22nd Street Site, Tucson, Arizona
VRP Site Code 501994-00

Proposed Remedial Action Plan

Draft Final

April 2021

Union Pacific Railroad

REGISTERED GEOLOGIST
CERTIFICATE NO.
53073
ERIC A EDWARDS
Date Signed 04/09/2021
ARIZONA U.S.A.

EXPIRES: 12/31/2023

22nd Street Site, Tucson, Arizona
VRP Site Code 501994-00

Project No:	UPSRAZ31
Document Title:	Proposed Remedial Action Plan
Document No.:	PPS0202201409PHX
Revision:	Draft Final
Date:	April 2021
Client Name:	Union Pacific Railroad
Project Manager:	Ramzi Ramzi
Author:	Rick Edwards

Jacobs Engineering Group Inc.

1501 W. Fountainhead Parkway
Suite 401
Phoenix, Arizona 85282
United States
T +1.480.966.8188
www.jacobs.com

Contents

Acronyms and Abbreviations

AAC	Arizona Administrative Code
ADEQ	Arizona Department of Environmental Quality
ARS	Arizona Revised Statutes
AST	aboveground storage tank
AWQS	Aquifer Water Quality Standard
CO_2	carbon dioxide
EPA	U.S. Environmental Protection Agency
FS	feasibility study
Jacobs	Jacobs Engineering Group Inc.
LNAPL	light nonaqueous phase liquid
MNA	monitored natural attenuation
NSZD	natural source zone depletion
PAH	polycyclic aromatic hydrocarbon
PRAP	proposed remedial action plan
RI	remedial investigation
RO	remedial objective
SRL	Soil Remediation Level
TPH	total petroleum hydrocarbons
UPRR	Union Pacific Railroad
VOC	volatile organic compound
VRP	Voluntary Remediation Program

1. Introduction

Jacobs Engineering Group Inc. (Jacobs) has prepared this proposed remedial action plan (PRAP) for the Union Pacific Railroad (UPRR) 22nd Street Site in Tucson, Arizona (site). The site has been assigned Voluntary Remediation Program (VRP) Site Code 501994-00. This PRAP presents the preferred remedial action alternative for addressing light nonaqueous phase liquid (LNAPL) and other site-related contaminants of concern (COCs) in the perched groundwater at the site.

This PRAP was prepared in accordance with Arizona Administrative Code (AAC) R18-16-408 and Arizona Revised Statutes (ARS) §49-287.04(A) and is based on data and findings from early response action, remedial investigation (RI), and feasibility study (FS) activities.

The purpose of the PRAP is to describe the proposed remedy selected to address the site-specific remediation objectives (ROs) from the alternatives evaluation presented in the FS report (Jacobs, 2019). The PRAP is part of the final remedy selection process where public input is solicited on remedial alternatives and on the rationale for proposing the preferred remedy. New information received during the public comment period could result in the selection of a final remedy that differs from the proposed remedy. Therefore, the public is encouraged to review and comment on the remedy presented in this PRAP. Information on public participation activities associated with this PRAP is provided in Section 4.8.

2. Site Description

UPRR acquired the site in 1997 when it merged with Southern Pacific Transportation Company, who had owned the site since the early 1900s. The site is located south of East 22nd Street and east of South Campbell Avenue in Tucson, Arizona (Figure 2-1). The central portion of the rail yard has been used as a locomotive fueling and service facility since the 1950s. Operations have included locomotive fueling (including associated underground piping and aboveground storage tanks [ASTs]), as well as minor maintenance and repair activities, including washing boxcars and changing lubrication oil and filters (Industrial Compliance, 1991).

The fueling facility, which occupies the western end of the rail yard, includes fueling tracks, an AST, and underground piping. From the 1950s until 2002, an underground fuel supply pipeline was used to convey No. 2 fuel oil along the UPRR right-of-way to a 10,000-barrel AST at the site. Underground distribution piping leads from the AST to two fueling tracks (the Mainline Track and the Service Track). These two fueling tracks, as well as a leak in the pipeline detected on September 2, 1998, are potential sources of the No. 2 fuel oil detected in the perched groundwater zone below the site (ERM, 2001). The supply pipeline was replaced by a new pipeline in October 1999, and the old pipeline was cleaned and grouted in place with cement. According to UPRR fueling operations records, the use of this new pipeline was discontinued in 2002. Fuel is currently brought to the site in tanker cars, transferred to the AST, and piped to the Service Track fueling platform.

2.1 Site Background

The site is in the Tucson Active Management Area and the Tucson subarea of the Santa Cruz Basin (ADWR, 1984). Sedimentary rocks of the Pantano Formation, Tinaja Beds, and the Fort Lowell Formation form a single regional aquifer system (ERM, 2001).

The site comprises four hydrostratigraphic units:

1. The upper vadose zone
2. A fined-grained unit including the perched groundwater zone
3. The lower vadose zone
4. The regional aquifer

The perched groundwater zone and the lower vadose zone are separated by an aquitard composed mostly of fine-grained partially cemented material.

Groundwater samples collected from monitoring and remediation wells indicate that several compounds are, or have been, present in the perched groundwater near the site. These compounds include total petroleum hydrocarbons (TPH); benzene, toluene, ethylbenzene, and xylenes; other volatile organic compounds (VOCs) such as chlorinated solvents and methyl tert-butyl ether; and polycyclic aromatic hydrocarbons (PAHs) such as naphthalene (CH2M, 2014). Analytical data from groundwater samples collected at the site indicate the only compound present at concentrations exceeding the Aquifer Water Quality Standard (AWQS) (AAC R18-11-406 [August 1994]) is benzene.

No organic compounds have been detected in regional aquifer monitoring well MW-22-14 at concentrations exceeding the AWQS (Jacobs, 2020). A groundwater sample was collected from a regional aquifer production well 1,100 feet downgradient of the nearest perched zone LNAPL on February 25, 2016, and analyzed for VOCs and PAHs. No organic compounds were detected in the sample. Data from these wells demonstrate that historical releases from the site have not caused exceedances of the AWQS in the regional aquifer.

2.2 Previous Investigations

Several investigations and field activities have been performed to assess impacts from historical releases associated with the fueling facilities. The results of these investigations are included in the following reports.

- Remedial Investigation Report, 22nd Street Site, Arizona Department of Environmental Quality (ADEQ) VRP Facility #501994-00, Tucson, Arizona (ERM, 2001)
- Final Remedial Investigation Report 22nd Street Site, Tucson, Arizona, VRP Site Code 501994-00 (CH2M, 2014)
- Revised Feasibility Study Report, 22nd Street Site, Tucson, Arizona (Jacobs, 2019)
- 2020 February 2020 Progress Report, Union Pacific Railroad 22nd Street Site, Tucson, Arizona (Jacobs, 2020)

In summary, concentrations of petroleum-related hydrocarbons in soil do not exceed the applicable Soil Remediation Levels (SRLs); therefore, soil remediation is not necessary. LNAPL is present in the perched groundwater zone over an area encompassing approximately 70 acres. Although benzene concentrations exceed the AWQS in some wells that contain LNAPL, groundwater sampling results indicate the LNAPL is not generating a plume of dissolved-phase constituents that migrates downgradient from the LNAPL body in the perched groundwater zone (Figure 2-2). Samples of the regional aquifer do not indicate impacts from petroleum compounds at concentrations exceeding the AWQS. Properties of the subsurface materials and LNAPL suggest that the LNAPL is physically contained. Monitoring has shown that the extent of LNAPL generally has remained stable over time (Jacobs, 2019).

An exposure pathway analysis was completed during the original RI and was updated in 2014 (CH2M, 2014). The analysis concluded that the only potentially complete exposure pathway is to construction workers during an excavation near the release points or during the installation of subsurface structures installed to a depth in excess of 110 feet. This exposure pathway is considered unlikely because of low-density zoning and development plan for the area (City of Tucson, 2020). During activities where impacted soil may be encountered, construction workers may be exposed to petroleum compounds through inhalation, ingestion, or absorption pathways. Temporary exposure during construction can be minimized using common health and safety protocols such as air monitoring, engineering controls, and personal protective equipment.

In 2014 and 2015, a carbon dioxide (CO_2) flux field sampling campaign was conducted to estimate the rate of LNAPL degradation through natural processes in the vadose zone. The results of the analysis indicated that LNAPL is being degraded at an average rate of almost 400 gallons per acre per year. Multiplying this by the estimated size of the LNAPL yields an estimated 27,000 gallons per year of LNAPL being degraded through natural processes in the vadose zone (Jacobs, 2019).

2.3 Previous Remedial Actions

Remediation systems were pilot tested at the source area between 2000 and 2003. During this time, approximately 1,700 gallons of LNAPL were removed. From 2003-2009, a multiphase extraction system operated, removing approximately 18,000 gallons of LNAPL (ERM, 2001). Because of increasing repair costs and a decreasing recovery rate, this system was replaced in 2010 by a vacuum-enhanced total fluids extraction system, which removed approximately 2,100 gallons of LNAPL between September 2010 and August 2013 (CH2M, 2014). In addition to the liquid extraction, over 4,000 gallons of LNAPL have been removed through vapor extraction by the multiphase extraction system and vacuum-enhanced skimming system and nearly 123,000 gallons of LNAPL have been destroyed through biodegradation (Jacobs, 2019).

In September 2006, a self-contained wellhead skimming pilot study was implemented at well MW-22-35. This well, located about 2,000 feet west of the fueling facility, was selected based on two factors: (1) the accumulated product observed in the well, which was greater than 3 feet, and (2) favorable well access.

The system operated from November 2006 until March 2010, when it was temporarily shut down, and then from September 2010 until May 2013. While operational, the wellhead system recovered about 7,400 gallons of LNAPL (CH2M, 2014).

3. Development and Evaluation of Remedial Alternatives

3.1 Remedial Objectives

The *Final Remedial Objectives Report, Union Pacific Railroad Tucson Yard, VRP Site Code 501994-00, Tucson, Arizona* (ADEQ, 2014) documented ROs for the site.

3.1.1 Soil

The RO for soil at the UPRR property is:

> *To restore soil conditions to the remediation standards for non-residential use specified in A.A.C. R18-7-203 (specifically background remediation standards prescribed in R18-204, pre-determined remediation standards prescribed in R18-7-205 or site-specific remediation standards prescribed in R18-7-206) that are applicable to petroleum related substances identified (volatile organic compounds [VOCs], polynuclear aromatic hydrocarbons [PAHs])* (ADEQ, 2014).

