WATER QUALITY MONITORING SAMPLE PLAN

BIG LAKE, ALASKA

FINAL
April 2009

Prepared for:

State of Alaska
Department of Environmental Conservation
Division of Water
Non-Point Source Water Pollution Control

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ACRONYMS AND ABBREVIATIONS

AAC..... Alaska Administrative Code
ADEC ..... Alaska Department of Environmental Conservation
BTEX..... Benzene, toluene, ethylbenzene, xylenes
CWA..... Clean Water Act
HCl ..... Hydrochloric acid
m ..... Meters
µg/L ..... Micrograms per liter
MS/MSD..... Matrix spike/matrix spike duplicate
OASIS ..... OASIS Environmental, Inc
QAPP ..... Quality Assurance Project Plan
TAH ..... Total aromatic hydrocarbons

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1. BACKGROUND AND OBJECTIVES

This section presents background information and objectives for conducting water quality monitoring at Big Lake, Alaska.

1.1. Introduction

Under Notice-to-Proceed No. 18-2011-26-11, the Alaska Department of Environmental Conservation (ADEC) has tasked OASIS Environmental, Inc. (OASIS) with conducting water quality monitoring at Big Lake, Alaska (Figure 1). The monitoring will assess the concentrations of dissolved-phased petroleum hydrocarbons that are present in the water column of the lake. This plan should be used in concert with the project-specific Quality Assurance Project Plan (QAPP), which has been prepared as a separate plan for this project. The two documents together comprise the sample and analysis plan for the project.

1.2. Background Information

In 2006, ADEC listed Big Lake as an impaired water body under the federal Clean Water Act (CWA) Section 303(d) for petroleum hydrocarbon pollution exceeding state water quality standards in 18 Alaska Administrative Code [AAC] 70. This listing in ADEC's *2008 Integrated Water Quality Monitoring and Assessment Report* occurred as the result of water sampling conducted in 2004 and 2005 by ADEC.

In 2004, ADEC conducted preliminary water quality sampling. Fourteen sites around the lake were sampled for petroleum hydrocarbons. Samples were collected at depths of 0.15 meters (m), 0.5 m, 1.5 m, and 5 m at four of the sites, and at 0.15 m at the remaining ten sites. Sampling occurred on two dates in May and one date in June. The analytical results showed that total aromatic hydrocarbons (TAH), which is the sum of concentrations for benzene, toluene, ethylbenzene, and xylenes (BTEX), exceeded the state water quality standard for aquatic life at some of the sites on the busier use days (ADEC 2004).

Based on the 2004 preliminary results, ADEC increased the sampling effort to six dates in 2005 during the open water months (May–September). The six days included weekdays, weekends, and holidays. The analytical data from 2005 again showed concentrations of TAH persistently exceeded the water quality standard for aquatic life at some of the sample sites (ADEC 2006b).

A total of 122 samples for analysis of TAH were collected in 2004 and 2005. Nineteen samples at six different sample sites exceeded the TAH water quality standard for aquatic life (10 micrograms per liter [µg/L]). These persistent exceedances led ADEC to list Big Lake as impaired for petroleum hydrocarbons. Specifically, the areas of impairment are an estimated 1,250 acres and are seasonal in nature, i.e., from May 15 to September 15. The impairment areas include the traffic lane between the east and west basins and heavily used regions near harbors and marinas, launch ramps, and

traffic lanes in the east basin, except for the area directly north of Long Island. Figure 2 highlights the impaired locations.

1.3. Objectives

The objectives for water quality monitoring in Big Lake are the following:

- Collect petroleum hydrocarbon data in Big Lake during the open water months (May–September) for a variety of use times to determine if lake water quality continues to exceed water quality standards.
- Increase the understanding of the relationship between motorized watercraft usage and petroleum hydrocarbon loading to the lake.

These objectives will be met by collecting water samples and water quality parameters from 12 sample sites on 13 different days and observing motorized watercraft on two days during both Memorial Day and Independence Day weekends.

