SKAGIT COUNTY WATER QUALITY MONITORING PROGRAM
QUALITY ASSURANCE PROJECT PLAN

FINAL 10-30-03

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Rick Haley, Project Manager
Surface Water Management Section
Skagit County Public Works

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Washington State Department of Ecology Signatory

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INTRODUCTION

The Skagit County Monitoring Program (Program) is an extension of the Skagit County Baseline Monitoring Plan begun in 2001 and is intended to determine conditions and trends in water quality in watercourses in Skagit County's agricultural areas. The purposes for gathering this data are to monitor possible changes in water quality as the County implements its new Critical Areas Ordinance for agricultural areas, and to provide data in support of the Washington State Department of Ecology's (ECY) local Total Maximum Daily Load (TMDL) programs. Skagit County will continue to sample most sites from the Baseline Plan and add more sample sites in areas not covered by the Baseline Plan.

PROJECT ORGANIZATION AND RESPONSIBILITY

Personnel

Project Manager: Rick Haley
Water Quality Analyst
Surface Water Management Section
Skagit County Public Works
1800 Continental Place
Mt. Vernon, WA 98273
360-336-9400

Field Technician: TBA
Skagit County Public Works
1800 Continental Place
Mt. Vernon, WA 98273
360-336-9400

Supervisor: Ric Boge
Natural Resource Project Manager
Surface Water Management Section
Skagit County Public Works
1800 Continental Place
Mt. Vernon, WA 98273
360-336-9400

SCHEDULE

Public review draft monitoring plan – August 1, 2003

Sample site scouting – August, 2003

QAPP Preparation – August, 2003

Public review of monitoring plan – August 1 – September 15, 2003

Begin monitoring - October 1, 2003

Grant funding commences - November 1, 2003

Monitoring continues biweekly through June, 2008

Progress reports issued quarterly

Data summaries issued annually

Final Report – September, 2008

BACKGROUND AND PROJECT DESCRIPTION

The Program was established by Skagit County Resolution R20030210 to continue Skagit County's investigations into water quality in agricultural areas. The investigation began with a Baseline Plan associated with Skagit County Ordinance 18069, a law to regulate commercial agricultural activities on critical areas. Subsequently, Skagit County repealed Ordinance 18069 and replaced it with Ordinance No. O20030020 (Ag-CAO) and Resolution R20030210. As part of the Resolution, Skagit County committed to an expanded monitoring program in the agricultural areas, the Skagit County Monitoring Program. The Program will also provide data in support of the ECY TMDL programs in Skagit County, including the Lower Skagit fecal coliform TMDL and the Lower Skagit River Tributaries Temperature TMDL.

Agriculture has been identified as responsible for some non-point source water quality problems in many areas of the country, including in ECY's publication, "Washington's Water Quality Management Plan to Control Nonpoint Source Pollution." Agricultural operators want water quality problems to be clearly documented and cause-and-effect relationships established prior to requirements for action on their part. Skagit County's monitoring efforts have laid the groundwork for providing that information, and the proposed Program will be an extension of the existing Baseline study designed to incorporate more monitoring sites on more watercourses in agricultural areas of the county.

The goals of the Program are to monitor conditions and trends in water quality in Skagit County's agricultural areas as the Ag-CAO is implemented, and to provide data in support of ECY's Skagit County TMDLs. The information will be used to evaluate the effectiveness of the CAO in protecting water quality, help determine water quality trends in the agricultural areas of Skagit County, and assist water cleanup initiatives (TMDLs) in identifying and correcting pollution sources.

Review of previous Baseline data and TMDLs

The Skagit County Baseline Monitoring Plan collected data for over two years at 27 sites in agricultural zones (Appendix A, Nos. 1-27). Parameters included dissolved oxygen, temperature, pH, turbidity, conductivity, fecal coliform, and nutrients. Field parameters and fecal coliform samples were obtained every two weeks at each location. Nutrient samples were obtained every four weeks. Results indicated many stations had water quality that at times approached or failed state standards for a variety of parameters and locations. The Baseline study was not designed to assign responsibility for water quality problems, nor is two years' data enough to establish firm trends. Instead, the Baseline provides a two-year characterization of the current state of water quality in Skagit County agricultural areas and the basis for future comparisons. The new Skagit County Monitoring Program will expand on the Baseline study to more areas, and with time will provide information on trends in water quality in the agricultural areas as the Ag-CAO takes effect.

