

Attachment E
MDEQ Comment Package on Remedial Investigation Report for
Reach 3

Executive Summary

MDEQ Comments on *“Remedial Investigation Report for Reach 3”* Enbridge, October 30, 2014

Non Aqueous Phase Liquid (NAPL)

Enbridge provided observations of visible oil, oil globules, and/or sheen on groundwater or soil cores at 22 locations in Reach 3 (see Figure 1 and Table 1a). Enbridge provided information that these observations are representative of post response activity conditions. Enbridge has not conducted petrophysical testing at locations within Reach 3. The presence of oil globules and/or oil sheen on groundwater in the boreholes and/or temporary wells suggests potential for NAPL mobility at those locations. Enbridge has not evaluated NAPL mobility in Reach 3. Additional evaluation is required to assess the presence and mobility of NAPL.

Aesthetic Impact

Enbridge provided observations of oil, oil globules, oil sheen, and/or petroleum odor at approximately 24 locations in Reach 3 (see Figure 1 and Table 1b). Enbridge provided information that these observations are representative of post response activity conditions. As such, these observations constitute aesthetic impacts that require further evaluation.

Ultraviolet Fluorescence (UV Fluorescence)

Enbridge provided observations of UV Fluorescence indicating potential locations of impact related to the Enbridge Line 6B Pipeline release. Five locations exist where analytical sample data was not collected (see Figure 2 and Table 2). Enbridge did not provide data indicating observations of UV Fluorescence do not result in potential exceedance of Part 201 Soil and/or Groundwater Criteria.

Groundwater Flow

It is presumed that groundwater flow direction is towards Talmadge Creek but has not been demonstrated through installation and monitoring of permanent monitoring wells within Reach 3. Additionally, groundwater samples collected from temporary monitoring wells within Reach 3 exhibited metals exceedances of Part 201 Criteria.

Soil

Inorganics (Metals) – Enbridge provided data that indicates metals that are constituents of the Line 6B pipeline release, specifically Molybdenum, are present in soil at concentrations in excess of Part 201 Drinking Water Protection Criteria (DWPC) in the spill area (see Figure 3 and Table 3). Results from MDEQ Soil Background Metals evaluation indicate soil concentrations of Molybdenum also exceed the site specific calculated background number (refer to Background Evaluation figure and table). Synthetic precipitation leaching procedure (SPLP) was conducted at one of these locations with an exceedance of Part 201 Residential Drinking Water Criteria as a result. SPLP analyses were not conducted at any other location.

Accordingly, Enbridge has not fully evaluated the potential for Molybdenum contamination in soil to present a risk to groundwater. Additional evaluation is required to evaluate Molybdenum risk to

groundwater. Additionally, Enbridge provided insufficient information to demonstrate these metals are not related to the Line 6B Pipeline release.

Volatile Organic Compounds (VOCs) – Enbridge provided data that indicates VOCs, which are constituents of the Line 6B pipeline release, are present in unsaturated soil at concentrations in excess of Part 201 DWPC and Groundwater Surface Water Interface Protection Criteria (GSIPC) in the spill area. Enbridge conducted SPLP analyses for two unsaturated soil samples with both sample results indicating the potential for VOC mobility at concentrations in excess of Part 201 Criteria (see Figure 4 and Table 4). Additionally, two other soil samples had VOC exceedances of Part 201 criteria but did not have corresponding SPLP data to indicate that no risk to groundwater was present. Additional evaluation is required to confirm the presence, absence, and/or mobility of VOC impact.

Polynuclear Aromatic Hydrocarbons (PNAs) – Enbridge provided data that indicates PNAs, which are constituents of the Line 6B pipeline release, are present in unsaturated soil at concentrations below Part 201 Criteria. A few samples exhibited detections of PNAs, but did not exceed applicable criteria or indicate the potential for impact to groundwater.

Groundwater

Inorganics (Metals) – Enbridge provided data that indicates metals, which are constituents of the Line 6B Pipeline release, (primarily Vanadium, but also Nickel) are present in groundwater at concentrations in excess of Part 201 Residential Drinking Water Criteria (DWC) and Groundwater Surface Water Interface Criteria (GSIC) in the spill area. Results from the MDEQ Groundwater Background Metals evaluation indicate groundwater concentrations of Vanadium also exceed the calculated site specific groundwater number (see Figure 5 and Table 5). Additional evaluation is required to assess the risks associated with Vanadium impact to groundwater.

In addition, nickel was also found to exceed both the calculated background number and the Part 201 Criteria. However the Background values calculated for these metals are lower than Criteria.

Volatile Organic Compounds (VOCs) – Enbridge provided data that indicates VOCs, which are constituents of the Line 6B Pipeline release, are potentially present in groundwater within the spill area (see Figure 6). The groundwater analytical data was screened to determine if any exceedances of criteria were present. Numerous groundwater samples within Reach 3 exhibited elevated reporting limits above Part 201 Criteria. Additional evaluation is required to confirm the presence or absence of VOC impact to groundwater and assess the associated risks.

