BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

MOTO, INC. (Swansea),	)	
	)	
Petitioner,	)	
	)	
v.	)	PCB 17-044
	)	(UST Appeal)
ILLINOIS ENVIRONMENTAL PROTECTION AGENCY,	)	
	)	
	)	
Respondent.	)	

CERTIFICATE OF RECORD ON APPEAL

Pursuant to 35 Ill. Adm. Code 105.116(b) and 105.410, the following constitutes an index of documents comprising the record:

PAGES	DOCUMENT	DATE
001-066	CWM e-mails with Illinois EPA and attachments	07/05/2016
067-207	CWM Corrective Action Plan and Budget	10/11/2016
208-222	Illinois EPA Leaking UST Technical Review Notes	11/18/2016
223-225	CWM e-mails with Illinois EPA and attachments	12/08/2016
226-229	Illinois EPA CAP	12/09/2016
230	Illinois EPA Environmental Justice Area Reporting Form	12/14/2016
231-237	Illinois EPA decision letter	12/20/2016

I, SHIRLENE SOUTH, certify on information and belief that the entire record of the Respondent's decision, as defined in 35 Ill. Adm. Code 105.410(b), is hereby enclosed.

BY: Shirlene South

Shirlene South
Project Manager/Environmental Protection Specialist III
Leaking Underground Storage Tank Section
Illinois Environmental Protection Agency

South, Shirlene

From: cwm@cwmcompany.com
Sent: Tuesday, July 05, 2016 12:49 PM
To: South, Shirlene
Subject: RE: 2002-0431 Moto Mart in Swansea

Shirlene,
I will prepare and send them to the client for signature, and forward them to you as soon as I receive them.
Vince

--------- Original Message ---------
Subject: 2002-0431 Moto Mart in Swansea
From: "South, Shirlene"
Date: 7/5/16 11:31 am
To: "CWM Company, Inc."

Hello Vince,

I saw that you were going to send the affidavits of the access denial in the CACR, but they are needed in the SICR. They are needed to prove that delineation of the contamination was attempted. Can you please send the as soon as possible so I can finish my review?

Thank you

Shirlene South

217/558-0347

South, Shirlene

From: cwm@cwmcompany.com
Sent: Thursday, July 07, 2016 8:15 AM
To: South, Shirlene
Subject: RE: 2002-0431 Moto Mart in Swansea
Attachments: Offsite affidavits.pdf

Shirlene,
A scan of the affidavits is attached, the originals will be delivered soon to the Agency. Let us know if you need anything else.
Vince

--------- Original Message ---------
Subject: 2002-0431 Moto Mart in Swansea
From: "South, Shirlene"
Date: 7/5/16 11:31 am
To: "CWM Company, Inc."

Hello Vince,

I saw that you were going to send the affidavits of the access denial in the CACR, but they are needed in the SICR. They are needed to prove that delineation of the contamination was attempted. Can you please send the as soon as possible so I can finish my review?

Thank you

Shirlene South

217/558-0347

In accordance with the 415 ILCS 5/57-57.17, I do solemnly swear that every effort has been attempted in order to gain access to properties west of the Moto, Inc. facility in Swansea, Illinois, owned by Medstar Ambulance, Inc., Sparta, Illinois. The Moto, Inc. facility property is located at 1324 North Illinois Street, Swansea, Illinois and has been assigned Incident number 2002-0431. The Medstar Ambulance, Inc. properties are identified as 1209 North Illinois Street, and a parking lot located north of 1209 North Illinois in Swansea, Illinois located adjacent to the west side of Illinois Street. The access requests have been completed for the purposes of site investigation and remediation of the Moto, Inc. property. The following is the attempt that has been made and the neighboring property owner's response to the attempt.

- A request for access was dated January 25, 2008 and sent via Certified Mail #7006 2760 0000 6494 4991 to Medstar Ambulance. The letter was received January 26, 2008. This letter included the language required by 35 Illinois Administrative Code 742.350 b).
- A second request for access was dated March 25, 2008 and sent via Certified Mail #7006 2760 0000 6494 4328 to Medstar Ambulance. The letter was received March 28, 2008. This letter included the language required by 35 Illinois Administrative Code 742.350 b).
- A third request for access was dated January 14, 2009 and sent via Certified Mail #7008 0500 0001 2051 2540 to Medstar Ambulance. The letter was received January 16, 2009. This letter included the language required by 35 Illinois Administrative Code 742.350 b).
- To date, no response to the requests has been received.

Copies of the requests and proof of delivery are attached.

Owner/Operator: Rob Whittington Title: Agent

Signature: Rob Whittington Date: 7/6/16

Subscribed and sworn to before me the 6th day of July, 2016

Helen O'Dell
(Notary Public)

Seal:
Official Seal
Helen M ClDell
Notary Public, State of Illinois
St. Clair County
My Commission Expires June 20, 2017

In accordance with the 415 ILCS 5/57-57.17, I do solemnly swear that every effort has been attempted in order to gain access to the property west of the Moto, Inc. facility in Swansea, Illinois, owned by Ms. Karen Roussel, Waddell, Arizona. The Moto, Inc. facility property is located at 1324 North Illinois Street, Swansea, Illinois and has been assigned Incident number 2002-0431. The Roussel property is identified 1309 North Illinois Street, Swansea, Illinois located adjacent to the west side of Illinois Street. The access requests have been completed for the purposes of site investigation and remediation of the Moto, Inc. property. The following is the attempt that has been made and the neighboring property owner's response to the attempt.

- A request for access was dated January 14, 2009 and sent via Certified Mail #7008 0500 0001 2051 2557 to Karen Roussel. This letter included the language required by 35 Illinois Administrative Code 742.350 b).
- To date, no response to the request has been received.

Copies of the requests and proof of delivery are attached.

Owner/Operator: Rob Whittington Title: Agent

Signature: Rob Whittington Date: 7/6/16

Subscribed and sworn to before me the 6th day of July, 2016

Helen M. O'Dell (Notary Public) Seal:

Official Seal
Helen M ODell
Notary Public, State of Illinois
St. Clair County
My Commission Expires June 20, 2017

In accordance with the 415 ILCS 5/57-57.17, I do solemnly swear that every effort has been attempted in order to gain access to the property west of the Moto, Inc. facility in Swansea, Illinois, owned by Mr. Dave Wuebbels, Belleville, Illinois. The Moto, Inc. facility property is located at 1324 North Illinois Street, Swansea, Illinois and has been assigned Incident number 2002-0431. The Wuebbels property is identified 1307 North Illinois Street, Swansea, Illinois located adjacent to the west side of Illinois Street. The access requests have been completed for the purposes of site investigation and remediation of the Moto, Inc. property. The following is the attempt that has been made and the neighboring property owner's response to the attempt.

- A request for access was dated January 14, 2009 and sent via Certified Mail #7008 0500 0001 2051 2533 to Dave Wuebbels. The letter was received January 15, 2009. This letter included the language required by 35 Illinois Administrative Code 742.350 b).
- To date, no response to the request has been received.

Copies of the requests and proof of delivery are attached.

Owner/Operator: Rob Whittington Title: Agent

Signature: Rob Whittington Date: 7/6/16

Subscribed and sworn to before me the 6th day of July, 2016

Helen M. O'Dell
(Notary Public)

Seal:

Official Seal
Helen M ODell
Notary Public, State of Illinois
St. Clair County
My Commission Expires June 20, 2017

South, Shirlene

From: vince@cwmcompany.com
Sent: Tuesday, July 12, 2016 2:50 PM
To: South, Shirlene
Subject: RE: 2002-0431 Moto mart
Attachments: Capture.JPG

Shirlene,

Looking at the aerial (capture.jpg), the right-of-way looks like it could be tight. I am also afraid the edges are full of utilities, since that is really the only location they could be. Not saying it is impossible to get a borings in there, but it might be difficult to find a location safe from utility conflicts.

We really hadn't started the modeling yet, but in a quick preliminary assessment, it looks like BH-5 would model a little less than 60 feet. The highest soil contamination, at BH-1, would model about 115 feet. The highest groundwater contamination, MW-1, would model about 265 feet, with MW-4 about 200 feet. Groundwater flow is away from the highway towards the east (and to a lesser extent south).

If you want us to complete the modeling now, let me know, and I should be able to get it to you in the next day or two.

Vince E. Smith, P.E.
Sr. Environmental Engineer
CWM Company, Inc.
701 W. South Grand Ave.
Springfield, IL 62704
217-522-8001
Fax 217-522-8009
vince@cwmcompany.com

-------- Original Message --------
Subject: 2002-0431 Moto mart
From: "South, Shirlene" <Shirlene.South@Illinois.gov>
Date: Tue, July 12, 2016 8:22 am
To: "vince@cwmcompany.com" <vince@cwmcompany.com>

HI Vince,
The question came up of whether a sb/mw could be put in the right-of-way, in order delineate the contamination at BH-5? I was also wondering if you have perhaps already modeled how far the contamination will travel across HWY 159?
Shirlene South
217/558-0347
Shirlene.South@illinois.gov

South, Shirlene

From: vince@cwmcompany.com
Sent: Tuesday, July 26, 2016 2:50 PM
To: South, Shirlene
Subject: RE: 2002-0431 Moto mart

Shirlene,

We never finished the modeling, but will. It should be ready either late today or tomorrow morning, and I will forward it to you.

Vince

-------- Original Message --------
Subject: RE: 2002-0431 Moto mart
From: "South, Shirlene" <Shirlene.South@Illinois.gov>
Date: Tue, July 26, 2016 12:02 pm
To: "vince@cwmcompany.com" <vince@cwmcompany.com>

Vince,
Could you please re-send the modeling that you did for the MotoMart in Swansea?
Thank you,
Shirlene

From: vince@cwmcompany.com [mailto:vince@cwmcompany.com]
Sent: Tuesday, July 12, 2016 2:50 PM
To: South, Shirlene
Subject: RE: 2002-0431 Moto mart
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We really hadn't started the modeling yet, but in a quick preliminary assessment, it looks like BH-5 would model a little less than 60 feet. The highest soil contamination, at BH-1, would model about 115 feet. The highest groundwater contamination, MW-1, would model about 265 feet, with MW-4 about 200 feet. Groundwater flow is away from the highway towards the east (and to a lesser extent south).
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Shirlene South
217/558-0347
Shirlene.South@illinois.gov

South, Shirlene

From: vince@cwmcompany.com
Sent: Wednesday, July 27, 2016 8:22 AM
To: South, Shirlene
Subject: RE: 2002-0431 Moto mart
Attachments: cwmcompany2000@gmail.com_20160727_080532.pdf; Moto Mart- model.pdf

Shirlene,

The modeling and a drawing showing the approximate limits of the contamination are attached. Let me know if you need anything else.

Vince

-------- Original Message --------
Subject: RE: 2002-0431 Moto mart
From: "South, Shirlene" <Shirlene.South@Illinois.gov>
Date: Wed, July 27, 2016 4:55 am
To: "vince@cwmcompany.com" <vince@cwmcompany.com>

Sorry, I thought you had sent me some figures.

From: vince@cwmcompany.com [mailto:vince@cwmcompany.com]
Sent: Tuesday, July 26, 2016 2:50 PM
To: South, Shirlene
Subject: RE: 2002-0431 Moto mart
Shirlene,
We never finished the modeling, but will. It should be ready either late today or tomorrow morning, and I will forward it to you.
Vince

-------- Original Message --------
Subject: RE: 2002-0431 Moto mart
From: "South, Shirlene" <Shirlene.South@Illinois.gov>
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To: "vince@cwmcompany.com" <vince@cwmcompany.com>

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Thank you,
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Sent: Tuesday, July 12, 2016 2:50 PM
To: South, Shirlene
Subject: RE: 2002-0431 Moto mart
Shirlene,
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We really hadn't started the modeling yet, but in a quick preliminary assessment, it looks like BH-5 would model a little less than 60 feet. The highest soil contamination, at BH-1, would

model about 115 feet. The highest groundwater contamination, MW-1, would model about 265 feet, with MW-4 about 200 feet. Groundwater flow is away from the highway towards the east (and to a lesser extent south).
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Vince E. Smith, P.E.
Sr. Environmental Engineer
CWM Company, Inc.
701 W. South Grand Ave.
Springfield, IL 62704
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Shirlene South
217/558-0347
Shirlene.South@illinois.gov

R-26 Input/Summary Sheet

Version: 8/25/2016

IEMA Incident # (6 or 8 digit)	2002-0431
IEPA LPC # (10 digit)	1631405021
Site Name:	MotoMart - Swansea
Site Address:	1324 North Illinois
City:	Swansea
County:	St. Clair
Zip Code:	62221
SSL Equations Used:	S5,6,7,8,9,10,17,18,19,20,21,22,24
RBCA Equations Used:	R-1, R-2, R3
Contact Information for Individual who Performed Calculat	CWM Company, Inc., VES
Land Use:	Residential & Construction Worker
Objective from S17 used in R26:	No
Groundwater:	Class 1
Standard or Mass Limit Equations:	Standard Equations — If Mass Limit, then Specify Acres:
Square Feet of Plume for Mass Limit Eq.:	0.00 < use this # above
Date Data is Entered:	July 26, 2016

Entry	Description	Reference	
60.4	Holcomb Bulk Density (pcf), or — Shelby Tube Location:		
	Dry Soil Bulk Density (g/cm³ or kg/L): 1.5, or Gravel =2.0, Sand = 1.8, Silt = 1.8, Clay = 1.7, or site specific		
2.54	ρs - Soil Particle Density		
0.619	Total Soil Porosity	0.619	0.619
0.327	Water Filled Porosity	0.327	0.327
0.292	Air Filled Porosity	0.292	0.292
0.430	θ_T - Total Soil Porosity (RBCA)	0.43 or; Gravel - 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.35	
0.286	w - Average Soil Moisture Content	0.1, or; Subsurface Soil (top 1m) = 0.1; Subsurface Soil (below 1 m) =0.2; or Site Specific	
Loamy Sand	USDA Soil Classification (Pick from List)		

Entry	
Organic Matter (%):	
Organic Matter (mg/kg):	
Total Organic Carbon (g/g):	0.00580

0.00580	Fractional Organic Carbon (foc) in g/g		
4.30E-05	Average Hydraulic Conductivity (cm/sec) — Well Name		
4.30E-05	Falling Hydraulic Conductivity (cm/sec) — MW-3		
	Rising Hydraulic Conductivity (cm/sec)		
0.09414	Hydraulic Gradient (0.02 for sites with no groundwater)	Meters	
10	d_a - Aquifer Thickness (ft)	3.048 m	
10	d_s - Depth of Source (ft) (Vertical Thickness of Contamination)	3.048 m	
	X - Distance along the centerline of the groundwater plume emanating to setback zone or surface water from the source in the direction of groundwater flow (ft) (RBCA)	0 cm	
220	L - Source Length Parallel to Groundwater Flow (ft)	67.056 m	
310	Sw: Source Width -horizontal plane (ft) (RBCA)	9448.8 cm	

Hydraulic Gradient Calculations

MW-3	92.10
MW-7	82.34
Distance:	116

$C_{(x)}$ - Concentration of Contaminant in groundwater at distance X from the source (mg/L)

Surface Water

	Benzene — MTBE	
	Toluene	
	Ethylbenzene	
	Total Xylenes	

Chemicals of Concern

Benzene	Naphthalene	
Toluene		Chrysene
Ethylbenzene		Benzo(k)fluoranthene
Total Xylenes		Indeno(1,2,3-cd)pyrene
MTBE		

☐ Mass Limit Equations

SSL Equations Needed

☑ Inhalation Equations

☑ Groundwater Ingestion Equations

☑ Csat Equations

☐ Fugitive Dust Equations

☑ Ingestion Equations

Text discussion for "I", L, d_s, d_a, S_w, S_d	
Hydraulic Gradient	The **Hydraulic Gradient** (*I*) was determined from an onsite survey of each of the groundwater monitoring wells. The riser elevations were determined and the depth to groundwater was noted in each well. This data was used to generate a potentiometric flow map with contour lines which show potentiometric head. A corresponding flow line, perpendicular to the contour lines, was determined between two known points of groundwater elevation. The hydraulic gradient was determined by the difference in elevation divided by the length of flow between the points.
Source Length	The **Source Length Parallel to Groundwater Flow (L)** was determined from the site map and analytical results. A value of 45.1104 m was used to encompass the length of contamination parallel to groundwater flow. This value is the distance between soil borings BH-1 and BH-2.
Aquifer Thickness	The **Aquifer Thickness (d_a)** is a site specific value determined by the length of the monitoring well screen. The Aquifer Thickness value used in the modeling equations was 3.048 meters.
Depth of Source	The **Depth of Source (d_s)** was determined from the analytical results and soil boring logs. A value of 3.048 m was used to encompass the vertical thickness of contamination based upon a clean soil sample at BH-1A, "hot" samples at BH-2B and BH-2C, and a clean soil sample at BH-2D. Thus the vertical thickness of soil contamination has been determined to be 3.048 m.
Source Width	**The source width perpendicular to groundwater flow direction in the Horizontal Plane (S_w)** was determined from the site map and analytical results. A value of 3566.16 cm was used to encompass the width of contamination in the horizontal plane. This value is the distance between clean wells MW-4 and and MW-6.
Source Depth	**The source width perpendicular to groundwater flow direction in the Vertical Plane (S_d)** was determined from the soil boring logs and analytical results. A value of 304.8 cm was used to encompass the width of contamination in the vertical plane based on the depths of contamination present and the PID readings from the bore logs.
Distance (X)	

BENZENE								
Soil Exceedances					Groundwater Exceedances			
Location	Soil Concentration (mg/kg)	X (ft)	Gw_{obj} (mg/L) R25 Csource	C(x) (mg/L)	Location	Groundwater Concentration (mg/L)	X (ft)	C(x) (mg/L)
BH1	3.03	116	0.217	0.0049	MW1	8.300	265	0.0049
BH2	0.096	10	0.007	0.0048	MW2	0.269	124	0.0048
BH3	0.463	58	0.033	0.0048	MW4	2.000	201	0.0049
BH5	0.474	58	0.034	0.0049				
BH9	0.312	46	0.022	0.0048				

Toluene

Soil Exceedances					Groundwater Exceedances			
Location	Soil Concentration (mg/kg)	X (ft)	Gw_{obj} (mg/L) R28 Csource	C(x) (mg/L)	Location	Groundwater Concentration (mg/L)	X (ft)	C(x) (mg/L)

Ethylbenzene

Soil Exceedances					Groundwater Exceedances			
Location	Soil Concentration (mg/kg)	X (ft)	Gw_{obj} (mg/L) R28 Csource	C(x) (mg/L)	Location	Groundwater Concentration (mg/L)	X (ft)	C(x) (mg/L)
					MW1	3.240	15	0.6391
					MW4	3.630	18	0.6875

Total Xylenes								
Soil Exceedances					Groundwater Exceedances			
Location	Soil Concentration (mg/kg)	X (ft)	Gw_{obj} (mg/L) R26 Csource	C(x) (mg/L)	Location	Groundwater Concentration (mg/L)	X (ft)	C(x) (mg/L)
BH1	16.4		0.300543354					
BH5	25.7		0.471					

MTBE								
Soil Exceedances					Groundwater Exceedances			
Location	Soil Concentration (mg/kg)	X (ft)	Gw_{obj} (mg/L) R26 Csource	C(x) (mg/L)	Location	Groundwater Concentration (mg/L)	X (ft)	C(x) (mg/L)

Naphthalene								
Soil Exceedances					Groundwater Exceedances			
Location	Soil Concentration (mg/kg)	X (ft)	Gw_{obj} (mg/L) R26 Csource	C(x) (mg/L)	Location	Groundwater Concentration (mg/L)	X (ft)	C(x) (mg/L)
					MW1	0.387	10	0.1386
					MW4	1.230	24	0.1332

Benzo[a]pyrene								
Soil Exceedances					Groundwater Exceedances			
Location	Soil Concentration (mg/kg)	X (ft)	Gw_{obj} (mg/L) R26 Csource	C(x) (mg/L)	Location	Groundwater Concentration (mg/L)	X (ft)	C(x) (mg/L)
BH2	0.16		0.000001352					
BH9	2.6		0.000021873					
BH11	0.11		0.000000930					
BH12	1.5		0.000012677					
BH14	0.13		0.000001099					
BH16	0.12		0.000001014					

Dibenz[a,h]anthracene								
Soil Exceedances					Groundwater Exceedances			
Location	Soil Concentration (mg/kg)	X (ft)	Gw_{obj} (mg/L) R26 Csource	C(x) (mg/L)	Location	Groundwater Concentration (mg/L)	X (ft)	C(x) (mg/L)
BH2	0.23		0.000000522					
BH9	0.54		0.000001225					
BH12	0.26		0.000000590					

Lead				
Soil Exceedances				
Location	Soil Concentration (mg/kg)	X (ft)	Gw_{obj} (mg/L) R26 Csource	C(x) (mg/L)

Benz[a]anthracene								
Soil Exceedances					Groundwater Exceedances			
Location	Soil Concentration (mg/kg)	X (ft)	Gw_{obj} (mg/L) R26 Csource	C(x) (mg/L)	Location	Groundwater Concentration (mg/L)	X (ft)	C(x) (mg/L)
BH9	2.5		0.000054142					

Acenaphthene								
Soil Exceedances					Groundwater Exceedances			
Location	Soil Concentration (mg/kg)	X (ft)	Gw_{obj} (mg/L) R26 Csource	C(x) (mg/L)	Location	Groundwater Concentration (mg/L)	X (ft)	C(x) (mg/L)

Illinois Enviromental Protection Agency
Leaking Underground Storage Tank Program
RBCA Input Parameters for Use with Tier 2 Calculations

A. **Site Identification**

IEMA Incident # (6- or 8-digit): 2002-0431 IEPA LPC # (10-digit): 1631405021

Site Name: MotoMart - Swansea

Site Address (not a P.O. Box): 1324 North Illinois

City: Swansea County: St. Clair Zip Code: 62221

Leaking UST Technical File

B. **Tier 2 Calculation Information**

Equation(s) Used (ex: R12,R14,R26): R16, R17, R18,R19, R21, R22, R23, R24.R28

Contact information for Individual Who Performed Calculations:

CWM Company, Inc., VES

Land Use: Residential Soil Type: Loamy Sand

Groundwater: [X] Class I [ ] Class II

Mass Limit: [ ] Yes [X] No If Yes, then Specify Acreage:

Objective from S17 used in R26? [ ] Yes [X] No

If Yes, then Specify C_{source} from S17 See Attached mg/L.

- Mass Limit Acreage other than defaults must always be rounded up.
- Failure to use site-specific parameters where allowed could affect payment from the UST Fund
- Maps depicting source width, plume dimensions, distance, etc. must also be submitted.
- Inputs must be submitted in the designated unit.

AT_c	=	70	yr
AT_n	=	Residential = 30 Con. Worker = 0.115	yr yr
BW	=	70	yr
C_{source}	=	See Attached	mg/L
$C_{(x)}$	=	See Attached	mg/L
d	=	100	cm

D^{air}	=	See Attached	cm^2/s
D^{water}	=	See Attached	cm^2/s
D_e^{soil}	=	See Attached	cm^2/s
ED	=	Residential = 30 Con. Worker = 1	yr yr
EF	=	Residential = 350 Con. Worker = 30	d/yr d/yr

erf	=	See Attached	unitless
f_{oc}	=	0.0058	g/g
GW_{comp}	=	See Attached	mg/L
GW_{source}	=	See Attached	mg/L
H'	=	See Attached	$cm3_{water}/cm^3_{air}$
I	=	0.084137931	cm/cm
I	=	30	cm/yr
IR_{air}	=	20	m^3/d
IR_{soil}	=	Residential = 100 Con. Worker = 480	mg/d mg/d
IR_w	=	Residential = 2	L/d
K	=	3.715 1356.048	cm/d cm/yr
K_{oc}	=	See Attached	cm^3/g or L/kg
k_s (non-ionizing organics)	=	See Attached	cm^3_{water}/g_{soil}
k_s (ionizing organics)	=	Not Applicable	cm^3_{water}/g_{soil}
k_s (inorganics)	=	Not Applicable	cm^3_{water}/g_{soil}
L_s	=	100	cm
LF_{inh}	=	See Attached	(mg/m^3 vapor)/(mg/kg soil)
M	=	0.5	mg/cm^2
Pe	=	$6.9 \cdot 10^{-14}$	g/cm^2-s
RAF_c	=	0.5	unitless
a_x	=	See Attached	cm
a_y	=	See Attached	cm
a_z	=	See Attached	cm
A	=	See Attached	d^{-1}
π	=	3.1416	
τ	=	$9.46 \cdot 10^8$	s

RAF_d (PNAs)	=	0.05	unitless
RAF_d (inorganics)	=	0	unitless
RAF_e	=	1	unitless
$RBSL_{air}$ (carcinogenic)	=	See Attached	$\mu g/m^3$
$RBSL_{air}$ (noncarcinogenic)	=	See Attached	$\mu g/m^3$
RfD_i	=	See Attached	mg/kg-d
SA	=	3,160	cm^2/d
S_d	=	200.0	cm
S_w	=	9,448.8	cm
SF_i	=	See Attached	$(mg/kg-d)^{-1}$
SF_o	=	See Attached	$(mg/kg-d)^{-1}$
THQ	=	1	unitless
TR	=	1.00E-06	unitless
U	=	0.7269	cm/d
U_{air}	=	225	cm/s
U_{gw}	=	1356.132	cm/y
VF_i	=	3.97133E-12	kg/m^3
VF_{comb}	=	See Attached	(mg/m^3 vapor)/(mg/kg soil or kg/m3
VF_{ss}	=	See Attached	kg/m3
W	=		cm
w	=	0.266	g_{water}/g_{soil}
δ_{air}	=	200	cm
δ_{gw}	=	200	cm
θ_{as}	=	0.153438	cm^3_{air}/cm^3_{soil}
θ_{ws}	=	0.276562	cm^3_{water}/cm^3_{soil}
θ_T	=	0.43	cm^3/cm^3_{soil}
ρ_b	=	0.967	g/cm^3
ρ_w	=	1	g/cm^3

	H'	λ	Koc
Benzene	0.23	0.0009	60
Toluene	0.271	0.011	158
Ethylbenzene	0.324	0.003	320
Total Xylenes	0.271	0.0019	398
MTBE	0.0241	0	11.5
Naphthalene	0.0198	0.0027	500

Benzene R26 Modeled Groundwater from Vertical Modeled Soils

Location	C_{source} from S17 (mg/L)	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $\delta_x / (4 \cdot \sqrt{[\alpha_x \cdot X]})$	erf: $\delta_y / (2 \cdot \sqrt{[\alpha_y \cdot X]})$
BH1	0.217	0.005	3535.68	353.568	117.856	17.6784	0.99999977	0.81135043
BH2	0.007	0.005	304.8	30.48	10.16	1.524	1	1
BH3	0.033	0.005	1767.84	176.784	58.928	8.8392	1	0.91531703
BH5	0.034	0.005	1767.84	176.784	58.928	8.8392	1	0.91531703
BH9	0.022	0.005	1402.08	140.208	46.736	7.0104	1	0.97028833

Benzene R26 Modeled Groundwater

Location	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $\delta_x / (4 \cdot \sqrt{[\alpha_x \cdot X]})$	erf: $\delta_y / (2 \cdot \sqrt{[\alpha_y \cdot X]})$
MW1	8.300	6077.2	607.72	202.24	40.388	0.87650755	0.29400279
MW2	0.289	3779.52	377.952	125.984	18.8976	0.99999671	0.5800175
MW4	2.000	6126.48	612.648	204.216	30.6324	0.99717928	0.38117227

Toluene R26 Modeled Groundwater from Vertical Modeled Soils

Location	C_{source} from S17 (mg/L)	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: S_w / (4 · $\sqrt{\alpha_y \cdot X}$)	erf: S_w / (2 · $\sqrt{\alpha_z \cdot X}$)

Toluene R26 Modeled Groundwater

Location	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: S_w / (4 · $\sqrt{\alpha_y \cdot X}$)	erf: S_w / (2 · $\sqrt{\alpha_z \cdot X}$)

Ethylbenzene R26 Modeled Groundwater from Vertical Modeled Soils								
Location	C_{source} from S17 (mg/L)	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $\delta_w / (4 \cdot \sqrt{(\alpha_y \cdot X)})$	erf: $\delta_w / (2 \cdot \sqrt{(\alpha_z \cdot X)})$

Ethylbenzene R26 Modeled Groundwater							
Location	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	$\sqrt{(\alpha_y \cdot X)}$	$\sqrt{(\alpha_z \cdot X)}$
MW1	3.240	457.2	45.72	15.24	2.286	1	1
MW4	3.830	487.68	48.768	16.256	2.4384	1	1

Total Xylenes R26 Modeled Groundwater from Vertical Modeled Soils								
Location	C_{source} from S17 (mg/L)	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $S_w / (4 \cdot \sqrt{\alpha_y \cdot X})$	erf: $S_w / (2 \cdot \sqrt{\alpha_z \cdot X})$
BH1	0.3005							
BH5	0.4710							

Total Xylenes R26 Modeled Groundwater							
Location	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $S_w / (4 \cdot \sqrt{\alpha_y \cdot X})$	erf: $S_w / (2 \cdot \sqrt{\alpha_z \cdot X})$

MTBE R26 Modeled Groundwater from Vertical Modeled Soils								
Location	C_{source} from S17 (mg/L)	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $S_w / (4 \cdot \sqrt{(\alpha_y \cdot X)})$	erf: $S_w / (2 \cdot \sqrt{(\alpha_z \cdot X)})$

MTBE R26 Modeled Groundwater							
Location	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $S_w / (4 \cdot \sqrt{(\alpha_y \cdot X)})$	erf: $S_w / (2 \cdot \sqrt{(\alpha_z \cdot X)})$

Naphthalene R28 Modeled Groundwater from Vertical Modeled Soils								
Location	C_{source} from S17 (mg/L)	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $\alpha_w / (4 \cdot \sqrt{\alpha_y \cdot X})$	erf: $\alpha_w / (2 \cdot \sqrt{\alpha_z \cdot X})$

Naphthalene R28 Modeled Groundwater							
Location	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $\alpha_w / (4 \cdot \sqrt{\alpha_y \cdot X})$	erf: $\alpha_w / (2 \cdot \sqrt{\alpha_z \cdot X})$
MW1	0.387	304.8	30.48	10.16	1.524	1	1
MW4	1.230	731.52	73.152	24.384	3.6576	1	0.99999909

Location	C_{source} from S17 (mg/L)	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $S_w / (4 \cdot \sqrt{(\alpha_y \cdot X)}$	erf: $S_w / (2 \cdot \sqrt{(\alpha_z \cdot X)}$

Location	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $S_w / (4 \cdot \sqrt{(\alpha_y \cdot X)}$	erf: $S_w / (2 \cdot \sqrt{(\alpha_z \cdot X)}$

Location	C_{source} from S17 (mg/L)	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $s_w / (4 \cdot \sqrt{(\alpha_y \cdot X)})$	erf: $s_w / (2 \cdot \sqrt{(\alpha_z \cdot X)})$
BH9	0.0001							

Location	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $s_w / (4 \cdot \sqrt{(\alpha_y \cdot X)})$	erf: $s_w / (2 \cdot \sqrt{(\alpha_z \cdot X)})$

Location	C_{source} from S17 (mg/L)	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: α_x / (4 · √[α_x · X])	erf: α_x / (2 · √[α_x · X])
BH2	0.0000							
BH9	0.0000							
BH11	0.0000							
BH12	0.0000							
BH14	0.0000							
BH16	0.0000							

Location	C(x) (mg/L)'	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: α_x / (4 · √[α_x · X])	erf: α_x / (2 · √[α_x · X])

Location	C_{source} from S17 (mg/L)	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $\alpha_w / (4 \cdot \sqrt{(\alpha_y \cdot X)})$	erf: $\alpha_w / (2 \cdot \sqrt{(\alpha_z \cdot X)})$
BH2	0.0000							
BH9	0.0000							
BH12	0.0000							

Location	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $\alpha_w / (4 \cdot \sqrt{(\alpha_y \cdot X)})$	erf: $\alpha_w / (2 \cdot \sqrt{(\alpha_z \cdot X)})$

Tier 2 Vertical Modeling & R-26 Calculations for Benzene

MotoMart - Swansea
2002-0431

RBCA | SSL | SSL & RBCA

Date Compiled: 02/23/16
Version: 8/25/2015

Input Values

Holcomb's Bulk Density -->	60.4	Converted Value to be used in calculation sheet -->			0.967515	USDA Soil Classification:	Loamy Sand				
Organic Matter (%) -->	0	FOC % (0.58 conversion) -->	0.000	Organic Matter (mg/kg) -->	0	FOC mg/kg (0.58 conversion)	0.000	foc conversion to g/g:	0.000		

0.967	ρ_b - Dry Soil Bulk Density			1.5 or; Gravel = 2.0; Sand = 1.8; Silt = 1.6; Clay = 1.7; or Site Specific					
2.54	ps - Soil Particle Density			2.65 or; Site Specific					
0.292	Θ_a - Air Filled Soil Porosity	0.292	Value from S-21	Top 1 meter = 0.28; below 1 meter = 0.13; Gravel = 0.05; Sand = 0.14; Silt =0.24; Clay = 0.19; or Calculated Value (S21)					
0.327	Θ_w - Water Filled Soil Porosity	0.327	Value from S-20	Top 1 meter = 0.15; below 1 meter = 0.30; Gravel = 0.20; Sand = 0.18; Silt =0.16; Clay = 0.17; or Calculated Value (S20)					
0.619	η - SSL Total Soil Porosity	0.619	Value from S-24	0.43 or; Gravel - 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.36; or Calculated Value (S24)					
0.43	η - RBCA Total Soil Porosity			0.43 or; Gravel - 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.36; or Calculated Value					
0.0841379	I - Hydraulic Gradient			Site Specific					
0.006	foc - Total Organic Carbon (g/g)			Surface Soil = 0.006; Subsurface Soil = 0.002; or Site Specific					
20.000	DF - Dilution Factor	1.575	Value from S-22	If calculated value for DF is less than 20, then 20 default is used, else calculated value is used					
10.135	d - Mixing Zone (m)	10.135	Value from S-25	2; or calculated value					
13.56	K - Hydraulic Conductivity (m/yr)	cm/sec =	4.30E-05	Site Specific	3.72E+00	cm/d	1.36E+03	cm/yr	Use cm/d for R15, R19, & R28; cm/yr for R24
67.06	L - Source Length Parallel to Groundwater Flow (m)		feet = 220	Site Specific (m)					
3.048	d_a - Aquifer Thickness (m)		feet = 10	Site Specific (m)					
9448.8	Sw - Source Width Horizontal plane (cm)		feet = 310	Source width perpendicular to groundwater flow direction in horizontal plane					
304.8	Sd - Source width Vertical plane (cm)			Use 200 or site specific					
0.0009	λ - First Order Degradation Constant			Benzene = 0.0009					
1.00	ρ_w - Water Density			1					
0.286	w - Average soil moisture content			0.1 or; Surface Soil = 0.1; Subsurface soil = 0.2; or Site Specific					
0.3	I - Infiltration Rate (m/yr)			0.3 for Illinois					
540	K_s - Saturated Hydraulic Conductivity			See Table K for Input Values					
0.005	GW_{obj} - Groundwater Remediation Objective Class 1			0.025	GW_{obj} - Groundwater Remediation Objective Class 2				
0.085	1/(2b+3) - Exponent for S20			See Table K for Input Values					
0.230	H' - Henry's Law Constant			Benzene = 0.228					
50.000	K_{oc} - Organic Carbon Partition Coefficient			Benzene = 58.9					

Soil Component of the Migration to Groundwater Cleanup Objective (Class 1)

$$S\text{-}17 = C_w \times \left[K_d + \frac{(\Theta_w + \Theta_a \times H')}{\rho b} \right] = C_w \times \left[0.29 + \left(\frac{0.327 + 0.292 \times 0.230}{0.967} \right) \right] = Cw \times 0.698 \text{ mg/kg}$$

Target Soil Leachate Concentration (Class 1)

$$S\text{-}18 = C_w = DF \times GW_{obj} = 20.00 \times 0.005 = 0.1$$

Soil-Water Partition Coefficient

$$S\text{-}19 = K_d = K_{oc} \times f_{oc} = 50.00 \times 0.006 = 0.29$$

Water-Filled Porosity

$$S\text{-}20 = \Theta_w = \eta \times \left(\frac{1}{K_s} \right)^{1/(2b+3)} = 0.62 \times \left[\frac{0.300}{540.000} \right]^{0.085} = 0.3273$$

Tier 2 Vertical Modeling & R-26 Calculations for Benzene

MotoMart - Swansea
2002-0431

Air-Filled Porosity

S-21 = $\Theta_a = \eta - \theta_w$ = 0.62 - 0.33 = 0.2920

Dilution Factor

S-22 = $DF = 1 + \frac{K \times i \times d}{I \times L}$ = $\frac{13.56}{0.300} \times \frac{0.0841}{67.056} \times 10.135 + 1$ = 1.5748

Total Soil Porosity

S-24 = $\eta = 1 - \frac{\rho_b}{\rho_s}$ = $1 - \frac{0.967}{2.54}$ = 0.6193

Estimation of Mixing Zone Depth

S-25 = $d = (0.0112 \times L^2)^{0.5} + d_a \left[1 - \exp \frac{(-L \times I)}{(K \times i \times d_a)} \right]$

= (0.0112 x 67.056 ^{2})$^{0.5}$ +

3.048 x [1 - exp { $\frac{-67.056}{13.560} \times \frac{0.3}{0.0841} \times 3.048$ }] = 10.135 m

Specific Discharge

R-19 = $U = \frac{K \times I}{\Theta_T}$ = $\frac{3.72E+00 \times 0.0841}{0.43000}$ = 0.72695 cm/d

Volumetric Air Content in Vadose Zone Soils

R-21 = $\theta_{as} = \theta_T - \frac{(w \times \rho_b)}{\rho_w}$ = $0.430 - \frac{0.29 \times 0.967}{1.00}$ = 0.153

Volumetric Water Content in Vadose Zone Soils

R-22 = $\theta_{ws} = \frac{w \times \rho_b}{\rho_w}$ = $\frac{0.29 \times 0.967}{1.00}$ = 0.27656

Total Soil Porosity

R-23 = $\theta_T = \theta_{as} + \theta_{ws}$ = 0.1534 + 0.27656 = 0.430

Groundwater Darcy Velocity

R-24 = $U_{gw} = K \times I$ = 1.36E+03 x 0.0841 = 1356 cm/y

Tier 2 Vertical Modeling & R-26 Calculations for Benzene

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2002-0431

Target Soil Leachate Concentration (Solve S-18 for GW_{obj})

S-18 = $GW_{obj} = \frac{C_w}{DF} =$

VERTICAL SOIL MODELING AND ASSOCIATED R-26 MODELING OF VIERTICAL MODELED SOIL

R-26 Equations:
R-16: $\alpha_x = 0.10 * X$
R-17: $\alpha_y = \alpha_x / 3$
R-18: $\alpha_z = \alpha_x / 20$
"Term 1" = $[X / (2 * \alpha_x)]$
"Term 2" = $\{1 - SQRT[1 + (4 * \lambda * \alpha_x) / (U)]\}$
erf: Section 742.APPENDIX C: Table G
$C_{(x)} = C_{source} \times e^{(Term\ 1 \times Term\ 2)} \times erf(\beta_1) \times erf(\beta_2)$

Sample Location	Soil Concentration (mg/kg)	C_w = Soil contamination at modeling point / $[K_d + (\theta_w + \theta_a \times H')/\rho_b]$	GW_{obj} = CW / DF	Distance along centerline of the groundwater plume emanating from a source.		Concentration of contaminant in groundwater at a Distance X from the source.	Longitudinal Dispersivity, Equation R 16.	Transverse Dispersivity, Equation R 17.	Vertical Dispersivity, Equation R 18	Term 1	Term 2	ERF (β1)	ERF (β2)	β1 = Sw / (4 * SQRT[αy * X])	β2 = Sd / (2 * SQRT[αz * X])
		C_w	GW_{obj} (mg/L) R26 Csource	X (ft)	X (cm)	C(x) (mg/L)	α_x (cm)	α_y (cm)	α_z (cm)						
BH1	3.03	4.343	0.21717	116	3535.7	0.00493	353.6	117.856	17.678	5	-0.8368	0.999999772	0.611350431	3.559353294	0.609574811
BH2	0.096	0.138	0.00688	10	304.8	0.00478	30.48	10.16	1.524	5	-0.0728	1	1	42.44849821	7.071067812
BH3	0.463	0.664	0.03318	58	1767.8	0.00479	176.8	58.928	8.8392	5	-0.3695	1	0.915317028	7.318706587	1.219149823
BH5	0.474	0.679	0.03397	58	1767.8	0.00490	176.8	58.928	8.8392	5	-0.3695	1	0.915317028	7.318706587	1.219149823
BH9	0.312	0.447	0.02236	46	1402.1	0.00480	140.2	46.736	7.0104	5	-0.3017	1	0.970288331	9.227934393	1.537188655

Tier 2 Vertical Modeling & R-26 Calculations for Benzene

MotoMart - Swansea
2002-0431

GROUNDWATER R-26 MODELING

	The concentration of Benzene in the groundwater at the monitoring well location.		Distance along centerline of the groundwater plume emanating from a source.		Concentration of contaminant in groundwater at a Distance X from the source.	Longitudinal Dispersivity, Equation R 16.	Transverse Dispersivity, Equation R 17.	Vertical Dispersivity, Equation R 18.	R-26 Equations	R-16: $\alpha_x = 0.10 * X$ R-17: $\alpha_y = \alpha_x / 3$ R-18: $\alpha_z = \alpha_y / 20$ "Term 1" = $[X / (2 * \alpha_x)]$ "Term 2" = $\{1 - SQRT[1 + (4 * \lambda * \alpha_x) / (U)]\}$ erf: Section 742.APPENDIX C: Table G $C_{(x)} = C_{source} \times e^{(Term\ 1 \times Term\ 2)} \times erf(\beta_1) \times erf(\beta_2)$					
Well Location	Csource (mg/L)		X (ft)	X (cm)	C(x) (mg/L)	α_x (cm)	α_y (cm)	α_z (cm)	Term 1	Term 2	ERF (β1)	ERF (β2)	β1 = $Sw / (4 * SQRT[\alpha_y * X])$	β2 = $Sd / (2 * SQRT[\alpha_z * X])$
MW1	8.3		265	8077.2	0.00493	807.7	269.24	40.386	5	-1.2361	0.976507553	0.29409279	1.601830121	0.268832748
MW2	0.269		124	3779.5	0.00484	378	125.984	18.898	5	-0.5940	0.99999871	0.580017502	3.423265984	0.570247404
MW4	2		201	6125.5	0.00491	612.6	204.216	30.632	5	-1.0085	0.997179281	0.381172265	2.111865582	0.351794419

Tier 2 Vertical Modeling & R-26 Calculations for Ethylbenzene

MotoMart - Swansea
2003-0431

[ ] RBCA IV [SSL] [SSL & RBCA]

Date Compiled: 02/23/16
Version: 6/25/2015

Input Values

Hollands's Bulk Density	90.4	Converted Value to be used in calculation sheet -->			0.968	USDA Soil Classification	Loamy Sand		
Organic Matter (%)	0	FOC % (0.58 conversion) -->		0.000	Organic Matter (mg/kg)	0	FOC mg/kg (0.58 conversion)	0.000	foc conversion to g/g:	0.000

0.987	ρ_b - Dry Soil Bulk Density			1.5 cr; Gravel = 2.0; Sand = 1.8; Silt = 1.6; Clay = 1.7; or Site Specific
2.54	ρ_s - Soil Particle Density			2.65 or; Site Specific
0.292	θ_a - Air Filled Soil Porosity	0.292	Value from S-21	Top 1 meter = 0.28; below 1 meter = 0.13; Gravel = 0.05; Sand = 0.14; Silt =0.24; Clay = 0.18; or Calculated Value (S21)
0.327	θ_w - Water Filled Soil Porosity	0.327	Value from S-20	Top 1 meter = 0.18; below 1 meter = 0.30; Gravel = 0.20; Sand = 0.18; Silt =0.18; Clay = 0.17; or Calculated Value (S20)
0.619	η - SSL: Total Soil Porosity	0.619	Value from S-24	0.43 or; Gravel - 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.36; or Calculated Value (S24)
0.43	η - RBCA: Total Soil Porosity			0.43 or; Gravel - 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.36; or Calculated Value
0.0841379	I - Hydraulic Gradient			Site Specific
0.008	foc - Total Organic Carbon (g/g)			Surface Soil = 0.008; Subsurface Soil = 0.002; or Site Specific
20.000	DF - Dilution Factor	1.578	Value from S-22	If calculated value for DF is less than 20, then 20 default is used, else calculated value is used
10.135	d - Mixing Zone (m)	10.135	Value from S-25	2; or calculated value
13.56	K - Hydraulic Conductivity (m/yr)	cm/sec = 4.30E-05		Site Specific	3.72E+00 [cm/d]	1.36E+03 [cm/y]; Use cm/d for R19; R19; & R26 - cm/y for R24
67.058	L - Source Length Parallel to Groundwater Flow (m)		feet = 220	Site Specific (m)
3.048	d_a - Aquifer Thickness (m)		feet = 10	Site Specific (m)
9448.8	Source Width - horizontal plane (cm)		feet = 310	Source width perpendicular to groundwater flow direction in horizontal plane
304.8	Source width - vertical plane (cm)			Use 200 or site specific
0.0030	λ - First Order Degradation Constant			Ethylbenzene = 0.003
1.90	ρ_w - Water Density			1
0.298	w - Average soil moisture content			0.1 cr; Surface Soil = 0.1; Subsurface soil = 0.2; or Site Specific
0.3	I - Infiltration Rate (m/yr)			0.3 for Illinois
540	K_s - Saturated Hydraulic Conductivity			See Table K for Input Values
0.700	GW_{ao} - Groundwater Remediation Objective Class 1			1 GW_{ao} - Groundwater Remediation Objective Class 2
0.086	1/(2b+3) - Exponent for S20			See Table K for Input Values
0.324	H' - Henry's Law Constant			Ethylbenzene = 0.323
320.00	K_{oc} - Organic Carbon Partition Coefficient			Ethylbenzene = 363

Soil Component of the Migration to Groundwater Cleanup Objective [Class 1]

$$S\text{-}17 = C_w \times \left[K_d + \frac{(\theta_w + \theta_a \times H')}{\rho b} \right] = C_w \times \left[1.856 + \left(\frac{0.327 + 0.292 \times 0.324}{0.987} \right) \right] = C_w \times 2.292 \text{ mg/kg}$$

Target Soil Leachate Concentration [Class 1]

$$S\text{-}18 = C_w = DF \times GW_{ao} = 20.00 \times 0.700 = 14$$

Soil-Water Partition Coefficient

$$S\text{-}19 = K_d = K_{oc} \times f_{oc} = 320.00 \times 0.008 = 1.856$$

Water-Filled Porosity

$$S\text{-}20 = \theta_w = \eta \times \left(\frac{1}{K_s} \right)^{1/(2b+3)} = 0.62 \times \left[\frac{0.300}{540.000} \right]^{0.086} = 0.3273$$

Air-Filled Porosity

$$S\text{-}21 = \theta_a = \eta - \theta_w = 0.62 - 0.33 = 0.2920$$

Dilution Factor

$$S\text{-}22 = DF = 1 + \frac{K \times I \times d}{I \times L} = \frac{13.56 \times 0.0841 \times 10.135}{0.300} + 1 = 1.5748$$

Tier 2 Vertical Modeling & R-26 Calculations for Ethylbenzene

MotoMart - Swansea
2002-0431

Total Soil Porosity

S-24 = $\eta = 1 - \frac{\rho_w}{\rho_s}$ = 1 - $\frac{0.997}{2.54}$ = 0.8193

Estimation of Mixing Zone Depth

S-25 = $d = (0.0112 \times L_p^2)^{0.5} + d_a \left[1 - \exp\frac{(-I_z \times I)}{(K \times I \times d_a)}\right]$

= (0.0112 x 87.056 ^{2})$^{0.5}$ +

3.048 x [1 - exp { $\frac{-87.056}{13.560}$ x $\frac{0.3}{0.0841}$ x 3.048 }] = 10.135 m

Specific Discharge

R-19 = $U = \frac{K \times I}{\theta_T}$ = $\frac{3.72E+00}{0.43000}$ x 0.0841 = 0.72695 cm/d

Volumetric Air Content in Vadose Zone Soils

R-21 = $\theta_{as} = \theta_T - \frac{(w \times \rho_b)}{\rho_w}$ = 0.430 - $\frac{0.29}{1.00}$ x 0.997 = 0.153

Volumetric Water Content in Vadose Zone Soils

R-22 = $\theta_{ws} = \frac{w \times \rho_b}{\rho_w}$ = $\frac{0.29}{1.00}$ x 0.997 = 0.27856

Total Soil Porosity

R-23 = $\theta_T = \theta_{as} + \theta_{ws}$ = 0.1534 + 0.27856 = 0.430

Groundwater Darcy Velocity

R-24 = $U_{gw} = K \times I$ = 1.38E+03 x 0.0841 = 1356 cm/y

Tier 2 Vertical Modeling & R-26 Calculations for Ethylbenzene

MotoMart - Swansea

2002-0431

Target Soil Leachate Concentration (Solve S-18 for GW_{obj})

$$S\text{-}18 = \quad GW_{obj} = \frac{C_w}{DF} =$$

VERTICAL SOIL MODELING AND ASSOCIATED R-26 MODELING OF VERTICAL MODELED SOIL

	The greatest potential concentration of Ethylbenzene in the groundwater at the source of the contamination.	C_w = (soil concentration at modeling point) / (K_d + (θ_w + θ_a x H)/ρb)	GW_{obj} = CW / DF	Distance along centerline of the groundwater plume emanating from a source.		Concentration of contaminant in groundwater at a Distance X from the source.	Longitudinal Dispersivity, Equation R 16.	Transverse Dispersivity, Equation R 17.	Vertical Dispersivity, Equation R 18.	R-26 Equations: R-16: α_x = 0.10 * X R-17: α_y = α_x / 3 R-18: α_z = α_x / 20 "Term 1" = [X / (2 * α_x)] "Term 2" = {1 - SQRT[1 + (4 * λ * α_x) / (U)]} erf: Section 742.APPENDIX C: Table G $C_{(x)} = C_{source} \times e^{(Term\ 1 \times Term\ 2)} \times erf(\beta_1) \times erf(\beta_2)$					
Sample Location	Soil Concentration (mg/kg)	C_w	GW_{obj} (mg/L) R26 Csource	X (ft)	x (cm)	C(x) (mg/L)	α_x (cm)	α_y (cm)	α_z (cm)	Term 1	Term 2	ERF (β1)	ERF (β2)	β1 = Sw / (4 * SQRT[αy * X])	β2 = Sd / (2 * SQRT[αz * X])

Tier 2 Vertical Modeling & R-26 Calculations for Ethylbenzene

MotoMart - Swansea
2002-0431

GROUNDWATER R-26 MODELING

	The greatest potential concentration of Ethylbenzene in the groundwater at the source of the contamination.		Distance along centerline of the groundwater plume emanating from a source.		Concentration of contaminant in groundwater at a Distance X from the source.	Longitudinal Dispersivity. Equation R 16.	Transverse Dispersivity. Equation R 17.	Vertical Dispersivity. Equation R 18.	R-26 Equations	R-16: $\alpha_x = 0.10 * X$ R-17: $\alpha_y = \alpha_x / 3$ R-18: $\alpha_z = \alpha_x / 20$ "Term 1" = $[X / (2 * \alpha_x)]$ "Term 2" = $(1 - SQRT[1 + (4 * \lambda * \alpha_x) / (U)])$ erf: Section 742.APPENDIX C: Table G $C_{(x)} = C_{source} \times e^{[Term\ 1 \times Term\ 2]} \times erf(\beta_1) \times erf(\beta_2)$					
Well Location	Csource (mg/L)		X (ft)	X (cm)	C(x) (mg/L)	α_x (cm)	α_y (cm)	α_z (cm)	Term 1	Term 2	ERF (β1)	ERF (β2)	β1 = $\alpha_y / (4 * SQRT[\alpha_z * X])$	β2 = $\alpha_z / (2 * SQRT[\alpha_x * X])$
MW1	3.24		15	457.2	0.83909	45.72	15.24	2.286	5	-0.3247	1	1	28.2989988	4.714045208
MW4	3.83		16	487.68	0.88750	48.77	16.259	2.4384	5	-0.3436	1	1	26.53031138	4.419417382

Tier 2 Vertical Modeling & R-26 Calculations for Total Xylenes

MotoMeri - Swansea
2002-0431

RBCA-1 | SSL | SSL & RBCA

Date Compiled: 02/23/16
Version: 6/25/2015

Input Values

Holcomb's Bulk Density =>	90.4	Converted Value to be used in calculation sheet -->		0.966	USDA Soil Classification:	Loamy Sand				
Organic Matter (%) =>	0	"FOC % (0.58 conversion) =>		0.000	Organic Matter (mg/kg):	0	FOC mg/kg (0.58 conversion)	0.000	foc conversion to g/g:	0.000

0.967	ρ_b - Dry Soil Bulk Density				1.5 or; Gravel = 2.0; Sand = 1.8; Silt = 1.6; Clay = 1.7; or Site Specific
2.64	ρ_s - Soil Particle Density				2.65 or; Site Specific
0.292	θ_a - Air Filled Soil Porosity	0.292	Value from S-21		Top 1 meter = 0.28; below 1 meter = 0.13; Gravel = 0.05; Sand = 0.14; Silt =0.24; Clay = 0.19; or Calculated Value (S21)
0.327	θ_w - Water Filled Soil Porosity	0.327	Value from S-20		Top 1 meter = 0.15; below 1 meter = 0.30; Gravel = 0.20; Sand = 0.18; Silt =0.18; Clay = 0.17; or Calculated Value (S20)
0.619	η - SSL: Total Soil Porosity	0.619	Value from S-24		0.43 or; Gravel - 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.36; or Calculated Value (S24)
0.43	η - RBCA: Total Soil Porosity		Value from S-24		0.43 or; Gravel - 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.36; or Calculated Value
0.0841379	i - Hydraulic Gradient				Site Specific
0.008	foc - Total Organic Carbon (g/g)				Surface Soil = 0.008; Subsurface Soil = 0.002; or Site Specific
20.000	DF - Dilution Factor	1.578	Value from S-22		If calculated value for DF is less than 20, then 20 default is used, else calculated value is used
10.135	d - Mixing Zone (m)	10.135	Value from S-25		2; or calculated value
13.56	K - Hydraulic Conductivity (m/yr)	cm/sec =	4.30E-05	Site Specific	3.72E+00 cm/yr 1.36E-03 cm/yr Use cm/yr for R16-R19, & R28. cm/yr for R24
67.056	L - Source Length Parallel to Groundwater Flow (m)	feet =	220	Site Specific (m)	
3.048	d_a - Aquifer Thickness (m)	feet =	10	Site Specific (m)	
9449.8	Sw - Source Width - horizontal plane (cm)	feet =	310	Source width perpendicular to groundwater flow direction in horizontal plane	
304.8	Sd - Source width - vertical plane (cm)			Use 200 or site specific	
0.0019	λ - First Order Degradation Constant			Total Xylenes = 0.0019	
1.00	ρ_w - Water Density			1	
0.296	w - Average soil moisture content			0.1 or; Surface Soil = 0.1; Subsurface soil = 0.2; or Site Specific	
0.3	I - Infiltration Rate (m/yr)			0.3 for Illinois	
540	K_s - Saturated Hydraulic Conductivity			See Table K for Input Values	
10.000	GW_{ml} - Groundwater Remediation Objective Class 1			10	GW_{ml} - Groundwater Remediation Objective Class 2
0.085	1/(2b+3) - Exponent for S20			See Table K for Input Values	
0.271	H' - Henry's Law Constant			Total Xylenes = 0.25	
398.00	K_{oc} - Organic Carbon Partition Coefficient			Total Xylenes = 260	

Soil Component of the Migration to Groundwater Cleanup Objective (Class 1)

$$S\text{-}17 = C_w \times \left[K_d + \frac{(\theta_w + \theta_a \times H')}{\rho b} \right] = C_w \times \left[2.3084 + \left(\frac{0.327 + 0.292 \times 0.271}{0.967} \right) \right] =$$

$C_w \times$ 2.728 mg/kg

Target Soil Leachate Concentration (Class 1)

$$S\text{-}18 = C_w = DF \times GW_{ml} = 20.00 \times 10.000 = 200$$

Soil-Water Partition Coefficient

$$S\text{-}19 = K_d = K_{oc} \times f_{oc} = 396.00 \times 0.006 = 2.3084$$

Water-Filled Porosity

$$S\text{-}20 = \theta_w = \eta \times \frac{I}{K_s}^{1/(2b+3)} = 0.62 \times \left[\frac{0.300}{540.000} \right]^{0.085} = 0.3273$$

Air-Filled Porosity

$$S\text{-}21 = \theta_a = \eta - \theta_w = 0.62 - 0.33 = 0.2920$$

Dilution Factor

$$S\text{-}22 = DF = 1 + \frac{K \times I \times d}{I \times L} = \frac{13.56}{0.300} \times \frac{0.0841}{67.056} \times \frac{10.135}{1} + 1 = 1.5748$$

VM-R28 (Xylenes)

Tier 2 Vertical Modeling & R-26 Calculations for Total Xylenes

MotoMart - Swansea
2002-0431

Total Soil Porosity

S-24 = $\eta = 1 - \frac{\rho_b}{\rho_s}$ = $1 - \frac{0.867}{2.54}$ = 0.6193

Estimation of Mixing Zone Depth

S-25 = $d = (0.0112 \times L_s^2)^{0.5} + d_a \left[1 - \exp \frac{(L_s \times I)}{(K \times I \times d_a)} \right]$

= $\left(0.0112 \times 67.056^2 \right)^{0.5} + 3.048 \times \left[1 - \exp \left(\frac{-67.056 \times 0.3}{13.580 \times 0.0841 \times 3.048} \right) \right]$ = 10.135 m

Specific Discharge

R-19 = $U = \frac{K \times I}{\theta_T}$ = $\frac{3.72E+00 \times 0.0841}{0.43000}$ = 0.72695 cm/d

Volumetric Air Content in Vadose Zone Soils

R-21 = $\theta_{as} = \theta_T - \frac{(w \times \rho_b)}{\rho_w}$ = $0.430 - \frac{0.29 \times 0.867}{1.00}$ = 0.153

Volumetric Water Content in Vadose Zone Soils

R-22 = $\theta_{ws} = \frac{w \times \rho_b}{\rho_w}$ = $\frac{0.29 \times 0.867}{1.00}$ = 0.27856

Total Soil Porosity

R-23 = $\theta_T = \theta_{ws} + \theta_{as}$ = 0.1634 + 0.27856 = 0.430

Groundwater Darcy Velocity

R-24 = $U_{gw} = K \times I$ = 1.38E+03 x 0.0841 = 1356 cm/y

Tier 2 Vertical Modeling & R-26 Calculations for Total Xylenes

MotoMart - Swansea
2002-0431

Target Soil Leachate Concentration (Solve S-18 for GW_{obj})

S-18 = $GW_{obj} = \frac{C_w}{DF} =$

VERTICAL SOIL MODELING AND ASSOCIATED R-26 MODELING OF VERTICAL MODELED SOIL

R-26 Equations:
R-18: $\alpha_x = 0.10 * X$
R-17: $\alpha_y = \alpha_x / 3$
R-18: $\alpha_z = \alpha_y / 20$
"Term 1" = $[X / (2 * \alpha_x)]$
"Term 2" = $\{1 - SQRT[1 + (4 * \lambda * \alpha_x) / (U)]\}$
erf: Section 742.APPENDIX C; Table G
$C_{(x)} = C_{source} \times e^{[Term\ 1\ x\ Term\ 2]} \times erf(\beta_1) \times erf(\beta_2)$

