

Interim Response to ADEM Comments, July 30, 2018 Downtown Environmental Assessment

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DATE: September 28, 2018

On July 30, 2018, the DEA technical team members met with ADEM representatives to present the summary finding of the Draft Risk Assessment/Alternatives Analysis (RA/AA) Report submitted to ADEM in July 2018. The following initial comments were received verbally from ADEM during the meeting based on the summary presentation:

- The discharge length of the plume used in the dilution attenuation factor (DAF) calculations is based on data that are over 10 years old. In addition, the conceptual site model (CSM) indicates that the Alabama River acts as a hydraulic barrier at the leading edge of the plume. Therefore, ADEM requested that the DEA consider the possibility that the plume may have spread over time and the estimated discharge length in the DAF calculations may be assumed to be too narrow. Please evaluate how changes in plume discharge length impact the DAF estimate.
- The human health risk assessment (HHRA) currently identifies the drinking water pathway as incomplete because the former municipal supply wells near downtown have been abandoned and there is a “no drill” ordinance for the downtown area. ADEM noted that their policy is to consider the drinking water pathway complete and carry it through the risk assessment.

In addition to the above comments provided by ADEM, after the preparation of Draft RA/AA Report, the DEA was notified during a July 2018 Community Outreach Group meeting, that a downtown commercial property is currently being used as an apartment, which is residential use.

This interim response has been prepared to provide ADEM with:

1. An estimation of impacts to the DAF calculations from the plume discharge length
2. The results of a cumulative risk evaluation of a potable groundwater use scenario
3. An additional evaluation of soil vapor data under a residential scenario

The risk evaluation updates for both the groundwater use scenario and residential evaluation for soil vapor will be incorporated into the revised Final RA/AA Report after DEA receives final comments from ADEM’s review of the report.

DAF Calculations

To estimate the impact of plume discharge length on the DAF calculations and estimated concentrations of tetrachloroethene (PCE) in Cypress Creek, the discharge length of the plume, which is assumed to interact with pore water, was increased to a nearly 0.5 mile (2,600 feet) as shown on Figure 1. The incremental increase of the discharge length and calculated percent decrease in the DAF are presented in Table 1. The results of the evaluation indicate that changes in DAF are more sensitive when the discharge length is smaller and less sensitive as discharge length assumptions increase, as follows:

- When the discharge length was increased by 10 percent, the DAF decreased by 9 percent.
- When the discharge length was increased from 100 to 200 percent, the DAF decreased by 17 percent.

Table 1 also summarizes the estimated surface water concentration in Cypress Creek by conservatively assuming the concentration across the entire plume discharge area (i.e., cross-sectional area) is represented by the concentration of PCE detected in TMPZ-1/MW-13S, which is the most downgradient monitoring well. Based on the evaluation, even if the plume width extended nearly 0.5 mile wide, only then would it exceed the most conservative human health risk screening value of 11 micrograms per liter that assumes consumption of both fish and surface water from the creek. Based on the hydrogeological conditions at the site and delineation of the plume discharge length from past investigations, it is highly unlikely that the length of the distal end of the plume has increased 550 percent. Given this result, and the fact that the effect of dilution was not factored into the estimate, it is highly unlikely that the human health screening value for surface water would be exceeded due to plume migration.

Potable Use of Groundwater

A cumulative risk evaluation of a potable groundwater use scenario was performed for the chemicals whose maximum detected concentration exceeded U.S. Environmental Protection Agency (EPA) Regional Screening Levels (RSLs) for tap water¹. The results of the cumulative risk evaluation are summarized in Table 2. Potential individual excess lifetime cancer risk (IELCR) and noncancer hazard index (HI) were estimated for the six monitoring well samples with an RSL exceedance. The allowable risk standards under the Alabama Risk-Based Corrective Action guidance are an IELCR of 1.0×10^{-5} and a noncancer HI of 1.0. Generally, remedial and/or mitigation actions are not warranted if the cumulative IELCR is equal to or less than 1.0×10^{-5} and the estimated HI is equal to or less than 1.0. The estimated cumulative IELCRs and HIs for a hypothetical future potable use scenario are as follows:²

