REMEDIAL ALTERNATIVES EVALUATION WORK PLAN AND SCHEDULE

FORMER FAIRFAX I SITE
KANSAS CITY, KANSAS

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1.0 INTRODUCTION AND PURPOSE

Conestoga-Rovers & Associates (CRA) has prepared this Remedial Alternatives Evaluation Work Plan and Schedule (Work Plan) for the former General Motors (GM) Fairfax I Plant in Kansas City, Kansas (Site). The Site location map is provided as Figure 1.1. This Work Plan has been prepared on behalf of the Revitalizing Auto Communities Environmental Responses Trust (RACER), formerly known as Motors Liquidation Company (MLC), for the Kansas Department of Health and Environment (KDHE) pursuant to the Consent Agreement and Final Order (Order) Case No. 11-E-109 BER dated November 21, 2011.

The Order identified five known Areas of Concern (AOC) which require further characterization and/or remediation. The Revised Work Plan for Supplemental Site-Wide Investigations report to address the remaining data gaps is being submitted under separate cover. The objectives of this Work Plan are to:

- Provide a brief description of the five known AOCs
- Describe clean-up objectives and goals
- Develop an initial list of appropriate remedial alternatives and technologies
- Establish screening criteria for evaluation of the potential remedial alternatives and technologies

The five known AOCs are identified on Figures 1.2, are discussed further in Section 2.4, and are summarized below:

- The area around soil boring S-8
- The area around soil boring SB-110
- The area around temporary monitoring well TMW-127
- The area around monitoring well MW-103A
- The area around temporary monitoring well TMW-130

For each AOC, at least two potential corrective action alternatives will be evaluated, in addition to the "no action" alternative.

2.0 BACKGROUND

This Site has a long history of investigations (since the late 1980s) and remedial activities. These were performed under a variety of regulatory oversight by the KDHE and in anticipation of the sale of distinct land parcels under the KDHE Voluntary Cleanup and Property Redevelopment Program (VCPRP). As a result of the over 25 years of studies at this Site, there is a wealth of information on Site conditions.

This section describes the Site location, history, geology and hydrogeology, and the five known AOCs.

2.1 SITE LOCATION

The former Fairfax I Plant Site is located at 100 Kindelberger Road in Kansas City, Kansas in an industrial area known as the Fairfax District. To the west and south of the Site are industrial facilities, including industrial operations, chemical companies, and refining and pipeline facilities. The Site is located south of a bend in the Missouri River, with the river located north, east, and southeast of the Site. A levee is present between the Site and the Missouri River (Figure 1.1). The active Fairfax II Plant is located to the southeast of the Site, between the Site and the Missouri River. The original Site property, that associated with the former Fairfax I Plant operations, covered over 107 acres. The western portion of the Site, which covered approximately 16 acres and is referred to as "Tract 2", was sold to a third party. The property associated with Tract 2 was entered into the VCPRP and received a No Further Action Letter from the KDHE in February 2007. The remaining Site property, approximately 91 acres, is also entered into the KDHE VCPRP.

2.2 SITE HISTORY

The Fairfax I Plant consisted of several buildings, a tank farm, rail support, and drum storage areas. The assembly building and former aircraft hangar provided over 2.2 million square feet of covered work area. The U.S. Government constructed the Fairfax I Plant in 1940 for North American Aviation. North American Aviation assembled B-25 bombers at the facility through 1944 for use in World War II. In 1945, GM negotiated a lease for this facility from the U.S. Government and began assembling automobiles. During the Korean conflict GM Corp. assembled F84F jet aircraft in addition to continuing to assemble automobiles. GM Corp. purchased the facility from the U.S. Government in 1960 and continued automobile assembly operations until 1986/1987.

The Fairfax I Site is vacant. Operations at the facility ceased in 1986/87, and the facility was demolished in 1987. All structures were taken down to the ground surface and current land is undeveloped. The newer Fairfax II Plant was constructed by GM Corp. on land adjacent to the Fairfax I property beginning in 1998. This is an active automobile assembly plant now operated by General Motors LLC (GM LLC).

