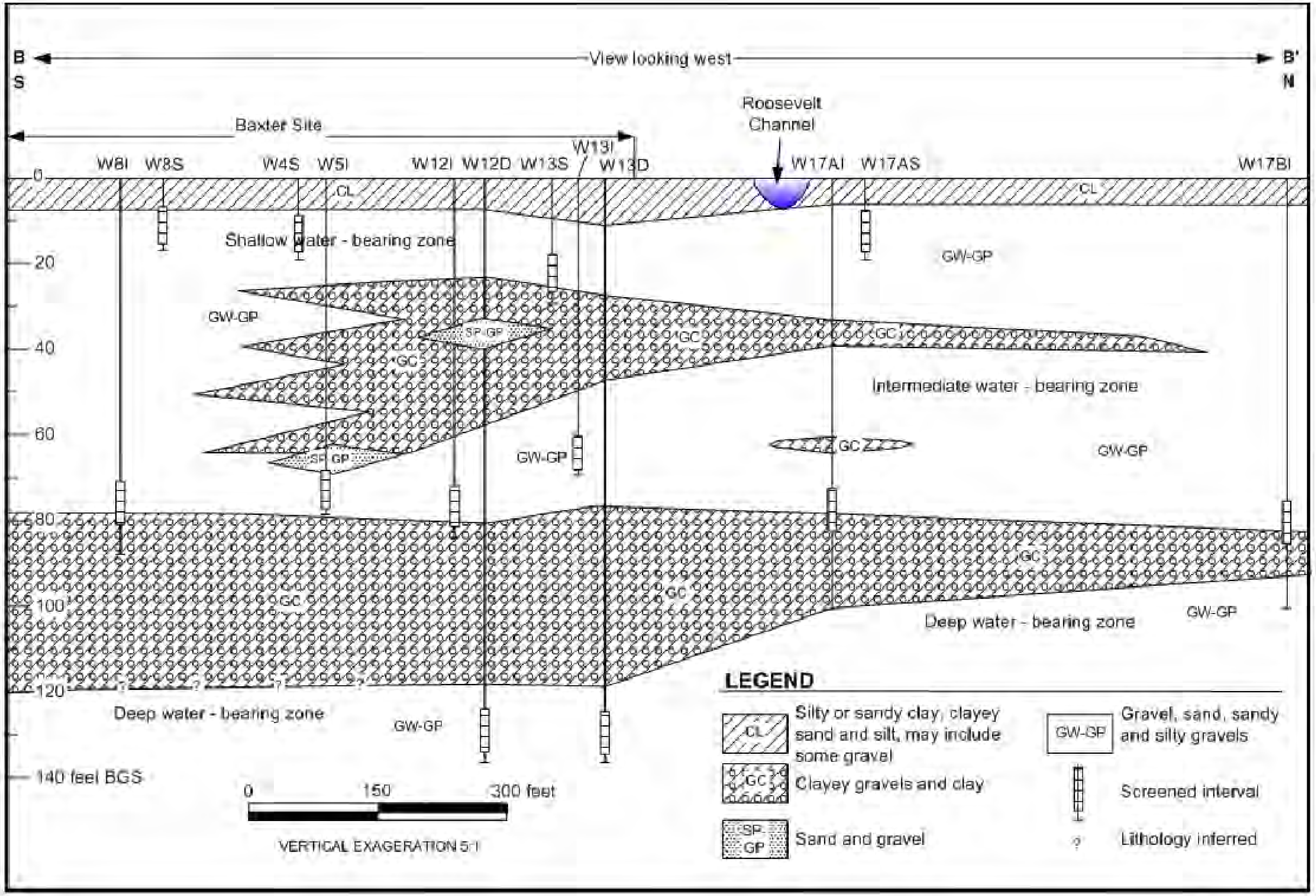

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GENERALIZED SOUTH - NORTH
GEOLOGIC CROSS SECTION (B-B')

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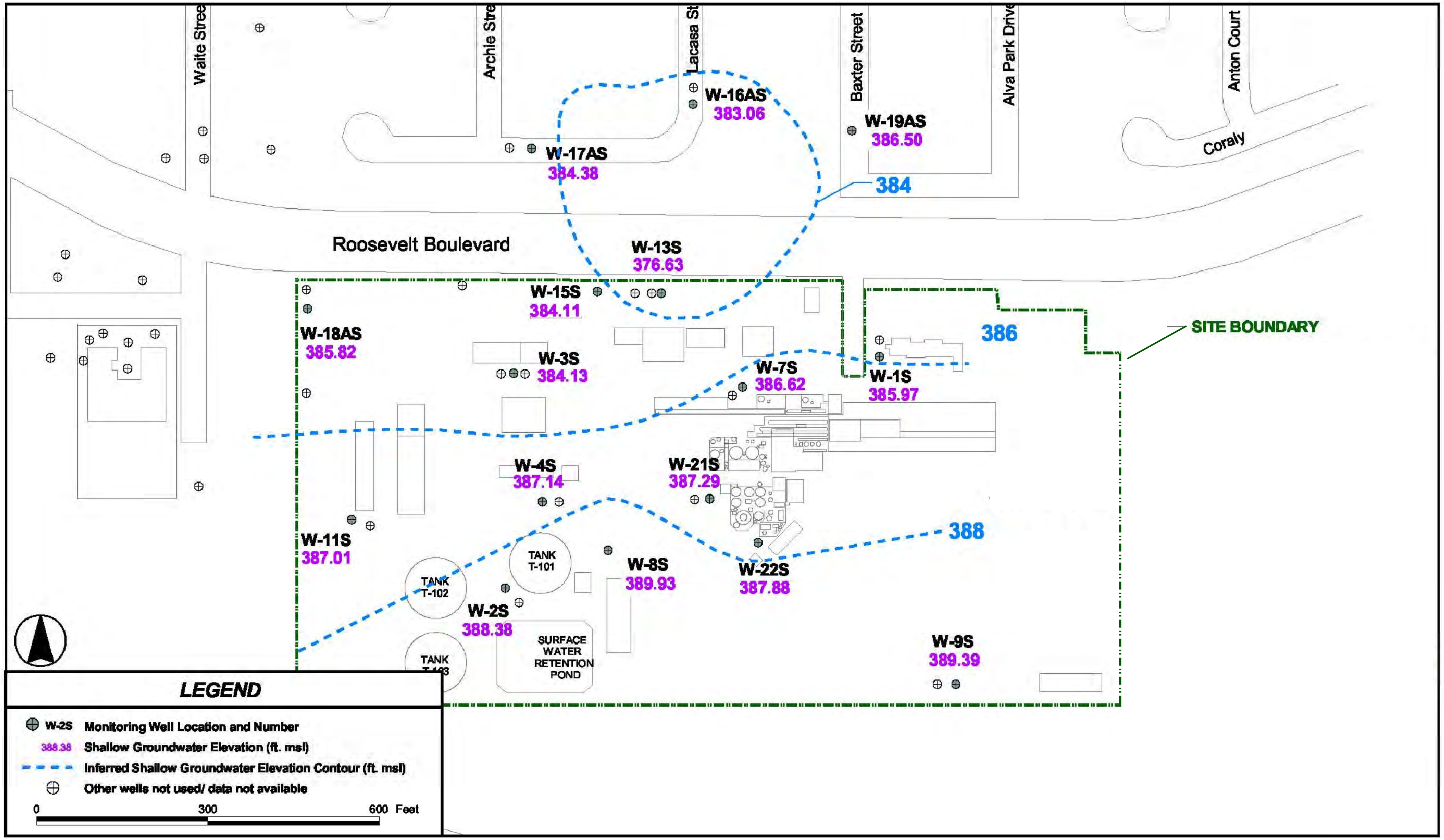

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SHALLOW ZONE GROUNDWATER ELEVATION CONTOURS (MARCH 2008)

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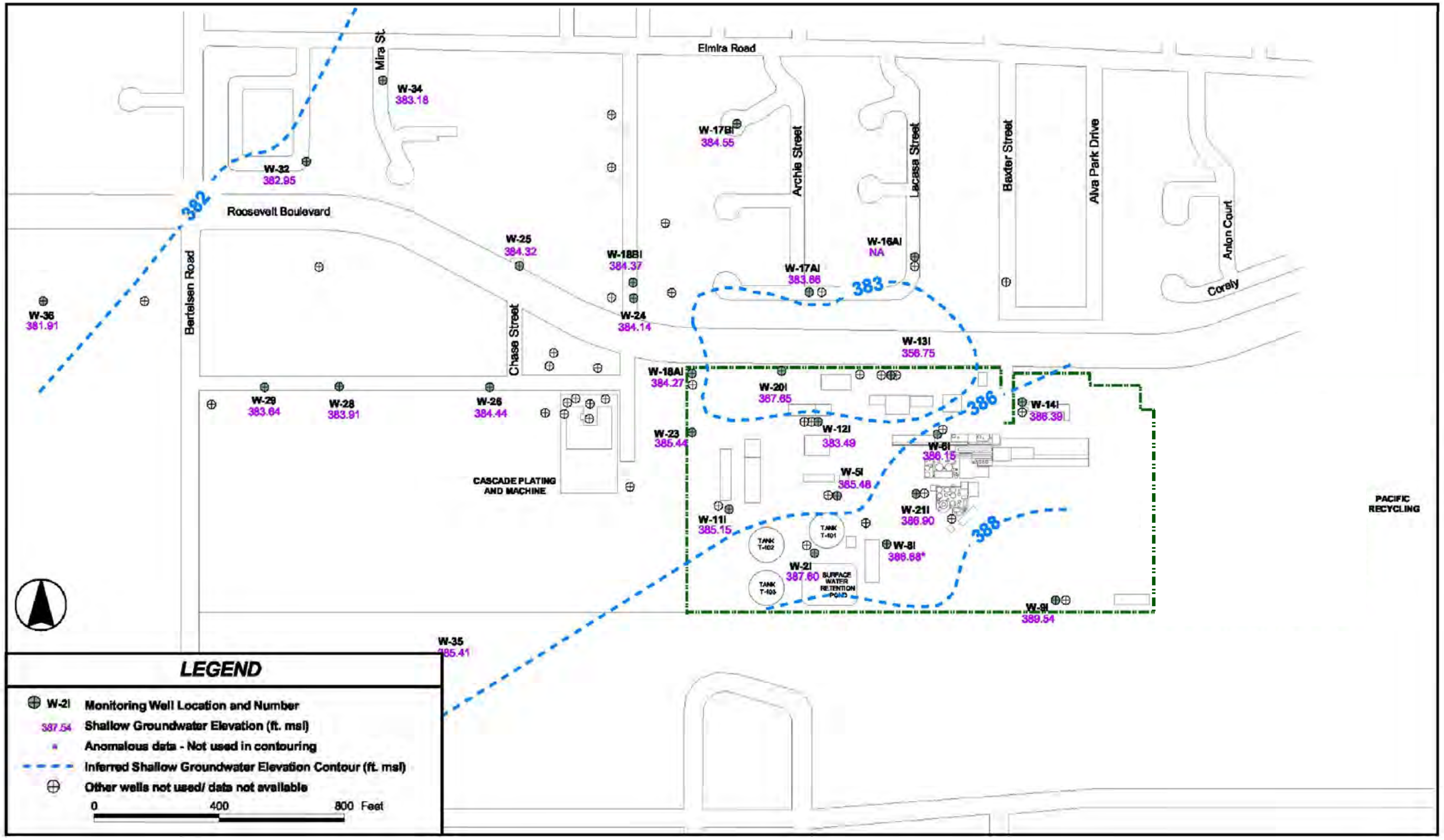

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INTERMEDIATE ZONE GROUNDWATER ELEVATION CONTOURS (MARCH 2008)

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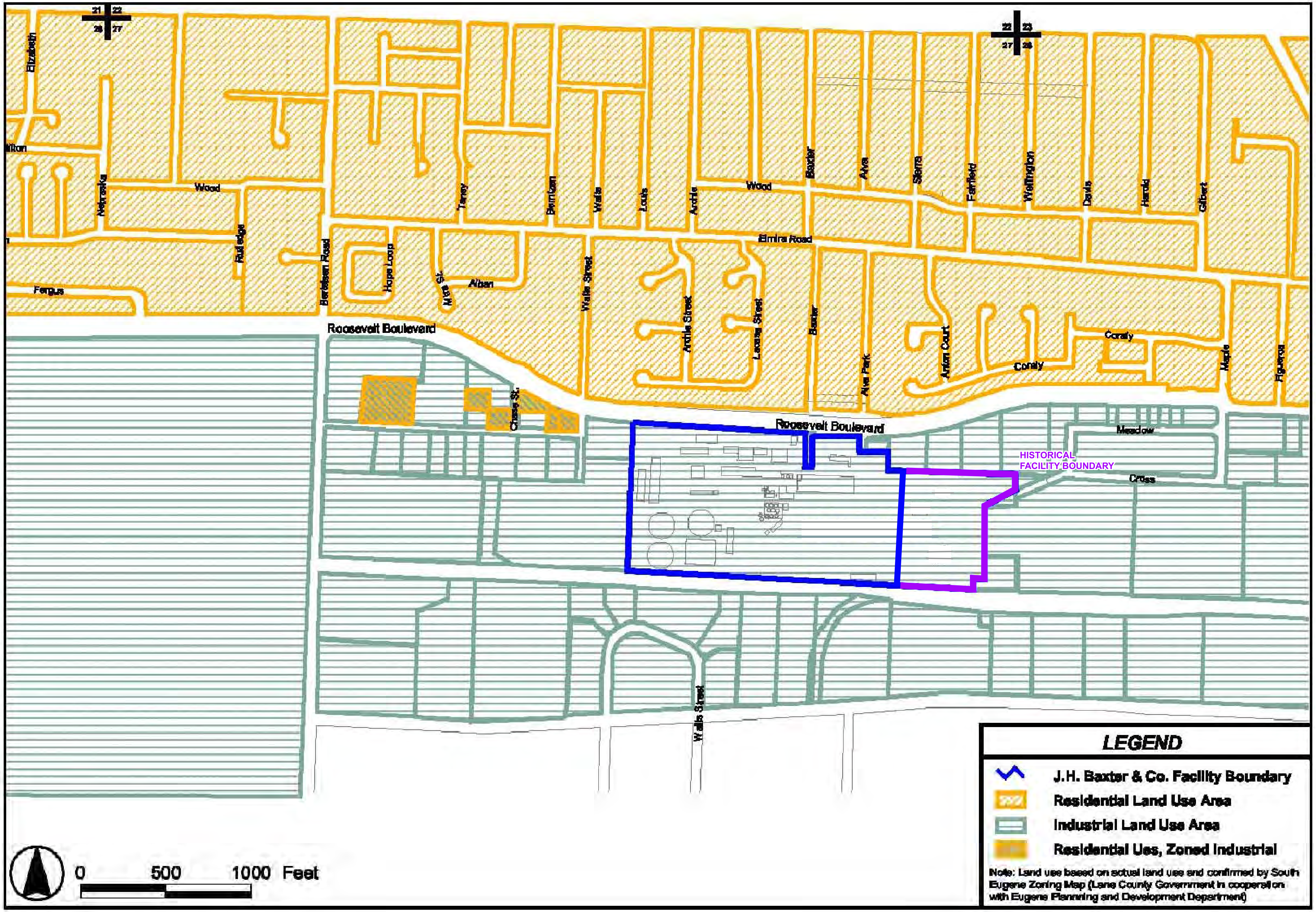

