PROPOSED REMEDIAL ACTION PLAN

EAST CENTRAL PHOENIX – 24th STREET AND GRAND CANAL
WATER QUALITY ASSURANCE REVOLVING FUND SITE

PHOENIX, ARIZONA

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Acronyms

A.A.C.	Arizona Administrative Code
ADEQ	Arizona Department of Environmental Quality
A.R.S.	Arizona Revised Statute
AWQS	Aquifer Water Quality Standard
COC	Contaminant(s) of Concern
COP	City of Phoenix
cis-1,2-DCE	cis-1,2-Dichloroethene
trans-1,2-DCE	trans-1,2-Dichloroethene
ECP	East Central Phoenix
ERA	Early Response Action(s)
ERD	Enhanced Reductive Dechlorination
FS	Feasibility Study
GETS	Groundwater Extraction and Treatment Systems
GPM	Gallons per Minute
ISCO	In-Situ Chemical Oxidation
LGAC	Liquid Phase Granular Activated Carbon
µg/L	Micrograms per Liter
MNA	Monitored Natural Attenuation
PCE	Tetrachloroethene
PRAP	Proposed Remedial Action Plan
RI	Remedial Investigation
RO	Remedial Objective(s)
ROD	Record of Decision
SRP	Salt River Project
SVE	Soil Vapor Extraction
TCE	Trichloroethene
VC	Vinyl Chloride
VOC	Volatile Organic Compound(s)
WQARF	Water Quality Assurance Revolving Fund

1.0 INTRODUCTION

The Arizona Department of Environmental Quality (ADEQ) prepared this Proposed Remedial Action Plan (PRAP) for the East Central Phoenix (ECP) 24th Street and Grand Canal Water Quality Assurance Revolving Fund (WQARF) Site (Site), located in Phoenix, Arizona (Figure 1). This PRAP was prepared in accordance with Arizona Revised Statute (A.R.S.) Section (§) 49-287.04 and Arizona Administrative Code (A.A.C.) R18-16-408. The PRAP is based on information contained in the following documents:

- *Remedial Investigation Report, East Central Phoenix 24th Street and Grand Canal Water Quality Assurance Revolving Fund Site, Phoenix, Arizona* (Geosyntec, 2019a)

- *Feasibility Study, East Central Phoenix 24th Street and Grand Canal Water Quality Assurance Revolving Fund Site, Phoenix, Arizona* (Geosyntec, 2019b)

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 (RI) and the FS.
- The proposed remedy and estimated cost.
- How the remediation goals and selection factors in A.R.S. §49-282.06 have been considered.

2.0 SITE BOUNDARIES

The boundaries of the Site subject to remedial action include the area bounded by East Pinchot Avenue to the north, East McDowell Road to the south, North 25th Street to the east, and North Edgemere Street to the west (Figure 1). The Site includes the source area property from which Carnation 1 Hour Cleaners (Former Carnation) and McKean's Model Laundry & Dry Cleaning (Former McKean's) dry-cleaning facilities operated and the area that encompasses the current groundwater plume impacted with volatile organic compounds (VOCs) above Arizona Aquifer Water Quality Standards (AWQS).

3.0 REMEDIAL INVESTIGATION RESULTS

This section presents a summary of the RI conducted at the Site as presented in the following documents:

- *Remedial Investigation Report, East Central Phoenix 24th Street and Grand Canal Water Quality Assurance Revolving Fund Site, Phoenix, Arizona (Geosyntec, 2019a)*

3.1 Site History and Description

The Site is in an urban setting that includes a mixture of commercial and light industrial businesses, warehouses, and manufacturing facilities. The Site has historically been occupied by dry-cleaning facilities since the 1950s. After several investigations, tetrachloroethene (PCE) source areas that resulted in VOC impacts to soil and groundwater were determined to be located at two dry-cleaning facilities: the former Carnation 1 Hour Cleaners (Former Carnation) and the former McKean's Model Laundry & Dry Cleaning (Former McKean's). These facilities historically operated on the northeast corner of the intersection of 24th Street and Thomas Road, herein referred to as "the Former Carnation/Former McKean's property."

3.2 Source of Contamination

Data collected during the RI indicate that contaminant releases occurred in soil and groundwater at the Site. These data identified the likely sources of contamination as the Former Carnation/Former McKean's property.

3.3 Contaminants of Concern

The contaminants of concern (COCs) include PCE and PCE daughter products trichloroethene (TCE), cis-1,2-dichloroethene (cis-1,2-DCE), trans-1,2-dichloroethene (trans-1,2-DCE), and vinyl chloride [VC]). Site COCs were identified due to the nature of the potential release from the two dry-cleaning establishments, their historical presence, and/or their potential to be generated through biological transformations.

3.3.1 Groundwater

The COCs in the groundwater at the Site include PCE, TCE, cis-1,2-DCE, trans-1,2-DCE, and VC. Two of these contaminants, PCE and TCE, have been detected at concentrations at or above regulatory levels in groundwater at the Site. Currently, only PCE is present in the groundwater at concentrations that exceed the AWQS. Other COCs were identified due to their potential to be generated through biological transformations.

3.3.2 Soil and Soil Vapor

The COC in soil and soil vapor at the Site is PCE. According to the RI, concentrations of PCE in soil and soil vapor were reduced to concentrations below the site-specific cleanup goals by previously completed Soil Vapor Extraction (SVE) treatment activities at the Site. Thus, residual VOC concentrations do not pose unacceptable vapor intrusion risk under a residential site redevelopment scenario, which is significantly more conservative than the current commercial site use and exposure scenario.

3.4 Nature and Extent of Contamination

The predominant COC at the Site is PCE. The lateral distribution of the PCE in groundwater defines the extent of VOC contamination at the Site. The current estimated extent of PCE in groundwater at concentrations exceeding the AWQS (5 micrograms per liter [µg/L]) is presented on Figure 2. As reported in the 2019 Geosyntec RI Report, there is an overlap of the PCE plumes associated with the Former Carnation/Former McKean's property, and the PCE impacts to groundwater associated with the ECP 32nd Street and Indian School Road WQARF site. The two plumes, however, were identified to be largely discrete, separate plumes, travelling alongside each other and at different vertical elevations, with the plume associated with the Site being shallower and located to the southeast.

No other COCs are currently present in groundwater at concentrations exceeding the AWQS. The maximum PCE concentration currently detected in the groundwater is 138 µg/L (Figure 2 [Geosyntec, 2020]).

3.5 Early Response Action

The following ERA was performed to remove contamination at the Site and/or to mitigate the exposure of the contamination to potential receptors:

- 2016 to 2019 – ADEQ operated an SVE pilot test at the Site to address vadose zone impacts. The system was shut down in August of 2017 due to low VOC mass removal Geosyntec, 2018). Approximately 76 pounds of VOCs were removed from the vadose zone. The system was decommissioned and removed from the Site in 2019.

3.6 Risk Evaluation Summary

Multiple investigations have been conducted beginning in 1984. The data from these investigations were used to evaluate the risks that the soil, soil vapor, and groundwater pose to the public and the environment. The risk evaluations indicate there is no current human health risk from soil, soil vapor, or groundwater. Soil equivalent concentrations calculated using soil vapor analysis results indicated PCE levels were significantly below the residential Soil Remediation Level. SVE operations have reduced PCE concentrations in soil gas significantly at the Site and the results of a human health risk assessment indicated the remaining PCE vapors do not pose an unacceptable risk to current or future receptors. Additionally, the RI concluded that the risk of vapor intrusion from PCE off-gassing from the groundwater plume is likely negligible. There is currently no exposure pathway associated with contaminated groundwater because there are no impacted water supply wells that are active in the vicinity of the Site. However, potential future risks may be associated with exposure to groundwater contamination should the deeper water supply wells present and adjacent to the Site be utilized in the future for water supply (Geosyntec, 2019a).