The resulting data from these activities will allow for the following estimations for Big Lake: the volume of impaired waters, the likely maximum load of petroleum hydrocarbons on a daily basis, and the trend of dissolved-phase hydrocarbon concentrations on a daily basis.

1.4. Regulatory Framework

Alaska water quality standards and the degree of degradation that may not be exceeded are contained in 18 AAC 70, *Water Quality Standards*, and its supporting document *Alaska Water Quality Criteria Supporting for Toxic and Other Deleterious Organic and Inorganic Substances*. Table 1 outlines water use classes, subclasses, and petroleum hydrocarbon standards for fresh water bodies.

TABLE 1: WATER QUALITY STANDARDS

Fresh Water Use Class and Subclass	Petroleum Hydrocarbon Standard
Water Supply – Drinking Water	May not cause a visible sheen upon the surface of the water. May not exceed concentrations that individually or in combination impart odor or taste as determined by organoleptic tests.
Water Supply – Agriculture	May not cause a visible sheen upon the surface of the water.
Water Supply – Aquaculture	TAqH in the water column may not exceed 15 µg/L. TAH in the water column may not exceed 10 µg/L. There may be no concentrations of petroleum hydrocarbons, animal fats, or vegetable oils in shoreline or bottom sediments that cause deleterious effects to aquatic life. Surface waters and adjoining shorelines must be virtually free from floating oil, film, sheen, or discoloration.
Water Supply – Industrial	May not make the water unfit or unsafe for the use.
Water Recreation – Contact and Secondary Recreation	May not cause a film, sheen, or discoloration on the surface or floor of the water body or adjoining shorelines. Surface waters must be virtually free from floating oils.
Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife	Same as Water Supply – Aquaculture

The standards that will be assessed during water quality monitoring are “may not cause a visible sheen on the surface of the water” and the TAH standard of 10 µg/L.

1.5. Limitations

OASIS will make every reasonable and safe effort to collect the data as per the guidelines of this sample plan and the QAPP in order to meet the objectives presented in Section 1.3; however, unforeseen events and situations may occur that could limit or alter the plan for data collection. For instance, sampling could be limited by physical impediments, such as ice or poor weather, which would greatly minimize boat traffic or cause the sampling to occur on alternate dates that may have different boat activity levels. In addition, the watercraft usage survey could provide data that does not accurately reflect the number of boats on the lake, hours of boating time, or types of motors being used. Any situation or events that cause deviations from the planned approach will be documented and included in the water quality monitoring report.

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2. SAMPLE STRATEGY

This section describes the overall strategy and rationale for sampling activities. The fieldwork will consist of these principal actions:

- Collection of water samples from 12 sample sites on 13 different days
- Observation of motorized watercraft on two days during both Memorial Day and Independence Day weekends

2.1. Water Sampling

ADEC has designed the sampling plan so that water samples are collected from key sample sites based on the 2004 and 2005 assessments. Table 2 lists the sample sites and the rationale for sampling each site. Figure 3 presents the locations of the planned sample sites. Appendix A contains position data for the sample sites.