- MW-02S – Estimated IELCR (3×10^{-6}) and HI (0.8); no ADEM cumulative risk standard exceedance
- MW-03S – Estimated IELCR (2×10^{-6}) and HI (0.4); no ADEM cumulative risk standard exceedance
- MW-08S – Estimated IELCR (8×10^{-6}) and HI (**2**); HI exceedance due to PCE
- MW-09S – Estimated IELCR (1×10^{-6}) and HI (0.2); no ADEM cumulative risk standard exceedance
- MW-12S – Estimated IELCR (6×10^{-6}) and HI (**2**); HI exceedance due to PCE
- TMPZ-1/MW-13S – Estimated IELCR (**2×10^{-5}**) and HI (**5**); IELCR and HI exceedances due to PCE

Based on these calculations, the estimated IELCR at three sampling locations (MW-08S, MW-12S, and TMPZ-1/MW-13S) would exceed the ADEM's target allowable risk of 1.0×10^{-5} and/or HI of 1.0. However, there is no current known potable use of groundwater within the site boundary. As a remedial action, the Montgomery Water Works and Sanitary Sewer Board discontinued the use of groundwater from downtown area supply wells in the 1990s and permanently abandoned the wells. Additionally, the City enacted an ordinance in 2003 that prohibits drilling of any new wells within the site boundary. Although current potable use is not occurring, one of the remedial objectives for the site is to protect human health and the environment from exposure to chemicals in groundwater at concentrations above their respective Maximum Contaminant Levels. Existing remedial actions will be considered in conjunction with proposed remedial alternatives and included in the Remedial Action/Institutional Control Plan.

¹ The results of the screening evaluation are presented in Appendix A-1, Table A-7 of the Draft RA/AA Report.

² Estimated IELCRs and HIs greater than the acceptable risk criteria (IELCR of 1.0×10^{-5} and noncancer HI of 1.0) are presented using bold font.

Residential Vapor Intrusion

The conceptual exposure model has been updated (Figure 2 and Table 3) to reflect the presence of potential residential properties within the DEAP site under current and future conditions; this will be incorporated into the revised Final RA/AA Report after DEA receives final comments from ADEM's review of the report. The soil vapor data used in the HHRA were screened using the EPA Vapor Intrusion Screening Levels (VISLs) for a residential scenario. A commercial scenario is not evaluated in this technical memorandum because it was evaluated in the Draft RA/AA Report.

Chemicals of concern (COCs) were identified and a cumulative risk evaluation was performed for the COCs at the locations with residential VISL exceedances. The results of the residential screening evaluation and cumulative risk evaluation are summarized in Tables 4 and 5, respectively. Potential cumulative IELCR and noncancer HI were estimated for the three soil vapor sampling locations (VIMS-10, MW-08S, and MW-02S), as follows:³

- VIMS-10 – Estimated IELCR (**8×10^{-4}**) and HI (**188**); IELCR and HI exceedances due to trichloroethene (TCE)
- MW-08S – Estimated IELCR (**2×10^{-5}**) and HI (**5**); IELCR and HI exceedances due to TCE
- MW-02S – Estimated IELCR (**1.3×10^{-5}**) and HI (**4**); IELCR and HI exceedances due to PCE

The estimated IELCR for a residential scenario at three of the sampling locations exceeds the ADEM's target allowable risk of 1.0×10^{-5} and/or HI of 1.0. This confirms the DEA's previous conclusion that another remedial goal for the site going forward is to make property owners within the site boundary aware of the potential for risk for residential property use from soil vapor; this will be included in the Remedial Action/Institutional Control Plan as an objective.

³ Estimated IELCRs and HIs greater than the acceptable risk criteria (IELCR of 1×10^{-5} and noncancer HI of 1) are presented using bold font.