2.3 GEOLOGY AND HYDROGEOLOGY

The Site is located in the floodplain of the Missouri River. Underlying Site geology typically consists of an upper layer of silty clay ranging in thickness from approximately 7 to 15 feet. This silty clay is underlain by fine to medium sands to depths of 25 to 40 feet, which grade into medium to coarse sands with some gravel and clay interbeds to depths of 60 to 80 feet. This interbedded layer is underlain by medium to coarse sands and gravels to the top of the bedrock. The thick sequence of sands and gravels comprise alluvial deposits that are underlain by shale bedrock at approximately 102 to 117 feet below grade. The present Missouri River channel follows a deeper valley cut into the bedrock by the ancestral Missouri River.

Groundwater flows beneath the Site area within a fining upward sequence of alluvial sands and gravels. Groundwater flow direction is seasonal and is dependent on precipitation events and the stage of the Missouri River. In general, groundwater flow direction is to the north and east, toward the Missouri River, in the fall and to the south and west, away from the Missouri River, in the spring. Significant vertical hydraulic gradients do not exist between deep and shallow groundwater zones, as water levels are similar in deep and shallow monitoring wells. Groundwater elevation is dependent on precipitation events and on the stage of the Missouri River, which is controlled by the Army Corps of Engineers. Depth to groundwater generally ranges from 15 to 25 feet below ground surface but greater variation has occurred.

2.4 AREAS OF CONCERN

The following summarizes the five AOCs (Figure 1.2) identified in the Order. Further characterization activities required for delineation are described in the Revised Work Plan for Supplemental Site-Wide Investigations report provided under separate cover.

It is anticipated that some or all of the AOCs will require remediation pending the results of the supplemental investigation activities.

2.4.1 S-8 AREA

The S-8 Area consists of the baler room and underground storage tank (UST) 10 area. The baler room was formerly located approximately 200 feet north of the southwest corner of the assembly building. The baler room was used to collect general plant refuse and contained a large trash compactor/baler. UST 10, which contained unleaded gasoline and was removed in August 1987, was located adjacent to the northern exterior wall of the baler room. The location of this AOC is indicated on Figure 1.2.

Previous studies indicated that the presence of tetrachloroethene (PCE) in soil and groundwater above the KDHE standard at sample location SB-8. A subsequent boring in this area in 2004 (SB-113) did not identify PCE at the same depth observed in 1987.

2.4.2 SB-110 AREA

The powerhouse/SB-110 Area is located northwest of the former main plant building (refer to Figure 1.2). Eight USTs, which were removed in August 1987, were located in the powerhouse area in three clusters. The USTs contained diesel fuel, waste fuel oil, and gasoline.

Previous studies in the late 1980s had investigated an area of former underground USTS and identified volatile organic compounds (VOCs) in soils and groundwater beneath the former USTs. More recent studies of soils and groundwater around this area in 2004 through 2007 have delineated the extent of impacts in soils and groundwater by VOCs.

2.4.3 TMW-127 AREA

The TMW-127 Area is located in the northeast quadrant of the footprint of the former Fairfax I Plant building (see Figure 1.2). Previous studies in 2006 indicated an isolated detection of cis-1,2-dichloroethene (cis-1,2,-DCE) above the standards in the groundwater sample from this temporary monitoring well.

2.4.4 MW-103A AREA

The MW-103A Area is located at the north-central portion of the Fairfax I property (refer to Figure 1.2). This area is near the former rail spur, the aboveground tank farm, and the location of the remediation system that operated from 1991 to 1994.

Investigations and remedial actions have been performed at this area since the early 1990s. The remedial system, which operated in this area for VOCs in soils and groundwater and the intermittent presence of light non-aqueous phase liquid (LNAPL), was shut down in 1994. Subsequent studies in 1999 and 2000 delineated the area of soil impacts that are the source of a localized area of groundwater contamination and of LNAPL. Studies in this area have also included the collection of information to support in situ biological remedial technologies.

2.4.5 TMW-130 AREA

The TWM-130 Area is located in the southeast quadrant of the footprint of the former Fairfax I Plant building (see Figure 1.2).

Initial studies in 2006 indicated the presence of LNAPL in monitoring well TMW-130. Since then, a number of soil and groundwater studies have been completed to delineate the extent of the separate phase hydrocarbons in soils and groundwater. The extent of the LNAPL has been well characterized. Recent studies in 2009 have also determined the extent of the impacts to soils and groundwater from dissolved phase chemical constituents.

