

**FEASIBILITY STUDY WORK PLAN
LAKE HAVASU AVENUE AND HOLLY AVENUE
WQARF REGISTRY SITE
LAKE HAVASU CITY, ARIZONA**



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FIGURES

Figure 1. Site Location

LIST OF ABBREVIATIONS & ACRONYMS

A.A.C.	Arizona Administrative Code
ADEQ	Arizona Department of Environmental Quality
amsl	above mean sea level
A.R.S.	Arizona Revised Statutes
AWQS	Aquifer Water Quality Standard
COCs	Contaminants of Concern
Cr(VI)	Chromium, hexavalent
FS	Feasibility Study
GPL	Groundwater Protection Limit
PCE	Tetrachloroethene
RO	Remedial Objectives
RI	Remedial Investigation
SRL	Soil Remediation Level
TCE	Trichloroethene
VOCs	Volatile Organic Compounds
WP	Work Plan
WQARF	Water Quality Assurance Revolving Fund

1.0 INTRODUCTION

1.1 Purpose

This Work Plan (WP) presents the methodology that will be followed for completion of the feasibility study (FS) for the Lake Havasu Avenue and Holly Avenue Water Quality Assurance Revolving Fund (WQARF) site (the site) in Lake Havasu City, Arizona. This work plan is required as part of the FS process, pursuant to Arizona Administrative Code (A.A.C.) R18-16-407(B).

The purpose of the FS is to develop and evaluate a reference remedy and alternative remedies that are capable of achieving the site's Remedial Objectives (ROs). An FS report will be developed that relies on data and information from the Remedial Investigation (RI), and further work that may be conducted during the FS, and will evaluate the reference remedy and at least two alternative remedies, to ensure that each remedy meets the following in accordance with A.A.C. R18-16-407(H):

- Achieves the ROs;
- Is consistent with water management plans and general land use plans; and
- Is evaluated with comparison criteria including practicability, risk, cost, and benefit.

One of the alternative remedies will be less aggressive than the reference remedy and one will be more aggressive as required by A.A.C. R18-16-407(E).

In accordance with A.A.C. R18-16-407(I), based on the evaluation of the reference remedy and the alternative remedies, the proposed remedy will be developed and described in the FS report. The FS report shall describe the reasons for selecting the remedy including all of the following:

- How the proposed remedy will achieve the ROs;
- How the comparison criteria were considered; and
- How the proposed remedy meets the requirements of Arizona Revised Statutes (A.R.S.) §49-282.06.

1.2 Site Description

The site is located in the area bounded approximately to the north by Centers Avenue, to the south by Holly Avenue, to the east by San Juan Drive and to the west by London Bridge Avenue (Figure 1).

The purpose of the RI was to determine the nature and extent of contamination at the site. The RI also identified present and reasonably foreseeable uses of land and waters of the state that have been or are threatened to be impacted by the contamination. Based upon the data collected, the following represents the interpretations and conclusions reached as a result of the RI.

From 1972 to 1998, the former McCulloch facility was situated on approximately 30 acres of commercial property located approximately one mile east of Lake Havasu. The McCulloch facility manufactured small gasoline-powered equipment. Manufacturing activities included machining, die casting, metal finishing, and chrome plating. Chemicals used at the facility included chromium, acids and bases, cyanide compounds, oxidizers, adhesives, phenolic surfactants, and a variety of solvents. Some of the facility waste stream was discharged into the former Kiowa Ponds.

The results of the site investigations indicate that soil, soil gas, and groundwater have been impacted at the site. The contaminants of concern (COCs) identified at the site are the chlorinated volatile organic compounds (VOCs) tetrachloroethene (PCE), trichloroethene (TCE), and their degradation products, nitrate, and chromium.

Various limited early remedial actions have been implemented at the former McCulloch Facility, including excavation and in-situ treatment of vadose zone soil with calcium polysulfide in an attempt to address vadose zone impacts of hexavalent chromium (Cr[VI]) beneath the former plating shop. However, data collected during the RI indicate that COCs are still present in the vadose zone in this area at concentrations that exceed regulatory standards. The analytical results from Site soil samples indicate that total chromium and Cr(VI) are present in the vadose zone at concentrations exceeding the Arizona Soil Remediation Levels (SRLs) and/or the Groundwater Protection Level (GPL) in the area of the former plating facility. Additionally, VOCs (primarily PCE and TCE) have been detected in soil gas at concentrations that exceed the United States Environmental Protection Agency Regional Screening Level for commercial worker ambient air, assuming a conservative 0.03 slab attenuation factor.

