STATE OF ARKANSAS

DEPARTMENT OF ENVIRONMENTAL QUALITY

REVISED REMEDIAL ACTION DECISION DOCUMENT (RADD) FOR CORRECTIVE ACTION

Whirlpool Corporation
Sebastian County, Arkansas

Arkansas Facility Identification Number: 66-00048

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REMEDIAL ACTION DECISION DOCUMENT (RADD)
WHIRLPOOL CORPORATION

1. INTRODUCTION

The former Whirlpool facility is located at 6400 Jenny Lind Road on the south side of Fort Smith, Arkansas (Figures 1 and 2). The facility is approximately 100 acres and includes the main manufacturing building (approximately 1.3 million square feet), and approximately 3 acres of undeveloped land. The former warehouse utilized by Whirlpool, located south of the main manufacturing building, has been sold. The facility had been operated by Whirlpool for over 45 years and ceased operation in June 2012.

Prior to the mid-1980s, the facility utilized trichloroethene (TCE) in the former degreaser building located near the northwestern corner of the main building. The use of TCE was discontinued in the mid 1980's. It is believed that TCE and other hazardous constituents in the soil and groundwater identified in the facility investigations were the result of historical work practices by Whirlpool prior to 1981. On February 7, 1983, Whirlpool Corporation (Whirlpool) submitted a notification of Hazardous Waste Activity to the Arkansas Department of Pollution Control and Ecology (ADPC&E), now known as Arkansas Department of Environmental Quality (ADEQ), which identified the facility engaging in hazardous waste activities. There are no historical records that document any specific spills or other release incidents from the degreaser building.

Whirlpool entered into a Letter of Agreement (LOA) with the ADEQ on July 10, 2002 to investigate and remediate impacted groundwater at the northern portion of the facility in accordance with the United States Environmental Protection Agency (USEPA) Corrective Action Strategy (CAS) and currently is conducting the investigation and remediation activities under the Consent Administrative Order (CAO) LIS 13-202. Whirlpool has conducted extensive investigations for the remedial action at the facility. The Revised Risk Management Plan (RRMP) submitted by Whirlpool Corporation on May 21, 2013 recommends remedial alternatives for the corrective action at the facility. No action, containment, removal, in-situ treatment, and institutional controls are among the corrective measure remedies considered for the facility.

This Remedial Action Decision Document (RADD) describes the possible remedies, documents ADEQ's decision for the remedial actions at the facility, and affords the public the opportunity to participate in decisions regarding the hazardous substance remediation within their community. Interested individuals at the Fort Smith area may submit written comments to ADEQ on

the RADD. Procedures regarding public comment are included in Section 16 of the RADD.

2. SITE BACKGROUND

The facility is located adjacent to a residential area to the north and industrial/commercial areas to the south, west, and recreational areas to the east. A tract of undeveloped land is also present on the east side. Residential properties to the north include single-family homes and multi-family units. A recreational facility (Boys and Girls Club) that includes three buildings, two basketball courts and three baseball fields is located northeast of the facility adjacent to the residential area. No agricultural properties are located in the vicinity of the facility.

The presence of TCE in the shallow groundwater was discovered in the late 1980's when Whirlpool conducted a series of groundwater and soil studies at the facility as part of a project to remove one underground storage tank (UST). The UST was recovered intact, however soil samples taken at the time of the tank removal revealed the presence of elevated TCE concentrations in the soil. Subsequent investigations to assess the potential TCE source area have been conducted to delineate the affected soil and groundwater. Based on the historical process, the primary constituent of concern (COC) is TCE. However, tetrachloroethene (PCE) and TCE daughter products, including cis-1,2-dichloroethene (cis-1,2-DCE), trans-1,2-dichloroethene (trans-1,2-DCE), 1,1-dichloroethene (1,1-DCE), and vinyl chloride (VC) resulting from the natural degradation of PCE and TCE have also been detected in the groundwater monitoring wells.

On August 13, 2002, a scoping meeting was held between ADEQ and Whirlpool which resulted in Whirlpool initiating the off-site delineation of groundwater north of the facility. The delineation included installation and sampling of new monitoring wells. Whirlpool submitted the CAS Work Plan on June 6, 2003. The CAS Work Plan contained information on the status of off-site investigations and provided information to help define the Conceptual Site Model (CSM) for the facility.

The Interim Status Report was submitted on June 25, 2004 providing details regarding the status of off-site investigations. The off-site investigations included off-site delineations in five phases. Additional monitoring wells were installed from November 2004 through April 2006 during each phase of delineation. The facility met with ADEQ staff in June 2006 to review the status of the off-site delineation and clarify the path forward. Following the meeting, a CAS Work Plan Addendum was submitted on September 1, 2006 and approved on January 25, 2007.

In addition to the above reports, a series of Annual Groundwater Monitoring Reports (AGWM) have been submitted since March 2000. The data from the AGWM reports were evaluated and summarized in the Risk Evaluation Report (RER) submitted on June 14, 2007. The RER was approved on January 30, 2008. The RER contained information regarding the elements necessary in guiding risk management decisions at the facility. Whirlpool submitted the Risk Management Plan (RMP) on March 27, 2008. The RMP introduced several alternatives for remedial activities at the facility.

In March 2008, implementation of an interim measure was proposed by the facility to provide a quick response in the core of the plume where the potential for risk to residential areas existed. Whirlpool Corporation utilized the interim measure task as a pilot study to obtain information pertaining to in-situ chemical oxidation and groundwater recovery. These processes were aimed at reducing the concentration of TCE in the groundwater. The facility submitted the Interim Measure Work Plan (IMWP) on March 17, 2008. The IMWP aimed to reduce any potential risk to human health and proposed to target the core of the off-site plume via groundwater pump-and-treat and in-situ chemical oxidation. The IMWP was approved on April 10, 2008.

Due to the generation of wastewater, the facility was offered options to obtain a permit from the Hazardous Waste Division or Water Division of ADEQ depending on the characteristics of the groundwater (hazardous or non-hazardous). Upon the evaluation of the wastewater characteristics, Whirlpool contacted the Water Division and requested a discharge permit. Whirlpool also requested an Underground Injection Control (UIC) permit for the in-situ chemical oxidation. The permit by rule was granted by the Water Division on April 17, 2009 allowing the facility to initiate the permanganate injection for the remediation of groundwater at the facility based on APC&EC Regulation No. 17.

Whirlpool submitted an Interim Measure Status Report on January 12, 2010. The report provided information regarding the activities conducted at the facility in accordance with the approved Interim Measure Work Plan dated March 17, 2008. The data obtained from the monitoring points adjacent to In-Situ Chemical Oxidation (ISCO) Treatment Wells exhibited reduction of TCE concentrations in some of the areas where treatment had been applied. ADEQ required the facility to proceed with the groundwater pilot test at monitoring well RW-69 to induce a hydraulic gradient in order to assist the ISCO at the facility.

Whirlpool continued to submit progress reports regarding the status of groundwater pilot test at the facility. The progress reports (July 2010 – March 2011) indicated that the in situ permanganate treatments continued to reduce the concentrations of TCE in the immediate vicinity of treatment wells. The interim measure data obtained suggested treating the affected groundwater in

the off-site plume using permanganate could be a viable method for remediating the groundwater.

However, the continuation of in-situ remediation (November 2010, March 2011, October 2011 and April 2012) showed the ability to influence the movement of permanganate across the treatment area was limited by the low transmissivity of the aquifer and the continued monitoring suggested portions of the core of the off-site plume have not been adequately treated. Ultimately, the facility submitted a RRMP on May 21, 2013 to implement a risk strategy for the protection of human health and the environment, which includes monitoring of the groundwater. The RRMP evaluated each potential corrective measure for its relative suitability to meet the goal of protecting human health and the environment.

In December 2013, ADEQ issued the Whirlpool RADD which required Whirlpool to reduce groundwater TCE concentrations in the source area near the northwest corner of the manufacturing building and in the core of the off-site northern plume in the vicinity of monitoring well IW-77. The Final Remedy Work Plan was submitted on January 24, 2014 providing details on the activities outlined in the RRMP and included a schedule for implementation of the final remedy for the Whirlpool site.

During 2014, Whirlpool began ISCO treatments of the eastern end of the source area and the off-site area near IW-77. Additionally, Whirlpool chose to treat the "neck" area between the source area and the off-site northern plume. Subsequently, a second round of ISCO treatments was conducted in the off-site area, the "neck" area and the western end of the source area.

During 2014, Whirlpool also conducted a site wide investigation of the subsurface using Membrane Interface Probe (MIP) to profile the electrical conductivity (EC) of the subsurface soil and various chlorinated ethene detection methodologies. Soil samples were also obtained using direct push technology (DPT) for contaminant analysis but not physical or geochemical analysis. During the course of these investigations the actual source for TCE contamination at the site was determined to be a stormwater drainage ditch located at the northwest corner of the manufacturing building (Figure 3) where a maximum saturated soil TCE concentration of 3,300 mg/kg was detected.