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SURROUNDING LAND USE

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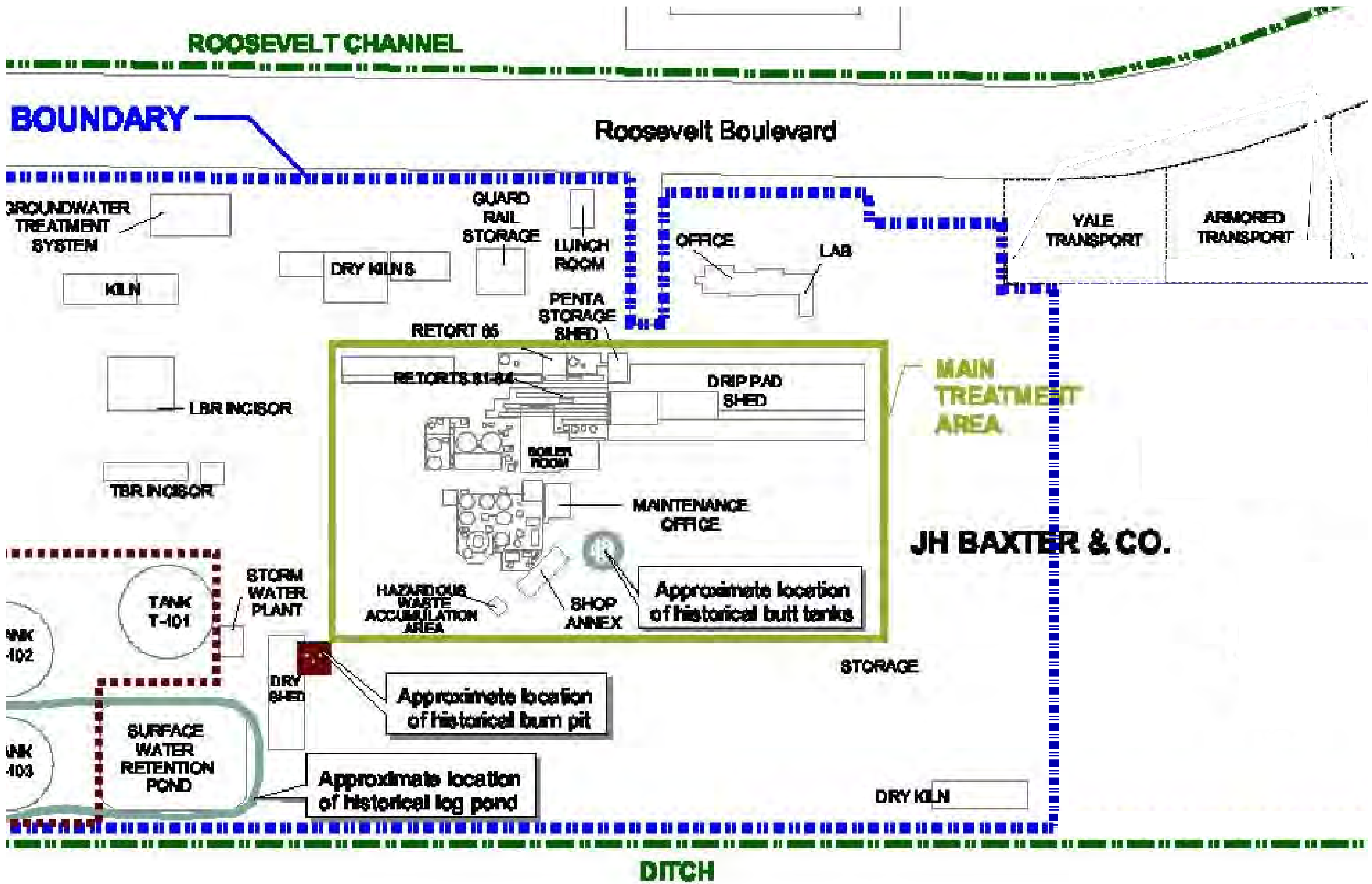

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1 inch = 200 feet

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HISTORICAL FACILITY DETAILS

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FIGURE 4-2

Shallow Groundwater Capture Zone

JH Baxter
Eugene, Oregon

LEGEND

- Groundwater Elevation Contours, September 2015 (dashed where inferred)
- Groundwater Flow Direction
- Monitoring Well, Shallow
- Extraction Well, Shallow

Pentachlorophenol Concentration (ug/L) (based on August 2014 data)

- 1 - <50
- 50 - <150
- ≥150

All Other Features

- Facility Boundary
- Tax Lot
- Railroad
- Watercourse

NOTES:

1. Pentachlorophenol concentration in ug/L (microgram per liter).
2. Samples taken on dates shown. Not all wells were sampled.
3. Water wells and Locality of Facility from Beneficial Water Use Determination. June 28, 2002.

Abbreviations:
J Estimated
< Not-Detected at concentration shown

N

0 175 350 525
Feet

MAP NOTES:
Date: February 24, 2016
Data Sources: AMEC, USGS, ESRI, Lane Co.

GSI Water Solutions, Inc.

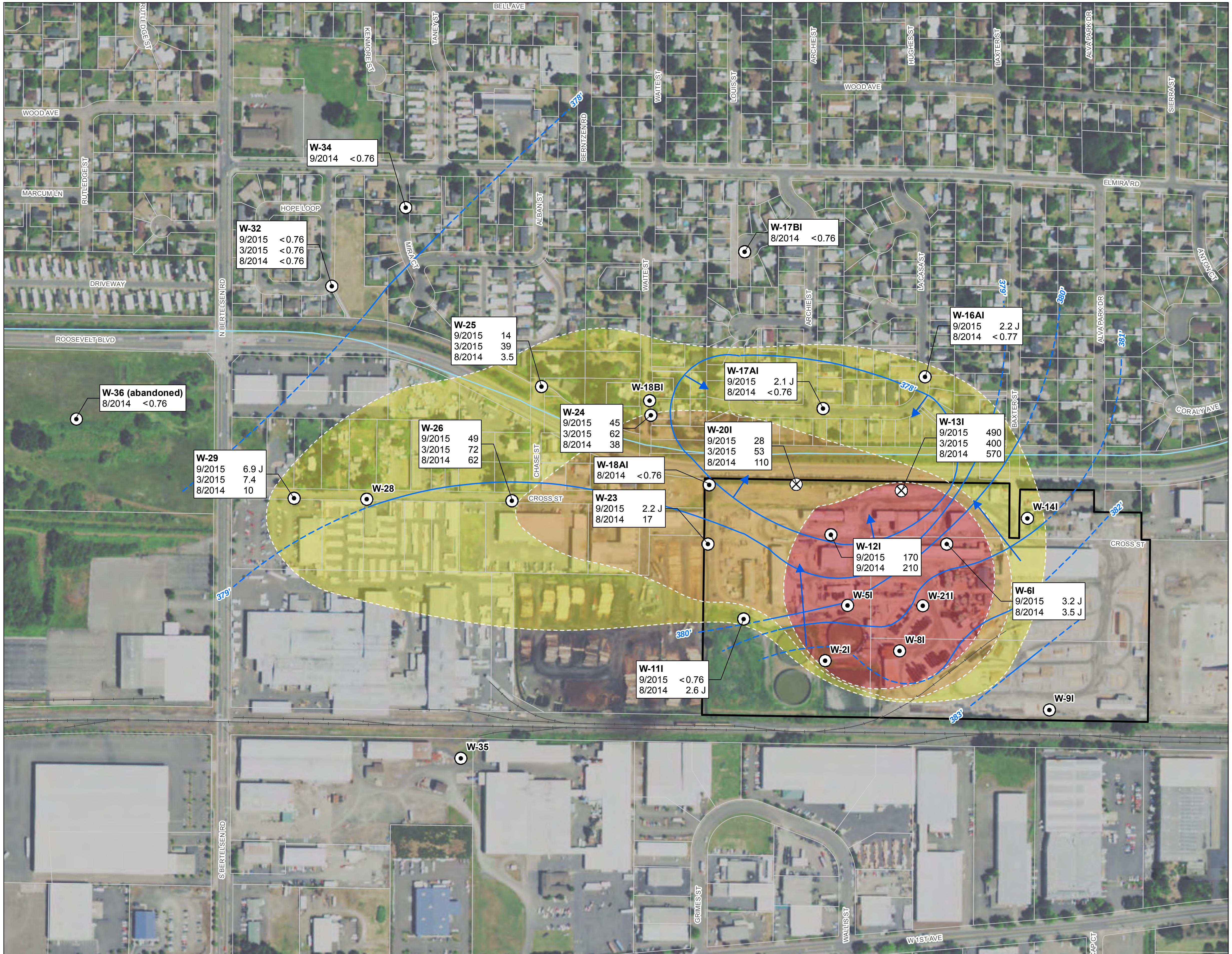

FIGURE 4-3

Intermediate Groundwater Capture Zone

JH Baxter
Eugene, Oregon

LEGEND

- Groundwater Elevation Contours, September 2015 (dashed where inferred)
- Groundwater Flow Direction
- Monitoring Well, Intermediate
- Extraction Well, Intermediate

Pentachlorophenol Concentration (ug/L) (based on August 2014 data)

- 1 - <50
- 50 - <150
- ≥150

All Other Features

- Facility Boundary
- Tax Lot
- Railroad
- Watercourse

NOTES:

1. Pentachlorophenol concentration in ug/L (microgram per liter).
2. Samples taken on dates shown. Not all wells were sampled.
3. Water wells and Locality of Facility from Beneficial Water Use Determination. June 28, 2002

Abbreviations:
J Estimated
< Not-Detected at concentration shown

N

0 175 350 525
Feet

MAP NOTES:
Date: February 24, 2016
Data Sources: AMEC, USGS, ESRI, Lane Co.

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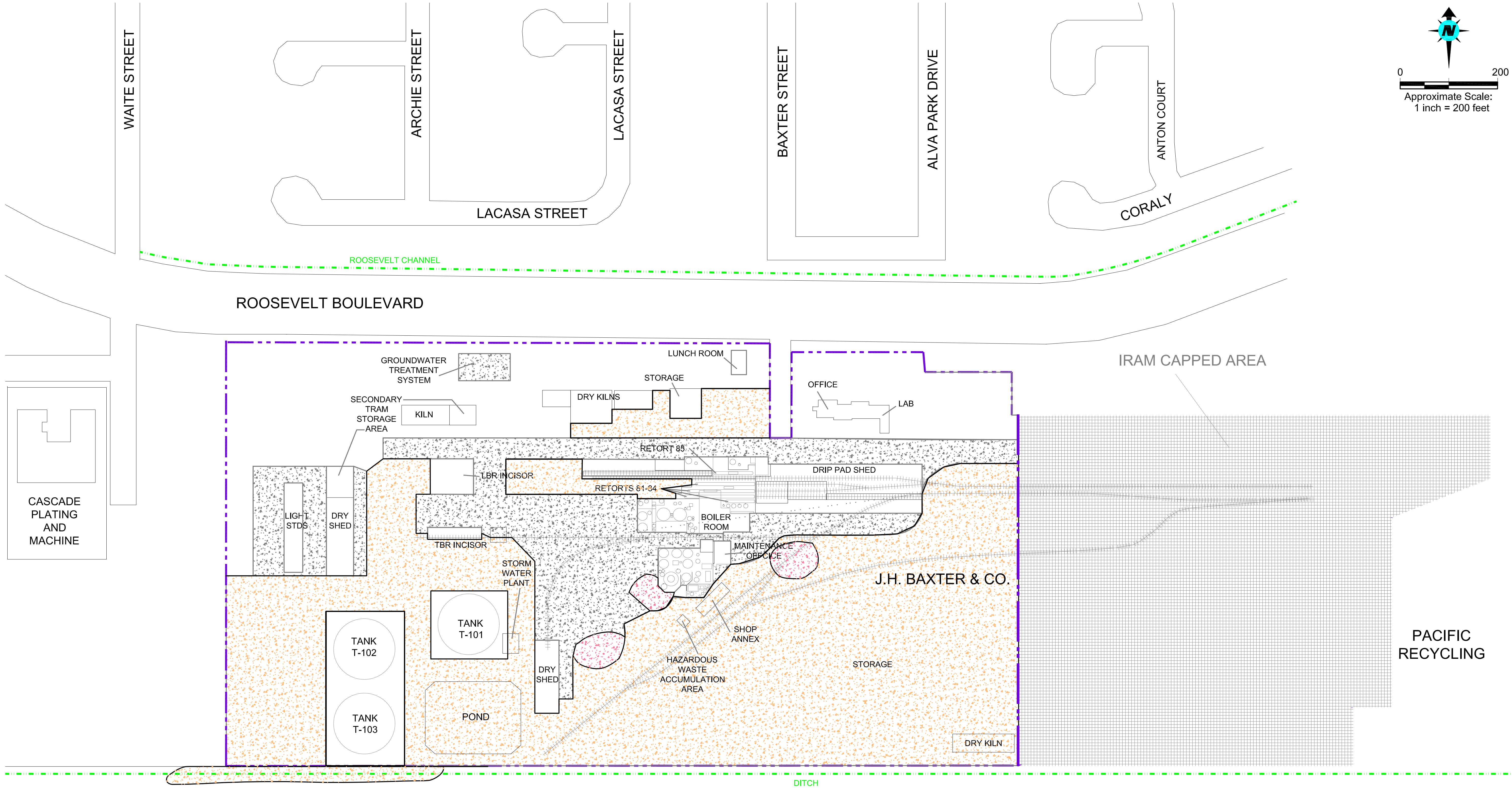

LEGEND

- FACILITY BOUNDARY
- RAILROAD
- PAVED AREAS
- AREAS WITH SOILS ABOVE HOT SPOT CLEANUP LEVELS
- AREA WITH SOILS ABOVE PROPOSED CLEANUP LEVELS

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AREAS OF CONCERN - SOIL

DRAWN:	CHECKED:	DATE:	FIGURE:
DCN	JSB	09/30/11	5-1

FIGURE 5-2

Area of Concern - Shallow Groundwater

JH Baxter
Eugene, Oregon

LEGEND

- Monitoring Well, Shallow
- Extraction Well, Shallow

Water Wells[3]

- Domestic, Irrigation in Use (depth)
- Industrial, in Use <35' (shallow)
- Industrial, in Use >100' (deep)
- Not in Use (residential)
- Abandoned (residential)

Pentachlorophenol Concentration (ug/L) (based on August 2014 data)

- 1 - <50
- 50 - <150
- ≥150 (source areas)

All Other Features

- Facility Boundary
- Locality of Facility
- Tax Lot
- Railroad
- Watercourse

NOTES:

1. Pentachlorophenol concentration in ug/L (microgram per liter).
2. Samples taken on dates shown. Not all wells were sampled.
3. Water wells and Locality of Facility from Beneficial Water Use Determination. June 28, 2002

Abbreviations:
J Estimated
< Not-Detected at concentration shown

N

0 175 350 525
Feet

MAP NOTES:
Date: February 24, 2016
Data Sources: AMEC, USGS, ESRI, Lane Co.

