Water Quality Evaluation of the Lower Little Susitna River

July 2008 through June 2009

Aquatic Restoration & Research Institute

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Summary

Water quality sampling was conducted on the Lower Little Susitna River to measure for potential increases in total aromatic hydrocarbon concentration and stream water turbidity during intensive use periods. Water samples were collected weekly from July 27 through September 6, 2008 and from May 17 through June 28, 2009 at seven sites ranging from 1 km upstream to 4 km downstream from the Little Susitna River Public Use Facility (PUF). Water samples were analyzed for benzene, toluene, ethyl benzene and xylene (BTEX). Grab samples collected concurrently were measured *in situ* for turbidity. Turbidity was also measured with Hydrolab meters at a site located 3.5 km downstream from the PUF and 9 km upstream from the PUF (August and September 2008) and near Houston (May and June 2009). Boat use at the PUF launch by motor size and type was recorded during each sampling event by Aquatic Restoration and Research Institute (ARRI) staff and recorded daily by Alaska State Park staff at the entrance booth. Concentrations of total aromatic hydrocarbons (TAH) and turbidity were compared with state water quality standards. Spatial and temporal variability in water quality parameters were evaluated relative to changes in the number of boats and motor types and changes in discharge. The concentration of macroinvertebrates in the water column, and catch rates of juvenile salmonids were used to evaluate potential effects of water quality on the aquatic community.

The concentration of TAH and turbidity exceeded state water quality standards repeatedly throughout the sampling period. Including all dates and sites, 24 samples out of 105 (23%) had TAH concentrations greater than or equal to 10 μg/L. Concentrations exceeded state standards more often during August of 2008 when the number of boats was high and discharge was between 390 and 425 cfs. TAH concentrations exceeded state standards on one date in June of 2009 when boat use was high and discharge was 857 cfs. Significant regression equations were developed between boat numbers by motor type and flow corrected TAH concentrations. Daily TAH concentrations were modeled using boat counts at the entrance booth and discharge. The model predicted concentrations of TAH above state standards on 18 days out of 102 (18%) during 2008.

Stream water turbidity at the PUF was greater than 5 NTU above background measures on most sampling dates. There was more than a 5 NTU difference on 10 of 15 days (67%) based upon weekly grab samples. Average daily turbidity from the hourly measures collected by the Hydrolabs, were more than a 5 NTU above background measures on 26 of 50 days (52%) in 2008, and 21 of 34 days (62%) during spring 2009. Turbidity at the reference sites and the PUF increase during spring runoff and storm events; however, high flows explain only a portion of the changes in turbidity. There is not a direct relationship between daily boat counts and daily average turbidity; however, maximum differences in turbidity coincide with periods of high boat counts.

Increases in turbidity are likely resulting in changes to the biotic community. Measures of primary production, invertebrate drift, and juvenile salmon catch rates all declined significantly between sites upstream and downstream of the PUF. The direct effect of increased turbidity on aquatic biota cannot be confirmed due to the lack of replication and limited data; however, the results are consistent with other published studies.

Introduction

The Little Susitna River is located within southcentral Alaska and flows from the Talkeetna Mountains adjacent to the communities of Wasilla and Houston. The river travels over 100 miles from the Mint Glacier to Cook Inlet. The river flows through the Hatcher Pass State Recreation Area, the Nancy Lake State Recreation Area and the Susitna Flats State Game Refuge. The Little Susitna River is one of the rivers managed under the Susitna Area Recreational Rivers Management Plan (DNR 1991). The river supports a highly popular salmon and trout fishery as well as recreational non-motorized and motorized boating. Most of the residential development is between Edgerton Park Road and Schrock Road, adjacent to the cities of Wasilla and Houston, resulting in bank and riparian modifications (Davis and Davis 2007).

Primary use of the Little Susitna River is related to the salmon sport fishery. Access is limited to undeveloped boat launches near Houston (River Mile 62) and at the Public Use Facility (PUF) (River Mile 25). In 2007, over 11,000 anglers accessed the Little Susitna River at the PUF during the Chinook and coho salmon sport fisheries.

The high amount of boat-accessed fishing, particularly near the PUF, has raised concerns over potential impacts to water quality. Stream water turbidity appears to increase in the lower river during the sport fishery, which was confirmed by sampling conducted in 2006 and 2007 (Davis and Davis 2007). Intensive boat use on the Kenai River and within Big Lake has resulted in concentrations of hydrocarbons within the water column that exceed state water quality standards (18 AAC 70) (Oasis 2006, Oasis 2008).

The evaluation of potential impacts to water quality within Alaska is reviewed and prioritized through the Alaska Clean Water Actions program (ACWA). This program is developed through the coordination of state resources agencies, including the Departments of Environmental Conservation, Fish and Game, and Natural Resources to prioritize waters throughout the state for water quality, quantity and aquatic habitat. Based upon preliminary data, the state developed ACWA priority actions for the Little Susitna River. These actions include intensive monitoring of the lower river (from Houston to Cook Inlet) for water quality parameters related to recreational use. Parameters included turbidity, dissolved oxygen, temperature and petroleum hydrocarbons.

Initial water quality sampling was conducted from July 2007 through June 2008 to determine the location and extent of potential hydrocarbon and turbidity contamination of the Little Susitna River. Sampling was conducted weekly through the fall coho fishery (July through mid September 2007) and the spring Chinook fishery (May and June 2008) above and below the city of Houston and above and below the PUF. Results indicate that total aromatic hydrocarbon concentrations exceeded state water quality standards adjacent to the PUF boat launch during the coho and Chinook fisheries. Stream water turbidities increased above background levels and periodically exceeded state standards (Davis and Davis 2008). These results led to further study in July 2008 – June 2009 in order to more fully understand the scope of the problem.

The objectives of this project are to further identify the extent and duration of hydrocarbon contamination and changes in turbidity adjacent to the developed boat launch at the PUF. Hydrocarbon concentrations were evaluated relative to boat use and motor type (2-cycle or 4-cycle engines), operation time, and stream flows. Secondary objectives included evaluating potential impacts to the macroinvertebrate and fish communities within the affected areas.

Methods

Sampling Locations

Water samples were collected from seven locations near the PUF boat launch. Water sampling locations were distributed from 1.0 km upstream to approximately 4 km downstream (Table 1 and Appendix B QAPP with Addendum 1 for location maps). Reference grab samples for turbidity were collected below Houston upstream of the undeveloped launch at Miller's Reach. In 2008, Hydrolab DS5 Multiprobes were deployed for hourly turbidity monitoring at stations approximately 9 km upstream (PUFUP) from the PUF boat launch and 3.5 km downstream (PUFDN). The PUFUP site was selected in 2008 as a reference turbidity location; however, due to extensive boat activity in the region, the site was relocated upstream of Miller's Reach in 2009 but below the Parks Highway bridge.

Table 1. Water quality sampling locations.

Name	Sample Collection	Distance from PUF Launch km/mi*	Latitude	Longitude
LS-1	Water Sampling Station, Discharge	1.15/0.71	61.44245	150.15931
LS-2	Water Sampling Station	0.44/0.27	61.44236	150.16751
LS-3	Water Sampling Station	0.00	61.43783	150.17386
LS-4	Water Sampling Station	-0.51/-0.32	61.43520	150.17470
LS-5	Water Sampling Station	-1.35/-0.84	61.43345	150.17239
LS-6	Water Sampling Station	-2.01/-1.25	61.43076	150.18345
LS-7	Water Sampling Station	-3.87/-2.40	61.42389	150.18958
Miller's Reach	Reference Turbidity 2008 and 2009, Continuous Turbidity 2009	60.48/37.8	62.62180	149.84939
PUFUP	Continuous Turbidity 2008, Invertebrate Drift, Juvenile Salmon	9.62/5.98	61.46311	150.14569
PUFDN	Continuous Turbidity 2008 and 2009, Invertebrate Drift, Juvenile Salmon	-3.50/-2.17	61.42787	150.18953

* Positive values are upstream and negative values are downstream from the PUF.

Boat Use

Boat use data were obtained from direct counts during water sampling events and from the PUF entrance booth. On each sampling event, an ARRI observer recorded all boat activity at the PUF boat launch. Observations by ARRI began upon arrival, generally between 12:00 and 14:00. The observer recorded the time that a boat entered the water from the launch or approached the launch from the water. The observer recorded the size (horse power), make, and type of motor (2-cycle, 2-cycle direct injection, or 4-cycle). Boat operators were interviewed in order to obtain motor type or size information when this information was not visible on the motor cowling. Time of operation within the launch area was recorded along with route of departure and activity. Observations ended upon completion of water sample collection, generally after 2 or 3 hours.

Boat motor size, boat length, and motor type (2-cycle or 4-cycle) were also recorded by Alaska State Park staff and volunteers at the entrance booth. Data were recorded daily, summarized following the 2008 season and were transmitted to ARRI staff in January 2009. Data collection at the entrance booth continues in 2009; however, results are not available at the time of this report.

Water Sampling

Water samples were collected weekly for 8 weeks in the fall of 2008 and 7 weeks in the spring of 2009 (see Appendix B for detailed Sampling Plan) for BTEX analyses which were used to calculate TAH. Sampling was conducted on Sundays between 12:00 and 16:00. Samples were collected near the thalweg but at a location that did not present a navigational hazard. Water samples were collected below the water surface at approximately 0.5 water depth. Duplicate samples and field blanks were collected on each sampling date. Water samples were preserved with HCL, kept on ice, and shipped to AM Test, Inc. in Kirkland, WA for hydrocarbon analyses (EPA Method 624).

At each sampling station LS-1 though LS-7, on each sampling date, we measured turbidity (mean of 3 samples), pH, specific conductivity, dissolved oxygen, and water temperature *in situ* using hand-held meters. Discharge was measured on each sampling date at LS-1 and downloaded from the U.S.G.S. gauging station (Station No. 15290000) located in Hatcher Pass, approximately 117 km (73 miles) upstream. Hydrolab DS5 Multiprobes were used to obtain hourly measures of dissolved oxygen (2008 only), turbidity, and water temperature. Hourly measures of water temperature were also obtained with Onset ProTemp V2 temperature loggers.

Macroinvertebrate Drift and Juvenile Salmon

Macroinvertebrates were sampled on August 17, 2008 and June 13, 2009 in drift nets (283 μm mesh, 45.7 x 30.5 cm opening) at PUFUP and PUFDN. Drift sampling was conducted following the methods described in Davis et al. 2001. A series of three nets were deployed across the channel 10 to 20 cm below the water surface. Water flow into the nets was measured with a General Oceanics flow meter centered in the net opening. Nets remained in the water until there was a visible decrease in flow. All material within the nets was transferred to 500-ml nalgene bottles and preserved with ethyl-alcohol. Samples were sorted and identified to genus.

Juvenile salmon were sampled concurrent with drift. Ten baited (salmon roe) minnow traps were placed in low velocity areas near or under cover along an outside bend. Traps were allowed to fish for 12 to 24 hours. All fish within the traps were identified to species, and all salmonids measured to fork length. Catches from each trap were recorded individually.

Community Metabolism

Community metabolism is a measure of the amount of energy produced within a stream system and available for insect consumers, the primary food base for rearing salmonids. This measure is the sum of autochthonus primary production from algae and aquatic plants and the respiration of all organic matter. Community metabolism was measured using the open system single station method (Odum 1956, Bott 2007). Dissolved oxygen (DO) and temperature were recorded on 1h or 0.5h intervals using Hach Environmental Minisonde 5 and YSI 600QS sondes deployed for 14-28 days. Turbidity was also monitored (Hach sondes only) and calibrated against a known turbidity sample prior to each deployment. Dissolved oxygen sensors were calibrated in water-saturated air at sea level prior to each deployment. All sondes were monitored for sensor drift prior to deployment and following retrieval. Data collection began on May 19, 2008 and ended September 5, 2008.

Gross primary production and community respiration were determined according to Bott (2007) based on the equation:

$$\Delta DO = P - R + K(t°C)(D)$$

Where ΔDO is the change in dissolved oxygen concentration (g O_2 m^{-3}) and P (g O_2 m^{-3}) and R (g O_2 m^{-3}) correspond to primary production and respiration respectively. The product of the temperature corrected reaeration coefficient (K(t°C)) and the oxygen deficit (D in g O_2 m-3) quantifies the net gas exchange with the atmosphere over a time interval (1 h or 0.5 h in this study). During the night, primary production is reduced and changes in DO concentration are due to respiration. Therefore, day-length community respiration (CR24) was determined as the average hourly respiration at night, extrapolated over a 24 -hour period. Gross primary production (GPP) was determined as the sum of daytime respiration and cumulative change in DO during the photoperiod. GPP and CR24 were converted to areal units (g O_2 m^{-2} d^{-1}) by multiplying volumetric rates by site specific average depth.

Results

Boat Use

Boat use observations were conducted at the launch on 15 Sundays during the fall of 2008 and spring of 2009 (Table 2). Observation time ranged from 1.5 to 4 hours. Boat use peaked during the fall coho fishery with a maximum of 43 total boats counted during 2.4 hours on August 10, 2008. From 9 to 18 boats were counted per hour from July 27 to August 17. Total boat counts increased during the spring Chinook fishery with a maximum of 57 boats operating in the launch area over a 2.4 hour period on June 7, 2009. Total boat counts ranged from 8 to 23 per hour through June.

Maximum outboard motor size was 200 HP; however boat motors ranging from 35 to 65 HP were most common. The percent of 2-cycle boat motors (not including 2-cycle direct fuel injection) ranged from 14 to 51%. The percent 2-cycle tended to increase with increasing total boats. The majority of users operated downstream of the boat launch on most dates. However, late in the coho and Chinook fisheries near 60% of the use was upstream of the launch.

Boat use counts obtained by the state for 2008 at the entrance booth are shown in Table 3. Boat counts during sampling events were correlated to boat counts obtained at the entrance booth (r^2 =0.89, n= 7). Maximum booth counts were 49 on June 8 and June 15, 2008, and 48 on August 10, 2008. Boat use was highest on Sundays with an average of 24% of weekly use, followed by Friday and Saturday at near 20%, Monday and Thursday at 16%, and lowest on Tuesdays and Wednesdays at 5% and 9%, respectively. Annual use in 2008 was divided evenly between the Chinook and coho fisheries. Approximately 35% of the annual use occurred from June 1 to June 22, 2008, and 33% from August 3 through August 17, 2008. The percent of 2-cycle motors in 2008 ranged from 0 to 61%. These motor types made up less than 30% of all motors on half of the recorded dates. Using this larger data set, there was no clear relationship between daily boat counts and the percent of boats with 2-cycle motors.

Table 2. Boat use by motor type and size counted at the launch during each sampling event.

	Day	Total Boats	2-Cycle	2-Cycle DI	4-Cycle	Maximum HP	Minimum HP	Average HP	Operated Upstream	Operated Downstream	Observation Time (hrs)	Percent 2-Cycle	Percent Upstream
7/27/2008	Su	39	11	0	28	200	15	61	16	26	4.0	28%	38%
8/2/2008	Sa	33	8	0	25	200	30	69	15	18	1.9	24%	45%
8/10/2008	Su	43	15	0	28	200	20	62	17	26	2.4	35%	40%
8/13/2008	We	29	10	0	19	150	23	61	9	18	3.0	34%	33%
8/17/2008	Su	37	19	0	18	225	2.5	55	18	21	2.0	51%	46%
8/24/2008	Su	20	8	0	12	65	8	47	10	13	2.5	40%	43%
8/30/2008	Sa	9	3	0	6	65	35	53	5	3	1.8	33%	63%
9/6/2008	Sa	5	1	0	4	115	50	67	1	4	1.5	20%	20%
5/17/2009	Su	14	2	2	10	200	6	70	6	5	2.5	14%	55%
5/24/2009	Su	47	20	3	24	140	9.9	60	28	30	3.1	43%	48%
5/31/2009	Su	37	13	1	23	115	15	53	8	30	3.8	35%	21%
6/7/2009	Su	57	21	2	34	200	20	68	44	35	2.4	37%	56%
6/14/2009	Su	36	9	1	26	200	9.9	62	10	16	2.3	25%	38%
6/21/2009	Su	16	8	0	8	140	20	56	5	8	2.0	50%	38%
6/28/2009	Su	31	14	1	16	140	15	63	17	12	3.0	45%	59%

Table 3. Daily booth counts collected at the PUF entrance, showing percent of total count by motor type and percent of seasonal use by week, and weekly use by day.

Date	Day	Boat Totals	2-Cycle	Percent 2-Cycle	Total/Week	Percent of Season Use by Week	Percent of Weekly Use by Day
5/22/2008	Thurs	4	2	50%			9%
5/23/2008	Fri	13	5	38%			28%
5/24/2008	Sat	12	6	50%			26%
5/25/2008	Sun	17	7	41%	46	2.54%	37%
5/26/2008	Mon	42	7	17%			27%
5/27/2008	Tues	6	1	17%			4%
5/28/2008	Wed	2	1	50%			1%
5/29/2008	Thurs	17	8	47%			11%
5/30/2008	Fri	22	7	32%			14%
5/31/2008	Sat	30	7	23%			19%
6/1/2008	Sun	36	10	28%	155	8.56%	23%
6/2/2008	Mon	20	3	15%			11%
6/3/2008	Tues	15	6	40%			8%
6/4/2008	Wed	4	2	50%			2%
6/5/2008	Thurs	25	10	40%			13%
6/6/2008	Fri	37	18	49%			19%
6/7/2008	Sat	40	17	43%			21%
6/8/2008	Sun	49	16	33%	190	10.49%	26%
6/9/2008	Mon	29	6	21%			17%
6/10/2008	Tues	7	1	14%			4%
6/11/2008	Wed	7	2	29%			4%
6/12/2008	Thurs	18	9	50%			10%
6/13/2008	Fri	29	11	38%			17%
6/14/2008	Sat	35	9	26%			20%
6/15/2008	Sun	49	14	29%	174	9.61%	28%
6/16/2008	Mon	22	4	18%			15%
6/17/2008	Tues	12	1	8%			8%
6/18/2008	Wed	5	2	40%			3%
6/19/2008	Thurs	26	14	54%			18%
6/20/2008	Fri	28	17	61%			19%
6/21/2008	Sat	19	1	5%			13%
6/22/2008	Sun	33	10	30%	145	8.01%	23%
6/23/2008	Mon	18	2	11%			17%
6/24/2008	Tues	5	0	0%			5%
6/25/2008	Wed	12	4	33%			12%
6/26/2008	Thurs	17	7	41%			17%
6/27/2008	Fri	21	2	10%			20%
6/28/2008	Sat	11	3	27%			11%
6/29/2008	Sun	19	8	42%	103	5.69%	18%

Date	Day	Boat Totals	2-Cycle	Percent 2-Cycle	Total/Week	Percent of Season Use by Week	Percent of Weekly Use by Day
6/30/2008	Mon	15	4	27%			16%
7/1/2008	Tues	11	3	27%			12%
7/2/2008	Wed	12	5	42%			13%
7/3/2008	Thurs	14	7	50%			15%
7/4/2008	Fri	15	1	7%			16%
7/5/2008	Sat	14	4	29%			15%
7/6/2008	Sun	11	5	45%	92	5.08%	12%
7/7/2008	Mon	3	2	67%			7%
7/8/2008	Tues	2	0	0%			5%
7/9/2008	Wed	8	2	25%			20%
7/10/2008	Thurs	10	4	40%			24%
7/11/2008	Fri	5	2	40%			12%
7/12/2008	Sat	5	1	20%			12%
7/13/2008	Sun	8	0	0%	41	2.26%	20%
7/14/2008	Mon	3	0	0%			8%
7/15/2008	Tues						
7/16/2008	Wed						
7/17/2008	Thurs	5	3	60%			13%
7/18/2008	Fri	7	0	0%			18%
7/19/2008	Sat	6	0	0%			16%
7/20/2008	Sun	17	3	18%	38	2.10%	45%
7/21/2008	Mon	3	1	33%			3%
7/22/2008	Tues	4	0	0%			4%
7/23/2008	Wed	5	1	20%			5%
7/24/2008	Thurs	13	4	31%			12%
7/25/2008	Fri	30	10	33%			28%
7/26/2008	Sat	32	9	28%			30%
7/27/2008	Sun	21	6	29%	108	5.96%	19%
7/28/2008	Mon	17	5	29%			9%
7/29/2008	Tues	3	1	33%			2%
7/30/2008	Wed	12	3	25%			7%
7/31/2008	Thurs	33	20	61%			18%
8/1/2008	Fri	45	12	27%			25%
8/2/2008	Sat	31	10	32%			17%
8/3/2008	Sun	40	9	23%	181	9.99%	22%
8/4/2008	Mon	29	7	24%			12%
8/5/2008	Tues	6	4	67%			3%
8/6/2008	Wed	32	7	22%			14%
8/7/2008	Thurs	40	15	38%			17%
8/8/2008	Fri	43	11	26%			18%
8/9/2008	Sat	37	18	49%			16%
8/10/2008	Sun	48	13	27%	235	12.98%	20%

Date	Day	Boat Totals	2-Cycle	Percent 2-Cycle	Total/Week	Percent of Season Use by Week	Percent of Weekly Use by Day
8/11/2008	Mon	41	13	32%			22%
8/12/2008	Tues	4	1	25%			2%
8/13/2008	Wed	21	5	24%			11%
8/14/2008	Thurs	19	4	21%			10%
8/15/2008	Fri	14	6	43%			8%
8/16/2008	Sat	45	20	44%			24%
8/17/2008	Sun	42	16	38%	186	10.27%	23%
8/18/2008	Mon	14	3	21%			14%
8/19/2008	Tues	8	3	38%			8%
8/20/2008	Wed	11	4	36%			11%
8/21/2008	Thurs	12	5	42%			12%
8/22/2008	Fri	21	10	48%			21%
8/23/2008	Sat	17	3	18%			17%
8/24/2008	Sun	17	6	35%	100	5.52%	17%
8/25/2008	Mon	7	2	29%			41%
8/26/2008	Tues	1	0	0%			6%
8/27/2008	Wed						
8/28/2008	Thurs	4	0	0%			24%
8/29/2008	Fri						
8/30/2008	Sat	1	1	50%			12%
8/31/2008	Sun	3	1	33%	17	0.94%	18%

Concentrations of TAH

TAH concentrations for all sampling dates in 2008 and 2009 are provided in Table 4 and Figure 1. Concentrations of TAH have ranged from below detection limits to 75.2 μg/L. The highest concentrations occurring during the fall of 2008 and spring of 2009 were 30 μg/L, and 10 μg/L, respectively. There were no consistent trends in TAH concentrations from upstream to downstream. On August 13, 2008 concentrations increased from LS-4 to LS-5 and on August 17, concentrations decreased considerably downstream from LS-4. These rapid changes suggest a plume of hydrocarbon contaminated water moving downstream on these sampling dates.

