NewFields

December 18, 2012

Mr. Tom Graan
Weston Solutions, Inc.
750 E. Bunker Court
Vernon Hills, IL 60061

RE: Technical Memorandum - Forensic Chemical Analysis of Oil Sheen And Globule Samples Collected From The Kalamazoo River Sediments.

Dear Mr. Graan,

1.0 Introduction

Line 6B oil is a high viscosity oil sands based bitumen product that is diluted with a gas condensate solvent pipeline flow improver. As such, it exhibits unique physical properties when released to the river environment. These physical changes include globule and droplet formation in the water column as the lighter condensate evaporates after the release. Re-suspended sediment particles adsorb onto the oil and the oil sinks to the sediment surface. Activities such as oil recovery efforts, natural river turbulence, and recreational activities (e.g., boating) mix the oil laden surface sediments deeper in the sediment core effectively diluting the original surface Line 6B chemical signal within a complex river sediment hydrocarbon background signature. The ability to forensically identify the presence of the line 6B oil in these sediments degrades as oil/sediment dilution increases.

Early during the oil spill, it was learned that the small droplets/globules could be physically released from the sediment matrix by a process called poling (Sediment Poling Standard Operating Procedure, Enbridge Energy, May 11, 2012). Once released back into the water column, the droplets/globules rise to the surface and form sheens in the surface water which can be collected on highly oleophilic Teflon© nets.[1] The visible amount of sheen and number of globules is used to monitor the degree of sediment contamination. These sheen samples are generally free of sediment particles which may confound the reliable oil identification in the sediment core. Empirical sheen sample data indicate that reliable oil source identification is achievable with sheen net sample oil loadings of approximately 1 mg gravimetric oil weight or greater. At less than approximately 1 mg, fine sediment particles can impact the hydrocarbon fingerprint of the sample, producing less reliable results (e.g., sample SWKR4010L001S052212HX).

[1] Greimann, D.E., Zohn A. I., Plourde, K.L., and Reilly, T.R. 1995. Teflon Nets: A Novel Approach to Thin Film Oil Sampling**.** Proceedings of the 1995 International Oil Spill Conference, 1995, p.519.

This Technical Memorandum describes the population of sheen and globule samples collected and analyzed for the various Kalamazoo River sediment investigations, the types of collection systems used to obtain the samples, the analytical procedures employed to identify and quantify the sheen oil signatures, and the identification of source oil within each sample.

2.0 Summary of Sheen and Globule Samples

Oil sheen and globule samples associated with the Enbridge Line 6B oil spill into the Kalamazoo River were collected at various times, locations, and for different purposes. These sample categories are described below.

2.1 Sediment Trap Samples

Oil sheen and globule samples were collected from Kalamazoo River sediment traps during June 2012 to provide additional samples for oil fingerprint analysis. Enbridge used standard poling procedures to agitate subsurface sediments, which caused a surface manifestation of submerged oil. Oil sheen and globule samples were collected at the following locations using Teflon sheen nets:

[SAMPLE ID (Sample Location)]

- SWKR0575C001S062512HX (Ceresco Sediment Trap)
- SWKR0575C001D062512HX (Ceresco Sediment Trap duplicate)
- SWKR0848C001S062512HX (MP 8.48 LDB)
- SWKR1040C001S062512HX (MP 10.40 N Sediment Trap)
- SWKR1050C001S062512HX (MP 10.50 LDB Sediment Trap)
- SWKR1075L001S062512HX (MP 10.75 LDB Sediment Trap)
- SWKR1121L001S062512HX (MP 11.21 LDB)
- SWKR1179L001S062512HX (MP 11.79 LDB Sediment Trap)
- SWKR1475R001S062512HX (MP 14.75 RDB Sediment Trap)
- SWKR1475R001D062512HX (MP 14.75 RDB Sediment Trap duplicate)
- SWKR1925L001S062512HX (MP 19.25 LDB Sediment Trap)
- SWKR2150R001S062612HX (MP 21.50 RDB Sediment Trap)
- SWKR2600C001S062612HX (MP 26.0 RDB Sediment Trap)
- SWKR26.25R001S062612HX (MP 26.25 RDB Backchannel)
- SWKR2825R001S062612HX (MP 28.25 RDB Sediment Trap)
- SWKR3080C001S062612HX (MP 30.80 LDB Sediment Trap)
- SWKR3300C001S062612HX (MP 33.00 A Sediment Trap)
- SWKR3300L001S062612HX (MP 33.00 B Sediment Trap)
- SWKR3610R001S062612HX (MP 36.10 NW RDB Sediment Trap)
- SWKR3675L001S062612HX (Delta A Sediment Trap)
- SWKR3700C001S062612HX (Delta H)
- SWKR3725C001S062612HX (Delta Z Sediment Trap)