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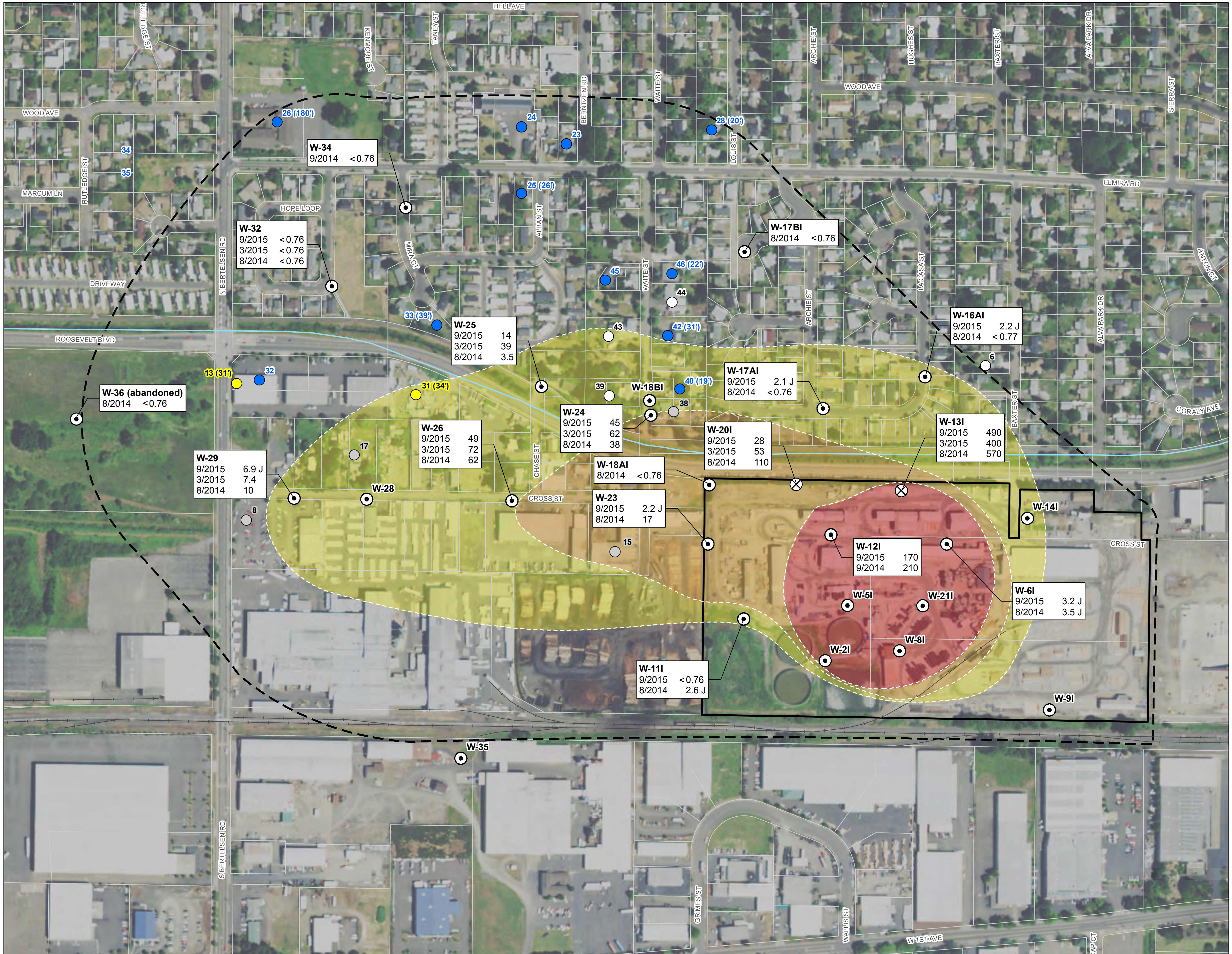

FIGURE 5-3

Area of Concern - Intermediate Groundwater

JH Baxter
Eugene, Oregon

LEGEND

- Monitoring Well, Intermediate
- Extraction Well, Intermediate

Water Wells[3]

- Domestic, Irrigation in Use (depth)
- Industrial, in Use <35' (shallow)
- Industrial, in Use >100' (deep)
- Not in Use (residential)
- Abandoned (residential)

Pentachlorophenol Concentration (ug/L) (based on August 2014 data)

- 1 - <50
- 50 - <150
- ≥150

All Other Features

- Facility Boundary
- Locality of Facility
- Tax Lot
- Railroad
- Watercourse

NOTES:

1. Pentachlorophenol concentration in ug/L (microgram per liter).
2. Samples taken on dates shown. Not all wells were sampled.
3. Water wells and Locality of Facility from Beneficial Water Use Determination. June 28, 2002

Abbreviations:
J Estimated
< Not-Detected at concentration shown

N

0 175 350 525
Feet

MAP NOTES:
Date: February 24, 2016
Data Sources: AMEC, USGS, ESRI, Lane Co.

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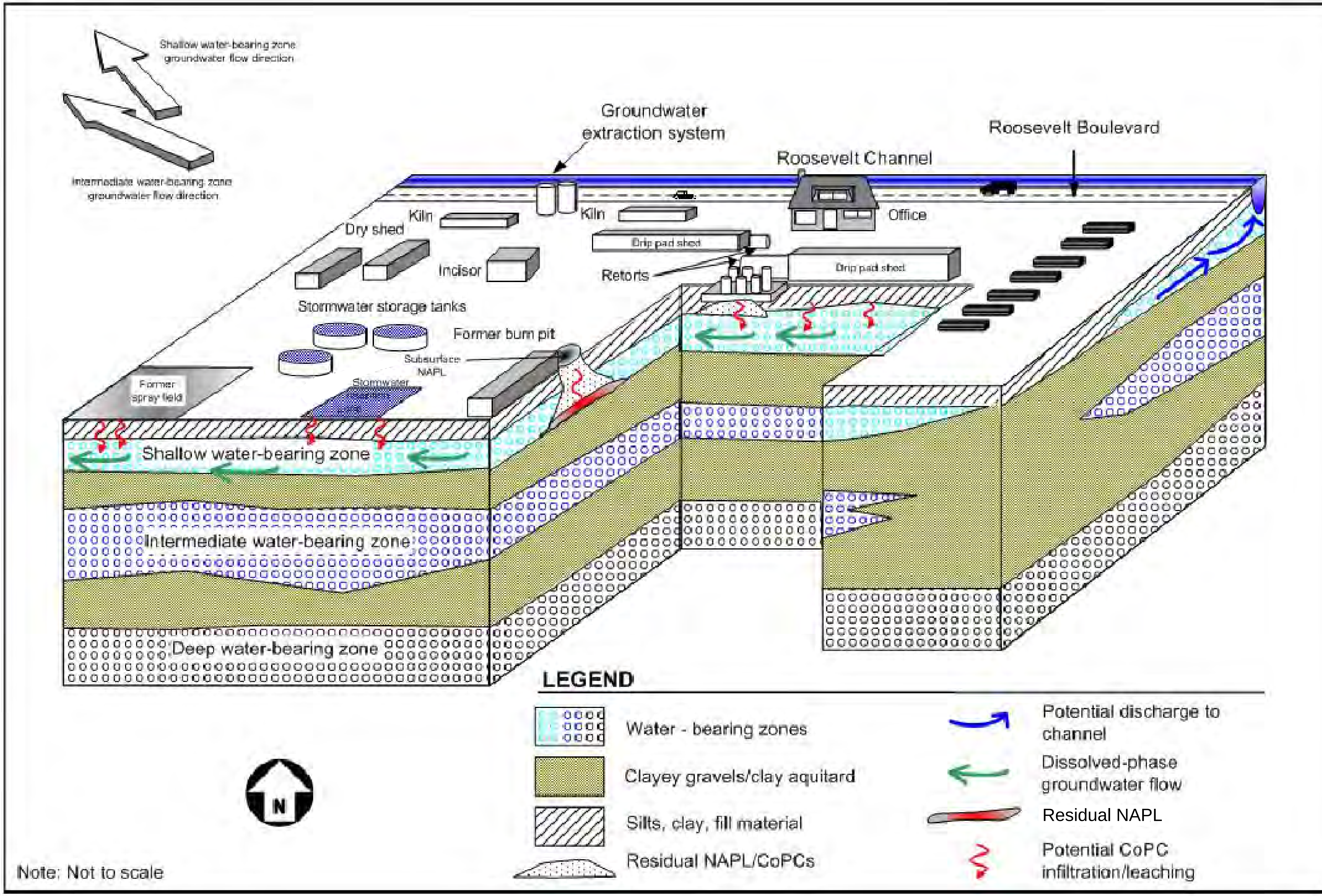

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CONCEPTUAL SITE MODEL

DRAWN:	CHECKED:	DATE:	FIGURE:
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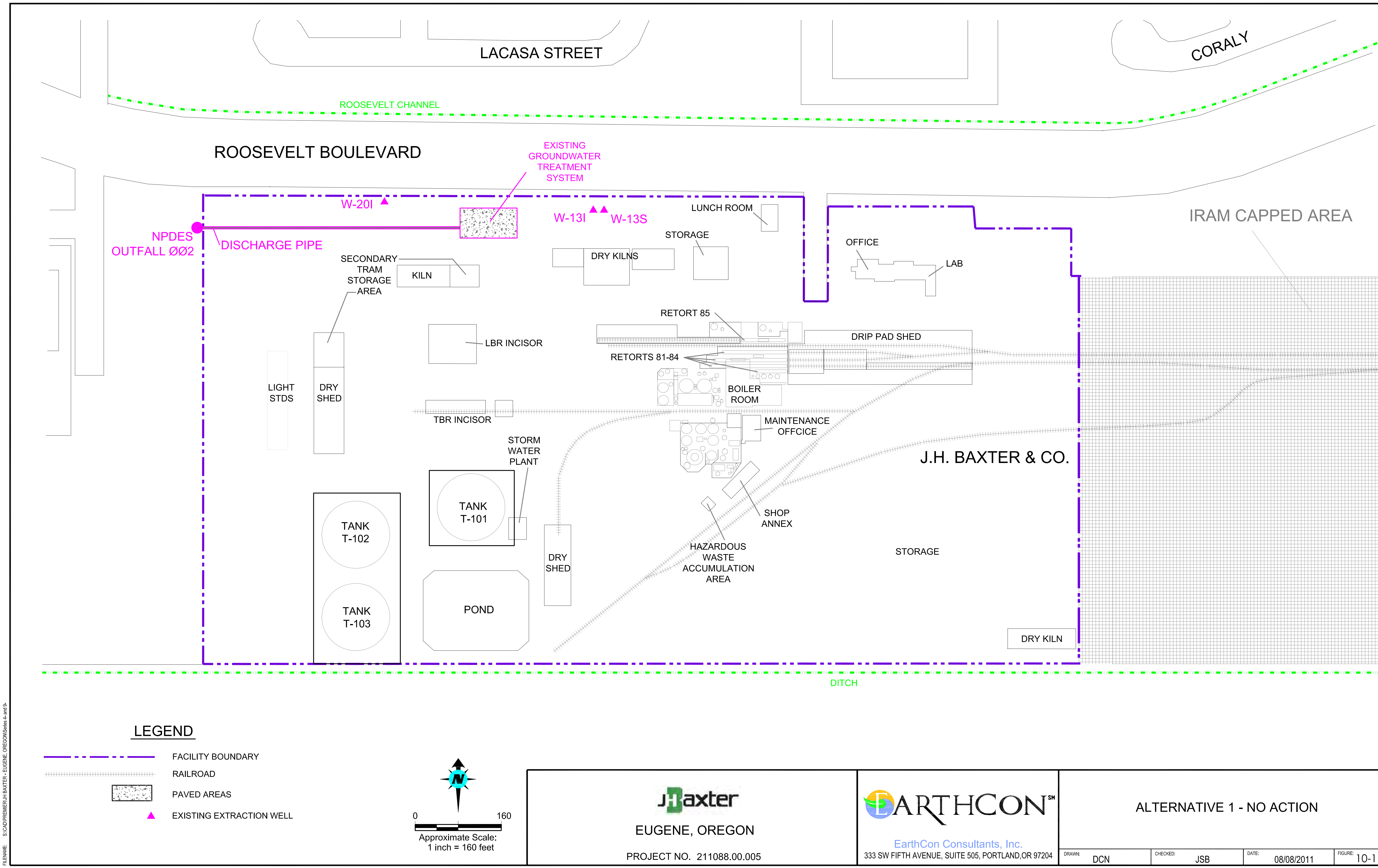
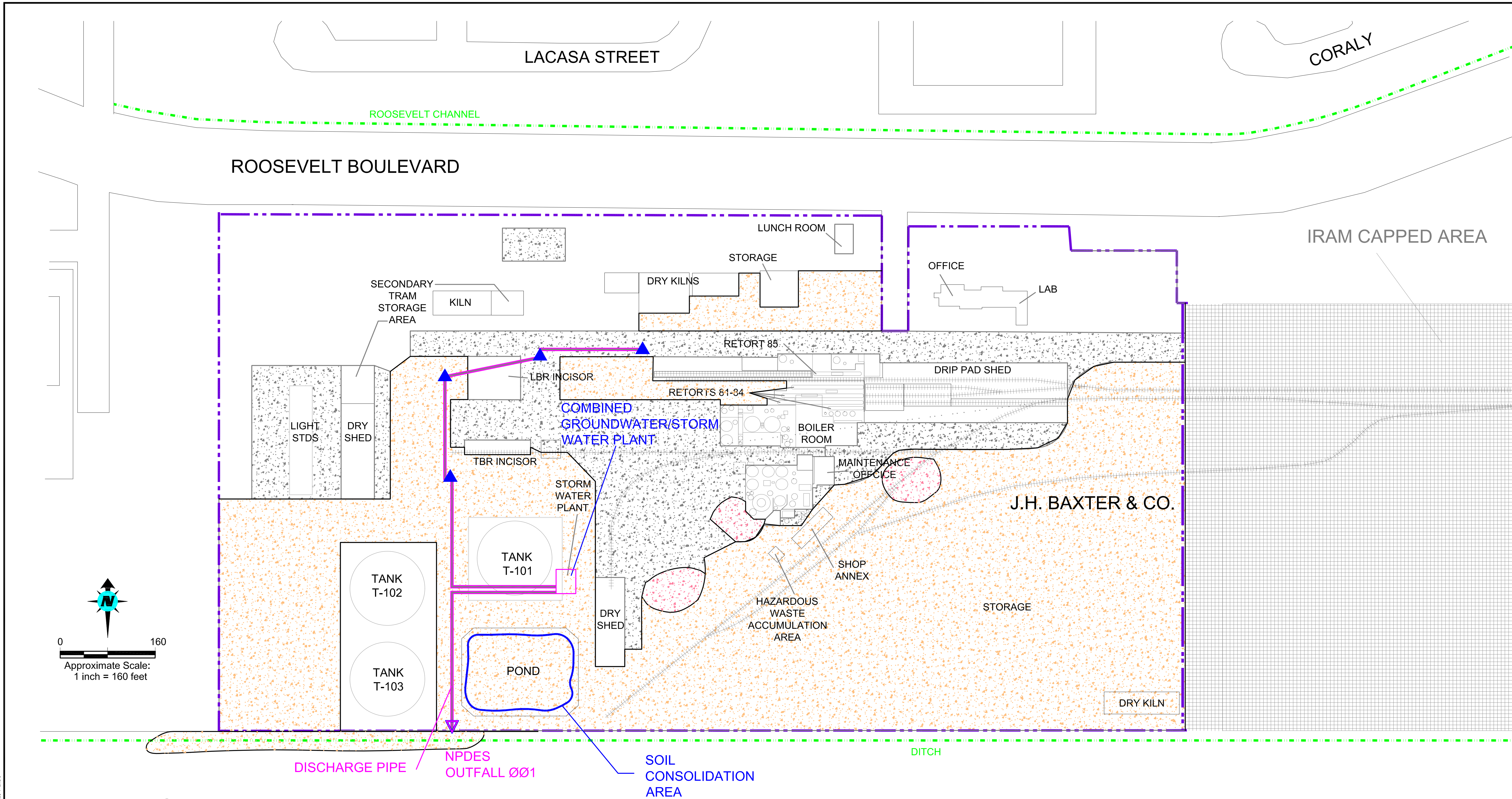