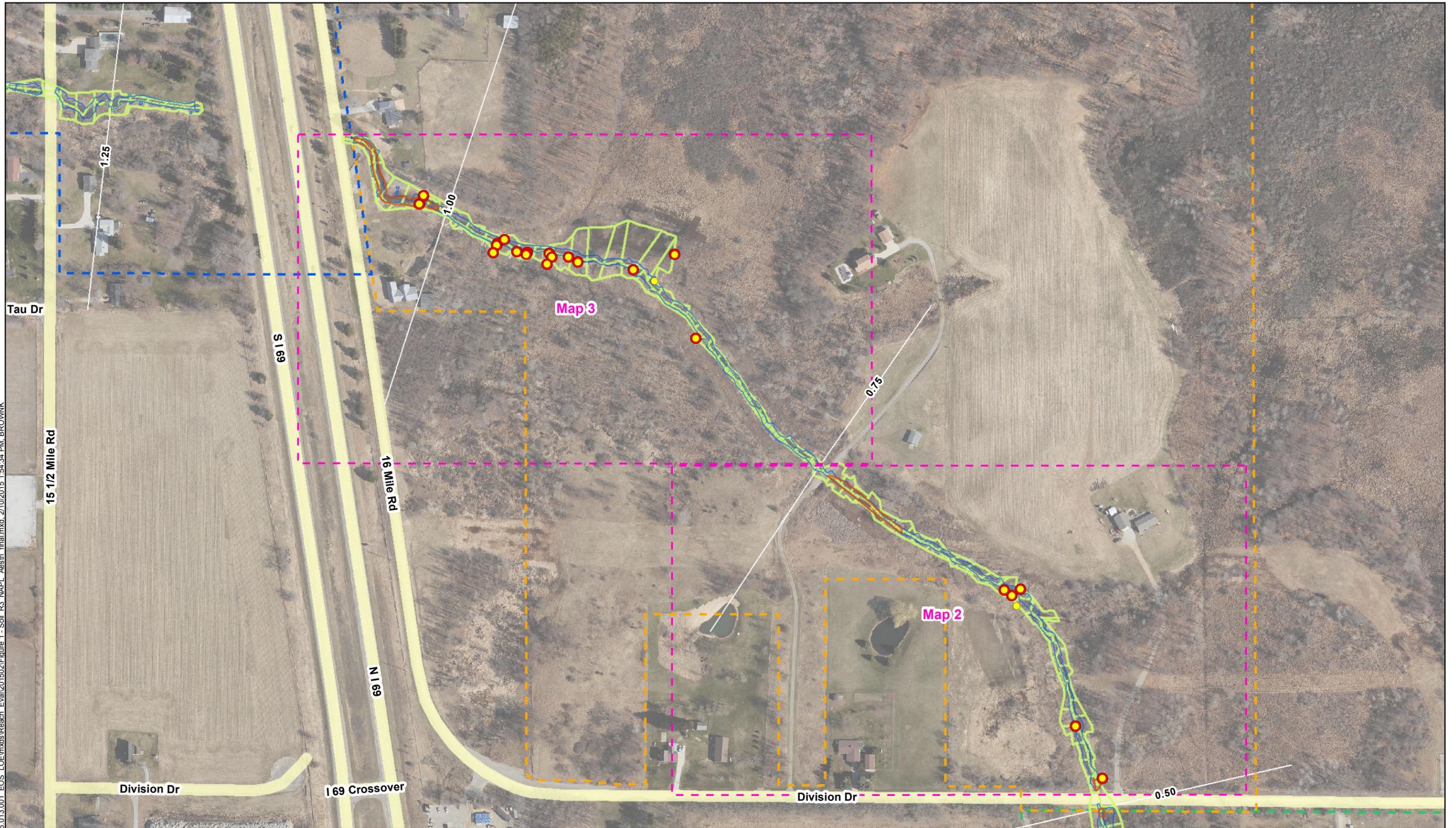
Polynuclear Aromatic Hydrocarbons (PNAs) – Enbridge provided data that indicates PNAs, which are constituents of the Line 6B Pipeline release, are potentially present in groundwater within the spill area. The groundwater analytical data was screened to determine if any exceedances of criteria were present. A total of nine sample locations exhibited elevated reporting limits in excess of Part 201 Criteria (see Figure 7). No additional samples were collected and permanent wells were not installed in these locations. Additional evaluation is required to confirm the presence or absence of impact and assess the associated risks.

Figures

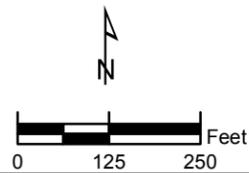
Figure 1.

Talmadge Creek Reach 3 Soil Evaluation Unsaturated Soil - NAPL and Aesthetic Observations

Path: T:\GIS Projects\20176 013.001 EOS LOE\mxds\Reach Eval\201502\Figure 1 - Soil R3 NAPL Aesth final.mxd, 2/10/2015 1:54:34 PM L.BROWMK



- | | |
|------------------------------------|--------------------------------|
| Soil Core Observation | Talmadge In Channel Excavation |
| Aesthetic Impact Observed | Excavations - Comprehensive |
| Aesthetic Impact and NAPL Observed | 2010 USEPA Clearance Polygons |



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**MICHIGAN DEPARTMENT
 OF ENVIRONMENTAL QUALITY**
 REMEDIATION AND REDEVELOPMENT DIVISION

WESTON SOLUTIONS
 Prepared by:
WESTON SOLUTIONS, INC.
 2501 Jolly Road, Suite 100
 Okemos, Michigan

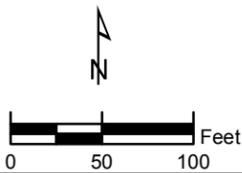
TALMADGE CREEK REACH 3 SOIL EVALUATION NAPL AND AESTHETIC OBSERVATIONS ENBRIDGE OIL SPILL MARSHALL, MICHIGAN			
SCALE: 1:3,000	DRAWN: SS	DATE: 2/10/2015	CHECKED BY: Figure 1 (Map 1 of 3)

Path: T:\GIS Projects\20176.013.001 EOS LOE\mxds\Reach Eval\201502\Figure 1 - Soil R3 NAPL Aesth final.mxd, 2/10/2015 1:54:34 PM, BROWMK



Soil Core Observation

- Aesthetic Impact Observed
- Aesthetic Impact and NAPL Observed
- Talmadge In Channel Excavation
- Excavations - Comprehensive
- 2010 USEPA Clearance Polygons