- SWKR3775I001S062612HX (MP 37.75 Islands Sediment Trap)

2.2 Source Area Samples

Source area samples (MP 0.0) were collected during a poling assessment of the ponded source area during June 2012. Enbridge used standard poling procedures to agitate subsurface sediments, which caused a surface manifestation of submerged oil. Oil sheen and globule samples were then collected using Teflon sheen nets from the following locations:

- SESA0000C0101S060812HX (Northeastern portion of the source area "pond")
- SESA0000C0107S060812HX (Western portion of the source area "pond")

2.3 Manual Collection of Globules from Sediment Samples

Enbridge collected sediment samples using a petite ponar dredge in February 2012. These samples were processed in April 2012 and oil globules were collected manually by individually retrieving the globule from the sediment sample surface. The original sediment samples were collected from the following locations:

- SEKR0900I3004D041912P005 (Near Island at MP 9.00)
- SEKR1075L201S042512PX (MP 10.75 Sediment Trap)
- SEKR1950C501S042612PX (MP 19.50 collected by S. Hamilton)
- SEKR3455C501S042612PX (MP 34.55 collected by S. Hamilton)

2.4 Spontaneous Sheen Samples

Enbridge collected samples of sheen and globules in April, June, and September 2012 in locations where the oil was observed to arrive at the surface spontaneously (i.e., without any known intentional or unintentional agitation). The intent of the sample collection and analysis was to determine the oil source at the following locations:

- STKR1700L01S042412HX (Rock Tenn facility sample taken from inside the primary containment for the intake.)
- STKR1700L02S042412HX (Rock Tenn facility sample taken from inside the secondary containment for the intake. Some agitation occurred during the sampling procedure but sheen was there spontaneously prior to collection.)
- SWKR1839C001S060912HX (Sample collected from sheen and globules observed spontaneously flowing past the D2 Boat Launch.)
- SWKR3310R00S090512HX (Sample collected from sheen emanating from the bank at MP 33.10.)

2.5 Heated Sediment Samples

Enbridge collected sediment samples using a petite ponar dredge in February 2012. These samples were processed in April 2012 in the following manner. Sediment samples were added to beakers of Kalamazoo River water, heated to 75°F, agitated, and sheen was collected from the

water surface using Teflon sample nets. The initial sediment samples were collected from the following locations:

- SEKR0900I3004S042012H005 (Near island at MP 9.0)
- SEKR0900I3004D042012H005 (Near island at MP 9.0 duplicate)
- SEKR1075L201S04261HX (MP 10.75 Sediment Trap)
- SEKR1934L013S042012H005 (MP 19.34 LDB)
- SEKR1950C501S042612PX (MP 19.50 collected by S. Hamilton)
- SEKR3455C501S042612HX (MP 34.55 collected by S. Hamilton)
- SEBC0000L012S042612HX (Battle Creek River Reference Sample)

2.6 Poling Sheen Sample

In May and June 2012 sheen samples were collected using poling techniques. Enbridge used standard poling procedures to agitate subsurface sediments, which caused a surface manifestation of submerged oil. Sheen and globule samples of that material were collected using Teflon sheen nets at the following locations.

- SWKR3800C001S061512HX (MP38.00 Morrow Lake)
- SWKR3975C002S052212HX (MP39.75 Morrow Lake)
- SWBC0000L010S062712HX (Battle Creek River Reference Sample)
- SWBC0000L015S062712HX (Battle Creek River Reference Sample)
- SWBC0000L015D062712HX (Battle Creek River Reference Sample Duplicate)

2.7 Samples Collected by S. Hamilton (MSU)

Dr. Steve Hamilton (Professor, Kellogg Biological Station and Dept. of Zoology, Michigan State University), and associates collected sediment and biological samples from the Kalamazoo River during August 2010 shortly after the oil spill. These samples were stored frozen until Enbridge took possession of them in April 2012. Enbridge allowed the samples to thaw, and then they were processed as described above in Subsections 2.3 and 2.5.

