Clark County Volunteer Monitoring Program
Vancouver Lake Monitoring

Quality Assurance Project Plan

Version 2.0 May, 2007

Project Name:	Clark County Volunteer Ambient Monitoring, Ambient Lake Monitoring
Project Code:	VOLMONAM
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Department:	Public Works Water Resources
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Table of Contents

Purpose of the Quality Assurance Project Plan

Clark County Public Works Water Resources (Water Resources) requires a QAPP for each monitoring project. The plan addresses project design, schedule, methods of data collection and management, quality assurance and quality control requirements, data analysis, and reporting. Water Resources follows the general Quality Assurance Project Plan (QAPP) format defined by the State of Washington Department of Ecology (Ecology) (Lombard and Kirchmer, 2001).

Background and Problem Statement

Clark County Clean Water Program

Volunteer monitoring is an integral part of **Clark County's Clean Water Program**. Clark County initiated the Clean Water Program to increase protection for our streams, lakes, and groundwater. The program began in response to federal and state mandates for local government agencies to better control and clean stormwater runoff. The Clean Water Fee, which is paid by property owners in unincorporated Clark County, supports the enhanced levels of service required to accomplish these goals (Clean Water Program Annual Report, 2001 summary).

Origins of the Clark County Volunteer Monitoring Program

A nine member citizen advisory commission, called the Clark County Clean Water Commission (Commission), serves as an advisory body to the Board of Clark County commissioners (BOCC) to provide advice and recommendations regarding Clean Water Program related issues. The Commission expressed concern in what its members view as 1) gaps in field data; 2) poor coordination among agencies and volunteers; 3) the lack of a centralized data management system; and 4) limited opportunities for volunteers and agency staff to be trained in collecting reliable data (Clark County Clean Water Commission 2001 Annual Report).

Water Resources staff took steps to address the commission's requests for 1) additional public education and outreach; 2) an increase in NPDES water quality-monitoring activity; and 3) seeking grant opportunities for coordination and training of volunteers. In 2001 Clark County was awarded a grant by the Washington Department of Ecology to establish a shared monitoring resource center for the various monitoring and coordination needs of local agencies, students, and adult volunteers. The resource center helps coordinate monitoring activities, provides training to volunteers and local agency staff, maintains an equipment borrowing facility, and establishes indicators, data management, and reporting systems suitable for volunteers.

In addition, Water Resources staff developed a volunteer monitoring program to provide opportunities for citizens who wish to volunteer their time studying and evaluating the health of regional water resources. Water Resources staff coordinates volunteers' monitoring activities at selected stream and lake sites on an ongoing basis.

Water Quality of Lakes in Clark County

There are several small ponds and impoundments that are important recreational resources for Clark County residents; however, the majority of recreational use is focused on three natural water bodies: Lacamas, Vancouver, and Battle Ground Lakes. In addition there are major impoundments on the North Fork of the Lewis River that provide storage for hydropower and recreation.

Lacamas Lake has been intensively studied over the past 15 years by Clark County and other various agencies. The lake's water quality and condition are well documented (Schnabel and Hutton, 2004). Currently Clark County implements a seasonal water quality monitoring program on Lacamas Lake (Schnabel, 2004).

Battle Ground Lake has limited data that focuses on bacteria levels at bathing areas along the shoreline. Clark County monitored the lake in 2003 to document the general condition of the lake and to monitor the effects of an herbicide used in the lake to control an aquatic invasive plant (Wierenga, 2003).

Current monitoring data for Vancouver Lake is limited, although it has been extensively studied in the past. A major restoration plan was implemented in the 1970's and 1980's, which involved dredging the lake sediments and constructing a channel to the Columbia River that aided in lake circulation. Pre- and post-restoration monitoring documented the condition of the lake and any improvements in water quality (Cooper Consultants, Inc, 1985). Although the restoration effort provided some improvement, the effect on lake problems, chiefly nuisance algal blooms, was minimal. Periodic lake monitoring by staff and volunteers working with the Washington State Department of Ecology water quality assessment program showed that the lake problems continued to limit lake uses in the mid 1990's.

