PROPOSED REMEDIAL ACTION PLAN
MIRACLE MILE
WQARF REGISTRY SITE
TUCSON, ARIZONA

4/14/2020

Arizona Department of Environmental Quality
Remedial Projects Unit
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LIST OF ABBREVIATIONS & ACRONYMS

A.A.C.	Arizona Administrative Code
ADEQ	Arizona Department of Environmental Quality
A.R.S.	Arizona Revised Statutes
AWQS	Aquifer Water Quality Standards
bgs	below ground surface
COC	Contaminant of Concern
Cr(IV)	hexavalent chromium
1,1-DCE	1,1-dichloroethene
DEUR	Declaration of Environmental Use Restriction
EPA	US Environmental Protection Agency
FS	Feasibility Study
FWID	Flowing Wells Irrigation District
ERA	Early Response Action
HVAC	Heating, ventilation, and air conditioning
µg/L	micrograms per liter
$\mu g/m^3$	micrograms per cubic meter
MHP	Mobile Home Park
MNA	Monitored Natural Attenuation
O&M	operation and maintenance
RO	Remedial Objective
RI	Remedial Investigation
RSL	Regional Screening Level
SRL	Soil Remediation Level
SVE	Soil Vapor Extraction
P+T	Pump and Treat
PRAP	Proposed Remedial Action Plan
PCE	tetrachloroethene
TCE	trichloroethene
VISL	Vapor Intrusion Screening Level
VOC	Volatile Organic Compound
WQARF	Water Quality Assurance Revolving Fund

1.0 INTRODUCTION

The Arizona Department of Environmental Quality (ADEQ) with assistance from Hargis + Associates (H+A) presents the Proposed Remedial Action Plan (PRAP) for the Miracle Mile Water Quality Assurance Revolving Fund (WQARF) site (the Site) located in Tucson, Arizona. This PRAP was prepared in accordance with Arizona Revised Statute (A.R.S.) §49-287.04 and Arizona Administrative Code (A.A.C.) R18-16-408, and was based on information contained in the following documents.

- URS, 2013. Remedial Investigation of the Miracle Mile WQARF Site, Tucson, Arizona. June 12.
- ADEQ and Hargis + Associates, Inc., 2019. Miracle Mile Water Quality Assurance Revolving Fund Feasibility Study. October 15.

The information presented in the PRAP is taken directly from the above-referenced reports without attribution other than that noted in this document. The detailed history of environmental investigations, Early Response Actions (ERAs), and preliminary screening of remedial alternatives completed for the Site is presented in the referenced documents and is not reiterated in detail in this document.

The purpose of the PRAP is to inform the public on the remedy selected from the alternatives evaluation presented in the Feasibility Study (FS), which addresses the site-specific Remedial Objectives (ROs). The PRAP is part of the final remedy selection process under the WQARF program where public input is solicited on the selected remedy and on the rationale for proposing the selected remedy. ADEQ will review the public comments and prepare a responsiveness summary to address the public comments. The responsiveness summary will be part of the Record of Decision (ROD). The remedy for the Site will be finalized by ADEQ in the ROD.
This PRAP, in accordance with A.R.S. §49-287.04, describes the following:

- The boundaries of the Site that is the subject of the remedial action.
- The results of the Remedial Investigation and the FS.
- The proposed remedy and estimated cost.
- How the remediation goals and selection factors in A.R.S. §49-282.06 and rules adopted by the ADEQ Director have been considered.

2.0 SITE BOUNDARIES

The Site is generally bounded by Curtis Road to the north, Prince Road to the south, Pomona Road to the east and La Cholla Boulevard to the west (Figure 1). The Site includes the area that encompasses the soil and groundwater impacted with compounds that exceed regulatory levels.

3.0 REMEDIAL INVESTIGATION RESULTS

The remedial investigation (RI) report was finalized in June 2013. A number of RI data gaps were identified in the RI and after the RI during evaluation for the feasibility study. The data gaps were all closed by subsequent investigations. This section presents the results and findings the RI and subsequent data gap investigations

3.1 Site History and Description

The Site is located within an urban setting that includes residential areas in the northern and central portions of the Site and a mixture of commercial and light industrial businesses, warehouses, and manufacturing facilities in the southern portions of the Site. Prior to 1940, the Site was generally undeveloped and an agricultural area. Gilpin Airport, which later became Freeway Airport, operated in the area from 1940 until approximately 1979 to 1980. During the mid-1960s to early-1970s, the R.E. Darling Inc. (R. E. Darling)/Fairfax Industrial Park (R. E. Darling), Abrams Airborne Manufacturing Inc. (Abrams), the Former Spring Joint Specialists, Inc., and the Former Coca Cola Bottling Company (Former Coca Cola) started operations on portions of the airport properties and nearby areas (Figure 2).

Groundwater contamination in the general vicinity of this Site was first detected in 1983 in an RV park well. ADEQ conducted research, performed facility inspections, and installed multiple monitoring wells to determine the origins of the areas of contamination in what was called at the time the Miracle Mile Interchange Area. A production well called the Fairfax well on the R. E. Darling property was found to contain contamination above regulatory standards (Figure 2). Flowing Wells Irrigation District (FWID) wells were found to also be impacted or threatened to be impacted by the contamination. Based on these detections and other investigations, the area of what became the Miracle Mile Site was defined as separate from several other areas of contamination (e.g. the Silverbell Jail Annex WQARF site). In 1998, the Site was placed on the WQARF registry.

The groundwater beneath the Site occurs within a perched aquifer and the deeper regional aquifer. The perched aquifer generally occurs from 60 to 95 feet below ground surface (bgs) within the southern portion of the Site; however, it is not a single water bearing unit, but rather a series of small horizontally and vertically discontinuous poorly connected saturated zones. There is no known flow direction in the perched aquifer due to its discontinuous nature. The perched aquifer is not used or anticipated to be used for irrigation or drinking water supply. The perched aquifer is absent in the northern portion of the Site.

The regional aquifer is generally encountered at approximately 160 to 180 feet bgs and is predominantly clayey sands, clayey gravels and sands. Since 2002, groundwater flow direction in the regional aquifer has been north to northwest. Between 1992 and 2000 the groundwater flow direction at the Site to the northeast (Amec, 2016), most likely due to groundwater pumping to the northeast of the Site.

3.2 Sources of Contamination

The sources of the soil and groundwater contamination at the Site are R. E. Darling, Abrams Abrams, the former Spring Joint, and the former Coca Cola facilities (Figure 2).

3.3 Contaminants of Concern

The contaminants of concern (COCs) at the Site include compounds that have been detected above regulatory levels. The COCs in groundwater at the Site are trichloroethene (TCE) and total chromium. The COCs in soil at the Site are TCE and hexavalent chromium (Cr(IV)). Other contaminants detected in the soil and groundwater at the Site below regulatory standards include tetrachloroethene (PCE) and 1,1-dichloroethene (1,1-DCE). Nitrate was named a contaminant of potential concern in the RI, but has since been found to be not related to the Site and likely stemming from area-wide sewage or septic tank sources (Amec, 2015).

3.4 Nature and Extent of Contamination

Soil contaminants were detected at several source properties. Concentrations of TCE in soil on the southeast corner of the R.E. Darling property were calculated at 3.04 mg/kg, above the residential 3.0 mg/kg Soil Remediation Level (SRL) (Figure 3a). The concentration was obtained by converting soil-gas sample results to soil equivalents pursuant to A.A.C. R18-7-203(C). There were no detected exceedances of the non-residential SRL for TCE at the Site. Concentrations of Cr(VI) in soil was detected above its residential (30 mg/kg) and non-residential (65 mg/kg) SRL on the former Spring Joint property, at concentrations up to 1,270 mg/kg in shallow soils and 1,630 mg/kg in deep soils (Figure 3a). The Cr(VI) contamination on this property extends down to the perched aquifer. Total chromium in soils over background levels were also observed on the Abrams property; however chromium was not detected above applicable standards in samples collected from the perched aquifer.

Concentrations of TCE in soil gas were detected exceeding the vapor intrusion screening levels (VISLs) over much of the source area of the Site (Figure 3b). The VISLs were calculated from the EPA Regional Screening Levels (RSLs) for indoor air, divided by an attenuation factor of 0.03. Non-source properties may have been impacted by lateral diffusion of contaminated soil vapor from source properties. The areas of highest TCE concentrations were detected on the Abrams, R.E. Darling, former Spring Joint, and the former Coca Cola properties. Deep soil-gas sample results indicated that TCE in the soil gas extended to the perched aquifer in these locations. PCE was also detected in soil gas above VISLs in the area of the former Coca Cola (Figure 3b). While PCE detections in soil gas extended to the depth of the perched aquifer, PCE was not detected over AWQS in the perched aquifer water samples collected from this area. The distribution of TCE and

PCE in the soil gas with depth in the vadose zone on the former Coca Cola properties are indicative of an older release pattern.

TCE and chromium were present at levels exceeding Aquifer Water Quality Standards (AWQS) in samples collected from the perched aquifer under the source area (Figure 3c). Multiple investigations during and after the RI determined that the perched aquifer was made up of discontinuous areas of perched water with little or no connectivity, rather than an aquifer with flowing water (ADEQ and H+A, 2019). TCE was detected above its 5 micrograms per liter (µg/L) AWQS in the perched aquifer at the Abrams, R.E. Darling, former Spring Joint, and the former Coca Cola properties (Figure 3c). TCE exceedances of AWQS in the perched aquifer currently range from 5.4 to 2,000 µg/L. Chromium is currently detected over the AWQS (100 µg/L) at the former Spring Joint property in concentrations of up to 80,000 µg/L. Historically, the perched aquifer near the former Coca Cola facility had one AWQS exceedance for Cr(VI) (Figure 3c); however this was an unfiltered sample, and may indicate sediment-associated chromium and not be representative of the groundwater that was in this area. This area of the perched aquifer has been dry since 2016.

TCE and chromium were also detected at levels exceeding AWQS in samples from the regional aquifer at the Site (Figure 3d). The TCE contamination over AWQS ranged from 5.5 to 88 µg/L in recent samples, with the highest detections near the former Fairfax production well. This well, located on the R.E. Darling property (Figure 2) is likely to have acted as a conduit for contamination from the perched to the regional aquifer. Concentrations of TCE and chromium upgradient of this location, however, indicate that the discontinuous nature of the perched aquifer also provided other routes for contamination to enter the regional aquifer. Historically the TCE plume extended to the northeast following historical groundwater flow. Since the early 2000s, however, TCE plume migration has shifted with the flow of groundwater and now extends approximately 1.75 miles to the northwest in the direction of groundwater flow.

The chromium concentrations in the regional aquifer over AWQS are highest in the area of the former Spring Joint property. Chromium exceedances of AWQS at the Site currently range from 150 to 2,200 µg/L. The chromium plume extends approximately 0.75 miles to the north-northwest.

3.5 Risk Evaluation Summary

Perched groundwater at the Site is not used for any purposes. This along with the depth of contamination (>70 feet below ground surface) makes the probability of exposure through ingestion or inhalation of volatile organic compounds (VOCs) from the perched groundwater very low.

