APPENDIX C

Water Quality Monitoring Plan

WATER QUALITY MONITORING PLAN

Green Lake Integrated Phosphorus Management Plan

Prepared for

Seattle Parks and Recreation

October 2003

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Green Lake Integrated Phosphorus Management Plan

Prepared for

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Introduction

Green Lake is a shallow eutrophic lake that is very productive due to high concentrations of dissolved nutrients such as nitrogen and phosphorus that promote algae and plant growth. Located just north of downtown Seattle, the lake is an important recreational and aesthetic resource for city residents. Although the lake remains heavily used, enjoyment of it has been diminished by its poor water quality. Intense blooms of blue-green bacteria (formerly known as blue-green algae) have plagued the lake since at least 1916 (KCM 1995). In addition, the rooted aquatic plant Eurasian watermilfoil (*Myriophyllum spicatum*) expanded during the 1980s to cover over 90 percent of the lake surface area, further restricting enjoyment and use of the lake (KCM 1995).

Green Lake was treated with alum and the buffering agent sodium aluminate in October 1991. Following the treatment, a 3-year limnological monitoring program was conducted for the lake (KCM 1995). Although the alum treatment improved water clarity for a few years, Green Lake has suffered from blue-green bacteria blooms on several occasions in recent summers. In the summers of 1999 and 2002, blooms of blue-green bacteria resulted in potentially toxic levels of microcystin produced by the bacteria and prompted closure of the lake to all contact recreation. The Seattle Department Parks and Recreation is planning to treat the lake again with alum in the winter (January – March) of 2004 to help prevent toxic bacteria blooms in the future. The 1995 project completion report recommended treating the lake with alum every 5 to 8 years to maintain the lake's water quality goals (KCM 1995).

This water quality monitoring plan has been written in support of the Green Lake Integrated Phosphorus Management Plan (IPMP). The goals of the monitoring under this plan are to:

- Conduct a jar test before the alum treatment and measure pH in Green Lake during the alum treatment to ensure that pH levels in the lake are within the allowable range (6.0 to 8.5) for protection of aquatic biota from aluminum toxicity.
- Collect water quality data before, during, and after the treatment to evaluate the short-term water quality effects of the alum treatment.
- Collect post-treatment water quality data to evaluate the long–term effectiveness of the alum treatment in relation to water quality goals that have been established for Green Lake.

This monitoring plan was prepared in accordance with *Guidelines and Specifications for Preparing Quality Assurance Project Plans* (Ecology 2001), and includes monitoring elements specified in Ecology's NPDES general permit (Ecology 2002) and aluminum sulfate treatment policy (Ecology 1991). This monitoring plan includes the following sections:

- Project organization and responsibilities
- Water quality monitoring design

- Sample collection procedures
- Analytical procedures
- Data quality objectives and assessment procedures
- Data evaluation and reporting procedures.

Project Organization and Responsibilities

The Green Lake Alum Treatment project is being funded through City of Seattle's cumulative reserve fund. Seattle Parks and Recreation (Seattle Parks) is responsible for oversight of the IPMP and the alum treatment project. Herrera Environmental Consultants (Herrera) is responsible for implementing this water quality monitoring plan. Aquatic Research is responsible for conducting the laboratory analysis and is certified by Ecology for all of the identified analytical procedures. Specific responsibilities of key personnel are identified below:

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Alex Svendsen	Project Scientist

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Steve Lazoff	Laboratory Manager

Seattle Parks may hire an alternative consultant and/or use city staff to conduct the monitoring. In addition, Seattle Parks may use citizen volunteers to implement the post-treatment component of this sampling and analysis plan

Water Quality Monitoring Design

Water quality monitoring for the Green Lake IPMP will include the following three components: jar test, treatment monitoring, and post-treatment monitoring. A jar test using the specified dose will be conducted on-site immediately prior to the first day of alum treatment to verify that the lake pH will be between 6.0 and 8.5 during the treatment. Treatment monitoring will include various elements to evaluate short-term effects of the treatment. Post-treatment monitoring will be conducted during subsequent summers over a period of 10 years to evaluate the long-term effects of alum treatment. The following sections describe the sampling locations and the design of each monitoring component. The overall monitoring design is summarized in Table 1.