Sample Location	Soil Concentration (mg/kg)	C_w = [soil concentration at modeling point] / [K_s + (θ_w + $\theta_a H'$)/ρ_b]	GW_{obj} (mg/L) R26 Csource	X (ft)	x (cm)	C(x) (mg/L)	α_x (cm)	α_y (cm)	α_z (cm)	Term 1	Term 2	ERF (β1)	ERF (β2)	β1 = $\alpha_x / (4 * SQRT(\alpha_y * X))$	β2 = $\alpha_z / (2 * SQRT(\alpha_x * X))$
BH1	16.4	6.011	0.30054												
BH5	25.7	9.419	0.47097												

Tier 2 Vertical Modeling & R-26 Calculations for Total Xylenes

Moto Mart - Swansea
2002-0431

GROUNDWATER R-25 MODELING

	The greatest potential concentration of Total Xylenes in the groundwater at the source of the contamination.		Distance along centerline of the groundwater plume emanating from a source.		Concentration at distance X from the source.	Longitudinal Dispersivity: Equation R 16.	Transverse Dispersivity: Equation R 17.	Vertical Dispersivity: Equation R 18.	R-26 Equations					
									R-16: $\alpha_x = 0.10 * X$ R-17: $\alpha_y = \alpha_x / 3$ R-18: $\alpha_z = \alpha_x / 20$ "Term 1" = $[X / (2 * \alpha_x)]$ "Term 2" = $[1 + SQRT[1 + (4 * \lambda * \alpha_x) / (v)]$ erf: Section 742.APPENDIX C: Table G $C_{(x)} = C_{source} \times e^{(Term\ 1 \times Term\ 2)} \times erf(\beta_1) \times erf(\beta_2)$					
Well Location	Csource (mg/L)		X (ft)	X (cm)	C(x) (mg/L)	α_x (cm)	α_y (cm)	α_z (cm)	Term 1	Term 2	ERF (β1)	ERF (β2)	β1 = $Sw/(4 * SQRT[\alpha y * X])$	β2 = $Sd/(2 * SQRT[\alpha z * X])$

Tier 2 Vertical Modeling & R-26 Calculations for Naphthalene

MotoMart - Swansea
2002-0431

TRBCR | SSL | SSL & RBCA

Date Compiled: 02/23/16
Version: 8/25/2015

Input Values

Holcomb Bulk Density →	60.4	Converted Value to be used in calculation sheet →		0.967515	USDA Soil Classification:	Loamy Sand			
Organic Matter (%) →	0	FOC % (0.58 conversion) →	0.000	Organic Matter (mg/kg)	0	FOC mg/kg (0.58 conversion)	0.000	foc conversion to g/g:	0.000

0.967	ρ_b - Dry Soil Bulk Density			1.5 or; Gravel = 2.0; Sand = 1.8; Silt = 1.6; Clay = 1.7; or Site Specific					
2.54	ρ_s - Soil Particle Density			2.65 or; Site Specific					
0.292	Θ_a - Air Filled Soil Porosity	0.292	Value from S-21	Top 1 meter = 0.28; below 1 meter = 0.13; Gravel = 0.05; Sand = 0.14; Silt =0.24; Clay = 0.19; or Calculated Value (S21)					
0.327	Θ_w - Water Filled Soil Porosity	0.327	Value from S-20	Top 1 meter = 0.15; below 1 meter = 0.30; Gravel = 0.20; Sand = 0.18; Silt =0.16; Clay = 0.17; or Calculated Value (S20)					
0.619	η - SSL: Total Soil Porosity	0.619	Value from S-24	0.43 or; Gravel - 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.36; or Calculated Value (S24)					
0.43	R26 Assess Total Soil Porosity			0.43 or; Gravel - 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.36					
0.0841979	I - Hydraulic Gradient			Site Specific					
0.008	foc - Total Organic Carbon (g/g)			Surface Soil = 0.008; Subsurface Soil = 0.002; or Site Specific					
20.000	DF - Dilution Factor			If calculated value for DF is less than 20, then 20 default is used, else calculated value is used					
10.135	d - Mixing Zone (m)			2; or calculated value					
13.59	K - Hydraulic Conductivity (m/yr)	cm/sec =	4.30E-05	Site Specific	3.72E+00	cm/d	1.36E+03	cm/yr	Use cm/d for R15, R19, & R26, cm/yr for R24
67.056	L - Source Length Parallel to Groundwater Flow (m)		feet = 220	Site Specific (m)					
3.048	d_a - Aquifer Thickness (m)		feet = 10	Site Specific (m)					
9448.8	Sw - Source Width Horizontal plane (cm)		feet = 310	Source width perpendicular to groundwater flow direction in horizontal plane					
304.8	Sd - Source width - vertical plane (cm)			Use 200 or site specific					
0.0027	λ - First Order Degradation Constant			Naphthalene = 0.027					
1.00	ρ_w - Water Density			1					
0.266	Θ_{ws} - Vadose Zone Moisture content			0.1 or; Surface Soil = 0.1; Subsurface soil = 0.2; or Site Specific					
0.3	I - Infiltration Rate (m/yr)			0.3 for Illinois					
540	K_s - Saturated Hydraulic Conductivity			See Table K for Input Values					
0.140	GW_{obj} - Groundwater Remediation Objective Class 1			0.22	GW_{obj} - Groundwater Remediation Objective Class 2				
0.085	1/(2b+3) - Exponent for S20			See Table K for Input Values					
0.0198	H' - Henry's Law Constant			Naphthalene = 0.0198					
500.00	K_{oc} - Organic Carbon Partition Coefficient			Naphthalene = 2000					

Soil Component of the Migration to Groundwater Cleanup Objective (Class 1)

$$S\text{-}17 = C_w \times \left[K_d + \frac{(\Theta_w + \Theta_a \times H')}{\rho b} \right] = C_w \times \left[2.9 + \left(\frac{0.327 + 0.292 \times 0.020}{0.967} \right) \right] = C_w \times 3.244 \text{ mg/kg}$$

Target Soil Leachate Concentration (Class 1)

$$S\text{-}18 = C_w = DF \times GW_{obj} = 20.00 \times 0.140 = 2.8$$

Soil-Water Partition Coefficient

$$S\text{-}19 = K_d = K_{oc} \times f_{oc} = 500.00 \times 0.006 = 2.9$$

Water-Filled Porosity

$$S\text{-}20 = \Theta_w = \eta \times \left(\frac{I}{K_s} \right)^{1/(2b+3)} = 0.62 \times \left[\frac{0.300}{540.000} \right]^{0.085} = 0.3273$$

Tier 2 Vertical Modeling & R-26 Calculations for Naphthalene

MotoMart - Swansea
2002-0431

Air-Filled Porosity

S-21 = $\Theta_a = \eta - \theta_w$ = 0.62 - 0.33 = 0.2920

Dilution Factor

S-22 = $DF = 1 + \frac{K \times i \times d}{I \times L}$ = $\frac{13.56}{0.300} \times \frac{0.0841}{67.056} \times 10.135 + 1$ = 1.5748

Total Soil Porosity

S-24 = $\eta = 1 - \frac{\rho_b}{\rho_s}$ = $1 - \frac{0.967}{2.54}$ = 0.6193

Estimation of Mixing Zone Depth

S-25 = $d = (0.0112 \times L^2)^{0.5} + d_a \left[1 - \exp \frac{(-L \times I)}{(K \times i \times d_e)} \right]$

= $(0.0112 \times 67.056 ^2)^{0.5} +$

$3.048 \times \left[1 - \exp \left(\frac{-67.056}{13.560} \times \frac{0.3}{0.0841} \times 3.048 \right) \right]$ = 10.135 m

Specific Discharge

R-19 = $U = \frac{K \times i}{\Theta_T}$ = $\frac{3.72E+00 \times 0.0841}{0.43000}$ = 0.72695 cm/d

Volumetric Air Content in Vadose Zone Soils

R-21 = $\theta_{as} = \theta_T - \frac{(w \times \rho_b)}{\rho_w}$ = $0.430 - \frac{0.29 \times 0.967}{1.00}$ = 0.153

Volumetric Water Content in Vadose Zone Soils

R-22 = $\theta_{ws} = \frac{w \times \rho_b}{\rho_w}$ = $\frac{0.29 \times 0.967}{1.00}$ = 0.27656

Total Soil Porosity

R-23 = $\theta_T = \theta_{as} + \theta_{ws}$ = 0.1534 + 0.27656 = 0.430

Groundwater Darcy Velocity

R-24 = $U_{gw} = K \times i$ = 1.36E+03 x 0.0841 = 1358 cm/y

Tier 2 Vertical Modeling & R-26 Calculations for Naphthalene

MotoMart - Swansea
2002-0431

Target Soil Leachate Concentration (Solve S-18 for GW_{obj})

S-18 = $GW_{obj} = \frac{C_w}{DF} =$

VERTICAL SOIL MODELING AND ASSOCIATED R-26 MODELING OF VERTICAL MODELED SOIL

	The greatest potential concentration of Naphthalene in the groundwater at the source of the contamination.	C_w = (soil contamination at modeling point) / (K_d + ((θ_w + θ_a * H') / ρ_b))	GW_{obj} = CW / DF	Distance along centerline of the groundwater plume emanating from a source.		Concentration of contaminant in groundwater at a Distance X from the source.	Longitudinal Dispersivity. Equation R 16.	Transverse Dispersivity. Equation R 17.	Vertical Dispersivity. Equation R 18.	R-26 Equations					
										R-16: $\alpha_x = 0.10 * X$ R-17: $\alpha_y = \alpha_x / 3$ R-18: $\alpha_z = \alpha_x / 20$ "Term 1" = $[X / (2 * \alpha_x)]$ "Term 2" = $\{1 - SQRT[1 + (4 * \lambda * \alpha_x) / (U)]\}$ erf: Section 742.APPENDIX C: Table G $C_{(x)} = C_{source} \times e^{(Term\ 1 \times Term\ 2)} \times erf(\beta_1) \times erf(\beta_2)$					
Sample Location	Soil Concentration (mg/kg)	C_w	GW_{obj} (mg/L) R26 Csource	X (ft)	X (cm)	C(x) (mg/L)	α_x (cm)	α_y (cm)	α_z (cm)	Term 1	Term 2	ERF (β1)	ERF (β2)	β1 = $\delta w / (4 * SQRT[\alpha_y * X])$	β2 = $\delta d / (2 * SQRT[\alpha_z * X])$

Tier 2 Vertical Modeling & R-26 Calculations for Naphthalene

MotoMart - Swansea
2002-0431

GROUNDWATER R-28 MODELING

	The greatest potential concentration of Naphtalene in the groundwater at the source of the contamination.		Distance along centerline of the groundwater plume emanating from a source,		Concentration of contaminant in groundwater at a Distance X from the source.	Longitudinal Dispersivity. Equation R 16.	Transverse Dispersivity. Equation R 17.	Vertical Dispersivity. Equation R 18.	R-26 Equations	R-16: $\alpha_x = 0.10 * X$ R-17: $\alpha_y = \alpha_z / 3$ R-18: $\alpha_z = \alpha_x / 20$ "Term 1" = $[X / (2 * \alpha_x)]$ "Term 2" = $\{1 - SQRT[1 + (4 * \lambda * \alpha_x) / (U)]\}$ erf: Section 742.APPENDIX C: Table G $C_{(x)} = C_{source} \times e^{(Term\ 1\ x\ Term\ 2)} \times erf(\beta_1) \times erf(\beta_2)$					
Well / Location	Csource (mg/L)		(ft)	X (cm)	C(x) (mg/L)	α_x (cm)	α_y (cm)	α_z (cm)	Term 1	Term 2	ERF (β1)	ERF (β2)	β1 = Sw / (4 * SQRT[αy * X])	β2 = Sd / (2 * SQRT[αz * X])
MW1	0.387		10	304.8	0.13962	30.48	10.16	1.524	5	-0.2063	1	1	42.44849821	7.071067812
MW4	1.23		24	731.52	0.13320	73.15	24.384	3.6578	5	-0.4448	1	0.999969091	17.68687425	2.946278256

Tier 2 Vertical Modeling & R-25 Calculations for Benzo[a]pyrene

MotoMart - Swansea
2002-0431

RBCA | SSL | SSL & RBCA

Date Compiled: 02/23/16
Version: 8/25/2015

Input Values

Holcomb's Soil Density =>	60.4	Converted	Value to be used in calculation sheet =>		0.9675152	USDA Soil Classification:	Loamy Sand			
Organic Matter (%) =>	0	FOC % (0.58 conversion) =>		0.000	Organic Matter (mg/kg)	0	FOC mg/kg (0.58 conversion)	0.000	foc conversion to g/g:	0.000

0.967	ρ_b - Dry Soil Bulk Density				1.5 or; Gravel = 2.0; Sand = 1.8; Silt = 1.6; Clay = 1.7; or Site Specific
2.64	ρ_s - Soil Particle Density				2.65 or; Site Specific
0.292	Θ_a - Air Filled Soil Porosity	0.292	Value from S-21		Top 1 meter = 0.28; below 1 meter = 0.13; Gravel = 0.05; Sand = 0.14; Silt =0.24; Clay = 0.19; or Calculated Value (S21)
0.327	Θ_w - Water Filled Soil Porosity	0.327	Value from S-20		Top 1 meter = 0.15; below 1 meter = 0.30; Gravel = 0.20; Sand = 0.18; Silt =0.18, Clay = 0.17, or Calculated Value (S20)
0.619	n - SSL: Total Soil Porosity	0.619	Value from S-24		0.43 or; Gravel - 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.36; or Calculated Value (S24)
0.43	Θ_T - RBCA: Total Soil Porosity				0.43 or; Gravel - 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.36
0.08413793	I - Hydraulic Gradient				Site Specific
0.006	foc - Total Organic Carbon (g/g)				Surface Soil = 0.006; Subsurface Soil = 0.002; or Site Specific
20.000	DF - Dilution Factor	1.575	Value from S-22		If calculated value for DF is less than 20, then 20 default is used, else calculated value is used
10.135	d - Mixing Zone (m)	10.135	Value from S-25		2; or calculated value
13.56	K - Hydraulic Conductivity (m/yr)	cm/sec =	4.30E-05	Site Specific	3.72E+00 cm/d = 1.36E+03 = cm/yr Use Ksat/d for R15/R19; & R25 (cm/yr full R24)
67.056	L - Source Length Parallel to Groundwater Flow (m)		feet = 220		Site Specific (m)
3.048	d_a - Aquifer Thickness (m)		feet = 10		Site Specific (m)
9448.8	SW - Source Width Horizontal plane (cm)		feet = 310		Source width perpendicular to groundwater flow direction in horizontal plane
304.8	Sd - Source width - vertical plane (cm)				Use 200 or site specific
0.00065	λ - First Order Degradation Constant				Benzo(a)pyrene = 0.00065
1.00	ρ_w - Water Density				1
0.286	w_c - Average soil moisture content				0.1 or; Surface Soil = 0.1; Subsurface soil = 0.2; or Site Specific
0.3	I - Infiltration Rate (m/yr)				0.3 for Illinois
540	K_v - Saturated Hydraulic Conductivity				See Table K for Input Values
0.005	GW_{ni} - Groundwater Remediation Objective Class 1			0.025	GW_{oi} - Groundwater Remediation Objective Class 2
0.065	1/(2b+3) - Exponent for S20				See Table K for Input Values
4.63E-06	H' - Henry's Law Constant				Benzo(a)pyrene = 4.63×10^{-6}
1.02E+06	K_{oc} - Organic Carbon Partition Coefficient				Benzo(a)pyrene = 1,020,000

Soil Component of the Migration to Groundwater Cleanup Objective (Class 1)

$$S\text{-}17 = C_w \times \left[K_d + \frac{(\Theta_w + \Theta_a \times H')}{\rho b} \right] = C_w \times \left[5916 + \left(\frac{0.327 + 0.292 \times 4.63E\text{-}05}{0.967} \right) \right] =$$

Cw x 5916.338 mg/kg

Target Soil Leachate Concentration (Class 1)

$$S\text{-}18 = C_w = DF \times GW_{ni} = 20.00 \times 0.005 = 0.1$$

Soil-Water Partition Coefficient

$$S\text{-}19 = K_d = K_{oc} \times f_{oc} = 1.02E+06 \times 0.006 = 5916$$

Water-Filled Porosity

$$S\text{-}20 = \Theta_w = n \times \left(\frac{I}{K_v} \right)^{1/(2b+3)} = 0.62 \times \left[\frac{0.300}{540.000} \right]^{0.065} = 0.3273$$

Tier 2 Vertical Modeling & R-26 Calculations for Benzo[a]pyrene

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Air-Filled Porosity

S-21 = $\Theta_a = \eta - \Theta_w$ = 0.62 - 0.33 = 0.2920

Dilution Factor

S-22 = $DF = 1 + \frac{K \times I \times d}{I \times L}$ = $\frac{13.56}{0.300} \times \frac{0.0841}{67.056} \times 10.135 + 1$ = 1.5748

Total Soil Porosity

S-24 = $\eta = 1 - \frac{\rho_b}{\rho_s}$ = $1 - \frac{0.967}{2.54}$ = 0.6193

Estimation of Mixing Zone Depth

S-25 = $d = (0.0112 \times L^2)^{0.5} + d_a \left[1 - \exp \frac{(-L \times I)}{(K \times I \times d_a)} \right]$

= $(0.0112 \times 67.056 ^2)^{0.5} + 3.048 \times \left[1 - \exp \left(\frac{-67.056}{13.560} \times \frac{0.3}{0.0841} \times 3.048 \right) \right]$ = 10.135 m

Specific Discharge

R-19 = $U = \frac{K \times I}{\Theta_T}$ = $\frac{3.72E+00}{0.43000} \times 0.0841$ = 0.72685 cm/d

Volumetric Air Content in Vadose Zone Soils

R-21 = $\theta_{as} = \theta_T - \frac{(w \times \rho_b)}{\rho_w}$ = $0.430 - \frac{0.29}{1.00} \times 0.967$ = 0.153

Volumetric Water Content in Vadose Zone Soils

R-22 = $\theta_{ws} = \frac{w \times \rho_b}{\rho_w}$ = $\frac{0.29}{1.00} \times 0.967$ = 0.27656

Total Soil Porosity

R-23 = $\theta_T = \theta_{as} + \theta_{ws}$ = 0.1534 + 0.27656 = 0.430

Groundwater Darcy Velocity

R-24 = $U_{gw} = K \times I$ = 1.36E+03 x 0.0841 = 1356 cm/y

Tier 2 Vertical Modeling & R-26 Calculations for Benzo[a]pyrene

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Target Soil Leachate Concentration (Solve S-18 for GW_{obj})

S-18 = $GW_{obj} = \frac{C_w}{DF} =$

VERTICAL SOIL MODELING AND ASSOCIATED R-28 MODELING OF VERTICAL MODELED SOIL

	The greatest potential concentration of Benzo[a]pyrene in the groundwater at the source of the contamination.	C_w = (soil contamination at modeling point / K_d + (((θ_w + (θ_a * H')) / ρ_b)	GW_{obj} = CW / DF	Distance along centerline of the groundwater plume emanating from a source.		Concentration of contaminant in groundwater at a Distance X from the source.	Longitudinal Dispersivity. Equation R 16.	Transverse Dispersivity. Equation R 17	Vertical Dispersivity. Equation R 18.	R-28 Equations	R-16: $\alpha_x = 0.10 * X$ R-17: $\alpha_y = \alpha_x / 3$ R-18: $\alpha_z = \alpha_x / 20$ "Term 1" = $[X / (2 * \alpha_x)]$ "Term 2" = $\{1 - SQRT[1 + (4 * \lambda * \alpha_x) / (U)]\}$ erf: Section 742.APPENDIX C: Table G $C_{(x)} = C_{source} \times e^{(Term\ 1\ \pm\ Term\ 2)} \times erf(\beta_1) \times erf(\beta_2)$					
Sample Location	Soil Concentration (mg/kg)	C_w	GW_{obj} (mg/L) R26 Csource	X (ft)	X (cm)	C(x) (mg/L)	α_x (cm)	α_y (cm)	α_z (cm)	Term 1	Term 2	ERF (β1)	ERF (β2)	$\beta 1 = \frac{\alpha_x}{\alpha_y * SQRT[\alpha_y * X]}$	$\beta 2 = \frac{\alpha_z}{\alpha_z * SQRT[\alpha_z * X]}$
BH2	0.16	0.000	0.00000												
BH9	2.6	0.000	0.00002												
BH11	0.11	0.000	0.00000												
BH12	1.5	0.000	0.00001												
BH14	0.13	0.000	0.00000												
BH16	0.12	0.000	0.00000												

Tier 2 Vertical Modeling & R-26 Calculations for Benzo[a]pyrene

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GROUNDWATER R-25 MODELING

	The greatest potential concentration of Benzo[a]pyrene in the groundwater at the source of the contamination.		Distance along centerline of the groundwater plume emanating from a source.		Concentration of contaminant in groundwater at a Distance X from the source.	Longitudinal Dispersivity, Equation R 17.	Transverse Dispersivity, Equation R 17.	Vertical Dispersivity, Equation R 18.	R-26 Equations	R-16: $\alpha_x = 0.10 * X$ R-17: $\alpha_y = \alpha_x / 3$ R-18: $\alpha_z = \alpha_y / 20$ "Term 1" = $[X / (2 * \alpha_x)]$ $C_{(x)} = C_{source} \times e^{[Term\ 1 \times Term\ 2]} \times erf(\beta_1) \times erf(\beta_2)$					
Well Location	C_{source} (mg/L)		Distance (ft)	X (cm)	C(x) (mg/L)	α_x (cm)	α_y (cm)	α_z (cm)	Term 1	Term 2	ERF (β1)	ERF (β2)	β1 = Sw / (4 * SQRT[αy * X])	β2 = Sd / (2 * SQRT[αz * X])

Tier 2 Vertical Modeling & R-26 Calculations for Dibenz[a,h]anthracene

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2002-0431

RBCA97 | SSL | SSL & RBCA

Date Compiled: 02/23/16
Version: 9/25/2015

Input Values

Hotzenb's Bulk Density -->	60.4	Converted Value to be used in calculation sheet -->			0.957515	USDA Soil classification:	Loamy Sand			
Organic Matter(%) -->	0	FOC % (0.58 conversion) -->	0.000	Organic Matter (mg/kg)	0	FOC mg/kg (0.58 conversion)	0.000	foc conversion to g/g:	0.000	

0.967	ρ_b - Dry Soil Bulk Density			1.5 or; Gravel = 2.0; Sand = 1.8; Silt = 1.6; Clay = 1.7; or Site Specific
2.54	ps - Soil Particle Density			2.65 or; Site Specific
0.292	θ_a - Air Filled Soil Porosity	0.292	Value from S-21	Top 1 meter = 0.26; below 1 meter = 0.13; Gravel = 0.05; Sand = 0.14; Silt =0.24; Clay = 0.19; or Calculated Value (S21)
0.327	θw - Water Filled Soil Porosity	0.327	Value from S-20	Top 1 meter = 0.15; below 1 meter = 0.30; Gravel = 0.20; Sand = 0.18; Silt =0.16; Clay = 0.17; or Calculated Value (S20)
0.619	η - SSL: Total Soil Porosity	0.619	Value from S-24	0.43 or; Gravel - 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.36; or Calculated Value (S24)
0.43	θ_T - RBCA Total Soil Porosity			0.43 or; Gravel - 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.36; or Calculated Value
0.08413793	i - Hydraulic Gradient			Site Specific
0.006	foc - Total Organic Carbon (g/g)			Surface Soil = 0.006; Subsurface Soil = 0.002; or Site Specific
20.000	DF - Dilution Factor	1.575	Value from S-22	If calculated value for DF is less than 20, then 20 default is used, else calculated value is used
10.135	d - Mixing Zone (m)	10.135	Value from S-25	2; or calculated value
13.55	K - Hydraulic Conductivity (m/yr)	cm/sec = 4.30E-05		Site Specific 3.72E+00 (cm/day) 1.36E+03 (cm/yr) Use cm/d for R17, R18 & R26; cm/yr for R24
67.056	L - Source Length Parallel to Groundwater Flow (m)		feet = 220	Site Specific (m)
3.048	d_s - Aquifer Thickness (m)		feet = 10	Site Specific (m)
9448.8	SW - Source Width - horizontal plane (cm)		feet = 310	Source width perpendicular to groundwater flow direction in horizontal plane
304.8	Sd - Source width - vertical plane (cm)			Use 200 or site specific
0.00037	λ - First Order Degradation Constant			Dibenz[a,h]anthracene = 0.00037
1.00	ρ_w - Water density (g/cm³)			1
0.286	w - Average soil moisture content			0.1 or; Surface Soil = 0.1; Subsurface soil = 0.2; or Site Specific
0.3	I - Infiltration Rate (m/yr)			0.3 for Illinois
540	K_s - Saturated Hydraulic Conductivity			See Table K for Input Values
0.005	GW_{ec} - Groundwater Remediation Objective Class 1			0.025 GW_{ec} - Groundwater Remediation Objective Class 2
0.085	1/(2b+3) - Exponent for S20			See Table K for Input Values
6.03E-07	H' - Henry's Law Constant			Dibenz[a,h]anthracene = 6.03 x 10^{-7}
3.800E+06	K_{oc} - Organic Carbon Partition Coefficient			Dibenz[a,h]anthracene = 3800000

Soil Component of the Migration to Groundwater Cleanup Objective (Class 1)

$$S\text{-}17 = C_w \times \left[K_d + \frac{(\theta_w + \theta_a \times H')}{\rho b} \right] = C_w \times \left[22040 + \left(\frac{0.327 + 0.292 \times 6.03E\text{-}07}{0.967} \right) \right] = Cw \times 22040.338 \text{ mg/kg}$$

Target Soil Leachate Concentration (Class 1)

$$S\text{-}18 = C_w = DF \times GW_{ec} = 20.00 \times 0.005 = 0.1$$

Soil-Water Partition Coefficient

$$S\text{-}19 = K_d = K_{oc} \times f_{oc} = 3.80E+06 \times 0.006 = 22040$$

Water-Filled Porosity

$$S\text{-}20 = \Theta_w = \eta \times \left(\frac{I}{K_s} \right)^{1/(2b+3)} = 0.62 \times \left[\frac{0.300}{540.000} \right]^{0.085} = 0.3273$$

Tier 2 Vertical Modeling & R-25 Calculations for Dibenz[a,h]anthracene

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Air-Filled Porosity

S-21 = $\Theta_a = \eta - \Theta_w$ = 0.62 - 0.33 = 0.2920

Dilution Factor

S-22 = $DF = 1 + \frac{K \times i \times d}{I \times L}$ = $\frac{13.56}{0.300} \times \frac{0.0841}{67.056} \times 10.135 + 1$ = 1.5748

Total Soil Porosity

S-24 = $\eta = 1 - \frac{\rho_b}{\rho_s}$ = $1 - \frac{0.967}{2.64}$ = 0.6193

Estimation of Mixing Zone Depth

S-25 = $d = (0.0112 \times L^2)^{0.5} + d_a \left[1 - \exp \frac{(-L \times I)}{(K \times I \times d_a)}\right]$

= $(0.0112 \times 67.056 ^{2})^{0.5} +$

$3.048 \times \left[1 - \exp \left\{ \frac{-67.056}{13.560} \times \frac{0.3}{0.0841} \times 3.048 \right\}\right]$ = 10.135 m

Specific Discharge

R-19 = $U = \frac{K \times I}{\Theta_T}$ = $\frac{3.72E+00}{0.43000} \times 0.0841$ = 0.72695 cm/d

Volumetric Air Content in Vadose Zone Soils

R-21 = $\theta_{as} = \theta_T - \frac{(w \times \rho_b)}{\rho_w}$ = $0.430 - \frac{0.29}{1.00} \times 0.967$ = 0.153

Volumetric Water Content in Vadose Zone Soils

R-22 = $\theta_{ws} = \frac{w \times \rho_b}{\rho_w}$ = $\frac{0.29}{1.00} \times 0.967$ = 0.27856

Total Soil Porosity

R-23 = $\theta_T = \theta_{as} + \theta_{ws}$ = 0.1534 + 0.27656 = 0.430

Groundwater Darcy Velocity

R-24 = $U_{gw} = K \times I$ = 1.36E+03 x 0.0841 = 1356 cm/y

Tier 2 Vertical Modeling & R-26 Calculations for Dibenz[a,h]anthracene

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Target Soil Leachate Concentration (Solve S-18 for GW_{obj})

S-18 = $GW_{obj} = \frac{C_w}{DF} =$

VERTICAL SOIL MODELING AND ASSOCIATED R-26 MODELING OF VERTICAL MODELED SOIL

	The greatest potential concentration of Dibenz[a,h]anthracene in the groundwater at the source of the contamination.	C_w = (soil contamination at modeling point) / [K_d + (θ_w + θ_a * H')/ρ_b]	GW_{obj} = CW / DF	Distance along centerline of the groundwater plume emanating from a source.		Concentration of contaminant in groundwater at a Distance X from the source.	Longitudinal Dispersitivity. Equation R 16.	Transverse Dispersitivity. Equation R 17.	Vertical Dispersitivity. Equation R 18.	R-26 Equations					
										R-16. $\alpha_x = 0.10 * X$ R-17: $\alpha_y = \alpha_x / 3$ R-18: $\alpha_z = \alpha_x / 20$ "Term 1" = [X / (2 * α_x)] "Term 2" = {1 - SQRT[1 + (4 * λ * α_x) / (U)]} erf: Section 742.APPENDIX C: Table G $C_{(x)} = C_{source} \times e^{(Term\ 1 \times Term\ 2)} \times erf(\beta_1) \times erf(\beta_2)$					
Sample Location	Soil Concentration (mg/kg)	C_w	GW_{obj} (mg/L) R26 Csource	X (ft)	x (cm)	C(x) (mg/L)	α_x (cm)	α_y (cm)	α_z (cm)	Term 1	Term 2	ERF (β1)	ERF (β2)	β1 = Sw / (4 * SQRT[α_y * X])	β2 = 5d / (2 * SQRT[α_z * X])
BH2	0.23	0.000	0.00000												
BH9	0.54	0.000	0.00000												
BH12	0.26	0.000	0.00000												

Tier 2 Vertical Modeling & R-26 Calculations for Dibenz[a,h]anthracene

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GROUNDWATER R-26 MODELING

R-26 Equations

R-16: $\alpha_x = 0.10 * X$

R-17: $\alpha_y = \alpha_x / 3$

R-18: $\alpha_z = \alpha_x / 20$

"Term 1" = $[X / (2 * \alpha_x)]$

$C_{(x)} = C_{source} \times e^{(Term 1 \times Term 2)} \times erf(\beta_1) \times erf(\beta_2)$

	The greatest potential concentration of Dibenz(a,h)anthracene in the groundwater at the source of the contamination.		Distance along centerline of the groundwater plume emanating from a source.		Concentration of contaminant in groundwater at a Distance X from the source.	Longitudinal Dispersivity. Equation R 15.	Transverse Dispersivity. Equation R 17.	Vertical Dispersivity. Equation R 18.						
Well Location	Csource (mg/L)		X (ft)	X (cm)	C(x) (mg/L)	α_x (cm)	α_y (cm)	α_z (cm)	Term 1	Term 2	ERF (β1)	ERF (β2)	β1 = Sw / (4 * SQRT[αy * X])	β2 = Sd / (2 * SQRT[αz * X])

Tier 2 Vertical Modeling & R-26 Calculations for Benz[a]anthracene

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2002-0431

[RBCA] [SSL] [SSL & RBCA]

Date Compiled: 02/23/16
Version: 6/25/2015

Input Values

Holcomb's Bulk Density:	60.4	Converted Value to be used in calculation sheet -->			0.967515	USDA Soil Classification:	Loamy Sand			
Organic Matter (%) -->	0	FOC % (0.58 conversion) -->		0.000	Organic Matter (mg/kg)	0	FOC mg/kg (0.58 conversion)	0.000	foc conversion to g/g:	0.000

0.967	ρ_b - Dry Soil Bulk Density				1.5 or; Gravel = 2.0; Sand = 1.8; Silt = 1.6; Clay = 1.7; or Site Specific
2.54	ρs - Soil Particle Density				2.65 or; Site Specific
0.292	θ_a - Air Filled Soil Porosity	0.292	Value from S-21		Top 1 meter = 0.28; below 1 meter = 0.13; Gravel = 0.05; Sand = 0.14; Silt =0.24; Clay = 0.19; or Calculated Value (S21)
0.327	θw - Water Filled Soil Porosity	0.327	Value from S-20		Top 1 meter = 0.15; below 1 meter = 0.30; Gravel = 0.20; Sand = 0.16; Silt =0.18; Clay = 0.17; or Calculated Value (S20)
0.619	η - SSL, Total Soil Porosity	0.619	Value from S-24		0.43 or; Gravel - 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.36; or Calculated Value (S24)
0.43	θ_T - RBCA Total Soil Porosity				0.43 or; Gravel - 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.36
0.0841379	I - Hydraulic Gradient				Site Specific
0.006	foc - Total Organic Carbon (g/g)				Surface Soil = 0.006; Subsurface Soil = 0.002; or Site Specific
20.000	DF - Dilution Factor	1.575	Value from S-22		If calculated value for DF is less than 20, then 20 default is used, else calculated value is used
10.135	d - Mixing Zone (m)	10.135	Value from S-25		2; or calculated value
13.56	K - Hydraulic Conductivity (m/yr)	cm/sec =	4.301E-05		Site Specific 3.72E+02 cm/d 1.36E+03 cm/yr Use cm/d for R19, & R26., cm/yr for R24.
67.056	L - Source Length Parallel to Groundwater Flow (m)		feet = 220		Site Specific (m)
3.048	d_a - Aquifer Thickness (m)		feet = 10		Site Specific (m)
9448.8	SW - Source Width perpendicular to groundwater flow (cm)		feet = 310		Source width perpendicular to groundwater flow direction in horizontal plane
304.8	Sd - Source width perpendicular to groundwater flow (cm)				Use 200 or site specific
0.00051	λ - First Order Degradation Constant				Benz[a]anthracene = 0.00051
0.3	I - Infiltration Rate (m/yr)				0.3 for Illinois
540	K_s - Saturated Hydraulic Conductivity				See Table K for Input Values
0.005	GW_{os} - Groundwater Remediation Objective Class 1				0.025 GW_{os} - Groundwater Remediation Objective Class 2
0.086	1/(2b+3) - Exponent for S20				See Table K for Input Values
1.37E-04	H - Henry's Law Constant				Benz[a]anthracene = 1.37×10^{-4}
398000	K_{oc} - Organic Carbon Partition Coefficient				Benz[a]anthracene = 398,000

Soil Component of the Migration to Groundwater Cleanup Objective (Class 1)

$$S\text{-}17 = C_w \times \left[K_d + \frac{(\theta_w + \theta_a \times H')}{\rho b} \right] = C_w \times \left[2308.4 + \left(\frac{0.327 + 0.292 \times 1.37E\text{-}04}{0.967} \right) \right] =$$

Cw x 2308.736 mg/kg

Target Soil Leachate Concentration (Class 1)

$$S\text{-}18 = C_w = DF \times GW_{os} = 20.00 \times 0.005 = 0.1$$

Soil-Water Partition Coefficient

$$S\text{-}19 = K_d = K_{oc} \times f_{oc} = 3.98E+05 \times 0.006 = 2308.4$$

Water-Filled Porosity

$$S\text{-}20 = \theta_w = \eta \times \frac{1}{K_s}^{(\eta - \theta_a)} = 0.62 \times \left[\frac{0.300}{540.000} \right]^{0.086} = 0.3273$$

Air-Filled Porosity

$$S\text{-}21 = \theta_a = \eta - \theta_w = 0.62 - 0.33 = 0.2920$$

Dilution Factor

$$S\text{-}22 = DF = 1 + \frac{K \times I \times d}{I \times L} = \frac{13.56}{0.300} \times \frac{0.0841}{67.056} \times \frac{10.135}{1} + 1 = 1.5748$$

Tier 2 Vertical Modeling & R-26 Calculations for Benz[a]anthracene

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Total Soil Porosity

S-24 = $\eta = 1 - \frac{\rho_b}{\rho_s}$ = 1 - 0.987 / 2.54 = 0.6193

Estimation of Mixing Zone Depth

S-25 = $d = (0.0112 \times L^2)^{0.5} + d_a \left[1 - \exp \frac{(-L \times I)}{(K \times i \times d_a)} \right]$

= (0.0112 x 67.056 ^{2})$^{0.5}$ + 3.048 x [1 - exp (-67.056 / 13.560 x 0.3 / 0.0841 x 3.048)] = 10.135 m

Specific Discharge

R-19 = $U = \frac{K \times I}{\theta_T}$ = 3.72E+00 / 0.43000 x 0.0841 = 0.72696 cm/d

Volumetric Air Content in Vadose Zone Soils

R-21 = $\theta_{as} = \theta_T - \frac{(w \times \rho_b)}{\rho_w}$ = 0.430 - 0.29 / 1.00 x 0.987 = 0.153

Volumetric Water Content in Vadose Zone Soils

R-22 = $\theta_{ws} = \frac{w \times \rho_b}{\rho_w}$ = 0.29 / 1.00 x 0.987 = 0.27856

Total Soil Porosity

R-23 = $\theta_T = \theta_{as} + \theta_{ws}$ = 0.1534 + 0.27856 = 0.430

Groundwater Darcy Velocity

R-24 = $U_{gw} = K \times I$ = 1.30E+03 x 0.0841 = 1358 cm/y

Tier 2 Vertical Modeling & R-26 Calculations for Benz[a]anthracene

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Target Soil Leachate Concentration (Solve S-18 for GW_{obj})

$$S\text{-}18 = \quad GW_{obj} = \frac{C_w}{DF} =$$

VERTICAL SOIL MODELING AND ASSOCIATED R-26 MODELING OF VERTICAL MODELED SOIL

R-26 Equations:
R-16: $\alpha_x = 0.10 * X$
R-17: $\alpha_y = \alpha_x / 3$
R-18: $\alpha_z = \alpha_x / 20$
"Term 1" = $[X / (2 * \alpha_x)]$
"Term 2" = $\{1 - SQRT[1 + (4 * \lambda * \alpha_x) / (U)]\}$
erf: Section 742.APPENDIX C: Table G
$C_{(x)} = C_{source} \times e^{(Term 1 \times Term 2)} \times erf(\beta_1) \times erf(\beta_2)$

	The greatest potential concentration of Benzo[a]anthracene in the groundwater at the source of the contamination.	C_w = (soil concentration at modeling point / (Ks + (θw + θa H) / Pb))	$GW_{obj} = CW / DF$	Distance along centerline of the groundwater plume emanating from a source.		Concentration of contaminant in groundwater at a Distance X from the source.	Longitudinal Dispersivity, Equation R 16.	Transverse Dispersivity, Equation R 17.	Vertical Dispersivity, Equation R 18.	R-26 Equations					
Sample Location	Soil Concentration (mg/kg)	C_w	Gw_{obj} (mg/L) R26 Csource	X (ft)	x (cm)	C(x) (mg/L)	α_x (cm)	α_y (cm)	α_z (cm)	Term 1	Term 2	ERF (β1)	ERF (β2)	β1 = Sw / (4 * SQRT[αy * X])	β2 = Sd / (2 * SQRT[αz * X])
BH9	2.5	0.001	0.00005												

Tier 2 Vertical Modeling & R-26 Calculations for Benz[a]anthracene

MotoMart - Swansea
2002-0431

GROUNDWATER R-26 MODELING

	The greatest potential concentration of Benz[a]anthracene in the groundwater at the source of the contamination.		Distance along centerline of the groundwater plume emanating from a source.	Concentration of contaminant in groundwater at a Distance X from the source.	Longitudinal Dispersivity, Equation R 11	Transverse Dispersivity, Equation R 12	Vertical Dispersivity, Equation R 13	R-26 Equations					
								R-16: $\alpha_x = 0.10 * X$ R-17: $\alpha_y = \alpha_x / 3$ R-18: $\alpha_z = \alpha_x / 20$ "Term 1" = $[X / (2 * \alpha_x)]$ $C_{(x,t)} = C_{source} \times e^{[Term\ 1 + Term\ 2]} \times erf[\beta_1] \times erf[\beta_2]$					
Well Location	Source Concentration C(0) (mg/L)		Cell (ft)	X (cm)	C(x) (mg/L)	α_x (cm)	α_y (cm)	α_z (cm)	Term 1	Term 2	ERF (β1)	ERF (β2)	β1 = $Y_w / (4 * SQRT[\alpha_y * X])$	β2 = $(d_d + Z) / (2 * SQRT[\alpha_z * X])$

VM-R26 (BaA)

4

CW[M] COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	MOTOMART SWANSEA, ILLINOIS INCIDENT # 2002-0431 ST. CLAIR COUNTY	MODELED CONTAMINATION MAP	SCALE: 1"=100' DATE: 7/27/16 REVISED DATE: DRAWING: 0011	DRAWN BY: VES REVISED BY: REVIEW BY: CLR MotoMart.dwg MODELED

South, Shirlene

From: Hawbaker, Carol
Sent: Wednesday, July 27, 2016 9:33 AM
To: South, Shirlene
Subject: RE: 2002-0431 Moto mart

No, I can't read the legend either. I would ask first for a clearer legend, and second, if the circles are supposed to depict a GW modeled plume in all directions, they should include the model distances on the modeled plume depictions.

Carol

Carol Hawbaker
Leaking Underground Storage Tank Section
Division of Remediation Management
Bureau of Land
Illinois Environmental Protection Agency
(217) 782-5713

From: South, Shirlene
Sent: Wednesday, July 27, 2016 9:27 AM
To: Hawbaker, Carol
Subject: FW: 2002-0431 Moto mart

From: vince@cwmcompany.com [mailto:vince@cwmcompany.com]
Sent: Wednesday, July 27, 2016 8:22 AM
To: South, Shirlene
Subject: RE: 2002-0431 Moto mart

Shirlene,

The modeling and a drawing showing the approximate limits of the contamination are attached. Let me know if you need anything else.

Vince

> -------- Original Message --------
> Subject: RE: 2002-0431 Moto mart
> From: "South, Shirlene" <Shirlene.South@Illinois.gov>
> Date: Wed, July 27, 2016 4:55 am
> To: "vince@cwmcompany.com" <vince@cwmcompany.com>
>
> Sorry, I thought you had sent me some figures.
>
> ---
>
> **From:** vince@cwmcompany.com [mailto:vince@cwmcompany.com]
> **Sent:** Tuesday, July 26, 2016 2:50 PM

To: South, Shirlene
Subject: RE: 2002-0431 Moto mart

Shirlene,

We never finished the modeling, but will. It should be ready either late today or tomorrow morning, and I will forward it to you.

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From: "South, Shirlene" <Shirlene.South@Illinois.gov>
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Vince E. Smith, P.E.
Sr. Environmental Engineer
CWM Company, Inc.
701 W. South Grand Ave.
Springfield, IL 62704
217-522-8001
Fax 217-522-8009
vince@cwmcompany.com

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Shirlene South
217/558-0347
Shirlene.South@illinois.gov

South, Shirlene

From: vince@cwmcompany.com
Sent: Wednesday, July 27, 2016 9:55 AM
To: South, Shirlene
Subject: RE: 2002-0431 Moto mart

Shirlene,

The dark blue is the perimeter of the furthest modeled contamination, which is the benzene in the groundwater at MW-1, which models 265 feet, beyond any other modeled soil or groundwater contamination in all directions.

I will prepare the drawings you are asking for, and will submit them later this morning, barring interruptions.

Vince

-------- Original Message --------
Subject: RE: 2002-0431 Moto mart
From: "South, Shirlene" <Shirlene.South@Illinois.gov>
Date: Wed, July 27, 2016 7:44 am
To: "vince@cwmcompany.com" <vince@cwmcompany.com>

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Shirlene South
217/558-0347

South, Shirlene

From: vince@cwmcompany.com
Sent: Wednesday, July 27, 2016 11:12 AM
To: South, Shirlene
Subject: RE: 2002-0431 Moto mart
Attachments: Moto Mart- soil model.pdf; Moto Mart- gw model.pdf

Shirlene,

Sorry for the confusion. Since the groundwater contamination modeling controlled, for the locations where there was both soil and water contamination, only the groundwater radii were used previously, and as I said before, groundwater at MW-1 defines the ultimate modeled boundary. On the attached drawings the dark lines are the modeled soil (drawing 0011A) or water (drawing 0011B) contamination, while the thin lines are the opposite (modeled groundwater on 0011A, modeled soil on 0011B). Each of the dark lines has an identifier for the sample location, and the radius of the circle.

Vince

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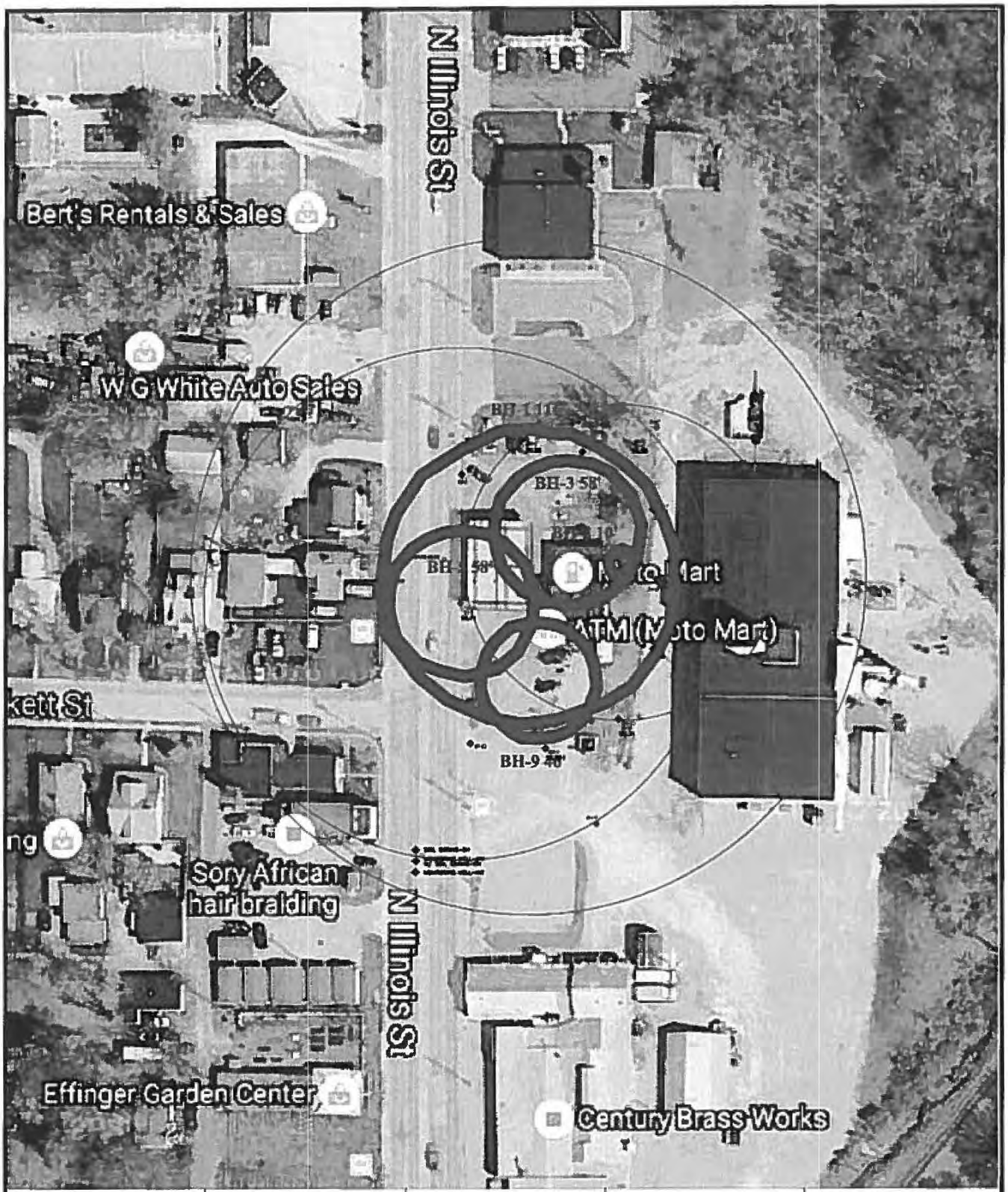
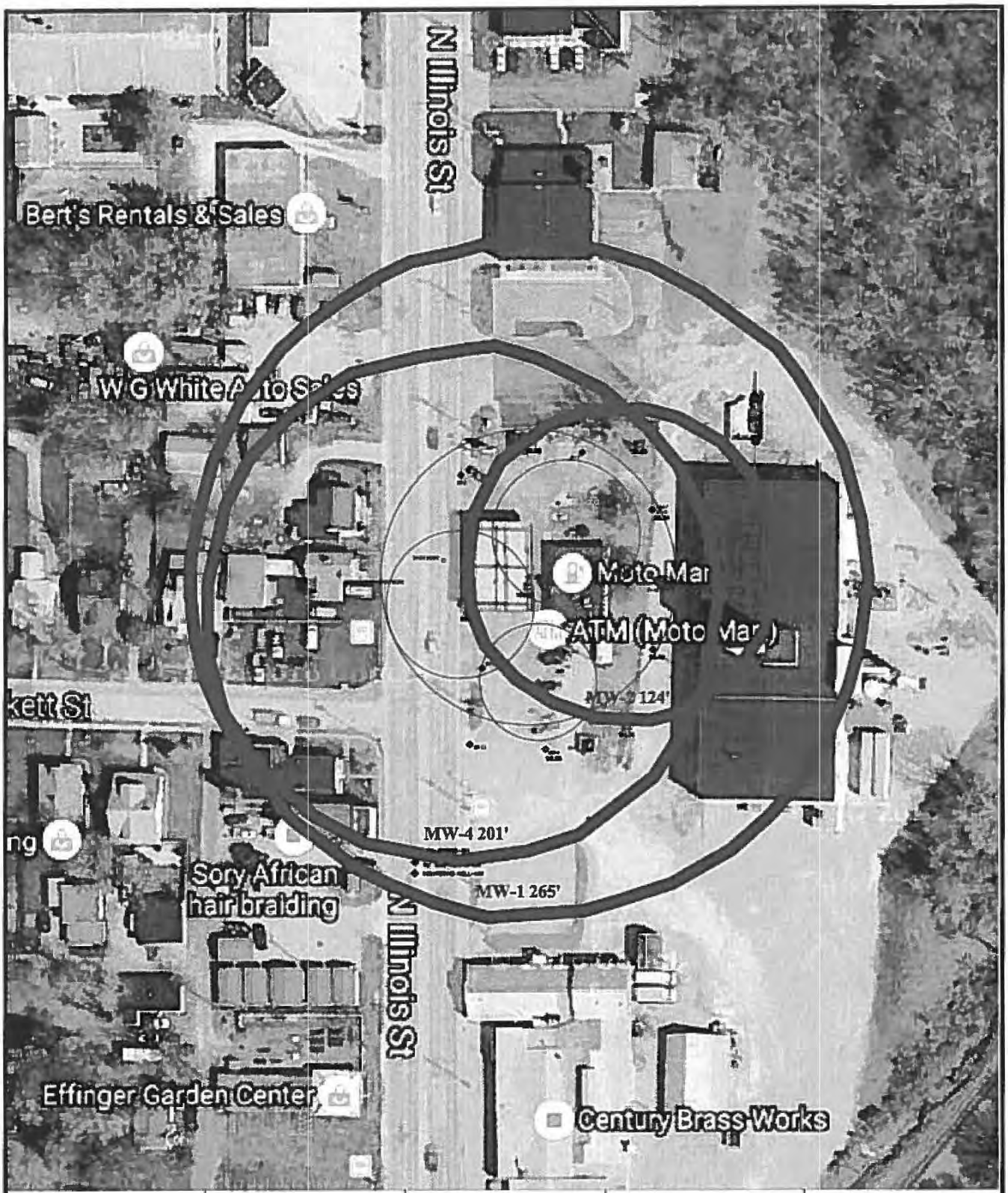
217/558-0347



CW[M] COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	MOTOMART SWANSEA, ILLINOIS INCIDENT # 2002-0431 ST. CLAIR COUNTY	MODELED SOIL CONTAMINATION MAP	SCALE: 1"=100' DATE: 7/27/16 REVISED DATE: DRAWING: 0011A	DRAWN BY: VES REVISED BY: REVIEW BY: CLR MotoMart.dwg MODELED SOIL



CW[M] COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	MOTOMART SWANSEA, ILLINOIS INCIDENT # 2002-0431 ST. CLAIR COUNTY	MODELED GROUNDWATER CONTAMINATION MAP	SCALE: 1"=100' DATE: 7/27/16 REVISED DATE: DRAWING: 0011B	DRAWN BY: VES REVISED BY: REVIEW BY: CLR MotoMart.dwg MODELED GW

CW³M Company
Environmental Consulting Services

701 W. South Grand Avenue
Springfield, IL 62704

Phone: (217) 522-8001
Fax: (217) 522-8009

October 3, 2016 PREVIOUSLY IMAGED

1631405021 – St. Clair County
Moto, Inc.
Incident # 20020431
Leaking UST Technical File

Ms. Shirlene South, Project Manager
LUST Section, Bureau of Land
Illinois Environmental Protection Agency
1021 North Grand Avenue East
Springfield, IL 62794-9276

RE: **LPC #1631405021—St. Clair County**
MotoMart – Swansea
1324 North Illinois St. (Route 159)
Incident Number: 2002-0431
LUST Technical Reports—Corrective Action Plan and Budget

Dear Ms. South:

On behalf of FKG Oil Company (MotoMart), owner of the USTs at the above-referenced site, we are submitting the attached Corrective Action Plan (CAP) and Budget. The CAP proposes using institutional controls to address the contamination defined in the Site Investigation Completion Report approved July 28, 2016. Also in the CAP is a vapor intrusion investigation and some re-sampling of on site and off-site contamination that would require remediation or additional institutional controls. Assuming that nothing is found that requires additional remediation, a Corrective Action Completion Report will be prepared. If there is contamination which requires remediation, a CAP Amendment will be submitted.

If you have any questions or require additional information, please contact Mr. Vince E. Smith or me at (217) 522-8001.

Sincerely,

Carol L. Rowe, P.G.
Senior Environmental Geologist

IEPA-DIVISION OF RECORDS MANAGEMENT
RELEASABLE
DEC 28 2016
REVIEWER: EMI

Enclosure

RECEIVED
OCT 11 2016
IEPA/BOL

xc: Mr. Rob Whittington, *MotoMart / FKG Oil Company*
Mr. William T. Sinnott, *CW³M Company, Inc.*

CORRECTIVE ACTION PLAN & BUDGET

MotoMart - Swansea

Swansea, Illinois
LPC #1631405021 – St. Clair County
Incident Number 2002-0431

Submitted to:
ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
Leaking Underground Storage Tank Section, Bureau of Land
1021 North Grand Avenue East
Springfield, Illinois 62794-9276

Prepared by:
CW³M COMPANY, INC.

701 South Grand Avenue West
Springfield, Illinois
(217) 522-8001

400 West Jackson, Suite C
Marion, Illinois
(618) 997-2238

OCTOBER 2016

TABLE OF CONTENTS

APPENDICES

TABLES

ACRONYMS AND ABBREVIATIONS

BETX	Benzene, Ethylbenzene, Toluene, Total Xylenes
CAP	Corrective Action Plan
CACR	Corrective Action Completion Report
CUO	Clean-up Objective
Csat	Soil saturation limit
CW³M	CW³M Company, Inc.
ELUC	Environmental Land Use Control
GEI	Greystone Environmental, Inc.
HAA	Highway Authority Agreement
IDOT	Illinois Department of Transportation
IEMA	Illinois Emergency Management Agency
IEPA	Illinois Environmental Protection Agency
Ill. Adm. Code	Illinois Administrative Code
ISGS	Illinois State Geological Survey
ISWS	Illinois State Water Survey
LEL	Lower explosive limit
LUST	Leaking Underground Storage Tank
MTBE	Methyl Tert-Butyl Ether
MW	Monitoring Well
NFR	No Further Remediation
OSFM	Illinois Office of the State Fire Marshal
PLA	Project Labor Agreement
PNA	Polynuclear Aromatic Hydrocarbon
PVC	Polyvinyl Chloride
SB	Soil Boring
SICR	Site Investigation Completion Report
SIP	Site Investigation Plan
SWAP	Source Water Assessment Program
TACO	Tiered Approach to Corrective Action Objectives
USI	United Science Industries, Inc.

UST	Underground Storage Tank
WCR	Well Completion Report

1. SITE HISTORY/EXECUTIVE SUMMARY

1.1 GENERAL

This proposed Corrective Action Plan (CAP) and Budget has been prepared in accordance with the requirements of the 35 Illinois Administrative Code (Ill. Adm. Code) 734. The Illinois Environmental Protection Agency (IEPA) Corrective Action Plan Form is included in this document as Appendix A.

A 560-gallon heating oil underground storage tank (UST) was discovered on-site during the construction of a new building that now serves as the active MotoMart station in Swansea, Illinois. FKG Oil Company (MotoMart) contracted Greystone Environmental, Inc. (GEI) to remove the 560-gallon heating oil UST and proceed with the reporting requirements in accordance with the requirements of 35 Illinois Ill. Adm. Code § 732. The UST was removed on April 3, 2002, at which time a slight petroleum odor was observed in the backfill. A release was therefore reported to the Illinois Emergency Management Agency (IEMA) and Incident Number 2002-0431 was assigned on April 3, 2002. This CAP and Budget is being prepared in response to Incident Number 2002-0431.

The 20-Day Certification was submitted to the Illinois Environmental Protection Agency (IEPA) on April 19, 2002 (GEI, 2002). A 45-Day Report was submitted to the IEPA on July 19, 2002 (GEI, 2002a), and approved by the IEPA on August 8, 2002 (IEPA, 2002).

Following the submission of the 45-Day Report, MotoMart requested that United Science Industries, Inc. (USI), proceed with the site investigation and reporting requirements in accordance with the requirements of 35 Ill. Adm. Code § 732. On July 28, 2006, USI submitted an Election to Proceed under 35 Ill. Adm. Code 734 (USI, 2006). A Stage 2 Site Investigation Plan (SIP) and Budget was submitted on February 13, 2007 (USI, 2007) and approved by the IEPA on March 27, 2007 (IEPA, 2007). A Stage 3 SIP and Budget was submitted on October 16, 2007 (USI, 2007a) and approved by the IEPA on January 10, 2008 (IEPA, 2008).

Since the submission of the Stage 3 SIP, USI declared bankruptcy and is no longer in existence. MotoMart has requested that CW³M Company, Inc. (CW³M) proceed with the site investigation and reporting requirements in accordance with the requirements of 35 Ill. Adm. Code § 734. CW³M submitted a Stage 3 SIP and Budget Amendment on April 16, 2012 (CW³M, 2012), which was approved by the IEPA on July 18, 2012 (IEPA, 2012). Once the work proposed in the April 2012 SIP Amendment was completed, a second Stage 3 SIP and Budget Amendment was submitted by CW³M on October 27, 2015 (CW³M, 2015), and approved with modifications on February 18, 2016 (IEPA, 2016).

A Site Investigation Completion Report (SICR) was submitted to the IEPA on April 4, 2016 (CW³M, 2016), and was approved by the IEPA on July 28, 2016 (IEPA, 2016a).

This report is certified by an Illinois Licensed Professional Engineer. The geological investigation and site investigation was performed under the direction of an Illinois Licensed Professional Geologist and completed in accordance with the Professional Geologist Licensing Act and its Rules for Administration.

1.2 SITE LOCATION

The site, known as MotoMart, is located at 1324 North Illinois Street (Route 159), Swansea, St. Clair County, Illinois. The site is located in the NE ¼ of the NE ¼ of the NE ¼ of Section 21, Township 1 North of the Centralia Baseline and Range 8 West of the Third Principal Meridian.