Data demonstrating that the soil RO has been met are provided in the ADEQ-approved *Final Remedial Investigation Report* (CH2M, 2014) and the ADEQ-approved *Revised Feasibility Study* (Jacobs, 2019). Soil sampling that occurred during remedial investigations (RIs) did not indicate the presence of TPH, PAHs, or VOCs at concentrations exceeding the SRLs for nonresidential land use. Appendix A includes a summary of soil analytical results. Soil at the site meets the pre-determined remediation standards prescribed in R18-7-205 (the non-residential SRLs) (AAC R-18-7-205 [May 2007]). Therefore, no soil remediation is necessary.

3.1.2 Groundwater

The RO for groundwater at the site is:

> *To protect for the use of the groundwater supply by Kalil Bottling Co. and City of Tucson from dissolved and LNAPL petroleum contamination from the UPRR 22nd Street site. This action will be needed for as long as the need for the water exists, the resource remains available and the contamination associated with the UPRR 22nd Street site prohibits or limits groundwater use.* (ADEQ, 2014).

Although LNAPL is present in the perched groundwater zone and benzene is present in the perched groundwater zone at levels greater than its AWQS, there is no current or reasonably foreseeable use of the perched groundwater zone (CH2M, 2014). Groundwater monitoring data also show that site-related COCs are not migrating beyond the extent of the LNAPL.

3.2 Alternatives Evaluated in the Feasibility Study

As discussed in Section 3.1, the RO is already met for soil; therefore, no action is needed. The August 2019 Revised Feasibility Study evaluated three remedial alternatives for LNAPL and dissolved-phase COCs in the perched aquifer to address the RO for groundwater. The alternatives evaluated include:

- Vacuum-enhanced skimming
- Distributed LNAPL recovery
- Monitored natural attenuation (MNA)/natural source zone depletion (NSZD)

The reference remedy, vacuum enhanced skimming, would augment NSZD through the use of LNAPL skimming pumps and a vacuum system to enhance LNAPL skimming recovery. Wells would be installed roughly perpendicular to the distal end of the LNAPL plume. A pneumatic skimming pump would be installed in each of the remediation wells and piping would connect the wells to a central remediation compound.

The more aggressive alternative remedy, distributed LNAPL recovery, would incorporate multiple methods of LNAPL recovery including NSZD, bioventing, skimming pumps, and sorbent tubes. Bioventing would consist of extracting and injecting air through existing remediation wells to enhance the subsurface aeration and increase the biodegradation of petroleum compounds. Skimming pumps will be used in nine onsite remediation wells to remove LNAPL. The wells not connected to the remediation system would have LNAPL recovery through the use of sorbent tubes that would be replaced quarterly.

The less aggressive alternative remedy, MNA and NSZD, relies on natural processes. Biodegradation has been shown to prevent plume migration and reduce the extent of LNAPL over time. Groundwater monitoring would be used to demonstrate that LNAPL is not moving and that it is not generating a plume of dissolved-phase contaminants at levels greater than the AWQS.

A full evaluation of each remedy, including cost estimates, can be found in the Revised Feasibility Study Report (Jacobs, 2019). Table 3-1 summarizes the remedy evaluation.

4. Proposed Remedy

The more aggressive remedial alternative, distributed LNAPL recovery is proposed as the remedy because it meets the requirements of ARS 49-282.06, meets ROs, meets water and land use plans (Jacobs, 2019), and provides for active LNAPL recovery as required by ADEQ.

4.1 Description

Distributed LNAPL recovery includes multiple methods of LNAPL recovery as follows:

- CO_2 flux data collected in 2014 and 2015 indicate that NSZD removes an estimated 27,000 gallons of LNAPL from the subsurface at the site each year. These processes will continue to remove LNAPL from the subsurface.
- Bioventing in nine wells containing LNAPL and connected to the existing onsite remediation system will augment NSZD processes near the LNAPL release. Eighty-four percent of historical mass removal has been removed through biodegradation, and aerating the subsurface will enhance this process. Bioventing through air injection was chosen over vacuum extraction to eliminate the discharge of soil vapor that contains VOCs and because it is expected to be more effective at providing oxygen to the subsurface than air extraction, further enhancing biodegradation. Bioventing will consist of extracting air from one or more existing remediation wells and injecting air into the subsurface through other existing remediation wells to remove carbon dioxide and redistribute oxygen in the subsurface, enhancing the biodegradation of petroleum compounds. Full-time aeration of the subsurface may not be necessary to maintain aerobic conditions. Operation of the bioventing system may vary depending on the measured oxygen depletion and CO_2 production rate, with the goal of maintaining at least 5 percent oxygen in the subsurface at the remediation wells.
- LNAPL will also be removed from the same nine onsite remediation wells using skimming pumps. The liquid remediation system will consist of a 5-horsepower reciprocating air compressor, a 500-gallon double-walled fuel recovery tank, and associated controls, piping, and valves. The air compressor will drive the pneumatic skimming pumps, which will extract LNAPL and convey it to the recovery tank. A licensed waste oil management contractor will remove the recovered LNAPL from the recovery tank. The operation of the skimming pumps may vary depending on the volume of LNAPL recovered. Examples of criteria for modifying skimming pump operation include:
  - For wells connected to the remediation system, but not operating as remediation wells, a skimming pump will be installed if the thickness of LNAPL exceeds 0.5 foot.
  - A skimming pump may be removed if the well contributes less than 5 percent of the total LNAPL recovered from the skimming system.
- LNAPL will be removed from wells containing LNAPL not connected to the remediation system using sorbent tubes. The sorbent tubes will be replaced quarterly if they are fully saturated. If a well contains LNAPL at the time that the sorbent tube is replaced, the LNAPL will be bailed from the well using a disposable bailer. The frequency of sorbent tube replacement and bailing may vary depending on the volume of LNAPL recovered. Examples of criteria for modifying LNAPL recovery include:
  - If the measured LNAPL thickness in a well with a sorbent tube exceeds the maximum historical thickness for that well, the tube replacement frequency will increase from quarterly to monthly until the thickness decreases below the maximum historical thickness. This would not apply to wells with safety considerations, such as wells MW-22-11 and MW-22-31.
  - If the thickness does not return to below the historical maximum, additional remedial actions may be considered for that well based on baildown testing (which would indicate the potential LNAPL recovery rate) access considerations, safety, and cost.
  - The LNAPL removal frequency may decrease if the LNAPL thickness in a well does not return to the thickness measured before bailing or sorbent tube installation by the next scheduled LNAPL removal event, or if the sorbent tube is less than 50 percent saturated.

- The LNAPL removal frequency will be increased to a maximum of monthly if the LNAPL thickness recovers to similar (pre-bailing) levels of greater than one foot within that time. If the LNAPL thickness does not return to a level similar to its pre-bailing level greater than one foot, the bailing frequency will decrease accordingly.

These actions will increase the removal of LNAPL from the subsurface. Removal of the LNAPL is expected to reduce the dissolution of COCs from the LNAPL into the perched groundwater zone, thereby reducing concentrations of COCs over time. Figure 4-1 shows the proposed remedial action for each well.

4.2 Remedy Monitoring

System monitoring will occur for the following components:

- Air pressure at the compressor and wells
- Airflow from the blower
- Fluid levels in the wells
- The volume of product recovered
- Oxygen and carbon dioxide concentrations in extracted soil vapor

Routine maintenance will include tasks such as changing the oil, oil filter, and air filter for the compressor and blower and periodically removing and cleaning the skimmer pumps.

In addition, a groundwater gauging and sampling program will be implemented. The results of the program will be provided to ADEQ on a semiannual basis. The monitoring program will consist of the following components:

- Semiannual gauging of fluid levels at 46 site monitoring and remediation wells (including proposed well MW-22-45).
- Semiannual sampling of downgradient perched groundwater zone wells MW-23-37, MW-22-38, MW-22-40, MW-22-41, MW-22-44, and MW-22-45 (proposed) and regional groundwater monitoring well MW-22-14.
- Semiannual sampling of LNAPL-containing wells EW-22-19, IW-22-26, MW-22-11, and MW-22-31 (samples will be analyzed for VOCs semiannually and for PAHs annually).
- Analyzing samples from six perched zone monitoring wells annually for MNA parameters including nitrate, ferrous iron, sulfate, methane, and alkalinity. This includes an upgradient well (well MW-22-3), a cross-gradient well (well MW-22-43), two wells within the LNAPL (wells MW-22-11 and MW-22-31), and two downgradient wells (wells MW-22-38 and MW-22-44) to evaluate changes in concentrations of MNA parameters.
- Collection of samples using Hydrasleeves, bailers, or another no-purge method and analyzing for PAHs using U.S. Environmental Protection Agency (EPA) Method 8270C SIM and for VOCs using EPA Method 8260B.

Results of the semiannual gauging and sampling program and a summary of remedy operations will be reported to ADEQ semiannually following each sampling event. Reports will include data obtained during each reporting period, a summary of remediation performance metrics, and remedial progress.

In addition, periodic remedy review reports will be prepared every three years. These reports will include historical water quality data, cumulative LNAPL removal volumes, an evaluation of trends in the concentrations of site-related COCs that exceed water quality standards, an evaluation of remediation metrics and progress towards Site cleanup, and recommendations for remedy optimization if any are identified.

The LNAPL transmissivity metric described in Section 4.5.1 is intended as a long-term metric and will not be updated in the semiannual reports but will be evaluated in the three-year review reports after periodic transmissivity testing is completed.

4.3 Cost

The cost of the proposed remedy is estimated at approximately $4 million, roughly proportioned as follows:

- Capital cost of $2 million including installation of remediation and monitoring wells and the remediation system
- Groundwater monitoring and reporting cost of $450,000 (net present value) for semiannual gauging and sampling over 30 years
- Operation and maintenance cost of $1.5 million (net present value) for LNAPL bailing and operation of the remediation system over 30 years

4.4 Schedule

Figure 4-2 shows the proposed schedule for remedy implementation. The schedule includes phases for a pilot test, design and procurement, remediation system construction, and system startup, plus ongoing operation, sampling and reporting.

4.5 Achievement of Remedial Objectives

The LNAPL is physically contained because of the properties of the LNAPL and the subsurface materials, and therefore does not threaten the current or expected future use of groundwater. The LNAPL is not generating a dissolved-phase plume that migrates outside of the LNAPL body. LNAPL removal by various methods would further reduce LNAPL transmissivity and provide additional protection for wells used for drinking water production. Monitoring would provide confirmation that progress is being made to meet the RO.