3.7 Remedial Objectives

The results of the RI, including the Land and Water Use Study, were used to develop the ROs for remediation at the Site pursuant to A.A.C. R18-16-406. The ROs were determined for each designated use, including soil and groundwater (e.g. potable water and irrigation water).

The RO for land use (soil) at the Site is to protect against the loss or impairment of land threatened by COCs at the Site and restore land that has been impaired by COCs at the Site to below applicable remediation levels. Action is needed for the present time and for as long as necessary to ensure that the level of contamination in the soil associated with the Site no longer exceeds applicable remediation levels (ADEQ, 2019).

The ROs for groundwater use at the Site are as follows:

- ***Irrigation Use*****:** Protect against the loss or impairment of irrigation water threatened by the COCs at the Site. Where protection cannot be achieved in a reasonable, necessary, or cost-effective manner; restore, replace, or otherwise provide for irrigation water that is lost or impaired by the COCs at the Site. Action is needed for as long as necessary to ensure that, while the water exists and the resource remains available, the contamination associated with the Site does not prohibit or limit the designated use of groundwater.

- ***Potable Use*:** Protect against the loss or impairment of potable water threatened by the COCs at the Site. Where protection cannot be achieved in a reasonable, necessary, or cost-effective manner; restore, replace, or otherwise provide for potable water that is lost or impaired by the COCs at the Site. Action is needed for as long as necessary to ensure that, while the water exists and the resource remains available, the contamination associated with the Site does not prohibit or limit the designated use of groundwater.

There are no ROs needed for surface water because there are no known current impacts from the Site directly to the surface water in the Salt River Project (SRP) canals. Current surface water use in the area of the Site is irrigation from man-made canals containing pumped groundwater. The projected future use of the canal water includes drinking water. However, ROs for surface water use are not necessary, as ROs for groundwater pumped into the canal address protection of this use in that the pumped groundwater will already meet drinking water standards.

4.0 FEASIBILITY STUDY RESULTS

This section presents a summary of the FS conducted for the Site. The results of the FS are presented in the following document:

- *Feasibility Study, East Central Phoenix 24th Street and Grand Canal Water Quality Assurance Revolving Fund Site, Phoenix, Arizona* (Geosyntec, 2019b)

4.1 Identification and Screening of Remedial Technologies

The FS identified several remedial technologies for addressing the soil and groundwater contamination at Site including No Action, Institutional Controls, Groundwater Extraction and Treatment Systems (GETS), In-Situ Chemical Oxidation (ISCO), In-Situ Chemical Reduction with zero-valent iron, Enhanced Reductive Dechlorination (ERD), Air Sparging, and Monitored Natural Attenuation (MNA).

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 contaminant treatment effectiveness, constructability, health and safety concerns, flexibility/expandability, operational hazards, and cost-effectiveness. Based on the screening results, GETS, ISCO, ERD, and MNA were retained as feasible for use at the Site.

4.2 Development of the Reference Remedy and Alternative 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 RI;
- The best available engineering and scientific information concerning available remedial technologies;
- Preliminary analysis of the comparison criteria and the ability of the remedies to comply with A.R.S. §49-282.06.

4.2.1 Reference Remedy

The Reference Remedy includes the following technologies:

- **ISCO** – ISCO would remediate the groundwater contamination present at the Site by treating the highest VOC concentrations near the Former Carnation/Former McKean's property, cut off the plume, and inhibit migration of PCE further downgradient.
- **MNA** – MNA would include groundwater monitoring and sampling to monitor the natural degradation of the groundwater contamination remaining after ISCO implementation.
- **ISCO - Hydrogen Peroxide (Contingency)** – The simultaneous injection of hydrogen peroxide and ozone into the ozone sparging wells as a mist will be a contingency if COC response to ozone sparging in fine grained lithology is slow.
- **Additional MNA (Contingency)** – Continued groundwater monitoring if the PCE concentrations continue to be greater than the AWQS after six years of monitoring.
- **Additional Liquid Oxidant Injections (Contingency)** – If persistent elevated PCE concentrations are measured farther from the source area, additional oxidant injection wells may be installed south of the Grand Canal, within the City right-of-way, for injection of a liquid oxidant. A liquid oxidant is proposed because it can be implemented quickly and with fewer potential property access restrictions. This contingency injection, if implemented, will occur as a one-time application.
- **Additional Ozone Sparge Injections (Contingency)** – The installation of additional ozone sparge injection wells and a mobile ozone sparge system in the areas surrounding SRP, City of Phoenix (COP), or other production wells would be a contingency to treat impacted groundwater if PCE concentrations are greater than the AWQS in these areas when the wells are needed to produce drinking water.
- **Wellhead Treatment (Contingency)** - Wellhead treatment would be a contingency to treat impacted groundwater that is withdrawn from SRP, COP, or other production wells if COC concentrations exceed the AWQS in these wells when the wells are needed to produce drinking water.
- **SVE (Contingency**) – SVE maintenance would be a contingency if elevated ozone concentrations are observed in the vadose zone below the Former Carnation/Former McKean's property during active ISCO implementation.

Figures 3 and 4 depict the layout of the Reference Remedy.

4.2.2 Less Aggressive Remedy

The Less Aggressive Remedy includes:

- **MNA** – MNA would include groundwater monitoring and sampling to monitor the natural degradation of the groundwater contamination at the Site.
- **ISCO (Contingency)** – The installation of ozone sparge injection wells and a mobile ozone sparge system in the areas surrounding SRP, COP, or other production wells would be a contingency to treat impacted groundwater if PCE concentrations continue to be greater than the AWQS in these areas.
- **Wellhead Treatment (Contingency)** - Wellhead treatment would be a contingency to treat impacted groundwater that is withdrawn from SRP, COP, or other production wells if COC concentrations exceed the AWQS in these wells when the wells are required to produce drinking water.

4.2.3 More Aggressive Remedy

The More Aggressive Remedy is similar to the Reference Remedy with the inclusion of the following technologies:

- **ISCO – Hydrogen Peroxide** – Installation of hydrogen peroxide injection wells and associated injection equipment within the Former Carnation/Former McKean's property;
- **ISCO – Liquid Oxidant** – ISCO would remediate the groundwater contamination present in the areas south of the Grand Canal.

The More Aggressive Remedy retains the same contingencies proposed as part of the Reference Remedy and are not changed.

4.3 Evaluation and Comparison of the Remedies

A comparative evaluation was conducted in the FS for the Reference, Less Aggressive, and More Aggressive Remedies to demonstrate that each remedial alternative will achieve the ROs in accordance with A.A.C. R18-16-407(H). The criteria used to evaluate each remedial alternative included practicability, risk, cost, and benefit. A summary of the evaluation for the remedial alternatives for groundwater as provided in the FS are presented below in Table 1.

