



A Report Prepared For:

California Regional Water Quality Control Board
San Francisco Bay Region
1515 Clay Street, Suite 1400
Oakland, California 94612

Attention: Mr. Alec W. Naugle, P.G.

**SUMMARY OF REMEDIAL INVESTIGATIONS,
FEASIBILITY STUDY AND REMEDIAL ACTION PLAN
NAPA PIPE FACILITY
1025 KAISER ROAD
NAPA, CALIFORNIA**

**VOLUME 2
SITE 2/3 - EXTERNAL COATING BUILDING AREA**

JUNE 7, 2007

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1068.001.11.004

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1.0 INTRODUCTION

This Volume 2 of this Summary of Remedial Investigations, Feasibility Study and Remedial Action Plan (RI/FS/RAP) has been prepared by PES Environmental, Inc. (PES) on behalf of Napa Redevelopment Partners, LLC (NRP) to address soil and groundwater affected primarily by petroleum hydrocarbons and volatile organic compounds (VOCs) at Site 2/3 (the Site). The Site consists of the area of the now-vacant External Coating Building (ECB) at the Napa Pipe Facility, located at 1025 Kaiser Road in Napa, California (hereafter, the Facility). The Site and Facility locations are shown on Plate 1. The Facility is divided into seven environmental sites (refer to Plate 2): Site 1, Site 2/3, Site 4, Site 5, Site 6, Site 7 and Other Areas. As shown on Plate 2, Site 2/3 is located in the southeastern portion of the Facility. As noted on Plate 2, Volumes 3, 4, and 5 of this RI/FS/RAP address cleanup of soil and groundwater at Site 4, Site 6, and Other Areas, respectively. Volume 1 provides an overview of the RI/FS/RAP for the Facility, including an executive summary.

As discussed in Volume 1, soil and groundwater investigations at Site 5, Site 7, and portions of Site 2/3 (the former Pipe Storage Areas) have indicated that these areas are absent of substantial environmental impacts. Accordingly, active remedial action measures are not anticipated for those portions of the Facility at this time. Nor are those portions of the Facility subject to on-going regulatory oversight. Site 7 is hydrogeologically upgradient of the other six sites and was previously chosen as a “background” site (James M. Montgomery, Consulting Engineers, Inc. [JMM], 1990a). Site 1 is permitted and maintained as a Class II Waste Management Unit (WMU).

The Facility contains both former and current steel pipe fabricating buildings. The tenant that leases the Fabrication Buildings and adjoining buildings, which are located in the northwestern portion of Facility (Plate 2), is currently conducting steel fabrication. The previous Facility owner (i.e., Napa Pipe Corporation, a wholly-owned subsidiary of Oregon Steel Mills, Inc.) removed equipment and materials from the remaining buildings after the purchase of the Facility by NRP.

The primary remedial action objective for the ECB was previously defined as hydraulic containment to prevent the migration of chemicals of concern in groundwater (Montgomery Watson [MW], 1993). This objective has been accomplished over the past 13 years via an extraction trench located near the southeast corner of the ECB.

When remedial action plans were developed in 1993 (and continuing through 2005) the Napa Pipe Facility was an active industrial site. At this time, plans are underway to redevelop the Facility for mixed residential, commercial and open space uses; consequently the remedial action objectives are being modified via this RI/FS/RAP to remediate soil and groundwater to levels consistent with intended land uses. This report presents new data collected to further characterize Site 2/3, and develops and evaluates remedial alternatives for cleanup in accordance with the remedial action objectives, and recommends a cleanup alternative for Site 2/3.

1.1 Regulatory Context and Cleanup Level Selection

This document has been prepared in accordance with: (1) discussions between NRP representatives and staff of the California Regional Water Quality Control Board – San Francisco Bay Region (RWQCB) and (2) the existing RWQCB orders for the Facility, Order No. 90-147 and Order No. R2-2205-0012. The RWQCB's Environmental Screening Levels (ESLs) (RWQCB, 2005) have been used as screening tools (with modifications discussed below) and are proposed in this RAP as cleanup levels for the Site/Facility. The ESLs are intended to provide conservative screening values such that the presence of chemicals in soil, soil gas or groundwater at concentrations below the corresponding ESL can be assumed not to pose a significant, long-term (chronic) threat to human health and the environment.

ESLs were developed by the RWQCB to address environmental protection goals presented in the Water Quality Control Plan for the San Francisco Bay Basin (Basin Plan). These goals include:

Surface Water and Groundwater:

- Protection of drinking water resources;
- Protection of aquatic habitats;
- Protection against vapor intrusion into buildings; and
- Protection against nuisance conditions.

Soil:

- Protection of human health (direct-exposure);
- Protection against vapor intrusion into buildings;
- Protection against leaching and subsequent impacts to groundwater;
- Protection of terrestrial biota; and
- Protection against nuisance conditions.

Through the use of standard risk assessment assumptions and methodology, the RWQCB's ESLs are protective of each of the above factors. Because the soil and groundwater data for the Site were compared to the conservative and protective ESLs, and because cleanup to those

levels is proposed in this RAP, a site-specific risk assessment is not included in this RI/FS/RAP¹.

The final ESLs defined in the RWQCB's ESL document were adjusted to account for two site specific factors: (1) shallow groundwater is not a current or potential source of drinking water²; and (2) groundwater gradients are relatively flat, groundwater plumes are stable and do not show migration; consequently, there is no pathway for discharge of groundwater plumes to the aquatic resources of the Napa River. Because of these factors, ESLs protective of drinking water and aquatic habitats do not apply and the next lowest default ESLs were used³. A summary of the ESLs used for the Facility is provided in Table 1. Note that many of the constituents listed on the table were not detected at Site 2/3. The table is intended to be comprehensive and inclusive of all of the constituents detected in soil and groundwater at Sites 2/3, 4, 6, and the Other Areas. As discussed in Section 6.0, only a few chemicals at the Site are chemicals of concern that require soil and groundwater remediation. The final cleanup levels for these chemicals are listed in Section 6.1.4 and are the same as the ESLs for these chemicals.

In applying ESLs for the Site, since residential land use is anticipated for the Site, soils data are compared to the residential ESLs (see Table 1). Shallow soil samples (collected from less than 3 meters, about 10 feet) are compared to the Shallow Soil ESLs. Deep soil samples (greater than 3 meters) are compared to the Deep Soil ESLs.

As indicated on Table 1, two Shallow Soil ESLs exist for the total petroleum hydrocarbons (TPH) middle distillates and TPH residual fuels parameters. For the shallowest soils (0 to 3 feet below ground surface [bgs]⁴) the lower of the two values (100 milligrams per kilogram [mg/kg] for TPH middle distillates and 500 mg/kg residual fuels) is selected to conservatively address nuisance odor issues.

¹ See the RWQCB's ESL website (<http://www.swrcb.ca.gov/rwqcb2/esl.htm>) for complete discussion of the ESL development process. As noted in the ESL document, additive risk due to the potential presence of multiple chemicals with similar target health effects are addressed through the use of conservative exposure assumptions and target risk levels. Also, while the ESLs do not specifically address potential synergistic effects, as noted in the ESL document, "Synergistic effects are primarily of concern for exposure to multiple chemicals at concentrations significantly higher than those expressed in the direct-exposure ESLs. Conservative target risk goals (e.g., target excess cancer risk of 10⁻⁶) and exposure parameters used to develop screening levels further reduce this concern." Note also that the bulk of the soil and groundwater contamination is from relatively low toxicity petroleum hydrocarbons with only a few carcinogenic compounds present.

² The average Facility-wide electrical conductivity (EC) of water samples collected from wells screened within the shallow and deep aquifers (see Section 2.3 for definitions of these aquifers) is 5,114 microSiemens/cm (µS/cm). By the State Water Resources Control Board Resolution 88-63 definition of sources of drinking water (i.e., water with EC less than 5,000 (µS/cm), the two shallowest groundwater aquifers at the Facility are not considered sources of drinking water. As such, the non-drinking water ESLs are applicable to the Facility.

³ The specific pathway is the protection of surface water resources via soil leaching to groundwater and discharge of groundwater to surface water.

⁴ To be conservative, samples collected from 3-3.5 feet bgs are considered "shallowest soil" in this report because the laboratory may have analyzed soil from the very top of the soil liner, which would be more representative of 3 feet bgs rather than 3.5 feet bgs.

1.2 Objectives of RI/FS/RAP

The objectives of the RI/FS/RAP are to: (1) identify remediation strategies that will meet the Remedial Action Objectives (prevent adverse impact to human health and avoid further degradation of groundwater quality); and (2) present a program for remediation of soil and groundwater affected by VOCs and petroleum hydrocarbons at the Site. The RI/FS/RAP:

1. Summarizes previous environmental investigations conducted at the Site;
2. Presents the results of the supplemental remedial investigation conducted by PES in September through November 2006;
3. Summarizes the chemicals of concern, specifies the chemicals to be remediated and associated Site cleanup levels, and defines the extent of soil and groundwater media that will require remediation;
4. Identifies and evaluates applicable remedial technologies and alternatives;
5. Recommends a preferred remedial alternative; and
6. Outlines the tasks to implement the recommended remedial action.

1.3 Organization

The RI/FS/RAP includes the following sections:

Section 1.0 – Introduction. The introduction presents a general explanation of the objectives and organization of the RI/FS/RAP.

Section 2.0 – Site Background. This section provides a description of the Site, summarizes current and historical Site uses, discusses the geology and hydrogeology of the Site, and summarizes previous remedial investigations and interim remedial actions conducted at the Site.

Section 3.0 – Supplemental Remedial Investigation. This section presents the methodologies and results of the supplemental remedial investigation recently conducted at the Site by PES.

Section 4.0 – Nature and Extent of Contamination. This section discusses the nature and extent of soil and groundwater contamination at the Site and presents a conceptual site model (CSM).

Section 5.0 – Contaminant Fate and Transport. This section discusses contaminant fate and transport including a discussion of potential routes of migration, degradation mechanisms, and transport mechanisms.

Section 6.0 – Chemicals of Concern and Remediation Extent. This section summarizes the chemicals of concern identified during the numerous investigations conducted at Site 2/3, specifies the chemicals to be remediated and associated Site cleanup levels and defines the extent of soil and groundwater media that will require remediation.

Section 7.0 – Feasibility Study Scoping. This section defines the scope of the feasibility study, the applicable and relevant and appropriate requirements, the remedial action objectives, and specifies the proposed cleanup levels.

Section 8.0 – Identification and Screening of Remedial Technologies. This section identifies and screens potentially applicable technologies for remediating soil and groundwater to meet the remedial action objectives.

Section 9.0 – Development of Remedial Alternatives. This section assembles technologies into remedial alternatives, describes them and presents costs to implement the alternative.

Section 10.0 – Evaluation of Remedial Alternatives. This section evaluates each alternative individually and comparatively, in terms of the remedial action objectives and regulatory evaluation criteria. A preferred remedial alternative is identified.

Section 11.0 – Remedial Action Plan Implementation. This section presents the procedures for implementation of the preferred remedial alternative for the Site and presents a schedule for remedial action implementation and reporting.

2.0 SITE BACKGROUND

A physical description of the Site and discussion of current and historical Site uses are presented below.

2.1 Site Description

The ECB area is located along the southeastern boundary of the Facility and is bounded on the east by a vacant easement parcel and the Napa Valley Corporate Park. The ECB is approximately 64,000 square feet in size and is currently unoccupied. All of the industrial equipment and materials have been removed from the building. For the most part, the floor of the ECB is concrete. Structures or features present in and around the ECB are shown on Plate 3. As shown on this plate, several pits that once housed large machinery are present inside the ECB. PES observed minor surface staining throughout the building. Significant

surface staining was observed near boring EC1 and in the vicinity of the machinery pits near boring EC6 (see Plate 3 for boring locations). The area surrounding the ECB is paved to the west, and unpaved to the north, south, and east.

2.2 Site History

The ECB was historically used to coat the external surfaces of steel pipe with a thin epoxy-film coating. This process was most recently conducted by Midwestern Pipeline Services Company, but was also performed in the 1990's by onsite vendors/subcontractors including Encoat, Inc. The ECB was constructed in the mid-1970s and ceased operations in spring of 2005. As mentioned in Section 2.1, equipment and materials in the ECB were removed by the former owner after the purchase of the Facility by the current owner.

An aboveground diesel fuel tank was previously located just southeast of the ECB and was contained within a 4-foot high, fabricated steel double containment wall (Plate 3). As shown on Plate 3, diesel was routed to the ECB through an underground pipeline. According to Jim Swindle (personal communication, 2006), who worked at the Napa Pipe Facility from the mid-1960s until closure, the diesel was used to fuel rail carts. The carts were used to transport pipe into the ECB along a trolley system. The hose and spigot used to fuel the carts was located within the ECB in its southeast corner. The original pipeline was replaced with a double-walled steel pipeline in 1985 because it was suspected that the pipeline's integrity had been compromised (MW, 1993).

As discussed in MW's *Site 2/3 Characterization, Groundwater Modeling, and Extraction Scenario Development* report (MW, 1993), diesel fuel was spilled by Encoat personnel on August 8, 1991 while fueling equipment on the compressor pad located on the east side of the ECB (see Plate 3). The diesel spill extended from the pad toward the Napa Valley Corporate Park easement to the east. To remediate the spill, approximately 36 cubic yards of affected soil was excavated. The excavated area was then backfilled with clean, imported, fill material. A summary report prepared by Artesian Environmental Consultants (Artesian, 1991) presents details of the spill, the area affected, and the response and cleanup measures undertaken by Encoat.

A 40-foot long groundwater extraction trench was installed on the east side of the ECB in December 1993 to hydraulically control groundwater flow and to prevent the migration of chemicals of concern in groundwater (MW, 1993). Interim remedial actions have been ongoing at Site 2/3 since October 1990 and are discussed in Section 2.5.

2.3 Geology and Hydrogeology

The following sections discuss the Facility-wide and Site 2/3-specific geology and hydrogeology. Much of the information presented in this section was obtained from MW's *Site 2/3 Characterization, Groundwater Modeling, and Extraction Scenario Development* report (MW, 1993).

2.3.1 Facility-Wide Hydrostratigraphy

Hydrostratigraphic units present at the Napa Pipe Facility include, from youngest (structurally shallowest) to oldest (structurally deepest), fill, younger alluvium, older alluvium, and the bedrock volcanics (MW, 1993). These units are described below.

2.3.1.1 Fill

According to MW, fill material placed in many low-lying areas along the Napa River floodplain have ranged from dredging spoils to imported engineered fill.

2.3.1.2 Younger Alluvium

Younger alluvium is characterized as a thin veneer of unconsolidated clay, silt, sand, and gravel that locally may yield water to wells if a sufficient thickness of the unit is saturated (Kunkel and Upson, 1960).

2.3.1.3 Older Alluvium

The older alluvium overlies the bedrock volcanics and is characterized by poorly sorted mixtures of clays, silts, sands, and gravels. At the Facility, a hardpan (cemented) horizon is commonly found in the uppermost part of this unit. Regionally, the older alluvium yields good quality water and is considered a source of potable groundwater (Kunkel and Upson, 1960).

2.3.1.4 Bedrock Volcanics

Tuff, breccia, and agglomerate, with locally interbedded volcanic flows characterize the bedrock volcanics. Depth to bedrock beneath the Facility is greater than approximately 380 feet below ground surface (Kunkel and Upson, 1960). Aquifers within tuff and breccia zones are usually confined and typically yield good quality water; wells completed in these zones are used for domestic, agricultural, and industrial water supply.

2.3.2 Site-Specific Geology and Hydrogeology

Site-specific geologic and hydrogeologic information was compiled based on data obtained during previous remedial investigations, the Facility-wide groundwater monitoring program (see Section 2.4), and PES's investigations conducted in September through November 2006 (discussed in Section 3.0). Plates 4 and 5 are geologic cross sections for the Site. The locations of these cross sections relative to the ECB are shown on Plate 3. Lithologic logs for PES's investigations are included in Appendix A. Geologic cross sections prepared by MW as part of *Site 2/3 Characterization, Groundwater Modeling, and Extraction Scenario Development* report (MW, 1993) are included in Appendix B. Lithologic logs and monitoring

well completion diagrams from previous investigations, including those used to construct MW's cross sections, are included in Appendix C.

MW previously defined three hydrostratigraphic units in the vicinity of the ECB (MW, 1993). From uppermost (youngest) to lowermost (oldest), these units are:

- Fill Unit (primarily the vadose zone beneath Site 2/3);
- Silty Clay Unit (Younger Alluvium, Shallow Groundwater Zone); and
- Cemented Clayey Silt Unit (Older Alluvium, Deep Groundwater Zone).

The results from PES's September through November 2006 investigations confirmed the presence of these units at the Site. The following sections describe each of these units.

2.3.2.1 Fill Unit

The fill is the uppermost unit encountered at the Site and is heterogeneous. As shown on the cross sections, the thickness of the fill varies across the Site. According to MW, the thickness of the fill varies because the topography of the underlying silty clay surface at the time of site grading was irregular (MW, 1993). The thickness of the fill in borings drilled within the ECB varies from approximately 2.75 to 5 feet thick and in borings surrounding the ECB the fill thickness varies from approximately 2 to 4.5 feet thick.

The fill unit can be characterized as heterogeneous, varying shades of brown, dry to moist, loose to dense, generally non-water bearing, and is classified as a clayey gravelly sand to silty gravelly sand surrounding the ECB and a silty sand with gravel beneath the ECB. In addition, MW encountered large gravel and building material debris such as concrete, asphalt, and brick during the investigations surrounding the ECB (MW, 1993; e.g., boring 2/3-B, Appendix C). The thickest intervals of fill were found in the borings completed through the soil berm located along the Napa Valley Corporate Park easement east of the ECB (see Plate 5, e.g., MW-42).

2.3.2.2 Silty Clay Unit

The silty clay unit, which correlates with the younger alluvium, is located stratigraphically below the fill unit and is underlain by the cemented clayey silt unit. The silty clay unit is heterogeneous, mottled blue/greenish gray to black (organic rich), moist to wet, and soft to stiff. The unit contains plant fragments, rootlets, and wet fibrous peat stringers up to 1-inch thick. Also, organic clay lenses and peat horizons up to 8 feet thick, and clayey to silty sand lenses up to 7.5 feet thick are present in this unit. In places, this unit grades to a soft to medium stiff, clayey to sandy silt. As shown on cross sections A-A' and B-B' (see Plates 4 and 5), a hydrocarbon sheen was encountered in the silty clay and cemented clayey silt units in some of the borings completed in the southern portion of the ECB. The presence of hydrocarbon sheens and separate-phase product in borings and wells completed within and surrounding the ECB is discussed in detail in Section 4.2.1 of this RI/FS/RAP.

MW interpreted the silty clay unit as floodplain and tidal marsh deposits and the interbedded sand stringers as likely representing deposits by small stream channels that drained the area (MW, 1993).

2.3.2.3 Cemented Clayey Silt Unit

This unit is located stratigraphically below the silty clay unit and correlates with the older alluvium. This unit is moderately to weakly cemented with minor sand and gravel lenses. The depth to the top of the cemented clayey silt unit varies from approximately 5 to 10 feet bgs in the southwest portion of the Site to 15 to 20 feet in the north-northeast portion of the Site (MW, 1993). MW attributed the variation in the depth to erosion processes that likely occurred prior to the deposition of the overlying silty clay unit (MW, 1993).

As discussed by MW and confirmed during the supplemental remedial investigation, the uppermost several feet of the cemented clayey silt unit is heterogeneous, yellowish to olive brown or greenish gray, dry to moist, stiff to very stiff, commonly well cemented (hardpan), and generally non-water bearing due to low hydraulic conductivity (MW, 1993). In general, the material encountered during the supplemental remedial investigation was described as silt rather than clayey silt. For consistency purposes, however, this unit will continue to be referred to as the cemented clayey silt unit in this RI/FS/RAP.

The thin, non-cemented sand and gravel lenses encountered within the unit were generally water-bearing and were considered by MW to comprise the Deep Groundwater Zone.

2.3.3 Groundwater Flow Directions and Gradients

Water level measurements at Site 2/3 are conducted on a semiannual basis as part of the Facility-wide groundwater monitoring program discussed in Section 2.4.6 of this document. Flow directions in the shallow groundwater at Site 2/3 are shown on the potentiometric surface maps for May 16, 2006 and October 3, 2006 water level measurement events (see Plates 6 and 7, respectively). These water-level measurement events are intended to show variations in groundwater elevation and flow direction between the end of the wet and end of dry seasons, respectively. The water level survey data for the May 16, 2006 and October 3, 2006 events are summarized on Tables 2 and 3, respectively.

Based on these potentiometric surface maps, a review of historic water-level data for Site 2/3, and discussions presented in the *Groundwater Monitoring Program Report Number 67, April – June 2006, Former Napa Pipe Facility, 1025 Kaiser Road, Napa, California* report (PES, 2006a), the primary flow direction at Site 2/3 is generally southwest to west, toward the Napa River.

As shown on Plate 6, a groundwater sink was present along the eastern side of the ECB in the vicinity of the extraction trench during the May 16, 2006 water-level measurement event⁵, but the sink was not present during the October 3, 2006 event (see Plate 7). The explanation for the absence of the sink in the October 3, 2006 event is that the extraction trench was not operating.⁶ As indicated on Tables 2 and 3, the depth to water in the extraction sump was 6.33 feet higher in October when the extraction trench was not operating.

As expected, groundwater elevations are generally higher in the May 16, 2006 event (end of wet season) than in the October 3, 2006 event (end of dry season). The exception is in the vicinity of the extraction trench where water levels were generally higher in the October 3, 2006 event because the trench was not operational. Water levels outside the area of influence of the extraction trench were 0.06 to 0.94 feet higher in the May 16, 2006 event.

The horizontal gradients for the May 16, 2006 event exhibited variations from a high of 0.0625 feet/foot (ft/ft) in the vicinity of the extraction trench to a low of 0.003 ft/ft (i.e., a flat gradient) in the western portion of the Site. The horizontal gradients for the October 3, 2006 event exhibited variations from a high of 0.017 ft/ft in the easternmost portion of the Site to a low of 0.003 ft/ft in vicinity of the ECB and the western portion of the Site. The flat horizontal gradients measured within the ECB and the western portion of the Site are consistent with the lack of plume migration to the west of the Site. The groundwater plume described in Section 4.0 has, through a combination of both flat gradients and the active extraction at the trench, been generally confined to the footprint of the ECB.

As indicated in MW's *Site 2/3 Characterization, Groundwater Modeling, and Extraction Scenario Development* report (MW, 1993), a net upward hydraulic gradient exists between the Shallow and Deep Groundwater Zones. Based on laboratory testing presented in the report, the estimated vertical permeabilities were low (10^{-7} centimeters per second [cm/sec]) and on the order of one to two orders-of-magnitude lower than horizontal conductivities.

2.3.4 Aquifer Testing Results

In December 1990 (wells MW-20 and MW-21) and June 1992 (other wells), MW conducted slug testing on 14 monitoring wells at Site 2/3. The results of their tests are summarized on a table included in Appendix G. The slug testing field methods and methods used to analyze the data are discussed in detail in the *Site 2/3 Characterization, Groundwater Modeling, and Extraction Scenario Development Report* (MW, 1993). Hydraulic conductivities ranged from 0.017 feet/day to 11 feet/day; the average hydraulic conductivity determined from the slug testing was 2.2 feet/day.

⁵ The groundwater sink was apparent in previous groundwater monitoring events during operation of the extraction trench.

⁶ The extraction trench was not operating because of electrical problems due partly to vandalism; it was turned back on in November 2006.

2.3.5 Tidal Influence

On July 2, 1992 MW conducted a tidal survey at Site 2/3 (MW, 1993). The survey consisted of collecting five rounds of water level measurements over a 6-hour period at 15 Site 2/3 monitoring wells and at benchmarks located along the Napa River tidal gate at the entrance to the Pond of Bedford located along the Napa River just south of the Napa Pipe Facility.

During the 6-hour survey, approximately 5.5 feet of tidal fluctuation was observed at the Napa River tidal gate at the entrance to the Pond of Bedford. However, the data from the survey indicated that no significant change in water levels occurred in the Site 2/3 monitoring wells, suggesting that groundwater at Site 2/3 is not influenced by tidal fluctuations in the Napa River.

2.4 Summary of Previous Investigations

The following section discusses the previous investigations conducted at Site 2/3. Pertinent tables and plates associated with these investigations are presented the appendices referenced below. The results for each investigation are generally compared to the ESLs discussed in Section 1.0 and presented on Table 1. The TPH soil results and selected groundwater results from these investigations, along with the current data presented in Section 3.0, are incorporated into the nature and extent of contamination discussion presented in Section 4.0. The results of these investigations are also discussed in Section 6.0 (Chemicals of Concern and Remediation Extent).

The analytical method for the TPH results discussed in Sections 2.4.1 and 2.4.2 did not specifically identify the type of petroleum hydrocarbon; the reported concentration for these results are for TPH as diesel (TPH-d) and TPH as motor oil (TPH-mo) combined. However, because the TPH constituent of concern at Site 2/3 is TPH-d (MW, 1993), these results are compared to the ESLs for diesel (i.e., TPH middle distillates; see Table 1), which are more conservative than the ESLs for motor oil (i.e., TPH residual fuels; see Table 1).

The following information is provided to clarify which ESLs presented on Table 1 are used as a screening tools for the various petroleum hydrocarbon soil and groundwater results discussed below:

- TPH gasoline ESLs are used for TPH as gasoline (TPH-g) results;
- TPH middle distillates ESLs are used for TPH and TPH-d results; and
- TPH (residual fuels) are used for TPH-mo and Oil & Grease (O&G) results.

2.4.1 Soil and Groundwater Testing at the Kaiser Steel Corporation Pipe Mill and Fabrication Facility in Napa California (1987)

In September 1987 JMM conducted a soil and groundwater investigation for Kaiser Steel Corporation. The results of this investigation are documented in the *Report of Soil and Groundwater Testing at the Kaiser Steel Corporation Pipe Mill and Fabrication Facility in Napa California* (James M. Montgomery, 1987).

As part of the investigation, four soil borings (BH-7, BH-22, BH-23, BH-24; see Plate 3 and the plate in Appendix D for boring locations) were drilled adjacent to the ECB to depths ranging between 6 and 15 feet bgs. The lithologic logs are included in Appendix C. One soil sample was collected from each boring and grab groundwater samples were collected from borings BH-7 and BH-22. Soil and groundwater samples collected from boring BH-7 were analyzed for VOCs, TPH⁷, pH, and California Administrative Manual (CAM) 17 metals including hexavalent chromium. The remaining soil samples were analyzed for VOCs and semivolatile organic compounds (SVOCs). The groundwater sample from boring BH-22 was analyzed for VOCs only. The analytical results for the soil and groundwater investigations are included in Appendix D.

In summary, TPH⁷ was detected at 3,200 mg/kg in the soil sample from boring BH-7 and at 3,100 milligrams per liter (mg/l) in the groundwater sample from this boring. Both of these concentrations are above the TPH-d ESL. The TPH soil results from this investigation are incorporated into the nature and extent of contamination discussion presented in Section 4.0.

The VOCs benzene, 1,1-dichloroethane (1,1-DCA), ethylbenzene, m,p-xylenes, o-xylenes, and cis-1,2-dichloroethene (cis-1,2-DCE) were detected in the groundwater sample from boring BH-7 at concentrations of 39, 17, 9.0, 12, 16, and 9.0 micrograms per liter (µg/l), respectively. The only constituent detected in groundwater from boring BH-22 was 1,1,1-trichloroethane (1,1,1-TCA) at 0.1 µg/l. All of these results are below their respective ESL values.

Toluene was detected at levels below the ESL in the soil sample taken from boring BH-7. VOC and SVOCs results for the soil samples from the remaining borings were nondetect.

Metals results for the soil sample collected from boring BH-7 were generally low, with only hexavalent chromium at 1.9 mg/kg and cobalt at 17 mg/kg exceeding their ESL values. None of the metals results for the groundwater sample exceeded their respective ESLs.

2.4.2 Site Investigation Report for the Napa Pipe Corporation Facility (1990)

From August to November of 1989 JMM conducted an extensive soil and groundwater investigation for Napa Pipe Corporation. The results of this investigation are documented in

⁷ Reported as TPH-d and TPH-mo combined.

the *Site Investigation Report for the Napa Pipe Corporation Facility* report (JMM, 1990a). As part of this investigation, seven soil borings (3-A, 3-B, 3-C, 3-D, 3-E, 3-F, and 3-G; see plates in Appendix E and Plate 3 for boring locations) were drilled around the ECB. Lithologic logs are included in Appendix C. Soil samples were collected from each boring at depths ranging from 0 to 9.5 feet bgs. These samples were analyzed for metals, VOCs, Base/Neutral/Acid Extractables (i.e., SVOCs), TPH⁷, and O&G.

In summary, high TPH and O&G levels were detected in many of the borings. Borings 3-B, 3-C, 3-D, and 3-E located near the compressor pad on the east side of the ECB contained the highest levels of contamination. Most of the TPH and O&G concentrations detected in these borings are above ESLs. Boring 3-D had the highest detection of TPH, 27,000 mg/kg, which is above the TPH-d ESL. The results of the TPH and O&G analysis are summarized on the tables in Appendix E. The TPH soil results from this investigation are incorporated into the nature and extent of contamination discussion presented in Section 4.0.

Metal contamination in the vicinity of the ECB was minimal. The results of the metal analysis are summarized on the tables in Appendix E. Only two results exceeded the calculated background thresholds; copper at 3.0 feet bgs in boring 3-C and barium at 3.0 feet bgs in boring 3-F. None of the metals in soil exceeded their corresponding ESL values.

Three VOCs (ethylbenzene, 1,1,1-trichloroethane and o-xylene) were detected in the soil sample collected at 5.0 feet bgs in boring 3-D. Boring 3-B also had a detection of o-xylene at 2.5 feet bgs. All VOC detections in soil were below their corresponding ESL values. Naphthalene was the only SVOC detected in soil at a concentration above its ESL value. This compound was detected at a concentration of 41,000 micrograms per kilogram ($\mu\text{g}/\text{kg}$) in the 2.5 feet bgs sample collected from boring 3-D.

In an effort to determine the extent of the contamination before monitoring wells were installed, a groundwater screening program was implemented in August of 1989 by JMM. Ten groundwater-sampling probes were extended from 6 to 7.5 feet bgs. The locations of probes E-1 through E-10 are depicted on figures in Appendix E. Location E-2 did not produce any groundwater, and therefore it was not sampled. The rest of the locations produced groundwater, which was analyzed for VOCs. Samples collected from the southeast corner of the ECB (E-7, E-8, E-9 and E-10) contained several VOCs. However, none of the detected VOCs are above ESLs. These results of this analysis are summarized on the tables in Appendix E.

Based on the findings of the groundwater screening program, five shallow wells (MW-6, MW-20, MW-21, MW-22 and MW-23; see plates in Appendix E and Plate 3 for well locations) were installed in the vicinity of the ECB. The lithologic logs for these wells are included in Appendix C. During the installation, soil samples were collected at 6 to 9.5 feet bgs and analyzed for TPH⁷ and O&G. The highest concentrations were detected in the soil samples from well MW-21: TPH at 3,900 mg/kg and O&G at 5,500 mg/kg. Both of these

results are above their respective ESL values. The TPH soil results are incorporated into the nature and extent of contamination discussion in Section 4.0.

Groundwater samples collected from these wells were analyzed for metals, VOCs, TPH⁷, and O&G. The results of the metal testing are summarized on tables in Appendix E. None of the metals detected exceeded their corresponding ESL values. The results of the VOC, TPH, and O&G are also summarized on tables in Appendix E. During sampling, a 29-inch layer of yellowish viscous floating product was observed in well MW-20.

2.4.3 June and July 1990 Investigation

From June to July, 1990 JMM conducted a soil investigation for Napa Pipe Corporation. This investigation was a follow up to the 1989 investigation discussed above. The results for this investigation are included in the *Corrective Action Plan for the Napa Pipe Mill* (JMM, 1990b). As part of this investigation, nine soil borings (3-I, 3-J, 3-K, 3-L, 3-M, 3-N, 3-O, 3-P, and 3-Q; see Plate 3 and plates in Appendix F for boring locations) were advanced in the vicinity of the ECB. Lithologic logs are included in Appendix C. Samples were collected from various depths, ranging from 0.5 feet bgs to 9.5 feet bgs. In addition, shallow monitoring wells MW-29, MW-30, and MW-31 and deep monitoring well DW-5 were installed (see Plate 3 and plates in Appendix F for well locations). During the installation process, soil samples were collected at various depths. Soil samples were analyzed for VOCs, Base/Neutral/Acid Extractables (i.e., SVOCs), TPH-d, and TPH-mo.

In summary, a number of VOCs were detected in the soil samples. However, none of the compounds were detected above their corresponding ESL values. The SVOC naphthalene was detected at concentrations above its ESL value in soil samples collected from four different borings; borings 3-I, 3-K, 3-N, and 3-P (see plates in Appendix F and Plate 3 for boring locations). Soil samples collected from locations 3-I and 3-Q had high concentrations of TPH-d and TPH-mo. The highest TPH-d concentration was 1,900 mg/kg in the 5.0 feet bgs interval from each boring, which is above the ESL. The analytical results for the soil samples are included in Appendix F. The TPH soil results from this investigation are incorporated into the nature and extent of contamination discussion presented in Section 4.0.

Soil samples collected during the installation of well MW-29 contained low levels (i.e., below ESLs) of acetone and total xylenes (0.17 mg/kg for both chemicals). Soil samples from well MW-30 had no organic detections and samples from well MW-31 had low levels of methylene chloride (0.0082 mg/kg) and TPH-mo as high as 370 mg/kg; the concentrations of these constituents are below ESLs. Soil samples from deep well DW-5 had low levels (i.e., below ESLs) of methylene chloride and acetone, at 0.0052 mg/kg and 0.016 mg/kg respectively. The shallow soil samples collected from well DW-5 at 1.0 and 2.5 feet bgs had maximum TPH-d and TPH-mo concentrations of 45 and 110 mg/kg, respectively. These concentrations are below ESLs. The deeper soil sample collected from 21 feet bgs had non-detectable TPH-d and TPH-mo. The TPH soil results from these wells is incorporated into the nature and extent of contamination discussion presented in Section 4.0.

2.4.4 Site 2/3 Characterization, Groundwater Modeling, and Extraction Scenario Development (MW, 1993)

In May and June of 1992, MW conducted a soil and groundwater investigation for Napa Pipe Corporation. The results of this investigation are presented in the *Site 2/3 Characterization, Groundwater Modeling, and Extraction Scenario Development* report (MW, 1993). This report presented the geology and hydrogeology at the Site (see discussion in Section 2.3) and the nature and extent of contamination, and provided a groundwater model and extraction scenario, and a preliminary design for the extraction system. A summary of the investigation is presented below and tables and plates that present the results of the investigation are included in Appendix G. The TPH soil and groundwater results, and the VOC groundwater results from this investigation are incorporated into the nature and extent of contamination discussion presented in Section 4.0.

As part of this investigation, eight monitoring wells (MW-39, MW-40, MW-41, MW-42, MW-43, MW-44, MW-45, and MW-46; see Plate 3 and plates in Appendix G for well locations), a replacement well for well MW-6 (e.g., well MW-6R), and fifteen soil borings (SB2/3-A, SB2/3-B, SB2/3-C, SB2/3-D, SB2/3-E, SB2/3-F, SB2/3-G, SB2/3-I, SB2/3-J, SB2/3-K, SB2/3-L, SB2/3-M, SB2/3-N, SB2/3-O, and SB2/3-P; see Plate 3 and plates in Appendix G for boring locations) were advanced around the ECB. Lithologic logs and monitoring well completion diagrams are included in Appendix C.

Thirty-eight soil samples were collected at various depths ranging from 4.5 feet bgs to 11.5 feet bgs from the soil borings, and during the installation of the new monitoring wells. Groundwater samples recovered from the wells in Site 2/3 were analyzed on two different occasions, the first was immediately after their installation in May of 1992, and the second was a quarterly monitoring event in June of 1992. Soil and groundwater samples were analyzed for VOCs, TPH-d, TPH-mo, TPH as hydraulic fluid (TPH-ho), and TPH as gasoline (TPH-g).

In summary, soil samples collected during this investigation displayed elevated levels of TPH-d. The highest concentration of 6,800 mg/kg, which is above the TPH-d ESL, was detected in the sample from 6.5 feet bgs in SB2/3-G. Soil borings SB2/3-C, SB2/3-I, SB2/3-J, SB2/3-L, and SB2/3-M also displayed concentrations TPH-d concentrations above the TPH-d ESL. The maximum concentration TPH-d in each of these borings was at least 1,000 mg/kg. TPH-ho and TPH-mo was also detected in most of the same locations that displayed diesel contamination. The highest TPH-ho concentration was 1,500 mg/kg in at 7 feet bgs in boring SB2/3-J and the highest TPH-mo concentration was 1,000 mg/kg at 8 feet bgs in boring SB2/3-C. Both of these concentrations are above their respective ESLs. Most of the hydrocarbon contamination seen in Site 2/3 was in the vicinity of the southeast corner of the ECB where elevated concentrations were detected previously. None of the soil samples collected during this investigation had VOC concentrations that exceeded their corresponding ESL values.

Separate-phase product was detected in three of the monitoring wells (MW-20, MW-21, MW-23) during this investigation. The maximum thickness detected in wells MW-20, MW-21, MW-23 was 2.5 feet, 3.0 feet, and 0.2 feet respectively. In addition, elevated VOCs concentrations were detected in various monitoring wells sampled during this investigation. All of the wells currently located at Site 2/3 are now included in the Facility-wide monitoring program discussed in Section 2.4.6.

2.4.5 Phase II Site Investigation (Shaw Environmental Inc., 2005)

In 2005 Shaw Environmental Inc. (Shaw) conducted a Phase II site investigation of the Napa Pipe Facility prior to NRPs acquisition of the Facility. The results were documented in the *Phase II Site Investigation at Napa Pipe Facility, 1025 Kaiser Road in Napa, CA* report (Shaw, 2005).

As part of the Phase II investigation, four soil borings (ECB-01, ECB-02, ECB-03, and ECB-04; see Plate 3 and the illustration in Appendix I for boring locations) were drilled at the ECB to a depth of 12 feet bgs. ECB-02 was completed within the ECB, ECB-01 was completed west of the ECB, and ECB-03 and ECB-04 were completed along a sanitary sewer line north of the ECB. Lithologic logs are included in Appendix C.

Two soil samples were collected from ECB-01, ECB-03, and ECB-04 and one soil sample was collected from ECB-02. In addition, one grab groundwater sample was collected from each boring. All of the soil and groundwater samples were analyzed for TPH-d, VOCs, and polynuclear aromatic hydrocarbons (PAHs). The analytical results tables for the soil and groundwater samples are included in Appendix I.

In summary, only the soil and groundwater samples collected from ECB-02 contained constituents above the respective ESL values. In the ECB-02 soil sample, only naphthalene exceeded its ESL. In the ECB-02 water sample, TPH-d, vinyl chloride, and naphthalene exceeded their respective ESL values. The remaining VOC and PAH constituents were detected at concentrations below ESLs. The TPH soil and groundwater results, and the VOC groundwater results from this investigation are incorporated into the nature and extent of contamination discussion presented in Section 4.0.

2.4.6 Facility-Wide Groundwater Monitoring Program

A Facility-wide groundwater monitoring program has been ongoing at the Napa Pipe Facility since April 1989. The scope of the sampling has been revised and updated (with approval from the RWQCB) several times since its inception. To date, sixty-eight monitoring rounds have been conducted at the Facility. Facility-wide groundwater monitoring events are conducted semi-annually during the second and fourth quarters of each year. Water-level measurements are collected from all monitoring wells during these events, but only selected wells are sampled. Currently, 48 of the 71 monitoring wells that exist at the Facility are sampled as part of this program; some of these wells are sampled semi-annually and others

annually. Analyses performed on the groundwater samples vary, but one or more of the following analyses are performed on the samples: VOCs; TPH-d; TPH-extractables (TPH-E); or metals (including aluminum, arsenic, barium, chromium, copper, lead, selenium, and zinc). In addition, selected wells at Site 4 are analyzed for a variety of monitored natural attenuation parameters.

At Site 2/3, 15 of 19 on-site monitoring wells are sampled; 4 wells (MW-29, MW-31, MW-42, and MW-55) are sampled semi-annually and 11 wells (MW-21, MW-22, MW-30, MW-39, MW-40, MW-44, MW-45R, MW-46, MW-53, MW-54, and DW-5) are sampled annually. Monitoring wells at Site 2/3 are sampled for either VOCs or TPH-d, or both⁸. The two most recent monitoring events were performed in May and October 2006. The TPH and VOC groundwater results from these events are summarized on Tables 4 and 5, respectively. The results for the October 2006 monitoring event are included on the groundwater concentration maps discussed in Section 4.0.

2.5 Summary of Interim Groundwater Remedial Actions

Interim remedial actions have been ongoing at Site 2/3 since October 1990. The primary objective of the interim remedial actions at Site 2/3 was previously defined as hydraulic containment to prevent migration of chemicals of concern in groundwater (MW, 1993). Therefore, MW used a non-attainment zone area (NZA) approach to groundwater management in developing an appropriate remedial strategy for Site 2/3 (MW, 1994). Interim remedial actions at the Site have included:

- Separate-phase product recovery in wells MW-20 and MW-21, and piezometer TPZ-7; and
- Installation of a groundwater extraction trench on the east side of the ECB in December 1993 (see Plate 3 for location of trench). The extracted groundwater has been pumped to a pre-treatment facility adjacent to the trench that is equipped with an oil/water separator to remove separate-phase hydrocarbon product prior to discharge to the Napa Sanitation District (NSD).