Tables

Table 1. Relationship between Cypress Creek Attenuation Factor and Plume Discharge Length

Downtown Environmental Assessment Project, Montgomery, Alabama

Discharge Length ⁽¹⁾ (feet)	Discharge Area ⁽²⁾ (ft ²)	Discharge Area ⁽²⁾ (cm ²)	Aquifer Discharge ⁽³⁾ (cm ³ /s)	Aquifer Discharge (L/day)	DAF using Cypress Creek discharge ⁽⁴⁾	Percent Increase in Discharge Length	Percent Change in DAF	Estimated Surface Water Concentration based on TMPZ-1 ⁽⁵⁾
400	14,000	13,006,000	375	32,363	103	---	---	1.69
440	15,400	14,306,600	412	35,599	93	10%	9%	1.86
600	21,000	19,509,000	562	48,545	68	50%	33%	2.54
800	28,000	26,012,000	749	64,726	51	100%	50%	3.39
1,200	42,000	39,018,000	1,124	97,089	34	200%	67%	5.08
2,400	84,000	78,036,000	2,247	194,179	17	500%	83%	10.16
2,600	91,000	84,539,000	2,435	210,360	16	550%	85%	11.01

Notes:

⁽¹⁾ Discharge length modified to evaluate impact of length assumptions on DAF calculations.

⁽²⁾ Plume thickness used for the discharge area is 35 feet as defined by the distance between the water table (approximately 40 feet bgs at MW-02S) and the point halfway between MW-02S bottom screen at 60 feet bgs and MW-07S top of screen at 85 feet bgs

⁽³⁾ Aquifer Discharge = hydraulic conductivity × hydraulic gradient × discharge area (does not assume retardation of flow from Alabama River porewater exchange). Hydraulic gradient = 0.008 measured between TMPZ-1 and MW-08S. Hydraulic conductivity = 0.0036 cm/s, based on geometric mean of hydraulic conductivities (slug test results in Black & Veatch Special Projects Corporation's *Data Evaluation Report* dated September 2000).

⁽⁴⁾ Assumes the Coliseum Boulevard Plume discharge accounts for all flow in Cypress Creek (National Pollutant Discharge Elimination System permit AL0081167) estimated annually (based on 2017) as 320.6 million gallons.

⁽⁵⁾ Most conservative screening level of **11** micrograms per liter calculated for consumption of water and fish. Note that the area of the Alabama River near Cypress Creek has a Fish and Wildlife Classification only and does not have a Public Water Supply or Swimming Classification.

DAF - dilution attenuation factor calculated as the ratio between surface water discharge and aquifer discharge

bgs = below ground surface

cm³/s = centimeters cubed per second

ft² = square feet

L/day = liters per day

cm² = square centimeter

cm/s = centimeters per second

Table 2. Estimated Risks and Hazards for Drinking Water Scenario
 Downtown Environmental Assessment Project, Montgomery, Alabama

Station ID	Sample ID	Collection Date	CAS	COC	Result/ Qualifier (µg/L)	Tap Water Carcinogenic RSL ⁽¹⁾ (µg/L)	Tap Water Noncarcinogenic RSL ⁽¹⁾ (µg/L)	IELCR ⁽²⁾	HI ⁽²⁾	Cumulative IELCR ⁽³⁾	Cumulative HI ⁽³⁾
MW-02S	GW-08-0716	7/13/2016	127-18-4	PCE	34.1	11	41.0	3.E-06	0.8	3.E-06	0.8
MW-03S	GW-09-0716	7/13/2016	127-18-4	PCE	6.27	11	41.0	6.E-07	0.2	2.E-06	0.4
		7/13/2016	79-01-6	TCE	0.566 J	0.49	2.8	1.E-06	0.2		
MW-08S	GW-10-0716	7/13/2016	127-18-4	PCE	78.4	11	41.0	7.E-06	2	8.E-06	2
		7/13/2016	79-01-6	TCE	0.599 J	0.49	2.8	1.E-06	0.2		
MW-09S	GW-01-0716	7/11/2016	79-01-6	TCE	0.567 J	0.49	2.8	1.E-06	0.2	1.E-06	0.2
MW-12S	GW-13-0716	7/13/2016	127-18-4	PCE	58.9	11	41.0	5.E-06	1.4	6.E-06	2
		7/13/2016	79-01-6	TCE	0.414 J	0.49	2.8	8.E-07	0.1		
TMPZ-1/MW-13S	GW-014-0716	7/22/2016	127-18-4	PCE	174	11	41.0	2.E-05	4.2	2.E-05	5
		7/22/2016	79-01-6	TCE	1.01	0.49	2.8	2.E-06	0.4		

Notes:

Only detected concentrations are included on this table.

⁽¹⁾ Source: EPA Regional Screening Level (RSL) table (May, 2018).