Concentrations exceeded state water quality standards of 10 μg/L ((18 AAC 70.020(b) (5) (A) (iii)) in 31 of 121 samples, or 26%. The highest number of exceedances occurred at sites LS-1 and LS-4 at 26% and 35%, respectively (these were the only sites sampled during the spring of 2008). TAH concentrations exceeded water quality standards on 3 or 4 (depending on the site) of the 15 sampling dates during fall 2008 and spring 2009.

High concentrations of TAH coincided with high boat counts and low flows. High concentrations that resulted in water quality exceedances occurred primarily during the

Chinook and coho fisheries in 2008. These high concentrations were associated with flows ranging from 380 to 600 cfs. Booth boat counts were near 50 for the sampling dates during the Chinook fishery and ranged from 33 to 48 during the coho fishery. In contrast, while high boat counts were obtained during the spring 2009 sampling events, concentrations were generally below the limits of water quality standards. These differences are likely due to the high flows during the spring that ranged from 600 to 900 cfs during the most intensive use.

TAH concentrations are expressed as mass per volume of water. The addition of 10 μg of hydrocarbons to 1 liter of water results in a concentration of 10 μg/L, and the addition of 10 μg to 2 liters of water results in a concentration of 5 μg/L. Similarly, if emissions from a boat result in concentrations of 10 μg/L at a stream flow of 100 cfs, the same emissions at 200 cfs, will result in a concentration of 5 μg/L. To determine the mass of hydrocarbon emission, the concentration is multiplied by the volume of water (i.e. 5 μg/L x 2 L = 10 μg) or, in this case, stream flow. The hydrocarbon emissions, or flow corrected values, can then be related to the number of boats operating by motor type. Therefore, we multiplied concentrations (mg/L) by flows (L/s) to obtain TAH emissions (mg/s), or flow corrected values. Flow corrected values were then compared to boat use by motor type.

Regression relationships were developed between flow corrected values and boat use during sampling events (Figure 2). The best relationships (highest r^2) were for samples collected at LS-3, directly downstream from the boat launch for total boats counted per hour. However, the regression r^2 was only slightly lower when using only 2-cycle motors per hour (0.7 vs. 0.8). The fit of the regression line decreased for sites upstream and downstream from the launch and were lowest upstream. These regression relationships were used to estimate the number of total boats operating within the launch area per hour that could result in water quality exceedances at different flows (Figure 3). Using the relationship with 2-cylcle motors, water quality standards for TAH will be exceeded downstream from the PUF when5 or more boats are operating per hour and discharge is less than 600 cfs.

The discharge measurements from upstream of the PUF were used to investigate the relationship with flows recorded at the U.S.G.S. gauging station. The gauging station is located 73 river miles upstream of the PUF. Using an average water velocity of 1.5 ft/s we estimated approximately 2.9 days for water to travel from the gauging station to the PUF. We found a significant regression relationship between discharge measured at the gauging station and flow at the PUF three days later (Figure 4) and used this equation to estimate discharge at the PUF.

Using the daily boat counts at the booth to estimate 2-cycle motor use per hour, the relationship between 2-cycle motors/hr and flow corrected TAH concentrations, and estimated daily flow at the PUF we could model daily TAH concentrations (Figure 5). Actual TAH values from water sampling were from 0.5 to 1.9 times predicted values; however, estimates from the model predicted water quality exceedances of TAH concentrations on 18 days at the boat launch from May 22 through August 31, 2008 (102 days) or 18% of the days.

Table 4. Total aromatic hydrocarbon concentrations (µg/L) and discharge for all sampling dates and sites in the fall of 2007, 2008, and spring 2009. Exceedance is the number of times concentrations were greater than state water quality standards of 10 µg/L.

	LS-1	LS-2	LS-3 PUF	LS-4	LS-5	LS-6	LS-7	Flow (cfs)
29 Jul 07	2.6			5.1				358*
5 Aug 07	0.0			0.0				400*
12 Aug 07	0.0			0.0				597*
19 Aug 07	6.7			10.17				459*
26 Aug 07	0.0			0.0				363*
2 Sept 07	0.0			0.0				800*
9 Sep 07	0.0			0.0				337*
16 Sept 07	0.0			0.0				321*
10 May 08	0.0			0.0				389
18 May 08	0.0			0.0				312
24 May 08	1.2			5.3				399
1 Jun 08	28.6			27.6				511
8 Jun 08	36.7			75.2				465
15 Jun 08	9.6			22.8				594
21 Jun 08	0.0			9.1				720
29 Jun 08	11.0			13.1				707
27 Jul 08	2.8	3.6	2.5	2.1	2.0	2.4	3.6	830
2 Aug 08	17.2	16.1	18.1	12.4	23.9	18.3	17.6	485
10 Aug 08	13.2	16.1	23.5	30.8	26.1	28.3	27.7	525
13 Aug 08	4.3	4.2	6.2	5.2	11.1	16.5	10.7	479
17 Aug 08	26.2	27.1	27.9	22.3	2.5	0.0	4.8	387
24 Aug 08	6.9	6.8	6.8	10.4	8.4	7.5	9.3	379
30 Aug 08	0.0	0.0	0.0	0.0	0.0	0.0	0.0	386
6 Sept 08	0.0	0.0	0.0	0.0	0.0	2.9	0.0	325
17 May 09	0.0	0.0	0.0	1.0	0.0	0.0	0.0	927
24 May 09	3.1	4.2	8.3	6.8	5.0	9.2	6.9	833
31 May 09	0.0	0.0	3.7	0.0	0.0	1.4	3.6	804
7 June 09	0.0	3.2	10.4	9.1	9.7	9.3	12.7	857
14 June 09	1.9	2.2	5.3	5.4	4.5	5.8	2.9	788
21 June 09	3.1	1.9	1.2	1.8	3.0	3.9	3.1	616
28 June 09	1.8	1.8	2.3	5.4	4.6	4.6	5.2	418
Exceedances	6	3	4	9	3	3	4	
Percent of Total	20%	20%	27%	29%	20%	20%	27%	

* Flows calculated from relationship with values measured at the USGS site in Hatcher Pass.

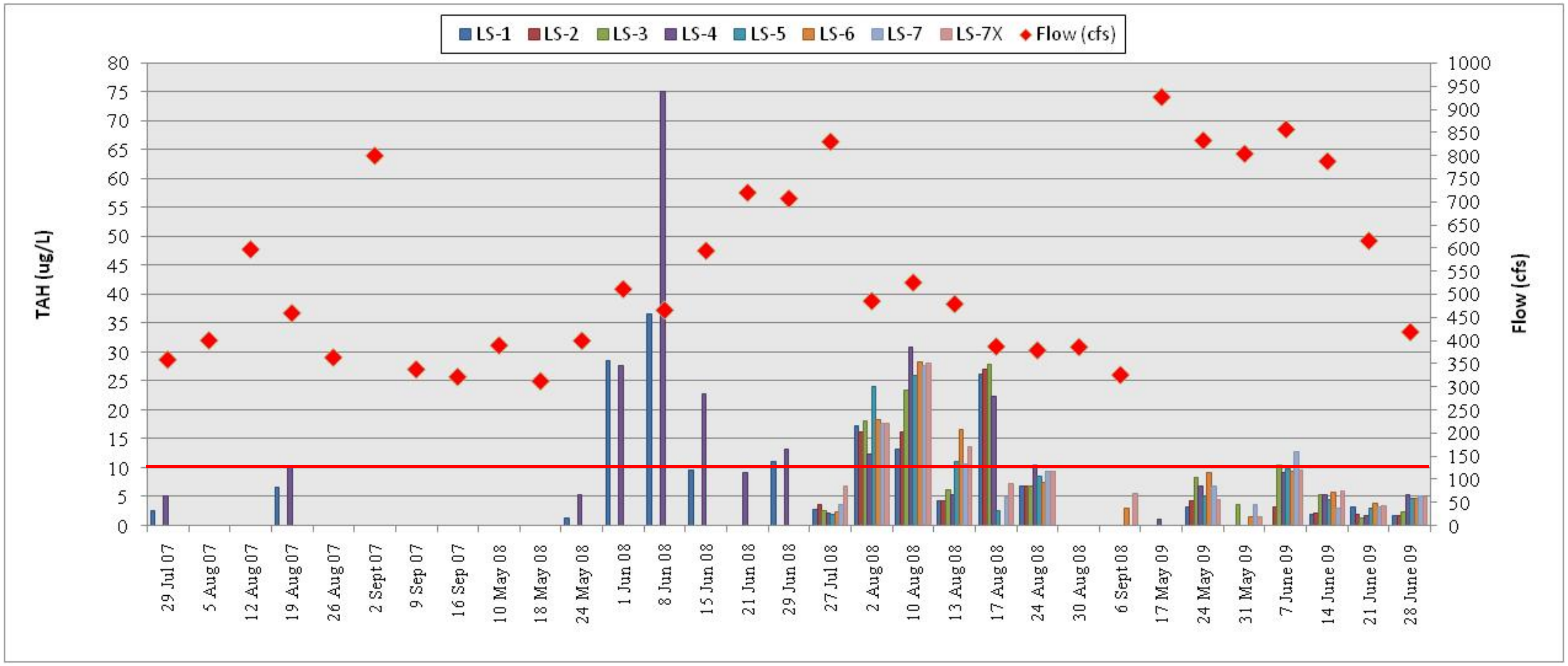

Figure 1. TAH concentrations for all sampling dates and locations, showing discharge (red diamonds). Red line denotes state water quality standard of 10μg/L.

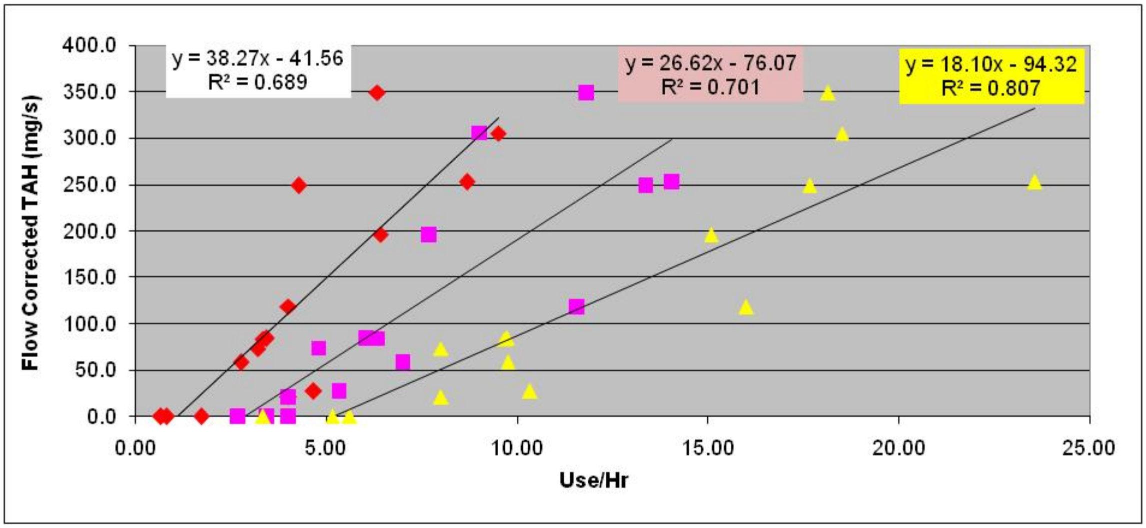

Figure 2. Regression relationships between flow-corrected TAH and the number of boats observed at the launch LS-3 per hour by motor type. Diamonds = 2-Cycle, squares = 4- Cycle, and triangles = total boats.

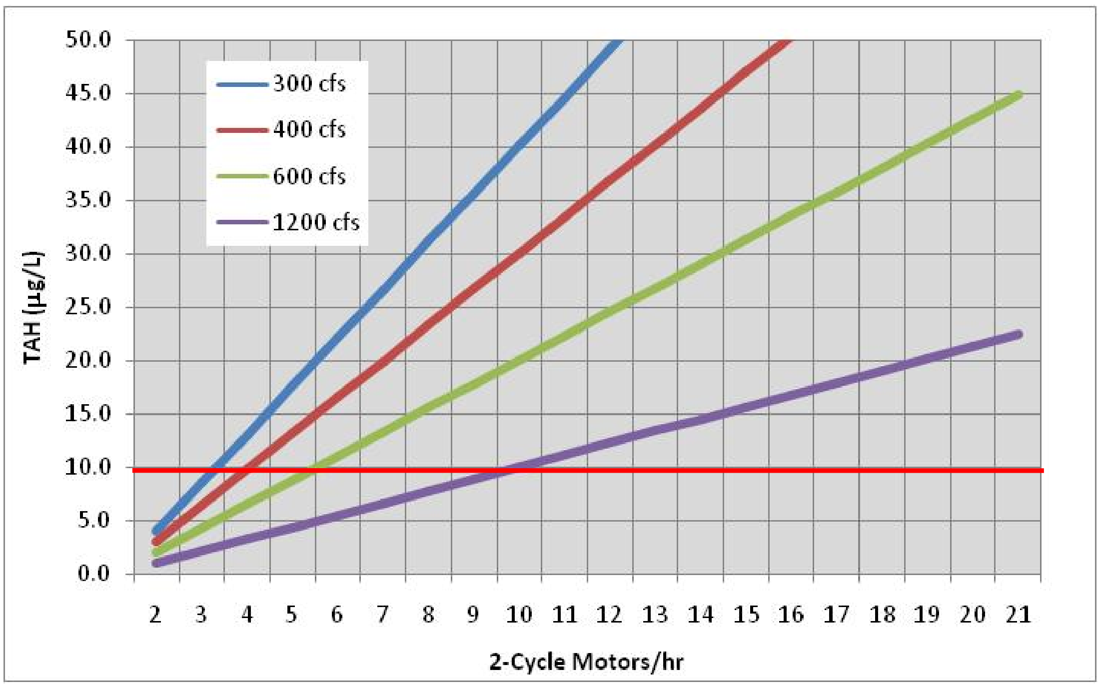

Figure 3. Estimated TAH concentrations at different flows as a function of boat (2-cycle motors) use per hour at the launch. The state water quality standard for TAH is 10 µg/L (red line).

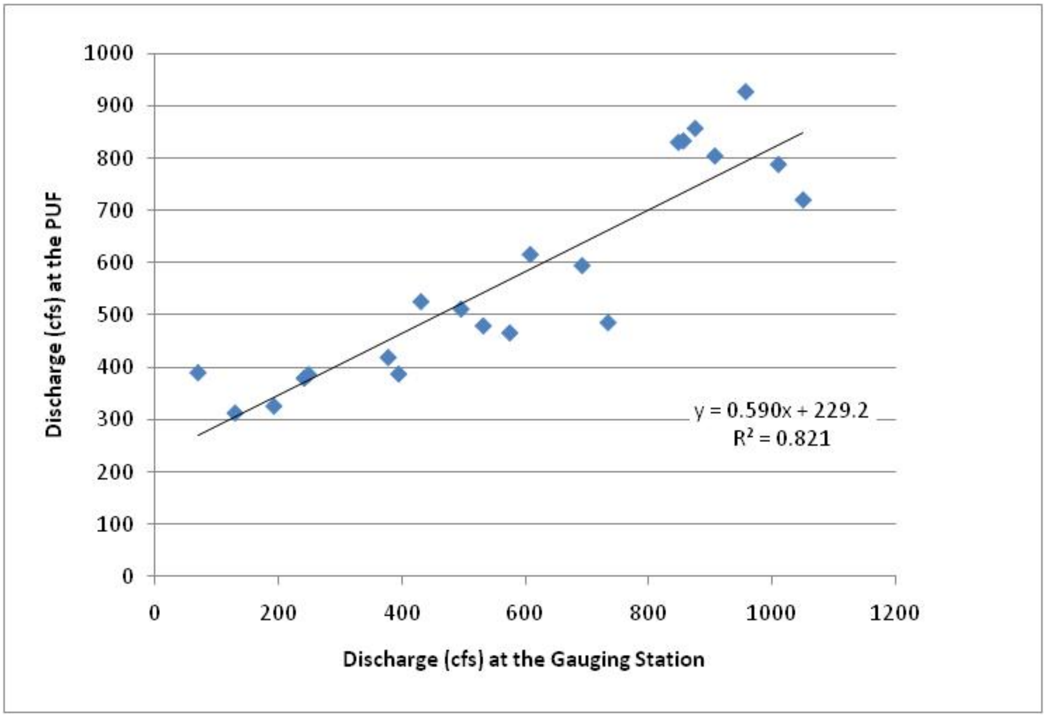

Figure 4. Regression relationship between Little Susitna River discharge measured at LS-1 and discharge 3-days previously measured at the U.S.G.S. gauging station.

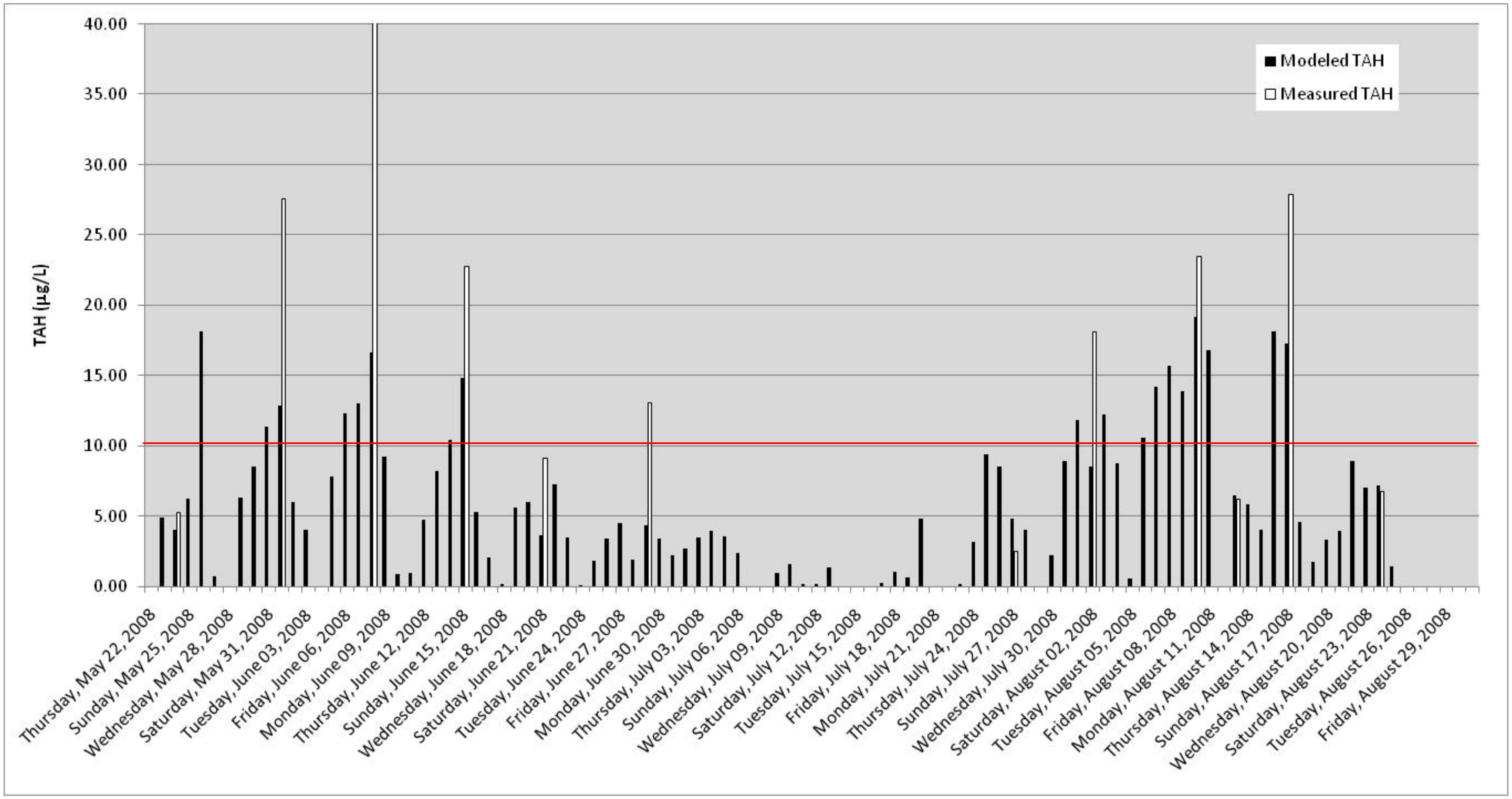

Figure 5. Estimated TAH concentrations at the Little Susitna River PUF (LS-3) based on discharge and 2-cycle boat use per hour modeled from total boat counts at the entrance booth and compared to measured values. Red line marks water quality standard concentration.