Table 1 - Summary of Remedial Alternatives				
Alternative	**Practicability**	**Risk**	**Cost***	**Benefit**
Reference Remedy	• Highly Feasible • Reliable • Moderately Effective • Potential Duration (<30 Years)	• Moderately protective from risk	$7.3M	• Active remediation of areas with highest concentrations of PCE • Dilute downgradient plume • Continued monitoring of the PCE plume
Less Aggressive Remedy	• Highly Feasible • Moderately Reliable • Potentially Effective • Potential Duration (>30 Years)	• Likely protective from risk • Could result in the potential spread of the plume further downgradient	$5.4M	• Continued monitoring of the PCE plume
More Aggressive Remedy	• Moderately Feasible • Least Implementable • Highly Effective • Potentially Reliable • Potential Duration (<30 Years)	• Highly protective from risk	$7.4M	• Active remediation of areas with highest concentrations of PCE • Dilute downgradient plume • Continued monitoring of the PCE plume • Expected decrease in timing required for remediation

Notes:
< - Less Than **> - Greater Than**
$ - United States Dollar **M - Million**
*** - Includes costs associated with the implementation of contingencies.**

4.4 Proposed Remedy

The remedy proposed by the FS for the Site was the Reference Remedy. The Reference Remedy was proposed because it was found to be have the best combination of effectiveness, protectiveness, benefits, and cost-effectiveness. Furthermore, the Reference Remedy 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.

5.0 PROPOSED REMEDY AND ESTIMATED COST

The Reference Remedy proposed in the FS is the remedial alternative proposed in the PRAP. It should be noted that one primary element of the Reference Remedy, which proposed a transect of ozone sparge wells along Grand Canal (Figure 4), has been carried over as a contingency in the PRAP. This section presents a description of the Proposed Remedy and the associated estimated costs. Potential contingencies and associated costs are also presented and discussed.

5.1 Remedy Description

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

5.1.1 Proposed Remedial Action – Groundwater

ISCO

ISCO includes the injection of oxidizing agents directly into the subsurface to degrade contamination. These reagents increase the oxidation state of certain materials converting them from hazardous to non-hazardous or less toxic compounds. As part of the proposed remedy, an ISCO ozone sparge system will be installed within the compound of the former SVE system located at the Former Carnation/Former McKean's property. The ozone sparge system will be configured to provide groundwater treatment to a series of five injection wells, which were recently installed as part of a recently implemented ISCO ozone sparge pilot study. Conveyance piping will be installed in a shallow trench to support connection from injection wells to the ozone generator system (Figure 3).

The indicated injection well configuration would intercept the anticipated path of the plume along the ambient gradient towards the southwest. This remedy would treat groundwater with highest VOC concentrations near the Former Carnation/Former McKean's property, cut off the plume, and inhibit migration of PCE further downgradient, ultimately mitigating the elevated impacts near the former source, with natural attenuation mitigating the dilute impacts further downgradient. Ozone sparge operations are expected to last for a period of up to three years, with three additional years of post-ISCO injection MNA. ADEQ will oversee the operation of the ISCO injection and subsequent groundwater monitoring.

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.

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 to manage risk associated with the groundwater plume migration (i.e., wellhead treatment at an impacted water supply well).

The MNA program will be conducted at the Site for a period of at least six years. The program will include semi-annual groundwater monitoring of 19 existing monitor wells and semi-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. Up to four additional performance monitor wells will be installed and subsequently sampled as part of the MNA program. ADEQ will oversee the MNA program.

5.1.3 Proposed Contingencies

ISCO Contingencies

The ISCO ozone treatment system along the Grand Canal, which was included as part of the reference remedy in the FS, will be carried over as a contingency to the proposed remedy presented in the PRAP. Should data indicate that ISCO treatment in this area is warranted, a second ozone treatment system can be installed to accelerate remediation. The ozone sparge system will be configured to provide groundwater treatment to a series of six injection wells, as described in the FS and shown on Figure 4. Furthermore, hydrogen peroxide may be injected simultaneously with the ozone as a mist added to all ozone sparging wells if COC treatment response to ozone sparging in fine grained lithology is slow.

If persistent elevated PCE concentrations are measured farther downgradient from the Former Carnation/Former McKean's property, additional oxidant injection wells may be installed south of the Grand Canal, within City right of way, for injection of a liquid oxidant (e.g., catalyzed hydrogen peroxide, potassium persulfate, or potassium permanganate). This contingency injection, if implemented, will occur as a onetime application. Furthermore, if PCE concentrations

continue to be greater than the AWQS in the areas surrounding SRP, COP, or other production wells that have the potential to be impinged by COC impacts above the AWQS, additional ozone sparge injection wells and a mobile ozone sparge system can be installed near the extraction well to restore the surrounding groundwater quality.

MNA – Continued Monitoring

If COC concentrations continue to exceed AWQSs at the Site following six years of monitoring, then the MNA program can be extended for up to four additional years (total of up to 10 years of MNA). The duration of the MNA program will be determined based on results of periodic site reviews.

Wellhead Treatment

If SRP, COP, or other wells that have the potential to be impinged by COC impacts above the AWQS resume pumping before COC concentrations are below AWQS, then wellhead treatment using liquid phase granular activated carbon (LGAC) may be performed to allow groundwater usage. Wellhead treatment with LGAC would be installed at a production well if monitoring results indicate COC concentrations are greater than the AWQS and the well owner requires drinking water quality out of the production well. The treated groundwater would then be pumped into the distribution system. The cost of installing wellhead treatment at a production well is well specific and would be variable depending on the well location, well production rate, and the timing of bringing the well online. This contingency assumes that one production well pumping at a production rate of 2,000 gallons per minute (GPM) will need wellhead treatment for a period of 10 years.

SVE Maintenance

Vasose zone monitoring will be conducted as part of ISCO ozone system operation and maintenance. Existing SVE wells will be maintained on site for SVE if elevated ozone concentrations are detected in the vadose zone below the Former Carnation/Former McKean's property. If elevated ozone gas is measured, a system consisting of a 2-horsepower blower may be required to reduce the potential for the accumulation of ozone in the subsurface. This contingency assumes that the SVE blower will be connected to the existing vapor extraction well and conveyance piping, and that no additional wells will be required. This contingency assumes a maximum duration of up to three years of operation.

5.1.4 Performance Monitoring and Periodic Reviews

Performance monitoring and periodic reviews will be used to evaluate the effectiveness and adequacy of the remedy. The monitoring will include the following:

- **Groundwater Performance Monitoring** –Groundwater monitoring, in addition to MNA, will be conducted to evaluate the remedial effectiveness of ISCO as well as the progress of MNA at the Site. The performance monitoring will include up to 12 sampling events conducted at up to 19 wells during the implementation of ISCO.

- **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 least every three to five years.

5.2 Estimated Cost

The estimated cost of the Proposed Remedy, without contingencies, is $2.2 million. The estimated cost with contingencies is $11 million. A summary of the costs associated with the remedy is presented in Table 2 below.

Table 2 - Summary of Costs for Proposed Remedy	
Remedial Technology	**Cost**
Proposed Remedy	
Groundwater	
ISCO + MNA	$2,151,000
Contingencies	
Groundwater	
ISCO	$4,438,000
Wellhead Treatment	$3,782,000
MNA – Continued Monitoring	$527,000
SVE Maintenance	$56,000
TOTAL	**$10,954,000**
Note: costs assume 3% annual inflation rate over the duration of the remedy.	

Detailed cost breakdowns are presented in Appendix A.

5.3 Duration

The overall duration of the proposed remedy is at least six years. The duration is the estimated number of years required for the primary elements of the proposed remedy to achieve the ROs. If periodic Site reviews indicate additional time is be needed to achieve the ROs, contingencies for the proposed remedy may be implemented.

6.0 CONSIDERATION OF REMEDIATION GOALS AND SELECTION FACTORS

This section presents how the remediation goals and selection factors outlined in A.R.S. §49-282.06 were considered for the proposed remedy.

6.1 Rationale for Selection of the Remedy

The proposed remedy includes source control, containment, and monitoring of the contamination. The proposed remedy provides the best combination of remedial effectiveness, practicability, cost, and benefit for the restoration and use of the groundwater resource. There are currently no unmitigated human health risks associated with the contamination at the Site and the components of the proposed remedy will be protective of the public health and the environment.

