

Revised Groundwater Monitoring Plan

Whirlpool Facility - Fort Smith, Arkansas

EPA No. ARD042755389

AFIN No. 66-00048

CAOI LIS 13-202

Prepared for:
Whirlpool Corporation

Prepared by:
Ramboll Environ US Corporation

Date:
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Project Number:
34-37500P

Author

Professional Geologist/Reviewer

STATE OF ARKANSAS
REGISTERED PROFESSIONAL GEOLOGIST
No. 1825
ANDREW A. GREMOS

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ENVIRONMENT
& HEALTH

Mr. Mostafa Mehran
Arkansas Department of Environmental Quality
5301 Northshore Drive
North Little Rock, Arkansas 72118

RE: Revised Groundwater Monitoring Plan
Whirlpool Facility – Fort Smith, Arkansas
EPA No. ARD042755389
AFIN No. 66-00048
CAO LIS 13-202

Dear Mr. Mehran:

Date September 20, 2016

Ramboll Environ
1807 Park 270 Drive
Suite 320
St. Louis, MO 63146
USA

T +1 314 590 2950
F +1 314 590 2951
www.ramboll-environ.com

Ramboll Environ US Corporation (Ramboll Environ), on behalf of Whirlpool Corporation (Whirlpool), is pleased to present this revised monitoring plan. The revised plan responds directly to comments provided by the Arkansas Department of Environmental Quality (ADEQ) on the Proposed Groundwater Monitoring Plan in its July 18, 2016, letter, during our meeting on July 19, 2016 and its September 9, 2016, letter. This Revised Groundwater Monitoring Plan is considered the written response to ADEQ comments dated September 9, 2016 and received on September 12, 2016. This monitoring plan is proposed to be implemented at the former Whirlpool Fort Smith property (Site) after ADEQ approval.

The Remedial Action Decision Documents (RADDs) (December 2013 RADD and November 2015 Revised RADD) indicate that the monitoring program at the Site would be evaluated two years after background conditions are established. To date, ten quarterly monitoring events (quarterly monitoring in 2014 and 2015 and first and second quarters 2016[1]) have been completed for all compounds identified in Tables 2 and 3 of the RADD consisting of volatile organic compounds (VOCs) and 25 monitored natural attenuation (MNA) parameters and measurement of water quality parameters [turbidity, dissolved oxygen (DO), specific conductance, temperature, pH and oxidation reduction potential (ORP)]. In addition, many groundwater monitoring wells have been monitored for a period of 20 or more years (VOC and water quality data) creating an extensive database. A review of this large volume of data has: (1) facilitated establishment of background conditions; (2) provided a firm basis for statistical analysis indicating concentration trends are stable to

[1] As of this date, the 2016 second quarter data has not been completely assessed and will be timely submitted later this month.

decreasing[2]; and (3) enabled well-founded determinations of both the locations at which continued monitoring would be prudent and adequate and optimal parameters meriting future monitoring.

This groundwater monitoring plan was developed to satisfy five objectives consisting of:

- Monitoring the north, south and northeast plume boundaries (thereby safeguarding and detecting any potential plume expansion);
- Monitoring to detect any unanticipated changes in groundwater conditions that could pose potential human health risks (in the event of a future complete exposure pathway) (safeguards protecting against complete exposure pathways are now in place including well drilling bans and engineering controls/deed restrictions on parcels within the plume boundary, neither of which existed two years ago when the monitoring plan in the 2013 RADD was prepared);
- Tracking the continuing effectiveness and rate of MNA at the Site;
- Assessing rebound in treatment areas and potential impacts to groundwater down-gradient of the treatment areas; and
- Assessing potential for vapor intrusion by continued monitoring of existing shallow groundwater monitoring wells and soil vapor points in residential areas.

Specific wells have been chosen to meet these objectives by means of analysis either every six months (semi-annual) or every year (annual). The locations and frequency of monitoring are appropriate given the history of chemical concentrations [trichloroethylene (TCE), cis-1,2-dichloroethylene (cis-1,2-DCE), vinyl chloride (VC), ethene, etc.)] and associated trends that are well established by the extensive database from the groundwater monitoring already conducted, the proximity of certain monitoring wells to specific plume boundaries and the suitability of certain well locations to serve as sentinel wells.

The objectives for the groundwater monitoring plan are supported by the following conclusions in the Two Year Technical Review Report[3]:

[2] These trends are depicted on Figure 5 Average Concentrations vs. Time (All Wells); Figure 6 Average Concentrations vs. Time (Northern Plume Wells); Figure 7 Average Concentrations vs. Time (Southern Plume Wells); and, Figure 8 Average Concentrations vs. Time (Source Area Wells) provided in the First Quarter 2016 Groundwater Monitoring Report (May 2016). As typical with groundwater plumes of this nature, a few wells exhibit increasing concentrations. These wells, including but not limited to ITMW-10 and MW-61, are described in the subject monitoring report.

[3] ADEQ provided comments on the Two Year Technical Review Report in a comment letter dated March 15, 2016 and a response to ADEQ comments was submitted on April 15, 2016. On May 23, 2016, ADEQ acknowledged the responses to the Two Year Technical Review Report, requested a groundwater monitoring plan and action plan with specific trigger points and acknowledged that ADEQ will make a determination concerning a soil remedy in light of future monitoring data.

- No unacceptable exposures exist onsite since the facility is not occupied or in use and there are no unacceptable exposures to trespassers who may access the Site[4].
- There are no unacceptable exposures to offsite residents, offsite routine workers or offsite utility maintenance workers.
- Analytical results for VOCs in groundwater demonstrate that natural attenuation of TCE is occurring via a combination of chemical, geochemical and biological mechanisms in areas of the southern, northern and northeastern plumes, as demonstrated by, among other things, the presence of the reductive dechlorination byproducts cis-1,2-DCE and VC.
- The fate and transport model projects groundwater in the south plume will not migrate offsite beyond the property boundaries at concentrations above the maximum contaminant level (MCL). TCE breakdown constituents (e.g. cis-1,2-DCE and VC) are expected to degrade in a similar manner and timeframe as TCE in the south plume, based upon regression analysis of site specific data.
- The fate and transport model projects the TCE concentration in groundwater in the north plume will be reduced to the MCL within approximately 30 to 35 years. TCE breakdown constituents (e.g. cis-1,2-DCE and VC) are expected to degrade in a similar manner and timeframe as TCE in the north plume, based upon regression analysis of site specific data.