4.5.1 Performance Metrics

The primary performance metric, which is continued protection of regional aquifer drinking water wells from site-related constituents, will be verified by the groundwater monitoring program described in Section 4.2. In addition, performance metrics to evaluate the effectiveness of distributed LNAPL recovery are based on:

- Volume of LNAPL removed from or degraded within the subsurface through NSZD, bioventing, skimming, absorption into sorbent tubes, and bailing
- Reductions in LNAPL transmissivity in onsite remediation wells
- Bioventing effectiveness at aerating the subsurface
- Stability of LNAPL
- Stability of dissolved-phase constituents

The volume of LNAPL recovered through skimming pumps will be measured in the recovery tank. For wells not connected to the remediation system, LNAPL recovery will be estimated based on the saturation of the sorbent tubes when they are replaced and by measuring the volume of LNAPL bailed. LNAPL transmissivity will be measured using baildown tests or manual skimming tests as described in Section 4.6.1.

The effectiveness of the bioventing system will be evaluated by measuring the oxygen and carbon dioxide concentrations in extracted soil vapor. This provides estimates of the oxygen consumed by microorganisms during degradation of LNAPL and the amount of LNAPL degraded. The operation of the blower may be modified based on the oxygen depletion to maintain at least 5 percent oxygen in the subsurface at the remediation wells.

Groundwater monitoring results will be used to confirm that dissolved-phase petroleum-related compounds are not migrating towards production wells in the perched groundwater zone and are not present in the regional aquifer at concentrations exceeding AWQS, and to track concentration trends.

These metrics, except transmissivity, will be evaluated in semiannual progress reports. The transmissivity metric will be evaluated in the three-year review reports after transmissivity testing is completed.

4.5.2 Contingency Measures

Contingency measures were developed for various conditions that may be encountered during site remediation. A number of contingency actions may be necessary depending on future conditions. Trigger events for contingencies include:

- A groundwater production well is impacted by site-related contaminants above an AWQS.
- A site-related COC in a perimeter sentinel monitoring well exceeds the AWQS for the first time.
- LNAPL is present in a perimeter monitoring well for the first time.
- Site-related COC concentrations in a monitoring well containing LNAPL show an increasing trend during a periodic review of site conditions.
- Site-related COC concentration in a perimeter sentinel monitoring well equals or exceeds a value equal to one half of the applicable AWQS.
- Remedy acceleration is required to meet the RO for groundwater.

Contingencies related to these triggers are described in the following subsections. Note that actions related to the remedy operation (for example, related to LNAPL thickness in remediation wells) are described in Section 4.1. In general, the following steps will be performed before a contingency is implemented:

- Notify ADEQ within 30 days of receiving final data indicating a contingency event has been triggered
- Develop and submit a contingency action plan and schedule for VRP review and approval within 30 days of notifying the VRP of the triggering event (60 days after identification of the triggering event)
- Review monitoring data to identify potential causes of the event or condition triggering the contingency
- Conduct additional gauging and/or sampling to confirm the condition exists, identify a trend, and provide additional lines of evidence that can be used for the evaluation
- Review nearby environmental sites or properties to assess whether releases have occurred in the area of the observed condition

Contingency actions will be based on the results of the data analysis and will be conducted with the notification and concurrence of ADEQ. Costs for the contingency actions are not included in this PRAP because the exact nature and duration of the contingencies are not estimable at this time.

4.5.2.1 Impacted Production Well

Remedial measures consistent with AAC R18-16-407(G) may be required if a production well becomes impacted by site-related constituents in the future. The site groundwater monitoring program is expected to provide ample warning before this could occur, allowing for implementation of the previously described contingency measures. However, if those contingency measures are insufficient and a production well becomes impacted by site-related constituents at concentrations above an AWQS, wellhead treatment will be considered as an additional contingency.

The following actions are proposed if a production well becomes impacted with site-related compounds that exceed an AWQS:

- Collect a second sample to confirm the presence and concentration of dissolved phase COC or LNAPL
- Monitor the COC concentration or presence of LNAPL in the well over time and develop and submit a contingency action plan and schedule for VRP review and approval within 30 days of notifying the VRP of the triggering event (60 days after identification of the triggering event)
- Identify the most appropriate remedial measure (for example, identifying an alternative water supply or implementing wellhead treatment) for the impacted well
- Design and implement the selected remedial measure

These activities would be expedited if there is public exposure to site-related compounds through the impacted production well.

4.5.2.2 A Site-Related COC Exceeds the Aquifer Water Quality Standard in a Perimeter Monitoring Well

Historical groundwater monitoring data indicate that dissolved phase COCs have not migrated beyond the LNAPL impacted area at concentrations exceeding an AWQS. If a site-related COC is detected in a downgradient perched zone monitoring well or regional aquifer monitoring well in the future at a concentration exceeding its AWQS this will not mean that the RO is not met. No production wells are known to be screened in the perched groundwater zone, and petroleum-related COCs typically attenuate rapidly in aerobic aquifers such as those that are present beneath the site.

The following actions are proposed if a site-related COC appears in a perimeter well at a concentration exceeding the AWQS:

- Collect a second sample to confirm the presence and concentration
- Monitor the concentration in the well over time and develop and submit a contingency action plan and schedule for VRP review and approval within 30 days of notifying the VRP of the triggering event (60 days after identification of the triggering event)
- Install a new delineation well if necessary to define the extent of the COC in groundwater relative to nearby production wells and to evaluate the natural attenuation rate outside of the LNAPL area
- Assess whether any production wells are threatened and whether wellhead treatment is necessary; see Section 4.5.2.1 for additional contingency actions related to an impacted production well

4.5.2.3 LNAPL Appearance in a Perimeter Monitoring Well

The appearance of LNAPL in a well that previously did not contain LNAPL does not necessarily demonstrate that LNAPL migrated into the well recently. Field screening during the installation of monitoring wells often showed potential impacts from petroleum hydrocarbons even at wells where LNAPL was not initially observed (CH2M, 2014). The appearance of LNAPL is sometimes dependent on fluctuations of the groundwater elevation. For example, if the groundwater elevation decreases, LNAPL that was previously submerged can enter the well. This does not mean that the LNAPL can expand in extent because of the decreased groundwater elevation. Site data indicate that the LNAPL at the site generally is not under sufficient head pressure to migrate into unimpacted areas (CH2M, 2010). The following actions are proposed if LNAPL appears in a perimeter well where it was previously absent:

- Confirm the presence of LNAPL in the well using a bailer
- Review analytical data and field screening data from soil samples collected from the boring before well installation, well boring logs, and historical groundwater elevation data and water quality data to assess whether LNAPL was already present at the well location when the well was installed
- Gauge and bail the affected well monthly for three months to monitor the presence of LNAPL in the well over time

- Discuss with ADEQ the LNAPL thickness, whether the LNAPL has migrated, and trends in thickness or COC concentrations observed
- Assess the recoverability of the LNAPL in the well
- If appropriate, implement LNAPL recovery using sorbent tubes as described in Section 4.1
- Install a new delineation well if necessary

4.5.2.4 COC Concentrations Beneath LNAPL Show Increasing Trend

During each periodic site review, the trend of site-related COC concentrations in wells containing LNAPL will be evaluated using a statistical approach such as the Mann-Kendall test. Wells showing a statistically significant increasing trend in a COC concentration exceeding an AWQS will be evaluated for additional remediation such as wellhead bioventing to increase volatilization and degradation.

4.5.2.5 Site-Related COC Concentration in a Perimeter Monitoring Well Equals or Exceeds One Half of the Applicable AWQS

The following actions are proposed if a site-related COC appears in a perimeter well at a concentration equal to or exceeding one half of the AWQS:

- Increase the monitoring frequency of that well to bimonthly.
- Begin evaluating whether remedy acceleration is necessary. If a COC concentration exceeds one half of the applicable AWQS, develop a schedule to evaluate remedy acceleration methods.

4.5.2.6 Reducing the Remediation Timeframe

Remedy acceleration will be implemented if a periodic review indicated that site-related COC concentrations are:

- Increasing above the applicable AWQS in perimeter monitoring wells MW-22-38, MW-22-40, MW-22-41, MW-22-44, or MW-22-45 (proposed) or regional aquifer monitoring well MW-22-14; and/or
- Migrating at a rate that would impact existing production wells without additional remediation.

Although prediction of future conditions and the responses needed is difficult using current data, one or more of the following contingency actions are anticipated:

- Optimize the bioventing system, which may include varying the air extraction, recirculation, fresh air dilution, and injection flow rates or locations to increase the distribution of oxygen in the vicinity of the remediation wells
- Evaluate a pilot test of wellhead bioventing for offsite wells to enhance natural LNAPL depletion processes and increase the LNAPL destruction rate
- Evaluate a bioaugmentation pilot test for the onsite remediation wells to enhance biodegradation
- Other contingency actions as agreed to with the VRP

4.6 Achievement of Remedial Action Criteria (ARS 49-282.06)

ARS. 49-282.06 requires that remedial actions:

1. Assure the protection of public health and welfare and the environment
2. To the extent practicable, provide for the control, management or cleanup of the hazardous substances to allow the maximum beneficial use of the waters of the state
3. Be reasonable, necessary, cost-effective, and technically feasible

No environmental receptors have been identified at the site, and the potential for public exposure is limited to short-term exposure by construction workers, which can be minimized through standard work practices.

Site-related impacts exceeding AWQSs are limited to the perched groundwater zone, which is not used for drinking water production. Historical data indicate that the LNAPL is not generating a plume of dissolved phase constituents that could threaten water supply wells.

The proposed remedy provides relatively cost-effective treatment of site contaminants and is based on readily implementable, proven technologies.

4.7 Pilot Test

ADEQ requested that UPRR conduct a pilot test before startup of the remediation system:

> *A pilot test must be included as part of the Proposed Remedial Action Plan to document baseline performance of the bioventing and skimming in wells connected to the existing on-site remediation system for future metrics comparisons* (ADEQ, 2019).

The following subsections describe the components of a proposed pilot test that will be conducted before routine system operation is implemented.

4.7.1 Skimming

Remediation progress for skimming wells is anticipated to be measured by evaluating decreases in LNAPL transmissivity over time. The LNAPL transmissivity is correlated to LNAPL saturation in the formation, thus changes in the measured transmissivity are expected to represent reductions in LNAPL saturation because of factors such as NSZD, bioventing, and skimming. Before remediation system startup, the LNAPL transmissivity will be measured in the wells designated for installation of skimming pumps. The transmissivity will be measured using either baildown tests or the manual skimming test method depending on conditions at each well. Typically, baildown tests will be used for wells where the LNAPL thickness is greater than 0.5 foot or for wells located in areas where equipment cannot remain at the well during the test. Manual skimming tests will be used at locations where the LNAPL thickness is less than 0.5 foot. ASTM Standard Guide for Estimation of LNAPL Transmissivity (May 2013) describes LNAPL transmissivity estimating procedures.