Vancouver Lake is a large, shallow lake in the Columbia River floodplain (Figure 1). It was most likely once a part of the Columbia River channel and then formed a lake as the river migrated to the south. Fill and the construction of levees along the south and west lake margins and along the Columbia River shoreline led to the eventual separation of the lake and the Columbia River. Major tributaries to the lake include Burnt Bridge Creek, small tributaries along the east shore, and intermittently Lake River. Lake River flow reverses direction depending on water levels in the lake relative to the Columbia River. When Lake River flows into the lake it may carry water from the Whipple, Salmon, and Flume Creek watersheds. A flushing channel constructed along the southwest shoreline also acts as an intermittent tributary from the Columbia River.

In recent history, since the development of the Columbia River shoreline and management of the river for hydropower, Vancouver Lake has had poor water quality (Bhagat and Orsborn, 1971; Cooper Consultants, Inc, 1985). Extremely high levels of phosphorus and nitrogen, high water temperature, and high turbidity levels have contributed to nuisance bluegreen algae blooms. Since the late 1960's lake uses have been severely limited in the late summer due to algae blooms. In fact, during the summers of 2004, 2005, and 2006 the swimming beach had to be closed to the public due to excessive algal blooms.

Water quality monitoring by Clark County volunteers in 2003 and 2004 reinforced previous conclusions regarding the poor condition of the lake. Trophic state indices calculated from chlorophyll a concentration and algal biovolumes indicated that the lake was *hyper-eutrophic*. Phosphorus levels were well above EPA's aquatic life criteria (Gold book source) and nitrogen to phosphorus ratios indicated that nitrogen was a likely limiter of algal growth. The open-lake water was shallow, warm, and turbid with algae and sediment suspended during wind-induced mixing and by benthic fish activity. Oxygen levels were typically super-saturated due to photosynthesis but levels appeared to decrease during calm weather conditions. pH levels were above state water quality standards during the periods of heavy algal growth. Light penetration was very low, with Secchi disk readings ranging from 0.1 to 0.4 meters. Overall the condition of the lake was poor and was considered to limit many recreational and aquatic life uses.

Project Description

Goals and Decision Statement

The data from this project will be used to estimate the current condition of Vancouver Lake by comparison of data to water quality standards and aquatic life criteria and the calculation of water quality and biological integrity ratings. The data will also serve as the baseline for comparison in future studies, and as part of a trend analysis after a minimum of five years of data has been collected.

Objectives

Project objectives include 1) establishing, training, and maintaining a team of volunteers for collecting and reporting useful, credible data to the public, and other agencies and organizations; 2) facilitating public involvement and education in water quality monitoring and watershed stewardship; and 3) monitoring and estimating the current condition of Vancouver Lake based on comparison with regulatory standards and aquatic life criteria, and standardized indicators.

Project Milestones

- Develop a set of water quality parameters that give an overall indication of ambient lake condition and trophic status.
- Develop a set of standard protocols for data gathering in lakes that are relatively easy for trained volunteers to collect.
- Identify, procure, and maintain equipment necessary for carrying out protocols for data gathering.
- Develop a data summary, as well as draft and final reports that present, summarize, and evaluate the data based on the project's goal of estimating current conditions of Vancouver Lake.

Organization and Schedule

Project Team

Water Resources' activities are administered through the Clark County Public Works department as part of the county's Clean Water Program.

Rod Swanson, Senior Planner, coordinates monitoring activities within the NPDES permit program and between the program and other agencies, and directs lead/support staff.

Jason Wolf, Natural Resources Specialist, is the project manager, primarily responsible for project implementation, data analysis, and writing the annual data summary. He is also the volunteer coordinator and is responsible for recruiting and managing the activities of volunteers, and maintaining and lending equipment to volunteers.

Jeff Schnabel, Natural Resources Specialist III, provides quality assurance review and technical assistance in regards to data analysis and report writing.

Trained volunteers carry out scheduled field activities, including collecting samples, and recording field measurements and observations. The volunteers document field activities on datasheets and forms, and submit samples to Water Resources for lab analysis.

Water quality samples are analyzed by Addy Lab, a Washington Department of Ecology (Ecology) accredited laboratory located in Vancouver Washington. Algae and chlorophyll-a samples are analyzed by Aquatic Analysts in White Salmon, Washington.