Water Temperature and Chemistry

Seasonal stream water temperature statistics for 2008 and 2009 are shown in Table 5. Stream water temperatures increase from Miller's Reach near Houston to the PUF. Water temperatures in 2009 were warmer than in 2008. Water temperatures in this semi-glacial river did not exceed 20°C in 2008 at the PUF but exceeded this temperature on 7 days in 2009.

Table 5. Stream water temperature statistics from measures recorded using temperature data loggers at Miller's Reach near Houston (mile 62.8) and at the PUF (mile 25).

	Season Maximum	Maximum Daily Range	Total Days	Days Max Temp >13	Percent of Total Days > 13	Days Max Temp >15	Percent of Total Days >15	Days Max Temp >20	Jun Cumulative Degree Days	Jul Cumulative Degree Days	Aug Cumulative Degree Days	Sep Cumulative Degree Days
Little Susitna River at Miller's Reach 2008	13.06	3.57	122	1	1	0	0	0	169	292	292	216
Little Susitna River at Miller's Reach 2009	15.20	3.46	100	15	15	1	1	0	183	419	323	228
Little Susitna River at the PUF 2008	16.30	5.50	122	52	43	5	4	0	232	373	373	261
Little Susitna River at the PUF 2009	20.87	5.81	122	85	70	43	35	7	254	501	410	274

Measures of dissolved oxygen, pH and specific conductivity are provided in Appendix A. Dissolved oxygen was near saturation on all sampling dates ranging from 95 to 105%. The pH of water samples ranged from 7.6 to 7.9. Specific conductivity ranged from 70 to 100 μS/cm but was near 80 on most sampling dates.

Turbidity

Stream water turbidity from grab samples from all sampling dates are provided in Table 6 and Figure 6. Average turbidity at the reference site including all sampling dates was 3.4 NTU and ranged from near 0 to 9.2 NTU. Average turbidity (LS-1 through LS-7) adjacent to the PUF ranged from 4 to15.9 NTU. The difference in turbidity between reference and average downstream values ranged from 2.5 to 11.2 NTU. Maximum differences in the fall of 2008 occurred on August 17 and in the spring of 2009 on June 7. Both of these days coincided with high boat counts.

Average daily turbidity values from the Hydrolab probes are shown in Figures 7 (2008) and 8 (Spring 2009). There are three tributaries between the reference site, and the site located below the launch. Theses tributaries, Nancy Lake Creek, Crooked Lake Creek and My Creek, drain wetlands and do not contribute suspended sediment to the Little Susitna River. There was a significant difference in turbidity between upstream and downstream locations (paired t-tests, $p<0.001$). August data during 2008 was lost due to equipment problems. However, differences in 2008 turbidity between the reference site located 9.0 km upstream from the launch, and the site located 3.5 km below the launch ranged from 1 to 14 NTU. Turbidity was very similar during late August and early September 2008. Maximum differences occurred from June 7 through June 14, 2008, (average difference of 10.9) coincidental with increased boat use during the Chinook fishery. The average difference between sites for the remainder of June was 4.3 NTU. Neither average turbidity nor differences in turbidity were correlated with boat counts during sampling events or at the entrance booth.

Turbidity differences also were observed between reference data collected upstream of the Miller's Reach and the site located below the PUF in the spring of 2009. There were only minor differences in turbidity on May 24, but these differences increased to 19 NTU during June. Daily entrance booth counts are not available at this time; therefore more complete comparisons between boat use and turbidity are not possible. Stream water turbidity clearly increased at both locations during spring runoff with average daily values up to 26 NTU at locations above and below the PUF. However, turbidity decreased along with changes in discharge at the reference site, but remained high throughout June downstream from the PUF.

Stream water turbidity was influenced by discharge, particularly during spring runoff; however, relationships are weak. Regression equations were developed between discharge and average daily turbidity. The highest r^2 value (0.58) was obtained for measures below the PUF from June through September 2008. However, this data set did not include 30 days from July 15 to August 15. When 2009 data are added to the regression, the r^2 value decreased to 0.36. There was a poor relationship between discharge and turbidity ($r^2 = 0.31$) at the initial reference site (9 km upstream) when using the 2008 data set. During spring of 2008 (June 6 through June 30), the relationship between discharge and turbidity below the PUF decreases ($r^2 = 0.25$), but increases at the reference site ($r^2 = 0.52$). A similar pattern was not present in 2009, and there was a poor relationship between discharge and turbidity at both the reference site and below the PUF. However, plots of turbidity as a function of discharge below the PUF during spring 2009 showed two distinct patterns with a linear relationship between turbidity and discharge when turbidity was less than 12 NTU (Figure 9). Therefore, in 2009, discharge explained differences in turbidity up to 12 NTU but discharge could not explain differences at higher turbidities.

Table 6. Stream water turbidity for all sampling locations and dates, with average values for sampling stations near the PUF and the difference between measures at Miller's Reach (reference).

	Miller's Reach	LS-1	LS-2	LS-3	LS-4	LS-5	LS-6	LS-7	Ave LS-1 to LS-7	Difference
27 Jul 08		8.4						12.2	10.3	
2 Aug 08	0.2	1.1						6.9	4.0	3.8
10 Aug 08	4.4	5.9	9.7	9.5	7.5	4.3	7.2	7.5	7.4	3.0
13 Aug 08	2.5	5.9	9.7	9.5	7.5	4.3	7.2	7.5	7.4	4.9
17 Aug 08	2.5	7.3	11.6	8.7	7.1	9.3	11.6	9.3	9.3	6.7
24 Aug 08	1.2	6.1	7.6	6.3	6.0	7.2	8.2	7.4	7.0	5.8
30 Aug 08	0.4	6.9	7.0	5.7	7.0	7.5	6.9	7.0	6.9	6.5
6 Sept 08	1.6	2.9	3.2	3.2	3.0	3.7	5.8	6.7	4.1	2.5
17-May-09	9.2	8.5	16.8	13.0	13.0	12.5	11.5	12.2	12.5	3.3
24-May-09	5.7	10.0	11.0	11.0	13.6	11.6	14.9	12.4	12.1	6.4
31-May-09	4.2	10.0	8.3	9.2	9.3	9.4	9.9	10.5	9.5	5.3
7-Jun-09	4.7	13.6	14.7	16.9	16.1	15.5	16.4	18.0	15.9	11.2
14-Jun-09	3.7	8.5	9.1	9.2	10.5	10.1	11.3	11.1	10.0	6.3
21-Jun-09	2.5	6.6	7.9	9.2	9.5	8.7	10.1	12.0	9.1	6.6
28-Jun-09	4.3	9.9	10.4	10.5	11.3	9.8	11.4	14.4	11.1	6.8

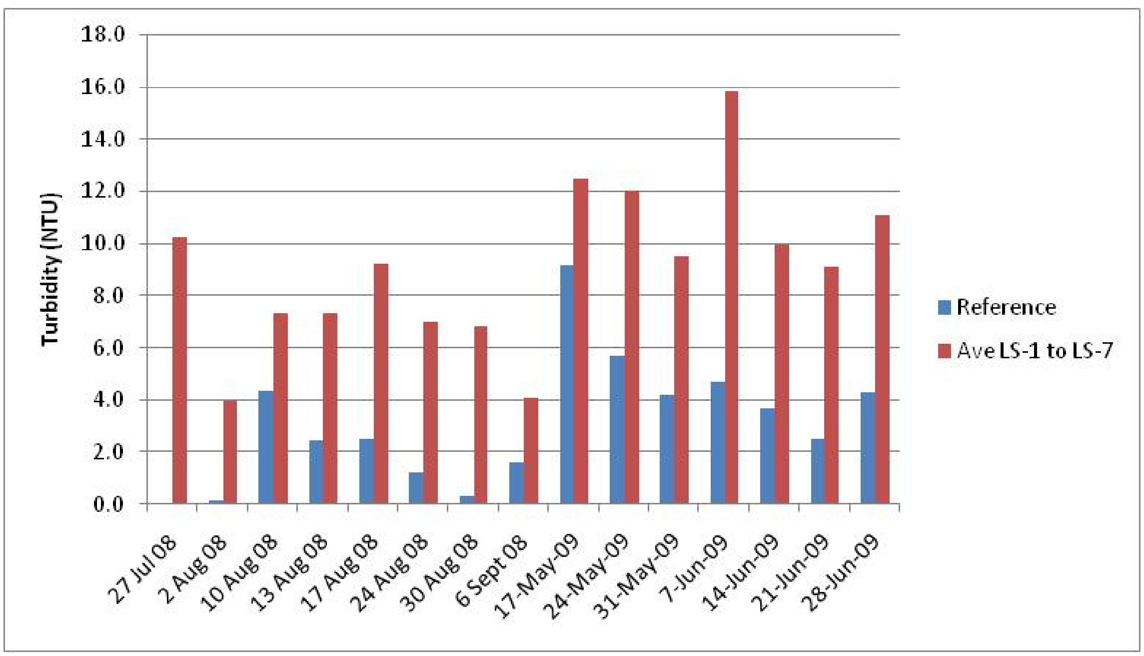

Figure 6. Graphical presentation of turbidity data from weekly grab samples.

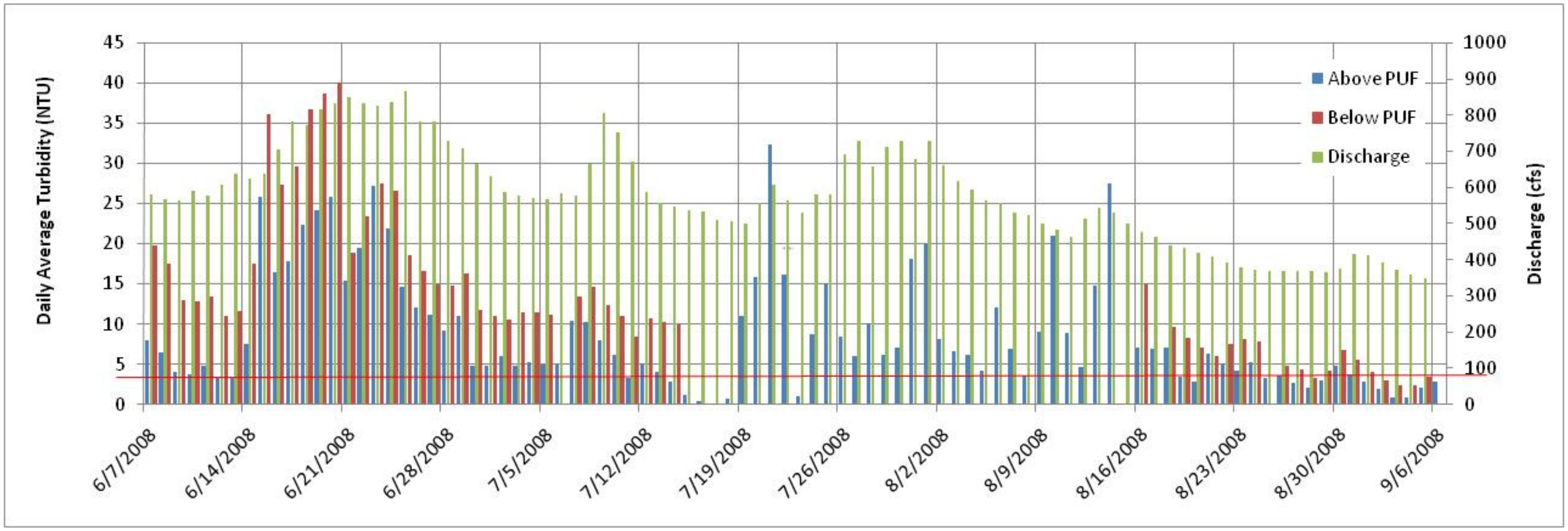

Figure 7. Average daily turbidity from hourly Hydrolab measures collected at PUFUP (9 km upstream from the boat launch) and PUFDN (3.5 km downstream from the boat launch), and discharge. Red line is average reference turbidity from grab samples collected between 2007 and 2009.

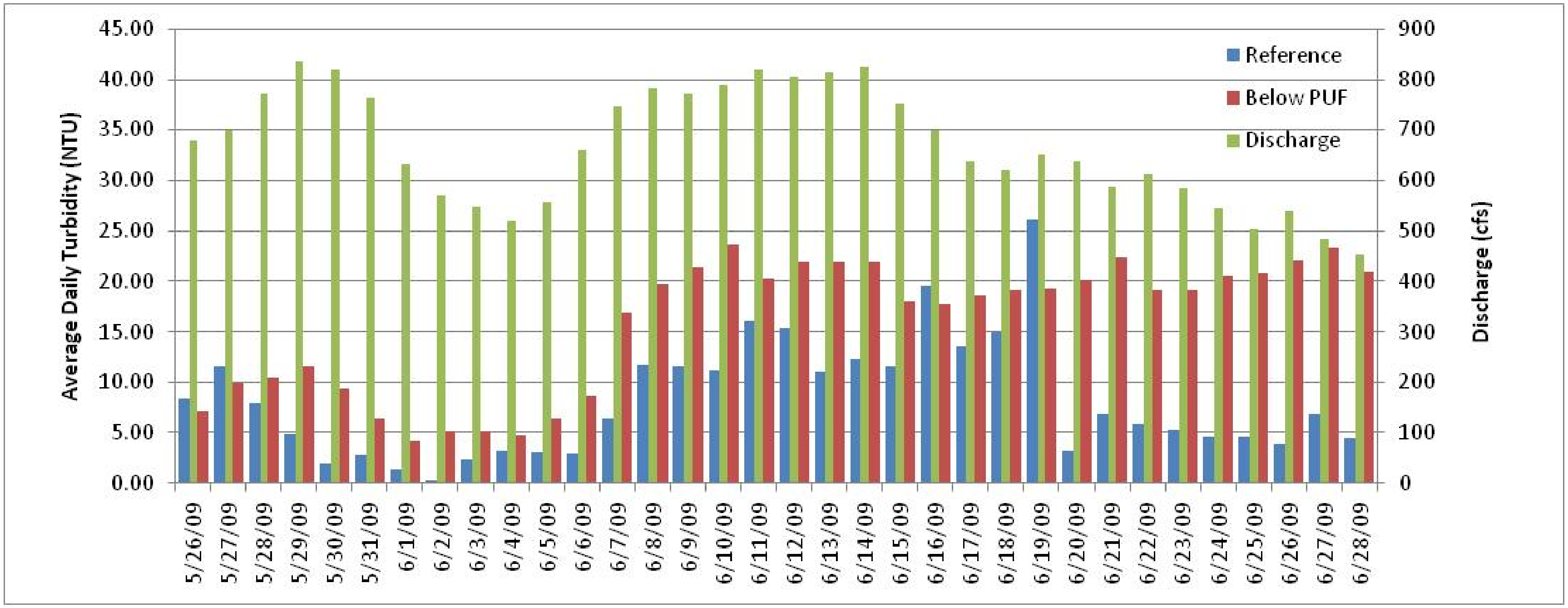

Figure 8. Average daily turbidity from hourly Hydrolab data collected at Miller's Reach and PUFDN, and discharge for the spring of 2009. Turbidity decreases at the reference site following spring runoff but remains high downstream from the PUF.

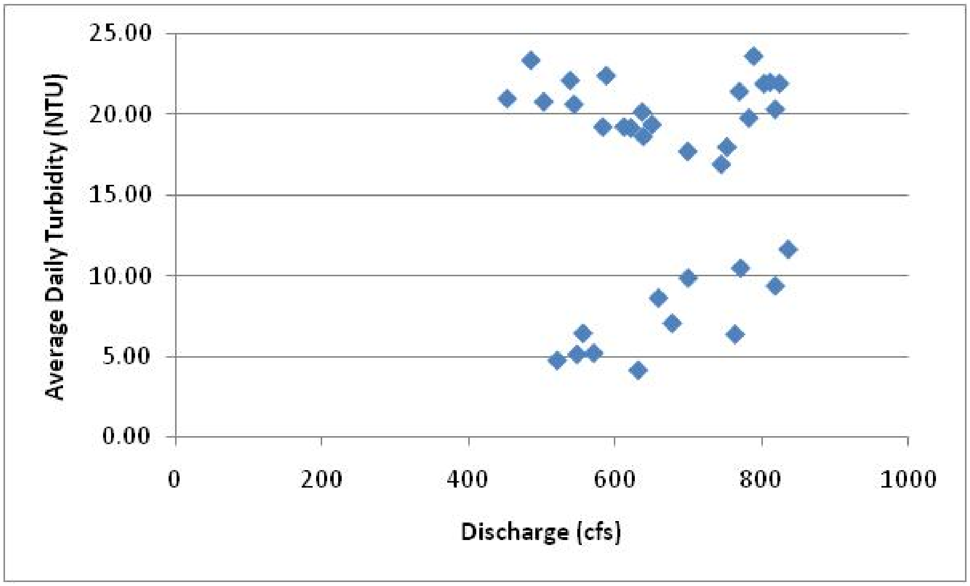

Figure 9. Relationship between discharge and average daily turbidity at PUFDN showing two distinct groupings. Turbidity changes from 5 to 12 NTU appear to be related to changes in discharge.

State water quality standards vary for designated uses, and the state regulates for the most stringent designated use. The most stringing standard is 5 NTU above natural background ((18 AAC 70.020(b)(12)(A)(i)). In the fall of 2008, based upon weekly grab samples, turbidity was 5 or more NTU higher than samples at the reference site on 10 of the 15 dates (67%) measured. Using average daily turbidity data from the Hydrolabs, there was a greater than 5 NTU increase in turbidity from PUFUP to PUFDN on 26 out of 50 (52%) days in 2008. In the fall of 2008, mean daily boat use was 11/day when turbidity differed by less than 5 NTU, however, mean daily boat use was over 20/day when turbidity differed by 5 or more NTU. When average daily turbidity differed from 5 to 10 NTU, average daily boat use increased to 13/day and when 10 NTU or greater difference, average boat use was 30/day. In the spring of 2009, turbidity below the PUF was 5 NTU or greater than average daily values at the reference site on 21 of 34 days (62%). Turbidity differences were generally less than 5 NTU in late May and early June (approximately June 6), and 5 NTU or greater throughout the rest of June concurrent with increased boat use.

Juvenile Salmon, Macroinvertebrate Drift, and Community Metabolism

We measured significant differences in all biotic measures among samples collected above and below the PUF. Juvenile salmon and macroinvertebrates were sampled on August 17, 2008 and June 14, 2009. Coho and Chinook salmon were captured on all sampling dates and locations. Total salmonid catch rates were significantly (t-test, $p < 0.05$) different in August, with average catch rates near 40 fish/trap 9 km upstream of the PUF, and 12 fish per trap downstream (Figure 10). Differences also were significant for catches of coho and Chinook salmon with significantly more fish per trap upstream.

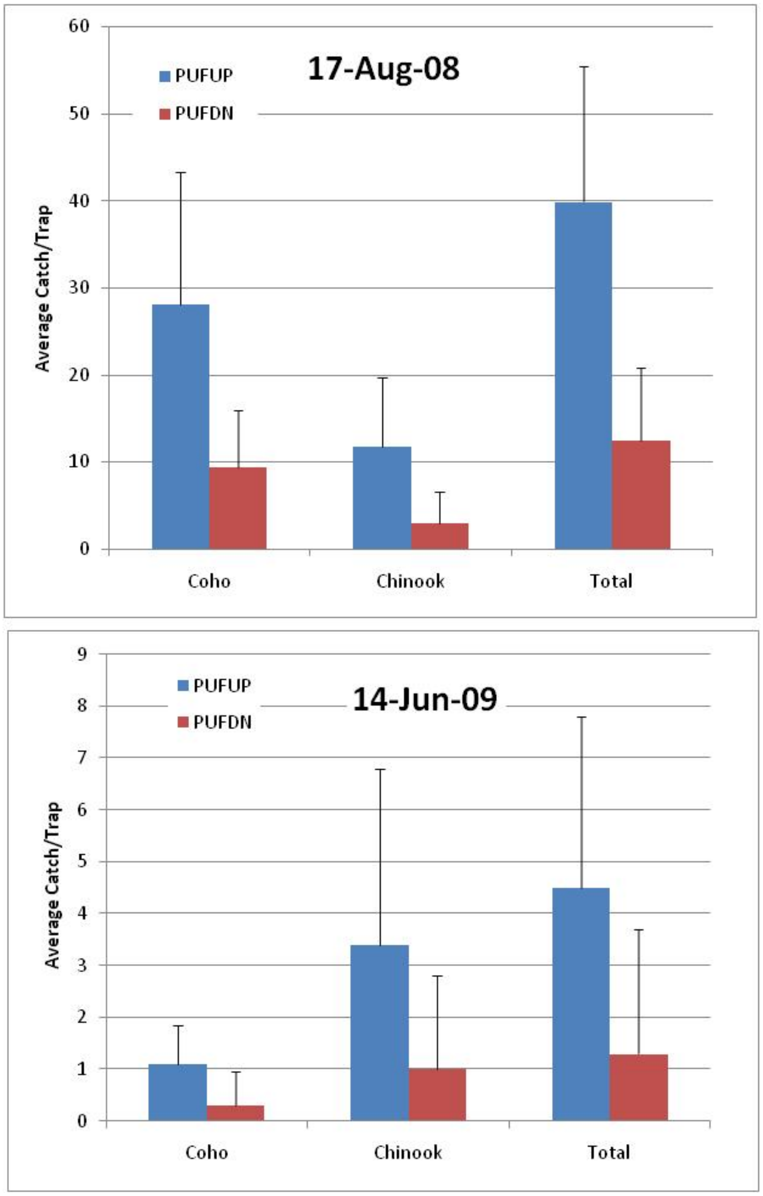

Figure 10. Average salmonid catch rates/trap (n=10) for sites located above and below the PUF in August 2008 and June 2009 showing the higher relative upstream catch rates. Differences were significant for all comparisons except for June Chinook salmon (p=0.08).