⁽²⁾ Individual excess lifetime cancer risk (IELCR) and noncarcinogenic hazard index (HI) were estimated using a ratio approach:

$$IELCR = \frac{C_{GW}}{RSL_c} \times TR \quad HI = \frac{C_{GW}}{RSL_n} \times THI$$

Where:

C_{GW} = Concentration (non-detect results based on MDL) in groundwater (µg/L)

RSL_c = Tap Water Carcinogenic RSL, based on cancer risk of 1 × 10⁻⁶ (µg/L)

RSL_n = Tap Water Non-carcinogenic RSL, based on hazard index of 1 (µg/L)

TR = Target Risk of 1 × 10⁻⁶

THI = Target Hazard Index of 1

⁽³⁾ Risk estimates (IELCR and noncarcinogenic HI) were summed for each sample location to obtain cumulative risk results.

IELCR = individual excess lifetime cancer risk

HI = hazard index

µg/L = micrograms per liter

COC = chemical of concern

J = result is estimated

PCE = tetrachloroethene

RSL = Regional Screening Level

TCE = trichloroethene

Table 3. Potentially Complete Exposure Pathways

Downtown Environmental Assessment Project, Montgomery, Alabama

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor	Exposure Route	Evaluation	Rationale
Current/ Future	Groundwater ⁽¹⁾	Surface Water ⁽²⁾	Surface Water (Cypress Creek)	Recreational Users	Ingestion, Dermal	Quant	Recreational users could potentially be exposed to site groundwater discharging to surface water in Cypress Creek.
			Fish	Fish Consumers	Ingestion	Quant	Fish consumers could potentially consume fish caught from Cypress Creek.
		Groundwater (Indoor Air)	Buildings Near Groundwater Plume	Industrial/Commercial and Government Workers and Residents	Inhalation	None ⁽⁴⁾	Workers and first-floor residents could inhale volatile constituents in indoor that potentially could migrate from underlying groundwater.
		Soil Vapor (Indoor Air)	Buildings Near Groundwater Plume	Industrial/Commercial and Government Workers and Residents	Inhalation	Quant	Workers and first-floor residents could inhale volatile constituents in indoor that potentially could migrate from soil vapor.
Future	Groundwater ⁽³⁾	Wash water	Wash water (Capital Trailways Bus Station)	Bus Maintenance Workers	Dermal, Inhalation	Quant	Future workers potentially could contact wash water from the industrial well while washing vehicles at the bus maintenance facility.

Notes:

- ⁽¹⁾ Potable use of groundwater is an incomplete exposure pathway under current and foreseeable future site conditions. The DEAP site is currently served by the Montgomery Water Works and Sanitary Sewer Board. All public water supply wells from the former North Well Field were abandoned and there are no known domestic wells in use at the DEAP. However, groundwater data were evaluated for a potable use scenario in accordance with the work plan.
- ⁽²⁾ Potential surface water concentrations were estimated using groundwater concentrations from monitoring well TMPZ-1 and a site-specific attenuation factor
- ⁽³⁾ The power lines and plumbing connected to the well and the water storage tank that the water was pumped into were removed in February 2017, rendering the well unusable in its current state (see Appendix B of the Draft RA/AA Report). Capital Trailways has connected to the City water supply and no longer uses groundwater under the DEAP site. However, per ADEM's request, it was conservatively assumed bus maintenance workers could use this well for washing vehicles in the future.
- ⁽⁴⁾ Potential exposures to indoor air associated with vapor intrusion from groundwater will not be evaluated because preference is given to the soil vapor data, which were collected at locations with groundwater concentrations greater than the vapor intrusion screening levels.

