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State of Washington

Quality Assurance Project Plan

McAllister Creek Water Quality Investigation for Fecal Coliform Bacteria

August 2009

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McAllister Creek
Water Quality Investigation
for Fecal Coliform Bacteria

August 2009

Approved by:

Signature:	Date: 7/28/09
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Abstract

McAllister Creek is in the Nisqually Basin and flows into the Nisqually Reach of Puget Sound. A Water Cleanup Study, called a Total Maximum Daily Load (TMDL), was conducted by Washington State Department of Ecology (Ecology) in 2002 – 2003 (Sargeant, et. al., 2005). Many of the downstream sites did not meet the fecal coliform (FC) bacteria water quality standard for Extraordinary Primary Contact (WAC 173-201A, previously Class AA). Efforts have been made to reduce FC bacteria concentrations with implementation of agricultural BMPs and sanitary inspections. However, in the summer of 2008 elevated concentrations were seen during Thurston County Environmental Health's routine sampling at River Mile (RM) 3.1 downstream of the Interstate 5 (I-5) bridge overpass. Implementation efforts for agriculture are reported to be complete in the upper watershed. This investigation is being initiated to characterize the creek in the reach between RM 3.7 (at the Martin Way bridge) and RM 3.1 where implementation efforts to reduce bacteria have not yet been completed. This study will assist Ecology and the Nisqually TMDL Advisory Group in prioritizing actions for cleaning up the bacteria in the creek.

Each study conducted by Ecology must have an approved Quality Assurance (QA) Project Plan. The plan describes the objectives of the study and the procedures to be followed to achieve those objectives. After completion of the study, a final report describing the study results will be posted to the Internet.

Background

McAllister Creek is in the Nisqually Basin and flows into the Nisqually Reach of Puget Sound. McAllister Creek was placed on Ecology's list of impaired waters (the 303(d) list, see Appendix A) for FC bacteria in 1998. A TMDL was conducted during 2002 and 2003. Many of the downstream sites did not meet the FC bacteria water quality standard for Extraordinary Primary Contact (WAC 173-201A, previously Class AA). Based on the TMDL investigation, McAllister Creek below RM 4.3 must meet marine standards. The state standard for marine bacteria is:

> **Fecal coliform organism levels must not exceed a geometric mean value of 14 colonies/100 mL, with not more than 10 percent of all samples (or any single sample when less than ten sample points exist) obtained for calculating the geometric mean value exceeding 43 colonies /100mL.**

Implementation efforts to reduce FC bacteria have moved forward as a result of the TMDL. Thurston Conservation District informed Ecology that all planned agricultural implementation efforts, such as fencing, have been completed in the upper watershed. Data collected monthly by the Thurston Environmental Health has shown that bacteria are elevated at sampling site RM 3.1 downstream of the I-5 bridge overpass. Elevated bacteria concentrations could reflect background levels, samples taken during different climatic conditions, or bacteria sources may still exist. This investigation will characterize low flow conditions between RM 3.7 (Martin Way crossing) and RM 3.1 (downstream of the I-5 crossing) where implementation efforts have not been completed.

Results from this study will assist the Nisqually TMDL Advisory Group in making decisions to determine what other implementation efforts may be needed to reduce bacteria concentrations.

Project Description

Data collected by the Thurston County Environmental Health has shown high summer concentrations http://www.co.thurston.wa.us/cm-ehswat/station.asp?site=NISMC0000&yrnbr=2008 at RM 3.1. The state is required to achieve clean water and protect other beneficial uses including the shellfish beds in the Nisqually Reach area. Further investigation is important to characterize bacteria concentrations in this reach of the creek.

This water quality investigation is being conducted to characterize FC bacteria in McAllister Creek from RM 3.7 to RM 3.1; an area where best management practices to reduce bacteria contributions have not been fully implemented. Samples will be collected during an out-going tide to minimize tidal influence. The three sample locations are mapped in Figure 1 and described in Table 1. Data collected from this sampling effort will be compared between sample sites and to the marine standard for fecal coliform.

The project goal for Ecology's water quality monitoring in McAllister Creek is to

- Characterize FC bacteria in the reach between RM 3.7 and RM 3.1 during low tide in July through September 2009.