ECY currently has two active TMDL efforts in Skagit County, the Lower Skagit Fecal Coliform TMDL and the Lower Skagit Tributaries Temperature TMDL. The Program will provide both fecal coliform and temperature data in support of those efforts, in addition to other standard water quality parameters.

Study Area

The study area encompasses the principal agricultural areas of Skagit County (Agriculture-Natural Resource Lands and Rural Resource-Natural Resource Lands zoning). Appendix A contains a map and list of sampling stations. This list may change slightly as a result Right-of-Entry issues. The sample sites were chosen based on watercourse location within the agricultural zones, and will be located to meet one or moreof the following objectives: 1) Downstream from agricultural influences to represent possible effects of agricultural land use activities on water quality; 2) Upstream from agricultural activities to represent background conditions, 3) Locations chosen to gather water quality information in support of TMDL development or implementation, and 4) Receiving waters for watercourses draining agricultural lands.

The watercourses to be sampled include salmonid streams, non-fish-bearing drainage infrastructure, and nearshore marine waters.

Objectives

Target population:	Watercourses in agricultural areas of Skagit County
Study boundaries:	Areas zoned Agriculture-Natural Resource Lands and Rural Resource-Natural Resource Lands in Skagit County, from October 2003 to October 2008
Goals:	Determine status and trends in water quality in Skagit County agricultural areas.
	Provide information to ECY in support of local TMDLs

MONITORING PARAMETERS AND PROCEDURES

Parameters (See Table 1):

Dissolved oxygen: Dissolved oxygen (DO) is one of the major factors that determine the type of biological communities that inhabit an aquatic system. Salmonids require high DO levels. DO will be measured in the thalweg of the watercourse with a meter to the nearest 0.1 mg/L. Target statistics include mean and range.

Temperature: Temperature is a major factor that influences the metabolism and structure of the biological communities in rivers and streams. Salmonids are sensitive to elevated temperature. Temperature will be continuously monitored from spring through fall with recording dataloggers. Dataloggers will be placed in areas with consistent water coverage and adequate flow. Temperature will be recorded to the nearest 0.1°C. Target statistics include summer high temperature as measured by the 7-day average maximum and daily maximum.

Nutrients: Nitrogen and phosphorus are the nutrients that most often limit aquatic algae growth in freshwater. Excess algal growth can lead to declines in DO and aesthetic impacts. At a minimum, total phosphorus, total kjeldahl nitrogen, and ammonia will be determined by a state-accredited laboratory. Samples will be obtained from the thalweg of the watercourse with clean sample bottles. Nitrate, nitrite, and/or orthophosphate may also be included. Nutrients will be reported to the precision indicated by the contract laboratory.

Conductivity: Conductivity serves as an indication of the concentration of dissolved ions in the water. Conductivity will be measured in the thalweg of the watercourse with a meter and reported to the nearest 0.1 us/cm.

Salinity: Salinity will be measured in the thalweg of the watercourse with a meter to the nearest 0.1 ppt. Salinity serves as an indicator of marine water intrusion and will be included in annual reports and as necessary to interpret other parameters.

pH: pH is a measure of acidity or alkalinity of water. pH outside of the normal range (generally 6.5 to 8.0 units) can be an indication of pollution and may be stressful to aquatic organisms. pH will be determined with a meter from a sample taken from the thalweg of the watercourse and reported to the nearest 0.01 units. Target statistics include mean and range.

Turbidity: Turbidity is a measure of the amount of suspended material in water. Turbidity can be an indicator of erosion or algal blooms. Turbidity will be determined from a sample taken from the thalweg of the watercourse with a nephelometer and reported to the nearest 0.01 NTU. Target statistics include individual readings and background levels when available.