4.7.2 Bioventing

The bioventing portion of the pilot test will measure the initial generation of carbon dioxide and consumption of oxygen in the subsurface. A recirculation system will allow for the collection of representative samples over the period of the pilot test while avoiding discharge of petroleum-impacted soil vapor to the atmosphere. Two pairs of wells will be tested. At each well pair, soil gas will be extracted from one well at a flow rate of about 30 to 60 standard cubic feet per minute and injected into the other well. Air flow will be measured and the carbon dioxide and oxygen concentrations in the extracted air will be sampled periodically during the test. Wellhead vacuum or pressure measurements will be monitored in nearby wells to assess air flow through the subsurface. Each test is anticipated to last 5 days. Data from the bioventing pilot test will be used to estimate the duration and frequency that the system will need to operate to maintain greater than five percent oxygen in the subsurface.

4.8 Community Involvement

Upon notification by ADEQ, UPRR will issue a notice to the public and to interested persons (including affected water providers, affected well owners, local government agencies, adjacent residents, and the Arizona Department of Water Resources) of the availability of, and of the opportunity to comment on, the PRAP. The notice will be posted on the ADEQ website. The public comment period will be of not less than 45 days. UPRR will respond to comments received during the public comment period in a Responsiveness Summary.

5. References

Arizona Department of Environmental Quality (ADEQ). 2014. *Final Remedial Objectives Report, Union Pacific Railroad Tucson Yard, VRP Site Code 501994-00, Tucson, Arizona*. January.

Arizona Department of Environmental Quality (ADEQ). 2019. *Review of Revised Feasibility Study, Union Pacific Railroad 22nd Street Site, Tucson, Arizona, Site Code 501994-00*. October 29.

Arizona Department of Water Resources (ADWR), 1984. *Maps Showing Groundwater Conditions in the Upper Santa Cruz Basin Area, Pima, Santa Cruz, Pinal and Cochise Counties, Arizona-1982*. Hydrologic Map Series Report Number 11.

CH2M HILL Engineers, Inc. (CH2M). 2010. *LNAPL Mobility Assessment for the UPRR 22nd Street Site, Tucson, Arizona (VRP Site Code 501994-00)*. May 12.

CH2M HILL Engineers, Inc. (CH2M). 2014. *Final Remedial Investigation Report, 22nd Street Site, Tucson, Arizona, VRP Site Code 501994-00*. February.

City of Tucson. 2020. https://maps2.tucsonaz.gov/Html5Viewer/?viewer=maptucson. February 4.

Environmental Resources Management (ERM). 2001. *Remedial Investigation Report, 22nd Street Site, ADEQ VRP Facility #501994-00, Tucson, Arizona*. January.

Industrial Compliance (IC), 1991. *Tucson Rail Yard Operations Scoping Document, Southern Pacific Transportation Company, Tucson Rail Yard, Tucson, Arizona*. 21 May 1991.

Jacobs Engineering Group Inc. (Jacobs). 2019. *Revised Feasibility Study Report, 22nd Street Site, Tucson, Arizona, VRP Site Code 501994-00*. August.

Jacobs Engineering Group, Inc. (Jacobs). 2020. *February 2020 Progress Report, Union Pacific Railroad 22nd Street Site, Tucson, Arizona, (VRP Site Code 501994-00)*. April 24.

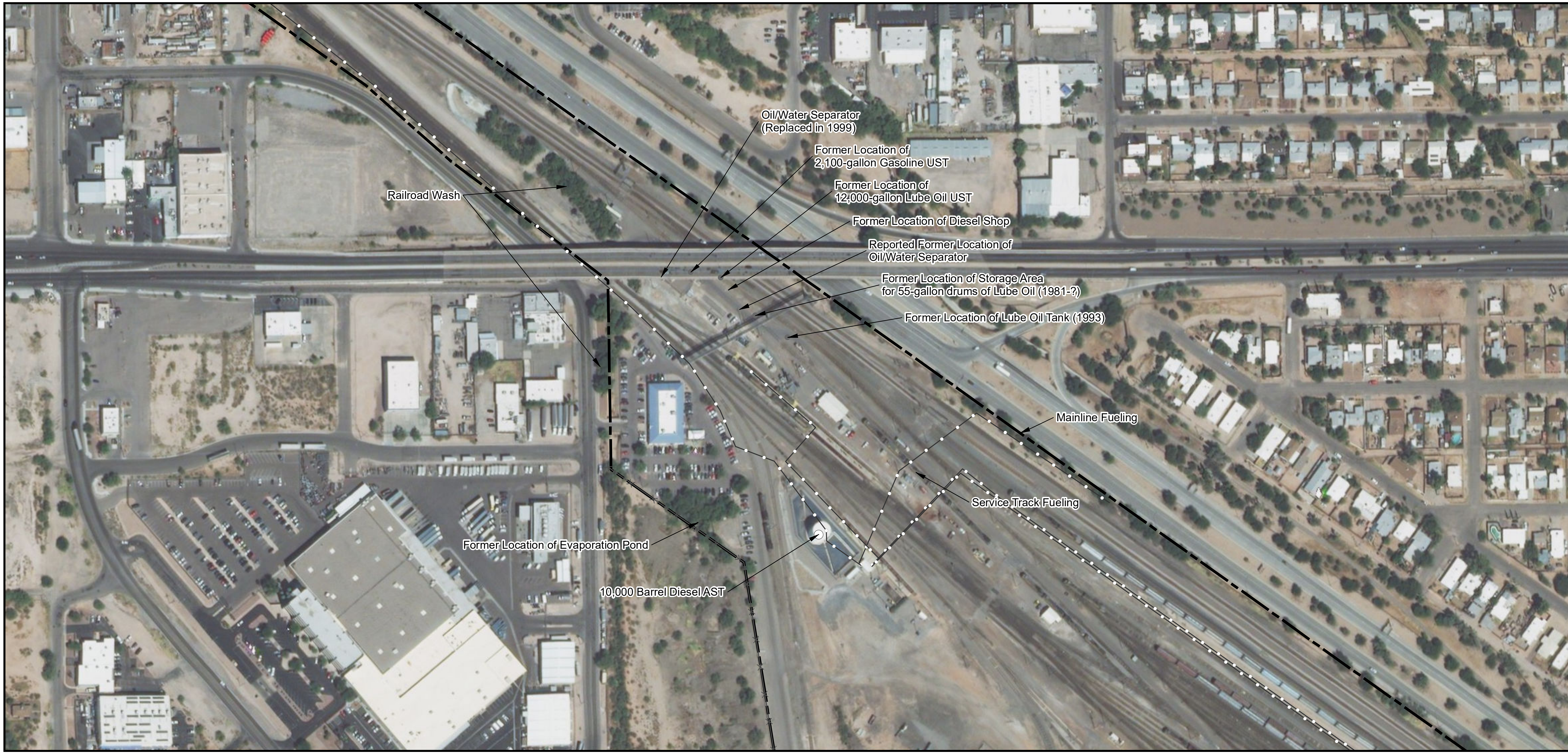
Table

Table 3-1. Comparative Evaluation of Remedial Alternatives

Proposed Remedial Action Plan, 22nd Street Site, Tucson, Arizona

Remedy	Meets Remedial Objectives?	Meets Water and Land Use Plans?	Practicability	Protective-ness	Cost ($million)	Benefit	Rank
Reference Remedy (Vacuum-enhanced Skimming)	Yes	Yes	2	1	$3.9	1	2
Alternative 1 (Distributed Light Nonaqueous Phase Liquid Recovery)	Yes	Yes	2	1	$4.0	1	3
Alternative 2 (Monitored Natural Attenuation / Natural Source Zone Depletion)	Yes	Yes	1	1	$1.8	1	1