Table 4. Soil Vapor Screening Comparison

Downtown Environmental Assessment Project, Montgomery, Alabama

Location	Sample ID	Collection Date	CAS	COPC	Result/ Qualifier ($\mu\text{g}/\text{m}^3$)	Residential VISL ⁽¹⁾ ($\mu\text{g}/\text{m}^3$)	Result > VISL
VIMS	VIMS-10-0916	9/21/2016	156-59-2	cis-1,2-DCE	88.6	NA	NA ⁽²⁾
			156-60-5	trans-1,2-DCE	2.55	NA	NA ⁽²⁾
			127-18-4	PCE	99.6	139 n	No
			79-01-6	TCE	13100	6.95 n	Yes
Alabama AG's Building (AMS-03, AMS-04)	AMS-03-0916	9/20/2016	127-18-4	PCE	9.68	139 n	No
	AMS-04-0916	9/20/2016	127-18-4	PCE	9.37	139 n	No
County Annex III Building (AMS-01, AMS-02)	AMS-01-0916	9/19/2016	127-18-4	PCE	14.2	139 n	No
	AMS-02-0916	9/19/2016	127-18-4	PCE	6.28	139 n	No
			79-01-6	TCE	6.67	6.95 n	No
Monitoring Wells/Piezometer (TMPZ-1/MW-13S, MW- 12S, MW-08S, MW-02S)	SV-TMPZ1-08	9/21/2016	127-18-4	PCE	3.49	139 n	No
	SV-MW12-08	9/21/2016	127-18-4	PCE	23.3	139 n	No
			79-01-6	TCE	3.56	6.95 n	No
	SV-MW08-08	9/22/2016	127-18-4	PCE	493	139 n	Yes
			79-01-6	TCE	336	6.95 n	Yes
	AMS-MW02-08	9/23/2016	127-18-4	PCE	4940	139 n	Yes
79-01-6			TCE	3.21	6.95 n	No	

Notes:

Only detected concentrations are included on this table.

(1) Vapor Intrusion Screening Levels (VISLs) were calculated for a residential scenario using the EPA's VISL Calculator, https://epa-visl.ornl.gov/cgi-bin/visl_search (EPA, May 2018) and are based on an excess lifetime cancer risk (ELCR) of 1×10^{-6} , hazard quotient (HQ) of 0.1 and default attenuation factor (AF) of 0.03.

(2) VISLs are not available for cis- and trans-1,2-dichloroethene because the inhalation toxicity criteria were withdrawn by EPA.

$\mu\text{g}/\text{m}^3$ = microgram per cubic meter

cis-1,2-DCE = cis-1,2-dichloroethene

COPC = chemical of potential concern

n = noncarcinogenic

PCE = tetrachloroethene

TCE = trichloroethene

trans-1,2-DCE = trans-1,2-dichloroethene

VIMS = Vapor Intrusion Monitoring System

VISL = Vapor Intrusion Screening Level

Table 5. Estimated Risks and Hazards for Soil Vapor-to-Indoor Air
Downtown Environmental Assessment Project, Montgomery, Alabama

Medium	Location	Sample ID	COC	Calculated Indoor Air Concentration ⁽¹⁾ ($\mu\text{g}/\text{m}^3$)	Residential Scenario ⁽¹⁾	
					IELCR	HQ/HI
Soil Vapor-to-Indoor Air	VIMS	VIMS-10-0916	TCE	393	8.E-04	188
	Monitoring Well (MW-08S)	SV-MW08-08	PCE	14.79	1.E-06	0.4
			TCE	10.08	2.E-05	5
			Total		2.E-05	5
	Monitoring Well (MW-02S)	AMS-MW02-08	PCE	148	1.3E-05	4

Notes:

⁽¹⁾ The indoor air concentrations, IELCRs, and HQs were estimated using the EPA's VISL Calculator, https://epa-visl.ornl.gov/cgi-bin/visl_search (May 2018).