Fecal coliform: Fecal coliform is an indicator of fecal pollution from warm-blooded animals in the water. Fecal coliform will be determined from 150-ml samples obtained from the thalweg of the watercourse in the field and held on ice until transferred to the Skagit County Health Department for analysis using the Most Probable Number (MPN) method. MPN is being used because of county lab certification and its robustness in the face of turbidity. Fecal coliform will be reported to the nearest 1 colony forming unit per 100 ml.

Discharge: Discharge (flow) is a measure of the amount of water flowing in a watercourse. It is measured to help interpret other parameters. Discharge will be determined with hand-held flow meters at approximately 10 selected locations and reported to the nearest 1 cfs.

Monitoring procedures

Table 1 summarizes methods to be used in the Skagit County Monitoring Program. Field instruments will be used to determine dissolved oxygen, instantaneous temperature, conductivity, salinity, pH, and turbidity. Fecal coliform samples obtained in the field will be transferred to the Skagit County Health Department Water Lab for analysis by the Most Probable Number method. Nutrient samples will be transferred to a state-accredited laboratory in Washington for analysis using standard methods.

Table 1. Water quality monitoring methods for the Skagit County Monitoring Program

Parameter	Frequency	Method	Reference
Dissolved oxygen	Biweekly	Meter: YSI Model 85	USGS
Temperature (air and water)	Continuous Spring-Fall	Recording datalogger Onset Stowaway Tidbit	Oregon Plan
Turbidity	Biweekly	Meter: LaMotte 2020	Oregon Plan
pH	Biweekly	Meter: Fisher Accumet AP62	Oregon Plan
Conductivity	Biweekly	Meter: YSI Model 85	ECY
Fecal coliform	Biweekly	Most Probable Number	USGS
Nutrients	Monthly	Standard Methods, EPA	Edge Analytical
Discharge	Monthly	Velocity-area method, Price-type flowmeter	USEPA, USGS

Dissolved oxygen, current temperature, conductivity, and salinity readings will be taken directly from a YSI Model 85 meter with the probe located in the thalweg of the watercourse. Water samples for all other purposes will be obtained from the thalweg using a sampling wand and clean, rinsed LPE sample container. Water for nutrient samples will be poured into the sample bottles provided by the contract lab to avoid loss of preservative. Fecal coliform samples will be obtained directly into the sample bottle. Care will be taken with the sampling wand to avoid disturbing bottom sediments or oversampling the surface film.

The sample container used with the wand will be rinsed thoroughly with stream water between samples. Extra sample containers will be included in the field kit in case of contamination that can't be addressed by simple rinsing.

Sample bottles for fecal coliform and nutrients will be marked with pre-printed adhesive labels describing the sample site by number and the date. Duplicate samples will be labeled with the date and the duplicate number (e.g. "Fecal 1"). The location of the duplicate samples will be recorded on a separate data sheet to avoid bias in the lab analysis.

Discharge measurements will be made using Price-type flowmeters on transects across stream widths. Smaller streams will be measured by wading, while discharge in larger streams will be measured from bridges.

Biweekly monitoring of most parameters provides a fairly detailed examination characterization of the trends in water quality in a given watercourse over time. Monthly sampling of nutrients will be adequate to characterize seasonal variation in nutrient levels while saving on the laboratory costs of more frequent analysis. All parameters except discharge will be determined at each site. Discharge monitoring will occur at approximately 10 locations, depending on logistical considerations. Discharge monitoring will concentrate on those sites where discharge data will be useful for TMDL

implementation and sites for which we have no previous discharge data. Skagit County will coordinate with ECY TMDL personnel to locate discharge monitoring sites.

Overall, the proposed sampling schedule will provide an in-depth indication of the physical and chemical conditions of the watercourses. Continuous monitoring of temperature is necessary in order to capture the critical summer temperatures and to demonstrate diurnal and seasonal trends.

QUALITY CONTROL PROCEDURES

Field QC Procedures

Field instruments will be calibrated prior to each sampling event and operated as per the manufacturers' instructions. Suspect readings from field meters will result in examination of probes, recalibration if necessary, and/or repeated measurement.

Field replicates will be collected for most analyses at a 10% rate. Fecal coliform replicates will be collected at a 20% rate, and will focus on the areas of suspected higher fecal coliform levels. This is to account for patchy distribution in the environment and document the variability of fecal coliform levels.