Details such as the amount of product recovery from the wells and volumes of groundwater and product extracted from the trench have been presented in the reports generated for the groundwater monitoring program (PES, 2006a).

Historically, piezometer TPZ-7, and wells MW-20, MW-21, and MW-23 have contained varying levels of floating separate-phase product. As mentioned in Section 2.4.4, in 1992,

⁸ Modifications to the analytical program have been made over the years in response to the findings of the monitoring program. For example, for well DW-5, a well screened from 18 to 23 feet bgs, TPH-d was sporadically detected at concentrations up to about 1,200 µg/l. When last sampled in 1997, TPH-d concentrations in this well were at 100 µg/l and the monitoring for TPH-d was discontinued. Historically, TPH-d concentrations at well DW-5 have been either non-detect or well below the ESL for groundwater.

separate-phase product thicknesses in wells MW-20, MW-21, and MW-23 were measured at 2.5 feet, 3.0 feet and 0.2 feet, respectively. Historically, up to 2.31 feet of separate-phase product has been measured at piezometer TPZ-7. A review of the groundwater monitoring reports indicate that the last detected product (0.02 feet thick) in well MW-23 occurred in October 1997. In the recent water level measurement events (i.e., May and October 2006), no product was detected in well MW-20 and piezometer TPZ-7, and 0.01 feet of product was detected in well MW-21 in May. However, product recovery efforts at these locations are ongoing, and, as indicated on Tables 2 and 3, oil absorbent socks are placed at these locations. While it is difficult to exactly estimate what the product thickness would be in the absence of the petroleum product recovery efforts, it is clear that the thickness of separate-phase petroleum hydrocarbons floating on the groundwater table has decreased substantially in the approximately 13 years of product recovery via oil absorbent socks and the extraction trench operation (e.g., in Well MW-21, thickness have dropped from 3.0 feet to 0.01 feet).

A total of 301,440 gallons of groundwater was pumped from the extraction trench between January and July 2006, representing an average flow rate of 1.1 gallons per minute (gpm). The extraction of groundwater from the trench temporarily ceased in July 2006 when power to the ECB was cut off as noted above. Groundwater extraction from the trench resumed in November 2006. A total of 16,823 gallons were pumped between November and December 27, 2006, representing an average flow rate of 0.33 gpm. As of December 27, 2006, the total volume of groundwater extracted from the trench since its installation was 1,734,881 gallons.

3.0 SUPPLEMENTAL REMEDIAL INVESTIGATION

The following sections present the field activities and methods (Section 3.1) and analytical results (Section 3.2) for the supplemental remedial investigation conducted by PES in September through November 2006.

3.1 Field Activities and Methods

Prior to conducting the supplemental remedial investigation, PES reviewed historical site documents and prepared a workplan that was submitted to RWQCB staff for review. The RWQCB approved the work plan in early September 2006. The workplan, titled *Supplemental Remedial Investigation Workplan, Site 2/3* (PES, 2006b), recommended that a subsurface investigation be conducted inside the ECB to address the following data gaps:

- The lateral extent of VOC and petroleum hydrocarbon contamination in soil and groundwater beneath the ECB;
- The extent of separate-phase hydrocarbons beneath the ECB; and
- Confirm/further refine estimated quantities of soil with VOC and petroleum hydrocarbon contamination.

During the initial phase of work for the supplemental remedial investigation, PES completed seven borings (EC1 through EC7; see Plate 3) inside the ECB. A summary of the samples collected from these borings and the analyses performed on the samples is provided in Table 6. As indicated on this table, soil and groundwater samples were collected from each of these borings.

Based on the results of the September 2006 supplemental remedial investigation, a second phase of work was conducted at Site 2/3 in November 2006. The purpose of this investigation was to:

- Further define the extent of VOCs and petroleum hydrocarbon contamination in soil and groundwater beneath and around the ECB; and
- Further assess the extent and amount of separate-phase hydrocarbons (i.e., separate-phase product) beneath the footprint of the ECB.

During the second phase of work for the supplemental remedial investigation, PES completed seven borings (EC8 through EC18; see Plate 3). A summary of the samples collected from these borings and the analyses performed on the samples is provided in Table 6.

The pre-field activities, and sampling and analytical methods used for the September through November investigations are discussed in Sections 3.1.1 through 3.1.3.

3.1.1 Pre-Field Activities

Drilling permits were obtained from the Napa County Department of Environmental Management prior to all phases of drilling. PES contacted Underground Service Alert more than 48 hours before beginning exterior drilling activities, and retained California Utility Surveyors, a private utility locating company, to clear all boring locations for subsurface utilities. A site-specific Health and Safety Plan was prepared for all sampling activities.

3.1.2 Sampling Methods

The following sections summarize the scope of work and the methodologies employed by PES during the supplemental remedial investigation. The drilling and sampling technology utilized during the supplemental remedial investigation included shallow soil and/or grab groundwater sampling using a direct-push drilling rig. All drilling and sampling activities were conducted with oversight by a California Professional Geologist.

RSI Drilling (RSI) of Woodland, California, under subcontract to PES, utilized a direct-push drilling rig to advance the borings to the desired depth, which ranged between 12 and 16 feet bgs. Either a single- or dual-walled sampling system equipped with a clear acetate liner was

used to collect a continuous soil cores from the borings. Soil samples for VOC analysis were collected with an Encore™ sampling device.

A PES geologist observed the borehole drilling and prepared a lithologic log of the borings using the Unified Soil Classification System (USCS). The soil cores were screened for VOCs using a photoionization detector (PID) and the results were recorded on the lithologic log. Lithologic logs are presented in Appendix A. A lithologic log was not created for boring EC12 because this location was sampled for groundwater only. Therefore, soil cores for logging and sampling purposes were not collected.

To facilitate groundwater sampling, a 1-inch diameter schedule 40 polyvinyl chloride (PVC) well casing fitted with a 10- to 15-foot section of factory-slotted PVC well screen was lowered into the boring selected for groundwater sampling. Groundwater samples were collected from the PVC casing with a peristaltic pump. New tubing was used at each sampling location. The samples were collected in appropriate laboratory-provided sample containers.

Sample containers were labeled to indicate project location, job number, boring number, sample number, and time and date collected. The samples were immediately placed in a thermally-insulated cooler containing ice. The samples were picked up daily by a courier who transported them under chain of custody protocol to Curtis & Tompkins, LTD (C&T) of Berkeley, California. C&T is certified by the State of California for the requested analyses.

Downhole drilling and sampling equipment was cleaned via pressure washing or using a non-phosphate detergent and double-rinsed with potable water prior to use. Borings were backfilled with cement grout. Drill cuttings, equipment rinsate, and purged groundwater were containerized and stored at the Napa Pipe Facility pending proper disposal.

3.1.3 Analytical Methods

All samples delivered to C&T were accompanied by a sampler's chain of custody. The following test methods were used to perform the soil and groundwater analyses indicated in Table 6:

- VOCs by United States Environmental Protection Agency (USEPA) Test Method 8260B;
- Total extractable hydrocarbons (i.e., reported as diesel [C10-C24] and motor oil [C24-C36]) by USEPA Test Method 8015B; a silica gel cleanup was included with this analysis; and
- 1,4-dioxane by USEPA Test Method 8270C-SIM.

3.2 Analytical Results

Analytical results for soil matrix and groundwater samples are presented in Tables 7 through 10. Plate 3 show site features and sample locations. Laboratory analytical reports and chain of custody forms are presented in Appendix J. Plates 8 through 10 provide a graphical presentation of soil sampling results for TPH-d. Selected groundwater sampling results are shown on Plates 11 and 12. The nature and extent of contamination shown on these plates, which also show results from previous investigations conducted at Site 2/3, are discussed in Section 4.0. The results presented on Tables 7 through 10 are compared to the ESLs discussed in Section 1.0 and presented on Table 1.

3.2.1 Soil Results

Petroleum Hydrocarbons

As shown in Table 7, TPH-d was detected in 23 of 24 soil samples analyzed for this constituent. Detected concentrations of TPH-d range from 1.1 mg/kg (3 to 3.5 feet sample from boring EC10) to 6,100 mg/kg (7 to 7.5 feet sample from boring EC6). Results for the following seven soil samples were at concentrations greater than the ESL for TPH-d:

- Boring EC1 at 2.5 to 3 feet = 820 mg/kg;
- Boring EC3 at 3 to 3.5 feet = 280 mg/kg;
- Boring EC5 at 7 to 7.5 feet = 1,900 mg/kg;
- Boring EC6 at 3 to 3.5 and 7 to 7.5 feet = 820 and 6,100 mg/kg, respectively;
- Boring EC7 at 7 to 7.5 feet = 220 mg/kg; and
- Boring EC14 at 7 to 7.5 feet = 920 mg/kg.

TPH-mo was detected in 16 of 24 soil samples analyzed for this constituent (Table 7). Detected concentrations of TPH-mo range from 7.4 mg/kg (7 to 7.5 feet sample from boring EC13) to 9,800 mg/kg (2.5 to 3 feet sample from boring EC1). Concentrations in the following three soil samples were greater than the ESL for TPH-mo:

- Boring EC1 at 2.5 to 3 feet = 9,800 mg/kg;
- Boring EC3 at 3 to 3.5 feet = 3,100 mg/kg; and
- Boring EC6 at 3 to 3.5 feet = 4,500 mg/kg.

The laboratory assigned a “H” qualifier (i.e., heavier hydrocarbons contributed to the quantitation) to each of these results and a “L” qualifier (lighter hydrocarbons contributed to

the quantitation) to the result from boring EC6. The “H” qualifier suggests that a heavier hydrocarbon, perhaps hydraulic oil based on its use in the machinery historically used at the ECB, contributed to the result for each sample. The “L” qualifier assigned to the result from boring EC6 can likely be attributed to diesel, the primary petroleum hydrocarbon contaminant of concern at the ECB.

Volatile Organic Compounds

Twelve different VOC compounds were detected in the soil samples collected during the supplemental remedial investigation (Table 8). However, only naphthalene exceeded its respective ESL. The concentration of naphthalene, which was detected in 4 of 24 soil samples, exceeded its ESL (460 µg/kg) in the following three samples:

- Boring EC2 at 7 to 7.5 feet = 4,400 µg/kg;
- Boring EC5 at 7 to 7.5 feet = 1,600 µg/kg; and
- Boring EC7 at 7 to 7.5 feet = 5,100 µg/kg.

The elevated naphthalene concentrations detected in soil reflect the presence of TPH-d in the soil. Naphthalene is a heavier fraction component of diesel.

3.2.2 Groundwater Results

Petroleum Hydrocarbons

TPH-d was detected in 9 of 14 groundwater samples analyzed for this constituent (Table 9). Detected concentrations of TPH-d range from 130 µg/l in boring EC3 to 1,000,000 µg/l in boring EC7. Concentrations in the following five borings were greater than the ESL for TPH-d:

- Boring EC1 = 5,000 µg/l;
- Boring EC2 = 38,000 µg/l;
- Boring EC5 = 210,000 µg/l;
- Boring EC6 = 260,000 µg/l; and
- Boring EC7 = 1,000,000 µg/l.

TPH-mo was detected in 4 of 14 groundwater samples analyzed for this parameter (Table 9). Detected concentrations of TPH-mo range from 480 µg/l in boring EC10 to 41,000 µg/l in boring EC1. The concentration in boring EC1 is above the TPH-mo ESL of 2,500 µg/l.

The laboratory assigned a “H” qualifier (i.e., heavier hydrocarbons contributed to the quantitation) to the result from boring EC1. As discussed above, the “H” qualifier suggests that a heavier hydrocarbon, perhaps hydraulic oil, contributed to the result for each sample.

Volatile Organic Compounds

- As shown on Table 10, VOCs were not detected in grab groundwater collected from three (EC10, EC11, EC12) of the 15 borings sampled during the supplemental remedial investigation. In all, 22 different VOCs were detected in the grab groundwater samples (Table 10). However, only naphthalene (in boring EC18 at a concentration of 250 µg/l) and vinyl chloride (in boring EC9 at a concentration of 18 µg/l) were detected at concentrations above their ESLs of 210 and 3.8 µg/l, respectively.

1,4-Dioxane

Groundwater from three borings (EC11, EC16, EC18) completed during the supplemental remedial investigation was analyzed for 1,4-dioxane (Table 10). This compound was not detected, but the reporting limit was elevated for the samples collected from EC16 (ND[28,000]) and EC18 (ND[10,000]). The 1,4-dioxane groundwater ESL of 50,000 µg/l is above these elevated detection limits.

As shown on Table 5, 1,4-dioxane was detected at a concentration of 80 µg/l in well MW-31 during the May 2006 groundwater monitoring event, which is well below the ESL. Groundwater samples collected during the October groundwater monitoring event were not analyzed for this constituent.

4.0 NATURE AND EXTENT OF CONTAMINATION

The distribution of TPH-d and VOCs in soil and groundwater at Site 2/3 as identified from the various investigations is summarized below. TPH-d and VOCs have regularly been detected at Site 2/3 and are considered to be the chemical parameters of concern (MW, 1993).

The maps presented on Plates 8, 9, and 10 incorporated TPH-d soil data from the previous investigations discussed in Section 2.0, and from the recently conducted supplemental remedial investigation.

The more recent investigations conducted by Shaw (Shaw, 2005) and PES included borings within the ECB, which had not been done previously because the building was occupied and active. Therefore, the extent of petroleum hydrocarbon and VOCs in soil and groundwater is now better defined beneath the ECB. In addition, the approximately 13 years of groundwater extraction and product removal have reduced the volume and extent of hydrocarbons within and exterior to the ECB.

4.1 Nature and Extent of Contamination in Soil

4.1.1 Petroleum Hydrocarbons

In general, Site 2/3 soils are primarily affected by elevated concentrations of TPH-d. As discussed above, a source area for the TPH-d in soil is likely the underground product pipeline located between the former above ground diesel tank and the southeast corner of the ECB.

The distribution of TPH-d in soil at three different depth intervals is shown on Plate 8 (0 to 4 feet bgs interval), Plate 9 (4 to 10 feet bgs interval), and Plate 10 (10 to 13 feet bgs interval). In general, results posted for the shallow depth interval correlate with the fill unit, those posted for the intermediate depth interval correlate with the silty clay unit, and those posted for the deep depth interval correlate with the lower portion of the silty clay unit and/or the upper portion of the clay silt unit. As shown in the explanation for each plate, the posted color dots represent various concentration ranges for TPH-d relative to the ESL. The TPH-d results posted on Plates 8 through 10 represent the maximum concentration in cases where multiple soil samples have been collected within a depth interval for a particular boring. TPH-d soil results are also posted on MW's cross sections A-A' through F-F' (see Appendix B).

As shown on Plates 8, 9, and 10, the highest concentrations of TPH-d have been detected near and outside the southeastern portion of the ECB, in the vicinity of the product pipeline and former diesel above ground storage tank (AST). The TPH-d contamination in this area extends from the area of the former diesel AST and associated product pipeline: (1) north towards the concrete compressor pad on the east side of the ECB; (2) westward along the south side of the ECB (see Plates 9 and 10, locations MW-23, 3-Q, and SB2/3-C); (3) under the southeastern portion of the ECB in the vicinity of borings ECB-02, EC5, EC6, EC7, and EC15 through EC18 (see Plate 9); and off-site towards the Napa Valley Corporate Park (elevated concentrations of TPH-d are found in the 4 to 10 feet bgs interval in borings SB2/3-D, SB2/3-I, SB2/3-J, SB2/3-M, and well MW-42; see Plate 9).

As discussed by MW (MW, 1993), the uppermost stratigraphic unit (fill) generally has low concentrations of TPH-d except in the area outside the southeastern portion of the ECB near the underground product pipeline and at isolated area inside the ECB (see Plate 8 and cross sections in Appendix B). The elevated TPH-d concentrations associated with interior borings EC1, EC3, and EC6 are likely related to the heavy surface staining present in these areas. The concentration of TPH-mo in these borings is also elevated at shallow depths and is significantly higher than TPH-d (Table 7). As indicated on Plate 11 and discussed in detail in Section 4.2.1, a sheen or separate-phase floating product was encountered in seven borings completed within the ECB, including borings EC1 and EC6, and two borings completed on the exterior of the ECB during previous investigations.

In general, the highest TPH-d concentrations in soil occur in the 4 to 10 feet bgs interval, which generally correlates with the silty clay unit (see Plate 9). Based on field observations during the supplemental remedial investigation, it appears that the cemented clayey silt unit,

which is located stratigraphically beneath the silty clay unit, is impeding downward migration of TPH-d. Borings EC15 through EC18 (see Appendix A), which were drilled inside the southeastern portion of the ECB, showed significantly less visual contamination in the cemented clayey silt unit compared to the overlying silty clay unit. In addition, PID readings showed a significant decline in this unit, especially readings taken from within 1 to 2 feet into the unit. MW also noted that “where the cemented clayey silt was encountered, it was observed to be relatively unaffected by petroleum hydrocarbons” (MW, 1993). Essentially, the cemented clayey silt unit has acted as a significant physical barrier to downward migration and caused the diesel contamination to laterally spread out. Seasonal and climatic (e.g., drought years) groundwater fluctuations have likely enhanced this spreading process via smearing of the separate-phase product along the groundwater table.

Limited TPH-d data are available for the 10 to 13 feet bgs interval, but the available data suggest that TPH-d concentrations are significantly lower in this interval (see Plate 10). In addition, significantly lower TPH-d concentrations are found in deeper soil samples collected in the 4 to 10 feet bgs interval from the following borings:

- **Boring 3-C:** 7.5 to 8 feet bgs sample has TPH-d concentration of 950 mg/kg. Posted TPH-d result (27,000 mg/kg) on Plate 9 is for sample collected from 5 to 5.5 feet bgs.
- **Boring 3-D:** 6.5 to 7 feet bgs sample has TPH-d concentration of 490 mg/kg. Posted TPH-d result (4,900 mg/kg) on Plate 9 is for sample collected from 5 to 5.5 feet bgs.
- **Boring 3-E:** 7.5 to 8 feet bgs sample has TPH-d concentration of 70 mg/kg. Posted TPH-d result (5,700 mg/kg) on Plate 9 is for sample collected from 5.5 to 6 feet bgs.
- **Boring 3-I:** TPH-d was not detected in the 9.5 to 10 feet bgs sample from this boring. Posted TPH-d result (1,900 mg/kg) on Plate 9 is for sample collected from 6 to 6.5 feet bgs.
- **Boring 3-Q:** 6.5 to 7 and 9.5 to 10 feet bgs samples have TPH-d concentrations of 220 and 33 mg/kg, respectively. Posted TPH-d result (1,900 mg/kg) on Plate 9 is for sample collected from 5 to 5.5 feet bgs.
- **Boring SB2/3-G:** 8 to 8.5 feet bgs sample has TPH-d concentration of 530 mg/kg. Posted TPH-d result (6,800 mg/kg) on Plate 9 is for sample collected from 6.5 to 7 feet bgs.
- **Boring SB2/3-I:** 9.5 to 10 feet bgs sample has TPH-d concentration of 3.3 mg/kg. Posted TPH-d result (2,300 mg/kg) on Plate 9 is for sample collected from 6 to 6.5 feet bgs.
- **Boring SB2/3-M:** TPH-d was not detected in the 7.5 to 8 feet bgs sample from this boring. Posted TPH-d result (1,200 mg/kg) on Plate 9 is for sample collected from 5 to 5.5 feet bgs.

Within the silty clays of the deeper groundwater zone (the older alluvium), petroleum hydrocarbons have not been detected. At well DW-5, the soil sample from 21 feet bgs had no detectable TPH-d and TPH-mo. The clayey soils of the older alluvium with their low hydraulic permeabilities, in conjunction with upward vertical gradients and the naturally buoyant characteristics of separate-phase petroleum hydrocarbons, appear to have largely prevented the downward migration of petroleum hydrocarbons.

4.1.2 Volatile Organic Compounds

According to MW, VOCs were only found in one soil sample collected adjacent to the compressor pad at a depth of 2.5 feet bgs in the investigations conducted prior to the supplemental remedial investigation. The compound detected was 1,1,1-TCA at 1.2 µg/kg.

VOCs (excluding acetone, which is a common laboratory contaminant) detected in soil during the supplemental remedial investigation were found in either: (1) in the southeastern portion of the ECB (i.e., in borings EC5, EC6, and EC7); or (2) in or just outside of the northwestern portion of the ECB (i.e., borings EC9 and EC10). As discussed in Section 3.0, naphthalene was the only VOC constituent in soil that was detected above its ESL.

The detections of naphthalene in soil (i.e., detected in 4 of 22 samples) only occur in the 7 to 7.5 feet bgs depth interval and the detections correspond to the supplemental remedial investigation borings with the highest TPH-d concentrations in groundwater. Therefore, it is likely that the naphthalene (i.e., a component of diesel) detections in soil are a result of the TPH-d groundwater contamination.

4.2 Nature and Extent of Contamination in Groundwater

The posted TPH-d and total VOCs groundwater concentrations shown on Plates 11 and 12 are results obtained from the more recent investigations conducted at Site 2/3. The posted results were obtained from either: (1) the site assessment conducted by Shaw (Shaw, 2005) in October 2005 (i.e., the ECB designated borings); (2) the supplemental remedial investigation conducted by PES in September through November 2006 (i.e., the EC designated borings); or (3) the most recent Facility-wide groundwater monitoring event conducted by PES in October 2006 (i.e., monitoring well results). Groundwater results for samples collected from borings completed during investigations in the late 1980s and 1990s (see Section 2.0 for discussions of these investigations) were taken into consideration when drawing the contours, especially in areas of the Site where limited data exists. However, because of the operation of the extraction system and natural attenuation these historical results do not represent current conditions.

4.2.1 Petroleum Hydrocarbons

Site 2/3 groundwater is primarily affected by TPH-d. TPH-d at Site 2/3 has historically been found as separate-phase floating product and as a dissolved constituent within the groundwater.

The following sections discuss the extent of separate-phase product and dissolved TPH-d in groundwater.

4.2.1.1 Separate-Phase Floating Product

As discussed in Section 2.5, interim remedial actions including groundwater extraction trench on the east side of the ECB and separate-phase product recovery in wells MW-20 and MW-21, and piezometer TPZ-7 have been ongoing at Site 2/3 since October 1990.

Separate-phase floating product has historically been detected in piezometer TPZ-7, and wells MW-20, MW-21, and MW-23. During MW's May and June 1992 investigation, the maximum thickness of product in wells MW-20, MW-21, MW-23 was 2.5 feet, 3.0 feet, and 0.2 feet respectively.

In the recent water level measurement events (i.e., May and October 2006) no product was detected in well MW-20 and piezometer TPZ-7, and 0.01 feet of product was detected in well MW-21 in May (see Tables 2 and 3). However, Jim Swindle, who oversees the operation and maintenance of interim remedial activities at Site 2/3, indicated (by personal communication, 2006) that product continues to accumulate on the oil absorbent socks at these locations. Product has not been detected in well MW-23 since October 1997.

As indicated on Plate 11, a sheen or separate-phase floating product was encountered in the following borings completed within the ECB during the supplemental remedial investigation (see lithologic logs in Appendix A):

- **Boring EC1** – Sheen present at 4.5 feet bgs (first encountered wet soil) in the lowermost portion of the fill unit.
- **Boring EC6** – Oily sheen present in a silty sand with gravel interval encountered between 10 and 10.5 feet bgs in the cemented clayey silt unit. As shown in cross section A-A', the silty sand with gravel interval lies at or near the top of the cemented clayey silt unit in the vicinity of borings EC6, EC18, and EC20.
- **Boring EC7** – Oily sheen present at 8.75 feet bgs (first encountered wet soil) in a 3-inch thick moist to wet interval in the silty clay unit.
- **Boring EC15** – Sheen present from 5 to 8 feet bgs (first encountered wet soil at 5 feet bgs) in the silty clay unit.
- **Boring EC16** – Sheen present from 7.75 to 10.25 feet bgs in an interval that extends over the lowermost portion of the silty clay unit and the upper 3 inches of the cemented clayey silt unit.
- **Boring EC17** – Sheen present from approximately 6.5 to 10.2 feet bgs (3.75 feet thick interval) that includes the following lithologies: (1) a wet (first encountered wet soil)

sandy silt with gravel interval (between 6.5 and 7.5 feet bgs) and moist to wet silty clay interval (between 7.5 and 10 feet bgs) in the silty clay unit; and (2) the upper 2 inches of a wet silty sand present at the top of the cemented clayey silt unit.

- **Boring EC18** – Sheen present from 7 to 8 feet bgs in the silty clay unit. In addition, separate-phase product was encountered when collecting a grab groundwater sample from this boring. The product had sensory characteristics that resembled diesel.

The lithologic logs from previous investigations (see Appendix C) were also reviewed for evidence of sheens or separate-phase product. The following borings showed evidence based on information presented on the lithologic logs (see Plate 11):

- **Boring 3Q** – An oily film was noted on the sampler pulled from approximately 5 feet Bgs (silty clay unit). This boring was drilled south of the ECB in 1990.
- **Boring ECB-02** – A heavy sheen was present at 5 feet bgs (first encountered wet soil at 5.5 feet bgs) in the silty clay unit. This boring was completed within the ECB during Shaw's 2005 investigation (Shaw, 2005).

As expected, sheens or evidence of separate-phase product have generally been found in wells or borings located outside the southeastern portion of the ECB (i.e., in the vicinity of the underground product pipeline) or within the southern portion of the ECB (i.e., downgradient of the underground product pipeline).

The current estimated extent of separate-phase product on groundwater is outlined on Plate 11 (Distribution of Total Petroleum Hydrocarbons as Diesel in Groundwater). Information pertaining to the presences of a sheen or separate-phase product is also presented on cross sections A-A' and B-B' (Plates 4 and 5).

4.2.1.2 Dissolved-Phase Petroleum Hydrocarbons

The distribution of TPH-d in groundwater is shown on Plate 11. As shown on this plate, concentrations greater than the groundwater ESL of 2,500 µg/l are present: (1) beneath most of the southern and northwestern portions of the ECB; and (2) on the southeastern exterior of the ECB. The highest concentrations in groundwater are found within the 50,000 µg/l contour, which extends from the location of the underground product pipeline (i.e., a likely source area) and encompasses much of the southern portion of the ECB. The maximum concentrations of TPH-d are found in the southeastern portion of the ECB in borings EC7 (1,000,000 µg/l) and ECB-02 (4,800,000 µg/l). Based on the results of the new borings completed within and immediately adjacent to the ECB, the extent of TPH-d in groundwater at concentrations greater than the ESL of 2,500 µg/l extends further north, northwest, east, and west than the extent shown in MW's *Site 2/3 Characterization, Groundwater Modeling, and Extraction Scenario Development* report (MW, 1993). As in the case of TPH-d in soil, elevated concentrations of

TPH-d in groundwater (i.e., 6,700 µg/l in well MW-42) also extend off-the Facility towards the Napa Valley Corporate Park (see Plate 11).

As noted in Section 2.2, in 1991 a diesel spill occurred at the compressor pad located east of the ECB. This is also a likely source of TPH-d at the Site.

Another separate source for petroleum hydrocarbons may exist in the vicinity of the machinery pits located in the northwestern portion of the ECB based on the elevated TPH concentrations in groundwater in boring EC1. In particular, the elevated concentration of TPH-mo in EC1 (41,000 µg/l) suggests that a separate source exists in this area.

Despite the high concentration of TPH-d in shallow groundwater, deeper groundwater at the Site has not been significantly impacted by TPH-d. As noted in Section 2.4, detections of TPH-d in well DW-5 (screened from 18 to 23 feet bgs) have been either non-detect or well below the ESL for groundwater. The low hydraulic permeabilities of the underlying clayey soils, in conjunction with upward vertical gradients and the naturally buoyant characteristics of the separate-phase petroleum hydrocarbons, have limited the downward migration of petroleum hydrocarbons into the deeper groundwater zone.

4.2.2 Volatile Organic Compounds

The extent of total VOCs in groundwater is shown on Plate 12. When comparing this plate to Plate 11 it can be seen that the higher total VOCs concentrations roughly correlates with the higher TPH-d at concentrations in groundwater.

The highest total VOC concentrations in groundwater are found within the 500 µg/l contour, which originates on the east side of the building and extends westward beneath the ECB. The upgradient (i.e., eastward) extent of this contour is in the vicinity of the compressor pad on the eastern side of the ECB, suggesting that the source was associated with historical activities at compressor pad and/or the diesel spill in this area (see Section 2.2).

The highest total VOC concentration in groundwater is found in well MW-21, with a total VOC concentration of 949.1 µg/l (including, 1,1-DCA [330 µg/l], naphthalene [160 µg/l], vinyl chloride [130 µg/l], chloroethane [120 µg/l], 1,1,1-TCA [110 µg/l], 1,1-DCE [8.6 µg/l], benzene [8 µg/l] with 12 other detections ranging from 2.2 to 105 µg/l). The only concentration for these listed constituents that exceeds its respective ESL is vinyl chloride at 130 µg/l. This is the only result from the second and fourth quarter 2006 monitoring rounds that is above an ESL. As discussed in Section 3.2, naphthalene (in boring EC18 at a concentration of 250 µg/l) and vinyl chloride (in boring EC9 at a concentration of 18 µg/l) were also detected in groundwater at concentrations above their ESLs of 210 and 3.8 µg/l, respectively.

A separate source for VOCs may exist in the vicinity of the machinery pits located in the northwestern portion of the ECB based on: (1) elevated 1,1-DCA concentrations in

groundwater in borings EC1 (76 µg/l) and EC9 (66 µg/l); and (2) the absence of naphthalene in borings EC1 and EC9, which is found at elevated levels in many of the other borings completed inside the ECB.

VOCs (including diesel-related constituents such as naphthalene and other polynuclear aromatic hydrocarbons or BTEX compounds) were not detected in well DW-5 in the fourth quarter 2006 monitoring event (Table 5). This well is located near the suspected VOC source area and is screened in the Deep Groundwater Zone. In other words, the VOC contamination at the ECB is confined to the Shallow Groundwater Zone.

4.3 Conceptual Site Model

Based on the data from the various Site 2/3 investigations completed to date, it appears that diesel was likely released to the subsurface from the underground product pipeline located near the southeast corner of the ECB. Once the diesel was released it likely migrated vertically through the more permeable fill unit and then migrated laterally outward along the contact between the fill and silty clay units. Some of this migration is likely due to smearing of the diesel via water table fluctuations. As discussed by MW (MW, 1993), secondary porosity features such as root holes, and more permeable lenses of peat and sands within the silty clay unit likely contributed to the migration of the diesel. The diesel may have also migrated along unknown and unobserved preferential pathways in the subsurface, such as the backfill of utility lines. MW (MW, 1993) developed a conceptual model for the distribution of diesel at Site 2/3. The figure for this model is included in Appendix H.

Separate sources for petroleum hydrocarbons may exist in the vicinity of the machinery pits located in the northwestern portion of the ECB based on the elevated TPH concentrations in groundwater in boring EC1 (see Section 4.2). In particular, the elevated concentration of TPH-mo in EC1 (41,000 µg/l) suggests that a separate source exists in this area. The 1991 diesel spill at the compressor pad is another likely source of TPH-d.

As discussed in Section 4.2, suspected sources of VOCs at the ECB include: (1) historical activities associated with the compressor pad on the east side of the ECB; and (2) the machinery pits located in the northwestern portion of the ECB. As with diesel, released VOCs are likely to have migrated vertically through the more permeable fill unit and then migrated laterally outward along the contact between the fill and silty clay units. Secondary porosity features such as root holes, and more permeable lenses of peat and sands within the silty clay unit likely attributed to the migration of the VOCs. VOCs may have also migrated along unknown and unobserved preferential pathways in the subsurface, such as the backfill of utility lines.

The lack of VOCs in deep well DW-5 indicates that the Deeper Groundwater Zone has not been affected by contamination in the Shallow Groundwater Zone. As indicated in MW's *Site 2/3 Characterization, Groundwater Modeling, and Extraction Scenario Development* report (MW, 1993), a net upward hydraulic gradient exists between the Shallow and Deep

Groundwater Zones. Based on laboratory testing presented in the report, estimated vertical permeabilities were low (10^{-7} centimeters per second [cm/sec]) and on the order of one to two orders-of-magnitude lower than horizontal conductivities.

Results of groundwater monitoring activities since the installation of the extraction trench in December 1993, indicate that the trench has been effective in controlling the migration of the groundwater contaminant plume and reducing the volume of separate-phase floating product in the Shallow Groundwater Zone. The horizontal distribution of TPH-d and VOCs in groundwater has generally remained consistent and in the recent water level measurement events (i.e., May and October 2006) separate-phase product was not detected in well MW-20 and piezometer TPZ-7, and a trace amount was detected in well MW-21 (0.01 feet of product in the May event). As discussed in Section 4.2.1.1, the maximum thickness of separate-phase floating product in wells MW-20, MW-21, MW-23 during MW's May and June 1992 investigation was 2.5 feet, 3.0 feet, and 0.2 feet, respectively.

The limited lateral migration of VOCs and petroleum hydrocarbons in groundwater is due both to the relatively flat groundwater gradients (especially on the west side of the ECB) and operation of the extraction trench. The net result is that groundwater plume has not migrated significantly beyond the footprint of the ECB. While the presence of petroleum hydrocarbons and VOCs in the northwestern portion of the ECB might be construed to represent migration of the plume in that direction, a more likely reason for their presence in this area is a release from a separate source (e.g., the machinery pits).

5.0 CONTAMINANT FATE AND TRANSPORT

As part of the *Site 2/3 Characterization, Groundwater Modeling, and Extraction Scenario Development* report (MW, 1993), MW discussed chemical fate and transport for the constituents of concern (i.e., VOCs and petroleum hydrocarbons) at Site 2/3. PES has reviewed the chemical fate and transport section of this report (i.e., Section 3.5) and generally concurs with the information presented. Therefore, Section 3.5 of MW's report is included in Appendix H because it is considered applicable to the current conditions at the Site. Table 3-6 of this report, which summarizes the results of their fate and transport model, is also included in this Appendix H.

In summary, MW indicated that chemical-specific density would affect the vertical migration of contaminants, such that the petroleum hydrocarbons are expected to remain dissolved throughout the aquifer, and floating on the groundwater. MW stated that the dense polychlorinated aliphatics (i.e., chlorinated VOCs) also dissolved in the aquifer, will tend to migrate deeper into the subsurface. However, PES notes that while density-driven vertical migration is an important factor at sites where dense non-aqueous phase liquids (DNAPLs) are present: (1) DNAPLs have not been identified at the Site and (2) the concentrations of chlorinated VOCs dissolved in groundwater are not large enough to cause the plume to sink because of the density of the aqueous solution. As noted in Pankow and Cherry (1996),

“Density is an important factor at DNAPL sites, but only with respect to movement of the DNAPL and not the migration of plumes”.

MW concluded that contamination in the Shallow Groundwater Zone would continue to migrate horizontally due to groundwater flow through this water-bearing zone and that sorption to the solid matrix would mediate this migration. MW predicted horizontal migrations of between 1 and 8 ft/year, depending upon the constituent, and that the VOCs will migrate significantly faster than the diesel contamination. While this would generally be true in the absence of the interim remedial actions, PES notes that operation of the extraction trench, the formation of the associated groundwater sink (See Section 2.3.3) and capture of the plume has significantly limited horizontal migration.

MW indicated that the presence of DCA, DCE, and vinyl chloride in the Shallow Groundwater Zone indicated that potential sources of chlorinated solvent contamination may be degrading by reduction reactions and that the mass of less-halogenated compounds may continue to rise as this reaction continued with time. In general, the concentration of less-halogenated daughter products have not risen since the early 1990s, most likely due to other degradation mechanisms such as aerobic oxidation reactions that are destroying the daughter products and preventing the accumulation of the daughter product compounds. For example, at well MW-21, 1992 concentrations of DCA, DCE and vinyl chloride in groundwater were 390, 2.2, and 200 µg/l, respectively (Appendix G). Fourteen years later, in 2006, their concentrations were not significantly different: 330, 8.6 and 130 µg/l, respectively.

MW did not anticipate significant degradation of petroleum or aromatic hydrocarbons. Other than the loss of separate-phase hydrocarbons via the interim remediation efforts, dissolved TPH-d concentration in groundwater have remained high, consistent with MW's conclusion.

Based on the suspected TPH-d and VOC source areas on the east side of the ECB and the distribution of these constituents in groundwater, it appears that groundwater plume migration was initially toward the west. However, through a combination of both flat gradients and the installation of the extraction trench in December 1993, the plume has been generally confined to the footprint of the ECB and the volume of separate-phase floating product in the Shallow Groundwater Zone has been reduced.

6.0 CHEMICALS OF CONCERN AND REMEDIATION EXTENT

This section summarizes the chemicals of concern (COC) identified during the previous investigations conducted at Site 2/3, specifies the chemicals to be remediated and associated Site cleanup levels and defines the extent of soil and groundwater media that will require remediation (i.e., the areas that exceed the cleanup levels).

6.1 Chemicals of Concern

Chemicals of concern for soil and groundwater were selected on the basis of the following primary factors:

- Chemicals previously identified in cleanup plans (e.g., MW, 1993) as COCs were retained;
- Frequency of detection. Chemicals detected at a frequency greater than 5% were further evaluated for possible retention as a COC;
- Exceedance of ESLs. If a chemical was frequently detected and soil or groundwater concentrations were above an ESL, the chemical was retained as a COC; and
- For metals, if detections were below background conditions, the metal was not retained as a COC.

6.1.1 Soil

As noted above and in MW's original cleanup plan for the Site (MW, 1993), petroleum hydrocarbons and VOCs are the primary chemicals of concern in both soil and groundwater. For soil, TPH-d and TPH-mo are considered the primary petroleum hydrocarbons requiring remediation. Table 11 summarizes the occurrence of petroleum hydrocarbons detected in soil samples collected from the Site. Although other petroleum hydrocarbon compounds were tested for in prior investigations (i.e., TPH, O&G, TPH-ho and TPH-g), these chemicals are not specifically treated as COCs because either: 1) the analytical method did not specifically identify the type of petroleum hydrocarbon (TPH and O&G); or 2) they were infrequently tested for and their presence is likely an artifact of chromatogram overlap of TPH-d or TPH-mo (i.e., TPH-g and TPH-ho). For TPH data, the results were considered to represent TPH-d results and were compared to the more conservative TPH-d ESL, as noted on Table 11. For O&G and TPH-ho data, the results were considered to represent TPH-mo and were compared to the TPH-mo ESL. TPH-d and TPH-mo are retained as COCs.

For VOCs, although a number of VOCs were detected (see Table 12), only acetone, methylene chloride, naphthalene, and xylenes were frequently detected (i.e., using a 5% frequency of detection as the criterion). Of these, naphthalene exceeded its respective ESL. Although naphthalene is a constituent of diesel, this chemical is retained as a COC.

Prior studies at the Site sampled for SVOCs and metals. Of the SVOCs detected in soil (see summary Table 13), only methylnaphthalene was detected at a frequency greater than 5%. However, the constituent is not retained as a chemical of concern because the detected concentrations are well below its ESL of 110,000 µg/kg.

For metals, three metals (barium, chromium VI and cobalt) were each detected in one soil sample at concentrations above their respective ESLs. Table 14 summarizes the maximum and

minimum concentration for each metal along with the frequency of detection, the number of detections above the ESL and the background concentrations for each metal (as available)⁹. For chromium VI, one soil sample was analyzed for this compound and the detection (1.9 mg/kg) is very slightly above the ESL (1.8 mg/kg). No Facility-specific background concentration has been established for chromium VI in soil. For comparison, the 95th percentile of chromium VI in background soils collected from California soils is 2 mg/kg¹⁰. Because of the very slight exceedance of the ESL and the likelihood that this represents a background condition, chromium VI is not retained as a chemical of concern. For cobalt, one sample at the Site was analyzed for this compound; the concentration, 17 mg/kg, is above the ESL (10 mg/kg). No background value has been established for cobalt in soil at the Facility. Studies of California soils have identified background cobalt concentrations that range from 2.7 to 46.9 mg/kg¹¹ or, in terms of the 95th percentile derived from Department of Toxic Substances Control's (DTSC's) study, 22.0 mg/kg¹². As was done in the ESL document (RWQCB, 2005), metals were compared to background concentrations in soil at the Lawrence Berkeley Laboratory (Berkeley Lab, 2002). The background concentrations established for cobalt at the Lawrence Berkeley Laboratory is 25 mg/kg. By comparison with the available California studies, the cobalt is considered to represent a background condition and is not carried forward as a chemical of concern. Finally, barium was detected in one out of ten soil samples at a concentration (910 mg/kg) above the ESL (750 mg/kg). Although this individual soil sample exceeded the background value (248 mg/kg), when the soil data are viewed in their entirety, the 95% Upper Confidence Limit (UCL) of the Site 2/3 dataset is 334 mg/kg, a value below the ESL. Consequently, the elevated concentration of barium in the one sample is viewed as anomaly and not representative of Site conditions; barium is not retained as a chemical of concern.

6.1.2 Groundwater

Tables 15 through 17 summarize the detections, frequency of detection and number of detections above ESLs for petroleum hydrocarbons, VOCs, and SVOCs. Unless otherwise noted, the groundwater results summarized in the tables are for the most recent groundwater sampling results from the fourth quarter 2006 monitoring event and recent grab groundwater sampling investigations.