3.0 Methods

Sheen and globule samples were extracted and analyzed according to Enbridge Kalamazoo River Analytical Quality Assurance Plan V2.2 by Alpha Analytical located in Mansfield, Massachusetts. Sheen nets containing the globule or sheen sample are serially extracted with methylene chloride, concentrated to 1 mL and analyzed for Total Extractable Hydrocarbons (TEH) by gravimetric analysis. The sample extract is then analyzed for alkanes, Total Petroleum Hydrocarbons (TPH), and Total Resolved Hydrocarbons (TRH) by gas chromatography with flame ionization detection (GC-FID). A second aliquot of the extract is analyzed by gas chromatography with mass spectrometer detector (GC-MS) for polycyclic aromatic hydrocarbons (e.g., phenanthrene), sulfur heterocyclics (e.g., dibenzothiophenes) and their associated alkylated homologs (e.g., C3-dibenzothiophenes). Triterpane, sterane and triaromatic sterane biomarker

compounds are also analyzed and reported during this procedure. The units for this analysis are ng/sheen net sampler or mg/kg oil weight (as defined by the gravimetric oil weight).

A multi-tiered interpretive approach was used to identify the presence or absence of Line 6B oil in the sheen/globule samples. These included the following interpretive analyses:

1. Direct comparison of the sheen/globule GC/FID hydrocarbon signatures to Line 6B and its weathered variants (Figure 1).
2. Direct comparison of the sheen/globule PAH distributions to Line 6B and its weathered variants (Figure 2).
3. Direct comparison of the relative sheen/globule Triterpane, Sterane, and Tri-Aromatic Sterane compound distribution to Line 6B and its weathered variants (Figure 3).
4. Preparation of diagnostic PAH C3-Dibenzothiophenes (C3-DBT)/C3-Phenanthrenes (C3-Phen)[2] and biomarker C28,20S-triaromatic steroid (TAS2)/C26,20R- +C27,20S-triaromatic steroid (TAS1) double source ratio plots to document the source relationships between the field samples and Line 6B oil (Figure 4).

The C28,20S-triaromatic steroid (TAS2)/hopane[3] ratio also provides powerful source ratio and oil/background mixing model potential. Due to GC mass discrimination issues related to the analysis of some sample analyses, the C28,20S-triaromatic steroid (TAS2) and hopane results are currently being recalculated and normalized to the *analytical batch specific* Cold Lake Control Oil to minimize analytical variability. This data will be used to refine the source ratio analysis for Line 6B Oil identification and to prepare mixing models to quantify the amount of Line 6B oil in complex river sediments.

Empirical analysis of the sheen/globule data have shown that the reliability of Line 6B Oil identification decreases below 1 mg oil weight in the sheen/globule sample due to instrument sensitivity constraints and increasing sediment particle/oil ratio. For this reason, only samples with 1 mg oil weight or greater are reported (Table 1). Two exceptions were samples SEKR3455C501S042612PX (0.96 mg oil weight) and SEKR1075L201S042512PX (0.88 mg oil weight) where the signal/noise in these samples was sufficient for a reliable oil identification. Table 2 is a listing of those samples and sheen field blanks with less than 1 mg oil weight.

4.0 Results

Table 1 is a listing of the sheen/globule samples with sufficient oil mass to provide a reliable source identification analysis. Forty one (41) samples in this Table (n=46) were identified as Line 6B oil with a high degree of scientific certainty. Five samples did not contain Line 6B oil, four samples (4) collected from the Battle Creek River and one diesel fuel sample collected in the Kalamazoo River at Mile Post 33.1. The spatial distribution of the sheen/globule samples identified as Line 6B oil is provided in Figure 5. The results show that Line 6B oil was identified

[2] Douglas, G.S., Bence, A.E., Prince, R.C., McMillen, S.J. and Butler, E.L. 1996. Environmental stability of selected petroleum hydrocarbon source and weathering ratios. *Environ. Sci. Technology*, 30(7):2332-2339.

[3] Wang, Z. and Stout, S.A. 2006. Spill Oil Environmental Forensics: Fingerprinting and Source Identification. Elsevier Publishing Co., Boston, MA.

during both 2010 and 2012 studies and extends throughout the Spill Zone located from the pipeline break in Talmadge Creek to Morrow Lake.