Overall, total catches were lower in June; however, total catch per trap, coho salmon catch per trap and Chinook salmon catch per trap were all significantly higher upstream. Coho salmon dominated the catch at both up and downstream locations during August but were less common than Chinook salmon in the spring.

The average concentration of organisms within the drift also was greater upstream. Differences were only significant however, in the spring. The number of food organisms increased by approximately 1.5 per m^3 at the upstream reference location (Figure 11).

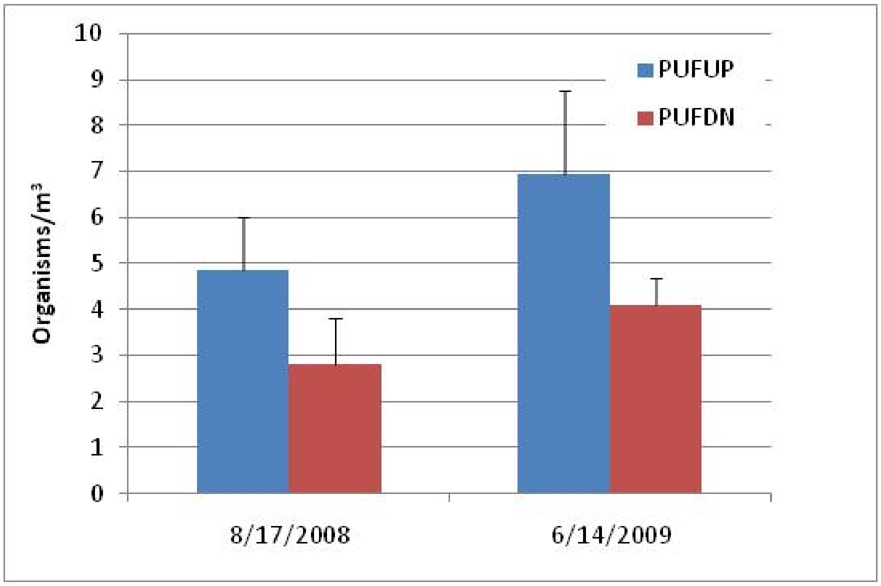

Figure 11. Average (n=3) concentrations of aquatic invertebrates captured in drift samples above and below the PUF. Differences were significant in June 2009.

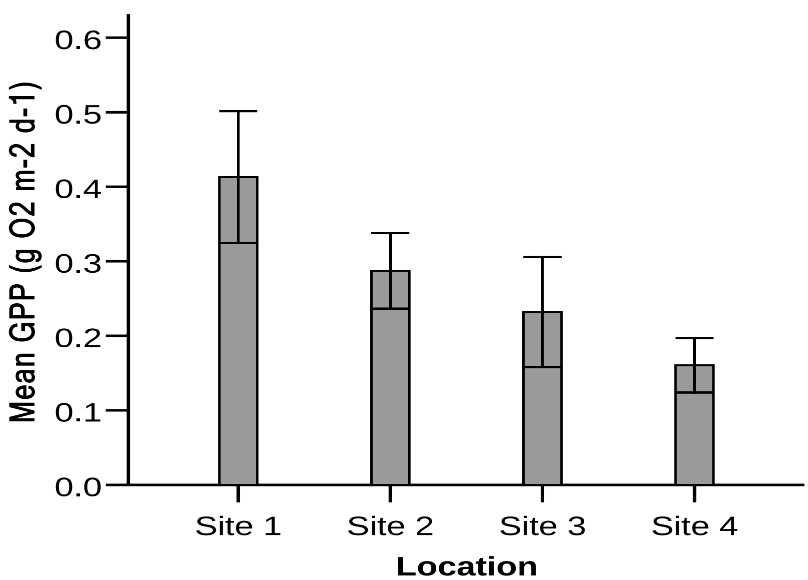

Figure 12. Average GPP for locations upstream and downstream of the PUF. Site 1 was at PUFUP (9 km upstream); Site 2 was approximately 1 km downstream from Site 1. Sites 3 and 4 were located at 2.5 and 3.5 km downstream from the PUF boat launch, respectively.

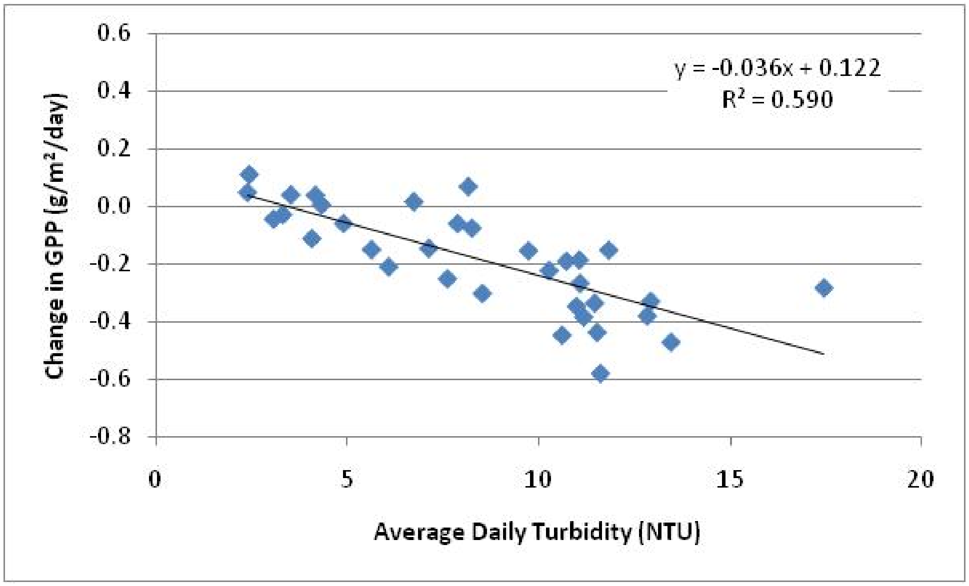

Figure 13. Relationship between the upstream to downstream change in GPP and average daily turbidity measured at PUFDN when turbidity is below 14 NTU.

The drift was dominated by Trichoptera larva (brachcentridae) at both locations in August 2009, and by Diptera (chironomidae and simulidae) during spring sampling.

Mean daily gross primary production decreased from upstream to downstream with significant differences between organic matter production at the upstream reference site and downstream of the PUF. Average GPP decreased consistently downstream to 0.5 times upstream values (Figure 12). The difference in GPP was negatively correlated to stream water turbidity when turbidity was between 1 and 14 NTU (Figure 13). There was no relationship between turbidity and average daily NTU at higher values.

Discussion

Concentrations of TAH

The intensive use of the Lower Little Susitna River is causing changes to the physical and chemical environment, is resulting in concentrations of hydrocarbons and turbidity that exceed state water quality standards, and appears to be affecting the aquatic community. Motor boats on the Lower Little Susitna River are used for recreation, and to access fishing and hunting locations. The highest use periods in 2008 were during the first three weeks in June and the first three weeks in August, which accounted for approximately 60% of the seasonal use (May 22 through Sept 4), which coincides with the peak Chinook and coho fisheries. Concentrations of TAH increased concurrently with increased boat use resulting in concentrations that exceeded state standards. However, high boat use did not result in concentrations above state water quality standards under conditions of high flow.

Regression analyses did not reveal a relationship between boat use and hydrocarbon concentrations. However, there were significant regression relationships between boat use and hydrocarbons when we corrected for changes in discharge. Fuel loss from 2-cycle motors is considered to be the primary cause of hydrocarbon contamination, and we expected the number of 2-cycle motors to explain most of the variability in hydrocarbon concentrations. The slightly weeker relationship with 2-cycle motors compared to total boat counts may be due to high variability in hydrocarbon discharge among 2-cycle motors. That is, considering only 2-cycle motors, hydrocarbon discharge from one boat may have a disproportional effect on resulting TAH concentrations and regression relationships, particularly when counts are low.

State water quality standards for TAH were exceeded on 3 or 4 dates out of 15 or 20% of the time. Sampling was conducted on Sundays, which, on average, were the busiest day of the week and during the middle of the day. These data, therefore, may overestimate the portion of days that the water quality standards were exceeded. However, the percent of days when concentrations were estimated to exceed 10 μg/L decreased only slightly, to 18%, when based on models for 2008 using boat counts for all days. While Sunday sampling did not account for low use days, it also did not include other high use days (Friday and Saturday). Maximum boat use per week was, on average, higher on Sundays, but for many weeks use was as high or higher on Fridays or Saturdays.

We did not observe any consistent decrease in hydrocarbon concentrations from the launch to 4.0 km downstream. We expected concentrations to decline with distance as molecules moved to, and evaporated from the water surface. However, either rates of downstream transportation must exceed rates of vertical migration and evaporation, or hydrocarbons discharged into the water as boats traveled downstream equaled loss rates. TAH concentrations were lower at sites upstream from the boat launch (LS-1 and LS-2) on 6 of the 12 sampling dates when hydrocarbons were present. Concentrations should be lower upstream since only a portion of the total boats travel in that direction.

Since TAH concentrations are related to total boat counts/hr and discharge, and boat counts/hr are related to daily boat counts at the entrance booth, we can use this relationship to predict exceedances from daily booth counts (Figure 14). Water quality exceedances can be predicted from discharge at the PUF and daily booth counts. Since discharge at the PUF is related to discharge 3 days previous in Hatcher Pass, the total number of boats that can enter the launch and still maintain water quality standards can be determined in advance by monitoring flows at the U.S.G.S gauging station. The current model can be improved over time with additional data and continuous monitoring downstream of the launch can ensure that water quality standards are maintained and allow for model adjustments over time.

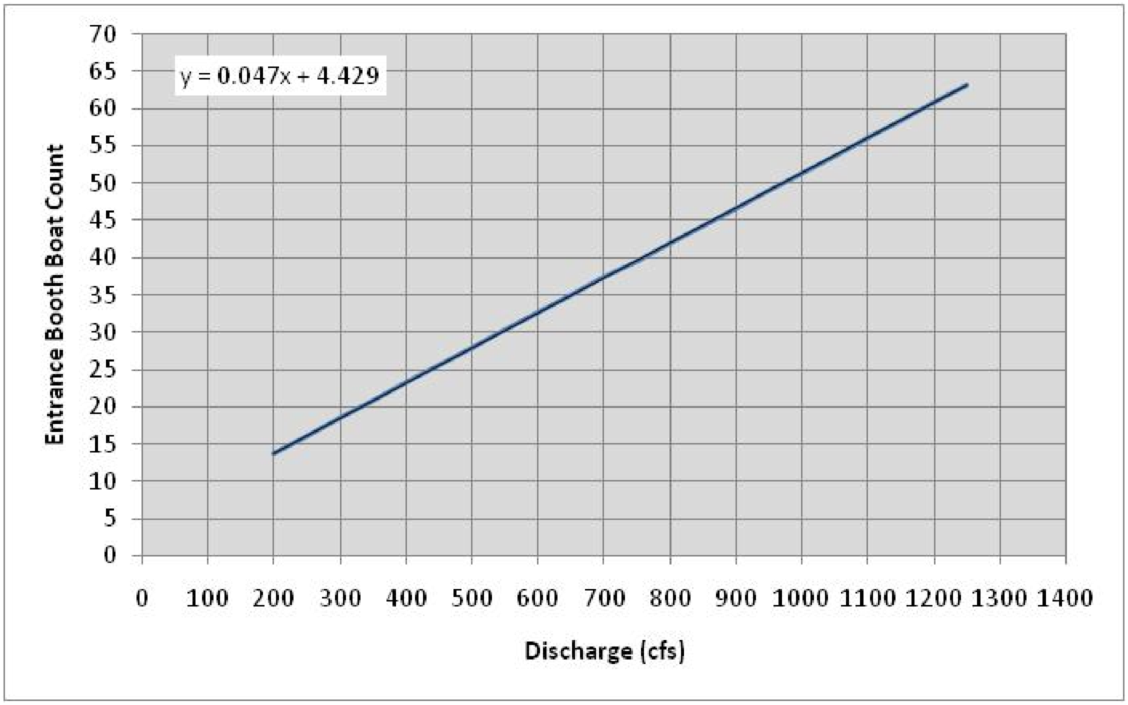

Figure 14. Estimate of the total number of boats counted at the entrance booth as a function of discharge that will result in TAH concentrations that exceed state standards.

Turbidity

The relationship between turbidity in the Lower Little Susitna River, boat use, and discharge is not clear. Stream water turbidity at reference sites located upstream of the PUF either 9 km upstream or at Miller's Reach are below 5 NTU on most sampling dates. Average turbidity at Miller's Reach based upon 35 grab samples collected from August 2006 to June 2009 is 3.7 NTU (Davis and Davis 2007, 2008). This average is consistent with turbidity data from samples collected at multiple locations in Hatcher Pass (Goldmint Trailhead to Edgerton Park Bridge) where average turbidity from 60 grab samples collected from 2006 through 2008 is 3.2 NTU (Davis and Davis 2008b, 2009b). Average turbidity from 35 grab samples collected below the PUF, on the same dates as those at Miller's reach, was 8.0 NTU. Based upon the average of grab samples, there is a 0.5 NTU difference in average turbidity between Hatcher Pass and Houston, and a 4.3 NTU difference between Houston and the PUF. Maximum differences between grab samples at Miller's Reach and the PUF occur during periods of high boat use in the Lower River.

Hourly Hydrolab turbidity monitoring showed greater differences between reference sites and sites below the PUF than the grab samples did. Average daily turbidity commonly differed by 10 to 20 NTU during heavy use periods based upon Hydrolab data compared to differences of 5 to 10 NTU based on grab samples. The Hydrolabs measured intermittent high turbidity values, up to 100 NTU, that likely occurred when turbidity recorded short-term increases following the passage of a boat, resulting in higher daily averages. We delayed collecting grab samples until approximately 10 minutes after reaching a sampling location or if there was an obvious increase after a boat passed. Therefore, average daily turbidity is probably a more accurate measure of turbidity differences between sites.

Turbidity at all sites increased with rising flows during spring runoff or storm events. However, this only explained a portion of the variability in turbidity. There was not a good relationship between daily boat use and turbidity or differences in turbidity with reference sites. However, large differences in turbidity that extended over weeks did coincide with higher average daily boat use. Increases in suspended sediment are visible as waves from boats entrain particles into the water column from shallow nearshore areas, wash in sediments from the bank, or suspend sediments from the stream bottom in shallow water as the jet intake draws water and sediment from the stream bed. Changes in nearshore turbidity following boat-induced waves have been documented previously (Hill et al. 2002). The influence of an individual boat however, will depend upon wave size that varies with hull shape, boat size, speed, and weight, bank types and water depths (Maynord 2001). The size of suspended particles also will influence sedimentation rates and the length of time particles are in the water column. Suspended sediments are more likely to remain in the water column if the water column is intermittently mixed due to jet intake or boat waves.

Increases in turbidity is likely resulting in changes to the biotic community. Considerable work has been conducted evaluating the impact of turbidity on primary production, macroinvertebrates and fish. Loyd et al. (1987) and Lloyd (1987) summarized these affects for Alaska streams and evaluated the effectiveness of Alaska Water Quality Standards. Lloyd et al. (1987) predicted a decrease in GPP of approximately 50% in streams with an average depth of 0.5 m with turbidity increases of near 25 NTU. Results of productivity measures on the Lower Little Susitna River are consistent with these findings. We measured an average decrease of 50% of reference GPP with tubidity differences of 10 to 20 NTU. Similarly, regression equations showed a change of -0.5 in GPP with a 14 NTU increase in turbidity. We measured an approximately 60% decline in macroinvertebrates in the drift between reference sites and sites located below the PUF. Lloyd et al. (1987) found that turbidity explained the greatest difference in macroinvertebrate density between mined and unmined streams. Increases in turbidity negatively affect fish metabolism, feeding ability, and behavior (Newcombe and Jensen 1996). We found a significant decrease in juvenile coho and Chinook salmon catch rates with increasing turbidity.

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Appendix A. Water Sample Results and Quality Objectives

Quality Objectives and Criteria for Measurement of Data

Water sampling results are provided in the following table. Water samples were collected on 15 dates which meets the completeness objective. One additional mid-week sampling event was scheduled during peak the Chinook fishery; however, this sampling date was eliminated due to the relatively low number of returning fish and a rapid decline in use. All field meters were calibrated as proposed and met accuracy criteria. Analyses of grab samples for turbidity did not meet precision measurements during initial sampling in the Fall of 2008 with precision from replicates greater than 20%. Due to the variability in replicate samples collected at the same location, sampling was modified so that three measures of turbidity were collected at each site on each sampling date and the average of these measures reported. Hydrocarbons were not detected in any of the field or trip blanks. Laboratory accuracy measures were within acceptable limits on all sampling dates. Differences between replicate samples TAH measures averaged 1.7 μg/L. The maximum TAH difference was 5.6 μg/L, with site LS-7 value below detection and the replicate value at 5.6 μg/L. A result below detection limits was used for this sampling date. Differences of 2 to 3 μg/L between replicates were found on 7 dates. At a 3 μg/L difference, precision criteria are not met when the lowest value is below 13 μg/L. This occurred on 5 sampling dates and on one date affected whether or not water quality standards were met. On this date, June 7, 2009, samples from LS-1 to LS-7 ranged from 9.1 to 12.7 μg/L, with concentrations at two sites above water quality standards.

Date	Site	Measurement	Value	Units
7/27/2008	LS-1	Temperature	10.6	Celsius
7/27/2008	LS-1	Discharge	830.2	csf
7/27/2008	LS-1	Latitude	61.44252	decimal degrees
7/27/2008	LS-1	Longitude	150.15929	decimal degrees
7/27/2008	LS-1	Benzene	<0.5	µg/L
7/27/2008	LS-1	D.O. mg/L	11.12	µg/L
7/27/2008	LS-1	Ethyl Benzene	0.63	µg/L
7/27/2008	LS-1	Toluene	1.01	µg/L
7/27/2008	LS-1	Total Xylene	1.18	µg/L
7/27/2008	LS-1	TAH	2.82	µg/L
7/27/2008	LS-1	Specific Conductivity	70.2	microS/cm
7/27/2008	LS-1	Turbidity	8.35	NTU
7/27/2008	LS-1	D.O. %	100.1	Percent Saturation
7/27/2008	LS-1	pH	7.64	
7/27/2008	LS-2	Latitude	61.44239	decimal degrees
7/27/2008	LS-2	Longitude	150.16745	decimal degrees
7/27/2008	LS-2	Benzene	<0.5	µg/L
7/27/2008	LS-2	Ethyl Benzene	0.59	µg/L
7/27/2008	LS-2	Toluene	1.19	µg/L
7/27/2008	LS-2	Total Xylene	1.78	µg/L
7/27/2008	LS-2	TAH	3.56	µg/L
7/27/2008	LS-3	Latitude	61.43782	decimal degrees
7/27/2008	LS-3	Longitude	150.17391	decimal degrees
7/27/2008	LS-3	Benzene	<0.5	µg/L
7/27/2008	LS-3	Ethyl Benzene	<0.5	µg/L
7/27/2008	LS-3	Toluene	0.98	µg/L
7/27/2008	LS-3	Total Xylene	1.5	µg/L
7/27/2008	LS-3	TAH	2.48	µg/L
7/27/2008	LS-4	Latitude	61.43518	decimal degrees
7/27/2008	LS-4	Longitude	150.17468	decimal degrees
7/27/2008	LS-4	Benzene	<0.5	µg/L
7/27/2008	LS-4	Ethyl Benzene	<0.5	µg/L
7/27/2008	LS-4	Toluene	0.86	µg/L
7/27/2008	LS-4	Total Xylene	1.23	µg/L
7/27/2008	LS-4	TAH	2.09	µg/L
7/27/2008	LS-5	Latitude	61.43345	decimal degrees
7/27/2008	LS-5	Longitude	150.17239	decimal degrees
7/27/2008	LS-5	Benzene	<0.5	µg/L
7/27/2008	LS-5	Ethyl Benzene	<0.5	µg/L
7/27/2008	LS-5	Toluene	0.84	µg/L
7/27/2008	LS-5	Total Xylene	1.16	µg/L
7/27/2008	LS-5	TAH	2.00	µg/L
7/27/2008	LS-6	Latitude	61.43077	decimal degrees
7/27/2008	LS-6	Longitude	150.18342	decimal degrees
7/27/2008	LS-6	Benzene	<0.5	µg/L
7/27/2008	LS-6	Ethyl Benzene	<0.5	µg/L
7/27/2008	LS-6	Toluene	0.99	µg/L
7/27/2008	LS-6	Total Xylene	1.39	µg/L

