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ExxonMobil Pipeline Company

Public Surface Water Supply Data Summary Report

Silvertip Pipeline Incident Response
Laurel, Montana

December 2011

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A Public Surface Water Supply Field Notes

1. Introduction

This Public Water Supply (PWS) Data Summary Report has been prepared by ExxonMobil Environmental Services Company (EMES) on behalf of ExxonMobil Pipeline Company (EMPCo) as part of the response to the Silvertip Pipeline Incident that occurred near Laurel, Montana on July 1, 2011. This report describes the results of the sampling activities conducted from September 14 to 17, 2011, and on October 25, 2011 to characterize the surface water and sediment quality at nine PWS intake areas, and sediments present within sedimentation units along the Yellowstone River (the river). Specifically, this sampling program was performed to address the PWS sampling requirements established in item 5b of the Montana Department of Environmental Quality's (MDEQ's) Violation Letter dated August 17, 2011 (MDEQ 2011a). A work plan was prepared by ARCADIS on behalf of EMES describing the proposed sampling program to address item 5b, which was submitted to MDEQ on September 9, 2011 (Public Water Supply [PWS] Sampling Plan; ARCADIS 2011a). The sampling program was conducted in accordance with the PWS Sampling Plan. Deviations from the plan are described in Sections 2.5 and 3.5.

On September 22, 2011, MDEQ provided comments on the PWS Sampling Plan (MDEQ 2011b), which included a request for sampling at the Glendive PWS facility that was not included in the August 17 Violation Letter. Sampling was conducted at the Glendive facility on October 25, 2011 to address the MDEQ's comments.

The locations of the Laurel, Billings, Lockwood, Hysham, Colstrip, Forsyth, Miles City, Glendive, and Montana Dakota Utilities (MDU) Sidney facilities are shown on Figure 1.

1.1 Purpose and Objectives

This report summarizes the surface water and sediment sampling field activities completed by ARCADIS and Incident Command Boat Operations from September 14 to 17, 2011 and on October 25, 2011, as well as field data and laboratory analytical data reported for surface water and sediment samples collected during the field activities. Surface water and sediment samples were collected near PWS intakes and sediment samples were collected in PWS sedimentation units (i.e., ponds, basins, tanks) where applicable and practical to generate quantitative water and sediment data and evaluate the need for further characterization of public drinking water supply.

The objectives of this report are to:

- Document the field and analytical procedures used during implementation of the PWS Sampling Plan (ARCADIS 2011a) and MDEQ comments (MDEQ 2011b).

- Describe the results of background and downstream surface water and sediment sampling that was conducted to characterize surface water and sediment upstream proximate to PWS intake structures and sediment present within PWS sedimentation units.

- Compare the surface water and sediment analytical results to applicable benchmark screening values.

1.2 Key Findings

The following key findings are based on the data presented in this report:

- Analytical results for surface water samples collected under the PWS sampling program were all below the DEQ-7 Human Health Standards.

- None of the 10 river sediment samples collected under the PWS sampling program, including 9 facilities with two samples collected in Colstrip, had detected compounds which exceeded screening benchmark values for sediment (i.e., Biological Technical Assistance Group [BTAG] screening values).

- No sheens were observed at any sediment sample locations during sample collection activities. Sediment probing to check for the presence of sheens was conducted as part of the sampling activities.

- Sedimentation units represent treatment units and are not intended to provide habitat for organisms that form the basis for BTAG screening levels; therefore, comparisons to the BTAG values are not applicable to these sediment sample results. However, it should be noted that none of the compounds with reported values above the reporting limit (i.e., not indicated as “J” or “estimated”) would have exceeded the BTAG screening levels. Sampling crews checked for indications of oil sheens during probing of the sediments. Sheens were not observed during probing.

More detailed discussions of the surface water and sediment data are provided in Sections 2 and 3.

1.3 Background and Site Setting

On July 1, 2011, there was a release of crude oil from the Silvertip Pipeline located near Laurel, Montana. EMPCo activated its Emergency Response Plan and provided a rapid and comprehensive response to the incident. An Incident Action Plan was developed, and an Incident Command System (ICS) organization and Unified Command (UC) were

established to manage the release response activities in a coordinated manner with the multiple stakeholders involved, including the MDEQ. Overall, substantial progress has been made by EMPCo and the UC team to assess and remediate oil and oil-affected material in response to the Silvertip Pipeline Incident.

The Silvertip Pipeline Incident site (site) is located along the Yellowstone River, which originates in northwest Wyoming and flows northeast through Montana to its confluence with the Missouri River near Buford, North Dakota (Figure 1). During the PWS surface water and sediment sampling activities conducted from September 14 to 17, 2011, river flow at Billings, Montana (U.S. Geological Survey [USGS] gage 06214500) ranged from 4,470 to 4,860 cubic feet per second (cfs), corresponding to river stages between approximately 3.45 and 3.52 feet (gage datum, 3,080 feet National Geodetic Vertical Datum of 1929 [NGVD 29]). During sampling activities conducted on October 25, 2011, river flow at Billings, Montana (USGS gage 06214500) was 4,660 cfs. These river flow and stage conditions were below the annual average river flow of approximately 6,600 cfs and the average river stage of approximately 5 feet gage datum.

The river is a source of drinking water to the communities of Laurel, Billings, Lockwood, Hysham, Colstrip, Forsyth, Miles City, Glendive, and MDU Sidney (Figure 1). These PWS utilities employ a variety of mechanisms for drawing water from the river and allowing for sedimentation prior to treating the water through the water treatment system for public distribution. Cleanout schedules for sedimentation units vary from monthly to every three to four years, as summarized in Table 1.

The area upstream from the Silvertip Pipeline Incident, represented by the Laurel PWS facility, is considered to represent background conditions relative to the Silvertip Pipeline Incident (Figure 1).

1.4 PWS Facilities

Available information for each PWS intake structure and settling process is summarized in Table 1, with a brief summary provided below.

The Laurel PWS Facility intake consists of a concrete structure located underwater in the Yellowstone River. The intake is located just downstream of the Highway 212 Bridge, between the two center bridge piers and approximately 1,300 feet upstream of the Silvertip Pipeline. This facility contains a concrete sedimentation unit located outside of the facility.

The Billings PWS Facility intake is approximately 15 miles downstream of the Silvertip Pipeline and consists of a channel lined with sheet pile. A secondary intake structure extends into the river upstream of the primary intake. At the primary intake, the water was 8.5 feet deep at the time of sampling. This facility contains a sedimentation unit measuring approximately 600 feet by 200 feet. A concrete structure or impermeable liner was not observed in the sedimentation unit.

The Lockwood PWS Facility is approximately 17 miles downstream of the Silvertip Pipeline. The intake is located approximately 100 feet upstream of the water treatment facility between the Rail Link bridge and Route 87. At the intake, the water was 8 inches deep at the time of sampling. This facility contains a concrete sedimentation unit inside the water treatment building.

The Hysham PWS Facility is approximately 90 miles downstream of the Silvertip Pipeline. The intake consists of a 1,250-foot long perforated pipe buried in a gravel pack approximately 18 feet below the water surface at the time of sampling. This facility does not have a sedimentation unit. Water is drawn directly into two clarifiers located inside the water treatment building.

The Colstrip-Yellowstone River intake is approximately 130 miles downstream of the Silvertip Pipeline and approximately 5 miles upstream of Forsyth. Water from the intake is pumped approximately 30 miles south to Castle Rock Lake in Colstrip. At the intake, the water was 5.2 feet deep at the time of sampling. The Colstrip-Castle Rock Lake intake is located approximately 1,000 feet south of the public boat ramp. The intake is located approximately 8 feet below the water surface. The Colstrip facility does not have a sedimentation unit. Water enters the facility directly into filter beds.

The Forsyth PWS Facility is approximately 140 miles downstream of the Silvertip Pipeline. The intake is located approximately 0.25 miles downstream of Highway 12 bridge. At the intake, the water was 2.3 feet deep at the time of sampling. The facility includes a wet well where sediment initially settles out and then enters a sedimentation unit inside the water treatment facility.

The Miles City PWS Facility is approximately 180 miles downstream of the Silvertip Pipeline. The intake is approximately 5 miles downstream of the Fort Keough boat ramp and 1.2 miles upstream of the Highway 59 bridge. At the intake, the water was 3.6 feet deep at the time of sampling. The facility includes four concrete sedimentation units approximately 5.5 feet deep.

The Glendive PWS Facility is approximately 220 miles downstream of the Silvertip Pipeline. The intake is located 200 feet north of the bridge. Water depth at the intake

was 2 feet deep at the time of sampling. The facility includes four concrete sedimentation units between 4 to 8 feet deep.

The MDU Sidney PWS Facility is approximately 260 miles downstream of the Silvertip Pipeline. The intake is located 0.5 miles from Sydney Bridge. At the intake, the water was 9.8 feet deep at the time of sampling. The sedimentation unit consists of a tank that is approximately 13 feet deep, located inside the facility; the water depth inside the tank was 11 feet at the time of sampling.

Sample location selection varied for each facility and is described in further detail in Tables 1, 2 and 3.

2. PWS Intake Structure Investigation

The PWS investigation activities were performed by ARCADIS and Incident Command Boat Operations on behalf of EMPCo from September 14 to 17, 2011, and on October 25, 2011. The following sections present the scope of work completed and the field and laboratory data collected during these activities, along with a discussion of the results.

2.1 Sampling Methodology

Except as noted in Section 2.5, surface water and sediment samples were collected in general accordance with the Comprehensive Sampling and Analysis Plan (SAP; CTEH 2011a), the Quality Assurance Project Plan for Comprehensive Sampling and Analysis Plan (QAPP; CTEH 2011b), the PWS Sampling Plan (ARCADIS 2011a), and the Surface Water and Sediment Sampling Standard Operating Procedure (SOP; CTEH 2011a).

Surface water samples were collected from boats and land (depending on field conditions at each target location) using either a peristaltic pump and Teflon-lined tubing or a clean dedicated jar for surface grab samples. The Teflon-lined tubing was attached to a weighted tape measure and lowered into the water to approximately 6 inches above the sediment surface. Water was pumped directly into laboratory-supplied sample containers. A Yellow Spring, Inc. (YSI) water quality meter was used with an aliquot of the surface water sample to measure field parameters (pH, conductivity, temperature, dissolved oxygen, and turbidity). The results of field measurements are summarized in Table 4.

Sediment samples were collected immediately following collection of surface water samples. The sediment was probed in the area where the surface water sample was collected using a steel rod or weighted measuring tape to determine if fine grained

sediments of sufficient thickness were present. Sediment sample locations were established where fine grained sediments were identified through probing. In some cases, this required moving upstream of the intake structure to find fine grained sediment for sampling. When the water was too deep to wade at the sediment sample location, a ponar dredge was used to collect sediment from a boat. A ponar dredge was used for locations in Billings, Colstrip-Yellowstone River, and Colstrip-Castle Rock Lake. Where shallow water was present and field workers could safely wade to the target sample location, a hand-push core was used to collect sediment. A hand push core method was used for locations in Laurel, Lockwood, Hysham, Forsyth, Miles City, Glendive, and MDU Sidney.

Surface sediment samples (i.e., 0 to 6 inches below sediment surface [bss]) were collected to be representative of the most recently deposited sediments (pursuant to SOP CTEH ES4; CTEH 2011a).

Surface water and sediment samples were submitted to Pace Analytical Services, Inc., of Billings, Montana, for the analyses listed in Table 5. The quality assurance/quality control (QA/QC) samples are listed in Table 6.

2.2 Sample Location Selection

Surface water and sediment sample locations were based on target coordinates identified during the reconnaissance activities conducted between August 29 and September 1, 2011 and outlined in the PWS Sampling Plan (ARCADIS 2011a). Locations were modified in the field, as needed, in response to field conditions to ensure safe access and successful sample collection.

Samples collected from boats were collected from locations as close to the intake structure as possible where the boat could be safely anchored to the shoreline. If a sample could not be collected adjacent to the intake due to inaccessibility or the absence of fine grained sediments, samples were collected upstream of the intake. Samples collected from land were accessed by walking towards the intake structure. Wherever physical obstructions prevented the sampling crews from accessing the target location, the sampling location was modified based on accessibility and safety concerns.

The locations where surface water and sediment samples were collected are illustrated on the attached Figures 2 through 10, and the coordinates are presented in Table 2.

2.3 Surface Water and Sediment Sample Data Quality

Field activities were completed in accordance with QA/QC procedures, as outlined in the QAPP (CTEH 2011b).

Field quality control samples were collected during implementation of the PWS sampling program, in accordance with the QAPP. During collection of surface water, river sediment, and sedimentation unit sediment, two matrix spike and matrix spike duplicate (MS/MSD) samples and two blind duplicate (BD) samples were collected. To verify the effectiveness of field decontamination procedures, equipment rinsate blanks were collected by rinsing laboratory-supplied analyte-free water over decontaminated field equipment, such as the ponar, push core tubes used to collect sediment and stainless steel bowls used for sample homogenization, at the end of each day of sampling. The QA/QC samples are tabulated in Table 6.

There are 31 VOCs, SVOCs, or PAHs results in river sediment samples with a detection level greater than the BTAG value. This is due to high moisture contents in the sediment samples.

The project QAPP requires third-party data validation of all analytical results. Validation of sediment analytical results was not completed as of the date of this report, but will be submitted as an addendum to this report once validation is complete.

2.4 Laboratory Analyses

Surface water samples were analyzed for:

- VPH parameters by VPH Massachusetts Method (MT Modified)
- Extractable petroleum hydrocarbon (EPH) Screen by EPH Massachusetts Method (MT Modified)
  - If the EPH screen produced a TEH value greater than 1,000 micrograms per liter (µg/l), the sample would be analyzed for EPH fractions; no surface water samples exceeded this screening criterion.
- Total suspended solids (TSS) by Standard Method 2540D

Sediment samples were analyzed for:

- SVOCs by U.S. Environmental Protection Agency (USEPA) Method 8270
- PAHs by USEPA Method 8270 SIM
- VPH parameters by VPH Massachusetts Method (MT Modified)

- EPH Screen by EPH Massachusetts Method (MT Modified)
  - If the EPH screen produced a TEH value greater than 200 milligrams per kilogram (mg/kg), the sample would be analyzed for EPH fractions; none of the river sediment samples exceeded this screening criterion.
- Total organic carbon (TOC) by EPA Method M9060

2.5 Deviations from the Sampling Plan

The PWS surface water and sediment sampling activities were implemented in accordance with the SAP (CTEH 2011a), the QAPP (CTEH 2011b), the PWS Sampling Plan (ARCADIS 2011a), and the Surface Water and Sediment SOP (CTEH 2011a) with the exception of the deviations noted below.

The PWS Sampling Plan stated that surface water samples would be collected from 6 inches above the sediment surface using a peristaltic pump. As a result of a pump malfunction, surface water grab samples collected from the Laurel, Lockwood, Billings, Hysham, and Glendive PWS intake locations were collected by dipping an unused, laboratory-supplied dedicated jar into the river and transferring the collected water into laboratory-supplied sample containers. Water was collected from the water surface.

Due to the configuration of the Colstrip PPL Montana PWS intake structure in Castle Rock Lake, the surface water sample collected adjacent to the intake structure was not collected from 6 inches above the sediment surface. The Colstrip PPL Montana intake collects water at 8 feet below the water surface. In order to collect a sample representative of water taken in at the intake, water was sampled from approximately 8 feet below the water surface using a peristaltic pump attached to a weighted measuring tape. The water at this location is approximately 30 to 40 feet deep at the intake location.

Water quality parameters were not collected for surface water at the Colstrip Castle Rock Lake, Hysham, and Glendive intake structures. Due to equipment shipping schedule, the equipment was not available for collection of water quality parameters at these locations.

2.6 Surface Water and Sediment Analytical Results

Ten surface water samples and 10 sediment samples associated with intake structures in the river at PWS facilities were collected. Nine PWS facilities were sampled; however, two samples were collected for Colstrip. Analytical results, as reported directly by Pace Lab (i.e., not yet validated by a third party), for sediment samples were compared to BTAG values (USEPA 2006). Surface water sample results were

compared to DEQ-7 Human Health Standards (MDEQ 2010) as established in the SAP (CTEH 2011a) and Tier 1 Groundwater Risk Based Screening Levels (RBSLs) and Standards per the Administrative Order on Consent (AOC). These results are tabulated in Tables 7 through 9.

The terms “individual organic compound” and “organic compound” are used in the discussion of surface water and sediment data. Individual organic compound indicates distinct organic compounds (i.e., SVOCs, PAHs, methyl tertiary-butyl ether, benzene, toluene, ethylbenzene, m,p-xylene, o-xylene, and naphthalene). Organic compound indicates a group of organic compounds (e.g., total purgeable hydrocarbons, TEH, C11-C12 aromatics, etc.).

Surface water concentrations were compared to MDEQ’s Circular DEQ-7 Montana Numeric Water Quality Human Health Standards (HHSs; MDEQ 2010) and Tier 1 Groundwater RBSLs. No DEQ-7 Aquatic Life Standards (ALSs) acute or chronic values are available for the constituents that were detected in the surface water samples. Surface water analytical results as reported by Pace Lab (i.e., not yet validated by a third party) along with the HHS values and Tier 1 Groundwater RBSLs are tabulated in Table 7.

Sediment analytical results were compared to USEPA Region 3 BTAG Freshwater Sediment Screening Benchmarks (USEPA 2006), if available. In cases where a BTAG value was not available for an individual organic compound or organic compound, National Oceanic and Atmospheric Administration Screening Quick Reference Table (SQuiRT) values were used (Buchman 2008). However, SQuiRT values were not available for compounds that were detected in sediment, but did not have a corresponding BTAG value, and as such were not utilized.

The Massachusetts Department of Environmental Protection (MADEP) EPH analysis includes an initial screen that provides a TEH result. If the TEH concentration was greater than 200 mg/kg in sediment samples or 1,000 µg/l in surface water samples, then the EPH fraction analysis was performed. The EPH fraction analysis provides results for ranges of aliphatic and aromatic petroleum hydrocarbons (e.g., aliphatic C9-C18, aromatic C11-C22). However, none of the sample results for water or sediment at the PWS intake sampling locations exceeded these screening values, so no fractional analysis was necessary.

The MADEP VPH analysis does not include an initial screen. The analysis provides results for individual organic compounds (e.g., benzene, ethylbenzene, toluene, and xylenes [BTEX]) and ranges of petroleum hydrocarbons (e.g., C5-C8 aliphatic, C9-C12 aliphatic), along with a total purgeable hydrocarbon result.

There are a number of individual organic compounds and organic compounds that do not have BTAG, SQuiRT, or HHS values. Detections of these individual organic compounds and organic compounds are discussed below.

Field observations conducted during implementation of the PWS sampling program did not result in any observations of sheen or staining on sediments or sheen on surface water in the background or downstream sediment sample locations.

2.6.1 Surface Water Results

Background conditions were characterized using data from the Laurel PWS location. Background surface water analytical data from the sample collected near the intake structure for the Laurel PWS facility are presented in Table 7. One surface water sample was collected at the intake structure for the Laurel PWS facility. Visual evidence of petroleum impacts on surface water (e.g., sheen) was not observed during sampling at the surface water background location.

Surface water samples were collected at 9 locations in the river downstream of the Silvertip Pipeline crossing at the intake structures for the Billings, Lockwood, Hysham, Colstrip in the Yellowstone River, Colstrip in Castle Rock Lake, Forsyth, Miles City, Glendive, and MDU Sidney PWS facilities. Visual evidence of petroleum impacts (e.g., sheen) was not observed during sampling at any of the downstream surface water sample locations. None of the detected compounds exceeded the HHS or Tier 1 Groundwater RBSLs. Surface water analytical data are presented in Table 7 and detections are summarized in the table below.

Summary of Detected Compounds in Surface Water Samples

		Location	Laurel	Billings	Lockwood	Hysham	Colstrip - Yellowstone River	Colstrip - Castle Rock Lake	Forsyth	Miles City	Glendive	Sidney	Sidney – Field Duplicate
Chemical	**Unit**	**Standard[1]**											
Aliphatic (C05-C08), Unadjusted[2]	µg/l	700	ND	ND	ND	ND	ND	ND	17.6 J	ND	ND	ND	ND
Aliphatic (C09-C12), Unadjusted[3]	µg/l	1,000	ND	ND	ND	ND	ND	ND	9.4 J	ND	ND	ND	ND
Aromatic (C09-C10)	µg/l	1,000	0.48 J	0.61 J	0.51 J	0.51 J	0.65 J	0.74 J	3.9 J	0.56 J	0.59 J	0.64 J	0.48 J
Benzene	µg/l	5	ND	ND	ND	ND	ND	ND	0.79	ND	ND	ND	ND
Ethylbenzene	µg/l	530	ND	ND	ND	ND	ND	ND	0.69	ND	ND	ND	ND
m&p-Xylene	µg/l	--	ND	ND	ND	ND	ND	ND	2.7	ND	ND	ND	ND
Methyl Tertiary-Butyl Ether	µg/l	30	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Naphthalene	µg/l	100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
o-Xylene	µg/l	10,000	ND	ND	ND	ND	ND	ND	1.2	ND	ND	ND	ND
Toluene	µg/l	1,000	ND	0.14 J	0.12 J	ND	0.62	2.9	6.6	0.39 J	ND	0.23 J	0.12 J
Total Purgeable Hydrocarbons	µg/l	--	ND	ND	ND	ND	6.2 J	7.9 J	26.0	6.0 J	ND	6.3 J	ND
Xylenes, Total	µg/l	10,000	ND	ND	ND	ND	ND	ND	3.9	ND	ND	ND	ND

Notes:

µg/l = micrograms per liter

J = Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit .

ND = not detected. See Table 7 for reporting limits for these compounds.

1 = Aliphatic (C05-C-08), aliphatic (C09-C12), and aromatic (C09-C10) were screened against Tier 1 Groundwater RBSLs. The remaining chemicals were screened against the DEQ-7 Human Health Standards.

2 = 'Unadjusted' values are defined as all aliphatic hydrocarbon compounds which are between five and eight carbon atoms.

3 = 'Unadjusted' values are defined as all aliphatic hydrocarbon compounds which are between nine and twelve carbon atoms.

2.6.2 River Sediment Results

Background sediment analytical data from the sample collected near the intake structure for the Laurel PWS facility are presented in Table 8. Visual evidence of petroleum impacts on river sediment (e.g., sheen) was not observed during sampling at the background location.

River sediment samples were collected at 9 locations downstream of the Silvertip Pipeline crossing in Laurel. River sediment samples were collected near the intakes in Billings, Lockwood, Hysham, Colstrip in the Yellowstone River, Colstrip in Castle Rock Lake, Forsyth, Miles City, Glendive, and MDU Sidney.

Visual evidence of petroleum impacts (e.g., sheen) was not observed during sampling at these locations. Additionally, there were no exceedances of the BTAG screening values at any of the river sediment locations. River sediment analytical data are presented in Table 8 and detections are summarized in the table below.

Summary of Detected Compounds in River Sediment Samples

		Location	Laurel	Billings	Lockwood	Hysham	Colstrip - Yellowstone River	Colstrip - Castle Rock Lake	Forsyth	Miles City	Glendive	Sidney	Sidney – Field Duplicate
Chemical	**Unit**	**Standard[1]**											
3&4-Methylphenol	mg/kg	--	3.57	3.35	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(a)Pyrene	mg/kg	0.15	ND	ND	ND	ND	ND	ND	ND	ND	0.0142 J	ND	ND
Benzo(b)fluoranthene	mg/kg	--	ND	ND	ND	ND	ND	ND	ND	ND	0.0179	ND	ND
Fluoranthene	mg/kg	0.423	ND	0.0176	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Extractable Hydrocarbons	mg/kg	--	ND	76.0	ND	ND	28.2	ND	ND	ND	ND	ND	ND
Aliphatic (C05-C08), Unadjusted[2]	mg/kg	--	0.21 J	9.1	0.33 J	0.27 J	ND	ND	ND	0.28 J	0.38 J	ND	0.20 J
Aliphatic (C09-C12), Unadjusted[3]	mg/kg	--	0.11 J	0.12 J	ND	ND	ND	ND	ND	ND	0.12 J	0.087 J	0.076 J
Aromatic (C09-C10)	mg/kg	--	0.063 J	0.11 J	0.080 J	0.064 J	0.049 J	0.056 J	0.046 J	0.052 J	0.058 J	0.066 J	0.059 J
Benzene	mg/kg	--	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	mg/kg	1.1	0.0050 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
m&p-Xylene	mg/kg	--	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methyl Tertiary-Butyl Ether	mg/kg	--	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Naphthalene	mg/kg	0.176	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
o-Xylene	mg/kg	--	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toluene	mg/kg	--	0.0060 J	4.5	0.010 J	ND	ND	ND	ND	ND	ND	ND	ND
Total Purgeable Hydrocarbons	mg/kg	--	0.33 J	7.5 J	0.39 J	0.30 J	0.40 J	ND	0.23 J	0.30 J	0.50 J	0.28 J	0.28 J
Xylenes, Total	mg/kg	--	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Notes:

mg/kg = milligrams per kilogram

J = Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

ND = not detected. See Table 8 for reporting limits for these compounds.

1 = Sediment concentrations screened against USEPA Region 3 BTAG Freshwater Sediment Screening Benchmarks.

2 = 'Unadjusted' values are defined as all aliphatic hydrocarbon compounds which are between five and eight carbon atoms.

3 = 'Unadjusted' values are defined as all aliphatic hydrocarbon compounds which are between nine and twelve carbon atoms.

3. Sedimentation Unit Sediment Sampling

3.1 Sampling Methodology

Except as noted in Section 3.5, sediment samples were collected in general accordance with the SAP (CTEH 2011a), the QAPP (CTEH 2011b), the PWS Sampling Plan (ARCADIS 2011a), and the Surface Water and Sediment Sampling SOP (CTEH 2011a).

PWS sedimentation unit sediment samples were collected from land using a ponar dredge or a hand-push core depending on the location. The sampling methodology was dependent on the conditions at the PWS facility. When possible, samples were collected and composited from multiple locations within an individual sedimentation unit. Composite samples were collected at the Lockwood and Miles City PWS facilities. For these samples, sediment was collected in equal volume from each location and homogenized to form the composite sample.

The ponar dredge sample collection method was used during sampling of the sedimentation units at the Laurel, Lockwood, Miles City, and MDU Sidney PWS facilities. The hand-push core sample collection method was used at the Billings and Glendive PWS facilities. The Forsyth sedimentation unit was not accessible because the wet well required confined space entry, and the sedimentation unit had metal weirs and grates that did not allow sampling. The Colstrip and Hysham facilities do not use sedimentation units as part of their water management operations. Additional detailed information about settling processes at each facility is included in Table 1.

3.2 Sample Location Selection

Sample locations were selected based on visual reconnaissance and discussions with PWS facility operators regarding the location of deposited sediments, as prescribed in the PWS Sampling Plan. Additionally, sample location selection was dependent on accessibility to the sedimentation unit and worker safety. Sample location selection varied for each facility and is described in further detail in Table 1.

3.3 Sediment Sample Data Quality

As described in the PWS Sampling Plan (ARCADIS 2011a), field activities were completed in accordance with QA/QC procedures, as outlined in the QAPP (CTEH 2011b).

Field quality control samples were collected during implementation of the PWS sampling program, in accordance with the QAPP, as described in Section 2.3. The QA/QC samples are tabulated in Table 6.

There are 45 VOCs, SVOCs, or PAHs results in sedimentation unit samples with a detection level greater than the BTAG value. This is due to high moisture contents in these sediment samples.

The project QAPP requires third-party data validation of all analytical results. Validation of sediment analytical results was not completed as of the date of this report, but will be submitted once validation is complete as an addendum to this report.

3.4 Laboratory Analyses

Sediment samples were analyzed for:

- SVOCs by USEPA Method 8270
- PAHs by USEPA Method 8270 SIM
- VPH by VPH Massachusetts Method (MT Modified)
- EPH Screen by EPH Massachusetts Method (MT Modified)
  - If the EPH screen produced a TEH value greater than 200 mg/kg, the sample would be analyzed for EPH fractions; two of the sedimentation unit sediment samples exceeded this criterion.
- TOC by EPA Method M9060

3.5 Deviations from the Sampling Plan

The sedimentation unit sediment sampling activities were implemented in accordance with the SAP (CTEH 2011a), the QAPP (CTEH 2011b), and the PWS Sampling Plan (ARCADIS 2011a), with the exception of the deviations noted below.

Sediment samples were collected from sedimentation units at 6 of the 9 PWS facilities. Sediment was not collected at the Forsyth facility due to inaccessibility. Sediment was not collected at the Hysham and Colstrip facilities as sedimentation units are not used at these locations.

At the Billings sedimentation unit two separate samples were collected. Annual maintenance dredging was being conducted during the time of the site visit. A sample was collected from the dredged sediment. The dredge operator deposited dredged sediment directly from the dredge into a decontaminated stainless steel bowl. The

sample was processed on shore. A separate sample was collected with a push core at the edge of the sedimentation unit.

3.6 Sedimentation Unit Sediment Results

Sedimentation units represent treatment units and are not intended to provide habitat for organisms that form the basis for BTAG screening levels; therefore, comparisons to the BTAG values are not applicable to these sediment sample results. However, it should be noted that none of the compounds with reported values above the reporting limit (i.e., not indicated as "J" or "estimated") would have exceeded the BTAG screening levels. The remainder of this section describes the compounds detected at each sample location.

One sample was collected from the background sedimentation unit in Laurel. Background sediment analytical data for this location are presented in Table 9. Visual evidence of petroleum impacts (e.g., sheen) was not observed during sampling at this location.

Six samples were collected from 5 sedimentation units downstream of the Silvertip Pipeline in Laurel. As noted previously, two samples were collected in Billings. One sample was collected from the edge of the sedimentation unit, and one was collected from a dredge that was conducting maintenance dredging. A sheen was observed directly adjacent to the maintenance dredge operating in the Billings sedimentation unit. The PWS facility operator confirmed this was from the dredge barge and not emanating from the sediment being dredged. No sheen was observed in the sediment sample collected from the sedimentation unit or the sediment sample collected from the dredge bucket, further supporting that the observed sheen was from the barge. Visual evidence of petroleum impacts was not observed during sampling at the other locations. The EPH screen for the Laurel and Billings sedimentation units produced a TEH value greater than 200 mg/kg. These samples were run for fractionation. Sedimentation unit sediment analytical data are presented in Table 9 and detections are summarized in the table below.

Summary of Detected Compounds in Sedimentation Unit Sediment Samples

Location		Laurel	Billings - Dredge	Billings - Sedimentation Unit	Lockwood	Miles City	Glendive	Sidney
Chemical	**Unit**							
3&4-Methylphenol	mg/kg	ND	ND	ND	ND	ND	0.125 J	ND
Fluoranthene	mg/kg	ND	ND	ND	0.869 J	ND	ND	ND
Phenanthrene	mg/kg	ND	ND	ND	0.809 J	ND	ND	ND
Pyrene	mg/kg	ND	ND	ND	0.697 J	ND	ND	ND
Benzo(b)fluoranthene	mg/kg	ND	ND	ND	ND	ND	0.0173 J	ND
Fluoranthene	mg/kg	ND	ND	ND	ND	ND	0.023 J	ND
Indeno(1,2,3-cd)Pyrene	mg/kg	ND	ND	ND	ND	ND	ND	0.027 J
Naphthalene	mg/kg	ND	ND	ND	0.0701	ND	ND	ND
Pyrene	mg/kg	ND	ND	ND	ND	ND	0.0219 J	ND
Total Extractable Hydrocarbons	mg/kg	274	383	ND	184	18.6	96.8	128
Aliphatic (C05-C08), Unadjusted[1]	mg/kg	3.3 J	8.4 J	1.8 J	0.72 J	ND	6.3 J	ND
Aliphatic (C09-C12), Unadjusted[2]	mg/kg	ND	1.3 J	0.16 J	6.2 J	ND	0.36 J	ND
Aromatic (C09-C10)	mg/kg	0.38 J	1.1 J	0.091 J	3.2 J	ND	0.15 J	0.072 J
Aromatic (C11-C22)	mg/kg	156 J	151 J	--	--	--	--	--
Benzene	mg/kg	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	mg/kg	0.061 J	0.11 J	ND	0.023 J	0.012 J	ND	0.042 J
m&p-Xylene	mg/kg	ND	ND	ND	ND	0.019 J	ND	0.089 J
Methyl Tertiary-Butyl Ether	mg/kg	ND	ND	ND	ND	ND	ND	ND
Naphthalene	mg/kg	ND	0.44 J	ND	1.8 J	ND	ND	ND
o-Xylene	mg/kg	ND	ND	ND	ND	0.0097 J	ND	0.049 J
Toluene	mg/kg	0.049 J	0.38 J	ND	ND	0.015 J	3.1	ND
Total Purgeable Hydrocarbons	mg/kg	3.7 J	9.3 J	1.7 J	10.5 J	ND	6.0 J	ND
Xylenes, Total	mg/kg	ND	ND	ND	ND	ND	ND	ND

Notes:

mg/kg = milligrams per kilogram

J = Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit .

ND = not detected. See Table 9 for reporting limits for these compounds.

1 = 'Unadjusted' values are defined as all aliphatic hydrocarbon compounds which are between five and eight carbon atoms.

2 = 'Unadjusted' values are defined as all aliphatic hydrocarbon compounds which are between nine and twelve carbon atoms.

4. References

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Table 1
PWS Facility Intake and Sedimentation Unit Features

Public Surface Water Supply Data Summary Report
Silvertip Pipeline Incident
Laurel, Montana

Public Surface Water Supply Location	Intake			Sedimentation Unit			
	Facility Intake Description[1]	Sample Location[2]	Water Depth[3]	Description of Sedimentation Unit	Water Depth[3]	Cleaning Frequency[4]	Chemicals Added[5]
Laurel	The intake is a cement structure located underwater in the middle of the river. The concrete structure adjacent to the bridge is the old intake and is no longer used.	Surface water and sediment samples collected approximately 200 feet upstream of intake structure.	NA	Sedimentation unit is a concrete structure located outside. Serpentine shape. Portions of the pond have sloped walls, others have vertical walls. Sample was collected from one location with vertical walls. Sample location is where water initially enters the pond.	5.2 feet	Sedimentation unit is cleaned every 2 weeks. Previous cleaning conducted on September 9, 2011.	Polyaluminum Hydroxychloride
Billings	The intake is a channel lined with sheet pile. Steep shoreline and heavy rip rap on either side of channel. A secondary intake structure extends into the river upstream of primary intake. This intake is only used when the primary structure is offline because of maintenance, construction, or emergency.	Surface water and sediment samples collected adjacent to intake structure.	8.5 feet	Sedimentation unit is approximately 650 feet by 200 feet and located outside. A concrete structure or impremeable liner was not observed. Water enters the pond from the river through a channel lined with sheet pile. During time of visit, maintenance dredging was occurring. Dredging had been occurring for about 1.5 months. A sample of dredged material was collected. The operator indicated sediment on the west side of the pond had been deposited in the spring. A hand-push core was used to collect an additional sample from this location. There is a smaller secondary basin south of the primary basin. This basin is only used when the primary basin is out of service due to maintenance, construction or emergency. This secondary intake had not been used between the time of the incident and when sampling occured.	NA	Sedimentation unit is cleaned once a year. Pond was being dredged during visit on September 14, 2011. Maintenance dredging usually lasted about 4 months.	Kemira PAX-XL3920LX
Lockwood	The intake is located approximately 100 feet upstream of the water treatment facility. Location is between the Montana Rail Link bridge and Route 87.	Surface water and sediment samples collected approximately 200 feet upstream of intake structure.	8 inches	Sedimentation unit is a concrete structure located inside water treatment building. Serpentine shape of sedimentation unit forces water to flow in a specific path, allowing sediment to settle out. Mechanical mixing occurs at mouth of settling pond. A catwalk is present along one side of pond. Sample collected from 3 locations using a ponar dredge to create composite sample.	4 feet, 14 feet, and 18 feet	Cleaned once a year. Last cleaned September 2010.	Ferric Chloride

Table 1
PWS Facility Intake and Sedimentation Unit Features

Public Surface Water Supply Data Summary Report
Silvertip Pipeline Incident
Laurel, Montana

Public Surface Water Supply Location	Intake			Sedimentation Unit			
	Facility Intake Description[1]	Sample Location[2]	Water Depth[3]	Description of Sedimentation Unit	Water Depth[3]	Cleaning Frequency[4]	Chemicals Added[5]
Hysham	Intake consists of a 1250 foot long perforated pipe buried in a gravel pack approximately 18 feet below water surface, running parallel to the shore.	Surface water and sediment sample collected on upstream end of buried perforated intake pipe.	NA	The Hysham water treatment facility does not have a sedimentation unit. Water is drawn directly into two clarifiers located inside the water treatment building. Clarifiers are backwashed every 3 hours.	NA	NA	NA
Colstrip - Yellowstone River	Intake in Yellowstone River is a cement structure located in a channel on the right bank looking downstream, approximately 5 miles upstream of Forsyth. Water from this intake is pumped by 2 pipes approximately 30 miles south to Castle Rock Lake in Colstrip.	Surface water and sediment samples collected adjacent to intake structure.	5.2 feet	The Colstrip water treatment facility does not have a settling pond. Water enters the facility directly into filter beds. Intake located in Castle Rock Lake. Sediment and surface water sample collected in lake from inflatable raft.	NA	NA	NA
Colstrip - Castle Rock Lake	Intake to the water treatment facility is a cement structure located in Castle Rock Lake. Intake is approximately 1000 feet from the public boat ramp. Intake is surrounded by a floating metal boom.	Surface water sample collected adjacent to intake structure. Sediment sample collected approximately 100 feet south of intake structure.	8 feet - surface water sample[6] 10 feet - sediment sample				
Forsyth	Intake is approximately 0.25 miles downstream of Highway 12 Bridge on right bank of river looking downstream. Cement structure with heavy rip rap along shore.	Surface water sample collected adjacent to intake structure. Sediment sample collected approximately 1000 feet upstream on opposite bank. The bank near the intake was exceptionally rocky and fine grained sediment was not present for collection of a sample.	2.3 feet	Sediment first settles out in a wet well. Wet well is located approximately 20 feet underground, accessible only by a trap door. Sampling was not possible without entering the confined space, as such, sampling did not occur at this location. Water leaves the wet well and enters a settling basin inside the water treatment facility. This basin contains metal grates and weirs which do not allow sampling.	NA	The wet well is cleaned out once a year, and last cleaned in August 2011. Settling basin cleaned out once a year, and last cleaned in October 2010.	NA
Miles City	Intake is approximately 5 miles downstream of Fort Keogh access point, and 1.2 miles upstream of Highway 59 bridge. Shoreline is steep with large riprap. Intake is cement structure on shoreline.	Surface water sample collected adjacent to intake structure. Sediment collected approximately 200 feet upstream of intake.	3.6 feet	Total of 4 concrete sedimentation units. Two small square basins (~40 ft by 60 ft) adjacent to two larger rectangular basins (~60 ft by 160 ft). One of the small ponds is covered and inaccessible for sampling. Water moves through the square pond to the rectangular pond, with the ponds running in parallel. The rectangular ponds have sloped sides and could not be sampled. The uncovered square pond have vertical sides. Sample collected using a ponar dredge from two locations in this pond to create a composite sample.	5.5 feet	Settling ponds cleaned every year in the fall. Last cleaned in September 2010.	Aluminum Sulfate Solution, Aluminum Chlorohydrate, Polydimethyldiallylammonium Chloride, SUPERFLOC® C-1598

Table 1
PWS Facility Intake and Sedimentation Unit Features

Public Surface Water Supply Data Summary Report
Silvertip Pipeline Incident
Laurel, Montana

Public Surface Water Supply Location	Intake			Sedimentation Unit			
	Facility Intake Description[1]	Sample Location[2]	Water Depth[3]	Description of Sedimentation Unit	Water Depth[3]	Cleaning Frequency[4]	Chemicals Added[5]
Glendive	Intake is located 200 ft north of the West Bell Street Bridge, adjacent to the water treatment plant. Boat access at Black Bridge boat launch approximately 1 mile upstream.	Surface water and sediment sample collected approximately 900 feet upstream of the intake structure.	2.0 feet	Total of 5 concrete sedimentation units 100 ft by 30 ft, 4 to 8 feet deep. Water intake comes into one basin and flows over into subsequent basins through a canal. Sample was collected from canal due to lack of sediment available for sampling in the sedimentation unit. Sedimentation unit was being cleaned on the day of sampling.	NA	Basins are cleaned twice a year. Previous cleaning prior to sampling was June 2011.	Pristine Chemicals 2386
MDU - Sidney	Intake is located 0.5 miles downstream from Sidney Bridge. Boat access at Sidney Bridge. Steep shoreline adjacent to intake structure.	Surface water sample collected adjacent to intake structure. Sediment sample collected approximately 400 feet upstream of intake.	9.8 feet	Sedimentation unit is a tank, approximately 13 feet deep, located inside MDU facility. Bottom of tank has a cone shape. Tank was accessed for sampling from a narrow catwalk adjacent to the tank. This was the only accessible location for sampling.	11 feet	Tank is flushed every 60 gallons.	NALCLEAR 8173 PULV Flocculant NALCOLYTE® 8100 Coagulant

Notes:

1. Information on the intake structures obtained from reconnaissance conducted between August 29 and September 1, 2011, discussion with facility operators during site visits conducted between September 14 and 17, and October 25, 2011 and visual observations in the field.
2. Sample location based on target coordinates and accessibility based on field conditions.
3. Water depth at time of sampling.
4. Cleaning frequency information from the PWS facility operators.
5. Information on chemicals added to the sedimentation units obtained from PWS facility operators during site visit. Material Safety Data Sheets were provided by each operator.
6. The Colstrip Water Treatment Facility operator and PPL Montana operator indicated that the water level at the intake was 30 feet deep but the intake was located 8 feet below the water surface. The surface water sample was collected at 8 feet below the water surface.

MDU = Montana Dakota Utilities; NA = Information not Available.