The remainder of this document discusses the proposed groundwater monitoring plan and the associated action plan in the event of unanticipated groundwater condition changes.

GROUNDWATER MONITORING PLAN

Monitoring well locations have been included in the monitoring plan for the north, south and northeast plumes. The wells and parameters selected to be monitored are listed on Table 1 and the well locations are depicted on Figure 1. Groundwater monitoring is proposed to be completed during two separate events each year. A semi-annual event will be held during March or April (primarily focused on plume boundaries and wells in the source area) and an annual event will be held during October or November to account for possible seasonal fluctuation. A letter report summarizing the data from the semi-annual spring sampling event will be provided to ADEQ by July 15 of each year. An Annual Report documenting and analyzing both sampling events and other activities or actions completed during the previous year will be submitted to ADEQ by February 15 of each year.

A five year remedy review will be performed summarizing activities for the years 2016 through 2020 with the Five Year Remedy Report due on or before February 15, 2021.

[4] Indoor air monitoring indicates that TCE concentrations within the building are below screening levels for commercial/industrial workers. The second indoor air monitoring event identified only one of six areas monitored in the building which exceeded screening levels for TCE and further monitoring will be performed when the future purpose of the building is determined to assess indoor air quality.

All sampling events will include the collection of static water level measurements and the use of standard operating procedures as described in the following sections.

Static Water Level Measurements

At the start of each monitoring event, static water level and total well depth measurements will be collected in each of the monitoring wells sampled, plus the wells at the down-gradient north plume boundaries, wells at the down-gradient northeast plume boundaries and wells at the down-gradient south plume boundaries[5]. Groundwater flow directions during monitoring events will be assessed at these locations to confirm groundwater flow directions in these areas remain consistent with historic groundwater flow directions.

Other monitoring wells where water levels are not measured will be inspected to make sure the wells are not damaged. Damaged wells will be noted and repairs scheduled accordingly.

Monitoring Well Sampling

After water level measurements have been collected, low flow sampling will be completed at each well at the schedule prescribed in Table 1. During low flow sampling, tubing will be placed at a depth within the well at approximately the midpoint of the well screen. The well will then be purged in accordance with the USEPA Low Stress (low flow) purging procedures (USEPA 1996); at a rate generally less than 0.1 liter (L)/minute to minimize the amount of drawdown in the well and to reduce the likelihood of elevated turbidity. Flow rates and drawdown will be checked continuously during purging. Purge water will be placed into a container for transfer to the onsite water holding tank for ultimate proper disposal.

Water quality parameters will be measured via a water quality probe and flow thru cell. Instruments will be calibrated daily prior to the start of sampling at a minimum. Readings will be recorded approximately every five minutes until the parameters stabilize. Stabilization will be considered obtained when three consecutive rounds of parameter readings meet the following requirements:

- Turbidity: +/- 10% for values greater than 10 Nephelometric Turbidity Unit (NTU), or less than 10 NTU;
- DO: +/- 10% for values greater than 0.5 milligrams per liter (mg/L);
- Specific Conductance: +/- 3%;
- Temperature: +/- 1°C;
- pH: Within +/- 0.1 standard units; and
- ORP: Within +/- 10 millivolts (mV).

[5] The water level meter will be calibrated by the manufacturer prior to use and therefore calibration in the field will not be necessary. Water levels will be measured to the nearest 0.01 foot with an accuracy of 0.02 foot per the manufacturers' specification. The water level meter probe and tape will be decontaminated prior to use at each well by spraying and scrubbing the probe and tape with Alconox detergent mixed with distilled water and then rinsing with distilled water prior to being wiped dry.

In addition, ferrous iron will be measured at each well location using a field instrument after purging.

Groundwater samples will be obtained by directly filling the laboratory provided sampling bottles from the pump discharge. Samples for assessing quality assurance/quality control (QA/QC) metrics will be collected by alternately filling investigative and QA/QC sample bottles for each parameter. Duplicate samples will be taken at a frequency of one duplicate sample per ten groundwater monitoring samples and matrix spike/matrix spike duplicate (MS/MSD) samples will be taken at a frequency of one sample per 20 groundwater monitoring samples. Equipment rinsate blanks will also be collected after decontamination of the water level meters to assess field decontamination procedures.

Sample containers will be labeled and packed on ice in insulated coolers before being shipped under chain of custody via overnight courier or FedEx to the laboratory. Chain of custody procedures will be followed from the point of sample collection through completion of analysis. Laboratories generally use infrared thermometers to take sample temperatures upon sample receipt in accordance with USEPA Manual for the Certification of Laboratories Analyzing Drinking Water, Fifth Edition.

Analytical Parameters

All groundwater samples collected during the semi-annual and annual groundwater monitoring events will be analyzed for VOCs using EPA Method 8260. The VOCs to be analyzed consist of the constituents of concern listed in Table 2 of the RADDs.

Groundwater samples from certain designated monitoring wells in the north, south and northeast plumes are proposed to be analyzed for an optimized set of MNA parameters on an annual basis (Table 1). This optimized set of MNA parameters for laboratory analysis includes methane, ethane, ethene, ferric iron, sulfate, nitrate, total organic carbon (TOC), Dehalococcoides (DHC), VC reductase (other MNA parameters will be measured with field instruments during well purging as discussed above), sulfide[6], acetylene[7] and dissolved hydrogen. Continued monitoring of these parameters will create and maintain the requisite database necessary to continue to assess the effectiveness and progress of natural attenuation in the plumes, including contaminant degradation rates. Ramboll Environ believes strongly that further monitoring of the other MNA parameters listed in the RADD will not contribute to nor improve our understanding of site conditions or the progress and verification of MNA over time.

[6] It is important to note that sulfide has been detected a total of eight times out of a total of 580 sample points and the remaining 572 sample results were all non-detect. Sulfide concentrations have shown little variability with time but will continue to be monitored as requested during the next monitoring phase.
[7] Although acetylene is a degradation product of abiotic dechlorination of tetrachloroethylene (PCE) and TCE (Butler and Hayes, 1999[8]; Lee and Batchelor, 2000[8]), this compound has only been detected in 19 of 580 sampling results during the last nine quarters of sampling. Acetylene will continue to be monitored as requested during the next monitoring phase.