Each component of the proposed remedy and contingencies are proven, reliable remedial alternatives that will be protective of the public health and the environment. The risk to human health and the environment with this remedy is low and all known exposure pathways have been addressed. Over time, the remedial actions will reduce the concentrations and the volume of contaminated groundwater at the Site. Environmental sampling and groundwater monitoring are included to verify that the remedy is protective of public health and the environment during and after remedy implementation. The combined components of the proposed remedy are consistent and compatible with current and anticipated future land and resource use. Upon implementation, this remedy is considered to have a positive impact in terms of enhancement of future land uses and impacts on the local economy.

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 for groundwater will achieve ROs for groundwater use by treating the source of contamination with ISCO and MNA to remediate the groundwater plume. The proposed remedy will clean up the groundwater to levels that are less than the AWQS. Environmental and performance monitoring will be used to confirm the groundwater ROs are being met.

6.3 Achievement of Remedial Action Criteria

A.R.S. § 49-282.06 requires that remedial actions shall:

- Assure the protection of public health and welfare and the environment.

- 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.
- Be reasonable, necessary, cost-effective, and technically feasible.

As demonstrated in this PRAP, the proposed remedies and contingencies for the Site meet the requirements of A.R.S. §49-282.06. The proposed remedies protective of human health and the environment, compliant with applicable laws, and allow 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.

6.4 Consistency with Water Management Plans

The proposed remedy and contingencies are consistent with the water management plans of local water providers and will protect water quality. The remedies will allow for the maximum beneficial use of the waters of the State, protect the groundwater supply for future use, and monitor that wider areas are not impacted for future water development options.

6.5 Consistency with General Land Use Planning

The proposed remedy and contingencies are consistent with the current land use and are not anticipated to negatively impact current or future land use at the Site.

6.6 Lead Agency Statement for Proposed Remedy

Based on the information currently available, ADEQ believes the proposed remedy and contingencies provide the best balance of tradeoffs among the other alternatives with respect to the comparison criteria. ADEQ expects the proposed remedies and contingencies 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 remedies at the Site include the following:

- **The duration of time required to remediate the groundwater at the Site.** The estimated duration for remedial efforts to achieve ROs is based on professional judgement and data available at the time of the PRAP. Predictive modeling can be performed as part of MNA implementation, if determined to be beneficial.

6.8 Public Comment Period

The PRAP will be issued for a 90-day public comment period. A Community Advisory Board 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:

Arizona Department of Environmental Quality
Attention: Mikel Morales, Project Manager
1110 West Washington Street
Phoenix, Arizona 85007
Email: Morales.Mikel@azdeq.gov

7.0 REFERENCES

ADEQ, 2019. Remedial Objectives Report, ECP 24th Street and Grand Canal WQARF Site, Phoenix, Arizona. 2 May.

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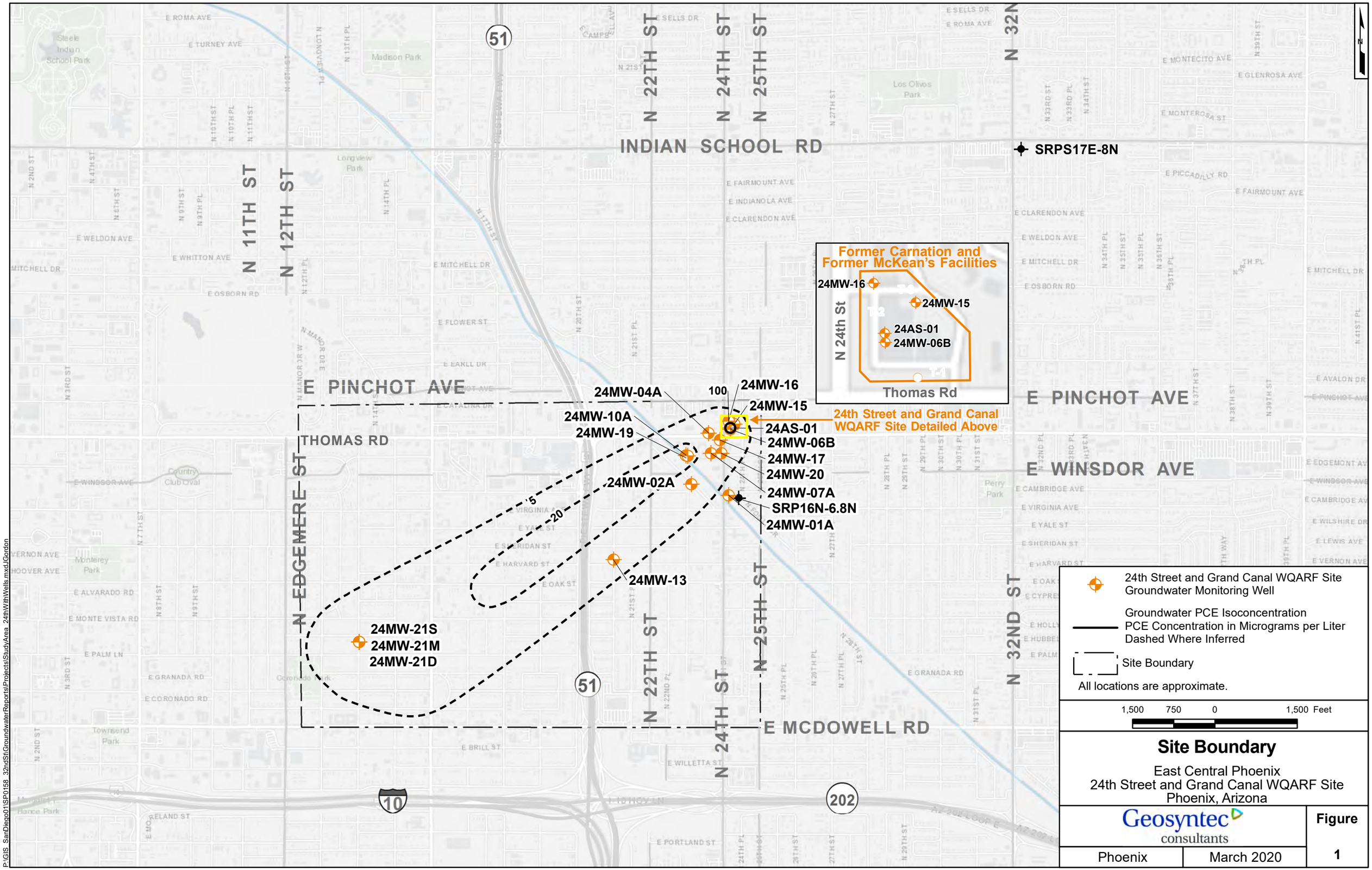
FIGURES


