DEPARTMENT OF
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Supplemental
Quality Assurance Project Plan

Walla Walla River Basin
Fecal Coliform Bacteria and pH
Total Maximum Daily Load Study

July 2009

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Supplemental Quality Assurance Project Plan

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Data for this project will be available on Ecology's Environmental Information Management (EIM) website at www.ecy.wa.gov/eim/index.htm. Search User Study ID, SCTA0001.

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July 2009

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WQP - Water Quality Program
EOS - Eastern Operations Section
EAP - Environmental Assessment Program
EIM - Environmental Information Management system

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Abstract

The Touchet River has been listed by Washington State under Section 303(d) of the federal Clean Water Act for non-attainment of Washington State fecal coliform bacteria and pH criteria. The U.S. Environmental Protection Agency requires the states to set priorities for cleaning up 303(d) listed waters and to establish a Total Maximum Daily Load (TMDL) water cleanup plan for each. The Touchet River was included in the Walla Walla River TMDL that was conducted in 2002. As a result, additional monitoring for the Touchet River has been recommended (Joy and Swanson, 2005; Joy et al, 2007).

This Supplemental Quality Assurance Project Plan describes additional monitoring that will address:

- Possible inconsistencies in the effectiveness of the Dayton Wastewater Treatment Plant ultraviolet (UV) disinfection levels.
- Possible groundwater nutrient transport from the wastewater lagoon at the Waitsburg Wastewater Treatment Plant to the Touchet River.
- Validation of nutrient levels in the Touchet River upstream and through the city of Dayton.

The study will be conducted by the Washington State Department of Ecology's Environmental Assessment Program.

Introduction

In 2002 the Walla Walla River fecal coliform (FC) bacteria and pH Total Maximum Daily Load (TMDL) Quality Assurance Project Plan (QAPP) was published. The QAPP described monitoring activities to address federal Clean Water Act 303(d) listings in the watershed. One of the tributaries to the Walla Walla River that was monitored, and the waterbody of interest for this supplemental QAPP, is the Touchet River. For TMDL background information and the watershed description, refer to the original QAPP, *Quality Assurance Project Plan: Walla Walla River Basin Fecal Coliform Bacteria and pH Total Maximum Daily Load Study,* written by Swanson and Joy (2002).

As a result of the FC TMDL (Joy and Swanson, 2005), additional FC monitoring is recommended in this report. This includes sampling at the (1) Dayton Wastewater Treatment Plant (WWTP), to ensure effective UV disinfection due to inconsistent effluent FC results, and (2) Patit Creek, to increase the number of samples for the percent FC reduction calculations. The Eastern Regional Office TMDL lead determined that additional sampling at Patit Creek is not a priority and will not be conducted due to resource constraints.

As a result of the pH and dissolved oxygen (DO) TMDL (Joy et al, 2007), additional monitoring is recommended in this report, as requested by the Eastern Regional Office TMDL lead. This includes additional surface and groundwater nutrient monitoring of the Touchet River, through the town of Waitsburg, to characterize possible groundwater transport from the Waitsburg WWTP. This possible groundwater nutrient transport may explain high levels of nutrients downstream of the Waitsburg WWTP. The TMDL lead is also requesting further nutrient monitoring of the Touchet River, upstream and through the town of Dayton, to validate nutrient levels.

This validation is being requested because the results of the 2002 TMDL call for a significant reduction in nutrients from the Dayton WWTP. To comply with this reduction, Dayton WWTP would need to update its treatment or remove its discharge from the Touchet River during the growing season. Reference nutrient concentrations in the forested area above Dayton are needed to verify that nutrient wasteload allocations for Dayton WWTP are correct.

This supplemental QAPP and its detailed monitoring will address the inconsistent effluent FC results at Dayton WWTP, the possible groundwater nutrient transport at Waitsburg WWTP, and the validation of nutrient levels through Dayton. Data will be available for further analyses using the QUAL2Kw water quality model of the Touchet River.

Sampling Design

Fecal Coliform

The Washington State Department of Ecology (Ecology) Environmental Assessment Program (EAP) conducted bimonthly (twice a month) FC sampling at Dayton WWTP from June 2002 to June 2003. The results revealed an inconsistency in the effectiveness of the facility's UV disinfection. Further split sampling between Ecology staff and Dayton WWTP staff did not find any more significant differences in results. However, some concern remains that the UV disinfection is inadequate.

EAP will collect monthly side-by-side FC grab samples with Dayton WWTP staff from May to October 2009. Samples will be collected at the end of the UV disinfection chamber before the effluent enters the discharge pipe. The samples will be analyzed with each party's typical procedure. EAP will ship their samples to Manchester Environmental Laboratory and Dayton WWTP will analyze their samples in house. Both labs use the same analytical technique, but their holding times are different. Both labs have been accredited by Ecology to provide credible FC data.