3.0 REMEDIAL ACTION OBJECTIVES AND GOALS

In general, the remedial action objectives include:

- provide protection of public health and the environment
- comply with applicable local, State, and Federal regulations
- mitigate or eliminate the AOCs
- provide practical, cost-effective remediation
- utilize remedies which may be completed in a short time frame, where applicable

To achieve the remedial action objectives, selected remedial technologies and remedial alternative goals will be evaluated.

Section 4.0 describes the primary remedial technologies for consideration. These remedial technologies will be initially screened, and a further detailed analysis of the technically feasibility alternatives will be evaluated based on the screening criteria described in Section 5.0. In some cases, a combination of remedial technologies may be appropriate.

At a minimum, the following remedial action goals will be assessed:

- KDHE Tier 2 residential risk-based standards
- KDHE Tier 2 non-residential risk-based standards
- KDHE Tier 3 Site-specific risk-based standards

The implementation of an Environmental Use Control (EUC) will be considered where required to eliminate potential exposure pathways through the development of permanent land use restrictions.

The remedial alternative evaluation will be completed on an AOC basis; however, the remedial technologies may be applied to multiple AOCs if appropriate.

Long term operation, maintenance, and monitoring (OMM) will also be evaluated where necessary to demonstrate achievement of the remedial action objectives and goals.

4.0 IDENTIFICIATION OF REMEDIAL TECHNOLOGIES

This section describes an initial list of remedial technologies that will be considered for the remedial alternatives evaluation. For each AOC, a minimum of two remedial alternatives (in addition to No Action) will be evaluated.

4.1 NO ACTION

The No Action alternative involves no additional action and is required by the KDHE to be through the detailed analysis of alternatives to provide a baseline against which other alternatives can be compared.

4.2 TARGETED EXCAVATION

Excavation actions may be undertaken to physically remove contaminated media, including LNAPL, from the Site. This remedial approach includes the excavation, characterization, and off-site disposal of impacted soil and/or groundwater.

4.3 MONITORED NATURAL ATTENUATION (MNA)

MNA is a remedial approach that relies on natural subsurface mechanisms that are classified as either destructive or nondestructive. In certain circumstances, MNA can be sufficiently protective of human health and the environment and it can be more cost-effective than other remedial alternatives. Biodegradation is the most important in situ destructive mechanism, while non-destructive mechanisms include sorption, dispersion, dilution, and volatilization. However, MNA has its inherent limitations and can be slow, making the time frame for completion relatively long.

In order to support successful implementation of MNA, the United States Environmental Protection Agency (USEPA) recommends that the site be thoroughly characterized and scientific evidence provided to demonstrate that the degradation of the site contaminants is occurring at rates sufficient to be protective of human health and the environment. Three lines of evidence are needed to support the occurrence of MNA:

- documented loss of contaminants at the field scale
- contaminant and geochemical analytical data

- direct lab and field microbiological evidence for microbial biodegradation

MNA is subject to many uncontrollable natural processes and site conditions, which make it slow and sometimes inadequate. Site conditions, such as nutrient concentration, oxidation-reduction (redox) potential, and pH can be manipulated to enhance MNA and speed up the degradation rates of the Site contaminants.

4.4 ENHANCED BIODEGRADATION

In situ biodegradation (aerobic or anaerobic) is a treatment process whereby contaminants in the source areas are metabolized into less toxic or non-toxic compounds by naturally occurring microorganisms. The microorganisms utilize the contaminants as a source of carbon and energy.

This technology can be an enhanced version of MNA (discussed above), in which substances are injected into the groundwater to promote the growth of microorganisms capable of degrading contaminants into less hazardous substances.

To stimulate biological activity, biodegradation processes can be enhanced by the injection of nutrients, microbial cultures, suitable electron acceptors, and carbon/energy sources. Site conditions can be manipulated to enhance in situ biodegradation processes and speed up degradation rates of Site contaminants. In this process, several techniques can be applied to enhance biodegradation of the organic contaminants such as chlorinated solvents and petroleum-related compounds.

Several options to enhance biodegradation exist that could address contaminants using this method. One, or a combination of these techniques, can be applied based on the groundwater conditions. Prior to implementation, a treatability study would be required to determine if conditions at the Site are aerobic or anaerobic and to determine the most suitable approach.