INDIAN SCHOOL RD
N 11TH ST
N 12TH ST
N 22TH ST
N 24TH ST
N 25TH ST
N 32ND ST
E PINCHOT AVE
THOMAS RD
N EDGEMERE ST
E WINSDOR AVE
E MCDOWELL RD
SRPS17E-8N
Former Carnation and Former McKean's Facilities
24MW-16
24MW-15
24AS-01
24MW-06B
N 24th St
Thomas Rd
24th Street and Grand Canal WQARF Site Detailed Above
24MW-04A
100
24MW-16
24MW-15
24MW-10A
24MW-19
24AS-01
24MW-06B
24MW-17
24MW-20
24MW-02A
24MW-07A
SRP16N-6.8N
24MW-01A
5
20
24MW-13
24MW-21S
24MW-21M
24MW-21D
24th Street and Grand Canal WQARF Site Groundwater Monitoring Well
Groundwater PCE Isoconcentration
PCE Concentration in Micrograms per Liter
Dashed Where Inferred
Site Boundary
All locations are approximate.
1,500 750 0 1,500 Feet
Site Boundary
East Central Phoenix
24th Street and Grand Canal WQARF Site
Phoenix, Arizona
Geosyntec consultants
Figure
1
Phoenix
March 2020
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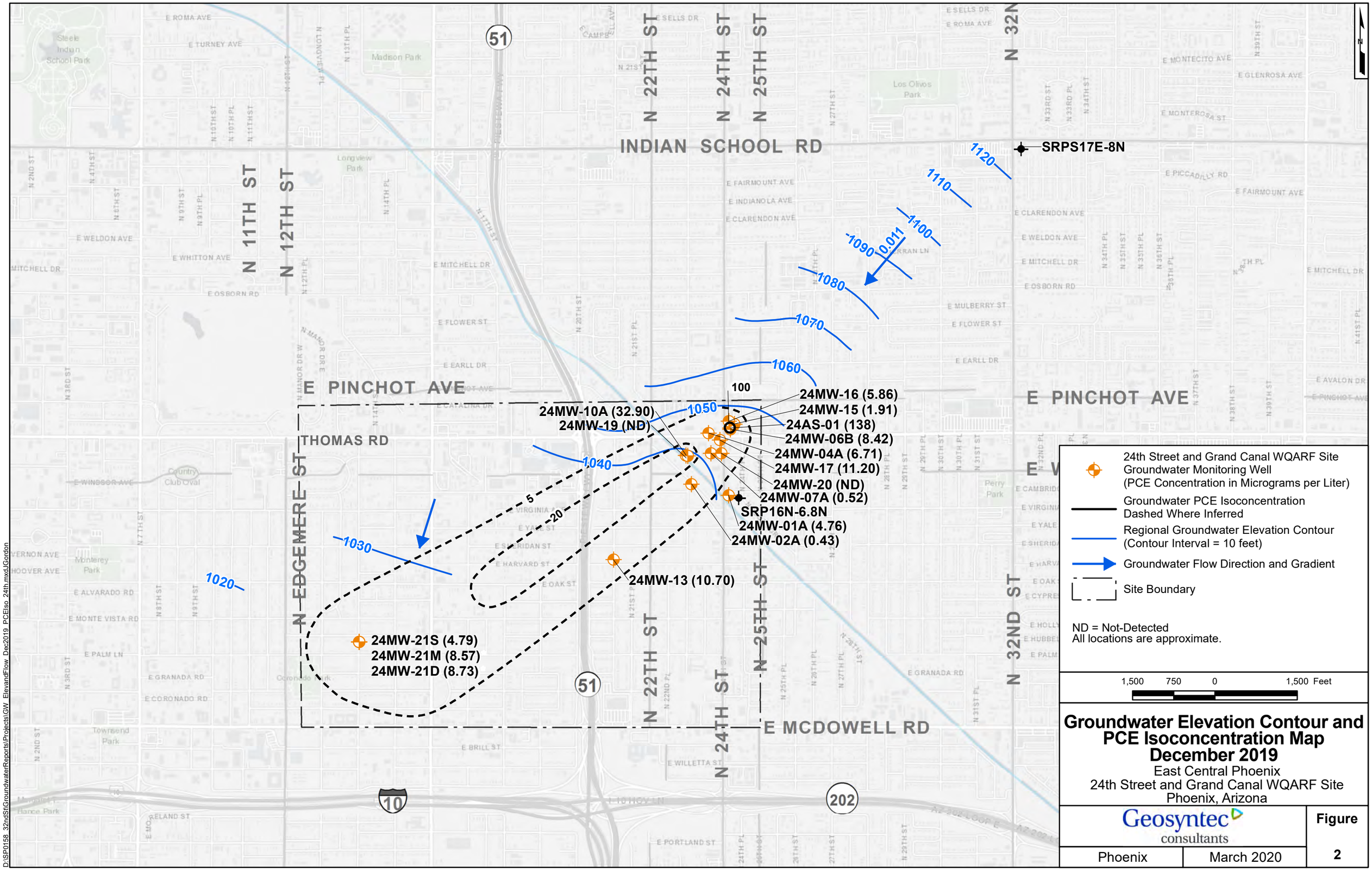