⁹ Background metals concentrations in soil were developed by James M. Montgomery in a Corrective Action Plan prepared for the Napa Pipe Facility in 1990 (JMM, 1990).

¹⁰ Hunter, Philip M., Davis, Brian K. and Frank Roach, 2005. *Inorganic Chemicals in Ground Water and Soil: Background Concentrations At California Air Force Bases*. Presented at: 44th Annual Meeting of the Society of Toxicology, New Orleans, Louisiana. March 10. Available on DTSC's website at http://www.dtsc.ca.gov/AssessingRisk/upload/Metals_Handout.pdf

¹¹ Kearney Foundation of Soil Science, 1996. *Background Concentrations of Trace and Major Elements in California Soils*. March.

¹² Hunter, Philip M., Davis, Brian K. and Frank Roach, 2005. *Inorganic Chemicals in Ground Water and Soil: Background Concentrations At California Air Force Bases*. Presented at: 44th Annual Meeting of the Society of Toxicology, New Orleans, Louisiana. March 10. Available on DTSC's website at http://www.dtsc.ca.gov/AssessingRisk/upload/Metals_Handout.pdf

Both TPH-d and TPH-mo are frequently detected in groundwater and often exceeded their respective ESLs (Table 15). Similar to soil, TPH-d and TPH-mo are considered the primary chemicals of concern for groundwater.

In contrast to soil, numerous VOCs including both chlorinated VOCs and diesel-related constituents (e.g., naphthalene; Table 16 includes naphthalene results analyzed by the SVOC method) were frequently detected in groundwater (Table 16). However, only naphthalene and vinyl chloride were detected at concentrations that exceed their respective ESLs. Therefore, these constituents are retained as chemicals of concern.

For SVOCs, anthracene, fluorene, methylnaphthalene, and phenanthrene were detected in one (location ECB-02) out of 4 grab groundwater samples collected by Shaw (Shaw, 2005). Each of these detections exceeded their respective ESL (Table 17). Most likely the presence of these compounds in the groundwater sample represents their presence as constituents of diesel in what appears to have been a product-rich water sample (TPH-d in this sample was 4,800 mg/l) and does not represent their occurrence as a dissolved phase in groundwater. Nevertheless, these compounds are retained as chemicals of concern.

6.1.3 Summary of Chemicals of Concern

Using the sorting process described above, the following chemicals were retained as COCs for soil and groundwater. As an indication of the relative importance of each COC, a summary of the number of samples exceeding the ESLs is also included.

- Soil
 - TPH-d: 37 samples (includes TPH results treated as TPH-d);
 - TPH-mo: 23 samples (includes O&G and TPH-ho results treated as TPH-mo); and
 - Naphthalene: 10 samples.

- Groundwater
 - TPH-d: 9 samples;
 - TPH-mo: 1 sample;
 - Naphthalene: 2 samples;
 - Vinyl chloride: 3 samples; and
 - Anthracene, fluorene, methylnaphthalene, and phenanthrene: 1 sample.

6.1.4 Cleanup Levels for Chemicals of Concern

As described in detail in Section 1.1, the ESLs were selected for use as cleanup levels for the Site. For the soil and groundwater COCs at the Site, the cleanup levels are as follows:

Soil:

<u>Parameter</u>	<u>Residential ESL</u>	<u>Residential ESL</u>	<u>Residential ESL</u>
	<u>Shallow Soil</u> <u>(0-3 ft. bgs)</u> <u>(mg/kg)</u>	<u>Shallow Soil</u> <u>(3-10 ft. bgs)</u> <u>(mg/kg)</u>	<u>Deep Soil</u> <u>(> 10 ft. bgs)</u> <u>(mg/kg)</u>
TPH-d	100	400	5000
TPH-mo	500	1000	5000
Naphthalene	0.46	0.46	0.46

Groundwater:

<u>Parameter</u>	<u>Nondrinking Water ESL</u> <u>(µg/l)</u>
TPH-d	2,500
TPH-mo	2,500
Naphthalene	210
Vinyl Chloride	3.8
Anthracene	22
Fluorene	950
Methylnapathalene	100
Phenanthrene	410

6.2 Areas Requiring Remediation

This section identifies the portions of the Site where soil or groundwater concentrations exceed the applicable cleanup levels and are therefore the target of remedial actions.

6.2.1 Areas and Volumes of Soil Exceeding Cleanup Levels

As described in Section 6.1.1, only TPH-d, TPH-mo, and naphthalene were detected above their respective cleanup levels in soil. Naphthalene exceeded its cleanup level at nine locations, all located in the areas of TPH contamination above the cleanup levels. Therefore, the areal extent and volume of soil requiring remediation is defined by the soil samples that exceed the ESLs for TPH (see Plates 8 through 10).

Unsaturated Soil. For unsaturated soils, the TPH data results presented on Plate 8 were used to delineate the area where it is likely that TPH concentrations exceed the cleanup levels; this area is shown on Plate 13. This area is approximately 42,800 square feet (sf) in size and, assuming an unsaturated zone thickness of 4 ft, the in-place volume of unsaturated soil that exceeds the cleanup levels in this area is approximately 6,300 cubic yards (cy).

Saturated Soil. For saturated soils, the TPH data presented on Plates 9 and 10 were used to delineate the area where it is likely that TPH concentrations exceed the cleanup levels. In

addition to this soil data, information presented in Plate 11 regarding the estimated extent of the separate-phase/sheen area was used to delineate the area where saturated soil likely exceeds the soil cleanup levels; this area is shown on Plate 14. This total area is approximately 51,100 sf in size. As shown on Plate 10, no samples collected below a depth of 10 ft exceeded the applicable cleanup levels, so it is assumed that the impacted saturated soil zone extends from 4 ft to 10 ft. Therefore, assuming a saturated thickness of 6 ft, the in-place volume of saturated soil that exceeds the cleanup levels in this area is approximately 11,400 cubic yards (cy).

6.2.2 Areas and Volumes of Groundwater Exceeding Cleanup Levels

As described in Section 6.1.2, the primary groundwater COCs that exceed their respective cleanup levels are TPH-d and TPH-mo, and to a limited extent vinyl chloride. Several other constituents including naphthalene, anthracene, fluorene, methylnaphthalene, and phenanthrene exceed their cleanup levels, but only in the areas of highest TPH contamination (e.g., boring ECB-02). Therefore, the areal extent and volume of groundwater requiring remediation is defined by the groundwater samples that exceed the cleanup levels for TPH (see Plate 11), with the exception of the area around boring EC9 where vinyl chloride was present at a concentration of 18 µg/l, exceeding its cleanup level of 3.8 µg/l.

As shown on Plate 14, a total area of approximately 94,400 sf has TPH and/or vinyl chloride concentrations exceeding the cleanup levels that includes: (1) the 51,100 sf area where saturated soil exceeds the soil cleanup levels; and (2) a 43,300 sf area where only the groundwater cleanup levels are exceeded. Assuming the same 6 ft thick saturated thickness as for the saturated soils, the total in-place volume of saturated soil in the area exceeding groundwater cleanup levels is 21,000 cy (11,400 cy in the area that also exceeds soil cleanup levels and 9,600 cy in the area where only groundwater cleanup levels are exceeded).

7.0 FEASIBILITY STUDY SCOPING

7.1 Scope of the Feasibility Study

This feasibility study is focused on developing remedial actions that address soil and groundwater affected by COCs identified at the Site, primarily petroleum hydrocarbons and VOCs. As defined in Section 6.2, the areas where soil and groundwater exceed applicable cleanup levels are shown in Plates 13 and 14. For soils, there is approximately 6,300 cubic yards (cy) of unsaturated soil and approximately 11,400 cy of saturated soil that exceed the applicable cleanup levels (primarily TPH-d and TPH-mo). Contaminants in groundwater not only exceed groundwater cleanup levels in the area where saturated soils exceed soil cleanup levels, but also exceed groundwater cleanup levels (primarily for TPH compounds) in an area approximately 43,300 sf in size adjacent to and north of the contaminated soil areas (see Plate 14). This area where only groundwater cleanup levels are exceeded encompasses another approximately 9,600 cy of saturated soil.

This feasibility study specifically addresses the Site, and the conclusions and recommended remedial action can be implemented independently of other remedial actions being considered elsewhere at the Napa Pipe Facility. It is important to recognize, however, that the remediation of the Site will potentially be conducted concurrent with the other areas of contamination (e.g., Site 4, Site 6) and that although some differences do exist between the various sites, the contaminant types are generally similar from site to site. This similarity in contaminant types leads to the possibility that certain remediation technologies will likely have applicability to more than one site and economies of scale may be recognized. See Volume I for a more detailed discussion of how the remediation activities of the different sites may be integrated.

7.2 Applicable or Relevant and Appropriate Requirements and “To Be Considered” Factors for Impacted Soil and Groundwater

In developing remedial action objectives, Applicable or Relevant and Appropriate Requirements (“ARARs”) must be considered. ARARs are described in 40 CFR Paragraph 300.430(e)(2)(i) and derived from the National Oil and Hazardous Substances Contingency Plan (“NCP”), set forth in 40 CFR Part 300. The selected remedial alternative must comply with the ARARs. It should also, to the extent practicable, reflect and account for other regulatory policy and criteria that while not necessarily legally applicable, are “to be considered” (TBC) during the development of remedial actions. ARARs and TBCs can be subdivided into three categories:

- **Chemical specific ARARs and TBCs** are health-based or risk-based standards that define the allowable limits of specific chemical constituents detected in or discharged to the environment. Cleanup and discharge levels that determine Site remedial goals can be provided by chemical specific ARARs. The RWQCB’s Environmental Screening Levels (ESLs) are examples of potential chemical specific TBCs.
- **Location-specific ARARs and TBCs** can apply to natural features located on a site, such as the presence of endangered species, seasonal wetlands, or flood plains and to man-made features and institutional factors, including zoning requirements, landfills, and locations of archaeological or historical significance. Location-specific ARARs restrict the types of remedial actions that can be implemented based on the site-specific characteristics or location.
- **Action-specific ARARs and TBCs** are activity-based or technology-based limitations that can set design and performance restrictions. These ARARs specify engineering controls and permit requirements that must be instituted during site activities, or restrict specific activities. The Federal Occupational Safety and Health Administration (OSHA) regulations regarding worker health and safety requirements, and California OSHA (Cal-OSHA) requirements for noise control and dust control during construction are examples of action specific ARARs.

7.2.1 Potential Chemical-Specific ARARs and TBCs

The primary potential chemical-specific ARARs for the Site are as follows:

- Federal Drinking Water Standards (40 CFR Part 141) and California Drinking Water Standards (22 CCR Section 64435) or MCLs;
- Porter-Cologne Water Quality Control Act, California Water Code, Division 7, Section 13000 et seq.; and
- National Pretreatment Standards (40 CFR Part 403);

The following are the identified potential chemical-specific TBCs for the property:

- RWQCB's Screening For Environmental Concerns at Sites With Contaminated Soil and Groundwater (4th edition, February 2005).

7.2.2 Potential Location-Specific ARARs and TBCs

The National Archeological and Historic Preservation Act (16 USC Section 469, 36 CFR Part 65) is the only location-specific ARAR identified for the Site. Although wetlands are located southwest and west of the Site, they are not located within or near the areas requiring remediation.

7.2.3 Potential Action-Specific ARARs and TBCs

Identified action-specific ARARs and TBCs for the property are presented below. The following are potential action-specific ARARs for the Site:

- Resource Conservation and Recovery Act (RCRA) regulations (40 CFR Parts 261 through 268; and California Code of Regulations [CCR] Sections 66261 through 66268);
- Land Disposal Unit Criteria (40 CFR Part 264.221, et seq., 22 CCR Section 66264.221, et seq.);
- Clean Water Act (40 CFR Parts 100-149), including National Pollutant Discharge Elimination System (NPDES) Permit Requirements;
- Safe Drinking Water and Toxics Enforcement Act of 1986 (Proposition 65), State of California;
- Hazardous Materials Transportation Regulations (49 CFR Part 107, 171-177);
- Clean Air Act (42 USC Section 7401, et seq.);

- Applicable Napa County Codes and Ordinances;
- Bay Area Air Quality Management District (BAAQMD) Rules and Regulations: Organic Compounds, Regulation 8; and Hazardous Pollutants, Regulation 11;
- Occupational Safety and Health Administration (29 CFR Part 1910.120 et seq.); and
- Cal-OSHA (Title 8).

The following are potential action-specific TBCs for the property:

- San Francisco Bay Basin Plan, Region 2, Water Quality Control Plan.

7.3 Additional Factors for Remedial Action Objective Development

In addition to the regulatory requirements summarized above in Section 7.2, there are several significant non-regulatory considerations that play a role in the future evaluation of remedial technologies and alternatives, and ultimately in the selection of a recommended remedial action plan for Site 2/3. These additional factors include:

- **Unrestricted Land Use.** Napa County is currently updating its General Plan. Use of substantial portions of the Site for residential purposes is within the range of plans currently being studied. Accordingly, to maximize the long-term protectiveness of remedial alternatives relative to the foreseeable land uses, remedial actions at the Site should, to the extent practicable, achieve cleanup levels without extensive use of institutional or engineering controls to control or limit exposure. In other words, cleanups should remediate soil and groundwater to below risk-based cleanup levels and leave the Site with no, or as few as possible, restrictions or long-term remedial actions (e.g., deed restrictions, monitoring, maintenance of engineering controls) as possible.
- **Need for Clean Imported Soil.** Remedial actions that result in soils being transported off-site will likely require the importing of the same volume of clean soil back onto the Site. In addition, the conceptual redevelopment plan for the Napa Pipe Facility includes raising the ground surface approximately 2 to 3 feet using imported soil. This presents an opportunity for soils excavated from one remedial site to be treated, as necessary, and placed as fill in other portions of the Facility in order to achieve final grade requirements.
- **Timeframe to Achieve Cleanup.** In light of the County's on-going planning process and currently anticipated redevelopment proposals, remedial actions should be completed, and the cleanup objectives for the Site met, in a relatively short timeframe.
- **Available Area for Remedial Actions.** The Napa Pipe Facility is quite large (approximately 150 acres), the majority of which is not known to be contaminated and is available for use in the various remedial actions, including the remediation of the

Site. This available land can be used for soil stockpiling, used to locate treatment systems (e.g., thermal treatment systems for soil) or processing areas (e.g., open areas for use as “landfarms”), or as a final location for placement of treated soils. Portions of the Facility, especially the southern portion, are to be zoned commercial within the Napa County Airport flyover zone. Therefore, cleanup standards in those commercially-zoned areas are proposed to be consistent with those uses.

These additional factors will influence the remedial strategies to be considered. For example, use of containment technologies such as capping, slurry walls, or hydraulic control (groundwater extraction) will not meet cleanup levels for groundwater or soil in a timely fashion and thereby would require extensive institutional and engineering controls.

7.4 Remedial Action Objectives

Remedial Action Objectives (RAOs) are goals specific to a facility, area, or to an affected medium (e.g., soil or groundwater) that are developed for protection of the environment and human health. RAOs for affected soil and groundwater are intended to guide remedial actions that mitigate the identified potential threats to human health and the environment. These objectives should be developed in a manner consistent with reasonably foreseeable future Site uses (i.e., residential and commercial uses). RAOs can address both chemical concentrations and potential exposure pathways. The RAOs for soil and groundwater, described in Sections 7.4.1 and 7.4.2, respectively, were developed based on the conceptual model described in Section 4.3, the cleanup levels defined for the site in Section 6.1.4, the ARARs listed in Section 7.2, and the additional factors described above in Section 7.3.

7.4.1 RAOs for Soil

The following RAOs have been developed for soil:

- Reduce concentrations of COCs in soil to below the lowest applicable cleanup level listed in Section 6.1.4 to the maximum extent practicable; and
- Minimize the use of and reliance on institutional and/or engineering controls to the extent practicable.

7.4.2 RAOs for Groundwater

The following RAOs have been developed for groundwater:

- Reduce concentrations of COCs in groundwater to below the lowest applicable cleanup levels listed in Section 6.1.4 to the maximum extent practicable; and
- Minimize the use of and reliance on institutional and/or engineering controls to the extent practicable.

7.5 General Response Actions

General response actions (GRAs) are broad categories of remedial actions that may be used alone or in combination with other GRAs to achieve the RAOs for the site. The GRAs that are potentially applicable to the remediation of the Site include:

- **No Action:** A “no action” alternative is required to be evaluated as a baseline alternative against which other remedial alternatives are compared. No other remedial action would be conducted;
- **Institutional Controls:** Institutional controls, such as deed restrictions on land or resource restrictions (e.g., water use restrictions), can be used to supplement engineering controls or in conjunction with active remedial alternatives to reduce or limit exposure to hazardous substances. As discussed in Section 10, even though institutional controls are in general not as protective of human health and the environment as active remediation, they will be retained as a GRA;
- **Engineering Controls:** Engineering controls are physical measures that prevent or minimize exposure to hazardous substances or reduce the mobility or migration of hazardous substances and can be combined with institutional controls, as required, to achieve protection of human health and the environment. Although engineering controls typically require long-term maintenance and, as mentioned above for institutional controls, tend to be somewhat less protective than active remediation, they will be retained as a GRA; and
- **Active Remediation:** These remedial actions include a broad range of technologies designed to remove or destroy contaminants in specific media. Active remedial actions typically are more protective of human health and the environment compared to the no action alternative as well as institutional and engineering controls. Active remedial actions are generally preferred because they: (1) provide the best long-term protection of human health and the environment, (2) result in the reduction of the mobility, toxicity, and volume of contaminants, and (3) restore the property to its highest productive use. In this feasibility study, active remedial actions are evaluated for soil and groundwater and each of these categories is further subdivided into: (1) *in situ* remediation options; and (2) *ex situ* remediation options. Active remediation for soil utilizing on-site treatment and off-site disposal are also evaluated.

8.0 IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES

Remedial technologies are actions that can be implemented at the site to address one or more of the RAOs. There may be more than one technology and associated processes that could be appropriate for any portion of a remedial site. Once identified, the potentially applicable technologies are screened based on specific criteria to determine if they should be retained for use in development of remedial alternatives. This section describes the process and the results

of identifying and screening remedial technologies potentially applicable to achieving the RAO requirements at the Site.

8.1 Preliminary Technology Identification and Screening

8.1.1 Technology Identification

Potentially applicable conventional and innovative remedial technologies and cleanup processes were identified and evaluated to address the RAOs. A preliminary list of potential applicable technologies were identified based on the physical and chemical nature of the Site contaminants (primarily TPH-d, TPH-mo, VOCs), the impacted media (soil and groundwater), the Site conditions (shallow groundwater table, extent of contamination, subsurface lithology), and the RAOs. Tables 18a and 18b list the potentially applicable remediation technologies and processes for soil and groundwater, respectively, that were evaluated to identify those that would be retained for development of the remedial alternatives.

In addition to chemical-specific technology limitations, implementing a remedy at the Site is limited by several constraints including:

- **Buildings and Structures.** Buildings or structures currently occupy a significant portion of the Site. For purposes of this FS, it is assumed that existing structures, including building foundations, will be removed prior to initiating remedial actions;
- **Subsurface Utilities.** Subsurface utilities, including water, gas, electric, and product lines, are likely located throughout the affected area. Because of the age of the Facility, the location and depth of some subsurface piping and utilities is not known with certainty. For purposes of this FS, it is assumed that subsurface utilities will be removed or deemed insignificant for remedial implementation purposes, prior to initiating remedial actions; and
- **Existing Monitoring Well Extraction System Abandonment** – Existing monitoring wells and the extraction system that are within, or adjacent to, areas where remedial activities could damage the wells, or monitoring wells that will no longer be needed, will be abandoned as part of demolition and site preparation activities prior to initiating remedial actions.

8.1.2 Technology Screening

Screening of the potentially applicable technologies used the following criteria to determine whether a potential remediation technology and process was appropriate for achieving the site RAOs:

- **Effectiveness** – the ability to treat the Site contaminants and meet the RAOs;

- **Implementability** – constraints or difficulties in implementing the technology and verifying effectiveness; and
- **Cost** – estimated costs for construction, operation, and maintenance of the technology to meet the RAOs. Cost is used primarily to differentiate between technologies or process options that had similar effectiveness and implementability but significantly different costs.

Based on the screening criteria, technologies were either retained for use in development of remedial alternatives or eliminated from consideration. The screening process for soil and groundwater technologies is summarized in Tables 18a and 18b, respectively, including the rationale for retaining or eliminating particular technologies. The technologies retained for use in development of remedial alternatives are described in more detail in the sections below.

8.2 Soil Treatment Technologies

The affected soil area and volume at the Site are specified in Section 6.2.1 and shown in Plates 13 and 14. As noted in Section 6.1.1, the primary COC in the soil at the Site is TPH-d, which is present in concentrations that exceed cleanup levels in the unsaturated and saturated zones. Potentially applicable technologies include those that are capable of effectively destroying or removing the contaminants in either zone. The soil remediation technologies can destroy the contaminants *in situ* within the subsurface or *ex situ* following excavation. Reducing contaminant concentrations in the soil will also reduce the potential for migration of contaminants to groundwater, thereby increasing the efficiency of subsequent groundwater cleanup.

Fourteen preliminary soil treatment technologies were identified and screened against the criteria defined above. These include conventional as well as alternative and innovative technologies. The results of the screening process are shown in Table 18a. Of the 14 technologies that were identified, six were retained for further evaluation after initial screening and are described in more detail below.

8.2.1 Excavation

Contaminated soils can be excavated using standard construction techniques and equipment, such as excavators, bulldozers, and scrapers. Excavated soils can then be managed using other remediation technologies depending on contaminant type and concentration, cleanup levels, and regulatory requirements. Limiting factors related to excavation include:

- Excavation of impacted soils may expose potentially volatile contaminants to the atmosphere and may require respiratory protection for workers or other nearby receptors as well as special excavation techniques to limit emissions;
- Excavation of saturated soils may require dewatering with subsequent management of the impacted groundwater generated by the dewatering activities;

- Shoring or other slope stabilization techniques (e.g. lay backs) will likely be required for excavations greater than 4 ft depth, and especially for excavations below the groundwater table; and
- Backfilling of excavations in the saturated zone may require importing engineered fill.

Because excavation is an implementable technology that would effectively remove the contaminated soil from the subsurface thereby eliminating the potential for future exposures and eliminating the potential for the soil to act as a source of groundwater contamination, and because it is a required first step when using *ex situ* treatment and soil management approaches, excavation will be retained for further evaluation.

8.2.2 *Ex Situ* Low Temperature Thermal Desorption

Low Temperature Thermal Desorption (LTTD) is an *ex situ* remedial technology that uses heat to increase the volatility of the contaminants and physically separate them from the soil. The impacted soil is excavated and placed in a thermal desorption unit where it is heated. The system is designed to separate contaminants from the soil rather than destroy them. A vacuum system is used to convey the volatilized products to a vapor treatment system where the contaminants are treated prior to atmospheric discharge. There are two common thermal desorption types: the rotary dryer and thermal screw.

Rotary dryers are horizontal cylinders that can be indirect or direct fired. Most rotary systems use an inclined rotating metallic cylinder where the soil is heated. For the thermal screw systems, hollow augers transport the soil through a jacketed trough and the soil is indirectly heated. All thermal desorption systems require treatment of the volatilized vapors to remove particulates and contaminants. Particulates are removed by wet scrubbers or fabric filters, and contaminants are removed by carbon adsorption or destroyed in a secondary combustion chamber or catalytic oxidizer.

The maximum temperature is limited by the material properties of the heated components. For LTTD, the soil is heated to between 200 and 600°F. Target contaminants are nonhalogenated VOCs and fuels with destruction efficiencies in the vapor phase treatment system of greater than 95 percent. The treated soil retains its physical properties, and unless heated to the higher end of the temperature range, natural organic components are not damaged. Limiting factors include:

- Large particles and debris – adversely impacts material handling, pre-feed requirements, and destruction efficiencies;
- Moisture – adversely impacts material handling, residence time, heating requirements, and destruction efficiencies. At moisture concentrations greater than 20 percent, drying the soil prior to the LTTD is highly recommended;

- Highly abrasive feed (e.g., large gravel and rocks) - adversely impacts desorber operation (may result in damage);
- High contaminant concentrations – adversely impacts desorber operation (may result in overheating and damage), handling requirements (may require blending), and disposal options;
- Heavy metals - adversely impacts treated soil (potentially requiring stabilization) and disposal options; and
- Clay and silty soils - adversely impacts reaction time as a result of contaminant binding or soil sticking to the cylinder.

Because the primary contaminants in soil (TPH-d, TPH-mo) are effectively treated using this technology, and the soil type and overall contaminant concentrations are suitable, and because it is implementable, *ex situ* LTTD was retained for further evaluation.

8.2.3 Biopiling

Biopiles are an *ex situ* remediation technology that involves stockpiling excavated soils into aboveground cells with interlayered process piping and systems to introduce fresh air, nutrients, and moisture as needed to stimulate aerobic biodegradation of the target contaminants. Biopiles are specifically constructed to optimize conditions for aerobic activity. The soils can be blended as needed to increase air permeability, homogeneity, and microbial population and ensure sufficient oxygen, moisture, and nutrients can be supplied throughout the pile. Measures are required to prevent contaminated vapors from being released into the atmosphere or liquids from draining into previously clean soil and groundwater. Additionally, regular monitoring is necessary to ensure optimization of biodegradation rates, track contaminant concentration reductions, and ensure ambient air and groundwater quality are not impacted. Limiting factors include:

- Soils with high percentage of fines and a high degree of saturation – adversely impacts air flowrates;
- Separate phase product – adversely impacts contaminant biodegradation rates (may be toxic to the microorganisms);
- Low contaminant concentrations – adversely impacts contaminant biodegradation rates due to less substrate for the microorganisms;
- High molecular weight compounds – adversely impacts contaminant biodegradation rates;
- Colder, wet climates – adversely impacts contaminant biodegradation rates (may require climate control measures); and

- High contaminant volatility – impacts system operation (may require treatment technology).

Because the primary contaminants in soil (TPH-d, TPH-mo) may be effectively treated using this technology, the treatment costs may be less when compared to *ex situ* LTTD, and it can be implemented in the available space, biopiling was retained for further evaluation.

8.2.4 Landfarming

The technology is the same as described for biopiles except the excavated soils are spread in a thin layer on the ground. Soil aeration is generally accomplished by tilling or plowing rather than by engineered measures such as process piping and air introduction systems. Because of the larger area of the land farm as compared to the biopiles, additional measures may be necessary to prevent soil and wind erosion and control surface water runoff and dust generation.

Because the primary contaminants in soil (TPH-d, TPH-mo) may be effectively treated using this technology, the treatment costs may be less when compared to *ex situ* LTTD or biopiling, and there may be sufficient available space to implement this technology, landfarming was retained for further evaluation.

8.2.5 *In Situ* Chemical Oxidation

This is an *in situ* remedial technology where chemical oxidants are injected into the subsurface to chemically convert contaminants into non-hazardous or less toxic compounds that are more stable, less mobile, and/or inert. For *in situ* soil treatment, this technology is almost exclusively applied to saturated soil; unsaturated soils (i.e., vadose zone) are very difficult to treat *in situ* using this technology due to problems associated with chemical delivery, distribution and contact in the soil.

The chemical oxidants most commonly used include hydrogen peroxide, persulfate, ozone, and permanganate. These oxidants have been able to cause rapid and complete chemical destruction of toxic organic compounds, and other organics have become amenable to subsequent bioremediation. The technology can achieve destruction efficiencies greater than 90% for unsaturated aliphatic compounds (e.g., TCE), aromatic compounds (e.g., benzene), and fuel-related organics with fast reaction rates. Matching the oxidant and delivery method to the contaminants and site conditions is critical to successful implementation and achieving performance goals. Limiting factors include:

- Soils with high percentage of fines – can adversely impact distribution of chemical oxidants within the target treatment zone;
- Soils with highly stratified lithology – adversely impacts the uniform delivery of chemical oxidants;

- The quantities of chemical oxidants required to ensure that target contaminants are oxidized can be large which may adversely impact handling and safety requirements;
- Indiscriminant and rapid reactions with other oxidant-consuming substances (natural organic matter, reduced minerals, carbonate, and other free radical scavengers) increase oxidant demand and can adversely impact contaminant destruction; and
- Inadvertent oxidation induced effects – adversely impacts soil properties (may decrease pH, generate colloids that result in reduced permeability, mobilize sorbed metals, form toxic byproducts, and increase temperatures and contaminated vapors).

Because the primary contaminants for the Site 2/3 (TPH-d and TPH-mo) are amenable to treatment using this technology, chemical oxidation was retained for further evaluation. Site soils are not ideal for *in situ* technologies such as chemical oxidation, but the relatively shallow distribution of contaminants and thin treatment zone may make implementation of oxidants feasible.

8.2.6 Off-Site Disposal

Impacted soil can be excavated and then disposed of at a permitted off-site landfill. The specific landfill that soil may be taken to will depend in part on the characterization of the soil with respect to state and federal hazardous waste regulations. Given the relatively high cost of off-site disposal, and the additional cost associated with replacing all soils taken off-site with imported fill, it is not anticipated that off-site disposal will be used as the primary approach for managing excavated soil. There may be situations, however, when unusual soil conditions and/or the presence of other contaminant types not currently identified (e.g., metals) are encountered. In these situations, other on-site treatment technologies may not be suitable and off-site disposal may be required. Therefore, off-site disposal was retained for further evaluation.

8.3 Groundwater Treatment Technologies

The affected groundwater area at the Site and volume of saturated soil associated with this affected groundwater are specified in Section 6.2.2 and shown on Plate 14. As noted in Section 6.1.2, the primary COCs in the groundwater at the Site are TPH-d and TPH-mo. Although vinyl chloride exceeds its cleanup level at a few locations, only the sample from boring EC-9 exceeds the cleanup level in an area with no other cleanup level exceedances. There are also a few other COCs (i.e., naphthalene, anthracene, fluorene, methylnaphthalene, and phenanthrene) that exceed their respective cleanup levels in groundwater, they do so in only a few locations that are co-located with much higher concentrations of TPH. Other VOCs and several SVOCs are also present in groundwater in the Site at concentrations below their ESLs, but at much lower concentrations than the primary COCs and are co-located with the primary COCs that are present at much higher concentrations.

Identified potentially applicable technologies include those that are capable of effectively destroying or removing the contaminants. The groundwater remediation technologies can destroy the contaminants *in situ* within the subsurface or *ex situ* following extraction or excavation of the saturated soil.

Ten preliminary groundwater treatment technologies were identified and screened against the criteria defined above. These included conventional as well as alternative and innovative technologies. The results of the screening process are shown in Table 18b. Of the ten technologies that were identified, two *ex situ* technology and two *in situ* technologies were retained for further evaluation after initial screening and are described in more detail below.

8.3.1 *In Situ* Enhanced Bioremediation

This *in situ* technology refers to the addition of oxygen, nutrients, co-substrates, and/or other amendments to the groundwater to increase whatever natural aerobic and/or anaerobic biodegradation rates that may be ongoing. The existing microorganisms are used to metabolize the organic contaminants in the groundwater. Limiting factors include:

- Soils with high percentage of fines – can adversely impact distribution of oxygen, nutrient, co-substrates, and other amendments within the target zone;
- Excessive localized microorganism growth – adversely impacts system operation (may result in clogging nutrient and water injection wells);
- Soils with highly stratified lithology – adversely impacts delivery of oxygen, nutrients, co-substrates, and other amendments to the microorganisms;
- High contaminant concentrations/separate-phase product – adversely impacts contaminant biodegradation rates (may be toxic to the microorganisms);
- Very low contaminant concentrations – adversely impacts contaminant biodegradation rates due to less substrate for the microorganisms; and
- High molecular weight compounds – adversely impacts contaminant biodegradation rates.

The primary COCs in groundwater at the Site (TPH-d and TPH-mo) would be effectively treated using enhanced biodegradation and the technology can be readily implemented at the Site. Saturated Site soils are not ideal for *in situ* technologies such as enhanced bioremediation, but relatively shallow distribution of contaminants makes effective application of amendments more feasible.

8.3.2 *In Situ* Chemical Oxidation

This *in situ* technology uses oxidizing agents to oxidize and destroy organic contaminants. This is a direct chemical reaction involving the application or injection of oxidants into the target zone to destroy or chemically transform the contaminants. Efficient oxidation depends on the reaction potential and the effective contact between oxidant and contaminant. Subsurface heterogeneities, preferential flow paths, and poor mixing in the subsurface may result in inefficient treatment. Additionally, oxidation is non-specific, and the oxidant will be consumed not only by the contaminant, but also by natural demands within the target zone. These include other organic material and reduced-state metals.

There are a number of oxidants that are potentially usable, including ozone, persulfate, hydrogen peroxide, and permanganate. Of these, ozone, persulfate, peroxide, and permanganate are the most widely used and are generally commercially available. Some oxidants (e.g., ozone and peroxide) are very strong and effective, but also rapidly decompose which can limit the ability to distribute them in the subsurface. Permanganate and persulfate are also strong oxidants and do not decompose as readily as peroxide and ozone and therefore can be easier to distribute in the subsurface. Matching the oxidant and delivery method to the contaminants and site conditions is critical to successful implementation and achieving performance goals. Limiting factors include:

- Saturated soils with high percentage of fines can adversely impact distribution of chemical oxidants within the target treatment zone;
- Saturated soils with highly stratified lithology may present preferential flow pathways that can adversely impact the uniform delivery of chemical oxidants;
- The quantities of chemical oxidants required to ensure target contaminants are oxidized can be large which may adversely impacts handling and safety requirements;
- Indiscriminant and rapid reactions with other oxidant-consuming substances (natural organic matter, reduced minerals, carbonate, and other free radical scavengers) increase oxidant demand and can adversely impact contaminant destruction; and
- Inadvertent oxidation induced effects – adversely impacts soil properties (may decrease pH, generate colloids that result in reduced permeability, mobilize sorbed metals, form toxic byproducts, and increase temperatures and contaminated vapors).

Because chemical oxidation would effectively treat the primary contaminants for the Site (TPH-d and TPH-mo), it was retained for further evaluation. Site conditions are not ideal for *in situ* technologies such as chemical oxidation, but the relatively shallow distribution of contaminants and thin treatment zone may make implementation of oxidants feasible.

8.3.3 Saturated Soil Excavation

This is an *ex situ* technology that involves physically removing the contaminated groundwater by excavating the saturated soil within the groundwater plume boundaries. Excavation for removal of contaminated soils (i.e., with COCs exceeding soil cleanup levels) is discussed in Section 8.2.1. Excavated saturated soil would be managed on-site through drying, treatment, or other appropriate methods and used as fill. Provisions are necessary to remove and control groundwater within the excavation boundaries. The excavation boundaries will overlap into clean areas to ensure the entire volume of the groundwater plume is removed. Limiting factors include:

- Excavation of saturated soil becomes increasingly more difficult and expensive the deeper contamination extends below the water table;
- High permeability saturated soils may result in excessive amounts of groundwater being generated by dewatering of the excavation, significantly increasing difficulty and cost; and
- Large excavations may require phased implementation.

Because contamination is relatively shallow at the Site and the soils are generally low permeability, excavation of saturated soils is an effective and implementable approach and will quickly remove the groundwater plume.

8.3.4 Existing Wastewater Treatment System

Excavation would require management of contaminated groundwater generated during dewatering activities. The Facility has an existing wastewater treatment system that discharges into the sanitary sewer under a permit with the Napa County Sanitation District. This system includes storage tanks, chemical injection systems (flocculant injection), settling tanks, an oil/water separator, and is maintained and periodically sampled to meet discharge requirements. Groundwater generated during dewatering can be treated using this existing wastewater treatment system and discharged to the sanitary sewer under the existing permit. If additional treatment is required to remove dissolved organic constituents (TPH, VOCs) to below permit limits, a series of granular activated carbon vessels can be added as a polishing step prior to discharge.

8.4 Summary of Retained Remedial Technologies

The technologies retained for use in alternative development include:

- **Soil Technologies**
 - Excavation
 - *Ex Situ* Low Temperature Thermal Desorption
 - Bio-Piling

- Landfarming
- Off-Site Disposal
- *In Situ* Chemical Oxidation

- **Groundwater Technologies**
 - *In Situ* Enhanced Bioremediation
 - *In Situ* Chemical Oxidation
 - Saturated Soil Excavation
 - Existing Wastewater Treatment System

These technologies include *in situ* and *ex situ* technologies for both soil and groundwater. All of the retained technologies are likely to be effective at treating the Site contaminants, are implementable, have costs that are not disproportionate to other retained technologies, and will likely meet the RAOs, but optimizing the manner in which these technologies may be utilized most effectively (and therefore most cost-effectively) will likely require limited treatability studies during the design process. Based on the results of these treatability studies and the variability in contaminant concentrations present at the Site, it is likely that one technology may be most effective at treating soil and/or groundwater with lower contaminant concentrations whereas another technology may be most effective for higher concentrations.

9.0 DEVELOPMENT OF REMEDIAL ALTERNATIVES

Remedial alternatives are combinations of technologies designed to meet the RAOs. The technologies retained from the screening process were assembled into the three remedial alternatives described below that could treat the contaminants in soil and groundwater and protect public health. Each remedial alternative is described in the following sections with respect to conceptual design, implementation, effectiveness and performance, estimated cleanup time, and estimated cost. The conceptual design is developed in sufficient detail to conduct the detailed comparative evaluation of the alternatives (Section 10).

The duration of remedy alternatives was estimated using engineering judgment and general knowledge of the remediation technologies. Depending on the nature of the alternative, the duration of the cleanup can be difficult to predict because numerous site conditions and processes impact the effectiveness of the remediation technologies that make up an alternative. Therefore, the alternatives were compared on the basis of the estimated relative effectiveness of the technologies and the likelihood that cleanup could be achieved in a timeframe consistent with the reasonably foreseeable future land use.

The costs of the remedial alternatives discussed below were developed by accounting for capital costs as well as recurring and future costs. Capital costs include workplans, design reports, other agency-required documents, and construction to implement the remedy. Recurring and future costs include groundwater monitoring, operation and maintenance, and reporting.

A contingency of 30 percent was added to each alternative to reflect a level of uncertainty in the estimated costs. The contingency on capital cost reflects uncertainty in construction costs. The contingency on recurring and future costs generally reflects uncertainty of the operation and maintenance costs and the duration of the remedy. These cost estimates should be considered accurate in the range of minus 30 percent to plus 50 percent of the estimated cost consistent with regulatory guidance for preparation of feasibility studies. The cost estimates are rounded to the nearest \$10,000.

9.1 Approach to Developing Remedial Alternatives

The approach to developing remedial alternatives for the Site is based both on the requirements of the RAOs and on the technologies retained based on the screening conducted in Section 8. The RAOs require that the remediation achieve cleanup levels minimizing the use of institutional or engineering controls after remediation is completed. These requirements are consistent with the general policies of state and federal cleanup regulations and guidance that favor remedial strategies that clean up and restore contaminated sites and that accommodate the range of reasonably foreseeable land uses. Since the anticipated future use of the Site includes residential development, remedial approaches relying on containment or risk-management approaches were not preferred.

The NCP requires that “no action” alternative be evaluated, and one is included in the development and evaluation of alternatives below. Typically, where existing remedial measures have occurred or are ongoing, an alternative is included in the feasibility study that, to varying degrees, maintains the existing remedial actions. At the Site, the existing RWQCB orders (Order No. 90-147 and Order No. R2-2205-0012) require, among other things, the ongoing operation of the groundwater extraction trench located on the east side of the ECB (see Section 2.5 for details) and groundwater monitoring to document groundwater contaminant levels. While these existing engineering and institutional controls would not, either by themselves or in conjunction with other similar measures, meet the RAOs for the Site, a remedial alternative based on the existing measures is included for evaluation in the FS.

9.1.1 General Remediation Approaches

Rather than developing separate remedial alternatives to evaluate each of the technologies individually, both the *in situ* and *ex situ* technologies will be retained and evaluated together as separate “tool boxes” for soil and groundwater remediation. The specific “tools” to be used in an alternative are defined in the alternative descriptions below. If an alternative is selected for implementation, the manner in which the tool box technologies would be applied may be optimized during design and in conjunction with the other remedial actions being conducted at other sites within the Napa Pipe Facility.

With respect to developing remedial alternatives that meet the RAOs, this tool box approach leads to the following two general remedial alternatives that will be evaluated:

- An *in situ* approach for groundwater and some soils, excluding the primary source area. Unsaturated soil exceeding the ESLs and highly contaminated soils within the primary source area will be addressed using *ex situ* technologies; and
- An all *ex situ* approach that involves excavation of all soil and groundwater (i.e., saturated soil) exceeding cleanup levels and managing the excavated soils using one of more of the *ex situ* treatment technologies, as needed.

An *in situ* approach for all saturated soil and groundwater, including the primary source area, is not deemed feasible due to the uncertainties about effectively treating the source area soil where separate-phase product may be present and the associated very high costs in attempting this type of treatment.

Additional development of the tool box approach for *in situ* and *ex situ* remediation is provided below, followed by a detailed description of the remedial alternatives to be evaluated in the FS.

9.1.2 In Situ Tool Box

The retained technologies for *in situ* remediation of soil and groundwater consists of enhanced bioremediation and chemical oxidation. These technologies can be implemented separately or, depending on the chemistry utilized, together in a complimentary way.