Schedule of activities

Volunteer monitoring activities typically take place during the lake's growing season, from May through October each year. Volunteers carry out field activities in a twice-monthly schedule. Samples are submitted by volunteers to county staff and the contracted laboratory according to the requirements prescribed by specific characteristic methodologies. This information is detailed in the 'Field and Laboratory Procedures' sections of this document. Preliminary data was collected in 2003 by staff to determine feasibility of the project. Since then, full data sets have been collected by volunteers from May-October, 2004-2006.

Schedule Limitations

This is a volunteer monitoring program and deviations from a planned schedule are to be expected. Factors such as inclement weather may affect the timing of field activities. Volunteers are instructed to determine specific dates for field activities depending on the team members' schedules. As a result, the timing of field activities may be affected by volunteer availability. Equipment is borrowed from Water Resources to perform field activities and is also subject to availability. Volunteers are encouraged to plan in advance and reserve equipment for the dates that suit their team's needs.

Project Duration
The Vancouver Lake monitoring station is part of an ongoing ambient monitoring project that aims to provide data over an extended time period. Minor changes may occur to the design and schedule as the monitoring is integrated with a developing Vancouver Lake management strategy. This QAPP, and future revisions, will apply to all Vancouver Lake monitoring activities carried out by volunteers in the volunteer monitoring program.

Sampling Design

Stations
Figure 1 shows the approximate location in Vancouver Lake where monitoring takes place. Volunteers are instructed to monitor an open-water portion of the lake, defined as an area at least 800-1000 feet from the shoreline. Previous Vancouver Lake studies, including volunteer monitoring with the Washington Department of Ecology, have collected water quality data from within this project's general target area. These investigations found that data from multiple open water stations did not have significantly different water quality. A few specific locations, such as near the mouths of Burnt Bridge Creek and Lake River, were found to have significantly different water quality characteristics than the open water area of the lake.

Monitoring characteristics and frequency
Volunteers perform field measurements and collect water samples twice-monthly from May to October. Chemical, physical, and biological characteristics are shown in Table 1. Many volunteers do not have a boat with which to collect data, so county staff will utilize the county boat to bring volunteers to the sampling location. This will also allow staff to easily supervise data collection.