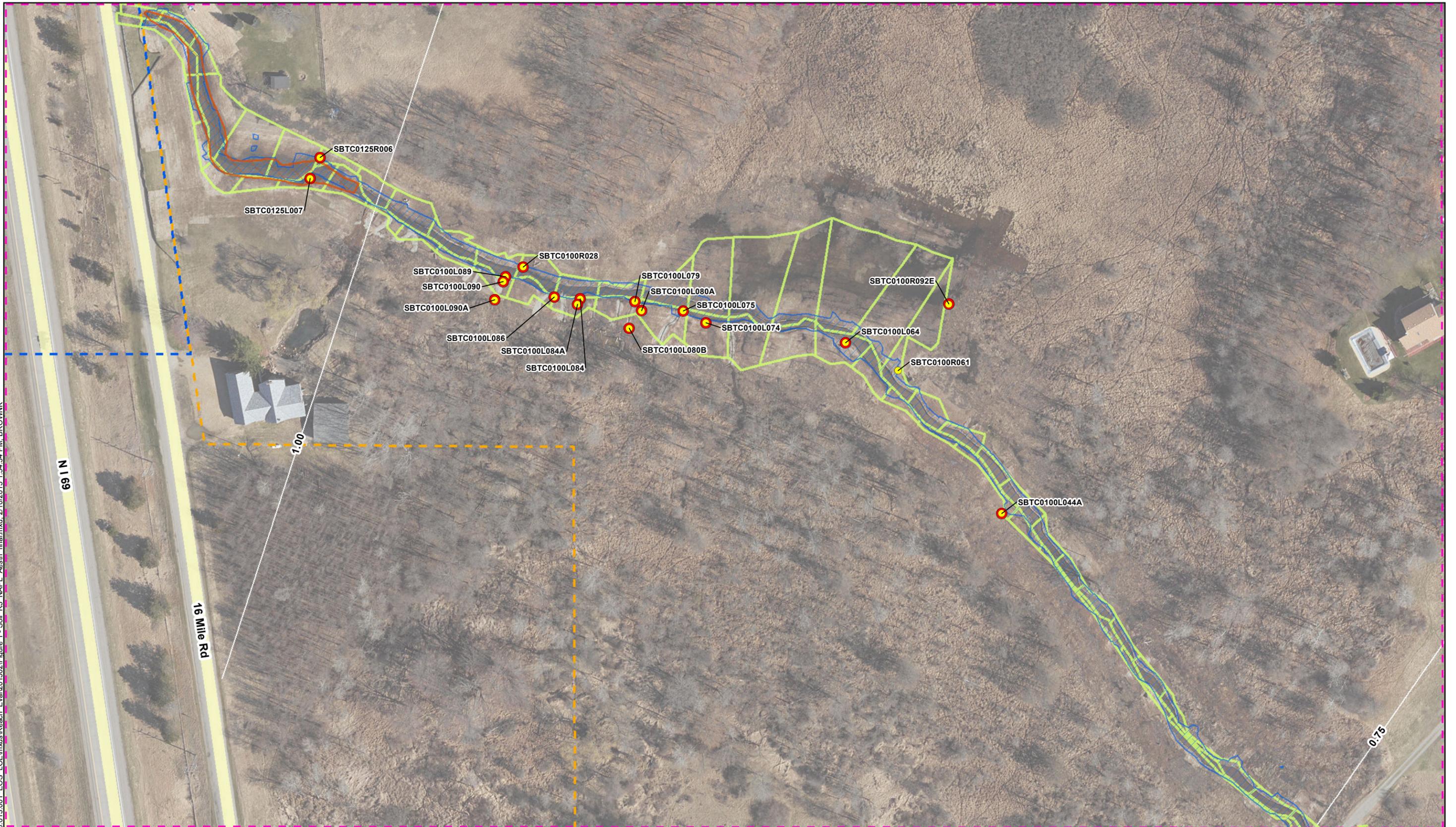
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**WESTON
 SOLUTIONS**
 Prepared by:
WESTON SOLUTIONS, INC.
 2501 Jolly Road, Suite 100
 Okemos, Michigan

**TALMADGE CREEK REACH 3 SOIL EVALUATION
 NAPL AND AESTHETIC OBSERVATIONS
 ENBRIDGE OIL SPILL
 MARSHALL, MICHIGAN**

SCALE: 1:1,200 | DRAWN: SS | DATE: 2/10/2015 | CHECKED BY: **Figure 1** (Map 2 of 3)

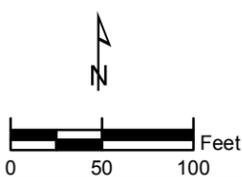
Path: T:\GIS Projects\20176_013_001 EOS LOE\mxds\Reach Eval\201502\Figure 1 - Soil R3 NAPL Aesth final.mxd, 2/10/2015 1:54:34 PM, BROWNIK



Soil Core Observation

- Aesthetic Impact Observed
- Aesthetic Impact and NAPL Observed

- ▣ Talmadge In Channel Excavation
- ▣ Excavations - Comprehensive
- ▭ 2010 USEPA Clearance Polygons



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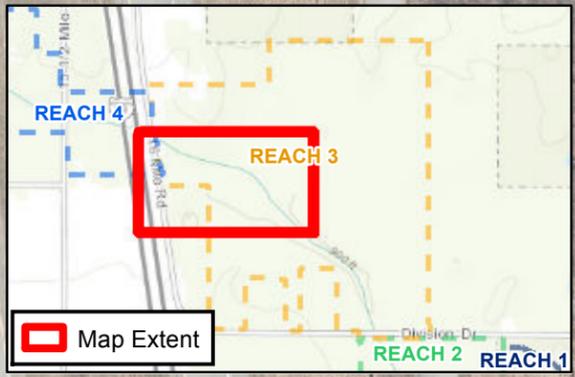
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 Prepared by:
WESTON SOLUTIONS, INC.
 2501 Jolly Road, Suite 100
 Okemos, Michigan

**TALMADGE CREEK REACH 3 SOIL EVALUATION
 NAPL AND AESTHETIC OBSERVATIONS
 ENBRIDGE OIL SPILL
 MARSHALL, MICHIGAN**

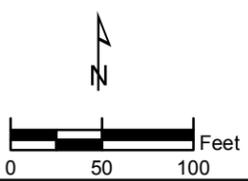
SCALE: 1:1,200	DRAWN: SS	DATE: 2/10/2015	CHECKED BY: Figure 1 (Map 3 of 3)
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Figure 2.
Talmadge Creek Reach 3 UV Fluorescence Evaluation

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- Core Collected with UV Fluorescence Observed but No Sample Collected at Location
- Talmadge In Channel Excavation
- Excavations - Comprehensive
- 2010 USEPA Clearance Polygons




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 Prepared by:
WESTON SOLUTIONS, INC.
 2501 Jolly Road, Suite 100
 Okemos, Michigan

**TALMADGE CREEK REACH 3
 UV FLUORESCENCE EVALUATION
 ENBRIDGE OIL SPILL
 MARSHALL, MICHIGAN**

SCALE: 1:1,200	DRAWN: SS	DATE: 2/10/2015	CHECKED BY:	Figure 2 (Map 1 of 1)
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Figure 3.
Talmadge Creek Reach 3 Soil Evaluation Unsaturated Soil - Metals Exceedances



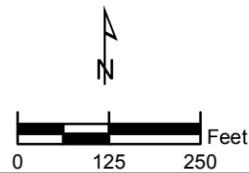
Metals Results

- Sample Result Exceeds Criteria
- Sample has Elevated Reporting Limit Exceeding Criteria

- ▭ Talmadge In Channel Excavation
- ▭ Excavations - Comprehensive
- ▭ 2010 USEPA Clearance Polygons

Notes:

- 1) Soil results are screened to MDEQ Part 201 Residential Drinking Water Protection Criteria (12-30-2013)
- 2) Soil locations screened to background values are excluded. Samples shown have unknown soil type.