For purposes of this FS, the *in situ* approach would consist of injecting a combination of sodium persulfate and calcium peroxide. Sodium persulfate is a stable, highly soluble, crystalline material, which upon activation generates the sulfate radical, a very strong oxidant, capable of oxidizing a broad range of compounds including fuel hydrocarbons. The calcium peroxide has a dual activating effect on the persulfate by the release of peroxide and by creating alkaline conditions. The degradation of the calcium peroxide would also provide a longer term source of oxygen which would enhance the biodegradation of contaminants. Finally, the sulfates generated by the reaction of persulfate can be also utilized by sulfate bacteria. These sulfate bacteria can assist in the bioremediation of the contaminants when the aquifer is converted from an aerobic system to an anaerobic system following consumption of oxygen by bacteria that aerobically degrade the petroleum hydrocarbons.

This dual chemical blend would be introduced to the subsurface through a series of injections. Geoprobe technology would be used to advance injection rods to the maximum depth of the vertical contaminant treatment zone (e.g., 10 ft. bgs). The chemicals will be injected through the bottom of the rods into the surrounding formation as the rods are retracted upwards through the entire length of the vertical contamination zone. The rate and total volume of treatment chemistry injected into the formation would be monitored to ensure an even distribution of treatment chemistry throughout the entire length of the vertical contamination zone. Once injected, the chemicals will disperse into the saturated zone through advective transport and dispersion.

As noted above, this *in situ* approach is best suited to saturated soil and groundwater outside of the primary source area and is not readily applicable to the primary source area or unsaturated soil. The source area and unsaturated soils will be addressed by *ex situ* technologies in all remedial alternatives developed below.

9.1.3 *Ex Situ* Tool Box and Soil Management Protocol

The first step in any *ex situ* remediation approach is removing the affected media from the subsurface so it can be managed using other technologies. For both soil and groundwater, excavation would be the approach used, with groundwater being “excavated” by removing the saturated soil (including the groundwater) as well as by the incidental dewatering that might be required as part of excavating below the water table.

Once removed from the subsurface, the soil would be segregated and managed using the tool box of *ex situ* treatment technologies consistent with a soil management protocol that will be developed during remedial design and documented in a Remedial Design and Implementation Plan (RDIP). The RDIP will be a document that presents a detailed protocol for managing all soil excavated not only at the Site, but for all remedial actions at the Napa Pipe Facility. With respect to the soils from the Site, the soil management protocol would utilize the *ex situ* treatment technologies retained in Section 8.0. Based on analytical testing results, soil would be segregated into the general categories listed below and managed by category as follows:

- 1) **Clean Overburden** – Unsaturated soil with contaminant concentrations below the cleanup levels that has to be excavated to access contaminated saturated soils or groundwater below. This soil would be stockpiled near the excavation and then reused as backfill (assuming it is suitable from a geotechnical perspective) after remedial activities are completed.
- 2) **Soil Exceeding Residential ESLs but Below Commercial Cleanup Levels** – Unsaturated or saturated soil that has concentrations of COCs in excess of the residential cleanup levels but below the commercial cleanup levels would be transported to commercially-zoned areas (e.g., the areas south of the ECB), dried as necessary, and used as fill in these areas without further treatment.
- 3) **Soil Exceeding both Residential and Commercial Cleanup Levels** – Unsaturated or saturated soil that has concentrations of COCs in excess of both residential and commercial cleanup levels would be transported to a central stockpile area for contaminated soil and treated using one or more of the treatment technologies in the “tool box”. Soil falling in this general category would likely be further segregated (e.g., unsaturated vs. saturated, total TPH concentrations greater than 30,000 mg/kg) to facilitate effective treatment. Once treated to below cleanup levels, the soil would be used as fill at the Facility.
- 4) **Saturated Soil from Groundwater Plume Areas** – Saturated soils located in areas where concentrations of COCs in groundwater exceed groundwater cleanup levels, but

COC concentrations in soil are below soil cleanup levels, would be transported to a stockpile area, dried as necessary, and used as fill at the Facility (residential or commercially-zoned areas) without further treatment.

Three of the four categories (1, 2, and 4) defined above would not require that the excavated soil be treated prior to use as fill at the Facility. For the third category, some treatment of the soil would be required before the soil can be used as fill. One or more of the following retained *ex situ* treatment technologies would be used:

- Biopiling;
- Landfarming; and
- *Ex Situ* Low Temperature Thermal Desorption.

All of these technologies are able to effectively treat the Site contaminants and the manner in which they would be utilized are defined in the alternative descriptions below. During development of the soil management protocol and the RDIP, the implementation approach will be optimized based on a variety of factors including contaminant concentrations of specific soil, the type and quantity of soil being remediated elsewhere at the Facility, the results of treatability studies, and refined cost estimates based on a detailed design.

Finally, off-site disposal is also retained for use as part of the soil management protocol for those situations when unusual soil conditions and/or the presence of other contaminant types not currently identified (e.g., metals) are encountered. In these situations, other on-site treatment technologies may not be suitable and off-site disposal may be required.

9.2 Alternative 1 – No Action

9.2.1 Alternative Description

The “no action” alternative is required by the NCP. In this alternative, no cleanup of soil or groundwater would be conducted and no additional groundwater monitoring would be conducted (the existing groundwater monitoring wells are assumed to be decommissioned during demolition activities).

9.2.2 Cost

There is little or no cost associated with implementing the no action alternative.

9.3 Alternative 2 – Maintain Existing Remedial Actions

9.3.1 Alternative Description

In this alternative, the status quo is maintained via continued groundwater monitoring and operation of the existing extraction systems as specified in the existing RWQCB orders, and the existing remedial plan (MW, 1994). For cost estimating purposes, the extraction system is assumed to be operated for another 20 years. The groundwater monitoring program is also assumed to continue for 20 years.

9.3.3 Cost

The annual costs for implementing Alternative 2 (i.e., continued groundwater monitoring and extraction system operation) is estimated to be \$110,000. The net present value of the O&M costs for this alternative over the durations defined above, and assuming a discount rate¹³ of 5%, is \$1.37 million.

9.4 Alternative 3 – *Ex Situ* Source Area Soil and Groundwater Treatment and *In situ* Groundwater Plume Remediation

9.4.1 Alternative 3 Description

Alternative 3 consists of two major components: (1) excavation and *ex situ* treatment of source area saturated and unsaturated soils and groundwater and (2) *in situ* treatment of groundwater exceeding cleanup levels but outside of the source area. The excavation of the source area would be conducted first in order to both remove the source contaminants and also to induce hydraulic gradients from the surrounding plume areas toward the excavation through dewatering activities. The dewatering would not only remove some of the contaminated groundwater for treatment, but the increased hydraulic gradients may assist in the distribution of the chemical oxidants to be used in the *in situ* treatment phase of the remediation.

Excavation and *Ex Situ* Treatment of Source Area Soil and Groundwater. For purposes of this FS, the source area of the Site is defined as including: (1) unsaturated soils exceeding the cleanup levels (see Plate 13) and (2) the saturated soil and groundwater located in the area where saturated soils exceed the soil cleanup levels (Plate 14). As described in Section 6.2, these two areas include 6,300 cy and 11,400 cy of soil, respectively, for a total excavation volume of approximately 17,700 cy.

The approach for managing the excavated soil is described above in Section 9.1.3, with the soil being segregated into categories based on contaminant levels and managed consistent with a soil management protocol. Where treatment is required to achieve cleanup levels, technologies in the “tool box” would be utilized as defined below. The initial excavation would be the

¹³ Discount rate equals interest rate minus inflation rate.

unsaturated soils exceeding cleanup levels and the clean overburden required to be removed to access the underlying saturated zone soils. The clean overburden would be stockpiled nearby for later use as backfill, and the soil exceeding the cleanup levels would be segregated by contaminant level and taken to the appropriate stockpile and/or treatment area for processing as defined below.

Next, the source area saturated zone would be excavated. Excavating the saturated zone would involve some form of dewatering. Groundwater generated during excavation dewatering, which will contain elevated contaminant levels, would be collected and transported to the existing wastewater treatment system for pretreatment prior to discharging to the sanitary sewer under the Facility's existing permit. It is assumed that granular activated carbon (GAC) adsorption vessels would be added to the existing treatment system to reduce the dissolved organic level prior to discharge. As with the unsaturated soils, the excavated saturated soils would be segregated by contaminant level and taken to the appropriate stockpile and/or treatment area for processing. If these saturated soils require the additional step of drying before they can be further treated, they would be spread and dried in a separate area designed such that water draining from the soil can be collected and treated on site.

The technologies retained in the "tool box" for managing soil *ex situ* include biopiling, landfarming, low temperature thermal desorption, and off-site disposal. Based on the available information and for purposes of developing a cost estimate for this FS, it is assumed that excavated soils would be managed as follows:

- Approximately 1,800 cy (10 percent) would have contaminant levels below commercial cleanup levels and can be used directly as fill in the commercially-zoned areas (after drying if necessary);
- Approximately 8,800 cy of the soil (50 percent), generally those with low to moderate contaminant levels, would be treated directly using biopiling techniques to at least commercial cleanup levels and used as fill in the commercially-zoned areas;
- Approximately 5,300 cy of the soils (30 percent), generally those with the highest contaminant levels, would be treated using low temperature thermal desorption; and
- Approximately 1,800 cy of the soil (10 percent) would require off-site disposal.

The above percentages are based on general technology limitations and available contaminant distribution information and are intended to be representative of technologies retained in the "tool box". As noted above, during development of the soil management protocol and the RDIP, the implementation approach will be optimized based on a variety of factors as well as detailed analysis of COC concentrations or specific requirements for individual technologies.

Verification soil samples would be collected from the excavation areas using a hand sampler and earthmoving equipment to evaluate whether the target cleanup levels have been met. Verification sample analyses would likely be performed utilizing an expedited laboratory turn-

around schedule, or an on-site mobile laboratory, in order to reduce the likelihood for significant delays to affect the remedial action schedule. In addition to verification soil sampling, it is anticipated that soil gas samples would be collected from shallow soil to confirm that residual contamination that may be present at depth, although below applicable soil or groundwater ESL values, is not causing an exceedance of a soil gas ESL. Should laboratory analytical results indicate that the cleanup level has not been attained, additional excavation will be performed.

Once the excavation is completed, it would be backfilled using a combination of recycled concrete (generated during demolition of the existing Facility building foundations) and imported granular fill to the approximate elevation of the water table and then using clean overburden, clean imported fill, or potentially soils treated to below the residential ESLs. In order to prevent the recontamination of the clean backfill in the saturated zone, amendments may be added to the backfill to promote enhanced biodegradation of contaminants in groundwater that flow back into the former excavation.

In Situ Treatment of Source Area Soil and Groundwater. The area where groundwater exceeds cleanup levels outside the source area is shown on Plate 14. As described in Section 6.2, this area comprises approximately 1 acre and contains an estimated 9,600 cy of saturated soil. The general approach to the *in situ* treatment of the groundwater in this area is described above in Section 9.1.2 and consists of *in situ* chemical oxidation and enhanced bioremediation using a sodium persulfate/calcium peroxide blend. For cost estimating, it is assumed that the blend would consist of a 5 to 1 mix of 25 percent sodium persulfate and 25 percent calcium peroxide.

Based on the existing information, the sodium persulfate/calcium peroxide mixture would be injected using Geoprobe technology. For cost estimating, it is assumed the injection points would be spaced approximately 10 ft apart, and with an assumed average radius of influence of approximately 6 ft, this should provide overlap of the coverage provided by each injection point. With this assumed spacing, it would take approximately 390 injection locations to effectively treat the target area.

Monitoring the effectiveness of the *in situ* treatment would be accomplished through a network of monitoring wells installed in the treatment area before the injections occur. Several pre-injection monitoring events would be conducted to establish pre-treatment baseline concentrations. Post-treatment monitoring would be conducted to confirm that cleanup levels have been achieved and that no “rebound” of contaminant concentrations is occurring. A typical post-treatment monitoring program would consist of a round of sampling 2 weeks after injection, 6 weeks after injection, 3 months after injection, and then quarterly for three events to provide a year of monitoring data. If cleanup levels in certain areas are not met initially, or concentrations “rebound”, additional injections of oxidant would be required.

In addition to the groundwater monitoring described above, it is anticipated that soil gas samples would be collected from shallow soil to confirm that residual groundwater

contamination, although below their respective soil or groundwater cleanup levels, is not causing an exceedance of a soil gas ESL.

9.4.2 Cost

The costs associated with implementing Alternative 3 are shown in Table 19. The capital costs for Alternative 3 include excavation and treatment of soils, *in situ* treatment of groundwater, placing treated soil as fill, amending the backfill to promote biodegradation of residual contaminants, and managing groundwater generated during dewatering. Operations and maintenance (O&M) costs associated with Alternative 3 are limited to short-term post-treatment monitoring of the *in situ* treatment area.

The estimated capital costs for Alternative 3 range from a low of \$1.57 million to a high of \$3.0 million, with an average capital cost of \$2.29 million. Average O&M costs are estimated at \$147,000 assuming one year of post-treatment monitoring. Total remediation costs for Alternative 3, using the average capital and O&M costs, are estimated at \$2.44 million. It is assumed that implementation of Alternative 3 would begin in 2008 and that all capital costs will be incurred during 2008, although some *ex situ* soil treatment activities could extend into 2009. O&M costs (groundwater monitoring) would extend into 2009.

9.5 Alternative 4 – Ex Situ Soil and Groundwater Remediation

9.5.1 Alternative Description

Alternative 4 consists of the excavation and *ex situ* treatment of all saturated and unsaturated soils and groundwater that exceed their respective cleanup levels. The areas that would be excavated are defined in Plates 13 and 14. As described in Section 6.2, the estimated volume of soil exceeding cleanup levels includes 6,300 cy of unsaturated soil and 11,400 cy of saturated soil. The area where only groundwater exceeds cleanup levels (Plate 14) contains an additional 9,600 cy of saturated soil. The total estimated volume of soil to be excavated in Alternative 4 is 27,200 cy.

The approach for managing the excavated soil is described above in Section 9.1.3, with the soil being segregated into categories based on contaminant levels and managed consistent with a soil management protocol. Where treatment is required to achieve cleanup levels, technologies in the “tool box” would be utilized as defined below. The initial excavation would be the unsaturated soils exceeding cleanup levels and the clean overburden required to be removed to access the underlying saturated zone soils. The clean overburden would be stockpiled nearby for later use as backfill, and the soil exceeding the cleanup levels would be segregated by contaminant level and taken to the appropriate stockpile and/or treatment area for processing as defined below.

Next, the saturated zone would be excavated as described above for Alternative 3, with dewatering activities used as necessary and the groundwater generated collected and treated

onsite using the existing wastewater treatment system prior to discharging to the sanitary sewer under the Facility's existing permit. The excavated saturated soils would be segregated by contaminant level and taken to the appropriate stockpile, dried as necessary prior to reuse or treatment, and then managed as defined below.

Similar to Alternative 3, the "tool box" of *ex situ* soil treatment technologies would be used to manage the excavated soil. Based on the available information and for purposes of developing a cost estimate for this FS it is assumed that excavated soils would be managed as defined in Alternative 3 with the exception that all of the 9,600 cy of soil being excavated to remove the areas where groundwater exceeds cleanup levels (but soil concentrations are below cleanup levels), would have soil concentrations below residential cleanup levels and could be used as fill without additional treatment beyond drying. With these assumptions, the excavated soil in Alternative 4 would be managed as follows:

- Approximately 11,400 cy (42 percent) would have contaminant levels below commercial cleanup levels and could be used directly as fill in the commercially-zoned areas (after drying if necessary);
- Approximately 8,800 cy of the soil (32 percent), generally those with low to moderate contaminant levels, would be treated directly using biopiling techniques to at least commercial cleanup levels and used as fill in the commercially-zoned areas;
- Approximately 5,300 cy of the soils (19 percent), generally those with the highest contaminant levels, would be treated using low temperature thermal desorption; and
- Approximately 1,800 cy of the soils (7 percent) would require off-site disposal.

Once the excavation is completed, it would be backfilled using a combination of recycled concrete (generated during demolition of the current building foundations) and imported granular fill to the approximate elevation of the water table and then using clean overburden, clean imported fill, or potentially soils treated to below the residential cleanup levels. In order to prevent the recontamination of the clean backfill in the saturated zone, amendments may be added to the backfill to promote enhanced biodegradation of contaminants in groundwater that flow back into the former excavation.

As described above for Alternative 3, verification soil and soil gas samples would be collected to evaluate whether the target cleanup levels have been met. Should verification results indicate that the cleanup level has not been attained, additional excavation would be performed.

9.5.2 Cost

The costs associated with implementing Alternative 4 are shown in Table 20. The capital costs for Alternative 4 would include excavation and treatment of soils, placing treated soil as fill, amending the backfill to promote biodegradation of residual contaminants, and managing

groundwater generated during dewatering. There are no ongoing O&M costs associated with Alternative 4.

The estimated capital costs (and total remediation costs since there are no O&M costs) for Alternative 4 range from a low of \$1.58 million to a high of \$3.1 million, with an average capital cost of \$2.34 million. It is assumed that implementation of Alternative 4 would be conducted in 2008 and that all capital costs will be incurred during 2008, although some *ex situ* soil treatment activities could extend into 2009.

10.0 EVALUATION OF REMEDIAL ALTERNATIVES

The following section: (1) summarizes the criteria for evaluation of remedial alternatives; (2) evaluates the four remedial alternatives against the evaluation criteria and RAOs; (3) presents a comparative evaluation of the four alternatives against each other with respect to the evaluation criteria and RAOs; and (4) recommends a preferred remedial alternative for implementation to address soil and groundwater contamination at the Site.

10.1 Criteria for Evaluation

In addition to the RAOs developed in Section 7.4, each remedial alternative will be evaluated against the nine evaluation criteria set forth in the NCP and accompanying USEPA guidance documents (NCP, 1990 and USEPA, 1998). These nine criteria are divided into three categories: “Threshold Criteria,” “Primary Balancing Criteria,” and “Modifying Criteria.”

In accordance with USEPA guidance in the NCP, the selected alternative is required to meet the two threshold criteria. The five primary balancing criteria provide comparisons between the alternatives and identify tradeoffs between them. The two modifying criteria consider acceptance by the State and by the local community. The nine evaluation criteria are described below.

10.1.1 Threshold Criteria

- 1. Overall Protection of Human Health and the Environment.** This criterion addresses whether a remedial alternative is protective of human health and the environment considering long-term and short-term site-specific characteristics. The remedy’s short-term effectiveness, long-term effectiveness and permanence, and ability to reduce chemical toxicity, mobility, and volume affect the evaluation under this criterion. This criterion considers the degree of certainty that an alternative can meet the site-specific remedial action goals.
- 2. Compliance with Applicable or Relevant and Appropriate Requirements.** RAOs for the site are developed by considering, among other things, ARARs. The remedial alternatives must comply with ARARs, which are presented in Section 7.2.

10.1.2 Balancing Criteria

1. **Long-Term Effectiveness and Permanence.** This criterion addresses how well a remedy maintains protection of human health and the environment after the site-specific remedial goals have been met to the extent feasible. Components to be addressed include the magnitude of residual risk, the adequacy and long-term reliability of institutional controls and containment systems, and potential consequences should the remedy or some portion of it fail.
2. **Reduction of Mobility, Toxicity, or Volume.** Under this criterion, the anticipated amount of the chemical of concern destroyed or treated and the amount remaining at the site are assessed, along with the degree of expected reduction in chemical mobility, toxicity, or volume.
3. **Short-Term Effectiveness.** This criterion concerns protection of human health and the environment during construction and implementation of the remedy.
4. **Implementability.** Implementability considers both the technical and administrative feasibility of implementation. The criterion also considers the ability to construct and operate remedial facilities, ease of undertaking additional remedial actions, ability to monitor remedial effectiveness, and the ability to obtain necessary approvals and permits.
5. **Cost.** The costs to be assessed include the capital cost, annual operation and maintenance costs.

10.1.3 Modifying Criteria

1. **State Acceptance.** The State Acceptance criterion incorporates input from state agencies to modify the alternative selection process. This input can be obtained via formal comments received during the project comment period.
2. **Community Acceptance.** This criterion addresses reaction from the local citizenry.

The NCP requires that an environmental evaluation of sensitive or critical habitats be conducted. In this Site 2/3 setting, there are no sensitive or critical habitats requiring environmental evaluation. While wetlands are present to the south and west of Site 2/3, these areas are not adjacent to the areas requiring remediation. Furthermore, through stormwater controls implemented during the rainy season, surface water runoff from the excavation area and/or ex-situ treatment or stockpile areas would be controlled to prevent contaminants from being released to sensitive environmental receptors.

10.2 Detailed Evaluation of Alternatives

The evaluation of the remedial alternatives against the NCP criteria and the RAOs is presented in Table 21, and summarized below for each alternative.

10.2.1 Alternative 1 – No Action

There is little or no cost associated with Alternative 1.

Alternative 1 does not meet either of the threshold NCP criteria – (1) protection of human health and the environment and (2) compliance with ARARs. It does not meet the RAOs described in Section 7.4. Therefore, Alternative 1 is judged not to be acceptable.

10.2.2 Alternative 2 – Maintain Existing Remedial Actions

Alternative 2 has an estimated cost of 1.37 million.

In light of the range of foreseeable land uses for the Site, Alternative 2 does not meet either of the threshold NCP criteria – (1) protection of human health and the environment and (2) compliance with ARARs. It does not meet the RAOs described in Section 7.4. Therefore, Alternative 2 is judged not to be acceptable and active remediation is required.

10.2.3 Alternative 3 – *Ex Situ* Source Area Soil and Groundwater Treatment and *In Situ* Groundwater Remediation

Because it reduces contaminant concentrations to below risk-based cleanup levels, Alternative 3 is protective of human health and the environment and meets the first threshold requirement. This alternative should also comply with ARARs. In general, Alternative 3 also performs well on the five balancing criteria, with the possible exception of technical implementability. Specifically, potential difficulties associated with uniformly distributing the chemical oxidant throughout the relatively low permeability soils of the treatment zone would need to be addressed prior to implementation. Treatability studies can be conducted to help address this issue.

Alternative 3 has an estimated cost of \$2.44 million, almost all of which are capital costs related to treatment of the soil and groundwater during the first year this alternative is implemented. The major uncertainties associated with this cost are related to unit costs for soil and groundwater treatment. Information developed during treatability studies conducted during design would help refine these unit costs and reduce the cost uncertainty.

10.2.4 Alternative 4 – *Ex Situ* Soil and Groundwater Remediation

The evaluation of Alternative 4 is very similar to that of Alternative 3, except there are no implementability concerns related to *in situ* chemical oxidation for Alternative 4. This alternative meets all of the NCP criteria with a relatively high degree of certainty.

Alternative 4 has an estimated cost of \$2.34 million, all of which are capital costs related to treatment of the soil and groundwater during the first year this alternative is implemented. As with Alternative 3, the major uncertainties associated with this cost are related to unit costs for soil and groundwater treatment, which can be refined based on treatability studies conducted during design.

10.3 Summary of Comparison of Remedial Alternatives

The comparative evaluation of the alternatives against each of the criteria is also shown in Table 21. Alternatives 1 and 2 compare poorly against the other two alternatives in all criteria (except cost) and, as such, are not acceptable alternatives for meeting the RAOs.

Comparing Alternatives 3 and 4, they are very similar in their ability to meet the cleanup objectives. Both compare favorably to the evaluation criteria, and both meet the RAOs for the Site. These alternatives have very similar costs. The only significant difference between the two alternatives is related to the *in situ* chemical oxidation component of Alternative 3. As described in Table 21, given the relatively low permeability and potentially stratified nature of the soils in the saturated zone, there may be some difficulties in effectively distributing the chemical oxidant throughout the treatment zone. Uniform distribution of treatment chemicals is critical to effectively treat the entire affected area. Failure to uniformly distribute the oxidant could lead to partially treated, or even untreated, areas that could lead to a “rebound” effect for contaminant levels in groundwater. If post-treatment monitoring indicated that a rebound in concentrations was occurring, supplemental injections of oxidant would be required to polish the residual contaminants and meet cleanup levels.

10.4 Recommended Remedial Alternative

Based on the evaluation of the three alternatives against the NCP criteria and the RAOs, Alternative 4 is superior in terms of long-term effectiveness, permanence, and implementability. Although Alternative 3 would also likely achieve the cleanup objectives in a timely manner, the higher level of certainty associated with Alternative 4 at essentially the same cost as Alternative 3 leads to the recommendation of Alternative 4.

11.0 REMEDIAL ACTION PLAN IMPLEMENTATION

This section discusses the conceptual design of the recommended remedial action. A preliminary schedule for remedial action implementation and reporting is also presented.

11.1 Conceptual Remedial Design

Alternative 4 is described in Section 9.5 and generally consists of the excavation of a total of approximately 27,300 cy of saturated and unsaturated soils and groundwater that exceed their respective cleanup levels. The excavated soil would be segregated into categories and managed consistent with a soil management protocol. Where treatment is required to achieve cleanup levels prior to use of the soil as fill, technologies in the “tool box” would be utilized. The soil management protocol would be prepared as part of the RDIP and would document the detailed protocol for managing all soil excavated not only at the Site, but for remedial actions at Site 4, Site 6 and Other Areas at the Facility.

11.1.1 Remediation Procedures and the Soil Management Protocol

The detailed approach for conducting the excavation at the Site will be developed during design in consultation with potential remediation contractors. In general, the initial excavation would be the unsaturated soils exceeding residential cleanup levels and the clean overburden followed by the saturated zone. Groundwater generated during required dewatering activities would be collected and treated onsite using the existing wastewater treatment system prior to discharging to the sanitary sewer under the Facility’s existing permit. The overall approach for handling the excavated soil is described above in Section 9.1.3, with the soil being segregated into categories based on contaminant levels and managed consistent with the soil management protocol.

Soil samples would be collected and submitted for chemical analysis to evaluate which category specific soil falls into and therefore how it will be managed. Soil samples to characterize the soil would be collected at a frequency specified in the RDIP. For soils requiring treatment prior to being used as backfill, the technologies retained in the “tool box” for treating soil *ex situ* include biopiling, landfarming, low temperature thermal desorption, and off-site disposal.

Following completion of excavation activities, backfilling would proceed using a combination of recycled concrete and imported granular fill to the approximate elevation of the water table and then using clean overburden, clean imported fill, or potentially soils treated to below the residential cleanup levels. Note that per the RWQCB, soils proposed for reuse within 5 feet of the ground surface in residential areas must meet the residential nuisance ESLs for TPH (middle distillates) and TPH (residual fuels) of 100 and 500 mg/kg, respectively. Amendments may be added to the backfill to promote enhanced biodegradation of contaminants in groundwater that flows back into the former excavation to prevent the recontamination of the clean backfill in the saturated zone.

11.1.2 Permitting and Contractor Health and Safety

The work will be conducted in accordance with applicable federal, state and local regulations. These include, but are not limited to:

- National Fire Protection Association (NFPA) NFPA 30 Flammable and Combustible Liquids;
- Occupational Safety and Health Administration (OSHA), Title 29 Code of Federal (CFR) 1910.120. Regulations applicable to hazardous waste site operations (HAZWOPER);
- Health and Safety Code Division 20, Chapters 6.5 and 6.8;
- Title 8 California Code of Regulations (CCR) General Industry Safety Orders (GISO) 5192 Hazardous Materials Storage Ordinance, and Title 8 CCR 1532.1;
- Title 22, CCR Sections 66261.2 and 66261.3;
- Napa County Grading and Construction Ordinances;
- Napa Sanitation District Discharge Limitations;
- Napa County Ordinance No. 1240, Stormwater Management and Discharge Control;
- Napa County Code, Section 13.12 (specifies that permits must be obtained prior to drilling and installing certain soil borings and groundwater wells); and
- Bay Area Air Quality Management District (BAAQMD) Rules and Regulations: Organic Compounds, Regulation 8; and Hazardous Pollutants, Regulation 11.

The excavation and soil handling would be conducted by a qualified, HAZWOPER-trained, contractor using conventional earthwork equipment. The contractor would prepare a Site Specific Health and Safety Plan (HSP), which will address identification of hazards, hazard mitigation, safe work practices and emergency response procedures for the project. The site-specific HSP would be prepared to comply with 29 CFR 1910.120 and Title 8 CCR GISO 5192. Additionally, any remediation subcontractors selected to perform remedial work on-Site would be required to prepare a HSP for its activities.

11.1.3 Site Preparation

Prior to conducting the proposed remedial activities, it is assumed that all structures including buildings, foundations and floor slabs, paving, and materials stored or stockpiled in or near the Site would be demolished and/or removed. In addition, it is assumed underground utilities (including the groundwater extraction trench) would be removed or abandoned as appropriate.

In addition to removing the structures, foundations, utilities, and existing groundwater monitoring wells in and near the excavation, areas of the Facility that would be utilized to implement the remedial action would be cleared of obstructions and otherwise prepared for use. This would include preparation of equipment lay down and staging areas, soil stockpile

areas, soil treatment areas, and areas where treated soil will be used as fill. Because soil stockpiling, soil treatment, and overall site filling would also be conducted at the other areas of the Facility, these activities would be coordinated with the remedial actions proposed for the other sites.

11.1.4 Verification Sampling

Verification soil samples will be collected from the excavation areas using a hand sampler and earthmoving equipment to evaluate whether the cleanup levels have been met. Detailed descriptions of the verification sampling procedures and analytical program will be provided in the Verification Sampling and Analysis Plan (VSAP) that will be included as part of the RDIP. The VSAP will specify the number of sidewall and excavation bottom soil samples that will be collected and the depth intervals where samples are to be collected. Sample locations and the number of samples collected may be adjusted in the field if necessary. Verification sample analyses will likely be performed utilizing an expedited laboratory turn-around schedule, or an on-site mobile laboratory, to reduce the likelihood for significant delays to affect the remedial action schedule.

In addition to verification soil sampling, it is anticipated that soil gas samples will be collected from shallow soil to confirm that residual contamination that may be present at depth, although below their respective soil or groundwater cleanup levels, is not causing an exceedance of a soil gas ESL. Should laboratory analytical results indicate that the cleanup level has not been attained, additional excavation will be performed.

11.1.5 Dust and Odor Control

During shallow excavation activities, depending on soil conditions, there is potential to generate airborne dust. Therefore, as required, the contractor would apply a water mist to the excavation and soil handling and haul routes to reduce the potential for dust generation. Soil would be wetted as needed to reduce the occurrence of visible dust. Air monitoring would be conducted in accordance with local air quality management regulations as described in the RDIP and/or the contractor's HSP.

11.1.6 Decontamination

Equipment used to excavate, transport, and manage the affected soil would be decontaminated prior to leaving the site. The equipment will first be decontaminated by removing visible soil by sweeping or brushing. Soil that cannot be removed by this procedure would be removed from equipment by washing in a prepared decontamination area. The decontamination area would be constructed in a central location that would be utilized for all remediation activities at the site. Decontamination wash water will be collected, characterized, treated on site using the existing wastewater treatment system, and discharged to the sanitary sewer.

11.1.7 Excavation Backfilling

The excavations would be backfilled once verification soil sampling confirms that cleanup levels are met throughout the excavation area. The specific backfill requirements would be determined during remedial design and will incorporate geotechnical considerations for future residential and commercial construction. Procedures and specifications would be included in the RDIP. For portions of the excavation below the water table, backfilling would typically utilize recycled concrete and asphalt in the bottom of the excavations to bridge over the wet, fined-grained soils and then utilize imported granular fill to bring the grade back up to above the water table elevation. Above the water table, backfill will likely consist of clean overburden, other excavated soils where COC concentrations are below the applicable cleanup levels, or treated soil, as appropriate.

11.2 Schedule of Remedial Action Implementation and Reporting

It is anticipated that the soil excavation would be completed during the 2008 construction season, approximately April through October, pending approval of this RI/FS/RAP, preparation of the RDIP, and issuance of the needed permits by the County and associated approvals. Approval of this document does not limit the County's normal environmental review associated with such permit(s) and related approvals. Depending on the total volume of soil requiring treatment from all the remediation areas (e.g., Areas 4 and 6), and the specific type of treatment utilized (e.g., biopiling, LTDD), treatment of excavated soils may extend beyond 2008 into 2009.

Treatability studies to develop design information for select technologies would be implemented during 2007. Initiation of these treatability studies is expected in the first quarter of 2007.

11.3 Performance Criteria

Evaluation of the progress of the soil and groundwater remediation program would be conducted throughout its implementation. The laboratory analytical results of the soil verification samples would be compared to the proposed target remedial goals. If these compounds are detected in verification soil sampling above the proposed target cleanup levels and further excavation is not feasible, PES will consult with RWQCB staff to evaluate the appropriateness of instituting additional remedial measures, if warranted.

11.4 Reporting

Following completion of remediation activities, a remedial action implementation report will be prepared and submitted to RWQCB for review and approval. The report will summarize the work that was performed, verification soil and soil gas sample analytical results, and document that the cleanup levels have been achieved. Performance monitoring results for soil treatment

will be reported and the final disposition of excavated soils will be documented. Copies of laboratory reports and chain-of-custody forms will be included.

12.0 REFERENCES

- Artesian Environmental Consultants, 1991. *Excavation of Soil Containing Diesel Fuel Around Generator*. November.
- Berkeley Lab, 2002. *Analysis of Background Distribution of Metals in the Soil at Lawrence Berkeley National Laboratory* for the Lawrence Berkeley National Laboratory, Environmental Restoration Program, June 2002.
- James M. Montgomery, Consulting Engineers, Inc. (JMM), 1987. *Report of Soil and Groundwater Testing at the Kaiser Steel Corporation Pipe Mill and Fabrication Facility in Napa California*. September.
- JMM, 1990a. *Site Investigation Report, Napa Pipe Corporation Facility, Napa, California*. January.
- JMM, 1990b. *Corrective Action Plan for the Napa Pipe Mill, Napa Pipe Corporation Facility, Napa, California*. November 5.
- Kunkel, F., and Upson, J.E., 1960. *Geology and Groundwater in Napa and Sonoma Valleys, Napa and Sonoma Counties, California*, USGS Water Supply Paper 1495, Washington, D.C.
- MW, 1993. *Site 2/3 Characterization, Groundwater Modeling, and Extraction Scenario Development*. May.
- MW, 1994. *Addendum to the Site 2/3 Technology Screening and Remedial Strategy Development Report, and Remedial Design and Implementation Plan*. December 29.
- Pankow. James F. and John A. Cherry, 1996. *Dense Chlorinated Solvents and other DNAPLs in Groundwater: History, Behavior and Remediation*. Waterloo Press.
- PES Environmental, Inc. (PES), 2006a. *Groundwater Monitoring Program Report Number 67, April – June 2006, Former Napa Pipe Facility, 1025 Kaiser Road, Napa, California*. August 15.
- PES Environmental, Inc. (PES), 2006b. *Supplemental Remedial Investigation Workplan, Site 2/3, Former External Coating Building, Napa Pipe Facility, 1025 Kaiser Road, Napa, California*. August 29.

San Francisco Regional Water Quality Control Board (RWQCB), 2005. *Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater*. Interim Final - February.

Shaw Environmental Inc. (Shaw), 2005. *Phase II Site Investigation at Napa Pipe Facility, 1025 Kaiser Road in Napa, CA*. December 5.

TABLES

**Table 1
Environmental Screening Levels
Napa Pipe Facility
Napa, California**

SOIL					GROUNDWATER	
Nondrinking Water Resource					Nondrinking Water Resource	
Parameter	ESL	ESL	ESL	ESL	Parameter	ESL
	Shallow Soil (<3m)	Shallow Soil (<3m)	Deep Soil (>3m)	Deep Soil (>3m)		
	Residential	Commercial	Residential	Commercial		(µg/l)
	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)		
TPH (gasoline)	100	500 ⁰	5000 ³	5000 ³	TPH (gasoline)	5000 ^{8,11}
TPH (middle distillates)	100/400 ¹	500/750 ²	5000 ³	5000 ³	TPH (middle distillates)	2500 ^{8,11}
TPH (residual fuels)	500/1000 ⁴	2500 ⁵	5000 ⁶	5000 ⁷	TPH (residual fuels)	2500 ⁸
Benzene	0.18	0.38	0.18	0.51	Benzene	540 ⁹
Naphthalene	0.46	1.5	0.46	1.5	Naphthalene	210 ¹⁰
TCE	0.26	0.73	0.26	0.73	TCE	530 ⁹
1,1-DCE	8.9 ¹²	2.1 ¹²	8.9 ¹²	21	1,1-DCE	6300 ⁹
cis-1,2-DCE	1.6	3.6	1.6	3.6	cis-1,2-DCE	6200 ⁹
Chloroethane	0.63	0.85	0.63	0.85	Chloroethane	160 ¹⁰
1,1-DCA	0.32	0.89	0.32	0.89	1,1-DCA	1000 ⁹
Vinyl Chloride	0.0067	0.019	0.0067	0.019	Vinyl Chloride	3.8
trans-1,2-DCE	3.1	7.3	3.1	7.3	trans-1,2-DCE	2600 ¹⁰
1,2-DCA	0.025	0.07	0.025	0.07	1,2-DCA	200
PCE	0.087	0.24	0.087	0.24	PCE	120 ⁹
1,1,1-TCA	98 ¹²	230 ¹²	98 ¹²	230 ¹²	1,1,1-TCA	50000 ¹⁰
1,1,2-TCA	0.032	0.089	0.032	0.089	1,1,2-TCA	350
Styrene	450 ¹²	1000 ¹⁴	450 ¹²	1100 ¹²	Styrene	110 ¹⁰
Methylene Chloride	0.52	1.5	0.52	1.5	Methylene Chloride	2400 ⁹
1,2-Dichlorobenzene	8.9 ¹²	21 ¹²	8.9 ¹²	21 ¹²	1,2-Dichlorobenzene	100 ¹⁰
1,4-Dichlorobenzene	0.046	0.13	0.046	0.13	1,4-Dichlorobenzene	110 ¹⁰
Chlorobenzene	2.7 ¹²	6.2 ¹²	2.7 ¹²	6.2 ¹²	Chlorobenzene	500 ¹⁰
Bromodichloromethane	0.014	0.039	0.014	0.039	Bromodichloromethane	170
Chloroform	0.88	1.9	78 ¹³	78 ¹³	Chloroform	330
Dibromochloromethane	0.019	0.054	0.019	0.054	Dibromochloromethane	170
Bromomethane	0.22	0.51	0.22	0.51	Bromomethane	580 ⁹
MTBE	2	5.6	2	5.6	MTBE	1800
Ethylbenzene	390 ¹²	390 ¹²	390 ¹²	390 ¹²	Ethylbenzene	300 ¹⁰
Xylenes	310 ¹²	420 ¹²	310 ¹²	420 ¹²	Xylenes	5300 ¹⁰
Toluene	100 ¹³	310 ¹²	130 ¹²	310 ¹²	Toluene	400 ¹⁰
2-Butanone	490 ¹²	1000 ¹⁴	490 ¹²	1300 ¹²	2-Butanone	50000 ¹⁰
Acetone	500 ¹⁴	1000 ¹⁴	1000 ¹⁴	2500 ¹⁴	Acetone	50000 ¹⁰
1,4-Dioxane	18	30	30	30	1,4-Dioxane	50000
Anthracene	6.1 ¹⁵	6.1 ¹⁵	6.1 ¹⁵	6.1 ¹⁵	Anthracene	22 ¹⁰
Fluorene	160 ¹⁵	160 ¹⁵	160 ¹⁵	160 ¹⁵	Fluorene	950 ¹⁰
Methylnaphthalene (total 1- & 2-)	110 ¹⁵	110 ¹⁵	110 ¹⁵	110 ¹⁵	Methylnaphthalene (total 1- & 2-)	100 ¹⁰
Phenanthrene	40 ¹⁶	40 ¹⁶	1000 ¹⁷	2500 ¹⁷	Phenanthrene	410 ¹⁰
Bis(2-ethylhexyl)Phthalate	160	570 ¹³	1000 ¹⁷	2500 ¹⁷	Bis(2-ethylhexyl)Phthalate	650 ¹⁰
Chrysene	3.8	13	150 ¹³	150 ¹³	Chrysene	0.8 ¹⁰
Fluoranthene	40	390 ¹⁵	1000 ¹⁷	2500 ¹⁷	Fluoranthene	130 ¹⁰
Pyrene	85	85 ¹⁵	85 ¹⁵	85 ¹⁵	Pyrene	68 ¹⁰
Antimony	6.1	40	280	280	Antimony	50000 ¹⁰
Arsenic	5.5	5.5	5.5	5.5	Arsenic	50000 ¹⁰
Barium	750	1500	2500	2500	Barium	50000 ¹⁰
Beryllium	4	8	36	36	Beryllium	50000 ¹⁰
Cadmium	1.7	7.4	38	38	Cadmium	50000 ¹⁰
Chromium	58	58	58	58	Chromium	50000 ¹⁰
Chromium VI	1.8	1.8	1.8	1.8	Chromium VI	50000 ¹⁰

**Table 1
Environmental Screening Levels
Napa Pipe Facility
Napa, California**

SOIL Nondrinking Water Resource					GROUNDWATER Nondrinking Water Resource	
Parameter	ESL	ESL	ESL	ESL	Parameter	ESL (µg/l)
	Shallow Soil (<3m) Residential (mg/kg)	Shallow Soil (<3m) Commercial (mg/kg)	Deep Soil (>3m) Residential (mg/kg)	Deep Soil (>3m) Commercial (mg/kg)		
Cobalt	10	10	10	10	Cobalt	50000 ¹⁰
Copper	230	230	2500	5000	Copper	50000 ¹⁰
Lead	150	750	750	750	Lead	50000 ¹⁰
Molybdenum	40	40	2500	3600	Molybdenum	50000 ¹⁰
Mercury	3.7	10	98	98	Mercury	50000 ¹⁰
Nickel	150	150	1000	1000	Nickel	50000 ¹⁰
Selenium	10	10	2500	3400	Selenium	50000 ¹⁰
Silver	20	40	2500	3600	Silver	50000 ¹⁰
Thallium	1	13	47	47	Thallium	50000 ¹⁰
Vanadium	110	200	2500	5000	Vanadium	50000 ¹⁰
Zinc	600	600	2500	5000	Zinc	50000 ¹⁰

Notes:

ESL = Environmental Screening Level (RWQCB, February 2005)

TPH (middle distillates) includes TPH as diesel

TPH (residual fuels) includes TPH as motor oil and TPH as hydraulic oil

0 = The final ESL from Table B-2 (commercial/industrial) of RWQCB, 2005 is 400 mg/kg, based on protection of surface water resources via soil leaching to groundwater and discharge of groundwater to surface water, Table G.