Table 2
PWS Intake Sediment and Surface Water Sample Locations

Public Surface Water Supply Data Summary Report
Silvertip Pipeline Incident
Laurel, Montana

Public Surface Water Supply Location[1]	Sample ID	Longitude[2]	Latitude[2]	Distance from Pipeline Incident	Sample Description	PID Reading (ppm)	Depth to Sample[3] (feet below water surface)
Laurel	LAMT0917SE0201	-108.76032	45.77434	0.25 miles upstream	Silt , some fine Sand, trace medium Sand, wet, very soft, dark grey	0.9	1.5
	LAMT0917SW0201	-108.76032	45.77431		Surface Water	--	0
Billings	BIMT0917SE0201	-108.47775	45.77434	15 miles downstream	Silt and Clay, non-plastic, little fine Sand, wet, very soft	2.4	8.5
	BIMT0917SW0201	-108.47777	45.77431		Surface Water	--	0
Lockwood	LOMT0917SE201	-108.46956	45.79556	17 miles downstream	Fine to coarse Sand, little very fine to fine Gravel, wet, loose	1.8	8.0
	LOMT0917SW201	-108.46955	45.79551		Surface Water	--	0.0
Hysham	HYMT091611SE303	-107.24098	46.31368	90 miles downstream	Silt, trace fine Sand, trace coarse Gravel, wet, very soft, grey	1.1	2
	HYMT091611SW304	-107.24098	46.31368		Surface Water	--	0
Colstrip - Yellowstone River	COMT0916SE0201	-106.796314	46.26574	130 miles downstream	Clay and Silt, wet, very soft, dark grey	0.0	5.2
	COMT0916SW0201	-106.79634	46.26574		Surface Water	--	4.7
Colstrip - Castle Rock Lake	COMT091611SE302	-106.63675	45.89395		Silt, trace fine Sand, trace Gravel, wet, soft, dark brown	1.7	10.0
	COMT091611SW301	-106.63688	45.89414		Surface Water	--	8.0
Forsyth	FOMT0916SE0201	-106.69305	46.26608	140 miles downstream	Fine Sand, little Silt, trace medium Sand, wet, loose, greyish brown	0.0	2.3
	FOMT0916SW0201	-106.69049	46.26656		Surface Water	--	1.8
Miles City	MCMT0915SE0201	-105.87087	46.40574	180 miles downstream	Silt, non plastic, some fine Sand, wet, very soft, greyish brown	0.7	3.6
	MCMT0915SW201	-105.87030	46.40631		Surface Water	--	3.1
Glendive	GLMT1025SD101	-104.71871	47.10362	220 miles downstream	Clay, some Silt, trace gravel and organics, high plasticity, moist, brown/gray	--	2.0
	GLMT1025SW101	-104.71871	47.10362		Surface Water	--	0.0
MDU-Sidney	SIMT0915SE0201	-105.87087	47.67711	260 miles downstream	Fine Sand, some Silt, trace medium Sand, wet, dense, greyish brown	0.6	9.8
	SIMT0915SW0201	-105.87030	47.67797		Surface Water	--	9.3

Notes:
1. Public Water Supply locations were recorded during sampling on September 14 through 17 and October 25, 2011.
2. Coordinate system in Geographic Coordinate System – WGS 1984. Sample locations were chosen from accessibility by land or boat, and bank river conditions.
3. Surface water samples were collected 6 inches above sediment surface except for the Laurel, Billings, Lockwood, Hysham, and Glendive locations. Surface water at these locations was collected by grab sample from the water surface.

MDU = Montana Dakota Utilities

PID = photoionization detector

ppm = parts per million

-- indicates not applicable

Table 3
PWS Settling Pond Sample Locations

Public Surface Water Supply Data Summary Report
Silvertip Pipeline Incident
Laurel, Montana

Public Surface Water Supply Location	Sample ID	Longitude[1]	Latitude[1]	Sample Description	PID Reading (ppm)	Water Depth to Sample (feet)
Laurel	LAMT091411SE304	-108.75946	45.65550	Sandy Silt, trace Organics, wet, very soft, medium brown	0.3	5.2
Billings	BIMT091411SE302	-108.47794	45.77398	Silty Sand, trace Organics, wet, very loose, medium brown	0.0	NA[4]
	BIMT091411SE303	-108.47853	45.77349	Sandy Silt, trace Organics, wet, very soft, medium brown	0.4	1
Lockwood[2]	LOMT091411SE301	-108.46758	45.79750	Silty Sand, trace organics, wet, soft, organic odor, medium brown	1.7	4, 14, 18
Miles City	MIMT091511SE302	-105.87071	46.40506	Silt, trace fine Sand, wet, very soft, brown	0.1	5.5
Glendive	GLMT1025SD102	-104.71770	47.10609	Silt, trace sand, wet, very soft, gray	--	NA[3]
MDU-Sidney	SIMT091511SE301	-104.15771	47.67852	Silt, trace Sand, wet, very soft, grayish brown	1.2	11

Notes:

1. Coordinate system in Geographic Coordinate System – WGS 1984. Sample locations were chosen from accessibility by land or boat, and bank river conditions.

2. Coordinates for the Lockwood location were collected using the iPhone from The Response Group. These coordinates are approximate. GPS could not be used because the sample location was indoors. The sample was a composite collected from three locations. The three water depths represent the water depth at the 3 composite locations.

3. Settling ponds were in the process of being cleaned and the water had already been drained from the basins.

4. This sample was collected from the maintenance dredge that was operating at the time of the site visit. The water depth at the dredge is unknown.

MDU = Montana Dakota Utilities

NA = Information not available

PID = photoionization detector

ppm = parts per million

-- indicates not applicable

Table 4
Field Water Quality Parameters

Public Surface Water Supply Data Summary Report
Silvertip Pipeline Incident
Laurel, Montana

Public Surface Water Supply Location	Sample ID	River and Shoreline Conditions	Depth of Water Column (ft)	pH	Conductivity (ms/cm)	Temperature (C^o)	Turbidity (NTU)	Dissolved Oxygen (mg/L)
Laurel	LAMT0917SW0201	Shoreline is a gravel bar with soft sediment	2.0	7.51	0.202	17.06	7.35	7.44
Billings	BIMT091711SW0201	Shoreline around intake is a sheet pile wall structure	8.5	8.75	0.268	15.52	11.3	8.81
Lockwood	LOMT0917SW0201	Shoreline is armored with medium riprap	0.67	4.92	0.278	14.98	4.98	7.25
Hysham	HYMT091611SW304	Shoreline is soft mudflat	2.0	NA	NA	NA	NA	NA
Colstrip - Yellowstone River	COMT0916SW0201	Banks are armored with medium riprap, channel seemed silty	5.2	9.42	0.339	15.56	19.9	8.11
Colstrip - Castle Rock Lake	COMT091611SW301	Manmade lake with riprap on shore	NA	NA	NA	NA	NA	NA
Forsyth	FOMT0916SW0201	Shoreline is rocky/armored with large boulders/concrete blocks	2.3	7.02	0.345	14.55	7.96	8.18
Miles City	MCMT0915SW0201	Shoreline covered with large concrete pieces	3.6	8.57	0.383	18.1	1.04	7.67
Glendive	GLMT1025SW101	Shoreline is armored with medium riprap	2.0	NA	NA	NA	NA	NA
MDU-Sidney	SIMT0915SW0201	Shoreline is armored with medium riprap	9.8	7.47	0.455	15.32	42.3	8.15

Notes:

1. Depth of water column for Hysham and Laurel are approximate.

2. Water quality parameters were not collected for surface water at the Colstrip Castle Rock Lake, Hysham, and Glendive intake structures. Due to equipment shipping schedule, the equipment was not available for collection of water quality parameters at these locations.

MDU = Montana Dakota Utilities; ft = feet; ms/cm = microsiemens per centimeter; C^o = Degrees in Celsius; NTU = Nephelometric Turbidity Units; mg/L = milligram per Liter; NA = Information not available

Table 5
Sample Analytical Matrix

Public Surface Water Supply Data Summary Report
Silvertip Pipeline Incident
Laurel, Montana

Public Surface Water Supply Location	Sample ID	Sample Type	Analysis Performed						
			VPH	SVOC	PAH	EPH	TOC	TSS	ARCHIVE
			Massachusetts Method (MT Modified)	EPA Method 8270C	EPA Method 8270 SIM	Massachusetts Method (MT Modified)	EPA Method M9060	Standard Method 2540 D	
Laurel	LAMT091411SE304	Settling Pond Sediment	x	x	x	x	x		x
	LAMT091411SE305	Rinsate	x	x	x	x	x		x
	LAMT0917SE0201	River Sediment	x	x	x	x	x		x
	LAMT0917SW0201	Surface Water	x		x	x		x	
	LAMT0917SE0202	Sediment	x	x	x	x	x		x
	LAMT0917SE0203	Rinsate	x	x	x	x	x		x
	LAMT0917SE0204	Trip Blank	x						
	LAMT0917SE0205	Trip Blank	x						
	LAMT0917SE0206	Trip Blank	x						
	LAMT0917SE0207	Trip Blank	x						
Billings	BIMT091411SE302	Settling Pond	x	x	x	x	x		x
	BIMT091411SE303	Settling Pond Sediment	x	x	x	x	x		x
	BIMT0917SE0201	River Sediment	x	x	x	x	x		x
	BIMT091711SW0201	Surface Water	x		x	x		x	
Lockwood	LOMT0917SE0201	River Sediment	x	x	x	x	x		x
	LOMT0917SW0201	Surface Water	x		x	x		x	
	LOMT091411SE301	Settling Pond Sediment	x	x	x	x	x		x
Hysham	HYMT091611SE303	River Sediment	x	x	x	x	x		x
	HYMT091611SW304	Surface Water	x		x	x		x	
	HYMT091611SE305	Rinsate	x	x	x	x	x		x
	HYMT091611SE306	Trip Blank	x						
Colstrip - Yellowstone River	COMT0916SE0201	River Sediment	x	x	x	x	x		x
	COMT0916SW0201	Surface Water	x		x	x		x	
	COMT0916SE0202	Rinsate	x	x	x	x	x		x
	COMT0916SE0203	Trip Blank	x						
	COMT0916SE0204	Trip Blank	x						
Colstrip - Castle Rock Lake	COMT091611SE302	Sediment	x	x	x	x	x		x
	COMT091611SW301	Surface Water	x		x	x		x	
Forsyth	FOMT0916SE0201	River Sediment	x	x	x	x	x		x
	FOMT0916SW0201	Surface Water	x		x	x		x	
Miles City	MCMT0915SE0201	River Sediment	x	x	x	x	x		x
	MCMT0915SW0201	Surface Water	x		x	x		x	
	MCMT0915SE0202	Rinsate	x	x	x	x	x		x
	MCMT0915SE0203	Trip Blank	x						
	MCMT0915SE0204	Trip Blank	x						
	MCMT091511SE302	Settling Pond Sediment	x	x	x	x	x		x
	MCMT061511SE303	Rinsate	x	x	x	x	x		x
	MCMT091511SE304	Trip Blank	x						
Glendive	GLMT1025SD101	River Sediment	x	x	x	x	x		x
	GLMT1025SW101	Surface Water	x		x	x		x	
	GLMT1025SD102	Settling Pond Sediment	x	x	x	x	x		x
	GLMT1025SW102	Rinsate							
MDU-Sidney	SIMT0915SE0201	River Sediment	x	x	x	x	x		x
	SIMT0915SE0202	Duplicate	x	x	x	x	x		x
	SIMT0915SW0201	Surface Water	x		x	x		x	
	SIMT0915SW0202	Duplicate	x		x	x		x	
	SIMT091511SE301	Settling Pond Sediment	x	x	x	x	x		x
	SIMT0915SE0203	Trip Blank	x						

Notes:
MDU = Montana Dakota Utilities; VPH = Volatile Petroleum Hydrocarbons; SVOC = Semivolatile Organic Compounds; PAHs = Polycyclic Aromatic Hydrocarbons; EPH = Extractable Petroleum Hydrocarbons; TOC = Total Organic Carbon; TSS = Total Suspended Solids

Table 6
QA/QC Sample Key

Public Surface Water Supply Data Summary Report
Silvertip Pipeline Incident
Laurel, Montana

Date	Sample ID	Sample Type
9/14/2011	LAMT091411SE305	Rinsate
9/14/2011	LOMT091411SE306	Trip Blank
9/15/2011	MCMT061511SE303	Rinsate
9/15/2011	MCMT091511SE304	Trip Blank
9/15/2011	MCMT0915SE0202	Rinsate
9/15/2011	MCMT0915SE0203	Trip Blank
9/15/2011	MCMT0915SE0204	Trip Blank
9/15/2011	SIMT0915SE0202	Duplicate
9/15/2011	SIMT0915SE0203	Trip Blank
9/15/2011	SIMT0915SW0202	Duplicate
9/16/2011	COMT0916SE0202	Rinsate
9/16/2011	COMT0916SE0203	Trip Blank
9/16/2011	COMT0916SE0204	Trip Blank
9/16/2011	HYMT091611SE305	Rinsate
9/16/2011	HYMT091611SE306	Trip Blank
9/17/2011	LOMT0917SE0201	MS/MSD
9/17/2011	BIMT0917SE0201	MS/MSD
9/17/2011	LAMT0917SE0203	Rinsate
9/17/2011	LAMT0917SE0204	Trip Blank
9/17/2011	LAMT0917SE0205	Trip Blank
9/17/2011	LAMT0917SE0206	Trip Blank
9/17/2011	LAMT0917SE0207	Trip Blank
10/25/2011	GLMT1025SW102	Rinsate

Notes:
MS/MSD = matrix spike/matrix spike duplicate
QA/QC = quality assurance/quality control

Table 7
PWS Surface Water Analytical Results

Public Surface Water Supply Data Summary Report
Silvertip Pipeline Incident
Laurel, Montana

					Location	Laurel	Billings	Lockwood	Hysham	Colstrip - Yellowstone River	Colstrip - Castle Rock Lake	Forsyth	Miles City	Glendive	Sidney	Sidney
					Sample ID	LAMT0917SW0201	BIMT0917SW0201	LOMT0917SW0201	HYMT091611SW304	COMT0916SW0201	COMT091611SW301	FOMT0916SW0201	MCMT0915SW0201	GLMT1025SW101	SIMT0915SW0201	SIMT0915SW0202
					Sample Date	9/17/2011	9/17/2011	9/17/2011	9/16/2011	9/16/2011	9/16/2011	9/16/2011	9/15/2011	10/25/2011	9/15/2011	9/15/2011
					Sample Type	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water Field Duplicate
Chemical	**Unit**	**DEQ-7 Human Health Standards - Surface Water**	**Supporting Note**	**Tier 1 Groundwater RBSLs and Standards**	**Tier 1 Groundwater RBSLs and Standards note**											
Suspended Solids (EPA 2540)																
Total Suspended Solids	mg/l	--	--	--	--	9.8	9.6	8.1	15.9	55.6	5.0	15.3	19.9	27.6	3240	42.0
Extractable Petroleum Hydrocarbons																
Total Extractable Hydrocarbons	ug/l	--	--	1000	n,rb	< 220 U	< 211 U	< 211 U	< 209 U	< 216 U	< 212 U	< 208 U	< 221 U	< 216 U	< 212 U	< 211 U
Volatile Petroleum Hydrocarbons																
Aliphatic (C05-C08), Adjusted[1]	ug/l	--	--	700	n,rb	< 20.0 U	< 20.0 U	< 20.0 U	< 20.0 U	< 20.0 U	< 20.0 U	10.2 J	< 20.0 U	< 20.0 U	< 20.0 U	< 20.0 U
Aliphatic (C05-C08), Unadjusted[2]	ug/l	--	--	700	n,rb	< 20.0 U	< 20.0 U	< 20.0 U	< 20.0 U	< 20.0 U	< 20.0 U	17.6 J	< 20.0 U	< 20.0 U	< 20.0 U	< 20.0 U
Aliphatic (C09-C12), Adjusted[3]	ug/l	--	--	1000	n,rb	< 20.0 U	< 20.0 U	< 20.0 U	< 20.0 U	< 20.0 U	< 20.0 U	< 20.0 U	< 20.0 U	< 20.0 U	< 20.0 U	< 20.0 U
Aliphatic (C09-C12), Unadjusted[4]	ug/l	--	--	1000	n,rb	< 20.0 U	< 20.0 U	< 20.0 U	< 20.0 U	< 20.0 U	< 20.0 U	9.4 J	< 20.0 U	< 20.0 U	< 20.0 U	< 20.0 U
Aromatic (C09-C10)[5]	ug/l	--	--	1000	n,rb	0.48 J	0.61 J	0.51 J	0.51 J	0.65 J	0.74 J	3.9 J	0.56 J	0.59 J	0.64 J	0.48 J
Benzene	ug/l	5.000	MCL	--	--	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	0.79	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U
Ethylbenzene	ug/l	530.0	PP	--	--	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	0.69	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U
m&p-Xylene	ug/l	--	--	--	--	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	2.7	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Methyl-Tert-Butyl Ether	ug/l	30.00	(21)	--	--	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U
Naphthalene	ug/l	100.0	HA	--	--	< 5.0 U	< 5.0 U	< 5.0 U	< 5.0 U	< 5.0 U	< 5.0 U	< 5.0 U	< 5.0 U	< 5.0 U	< 5.0 U	< 5.0 U
o-Xylene	ug/l	10000	MCL	--	--	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U	1.2	< 0.50 U	< 0.50 U	< 0.50 U	< 0.50 U
Toluene	ug/l	1000	MCL	--	--	< 0.50 U	0.14 J	0.12 J	< 0.50 U	0.62	2.9	6.6	0.39 J	< 0.50 U	0.23 J	0.12 J
Total Purgeable Hydrocarbons	ug/l	--	--	--	--	< 20.0 U	< 20.0 U	< 20.0 U	< 20.0 U	6.2 J	7.9 J	26.0	6.0 J	< 20.0 U	6.3 J	< 20.0 U
Xylenes, Total	ug/l	10000	MCL	--	--	< 1.5 U	< 1.5 U	< 1.5 U	< 1.5 U	< 1.5 U	< 1.5 U	3.9	< 1.5 U	< 1.5 U	< 1.5 U	< 1.5 U

Notes:
1. Adjusted C05-C08 Aliphatic Hydrocarbons is defined and reported as the Unadjusted C5-C8 minus MTBE, Benzene and Toluene results.
2. C05-C08 Aliphatic Hydrocarbons are defined as all aliphatic hydrocarbon compounds which are between five and eight carbon atoms.
3. Adjusted C09-C12 Aliphatic Hydrocarbons are defined and reported as the Unadjusted C9-C12 minus Ethyl Benzene, Total xylenes and Aromatic C9-C10 values.
4. C09-C12 Aliphatic Hydrocarbons are defined as all aliphatic hydrocarbon compound which contain between nine and twelve carbon atoms.
5. C09-C10 Aromatic Hydrocarbons are defined as all aromatic hydrocarbons which contain between nine and ten carbon atoms.

Results that exceed the DEQ-7 Human Health Standards - Surface Water are shaded.
- = Not Applicable or Available
< = less than
DEQ-7 = Montana Department of Environmental Quality Circular DEQ-7 Montana Numeric Water Quality Standards
mg/l = milligrams per liter
µg/l = micrograms per liter
J = Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.
U = The compound was analyzed for, but not detected.