Table 1. Design of the Green Lake IPMP water quality monitoring plan.

Monitoring Component	Sampling Locations[a]	Analytical Parameters	Sampling Frequency	Number of Samples[b]
Pre-treatment Jar Test	Small craft center	Alkalinity, pH	One or more tests	3
Treatment Monitoring				
Short-term impact	Composite A, Composite B, Index (surface, bottom)	Alkalinity, dissolved Al, total recoverable Al, sulfate, TP, SRP, nitrite + nitrate, ammonia, fecal coliform, chlorophyll *a*, Secchi depth, temperature/DO/pH/ conductivity profile	Once before and twice after treatment period	18
Twice daily	Composite A, Composite B, Index (surface, bottom)	Alkalinity, dissolved Al[c], total recoverable Al[c], Secchi depth, temperature/DO/pH/ conductivity profile	Morning before and evening after each day of treatment,	120
Hourly	Treatment site (surface, bottom)	Alkalinity, pH	Hourly during treatment	160
Post-treatment Monitoring	Composite A + Composite B (depth composite); Index (profile)	Chlorophyll *a*, TP, Secchi depth, temperature/DO/pH/ conductivity profile	Twice each month from May though October for 10 years	120

[a] Treatment sampling stations include Index, Composite A, and Composite B at 1 meter below water surface and 1 meter above lake bottom. Post-treatment sampling includes one composite sample from Composite A and Composite B stations for chlorophyll *a* and TP, and field measurements at the Index station.

[b] Number of samples assumes: three samples for one jar test; two samples at three stations on three occasions for short-term impact monitoring; two samples at three stations on two occasions during each day of 10 treatment days for twice daily monitoring; two samples every hour at one location during eight hours each day of 10 treatment days for hourly monitoring; one sample on two occasions during each of six summer months in a 10-year period for post-treatment monitoring.

[c] Dissolved Al and total recoverable Al will be analyzed only if the pH is less than 6.0.

Al aluminum
TP total phosphorus
SRP soluble reactive phosphorus
DO dissolved oxygen

Lake Sampling Locations

Water quality monitoring will be conducted at three stations on Green Lake that have been used for previous monitoring projects to allow for comparison to historic data. The Index Station, Composite A Station, and Composite B Station were used during Phase II of the Green Lake Restoration Project to collect pre- and post treatment data to measure the effectiveness of the 1991 treatment (see Figure 1). Each monitoring station is described briefly below:

- Index Station: Located at the deepest (approximately 9 meters) point in Green Lake, which is near the northeast corner of the lake.
- Composite A Station: Located in a moderately deep (approximately 5 meters) portion of Green Lake near the north corner of the lake.
- Composite B Station: Located in a moderately deep (approximately 4 meters) portion of Green Lake near the south corner of the lake.

In addition, the pre-treatment jar test will be conducted at the treatment staging area, which is located on the southwest shore of the lake near the small craft center.

Jar Test

One jar test will be conducted on the day before the first day of alum treatment. This testing will be performed to verify the 2003 jar test results (Herrera 2003) for pH and alkalinity using the alum treatment chemicals, dose, and application method provided by the treatment contractor using water and water quality conditions present at the time of application. This large-scale jar test will be performed at the alum treatment staging area located near the small craft center on the southwest shore of Green Lake.

A large testing vessel (e.g., 55 gallon plastic container) will be filled with lake water by pumping water from the end of the dock located near the crew shed. The collected water will be treated with aluminum sulfate and sodium aluminate using the specified dose of 23 mg Al/L. The pH and alkalinity of the collected water will be tested immediately before treatment, one hour after treatment, and again on the following morning (approximately 16 hours) after treatment.

The treatment rate and/or amount or buffer (sodium aluminate) will be adjusted if the pH of the treated water is not within the required range of 6.0 to 8.5. The jar test will be repeated if the treatment specifications are adjusted.

