February 3, 2015

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

Re: Response to ADEQ Correspondence Dated January 12, 2015
Third Quarter 2014 Progress Report
Whirlpool Corporation
Fort Smith, Arkansas
EPA No. ARD042755389
AFIN No. 66-00048
CAO LIS 13-202

Dear Mr. Mehran:

ENVIRON International Corporation (ENVIRON), on behalf of Whirlpool Corporation, is submitting this response to your January 12, 2015, comment letter (received on January 16) providing comments on the Third Quarter 2014 Progress Report submitted on November 14, 2014. Arkansas Department of Environmental Quality (ADEQ) comments are provided in italics below and the respective response follows.

VOLUME 1, ATTACHMENT A, THIRD QUARTER 2014 GROUNDWATER MONITORING REPORT

3.1 Hydrogeology, First Paragraph, Second Sentence:

The 5 micrograms per liter (µg/L) trichloroethene (TCE) concentration isopleth line on Figure 2 is drawn at the location of monitoring well MW-55. Although currently sampling was not conducted at monitoring well MW-55, the last TCE result obtained for MW-55 on November 15, 2013, revealed the concentration of 13 µg/L. The TCE concentration isopleth line should use the most recent result obtained. The 5 µg/L TCE concentration isopleth line should be redrawn to the northwest of MW-55. Please revise.

ENVIRON Response: A revised Figure 2 is attached with a note at MW-55 indicating "Last sampled 10/16/2013" and the isopleth line is dashed to infer the extent of TCE impact in groundwater at this location.

4.1.1 Statistical Analysis of Temporal Trends, Third Paragraph, First Bullet, Fifth Item:

The text states that there are six wells with increasing trends for TCE concentration in the northern plume. This statement changes in the following paragraph and it is indicated five wells show increasing trends for the concentration of TCE. Please clarify.

ENVIRON Response: The discussion of temporal trends for the northern plume wells indicates that six wells exhibit an increasing trend in TCE concentrations. The six wells were specifically identified as MW-36, MW-55, MW-56, MW-57, MW-61 and IW-77. The

discussion in the report inadvertently indicated that five wells exhibited an increasing concentration. The text of the report should have indicated "Further, of the **six** wells located in the northern plume with increasing TCE concentration trends:"

4.1.1 Statistical Analysis of Temporal Trends, General Comment:

It is apparent that, in general, wells with decreasing trends are located near the source area and, wells with increasing trends are located farther from the source area. In discussions of plume "stability", please differentiate between changes in plume mass and changes in plume aerial extent. Please revise the text appropriately.

ENVIRON Response: Section 4.1.1 discusses neither the plume mass nor changes in plume aerial extent. Section 4.1.1 discusses the statistical analysis of changes in TCE, cis-1,2-DCE and vinyl chloride concentrations in groundwater over time. The report does note an increase in the aerial extent of the plume in the area of MW-61 (Section 4.1.3 and Section 4.2). Additionally, 21 of the 23 plume boundary wells as defined by the RADD do not have increasing trends. This further indicates only a marginal change in the aerial extent of the plume during the third quarter of 2014.

4.1.3 Concentration vs. Time Plots, Second Paragraph, Third Sentence:

Mann-Kendal trend analysis of the TCE concentration over the last four quarters at ITMW-09 shows an increasing trend. Please correct.

ENVIRON Response: The statistical trend analysis presented in Section 4 of the report clearly states that the trend analysis is performed using available data from 2009 through the third quarter of 2014 (Section 4.1.1, Second Paragraph). The results of the trend analysis are summarized in Table 8 and a graph of TCE concentrations at ITMW-9 is shown on Figure 11. Both Table 8 and Figure 11 show that TCE concentrations at ITMW-9 are stable. An analysis of short term (one year or four quarters) TCE concentration trends would indicate that there is an increasing trend at ITMW-9; however, if only the next prior sampling result for ITMW-09 from April 2013 is included in the analysis it indicates a stable trend. It should also be noted that a Mann-Kendal trend analysis is not considered valid for data from fewer than four sampling events.

VOLUME 1, ATTACHMENT B, APPENDIX C

Attachments C.5 to C.1O:

ADEQ cannot determine the origin of the C_{air} values found in attachments C.5 to C.10. Please explain the origin of the C_{air} values found in these attachments.

ENVIRON Response: The C_{air} values in appendix tables C.5, C.6, C.7, and C.10 are the calculated chemical concentrations in indoor air or the $C_{building}$ term discussed in Section 6.2.2 of the human health risk assessment (HHRA). The C_{air} term on these tables is calculated as the product of the concentration in groundwater (C_{gw}) and the normalized [based on a unit concentration of 1 milligrams per liter (mg/L)] C_{bldg} presented in Appendix

tables C.4 and C.9. The nomenclature on appendix tables C.5, C.6, C.7, and C.10 has been revised to read $C_{building}$ for consistency with the HHRA.

VOLUME 2, ATTACHMENT D, PROPERTY BOUNDARY REPORT

3.2 Southwest Corner, First Paragraph:

Given the increase in TCE concentration in ITMW-09, ITMW-10 and the field detection of TCE concentrations in groundwater from membrane interface probe (MIP) locations 325 and 329, ADEQ request a monitoring well be installed south of MIP-325 (near latitude 35.31958, longitude 94.41967) to monitor the southern plume in this area.

ENVIRON Response: A new monitoring well will be proposed for installation as requested in order to monitor the southern plume south of MIP-325. The new monitoring well will be installed during the second quarter of 2015, if not earlier. ADEQ will be informed of the schedule for well installation.

GENERAL COMMENT

Please provide well construction/lithology logs for MW-81 through MW-86 with Easting, northing, ground surface elevation (GSE), and top of casing (TOC) elevation information. Also, please note that all well construction/lithology logs should include casing diameter information as well as borehole diameter.

ENVIRON Response: Well construction diagrams for MW-81 through MW-86 are attached with the requested survey data included on the construction logs.

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If you have any questions or comments please contact me at your earliest convenience.

Sincerely,

ENVIRON International Corporation

Michael F. Ellis, PE
Principal

LIST OF ATTACHMENTS

Figure 2: Third Quarter 2014 TCE Isoconcentration Map
Appendix C: Risk Calculations and Input Parameters
Well Construction Diagrams for MW-81 through MW-86

FIGURE 2:
Third Quarter 2014 TCE Isoconcentration Map

Notes:
1 - MW-55 last sampled 10/16/2013. Property access restricted by owner
- Trichloroethene (TCE) in groundwater reported in µg/L
U - Not Detected
< - Detection Limit
J - Estimated Concentration