DEQ-7 Surface Water Human Health Standards Supporting Notes
(21) = Based on taste and odor thresholds given in EPA 822-f-97-008 December 1997.
PP = priority pollutant criteria
MCL = Maximum contaminate level from the drinking water regulations
HA = health advisory all from EPA's "Drinking Water Standards and Health Advisories" (October 1996)

Tier 1 Groundwater RBSLs and Standards
n = non-carcinogenic and direct contact RBSLs are based on a hazard quotient of 1
rb = risk-based screening level

Table 8
PWS River Sediment Analytical Results

Public Surface Water Supply Data Summary Report
Silvertip Pipeline Incident
Laurel, Montana

			Location	Laurel	Billings	Lockwood	Hysham	Colstrip - Yellowstone River	Colstrip - Castle Rock Lake	Forsyth	Miles City	Glendive	Sidney	Sidney
			Sample ID	LAMT0917SE0201	BIMT0917SE0201	LOMT0917SE0201	HYMT091611SE303	COMT0916SE0201	COMT091611SE302	FOMT0916SE0201	MCMT0915SE0201	GLMT1025SE101	SIMT0915SE0201	SIMT0915SE0202
			Sample Date	9/17/2011	9/17/2011	9/17/2011	9/16/2011	9/16/2011	9/16/2011	9/16/2011	9/15/2011	10/25/2011	9/15/2011	9/15/2011
			Sample Type	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment Field Duplicate
Chemical	**Unit**	**Freshwater Sediment Screening Value[1]**	**Supporting Note[1]**											
Percent Moisture	%			24.0	40.5	31.6	32.9	51.5	32.3	22.4	21.3	33.1	20.6	21.6
EPA 8270														
1,2,4-Trichlorobenzene	ug/kg	2100	a,b,1,B	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
1,2-Dichlorobenzene	ug/kg	16.50	a,b,1,B	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
1,2-Diphenylhydrazine	ug/kg	--	--	< 2230 U	< 2850 U	< 2490 U	< 2530 U	< 3500 U	< 2500 U	< 2180 U	< 2150 U	< 2540 U	< 2130 U	< 2160 U
1,3-Dichlorobenzene	ug/kg	4430	a,b,1,B	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
1,4-Dichlorobenzene	ug/kg	599.0	a,b,1,B	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
1-Methylnaphthalene	ug/kg	--	--	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
2,4,5-Trichlorophenol	ug/kg	--	--	< 2230 U	< 2850 U	< 2490 U	< 2530 U	< 3500 U	< 2500 U	< 2180 U	< 2150 U	< 2540 U	< 2130 U	< 2160 U
2,4,6-Trichlorophenol	ug/kg	213.0	a,b,1	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
2,4-Dichlorophenol	ug/kg	117.0	a,b,1	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
2,4-Dimethylphenol	ug/kg	29.00	f,3	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
2,4-Dinitrophenol	ug/kg	--	--	< 2230 U	< 2850 U	< 2490 U	< 2530 U	< 3500 U	< 2500 U	< 2180 U	< 2150 U	< 2540 U	< 2130 U	< 2160 U
2,4-Dinitrotoluene	ug/kg	41.60	a,b,1	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
2,6-Dinitrotoluene	ug/kg	--	--	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
2-Chloronaphthalene	ug/kg	--	--	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
2-Chlorophenol	ug/kg	31.20	a,b,1	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
2-Methylnaphthalene	ug/kg	20.20	c	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
2-Methylphenol(o-Cresol)	ug/kg	--	--	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
2-Nitroaniline	ug/kg	--	--	< 2230 U	< 2850 U	< 2490 U	< 2530 U	< 3500 U	< 2500 U	< 2180 U	< 2150 U	< 2540 U	< 2130 U	< 2160 U
2-Nitrophenol	ug/kg	--	--	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
3&4-Methylphenol	ug/kg	--	--	3570	3350	< 965 U	< 984 U	< 1360 U	< 972 U	< 848 U	< 836 U	< 987 U	< 828 U	< 839 U
3,3'-Dichlorobenzidine	ug/kg	127.0	a,b,1	< 878 U	< 1120 U	< 980 U	< 999 U	< 1380 U	< 987 U	< 861 U	< 849 U	< 1000 U	< 841 U	< 852 U
3-Nitroaniline	ug/kg	--	--	< 2230 U	< 2850 U	< 2490 U	< 2530 U	< 3500 U	< 2500 U	< 2180 U	< 2150 U	< 2540 U	< 2130 U	< 2160 U
4,6-Dinitro-2-methylphenol	ug/kg	--	--	< 2230 U	< 2850 U	< 2490 U	< 2530 U	< 3500 U	< 2500 U	< 2180 U	< 2150 U	< 2540 U	< 2130 U	< 2160 U
4-Bromophenyl Phenyl Ether	ug/kg	1230	a,b,1,B	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
4-Chloro-3-Methylphenol	ug/kg	--	--	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
4-Chloroaniline	ug/kg	--	--	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
4-Chlorophenyl Phenyl Ether	ug/kg	--	B	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
4-Nitroaniline	ug/kg	--	--	< 2230 U	< 2850 U	< 2490 U	< 2530 U	< 3500 U	< 2500 U	< 2180 U	< 2150 U	< 2540 U	< 2130 U	< 2160 U
4-Nitrophenol	ug/kg	--	--	< 2230 U	< 2850 U	< 2490 U	< 2530 U	< 3500 U	< 2500 U	< 2180 U	< 2150 U	< 2540 U	< 2130 U	< 2160 U
Acenaphthene	ug/kg	6.700	c,B	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
Acenaphthylene	ug/kg	5.900	c,B	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
Anthracene	ug/kg	57.20	h,B	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
Benzo(a)Anthracene	ug/kg	108.0	h,B	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
Benzo(a)Pyrene	ug/kg	150.0	h,B	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
Benzo(b)fluoranthene	ug/kg	--	--	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
Benzo(g,h,i)Perylene	ug/kg	170.0	g,B	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
Benzo(k)Fluoranthene	ug/kg	240.0	g,B	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
Bis(2-Chloroethoxy)methane	ug/kg	--	--	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
Bis(2-Chloroethyl)ether	ug/kg	--	--	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
bis(2-Chloroisopropyl) ether	ug/kg	--	--	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
Bis(2-Ethylhexyl)phthalate	ug/kg	180.0	k	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
Butylbenzylphthalate	ug/kg	10900	a,b,1	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
Carbazole	ug/kg	--	--	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
Chrysene	ug/kg	166.0	h,B	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
Dibenzo(a,h)Anthracene	ug/kg	33.00	h,B	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
Dibenzofuran	ug/kg	415.0	a,b,1	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
Diethyl Phthalate	ug/kg	603.0	a,b,1	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
Dimethyl Phthalate	ug/kg	--	--	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
Di-N-Butyl Phthalate	ug/kg	6470	a,b,1	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
Di-n-Octyl Phthalate	ug/kg	--	--	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
Fluoranthene	ug/kg	423.0	h,B	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
Fluorene	ug/kg	77.40	h,B	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
Hexachloro-1,3-Butadiene	ug/kg	--	B	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
Hexachlorobenzene	ug/kg	20.00	g,4,B	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
Hexachloroethane	ug/kg	1027	a,b,1,B	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
Indeno(1,2,3-cd)Pyrene	ug/kg	17.00	j,9,B	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
Isophorone	ug/kg	--	--	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
Naphthalene	ug/kg	176.0	h	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
Nitrobenzene	ug/kg	--	--	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
N-Nitrosodimethylamine	ug/kg	--	--	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
N-Nitroso-di-n-propylamine	ug/kg	--	--	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
N-nitrosodiphenylamine	ug/kg	2680	a,b,1	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
Pentachlorophenol	ug/kg	504.0	a,b,1,B	< 878 U	< 1120 U	< 980 U	< 999 U	< 1380 U	< 987 U	< 861 U	< 849 U	< 1000 U	< 841 U	< 852 U

Table 8
PWS River Sediment Analytical Results

Public Surface Water Supply Data Summary Report
Silvertip Pipeline Incident
Laurel, Montana

			Location	Laurel	Billings	Lockwood	Hysham	Colstrip - Yellowstone River	Colstrip - Castle Rock Lake	Forsyth	Miles City	Glendive	Sidney	Sidney
			Sample ID	LAMT0917SE0201	BIMT0917SE0201	LOMT0917SE0201	HYMT091611SE303	COMT0916SE0201	COMT091611SE302	FOMT0916SE0201	MCMT0915SE0201	GLMT1025SE101	SIMT0915SE0201	SIMT0915SE0202
			Sample Date	9/17/2011	9/17/2011	9/17/2011	9/16/2011	9/16/2011	9/16/2011	9/16/2011	9/15/2011	10/25/2011	9/15/2011	9/15/2011
			Sample Type	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment Field Duplicate
Chemical	**Unit**	**Freshwater Sediment Screening Value[1]**	**Supporting Note[1]**											
Phenanthrene	ug/kg	204.0	h,B	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
Phenol	ug/kg	420.0	f,3,B	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
Pyrene	ug/kg	195.0	h,B	< 433 U	< 552 U	< 483 U	< 492 U	< 680 U	< 486 U	< 424 U	< 418 U	< 494 U	< 414 U	< 419 U
EPA 8270 by SIM														
Acenaphthene	ug/kg	6.700	c,B	< 13.1 U	< 16.8 U	< 14.6 U	< 14.9 U	< 20.5 U	< 14.7 U	< 12.8 U	< 12.7 U	< 15.0 U	< 12.6 U	< 12.7 U
Anthracene	ug/kg	57.20	h,B	< 13.1 U	< 16.8 U	< 14.6 U	< 14.9 U	< 20.5 U	< 14.7 U	< 12.8 U	< 12.7 U	< 15.0 U	< 12.6 U	< 12.7 U
Benzo(a)Anthracene	ug/kg	108.0	h,B	< 13.1 U	< 16.8 U	< 14.6 U	< 14.9 U	< 20.5 U	< 14.7 U	< 12.8 U	< 12.7 U	< 15.0 U	< 12.6 U	< 12.7 U
Benzo(a)Pyrene	ug/kg	150.0	h,B	< 13.1 U	< 16.8 U	< 14.6 U	< 14.9 U	< 20.5 U	< 14.7 U	< 12.8 U	< 12.7 U	14.2 J	< 12.6 U	< 12.7 U
Benzo(b)fluoranthene	ug/kg	--	--	< 13.1 U	< 16.8 U	< 14.6 U	< 14.9 U	< 20.5 U	< 14.7 U	< 12.8 U	< 12.7 U	17.9	< 12.6 U	< 12.7 U
Benzo(k)Fluoranthene	ug/kg	240.0	g,B	< 13.1 U	< 16.8 U	< 14.6 U	< 14.9 U	< 20.5 U	< 14.7 U	< 12.8 U	< 12.7 U	< 15.0 U	< 12.6 U	< 12.7 U
Chrysene	ug/kg	166.0	h,B	< 13.1 U	< 16.8 U	< 14.6 U	< 14.9 U	< 20.5 U	< 14.7 U	< 12.8 U	< 12.7 U	< 15.0 U	< 12.6 U	< 12.7 U
Dibenzo(a,h)Anthracene	ug/kg	33.00	h,B	< 13.1 U	< 16.8 U	< 14.6 U	< 14.9 U	< 20.5 U	< 14.7 U	< 12.8 U	< 12.7 U	< 15.0 U	< 12.6 U	< 12.7 U
Fluoranthene	ug/kg	423.0	h,B	< 13.1 U	17.6	< 14.6 U	< 14.9 U	< 20.5 U	< 14.7 U	< 12.8 U	< 12.7 U	< 15.0 U	< 12.6 U	< 12.7 U
Fluorene	ug/kg	77.40	h,B	< 13.1 U	< 16.8 U	< 14.6 U	< 14.9 U	< 20.5 U	< 14.7 U	< 12.8 U	< 12.7 U	< 15.0 U	< 12.6 U	< 12.7 U
Indeno(1,2,3-cd)Pyrene	ug/kg	17.00	j,9,B	< 13.1 U	< 16.8 U	< 14.6 U	< 14.9 U	< 20.5 U	< 14.7 U	< 12.8 U	< 12.7 U	< 15.0 U	< 12.6 U	< 12.7 U
Naphthalene	ug/kg	176.0	h	< 13.1 U	< 16.8 U	< 14.6 U	< 14.9 U	< 20.5 U	< 14.7 U	< 12.8 U	< 12.7 U	< 15.0 U	< 12.6 U	< 12.7 U
Pyrene	ug/kg	195.0	h,B	< 13.1 U	< 16.8 U	< 14.6 U	< 14.9 U	< 20.5 U	< 14.7 U	< 12.8 U	< 12.7 U	< 15.0 U	< 12.6 U	< 12.7 U
EPA 9060														
Mean Total Organic Carbon	mg/kg	--	--	2460	9780	3450	6810	10800	2840	781	2810	12200	1690	1750
Total Organic Carbon	mg/kg	--	--	1930	9840	4650	5420	10500	2640	795	2570	13000	1820	1700
				3940	10000	3460	6570	11300	3110	777	3060	11400	1620	1810
				2030	9060	2800	7900	10900	2770	826	3080	11100	1670	1440
				1940	10200	2900	7340	10400	2850	726	2530	13500	1660	2040
MADEP EPH														
Total Extractable Hydrocarbons	mg/kg	--	--	< 13.0 U	76.0	< 14.2 U	< 14.7 U	28.2	< 14.4 U	< 12.7 U	< 12.7 U	< 14.7 U	< 12.5 U	< 12.5 U
MADEP VPH														
Aliphatic (C05-C08), Adjusted[2]	mg/kg	--	--	< 6.4 U	4.6 J	0.32 J	0.26 J	< 9.6 U	< 7.2 U	< 6.3 U	0.27 J	0.37 J	< 6.2 U	< 6.3 U
Aliphatic (C05-C08), Unadjusted	mg/kg	--	--	0.21 J	9.1	0.33 J	0.27 J	< 9.6 U	< 7.2 U	< 6.3 U	0.28 J	0.38 J	< 6.2 U	0.20 J
Aliphatic (C09-C12), Adjusted[4]	mg/kg	--	--	< 6.4 U	< 8.3 U	< 7.2 U	< 7.2 U	< 9.6 U	< 7.2 U	< 6.3 U	< 6.2 U	< 7.3 U	< 6.2 U	< 6.3 U
Aliphatic (C09-C12), Unadjusted	mg/kg	--	--	0.11 J	0.12 J	< 7.2 U	< 7.2 U	< 9.6 U	< 7.2 U	< 6.3 U	< 6.2 U	0.12 J	0.087 J	0.076 J
Aromatic (C09-C10)[6]	mg/kg	--	--	0.063 J	0.11 J	0.080 J	0.064 J	0.049 J	0.056 J	0.046 J	0.052 J	0.058 J	0.066 J	0.059 J
Benzene	mg/kg	--	--	< 0.032 U	< 0.041 U	< 0.036 U	< 0.036 U	< 0.048 U	< 0.036 U	< 0.032 U	< 0.031 U	< 0.037 U	< 0.031 U	< 0.031 U
Ethylbenzene	mg/kg	1.100	a,b,1	0.0050 J	< 0.083 U	< 0.072 U	< 0.072 U	< 0.096 U	< 0.072 U	< 0.063 U	< 0.062 U	< 0.073 U	< 0.062 U	< 0.063 U
m&p-Xylene	mg/kg	--	--	< 0.13 U	< 0.17 U	< 0.14 U	< 0.14 U	< 0.19 U	< 0.14 U	< 0.13 U	< 0.12 U	< 0.15 U	< 0.12 U	< 0.13 U
Methyl-Tert-Butyl Ether	mg/kg	--	--	< 0.064 U	< 0.083 U	< 0.072 U	< 0.072 U	< 0.096 U	< 0.072 U	< 0.063 U	< 0.062 U	< 0.073 U	< 0.062 U	< 0.063 U
Naphthalene	mg/kg	0.1760	h	< 0.77 U	< 0.99 U	< 0.86 U	< 0.86 U	< 1.2 U	< 0.86 U	< 0.76 U	< 0.74 U	< 0.88 U	< 0.75 U	< 0.75 U
o-Xylene	mg/kg	--	--	< 0.064 U	< 0.083 U	< 0.072 U	< 0.072 U	< 0.096 U	< 0.072 U	< 0.063 U	< 0.062 U	< 0.073 U	< 0.062 U	< 0.063 U
Toluene	mg/kg	--	--	0.0060 J	4.5	0.010 J	< 0.072 U	< 0.096 U	< 0.072 U	< 0.063 U	< 0.062 U	< 0.073 U	< 0.062 U	< 0.063 U
Total Purgeable Hydrocarbons	mg/kg	--	--	0.33 J	7.5 J	0.39 J	0.30 J	0.40 J	< 14.4 U	0.23 J	0.30 J	0.50 J	0.28 J	0.28 J
Xylenes, Total	mg/kg	--	--	< 0.19 U	< 0.25 U	< 0.21 U	< 0.22 U	< 0.29 U	< 0.22 U	< 0.19 U	< 0.19 U	< 0.22 U	< 0.19 U	< 0.19 U

Table 8
PWS River Sediment Analytical Results

Public Surface Water Supply Data Summary Report
Silvertip Pipeline Incident
Laurel, Montana

Notes:

1. USEPA Freshwater Sediment Screening Benchmarks
2. Adjusted C05-C08 Aliphatic Hydrocabons is defined and reported as the Unadjusted C5-C8 minus MTBE, Benzene and Toluene results.
3. C05-C08 Aliphatic Hydrocarbons are defined as all aliphatic hydrocarbon compounds which are between five and eight carbon atoms.
4. Adjusted C09-C12 Aliphatic Hydrocarbons are defined and reported as the Unadjusted C9-C12 minues Ethyl Benzene, Total xylenes and Aromatic C9-C10 values.
5. C09-C12 Aliphatic Hydrocarbons are defined as all aliphatic hydrocarbon compound which contain between nine and twelve carbon atoms.
6. C09-C10 Aromatic Hydrocarbons are defined as all aromatic hydrocarbons which contain between nine and ten carbon atoms.

Results that exceed the USEPA Region 3 BTAG Freshwater Sediment Screening Benchmarks are shaded.
- = Not Applicable or Available
< = less than
µg/kg = micrograms per kilgram
mg/kg = milligrams per kilogram
J = Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.
U = The compound was analyzed for, but not detected.
USEPA = United States Environmental Protection Agency

USEPA Freshwater Sediment Screening Benchmarks

1	Value derived from the EqP method with Region III BTAG freshwater values (2004[a]) and logKow values from Karickhoff and Long (1995[b]). Only logKow values between 2 and 6 were used, as suggested by the EPA (2000[o]).
3	Apparent Effects Threshold (AET) marine value from Washington State Sediment Quality Standards as cited by Jones et al. (1997 [f]).
4	Lowest Effect Level (LEL).
6	EPA has published Equilibrium Partitioning Sediment Benchmarks (ESB) for metal mixtures including this metal. Implementation of the ESB requires metal concentration data based on the simultaneously extracted metals procedure (SEM) and measurement of the acid volatile sulfide (AVS) concentration during the period from November to May. Application of ESB benefits significantly from the quantification of the organic carbon. BTAG recommends that these metals be screened against listed benchmarks in the screening level ecological risk assessment. Any exceedances should be further evaluated using ESBs following the sampling and analysis guidance in EPA-600-R-02-011 in Step 3 of the baseline ecological risk assessment.
9	ARCs TEL (Assessment and Remediation of Contaminated Sediments Program Threshold Effects Level - 28d test using Hyallela azteca from U.S. EPA (1996[h]).
a	Region III BTAG Freshwater Screening Benchmarks. 2004. http://www.epa.gov/reg3hwmd/risk/eco/btag/sbv/fw/screenbench.htm
b	Karickhoff, S.W. and J.M. Long. Environmental Research Laboratory. U.S. EPA.1995. Internal Report on Summary of Measured, Calculated and Recommended Log K_{ow} Values.
B	Bioaccumulative
c	CCME (Canadian Council of Ministers of the Environment). 2003. Canadian Environmental Quality Guidelines: Summary Table December 2003. Canadian Council of Ministers of the Environment, Winnipeg, Manitoba. Available at http://www.ccme.ca/publications/ceqg_rcqe.html
f	Jones, D.S., G.W. Suter II and R.N. Hull. 1997. Toxicological benchmarks for screening contaminants of potential concern for effects on sediment-associated biota: 1997 Revision. ES/ER/TM-95/R4. Oak Ridge National Laboratory, Oak Ridge, TN. Available at: http://www.esd.ornl.gov/programs/ecorisk/documents/tm95r4.pdf
g	Persaud, D., R. Jaagumagi and A. Hayton. 1993. Guidelines for the protection and management of aquatic sediment quality in Ontario. Ontario Ministry of the Environment. Queen's Printer of Ontario.
h	MacDonald, D.D., C.G. Ingersoll, and T.A. Berger. 2000. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. Arch. Environ. Contam. Toxicol. 39: 20-31.

i Long, E.R. and L.G. Morgan. 1990. The potential for biological effects of sediment-sorbed contaminants tested in the national status and trends program. NOAA Technical Memorandum NOS OMA 52.

j Ingersoll, C.G., P.S. Haverland, E.L. Brunson, T.J. Canfield, F.J. Dwyer, C.E. Henke, N.E. Kemble, D.R. Mount, and R.G. Fox. 1996. Calculation and evaluation of sediment effect concentrations for the amphipod Hyallela azteca and the midge Chironomus riparius. International Association of Great Lakes Research. 22:602-623.

k MacDonald, D.D., C.G. Ingersoll, D.E. Smrong, R.A. Lindskoog, G. Sloane, T. Biernacki. 2003. Development and evaluation of numerical sediment quality assessment guidelines for Florida inland waters. Florida Department of Environmental Protection. Available at: http://www.dep.state.fl.us/water/monitoring/docs/seds/SQAGs_for_Florida_Inland_Waters_01_03.PDF

m Lemley, A.D. 2002. Selenium assessment in aquatic ecosystems. US Forest Service, Blacksburg, VA.

n Buchman, M.F. 1999. NOAA Screening Quick Reference Tables, NOAA HAZMAT Report 99-1, Seattle, WA, Coastal Protection and Restoration Division, National Oceanic Atmospheric Administration. Available at: http://response.restoration.noaa.gov/book_shelf/122_squirt_cards.pdf

Table 9
PWS River Settling Basin Sediment Analytical Results

Public Surface Water Supply Data Summary Report
Silvertip Pipeline Incident
Laurel, Montana