The regional aquifer is used as a municipal water supply at the Site by FWID, Tucson Water, Metro Water, and multiple small water providers including Villa Capri Mobile Home Park (MHP), Silver Cholla MHP, and North La Cholla MHP. Currently, wells at the Silver Cholla MHP and North La Cholla MHP have levels of TCE over AWQS and are considered threatened. Chromium has also been detected in some supply wells, but below AWQS and at levels consistent with background levels at the Site. The Silver Cholla MHP well has an early response action (ERA) wellhead treatment system installed. The samples collected after the wellhead treatment system do not contain detectable levels of TCE. The North La Cholla well is currently not being used and the residents are receiving an alternate water supply while a treatment system is designed. Historically, FWID well #70 had TCE over AWQS, and had a treatment system installed; however this well has been below AWQS since 2012, and the system is currently on bypass (Figure 3f).

The RI states that the water quality data collected from the numerous known private wells and public supply wells in the Site since 1990 showed no evidence to indicate that levels of COCs in the domestic supply wells currently in use were ever high enough to cause adverse health effects or cancer. Based on this and the recent water quality data and the current treatment systems in place at the Site, there is no current exposure from the regional groundwater plume.

3.6 Early Response Actions

In 1995 the Fairfax conduit well was abandoned by pressure grouting. In December 1999, Arizona Department of Water Resources conducted a review of the Fairfax well abandonment report and concluded that the well may not have been properly abandoned. The well was re-abandoned in 2002.

In the late 1990s/early 2000s, FWID-72 was re-equipped to increase production to address loss of use of other FWID wells due to TCE contamination.

In 2005, an engineered asphalt cap was installed over chromium-contaminated soil at the former Spring Joint property.

In 2006, a treatment system was constructed to remove TCE from groundwater pumped from FWID wells 70 and 75. This system is currently on by-pass due to TCE concentrations being below AWQS since 2012. FWID continues to monitor for TCE in these wells should the concentrations increase again.

In 2019, a well head treatment system was installed at the Silver Cholla MHP water supply well to treat the water for TCE.

3.7 Remedial Objectives

A Final Remedial Objectives (RO) Report was provided as Appendix D in the Remedial Investigation report (URS, 2013b). The following ROs were presented:

The RO for land use at the former Spring Joint Specialists and RSC properties is to protect against possible exposure to hazardous substances in surface and subsurface soils that could occur if property improvements were made to facilitate commercial use. ADEQ will ask the property owners to place a DEUR on their properties (or portions of properties) containing hexavalent chromium above the residential SRL to ensure that current and future property owners maintain the property as non-residential use and maintain the asphalt as an engineering control. If additional work at the Site is necessary beyond maintenance of the asphalt cover, ADEQ will coordinate with the property owners and work towards a remedy that is compatible with these development plans.

The RO for groundwater will be to restore, replace or otherwise provide and protect for the current and future municipal use of the regional aquifer threatened or impacted by TCE and/or chromium contamination emanating from the Site. This action is needed for as long as the level of contamination in the groundwater resource threatens or prohibits its use as a municipal water supply.

The RO for groundwater will be to protect for the future non-potable use of the regional aquifer threatened by the TCE and/or chromium contamination emanating from the Site. This action is needed for as long as the level of contamination in the groundwater resource threatens its use as a non-potable water supply.

4.0 FEASIBILITY STUDY RESULTS

The Feasibility Study (FS) report was finalized in October 2019. The section below summarizes the findings of that report.

4.1 Identification and Screening of Remedial Technologies

Remedial technologies were identified and screened as shown in Table 1.

Table 1: Screening of Remedial Technologies

Technology	Retained	Reason for Retention or Elimination
No Action	No	This alternative would not achieve Site ROs.
Monitored Natural Attenuation	Yes	Can be applied to all or part of the site in conjunction with other remedial measures.
Enhanced Bioremediation	No	Has a relatively high cost and would be difficult to implement.
Soil Flushing	Yes	More applicable to smaller areas of chromium contamination.
Soil Vapor Extraction	Yes	SVE is a presumptive remedy for treatment of VOCs in soil.
Ex Situ Treatment	No	Cost prohibited because of size and depths of contamination.
Institutional Controls	Yes	Cost effective. Can achieve some Site ROs.
Engineering Control	Yes	Includes placement of caps. Inhibits direct contact and reduces water infiltration.
Depressurization	Yes	Cost effective. Used to reduce vapor intrusion.
Chemical Reduction/Oxidation	Yes	More useful for hot spot treatment. Bench testing / pilot testing may be required.
Air Sparging	No	Not amenable with Site lithology.
DPE	No	Too expensive and inefficient for regional aquifer. Not useful for Chromium.
Pump and Treat	Yes	Can be used for cleanup and containment.

These remedial technologies were screened based on the anticipated ability of the technology to address the ROs at the Site and reduce the contaminant concentration, mass, and/or toxicity. Each technology was screened for effectiveness, implementability, health and safety concerns, flexibility, expandability, and cost. Based on the screening results, MNA, Soil Flushing, SVE, Institutional/Engineering Controls, Depressurization, Chemical Reduction/Oxidation, and Pump and Treat were retained for use at the Site.

4.2 Development of the Reference, Less Aggressive and More Aggressive Remedies

The retained remedial technologies were used to develop a reference remedy and two alternative remedies (a less aggressive remedy and a more aggressive remedy). The reference remedy and the alternative remedies are capable of achieving the ROs. The development of the reference remedy and alternative remedies considered the following:

- The data obtained from the remedial investigations;
- The best available engineering and scientific information concerning available remedial technologies; and
- Preliminary analysis of the comparison criteria and the ability of the remedies to comply with A.R.S. §49-282.06.

The Reference Remedy includes a combination of remedial technologies for source control, the remediation of soil, and the remediation of groundwater including the following:

- Contain the toe of the TCE regional aquifer plume by a pump and treatment (P+T) system. Assuming two extraction wells and four monitor wells will be installed. Costs assumed for 30 years. Contingencies include: P+T system upgrade to treat chromium contamination; use of existing water supply wells for extraction; treated groundwater discharge to injection wells or river/settling basin.

- Perform monitored natural attenuation (MNA) on the regional aquifer and perched aquifer. Assuming two additional groundwater monitor wells will be installed. Costs assumed for 30 years of monitoring.

- Continue operation and maintenance of existing well head treatment system(s). Contingencies include impacted well owners connecting to alternate water supplies (e.g. municipal water companies), installation of additional well head treatment systems, and upgrading treatment system to treat chromium contamination (e.g. exchange resin technology).

- Reduce mass of TCE in soil vapor by installing and operating a SVE system. Assuming installation of deep and shallow SVE extraction wells and monitoring points near to the former Fairfax well, and shallow points in other hot spot areas, assuming using a mobile system. Costs assumed for 10 years of SVE. Contingencies include application of heating, ventilation, and air conditioning (HVAC) adjustments or slab depressurization may be performed to address potential future vapor intrusion.

- Maintain the existing engineering controls of the asphalt cap and asphalt parking lot at the former Spring Joint property through a Declaration of Environmental Use Restriction (DEUR). A contingency is included for ADEQ inspect for integrity and require repairs as needed if the DEUR is not signed by the property owner.

The Less Aggressive Remedy continues operation of current wellhead treatment, mitigates for potential future vapor intrusion via building modifications, and provides for inspection of the Spring Joint engineering controls. Details as follows:

- Perform MNA on the regional and perched aquifers for. This installation of two additional groundwater monitor wells. Costs assume 30 years.

- Continue operation and maintenance of existing well head treatment system(s) and adding additional systems as needed. This is assuming two additional well head treatments systems will be needed. Contingencies include impacted well owners connecting to alternate water supplies (e.g. municipal water companies), installation of additional well head treatment systems, and upgrading treatment system to treat chromium contamination (e.g. exchange resin technology).

- Perform indoor air monitoring at locations deemed necessary (e.g. on a change in building use to residential) to assess need for future vapor intrusion mitigation. If indoor air concentrations exceed the applicable RSL for indoor air ADEQ will notify property owners and tenants. Contingencies include mitigating indoor air quality by measures such as adjustments to the HVAC system, installation of a sub-slab depressurization system or a SVE system, and/or sealing the building.

- Maintain the existing engineering controls of the asphalt cap and asphalt parking lot at the former Spring Joint property through a DEUR. A contingency is included for ADEQ inspect for integrity and require repairs as needed if the DEUR is not signed by the property owner.

The More Aggressive Remedy includes all the remedial technologies proposed for the Reference Remedy plus an additional P+T system to treat the areas of highest concentration, additional SVE system locations, and chromium soil treatment. Details as follows:

- Contain the toe of the TCE regional aquifer plume by a P+T system. Assuming three extraction wells and five monitor wells will be installed. Costs assumed for 30 years. Contingencies include: P+T system upgrade to treat chromium contamination; use of existing water supply wells for extraction; treated groundwater discharge to injection wells or river/ settling basin.

- Mass reduction of TCE and chromium will be performed by operation of a portable P+T System. The perched and regional aquifer hot spots will be targeted for the portable P+T system operation. The portable system will be operated at single well points until asymptotic conditions are observed. Because of anticipated short operation time at single well points, smaller extracted volumes, and high costs for transferring to water system entry points the treated groundwater will be discharged to storm channels or to sewers.

- Perform MNA on the regional aquifer and perched aquifer. Assuming two additional groundwater monitor wells will be installed. Costs assumed for 30 years.

- Continue operation and maintenance of existing well head treatment system(s) and adding additional systems as needed. This is assuming two additional well head treatments systems will be needed. Contingencies include impacted well owners connecting to alternate water supplies (e.g. municipal water companies), installation of additional well head treatment systems, and upgrading treatment system to treat chromium contamination (e.g. exchange resin technology).

- Reduce mass of TCE in soil vapor by installing and operating a SVE system. Assuming installation of deep and shallow SVE extraction wells and monitoring points near to the former Fairfax well, and in the vicinity of perched wells IRA-16, IRA-17, and IRA-23, and SJ-MW-2, and shallow points in other hot spot areas, assuming using a mobile system. Costs assumed for 10 years of SVE. Costs assume 10 years of operation. As a Contingencies include application of heating, ventilation, and air conditioning (HVAC) adjustments or slab depressurization may be performed to address potential future vapor intrusion.

- Reduce mass of Cr(IV) in soil and chromium in perched aquifer by application of reductive agent and limited P+T. A reducing agent will be injected in the vadose zone above the perched aquifer at the former Spring Joint property and allowed to slowly percolate down into the perched groundwater. A perched aquifer extraction system will be installed to treat chromium contaminated perched groundwater. Extraction and treatment will continue until relative asymptotic removal conditions are reached. Bench-scale studies will be necessary to verify effectiveness

4.3 Evaluation and Comparison of the Remedies

The Feasibility Study included a comparative evaluation of the Reference, Less Aggressive and More Aggressive Remedies to demonstrate that each remedial alternative will achieve the ROs in accordance A.A.C. R18-16-407(H). The criteria used to evaluate each remedial alternative included the following:

- An evaluation of consistency with the water management plans of affected water providers and the general land use plans of local governments with land use jurisdiction.
- An evaluation of the comparison criteria, including:
    - Practicability
    - Risk
    - Cost
    - Benefit

All remedies met all of the above criteria. A summary of the evaluation for each remedial alternative is presented in Table 2.