TABLE 2: SAMPLE SITES

Site	Description and Rationale
BL-1	Historical U.S. Geological Survey sampling site at the deepest area of the west basin. Serves as a control site for the project.
BL-2	Existing sample site that is a major traffic lane between the two basins. This site has previously exceeded the water quality standard for TAH.
BL-3	Historical U.S. Geological Survey sampling site at the deepest area of the east basin. Serves as a control site for the project. There is boat traffic in this area.
BL-4	Existing sample site near the South Shore State Recreation Area. This area is the most heavily used basin in the lake.
BL-5	Existing sample site that is a traffic lane for the bay to the southwest. This site has previously exceeded the water quality standard for TAH.
BL-6	Existing sample site near Southport Marina. This site has previously exceeded the water quality standard for TAH.
BL-7	Existing sample site located at the mouth of Fish Creek. This is a popular fishing area as well as a high use traffic lane. This site has previously exceeded the water quality standard for TAH.
BL-8	Existing sample site located near Burkeshore Marina. This site has previously exceeded the water quality standard for TAH.
BL-10	Existing sample site near the North Shore State Recreation Area. This area is heavily used for launching boats, swimming, camping, and personal watercraft operation. This site has previously exceeded the water quality standard for TAH.
BL-11	Existing sample site in the east basin near the mouth of Meadow Creek.
BL-26	New sample site located in the middle of the bay near North Shore State Recreation Area and west of location BL-10. Location will assess attenuation of hydrocarbons commonly detected at sample site BL-10
BL-27	New sample site located in the main traffic lane for users leaving North Shore State Recreation Area. Location will assess the area between the north bay and east basin.

In addition, ADEC has designed a sampling schedule to collect samples on days that should represent a variety of watercraft usage patterns. These sample dates are divided into “standard” sample days and “intensive” sample days to reflect the frequency of sampling that will occur for each day. There will be seven intensive sample days: four days over Memorial Day weekend and three days over Independence Day weekend.

Table 3 presents the planned sample days, the type of sampling that will occur, and the reasoning for sampling on each day.

TABLE 3: SAMPLE SCHEDULE

Sample Date	Type	Reason
May 9, 2009 (approximate – date will occur soon after ice goes out)	Standard	Low watercraft activity – Establish baseline lake conditions for the summer and determine hydrocarbon accumulation from winter activities
May 23, 2009	Intensive	High watercraft activity – Memorial Day weekend
May 24, 2009	Intensive	High watercraft activity – Memorial Day weekend
May 25, 2009	Intensive	High watercraft activity – Memorial Day
May 26, 2009	Intensive	Low watercraft activity – Monitor lake conditions following holiday
June 17, 2009	Standard	Low watercraft activity – Mid-week sample date
June 27, 2009	Standard	Moderate to high watercraft activity – Weekend day
July 4, 2009	Intensive	High watercraft activity – Independence Day
July 5, 2009	Intensive	High watercraft activity – Independence Day weekend
July 6, 2009	Intensive	High watercraft activity – Independence Day weekend
July 25, 2009	Standard	Moderate to high watercraft activity – Weekend day
August 15, 2009	Standard	Moderate to high watercraft activity – Weekend day
September 7, 2009	Standard	High watercraft activity – Labor Day

The following subsections detail the sample rationale and plan for “standard” and “intensive” sample days.

2.1.1. Standard Sample Day

Following the protocol outlined in the project-specific QAPP, a “standard” sample day will entail a single sample event for each sample site. This approach will provide a discrete snapshot of water quality in Big Lake for each “standard” sample day.

OASIS field personnel will begin “standard” sample days by launching the sample boat at approximately 13:45 hours from the South Shore State Recreation Area. Sampling activities will commence at approximately 14:00 hours. Sampling will occur in a planned order to minimize temporal variability between different “standard” sample days. Table 4 lists the planned order of sample sites.

TABLE 4: SAMPLE SITE ORDER FOR STANDARD SAMPLE DAYS

BL-4
BL-7
BL-8
BL-27
BL-26
BL-10
BL-11
BL-1
BL-2
BL-3
BL-5
BL-6

Table 5 lists the sample depths and parameters for which sampling will occur at each sample site.

TABLE 5: SAMPLING PROGRAM FOR STANDARD SAMPLE DAYS

Sample Site	Sample Depth	Sample Parameters
BL-1	0.15 meters	BTEX, Water quality
BL-2	0.15 meters	BTEX, Water quality
BL-3	0.15 meters	BTEX, Water quality
BL-4	0.15 meters and 0.5 meters	BTEX, Water quality
BL-5	0.15 meters	BTEX, Water quality
BL-6	0.15 meters	BTEX, Water quality
BL-7	0.15 meters	BTEX, Water quality
BL-8	0.15 meters and 0.5 meters	BTEX, Water quality
BL-10	0.15 meters and 0.5 meters	BTEX, Water quality
BL-11	0.15 meters	BTEX, Water quality
BL-26	0.15 meters	BTEX, Water quality
BL-27	0.15 meters	BTEX, Water quality

Note: Water quality parameters to be measured are pH, temperature, specific conductivity, and dissolved oxygen.