1.3 UNDERGROUND STORAGE TANK INFORMATION

The 560-gallon steel tank was uncovered during site construction, within the footprint of the new building which now serves as the active MotoMart station. This tank has never been used by MotoMart as they were unaware of its existence until it was uncovered during the construction. After obtaining a permit for removal from the Illinois Office of the State Fire Marshal (OSFM), the product was first removed by a vacuum truck for disposal by fuel recycling. Then the inside tank atmosphere was measured with a combustible gas indicator. When volatile vapors inside the tank were less than the Lower Explosive Limit (LEL), the tank was removed by GEI with a backhoe. The tank appeared to be intact, with no holes on the sides and bottom.

Table 1-1. Underground Storage Tank Summary

Tank Number	Tank Volume (gallons)	Tank Contents	Incident Number	Release Information	Current Status
1	8,000	Gasoline	None	N/A	Currently in use
2	4,000	Gasoline	None	N/A	Currently in use
3	10,000	Gasoline	None	N/A	Currently in use
4	6,000	Diesel Fuel	None	N/A	Currently in use
5	560	Heating Oil	2002-0431	Tank Leak	Removed 4/3/2002

1.4 EARLY ACTION SUMMARY

GEI removed the 560-gallon heating oil UST located beneath the building on April 3, 2002. A slight petroleum odor was observed in the backfill, so a release was reported to the IEMA and Incident Number 2002-0431 was assigned that day. Approximately 6 tons (4 cubic yards) of contaminated backfill and approximately 1.5 tons (1 cubic yard) of contaminated native soil was removed from the former tank pit and taken to the Roxana Landfill in Edwardsville, Illinois. Two soil samples were collected during the excavation and analyzed for benzene, ethylbenzene, toluene, and total xylenes (BETX) and polynuclear aromatic hydrocarbons (PNAs). One sample (M 8) was collected immediately below the tank as it was removed and the other sample (M 10) was collected in the clay soil beneath the coal seam. Both sample locations were located within the soil that was removed and disposed of at the Roxana Landfill. A summary of the analytical results is included in Appendix F.

1.5 SITE INVESTIGATION SUMMARY

Soil analytical results from site investigation activities, indicate that Tiered Approach to Clean-up Objectives (TACO) Tier 1 Residential Clean-Up Objectives (CUOs) have been exceeded on-site and off-site to the northeast, east, southeast, and west.

Groundwater analytical results from site investigation activities indicate that the groundwater quality has exceeded the Class 1 Groundwater Objectives at the western

property boundary and off-site to the east. One well (MW-8) that was installed during Stage 3 site investigations activities did not produce groundwater in two separate sampling attempts. During the most recent drilling event, groundwater had produced and was sampled, from MW-8, showing PNA contamination just over Tier 1 CUOs.

As mentioned above, soil and groundwater analytical results indicate that Tier 1 CUOs have been exceeded at the western property boundary. Off-site access was requested to investigate the extent of contamination west of the site; however access was considered denied. Additional soil investigation was proposed to the south (CW³M, 2015), but the Agency determined the soil contamination identified in that direction to not be associated with the 2002-0431 release (IEPA, 2016). In the second Stage 3 Plan Amendment (CW³M, 2015), it was also proposed to not continue the groundwater investigation to the east.

On September 6, 2006, USI advanced five soil borings (BH-1, BH-2, BH-3, BH-4, BH-5) and five monitoring wells (MW-1, MW-2, MW-3, MW-4, MW-5) as part of Stage 1 site investigation activities. Soil samples were analyzed for BETX and PNAs. Soil analytical results indicate that Tier 1 objectives have been exceeded for the indicator contaminants benzene, total xylenes, benzo(a)pyrene, and dibenz(a,h)anthracene. USI returned to the site on October 5, 2006, to sample the installed monitoring wells for BETX, methyl tert-butyl ether (MTBE), and PNAs. Groundwater analytical results indicated that Tier 1 objectives have been exceeded for the indicator contaminants benzene, ethybenzene, and naphthalene. The soil boring logs, well completion reports (WCRs), and analytical results were included in the Stage 2 SIP and Budget submitted on February 13, 2007 (USI, 2007), and were included in the SICR (CW³M, 2016). A table summarizing the groundwater analytical results is included in Appendix F.

On May 10, 2007, USI advanced four soil borings (BH-6, BH-7, BH-8, BH-9) as part of Stage 2 site investigation activities. Soil samples were analyzed for BETX and PNAs. Soil analytical results indicate that the Tier 1 objectives have been exceeded for the indicator contaminants benzene and PNAs. An additional soil boring (ST-1) was advanced during Stage 2 site investigation activities to obtain site specific physical parameters. The soil boring logs and analytical results were included in the Stage 3 SIP and Budget submitted on October 16, 2007 (USI, 2007a), and were included in the SICR (CW³M, 2016). A summary of the analytical results are included in Appendix F.

On July 25, 2007, USI advanced an additional two soil borings (BH-10 and BH-11) to complete Stage 2 site investigation activities. Soil samples were analyzed for BETX and PNAs. Soil analytical results indicate that the Tier 1 objectives have been exceeded at BH-11 for the PNA indicator contaminant benzo(a)pyrene. A summary of the analytical results were included in the SICR (CW³M, 2016). The soil boring logs and analytical results were included in the SICR (CW³M, 2016). A summary of the analytical results are included in Appendix F.

On September 3, 2015, CW³M personnel returned to the site to conduct off-site soil and groundwater investigation activities. Three soil borings (BH-17, BH-18, and BH-19) were advanced to fifteen feet. Soil samples were analyzed for PNAs. The samples were sampled to fifteen feet based on the previous sampling by USI and previously approved plans. The seasonal fluctuation of the water table and the lack of groundwater produced in wells in past investigations also back up soil sampling to fifteen feet. Soil analytical results indicate that the Tier 1 objectives have been exceeded for the PNA indicator contaminants benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and dibenz(a,h)anthracene at BH-19 at a depth of 7.5 feet. Previously dry MW-8 was also sampled for PNAs, resulting in levels of benzo(a)anthracene and benzo(b)fluoranthene higher than Tier 1 CUOs. Soil boring logs and WCRs were included in the SICR (CW³M, 2016). A summary of the analytical results are included in Appendix F.

At the end of Stage 2 Site Investigation, the plumes remained undefined in the southern, eastern, and western directions, so access was sought for the offsite properties in those directions. Access to the east and south was sought and granted to two properties owned by Century Brass Works, and subsequent investigations were conducted. Access requests for properties to the west, across Route 159 (North Illinois Street), were requested at 1509 (Karen Roussel), 1507 (Dave Wuebbels), and two properties owned by Medstar Ambulance, one north and one south of Brackett Street. Each of the property owners west of Route 159 failed to grant access, so access is considered denied to each property. Copies of the access correspondence were included in the SICR (CW³M, 2016). Affidavits for the properties have been prepared in accordance with 35 Ill. Admin. Code 734.350 c) and were submitted during the review of the SICR, and are copied in Appendix G. They will also be included in the Corrective Action Completion Report (CACR).

1.6 CORRECTIVE ACTION SUMMARY

The results from the site investigation activities indicated that soil contamination above Tier 1 Clean-up Objectives is present on site, and extends off-site to the east and west. Upon the determination of the TACO Tier 2 CUOs, it was apparent that the levels of contamination at sample BH-9-A will require additional remediation, and the off-site soil contamination to the east will require additional remediation.

Groundwater analytical results indicate that Tier 1 CUOs have been exceeded on site at MW-1, MW-2, MW-4 and MW-8. The groundwater plume covers much of the same area as the soil contamination, extending slightly further to the east. It is proposed that a groundwater ordinance be used, effectively eliminating the migration of the soil to groundwater pathway.

The vapor intrusion pathway has not been investigated previously, and an investigation is proposed in this CAP.

2. REMEDIATION OBJECTIVES

2.1 DETERMINATION OF CLEAN-UP OBJECTIVES

In accordance with 35 Ill. Adm. Code 734, remediation objectives will be determined in accordance with 35 Ill. Adm. Code 742. The site specific physical parameters have been determined, and are calculated below.

Hydraulic Conductivity (K), 4.30 x 10^{-5} cm/sec
Soil bulk density (ρ_b), 60.4 lb/ft^3 (0.967 g/cm^3)
Soil particle density (ρ_s), 2.54 g/cm^3
Moisture content (w), 0.286
Organic carbon content (f_{oc}), 0.0058 g/g
Classification, Loamy Sand

In order to determine the hydraulic conductivity, a slug test was performed on May 10, 2007, in monitoring well MW-3. The test was performed by lowering a "slug" constructed of polyvinyl chloride (PVC). USI used the Bouwer & Rice Method for calculating the falling and rising hydraulic conductivities. The average hydraulic conductivity was then determined by averaging the falling hydraulic conductivity and the rising hydraulic conductivity. Two tests were performed, and the results were averaged. The hydraulic conductivity was determined to be 4.30 x 10^{-5} cm/sec. Hydraulic conductivity calculations were originally provided in Appendix E of the Stage 2 SIP and Budget (USI, 2007), and was also included in the SICR (CW^{3}M, 2016).

Velocity was calculated using the hydraulic conductivity results determined at the site, as well as the hydraulic gradient. The hydraulic gradient was found by calculating the change in gradient between the most up-gradient well (MW-3, 92.10 feet) and the most down-gradient well in the direction of flow (MW-7, 82.34 feet), then dividing this answer by the distance in feet between the two wells (116.36 feet). Formula R24, ($U_{gw} = K \bullet i$) of 35 Ill. Adm. Code § 742 Appendix C, Table C was used. The hydraulic gradient was calculated to be 8.39 x 10^{-2}. Velocity was calculated to be 3.61 x 10^{-6} cm/sec.

2.2 SOIL AND GROUNDWATER OBJECTIVES

The soil and groundwater objectives are listed for the site below in tabular format. Additionally, the groundwater at this site continues to be considered Class 1 unless demonstrated otherwise pursuant to 35 Ill. Adm. Code § 620.210. The site is not within the setback of a known potable well, so it is assumed a groundwater use restriction will be imposed on the impacted or potentially impacted area, so the groundwater pathway was removed in determining the on site soil objectives.

The site is located in Swansea, Saint Clair County, Illinois. The population of Swansea was 13,430 in the 2010 census, so in accordance with 35 Ill. Adm. Code § 742, Appendix A, Table H background values for PNAs for a Metropolitan Area can be used. Only those PNAs for which the incident had an exceedence have been replaced by background values.

Table 2-1. Soil Remediation Objectives

Parameter	TACO Residential Tier 1 Clean-up Objective (mg/kg)	TACO Industrial / Commercial Tier 2 Clean-up Objective (mg/kg)
Benzene	**0.03**	**3.21**
Ethylbenzene	**13.0**	**389.64**
Toluene	**12.0**	**371.29**
Total Xylenes	**5.6**	**46.17**
MTBE	**0.32**	
Acenaphthene	**570.0**	
Acenaphtylene	**15.0**	
Anthracene	**12000.0**	
Benzo(a)anthracene	**1.8***	
Benzo(a)pyrene	**2.1***	
Benzo(b)fluoranthene	**2.1***	
Benzo(g,h,i)perylene	**2300.0**	
Benzo(k)fluoranthene	**9.0**	
Chrysene	**88.0**	
Dibenz(a,h)anthracene	**0.42***	
Fluoranthene	**3,100.0**	
Fluorene	**560.0**	

Indeno(1,2,3-cd)pyrene	**1.6***	
Naphthalene	**1.8**	
Phenanthrene	**140.0**	
Pyrene	**2300.0**	

* - value replaced by background value from 35 Ill. Adm. Code § 742, Appendix A, Table H

Tier 2 Clean-Up Objectives and modeling has been conducted in accordance with 35 Ill. Adm. Code § 742, and is included in Appendix E. In a review of the off-site soil results from site investigation, only BH2-8', and BH19-7.5' exceed the Tier 1 Clean-Up Objectives in the table above. The contamination at BH-19 was determined to not be associated with incident 2002-0431. The BH-2-8' sample exceeds the benzene Clean-Up Objective. It should be noted that Drawings showing soil values (0006A, 0006B, and 0006C) and soil plumes (0008A, 0008B, and 0008C) in Appendix B have not been revised to show the application of background PNA values, but a new overall soil plume map showing the area where soil contamination above background values and over TACO Tier 1 Clean-Up Objectives has been prepared and included as Drawing 0012.

Comparing the on site soil results from site investigation to the Tier 2 Clean-Up Objectives listed above, only BH9A, the sample from the three to four foot depth, exceeds any Clean-Up Objectives. It exceeds the objectives for the Tier 1 Residential PNA components listed in the following table.

Table 2-2. Soil Industrial Commercial Remediation Objectives

Parameter	BH9-A Result (mg/kg)	TACO Industrial / Commercial Tier 1 Objective (mg/kg)	TACO Construction Worker Tier 1 Objective (mg/kg)
Benzo(a)anthracene	**2.5**	**7.84**	**18**
Benzo(a)pyrene	**2.6**	**0.784**	**17.01**
Benzo(b)fluoranthene	**2.5**	**8**	**170**
Dibenz(a,h)anthracene	**0.54**	**0.467**	**17.01**
Indeno(1,2,3-cd)pyrene	**1.7**	**8**	**170**

Sample BH9-A exceeds the industrial / commercial ingestion pathway Clean-Up Objectives for benzo(a)pyrene and dibenz(a,h)anthracene. Tier 2 ingestion values for these two

constituents were calculated, but the calculated values were equal to or less than the Tier 1 values, so the Tier 1 values were used.

Table 2-3. Groundwater Remediation Objectives

Parameter	TACO Residential Tier 1 Clean-up Objective (mg/L)
Benzene	0.005
Ethylbenzene	0.7
Toluene	1.0
Total Xylenes	10.0
MTBE	0.07
Acenaphthene	0.42
Acenaphtylene	0.01
Anthracene	2.1
Benzo(a)anthracene	0.00013
Benzo(a)pyrene	0.0002
Benzo(b)fluoranthene	0.00018
Benzo(g,h,i)perylene	0.00076
Benzo(k)fluoranthene	0.00017
Chrysene	0.0015
Dibenz(a,h)anthracene	0.0003
Fluoranthene	0.28
Fluorene	0.28
Indeno(1,2,3-cd)pyrene	0.00043
Naphthalene	0.14
Phenanthrene	0.0064
Pyrene	0.210

3. CORRECTIVE ACTION PLAN

Based upon the analytical data from the soil boring and groundwater samples collected, it is apparent that soil contamination is present over the majority of the site, extending into the right-of-way of Route 159, where the ultimate limits were not defined due to denial of access, and onto the off-site property to the east, where it was defined through investigation. Groundwater contamination is very similar to the soil contamination in

terms of the areas affected. All site investigation details were presented in the SICR (CW³M, 2016).

The following CAP and Budget has been prepared by CW³M Company, Inc., as their recommendation for the most appropriate and economical approach to the remediation of the contamination at the Motomart site in Swansea, Illinois. Tier 2 CUOs were developed using various parameters to help determine the most beneficial and feasible outcome.

Soil to groundwater and groundwater modeling in accordance with 35 Ill. Adm. Code § 742 has been conducted, as depicted in Drawings 0011A for soil to groundwater modeling, and Drawing 0011B for groundwater modeling. The Village of Swansea has an existing groundwater use ordinance but it does not include the area affected by the potential groundwater contamination for this incident. It is proposed to request the Village to either amend the existing ordinance or to adopt another ordinance covering the area potentially affected by this release.

Soil contamination will need to be addressed on three parcels, the site itself, the off-site property to the east, and the right-of-way of Route 159.

The soil and groundwater contamination beneath Route 159 is proposed to be addressed through a Highway Authority Agreement (HAA) with the Illinois Department of Transportation (IDOT). The off-site soil contamination on the property to the east is minor, and the contamination was sampled in 2006. This CAP proposes to resample the location of BH2 to verify if contamination over TACO Tier 1 Clean-Up Objectives remains. Samples will be taken from the 8 and 14 foot depths and analyzed for BETX, MTBE, and PNAs to see if the contamination remains, or has travelled deeper. Should the results not prove that the contamination has diminished to a level below TACO Tier 1 Clean-Up Objectives, a CAP Amendment will be prepared to address the contamination in a manner acceptable to the off-site property owner, such as an Environmental Land Use Control (ELUC) or an excavation to remove it.

With the use of a groundwater ordinance and the acceptance of an industrial / commercial use restriction on the property, the only contamination that would need to be addressed in the soil contamination found at sample BH9-A. Given that the sample at BH9-A was obtained in 2007, it is proposed to resample BH-9 at the depths of 3-4 feet and 7-8 feet to see if the contamination still exceeds the TACO Tier 2 industrial / commercial Clean-Up Objectives. If the results are not favorable, a CAP amendment proposing additional definition of the area exceeding the industrial / commercial inhalation pathway will be proposed. Once the affected area is defined, the owner / operator will then decide the preferable course of remediation of the affected area.

The proposed soil investigation of BH2 to 15 feet, and BH9 to 10 feet will be conducted using the same techniques and protocols as used in Site Investigation as detailed in the SICR (CW³M, 2016).

As discussed in the SICR (CW³M, 2016), following the June, 2013 IEPA Leaking Underground Storage Tank (LUST) flowchart for vapor intrusion assessment, CW³M conducted a screening evaluation of the site and assessment of data to date. While there is not free product in the monitoring wells, there is groundwater contamination present on and off site. No soil sample exceeded the soil saturation (Csat) limit.

Groundwater elevation surveys to date show depth to groundwater measurements to be at least 7 feet. Therefore the vertical separation distance is greater than the appropriate screening distance (5 ft) required for soil gas sampling in respect to groundwater contamination. Numerous manmade pathways for utilities intercept the area of contamination and lead to the station building. Therefore, a soil gas sampling is recommended for this site as groundwater contamination and pathways to the buildings meet the criteria to require soil gas sampling. Given these facts, a threat to the health and safety of the public from the inhalation of vapors from either groundwater or soil contamination is unlikely but still required when following the LUST flowchart for vapor intrusion assessment.

Since the review and approval of the SICR contained no information to the contrary, a soil vapor investigation is proposed to be conducted in the area of MW-1, which has the largest modeled distances for contamination at the site.

Assuming the soil vapor sampling and the proposed re-sampling results on site and off-site are favorable, a CACR will be prepared once the HAA and the groundwater ordinance are in place.

The attached CAP Budget includes the preparation of this report, as well as the preparation of the CACR. The abandonment of the existing monitoring wells and the recording of the No Further Remediation (NFR) letter are also included in the proposed budget.

3.1 CURRENT AND PROJECTED USES OF THE SITE

The site is surrounded by commercial properties. The site is currently being used as an operating gas station and convenience store and will continue to be used for such purposes.

3.2 INSTITUTIONAL CONTROLS PROPOSED

The site has public water available and is not within the setback of a known potable well, so a groundwater ordinance will be sought for the potentially impacted area. Soil and groundwater contamination are known to exist beneath the right-of-way of Route 159, so a HAA with IDOT is proposed to address that contamination. The site itself has a commercial usage with no plans to change, so the site will accept an industrial / commercial land use restriction. There is known soil contamination on the property to the east of the subject site, which is proposed to be re-sampled in this CAP to verify that it remains. No institutional controls are proposed on that property at this time, but may be proposed later, if soil contamination is verified to still exist, and the controls are acceptable to the property owner.

3.3 WATER SUPPLY WELL SURVEY

A survey of water supply wells for the purpose of identifying and locating all community water supply wells within 2,500 feet of the UST systems and all potable water supply wells within 200 feet of the UST systems has been conducted. The Illinois State Water Survey (ISWS), the Illinois State Geological Survey (ISGS) and the IEPA Division of Public Water Supplies were contacted via Source Water Assessment Program (SWAP) online.

The ISGS, ISWS, and IEPA Division of Public Water Supplies were accessed online on March 27, 2012 (EPA.STATE.IL.US, 2012). The response indicated that eight wells were located within 2,500 feet of the site and no wells are within the designated set back zones. Also, the response stated that there are no community water supply wells located within 2,500 feet of the site. A groundwater ordinance in effect for a portion of Swansea, but does not cover the subject site. It is located 2,165 feet from the USTs. Refer to Drawing 0001C in Appendix B for a map depicting the well and groundwater ordinance locations.

Table 3-1. Water Supply Well Information

Well ID	Type	Depth of Well *(feet)*	Distance From USTs *(feet)*	Setback Zone *(feet)*
00216	ISGS	1	792	200
00216	ISGS	231	950	200
00273	ISGS	1	1,214	200
01809	ISGS	95	1,426	200

01812	ISGS	510	1,426	200
00272	ISGS	125	1,637	200
28103	ISGS	42	2,112	200
28104	ISGS	30	2,112	200
R08030303	GWO	---	2,165	200

3.4 CLOSURE

Once all CAP activities conclude, a CACR will be submitted to the IEPA. The closure report will be accompanied by a certification from an Illinois Registered Professional Engineer. Should the activities proposed in this CAP verify that on site and / or off-site soil contamination still remains above the allowable Clean-Up Objectives, then a CAP amendment will be prepared to address the unresolved issues.

REFERENCES

CW³M, 2012. CW³M Company, Inc., *Stage 3 Site Investigation Plan and Budget Amendment,* MotoMart – Swansea, Swansea, Illinois, April 16, 2012.

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GEI, 2002. Greystone Environmental, Inc., *20-Day Certification,* MotoMart – Swansea, Swansea, Illinois, April 19, 2002.

GEI, 2002a. Greystone Environmental, Inc., *45-Day Report,* MotoMart – Swansea, Swansea, Illinois, July 19, 2002.

EPA.SATE.IL.US, 2012. Source Water Assessment Program, *Water Well Survey Map* www.maps.epa.state.il.us, accessed March 27, 2012.

IEPA, 2002. Illinois Environmental Protection Agency, *45-Day Report Correspondence,* MotoMart – Swansea, Swansea, Illinois, August 8, 2002.

IEPA, 2007. Illinois Environmental Protection Agency, *Stage 2 Site Investigation Plan and Budget Correspondence,* MotoMart – Swansea, Swansea, Illinois, March 27, 2007.

IEPA, 2008. Illinois Environmental Protection Agency, *Stage 3 Site Investigation Plan and Budget Correspondence,* MotoMart – Swansea, Swansea, Illinois, January 10, 2008.

IEPA, 2012. Illinois Environmental Protection Agency, *Stage 3 Site Investigation Plan and Budget Amendment Correspondence,* MotoMart – Swansea, Swansea, Illinois, July 18, 2012.

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IEPA, 2016a. Illinois Environmental Protection Agency, *Site Investigation Completion Report Correspondence,* MotoMart – Swansea, Swansea, Illinois, July 28, 2016.

USI, 2006. United Science Industries, Inc., *Election to Proceed under 35 Ill. Adm. Code 734,* MotoMart - Swansea, Swansea, Illinois, July 28, 2006.

USI, 2007. United Science Industries, Inc., *Stage 2 Site Investigation Plan and Budget,* MotoMart - Swansea, Swansea, Illinois, February 13, 2007.

USI, 2007a. United Science Industries, Inc., *Stage 3 Site Investigation Plan and Budget,* MotoMart - Swansea, Swansea, Illinois, October 16, 2007.

APPENDIX A

CORRECTIVE ACTION PLAN FORM

CORRECTIVE ACTION PLAN
MOTOMART
SWANSEA, ILLINOIS

Illinois Environmental Protection Agency

Bureau of Land • 1021 N. Grand Avenue E. • P.O. Box 19276 • Springfield • Illinois • 62794-9276

The Agency is authorized to require this information under Section 4 and Title XVI of the Environmental Protection Act (415 ILCS 5/4, 5/57 – 57.17). Failure to disclose this information may result in a civil penalty of not to exceed $50,000.00 for the violation and an additional civil penalty of not to exceed $10,000.00 for each day during which the violation continues (415 ILCS 5/42). Any person who knowingly makes a false material statement or representation, orally or in writing, in any label, manifest, record, report, permit, or license, or other document filed, maintained or used for the purpose of compliance with Title XVI commits a Class 4 felony. Any second or subsequent offense after conviction hereunder is a Class 3 felony (415 ILCS 5/44 and 57.17). This form has been approved by the Forms Management Center.

Leaking Underground Storage Tank Program
Corrective Action Plan

A. Site Identification

IEMA Incident # (6- or 8-digit): 20020431 IEPA LPC# (10-digit): 1631405021

Site Name: MotoMart - Swansea

Site Address (Not a P.O. Box): 1324 North Illinois St. (Route 159)

City: Swansea County: St. Clair ZIP Code: 62221

B. Site Information

1. Will the owner or operator seek reimbursement from the Underground Storage Tank Fund? ☑ Yes ☐ No
2. If yes, is the budget attached? ☑ Yes ☐ No
3. Is this an amended plan? ☐ Yes ☑ No
4. Identify the material(s) released: heating oil
5. This Corrective Action Plan is submitted pursuant to:
   - a. 35 Ill. Adm. Code 731.166 ☐
     The material released was:
     - -petroleum ☐
     - -hazardous substance (see Environmental Protection Act Section 3.215) ☐
   - b. 35 Ill. Adm. Code 732.404 ☐
   - c. 35 Ill. Adm. Code 734.335 ☑

C. Proposed Methods of Remediation

1. Soil Re-evaluation, HAA
2. Groundwater Groundwater Ordinance, HAA

D. Soil and Groundwater Investigation Results

(for incidents subject to 35 Ill. Adm. Code 731 only or 732 that were classified using Method One or Two, if not previously provided)

Provide the following:

1. Description of investigation activities performed to define the extents of soil and/or groundwater contamination;
2. Analytical results, chain-of-custody forms, and laboratory certifications;
3. Tables comparing analytical results to applicable remediation objectives;

4. Boring logs;
5. Monitoring well logs; and
6. Site maps meeting the requirements of 35 Ill. Adm. Code 732.110(a) or 734.440 and showing:
   a. Soil sample locations;
   b. Monitoring well locations; and
   c. Plumes of soil and groundwater contamination.

E. Technical Information - Corrective Action Plan

Provide the following:

1. Executive summary identifying the objectives of the corrective action plan and the technical approach to be utilized to meet such objectives;
   a. The major components (e.g., treatment, containment, removal) of the corrective action plan;
   b. The scope of the problems to be addressed by the proposed corrective action; and
   c. A schedule for implementation and completion of the plan;
2. Identification of the remediation objectives proposed for the site;
3. A description of the remedial technologies selected:
   a. The feasibility of implementing the remedial technologies;
   b. Whether the remedial technologies will perform satisfactorily and reliably until the remediation objectives are achieved; and
   c. A schedule of when the technologies are expected to achieve the applicable remediation objectives;
4. A confirmation sampling plan that describes how the effectiveness of the corrective action activities will be monitored during their implementation and after their completion;
5. A description of the current and projected future uses of the site;
6. A description of engineered barriers or institutional controls that will be relied upon to achieve remediation objectives:
   a. an assessment of their long-term reliability;
   b. operating and maintenance plans; and
   c. maps showing area covered by barriers and institutional controls;
7. The water supply well survey:
   a. Map(s) showing locations of community water supply wells and other potable wells and the setback zone for each well;
   b. Map(s) showing regulated recharge areas and wellhead protection areas;
   c. Map(s) showing the current extent of groundwater contamination exceeding the most stringent Tier 1 remediation objectives;
   d. Map(s) showing the modeled extent of groundwater contamination exceeding the most stringent Tier 1 remediation objectives;
   e. Tables listing the setback zone for each community water supply well and other potable water supply wells;
   f. A narrative identifying each entity contacted to identify potable water supply wells, the name and title of each person contacted, and any field observations associated with any wells identified; and
   g. A certification from a Licensed Professional Engineer or Licensed Professional Geologist that the survey was conducted in accordance with the requirements and that documentation submitted includes information obtained as a result of the survey (certification of this plan satisfies this requirement);

8. Appendices:
   a. References and data sources report that are organized; and
   b. Field logs, well logs, and reports of laboratory analyses;
9. Site map(s) meeting the requirements of 35 Ill. Adm. Code 732.110(a) or 734.440;
10. Engineering design specifications, diagrams, schematics, calculations, manufacturer's specifications, etc.;
11. A description of bench/pilot studies;
12. Cost comparison between proposed method of remediation and other methods of remediation;
13. For the proposed Tier 2 or 3 remediation objectives, provide the following:
    a. The equations used;
    b. A discussion of how input variables were determined;
    c. Map(s) depicting distances used in equations; and
    d. Calculations; and
14. Provide documentation to demonstrate the following for alternative technologies:
    a. The proposed alternative technology has a substantial likelihood of successfully achieving compliance with all applicable regulations and remediation objectives;
    b. The proposed alternative technology will not adversely affect human health and safety or the environment;
    c. The owner or operator will obtain all Illinois EPA permits necessary to legally authorize use of the alternative technology;
    d. The owner or operator will implement a program to monitor whether the requirements of subsection (14)(a) have been met;
    e. Within one year from the date of Illinois EPA approval, the owner or operator will provide to the Illinois EPA monitoring program results establishing whether the proposed alternative technology will successfully achieve compliance with the requirements of subsection (14)(a); and
    f. Demonstration that the cost of alternative technology will not exceed the cost of conventional technology and is not substantially higher than at least two other alternative technologies, if available and technically feasible.

F. Exposure Pathway Exclusion

Provide the following:

1. A description of the tests to be performed in determining whether the following requirements will be met:
   a. Attenuation capacity of the soil will not be exceeded for any of the organic contaminants;
   b. Soil saturation limit will not be exceeded for any of the organic contaminants;
   c. Contaminated soils do not exhibit any of the reactivity characteristics of hazardous waste per 35 Ill. Adm. Code 721.123;
   d. Contaminated soils do not exhibit a pH $\leq$ 2.0 or $\geq$ 12.5; and
   e. Contaminated soils which contain arsenic, barium, cadmium, chromium, lead, mercury, or selenium (or their associated salts) do not exhibit any of the toxicity characteristics of hazardous waste per 35 Ill. Adm. Code 721.124.
2. A discussion of how any exposure pathways are to be excluded.

G. Signatures

All plans, budgets, and reports must be signed by the owner or operator and list the owner's or operator's full name, address, and telephone number.

UST Owner or Operator

Name Moto, Inc.
Contact Rob Whittington
Address 721 W. Main Street
City Belleville
State IL
Zip Code 62222
Phone 618-233-6754
Signature Rob Whittington (Agent)
Date 9/28/16

Consultant

Company CWM Company, Inc.
Contact Carol L. Rowe
Address 7001 W. South Grand Ave.
City Springfield
State IL
Zip Code 62704
Phone 217-522-8001
Signature
Date 10/3/2016

I certify under penalty of law that all activities that are the subject of this plan were conducted under my supervision or were conducted under the supervision of another Licensed Professional Engineer or Licensed Professional Geologist and reviewed by me; that this plan and all attachments were prepared under my supervision; that, to the best of my knowledge and belief, the work described in this plan has been completed in accordance with the Environmental Protection Act [415 ILCS 5], 35 Ill. Adm. Code 731, 732 or 734, and generally accepted standards and practices of my profession; and that the information presented is accurate and complete. I am aware there are significant penalties for submitting false statements or representations to the Illinois EPA, including but not limited to fines, imprisonment, or both as provided in Sections 44 and 57.17 of the Environmental Protection Act [415 ILCS 5/44 and 57.17].

Licensed Professional Engineer or Geologist

Name Vince E. Smith
Company CWM Company, Inc.
Address 701 W. South Grand Ave.
City Springfield
State IL
Zip Code 62704
Phone 217-522-8001
Ill. Registration No. 062-046118
License Expiration Date 11/30/17
Signature
Date 10/3/16

L.P.E. or L.P.G. Seal

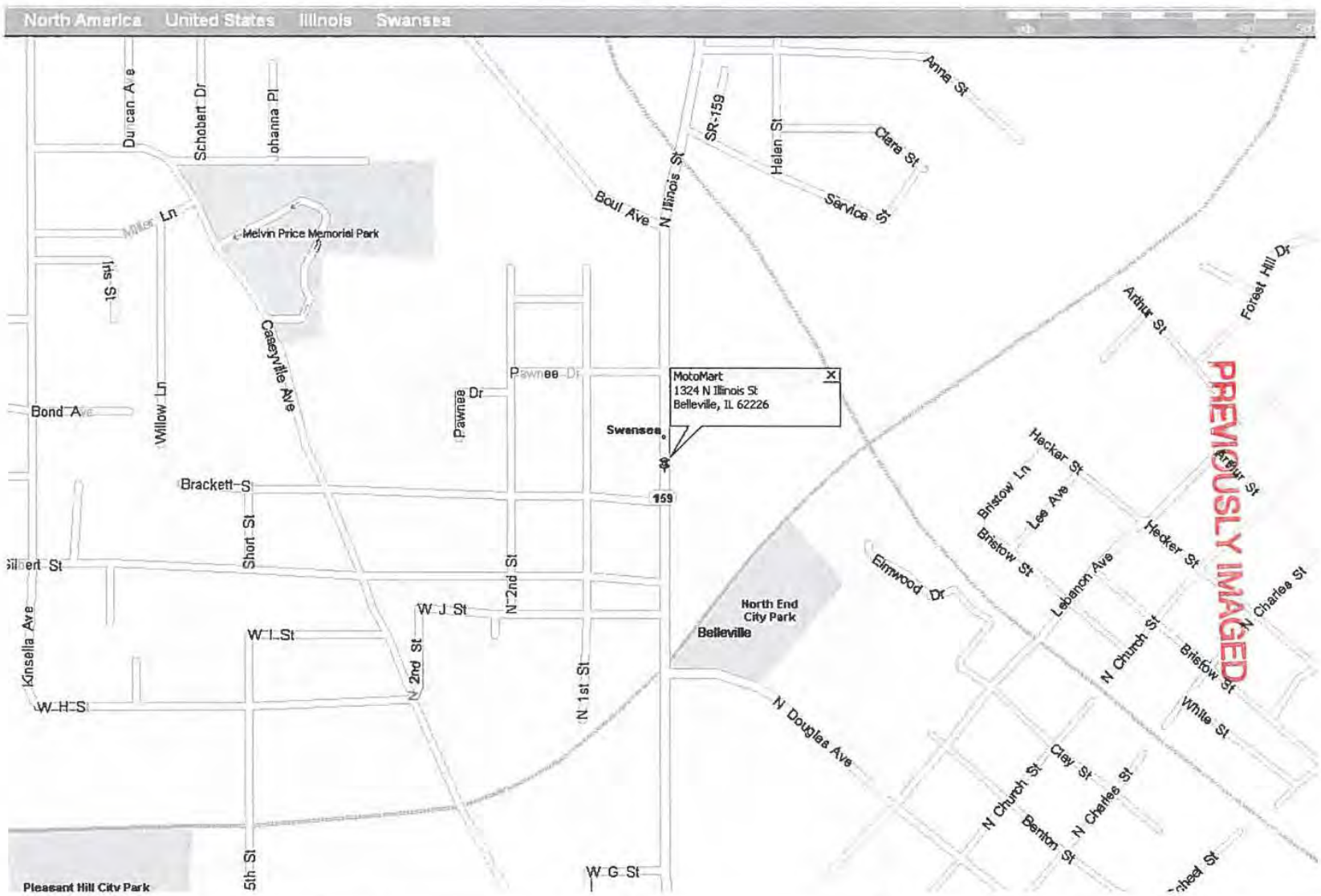
APPENDIX B

SITE MAPS AND ILLUSTRATIONS

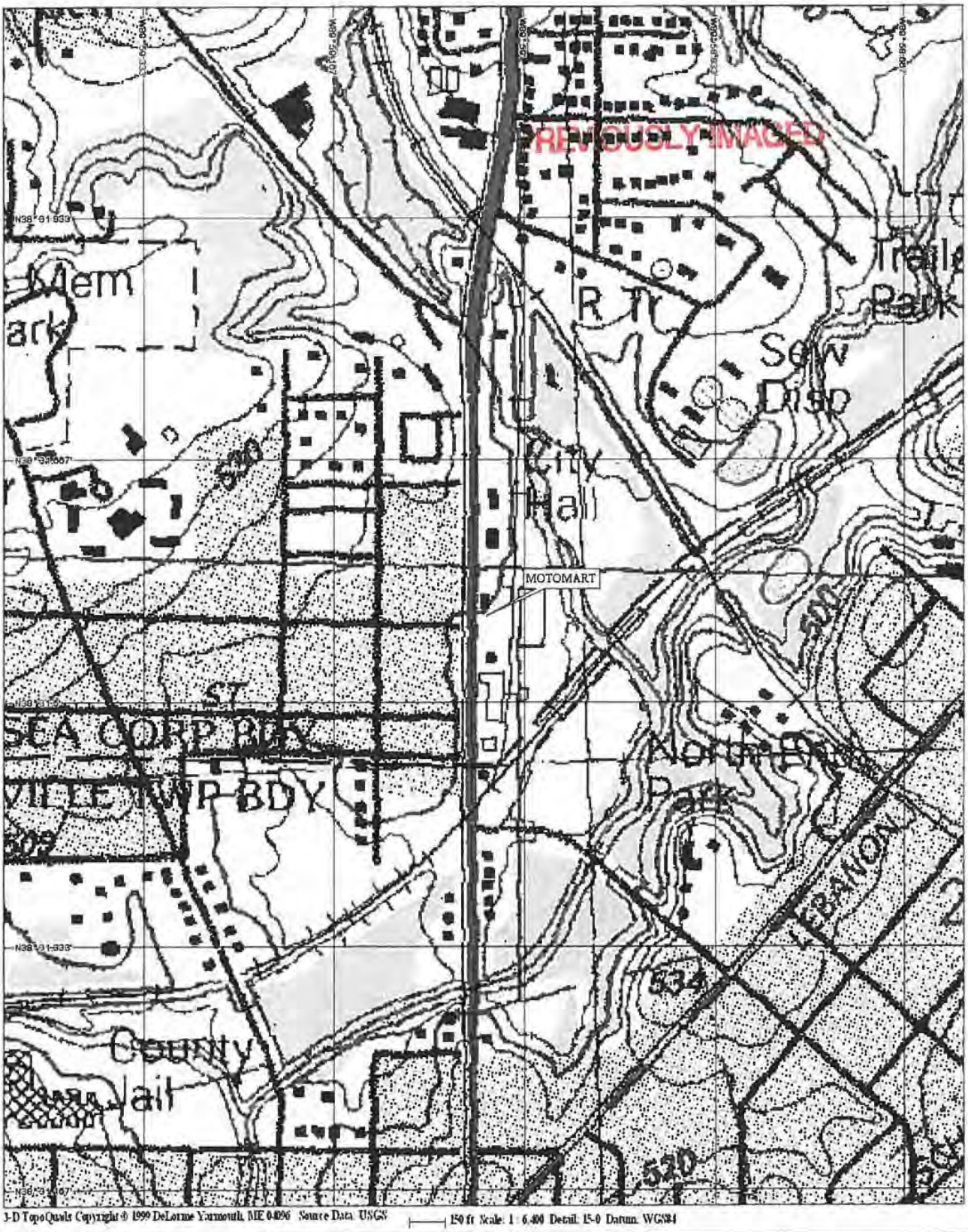
CORRECTIVE ACTION PLAN
MOTOMART
SWANSEA, ILLINOIS

INDEX OF DRAWINGS

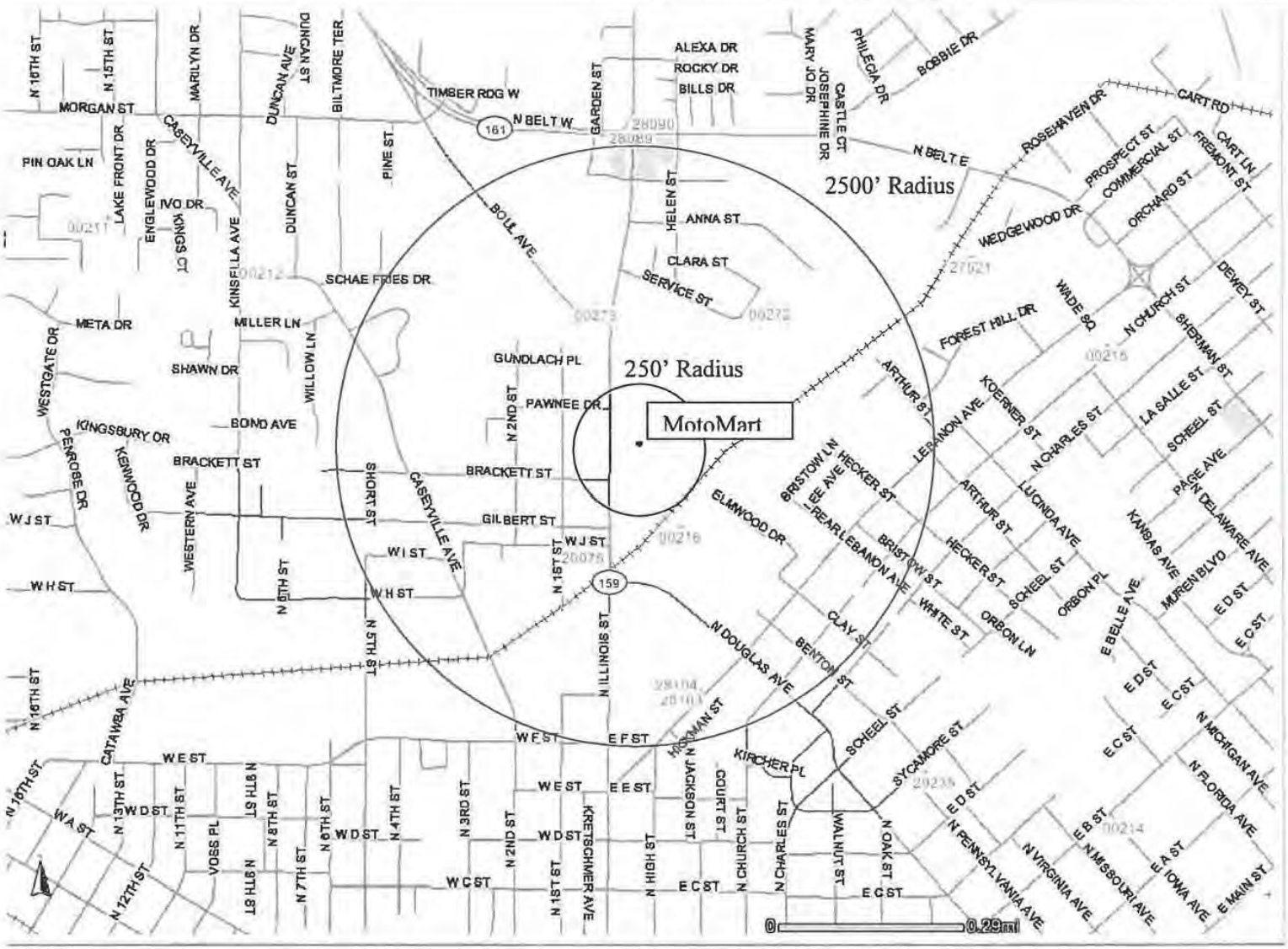
Drawing Number	Description	File Name
0001A	Site Location Map	SiteMap.doc
0001B	Topographic Map	TopoMap.doc
0001C	Well Survey Map	wells.doc
0002	Site Map	Site
0003	Soil Boring Location Map	SB Loc
0004	Monitoring Well Location Map	MW Loc
0005	Monitoring Well Elevation Map	MW Elev
0005A	Groundwater Elevation Map (October 2006)	GW 10-5-06
0005B	Groundwater Elevation Map (December 2008)	GW 12-2-08
0006A	Soil Contamination Values Map (0-5 Feet)	Soil Con 0-5
0006B	Soil Contamination Values Map (5-10 Feet)	Soil Con 5-10
0006C	Soil Contamination Values Map (10-15 Feet)	Soil Con 10-15
0007	Groundwater Contamination Values Map	GW Con
0008A	Soil Contamination Plume Map (0-5 Feet)	Soil Plume 0-5
0008B	Soil Contamination Plume Map (5-10 Feet)	Soil Plume 5-10
0008C	Soil Contamination Plume Map (10-15 Feet)	Soil Plume 10-15
0009	Groundwater Contamination Plume Map	GW Plume
0010	TACO Parameters Map	TACO
0011A	Modeled Soil Contamination Map	Modeled Soil
0011B	Modeled Groundwater Contamination Map	Modeled GW
0012	Soil Contamination Over Background Plume Map	Background



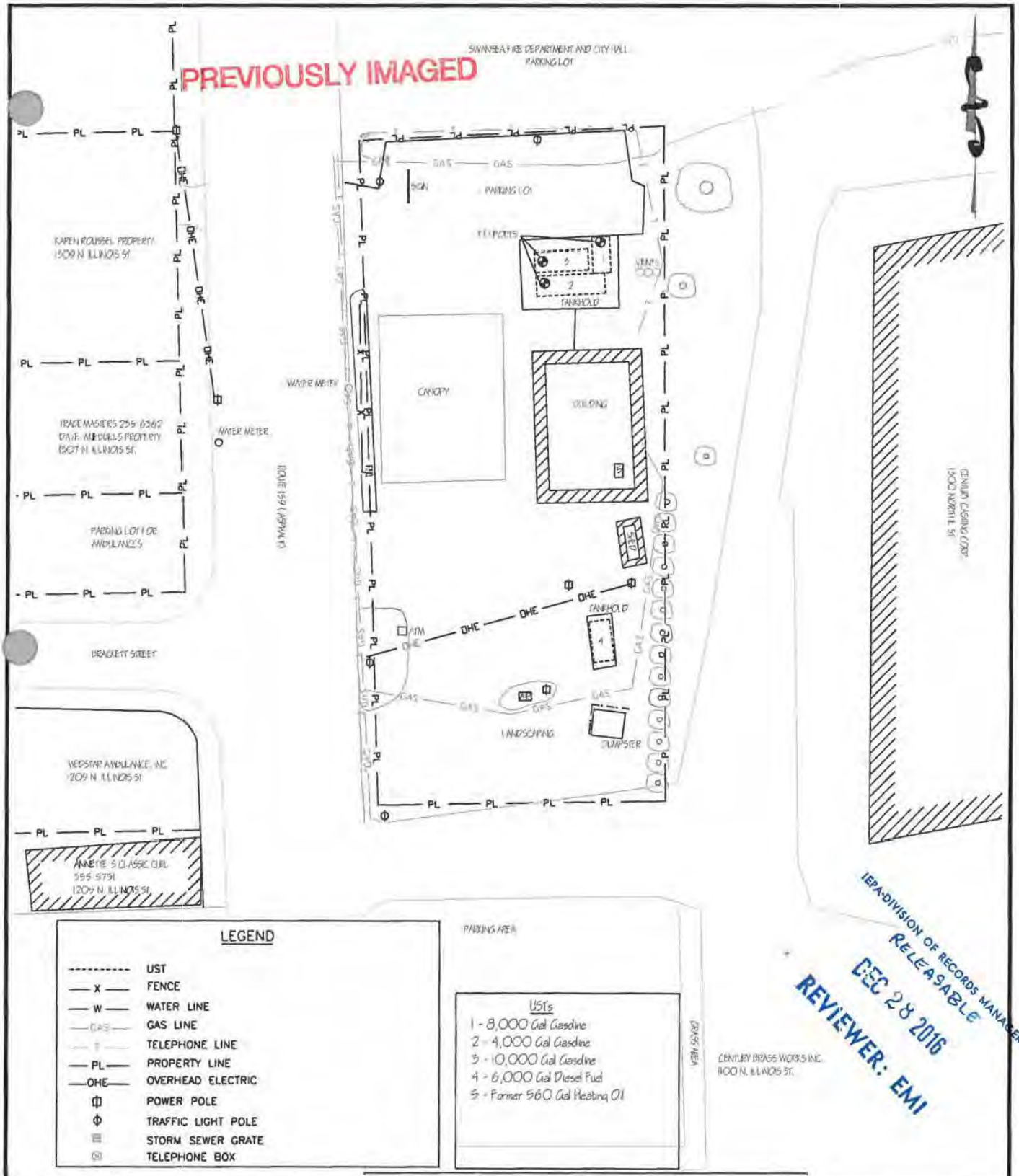
CW³M Company, Inc. 701 South Grand Avenue West Springfield, IL 62704 (217)-522-8001	**Site Location Map** 1324 North Illinois St. (Route 159) Swansea, Illinois	Drawn By: RCW Reviewed By: CLR Drawing.0001A SiteMap.doc



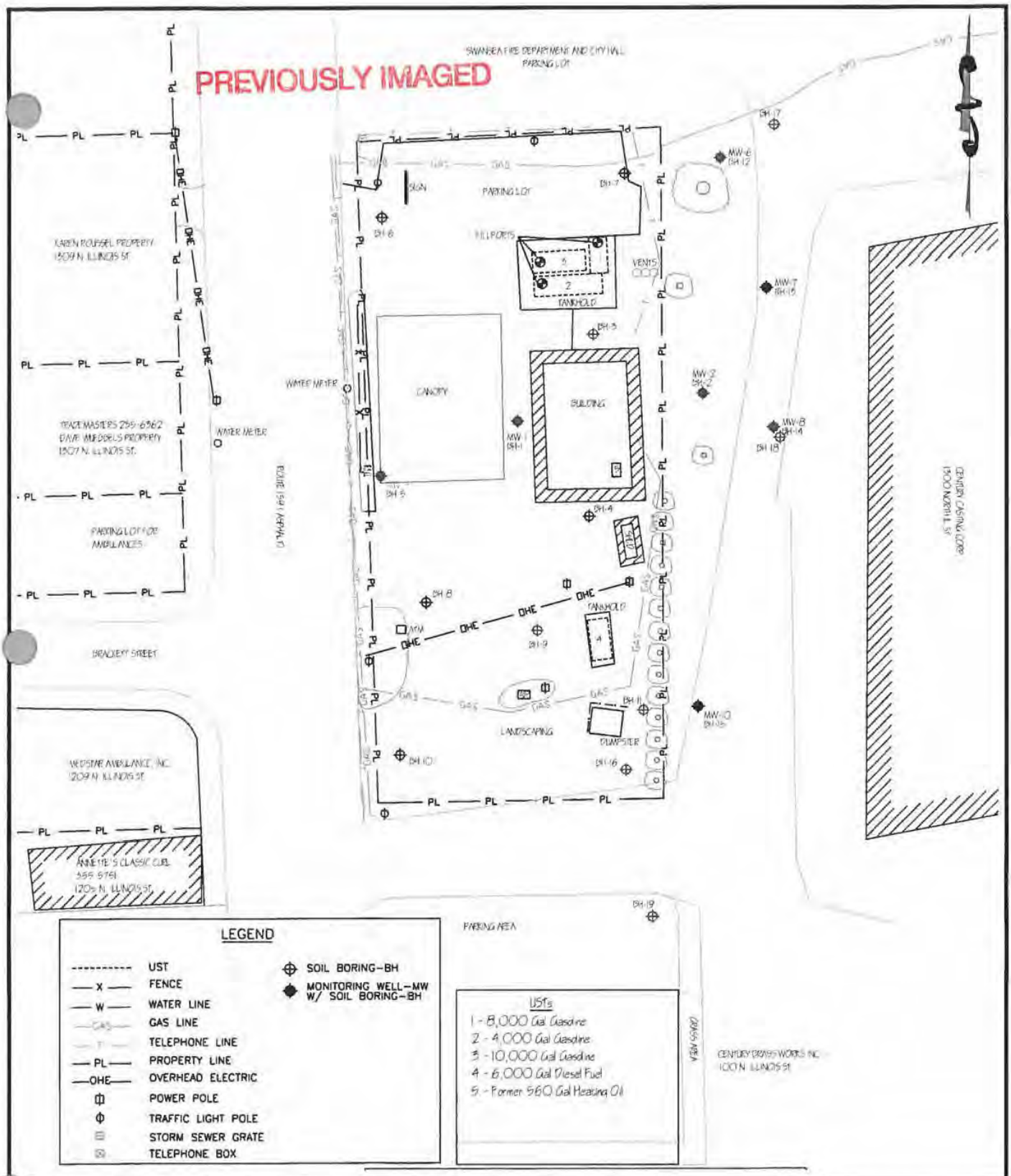
CW³M Company, Inc. 701 W. South Grand Ave. Springfield, IL 62704 (217) 522-8001	PREVIOUSLY IMAGED **Topographic Map** 1324 North Illinois St. (Route 159) Swansea, Illinois	Drawn By: RCW Reviewed By: CLR Drawing 0001B TopoMap.doc



CW³M Company, Inc. 701 South Grand Avenue West Springfield, IL 62704 (217)-522-8001	**Well Survey Map** 1324 North Illinois St. (Route 159) Swansea, Illinois	Drawn By: RCW Reviewed By: CLR Drawing 0001C wells.doc

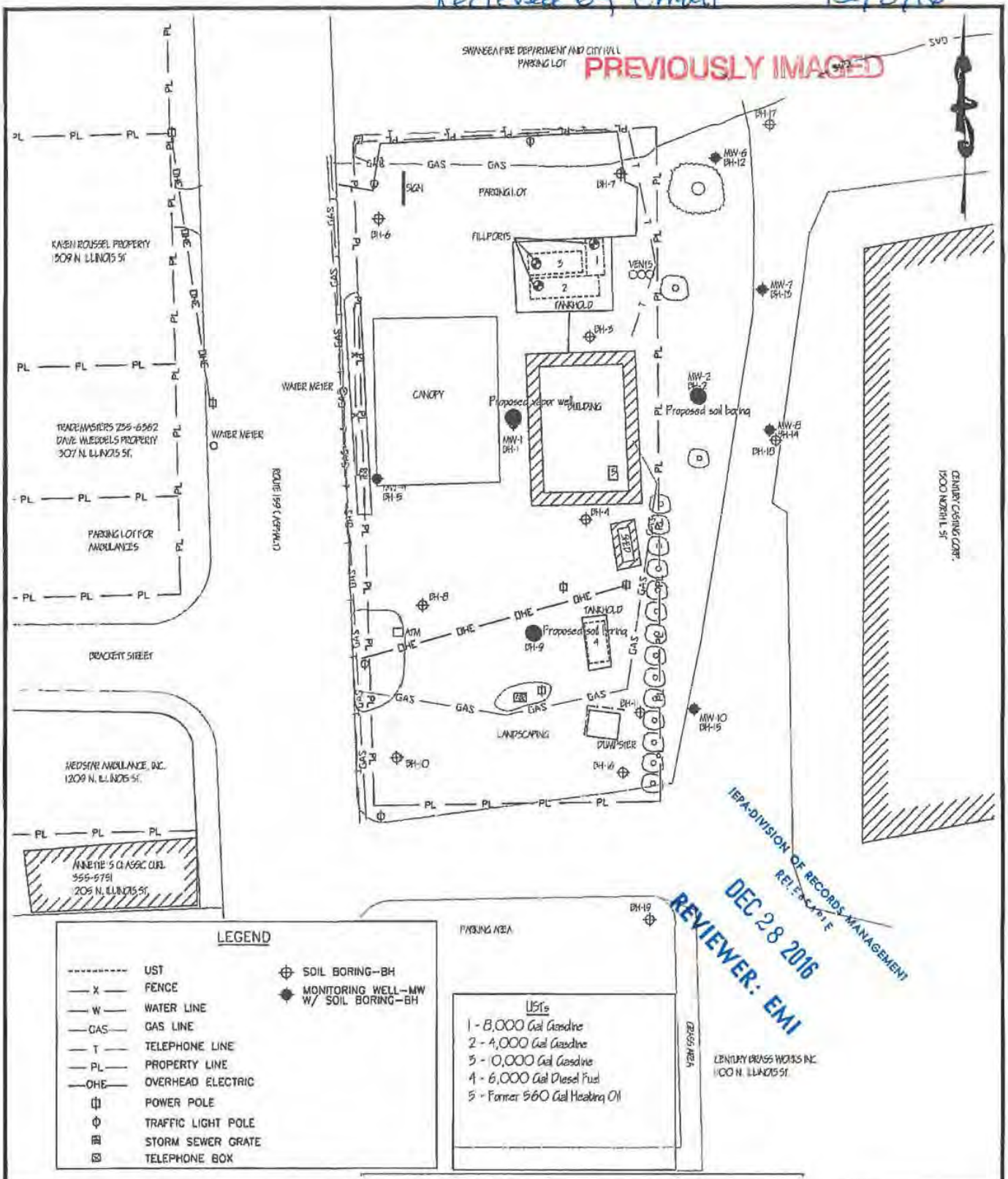


CWM COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	MOTOMART SWANSEA, ILLINOIS INCIDENT # 2002-0431 ST. CLAIR COUNTY	SITE MAP	SCALE: 1"=50' DATE: 3/24/12 REVISED DATE: 1/27/16 DRAWING: 0002	DRAWN BY: USI REVISED BY: VES REVIEW BY: CLR MotoMart.dwg Site

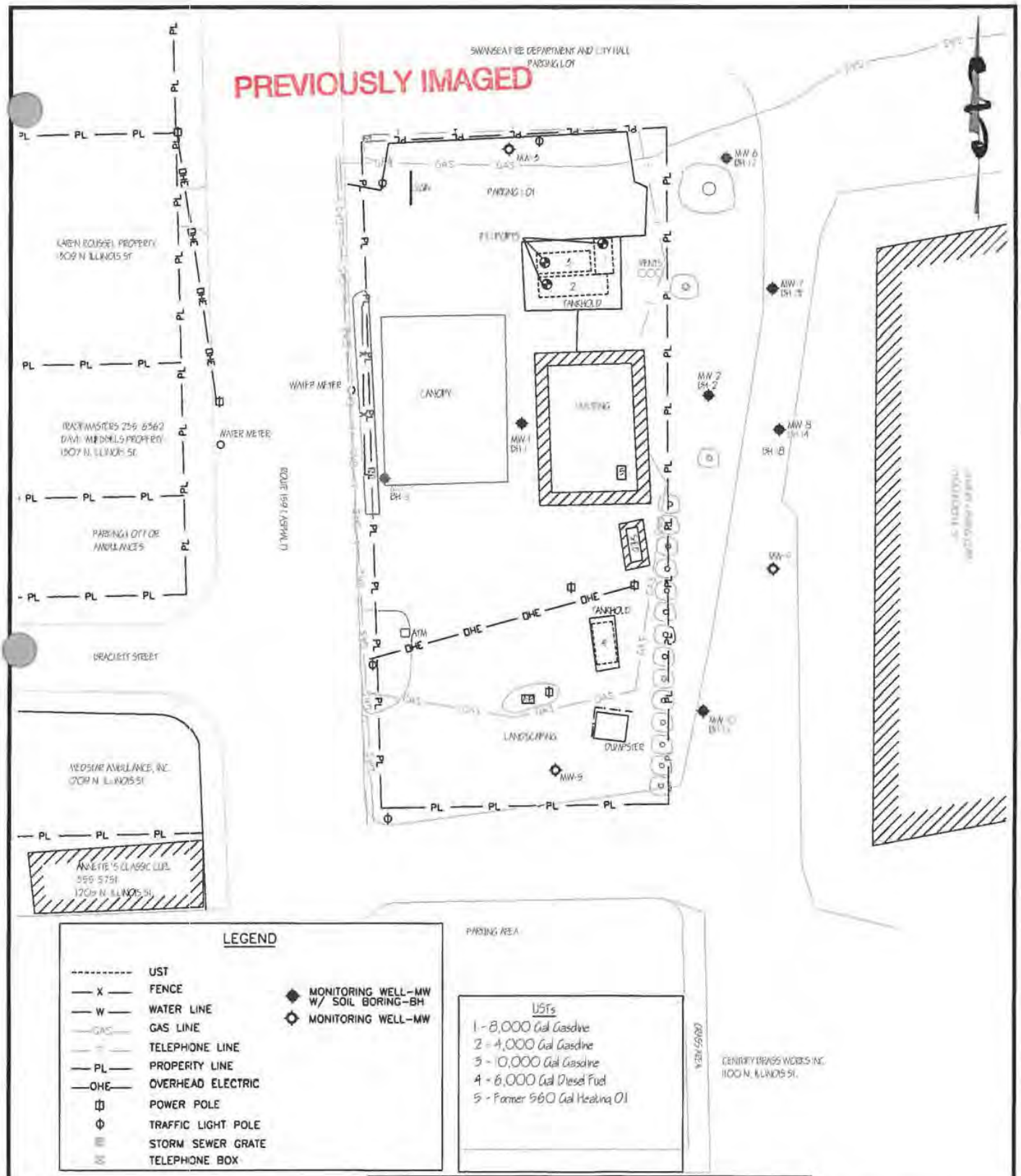


CWM COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	MOTOMART SWANSEA, ILLINOIS INCIDENT # 2002-0431 ST. CLAIR COUNTY	SOIL BORING LOCATION MAP	SCALE: 1"=50' DATE: 3/24/12 REVISED DATE: 1/27/16 DRAWING: 0003	DRAWN BY: USI REVISED BY: VES REVIEW BY: CLR MotoMart.dwg SB LOC