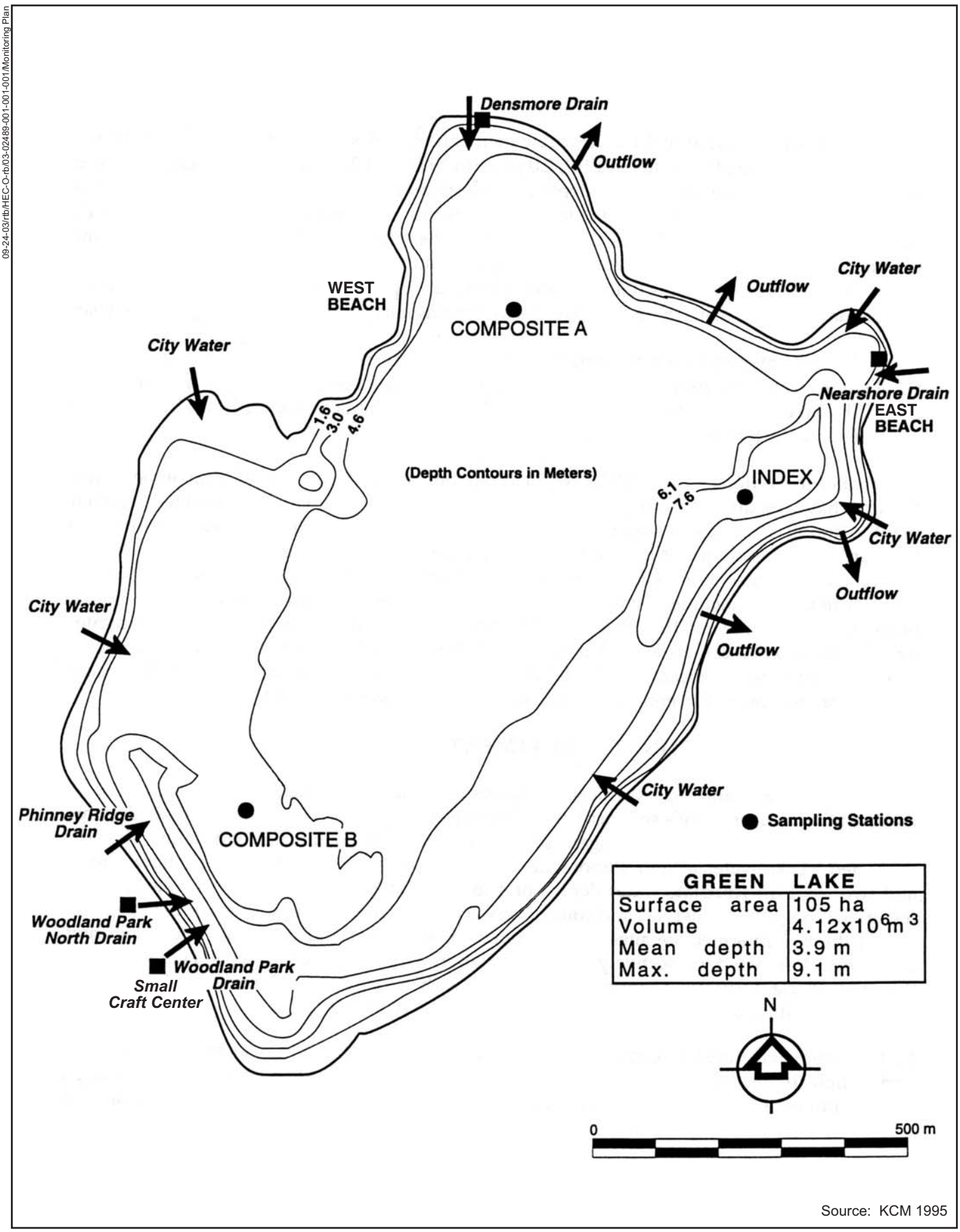

Figure 1. Locations of water quality monitoring stations in Green Lake.