Figures



Legend

Approximate Location of Pipeline

Fence

Property Boundary

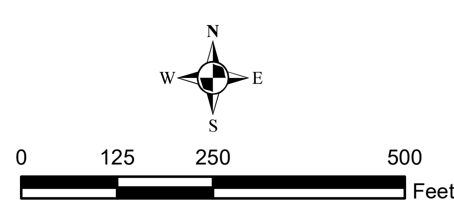


Figure 2-1. Locations of Historical Operations

Union Pacific Railroad Company

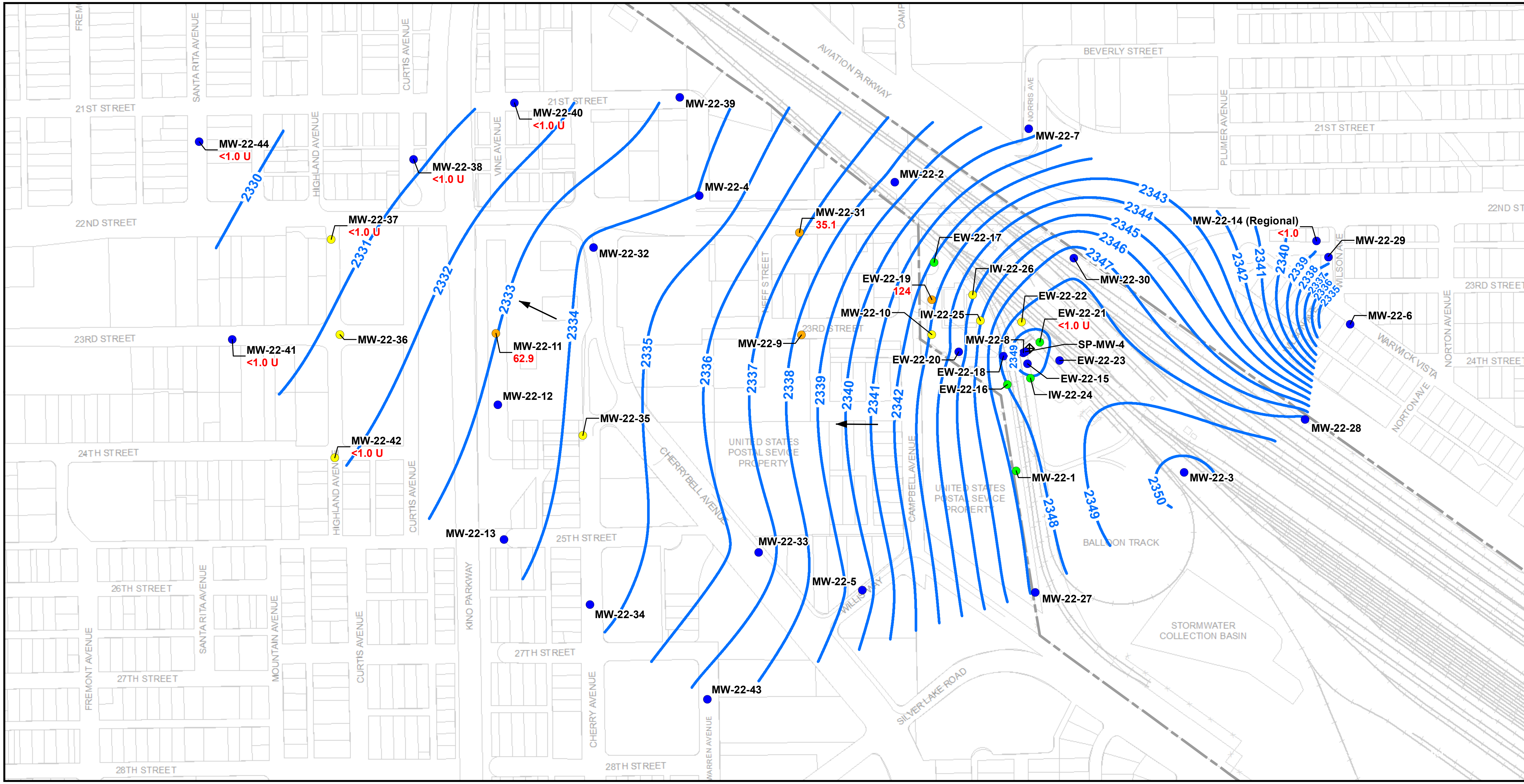
22nd Street Fueling Facility

Tucson, Arizona

Notes:
1. All locations of existing and former structures are approximate.
2. Source of the historical map and facility descriptions: ERM, 2001

JACOBS

R:\ENBG\00_PROJ\U\UPRR\UPRR_22NDST\MAPFILES\2019\REVISED_2019_FEASIBILITY STUDY\FIG02-01_22NDST_HISTORICAL_OPERATIONS.MXD AESPEJO 8/8/2019 6:28:36 PM



LEGEND

LNAPL Thickness (feet)

- Not Detected
- ≥ 0.01 to 1
- ≥1 to 4
- ≥ 4
- Not Measured
- 2339 Groundwater Elevation Contour (feet NAVD88); Estimated based on February 2020 Gauging Data
- Approximate Groundwater Flow Direction
- Property Boundary

MW-22-37 — Location ID
<1.0 — Benzene concentrations in micrograms per liter

Notes:
1. < = not detected; value given is the reporting limit
2. LNAPL = light nonaqueous phase liquid

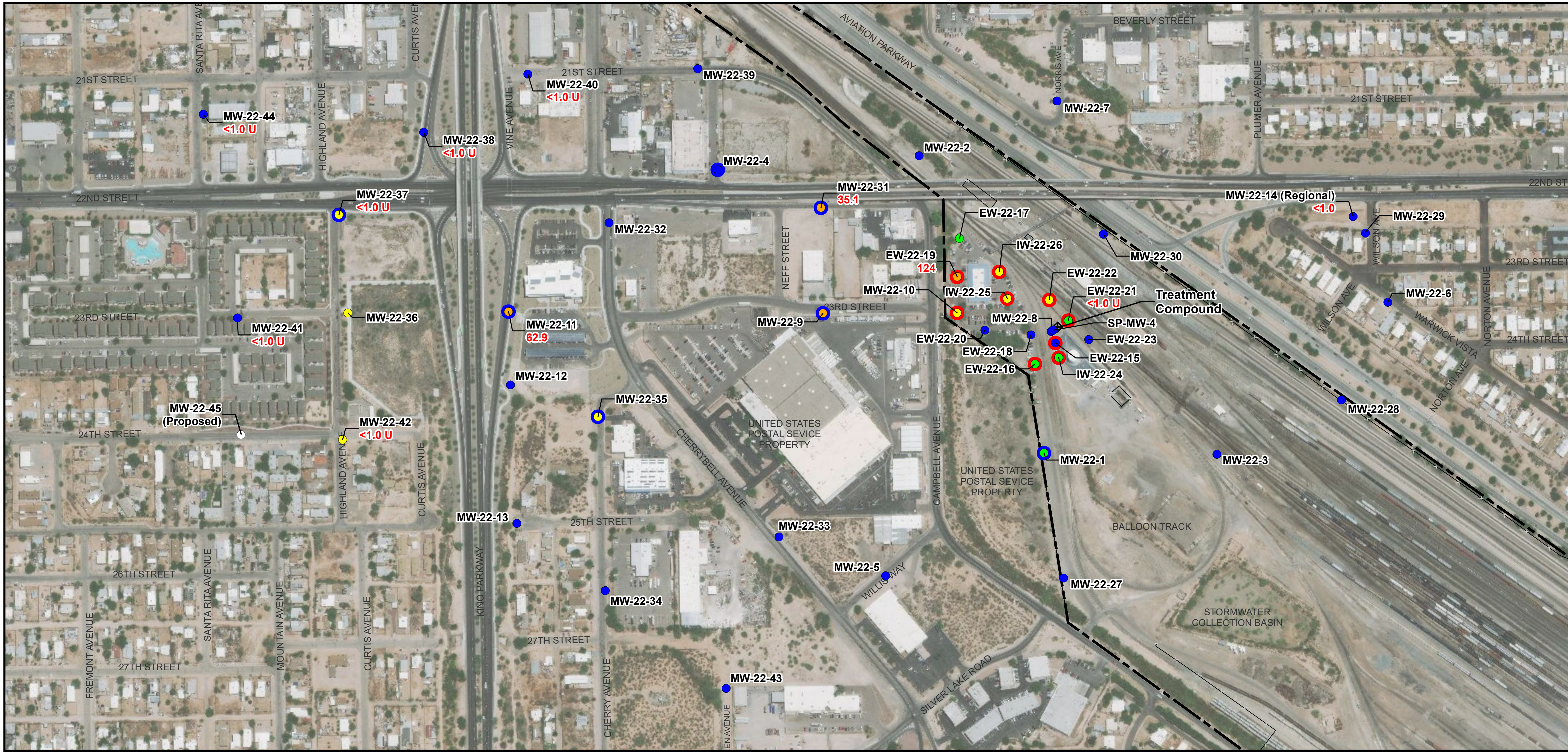
N W E S

0 200 400 800 Feet

Figure 2-2. Benzene and LNAPL Distribution
February 2020
Union Pacific Railroad Company
22nd Street Fueling Facility
Tucson, Arizona

Jacobs

\\DC1VS01\GISPROJ\U\UPRR\UPRR_22NDST\MAPFILES\2020\FIG02-02_22NDST_BZ_AND_LNAPL_DISTRIBUTION_FEB2020.MXD AESPEJO 2/17/2021 10:53:12 AM



Legend

LNAPL Thickness (feet)

- Not Detected
- ≥ 0.01 to 1
- ≥1 to 4
- ≥ 4
- Not Measured

2.2 Benzene Concentration (µg/L) (February 2020)

Property Boundary

Remedial Action Category

- Bioventing and Skimming
- Sorbent Tubes Changed Quarterly, Bail if LNAPL Present

N W E S

0 200 400 800 Feet

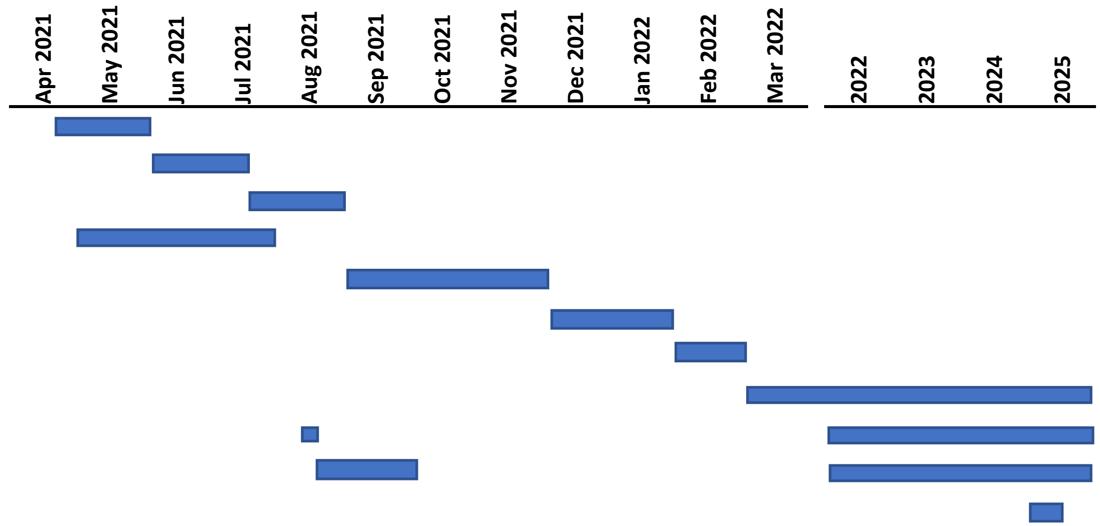
Figure 4-1. Proposed Remedy - Distributed LNAPL Recovery

Union Pacific Railroad Company
22nd Street Fueling Facility
Tucson, Arizona

Jacobs

\\DC1VS01\GISPROJ\U\UPRR\UPRR_22NDST\MAPFILES\2020\FIG04-01_22NDST_PROPOSED_REMEDY_FEB2020.MXD AESPEJO 2/17/2021 10:45:47 AM

Task Name	Duration (Days)	Start	Finish
PRAP Public Comment Period	45	4/21/2021	6/5/2021
Responsiveness Summary	45	6/5/2021	7/20/2021
Responsiveness Summary Approval	45	7/20/2021	9/3/2021
Pilot Test, Analysis and Reporting	90	5/1/2021	7/30/2021
Design and Procurement	90	9/3/2021	12/2/2021
Construction	60	12/2/2021	1/31/2022
System Startup	30	1/31/2022	3/2/2022
Operation and Maintenance	Ongoing	3/2/2022	Ongoing
Groundwater Gauging and Sampling	5	Semiannual	
Progress Reporting	45	Semiannual	
3-Year Review Report	90	Triennial	



Notes:

PRAP = Proposed Remedial Action Plan

Years after 2025 are not shown for clarity. Operation and maintenance of the remediation system, groundwater gauging and sampling, progress reporting, and 3-year review reporting will continue on a cycle identical to that shown for years 2022 through 2025.