5.0 Summary

Based on the forensic analysis of the sheen/globule samples listed in Table 1 the following findings are provided with a high degree of scientific certainty.

1. The analysis of sheen/globule samples released from Kalamazoo River Sediments (e.g., poling) provides a highly reliable means to identify the presence of Line 6B oil in the spill zone sediment.

2. There is no evidence that a second oil (e.g., Battle Creek River related) is present in the sheen/globule samples identified as Line 6B. The elevated pyrogenic PAH compounds (e.g., fluoranthene and pyrene) observed in some Line 6B sheen/globule samples (e.g., SWKR4010L001S052212HX) are derived from sediment particles that are rich in these compounds which are carried to the surface with the sheen/globule samples.[4]

3. Only one sheen sample with sufficient oil mass collected from the Kalamazoo River Spill Zone contained a non-Line 6B oil (Figure 4). Sheen/globule sample SWKR3310R500S090512HX was a diesel fuel associated with a known shoreline release.

4. Sheen/globule samples collected from the Battle Creek River are readily differentiated from Line 6B oil.

5. The temporal (2010-2012) and spatial distribution of Line 6B sheen/globule samples collected from the Kalamazoo River spill zone document the consistent presence of the spilled oil in these sediments over the entire spill zone from Talmadge Creek to Morrow Lake.

The conclusions in this report are based on currently available data. Should additional data or information become available to me, or if the analytical data is modified as a result of the on-going quality assurance reviews, I reserve the right to update this report as needed.

Please let me know if you have any additional questions concerning the identification of Line 6B oil Kalamazoo River sheen/globule samples.

Sincerely,

Gregory S. Douglas, Ph.D.
Sr. Consultant.

[4] Personal observation of poling in Morrow Lake.

Table 1. Source oil identification of sheen and globule samples collected from the Kalamazoo and Battle Creek (BC) river sediments. Samples greater than 1 mg oil weight.

			Mile	Source Oil	
Field ID	Lab ID	Matrix	Post	Identification	Notes
SESA0000C0101S060812HX	1206023-01	Sheen	0.0	Line 6B	Source Area
SESA0000C0107S060812HX	1206023-02	Sheen	0.0	Line 6B	Source Area
SWKR0575C001D062512HX	1206067-05	Sheen	5.75	Line 6B	Sediment Trap Sheen/Globule Sample
SWKR0575C001S062512HX	1206067-06	Sheen	5.75	Line 6B	Sediment Trap Sheen/Globule Sample
SWKR0848C001S062512HX	1206067-04	Sheen	8.48	Line 6B	Sediment Trap Sheen/Globule Sample
SEKR0900I3004D041912P005	1204031-05	Globule	9.0	Line 6B	Oil globules collected by hand from sediment sample
SEKR0900I3004S042012H005	1204031-06	Sheen	9.0	Line 6B	Sheen sample collected in lab after sediment sample warmed to 75°F and agitated
SEKR0900I3004DS042012H005	1204031-07	Sheen	9.0	Line 6B	Sheen sample collected in lab after sediment sample warmed to 75°F and agitated
SWKR1040C001S062512HX	1206067-02	Sheen	10.4	Line 6B	Sediment Trap Sheen/Globule Sample
SWKR1050L001S062512HX	1206067-01	Sheen	10.5	Line 6B	Sediment Trap Sheen/Globule Sample
SEKR1075L201S042612HX	1204035-08	Sheen	10.75	Line 6B	Sheen sample collected in lab after sediment sample warmed to 75°F and agitated
SEKR1075L201S042512PX	1204035-01	Globule	10.75	Line 6B	Oil globules collected by hand from sediment sample
SWKR1075L001S062512HX	1206067-03	Sheen	10.75	Line 6B	Sediment Trap Sheen/Globule Sample
SWKR1121L001S062512HX	1206067-08	Sheen	11.21	Line 6B	Sediment Trap Sheen/Globule Sample
SWKR1179L001S062512HX	1206067-09	Sheen	11.79	Line 6B	Sediment Trap Sheen/Globule Sample
SWKR1475R001S062512HX	1206067-10	Sheen	14.75	Line 6B	Sediment Trap Sheen/Globule Sample
SWKR1475R001D062512HX	1206067-11	Sheen	14.75	Line 6B	Sediment Trap Sheen/Globule Sample
STKR1700L01S042412HX	1204029-01	Sheen	17.0	Line 6B	RockTenn clean out sample
STKR1700L02S042412HX	1204029-02	Sheen	17.0	Line 6B	RockTenn clean out sample
SWKR1839C001S060912HX	1206023-04	Sheen	18.39	Line 6B	Spontaneous sheen collected near boat launch D2
SWKR1925L001S062512HX	1206067-12	Sheen	19.25	Line 6B	Sediment Trap Sheen/Globule Sample

Table 1. Source oil identification of sheen and globule samples collected from the Kalamazoo and Battle Creek (BC) river sediments. Samples greater than 1 mg oil weight.