Table 2: Summary of Remedial Alternatives				
Alternative	**Practicability**	**Risk**	**Cost**	**Benefit**
Reference Remedy	• Very Feasible • Very Implementable • Likely Effective	• Protective • Reliable • Reduces VOC risk to Groundwater and vapor intrusion	$9,843,000	• Protects Water Supply • Reduced risk to human receptors • Reduced VOC mass and spreading
Less Aggressive Remedy	• Very Feasible • Moderately Implementable • Potentially Effective	• Continued Migration of VOCs • Some Potential Risk • Potential Vapor Mitigation	$6,617,000	• Protects Water Use • Less Beneficial
More Aggressive Remedy	• Moderately Feasible • Least Implementable • Likely Effective	• Protective • Reduces Groundwater Mass • Reduces Soil Cr(VI) Mobility	$11,262,000	• Protects Water Supply • Reduced VOC mass and spreading • Potential Decrease MNA Duration
Notes: **The costs presented in this table were taken directly from the FS Report.** **The costs were adjusted for Net Present Value**				

5.0 PROPOSED REMEDY AND ESTIMATED COST

The remedy proposed in the FS for the Site is the Reference Remedy. The Reference Remedy was proposed because it was found to be the most effective, to have the least amount of risk, to be the most beneficial, and to be less expensive to implement than the More Aggressive Remedy without incurring any additional risks. The Reference Remedy was proposed because it will achieve the ROs, it meets the remedial action criteria pursuant to A.R.S. §49-282.06, and it is consistent with current and future land and water use.

5.1 Remedy Description

The proposed remedy includes a combination of remedial technologies for remediating the soil and groundwater at the Site. Each of these remedial technologies is described in the following subsections.

5.1.1 Proposed Remedial Actions – Soil

SVE

SVE remediates soils by drawing volatile compounds towards extraction wells set into the vadose zone. The operation of an SVE system will be incorporated into the remedy to remediate the elevated VOC concentrations in the soil vapor that are a source of groundwater contamination and potential vapor intrusion risk (Figure 4a). The SVE system will include installation of up to 30 deep and shallow duel-nested SVE extraction wells and up to 30 monitoring points near the former Fairfax well and other hot spot areas. The costs assume the use of mobile SVE systems which can be moved around the site over the projected operation time period. The systems will be operated for up to 10 years, with a contingency to operate the SVE system up to two additional years as warranted by the VOC concentrations in the vadose zone.

Institutional/Engineering Control

Maintenance of the existing engineering controls of the asphalt cap and asphalt parking lot at the former Spring Joint property will be included in the remedy to prevent the exposure to contaminated soils in the area and further spreading of chromium concentrations due to infiltration from the surface. This part of the remedy can be achieved through a DEUR, which places a notification on the deed that the property is restricted to non-residential use, and identifies the concentrations and locations of contaminants on the property, with further instructions on engineering control maintenance. This component of the remedy includes a contingency for inspections and repairs/maintenance of the cap and parking lot of the former Spring Joint property for 30 years if the DEUR is not signed by the property owner.

5.1.2 Proposed Remedial Actions – Groundwater

P+T

P+T is a remedial measure that involves pumping of contaminated groundwater into an above-ground treatment system, then either re-injecting, infiltrating, or using the treated water. P+T can be used to hydraulically contain plumes by pumping groundwater at a rate where all contaminated water is captured by the extraction well and treated.

The P+T system for the remedy will include the installation of up to two extraction wells to hydraulically contain the toe of the TCE regional aquifer plume, and four additional monitoring wells to monitor for hydraulic containment (Figure 4b). The extracted groundwater will be treated utilizing granular activated carbon and discharged to a distribution system of a water provider. Monthly monitoring of the well water, the water after the lead vessel, and the water after the lag vessel are included in the O&M costs. It is assumed that the pump and treat system will be operated for a period of up to 30 years, with a contingency to operate the P+T system for an additional five years. This component of the remedy includes contingencies for discharging the treated water to nearby settling basins or for re-injecting the treated water into the aquifer should the water provider not accept the treated water. This component of the remedy also includes upgrading the system to treat chromium if chromium concentrations exceed AWQS in the extracted water.

Wellhead treatment

Wellhead treatment is similar to P+T, but is the term used when an already existing pumping well (e.g. a municipal supply well) becomes contaminated. Here, a treatment system is installed at the wellhead to treat the water after the existing well has pumped it out of the ground but prior to its entering the water distribution system. The main purpose is to protect public health and the environment from being exposed to contaminated water.

One current wellhead treatment system at the Silver Cholla MHP is in operation at the Site as an ERA. This treatment system will become part of the remedy. The costs include O&M for this system, including monthly monitoring of the system and treatment vessel change-outs. Two additional wellhead treatment systems are included in the contingency costs. Additional wellhead treatment contingencies will be triggered if the concentrations of TCE in the extracted groundwater of a drinking water supply well exceed AWQS. Other contingencies include five additional years of wellhead treatment, and upgrading of the systems to remove chromium should chromium exceed AWQS in the extracted groundwater at the drinking water well.

MNA

MNA is a remedial measure that involves routine groundwater sampling and analysis to monitor the results of one or more naturally occurring physical, chemical, or biological processes that reduce the mass, toxicity, volume, or concentration of chemicals in groundwater. MNA is a mechanism by which COCs are reduced by natural means without other control, removal, treatment, or aquifer-modifying activities. These in-situ processes may include dilution, adsorption, volatilization, precipitation, and biological degradation of the contaminants in the groundwater. Of these processes, reductive dechlorination (using biological and/or abiotic degradation processes) is usually the most significant degradation process for chlorinated solvents such as the COCs.

MNA will consist of routine groundwater monitoring and sampling to monitor groundwater contamination at the Site. The groundwater monitoring data will be used to evaluate plume migration, plume stability, and natural attenuation of the plume. The data will also be used to trigger appropriate contingency actions (i.e., wellhead treatment at an impacted water supply well) to manage risk associated with the groundwater plume migration. MNA will continue until the concentrations of the COCs drop below the AWQS.

The MNA program will be conducted at the Site for a period up to 30 years. The program will include semi-annual water level monitoring of up to 55 wells; semi-annual groundwater sampling of up to 50 wells and annual reporting. The number of wells to be monitored and the frequency of monitoring will be adjusted over time in response to changing groundwater conditions. Costs have been included for the installation of four additional groundwater monitor wells. Costs assumed for up to 30 years of MNA, with a contingency for an additional 10 years.

5.2 Proposed Contingencies

Contingencies mentioned above are to operate the SVE system up to two additional years, and the coverage of maintenance costs of the cap and parking lot of Spring Joint for 30 years. Should the SVE system not remove the vapor intrusion risk, an additional contingency is indoor air sampling for 25 samples. If indoor air samples indicate an on-going vapor intrusion issue, contingencies are included for HVAC adjustments, slab depressurization, or slab sealing for buildings found to be impacted.

Contingencies for groundwater mentioned above are:

- P+T system upgrade to treat chromium contamination;
- Use of existing water supply wells for extraction;
- Treated groundwater discharge to injection wells or river/ settling basin;
- Additional five years of running P+T system;
- Additional 10 years of MNA monitoring;
- Installation of additional well head treatment systems on domestic/municipal supply wells should they exceed AWQS for TCE;
- Impacted small water providers/well owners connecting to alternate water supplies (e.g. municipal water companies); and
- Upgrading wellhead treatment system(s) to treat chromium contamination (e.g. exchange resin technology) should they exceed AWQS for chromium.

5.3 Inspections, Performance Monitoring, and Periodic Reviews

Operation and maintenance of the P+T and SVE systems will be performed during system operation. Monthly performance monitoring will occur, with periodic reviews to insure the systems are operating as expected and to judge the effectiveness and adequacy of the remedy. Monitoring will include the following:

- **Inspections** – Inspections will be conducted to evaluate the condition of the remedies and insure there are no damage, visible leaks or other mechanical issues with the systems or damage to the asphalt cap/parking lot at Spring Joint.

- **SVE System Monitoring** – Routine process monitoring will be conducted during the operation of the SVE system to ensure the system is operating effectively. The process monitoring will include the collection of samples from process wells and the carbon adsorption system.

- **P+T and Wellhead Treatment System Monitoring** – Routine process monitoring will be conducted during the operation of the P+T and wellhead treatment systems to ensure the system is operating effectively. The process monitoring will include the collection of samples from the wells and the treatment vessels.

- **Groundwater Performance Monitoring** – Groundwater monitoring, in addition to MNA, will be conducted to evaluate the performance of the P+T system. The performance monitoring would include quarterly sampling for the first three years, then semi-annual sampling for years four through 15, and annual sampling thereafter. These performance monitoring events will be conducted at up to 6 wells located within area to ensure on-going hydraulic containment.

- **Periodic Reviews** - Periodic reviews of remedial progress will be conducted as necessary to determine the effectiveness of the remedy in achieving the ROs. These reviews will be conducted, at a minimum, every five years.

- **Engineering/Institutional Control Inspections** – Inspections for integrity of the engineering control at the former Spring Joint property will occur annually, either under the DEUR or the contingency of annual ADEQ inspections.

5.4 Estimated Cost

The estimated cost of the proposed remedy is $13,565,000. The estimated cost with contingencies is $21,358,000. A summary of the costs is available in Table 3 below, and a detailed cost breakout is available in Appendix A.

Table 3: Summary of Proposed Remedy Costs	
Remedial Action Element Description	**Cost**
PRIMARY ELEMENTS	
P+T for Regional Aquifer Plume	$3,800,000
MNA for perched and regional aquifers	$2,130,000
Install and operate SVE system	$5,354,000
Well Head Treatment Systems	$1,810,000
Maintain asphalt cap and parking lot at Spring Joint	$471,000
PRIMARY ELEMENTS SUBTOTAL:	**$13,565,000**
CONTINGENCY ELEMENTS	
Additional Time-Frames for SVE, P+T, wellhead treatment	$2,584,000
Modifications to P&T System	$2,369,500
Wellhead Treatment System Additions	$1,761,500
Vapor Intrusion Building Mitigation	$1,078,000
CONTINGENCY ELEMENTS SUBTOTAL:	**$7,793,000**
PROPOSED REMEDY GRAND TOTAL:	**$21,358,000**
Notes: Cost assumes 3% annual inflation rate for multi-year items (e.g. groundwater sampling)	

The cost of the Proposed Remedy is different from that in the FS due to the FS using net present value and no inflation, and the PRAP not using net present value and considering inflation at 3%. The cost of the other remedies discussed in the FS would be impacted in the same manner as the Proposed Remedy, thereby making the outcome of the cost comparison between the three remedies the same.

5.5 Duration

The overall duration of the remedy is up to 30 years. The duration is the estimated number of years required for the proposed remedy to achieve the ROs.

6.0 CONSIDERATION OF REMEDIATION GOALS AND SELECTION FACTORS

6.1 Rationale for Selection of the Remedy

The proposed remedy is based on what is considered the best combination of effectiveness, practicability, cost and benefit. The proposed remedy includes the following remedial strategies:

- Contain the toe of the TCE regional aquifer plume by a P+T, protecting wells downgradient.
- Perform MNA on the regional aquifer and perched aquifer, including the installation of two additional groundwater monitor wells near the toe of the plume.
- Maintain use of groundwater by continuing operation and maintenance of existing well head treatment systems.
- Reducing source area contaminant mass by installing and operating a mobile SVE system in the areas of highest TCE/PCE soil vapor contamination.
- Maintain containment of Cr(IV) and decrease mobility of chromium in soil by maintaining the existing asphalt cap and asphalt parking lot at the former Spring Joint property.