This process option would also require implementation of a long-term monitoring program.

4.5 PUMP AND TREAT

Groundwater pump and treat (P&T) technology has been used as a means to maintain hydraulic control of contaminant plumes and to remove separate phase (LNAPL) and dissolved-phase petroleum hydrocarbons for many years.

A pumping test or slug test is usually performed to determine if P&T would be feasible for a given site. The geologic formation is monitored to determine the aquifer hydraulics (permeability of the saturated materials and thickness of the saturated zone) and radius of influence (capture zone) that develops at a given pumping rate. If the formation cannot yield a significant quantity of groundwater, then a large number of extraction (recovery) wells would be needed to produce the desired capture zone, potentially reducing the cost-effectiveness of remedial approach. Generally, the "tighter" (less permeable) the formation, the less effective P&T is.

An advantage to using groundwater P&T is its ability to be used to treat an isolated zone of groundwater. If groundwater needs to be extracted at a shallow or deep zone or any zone in between, the technology can accommodate most situations through pump and/or well design modifications.

A disadvantage to using groundwater P&T technology is that a large quantity of groundwater usually needs to be processed to decrease contaminant concentrations to clean-up standards. Once the majority of the contaminants are recovered, other treatment techniques are generally used to address residual contamination.

4.6 RECIRCULATING WELL TECHNOLOGY

Recirculating well technology is relatively new and involves in situ treatment of groundwater. With recirculating wells, groundwater is treated using the same mass transfer principles that allow air stripping to be effective, which are based upon the Henry's Law Constant for each contaminant of concern (COC). The contaminants are volatilized out of the groundwater via compressed air within the well, and evacuated from the well cavity via soil vapor extraction (SVE).

A recirculation well is constructed with a screened interval at the water table and another screened interval at the bottom of the well (distance between the screens varies from site to site). The annular space between the two screened intervals is sealed with a bentonite-cement grout mixture to prevent short-circuiting between the two zones. An air diffuser is deployed at the bottom of the well and used to create air bubbles that will transport the volatilized contaminants to the top of the well. A vacuum extraction blower is connected to the top of the well, and is used to remove volatilized compounds from the well and direct them back to an aboveground treatment system.

As the air bubbles from the diffuser rise within the well, water density in the well decreases and the in-well water elevation rises. The well water is at a higher elevation than the surrounding water so the well water flows out of the upper-screened interval and back into the surrounding groundwater. The surrounding groundwater tends to seek out an equilibrium condition (equal density in this case) and flows into the lower screened interval of the well. The overall effect results in groundwater flowing into the bottom screened interval, dissolved-phase VOCs being stripped (volatilized) within the well, and treated groundwater is then discharged out the upper well screen.

4.7 AIR SPARGE (AS)/SOIL VAPOR EXTRACTION (SVE) SYSTEM

AS is accomplished by introducing air into or above the groundwater and below the contaminated zone. The contaminants are volatilized out of the groundwater via compressed air injected several feet below the water table (generally greater than 10 feet) through specially-constructed wells. The contaminant-laden vapors produced by air sparging are collected and treated with a SVE system. Soil vapor extraction uses a vacuum that is applied to unsaturated soils (vadose zone) to remove vapors present within the soil matrix (in pore spaces between soil particles). The extracted vapors are typically directed to an aboveground treatment system, prior to being discharged to the atmosphere.

4.8 DUAL-PHASE VACUUM EXTRACTION (DPVE) SYSTEM

DPVE systems operate under the principle of applying a high vacuum (10 – 30 inches of mercury) to simultaneously extract vapor, groundwater, and liquid (separate phase or LNAPL) petroleum hydrocarbons (if present) via a drop tube (extraction tube). The drop tube is typically placed at 6-inches to several feet below the static water table elevation. Since DPVE uses vacuum to extract liquids, DPVE is limited to the depth at which liquids can be extracted. Generally DPVE is effective to depths of approximately 25 feet below ground surface.

The use of DPVE is somewhat limited to geologic formations that are normally of low permeability and/or low hydraulic conductivity. If the site's geology produces high air or water flow rates through the formation, then DPVE will be less effective. Generally, the "tighter" the formation, the more applicable DPVE would be.