	Location	Laurel	Billings	Billings	Lockwood	Miles City	Glendive	Sidney
	Sample ID	LAMT091411SE304	BIMT091411SE302	BIMT091411SE303	LOMT091411SE301	MCMT091511SE302	GLMT1025SE102	SIMT091511SE301
	Sample Date	9/14/2011	9/14/2011	9/14/2011	9/14/2011	9/15/2011	10/25/2011	9/15/2011
	Sample Type	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Chemical	**Unit**		**Dredge**	**Sedimentation Unit**				
Percent Moisture	%	92.0	95.1	65.5	76.2	28.9	67.7	72.1
EPA 8270								
1,2,4-Trichlorobenzene	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
1,2-Dichlorobenzene	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
1,2-Diphenylhydrazine	ug/kg	< 21300 U	< 34500 U	< 4920 U	< 7130 U	< 2390 U	< 5270 U	< 6080 U
1,3-Dichlorobenzene	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
1,4-Dichlorobenzene	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
1-Methylnaphthalene	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
2,4,5-Trichlorophenol	ug/kg	< 21300 U	< 34500 U	< 4920 U	< 7130 U	< 2390 U	< 5270 U	< 6080 U
2,4,6-Trichlorophenol	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
2,4-Dichlorophenol	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
2,4-Dimethylphenol	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
2,4-Dinitrophenol	ug/kg	< 21300 U	< 34500 U	< 4920 U	< 7130 U	< 2390 U	< 5270 U	< 6080 U
2,4-Dinitrotoluene	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
2,6-Dinitrotoluene	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
2-Chloronaphthalene	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
2-Chlorophenol	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
2-Methylnaphthalene	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
2-Methylphenol(o-Cresol)	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
2-Nitroaniline	ug/kg	< 21300 U	< 34500 U	< 4920 U	< 7130 U	< 2390 U	< 5270 U	< 6080 U
2-Nitrophenol	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
3&4-Methylphenol	ug/kg	< 8290 U	< 13400 U	< 1910 U	< 2770 U	< 928 U	1250 J	< 2360 U
3,3'-Dichlorobenzidine	ug/kg	< 8410 U	< 13600 U	< 1940 U	< 2810 U	< 942 U	< 2080 U	< 2390 U
3-Nitroaniline	ug/kg	< 21300 U	< 34500 U	< 4920 U	< 7130 U	< 2390 U	< 5270 U	< 6080 U
4,6-Dinitro-2-methylphenol	ug/kg	< 21300 U	< 34500 U	< 4920 U	< 7130 U	< 2390 U	< 5270 U	< 6080 U
4-Bromophenyl Phenyl Ether	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
4-Chloro-3-Methylphenol	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
4-Chloroaniline	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
4-Chlorophenyl Phenyl Ether	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
4-Nitroaniline	ug/kg	< 21300 U	< 34500 U	< 4920 U	< 7130 U	< 2390 U	< 5270 U	< 6080 U
4-Nitrophenol	ug/kg	< 21300 U	< 34500 U	< 4920 U	< 7130 U	< 2390 U	< 5270 U	< 6080 U
Acenaphthene	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
Acenaphthylene	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
Anthracene	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
Benzo(a)Anthracene	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
Benzo(a)Pyrene	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
Benzo(b)fluoranthene	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
Benzo(g,h,i)Perylene	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U

Table 9
PWS River Settling Basin Sediment Analytical Results

Public Surface Water Supply Data Summary Report
Silvertip Pipeline Incident
Laurel, Montana

	Location	Laurel	Billings	Billings	Lockwood	Miles City	Glendive	Sidney
	Sample ID	LAMT091411SE304	BIMT091411SE302	BIMT091411SE303	LOMT091411SE301	MCMT091511SE302	GLMT1025SE102	SIMT091511SE301
	Sample Date	9/14/2011	9/14/2011	9/14/2011	9/14/2011	9/15/2011	10/25/2011	9/15/2011
	Sample Type	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Chemical	**Unit**		**Dredge**	**Sedimentation Unit**				
Benzo(k)Fluoranthene	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
Bis(2-Chloroethoxy)methane	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
Bis(2-Chloroethyl)ether	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
bis(2-Chloroisopropyl) ether	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
Bis(2-Ethylhexyl)phthalate	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
Butylbenzylphthalate	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
Carbazole	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
Chrysene	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
Dibenzo(a,h)Anthracene	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
Dibenzofuran	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
Diethyl Phthalate	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
Dimethyl Phthalate	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
Di-N-Butyl Phthalate	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
Di-n-Octyl Phthalate	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
Fluoranthene	ug/kg	< 4140 U	< 6700 U	< 956 U	869 J	< 464 U	< 1020 U	< 1180 U
Fluorene	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
Hexachloro-1,3-Butadiene	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
Hexachlorobenzene	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
Hexachloroethane	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
Indeno(1,2,3-cd)Pyrene	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
Isophorone	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
Naphthalene	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
Nitrobenzene	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
N-Nitrosodimethylamine	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
N-Nitroso-di-n-propylamine	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
N-nitrosodiphenylamine	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
Pentachlorophenol	ug/kg	< 8410 U	< 13600 U	< 1940 U	< 2810 U	< 942 U	< 2080 U	< 2390 U
Phenanthrene	ug/kg	< 4140 U	< 6700 U	< 956 U	809 J	< 464 U	< 1020 U	< 1180 U
Phenol	ug/kg	< 4140 U	< 6700 U	< 956 U	< 1380 U	< 464 U	< 1020 U	< 1180 U
Pyrene	ug/kg	< 4140 U	< 6700 U	< 956 U	697 J	< 464 U	< 1020 U	< 1180 U
EPA 8270 by SIM								
Acenaphthene	ug/kg	< 125 U	< 203 U	< 28.9 U	< 41.9 U	< 14.1 U	< 30.9 U	< 35.9 U
Anthracene	ug/kg	< 125 U	< 203 U	< 28.9 U	< 41.9 U	< 14.1 U	< 30.9 U	< 35.9 U
Benzo(a)Anthracene	ug/kg	< 125 U	< 203 U	< 28.9 U	< 41.9 U	< 14.1 U	< 30.9 U	< 35.9 U
Benzo(a)Pyrene	ug/kg	< 125 U	< 203 U	< 28.9 U	< 41.9 U	< 14.1 U	< 30.9 U	< 35.9 U
Benzo(b)fluoranthene	ug/kg	< 125 U	< 203 U	< 28.9 U	< 41.9 U	< 14.1 U	17.3 J	< 35.9 U
Benzo(k)Fluoranthene	ug/kg	< 125 U	< 203 U	< 28.9 U	< 41.9 U	< 14.1 U	< 30.9 U	< 35.9 U
Chrysene	ug/kg	< 125 U	< 203 U	< 28.9 U	< 41.9 U	< 14.1 U	< 30.9 U	< 35.9 U

Table 9
PWS River Settling Basin Sediment Analytical Results

Public Surface Water Supply Data Summary Report
Silvertip Pipeline Incident
Laurel, Montana

	Location	Laurel	Billings	Billings	Lockwood	Miles City	Glendive	Sidney
	Sample ID	LAMT091411SE304	BIMT091411SE302	BIMT091411SE303	LOMT091411SE301	MCMT091511SE302	GLMT1025SE102	SIMT091511SE301
	Sample Date	9/14/2011	9/14/2011	9/14/2011	9/14/2011	9/15/2011	10/25/2011	9/15/2011
	Sample Type	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Chemical	**Unit**		**Dredge**	**Sedimentation Unit**				
Dibenzo(a,h)Anthracene	ug/kg	< 125 U	< 203 U	< 28.9 U	< 41.9 U	< 14.1 U	< 30.9 U	< 35.9 U
Fluoranthene	ug/kg	< 125 U	< 203 U	< 28.9 U	< 41.9 U	< 14.1 U	23.0 J	< 35.9 U
Fluorene	ug/kg	< 125 U	< 203 U	< 28.9 U	< 41.9 U	< 14.1 U	< 30.9 U	< 35.9 U
Indeno(1,2,3-cd)Pyrene	ug/kg	< 125 U	< 203 U	< 28.9 U	< 41.9 U	< 14.1 U	< 30.9 U	2.7 J
Naphthalene	ug/kg	< 125 U	< 203 U	< 28.9 U	70.1	< 14.1 U	< 30.9 U	< 35.9 U
Pyrene	ug/kg	< 125 U	< 203 U	< 28.9 U	< 41.9 U	< 14.1 U	21.9 J	< 35.9 U
EPA 9060								
Mean Total Organic Carbon	mg/kg	18800	24100	17900	7040	7380	15200	11900
Total Organic Carbon	mg/kg	20700	17300	18100	7330	6920	13400	13300
		18000	44100	19100	7410	7880	16400	10800
		18300	18100	15800	6130	7950	16300	10900
		18400	16800	18700	7290	6750	14700	12800
MADEP EPH								
Total Extractable Hydrocarbons	mg/kg	274	383	< 28.8 U	184	18.6	96.8	128
C11-C22 Aromatics	mg/kg	156 J	151 J	--	--	--	--	--
C19-C36 Aliphatics	mg/kg	< 173 U	< 203 U	--	--	--	--	--
C9-C18 Aliphatics	mg/kg	< 173 U	< 203 U	--	--	--	--	--
MADEP VPH								
Aliphatic (C05-C08), Adjusted[2]	mg/kg	3.2 J	7.9 J	1.8 J	0.69 J	< 6.7 U	3.2 J	< 17.7 U
Aliphatic (C05-C08), Unadjusted[3]	mg/kg	3.3 J	8.4 J	1.8 J	0.72 J	< 6.7 U	6.3 J	< 17.7 U
Aliphatic (C09-C12), Adjusted[4]	mg/kg	< 61.9 U	< 101 U	< 14.3 U	2.9 J	< 6.7 U	0.20 J	< 17.7 U
Aliphatic (C09-C12), Unadjusted[5]	mg/kg	< 61.9 U	1.3 J	0.16 J	6.2 J	< 6.7 U	0.36 J	< 17.7 U
Aromatic (C09-C10)[6]	mg/kg	0.38 J	1.1 J	0.091 J	3.2 J	< 1.3 U	0.15 J	0.072 J
Benzene	mg/kg	< 0.31 U	< 0.51 U	< 0.071 U	< 0.11 U	< 0.033 U	< 0.074 U	< 0.089 U
Ethylbenzene	mg/kg	0.061 J	0.11 J	< 0.14 U	0.023 J	0.012 J	< 0.15 U	0.042 J
m&p-Xylene	mg/kg	< 1.2 U	< 2.0 U	< 0.29 U	< 0.42 U	0.019 J	< 0.30 U	0.089 J
Methyl-Tert-Butyl Ether	mg/kg	< 0.62 U	< 1.0 U	< 0.14 U	< 0.21 U	< 0.067 U	< 0.15 U	< 0.18 U
Naphthalene	mg/kg	< 7.4 U	0.44 J	< 1.7 U	1.8 J	< 0.80 U	< 1.8 U	< 2.1 U
o-Xylene	mg/kg	< 0.62 U	< 1.0 U	< 0.14 U	< 0.21 U	0.0097 J	< 0.15 U	0.049 J
Toluene	mg/kg	0.049 J	0.38 J	< 0.14 U	< 0.21 U	0.015 J	3.1	< 0.18 U
Total Purgeable Hydrocarbons	mg/kg	3.7 J	9.3 J	1.7 J	10.5 J	< 13.4 U	6.0 J	< 35.5 U
Xylenes, Total	mg/kg	< 1.9 U	< 3.0 U	< 0.43 U	< 0.63 U	< 0.20 U	< 0.44 U	< 0.53 U

Table 9
PWS River Settling Basin Sediment Analytical Results

Public Surface Water Supply Data Summary Report
Silvertip Pipeline Incident
Laurel, Montana

Notes:

1. Sediment from sedimentation units is not compared to BTAG screening levels because the treatment process units are not intended to provide habitat for organisms that form the basis for BTAG screening levels.
2. Adjusted C05-C08 Aliphatic Hydrocabons is defined and reported as the Unadjusted C5-C8 minus MTBE, Benzene and Toluene results.
3. C05-C08 Aliphatic Hydrocarbons are defined as all aliphatic hydrocarbon compounds which are between five and eight carbon atoms.
4. Adjusted C09-C12 Aliphatic Hydrocarbons are defined and reported as the Unadjusted C9-C12 minues Ethyl Benzene, Total xylenes and Aromatic C9-C10 values.
5. C09-C12 Aliphatic Hydrocarbons are defined as all aliphatic hydrocarbon compound which contain between nine and twelve carbon atoms.
6. C09-C10 Aromatic Hydrocarbons are defined as all aromatic hydrocarbons which contain between nine and ten carbon atoms.

Results that exceed the USEPA Region 3 BTAG Freshwater Sediment Screening Benchmarks are shaded.
- = Not Applicable or Available
< = less than
µg/kg = micrograms per kilgram
mg/kg = milligrams per kilogram
J = Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.
U = The compound was analyzed for, but not detected.
USEPA = United States Environmental Protection Agency

USEPA Freshwater Sediment Screening Benchmarks

1	Value derived from the EqP method with Region III BTAG freshwater values (2004[a]) and logKow values from Karickhoff and Long (1995[b]). Only logKow values between 2 and 6 were used, as suggested by the EPA
3	Apparent Effects Threshold (AET) marine value from Washington State Sediment
4	Lowest Effect Level (LEL).
6	EPA has published Equilibrium Partitioning Sediment Benchmarks (ESB) for metal mixtures including this metal. Implementation of the ESB requires metal concentration data based on the simultaneously extracted metals procedure (SEM) and measurement of the acid volatile sulfide (AVS) concentration during the period from November to May. Application of ESB benefits significantly from the quantification of the organic carbon. BTAG recommends that these metals be screened against listed benchmarks in the screening level ecological risk assessment. Any exceedances should be further evaluated using ESBs following the sampling and analysis guidance in EPA-600-R-02-011 in Step 3 of the baseline ecological risk assessment.
9	ARCs TEL (Assessment and Remediation of Contaminated Sediments Program Threshold Effects Level - 28d test using Hyallela azteca from U.S. EPA (1996[h]).
a	Region III BTAG Freshwater Screening Benchmarks. 2004. http://www.epa.gov/reg3hwmd/risk/eco/btag/sbv/fw/screenbench.htm
b	Karickhoff, S.W. and J.M. Long. Environmental Research Laboratory. U.S. EPA.1995. Internal Report on Summary of Measured, Calculated and Recommended Log K_{ow} Values.
B	Bioaccumulative
c	CCME (Canadian Council of Ministers of the Environment). 2003. Canadian Environmental Quality Guidelines: Summary Table December 2003. Canadian Council of Ministers of the Environment, Winnipeg, Manitoba. Available at http://www.ccme.ca/publications/ceqg_rcqe.html
f	Jones, D.S., G.W. Suter II and R.N. Hull. 1997. Toxicological benchmarks for screening contaminants of potential concern for effects on sediment-associated biota: 1997 Revision. ES/ER/TM-95/R4. Oak Ridge National Laboratory, Oak Ridge, TN. Available at: http://www.esd.ornl.gov/programs/ecorisk/documents/tm95r4.pdf

g Persaud, D., R. Jaagumagi and A. Hayton. 1993. Guidelines for the protection and management of aquatic sediment quality in Ontario. Ontario Ministry of the Environment. Queen's Printer of Ontario.

h MacDonald, D.D., C.G. Ingersoll, and T.A. Berger. 2000. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. Arch. Environ. Contam. Toxicol. 39: 20-31.

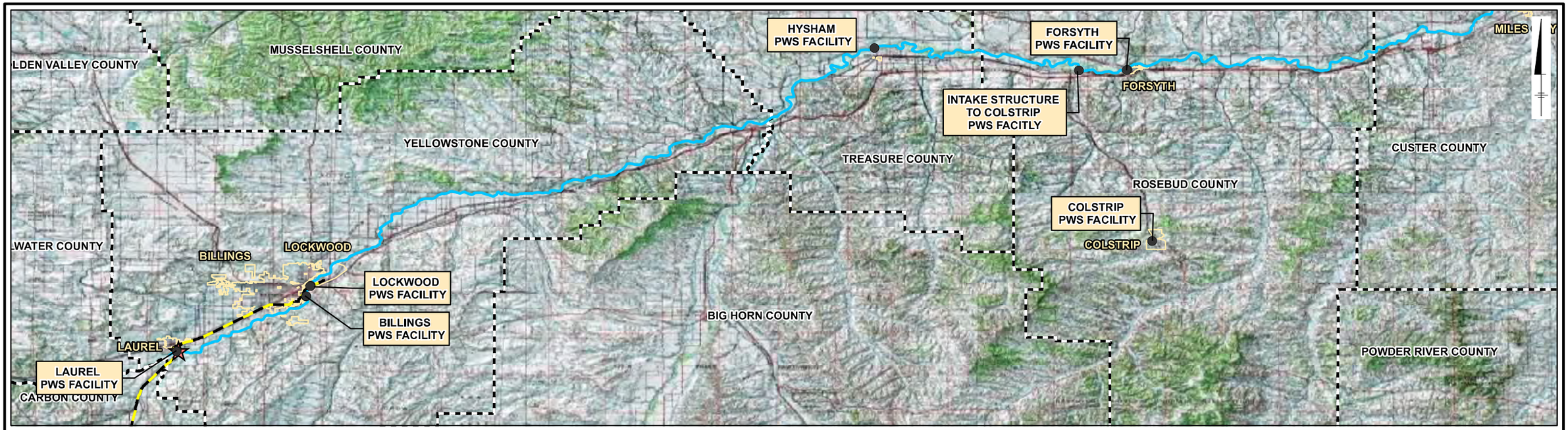
i Long, E.R. and L.G. Morgan. 1990. The potential for biological effects of sediment-sorbed contaminants tested in the national status and trends program. NOAA Technical Memorandum NOS OMA 52.

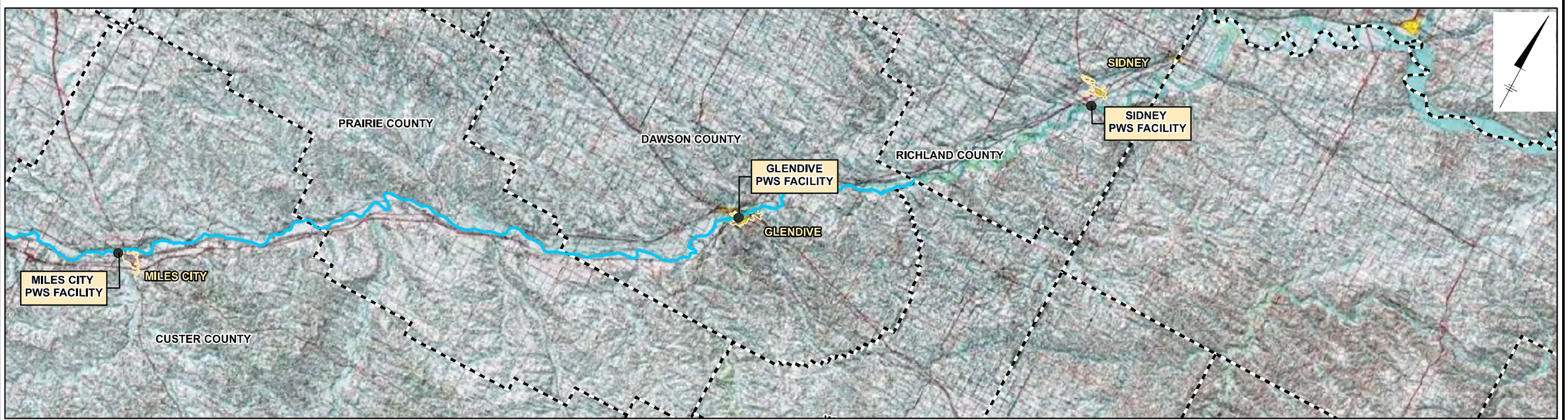
j Ingersoll, C.G., P.S. Haverland, E.L. Brunson, T.J. Canfield, F.J. Dwyer, C.E. Henke, N.E. Kemble, D.R. Mount, and R.G. Fox. 1996. Calculation and evaluation of sediment effect concentrations for the amphipod Hyallela azteca and the midge Chironomus riparius. International Association of Great Lakes Research. 22:602-623

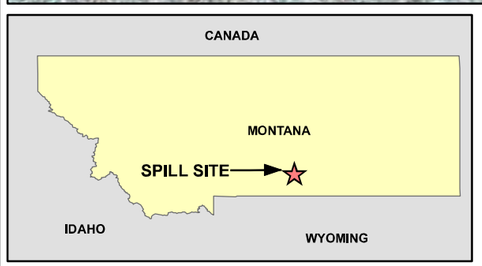
k MacDonald, D.D., C.G. Ingersoll, D.E. Smrong, R.A. Lindskoog, G. Sloane, T. Biernacki. 2003. Development and evaluation of numerical sediment quality assessment guidelines for Florida inland waters. Florida Department of Environmental Protection. Available at: http://www.dep.state.fl.us/water/monitoring/docs/seds/SQAGs_for_Florida_Inland_Waters_01_03.PDF

m Lemley, A.D. 2002. Selenium assessment in aquatic ecosystems. US Forest Service, Blacksburg, VA.

n Buchman, M.F. 1999. NOAA Screening Quick Reference Tables, NOAA HAZMAT Report 99-1, Seattle, WA, Coastal Protection and Restoration Division, National Oceanic Atmospheric Administration. Available at: http://response.restoration.noaa.gov/book_shelf/122_squirt_cards.pdf







LEGEND:

- SPILL SITE
- PUBLIC WATER SUPPLY SAMPLE LOCATION
- PIPELINE
- YELLOWSTONE RIVER CENTERLINE (APPROXIMATE)
- CITY BOUNDARY
- COUNTY BOUNDARY

0 15 30 Miles

GRAPHIC SCALE

NOTES:

1. BASEMAPPING TOPOGRAPHIC MAP PROVIDED BY ESRI ARCGIS ONLINE MAP SERVICE.
2. YELLOWSTONE RIVER CENTERLINE APPROXIMATED FROM 2009 AERIAL IMAGERY.
3. DATA RESULTS DISPLAYED HAVE NOT BEEN VALIDATED.