Figure 4-2. Proposed Remedy Implementation Schedule
Union Pacific Railroad Company
22nd Street Fueling Facility
Tucson, Arizona

Appendix A
Summary of Historical Soil Sampling Results

1. Summary of Historical Soil Sampling Results

Various investigations and field activities were performed to assess historical releases associated with fueling facilities at the Union Pacific Railroad (UPRR) 22nd Street Site in Tucson, Arizona (site). The primary investigations related to characterizing the nature and extent of petroleum-related compounds in soil include an initial site investigation conducted in 1991 (Southern Pacific Environmental Systems, Inc. 1991) and the remedial investigation conducted in 2000 (Environmental Resources Management Inc. 2001). Additional monitoring wells were installed in 2005 (Environmental Resources Management, Inc, 2006) and soil borings were drilled in 2010 (CH2M Hill Engineers Inc. 2010). Figure A-1 shows historical soil sampling locations.

Results of the soil investigations indicate that the impact to vadose zone soil is generally limited to the area near the fueling facilities. Away from the UPRR property, the impact to soil is limited to a thin zone associated with the light nonaqueous phase liquid present in the capillary fringe of the perched aquifer. The *Final Remedial Investigation Report, 22nd Street Site, Tucson, Arizona, VRP Site Code 501994-00* (CH2M Hill Engineers Inc, 2014) provides additional information regarding the nature and extent of petroleum hydrocarbons in soil.

Analytical data indicate that no soil samples collected from various hydrogeologic zones analyzed for polycyclic aromatic hydrocarbons or volatile organic compounds exceeded the soil remediation levels for nonresidential land use for these compounds. Table A-1 summarizes analytical laboratory results.

2. References

CH2M Hill Engineers Inc, 2014. *Final Remedial Investigation Report, 22nd Street Site, Tucson, Arizona, VRP Site Code 501994-00*. February.

CH2M HILL Engineers, Inc. (CH2M). 2010. *LNAPL Mobility Assessment for the UPRR 22nd Street Site, Tucson, Arizona (VRP Site Code 501994-00)*. May 12.

Environmental Resources Management, Inc, 2001. *Remedial Investigation Report, 22nd Street Site, ADEQ VRP Facility #501994-00, Tucson, Arizona*. January.

Environmental Resources Management, Inc, 2006. *Remedial Investigation Report Addendum, 22nd Street, Union Pacific Railroad Company, Tucson, Arizona, VRP Site Code 501994-00*. August 17.

Southern Pacific Environmental Systems, Inc. 1991. *Initial Site Investigation Report, Southern Pacific Transportation Company, Tucson Yard, Tucson, Arizona*. June 27.

Table A-1. Remedial Investigation Soil Sample Results

Union Pacific Railroad Company, 22nd Street Site, Tucson, Arizona

Location	Sample ID	Date Sampled	TPH GRO (mg/kg)	TPH DRO (mg/kg)	TPH HRO (mg/kg)	Total TPH (DRO + HRO) (mg/kg)	Benzene (µg/kg)	Toluene (µg/kg)	Ethylbenzene (µg/kg)	Total Xylenes (µg/kg)	1,2,4-Trimethylbenzene (µg/kg)	1,3,5-Trimethylbenzene (µg/kg)	4-Isopropyltoluene (µg/kg)	n-Butylbenzene (µg/kg)	n-Propylbenzene (µg/kg)	sec-Butylbenzene (µg/kg)	Other VOCs (µg/kg)	Acenaphthene (µg/kg)	Acenaphthylene (µg/kg)	Anthracene (µg/kg)	Benzo(a) anthracene (µg/kg)	Chrysene (µg/kg)	Fluoranthene (µg/kg)	Flourene (µg/kg)	Indeno[1,2,3-cd]pyrene (µg/kg)	Naphthalene (µg/kg)	Phenanthrene (µg/kg)	Pyrene (µg/kg)
		Analytical Method:	**8015AZ**	**8015AZ**	**8015AZ**	**8015AZ**	**8021B**	**8021B**	**8021B**	**8021B**	**8021B**	**8021B**	**8021B**	**8021B**	**8021B**	**8021B**	**8021B**	**8310**	**8310**	**8310**	**8310**	**8310**	**8310**	**8310**	**8310**	**8310**	**8310**	**8310**
	Nonresidential Soil Remediation Level:		*NE*	*NE*	*NE*	*NE*	*1,400*	*650,000*	*400,000*	*420,000*	*170,000*	*70,000*	*NE*	*240,000*	*240,000*	*220,000*	*Varies*	*29,000,000*	*NE*	*240,000,000*	*21,000*	*2,000,000*	*22,000,000*	*26,000,000*	*21,000*	*190,000*	*NE*	*29,000,000*
SB-22-1	SB22-1-115	6/11/1998	510	11,000	2,200	13,200	<250	600	4,500	14,000	ND	ND	ND	ND	ND	ND	ND	ND	ND	1,000	ND	ND	ND	5,600	ND	ND	ND	ND
	SB22-1-117	6/11/1998	90	2,100	130	2,230	<100	150	1,300	4,000	ND	ND	ND	ND	ND	ND	ND	ND	ND	300	ND	ND	ND	1,900	ND	ND	ND	ND
SB-22-2	SB22-2-116	6/13/1998	<20	570	150	720	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	900	ND	ND	3,600	ND
	SB22-2-118	6/13/1998	<20	45	68	113	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SB-22-3	SB22-3-121	6/14/1998	<20	1,400	170	1,570	<50	<50	<50	140	ND	ND	ND	ND	ND	ND	ND	ND	ND	500	ND	ND	ND	4,200	ND	ND	ND	ND
	SB22-3-123	6/14/1998	78	1,400	230	1,630	<50	100	670	1,600	ND	ND	ND	ND	ND	ND	ND	ND	ND	100	ND	ND	ND	700	ND	ND	ND	ND
SB-22-4	SB22-4-117	6/16/1998	<20	<30	<50	<80	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB22-4-119	6/16/1998	<20	<30	<50	<80	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SB-22-5	SB22-5-116	6/18/1998	<20	<30	<50	<80	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB22-5-118	6/18/1998	<20	<30	<50	<80	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SB-22-6	SB22-6-116	6/24/1998	<20	<30	<50	<80	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB22-6-118	6/24/1998	<20	<30	<50	<80	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SB-22-7	SB22-7-3	6/25/1998	<20	1,000	220	1,220	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1,200	ND	ND	4,700	ND
	SB22-7-6	6/25/1998	<200	9,100	820	9,920	<100	<100	<100	<200	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2,200	ND	ND	8,400	ND
	SB22-7-12	6/25/1998	<20	53	<50	53	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	40	ND
	SB22-7-44	6/25/1998	<20	<30	<50	<80	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB22-7-74	6/25/1998	<20	<30	<50	<80	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB22-7-99	6/25/1998	<20	<30	<50	<80	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB22-7-115	6/26/1998	<20	260	<50	260	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	40	ND	ND	ND	150	ND	ND	800	ND
	SB22-7-117	6/26/1998	<20	1,300	87	1,387	<50	<50	63	120	ND	ND	ND	ND	ND	ND	ND	ND	ND	100	ND	ND	ND	1,000	ND	ND	5,500	ND
	SB22-7-118	6/26/1998	<20	1,800	220	2,020	<50	<50	350	1,200	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	420	ND	ND	2,000	ND
	SB22-7-124	6/26/1998	<20	<30	<50	<80	<50	<50	61	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SB-22-8	SB22-8-3	6/28/1998	<20	55	200	255	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB22-8-113	6/28/1998	<100	8,300	1,200	9,500	<100	<100	<100	260	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2,900	ND	ND	2,000	ND
	SB22-8-115	6/28/1998	280	13,000	970	13,970	<100	330	<100	660	ND	ND	ND	ND	ND	ND	ND	ND	ND	600	ND	ND	ND	5,200	ND	ND	26,000	ND
	SB22-8-117	6/28/1998	<20	700	<50	700	<100	<100	130	200	ND	ND	ND	ND	ND	ND	ND	ND	ND	400	ND	ND	ND	3,300	ND	ND	16,000	ND
	SB22-8-120	6/28/1998	83	2,500	170	2,670	<100	410	<100	700	ND	ND	ND	ND	ND	ND	ND	ND	ND	300	ND	ND	ND	1,600	ND	ND	7,700	ND
	SB22-8-122	6/28/1998	<20	<30	<50	<80	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	30	ND
SB-22-9	SB22-9-119	6/29/1998	<20	<30	<50	<80	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB22-9-122	6/29/1998	<40	3,000	400	3,400	<100	<100	<100	<200	ND	ND	ND	ND	ND	ND	ND	ND	ND	100	ND	ND	ND	600	ND	ND	2,900	ND
SB-22-10	SB22-10-12	7/8/1998	<20	<30	<50	<80	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB22-10-38	7/8/1998	<20	<30	<50	<80	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB22-10-64.5	7/8/1998	<20	<30	<50	<80	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB22-10-88	7/8/1998	<20	<30	<50	<80	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB22-10-114	7/10/1998	72	2,100	330	2,430	<50	93	1,100	1,200	ND	ND	ND	ND	ND	ND	ND	ND	ND	300	ND	ND	ND	1,100	ND	ND	5,500	ND
	SB22-10-115	7/10/1998	28	1,600	270	1,870	<50	<50	150	460	ND	ND	ND	ND	ND	ND	ND	ND	ND	300	ND	ND	ND	1,300	ND	ND	6,200	ND
SB-22-11	SB22-11-116	7/11/1998	<20	<30	<50	<80	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB22-11-118	7/11/1998	<20	<30	<50	<80	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SB-22-12	SB22-12-113	7/13/1998	<20	50	<50	50	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	200	ND	ND	1,300	ND
	SB22-12-115	7/13/1998	350	6,200	1,100	7,300	<100	310	2,400	3,900	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1,800	ND	ND	9,700	ND