Laboratory QC Procedures

Laboratory replicates and blank samples will be analyzed along with the normal samples. This will occur at a 10% rate. For appropriate analyses, check standards and spike analyses will be conducted for each run of samples. An external laboratory check will be conducted randomly to verify accuracy and precision of laboratory results.

Corrective Procedures

Corrective procedures will take place as they are warranted. The laboratory will be responsible for implementing corrective actions should problems arise with laboratory analyses. These procedures may involve control charts, recovery charts, and blank analysis charts to locate the source of the problem. The Project Manager will be responsible for corrective actions regarding problems with field data and sample collection. These actions may include additional sample collection, field equipment training, equipment checks, calibration standard verification, and recalibration in the field. Office activities may include correction of the database, meetings with monitoring team members, instrument repair, and revision of procedures.

Data Quality Objectives

The goal of this program is to generate sufficient reliable data to detect trends in water quality in the agricultural areas of Skagit County. A secondary data quality goal is to generate data that will allow determination of a stream's status compared to state water quality standards.

Bias

Bias will be minimized by use of standardized procedures by an experienced staff. Samples will be taken and preserved according to written procedures and instruments will be calibrated and operated according to manufacturer's instructions.

Some forms of bias, such as the tendency of dissolved oxygen to be at a minimum in the morning and higher during the day, are unavoidable since we can't sample everywhere at once. In such cases, we will be aware of the source of bias and substitute consistency for lack of bias in order to preserve data comparability over time.

Precision

Precision expectations will be determined from previous duplicate analyses. See Measurement Quality Objectives below.

Measurement Quality Objectives

Table 2 summarizes the Measurement Quality Objectives (MQOs) for the Skagit County Monitoring Program. The MQOs were derived by examining the MQOs from the Washington State Department of Ecology's similar Stream Ambient Water Quality Monitoring program, then comparing those MQOs with the results obtained during Skagit County's Baseline Monitoring Program and the manufacturer's specifications of the equipment to be used in the Skagit County program. In most cases the state MQOs appear to be appropriate for the Skagit County program.

DATA ASSESSMENT PROCEDURES

QA/QC Process

The Project Manager will review laboratory reports and field data and notes to validate laboratory and field techniques, calculate precision, account for bias, and verify completeness. In addition, the reports will be reviewed and summarized annually during the project.

Table 2. Measurement Quality Objectives for Skagit County Monitoring Program

Parameter	Accuracy	Precision	Bias	Reporting Limit
Dissolved oxygen	±0.3 mg/L	NA	NA	NA
Conductivity	±0.5 us/cm at 100 ntu	NA	NA	NA
Salinity	±0.2°C	NA	NA	NA
pH	±0.01 units	NA	NA	NA
Temperature	±0.2°C	NA	NA	NA
Discharge	± 2%	NA	NA	1 cfs
Fecal coliform	NA	33% RSD	NA	2 colonies/100 ml
Turbidity	± 2%	NA	NA	NA
Ammonia (mg/L)	20%	10%	NA	0.02 mg/L as N
Total kjeldahl nitrogen	20%*	10%*	NA	0.5 mg/L as N
Total phosphorus	20%	10%	NA	0.01 mg/L as P

*Estimate from Baseline Project NO3-NO2 duplicates

Data Entry and Review

Data will be entered into the Skagit County Monitoring Database. After entry in the database, printouts will be compared with field sheets to detect and correct data entry errors. For analysis, data will be exported to spreadsheets and reviewed to focus on parameters of interest. Trends will also be analyzed using graphical formats and other tools as deemed appropriate. Because all of the field and laboratory analyses are standard procedures and Skagit County personnel have extensive water quality monitoring experience, major problems with quality control are not expected. However, data reports will be reviewed regularly by the Project Manager.

Statistics

Standard summary statistics (mean, standard deviation, etc.) will be computed for each parameter and included annual reports. Skagit County is investigating applicable statistics for trend analysis and is consulting with ECY concerning proper techniques. ECY personnel have confirmed that the data collection methods and frequency delineated above will provide robust data sets for trend analysis.