Brazil Ave
Ferguson St
Jenny Lind Rd
Jacobs Ave
Ingersoll Ave

MW-55[1] 13 µg/L
Last sampled 10/16/2013

MW-50 < 5.0U
MW-60 1.0J
MW-61 8.1
MW-67 < 5.0U
MW-66 2.6J
MW-68 < 5.0U
MW-71 181
MW-58 399
MW-57 308
MW-56 516
IW-72 < 5.0U
MW-40 < 5.0U
IW-74 177
RW-69 164
MW-46R 472
MW-63 8.3
MW-62 < 5.0U
IW-73 138
IW-77 1540
MW-41 511
MW-39 0.79J
IW-76 319
IW-80 25.6
MW-34 78.2
MW-36 0.61J
MW-35R 64.7
MW-31 < 5.0U
MW-32 37.2
MW-65 17.1
MW-28 < 5.0U
MW-26 < 5.0U
MW-33 1600
MW-27 0.63J
ITMW-16 < 5.0U
ITMW-17 2260
ITMW-14 4.0J
ITMW-20 < 5.0U
ITMW-2 < 5.0U
MW-25 71700
ITMW-13 36.5
ITMW-1 8.9
MW-22 < 5.0U
ITMW-11 7380
ITMW-19 13300
ITMW-12 2710
ITMW-21 9.4
ITMW-15 1850
MW-38 1720
ITMW-18 5360
MW-29 < 5.0U
ITMW-7 36.7
ITMW-4 2.8J
ITMW-10 273
ITMW-9 143
ITMW-6 4.4J

TCE Concentration (µg/L)
- ≤ 5.0
- 5.1 to 100
- 101 to 1,000
- 1,001 to 10,000
- > 10,000
- Monitoring Well Not sampled. Property access denied.

TCE Isoconentration Line
- 5 µg/L (inferred)
- 5 µg/L
- 100 µg/L (inferred)
- 100 µg/L
- 1,000 µg/L (inferred)
- 1,000 µg/L
- 10,000 µg/L
- Approximate Property Boundary (2014)

0 200 400
Feet
1 inch = 200 feet

ENVIRON

THIRD QUARTER 2014 TCE ISOCONCENTRATION MAP

Whirlpool Facility - Fort Smith, Arkansas

Figure 2

DRAFTED BY: KTS | DATE: 01/19/2015 | PROJECT: 2131344A

APPENDIX C:
Risk Calculations and Input Parameters

Appendix C

Risk Calculations and Input Parameters

Contents:

Attachment C.1: Toxicity Values
Whirlpool, Fort Smith, Arkansas

Chem Group	Chemical	CASRN	Cancer Classification			ADAF			URF $(mg/m^3)^{-1}$			RfC (mg/m^3)			
			Group	Ref	Note	Y/N	f_{oral}	f_{inh}	Value	Ref	Notes	Value	UF	Ref	Notes
VOC	Acetone	67-64-1	ID	1		N						3.1E+01	100	129	111
VOC	Bromodichloromethane	75-27-4	B2	1		N								126	90
VOC	Bromoform	75-25-2	B2	1		N			1.1E-03	1				126	90
VOC	Bromomethane	74-83-9	ID	126		N						5.0E-03	100	1	
VOC	Chloromethane	74-87-3	D	1		N						9.0E-02	1,000	1	
VOC	Dibromochloromethane	124-48-1	C	1		N								126	90
VOC	1,1-Dichloroethene	75-35-4	C	1		N						2.0E-01	30	1	
VOC	cis-1,2-Dichloroethene	156-59-2	ID	1		N								1	90
VOC	trans-1,2-Dichloroethene	156-60-5	ID	1		N								1	90
VOC	Trichloroethene	79-01-6	HC	1		Y	0.202	0.244	4.1E-03	1	159	2.0E-03	100	1	
VOC	Vinyl Chloride	75-01-4	A	1		N			4.4E-03	1	79	1.0E-01	30	1	

References

Toxicity values were selected following the hierarchy of sources defined by USEPA (Human Health Toxicity Values in Superfund Risk Assessment, 2003), as discussed in Appendix A, Section 4 of the ADEQ-approved Revised Risk Management Plan, which was used as the basis for the ADEQ Remedial Action Decision. Values are current as of March 5, 2014.

1 USEPA. Integrated Risk Information System (IRIS). On-line database.

126 Provisional Peer Reviewed Toxicity Values for Superfund (PPRTV) Database.

129 ATSDR. 2013. Minimal Risk Levels. March.

Notes:

79 For evaluating partial lifetime exposures that include early-life exposure, the unit risk factor is also used in risk calculations that do not prorate the early-life exposure, per USEPA's May 2000 Toxicological Review.

90 Inadequate data exist to derive a toxicity value, according to the indicated reference.

111 Value as published is an MRL in the indicated reference.

159 Because the chemical has a mutagenic mode of action according to USEPA, the SF and URF are adjusted by the following age-dependent adjustment factors (ADAFs) before use: 10 for ages 0 to 2; 3 for ages 2 to 16; and 1 for ages 16 and older (USEPA 2005).

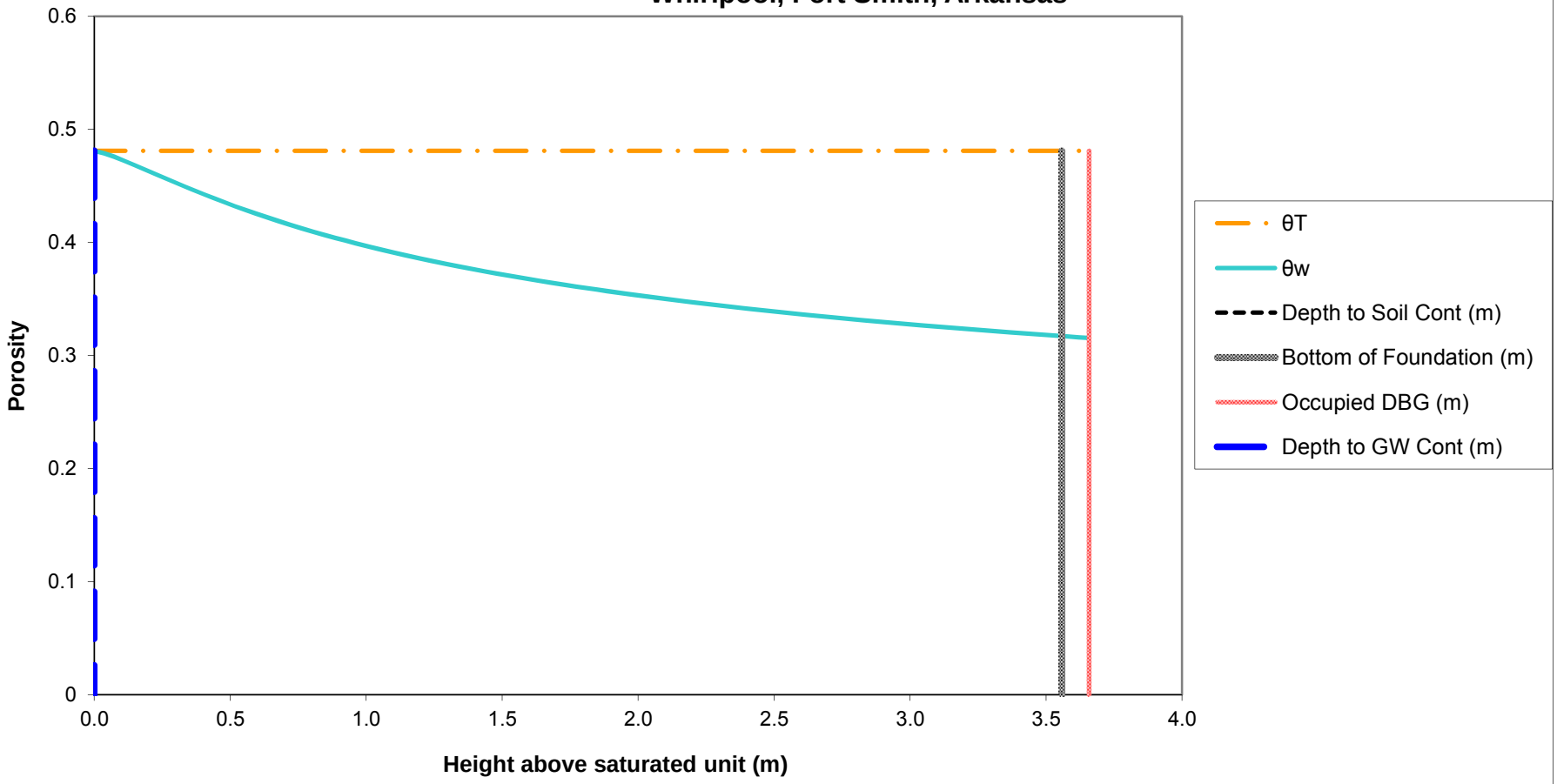
Attachment C.2: Physical and Chemical Properties
Whirlpool, Fort Smith, Arkansas