The metric for determining the difference between the two methods will be the same as the field replicate metric. It is described in *Replicate Precision for 12 TMDL Studies and Recommendations for Precision Measurement Quality Objectives for Water Quality Parameters* (Mathieu, 2006).

The results from the side-by-side FC grab samples will address the possible inconsistency in the effectiveness of the WWTP UV disinfection. If a significant inconsistency is found, Ecology's Water Quality program will work with the City of Dayton to address the problem.

Nutrients

The Walla Walla River pH and DO TMDL recommends additional monitoring on the Touchet River through Dayton and Waitsburg. The monitoring will address reference nutrient levels above Dayton, nutrient loading within Dayton, and nutrient loading in Waitsburg with the possible groundwater nutrient transport from the Waitsburg WWTP seepage lagoons.

Groundwater will be monitored around the Waitsburg WWTP. This monitoring will help characterize the possible groundwater transport of nutrients from the Waitsburg WWTP or an old landfill to the Touchet River. An additional QAPP, that will address groundwater monitoring, will be submitted by Charles Pitz, EAP.

The surface water monitoring will include two synoptic surveys during Touchet River baseflow conditions, one in July 2009 and the other in August 2009. Surface water parameters measured during the synoptic surveys are listed in Table 6. Instantaneous streamflow, temperature, pH, DO, and conductivity data will also be collected at all sites.

The synoptic surveys will include 18 sites (Table 1 and Figure 1). The sites are within the Dayton and Waitsburg study areas. Sites upstream of the Dayton (North Fork Touchet River, Wolf Creek, and South Fork Touchet River) will establish nutrient reference conditions. Nutrient inputs will be determined through Dayton and past the WWTP outfall (Touchet River mile ~ 54 to 51). Sites will be located above, through, and below Waitsburg (Touchet River mile ~ 44 to 40) to determine possible changes in nutrient loads. Each synoptic survey site will be visited once in the morning and once in the afternoon.

Table 1. Potential site list for the Touchet River synoptic survey.

User Location ID	Location Description
32NFT15.1	N Fork Touchet River Reference Site along FS Rd 64
32NFT-04.9	N Fork Touchet River at Wolf Fork Rd
32WFT- 00.2	Wolf Fork Touchet River at confluence
32NFT-00.0	N Fork Touchet River 75 ft above confluence with S Fork
32SFT-00.0	S Fork Touchet River 40 ft above confluence with N Fork
32B130	Touchet River at the bridge on US Highway 12
32PAT-00.1	Patit Creek at Front St Bridge (Below 5 ft)
32TOU-52.2	Touchet River above Dayton WWTP outfall
32DAY-WWTP	Dayton Wastewater Treatment Plant
32TOU-52.1	Touchet River below Dayton WWTP outfall
32TOU-51.2	Touchet River under Ward Rd bridge
32TOU-44.2	Touchet River under Hwy 12 bridge in Waitsburg
32TOU-43.5	Touchet River above Waitsburg WWTP lagoons
32WAI-WWTP	Waitsburg Wastewater Treatment Plant
32TOU-43.0	Touchet River at/above confluence with Coppei Creek, below WWTP lagoons
32COP-00.0	Coppei Creek just above confluence with Touchet River
32TOU-42.9	Touchet River just below confluence with Coppei Creek
32B100	Touchet River at Bolles Rd

Additional data will be collected to help determine the effects of nutrients on the Touchet River. Prior to the synoptic surveys, periphyton (chlorophyll a) will be sampled at four locations: upstream and downstream of the Dayton WWTP and Waitsburg WWTP. Hydrolabs will be deployed for at least 24 hours at critical site locations to characterize diel fluctuations in pH, DO, conductivity, and temperature. Critical site locations include upstream and downstream of WWTPs, the mouths of major tributaries to the Touchet River, and the North Fork Touchet River reference site.

Sample collection methods, described in more detail in the original QAPP (Swanson and Joy, 2002), will be consistent with the TMDL and current EAP standard operating procedures (www.ecy.wa.gov/programs/eap/quality.html). Grab samples will be shipped and analyzed at Manchester Environmental Laboratory (MEL).

The synoptic surveys will provide additional data that will be used to fine-tune the reaches through Dayton and Waitsburg in the QUAL2K model, used in the original TMDL.