Following determination of the TCE source at the site, Whirlpool elected to remove a portion of the contaminated soil using 4 foot diameter augers placed at approximately fifteen (15) foot centers drilled down to the bedrock . The large diameter borings were backfilled with limestone gravel in the saturated zone to passively adjust naturally low groundwater pH (to enhance MNA processes), and backfilled with lean cement in the vadose zone.

Approximately 300 cubic yards of soil (about 10 to 20 percent of the contaminated soil) was removed from the source area at the site.

Subsequent to the removal of soil from the source area an ISCO event was conducted in Area 1 focusing on the drainage ditch at the end of October 2014 (third ISCO event at the site).

Figure 4 shows the location of the current monitoring wells on-site and off-site. The highest concentration of TCE in groundwater on-site has been identified at MW-86 near the northwestern corner of the building, along the centerline of the drainage ditch. TCE concentration at MW-86 in 2014 was measured at 533,000 micrograms per liter (ug/l). Additional areas of impact (greater than 10,000 ug/l of TCE) have been identified at ITMW-19 with 15,000 ug/l, and at MW-25 with 18,500 ug/l. These three points are located proximal to the old drainage ditch which extends approximately 250 feet from the western end of the old degreasing building to a stormwater drain just north of the northwest corner of the manufacturing building. The southern groundwater plume still extends approximately 1,000 feet to the south from this source area. The southern boundary of affected groundwater remains on-site at this time. There are no known off-site groundwater impacts to the southeast, south or west of the Whirlpool property boundaries.

The northern portion of the plume with groundwater concentrations of TCE above USEPA maximum contaminant levels (MCLs) extends to the residential neighborhood north of the facility. North of the main source area, TCE concentrations greater than 1,000 ug/l were detected at wells MW-33 and IW-77. From the vicinity of well IW-77, the northern portion of the plume extends approximately 1,000 feet to the northeast to well MW-61. The depth to groundwater is routinely observed (during the construction of monitoring wells) to be 15 to 25 feet below ground surface (bgs). The measured depth to water in the monitoring wells ranges from more than 10 feet bgs to almost zero in the northeast direction from the site.

Additionally, groundwater with TCE concentrations slightly above the MCL has been detected on Boys and Girls Club property, immediately northeast of the Whirlpool site.

3. SUMMARY OF SITE RISKS

A. HUMAN HEALTH RISKS

A Human Health Risk Assessment (HHRA) was submitted as an appendix to the May 21, 2013 RRMP. The HHRA was conducted to determine potential risks related to current and future human exposure to constituents detected in groundwater, soil, and soil gas at and around the Whirlpool facility. The

primary COC is TCE. However, PCE and TCE daughter products including cis-1,2-DCE, trans-1,2-DCE, 1,1-DCE, VC, and several other volatile organic compounds (VOCs) were also retained for evaluation in these media.

On-Site Receptors and Exposure Routes

On-site receptors evaluated for potential exposure to these COCs include 1) routine workers, 2) maintenance workers, and 3) construction workers.

Exposure routes for on-site routine workers from COCs in surface soil include ingestion, dermal contact, inhalation of soil-derived vapors and airborne particulates in outdoor air, and inhalation of soil-derived vapors that migrate through building foundations to indoor air. Exposure routes for on-site routine workers from COCs in subsurface soil include inhalation of soil-derived vapors in outdoor air and inhalation of soil-derived vapors that migrate through building foundations to indoor air. Exposure routes for on-site routine workers from COCs in groundwater include inhalation of groundwater-derived vapors in outdoor air and inhalation of groundwater-derived vapors that migrate through building foundations to indoor air.

Exposure routes for on-site maintenance workers and construction workers from COCs in surface and subsurface soil include ingestion, dermal contact, and inhalation of soil-derived vapors and airborne particulates in work-space air. Exposure routes for on-site maintenance workers and construction workers from COCs in groundwater include ingestion, dermal contact, and inhalation of vapors from exposed groundwater during excavation activities.

Off-Site Receptors and Exposure Routes

Off-site receptors evaluated for potential exposure to these COCs include 1) residents, 2) routine workers, and 3) community maintenance workers.

Exposure routes for off-site residents from COCs in surface and subsurface soil include inhalation of soil-derived vapors and airborne particulates in outdoor air. Exposure routes for off-site residents from COCs in groundwater include inhalation of groundwater-derived vapors in outdoor air and inhalation of groundwater-derived vapors that migrate through building foundations to indoor air.

Exposure routes for off-site routine workers from COCs in surface and subsurface soil include inhalation of soil-derived vapors and airborne particulates in outdoor air. Exposure routes for routine community workers from COCs in groundwater include inhalation of groundwater-derived vapors in outdoor air and inhalation of groundwater-derived vapors that migrate through building foundations to indoor air.

Exposure routes for off-site community maintenance workers from COCs in groundwater include incidental ingestion and dermal contact with exposed groundwater, and inhalation of vapors from exposed groundwater in work-space air.

Current Potential Carcinogenic and Non-Carcinogenic Risks

The potential carcinogenic and non-carcinogenic risks to human receptors were estimated by first calculating individual potential risks for each COC. These potential risks were then summed to arrive at a cumulative potential carcinogenic risk and non-carcinogenic risk for each completed exposure pathway.

On-Site Potential Carcinogenic and Non-Carcinogenic Risks

As shown in the following table, none of the summed potential carcinogenic risk estimates exceed USEPA acceptable cancer risk range of 1E-06 to 1E-04 for direct contact with on-site soils. However, based upon the latest subsurface soil data, ADEQ evaluated the indoor air pathway via vapor intrusion from subsurface soils using a Johnson and Ettinger (J&E) Model. The J&E Model indicated potential non-carcinogenic risks from vapor intrusion via subsurface soils.

Summed Potential Risk Estimates for On-Site Soil

On-Site Receptor	Exposure Type	Carcinogenic Risk	Non-Carcinogenic Risk (HI)	Occupational
Routine Worker	Direct Contact	1E-08	0.004	NA
Maintenance Worker	Direct Contact	1E-09	0.001	NA
Construction Worker	Direct Contact	4E-09	0.0009	NA

HI – Hazard Index
NA – Not applicable. Occupational air standards are only applicable for routine worker vapor intrusion exposures

As shown in the following table, none of the summed potential carcinogenic cancer risk estimates exceed the USEPA acceptable cancer risk range of 1E-06 to 1E-04 for receptors potentially exposed to chemicals in on-site groundwater. However, the summed potential non-carcinogenic risk does exceed an HI of 1 for on-site routine workers via the vapor intrusion pathway, maintenance workers via direct contact, and construction workers via direct contact which could be potentially exposed to chemicals in on-site groundwater.

Furthermore, additional investigations have revealed a discontinuous perched groundwater zone around five feet bgs, with concentrations exceeding the USEPA MCL. Therefore, future excavation/construction workers should exercise caution and utilize proper personal protective equipment when

working in areas above the established Remedial Action Levels listed in Section 8.

As with the on-site soil, potential vapor intrusion was also assessed for on-site routine workers potentially exposed to chemicals in on-site groundwater using occupational inhalation limits. As shown in the following table, the vapor intrusion pathway from chemicals in on-site groundwater does not result in an unacceptable exposure in the workplace for on-site routine workers.

Summed Potential Risk Estimates for On-Site Groundwater

On-Site Receptor	Exposure Type	Carcinogenic Risk	Non-Carcinogenic Risk (HI)	Occupational
Routine Worker	Vapor Intrusion	1E-05	**3**	8E-04
	Inhalation of Outdoor Air	4E-07	0.1	NA
Maintenance Worker	Direct Contact	5E-05	**30**	NA
Construction Worker	Direct Contact	5E-06	**6**	NA

HI – Hazard Index
NA – Not applicable. Occupational air standards are only applicable for routine worker vapor intrusion exposures.
Bold values exceed an HI of 1.

Off-Site Potential Carcinogenic and Non-Carcinogenic Risks

As shown in the following table, none of the summed potential carcinogenic risk estimates exceed USEPA acceptable cancer risk range of 1E-06 to 1E-04 and none of the summed potential non-carcinogenic risks exceed a Hazard Index (HI) of 1 for receptors potentially exposed to chemicals in off-site soils.

Summed Potential Risk Estimates for Off-Site Soil

Off-Site Receptor	Exposure Type	Carcinogenic Risk	Non-Carcinogenic Risk (HI)
Resident	Inhalation of Outdoor Air	6E-08	0.01
Routine Worker	Inhalation of Outdoor Air	1E-08	0.004

As shown in the following table, none of the summed potential carcinogenic risk estimates exceed USEPA acceptable cancer risk range of 1E-06 to 1E-04 and none of the summed potential non-carcinogenic risks exceed a Hazard Index (HI) of 1 for receptors potentially exposed to chemicals in off-site groundwater.

Additional investigations have revealed a discontinuous perched groundwater zone around five feet bgs, with concentrations exceeding the USEPA MCL. Therefore, future excavation/construction workers should exercise caution and

utilize proper personal protective equipment when working in areas above the established Remedial Action Levels listed in Section 8.