Treatment Monitoring

It is anticipated that it will take seven days to complete the alum treatment if the treatment equipment operates at full capacity (Herrera 2003). However, there is a potential for the treatment to be delayed due to the presence of high winds or observations of low pH. For planning purposes, it is assumed that the treatment monitoring will be conducted over a 20-day period, which will include the application of alum during 10 of the 20 days. Water quality monitoring for the treatment component is anticipated to occur between January and March 2004.

Treatment monitoring will include the following three elements:

- Monitoring before and after the alum addition to evaluate short-term impacts of the treatment on various water quality parameters at established monitoring stations.

- Twice daily monitoring (in the morning before treatment begins and in the afternoon or evening when treatment ends) to verify that the lake pH is not less than 6.0 at established monitoring stations.

- Hourly monitoring of pH and alkalinity during the alum application at the treatment site.

Short-term impact monitoring will consist of measuring field parameters, and collecting water samples from 1 meter below the water surface and 1 meter above the lake bottom at each of the following three stations: Composite A, Composite B, and Index. A total of six water samples will be collected from the lake on three occasions: 1) the day before the first day of treatment, 2) two days following the last day of treatment, and 3) two weeks following the last day of treatment. The collected samples will be analyzed for the following parameters:

- Secchi depth (field measurement)
- Temperature (field measurement at 1-meter intervals)
- Dissolved oxygen (field measurement at 1-meter intervals)
- pH (field measurement at 1-meter intervals)
- Conductivity (field measurement at 1-meter intervals)
- Total alkalinity
- Dissolved aluminum
- Total recoverable aluminum
- Sulfate
- Soluble reactive phosphorus
- Total phosphorus
- Nitrate+nitrite nitrogen
- Ammonia nitrogen

- Chlorophyll *a*
- Fecal coliform bacteria (surface grab only).

Twice daily monitoring will consist of measuring field parameters at the Composite A, Composite B, and Index stations in the morning before treatment begins, and in the afternoon or evening when treatment ends. The field parameters include Secchi depth and vertical profiles of temperature, dissolved oxygen, pH, and conductivity at 1-meter intervals. In addition, total alkalinity will be tested in the field on water samples collected from 1 meter below the water surface and 1 meter above the lake bottom at each of the three stations. If the pH is consistently less than 6.0 at a monitoring station, then the samples collected from that station will be analyzed for dissolved aluminum and total recoverable aluminum.

Hourly monitoring will consist of measuring pH and alkalinity at the treatment site on an hourly basis during the alum application. Water samples will be collected from 1 meter below the water surface and 1 meter above the lake bottom at the location where alum was applied approximately one hour before the time of sample collection. The one hour delay in sampling will allow for settling of the alum floc and stabilization of water quality conditions.

The alum treatment will be suspended if the pH is consistently less that 6.0 at the treatment site or at the monitoring stations. Additional monitoring will be conducted as necessary to determine when the lake pH and alkalinity have adequately recovered. Treatment may resume if the pH is greater than 6.2 and the alkalinity is greater than 5 mg/L at all monitoring locations.

Observations of the alum treatment activities, floc formation, and potential fish and wildlife impacts will be made during hourly monitoring. All data and observations will be recorded in a field notebook as described in the Sample Collection Procedures section. Water quality, fish, and wildlife impacts will be reported immediately as described in the Data Evaluation and Reporting Procedures section.

Post-Treatment Monitoring

Long-term water quality monitoring will be conducted for a 10-year period after the alum treatment has been completed. The objective of post-treatment monitoring will be to evaluate whether the total phosphorus goal (summer mean value less than 25 µg/L) and Secchi depth goal (summer mean value greater than 2.5 meters) for Green Lake are being met. The design of post-treatment monitoring generally follows that used for Green Lake since the first alum treatment in 1991.