Enhanced Fluid Recovery (EFR) events are a short-duration DPVEs that involves using non-permanent equipment to extract air and groundwater from the saturated zone using existing source area monitoring wells. The vacuum system is connected to select wells and operated for approximately 2 to 4 hours, depending on site conditions. EFRs are usually conducted on a routine basis, such as quarterly, to enhance remediation.

4.9 CHEMICAL OXIDATION

In situ chemical oxidation (ISCO) is a cost-effective method for destroying localized high concentrations of a wide range of organic compounds, particularly organic volatile compounds, and can be an effective method for treatment of LNAPL. In an oxidation reaction, the oxidizing agent breaks the carbon bonds and converts them into non hazardous or less toxic compounds, primarily carbon dioxide, and water. Commonly used oxidizing reagents include potassium permanganate ($KMnO_4$), Fenton's Reagent (hydrogen peroxide in a solution of ferrous salts), and sodium persulfate.

ISCO is site specific, and successful treatment is typically a function of the effectiveness of the delivery system (being able to deliver sufficient amounts of oxidant to the impacted groundwater and making sufficient "contact") and subsequent transport of the oxidant within the groundwater. The treatment performance is dependent to a great extent on the groundwater chemistry. A critical factor in the evaluation of ISCO treatment is determining the dosages of oxidant that are required to effectively oxidize the contaminants present (referred to as stoichiometric demand) as well as the competing reactions. The competing reactions are typically caused by the presence of natural organic materials such as humates and fulvates as well as reduced metal species. The consumption of oxidants by these non-target compounds is defined as natural oxidant demand (NOD). In order to determine the optimum dosage, treatability studies are required.

5.0 EVALUATION OF REMEDIAL ALTERNATIVES

CRA will assemble and screen the remedial alternatives against the short- and long-term aspects of effectiveness, implementability, cost, reliability, risks, and timeliness.

Effectiveness

CRA will assess the effectiveness of each remedial alternative based on the following:

- The effectiveness of a remedial alternative in handling the estimated areas or volumes of contaminated media and meeting the remediation goals identified
- The effectiveness of a remedial alternative in protecting human health and the environment during the construction and implementation phase
- The effectiveness of a remedial alternative with respect to the COCs and conditions at the Site

Implementability

CRA will assess the implementability of each remedial alternative from both the technical perspective and the administrative perspective in terms of:

- Technical complexity
- Ability to obtain necessary permits for off-Site actions, if required
- Availability of treatment, storage, and disposal services
- Availability of necessary equipment and workers to implement the technology

Costs

CRA will estimate the relative cost of each remedial alternative based on previous CRA experience, available applicable guidance, industry cost averages, and engineering judgment. The remedial alternatives will be evaluated whether costs are low, medium, or high relative to other processes in the same remedial technology type.

Reliability

Each remedial alternative will be evaluated in terms of their reliability of:

- attaining a degree of certainty that the alternative will be successful
- achieving long-term effectiveness of any measures that are required to manage the residues or remaining wastes or control emission or discharges to the environment

Risks

Each remedial alternative will be evaluated for their risks, including:

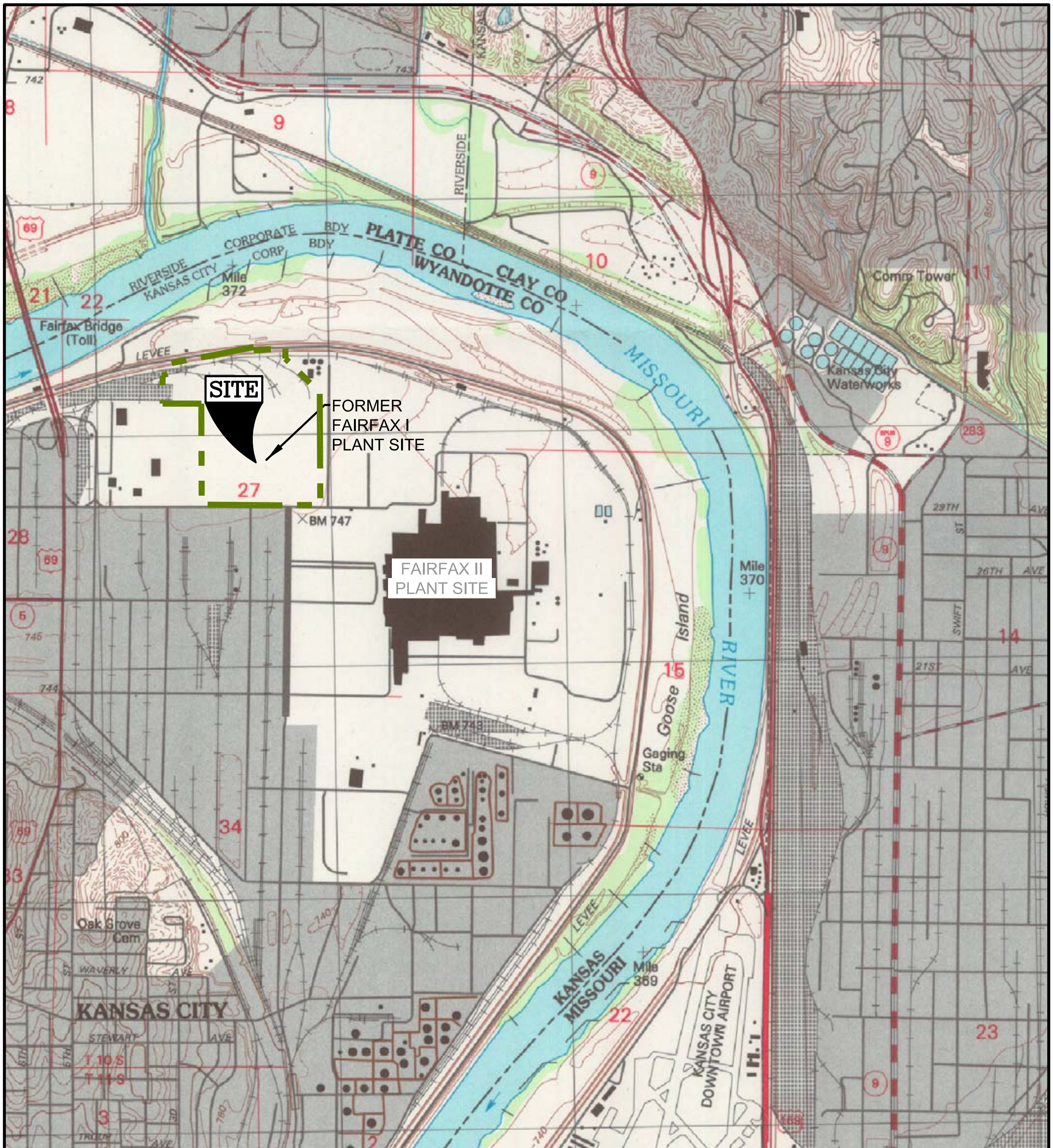
- short-term risk of implementation (including excavation, transportation, disposal, construction, operation, or maintenance activities) or discharges or damages to the environment from remedial activities
- risk posed over the period of time required to attain applicable remedial goals (including transportation, disposal, containment, operation, or maintenance activities) or discharges from remedial systems
- risk of harming health, safety, public welfare, or the environment by contaminants remaining after completion of remedial actions

Timeliness

Each remedial alternative will be evaluated for their timeliness of mitigating or eliminating the AOCs.

6.0 SCHEDULE

The schedule for completion of the Remedial Alternatives Evaluation report will be 60 days from completion of data validation of data collected during the supplemental investigation activities.



LEGEND:

BASE SOURCE: USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE;
NORTH KANSAS CITY, MO-KS 1990

FORMER FAIRFAX I PROPERTY BOUNDARY
(MLC PROPERTY ID 1289-1)