Summed Potential Risk Estimates for Off-Site Groundwater

Off-Site Receptor	Exposure Type	Carcinogenic Risk	Non-Carcinogenic Risk (HI)
Resident	Vapor Intrusion	6E-06	1
	Inhalation of Outdoor Air	5E-08	0.01
Routine Worker	Vapor Intrusion	2E-07	0.06
	Inhalation of Outdoor Air	7E-09	0.002
Community Maintenance Worker	Direct Contact	9E-07	0.5

On-site and off-site potable water is provided by the Fort Smith municipal water system. Currently, groundwater is not known to be used as a potable source for drinking water. However, if drinking water wells are installed on-site, off-site, or in perched groundwater zones and exhibit elevated levels of TCE, significant potential risks could result from the use of groundwater as a potable source.

B. ECOLOGICAL RISKS

The facility operated for over 45 years. The surrounding area is developed with little to no viable ecological habitats. No ecological impacts have been identified for the facility and the surrounding area. Additionally, no sensitive ecological receptors have been identified in the vicinity of the facility. As a result, the contaminants attributed to the historical facility operations do not present an ecological threat to the surrounding area.

4. SUMMARY OF REMEDIAL APPROACH

The ADEQ determines whether a release of hazardous substances must be addressed through remedial action(s) and whether the actions taken to address said release are protective of human health and the environment. The two performance standards of the source control are: applicable statutory and regulatory requirements, and final risk goal. The final risk goal must ensure that no potential unacceptable risks to human health or the environment remain at the conclusion of remedial activities. A remedy's cleanup standards can fall within the range of $1x10^{-4}$ to $1x10^{-6}$ excess lifetime risk from exposure to a carcinogenic hazardous constituent, and a hazard quotient of 1.0 for non-carcinogens. The final risk goal performance standard developed will generally fall within that range as well. The source control and statutory and

regulatory requirement performance standards will determine the need for and the degree of any necessary remedial actions.

Based on the data collected from the investigations conducted at the Whirlpool facility in Fort Smith, Arkansas over a period from 1980 to 2014, the areas of concern are the soil and groundwater impacted by the historical usage of TCE as a degreaser. The "Source Area" is understood to be a drainage ditch located immediately to the west of the former degreaser building and extending approximately 250 feet to the west. Elevated concentrations of TCE were detected in the soil and groundwater beneath this drainage feature (See Figure 4). The impacted soil and groundwater are present within the fenced boundary of the Whirlpool facility (on-site) and impacted groundwater with detected concentrations of TCE above the MCL extends beneath a portion of the off-site residential area north of the facility and a portion of the Boys and Girls Club property to the northeast. The initially identified area of impacted soil is an approximately 20 by 250-foot area west of the former degreaser building, with the groundwater plume extending to the north and to the south. The remedial action includes alternatives to reduce concentrations of TCE in the soil and groundwater at the source and eliminate the source to the off-site groundwater plume which will ultimately reduce the concentrations in off-site groundwater. The goal to eliminate the source of contaminants to the off-site groundwater plume does not necessarily mean the contaminant concentrations in soil will be non-detect, but a reduction of the concentrations of contaminants to levels that no longer adversely impact groundwater.

The latest data collected shows TCE in soils appear to be correlated to a former linear drainage feature that extends from the former degreaser building to the west southwest toward the former rail spur on the north side of the building. The eastern portions of the former linear drainage feature are located north of Area 1 and the western portions are located within the northwestern corner of Area 1. The soil investigation also indicates the presence of TCE contaminated soils under the main manufacturing building. North, geologically down-slope of the source area, elevated TCE concentrations in groundwater (greater than 1,000 ug/l) extend approximately 400 feet to a marked depression present in the surface of the weathered shale comprising the lower confining unit near the location of well IW-77. The northern plume extends approximately 1000 feet northeastward past well IW-77. Remedial action to reduce TCE levels in the areas of elevated concentrations near well IW-77 will ultimately reduce the concentrations down-gradient in the northern plume which extends beneath the off-site residential area. The data also appear to indicate that the treatment undertaken has caused the plume in the residential areas to separate from on-site contamination. However, rebound of contamination in the groundwater may occur that could connect the on-site and off-site plumes.

5. SUMMARY OF ALTERNATIVES CONSIDERED IN REVISED RISK MANAGEMENT PLAN

The concentration of COCs in the subsurface soil (source area, under the building, drainage ditch and Area 1) and groundwater (on-site and off-site) are the main focus of remedial alternatives at the facility. The elected alternative(s) should assure protection of human health and the environment and should eliminate the exposure pathway to the COCs.

A. SUBSURFACE SOILS

The alternatives considered for the impacted subsurface soils are as follows:

No Action – The No Action measure represents a baseline against which other alternatives are compared. This measure does not include remedial activities to address the affected soil on-site and would not limit risk posed by the COCs.

Containment – Containment involves placing a physical barrier which prevents the movement of COCs and therefore provides a means to reduce or eliminate an exposure pathway. Containment technologies like a concrete cover or asphalt cover can effectively isolate soils. The cover prevents contact between impacted soil COC migrations via infiltration into groundwater. The cover could also be engineered to limit vapor intrusion.

Removal – Removal of the impacted soils involves excavation and proper disposal of the soils. Excavation is a proven technology for direct mass removal and is technically feasible for small to moderate soil volumes. Excavation will reduce or eliminate the amount of COC mass.

In-Situ Treatments - The treatment methods are designed to reduce the COCs in the subsurface soils without removing the impacted media. The in-situ treatment technologies for the soils include Biological and Physical/Chemical treatments as follows:

Biological Treatment:

Natural Attenuation – This alternative relies on naturally occurring subsurface biological processes under favorable conditions to achieve site specific remediation objectives over time by reducing the concentration of COCs in the soils.

Enhanced Aerobic/Anaerobic Biodegradation – In-situ biological treatment includes the addition of nutrients, oxygen, and/or acclimated microbes to enhance the natural degradation processes. Biodegradation in

the saturated zone can be used for the remediation of impacted soils. The correct site geologic and hydrogeological conditions are very important when considering the use of biodegradation technologies.

Physical/Chemical Treatment:

Vapor Extraction – Vapor extraction includes the addition of a vacuum on the subsurface soils to induce volatilization of organic constituents. Volatilization allows for the COCs to be removed from the subsurface soils in the gas phase.

In-Situ Thermal Desorption – Thermal treatment of the soil is used to elevate the soil temperature to above the point of vaporization of TCE. The TCE is then removed from the soil through vapor extraction. Extracted vapors are then destroyed using a thermal oxidizer or trapped in granular activated carbon filters.

Chemical Oxidation – In-situ chemical oxidation (ISCO) involves decomposition and in-situ destruction of COCs in the soils using chemical oxidation technologies. Soil reactivity with chemical oxidants or reducing agents is important when considering chemical oxidation. Successful chemical oxidation requires the oxidant to come into direct contact with the contaminant.

Soil Flushing – Soil flushing involves the use of a co-solvent or surfactant using an injection or infiltration process to move the co-solvent or surfactant through the impacted soils with the intent of removing COCs from the soils.

Institutional Controls – Applying institutional controls as a remedial measure involves the implementation of legally enforceable restrictions on land use to prevent exposure to impacted media. By preventing exposure, institutional controls can protect human health.

B. GROUNDWATER

The alternatives considered for the impacted groundwater, both on-site and off-site are as follows:

No Action – The No Action measure represents a baseline against which other alternatives are compared. This measure does not include remedial activities to address the affected groundwater on-site or off-site and would not limit risk posed by the COCs. The No Action measure would effectively amount to unmonitored natural attenuation.

Containment – Containment involves placing a physical barrier which prevents the lateral movement of COCs and therefore provides a means to reduce or eliminate an exposure pathway. Containment technologies like vertical impermeable barriers keyed into an impermeable zone below the contaminated groundwater aquifer would effectively block or redirect groundwater flow.

Removal – Removal involves the actual removal and treatment of the groundwater to remove COCs. The direct removal of COCs from groundwater can be accomplished by air stripping. Air stripping involves the removal of groundwater by pumping. The groundwater is then aerated to remove (volatilize) the COCs which are then trapped in activated carbon filters. The treated groundwater can be returned to the groundwater aquifer by injection or discharged through an ADEQ permitted discharge point.

In-Situ Treatments – These treatment methods are designed to reduce the COCs in the groundwater without removing the impacted groundwater. The in-situ treatment technologies for groundwater include Biological and Physical/Chemical treatments as follows:

Biological Treatment:

Monitored Natural Attenuation (MNA) – This alternative relies on naturally occurring subsurface processes under favorable conditions to achieve site specific remediation objectives over time to reduce the concentration of COCs in the groundwater. Abiotic degradation changes the chemical composition of TCE through naturally occurring chemical reactions. However, this process is thought to be too slow to be considered a viable alternative for MNA. Aerobic and anaerobic biodegradation reduce TCE concentrations through biological processes carried out by bacteria in the subsurface.