SILVERTIP PIPELINE INCIDENT
LAUREL, MONTANA

PUBLIC SURFACE WATER SUPPLY DATA SUMMARY REPORT

SILVERTIP PIPELINE INCIDENT STUDY AREA

ARCADIS

FIGURE
1

City: SYR Div/Group: 90 Created By: mkohberger Last Saved By: gmckinney
Exxon-Mobil (B0085883.1103.00001)
H:\GIS\PROJECTS_ENV\Laurel\MT\PublicWaterSupplyIntakeSedBasinSampPlan\mxd\StudyArea_rev5.mxd 11/18/2011 12:32:22 PM (Page of)

LEGEND:

- SPILL SITE
- PUBLIC WATER SUPPLY SAMPLE LOCATION
- PIPELINE
- PUBLIC WATER SUPPLY FACILITY

0 200 400 Feet

GRAPHIC SCALE

NOTE:

1. AERIALS: IMAGERY FOR DIVISIONS A THROUGH C WAS ACQUIRED JULY 20 - 21, 2011. 4-BAND DIGITAL AERIAL PHOTOGRAPHY, 1-FOOT PIXEL RESOLUTION. IMAGERY FOR DIVISIONS D THROUGH H OBTAINED FROM BING MAPS AERIAL, SERVICED BY ESRI ARCGIS ONLINE.

SILVERTIP PIPELINE INCIDENT
LAUREL, MONTANA

PUBLIC SURFACE WATER SUPPLY DATA SUMMARY REPORT

LAUREL PUBLIC WATER SUPPLY FACILITY SAMPLING LOCATIONS LAUREL, MONTANA

ARCADIS

FIGURE
2

City: SYR Div/Group: 90 Created By: mkohberger Last Saved By: gmckinney
Exxon-Mobil (B0085883.1103.00001)
H:\GISPROJECTS_ENV\Laurel\MT\PublicWaterSupplyIntakeSedBasinSampPlan\mxd\PublicWaterIntake_SamplePlan_LAUREL_v2.mxd 11/17/2011 9:39:43 AM (Page of)

LEGEND:

- PUBLIC WATER SUPPLY SAMPLE LOCATION
- PUBLIC WATER SUPPLY FACILITY

0 300 600 Feet

GRAPHIC SCALE

NOTE:

1. AERIALS: IMAGERY FOR DIVISIONS A THROUGH C WAS ACQUIRED JULY 20 - 21, 2011. 4-BAND DIGITAL AERIAL PHOTOGRAPHY, 1-FOOT PIXEL RESOLUTION. IMAGERY FOR DIVISIONS D THROUGH H OBTAINED FROM BING MAPS AERIAL, SERVICED BY ESRI ARCGIS ONLINE.

SILVERTIP PIPELINE INCIDENT
LAUREL, MONTANA

PUBLIC SURFACE WATER SUPPLY DATA SUMMARY REPORT

BILLINGS PUBLIC WATER SUPPLY FACILITY SAMPLING LOCATIONS BILLINGS, MONTANA

ARCADIS

FIGURE 3

City: SYR Div/Group: 90 Created By: mkohlberger Last Saved By: gmckinney
Exxon-Mobil (B0085883.1103.00001)
H:\GIS\PROJECTS_ENV\Laurel\MT\PublicWaterSupplyIntakeSedBasinSampPlan\mxd\PublicWaterIntake_SamplePlan_Billings_v2.mxd 11/17/2011 9:40:36 AM (Page of)

LEGEND:

- PUBLIC WATER SUPPLY SAMPLE LOCATION
- PUBLIC WATER SUPPLY FACILITY

0 200 400 Feet

GRAPHIC SCALE

NOTE:

1. AERIALS: IMAGERY FOR DIVISIONS A THROUGH C WAS ACQUIRED JULY 20 - 21, 2011. 4-BAND DIGITAL AERIAL PHOTOGRAPHY, 1-FOOT PIXEL RESOLUTION. IMAGERY FOR DIVISIONS D THROUGH H OBTAINED FROM BING MAPS AERIAL, SERVICED BY ESRI ARCGIS ONLINE.
2. SEDIMENT SAMPLE LOCATIONS WERE ESTABLISHED WHERE FINE GRAINED SEDIMENTS WERE IDENTIFIED THROUGH PROBING. AT LOCKWOOD, THIS REQUIRED MOVING UPSTREAM OF THE INTAKE STRUCTURE TO FIND FINE GRAINED SEDIMENT FOR SAMPLING

SILVERTIP PIPELINE INCIDENT
LAUREL, MONTANA

PUBLIC SURFACE WATER SUPPLY DATA SUMMARY REPORT

LOCKWOOD PUBLIC WATER SUPPLY FACILITY SAMPLING LOCATIONS LOCKWOOD, MONTANA

ARCADIS

FIGURE
4

City: SYR Div/Group: 90 Created By: mkohberger Last Saved By: gmckinney
Exxon-Mobil (B0085883.1103.00001)
H:\GISPROJECTS_ENV\Laurel\MT\PublicWaterSupplyIntakeSedBasinSampPlan\mxd\PublicWaterIntake_SamplePlan_Lockwood_v3.mxd 11/20/2011 2:18:08 PM (Page of)

LEGEND:

- PUBLIC WATER SUPPLY SAMPLE LOCATION
- PUBLIC WATER SUPPLY FACILITY

0 200 400 Feet

GRAPHIC SCALE

NOTES:

1. AERIALS: IMAGERY FOR DIVISIONS A THROUGH C WAS ACQUIRED JULY 20 - 21, 2011. 4-BAND DIGITAL AERIAL PHOTOGRAPHY, 1-FOOT PIXEL RESOLUTION. IMAGERY FOR DIVISIONS D THROUGH H OBTAINED FROM BING MAPS AERIAL, SERVICED BY ESRI ARCGIS ONLINE.
2. AERIAL PHOTO TAKEN DURING FLOOD EVENT AND WATER LEVEL IS ABOVE NORMAL.
3. SEDIMENT SAMPLE LOCATIONS WERE ESTABLISHED WHERE FINE GRAINED SEDIMENTS WERE IDENTIFIED THROUHG PROBING. AT HYSHAM, THIS REQUIRED MOVING UPSTREAM OF THE INTAKE STRUCTURE TO FIND FINE GRAINED SEDIMENT FOR SAMPLING.

SILVERTIP PIPELINE INCIDENT
LAUREL, MONTANA

PUBLIC SURFACE WATER SUPPLY DATA SUMMARY REPORT

HYSHAM PUBLIC WATER SUPPLY FACILITY SAMPLING LOCATIONS HYSHAM, MONTANA

ARCADIS

FIGURE
5

City: SYR Div/Group: 90 Created By: mkohberger Last Saved By: gmckinney
Exxon-Mobil (B0085883.1103.00001)
H:\GISPROJECTS_ENV\Laurel\MT\PublicWaterSupplyIntakeSedBasinSampPlan\mxd\PublicWaterIntake_SamplePlan_Hysham_v3.mxd 11/20/2011 2:08:45 PM (Page of)

LEGEND:

- PUBLIC WATER SUPPLY SAMPLE LOCATION
- PUBLIC WATER SUPPLY FACILITY

0 200 400 Feet
GRAPHIC SCALE

0 400 800 Feet
INSET GRAPHIC SCALE

NOTE:

1. AERIALS: IMAGERY FOR DIVISIONS A THROUGH C WAS ACQUIRED JULY 20 - 21, 2011. 4-BAND DIGITAL AERIAL PHOTOGRAPHY, 1-FOOT PIXEL RESOLUTION. IMAGERY FOR DIVISIONS D THROUGH H OBTAINED FROM BING MAPS AERIAL, SERVICED BY ESRI ARCGIS ONLINE.
2. INSET MAP: CASTLE ROCK LAKE IS LOCATED APPROXIMATELY 30 MILES SOUTH OF THE YELLOWSTONE RIVER.

SILVERTIP PIPELINE INCIDENT
LAUREL, MONTANA

PUBLIC SURFACE WATER SUPPLY DATA SUMMARY REPORT

COLSTRIP PUBLIC WATER SUPPLY FACILITY SAMPLING LOCATIONS COLSTRIP, MONTANA

ARCADIS

FIGURE
6

City: SYR Div/Group: 90 Created By: mkohberger Last Saved By: gmckinney
Exxon-Mobil (B0085883.1103.00001)
H:\GISPROJECTS_ENV\LaurelMT\PublicWaterSupplyIntakeSedBasinSampPlan\mxd\PublicWaterIntake_SamplePlan_Colstrip_v3.mxd 11/17/2011 9:51:06 AM (Page of)

LEGEND:

- PUBLIC WATER SUPPLY SAMPLE LOCATION
- PUBLIC WATER SUPPLY FACILITY

0 200 400 Feet

GRAPHIC SCALE

NOTE:

1. AERIALS: IMAGERY FOR DIVISIONS A THROUGH C WAS ACQUIRED JULY 20 - 21, 2011. 4-BAND DIGITAL AERIAL PHOTOGRAPHY, 1-FOOT PIXEL RESOLUTION. IMAGERY FOR DIVISIONS D THROUGH H OBTAINED FROM BING MAPS AERIAL, SERVICED BY ESRI ARCGIS ONLINE.
2. SEDIMENT SAMPLE LOCATIONS WERE ESTABLISHED WHERE FINE GRAINED SEDIMENTS WERE IDENTIFIED THROUGH PROBING. AT FORSYTH, THIS REQUIRED MOVING UPSTREAM OF THE INTAKE STRUCTURE TO FIND FINE GRAINED SEDIMENT FOR SAMPLING.

SILVERTIP PIPELINE INCIDENT
LAUREL, MONTANA

PUBLIC SURFACE WATER SUPPLY DATA SUMMARY REPORT

FORSYTH PUBLIC WATER SUPPLY FACILITY SAMPLING LOCATIONS FORSYTH, MONTANA

ARCADIS

FIGURE 7

City: SYR Div/Group: 90 Created By: mkohberger Last Saved By: gmckinney
Exxon-Mobil (B0085883.1103.00001)
H:\GISPROJECTS_ENV\Laurel\MT\PublicWaterSupplyIntakeSedBasinSampPlan\mxd\PublicWaterIntake_SamplePlan_Forsyth_v3.mxd 11/20/2011 2:33:34 PM (Page of)

LEGEND:

- PUBLIC WATER SUPPLY SAMPLE LOCATION
- PUBLIC WATER SUPPLY FACILITY

0 200 400 Feet

GRAPHIC SCALE

NOTE:

1. AERIALS: IMAGERY FOR DIVISIONS A THROUGH C WAS ACQUIRED JULY 20 - 21, 2011. 4-BAND DIGITAL AERIAL PHOTOGRAPHY, 1-FOOT PIXEL RESOLUTION. IMAGERY FOR DIVISIONS D THROUGH H OBTAINED FROM BING MAPS AERIAL, SERVICED BY ESRI ARCGIS ONLINE.
2. SEDIMENT SAMPLE LOCATIONS WERE ESTABLISHED WHERE FINE GRAINED SEDIMENTS WERE IDENTIFIED THROUGH PROBING. AT MILES CITY, THIS REQUIRED MOVING UPSTREAM OF THE INTAKE STRUCTURE TO FIND FINE GRAINED SEDIMENT FOR SAMPLING.

SILVERTIP PIPELINE INCIDENT
LAUREL, MONTANA

PUBLIC SURFACE WATER SUPPLY DATA SUMMARY REPORT

MILES CITY PUBLIC WATER SUPPLY FACILITY SAMPLING LOCATIONS MILES CITY, MONTANA

ARCADIS

FIGURE
8

City: SYR Div/Group: 90 Created By: mkohberger Last Saved By: gmckinney
Exxon-Mobil (B0085883.1103.00001)
H:\GISPROJECTS_ENV\LaurelMT\PublicWaterSupplyIntakeSedBasinSampPlan\mxd\PublicWaterIntake_SamplePlan_MilesCity_v3.mxd 11/20/2011 2:43:31 PM (Page of)

LEGEND:

- PUBLIC WATER SUPPLY SAMPLE LOCATION
- PUBLIC WATER SUPPLY FACILITY

0 300 600 Feet

GRAPHIC SCALE

NOTE:

1. AERIALS: IMAGERY FOR DIVISIONS A THROUGH C WAS ACQUIRED JULY 20 - 21, 2011. 4-BAND DIGITAL AERIAL PHOTOGRAPHY, 1-FOOT PIXEL RESOLUTION. IMAGERY FOR DIVISIONS D THROUGH H OBTAINED FROM BING MAPS AERIAL, SERVICED BY ESRI ARCGIS ONLINE.
2. SEDIMENT SAMPLE LOCATIONS WERE ESTABLISHED WHERE FINE GRAINED SEDIMENTS WERE IDENTIFIED THROUGH PROBING. AT GLENDIVE, THIS REQUIRED MOVING UPSTREAM OF THE INTAKE STRUCTURE TO FIND FINE GRAINED SEDIMENT FOR SAMPLING.

SILVERTIP PIPELINE INCIDENT
LAUREL, MONTANA

PUBLIC SURFACE WATER SUPPLY DATA SUMMARY REPORT

GLENDIVE PUBLIC WATER SUPPLY FACILITY SAMPLING LOCATIONS GLENDIVE, MONTANA

ARCADIS

FIGURE
9

City: SYR Div/Group: 90 Created By: mkohberger Last Saved By: gmckinney
Exxon-Mobil (B0085883.1103.00001)
H:\GISPROJECTS_ENV\Laurel\MT\PublicWaterSupplyIntakeSedBasinSampPlan\mxd\PublicWaterIntake_SamplePlan_Glendive_v2.mxd 11/20/2011 2:54:15 PM (Page of)

LEGEND:

- PUBLIC WATER SUPPLY SAMPLE LOCATION
- PUBLIC WATER SUPPLY FACILITY

0 200 400 Feet

GRAPHIC SCALE

NOTE:

1. AERIALS: IMAGERY FOR DIVISIONS A THROUGH C WAS ACQUIRED JULY 20 - 21, 2011. 4-BAND DIGITAL AERIAL PHOTOGRAPHY, 1-FOOT PIXEL RESOLUTION. IMAGERY FOR DIVISIONS D THROUGH H OBTAINED FROM BING MAPS AERIAL, SERVICED BY ESRI ARCGIS ONLINE.
2. SEDIMENT SAMPLE LOCATIONS WERE ESTABLISHED WHERE FINE GRAINED SEDIMENTS WERE IDENTIFIED THROUGH PROBING. AT MONTANA DAKOTA UTILITIES NEAR SIDNEY, THIS REQUIRED MOVING UPSTREAM OF THE INTAKE STRUCTURE TO FIND FINE GRAINED SEDIMENT FOR SAMPLING.

SILVERTIP PIPELINE INCIDENT
LAUREL, MONTANA

PUBLIC SURFACE WATER SUPPLY DATA SUMMARY REPORT

MONTANA DAKOTA UTILITIES PUBLIC WATER SUPPLY FACILITY SAMPLING LOCATIONS NEAR SIDNEY, MONTANA

ARCADIS

FIGURE **10**

City: SYR Div/Group: 90 Created By: mkohlberger Last Saved By: gmckinney
Exxon-Mobil (B0085883.1103.00001)
H:\GIS\PROJECTS_ENV\Laurel\MT\PublicWaterSupplyIntakeSedBasinSampPlan\mxd\PublicWaterIntake_SamplePlan_Sydney_v4.mxd 11/20/2011 3:05:30 PM (Page of)

Imagine the result

ExxonMobil Pipeline Company

Public Surface Water Supply Data Summary Report

Silvertip Pipeline Incident Response
Laurel, Montana

December 2011

Appendix A

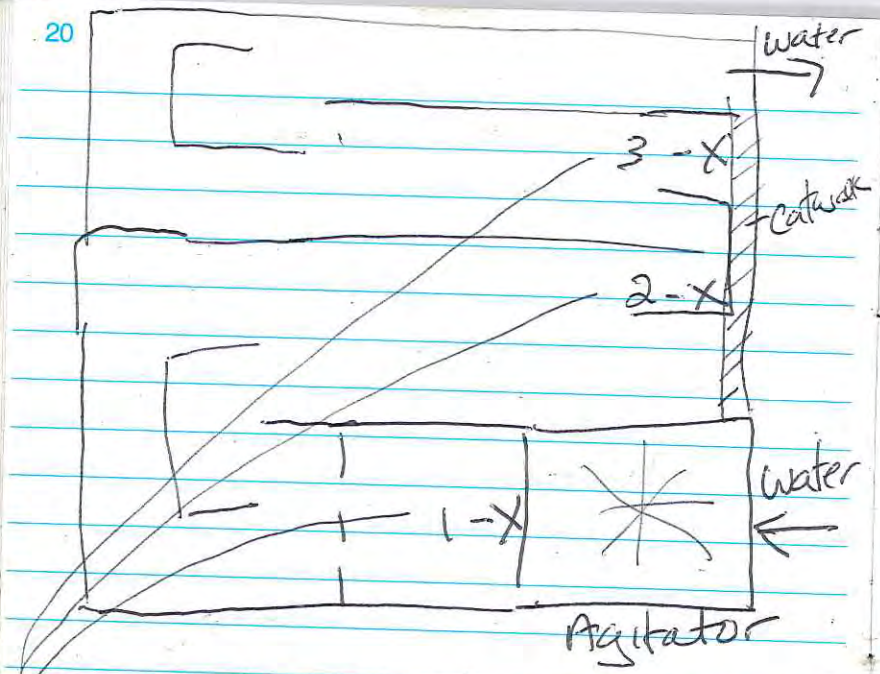
Public Surface Water Supply
Field Notes

Personell: Sam Magee, Rory Kilkenny, Kirk Schweim (ARCADIS)
Weather: 50's, cloudy, some rain
Objective: sample settling basins at Lockwood, Billings, and Laurel Facilities. Talk to operators to determine settling process/rate.
700. Meet at IC. Meet w/ N Pagano load truck
730 Depart IC for Lockwood
7:45 Arrive at Lockwood. Call George Schneider
800 Meet w/ George Schneider. Tour Pre-sedimentation Basin. Water comes in through intake into an agitator, mixed with a polymer. George will provide MSDS. Water flows through winding concrete structure as sediment settles out. Basin is cleaned out once a year. It was last cleaned this time last year. When cleaned, sediment removed and sits in a pond. When pond is full, testing is completed to see if any hazardous substances

Testing has never come back positive. Sediment then sometimes goes to a landfill and sometimes sold to a private owner for use as fill. Owner name was not known. Landfill was not known. George did not know exact sedimentation rate, but believed ~~2000~~ 20 SCM 9/14 cubic yards a year was an appropriate estimate. George noted plant had been shut off at time of spill. Did not start up until ~8 am the following morning. Pre-sed. Basin is 25 ft deep
SCM 9-14-11

845 Bring equipment inside, set up. Scope where to sample. Confirm with N. Pagano to sample multiple locations and composite sample.
850 Attempt to use Trimble to collect coordinates. Can not locate satellites indoors. Enter sample into iphone
SCM 9-14-11

900 Deploy ponar in first location. Ponar is full, 7 inches of sediment. Sediment very saturated. At location, ~4 ft standing water on top of sed.



composite collected. Can stand above agitator

915 ~~Composite~~ sample collected at second location. Standing water is ~~18 ft~~ 14 ft above sediment. There is 4 ft between top of water and grated catwalk (standing area). sim 9/14 sim 9/14

920 deploy poncar at 3rd location. 18 ft of standing water. 4 ft from catwalk to top of water. George Schneider comes back to check in. Shows the electric water depth reader on

wall. Current water depth is 19.4 ft from top of water to bottom of basin.

925 Begin collecting sample. Sample ID LOMT@9141155E301. Sample time 900. Silty sand, soft, wet, medium brown, trace organics, can smell organics

PID = ~~17 ppm~~ sim 9/14 1.7 ppm

950 Talk with George about MSDS obtain # and company. Brenntag West Inc, Ferric Chloride MSDS# 6069 Phone # (562) 903 9626

1000 Depart site

1020 Arrive at Billings. Check in with Mike Rubach. Discuss layout of facility. Large settling basin next to river. Open pond. Polymer added and mixed before water enters ~~pond~~ basin. There is a secondary settling ~~pond~~ basin to the southeast. Basins are cleaned/dredged out once a year. Takes approximately 4 months to dredge. They have

been dredging for ~1.5 months. When sediment is removed from drying pond testing occurs. Sometimes higher than drinking levels of ~~problems with~~ arsenic. Sediment is brought to Coulson Park and used for capping. About 900 trucks per year remove sediment. About 9000 yards. Settling rate depends on flow. Different throughout year. 5 NTU in winter, 2000 NTU in spring. Can't give an average sedimentation rate. Testing of sediment never had high concentrations needing treatment.

1045 drive to settling basin with Mike.
Dredge crew operating on pond. Pond is approx 660 ft x 210 ft. It is approx 20 ft from river. Utility's location on west side of pond. Secondary settling basin on east side of pond. Open area. Gates surrounding facility.

1100 Collect sediment from dredge.
Mike had crew deposit dredge material in stainless steel bowls and brought to shore. Let sediment settle. removed water from top by pouring and using turkey baster. 2 bowls of sediment - bowls had about 2/3 water.