Groundwater Elevation Contour and PCE Isoconcentration Map December 2019

East Central Phoenix
24th Street and Grand Canal WQARF Site
Phoenix, Arizona

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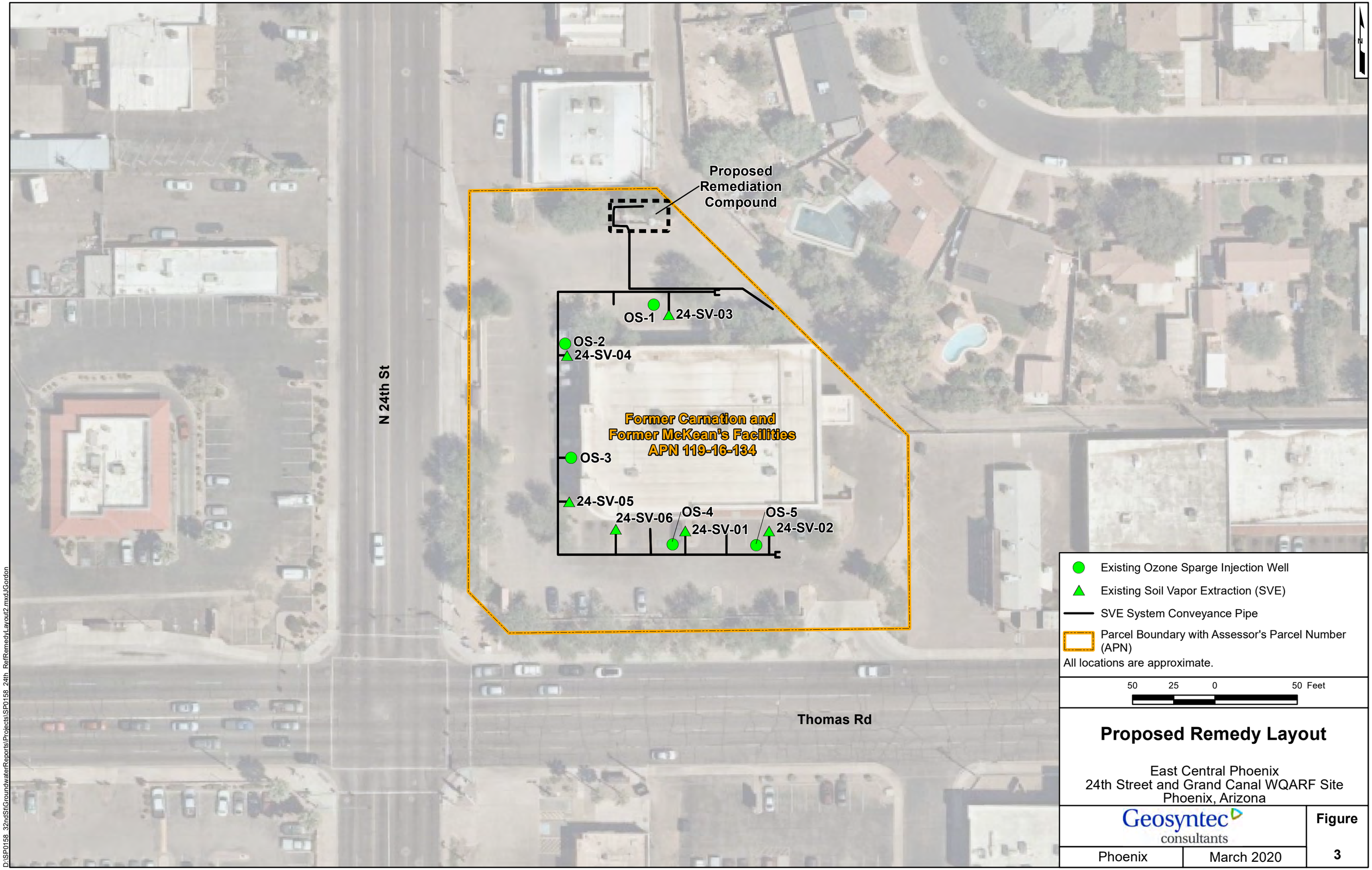
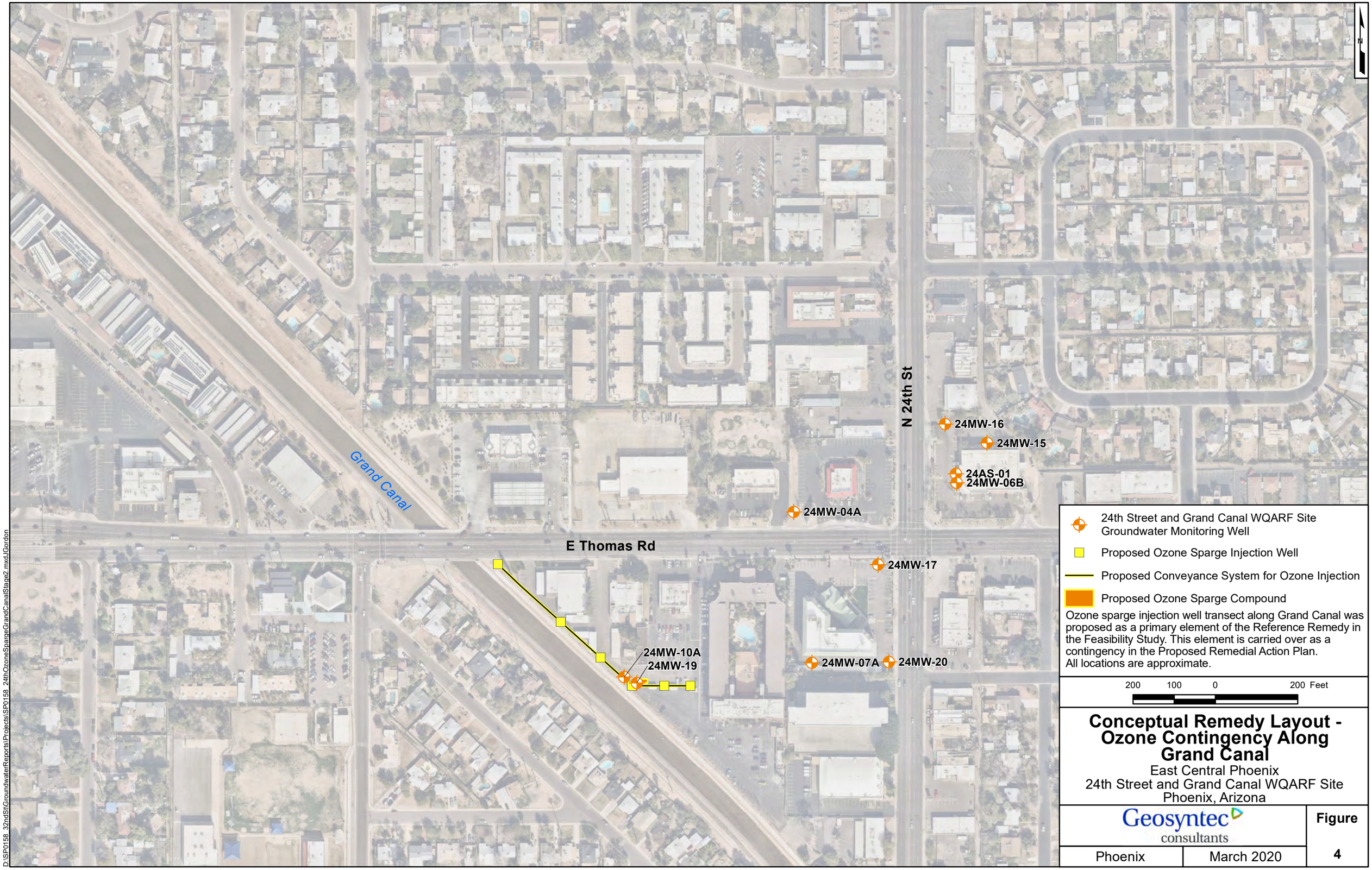

Proposed
Remediation
Compound
OS-1
24-SV-03
OS-2
24-SV-04
Former Carnation and
Former McKean's Facilities
APN 119-16-134
OS-3
24-SV-05
24-SV-06
OS-4
24-SV-01
OS-5
24-SV-02
N 24th St
Thomas Rd
Existing Ozone Sparge Injection Well
Existing Soil Vapor Extraction (SVE)
SVE System Conveyance Pipe
Parcel Boundary with Assessor's Parcel Number (APN)
All locations are approximate.
50 25 0 50 Feet
Proposed Remedy Layout
East Central Phoenix
24th Street and Grand Canal WQARF Site
Phoenix, Arizona
Geosyntec consultants
Figure
Phoenix
March 2020
3
D:\SP0158_32ndSt\GroundwaterReports\Projects\SP0158_24th_RefRemedyLayout2.mxd\Gordon


N 24th St
E Thomas Rd
Grand Canal
24MW-16
24MW-15
24AS-01
24MW-06B
24MW-04A
24MW-17
24MW-10A
24MW-19
24MW-07A
24MW-20
24th Street and Grand Canal WQARF Site Groundwater Monitoring Well
Proposed Ozone Sparge Injection Well
Proposed Conveyance System for Ozone Injection
Proposed Ozone Sparge Compound
Ozone sparge injection well transect along Grand Canal was proposed as a primary element of the Reference Remedy in the Feasibility Study. This element is carried over as a contingency in the Proposed Remedial Action Plan.
All locations are approximate.
200 100 0 200 Feet
Conceptual Remedy Layout - Ozone Contingency Along Grand Canal
East Central Phoenix
24th Street and Grand Canal WQARF Site
Phoenix, Arizona
Geosyntec consultants
Figure
Phoenix
March 2020
4
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APPENDIX A – Detailed Cost Summary

Table A-1
In-Situ Chemical Oxidation Cost Summary
Proposed Remedial Action Plan
East Central Phoenix - 24th Street and Grand Canal WQARF Site
Phoenix, Arizona
March 2020