Enhanced Aerobic/Anaerobic Biodegradation –With anaerobic biodegradation, nutrients are added to enhance the natural degradation of COCs through reductive de-chlorination. For reductive de-chlorination to occur, bacteria (i.e. Dehalococcoides) capable of de-chlorination must be present in sufficient quantity. If laboratory analysis indicates bacteria are not present or deficient in quantity, bacteria may be introduced to the groundwater along with the addition of nutrients. Reductive de-chlorination of TCE to DCE can occur under mildly reducing conditions utilizing NO_3^- or Fe^{3+}-reduction; however, the dechlorination of DCE to VC, and VC to ethene requires the stronger reducing conditions of SO_4^{2-}-reduction or methanogensis.

Both enhanced aerobic and anaerobic biodegradation require a thorough understanding of site geologic, hydrologic and groundwater geochemical conditions to be utilized successfully.

Physical/Chemical Treatment:

Vapor Extraction or Sparging – Vapor extraction includes the addition of a vacuum on the subsurface soil to induce volatilization of organic constituents. Sparging is the process of pumping air into the groundwater to assist in volatilization of the COCs. Volatilization allows for the COCs to be transferred from the groundwater to the subsurface soils in the gas phase. The COCs are then removed from the subsurface soils in the gas phase. Extracted vapors must then be processed through an activated carbon filter to remove the COCs.

In-Situ Thermal Desorption – Thermal treatment is used to elevate the groundwater temperature to above the volatilization temperature of the dissolved TCE. The water vapor and TCE is then removed from the soil through vapor extraction. Extracted vapors are then routed to a vapor processing facility.

Chemical Oxidation/Reduction – ISCO involves the decomposition and in-situ destruction of COCs in the groundwater using chemical treatment technologies. Saturated soil reactivity with chemical oxidants or reducing agents is important when considering the use of chemical oxidation or reduction. Successful chemical treatment requires the chemical agent to come into direct contact with the contaminant. ISCO involves the introduction of an oxidizing agent such as potassium permanganate or persulfate. In situ chemical reduction (ISCR) involves the introduction of a reducing agent, such as Zero Valent Iron, which can be used to destroy COCs in the groundwater. As with anaerobic bio-remediation, the correct site geologic, hydrogeological, and geochemical conditions are critically important when considering the use of this technology.

Permeable Treatment Beds – Permeable treatment beds include the construction of a down-gradient trench filled with a material designed to either adsorb or chemically react with constituents in groundwater. As groundwater passes through the permeable bed, COCs would be treated or removed. Treatment beds include media (e.g. granular zero valent iron, mulch or other proven materials) that create a strong reducing or oxidizing environment to change chlorinated solvents to nontoxic end products.

Institutional Controls – Applying institutional controls as a remedial measure involves the implementation of legally enforceable restrictions on land use to prevent exposure to impacted media. By preventing exposure, institutional controls can protect human health.

6. PROPOSED/RECOMMENDED REMEDIES

A. SUBSURFACE SOILS

TCE impacted soils are not present off-site and are located on site near the former degreaser building at Area 1 (includes the drainage ditch) and under the previous manufacturing building. If the December 2015 technical review reveals Whirlpool's actions have not achieved the soil remedy goals defined in 2013 RADD, Whirlpool should initiate the soil remedy within forty-five (45) days of written notice by ADEQ. A portion of the TCE impacted soils along the former drainage pathway have been excavated by using a four (4) foot diameter boring on fifteen (15) foot centers. Excavation of additional contaminated soils by placing four (4) foot diameter soil borings on seven (7) foot centers instead of fifteen (15) foot centers in the source area, drainage ditch and Area 1 is the recommended remedy for the unsaturated subsurface soils. This method would insure the removal of a greater volume of soils. If Whirlpool chooses not to remove the additional soil volume, the remaining unsaturated contaminated soils in the impacted areas and under the building can be treated via In-Situ Thermal Desorption (ISTD). A pilot test to evaluate the effectiveness of the ISTD should be performed. Either removal of the additional source area or the combination of soil removal via soil borings and thermal treatment of the remaining soils that are above the remedial action level established for the site would help reduce source area contamination. Whirlpool should submit a work plan to implement the soil remedy upon ADEQ's notice. The building foundation should remain in place and be monitored in order to prevent infiltration of storm water through the soil. The existing on-site deed restriction requires submittal of work plans to ADEQ to investigate beneath the building as part of a demolition effort.

B. GROUNDWATER

Impacted groundwater is present both on-site and off-site. Figure 3 shows the location of the monitoring wells on-site and off-site. The highest impact of TCE in groundwater on-site has been identified at MW-86 near the northwestern corner of the building. TCE concentration at MW-86 in 2014 was measured at 533,000 micrograms per liter (ug/l). Additional areas of impact (greater than 10,000 ug/l of TCE) have been identified at MW-25 with 18,500 ug/l and ITMW-19 with 15,300 ug/l. These points are associated with a TCE source area extending approximately 250 feet from the western end of the former degreaser building to a storm drain. The southern groundwater plume extends approximately 1,000 feet to the south from this source area. The southern boundary of affected groundwater remains on-site in this direction. There are no known off-site groundwater impacts to the east, south or west of the Whirlpool property boundaries. The northern plume extends northward from the narrow "neck" within the north parking area. The northern end of the "neck" terminates near well IW-77. From the vicinity of

IW-77 the northern plume extends northeastward for approximately 1000 feet. Natural attenuation will not have a significant effect regarding the south plume or the north plume until significant reduction in TCE concentrations and related "daughter" constituents has occurred and are no longer contributing to the groundwater plumes (See Tables 2 and 3).

In situ chemical treatments (utilizing either oxidation or reduction agents) has been chosen by the ADEQ as a remedy to reduce the elevated TCE concentrations in the on-site and off-site groundwater. This information will be utilized to determine the type and quantity of in situ chemical treatment material required to effectively treat the on-site and off-site groundwater. Application of chemical treatments will be of sufficient lateral and vertical density to ensure contact between the treatment materials and groundwater contaminants. Based on subsequent monitoring results, it may be necessary to expand the treatment areas and/or re-treat the areas utilizing existing injection points and/or additional injection points as needed until elimination trends in TCE concentrations and other COCs are achieved. ISCO was implemented during 2014 in Areas 2 and 3, neck area, and Area 1 and drainage ditch.

In addition to the chemical treatment remedy, MNA will be conducted for the contaminant plume. Aquifer material and groundwater samples representative of the horizons with impacted groundwater will be obtained for laboratory evaluation to determine if MNA will produce viable reductions in chlorinated ethene concentrations over a reasonable time. Groundwater samples will be collected quarterly for the first two years. Sampling frequency after two years will be evaluated and future sampling frequency will be determined based on groundwater data. These groundwater samples should be of sufficient lateral and vertical distribution to adequately define the hydrologic and geochemical makeup of the impacted groundwater flow system. The samples will be tested for the parameters listed in Table 3. .

7. EVALUATION OF THE PROPOSED REMEDY & ALTERNATIVES

Each remedial alternative was evaluated on the following criteria: Overall protection of human health and the environment, short term effectiveness, long term effectiveness, implementability and cost. Please see Table 1 for alternative comparisons.

8. REMEDIAL ACTION LEVELS

A. SURFACE SOILS

The surface soils at the facility do not contain contaminants above acceptable direct contact risk-based screening levels. Therefore, no Remedial Action Levels (RALs) are required to be established for surface soils.

B. SUBSURFACE SOILS

The subsurface soils at the facility were evaluated using acceptable direct contact risk-based screening levels for site workers and constructions workers. Subsurface soils at the facility were also evaluated using site-specific risk-based groundwater protection screening levels. No contaminants in subsurface soils exceeded the acceptable direct contact risk-based screening levels for site workers or construction workers. However, TCE did exceed the site-specific risk-based groundwater protection screening level. TCE in subsurface soils beneath the Whirlpool manufacturing building were reevaluated for potential vapor intrusion using the J&E Model. The J&E Model indicated potential non-carcinogenic risks exceeding a HI of 1. No other contaminants in subsurface soils exceeded the respective site-specific risk-based groundwater protection screening levels. Therefore, TCE is the only COC retained in subsurface soil. The Remedial Action Level for TCE in subsurface soils is based on potential leachability from soil to groundwater. The established RAL to protect groundwater to drinking water criteria is also considered protective of the vapor intrusion pathway. The Remedial Action Level for TCE in subsurface soils is presented in the following table:

Remedial Action Level for On-Site Subsurface Soils

Chemical	Subsurface Soil Remedial Action Level (mg/kg)(1)
Trichloroethylene (TCE)	0.129

(1) Site-Specific Risk-Based Protection of Groundwater Soil Screening Level – DAF 43.3 (Risk Evaluation Report June 2007)

C. GROUNDWATER

Groundwater Remedial Action Levels are applicable for on-site, off-site, and perched groundwater. Remedial Action Levels for groundwater are presented in the following table:

Remedial Action Levels for On-Site and Off-Site Groundwater

Chemical	Remedial Action Level (ug/L)[1]
Acetone	12,000[2]
Benzene	5.0
Bromodichloromethane	80
Bromoform	80
Bromomethane	7.0[2]
2-Butanone	4,900[2]
Carbon Disulfide	720[2]
Carbon Tetrachloride	5.0
Chlorobenzene	100
Chloroethane	21,000[2]
Chloroform	80
Chloromethane	190[2]
Dibromochloromethane	80
1,1-Dichloroethane	2.4[2]
1,2-Dichloroethane	5.0
1,1-Dichloroethene	7.0
cis-1,2-Dichloroethene	70
trans-1,2-Dichloroethene	100
1,2-Dichloropropane	5.0
1,3 Dichloropropene	0.41[2]
Ethylbenzene	700
2-Hexanone	34[2]
4-methyl-2-pentanone	1,000[2]
Methylene chloride	5.0
Styrene	100
1,1,2,2-Tetrachloroethane	0.066[2]
Tetrachloroethene (PCE)	5.0
Toluene	1,000
1,1,1-Trichloroethane	200
1,1,2-Trichloroethane	5.0
Trichloroethene (TCE)	5.0
Vinyl chloride	2.0
Xylenes (total)	10,000

(1) Maximum Contaminant Level (USEPA May 2013)
(2) USEPA Tapwater Screening Level (MCL and Maximum Contaminant Level Goal Unavailable)

9. JUSTIFICATIONS FOR SELECTIONS

ADEQ has determined excavation with possible ISTD of the soils and In-Situ Chemical Oxidation/Reduction coupled with Monitored Natural Attenuation for the groundwater are the most effective remedial approaches at the Whirlpool facility. Whirlpool may request modification of this section should Whirlpool determine an alternate remedy be evaluated by ADEQ that would achieve the performance standards of this RADD.

A. SUBSURFACE SOILS

Soil removal by installing large diameter soil borings with possible ISTD of soils are the corrective measures that would help reduce source area contamination at Whirlpool site. ISTD has been applied in similar sites. In this process, the heat flows downward by radiation and thermal conduction. The consequent increase in the soil temperature results in the removal of contaminants in the subsurface soils. Contaminant vapors or volatile decomposition products are carried by the vacuum to the surface where they are collected into a vapor treatment device. This method is designed to reduce and/or eliminate the concentration of TCE in subsurface soils. Additionally, use of thermal desorption technology, as opposed to physical removal of the soil, will not endanger nearby structures and the elevated subsurface temperatures following treatment will encourage biological destruction of remaining TCE and daughter products. Lower concentrations of TCE in the soils will reduce the concentration of TCE transferred from the soil into the groundwater. This remedy will be coupled with an institutional control to prevent unauthorized excavation of the on-site impacted soils. The floor and foundation of the building should remain in place as a component of the remedy since they provide containment for the contaminated soil and prevent the surface water infiltration of the soil. If the floor and foundation is removed in whole or in part in the future, such removal would be contingent upon prior ADEQ approval and the investigation of subsurface soils at the proposed location of floor and foundation removal.

B. GROUNDWATER

In-Situ Chemical Oxidation/Reduction to reduce areas of elevated TCE concentrations in groundwater, coupled with Monitored Natural Attenuation would be effective in lowering the concentration of TCE in the groundwater both off-site and on-site to the RALs provided laboratory tests deem these to be viable remedies. These remedies will also be coupled with an institutional control to ensure that there is no on-site use of the contaminated groundwater.

10. SELECTED REMEDY/SITE PLAN

A. SURFACE AND SUBSURFACE SOILS

Soil removal via soil boring installations with possible ISTD is the chosen remedy for the unsaturated subsurface soil. Whirlpool is required to submit a Work Plan to conduct further soil removal or to perform a pilot test to evaluate the feasibility of ISTD for the site within 45 day of notice from ADEQ, if the December 2015 technical review reveals Whirlpool's actions have not achieved the soil remedy goals defined in 2013 RADD. If the data obtained shows reduction of TCE concentration in the soil, the aforementioned remedy will be selected as the final remedial plan for the site soils in the source area, under the building, drainage ditch and the remaining part of Area 1. The building foundation should remain in place and be monitored in order to prevent infiltration of storm water through the soil. In addition, Whirlpool will implement a soil gas monitoring program to be sampled on a quarterly basis. Pending results, sampling frequency will be evaluated to determine if semiannual sampling for the remainder of a five year period is appropriate to ensure that vapor intrusion continues to be an incomplete pathway. Soil gas samples will be collected at approved monitoring points where groundwater concentrations exceed the MCL at or near the soil gas sampling point. In addition, if the review of the December 2015 technical report by ADEQ reveals concentrations of TCE and other hazardous constituents could pose an unacceptable potential exposure via the vapor intrusion pathway, and a deed restriction has not been successfully placed on all of the impacted areas, Whirlpool will be required to initiate a remedy to mitigate such potential risks. Whirlpool may request modification of this section should Whirlpool determine an alternate remedy be evaluated by ADEQ that would achieve the performance standards of this RADD. ADEQ's decision on approval or denial will be timely and not unreasonably withheld.

B. GROUNDWATER

At least two treatment areas of groundwater with elevated TCE concentrations (the source area and the vicinity of well IW-77), one off-site and one on-site have been constructed. These areas will continue to be treated with an in situ chemical treatment (Figures 5 and 6).

In-situ chemical treatments will be completed using combination of permanent wells and DPT temporary points. The first area (the on-site source area) is currently estimated to be 250 feet by 20 feet. The second area (near IW-77) is estimated to be 90 feet by 30 feet. A number of permanent injection wells have been constructed at these two locations as well as the "neck" area separating the southern and northern plumes. Based on subsequent monitoring results it may be necessary to expand these treatment areas and/or re-treat

these areas until a permanent satisfactory reduction trend in TCE concentrations is achieved.

In addition to the chemical treatment remedy, MNA will continue to be conducted for the on-site and off-site plume. The current monitoring wells to be sampled include:

Plume Boundary Wells				
MW-50	MW-60	MW-61	MW-67	MW-66
MW-63	MW-62	MW-36	MW-27	MW-28
ITMW-16	ITMW-2	MW-22	ITMW-4	ITMW-6
MW-29	ITMW-20	MW-26	MW-31	MW-39
MW-40	IW-72	MW-68	MW-96	MW-97
MW-98	MW-99			

On-Site Wells				
MW-25	ITMW-19	ITMW-17	ITMW-11	ITMW-12
ITMW-18	ITMW-15	MW-38	MW-33	MW-65
MW-35R	IW-80	MW-34	MW-32	ITMW-21
ITMW-7	ITMW-10	ITMW-9	ITMW-1	ITMW-13
ITMW-14	MW-85	MW-86	MW-87	MW-88
MW-89	MW-90	MW-83	MW-84	MW-91
MW-92	MW-93	MW-94	MW-95	MW-172

Off-Site Wells				
IW-73	IW-74	MW-41	IW-76	IW-77
MW-71	MW-46R	RW-69	MW-55	MW-56
MW-57	MW-58	MW-81	MW-82	

Plume boundary wells will be analyzed for MNA indicator parameters to determine background values against which plume well parameters can be compared. The monitoring well samples will continue to be tested for COCs (see Table 2) and geochemical properties (see Table 3). In the event of changes in the plume configuration it may become appropriate to add or delete monitoring locations. Whirlpool shall submit a plan to adjust the monitoring network whenever data indicate a change in plume geometry that indicates an expansion or outward movement of the plume boundary or otherwise warrants a change in the monitoring plan.

C. Placement of an Institutional Control

In order to further protect human health and prevent future groundwater use from the aquifer, institutional controls (ICs) have been implemented at the facility. A deed notification has been filed with the appropriate land records office. The deed notification identifies the kinds of contaminants present, and describes activities that should not be conducted at the facility and grant site access to ADEQ. During the performance of routine groundwater monitoring at the facility, a facility evaluation shall be conducted to confirm that there is no on-site use of the contaminated groundwater.

A deed restriction, prohibiting use of groundwater onsite, was filed on 4th day of April, 2014 with the Real Estate Records of Sebastian County, Arkansas.

11. EFFECTIVENESS MONITORING PROGRAM

A Quarterly Progress Report summarizing all remediation activities undertaken during the preceding calendar quarter should be submitted to ADEQ. The quarterly report shall include the following information:

- Soil Gas Monitoring Report – To monitor the soil gas concentration to confirm the groundwater-derived vapors are not migrating and that vapor intrusion continues to be an incomplete pathway.

- Groundwater Monitoring Report – To monitor the concentration of COCs in the groundwater including TCE and daughter products (Table 2), and the geochemical parameters (Table 3) necessary to verify the effectiveness of the natural attenuation.

An Annual Progress Report summarizing the results of the groundwater remedial activities shall be submitted annually on January 15 for the previous years' activities to the citizens residing in the neighborhoods north of the Facility, city council, and ADEQ.