Water quality parameters will be collected for one of two purposes depending on the sample site: 1) for all sample sites except BL-7 and BL-11, water quality parameters will determine the location and thickness of the lake's thermocline, which is the portion of the water body where water temperature rapidly changes between the epilimnion, the layer of warm water at the surface, and the hypolimnion, the underlying layer of cold water, and 2) for samples site BL-11, water quality parameters will assess the degree of influence from Meadow Creek, based on changes primarily to the specific conductivity of the water. For the former reason, water quality data will be used with the analytical results for BTEX samples to assess the depth and resulting volume of water that may be impaired, based on the assumption that mixing of hydrocarbons will not occur within the hypolimnion, and for the latter reason, water quality data will be used with analytical results for BTEX samples to assess the contribution of hydrocarbons from upgradient in the watershed.

OASIS field personnel will measure water quality parameters using a YSI® 556 multi-probe meter. OASIS field personnel will collect BTEX samples using a Wildco®

hydrocarbon sampler. BTEX samples will be analyzed by EPA method 624 for the determination of TAH.

2.1.2. Intensive Sample Day

Following the protocol outlined in the project-specific QAPP, an "intensive" sample day will include multiple sample events for sample sites BL-10, BL-26, and BL-27, as well as single sample events for the other sample sites. This plan will allow for an analysis of the trend of TAH concentrations during the boating day at the intensive sample sites. In addition, the sample design, combined with watercraft usage observations described in Section 2.2, will yield the necessary contaminant concentrations, lake characteristics, and watercraft data to estimate loading of petroleum hydrocarbons in Big Lake.

OASIS field personnel will begin "intensive" sample days by launching the sample boat at approximately 08:45 hours from the North Shore State Recreation Area. Sampling activities will commence at 09:00 hours at sample site BL-27, followed by sampling activities at BL-26, and then at BL-10. This order will be repeated again at 12:00 hours, 15:00 hours, 18:00 hours, and 21:00 hours, so that each sample site is sampled five times per "intensive" sample day. In the interim between intensive sample efforts at BL-10, BL-26, and BL-27, OASIS field personnel will sample the other nine sample sites. The order for sampling these sites is not set; the important factor is to plan the sampling of the other sites so that the intensive sample schedule is maintained at three hour intervals. Table 6 lists the sample times, depths, and parameters for which sampling will occur at each sample site on "intensive" sample days.

TABLE 6: SAMPLING PROGRAM FOR INTENSIVE SAMPLE DAYS

Sample Site	Sample Time	Sample Depth	Sample Parameters
BL-1	Any	0.15 meters	BTEX, Water quality
BL-2	Any	0.15 meters	BTEX, Water quality
BL-3	Any	0.15 meters	BTEX, Water quality
BL-4	Any	0.15 meters and 0.5 meters	BTEX, Water quality
BL-5	Any	0.15 meters	BTEX, Water quality
BL-6	Any	0.15 meters	BTEX, Water quality
BL-7	Any	0.15 meters	BTEX, Water quality
BL-8	Any	0.15 meters and 0.5 meters	BTEX, Water quality
BL-10	09:00, 12:00, 15:00, 18:00, 21:00	0.15 meters and 0.5 meters	BTEX, Water quality
BL-11	Any	0.15 meters	BTEX, Water quality
BL-26	09:00, 12:00, 15:00, 18:00, 21:00	0.15 meters	BTEX, Water quality
BL-27	09:00, 12:00, 15:00, 18:00, 21:00	0.15 meters	BTEX, Water quality

The purpose of collecting water quality parameters is the same as outlined in Section 2.1.1. In addition, similar to a "standard" sample day, OASIS field personnel will measure water quality parameters using a YSI® 556 multi-probe meter; OASIS field personnel will collect BTEX samples using a Wildco® hydrocarbon sampler; and BTEX samples will be analyzed by EPA method 624 for the determination of TAH.