Monitoring will occur twice each month from May through October, beginning in May 2004. Field parameters will be measured at 1-meter intervals at the Index station, and water samples will be collected at 1-meter intervals from the Composite A and B stations. Water samples collected from both stations will be composited into a single sample for each monitoring event. The samples will be analyzed for the following parameters:

- Secchi depth (field measurement)
- Temperature (field measurement at 1-meter intervals)
- Dissolved oxygen (field measurement at 1-meter intervals)
- pH (field measurement at 1-meter intervals)
- Conductivity (field measurement at 1-meter intervals)
- Total phosphorus
- Chlorophyll *a.*

It is anticipated that additional water quality monitoring of Green Lake will be conducted by others to address public health concerns. If a bacteria bloom is observed in Green Lake, Seattle Public Utilities (SPU) will measure microcystin concentrations and identify the species present in samples of scum collected from the lake. In addition, King County Department of Natural Resources may continue monitoring fecal coliform bacteria in Green Lake. Recent monitoring efforts by SPU and King County have been summarized by Herrera (2003).

Sample Collection Procedures

Measurements for field parameters will be made prior to the collection of water samples during treatment and post-treatment monitoring. Water temperature, dissolved oxygen, pH, and conductivity will be measured *in situ* by lowering the probe of a portable, multi-parameter water quality meter from a boat to record values at 1-meter intervals from the water surface to the lake bottom. The water quality meter will be calibrated according to the manufacturer's directions and following standard measurement procedures (APHA, et al. 1992).

Secchi depth will be measured by using a Secchi disk measuring 20 centimeters in diameter according to standard measurement procedures (NALMS 1995). The Secchi disk will be lowered from the sunny side of the boat to the depth where the disk disappears from view and raised to the depth where the disk reappears. Secchi depth is the average depth of the disk disappearance and reappearance. An underwater viewer (viewscope) will not be used during the measurement because it has not been used historically at Green Lake

Water samples will be collected by deploying a clean Van Dorn sampler or similar sampling device from a boat. The sampler will be opened, lowered to the desired depth, and then closed by releasing the messenger.

For treatment monitoring, water samples will be collected from one meter below the lake surface and one meter above the lake bottom at the treatment site and three monitoring stations. Sample bottles will be filled directly from the Van Dorn sampler. Bacteria sample bottles will be filled directly from the lake by submerging the sample bottle below the water surface to avoid contamination by hands or equipment.

For post-treatment monitoring, water samples will be collected at every meter depth from one meter below the lake surface and to one meter above the lake bottom at the Composite A and B stations. Equal volumes of all collected samples will poured into in a clean bucket to yield one composite sample for each monitoring event. The composite sample will be thoroughly mixed and poured into sample bottles for laboratory analysis.

The following quality control procedures will be used in the field to ensure that data quality objectives are met.

Equipment Decontamination

The Van Dorn water sampler, compositing bucket, and any other sampling equipment will be decontaminated before each day of use. The equipment will be scrubbed with a brush and phosphate-free detergent (e.g., Alconox ®), and thoroughly rinsed with potable water. Cleaned sampling equipment will be protected from contamination and will be rinsed with lake water prior to the collection of each sample.

Field Notes

At each water quality monitoring station, the following information will be recorded in a waterproof bound field notebook:

- Sampling date
- Name of sampler
- Time of sample collection, measurement, or observation
- Station location
- Weather conditions
- Calibration results for field instruments
- Field measurements
- Number and type of samples collected
- Unusual conditions (e.g., oily sheen, odor, color, fish kill)
- Modifications of or unusual sampling procedures.

Sample Containers, Preservation, and Holding Times

Pre-cleaned sample containers will be obtained from the analytical laboratory for the required analyses. Spare sample containers will be carried by the sampling team in case of breakage or possible contamination. Sample containers, preservation techniques, and holding times will follow the analytical method requirements and U.S. EPA guidelines (40 Code of Federal Regulations [CFR] Part 136, July 1, 1992).

Sample Identification and Labeling

Each sample will be identified by its station number and the date of collection. Prior to filling, sample containers will be labeled with the following information using indelible ink:

- Station ID
- Date of collection (month/day/year)
- Time of collection (military format)
- Project ID (Green Lake)
- Company/sampler initials.