This pathway does not apply and the cleanup value defaults to 500 mg/kg (gross contamination ceiling value) and with the recognition that confirmation soil gas testing may be required

1 = The final ESL from Table B-1 of RWQCB, 2005 is 100 mg/kg, based on the Gross Contamination Ceiling Value (Odors, etc.), Table H-2. However, the MADEP screening values, (Appendix 7, RWQCB, 2005) on which Table H-2 is based state that the nuisance ceiling value for C9 to C18 carbon range (equivalent to the lighter fraction of diesel is 1000 mg/kg (not 100 mg/kg). This value is higher than the next lowest value of 400 mg/kg (direct exposure) shown on Table B-1

For the shallowest soils (0-3 ft. bgs) the lower of the two values (100 mg/kg) is selected to conservatively protect for nuisance odor issues. For deeper soils (>3 ft bgs but <3 m), the proposed cleanup value is 400 mg/kg

2 = The final ESL from Table B-2 of RWQCB, 2005 is 500 mg/kg, based on both the gross contamination ceiling value (odors, etc.) from Table H-2 and protection of surface water resources via soil leaching to groundwater and discharge of groundwater to surface water, Table G. Note that the 500 mg/kg value for soil from Table G is already a non-drinking water number and is based on soil leaching protective of surface water discharge at 640 mg/l. This pathway would likely not apply

In addition, similar to footnote 1, the MADEP screening levels are listed as 1,000 mg/kg, not 500 mg/kg. The next highest value on Table B-2 is the direct contact value of 750 mg/kg.

For the shallowest soils (0-3 ft. bgs) the lower of the two values (500 mg/kg) is selected to conservatively protect for nuisance odor issues. For deeper soils (>3 ft bgs but <3 m), the proposed cleanup value is 750 mg/kg. It also recognized that confirmation soil gas testing may be required.

3 = The final ESL from Table D-1 (residential) and Table D-2 (commercial/industrial) of RWQCB, 2005 is 400 for TPH(gasolines) and 500 mg/kg for TPH(middle distillates), based on protection of surface water resources via soil leaching to groundwater and discharge of groundwater to surface water, Table G. This pathway does not apply and the cleanup value defaults to 5000 mg/kg (gross contamination ceiling value) and with the recognition that confirmation soil gas testing may be required

4 = The final ESL from Table B-1 of RWQCB, 2005 is 500 mg/kg, based on the Gross Contamination Ceiling Value, Table H-2. However, the MADEP screening values, (Appendix 7, RWQCB, 2005) on which Table H-2 is based, states that the nuisance ceiling value for C19 to C36 carbon range (equivalent to motor oil and hydraulic oil) is 2500 mg/kg. This value is higher than the next lowest value of 1,000 (direct exposure) shown on Table B-

As in footnotes 1 and 2, the lower value (in this case 500 mg/kg) is retained to conservatively protect for nuisance odor issues in the shallowest soils (0-3 ft bgs). For the deeper soils (>3 ft and <3m), the direct exposure number (1,000 mg/kg) is proposed

5 = The final ESL from Table B-2 of RWQCB, 2005 is 1000 mg/kg, based on the Groundwater Protection (Soil Leaching), Non-Drinking Water Resource, Table G. However, the value listed follows the LARWQCB guidance, which is based on the protection of drinking water resource. Shallow groundwater is not a drinking water resource; the drinking water resource is over 150 feet below ground surface. At this depth, the LARWQCB's soil screening level would be 50,000 mg/kg (see Table 4-1 of LARWQCB, 1996). This value is higher than the next lowest value of 2,500 mg/kg, based on the nuisance ceiling as shown on Table B-2; therefore the proposed cleanup goal defaults to 2500 mg/kg

6 = The final ESL from Table D-1 of RWQCB, 2005 is 1000 mg/kg, based on the Groundwater Protection (Soil Leaching), Non-Drinking Water Resource, Table G. However, the value listed follows the LARWQCB guidance (see footnote on Table D-1 and Section 5.3.2 text of RWQCB, 2005), which is based on the protection of a drinking water resource. Shallow groundwater is not a drinking water resource; the drinking water resource is over 150 feet below ground surface. At this depth, the LARWQCB soil screening level would be 50,000 mg/kg (see Table 4-1 of LARWQCB, 1996). This value is higher than the next lowest value of 5000 (gross contamination ceiling value) shown on Table D-1; therefore the proposed cleanup goal defaults to 5000 mg/kg

7 = The final ESL from Table D-2 of RWQCB, 2005 is 1000 mg/kg, based on the Groundwater Protection (Soil Leaching), Non-Drinking Water Resource, Table G. However, the value listed follows the LARWQCB's guidance (see footnote on Table D-1 and Section 5.3.2 text of RWQCB, 2005), which is based on the protection of a drinking water resource. Shallow groundwater is not a drinking water resource; the drinking water resource is over 150 feet below ground surface. At this depth, the LARWQCB soil screening level would be 50,000 mg/kg (see Table 4-1 of LARWQCB, 1996). This value is higher than the next lowest value of 5000 (gross contamination) shown on Table D-2; therefore the proposed cleanup goal defaults to 5000 mg/kg

8 = No aquatic habitat pathway. Defaults to gross contamination ceiling level value.

9 = No aquatic habitat pathway. Defaults to vapor intrusion pathway.

10 = No aquatic habitat pathway. Defaults to gross contamination ceiling value.

11 = Soil gas values to be used for verifying cleanup.

12 = Protection of surface water resources via soil leaching to groundwater and discharge of groundwater to surface water does not apply; therefore, the cleanup value defaults to the vapor intrusion pathway

13 = Protection of surface water resources via soil leaching to groundwater and discharge of groundwater to surface water does not apply; therefore, the cleanup value defaults to the direct exposure pathway

14 = Protection of surface water resources via soil leaching to groundwater and discharge of groundwater to surface water does not apply; therefore, the cleanup value defaults to the gross contamination ceiling value

15 = The final ESLs from Tables B-1 and D-1 (residential) and Tables B-2 and D-2 (Commercial/Industrial) of RWQCB, 2005 are based on protection of surface water resources via soil leaching to groundwater and discharge of groundwater to surface water, Table G. This pathway does not apply and the cleanup value defaults to the vapor intrusion into buildings pathway

16 = The final ESLs from Tables B-1 and D-1 (residential) and Tables B-2 and D-2 (Commercial/Industrial) of RWQCB, 2005 are based on protection of surface water resources via soil leaching to groundwater and discharge of groundwater to surface water, Table G. This pathway does not apply and the cleanup value defaults to the Urban Area Ecotoxicity Criteria

17 = The final ESLs from Tables D-1 (residential) and D-2 (Commercial/Industrial) of RWQCB, 2005 are based on protection of surface water resources via soil leaching to groundwater and discharge of groundwater to surface water, Table G

This pathway does not apply and the cleanup value defaults to the Gross Contamination Ceiling Value

Table 2
Water Level Survey Data - May 16, 2006
Site 2/3, Second Quarter 2006 Monitoring Event
Napa Pipe Facility
Napa, California

Well Identification	Top of Well Casing Elevation (ft MSL)	Depth to Water (ft bTOC)	Depth to FPLH (ft bTOC)	FPLH Thickness (ft)	Groundwater Elevation (feet MSL)	Screened Interval (feet bgs)	Screened Interval (feet MSL)
Extraction Sump ^c	7.72	9.60	--	--	-1.88	N/A	N/A
DW-5	6.90	3.02	--	--	3.88	18 to 23	-11.1 to -16.1
MW-6R	6.62	3.38	--	--	3.24	4 to 14	2.6 to -7.4
MW-9R	8.78	5.87	--	--	2.91	5 to 15	0.6 to -9.4
MW-20 ^b	8.02	4.15	--	--	3.87	5 to 10	3.0 to -2.0
MW-21 ^b	7.08	4.45	4.44	0.01	2.64 ^a	5 to 10	2.1 to -2.9
MW-22	7.51	3.63	--	--	3.88	5.5 to 10.5	2.0 to -3.0
MW-23	6.82	2.65	--	--	4.17	5 to 10	1.8 to -3.2
MW-29	8.02	4.75	--	--	3.27	4 to 9	4.0 to -1.0
MW-30	6.33	2.35	--	--	3.98	5 to 10	1.3 to -3.7
MW-31	7.60	3.94	--	--	3.66	5 to 10	2.6 to -2.4
MW-39	6.33	na	na	na	nc	5 to 15	1.3 to -8.7
MW-40	6.24	3.13	--	--	3.11	4.5 to 14.5	1.7 to -8.3
MW-41	5.76	1.31	--	--	4.45	5 to 15	0.8 to -9.2
MW-42	5.06	0.92	--	--	4.14	5 to 15	0.1 to -9.9
MW-44	7.07	2.71	--	--	4.36	5 to 15	2.1 to -7.9
MW-45R	7.64	2.90	--	--	4.74	5 to 17.5	2.6 to -9.9
MW-46	7.53	2.51	--	--	5.02	5 to 17.5	2.5 to -10
MW-53	6.30	na	na	na	nc	4.5 to 14.5	1.8 to -8.2
MW-54	5.99	2.99	--	--	3.00	4 to 14	2.0 to -8.0
MW-55	6.09	3.32	--	--	2.77	5 to 15	1.1 to -8.9
TPZ-10	5.68	2.40	--	--	3.28	4 to 14	3.8 to -6.2
TPZ-7 ^b	7.05	3.13	--	--	3.92	5 to 15	2.0 to -8.0
TPZ-8	6.98	3.53	--	--	3.45	3 to 13	5.7 to -4.3
TPZ-9	7.07	3.00	--	--	4.07	4 to 14	4.7 to -5.3

Notes:

TOC = Top of casing

bTOC = Below top of casing

ft = Feet

ft msl = Feet mean sea level

na = Well was not accessible; not able to measure

N/A = Not applicable

nc = Not calculated

Table 3
Water Level Survey Data - October 3, 2006
Site 2/3, Fourth Quarter 2006 Monitoring Event
Napa Pipe Facility
Napa, California

Well Identification	Top of Well Casing Elevation (ft MSL)	Depth to Water (ft bTOC)	Depth to FPLH (ft bTOC)	FPLH Thickness (ft)	Groundwater Elevation (feet MSL)	Screened Interval (feet bgs)	Screened Interval (feet MSL)
Extraction Sump ^b	7.72	3.27	--	--	4.45	N/A	N/A
DW-5	6.90	3.12	--	--	3.78	18 to 23	-11.1 to -16.1
MW-6R	6.62	3.57	--	--	3.05	4 to 14	2.6 to -7.4
MW-9R	8.78	5.93	--	--	2.85	5 to 15	0.6 to -9.4
MW-20 ^a	8.02	4.35	--	--	3.67	5 to 10	3.0 to -2.0
MW-21 ^a	7.08	3.60	--	--	3.48	5 to 10	2.1 to -2.9
MW-22	7.51	3.38	--	--	4.13	5.5 to 10.5	2.0 to -3.0
MW-23	6.82	2.99	--	--	3.83	5 to 10	1.8 to -3.2
MW-29	8.02	3.60	--	--	4.42	4 to 9	4.0 to -1.0
MW-30	6.33	3.29	--	--	3.04	5 to 10	1.3 to -3.7
MW-31	7.60	4.18	--	--	3.42	5 to 10	2.6 to -2.4
MW-39	6.33	na	na	na	nc	5 to 15	1.3 to -8.7
MW-40	6.24	3.19	--	--	3.05	4.5 to 14.5	1.7 to -8.3
MW-41	5.76	1.46	--	--	4.30	5 to 15	0.8 to -9.2
MW-42	5.06	1.23	--	--	3.83	5 to 15	0.1 to -9.9
MW-44	7.07	3.59	--	--	3.48	5 to 15	2.1 to -7.9
MW-45R	7.64	3.14	--	--	4.50	5 to 17.5	2.6 to -9.9
MW-46	7.53	2.80	--	--	4.73	5 to 17.5	2.5 to -10
MW-53	6.30	na	na	na	nc	4.5 to 14.5	1.8 to -8.2
MW-54	5.99	3.15	--	--	2.84	4 to 14	2.0 to -8.0
MW-55	6.09	3.50	--	--	2.59	5 to 15	1.1 to -8.9
TPZ-10	5.68	2.63	--	--	3.05	4 to 14	3.8 to -6.2
TPZ-7 ^a	7.05	3.16	--	--	3.89	5 to 15	2.0 to -8.0
TPZ-8	6.98	3.07	--	--	3.91	3 to 13	5.7 to -4.3
TPZ-9	7.07	3.15	--	--	3.92	4 to 14	4.7 to -5.3

Notes:

- TOC = Top of casing
- bTOC = Below top of casing
- ft = Feet
- ft msl = Feet mean sea level
- na = Well was not accessible; not able to measure
- N/A = Not applicable
- = Not tested

Table 4
TPH as Diesel and TPH as Motor Oil in Groundwater Monitoring Wells
Site 2/3, Second and Fourth Quarter 2006 Monitoring Event
Napa Pipe Facility
Napa, California

Well Identification	Quarter	TPH as Diesel (µg/l)	TPH as Motor Oil (µg/l)
MW-9R	4th	ND (50)	ND (300)
MW-22	4th	ND (50)	NA
MW-29	2nd	2,400	ND (430)
	4th	5,600	NA
MW-30	4th	12,000	NA
MW-31	2nd	130Y	ND (210)
	4th	ND (50)	NA
MW-40	4th	ND (50)	NA
MW-42	2nd	400	ND (210)
	4th	6,700	NA
MW-44	4th	ND (50)	NA
MW-45R	4th	ND (50)	NA
MW-46	4th	58Y	NA
MW-54	4th	ND (50)	NA
Groundwater ESL¹		2,500	2,500

Notes:

ESL¹ = San Francisco Bay Regional Water Quality Control Board (RWQCB) Environmental Screening Level (ESL where groundwater is not a current or potential drinking water resource and where the soil leaching to groundwater and discharge of groundwater to surface water pathway does not apply (i.e., no aquatic habitat pathway).

Results exceeding ESLs are shaded

Samples analyzed using U.S. EPA Test Method 8015B

µg/l = Micrograms per liter

ND = Not detected at or above the indicated laboratory reporting limit.

NA = Not analyzed

TPH = Total petroleum hydrocarbons

Y = Sample exhibits chromatographic pattern which does not resemble standard

Table 5
Volatile Organic Compounds in Groundwater Monitoring Wells
Site 2/3, Second and Fourth Quarter 2006 Monitoring Event
Napa Pipe Facility
Napa, California

Well Identification	Quarter	1,1,1-TCA (µg/l)	1,1-DCA (µg/l)	1,1-DCE (µg/l)	1,2,4-TMB (µg/l)	1,3,5-TMB (µg/l)	1,4-Dioxane (µg/l)	Benzene (µg/l)	Chloroethane (µg/l)	cis-1,2-DCE (µg/l)	Ethylbenzene (µg/l)	Isopropylbenzene (µg/l)	Naphthalene (µg/l)	n-Butylbenzene (µg/l)	para-Isopropyl Toluene (µg/l)	Propylbenzene (µg/l)	sec-Butylbenzene (µg/l)	Styrene (µg/l)	Toluene (µg/l)	trans-1,4-Dichloro-2-butene (µg/l)	Vinyl Chloride (µg/l)	Xylenes (µg/l)
DW-5	4th	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	NA	ND (0.5)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (2)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	NA	ND (0.5)	ND (0.5)
MW-21	4th	110	330	8.6	21	5.5	NA	6.6	120	7.0	3.6	4.7	160	6.5	2.2	3.3	2.2	ND (1.7)	15	NA	130	12.9
MW-22	4th	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	NA	ND (0.5)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (2)	ND (0.5)	1.3	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	NA	ND (0.5)	ND (0.5)
MW-29	2nd	ND (0.5)	0.83	ND (0.5)	16	ND (0.5)	ND (50)	2.6	ND (0.5)	2.0	1.8	5.0	86	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	0.94	ND (0.5)	1.4	2.0	3.6
	4th	ND (5)	ND (5)	ND (5)	20	ND (5)	NA	ND (5)	ND (10)	ND (5)	ND (5)	ND (5)	65	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	NA	ND (5)	ND (5)
MW-30	4th	ND (1)	ND (1)	ND (1)	1.1	ND (1)	NA	4.2	ND (2)	1.4	ND (1)	1.7	29	4.6	1.2	ND (1)	1.4	ND (1)	ND (1)	NA	ND (1)	ND (1)
MW-31	2nd	ND (0.5)	17	4.0	ND (5)	ND (0.5)	80	ND (0.5)	0.74	0.55	ND (0.5)	ND (1)	ND (5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (1)	2.6	ND (0.5)
	4th	ND (2.5)	35	7.8	ND (2.5)	ND (2.5)	NA	ND (2.5)	ND (5)	ND (2.5)	ND (2.5)	ND (2.5)	ND (10)	ND (2.5)	ND (2.5)	ND (2.5)	ND (2.5)	ND (2.5)	ND (2.5)	NA	ND (2.5)	ND (2.5)
MW-40	4th	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	NA	ND (0.5)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (2)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	NA	ND (0.5)	ND (0.5)
MW-42	2nd	ND (0.5)	ND (0.5)	ND (0.5)	ND (5)	ND (0.5)	ND (50)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (1)	ND (5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (1)	ND (0.5)	ND (0.5)
	4th	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	NA	ND (0.5)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (2)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	NA	ND (0.5)	ND (0.5)
MW-44	4th	ND (2.5)	ND (2.5)	ND (2.5)	ND (2.5)	ND (2.5)	NA	ND (2.5)	ND (5)	ND (2.5)	ND (2.5)	ND (2.5)	ND (10)	ND (2.5)	ND (2.5)	ND (2.5)	ND (2.5)	ND (2.5)	ND (2.5)	NA	ND (2.5)	ND (2.5)
MW-54	4th	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	NA	ND (0.5)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (2)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	NA	ND (0.5)	ND (0.5)
MW-55	2nd	ND (0.5)	ND (0.5)	ND (0.5)	ND (5)	ND (0.5)	ND (50)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (1)	ND (5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (1)	ND (0.5)	ND (0.5)
	4th	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	NA	ND (0.5)	ND (1)	ND (0.5)	ND (0.5)	ND (0.5)	ND (2)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	NA	ND (0.5)	ND (0.5)
Groundwater ESL¹		50,000	1,000	6,300	NE	NE	50,000	540	160	6,200	300	NE	210	NE	NE	NE	NE	110	400	NE	3.8	5,300

Notes:

ESL¹ = San Francisco Bay Regional Water Quality Control Board (RWQCB) Environmental Screening Level (ESL) where groundwater is not a current or potential drinking water resource and where the soil leaching to groundwater and discharge of groundwater to surface water pathway does not apply (i.e., no aquatic habitat pathway).

Results exceeding ESLs are shaded

µg/l = Micrograms per liter

TCA = Trichloroethane

DCA = Dichloroethane

DCE = Dichloroethene

TMB = Trimethylbenzene

ND = Not detected at or above the indicated laboratory reporting limit.

NA = Not analyzed

NE = Not established

Table 6
Summary of Analyses Performed on Soil and Groundwater Samples
Site 2/3, External Coating Building
Supplemental Remedial Investigation
Napa Pipe Facility
Napa, California

Boring Location	Soil Analyses		Groundwater Analyses			Comments
	TPH-d/mo	VOCs	TPH-d/mo	VOCs	1,4-Dioxane	
EC1	X	X	X	X	NR	Soil samples collected at 2.5 and 7 feet bgs
EC2	X	X	X	X	NR	Soil samples collected at 3 and 7 feet bgs
EC3	X	X	X	X	NR	Soil samples collected at 3 and 7 feet bgs
EC4	X	X	X	X	NR	Soil samples collected at 3 and 5.5 feet bgs
EC5	X	X	X	X	NR	Soil samples collected at 3 and 7 feet bgs
EC6	X	X	X	X	NR	Soil samples collected at 3 and 7 feet bgs
EC7	X	X	X	X	NR	Soil samples collected at 3 and 7 feet bgs
EC8	NR	NR	X	X	NR	Groundwater only
EC9	X	X	X	X	NR	Soil samples collected at 3 and 7 feet bgs
EC10	X	X	X	X	NR	Soil samples collected at 3 and 7 feet bgs
EC11	X	X	X	X	X	Soil samples collected at 3 and 7 feet bgs
EC12	NR	NR	X	X	NR	Groundwater only
EC13	X	NR	X	NR	NR	Soil samples collected at 3 and 7 feet bgs
EC14	X	X	X	X	NR	Soil samples collected at 3 and 7 feet bgs
EC15	NR	NR	NR	NR	NR	Lithology only; no samples collected
EC16	NR	NR	NR	X	X	Groundwater only
EC17	NR	NR	NR	NR	NR	Lithology only; no samples collected
EC18	NR	NR	NR	X	X	Groundwater only

Notes:

- bgs = below ground surface
- TPH-d/mo = Total petroleum hydrocarbons (TPH) as diesel and TPH as motor oil
- VOCs = Volatile organic compounds
- NR = Not requested
- X = Analysis performed on sample

Table 7
TPH as Diesel and TPH as Motor Oil in Soil
Site 2/3, External Coating Building
Napa Pipe Facility
Napa, Pipe

Sample Location	Sample Identification	Sample Depth (Feet bgs)	Sample Date	TPH as Diesel (mg/kg)		TPH as Motor Oil (mg/kg)	
EC1	EC1-2.5'	2.5-3	9/8/2006	820	HY	9,800	H
	EC1-7'	7-7.5	9/8/2006	49	HY	480	H
EC2	EC2-3'	3-3.5	9/8/2006	3.1	HY	12	
	EC2-7'	7-7.5	9/8/2006	4.5	HY	8.8	Y
EC3	EC3-3'	3-3.5	9/8/2006	280	HY	3,100	H
	EC3-7'	7-7.5	9/8/2006	1.8	Y	ND(5)	
EC4	EC4-3'	3-3.5	9/8/2006	2.1	HY	10	
	EC4-5.5'	5.5-6	9/8/2006	1.7	Y	ND(5)	
EC5	EC5-3'	3-3.5	9/8/2006	5.3	HY	60	H
	EC5-7'	7-7.5	9/8/2006	1,900		ND(50)	
EC6	EC6-3'	3-3.5	9/8/2006	820	HY	4,500	HL
	EC6-7'	7-7.5	9/8/2006	6,100	L	ND(100)	
EC7	EC7-3'	3-3.5	9/8/2006	18	HY	120	
	EC7-7'	7-7.5	9/8/2006	220		11	LY
EC9	EC9-3'	3-3.5	11/2/2006	3.0	HLY	15	H
	EC9-7'	7-7.5	11/2/2006	ND(1)		ND(5)	
EC10	EC10-3'	3-3.5	11/2/2006	1.1	YZ	ND(5)	
	EC10-7'	7-7.5	11/2/2006	1.3	HYZ	ND(5)	
EC11	EC11-3'	3-3.5	11/3/2006	4.0	HLY	7.9	H
	EC11-7'	7-7.5	11/3/2006	3.0	HLY	ND(5)	
EC13	EC13-3'	3-3.5	11/3/2006	4.1	HLY	19	H
	EC13-7'	7-7.5	11/3/2006	1.7	HY	7.4	HY
EC14	EC14-3'	3-3.5	11/3/2006	4.0	HY	21	H
	EC14-7'	7-7.5	11/3/2006	920		16	LY
Shallow (<3 meters bgs) Soil ESL¹				100²/400³		500²/1,000³	
Deep (>3 meters bgs) Soil ESL¹				5,000		5,000	

Notes:

ESL¹ = San Francisco Bay Regional Water Quality Control Board (RWQCB) Environmental Screening Level (ESL) for residential land use where potentially impacted groundwater is not a current or potential drinking water resource, and where the soil leaching to groundwater and discharge of groundwater to surface water pathway does not apply (i.e., no aquatic habitat pathway).

² = 0 to 3 feet bgs interval, including samples collected from 0 to 3.5 feet bgs.

³ = 3 to 10 feet bgs interval, excluding soil samples collected from 3 to 3.5 feet bgs.

Results exceeding ESLs are shaded

bgs = below ground surface

mg/kg = milligrams per kilogram

ND = Not detected at or above the indicated laboratory reporting limit.

H = Heavier hydrocarbons contributed to the quantitation

Y = Sample exhibits chromatographic pattern which does not resemble standard

L = Lighter hydrocarbons contributed to the quantitation

Z = Sample exhibits unknown single peak or peaks

**Table 8
Volatile Organic Compounds in Soil
Site 2/3, External Coating Building
Napa Pipe Facility
Napa, California**

Sample Location	Sample Identification	Sample Depth (Feet bgs)	Sample Date	1,1-DCA (µg/kg)	1,1-DCE (µg/kg)	1,2,4-TMB (µg/kg)	1,3,5-TMB (µg/kg)	Isopropylbenzene (µg/kg)	Acetone (µg/kg)	Methylene Chloride (µg/kg)	Naphthalene (µg/kg)	n-Butylbenzene (µg/kg)	Para-Isopropyl Toluene (µg/kg)	Propylbenzene (µg/kg)	sec-Butylbenzene (µg/kg)
EC1	EC1-2.5'	2.5-3	9/8/2006	ND(4.1)	ND(4.1)	ND(4.1)	ND(4.1)	ND(4.1)	ND(16)	ND(4.1)	ND(4.1)	ND(4.1)	ND(4.1)	ND(4.1)	ND(4.1)
	EC1-7'	7-7.5	9/8/2006	15	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(18)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)
EC2	EC2-3'	3-3.5	9/8/2006	ND(3.8)	ND(3.8)	ND(3.8)	ND(3.8)	ND(3.8)	ND(15)	ND(3.8)	ND(3.8)	ND(3.8)	ND(3.8)	ND(3.8)	ND(3.8)
	EC2-7'	7-7.5	9/8/2006	ND(130)	ND(130)	2,200	790	380	ND(500)	ND(130)	4,400	770	450	400	510
EC3	EC3-3'	3-3.5	9/8/2006	ND(4.4)	ND(4.4)	ND(4.4)	ND(4.4)	ND(4.4)	26	ND(4.4)	ND(4.4)	ND(4.4)	ND(4.4)	ND(4.4)	ND(4.4)
	EC3-7'	7-7.5	9/8/2006	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(19)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)
EC4	EC4-3'	3-3.5	9/8/2006	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(19)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)
	EC4-5.5'	5.5-6	9/8/2006	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(19)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)
EC5	EC5-3'	3-3.5	9/8/2006	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(19)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)
	EC5-7'	7-7.5	9/8/2006	ND(170)	ND(170)	ND(170)	ND(170)	ND(170)	ND(670)	ND(170)	1,600	280	ND(170)	ND(170)	ND(170)
EC6	EC6-3'	3-3.5	9/8/2006	ND(130)	150	ND(130)	ND(130)	ND(130)	ND(500)	ND(130)	ND(130)	ND(130)	ND(130)	ND(130)	ND(130)
	EC6-7'	7-7.5	9/8/2006	ND(4.4)	6.0	9.5	ND(4.4)	ND(4.4)	ND(18)	ND(4.4)	30	ND(4.4)	ND(4.4)	ND(4.4)	ND(4.4)
EC7	EC7-3'	3-3.5	9/8/2006	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(19)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)
	EC7-7'	7-7.5	9/8/2006	ND(310)	ND(310)	1,100	ND(310)	ND(310)	ND(1,300)	ND(310)	5,100	320	ND(310)	ND(310)	ND(310)
EC9	EC9-3'	3-3.5	11/2/2006	ND(4.8)	ND(4.8)	ND(4.8)	ND(4.8)	ND(4.8)	ND(24)	98 >LR	ND(4.8)	ND(4.8)	ND(4.8)	ND(4.8)	ND(4.8)
	EC9-7'	7-7.5	11/2/2006	38	25	ND(4.3)	ND(4.3)	ND(4.3)	ND(22)	160 >LR	ND(4.3)	ND(4.3)	ND(4.3)	ND(4.3)	ND(4.3)
EC10	EC10-3'	3-3.5	11/2/2006	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(23)	110 >LR	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)
	EC10-7'	7-7.5	11/2/2006	ND(4.8)	ND(4.8)	ND(4.8)	ND(4.8)	ND(4.8)	ND(24)	73	ND(4.8)	ND(4.8)	ND(4.8)	ND(4.8)	ND(4.8)
EC11	EC11-3'	3-3.5	11/3/2006	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	49	ND(18)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)
	EC11-7'	7-7.5	11/3/2006	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(18)	ND(18)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)
EC14	EC14-3'	3-3.5	11/3/2006	ND(5.4)	ND(5.4)	ND(5.4)	ND(5.4)	ND(5.4)	ND(22)	ND(22)	ND(5.4)	ND(5.4)	ND(5.4)	ND(5.4)	ND(5.4)
	EC14-7'	7-7.5	11/3/2006	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(19)	ND(19)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)
Shallow (<3 meters bgs) soil ESL¹				320	8,900	NE	NE	NE	500,000	520	460	NE	NE	NE	NE
Deep (>3 meters bgs) Soil ESL¹				320	8,900	NE	NE	NE	1,000,000	520	460	NE	NE	NE	NE

Notes:

ESL¹ = San Francisco Bay Regional Water Quality Control Board (RWQCB) Environmental Screening Level (ESL) for residential land use where potentially impacted groundwater is not a current or potential drinking water resource, and where the soil leaching to groundwater and discharge of groundwater to surface water pathway does not apply (i.e., no aquatic habitat pathway).

Results exceeding ESLs are shaded

bgs = Below ground surface

µg/kg = Micrograms per kilogram

DCA = Dichloroethane

DCE = Dichloroethene

TMB = Trimethylbenzene

ND = Not detected at or above the indicated laboratory reporting limit.

>LR=Response exceeds instrument's linear range

NE = Not established

Table 9
TPH as Diesel and TPH as Motor Oil in Groundwater
Site 2/3, External Coating Building
Napa Pipe Facility
Napa, California

Sample Location	Sample Identification	Sample Date	TPH as Diesel (µg/l)		TPH as Motor Oil (µg/l)	
			Value	Qualifier	Value	Qualifier
EC1	EC1-W	9/8/2006	5,000	HY	41,000	H
EC2	EC2-W	9/8/2006	38,000		1,500	LY
EC3	EC3-W	9/11/2006	130	Y	ND(300)	
EC4	EC4-W	9/8/2006	ND(50)		ND(300)	
EC5	EC5-W	9/11/2006	210,000		ND(6,000)	
EC6	EC6-W	9/11/2006	260,000		ND(6,000)	
EC7	EC7-W	9/11/2006	1,000,000		ND(30,000)	
EC8	EC8-W	11/10/2006	180	HY	880	H
EC9	EC9-W	11/2/2006	ND(50)		ND(300)	
EC10	EC10-W	11/2/2006	160	Y	480	H
EC11	EC11-W	11/3/2006	ND(50)		ND(300)	
EC12	EC12-W	11/2/2006	ND(50)		ND(300)	
EC13	EC13-W	11/3/2006	ND(50)		ND(300)	
EC14	EC14-W	11/6/2006	410	Y	ND(300)	
Groundwater ESL¹			2,500		2,500	

Notes:

ESL¹ = San Francisco Bay Regional Water Quality Control Board (RWQCB) Environmental Screening Level (ESL) where groundwater is not a current or potential drinking water resource and where the soil leaching to groundwater and discharge of groundwater to surface water pathway does not apply (i.e., no aquatic habitat pathway).

Results exceeding ESLs are shaded

µg/l = Micrograms per liter

ND = Not detected at or above the indicated laboratory reporting limit

H = Heavier hydrocarbons contributed to the quantitation

Y = Sample exhibits chromatographic pattern which does not resemble standard

L = Lighter hydrocarbons contributed to the quantitation

Table 10
Volatile Organic Compounds in Groundwater
Site 2/3, External Coating Building
Napa Pipe Facility
Napa, California

Sample Location	Sample Identification	Sample Date	1,1,1-TCA (µg/l)	1,1-DCA (µg/l)	1,1-DCE (µg/l)	1,2,4-TMB (µg/l)	1,3,5-TMB (µg/l)	Acetone (µg/l)	Benzene (µg/l)	Carbon Disulfide (µg/l)	Chloroethane (µg/l)	cis-1,2-DCE (µg/l)	Ethylbenzene (µg/l)	Isopropylbenzene (µg/l)	Xylenes (µg/l)	Naphthalene (µg/l)	Toluene (µg/l)	n-Butylbenzene (µg/l)	para-Isopropyl Toluene (µg/l)	Propylbenzene (µg/l)	sec-Butylbenzene (µg/l)	tert-Butylbenzene (µg/l)	1,4 Dioxane ² (µg/l)	Vinyl Chloride (µg/l)
EC1	EC1-W	9/11/2006	6.2	76	3.4	ND(0.5)	ND(0.5)	11	ND(0.5)	ND(0.5)	2.7	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(2)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	NA	ND(0.5)
EC2	EC2-W	9/8/2006	1.1	2.5	ND(1)	57	19	24	2.1	ND(1)	ND(2)	ND(1)	3.5	11	4.6	150	ND(1)	12	5.5	8.8	5.6	ND(1)	NA	ND(1)
EC3	EC3-W	9/8/2006	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	16	ND(0.5)	ND(0.5)	ND(1)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(2)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	NA	ND(0.5)
EC4	EC4-W	9/8/2006	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(10)	ND(0.5)	1.0	ND(1)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(2)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	NA	ND(0.5)
EC5	EC5-W	9/8/2006	ND(1.7)	ND(1.7)	ND(1.7)	5.4	3.5	ND(33)	9.3	ND(1.7)	ND(3.3)	11	5.2	8.9	2.7	170	ND(1.7)	8.8	2.3	6.2	3.7	ND(1.7)	NA	3.5
EC6	EC6-W	9/8/2006	ND(0.5)	2.8	5.0	11	1.7	13	1.3	ND(0.5)	3.8	3.1	2.7	13	5.4	64	ND(0.5)	9.3	1.4	6.7	3.7	0.7	NA	1.7
EC7	EC7-W	9/11/2006	ND(1.7)	6.1	ND(1.7)	36	5.7	ND(33)	8.5	ND(1.7)	ND(3.3)	8.7	5.5	11	15.8	190	ND(1.7)	9.9	2.6	7.1	4.0	ND(1.7)	NA	ND(1.7)
EC8	EC8-W	11/10/2006	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(10)	ND(0.5)	ND(0.5)	ND(1.0)	ND(0.5)	ND(0.5)	ND(0.5)	0.7	ND(2)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	NA	ND(0.5)
EC9	EC9-W	11/2/2006	ND(0.5)	66	70	ND(0.5)	ND(0.5)	ND(10)	ND(0.5)	0.5	ND(1.0)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(2)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	NA	18
EC10	EC10-W	11/2/2006	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(10)	ND(0.5)	ND(0.5)	ND(1.0)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(2)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	NA	ND(0.5)
EC11	EC11-W	11/3/2006	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(10)	ND(0.5)	ND(0.5)	ND(1)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(2)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.98)	ND(0.5)
EC12	EC12-W	11/2/2006	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(10)	ND(0.5)	ND(0.5)	ND(1)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(2)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	NA	ND(0.5)
EC14	EC14-W	11/3/2006	ND(0.5)	0.8	ND(0.5)	8.8	2.1	12	ND(0.5)	ND(0.5)	ND(1)	ND(0.5)	ND(0.5)	3.6	2.1	6.5	0.5	1.8	1.1	2.0	1.8	ND(0.5)	NA	ND(0.5)
EC16	EC16-W	11/6/2006	ND(1.3)	ND(1.3)	ND(1.3)	7.2	6.8	ND(25)	12	ND(1.3)	ND(2.5)	25	3.8	6.6	ND(1.3)	180	ND(1.3)	4.5	1.4	4.8	3.3	ND(1.3)	ND(28,000)	ND(1.3)
EC18	EC18-W	11/3/2006	ND(1.0)	ND(1.0)	ND(1.0)	49	11	41	8.6	ND(1.0)	ND(2.0)	6.0	7.0	11	24	250	1.2	6.2	3.2	7.8	4.4	ND(1.0)	ND(10,000)	ND(1.0)
Groundwater ESL¹			50,000	1,000	6,300	NE	NE	50,000	540	NE	160	6,200	300	NE	5,300	210	400	NE	NE	NE	NE	NE	50,000	3.8

Notes:

ESL¹ = San Francisco Bay Regional Water Quality Control Board (RWQCB) Environmental Screening Level (ESL) where groundwater is not a current or potential drinking water resource and where the soil leaching to groundwater and discharge of groundwater to surface water pathway does not apply (i.e., no aquatic habitat pathway).

Results exceeding ESLs are shaded

µg/l = Micrograms per liter

TCA = Trichloroethane

DCA = Dichloroethane

DCE = Dichloroethene

TMB = Trimethylbenzene

ND = Not detected at or above the indicated laboratory reporting limit.

NA = Not analyzed

NE = Not established

² = Analyzed by EPA 8270-SIM Method

**Table 11
Summary of Petroleum Hydrocarbons in Soil
Site 2/3, External Coating Building
Napa Pipe Facility
Napa, Pipe**

Constituent	Maximum Detection (mg/kg)	Minimum Detection (mg/kg)	Number of Samples	Number of Detections	Frequency of Detection	Shallow (<3 meters bgs) Soil ESL ¹ (mg/kg)	Deep (>3 meters bgs) Soil ESL ¹ (mg/kg)	# of Detections Above ESL
TPH ²	27,000	ND	33	18	55%	100 ⁴ /400 ⁵	5,000	16
O&G	27,000	ND	32	25	78%	500 ^{3,4} /1000 ⁵	5,000	14
TPH-d	6,800	ND	86	62	72%	100 ⁴ /400 ⁵	5,000	21
TPH-mo	9,800	ND	79	50	63%	500 ⁴ /1000 ⁵	5,000	5
TPH-ho	1,500	ND	21	17	81%	500 ⁴ /1000 ⁵	5,000	4
TPH-g	170	18	2	2	100%	100	5,000	1

Notes:

ESL¹ = San Francisco Bay Regional Water Quality Control Board (RWQCB) Environmental Screening Level (ESL) for residential land use where potentially impacted groundwater is not a current or potential drinking water resource and where the soil leaching to groundwater and discharge of groundwater to surface water pathway does not apply (i.e. no aquatic habitat pathway).

² = Results represent the sum of TPH-d and TPH-mo concentrations. Therefore, the results are compared to the more conservative ESLs for TPH as diesel (i.e., TPH [middle distillates]).

³ = ESL for residual fuels

⁴ = 0 to 3 feet bgs interval, including samples collected from 3 to 3.5 feet bgs.

⁵ = 3 to 10 feet bgs interval, excluding soil samples collected from 3 to 3.5 feet bgs.

bgs = Below ground surface

mg/kg = milligrams per kilogram

ND = Not detected

NE = No established ESL

N/A = Not applicable

O&G = Oil & grease

TPH = Total petroleum hydrocarbons

TPH-d = TPH as diesel

TPH-g = TPH as gasoline

TPH-ho = TPH as hydraulic oil

TPH-mo = TPH as motor oil

Table 12
Summary of Volatile Organic Compounds in Soil
Site 2/3, External Coating Building
Napa Pipe Facility
Napa, Pipe

Constituent	Maximum Detection (µg/kg)	Minimum Detection (µg/kg)	Number of Samples	Number of Detections	Frequency of Detection	Shallow (<3 meters bgs) Soil ESL ¹ (µg/kg)	Deep (>3 meters bgs) Soil ESL ¹ (µg/kg)	# of Detections Above ESL
2-Butanone (MEK)	45	ND	98	2	2%	490,000	490,000	0
1,1-DCA	38	ND	98	3	3%	320	320	0
1,1-DCE	150	ND	98	3	3%	8,900	8,900	0
1,1,1-TCA	1,200	ND	98	2	2%	98,000	98,000	0
1,2,4-TMB	2,200	ND	98	4	4%	NE	NE	N/A
1,3,5-TMB	790	ND	98	2	2%	NE	NE	N/A
Acetone	250	ND	98	8	8%	500,000	1,000,000	0
Ethylbenzene	170	ND	98	4	4%	390,000	390,000	0
Isopropylbenzene	380	ND	98	2	2%	NE	NE	N/A
Methylene Chloride	160	ND	98	7	7%	520	520	0
Naphthalene ²	5,400	ND	139	11	8%	460	460	10
Nitrobenzene	39	ND	98	1	1%	NE	NE	N/A
n-Butylbenzene	770	ND	98	4	4%	NE	NE	N/A
n-Propylbenzene	36	ND	98	1	1%	NE	NE	N/A
Para(4)-Isopropyl Toluene	450	ND	98	2	2%	NE	NE	N/A
Propylbenzene	400	ND	98	1	1%	NE	NE	N/A
sec-Butylbenzene	510	ND	98	2	2%	NE	NE	N/A
Toluene	1,500	ND	98	3	3%	100,000	130,000	0
Xylenes	1,400	ND	98	11	11%	310,000	310,000	0

Notes:

ESL¹ = San Francisco Bay Regional Water Quality Control Board (RWQCB) Environmental Screening

Level (ESL) for residential land use where potentially impacted groundwater is not a current or potential drinking water resource and where the soil leaching to groundwater and discharge of groundwater to surface water pathway does not apply (i.e. no aquatic habitat pathway).