Two years after initiating the remediation outlined in this RADD, Whirlpool is required to submit a technical review of the remedial activities and status of the remediation at the Whirlpool facility. This technical review shall assess the need for necessary further action beyond continued MNA. If after two years, there is not a significant reduction in COCs, Whirlpool will be required to submit plans for a separate remedial alternative to address the subsurface soils and on and off-site groundwater. The alternative remedial plan must be submitted within forty-five (45) calendar days of written notice by ADEQ that MNA has been determined to not have the capability of effectively reducing the COCs on-site to below RALs, and reducing COCs to below MCLs in off-site groundwater within a reasonable period of time.

12. SCHEDULE

A Final Remedy Work Plan containing the design specifications was submitted on July 16, 2013.

- All work plans submitted by the facility shall be updated to include the requirements of this RADD within 30 days of the effective date of the RADD.
- Whirlpool shall begin remediation of the TCE plume within 60 days after the effective date RADD.
- Within sixty (60) days of the effective date of this RADD, the Facility must provide documentation of deed restrictions or other legally binding restrictive mechanism for the facility which is impacted by the groundwater contamination.
- Quarterly reports will be due on February 15, May 15, August 15, and November 15 for the previous quarter's activities. Due to the due date of the two year technical review, the 2015 Fourth Quarter report is due on January 29, 2016.
- Annual Progress Reports are due on January 15 for the previous years' groundwater remediation activities. Due to the due date of the two year technical review, the 2015 Annual Progress Report is due on January 29, 2016.
- The technical review of the remedial activities, as well as the 2015 Annual Progress Report and the 2015 Fourth Quarter report, will be due January 29, 2016.

13. NOTIFICATION REQUIREMENTS AND ASSESSMENT OF NEWLY-IDENTIFIED AREAS OF CONCERN (AOCs)

1. The Facility shall notify the Director, in writing, of any newly-identified AOC(s) (i.e., area with potential contamination not specifically identified within the RADD or during the investigation). This notification must be submitted no later than fifteen (15) calendar days after discovery. The notification shall include the following items, to the extent available:

    a. the location of the newly-identified AOC in relation to other AOCs;
    b. the type and function of any waste management units in the area;
    c. the general dimensions, capacities, and structural description of the area (supply available figures and drawings);
    d. the period during which the operations were conducted at or in the area around the AOC;
    e. the specifics on wastes that have been or are being managed at the AOC, to the extent available; and
    f. the results of any sampling and analysis required for the purpose of determining whether releases of hazardous wastes, including hazardous substances, have occurred, are occurring, or are likely to occur from this unit.

2. Based on the results of this Notification, the Director will determine the need for further investigations or corrective measures at any newly-identified AOC(s)

covered in the Notification. If the Director determines that such investigations are needed, the Director may require the facility to prepare a plan for such investigations.

3. All Remedial Action Levels established in the RADD will be applicable to these newly identified AOC(s).

14. NOTIFICATION REQUIREMENTS FOR NEWLY-DISCOVERED RELEASES AT AOC(s)

The Facility shall notify the Director, in writing, of any release(s) of hazardous waste or hazardous substances discovered during the course of ground water monitoring, field investigation, environmental auditing, or other activities undertaken after the commencement of any environmental investigation, no later than fifteen (15) calendar days after discovery. Such newly-discovered releases may be from newly-identified areas, from areas for which, based on the findings of the previous investigation, the Director has previously determined that no further investigation was necessary, or from areas investigated or discovered as part of the investigations. The Director may require further investigation and/or Interim Measures for the newly-identified release(s). All Remedial Action Levels established in the RADD will be applicable to these newly identified releases.

15. COMMUNITY RELATIONS PLAN

Whirlpool has made a commitment to the City of Fort Smith and the citizens of Fort Smith to be open and responsive regarding the TCE plume at the former Whirlpool facility. Whirlpool meets with the City Directors when requested and maintains a website where all reports are located. In addition, Whirlpool shall notify each affected property owner within thirty (30) days after the concentrations in the groundwater TCE plume initially exceeds the MCL at a location not previously so notified. Whirlpool shall also notify each affected property owner within thirty (30) days if the groundwater plume falls below the MCL. A copy of these notices must be concurrently provided to ADEQ.

16. COMMUNITY PARTICIPATION

The notice of the RADD will be published in the Times Record by ADEQ to receive public comment. The public comment period for this RADD is thirty (30) calendar days. Due to public interest, ADEQ will hold a public meeting (public hearing). The day and time of the meeting will be included in the public notice.

Documents that aided in the development of this RADD are included in the administrative record. The administrative record for Whirlpool may be reviewed at the following locations:

Arkansas Department of Environmental Quality
Public Outreach and Assistance Division
5301 Northshore Drive
North Little Rock, AR 72218-5317

Or

Fort Smith Public Library
3201 Rogers Ave
Fort Smith, AR 72903

17. COORDINATION WITH OTHER DIVISIONS/AGENCIES

It is important to involve/inform other divisions of ADEQ and other agencies as applicable, in the development of a RADD. To keep the USEPA informed of all remedial action work, the USEPA Region 6 will be provided a copy of the Public Notice and RADD for review and comment.

INTERNAL COORDINATION

ADEQ Divisions	Sent Notice of Decision
Water	Yes
NPDES	Yes
Air	Yes
Solid Waste	Yes
Regulated Storage Tanks	Yes
Environmental Preservation And Technical Services	Yes
Mining	Yes

EXTERNAL COORDINATION

Other State and Federal Organizations	Sent Notice of Decision
U.S. EPA, Region 6	Yes
AR Office of Emergency Services	No
AR Dept. of Health	Yes
AR State Clearinghouse	Yes
AR State Historic Preservation	Yes
AR Natural Heritage Commission	Yes
AR Game & Fish Commission	Yes
U.S. Army Corps of Engineers	Yes

The RADD was also sent to all applicable branches/sections of the Hazardous Waste Division, and to all division and agencies listed above.

TABLES

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Table 1- Comparison of Remedial Alternatives

Remedial Alternative	**Overall protection of human health and the environment**	**Compliance with ARAR**	**Long term effectiveness**	**Reduction of toxicity, mobility, or volume through treatment**	**Short term effectiveness**	**Implementability**	**cost**	**Community Acceptance**
No Action	No	No	No	No	No	No	N/A	No
In-Situ Thermal Desorption and Soil Borings	Yes	Yes	Yes	Yes	Yes	Yes	$4,427,857	Acceptable since it reduces the COCs
Containment – Horizontal Barriers (Asphalt Cover)	Yes, protective on-site	Yes	Yes, regular maintenance is required	No, only reduces mobility of water through source area	Yes	Yes	$600,000	Acceptable if coupled with restrictive covenant
Containment – Vertical Barriers (Slurry Wall)	Yes	Yes	Yes	No, only reduces mobility of on-site impacts to off-site	Yes	Yes, however due to electric substation next to facility, difficult to implement.	$2,100,000	Potentially Acceptable
Removal – Soil (Excavation and Disposal)	Yes	Yes	Yes	Yes, reduces volume of contaminated soil	Yes, minimal effect due to high level of COCs in the groundwater comparing to soil	No, due to physical constraints like depth of contamination, surrounding structures & subsurface utilities	$9,500,000	Acceptance not likely due to limited benefit to the concentration of COCs in the groundwater
Removal - Groundwater – Extraction Wells and Extraction Trench (Pump & Treat)	Yes	Yes	Yes, reduces toxicity	Yes, reduces mobility of on-site impacts to off-site and reduces	Yes, effective in transmissive portions of aquifer	Potentially however difficult due to physical constraints like the presence of utilities and structures in addition to variation in	$3,200,000	Potentially Acceptable

Table 1- Comparison of Remedial Alternatives

Remedial Alternative	Overall protection of human health and the environment	Compliance with ARAR	Long term effectiveness	Reduction of toxicity, mobility, or volume through treatment	Short term effectiveness	Implementability	cost	Community Acceptance
				toxicity		the flow of groundwater		
In-Situ Treatment-Chemical Oxidation/ Reduction	Yes	Yes	Yes, reduces source COCs which in turn reduces the plume	Yes, reduces toxicity	Yes, reduces toxicity in a short period of time	Yes, it is effective in areas of elevated TCE concentrations but not favored site wide due to large number of wells required.	$4,500,000	Acceptable since it reduces the COCs
In-Situ Treatment – Permeable Treatment Beds	Yes	Yes	Yes, reduces COCs	Yes, reduces mobility and toxicity	Yes, minimally effective due to the need for groundwater to pass through the media	Potentially, however difficult due to physical constraints like the presence of structures and utilities and low groundwater flow	$4,800,000	Potentially Acceptable
In-Situ Treatment – Enhanced Biodegradation	Yes	Yes	Yes, reduces source COCs	Yes, reduces volume, mobility and toxicity	Yes, time is required to reduce the concentration of COCs	No, use may be limited due to high COC concentration	$2,300,000	Potentially Acceptable
Monitored Natural Attenuation	Yes	Yes	Yes, COCs decrease over time	Yes, reduces volume, mobility and toxicity	No, minimally effective due to time required	Yes	$900,000	Potentially acceptable when combined with on-site remedy
Institutional Controls – On-site	Yes	Yes	Yes	No Reduction	Yes	Yes	TBD	Potentially acceptable when combined with additional remedial option