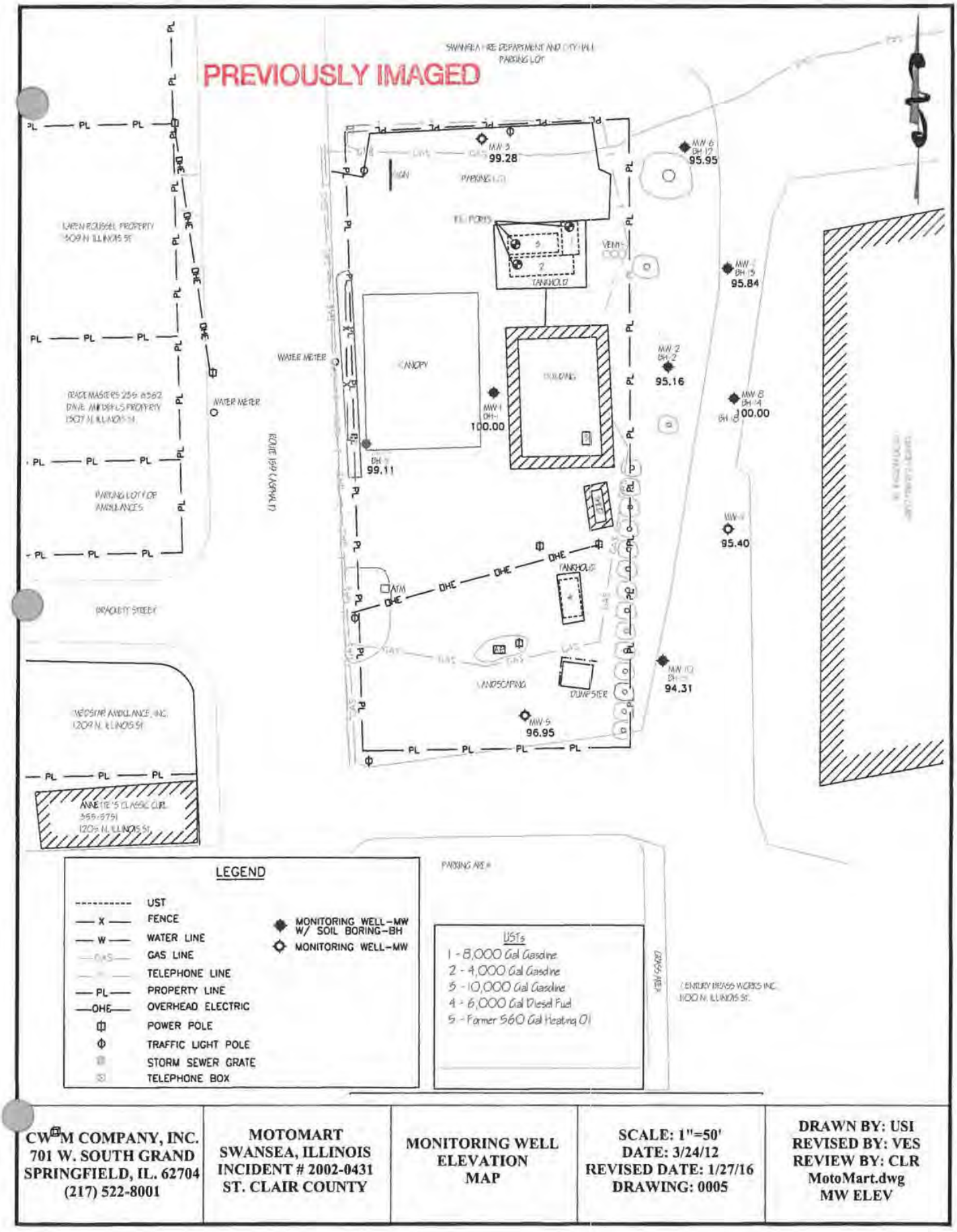
Recieved by email 12/8/16



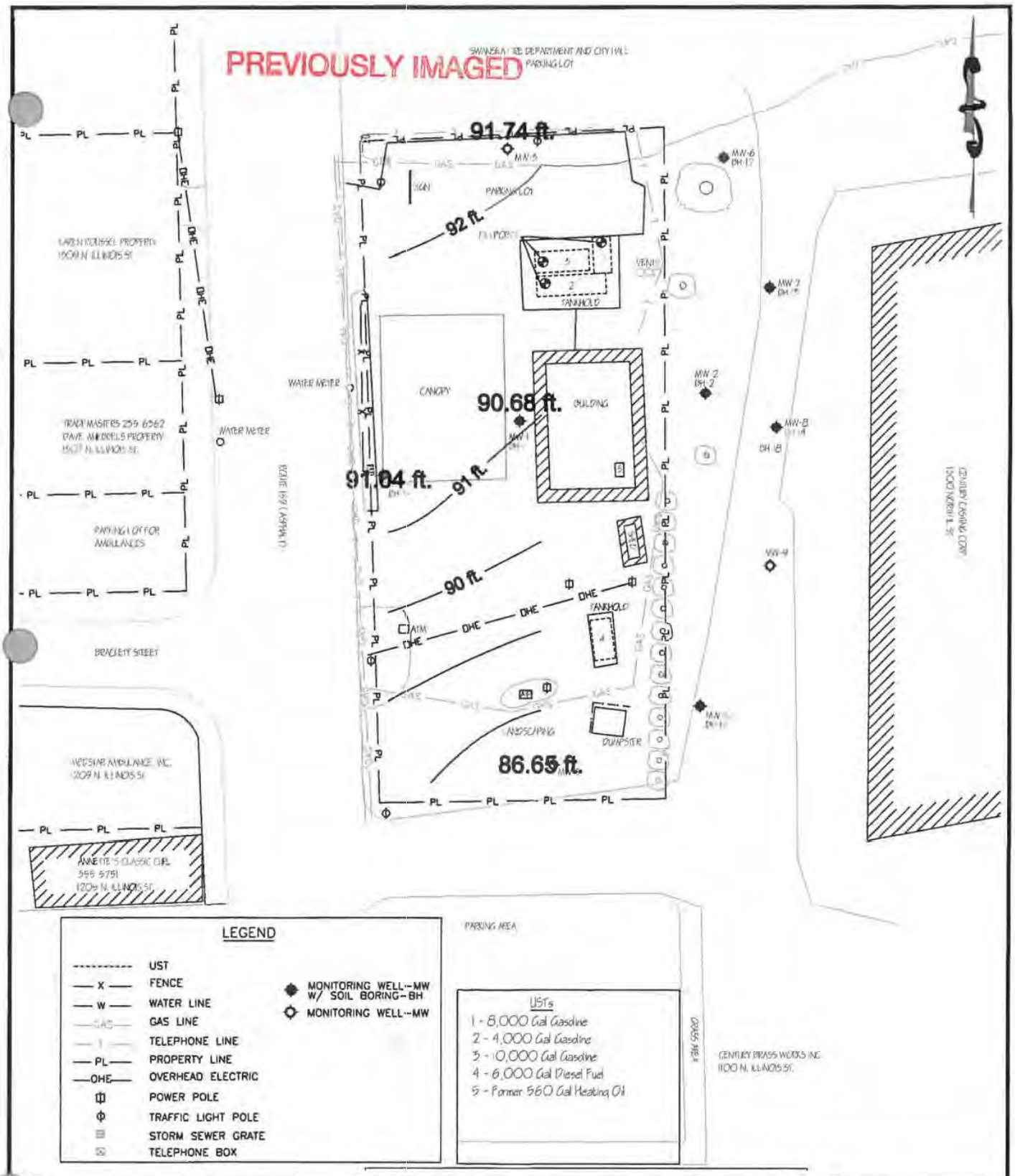
CWM COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	MOTOMART SWANSEA, ILLINOIS INCIDENT # 2002-0431 ST. CLAIR COUNTY	PROPOSED SOIL BORING LOCATION MAP	SCALE: 1"=50' DATE: 3/24/12 REVISED DATE: 12/8/16 DRAWING: 0003A	DRAWN BY: USI REVISED BY: VES REVIEW BY: CLR MotoMart.dwg PSB



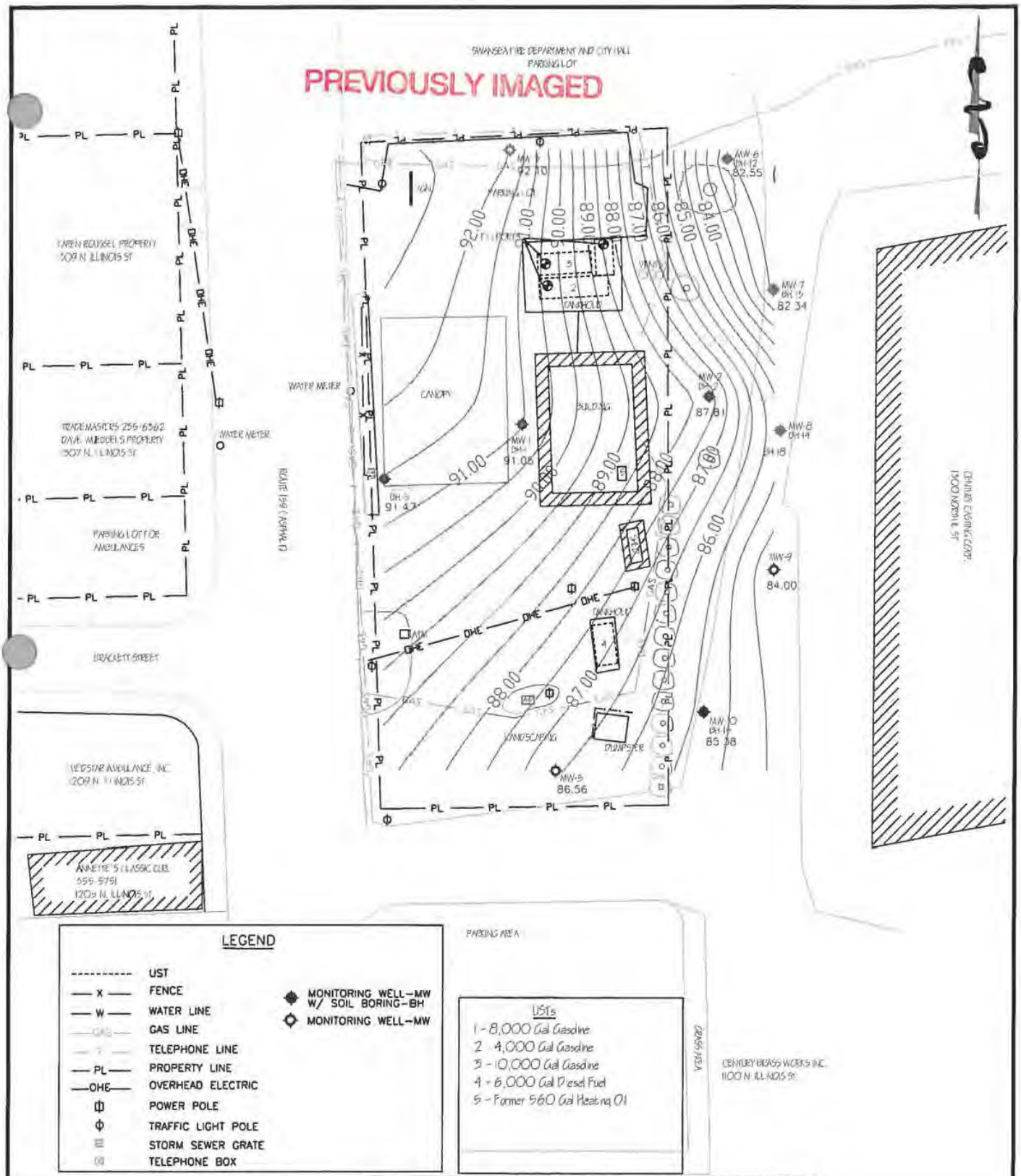
CWM COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	MOTOMART SWANSEA, ILLINOIS INCIDENT # 2002-0431 ST. CLAIR COUNTY	MONITORING WELL LOCATION MAP	SCALE: 1"=50' DATE: 3/24/12 REVISED DATE: 1/27/16 DRAWING: 0004	DRAWN BY: USI REVISED BY: VES REVIEW BY: CLR MotoMart.dwg MW LOC



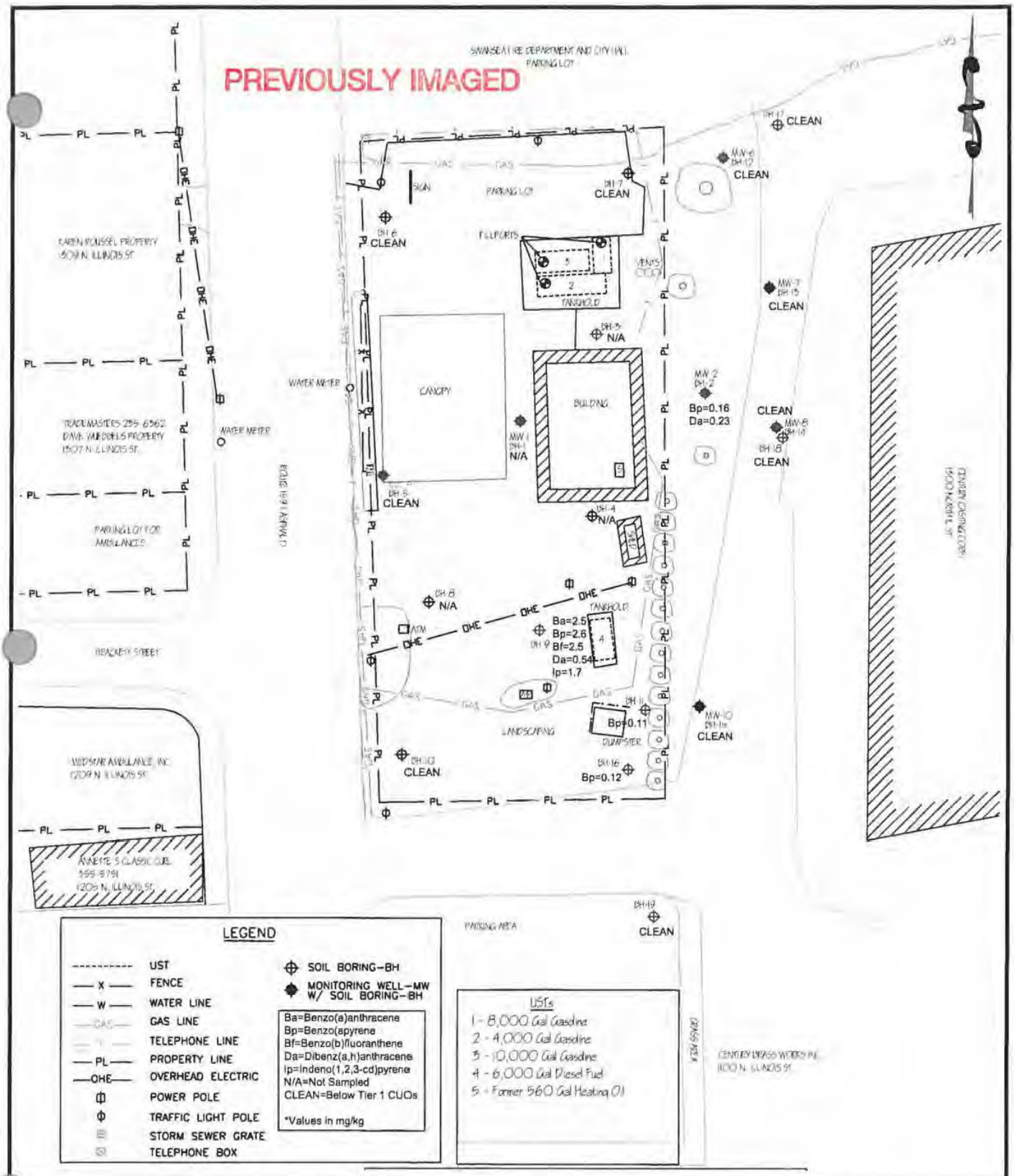
CWM COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	MOTOMART SWANSEA, ILLINOIS INCIDENT # 2002-0431 ST. CLAIR COUNTY	MONITORING WELL ELEVATION MAP	SCALE: 1"=50' DATE: 3/24/12 REVISED DATE: 1/27/16 DRAWING: 0005	DRAWN BY: USI REVISED BY: VES REVIEW BY: CLR MotoMart.dwg MW ELEV



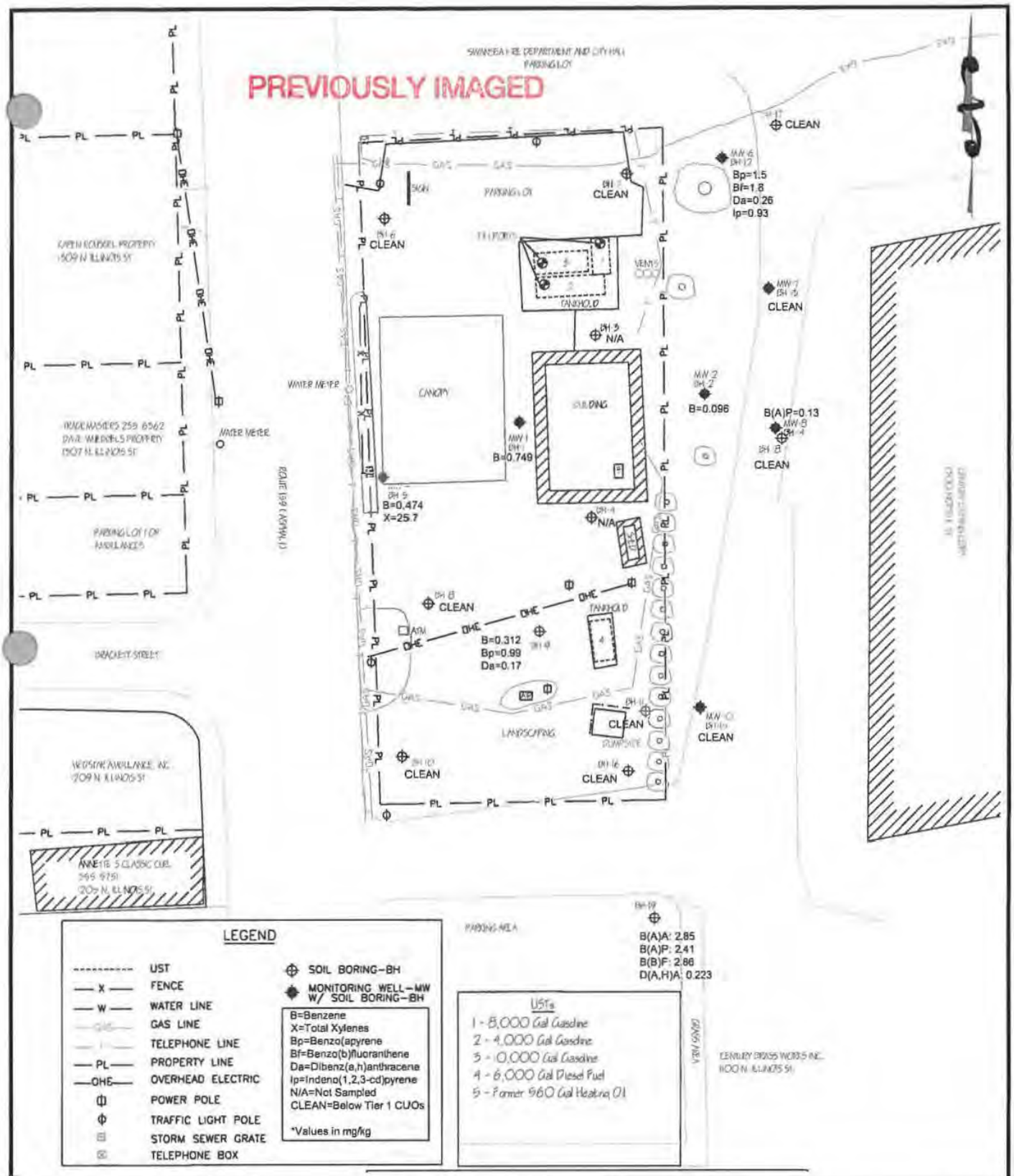
CWM COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	MOTOMART SWANSEA, ILLINOIS INCIDENT # 2002-0431 ST. CLAIR COUNTY	GROUNDWATER FLOW (OCTOBER 2006) MAP	SCALE: 1"=50' DATE: 3/24/12 REVISED DATE: 1/27/16 DRAWING: 0005A	DRAWN BY: USI REVISED BY: VES REVIEW BY: CLR MotoMart.dwg GW 10-5-06



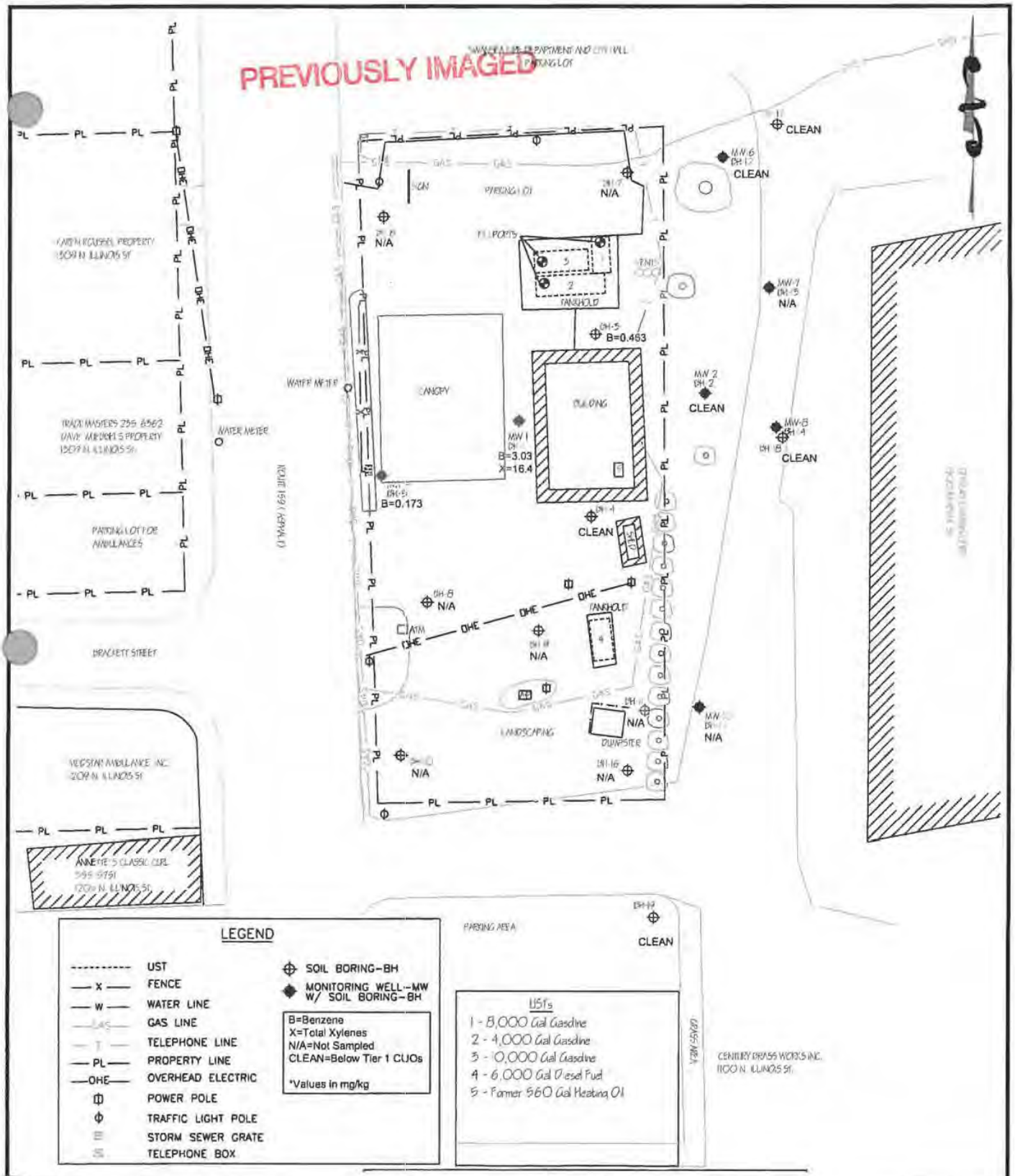
CW[illegible]M COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	MOTOMART SWANSEA, ILLINOIS INCIDENT # 2002-0431 ST. CLAIR COUNTY	GROUNDWATER FLOW (DECEMBER 2008) MAP	SCALE: 1"=50' DATE: 3/24/12 REVISED DATE: 1/27/16 DRAWING: 0005B	DRAWN BY: USI REVISED BY: VES REVIEW BY: CLR MotoMart.dwg GW 12-2-08



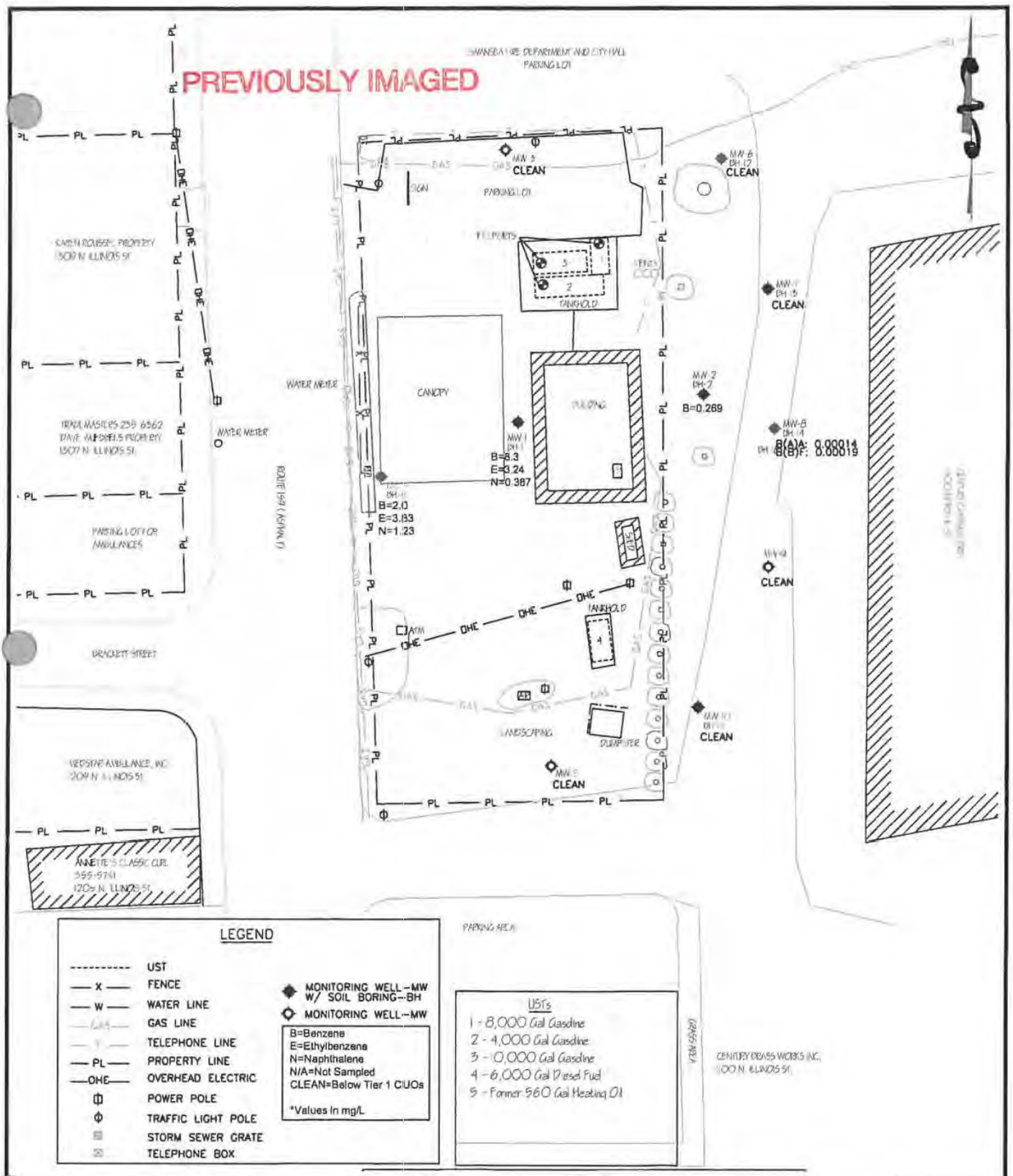
CWM COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	MOTOMART SWANSEA, ILLINOIS INCIDENT # 2002-0431 ST. CLAIR COUNTY	SOIL CONTAMINATION VALUES MAP (0-5 FEET)	SCALE: 1"=50' DATE: 3/24/12 REVISED DATE: 1/27/16 DRAWING: 0006A	DRAWN BY: USI REVISED BY: VES REVIEW BY: CLR MotoMart.dwg SOIL CON 0-5



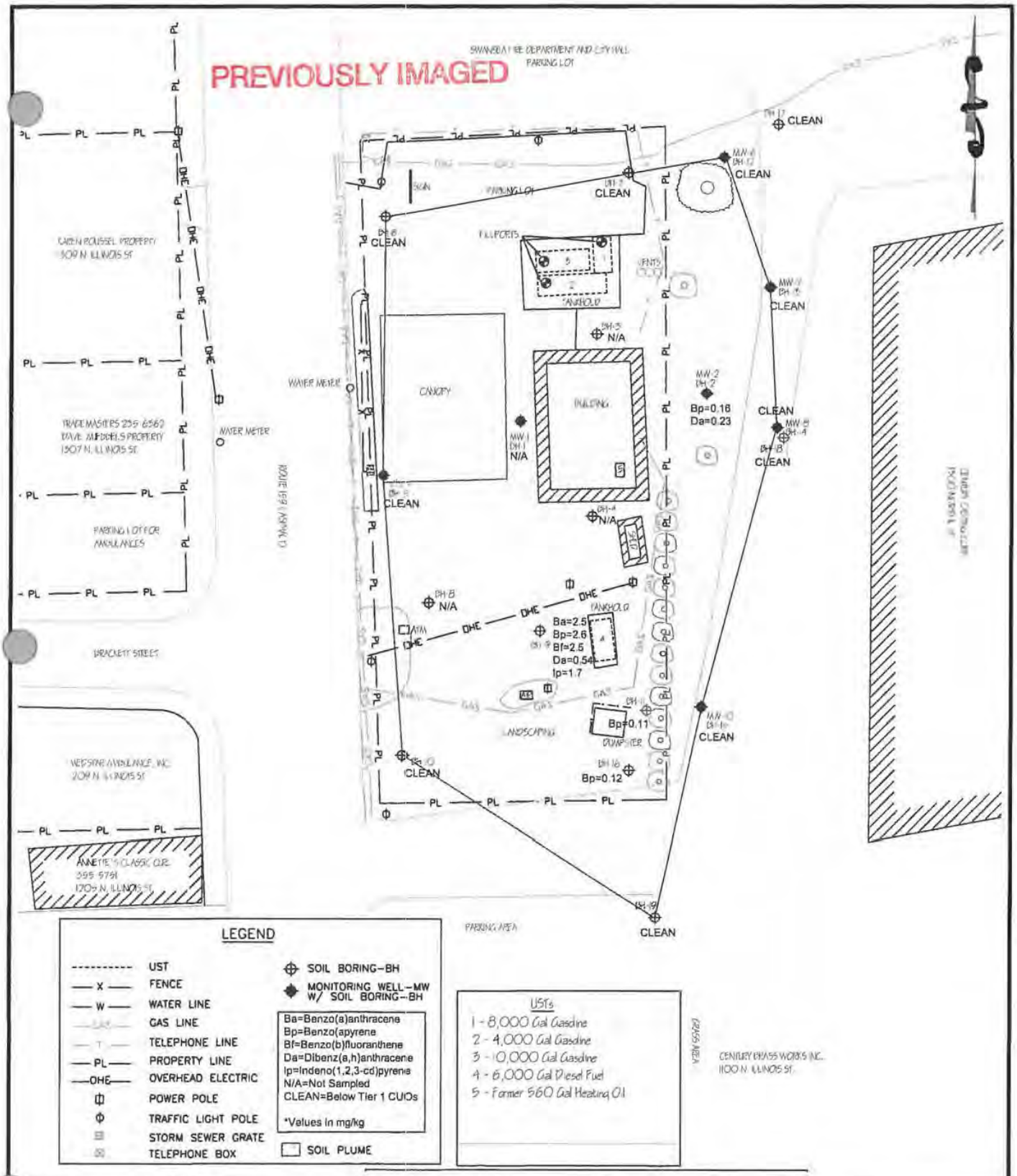
CW[4]M COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	MOTOMART SWANSEA, ILLINOIS INCIDENT # 2002-0431 ST. CLAIR COUNTY	SOIL CONTAMINATION VALUES MAP (5-10 FEET)	SCALE: 1"=50' DATE: 3/24/12 REVISED DATE: 1/27/16 DRAWING: 0006B	DRAWN BY: USI REVISED BY: VES REVIEW BY: CLR MotoMart.dwg SOIL CON 5-10



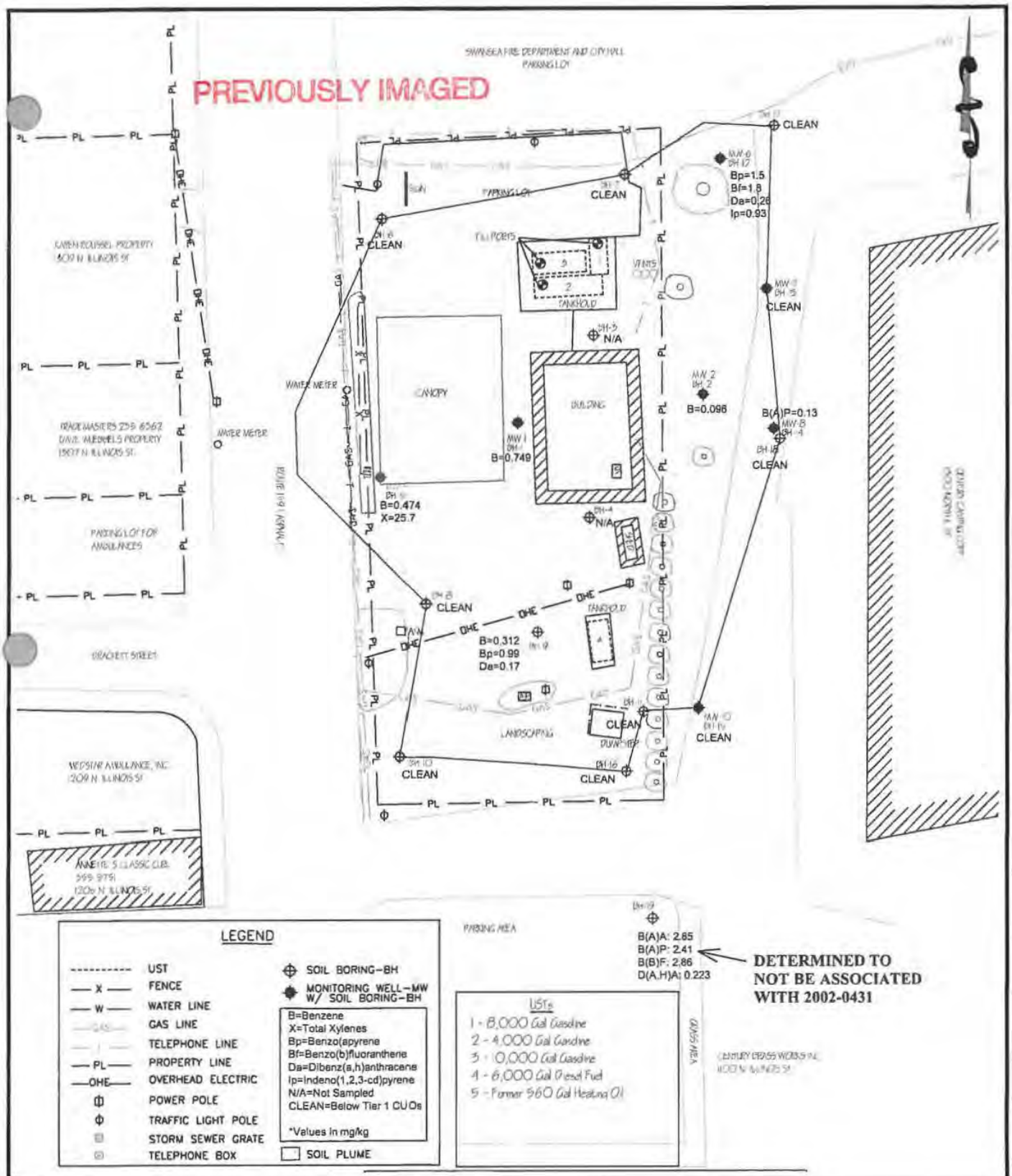
CWM COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	MOTO MART SWANSEA, ILLINOIS INCIDENT # 2002-0431 ST. CLAIR COUNTY	SOIL CONTAMINATION VALUES MAP (10-15 FEET)	SCALE: 1"=50' DATE: 3/24/12 REVISED DATE: 2/23/16 DRAWING: 0006C	DRAWN BY: USI REVISED BY: VES REVIEW BY: CLR MotoMart.dwg SOIL CON 10-15



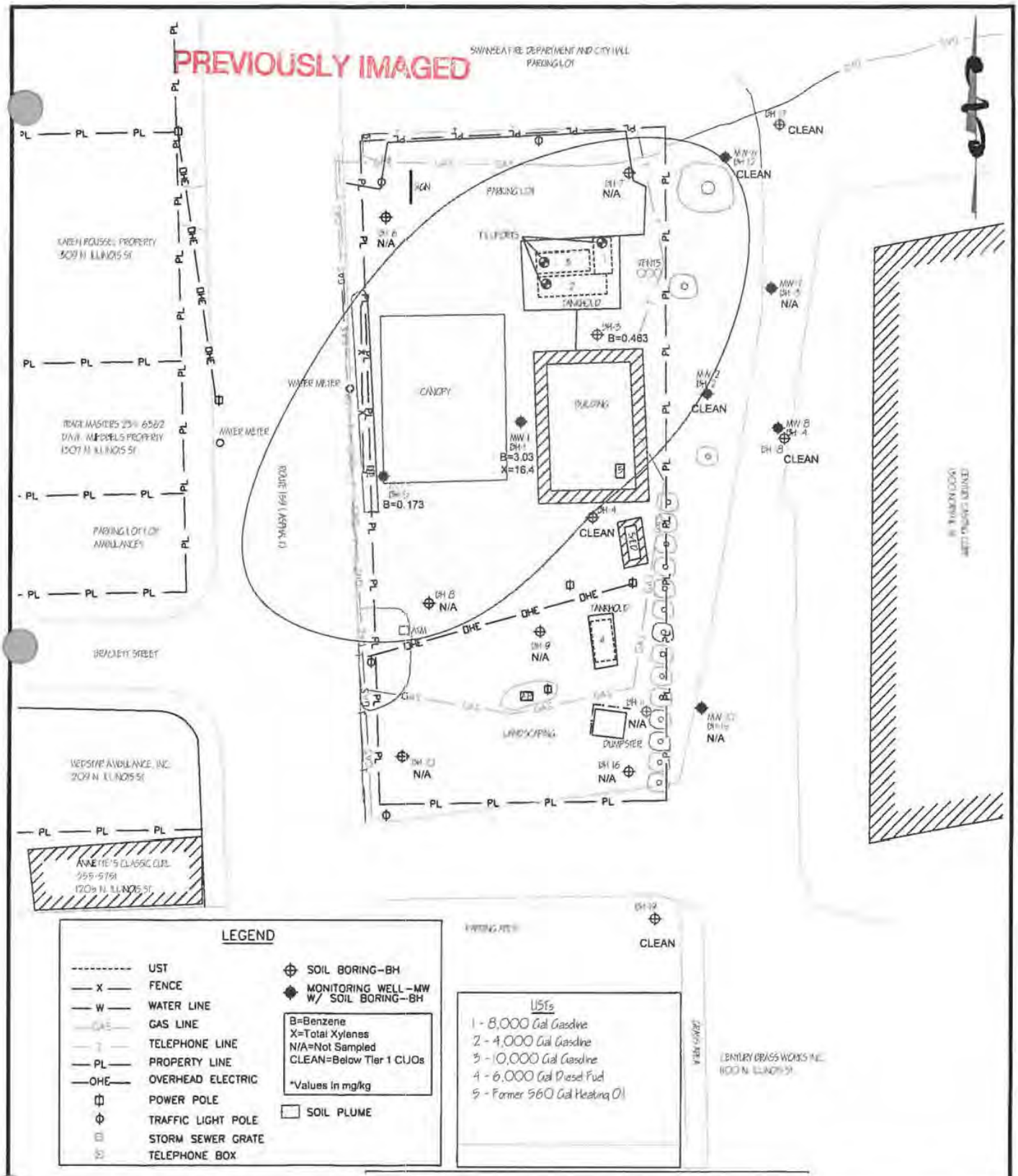
CW[M] COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	MOTOMART SWANSEA, ILLINOIS INCIDENT # 2002-0431 ST. CLAIR COUNTY	GROUNDWATER CONTAMINATION VALUES MAP	SCALE: 1"=50' DATE: 3/24/12 REVISED DATE: 1/27/16 DRAWING: 0007	DRAWN BY: USI REVISED BY: VES REVIEW BY: CLR MotoMart.dwg GW CON



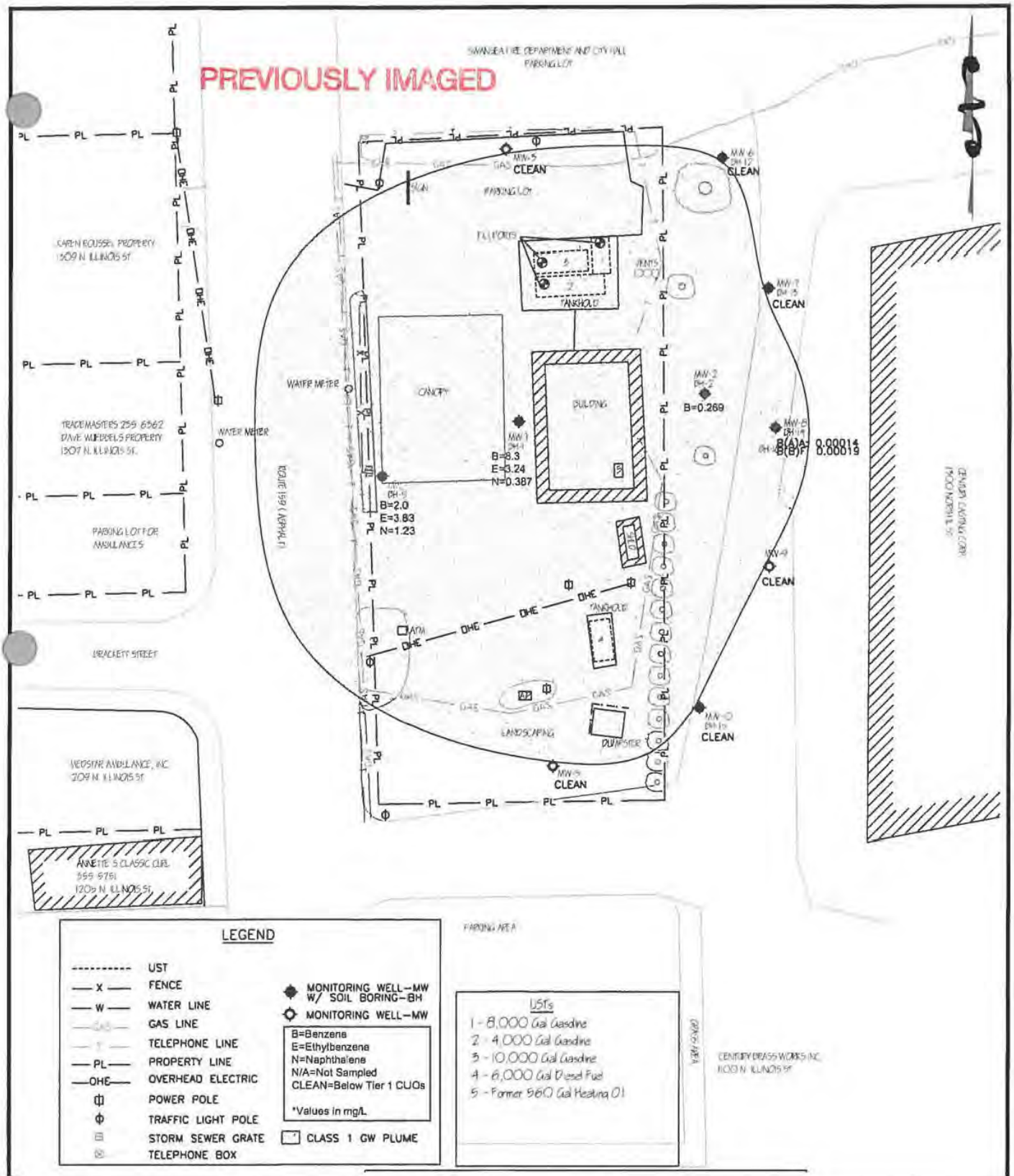
CW[illegible]M COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	MOTOMART SWANSEA, ILLINOIS INCIDENT # 2002-0431 ST. CLAIR COUNTY	SOIL CONTAMINATION PLUME MAP (0-5 FEET)	SCALE: 1"=50' DATE: 3/24/12 REVISED DATE: 1/27/16 DRAWING: 0008A	DRAWN BY: USI REVISED BY: VES REVIEW BY: CLR MotoMart.dwg SOIL PLUME 0-5



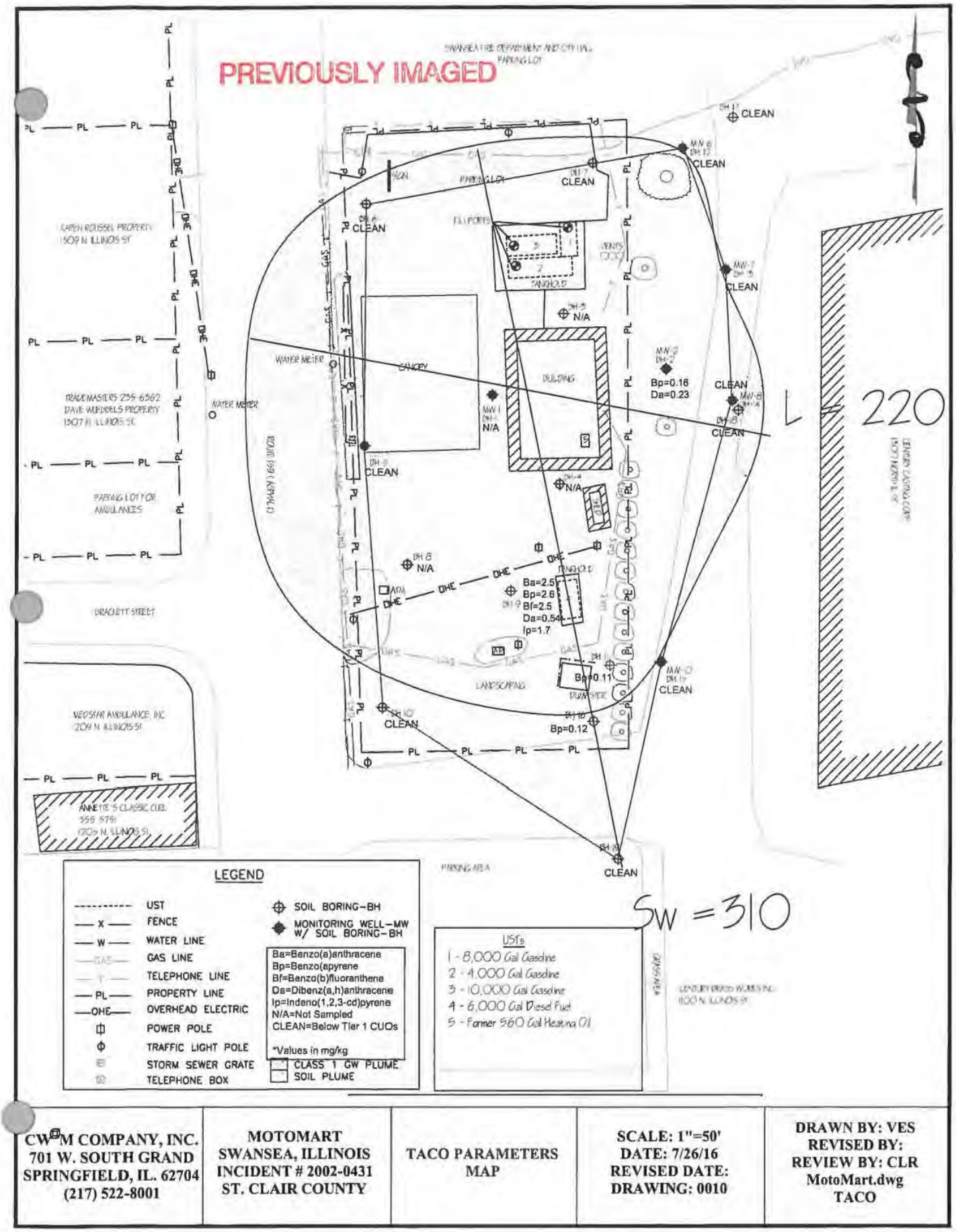
CWM COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	MOTOMART SWANSEA, ILLINOIS INCIDENT # 2002-0431 ST. CLAIR COUNTY	SOIL CONTAMINATION PLUME MAP (5-10 FEET)	SCALE: 1"=50' DATE: 3/24/12 REVISED DATE: 2/23/16 DRAWING: 0008B	DRAWN BY: USI REVISED BY: VES REVIEW BY: CLR MotoMart.dwg SOIL PLUME 5-10



CWM COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	MOTO MART SWANSEA, ILLINOIS INCIDENT # 2002-0431 ST. CLAIR COUNTY	SOIL CONTAMINATION PLUME MAP (10-15 FEET)	SCALE: 1"=50' DATE: 3/24/12 REVISED DATE: 1/27/16 DRAWING: 0008C	DRAWN BY: USI REVISED BY: RCW REVIEW BY: CLR MotoMart.dwg SOIL PLUME 10-15

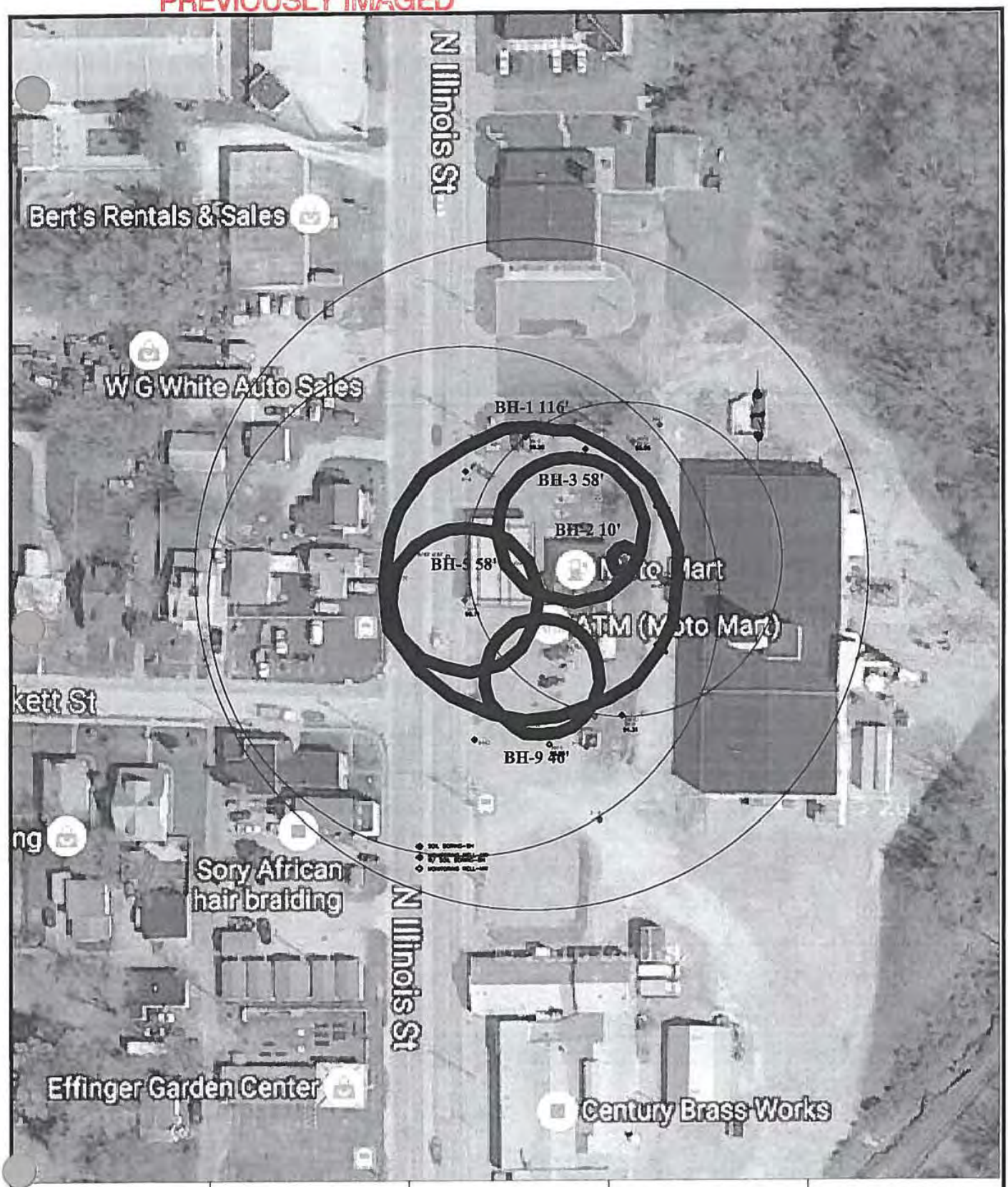


CW M COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	MOTOMART SWANSEA, ILLINOIS INCIDENT # 2002-0431 ST. CLAIR COUNTY	GROUNDWATER CONTAMINATION PLUME MAP	SCALE: 1"=50' DATE: 3/24/12 REVISED DATE: 1/27/16 DRAWING: 0009	DRAWN BY: USI REVISED BY: VES REVIEW BY: CLR MotoMart.dwg GW PLUME

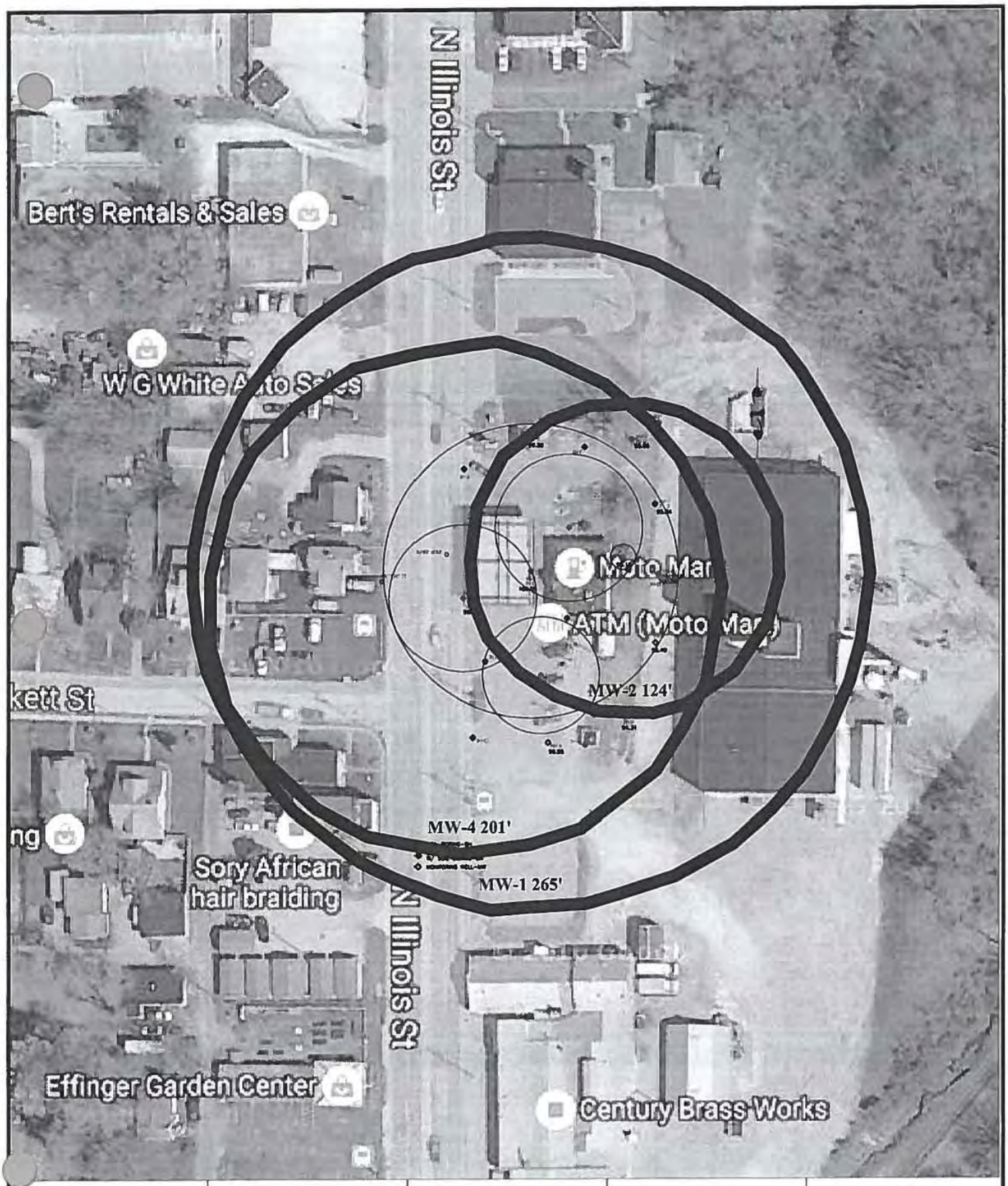


CWM COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	MOTOMART SWANSEA, ILLINOIS INCIDENT # 2002-0431 ST. CLAIR COUNTY	TACO PARAMETERS MAP	SCALE: 1"=50' DATE: 7/26/16 REVISED DATE: DRAWING: 0010	DRAWN BY: VES REVISED BY: REVIEW BY: CLR MotoMart.dwg TACO

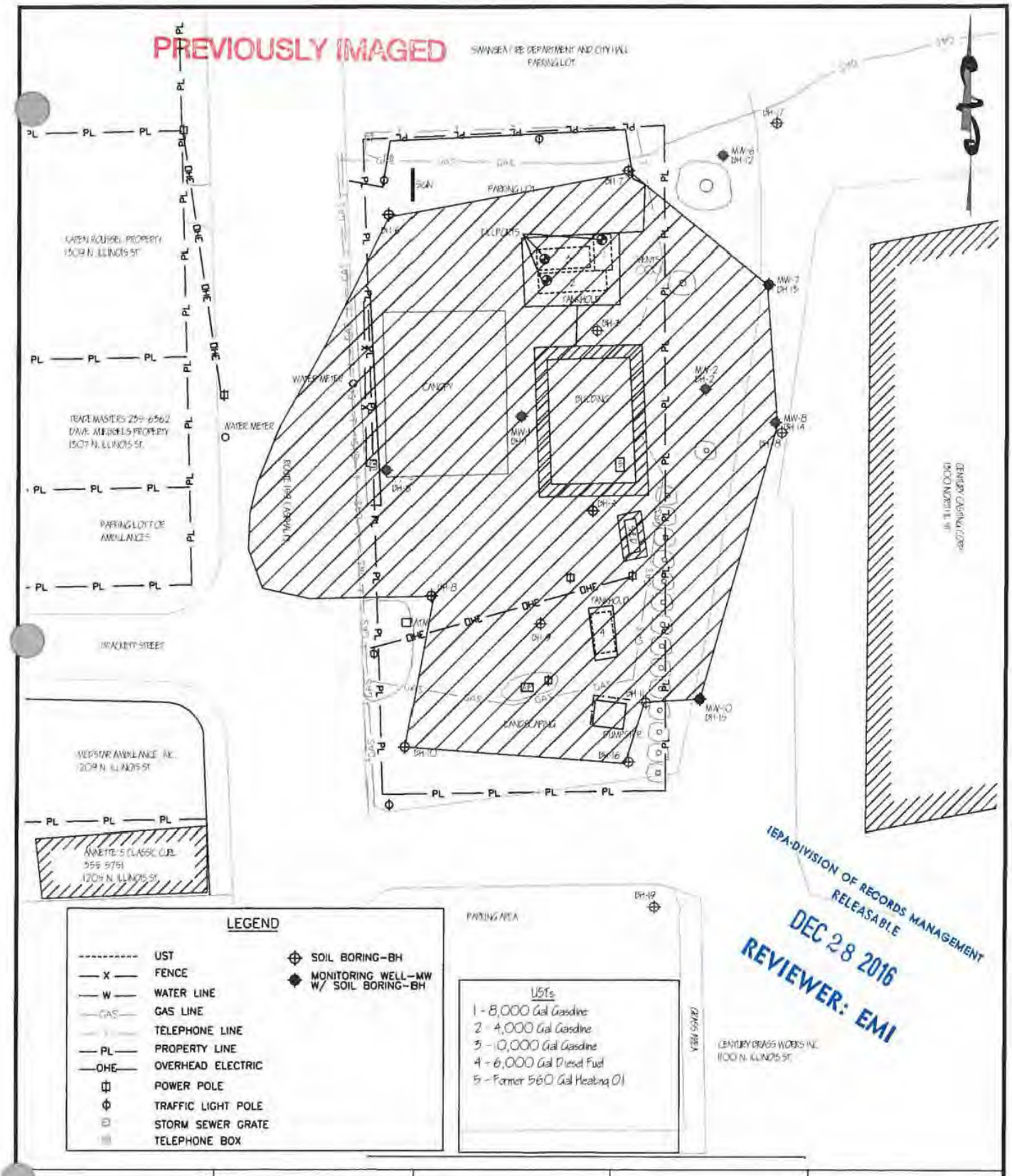
PREVIOUSLY IMAGED



CW[M] COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	MOTOMART SWANSEA, ILLINOIS INCIDENT # 2002-0431 ST. CLAIR COUNTY	MODELED SOIL CONTAMINATION MAP	SCALE: 1"=100' DATE: 7/27/16 REVISED DATE: DRAWING: 0011A	DRAWN BY: VES REVISED BY: REVIEW BY: CLR MotoMart.dwg MODELED SOIL



CW[R]M COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	MOTOMART SWANSEA, ILLINOIS INCIDENT # 2002-0431 ST. CLAIR COUNTY	MODELED GROUNDWATER CONTAMINATION MAP	SCALE: 1"=100' DATE: 7/27/16 REVISED DATE: DRAWING: 0011B	DRAWN BY: VES REVISED BY: REVIEW BY: CLR MotoMart.dwg MODELED GW



CW[M] COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	MOTOMART SWANSEA, ILLINOIS INCIDENT # 2002-0431 ST. CLAIR COUNTY	SOIL CONTAMINATION OVER BACKGROUND PLUME MAP	SCALE: 1"=50' DATE: 9/15/16 REVISED DATE: DRAWING: 0012	DRAWN BY: VES REVISED BY: REVIEW BY: CLR MotoMart.dwg BACKGROUND

APPENDIX C

OSFM ELIGIBILITY DETERMINATION

CORRECTIVE ACTION PLAN
MOTOMART
SWANSEA, ILLINOIS

1806032 JB

Office of the Illinois
State Fire Marshal
"Partnering With the Fire Service to Protect Illinois"

CERTIFIED MAIL - RECIPT REQUESTED #7006 2150 0004 2745 6290

December 22, 2006

Moto Mart, Inc.
721 W. Main Street
P.O. Box 122
Belleville, IL 62222-0122

In Re: Facility No. 6-011102
IEMA Incident No. 02-0431
Swansea Moto Mart
1324 N. Illinois Street
Swansea, St. Clair Co., IL

Dear Applicant:

The Reimbursement Eligibility and Deductible Application received on December 20, 2006 for the above referenced occurrence has been reviewed. The following determinations have been made based upon this review.