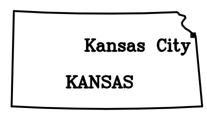


figure 1.1

SITE LOCATION
FORMER FAIRFAX I SITE
Kansas City, Kansas

0 1/4 1/2 mile

N

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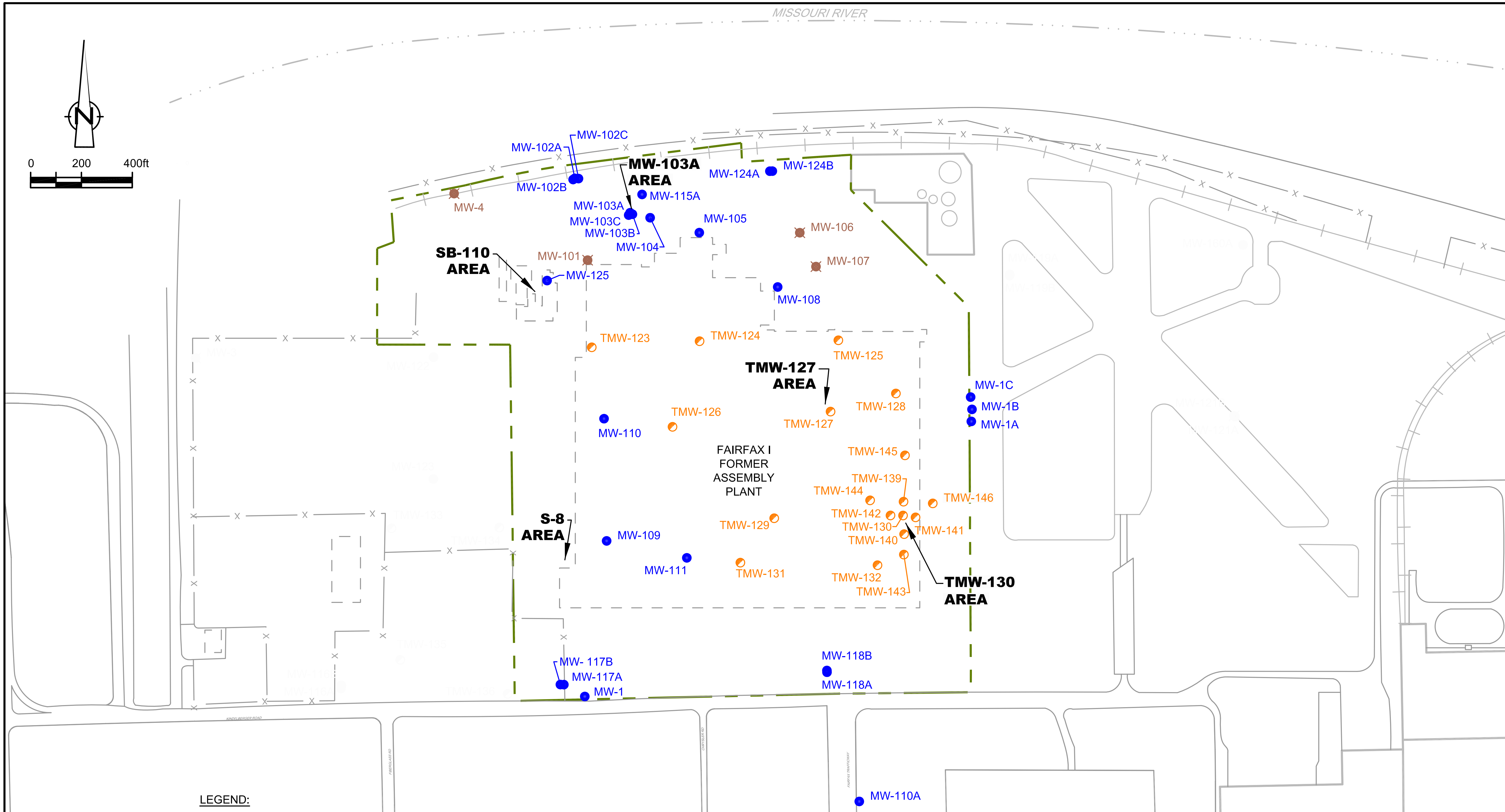

LEGEND:

FORMER FAIRFAX I PROPERTY BOUNDARY (MLC PROPERTY ID 1289-1)

FENCE LINE

FORMER RAILROAD TRACK

APPROXIMATE OUTLINE OF FORMER FAIRFAX I ASSEMBLY PLANT BUILDING

MW-1 EXISTING MONITORING WELL LOCATION AND IDENTIFIER

TMW-130 TEMPORARY MONITORING WELL LOCATION AND IDENTIFIER

MW-3 FORMER MONITORING WELL LOCATION AND IDENTIFIER

figure 1.2

SITE PLAN
FORMER FAIRFAX I SITE
Kansas City, Kansas

012559-T03(023)GN-CO002 FEB 24/2012