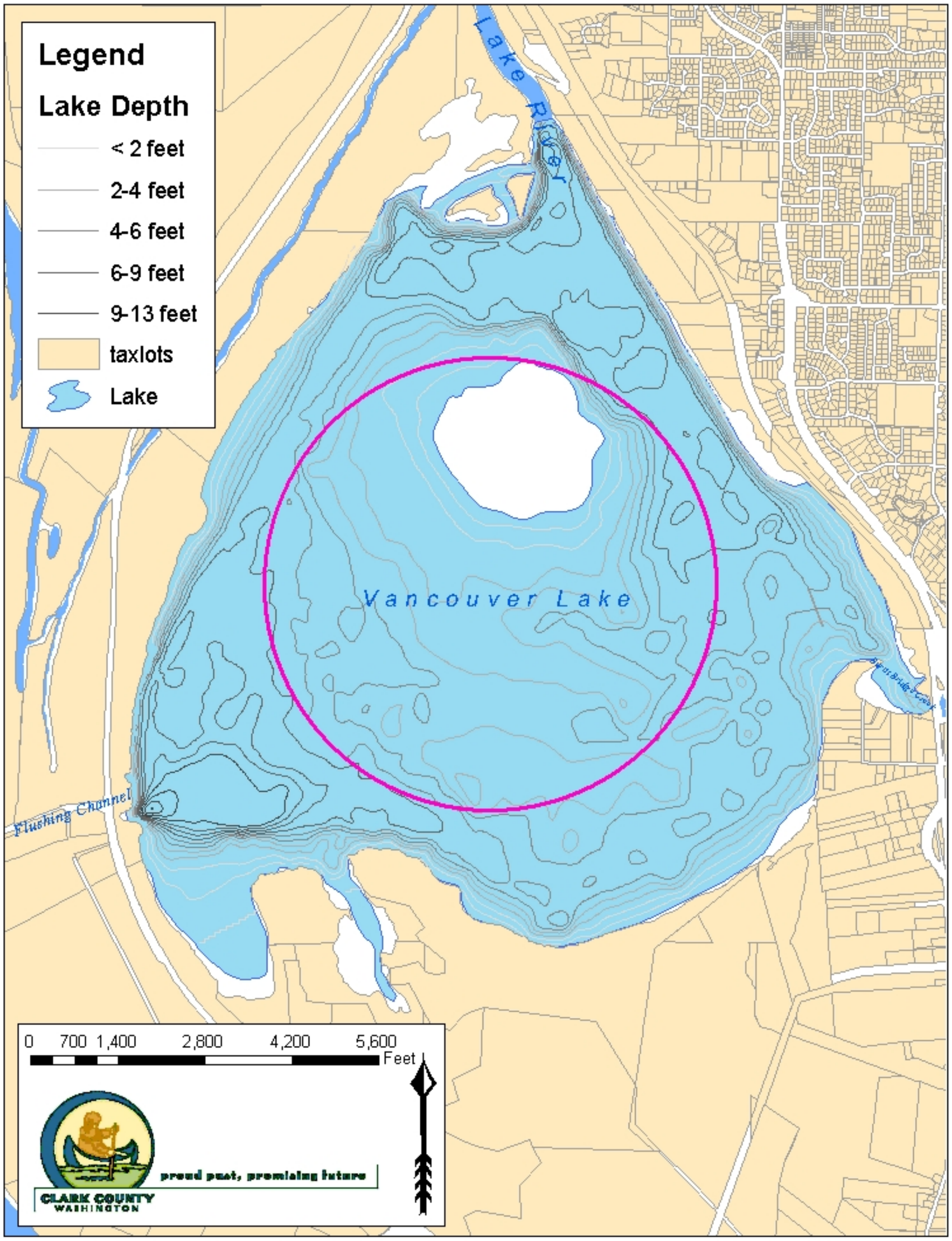

Figure 1. Map of Vancouver Lake and vicinity.

Table 1. Chemical, physical, and biological characteristics of the project.

Biological Parameters	Chemical Parameters	Physical Parameters
Algae density and type	Phosphorus, inorganic and total	Water temperature, pH, conductivity
Chlorophyll-a concentration	Nitrogen, inorganic and total	Dissolved Oxygen
		Turbidity
		Secchi depth

Data analysis

Data analysis focuses on assessment of lake condition, specifically on the level of algal growth and related parameters. Tables of basic summary statistics showing central tendency and variability are calculated using seasonal datasets. Data are also displayed using simple graphical techniques such as time series and box plots that show central tendency and variability of the data.

The Trophic State Index (TSI) is used to describe the level of production of a lake, or the amount of algal matter produced by photosynthesis in a lake (Carlson, 1981; Wetzel, 1983). An index generally uses a numbered scale to compare variables with one another, or with a reference number. Thus, indices provide a “common currency” with which to describe lake conditions. A single measurement of TSI does not imply whether a lake’s health is deteriorating, nor does it imply where a lake *should be* in terms of the current health. Equations, taken from Carlson and Simpson (1996) are used to calculate the TSI from chlorophyll-a , Secchi depth, and total phosphorus data. An equation calculating TSI from algal biovolume is provided by the consultant performing the algal counts (Jim Sweet, personal communication).

In the short-term, comparison between individual years will utilize ANOVA procedures on seasonal averages. In the long-term, trend analysis for particular parameters, such as Secchi depth and total phosphorus concentration, will utilize a non-parametric seasonal Kendall test. Please note that the lake level changes throughout the summer. Depths over two meters in the spring are typical, and at the lowest level in early fall the lake is about one meter at the sampling location. This prevents consistent data collection beyond one meter and comparisons and trend analysis will have to be adjusted accordingly.

Representativeness

Previous investigations concluded that monitoring stations from within the open-water portion of the lake did not have significantly different water quality. Data are intended to be representative of overall lake conditions at the time of sample collection. Volunteers are instructed to collect samples from the open-water portion of the lake, defined as any point located at least 800-1000 feet from the shoreline. In addition, the lake appears to be well-mixed and little variation has been found in water quality data at different depths. The lake is shallow, especially in late summer and early fall. Volunteers will be asked, then, to fill all sample bottles from a one meter grab sample for data consistency.

Water Resources staff has trained volunteers on standard monitoring procedures to collect representative samples. In most cases sampling is performed at approximately mid-day to minimize diurnal effects on characteristics which show large diurnal variations (temperature, pH, dissolved oxygen, chlorophyll-*a*, water clarity). However, collection times will vary with volunteer availability and schedules.