It has been determined that you are eligible to seek payment of costs in excess of $15,000. The costs must be in response to the occurrence referenced above and associated with the following tanks:

Eligible Tanks

Tank 5 560 gallon Heating Oil

You must contact the Illinois Environmental Protection Agency to receive a packet of Agency billing forms for submitting your request for payment.

An owner or operator is eligible to access the Underground Storage Tank Fund if the eligibility requirements are satisfied:

1. Neither the owner nor the operator is the United States Government,
2. The tank does not contain fuel which is exempt from the Motor Fuel Tax Law,
3. The costs were incurred as a result of a confirmed release of any of the following substances:

"Fuel", as defined in Section 1.19 of the Motor Fuel Tax Law

Aviation fuel

Heating oil

Kerosene

Used oil, which has been refined from crude oil used in a motor vehicle, as defined in Section 1.3 of the Motor Fuel Tax Law.

4. The owner or operator registered the tank and paid all fees in accordance with the statutory and regulatory requirements of the Gasoline Storage Act.

5. The owner or operator notified the Illinois Emergency Management Agency of a confirmed release, the costs were incurred after the notification and the costs were a result of a release of a substance listed in this Section. Costs of corrective action or indemnification incurred before providing that notification shall not be eligible for payment.

6. The costs have not already been paid to the owner or operator under a private insurance policy, other written agreement, or court order.

7. The costs were associated with "corrective action".

This constitutes the final decision as it relates to your eligibility and deductibility. We reserve the right to change the deductible determination should additional information that would change the determination become available. An underground storage tank owner or operator may appeal the decision to the Illinois Pollution Control Board (Board), pursuant to Section 57.9 (c) (2). An owner or operator who seeks to appeal the decision shall file a petition for a hearing before the Board within 35 days of the date of mailing of the final decision, (35 Illinois Administrative Code 105.102(a) (2)).

For information regarding the filing of an appeal, please contact:

Dorothy Gunn, Clerk
Illinois Pollution Control Board
State of Illinois Center
100 West Randolph, Suite 11-500
Chicago, Illinois 60601
(312) 814-3620

The following tanks are also listed for this site:

Tank 1 8,000 gallon Gasoline
Tank 2 4,000 gallon Gasoline
Tank 3 10,000 gallon Gasoline
Tank 4 6,000 gallon Diesel Fuel

Your application indicates that there has not been a release from these tanks under this incident number. You may be eligible to seek payment of corrective action costs associated with these tanks if it is determined that there has been a release from one or more of these tanks. Once it is determined that there has been a release from one or more of these tanks you may submit a separate application for an eligibility determination to seek corrective action costs associated with this/these tanks.

APPENDIX D

CORRECTIVE ACTION PLAN BUDGET AND CERTIFICATION

CORRECTIVE ACTION PLAN
MOTOMART
SWANSEA, ILLINOIS

Owner/Operator and Licensed Professional Engineer/Geologist Budget Certification Form

I hereby certify that I intend to seek payment from the UST Fund for costs incurred while performing corrective action activities for Leaking UST incident 2002-0431. I further certify that the costs set forth in this budget are for necessary activities and are reasonable and accurate to the best of my knowledge and belief. I also certify that the costs included in this budget are not for corrective action in excess of the minimum requirements of 415 ILCS 5/57, no costs are included in this budget that are not described in the corrective action plan, and no costs exceed Subpart H: Maximum Payment Amounts, Appendix D Sample Handling and Analysis amounts, and Appendix E Personnel Titles and Rates of 35 Ill. Adm. Code 732 or 734. I further certify that costs ineligible for payment from the Fund pursuant to 35 Ill. Adm. Code 732.606 or 734.630 are not included in the budget proposal or amendment. Such ineligible costs include but are not limited to:

Costs associated with ineligible tanks.
Costs associated with site restoration (e.g., pump islands, canopies).
Costs associated with utility replacement (e.g., sewers, electrical, telephone, etc.).
Costs incurred prior to IEMA notification.
Costs associated with planned tank pulls.
Legal fees or costs.
Costs incurred prior to July 28, 1989.
Costs associated with installation of new USTs or the repair of existing USTs.

Owner/Operator: Moto, Inc.

Authorized Representative: Rob Whittington Title: Environmental Manager

Signature: Rob Whittington (Agent) Date: 9/28/16

Subscribed and sworn to before me the 28th day of September 2016.

Helen M O'Dell
(Notary Public)

Seal: Official Seal
Helen M ODell
Notary Public, State of Illinois
St. Clair County
My Commission Expires June 20, 2017

In addition, I certify under penalty of law that all activities that are the subject of this plan, budget, or report were conducted under my supervision or were conducted under the supervision of another Licensed Professional Engineer or Licensed Professional Geologist and reviewed by me; that this plan, budget, or report and all attachments were prepared under my supervision; that, to the best of my knowledge and belief, the work described in the plan, budget, or report has been completed in accordance with the Environmental Protection Act [415 ILCS 5], 35 Ill. Adm. Code 732 or 734, and generally accepted standards and practices of my profession; and that the information presented is accurate and complete. I am aware there are significant penalties for submitting false statements or representations to the Illinois EPA, including but not limited to fines, imprisonment, or both as provided in Sections 44 and 57.17 of the Environmental Protection Act [415 ILCS 5/44 and 57.17].

L.P.E./L.P.G.: Vince E. Smith L.P.E./L.P.G. Seal:

L.P.E./L.P.G. Signature: Vince E. Smith Date: 10/3/16

Subscribed and sworn to before me the 3rd day of October 2016.

(Notary Public) Seal:

The Illinois EPA is authorized to require this information under 415 ILCS 5/1. Disclosure of this information is required. Failure to do so may result in the delay or denial of any budget or payment requested hereunder.

Illinois Environmental Protection Agency

Bureau of Land • 1021 N. Grand Avenue E. • P.O. Box 19276 • Springfield • Illinois • 62794-9276

General Information for the Budget and Billing Forms

LPC #: 1631405021 County: St. Clair

City: Swansea Site Name: MotoMart - Swansea

Site Address: 1324 North Illinois Street (Route 159

IEMA Incident No.: 2002-0431

IEMA Notification Date: Apr 3, 2002

Date this form was prepared: Sep 15, 2016

This form is being submitted as a (check one, if applicable):

- ☒ Budget Proposal
- ☐ Budget Amendment (Budget amendments must include only the costs over the previous budget.)
- ☐ Billing Package

Please provide the name(s) and date(s) of report(s) documenting the costs requested:

Name(s):

Date(s):

This package is being submitted for the site activities indicated below:

35 Ill. Adm. Code 734:

- ☐ Early Action
- ☐ Free Product Removal after Early Action
- ☐ Site Investigation . . . . . Stage 1: ☐ Stage 2: ☐ Stage 3: ☐
- ☒ Corrective Action Actual Costs

35 Ill. Adm. Code 732:

- ☐ Early Action
- ☐ Free Product Removal after Early Action
- ☐ Site Classification
- ☐ Low Priority Corrective Action
- ☐ High Priority Corrective Action

35 Ill. Adm. Code 731:

- ☐ Site Investigation
- ☐ Corrective Action

General Information for the Budget and Billing Forms

The following address will be used as the mailing address for checks and any final determination letters regarding payment from the Fund.

Pay to the order of: Moto, Inc.

Send in care of: CW M Company, Inc.

Address: P.O. Box 571

City: Carlinville State: IL Zip: 62626

The payee is the: Owner ☒ Operator ☐ (Check one or both.)

Signature of the owner or operator of the UST(s) (required)

W-9 must be submitted.
Click here to print off a W-9 Form.

Number of petroleum USTs in Illinois presently owned or operated by the owner or operator; any subsidiary, parent or joint stock company of the owner or operator; and any company owned by any parent, subsidiary or joint stock company of the owner or operator:

Fewer than 101: ☐ 101 or more: ☒

Number of USTs at the site: 5 (Number of USTs includes USTs presently at the site and USTs that have been removed.)

Number of incidents reported to IEMA for this site: 1

Incident Numbers assigned to the site due to releases from USTs: 2002-0431

Please list all tanks that have ever been located at the site and tanks that are presently located at the site.

Product Stored in UST	Size (gallons)	Did UST have a release?	Incident No.	Type of Release Tank Leak / Overfill / Piping Leak
Gasoline	10,000	Yes ☐ No ☒		
Gasoline	8,000	Yes ☐ No ☒		
Gasoline	4,000	Yes ☐ No ☒		
Diesel Fuel	6,000	Yes ☐ No ☒		
Heating Oil	560	Yes ☐ No ☐	2002-0431	Tank Leak
		Yes ☐ No ☐		
		Yes ☐ No ☐		
		Yes ☐ No ☐		
		Yes ☐ No ☐		

Add More Rows | Undo Last Add

Budget Summary

Choose the applicable regulation: (•) 734 ( ) 732

734	Free Product	Stage 1 Site Investigation	Stage 2 Site Investigation	Stage 3 Site Investigation	Corrective Action
					Proposed
Drilling and Monitoring Well Costs Form	$	$	$	$	$ 2,033.75
Analytical Costs Form	$	$	$	$	$ 1,661.72
Remediation and Disposal Costs Form	$	$	$	$	$
UST Removal and Abandonment Costs Form	$	$	$	$	$
Paving, Demolition, and Well Abandonment Costs Form	$	$	$	$	$ 2,191.00
Consulting Personnel Costs Form	$	$	$	$	$ 38,571.22
Consultant's Materials Costs Form	$	$	$	$	$ 1,492.50
Handling Charges Form	Handling charges will be determined at the time a billing package is submitted to the Illinois EPA. The amount of allowable handling charges will be determined in accordance with the Handling Charges Form.				
Total	$	$	$	$	$ 45,950.19

Drilling and Monitoring Well Costs Form

1. Drilling

Number of Borings to Be Drilled	Type HSA/PUSH/ Injection	Depth (feet) of Each Boring	Total Feet Drilled	Reason for Drilling
1	HSA	5.00	5.00	Vapor Intrusion Assessment
1	PUSH	15.00	15.00	Soil investigation
1	PUSH	10.00	10.00	Soil investigation

☒ Subpart H minimum payment amount applies.

	Total Feet	Rate per Foot ($)	Total Cost ($)
Total Feet via HSA:	5.00	28.79	143.95
Total Feet via PUSH:	25.00	22.53	563.25
Total Feet for Injection via PUSH:		18.59	
		Total Drilling Costs:	1,877.30

2. Monitoring / Recovery Wells

Number of Wells	Type of Well HSA / PUSH / 4" or 6" Recovery / 8" Recovery	Diameter of Well (inches)	Depth of Well (feet)	Total Feet of Wells to Be Installed ($)
1	4" or 6" Recovery	4.00	5.00	5.00

Well Installation	Total Feet	Rate per Foot ($)	Total Cost ($)
Total Feet via HSA:			
Total Feet via PUSH:			
Total Feet of 4" or 6" Recovery:	5.00	31.29	156.45
Total Feet of 8" or Greater Recovery:			
		Total Well Costs:	156.45

Total Drilling and Monitoring Well Costs:	$2,033.75

Analytical Costs Form

Laboratory Analysis	Number of Samples		Cost ($) per Analysis		Total per Parameter
Chemical Analysis					
BETX Soil with MTBE EPA 8260	4	X	106.38	=	$425.52
BETX Water with MTBE EPA 8260		X		=	
COD (Chemical Oxygen Demand)		X		=	
Corrosivity		X		=	
Flash Point or Ignitability Analysis EPA 1010		X		=	
Fraction Organic Carbon Content (f_{oc}) ASTM-D 2974-00		X		=	
Fat, Oil, & Grease (FOG)		X		=	
LUST Pollutants Soil - analysis must include volatile, base/ neutral, polynuclear aromatics and metals list in Section 732. Appendix B and 734.Appendix B		X		=	
Dissolved Oxygen (DO)		X		=	
Paint Filter (Free Liquids)		X		=	
PCB / Pesticides (combination)		X		=	
PCBs		X		=	
Pesticides		X		=	
pH		X		=	
Phenol		X		=	
Polynuclear Aromatics PNA, or PAH SOIL EPA 8270	4	X	190.24	=	$760.96
Polynuclear Aromatics PNA, or PAH WATER EPA 8270		X		=	
Reactivity		X		=	
SVOC - Soil (Semi-Volatile Organic Compounds)		X		=	
SVOC - Water (Semi-Volatile Organic Compounds)		X		=	
TKN (Total Kjeldahl) "nitrogen"		X		=	
TPH (Total Petroleum Hydrocarbons)		X		=	
VOC (Volatile Organic Compounds) - Soil (Non-Aqueous)		X		=	
VOC (Volatile Organic Compounds) - Water		X		=	
Vapor Intrusion Sampling	1	X	300.00	=	$300.00
		X		=	
		X		=	
		X		=	
		X		=	
Geo-Technical Analysis					
Soil Bulk Density (p_b) ASTM D2937-94		X		=	
Ex-situ Hydraulic Conductivity / Permeability		X		=	
Moisture Content (w) ASTM D2216-92 / D4643-93		X		=	
Porosity		X		=	
Rock Hydraulic Conductivity Ex-situ		X		=	
Sieve / Particle Size Analysis ASTM D422-63 / D1140-54		X		=	
Soil Classification ASTM D2488-90 / D2487-90		X		=	
Soil Particle Density (p_s) ASTM D854-92		X		=	
		X		=	
		X		=	
		X		=	

Analytical Costs Form

Metals Analysis					
Soil preparation fee for Metals TCLP Soil (one fee per soil sample)		X		=	
Soil preparation fee for Metals Total Soil (one fee per soil sample)		X		=	
Water preparation fee for Metals Water (one fee per water sample)		X		=	
Arsenic TCLP Soil		X		=	
Arsenic Total Soil		X		=	
Arsenic Water		X		=	
Barium TCLP Soil		X		=	
Barium Total Soil		X		=	
Barium Water		X		=	
Cadmium TCLP Soil		X		=	
Cadmium Total Soil		X		=	
Cadmium Water		X		=	
Chromium TCLP Soil		X		=	
Chromium Total Soil		X		=	
Chromium Water		X		=	
Cyanide TCLP Soil		X		=	
Cyanide Total Soil		X		=	
Cyanide Water		X		=	
Iron TCLP Soil		X		=	
Iron Total Soil		X		=	
Iron Water		X		=	
Lead TCLP Soil		X		=	
Lead Total Soil		X		=	
Lead Water		X		=	
Mercury TCLP Soil		X		=	
Mercury Total Soil		X		=	
Mercury Water		X		=	
Selenium TCLP Soil		X		=	
Selenium Total Soil		X		=	
Selenium Water		X		=	
Silver TCLP Soil		X		=	
Silver Total Soil		X		=	
Silver Water		X		=	
Metals TCLP Soil (a combination of all metals) RCRA		X		=	
Metals Total Soil (a combination of all metals) RCRA		X		=	
Metals Water (a combination of all metals) RCRA		X		=	
		X		=	
		X		=	
		X		=	
		X		=	
Other					
EnCore® Sampler, purge-and-trap sampler, or equivalent sampling device	4	X	12.52	=	$50.08
Sample Shipping per sampling event[1]	2	X	62.58	=	$125.16

[1]A sampling event, at a minimum, is all samples (soil and groundwater) collected in a calendar day.

Total Analytical Costs: $ 1,661.72

Paving, Demolition, and Well Abandonment Costs Form

A. Concrete and Asphalt Placement/Replacement

Number of Square Feet	Asphalt or Concrete	Thickness (inches)	Cost ($) per Square Foot	Replacement or Placement for an Engineered Barrier	Total Cost

Total Concrete and Asphalt Placement/Replacement Costs:	

B. Building Destruction or Dismantling and Canopy Removal

Item to Be Destroyed, Dismantled, or Removed	Unit Cost ($)	Total Cost ($)

Total Building Destruction or Dismantling and Canopy Removal Costs:	

Paving, Demolition, and Well Abandonment Costs Form

C. Well Abandonment

Monitoring Well ID #	Type of Well (HSA / PUSH / Recovery)	Depth of Well (feet)	Cost ($) per Foot	Total Cost
MW-1	HSA	20.00	12.52	$250.40
MW-2	HSA	20.00	12.52	$250.40
MW-3	HSA	15.00	12.52	$187.80
MW-4	HSA	20.00	12.52	$250.40
MW-5	HSA	20.00	12.52	$250.40
MW-6	HSA	20.00	12.52	$250.40
MW-7	HSA	15.00	12.52	$187.80
MW-8	HSA	15.00	12.52	$187.80
MW-9	HSA	15.00	12.52	$187.80
MW-10	HSA	15.00	12.52	$187.80

Total Monitoring Well Abandonment Costs:	**$2,191.00**

Total Paving, Demolition, and Well Abandonment Costs:	**$2,191.00**

Consulting Personnel Costs Form

Employee Name	Personnel Title	Hours	Rate* ($)	Total Cost
Remediation Category	**Task**			
	Senior Project Manager	6.00	125.15	$750.90
CCAP	Report Coordination / Technical Oversight / Compliance			
	Senior Prof. Engineer	3.00	162.70	$488.10
CCAP	Report Review and Certification			
	Engineer III	36.00	125.15	$4,505.40
CCAP	Corrective Action Design / Report Development / IEPA Correspondence			
	Senior Draftperson/CAD	6.00	75.08	$450.48
CCAP	Drafting and Editing Maps for Report			
	Senior Admin. Assistant	2.00	56.32	$112.64
CCAP	Report Compilation, Assembly, and Distribution			
	Engineer III	8.00	125.15	$1,001.20
TACO 2 or 3	TACO GW Modeling / Plume Delineation			
	Engineer III	12.00	125.15	$1,501.80
TACO 2 or 3	TACO Tier 2 Calculations / Development of CUOs			
	Senior Project Manager	4.00	125.15	$500.60
TACO 2 or 3	TACO Tier 2 Evaluation / Calculation / Modeling Review / Assessment of Analytical			

Employee Name	Personnel Title	Hours	Rate* ($)	Total Cost
Remediation Category	**Task**			
	Senior Project Manager	6.00	125.15	$750.90
CCAP-Budget	Budget Compliance / Technical Oversight			
	Engineer III	18.00	125.15	$2,252.70
CCAP-Budget	Budget Calculations / Design			
	Senior Prof. Engineer	3.00	162.70	$488.10
CCAP-Budget	Budget Review & Certification			
	Senior Admin. Assistant	2.00	56.32	$112.64
CCAP-Budget	Budget Compilation, Assembly, and Distribution			
	Senior Prof. Engineer	6.00	162.70	$976.20
CA-Pay	Reimbursement Review and Certification (CAP, Drilling, Closure Submittals)			
	Senior Acct. Technician	30.00	68.83	$2,064.90
CA-Pay	Reimbursement Preparation (CAP, Drilling, Closure Submittals)			
	Senior Admin. Assistant	4.00	56.32	$225.28
CA-Pay	Reimbursement Compilation, Assembly, and Distribution (CAP, Drilling, Closure Submittals)			
	Senior Project Manager	12.00	125.15	$1,501.80
CA-Pay	Reimbursement Compliance / Technical Oversight (CAP, Drilling, Closure Submittals)			

Employee Name	Personnel Title	Hours	Rate* ($)	Total Cost
Remediation Category	**Task**			
	Senior Project Manager	8.00	125.15	$1,001.20
CACR	Report Coordination / Technical Oversight / Compliance			
	Senior Prof. Engineer	4.00	162.70	$650.80
CACR	Report Review and Certification			
	Senior Admin. Assistant	2.00	56.32	$112.64
CACR	Report Compilation, Assembly, and Distribution			
	Engineer III	36.00	125.15	$4,505.40
CACR	Report Preparation / Development			
	Senior Admin. Assistant	2.00	56.32	$112.64
CACR	NFR Recording / Correspondence with Village / Sending Fee			
	Senior Project Manager	2.00	125.15	$250.30
CACR	NFR Review / IEPA Correspondence			

Employee Name	Personnel Title	Hours	Rate* ($)	Total Cost
Remediation Category	**Task**			
	Engineer III	24.00	125.15	$3,003.60
ELUC	Groundwater Ordinance Development / Meetings with City, Ordinance Notifications			
	Senior Project Manager	6.00	125.15	$750.90
ELUC	Groundwater Ordinance Negotiation Correspondence and Notifications			
	Senior Admin. Assistant	2.00	56.32	$112.64
ELUC	Groundwater Ordinance Correspondence / Notifications			
	Senior Project Manager	6.00	125.15	$750.90
HAA	HAA IDOT Review / Coordination			
	Engineer III	24.00	125.15	$3,003.60
HAA	HAA IDOT Development / Correspondence			
	Senior Draftperson/CAD	4.00	75.08	$300.32
HAA	HAA Drawings			
	Senior Admin. Assistant	2.00	56.32	$112.64
HAA	HAA Compilation, Assembly, and Distribution			

Employee Name	Personnel Title	Hours	Rate* ($)	Total Cost
Remediation Category	**Task**			
	Senior Project Manager	4.00	125.15	$500.60
CCA-Field	Field Preparation, Scheduling, Arrangements / Coordination for Investigation Activities			
	Engineer III	16.00	125.15	$2,002.40
CCA-Field	Drilling / Vapor Sampling and preparations			
	Engineer II	14.00	106.38	$1,489.32
CCA-Field	Drilling / Vapor Sampling			
	Senior Admin. Assistant	2.00	56.32	$112.64
CCA-Field	Arrangements for Investigation, Utilities/JULIE, Scheduling			
	Engineer III	4.00	125.15	$500.60
CCA-Field	Borelogs, SI Documentation, Analytical Entry			
	Senior Project Manager	2.00	125.15	$250.30
CCA-Field	Reviewing, Evaluating Analytical Results / SI Documentation, Field Data			
	Senior Project Manager	6.00	125.15	$750.90
CCA-Field	Off-Site SI Coordination			
	Engineer III	4.00	125.15	$500.60
CCA-Field	Off-Site Property Owner Notification / Results Report			
	Senior Admin. Assistant	2.00	56.32	$112.64
CCA-Field	Off-Site Property Owner Drilling Notification and Reports			

*Refer to the applicable Maximum Payment Amounts document.

Total of Consulting Personnel Costs	**$38,571.22**

Consultant's Materials Costs Form

Materials, Equipment, or Field Purchase	Time or Amount Used	Rate ($)	Unit	Total Cost
Remediation Category	**Description/Justification**			
Copies	600.00	.15	/each	$90.00
CCAP	Copies of Plan and Report / Draft Plan			
Postage	3.00	6.00	/each	$18.00
CCAP	Report/ Forms/ Draft/ Distribution			
Copies	300.00	.15	/each	$45.00
CCAP-Budget	Copies of Budget/ Draft			
Postage	3.00	6.00	/each	$18.00
CCAP-Budget	Budget Distribution			
Copies	800.00	.15	/each	$120.00
CACR	Copies of Completion Report and Attachments/ Draft			
Postage	3.00	6.00	/each	$18.00
CACR	Completion Report Distribution/ Draft			
Copies	1,200.00	.15	/each	$180.00
CA-Pay	Copies of Reimbursement Claims			
Postage	6.00	6.00	/each	$36.00
CA-Pay	Reimbursement Distribution/ Forms			
Field Purchase	1.00	68.00	/each	$68.00
CACR	NFR Recording Fees			

Materials, Equipment, or Field Purchase	Time or Amount Used	Rate ($)	Unit	Total Cost
Remediation Category	**Description/Justification**			
Postage	4.00	6.00	/each	$24.00
CACR	NFR Recording / Correspondence/ County/ IEPA/ Client			
Copies	150.00	.15	/each	$22.50
CACR	NFR / Recording / Submittal / IEPA Correspondence			
Copies	150.00	.15	/each	$22.50
ELUC	Ordinance Submittal and Notifications			
Postage	8.00	6.00	/each	$48.00
ELUC	Ordinance Submittal and Notifications			
Mileage	400.00	.65	/mile	$260.00
CCA-Field	2 Round Trips from Springfield Office to Site (Drilling/ Vapor Sampling)			
Water Level Indicator	1.00	28.00	/day	$28.00
CCA-Field	Test for Groundwater During Drilling Activities			
Disposable Gloves	1.00	16.00	/box	$16.00
CCA-Field	Disposable Latex Gloves for Soil and Vapor Sampling			
PID Rental	1.00	148.00	/day	$148.00
CCA-Field	Test VOC Levels in Soil Samples			

Materials, Equipment, or Field Purchase	Time or Amount Used	Rate ($)	Unit	Total Cost
Remediation Category	**Description/Justification**			
Shroud supplies, canister and regulator rental	1.00	200.00	/each	$200.00
CCA-Field	Shroud construction and operation materials, rental of gas canister and regulator			
Measuring Wheel	1.00	18.00	/day	$18.00
CCA-Field	Locating soil borings and vapor well			
Postage	8.00	6.00	/each	$48.00
HAA	HAA Correspondence / Execution / Distribution			
Copies	250.00	.15	/each	$37.50
HAA	HAA Correspondence / Execution / Distribution			
Postage	2.00	6.00	/each	$12.00
CCA-Field	Postage for Off-Site Property Owner Drilling Coordination / SI Results Report			
Copies	100.00	.15	/each	$15.00
CCA-Field	Copies for Off-Site Property Owner Drilling Coordination / SI Results Report			

Total of Consultant Materials Costs	$1,492.50

APPENDIX E

TACO VARIABLES AND EQUATIONS & HYDRAULIC CONDUCTIVITY CALCULATIONS

CORRECTIVE ACTION PLAN
MOTOMART
SWANSEA, ILLINOIS

MotoMart - Swansea
Site Assessment Data

Soil CUOs

Parameter	Tier 1 Residential with GW Class I CUO	Tier 1 I/ C without GW	Appendix A Table H Background	Tier 1 CW	Tier 2 CW	Tier 2 I/C without GW
Benzene	0.03	1.6		2.2	4.52	3.21
Ethylbenzene	13.0	400		58	10,202	389.64
Toluene	12.0	650		42	371.27	371.29
Total Xylenes	5.6	320		5.6	46.17	46.17
Benzo(a)anthracene	0.9	8.	1.8	170		
Benzo(a)pyrene	0.09	0.8	2.1	17		
Benzo(b)fluoranthene	0.9	8.	2.1	170		
Dibenz(a,h)anthracene	0.09	0.8	0.42	17		
Indeno(1,2,3-cd)pyrene	0.9	8.	1.6	170		
All values in mg/kg						

Summary of Tier 2 Calculations
MotoMart - Swansea
2002-0431
07/26/16

Table 3

Tier 1 Objectives

		Benzene		Toluene		Ethylbenzene		Total Xylenes		Naphthalene		MTBE	
Residential	Ingestion	12	mg/kg	16,000	mg/kg	7,800	mg/kg	16,000	mg/kg	1,600	mg/kg	780	mg/kg
	Inhalation	0.8	mg/kg	650	mg/kg	400	mg/kg	320	mg/kg	170	mg/kg	8,800	mg/kg
	Migration Class 1	0.03	mg/kg	12	mg/kg	13	mg/kg	150	mg/kg	12	mg/kg	0.32	mg/kg
	Migration Class 2	0.17	mg/kg	29	mg/kg	19	mg/kg	150	mg/kg	18	mg/kg	0.32	mg/kg
Industrial/Commercial	Ingestion	100	mg/kg	410,000	mg/kg	200,000	mg/kg	410,000	mg/kg	41,000	mg/kg	20,000	mg/kg
	Inhalation	1.60	mg/kg	650	mg/kg	400	mg/kg	320	mg/kg	270	mg/kg	8,800	mg/kg
Construction Worker	Ingestion	2,300	mg/kg	410,000	mg/kg	20,000	mg/kg	41,000	mg/kg	4,100	mg/kg	2,000	mg/kg
	Inhalation	2.20	mg/kg	42	mg/kg	58	mg/kg	5.6	mg/kg	1.80	mg/kg	140	mg/kg
Soil Saturation		580	mg/kg	290	mg/kg	150	mg/kg	110	mg/kg	100.57	mg/kg	8,400	mg/kg

Tier 2 SSL Objectives

		Benzene	Equation	Toluene	Equation	Ethylbenzene	Equation	Total Xylenes	Equation	Naphthalene	Equation	MTBE	
Residential	Ingestion	11.64	S-2	6,257	S-1	7,821	S-1	15,643	S-1	1,564	S-1	782.1	S-1
	Inhalation	1.68	S-6	[illegible]	S-4	[illegible]	S-4	[illegible]	S-4	150.72	S-4	[illegible]	S-4
	Migration Mass-Limit Class 1	0.43	S-28	85.50	S-28	59.85	S-28	854.99	S-28	11.97	S-28	5.98	S-28
	Migration Class 1	0.070	S-17	26.73	S-17	32.09	S-17	545.98	S-17	9.08	S-17	0.58	S-17
Industrial-Commercial	Ingestion	104.06	S-2	1,635,200	S-1	204,400	S-1	408,800	S-1	40,880	S-1	20,440	S-1
	Inhalation	3.21	S-6	[illegible]	S-4	[illegible]	S-4	[illegible]	S-4	239.96	S-4	[illegible]	S-4
	Migration Mass-Limit Class 1	0.43	S-28	85.50	S-28	59.85	S-28	854.99	S-28	11.97	S-28	5.98	S-28
	Migration Class 1	0.070	S-17	26.73	S-17	32.09	S-17	545.98	S-17	9.08	S-17	0.58	S-17
Construction Worker	Ingestion	2,258.21	S-3	163,236	S-1	10,202	S-1	81,618	S-1	122,427	S-1	20,405	S-1
	Inhalation	4.52	S-7	371.27	S-5	[illegible]	S-5	46.17	S-5	1.55	S-5	318.31	S-5
Soil Saturation		1,255.70	S-29	708.29	S-29	389.64	S-29	300.12	S-29	100.57	S-29	21,018.97	S-29

all values are in mg/kg

[illegible] Site Specific Value cannot exceed Soil Saturation Limit, otherwise Tier 2 Inhalation or Tier 2 Migration objectives are the Soil Saturation objective

Groundwater Contaminate Concentration Exceedances at Surface Water or Set Back Zone (mg/L)

	Benzene	Equation	Toluene	Equation	Ethylbenzene	Equation	Total Xylenes	Equation	Naphthalene	Equation	MTBE	
Result	#DIV/0!	R-26	#DIV/0!	R-26	#DIV/0!	R-26	#DIV/0!	R-26			#DIV/0!	R-26
Surface Water Objective	0.86		0.6		0.014		0.35					

Version: 8/25/2015

Section 742.APPENDIX A: General

Section 742.TABLE H Concentrations of Polynuclear Aromatic Hydrocarbon Chemicals in Background Soils

Chemical Name	Chicago[a] mg/kg	Metropolitan Areas[b] (mg/kg)	Non-Metropolitan Areas[c] (mg/kg)
2-Methylnaphthalene	-----	0.14	0.29
Acenaphthene	0.09	0.13	0.04
Acenaphthylene	0.03	0.07	0.04
Anthracene	0.25	0.40	0.14
Benzo(a)anthracene	1.1	1.8	0.72
Benzo(a)pyrene	1.3	2.1	0.98
Benzo(b)fluoranthene	1.5	2.1	0.70
Benzo(g,h,i)perylene	0.68	1.7	0.84
Benzo(k)fluoranthene	0.99	1.7	0.63
Chrysene	1.2	2.7	1.1
Dibenzo(a,h)anthracene	0.20	0.42	0.15
Fluoranthene	2.7	4.1	1.8
Fluorene	0.10	0.18	0.04
Indeno(1,2,3-c,d)pyrene	0.86	1.6	0.51
Naphthalene	0.04	0.20	0.17
Phenanthrene	1.3	2.5	0.99
Pyrene	1.9	3.0	1.2

[a] Chicago means within the corporate limits of the City of Chicago.

[b] Metropolitan area means a populated area, as defined in Section 742.200, (other than the City of Chicago) that is located within any county in a Metropolitan Statistical Area listed in Appendix A, Table G, footnote a.

[c] Non-Metropolitan area means a populated area, as defined in Section 742.200, that is not located within any county in a Metropolitan Statistical Area listed in Appendix A, Table G, footnote a.

(Source: Appendix A, Table H renumbered to Appendix A, Table I and new Appendix A, Table H Added at 31 Ill. Reg. 4063, effective February 23, 2007)

Illinois Enviromental Protection Agency
Leaking Underground Storage Tank Program
SSL Input Parameters for Use with Tier 2 Calculations

A. Site Identification

IEMA Incident # (6- or 8-digit): 2002-0431 IEPA LPC # (10-digit): 1631405021

Site Name: MotoMart - Swansea

Site Address (not a P.O. Box): 1324 North Illinois

City: Swansea County: St. Clair Zip Code: 62221

Leaking UST Technical File

B. Tier 2 Calculation Information

Equation(s) Used (ex: S12,S17,S28): S5,6,7,8,9,10,17,18,19,20,21,22,24

Contact Information for Individual Who Performed Calculations:

CWM Company, Inc., VES

Land Use: Residential Soil Type: Loamy Sand

Groundwater: [X] Class I [ ] Class II

Mass Limit: [ ] Yes [X] No If Yes, then Specify Acreage: _____

- Mass Limit Acreage other than defaults must always be rounded up.
- Failure to use site-specific parameters where allowed could affect payment from the UST Fund
- Maps depicting source width, plume dimensions, distance, etc. must also be submitted.
- Inputs must be submitted in the designated unit.

AT (ingestion)	=	Residential = 6	yr
		Con. Worker = 0.115	yr
AT (inhalation)	=	Residential = 30	yr
		Con. Worker = 0.115	yr
AT_c	=	70	yr
BW	=	Res. (NonCarcinogen) = 15	kg
		Res. (Carcinogen) = 70	kg
		Con. Worker = 70	kg
C_{sat}	=	Benzene = 1255.7	mg/kg
		Toluene = 706.287	mg/kg
		Ethylbenzene = 389.639	mg/kg
		Total Xylenes = 300.123	mg/kg
		MTBE = 21016.967	mg/kg
		Naphthalene = 100.568	mg/kg
			mg/kg
			mg/kg
			mg/kg
			mg/kg

d_a	=	3.048	m
d_s	=	3.048	m
DA	=	Benzene = 0.00129967021009136	cm^2/s
		Toluene = 0.000790137682765876	cm^2/s
		Ethylbenzene = 0.000474802231720363	cm^2/s
		Xylenes = 0.000327009464361197	cm^2/s
		MTBE = 0.000268730820195097	cm^2/s
		Naphthalene = 1.62697528722497E-05	cm^2/s
			cm^2/s
			cm^2/s
			cm^2/s
			cm^2/s

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C_w	=	Benzene = 0.1	mg/L
		Toluene = 20	mg/L
		Ethylbenzene = 32.087	mg/L
		Total Xylenes = 545.678	mg/L
		MTBE = 0.576	mg/L
		Naphthalene = 9.083	mg/L
			mg/L
			mg/L
			mg/L
			mg/L
			mg/L
d	=	10.135	m
ED (inhalation of carcinogens)	=	Residential = 30	yr
		Con. Worker = 1	yr
ED (ingestion of noncarcinogens)	=	Residential = 6	yr
		Con. Worker = 1	yr
ED (inhalation of noncarcinogens)	=	Residential = 30	yr
		Con. Worker = 1	yr
ED (ingestion of groundwater)	=	Residential = 30	yr
		Con. Worker = 1	yr
ED_{M-L}	=	70	yr
EF	=	Residential = 350	d/yr
		Con. Worker = 30	d/yr
F(x)	=	0.194	unitless
f_{oc}	=	0.0058	g/g
GW_{obj}	=	Benzene = 0.005	mg/L
		Toluene = 1	mg/L
		Ethylbenzene = 0.7	mg/L
		Total Xylenes = 10	mg/L
		MTBE = 0.07	mg/L
		Naphthalene = 0.14	mg/L
			mg/L
			mg/L
			mg/L
			mg/L
H'	=	Benzene = 0.23	unitless
		Toluene = 0.271	unitless
		Ethylbenzene = 0.324	unitless
		Total Xylenes = 0.271	unitless
		MTBE = 0.0241	unitless
		Naphthalene = 0.0198	unitless
			unitless
			unitless
			unitless
			unitless
i	=	0.084137931	m/m
I	=	0.3	m/yr
I_{M-L}	=	0.18	m/yr
$IF_{soil-adj}$	=	114	(mg-yr)/(kg-d)
IR_{soil}	=	Residential = 200	mg/d
		Con. Worker = 480	mg/d

D_i	=	Benzene = 0.088	cm^2/s
		Toluene = 0.087	cm^2/s
		Ethylbenzene = 0.075	cm^2/s
		Total Xylenes = 0.0735	cm^2/s
		MTBE = 0.102	cm^2/s
		Naphthalene = 0.0000075	cm^2/s
			cm^2/s
			cm^2/s
			cm^2/s
			cm^2/s
D_w	=	Benzene = 0.0000102	cm^2/s
		Toluene = 0.0000086	cm^2/s
		Ethylbenzene = 0.0000078	cm^2/s
		Total Xylenes = 0.00000923	cm^2/s
		MTBE = 0.000011	cm^2/s
		Naphthalene = 0.0000075	cm^2/s
			cm^2/s
			cm^2/s
			cm^2/s
			cm^2/s
DF	=	1.574829435	unitless
ED (ingestion of carcinogens	=		yr
		Con. Worker = 1	yr
K_{oc}	=	Benzene = 50	cm^3/g or L/kg
		Toluene = 158	cm^3/g or L/kg
		Ethylbenzene = 320	cm^3/g or L/kg
		Total Xylenes = 398	cm^3/g or L/kg
		MTBE = 11.5	cm^3/g or L/kg
		Naphthalene = 500	cm^3/g or L/kg
			cm^3/g or L/kg
			cm^3/g or L/kg
			cm^3/g or L/kg
			cm^3/g or L/kg
K_s	=	540	m/yr
L	=	67.056	m
PEF	=		m^3/kg
PEF'	=		m^3/kg
Q/C (VF equations)	=	Residential = 68.81	$(g/m^2\text{-}s)/(kg/m^3)$
		Con. Worker = 85.81	$(g/m^2\text{-}s)/(kg/m^3)$
Q/C (PEF equations)	=		$(g/m^2\text{-}s)/(kg/m^3)$

RfC (mg/m^3)		Chronic	Subchronic
Benzene	=	0.03	0.08
Toluene	=	5	5
Ethylbenzene	=	1	9
Total Xylenes	=	0.1	0.4
MTBE	=	3	2.5
Naphthalene	=	0.003	0.003
	=		NA
	=		NA
	=		NA
	=		NA

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IR_w	=	Residential = 2	L/d
K	=	13.56048	m/yr
K_a(non-ionizing organics)	=	Benzene = 0.29	cm^3/g or L/kg
		Toluene = 0.9164	cm^3/g or L/kg
		Ethylbenzene = 1.856	cm^3/g or L/kg
		Total Xylenes = 2.3084	cm^3/g or L/kg
		MTBE = 0.0667	cm^3/g or L/kg
		Naphthalene = 2.9	cm^3/g or L/kg
			cm^3/g or L/kg
			cm^3/g or L/kg
			cm^3/g or L/kg
			cm^3/g or L/kg
			cm^3/g or L/kg
K_d (ionizing organics)	=		cm^3/g or L/kg
K_d (inorganics)	=		cm^3/g or L/kg
VF'	=	Benzene = 413.79	m^3/kg
		Toluene = 530.696	m^3/kg
		Ethylbenzene = 684.606	m^3/kg
		Total Xylenes = 824.93	m^3/kg
		MTBE = 909.994	m^3/kg
		Naphthalene = 3698.341	m^3/kg
			m^3/kg
			m^3/kg
			m^3/kg
			m^3/kg
VM_{M-L}	=	#VALUE!	m^3/kg
		#VALUE!	m^3/kg
		#VALUE!	m^3/kg
		#VALUE!	m^3/kg
		#VALUE!	m^3/kg
		#VALUE!	m^3/kg
			m^3/kg
			m^3/kg
			m^3/kg
			m^3/kg
VF'_{M-L}	=	#VALUE!	m^3/kg
		#VALUE!	m^3/kg
		#VALUE!	m^3/kg
		#VALUE!	m^3/kg
		#VALUE!	m^3/kg
		#VALUE!	m^3/kg
			m^3/kg
			m^3/kg
			m^3/kg
			m^3/kg
			m^3/kg
η	=	0.619	L_{pore}/L_{soil}
θ_a	=	0.292	L_{air}/L_{soil}

RfD_o mg/(kg-d)		Chronic	Subchronic
Benzene	=	0.004	0.012
Toluene	=	0.08	0.8
Ethylbenzene	=	0.1	0.05
Total Xylenes	=	0.2	0.4
MTBE	=	0.01	0.1
Naphthalene	=	0.02	0.6
	=		0.6
	=		NA
	=		NA
	=		NA

S	=	Benzene = 1800	mg/L
		Toluene = 530	mg/L
		Ethylbenzene = 170	mg/L
		Total Xylenes = 110	mg/L
		MTBE = 51000	mg/L
		Naphthalene = 31	mg/L
			mg/L
			mg/L
			mg/L
			mg/L
SF_o	=	Benzene = 0.055	$(mg/kg-d)^{-1}$
		Toluene = NA	$(mg/kg-d)^{-1}$
		Ethylbenzene = 0.011	$(mg/kg-d)^{-1}$
		Total Xylenes = NA	$(mg/kg-d)^{-1}$
		MTBE = NA	$(mg/kg-d)^{-1}$
		Naphthalene = NA	$(mg/kg-d)^{-1}$
			$(mg/kg-d)^{-1}$
			$(mg/kg-d)^{-1}$
			$(mg/kg-d)^{-1}$
			$(mg/kg-d)^{-1}$
T	=	Residential = 9.5E08	s
		Con. Worker = 3.6×10^6	s
T_{M-L}	=	30	yr
THQ	=	1	unitless
TR	=	1.00E-06	unitless
U_m	=	4.69	m/s
URF	=	Benzene = 7.8×10^{-6}	$(\mu g/m^3)^{-1}$
U_t	=	11.32	m/s
V	=	0.5	unitless
VF	=	Benzene = 5390.203	m^3/kg
		Toluene = 6913.06	m^3/kg
		Ethylbenzene = 8917.956	m^3/kg
		Total Xylenes = 10745.869	m^3/kg
		MTBE = 11853.951	m^3/kg
		Naphthalene = 48176.055	m^3/kg
			m^3/kg
			m^3/kg
			m^3/kg
			m^3/kg

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θ_w	=	0.327	L_{water}/L_{soil}
ρ_b	=	0.967	kg/l or g/cm^3
ρ_s	=	2.54	g/cm^3
ρ_w	=	1	g/cm^3
1/(2b+3)	=	0.085	unitless

Illinois Enviromental Protection Agency
Leaking Underground Storage Tank Program
RBCA Input Parameters for Use with Tier 2 Calculations

A. Site Identification

IEMA Incident # (6- or 8-digit): 2002-0431 IEPA LPC # (10-digit): 1631405021

Site Name: MotoMart - Swansea

Site Address (not a P.O. Box): 1324 North Illinois

City: Swansea County: St. Clair Zip Code: 62221

Leaking UST Technical File

B. Tier 2 Calculation Information

Equation(s) Used (ex: R12,R14,R26): R16, R17, R18,R19, R21, R22, R23, R24,R26

Contact Information for Individual Who Performed Calculations:

CWM Company, Inc., VES

Land Use: Residential Soil Type: Loamy Sand

Groundwater: [X] Class I [ ] Class II

Mass Limit: [ ] Yes [X] No If Yes, then Specify Acreage:

Objective from S17 used in R26? [ ] Yes [X] No

If Yes, then Specify C_{source} from S17 See Attached mg/L

- Mass Limit Acreage other than defaults must always be rounded up.
- Failure to use site-specific parameters where allowed could affect payment from the UST Fund
- Maps depicting source width, plume dimensions, distance, etc. must also be submitted.
- Inputs must be submitted in the designated unit.

AT_c	=	70	yr
AT_n	=	Residential = 30 Con. Worker = 0.115	yr yr
BW	=	70	yr
C_{source}	=	See Attached	mg/L
$C_{(x)}$	=	See Attached	mg/L
d	=	100	cm

D^{air}	=	See Attached	cm^2/s
D^{water}	=	See Attached	cm^2/s
D_s^{eff}	=	See Attached	cm^2/s
ED	=	Residential = 30 Con. Worker = 1	yr yr
EF	=	Residential = 350 Con. Worker = 30	d/yr d/yr

erf	=	See Attached	unitless
I_{oc}	=	0.0058	g/g
GW_{comp}	=	See Attached	mg/L
GW_{source}	=	See Attached	mg/L
H'	=	See Attached	$cm3_{water}/cm^3_{air}$
I	=	0.084137931	cm/cm
I	=	30	cm/yr
IR_{air}	=	20	m^3/d
IR_{soil}	=	Residential = 100 Con. Worker = 480	mg/d mg/d
IR_w	=	Residential = 2	L/d
K	=	3.715 1356.048	cm/d cm/yr
K_{oc}	=	See Attached	cm^3/g or L/kg
k_s (non-ionizing organics)	=	See Attached	cm^3_{water}/g_{soil}
k_s (ionizing organics)	=	Not Applicable	cm^3_{water}/g_{soil}
k_s (inorganics)	=	Not Applicable	cm^3_{water}/g_{soil}
L_g	=	100	cm
LF_{gw}	=	See Attached	$(mg/L_{water})/(mg/kg_{soil})$
M	=	0.5	mg/cm^2
Pe	=	$6.9 \cdot 10^{14}$	g/cm^3-s
RAF_d	=	0.5	unitless
a_x	=	See Attached	cm
a_y	=	See Attached	cm
a_z	=	See Attached	cm
λ	=	See Attached	d^{-1}
π	=	3.1416	
τ	=	$9.46 \cdot 10^8$	s

RAF_d (PNAs)	=	0.05	unitless
RAF_d (inorganics)	=	0	unitless
RAF_a	=	1	unitless
$RBSL_{air}$ (carcinogenic)	=	See Attached	$\mu g/m^3$
$RBSL_{air}$ (noncarcinogenic)	=	See Attached	$\mu g/m^3$
RfD_i	=	See Attached	mg/kg-d
SA	=	3,160	cm^2/d
S_d	=	200.0	cm
S_w	=	9,448.8	cm
SF_i	=	See Attached	$(mg/kg-d)^{-1}$
SF_o	=	See Attached	$(mg/kg-d)^{-1}$
THQ	=	1	unitless
TR	=	1.00E-06	unitless
U	=	0.7269	cm/d
U_{air}	=	225	cm/s
U_{gw}	=	1356.132	cm/y
VF_p	=	3.97133E-12	kg/m^3
VF_{semb}	=	See Attached	$(mg/m^3_{air})/(mg/kg_{soil}$ or kg/m
VF_{ss}	=	See Attached	kg/m3
W	=		cm
w	=	0.286	$\theta_{water}/\theta_{soil}$
δ_{air}	=	200	cm
δ_{gw}	=	200	cm
θ_{as}	=	0.153438	cm^3_{air}/cm^3_{soil}
θ_{ws}	=	0.276562	cm^3_{water}/cm^3_{soil}
θ_T	=	0.43	cm^3/cm^3_{soil}
ρ_b	=	0.967	g/cm^3
ρ_w	=	1	g/cm^3

	H'	λ	Koc
Benzene	0.23	0.0009	50
Toluene	0.271	0.011	158
Ethylbenzene	0.324	0.003	320
Total Xylenes	0.271	0.0019	398
MTBE	0.0241	0	11.5
Naphthalene	0.0198	0.0027	500

Benzene R26 Modeled Groundwater from Vertical Modeled Soils

Location	C_{source} from S17 (mg/L)	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $S_w / (4 \sqrt{[\alpha_y \cdot X]})$	erf: $S_w / (2 \sqrt{[\alpha_z \cdot X]})$
BH1	0.217	0.005	3535.68	353.568	117.856	17.6784	0.99999977	0.61135043
BH2	0.007	0.005	304.8	30.48	10.16	1.524	1	1
BH3	0.033	0.005	1767.84	176.784	58.928	8.8392	1	0.91531703
BH5	0.034	0.005	1767.84	176.784	58.928	8.8392	1	0.91531703
BH9	0.022	0.005	1402.08	140.208	46.736	7.0104	1	0.97028833

Benzene R26 Modeled Groundwater

Location	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $S_w / (4 \sqrt{[\alpha_y \cdot X]})$	erf: $S_w / (2 \sqrt{[\alpha_z \cdot X]})$
MW1	8.300	8077.2	807.72	269.24	40.386	0.97650755	0.29409279
MW2	0.269	3779.52	377.952	125.984	18.8976	0.99999871	0.5800175
MW4	2.000	6126.48	612.648	204.216	30.6324	0.99717928	0.38117227

Ethylbenzene R26 Modeled Groundwater from Vertical Modeled Soils								
Location	C_{source} from S17 (mg/L)	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: S_w / (4 $\sqrt{[\alpha_y \cdot X]}$)	erf: S_w / (2 $\sqrt{[\alpha_z \cdot X]}$)

Ethylbenzene R26 Modeled Groundwater							
Location	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	$\sqrt{[\alpha_y \cdot X]}$	$\sqrt{[\alpha_z \cdot X]}$
MW1	3.240	457.2	45.72	15.24	2.286	1	1
MW4	3.830	487.68	48.768	16.256	2.4384	1	1

Total Xylenes R26 Modeled Groundwater from Vertical Modeled Soils								
Location	C_{source} from S17 (mg/L)	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $S_w / (4 \cdot \sqrt{[\alpha_y \cdot X]})$	erf: $S_w / (2 \cdot \sqrt{[\alpha_z \cdot X]})$
BH1	0.3005							
BH5	0.4710							

Total Xylenes R26 Modeled Groundwater							
Location	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $S_w / (4 \cdot \sqrt{[\alpha_y \cdot X]})$	erf: $S_w / (2 \cdot \sqrt{[\alpha_z \cdot X]})$

Naphthalene R26 Modeled Groundwater from Vertical Modeled Soils								
Location	C_{source} from S17 (mg/L)	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $S_w / (4 \cdot \sqrt{[\alpha_y \cdot X]})$	erf: $S_w / (2 \cdot \sqrt{[\alpha_z \cdot X]})$

Naphthalene R26 Modeled Groundwater							
Location	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $S_w / (4 \cdot \sqrt{[\alpha_y \cdot X]})$	erf: $S_w / (2 \cdot \sqrt{[\alpha_z \cdot X]})$
MW1	0.387	304.8	30.48	10.16	1.524	1	1
MW4	1.230	731.52	73.152	24.384	3.6576	1	0.99996909

PREVIOUSLY IMAGED

Location	C_{source} from S17 (mg/L)	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $S_w / (4 \cdot \sqrt{[\alpha_x \cdot X]})$	erf: $S_w / (2 \cdot \sqrt{[\alpha_z \cdot X]})$
BH9	0.0001							

Location	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $S_w / (4 \cdot \sqrt{[\alpha_x \cdot X]})$	erf: $S_w / (2 \cdot \sqrt{[\alpha_z \cdot X]})$

Location	C_{source} from S17 (mg/L)	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $S_w / (4 \cdot \sqrt{[\alpha_y \cdot X]})$	erf: $S_w / (2 \cdot \sqrt{[\alpha_z \cdot X]})$
BH2	0.0000							
BH9	0.0000							
BH11	0.0000							
BH12	0.0000							
BH14	0.0000							
BH16	0.0000							

Location	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $S_w / (4 \cdot \sqrt{[\alpha_y \cdot X]})$	erf: $S_w / (2 \cdot \sqrt{[\alpha_z \cdot X]})$

Location	C_{source} from S17 (mg/L)	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $S_w / (4 \cdot \sqrt{[\alpha_y \cdot X]})$	erf: $S_w / (2 \sqrt{[\alpha_z \cdot X]})$
BH2	0.0000							
BH9	0.0000							
BH12	0.0000							

Location	C(x) (mg/L)	X (cm)	α_x (cm)	α_y (cm)	α_z (cm)	erf: $S_w / (4 \cdot \sqrt{[\alpha_y \cdot X]})$	erf: $S_w / (2 \cdot \sqrt{[\alpha_z \cdot X]})$

MotoMart - Swansea 2002-0431

Math for R-26 Calculations
BENZENE MATH FOR VERTICAL SOIL MODELING AND R-26 MODELING OF VERTICAL MODELED SOIL (Attachment A)

Sample Location	C_s = (soil contamination at modeling point) / (Equation S-17)				C_s	$GW_{obj} = C_s / DF$					Conversion: 1 foot = 30.48 cm		R-16: $a_x = 0.10 * X$					R-17: $a_y = a_x / 3$					R-18: $a_z = a_x / 20$					"Term 1" = [X / (2 * a_x)]						
					C_s	C_s	/	DF	=	GW_{obj} (mg/L)	X (ft)	X (cm)	0.1	x	X (cm)	=	a_x (cm)	a_x (cm)	/	3	=	a_y (cm)	a_x (cm)	/	20	=	a_z (cm)	X	/	2	x	a_x	=	"Term 1"
BH1	3.03	/	0.698	=	4.343	4.343	/	20.000	=	0.21717	116	3535.68	0.1	x	3535.68	=	353.568	353.568	/	3	=	117.856	353.568	/	20	=	17.6784	3535.68	/	2	x	353.568	=	5
BH2	0.096	/	0.698	=	0.138	0.138	/	20.000	=	0.00688	10	304.8	0.1	x	304.8	=	30.48	30.48	/	3	=	10.16	30.48	/	20	=	1.524	304.8	/	2	x	30.48	=	5
BH3	0.463	/	0.698	=	0.664	0.664	/	20.000	=	0.03318	58	1767.84	0.1	x	1767.84	=	176.784	176.784	/	3	=	58.928	176.784	/	20	=	8.8392	1767.84	/	2	x	176.784	=	5
BH5	0.474	/	0.698	=	0.679	0.679	/	20.000	=	0.03397	58	1767.84	0.1	x	1767.84	=	176.784	176.784	/	3	=	58.928	176.784	/	20	=	8.8392	1767.84	/	2	x	176.784	=	5
BH9	0.312	/	0.698	=	0.447	0.447	/	20.000	=	0.02236	46	1402.08	0.1	x	1402.08	=	140.208	140.208	/	3	=	46.736	140.208	/	20	=	7.0104	1402.08	/	2	x	140.208	=	5

Sample Location	"Term 2" = [1 - SQRT[1 + (4 * λ * a_x) / (U)]]												
	1	-	SQRT [	1	+ (	4	x	λ	x	a_x	) /	U	] = "Term 2"
BH1	1	-	SQRT [	1	+ (	4	x	0.0009	x	353.568	) /	0.72695	] = -0.6488
BH2	1	-	SQRT [	1	+ (	4	x	0.0009	x	30.48	) /	0.72695	] = -0.0728
BH3	1	-	SQRT [	1	+ (	4	x	0.0009	x	176.784	) /	0.72695	] = -0.3686
BH5	1	-	SQRT [	1	+ (	4	x	0.0009	x	176.784	) /	0.72695	] = -0.3686
BH9	1	-	SQRT [	1	+ (	4	x	0.0009	x	140.208	) /	0.72695	] = -0.3017