LACASA STREET
CORALY
ROOSEVELT CHANNEL
ROOSEVELT BOULEVARD
EXISTING GROUNDWATER TREATMENT SYSTEM
W-20I
W-13I
W-13S
NPDES OUTFALL ØØ2
DISCHARGE PIPE
LUNCH ROOM
STORAGE
DRY KILNS
SECONDARY TRAM STORAGE AREA
KILN
OFFICE
LAB
IRAM CAPPED AREA
RETORT 85
DRIP PAD SHED
LBR INCISOR
RETORTS 81-84
LIGHT STDS
DRY SHED
BOILER ROOM
TBR INCISOR
MAINTENANCE OFFCICE
STORM WATER PLANT
J.H. BAXTER & CO.
TANK T-101
TANK T-102
TANK T-103
SHOP ANNEX
HAZARDOUS WASTE ACCUMULATION AREA
STORAGE
DRY SHED
POND
DRY KILN
DITCH
LEGEND
FACILITY BOUNDARY
RAILROAD
PAVED AREAS
EXISTING EXTRACTION WELL
N
0
160
Approximate Scale:
1 inch = 160 feet
JHBaxter
EUGENE, OREGON
PROJECT NO. 211088.00.005
EARTHCON
EarthCon Consultants, Inc.
333 SW FIFTH AVENUE, SUITE 505, PORTLAND,OR 97204
ALTERNATIVE 1 - NO ACTION
DRAWN: DCN
CHECKED: JSB
DATE: 08/08/2011
FIGURE: 10-1



LEGEND

- FACILITY BOUNDARY
- RAILROAD
- PAVED AREAS
- HOT SPOT EXCAVATION AREAS
- CAPPED AREAS
- NEW EXTRACTION WELL
- PIPING

JHBaxter

EUGENE, OREGON

PROJECT NO. 211088.00.005

EARTHCON[SM]

EarthCon Consultants, Inc.

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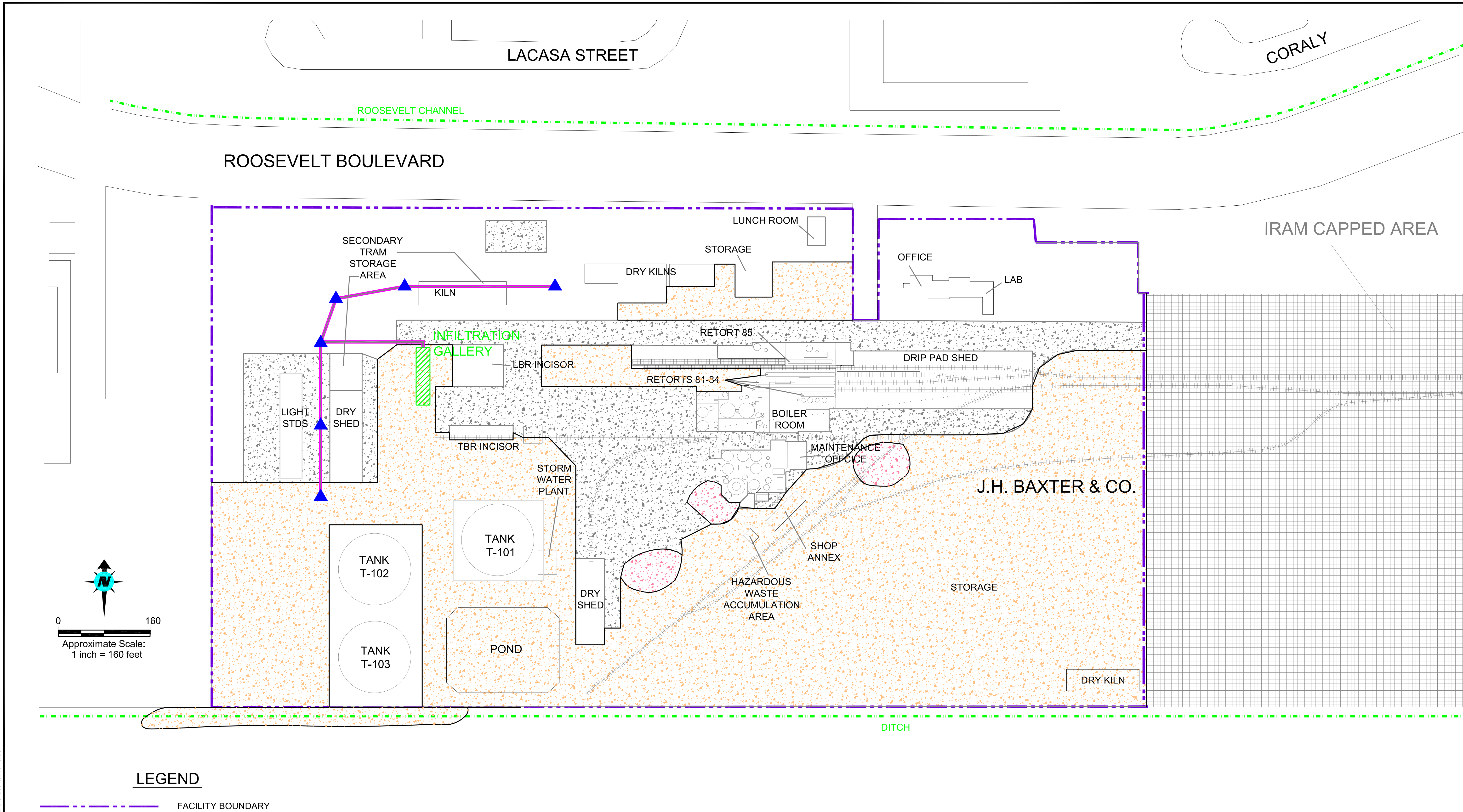
ALTERNATIVE 2 -
CAPPING, HOT SPOT CONSOLIDATION, AND
ENHANCED GROUNDWATER EXTRACTION, MNA

DRAWN:	CHECKED:	DATE:	FIGURE:
DCN	JSB	09/30/11	10-2



J.H. Baxter

EUGENE, OREGON

PROJECT NO. 211088.00.005

EARTHCON

EarthCon Consultants, Inc.

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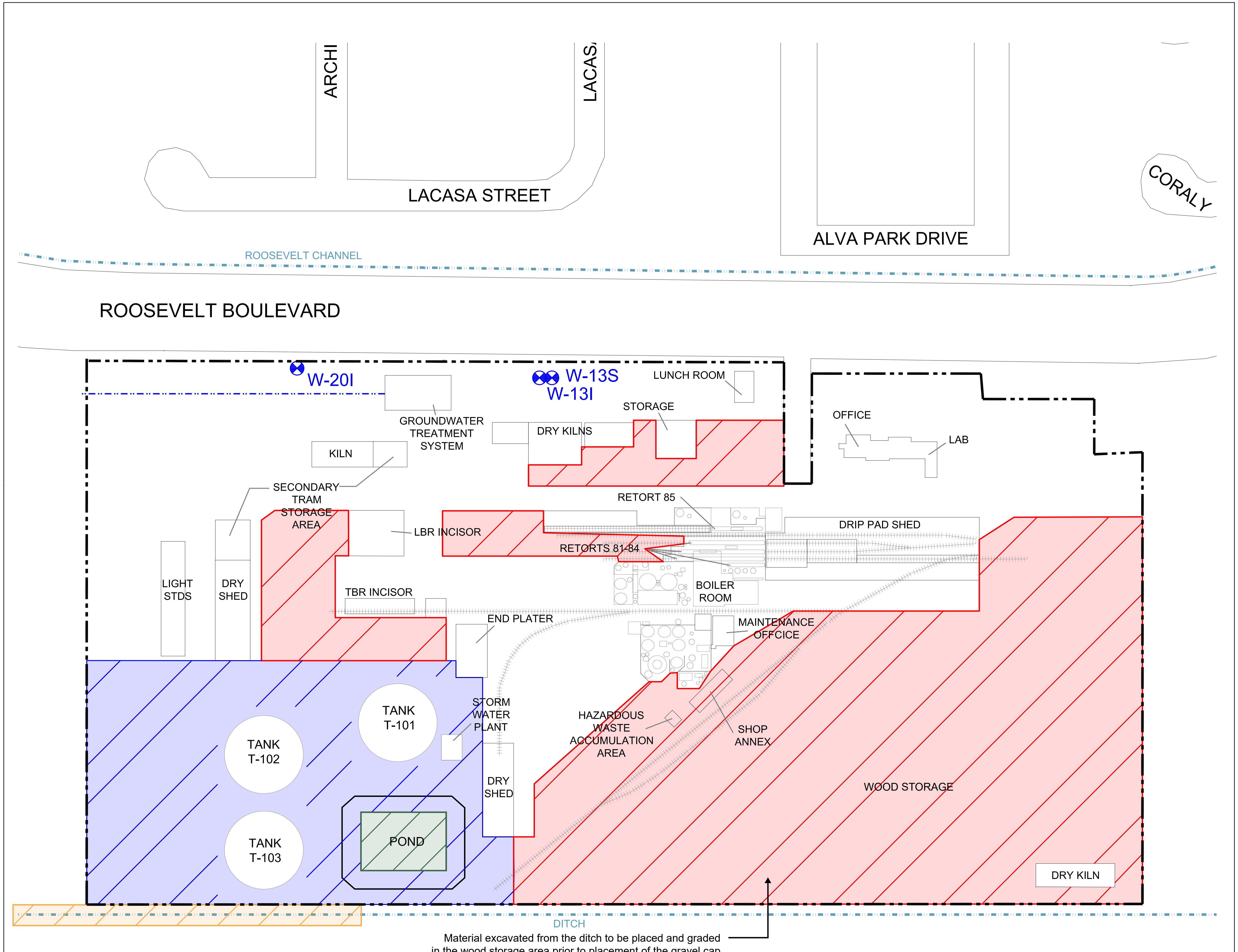
ALTERNATIVE 3 -
CAPPING, HOT SPOT EXCAVATION AND DISPOSAL
ENHANCED BIOREMEDIATION

DRAWN:	CHECKED:	DATE:	FIGURE:
DCN	JSB	09/30/11	10-3

FIGURE 10-3a

Preferred Alternative 3a

J. H. Baxter Wood Treating Facility
Eugene, Oregon



LEGEND

- Groundwater Extraction Well
- Facility Boundary (RCRA Area Of Contamination)
- Railroad
- Treatment System Discharge (Outfall 002)
- 12" Gravel and Geotextile Cap
- 6" Gravel and Geotextile Cap
- 6" Sediment Removal and Gravel Cap
- 3" Gravel and Geotextile Cap in Pond Bottom

NOTE:
The thickness and construction material for the cap may be different than described in the legend, based on operational needs and approval by DEQ.

N

0 100 200
Feet

Data Sources: AMEC

GSI Water Solutions, Inc.

P:\Portland\001-ODEQ PPA\Figures\FS

Document Path: P:\Portland\302 - Baxter\GIS\Eugene\Project_mxds\2015_Final_FS\Figure10-4_PCP_Concentrations_2001_Shallow.mxd

FIGURE 10-4

PCP Concentrations in Shallow Monitoring Wells 2001 or Maximum Concentration Prior to 2001

JH Baxter
Eugene, Oregon

LEGEND

- Inferred Groundwater Elevation Contours (dashed where inferred) September 2001 (AMEC)
- Groundwater Flow Direction
- Monitoring Well, Shallow

PCP Concentration (ug/L)

- 1 - <100
- ≥100 - 500
- ≥500

All Other Features

- Facility Boundary
- Tax Lot
- Railroad
- Watercourse

NOTES:
PCP results in ug/L
ND: Non-Detect

N

0 160 320 480
Feet

MAP NOTES:
Date: February 24, 2016
Data Sources: AMEC, USGS, ESRI, Lane Co.

GSI Water Solutions, Inc.

FIGURE 10-5

PCP Concentrations in Shallow Monitoring Wells 2014

JH Baxter
Eugene, Oregon

LEGEND

- Groundwater Elevation Contours (dashed where inferred)
- Groundwater Flow Direction
- Monitoring Well, Shallow

PCP Concentration (ug/L)

- 1 - <100
- ≥100 - 500
- ≥500

All Other Features

- Facility Boundary
- Tax Lot
- Railroad
- Watercourse

NOTES:
PCP results in ug/L
ND: Non-Detect

N

0 160 320 480
Feet

MAP NOTES:
Date: February 24, 2016
Data Sources: AMEC, USGS, ESRI, Lane Co.

GSI Water Solutions, Inc.