Labels on glass containers will be secured with clear adhesive tape.

Sample Handling

To minimize contamination, laboratory containers will be rinsed twice with sample water before filling. Samples will be stored at 4° C in a cooler and transported to the laboratory within 12 hours of collection. A chain-of-custody record will accompany the samples that clearly identifies the analytical parameters and methods.

Analytical Procedures

Analytical methods are presented in Table 2 for field and laboratory parameters. Also included in Table 2 are the required detection limits, units of measurement, and maximum sample holding times.

Table 2. Analytical methods, detection limits, and holding times for the Green Lake IPMP water quality monitoring plan.

Parameter	Analytical Method	Method Number[a]	Detection Limit/Unit	Maximum Holding Time
Secchi depth	20-cm disc	NA	0.1 meters	*in situ*
Temperature	Electrode	SM 2550 B	0.1 °C	*in situ*
Dissolved oxygen	Electrode	SM 4500-O G	0.1 mg/L	*in situ*
pH	Electrometric	SM 4500-H^+ B	NA	*in situ*
Conductivity	Platinum electrode	SM 2510 B	1 µmhos/cm	*in situ*
Total alkalinity	Titration	EPA 310.1	1.00 mg/L as $CaCO_3$	14 days
Dissolved aluminum	GFAA	EPA 202.2	0.003 mg/L	6 months[b]
Total recoverable aluminum	ICP	EPA 200.7	0.100 mg/L	6 months
Sulfate	Tubidimetric	EPA 375.4	1.00 mg/L	28 days
Soluble reactive phosphorus	Auto. ascorbic acid	EPA 365.1	0.001 mg/L	48 hours[b]
Total phosphorus	Auto. ascorbic acid	EPA 365.1	0.002 mg/L	28 days
Nitrite + nitrate nitrogen	Auto. cadmium reduction	EPA 353.2	0.010 mg/L	28 days
Ammonia nitrogen	Automated phenate	EPA 350.1	0.010 mg/L	28 days
Chlorophyll *a*	Spectrophotometric	SM 10200 H	0.1 µg/L	28 days
Fecal coliform bacteria	Membrane filter	SM 9222D	1 CFU/100mL	36 hours

[a] SM method numbers are from APHA et al. (1992); EPA method numbers are from U.S. EPA (1983).
[b] Samples must be filtered within 24 hours of collection.
NA: Not applicable.
GFAA: graphite furnace
ICP: inductively coupled plasma.
Mg/L: milligrams per liter
µg/L: micrograms per liter.
µmhos/cm: micromhos per centimeter
$CaCO_3$: calcium carbonate.
CFU: colony forming units

Field measurements of Secchi depth will be conducted using a 20-centimeter Secchi disk according to standard measurement procedures (NALMS 1995) (see Sample Collection Procedures). Field measurements of temperature, dissolved oxygen, pH, and conductivity will be conducted using a portable meter operated according to the manufacturer's directions and following standard measurement procedures (APHA, et al. 1992).

Laboratory analytical procedures will follow U.S. EPA approved methods (APHA et al. 1992; U.S. EPA 1983). These methods provide detection limits that are below the state and federal

regulatory criteria or guidelines, and will enable direct comparison of analytical results with these criteria.

The laboratory identified for this project (Aquatic Research, Inc.) is certified by Ecology for each of the analytical parameters, and participates in audits and interlaboratory studies by Ecology and U.S. EPA. These performance and system audits have verified the adequacy of the laboratory standard operating procedures, which include preventative maintenance and data reduction procedures.

The laboratory will report the analytical results within 30 days of receipt of the samples. If necessary, the laboratory will provide draft results within hours of receipt of the samples. Sample and quality control data will be reported in a standard format. The reports will also include a case narrative summarizing any problems encountered in the analyses.

Data Quality Objectives and Assessment Procedures

The overall quality assurance objective is to ensure that data of known and acceptable quality are obtained. All measurements will be performed to yield consistent results that are representative of the media and conditions measured. Specific objectives and procedures for precision, accuracy, representativeness, completeness, and comparability are identified below. In this document, the term "detection limit" refers to the practical quantitation level established by the laboratory, not the method detection limit.