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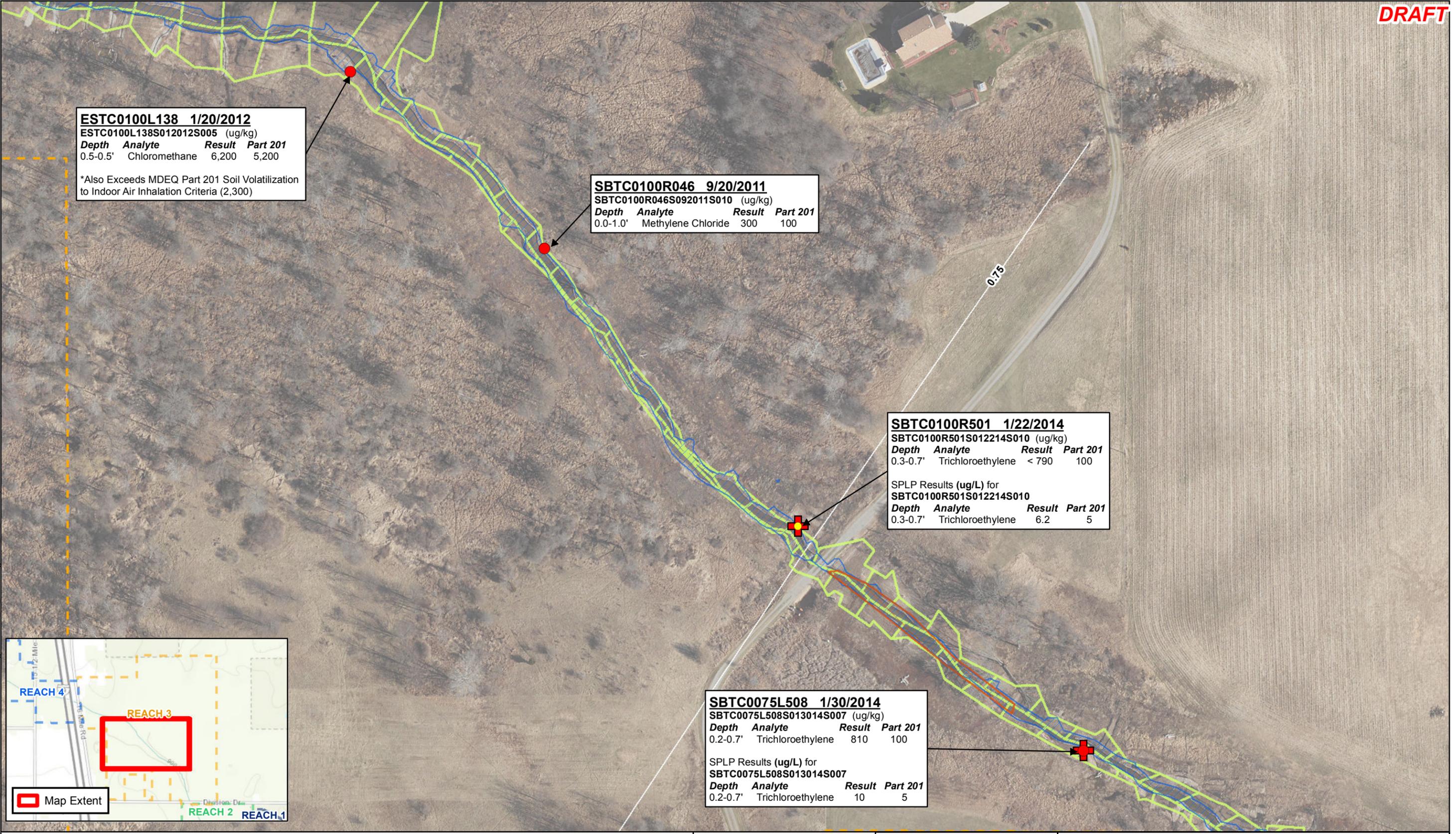
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WESTON SOLUTIONS, INC.
 2501 Jolly Road, Suite 100
 Okemos, Michigan

**TALMADGE CREEK REACH 3 SOIL EVALUATION
 UNSATURATED SOIL - METALS EXCEEDANCES
 ENBRIDGE OIL SPILL
 MARSHALL, MICHIGAN**

SCALE: 1:3,000	DRAWN: SS	DATE: 2/10/2015	CHECKED BY: Figure 3 (Map 1 of 1)
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Path: T:\GIS\Projects\20176_013_001_EOS_LOE\mxd\Reach_Eval\201502\Figure 3 - Soil_R3_ExceedingMetals_final.mxd, 2/10/2015 1:41:24 PM, BROWNK

Figure 4.
Talmadge Creek Reach 3 Soil Evaluation Unsaturated Soil - VOC Exceedances

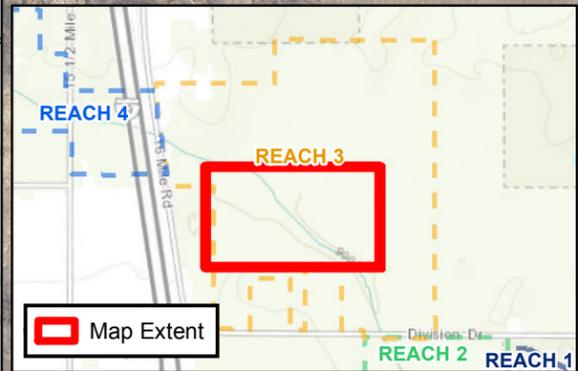


ESTC0100L138 1/20/2012
 ESTC0100L138S012012S005 (ug/kg)
 Depth Analyte Result Part 201
 0.5-0.5' Chloromethane 6,200 5,200
 *Also Exceeds MDEQ Part 201 Soil Volatilization to Indoor Air Inhalation Criteria (2,300)