Comparability

One of the objectives of this project is to produce data that are comparable to other local and regional data standards and metrics. In volunteer monitoring, projects must balance 1) monitoring and data requirements on a regional scale; 2) the level of sophistication and effort associated with professionally collected data; and 3) techniques volunteers can utilize with a high likelihood of success. Utilizing comparable protocols and techniques that are less intense than more rigorous investigations, volunteers are capable of successfully collecting a number of types of data. Specifying standard procedures for data collection and analyses facilitates the long-term comparability of volunteer-collected data. Furthermore, following examples of established volunteer monitoring procedures, developed in consultation with experts, guards against generating data that will be irrelevant to natural resource managers or the public.

Data Quality Objectives

Field and Lab

Analytical methods, detection or precision limits, and Measurement Quality Objectives (MQOs) for accuracy, precision, and bias are listed in Table 2. MQOs for this project are set at generally accepted targets for ambient water quality monitoring projects utilizing volunteers. Data quality objectives and quality control procedures for laboratory characteristics are detailed in the lab's quality assurance documents maintained and stored at their facility.

Collection, preservation, transportation, and storage of samples follow standard procedures designed to reduce most sources of sampling bias. Analytical bias is minimized by adherence to the methods listed in Tables 3 and 4. The laboratories employ quality control procedures appropriate to the analytical procedures, including analysis of method blanks, matrix spikes, and check standards.

Table 2. Monitoring characteristics and measurement quality objectives

Characteristic	**Reporting Limit**	**Precision**	**Accuracy**	**Bias**
	Concentration units	Relative Standard Deviation	% deviation from true value or units of measurement	% of true value
Water temperature	0.01 C	10%	±0.15 C	na
Dissolved Oxygen	0.01 mg/L	10%	±0.2 mg/L	na
Conductivity	4 digits	10%	±0.5% of reading	na
pH	0.01 units	10%	±0.2 units	na
Turbidity	0.01 NTU	25%	±2% of reading	na
Total Phosphorus	0.01 mg/L	15%	40%	10%
Ortho-phosphate	0.01 mg/L	15%	40%	10%
Total Kjeldahl Nitrogen	0.1 mg/L	15%	40%	10%
Nitrate - N Nitrite - N	0.01 mg/L 0.05 mg/L	15%	40%	10%
Ammonia-N	0.05 mg/L	20%	50%	10%
Chlorophyll *a*	0.8 ug/L	20%	50%	10%
Algae	na	na	na	na

Field Procedures

Clark County Water Resources utilizes a field procedure manual (Wierenga, 2003). Table 3 details the field procedures and the sampling requirements for each characteristic.

Calibrating field instruments

The Hach 2100P turbidimeters, the YSI 60 pH meter and the YSI 85 conductivity and dissolved oxygen meter are calibrated by county staff prior to checkout by volunteers. The calibration and maintenance procedures, as described in instrument operation manuals, are followed.

Flow of field activities
Volunteers are trained to follow a general flow of sampling procedures. Monitoring dates are arranged by the team and confirmed with county staff to ensure equipment availability. Volunteers inspect field kits for completeness given the parameters to be monitored on each trip. Once at the desired sampling location volunteers begin with a general site assessment including weather conditions. Vertical profiles for physical parameters and Secchi disk readings are recorded, followed by collecting water samples using the Van Dorn water bottle and individual sample bottles. Volunteers verify that the tasked work has been completed before leaving the site and returning the equipment and samples to county staff.

Equipment cleaning and waste disposal
Volunteers use a Van Dorn water bottle to collect grab samples from a specific depth. Individual sample bottles for nutrients, turbidity, and algae are filled out of the bottle. If more than one sample site is monitored on the trip, volunteers rinse the Van Dorn bottle with lake water from the desired collection depth before the final collection. Volunteers use de-ionized water provided by county staff to rinse field instruments and equipment prior to use and storage. There are no procedures used in the field that generate regulated wastes requiring special handling and disposal.

Sample identification and handling
The site name and sample date identify samples collected by volunteers. County staff fills in 'Client Name', 'Project Name', and 'Sample ID' fields on bottle labels; volunteers fill in the 'Date' and 'Time' fields. Unique sample ID numbers are assigned by contracted laboratories. Sample bottles are stored in large coolers with an appropriate amount of ice packs to keep them cold. Prior to sampling, arrangements are made with contracted labs to pick up samples, allowing sufficient time to analyze them within holding-time requirements.