- **Precision.** Precision will be assessed using laboratory and field duplicates, which will be analyzed at random with every sample batch. Two levels of precision for duplicate analyses will be evaluated. The relative percent difference (RPD) of laboratory duplicates will be less than or equal to 25 percent for values that are greater than 5 times the detection limit, and ±2 times the detection limit for values that are less than or equal to 5 times the detection limit. Laboratory and field duplicates will be analyzed at a frequency of at least 5 percent of the total number of samples submitted (i.e., one in 20 samples).
- **Accuracy.** Accuracy will be assessed with analyses of laboratory preparation blanks, matrix spikes, and control standards. Where applicable, these quality control analyses will be performed for every sample batch. The values for blanks will not exceed 2 times the detection limit. The percent recovery of matrix spikes will be between 75 and 125 percent. The percent recovery of control standards will be within control limits reported by the laboratory based on historic performance. The laboratory will analyze a preparation blank with every sample batch. The laboratory will analyze matrix spikes and standard solutions at a frequency of at least 5 percent of the total number of samples submitted.
- **Representativeness.** The sampling design will provide samples that represent a wide range of water quality conditions during storm flow conditions. Sample representativeness will be ensured by employing consistent and standard sampling procedures.
- **Completeness.** A minimum of 95 percent of the samples submitted to the laboratory will be judged valid. It is anticipated that all samples will be collected. An equipment checklist will be used to prevent loss of data resulting from missing containers or inoperable instruments prior to embarking on field sampling trips.
- **Comparability.** Data comparability will be ensured through the application of standard sampling procedures, analytical methods, units of measurement, and detection limits. The results will be tabulated in

standard spreadsheets for comparison with threshold limits and background data.

Quality control problems and corrective actions will be summarized in a quality assurance worksheet. Values associated with minor quality control problems will be considered estimates and assigned *J* qualifiers. Values associated with major quality control problems will be rejected and qualified *R*. Estimated values may be used for evaluation purposes, while rejected values will not be used. The following sections describe the data assessment procedures for these quality control elements:

- Completeness
- Methodology
- Holding times
- Blanks
- Detection limits
- Duplicates
- Matrix spikes
- Control standards.

Completeness

Completeness will be assessed by comparing valid sample data with this quality assurance project plan and the chain-of-custody records. Completeness will be calculated by dividing the number of valid values by the total number of values. Samples will be reanalyzed or re-collected if completeness is less than 95 percent.

Methodology

Methodology will be assessed by examination of the field notebook and laboratory reports for deviation from this sampling and analysis plan. Unacceptable deviations will result in rejected values (R) and will be corrected for future analyses.

Holding Times

Analysis dates will be reported by the laboratory. Holding times will be assessed by comparing analytical dates to sample collection dates. Values that exceed the maximum holding time required by the analytical method and U.S. EPA guidelines (40 Code of Federal Regulations [CFR] Part 136, July 1, 1992) will be considered estimates (J).

Blanks

Blanks consisting of de-ionized distilled water will also be analyzed, and the results will be reported in each laboratory report. Sample values that are less than 5 times a detected blank value will be considered estimates (J).

Detection Limits

Detection limits will be reported in each laboratory report. If proposed detection limits are not met by the laboratory, the laboratory will be requested to reanalyze the samples and/or revise the method, if time permits.

Duplicates

Precision of laboratory duplicate results will be presented in each laboratory report. Data for batch samples (i.e., samples from other projects analyzed with samples from this project) will be acceptable as long as duplicates are analyzed at a frequency of at least 5 percent. Precision of field and laboratory duplicate results will be calculated according to the following equation:

$$RPD = \frac{(C_1 - C_2) \times 100\%}{(C_1 + C_2) / 2}$$

where:

RPD = relative percent difference
C_1 = larger of two values
C_2 = smaller of two values.