SBTC0100R046 9/20/2011
 SBTC0100R046S092011S010 (ug/kg)
 Depth Analyte Result Part 201
 0.0-1.0' Methylene Chloride 300 100

SBTC0100R501 1/22/2014
 SBTC0100R501S012214S010 (ug/kg)
 Depth Analyte Result Part 201
 0.3-0.7' Trichloroethylene < 790 100
 SPLP Results (ug/L) for SBTC0100R501S012214S010
 Depth Analyte Result Part 201
 0.3-0.7' Trichloroethylene 6.2 5

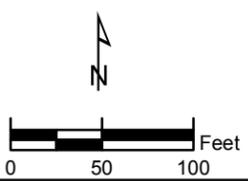
SBTC0075L508 1/30/2014
 SBTC0075L508S013014S007 (ug/kg)
 Depth Analyte Result Part 201
 0.2-0.7' Trichloroethylene 810 100
 SPLP Results (ug/L) for SBTC0075L508S013014S007
 Depth Analyte Result Part 201
 0.2-0.7' Trichloroethylene 10 5



VOC Results

- ⊕ SPLP Result Exceeds Criteria
- Sample Result Exceeds Criteria
- Sample has Elevated Reporting Limit Exceeding Criteria
- ▭ Talmadge In Channel Excavation
- ▭ Excavations - Comprehensive
- ▭ 2010 USEPA Clearance Polygons

Notes:
 1) Soil results are screened to MDEQ Part 201 Residential Drinking Water Protection Criteria (12-30-2013)
 2) SPLP results are screened to MDEQ Part 201 Residential Drinking Water Criteria (12-30-2013)



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WESTON SOLUTIONS
 Prepared by:
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 2501 Jolly Road, Suite 100
 Okemos, Michigan

**TALMADGE CREEK REACH 3 SOIL EVALUATION
 UNSATURATED SOIL - VOC EXCEEDANCES
 ENBRIDGE OIL SPILL
 MARSHALL, MICHIGAN**

SCALE: 1:1,200 DRAWN: SS DATE: 2/10/2015 CHECKED BY: **Figure 4** (Map 1 of 1)

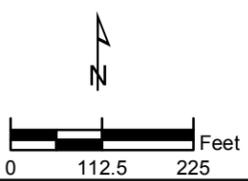
Figure 5.
Talmadge Creek Reach 3 Groundwater Evaluation - Metals



Path: T:\GIS\Projects\20176_013_001_EOS_LOE\mxds\Reach_Eval\201502\Figure 5 - GW_R3_Metals_final.mxd, 2/10/2015 2:43:41 PM, BROWNK

- Groundwater Metals Results**
- Exceeds Part 201 Criteria
 - Elevated Reporting Limit Exceeds Criteria
 - ☐ Talmadge In Channel Excavation
 - ☐ Excavations - Comprehensive
 - ☐ 2010 USEPA Clearance Polygons

Notes:
 1) Groundwater results are screened to MDEQ Part 201 Residential Drinking Water Criteria (12-30-2013)



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WESTON SOLUTIONS
 Prepared by:
WESTON SOLUTIONS, INC.
 2501 Jolly Road, Suite 100
 Okemos, Michigan

**TALMADGE CREEK REACH 3 EVALUATION
 GROUNDWATER - METALS
 ENBRIDGE OIL SPILL
 MARSHALL, MICHIGAN**

SCALE: 1:2,700	DRAWN: SS	DATE: 2/10/2015	CHECKED BY:	Figure 5 (Map 1 of 1)
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Figure 6.
Talmadge Creek Reach 3 Groundwater Evaluation - VOCs

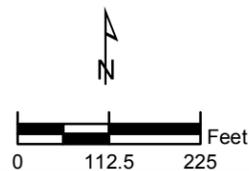


Groundwater VOC Results

- Elevated Reported Limit Exceeds Criteria
- ▣ Talmadge In Channel Excavation
- ▣ Excavations - Comprehensive
- ▣ 2010 USEPA Clearance Polygons

Notes:

1) Groundwater results are screened to MDEQ Part 201 Residential Drinking Water Criteria (12-30-2013)



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Prepared by:
WESTON SOLUTIONS, INC.
 2501 Jolly Road, Suite 100
 Okemos, Michigan

**TALMADGE CREEK REACH 3 EVALUATION
 GROUNDWATER - VOCs
 ENBRIDGE OIL SPILL
 MARSHALL, MICHIGAN**

SCALE: 1:2,700 DRAWN: SS DATE: 2/10/2015 CHECKED BY: **Figure 6** (Map 1 of 1)

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Figure 7.
Talmadge Creek Reach 3 Groundwater Evaluation - PNAs

Tables

Table 1a.
Talmadge Creek Reach 3 Soil Evaluation Unsaturated Soil - NAPL Observations

Table 1a.
Summary of Reach 3 RI Report Data
Soil NAPL Evaluation
MDEQ - Remediation and Redevelopment Division
Enbridge Oil Spill - Marshall, Michigan

Sample ID/Location ID	Date	NAPL Observation
SBTC0075L014	9/13/2011	Slight oil sheen observed on surface
SBTC0075L040A	9/21/2011	Sheen on core
SBTC0075L042	9/15/2014	Sheen in bore hole
SBTC0075R004	9/12/2011	Sheen on core
SBTC0075R048	9/14/2011	Sheen present next to borehole after mat removed
SBTC0100L044A	9/22/2011	Slight silver sheen on surface water near coring location
SBTC0100L064	9/19/2011	Sheen/petroleum odor
SBTC0100L074	9/23/2011	Sheen in bore hole
SBTC0100L075	9/23/2011	Sheen on core
SBTC0100L079	9/23/2011	Sheen on core
SBTC0100L080A	9/23/2011	Sheen in bore hole
SBTC0100L080B	9/26/2011	Rainbow sheen on surface water at core location
SBTC0100L084	9/24/2011	Sheen on core
SBTC0100L084A	9/26/2011	Sheen on surface water at core location
SBTC0100L086	9/24/2011	Sheen on core
SBTC0100L089	9/24/2011	Sheen on core
SBTC0100L090	9/24/2011	Sheen in bore hole
SBTC0100L090A	9/26/2011	Sheen observed at top of casing
SBTC0100R028	9/19/2011	Odor and sheen in core
SBTC0100R092E	10/14/2011	Silver Sheen noted on surface soils around core location
SBTC0125L007	9/22/2011	Sheen in bore hole
SBTC0125R006	9/20/2011	Sheen on Core