Date	Site	Measurement	Value	Units
7/27/2008	LS-6	TAH	2.38	µg/L
7/27/2008	LS-7	Temperature	11.6	Celsius
7/27/2008	LS-7	Latitude	61.42389	decimal degrees
7/27/2008	LS-7	Longitude	150.18958	decimal degrees
7/27/2008	LS-7	Benzene	<0.5	µg/L
7/27/2008	LS-7	D.O. mg/L	11.01	mg/L
7/27/2008	LS-7	Ethyl Benzene	0.7	µg/L
7/27/2008	LS-7	Toluene	1.65	µg/L
7/27/2008	LS-7	Total Xylene	1.22	µg/L
7/27/2008	LS-7	TAH	3.57	µg/L
7/27/2008	LS-7	Specific Conductivity	70.5	microS/cm
7/27/2008	LS-7	Turbidity	12.20	NTU
7/27/2008	LS-7	D.O. %	101.3	Percent Saturation
7/27/2008	LS-7	pH	7.36	
7/27/2008	LS-7X	Benzene	<0.5	µg/L
7/27/2008	LS-7X	Ethyl Benzene	1.04	µg/L
7/27/2008	LS-7X	Toluene	2.43	µg/L
7/27/2008	LS-7X	Total Xylene	3.37	µg/L
7/27/2008	LS-7X	TAH	6.84	µg/L
7/27/2008	My Creek	Temperature	13.7	Celsius
7/27/2008	My Creek	D.O. mg/L	9.8	mg/L
7/27/2008	My Creek	Specific Conductivity	173.1	microS/cm
7/27/2008	My Creek	Turbidity	0.15	NTU
7/27/2008	My Creek	D.O. %	94.2	Percent Saturation
8/2/2008	LS-1	Temperature	12.3	Celsius
8/2/2008	LS-1	Discharge	485.02	cfs
8/2/2008	LS-1	Benzene	8.91	µg/L
8/2/2008	LS-1	D.O. mg/L	10.38	mg/L
8/2/2008	LS-1	Ethyl Benzene	1.46	µg/L
8/2/2008	LS-1	Toluene	2.81	µg/L
8/2/2008	LS-1	Total Xylene	3.99	µg/L
8/2/2008	LS-1	TAH	17.17	µg/L
8/2/2008	LS-1	Turbidity	1.06	NTU
8/2/2008	LS-1	D.O. %	96.9	Percent Saturation
8/2/2008	LS-1	pH	7.64	
8/2/2008	LS-2	Benzene	8.83	µg/L
8/2/2008	LS-2	Ethyl Benzene	1.13	µg/L
8/2/2008	LS-2	Toluene	2.62	µg/L
8/2/2008	LS-2	Total Xylene	3.54	µg/L
8/2/2008	LS-2	TAH	16.12	µg/L
8/2/2008	LS-3	Benzene	9.88	µg/L
8/2/2008	LS-3	Ethyl Benzene	1.28	µg/L
8/2/2008	LS-3	Toluene	2.93	µg/L
8/2/2008	LS-3	Total Xylene	4	µg/L
8/2/2008	LS-3	TAH	18.09	µg/L
8/2/2008	LS-4	Benzene	6.84	µg/L
8/2/2008	LS-4	Ethyl Benzene	0.87	µg/L
8/2/2008	LS-4	Toluene	2.01	µg/L
8/2/2008	LS-4	Total Xylene	2.72	µg/L
8/2/2008	LS-4	TAH	12.44	µg/L

Date	Site	Measurement	Value	Units
8/2/2008	LS-5	Benzene	13.2	µg/L
8/2/2008	LS-5	Ethyl Benzene	1.67	µg/L
8/2/2008	LS-5	Toluene	3.9	µg/L
8/2/2008	LS-5	Total Xylene	5.17	µg/L
8/2/2008	LS-5	TAH	23.94	µg/L
8/2/2008	LS-6	Benzene	10.3	µg/L
8/2/2008	LS-6	Ethyl Benzene	1.24	µg/L
8/2/2008	LS-6	Toluene	2.95	µg/L
8/2/2008	LS-6	Total Xylene	3.83	µg/L
8/2/2008	LS-6	TAH	18.32	µg/L
8/2/2008	LS-7	Temperature	12.4	Celsius
8/2/2008	LS-7	Benzene	9.68	µg/L
8/2/2008	LS-7	D.O. mg/L	10.33	mg/L
8/2/2008	LS-7	Ethyl Benzene	1.2	µg/L
8/2/2008	LS-7	Toluene	2.92	µg/L
8/2/2008	LS-7	Total Xylene	3.77	µg/L
8/2/2008	LS-7	TAH	17.57	µg/L
8/2/2008	LS-7	Turbidity	4.86	NTU
8/2/2008	LS-7	D.O. %	96.6	Percent Saturation
8/2/2008	LS-7	pH	7.67	
8/2/2008	LS-7X	Benzene	10.1	µg/L
8/2/2008	LS-7X	Ethyl Benzene	1.59	µg/L
8/2/2008	LS-7X	Toluene	2	µg/L
8/2/2008	LS-7X	Total Xylene	4.02	µg/L
8/2/2008	LS-7X	TAH	17.71	µg/L
8/2/2008	LS-7X	Turbidity	8.92	NTU
8/2/2008	LS-Houston	Turbidity	0.16	NTU
8/10/2008	LS-1	Temperature	11.0	Celsius
8/10/2008	LS-1	Discharge	525.24	cfs
8/10/2008	LS-1	Benzene	6.68	µg/L
8/10/2008	LS-1	D.O. mg/L	11.76	mg/L
8/10/2008	LS-1	Ethyl Benzene	1	µg/L
8/10/2008	LS-1	Toluene	2.2	µg/L
8/10/2008	LS-1	Total Xylene	3.34	µg/L
8/10/2008	LS-1	TAH	13.22	µg/L
8/10/2008	LS-1	Turbidity	4.57	NTU
8/10/2008	LS-1	D.O. %	106.4	Percent Saturation
8/10/2008	LS-1	pH	7.66	
8/10/2008	LS-2	Benzene	8.16	µg/L
8/10/2008	LS-2	Ethyl Benzene	1.21	µg/L
8/10/2008	LS-2	Toluene	2.85	µg/L
8/10/2008	LS-2	Total Xylene	3.89	µg/L
8/10/2008	LS-2	TAH	16.11	µg/L
8/10/2008	LS-3	Benzene	12	µg/L
8/10/2008	LS-3	Ethyl Benzene	1.82	µg/L
8/10/2008	LS-3	Toluene	4.06	µg/L
8/10/2008	LS-3	Total Xylene	5.58	µg/L
8/10/2008	LS-3	TAH	23.46	µg/L
8/10/2008	LS-4	Benzene	15.7	µg/L
8/10/2008	LS-4	Ethyl Benzene	2.34	µg/L

Date	Site	Measurement	Value	Units
8/10/2008	LS-4	Toluene	5.3	µg/L
8/10/2008	LS-4	Total Xylene	7.48	µg/L
8/10/2008	LS-4	TAH	30.82	µg/L
8/10/2008	LS-5	Benzene	13.2	µg/L
8/10/2008	LS-5	Ethyl Benzene	2.01	µg/L
8/10/2008	LS-5	Toluene	4.4	µg/L
8/10/2008	LS-5	Total Xylene	6.45	µg/L
8/10/2008	LS-5	TAH	26.06	µg/L
8/10/2008	LS-6	Benzene	14.3	µg/L
8/10/2008	LS-6	Ethyl Benzene	2.14	µg/L
8/10/2008	LS-6	Toluene	4.89	µg/L
8/10/2008	LS-6	Total Xylene	6.96	µg/L
8/10/2008	LS-6	TAH	28.29	µg/L
8/10/2008	LS-7	Temperature	12.0	Celsius
8/10/2008	LS-7	Benzene	14	µg/L
8/10/2008	LS-7	D.O. mg/L	11.53	mg/L
8/10/2008	LS-7	Ethyl Benzene	2.11	µg/L
8/10/2008	LS-7	Toluene	4.88	µg/L
8/10/2008	LS-7	Total Xylene	6.75	µg/L
8/10/2008	LS-7	TAH	27.74	µg/L
8/10/2008	LS-7	Turbidity	10.97	NTU
8/10/2008	LS-7	D.O. %	107.4	Percent Saturation
8/10/2008	LS-7	pH	7.77	
8/10/2008	LS-7X	Benzene	14	µg/L
8/10/2008	LS-7X	Ethyl Benzene	2.12	µg/L
8/10/2008	LS-7X	Toluene	4.86	µg/L
8/10/2008	LS-7X	Total Xylene	7.09	µg/L
8/10/2008	LS-7X	TAH	28.07	µg/L
8/10/2008	LS-7X	Turbidity	11.80	NTU
8/10/2008	LS-Houston	Turbidity	4.40	NTU
8/13/2008	LS-1	Temperature	11.8	Celsius
8/13/2008	LS-1	Discharge	478.8	cfs
8/13/2008	LS-1	Benzene	2.32	µg/L
8/13/2008	LS-1	D.O. mg/L	10.94	mg/L
8/13/2008	LS-1	Ethyl Benzene	<0.5	µg/L
8/13/2008	LS-1	Toluene	0.79	µg/L
8/13/2008	LS-1	Total Xylene	1.2	µg/L
8/13/2008	LS-1	TAH	4.31	µg/L
8/13/2008	LS-1	Specific Conductivity	65.6	microS/cm
8/13/2008	LS-1	Turbidity	5.91	NTU
8/13/2008	LS-1	D.O. %	101.1	Percent Saturation
8/13/2008	LS-1	pH	7.64	
8/13/2008	LS-2	Benzene	2.31	µg/L
8/13/2008	LS-2	Ethyl Benzene	<0.5	µg/L
8/13/2008	LS-2	Toluene	0.78	µg/L
8/13/2008	LS-2	Total Xylene	1.12	µg/L
8/13/2008	LS-2	TAH	4.21	µg/L
8/13/2008	LS-2	Turbidity	9.65	NTU
8/13/2008	LS-3	Benzene	3.64	µg/L
8/13/2008	LS-3	Ethyl Benzene	<0.5	µg/L

Date	Site	Measurement	Value	Units
8/13/2008	LS-3	Toluene	1.05	µg/L
8/13/2008	LS-3	Total Xylene	1.49	µg/L
8/13/2008	LS-3	TAH	6.18	µg/L
8/13/2008	LS-3	Turbidity	9.48	NTU
8/13/2008	LS-4	Benzene	2.9	µg/L
8/13/2008	LS-4	Ethyl Benzene	<0.5	µg/L
8/13/2008	LS-4	Toluene	0.97	µg/L
8/13/2008	LS-4	Total Xylene	1.35	µg/L
8/13/2008	LS-4	TAH	5.22	µg/L
8/13/2008	LS-4	Turbidity	7.50	NTU
8/13/2008	LS-5	Benzene	5.58	µg/L
8/13/2008	LS-5	Ethyl Benzene	0.81	µg/L
8/13/2008	LS-5	Toluene	1.97	µg/L
8/13/2008	LS-5	Total Xylene	2.69	µg/L
8/13/2008	LS-5	TAH	11.05	µg/L
8/13/2008	LS-5	Turbidity	4.25	NTU
8/13/2008	LS-6	Benzene	8.28	µg/L
8/13/2008	LS-6	Ethyl Benzene	1.36	µg/L
8/13/2008	LS-6	Toluene	2.78	µg/L
8/13/2008	LS-6	Total Xylene	4.08	µg/L
8/13/2008	LS-6	TAH	16.50	µg/L
8/13/2008	LS-6	Turbidity	7.19	NTU
8/13/2008	LS-7	Benzene	5.03	µg/L
8/13/2008	LS-7	Ethyl Benzene	0.92	µg/L
8/13/2008	LS-7	Toluene	1.74	µg/L
8/13/2008	LS-7	Total Xylene	3.03	µg/L
8/13/2008	LS-7	TAH	10.72	µg/L
8/13/2008	LS-7	Turbidity	7.48	NTU
8/13/2008	LS-7X	Benzene	6.12	µg/L
8/13/2008	LS-7X	Ethyl Benzene	1.19	µg/L
8/13/2008	LS-7X	Toluene	2.28	µg/L
8/13/2008	LS-7X	Total Xylene	4.12	µg/L
8/13/2008	LS-7X	TAH	13.71	µg/L
8/13/2008	LS-Houston	Turbidity	2.48	NTU
8/14/2008	LS-7	Temperature	12.6	Celsius
8/14/2008	LS-7	D.O. mg/L	10.73	mg/L
8/14/2008	LS-7	Specific Conductivity	65.7	microS/cm
8/14/2008	LS-7	D.O. %	100.7	Percent Saturation
8/14/2008	LS-7	pH	7.59	
8/17/2008	LS-1	Temperature	11.8	Celsius
8/17/2008	LS-1	Benzene	12.1	µg/L
8/17/2008	LS-1	D.O. mg/L	10.85	mg/L
8/17/2008	LS-1	Ethyl Benzene	2.22	µg/L
8/17/2008	LS-1	Toluene	4.5	µg/L
8/17/2008	LS-1	Total Xylene	7.37	µg/L
8/17/2008	LS-1	TAH	26.19	µg/L
8/17/2008	LS-1	Specific Conductivity	72.2	microS/cm
8/17/2008	LS-1	Turbidity	7.27	NTU
8/17/2008	LS-1	D.O. %	100.4	Percent Saturation
8/17/2008	LS-1	pH	7.7	

Date	Site	Measurement	Value	Units
8/17/2008	LS-2	Temperature	12.1	Celsius
8/17/2008	LS-2	Benzene	11.9	µg/L
8/17/2008	LS-2	D.O. mg/L	10.77	mg/L
8/17/2008	LS-2	Ethyl Benzene	2.37	µg/L
8/17/2008	LS-2	Toluene	4.8	µg/L
8/17/2008	LS-2	Total Xylene	8.02	µg/L
8/17/2008	LS-2	TAH	27.09	µg/L
8/17/2008	LS-2	Specific Conductivity	72.7	microS/cm
8/17/2008	LS-2	Turbidity	11.60	NTU
8/17/2008	LS-2	D.O. %	100.1	Percent Saturation
8/17/2008	LS-2	pH	7.74	
8/17/2008	LS-3	Benzene	12.4	µg/L
8/17/2008	LS-3	Ethyl Benzene	2.42	µg/L
8/17/2008	LS-3	Toluene	4.93	µg/L
8/17/2008	LS-3	Total Xylene	8.12	µg/L
8/17/2008	LS-3	TAH	27.87	µg/L
8/17/2008	LS-3	Turbidity	8.40	NTU
8/17/2008	LS-3	Turbidity	9.06	NTU
8/17/2008	LS-4	Benzene	10.1	µg/L
8/17/2008	LS-4	Ethyl Benzene	2	µg/L
8/17/2008	LS-4	Toluene	3.77	µg/L
8/17/2008	LS-4	Total Xylene	6.46	µg/L
8/17/2008	LS-4	TAH	22.33	µg/L
8/17/2008	LS-4	Turbidity	7.05	NTU
8/17/2008	LS-5	Benzene	<0.5	µg/L
8/17/2008	LS-5	Ethyl Benzene	1.12	µg/L
8/17/2008	LS-5	Toluene	<0.5	µg/L
8/17/2008	LS-5	Total Xylene	1.33	µg/L
8/17/2008	LS-5	TAH	2.45	µg/L
8/17/2008	LS-5	Turbidity	9.26	NTU
8/17/2008	LS-6	Benzene	<0.5	µg/L
8/17/2008	LS-6	Ethyl Benzene	<0.5	µg/L
8/17/2008	LS-6	Toluene	<0.5	µg/L
8/17/2008	LS-6	Total Xylene	<1	µg/L
8/17/2008	LS-6	TAH	0.00	µg/L
8/17/2008	LS-6	Turbidity	11.60	NTU
8/17/2008	LS-7	Temperature	12.4	Celsius
8/17/2008	LS-7	Benzene	0.91	µg/L
8/17/2008	LS-7	D.O. mg/L	10.66	mg/L
8/17/2008	LS-7	Ethyl Benzene	<0.5	µg/L
8/17/2008	LS-7	Toluene	2.36	µg/L
8/17/2008	LS-7	Total Xylene	1.56	µg/L
8/17/2008	LS-7	TAH	4.83	µg/L
8/17/2008	LS-7	Specific Conductivity	74.1	microS/cm
8/17/2008	LS-7	Turbidity	8.93	NTU
8/17/2008	LS-7	D.O. %	99.7	Percent Saturation
8/17/2008	LS-7	pH	7.72	
8/17/2008	LS-7X	Benzene	1.28	µg/L
8/17/2008	LS-7X	Ethyl Benzene	<0.5	µg/L
8/17/2008	LS-7X	Toluene	3.09	µg/L

Date	Site	Measurement	Value	Units
8/17/2008	LS-7X	Total Xylene	2.96	μg/L
8/17/2008	LS-7X	TAH	7.33	μg/L
8/17/2008	LS-7X	Turbidity	9.58	NTU
8/18/2008	LS-1	Discharge	386.61	cfs
8/18/2008	LS-Houston	Turbidity	3.06	NTU
8/18/2008	LS-Houston	Turbidity	1.97	NTU
8/18/2008	LS-Houston	Turbidity	2.58	NTU
8/24/2008	LS-1	Temperature	11.3	Celsius
8/24/2008	LS-1	Discharge	378.5	cfs
8/24/2008	LS-1	Benzene	2.6	μg/L
8/24/2008	LS-1	D.O. mg/L	11.24	mg/L
8/24/2008	LS-1	Ethyl Benzene	1.58	μg/L
8/24/2008	LS-1	Toluene	1.03	μg/L
8/24/2008	LS-1	Total Xylene	1.67	μg/L
8/24/2008	LS-1	TAH	6.88	μg/L
8/24/2008	LS-1	Specific Conductivity	72.9	microS/cm
8/24/2008	LS-1	Turbidity	5.86	NTU
8/24/2008	LS-1	Turbidity	4.86	NTU
8/24/2008	LS-1	Turbidity	7.70	NTU
8/24/2008	LS-1	D.O. %	102.8	Percent Saturation
8/24/2008	LS-1	pH	7.69	
8/24/2008	LS-2	Benzene	2.64	μg/L
8/24/2008	LS-2	Ethyl Benzene	1.52	μg/L
8/24/2008	LS-2	Toluene	0.98	μg/L
8/24/2008	LS-2	Total Xylene	1.67	μg/L
8/24/2008	LS-2	TAH	6.81	μg/L
8/24/2008	LS-2	Turbidity	8.17	NTU
8/24/2008	LS-2	Turbidity	7.05	NTU
8/24/2008	LS-2	Turbidity	7.05	NTU
8/24/2008	LS-3	Benzene	2.96	μg/L
8/24/2008	LS-3	Ethyl Benzene	0.6	μg/L
8/24/2008	LS-3	Toluene	1.22	μg/L
8/24/2008	LS-3	Total Xylene	2.04	μg/L
8/24/2008	LS-3	TAH	6.82	μg/L
8/24/2008	LS-3	Turbidity	6.39	NTU
8/24/2008	LS-3	Turbidity	6.52	NTU
8/24/2008	LS-3	Turbidity	5.96	NTU
8/24/2008	LS-4	Benzene	4.84	μg/L
8/24/2008	LS-4	Ethyl Benzene	0.84	μg/L
8/24/2008	LS-4	Toluene	1.76	μg/L
8/24/2008	LS-4	Total Xylene	2.91	μg/L
8/24/2008	LS-4	TAH	10.35	μg/L
8/24/2008	LS-4	Turbidity	6.08	NTU
8/24/2008	LS-4	Turbidity	5.88	NTU
8/24/2008	LS-4	Turbidity	6.05	NTU
8/24/2008	LS-5	Benzene	3.86	μg/L
8/24/2008	LS-5	Ethyl Benzene	0.73	μg/L
8/24/2008	LS-5	Toluene	1.39	μg/L
8/24/2008	LS-5	Total Xylene	2.46	μg/L
8/24/2008	LS-5	TAH	8.44	μg/L
8/24/2008	LS-5	Turbidity	7.55	NTU

Date	Site	Measurement	Value	Units
8/24/2008	LS-5	Turbidity	6.32	NTU
8/24/2008	LS-5	Turbidity	7.75	NTU
8/24/2008	LS-6	Benzene	3.27	µg/L
8/24/2008	LS-6	Ethyl Benzene	0.64	µg/L
8/24/2008	LS-6	Toluene	1.3	µg/L
8/24/2008	LS-6	Total Xylene	2.3	µg/L
8/24/2008	LS-6	TAH	7.51	µg/L
8/24/2008	LS-6	Turbidity	7.26	NTU
8/24/2008	LS-6	Turbidity	8.36	NTU
8/24/2008	LS-6	Turbidity	8.95	NTU
8/24/2008	LS-7	Temperature	12.0	Celsius
8/24/2008	LS-7	Benzene	4.15	µg/L
8/24/2008	LS-7	D.O. mg/L	11.03	mg/L
8/24/2008	LS-7	Ethyl Benzene	0.79	µg/L
8/24/2008	LS-7	Toluene	1.66	µg/L
8/24/2008	LS-7	Total Xylene	2.74	µg/L
8/24/2008	LS-7	TAH	9.34	µg/L
8/24/2008	LS-7	Specific Conductivity	75.7	microS/cm
8/24/2008	LS-7	Turbidity	10.63	NTU
8/24/2008	LS-7	Turbidity	7.98	NTU
8/24/2008	LS-7	Turbidity	6.51	NTU
8/24/2008	LS-7	Turbidity	7.83	NTU
8/24/2008	LS-7	D.O. %	102.3	Percent Saturation
8/24/2008	LS-7	pH	7.62	
8/24/2008	LS-7X	Benzene	4.14	µg/L
8/24/2008	LS-7X	Ethyl Benzene	0.8	µg/L
8/24/2008	LS-7X	Toluene	1.63	µg/L
8/24/2008	LS-7X	Total Xylene	2.76	µg/L
8/24/2008	LS-7X	TAH	9.33	µg/L
8/24/2008	LS-Houston	Turbidity	1.12	NTU
8/24/2008	LS-Houston	Turbidity	1.26	NTU
8/24/2008	LS-Houston	Turbidity	1.26	NTU
8/30/2008	LS-1	Temperature	13.0	Celsius
8/30/2008	LS-1	Discharge	385.54	cfs
8/30/2008	LS-1	Benzene	<0.5	µg/L
8/30/2008	LS-1	Ethyl Benzene	<0.5	µg/L
8/30/2008	LS-1	Toluene	<0.5	µg/L
8/30/2008	LS-1	Total Xylene	<1	µg/L
8/30/2008	LS-1	TAH	0.00	µg/L
8/30/2008	LS-1	Specific Conductivity	70.6	microS/cm
8/30/2008	LS-1	Turbidity	5.92	NTU
8/30/2008	LS-1	Turbidity	7.38	NTU
8/30/2008	LS-1	Turbidity	7.43	NTU
8/30/2008	LS-1	pH	7.73	
8/30/2008	LS-2	Benzene	<0.5	µg/L
8/30/2008	LS-2	Ethyl Benzene	<0.5	µg/L
8/30/2008	LS-2	Toluene	<0.5	µg/L
8/30/2008	LS-2	Total Xylene	<1	µg/L
8/30/2008	LS-2	TAH	0.00	µg/L
8/30/2008	LS-2	Turbidity	6.53	NTU
8/30/2008	LS-2	Turbidity	7.11	NTU