Chem Group	Chemical	CASRN	H (unitless)			D_{air} (m^2/d)		D_{water} (m^2/d)		HENRY Ref Temp (°C)
			Value	Adjusted	Ref	Value	Ref	Value	Ref	Value
VOC	Acetone	67-64-1	1.6E-03	1.1E-03	44	1.1E+00	44	9.8E-05	44	2.5E+01
VOC	Bromodichloromethane	75-27-4	6.6E-02	4.5E-02	44	2.6E-01	44	9.2E-05	44	2.5E+01
VOC	Bromoform	75-25-2	2.2E-02	1.3E-02	44	1.3E-01	44	8.9E-05	44	2.5E+01
VOC	Bromomethane	74-83-9	2.6E-01	2.0E-01	44	6.3E-01	44	1.0E-04	44	2.5E+01
VOC	Chloromethane	74-87-3	3.6E-01	3.3E-01	50.1	1.1E+00	69	5.6E-05	69	2.0E+01
VOC	Dibromochloromethane	124-48-1	3.2E-02	2.4E-02	44	1.7E-01	44	9.1E-05	44	2.5E+01
VOC	1,1-Dichloroethene	75-35-4	1.1E+00	8.1E-01	44	7.8E-01	44	9.0E-05	44	2.5E+01
VOC	cis-1,2-Dichloroethene	156-59-2	1.7E-01	1.2E-01	44	6.4E-01	44	9.8E-05	44	2.5E+01
VOC	trans-1,2-Dichloroethene	156-60-5	3.9E-01	2.8E-01	44	6.1E-01	44	1.0E-04	44	2.5E+01
VOC	Trichloroethene	79-01-6	4.2E-01	2.9E-01	44	6.8E-01	44	7.9E-05	44	2.5E+01
VOC	Vinyl Chloride	75-01-4	1.1E+00	9.0E-01	44	9.2E-01	44	1.1E-04	71	2.5E+01

References:

	Physical and chemical parameters were selected following the hierarchy of sources used by USEPA (Soil Screening Guidance: Technical Background Document, 1996), as discussed in Appendix A, Section 54 of the ADEQ-approved Revised Risk Management Plan, which was used as the basis for the ADEQ Remedial Action Decision.
44	USEPA. 1996. Soil Screening Guidance: Technical Background Document and User Guide. Office of Emergency and Remedial Response. EPA/540/R-95/128. May.
50.1	USEPA. 1997. Superfund Chemical Data Matrix (SCDM). Office of Emergency and Remedial Response. September 12.
69	USEPA. 2004. WATER9. Version 2.0.0. Office of Air Quality Planning and Standards. July.
71	USEPA. 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. Office of Solid Waste and Emergency Response. OSWER 9355.4-24. December.

Appendix C.3: Soil Moisture Profile for Residential Building (Slab on Grade) for Groundwater Risk Calculations
Whirlpool, Fort Smith, Arkansas



Notes:
The soil-water profile in the vadose zone is estimated using the van Genuchten soil-water retention equation with default water retention parameters appropriate for silt clay, as discussed in Appendix A, Section 3.3.1 of the ADEQ-approved Revised Risk Management Plan, which was used as the basis for the ADEQ Remedial Action Decision.

Attachment C.4: Normalized Indoor Air Concentration in a Residential Building (Slab on Grade) due to Vapor Intrusion from Groundwater
Whirlpool, Fort Smith, Arkansas