This remedy is the most practicable with the most benefits for the cost, combined with lower long-term risk at the Site. The proposed remedy will protect against human exposure while allowing continued use of the properties. The proposed systems can be installed and operated with a minimal impact on property operations. There will be no risk of mobilizing contamination in the perched aquifer with this remedy. The threat of the perched aquifer acting as a continuing source for VOCs is reduced by the SVE systems. The proposed remedy allows for the continued use of the regional groundwater for drinking water, while protects downgradient water supply wells by containment of the TCE plume.

6.2 Achievement of Remedial Objectives

Per A.C.C. R18-16-408(B)(3), the proposed remedy must achieve each of the ROs established by ADEQ for the Site as presented in this PRAP.

The proposed remedy will achieve the Site ROs for land use at the former Spring Joint by protecting against human exposure to Cr(IV) contaminated soils. A maintained asphalt cap and parking lot provides a barrier to human contact. The RO will be achieved by either the proposed DEUR or the contingency for the DEUR providing for appropriate monitoring and mitigation measures.

The proposed remedy will achieve the Site ROs by mass removal and treatment using a mobile SVE system. Soil-gas sampling and SVE rebound testing will be used to confirm the land use ROs are being met.

The proposed remedy achieves the Site ROs by continuing wellhead treatment systems which protects current use and containing the plume with P+T which protects the downgradient aquifer use. After treatment, the extracted groundwater is restored to meet AWQS. The remedies provide for continued beneficial use of the regional groundwater source. Achievement of the ROs will be shown through routine system and groundwater monitoring.

As demonstrated in this PRAP, the proposed remedy for the Site meets the requirements of A.R.S. § 49-282.06. The proposed remedy is protective of human health and the environment, compliant with applicable laws, and allows for the maximum beneficial use of the waters of the State with the lowest cost. The proposed remedy is the best combination of practicability, risk, cost, and benefit to achieve the ROs.

6.3 Consideration of Remedial Action Criteria

Consistent with A.R.S. §49-282.06 the proposed remedy will:

- Assure the protection of public health and welfare and the environment by reducing contaminant mass, providing physical barriers to exposure, and preventing further spread of contamination;
- Provide for the control, management or cleanup of the COCs in the groundwater by pump and treat;
- Allow the maximum beneficial use of the waters of the state by continuing operation of wellhead treatment systems, providing for possible future well head treatment system, and containing the plume with pump and treat;
- Be reasonable, necessary, cost-effective and technically feasible.

Water from the wellhead treatment remedies will be supplied to the water provider/well owner for use. Extracted groundwater from the P+T system will be routed through subsurface piping and provided to municipal water providers. Contingencies include treated groundwater being discharged to injection wells or the nearby Rillito River.

6.4 Consistency with Water Management Plans

The proposed remedy is consistent with the water management plans of local water providers. The active supply wells currently impacted by the plume have wellhead treatment systems or are on alternate water supplies, and the proposed remedial actions will continue to protect water use. This remedy will allow for the maximum beneficial use of the waters of the State and protects the groundwater supply for future use by treating the water at the wellhead or by containing the plume to prevent wells in the future being impacted.

6.5 Consistency with General Land Use Planning

The proposed remedy allows continued non-residential use of the properties with minimal disturbance to site operations.

6.6 Lead Agency Statement for Proposed Remedy

Based on the information currently available, ADEQ believes the proposed remedy provides the best balance of tradeoffs among the other alternatives with respect to the comparison criteria. ADEQ expects the Proposed Remedy will satisfy the remedial action criteria pursuant to A.R.S. §49-282.06 and the ROs.

6.7 Uncertainties

Uncertainties associated with the proposed remedy at the Site include the following:

- The volume of COCs that were released and are still present in the vadose zone is unknown. Thus, the estimated duration required to remediate the vadose zone at the Site could be more or less than the time-frame assumed by the Proposed Remedy.
- The rate at which VOCs will desorb/volatilize from fine materials is unknown.
- The duration of time required for the groundwater to meet cleanup standards is unknown. No groundwater model has been prepared to assess the duration of time required for the reduction of COC concentrations in groundwater to below cleanup standards. The time required was estimated on observations of changes of COCs at the Site along with professional judgement from working on similar environmental investigations. Thus, the estimated duration required to remediate the groundwater at the Site could be more or less than the time-frame estimated.

6.8 Public Comment Period

Notice of the PRAP shall be issued according to the community involvement plan and R18-16-404, and will include a description of the proposed remedy and its estimated cost, the location where the RI, FS, and PRAP reports can be inspected, how comments on the PRAP can be submitted, and the closing date for comments The PRAP will be issued for a 90-day public comment period. A Community Advisory Board (CAB) meeting may be held during the public comment period. ADEQ will accept written comments on this PRAP that are postmarked within the comment period and submitted to the address provided in the public notice.

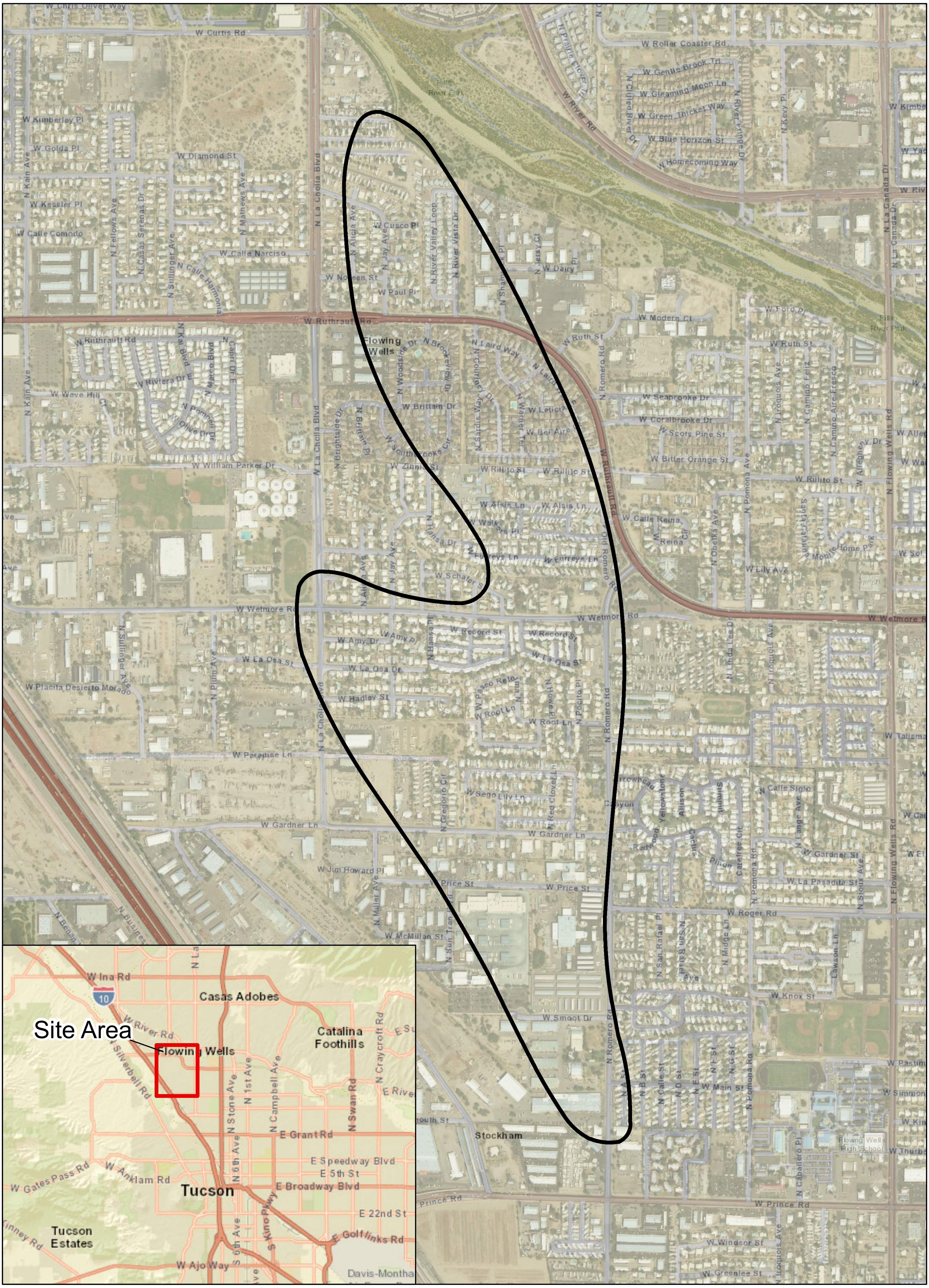
Copies of the PRAP shall also be sent to each person on the preliminary list of potentially responsible parties, including the information on the notice above and that prescribed by 287.04(C).

7.0 REFERENCES

ADEQ and H+A, 2019. Miracle Mile Water Quality Assurance Revolving Fund (WQARF) Feasibility Study. October 15, 2019

Amec, 2015. Final Perched Groundwater Evaluation Report, Miracle Mile WQARF Registry Site, Tucson, Arizona. September 11, 2015

Amec, 2016. Groundwater Monitoring Report for the March 2015 Event, Miracle Mile WQARF Registry Site, Tucson, Arizona. January 7, 2016.



Legend

Site boundary

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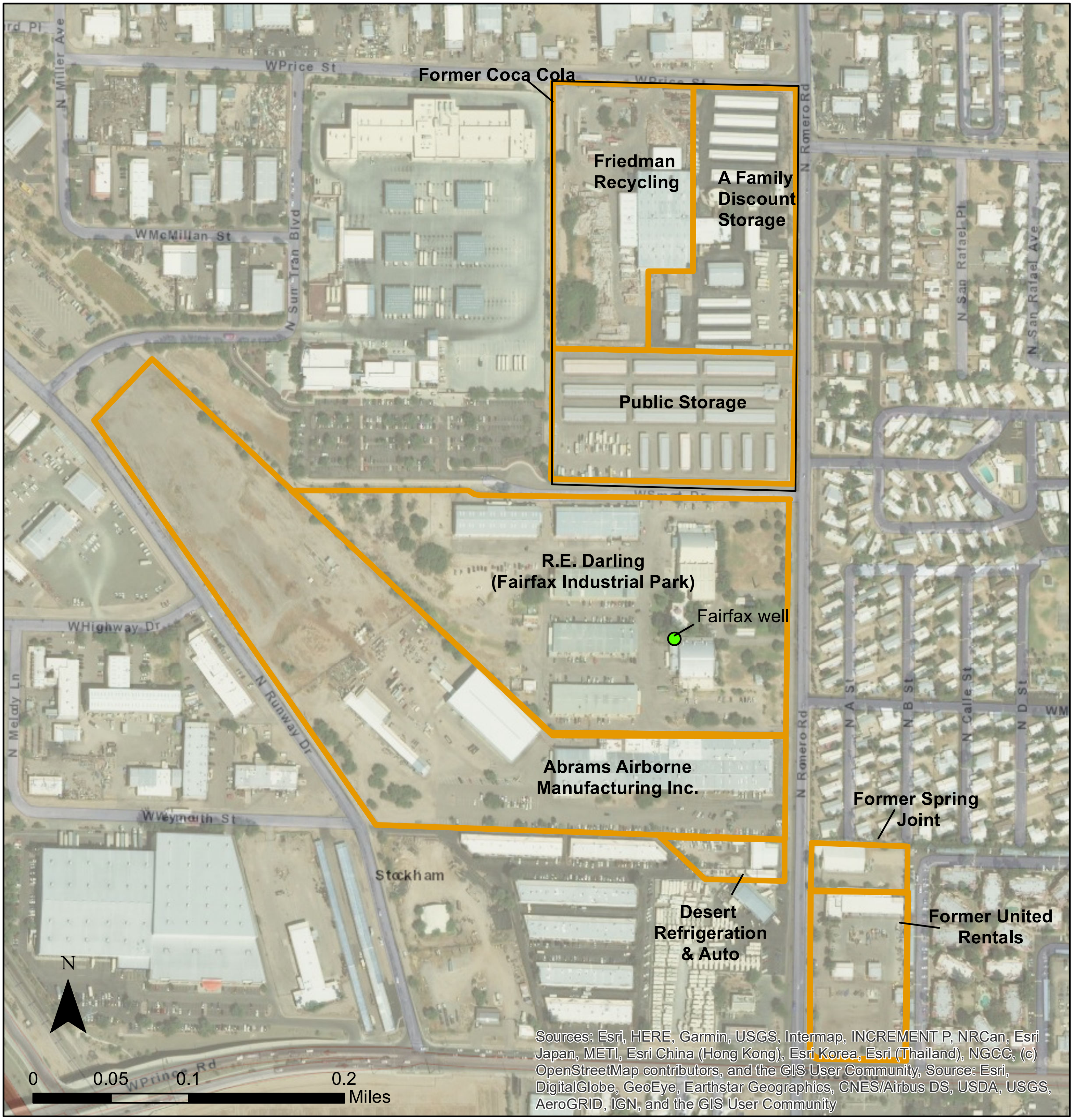
Figure 1
Site Location
Miracle Mile WQARF Site
Proposed Remedial
Action Plan