2.2. Watercraft Usage

OASIS field personnel will monitor motorized watercraft usage patterns on four of the seven "intensive" sample days: May 24, May 25, July 5, and July 6. The purpose is to gather watercraft usage data that will be used in conjunction with sample analytical data to estimate daily loading of petroleum hydrocarbons to Big Lake. The calculated loading estimates for these four "intensive" sample days will be extrapolated to "standard" sample days to assess loading throughout the summer season. The strategy for monitoring watercraft involves the placement of an observer at the South Shore State Recreation Area and the placement of an interviewer at the North Shore State Recreation Area.

The observer at the South Shore State Recreation Area will count the number of motorized watercraft during each hour for a 12-hour period from 09:00 to 21:00 hours. Each watercraft will only be counted once per hour. The observer, who will be experienced in visual determination of engine types, will identify, if possible, the type of engine (2-stroke or 4-stroke) on each motorized watercraft. It should be noted that the determination of engine type by visual identification is not always obvious; therefore, this technique likely will produce some errors in engine counts. However, the engine type counts made by the observer will be cross-checked against the survey results of the interviewer, which are discussed below, to ascertain the quality of the data. Appendix B contains the form that the observer will use for recording observations.

The interviewer located at the North Shore State Recreation Area will conduct brief, voluntary surveys of each user at the public boat launch. For lake users who are launching, the interviewer will count the watercraft, note the time of launch, and ask the user what type and size of engine is being used. For lake users returning to the launch area, the interviewer will verify the number of hours the user was on the lake. In addition, the interviewer will count any other motorized watercraft visible in the north bay area that were not launched from the North Shore Recreation Area and note what type of engine likely is powering the watercraft. Appendix C contains the form that the interviewer will use for recording observations.

The field team collecting water samples also will make general use observations at each sample site for all sample days to augment watercraft usage data. In addition, OASIS will cross-check its watercraft counts against launch fees collected by Alaska Department of Natural Resources at the North Shore and South Shore State Recreation Areas.

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3. FIELDWORK METHODOLOGY

This section presents the activities that will be conducted to execute the sample strategy and meet the project objectives.

3.1. Water Sampling

Field personnel will conduct water sampling from a 22-foot, v-hull boat powered with a 4-stroke engine. The field team will navigate to the sample sites using an onboard GPS unit with stored waypoints. When the boat is approximately 100 feet from the sample site, the boat operator will turn off the engine to allow the boat to coast to the sample site. When the boat reaches the sample site, the field team will deploy an anchor to maintain sample position.

When the field team reaches the initial sample site each day, a sample will be collected off the stern of the boat directly adjacent to the outboard to assess potential hydrocarbon contribution from the sample watercraft. The sample will be collected by placing three uncapped 40-millilter amber sample vials in the Wildco® hydrocarbon sampler and lowering the sampler so that inlet ports on the top of the sampler are at a depth of 0.15 m. The sampler will release air bubbles as it fills, and when the bubbles cease the sampler will be brought to the surface. At this point, the sample bottles will be retrieved from inside the sampler where they are immersed in water. The bottles will be field-preserved with hydrochloric acid (HCl) and capped so that no headspace remains in the bottles. Sample protocol will follow the United States Geological Survey report “Field Guide for Collecting Samples for Analysis of Volatile Organic Compounds in Stream Water for the National Water Quality Assessment Program” (USGS 1997). During this initial sample, the field team will document the number of other motorized watercraft on the water in order to assess potential hydrocarbon contribution from other watercraft.