After evaluating nine quarters of monitoring data for all of the MNA parameters listed in Table 3 of the RADD [the data from the second quarter of 2016 is currently under evaluation (i.e. tenth quarter of data)], a comprehensive amount of data has been obtained to establish baseline groundwater conditions at onsite and offsite locations. Going forward it is important to collect additional data that will provide indications of changes which may affect the rate or extent of natural attenuation versus the baseline data, which have already been established throughout the plumes. Given our current site understanding, refining both the number of parameters sampled and the locations where the samples are collected is appropriate and justified.

MNA parameters proposed to be discontinued in future monitoring events include: manganese, carbon dioxide, alkalinity, chloride, acetic acid, phosphate and ammonia. The rationale for excluding these parameters from this proposed groundwater monitoring plan is summarized below.

- Manganese concentrations range from non-detect (<0.005 mg/L) to approximately 20 mg/L. Although manganese concentrations are relatively low in the groundwater, the concentrations significantly vary over time within the same area. The majority of the wells show manganese concentrations less than 1 mg/L, which indicates that manganese is not being used as a predominant terminal electron acceptor in the Site groundwater. Therefore, manganese is not recommended for further monitoring. Also manganese is recommended to be sampled for “one round of sampling” based upon the USEPA guidance document Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water[8], we currently have nine rounds of manganese data for the Site.
- Carbon dioxide has been detected over a wide range of concentrations from less than 20 mg/L to greater than 8,000 mg/L in groundwater whereas methane, ethane and ethene were detected at low concentrations or were non-detect in groundwater samples, which may be due to low levels of TOC present in the groundwater. However, some wells showed elevated levels of ethene and therefore, it is appropriate to continue monitoring methane, ethane and ethene in the wells selected for further MNA sampling based on the data collected to date and to discontinue carbon dioxide. Also as noted in the March 7, 2016, Fate and Transport Model Question Response by Ramboll Environ, carbon dioxide concentrations are a function of TCE and iron concentrations. Since both TCE and iron will continue to be monitored directly, carbon dioxide results will not be a valuable parameter or add anything to our understanding of the plume, moving forward.
- Volatile fatty acids (VFAs) (acetic acid) have been non-detect at all but six sample points where acetic acid has been present at very low levels in groundwater samples. Therefore, it is appropriate to remove VFAs from further monitoring.

[8] Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water**,** EPA/600/R-98/128.

- The alkalinity of the groundwater is relatively low with many of the groundwater samples showing alkalinity concentrations less than 100 mg/L. Since there is minimal variability in the alkalinity results received to date, it is appropriate to remove this parameter from further monitoring. The baseline is well established.
- Chloride concentrations in groundwater at the Site are relatively stable over the nine monitoring events completed to date. The majority of wells show chloride concentrations greater than 100 mg/L however these elevated chloride concentrations do not necessarily correspond to elevated VOC levels in the same wells. An evaluation of the results shows that there are significant background levels of chloride throughout the majority of the wells sampled and therefore there is no benefit to monitoring chloride further.
- Chloroacetylene was removed from the list of parameters since an accredited laboratory to perform the analysis is not available.
- Major nutrients, ammonia and phosphate, were evaluated in groundwater and the results indicate that the groundwater contains low levels of ammonia. Likewise, phosphate was detected at concentrations ranging from non-detect (<0.03 mg/L) to approximately 95 mg/L with the majority of results less than 1 mg/L, which suggests that phosphate is present in non-limiting concentrations to the indigenous microbial community in some areas. Since the ammonia levels have been relatively consistent between the sampling events, it is appropriate to remove ammonia from further monitoring. It is also appropriate to remove phosphate from further monitoring because the concentrations of phosphate are low in groundwater.

REBOUND

Rebound is a term used when concentrations of a constituent of concern (COC) in groundwater are observed to decrease following the implementation of a remediation technology and then increase at a later time. Rebound may be the result of back diffusion of COCs out of low permeability media; incomplete treatment of sorbed TCE followed by re-equilibration with the aqueous phase; or other processes[9].

Rebound is an expected phenomenon and is known, in particular, to be a common occurrence when using in-situ chemical oxidation (ISCO) as a source area remedy, as noted in the June 29, 2015, letter submitted to ADEQ titled *Methods for Assessment of Constituent Concentration Rebound* by Ramboll Environ. A rebound condition does not necessarily mean that the ISCO injection event has failed. Rebound can be an indication of the positive effects of the transfer of contaminants to the more treatable aqueous phase. ISCO was performed at the site using base-activated sodium persulfate (BASP) (Areas 1 – 3 and Neck Area) and Modified Fenton's Reagent (MFR) (west portion of Area 1). The capacity of these oxidants to effectively oxidize TCE dissipates within approximately 2 to 3 months (depending upon pH)

[9] ISCO for Groundwater Remediation: Analysis of Field Applications and Performance; Krembs, Siegrist, Crimi, Furrer and Petri; Groundwater Monitoring and Remediation 30, No. 4, Fall 2010, pages 42–53 (Peer reviewed reference).

for BASP and within two to three weeks for MFR. Based upon the active life-span for the BASP and MFR oxidants and groundwater flow conditions, the assessment of rebound should be limited to approximately one to two years post-ISCO (i.e. subsequent fluctuations in TCE concentrations more than one to two years after ISCO are due to conditions other than rebound).

Before assessing rebound, an evaluation of variability should be performed to assess groundwater conditions at the respective monitoring wells. Variability consists of inconsistent constituent or oxidant concentrations or field parameters varying 10% or more over three consecutive monitoring events. A consistent increase in constituent concentrations is not an indication of variability. Monitoring wells exhibiting low variability consist of: the monitoring wells in Areas 2 and 3, those in the Neck Area and ITMW-18 and ITMW-19 in Area 1. Only two monitoring wells in the ISCO treatment areas continue to exhibit variable TCE concentrations (MW-25 and MW-38) as summarized in Table 3. Monitoring wells adjacent to Area 1 consisting of MW-93 and MW-95 also exhibit variable TCE concentrations. It is premature to assess rebound definitively in treatment areas that continue to exhibit variable TCE concentrations, sodium persulfate concentrations or field parameters. However, further monitoring of those identified wells is warranted and proposed, in order to facilitate more conclusive assessments of rebound at those specific locations.