All raw data will be forwarded to ECY for their use and posted on the County's website for use by other interested parties.

REPORTS

Progress reports to ECY will be made quarterly. These reports will include activities conducted, problems encountered and their solution, and budgetary considerations.

Skagit County will produce annual reports for the life of the project. These reports will include all raw data collected during the reporting period, summary statistics, an assessment of the accuracy and completeness of the data, and any significant challenges confronted during the reporting period. As the project progresses, trends developing in critical parameters will also be reported and discussed.

Skagit County will also produce a final report at the end of the project. In addition to the topics covered in annual reports, the final report will summarize all data collected, report on trends in water quality in Skagit County's agricultural areas, discuss any challenges confronted during the study, and provide recommendations for future activities to monitor and protect water quality in the study area. The final report will also provide an indication of the success of Skagit County's Critical Areas Ordinance for Ongoing Agriculture in protecting water quality in the target areas.

REFERENCES

Edge Analytical, Inc. Burlington, WA

The Oregon Plan for Salmon and Watersheds, "Water Quality Monitoring Technical Guide Book," (1999).

USEPA, "Environmental Monitoring and Assessment Program Surface Waters: Field Operations and Methods for Measuring the Ecological Condition of Wadeable Streams," EPA/620/R-94/004F (1998)

USGS, "National Field Manual for the Collection of Water Quality Data, Techniques of Water Resources Investigations, Book 9 (1998).

USGS, "Measurement and Computation of Stream Flow," Water Supply Paper No. 2175 (1982).

Washington State Department of Ecology, "Stream Sampling Protocols for the Environmental Monitoring and Trends Section," Publication No. 01-03-036 (2001),

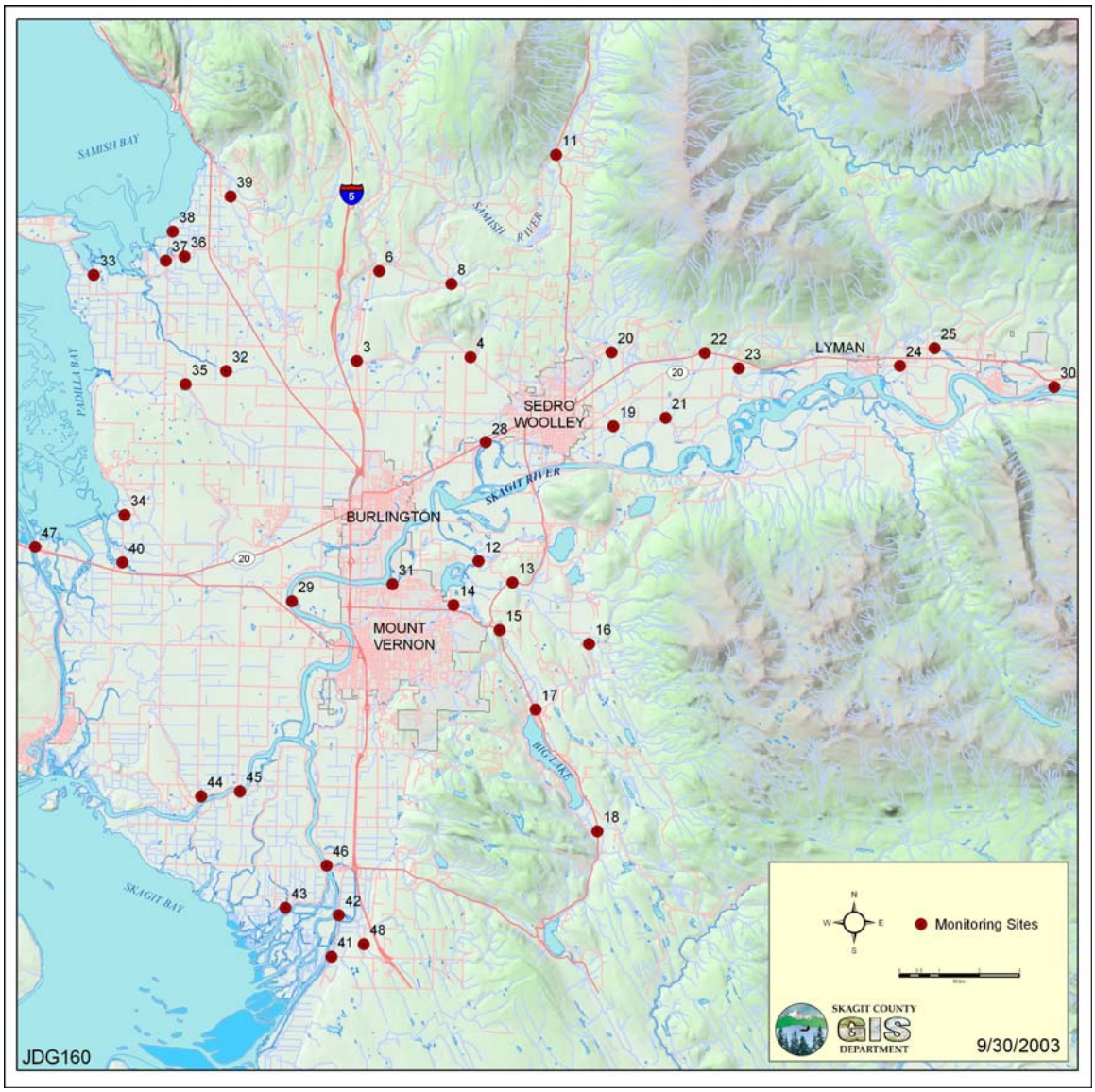
Washington State Department of Ecology, "Quality Assurance Monitoring Plan, Stream Ambient Water Quality Monitoring," Publication No. 03-03-200