Table 1b.
Talmadge Creek Reach 3 Soil Evaluation Unsaturated Soil - Aesthetic Observations

Table 1b.
Summary of Reach 3 RI Report Data
Soil Aesthetic Evaluation
MDEQ - Remediation and Redevelopment Division
Enbridge Oil Spill - Marshall, Michigan

Sample ID/Location ID	Date	Aesthetic Observation
SBTC0075L014	9/13/2011	Slight oil sheen observed on surface
SBTC0075L038B	9/22/2011	Odor detected on 4-8 foot core
SBTC0075L040A	9/21/2011	Sheen on core
SBTC0075L042	9/15/2014	Sheen in bore hole
SBTC0075R004	9/12/2011	Sheen on core
SBTC0075R048	9/14/2011	Sheen present next to borehole after mat removed
SBTC0100L044A	9/22/2011	Slight silver sheen on surface water near coring location
SBTC0100L064	9/19/2011	Sheen/petroleum odor
SBTC0100L074	9/23/2011	Sheen in bore hole
SBTC0100L075	9/23/2011	Sheen on core
SBTC0100L079	9/23/2011	Sheen on core
SBTC0100L080A	9/23/2011	Sheen in bore hole
SBTC0100L080B	9/26/2011	Rainbow sheen on surface water at core location
SBTC0100L084	9/24/2011	Sheen on core
SBTC0100L084A	9/26/2011	Sheen on surface water at core location
SBTC0100L086	9/24/2011	Sheen on core
SBTC0100L089	9/24/2011	Sheen on core
SBTC0100L090	9/24/2011	Sheen in bore hole
SBTC0100L090A	9/26/2011	Sheen observed at top of casing
SBTC0100R028	9/19/2011	Odor and sheen in core
SBTC0100R061	9/27/2011	Odor noted at bore hole
SBTC0100R092E	10/14/2011	Silver Sheen noted on surface soils around core location
SBTC0125L007	9/22/2011	Sheen in bore hole
SBTC0125R006	9/20/2011	Sheen on Core

Table 2.
Talmadge Creek Reach 3 UV Fluorescence Evaluation

Table 2.
Summary of Reach 3 RI Report Data
UV Fluorescence Evaluation
MDEQ - Remediation and Redevelopment Division
Enbridge Oil Spill - Marshall, Michigan

Date Collected	Location ID	Top of Interval ft. bgs	Bottom of Interval ft. bgs	UV Detection
9/19/2011	SBTC0100L059	0	0.2	Fluoresced Oil
9/26/2011	SBTC0100L086B	0	1	Fluoresced Oil
9/27/2011	SBTC0100R076	0	2.1	Fluoresced Oil
9/22/2011	SBTC0125L005	0	0.3	Fluoresced Oil
9/21/2011	SBTC0125R015	4	4.95	Fluoresced Oil

Table 3.
Talmadge Creek Reach 3 Soil Evaluation Unsaturated Soil - Metals Exceedances

Table 3.
Summary of Reach 3 RI Report Data
Soil Metals Evaluation
MDEQ - Remediation and Redevelopment Division
Enbridge Oil Spill - Marshall, Michigan

Date	Time	Location	Sample	Sample Interval	USCS Code	Saturation Status	Sample Note	Sample Type	Beryllium	Molybdenum	Nickel	Vanadium	Exceedance
									mg/kg	mg/kg	mg/kg	mg/kg	
									51	1.5(B)	100(B)	72	Part 201 Drinking Water Protection Criteria
12/12/2011	10:49 AM	ESTC0075L107	ESTC0075L107S121211S010-SPLIT	1 - 1 ft	Unknown	Unsaturated		Split	< 0.2	3.4	25	18	Sample exceeded
1/18/2012	2:47 PM	ESTC0100R146	ESTC0100R146S011812S005	0.5 - 0.5 ft	Unknown	Unsaturated		Result	< 0.50	5.6	11	14	Sample exceeded
1/20/2012	3:37 PM	ESTC0100R154	ESTC0100R154S012012S020-SPLIT	2 - 2 ft	Unknown	Unsaturated		Split	0.29	5.8	8.7	15	Sample exceeded
1/11/2013	9:50 AM	SSTC0100L01	SSTC0100L01S011113SX	0.0-0.5 ft	Unknown	Unsaturated		Result	< 0.93	< 2.3	12	18	Sample has ERL
1/11/2013	10:05 AM	SSTC0100L02	SSTC0100L02S011113SX	0.0-0.5 ft	Unknown	Unsaturated		Result	< 1.6	4.2	10	12	Sample exceeded
1/11/2013	10:00 AM	SSTC0100L03	SSTC0100L03S011113SX	0.0-0.5 ft	Unknown	Unsaturated		Result	< 1.2	5.4	11	15	Sample exceeded
1/11/2013	10:00 AM	SSTC0100L03	SSTC0100L03D011113SX	0.0-0.5 ft	Unknown	Unsaturated		Duplicate	< 1.2	7.3	9.2	13	Sample exceeded
1/11/2013	10:45 AM	SSTC0100R01	SSTC0100R01S011113SX	0.0-0.5 ft	Unknown	Unsaturated		Result	< 0.97	2.6	9.3	12	Sample exceeded
1/11/2013	10:50 AM	SSTC0100R02	SSTC0100R02S011113SX	0.0-0.5 ft	Unknown	Unsaturated		Result	< 0.91	3.6	7.1	9.3	Sample exceeded
1/10/2013	11:25 AM	SSTC0125R01	SSTC0125R01D011013SX	0.0-0.5 ft	Unknown	Unsaturated		Duplicate	< 0.66	< 1.6	10	12	Sample has ERL
1/10/2013	11:34 AM	SSTC0125R03	SSTC0125R03S011013SX	0.0-0.5 ft	Unknown	Unsaturated		Result	< 0.68	< 1.7	11	11	Sample has ERL
1/11/2013	11:00 AM	SSTC0125R10	SSTC0125R10S011113SX	0.0-0.5 ft	Unknown	Unsaturated		Result	< 1.1	5.4	8	12	Sample exceeded
10/24/2011	10:01 AM	TC-STAGING-01-102411	TC-STAGING-01-102411-DUP	0 - 0.5 ft	Unknown	Unsaturated		Duplicate	< 0.50	3.6	10	11	Sample exceeded
10/24/2011	10:01 AM	TC-STAGING-01-102411	TC-STAGING-01-102411	0 - 0.5 ft	Unknown	Unsaturated		Result	< 0.50	2.7	7.2	7.9	Sample exceeded
10/24/2011	10:09 AM	TC-STAGING-02-102411	TC-STAGING-02-102411	0 - 0.5 ft	Unknown	Unsaturated		Result	< 0.50	3.1	10	11	Sample exceeded
10/24/2011	10:24 AM	TC-STAGING-04-102411	TC-STAGING-04S102411S X	0 - 0.5 ft	Unknown	Unsaturated		Result	< 0.50	3.6	11	13	Sample exceeded