Project objectives for McAllister Creek water quality monitoring are:

- Collect water quality samples to be analyzed for FC bacteria.
- Identify potential source areas for bacteria during low flow conditions.
- Provide Cindy James (TMDL Lead) and the Nisqually TMDL Advisory Group with additional data to prioritize implementation activities to improve water quality.

Figure 1. Map of McAllister Creek sampling locations

Table 1. Sample site locations.

Site River Mile	Description	Latitude	Longitude
3.1	I-5 south on-ramp, upstream side of bridge	47°04' 07.6"	122° 43' 11.9"
3.2	I-5 North off-ramp, upstream side of bridge	47°04' 02.2"	122° 43' 14.9"
3.7	Martin Way, downstream side of bridge	47°03' 54.0"	122° 43' 26.3"

Sampling Process Design (Experimental Design)

Water samples will be collected from McAllister Creek every other week from a low and outgoing tide, from July 6, 2009, through August 31, 2009. The project manager will coordinate sampling dates, laboratory identification numbers, and methods with MEL, using standard Ecology protocol.

All sites in this study will be sampled from bridges. Samples will be collected sequentially downstream to upstream to avoid possible contamination. Sample locations RM 3.1 and RM 3.7 are taken in comparable locations relative to previous investigations for the river mile location. Separate left and right bank samples will be taken at RM 3.7 to characterize mixing in this wider portion of the stream channel. The sample location at RM 3.2 is a new location chosen to determine possible impacts from the swallows nesting under the off-ramp bridge. Tide gates will not be sampled during this water quality investigation.

Sampling Procedures

Safety
Field personnel have the authority to ensure their safety. Reviewing environmental conditions for safety will always be a priority before accessing a sampling site. Personnel safety takes priority over completing the sampling event.

Sampling
Standard Ecology Environmental Assessment Program protocols will be used for sample collection. Field sampling and measurement protocols will follow those described in Ecology's Environmental Assessment Programs Standard Operating Procedure 012 (Mathieu, 2006).

Water samples will be collected using a 'bridge-sampler'. Samples will be collected directly into pre-cleaned autoclaved polyethylene 250 ml bottle supplied by the laboratory and described in Manchester Environmental Laboratory (MEL, 2005). The bridge-sampler securely holds the bottle while being manually lowered from the bridge side into the stream channel. Samples will be collected from the stream thalweg (center of flow) at RM 3.1 and RM 3.2. Two discreet samples will be collected at RM 3.7, one from the left third and the other from right third of the creek. This is being done in the event the tide gates just upstream result in incomplete mixing.

Samples will be collected from below the surface of the water to avoid collecting material caught in the surface film. Each sample will be labeled and immediately placed in a portable thermal cooler with ice.

The sample bottles will be labeled with:

- Project name
- Date
- Site name
- Name of lead sampler
- Laboratory ID number
- Analyte
- Sampling time

The portable cooler will then be stored overnight in the walk-in cooler in Ecology's chain-of-custody room. Samples will be kept in the dark at 0-10°C until the samples are processed by the laboratory. An Ecology courier will pick up the sample cooler on the following morning and deliver them to Ecology's Manchester Environmental Laboratory (MEL) to meet the 24-hour analytical holding time. The cooler, containing the samples and ice, will be transferred to the lab vehicle using chain of custody protocol.

A waterproof loose-leaf field notebook will be used to record typical field data and any unusual occurrence that may have impacts on the project or sample results.

The project manager will provide training for anyone who is assisting with field work. This will include discussion of quality assurance and contamination prevention. Upon completion of sampling at each site, the notes will be reviewed by the project manager to ensure all activities were performed and records are legible.

All sites are tidally influenced. Sampling will be coordinated to occur on an out-going low tide. The tide will be determined using information for the DuPont Wharf/Nisqually tide station (Station ID 1093).

Measurement Procedures

Table 2. Summary of sampling and analysis procedures for field and laboratory procedures.