For sampling at all sample sites, the following activities will occur:

- Lower weighted, graduated polyethylene tubing that is connected to a peristaltic pump to a depth of 0.15 m below water surface. Use the peristaltic pump to draw water through a flow cell and measure pH, temperature, specific conductivity, and dissolved oxygen using the YSI® multi-probe meter. Parameters will be recorded when readings stabilize.
- Perform the first step again at 0.5 m, and then at 1 m increments beginning at 1 m and ending at 10 m or the bottom of the water body, whichever is less.
- Collect samples for analysis of BTEX by placing three uncapped 40-millilter amber sample vials in the Wildco® hydrocarbon sampler and lowering the sampler so that inlet ports on the top of the sampler are at a depth of 0.15 m. The sampler will release air bubbles as it fills, and when the bubbles cease the sampler will be brought to the surface. At this point, the sample bottles will be retrieved from inside the sampler where they are immersed in water. The bottles will be field-preserved with HCl and capped so that no headspace remains in the

bottles. Sample protocol will follow the United States Geological Survey report "Field Guide for Collecting Samples for Analysis of Volatile Organic Compounds in Stream Water for the National Water Quality Assessment Program" (USGS 1997).

- For sample sites BL-4, BL-8, and BL-10, also perform the previous step at a depth of 0.5 m.

For the collection of field duplicate samples, place four uncapped 40-millilter amber sample vials in the Wildco® hydrocarbon sampler and lower the sampler so that inlet ports on the top of the sampler are at the required sample depth (0.15 m or 0.5 m). The sampler will release air bubbles as it fills, and when the bubbles cease the sampler will be brought to the surface. At this point, the sample bottles will be retrieved from inside the sampler where they are immersed in water. The bottles will be field-preserved with HCl and capped so that no headspace remains in the bottles. Two vials will be labeled as the primary sample, and the other two vials will be labeled as the blind duplicate sample.

For the collection of matrix spike/matrix spike duplicate (MS/MSD) samples, place four uncapped 40-millilter amber sample vials in the Wildco® hydrocarbon sampler and lower the sampler so that inlet ports on the top of the sampler are at the required sample depth (0.15 m or 0.5 m). The sampler will release air bubbles as it fills, and when the bubbles cease the sampler will be brought to the surface. At this point, the sample bottles will be retrieved from inside the sampler where they are immersed in water. The bottles will be field-preserved with HCl and capped so that no headspace remains in the bottles. All four vials will be labeled as a single sample.

Lastly, during sampling at each sample site, field personnel will count or make an estimate of the number of motorized watercraft that are present in the area during sampling activities. This data and all other sampling data will be recorded on a sample data sheet, which is included in Appendix D.

3.2. Watercraft Usage

The procedures for the observer at the South Shore State Recreation Area are the following:

- Maintain a position for 12 hours (09:00 to 21:00 hours).
- Count the number of motorized watercraft observed each hour without counting the same watercraft twice during the same hour.
- Identify whether each watercraft has a 2-stroke or 4-stroke engine.

Appendix B contains the form that the observer will use for recording observations.

The procedures for the interviewer at the North Shore State Recreation Area are the following:

- Maintain a position adjacent to the public launch for 12 hours (09:00 to 21:00 hours).
- Count each watercraft that is launched and note the time.

- Introduce yourself to the watercraft user, explaining that you are conducting a survey for ADEC to determine the type of engines (i.e., 2-stroke, 4-stroke, or 2-stroke direct-fuel injected) being used on Big Lake.
- Record the size (i.e., horsepower) and engine type used on the watercraft.
- Record the time each boat returns to the public launch.

If a watercraft returns to the public launch that did not launch from there, then the interviewer should request a survey with the user to determine the number of hours the user spent on the lake and the size and type of engine used on the watercraft. Lastly, the interviewer also should count any other motorized watercraft visible in the north bay area that was not launched from the North Shore Recreation Area and note what type of engine likely is powering the watercraft. Appendix C contains the form that the interviewer will use for recording observations.