Table 4.
Talmadge Creek Reach 3 Soil Evaluation Unsaturated Soil - VOC Exceedances

Table 4.
Summary of Reach 3 RI Report Data
Soil VOC Evaluation
MDEQ - Remediation and Redevelopment Division
 Enbridge Oil Spill - Marshall, Michigan

Date	Time	Location	Sample	Depth	USCS Code	Saturation Status	Sample Note	Sample Type	Chloromethane ug/kg	Methylenechloride ug/kg	Trichloroethylene ug/kg	Exceedance
1/20/2012	4:31 PM	ESTC0100L138	ESTC0100L138S012012S005	0.5 - 0.5 ft	Unknown	Unsaturated		Result	6200	< 4100	< 4100	Sample Exceeds
1/30/2014	1:35 PM	SBTC0075L508	SBTC0075L508S013014S007	0.2 - 0.7 ft	OL	Unsaturated	Data Gap	Result	< 250	< 190	810	Sample Exceeds
1/30/2014	1:35 PM	SBTC0075L508	SBTC0075L508S013014S007	0.2 - 0.7 ft	SPLP	Unsaturated		Result	--	--	10	Sample Exceeds
9/20/2011	4:15 PM	SBTC0100R046	SBTC0100R046S092011S010	0 - 1 ft	OL	Unsaturated		Result	270	300	< 270	Sample Exceeds
1/22/2014	11:30 AM	SBTC0100R501	SBTC0100R501S012214S007	0.3 - 0.7 ft	OL	Unsaturated	Data Gap	Result	< 790	< 790	< 790	Reporting Limit Exceeds
1/22/2014	11:30 AM	SBTC0100R501	SBTC0100R501S012214S007	0.3 - 0.7 ft	SPLP	Unsaturated		Result	--	--	6.2	Sample Exceeds
MDEQ Part 201 Residential Drinking Water Protection Criteria									5200	100	100	
MDEQ Part 201 Residential Drinking Water Criteria									--	--	5	

Table 5.
Talmadge Creek Reach 3 Groundwater Evaluation - Metals

Table 5. Talmadge Creek Background Metals Evaluation

Reach 3 Outstanding Water Exceedance Locations

Enbridge Oil Spill
Marshall, Michigan

Sample Date	Location	Sample Interval	Sample ID	Recorded Turbidity	Metal	Result Total ug/L	Criteria ¹ ug/L	Calculated Background ug/L	Exceeds Criteria	Exceeds Background
9/24/2011	SBTC0075L066	8.2-9.2 ft	SBTC0075L066S092411G092	--	Beryllium	<1	4	1	No	No
					Molybdenum	<50	73	50	No	No
					Nickel	26	100	20	No	Yes
					Vanadium	71	4.5	4	Yes	Yes
9/26/2011	SBTC0075R066	6.45-7.45 ft	SBTC0075R066S092611G075	--	Beryllium	<1	4	1	No	No
					Molybdenum	<50	73	50	No	No
					Nickel	41	100	20	No	Yes
					Vanadium	59	4.5	4	Yes	Yes
9/23/2011	SBTC0075L050	7.4-8.4 ft	SBTC0075L050S092311G084	--	Beryllium	<1	4	1	No	No
					Molybdenum	<50	73	50	No	No
					Nickel	<20	100	20	No	No
					Vanadium	18	4.5	4	Yes	Yes
9/26/2011	SBTC0075R056	6-7 ft	SBTC0075R056S092611G070	1245.4	Beryllium	<1	4	1	No	No
					Molybdenum	<50	73	50	No	No
					Nickel	32	100	20	No	Yes
					Vanadium	32	4.5	4	Yes	Yes
9/26/2011	SBTC0075R046	5.8-6.8 ft	SBTC0075R046S092611G068	93.1	Beryllium	<1	4	1	No	No
					Molybdenum	<50	73	50	No	No
					Nickel	<20	100	20	No	No
					Vanadium	16	4.5	4	Yes	Yes
9/22/2011	SBTC0075L036	7.75-8.75 ft	SBTC0075L036S092211G088	--	Beryllium	<2	4	1	No	No
					Molybdenum	<50	73	50	No	No
					Nickel	27	100	20	No	Yes
					Vanadium	31	4.5	4	Yes	Yes
9/22/2011	SBTC0075L026	4.4-5.4 ft	SBTC0075L026S092211G054	--	Beryllium	<2	4	1	No	No
					Molybdenum	<50	73	50	No	No
					Nickel	54	100	20	No	Yes
					Vanadium	61	4.5	4	Yes	Yes
9/21/2011	SBTC0075L012	7.7-8.7 ft	SBTC0075L012S092111G087	746.7	Beryllium	<2	4	1	No	No
					Molybdenum	<50	73	50	No	No
					Nickel	99	100	20	No	Yes
					Vanadium	55	4.5	4	Yes	Yes
9/21/2011	SBTC0075L001	6.4-7.4 ft	SBTC0075L001S092111G074	89.7	Beryllium	<1	4	1	No	No
					Molybdenum	<50	73	50	No	No
					Nickel	<2	100	20	No	No
					Vanadium	14	4.5	4	Yes	Yes