Chem Group	Chemical	CASRN	D_{air} (m^2/day)	D_{water} (m^2/day)	H (unitless)	D_{crack} (m^2/day)	D_{eff}^T (m^2/day)	α_{soil}	α_{slab}	α_{∞}	C_{bldg} (L-water/m^3)
VOC	Acetone	67-64-1	1.07E+00	9.85E-05	1.14E-03	1.72E-01	1.87E-02	6.80E-02	2.73E-03	1.86E-04	2.12E-04
VOC	Bromodichloromethane	75-27-4	2.57E-01	9.16E-05	4.45E-02	4.13E-02	1.07E-03	4.17E-03	2.73E-03	1.14E-05	5.07E-04
VOC	Bromoform	75-25-2	1.29E-01	8.90E-05	1.34E-02	2.07E-02	1.64E-03	6.37E-03	2.73E-03	1.74E-05	2.33E-04
VOC	Bromomethane	74-83-9	6.29E-01	1.05E-04	2.01E-01	1.01E-01	7.43E-04	2.89E-03	2.73E-03	7.90E-06	1.59E-03
VOC	Chloromethane	74-87-3	1.09E+00	5.62E-05	3.33E-01	1.75E-01	4.61E-04	1.80E-03	2.73E-03	4.90E-06	1.63E-03
VOC	Dibromochloromethane	124-48-1	1.69E-01	9.07E-05	2.38E-02	2.72E-02	1.27E-03	4.94E-03	2.73E-03	1.35E-05	3.21E-04
VOC	1,1-Dichloroethene	75-35-4	7.78E-01	8.99E-05	8.10E-01	1.25E-01	3.12E-04	1.22E-03	2.73E-03	3.32E-06	2.69E-03
VOC	cis-1,2-Dichloroethene	156-59-2	6.36E-01	9.76E-05	1.19E-01	1.02E-01	9.72E-04	3.78E-03	2.73E-03	1.03E-05	1.22E-03
VOC	trans-1,2-Dichloroethene	156-60-5	6.11E-01	1.03E-04	2.81E-01	9.81E-02	5.96E-04	2.32E-03	2.73E-03	6.35E-06	1.79E-03
VOC	Trichloroethene	79-01-6	6.83E-01	7.86E-05	2.88E-01	1.10E-01	5.23E-04	2.04E-03	2.73E-03	5.57E-06	1.60E-03
VOC	Vinyl Chloride	75-01-4	9.16E-01	1.06E-04	9.00E-01	1.47E-01	3.44E-04	1.34E-03	2.73E-03	3.66E-06	3.30E-03
Notes:	**Crack Soil and Building Characteristics**			**Crack Soil**							
	SCS Soil texture class			Sand							
	Bulk density	kg/L	ρ_b	1.66							
	Total porosity	L/L-soil	θ_T	0.375							
	Water-filled porosity	L/L-soil	θ_w	0.054							
	Air-filled porosity	L/L-soil	θ_a	0.321							
	Residual saturation	L/L-soil	θ_r	0.053							
	Hydraulic conductivity	cm/s	K	7.4E-03							
	Dynamic viscosity of water	g/cm-s	μ_w	0.01307							
	Density of water	g/cm^3	ρ_w	1.0							
	Gravitational acceleration	cm/s^2	g	980.7							
	Intrinsic permeability	cm^2	k	9.9E-08							
	Relative saturation	unitless	S_e	0.004							
	van Genuchten N	unitless	N	3.177							
	van Genuchten M	unitless	M	0.685							
	Relative air permeability	unitless	k_{rg}	0.998							
	Permeability to vapor	cm^2	k_v	9.89E-08							
	Distance from building foundation to source	m	L_{T-gw}	3.56							
	Bldg foundation thickness	m	L_{crack}	0.1							
	Bldg foundation length	m		10.00							
	Bldg foundation width	m		10.00							
	Bldg occupied height	m		2.44							
	Bldg occupied volume	m^3		244.00							
	Occupied depth below ground	m		0.0							
	Bldg area for vapor intrusion	m^2	A_B	100.0							
	Ratio of A_{crack} to A_B		η	4E-04							
	Area of cracks	m^2	A_{crack}	4E-02							
	Air exchange rate	$hour^{-1}$	ach	0.45							
	Building ventilation rate	m^3/day	Q_{bldg}	2.64E+03							
	Pressure difference between outdoors-indoors	$kg/m-s^2$	ΔP	1.0							
	Viscosity of air	kg/m-s	μ_a	1.8E-05							
	Crack length (bldg perimeter)	m	X_{crack}	40							
	Crack depth below ground	m	Z_{crack}	0.10							
	Crack radius	m	r_{crack}	1E-03							
	Soil gas flow rate into bldg	m^3/day	Q_{soil}	7.20							
	Indoor air concentrations resulting from groundwater vapor intrusion into a building are estimated using the relationships described by Johnson and Ettinger (Heuristic model for predicting the intrusion rate of contaminant vapors into buildings, 1991), which USEPA recommends for screening level calculations, as discussed in Appendix A, Section 3.3.1 of the ADEQ-approved Revised Risk Management Plan, which was used as the basis for the ADEQ Remedial Action Decision.										
	The effective diffusion term DeffT is calculated based on a silty clay soil, as discussed in Appendix A, Section 3.3.1 of the ADEQ-approved Revised Risk Management Program.										

Attachment C.5: Cancer Risk and Hazard Index Calculations for Vapor Intrusion into a Residential Building (Slab on Grade) from Groundwater in Off-Site Wells Whirlpool, Fort Smith, Arkansas

							Cancer				Noncancer	
Chem Group	**Chemical**	**CASRN**	**Carc Class**	**ADAF**	**C_{gw}** (mg/L)	**$C_{building}$** (mg/m^3)	**URF** (m^3/mg)	**f_{inh}**	**Risk**		**RfC** (mg/m^3)	**HQ**
VOC	Acetone	67-64-1	ID	N	5.89E-01	1.25E-04					3.1E+01	3.9E-06
VOC	Bromodichloromethane	75-27-4	B2	N	7.40E-04	3.75E-07						
VOC	Bromoform	75-25-2	B2	N	3.69E-02	8.58E-06	1.1E-03		3.9E-09			
VOC	Bromomethane	74-83-9	ID	N	4.87E-02	7.74E-05					5.0E-03	1.5E-02
VOC	Chloromethane	74-87-3	D	N	1.08E-02	1.76E-05					9.0E-02	1.9E-04
VOC	Dibromochloromethane	124-48-1	C	N	2.40E-03	7.71E-07						
VOC	1,1-Dichloroethene	75-35-4	C	N	2.50E-03	6.73E-06					2.0E-01	3.2E-05
VOC	cis-1,2-Dichloroethene	156-59-2	ID	N	1.97E-02	2.41E-05						
VOC	trans-1,2-Dichloroethene	156-60-5	ID	N	4.40E-03	7.86E-06						
VOC	Trichloroethene	79-01-6	HC	Y	5.18E-01	8.31E-04	4.1E-03	0.244	1.9E-06		2.0E-03	4.0E-01
VOC	Vinyl Chloride	75-01-4	A	N	7.60E-04	2.51E-06	4.4E-03		1.6E-08		1.0E-01	2.4E-05
							Cumulative Risk:		2E-06		**HI:**	4E-01
Note:												
f_{inh} is the fraction of the inhalation toxicity value that USEPA identified as having a mutagenic mode of action.												
Only VOCs detected in the 3rd Quarter 2014 off-site groundwater samples are shown.												
Residential risks were calculated assuming residents could be exposed to soil vapor intrusion into indoor air for 24 hours per day and 350 days per year for 30 years.												