Field ID	Lab ID	Matrix	Mile Post	Source Oil Identification	Notes
SEKR1934L013S042012H005	1204031-08	Sheen	19.34	Line 6B	Sheen sample collected in lab after sediment sample warmed to 75°F and agitated
SEKR1950C501S042612HX	1204035-12	Sheen	19.5	Line 6B	Sample collected by S. Hamilton (MSU). Sheen sample collected in lab after sediment sample warmed to 75°F and agitated
SEKR1950C501S042612PX	1204035-04	Globule	19.5	Line 6B	Sample collected by S. Hamilton (MSU). Oil globules collected by hand from sediment sample
SWKR2150R001S062612HX	1206070-08	Sheen	21.5	Line 6B	Sediment Trap Sheen/Globule Sample
SWKR2600C001S062612HX	1206070-09	Sheen	26.0	Line 6B	Sediment Trap Sheen/Globule Sample
SWKR2625R001S062612HX	1206070-10	Sheen	26.25	Line 6B	Sediment Trap Sheen/Globule Sample
SWKR2825R001S062612HX	1206070-11	Sheen	28.25	Line 6B	Sediment Trap Sheen/Globule Sample
SWKR3080C001S062612HX	1206070-14	Sheen	30.8	Line 6B	Sediment Trap Sheen/Globule Sample
SWKR3300C001S062612HX	1206070-13	Sheen	33.0	Line 6B	Sediment Trap Sheen/Globule Sample
SWKR3300L001S062612HX	1206070-07	Sheen	33.0	Line 6B	Sediment Trap Sheen/Globule Sample
SEKR3455C501S042612PX	1204035-03	Globule	34.55	Line 6B	Sample collected by S. Hamilton (MSU). Oil globules collected by hand from sediment sample
SEKR3455C501S042612HX	1204035-11	Sheen	34.55	Line 6B	Sample collected by S. Hamilton (MSU). Sheen sample collected in lab after sediment sample warmed to 75°F and agitated
SWKR3610R001S062612HX	1206070-06	Sheen	36.1	Line 6B	Sediment Trap Sheen/Globule Sample
SWKR3675L001S062612HX	1206070-05	Sheen	36.75	Line 6B	Sediment Trap Sheen/Globule Sample
SWKR3700C001S062612HX	1206070-03	Sheen	37.0	Line 6B	Sediment Trap Sheen/Globule Sample
SWKR3725C001S062612HX	1206070-02	Sheen	37.25	Line 6B	Sediment Trap Sheen/Globule Sample
SWKR3775I001S062612HX	1206070-01	Sheen	37.75	Line 6B	Sediment Trap Sheen/Globule Sample
SWKR3800C001S061512HX	1206028-01	Sheen	38	Line 6B	Sheen Released by Poling
SWKR3975C002S052212HX	1205027-02	Sheen	39.75	Line 6B	Sheen Released By Poling

Table 1. Source oil identification of sheen and globule samples collected from the Kalamazoo and Battle Creek (BC) river sediments. Samples greater than 1 mg oil weight.

Field ID	Lab ID	Matrix	Mile Post	Source Oil Identification	Notes
SWKR3975C002S052212HX	1205027-02R	Sheen	39.75	Line 6B	Sheen Released by Poling
SWBC0000L010S062712HX	1206071-03	Sheen	BC L010	Not Line 6B	Battle Creek River Reference Site
SEBC0000L012S042612HX	1204035-10	Sheen	BC L012	Not Line 6B	Battle Creek River Reference Site Sheen sample collected in lab after sediment sample warmed to 75°F and agitated
SWBC0000L015S062712HX	1206071-01	Sheen	BC L015	Not Line 6B	Battle Creek River Reference Site
SWBC0000L015D062712HX	1206071-02	Sheen	BC L015	Not Line 6B	Battle Creek River Reference Site
SWKR3310R500S090512HX	1209007-01	Sheen	33.1	Not Line 6B	Diesel Fuel release

Table 2. Source oil identification of field blank, sheen and globule samples collected from the Kalamazoo and Battle Creek (BC) river sediments. Samples less than 1 mg oil weight, and therefore excluded from analysis (See Section 3.0 text).