Date	Site	Measurement	Value	Units
8/30/2008	LS-2	Turbidity	7.49	NTU
8/30/2008	LS-3	Benzene	<0.5	μg/L
8/30/2008	LS-3	Ethyl Benzene	<0.5	μg/L
8/30/2008	LS-3	Toluene	<0.5	μg/L
8/30/2008	LS-3	Total Xylene	<1	μg/L
8/30/2008	LS-3	TAH	0.00	μg/L
8/30/2008	LS-3	Turbidity	5.57	NTU
8/30/2008	LS-3	Turbidity	6.20	NTU
8/30/2008	LS-3	Turbidity	5.40	NTU
8/30/2008	LS-4	Benzene	<0.5	μg/L
8/30/2008	LS-4	Ethyl Benzene	<0.5	μg/L
8/30/2008	LS-4	Toluene	<0.5	μg/L
8/30/2008	LS-4	Total Xylene	<1	μg/L
8/30/2008	LS-4	TAH	0.00	μg/L
8/30/2008	LS-4	Turbidity	6.45	NTU
8/30/2008	LS-4	Turbidity	7.58	NTU
8/30/2008	LS-4	Turbidity	6.91	NTU
8/30/2008	LS-5	Benzene	<0.5	μg/L
8/30/2008	LS-5	Ethyl Benzene	<0.5	μg/L
8/30/2008	LS-5	Toluene	<0.5	μg/L
8/30/2008	LS-5	Total Xylene	<1	μg/L
8/30/2008	LS-5	TAH	0.00	μg/L
8/30/2008	LS-5	Turbidity	7.26	NTU
8/30/2008	LS-5	Turbidity	9.17	NTU
8/30/2008	LS-5	Turbidity	6.11	NTU
8/30/2008	LS-6	Benzene	<0.5	μg/L
8/30/2008	LS-6	Ethyl Benzene	<0.5	μg/L
8/30/2008	LS-6	Toluene	<0.5	μg/L
8/30/2008	LS-6	Total Xylene	<1	μg/L
8/30/2008	LS-6	TAH	0.00	μg/L
8/30/2008	LS-6	Turbidity	5.51	NTU
8/30/2008	LS-6	Turbidity	6.79	NTU
8/30/2008	LS-6	Turbidity	8.30	NTU
8/30/2008	LS-7	Temperature	13.3	Celsius
8/30/2008	LS-7	Benzene	<0.5	μg/L
8/30/2008	LS-7	Ethyl Benzene	<0.5	μg/L
8/30/2008	LS-7	Toluene	<0.5	μg/L
8/30/2008	LS-7	Total Xylene	<1	μg/L
8/30/2008	LS-7	TAH	0.00	μg/L
8/30/2008	LS-7	Specific Conductivity	72.7	micrS/cm
8/30/2008	LS-7	Turbidity	6.62	NTU
8/30/2008	LS-7	Turbidity	7.30	NTU
8/30/2008	LS-7	Turbidity	7.09	NTU
8/30/2008	LS-7	pH	7.7	
8/30/2008	LS-7X	Benzene	<0.5	μg/L
8/30/2008	LS-7X	Ethyl Benzene	<0.5	μg/L
8/30/2008	LS-7X	Toluene	<0.5	μg/L
8/30/2008	LS-7X	Total Xylene	<1	μg/L
8/30/2008	LS-7X	TAH	0.00	μg/L
8/30/2008	LS-Houston	Turbidity	0.41	NTU

Date	Site	Measurement	Value	Units
8/30/2008	LS-Houston	Turbidity	0.61	NTU
8/30/2008	LS-Houston	Turbidity	0.04	NTU
9/6/2008	LS-1	Temperature	10.9	Celsius
9/6/2008	LS-1	Discharge	325.02	cfs
9/6/2008	LS-1	Benzene	<0.5	μg/L
9/6/2008	LS-1	D.O. mg/L	11.39	mg/L
9/6/2008	LS-1	Ethyl Benzene	<0.5	μg/L
9/6/2008	LS-1	Toluene	<0.5	μg/L
9/6/2008	LS-1	Total Xylene	<1	μg/L
9/6/2008	LS-1	TAH	0.00	μg/L
9/6/2008	LS-1	Specific Conductivity	100.8	microS/cm
9/6/2008	LS-1	Turbidity	3.16	NTU
9/6/2008	LS-1	Turbidity	2.04	NTU
9/6/2008	LS-1	Turbidity	3.56	NTU
9/6/2008	LS-1	D.O. %	102.5	Percent Saturation
9/6/2008	LS-1	pH	7.92	
9/6/2008	LS-2	Benzene	<0.5	μg/L
9/6/2008	LS-2	Ethyl Benzene	<0.5	μg/L
9/6/2008	LS-2	Toluene	<0.5	μg/L
9/6/2008	LS-2	Total Xylene	<1	μg/L
9/6/2008	LS-2	TAH	0.00	μg/L
9/6/2008	LS-2	Turbidity	2.28	NTU
9/6/2008	LS-2	Turbidity	3.00	NTU
9/6/2008	LS-2	Turbidity	4.39	NTU
9/6/2008	LS-3	Benzene	<0.5	μg/L
9/6/2008	LS-3	Ethyl Benzene	<0.5	μg/L
9/6/2008	LS-3	Toluene	<0.5	μg/L
9/6/2008	LS-3	Total Xylene	<1	μg/L
9/6/2008	LS-3	TAH	0.00	μg/L
9/6/2008	LS-3	Turbidity	3.44	NTU
9/6/2008	LS-3	Turbidity	3.70	NTU
9/6/2008	LS-3	Turbidity	2.51	NTU
9/6/2008	LS-4	Benzene	<0.5	μg/L
9/6/2008	LS-4	Ethyl Benzene	<0.5	μg/L
9/6/2008	LS-4	Toluene	<0.5	μg/L
9/6/2008	LS-4	Total Xylene	<1	μg/L
9/6/2008	LS-4	TAH	0.00	μg/L
9/6/2008	LS-4	Turbidity	2.64	NTU
9/6/2008	LS-4	Turbidity	3.05	NTU
9/6/2008	LS-4	Turbidity	3.27	NTU
9/6/2008	LS-5	Benzene	<0.5	μg/L
9/6/2008	LS-5	Ethyl Benzene	<0.5	μg/L
9/6/2008	LS-5	Toluene	<0.5	μg/L
9/6/2008	LS-5	Total Xylene	<1	μg/L
9/6/2008	LS-5	TAH	0.00	μg/L
9/6/2008	LS-5	Turbidity	3.67	NTU
9/6/2008	LS-5	Turbidity	3.89	NTU
9/6/2008	LS-5	Turbidity	3.57	NTU
9/6/2008	LS-6	Benzene	<0.5	μg/L

Date	Site	Measurement	Value	Units
9/6/2008	LS-6	Ethyl Benzene	0.52	µg/L
9/6/2008	LS-6	Toluene	0.86	µg/L
9/6/2008	LS-6	Total Xylene	1.53	µg/L
9/6/2008	LS-6	TAH	2.91	µg/L
9/6/2008	LS-6	Turbidity	5.36	NTU
9/6/2008	LS-6	Turbidity	4.98	NTU
9/6/2008	LS-6	Turbidity	7.09	NTU
9/6/2008	LS-7	Temperature	11.2	Celsius
9/6/2008	LS-7	Benzene	<0.5	µg/L
9/6/2008	LS-7	D.O. mg/L	11.23	mg/L
9/6/2008	LS-7	Ethyl Benzene	<0.5	µg/L
9/6/2008	LS-7	Toluene	<0.5	µg/L
9/6/2008	LS-7	Total Xylene	<1	µg/L
9/6/2008	LS-7	Specific Conductivity	101.7	microS/cm
9/6/2008	LS-7	Turbidity	6.11	NTU
9/6/2008	LS-7	Turbidity	6.64	NTU
9/6/2008	LS-7	Turbidity	7.48	NTU
9/6/2008	LS-7	D.O. %	101	Percent Saturation
9/6/2008	LS-7	pH	7.69	
9/6/2008	LS-7X	Benzene	2.34	µg/L
9/6/2008	LS-7X	Ethyl Benzene	0.54	µg/L
9/6/2008	LS-7X	Toluene	0.87	µg/L
9/6/2008	LS-7X	Total Xylene	1.88	µg/L
9/6/2008	LS-7X	TAH	5.63	µg/L
9/6/2008	LS-Houston	Turbidity	1.36	NTU
9/6/2008	LS-Houston	Turbidity	0.81	NTU
9/6/2008	LS-Houston	Turbidity	2.63	NTU
5/17/2009	Houston	turbidity	10.52	NTU
5/17/2009	Houston	Turbidity	8.86	NTU
5/17/2009	Houston	Turbidity	8.27	NTU
5/17/2009	Houston	Temp Logger	2004066	
5/17/2009	LS-1	D.O. %	98.9	%
5/17/2009	LS-1	Temperature	7.6	Celsius
5/17/2009	LS-1	Temperature	7.6	Celsius
5/17/2009	LS-1	Discharge	927.1	cfs
5/17/2009	LS-1	Benzene	<1	µg/L
5/17/2009	LS-1	D.O. mg/L	11.8	mg/L
5/17/2009	LS-1	Ethyl Benzene	<1	µg/L
5/17/2009	LS-1	m,p Xylene	<1	µg/L
5/17/2009	LS-1	o-Xylene	<1	µg/L
5/17/2009	LS-1	TAH	0.00	µg/L
5/17/2009	LS-1	Toluene	<1	µg/L
5/17/2009	LS-1	Total Xylenes	<1	µg/L
5/17/2009	LS-1	Specific Conductivity	79.9	microS/cm
5/17/2009	LS-1	Turbidity	8.53	NTU
5/17/2009	LS-1	Turbidity	12.70	NTU
5/17/2009	LS-1	Turbidity	10.86	NTU
5/17/2009	LS-1	pH	7.52	
5/17/2009	LS-2	D.O. %	93.8	%
5/17/2009	LS-2	Temperature	8.1	Celsius

Date	Site	Measurement	Value	Units
5/17/2009	LS-2	Temperature	8.1	Celsius
5/17/2009	LS-2	Benzene	<1	µg/L
5/17/2009	LS-2	D.O. mg/L	11.06	mg/L
5/17/2009	LS-2	Ethyl Benzene	<1	µg/L
5/17/2009	LS-2	m,p Xylene	<1	µg/L
5/17/2009	LS-2	o-Xylene	<1	µg/L
5/17/2009	LS-2	TAH	0.00	µg/L
5/17/2009	LS-2	Toluene	<1	µg/L
5/17/2009	LS-2	Total Xylenes	<1	µg/L
5/17/2009	LS-2	Specific Conductivity	80.4	microS/cm
5/17/2009	LS-2	Turbidity	17.60	NTU
5/17/2009	LS-2	Turbidity	15.10	NTU
5/17/2009	LS-2	Turbidity	17.80	NTU
5/17/2009	LS-2	pH	7.57	
5/17/2009	LS-3	D.O. %	95.6	%
5/17/2009	LS-3	Temperature	8.1	Celsius
5/17/2009	LS-3	Temperature	8.2	Celsius
5/17/2009	LS-3	Benzene	<1	µg/L
5/17/2009	LS-3	D.O. mg/L	11.28	mg/L
5/17/2009	LS-3	Ethyl Benzene	<1	µg/L
5/17/2009	LS-3	m,p Xylene	<1	µg/L
5/17/2009	LS-3	o-Xylene	<1	µg/L
5/17/2009	LS-3	TAH	0.00	µg/L
5/17/2009	LS-3	Toluene	<1	µg/L
5/17/2009	LS-3	Total Xylenes	<1	µg/L
5/17/2009	LS-3	Specific Conductivity	81.5	microS/cm
5/17/2009	LS-3	Turbidity	12.80	NTU
5/17/2009	LS-3	Turbidity	15.20	NTU
5/17/2009	LS-3	Turbidity	10.95	NTU
5/17/2009	LS-3	pH	7.54	
5/17/2009	LS-4	D.O. %	95.6	%
5/17/2009	LS-4	Temperature	8.3	Celsius
5/17/2009	LS-4	Temperature	8.3	Celsius
5/17/2009	LS-4	Benzene	<1	µg/L
5/17/2009	LS-4	D.O. mg/L	11.24	mg/L
5/17/2009	LS-4	Ethyl Benzene	<1	µg/L
5/17/2009	LS-4	m,p Xylene	<1	µg/L
5/17/2009	LS-4	o-Xylene	<1	µg/L
5/17/2009	LS-4	TAH	1.00	µg/L
5/17/2009	LS-4	Toluene	<1	µg/L
5/17/2009	LS-4	Total Xylenes	1	µg/L
5/17/2009	LS-4	Specific Conductivity	81.1	microS/cm
5/17/2009	LS-4	Turbidity	10.12	NTU
5/17/2009	LS-4	Turbidity	15.80	NTU
5/17/2009	LS-4	Turbidity	13.20	NTU
5/17/2009	LS-4	pH	7.56	
5/17/2009	LS-5	D.O. %	95.4	%
5/17/2009	LS-5	Temperature	8.5	Celsius
5/17/2009	LS-5	Temperature	8.5	Celsius
5/17/2009	LS-5	Benzene	<1	µg/L
5/17/2009	LS-5	D.O. mg/L	11.18	mg/L

Date	Site	Measurement	Value	Units
5/17/2009	LS-5	Ethyl Benzene	<1	μg/L
5/17/2009	LS-5	m,p Xylene	<1	μg/L
5/17/2009	LS-5	o-Xylene	<1	μg/L
5/17/2009	LS-5	TAH	0.00	μg/L
5/17/2009	LS-5	Toluene	<1	μg/L
5/17/2009	LS-5	Total Xylenes	<1	μg/L
5/17/2009	LS-5	Specific Conductivity	81.1	microS/cm
5/17/2009	LS-5	Turbidity	11.70	NTU
5/17/2009	LS-5	Turbidity	11.80	NTU
5/17/2009	LS-5	Turbidity	13.90	NTU
5/17/2009	LS-5	pH	7.54	
5/17/2009	LS-6	D.O. %	95.5	%
5/17/2009	LS-6	Temperature	8.6	Celsius
5/17/2009	LS-6	Temperature	8.6	Celsius
5/17/2009	LS-6	Benzene	<1	μg/L
5/17/2009	LS-6	D.O. mg/L	11.13	mg/L
5/17/2009	LS-6	Ethyl Benzene	<1	μg/L
5/17/2009	LS-6	m,p Xylene	<1	μg/L
5/17/2009	LS-6	o-Xylene	<1	μg/L
5/17/2009	LS-6	TAH	0.00	μg/L
5/17/2009	LS-6	Toluene	<1	μg/L
5/17/2009	LS-6	Total Xylenes	<1	μg/L
5/17/2009	LS-6	Specific Conductivity	81.1	microS/cm
5/17/2009	LS-6	Turbidity	12.10	NTU
5/17/2009	LS-6	Turbidity	11.00	NTU
5/17/2009	LS-6	Turbidity		NTU
5/17/2009	LS-6	pH	7.55	
5/17/2009	LS-7	D.O. %	95.1	%
5/17/2009	LS-7	Temperature	8.7	Celsius
5/17/2009	LS-7	Temperature	8.7	Celsius
5/17/2009	LS-7	Benzene	<1	μg/L
5/17/2009	LS-7	D.O. mg/L	11.08	mg/L
5/17/2009	LS-7	Ethyl Benzene	<1	μg/L
5/17/2009	LS-7	m,p Xylene	<1	μg/L
5/17/2009	LS-7	o-Xylene	<1	μg/L
5/17/2009	LS-7	TAH	0.00	μg/L
5/17/2009	LS-7	Toluene	<1	μg/L
5/17/2009	LS-7	Total Xylenes	<1	μg/L
5/17/2009	LS-7	Specific Conductivity	81.1	microS/cm
5/17/2009	LS-7	Turbidity	11.50	NTU
5/17/2009	LS-7	Turbidity	11.60	NTU
5/17/2009	LS-7	Turbidity	13.40	NTU
5/17/2009	LS-7	pH	7.54	
5/17/2009	LS-7x	Benzene	<1	μg/L
5/17/2009	LS-7x	Ethyl Benzene	<1	μg/L
5/17/2009	LS-7x	m,p Xylene	<1	μg/L
5/17/2009	LS-7x	o-Xylene	<1	μg/L
5/17/2009	LS-7x	TAH	0.00	μg/L
5/17/2009	LS-7x	Toluene	<1	μg/L
5/17/2009	LS-7x	Total Xylenes	<1	μg/L
5/24/2009	Houston	Hach Latitude	61.62196	decimal degrees

Date	Site	Measurement	Value	Units
5/24/2009	Houston	Hach Longitude	149.89702	decimal degrees
5/24/2009	Houston	Turbidity	4.88	NTU
5/24/2009	Houston	Turbidity	6.34	NTU
5/24/2009	Houston	Turbidity	5.90	NTU
5/24/2009	LS-1	D.O. %	102.7	%
5/24/2009	LS-1	Temperature	9.4	Celsius
5/24/2009	LS-1	Temperature	9.6	Celsius
5/24/2009	LS-1	Discharge	832.97	cfs
5/24/2009	LS-1	Benzene	1.1	µg/L
5/24/2009	LS-1	D.O. mg/L	11.71	mg/L
5/24/2009	LS-1	Ethyl Benzene	<1	µg/L
5/24/2009	LS-1	m,p Xylene	<1	µg/L
5/24/2009	LS-1	o-Xylene	<1	µg/L
5/24/2009	LS-1	TAH	3.10	µg/L
5/24/2009	LS-1	Toluene	2	µg/L
5/24/2009	LS-1	Total Xylenes	<1	µg/L
5/24/2009	LS-1	Specific Conductivity	79.5	microS/cm
5/24/2009	LS-1	Turbidity	9.02	NTU
5/24/2009	LS-1	Turbidity	10.49	NTU
5/24/2009	LS-1	Turbidity	10.49	NTU
5/24/2009	LS-1	pH	7.95	
5/24/2009	LS-2	D.O. %	101.5	%
5/24/2009	LS-2	Temperature	9.6	Celsius
5/24/2009	LS-2	Temperature	9.8	Celsius
5/24/2009	LS-2	Benzene	1.9	µg/L
5/24/2009	LS-2	D.O. mg/L	11.51	mg/L
5/24/2009	LS-2	Ethyl Benzene	<1	µg/L
5/24/2009	LS-2	m,p Xylene	<1	µg/L
5/24/2009	LS-2	o-Xylene	<1	µg/L
5/24/2009	LS-2	TAH	4.20	µg/L
5/24/2009	LS-2	Toluene	2.3	µg/L
5/24/2009	LS-2	Total Xylenes	<1	µg/L
5/24/2009	LS-2	Specific Conductivity	70.6	microS/cm
5/24/2009	LS-2	Turbidity	9.96	NTU
5/24/2009	LS-2	Turbidity	12.10	NTU
5/24/2009	LS-2	Turbidity		NTU
5/24/2009	LS-2	pH	7.59	
5/24/2009	LS-3	D.O. %	101.8	%
5/24/2009	LS-3	Temperature	9.8	Celsius
5/24/2009	LS-3	Temperature	10.0	Celsius
5/24/2009	LS-3	Benzene	3.8	µg/L
5/24/2009	LS-3	D.O. mg/L	11.47	mg/L
5/24/2009	LS-3	Ethyl Benzene	<1	µg/L
5/24/2009	LS-3	m,p Xylene	<1	µg/L
5/24/2009	LS-3	o-Xylene	<1	µg/L
5/24/2009	LS-3	TAH	8.30	µg/L
5/24/2009	LS-3	Toluene	4.5	µg/L
5/24/2009	LS-3	Total Xylenes	<1	µg/L
5/24/2009	LS-3	Specific Conductivity	80.8	microS/cm
5/24/2009	LS-3	Turbidity	12.50	NTU
5/24/2009	LS-3	Turbidity	10.91	NTU