Sample Location	$β_1 = S_w / (4 * SQRT(a_y * X))$											$β_2 = S_d / (2 * SQRT(a_z * X))$											ERF($β_1$)	ERF($β_2$)
	S_w	/ (	4	x	SQRT	(	a_y	x	X	)) =	$β_1$	S_d	/ (	2	x	SQRT	(	a_z	x	X	)) =	$β_2$	Section 742 APPENDIX C: Table G	
BH1	9448.8	/ (	4	x	SQRT	(	117.856	x	3535.68	)) =	3.66836	304.8	/ (	2	x	SQRT	(	17.6784	x	3535.68	)) =	0.60967	1.000000	0.611350
BH2	9448.8	/ (	4	x	SQRT	(	10.16	x	304.8	)) =	42.44860	304.8	/ (	2	x	SQRT	(	1.524	x	304.8	)) =	7.07107	1.000000	1.000000
BH3	9448.8	/ (	4	x	SQRT	(	58.928	x	1767.84	)) =	7.31871	304.8	/ (	2	x	SQRT	(	8.8392	x	1767.84	)) =	1.21918	1.000000	0.915317
BH5	9448.8	/ (	4	x	SQRT	(	58.928	x	1767.84	)) =	7.31871	304.8	/ (	2	x	SQRT	(	8.8392	x	1767.84	)) =	1.21918	1.000000	0.915317
BH9	9448.8	/ (	4	x	SQRT	(	46.736	x	1402.08	)) =	9.22783	304.8	/ (	2	x	SQRT	(	7.0104	x	1402.08	)) =	1.53719	1.000000	0.970288

Sample Location	$C_{gw} = C_{source} \times e^{(Term 1 \times Term 2)} \times erf(β_1) \times erf(β_2)$									
	C_{source}	x e	^("Term 1"	*	"Term 2")	x ERF($β_1$)		x ERF($β_2$)	=	mg/L
BH1	0.21717	x e	5	*	-0.6488	x	1.000000	x 0.611350	=	0.00683
BH2	0.00688	x e	5	*	-0.0728	x	1.000000	x 1.000000	=	0.00478
BH3	0.03318	x e	5	*	-0.3686	x	1.000000	x 0.915317	=	0.00479
BH5	0.03397	x e	5	*	-0.3686	x	1.000000	x 0.915317	=	0.00490
BH9	0.02236	x e	5	*	-0.3017	x	1.000000	x 0.970288	=	0.00480

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R-26 Calculations
BENZENE MATH FOR R-26 MODELING OF GROUNDWATER (Attachment A)

Sample Location	GW Value	Conversion: 1 foot = 30.48 cm		R-16: a_x = 0.10 * X					R-17: a_y = a_x / 3					R-18: a_z = a_x / 20				
		X (ft)	X (cm)	0.1	x	X (cm)		a_x (cm)	a_x (cm)	/	3	=	a_y (cm)	a_x (cm)	/	20	=	a_z (cm)
MW1	8.3	265	8077.2	0.1	x	8077.2	=	807.72	807.72	/	3	=	269.24	807.72	/	20	=	40.386
MW2	0.269	124	3779.52	0.1	x	3779.52	=	377.952	377.952	/	3	=	125.984	377.952	/	20	=	18.8976
MW4	2	201	6126.48	0.1	x	6126.48	=	612.648	612.648	/	3	=	204.216	612.648	/	20	=	30.6324

Sample Location	"Term 1" = (X / (2 * a_x))							"Term 2" = (1 - SQRT(1 + (4 * λ * a_x) / (U)))													
	X	/	2	x	a_x	=	"Term 1"	1	-	SQRT (	1	+ (	4	x	λ	x	a_x	) /	U	) =	"Term 2"
MW1	8077.2	/	2	x	807.72	=	5	1	-	SQRT (	1	+ (	4	x	0.0009	x	807.72	) /	0.72895	) =	-1.2361
MW2	3779.52	/	2	x	377.952	=	8	1	-	SQRT (	1	+ (	4	x	0.0009	x	377.952	) /	0.72895	) =	-0.9948
MW4	6126.48	/	2	x	612.648	=	8	1	-	SQRT (	1	+ (	4	x	0.0009	x	612.648	) /	0.72895	) =	-1.0986

Sample Location	$β_1$ = S_w / (4 * SQRT(a_y * X))											$β_2$ = S_d / (2 * SQRT(a_z * X))									
	S_w	/ (	4	x	SQRT	(	a_y	x	X	)) =	$β_1$	S_d	/ (	2	x SQRT	(	a_z	x	X	)) =	$β_2$
MW1	9448.8	/ (	4	x	SQRT	(	269.24	x	8077.2	)) =	1.68183	304.8	/ (	2	x SQRT	(	40.386	x	8077.2	)) =	0.29083
MW2	9448.8	/ (	4	x	SQRT	(	125.984	x	3779.52	)) =	3.42327	304.8	/ (	2	x SQRT	(	18.8976	x	3779.52	)) =	0.57925
MW4	9448.8	/ (	4	x	SQRT	(	204.216	x	6126.48	)) =	2.11187	304.8	/ (	2	x SQRT	(	30.6324	x	6126.48	)) =	0.36179

Sample Location	ERF($β_1$)	ERF($β_2$)	$C_{(x)} = C_{source} \times e^{(Term 1 x Term 2)} \times erf(β_1) \times erf(β_2)$									
	Section 742 APPENDIX C: Table G		C_{source}	x e	("Term 1"	x	"Term 2")	x	ERF($β_1$)	x	ERF($β_2$)	= mg/L
MW1	0.978508	0.294093	8.30000	x e	[illegible]	x	[illegible]	x	0.978508	x	0.294093	= 0.00482
MW2	0.999999	0.580018	0.26900	x e	[illegible]	x	[illegible]	x	0.999999	x	0.580018	= 0.00484
MW4	0.997179	0.381172	2.00000	x e	[illegible]	x	[illegible]	x	0.997179	x	0.381172	= 0.00481

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R-35 Calculations

ETHYLBENZENE MATH FOR R-26 MODELING OF GROUNDWATER (Attachment A)

Sample Location	DW Value	Conversion: 1 foot = 30.48 cm		R-16: α_x = 0.10 * X					R-17: $\alpha_y = \alpha_x / 3$					R-18: $\alpha_z = \alpha_x / 20$					"Term 1" = [X / (2 * α_x)]						"Term 2" = [1 - SQRT[1 + (4 * λ * α_x) / U]]												
		X (ft)	X (cm)	0.1	x	X (cm)		α_x (cm)	α_x (cm)	/	3	=	α_y (cm)	α_x (cm)	/	20	=	α_z (cm)	X	/	2	x	α_x	= "Term 1"	1 -	SQRT[	1	+ (	4	x	λ	x	α_x	)/	U	]=	"Term 2"
MW1	3.24	15	457.2	0.1	x	457.2	=	45.72	45.72	/	3	=	15.24	45.72	/	20	=	2.286	457.2	/	2	x	45.72	= 5	1 -	SQRT[	1	+ (	4	x	0.003	x	45.72	)/	0.72695	]=	-0.3247
MW4	3.83	16	487.68	0.1	x	487.68	=	48.768	48.768	/	3	=	16.256	48.768	/	20	=	2.4384	487.68	/	2	x	48.768	= 5	1 -	SQRT[	1	+ (	4	x	0.003	x	48.768	)/	0.72695	]=	-0.3436

Sample Location	$\beta_1 = S_w$ / (4 * SQRT[α_y * X])										$\beta_2 = S_d$ / (2 * SQRT[α_z * X])										ERF(β_1)	ERF(β_2)
	S_w	/(	4	x	SQRT	(	α_y	x	X	))=	β_1	S_d	/(	2	x SQRT	(	α_z	x	X	))=	β_2	Section 742 APPENDIX C: Table O	
MW1	9448.8	/(	4	x	SQRT	(	15.24	x	457.2	))=	29.25900	304.8	/(	2	x SQRT	(	2.286	x	457.2	))=	4.71498	1.000000	1.000000
MW4	9448.8	/(	4	x	SQRT	(	16.256	x	487.68	))=	26.53601	304.8	/(	2	x SQRT	(	2.4384	x	487.68	))=	4.41843	1.000000	1.000000

Sample Location	$C_{(x)} = C_{source}$ x $e^{(Term 1 \times Term 2)}$ x erf(β_1) x erf(β_2)									
	C_{source}	x e	("Term 1"	x	"Term 2")	x ERF(β_1)	x	ERF(β_2)	=	mg/L
MW1	3.24000	x e	6	x	-0.3247	x 1.000000	x	1.000000	=	0.63909
MW4	3.83000	x e	6	x	-0.3436	x 1.000000	x	1.000000	=	0.68750

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Math for R-26 Calculations

TOTAL XYLENES MATH FOR VERTICAL SOIL MODELING AND R-26 MODELING OF VERTICAL MODELED SOIL (Attachment A)

Sample Location	C_w = (soil contamination at modeling point) / (Equation S-17)					$GW_{obj} = C_w / DF$					Conversion: 1 foot = 30.48 cm		R-16: α_x = 0.10 * X				R-17: $\alpha_y = \alpha_x / 3$				R-18: $\alpha_z = \alpha_x / 20$				"Term 1" = [X / (2 * α_x)]						"Term 2" = (1 - SQRT[1 + (4 * λ * α_x) / (U)])												
					C_w	C_w	/ DF		=	GW_{obj} (mg/L)	X (ft)	X (cm)	0.1	x	X (cm)	α_x (cm)	α_x (cm)	/	3	= α_y (cm)	α_x (cm)	/	20	= α_z (cm)	X	/	2	x	α_x	= "Term 1"	1	-	SQRT [	1	+ (	4	x	λ	x	α_x	) /	U	] = "Term 2"
BH1	18.4	/	2.728	=	6.811	6.811	/	20.000	=	0.30054																																	
BH5	25.7	/	2.728	=	9.419	9.419	/	20.000	=	0.47097																																	

Sample Location	$\beta_1 = S_w / (4 * SQRT[\alpha_y * X])$											$\beta_2 = S_d / (2 * SQRT[\alpha_z * X])$											ERF(β_1)	ERF(β_2)	$C_{(x)} = C_{source} \times e^{(Term 1 + Term 2)} \times erf(\beta_1) \times erf(\beta_2)$								
	S_w	/ (	4	x	SQRT	(	α_y	x	X	)) =	β_1	S_d	/ (	2	x	SQRT	(	α_z	x	X	)) =	β_2	Section 742 APPENDIX C: Table G		C_{source}	x e	("Term 1"	+	"Term 2")	x ERF(β_1)	x ERF(β_2)	=	mg/L
BH1																									0.30054								
BH5																									0.47097								

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R-38 Calculations

NAPTHALENE MATH FOR R-38 MODELING OF GROUNDWATER (Attachment A)

Sample Location	GW Value	Conversion: 1 foot = 30.48 cm		R-16: α_x = 0.10 * X					R-17: $\alpha_y = \alpha_x / 3$					R-18: $\alpha_z = \alpha_x / 20$				
		X (ft)	X (cm)	0.1	x	X (cm)		α_x (cm)	α_x (cm)	/	3	=	α_y (cm)	α_x (cm)	/	20	=	α_z (cm)
MW1	0.387	10	304.8	0.1	x	304.8	=	30.48	30.48	/	3	=	10.16	30.48	/	20	=	1.524
MW4	1.23	24	731.52	0.1	x	731.52	=	73.152	73.152	/	3	=	24.384	73.152	/	20	=	3.6576

Sample Location	"Term 1" = (X / (2 * α_x))							"Term 2" = (1 - SQRT[1 + (4 * λ * α_x) / (U)])													
	X	/	2	x	α_x	=	"Term 1"	1	-	SQRT [	1	+ (	4	x	λ	x	α_x	) /	U	] =	"Term 2"
MW1	304.8	/	2	x	30.48	=	5	1	-	SQRT [	1	+ (	4	x	0.0027	x	30.48	) /	0.72895	] =	-0.2053
MW4	731.52	/	2	x	73.152	=	5	1	-	SQRT [	1	+ (	4	x	0.0027	x	73.152	) /	0.72895	] =	-0.4448

Sample Location	$\beta_1 = S_w / (4 * SQRT(\alpha_y * X))$										
	S_w	/ (	4	x	SQRT	(	α_y	x	X	)) =	β_1
MW1	9448.8	/ (	4	x	SQRT	(	10.16	x	304.8	)) =	42.44860
MW4	9448.8	/ (	4	x	SQRT	(	24.384	x	731.52	)) =	17.69687

Sample Location	$\beta_2 = S_z / (2 * SQRT(\alpha_z * X))$										ERF(β_1)	ERF(β_2)
											Section 742 APPENDIX C: Table G	
	S_z	/ (	2	x SQRT	(	α_z	x	X	)) =	β_2		
MW1	304.8	/ (	2	x SQRT	(	1.524	x	304.8	)) =	7.07107	1.000000	1.000000
MW4	304.8	/ (	2	x SQRT	(	3.6576	x	731.52	)) =	2.94628	1.000000	0.999998

Sample Location	$C_{gw} = C_{source} \times e^{(Term 1 \times Term 2)} \times erf(\beta_1) \times erf(\beta_2)$									
	C_{source}	x e	("Term 1"	x	"Term 2")	x	ERF(β_1)	x	ERF(β_2) =	mg/L
MW1	0.38700	x e	5	x	-0.2053	x	1.000000	x	1.000000 =	0.13863
MW4	1.23000	x e	5	x	-0.4448	x	1.000000	x	0.999998 =	0.13330

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BENZO(a)PYRENE MATH FOR VERTICAL SOIL MODELING AND R-38 MODELING OF VERTICAL MODELED SOIL (Attachment A1)

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BENZO(a)PYRENE MATH FOR R-39 MODELING OF GROUNDWATER (Attachment A)

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Math for R-26 Calculations

Dibenzo(a,h)Anthracene MATH FOR VERTICAL SOIL MODELING AND R-26 MODELING OF VERTICAL MODELED SOIL (Attachment A)

Sample Location	C_u = (soil contamination at modeling point) / (Equation S-17)					$GW_{ms} = C_u / DF$					Conversion: 1 foot = 30.48 cm		R-16: $\alpha_x = 0.10 * X$	R-17: $\alpha_y = \alpha_x / 3$	R-18: $\alpha_z = \alpha_x / 20$	"Term 1" = $[X / (2 * \alpha_x)]$	"Term 2" = $[1 - SQRT[1 + (4 * \lambda * \alpha_x) / (U)]]$
		/		=	C_u	C_u	/	DF	=	GW_{ms} (mg/L)	X (ft)	X (cm)	0.1 x X (cm) = α_x (cm)	α_x (cm) / 3 = α_y (cm)	α_x (cm) / 20 = α_z (cm)	X / 2 x α_x = "Term 1"	1 - SQRT[1 + (4 x λ x α_x) / U] = "Term 2"
BH2	0.23	/	22040.338	=	0.000	0.000	/	20.000	=	0.00000							
BH9	0.54	/	22040.338	=	0.000	0.000	/	20.000	=	0.00000							
BH12	0.28	/	22040.338	=	0.000	0.000	/	20.000	=	0.00000							

Sample Location	$\beta_1 = S_w / (4 * SQRT(\alpha_y * X))$	$\beta_2 = S_d / (2 * SQRT(\alpha_z * X))$	ERF(β_1)	ERF(β_2)	$C_{gw} = C_{source} \times e^{(Term 1 + Term 2)} \times erf(\beta_1) \times erf(\beta_2)$	
	S_w / (4 x SQRT (α_y x X)) = β_1	S_d / (2 x SQRT (α_z x X)) = β_2	Section 742 APPENDIX C: Table G		C_{source}	x $e^{("Term 1" + "Term 2")}$ x ERF(β_1) x ERF(β_2) = mg/L
BH2					0.00000	
BH9					0.00000	
BH12					0.00000	

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R-26 Calculations

Dibenzo(a,h)Anthracene MATH FOR R-26 MODELING OF GROUNDWATER (Attachment A)

Sample Location	GW Value	Conversion: 1 foot = 30.48 cm		R-16: $\alpha_x = 0.10 * X$			R-17: $\alpha_y = \alpha_x / 3$				R-18: $\alpha_z = \alpha_x / 20$				"Term 1" = $(X / (2 * \alpha_x))$						"Term 2" = $(1 - SQRT(1 + (4 * \lambda * \alpha_x) / U))$											
		X (ft)	X (cm)	0.1	x X (cm)	α_x (cm)	α_x (cm)	/	3	= α_y (cm)	α_x (cm)	/	20	= α_z (cm)	X	/	2	x	α_x	= "Term 1"	1	- SQRT [	1	+ (	4	x	λ	x	α_x	) /	U	] = "Term 2"

Sample Location	$\beta_1 = S_w / (4 * SQRT(\alpha_y * X))$									$\beta_2 = S_d / (2 * SQRT(\alpha_z * X))$									ERF(β_1)	ERF(β_2)	$C_{(x)} = C_{source} \times e^{(Term 1 \times Term 2)} \times erf(\beta_1) \times erf(\beta_2)$							
																			Section 742.APPENDIX C: Table G									
	S_w	/ (	4	x SQRT	(	α_y	x	X	)) = β_1	S_d	/ (	2	x SQRT	(	α_z	x	X	)) = β_2			C_{source}	x e	("Term 1"	"Term 2")	x ERF(β_1)	x ERF(β_2)	=	mg/L

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R-25 Calculations

Benz(a)Anthracene MATH FOR R-26 MODELING OF GROUNDWATER (Attachment A)

Sample Location	GW Value	Conversion: 1 foot = 30.48 cm		R-19: $\alpha_x = 0.10 * X$				R-17: $\alpha_y = \alpha_x / 3$					R-18: $\alpha_z = \alpha_x / 20$					"Term 1" = $[X / (2 * \alpha_x)]$							"Term 2" = $\{1 - SQRT[1 + (4 * \lambda * \alpha_x) / (U)]\}$													
		X (ft)	X (cm)	0.1	x	X (cm)	α_x (cm)	α_x (cm)	/	3	=	α_y (cm)	α_x (cm)	/	20	=	α_z (cm)	X	/	2	x	α_x	=	"Term 1"	1	-	SQRT [	1	+ (	4	x	λ	x	α_x	) /	U	] = "Term 2"

Sample Location	$\beta_1 = S_w / (4 * SQRT(\alpha_y * X))$										$\beta_2 = S_d / (2 * SQRT(\alpha_z * X))$										ERF(β_1)	ERF(β_2)	$C_{(x)} = C_{source} \times e^{(Term 1 \times Term 2)} \times erf(\beta_1) \times erf(\beta_2)$								
	S_w	/ (	4	x SQRT	(	α_y	x	X	)) =	β_1	S_d	/ (	2	x SQRT	(	α_z	x	X	)) =	β_2	Section 742 APPENDIX C: Table G		C_{source}	x e	(Term 1)	(Term 2)	x	ERF(β_1)	x	ERF(β_2)	= mg/L

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R-26 Calculations

Acenaphthene MATH FOR R-26 MODELING OF GROUNDWATER (Attachment A)

Sample Location	GW Value	Conversion: 1 foot = 30.48 cm		R-18: $a_x = 0.10 * X$				R-17: $a_y = a_x / 3$					R-18: $a_z = a_x / 20$					"Term 1" = $(X / (2 * a_x))$						"Term 2" = $(1 - SQRT[1 + (4 * \lambda * a_x) / (U)])$													
		X (ft)	X (cm)	0.1	x	X (cm)	a_x (cm)	a_x (cm)	/	3	=	a_y (cm)	a_x (cm)	/	20	=	a_z (cm)	X	/	2	x	a_x	= "Term 1"	1	-	SQRT[	1	+(	4	x	λ	x	a_x	)/	U	]=	"Term 2"

Sample Location	$\beta_1 = S_w / (4 * SQRT(a_y * X))$										$\beta_2 = S_d / (2 * SQRT(a_z * X))$										ERF(β_1)	ERF(β_2)	$C_{(x)} = C_{source} \times e^{(Term 1 \times Term 2)} \times erf(\beta_1) \times erf(\beta_2)$									
																					Section 742 APPENDIX C Table G											
	S_w	/(	4	x	SQRT	(	a_y	x	X	))=	β_1	S_d	/(	2	x SQRT	(	a_z	x	X	))=	β_2			C_{source}	x e	("Term 1"	"Term 2")	x	ERF(β_1)	x	ERF(β_2)	= mg/L

R-26 Input/Summary Sheet

Version: 8/25/2015

IEMA Incident # (6 or 8 digit)	2002-0431
IEPA LPC # (10 digit)	1631405021
Site Name:	MotoMart - Swansea
Site Address:	1324 North Illinois
City:	Swansea
County:	St. Clair
Zip Code:	62221
SSL Equations Used:	S5,6,7,8,9,10,17,18,19,20,21,22,24
RBCA Equations Used:	R-1, R-2, R3
Contact Information for Individual who Performed Calculat	CWM Company, Inc., VES
Land Use:	Residential & Construction Worker
Objective from S17 used in R26:	No
Groundwater:	Class 1
Standard or Mass Limit Equations:	Standard Equations — If Mass Limit, then Specifiy Acres:
Square Feet of Plume for Mass Limit Eq.:	0.00 < use this # above
Date Data is Entered:	July 26, 2016

Entry	Description		
60.4	Holcomb Bulk Density (pcf), or Shelby Tube Location:		
	Dry Soil Bulk Density (g/cm³ or kg/L): 1.5, or Gravel =2.0, Sand = 1.8, Silt = 1.6, Clay = 1.7, or site specific		
2.54	ρs - Soil Particle Density	Reference	
0.619	Total Soil Porosity	0.619	0.619
0.327	Water Filled Porosity	0.327	0.327
0.292	Air Filled Porosity	0.292	0.292
0.430	θ_T - Total Soil Porosity (RBCA)	0.43 or; Gravel - 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.36	
0.286	w - Average Soil Moisture Content	0.1, or; Subsurface Soil (top 1m) = 0.1; Subsurface Soil (below 1 m) =0.2, or Site Specific	
Loamy Sand	USDA Soil Classification (Pick from List)		

Entry		
0.00580	Fractional Organic Carbon (foc) in g/g	Organic Matter (%):
		Organic Matter (mg/kg):
		Total Organic Carbon (g/g): 0.0058

4.30E-05	Average Hydraulic Conductivity (cm/sec)	Well Name
4.30E-05	Falling Hydraulic Conductivity (cm/sec)	MW-3
	Rising Hydraulic Conductivity (cm/sec)	
0.08414	Hydraulic Gradient (0.02 for sites with no groundwater)	Meters
10	d_a - Aquifer Thickness (ft)	3.048 m
10	d_s - Depth of Source (ft) (Vertical Thickness of Contamination)	3.048 m
	X - Distance along the centerline of the groundwater plume emanating to setback zone or surface water from the source in the direction of groundwater flow (ft) (RBCA)	0 cm
220	L - Source Length Parallel to Groundwater Flow (ft)	67.056 m
310	Sw: Source Width -horizontal plane (ft) (RBCA)	9448.8 cm

Hydraulic Gradient Calculations

MW-3	92.10
MW-7	82.34
Distance:	116

$C_{(x)}$ - Concentration of Contaminant in groundwater at distance X from the source (mg/L)

Surface Water

	Benzene	MTBE
	Toluene	
	Ethylbenzene	
	Total Xylenes	

Chemicals of Concern

Benzene	Naphthalene	
Toluene		Chrysene
Ethylbenzene		Benzo(k)fluoranthene
Total Xylenes		Indeno(1,2,3-cd)pyrene
MTBE		

☐ Mass Limit Equations

SSL Equations Needed

☑ Inhalation Equations

☑ Groundwater Ingestion Equations

☑ Csat Equations

☐ Fugitive Dust Equations

☑ Ingestion Equations

Text discussion for "i", L, d_a, d_s, S_w, S_d	
Hydraulic Gradient	The **Hydraulic Gradient** ***(i)*** was determined from an onsite survey of each of the groundwater monitoring wells. The riser elevations were determined and the depth to groundwater was noted in each well. This data was used to generate a potentiometric flow map with contour lines which show potentiometric head. A corresponding flow line, perpendicular to the contour lines, was determined between two known points of groundwater elevation. The hydraulic gradient was determined by the difference in elevation divided by the length of flow between the points.
Source Length	The **Source Length Parallel to Groundwater Flow (L)** was determined from the site map and analytical results. A value of 45.1104 m was used to encompass the length of contamination parallel to groundwater flow. This value is the distance between soil borings BH-1 and BH-2.
Aquifer Thickness	The **Aquifer Thickness (d_a)** is a site specific value determined by the length of the monitoring well screen. The Aquifer Thickness value used in the modeling equations was 3.048 meters.
Depth of Source	The **Depth of Source (d_s)** was determined from the analytical results and soil boring logs. A value of 3.048 m was used to encompass the vertical thickness of contamination based upon a clean soil sample at BH-1A, "hot" samples at BH-2B and BH-2C, and a clean soil sample at BH-2D. Thus the vertical thickness of soil contamination has been determined to be 3.048 m.
Source Width	**The source width perpendicular to groundwater flow direction in the Horizontal Plane (S_w)** was determined from the site map and analytical results. A value of 3566.16 cm was used to encompass the width of contamination in the horizontal plane. This value is the distance between clean wells MW-4 and and MW-6.
Source Depth	**The source width perpendicular to groundwater flow direction in the Vertical Plane (S_d)** was determined from the soil boring logs and analytical results. A value of 304.8 cm was used to encompass the width of contamination in the vertical plane based on the depths of contamination present and the PID readings from the bore logs.
Distance (X)	

BENZENE								
Soil Exceedances					Groundwater Exceedances			
Location	Soil Concentration (mg/kg)	X (ft)	Gw_{obj} (mg/L) R26 Csource	C(x) (mg/L)	Location	Groundwater Concentration (mg/L)	X (ft)	C(x) (mg/L)
BH1	3.03	116	0.217	0.0049	MW1	8.300	265	0.0049
BH2	0.096	10	0.007	0.0048	MW2	0.269	124	0.0048
BH3	0.463	58	0.033	0.0048	MW4	2.000	201	0.0049
BH5	0.474	58	0.034	0.0049				
BH9	0.312	46	0.022	0.0048				

Toluene

Soil Exceedances					Groundwater Exceedances			
Location	Soil Concentration (mg/kg)	X (ft)	Gw_{obj} (mg/L) R26 Csource	C(x) (mg/L)	Location	Groundwater Concentration (mg/L)	X (ft)	C(x) (mg/L)

Ethylbenzene

Soil Exceedances					Groundwater Exceedances			
Location	Soil Concentration (mg/kg)	X (ft)	Gw_{obj} (mg/L) R26 Csource	C(x) (mg/L)	Location	Groundwater Concentration (mg/L)	X (ft)	C(x) (mg/L)
					MW1	3.240	15	0.6391
					MW4	3.830	16	0.6875

Total Xylenes								
Soil Exceedances					Groundwater Exceedances			
Location	Soil Concentration (mg/kg)	X (ft)	Gw_{obj} (mg/L) R26 Csource	C(x) (mg/L)	Location	Groundwater Concentration (mg/L)	X (ft)	C(x) (mg/L)
BH1	16.4		0.300543354					
BH5	25.7		0.471					

MTBE								
Soil Exceedances					Groundwater Exceedances			
Location	Soil Concentration (mg/kg)	X (ft)	Gw_{obj} (mg/L) R26 Csource	C(x) (mg/L)	Location	Groundwater Concentration (mg/L)	X (ft)	C(x) (mg/L)

Naphthalene								
Soil Exceedances					Groundwater Exceedances			
Location	Soil Concentration (mg/kg)	X (ft)	Gw_{obj} (mg/L) R26 Csource	C(x) (mg/L)	Location	Groundwater Concentration (mg/L)	X (ft)	C(x) (mg/L)
					MW1	0.387	10	0.1386
					MW4	1.230	24	0.1332

Benzo[a]pyrene								
Soil Exceedances					Groundwater Exceedances			
Location	Soil Concentration (mg/kg)	X (ft)	Gw_{obj} (mg/L) R26 Csource	C(x) (mg/L)	Location	Groundwater Concentration (mg/L)	X (ft)	C(x) (mg/L)
BH2	0.16		0.000001352					
BH9	2.6		0.000021973					
BH11	0.11		0.000000930					
BH12	1.5		0.000012677					
BH14	0.13		0.000001099					
BH16	0.12		0.000001014					

Dibenz[a,h]anthracene								
Soil Exceedances					Groundwater Exceedances			
Location	Soil Concentration (mg/kg)	X (ft)	Gw_{obj} (mg/L) R26 Csource	C(x) (mg/L)	Location	Groundwater Concentration (mg/L)	X (ft)	C(x) (mg/L)
BH2	0.23		0.000000522					
BH9	0.54		0.000001225					
BH12	0.26		0.000000590					

Lead				
Soil Exceedances				
Location	Soil Concentration (mg/kg)	X (ft)	Gw_{obj} (mg/L) R26 Csource	C(x) (mg/L)

Benz[a]anthracene

Soil Exceedances					Groundwater Exceedances			
Location	Soil Concentration (mg/kg)	X (ft)	Gw_{obj} (mg/L) R26 Csource	C(x) (mg/L)	Location	Groundwater Concentration (mg/L)	X (ft)	C(x) (mg/L)
BH9	2.5		0.000054142					

Acenaphthene

Soil Exceedances					Groundwater Exceedances			
Location	Soil Concentration (mg/kg)	X (ft)	Gw_{obj} (mg/L) R26 Csource	C(x) (mg/L)	Location	Groundwater Concentration (mg/L)	X (ft)	C(x) (mg/L)

Tier 2 Industrial/Commercial Calculations for Benzene

MotoMart - Swansea
2002-0431

SSL / RBCA | SSL & RBCA / IRIS/MEAST

Date Compiled: 07/26/16
Version: 8/25/2015

Input Values

Holcomb's Bulk Density -->	60.4	Converted Value to be used in calculation sheet -->			0.968	USDA Soil Classification:	Loamy Sand				
Organic Matter (%) -->	0	FOC % (0.58 conversion) -->	0.000	Organic Matter (mg/kg)	0	FOC mg/kg (0.58 conversion)	0.000	foc conversion to g/g:	0.000		

0.967	ρ_b - Dry Soil Bulk Density			1.5 or; Gravel = 2.0; Sand = 1.8; Silt = 1.6; Clay = 1.7; or Site Specific					
2.54	ps - Soil Particle Density			2.65 or; Site Specific					
0.292	Θ_a - Air Filled Soil Porosity	0.292	Value from S-21	Top 1 meter = 0.28; below 1 meter = 0.13; Gravel = 0.05; Sand = 0.14; Silt =0.24; Clay = 0.19; or Calculated Value (S21)					
0.327	Θw - Water Filled Soil Porosity	0.327	Value from S-20	Top 1 meter = 0.15; below 1 meter = 0.30; Gravel = 0.20; Sand = 0.18; Silt =0.16; Clay = 0.17; or Calculated Value (S20)					
0.619	η - SSL: Total Soil Porosity	0.619	Value from S-24	0.43 or; Gravel - 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.36; or Calculated Value (S24)					
0.0841379	I - Hydraulic Gradient			Site Specific					
0.006	foc - Total Organic Carbon (g/g)			Surface Soil = 0.006; Subsurface Soil = 0.002; or Site Specific					
20.000	DF - Dilution Factor	1.575	Value from S-22	If calculated value for DF is less than 20, then 20 default is used, else calculated value is used					
10.135	d - Mixing Zone (m)	10.135	Value from S-25	2; or calculated value					
3.048	d_a - Depth of source (m)		feet = 10	Depth of Source (Vertical thickness of contamination)					
13.56	K - Hydraulic Conductivity (m/yr)	cm/sec =	4.30E-05	Site Specific	3.72E+00	cm/d	1.36E+03	cm/yr	Use cm/d for R15, R19, & R26. cm/yr for R24
67.056	L - Source Length Parallel to Groundwater Flow (m)		feet = 220	Site Specific (m)					
3.048	d_a - Aquifer Thickness (m)		feet = 10	Site Specific (m)					
0.3	I - Infiltration Rate (m/yr)			0.3 for Illinois					
540	K_s - Saturated Hydraulic Conductivity			See Table K for Input Values					
0.005	GW_{ing} - Groundwater Remediation Objective Class 1			0.025 GW_{ing} - Groundwater Remediation Objective Class 2					
0.085	1/(2b+3) - Exponent for S20			See Table K for Input Values					
70	BW - Body Weight			Residential = 70 (carcinogenic); 15 (non-carcinogenic); Industrial/Commercial = 70; Construction Worker = 70; RBCA = 70					
114	$IF_{soil-adj}$ -Age Adjusted Soil Ingestion Factor for Carcinogens			114					
50	IR_{soil} -Soil Ingestion Rate			Residential = 200; Industrial/Commercial = 50; Construction Worker = 480					
0.055	SF_o -Oral Slope Factor			Benzene = 0.055					
1	IR_w -Daily Water Ingestion Rate			Residential = 2; Industrial/Commercial = 1					
1800	S - Solubility in Water			Benzene = 1750					
1.0E-06	TR - Target Cancer Risk			Residential = 10^{-6}; Industrial/Commercial = 10^{-6}; Construction Worker = 10^{-4} at point of human exposure					
70	AT_c -Average Time for Carcinogens			70					
7.80E-06	URF - Inhalation Unit Risk Factor			Benzene =7.8 x 10^{-6}					
250	EF - Exposure Frequency			Residential = 350; Industrial/Commercial = 250; Construction Worker = 30					
25	ED - Exposure Duration for Inhalation fo Carcinogens			Residential = 30; Industrial/Commercial = 25; Construction Worker = 1					
68.81	Q/C - Inverse of the mean concentration at the center of a square source			Residential = 68.81; Industrial/Commercial = 85.81; Construction Worker = 85.81; or Table H					
7.90E+08	T - Exposure Interval			Residential = 9.5 x10^{8}; Industrial/Commercial = 7.9 x 10^{8}; Construction Worker = 3.6 x 10^{6}					
30	T_{M-L} - Exposure Interval for Mail Limit Volatilization Factor Equation S26			30					
70	ED_{M-L} - Exposure Duration for Migration to Groundwater Mass-Limit Equation S28			70					
0.18	I_{M-L} - Infiltration Rate for Migration to Groundwater Mass-Limit Equation S28			0.18					
0.088	D_i - Diffusivity in Air			Benzene = 0.088					
0.23	H' - Henry's Law Constant			Benzene = 0.228					
1.02E-05	D_w - Diffusivity in Water			Benzene = 9.8 x 10^{-6}					
50	K_{oc} - Organic Carbon Partition Coefficient			Benzene = 58.9					

Industrial/Commercial Ingestion Tier II Benzene Objective

$$S\text{-}3 = \frac{TR \times BW \times AT_c \times 365}{SF_o \times 10^{-6} \times EF \times ED \times IRsoil} = \frac{1.0E\text{-}06 \times 70 \times 70 \times 365}{0.055 \times 1.00E\text{-}06 \times 250 \times 25 \times 50} = \frac{1.8E+00}{1.72E\text{-}02} = 104.058 \text{ mg/kg}$$

Construction Worker Ingestion Tier II Benzene Objective

$$S\text{-}3 = \frac{TR \times BW \times AT_c \times 365}{SF_o \times 10^{-6} \times EF \times IRsoil} = \frac{1.0E\text{-}06 \times 70 \times 70 \times 365}{0.055 \times 1.00E\text{-}06 \times 30 \times 480} = \frac{1.8E+00}{7.92E\text{-}04} = 2258.21 \text{ mg/kg}$$

Tier 2 Industrial/Commercial Calculations for Benzene

MotoMart - Swansea
2002-0431

Industrial/Commercial Inhalation Tier II Benzene Objective

$$S\text{-}6 = \frac{TR \times ATc \times 365}{URF \times 1000 \times EF \times ED \times 1/VF} = \frac{1.0E\text{-}06 \times 70 \times 365}{7.80E\text{-}06 \times 1000 \times 250 \times 25 \times (1/\ 6.13E+03)} = \frac{0.02555}{7.95E\text{-}03} = 3.213 \text{ mg/kg}$$

Construction Worker Inhalation Tier II Benzene Objective

$$S\text{-}7 = \frac{TR \times ATc \times 365}{URF \times 1000 \times EF \times ED \times 1/VF'} = \frac{1.0E\text{-}06 \times 70 \times 365}{7.80E\text{-}06 \times 1000 \times 30 \times 1 \times (1/\ 4.14E+01)} = \frac{0.02555}{5.66E\text{-}03} = 4.518 \text{ mg/kg}$$

RESIDENTIAL OR COMMERCIAL

$$S\text{-}8 = VF = \frac{Q}{C} \times \frac{(3.14 \times D_A \times T)^{1/2} \times 10^{-4}}{(2 \times \rho_b \times D_A)} = 85.81 \times \frac{(3.14 \times 1.30E\text{-}03 \times 7.90E+08)^{1/2} \times 0.0001}{(2 \times 0.967 \times 1.30E\text{-}03)} = \frac{15.4075}{0.0025} = 6129.7565$$

Construction Worker

$$S\text{-}8 = VF = \frac{Q}{C} \times \frac{(3.14 \times D_A \times T)^{1/2} \times 10^{-4}}{(2 \times \rho_b \times D_A)} = 85.81 \times \frac{(3.14 \times 1.30E\text{-}03 \times 3.60E+06)^{1/2} \times 0.0001}{(2 \times 0.967 \times 1.30E\text{-}03)} = \frac{1.0401}{0.0025} = 413.7909$$

Equation for Derivation of Volatilization Factor - Construction Worker

$$S\text{-}9 = VF' = \frac{VF}{10} = \frac{413.7909}{10} = 41.3791$$

Equation for Derivation of Apparent Diffusivity

$$S\text{-}10 = D_A = \frac{(\theta_a^{3.33} \times D_i \times H') + (\theta_w^{2.33} \times D_w)}{\eta^2} \times \frac{1}{(\rho_b \times K_d) + \theta_w + (\theta_a \times H')}$$

$$= \frac{(1.66E\text{-}02 \times 0.088 \times 0.230) + (0.0242 \times 1.02E\text{-}05)}{0.3832} \times \frac{1}{(0.967 \times 0.29) + 0.33 + (0.292 \times 0.230)} = 1.30E\text{-}03$$

Soil Component of the Migration to Groundwater Cleanup Objective (Class 1)

$$S\text{-}17 = C_w \times \left[K_d + \frac{(\theta_w + \theta_a \times H')}{\rho b} \right] = 0.1 \times \left[0.29 + \frac{(0.327 + 0.292 \times 0.230)}{0.967} \right] = 0.070 \text{ mg/kg}$$

Tier 2 Industrial/Commercial Calculations for Benzene

MotoMart - Swansea
2002-0431

Target Soil Leachate Concentration (Class 1)

S-18 = C_w = $DF \times GW_{std}$ = 20.00 x 0.005 = 0.1

Soil-Water Partition Coefficient

S-19 = K_d = $K_{oc} \times f_{oc}$ = 50.00 x 0.006 = 0.29

Water-Filled Porosity

S-20 = Θ_w = $\eta \times \frac{1}{K_s}^{1/(2b+3)}$ = 0.62 x $\left[\frac{0.300}{540.000}\right]^{0.089}$ = 0.3273

Air-Filled Porosity

S-21 = Θ_a = $\eta - \Theta_w$ = 0.62 - 0.33 = 0.2920

Dilution Factor

S-22 = DF = $1 + \frac{K \times i \times d}{I \times L}$ = $\frac{13.56}{0.300} \times \frac{0.0841}{67.056} \times \frac{10.135}{1} + 1$ = 1.5748

GW Ingestion

S-23 = $\frac{TR \times BW \times AL_c \times 365}{SF_o \times IR_w \times EF \times ED}$ = $\frac{1.0E\text{-}06}{0.055} \times \frac{70}{1.000} \times \frac{70}{250} \times \frac{365}{25}$ = $\frac{1.6E+00}{343.75}$ = 0.0052 mg/L

Total Soil Porosity

S-24 = η = $1 - \frac{\rho_b}{\rho_s}$ = 1 - $\frac{0.967}{2.54}$ = 0.6193

Estimation of Mixing Zone Depth

S-25 = $d = (0.0112 \times L^2)^{0.5} + d_a\left[1 - \exp\frac{(-L \times I)}{(K \times i \times d_a)}\right]$

= (0.0112 x 67.056 ^{2})$^{0.5}$ + 3.048 x $\left[1 - \exp\left(\frac{-67.056}{13.560} \times \frac{0.3}{0.0841} \times \frac{1}{3.048}\right)\right]$ = 10.135 m

Soil Saturation Limit

S-29 = $C_{sat} = \frac{S}{\rho_b} \times [(K_d \times \rho b) + \Theta w + (H' \times \Theta a)]$ = $\frac{1800}{0.967}$ x [(0.29 x 0.967) + 0.327 + (0.230 x 0.292)] = 1,255.70 mg/kg

Tier 2 Industrial/Commercial Calculations for Toluene

MotoMart - Swansea
2002-0431

SSL | SSL & RBCA
RBCA | IRIS/HEAST

Date Compiled: 07/26/16
Version: 8/25/2015

Input Values

Holcomb's Bulk Density -->	60.4	Converted Value to be used in calculation sheet -->			0.967515	USDA Soil Classification:	Loamy Sand			
Organic Matter (%) -->	0	FOC % (0.58 conversion) -->	0.000	Organic Matter (mg/kg)	0	FOC mg/kg (0.58 conversion)	0.000	foc conversion to g/g:	0.000	

0.967	ρ_b - Dry Soil Bulk Density				1.5 or; Gravel = 2.0; Sand = 1.8; Silt = 1.6; Clay = 1.7; or Site Specific
2.54	ps - Soil Particle Density				2.65 or; Site Specific
0.292	Θ_a - Air Filled Soil Porosity	*0.292*	Value from S-21		Top 1 meter = 0.28; below 1 meter = 0.13; Gravel = 0.05; Sand = 0.14; Silt =0.24; Clay = 0.19; or Calculated Value (S21)
0.327	Θ_w - Water Filled Soil Porosity	*0.327*	Value from S-20		Top 1 meter = 0.15; below 1 meter = 0.30; Gravel = 0.20; Sand = 0.18; Silt =0.16; Clay = 0.17; or Calculated Value (S20)
0.619	η - SSL Total Soil Porosity	*0.619*	Value from S-24		0.43 or; Gravel = 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.36; or Calculated Value (S24 or R23)
0.0841379	I - Hydraulic Gradient				Site Specific
0.006	foc - Total Organic Carbon (g/g)				Surface Soil = 0.006, Subsurface Soil = 0.002, or Site Specific
20.000	DF - Dilution Factor	*1.575*	Value from S-22		If calculated value for DF is less than 20, then 20 default is used, else calculated value is used
10.135	d - Mixing Zone (m)	10.135	Value from S-25		2; or calculated value
3.048	d_s - Depth of source (m)		feet = 10		Depth of Source (Vertical thickness of contamination)
13.56	K - Hydraulic Conductivity (m/yr)	cm/sec =	4.30E-05	Site Specific	3.72E+00 cm/d | 1.36E+03 cm/yr | Use cm/d for R15, R19, & R26; cm/yr for R24
67.056	L - Source Length Parallel to Groundwater Flow (m)		feet = 220		Site Specific (m)
3.048	d_a - Aquifer Thickness (m)		feet = 10		Site Specific (m)
0.3	I - Infiltration Rate (m/yr)				0.3 for Illinois
540	K_s - Saturated Hydraulic Conductivity				See Table K for Input Values
1.000	GW_{obj} - Groundwater Remediation Objective Class 1				2.5 GW_{obj} - Groundwater Remediation Objective Class 2
0.085	1/(2b+3) - Exponent for S20				See Table K for Input Values
15	BW - Body Weight				Residential = 70 (carcinogenic); 15 (non-carcinogenic); Industrial/Commercial = 70; Construction Worker = 70; RBCA = 70
114	IF_{ca-adj} -Age Adjusted Soil Ingestion Factor for Carcinogens				114
50	IR_{soil} -Soil Ingestion Rate				Residential = 200; Industrial/Commercial = 50; Construction Worker = 480
1	IR_w -Daily Water Ingestion Rate				Residential = 2; Industrial/Commercial = 1
530	S - Solubility in Water				Toluene = 526
1.0E-06	TR - Target Cancer Risk				Residential = 10^{-6}; Industrial/Commercial = 10^{-5}; Construction Worker = 10^{-6} at point of human exposure
250	EF - Exposure Frequency				Residential = 350; Industrial/Commercial = 250; Construction Worker = 30
25	ED - Exposure Duration for Inhalation for Non-Carcinogens				Residential = 30; Industrial/Commercial = 25; Construction Worker = 1
68.81	C/C - Inverse of the mean concentration at the center of a square source				Residential = 68.81; Industrial/Commercial = 85.81; Construction Worker = 85.81; or Table H
7.90E+08	T - Exposure Interval				Residential = 9.5 x 10^8; Industrial/Commercial = 7.9 x 10^8; Construction Worker = 3.6 x 10^8
30	T_{sl-L} - Exposure Interval for Mass Limit Volatilization Factor Equation S28				30
70	ED_{sl-L} - Exposure Duration for Migration to Groundwater Mass-Limit Equation S28				70
0.18	I_{sl-L} - Infiltration Rate for Migration to Groundwater Mass-Limit Equation S28				0.18
0.087	D_i - Diffusivity in Air				Toluene = 0.087
0.271	H' - Henry's Law Constant				Toluene = 0.272
8.60E-06	D_w - Diffusivity in Water				Toluene = 8.6 x 10^{-6}
25	AT - Average Time for Non-Carcinogens in Ingestion Equation				Residential = 6; Industrial/Commercial = 25; Construction Worker = 0.115
25	AT - Average Time for Non-Carcinogens in Inhalation Equation				Residential = 30; Industrial/Commercial = 25; Construction Worker = 0.115
1	THQ - Target Hazard Quotient				1
.5	RfC - Inhalation Reference Concentration				Chronic = 5; Subchronic = 5
0.8	RfD_o - Oral Reference Dose				Chronic = 0.08; Subchronic = 0.8
158.00	K_{oc} - Organic Carbon Partition Coefficient				Toluene = 182

Industrial/Commercial Ingestion Remediation Objectives for Non-Carcinogenic Contaminants

$$S\text{-}1 = \frac{THQ \times BW \times AT \times 365}{10^{-6} \times (1/RfD_o) \times EF \times ED \times IR_{soil}} = \frac{1}{0.000001} \times \frac{70}{1/0.8} \times \frac{25}{250} \times \frac{365}{25} \times \frac{}{50} = \frac{638750}{0.390625} = 1635200 \text{ mg/kg}$$

Construction Worker Ingestion Remediation Objectives for Non-Carcinogenic Contaminants

$$S\text{-}1 = \frac{THQ \times BW \times AT \times 365}{10^{-6} \times (1/RfD_o) \times EF \times ED \times IR_{soil}} = \frac{1}{0.000001} \times \frac{70}{1/0.8} \times \frac{0.115}{30} \times \frac{365}{1} \times \frac{}{480} = \frac{2938.25}{0.018} = 163236 \text{ mg/kg}$$

Inhalation Non-Carcinogenic Residential, Ind/Commercial

$$S\text{-}4 = \frac{THQ \times AT \times 365}{EF \times ED \times (1/RfC \times 1/VF)} = \frac{1}{250} \times \frac{25}{1/25} \times \frac{365}{1/5} \times \frac{}{7861.554232} = \frac{9125}{0.159002} = 57389.346 \text{ mg/kg}$$

Tier 2 Inhalation Objective cannot exceed Soil Saturation Limit

Inhalation Non-Carcinogenic Construction Worker

$$S\text{-}5 = \frac{THQ \times AT \times 365}{EF \times ED \times (1/RfC \times 1/VF)} = \frac{1}{30} \times \frac{0.115}{1/1} \times \frac{365}{1/5} \times \frac{}{53.06963729} = \frac{41.975}{0.113059} = 371.266 \text{ mg/kg}$$

RESIDENTIAL OR COMMERCIAL

$$S\text{-}8 = VF = \frac{Q}{C} \times \frac{(3.14 \times D_A \times T)^{1/2} \times 10^{-4}}{(2 \times \rho_b \times D_A)} = 85.81 \times \left(\frac{3.14}{2} \times \frac{7.90E\text{-}04}{0.967} \times \frac{7.90E+08}{7.90E\text{-}04}\right)^{1/2} \times 0.0001 = \frac{12.0134}{1.53E\text{-}03} = 7861.5542$$

Tier 2 Industrial/Commercial Calculations for Toluene

MotoMart - Swansea
2002-0431

Construction Worker

$$S\text{-}8 = VF = \frac{Q}{C} \times \frac{(3.14 \times D_A \times T)^{1/2} \times 10^{-4}}{(2 \times \rho_b \times D_A)} = 85.81 \times \frac{\left(\frac{3.14 \times 7.90E\text{-}04 \times 3.60E+06}{2 \times 0.967 \times 7.90E\text{-}04}\right)^{1/2} \times 0.0001}{1.53E\text{-}03} = 530.6964$$

Equation for Derivation of Volatilization Factor - Construction Worker

$$S\text{-}9 = VF' = \frac{VF}{10} = \frac{530.6964}{10} = 53.0696$$

Equation for Derivation of Apparent Diffusivity

$$S\text{-}10 = D_A = \frac{(\theta_a^{3.33} \times D_i \times H') + (\theta_w^{3.33} \times D_w)}{\eta^2} \times \frac{1}{(\rho_b \times K_d) + \theta_w + (\theta_a \times H')}$$

$$= \frac{\left(\frac{1.66E\text{-}02 \times 0.087 \times 0.271}{0.3832}\right) + \left(0.0242 \times 8.60E\text{-}06\right)}{\left(0.967 \times 0.9164\right) + 0.33 + \left(0.292 \times 0.271\right)} \times \frac{1}{} = 7.90E\text{-}04$$

Soil Component of the Migration to Groundwater Cleanup Objective (Class 1)

$$S\text{-}17 = C_w \times \left[K_d + \frac{(\theta_w + \theta_a \times H')}{\rho b}\right] = 20 \times \left[0.9164 + \frac{0.327 + 0.292 \times 0.271}{0.967}\right] = 26.728 \text{ mg/kg}$$

Target Soil Leachate Concentration (Class 1)

$$S\text{-}18 = C_w = DF \times GW_{obj} = 20.00 \times 1.000 = 20$$

Soil-Water Partition Coefficient

$$S\text{-}19 = K_d = K_{oc} \times f_{oc} = 158.00 \times 0.006 = 0.9164$$

Water-Filled Porosity

$$S\text{-}20 = \Theta_w = \eta \times \frac{1}{K_s}^{1/(2b+3)} = 0.62 \times \left[\frac{0.300}{540.000}\right]^{0.065} = 0.3273$$

Tier 2 Industrial/Commercial Calculations for Toluene

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Air-Filled Porosity

$S\text{-}21 = \Theta_a = \eta - \Theta_w = 0.62 - 0.33 = 0.2920$

Dilution Factor

$S\text{-}22 = DF = 1 + \frac{K \times i \times d}{I \times L} = \frac{13.56}{0.300} \times \frac{0.0841}{67.056} \times 10.135 + 1 = 1.5748$

GW Ingestion

$S\text{-}23 = \frac{TR \times BW \times AT_c \times 365}{SF_o \times IR_w \times EF \times ED} = \frac{1.0E\text{-}06}{0.000} \times \frac{15}{1.000} \times \frac{0}{250} \times \frac{365}{25} = \frac{0.0E+00}{0} = \#DIV/0!$ mg/L

Total Soil Porosity

$S\text{-}24 = \eta = 1 - \frac{\rho_b}{\rho_s} = 1 - \frac{0.967}{2.54} = 0.6193$

Estimation of Mixing Zone Depth

$S\text{-}25 = d = (0.0112 \times L^2)^{0.5} + d_a \left[1 - \exp\frac{(-L \times I)}{(K \times i \times d_a)}\right]$

$= (0.0112 \times 67.056^2)^{0.5} + 3.048 \times \left[1 - \exp\left(\frac{-67.056}{13.560} \times \frac{0.3}{0.0841} \times \frac{1}{3.048}\right)\right] = 10.135$ m

Soil Saturation Limit

$S\text{-}29 = C_{sat} = \frac{S}{\rho_b} \times [(K_d \times \rho b) + \Theta w + (H' \times \theta a)] = \frac{530}{0.967} \times [(0.9164 \times 0.967) + 0.327 + (0.271 \times 0.292)] = 708.29$ mg/kg

Tier 2 Industrial/Commercial Calculations for Ethylbenzene

MotoMart - Swansea
2002-0431

SSL / RBCA | SSL & RBCA / IRIS/HEAST

Date Compiled: 07/26/16
Version 8/25/2015

Input Values

Holcomb's Bulk Density -->	80.4	Converted Value to be used in calculation sheet -->			0.967515	USDA Soil Classification	Loamy Sand				
Organic Matter (%) -->	0	FOC % (0.58 conversion) -->	0.000		Organic Matter (mg/kg)	0	FOC mg/kg (0.58 conversion)	0.000	foc conversion to g/g:	0.000	

0.967	ρ_b - Dry Soil Bulk Density				1.5 or; Gravel = 2.0; Sand = 1.8; Silt = 1.6; Clay = 1.7, or Site Specific
2.54	ps - Soil Particle Density				2.65 or; Site Specific
0.292	Θ_a - Air Filled Soil Porosity	0.292	Value from S-21		Top 1 meter = 0.28; below 1 meter = 0.13, Gravel = 0.05; Sand = 0.14; Silt =0.24; Clay = 0.19; or Calculated Value (S21)
0.327	Θw - Water Filled Soil Porosity	0.327	Value from S-20		Top 1 meter = 0.15; below 1 meter = 0.30; Gravel = 0.20; Sand = 0.18; Silt =0.16; Clay = 0.17; or Calculated Value (S20)
0.619	n - SSL Total Soil Porosity	0.619	Value from S-24		0.43 or; Gravel - 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.36; or Calculated Value (S24)
0.0841379	I - Hydraulic Gradient				Site Specific
0.006	foc - Total Organic Carbon (g/g)				Surface Soil = 0.006; Subsurface Soil = 0.002; or Site Specific
20.000	DF - Dilution Factor	1.575	Value from S-22		If calculated value for DF is less than 20, then 20 default is used, else calculated value is used
10.135	d - Mixing Zone (m)	10.135	Value from S-25		2; or calculated value
3.048	d_a - Depth of source (m)		feet = 10		Depth of Source (Vertical thickness of contamination)
13.56	K - Hydraulic Conductivity (m/yr)	cm/sec =	4.30E-05	Site Specific	3.72E+00 cm/d | 1.35E+03 cm/yr | Use cm/d for R15, R19, & R25; cm/yr for R24
67.056	L - Source Length Parallel to Groundwater Flow (m)		feet = 220		Site Specific (m)
3.048	d_a - Aquifer Thickness (m)		feet = 10		Site Specific (m)
0.3	I - Infiltration Rate (m/yr)				0.3 for Illinois
.540	K_s - Saturated Hydraulic Conductivity				See Table K for Input Values
0.700	GW_{obj} - Groundwater Remediation Objective Class 1			1	GW_{obj} - Groundwater Remediation Objective Class 2
0.085	1/(2b+3) - Exponent for S20				See Table K for Input Values
70	BW - Body Weight				Residential = 70 (carcinogenic); 15 (non-carcinogenic); Industrial/Commercial = 70; Construction Worker = 70; RBCA = 70
114	IF_{ca-adj} -Age Adjusted Soil Ingestion Factor for Carcinogens				114
50	IR_{soil} -Soil Ingestion Rate				Residential = 200; Industrial/Commercial = 50; Construction Worker = 480
1	IR_w -Daily Water Ingestion Rate				Residential = 2; Industrial/Commercial = 1
170	S - Solubility in Water				Ethylbenzene = 169
1.0E-05	TR - Target Cancer Risk				Residential = 10^{-5}; Industrial/Commercial = 10^{-5}; Construction Worker = 10^{-5} at point of human exposure
250	EF - Exposure Frequency				Residential = 350; Industrial/Commercial = 250; Construction Worker = 30
25	ED - Exposure Duration for Inhalation for Non-Carcinogens				Residential = 30; Industrial/Commercial = 25; Construction Worker = 1
68.81	Q/C - Inverse of the mean concentration at the center of a square source				Residential = 68.81; Industrial/Commercial = 85.81; Construction Worker = 85.81; or Table H
7.90E+08	T - Exposure Interval				Residential = 9.5×10^8; Industrial/Commercial = 7.9×10^8; Construction Worker = 3.6×10^6
30	T_{MLA} - Exposure Interval for Mass Limit Volatilization Factor Equation S26				30
70	ED_{GCL} - Exposure Duration for Migration to Groundwater Mass-Limit Equation S28				70
0.18	I_{MLA} - Infiltration Rate for Migration to Groundwater Mass-Limit Equation S28				0.18
0.075	D_i - Diffusivity in Air				Ethylbenzene = 0.075
0.324	H' - Henry's Law Constant				Ethylbenzene = 0.323
7.80E-06	D_w - Diffusivity in Water				Ethylbenzene = 7.8×10^{-6}
25	AT - Average Time for Non-Carcinogens in Ingestion Equation				Residential = 6; Industrial/Commercial = 25; Construction Worker = 0.115
25	AT - Average Time for Non-Carcinogens in Inhalation Equation				Residential = 30; Industrial/Commercial = 25; Construction Worker = 0.115
1	THQ - Target Hazard Quotient				1
1	RfC - Inhalation Reference Concentration				Chronic = 1; Subchronic = 9
0.1	RfD_o - Oral Reference Dose				Chronic = 0.1; Subchronic = 0.05
320.00	K_{oc} - Organic Carbon Partition Coefficient				Ethylbenzene = 363

Industrial/Commercial Ingestion Remediation Objectives for Non-Carcinogenic Contaminants

$$S\text{-}1 = \frac{THQ \times BW \times AT \times 365}{10^{-6} \times (1/RfD_o) \times EF \times ED \times IR_{soil}} = \frac{1 \times 70 \times 25 \times 365}{0.000001 \times 1/0.1 \times 250 \times 25 \times 50} = \frac{638750}{3.125} = 204400 \text{ mg/kg}$$

Construction Worker Ingestion Remediation Objectives for Non-Carcinogenic Contaminants

$$S\text{-}1 = \frac{THQ \times BW \times AT \times 365}{10^{-6} \times (1/RfD_o) \times EF \times ED \times IR_{soil}} = \frac{1 \times 70 \times 0.115 \times 365}{0.000001 \times 1/0.05 \times 30 \times 1 \times 480} = \frac{2938.25}{0.288} = 10202 \text{ mg/kg}$$

Inhalation Non-Carcinogenic Residential, Ind/Commercial

$$S\text{-}4 = \frac{THQ \times AT \times 365}{EF \times ED \times (1/RfC \times 1/VF)} = \frac{1 \times 25 \times 365}{250 \times 25 \times 1/1 \times 1/10141.52875} = \frac{9125}{0.616278} = 14807 \text{ mg/kg}$$

Tier 2 Inhalation Objective cannot exceed Soil Saturation Limit

Inhalation Non-Carcinogenic Construction Worker

$$S\text{-}5 = \frac{THQ \times AT \times 365}{EF \times ED \times (1/RfC \times 1/VF)} = \frac{1 \times 0.115 \times 365}{30 \times 1 \times 1/9 \times 1/68.46056775} = \frac{41.975}{0.04869} = 862.091 \text{ mg/kg}$$