The calculation of rebound consists of comparing the pre-ISCO concentration in respective wells with the post-ISCO concentration in respective wells. As directed by ADEQ technical staff, the pre-ISCO concentrations at the Site have been calculated as the average of the TCE concentrations for the four quarters of the year prior to performance of ISCO. Several wells used to monitor ISCO were installed immediately prior to performance of ISCO; and therefore, for those particular wells, only limited data prior to the ISCO event is available for comparison. Table 2 summarizes the pre-ISCO concentration data for the listed groundwater monitoring wells.

As directed by ADEQ technical staff, the threshold assessment to identify circumstances where rebound may exist will be done by a formula. The formula is as follows. The concentration detected one full year after the ISCO treatment[10], minus the lowest post-ISCO concentration, shall be divided by the pre-ISCO concentration. If the resulting number is equal to or greater than 25%, a threshold indication of rebound is deemed to exist in the respective well. Mathematically stated: one year post-ISCO concentration - lowest post-ISCO concentration/pre-ISCO concentration ≥25%. However, this presumption of rebound

[10] A qualitative assessment of rebound will continue thereafter, as appropriate.

shall only occur when the lowest post-ISCO concentration is greater than 20% and less than 60% of the pre-ISCO concentration[11].

The reasons for this qualifier are as follows. When the lowest post-ISCO concentration is less than approximately 20% of the pre-ISCO concentration, then an inadvertent penalty for highly successful treatment would otherwise occur with the 25% trigger in the formula. If the lowest post-ISCO concentration is greater than 60% of the pre-ISCO concentration, then the ISCO event was not effective in reducing constituent concentrations versus a rebound condition.

In addition to the preceding formula, as requested by ADEQ technical staff, wells will be considered to be experiencing rebound if the one-year post ISCO concentration is 90% of the pre-treatment concentration as long as effective ISCO treatment occurred in the respective treatment area. Based on the data collected to data, rebound based upon this supplemental criteria is found to be occurring at MW-25 (only). Further discussion of MW-25 is presented below.

In summary and as shown on Table 3, based on these multiple objective criteria: MW-25 exhibits a rebound condition[12]; and MW-38 exhibits less than effective ISCO treatment. Assessment of the variability of TCE concentrations and rebound for the wells in Area 1 is summarized below:

- The percentage change in TCE concentrations in ITMW-18 and ITMW-19 after ISCO was completed exhibits low variability and no indication of rebound is present (i.e. greater than 97% reduction in TCE concentrations observed for these two wells during the last year).
- Post-ISCO TCE concentrations at MW-25 during the last year commencing with the July 2015 monitoring have exhibited increases in concentrations ranging from 86% to

[11] Absent this qualified, an inadvertent "penalty" would occur in instances of highly successful ISCO treatment, as depicted in the table below.

Scenario	Pre-ISCO Concentration (conc. is relative)	Lowest Post-ISCO Concentration	Rebound Occurs at the following One-year Post-ISCO Concentration (i.e. 25%)	Notes
1	100	1	26	A rebound "penalty" occurs at a significantly lower relative concentration with Scenario 1 after achieving a 99% concentration reduction via ISCO vs. Scenario 4 where only a 50% concentration reduction via ISCO occurs.
2	100	10	35	
3	100	25	50	
4	100	50	75	

[12] The lowest post-ISCO concentration at MW-25 was 11.7% of the pre-ISCO concentration which is less than 20% of the pre-ISCO concentration; however, based upon qualitative assessment of data collected after one year post-ISCO, rebound is concluded to be occurring at this location.

221%[13] (see discussion below of MW-86 which is adjacent to MW-25). Further discussion of the rebound condition at MW-25 is presented below.

- Post-ISCO TCE concentrations at MW-38 during the last year have ranged from reductions of 12% to increases of 18% and concentrations have consistently varied with increases and decreases comparing sequential quarterly monitoring data. A post-ISCO decrease in TCE concentration was not observed at MW-38 indicating the effectiveness of ISCO at MW-38 has been limited.
- Post-ISCO TCE concentrations at MW-86 during the last year have ranged from decreases of 75% to 88% of the pre-ISCO concentration. Only slight indications of rebound are present.
- ISCO was not performed in the vicinity of MW-93, MW-94 and MW-95 (interior monitoring wells); therefore, ISCO has not impacted TCE concentrations at MW-93 and MW-95, but TCE concentrations in MW-94 have been decreasing during the past year.

A similar assessment of the calculations for variability and percentage change in concentrations comparing pre-ISCO and post-ISCO concentrations for the wells in Areas 2 and 3 and Neck Area is summarized below:

- Post-ISCO TCE concentrations at IW-77 during the last two quarters since ISCO was performed in October 2015 (initial event in May 2014) have been reduced by nearly 90% compared to pre-ISCO concentration;
- Post-ISCO TCE concentrations at IW-78 have been reduced to less than 5 micrograms per liter (µg/L) (monitoring data from January and May 2016) and no indications of rebound are present; and
- Post-ISCO TCE concentrations at MW-83 have been reduced to less than 5 µg/L (monitoring data from four monitoring events since November 2015) and no indications of rebound are present.

A qualitative review of the data (TCE concentration trends, residual oxidant concentrations and water quality parameters including DO, ORP and pH conditions) and comparison of pre-ISCO and post-ISCO concentrations provided on Table 3 indicates assessment of rebound should focus on MW-25 (noting variable increasing TCE concentrations have occurred at this well). All other wells in the treatment areas exhibit significant concentration reductions with no indication of rebound (regardless of a quantitative computation to calculate rebound), excluding MW-38 which currently exhibits less than effective ISCO treatment at this well.

[13] TCE concentrations at MW-25 historically have varied by factors of four to five between monitoring events and the concentrations immediately prior to ISCO exhibited concentrations lower than historically observed. For example, the highest TCE concentrations in MW-25 have always occurred during the fall as exhibited by the five fall sampling events prior to ISCO consisting of: October 2009 (TCE concentration of 140,000 µg/L); November 2010 (TCE concentration of 270,000 µg/L); October 2011 (TCE concentration of 120,000 µg/L); October 2012 (TCE concentration of 56,000 µg/L); and, October 2013 (TCE concentration of 43,000 µg/L). The four TCE concentrations used to calculate the average pre-ISCO concentration were 9,500 µg/L, 43,000 µg/L, 14,500 µg/L and 18,500 µg/L producing an average concentration of 21,375 µg/L.