1140 Collect GPS coordinates from top of ~~HA~~ RK concrete structure. Approximately 10 feet from dredge location. ARCADIS did not go on dredge.
45°46' 26.31" N RE 108° 28' 40.578" W
ELEVATION: 930.35 m

1145 Sheen can be seen on top of water from Barge. Mike confirmed this is hydraulic oil from dredge.

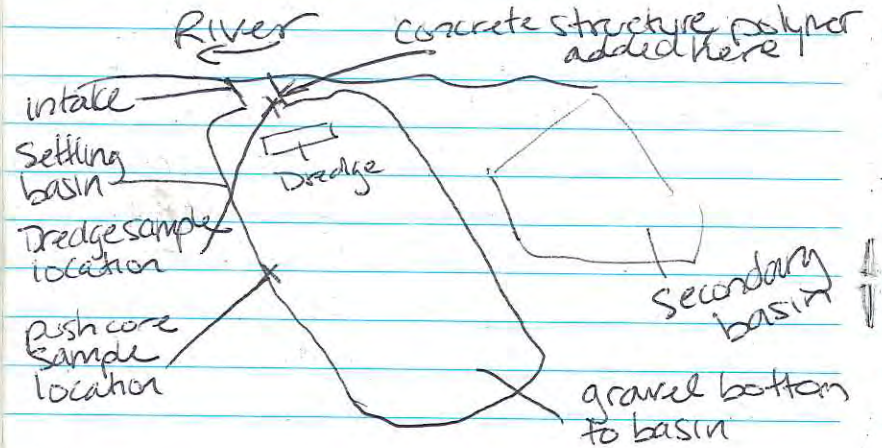
1147 Begin collecting sample
sample ID BINT09141 1SE302
sample time 1100
Silty sand, trace organics, wet very loose to soft, medium brown.
PID = 0.0 ppm

1200 Drive truck to west side of pond, half way down. There is a 25° slope to pond. Walked down slope. Muddy at bottom. Water color is green. Take push core sample. 2 grabs to get composite sample
Sandy silt, trace organics, very soft, wet, medium brown

1225 Collect sample

9/14/11

1225 Sample ID BIMT091411SE3Ø3
Sample time: 1200
GPS coordinates
45°46'24.546"N 7 satellites
108°28'42.721"W
927.58 m



PID = 0.4 ppm
1245 leave site for front building to get MSDS from Mike and sign out.
1250 get MSDS. sign out of plant. meet Sean McGrane to give him YSI and turbidity meter (ARCADIS)
1255 leave Billings, head to Laurel.

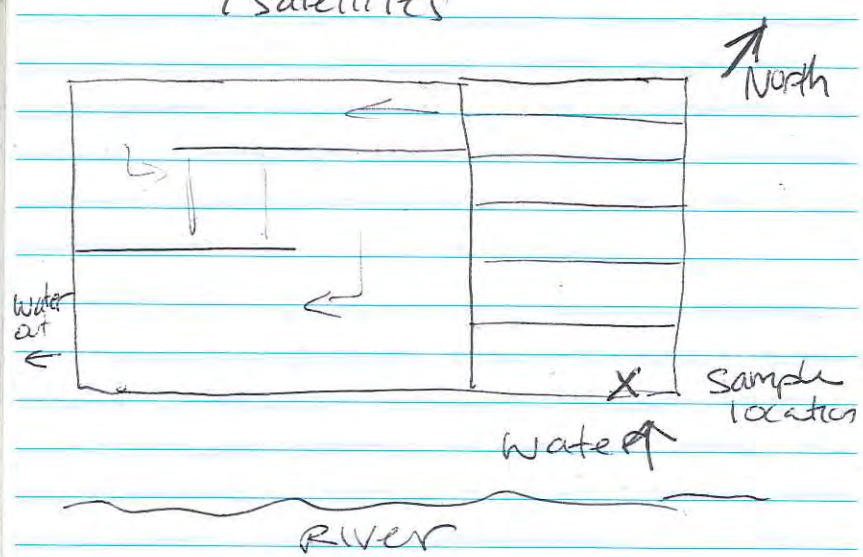
1320 Arrive in Laurel. Call Nathan and leave message. Go into plant, speak w/ Derek Tomak, get tour of settling basins. They are cleaned every 2 weeks. last cleaned on Friday 9/9/11. May be some sediment. Will try to collect. Confirmed ok to use Ponar. Derek did not know sedimentation rate. When ~~po~~ sum 9/14 basins are cleaned, sediment put in drying ponds. Sediment placed in piles onsite. Not brought to landfills. Sometimes used for fill around town. Derek did not know any more details, including if sediment is sampled. Will have to call Nathan. Polymer is added. Will get MSDS from Derek. Settling basins are outside, not covered. Concrete bottom and sides. Some sides are sloped, some are vertical. River is on south side of water treatment facility.

1340 ~~Dede~~ sum 9/14 Derek asks us to wait to start sampling until Nathan returns. Prepare labels, take pictures, and GPS.

1315 Nathan arrives. Does not think any sediment is present, but says it is okay to try. Wants to know contact at DEQ

1350 Deploy ponar, collect some sediment. Multiple grabs necessary

GPS 45°39'19.800"N
108°45'34.073"W
990.72 m
7 satellites



1400 Water depth is 5'2". 7ft from bottom of basin to top of concrete. Begin collecting sample. Sandy silt, trace organics, very soft, wet, medium brown.

Sample ID LAMTØ91411SE3Ø4
Sample time 1400
PID = 0.3 ppm

★ PID calibration was done at 845. PID # 08858
Calibration gas isobutylene air
lot # 0207FD11
Part # ~~GP1102~~ sum 9/14 GP11012
Calibrated to 101 ppm
fresh air cal 0.0 ppm

1430 finish sampling, load truck, depart site. Break for lunch

1515 Arrive at storage unit

1545 Collect Rinsate Blank on deconed spoons and bowls
Sample ID LAMTØ91411SE3Ø5
time 1530

1630 Load truck with equipment for tomorrows sampling

 9/14/11

1710 Leave storage unit.
1730 Get life jackets from Duck Creek
1820 Arrive at IC

SUM 9/14/11

9/15/11

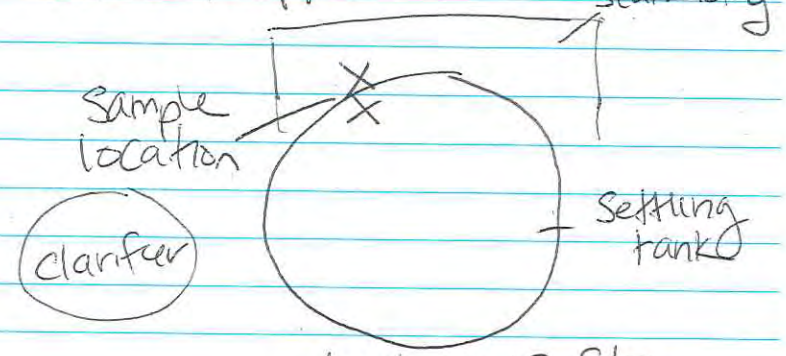
600 Met at Residence Inn. Rory Kilken
Kirk Schweim, Sam Magee (ARCA)
Safety meeting. Discuss driving
hazards. Vehicle inspection. Tires
low in air.
615 Stop to purchase tire gauge, put
air in tires. Weather is clear
temp. in 50's
845 Stop in Miles City for gas
1115 Arrive at MDU plant. Meet w/
Chad Miller, Kentucky Sloo (MDU)
Discuss processes of water at
plant. See settling tank
1145 Measure water depth of tank
11ft ~~10ft~~ until hit sediment.
Deploy ponar. 2 grabs to get
enough for sample. Fill ponar
1200 Bring sample to parking lot to
package. Calibrate PID
PID # 088558
Cal Gas Isobutylene
lot # 0207FDH
Part # 6P11012
fresh air cal 0.0 ppm
calibrated to 100 ppm

1710 Leave storage unit.
1730 Get life jackets from Duck Creek
1820 Arrive at IC

SUM 9/14/11

600 Met at Residence Inn. Rory Kilkenn
Kirk Schweim, Sam Magee (ARCADIS)
Safety meeting. Discuss driving
hazards. Vehicle inspection. Tires
low in air.
615 Stop to purchase tire gauge, put
air in tires. Weather is clear,
temp. in 50's
845 Stop in Miles City for gas
115 Arrive at MDU plant. Meet w/
Chad Miller, Kentucky Sloo (MDU)
Discuss processes of water at the
plant. See settling tank
1145 Measure water depth of tank
11Pm SUM ~~10ft~~ until hit sediment.
Deploy ponar. 2 grabs to get
enough for sample. Full ponar
1200 Bring sample to parking lot to
package. Calibrate PID
PID # 088558
Cal Gas Isobutylene
lot # 02007FD11
Part # 6P11012
fresh air cal 0.0 ppm
calibrated to 100ppm

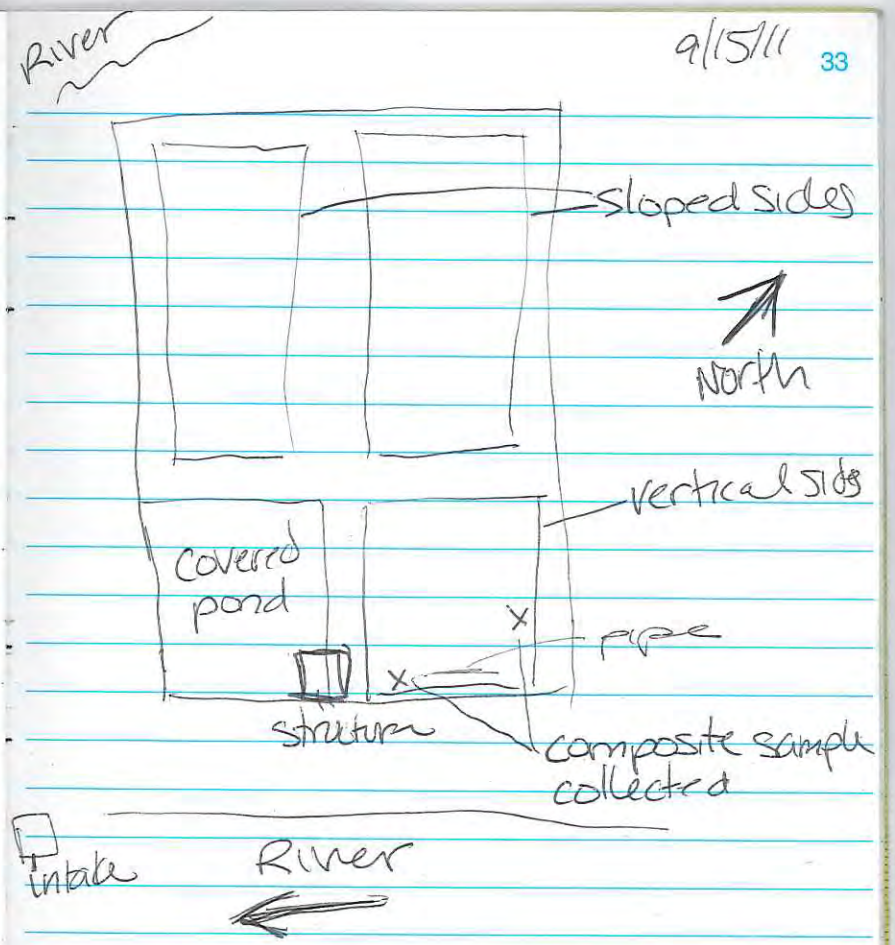
1205 Collect sample
Sample ID SIMT091511SE301
Sample time 1200
silt, trace sand, very soft, wet, grayish brown
collect GPS coordinates next to building. Could not get satellites in building
47°40'42.655" N
105°09'27.739" W
570.16m
PID = 1.2 ppm



tank is 13 ft
water depth is 11 ft
Chad says tank flushes every 60 gallons. Did not flush while sampling.
Flocculent and coagulent added

in this tank. Will get MSDS. water not used for drinking water. Only used for cooling. Sediment disposed onsite with waste ash. Chad requested results of analysis
1230 Pack up truck. Get MSDS from Chad. leave site.
~~1300~~ 1500 Arrive at Miles City Water treatment plant. Speak with Dave Harris. Obtain MSDS for chemicals added to pond. Dave showed us facility. 4 sediment ponds total. 2 smaller (~40x60 ft) and 2 larger. Larger ponds have sloped concrete sides. Can not safely obtain sample. One of smaller ponds is covered, can not sample. Small pond has vertical sides. Dave does not know how much sediment is removed every year. Sediment removed from pond deposited on site. facility does not test sediment.

1530 measure water depth. water depth = 5.5 ft to sediment
10 ft from top of sediment to top of concrete pond.
1535 Deploy ponar. Rory wearing life jacket.
1540 Log sample. SILT, trace fine Sand, wet, very soft, brown.
1550 Deploy ponar on south side of basin to get composite sample. 11 ft to top of wall. 5½ ft from top of sediment to top of water.
GPS first location
46°24'18.210"N
105°52'14.570"W
706.20 m
GPS Second location
46°24'17.741"N
105°52'14.973"W 7 satellites
705.93m
1555 Homogenize sample.
MCMT09151SE302
Sample time 1545
PID = 0.1 ppm



settling basins are located outside facility surrounded by fence. Grassy, open area. Basins are made of concrete. Pipe located parallel to side of basin according to Dave. Sample location selected in area clear of pipe. Pipe

distributes water from intake evenly throughout basin. Water runs through small pond to big pond. Two sets of ponds run in paralel Dave does not know sedimentation rate. Basins are cleaned once a year in the fall. Last cleaned fall of 2010. Pile of sediment can be seen from basins. This was cleaned out from basins. About 3 years of sediment, maybe 2 years, Dave did not know. Between approx 100-150 cubic yards. Dave mentioned water is sampled.

1615 Depart site

1700 Collect Rinsate Blank on decomed spoon and decomed ponar.
Sample ID MCMT09151SE3Ø3
Sample time 1700
Trip blank ID MCMT Ø9151 SE3 Ø4

1730 Finish Rinsate Blank, pack coolers and truck

1745 Arrive at hotel

700 Start day in Miles City safety meeting. Proper sampling form. Get ice and gas.

820 Arrive in Forsyth. Meet Patrick Zent. See wet well, in concrete building. Trap door in floor to wet well. Confined space. Not safe to enter, can not get sample. Was cleaned out 2 weeks prior due to clog. When cleaned out, brought to drying bed. Then to wastewater plant. Sits there for 2 years. Been there longer now, tested before goes to a landfill. There is no settling basin. Wet well takes place. Water then goes into building into settling basin. Metal grates and weirs throughout basin. Can not use ponar or core tube. Cleaned out 1X a year in October or November. Cleaned out with a fire hose. Remove grate to clean. Flocculent added

9/15/11 WEATHER: SUNNY
WINDY 50°F
PROJECT: SILVERTIP PIPELINE
PWS SAMPLING
PERSONAL: SEAN MCGRANE, LAUREN
PUTNAM, MISHAL AL-JOHAR
(ARCADIS) DANNY PARKS
YAEL GIRARD, DAN REES
BECKA WALLACE (WRI)
OBJECTIVE: COLLECT SURFACE WATER
+ SEDIMENT SAMPLES
FOR SYDNEY + MILE CITY
0900 ARRIVE AT BOAT LAUNCH
0910 CONDUCTED H+S MEETING
SEAN MCGRANE S. McG ARCADIS
DANIEL N REES WRI
YAEL GIRARD WRI
Rebecca Wallace Rebecca Wallace WRI
Danny Parks WRI
Mishal Al-Johar ARCADIS
LAUREN PUTNAM Lauren Putnam
0925 YSI CALIBRATION
SN# 09J100317

PARAMETER	INITIAL	VALUE SET BY	FINAL
PH7	~~6.92~~ 7.00 SM	7.00	7.00

PARAMETER	INITIAL	VALUE	FINAL
PH	4.57	4.00	3.98
CONDUCTIVITY	1453	1.413	1414
DO%	BARO 760.4mmHg 86.6%	100%	99.9
ORP	243.0	240	239.9

0930 PID CALIBRATION
SN# 110-005155
ISOBUTYLENE SPAN CAL 100ppm
LOT# 0426FK111
ZERO CAL 0.0ppm
SPAN CAL 98.6ppm
EMPTY ZIPLOCK BAG READING
AMBIENT 0.1ppm
READING 0.5ppm
0949 TURBITY CAL
SN#
1.0NTU INTIAL 0.82 FINAL 1.01
* 1030 10.0NTU INTIAL 9.91 FINAL 10.08
~~1000~~ arrive at intake, shoreline armored with large rocks adjacent to intake
Water Depth = 9.8'
1045 collect Surface water sample
SIMT0915SW0201
SIMT0915*SW0202 = Dup. @1200

GPS coordinates:
5 sat, 100, 24 47° 40' 40.698" N
104° 9' 22.888" W
elv. 560.09 m
PDOP = 5.73

1040 WATER QUALITY READINGS
TEMP 15.32°C
SPECIFIC COND 560 us/cm @ 0.455 ms/cm
DO% 81.5%
DO 8.15 mg/L
PH 7.47 ph
ORP 179.6 ORP
TURBIDITY 42.3 NTU
Probed - soft sediment at location with ~~surfe~~* surface water sample. multiple attempts to get ponar to close due to deep water depth, dent in ponar didn't allow seal
1115 COLLECTED SAMPLES
SIMT0915SE0201
SIMT0915SE0202 Dup @1200
SEDIMENT CLASSIFICATION
(0"-6") GREYISH BROWN, FINE SAND, SOME SILT, TRACE MEDIUM SAND, ~~LOOS~~ DENSE, WET
* calected with core

PID READING
AMBIENT 0.1ppm STABLE 0.0 ppm
HIGH 0.6ppm
COORDS
8 SATALITES 10cm
47°40'37.595"N
104° 9'26.678"W
559.93m PDOP 2.09
1200 DROVE BACK TO BOAT
LAUNCH AND STARTED
UNLOADING BOATS
1230 trip blank SIMT0915SE0203
1545 PINE RENTAL CONFERMATION
JSH 664 TOOK YSI, PID
AND PERI PUMP OFF
RENT
1650 ARRIVED AT MILES CITY
BOAT LAUNCH TO SHALLOW
TO LAUNCH BOATS SAFELY
DRIVING TO FT KEOGH BOAT
LAUNCH
1726 ARRIVED AT 2ND BOAT LAUNCH
1800 STOPPED TO REMOVE ROCKS
FROM JET MOTOR INTAKE
1816 ROCKS CLEAR + TRAVELING TO SITE

~~1800~~ JP
~~1820~~ JP
~~1420~~ arrive at location for Miles City PWS
1820 JP 9 sat 10 cm
46°24'22.712" N
105°52'13.066" W
700.98 m elev.
PDOP 1.66
Water Depth = 3.6'
1830 collect MCMT0915SW0201
WATER QUALITY
TEMP 18.10°C
CONDUCTIVITY 440µS/cm 0.383 mS/cm
DO 80.5% 7.67 mg/L
PH 8.57 ph
ORP 49.4
TURTUDITY 1.04 NTU
bottom very rocky near intake - moved upstream for sediment (shoreline covered with large concrete pieces).
1900 COLLECT SAMPLE ~~MAG~~ SM
~~SM~~ MCMT0915SE0201
(0"-6")
Grayish brown silt, non plastic, some fine sand, very soft, wet
* collected with core

6 satellites
22 cm error
46° 24' 20.666" N
105° 52' 15.134" W
697.15m
PDOP: 3.03
PID: ambient 0.0 ppm
sample 0.7 ppm
1930 back to cars
1945 rinse blank = MCMTØ915SEØ2Ø2
MCMTØ915SEØ2Ø3 = trip blank
MCMTØ915SEØ2Ø~~4~~5 = trip blank

DATE 9/16/11 WEATHER SUNNY 44°F
PROJECT SLIVERTIP PIPELINE
PWS SAMPLING
PERSONEL: SEAN MCGRANE, LAUREN PUTNAM, MISHAL AL-JOHAR (ARCADIS) DANNY PARKS, YAEL GIRARD, DAN RIES BECKA WALLACE (WRI)
OBJECTIVE: COLLECT SURFACE WATER SAMPLE + SEDIMENT SAMPLE FOR COLSTRIP + FORSYTH INTAKES
0645 LEFT HOTEL FOR FORSYTH
0740 ARRIVE AT BOAT LAUNCH ~~H-SMRT~~
0745 EQUIPMENT CALIBRATION
TURBIDITY METER
SN# ~~3144~~ SM 3144-1602

	INITIAL	FINAL
1.0 NTU	0.97	1.05
10.0 NTU	10.71	10.62

PID SN# 110-005155
ZERO CAL 0.0 ppm
SPAN CAL 101 ppm
YSI SN# 08J100317

PARAMETER	INITIAL VALUE	FINAL
PH7	6.14	7.0	6.99

PARAMETER	INITIAL	VALUE ~~FINAL~~	FINAL
PH4	7.13	4.0	4.04
COND	1,470	1,413	1,412
DO	107.4	100%	99.6
ORP	241.5	240	240.3

BARO 760.4 mm/Hg

0820 arrive at location for Forsyth PWS
shoreline rocky/armored with large boulders/concrete blocks
Depth of water = ~~3.4'~~ 2.3'
GPS:
10 satellites
10cm error
46° 15' 59.632" N
106° 41' 25.773" W
751.83 m
PDOP: 2.36

0840 SURFACE WATER SAMPLE
FOMT0916SW0201
WATER QUALITY
TEMP 14.55°C
COND 431 µS/cm 0.345 µS/cm
DO 79.9% 8.18 mg/L
PH 7.02 ORP 211.2
TURBIDITY 7.96 NTU

0915 collect FOMT0916SE02 sediment
Right bank exceptionally rocky well into channel and greater than 1,000' upstream - moved sediment sample location to left bank
SAMPLE COORDS
46° 15' 57.877" N
106° 41' 34.997" W
748.57 m PDOP 1.88
10cm 8 SATALITES
sample log:
0-6" greyish brown, fine sand, little silt, trace medium sand, loose, wet,
PID: AMBIENT 0.0 ppm
sample 0.0 ppm
collected with core

1030 arrive at intake for Colstrip PWS
sample location next to intake in channel.
NOTE channel being dredged
banks are armored with med rip rap, channel seems silty.