Tier 2 Inhalation Objective cannot exceed Soil Saturation Limit

RESIDENTIAL OR COMMERCIAL

$$S\text{-}8 = VF = \frac{Q}{C} \times \frac{(3.14 \times D_A \times T)^{1/2} \times 10^{-4}}{(2 \times \rho_b \times D_A)} = 85.81 \times \frac{\left(3.14 \times 4.75E\text{-}04 \times 7.90E+08\right)^{1/2} \times 0.0001}{\left(2 \times 0.967 \times 4.75E\text{-}04\right)} = \frac{9.3128}{9.18E\text{-}04} = 10141.5287$$

Tier 2 Industrial/Commercial Calculations for Ethylbenzene

MotoMart - Swansea
2002-0431

Construction Worker

$$S\text{-}8 = VF = \frac{Q}{C} \times \frac{(3.14 \times D_A \times T)^{1/2} \times 10^{-4}}{(2 \times \rho_b \times D_A)} = 85.81 \times \frac{\left(\frac{3.14 \times 4.75E\text{-}04 \times 3.60E{+}06}{2 \times 0.967 \times 4.75E\text{-}04}\right)^{1/2} \times 0.0001}{9.18E\text{-}04} = 684.6067$$

Equation for Derivation of Volatilization Factor - Construction Worker

$$S\text{-}9 = VF' = \frac{VF}{10} = \frac{684.6067}{10} = 68.4607$$

Equation for Derivation of Apparent Diffusivity

$$S\text{-}10 = D_A = \frac{(\theta_a^{3.33} \times D_i \times H') + (\theta_w^{3.33} \times D_w)}{\eta^2} \times \frac{1}{(\rho_b \times K_d) + \theta_w + (\theta_a \times H')}$$

$$= \frac{\left(\frac{1.66E\text{-}02 \times 0.075 \times 0.324}{0.3832}\right) + \left(\frac{0.0242 \times 7.80E\text{-}06}{0.3832}\right)}{\left(0.967 \times 1.856\right) + 0.33 + \left(0.292 \times 0.324\right)} \times \frac{1}{} = 4.75E\text{-}04$$

Soil Component of the Migration to Groundwater Cleanup Objective (Class 1)

$$S\text{-}17 = C_w \times \left[K_d + \frac{(\theta_w + \theta_a \times H')}{\rho b}\right] = 14 \times \left[1.856 + \left(\frac{0.327 + 0.292 \times 0.324}{0.967}\right)\right] = 32.088 \text{ mg/kg}$$

Target Soil Leachate Concentration (Class 1)

$$S\text{-}18 = C_w = DF \times GW_{obj} = 20.00 \times 0.700 = 14$$

Soil-Water Partition Coefficient

$$S\text{-}19 = K_d = K_{oc} \times f_{oc} = 320.00 \times 0.006 = 1.856$$

Water-Filled Porosity

$$S\text{-}20 = \Theta_w = \eta \times \frac{1}{K_a}^{1/(2+3)} = 0.62 \times \left[\frac{0.300}{540.000}\right]^{0.065} = 0.3273$$

Tier 2 Industrial/Commercial Calculations for Ethylbenzene

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Air-Filled Porosity

S-21 = $\Theta_a = \eta - \Theta_w$ = 0.62 - 0.33 = 0.2920

Dilution Factor

S-22 = $DF = 1 + \frac{K \times i \times d}{I \times L}$ = $\frac{13.56}{0.300} \times \frac{0.0841}{67.056} \times \frac{10.135}{} + 1$ = 1.5748

GW Ingestion

S-23 = $\frac{TR \times BW \times AL_c \times 365}{SF_o \times IR_w \times EF \times ED}$ = $\frac{1.0E-06}{0.000} \times \frac{70}{1.000} \times \frac{0}{250} \times \frac{365}{25}$ = $\frac{0.0E+00}{0}$ = #DIV/0! mg/L

Total Soil Porosity

S-24 = $\eta = 1 - \frac{\rho_b}{\rho_s}$ = 1 - $\frac{0.967}{2.54}$ = 0.6193

Estimation of Mixing Zone Depth

S-25 = $d = (0.0112 \times L^2)^{0.5} + d_a \left[1 - \exp \frac{(-L \times I)}{(K \times i \times d_a)}\right]$

= $(0.0112 \times 67.056^2)^{0.5} + 3.048 \times \left[1 - \exp \frac{(-67.056 \times 0.3)}{(13.560 \times 0.0841 \times 3.048)}\right]$ = 10.135 m

Soil Saturation Limit

S-29 = $C_{sat} = \frac{S}{\rho_b} \times [(K_d \times \rho b) + \Theta w + (H' \times \theta a)]$ = $\frac{170}{0.967} \times [(1.856 \times 0.967) + 0.327 + (0.324 \times 0.292)]$ = 389.64 mg/kg

Tier 2 Industrial/Commercial Calculations for Total Xylenes

MotoMart - Swansea
2002-0431

SSL | SSL & RBCA
RBCA | IR/S/HEAS

Date Compiled: 07/26/16
Version: 8/25/2015

Input Values

Holcomb's Bulk Density -->	60.4	Converted Value to be used in calculation sheet -->			0.967515	USDA Soil Classification:	Loamy Sand				
Organic Matter (%) -->	0	FOC % (0.58 conversion) -->		0.000	Organic Matter (mg/kg)	0	FOC mg/kg (0.58 conversion)	0.000	foc conversion to g/g:	0.000	

0.967	ρ_b - Dry Soil Bulk Density				1.5 or; Gravel = 2.0; Sand = 1.8; Silt = 1.6; Clay = 1.7; or Site Specific
2.54	ρ_s - Soil Particle Density				2.65 or; Site Specific
0.292	Θ_a - Air Filled Soil Porosity	0.292	Value from S-21		Top 1 meter = 0.28; below 1 meter = 0.13; Gravel = 0.05; Sand = 0.14; Silt =0.24; Clay = 0.19, or Calculated Value (S21)
0.327	Θ_w - Water Filled Soil Porosity	0.327	Value from S-20		Top 1 meter = 0.15, below 1 meter = 0.30; Gravel = 0.20; Sand = 0.18, Silt =0.16; Clay = 0.17, or Calculated Value (S20)
0.619	η - SSL Total Soil Porosity	0.619	Value from S-24		0.43 or; Gravel - 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.36; or Calculated Value (S24)
0.0841379	I - Hydraulic Gradient				Site Specific
0.006	foc - Total Organic Carbon (g/g)				Surface Soil = 0.006; Subsurface Soil = 0.002; or Site Specific
20.000	DF - Dilution Factor	1.575	Value from S-22		If calculated value for DF is less than 20, then 20 default is used, else calculated value is used
10.135	d - Mixing Zone (m)	10.135	Value from S-25		2; or calculated value
3.048	d_a - Depth of source (m)		feet = 10		Depth of Source (Vertical thickness of contamination)
13.56	K - Hydraulic Conductivity (m/yr)	cm/sec =	4.30E-05	Site Specific	3.72E+00 cm/d 1.36E+03 cm/yr Use cm/d for R15, R19, & R26 cm/yr for R24
67.056	L_s - Source Length Parallel to Groundwater Flow (m)		feet = 220		Site Specific (m)
3.048	d_s - Aquifer Thickness (m)		feet = 10		Site Specific (m)
0.3	I - Infiltration Rate (m/yr)				0.3 for Illinois
540	K_s - Saturated Hydraulic Conductivity				See Table K for Input Values
10.000	GW_{obj} - Groundwater Remediation Objective Class 1			10	GW_{obj} - Groundwater Remediation Objective Class 2
0.085	1/(2b+3) - Exponent for S20				See Table K for Input Values
70	BW - Body Weight				Residential = 70 (carcinogenic); 15 (non-carcinogenic); Industrial/Commercial = 70; Construction Worker = 70; RBCA = 70
114	$IF_{ADAF-ing}$ -Age Adjusted Soil Ingestion Factor for Carcinogens				114
50	IR_{calc} -Soil Ingestion Rate				Residential = 200; Industrial/Commercial = 50; Construction Worker = 480
1	IR_w -Daily Water Ingestion Rate				Residential = 2; Industrial/Commercial = 1
110	S - Solubility in Water				Total Xylenes = 186
1.0E-05	TR - Target Cancer Risk				Residential = 10^{-5}; Industrial/Commercial = 10^{-5}; Construction Worker = 10^{-5} at point of human exposure
250	EF - Exposure Frequency				Residential = 350; Industrial/Commercial = 250; Construction Worker = 30
25	ED - Exposure Duration for Inhalation for Non-Carcinogens				Residential = 30; Industrial/Commercial = 25; Construction Worker = 1
68.81	Q/C - Inverse of the mean concentration at the center of a square source				Residential = 68.81; Industrial/Commercial = 65.81; Construction Worker = 65.81; or Table H
7.90E+08	T - Exposure Interval				Residential = 9.5 x 10^8; Industrial/Commercial = 7.9 x 10^8; Construction Worker = 3.6 x 10^8
30	T_{M-L} - Exposure Interval for Mass Limit Volatilization Factor Equation S26				30
70	ED_{M-L} - Exposure Duration for Migration to Groundwater Mass-Limit Equation S28				70
0.18	I_{M-L} - Infiltration Rate for Migration to Groundwater Mass-Limit Equation S28				0.18
0.074	D_i - Diffusivity in Air				Total Xylenes = 0.072
0.271	H' - Henry's Law Constant				Total Xylenes = 0.25
9.23E-06	D_w - Diffusivity in Water				Total Xylenes = 9.34 x 10^{-6}
25	AT - Average Time for Non-Carcinogens In Ingestion Equation				Residential = 6; Industrial/Commercial = 25, Construction Worker = 0.115
25	AT - Average Time for Non-Carcinogens In Inhalation Equation				Residential = 30; Industrial/Commercial = 25, Construction Worker = 0.115
1	THQ - Target Hazard Quotient				1
0.1	RfC - Inhalation Reference Concentration				Chronic = 0.1; Subchronic = 0.4
0.2	RfD_o - Oral Reference Dose				Chronic = 0.2; Subchronic = 0.4
398.00	K_{oc} - Organic Carbon Partition Coefficient				Total Xylenes = 260

Industrial/Commercial Ingestion Remediation Objectives for Non-Carcinogenic Contaminants

$$S\text{-}1 = \frac{THQ \times BW \times AT \times 365}{10^{-6} \times (1/RfD_o) \times EF \times ED \times IR_{calc}} = \frac{1}{0.000001} \times \frac{70}{0.2} \times \frac{25}{250} \times \frac{365}{25} \times \frac{}{50} = \frac{638750}{1.5625} = 408800 \text{ mg/kg}$$

Construction Worker Ingestion Remediation Objectives for Non-Carcinogenic Contaminants

$$S\text{-}1 = \frac{THQ \times BW \times AT \times 365}{10^{-6} \times (1/RfD_o) \times EF \times ED \times IR_{calc}} = \frac{1}{0.000001} \times \frac{70}{0.4} \times \frac{0.115}{30} \times \frac{365}{1} \times \frac{}{480} = \frac{2938.25}{0.036} = 81618 \text{ mg/kg}$$

Inhalation Non-Carcinogenic Residential, Ind/Commercial

$$S\text{-}4 = \frac{THQ \times AT \times 365}{EF \times ED \times (1/RfC \times 1/VF)} = \frac{1}{250} \times \frac{25}{25} \times \frac{365}{0.1} \times \frac{}{12220.23734} = \frac{9125}{5.114466951} = 1784.155 \text{ mg/kg}$$

Tier 2 Inhalation Objective cannot exceed Soil Saturation Limit

Inhalation Non-Carcinogenic Construction Worker

$$S\text{-}5 = \frac{THQ \times AT \times 365}{EF \times ED \times (1/RfC \times 1/VF)} = \frac{1}{30} \times \frac{0.115}{1} \times \frac{365}{0.4} \times \frac{}{82.49304706} = \frac{41.975}{0.909167532} = 46.169 \text{ mg/kg}$$

RESIDENTIAL OR COMMERCIAL

$$S\text{-}8 = VF = \frac{Q}{C} \times \frac{(3.14 \times D_A \times T)^{1/2} \times 10^{-4}}{(2 \times \rho_b \times D_A)} = 65.81 \times \frac{\left(3.14 \times 3.27E\text{-}04 \times 7.90E+08\right)^{1/2}}{\left(2 \times 0.967 \times 3.27E\text{-}04\right)} \times 0.0001 = \frac{7.7285}{6.32E\text{-}04} = 12220.2373$$

Tier 2 Industrial/Commercial Calculations for Total Xylenes

MotoMart - Swansea
2002-0431

Construction Worker

$$S\text{-}8 = VF = \frac{Q}{C} \times \frac{(3.14 \times D_A \times T)^{1/2} \times 10^{-4}}{(2 \times \rho_b \times D_A)} = 85.81 \times \frac{\left(\frac{3.14}{2} \times \frac{3.27E\text{-}04}{0.967} \times \frac{3.60E+06}{3.27E\text{-}04}\right)^{1/2} \times 0.0001}{6.32E\text{-}04} = 824.9305$$

Equation for Derivation of Volatilization Factor - Construction Worker

$$S\text{-}9 = VF' = \frac{VF}{10} = \frac{824.9305}{10} = 82.4930$$

Equation for Derivation of Apparent Diffusivity

$$S\text{-}10 = D_A = \frac{(\theta_a^{3.33} \times D_i \times H') + (\theta_w^{3.33} \times D_w)}{\eta^2} \times \frac{1}{(\rho_b \times K_d) + \theta_w + (\theta_a \times H')}$$

$$= \frac{\left(\frac{1.66E\text{-}02}{0.3832} \times 0.074 \times 0.271\right) + \left(0.0242 \times 9.23E\text{-}06\right)}{\left(0.967 \times 2.3084\right) + 0.33 + \left(0.292 \times 0.271\right)} \times \frac{1}{} = 3.27E\text{-}04$$

Soil Component of the Migration to Groundwater Cleanup Objective (Class 1)

$$S\text{-}17 = C_w \times \left[K_d + \frac{(\theta_w + \theta_a \times H')}{\rho b}\right] = 200 \times \left[2.3084 + \frac{0.327 + 0.292 \times 0.271}{0.967}\right] = 545.678 \text{ mg/kg}$$

Tier 2 Soil Component of GW Ingestion Objective cannot exceed Soil Saturation Limit

Target Soil Leachate Concentration (Class 1)

$$S\text{-}18 = C_w = DF \times GW_{obj} = 20.00 \times 10.000 = 200$$

Soil-Water Partition Coefficient

$$S\text{-}19 = K_d = K_{oc} \times f_{oc} = 398.00 \times 0.006 = 2.3084$$

Water-Filled Porosity

$$S\text{-}20 = \Theta_w = \eta \times \frac{1}{K_a}^{1/(2b+3)} = 0.62 \times \left[\frac{0.300}{540.000}\right]^{0.045} = 0.3273$$

Tier 2 Industrial/Commercial Calculations for Total Xylenes

MotoMart - Swansea
2002-0431

Air-Filled Porosity

S-21 = $\Theta_a = \eta - \Theta_w$ = 0.62 - 0.33 = 0.2920

Dilution Factor

S-22 = $DF = 1 + \frac{K \times i \times d}{I \times L}$ = $\frac{13.56}{0.300} \times \frac{0.0841}{67.056} \times 10.135 + 1$ = 1.5748

GW Ingestion

S-23 = $\frac{TR \times BW \times AL_c \times 365}{SF_o \times IR_w \times EF \times ED}$ = $\frac{1.0E\text{-}06}{0.000} \times \frac{70}{1.000} \times \frac{0}{250} \times \frac{365}{25}$ = $\frac{0.0E+00}{0}$ = #DIV/0! mg/L

Total Soil Porosity

S-24 = $\eta = 1 - \frac{\rho_b}{\rho_s}$ = 1 - $\frac{0.967}{2.54}$ = 0.6193

Estimation of Mixing Zone Depth

S-25 = $d = (0.0112 \times L^2)^{0.5} + d_a \left[1 - \exp \frac{(-L \times I)}{(K \times I \times d_a)}\right]$

= (0.0112 x 67.056 ^{2})$^{0.5}$ + 3.048 x [1 - exp ($\frac{-67.056}{13.560} \times \frac{0.3}{0.0841} \times \frac{}{3.048}$)] = 10.135 m

Soil Saturation Limit

S-29 = $C_{sat} = \frac{S}{\rho_b} \times [(K_d \times \rho b) + \Theta w + (H' \times \theta a)]$ = $\frac{110}{0.967}$ x [(2.3084 x 0.967) + 0.327 + (0.271 x 0.292)] = 300.12 mg/kg

Tier 2 Industrial/Commercial Calculations for Benzo[a]pyrene

MotoMart - Swansea
2002-0431

SSL | SSL & RBCA
RSCA | IRIS/HEAST

Date Compiled: 07/26/16
Version: 8/25/2015

Input Values

Holcomb's Bulk Density -->	60.4	Converted Value to be used in calculation sheet -->			0.967515	USDA Soil Classification:	Loamy Sand				
Organic Matter (%) -->	0	FOC % (0.58 conversion) -->		0.000	Organic Matter (mg/kg)	0	FOC mg/kg (0.58 conversion)	0.000	foc conversion to g/g:	0.000	

0.967	ρ_b - Dry Soil Bulk Density				1.5 or; Gravel = 2.0; Sand = 1.8, Silt = 1.6, Clay = 1.7, or Site Specific					
2.54	ps - Soil Particle Density				2.65 or; Site Specific					
0.292	θ_a - Air Filled Soil Porosity	0.292	Value from S-21		Top 1 meter = 0.28; below 1 meter = 0.13, Gravel = 0.05; Sand = 0.14; Silt =0.24; Clay = 0.19, or Calculated Value (S21)					
0.327	θw - Water Filled Soil Porosity	0.327	Value from S-20		Top 1 meter = 0.15, below 1 meter = 0.30; Gravel = 0.20; Sand = 0.18, Silt =0.15, Clay = 0.17, or Calculated Value (S20)					
0.619	η - SSL Total Soil Porosity	0.619	Value from S-24		0.43 or; Gravel - 0.25, Sand = 0.32, Silt = 0.40, Clay = 0.36, or Calculated Value (S24)					
0.0841379	I - Hydraulic Gradient				Site Specific					
0.006	foc - Total Organic Carbon (g/g)				Surface Soil = 0.006; Subsurface Soil = 0.002; or Site Specific					
20.000	DF - Dilution Factor	1.575	Value from S-22		If calculated value for DF is less than 20, then 20 default is used, else calculated value is used					
10.135	d - Mixing Zone (m)	10.135	Value from S-25		2, or calculated value					
13.56	K - Hydraulic Conductivity (m/yr)	cm/sec =	4.30E-05		Site Specific	3.72E+00	cm/d	1.36E+03	cm/yr	Use cm/d for R15, R19, & R26 cm/yr for R24
67.056	L - Source Length Parallel to Groundwater Flow (m)		feet = 220		Site Specific (m)					
3.048	d_a - Aquifer Thickness (m)		feet = 10		Site Specific (m)					
0.3	I - Infiltration Rate (m/yr)				0.3 for Illinois					
540	K_s - Saturated Hydraulic Conductivity				See Table K for Input Values					
0.005	GW_{obj} - Groundwater Remediation Objective Class 1				0.025 GW_{obj} - Groundwater Remediation Objective Class 2					
0.085	1/(2b+3) - Exponent for S20				See Table K for Input Values					
70	BW - Body Weight				Residential = 70 (carcinogenic); 15 (non-carcinogenic); Industrial/Commercial = 70; Construction Worker = 70; RBCA = 70					
114	$IF_{ind-adj}$ -Age Adjusted Soil Ingestion Factor for Carcinogens				114					
50	IR_{soil} -Soil Ingestion Rate				Residential = 200; Industrial/Commercial = 50; Construction Worker = 480					
7.3	SF_o -Oral Slop Factor				Benzo[a]Pyrene = 7.3					
1	IR_w -Daily Water Ingestion Rate				Residential = 2; Industrial/Commercial = 1					
0.00162	S - Solubility in Water				Benzo[a]pyrene = 0.00162					
1.0E-06	TR - Target Cancer Risk				Residential = 10^{-6}; Industrial/Commercial = 10^{-6}; Construction Worker = 10^{-6} at point of human exposure					
70	AT_c -Average Time for Carcinogens				70					
1.10E-03	URF - Inhalation Unit Risk Factor				Benzo[a]pyrene =8.8 x 10^{-3}					
250	EF - Exposure Frequency				Residential = 350; Industrial/Commercial = 250; Construction Worker = 30					
25	ED - Exposure Duration for Inhalation fo Carcinogens				Residential = 30; Industrial/Commercial = 25; Construction Worker = 1					
85.81	Q/C - Inverse of the mean concentration at the center of a square source				Residential = 68.81; Industrial/Commercial = 85.81; Construction Worker = 85.81					
9.50E+08	T - Exposure Interval				Residential = 9.5 x 10^8; Industrial/Commercial = 7.9 x 10^8; Construction Worker = 3.6 x 10^8					
0.043	D_i - Diffusivity in Air				Benzo[a]pyrene = 0.043					
4.63E-05	H' - Henry's Law Constant				Benzo[a]pyrene = 4.63 x 10^{-5}					
9.00E-06	D_w - Diffusivity in Water				Benzo[a]pyrene = 9.00 x 10^{-6}					
1020000	K_{oc} - Organic Carbon Partition Coefficient				Benzo[a]pyrene = 1,020,000					

Industrial/Commercial Ingestion Tier II Objective

$$S\text{-}3 = \frac{TR \times BW \times AT_c \times 365}{SF_o \times 10^{-6} \times EF \times ED \times IRsoil} = \frac{1.0E\text{-}06 \times 70 \times 70 \times 365}{7.300 \times 1.00E\text{-}06 \times 250 \times 25 \times 50} = \frac{1.8E+00}{2.28E+00} = 0.784 \text{ mg/kg}$$

Construction Worker Ingestion Tier II Objective

$$S\text{-}3 = \frac{TR \times BW \times AT_c \times 365}{SF_o \times 10^{-6} \times EF \times IRsoil} = \frac{1.0E\text{-}06 \times 70 \times 70 \times 365}{7.300 \times 1.00E\text{-}06 \times 30 \times 480} = \frac{1.8E+00}{1.05E-01} = 17.01 \text{ mg/kg}$$

Industrial/Commercial Inhalation Tier II Objective

$$S\text{-}6 = \frac{TR \times ATc \times 365}{URF \times 1000 \times EF \times ED \times I/VF} = \frac{1.0E\text{-}06 \times 70 \times 365}{1.10E\text{-}03 \times 1000 \times 250 \times 25 \times (1/\ 2.27E+07\ )} = \frac{0.02555}{3.03E\text{-}04} = 8.42E+01 \text{ mg/kg}$$

Tier 2 Industrial/Commercial Calculations for Benzo[a]pyrene

MotoMart - Swansea
2002-0431

Construction Worker Inhalation Tier II Objective

$$S\text{-}7 = \frac{TR \times ATc \times 365}{URF \times 1000 \times EF \times ED \times 1/VF'} = \frac{1.0E\text{-}06 \times 70 \times 365}{1.10E\text{-}03 \times 1000 \times 30 \times 1 \times (1/\ 1.40E+05)} = \frac{0.02555}{2.37E\text{-}04} = 1.08E+02 \text{ mg/kg}$$

RESIDENTIAL OR COMMERCIAL

$$S\text{-}8 = VF = \frac{Q}{C} \times \frac{(3.14 \times D_A \times T)^{1/2} \times 10^{-4}}{(2 \times \rho_b \times D_A)} = 85.81 \times \frac{\left(\frac{3.14 \times 1.14E\text{-}10 \times 9.50E+08}{2 \times 0.967 \times 1.14E\text{-}10}\right)^{1/2} \times 0.0001}{2.21E\text{-}10} = 22663071.0232$$

Construction Worker

$$S\text{-}8 = VF = \frac{Q}{C} \times \frac{(3.14 \times D_A \times T)^{1/2} \times 10^{-4}}{(2 \times \rho_b \times D_A)} = 85.81 \times \frac{\left(\frac{3.14 \times 1.14E\text{-}10 \times 3.80E+06}{2 \times 0.967 \times 1.14E\text{-}10}\right)^{1/2} \times 0.0001}{2.21E\text{-}10} = 1.40E+06$$

Equation for Derivation of Volatilization Factor - Construction Worker

$$S\text{-}9 = VF' = \frac{VF}{10} = \frac{139509.2157}{10} = 139510.9216$$

Equation for Derivation of Apparent Diffusivity

$$S\text{-}10 = D_A = \frac{(\theta_a^{3.33} \times D_i \times H') + (\theta_w^{2.33} \times D_w)}{\eta^2} \times \frac{1}{(\rho_b \times K_d) + \theta_w + (\theta_a \times H')}$$

$$= \frac{\left(1.66E\text{-}02 \times 0.043 \times 0.000\right) + \left(0.0242 \times 9.00E\text{-}06\right)}{0.3832} \times \frac{1}{\left(0.967 \times 5916\right) + 0.33 + \left(0.292 \times 4.63E\text{-}05\right)} = 1.14E\text{-}10$$

Soil Component of the Migration to Groundwater Cleanup Objective (Class 1)

$$S\text{-}17 = C_w \times \left[K_d + \frac{(\theta_w + \theta_a \times H')}{\rho b}\right] = 0.1 \times \left[5916 + \frac{0.327 + 0.292 \times 4.63E\text{-}05}{0.967}\right] = 591.634 \text{ mg/kg}$$

Target Soil Leachate Concentration (Class 1)

$$S\text{-}18 = C_w = DF \times GW_{cl} = 20.00 \times 0.005 = 0.1$$

Soil-Water Partition Coefficient

$$S\text{-}19 = K_d = K_{oc} \times f_{oc} = 1.02E+06 \times 0.006 = 5916$$

Water-Filled Porosity

$$S\text{-}20 = \Theta_w = \eta \times \frac{1}{K_a}^{(1/2n-2)} = 0.62 \times \left[\frac{0.300}{540.000}\right]^{0.667} = 0.3273$$

Tier 2 Industrial/Commercial Calculations for Benzo[a]pyrene

MotoMart - Swansea
2002-0431

Air-Filled Porosity

S-21 = $\Theta_a = \eta - \Theta_w$ = 0.62 - 0.33 = 0.2920

Dilution Factor

S-22 = $DF = 1 + \frac{K \times i \times d}{I \times L}$ = $\frac{13.56}{0.300} \times \frac{0.0841}{67.056} \times 10.135 + 1$ = 1.5748

GW Ingestion

S-23 = $\frac{TR \times BW \times AT_c \times 365}{SF_o \times IR_w \times EF \times ED}$ = $\frac{1.0E-06}{7.300} \times \frac{70}{1.000} \times \frac{70}{250} \times \frac{365}{25}$ = $\frac{1.8E+00}{45625}$ = 0.0000 mg/L

Total Soil Porosity

S-24 = $\eta = 1 - \frac{\rho_b}{\rho_s}$ = 1 - $\frac{0.967}{2.54}$ = 0.6193

Estimation of Mixing Zone Depth

S-25 = $d = (0.0112 \times L^2)^{0.5} + d_a \left[1 - \exp \frac{(-L \times I)}{(K \times i \times d_a)}\right]$

= (0.0112 x 67.056 ^{2})$^{0.5}$ + 3.048 x [1 - exp ($\frac{-67.056}{13.560} \times \frac{0.3}{0.0841} \times \frac{)}{3.048}$] = 10.135 m

Soil Saturation Limit

S-29 = $C_{sat} = \frac{S}{\rho_b} \times [(K_d \times \rho b) + \Theta w + (H' \times \Theta a)]$ = $\frac{1.62E-03}{0.967}$ x [(5916 x 0.967) + 0.327 + (4.63E-05 x 0.292)] = 9.58 mg/kg

Tier 2 Industrial/Commercial Calculations for Dibenz[a,h]anthracene

MotoMart - Swansea
2002-0431

SSL | SSL & RBCA
RBCA | IRIS/HEAST

Date Compiled: 07/26/16
Version 8/25/2015

Input Values

Holcomb's Bulk Density -->	60.4	Converted Value to be used in calculation sheet -->			0.967515	USDA Soil Classification	Loamy Sand				
Organic Matter (%) -->	0	FOC % (0.58 conversion) -->		0.000	Organic Matter (mg/kg)	0	FOC mg/kg (0.58 conversion)	0.000	foc conversion to g/g:	0.000	

0.967	ρ_b - Dry Soil Bulk Density				1.5 or; Gravel = 2.0; Sand = 1.6; Silt = 1.6; Clay = 1.7; or Site Specific					
2.54	ps - Soil Particle Density				2.65 or; Site Specific					
0.292	Θ_a - Air Filled Soil Porosity	0.292	Value from S-21		Top 1 meter = 0.28; below 1 meter = 0.13; Gravel = 0.05; Sand = 0.14; Silt =0.24; Clay = 0.19; or Calculated Value (S21)					
0.327	Θ_w - Water Filled Soil Porosity	0.327	Value from S-20		Top 1 meter = 0.15; below 1 meter = 0.30; Gravel = 0.20; Sand = 0.18; Silt =0.16; Clay = 0.17; or Calculated Value (S20)					
0.619	n - SSL Total Soil Porosity	0.619	Value from S-24		0.43 or; Gravel = 0.25; Sand = 0.32; Silt = 0.40; Clay = 0.36; or Calculated Value (S24)					
0.0841379	I - Hydraulic Gradient				Site Specific					
0.0056	foc - Total Organic Carbon (g/g)				Surface Soil = 0.006, Subsurface Soil = 0.002; or Site Specific					
20	DF - Dilution Factor	1.575	Value from S-22		If calculated value for DF is less than 20, then 20 default is used, else calculated value is used					
10.135169	d - Mixing Zone (m)	10.135	Value from S-25		2; or calculated value					
13.56048	K - Hydraulic Conductivity (m/yr)	cm/sec =	4.30E-05		Site Specific	3.72E+00	cm/d	1.36E+03	cm/yr	Use cm/d for R15, R19, & R26; cm/yr for R24
67.056	L - Source Length Parallel to Groundwater Flow (m)		feet = 220		Site Specific (m)					
3.048	d_a - Aquifer Thickness (m)		feet = 10		Site Specific (m)					
304.8	X - Distance along CL of GW Plume (cm)		feet = 10		Distance along the centerline of the groundwater plume emanating from a Source. The x direction is the direction of gw flow					
9448.8	Sw - Source Width -horizontal plane (cm)		feet = 310		Source with perpendicular to groundwater flow direction in horizontal plane					
200.22312	Sd - Source with - vertical plane (cm)		feet = 6.569		Source with perpendicular to groundwater flow direction in vertical plane					
2438.4	W - Width of source area (cm)		feet = 80		Width of Source Area Parallel to Direction to Wind or Groundwater Movement					
0.0009	λ - First Order Degradation Constant				Benzene = 0.0009					
1	ρ_w - Water Density				1					
0.1	w - Average soil moisture content				0.1 or; Surface Soil = 0.1; Subsurface soil = 0.2; or Site Specific					
0.3	I - Infiltration Rate (m/yr)				0.3 for Illinois					
30	I - Infiltration Rate (cm/yr)				30 for Illinois					
200	δ_{gw} - Groundwater Mixing Zone Thickness (cm)				200					
540	K_s - Saturated Hydraulic Conductivity				See Table K for Input Values					
0.005	GW_{obj} - Groundwater Remediation Objective Class 1				0.025	GW_{obj} - Groundwater Remediation Objective Class 2				
0.085	1/(2b+3) - Exponent for S20				See Table K for Input Values					
70	BW - Body Weight				Residential = 70 (carcinogenic), 15 (non-carcinogenic); Industrial/Commercial = 70; Construction Worker = 70; RBCA = 70					
114	$IF_{soil-adj}$ -Age Adjusted Soil Ingestion Factor for Carcinogens				114					
200	IR_{soil} -Soil Ingestion Rate				Residential = 200; Industrial/Commercial = 50; Construction Worker = 480					
7.3	SF_o -Oral Slop Factor				Dibenz[a,h]anthracene = 7.3					
2	IR_w -Daily Water Ingestion Rate				Residential = 2; Industrial/Commercial = 1					
0.00249	S - Solubility in Water				Dibenz[a,h]anthracene = 0.00249					
0.000001	TR - Target Cancer Risk				Residential = 10^{-6}; Industrial/Commercial = 10^{-6}; Construction Worker = 10^{-5} at point of human exposure					
70	AT_c -Average Time for Carcinogens				70					
0.0012	URF - Inhalation Unit Risk Factor				Dibenz[a,h]anthracene = 8.8×10^{-2}					
350	EF - Exposure Frequency				Residential = 350; Industrial/Commercial = 250; Construction Worker = 30					
30	ED - Exposure Duration for Inhalation fo Carcinogens				Residential = 30; Industrial/Commercial = 25; Construction Worker = 1					
68.81	Q/C - Inverse of the mean concentration at the center of a square source				Residential = 68.81; Industrial/Commercial = 85.81; Construction Worker = 85.81					
9500000000	T - Exposure Interval				Residential = 9.5×10^8; Industrial/Commercial = 7.9×10^8; Construction Worker = 3.6×10^8					
0.0202	D_i - Diffusivity in Air				Dibenz[a,h]anthracene = 0.0202					
6.03E-07	H' - Henry's Law Constant				Dibenz[a,h]anthracene = 6.03×10^{-7}					
5.18E-06	D_w - Diffusivity in Water				Dibenz[a,h]anthracene = 5.18×10^{-6}					
6	AT - Average Time for Non-Carcinogens In Ingestion Equation				Dibenz[a,h]anthracene = 0.00249					
30	AT - Average Time for Non-Carcinogens In Inhalation Equation				Dibenz[a,h]anthracene = 0.00249					
1	THQ - Target Hazard Quotient				Dibenz[a,h]anthracene = 0.00249					
0.003	RfC - Inhalation Reference Concentration				Dibenz[a,h]anthracene = 0.00249					
3800000	K_{oc} - Organic Carbon Partition Coefficient				Dibenz[a,h]anthracene = 3800000					

Industrial/Commercial Ingestion Tier II Objective

$$S\text{-}3 = \frac{TR \times BW \times AT_c \times 365}{SI_o \times 10^{-6} \times EF \times ED \times IRsoil} = \frac{1.0E\text{-}06 \times 70 \times 70 \times 365}{7.300 \times 1.00E\text{-}06 \times 350 \times 30 \times 50} = \frac{1.8E+00}{3.83E+00} = 0.467 \text{ mg/kg}$$

Construction Worker Ingestion Tier II Objective

$$S\text{-}3 = \frac{TR \times BW \times AT_c \times 365}{SI_o \times 10^{-6} \times EF \times IRsoil} = \frac{1.0E\text{-}06 \times 70 \times 70 \times 365}{7.300 \times 1.00E\text{-}06 \times 30 \times 480} = \frac{1.8E+00}{1.05E-01} = 17.01 \text{ mg/kg}$$

Tier 2 Industrial/Commercial Calculations for Dibenz[a,h]anthracene

MotoMart - Swansea
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Industrial/Commercial Inhalation Tier II Objective

$$S\text{-}6 = \frac{TR \times ATc \times 365}{URF \times 1000 \times EF \times ED \times 1/VF} = \frac{1.0E\text{-}06 \times 70 \times 365}{1.20E\text{-}03 \times 1000 \times 350 \times 30 \times (1/\ 4.96E+07)} = \frac{0.02555}{2.54E\text{-}04} = 1.01E+02 \text{ mg/kg}$$

Construction Worker Inhalation Tier II Objective

$$S\text{-}7 = \frac{TR \times ATc \times 365}{URF \times 1000 \times EF \times ED \times 1/VF'} = \frac{1.0E\text{-}06 \times 70 \times 365}{1.20E\text{-}03 \times 1000 \times 30 \times 1 \times (1/\ 3.81E+05)} = \frac{0.02555}{9.46E\text{-}05} = 2.70E+02 \text{ mg/kg}$$

RESIDENTIAL OR COMMERCIAL

$$S\text{-}8 = VF = \frac{Q}{C} \times \frac{(3.14 \times D_A \times T)^{1/2} \times 10^{-4}}{(2 \times \rho_b \times D_A)} = 68.81 \times \frac{(3.14 \times 1.54E\text{-}11 \times 9.50E+08)^{1/2} \times 0.0001}{(2 \times 0.967 \times 1.54E\text{-}11)} = \frac{0.0015}{2.97E\text{-}11} = 49579012.7947$$

Construction Worker

$$S\text{-}8 = VF = \frac{Q}{C} \times \frac{(3.14 \times D_A \times T)^{1/2} \times 10^{-4}}{(2 \times \rho_b \times D_A)} = 85.81 \times \frac{(3.14 \times 1.54E\text{-}11 \times 3.60E+08)^{1/2} \times 0.0001}{(2 \times 0.967 \times 1.54E\text{-}11)} = \frac{0.0001}{2.97E\text{-}11} = 3.81E+06$$

Equation for Derivation of Volatilization Factor - Construction Worker

$$S\text{-}9 = VF' = \frac{VF}{10} = \frac{380642.8}{10} = 380604.28$$

Equation for Derivation of Apparent Diffusivity

$$S\text{-}10 = D_A = \frac{(\theta_a^{3.33} \times D_i \times H') + (\theta_w^{3.33} \times D_w)}{\eta^2} \times \frac{1}{(\rho_b \times K_d) + \theta_w + (\theta_a \times H')}$$

$$= \frac{(1.66E\text{-}02 \times 0.020 \times 0.000) + (0.0242 \times 5.18E\text{-}06)}{0.3832} \times \frac{1}{(0.967 \times 22040) + 0.33 + (0.292 \times 6.03E\text{-}07)} = 1.54E\text{-}11$$

Soil Component of the Migration to Groundwater Cleanup Objective (Class 1)

$$S\text{-}17 = C_w \times \left[K_d + \frac{(\theta_w + \theta_a \times H')}{\rho b}\right] = 0.1 \times \left[22040 + \frac{(0.327 + 0.292 \times 6.03E\text{-}07)}{0.967}\right] = 2204.034 \text{ mg/kg}$$

Target Soil Leachate Concentration (Class 1)

$$S\text{-}18 = C_w = DF \times GW_{std} = 20.00 \times 0.005 = 0.1$$

Soil-Water Partition Coefficient

$$S\text{-}19 = K_d = K_{oc} \times f_{oc} = 3.80E+06 \times 0.006 = 22040$$

Water-Filled Porosity

$$S\text{-}20 = \Theta_w = \eta \times \frac{I}{K_s}^{1/(2b+3)} = 0.52 \times \left[\frac{0.300}{540.000}\right]^{0.089} = 0.3273$$

Tier 2 Industrial/Commercial Calculations for Dibenz[a,h]anthracene

MotoMart - Swansea
2002-0431

Air-Filled Porosity

S-21 = $\Theta_a = \eta - \Theta_w$ = 0.62 - 0.33 = 0.2920

Dilution Factor

S-22 = $DF = 1 + \frac{K \times i \times d}{I \times L}$ = $\frac{13.56}{0.300} \times \frac{0.0841}{67.056} \times 10.135 + 1$ = 1.5748

GW Ingestion

S-23 = $\frac{TR \times BW \times At_c \times 365}{SF_o \times IR_w \times EF \times ED}$ = $\frac{1.0E-06}{7.300} \times \frac{70}{2.000} \times \frac{70}{350} \times \frac{365}{30} = \frac{1.8E+00}{153300}$ = 0.0000 mg/L

Total Soil Porosity

S-24 = $\eta = 1 - \frac{\rho_b}{\rho_s}$ = $1 - \frac{0.967}{2.54}$ = 0.6193

Estimation of Mixing Zone Depth

S-25 = $d = (0.0112 \times L^2)^{0.5} + d_a \left[1 - \exp \frac{(-L \times I)}{(K \times i \times d_a)} \right]$

= $(0.0112 \times 67.056 ^{2})^{0.5} +$

$3.048 \left[1 - \exp \left(\frac{-67.056}{13.560} \times \frac{0.3}{0.0841} \times \frac{)}{3.048} \right] \right]$ = 10.135 m

Soil Saturation Limit

S-29 = $C_{sat} = \frac{S}{\rho_b} \times [(K_d \times \rho b) + \Theta w + (H' \times \Theta a)]$ = $\frac{2.49E-03}{0.967} \times [(22040 \times 0.967) + 0.327 + (6.03E-07 \times 0.292)]$ = 54.88 mg/kg

APPENDIX F

ANALYTICAL RESULTS

CORRECTIVE ACTION PLAN
MOTOMART
SWANSEA, ILLINOIS

MotoMart - Swansea
Site Assessment Data

Waste Characterization

	Location	M 8	M 10
	Date	4/3/2002	4/3/2002
	Depth	2.5'	2.5'
Parameter	Class I CUO		
Benzene	**0.03**	**0.531**	**0.444**
Ethylbenzene	**13.0**	2.32	1.74
Toluene	**12.0**	0.721	<0.002
Total Xylenes	**5.6**	5.26	2.77
MTBE	**0.32**		
Acenaphthene	**570.0**	ND	ND
Acenaphtylene	**15.0**	4.1	4.4
Anthracene	**12,000.0**	ND	ND
Benzo(a)anthracene	**0.9**	ND	0.19
Benzo(a)pyrene	**0.09**	ND	ND
Benzo(b)fluoranthene	**0.9**	ND	ND
Benzo(g,h,i)perylene	**2,300.0**	ND	ND
Benzo(k)fluoranthene	**9.0**	ND	ND
Chrysene	**88.0**	ND	ND
Dibenz(a,h)anthracene	**0.09**	ND	ND
Fluoranthene	**4,300.0**	2.5	0.8
Fluorene	**560.0**	0.17	0.27
Indeno(1,2,3-cd)pyrene	**0.9**	ND	ND
Naphthalene	**1.8**	**2.8**	**3.8**
Phenanthrene	**140.0**	1.9	2.
Pyrene	**2,300.0**	ND	1.1

MotoMart - Swansea
Site Assessment Data

Stage 1 Soil - 9.6.06

	Location	BH-1A	BH-1B	BH-2A	BH-2B	BH-2C	BH-3	BH-4	BH-5A	BH-5B	BH-5C
	Date	9/6/2006	9/6/2006	9/6/2006	9/6/2006	9/6/2006	9/6/2006	9/6/2006	9/6/2006	9/6/2006	9/6/2006
	Depth	10'	12'	4'	8'	14'	13'	14'	4'	9'	13'
Parameter	Class I CUO										
Benzene	**0.03**	**0.749**	**3.03**	0.025	**0.096**	0.001	**0.463**	ND	0.001	**0.474**	**0.173**
Ethylbenzene	**13.0**	0.039	6.01	ND	0.274	ND	ND	ND	ND	9.86	2.62
Toluene	**12.0**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Xylenes	**5.6**	0.037	**16.4**	0.012	ND	ND	ND	ND	ND	**25.7**	1.76
MTBE	**0.32**										
Acenaphthene	**570.0**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphtylene	**15.0**	ND	ND	0.058	ND	ND	ND	ND	ND	ND	ND
Anthracene	**12,000.0**	ND	ND	0.045	ND	ND	ND	0.021	ND	ND	ND
Benzo(a)anthracene	**0.9**	ND	ND	0.012	ND	ND	ND	0.044	ND	ND	ND
Benzo(a)pyrene	**0.09**	ND	ND	**0.16**	ND	ND	ND	0.054	ND	ND	ND
Benzo(b)fluoranthene	**0.9**	ND	ND	0.18	ND	ND	ND	0.054	ND	ND	ND
Benzo(g,h,i)perylene	**2,300.0**	ND	ND	0.13	0.17	ND	ND	0.017	ND	ND	ND
Benzo(k)fluoranthene	**9.0**	ND	ND	0.1	ND	ND	ND	0.023	ND	ND	ND
Chrysene	**88.0**	ND	ND	0.19	ND	ND	ND	0.058	ND	ND	ND
Dibenz(a,h)anthracene	**0.09**	ND	ND	**0.23**	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	**4,300.0**	ND	ND	0.46	ND	ND	ND	0.15	ND	ND	ND
Fluorene	**560.0**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	**0.9**	ND	ND	0.12	ND	ND	ND	0.025	ND	ND	ND
Naphthalene	**1.8**	ND	ND	ND	ND	ND	ND	0.11	ND	0.15	0.18
Phenanthrene	**140.0**	ND	ND	0.25	ND	ND	ND	0.11	ND	0.014	0.014
Pyrene	**2,300.0**	ND	ND	0.3	ND	ND	ND	0.11	ND	ND	ND

MotoMart - Swansea
Site Assessment Data

Stage 1 GW - 10.5.06

	Location	MW-1	MW-2	MW-3	MW-4	MW-5
	Date	10/5/2006	10/5/2006	10/5/2006	10/5/2006	10/5/2006
Parameter	Class I CUO					
Benzene	**0.005**	**8.3**	**0.269**	ND	**2.**	ND
Ethylbenzene	**0.7**	**3.24**	0.036	ND	**3.83**	ND
Toluene	**1.0**	ND	0.01	ND	0.122	ND
Total Xylenes	**10.0**	5.24	0.019	ND	8.77	ND
MTBE	**0.07**	0.048	0.037	ND	ND	0.032
Acenaphthene	**0.42**	ND	ND	ND	ND	ND
Acenaphtylene	**0.010**	ND	ND	ND	ND	ND
Anthracene	**2.1**	ND	ND	ND	ND	ND
Benzo(a)anthracene	**0.00013**	ND	ND	ND	ND	ND
Benzo(a)pyrene	**0.0002**	ND	ND	ND	ND	ND
Benzo(b)fluoranthene	**0.00018**	ND	ND	ND	ND	ND
Benzo(g,h,i)perylene	**0.00076**	ND	ND	ND	ND	ND
Benzo(k)fluoranthene	**0.00017**	ND	ND	ND	ND	ND
Chrysene	**0.0015**	ND	ND	ND	ND	ND
Dibenz(a,h)anthracene	**0.0003**	ND	ND	ND	ND	ND
Fluoranthene	**0.28**	ND	ND	ND	ND	ND
Fluorene	**0.28**	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	**0.00043**	ND	ND	ND	ND	ND
Naphthalene	**0.14**	**0.387**	ND	ND	**1.23**	ND
Phenanthrene	**0.0064**	0.002	0.001	ND	0.003	ND
Pyrene	**0.21**	ND	ND	ND	ND	ND

MotoMart - Swansea
Site Assessment Data

Stage 2 Soil - 5.10.07

	Location	BH-6A	BH-6B	BH-7A	BH-7B	BH-8	BH-9A	BH-9B
	Date	5/10/2007	5/10/2007	5/10/2007	5/10/2007	5/10/2007	5/10/2007	5/10/2007
	Depth	4-5'	6-7'	4-5'	6-7'	7-8'	3-4'	7-8'
Parameter	Class I CUO							
Benzene	**0.03**	ND	ND	ND	0.001	ND	ND	**0.312**
Ethylbenzene	**13.0**	ND	ND	ND	ND	ND	ND	0.195
Toluene	**12.0**	ND	ND	ND	ND	ND	ND	ND
Total Xylenes	**5.6**	ND	ND	ND	ND	ND	ND	0.31
MTBE	**0.32**							
Acenaphthene	**570.0**	ND	ND	ND	ND	ND	0.41	0.11
Acenaphtylene	**15.0**	ND	ND	ND	ND	ND	0.94	0.21
Anthracene	**12,000.0**	ND	ND	ND	ND	ND	1.2	0.25
Benzo(a)anthracene	**0.9**	ND	0.011	ND	ND	ND	**2.5**	0.79
Benzo(a)pyrene	**0.09**	0.012	0.024	0.02	ND	ND	**2.6**	**0.99**
Benzo(b)fluoranthene	**0.9**	ND	0.03	0.016	ND	ND	**2.5**	0.84
Benzo(g,h,i)perylene	**2,300.0**	ND	0.046	ND	ND	ND	1.8	0.42
Benzo(k)fluoranthene	**9.0**	ND	ND	ND	ND	ND	1.3	0.47
Chrysene	**88.0**	ND	0.021	ND	ND	ND	2.9	0.88
Dibenz(a,h)anthracene	**0.09**	ND	ND	ND	ND	ND	**0.54**	**0.17**
Fluoranthene	**4,300.0**	ND	0.058	0.029	ND	ND	8.	2.1
Fluorene	**560.0**	ND	ND	ND	ND	ND	0.21	0.38
Indeno(1,2,3-cd)pyrene	**0.9**	ND	0.019	ND	ND	ND	**1.7**	0.52
Naphthalene	**1.8**	ND	ND	ND	ND	ND	0.23	0.2
Phenanthrene	**140.0**	0.012	0.025	0.18	ND	ND	5.2	0.93
Pyrene	**2,300.0**	0.012	0.032	0.18	ND	ND	4.7	1.5

MotoMart - Swansea
Site Assessment Data

Stage 2 Soil - 7.25.07

	Location	BH-10A	BH-10B	BH-11A	BH-11B
	Date	7/25/2007	7/25/2007	7/25/2007	7/25/2007
	Depth	4'	9'	4'	8'
Parameter	Class I CUO				
Benzene	**0.03**	0.004	0.006	ND	ND
Ethylbenzene	**13.0**	ND	ND	ND	ND
Toluene	**12.0**	0.01	0.011	ND	ND
Total Xylenes	**5.6**	0.007	0.008	0.015	ND
MTBE	**0.32**				
Acenaphthene	**570.0**	ND	ND	ND	ND
Acenaphtylene	**15.0**	ND	ND	0.23	ND
Anthracene	**12,000.0**	ND	ND	0.015	ND
Benzo(a)anthracene	**0.9**	ND	ND	0.042	ND
Benzo(a)pyrene	**0.09**	ND	ND	**0.11**	ND
Benzo(b)fluoranthene	**0.9**	ND	ND	0.087	ND
Benzo(g,h,i)perylene	**2,300.0**	ND	ND	0.018	ND
Benzo(k)fluoranthene	**9.0**	ND	ND	0.074	ND
Chrysene	**88.0**	ND	ND	0.078	ND
Dibenz(a,h)anthracene	**0.09**	ND	ND	ND	ND
Fluoranthene	**4,300.0**	ND	ND	0.42	ND
Fluorene	**560.0**	ND	ND	0.059	ND
Indeno(1,2,3-cd)pyrene	**0.9**	ND	ND	0.042	ND
Naphthalene	**1.8**	ND	ND	ND	ND
Phenanthrene	**140.0**	ND	ND	0.4	ND
Pyrene	**2,300.0**	ND	ND	0.1	ND

MotoMart - Swansea
Site Assessment Data

Stage 3 Soil - 11.19.08

	Location	BH-12A	BH-12B	BH-12C	BH-13A	BH-13B	BH-14A	BH-14B	BH-15A	BH-15B	BH-16A	BH-16B
	Date	11/19/2008	11/19/2008	11/19/2008	11/19/2008	11/19/2008	11/19/2008	11/19/2008	11/19/2008	11/19/2008	11/19/2008	11/19/2008
	Depth	4'	8'	12'	4'	8'	4'	8'	4'	8'	4'	8'
Parameter	Class I CUO											
Benzene	**0.03**	ND	ND	ND	ND	ND	ND	ND	0.002	ND	ND	ND
Ethylbenzene	**13.0**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toluene	**12.0**	ND	ND	ND	ND	ND	ND	ND	0.001	ND	ND	ND
Total Xylenes	**5.6**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MTBE	**0.32**											
Acenaphthene	**570.0**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphtylene	**15.0**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Anthracene	**12,000.0**	ND	0.15	ND	ND	ND	ND	0.02	ND	ND	ND	ND
Benzo(a)anthracene	**0.9**	0.029	0.75	0.047	ND	0.025	0.032	0.13	ND	ND	0.063	0.051
Benzo(a)pyrene	**0.09**	0.033	**1.5**	0.077	ND	0.037	0.053	**0.13**	ND	ND	**0.12**	0.08
Benzo(b)fluoranthene	**0.9**	0.045	**1.8**	0.058	ND	0.025	0.028	0.12	ND	ND	0.087	0.06
Benzo(g,h,i)perylene	**2,300.0**	0.013	1.3	0.043	ND	0.015	0.036	0.078	ND	ND	0.042	0.039
Benzo(k)fluoranthene	**9.0**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chrysene	**88.0**	0.049	1.5	0.08	ND	0.039	0.051	0.21	ND	ND	0.082	0.076
Dibenz(a,h)anthracene	**0.09**	ND	**0.26**	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	**4,300.0**	0.15	2.8	0.23	ND	0.09	0.11	0.55	ND	ND	0.23	0.22
Fluorene	**560.0**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	**0.9**	0.028	**0.93**	0.043	ND	0.024	0.029	0.073	ND	ND	0.061	0.043
Naphthalene	**1.8**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	**140.0**	0.099	0.8	0.14	ND	0.034	0.046	0.25	ND	ND	0.1	0.12
Pyrene	**2,300.0**	0.1	2.4	0.13	ND	0.08	0.081	0.4	ND	ND	0.14	0.12

MotoMart - Swansea
Site Assessment Data

Stage 3 GW - 12.2.08

	Location	MW-6	MW-7	MW-9	MW-10
	Date	12/2/2008	12/2/2008	12/2/2008	12/2/2008
Parameter	Class I CUO				
Benzene	0.005	ND	ND	ND	ND
Ethylbenzene	0.7	ND	ND	ND	ND
Toluene	1.0	ND	ND	ND	ND
Total Xylenes	10.0	ND	ND	ND	ND
MTBE	0.07				
Acenaphthene	0.42	ND	ND	ND	ND
Acenaphtylene	0.010	ND	ND	ND	ND
Anthracene	2.1	ND	ND	ND	ND
Benzo(a)anthracene	0.00013	ND	ND	ND	ND
Benzo(a)pyrene	0.0002	ND	ND	ND	ND
Benzo(b)fluoranthene	0.00018	ND	ND	ND	ND
Benzo(g,h,i)perylene	0.00076	ND	ND	ND	ND
Benzo(k)fluoranthene	0.00017	ND	ND	ND	ND
Chrysene	0.0015	ND	ND	ND	ND
Dibenz(a,h)anthracene	0.0003	ND	ND	ND	ND
Fluoranthene	0.28	ND	ND	ND	ND
Fluorene	0.28	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	0.00043	ND	ND	ND	ND
Naphthalene	0.14	ND	ND	ND	ND
Phenanthrene	0.0064	ND	ND	ND	ND
Pyrene	0.21	ND	ND	ND	ND

MotoMart - Swansea
Site Assessment Data

Stage 3 Soil - 9.3.15

	Location	BH-17	BH-17	BH-17	BH-18	BH-18	BH-18	BH-19	BH-19	BH-19
	Date	9/3/2015	9/3/2015	9/3/2015	9/3/2015	9/3/2015	9/3/2015	9/3/2015	9/3/2015	9/3/2015
	Depth	2.5'	7.5'	12.5'	2.5	7.5'	12.5'	2.5'	7.5'	12.5'
Parameter	Class I CUO									
Acenaphthene	570.0	ND	ND	ND	ND	ND	ND	ND	0.265	ND
Acenaphtylene	15.0	ND	ND	ND	0.004	ND	0.006	ND	0.183	ND
Anthracene	12,000.0	0.006	ND	ND	0.012	ND	0.012	0.006	0.913	ND
Benzo(a)anthracene	0.9	0.047	ND	ND	0.123	ND	0.061	0.031	**2.85**	0.027
Benzo(a)pyrene	0.09	0.065	ND	ND	0.141	ND	0.063	0.034	**2.41**	0.026
Benzo(b)fluoranthene	0.9	0.109	ND	ND	0.195	ND	0.093	0.046	**2.86**	0.044
Benzo(g,h,i)perylene	2,300.0	0.038	ND	ND	0.064	ND	0.033	0.017	0.955	0.019
Benzo(k)fluoranthene	9.0	0.039	ND	ND	0.067	ND	0.035	0.015	1.18	0.017
Chrysene	88.0	0.068	ND	ND	0.116	ND	0.069	0.036	2.28	0.032
Dibenz(a,h)anthracene	0.09	0.01	ND	ND	0.018	ND	0.009	0.004	**0.223**	ND
Fluoranthene	4,300.0	0.096	ND	ND	0.159	ND	0.139	0.056	6.95	0.067
Fluorene	560.0	ND	ND	ND	ND	ND	0.004	ND	0.32	ND
Indeno(1,2,3-cd)pyrene	0.9	0.034	ND	ND	0.068	ND	0.031	0.014	0.858	0.016
Naphthalene	1.8	ND	ND	ND	ND	ND	ND	0.005	0.138	ND
Phenanthrene	140.0	0.036	ND	ND	0.055	ND	0.071	0.039	4.42	0.026
Pyrene	2,300.0	0.086	ND	ND	0.146	ND	0.117	0.06	5.49	0.056

MotoMart - Swansea
Site Assessment Data

Stage 3 GW - 9.3.15

	Location	MW-8
	Date	9/3/2015
Parameter	Class I CUO	
Benzene	**0.005**	ND
Ethylbenzene	**0.7**	ND
Toluene	**1.0**	ND
Total Xylenes	**10.0**	ND
Acenaphthene	**0.42**	ND
Acenaphtylene	**0.010**	ND
Anthracene	**2.1**	ND
Benzo(a)anthracene	**0.00013**	**0.00014**
Benzo(a)pyrene	**0.0002**	0.00011
Benzo(b)fluoranthene	**0.00018**	**0.00019**
Benzo(g,h,i)perylene	**0.00076**	0.00010
Benzo(k)fluoranthene	**0.00017**	ND
Chrysene	**0.0015**	0.00014
Dibenz(a,h)anthracene	**0.0003**	ND
Fluoranthene	**0.28**	0.00022
Fluorene	**0.28**	ND
Indeno(1,2,3-cd)pyrene	**0.00043**	ND
Naphthalene	**0.14**	ND
Phenanthrene	**0.0064**	0.00012
Pyrene	**0.21**	0.00017

APPENDIX G

OFF-SITE AFFIDAVITS

CORRECTIVE ACTION PLAN
MOTOMART
SWANSEA, ILLINOIS

In accordance with the 415 ILCS 5/57-57.17, I do solemnly swear that every effort has been attempted in order to gain access to properties west of the Moto, Inc. facility in Swansea, Illinois, owned by Medstar Ambulance, Inc., Sparta, Illinois. The Moto, Inc. facility property is located at 1324 North Illinois Street, Swansea, Illinois and has been assigned Incident number 2002-0431. The Medstar Ambulance, Inc. properties are identified as 1209 North Illinois Street, and a parking lot located north of 1209 North Illinois in Swansea, Illinois located adjacent to the west side of Illinois Street. The access requests have been completed for the purposes of site investigation and remediation of the Moto, Inc. property. The following is the attempt that has been made and the neighboring property owner's response to the attempt.

- A request for access was dated January 25, 2008 and sent via Certified Mail #7006 2760 0000 6494 4991 to Medstar Ambulance. The letter was received January 26, 2008. This letter included the language required by 35 Illinois Administrative Code 742.350 b).
- A second request for access was dated March 25, 2008 and sent via Certified Mail #7006 2760 0000 6494 4328 to Medstar Ambulance. The letter was received March 28, 2008. This letter included the language required by 35 Illinois Administrative Code 742.350 b).
- A third request for access was dated January 14, 2009 and sent via Certified Mail #7008 0500 0001 2051 2540 to Medstar Ambulance. The letter was received January 16, 2009. This letter included the language required by 35 Illinois Administrative Code 742.350 b).
- To date, no response to the requests has been received.

Copies of the requests and proof of delivery are attached.

Owner/Operator: Rob Whittington Title: Agent

Signature: Rob Whittington Date: 7/6/16

Subscribed and sworn to before me the 6th day of July, 2016

Helen O'Dell
(Notary Public)

Seal:
Official Seal
Helen M ODell
Notary Public, State of Illinois
St. Clair County
My Commission Expires June 20, 2017

In accordance with the 415 ILCS 5/57-57.17, I do solemnly swear that every effort has been attempted in order to gain access to the property west of the Moto, Inc. facility in Swansea, Illinois, owned by Ms. Karen Roussel, Waddell, Arizona. The Moto, Inc. facility property is located at 1324 North Illinois Street, Swansea, Illinois and has been assigned Incident number 2002-0431. The Roussel property is identified 1309 North Illinois Street, Swansea, Illinois located adjacent to the west side of Illinois Street. The access requests have been completed for the purposes of site investigation and remediation of the Moto, Inc. property. The following is the attempt that has been made and the neighboring property owner's response to the attempt.