$\mu\text{g}/\text{m}^3$ = microgram(s) per cubic meter

COC = chemical of concern

IELCR = individual excess lifetime cancer risk

HI = hazard index

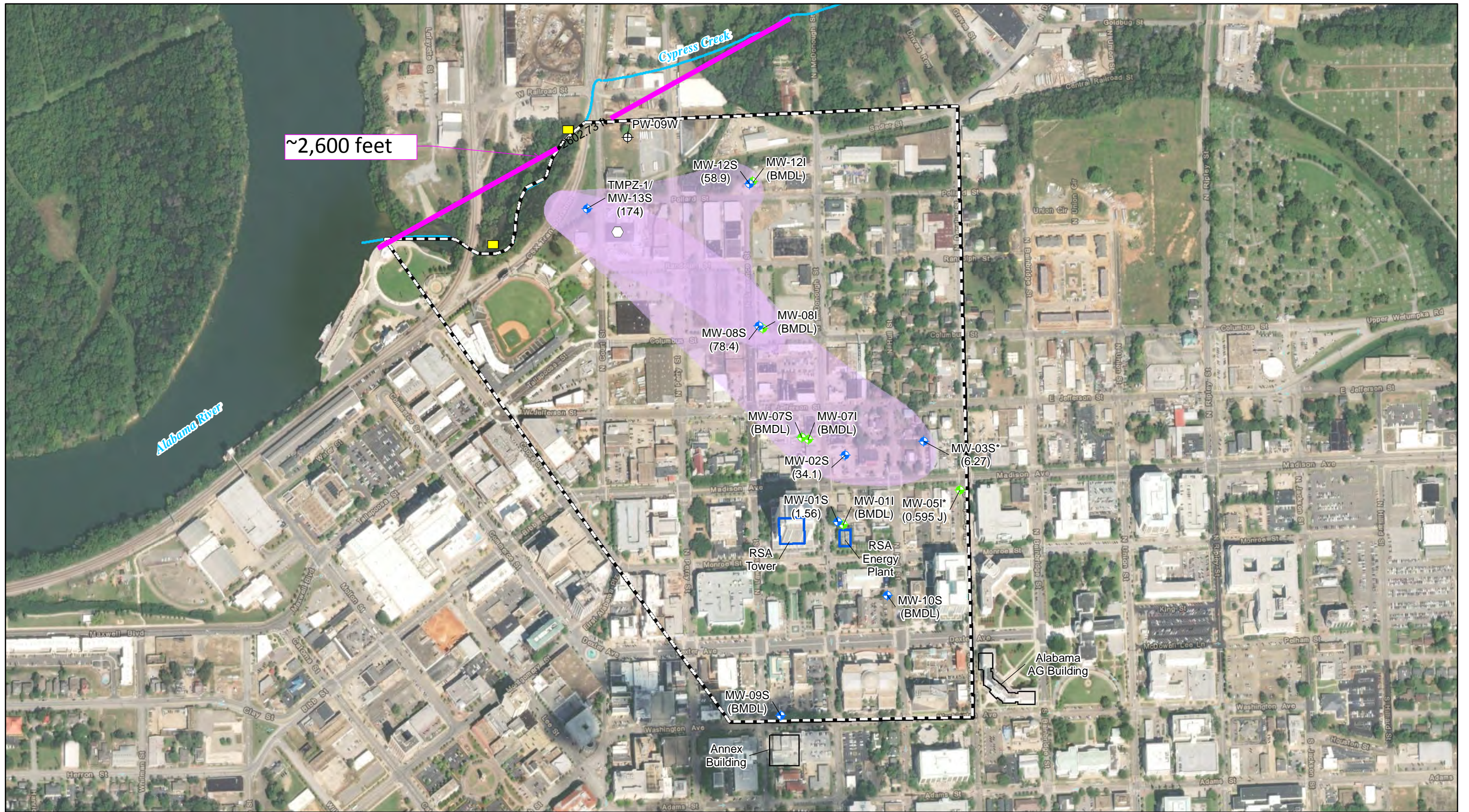
HQ = hazard quotient

PCE = tetrachloroethene

TCE = trichloroethene

VIMS = Vapor Intrusion Monitoring System

Figures



LEGEND

- ◆ Shallow Monitoring Well
- ◆ Intermediate Monitoring Well
- ⊕ Former City Water Supply Well
- Approximate Culvert Location
- Commercial Bus-Washing Station
- Approximate Extent of PCE > 5 µg/L
- Site Boundary
- RSA Building

Notes:

1. AG = Attorney General
2. BMDL = below method detection limit
3. J = concentration is estimated
4. PCE = tetrachloroethene
5. RSA = Retirement Systems of Alabama
6. µg/L = micrograms per liter
7. * = field duplicate sample location, highest result presented
8. (34.1) = PCE concentration in groundwater in µg/L
9. Darker plume shading shows the approximate extent of the commingled portion of the PCE plumes.
10. DigitalGlobe Aerial Imagery (September 26, 2017).