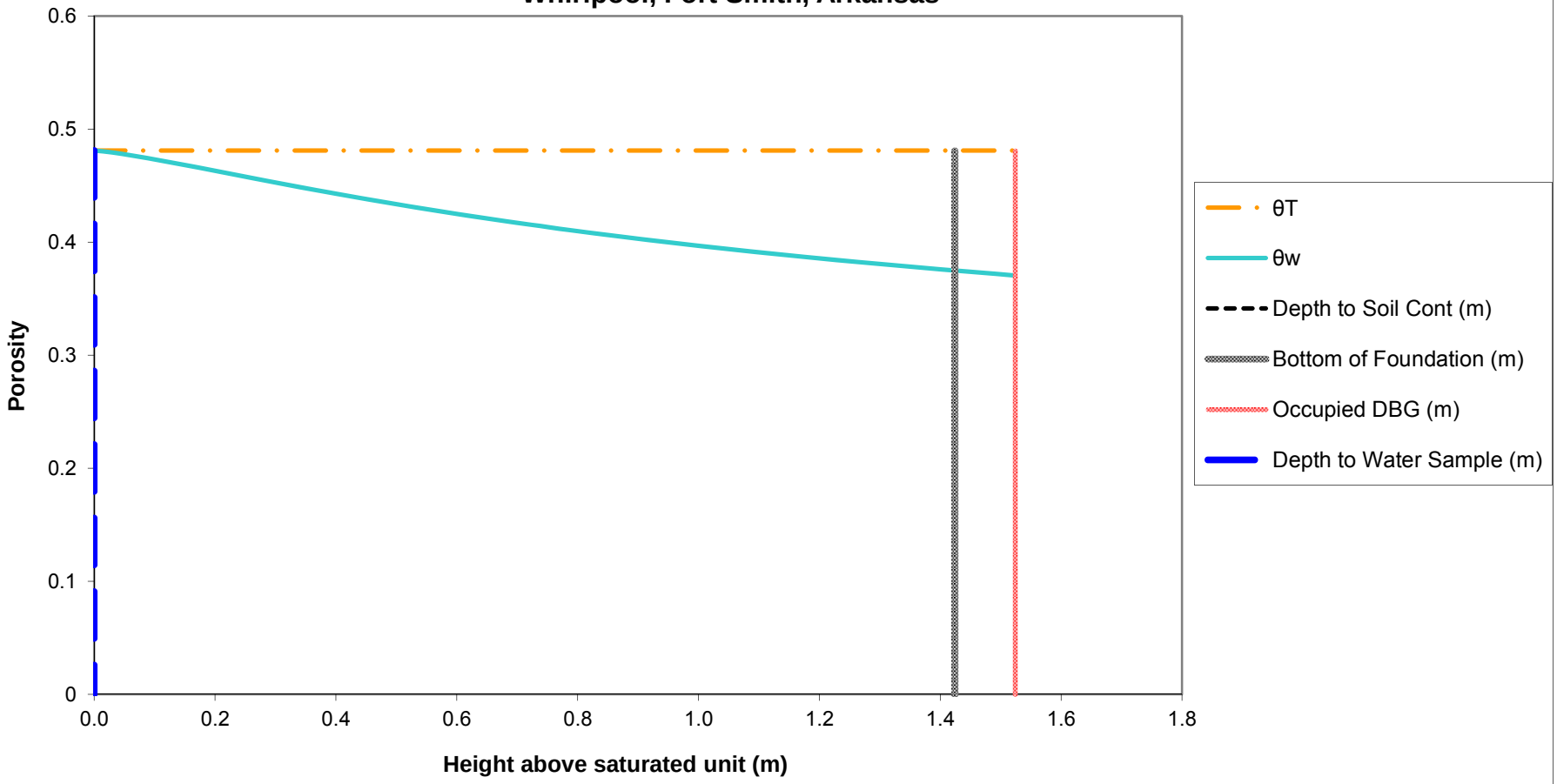
Attachment C.6: Cancer Risk and Hazard Index Calculations for Vapor Intrusion into a Residential Building (Slab on Grade) from Groundwater at MW-71 Whirlpool, Fort Smith, Arkansas

							Cancer				Noncancer	
Chem Group	**Chemical**	**CASRN**	**Carc Class**	**ADAF**	**C_{gw}** (mg/L)	**$C_{building}$** (mg/m^3)	**URF** (m^3/mg)	**f_{inh}**	**Risk**		**RfC** (mg/m^3)	**HQ**
VOC	1,1-Dichloroethene	75-35-4	C	N	1.70E-03	4.57E-06					2.0E-01	2.2E-05
VOC	cis-1,2-Dichloroethene	156-59-2	ID	N	6.40E-03	7.84E-06						
VOC	Trichloroethene	79-01-6	HC	Y	1.81E-01	2.90E-04	4.1E-03	0.244	6.7E-07		2.0E-03	1.4E-01
							Cumulative Risk:		7E-07		**HI:**	1E-01
Note:												
f_{inh} is the fraction of the inhalation toxicity value that USEPA identified as having a mutagenic mode of action.												
Only VOCs detected in the 3rd Quarter 2014 groundwater sample at MW-71 are shown.												
Residential risks were calculated assuming residents could be exposed to soil vapor intrusion into indoor air for 24 hours per day and 350 days per year for 30 years.												

Attachment C.7: Cancer Risk and Hazard Index Calculations for Vapor Intrusion into a Residential Building (Slab on Grade) from Groundwater at MW-33 Whirlpool, Fort Smith, Arkansas

							Cancer				Noncancer	
Chem Group	**Chemical**	**CASRN**	**Carc Class**	**ADAF**	**C_{gw}** (mg/L)	**$C_{building}$** (mg/m^3)	**URF** (m^3/mg)	**f_{inh}**	**Risk**		**RfC** (mg/m^3)	**HQ**
VOC	1,1-Dichloroethene	75-35-4	C	N	2.10E-03	5.65E-06					2.0E-01	2.7E-05
VOC	cis-1,2-Dichloroethene	156-59-2	ID	N	2.08E-02	2.55E-05						
VOC	Trichloroethene	79-01-6	HC	Y	1.60E+00	2.57E-03	4.1E-03	0.244	5.9E-06		2.0E-03	1.2E+00
VOC	Vinyl Chloride	75-01-4	A	N	5.90E-04	1.95E-06	4.4E-03		1.2E-08		1.0E-01	1.9E-05
							Cumulative Risk:		6E-06		**HI:**	1E+00
Note:												
f_{inh} is the fraction of the inhalation toxicity value that USEPA identified as having a mutagenic mode of action.												
Only VOCs detected in the 3rd Quarter 2014 groundwater sample at MW-33 are shown.												
Residential risks were calculated assuming residents could be exposed to soil vapor intrusion into indoor air for 24 hours per day and 350 days per year for 30 years.												

Appendix C.8: Soil Moisture Profile for Residential Building (Slab on Grade) for Soil Vapor Monitoring Point Water Risk Calculations Whirlpool, Fort Smith, Arkansas



Notes:
The soil-water profile in the vadose zone is estimated using the van Genuchten soil-water retention equation with default water retention parameters appropriate for silt clay, as discussed in Appendix A, Section 3.3.1 of the ADEQ-approved Revised Risk Management Plan, which was used as the basis for the ADEQ Remedial Action Decision.

Attachment C.9: Normalized Indoor Air Concentration in a Residential Building (Slab on Grade) due to Vapor Intrusion from Water at the On-Site Soil Vapor Monitoring Point
Whirlpool, Fort Smith, Arkansas