Legend

Area Parcels

Former Production Well

Figure 2

Site Detail

Miracle Mile WQARF Site

Proposed Remedial Action Plan

ADEQ Arizona Department of Environmental Quality

Legend

208 (60 ft) Borehole location with maximum result shown (depth of sample)

TCE in soil over SRL

Hexavalent chromium in soil over SRL

Asphalt cap/parking lot

Area Parcels

Hexavalent chromium result, mg/kg

TCE result, mg/kg

Figure 3a

Extent of Contamination in Soil
Miracle Mile WQARF site
Proposed Remedial Action Plan

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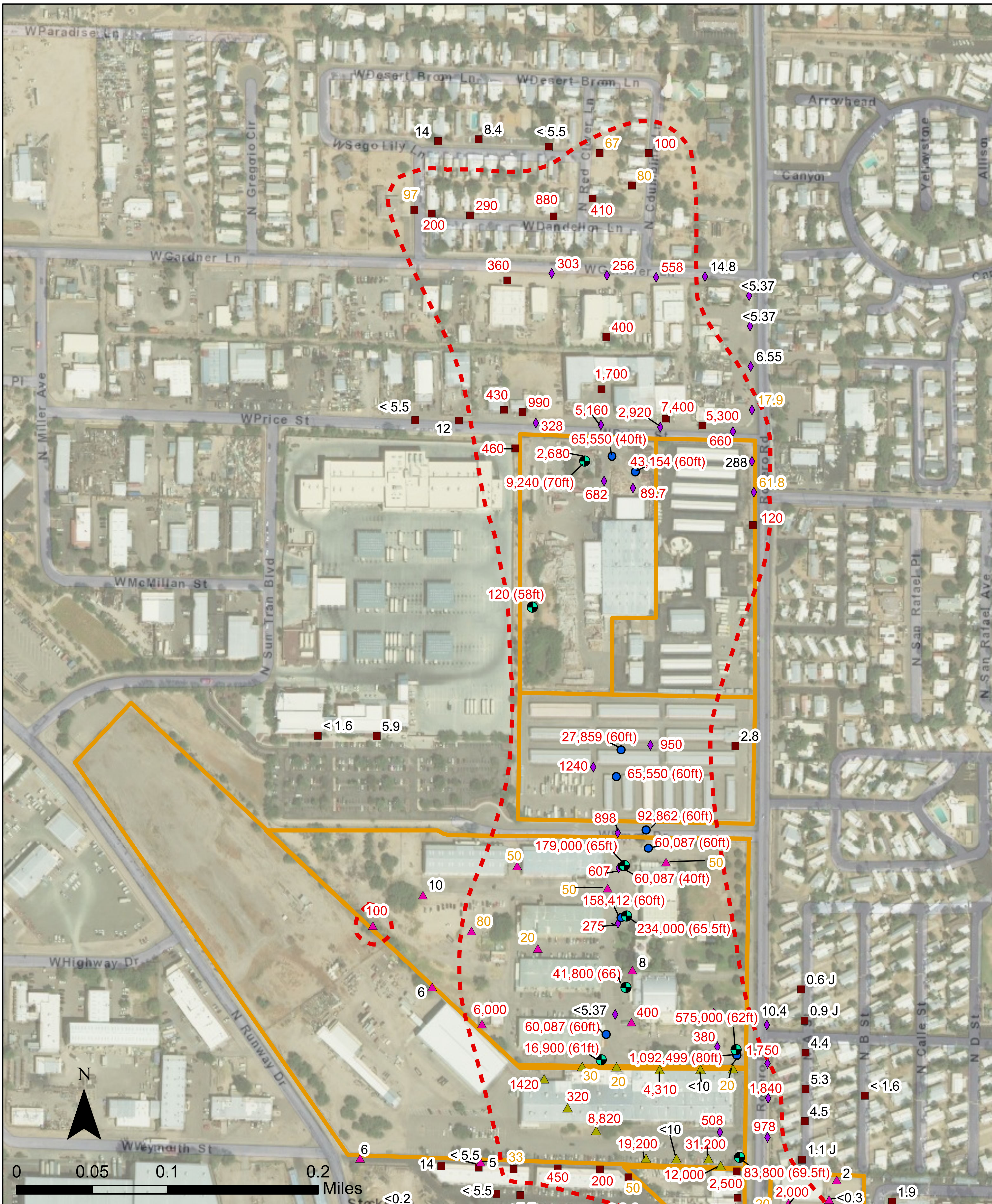

Legend

- Soil-gas sample location, 1989
- Soil-gas sample location, 1990
- Deep soil-gas sample location, 2002
- Dry perched well soil-gas sample location, 2016
- Soil-gas sample location, 2016
- Soil-gas sample location, 2018
- Approximate extent of TCE in soil gas
- Area parcels

Notes:
All results in µg/m³
Soil-gas colected 5-15 ft bgs unless indicated otherwise by (xxft)
Red indicates above non-residential SVSL
Orange indicates above residential SVSL
ft = feet
bgs = feet below ground surface
SVSL = soil vapor screening level

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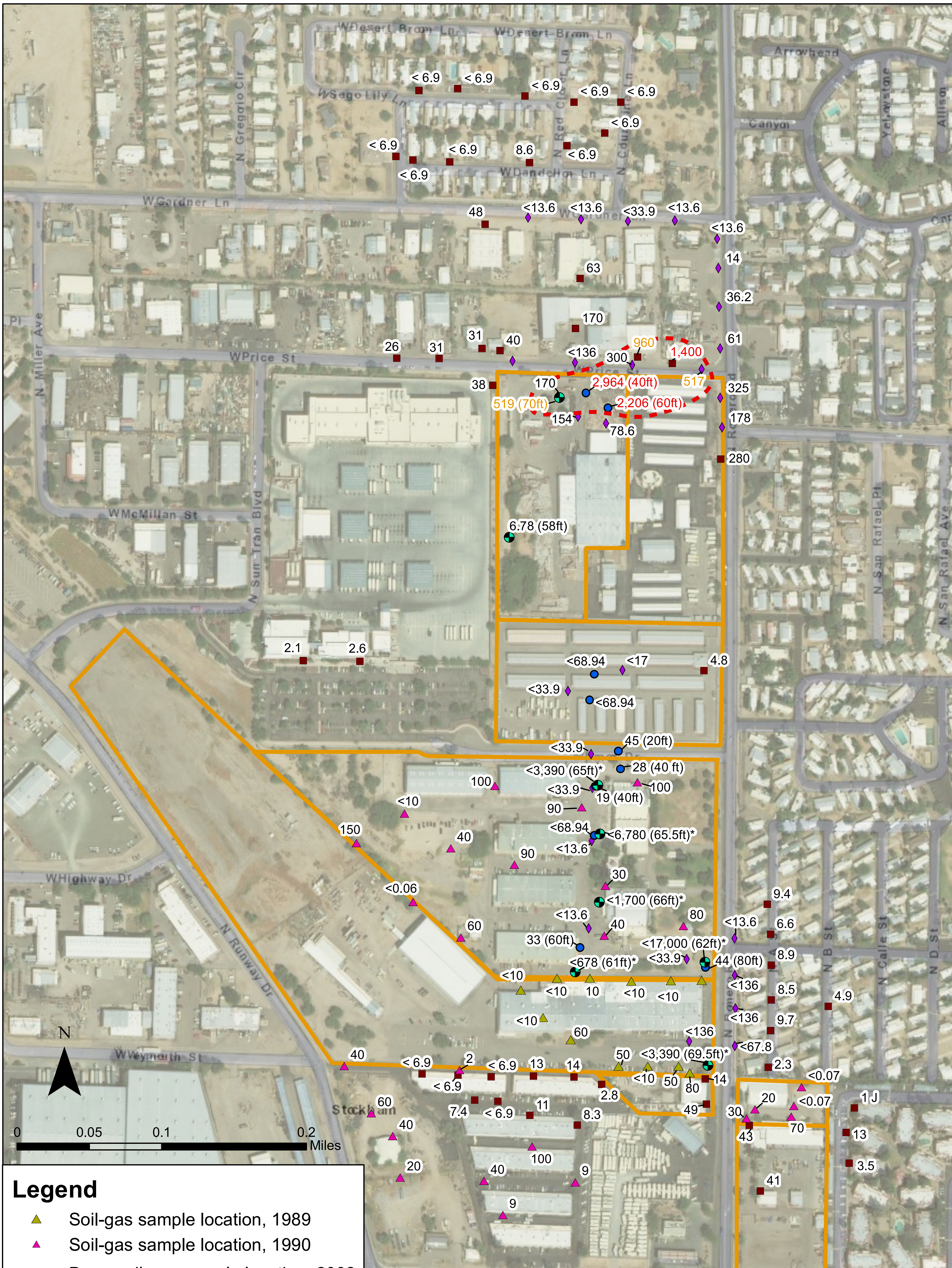
Figure 3b
Extent of Contamination in Soil Gas - TCE
Miracle Mile WQARF site
Proposed Remedial Action Plan



Legend

- Soil-gas sample location, 1989
- Soil-gas sample location, 1990
- Deep soil-gas sample location, 2002
- Dry perched well soil-gas sample location, 2016
- Soil-gas sample location, 2016
- Soil-gas sample location, 2018
- Approximate extent of PCE in soil gas
- Area parcels