Data management and field activity logs
The volunteers fill-in the appropriate fields on the data sheets, including the checklists detailing the actions required to verify the data and submit it to staff for review and entry into the database (See Appendix A for data sheet examples). Volunteers are directed to review all of the sheets and then initial appropriate fields indicating that the forms are complete. County staff completes the chain of custody forms when samples are submitted to the lab. County staff confirms that the data was received and reviewed for completeness, then enters available data into the Water Quality Database (WQDB). All field data sheets and sample tracking forms are bound and stored at the county office as a log of field activities.

Table 3. Field measurements and sampling requirements of the project.

Field Activity Type	Sampling Frequency	Method	Equipment	Sample Size	Container/ preservation	Holding Time
Water temperature measurement	Twice-monthly	EPA170.1 thermistor	YSI 85 multimeter	NA	NA	In-situ
Dissolved oxygen measurement	Twice-monthly	EPA360.1 membrane electrode	YSI 85 multimeter	NA	NA	In-situ
Conductivity	Twice-monthly	EPA120.1	YSI 85 multimeter	NA	NA	In situ/ 24 hours
pH measurement	Twice-monthly	EPA150.1 electrometric	YSI 60 multimeter	NA	NA	In-situ
Turbidity measurement	Twice-monthly	EPA180.1 nephelometric	Hach 2100P	10-mL	Hach sample vial	48 hours
Nitrogen samples	Twice-monthly	Grab sample at 1m	NA	500-mL	500-mL HDPE/sulfuric acid	28 days
Phosphorus samples	Twice-monthly	Grab sample at 1m	NA	500-mL	500-mL HDPE/sulfuric acid	28 days
Algae samples	Twice-monthly	Grab sample at 1m	NA	1 liter	1L opaque HDPE/ lugols or MgCO3	24 hours

Laboratory Procedures

Analytical requirements are shown in Table 4. Samples may be submitted to multiple laboratories for analysis depending on parameters, logistics, analytical fees etc.

Table 4. Analytical procedures for water samples.

Characteristic	Sample Matrix	Number of Samples	Analytical Method	Expected Range of Results
Total Phosphorus	Surface Water	12 per season at 1m	EPA 365.3 colorimetry	< 0.01-0.500 mg/L
Total Kjeldahl Nitrogen	Surface Water	12 per season at 1m	EPA 351.4 colorimetry	< 0.5-5 mg/L
Nitrate+Nitrite-N	Surface Water	12 per season at 1m	EPA 300.0 ion chromatography	< 0.01-3.0 mg/L
Ammonia-N	Surface Water	12 per season at 1m	EPA350.1 colorimetry	< 0.05-1.0 mg/L
Chlorophyll *a*	Surface Water	12 per season at 1m	SM 10200H	< 0.2-100 ug/L
Phytoplankton	Surface Water	12 per season at 1m	SM10200F2C	na

Water samples are transported to the labs by county staff or preserved, packed and shipped to the laboratory for analysis within 24 hours after collection. Standard chain of custody procedures are followed. Labs usually provide analytical results within four weeks of receipt of the samples. Data that is reported as digital Excel worksheet files are backed up with mailed hard copies.

Quality Control

Laboratory QC

Laboratory check standards, matrix spikes, analytical duplicates, and blanks are analyzed in accordance with the lab's quality assurance programs. All QC sample results are reported to county staff along with sample data. Laboratory data reduction, review, and reporting are performed according to the lab's data reporting procedures. Laboratory QC data is reviewed by county staff upon receipt of the data report and outstanding issues are referred to the laboratory for follow-up or clarification.

Field QC

Table 5 lists field QC sample types, frequencies, and definitions for water quality samples. Laboratory water quality samples and field meter measurements are replicated during at least one sampling event.

All meters are calibrated and maintained by county staff in accordance with the manufacturer's instructions. Check standards for conductivity, pH and turbidity are used to verify the accuracy of field meters. An NIST-certified thermometer is used to verify the accuracy of temperature sensors. Calibration logs are completed during each calibration and are archived in county files. These activities confirm that field instruments are attaining stated accuracy and resolution specifications.

Table 5. QC sample types, frequencies, and definitions required for the project.