Chem Group	Chemical	CASRN	D_{air} (m^2/day)	D_{water} (m^2/day)	H (unitless)	D_{crack} (m^2/day)	D_{eff}^T (m^2/day)	α_{soil}	α_{slab}	α_{∞}	C_{bldg} (L-water/m^3)
VOC	Acetone	67-64-1	1.07E+00	9.85E-05	1.14E-03	1.58E-01	2.13E-02	1.72E-01	2.73E-03	4.69E-04	5.35E-04
VOC	1,1-Dichloroethene	75-35-4	7.78E-01	8.99E-05	8.10E-01	1.15E-01	1.30E-04	1.27E-03	2.73E-03	3.46E-06	2.80E-03
VOC	cis-1,2-Dichloroethene	156-59-2	6.36E-01	9.76E-05	1.19E-01	9.37E-02	4.63E-04	4.50E-03	2.73E-03	1.23E-05	1.46E-03
VOC	Trichloroethene	79-01-6	6.83E-01	7.86E-05	2.88E-01	1.01E-01	2.28E-04	2.21E-03	2.73E-03	6.05E-06	1.74E-03
Notes:	**Crack Soil and Building Characteristics**			**Crack Soil**							
	SCS Soil texture class			Sand							
	Bulk density	kg/L	ρ_b	1.66							
	Total porosity	L/L-soil	θ_T	0.375							
	Water-filled porosity	L/L-soil	θ_w	0.062							
	Air-filled porosity	L/L-soil	θ_a	0.313							
	Residual saturation	L/L-soil	θ_r	0.053							
	Hydraulic conductivity	cm/s	K	7.4E-03							
	Dynamic viscosity of water	g/cm-s	μ_w	0.01307							
	Density of water	g/cm^3	ρ_w	1.0							
	Gravitational acceleration	cm/s^2	g	980.7							
	Intrinsic permeability	cm^2	k	9.9E-08							
	Relative saturation	unitless	S_e	0.029							
	van Genuchten N	unitless	N	3.177							
	van Genuchten M	unitless	M	0.685							
	Relative air permeability	unitless	k_{rg}	0.977							
	Permeability to vapor	cm^2	k_v	9.69E-08							
	Distance from building foundation to source	m	L_{T-gw}	1.42							
	Bldg foundation thickness	m	L_{crack}	0.1							
	Bldg foundation length	m		10.00							
	Bldg foundation width	m		10.00							
	Bldg occupied height	m		2.44							
	Bldg occupied volume	m^3		244.00							
	Occupied depth below ground	m		0.0							
	Bldg area for vapor intrusion	m^2	A_B	100.0							
	Ratio of A_{crack} to A_B		η	4E-04							
	Area of cracks	m^2	A_{crack}	4E-02							
	Air exchange rate	$hour^{-1}$	ach	0.45							
	Building ventilation rate	m^3/day	Q_{bldg}	2.64E+03							
	Pressure difference between outdoors-indoors	$kg/m\text{-}s^2$	ΔP	1.0							
	Viscosity of air	kg/m-s	μ_a	1.8E-05							
	Crack length (bldg perimeter)	m	X_{crack}	40							
	Crack depth below ground	m	Z_{crack}	0.10							
	Crack radius	m	r_{crack}	1E-03							
	Soil gas flow rate into bldg	m^3/day	Q_{soil}	7.20							
	Indoor air concentrations resulting from water vapor intrusion into a building are estimated using the relationships described by Johnson and Ettinger (Heuristic model for predicting the intrusion rate of contaminant vapors into buildings, 1991), which USEPA recommends for screening level calculations, as discussed in Appendix A, Section 3.3.1 of the ADEQ-approved Revised Risk Management Plan, which was used as the basis for the ADEQ Remedial Action Decision.										
	The effective diffusion term DeffT is calculated based on a silty clay soil, as discussed in Appendix A, Section 3.3.1 of the ADEQ-approved Revised Risk Management Program.										

Attachment C.10: Cancer Risk and Hazard Index Calculations for Vapor Intrusion into a Residential Building (Slab on Grade) from Water at the On-Site Soil Vapor Monitoring Point Whirlpool, Fort Smith, Arkansas

							Cancer				Noncancer	
Chem Group	**Chemical**	**CASRN**	**Carc Class**	**ADAF**	**C_{gw}** (mg/L)	**$C_{building}$** (mg/m^3)	**URF** (m^3/mg)	**f_{inh}**	**Risk**		**RfC** (mg/m^3)	**HQ**
VOC	Acetone	67-64-1	ID	N	5.30E-03	2.83E-06					3.1E+01	8.8E-08
VOC	1,1-Dichloroethene	75-35-4	C	N	8.90E-04	2.49E-06					2.0E-01	1.2E-05
VOC	cis-1,2-Dichloroethene	156-59-2	ID	N	5.70E-03	8.31E-06						
VOC	Trichloroethene	79-01-6	HC	Y	3.64E-02	6.35E-05	4.1E-03	0.244	1.5E-07		2.0E-03	3.0E-02
							Cumulative Risk:		1E-07		**HI:**	3E-02
Note:												

f_{inh} is the fraction of the inhalation toxicity value that USEPA identified as having a mutagenic mode of action.

Only VOCs detected in the 3rd Quarter 2014 water sample at the on-site soil vapor monitoring point VP-2S are shown.

Residential risks were calculated assuming residents could be exposed to soil vapor intrusion into indoor air for 24 hours per day and 350 days per year for 30 years.

Well Construction Diagrams
MW-81 through MW-86

ENVIRON

2118 North Tyler Road Building A, Wichita, KS 67212

Site ID: MW-81		Date(s): **5/22/2014**	
Location: **Fort Smith, Arkansas**			
Logged By: **N. Zurweller**		Checked By: **K. Stonestreet**	
Contractor: **Able Environmental**		Purpose: **Monitoring Well**	
Drilling Method: **Hollow Stem Auger**		GS Elevation: **473.77 ft amsl**	TOC Elevation: **473.54 ft amsl**
Sampling Method: **HSA Continuous Sampler**		North: **369395.23**	East: **590977.40**
Well Construction:		Borehole Dia.: **8.25 inches**	Total Depth: **25.0 feet**
Blank Casing: Sch 40 PVC 2 Inch	0 FT to 20 FT	Project Number: **3433244A**	
Screen: Sch. 40 0.10 PVC	20 FT to 25 FT	Project Name: **Whirlpool Corporation**	
Annular Fill: Cement Grout Bentonite Sand	0 FT to 15.5 FT 15.5 FT to 17.5 FT 17.5 FT to 25 FT	Remarks:	

Elevation (ft)	Depth (ft)	Recovery (feet)	Sample No.	PID (ppm)	Graphic Log	USCS Code	Material Description	Water Level	Well Construction
				3			Fill, dark grayish brown, silty, with gravel		Flush Mount
		5				CL	Silty Clay, dark grayish brown, dark grayish brown, some reddish brown mottling, plastic, sticky, very moist		
470				0.6			Silty Clay, strong brown, some dark gray and red mottling, very stiff, plastic, moist		
	5			7.6					
		5							
465				7.8			Silty Clay, strong brown and light gray, little subrounded gravel up to 1/4", little black nodules, very stiff, plastic, moist, with black nodules from 8.0-8.4' bgs		
	10								
		5		10.1			Sandy Clay, strong brown, light greenish gray mottling, trace black nodules, fine sand, stiff, slightly plastic, slightly moist		
460				8.7					
	15								
		5		13.3					
455				15.9		SC	Clayey Sand, strong brown and light greenish gray, some sandy clay seams, fine sand, slightly cohesive to cohesive, wet		
	20					GC	Sand and Gravel, strong brown, subrounded gravel up to 1/2", medium to coarse sand, cohesive, slightly sticky, wet		
		2.5		18			Sand and Gravel and Silty Clay, strong brown, trace weathered shale, subrounded gravel up to 2", cohesive, very moist to wet		
450				14.7					
	25								
445									

Report: WELL_LOG_REV_MKE; File: WHIRLPOOL_LOGS (JH_EDITS).GPJ; 1/20/15

ENVIRON

2118 North Tyler Road Building A, Wichita, KS 67212

Site ID: MW-82		Date(s): **5/22/2014**	
Location: **Fort Smith, Arkansas**			
Logged By: **N. Zurweller**		Checked By: **K. Stonestreet**	
Contractor: **Able Environmental**		Purpose: **Monitoring Well**	
Drilling Method: **Hollow Stem Auger**		GS Elevation: **473.85 ft amsl**	TOC Elevation: **473.60 ft amsl**
Sampling Method: **HSA Continuous Sampler**		North: **369405.69**	East: **591039.21**
Well Construction:		Borehole Dia.: **8.25 inches**	Total Depth: **26.0 feet**
Blank Casing: Sch 40 PVC 2 Inch	0 FT to 21 FT	Project Number: **3433244A**	
Screen: Sch. 40 0.10 PVC	21 FT to 26 FT	Project Name: **Whirlpool Corporation**	
Annular Fill: Cement Grout Bentonite Sand	0 FT to 15 FT 15 FT to 17 FT 17 FT to 26 FT	Remarks:	