Based upon the review of data presented above, continued assessment of rebound should continue for Area 1 and specifically along at the northwest portion of Area 1 at MW-25. Monitoring should continue at MW-86 to further assess the impacts of rebound at MW-25.

The proposed criteria for rebound conditions which may trigger implementation of an action plan consist of a combination of the following conditions:

- Stable conditions must be present for at least two monitoring events in the respective wells assessed before rebound calculations are performed (i.e. variability of monitoring parameter concentrations at 10% or less).
- A qualitative assessment of the monitoring data (TCE concentration trends, residual oxidant concentrations and water quality parameters including DO, ORP and pH conditions) must conclude that TCE concentrations in a respective well have consistently exhibited higher TCE concentrations post-ISCO compared to the pre-ISCO with consideration of other data regarding the presence of oxidants for a rebound condition to exist.
- A quantitative assessment using the following equations:
  - Assuming the lowest post-ISCO concentration is between 20% and 60% of the pre-ISCO concentration then a rebound condition is present if: (one year post-ISCO concentration - lowest post-ISCO concentration)/pre-ISCO concentration ≥25%; and
  - If the one year post ISCO concentration is 90% of the pre-treatment concentration then a rebound condition is present (as long as ISCO was an effective treatment remedy).
- Rebound conditions must be characterized by more than one well experiencing rebound in a treatment area to facilitate triggering an action plan (i.e. an action plan is not triggered by a single well potentially exhibiting rebound to preclude implementing a remedy for a single well as discussed during our July 19 meeting). However, the wells (i.e. more than one well) experiencing rebound potentially triggering an action plan must be located in close proximity to conclude rebound is occurring in the specific area (i.e. if two wells experiencing rebound are separated by other wells not experiencing a rebound condition, then a trigger for an action plan does not exist to preclude the concept of only treating a single well to reduce constituent concentrations).

The foregoing conditions will trigger an obligation of Whirlpool to provide a report on the significance of this data and what specific steps are recommended in light of that analysis.

The action plan is discussed in the following section.

SHALLOW GROUNDWATER MONITORING FOR VAPOR INTRUSION ASSESSMENT

The shallow groundwater monitoring wells consisting of MW-175 through MW-179 will be monitored during the semi-annual and annual groundwater monitoring events and these samples from the shallow groundwater monitoring wells will be analyzed for VOCs. Soil vapor samples will be collected from the soil vapor points installed at these locations if these locations are not filled with water. Soil vapor samples will be analyzed for VOCs similar to the analysis historically performed at these locations. The data from these monitoring events will be compiled into the soil vapor monitoring report on a semi-annual basis in a manner similar to the soil vapor reporting performed quarterly during the last two years.

ACTION PLAN

Whirlpool has committed to implement responsive actions in the event significant changes in groundwater conditions should unexpectedly occur. Such changes triggering the creation of an action plan[14] consist of: (1) expansion of the existing groundwater plume boundaries (i.e., expansion of the plume is confirmed by validated data indicating constituent concentrations exceeding the RALs[15] collected during two consecutive monitoring events); (2) unanticipated conditions confirmed by two consecutive groundwater monitoring events that could pose potential human health risks by creating a complete exposure pathway (none of which exist today); or (3) significant rebound at ISCO treatment areas [i.e. significant rebound consists of rebound conditions present in two or more wells in close proximity as further defined in the rebound section of this Revised Groundwater Monitoring Plan based upon a quantitative and qualitative assessment of the data from surrounding wells (TCE concentration trends, residual oxidant concentrations and water quality parameters including DO, ORP and pH conditions)]. The objective of a respective action plan regarding plume expansion is to address groundwater impacts which exceed the RAL within the area near the plume boundaries versus simply reducing concentrations at a specific monitoring well. Whirlpool is committed to developing an action plan addressing any significant changes that occur in these respects <u>during</u> this monitoring phase versus waiting until the next pending technical review.

The respective action plans may include further investigation including characterization of groundwater at potential plume expansion locations as appropriate to implement subsequent actions or supplemental monitoring of existing wells and/or implementation of a focused remedy [i.e. ISCO or in-situ chemical reduction (ISCR)] at the locations of concern in the event of plume expansion, other unanticipated changed conditions or rebound. Specific details of potential action plans cannot be provided until conditions triggering a respective action plan are identified. Potential future action plans are anticipated to be

[14] The proposed action plan will not supersede existing obligations presented in the site deed restriction to submit work plans to ADEQ in the event of building demolition or significant construction projects on the Whirlpool site.
[15] Additional monitoring may be implemented if the exceedance of the RAL is marginal (i.e. the RAL is exceedance is less than 10% of the RAL concentration) or if the data appears to be statistical data outlier when compared to historical concentrations trends for the respective monitoring well.

similar to the work plan for ISCR at the northeast portion of the north plume. These action plans designed to reduce constituent concentrations, when appropriate, will consider the use of ISCR, ISCO, or other in-situ treatment methods, in the vicinity of the monitoring well (or wells) experiencing unanticipated changes in groundwater conditions that result in the triggering of an action plan. The action plans will address the groundwater impact present versus addressing the constituent concentrations at a specific well location. The respective action plans will be submitted for ADEQ review within 60 days of receiving the second round of (validated) data triggering an action plan (i.e. data indicating possible plume expansion, human health risks or significant rebound at treatment areas). Upon approval by ADEQ of the respective action plans, Whirlpool will commence implementation of the respective action plan to address plume expansion or unanticipated changes in groundwater conditions within 60 days or as otherwise provided in the approved plan.

Indoor air monitoring in the manufacturing building will be assessed after re-purposing of the building is determined. Two indoor air monitoring events have been completed (the results of the second indoor air monitoring event and subsequent report are pending).

The monitoring plan discussed above represents the baseline monitoring that will be undertaken over the period. However, additional groundwater monitoring may be performed if warranted. ADEQ will be notified if additional groundwater monitoring is proposed to be performed for any reason. Also, the data set will continue to be reassessed as appropriate in light of future data collection and modifications to the groundwater monitoring plan will be proposed as necessary to fulfill the plan's objectives.