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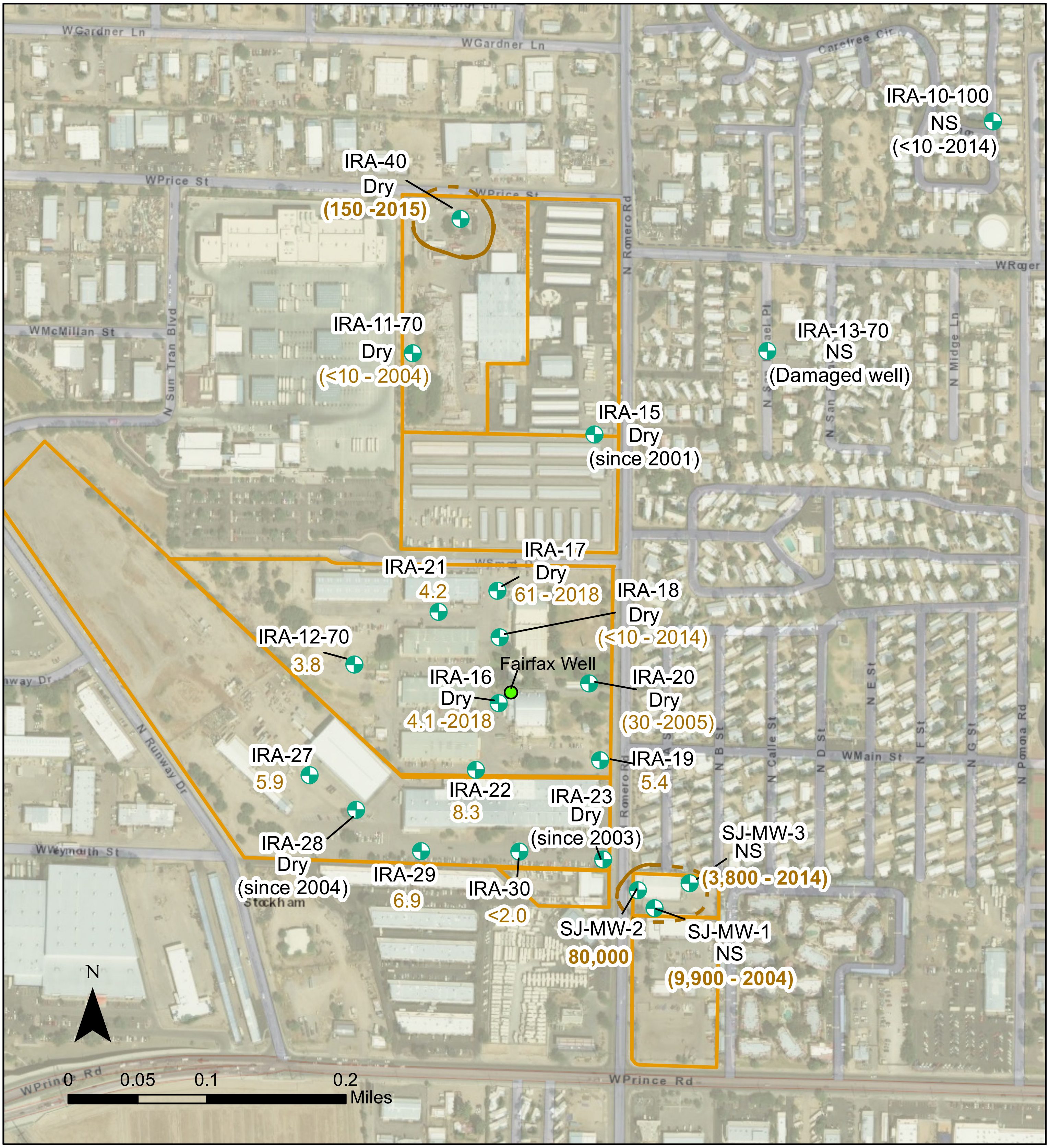
Notes:
All results in µg/m³
Soil-gas colected 5-15 ft bgs unless indicated otherwise by (xxft)
Red indicates above non-residential SVSL
Orange indicates above residential SVSL
ft = feet
bgs = feet below ground surface
SVSL = soil vapor screening level
*High detection limit due to high TCE concentration

Figure 3c
Extent of Contamination in Soil Gas - PCE
Miracle Mile WQARF Site
Proposed Remedial Action Plan



Legend

50 Perched well with most recent chromium result

Approximate chromium extent (dashed where inferred)

Property boundaries

Results in µg/L

Bold indicates over the Aquifer Water Quality Stndard

Figure 3e
Extent of Contamination
in Perched Groundwater - Chromium
Miracle Mile WQARF Site
Proposed Remedial Action Plan

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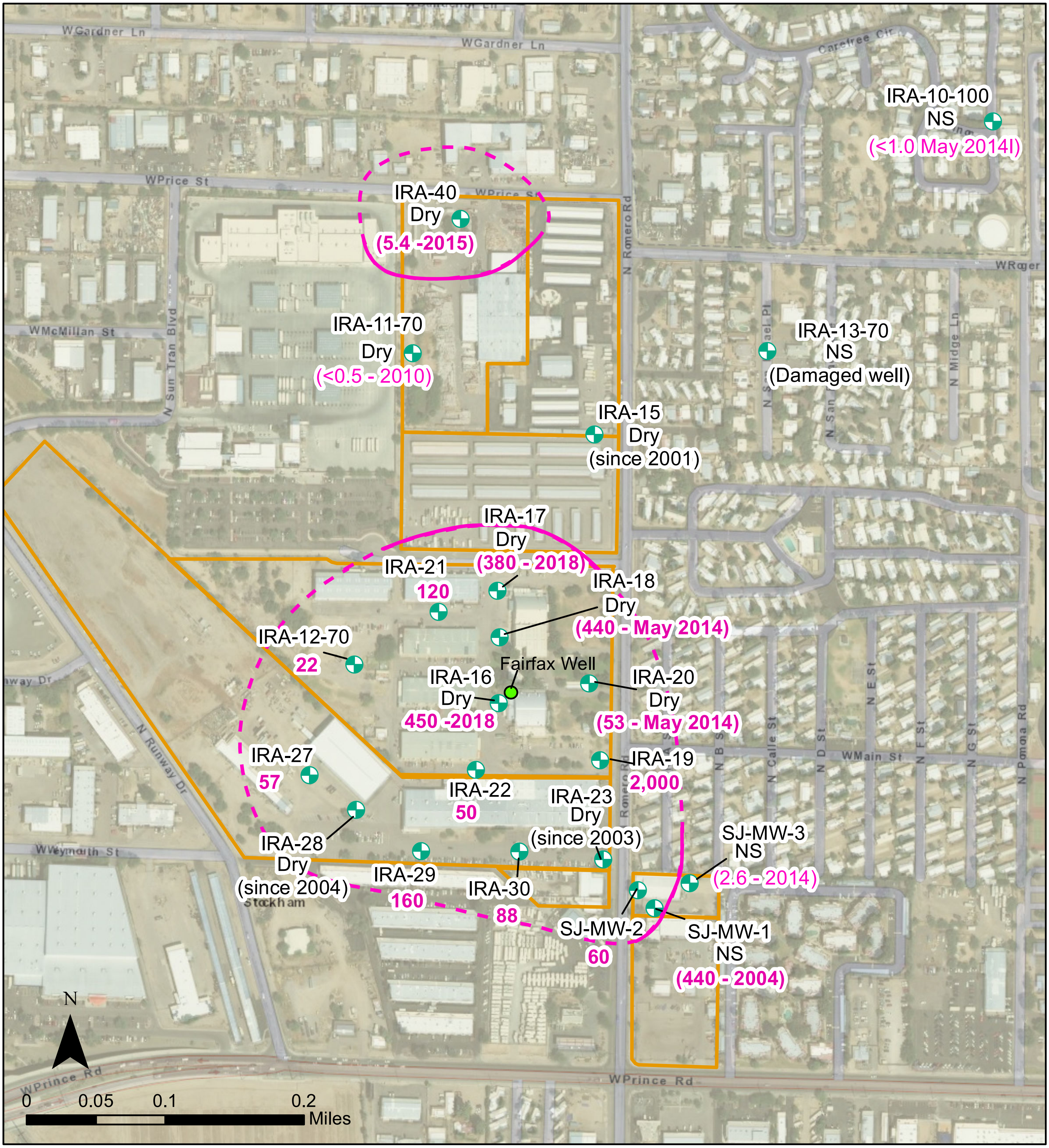

Legend

50 Perched well with most recent TCE result

Approximate TCE extent (dashed where inferred)

Area Parcels

Results in µg/L

Bold indicates over the Aquifer Water Quality Stndard

Results from 2019 unles indicated otherwise

Figure 3d
Extent of Contamination
in Perched Groundwater -TCE
Miracle Mile WQARF Site
Proposed Remedial Action Plan

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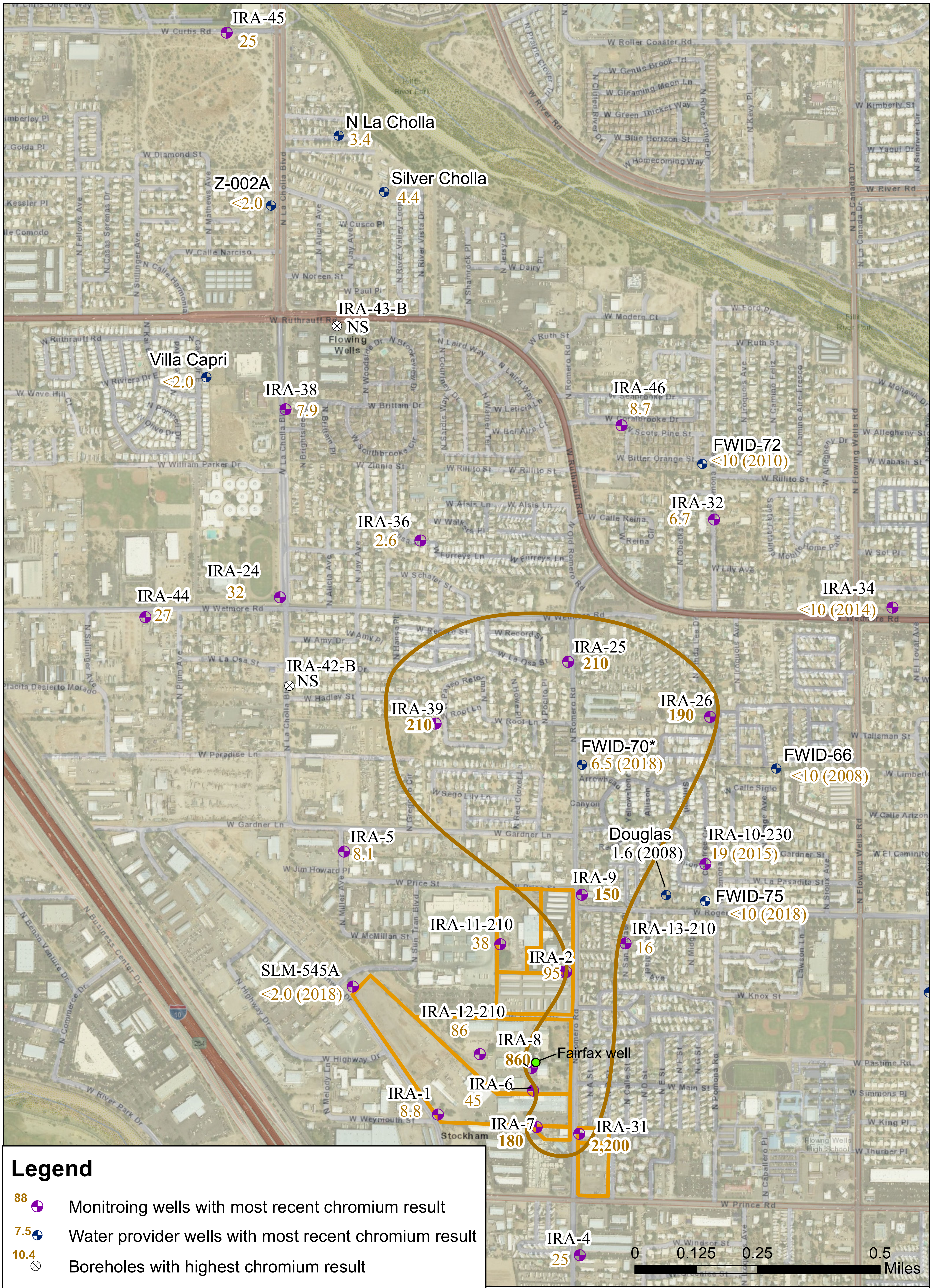