Results exceeding the objectives will be noted in the quality assurance worksheets, and associated values will be flagged as estimates (J). If the objectives are severely exceeded (e.g., more than twice the objective), then associated values will be rejected (R).

Matrix Spikes

Accuracy of matrix spike results will be presented in each laboratory report. Data for batch samples will be acceptable as long as spikes of project samples are analyzed at a frequency of at least 5 percent. Accuracy of matrix spike results will be calculated according to the following equation:

$$\%R = \frac{(S - U) \times 100\%}{C_{sa}}$$

where:

%R	=	percent recovery
S	=	measured concentration in spike sample
U	=	measured concentration in unspiked sample
C_{sa}	=	actual concentration of spike added.

If the analyte is not detected in the unspiked sample, then a value of zero will be used in the equation.

Results exceeding the objective will be noted in the quality assurance worksheets, and associated values will be flagged as estimates (J). However, if the percent recovery exceeds 125 and a value is less than the detection limit, the result will not be flagged as an estimate. Nondetected values will be rejected (R) if percent recovery is less than 30 percent.

Control Standards

Accuracy of control standards will be presented in each laboratory report and checked by the quality assurance officer. Accuracy for these elements will be calculated according to the following equation:

$$\%R = \frac{(M - T) \times 100\%}{T}$$

where:

%R	=	percent recovery
M	=	measured value
T	=	true value.

Results exceeding the objective will be noted in the quality assurance worksheets, and associated values will be flagged as estimates (J). If the objectives are severely exceeded (e.g., more than twice the objective), then associated values will be rejected (R).

Data Evaluation and Reporting Procedures

Monitoring reports will be submitted to Ecology's Northwest Regional Office in accordance with the NPDES permit requirements (Ecology 2002). Annual monitoring reports will be prepared for the first year (Year 1 in 2004) and last year (Year 10 in 2013) of monitoring, and semi-annual monitoring reports will be prepared for the intervening years (i.e., Years 2+3, 4+5, 6+7, and 8+9). Each report will be completed by February 1 of the year following the completed monitoring period. All project related data and results will be included in the annual monitoring reports.

In the event that treatment monitoring data do not comply with the permit terms and conditions, Ecology's Northwest Regional Office will be notified immediately. In addition, observations of fish or wildlife impacts will be immediately reported to the Region 4 (Mill Creek) office of the Washington Department of Fish and Wildlife.

All monitoring records will be retained for a minimum of five years. Information shall include: all calibration and maintenance records, all original recordings for continuous monitoring instrumentation, copies of all reports required by the NPDES permit, records of all data used to complete the application for the permit.

Ecology requires that all applications, reports, or information submitted to Ecology be signed and certified. For the Green Lake alum treatment, these materials must be signed by a ranking elected official or by a duly authorized representative in accordance with general conditions (G15.B of the NPDES permit). The permit allows for changes in authorization as specified in the condition G15.C. The person signing documents related to this permit is required to make the declaration found in general condition G15.D.

Laboratory reports and quality assurance worksheets will be included in each annual monitoring report. Data quality assurance reports will be prepared that summarize the following information:

- Changes in the monitoring plan
- Significant quality assurance problems and corrective actions
- Data quality assessment in terms of precision, accuracy, representativeness, completeness, comparability, and detection limits
- Discussion of whether the quality assurance objectives were met, and the resulting impact on decision-making
- Limitations on use of the measurement data.

Field and laboratory results will be tabulated in spreadsheets that include associated data qualifiers for estimated values, rejected values, and values exceeding established thresholds, goals, or water quality criteria.

The monitoring reports will describe monitoring methods, present data tables, and discuss the monitoring results. The first (Year 1) monitoring report will present methods and results of the pre-treatment jar test, all treatment monitoring, and the first year of post-treatment monitoring. The pre-treatment jar test results will be compared to results of jar tests conducted for the alum treatment study (Herrera 2003). Treatment monitoring results will be compared to the terms and conditions of the NPDES permit, and the short-term water quality impact of the alum treatment will be discussed. Post-treatment monitoring results will be evaluated by comparing summer mean values to established goals and historical data.

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