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If you have any questions or require additional information, please feel free to contact me.

Yours sincerely,

Michael F. Ellis, PE
Principal
D +1 314 590 2967
mellis@ramboll.com

LIST OF ATTACHMENTS

Table 1: Proposed Groundwater Monitoring Plan
Table 2: Pre-ISCO Data
Table 3: Calculation of Variance of TCE Concentration by Sampling Event

Figure 1: Groundwater Monitoring Plan
Figure 2: Status of Residential Property Deed Restriction

TABLES

TABLE 1
PROPOSED GROUNDWATER MONITORING PLAN
Whirlpool Facility - Fort Smith, Arkansas

WELL ID	SEMI-ANNUAL	ANNUAL
Onsite Wells		
MW-22		X
MW-24		X
MW-25		X*
MW-26 (B)	X	X
MW-27		X
MW-28		X
MW-29 (B)	X	X
MW-38	X	X*
MW-50 (B)	X	X*
MW-68 (B)	X	X
MW-86	X	X*
MW-87		X*
MW-89		X*
MW-91	X	X
MW-93	X	X
MW-95	X	X*
MW-175	X	X
MW-176	X	X
MW-178	X	X
MW-179	X	X
MW-182		X
MW-186 (B)	X	X
MW-189 (B)	X	X
ITMW-1		X
ITMW-2		X
ITMW-5	X	X
ITMW-7	X	X
ITMW-9		X*
ITMW-10	X	X
ITMW-16		X
ITMW-18		X
ITMW-19		X
ITMW-20 (B)	X	X
ITMW-21 (B)	X	X

WELL ID	SEMI-ANNUAL	ANNUAL
Offsite Wells		
MW-33R		X
MW-39R (B)	X	X
MW-40R (B)	X	X
MW-46R	X	X
MW-55R (B)	X	X
MW-56R		X
MW-57R		X
MW-58R		X*
MW-60R (B)	X	X
MW-61R (B)	X	X
MW-62R	X	X
MW-63R (B)	X	X
MW-194 (B)	X	X
MW-195 (B)	X	X
MW-82		X
MW-83		X
MW-84	X	X
MW-96 (B)	X	X
MW-97 (B)	X	X
MW-98 (B)	X	X
MW-99 (B)	X	X
IW-73	X	X*
IW-77	X	X
IW-78		X
RW-69	X	X*
MW-183 (B)	X	X
MW-184 (B)	X	X
MW-185 (B)	X	X
MW-187 (B)	X	X
MW-188 (B)	X	X
MW-190 (B)	X	X
MW-191 (B)	X	X
MW-192 (B)	X	X
MW-196 (B)	X	X
TMW-10	X	X*
TMW-11	X	X*

*Samples will be collected for VOCs, field measured parameters, and MNA parameters including: Methane, ethane, ethane, ferric iron, sulfate, nitrate, TOC, DHC and VC reductase.

All samples will be analyzed for VOCs unless otherwise noted including the following field measured parameters including: DO, ORP, pH, temperature, specific conductance, ferrous iron and turbidity.

TABLE 2
PRE-ISCO DATA
Whirlpool Facility - Fort Smith, Arkansas

		Pre-ISCO Data		
Well ID	**Baseline ISCO Event**	**Date**	**TCE Concentration (µg/L)**	**Average TCE Concentration (µg/L)**
Area 1				
ITMW-18	1st Event (March 2014)	10/19/2012	7600	7795
		4/25/2013	7200	
		10/17/2013	7000	
		3/8/2014	9380	
ITMW-19	3rd Event (October 2014)	3/8/2014	8850	12563
		5/15/2014	15300	
		7/31/2014	13300	
		10/16/2014	12800	
MW-25	2nd Event (May 2014)	4/25/2013	9500	21375
		10/18/2013	43000	
		3/8/2014	14500	
		5/15/2014	18500	
MW-38	3rd Event (October 2014)	3/8/2014	1790	3130
		5/14/2014	2040	
		7/31/2014	1720	
		10/16/2014	6970	
MW-86	2nd Event (May 2014)	5/29/2014	533000	533000
Down-gradient of Area 1				
MW-93	3rd Event (October 2014)	10/22/2014	18200	NA
MW-94	3rd Event (October 2014)	10/22/2014	11100	NA
MW-95	3rd Event (October 2014)	10/22/2014	22300	NA
Areas 2 and 3				
IW-77	1st Event (March 2014)	10/19/2012	1000	769
		4/24/2013	530	
		10/16/2013	1000	
		3/8/2014	546	
IW-78	2nd Event (May 2014)	10/20/2012	310	190.5
		4/24/2013	7	
		10/17/2013	190	
		5/28/2014	255	
Neck Area				
MW-83	2nd Event (May 2014)	5/23/2014	470	470
MW-84	2nd Event (May 2014)	5/27/2014	214	214

Notes:

ISCO = In-situ chemical oxidation
TCE = Trichloroethane
µg/L = Micrograms per liter

RAMBOLL ENVIRON

TABLE 3
CALCULATION OF VARIATION IN TCE CONCENTRATION BY SAMPLING EVENT
Whirlpool Facility - Fort Smith, Arkansas