Elevation (ft)	Depth (ft)	Recovery (feet)	Sample No.	PID (ppm)	Graphic Log	USCS Code	Material Description	Water Level	Well Construction (Flush Mount)
				9.2			Fill - very dark brown, silty, some root hairs, very moist		
		5				CL	Silty Clay, dark grayish brown, little strong brown mottling, little clayey silt, slightly stiff, plastic, moist		
470				7.9					
	5						Silty Clay as above, little subrounded gravel up to 1/4", very moist		
		5		7.9			Silty Clay, strong brown, some light gray mottling, little subrounded gravel up to 1/4", trace black nodules, very stiff, plastic, slightly moist		
465				10.2					
	10								
		5		10.9			Silty Clay as above, little very fine sand		
460				12.1					
	15						Silty Clay as above, some very fine sand, light greenish gray mottling, little black nodules		
		5		9.4					
455				10.6					
	20					GC	Sandy Clay, strong brown, some light greenish gray, fine sand, slightly stiff, cohesive, slightly plastic, moist to very moist, sand and gravel in shoe of sampler		
		3.3		14.3		CL			
						GC	Sand and Gravel, strong brown, subrounded gravel up to 1/2", medium to coarse sand, cohesive, sticky, wet		
450				6.6			Sandy Clay, strong brown, little light greenish gray mottling, little clayey sand, fine to medium sand, slightly stiff, cohesive, wet		
	25						Sand and Gravel, strong brown, with clay, subrounded gravel up to 1", slightly cohesive, wet		
		1		16.6			Sand and Gravel as above, little weathered shale, approx. 4 ft of sluff in sampler due to heave		
445									

ENVIRON

2118 North Tyler Road Building A, Wichita, KS 67212

Site ID: MW-83		Date(s): **5/20/2014**	
Location: **Fort Smith, Arkansas**			
Logged By: **N. Zurweller**		Checked By: **K. Stonestreet**	
Contractor: **Able Environmental**		Purpose: **Monitoring Well**	
Drilling Method: **Hollow Stem Auger**		GS Elevation: **475.99 ft amsl**	TOC Elevation: **474.44 ft amsl**
Sampling Method: **HSA Continuous Sampler**		North: **369210.97**	East: **590946.39**
Well Construction:		Borehole Dia.: **8.25 inches**	Total Depth: **27.0 feet**
Blank Casing: Sch 40 PVC 2 Inch	0 FT to 22 FT	Project Number: **3433244A**	
Screen: Sch. 40 0.10 PVC	22 FT to 27 FT	Project Name: **Whirlpool Corporation**	
Annular Fill: Cement Grout Bentonite Sand	0 FT to 18 FT 18 FT to 20 FT 20 FT to 27 FT	Remarks:	

Elevation (ft)	Depth (ft)	Recovery (feet)	Sample No.	PID (ppm)	Graphic Log	USCS Code	Material Description	Water Level	Well Construction
							Asphalt		Flush Mount
475		3.9		7.8		MH	Clayey Silt, dark grayish brown, little yellowish brown, little root hairs, trace subrounded gravel up to 1/4", slightly plastic, slightly moist		
				2.0			Clayey Silt, strong brown, with light gray mottling, little red brown mottling, some subrounded gravel up to 1/4", slightly stiff, slightly plastic, slightly moist		
	5								
470		5		3.9		CL	Silty Clay, strong brown, with light gray mottling, with black nodules, some subrounded gravel up to 1/4", stiff, plastic, slightly moist		
				6.3			Silty Clay, strong brown, some fine sand, some subrounded gravel up to 1/4", slightly stiff, slightly plastic, slightly moist		
	10								
465		5		4.5			Sandy Clay, strong brown, with light gray mottling, trace black nodules, fine to very fine sand, stiff, cohesive, slightly moist to moist		
				10.1					
	15								
460		5		7					
				14.4		SC	Clayey Sand, strong brown, little light gray mottling, some black nodules, fine sand, slightly stiff, cohesive, moist		
	20						Clayey Sand as above, wet		
455		3.1		9.8		GC	Sand and Gravel, strong brown, with clay, little subrounded gravel up to 3/4", medium to coarse sand, slightly cohesive, wet		
				10.4					
	25			16.4			Sand and Gravel as above, little to some clay, slightly cohesive		
450		2		10.7			Sand and Gravel, strong brown, with clay, subrounded gravel up to 2", medium to coarse sand, stiff, cohesive, very moist		

ENVIRON

2118 North Tyler Road Building A, Wichita, KS 67212

Site ID: MW-84		Date(s): **5/22/2014**	
Location: **Fort Smith, Arkansas**			
Logged By: **N. Zurweller**		Checked By: **K. Stonestreet**	
Contractor: **Able Environmental**		Purpose: **Monitoring Well**	
Drilling Method: **Hollow Stem Auger**		GS Elevation: **475.87 ft amsl**	TOC Elevation: **475.53 ft amsl**
Sampling Method: **HSA Continuous Sampler**		North: **369194.32**	East: **590881.99**
Well Construction:		Borehole Dia.: **8.25 inches**	Total Depth: **29.0 feet**
Blank Casing: Sch 40 PVC 2 Inch	0 FT to 24 FT	Project Number: **3433244A**	
Screen: Sch. 40 0.10 PVC	24 FT to 29 FT	Project Name: **Whirlpool Corporation**	
Annular Fill: Cement Grout Bentonite Sand	0 FT to 19 FT 19 FT to 21 FT 21 FT to 29 FT	Remarks:	

Elevation (ft)	Depth (ft)	Recovery (feet)	Sample No.	PID (ppm)	Graphic Log	USCS Code	Material Description	Water Level	Well Construction (Flush Mount)
475		3.7		3.7		MH	Clayey Silt, grayish brown, little red streaking, stiff, slightly plastic, moist		
				2.6			Clayey Silt, strong brown, little light gray mottling, trace subrounded gravel up to 1/4", stiff, plastic, moist		
	5			5.3					
470		5				CL	Silty Clay, strong brown, with light gray mottling, little red, some black nodules, very stiff, plastic, slightly moist, moist and slightly sticky from 14.8-15.0' bgs		
				5.7					
	10						Silty Clay as above, little subrounded gravel up to 1/4"		
465		5		7.3					
				7.1			Silty Clay, strong brown, with light gray mottling, little red, little subrounded gravel up to 1/4", some to little very fine sand, trace black nodules, very stiff, plastic, slightly moist		
	15						Sandy Clay, strong brown, little gray mottling, fine sand, cohesive, very moist		
460		5		9.3		SC	Clayey Sand, strong brown, fine to medium sand, slightly cohesive, wet		
				9.3		CL	Sandy Clay, strong brown, little gray mottling, some silty clay, fine sand, cohesive, very moist		
	20						Sandy Clay and Clayey Sand, strong brown, some greenish gray mottling, some subrounded gravel up to 1/4", fine sand, cohesive, moist		
455		4.5		8.7			Sandy Clay and Clayey Sand as above, wet		
				10.8		GC	Sand and Gravel, strong brown, little clay, subrounded gravel up to 1/2", medium to coarse sand, slightly cohesive, wet		
	25			11			Sand and Gravel, strong brown, little greenish gray, with clay, subrounded gravel up to 1/2", medium to coarse sand, cohesive, very moist		
450		2.5		10.2		CL	Silty Clay, strong brown, with sand and gravel, subrounded and subangular gravel up to 1", medium to coarse sand, stiff, very moist		