Document Path: P:\Portland\302 - Baxter\GIS\Eugene\Project_mxds\2015_Final_FS\Figure10-5_PCP_Concentrations_2014_Shallow.mxd

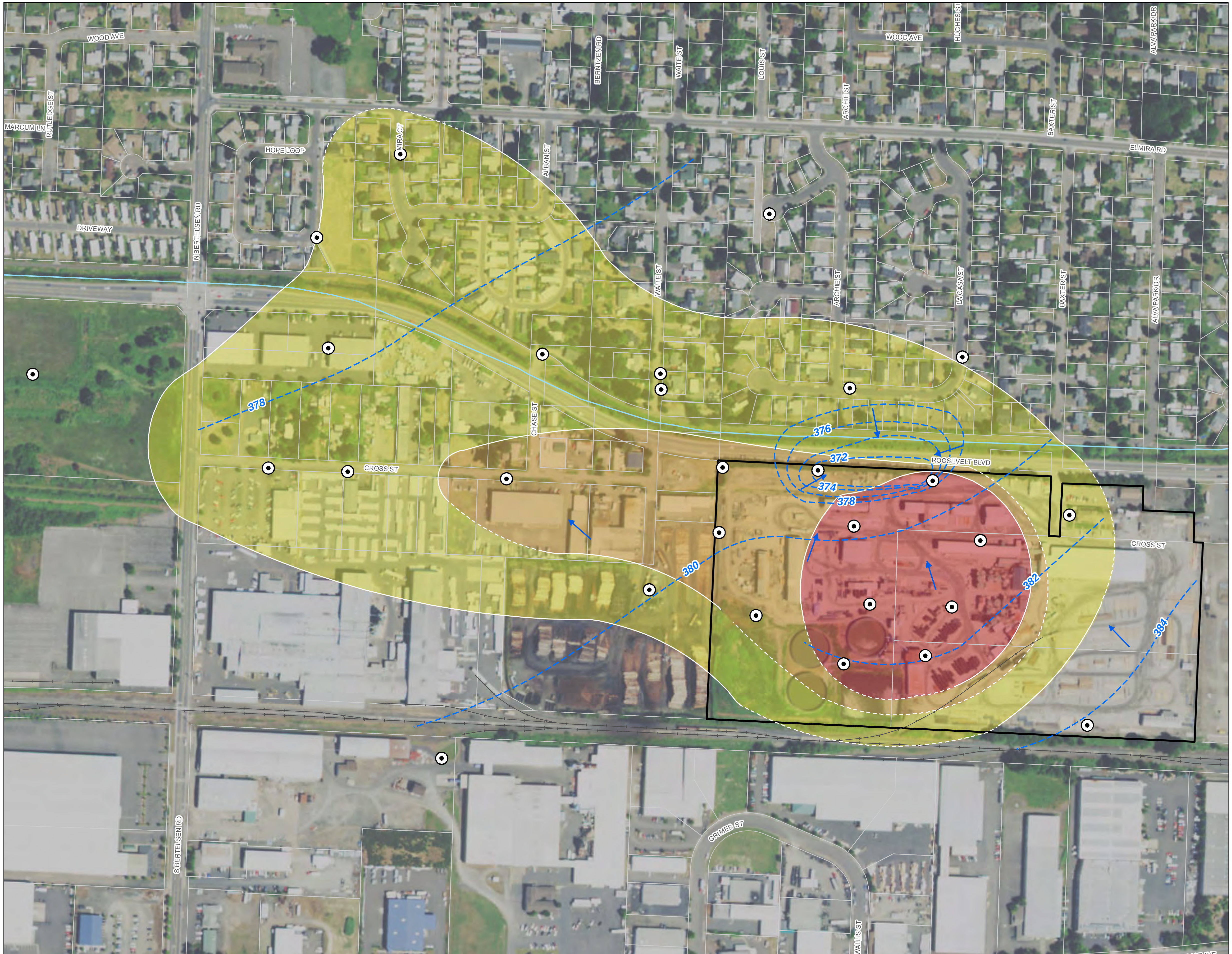


FIGURE 10-6

PCP Concentrations in Intermediate Monitoring Wells 2001 or Maximum Concentration Prior to 2001

JH Baxter
Eugene, Oregon

LEGEND

Inferred Groundwater Elevation Contours (dashed where inferred) September 2001 (AMEC)

Groundwater Flow Direction

Monitoring Well, Intermediate

PCP Concentration (ug/L)

1 - <100

≥100 - 500

≥500

All Other Features

Facility Boundary

Tax Lot

Railroad

Watercourse

NOTES:
PCP results in ug/L
ND: Non-Detect

N

0 160 320 480
Feet

MAP NOTES:
Date: February 24, 2016
Data Sources: AMEC, USGS, ESRI, Lane Co.

GSI Water Solutions, Inc.

Document Path: P:\Portland\302 - Baxter\GIS\Eugene\Project_mxds\2015_Final_FS\Figure10-6_PCP_Concentrations_2001_Intermediate.mxd

FIGURE 10-7

PCP Concentrations in Intermediate Monitoring Wells 2014

JH Baxter
Eugene, Oregon

LEGEND

- Groundwater Elevation Contours (dashed where inferred)
- Groundwater Flow Direction
- Monitoring Well, Intermediate

PCP Concentration (ug/L)

- 1 - <100
- ≥100 - 500
- ≥500

All Other Features

- Facility Boundary
- Tax Lot
- Railroad
- Watercourse

NOTES:
PCP results in ug/L
ND: Non-Detect

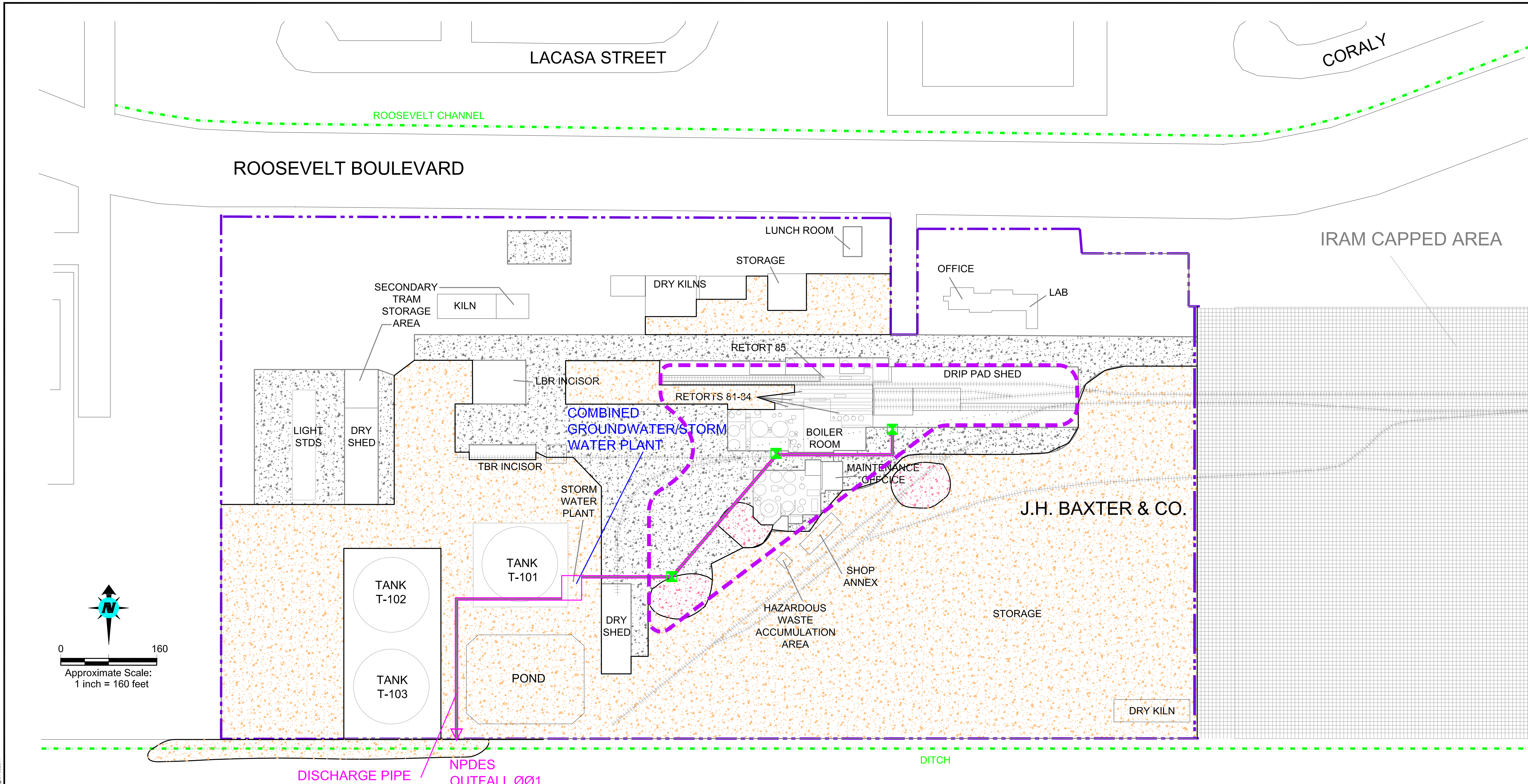
N

0 160 320 480
Feet

MAP NOTES:
Date: February 24, 2016
Data Sources: AMEC, USGS, ESRI, Lane Co.

GSI Water Solutions, Inc.

Document Path: P:\Portland\302 - Baxter\GIS\Eugene\Project_mxds\2015_Final_FS\Figure10-7_PCP_Concentrations_2014_Intermediate.mxd



LEGEND

- FACILITY BOUNDARY
- RAILROAD
- PAVED AREAS
- HOT SPOT EXCAVATION AREAS
- CAPPED AREAS
- TOTAL FLUID EXTRACTION WELL
- PIPING
- APPROXIMATE LOCATION OF CONTAINMENT WALL

J.H. Baxter
EUGENE, OREGON
PROJECT NO. 211088.00.005

EARTHCON℠
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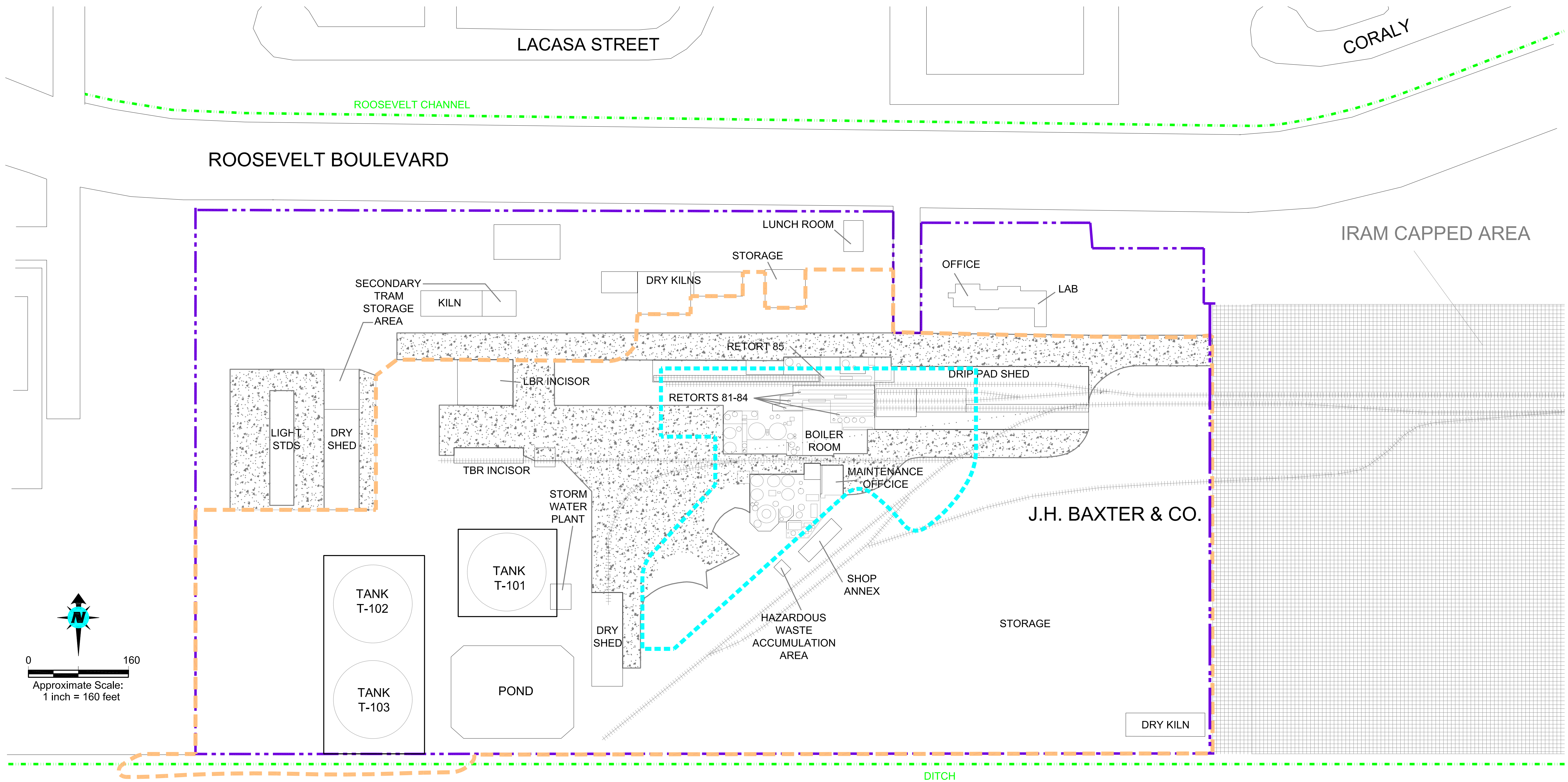
ALTERNATIVE 4 -
CAPPING, HOT SPOT EXCAVATION AND DISPOSAL,
PHYSICAL/HYDRAULIC CONTAINMENT, MNA

DRAWN:	CHECKED:	DATE:	FIGURE:
DCN	JSB	09/30/11	10-8



LEGEND

- FACILITY BOUNDARY
- RAILROAD
- APPROXIMATE LIMIT OF DEEPER EXCAVATION (± 10 FT.)
- APPROXIMATE LIMIT OF SHALLOW EXCAVATION
- PAVED AREAS

JHBaxter

EUGENE, OREGON

PROJECT NO. 211088.00.005

EARTHCON℠

EarthCon Consultants, Inc.

333 SW FIFTH AVENUE, SUITE 505, PORTLAND,OR 97204

ALTERNATIVE 5 -
SOIL EXCAVATION AND
OFFSITE DISPOSAL, MNA

DRAWN:	CHECKED:	DATE:	FIGURE:
DCN	JSB	09/30/11	10-9

TABLES

Table 4-1. Summary of Human Health Risk Assessment Conclusions
J.H. Baxter Wood Treating Facility
Eugene, Oregon

Exposure Medium	Receptor	Exposure Scenario	Chemicals of Concern	Source
On-site Soil	Worker	direct contact	Arsenic, Benzo(a)pyrene, Dibenzo(a,h)anthracene, dioxins/furans	Baxter, 2006
	Trenchworker	direct contact	none	Baxter, 2006
Off-site Soil	Off-site Resident	direct contact	none	AMEC, 2014
On-site Groundwater	Trenchworker	direct contact	Benzo(a)pyrene, Dibenzo(a,h)anthracene, Pentachlorophenol	Baxter, 2006
Off-site Groundwater	Off-site Resident	direct contact	Pentachlorophenol, Indeno(1,2,3-cd)pyrene (based on non-detect data) Dioxins/furans (based on non-detect data)	AMEC, 2014
	Off-site Industrial Worker	direct contact	Pentachlorophenol	Baxter, 2006
Surface Water	Recreational User	direct contact	none	AMEC, 2014
Sediment	Recreational User	direct contact	none	AMEC, 2014

,

Sources

Baxter 2006. Revised Baseline Human Health Risk Assessment. Prepared for Oregon Department of Environmental Quality by J.H. Baxter. July 28, 2006.
AMEC, 2014. Memorandum to Geoff Brown, DEQ, from AMEC Environmental & Infrastructure, Inc. RE: *Revised Baseline Human Health Risk Assessment Addendum* . February 19, 2014.