Table 1- Comparison of Remedial Alternatives

Table 2. Constituents of Concern

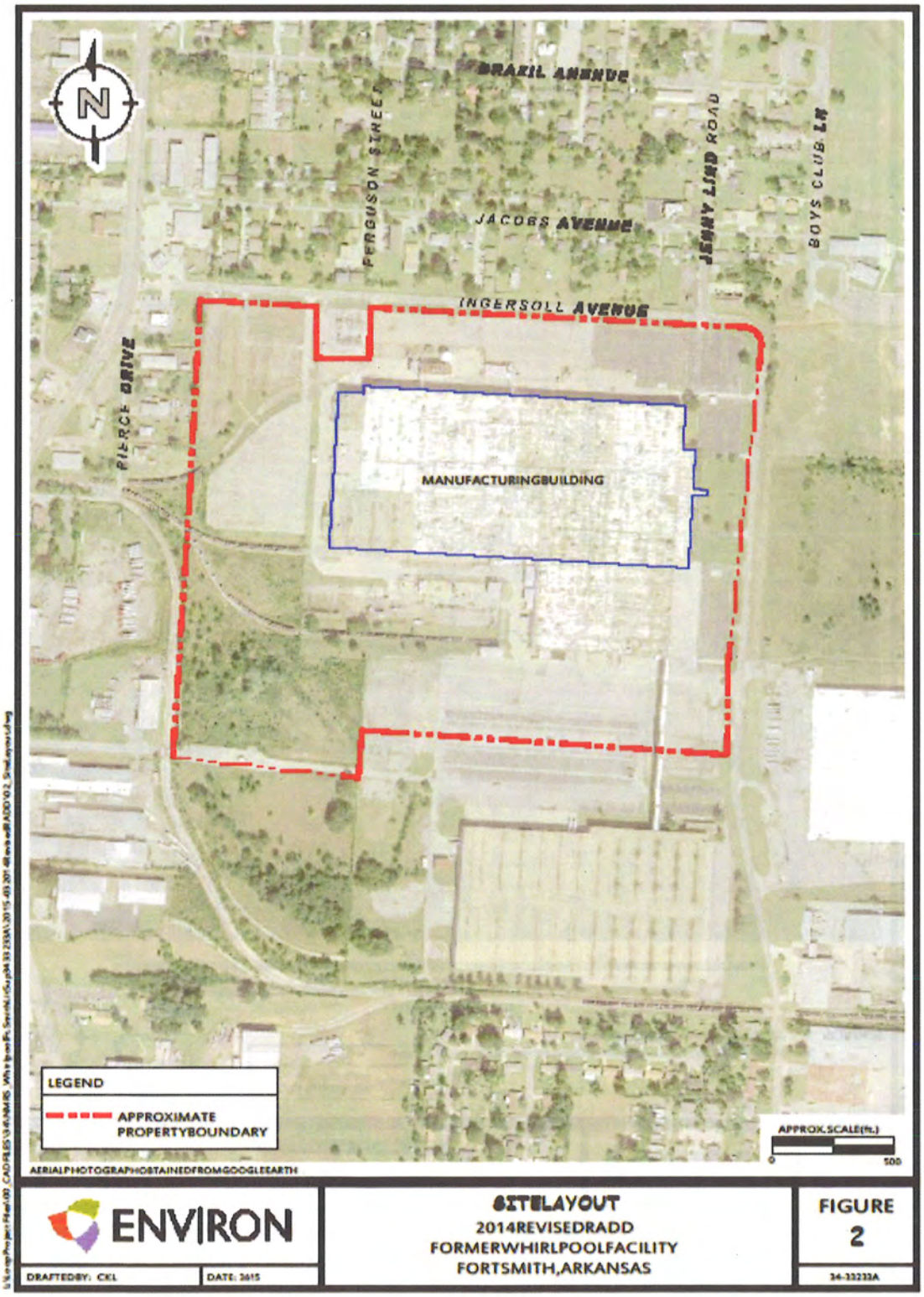
Acetone
Benzene
Bromodichloromethane
Bromoform
Bromomethane
2-Butanone
Carbon Disulfide
Carbon Tetrachloride
Chlorobenzene
Chloroethane
Chloroform
Chloromethane
Dibromochloromethane
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethene
cis-1,2-Dichloroethene
trans-1,2-Dichloroethene
1,2-Dichloropropane
1,3 Dichloropropene
Ethylbenzene
2-Hexanone
4-methyl-2-pentanone
Methylene chloride
Styrene
1,1,2,2-Tetrachloroethane
Tetrachloroethene (PCE)
Toluene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethene (TCE)
Vinyl chloride
Xylenes (total)

Table 3. MNA Evaluation Constituents

Analysis
Ethene/Ethane
Methane
Manganese
Dissolved Oxygen
Nitrate/Nitrite
$Iron^{+3}$
Sulfate
$Iron^{+2}$
Sulfide
Oxidation Reduction Potential (ORP)
pH
Total Organic Carbon
Temperature
Specific Conductance
Carbon Dioxide
Acetylene
Chloroethanol
Alkalinity
Chloride
Hydrogen
Volatile Fatty Acids (Acetic Acid)
Phosphate
Ammonia
Dehalococcoides
Vinyl Chloride Reductase

FIGURES

Figure 1. Portion of USGS 7.5 minute quadrangle showing topography at Whirlpool facility and approximate location of property boundary



ENVIRON

DRAFTEDBY: CKL | DATE: 2015

SITELAYOUT
2014REVISEDRADD
FORMERWHIRLPOOLFACILITY
FORTSMITH,ARKANSAS

FIGURE 2

34-33233A

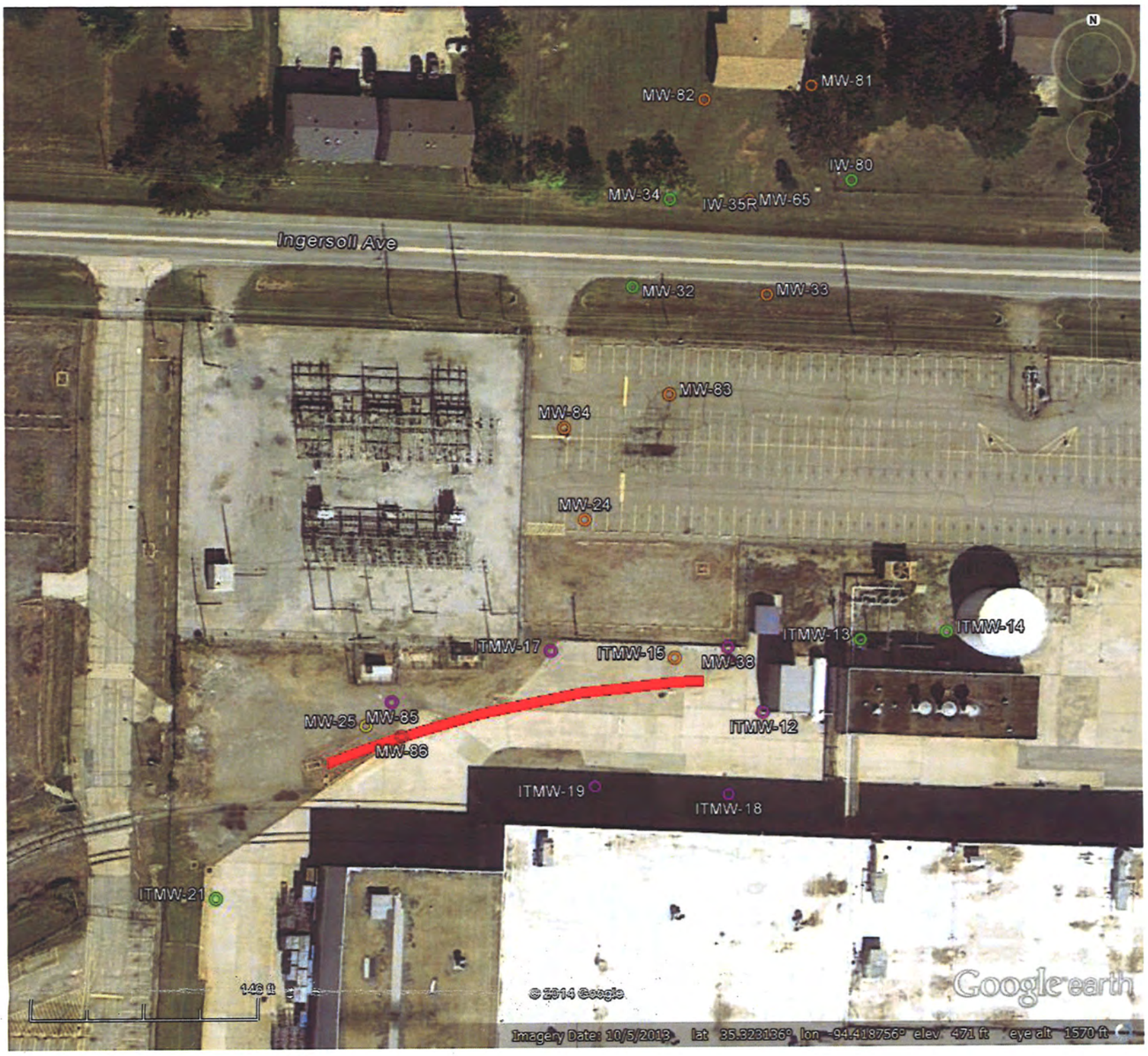


Figure 3. TCE contamination source area (red line) at northwest corner of manufacturing building.