² = Also includes naphthalene results for samples analyzed by the semivolatile organic compound (SVOC) method

bgs = Below ground surface

µg/kg = Micrograms per kilogram

ND = Not detected

NE = No established ESL

N/A = Not applicable

DCA = Dichloroethane

DCE = Dichloroethene

MEK = Methyl ethyl ketone

TCA = Trichloroethane

TMB = Trimethylbenzene

Table 13
Summary of Semivolatile Organic Compounds in Soil
Site 2/3, External Coating Building
Napa Pipe Facility
Napa, Pipe

Constituent	Maximum Detection (µg/kg)	Minimum Detection (µg/kg)	Number of Samples	Number of Detections	Frequency of Detection	Shallow (<3 meters bgs) Soil ESL ¹ (µg/kg)	Deep (>3 meters bgs) Soil ESL ¹ (µg/kg)	# of Detections Above ESL
Anthracene	830	ND	41	1	2%	6,100	6,100	0
Dibenzofuran	700	ND	41	1	2%	NE	NE	N/A
Fluorene	2,000	ND	41	1	2%	160,000	160,000	0
Methylnaphthalene (total 1- & 2-)	10,000	ND	41	8	20%	110,000	110,000	0
Phenanthrene	4,300	ND	41	1	2%	40,000	1,000,000	0

Notes:

ESL¹ = San Francisco Bay Regional Water Quality Control Board (RWQCB) Environmental Screening Level (ESL) for residential land use where potentially impacted groundwater is not a current or potential drinking water resource and where the soil leaching to groundwater and discharge of groundwater to surface water pathway does not apply (i.e. no aquatic habitat pathway).

Naphthalene, a semivolatile organic compound (SVOC) was also analyzed as a volatile organic compound (VOC) under the supplemental remedial investigation conducted by PES. Therefore, naphthalene results are summarized in Table 12.

bgs = Below ground surface

µg/kg = Micrograms per kilogram

ND = Not detected

NE = No established ESL

N/A = Not applicable

**Table 14
Summary of Metals in Soil
Site 2/3, External Coating Building
Napa Pipe Facility
Napa, Pipe**

Constituent	Maximum Detection (mg/kg)	Minimum Detection (mg/kg)	Number of Samples	Number of Detections	Frequency of Detection	Shallow (<3 meters bgs) Soil ESL ¹ (mg/kg)	Deep (>3 meters bgs) Soil ESL ¹ (mg/kg)	# of Detections Above ESL	Background (mg/kg)	# of Detections Above Background
Aluminum	10,000	82	9	9	100%	NE	NE	N/A	20,293	0
Arsenic	3.8	ND	10	9	90%	5.5	5.5	0	15.3	0
Barium	910	43	10	10	100%	750	2,500	1	248	1
Cadmium	ND	ND	9	0	0%	1.7	38	0	13.7	0
Chromium	34	ND	10	8	80%	58	58	0	98	0
Chromium VI	1.9	1.9	1	1	100%	1.8	1.8	1	NE	N/A
Cobalt	17	17	1	1	100%	10	10	1	NE	N/A
Copper	77	ND	10	9	90%	230	2,500	0	49	1
Lead	20	ND	9	1	11%	150	750	0	27	0
Mercury	0.16	ND	10	10	100%	3.7	98	0	0.69	0
Nickel	102	ND	10	9	90%	150	1,000	0	125	0
Selenium	ND	ND	9	0	0%	10	2,500	0	0.9	0
Vanadium	36	36	1	1	100%	110	2,500	0	NE	N/A
Zinc	71	17	10	10	100%	600	2,500	0	134	0

Notes:

ESL¹ = San Francisco Bay Regional Water Quality Control Board (RWQCB) Environmental Screening Level (ESL) for residential land use where potentially impacted groundwater is not a current or potential drinking water resource and where the soil leaching to groundwater and discharge of groundwater to surface water pathway does not apply (i.e. no aquatic habitat pathway).

bgs = Below ground surface

mg/kg = milligrams per kilogram

ND = Not detected

NE = No established ESL or background level

N/A = Not applicable

Background = Proposed threshold concentrations, Table B-3 of JMM, 1990

Table 15
Summary of TPH as Diesel and TPH as Motor Oil in Groundwater
Site 2/3, External Coating Building
Napa Pipe Facility
Napa, California

Constituent	Maximum Detection ¹ (µg/l)	Minimum Detection ¹ (µg/l)	Number of Samples	Number of Detections	Frequency of Detection ¹	Groundwater ESL ² (µg/l)	# of Detections Above ESL
TPH as Diesel	4,800,000	ND	29	14	48%	2,500	9
TPH as Motor Oil	41,000	ND	15	4	27%	2,500	1

Notes:

¹ = Unless otherwise noted, groundwater results from: (1) the fourth quarter 2006 monitoring event; (2) Shaw Environmental Inc.'s 2005 *Phase II Site Investigation*; and (3) PES's 2006 *Supplemental Remedial Investigation* were used to compile the information presented on this table.

ESL² = San Francisco Bay Regional Water Quality Control Board (RWQCB) Environmental Screening Level (ESL) where groundwater is not a current or potential drinking water resource and where the soil leaching to groundwater and discharge of groundwater to surface water pathway does not apply (i.e., no aquatic habitat pathway).

Results exceeding ESLs are shaded

µg/l = Micrograms per liter

TPH = Total petroleum hydrocarbons

ND = Not detected

Table 16
Summary of Volatile Organic Compounds in Groundwater
Site 2/3, External Coating Building
Napa Pipe Facility
Napa, Pipe

Constituent	Maximum Detection ¹ (µg/l)	Minimum Detection ¹ (µg/l)	Number of Samples	Number of Detections	Frequency of Detection ¹	Groundwater ESL ² (µg/l)	# of Detections Above ESL
2-Butanone (MEK)	2.5	ND	30	1	3%	50,000	N/A
1,1-DCA	330	ND	30	8	27%	1,000	0
1,1-DCE	70	ND	30	5	17%	6,300	0
1,4 Dioxane	80	ND	7	1	14%	50,000	0
1,1,1-TCA	110	ND	30	3	10%	50,000	0
1,2,4-TMB	57	ND	30	10	33%	NE	N/A
1,3,5-TMB	19	ND	30	9	30%	NE	N/A
Acetone	41	ND	30	7	23%	50,000	0
Benzene	12	ND	30	9	30%	540	0
Carbon Disulfide	1.0	ND	30	2	7%	NE	N/A
Chloroethane	120	ND	30	3	10%	160	0
cis-1,2-DCE	25	ND	30	8	27%	6,200	0
Ethylbenzene	7	ND	30	8	27%	300	0
Isopropylbenzene	17	ND	30	10	33%	NE	N/A
Naphthalene ⁴	4,100	ND	34	12	35%	210	2
Nitrobenzene	140	ND	4	1	25%	NE	N/A
n-Butylbenzene	31	ND	30	10	33%	NE	N/A
n-Propylbenzene	14	ND	4	1	25%	NE	N/A
para(4)-Isopropyl Toluene	13	ND	30	11	37%	NE	N/A
Propylbenzene	8.8	ND	26	8	31%	NE	N/A
sec-Butylbenzene	15	ND	30	10	33%	NE	N/A
tert-Butylbenzene	0.7	ND	30	1	3%	NE	N/A
Toluene	15	ND	30	1	3%	400	0
Trimethylbenzene	52	ND	4	1	25%	NE	N/A
Vinyl Chloride	130	ND	30	5	17%	3.8	3
Xylenes	24	ND	30	8	27%	5,300	0

Notes:

¹ = Unless otherwise noted, groundwater results from: (1) the fourth quarter 2006 monitoring event; (2) Shaw Environmental Inc.'s 2005 *Phase II Site Investigation*; and (3) PES's 2006 *Supplemental Remedial Investigation* were used to compile the information presented on this table.

ESL² = San Francisco Bay Regional Water Quality Control Board (RWQCB) Environmental Screening Level (ESL) where groundwater is not a current or potential drinking water resource and where the soil leaching to groundwater and discharge of groundwater to surface water pathway does not apply (i.e., no aquatic habitat pathway).

Results exceeding ESLs are shaded

³ = 1,4-dioxane results from the second quarter 2006 monitoring round were used because the samples collected during the fourth quarter 2006 monitoring round were not analyzed for this constituent.

⁴ = Also includes naphthalene results for samples analyzed by the semivolatile organic compound (SVOC) method

µg/l = Micrograms per liter

DCA = Dichloroethane

DCE = Dichloroethene

MEK = Methyl ethyl ketone

TCA = Trichloroethane

TMB = Trimethylbenzene

N/A = Not applicable

ND = Not detected

NE = Not established

Table 17
Summary of Semivolatile Organic Compounds in Groundwater
Site 2/3, External Coating Building
Napa Pipe Facility
Napa, Pipe

Constituent	Maximum Detection ¹ (µg/l)	Minimum Detection ¹ (µg/l)	Number of Samples	Number of Detections	Frequency of Detection ¹	Groundwater ESL ² (µg/l)	# of Detections Above ESL
Anthracene	310	ND	4	1	25%	22	1
Fluorene	2,000	ND	4	1	25%	950	1
Methylnaphthalene (total 1- & 2-)	25,000	ND	4	1	25%	100	1
Phenanthrene	3,100	ND	4	1	25%	410	1

Notes:

¹ = Results used to compile the information presented on this table are from Shaw Environmental Inc. 2005 *Phase II*

Site Investigation at Napa Pipe Facility, 1025 Kaiser Road, Napa, CA

ESL² = San Francisco Bay Regional Water Quality Control Board (RWQCB) Environmental Screening Level (ESL)

where groundwater is not a current or potential drinking water resource and where the soil leaching to groundwater and discharge of groundwater to surface water pathway does not apply (i.e., no aquatic habitat pathway).

Results exceeding ESLs are shaded

µg/l = Micrograms per liter

ND = Not detected

**Table 18a
Preliminary Screening of Remedial Technologies for Soil
Napa Pipe Facility, Napa, California**

Technology	Description	General Applicability/Limitations	Comments Specific to Site 2/3			Retained?
			Effectiveness ^a	Implementability ^b	Relative Cost ^c	
Soil Vapor Extraction	Vacuum is applied to the subsurface to extract contaminant-laden soil gas. Induced concentration gradients result in desorption and mobilization of contaminants to fresh air pulled in from outside the target zone.	<p>Applicability. Applicable to volatile organics and some fuels (Henry's law constant greater than 0.01 or vapor pressure greater than 0.5 mm Hg). Moisture content, organic content, and air permeability of soil affect applicability. Aeration by SVE can promote <i>in situ</i> aerobic biodegradation but can also limit anaerobic biodegradation.</p> <p>Limitations. Performance is function of air permeability and contaminant volatility. High amount of fines and high degree of saturation limit airflow require higher vacuums. Stratified soils result in non-uniform airflow causing hot spots to remain. High sorption capacity can reduce removal rates. Off-gas and residual liquids may require treatment/disposal.</p>	<p>Low Primary site contaminants (diesel and motor oil) are not readily amenable to SVE. Unsaturated zone is not very thick and consists of low permeability silts and clays. Site lithology is not conducive to technologies relying on subsurface air flow. Potential for free product makes this technology even less viable.</p>	<p>Easy After all aboveground structures are removed, implementing this technology is fairly easy. The system is simple to operate and maintain, requiring no specialized skill level and experience. Equipment is readily available with numerous vendors.</p>	<p>Low ⑤ SVE is a proven and relatively easy to operate remediation technology. System installation and operating costs are not excessive requiring no special equipment and consumables. High uncertainty since no data is available to determine long-term effectiveness and remediation duration, and contaminants are not prone to volatilization.</p>	No – due to low effectiveness.
Thermally Enhanced Soil Vapor Extraction	Hot air, steam, or soil heating is used to enhance desorption, volatilization and mobility. Vacuum is applied to subsurface to remove the volatilized contaminants.	<p>Applicability. Technology improves volatility of VOCs and SVOCs. Heating soil may increase air permeability by drying soils or interstitial pore space. Thermally enhanced SVE can improve conditions for biodegradation of residual contaminants.</p> <p>Limitations. Performance is function of attainable soil temperature, air permeability, and contaminant volatility. Same limitations as SVE. Offgas and residual liquids may be required treatment/disposal. Higher process temperatures require specialized equipment.</p>	<p>Low to Medium Thermal enhancement may provide limited improvement of contaminant extraction rates compared to SVE. Soils can become more permeable as they dry out. Diesel and motor oil contaminants will volatilize more when heated. Thin unsaturated zone, low permeability silts and clays, and heterogeneous lithology is not conducive to technologies relying on subsurface air flow. Potential for free product further reduces effectiveness.</p>	<p>Moderately Difficult Similar to SVE except specialized process equipment and higher temperature-rated components are needed. Also, specialized skills are required to operate and maintain the heat source systems. Boundary control becomes a challenge to ensure contaminated vapors and liquids do not contaminate previously clean areas.</p>	<p>Moderate to High ⑤ Significantly higher costs than conventional SVE due to need for high temperature rated equipment and material. Also, electrical and/or fuel costs are significantly higher to supply the heat source. Shallow water table may require additional measures to ensure contaminated vapors are not released from the site. Maximum soil temperatures may be limited by low air permeability and shallow water table. High uncertainty since no data is available to determine long-term effectiveness and remediation duration. Site lithology not conducive to technologies relying on subsurface air flow.</p>	No – due to low effectiveness and relatively high cost

**Table 18a
Preliminary Screening of Remedial Technologies for Soil
Napa Pipe Facility, Napa, California**

Technology	Description	General Applicability/Limitations	Comments Specific to Site 2/3			Retained?
			Effectiveness ^a	Implementability ^b	Relative Cost ^c	
Excavation	Contaminated soils are excavated using standard construction techniques such as excavators, bulldozers, and scrapers. Excavation of saturated soils may require dewatering. Excavated soils are managed using other remediation technologies depending on contaminant type and concentration, cleanup levels, and regulatory requirements.	<p>Applicability. Excavation of soils above water table is a common remediation method. Relatively shallow unsaturated zone minimizes excavation volumes and limits need for shoring or slope stabilization. Excavation of soils below water table is less common, but limited depth of contamination below the water table makes this approach feasible.</p> <p>Limitations. Requires heavy construction equipment. Potential free phase product and high concentrations may present safety concerns requiring engineering controls to prevent exposure and fire/explosion. Silty/clayey soils may involve additional handling requirements.</p>	<p>High Impacted soil and contaminants are removed and no longer provide a potential source of exposure or secondary source of contamination to groundwater.</p>	<p>Moderately Easy After all aboveground structures are removed, excavation is fairly straightforward to implement using standard construction techniques. Large excavations below the water table will require dewatering and/or specialized excavation methods.</p>	<p>Moderate ① Large contaminated area and potential need to use respiratory equipment and handle contaminated soils and free phase product increase costs. Also, all contaminants are excavated and clean boundaries are confirmed via on-site sampling.</p>	Yes – effective and readily implemented at reasonable cost.
<i>Ex Situ</i> Low Temperature Thermal Desorption	Excavated soil is processed through an aboveground low temperature thermal desorption (LTTD) unit where it is heated to upwards of 600°F. Contaminants volatilize and are removed and treated in the vapor phase. Clean soils can be used as backfill material. Pre-processing of contaminated soils may be required to remove debris or oversize material, reduce moisture content to <20 to 30%, and reduce excessively high contaminant concentrations.	<p>Applicability. Site 2/3 contaminants will desorb at temperatures achievable by LTTD and are readily destroyed in standard vapor phase treatment systems (e.g., thermal oxidizers).</p> <p>Limitations. Moisture content of saturated soils and silty/clayey soils may involve additional handling requirements (e.g., drying). Large LTTD units require significant mobilization of equipment and access to large supplies of natural gas or propane. Operation of LTTD units will likely require air discharge permitting and associated emission limits.</p>	<p>High LTTD is a proven technology that has been shown effective at reducing contaminant concentrations to well below site cleanup levels. Effective operation results in soil suitable for reuse and destruction of contaminants in vapor phase treatment systems.</p>	<p>Moderately Difficult LTTD units of the size potentially required at Site 2/3 are large specialized systems and require significant mobilization and setup. Permitting requirements can be significant, but rarely prevent operations. Once set up, operations are relatively straightforward and involve providing a constant feed of contaminated soil to the LTTD unit, operation and monitoring of the unit itself, and managing the treated soils.</p>	<p>Moderate to High ③ Fuel requirements to run the LTTD unit increase operating costs. Contaminants are heated well above the boiling point, and soils can be blended to ensure soil is uniformly heated. Soils excavated from the capillary fringe will be wet and likely require drying. Although this is a proven technology for the site contaminants and confirmation sampling documents treatment effectiveness, moderate uncertainty associated with permitting requirements and exact nature of soil pre-processing requirements.</p>	Yes – effective and implementable for site contaminants at moderate cost.

**Table 18a
Preliminary Screening of Remedial Technologies for Soil
Napa Pipe Facility, Napa, California**

Technology	Description	General Applicability/Limitations	Comments Specific to Site 2/3			Retained?
			Effectiveness ^a	Implementability ^b	Relative Cost ^c	
Incineration	Excavated soil is processed through an aboveground incinerator unit where it is heated to high temperatures (upwards of 1,800°F). Contaminants are destroyed due to the high combustion temperatures. Clean soils can be used as backfill material.	<p>Applicability. Use of incinerator requires mobilizing a unit to the site (readily available technology). Contaminants are suitable for high temperature volatilization and removal/destruction.</p> <p>Limitations. Moisture content of saturated soils and silty/clayey soils may involve additional handling requirements. Large soil incineration units require significant mobilization of equipment and access to large supplies of natural gas or propane. Operation of incinerator unit will likely require air discharge permitting and associated emission limits.</p>	<p>High Incineration is a proven technology that has been shown effective at reducing contaminant concentrations to well below site cleanup levels. Effective operation results in soil suitable for reuse.</p>	<p>Moderately Difficult Incineration units of the size potentially required at Site 2/3 are large and specialized systems and require significant mobilization and setup. Permitting requirements can be significant.</p>	<p>High ③ Due to significantly higher operational temperatures, incinerators are more expensive to build and operate, with large fuel requirements increasing operating costs. Soils excavated from the capillary fringe will be wet and likely require drying. Although this is a proven technology for the site contaminants, the moderate uncertainty is associated with permitting requirements and exact nature of soil pre-processing requirements.</p>	No – Higher costs compared to LTTD with no benefit.
In-Pile Thermal Desorption	Excavated soil is stockpiled in engineered cells with embedded thermal desorption heaters and extractors. A heat source adds thermal energy to the pile to volatilize VOCs and SVOCs. Depending on the temperature (upwards of 1,600°F), contaminants can be destroyed or extracted and treated. Clean soils can be used as backfill material.	<p>Applicability. Contaminants are susceptible to high temperature volatilization and removal/destruction. Large available land area to set up cells.</p> <p>Limitations. Requires heavy construction equipment. Contaminant aeration is likely during excavation, potentially requiring respiratory protection for on-site workers. Potential free phase product and high concentrations present safety concerns due to exposure and fire/explosion. Desorbed vapors and drained liquids require containment measures and treatment systems.</p>	<p>High Thermal desorption is a proven technology that has been shown effective at reducing contaminant concentrations, although in-pile technique utilized less than continuous feed LTTD and incineration technologies. Effective operation results in soil suitable for reuse and destruction of contaminants in vapor phase treatment systems.</p>	<p>Moderately Difficult to Difficult Specialized skills and experience required to operate the IPTD system. If necessary, vapor treatment technologies are readily available for diesel and motor oil.</p>	<p>High ④ Large contaminated area and potential need to use respiratory equipment and handle contaminated soils and free phase product increase costs. Fuel or electrical requirements to provide the heat source increase operating costs. Uncertainty higher compared to LTTD due to difficulties ensuring uniform treatment and management of vapors and liquids from piles.</p>	No – higher cost and uncertainty compared to LTTD.
<i>In Situ</i> Thermal Desorption (ISTD)	ISTD is similar to In-Pile Thermal Desorption except heat is applied in-situ (without excavation) through heater wells and contaminant vapors extracted through heated extraction wells. The thermal energy is transmitted to the subsurface via thermal convection and radiant heating to volatilize VOCs and SVOCs. Temperatures of greater than 1,000°F can be achieved. Contaminants can be destroyed in situ or extracted and treated.	<p>Applicability. Site contaminants are susceptible to high temperature volatilization and removal/destruction.</p> <p>Limitations. Sites with thin contaminated zones less suited to technology due to cost considerations. Certain underground utilities can must be removed prior to treatment.</p>	<p>High Thermal desorption is a proven technology that has been shown effective at reducing contaminant concentrations.</p>	<p>Moderately Difficult to Difficult Specialized skills and experience required to operate the ISTD system. If necessary, vapor treatment technologies are readily available for diesel and motor oil.</p>	<p>High ④ Relatively thin contaminated zone significantly increases unit cost of ISTD compared to other thermal technologies. Uncertainty higher compared to LTTD due to difficulties ensuring uniform treatment and collection and treatment of vapors from subsurface.</p>	No – higher cost and uncertainty compared to <i>Ex Situ</i> LTTD.

**Table 18a
Preliminary Screening of Remedial Technologies for Soil
Napa Pipe Facility, Napa, California**

Technology	Description	General Applicability/Limitations	Comments Specific to Site 2/3			Retained?
			Effectiveness ^a	Implementability ^b	Relative Cost ^c	
Bioventing	Oxygen is delivered <i>in situ</i> by forced air movement to stimulate aerobic biodegradation.	<p>Applicability. Generally applies to aerobic biodegradation of contaminants sorbed to soil particles. Target contaminants are typically petroleum hydrocarbons, nonchlorinated solvents, and other organic chemicals.</p> <p>Limitations. Shallow water table, saturated soils, high concentrations and/or free phase product, and low permeability soils reduce bioventing performance.</p>	<p>Low Could enhance aerobic degradation in areas with lower contaminant concentrations. Unsaturated zone is not very thick and consists of low permeability silts and clays. Potential free product and high contaminant concentrations may be too toxic for effective biodegradation.</p>	<p>Easy After all aboveground structures are removed, implementing this technology is fairly easy. The system is easy to operate and maintain, requiring no specialized skill level and experience. Also, the equipment is readily available with numerous vendors.</p>	<p>Low ⑤ Adding oxygen to the subsurface involves easy-to-operate and fairly common equipment. High uncertainty since biodegradation rates adversely affected by high contaminant concentrations and potential free phase product. Also, site lithology not conducive to technologies relying on subsurface air flow.</p>	No – ineffective due to site conditions.
Bio-Piling	Excavated soils are stockpiled in engineered cells with embedded injectors to add oxygen, nutrients, and/or amendments as needed to stimulate biodegradation. Clean soils can be used as backfill material.	<p>Applicability. Similar to bioventing except <i>ex situ</i>. Target contaminants are typically petroleum hydrocarbons, nonchlorinated solvents, and other organic chemicals. Large available land area to set up cells.</p> <p>Limitations. Potential free phase product and high concentrations present safety concerns due to exposure, and may be toxic to bacteria. Potential vapors and drained liquids may require containment measures and treatment. Depending on biodegradation rates, cleanup levels, and quantity of soil requiring remediation, treatment can a significant amount of time (months or years).</p>	<p>Medium to High Could enhance aerobic degradation in areas with low to moderate contaminant concentrations. Silts and clays are low permeability, which would adversely affect airflow through the pile. Potential free product and high contaminant concentrations may inhibit bioactivity. These factors may improve with proper blending/mixing with cleaner more permeable soils.</p>	<p>Moderate Skill and experience requirements to construct and operate biopiles are relatively common. Equipment requirements are minimal, and equipment is readily available. Management of vapors and liquids increase complexity.</p>	<p>Low to Moderate ④ Large contaminated area and potential need to use respiratory equipment and handle contaminated soils and free phase product increase costs. Higher uncertainty since biodegradation rates are unknown and would need to be evaluated in treatability studies. Rates adversely affected by high contaminant concentrations and potential free phase product.</p>	Yes – effective and implementable treatment at moderate cost.
Landfarming	Excavated soil is spread in thin layers on the ground. Soil is aerated by tilling and/or plowing to stimulate biodegradation. Nutrients or amendments can be utilized if needed. Clean soils can be used as backfill material.	<p>Applicability. Similar to bio-piling, except land requirements are significantly higher in order to set up “landfarms”.</p> <p>Limitations. Similar to bio-piling, except more difficult to control moisture content since landfarms are not typically covered and are exposed to rainfall. Also more difficult to control vapors.</p>	<p>Medium Similar to bio-piling except it can be more difficult to control factors effecting biodegradation (e.g., moisture content, temperature). Technology may not be effective during wet season due to excessive rainfall.</p>	<p>Moderately Easy Skills, experience and equipment requirements to implement this technology are minimal. Because soil is treated in relatively shallow lifts, treatment of large volumes of soil require either very large areas to conduct treatment or longer treatment periods to process multiple lifts.</p>	<p>Low ④ Costs lower than bio-piling due to minimal equipment and operational requirements. Uncertainty similar to or slightly higher than bio-piling due to potential impacts of rainfall on performance.</p>	Yes – potentially effective treatment at low cost.

**Table 18a
Preliminary Screening of Remedial Technologies for Soil
Napa Pipe Facility, Napa, California**

Technology	Description	General Applicability/Limitations	Comments Specific to Site 2/3			Retained?
			Effectiveness ^a	Implementability ^b	Relative Cost ^c	
Monitored Natural Attenuation	Natural processes (volatilization, biodegradation, adsorption, and chemical reactions) are used to reduce contaminant concentrations to acceptable levels.	<p>Applicability. Natural attenuation is a common element of cleanup programs for fuel hydrocarbons and halogenated VOCs. Can be used to manage residual contamination following site stabilization and source control activities. Timeframe for cleanup not consistent with RAOs.</p> <p>Limitations. Extensive site characterization, modeling, and monitoring are required to document the natural attenuation of the contaminants. High contaminant concentrations and/or free phase product limit applicability of biodegradation. Similarly, higher molecular weight contaminants hinder volatilization.</p>	<p>Low As compared to other remedial technologies, use of MNA will take much longer (e.g., decades) to achieve cleanup levels. Diesel and motor oil are not amenable to volatilization, and areas of high concentrations and/or free phase product may be toxic to the bacteria.</p>	<p>Moderately Easy The required equipment, skills, and experience to implement monitored natural attenuation is minimal, although extensive sampling and analysis are needed to baseline the process and monitor ongoing progress.</p>	<p>Low ⑤ Because there are no major equipment and construction requirements, the cost to implement this technology is low although long-term monitoring costs could be significant. The uncertainty of achieving the RAOs is high since contaminant concentrations have remained high after many years of potential bioactivity. High concentrations and free product inhibit natural biodegradation, and the site contaminants are not amenable to natural volatilization.</p>	No –not suitable to achieve cleanup goals.
<i>In Situ</i> Chemical Oxidation	Strong oxidizer is injected into subsurface to oxidize and destroy organic contaminants.	<p>Applicability. Chemical oxidation commonly applied to wide range of organic compounds including unsaturated aliphatic (i.e., TCE), aromatic compounds (i.e., benzene), and fuel hydrocarbons. Fast reaction rates can be achieved depending on oxidant type used.</p> <p>Limitations. Incomplete oxidation can result in intermediate contaminants. Some oxidizers can be explosive, particularly in high concentrations of high energy contaminants. Uniform application of oxidants required to ensure all contaminants are being treated can be difficult to achieve in stratified soils. Indiscriminant and rapid reactions with other oxidant-consuming substances (e.g., natural organic matter) reduce effectiveness.</p>	<p>Medium Diesel and motor oil amendable to treatment using chemical oxidation. Low soil permeability from silts and clays will make uniform distribution of the chemical oxidizer within the subsurface more difficult although relatively shallow and thin treatment zone will help this. Also, high contaminant concentrations and/or free phase product could require large amount of oxidizer.</p>	<p>Moderately Difficult After all aboveground structures are removed, injecting the oxidants would not be difficult, although effective distribution of oxidants through treatment zone may be challenging. Handling large quantities of strong oxidizers presents health and safety concerns.</p>	<p>Medium to High④ Costs dependent on contaminant concentrations. High concentrations and the potential presence of free phase product could require large quantities and frequent applications of the oxidizer and result in much higher costs. Less contaminated soils will require less oxidant, fewer applications, and would cost less. Handling and safety requirements add additional costs. The uncertainty is moderate to high since the stratified lithology and low soil permeability could prevent oxidant from being uniformly distributed within the contaminated regions – treatability studies would be required to address uncertainty.</p>	Yes – although site soils not well suited for <i>in situ</i> approach, chemical oxidation retained as representative <i>in situ</i> remediation technology. May not be appropriate for treating source area soils.
<i>In Situ</i> Soil Washing	Water, or water containing an additive to enhance contaminant mobility, is applied to the soil surface or injected into the ground to flush contaminants into the groundwater. The groundwater is then extracted and treated.	<p>Applicability. Soil washing can be used to treat VOCs, SVOCs, and some fuels and enhance recovery of NAPL.</p> <p>Limitations. Different contaminants require different wash water mixtures. Clayey soil causes the contaminant to adhere more strongly to the soil, making it difficult to desorb. Also, the wash water may alter the physical and chemical properties of soil.</p>	<p>Low Contaminants are hydrophobic and soil washing would not mobilize the contaminants to the water table. Amendments may help, but there is significant uncertainty as to effectiveness. Soil washing could also result in contaminating previously clean areas.</p>	<p>Moderately Difficult Implementation requires uniform application of water and amendments through the contaminated region, which would be difficult given stratified and low-permeability soils.</p>	<p>Low to Medium⑤ This technology involves a low-cost network of aboveground piping and systems to inject the wash water. The high uncertainty is a result of the stratified lithology, low soil permeability, and hydrophobic contaminants.</p>	No – effectiveness uncertain

Table 18a
Preliminary Screening of Remedial Technologies for Soil
Napa Pipe Facility, Napa, California

Technology	Description	General Applicability/Limitations	Comments Specific to Site 2/3			Retained?
			Effectiveness ^a	Implementability ^b	Relative Cost ^c	
Off-Site Disposal	Excavated soil is disposed off-site at an approved and permitted facility.	<p>Applicability. Off-site disposal facilities are readily available that accept soils contaminated with fuels and VOCs.</p> <p>Limitations. None.</p>	<p>High</p> <p>Impacted soil is removed and no longer provides a potential source of contamination to groundwater.</p>	<p>Easy</p> <p>Off-site disposal facilities readily available and only require transportation of contaminated soils.</p>	<p>Moderate to High ①</p> <p>Costs for off-site disposal are moderate to high depending on waste classification of soils. Costs further increased due to need for importing of additional fill to site. Low uncertainty.</p>	Yes – retained for use with soils that may not be amenable for treatment with on-site technologies.

NOTE: Uncertainty rating reflects additional data needs or technology development needed to demonstrate applicability, implementability, and cost uncertainty. ① = low degree of uncertainty. Site data generally available to determine applicability. ⑤ = high degree of uncertainty. Additional data, analysis, pilot testing, or technology development required to determine applicability to site.

^a Preliminary effectiveness ratings of high, medium, and low reflect estimated relative effectiveness of the technology to treat the site contaminants and meet RAOs.

^b Implementability rating of easy, moderately easy, moderately difficult, and difficult reflect estimated relative complexity and cost of implementing the technology.

^c Cost reflects the relative overall costs (low, medium, high) of implementing the technology at the site.

**Table 18b
Preliminary Screening of Remedial Technologies for Groundwater
Napa Pipe Facility, Napa, California**

Technology	Description	General Applicability/Limitations	Comments Specific to Site 2/3			Retained?
			Effectiveness ^a	Implementability ^b	Relative Cost ^c	
Groundwater Extraction	Groundwater is pumped to extract contaminants and generate hydraulic gradients that can contain the plume and mobilize the contaminants to the extraction wells. Extracted groundwater is treated aboveground as needed and discharged.	<p>Applicability. Groundwater pumping is common for achieving hydraulic control and recovering contaminant mass. The contaminants are removed from the subsurface in the dissolved phase and then removed by the carbon. Technology is applicable to high contaminant concentrations in the dissolved phase in soils with high permeability and yields.</p> <p>Limitations. Groundwater extraction for contaminant removal is dependent on the hydraulic permeability of the formation.</p>	<p>Low Given low permeability and stratified soils at Site 2/3, achieving cleanup goals with groundwater extraction will be slow and may not affect residual free phase product (light or dense). Existing extraction trench has contained the groundwater plume/recovered contaminant mass, but has not cleaned up the contamination in the 14 years of operation.</p>	<p>Easy Groundwater extraction involves installing pumping systems to remove groundwater from the subsurface. These systems are relatively easy to install and operate. The required skills and experience for this technology is widely available. There are numerous vendors that can supply the equipment.</p>	<p>Medium to High ⑤ System installation costs are not excessive. Due to long cleanup timeframe, however, life-cycle costs for groundwater extraction and treatment systems are often high. Treatment costs could be high due to potentially significant contaminant mass. There is a high uncertainty regarding the timeframe required to achieve cleanup goals, if they can be achieved with this technology at all.</p>	No – low effectiveness due to site conditions (presence of free-phase product) and inability to meet RAOs.
Existing Wastewater Treatment System and Sanitary Sewer Discharge	The Napa Pipe facility currently maintains a wastewater treatment system that discharges into the sanitary sewer under a permit with the Napa County Sanitation District. This system includes storage tanks, chemical injection systems (flocculant injection), settling tanks, an oil/water separator. Groundwater generated during dewatering will be treated using this existing wastewater treatment system and discharged to the sanitary sewer under the existing permit. If additional treatment is required to remove dissolved organic constituents (TPH, VOCs) to below permit limits, a series of granular activated carbon (GAC) vessels will be added as a polishing step prior to discharge.	<p>Applicability. The existing wastewater treatment system appears to be suitable for use in treating groundwater with only minimal modification required, including the potential addition of GAC vessels to remove dissolved organics.</p> <p>Limitations. The existing wastewater treatment system must be operated within the requirements of the sanitary sewer discharge permit. Temporary transfer piping may be required to get groundwater from remediation areas to the system, or it can be moved using portable tanks or tanker trucks.</p>	<p>High The existing system has been demonstrated effective at meeting discharge requirements for the sanitary sewer and has the major treatment components needed to be treat groundwater, with the possible addition of GAC vessels.</p>	<p>Easy The existing facility is already constructed and permitted, and modifications necessary for use in treating groundwater are relatively straightforward to implement.</p>	<p>Low ③ The existing system will cost very little to modify for use as a groundwater treatment system, and operational costs are expected to be moderate. Uncertainty is associated with need to determine whether GAC adsorption vessels will be required and the means in getting the groundwater to the system.</p>	Yes – will be effective in managing groundwater extracted as part of excavation dewatering activities.
Permeable Reactive Barrier	Subsurface barrier allows passage of groundwater and controls movement of contaminants. The barrier is filled with reactive agents or microorganisms where the concentrated contaminants are either degraded or retained in the barrier material.	<p>Applicability. Reactive barriers apply to VOCs, SVOCs, and inorganics. A variety of media have been used to treat various classes of contaminants.</p> <p>Limitations. Requires heavy construction equipment. The reactive agents must be matched to the contaminants. Effectiveness is specific to barrier media and contaminants. Needs to be keyed into a confining layer. Barriers can lose hydraulic or reactive capacity over time. May be susceptible to fouling or excessive leakage if not designed and/or installed properly.</p>	<p>Low At the site, with the low groundwater flowrates, there may be limited effectiveness in achieving cleanup goals. Contaminant mass removal is a function of the flowrates through the wall. Unlikely to have efficiency for TPH compounds dissolved in groundwater.</p>	<p>Moderately Difficult Because of the shallow water table and relatively shallow depth to confining layer, installing the slurry wall barrier is straightforward. However, the extent of the contaminant boundary requires a large area to be contained and the plume would need to be more clearly delineated.</p>	<p>Medium to High ③ This technology involves excavating a large quantity of soil, but significantly less than the entire contaminated volume. Additional costs would be incurred. The medium uncertainty is associated with the determining the nature of the permeable barrier and evaluating the site hydraulics to effectively design the slurry wall/barrier system..</p>	No – not effective given site conditions and TPH contaminants.

**Table 18b
Preliminary Screening of Remedial Technologies for Groundwater
Napa Pipe Facility, Napa, California**

Technology	Description	General Applicability/Limitations	Comments Specific to Site 2/3			Retained?
			Effectiveness ^a	Implementability ^b	Relative Cost ^c	
<i>In Situ</i> Enhanced Bioremediation	<p>Adding oxygen, nutrients, co-substrates, or amendments to the groundwater to increase the rate of biodegradation.</p> <p>Can also implement this technology by applying amendments to open excavations during backfilling for treatment of residual contamination.</p>	<p>Applicability. Bioremediation is applicable to petroleum hydrocarbons, some solvents, and other organic chemicals. Can be effective for remediating low level residual contamination in conjunction with source removal.</p> <p>Limitations. Applies to contaminants that can be biodegraded. Low permeability soils can hinder contact between contaminant, oxygen, and applied nutrients. Bio-fouling can result from biomass accumulation on well screens. Too low or too high contaminant concentrations adversely affect biodegradation rates.</p>	<p>Medium</p> <p>Could enhance aerobic degradation in areas with lower contaminant concentrations. Potential for free product and high contaminant concentrations in source areas may be too toxic for effective biodegradation. Can be effective in controlling residual contamination in excavations by adding amendments to backfill in the saturated zone.</p>	<p>Moderately Easy</p> <p>Implementing this technology is fairly easy, and skills, experience and equipment requirements are minimal. However, ensuring uniform application throughout the subsurface may be problematic due to the silty and clayey soils. This could result in hot spots continuing to contaminate the groundwater. Implementation as a backfill amendment is very simple.</p>	<p>Low ④</p> <p>Adding oxygen, nutrients, and amendments to the subsurface involves easy-to-operate and fairly common equipment. Moderate uncertainty associated with need to determine nature of amendments through treatability studies and uncertainty related to timeframe for achieving cleanup goals. Also, stratified lithology/ low permeability soils may prevent complete contact with all contaminant mass.</p>	<p>Yes – may be cost effective for lower concentration groundwater plumes but would require treatability studies to evaluate further.</p>
Monitored Natural Attenuation	<p>Natural processes (volatilization, biodegradation, adsorption, and chemical reactions) are used to reduce contaminant concentrations to acceptable levels.</p>	<p>Applicability. Natural attenuation is a common element of cleanup programs for fuel hydrocarbons and halogenated VOCs. Can be used to manage residual contamination following site stabilization and source control activities.</p> <p>Limitations. Extensive site characterization, modeling, and monitoring are required to document the natural attenuation of the contaminants. Typically involves long cleanup timeframe. High contaminant concentrations and/or free phase product limit applicability of biodegradation. Similarly, higher molecular weight contaminants hinder volatilization.</p>	<p>Low</p> <p>As compared to other remedial technologies, use of MNA will result in an extended cleanup timeframe. Diesel and motor oil are not amenable to volatilization, and areas of high concentrations and/or free phase product will be toxic to the bacteria.</p>	<p>Easy</p> <p>The skills and experience to implement monitored natural attenuation is minimal. Sampling and analysis are needed to baseline the process and monitor ongoing progress.</p>	<p>Low to Medium ⑤</p> <p>Because there are no major equipment and construction requirements, the cost to implement this technology is low, although long-term monitoring costs can be significant. The uncertainty of achieving the RAOs is high since contaminant concentrations have remained high after many years of potential bioactivity. High concentrations and free product inhibit natural biodegradation, and the site contaminants are not amenable to natural volatilization.</p>	<p>No –not effective in achieving cleanup goals in reasonable timeframe.</p>
Air Sparging	<p>Air is injected into groundwater to volatilize contaminants, and oxygen potentially increases biodegradation rates. Contaminants sparged from groundwater are recovered in the unsaturated zone by SVE.</p>	<p>Applicability. Target contaminants for sparging include VOCs and volatile fuels. Removal mechanisms can include volatilization and enhanced bioremediation.</p> <p>Limitations. Non-volatile contaminants not removed with this technology. Effectiveness requires uniform flow of air through saturated soil. Heterogeneous soils can result in non-uniform treatment and uncontrolled movement of contaminated vapors. High contaminant solubility limits transfer to the vapor phase. Addition of oxygen could cause oxidation and precipitation of iron and impact air permeability.</p>	<p>Low</p> <p>Diesel and motor oil are not readily amenable to this technology with lower volatilization rate. Silts and clays result in areas of low permeability, adversely affecting air flowrates. High contaminant concentrations and/or free phase product increase the potential for spreading contamination into previously clean areas.</p>	<p>Easy</p> <p>Equipment to implement this technology is readily available and easy to operate. Similarly, the necessary skills and experience are minimal.</p>	<p>Medium ④</p> <p>Air sparging equipment costs are relatively low due to minimal equipment, although operating costs would add to the total cost. The uncertainty is high due to low air permeability, high contaminant concentrations, and unknown design parameters. Site lithology not conducive to technologies relying on subsurface air flow.</p>	<p>No – technology ineffective with heavier contaminants and not suited to soil conditions.</p>

**Table 18b
Preliminary Screening of Remedial Technologies for Groundwater
Napa Pipe Facility, Napa, California**

Technology	Description	General Applicability/Limitations	Comments Specific to Site 2/3			Retained?
			Effectiveness ^a	Implementability ^b	Relative Cost ^c	
Thermally Enhanced Air Sparging	Hot air, steam, or electric heating is used to enhance desorption and volatilization of the contaminants. Other potential benefits are increased contaminant mobility and biodegradation rates.	<p>Applicability. Heating improves the volatility of VOCs and SVOCs. Effective for subsurfaces with higher air permeability.</p> <p>Limitations. Performance is function of attainable temperature, air permeability, and contaminant volatility. Off-gas and residual liquids may be required treatment/disposal. Higher process temperatures require specialized equipment. Shallow water tables may allow contaminated vapors to escape.</p>	<p>Medium</p> <p>Thermal enhancement may improve volatilization. Diesel and motor oil contaminants will volatilize more when heated. Maximum groundwater temperatures are limited by low air permeability and shallow water table. Stratified lithology may result in cold spots where contaminants are not treated, thereby continuing to contaminate the groundwater above RAO requirements.</p>	<p>Moderately Difficult</p> <p>Similar to air sparging except process equipment rated for higher temperature may be needed. Also, specialized skills are required to operate and maintain the heat source systems. Vapor control becomes a challenge to ensure contaminated vapors and liquids do not contaminate previously clean areas.</p>	<p>Medium to High ⑤</p> <p>Costs are higher than conventional air sparging due to need for high temperature rated equipment and material. Also, electrical and/or fuel costs are significantly higher to supply the heat source. Shallow water table may require additional measures to ensure contaminated vapors are not released from the site. Maximum soil temperatures are limited by low air permeability and shallow water table. High uncertainty since no data is available to determine long-term effectiveness and remediation duration. Site lithology not conducive to technologies relying</p>	No – technology likely ineffective due to soil conditions
In Well Vapor Stripping	In this technology, a groundwater circulation cell is created around a circulation well. Contaminated groundwater is cycled through lower and upper screened intervals. The lower screened interval is below the water table, and the upper screened interval is across or above the water table. This causes the water to aerated as it discharges into the unsaturated zone, causing contaminants to volatilize.	<p>Applicability. Air stripping is applicable to VOCs with Henry's law constant greater than 0.01 or vapor pressure greater than 0.5 mm Hg. Some compounds that have been successfully separated from water using air stripping include BTEX, chloroethane, TCE, vinyl chloride, DCE, and PCE.</p> <p>Limitations. High solubility, low Henry's constant, and low permeability reduce the overall effectiveness. High iron and hardness or biomass accumulation can cause operational problems and reduce efficiency or require pretreatment. Similarly, presence of free phase product will coat the circulation well and significantly decrease performance.</p>	<p>Low</p> <p>For stripping, diesel and motor oil are not readily amenable for air stripping with low volatilization rates. Silts and clays and stratified lithology result in areas of low permeability, adversely vertical flow of groundwater through subsurface.</p>	<p>Moderately Difficult</p> <p>The shallow water table makes this an easy technology to implement. With the confining layer close to the water table, short-circuiting may occur.</p>	<p>Medium ④</p> <p>Costs are moderate because although readily available conventional equipment is used, shallow groundwater zone being treated would require numerous wells. The uncertainty is high due to soil conditions and since the contaminants are not amenable to vapor phase partitioning.</p>	No – not effective with site contaminants or soil conditions.