Appendix A. Sample site locations for Skagit County Monitoring Program

NOTE: Current project has 40 sites total. Site numbers 1-27 were previously assigned to the Skagit County Baseline Monitoring Project (2001-2003). Baseline sites included in this project maintain their Baseline site numbers. Missing numbers represent Baseline sites not included in this project, but which need to maintain their site number identity in the monitoring database.

Site Number	Stream Name	Road Name or Location
3	Thomas Creek	Old Hwy 99 North
4	Thomas Creek	F&S Grade
6	Friday Creek	Prairie Road
8	Swede Creek	Grip Road
11	Samish River	State Route 9
12	Nookachamps Creek	Swan Road
13	East Fork Nookachamps Creek	State Route 9
14	College Way Creek	College Way
15	Nookachamps Creek	Knapp Road
16	East Fork Nookachamps Creek	Beaver Lake Road
17	Nookachamps Creek	Big Lake Outlet
18	Lake Creek	State Route 9
19	Hansen Creek	Hoehn Road
20	Hansen Creek	Northern State
21	Coal Creek	Hoehn Road
22	Coal Creek	Hwy 20
23	Wiseman Creek	Minkler Road
24	Mannser Creek	Lyman Hamilton Highway
25	Red Cabin Creek	Hamilton Cemetery Road
28	Brickyard Creek	Hwy 20
29	Skagit River	River Bend Rd
30	Skagit River	Cape Horn Rd
31	Drainage district 20 near floodgate	Francis Road
32	Samish River	Thomas Road
33	Alice Bay Pump Station	Samish Island Road
34	Noname Slough	Bayview-Edison Road
35	Joe Leary Slough	Allen West Road
36	Edison Slough at school	W. Bow Hill Road
37	Edison Drainage ditch in Edison	Farm to Market Road
38	Drainage north of Edison	North Edison Rd
39	Colony Creek	Colony Road
40	Big Indian Slough	Bayview-Edison Road
41	Maddox Slough/Big Ditch	Milltown Road
42	Hill Ditch	Pioneer Highway
43	Wiley Slough	Wylie Road
44	Rexville Pump Station	Summers Drive
45	Skagit River – North Fork	Moore Road
46	Skagit River – South Fork	Fir Island Road
47	Swinomish Channel	County Boat Launch
48	Fisher Creek	Franklin Rd

Draft Figure A-1. Map of Sample Locations for Skagit County Water Quality Monitoring Program



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