Legend

88 Monitroing wells with most recent chromium result

7.5 Water provider wells with most recent chromium result

10.4 Boreholes with highest chromium result

Former production well

Approximate chromium extent (dashed where inferred)

Property boundaries

Results in µg/L

*Well not used for contouring

Bold indicates over the Aquifer Water Quality Standard

Results from 2019 unles indicated otherwise

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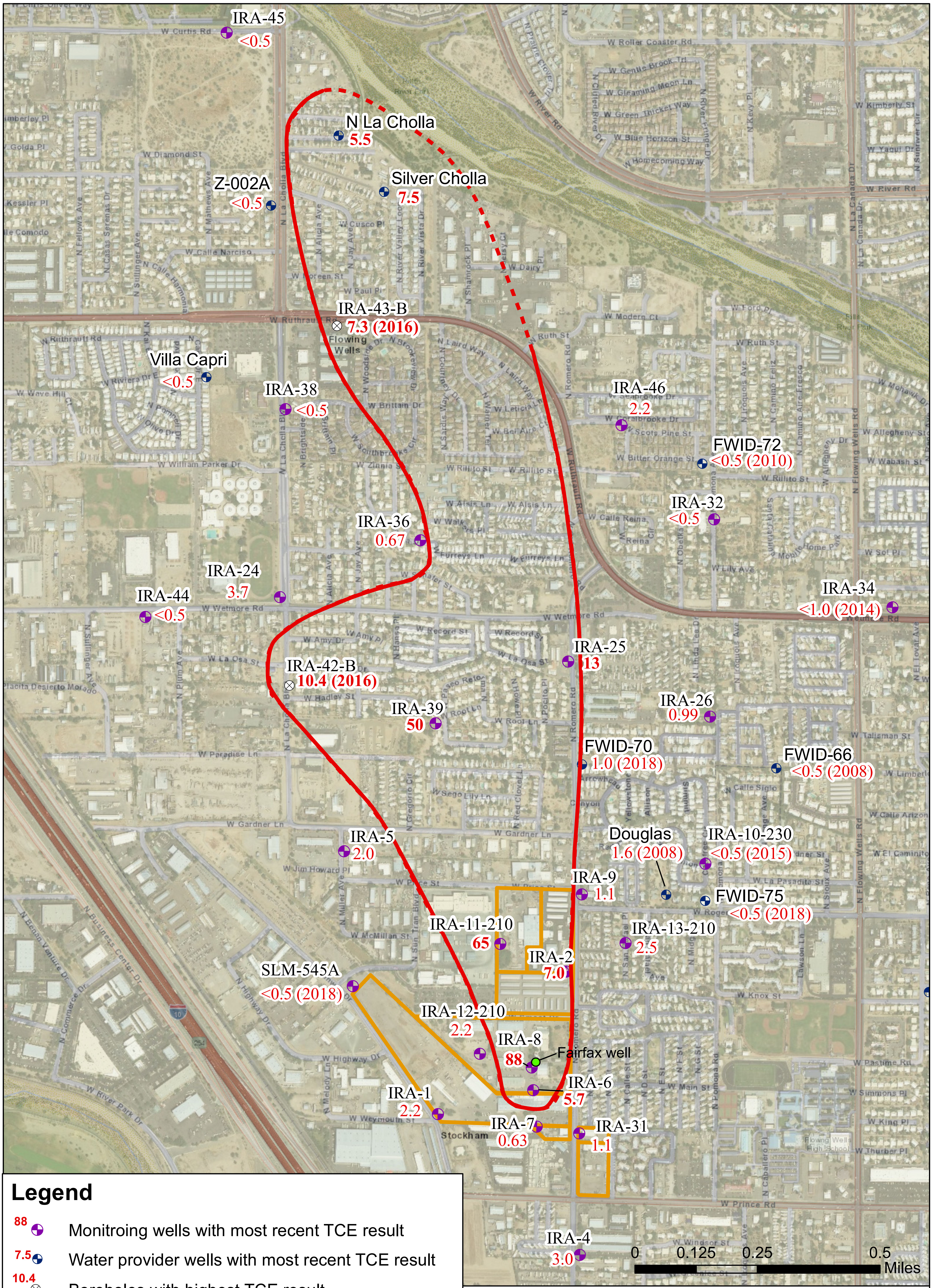
Figure 3e
Extent of Contamination in Regional Groundwater Chromium
Miracle Mile WQARF Site
Proposed Remedial Action Plan



Legend

88 Monitroing wells with most recent TCE result

7.5 Water provider wells with most recent TCE result

10.4 Boreholes with highest TCE result

Former production well

Approximate TCE extent (dashed where inferred)

Area Parcels

Results in µg/L

Bold indicates over the Aquifer Water Quality Standard

Results from 2019 unles indicated otherwise

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Figure 3f

Extent of Contamination in Regional Groundwater - TCE

Miracle Mile WQARF Site

Proposed Remedial Action Plan

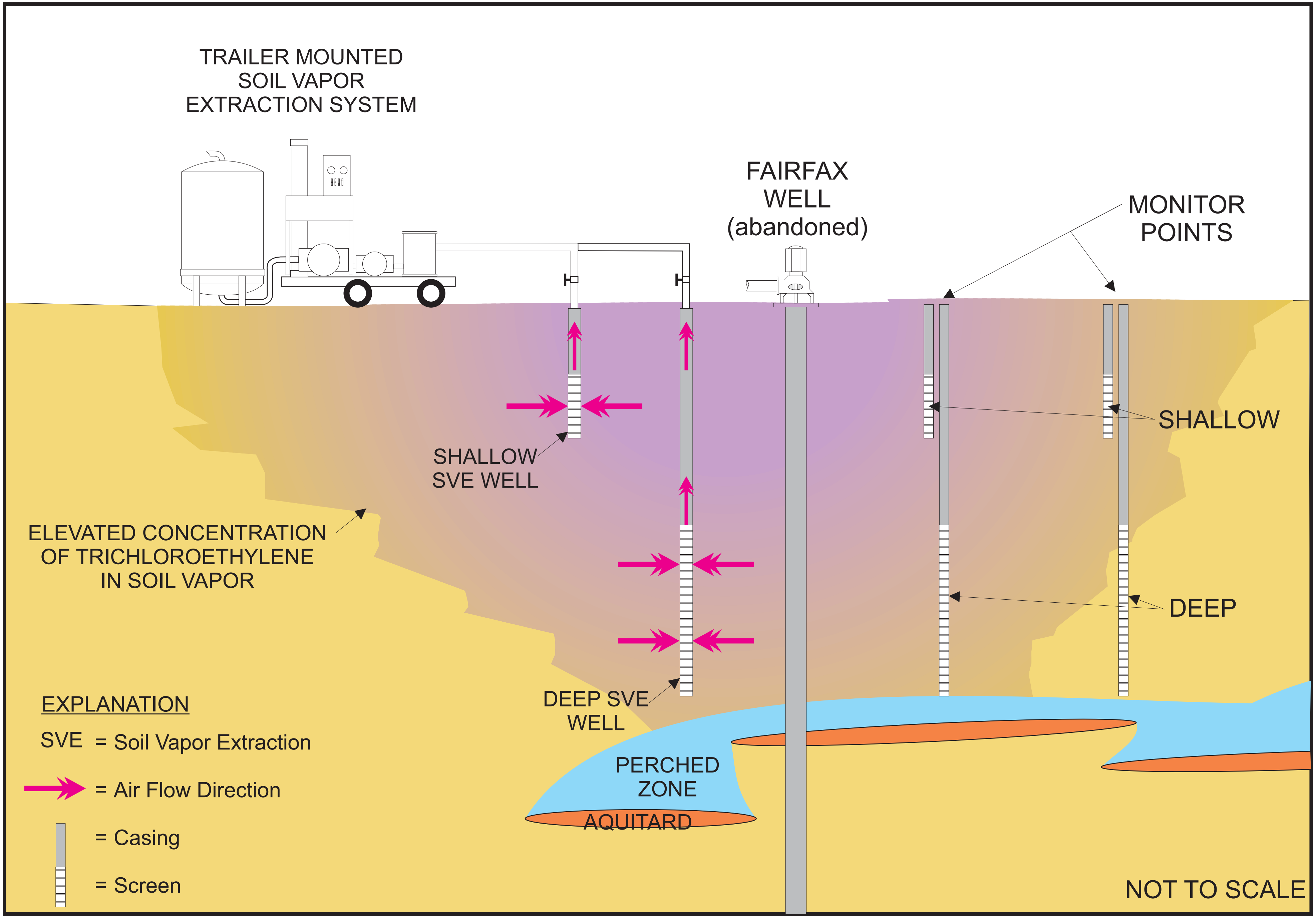
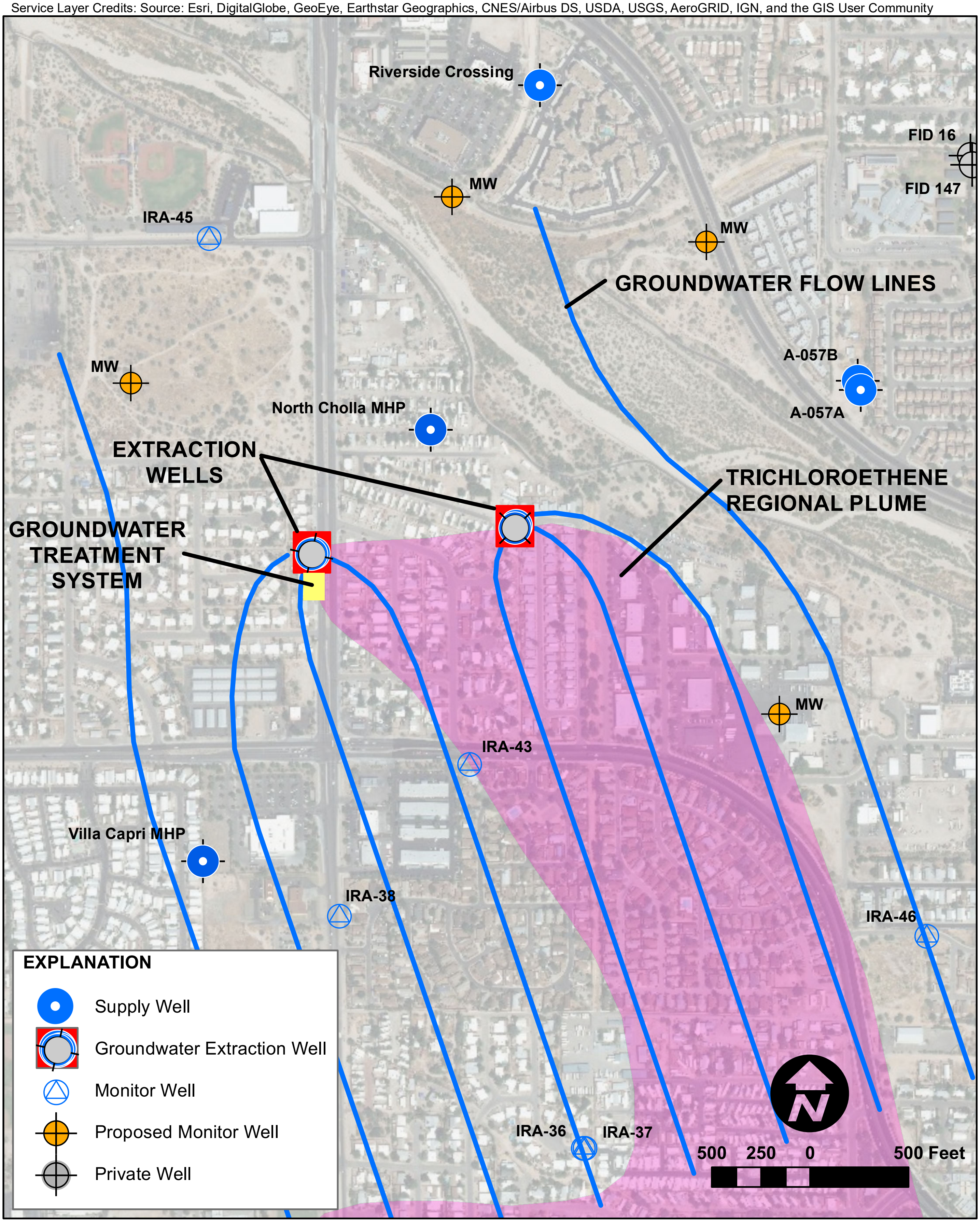