Soil removals were also historically conducted at the former Kiowa Ponds. Data collected during the period of the RI by Lake Havasu City demonstrated there are currently no COCs in soils over regulatory limits in the vicinity of the former Kiowa Ponds.

COCs in the source area have migrated vertically through interbedded vadose zone sand, gravelly sand, silty sand, and minor layers of fine-grained materials. The COCs have encountered groundwater and are migrating in a westerly flow direction. The current multi-phase groundwater plume boundary is shown on Figure 1. Chromium, nitrate, PCE and TCE are consistently detected above Aquifer Water Quality Standards (AWQS). There are background nitrate detections in the groundwater in the area of the site; however, nitrate concentrations at the site are elevated over these background levels.

Groundwater elevations at the Site have ranged from approximately 454 feet above mean sea level (amsl) to approximately 465 feet amsl. The direction of groundwater flow within the Site is to the west with a hydraulic gradient of approximately 0.004 feet per foot in 2019. Groundwater elevations are currently elevated at the Site when compared to historical data.

Land use in the area around the facility consists of a mix of residential, commercial/industrial, recreation/resort, and undeveloped uses. Lake Havasu is approximately one mile to the west of the site; however at this time the lake is not considered threatened. Groundwater approximately 0.75 miles to the west of the site is used as a backup supply for Lake Havasu City when their main collector well located south of the area of the Site is undergoing maintenance.

2.0 FEASIBILITY STUDY TASKS

This section discusses the tasks associated with the development of the FS report. The FS tasks will be performed in order to meet the requirements of A.A.C. R18-16-407. The FS process considers the data gathered during the RI and further work that may be conducted during the FS and;

- Considers the ROs;
- Includes the identification of potential treatment and containment technologies that satisfy the ROs;
- Includes remedial technology screening;
- Includes the development and analysis of remediation alternatives and technologies; and
- Includes a comparison of the remedies and proposes a remedy.

2.1 Remedial Objectives

The ROs developed as part of the RI process, pursuant to A.A.C. R18-16-406 (I), were based on field investigation results, the land and water use surveys, the screening level risk evaluation, and Arizona Department of Environmental Quality (ADEQ) input, and input from the community during the draft RO Report public comment period. ROs are used during remedial alternatives development to identify appropriate remedial technologies.

2.2 Development and Screening of Remedial Measures

Remedial measures are remediation technologies or methodologies, and are screened based on anticipated removal or reduction of contaminants at a site and the ability to achieve the ROs. The FS evaluation will look at future risk under reasonably foreseeable uses of the source facility and surrounding properties. Typically, appropriate remediation alternatives and technologies are screened using the following criteria:

- Compatibility with current and reasonably foreseeable land use,
- COC treatment effectiveness,
- Regulatory requirements,
- Constructability,
- Operation and maintenance requirements,
- Health and safety considerations,
- Generation and management of waste products,
- Flexibility/expandability, and
- Cost.

Selected remedial measures will then be assembled with selected strategies to develop the reference remedy and alternative remedies. The remedial strategies to be developed, consistent with A.A.C. R18-16-407 (F), are listed below. Source control shall be considered as an element of the reference remedy and all alternative remedies, if applicable, except for the monitoring and no action strategies. A strategy may incorporate more than one remedial measure.

- Plume remediation;
- Physical containment;
- Controlled migration;
- Source control;
- Monitoring; and,
- No action alternative.

2.3 Development of Reference Remedy and Alternative Remedies

Based upon the retained remedial measures and strategies, a reference remedy and two alternative remedies will be developed as described in A.A.C. R18-16-407(E). The combination of the remedial strategy and the remedial measures for each alternative remedy shall achieve the ROs. The reference remedy and any alternative remedy also may include contingent remedial strategies or remedial measures to address reasonable uncertainties regarding the achievement of ROs or uncertain time-frames in which ROs will be achieved. The reference remedy and alternative remedies will be described in the FS report in sufficient detail to allow evaluation using the comparison criteria, but plans at construction level details are not required at this time. Where appropriate, the reference remedy and an alternative remedies may incorporate different strategies for different aquifers, or portions of aquifers.

The reference remedy shall be developed based upon best engineering, geological, or hydrogeological judgment following engineering, geological, or hydrogeological standards of practice, considering the following:

- The information in the RI;
- The best available scientific information concerning available remedial technologies;
- Preliminary analysis of the comparison criteria and the ability of the reference remedy to comply with A.R.S. §49-282.06.