Table A-1. Remedial Investigation Soil Sample Results

Union Pacific Railroad Company, 22nd Street Site, Tucson, Arizona

Location	Sample ID	Date Sampled	TPH GRO (mg/kg)	TPH DRO (mg/kg)	TPH HRO (mg/kg)	Total TPH (DRO + HRO) (mg/kg)	Benzene (µg/kg)	Toluene (µg/kg)	Ethylbenzene (µg/kg)	Total Xylenes (µg/kg)	1,2,4-Trimethylbenzene (µg/kg)	1,3,5-Trimethylbenzene (µg/kg)	4-Isopropyltoluene (µg/kg)	n-Butylbenzene (µg/kg)	n-Propylbenzene (µg/kg)	sec-Butylbenzene (µg/kg)	Other VOCs (µg/kg)	Acenaphthene (µg/kg)	Acenaphthylene (µg/kg)	Anthracene (µg/kg)	Benzo(a) anthracene (µg/kg)	Chrysene (µg/kg)	Fluoranthene (µg/kg)	Flourene (µg/kg)	Indeno[1,2,3-cd]pyrene (µg/kg)	Naphthalene (µg/kg)	Phenanthrene (µg/kg)	Pyrene (µg/kg)
		Analytical Method:	**8015AZ**	**8015AZ**	**8015AZ**	**8015AZ**	**8021B**	**8021B**	**8021B**	**8021B**	**8021B**	**8021B**	**8021B**	**8021B**	**8021B**	**8021B**	**8021B**	**8310**	**8310**	**8310**	**8310**	**8310**	**8310**	**8310**	**8310**	**8310**	**8310**	**8310**
	Nonresidential Soil Remediation Level:		*NE*	*NE*	*NE*	*NE*	*1,400*	*650,000*	*400,000*	*420,000*	*170,000*	*70,000*	*NE*	*240,000*	*240,000*	*220,000*	*Varies*	*29,000,000*	*NE*	*240,000,000*	*21,000*	*2,000,000*	*22,000,000*	*26,000,000*	*21,000*	*190,000*	*NE*	*29,000,000*
SB-22-13	SB22-13-29	7/14/1998	740	9,600	3,700	13,300	<500	730	2,100	6,600	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5,900	ND	ND	26,000	ND
	SB22-13-49	7/14/1998	520	7,300	1,400	8,700	<500	710	7,600	9,400	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4,200	ND	ND	18,000	ND
	SB22-13-79	7/14/1998	330	6,400	860	7,260	<500	550	1,600	5,500	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2,300	ND	ND	12,000	ND
	SB22-13-105	7/14/1998	400	6,400	1,200	7,600	<250	420	1,400	5,000	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2,900	ND	ND	13,000	ND
	SB22-13-113	7/14/1998	22	480	210	690	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	600	ND
	SB22-13-114	7/14/1998	34	560	180	740	<50	280	600	1,900	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	800	ND	ND	3,900	ND
	SB22-13-115	7/14/1998	240	4,800	660	5,460	<50	140	750	2,200	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2,300	ND	ND	12,000	ND
SB-22-14	SB22-14-113	7/16/1998	<20	<30	<50	<80	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	500	ND
	SB22-14-115	7/16/1998	250	5,700	560	6,260	<50	230	210	1,500	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2,000	ND	ND	9,000	ND
SB-22-15	SB22-15-107	7/22/1998	<20	<30	<50	<80	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB22-15-109	7/22/1998	<20	<30	<50	<80	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SB-22-16	SB22-16-106.5	7/23/1998	<20	<30	<50	<80	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB22-16-109.5	7/23/1998	<20	<30	<50	<80	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SB-22-17	SB-22-17-122.5	7/29/1998	<20	830	170	1,000	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB-22-17-123.5	7/29/1998	250	14,000	1,100	15,100	<50	420	390	1,500	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4,000	ND	ND	ND	ND
SB-22-18	SB-22-18-127	7/31/1998	<20	<30	<50	<80	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB-22-18-129.5	7/31/1998	<20	<30	<50	<80	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SB-22-19	SB-22-19-120	8/6/1998	<20	<30	<50	<80	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB-22-19-122	8/6/1998	670	18,000	1,500	19,500	140	1,700	3,500	11,000	ND	ND	ND	ND	ND	ND	ND	100	ND	50	250	240	ND	ND	ND	ND	ND	ND
SB-22-20	SB-22-20-121	8/7/1998	<20	<30	<50	<80	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB-22-20-124	8/7/1998	<20	<30	<50	<80	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SB-22-21	SB-22-21-111	8/8/1998	<20	<30	<50	<80	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SB-22-22	SB-22-22-111	8/10/1998	<20	<30	<50	<80	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB-22-22-117	8/10/1998	<20	<30	<50	<80	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SB-22-23	SB-22-23-114	8/11/1998	<20	<30	<50	<80	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB-22-23-117	8/11/1998	<20	<30	<50	<80	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SB-22-24	SB-22-24-112	8/13/1998	<20	<30	<50	<80	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB-22-24-118.5	8/13/1998	<20	<30	<50	<80	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SB-22-25	SB-22-25-110	8/14/1998	<20	<30	<50	<80	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB-22-25-111	8/14/1998	<20	<30	<50	<80	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SB-22-26	SB-22-26-111	8/20/1998	<20	<30	<50	<80	<50	<50	<50	<100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB-22-26-115	8/20/1998	68	2,900	380	3,280	<250	<250	<250	640	ND	ND	ND	ND	ND	ND	ND	1,000	ND	ND	ND	ND	ND	2,200	ND	2,000	ND	ND
SB-22-27	SB-22-27-105	12/19/1998	<1.0	<1.0	<5.0	<6.0	<5.0	<5.0	<5.0	<10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB-22-27-123	12/20/1998	17	1,700	56	1,756	<420	<420	<420	420	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	210	2,300	3,100	ND	ND	13,000	500
	SB-22-27-125	12/20/1998	580	19,000	710	19,710	<1,300	1,700	4,100	12,500	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	53,000	ND
SB-22-28	SB-22-28-122	12/22/1998	<1.0	2.5	<5.0	2.5	<5.0	<5.0	<5.0	<10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	SB-22-28-128	12/22/1998	13	720	28	748	<130	<130	<130	<260	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	55	100	220	1,000	ND	ND	3,300	210
	SB-22-28-131	12/22/1998	410	8,500	280	8,780	<630	1,000	3,800	9,300	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	730	ND	14,000	ND	ND	41,000	1,900