			Mile
Field ID	Lab ID	Matrix	Post
SEKR0900I3004S041912P005	1204031-04	Globule	9.0
SWKR1050L001T062512HX	1206067-07	Sheen	10.5
SEKR1075L201E042512PX	1204035-02	Globule	10.75
SWKR1925L001T062512HX	1206067-13	Sheen	19.25
SEKR1934L013S041912P005	1204031-03	Globule	19.34
SEKR1934L013S041912P005	1204031-03R	Globule	19.34
SWKR2825R001T062612HX	1206070-12	Sheen	28.25
SWKR3310R500T090512HX	1209007-02	Sheen	33.1
SWKR3700C001T062612HX	1206070-04	Sheen	37.0
SWKR3800C001T061512HX	1206028-02	Sheen	38.0
SWKR3975C001S052212HX	1205027-01	Sheen	39.75
SWKR3975C001S052212HX	1205027-01R	Sheen	39.75
SWKR3990L01S051812HX	1205024-01	Sheen	39.9
SWKR3990L02S051812HX	1205024-02	Sheen	39.9
SWKR3990L03S051812HX	1205024-03	Sheen	39.9
SWKR3990L03T051812HX	1205024-04	Sheen	39.9
SWKR3990L001S052212HX	1205027-03	Sheen	39.9
SWKR3990L001S052212HX	1205027-03R	Sheen	39.9
SWKR4010L001S052212HX	1205027-04	Sheen	40.1
SWKR4010L001S052212HX	1205027-04R	Sheen	40.1
SWBC0000L015T062712HX	1206071-04	Sheen	BC L015
SESA0000C0107T060812HX	1206023-03	Sheen	SESA1
SEBC0000R011S042612HX	1204035-09	Sheen	R011
SEBC0000R011S042612HX	1204035-09R	Sheen	R011

Figure 1. GC/FID chromatograms of A) Cold Lake Oil sample SO062112CL01 versus Sheen sample SWKR1839C001S060912HX. The loss of the light end C9-20 alkanes is due to environmental weathering.