Date	Site	Measurement	Value	Units
5/24/2009	LS-3	Turbidity	9.47	NTU
5/24/2009	LS-3	pH	7.6	
5/24/2009	LS-4	D.O. %	102.3	%
5/24/2009	LS-4	Temperature	10.0	Celsius
5/24/2009	LS-4	Temperature	10.2	Celsius
5/24/2009	LS-4	Benzene	2.2	µg/L
5/24/2009	LS-4	D.O. mg/L	11.48	mg/L
5/24/2009	LS-4	Ethyl Benzene	<1	µg/L
5/24/2009	LS-4	m,p Xylene	<1	µg/L
5/24/2009	LS-4	o-Xylene	<1	µg/L
5/24/2009	LS-4	TAH	6.80	µg/L
5/24/2009	LS-4	Toluene	3.5	µg/L
5/24/2009	LS-4	Total Xylenes	1.1	µg/L
5/24/2009	LS-4	Specific Conductivity	80.6	microS/cm
5/24/2009	LS-4	Turbidity	13.30	NTU
5/24/2009	LS-4	Turbidity	14.70	NTU
5/24/2009	LS-4	Turbidity	12.90	NTU
5/24/2009	LS-4	pH	7.57	
5/24/2009	LS-5	D.O. %	102.5	%
5/24/2009	LS-5	Temperature	10.4	Celsius
5/24/2009	LS-5	Temperature	10.2	Celsius
5/24/2009	LS-5	Benzene	2.2	µg/L
5/24/2009	LS-5	D.O. mg/L	11.47	mg/L
5/24/2009	LS-5	Ethyl Benzene	<1	µg/L
5/24/2009	LS-5	m,p Xylene	<1	µg/L
5/24/2009	LS-5	o-Xylene	<1	µg/L
5/24/2009	LS-5	TAH	5.00	µg/L
5/24/2009	LS-5	Toluene	2.8	µg/L
5/24/2009	LS-5	Total Xylenes	<1	µg/L
5/24/2009	LS-5	Specific Conductivity	80.6	microS/cm
5/24/2009	LS-5	Turbidity	12.20	NTU
5/24/2009	LS-5	Turbidity	10.38	NTU
5/24/2009	LS-5	Turbidity	12.30	NTU
5/24/2009	LS-5	pH	7.56	
5/24/2009	LS-6	D.O. %	102.6	%
5/24/2009	LS-6	Temperature	10.5	Celsius
5/24/2009	LS-6	Temperature	10.3	Celsius
5/24/2009	LS-6	Benzene	3.2	µg/L
5/24/2009	LS-6	D.O. mg/L	11.44	mg/L
5/24/2009	LS-6	Ethyl Benzene	<1	µg/L
5/24/2009	LS-6	m,p Xylene	<1	µg/L
5/24/2009	LS-6	o-Xylene	<1	µg/L
5/24/2009	LS-6	TAH	9.20	µg/L
5/24/2009	LS-6	Toluene	6	µg/L
5/24/2009	LS-6	Total Xylenes	<1	µg/L
5/24/2009	LS-6	Specific Conductivity	80.7	microS/cm
5/24/2009	LS-6	Turbidity	16.00	NTU
5/24/2009	LS-6	Turbidity	14.00	NTU
5/24/2009	LS-6	Turbidity	14.70	NTU
5/24/2009	LS-6	pH	7.54	
5/24/2009	LS-7	D.O. %	102.5	%

Date	Site	Measurement	Value	Units
5/24/2009	LS-7	Temperature	10.7	Celsius
5/24/2009	LS-7	Temperature	10.4	Celsius
5/24/2009	LS-7	Benzene	2.2	µg/L
5/24/2009	LS-7	D.O. mg/L	11.4	mg/L
5/24/2009	LS-7	Ethyl Benzene	<1	µg/L
5/24/2009	LS-7	m,p Xylene	<1	µg/L
5/24/2009	LS-7	o-Xylene	<1	µg/L
5/24/2009	LS-7	TAH	6.90	µg/L
5/24/2009	LS-7	Toluene	4.7	µg/L
5/24/2009	LS-7	Total Xylenes	<1	µg/L
5/24/2009	LS-7	Specific Conductivity	80.8	microS/cm
5/24/2009	LS-7	Turbidity	12.60	NTU
5/24/2009	LS-7	Turbidity	11.90	NTU
5/24/2009	LS-7	Turbidity	12.60	NTU
5/24/2009	LS-7	pH	7.52	
5/24/2009	LS-7x	Benzene	2	µg/L
5/24/2009	LS-7x	Ethyl Benzene	<1	µg/L
5/24/2009	LS-7x	m,p Xylene	<1	µg/L
5/24/2009	LS-7x	o-Xylene	<1	µg/L
5/24/2009	LS-7x	TAH	4.50	µg/L
5/24/2009	LS-7x	Toluene	2.5	µg/L
5/24/2009	LS-7x	Total Xylenes	<1	µg/L
5/31/2009	Houston	Turbidity	2.92	NTU
5/31/2009	Houston	Turbidity	5.75	NTU
5/31/2009	Houston	Turbidity	4.04	NTU
5/31/2009	LS-1	D.O. %	101.5	%
5/31/2009	LS-1	Temperature	8.6	Celsius
5/31/2009	LS-1	Temperature	8.0	Celsius
5/31/2009	LS-1	Discharge	804.08	cfs
5/31/2009	LS-1	Benzene	<1	µg/L
5/31/2009	LS-1	D.O. mg/L	12.02	mg/L
5/31/2009	LS-1	Ethyl Benzene	<1	µg/L
5/31/2009	LS-1	m,p Xylene	<1	µg/L
5/31/2009	LS-1	o-Xylene	<1	µg/L
5/31/2009	LS-1	TAH	0.00	µg/L
5/31/2009	LS-1	Toluene	<1	µg/L
5/31/2009	LS-1	Total Xylenes	<1	µg/L
5/31/2009	LS-1	Specific Conductivity	81.5	microS/cm
5/31/2009	LS-1	Turbidity	11.90	NTU
5/31/2009	LS-1	Turbidity	9.48	NTU
5/31/2009	LS-1	Turbidity	8.47	NTU
5/31/2009	LS-1	pH	7.65	
5/31/2009	LS-2	D.O. %	101.5	%
5/31/2009	LS-2	Temperature	8.8	Celsius
5/31/2009	LS-2	Temperature	8.3	Celsius
5/31/2009	LS-2	Benzene	<1	µg/L
5/31/2009	LS-2	D.O. mg/L	11.94	mg/L
5/31/2009	LS-2	Ethyl Benzene	<1	µg/L
5/31/2009	LS-2	m,p Xylene	<1	µg/L
5/31/2009	LS-2	o-Xylene	<1	µg/L
5/31/2009	LS-2	TAH	0.00	µg/L

Date	Site	Measurement	Value	Units
5/31/2009	LS-2	Toluene	<1	μg/L
5/31/2009	LS-2	Total Xylenes	<1	μg/L
5/31/2009	LS-2	Specific Conductivity	58.1	microS/cm
5/31/2009	LS-2	Turbidity	7.47	NTU
5/31/2009	LS-2	Turbidity	7.70	NTU
5/31/2009	LS-2	Turbidity	9.76	NTU
5/31/2009	LS-2	pH	7.7	
5/31/2009	LS-3	D.O. %	101.6	%
5/31/2009	LS-3	Temperature	8.9	Celsius
5/31/2009	LS-3	Temperature	8.4	Celsius
5/31/2009	LS-3	Benzene	1.3	μg/L
5/31/2009	LS-3	D.O. mg/L	11.92	mg/L
5/31/2009	LS-3	Ethyl Benzene	<1	μg/L
5/31/2009	LS-3	m,p Xylene	<1	μg/L
5/31/2009	LS-3	o-Xylene	<1	μg/L
5/31/2009	LS-3	TAH	3.70	μg/L
5/31/2009	LS-3	Toluene	2.4	μg/L
5/31/2009	LS-3	Total Xylenes	<1	μg/L
5/31/2009	LS-3	Specific Conductivity	83.8	microS/cm
5/31/2009	LS-3	Turbidity	7.76	NTU
5/31/2009	LS-3	Turbidity	8.56	NTU
5/31/2009	LS-3	Turbidity	11.40	NTU
5/31/2009	LS-3	pH	7.67	
5/31/2009	LS-4	D.O. %	101.7	%
5/31/2009	LS-4	Temperature	9.0	Celsius
5/31/2009	LS-4	Temperature	8.4	Celsius
5/31/2009	LS-4	Benzene	<1	μg/L
5/31/2009	LS-4	D.O. mg/L	11.93	mg/L
5/31/2009	LS-4	Ethyl Benzene	<1	μg/L
5/31/2009	LS-4	m,p Xylene	<1	μg/L
5/31/2009	LS-4	o-Xylene	<1	μg/L
5/31/2009	LS-4	TAH	0.00	μg/L
5/31/2009	LS-4	Toluene	<1	μg/L
5/31/2009	LS-4	Total Xylenes	<1	μg/L
5/31/2009	LS-4	Specific Conductivity	83.4	microS/cm
5/31/2009	LS-4	Turbidity	9.60	NTU
5/31/2009	LS-4	Turbidity	7.61	NTU
5/31/2009	LS-4	Turbidity	10.68	NTU
5/31/2009	LS-4	pH	7.67	
5/31/2009	LS-5	D.O. %	101.6	%
5/31/2009	LS-5	Temperature	9.1	Celsius
5/31/2009	LS-5	Temperature	8.5	Celsius
5/31/2009	LS-5	Benzene	<1	μg/L
5/31/2009	LS-5	D.O. mg/L	11.87	mg/L
5/31/2009	LS-5	Ethyl Benzene	<1	μg/L
5/31/2009	LS-5	m,p Xylene	<1	μg/L
5/31/2009	LS-5	o-Xylene	<1	μg/L
5/31/2009	LS-5	TAH	0.00	μg/L
5/31/2009	LS-5	Toluene	<1	μg/L
5/31/2009	LS-5	Total Xylenes	<1	μg/L
5/31/2009	LS-5	Specific Conductivity	83.5	microS/cm

Date	Site	Measurement	Value	Units
5/31/2009	LS-5	Turbidity	9.39	NTU
5/31/2009	LS-5	Turbidity	8.96	NTU
5/31/2009	LS-5	Turbidity	9.95	NTU
5/31/2009	LS-5	pH	7.66	
5/31/2009	LS-6	D.O. %	101.3	%
5/31/2009	LS-6	Temperature	9.1	Celsius
5/31/2009	LS-6	Temperature	8.6	Celsius
5/31/2009	LS-6	Benzene	<1	μg/L
5/31/2009	LS-6	D.O. mg/L	11.84	mg/L
5/31/2009	LS-6	Ethyl Benzene	<1	μg/L
5/31/2009	LS-6	m,p Xylene	<1	μg/L
5/31/2009	LS-6	o-Xylene	<1	μg/L
5/31/2009	LS-6	TAH	1.40	μg/L
5/31/2009	LS-6	Toluene	1.4	μg/L
5/31/2009	LS-6	Total Xylenes	<1	μg/L
5/31/2009	LS-6	Specific Conductivity	8.36	microS/cm
5/31/2009	LS-6	Turbidity	10.58	NTU
5/31/2009	LS-6	Turbidity	8.74	NTU
5/31/2009	LS-6	Turbidity	10.41	NTU
5/31/2009	LS-6	pH	7.65	
5/31/2009	LS-7	D.O. %	101.2	%
5/31/2009	LS-7	Temperature	9.3	Celsius
5/31/2009	LS-7	Temperature	8.7	Celsius
5/31/2009	LS-7	Benzene	1.5	μg/L
5/31/2009	LS-7	D.O. mg/L	11.79	mg/L
5/31/2009	LS-7	Ethyl Benzene	<1	μg/L
5/31/2009	LS-7	m,p Xylene	<1	μg/L
5/31/2009	LS-7	o-Xylene	<1	μg/L
5/31/2009	LS-7	TAH	3.60	μg/L
5/31/2009	LS-7	Toluene	2.1	μg/L
5/31/2009	LS-7	Total Xylenes	<1	μg/L
5/31/2009	LS-7	Specific Conductivity	83.4	microS/cm
5/31/2009	LS-7	Turbidity	10.37	NTU
5/31/2009	LS-7	Turbidity	9.73	NTU
5/31/2009	LS-7	Turbidity	11.30	NTU
5/31/2009	LS-7	pH	7.65	
5/31/2009	LS-7x	Benzene	1.2	μg/L
5/31/2009	LS-7x	Ethyl Benzene	<1	μg/L
5/31/2009	LS-7x	m,p Xylene	<1	μg/L
5/31/2009	LS-7x	o-Xylene	<1	μg/L
5/31/2009	LS-7x	TAH	1.40	μg/L
5/31/2009	LS-7x	Toluene	2	μg/L
5/31/2009	LS-7x	Total Xylenes	<1	μg/L
6/7/2009	LS-1	D.O. %	104.1	%
6/7/2009	LS-1	Temperature	10.9	Celsius
6/7/2009	LS-1	Temperature	10.4	Celsius
6/7/2009	LS-1	Discharge	857	cfs
6/7/2009	LS-1	Benzene	<1	μg/L
6/7/2009	LS-1	D.O. mg/L	11.66	μg/L
6/7/2009	LS-1	Ethyl Benzene	<1	μg/L
6/7/2009	LS-1	m,p Xylene	<1	μg/L

Date	Site	Measurement	Value	Units
6/7/2009	LS-1	o-Xylene	<1	µg/L
6/7/2009	LS-1	TAH	0.00	µg/L
6/7/2009	LS-1	Toluene	<1	µg/L
6/7/2009	LS-1	Total Xylenes	<1	µg/L
6/7/2009	LS-1	Specific Conductivity	76.9	microS/cm
6/7/2009	LS-1	Turbidity	11.30	NTU
6/7/2009	LS-1	Turbidity	16.30	NTU
6/7/2009	LS-1	Turbidity	13.30	NTU
6/7/2009	LS-1	pH	7.66	
6/7/2009	LS-2	D.O. %	104.1	%
6/7/2009	LS-2	Temperature	11.3	Celsius
6/7/2009	LS-2	Temperature	10.7	Celsius
6/7/2009	LS-2	Benzene	<1	µg/L
6/7/2009	LS-2	D.O. mg/L	11.58	mg/L
6/7/2009	LS-2	Ethyl Benzene	<1	µg/L
6/7/2009	LS-2	m,p Xylene	<1	µg/L
6/7/2009	LS-2	o-Xylene	<1	µg/L
6/7/2009	LS-2	TAH	3.20	µg/L
6/7/2009	LS-2	Toluene	3.2	µg/L
6/7/2009	LS-2	Total Xylenes	<1	µg/L
6/7/2009	LS-2	Specific Conductivity	79.2	microS/cm
6/7/2009	LS-2	Turbidity	11.80	NTU
6/7/2009	LS-2	Turbidity	15.50	NTU
6/7/2009	LS-2	Turbidity	16.70	NTU
6/7/2009	LS-2	pH	7.67	
6/7/2009	LS-3	D.O. %	104.1	%
6/7/2009	LS-3	Temperature	11.5	Celsius
6/7/2009	LS-3	Temperature	10.9	Celsius
6/7/2009	LS-3	Benzene	3.9	µg/L
6/7/2009	LS-3	D.O. mg/L	11.52	mg/L
6/7/2009	LS-3	Ethyl Benzene	<1	µg/L
6/7/2009	LS-3	m,p Xylene	<1	µg/L
6/7/2009	LS-3	o-Xylene	<1	µg/L
6/7/2009	LS-3	TAH	10.40	µg/L
6/7/2009	LS-3	Toluene	6.5	µg/L
6/7/2009	LS-3	Total Xylenes	<1	µg/L
6/7/2009	LS-3	Specific Conductivity	78.1	microS/cm
6/7/2009	LS-3	Turbidity	18.90	NTU
6/7/2009	LS-3	Turbidity	13.90	NTU
6/7/2009	LS-3	Turbidity	17.80	NTU
6/7/2009	LS-3	pH	7.6	
6/7/2009	LS-4	D.O. %	104.1	%
6/7/2009	LS-4	Temperature	11.6	Celsius
6/7/2009	LS-4	Temperature	11.0	Celsius
6/7/2009	LS-4	Benzene	3.1	µg/L
6/7/2009	LS-4	D.O. mg/L	11.48	mg/L
6/7/2009	LS-4	Ethyl Benzene	<1	µg/L
6/7/2009	LS-4	m,p Xylene	<1	µg/L
6/7/2009	LS-4	o-Xylene	<1	µg/L
6/7/2009	LS-4	TAH	9.10	µg/L
6/7/2009	LS-4	Toluene	6	µg/L

Date	Site	Measurement	Value	Units
6/7/2009	LS-4	Total Xylenes	<1	µg/L
6/7/2009	LS-4	Specific Conductivity	78.1	microS/cm
6/7/2009	LS-4	Turbidity	15.80	NTU
6/7/2009	LS-4	Turbidity	16.90	NTU
6/7/2009	LS-4	Turbidity	15.50	NTU
6/7/2009	LS-4	pH	7.57	
6/7/2009	LS-5	D.O. %	104.1	%
6/7/2009	LS-5	Temperature	11.7	Celsius
6/7/2009	LS-5	Temperature	11.1	Celsius
6/7/2009	LS-5	Benzene	3.2	µg/L
6/7/2009	LS-5	D.O. mg/L	11.46	mg/L
6/7/2009	LS-5	Ethyl Benzene	<1	µg/L
6/7/2009	LS-5	m,p Xylene	<1	µg/L
6/7/2009	LS-5	o-Xylene	<1	µg/L
6/7/2009	LS-5	TAH	9.70	µg/L
6/7/2009	LS-5	Toluene	6.5	µg/L
6/7/2009	LS-5	Total Xylenes	<1	µg/L
6/7/2009	LS-5	Specific Conductivity	78.2	microS/cm
6/7/2009	LS-5	Turbidity	15.60	NTU
6/7/2009	LS-5	Turbidity	16.70	NTU
6/7/2009	LS-5	Turbidity	14.30	NTU
6/7/2009	LS-5	pH	7.59	
6/7/2009	LS-6	D.O. %	104.1	%
6/7/2009	LS-6	Temperature	11.9	Celsius
6/7/2009	LS-6	Temperature	11.3	Celsius
6/7/2009	LS-6	Benzene	3.2	µg/L
6/7/2009	LS-6	D.O. mg/L	11.42	mg/L
6/7/2009	LS-6	Ethyl Benzene	<1	µg/L
6/7/2009	LS-6	m,p Xylene	<1	µg/L
6/7/2009	LS-6	o-Xylene	<1	µg/L
6/7/2009	LS-6	TAH	9.30	µg/L
6/7/2009	LS-6	Toluene	6.1	µg/L
6/7/2009	LS-6	Total Xylenes	<1	µg/L
6/7/2009	LS-6	Specific Conductivity	78.1	microS/cm
6/7/2009	LS-6	Turbidity	14.40	NTU
6/7/2009	LS-6	Turbidity	16.90	NTU
6/7/2009	LS-6	Turbidity	17.90	NTU
6/7/2009	LS-6	Hach Logger	47921	
6/7/2009	LS-6	pH	7.58	
6/7/2009	LS-7	D.O. %	104.3	%
6/7/2009	LS-7	Temperature	12.0	Celsius
6/7/2009	LS-7	Temperature	11.4	Celsius
6/7/2009	LS-7	Benzene	3.3	µg/L
6/7/2009	LS-7	D.O. mg/L	11.37	mg/L
6/7/2009	LS-7	Ethyl Benzene	<1	µg/L
6/7/2009	LS-7	m,p Xylene	<1	µg/L
6/7/2009	LS-7	o-Xylene	<1	µg/L
6/7/2009	LS-7	TAH	12.70	µg/L
6/7/2009	LS-7	Toluene	9.4	µg/L
6/7/2009	LS-7	Total Xylenes	<1	µg/L
6/7/2009	LS-7	Specific Conductivity	78.2	microS/cm

Date	Site	Measurement	Value	Units
6/7/2009	LS-7	Turbidity	17.00	NTU
6/7/2009	LS-7	Turbidity	18.60	NTU
6/7/2009	LS-7	Turbidity	18.40	NTU
6/7/2009	LS-7	pH	7.64	
6/7/2009	LS-7x	Benzene	3.1	μg/L
6/7/2009	LS-7x	Ethyl Benzene	<1	μg/L
6/7/2009	LS-7x	m,p Xylene	<1	μg/L
6/7/2009	LS-7x	o-Xylene	<1	μg/L
6/7/2009	LS-7x	TAH	9.60	μg/L
6/7/2009	LS-7x	Toluene	6.5	μg/L
6/7/2009	LS-7x	Total Xylenes	<1	μg/L
6/7/2009	Miller's Reach	Turbidity	3.59	NTU
6/7/2009	Miller's Reach	Turbidity	5.58	NTU
6/7/2009	Miller's Reach	Turbidity	4.80	NTU
6/7/2009	Miller's Reach	Hach Logger	47920	
6/13/2009	DN Drift	Lt bank time	2.52	min
6/13/2009	DN Drift	Rt bank time	3	min
6/13/2009	DN Drift	Lt bank Start	98938	
6/13/2009	DN Drift	Lt bank Stop	102577	
6/13/2009	DN Drift	Rt bank Start	94339	
6/13/2009	DN Drift	Rt bank Stop	96536	
6/13/2009	Little Su	Mid time	3	min
6/13/2009	Little Su	Mid time	2.24	min
6/13/2009	Little Su	Mid Start	96536	
6/13/2009	Little Su	Mid Start	109564	
6/13/2009	Little Su	Mid Stop	98934	
6/13/2009	Little Su	Mid Stop	113206	
6/13/2009	UP Drift	Lt bank time	2.35	min
6/13/2009	UP Drift	Rt bank time	2.46	min
6/13/2009	UP Drift	Lt bank Start	105472	
6/13/2009	UP Drift	Lt bank Stop	109569	
6/13/2009	UP Drift	Rt bank Start	102591	
6/13/2009	UP Drift	Rt bank Stop	105469	
6/14/2009	Houston	Turbidity	3.50	NTU
6/14/2009	Houston	Turbidity	3.43	NTU
6/14/2009	Houston	Turbidity	4.30	NTU
6/14/2009	LS-1	D.O. %	100.8	%
6/14/2009	LS-1	Temperature	12.0	Celsius
6/14/2009	LS-1	Temperature	12.3	Celsius
6/14/2009	LS-1	Discharge	787.87	cfs
6/14/2009	LS-1	Benzene	<1	μg/L
6/14/2009	LS-1	D.O. mg/L	10.78	mg/L
6/14/2009	LS-1	Ethyl Benzene	<1	μg/L
6/14/2009	LS-1	m,p Xylene	<1	μg/L
6/14/2009	LS-1	o-Xylene	<1	μg/L
6/14/2009	LS-1	TAH	1.90	μg/L
6/14/2009	LS-1	Toluene	1.9	μg/L
6/14/2009	LS-1	Total Xylenes	<1	μg/L
6/14/2009	LS-1	Specific Conductivity	81.1	microS/cm
6/14/2009	LS-1	Turbidity	7.59	NTU
6/14/2009	LS-1	Turbidity	8.39	NTU
6/14/2009	LS-1	Turbidity	9.45	NTU