Table 5-1. Proposed Cleanup Levels
J.H. Baxter Wood Treating Facility
Eugene, Oregon

Medium		Proposed Cleanup Level	Source	Proposed Hot Spot Level	Source
On-site Soil	Arsenic	18 mg/kg[a]	DEQ South Willamette Valley regional background, DEQ 2013 (AMEC 2014)	340 mg/kg	Baxter 2011
	Benzo(a)pyrene	0.27 mg/kg	Baxter 2011	27 mg/kg	Baxter 2011
	Dibenzo(a,h)anthracene	0.27 mg/kg	Baxter 2011	27 mg/kg	Baxter 2011
	Dioxins/furans	$2x\ 10^{-5}$ mg/kg TEQ[b]	Baxter 2011	$2x\ 10^{-3}$ mg/kg TEQ	Baxter 2011
Off-site Groundwater	Pentachlorophenol	1.5 ug/l[c]	Baxter 2011 (Industrial Worker) [d]	NA	*Baxter 2006a, DEQ 2015*
	Pentachlorophenol	0.65 ug/l	Off-site residential irrigation [e]	NA	*See Table 3*

Notes
a mg/kg = milligrams per kilogram
b pg/g TEQ = picograms per gram of 2,3,7,8-tetrachlorodibenzodioxin toxic equivalence
c ug/l = micrograms per liter
e Cleanup level for the off-site residential irrigation scenario was developed from exposure parameter values used in the BHHRA for an off-site industrial worker (Baxter 2006a) , and chemical/toxicity factors used in the 2015 DEQ RBDM spreadsheet.
d Cleanup level for the off-site residential irrigation scenario was developed from exposure parameters provided by DEQ, and chemical/toxicity factors used in the 2015 DEQ RBDM spreadsheet. Parameter values are presented in Table 5-1.

Sources

DEQ 2013. Development of Oregon Background Metals Concentrations in Soil. Oregon Department of Environmental Quality. Portland, OR. March 2013.

Baxter 2011. Feasibility Study Report, Revision 0, J.H. Baxter & Co. Eugene, Oregon Facility. Prepared by J.H.Baxter & Co. October 3, 2011.

AMEC, 2014. Memorandum to Geoff Brown, DEQ, from AMEC Environmental & Infrastructure, Inc. RE: *Revised Baseline Human Health Risk ASsessment Addendum.* February 19, 2014.

Table 5-2. Parameters Used in the Calculation of Off-site Groundwater Cleanup Level for Residential Irrigation

J.H. Baxter Wood Treating Facility

Eugene, Oregon

Exposure Parameters	Units	Value	Source
Averaging Time - Carcinogen	d	25550	DEQ 2010
Averaging Time - Noncarcinogen - adult	d	10950	DEQ 2010
Averaging Time - Noncarcinogen - child	d	2190	DEQ 2010
Body Weight - adult	kg	70	DEQ 2010
Body Weight - child	kg	15	DEQ 2010
Exposure Duration - adult resident	yr	30	DEQ 2010
Exposure Duration - child resident	yr	6	DEQ 2010
Exposure Frequency-groundwater	d/yr	60	DEQ 2015
Event frequency	ev/d	1	DEQ 2015
Duration of exposure event	hr/ev	2	DEQ 2015
Water Ingestion Rate - adult	L/d	0.05	DEQ 2015
Water Ingestion Rate - child	L/d	0.1	DEQ 2015
Skin Surface Area to Groundwater - adult	cm2	3300	DEQ 2015
Skin Surface Area to Groundwater - child	cm3	6600	DEQ 2015

Sources:

DEQ 2015. Provided by DEQ during discussions regarding preliminary remediation goal development.

DEQ 2010. Human Health Risk Assessment Guidance. Oregon Department of Environmental Quality. Portland, Oregon.

Table 5-3. Soil Stations Above Proposed Cleanup Levels
J.H. Baxter Wood Treating Facility
Eugene, Oregon

Station ID	Date	Depth	2,3,7,8-TCDD equivalent (TEQ-WHO) pg/g	Arsenic mg/kg	Dibenz(a,h)anthracene ug/kg	Benzo(a)pyrene ug/kg
B-10	1/26/1994	0.00-1.50 Feet	nr	16	686	966
B-11	1/27/1994	0.00-1.00 Feet	nr	1,710	15,200	4,440
B-11	1/27/1994	2.50-4.00 Feet	nr	1,710	15,200	4,440
B-12	1/27/1994	4.00-5.50 Feet	nr	7.9	1,110	703
B-13	1/27/1994	0.67-1.50 Feet	nr	13	1,820	377
B-13	1/27/1994	4.00-5.50 Feet	nr	13	1,820	377
B-14	1/27/1994	0.00-1.00 Feet	nr	20.5	2,570	317
B-14	1/27/1994	4.00-5.50 Feet	nr	20.5	2,570	317
B-16	1/27/1994	0.00-1.00 Feet	nr	7.6	10.5 U	410
B-16	1/27/1994	2.50-4.00 Feet	nr	7.6	10.5 U	410
B-18	1/27/1994	0.00-1.00 Feet	nr	29.9	232	70
B-18	1/27/1994	2.50-4.00 Feet	nr	29.9	232	70
B-20	1/27/1994	0.00-1.50 Feet	nr	2,390	1,300	225
B-20	1/27/1994	2.50-4.00 Feet	nr	2,390	1,300	225
B-23	1/26/1994	0.00-1.00 Feet	115	48.1	10.9 U	721
B-23	1/26/1994	4.00-5.50 Feet	115	48.1	10.9 U	721
B-24	1/25/1994	0.00-1.00 Feet	nr	8.45	650	248
B-24	1/25/1994	4.00-5.50 Feet	nr	8.45	650	248
B-25	1/27/1994	0.50-2.00 Feet	nr	29.4	1.1 U	13.6
B-25	1/27/1994	2.50-4.00 Feet	nr	29.4	1.1 U	13.6
B-26	1/27/1994	0.00-1.00 Feet	nr	62.2	514	1,510
B-26	1/27/1994	4.00-5.50 Feet	nr	62.2	514	1,510
B-27	1/25/1994	0.00-1.00 Feet	nr	8.15	779	170
B-27	1/25/1994	4.00-5.50 Feet	nr	8.15	779	170
B-28	1/25/1994	0.00-1.00 Feet	nr	22.5	230	51.4
B-28	1/25/1994	4.00-5.50 Feet	nr	22.5	230	51.4
B-29	1/25/1994	0.00-1.00 Feet	nr	29.4	1.1 U	2.64
B-29	1/25/1994	4.00-5.50 Feet	nr	29.4	1.1 U	2.64
B-3	1/26/1994	0.00-1.00 Feet	nr	90.3	1.1 U	60.4
B-3	1/26/1994	4.00-5.50 Feet	nr	90.3	1.1 U	60.4
B-31	1/25/1994	1.50-2.50 Feet	nr	15.9	1.3 U	0.91 U
B-31	1/25/1994	4.50-5.50 Feet	nr	15.9	1.3 U	0.91 U
B-32	1/25/1994	0.00-1.00 Feet	nr	123	1.1 U	70.5
B-32	1/25/1994	3.00-4.00 Feet	nr	123	1.1 U	70.5
B-35	11/1/1995	7.00-9.00 Feet	nr	17.5	330 U	330 U
B-35	11/1/1995	12.00-14.00 Ft	nr	17.5	330 U	330 U
B-37	10/31/1995	2.00-4.00 Ft	nr	31.6	330 U	330 U
B-37	10/31/1995	12.00-14.00 Ft	nr	31.6	330 U	330 U
B-38	11/3/1995	2.00-4.00 Feet	nr	45.2	3300 U	8,100
B-38	11/3/1995	12.00-14.00 Ft	nr	45.2	3300 U	8,100
B-4	1/26/1994	0.25-1.90 Feet	nr	28.3	1.2 U	11.2
B-4	1/26/1994	4.00-5.50 Feet	nr	28.3	1.2 U	11.2
B-6	1/26/1994	0.00-1.50 Feet	nr	84.4	5.2 U	151
B-6	1/26/1994	2.50-4.00 Feet	nr	84.4	5.2 U	151
B-7	1/26/1994	0.00-1.50 Feet	14	167	6,470	3,850
B-7	1/26/1994	4.00-5.50 Feet	14	167	6,470	3,850
B-8	1/26/1994	0.00-1.00 Feet	nr	234	33 U	2,030
B-8	1/26/1994	4.00-5.50 Feet	nr	234	33 U	2,030
B-9	1/26/1994	1.00-2.50 Feet	nr	227	1.2 U	65.7
B-9	1/26/1994	5.00-6.50 Feet	nr	227	1.2 U	65.7
BH00-1	3/16/2000	0-0.5 ft.	nr	29.9	nr	nr
BH00-2	3/16/2000	0-0.5 ft.	nr	33.8	nr	nr
BH00-3	3/16/2000	0-0.5 ft.	nr	29.0	nr	nr
BH00-4	3/16/2000	0-0.5 ft.	nr	39.1	nr	nr
BH00-4 FD	3/16/2000	2.75-3 ft.	nr	12.7	nr	nr
BH00-5	3/17/2000	0-0.5 ft.	nr	44.5	nr	nr
BH00-5	3/17/2000	2.75-3.25 ft.	nr	8.52	nr	nr
COMP_S1	8/27/2001	0.00-0.50 Feet	192	37.9	134 U	196
COMP_S2	8/27/2001	0.00-0.50 Feet	474	61.9	134 U	406
CS-401-1	10/11/1999	1.00-1.00 Feet	nr	89.3	nr	nr
CS-401-1	10/13/1999	1.50-1.50 Feet	nr	63.2	nr	nr
CS-401-1	10/14/1999	2.00-2.00 Feet	nr	24.7	nr	nr
CS-401-2	10/11/1999	1.00-1.00 Feet	nr	14.5	nr	nr
CS-401-2	10/13/1999	1.50-1.50 Feet	nr	9.6	nr	nr
CS-401-3	10/11/1999	0.00-1.00 Feet	nr	8.8	nr	nr
CS-401-4	10/11/1999	0.00-1.00 Feet	nr	8.7	nr	nr
CS-401-5	10/11/1999	0.00-1.00 Feet	nr	25.4	nr	nr
CS-402-2	10/16/1999	1.00-1.50 Feet	nr	7.7	nr	nr

Table 5-3. Soil Stations Above Proposed Cleanup Levels
J.H. Baxter Wood Treating Facility
Eugene, Oregon

Station ID	Date	Depth	**2,3,7,8-TCDD** equivalent (TEQ-WHO) pg/g	**Arsenic** mg/kg	**Dibenz(a,h)anthracene** ug/kg	**Benzo(a)pyrene** ug/kg
CS-402-3	10/12/1999	0.50-0.50 Feet	nr	10.8	nr	nr
CS-402-4	10/16/1999	1.50-1.50 Feet	nr	100	nr	nr
CS-402-4E	10/18/1999	1.50-2.00 Feet	nr	174	nr	nr
CS-402-4S	10/18/1999	1.50-2.00 Feet	nr	56.1	nr	nr
CS-402-4W	10/18/1999	1.50-2.00 Feet	nr	9.7	nr	nr
CS-402-6	10/12/1999	0.50-0.50 Feet	nr	9.1	nr	nr
CS-402-8	10/13/1999	0.00-0.50 Feet	nr	15.4	nr	nr
CS-6700-1	10/13/1999	0.00-0.50 Feet	nr	7.3	nr	nr
CS-6700-1	10/15/1999	0.50-1.00 Feet	nr	10.3	nr	nr
CS-6700-1	10/18/1999	0.50-1.50 Feet	nr	61.8	nr	nr
CS-6700-2	10/13/1999	0.50-0.50 Feet	nr	67.7	nr	nr
CS-6700-2	10/15/1999	1.50-1.50 Feet	nr	26.1	nr	nr
CS-6700-2	10/18/1999	2.00-2.00 Feet	nr	36.2	nr	nr
CS-6700-2	10/19/1999	2.50-2.50 Feet	nr	7.6	nr	nr
CS-6700-2.5	10/18/1999	1.50-2.00 Feet	nr	21.1	nr	nr
CS-6700-3	10/13/1999	0.50-0.50 Feet	nr	188	nr	nr
CS-6700-3	10/15/1999	1.50-1.50 Feet	nr	9.1	nr	nr
SD98-6	10/7/1989	0.00-0.50 Feet	743	58.9	10	13
SOIL-PILE	11/00/1995	0.00-0.50 Feet	nr	236	3300 U	15,000
SOIL-PILE-COMP	2/4/1998	0.00-2.00 Feet	140	nr	nr	nr
SS-1	11/00/1995	0.00-0.50 Feet	nr	80.4	330 U	330 U
SS-10	11/00/1995	0.00-0.50 Feet	nr	188	nr	nr
SS-11	11/00/1995	0.00-0.50 Feet	nr	86	3300 U	3300 U
SS-2	11/00/1995	0.00-0.50 Feet	nr	78.3	330 U	330 U
SS-3	11/00/1995	0.00-0.50 Feet	nr	82.5	3300 U	3300 U
SS-4	11/00/1995	0.00-0.50 Feet	nr	**385**	3300 U	3,300
SS-402-4	10/11/1999	0.00-1.00 Feet	nr	7.5	nr	nr
SS-402-5	10/11/1999	0.00-1.00 Feet	nr	7.3	nr	nr
SS-5	6/24/1993	0.00-0.25 Feet	nr	7	3.66	1.19
SS-5	11/00/1995	0.00-0.50 Feet	nr	198	3300 U	3300 U
SS-6	11/00/1995	0.00-0.50 Feet	nr	64	330 U	330 U
SS-7	11/00/1995	0.00-0.50 Feet	nr	120	3300 U	3300 U
SS-8	11/00/1995	0.00-0.50 Feet	nr	159	nr	nr
SS-9	11/00/1995	0.00-0.50 Feet	nr	156	nr	nr
SS98-1	2/3/1998	0.00-1.00 Feet	nr	80.5	50 U	25
SS98-10	2/2/1998	0.00-1.00 Feet	nr	120	nr	nr
SS98-11	2/2/1998	0.00-1.00 Feet	nr	57.6	nr	nr
SS98-12	10/7/1989	0.00-0.50 Feet	672	38.6	58	120
SS98-1-4-COMP	2/3/1998	0.00-1.00 Feet	158	nr	nr	nr
SS98-2	2/3/1998	0.00-1.00 Feet	nr	72.7	50 U	23
SS98-3	2/3/1998	0.00-1.00 Feet	nr	13.8	50 U	94
SS98-4	2/3/1998	0.00-1.00 Feet	nr	43.6	50 U	94
SS98-5	2/2/1998	0.00-1.00 Feet	nr	61.7	50 U	145
SS98-6	2/2/1998	0.00-1.00 Feet	nr	119	50 U	108
SS98-7	2/2/1998	0.00-1.00 Feet	nr	**406**	nr	nr
SS98-8	2/2/1998	0.00-1.00 Feet	nr	14.5	nr	nr
SS98-9	2/2/1998	0.00-1.00 Feet	nr	111	nr	nr
W-21S	11/3/1995	8.00-10.00 Feet	nr	21.6	3300 U	3300 U
W-21S	11/3/1995	13.00-15.00 Ft	nr	21.6	3300 U	3300 U
W-22S	11/2/1995	9.00-11.00 Ft	nr	20.8	330 U	330 U
W-22S	11/2/1995	14.00-16.00 Ft	nr	20.8	330 U	330 U
W-22S FD	11/2/1995	9.00-11.00 Ft	nr	20.8	330 U	330 U
W-7S	12/00/1986	6.50-7.00 Feet	nr	nr	nr	400
W-8S	12/00/1986	5.50-6.00 Feet	nr	nr	nr	1,100
W-9S	5/8/1990	3.00-5.00 Feet	nr	7.06	45	7.94

Notes:
Table is extracted directly from Baxter 2011.
Values in yellow highlight exceed proposed cleanup levels
Values in red bold exceed proposed hot spot cleanup levels
nr - not reported
U - Undetected above the listed reporting limit
Proposed arsenic cleanup levels: 7 mg/kg and 340 mg/kg hot spot
Proposed benzo(a)pyrene cleanup levels: 0.27 mg/kg and 27 mg/kg hot spot
Proposed dibenz(a,h)anthracene cleanup levels: 0.27 mg/kg and 27 mg/kg hot spot
Proposed 2,3,7,8-TCDD TEQ cleanup levels: 20 pg/kg and 2000 pg/kg hot spot

Table 11-1. Comparative Evaluation of Balancing Factors
J.H. Baxter Wood Treating Facility
Eugene, Oregon

Alternative	Effectiveness	Long-term Reliability	Implementability	Implementation Risk	Reasonableness fo Cost	Total Score
1. No Action	1	1	1	4	5	12
2. Capping, hot spot excavation and consolidation, enhanced groundwater treatement, MNA	3	4	2	3	3	15
3. Capping, hot spot excavation and disposal, enhanced biodegradation and recirculation, MNA	2	3	2	3	3	13
3a. Capping, ex situ groundwater treatment, MNA, groundwater contingency plan	**4**	**4**	**4**	**4**	**4**	**20**
4. Capping, hot spot excavation and disposal, physical/hydraulic containment, MNA	3	3	2	2	2	12
5. Capping, excavation and disposal, MNA	5	5	1	1	1	13

Notes
Bold font indicates preferred alternative.