1045 collect COMT0916SW0201
WATER QUALITY
MEASUREMENTS

MEASUREMENTS
TEMP 15.56°C
COND 414 µs/cm 0.339 ms/cm
DO 82.0 % 8.11 mg/L
PH 9.42
ORP 9.1
TURBIDITY 19.9
SAMPLE COORDS
46° 15' 56.648" N
106° 47' 46.811" W
754.68 m PDOP 2.91
7 SATALITES 10 cm
SAMPLE ~~Dr~~ SM LOCATION
DEPTH 5.2 ft
11:05 collect COMT0916SE021
LOG: PID: ambient = 0.0 ppm ~~stable/peak~~ = 0.0 ppm
0-6" Dark grey, silt and clay, very soft, wet
GPS: MP
46° 15' 56.654" N
~~106° 47' 72.46.72~~ MP
106° 47' 46.727" W
PDOP: 2.63
10 cm error
6 satellites

H&S Signatures (from morning meeting)
LAUREN PUTNAM Lauren Putnam
Rebecca Wallace Rebecca Wallace WRI
YAEL GIRARD Yael Girard WRI
DANIEL RIES Daniel Ries WRI
SEAN McGRAWE Sean McGrawe ARCADIS
Danny Parks Danny Parks WRI
Mishal Al-Johar Mishal Al-Johar ARCADIS
12:30 back to boat launch
16:15 rinse blank COMT0916SE0202
trip blank COMT0916SE0203
trip blank COMT0916SE0204
17:30 drop off samples to lab
2nd team demobilize / set up for following day

distributes water from intake evenly throughout basin. Water runs through small pond to big pond. Two sets of ponds run in parallel. Dave does not know sedimentation rate. Basins are cleaned once a year in the fall. Last cleaned fall of 2010. Pile of sediment can be seen from basins. This was cleaned out from basins. About 3 years of sediment, maybe 2 years, Dave did not know. Between approx 100-150 cubic yards. Dave mentioned water is sampled.

1615 Depart site.

1700 Collect Rinsate Blank on decomed spoon and decomed ponar.
Sample ID MCMT09151SE3Ø3
Sample time 1700
Trip blank ID MCMT09151SE3Ø4

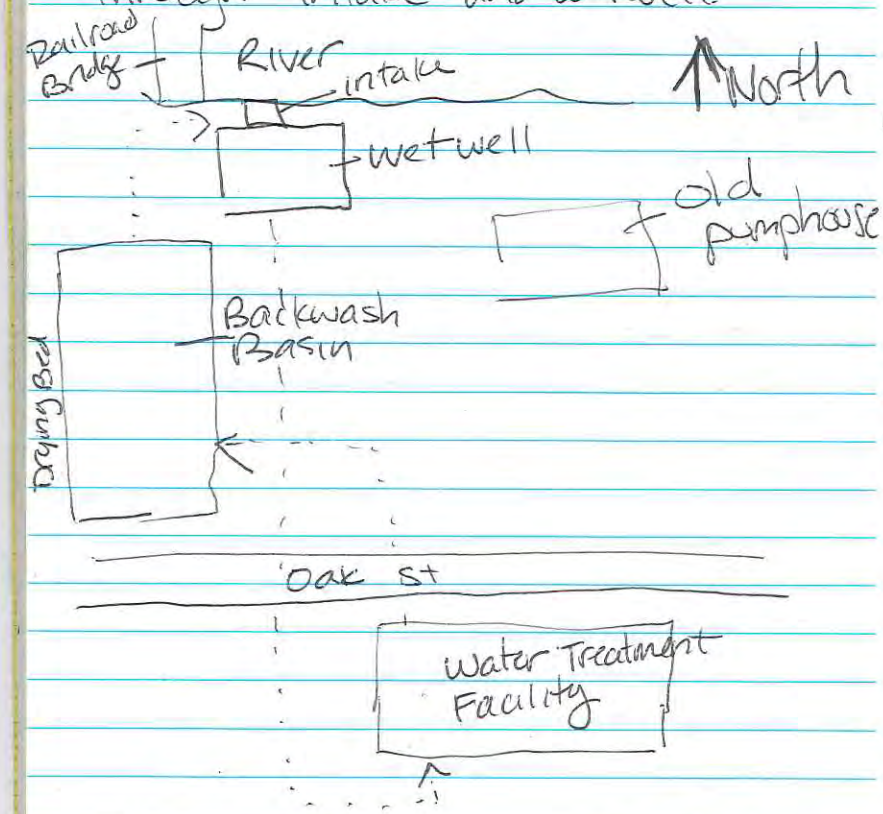
1730 Finish Rinsate Blank, pack coolers and truck

1745 Arrive at hotel

700 Start day in Miles City. Safety meeting. Proper sampling form. Get ice and gas.

820 Arrive in Forsyth. Meet Patrick Zent. See wet well, in concrete building. Trapdoor in floor to wet well. Confined space. Not safe to enter, can not get sample. Was cleaned out 2 weeks prior due to clog. When cleaned out, brought to drying bed. Then to wastewater plant. Sits there for 2 years. Been there longer now, tested before goes to a landfill. There is no settling basin. Wet well takes place. Water then goes into building into settling basin. Metal grates and weirs throughout basin. Can not use ponar or core tube. Cleaned out 1X a year in October or November. Cleaned out with a fire hose. Remove grate to clean. Flocculent added

here. Water then goes through filter. Then backwash goes to basin outside. Basin is open air. This is treated water. Not representative. Water from backwash goes back through intake and wetwell



Weather: 50°, sunny, clear skies
Personell: Sam Magee, Rory Kilkenny, Kirk Schweim (ARCADIS)

910 Speak with John Bleth from Colstrip (on phone) Discuss water treatment. There are no settling basins. water taken directly from lake through filter. There is no where in facility where sediment settles out and is cleaned out. John will meet us in Colstrip to show facility and give us access to lake.

920 Depart Forsyth for Colstrip

☆ Filter is made of gravel, sand, and anthracite.

100 Arrive in Colstrip. Meet John. John shows us the intake and where we can launch boat. Net around intake structure. We are not to go inside net. John points out discharge from Yellowstone. Go to water treatment plant. See 4 filter beds. No settling basins. Backwash basin with liner on river.

1030 Mike Holzworth from APL meets us on shore of lake. Says there are 2 discharge pipes from yellowstone. Pumps were shut off for a day after spill. Says lake is deepest at intake, about 40ft deep. Intake water from about 8 ft below water surface. Lake is manmade in 1976. R-prap on shore

1040 Call Nichole Pagano. Discuss that water intake is at 8ft below surface. Will sample at 8 ft below water surface.

1100 Setting up raft. Getting supplies ready

1115 Launch raft. Row to intake.

1117 Measure water depth. 30ft to bottom. Call Nichole to ask if we can sample water here and sediment where we can grab it. reach it. Nichole confirms this is ok to not co-locate.

1145 collect water sample from 8 ft below surface.
Sample ID COMT091611SW30D1
Sample time 1145 sam 9/15
GPS ~~45°53'38.12 911"N~~ sam 9/15
45°53'38.911"N
106°38'12.773"W
987.05m
fill 2 ambers, 4 VOAs, 1 poly
Bring samples to shore. Get Ponar

1205 row back out. Try and find location to sample

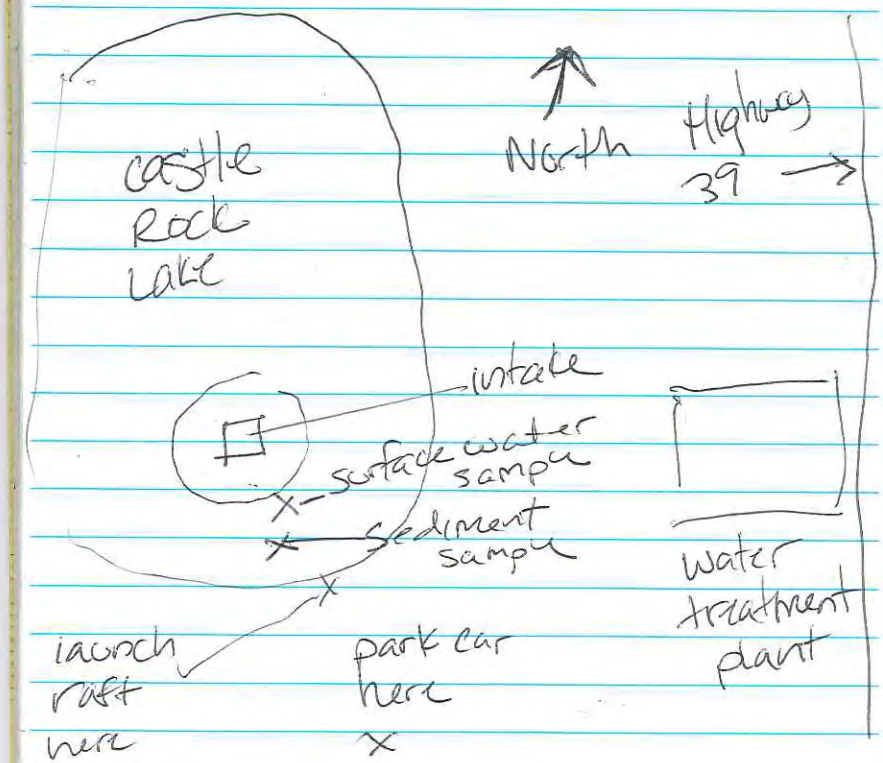
1215 measure water depth 10ft ☆ to top of sediment. Deploy Ponar. take GPS coordinates
45°53'38.215"N
106°38'12.306W
984.97m

1230 Paddle to shore, put sediment in containers
Sample ID COMT091611SE30D2
Sample time 1215
PID = 1.7ppm
Silt, trace fine sand trace gravel, wet soft, dark brown

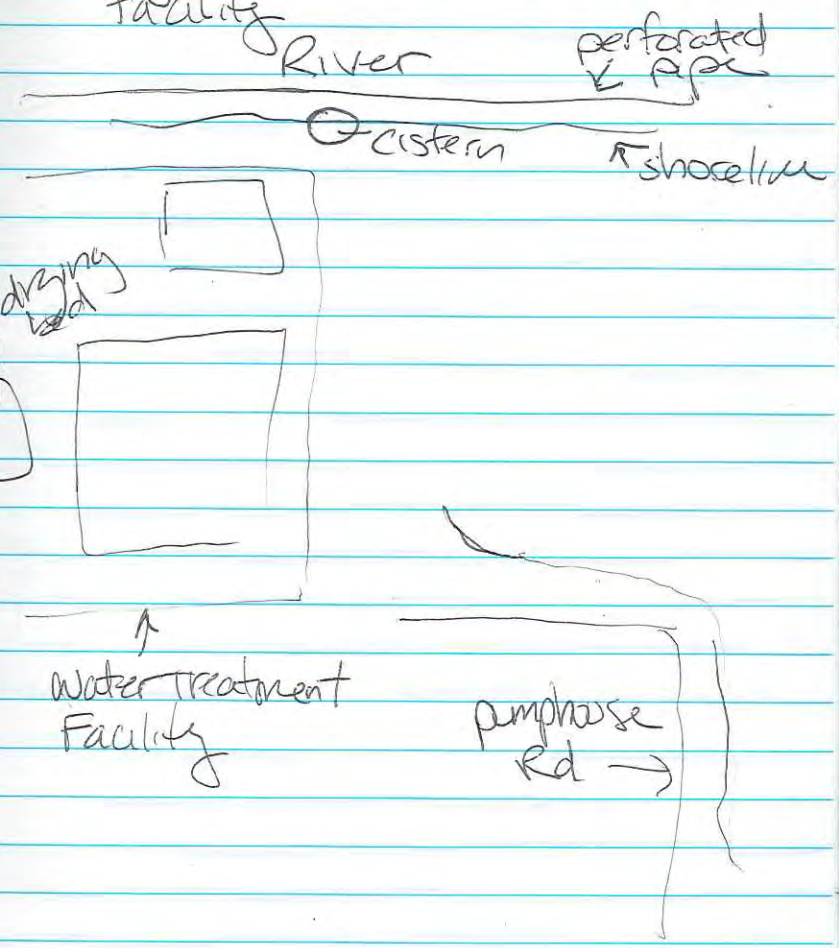
 9/16/11

* PID Calibration
PID # 08858
Cal gas isobutylene
lot # 02Ø7FD11
Part # EP 11012
fresh air cal 0.0 ppm
Calibrated to 99.8

1300 Pack up car, Depart site



1430 Arrive at Hysham water Treatment Facility. Call operator. Will come meet us. Facility is 2 aluminum structures surrounded by fence. Farmland south of facility



 9/16/11

1440 meet Lyle at facility. No settling basins. water is drawn from 14 ft below surface. water drawn into facility directly into clarifiers. Clarifiers are backwashed every three hours into drying bed. Drying beds are not cleaned. 1250 ft perforated pipe runs parallel to shore in river. It is buried in gravel pack. 18 ft below top of water. ~~WS~~ Lyle says water depth is about 14 ft

1450 walk shoreline. find sampling location just upstream of ~~system~~ surface system. Shallow water in small cove

1510 wade into water. Pump not working. Call Nichole. Nichole says take Grab sample.

1515 Grab sample taken
Sample ID HYMT091611SW304
Sample Time 1515

1545 Collect sediment sample using ponar. Could not get any sample with core.
Sample ID HYMT091611SE303
Sample time 1545
PID = 1.1 ppm
GPS coordinates
46°18'49.246"N
107°14'27.530"W
786.72m
surface water and sediment sample taken from same location.

1550 Silt, trace fine sand, trace coarse gravel, wet, very soft gray.

1605 Demob from site

1730 Arrive at storage unit for Rinsate Blank and demob truck
Rinsate ID HYMT091611SE05
Time 1800
Trip blank ID HYMT091611SE306

1900 Arrive at IC

700 Meet in Crown Lobby
Personell Mishal Al-Johor, Sean McGrane, Sam Mezger (ARCADIS
710 Arrive at Air strip. unload truck
INSTURMENT CALIBRATION
YSI SN# 08J100317

PARAMETER	INITIAL	VALUE	FINAL
PH7	7.13	7.0	7.0
PH4	3.68	4.0	4.10
COND	1.343	1.413	1.413
DO Baro 7.064 mm/Hg	97.0	100%	98.6
ORP	228.3	240	240.0

PID Calibration # 08858
Lot #0207FD11
Zero Cal 0.0 ppm
Span Cal (100 ppm) 100.0 ppm
Turbidity Calibration
Serial # Initial 3144 Final 1662

mA		
1.0	1.17	0.9
10.0	11.30	11.10

0822 CONDUCTED H+S MEETING
Mishal Al-Johor
Sam Mezger

SEAN MCGRANE - MCG - ARCADIS
YAEL GIRARD (SWR TECH).
DAN RIES (BOAT OPS).
Danny Parks (Boat ops) WRI
Rebecca Wallace (SWR Tech) WRI
weather: gray skies, 50's, rain.
830 Launch boats from airstrip
855 Arrive at Lockwood. Look for intake
900 Can find discharge point between railroad bridge and I-90 bridge on right side of river. Find dead deer by discharge. Call IN Pagano to report deer. Can not see intake pipe. May be underwater. Information from operator says intake is between 2 bridges. Found location to sample just upstream of railroad bridge on right side of river
0920 LOMT0917SW02D1
WATER QUALITY
TEMP 14.98°C
DO ~~COND~~ SM 67.28 9.SM 7.25 mg/L
COND ~~DO~~ SM 0.344 mS/cm 0.278 mS/cm

WATER QUALITY CONT.
PH 4.92
ORP 279.6
TURBIDITY 4.98
Depth to water 8 inches
MS/MSD sample collected
GPS:
5 satellites
45° 47' 43.826" N
108° 28' 10.370" W
928.77M
17 cm error
2.10 PDOP
10:10 sediment sample
ID: LOMT0917SE02D1
~~GPS:~~ MA
Soil Log:
0-2" greyish brown course sand, sub angular, sub rounded, some silt and fine sand, little fine to coarse pebbles angular to rounded, loose, wet
GPS: 45° 47' 44.033" N
108° 28' 10.426" W

GPS con'td:
927.90 m
PDOP 2.82
6 sattellites
22 cm error
1030 Talk to N Pagano. Can not get enough sample for MS/MSD Will only take 1 sample and take MS/MSD at next location
1100 PID = 1.8 ppm
ambient = 0.0 ppm
Nichole will stop by to bring more supplies
empty Ziplock bag PID = 0.7 ppm
1110 Talk to Nichole. Will head back to airstrip before going to Billings site
1200 Arrive at Airstrip Discussion with Shannon Dunn and Nichole Pagano regarding equipment and safety.
1245 Launch from airstrip
1310 Arrive at Billings intake. Tie up ~~North side of~~ upstream side of intake. Take water depth and feel for sediment. water depth is 8.5 ft

 9/17/11

Intake is metal structure/channel on left side of the river. Structure extends approx 8 feet above water line. Weather is sunny and mostly clear with some clouds

1320 Take GPS coordinates for SW
45°46'27.523"N
108° 28'39.995"W
934.82m
5 satellites 50cm

take water sample
Sample ID BMT091711SW0201
Sample time 1320
WATER QUALITY
TEMP 15.52°C
COND 0.327 mS/cm 0.268 mS/cm
DO 89.28 8.81 mg/L
PH 8.75
ORP 18.5
TURBIDITY 11.3 NTU

SLM 9/17/11

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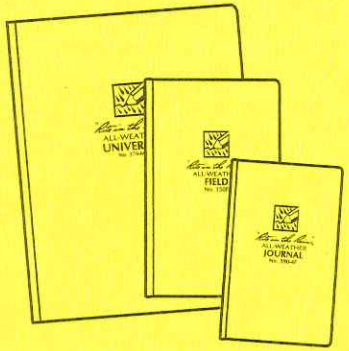
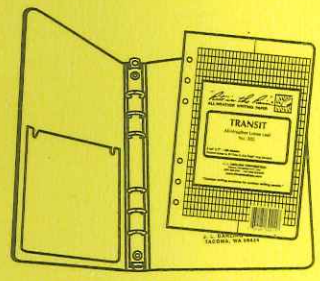
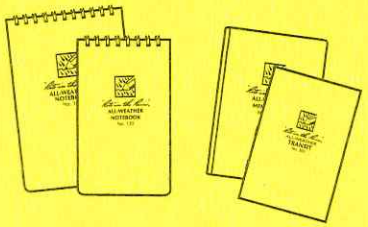
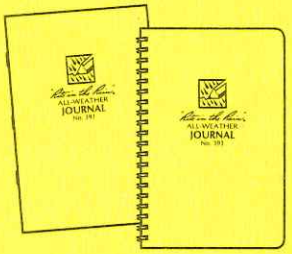

Bound Books



Loose Leaf / Ring Binders


Memo Books

All-Weather Pens



Notebooks

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PWS Sampling team 2 continued
1330 collect sediment sample
with ponar
sample ID BIMT Ø917 SM SE Ø201
* time 1330
0-6" Dark grey, silt and clay
* non-plastic, little fine
sand, very soft, wet
GPS:
45° 46' 27.627" N
108° 28' 39.892" W
931.47m
PDOP: 4.92
4 satellites
43 cm error
1400 Pick up site
* PID Reading = 2.4 ppm peak
= 1.6 ppm stable
ambient = 0.0 ppm
1430 Arrive at air strip. Take
boats out of water.
1500 leave airstrip for laurel
* MS/MSD collected at Billing
location on sediment
1600 Arrive at Public Access location

1630 Launch boats at ~~airstrip~~ SM
Buffalo Mirage Public Access
Head downstream
1700 Arrive at Laurel intake.
Scout out area for sample
location
1720 LAMT Ø917 SW Ø2Ø1
WATER QUALITY
TEMP 17.06°C
COND 0.238 mS/cm 0.202 mS/cm
DO 77.5% 7.44 ~~DO~~ SM mg/L
PH 7.51
ORP 135.7
TURBIDITY 7.35 NTU
1735 COLLECTED SAMPLE
LAMT Ø917 SE Ø2Ø1
(0'-6") DARK GREY, SILT,
~~LITT~~ SM SOME FINE
SAND, TRACE MEDIUM
SAND VERY SOFT, WET
GPS:
45° 39' 13.608" N
108° 45' 37.138" W
978.31 m elev.

 9/17/11

9 satellites
10 cm error
sediment and surface water
collected at same location
PID - 0.9 ppm High
0.9 ppm Stable
0.0 ppm ambient
Location is upstream of
intake, upstream of Railroad
bridge on left side of river.
Gravel bar, with soft sediment
1740 collect field blank
SM
LAMTØ917ASEØ2Ø2
time 1740
when driving boat to location
could see ~~at~~ SM concrete structure
underwater in the middle of
river. A pipe could be seen
coming vertically out of the
concrete.
1800 Pack up site, load boat
1830 Arrive at boat launch
pack up truck
1900 Arrive at Storage shed to
do Rinsate Blank

1920 Collect Rinsate blank on
decorned equipment SM 9/17
~~LAMTØ917111~~ SM 9/17
LAMTØ917SEØ2ØØ3
time 1920
TripBlank ID LAMTØ917SEØ2Ø4
LAMTØ917SEØ2Ø5
LAMTØ917SEØ2Ø6
LAMTØ917SEØ2Ø7
SM ~~2000~~ 2000 Leave storage unit

SM 9/17/11