3.3. Decontamination

Disposable personal protective equipment will be used for field activities; however, sampling equipment will be decontaminated between uses. Equipment anticipated for field decontamination includes, but is not limited to the following:

- YSI® multi-probe meter
- Wildco® hydrocarbon sampler
- Flow-through cell

The decontamination procedures will consist of rinsing the equipment with lake water before sampling at each new sample site. No detergent will be used to eliminate the potential for accidental discharge to the water body.

3.4. Investigation-Derived Waste

The water quality monitoring program will generate the following investigation-derived waste:

- Purge water from monitoring water quality parameters
- Unused surface water from inside the Wildco® hydrocarbon sampler
- Used disposable protective clothing and sampling equipment

Purge water and unused surface water will be placed back into Big Lake. Used disposable protective clothing and sampling equipment will be bagged and disposed of at the regional landfill.

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4. QUALITY ASSURANCE

This assessment will be performed under the guidelines of a project-specific QAPP, submitted under separate cover. This section highlights pertinent quality assurance procedures for the project and is adapted from the QAPP.

4.1. Personnel

Ben Martich of OASIS will manage this project in coordination with the ADEC project manager. Tom Beckman, principal chemist at OASIS, will serve as the Quality Assurance Officer. The OASIS field team will consist of Mr. Martich, Julie Clark, Zack Kirk, and Ryan Burich. All individuals participating in planning, sampling, and analytical reporting meet the definition of "qualified person" as per 18 AAC 75.990(100).

4.2. Field Procedures

Field personnel will collect samples in a manner that preserves the integrity of the sample matrix. Samplers will use dedicated personal protective equipment to prevent cross-contamination between samples. The sample matrix will have minimal disturbance prior to collection. Sample containers will be sealed, labeled, and placed on ice immediately following collection.

All equipment will be calibrated, maintained, and operated according manufacturer recommendations. Field documentation will consist of the use of field logs, sample identification labels, and photographs. The OASIS field team leader will maintain a field logbook to record a description of field activities and samples collected. Corrections will be struck, initialed, and dated.

Samples will be tracked by the use of chain-of-custody laboratory forms. Each sample will be individually identified on a chain-of-custody form. These forms will include the sample identification number, sample date, sample time, requested analysis, type and number of sample containers, sample preservatives, quality control information, and requested analytical turnaround time. Each form will be signed and dated upon relinquishment to another party, whether shipper, courier, or laboratory, to maintain the custody the samples.

Sample numbers will use the following format:

09-BL-0523-01-15-SW,

where 09 is the year; BL is "Big Lake"; 0523 is the month and date; 01 is the sample site; 15 is the sample depth (0.15 m); and SW is the designator for sample type. Possible sample types include SW for surface and TB for trip blank. For the initial sample collected each sample day near the outboard engine, the sample date will change, but the sample site always will be identified as "100." Field personnel will assign sample site numbers for field duplicates and trip blanks beginning at "101" and "201," respectively.

4.3. Analytical Program

Table 7 presents the analytical program for the Big Lake Water Quality Monitoring project based on the type of sample day.

TABLE 7: ANALYTICAL PROGRAM

Parameter / Analytical Method	Bottle Type	Preservative	Holding Time	Sample Day	Number of Sample Days	Number of Primary Samples Per Day	Number of Primary Samples Per Program
BTEX / EPA 624	Three 40-mL amber vials	HCL (pH < 2); < 4°C	14 days	Standard	6	16	96
				Intensive	7	32	224

OASIS will subcontract with OnSite Environmental of Redmond, Washington, for analysis of water samples. Contact information for OnSite Environmental is:

OnSite Environmental
14648 NE 95th Street
Redmond, WA 98052
425-883-3881
Contact: David Baumeister