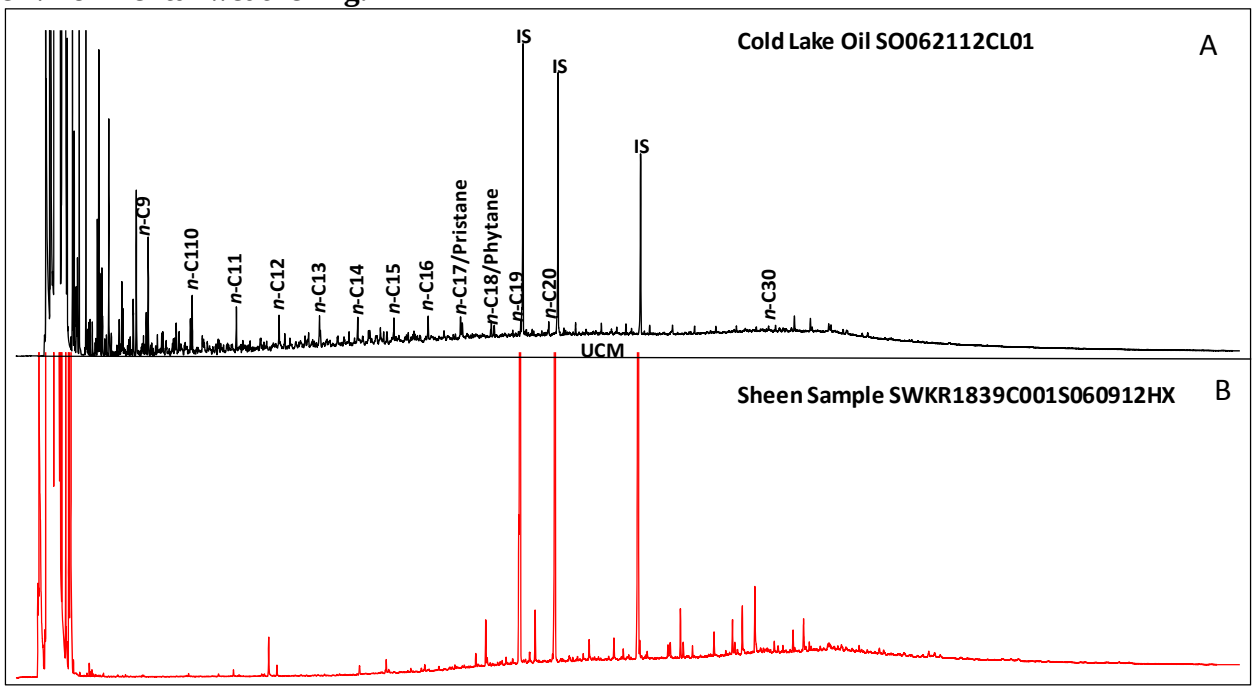

Figure 2. PAH and sulfur heterocyclic distribution plot of un-weathered Cold Lake oil (blue bars) versus sheen/globule sample SWKR1839C001S060912HX (red bars) collected at Mile Post 18.39 miles just below the Battle Creek and Kalamazoo convergence. The reference Cold Lake Oil was analyzed with the same analytical batch to minimize the analytical variability due to GC performance. The difference in relative concentrations of the source oil and sheen/globule are primarily due to environmental weathering of the field sample. The Y axis for each sample has been visually adjusted to compare the PAH distributions between the two samples.

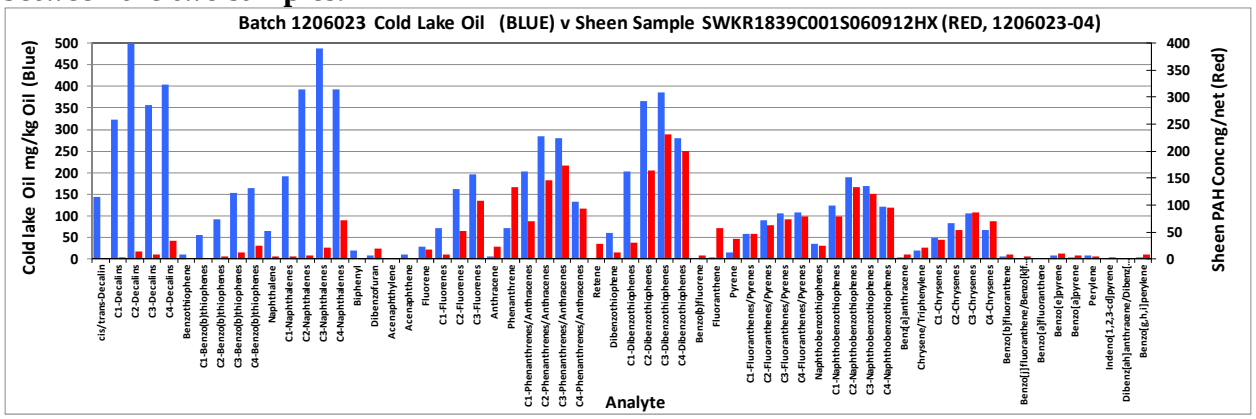

Figure 3. Triterpane, sterane and tri-aromatic sterane biomarker distribution plot of un-weathered Cold Lake oil (blue bars) versus sheen/globule sample SWKR1839C001S060912HX (red bars) collected at Mile Post 18.39 miles just below the Battle Creek and Kalamazoo convergence. The reference Cold Lake Oil was analyzed with the same analytical batch to minimize the analytical variability due to GC performance. Due to the higher molecular weight and chemical properties of the biomarker compounds, they are less susceptible to alteration by environmental weathering. The almost perfect biomarker match between the Cold Lake Oil and the sheen sample is definitive proof that the sheen sample was derived from the Line 6B oil spill. The Y axis for each sample has been visually adjusted to compare the biomarker distributions between the two samples.