Table A-1. Remedial Investigation Soil Sample Results

Union Pacific Railroad Company, 22nd Street Site, Tucson, Arizona

Location	Sample ID	Date Sampled	TPH GRO (mg/kg)	TPH DRO (mg/kg)	TPH HRO (mg/kg)	Total TPH (DRO + HRO) (mg/kg)	Benzene (µg/kg)	Toluene (µg/kg)	Ethylbenzene (µg/kg)	Total Xylenes (µg/kg)	1,2,4-Trimethylbenzene (µg/kg)	1,3,5-Trimethylbenzene (µg/kg)	4-Isopropyltoluene (µg/kg)	n-Butylbenzene (µg/kg)	n-Propylbenzene (µg/kg)	sec-Butylbenzene (µg/kg)	Other VOCs (µg/kg)	Acenaphthene (µg/kg)	Acenaphthylene (µg/kg)	Anthracene (µg/kg)	Benzo(a) anthracene (µg/kg)	Chrysene (µg/kg)	Fluoranthene (µg/kg)	Flourene (µg/kg)	Indeno[1,2,3-cd]pyrene (µg/kg)	Naphthalene (µg/kg)	Phenanthrene (µg/kg)	Pyrene (µg/kg)
		Analytical Method:	**8015AZ**	**8015AZ**	**8015AZ**	**8015AZ**	**8021B**	**8021B**	**8021B**	**8021B**	**8021B**	**8021B**	**8021B**	**8021B**	**8021B**	**8021B**	**8021B**	**8310**	**8310**	**8310**	**8310**	**8310**	**8310**	**8310**	**8310**	**8310**	**8310**	**8310**
	Nonresidential Soil Remediation Level:		*NE*	*NE*	*NE*	*NE*	*1,400*	*650,000*	*400,000*	*420,000*	*170,000*	*70,000*	*NE*	*240,000*	*240,000*	*220,000*	*Varies*	*29,000,000*	*NE*	*240,000,000*	*21,000*	*2,000,000*	*22,000,000*	*26,000,000*	*21,000*	*190,000*	*NE*	*29,000,000*
MW-22-9	MW-22@118.5-119	7/7/1999	24	23	<5.0	23	<130	<130	<130	130	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	12	32	43	41	ND	ND	140	9.8
	MW-22@122.5-123.5	7/7/1999	130	5,700	<500	5,700	<250	<250	<250	1,100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	700	1,600	2,900	3,900	ND	9,100	12,000	660
	MW-22@123.5-126	7/7/1999	40	4,000	<500	4,000	<250	<250	<250	810	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	560	1,200	2,300	2,600	ND	ND	9,000	500
MW-22-10	MW-22-10-111	8/18/1999	<1.0	3.3	<5.0	3.3	<5.0	<5.0	<5.0	<10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MW-22-10-112.5	8/18/1999	51	17,000	410	17,410	<1,000	<1000	1,300	3,300	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	910	1,800	3,900	5,700	ND	ND	16,000	970
	MW-22-10-116	8/18/1999	38	6,100	<500	6,100	<1,000	<1,000	<1000	1,200	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	900	1,900	2,700	3,900	ND	8,400	10,000	800
MW-22-11	MW-22-11-110	2/3/2000	<1.0	160	<50	160	<5.0	<5.0	<5.0	<10.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	34	34	ND	ND	ND	ND	370	ND
	MW-22-11-115	2/3/2000	<1.0	<10	<50	<60	<5.3	<5.3	<5.3	<10.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-22-12	MW-22-12-112	2/9/2000	<1.0	<1.0	<5.0	<6.0	<5.0	<5.0	<5.0	<10.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MW-22-12-114	2/9/2000	<1.0	<1.0	<5.0	<6.0	<4.8	<4.8	<4.8	<9.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-22-14	MW-22-14-115	8/10/2000	<0.94	<10	<50	<60	<4.8	<4.8	<4.8	<9.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5	ND	ND	ND	ND	ND	ND
	MW-22-14-126	8/10/2000	<1.0	<10	<50	<60	<5.1	<5.1	<5.1	<10.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MW-22-14-222	8/24/2000	<0.94	<9.9	<49	<58.9	<4.7	<4.7	<4.7	<9.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MW-22-14-244	8/24/2000	<1.1	<9.9	<49	<58.9	<5.1	<5.1	<5.1	<10.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MW-22-14-246	8/24/2000	<0.94	<9.9	<50	<59.9	<4.8	<4.8	<4.8	<9.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-22-27	MW-22-27-128	3/17/2005	<20.0	<30.0	<100	<130	<57	<57	<57	<170	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MW-22-27-129	3/17/2005	<20.0	<30.0	<100	<130	<51	<51	<51	<150	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-22-28	MW-22-28-117	3/30/2005	<20.0	<30.0	<100	<130	<49	<49	<49	<150	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MW-22-28-118	3/30/2005	<20.0	<30.0	<100	<130	<48	<48	<48	<140	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-22-29	MW-22-29-118	3/21/2005	<20	<30	<100	<130	<53	<53	<53	<160	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MW-22-29-120	3/21/2005	<20	<30	<100	<130	<59	<59	<59	<180	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-22-30	MW-22-30-117	3/14/2006	<70.0	71.7	<100	<130	<57	<57	<57	<170	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	75	ND
	MW-22-30-118	3/14/2006	185	3,720	383	4,100	<52	<52	<52	<150	ND	ND	ND	ND	ND	ND	ND	ND	ND	410	ND	ND	ND	3,100	ND	3,900	7,900	ND
MW-22-31	MW-22-31-121	2/16/2005	<20.0	<30.0	<100	<130	<50	<50	150	390	960	370	190	470	220	260	ND	ND	ND	ND	ND	ND	ND	100	ND	ND	310	ND
	MW-22-31-121.5	2/16/2005	951	8,960	1,130	10,100	<50	<50	0	1,170	3,000	1,000	580	ND	650	730	ND	1,500	1,100	ND	ND	ND	ND	7,400	19	8,500	14,000	550
MW-22-32	MW-22-32-124.5-126	3/1/2005	21.6	592	123	715	<50	<50	180	410	1,100	230	140	370	200	190	ND	ND	ND	37	ND	ND	ND	280	ND	450	850	ND
	MW-22-32-126-127.5	3/1/2005	<20.0	<30.0	<100	<130	<52	<52	<52	<150	160	ND	ND	ND	120	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	51	ND
MW-22-33	MW-22-33-127-128.5	3/18/2005	62	1,100	<100	1,100	<49	93	430	1,180	2,500	700	360	ND	530	510	ND	320	ND	320	ND	300	100	2,200	ND	3,200	4,800	140
	MW-22-33-128.5-129	3/18/2005	<20	650	<100	650	<48	<48	<48	<140	ND	ND	ND	ND	ND	ND	ND	ND	ND	77	ND	ND	31	310	ND	ND	1,000	36
	MW-22-33-131-132.5	3/18/2005	56	990	<100	990	<49	220	1,200	3,400	7,100	2,100	1,100	ND	1,500	1,500	ND	ND	ND	64	ND	ND	ND	290	ND	ND	920	28
	MW-22-33-132.5-133	3/18/2005	<20	420	<100	420	<47	<47	83	250	530	220	90	ND	100	120	ND	ND	ND	130	ND	ND	ND	540	ND	480	1,500	55
MW-22-34	MW-22-34-118	3/16/2005	<20.0	34	<100	34	<49	<49	<49	<150	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MW-22-34-119	3/16/2005	<20.0	<30	<100	<130	<48	<48	<48	<140	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-22-35	MW-22-35-117-118.5	3/14/2005	1,500	19,000	2,600	21,600	140	280	3,200	8,500	24,000	5,400	2,300	ND	3,200	2,900	ND	2,000	1,600	1,100	ND	160	ND	8,200	ND	15,000	19,000	550
	MW-22-35-118.5-119	3/14/2005	210	980	150	1,130	<49	<49	220	910	2,600	650	320	ND	300	360	ND	ND	ND	240	ND	150	5,400	1,700	ND	2,100	4,200	4,100
MW-22-36	MW-22-36-110.5	2/17/2005	<20.0	139	<100	139	<49	<49	<49	<150	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	40	ND	ND	ND	ND
	MW-22-36-111.5	2/17/2005	<20.0	<30.0	<100	<130	<50	<50	<50	<150	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-22-37	MW-22-37-112	2/20/2005	<20.0	<30.0	<100	<130	<53	<53	<53	<160	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MW-22-37-113	2/20/2005	<20.0	<30.0	<100	<130	<51	<51	<51	<150	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-22-38	MW-22-38-114	2/22/2005	<20.0	<30.0	<100	<130	<49	<49	<49	<150	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MW-22-38-115	2/22/2005	<20.0	<30.0	<100	<130	<50	<50	<50	<150	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-22-39	MW-22-39-114	3/7/2005	<20.0	<30.0	<50.0	<100	<58	<58	<58	<180	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MW-22-39-115	3/7/2005	<20.0	<30.0	<50.0	<100	<49	<49	<49	<150	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-22-40	MW-22-40-122-122.5	3/3/2005	<20.0	<30.0	<50.0	<100	<51	<51	<51	<150	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MW-22-40-122.5-123	3/3/2005	<20.0	<30.0	<50.0	<100	<52	<52	<52	<150	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-22-41	MW-22-41-108	3/23/2005	<20	<30	<100	<130	<48	<48	<48	<140	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MW-22-41-109	3/23/2005	<20	<30	<100	<130	<49	<49	<49	<150	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-22-42	MW-22-42-114	4/2/2005	<20.0	<30.0	<100	<130	<46	<46	<46	<140	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MW-22-42-115	4/2/2005	<20.0	<30.0	<100	<130	<48	<48	<48	<150	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-22-43	MW-22-43-130	3/9/2006	<70.0	<30.0	<100	<130	<230	<230	<230	<690	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	MW-22-43-131	3/9/2006	<20.0	<30.0	<100	<130	<260	<260	<260	<780	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Notes:

TPH = Total petroleum hydrocarbons

DRO = Diesel-range organics

GRO = Gasoline-range organics

HRO = Heavy-oil range organics

< = less than the laboratory detection limit

µg/kg = micrograms per kilogram

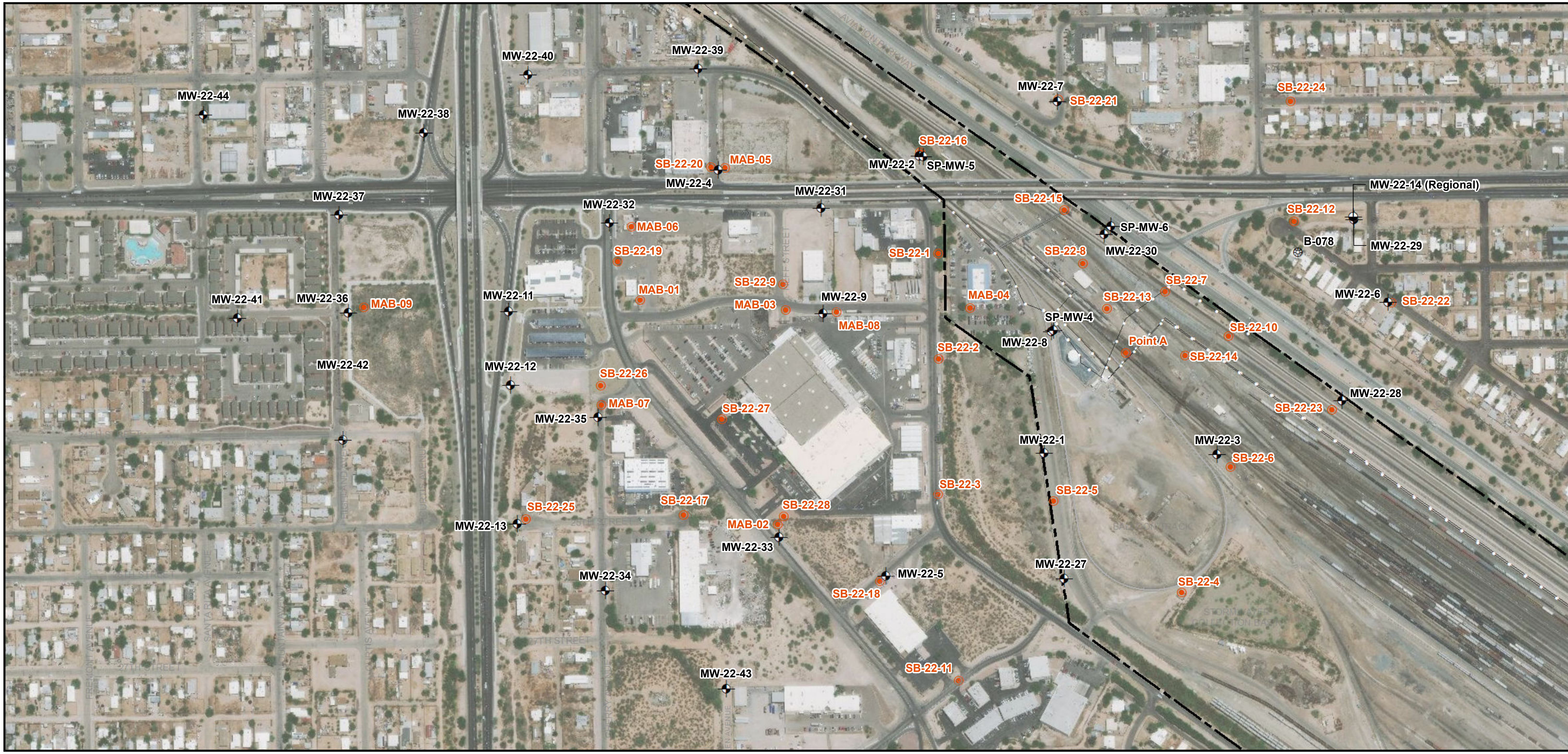
mg/kg = milligrams per kilogram

ND = Not detected

NE = Not established

VOCs = Volatile organic compounds

Source: ERM, 2001; ERM, 2006



Legend

- Soil Boring/Temporary Observation Point
- Perched Groundwater Zone Monitoring Well
- Regional Aquifer Monitoring Well
- Former City of Tucson Regional Aquifer Well (Abandoned)
- Property Boundary
- Approximate Location of Former Fuel Pipeline
- Fence
- Railroad Track

N
W E
S

0 200 400 800
Feet

Note:
Source of soil boring locations: ERM, 2001

Figure A-1. Historical Soil Sampling Locations
Union Pacific Railroad Company
22nd Street Fueling Facility
Tucson, Arizona

\\DC1VS01\GISPROJ\U\UPRR\UPRR_22NDST\MAPFILES\2021\FEASIBILITYSTUDY\FIG_A-1_22NDST_HISTORICAL_SOIL_SAMPLING_LOCATIONS.MXD AESPEJO 2/2/2021 2:53:25 PM

Jacobs