Analysis	Method or Equipment	Estimated Range	Lower Reporting Limit	Holding Time	Preservation	Container	Estimated Samples per event
Fecal Coliform Bacteria	Standard Methods, Membrane Filter 9222D	0 - 1000 cfu/100mL	1cfu/100 mL	24 hours	Cool to 4º-10 º C	250 ml autoclaved poly-bottle	5

Quality Objectives

The measurement quality objectives are presented below in Table 3.

Table 3. Field measurement quality objectives.

Analysis	**Accuracy** percent deviation from true value	**Precision** Relative Standard Deviation (RSD)	**Bias** deviation from true value due to systematic error	**Lower reporting Limits**
Fecal Coliform Bacteria	N/A	20 - 50% RSD*	N/A	1 cfu/ 100mL

*replicate results with a mean of less than or equal to 20cfu/100mL will be evaluated separately

Accuracy of measurements can be assessed by evaluating both precision and bias. Precision is a measure of data scatter due to random error, while bias is a measure of differences between a parameter value and the true value due to systematic errors. Precision will be quantified by collecting one replicate sample per sampling event. A target of 20-50% relative standard deviation (%RSD) will be expected based on historical bacteria data collected by Ecology (Mathieu, 2006a). Adherence to established protocols should eliminate most sources of bias.

The laboratory's data quality objectives and quality control procedures are documented in the MEL Lab Users Manual (MEL, 2008) and the MEL Quality Assurance Manual (MEL, 2006).

The methods for determining river mile and mapping locations have inherent variability. Therefore the river mile and latitude longitude designators should be used as relative positioning guides rather than exact locations. The stream sampling locations were mapped using a Garmin 76CSx field Global Positioning System (GPS) system (NAD 83). The GPS readings were accurate within 20 feet. Map source data was obtained using Washington Hydrography

Framework 1:24,000 scale stream layer, USGS 7.5 minute, and1:24,000 scale quad map image. The accuracy of that system is within 40 feet.

Data Management Procedures

Data reduction, review, and reporting will follow the procedures outlined in MEL's Lab Users Manual (MEL, 2008). Laboratory staff will be responsible for internal quality control verification, proper data transfer, and reporting data to the project manager via the Laboratory Information Management System (LIMS).

The project manager will assess the quality of the data received from the laboratory and collected in the field in reference to the measurement quality objectives. Adjustments to field or laboratory procedures or the measurement quality objectives will be made, as necessary. Elevated fecal coliform concentrations will be reported to the TMDL Lead as soon as possible. The Lead will also be notified if major changes are made to the sampling plan.

All water quality data will be electronically transferred from LIMS into Ecology's Environmental Information Management (EIM) system. Data will be reviewed for errors. If errors are suspected, discussions will be arranged with the appropriate staff and data rejected or qualifiers added where necessary. Data that do not meet objectives may be approved for use by the project manager, but this data will be qualified appropriately.

Data analysis will be made using Microsoft Excel software (Microsoft, 2007). Data will be compared between sites as well as to the marine water quality standard. This study is not a TMDL or a formal effectiveness monitoring study; primarily the data will be used for source identification.

The left and right bank samples collected on the same day at RM 3.7 will be arithmetically averaged for analysis. The data will also be reviewed separately to see if the channel was well mixed at this location during the study period.

Data for the replicate samples will be averaged and used for subsequent data analyses. As mentioned, analyses for quality assurance will look at precision using an acceptable range for relative standard deviation.

Data Verification, Usability Determination, and Review

The project manager is responsible for verifying that field data entries are complete and correct.

Data verification involves examining the data for errors, omissions, and compliance with quality control (QC) acceptance criteria. Once measurement results have been recorded, they are verified to ensure that:

- Data are consistent, correct, and complete, with no errors or omissions.

- Results for QC samples accompany the sample results.
- Established criteria for QC results were met.
- Data qualifiers are properly assigned where necessary.
- Methods and protocols specified in the QA Project Plan were followed.

Qualified and experienced laboratory staff will examine lab results for errors, omissions, and compliance with QC acceptance criteria. Findings will be documented in each case narrative sent to the project manager. MEL is responsible for verifying their analytical results. Analytical data will be reviewed. It will be verified according to the data review procedures outlined in the Lab User's Manual (MEL, 2008). Results that do not meet quality assurance requirements will be labeled with appropriate qualifiers, and an explanation will be provided in a quality assurance memorandum attached to the data package.