FIGURE 4A: CONCEPTUAL DESIGN REMEDY: SOIL VAPOR EXTRACTION
MIRACLE MILE WQARF SITE - PROPOSED REMEDIAL ACTION PLAN

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



X:\H+A_GIS FILES\1195_7thSt_ArizonaAve\GIS_1195_01_SV_Sampling\GIS_maps\FIGURE 4B PRAP.mxd

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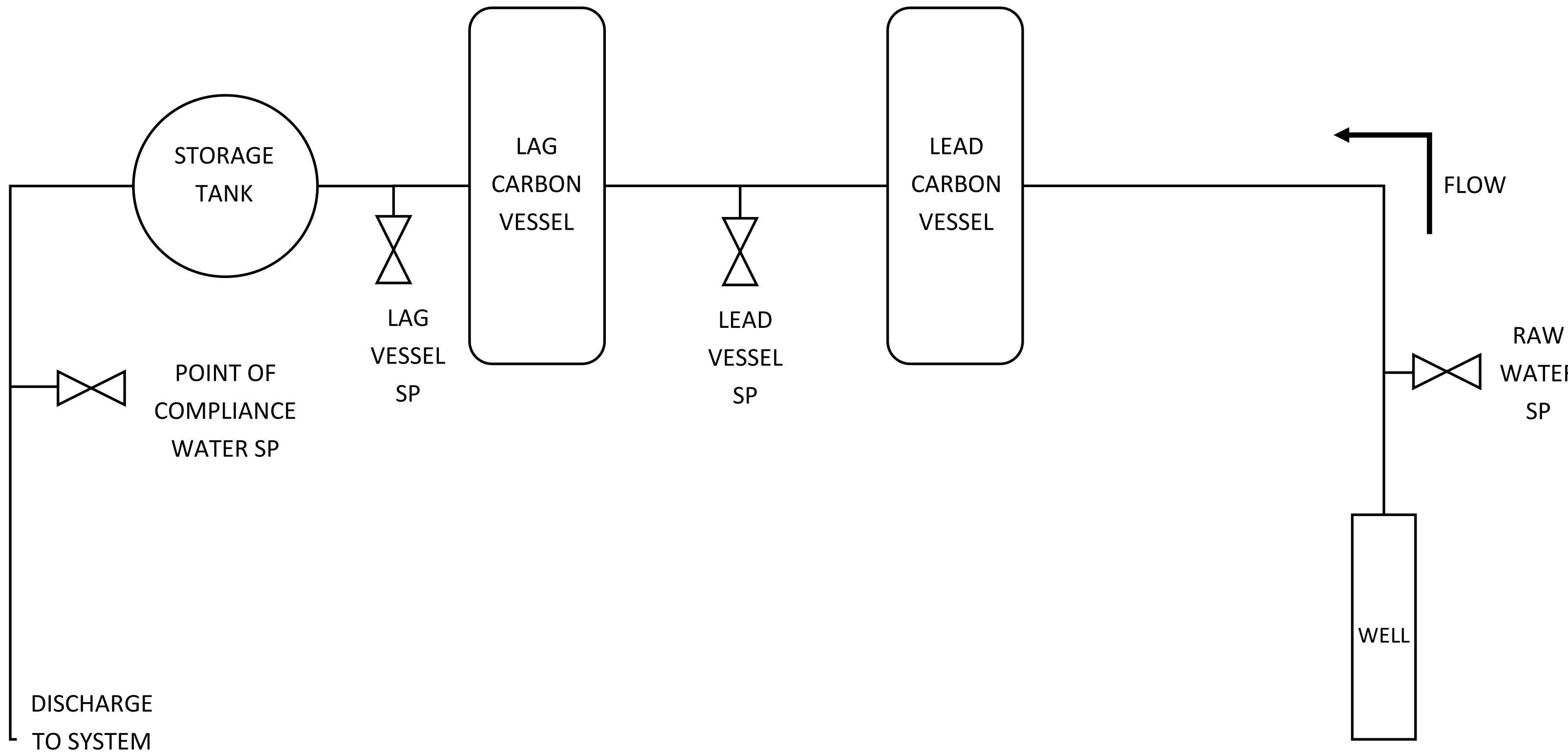
FIGURE 4B: CONCEPTUAL DESIGN REMEDY:
TOE OF PLUME CONTAINMENT & MNA
MIRACLE MILE WQARF SITE - PROPOSED REMEDIAL ACTION PLAN



FE Flow Element (Totalizer)

Sample Port

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

2/19/2020

Figure 4c

Conceptual Design of Remedy - Well Head Treatment

Miracle Mile WQARF Site

Proposed Remedial Action Plan

APPENDIX A - PROPOSED REMEDY DETAILED COST SUMMARY
Miracle Mile WQARF Site
Proposed Remedial Action Plan

Remedial Action Element Description	Quantity	Unit	Unit Cost	Cost	Detail
PRIMARY ELEMENTS					
P&T for Regional Aquifer Plume					
Installation P&T System, Capital Costs	1	Lump Sum	$1,190,000	$1,190,000	Includes cost of equipment and installation, including installation of two additional monitoring wells
P&T System O&M Costs (Year 1-30)	30	Year	$82,000	$2,460,000	Cost was adjusted to reflect an average of 3.0% inflation over 30 years
System Closure	1	Lump Sum	$150,000	$150,000	
			Subtotal:	**$3,800,000**	
MNA for perched and regional aquifers					
Installation of two additional monitoring wells	2	Lump Sum	-	-	Included above
Annual groundwater sampling and reporting	30	Year	$71,000	$2,130,000	Cost was adjusted to reflect an average of 3.0% inflation over 30 years
			Subtotal:	**$2,130,000**	
Install and operate SVE system					
Install of SVE System, Capital Costs	1	Lump Sum	$209,000	$209,000	Includes cost of equipment and installation
Operation of SVE System, O&M	10	Years	$477,000	$4,770,000	Cost was adjusted to reflect an average of 3.0% inflation over 10 years
System Closure	1	Lump Sum	$375,000	$375,000	
			Subtotal:	**$5,354,000**	
Well Head Treatment Systems					
Operation and Maintenance of well head treatment system	30	Year	$57,000	$1,710,000	Cost was adjusted to reflect an average of 3.0% inflation over 30 years
Carbon Change out	10	Each	$10,000	$100,000	Assumes carbon changeout every 3 years of the 30-year operation
			Subtotal:	**$1,810,000**	
Maintain asphalt cap and parking lot at Spring Joint					
Maintain asphalt cap and parking lot, Capital Costs	1	Lump Sum	$9,000	$9,000	Re-sealing 1st year
Maintain asphalt cap and parking lot, O&M	30	Year	$15,400	$462,000	Includes repaving every 10 years, resealing every 5
				$471,000	
			PRIMARY ELEMENTS SUBTOTAL:	**$13,565,000**	
CONTINGENCY ELEMENTS					
Additional Time-Frames					
Additional 2 years SVE O&M	2	Year	$492,000	$984,000	Assuming an average of 3.0% inflation over years 11-12
Additional 5 years P&T O&M	5	Year	$90,000	$450,000	Includes labor, laboratory, and electrical costs, assuming an average of 3.0% inflation over years 31-35
Additional 5 years well head treatment	5	Year	$62,000	$310,000	Includes labor and laboratory costs, assuming an average of 3.0% inflation over years 31-35
Additional 10 years MNA	10	Year	$84,000	$840,000	assuming an average of 3.0% inflation over years 31-40
			Subtotal:	**$2,584,000**	
Modifications to P&T System					
Install 3 Injection Wells	3	Each	$94,000	$282,000	Includes installation of three re-injection wells
Discharge to River/Settling Basin	1	Lump sum	$550,000	$550,000	Includes equipment, install, and 1 year O&M (additional years assumed to be part of normal O&M costs)
Upgrade Groundwater Treatment for Chromium	1	Each	$1,537,500	$1,537,500	Includes equipment, install, and 1 year O&M (additional years assumed to be part of normal O&M costs)
			Subtotal:	**$2,369,500**	
Well Head Treatment System Additions					
Install Additional Well Head Treatment System	1	Each	$1,207,000	$1,207,000	Includes equipment, install, and 30 years of O&M
Upgrade Groundwater Treatment for Chromium	1	Each	$554,500	$554,500	Includes equipment, install, and 1 year O&M (additional years assumed to be part of normal O&M costs)
			Subtotal:	**$1,761,500**	
Vapor Intrusion Building Mitigation					
Collection of Indoor Air Samples	1	Lump sum	$40,000	$40,000	
Install depressurization systems at buildings	1	Each	$650,000	$650,000	Includes equipment, install, and 10 years O&M
HVAC: 5,000 sqft bldg; existing system	1	Each	$104,000	$104,000	Includes current HVAC system adjustments, and 10 year O&M
HVAC: 5,000 sqft bldg; Replace System	1	Each	$260,000	$260,000	Includes equipment, install, and 10 year O&M
Vapor barrier installation	1	Each	$24,000	$24,000	
			Subtotal:	**$1,078,000**	
			CONTINGENCY ELEMENTS SUBTOTAL:	**$7,793,000**	
			PROPOSED REMEDY GRAND TOTAL:	**$21,358,000**	