Description	Quantity	Unit	Unit Cost	Subtotal
ISCO Capital Costs				
Ozone Sparging System Design	1	LS	$30,000	$30,000
Ozone Injection Well Installations				
Installation & Oversight*	0	EA	$70,000	$0
Vertical Profiling, Surveying, Permitting, & IDW Disposal*	0	LS	$40,000	$0
Ozone Sparging System Installations				
Ozone Generator (Including Conex Box & Telemetry)	1	EA	$200,000	$200,000
Earthwork, Trenching, & Pipe Installation*	0	LF	$150	$0
Asphalt Repair*	0	LF	$60	$0
Related Appurtenances, Equipment, & Repairs	1	LS	$30,000	$30,000
Downgradient Performance Well Installation				
Triple-Nested Monitoring Well Installation & Oversight	4	EA	$100,000	$400,000
Vertical Profiling, Surveying, Permitting, IDW Disposal, & Tech Memo	1	LS	$50,000	$50,000
Capital Project Oversight	-	-	15%	$106,500
Capital Costs Subtotal (Pre-Inflation)				***$817,000***
ISCO System Annual OMM Costs - Years 1-3				
Ozone Sparging System Operation & Maintenance	1	YR	$100,000	$100,000
Semiannual Groundwater Monitoring & Reporting	2	EA	$40,000	$80,000
Annual Reporting	1	YR	$15,000	$15,000
Sampling & Field Supplies	1	YR	$6,000	$6,000
Equipment Repairs & Maintenance (As Needed)	1	YR	$10,000	$10,000
Annual OMM Subtotal (Pre-Inflation)				***$211,000***
Post ISCO System OMM Annual Groundwater Monitoring Costs - Years 4-6				
Semiannual Groundwater Monitoring & Reporting	2	EA	$40,000	$80,000
Annual Reporting	1	YR	$15,000	$15,000
Annual OMM Subtotal (Pre-Inflation)				***$95,000***
Site Decommissioning and Project Closeout - Year 7				
Decommissioning of ISCO System and Associated Infrastructure	1	LS	$150,000	$150,000
Decommissioning of Monitoring Well Network	1	LS	$100,000	$100,000
Annual Subtotal (Pre-Inflation)				***$250,000***
Total Annual Cost (With 3% Inflation per Year)				**Subtotal**
Year 1				$1,058,800
Year 2				$223,800
Year 3				$230,600
Year 4				$106,900
Year 5				$110,100
Year 6				$113,400
Year 7				$307,500
Total 7 Year ISCO Treatment Costs (With 3% Inflation per Year)				***$2,151,000***

Notes and Assumptions:

EA - Each
IDW - Investigation derived waste
ISCO - In-situ chemical oxidation
LF - Linear feet
LS - Lump sum
OMM - Operation, maintenance, and monitoring
YR - Year
WQARF - Water Quality Assurance Revolving Fund
Inflation Rate = 3% per year
* - Installed or performed as part of a pilot study implemented in February 2020

Table A-2
In-Situ Chemical Oxidation Contingency Cost Summary
Proposed Remedial Action Plan
East Central Phoenix - 24th Street and Grand Canal WQARF Site
Phoenix, Arizona
March 2020

Description	Quantity	Unit	Unit Cost	Subtotal
ISCO Capital Costs				
Ozone Sparging System Design	1	LS	$100,000	$100,000
Ozone Injection Well Installations				
Installation & Oversight*	6	EA	$70,000	$420,000
Vertical Profiling, Surveying, Permitting, & IDW Disposal*	1	LS	$40,000	$40,000
Ozone Sparging System Installations				
Ozone Generator (Including Conex Box & Telemetry)	1	EA	$200,000	$200,000
Earthwork, Trenching, & Pipe Installation*	1,400	LF	$150	$210,000
Asphalt Repair*	1,400	LF	$60	$84,000
Related Appurtenances, Equipment, & Repairs	1	LS	$30,000	$30,000
Capital Project Oversight	-	-	15%	$162,600
Capital Costs Subtotal (Pre-Inflation)				***$1,247,000***
ISCO System Annual OMM Costs - Years 1-3				
Ozone Sparging System Operation & Maintenance	1	YR	$100,000	$100,000
Semiannual Groundwater Monitoring & Reporting	2	EA	$40,000	$80,000
Annual Reporting	1	YR	$15,000	$15,000
Sampling & Field Supplies	1	YR	$6,000	$6,000
Equipment Repairs & Maintenance (As Needed)	1	YR	$10,000	$10,000
Annual OMM Subtotal (Pre-Inflation)				***$211,000***
Post ISCO System OMM Annual Groundwater Monitoring Costs - Years 4-6				
Semiannual Groundwater Monitoring & Additional Reporting	2	EA	$5,000	$10,000
Additional Annual Reporting	1	YR	$2,000	$2,000
Annual OMM Subtotal (Pre-Inflation)				***$12,000***
Site Decommissioning and Project Closeout - Year 7				
Decommissioning of ISCO System and Associated Infrastructure	1	LS	$150,000	$150,000
Annual OMM Subtotal (Pre-Inflation)				***$150,000***
Total Annual Cost (With 3% Inflation per Year)				**Subtotal**
Year 1				$1,501,700
Year 2				$223,800
Year 3				$230,600
Year 4				$13,500
Year 5				$13,900
Year 6				$14,300
Year 7				$184,500
Total 7 Year ISCO Treatment Costs (With 3% Inflation per Year)				***$2,182,000***

Notes and Assumptions:

EA - Each
IDW - Investigation derived waste
LF - Linear feet
LS - Lump sum
OMM - Operation, maintenance, and monitoring
YR - Year
WQARF - Water Quality Assurance Revolving Fund
Inflation Rate = 3% per year

Table A-3
Extended Groundwater Monitoring Contingency Cost Summary
Proposed Remedial Action Plan
East Central Phoenix - 24th Street and Grand Canal WQARF Site
Phoenix, Arizona
March 2020

Description	Quantity	Unit	Unit Cost	Subtotal
Extended Post ISCO System OMM Annual Groundwater Monitoring Costs - Years 7-10				
Semiannual Groundwater Monitoring & Reporting	2	EA	$40,000	$80,000
Annual Report	1	YR	$15,000	$15,000
Annual OMM Subtotal (Pre-Inflation)				***$95,000***
Site Decommissioning and Project Closeout - Year 11				
Decommissioning of ISCO System and Associated Infrastructure	1	LS	$150,000	$150,000
Decommissioning of Monitoring Well Network	1	LS	$100,000	$100,000
Annual Subtotal (Pre-Inflation)				***$250,000***
Total Annual Cost (With 3% Inflation per Year)				**Subtotal**
Year 1				$0
Year 2				$0
Year 3				$0
Year 4				$0
Year 5				$0
Year 6				$0
Year 7				$116,838
Year 8				$120,343
Year 9				$123,953
Year 10				$127,672
Year 11				$38,558
Total 11 Year Extended Groundwater Monitoring Costs (With 3% Inflation per Year)				***$527,000***

Notes and Assumptions:

EA - Each
LS - Lump sum
ISCO - In-situ chemical oxidation
OMM - Operation, monitoring, and maintenance
YR - Year
WQARF - Water Quality Assurance Revolving Fund
Inflation Rate = 3% per year

Table A-4
Soil Vapor Extraction Contingency Cost Summary
Proposed Remedial Action Plan
East Central Phoenix - 24th Street and Grand Canal WQARF Site
Phoenix, Arizona
March 2020

Description	Quantity	Unit	Unit Cost	Subtotal
SVE Capital Costs				
One 2-horsepower Blower Purchase & Installation	1	LS	$10,000	$10,000
Ozone Injection Well Installations	1	LS	$10,000	$10,000
Installation & Oversight*	-	-	15%	$3,000
Vertical Profiling, Surveying, Permitting, & IDW Disposal*				***$23,000***
Ozone Sparging System Installations				
SVE Annual OMM Costs (2-horsepower blower system) - Years 1-3				
Earthwork, Trenching, & Pipe Installation*	1	LS	$5,000	$5,000
Asphalt Repair*	1	YR	$5,000	$5,000
Electrical Consumption & Carbon Disposal	1	YR	$5,000	$5,000
Annual Costs Subtotal (Pre-Inflation)				***$10,000***
Total Annual Cost (With 3% Inflation per Year)				**Subtotal**
Year 1				$34,000
Year 2				$10,600
Year 3				$10,900
Total SVE Costs (With 3% Inflation per Year)				***$56,000***

Notes and Assumptions:

LS - Lump sum
OMM - Operation, monitoring, and maintenance
SVE - Soil vapor extraction
VGAC - Vapor phase granular activated carbon
WQARF - Water Quality Assurance Revolving Fund
Inflation Rate = 3% per year