- A request for access was dated January 14, 2009 and sent via Certified Mail #7008 0500 0001 2051 2557 to Karen Roussel. This letter included the language required by 35 Illinois Administrative Code 742.350 b).
- To date, no response to the request has been received.

Copies of the requests and proof of delivery are attached.

Owner/Operator: Rob Whittington Title: Agent

Signature: Rob Whittington Date: 7/6/16

Subscribed and sworn to before me the 6th day of July, 2016

Helen M. O'Dell
(Notary Public)

Seal:

Official Seal
Helen M ODell
Notary Public, State of Illinois
St. Clair County
My Commission Expires June 20, 2017

In accordance with the 415 ILCS 5/57-57.17, I do solemnly swear that every effort has been attempted in order to gain access to the property west of the Moto, Inc. facility in Swansea, Illinois, owned by Mr. Dave Wuebbels, Belleville, Illinois. The Moto, Inc. facility property is located at 1324 North Illinois Street, Swansea, Illinois and has been assigned Incident number 2002-0431. The Wuebbels property is identified 1307 North Illinois Street, Swansea, Illinois located adjacent to the west side of Illinois Street. The access requests have been completed for the purposes of site investigation and remediation of the Moto, Inc. property. The following is the attempt that has been made and the neighboring property owner's response to the attempt.

- A request for access was dated January 14, 2009 and sent via Certified Mail #7008 0500 0001 2051 2533 to Dave Wuebbels. The letter was received January 15, 2009. This letter included the language required by 35 Illinois Administrative Code 742.350 b).
- To date, no response to the request has been received.

Copies of the requests and proof of delivery are attached.

Owner/Operator: Rob Whittington Title: Agent

Signature: [signature] Date: 7/6/16

Subscribed and sworn to before me the 6th day of July, 2016

[signature]
(Notary Public)

Seal:

Official Seal
Helen M ODell
Notary Public, State of Illinois
St. Clair County
My Commission Expires June 20, 2017

LEAKING UST TECHNICAL REVIEW NOTES

Reviewed by: Shirlene South
Date Reviewed: 3/8/07
Re-reviewed: 7/10/2012
Reviewed: **7/1/2016**
Re-Reviewed: 11/18/16
IEMA Date: 04/03/02

File Heading: LPC # 1631405021 Co. St. Clair
Swansea/ Moto Mart, Inc

Leaking UST Incident No. **20020431**
H. Oil
Under : 734

LUST Technical File

PRP: MotoMart, Inc
Attn: ~~Joseph Hooten~~ Rob Whittington Env Mang
P.O. Box 122
Belleville, Ill 62222
618/233-6754

Consultant: CWM ~~USI~~
Attn: Vince Smith
701 s. grand Ave
Springfield, Il 62704
217-522-8001

Document(s) Reviewed:
SIP I AND SIP II

General Site Information:
Site subject to: Title 734

IEMA date(s) 4/03/02		Reimbursement (Y/N/unknown): Y		
UST System removed (Y/N): Y		OSFM Fac. ID #: «OSFM_ID»		
Encountered Groundwater (Y/N): Y		SWAP mapping and evaluation completion date: 3/09/2007		
Free Product (Y/N): N		Site placement correct in SWAP (Y/N): Y 38.526140/-89.983725		
Current/Past Land Use: Gas Station		MTBE > 40 ppb (Y_N):«Date»		
E & J: minority and low income as of 7/25/16		VI: Y 7/25/16		RTK-Y 7/26/16
Size & Product of Tanks:	Release	Cause	Removed	Eligibility
Tank 1- 560 g Heating Oil	Y	Tank leak	Y	Y
Tank 2 10,000 GASOLINE	N		N	N/A
Tank 3 -8,000 GASOLINE	N		N	N/A
Tank 4 -4,000 GASOLINE	N		N	N/A
Tank 5 -6,000 DIESEL	N		N	N/A

*at issuance of CAP will need to finish filing out E & J Reporting Form

Review Notes:
From D/ ware
7/16/02-45 day report
560 g H.Oil / fuel ??
Removed 5 yds3 of contaminated fill and native soil
Small amount of odorous water emptied in to tank pit after removal of tank
Did not recharge,
45 day reports states gw-Y,
sheen-Y,
F.P. N

8/8/02-Letter from EPA
7/28/06-Elect to Proceed

3/8/07- Summary of Sip Stage I and Budget

- GEI collected 2 soil samples , one beneath the tank and one from the claysoil beneath the clay seam
- USI advanced 5 SB's and 5 MW's. Results exceeded TACO TI c.u.obj's for BTEX and PNA's, and GW ClassI obj's
- The site is primarily silty clay
- Hy . Con.(K) -4.030 $X10^{-5}$ cm/sec
- No community wells with in 2500' radius and no privte wells locted w/in 200' , no regulated recharge areas or well head protection w/in setback
-

Proposal for obtaining Teir 2 obj's

HY/ cond (K)
Soil bulk density(Pb)
Soil particle(Ps)
Moisture Content(w)
Organic carbon content(foc)

Four additional soil borings(6-,7,8, and 9). Two of these sb's will be to the nw and ne of the tank hold along those property lines. Along with two contingency boring to the south if needed during stage III

Will install monitoring wells during Stage III investigation for off-site, since they are already at property boudaries.

Budgets

Stage I	(Proposed)	(Actual)
Drilling and Monitoring Well costs Form:	$4,615.00	$-
Analytical Costs Form:	$4,100.39	$-
Remediation and Disposal Costs Form:	$1,541.88	$-
UST Removal and abandonment Costs Form:	$-	$-
Paving, Demolition and Well Abandonment Costs Form:	$-	$-
Consulting Fees Form:	$3,932.58	$-
Total Proposed Budget	$14,189.85	$-

L.P.E./L.P.G. Certification:

Joseph Kelly
11/30/07

IEPA Recommendation/Comments:

Requesting information for the following:

- Actual source of the contamination and of the MTBE > 40 ppb*
- Tank and pipe tightness results since 2002.

Response Due:
6/13/07
* sent required email to D. Clay and HAA
SLS:sls\

Document(s) Reviewed:
SIP Stage II & III

Review Notes:
SII-6 sb's were advanced, BH-9 and BH-11 were found to exceed objectives.
5 mw's were advanced

Proposed:
SIII- 6 add'l borings BH12-17 to define off-site
9(3) add'l mw.s to define gw contamination, BH12-17, will be converted from sb'ing to mw. will be off-site and one will be to the south

Stage II	(Proposed)	(Actual)
Drilling and Monitoring Well costs Form:	$2,775.33	$
Analytical Costs Form:	$5.001.83	$
Remediation and Disposal Costs Form:	$770.94	$
UST Removal and abandonment Costs Form:	$-	$
Paving, Demolition and Well Abandonment Costs Form:	$-	$
Consulting Fees Form:	$12,697.65	$
Total Proposed Budget	$21,245.75	$

L.P.E./L.P.G. Certification:
Joseph Kelly

11/30/07

IEPA Recommendation/Comments:

Response Due:
2/13/08
* sent required email to D. Clay and HAA
SLS:sls\

Document(s) Reviewed: 7/3/2012
SIP stage III CW3M is the new consultant

Review Notes:
Soil – has been delineated for btex but not pna's. Proposing three soil borings to the east. Access has been denied to the west. The plume goes off-site into the neighboring property and into the street (RT 159) to the west.

BH-1, 2, 3, 5, 9,11 ,12 &16-9 & 12 had PNA's

GW-propose only sampling mw-8 as have not been able to get a sample as yet.

MW-1, 2, 4, BH-9, 11, 12, & 14, off site

7/9/12-Spoke to Vince Smith to clarify the reports statement of completing previously approved work pertaining to GW they only plan on sampling mw-8.

The report is only 100 pages in to with 10 pages being the budget so
The plan is narrowed down to 100 pages, 3x's ($50-$20=$30)
The budget to 10 pages, 3x's ($20-$17=$3)
And the reimbursement generously 30 pages, 3x's.($50-$35=$15)
In total $72 adjusted in the consultant material costs

L.P.E./L.P.G. Certification:
Vince Smith

IEPA Recommendation/Comments:
Approve plan with modified budget
Response Due:
8/14/2012

sls\

Document Reviewed: Stage 3 SIP and budget amendment
Dated: 10/15
Received: 10/27/15

Last report received in July of 2012
Watch budget for rates used

Review Notes:

Two soil borings are being proposed to delineate extent of soil contamination off-site for PNA's
The 3 PNA's are BaA, BaP, BbF and Di(a,h)BA theses are locate on the south and east properties, due to the poorly marked map(failed to show bldg. to the south or grassy area to the south) it is difficult to say exactly where they plan to place them. The area is gravel per google satellite map. Cannot see where it would be coming from off-site

And a gw sample from mw-8 which after two dry attempts and 1 event where it had exceedences. (that barely qualified)

Gw map is drawn incorrectly plume goes out into HWY 159 there is a clean mw at the edge of the property, there are multiple borings and mw marked incorrectly or plume not drawn and one bh-5 needs to be delineated so I called Vince Smith and asked him to have it corrected and send me new maps. Some say it is not sampled , but are rather no exceedences. And BH-19 needs to be delineated and they ask for 2 more borings to delineate and yet map is marked clean??? Putting to the side and hoping I get a map quickly.]
1-27/16--Have received new maps (all of them redone)

The two proposed boring are for delineating BH-19(it is decided that the contamination at BH-19 is unrelated to this incident and is from another source, but another boring/mw is required to delineate BH-5/mw-4 on the west property boundary which has soil exceedance, (yet the gw plume is drawn out into the street, because of the soil/gw exceedance)
The plan will require modification of an additional SB/mw in the street (?) in order to delineate BH-5/mw-4

Soil	ft.	B	E	T	X	BaP	DiB	Nap	In	BbF	
Bh-1	10	.749	-	-	-	-	-	-			#1
BH-1	12	3.03	-	-	16.4	-	-	-			
BH-2	4	-	-	-	-	-	0.23	-			
BH-2	8	.096	-	-	-	-	-	-			
BH-3	13	0.463	-	-	-	-	-	-			
BH-5	9	.474			25.7	-	-	-			

BH-9	3-4	-	-	-	-	-	.54	-	1.7	#2
Bh-9	7-8	.312	-	-	-	.99	.17			
BH-11	4	-	-	-	-	.11	-	-	-	
BH-12	8	-	-	-	-	1.5	.2[illegible]	-	.93	1.8 #3
BH-19	7.5	-	-	-	-	2.41	.223	BaA 2.85(OUT OF ROOM)		

GW	B	E	T	X	NAP		
Mw-1	8.3	3.24	-	-	.387	STAGE #1	
Mw-2	.269	-	-	-	-		
Mw-4	2	3.83	-	-	1.23		
MW-5	?						
MW-6		-	-	-	-	-	STAGE #3
		BaA		BaP	DiB	Nap	In BbF
MW-8		.00014		-	-	-	- .0001

Drilling and Monitoring Costs	$1,486.97	$.00	$.00
Analytical costs	$1,454.82	$602.25	$852.57
Remediation and Disposal Costs	$.00	$.00	$.00
Ust Removal and Abandonment Costs	$0.00	$.00	$.00
Paving, Demo, and Well Abandonment	$0.00	$.00	$.00
Consulting Personnel Costs Form	$14,520.87	$.00	$.00
Consulting Materials Costs Form	$695.00	$.00	$.00
Total Budget	$18,777.23	$.00	$18,174.98

Subtracted the costs for 3 of the PNA soil cost sand encore sample kits
~~6 X 188.36=$1,130.16~~; 3x 188.36=$ 565.08
~~6 x 12.39=$74.34~~ ; 3 x 12.39=$37.17
There will be additional cost for mw which will be received in an amended report
The costs for the drilling was subpart H and would not change.

L.P.E./L.P.G. Certification:
Vince Smith

IEPA Recommendation/Comments:
Modify plan to delineate east of BH-5 / mw-4 which has soil and gw exceedences.
No boring is needed south of BH-19 and can go ahead and check mw-8(gw)
Budget is modified

Response Due:
2/24/16-120 days
Completed: 2-29-16

sls\

Document Reviewed: SICR 7/5/16
Dated: April 1 2016
Received: April 4, 2016

-State that they will be including a soil gas sample in the CAP, unless the IEPA decides otherwise.
-

Review Notes:

Hy C(K)=1.30 x 10^{-5}
Soil bulk Density(pb)=60.4lb/ft3 or (0.967cm/sec)
Soil particle Density (ps)=2.54 g/cm3
Moisture content(w)=2.86
FOC=0.0058g/g
Classification=Loamy sand

Soil : BZ, XY, BaP, DiBenzo A,h
GW: BZ, ETBZ, Nap

Soil is delineated for 0-5 feet
Soil is (?) delineated 5-10 feet, BH-19 has PNA's and is not delineated and BH-5 has BTEX at same depth and not delineated. Apparently access was denied
Requested copied of the access denial s and Vince smith emailed me copies of these and are attached to the front cover of the report.
Gw is Class I
There is no GW ordinance in effect, there is a limited gw ordinance just north east of the site.
There is likely contamination in the roadway(HWY 159) but all the properties to the west have denied access.
The contamination south of the site is likely from the copper smelt as it is higher in concentration to that found on the property.

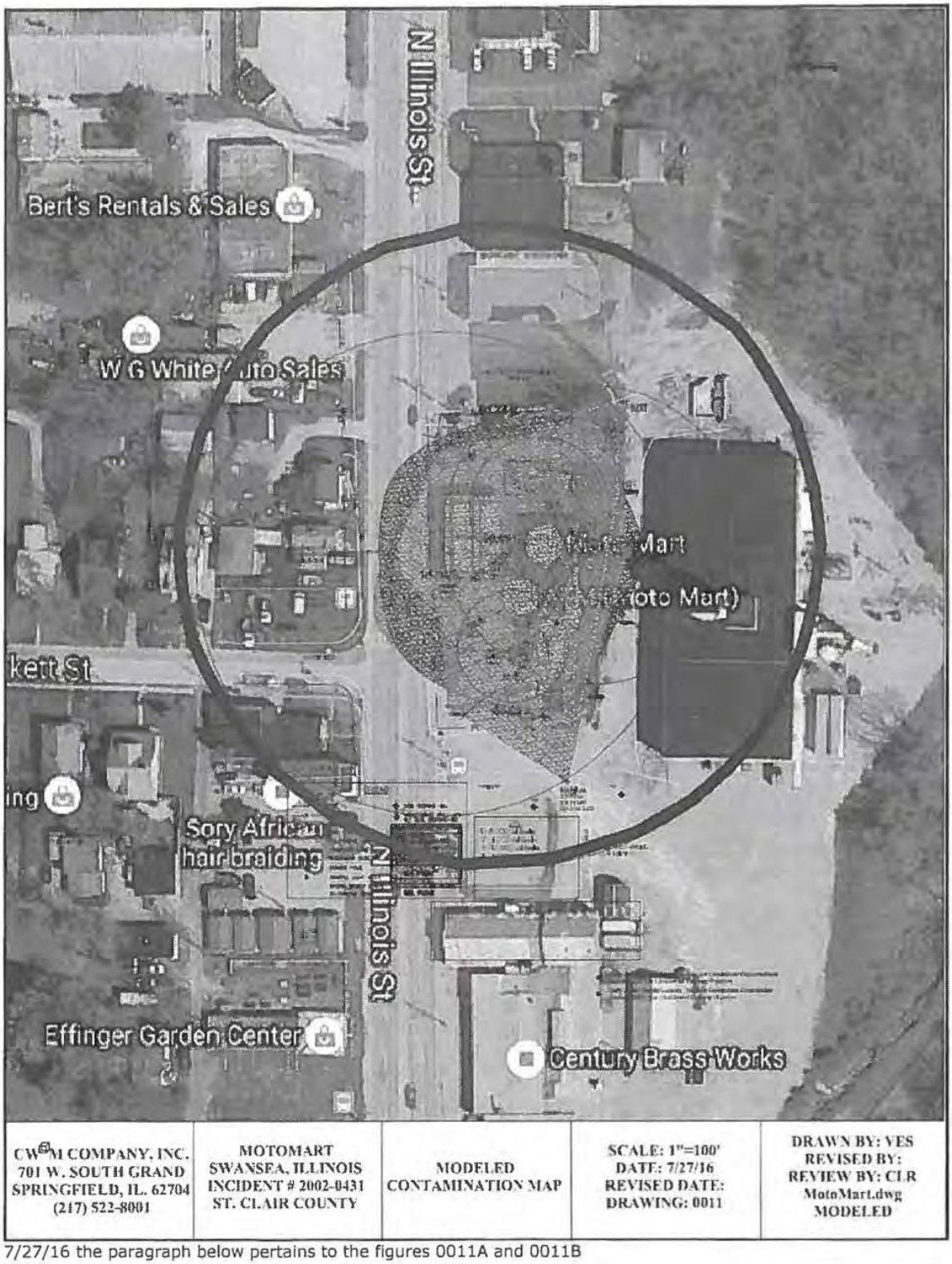
This went to the managers meeting and it was decided to question whether or not one boring could be put in the ROW, appears it cannot also requested modeling which V. Smith provided.

Pertaining to the budget:

There are costs such as PID, measuring wheel, camera, bailers and oversight/technical review that presently would be either eliminated as indirect costs or reduced to more reasonable rates. Since the proposed budgets were approved the costs stand as submitted.

	total	USI Part 1	CWM Part of part ISICR	CWM Part 3	CWM Part 4
Drilling and Monitoring Costs	$4,911.28	$3,536.20	$1,375.08	$1,375.08	$.00
Analytical costs	$6,093.09	$4,100.65	$1,992.44	$1,992.44	$.00
Remediation and Disposal Costs	$.00	$	$.00	$.00	$.00
Ust Removal and Abandonment Costs	$0.00	$.00	$.00	$.00	$.00
Paving, Demo, and Well Abandonment	$0.00	$.00	$.00	$.00	$.00
Consulting Personnel Costs Form	$41,825.73	$13,451.43	*$9,456.42*(**)*	$11,509.30	$7,620.32
Consulting Materials Costs Form	$1,445.35	$739.35	$49.50	$418.00	$238.50
Total Budget	$54,487.19	$21,827.63	$15,083.08	$15,294.82	$7,858.82

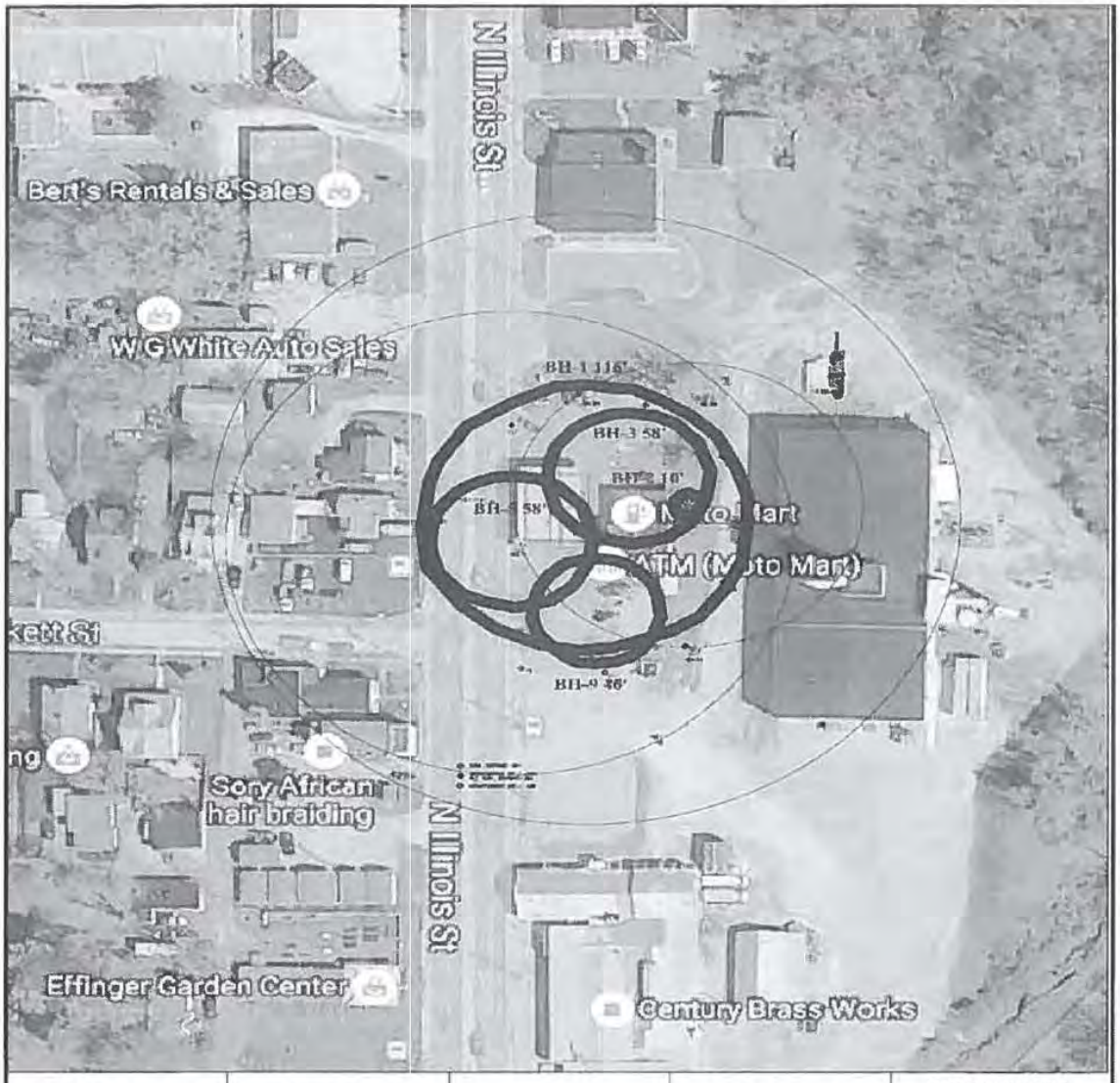
2*105.87=211.74
exceeds the original approved budget of 8 hours for projects cost review/ approval, reimbursement package review for Sr. PM
(**) 9456.42-211.74=**$9,244.68 is approved**



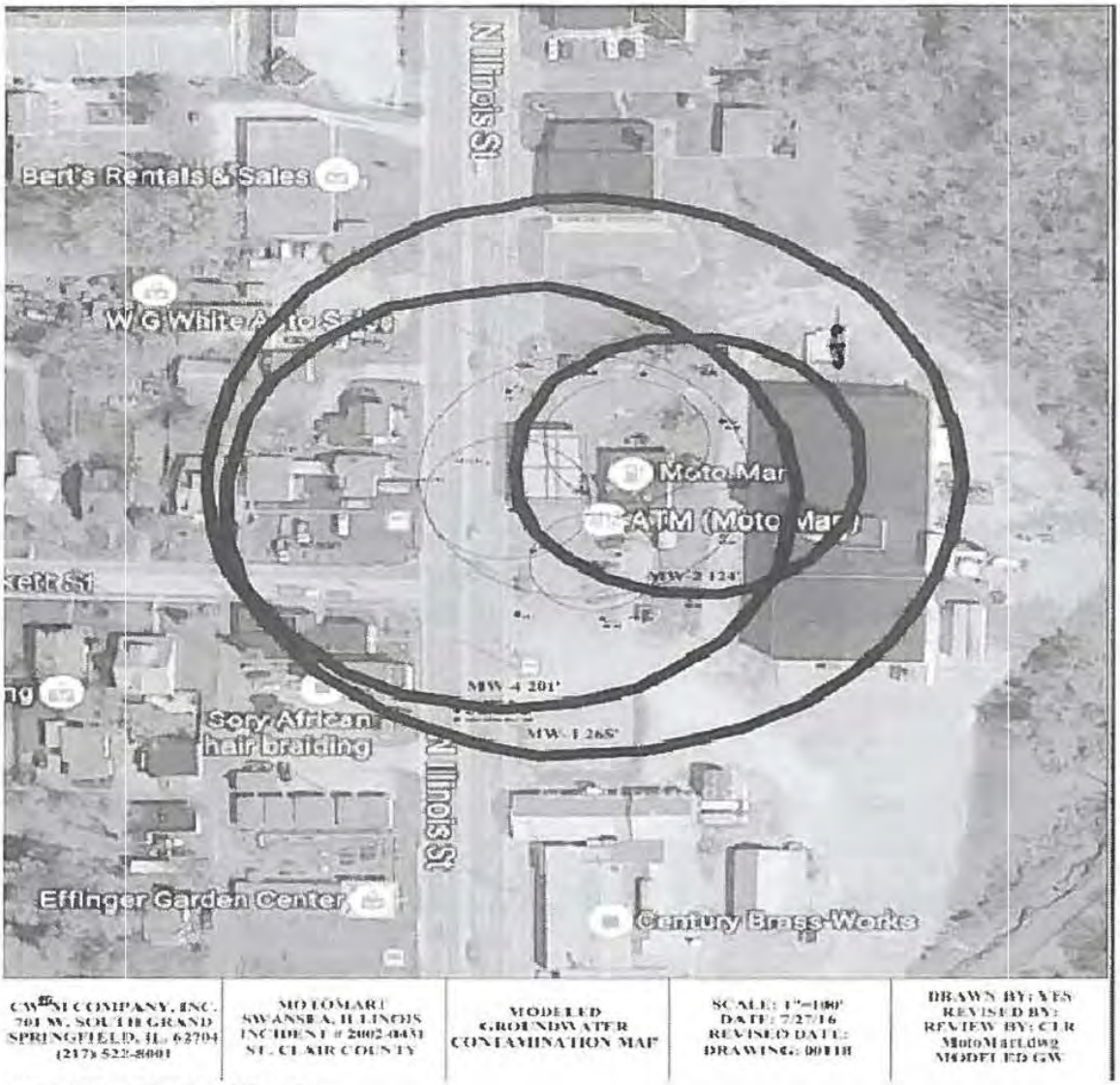
CW-M COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	MOTOMART SWANSEA, ILLINOIS INCIDENT # 2002-0431 ST. CLAIR COUNTY	MODELED CONTAMINATION MAP	SCALE: 1"=100' DATE: 7/27/16 REVISED DATE: DRAWING: 0011	DRAWN BY: VES REVISED BY: REVIEW BY: CLR MotoMart.dwg MODELED

7/27/16 the paragraph below pertains to the figures 0011A and 0011B
Shirlene,

Sorry for the confusion. Since the groundwater contamination modeling controlled, for the locations where there was both soil and water contamination, only the groundwater radii were used previously, and as I said before, groundwater at MW-1 defines the ultimate modeled boundary. On the attached drawings the dark lines are the modeled soil (drawing 0011A) or water (drawing 0011B) contamination, while the thin lines are the opposite (modeled groundwater on 0011A, modeled soil on 0011B). Each of the dark lines has an identifier for the sample location, and the radius of the circle.



CWM COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	MOTOMART SWANSEA, ILLINOIS INCIDENT # 2002-0431 ST. CLAIR COUNTY	MODELED SOIL CONTAMINATION MAP	SCALE: 1"=100' DATE: 7/27/16 REVISED DATE: DRAWING: 0011A	DRAWN BY: VES REVISED BY: REVIEW BY: CLR MotoMart.dwg MODELED SOIL



L.P.E./L.P.G. Certification:
Vince Smith

IEPA Recommendation/Comments: approve with budget modifications.
Response Due:
8/2/16-120 days
Completed: 7-26-16

sls\

9-22-16 spoke to Vince smith about the CAP not be submitted due to Val sending a email about VN letters. He said client has report and it should be in-house in the next week or so.

Document Reviewed: CAP/Budget
Dated: 10/3/16
Received: 10/11/16

Reviewed 12/--/16
Review Notes:
In this cap is a vapor intrusion investigation and some resampling of on-site and off-site contamination that would require remediation or additional institutional controls.

The former heating oil was where the new bldg. is now.
Hy C(K)=1.30 x 10^{-5} **now 4.30 x 10-5 cm/sec?? why different**
Soil bulk Density(pb)=60.4lb/ft3 or (0.967cm/sec)
Soil particle Density (ps)=2.54 g/cm3
Moisture content(w)=2.86
FOC=0.0058g/g
Classification=Loamy sand

Soil : BZ, XY, BaP, DiBenzo A,h
GW: BZ, ETBZ, Nap

Corrective Action Summary

Soil-Tier 1 extends off site to the east and west. BH-9 will require additional remediation, and the off-site soil contamination to the east will require additional remediation.

GW- MW-1, MW-2, MW-4 and MW-8 tier 1 has been exceeded. The plume covers much of the same area as the soil plume, extending slightly further to the east. It is proposed that a gw ordinance be used, effectively eliminating the migration to gw pathway.

Vapor intrusion pathway has not been investigated previously and in proposed in this CAP.

Soil remediation obj's

Parameter	TACO Tier 1-CUO mg/kg	Tier 2 CUO's
Benzene	0.03	3.21
Ethylbenzene	13.0	389.64
Toluene	12.0	371.29
MTBE	5.6	46.17

BaA, BaP, BbF, DiB(ah)A and Indeno replaced by background values.

Parameter	BH-9	TACO Tier 1-CUO industrial/commercial	Tier 1 CUO's Construction mg/kg
B(a) anthracene	2.5	7.84	18
Benzo(a)pyrene	*2.6*	0.784	17.01
Benzo(b) fluoranthene	2.5	8	170
Dibenzop(a,h)anthracene	*0.54*	0.467	17.01
Inden(1,2,3-cd)pyrene	1.7	8	170

Check to see if Tier 2 values were less or equal to tier 1
Soil need to be addressed on three parcels the site itself, off-site to the east and the ROW (RT. 159). From report

Where is map of where proposed boring / mw are going and is VI necessary? Received one bu email on 12/8/16 from V. smith

Proposing:

734 Budget	Proposed	/ Modified / Final	
Drilling and Monitoring Costs	$2,033.75	$.00	$2,033.75
Analytical costs	$1,661.72	$.00	$1,661.72
Remediation and Disposal Costs	$0.00	$.00	$.00
Ust Removal and Abandonment Costs	$0.00	$.00	$.00
Paving, Demo, and Well Abandonment	$2,191.00	$.00	$2,191.00
Consulting Personnel Costs Form	$38,571.22	$23,240.42	$15,330.80
Consulting Materials Costs Form	$1,492.50	$901.50	$591.00
Total Budget	$45,950.19	$26.332.92	$19,617.27

Except for measuring wheel; sr pm reimbursement which were cut , other costs can be submitted in a plan that is consistent to the plan with documentation. As stated before these were discussed with vince smith. So work related to the proposed boring including vI are approved. Some could not be separated
therefore are delayed in approval with next submittal

L.P.E./L.P.G. Certification:
Vince Smith

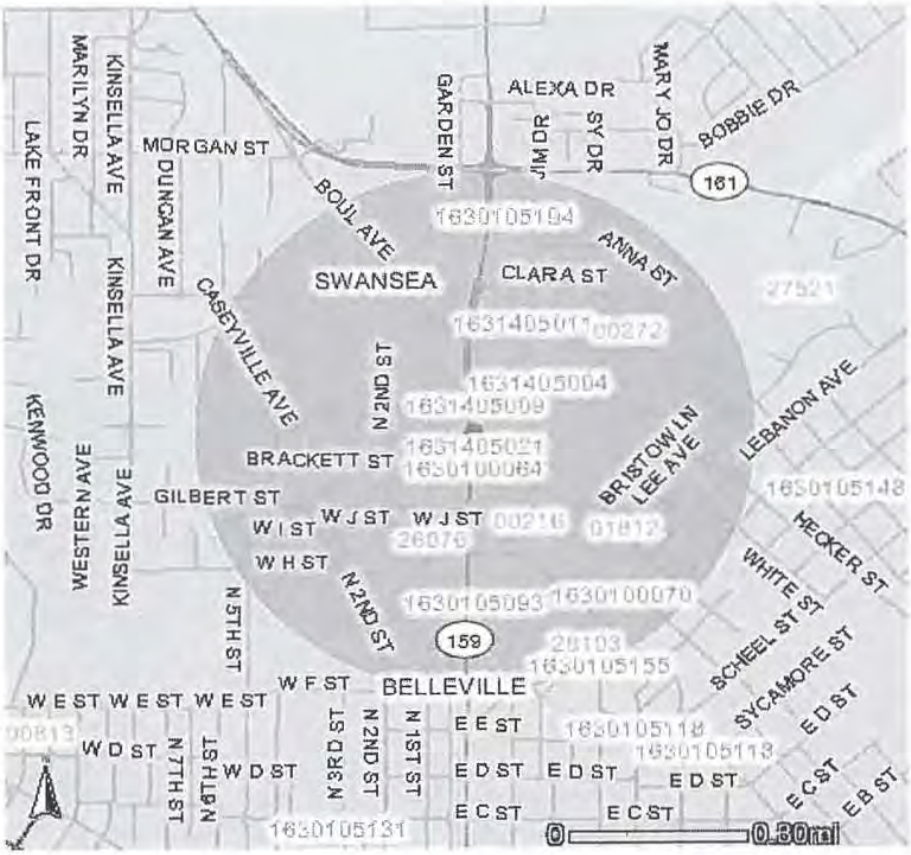
IEPA Recommendation/Comments:

Response Due:
2/28/17-120 days
Completed: 1-14-16

sls\

12/9/16 – spoke to Vince smith about teh three proposed boring and having possible excavation or ELUC proposed for corrective action, that first the Agency would need to see the results of the borings before approving a CAP. Those should be in the next submittal, which should be very similar to the one in-house.

Allowing drilling, analytical, and field costs at this time . the MW abandonment, consultant costs TACO, CACR, ELUC, HAA are all cut at this time. The soil gas sample costs need to be broken down for approval from agency.



Legend
- Highlighted Feature
- Selected Features
- theBufferPolygons
- Municipal boundaries
- County lines
- State line
- Leaking UST
- Local Roads
- Major Roads
- State Highways
- U.S. Highways
- Potential for Aquifer Recharge
- Very High
- Very High to High
- Moderately High to Moderate
- High to Moderately High
- Moderate to Moderately Low
- Moderately Low to Low
- Low
- Disturbed Lands
- Water
- Regulated Recharge Areas
- Class III Ground Water
- ISGS Wells
- Non-CWS Wells
- CWS Phase II Wellhead Protection Area
- CWS Phase I Wellhead Protection Area
- CWS Wells
- Active
- Abandoned
- Inactive
- Planned
- Adopted Maximum Setback Zones
- Groundwater Ordinances

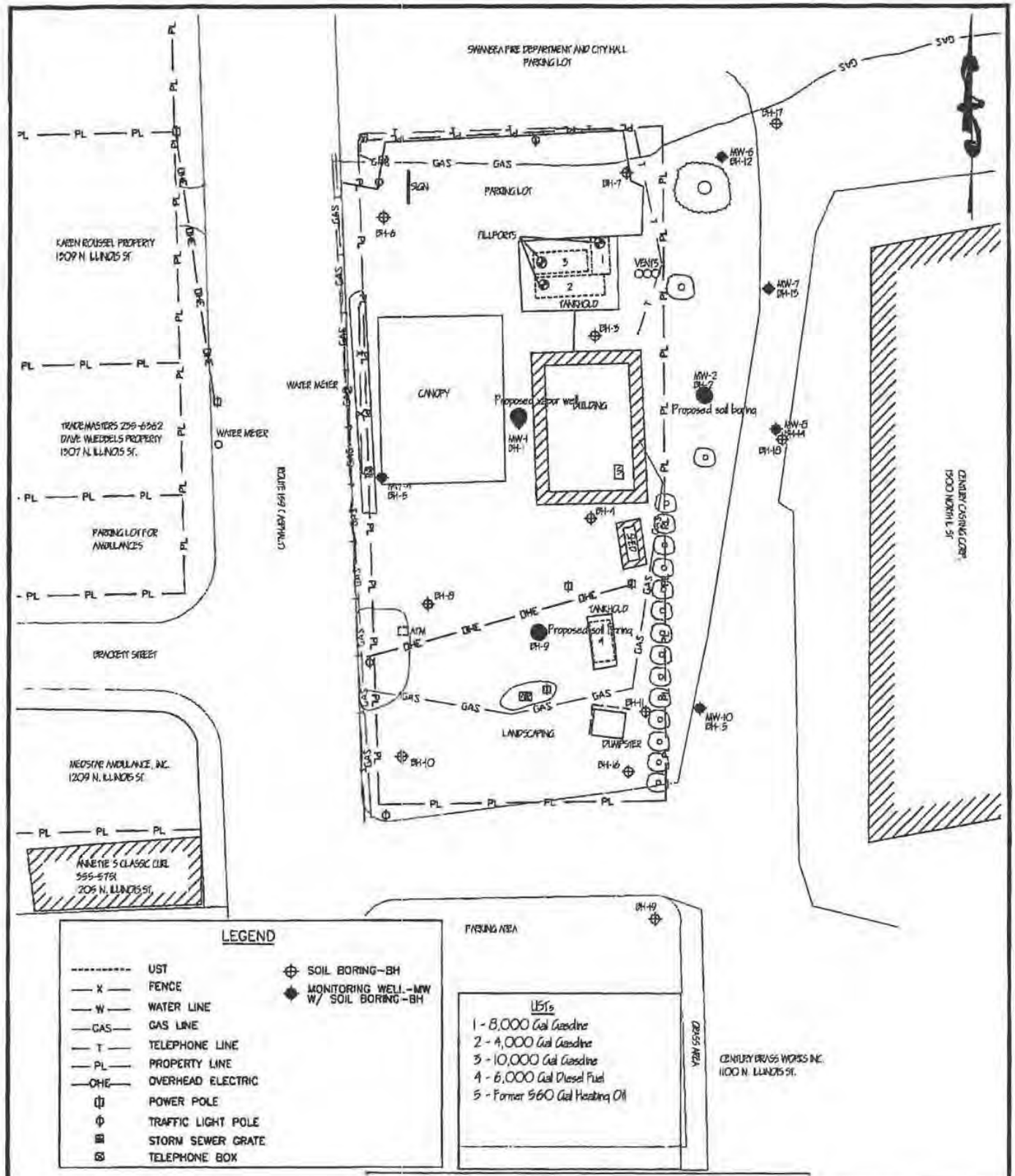
South, Shirlene

From: vince@cwmcompany.com
Sent: Thursday, December 08, 2016 9:19 AM
To: South, Shirlene
Subject: [External] Motomart - Swansea 2002-0431 CAP
Attachments: Moto Swansea - Proposed SB map.pdf

Shirlene,

As you requested, we have prepared and attached a proposed soil boring map showing the two proposed soil boring locations and the vapor intrusion sampling well location. If you need any other information, let us know.

Vince E. Smith, P.E.
Sr. Environmental Engineer
CWM Company, Inc.
701 W. South Grand Ave.
Springfield, IL 62704
217-522-8001
Fax 217-522-8009
vince@cwmcompany.com



CW[D]M COMPANY, INC. 701 W. SOUTH GRAND SPRINGFIELD, IL. 62704 (217) 522-8001	MOTOMART SWANSEA, ILLINOIS INCIDENT # 2002-0431 ST. CLAIR COUNTY	PROPOSED SOIL BORING LOCATION MAP	SCALE: 1"=50' DATE: 3/24/12 REVISED DATE: 12/8/16 DRAWING: 0003A	DRAWN BY: USI REVISED BY: VES REVIEW BY: CLR MotoMart.dwg PSB

South, Shirlene

From: vince@cwmcompany.com
Sent: Thursday, December 08, 2016 10:02 AM
To: South, Shirlene
Subject: RE: [External] Motomart - Swansea 2002-0431 CAP

Shirlene,

Yes, it is labeled "Proposed vapor well", located between the station building and the canopy.

Vince

-------- Original Message --------
Subject: RE: [External] Motomart - Swansea 2002-0431 CAP
From: "South, Shirlene" <Shirlene.South@Illinois.gov>
Date: Thu, December 08, 2016 8:25 am
To: "vince@cwmcompany.com" <vince@cwmcompany.com>

Is the VI boring on here?

From: vince@cwmcompany.com [mailto:vince@cwmcompany.com]
Sent: Thursday, December 08, 2016 9:19 AM
To: South, Shirlene
Subject: [External] Motomart - Swansea 2002-0431 CAP

Shirlene,

As you requested, we have prepared and attached a proposed soil boring map showing the two proposed soil boring locations and the vapor intrusion sampling well location. If you need any other information, let us know.

Vince E. Smith, P.E.
Sr. Environmental Engineer
CWM Company, Inc.
701 W. South Grand Ave.
Springfield, IL 62704
217-522-8001
Fax 217-522-8009
vince@cwmcompany.com

CAP

1631405021/ MotoMart-Swansea
Swansea/ St. Clair
1324 N. Illinois St (RT 159)
inc# 2002-0431
LEAKING UST TECH FILE

DATE December 9, 2016

REVIEWER sls

	REQUESTED	DEDUCTED	APPROVED
Drilling and Monitoring Well Cost	$2,033.75	$0.00	$2,033.75
ANALYTICAL	$1,661.72	$0.00	$1,661.72
Remediation and Disposal	$0.00	$0.00	$0.00
ust removal and abandonment	$0.00	$0.00	$0.00
paving, Demolition and Well abandonment	$2,191.00	$2,191.00	$0.00
Consultant Cost	$38,571.22	$23,240.42	$15,330.80
CONSULTANT'S MATERIALS	$1,492.50	$901.50	$591.00
TOTAL	$45,950.19	$26,332.92	$19,617.27

DEDUCTIONS - EXPLANATION

(AMOUNT DEDUCTED) - REASON	hours*rate	deduction	reason
Paving ,Demo and MW abandonment			
MW-1 -MW-10 only those not removed by an possible excavation			
personnel costs			6307.52
CCAP			3003.6
sR. PM.-report coor/techoversight/compliance	6*125.15	750.9	3604.34
sr. PE-report review and cert	3*162.70	488.1	1501.8
engIII-CA design/reprt dev/IEPA corres	36*125.15	4,505.40	
SR DRAfT-draft/edit/CAD	6*75.08	450.48	6532.98
SR Admin Asst-reprt compl/assembly/distru	2*56.32	112.64	20950.24
total		**6307.52**	
TACO			
engIII- gwmodeling/plume delination	8*125.15	1001.2	paying for one time only
eng III-tier 2 calc/dev cuo's	12*125.15	1,501.80	
sr PM-tier 2 eval/calc/modeling review/	4*125.15	500.6	
assessment	total	**3,003.60**	

CAP

CCAP-Budget				
SR. PM-budget compliance/tech oversight	6*125.15	750.9		
engIII-budget calc/desigh	18*125.15	2,252.70		
SR PE-budger review/cert	3*162.70	488.1		
sr admin asst-budget compl/assembly/distru	2*56.32	112.64		
total		**3604.34**		
CA-PAY				
SR PE- budget review/cert(CAP,Drilling closure submittal	6*162.70	976.2		
SR ACCT Techreim prep(cap/DR/Cl submit	30*68.83	2,064.90		
Sr Ad Asst-RE compliation, Ass/Dist/()	4*56.32	225.28		
Sr PM-RE comp/tech oversight()	*12*125.15*	*1,501.80*	** cut per BB 17/31/30	
total		**3,791.98**		2290.18
CACR				
Sr PM-reprt coor/tech oversight /compliance	8*125.15	1,001.20		
sr PE-reprt review and cert	4*162.70	650.8		
SR Admin Asst-reprt compl/assembly/distru	2*56.32	112.64		
ENG III-report prep/development	36*125.15	4,505.40		
sr admin asst-NFR recording/corres	2*56.32	112.64	**was off by 100.00	
w/ village			rose called and I had the 100.00	
sR PM-NFR review/IEPA correspondence	2*125.15	250.3		
total		**6,632.98**		
ELUC				
ENGIII-gw ord dev/meeting/notification	24*125.15	3,003.60		
SR PM- gw ord negotiations/notific	6*125.15	750.9		
Sr Ad asst-gw ord corres/ notifications	2*56.32	112.64		
sR PM-HAA IDOT review/ COOR	6*125.15	750.9		
ENGIII-HAA IDOT Dev/ corres	24*125.15	3,003.60		
SR Draft/CAD-HAA drawing	4*75.08	300.32		
Sr. ad Asst- HAA compliation/ Ass Dist	2*56.32	112.64		
total		8,034.60		
CCA-field				
SR PM-field prep, sched/arrang/coor	4*125.15	500.6		
ENGIII-dr/VI sampland prep	16*125.15	2,002.40		
ENG II-Drilling/VI sampling	14*106.38	1,489.32		
SR AD Asst- arangfor Invest, utilities julie scheduling	2*56.32	112.64		
ENG III-borlogs, SI Doc, Analytical entry	4*125.15	500.6		
sR PM-reviewin. Eval analytical/sI Doc , field data	2*125.15	250.3		
Sr PM-off-site SI coor	6*125.15	750.9		
ENG III-off-site notifation/result reports	4*125.15	500.6		
sR Ad asst-off-site PO drilling notif and re	2*56.32	112.64		
total CCA		6220		

CAP

Material Costs				
CCAP				
CCAP-copies of plan and report/draft plan	60*.15	90		
postage-report/forms/ draft/dist	3*6	18		
copiesbudget -budget / draft	300*.15	45		
postage-rbudget dist	3*6	18		
total		**171**		
CACR				262
copies -completion report dist/ draft	800*.15	120		639.5
postge-copies report dist	3*6	18		901.5
Material costs cont.				
CA-PAY			cut	
ca-copies of RE c;aim	1200*.15	180		200
postage	6*6	36		18
NFR recording	68*1	68		262
total		**284**		
				171
CACR				138
postage -NFR	4*6	24		284
NFR-recordin/submittal / IEPA corres	150*.15	22.5		46.5
total		**46.5**		639.5
ELUC				
copies- ordinca submittal;/notifica	150*.15	22.5		
2 round trip from spfld-VI/ Drillling	400*0.54(not 0.65)	-44		
water level	28*1	28		
gloves	1*16	16		
PID	1*148	148		
vi shroud, OH, canister/regualtor	1*200	*200*	cut,17/30/31	
CCA Field				
measuring wheel-vi	1*18	18	CUT,31	
postage-HAA	8*6	48		
copies-HAA corres/exec/dist	250*.15	37.5		
postage-CCA -filed off-site po dril/s results	2*6	12		
copies-off-site""	100*.15	15		
total		**501**		

green is for items being addressed in this report and budget. Does not signify whether they are being approved

drilling
analytical
eluc , HAA
field costs, minus shroud($200), measuring wheel

make sure Rob Miluer is contacted and is at the site and the time is noted for the three wells.

CAP

Environmental Justice (EJ) Area Reporting Form for Leaking UST Program Sites

Reviewed by: Shirlene South
Date Reviewed: 12-14-16

Re: LPC #1631405021 – St. Clair County
Swansea/ MotoMart Inc.
1324 North Illinois Street (Rt 159)
Incident No. 20020431
LUST Technical File

For a site located in an **EJ area**, as defined on the EJ GIS map, the information listed below will be provided by the Leaking UST Section's assigned project manager to the EJ Officer as soon as possible ***upon receipt*** of all Corrective Action Plans (CAPs) and Completion Reports (CACRs). For subsequent amended CAPs, if no substantial change in remedial effort is proposed then an additional memo is not necessary.

Request for Review of Leaking UST Program Site Located in EJ Area	
Item	Complete field below for known items at time of request (leave blank if unknown)
Project Manager Name	**Shirlene South**
BOL ID#	1631405021
Site Name	MotoMart-Swansea
Site Address (Street Address)	1324 North Illinois Street(RT. 159)
Site City	Swansea
Site County	St. Clair
UST Owner or Operator Name	MotoMart
UST Owner or Operator Contact	Rob Whittington
UST Owner or Operator Phone	618/233-6754
Description of Facility: Previous Use of Site and Current/Proposed Use of Site	Gas station
Proposed Corrective Action	possible excavation
Land Use after Corrective Action	Gas station
Engineered Barriers Used	
Institutional Controls Used	HAA, groundwater ordinance, ELUC , Ind/ Com land use
Contaminants of Concern	
Is there off-site contamination as a result of the release?	yes
Was site referred to CEG for Right-to-Know notifications? **If yes**, have notifications been sent, and who is the assigned Community Relations Coordinator?	no
Other Relevant Information: Enforcement, citizen complaint, public interest, etc.	
Date CAP/CACR Received	10/3/16
Date Request for Review Sent to EJ Officer	

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
1021 NORTH GRAND AVENUE EAST, P.O. BOX 19276, SPRINGFIELD, ILLINOIS 62794-9276 • (217) 782-3397
BRUCE RAUNER, GOVERNOR ALEC MESSINA, ACTING DIRECTOR

217/524-3300

CERTIFIED MAIL
7014 2120 0002 3292 2094

DEC 20 2016

Moto Inc.
Attn: Rob Whittington, Environmental Manager
P.O. Box 122
Belleville, Illinois 62222

Re: LPC #1631405021 – St. Clair County
Swansea/ MotoMart-Swansea
1324 North Illinois (Route 159)
Leaking UST Incident No. 20020431
Leaking UST Technical File

Dear Mr. Whittington

The Illinois Environmental Protection Agency (Illinois EPA) has reviewed the Corrective Action Plan (plan) submitted for the above-referenced incident. This plan, dated October 3, 2016 was received by the Illinois EPA on October 11, 2016. Citations in this letter are from the Environmental Protection Act (415 ILCS 5) (Act) and Title 35 of the Illinois Administrative Code (35 Ill. Adm. Code).

The Illinois EPA requires modification of the plan; therefore, the plan is conditionally approved with the Illinois EPA's modifications. The following modifications are necessary, in addition to those provisions already outlined in the plan, to demonstrate compliance with Title XVI of the Act (Sections 57.7(b)(2) and 57.7(c) of the Act and 35 Ill. Adm. Code 734.505(b) and 734.510(a)):

Without results from the proposed soil boring (resampling for BH-2 and BH-9), monitoring well installation and soil vapor investigation in the area of MW-1, the Illinois EPA cannot approve the plan as submitted. Subsequently, the Illinois EPA only approves the two soil borings (collection and analysis of additional soil samples), installation of one groundwater monitoring well and performance of a soil vapor investigation.

Please note that all activities associated with the remediation of this release proposed in the plan must be executed in accordance with all applicable regulatory and statutory requirements, including compliance with the proper permits.

In addition, the budget is modified pursuant to Sections 57.7(b)(3) and 57.7(c) of the Act and 35 Ill. Adm. Code 734.505(b) and 734.510(b). Based on the modifications listed in Section 2 of Attachment A, the amounts listed in Section 1 of Attachment A have been approved. Please note that the costs must be incurred in accordance with the approved plan. Be aware that the amount of payment from the Fund may be limited by Sections 57.7(c), 57.8(d), 57.8(e), and 57.8(g) of the Act, as well as 35 Ill. Adm. Code 734.630 and 734.655.

If the owner or operator agrees with the Illinois EPA's modifications, submittal of an amended plan and/or budget, if applicable, is not required (Section 57.7(c) of the Act).

NOTE: Pursuant to Section 57.8(a)(5) of the Act, if payment from the Fund will be sought for any additional costs that may be incurred as a result of the Illinois EPA's modifications, an amended budget must be submitted. Amended plans and/or budgets must be submitted and approved prior to the issuance of a No Further Remediation (NFR) Letter. Costs associated with a plan or budget that have not been approved prior to the issuance of an NFR Letter will not be paid from the Fund.

Further, pursuant to 35 Ill. Adm. Code 734.145, it is required that the Illinois EPA be notified of field activities prior to the date the field activities take place. This notice must include a description of the field activities to be conducted; the name of the person conducting the activities; and the date, time, and place the activities will be conducted. This notification of field activities may be done by telephone, facsimile, or electronic mail—and must be provided at least two weeks prior to the scheduled field activities.

Besides providing at least two weeks' notice to Leaking UST Section staff in Springfield, notification must be provided to Rob Mileur either by telephone at (618) 993-7223 or by e-mail at Robert.Mileur@illinois.gov.

Pursuant to Sections 57.7(b)(5) and 57.12(c) and (d) of the Act and 35 Ill. Adm. Code 734.100 and 734.125, the Illinois EPA requires that a Corrective Action Completion Report that achieves compliance with applicable remediation objectives be submitted within 30 days after completion of the plan to:

Illinois Environmental Protection Agency
Bureau of Land - #24
Leaking Underground Storage Tank Section
1021 North Grand Avenue East
Post Office Box 19276
Springfield, IL 62794-9276

Please submit all correspondence in duplicate and include the Re: block shown at the beginning of this letter.

If within four years after the approval of this plan, compliance with the applicable remediation objectives has not been achieved and a Corrective Action Completion Report has not been submitted, the Illinois EPA requires the submission of a status report pursuant to Section 57.7(b)(6) of the Act.

An underground storage tank system owner or operator may appeal this decision to the Illinois Pollution Control Board. Appeal rights are attached.

If you have any questions or need further assistance, please contact Shirlene South at 217/558-0347.

Sincerely,

SA Colantino

Stephen A. Colantino
Acting Unit Manager
Leaking Underground Storage Tank Section
Division of Remediation Management
Bureau of Land

SAC:sls:SS\

Attachment: Attachment A

c: vince@cwmcompany.com (electronic copy),

BOL File

Appeal Rights

An underground storage tank owner or operator may appeal this final decision to the Illinois Pollution Control Board pursuant to Sections 40 and 57.7(c)(4) of the Act by filing a petition for a hearing within 35 days after the date of issuance of the final decision. However, the 35-day period may be extended for a period of time not to exceed 90 days by written notice from the owner or operator and the Illinois EPA within the initial 35-day appeal period. If the owner or operator wishes to receive a 90-day extension, a written request that includes a statement of the date the final decision was received, along with a copy of this decision, must be sent to the Illinois EPA as soon as possible.

For information regarding the filing of an appeal, please contact:

John Therriault, Assistant Clerk
Illinois Pollution Control Board
James R. Thompson Center
100 West Randolph, Suite 11-500
Chicago, IL 60601
312/814-3620

For information regarding the filing of an extension, please contact:

Illinois Environmental Protection Agency
Division of Legal Counsel
1021 North Grand Avenue East
Post Office Box 19276
Springfield, IL 62794-9276
217/782-5544

Attachment A

Re: LPC #1631405021 – St. Clair County
Swansea/ MotoMart-Swansea
1324 North Illinois (Route 159)
Leaking UST Incident No. 20020431
Leaking UST Technical File

SECTION 1

As a result of Illinois EPA's modification(s) in Section 2 of this Attachment A, the following amounts are approved:

$2,033.75	Drilling and Monitoring Well Costs
$1,661.72	Analytical Costs
$0.00	Remediation and Disposal Costs
$0.00	UST Removal and Abandonment Costs
$0.00	Paving, Demolition, and Well Abandonment Costs
$15,330.81	Consulting Personnel Costs
$609.00	Consultant's Materials Costs

Handling charges will be determined at the time a billing package is reviewed by the Illinois EPA. The amount of allowable handling charges will be determined in accordance with Section 57.1(a) of the Environmental Protection Act (Act) and 35 Illinois Administrative Code (35 Ill. Adm. Code) 734.635.

SECTION 2

1. $2,191.00 for costs for well abandonment, which exceed the minimum requirements necessary to comply with the Act. Costs associated with site investigation and corrective action activities and associated materials or services exceeding the minimum requirements necessary to comply with the Act are not eligible for payment from the Fund pursuant to Section 57.7(c)(3) of the Act and 35 Ill. Adm. Code 734.630(o).

   These costs may be included in an amended corrective action plan and be reviewed at that time

2. $21,738.62 for costs for personnel that are inconsistent with the associated technical plan. One of the overall goals of the financial review is to assure that costs associated with materials, activities, and services are consistent with the associated technical plan. Such costs are ineligible for payment from the Fund pursuant to Section 57.7(c)(3) of the Act and 35 Ill. Adm. Code 734.510(b).

   These costs may be included in an amended corrective action plan and be reviewed at that time.

3. $1,501.80 for costs for personnel, which exceed the minimum requirements necessary to comply with the Act. Costs associated with site investigation and corrective action activities and associated materials or services exceeding the minimum requirements necessary to comply with the Act are not eligible for payment from the Fund pursuant to Section 57.7(c)(3) of the Act and 35 Ill. Adm. Code 734.630(o).

   Senior Project Manager costs for reimbursement compliance/technical oversight(CAP, Drilling, Closure submittals)

   In addition, for costs for corrective action –pay which lack supporting documentation. Such costs are ineligible for payment from the Fund pursuant to 35 Ill. Adm. Code 734.630(cc). Since there is no supporting documentation of costs, the Illinois EPA cannot determine that costs will not be used for activities in excess of those necessary to meet the minimum requirements of Title XVI of the Act. Therefore, such costs are not approved pursuant to Section 57.7(c)(3) of the Act because they may be used for site investigation or corrective action activities in excess of those required to meet the minimum requirements of Title XVI of the Act.

   Also, for site investigation or corrective action costs for corrective action-pay that are not reasonable as submitted. Such costs are ineligible for payment from the Fund pursuant to Section 57.7(c)(3) of the Act and 35 Ill. Adm. Code 734.630(dd).

4. $639.50 for costs for material cost that are inconsistent with the associated technical plan. One of the overall goals of the financial review is to assure that costs associated with materials, activities, and services are consistent with the associated technical plan. Such costs are ineligible for payment from the Fund pursuant to Section 57.7(c)(3) of the Act and 35 Ill. Adm. Code 734.510(b).

   These costs may be included in an amended corrective action plan and be reviewed at that time.

5. $200.00 for costs for material costs that are inconsistent with the associated technical plan. One of the overall goals of the financial review is to assure that costs associated with materials, activities, and services are consistent with the associated technical plan. Such costs are ineligible for payment from the Fund pursuant to Section 57.7(c)(3) of the Act and 35 Ill. Adm. Code 734.510(b).

   The Illinois EPA is requesting documentation for the shroud construction and operation materials, rental of gas canister and regulator prior to approving these costs as was discussed in the phone conversation on December 9, 2016 with the project manager.

6. $18 for indirect corrective action costs for a measuring wheel charged as direct costs. Such costs are ineligible for payment from the Fund pursuant to 35 Ill. Adm. Code 734.630(v). In addition, such costs are not approved pursuant to 35 Ill. Adm. Code 734.630(dd) and Section 57.7(c)(3) of the Act because they are not reasonable

7. $44.00 for costs for mileage, which lack supporting documentation. Such costs are ineligible for payment from the Fund pursuant to 35 Ill. Adm. Code 734.630(cc). Since there is no supporting documentation of costs, the Illinois EPA cannot determine that costs will not be used for activities in excess of those necessary to meet the minimum requirements of Title XVI of the Act. Therefore, such costs are not approved pursuant to Section 57.7(c)(3) of the Act because they may be used for site investigation or corrective action activities in excess of those required to meet the minimum requirements of Title XVI of the Act.

   The current federal rate for mileage is $0.54, therefore the cost as been adjusted to reflect this in the budget.

sls:SS\

CERTIFICATE OF SERVICE

I, the undersigned, on affirmation state the following:

That I have served the attached **CERTIFICATE OF RECORD ON APPEAL and the accompanying documents comprising the entire record of the Respondent's decision** by e-mail upon Patrick D. Shaw at the e-mail address of pdshaw1law@gmail.com and upon Hearing Officer Carol Webb at the e-mail address of Carol.Webb@Illinois.gov.

That my e-mail address is Scott.Sievers@Illinois.gov.

That the number of pages in the e-mail transmission is two-hundred and thirty-nine (239).

That the e-mail transmission took place before 5:00 p.m. on the date of March 9, 2017.

/s/Scott B. Sievers
March 9, 2017