TABLE 11-2
ESTIMATED COSTS FOR REMEDIAL ALTERNATIVES

Alternative	Initial Cost	Total Cost	Net Present Value Cost
1. No Action	$10,000	$1,339,000	$1,041,000
2. Capping, hot spot excavation and consolidation, enhanced groundwater treatment, and MNA	$3,063,171	$6,380,000	$5,654,000
3. Capping, hot spot excavation and disposal, enhanced biodegradation and recirculations, and MNA	$3,864,271	$6,057,000	$5,640,000
3a. Capping, groundwater extraction and treatment, contingency plan for off-site groundwater use, and MNA	$1,656,600	$2,985,000	$2,775,000
4. Capping, hot spot excavation and disposal, physical/hydraulic containment, and MNA	$7,401,231	$10,085,000	$9,639,000
5. Capping, excavation and disposal, and MNA	$54,974,251	$66,424,000	$65,043,000

GSI prepared the costs associated with Alternative 3a; EarthCon prepared the costs for the other alternatives.

APPENDIX A

TABLE A-1
ESTIMATED COST - ALTERNATIVE 1 (NO ACTION)

Initial and Annual Costs

Item	Quantity	Unit	Rate/ %	Total
Initial Construction Costs				
				0
				0
				0
				0
				0
				0
				0
				0
Initial Construction Costs Subtotal				**0**
Initial Other Costs				
Intitutional controls	1	LS	10,000	10,000
				0
				0
				0
				0
Initial Other Cost Subtotal				**$10,000**
Total Initial Construction and Other Costs				**$10,000**

Annual Long Term Costs	Quantity	Unit	Rate/ %	Annual Total	Years	Total
Annual Costs - Yrs 1-5						
Maintain Inst. Controls	1	LS	$1,000	$1,000	5	$5,000
Groundwater Treatment O&M	1	LS	10,000	10,000	5	50,000
Groundwater Sampling	2	LS (ave)	2,500	5,000	5	25,000
Analytical Costs/round	2	LS (ave)	4,200	8,400	5	42,000
Evaluation / Reporting	2	LS	5,000	10,000	5	50,000
Annual Costs - Yrs 6-30						
Maintain Inst. Controls	1	LS	1,000	1,000	25	25,000
Groundwater Treatment O&M	1	LS	10,000	10,000	25	250,000
Groundwater Sampling	1	LS	2,500	2,500	25	62,500
Analytical Costs/round	1	LS	4,850	4,850	25	121,250
Evaluation / Reporting	1	LS	5,000	5,000	25	125,000
One-time Construction Costs						
Abandon wells	24	LS	2,500	60,000	yr 10	60,000
Replace wells	24	LS	10,000	240,000	yr 10	240,000
Replace GW System Components	2	LS	25,000	50,000	yr 11 and 21	50,000
Subtotal Long Term Costs						**$1,105,750**
Total Construction and Other Initial Costs						**$10,000**
Total Construction, Other, and Long Term Costs						**$1,115,750**
Contingency (20%)						**$223,150**
Total Project Cost						**$1,339,000**
Total Net Present Value						**$1,041,000**

Net Present Value Calculation

Year	Initial/One Time Costs	Annual	Contingency (20%)	Total
1	$10,000	$34,400	$8,880	$53,280
2	0	34,400	6,880	41,280
3	0	34,400	6,880	41,280
4	0	34,400	6,880	41,280
5	0	34,400	6,880	41,280
6	0	23,350	4,670	28,020
7	0	23,350	4,670	28,020
8	0	23,350	4,670	28,020
9	0	23,350	4,670	28,020
10	300,000	23,350	64,670	388,020
11	25,000	23,350	9,670	58,020
12	0	23,350	4,670	28,020
13	0	23,350	4,670	28,020
14	0	23,350	4,670	28,020
15	0	23,350	4,670	28,020
16	0	23,350	4,670	28,020
17	0	23,350	4,670	28,020
18	0	23,350	4,670	28,020
19	0	23,350	4,670	28,020
20	0	23,350	4,670	28,020
21	25,000	23,350	9,670	58,020
22	0	23,350	4,670	28,020
23	0	23,350	4,670	28,020
24	0	23,350	4,670	28,020
25	0	23,350	4,670	28,020
26	0	23,350	4,670	28,020
27	0	23,350	4,670	28,020
28	0	23,350	4,670	28,020
29	0	23,350	4,670	28,020
30	0	23,350	4,670	28,020
	Totals	**$755,750**	**$223,150**	**$1,339,000**
			Net Present Value (2%)	**$1,041,000**

Notes:
NPV based on a net discount rate of 2% (interest rate of 4.5% and inflation of 2%
Groundwater monitoring assumes reduction in frequency to annual after 5 years
All estimated costs in 2011 dollars
Assumes average well operation life of 20 years (replacement of existing wells in year 10)

TABLE A-2

ESTIMATED COST - ALTERNATIVE 2 (CAPPING, HOT SPOT EXCAVATION AND CONSOLIDATION, ENHANCED GROUNDWATER TREATMENT, MNA)

Initial and Annual Costs

Item	Quantity	Unit	Rate/ %	Total	
Initial Construction Costs					
Mobilization	1	LS	25,000	25,000	
Hot spot excavation (5 ft deep)	4817	ton	12	57,806	
Backfill	4817	ton	10	48,170	
Line, consolidate soils in pond, cap	1	LS	400,000	400,000	
Place and grade soil cap (18" +textile)	16	ac	85,000	1,360,000	
Groundwater treatment system	1	LS	300,000	300,000	
Extraction wells and piping	6	LS	20,000	120,000	
Drain and place ditch material in pond	1	LS	50,000	25,000	
Initial Construction Costs Subtotal				**2,335,976**	
Initial Other Costs					
Intitutional controls	1	LS	10,000	10,000	
Consultant	1	LS	50,000	50,000	
Design and Permitting	1	LS	200,000	200,000	
Construction Management			20%	467,195	
				0	
Initial Other Cost Subtotal				**$727,195**	$3,383,171
Total Initial Construction and Other Costs				**$3,063,171**	$3,383,171

Annual Long Term Costs	Quantity	Unit	Rate/ %	Annual Total	Years	Total
Annual Costs - Yrs 1-5						
Maintain Inst. Controls	1	LS	$1,000	$1,000	5	$5,000
Groundwater Treatment O&M	1	LS	50,000	50,000	5	250,000
Groundwater Sampling	2	LS (ave)	2,500	5,000	5	25,000
Analytical Costs/round	2	LS (ave)	4,200	8,400	5	42,000
Evaluation / Reporting	2	LS	5,000	10,000	5	50,000
Annual Costs - Yrs 6-30						
Maintain Inst. Controls	1	LS	1,000	1,000	25	25,000
Groundwater Treatment O&M	1	LS	50,000	50,000	25	1,250,000
Groundwater Sampling	1	LS	2,500	2,500	25	62,500
Analytical Costs/round	1	LS	3,950	3,950	25	98,750
Evaluation / Reporting	1	LS	5,000	5,000	25	125,000
One-time Construction Costs						
Abandon wells	24	LS	2,500	60,000	yr 10	60,000
Replace wells	16	LS	10,000	160,000	yr 10	160,000
Replace GW System Components	2	LS	50,000	100,000	yr 11 and 21	100,000
Subtotal Long Term Costs						**$2,253,250**
Total Construction and Other Initial Costs						**$3,063,171**
Total Construction, Other, and Long Term Costs						**$5,316,421**
Contingency (20%)						**$1,063,284**
Total Project Cost						**$6,380,000**
Total Net Present Value						**$5,654,000**

Net Present Value Calculation

Year	Initial/One Time Costs	Annual	Contingency (20%)	Total
1	$3,063,171	$74,400	$627,514	$3,765,086
2	0	74,400	14,880	89,280
3	0	74,400	14,880	89,280
4	0	74,400	14,880	89,280
5	0	74,400	14,880	89,280
6	0	62,450	12,490	74,940
7	0	62,450	12,490	74,940
8	0	62,450	12,490	74,940
9	0	62,450	12,490	74,940
10	220,000	62,450	56,490	338,940
11	50,000	62,450	22,490	134,940
12	0	62,450	12,490	74,940
13	0	62,450	12,490	74,940
14	0	62,450	12,490	74,940
15	0	62,450	12,490	74,940
16	0	62,450	12,490	74,940
17	0	62,450	12,490	74,940
18	0	62,450	12,490	74,940
19	0	62,450	12,490	74,940
20	0	62,450	12,490	74,940
21	50,000	62,450	22,490	134,940
22	0	62,450	12,490	74,940
23	0	62,450	12,490	74,940
24	0	62,450	12,490	74,940
25	0	62,450	12,490	74,940
26	0	62,450	12,490	74,940
27	0	62,450	12,490	74,940
28	0	62,450	12,490	74,940
29	0	62,450	12,490	74,940
30	0	62,450	12,490	74,940
	Totals	**$1,933,250**	**$1,063,284**	**$6,380,000**
			Net Present Value (2%)	**$5,654,000**

Notes:

NPV based on a net discount rate of 2% (interest rate of 4.5% and inflation of 2%

Groundwater monitoring assumes reduction in frequency to annual after 5 years

All estimated costs in 2011 dollars

Assumes average well operation life of 20 years (replacement of existing wells in year 10)

TABLE A-3

ESTIMATED COST - ALTERNATIVE 3 (CAPPING, HOT SPOT EXCAVATION AND DISPOSAL, ENHANCED BIODEGRADATION AND RECIRCULATION, MNA)

Initial and Annual Costs

Item	Quantity	Unit	Rate/ %	Total
Initial Construction Costs				
Mobilization	1	LS	25,000	25,000
Hot spot excavation (5 ft deep)	4817	ton	12	57,806
Backfill	4817	ton	10	48,170
Offsite transportation and disposal	4817	ton	250	1,204,250
Place and grade soil cap (18" +textile)	16	ac	85,000	1,360,000
Infiltration gallery and controls	1	LS	150,000	150,000
Extraction wells and piping	6	LS	25,000	150,000
Drain and place ditch material in pond	1	LS	50,000	50,000
Initial Construction Costs Subtotal				**3,045,226**
Initial Other Costs				
Intitutional controls	1	LS	10,000	10,000
Consultant	1	LS	50,000	50,000
Design and Permitting	1	LS	150,000	150,000
Construction Management			20%	609,045
				0
Initial Other Cost Subtotal				**$819,045**
Total Initial Construction and Other Costs				**$3,864,271**

Annual Long Term Costs	Quantity	Unit	Rate/ %	Annual Total	Years	Total
Annual Costs - Yrs 1-5						
Maintain Inst. Controls	1	LS	$1,000	$1,000	5	$5,000
Groundwater recirculation O&M	1	LS	15,000	15,000	5	75,000
Groundwater Sampling	2	LS (ave)	2,500	5,000	5	25,000
Analytical Costs/round	2	LS (ave)	4,200	8,400	5	42,000
Evaluation / Reporting	2	LS	5,000	10,000	5	50,000
Annual Costs - Yrs 6-30						
Maintain Inst. Controls	1	LS	1,000	1,000	25	25,000
Groundwater Recirc O&M	1	LS	15,000	15,000	25	375,000
Groundwater Sampling	1	LS	2,500	2,500	25	62,500
Analytical Costs/round	1	LS	3,950	3,950	25	98,750
Evaluation / Reporting	1	LS	5,000	5,000	25	125,000
One-time Construction Costs				27,450		
Abandon wells	24	LS	2,500	60,000	yr 10	60,000
Replace wells	16	LS	10,000	160,000	yr 10	160,000
Replace GW Recirc Components	4	LS	20,000	80,000	yr 6, 12, 18, 24	80,000
Subtotal Long Term Costs						**$1,183,250**
Total Construction and Other Initial Costs						**$3,864,271**
Total Construction, Other, and Long Term Costs						**$5,047,521**
Contingency (20%)						**$1,009,504**
Total Project Cost						**$6,057,000**
Total Net Present Value						**$5,640,000**

Net Present Value Calculation

Year	Initial/One Time Costs	Annual	Contingency (20%)	Total
1	$3,864,271	$39,400	$780,734	$4,684,406
2	0	39,400	7,880	47,280
3	0	39,400	7,880	47,280
4	0	39,400	7,880	47,280
5	0	39,400	7,880	47,280
6	20,000	27,450	9,490	56,940
7	0	27,450	5,490	32,940
8	0	27,450	5,490	32,940
9	0	27,450	5,490	32,940
10	220,000	27,450	49,490	296,940
11	0	27,450	5,490	32,940
12	20,000	27,450	9,490	56,940
13	0	27,450	5,490	32,940
14	0	27,450	5,490	32,940
15	0	27,450	5,490	32,940
16	0	27,450	5,490	32,940
17	0	27,450	5,490	32,940
18	20,000	27,450	9,490	56,940
19	0	27,450	5,490	32,940
20	0	27,450	5,490	32,940
21	0	27,450	5,490	32,940
22	0	27,450	5,490	32,940
23	0	27,450	5,490	32,940
24	20,000	27,450	9,490	56,940
25	0	27,450	5,490	32,940
26	0	27,450	5,490	32,940
27	0	27,450	5,490	32,940
28	0	27,450	5,490	32,940
29	0	27,450	5,490	32,940
30	0	27,450	5,490	32,940
	Totals	**$883,250**	**$1,009,504**	**$6,057,000**
			Net Present Value (2%)	**$5,640,000**