**Table 18b
Preliminary Screening of Remedial Technologies for Groundwater
Napa Pipe Facility, Napa, California**

Technology	Description	General Applicability/Limitations	Comments Specific to Site 2/3			Retained?
			Effectiveness ^a	Implementability ^b	Relative Cost ^c	
<i>In Situ</i> Chemical Oxidation	Strong oxidizer is injected into subsurface to oxidize and destroy organic contaminants.	<p>Applicability. Chemical oxidation commonly applied to wide range of organic compounds including unsaturated aliphatic (i.e., TCE), aromatic compounds (i.e., benzene), and fuel hydrocarbons. Fast reaction rates can be achieved depending on oxidant type used.</p> <p>Limitations. Incomplete oxidation can result in intermediate contaminants. Uniform application of oxidants required to ensure all contaminants are being treated can be difficult to achieve in stratified soils. Indiscriminant and rapid reactions with other oxidant-consuming substances reduce effectiveness.</p>	<p>Medium to High</p> <p>Diesel and motor oil amendable to treatment using chemical oxidation. Effectiveness largely dependent on ability to distribute oxidant through target zone and low soil permeability from silts and clays will make uniform distribution of within the subsurface more difficult. Relatively shallow and thin treatment zone may help overcome this difficulty. Also, high contaminant concentrations and/or free phase product could require large amount of oxidizer.</p>	<p>Moderately Difficult</p> <p>After all aboveground structures are removed, injecting the oxidants would not be difficult, although effective distribution of oxidants through treatment zone may be challenging. Handling large quantities of strong oxidizers presents health and safety concerns.</p>	<p>Medium ④</p> <p>Costs dependent on contaminant concentrations. High concentrations and the potential presence of free phase product could require large quantities and frequent applications of the oxidizer and result in much higher costs. Handling and safety requirements add additional costs. The uncertainty is moderate to high since the stratified lithology and low soil permeability could prevent oxidant from being uniformly distributed within the contaminated regions – treatability studies would be required to address uncertainty.</p>	Yes – although site soils not well suited for in situ approach, may be cost effective for lower concentration groundwater plumes.
Saturated Soil Excavation	The contaminated groundwater plume is physically removed by excavating the saturated soil within the groundwater plume boundaries. Excavated soil is managed on-site through treatment or other appropriate methods and used as fill.	<p>Applicability. Excavation of soils below water table as a means of groundwater plume remediation is not a common approach, although shallow depth to water, relatively thin contaminated zone, and need for a short remediation timeframe may make it applicable at this site.</p> <p>Limitations. Requires heavy construction equipment. Dewatering likely required as part of saturated zone excavation. Extent of excavation is fairly large to ensure removal of all contaminated material. Contaminant aeration is likely during excavation, potentially requiring respiratory protection for on-site workers.</p>	<p>High</p> <p>Impacted groundwater (and associated saturated soil) is physically removed and no longer provides a potential source of contamination to groundwater.</p>	<p>Moderately Difficult</p> <p>Although standard soil excavation techniques would likely be utilized, implementing this approach will be complicated by need for dewatering and by the relatively large area to be excavated.</p>	<p>Medium ①</p> <p>Large contaminated area may require dewatering and hydraulic control. Costs impacted by approach to managing soil and groundwater once excavated. Potential need to use respiratory equipment and possible exposure to contaminated soils and groundwater increase costs. Low uncertainty since all contaminants are excavated and confirmed via on-site sampling.</p>	Yes – would quickly and effectively eliminate groundwater contamination

NOTE: Uncertainty rating reflects additional data needs or technology development needed to demonstrate applicability, implementability, and cost uncertainty. ① = low degree of uncertainty. Site data generally available to determine applicability. ⑤ = high degree of uncertainty. Additional data, analysis, pilot testing, or technology development required to determine applicability to site.

^a Preliminary effectiveness ratings of high, medium, and low reflect estimated relative effectiveness of the technology to treat the site contaminants and meet RAOs.

^b Implementability rating of easy, moderately easy, moderately difficult, and difficult reflect estimated relative complexity and cost of implementing the technology.

^c Cost reflects the relative overall costs (low, medium, high) of implementing the technology at the site.

Table 19
Estimated Capital and O&M Costs - Alternative 3
Ex Situ Source Area Soil and Groundwater Treatment and In Situ Groundwater Plume Remediation
Site 2/3 (External Coating Building)
Napa Pipe Facility, Napa, California

Construction Costs							
ITEM	UNIT COST		UNITS	QUANTITY		COST	
	low	high		low	high	low	high
Construction Costs							
1. Mobilization/demobilization	\$50,000	\$ 100,000	LS	1	1	\$ 50,000	\$ 100,000
2. Excavate, stockpile, and replace clean overburden	\$ 11	\$ 14	CY	1,800	1,800	\$ 20,000	\$ 25,000
3. Excavate contaminated unsaturated soil >cleanup levels and stockpile for on-site treatment	\$ 4	\$ 7	CY	6,300	6,300	\$ 25,000	\$ 44,000
4. Excavate saturated source area soil >cleanup levels and stockpile for on-site treatment	\$ 6	\$ 9	CY	11,400	11,400	\$ 68,000	\$ 103,000
5. Excavation dewatering, treat groundwater on-site, and discharge to sewer	\$75,000	\$ 125,000	LS	1	1	\$ 75,000	\$ 125,000
6. <i>In situ</i> treatment of area where groundwater >cleanup levels	\$ 25	\$ 35	CY	9,600	9,600	\$ 240,000	\$ 336,000
7. Amend excavation bottom prior to backfill	\$40,000	\$ 80,000	acre	1	1.5	\$ 40,000	\$ 120,000
8. Treatment of contaminated soil on-site							
- Move and replace untreated in commercial area (10% of volume)	\$ 9	\$ 12	CY	1,800	1,800	\$ 16,000	\$ 22,000
- Biopile Treatment (50% of total volume)	\$ 20	\$ 60	CY	8,850	8,850	\$ 177,000	\$ 531,000
- Low Temperature Thermal Desorption (30% of total volume)	\$ 40	\$ 75	CY	5,300	5,300	\$ 212,000	\$ 398,000
- Off-Site Disposal (10% of total volume)	\$ 60	\$ 90	CY	1,800	1,800	\$ 108,000	\$ 162,000
9. Installation of monitoring wells	\$25,000	\$ 50,000	LS	1	1	\$ 25,000	\$ 50,000
10. Confirmation soil/soil gas sampling	\$25,000	\$ 50,000	LS	1	1	\$ 25,000	\$ 50,000
				Subtotal		\$ 1,081,000	\$ 2,066,000
				Engineering and Permitting (15%)		\$ 162,000	\$ 310,000
				Construction Cost Contingency (30%)		\$ 324,000	\$ 620,000
				Total Estimated Capital Costs		\$ 1,570,000	\$ 3,000,000
				Average Capital Cost		\$ 2,290,000	
Operation and Maintenance Costs							
Activity	Estimated Annual Cost						
	low	high					
1. Confirmation Monitoring for <i>In Situ</i> Groundwater Treatment Area (assume 1 year)	\$ 50,000	\$ 75,000					
2. Monitoring well abandonment	\$ 40,000	\$ 80,000					
			Subtotal		\$ 90,000	\$ 155,000	
			O&M Cost Contingency (20 %)		\$ 18,000	\$ 31,000	
			Total Estimated O&M Costs		\$ 108,000	\$ 186,000	
			Average O&M Cost		\$ 147,000		
			TOTAL ESTIMATED COST		\$ 2,440,000		

Table 20
Estimated Capital and O&M Costs - Alternative 4
Ex Situ Soil and Groundwater and Groundwater Remediation
Site 2/3 (External Coating Building) Feasibility Study
Napa Pipe Facility, Napa California

Construction Costs							
ITEM	UNIT COST		UNITS	QUANTITY		COST	
	low	high		low	high	low	high
Construction Costs							
1. Mobilization/demobilization	\$ 50,000	\$ 100,000	LS	1	1	\$ 50,000	\$ 100,000
2. Excavate, stockpile, and replace clean overburden	\$ 11	\$ 14	CY	6,400	6,400	\$ 70,000	\$ 90,000
3. Excavate unsaturated and saturated soil >cleanup levels and stockpile for on-site treatment	\$ 4	\$ 7	CY	17,700	17,700	\$ 71,000	\$ 124,000
4. Excavate soil in area where groundwater >cleanup levels	\$ 6	\$ 9	CY	9,600	9,600	\$ 58,000	\$ 86,000
5. Pump groundwater from excavations, treat on-site, and discharge to sewer	\$100,000	\$ 150,000	LS	1	1	\$ 100,000	\$ 150,000
6. Amend excavation bottom prior to backfill	\$ 40,000	\$ 80,000	acre	2	3	\$ 80,000	\$ 240,000
7. Treatment of contaminated soil on-site (with other soils)							
- Move and replace untreated in commercial area (42% of volume)	\$ 9	\$ 12	CY	11,400	11,400	\$ 103,000	\$ 137,000
- Biopile Treatment (50% of total volume)	\$ 20	\$ 60	CY	8,900	8,900	\$ 178,000	\$ 534,000
- Low Temperature Thermal Desorption (30% of total volume)	\$ 40	\$ 75		5,300	5,300	\$ 212,000	\$ 398,000
- Off-Site Disposal (10% of total volume)	\$ 60	\$ 90	CY	1,800	1,800	\$ 108,000	\$ 162,000
8. Confirmation groundwater sampling (Geoprobe)	\$ 20,000	\$ 40,000	LS	1	1	\$ 20,000	\$ 40,000
9. Confirmation soil/soil gas sampling	\$ 40,000	\$ 75,000	LS	1	1	\$ 40,000	\$ 75,000
				Subtotal		\$ 1,090,000	\$ 2,136,000
				Engineering and Permitting (15%)		\$ 164,000	\$ 320,000
				Construction Cost Contingency (30%)		\$ 327,000	\$ 641,000
				Total Estimated Capital Costs		\$ 1,580,000	\$ 3,100,000
				Average Capital Cost		\$ 2,340,000	

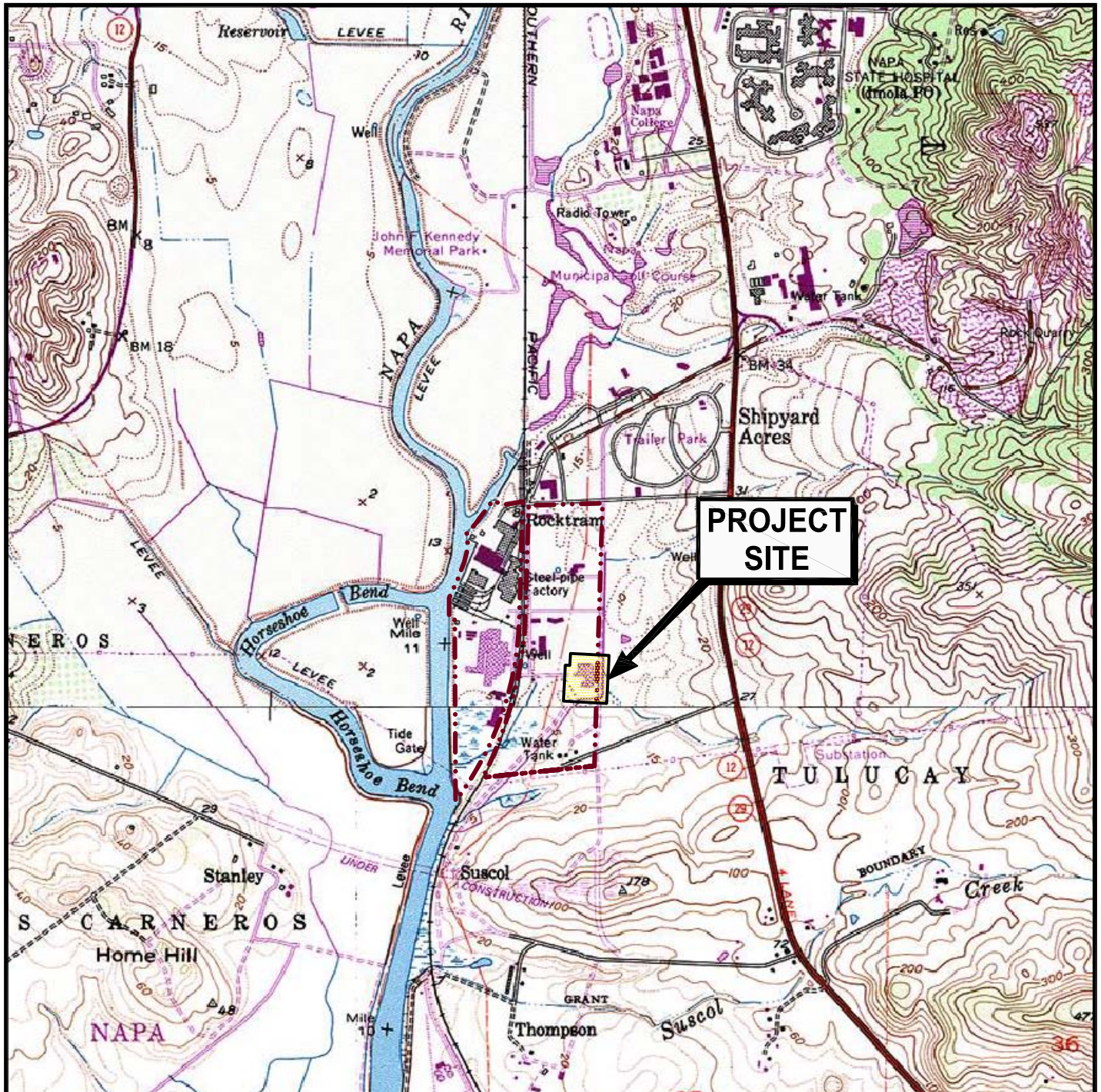
**Table 21
Evaluation of Remedial Alternatives
Site 2/3 (External Coating Building)
Napa Pipe Facility
Napa, California**

Evaluation Criteria	Remedial Alternatives				Comparison of Alternatives
	Alternative 1 - No Action	Alternative 2 - Maintain Existing Remedial Actions	Alternative 3 - <i>Ex Situ</i> Source Area Treatment with <i>In Situ</i> Groundwater Remediation	Alternative 4 - <i>Ex Situ</i> Soil and Groundwater Remediation	
NCP Threshold Criteria					
Overall Protection of Human Health and the Environment	Not protective. Would leave COCs in place above cleanup levels in both soil and groundwater.	Would require long-term institutional and engineering controls to be protective. Would leave COCs in place above residential-based cleanup levels in both soil and groundwater.	By reducing COCs to below the risk-based cleanup levels, human health and the environment would be protected.	By excavating soil and groundwater with COCs above cleanup levels and treating this soil and groundwater to below the risk-based cleanup levels, Alternative 4 would be protective of human health and the environment.	Alternatives 1 and 2 are not protective of human health and the environment. Both Alternatives 3 and 4 appear to offer similar high levels of protectiveness through aggressive treatment of contaminants.
Compliance With ARARs	Would not comply with ARARs related to protection of human health.	Would comply with some ARARs, but would require long-term institutional and engineering controls.	Alternative 3 is expected to comply with the applicable ARARs. Contaminant levels in soil and groundwater would be reduced to below cleanup level TBCs (ESLs) and treatment technologies would be designed and implemented in compliance with applicable regulations and permit requirements.	Alternative 4 is expected to comply with applicable ARARs. Contaminated soil and groundwater would be excavated and treated to below cleanup level TBCs (ESLs) and treatment technologies would be designed and implemented in compliance with applicable regulations and permit requirements.	Alternative 1 would not comply with ARARs. Alternative 2 would comply with the few applicable ARARs, but only through extensive use of institutional and engineering controls. Alternatives 3 and 4 would comply with ARARs to essentially the same degree.
NCP Primary Balancing Criteria					
Long-Term Effectiveness	Ineffective in the long-term as alternative does not achieve, nor maintain, protection of human health and the environment.	Ineffective in the long-term as alternative does not achieve cleanup levels in all but the longest term and requires institutional and engineering controls to maintain protection of human health and the environment.	Through a combination of excavating with <i>ex situ</i> treatment and <i>in situ</i> chemical oxidation, Alternative 3 would permanently reduce contaminant concentrations to below cleanup levels and would therefore be very effective in the long-term.	By excavating soil and groundwater exceeding ESLs and treating them <i>ex situ</i> to destroy the contaminants, Alternative 4 would permanently reduce contaminant concentrations to below cleanup levels and therefore would be very effective in the long-term.	Alternatives 1 and 2 would not be effective in the long-term. By significantly reducing contaminant concentrations in soil and groundwater, both Alternatives 3 and 4 would be effective in the long-term. By relying solely on excavation to remove contaminants from the subsurface, Alternative 4 would appear to achieve this with a higher degree of certainty as compared to Alternative 3 which uses <i>in situ</i> treatment.
Reduction of Mobility, Toxicity, Volume	Alternative 1 does not achieve reduction in contaminant mobility, toxicity, or volume.	Alternative 2 achieves moderate reduction in contaminant mobility, toxicity, or volume via continued groundwater extraction.	The mobility, toxicity, and volume of contaminants would be effectively and significantly reduced through the use of treatment technologies in Alternative 3. The majority of the contaminant mass would be excavated and managed <i>ex situ</i> , thereby effectively eliminating the majority of contaminants from the subsurface. The remaining contaminants present in excess of cleanup levels would be treated <i>in situ</i> to below cleanup levels.	Alternative 4 would significantly reduce the mobility, toxicity, and volume of contaminants through the use of excavation and treatment. This approach would effectively eliminate the majority of contaminants from the subsurface.	Alternative 1 would not reduce contaminant mobility, toxicity, and volume. Over the long-term, Alternative 2 would achieve moderate reduction in contaminant mobility, toxicity, and volume via groundwater extraction, but would not address soil contamination. Both Alternative 3 and 4 would provide significant reductions through treatment, although Alternative 4 may achieve this more reliably compared to Alternative 3, as noted above.
Short-Term Effectiveness	Because there are no remedial activities to be implemented or constructed, there are very few short-term risks with this alternative, although the existing risks to human health and the environment due to elevated contaminant concentrations will remain.	There are few short-term risks with this alternative, although the existing risks to human health and the environment due to elevated contaminant concentrations will remain.	There are several potential short-term risks associated with implementing Alternative 3 that would need to be managed to maintain worker health and safety including risks associated with heavy excavation and earthmoving equipment, handling the chemical oxidants, potential vapors present during excavation and treatment operations, and risks related to the <i>ex situ</i> treatment technologies (e.g., LTTD). These risks can be effectively mitigated through careful design, appropriate use of health and safety procedures, personal protective equipment, and engineering controls during implementation.	As with Alternative 3, there are several potential short-term risks associated with implementing Alternative 4. These include risks associated with heavy excavation and earthmoving equipment, potential vapors present during excavation and treatment operations, and risks related to the <i>ex situ</i> treatment technologies (e.g., LTTD). These risks can be effectively mitigated through careful design, appropriate use of health and safety procedures, personal protective equipment, and engineering controls during implementation.	Alternatives 1 and 2 would have few if any short-term risks associated with their implementation. Both Alternatives 3 and 4 would have short-term implementation risks, but in general these are common construction-related concerns encountered at environmental remediation sites and would be easily mitigated through careful design and use of appropriate health and safety procedures. Alternative 3 may have a slightly higher short-term risk due to the use of large quantities of chemical oxidants for the <i>in situ</i> treatment component of this alternative.

**Table 21
Evaluation of Remedial Alternatives
Site 2/3 (External Coating Building)
Napa Pipe Facility
Napa, California**

Evaluation Criteria	Remedial Alternatives				Comparison of Alternatives
	Alternative 1 - No Action	Alternative 2 - Maintain Existing Remedial Actions	Alternative 3 - Ex Situ Source Area Treatment with In Situ Groundwater Remediation	Alternative 4 - Ex Situ Soil and Groundwater Remediation	
Implementability	The no action alternative is technically implementable, but because it is not protective and does not comply with ARARs, it is not administratively implementable.	Alternative 2 is technically implementable, but because in the long-term it would not comply with ARARs or be protective it is not likely to be an administratively implementable alternative.	The technologies utilized in Alternative 3 are generally well established and proven technologies. There are, however, implementability issues that need to be addressed to ensure the effectiveness of the remedial activities. Most notable of these are the issues related to <i>in situ</i> chemical oxidation, specifically potential problems with uniformly distributing the oxidant blend throughout the fine-grained soils of the treatment zone. Treatability studies would be performed to develop the appropriate injection approach and spacing and the correct oxidant dosing. Other less significant implementability issues include treatability studies for <i>ex situ</i> biological treatment and conducting significant excavations below the water table; these potential issues can be addressed during the design process. Administratively, the most significant implementability issues would likely be permitting requirements associated with the <i>ex situ</i> treatment technologies, most importantly the air permitting requirements for the low temperature thermal desorption unit.	Alternative 4 utilizes well established construction and treatment technologies with relative few implementability issues including: the need to conduct treatability studies to establish the design parameters for <i>ex situ</i> biological treatment and procedures for conducting significant excavations below the water table. These potential issues can be addressed during the design process and should not pose significant problems for implementation of Alternative 4. Permitting requirements for the soil treatment technologies, especially the air permitting requirements for the low temperature thermal desorption unit present the most significant administrative implementability concerns.	Although Alternatives 1 and 2 are technically implementable; they would not be administratively implementable. The excavation and <i>ex situ</i> components of Alternatives 3 and 4 would utilize the same construction and treatment technologies and therefore this aspect of these alternatives have identical implementability. The <i>in situ</i> component of Alternative 3 would present some potentially more significant implementability issues related to the difficulties in uniformly distributing the oxidant blend throughout the treatment zone, especially given the low permeability soils present at the Site. Bench and pilot scale treatability studies would help address this concern, but even then this aspect of Alternative 3 would make its implementation somewhat less certain compared to Alternative 4. Administratively, the main issue for Alternatives 3 and 4 would be permitting requirements associated with the soil and groundwater treatment technologies, especially the LTTD unit.
Cost	There is little to no costs associated with the no action alternative.	Groundwater monitoring and extraction system operation for 20 years would cost approximately \$1.37 million.	Average estimated capital costs for Alternative 3 are \$2.29 million and O&M costs consisting of an estimated one year of groundwater monitoring and well abandonment total \$147,000. The total estimated cost of this alternative is \$2.44 million.	Average estimated capital costs for Alternative 4 are \$2.34 million. There are no O&M costs. The total estimated cost of this alternative is \$2.34 million.	Alternative 1 is by far the least costly, but does not achieve the comparison criteria or remedial objectives. Alternative 2, which only involves maintaining the existing monitoring and limited extraction system, still would cost \$1.37 million over 20 years. Within the accuracy of these feasibility study cost estimates, Alternatives 3 and 4 would have essentially the same cost of approximately \$2.3 to \$2.4 million.
NCP Modifying Criteria					
State Acceptance	Would not likely be accepted by State regulatory agencies (with residential development).	Would not likely be accepted by State regulatory agency (with residential development).	Given the protectiveness that would be achieved almost exclusively through contaminant treatment, it is expected that State agencies would accept this alternative.	Given the protectiveness that would be achieved almost exclusively through contaminant treatment, it is expected that State agencies would accept this alternative.	Alternatives 1 and 2 would not likely be acceptable to the State; they would not be protective nor comply with one or more of the applicable regulatory requirements. Given the protectiveness that would be achieved almost exclusively through contaminant treatment, both Alternatives 3 and 4 would likely be acceptable to the State. Specific concerns could be addressed during the remedial design process.
Community Acceptance	Would not likely be accepted by public (with residential development).	Would not likely be accepted by public (with residential development).	Assuming that the short-term risks identified above can be addressed, it is anticipated that the community would accept this alternative due to its high level of protectiveness and permanence.	Potentially more acceptable to the community because all of the contaminants exceeding cleanup levels are removed and treated elsewhere instead of a portion of them being treated <i>in situ</i> .	Alternatives 1 and 2 would not likely be acceptable to the public. Alternatives 3 and 4 are anticipated to both be acceptable to the public given the aggressive approach to treating the contaminants and the cleanup levels achieved. Specific implementability concerns could be addressed during the remedial design process.
Summary of Evaluation for Alternatives	The no action alternative does not meet the NCP threshold, primary balancing, or modifying criteria.	Alternative 2 does not meet the NCP threshold, primary balancing, or modifying criteria.	Alternative 3 will meet both the threshold NCP requirements as well as most if not all of the balancing and modifying criteria. The one possible exception is the implementability concerns related to the <i>in situ</i> chemical oxidation. Treatability studies can be conducted to help address these concerns.	Alternative 4 appears to meet all of the NCP criteria with a high degree of certainty.	

ILLUSTRATIONS



--- Napa Pipe Facility Boundary



Scale In Feet

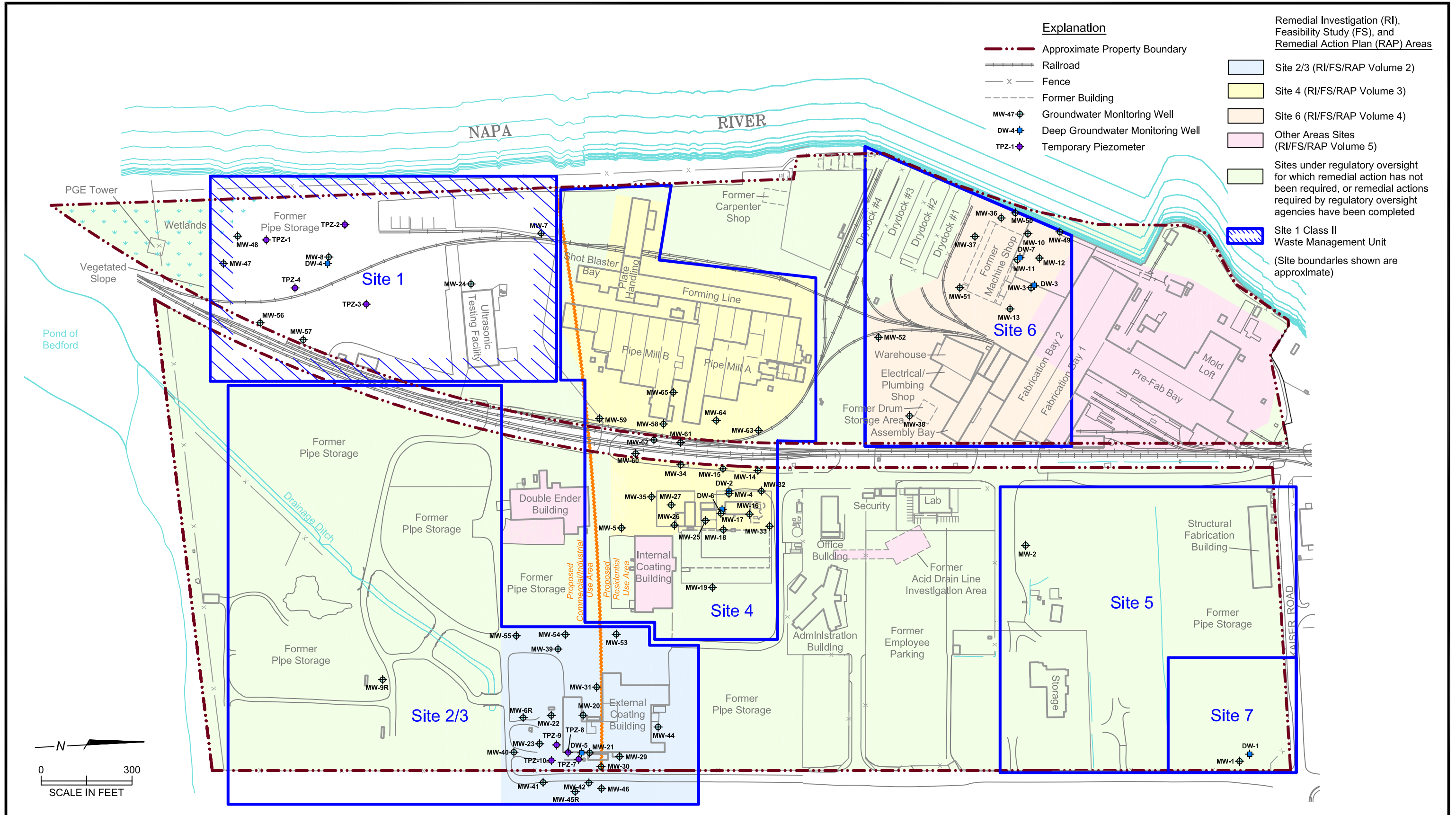


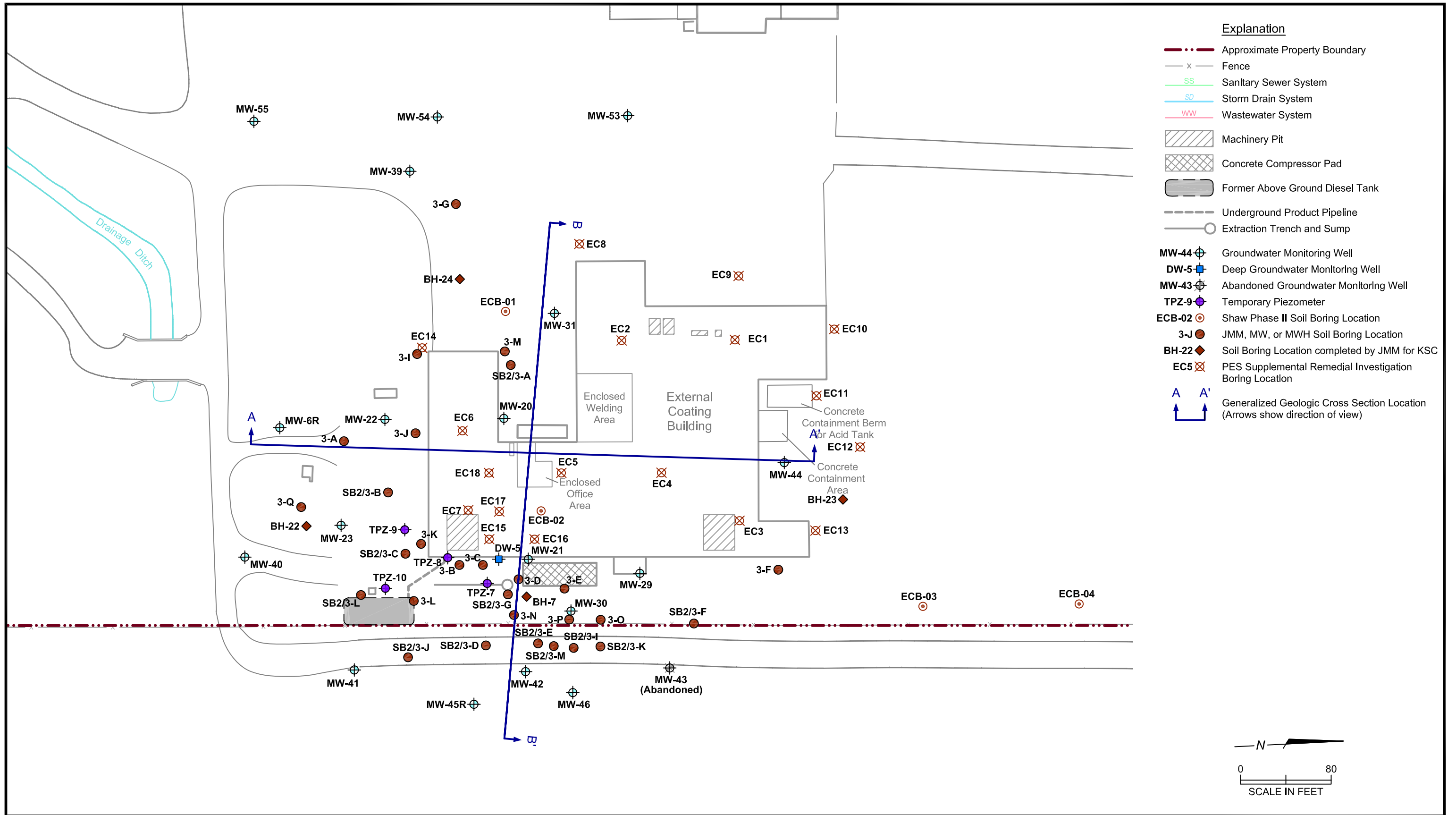
U.S.G.S. Topo Map - Napa, California, 7.5-minute quadrangle. Map version 1978; current as of 1980.
 U.S.G.S. Topo Map - Cuttings Wharf, California, 7.5-minute quadrangle. Map version 1978; current as of 1981.