4.4. Quality Control

Table 8 presents the quality control program for the project. Laboratory performance and analytical results for OnSite Environmental will be checked through a quality assurance review, which will include ADEC's Laboratory Data Review Checklist. The review will assess analytical quality through five data quality indicators: completeness, accuracy, precision, comparability, and representativeness. The following are data quality objectives for this project:

- Completeness – At least 90% percent of all samples collected should be analyzed.
- Accuracy – Collection of MS/MSD samples will be at a rate of 5% for all samples collected. Percent recoveries of MS/MSD samples and surrogate recoveries in primary samples will be compared against method standards.
- Precision – Field precision will be measured through the collection and analysis of duplicate water samples at the rate of 10% for all samples collected. Relative percent differences should be less than 30% for duplicate samples. Analytical precision will be measured through the comparison of relative percent differences for MS/MSD and laboratory control samples.
- Comparability – Samples will be analyzed for the same parameters using the same analytical methods in order to compare data. Detection limits will be less than the Alaska Water Quality Standards, as defined in 18 AAC 70.020(b) and

Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances (ADEC 2003).

- Representativeness – Water samples will be collected from the desired depth by using graduated line attached to the Wildco® hydrocarbon sampler. The Wildco® hydrocarbon sampler is an in-situ device that minimizes disturbance of the sample matrix. Trip blank samples will travel with field personnel and will be analyzed to determine if cross-contamination from ambient conditions has occurred for volatiles in water samples.

TABLE 8: QUALITY CONTROL PROGRAM

Parameter/ Analytical Method	Frequency of Duplicate Samples	Frequency of Trip Blanks	Frequency of MS/MSD Samples	Sample Day	Number of Duplicate Samples	Number of Trip Blanks	Number of MS/MSD Samples
BTEX/EPA 624	10%	1 per day	5%	Standard	2/day x 6 days = 12	1/day x 6 days = 6	1/day x 6 days = 6
				Intensive	4/day x 7 days = 28	1/day x 7 days = 7	2/day x 7 days = 14

Table 9 presents analytical summary, which includes the analytical program of Table 7 and the quality control program of Table 8.

TABLE 9: ANALYTICAL SUMMARY

Parameter/ Analytical Method	Sample Day	Number of Primary Samples Per Program	Number of Duplicate Samples Per Program	Number of Trip Blanks Per Program	Number of MS/MSD Samples Per Program	Total Number of Samples Per Program
BTEX/EPA 624	Standard	96	12	6	6	120
	Intensive	224	28	7	14	273

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5. REPORTING AND SCHEDULE

5.1. Reporting

Following receipt of analytical data for the final field event, an assessment report will be prepared. The report will include a description of field activities and present analytical results in tabular and GIS graphical forms. The report also will include a quality assurance review, as outlined in the QAPP and Section 4, to analyze the effectiveness of both field and analytical quality control measures. Water quality exceedances will be documented, and comparisons to past sampling events will be made. Loading estimates will be calculated for the two holiday weekends for which watercraft observations were made, and these results will be extrapolated to the other sample days. As part of recommendations, OASIS will highlight potential best management practices for Big Lake and identify options for development of a total maximum daily load.

5.2. Schedule

The schedule for water quality monitoring activities at Big Lake is as follows:

- Sample dates as per Table 3
- October 30, 2009—Submit draft report
- November 13, 2009—Discuss draft report with ADEC
- December 15, 2009—Submit final report

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6. REFERENCES

Alaska Department of Environmental Conservation (ADEC), 2008, *Alaska's Final 2008 Integrated Water Quality Monitoring and Assessment Report*. April 1.

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———, 2003, *Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances*. May 15.

United States Geological Survey (USGS), 1997, Field Guide for Collecting Samples for Analysis of Volatile Organic Compounds in Stream Water for the National Water Quality Assessment Program.

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FIGURES

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APPENDIX A

Sample Site Position Data

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APPENDIX B

Observer Form

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APPENDIX C

Interviewer Form

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APPENDIX D

Water Sampling Data Sheet

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