Date	Site	Measurement	Value	Units
6/14/2009	LS-1	pH	7.77	
6/14/2009	LS-2	D.O. %	98.9	%
6/14/2009	LS-2	Temperature	11.9	Celsius
6/14/2009	LS-2	Temperature	12.2	Celsius
6/14/2009	LS-2	Benzene	<1	µg/L
6/14/2009	LS-2	D.O. mg/L	10.63	mg/L
6/14/2009	LS-2	Ethyl Benzene	<1	µg/L
6/14/2009	LS-2	m,p Xylene	<1	µg/L
6/14/2009	LS-2	o-Xylene	<1	µg/L
6/14/2009	LS-2	TAH	2.20	µg/L
6/14/2009	LS-2	Toluene	2.2	µg/L
6/14/2009	LS-2	Total Xylenes	<1	µg/L
6/14/2009	LS-2	Specific Conductivity	83.4	microS/cm
6/14/2009	LS-2	Turbidity	9.64	NTU
6/14/2009	LS-2	Turbidity	7.73	NTU
6/14/2009	LS-2	Turbidity	9.95	NTU
6/14/2009	LS-2	pH	7.77	
6/14/2009	LS-3	D.O. %	98.7	%
6/14/2009	LS-3	Temperature	12.0	Celsius
6/14/2009	LS-3	Temperature	12.2	Celsius
6/14/2009	LS-3	Benzene	1.6	µg/L
6/14/2009	LS-3	D.O. mg/L	10.56	mg/L
6/14/2009	LS-3	Ethyl Benzene	<1	µg/L
6/14/2009	LS-3	m,p Xylene	<1	µg/L
6/14/2009	LS-3	o-Xylene	<1	µg/L
6/14/2009	LS-3	TAH	5.30	µg/L
6/14/2009	LS-3	Toluene	3.7	µg/L
6/14/2009	LS-3	Total Xylenes	<1	µg/L
6/14/2009	LS-3	Specific Conductivity	82.8	microS/cm
6/14/2009	LS-3	Turbidity	10.27	NTU
6/14/2009	LS-3	Turbidity	8.14	NTU
6/14/2009	LS-3	Turbidity	9.27	NTU
6/14/2009	LS-3	pH	7.75	
6/14/2009	LS-4	D.O. %	98.5	%
6/14/2009	LS-4	Temperature	12.1	Celsius
6/14/2009	LS-4	Temperature	12.3	Celsius
6/14/2009	LS-4	Benzene	1.6	µg/L
6/14/2009	LS-4	D.O. mg/L	10.54	mg/L
6/14/2009	LS-4	Ethyl Benzene	<1	µg/L
6/14/2009	LS-4	m,p Xylene	<1	µg/L
6/14/2009	LS-4	o-Xylene	<1	µg/L
6/14/2009	LS-4	TAH	5.40	µg/L
6/14/2009	LS-4	Toluene	3.8	µg/L
6/14/2009	LS-4	Total Xylenes	<1	µg/L
6/14/2009	LS-4	Specific Conductivity	82.4	microS/cm
6/14/2009	LS-4	Turbidity	10.61	NTU
6/14/2009	LS-4	Turbidity	12.60	NTU
6/14/2009	LS-4	Turbidity	8.14	NTU
6/14/2009	LS-4	pH	7.74	
6/14/2009	LS-5	D.O. %	98.6	%
6/14/2009	LS-5	Temperature	12.2	Celsius

Date	Site	Measurement	Value	Units
6/14/2009	LS-5	Temperature	12.5	Celsius
6/14/2009	LS-5	Benzene	1.4	µg/L
6/14/2009	LS-5	D.O. mg/L	10.5	mg/L
6/14/2009	LS-5	Ethyl Benzene	<1	µg/L
6/14/2009	LS-5	m,p Xylene	<1	µg/L
6/14/2009	LS-5	o-Xylene	<1	µg/L
6/14/2009	LS-5	TAH	4.50	µg/L
6/14/2009	LS-5	Toluene	3.1	µg/L
6/14/2009	LS-5	Total Xylenes	<1	µg/L
6/14/2009	LS-5	Specific Conductivity	82.6	microS/cm
6/14/2009	LS-5	Turbidity	11.40	NTU
6/14/2009	LS-5	Turbidity	9.96	NTU
6/14/2009	LS-5	Turbidity	9.08	NTU
6/14/2009	LS-5	pH	7.75	
6/14/2009	LS-6	D.O. %	98.7	%
6/14/2009	LS-6	Temperature	12.4	Celsius
6/14/2009	LS-6	Temperature	12.6	Celsius
6/14/2009	LS-6	Benzene	1.3	µg/L
6/14/2009	LS-6	D.O. mg/L	10.48	mg/L
6/14/2009	LS-6	Ethyl Benzene	<1	µg/L
6/14/2009	LS-6	m,p Xylene	<1	µg/L
6/14/2009	LS-6	o-Xylene	<1	µg/L
6/14/2009	LS-6	TAH	5.80	µg/L
6/14/2009	LS-6	Toluene	4.5	µg/L
6/14/2009	LS-6	Total Xylenes	<1	µg/L
6/14/2009	LS-6	Specific Conductivity	82.5	microS/cm
6/14/2009	LS-6	Turbidity	12.20	NTU
6/14/2009	LS-6	Turbidity	10.96	NTU
6/14/2009	LS-6	Turbidity	10.81	NTU
6/14/2009	LS-6	pH	7.73	
6/14/2009	LS-7	D.O. %	98.1	%
6/14/2009	LS-7	Temperature	12.7	Celsius
6/14/2009	LS-7	Temperature	12.9	Celsius
6/14/2009	LS-7	Benzene	<1	µg/L
6/14/2009	LS-7	D.O. mg/L	10.34	mg/L
6/14/2009	LS-7	Ethyl Benzene	<1	µg/L
6/14/2009	LS-7	m,p Xylene	<1	µg/L
6/14/2009	LS-7	o-Xylene	<1	µg/L
6/14/2009	LS-7	TAH	2.90	µg/L
6/14/2009	LS-7	Toluene	2.9	µg/L
6/14/2009	LS-7	Total Xylenes	<1	µg/L
6/14/2009	LS-7	Specific Conductivity	82.7	microS/cm
6/14/2009	LS-7	Turbidity	12.70	NTU
6/14/2009	LS-7	Turbidity	9.68	NTU
6/14/2009	LS-7	Turbidity	10.82	NTU
6/14/2009	LS-7	pH	7.75	
6/14/2009	LS-7x	Benzene	1.9	µg/L
6/14/2009	LS-7x	Ethyl Benzene	<1	µg/L
6/14/2009	LS-7x	m,p Xylene	<1	µg/L
6/14/2009	LS-7x	o-Xylene	<1	µg/L
6/14/2009	LS-7x	TAH	6.00	µg/L

Date	Site	Measurement	Value	Units
6/14/2009	LS-7x	Toluene	4.1	µg/L
6/14/2009	LS-7x	Total Xylenes	<1	µg/L
6/21/2009	Houston	Turbidity	1.51	NTU
6/21/2009	Houston	Turbidity	4.77	NTU
6/21/2009	Houston	Turbidity	1.19	NTU
6/21/2009	Houston	Turbidity	2.52	NTU
6/21/2009	LS-1	D.O. %	96.8	%
6/21/2009	LS-1	Temperature	10.7	Celsius
6/21/2009	LS-1	Temperature	11.0	Celsius
6/21/2009	LS-1	Discharge	615.53	cfs
6/21/2009	LS-1	Benzene	1.2	µg/L
6/21/2009	LS-1	D.O. mg/L	10.67	mg/L
6/21/2009	LS-1	Ethyl Benzene	<1	µg/L
6/21/2009	LS-1	m,p Xylene	<1	µg/L
6/21/2009	LS-1	o-Xylene	<1	µg/L
6/21/2009	LS-1	TAH	3.10	µg/L
6/21/2009	LS-1	Toluene	2.1	µg/L
6/21/2009	LS-1	Total Xylenes	<1	µg/L
6/21/2009	LS-1	Specific Conductivity	86.3	microS/cm
6/21/2009	LS-1	Turbidity	6.71	NTU
6/21/2009	LS-1	Turbidity	6.16	NTU
6/21/2009	LS-1	Turbidity	6.87	NTU
6/21/2009	LS-1	pH	7.83	
6/21/2009	LS-2	D.O. %	95.8	%
6/21/2009	LS-2	Temperature	10.8	Celsius
6/21/2009	LS-2	Temperature	11.1	Celsius
6/21/2009	LS-2	Benzene	<1	µg/L
6/21/2009	LS-2	D.O. mg/L	10.55	mg/L
6/21/2009	LS-2	Ethyl Benzene	<1	µg/L
6/21/2009	LS-2	m,p Xylene	<1	µg/L
6/21/2009	LS-2	o-Xylene	<1	µg/L
6/21/2009	LS-2	TAH	1.90	µg/L
6/21/2009	LS-2	Toluene	1.9	µg/L
6/21/2009	LS-2	Total Xylenes	<1	µg/L
6/21/2009	LS-2	Specific Conductivity	88.9	microS/cm
6/21/2009	LS-2	Turbidity	8.52	NTU
6/21/2009	LS-2	Turbidity	7.35	NTU
6/21/2009	LS-2	Turbidity	7.92	NTU
6/21/2009	LS-2	pH	7.85	
6/21/2009	LS-3	D.O. %	95.7	%
6/21/2009	LS-3	Temperature	10.9	Celsius
6/21/2009	LS-3	Temperature	11.1	Celsius
6/21/2009	LS-3	Benzene	<1	µg/L
6/21/2009	LS-3	D.O. mg/L	10.52	mg/L
6/21/2009	LS-3	Ethyl Benzene	<1	µg/L
6/21/2009	LS-3	m,p Xylene	<1	µg/L
6/21/2009	LS-3	o-Xylene	<1	µg/L
6/21/2009	LS-3	TAH	1.20	µg/L
6/21/2009	LS-3	Toluene	1.2	µg/L
6/21/2009	LS-3	Total Xylenes	<1	µg/L
6/21/2009	LS-3	Specific Conductivity	87.3	microS/cm

Date	Site	Measurement	Value	Units
6/21/2009	LS-3	Turbidity	8.18	NTU
6/21/2009	LS-3	Turbidity	9.30	NTU
6/21/2009	LS-3	Turbidity	10.03	NTU
6/21/2009	LS-3	pH	7.79	
6/21/2009	LS-4	D.O. %	95.6	%
6/21/2009	LS-4	Temperature	10.9	Celsius
6/21/2009	LS-4	Temperature	11.2	Celsius
6/21/2009	LS-4	Benzene	<1	μg/L
6/21/2009	LS-4	D.O. mg/L	10.51	mg/L
6/21/2009	LS-4	Ethyl Benzene	<1	μg/L
6/21/2009	LS-4	m,p Xylene	<1	μg/L
6/21/2009	LS-4	o-Xylene	<1	μg/L
6/21/2009	LS-4	TAH	1.80	μg/L
6/21/2009	LS-4	Toluene	1.8	μg/L
6/21/2009	LS-4	Total Xylenes	<1	μg/L
6/21/2009	LS-4	Specific Conductivity	85.2	microS/cm
6/21/2009	LS-4	Turbidity	9.69	NTU
6/21/2009	LS-4	Turbidity	8.67	NTU
6/21/2009	LS-4	Turbidity	10.10	NTU
6/21/2009	LS-4	pH	7.81	
6/21/2009	LS-5	D.O. %	95	%
6/21/2009	LS-5	Temperature	11.0	Celsius
6/21/2009	LS-5	Temperature	11.2	Celsius
6/21/2009	LS-5	Benzene	<1	μg/L
6/21/2009	LS-5	D.O. mg/L	10.41	mg/L
6/21/2009	LS-5	Ethyl Benzene	<1	μg/L
6/21/2009	LS-5	m,p Xylene	<1	μg/L
6/21/2009	LS-5	o-Xylene	<1	μg/L
6/21/2009	LS-5	TAH	3.00	μg/L
6/21/2009	LS-5	Toluene	3	μg/L
6/21/2009	LS-5	Total Xylenes	<1	μg/L
6/21/2009	LS-5	Specific Conductivity	87.6	microS/cm
6/21/2009	LS-5	Turbidity	8.19	NTU
6/21/2009	LS-5	Turbidity	9.88	NTU
6/21/2009	LS-5	Turbidity	8.03	NTU
6/21/2009	LS-5	pH	7.8	
6/21/2009	LS-6	D.O. %	94.7	%
6/21/2009	LS-6	Temperature	11.0	Celsius
6/21/2009	LS-6	Temperature	11.3	Celsius
6/21/2009	LS-6	Benzene	<1	μg/L
6/21/2009	LS-6	D.O. mg/L	10.38	mg/L
6/21/2009	LS-6	Ethyl Benzene	<1	μg/L
6/21/2009	LS-6	m,p Xylene	<1	μg/L
6/21/2009	LS-6	o-Xylene	<1	μg/L
6/21/2009	LS-6	TAH	3.90	μg/L
6/21/2009	LS-6	Toluene	3.9	μg/L
6/21/2009	LS-6	Total Xylenes	<1	μg/L
6/21/2009	LS-6	Specific Conductivity	87.7	microS/cm
6/21/2009	LS-6	Turbidity	11.70	NTU
6/21/2009	LS-6	Turbidity	9.09	NTU
6/21/2009	LS-6	Turbidity	9.49	NTU

Date	Site	Measurement	Value	Units
6/21/2009	LS-6	pH	7.77	
6/21/2009	LS-7	D.O. %	94.4	%
6/21/2009	LS-7	Temperature	11.1	Celsius
6/21/2009	LS-7	Temperature	11.4	Celsius
6/21/2009	LS-7	Benzene	<1	μg/L
6/21/2009	LS-7	D.O. mg/L	10.31	mg/L
6/21/2009	LS-7	Ethyl Benzene	<1	μg/L
6/21/2009	LS-7	m,p Xylene	<1	μg/L
6/21/2009	LS-7	o-Xylene	<1	μg/L
6/21/2009	LS-7	TAH	3.10	μg/L
6/21/2009	LS-7	Toluene	3.1	μg/L
6/21/2009	LS-7	Total Xylenes	<1	μg/L
6/21/2009	LS-7	Specific Conductivity	81.6	microS/cm
6/21/2009	LS-7	Turbidity	14.50	NTU
6/21/2009	LS-7	Turbidity	11.00	NTU
6/21/2009	LS-7	Turbidity	10.53	NTU
6/21/2009	LS-7	pH	7.75	
6/21/2009	LS-7x	Benzene	<1	μg/L
6/21/2009	LS-7x	Ethyl Benzene	<1	μg/L
6/21/2009	LS-7x	m,p Xylene	<1	μg/L
6/21/2009	LS-7x	o-Xylene	<1	μg/L
6/21/2009	LS-7x	TAH	3.40	μg/L
6/21/2009	LS-7x	Toluene	3.4	μg/L
6/21/2009	LS-7x	Total Xylenes	<1	μg/L
6/28/2009	LS-1	Discharge	418.32	cfs
6/28/2009	LS-1	Benzene	<1	mg/L
6/28/2009	LS-1	Ethyl Benzene	<1	μg/L
6/28/2009	LS-1	m,p Xylene	<1	μg/L
6/28/2009	LS-1	o-Xylene	<1	μg/L
6/28/2009	LS-1	TAH	1.80	μg/L
6/28/2009	LS-1	Toluene	1.8	μg/L
6/28/2009	LS-1	Total Xylenes	<1	μg/L
6/28/2009	LS-1	Turbidity	7.86	NTU
6/28/2009	LS-1	Turbidity	9.08	NTU
6/28/2009	LS-1	Turbidity	12.60	NTU
6/28/2009	LS-1	Turbidity	9.85	NTU
6/28/2009	LS-2	Benzene	<1	μg/L
6/28/2009	LS-2	Ethyl Benzene	<1	μg/L
6/28/2009	LS-2	m,p Xylene	<1	μg/L
6/28/2009	LS-2	o-Xylene	<1	μg/L
6/28/2009	LS-2	TAH	1.80	μg/L
6/28/2009	LS-2	Toluene	1.8	μg/L
6/28/2009	LS-2	Total Xylenes	<1	μg/L
6/28/2009	LS-2	Turbidity	8.07	NTU
6/28/2009	LS-2	Turbidity	8.49	NTU
6/28/2009	LS-2	Turbidity	13.20	NTU
6/28/2009	LS-2	Turbidity	11.80	NTU
6/28/2009	LS-2	Turbidity	10.40	NTU
6/28/2009	LS-3	Benzene	<1	μg/L
6/28/2009	LS-3	Ethyl Benzene	<1	μg/L
6/28/2009	LS-3	m,p Xylene	<1	μg/L

Date	Site	Measurement	Value	Units
6/28/2009	LS-3	o-Xylene	<1	µg/L
6/28/2009	LS-3	TAH	2.30	µg/L
6/28/2009	LS-3	Toluene	2.3	µg/L
6/28/2009	LS-3	Total Xylenes	<1	µg/L
6/28/2009	LS-3	Turbidity	13.80	NTU
6/28/2009	LS-3	Turbidity	10.67	NTU
6/28/2009	LS-3	Turbidity	7.03	NTU
6/28/2009	LS-3	Turbidity	10.50	NTU
6/28/2009	LS-4	Benzene	2.3	µg/L
6/28/2009	LS-4	Ethyl Benzene	<1	µg/L
6/28/2009	LS-4	m,p Xylene	<1	µg/L
6/28/2009	LS-4	o-Xylene	<1	µg/L
6/28/2009	LS-4	TAH	5.40	µg/L
6/28/2009	LS-4	Toluene	3.1	µg/L
6/28/2009	LS-4	Total Xylenes	<1	µg/L
6/28/2009	LS-4	Turbidity	12.70	NTU
6/28/2009	LS-4	Turbidity	9.17	NTU
6/28/2009	LS-4	Turbidity	11.90	NTU
6/28/2009	LS-4	Turbidity	11.30	NTU
6/28/2009	LS-5	Benzene	2	µg/L
6/28/2009	LS-5	Ethyl Benzene	<1	µg/L
6/28/2009	LS-5	m,p Xylene	<1	µg/L
6/28/2009	LS-5	o-Xylene	<1	µg/L
6/28/2009	LS-5	TAH	4.60	µg/L
6/28/2009	LS-5	Toluene	2.6	µg/L
6/28/2009	LS-5	Total Xylenes	<1	µg/L
6/28/2009	LS-5	Turbidity	9.63	NTU
6/28/2009	LS-5	Turbidity	10.73	NTU
6/28/2009	LS-5	Turbidity	9.14	NTU
6/28/2009	LS-5	Turbidity	9.80	NTU
6/28/2009	LS-6	Benzene	2	µg/L
6/28/2009	LS-6	Ethyl Benzene	<1	µg/L
6/28/2009	LS-6	m,p Xylene	<1	µg/L
6/28/2009	LS-6	o-Xylene	<1	µg/L
6/28/2009	LS-6	TAH	4.60	µg/L
6/28/2009	LS-6	Toluene	2.6	µg/L
6/28/2009	LS-6	Total Xylenes	<1	µg/L
6/28/2009	LS-6	Turbidity	11.50	NTU
6/28/2009	LS-6	Turbidity	13.60	NTU
6/28/2009	LS-6	Turbidity	9.13	NTU
6/28/2009	LS-6	Turbidity	11.40	NTU
6/28/2009	LS-7	Benzene	2.2	µg/L
6/28/2009	LS-7	Ethyl Benzene	<1	µg/L
6/28/2009	LS-7	m,p Xylene	<1	µg/L
6/28/2009	LS-7	o-Xylene	<1	µg/L
6/28/2009	LS-7	TAH	5.20	µg/L
6/28/2009	LS-7	Toluene	3	µg/L
6/28/2009	LS-7	Total Xylenes	<1	µg/L
6/28/2009	LS-7	Turbidity	13.60	NTU
6/28/2009	LS-7	Turbidity	15.50	NTU

Date	Site	Measurement	Value	Units
6/28/2009	LS-7	Turbidity	14.00	NTU
6/28/2009	LS-7	Turbidity	14.40	NTU
6/28/2009	LS-7x	Benzene	2	μg/L
6/28/2009	LS-7x	Ethyl Benzene	<1	μg/L
6/28/2009	LS-7x	m,p Xylene	<1	μg/L
6/28/2009	LS-7x	o-Xylene	<1	μg/L
6/28/2009	LS-7x	TAH	4.80	μg/L
6/28/2009	LS-7x	Toluene	2.8	μg/L
6/28/2009	LS-7x	Total Xylenes	<1	μg/L
6/28/2009	Miller's Reach	Turbidity	2.92	NTU
6/28/2009	Miller's Reach	Turbidity	5.81	NTU
6/28/2009	Miller's Reach	Turbidity	4.17	NTU
6/28/2009	Miller's Reach	Turbidity	4.30	NTU

Appendix B. Sampling Plan and QAPP

Appendix C. Site Photographs