				Sampling Event Date													
Well ID			**Average TCE Concentration (µg/L) (see Table 2)**	**March 2014**	**May 2014**	**July 2014**	**Sept/Oct 2014**	**Dec 2014**	**Jan 2015**	**April/May 2015**	**July 2015**	**Oct 2015**	**Jan 2016**	**May 2016**	**Comparison of Lowest Post-ISCO and Pre-ISCO**	**Rebound**	**Description**
Area 1																	
ITMW-18	3rd Event (October 2014)	TCE Conc. (µg/L)	7795	9380	2940	5360	3540	3690	488	43.5	24.7	12.9	48.8	13.9	0.2%	0%	No indication of rebound.
		% Change Avg. to Event		-	-	-	**ISCO**	-53%	-94%	-99%	-100%	-100%	-99%	-100%			
ITMW-19	3rd Event (October 2014)	TCE Conc. (µg/L)	12563	8850	15300	13300	12800	33.5	17.4	594	15.2	87.1	336	105	0.1%	1%	No indication of rebound.
		% Change Avg. to Event		-	-	-	**ISCO**	-100%	-100%	-95%	-100%	-99%	-97%	-99%			
MW-25	3rd Event (October 2014)	TCE Conc. (µg/L)	21375	14500	18500	71700	59800	2620	2510	4650	39800	68700	43400	53000	11.7%	310%	Rebound condition
		% Change Avg. to Event		-	-	-	**ISCO**	-88%	-88%	-78%	86%	221%	103%	148%			
MW-38	3rd Event (October 2014)	TCE Conc. (µg/L)	3130	1790	2040	1720	6970	3190	5440	3060	3420	2740	3680	3040	87.5%	0%	Variability greater than 10% per monitoring event. ISCO not effective at this location.
		% Change Avg. to Event		-	-	-	**ISCO**	2%	74%	-2%	9%	-12%	18%	-3%			
MW-86	3rd Event (October 2014)	TCE Conc. (µg/L)	533000	NS	533000	NS	129000	169000	81200	46700	65100	131000	95500	64900	8.8%	16%	Slight indication of rebound.
		% Change Avg. to Event		-	-	-	**ISCO**	-68%	-85%	-91%	-88%	-75%	-82%	-88%			
Down-gradient of Area 1																	
MW-93		TCE Conc. (µg/L)	18200	NS	NS	NS	18200	14600	18000	21500	20800	21100	21200	17300	NA	NA	Not in the treatment zone.
		% Change Avg. to Event		pre-ISCO	pre-ISCO	pre-ISCO	**ISCO**	-20%	-1%	18%	14%	16%	16%	-5%			
MW-94		TCE Conc. (µg/L)	11100	NS	NS	NS	11100	9570	9530	11800	3890	1990	936	424	NA	NA	Not in the treatment zone. Decrease in TCE concentrations noted during the last four quarters of groundwater monitoring.
		% Change Avg. to Event		pre-ISCO	pre-ISCO	pre-ISCO	**ISCO**	-14%	-14%	6%	-65%	-82%	-92%	-96%			
MW-95		TCE Conc. (µg/L)	22300	NS	NS	NS	22300	20900	21100	26700	25200	26300	24700	21600	NA	NA	Not in the treatment zone.
		% Change Avg. to Event		pre-ISCO	pre-ISCO	pre-ISCO	**ISCO**	-6%	-5%	20%	13%	18%	11%	-3%			
Areas 2 and 3																	
IW-77	4th Event (October 2014)	TCE Conc. (µg/L)	769	546	1460	1540	741	NS	201	153	130	24.3	95.3	101	3.2%	10%	Slight indication of rebound. One year sample collected after seven months
		% Change Avg. to Event		-29%	90%	100%	-4%	-	-74%	-80%	-83%	**ISCO**	-88%	-87%			
IW-78	4th Event (October 2014)	TCE Conc. (µg/L)	190.5	NS	255	NS	39.6	NS	1.5	1.3	NS	NS	1.5	1.3	0.7%	NA	No indication of rebound.
		% Change Avg. to Event		--	34%	--	-79%	--	NA	NA	--	**ISCO**	--	--			
Neck Area																	
MW-83	4th Event (October 2014)	TCE Conc. (µg/L)	470	NS	470	NS	213	NS	101	151	27.9	9.8	1.1	3.3	0.2%	0%	No indication of rebound. One year sample collected after seven months
		% Change Avg. to Event		-	-	--	-55%	-	-79%	-68%	-94%	**ISCO**	-100%	-99%			
MW-84	4th Event (October 2014)	TCE Conc. (µg/L)	214	NS	214	NS	0.93	NS	<0.5	<0.5	0.29	<0.17	<0.17	<0.17	0.0%	0%	No indication of rebound. One year sample collected after seven months
		% Change Avg. to Event		-	-	-	-100%	-	-100%	-100%	-100%	**ISCO**	-100%	-100%			

Notes:

Rebound: Values used for the rebound calculation as directed by the ADEQ staff are highlighted based upon the ISCO dates from Table 2.
TCE = Trichloroethane
µg/L = Micrograms per liter
One-Year Post-ISCO Concentration is shaded - Orange (may also consist of the lowest post-ISCO concentration)
Lowest Post-ISCO Concentration is shaded - Blue
The pre-ISCO concentration in Table 2 is based upon the initial ISCO event performed at or near the respective well. The calculation of rebound in this table is based upon the last comprehensive ISCO event in the respective area.