ENVIRON

2118 North Tyler Road Building A, Wichita, KS 67212

Site ID: MW-85		Date(s): **5/21/2014**	
Location: **Fort Smith, Arkansas**			
Logged By: **N. Zurweller**		Checked By: **K. Stonestreet**	
Contractor: **Able Environmental**		Purpose: **Monitoring Well**	
Drilling Method: **Hollow Stem Auger**		GS Elevation: **474.73 ft amsl**	TOC Elevation: **474.41 ft amsl**
Sampling Method: **HSA Continuous Sampler**		North: **369017.66**	East: **590760.26**
Well Construction:		Borehole Dia.: **8.25 inches**	Total Depth: **30.0 feet**
Blank Casing: Sch 40 PVC 2 Inch	0 FT to 25 FT	Project Number: **3433244A**	
Screen: Sch. 40 0.10 PVC	25 FT to 30 FT	Project Name: **Whirlpool Corporation**	
Annular Fill: Cement Grout Bentonite Sand	0 FT to 20 FT 20 FT to 22 FT 22 FT to 30 FT	Remarks:	

Elevation (ft)	Depth (ft)	Recovery (feet)	Sample No.	PID (ppm)	Graphic Log	USCS Code	Material Description	Water Level	Well Construction (Flush Mount)
		5		96.1		CL	Fill, gravel and silty topsoil Silty Clay, strong brown, some light gray mottling, little red brown mottling, little black nodules, stiff, slightly plastic, slightly moist		
			MW-85 4.5-5	186.4					
470	5						Silty Clay as above, some dark brown, little subrounded gravel up to 1/4", moist, slight solvent odor		
		5		264.9			Silty Clay as above, no dark brown, solvent odor		
			MW-85 9-9.5	379.3			Silty Clay, strong brown, little light gray, some subrounded gravel up to 1/4", some fine sand, slightly plastic, dry, solvent odor		
465	10						Silty Clay, strong brown, some light gray mottling, some black nodules, stiff, plastic, moist		
		5		466.1					
			MW-85 14-14.5	601.6					
460	15		MW-85 16-16.5				Silty Clay as above, little very fine sand Silty Clay as above, very stiff, slight solvent odor		
		5		327.2					
				185.7			Silty Clay, strong brown, some light gray mottling, little fine sand, some black nodules, very stiff, plastic, moist, slight solvent odor		
455	20						Silty Clay as above, with fine sand		
		5		83.1					
			MW-85 24.5-25	95.1		SC	Clayey Sand, strong brown, some light gray, some subrounded gravel up to 1", fine to medium sand, cohesive, moist, solvent odor		
450	25					GC	Sand and Gravel, strong brown, with clay, subrounded to subangular gravel up to 1", medium to coarse sand, cohesive, wet, solvent odor		
		2.4		16					
			MW-85 28.5-29	305.2					
445									

ENVIRON

2118 North Tyler Road Building A, Wichita, KS 67212

Site ID: MW-85

Project Name: **Whirlpool Corporation**

Project Number: **3433244A**

Elevation (ft)	Depth (ft)	Recovery (feet)	Sample No.	PID (ppm)	Graphic Log	USCS Code	Material Description	Water Level	Well Construction
							Sand and Gravel and Silty Clay, strong brown, subrounded to subangular gravel up to 1", medium to coarse sand, cohesive, wet, solvent odor		
440	35								
435	40								
430	45								
425	50								
420	55								
415	60								
410	65								
405									

Report: WELL_LOG_REV_MKE; File: WHIRLPOOL_LOGS (JH_EDITS).GPJ; 1/20/15

ENVIRON

2118 North Tyler Road Building A, Wichita, KS 67212

Site ID: MW-86		Date(s): **5/21/2014**	
Location: **Fort Smith, Arkansas**			
Logged By: **N. Zurweller**		Checked By: **K. Stonestreet**	
Contractor: **Able Environmental**		Purpose: **Monitoring Well**	
Drilling Method: **Hollow Stem Auger**		GS Elevation: **473.51 ft amsl**	TOC Elevation: **473.19 ft amsl**
Sampling Method: **HSA Continuous Sampler**		North: **368995.35**	East: **590767.35**
Well Construction:		Borehole Dia.: **8.25 inches**	Total Depth: **28.0 feet**
Blank Casing: Sch 40 PVC 2 Inch	0 FT to 23 FT	Project Number: **3433244A**	
Screen: Sch. 40 0.10 PVC	23 FT to 28 FT	Project Name: **Whirlpool Corporation**	
Annular Fill: Cement Grout Bentonite Sand	0 FT to 19 FT 19 FT to 21 FT 21 FT to 28 FT	Remarks:	

Elevation (ft)	Depth (ft)	Recovery (feet)	Sample No.	PID (ppm)	Graphic Log	USCS Code	Material Description	Water Level	Well Construction
				106.7			Silty Clay Fill, very dark grayish brown, with subangular gravel, stiff, dry, strong odor		Flush Mount
		4	MW-86 3.5-4	480.1		CL	Silty Clay, strong brown, some light gray mottling, little red mottling, little black nodules, stiff, slightly plastic, moist		
470	5								
		5	MW-86 8.5-9	326			Silty Clay as above, no red mottling, some subrounded gravel up to 1/2", very stiff, plastic		
465				557.3					
	10			383.2					
		5	MW-86 14-14.5	2024			Silty Clay, strong brown, some light gray mottling, some subrounded gravel up to 1/2", some very fine sand, little black nodules, stiff, slightly plastic, moist, solvent odor		
460			MW-86 15.5-16						
	15			1678			Silty Clay as above, no gravel, some black nodules, stiff to very stiff, slightly plastic to plastic		
		5		1349					
455									
	20		MW-86 21-21.5	1407		GC	Silty Clay, strong brown, some light gray mottling, some very fine sand, some black nodules, stiff to very stiff, slightly plastic to plastic, very moist, solvent odor		
		3.8					Silty Clay and Gravel, with fine to medium sand, strong brown, little light gray, subrounded gravel up to 1", cohesive, wet, strong solvent odor		
450				873					
	25		MW-86 26-26.5	9570			Sand and Gravel, with clay, subrounded gravel up to 1", strong brown, cohesive to slightly cohesive, wet		
		3		1234			Sand and Gravel as above, subrounded and subangular gravel up to 2", little black weathered shale, strong solvent odor		
445									