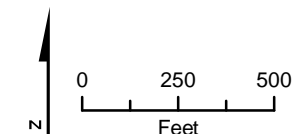
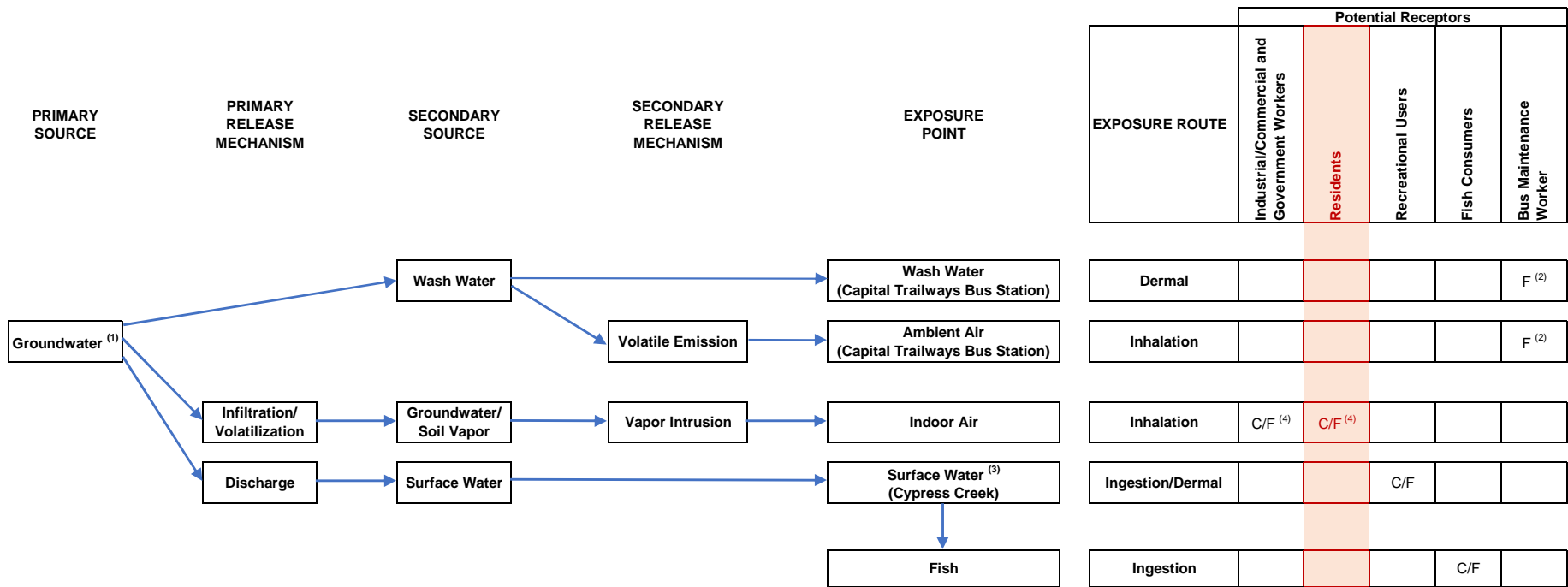


FIGURE 1
 PCE Groundwater Results - July 2016
 Risk Assessment/Alternatives Analysis Report
 Downtown Environmental Assessment Project
 Montgomery, AL



Notes:

- (1) Potable use of groundwater is an incomplete pathway under current and future site conditions. The DEAP site is currently served by the Montgomery Water Works and Sanitary Sewer Board. All public water supply wells from the former North Well Field were abandoned and there are no known domestic wells in use at the DEAP site. Additionally, the City enacted an ordinance in 2003 to prohibit future well drilling in the downtown area.
- (2) As discussed in Section 1.2.6 of the Draft RA/AA Report, the Capital Trailways well has been decommissioned and it is unlikely to be reconstructed and used in the future. However, per ADEM's request, bus maintenance workers were evaluated under a future exposure scenario.
- (3) Potential surface water concentrations were estimated using groundwater concentrations from monitoring well TMPZ-1 and a site-specific attenuation factor.
- (4) Potential exposures to indoor air associated with vapor intrusion from groundwater were not evaluated because preference is given to the soil vapor data, which were collected at locations with groundwater concentrations greater than the vapor intrusion screening levels.

C/F - Potentially Complete Pathway under Current and Future Exposure Scenarios
 F - Potentially Complete Pathway under Future Exposure Scenario

FIGURE 2
Conceptual Exposure Model
 Risk Assessment/Alternatives Analysis Report
 Downtown Environmental Assessment Project, Montgomery, Alabama