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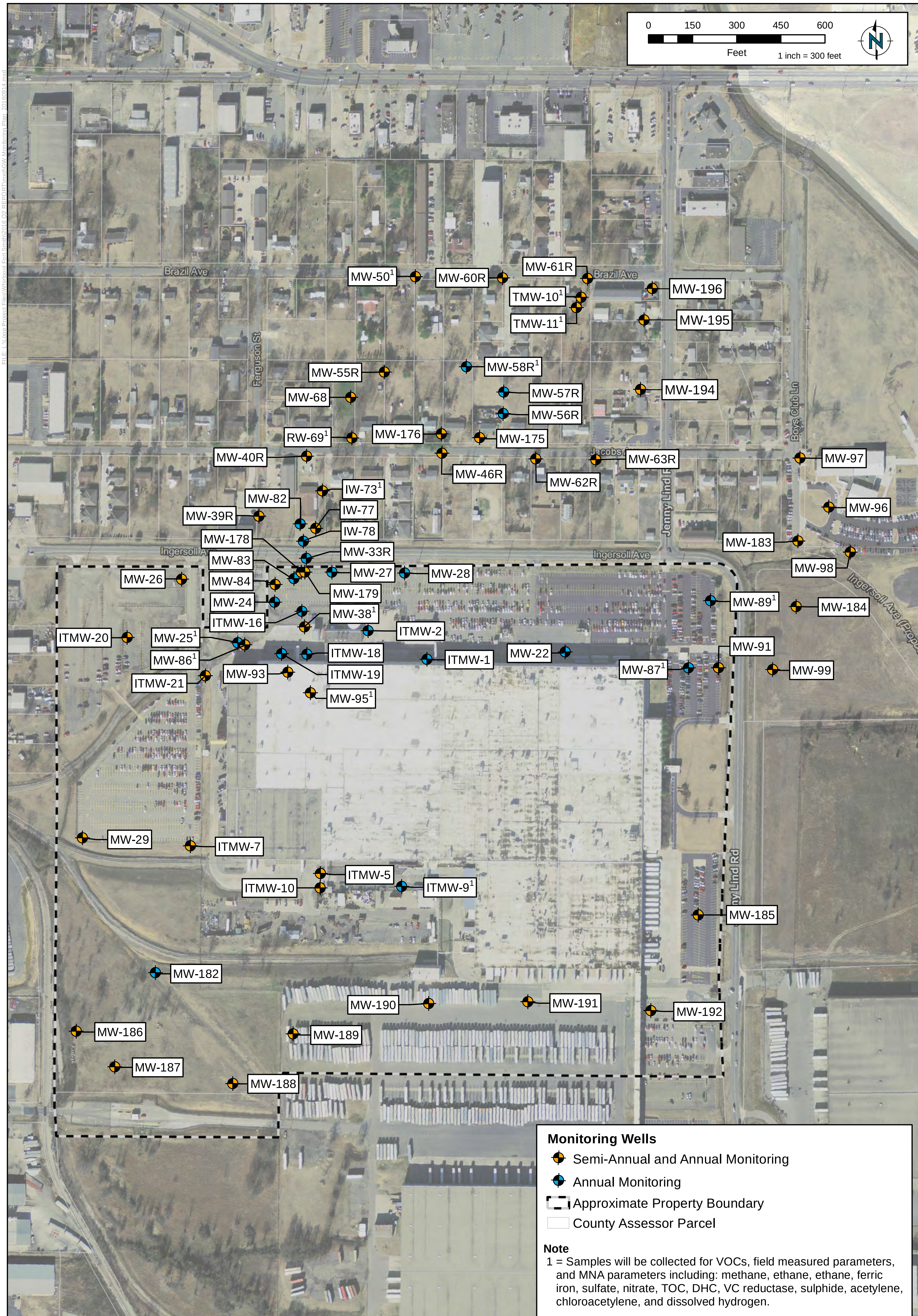
FIGURES



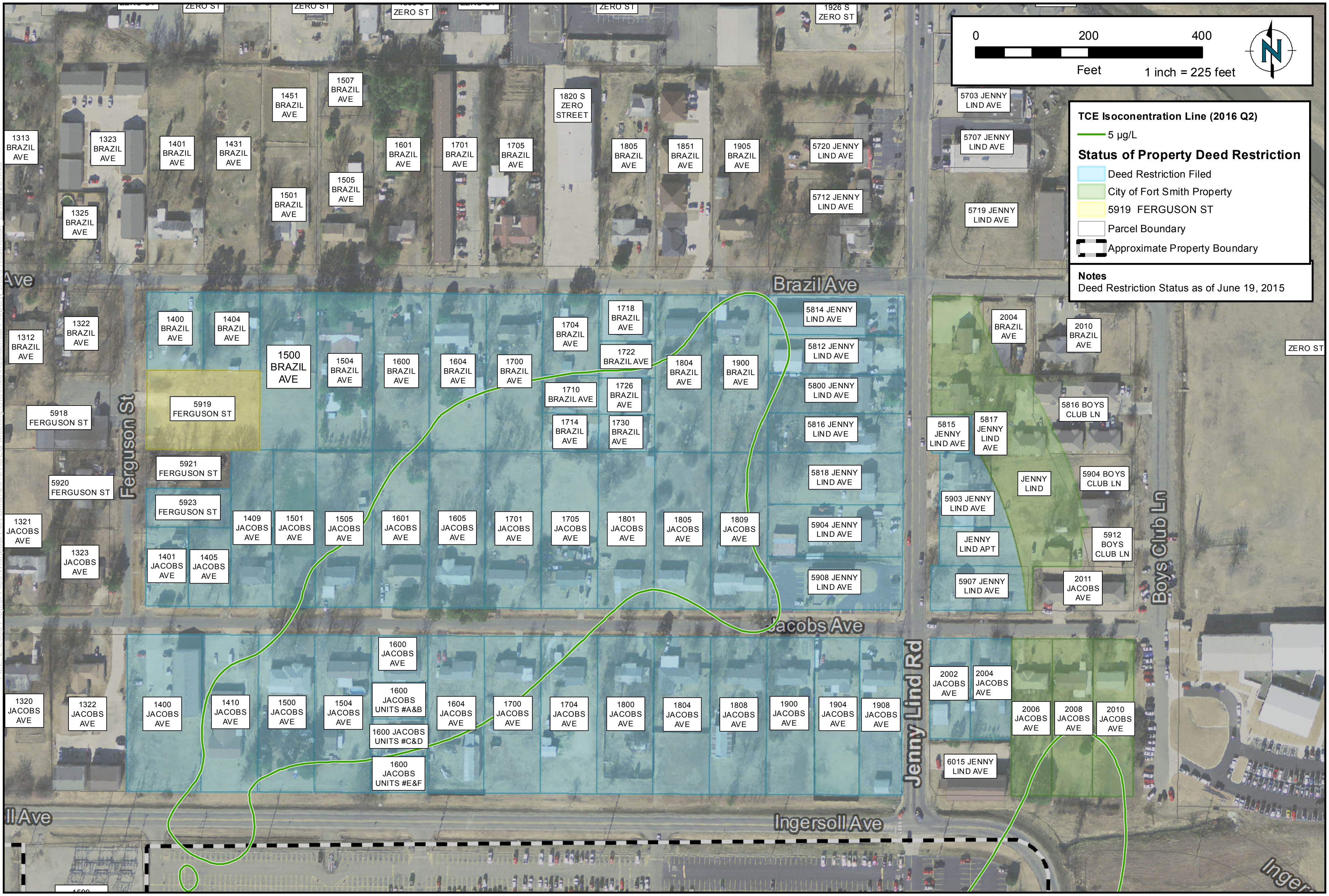
RAMBOLL ENVIRON

GOUNDWATER MONITORING PLAN

Whirlpool Facility - Fort Smith, Arkansas

Figure 1

DRAFTED BY: FK | DATE: 09/14/2016 | PROJECT: 3437500P



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DRAFTED BY: FK

DATE: 07/25/2016

STATUS OF RESIDENTIAL PROPERTY DEED RESTRICTION

Whirlpool Facility - Fort Smith, Arkansas

Figure 2

PROJECT: 3437500M