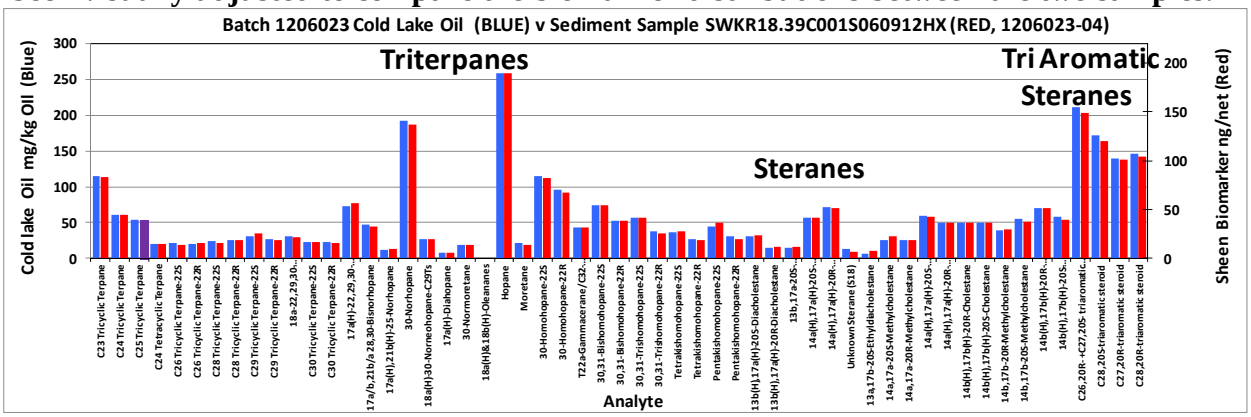

Figure 4. PAH C3-Dibenzothiophenes/C3-Phenanthrenes and biomarker C28,20S-triaromatic steroid (TAS2)/C26,20R- +C27,20S- triaromatic steroid (TAS1) source ratio plot of the sheen/globule samples evaluated and reported in Table 1 of this report. TAS2/Hopane is also a significant source ratio for resolving Line 6B oil from other oils at the Site.

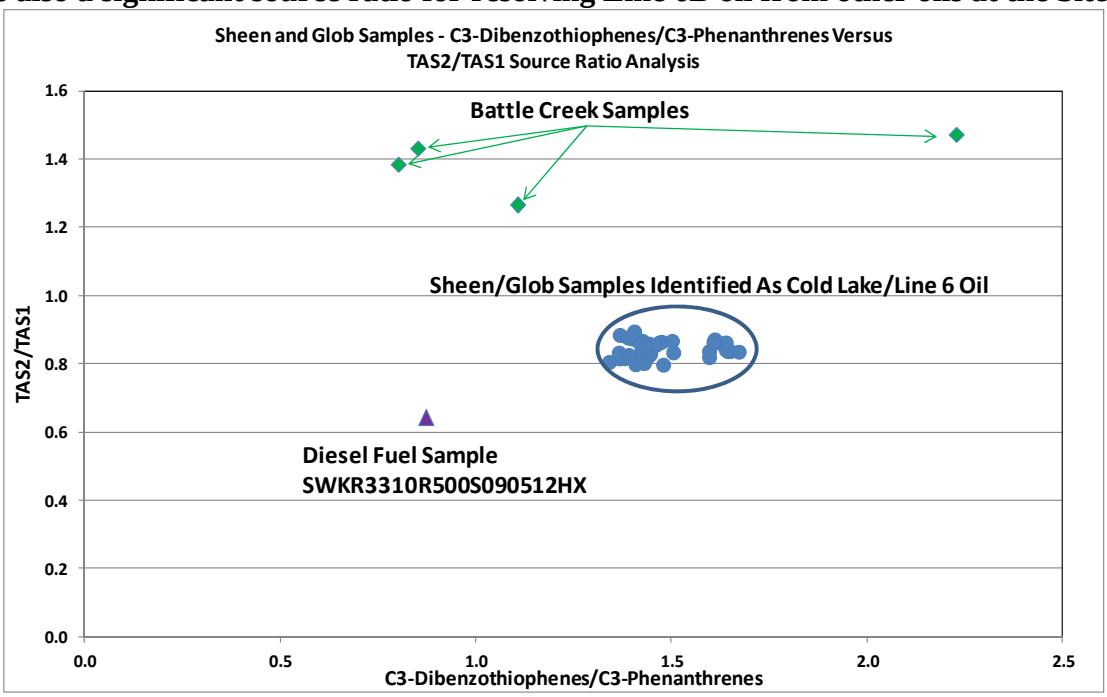

Figure 5. Identification of Kalamazoo River locations (red circles) where sheen/globule samples were positively identified as Line 6B oil. These samples document the temporal and spatial range of the Line 6B oil in the river spill zone. (Map Source: Weston Solutions, Inc.)