Table A-5
Hydrogen Peroxide Injection at CVS Contingency Cost Summary
Proposed Remedial Action Plan
East Central Phoenix - 24th Street and Grand Canal WQARF Site
Phoenix, Arizona
March 2020

Description	Quantity	Unit	Unit Cost	Subtotal
Hydrogen Peroxide Injection Capital Costs				
Hydrogen Peroxide Injection Remedy Design	1	EA	$30,000	$30,000
Ozone Injection Well Installations	1	LS	$20,000	$20,000
Installation & Oversight*	-	-	15%	$7,500
Vertical Profiling, Surveying, Permitting, & IDW Disposal*				***$58,000***
Ozone Sparging System Installations				
Hydrogen Peroxide Injection Annual OMM Costs				
Earthwork, Trenching, & Pipe Installation*	1	YR	$3,300	$3,300
Asphalt Repair*	1	LS	$80,000	$80,000
Annual OMM Subtotal (Pre-Inflation)				***$83,300***
Total Annual Cost (With 3% Inflation per Year)				**Subtotal**
Year 1				$145,500
Year 2				$88,400
Year 3				$91,000
Total Hydrogen Peroxide Injection Costs (With 3% Inflation per Year)				***$325,000***

Notes and Assumptions:

EA - Each
LS - Lump sum
OMM - Operation, monitoring, and maintenance
WQARF - Water Quality Assurance Revolving Fund
Inflation Rate = 3% per year

Table A-6
In-Situ Chemical Oxidation Downgradient of Grand Canal Contingency Cost Summary
Proposed Remedial Action Plan
East Central Phoenix - 24th Street and Grand Canal WQARF Site
Phoenix, Arizona
March 2020

Description	Quantity	Unit	Unit Cost	Subtotal
ISCO Capital Costs				
ISCO System Remedy Design	1	LS	$50,000	$50,000
Ozone Injection Well Installations	7	EA	$50,000	$350,000
Installation & Oversight*	1	LS	$10,000	$10,000
Vertical Profiling, Surveying, Permitting, & IDW Disposal*	200	LF	$50	$10,000
Ozone Sparging System Installations	1	LS	$30,000	$30,000
ISCO Injection & Oversight	1	LS	$100,000	$100,000
Earthwork, Trenching, & Pipe Installation*	-	-	15%	$82,500
Asphalt Repair*				***$633,000***
Total Annual Cost (With 3% Inflation per Year)				**Subtotal**
Year 1				$652,000
Total ISCO Treatment Downgradient of Grand Canal Costs (With 3% Inflation per Year)				***$652,000***

Notes and Assumptions:

IDW - Investigation derived waste
ISCO - In-situ chemical oxidation
LF - Linear feet
LS - Lump sum
Inflation Rate = 3% per year

Table A-7
Well Protection Ozone Sparge Injection Wells Installation Contingency Cost Summary
Proposed Remedial Action Plan
East Central Phoenix - 24th Street and Grand Canal WQARF Site
Phoenix, Arizona
March 2020

Description	Quantity	Unit	Unit Cost	Subtotal
SRP Protection Capital Costs				
Ozone Sparging System Design	1	LS	$50,000	$50,000
Ozone Injection Well Installations				
Installation & Oversight*	2	EA	$85,000	$170,000
Vertical Profiling, Surveying, Permitting, & IDW Disposal*	1	LS	$20,000	$20,000
Ozone Sparging System Installations				
Ozone Generator (Including Conex Box & Telemetry)	1	LS	$50,000	$50,000
Earthwork, Trenching, & Pipe Installation*	100	LF	$150	$15,000
Asphalt Repair*	100	LF	$60	$6,000
Related Appurtenances, Equipment, & Repairs	1	LS	$10,000	$10,000
Capital Project Oversight	-	-	15%	$127,700
Capital Costs Subtotal (Pre-Inflation)				***$979,000***
SRP Protection Ozone Sparging Annual OMM Costs - Years 1-3				
Ozone Sparging System Operation & Maintenance	1	YR	$20,000	$20,000
Reporting	1	YR	$5,000	$5,000
Sampling & Field Supplies	1	YR	$2,000	$2,000
Equipment Repairs & Maintenance (As Needed)	1	YR	$20,000	$20,000
Annual OMM Subtotal (Pre-Inflation)				***$47,000***
SRP Protection Sampling Costs - Years 4-6				
Production Well Sampling	12	MO	$1,000	$12,000
Annual Reporting	1	YR	$5,000	$5,000
Annual OMM Subtotal (Pre-Inflation)				***$17,000***
Site Decommissioning and Project Closeout - Year 7				
Decommissioning of ISCO System and Associated Infrastructure	1	LS	$50,000	$50,000
Annual Subtotal (Pre-Inflation)				***$50,000***
Total Annual Cost (With 3% Inflation per Year)				**Subtotal**
Year 1				$1,056,800
Year 2				$49,900
Year 3				$51,400
Year 4				$19,100
Year 5				$19,700
Year 6				$20,300
Year 7				$61,500
Total 7 Year Stage 1 In-Situ Chemical OxidationTreatment Costs (With 3% Inflation per Year)				***$1,279,000***

FASA - Fairmont Avenue Study Area
ISCO - In-situ chemical oxidation
LGAG - Liquid phase granular activated carbon
OMM - Operation, maintenance, and monitoring
SVE - Soil vapor extraction
VGAC - Vapor phase granular activated carbon
VGAC - Vapor phase granular activated carbon
WQARF - Water Quality Assurance Revolving Fund
YR - Year
Inflation Rate = 3% per year

Table A-8
Wellhead Treatment Contingency Cost Summary
Proposed Remedial Action Plan
East Central Phoenix - 24th Street and Grand Canal WQARF Site
Phoenix, Arizona
March 2020

Description	Quantity	Unit	Unit Cost	Subtotal
Wellhead Treatment Capital Costs				
Treatment Compound Construction - Foundation, Fencing, Controls, Etc.	1	LS	$500,000	$500,000
Ozone Injection Well Installations	1	LS	$985,000	$985,000
Installation & Oversight*	1	LS	$30,000	$30,000
Vertical Profiling, Surveying, Permitting, & IDW Disposal*	1	LS	$35,000	$35,000
Asphalt Repair*	-	-	15%	$232,500
Capital Costs Subtotal (Pre-Inflation)				***$1,783,000***
Wellhead Treatment Annual OMM Costs - Years 1-10				
Equipment Repairs & Maintenance (As Needed)	1	YR	$3,300	$3,300
Operation, Monitoring, & Maintenance	1	YR	$150,000	$150,000
Annual OMM Subtotal (Pre-Inflation)				***$153,000***
Site Decommissioning and Project Closeout - Year 11				
Decommissioning of Treatment System and Associated Infrastructure	1	LS	$100,000	$100,000
Annual Subtotal (Pre-Inflation)				***$100,000***
Total Annual Cost (With 3% Inflation per Year)				**Subtotal**
Year 1				$1,994,100
Year 2				$162,300
Year 3				$167,200
Year 4				$172,200
Year 5				$177,400
Year 6				$182,700
Year 7				$188,200
Year 8				$193,800
Year 9				$199,600
Year 10				$205,600
Year 11				$138,400
Total Wellhead Treatment Costs (With 3% Inflation per Year)				***$3,782,000***

Notes and Assumptions:

gpm - Gallons per minute
IDW - Investigation derived waste
LGAC - Liquid phase granular activated carbon
LS - Lump sum
OMM - Operation, maintenance, and monitoring
YR - Year
WQARF - Water Quality Assurance Revolving Fund
Inflation Rate = 3% per year