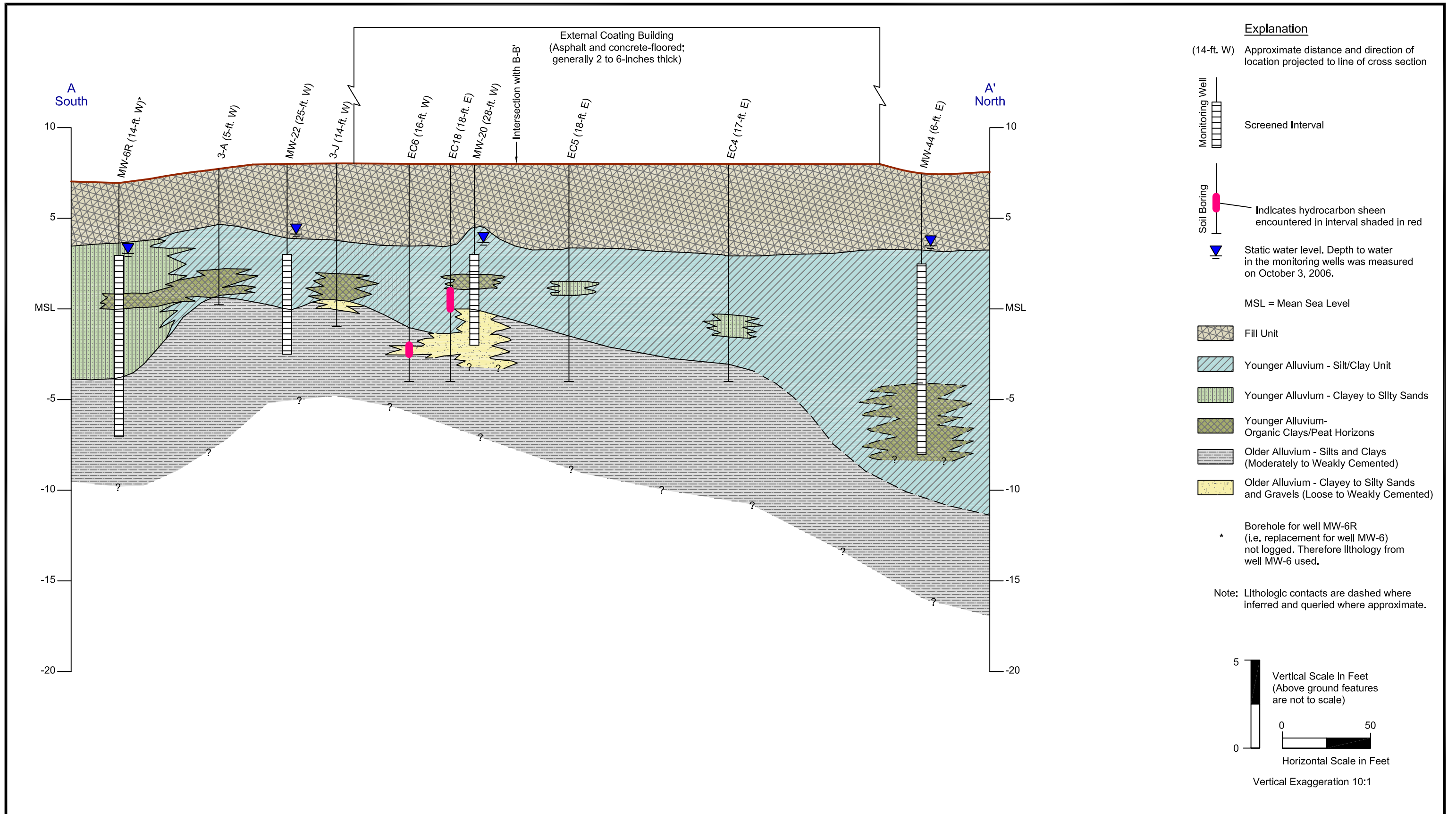


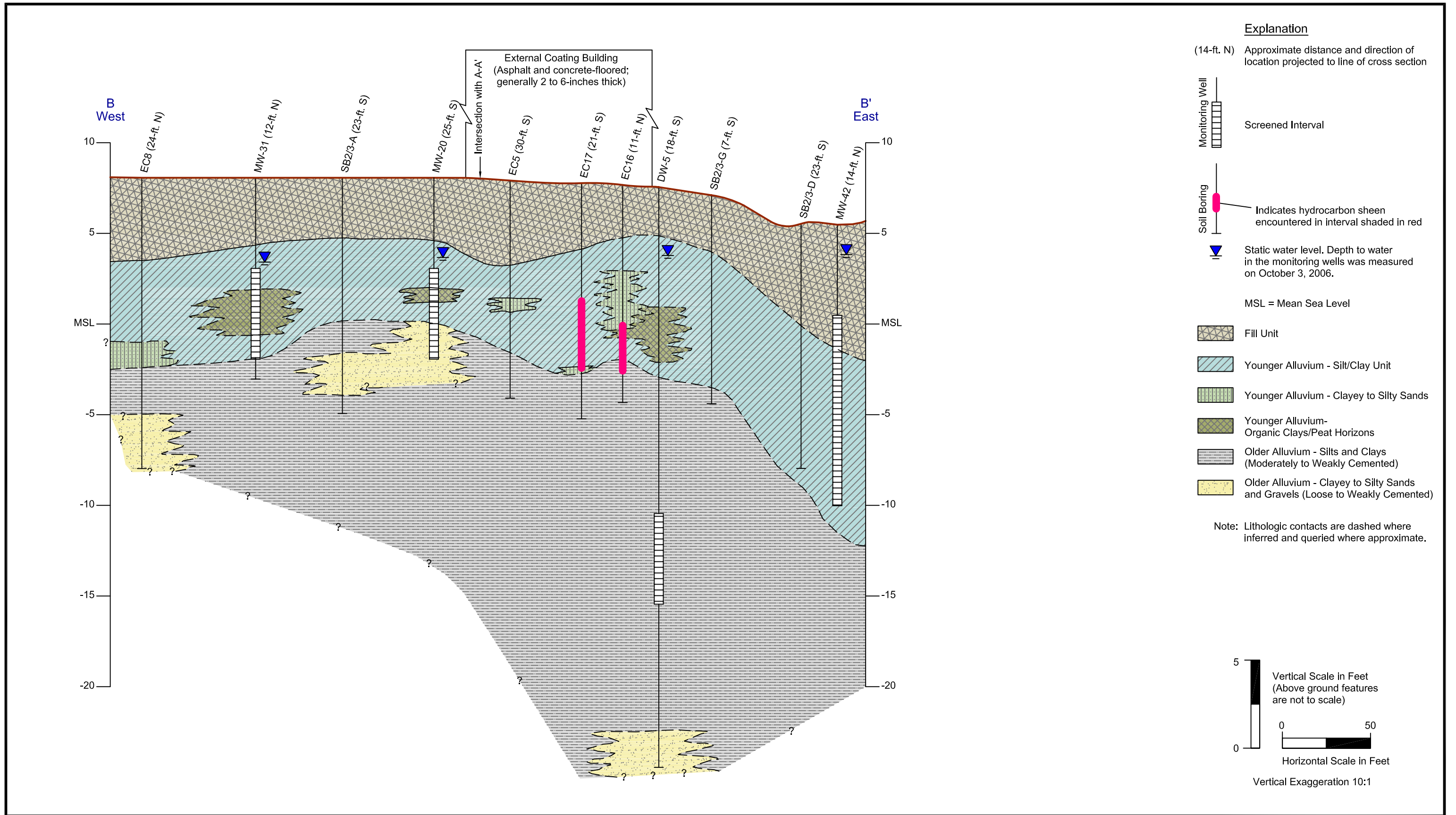
Site Location Map
 Napa Pipe Facility
 1025 Kaiser Road
 Napa, California

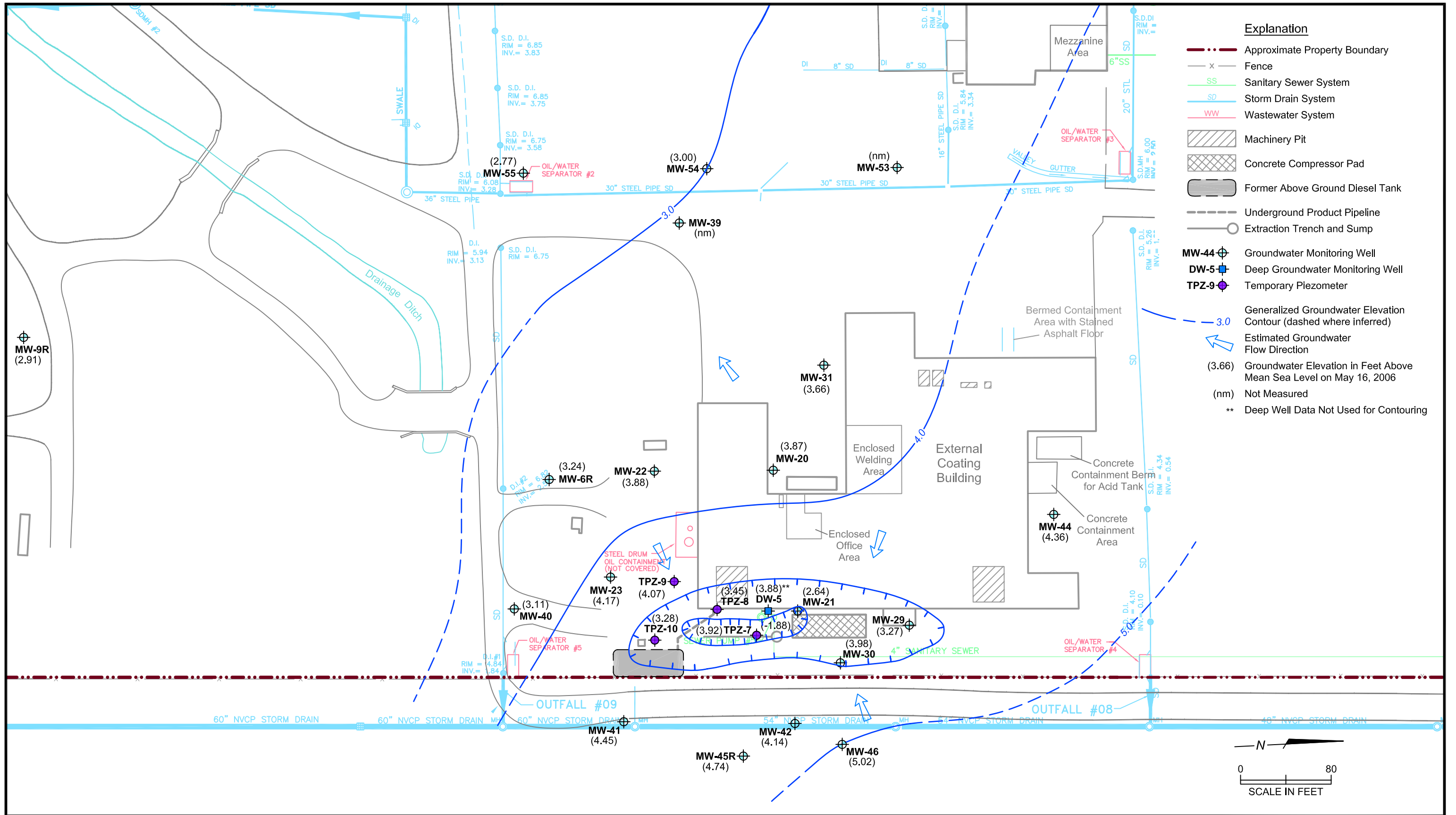
PLATE
1

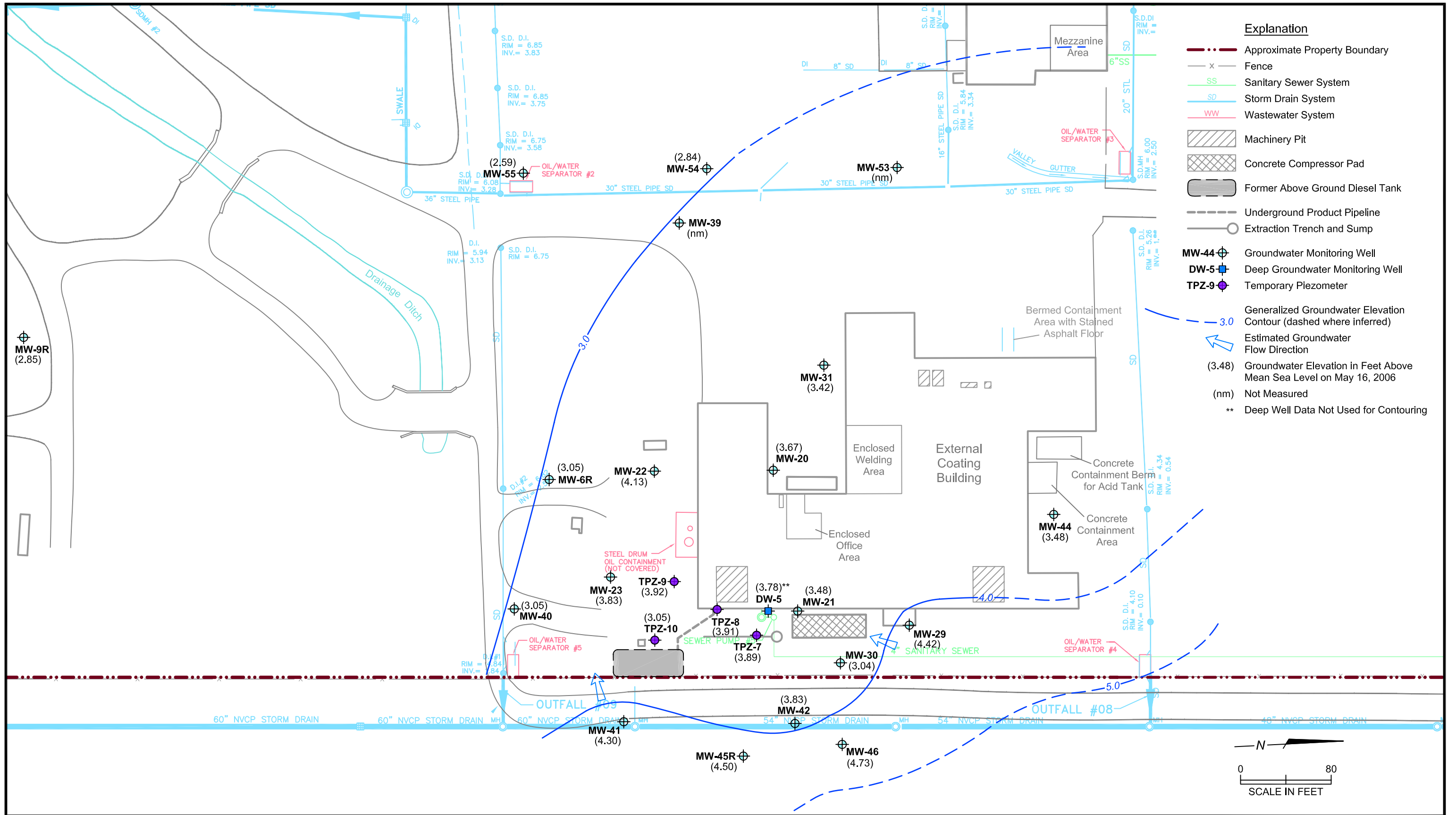


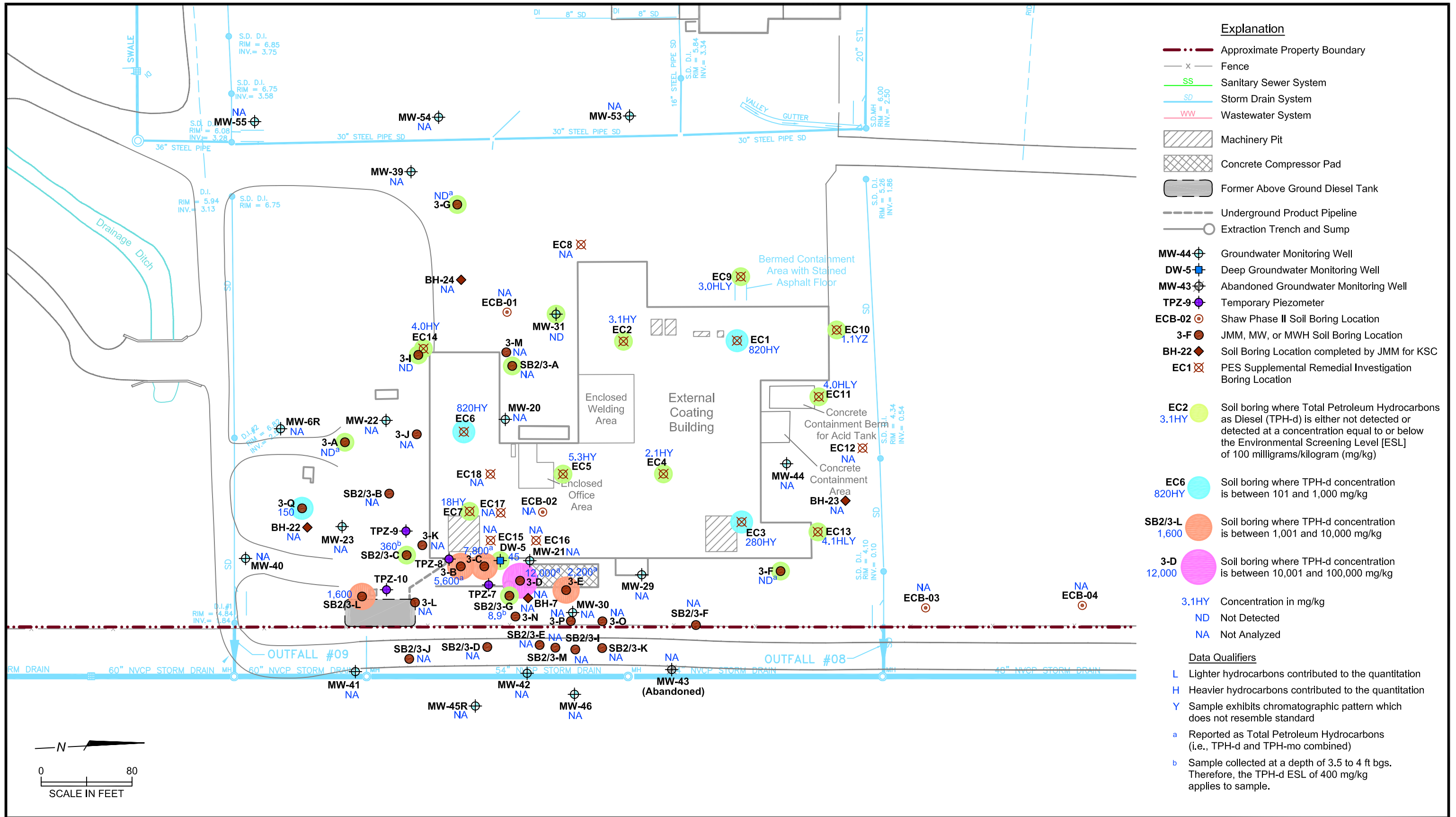


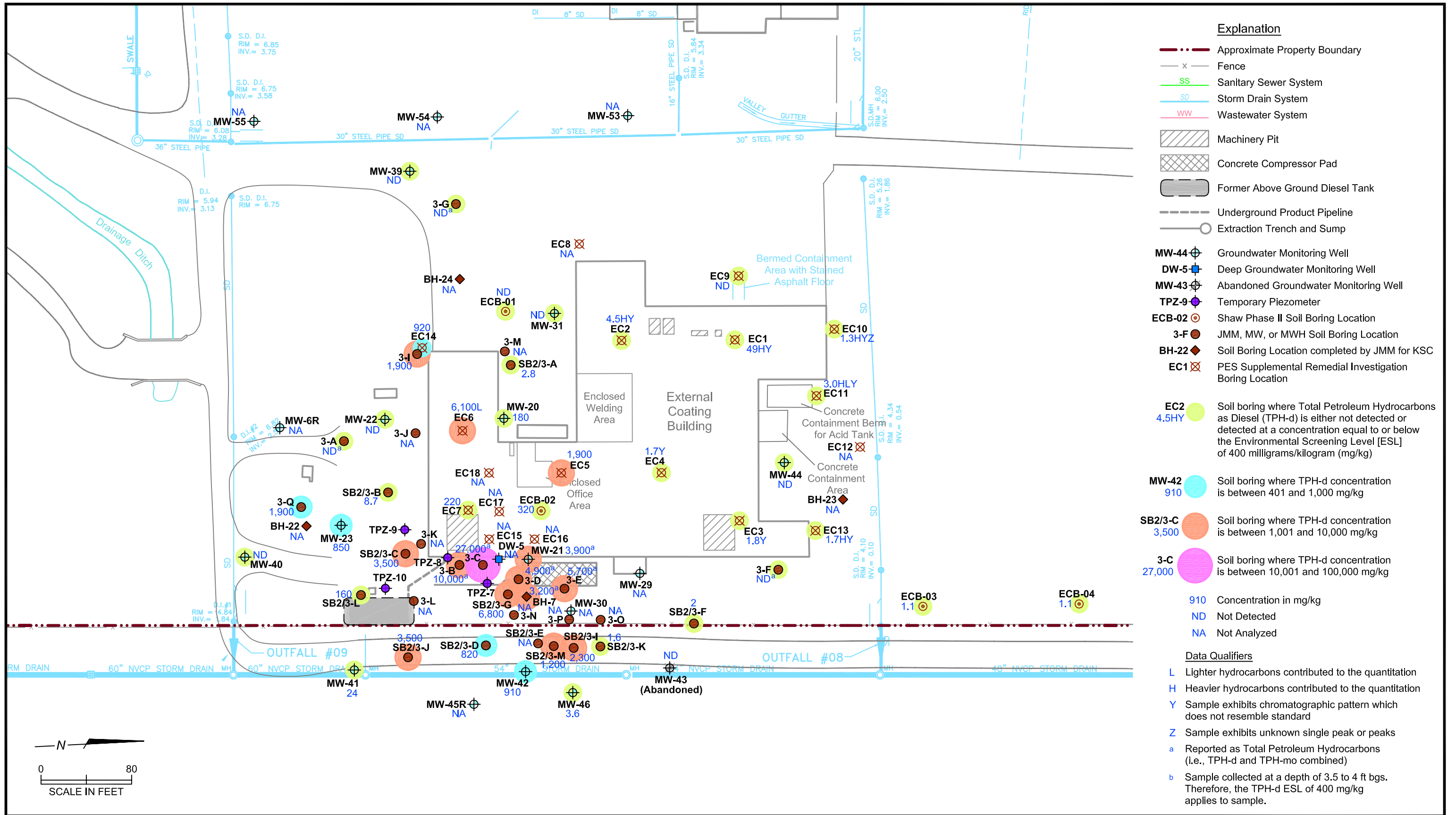




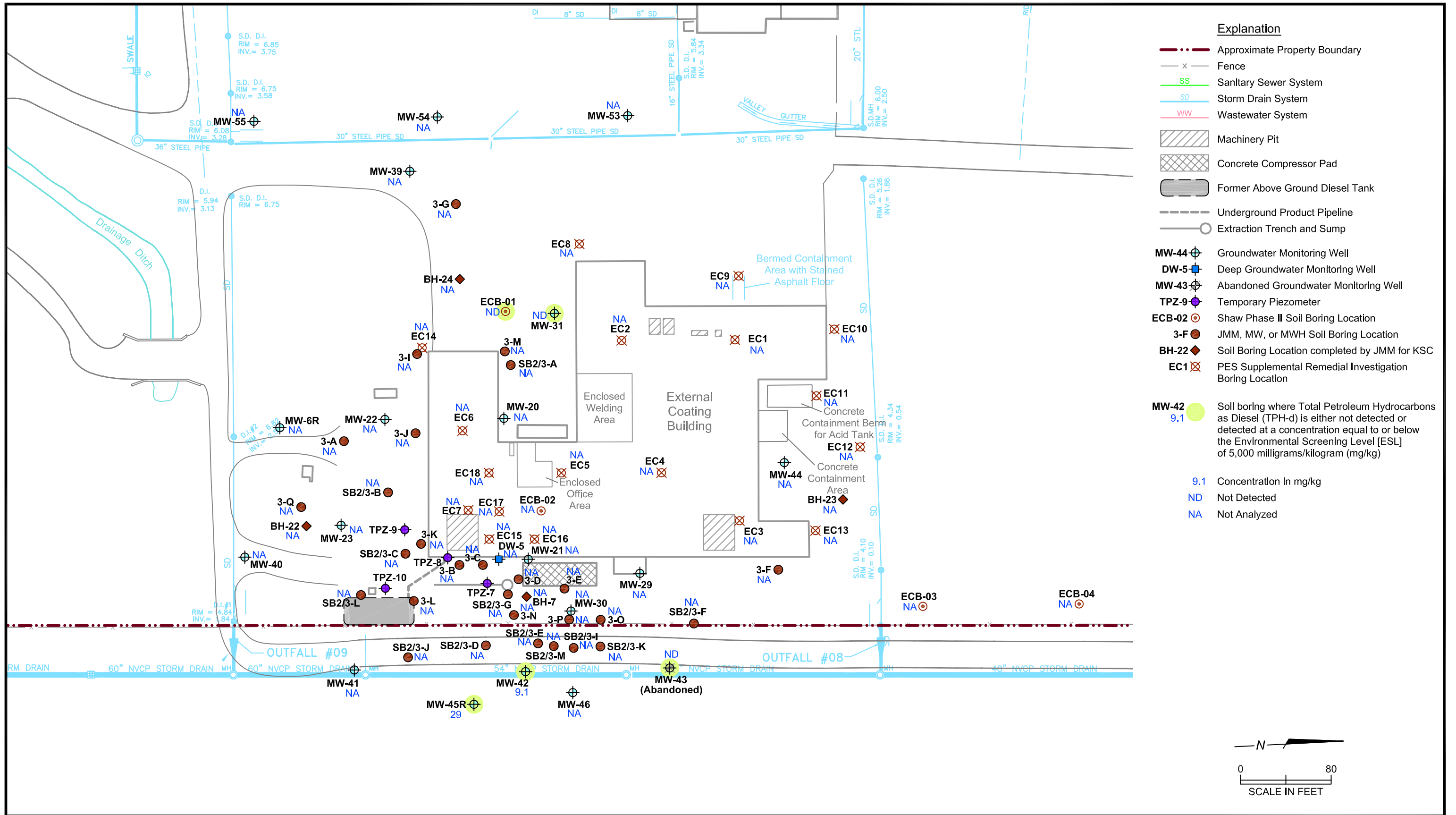


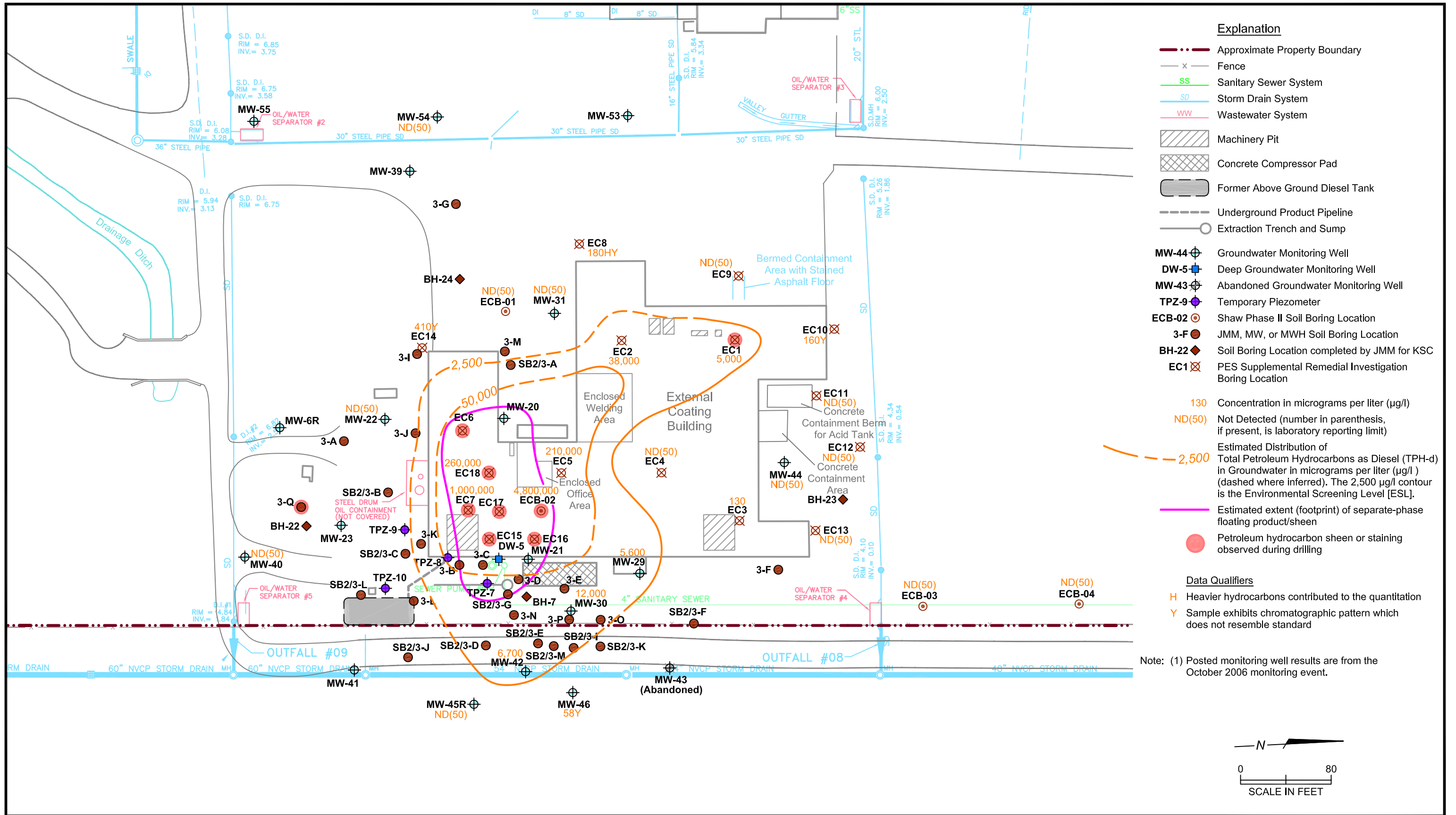






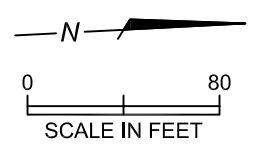
- ### Explanation
- Approximate Property Boundary
 - x Fence
 - SS Sanitary Sewer System
 - SD Storm Drain System
 - WW Wastewater System
 - Machinery Pit
 - Concrete Compressor Pad
 - Former Above Ground Diesel Tank
 - Underground Product Pipeline
 - Extraction Trench and Sump
- ⊕ MW-44 Groundwater Monitoring Well
 - ⊕ DW-5 Deep Groundwater Monitoring Well
 - ⊕ MW-43 Abandoned Groundwater Monitoring Well
 - ⊕ TPZ-9 Temporary Piezometer
 - ⊕ ECB-02 Shaw Phase II Soil Boring Location
 - ⊕ 3-F JMM, MW, or MWH Soil Boring Location
 - ⊕ BH-22 Soil Boring Location completed by JMM for KSC
 - ⊕ EC1 PES Supplemental Remedial Investigation Boring Location
- EC2 4.5HY Soil boring where Total Petroleum Hydrocarbons as Diesel (TPH-d) is either not detected or detected at a concentration equal to or below the Environmental Screening Level [ESL] of 400 milligrams/kilogram (mg/kg)
 - MW-42 910 Soil boring where TPH-d concentration is between 401 and 1,000 mg/kg
 - SB2/3-C 3,500 Soil boring where TPH-d concentration is between 1,001 and 10,000 mg/kg
 - 3-C 27,000 Soil boring where TPH-d concentration is between 10,001 and 100,000 mg/kg
- 910 Concentration in mg/kg
 - ND Not Detected
 - NA Not Analyzed
- ### Data Qualifiers
- L Lighter hydrocarbons contributed to the quantitation
 - H Heavier hydrocarbons contributed to the quantitation
 - Y Sample exhibits chromatographic pattern which does not resemble standard
 - Z Sample exhibits unknown single peak or peaks
 - ^a Reported as Total Petroleum Hydrocarbons (i.e., TPH-d and TPH-mo combined)
 - ^b Sample collected at a depth of 3.5 to 4 ft bgs. Therefore, the TPH-d ESL of 400 mg/kg applies to sample.

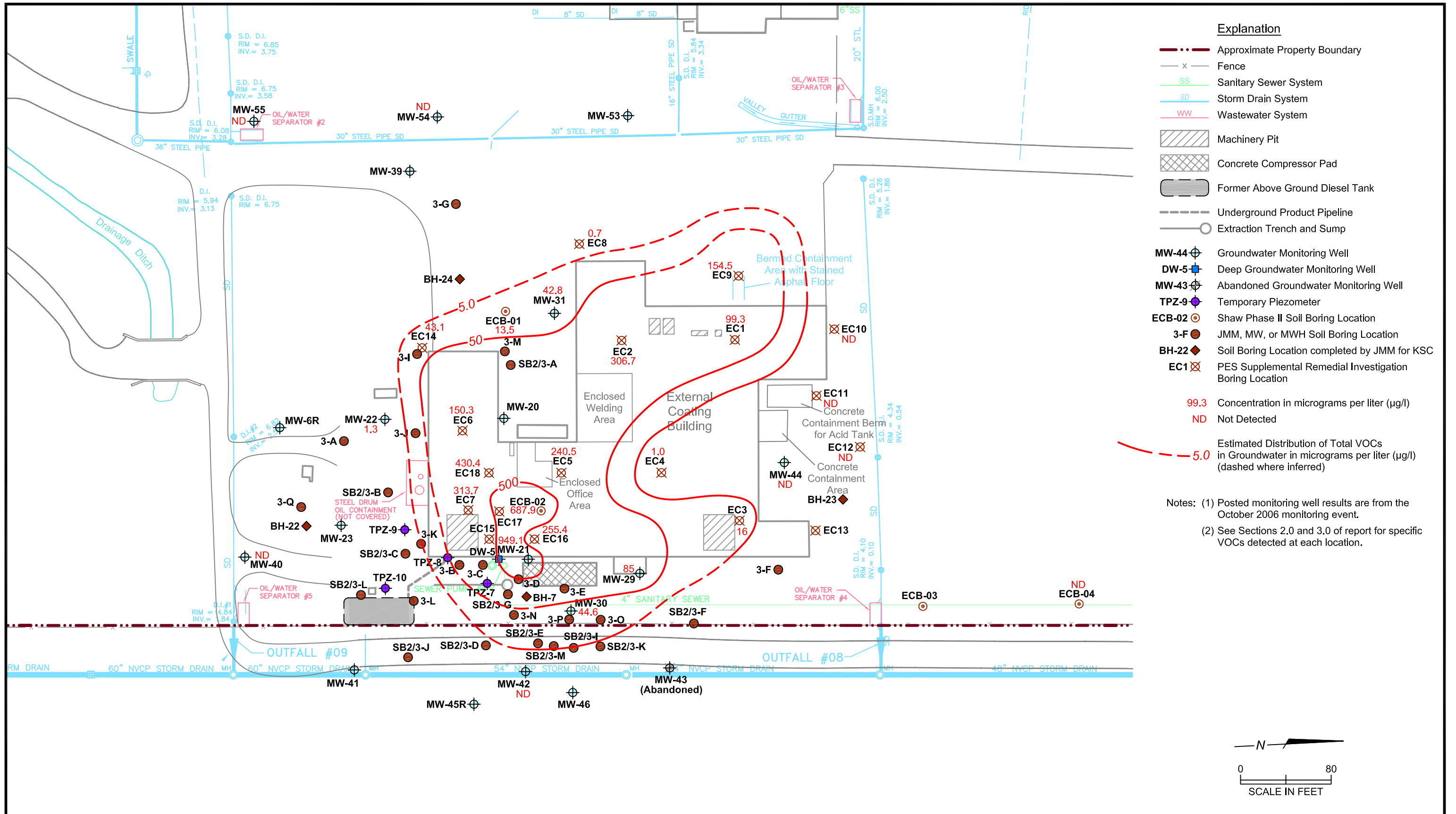


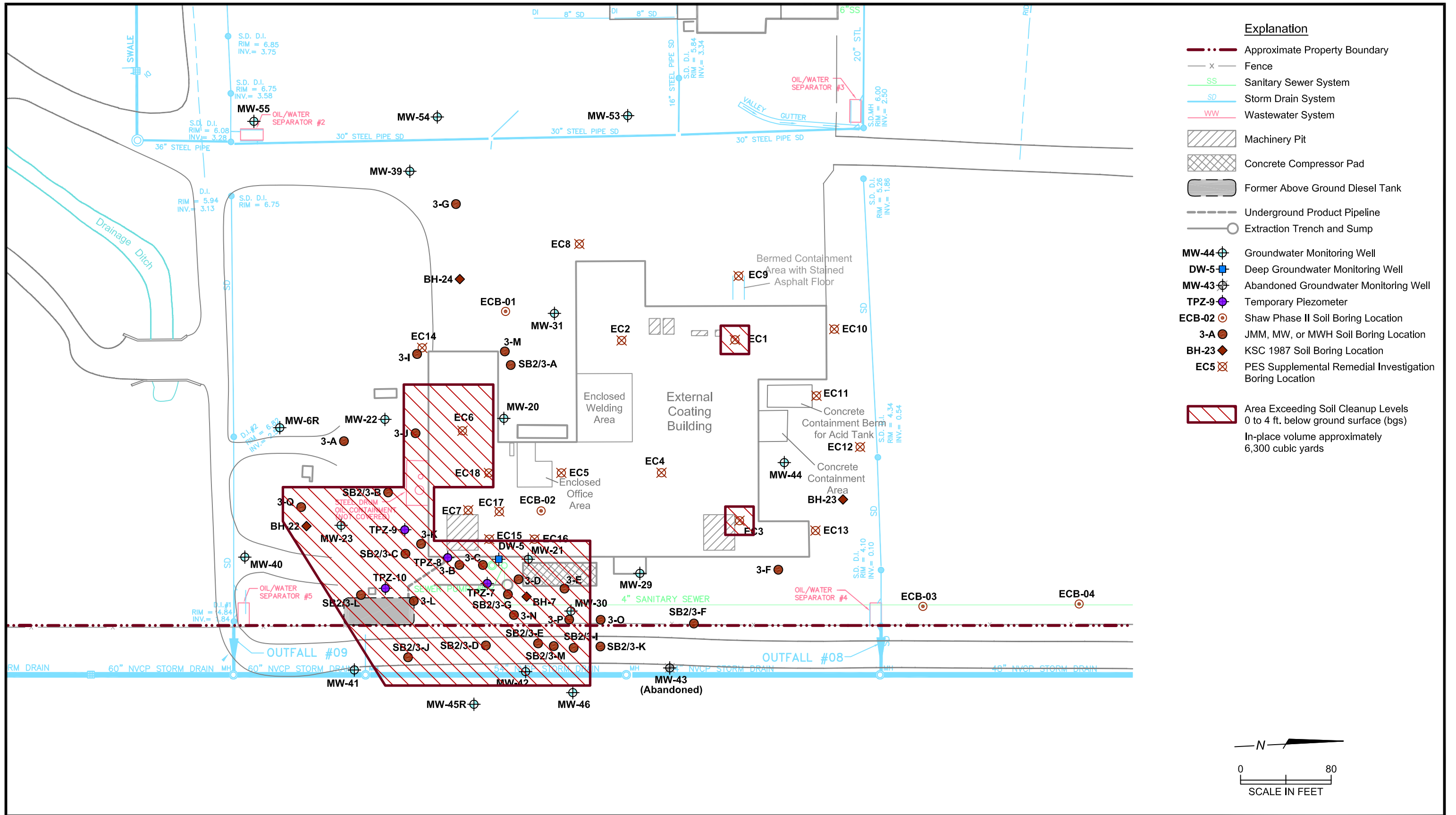


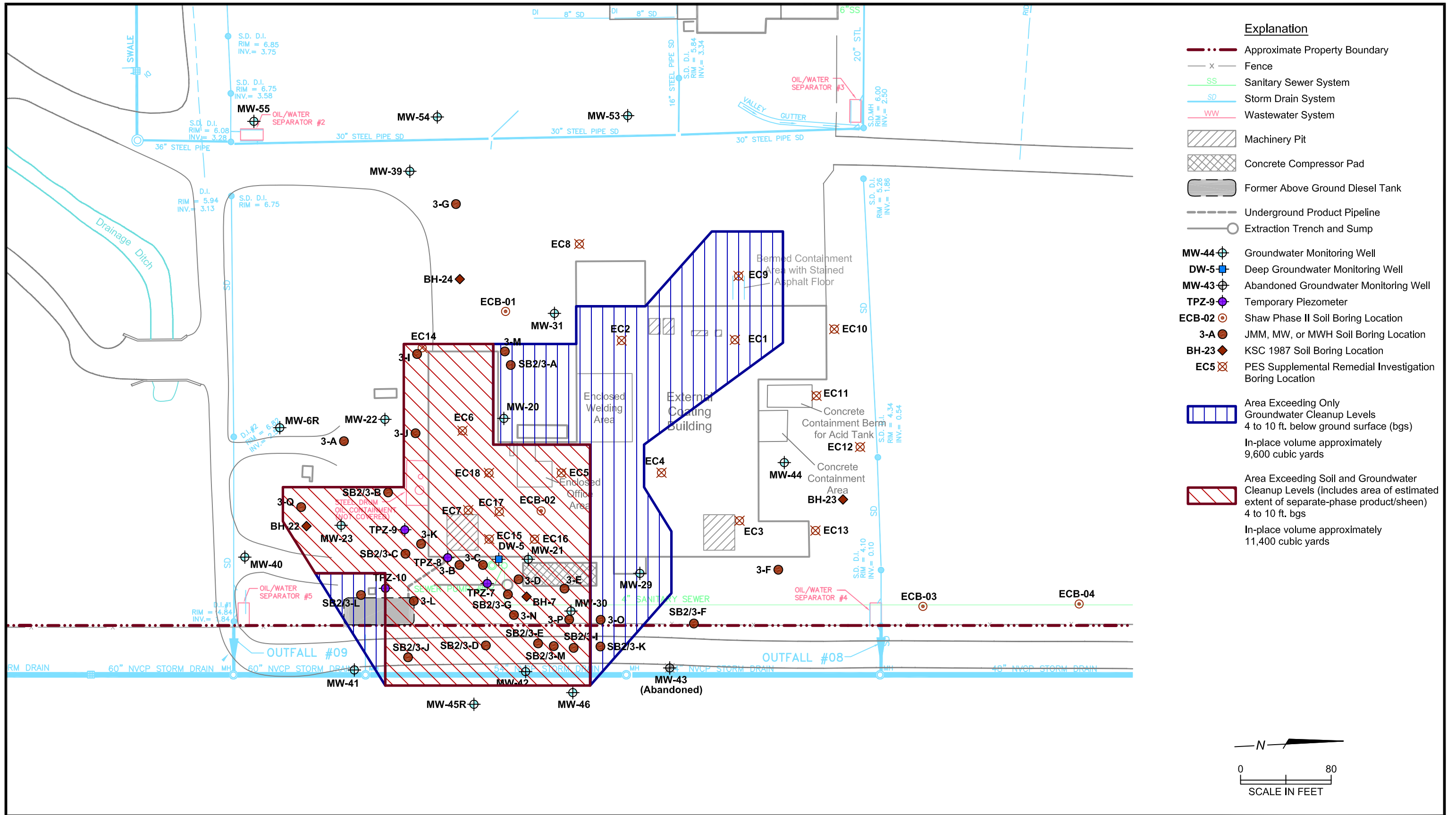
- Explanation**
- Approximate Property Boundary
 - x — Fence
 - SS — Sanitary Sewer System
 - SD — Storm Drain System
 - WW — Wastewater System
 - ▨ Machinery Pit
 - ▩ Concrete Compressor Pad
 - ▭ Former Above Ground Diesel Tank
 - Underground Product Pipeline
 - Extraction Trench and Sump
 - MW-44 ⊕ Groundwater Monitoring Well
 - DW-5 ⊕ Deep Groundwater Monitoring Well
 - MW-43 ⊕ Abandoned Groundwater Monitoring Well
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 - ECB-02 ⊕ Shaw Phase II Soil Boring Location
 - 3-F ⊕ JMM, MW, or MWH Soil Boring Location
 - BH-22 ⊕ Soil Boring Location completed by JMM for KSC
 - EC1 ⊕ PES Supplemental Remedial Investigation Boring Location
- 130 Concentration in micrograms per liter (µg/l)
- ND(50) Not Detected (number in parenthesis, if present, is laboratory reporting limit)
- 2,500 Estimated Distribution of Total Petroleum Hydrocarbons as Diesel (TPH-d) in Groundwater in micrograms per liter (µg/l) (dashed where inferred). The 2,500 µg/l contour is the Environmental Screening Level [ESL].
- Estimated extent (footprint) of separate-phase floating product/sheen
- Petroleum hydrocarbon sheen or staining observed during drilling
- Data Qualifiers**
- H Heavier hydrocarbons contributed to the quantitation
 - Y Sample exhibits chromatographic pattern which does not resemble standard

Note: (1) Posted monitoring well results are from the October 2006 monitoring event.









APPENDIX A

SUPPLEMENTAL REMEDIAL INVESTIGATION LITHOLOGIC LOGS

APPENDIX B

GEOLOGIC CROSS SECTIONS PREPARED BY MONTGOMERY WATSON

APPENDIX C

**PREVIOUS INVESTIGATION LITHOLOGIC LOGS AND
MONITORING WELL COMPLETION DIAGRAMS**

APPENDIX D

**TABLES, LABORATORY REPORTS, AND PLATES FOR 1987
SOIL AND GROUNDWATER TESTING BY
JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.**

APPENDIX E

**TABLES AND PLATES FOR 1989 SOIL AND
GROUNDWATER INVESTIGATION BY
JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.**

APPENDIX F

**TABLES AND PLATES FOR 1990 SOIL INVESTIGATION BY
JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.**

APPENDIX G

**TABLES AND PLATES FROM THE 1993 SITE 2/3
CHARACTERIZATION, GROUNDWATER MODELING, AND EXTRACTION
SCENARIO DEVELOPMENT REPORT BY MONTGOMERY WATSON**

APPENDIX H

**CHEMICAL FATE AND TRANSPORT FROM
MONTGOMERY WATSON'S 1993 SITE 2/3 REPORT**

APPENDIX I

**TABLES AND PLATES FOR DECEMBER 2005 PHASE II SITE
INVESTIGATION BY SHAW ENVIRONMENTAL, INC.**

APPENDIX J

LABORATORY ANALYTICAL REPORTS AND CHAIN-OF-CUSTODY FORMS

DISTRIBUTION

**SUMMARY OF REMEDIAL INVESTIGATIONS,
FEASIBILITY STUDY AND REMEDIAL ACTION PLAN
NAPA PIPE FACILITY
1025 KAISER ROAD
NAPA, CALIFORNIA**

**VOLUME 2
SITE 2/3 - EXTERNAL COATING BUILDING AREA**

JUNE 7, 2007

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