Figure 4. Groundwater monitoring well locations with TCE concentrations.

Figure 5. Approximate location of source area near northwest corner of manufacturing building.

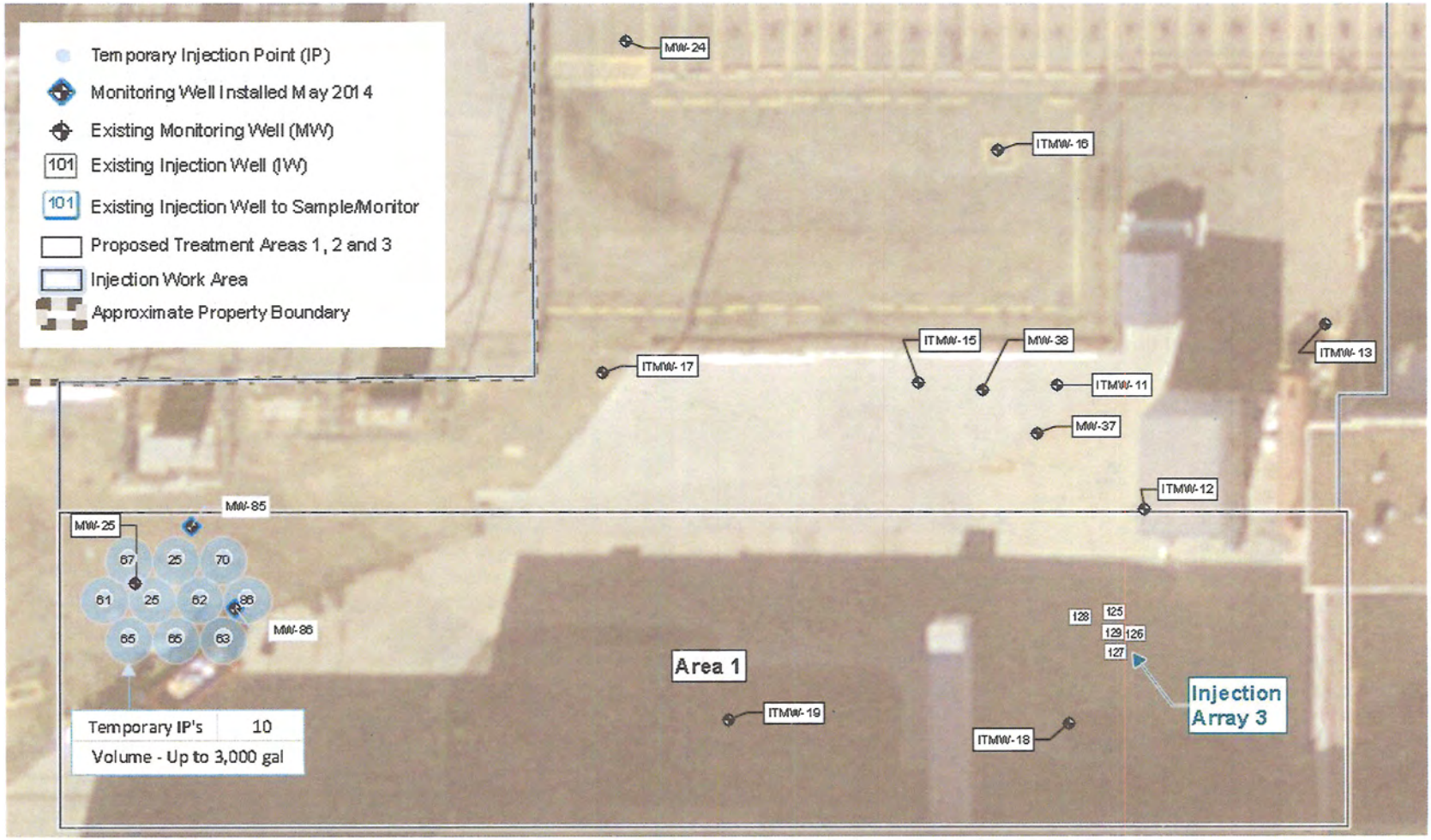


Figure 6. Area of elevated TCE concentration in source area (Area 1) with existing monitoring wells.

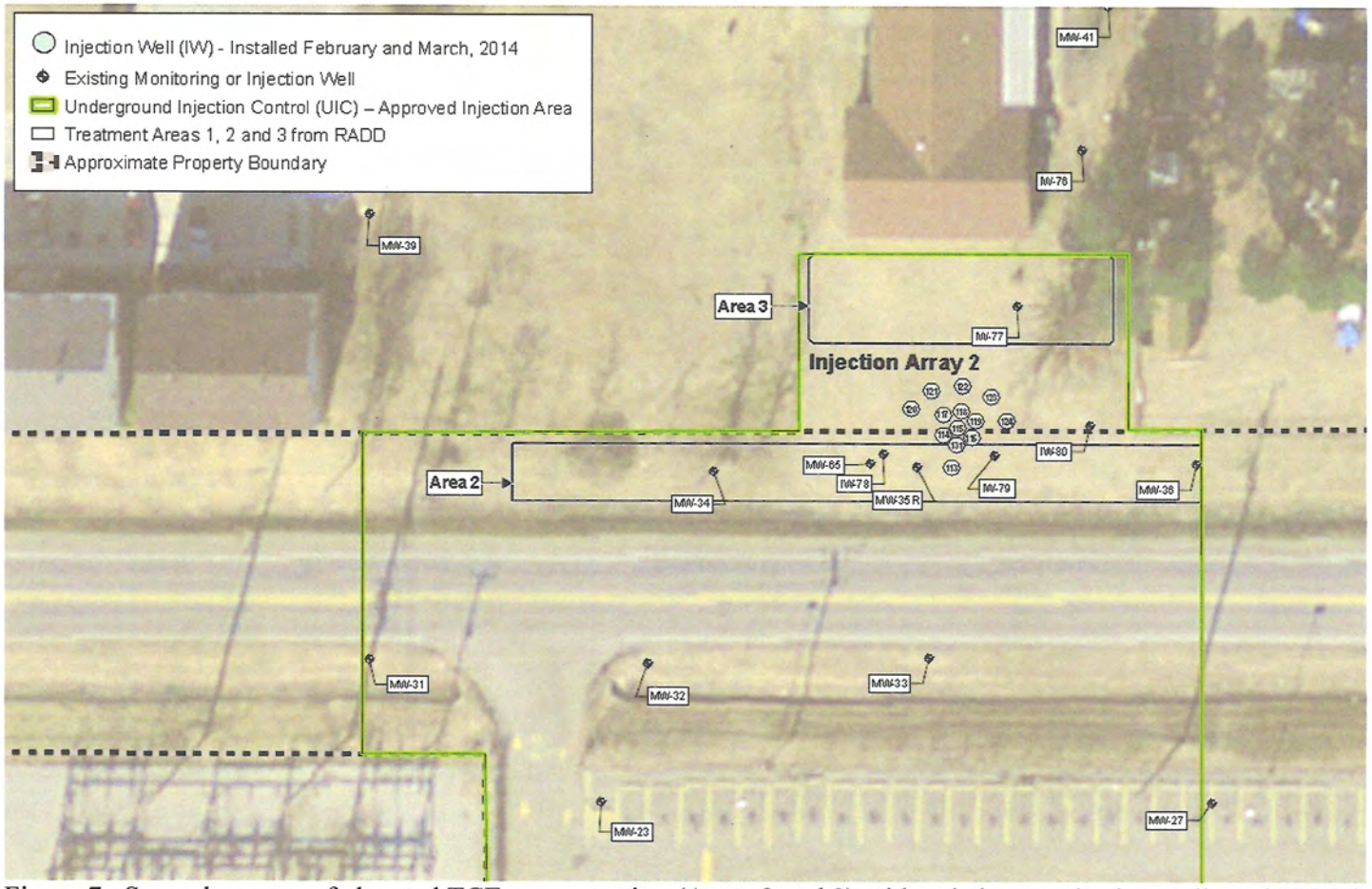


Figure 7. Secondary area of elevated TCE concentration (Areas 2 and 3) with existing monitoring wells and ISCO injection points. -.