Table 5. Talmadge Creek Background Metals Evaluation

Reach 3 Outstanding Water Exceedance Locations

Enbridge Oil Spill
Marshall, Michigan

Sample Date	Location	Sample Interval	Sample ID	Recorded Turbidity	Metal	Result Total ug/L	Criteria ¹ ug/L	Calculated Background ug/L	Exceeds Criteria	Exceeds Background
9/21/2011	SBTC0075L001	6.4-7.4 ft	GWTC0075L001S09211G074-split	--	Beryllium	<1	4	1	No	No
					Molybdenum	<25	73	50	No	No
					Nickel	12	100	20	No	No
					Vanadium	24	4.5	4	Yes	Yes
1/16/2012	SBTC0125R512A	6.7-7.7 ft	SBTC0125R512AS011612G077	183.0	Beryllium	<1	4	1	No	No
					Molybdenum	<50	73	50	No	No
					Nickel	<20	100	20	No	No
					Vanadium	8.1	4.5	4	Yes	Yes
1/16/2012	SBTC0125R512A	6.7-7.7 ft	SBTC0125R512AS011612G070-SPLIT	--	Beryllium	<1	4	1	No	No
					Molybdenum	<25	73	50	No	No
					Nickel	3.6	100	20	No	No
					Vanadium	4.6	4.5	4	Yes	Yes
2/6/2014	SBTC0125L501	0.5-4.3 ft	SBTC0125L501S020614G043	760.0	Beryllium	<1	4	1	No	No
					Molybdenum	<50	73	50	No	No
					Nickel	24	100	20	No	Yes
					Vanadium	36	4.5	4	Yes	Yes
2/6/2014	SBTC0125R502	2-5.5 ft	SBTC0125R502S020614G055	52.0	Beryllium	<1	4	1	No	No
					Molybdenum	<50	73	50	No	No
					Nickel	<20	100	20	No	No
					Vanadium	7.3	4.5	4	Yes	Yes
9/27/2011	SBTC0100R037B	7.2-8.2 ft	SBTC0100R037BS092711G082	-7.7	Beryllium	<1	4	1	No	No
					Molybdenum	<50	73	50	No	No
					Nickel	<2	100	20	No	No
					Vanadium	5.1	4.5	4	Yes	Yes
9/27/2011	SBTC0100L100	7.3-8.3 ft	SBTC0100L100S092711G083	160.2	Beryllium	<1	4	1	No	No
					Molybdenum	<50	73	50	No	No
					Nickel	<20	100	20	No	No
					Vanadium	5.2	4.5	4	Yes	Yes
9/28/2011	SBTC0100R027	7.7-8.7 ft	SBTC0100R027S092811G087	22.7	Beryllium	<1	4	1	No	No
					Molybdenum	<50	73	50	No	No
					Nickel	<2	100	20	No	No
					Vanadium	15	4.5	4	Yes	Yes
3/6/2014	SBTC0100R515	2.3-4.25 ft	SBTC0100R515S030614G043	1000.0	Beryllium	2	4	1	No	Yes
					Molybdenum	<50	73	50	No	No
					Nickel	170	100	20	Yes	Yes
					Vanadium	150	4.5	4	Yes	Yes

Table 5. Talmadge Creek Background Metals Evaluation

Reach 3 Outstanding Water Exceedance Locations

Enbridge Oil Spill
Marshall, Michigan

Sample Date	Location	Sample Interval	Sample ID	Recorded Turbidity	Metal	Result Total ug/L	Criteria ¹ ug/L	Calculated Background ug/L	Exceeds Criteria	Exceeds Background
10/3/2011	SBTC0100R097	7.4-8.4 ft	SBTC0100R097S100311G084	--	Beryllium	<1	4	1	No	No
					Molybdenum	<50	73	50	No	No
					Nickel	<20	100	20	No	No
					Vanadium	7.6	4.5	4	Yes	Yes
2/26/2014	SBTC0100R522R1	0.5-4.46 ft	SBTC0100R522R1S022614G045	522.0	Beryllium	<1	4	1	No	No
					Molybdenum	<50	73	50	No	No
					Nickel	<20	100	20	No	No
					Vanadium	16	4.5	4	Yes	Yes
9/27/2011	SBTC0100R047	6.8-7.8 ft	SBTC0100R047D092711G078	60.1	Beryllium	<1	4	1	No	No
					Molybdenum	<50	73	50	No	No
					Nickel	<20	100	20	No	No
					Vanadium	5	4.5	4	Yes	Yes
9/26/2011	SBTC0100L030	7.5-8.5 ft	SBTC0100L030S092611G085	8.7	Beryllium	<1	4	1	No	No
					Molybdenum	<50	73	50	No	No
					Nickel	47	100	20	No	Yes
					Vanadium	11	4.5	4	Yes	Yes
9/26/2011	SBTC0100L020	7.5-8.5 ft	SBTC0100L020S092611G085	75.5	Beryllium	<1	4	1	No	No
					Molybdenum	<50	73	50	No	No
					Nickel	<20	100	20	No	No
					Vanadium	5.6	4.5	4	Yes	Yes
9/24/2011	SBTC0100L010	7.2-8.2 ft	SBTC0100L010D092411G082	--	Beryllium	<1	4	1	No	No
					Molybdenum	<50	73	50	No	No
					Nickel	<20	100	20	No	No
					Vanadium	4.8	4.5	4	Yes	Yes
9/26/2011	SBTC0075R086	6.6-7.6 ft	SBTC0075R086S092611G076	340.6	Beryllium	<1	4	1	No	No
					Molybdenum	<50	73	50	No	No
					Nickel	26	100	20	No	Yes
					Vanadium	88	4.5	4	Yes	Yes
9/26/2011	SBTC0075R086A	6.3-7.3 ft	SBTC0075R086AS092611G073	276.0	Beryllium	<1	4	1	No	No
					Molybdenum	<50	73	50	No	No
					Nickel	21	100	20	No	Yes
					Vanadium	63	4.5	4	Yes	Yes
9/23/2011	SBTC0100L002	7.8-8.8 ft	SBTC0100L002S092311G088	--	Beryllium	<1	4	1	No	No
					Molybdenum	<50	73	50	No	No
					Nickel	<2	100	20	No	No
					Vanadium	7.9	4.5	4	Yes	Yes

Footnotes: Criteria¹ = Michigan Department of Environment Quality Residential and Non-Residential Part 201 Groundwater Generic Cleanup Criteria - Residential Drinking Water Criteria

 = Yellow shaded cells indicate exceedances of Part 201 Criteria and Calculated Background results