Professional judgment and data results will be used to determine whether data quality objectives have been met. The project manager will examine the complete data package in detail to determine whether the procedures in the methods and procedures specified in this QAPP were followed. Laboratory duplicates help estimate laboratory precision. Field replicates should indicate *overall* variability (environmental + sampling + laboratory). Laboratory values below the detection limit will be assumed to be the detection limit for analysis purposes.

Organization and Schedule

Betsy Dickes, Project Manager, Water Quality Program, Southwest Regional Office (SWRO). Responsible for writing the Quality Assurance Project Plan (QAPP). Collects water samples. Conducts data review and analysis. Performs data entry into EIM. Prepares final report. 360-407-6296 bedi461@ecy.wa.gov

Cindy James, Client, Water Quality Program, SWRO.
Responsible for review and approval of the QAPP and final report.

Kim McKee, Unit Supervisor, Water Quality Program, SWRO.
Responsible for review and approval of the QAPP and final report.

Garin Schrieve, Section Manager, Acting, Water Quality Program, SWRO.
Responsible for review and approval of the QAPP and final report.

Nancy Rosenbower, Environmental Assessment Program. Receives and processes incoming samples. Ensures chain of custody.

Nancy Jensen, Microbiologist, Environmental Assessment Program. Analyzes samples for FC bacteria. Provides analytical results for concentration (number of colonies/100mL).

Leon Weiks, Environmental Assessment Program. Sample Courier. Picks up samples from headquarters cooler, ensuring chain of custody protocol is retained.

Completion of Final Approved QA Project Plan	**July 2009**
Sampling Period	**July – September 2009**
Draft Study Report	**January 15, 2010**
Final Report	**March 15, 2010**

The schedule may need to be updated periodically to adapt to data and environmental conditions.

Laboratory Budget

The laboratory budget in Table 4 includes all analyses that will be conducted for this project by Manchester Environmental Laboratory.

Table 4. Budget estimate for the McAllister Creek FC bacteria investigation 2009.

Parameter	No. of Events	Samples per Event	Total Samples	Cost per sample	Total Estimated Cost
Fecal coliform (MF)	7	5	35	$22	$1,000

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WAC 173-201A. Water Quality Standards for Surface Waters in the State of Washington Washington State Department of Ecology, Olympia, WA. www.ecy.wa.gov/laws-rules/ecywac.html

Appendix
Glossary and Acronyms

303(d) list: Section 303(d) of the federal Clean Water Act requires Washington State to periodically prepare a list of all surface waters in the state for which beneficial uses of the water–such as for drinking, recreation, aquatic habitat, and industrial use–are impaired by pollutants. These are water quality limited estuaries, lakes, and streams that fall short of state surface water

Geometric mean: A mathematical expression of the central tendency (an average) of multiple sample values. A geometric mean, unlike an arithmetic mean, tends to dampen the effect of very high or low values, which might bias the mean if a straight average (arithmetic mean) were calculated. This is helpful when analyzing bacteria concentrations, because levels may vary anywhere from 10 to 10,000 fold over a given period. The calculation is performed by either: (1) taking the nth root of a product of n factors, or (2) taking the antilogarithm of the arithmetic mean of the logarithms of the individual values.

Total Maximum Daily Load (TMDL): A distribution of a substance in a waterbody designed to protect it from exceeding water quality standards. A TMDL is equal to the sum of all of the following: (1) individual wasteload allocations for point sources, (2) the load allocations for nonpoint sources, (3) the contribution of natural sources, and (4) a Margin of Safety to allow for uncertainty in the wasteload determination. A reserve for future growth is also generally

Acronyms

Following are acronyms used frequently in this report.

Ecology	Washington State Department of Ecology
GPS	Global Positioning System
MEL	Manchester Environmental Laboratory
RM	River mile
RSD	Relative standard deviation
TMDL	Total Maximum Daily Load (See Glossary above)
WAC	Washington Administrative Code