Notes:

NPV based on a net discount rate of 2% (interest rate of 4.5% and inflation of 2%

Groundwater monitoring assumes reduction in frequency to annual after 5 years

All estimated costs in 2011 dollars

Assumes average well operation life of 20 years (replacement of existing wells in year 10)

Table A-3a.
ESTIMATED COST - ALTERNATIVE 3a (CAPPING, GROUNDWATER TREATMENT SYSTEM OPERATION)

Initial and Annual Costs[1]

Item	Quantity	Unit	Rate/ %	Total
Initial Construction Costs				
Mobilization	1	LS	30,000	$30,000
Place and grade soil cap (12" + heavy textile)	12	ac	80,000	$960,000
Place and grade soil cap (6" + light textile)	4	ac	40,000	$160,000
Ditch sediment removal and backfill (6")[9]	600	L.F.	30	$18,000
Refurbish groundwater treatment system[2]	1	LS	65,000	$65,000
Offsite groundwater protection[8]	1	LS	48,000	$48,000
			Initial Construction Costs Subtotal	**$1,281,000**
Initial Other Costs				
Offsite well use determination	1	LS	30,000	$30,000
Intitutional controls	1	LS	10,000	$10,000
Design and Permitting	1	LS	80,000	$80,000
Construction Management			5%	$60,000
DEQ Review/Oversight for Implementation	1	LS	45,000	$45,000
			Initial Other Cost Subtotal	**$225,000**
			Initial Construction and Other Costs Contingency[6] (10%)	**$150,600**
			Total Initial Construction and Other Costs	**$1,656,600**

Annual Long Term Costs	Quantity	Unit	Rate/ %	Annual Total	Years	Total
Annual Costs - Yrs 1-5						
Maintain Inst. Controls	1	LS	1,000	$1,000	5	5,000
Groundwater extraction O&M[3]	1	LS	7,400	$7,400	5	37,000
Offsite wells periodic repairs	1	LS	1,800	$1,800	5	9,000
NPDES discharge analytical costs	12	LS	208	$2,500	5	12,500
Groundwater Sampling	2	LS	2,500	$5,000	5	25,000
Analytical Costs/round	2	LS	3,625	$7,300	5	36,500
Evaluation / Reporting	2	LS	10,000	$20,000	5	100,000
DEQ Review/Oversight for annual events	1	LS	2,000	$2,000	5	10,000
Annual Costs - Yrs 6-30						
Maintain Inst. Controls	1	LS	1,000	$1,000	25	25,000
Groundwater Treatment O&M	1	LS	7,400	$7,400	25	185,000
Offsite wells periodic repairs	1	LS	1,800	$1,800	25	45,000
NPDES discharge lab costs[4] (remedy costs)	12	LS	208	$2,500	25	62,500
NPDES monthly reporting costs[4] (remedy costs)	12	LS	100	$1,200	25	30,000
NPDES permit annual costs[4] (remedy costs)	1	LS	2,650	$2,700	25	67,500
Groundwater Sampling[4]	1	LS	2,500	$2,500	25	62,500
Analytical Costs for two gw sampling events[4]	1	LS	5,300	$5,300	25	132,500
Evaluation / Reporting	2	LS	2,500	$5,000	25	125,000
DEQ Review/Oversight for annual events	1	LS	2,000	$2,000	25	50,000
One-time Construction and Permit Costs						
NPDES Permit Renewal	3	LS	4,000	12,000	yr 8, 17, 26	12,000
Offsite wells filter replacements	6	LS	1,800	11,000	yr 5, 10, 15, 20, 25, 30	11,000
Replace extraction wells[5]	2	LS	15,000	30,000	yr 10, 30	30,000
Replace GW Treatment System Components	1	LS	20,000	20,000	yr 20	20,000
Abandon wells	46	LS	2,500	115,000	yr 30	115,000
					Subtotal Long Term Costs	**$1,208,000**
					Long Term Cost Contingency[6] (10%)	**$121,000**
					Total Long Term Costs	**$1,329,000**
					Total Construction and Other Initial Costs	**$1,656,600**
					Total Construction, Other, and Long Term Costs	**$2,985,600**
					Total Net Present Value	**$2,775,000**

Net Present Value Calculation

Year	Initial/One Time Costs	Annual	Contingency (10%)	Total
1	$1,506,000	$47,000	$155,300	$1,708,300
2	0	47,000	4,700	51,700
3	0	47,000	4,700	51,700
4	0	47,000	4,700	51,700
5	1,800	47,000	4,880	53,680
6	0	31,400	3,140	34,540
7	0	31,400	3,140	34,540
8	4,000	31,400	3,540	38,940
9	0	31,400	3,140	34,540
10	16,800	31,400	4,820	53,020
11	0	31,400	3,140	34,540
12	0	31,400	3,140	34,540
13	0	31,400	3,140	34,540
14	0	31,400	3,140	34,540
15	1,800	31,400	3,320	36,520
16	0	31,400	3,140	34,540
17	4,000	31,400	3,540	38,940
18	0	31,400	3,140	34,540
19	0	31,400	3,140	34,540
20	21,800	31,400	5,320	58,520
21	0	31,400	3,140	34,540
22	0	31,400	3,140	34,540
23	0	31,400	3,140	34,540
24	0	31,400	3,140	34,540
25	1,800	31,400	3,320	36,520
26	4,000	31,400	3,540	38,940
27	0	31,400	3,140	34,540
28	0	31,400	3,140	34,540
29	0	31,400	3,140	34,540
30	131,800	31,400	16,320	179,520
	Totals	**$1,020,000**	**$271,380**	**$2,985,000**
			Net Present Value[7] (1%)	**$2,775,000**

Notes:

1. Estimated costs are in 2015 dollars
2. Assumes groundwater treatment system requires carbon vessel and media replacement with minor conveyance upgrades.
3. Assumes intermittent treatment system maintenance provided by owner/operator staff
4. GW and NPDES discharge monitoring assumes reduction in frequency to annual after 5 years
5. Assumes average well operation life of 20 years (replacement of existing wells in year 10)
6. Contingency rate based upon EPA cost estimating guidance for surface grading, synthetic cap installation (EPA 540-R-00-002)
7. NPV based on a net discount rate of 1% (interest rate of 3% and inflation of 2%). 3% corresponds to the 30-yr U.S. Treasury Bond rate as of 6/2/2015 (www.treasury.gov) and an averaged 2% inflation rate from construction cost inflation of 2.4% and a CPI of 1.6% for 2014 (enr.construction.com)
8. Offsite groundwater protection tasks assumes abandonment of 4 domestic water wells and installation of 6 residential and 3 commercial GAC well head treatment systems.
9. Assumes 600' by 4' wide by 6" deep = 44 c.yds; assumes 3 working days to complete

TABLE A-4

ESTIMATED COST - ALTERNATIVE 4 (CAPPING, HOT SPOT EXCAVATION AND DISPOSAL, PHYSICAL/HYDRAULIC CONTAINMENT, MNA)

Initial and Annual Costs

Item	Quantity	Unit	Rate/ %	Total
Initial Construction Costs				
Mobilization	1	LS	100,000	100,000
Hot spot excavation (5 ft deep)	4817	ton	12	57,806
Backfill	4817	ton	10	48,170
Offsite transportation and disposal	4817	ton	250	1,204,250
Place and grade soil cap (18" +textile)	16	ac	85,000	1,360,000
Containment wall (40 ft deep x 3ft wide)	248400	sf	12	2,980,800
Extraction wells and treatment system	1	LS	150,000	150,000
Drain and place ditch material in pond	1	LS	50,000	50,000
Initial Construction Costs Subtotal				**5,951,026**
Initial Other Costs				
Intitutional controls	1	LS	10,000	10,000
Consultant	1	LS	50,000	50,000
Design and Permitting	1	LS	200,000	200,000
Construction Management			20%	1,190,205
				0
Initial Other Cost Subtotal				**$1,450,205**
Total Initial Construction and Other Costs				**$7,401,231**

Annual Long Term Costs	Quantity	Unit	Rate/ %	Annual Total	Years	Total
Annual Costs - Yrs 1-5						
Maintain Inst. Controls	1	LS	$1,000	$1,000	5	$5,000
Groundwater recirculation O&M	1	LS	10,000	10,000	5	50,000
Groundwater Sampling	2	LS (ave)	2,500	5,000	5	25,000
Analytical Costs/round	2	LS (ave)	4,200	8,400	5	42,000
Evaluation / Reporting	2	LS	5,000	10,000	5	50,000
Annual Costs - Yrs 6-30						
Maintain Inst. Controls	1	LS	1,000	1,000	25	25,000
Groundwater Treatment Recirc O&M	1	LS	10,000	10,000	25	250,000
Groundwater Sampling	1	LS	2,500	2,500	25	62,500
Analytical Costs/round	1	LS	3,950	3,950	25	98,750
Evaluation / Reporting	1	LS	5,000	5,000	25	125,000
One-time Construction Costs				22,450		
Abandon wells	24	LS	2,500	60,000	yr 10	60,000
Replace wells	16	LS	10,000	160,000	yr 10	160,000
Replace GW Treatment components	2	LS	25,000	50,000	yr 11 and 21	50,000
Subtotal Long Term Costs						**$1,003,250**
Total Construction and Other Initial Costs						**$7,401,231**
Total Construction, Other, and Long Term Costs						**$8,404,481**
Contingency (20%)						**$1,680,896**
Total Project Cost						**$10,085,000**
Total Net Present Value						**$9,639,000**

Net Present Value Calculation

Year	Initial/One Time Costs	Annual	Contingency (20%)	Total
1	$7,401,231	$34,400	$1,487,126	$8,922,758
2	0	34,400	6,880	41,280
3	0	34,400	6,880	41,280
4	0	34,400	6,880	41,280
5	0	34,400	6,880	41,280
6	0	22,450	4,490	26,940
7	0	22,450	4,490	26,940
8	0	22,450	4,490	26,940
9	0	22,450	4,490	26,940
10	220,000	22,450	48,490	290,940
11	25,000	22,450	9,490	56,940
12	0	22,450	4,490	26,940
13	0	22,450	4,490	26,940
14	0	22,450	4,490	26,940
15	0	22,450	4,490	26,940
16	0	22,450	4,490	26,940
17	0	22,450	4,490	26,940
18	0	22,450	4,490	26,940
19	0	22,450	4,490	26,940
20	0	22,450	4,490	26,940
21	25,000	22,450	9,490	56,940
22	0	22,450	4,490	26,940
23	0	22,450	4,490	26,940
24	0	22,450	4,490	26,940
25	0	22,450	4,490	26,940
26	0	22,450	4,490	26,940
27	0	22,450	4,490	26,940
28	0	22,450	4,490	26,940
29	0	22,450	4,490	26,940
30	0	22,450	4,490	26,940
	Totals	**$733,250**	**$1,680,896**	**$10,085,000**
			Net Present Value (2%)	**$9,639,000**

Notes:

NPV based on a net discount rate of 2% (interest rate of 4.5% and inflation of 2%

Groundwater monitoring assumes reduction in frequency to annual after 5 years

All estimated costs in 2011 dollars

Assumes average well operation life of 20 years (replacement of existing wells in year 10)

TABLE A-5
ESTIMATED COST - ALTERNATIVE 5 (CAPPING, EXCAVATION AND DISPOSAL, MNA)

Initial and Annual Costs

Item	Quantity	Unit	Rate/ %	Total
Initial Construction Costs				
Mobilization	1	LS	100,000	100,000
Deeper excavation (10 ft)	81685	ton	30	2,450,560
Shallow excavation (2 ft)	111488	ton	15	1,672,313
Offsite transportation/disposal HAZ	81685	ton	250	20,421,333
Offsite transportation/disposal NONHAZ	111488	tons	125	13,935,941
Backfill and grading	96586	tons	20	1,931,729
Facility demolition	1	LS	1,000,000	1,000,000
Facility reconstruction	1	LS	4,000,000	4,000,000
Initial Construction Costs Subtotal				**45,511,876**
Initial Other Costs				
Intitutional controls	1	LS	10,000	10,000
Consultant	1	LS	50,000	50,000
Design and Permitting	1	LS	300,000	300,000
Construction Management			20%	9,102,375
				0
Initial Other Cost Subtotal				**$9,462,375**
Total Initial Construction and Other Costs				**$54,974,251**

Annual Long Term Costs	Quantity	Unit	Rate/ %	Annual Total	Years	Total
Annual Costs - Yrs 1-5						
Maintain Inst. Controls	1	LS	$1,000	$1,000	5	$5,000
Groundwater Sampling	2	LS (ave)	2,500	5,000	5	25,000
Analytical Costs/round	2	LS (ave)	4,200	8,400	5	42,000
Evaluation / Reporting	2	LS	5,000	10,000	5	50,000
Annual Costs - Yrs 6-30						
Maintain Inst. Controls	1	LS	1,000	1,000	25	25,000
Groundwater Sampling	1	LS	2,500	2,500	15	37,500
Analytical Costs/round	1	LS	3,950	3,950	15	59,250
Evaluation / Reporting	1	LS	5,000	5,000	15	75,000
One-time Construction Costs						
Abandon wells	24	LS	2,500	60,000	yr 20	60,000
Subtotal Long Term Costs						**$378,750**
Total Construction and Other Initial Costs						**$54,974,251**
Total Construction, Other, and Long Term Costs						**$55,353,001**
Contingency (20%)						**$11,070,600**
Total Project Cost						**$66,424,000**
Total Net Present Value						**$65,043,000**

Net Present Value Calculation

Year	Initial/One Time Costs	Annual	Contingency (20%)	Total
1	$54,974,251	$24,400	$10,999,730	$65,998,381
2	0	24,400	4,880	29,280
3	0	24,400	4,880	29,280
4	0	24,400	4,880	29,280
5	0	24,400	4,880	29,280
6	0	12,450	2,490	14,940
7	0	12,450	2,490	14,940
8	0	12,450	2,490	14,940
9	0	12,450	2,490	14,940
10	0	12,450	2,490	14,940
11	0	12,450	2,490	14,940
12	0	12,450	2,490	14,940
13	0	12,450	2,490	14,940
14	0	12,450	2,490	14,940
15	0	12,450	2,490	14,940
16	0	12,450	2,490	14,940
17	0	12,450	2,490	14,940
18	0	12,450	2,490	14,940
19	0	12,450	2,490	14,940
20	60,000	12,450	14,490	86,940
21	0	1,000	200	1,200
22	0	1,000	200	1,200
23	0	1,000	200	1,200
24	0	1,000	200	1,200
25	0	1,000	200	1,200
26	0	1,000	200	1,200
27	0	1,000	200	1,200
28	0	1,000	200	1,200
29	0	1,000	200	1,200
30	0	1,000	200	1,200
	Totals	**$318,750**	**$11,070,600**	**$66,424,000**
			Net Present Value (2%)	**$65,043,000**

Notes:
NPV based on a net discount rate of 2% (interest rate of 4.5% and inflation of 2%
Groundwater monitoring assumes reduction in frequency to annual after 5 years
All estimated costs in 2011 dollars
Assumes all monitoring stops after 20 years
Assumes soil excavated from deeper area are hazardous; other soils are not.