Field QC sample type	Frequency	Definition
Field measurement replicate	2X per season	repeat all field meter measurements at 1m depth
Sample duplicate	2X per season	duplicate all samples collected for laboratory analysis from 1m grab
Transfer blank	1X per season	D.I. water sample collected in field with sampling equipment
Winkler dissolved oxygen test	2X per season	Surface (0.2m) sample collected in field and preserved for Winkler titration to be compared to surface meter reading

Corrective Actions

Deviations from specified data quality objectives are addressed as needed through re-calibration, modifications to the field procedures, increased volunteer training, or by qualifying results appropriately. Documentation of corrective action steps includes problem identification, investigation procedures, corrective action taken, and effectiveness of the corrective action.

Data Management Procedures

Volunteers record field data on standardized data sheets. Volunteers review field data sheets for errors and then submit a completed package to county staff for entry into the database and archiving in bound notebooks.

Contracted laboratories submit data either electronically in Excel spreadsheets or in paper reports. Hard copies of laboratory reports are stored in a project binder.

After review, data is entered or imported into the WQDB, developed by Water Resources staff. The database is in a SQL Server format, utilizing Access for data entry, editing, analysis, and reporting. A routine is built into the utilities of the database for reporting following the data standard and submittal requirements of Ecology's Environmental Information Management system.

Data Review, Verification, and Validation

During each sample trip, volunteers or staff check field data sheets to confirm that all necessary field measurements and samples have been collected. Laboratory QC results are reviewed and verified by laboratory staff and documented in data reports to Water Resources. Upon receipt, laboratory data are reviewed for errors, omissions, and data qualifiers prior to data entry.

Data verification involves examination of QC results analyzed during the project to provide an indication of whether the precision and bias MQOs have been met. To evaluate whether precision targets have been met, pairs of duplicate sample results are pooled and an estimate of standard deviation is calculated. This estimate divided by the mean concentration of the duplicate results and converted to percent can be used to judge whether the %RSD target has been met.

To evaluate whether bias targets have been met, the mean percent recovery of the check standards should be within +/- %bias target of the true value (e.g. true value +/- 10%). Unusually high blank results indicate bias due to contamination that may affect low-level results. To evaluate whether the target for reporting limit has been met, results will be examined to determine if any of the values exceed the required reporting limits.

Data validation consists of a detailed examination of the complete data package using professional judgment to assess whether the procedures in the volunteer methods manual and QAPP have been followed. Data validation is performed by the project manager and QC coordinator during the preparation of annual reports.

Data Quality Assessment

Taking into account the results of data review, verification, and validation, an assessment will be made as to whether the data are of sufficient quality to attain project objectives at the end of the project.

Audits and Reports

Audits

The project manager and QC coordinator periodically review the field data, methods, lab results, and data management activities to make an assessment of the program and identify corrective actions or method revisions.

Reports

An annual data summary detailing field activity and preliminary results will be completed by county staff and distributed to interested parties. Data summaries address project methods, present data, summarize data accuracy and completeness, describe any significant data quality problems, and suggest modifications for future monitoring. Reports are peer reviewed by Water Resources staff. The summary will be made available to volunteers via e-mail list service or in hard copy.

Draft and final reports that present, summarize, and evaluate the data based on the project's goal of estimating current conditions will be completed before the field activities for the next year begin. Volunteer-collected data may also be used in the Water Resources' reports of stream-health in major watersheds. Executive summaries, and full reports as warranted, are placed on Water Resources' website to disseminate information to the public.

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Appendix A: Field data sheets.

Project: Vancouver Lake Ambient Monitoring   Location Name: VANL050

Sampling Date: ____________________   Time: ______________________________________

Field Crew: ____

Weather: Air temperature ______ (°C); Estimated wind velocity and direction ________________

Surface Waves ____________________; Precipitation ___________________________________

Note: Entries for wind velocity, waves, and precipitation should be "light", "medium", and "heavy". Estimate general wind direction as N, NE, E, SE, S, SW, W, NW.

Turbidity Meter Calibration Date:	
Gelex Vial Expected Value:	
Gelex Vial Observed Value:	

Depth (m)	Water Temperature (°C)	pH (units)	Dissolved Oxygen (mg/L) and (%Sat)		Conductivity (*u*S/cm)	Turbidity (NTU)

Secchi Disk Depth (m): _________________   Composite Sample Depth (m): N/A

Sample Depth (m): Always from 1 meter   Total depth (m): _______________________

Comments :

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