At a minimum, at least two alternative remedies shall be developed for comparison with the reference remedy. At least one of the alternative remedies must employ a remedial strategy or combination of strategies that is more aggressive than the reference remedy, and at least one of the alternative remedies must employ a remedial strategy or combination of strategies that is less

aggressive than the reference remedy. A more aggressive strategy is a strategy that requires fewer remedial measures to achieve the ROs; a strategy that achieves the ROs in a shorter period of time; or a strategy that is more certain in the long term and requires fewer contingencies.

In accordance A.A.C. R18-16-407(G), in identifying remedial measures, the needs of the well owners and the water providers and their customers will be considered, including quantity and quality of water, water rights, and other legal constraints on water supplies, reliability of water suppliers and any operational implications. Such remedial measures may include, but will not be limited to, well replacement, well modification, water treatment, provision of replacement water supplies and engineering controls. Where remedial measures are relied upon to achieve ROs, such remedial measures will remain in effect as long as required to ensure the continued achievement of those objectives.

A comparative evaluation of the reference remedy and the alternative remedies developed will be conducted. In accordance with A.A.C.18-16-407(H), each remedy will be evaluated using the following:

- A demonstration that the remedial alternative will achieve the ROs.
- An evaluation of consistency with the water management plans of the affected water providers and the general land use plans of the local governments with land use jurisdiction.
- An evaluation of the comparison criteria, including:
 - a. practicability of the alternative;
 - b. an evaluation of risk, including the overall protectiveness of public health and aquatic and terrestrial biota;
 - c. cost of the alternative;
 - d. benefit or value the alternative;
 - e. a discussion of the comparison criteria as evaluated in relation to each other.

Based upon the evaluation and comparison of the reference remedy and the other alternative remedies developed, a proposed remedy will be developed and described in the FS in accordance with A.A.C. R18-16-407(I). The FS report shall describe the reasons for selection of the proposed remedy including the following:

- How the proposed remedy will achieve the ROs;
- How the comparison criteria were considered; and
- How the proposed remedy meets the requirements of Arizona Revised Statutes (A.R.S.) §49-282.06.

3.0 COMMUNITY INVOLVEMENT

ADEQ will issue a Notice to the Public announcing availability of the work plan to implement the Feasibility Study on ADEQ's website at www.azdeq.gov. The notice may be mailed to the Public Mailing List for the site; water providers, the Community Advisory Board, and any other interested parties.

4.0 FEASIBILITY STUDY REPORT FORMAT

An FS report will be prepared documenting the FS process. The FS report will be organized into the following sections:

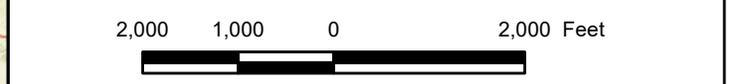
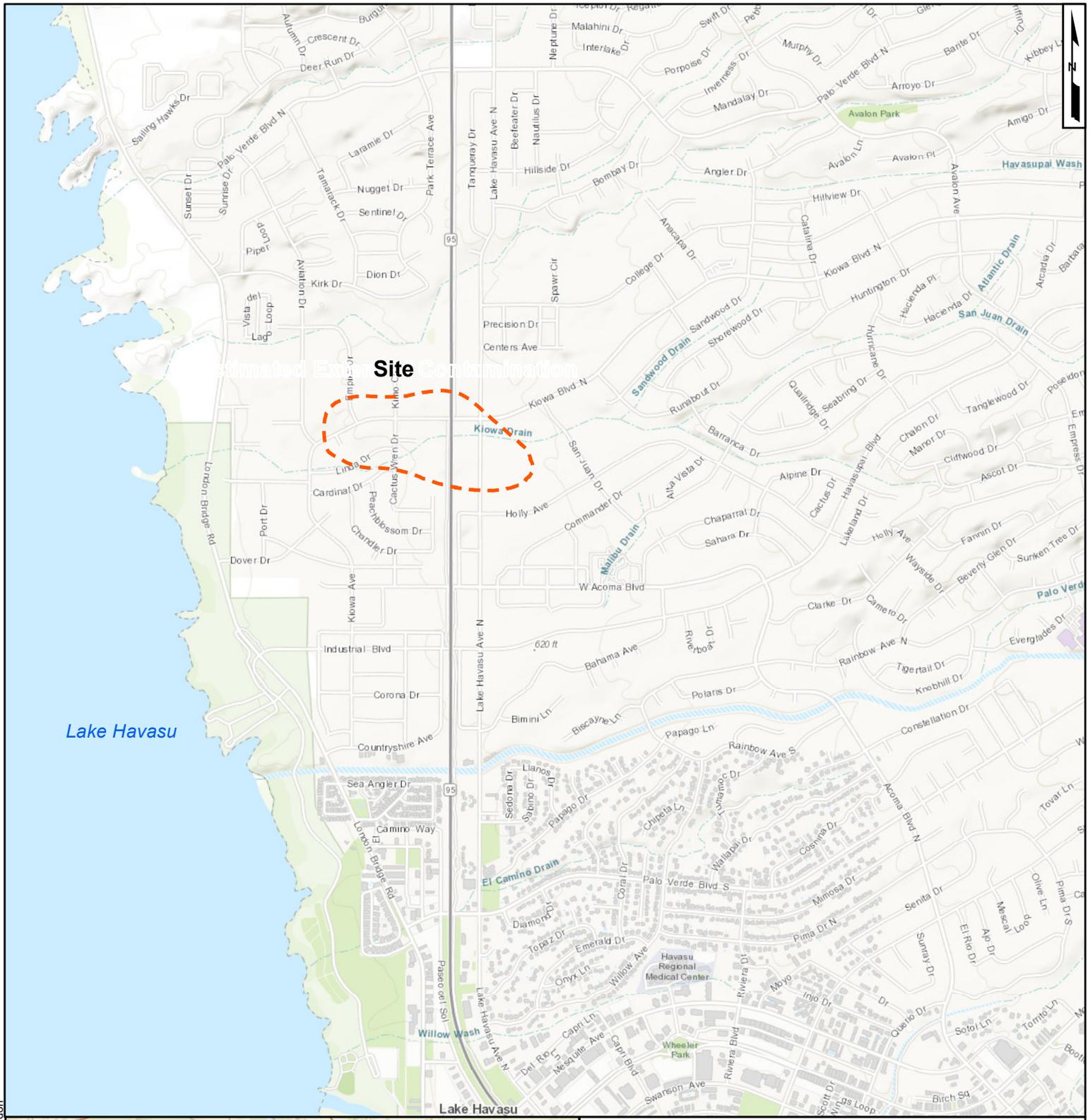
- **Section 1.0 INTRODUCTION**
This section will summarize the purpose of the FS report.
- **Section 2.0 SITE BACKGROUND**
This section will present a summary of the site description, physiographic setting, nature and extent of contamination and a risk evaluation.
- **Section 3.0 FEASIBILITY STUDY SCOPING**
This section will present the regulatory requirements presented in statute and rule, delineate the remediation areas and present the ROs identified in the RI.
- **Section 4.0 IDENTIFICATION AND SCREENING OF REMEDIAL MEASURES AND REMEDIAL STRATEGIES**
This section will present the evaluation and screening of various remedial measures and strategies related to contamination in soil and groundwater and lists the technologies that have been retained for evaluation as part of the reference and alternative remedies pursuant to A.A.C. R18-16-407 (E) and (F).
- **Section 5.0 DEVELOPMENT OF REFERENCE REMEDY AND ALTERNATIVE REMEDIES**
This section will present the selected reference remedy and, at a minimum, a more aggressive remedy and a less aggressive remedy. Each remedy will include a discussion of the associated remedial measures and remedial strategies pursuant to A.A.C. R18-16-407(E).
- **Section 6.0 DETAILED COMPARISON OF THE REFERENCE REMEDY AND THE ALTERNATIVE REMEDIES**
The remedies will be compared to each other based on the comparison criteria of practicability, cost, risk and benefit. Uncertainties, if identified, associated with each remedy or comparison criteria will be discussed pursuant to A.A.C. R18-16-407(H).
- **Section 7.0 PROPOSED REMEDY**
This section will present the proposed remedy as required in A.A.C. R18-16-407(I), and

discusses how it will achieve the ROs, how the comparison criteria were considered, and how the proposed remedy will meet the requirements of A.R.S. §49-282.06.

- **Section 8.0 COMMUNITY INVOLVEMENT**

This section will document the community involvement activities conducted in association with the FS.

FIGURES



Site Location
 Feasibility Study Work Plan
 Lake Havasu Ave and Holly Ave WQARF Site
 Lake Havasu City, Arizona

		Figure
Phoenix, AZ	December 2020	1

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