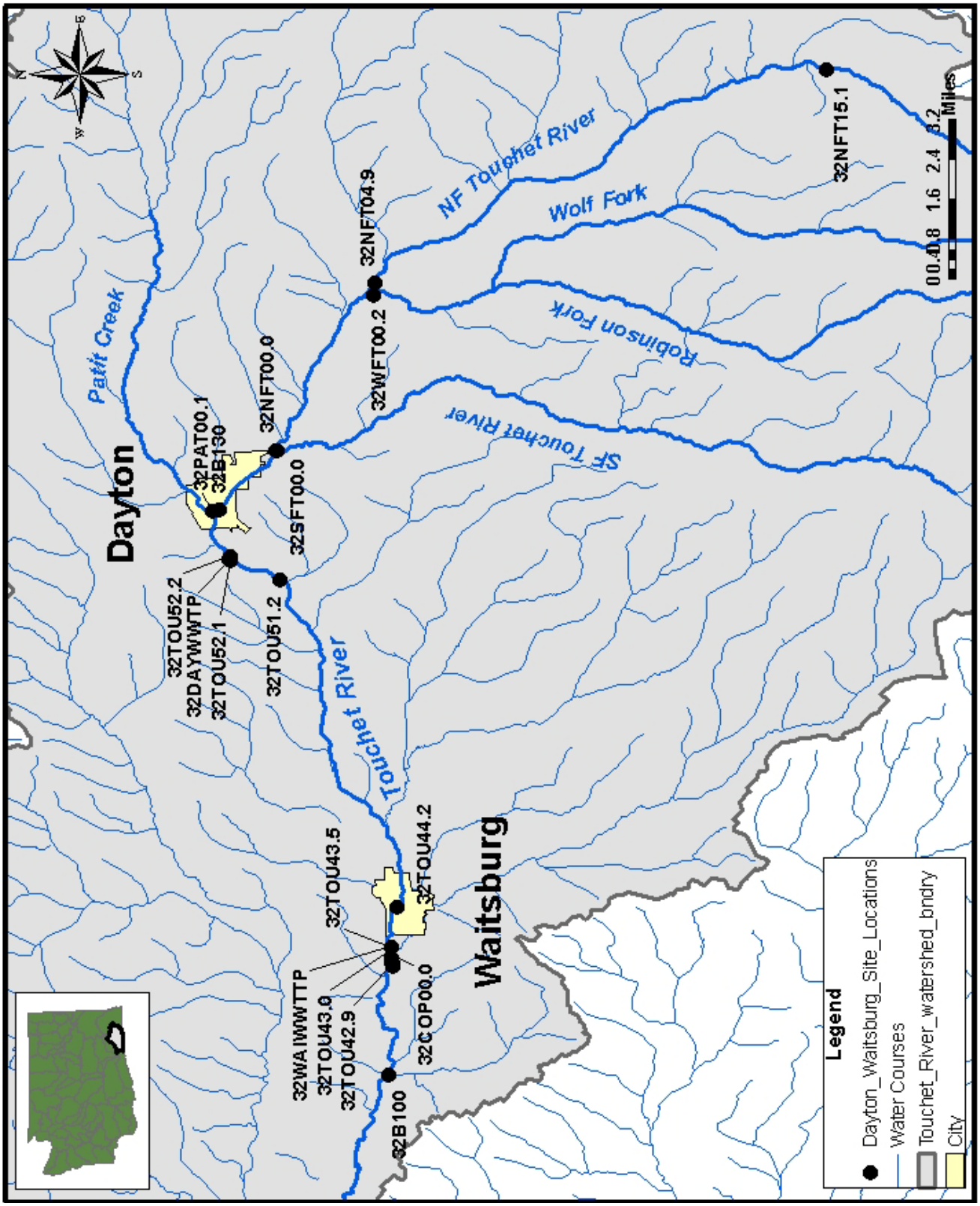

Figure 1. Proposed 2009 sampling sites.

Organization, Schedule, and Laboratory Budget

The following is the project's staff organization, time schedule, and laboratory budget.

Organization

Table 2. Staff organization for the 2009 supplemental study.

Name	Organization	Role	Phone Number
Karin Baldwin	WQ-ERO	Client	509-329-3472
Jim Ross	EAP-EOS	Project Manager	509-329-3425
Scott Tarbutton	EAP-EOS	QAPP Author/Principal Investigator/ EIM Data Engineer	509-329-3453
Joe Joy	EAP-EOS	Technical Support	360-407-6486
Tighe Stuart	EAP-EOS	Field Assistance	509-329-3476
Gary Arnold	EAP-EOS	Section Manager	509-454-4244
Stuart Magoon	MEL	Lab Director	360-871-8801
Dean Momohara	MEL	Lab Unit Supervisor/Sample Transport	360-871-8808
Nancy Rosenbower	MEL	Sample Scheduling/Receipt	360-871-8827
Bill Kammin	EAP	Quality Assurance Officer	360-407-6964
Charles Pitz	EAP-GWFF	Waitsburg Groundwater Project Lead	360-407-6775

WQ-ERO = Water Quality – Eastern Regional Office
EAP-EOS = Environmental Assessment Program – Eastern Operations Section
MEL = Manchester Environmental Laboratory
EAP-GWFF = Environmental Assessment Program – Groundwater Forest and Fish Unit

Schedule

Table 3. Schedule for the 2009 supplemental study.

Field and Laboratory Work	
Field Work Commences	May 2009
Field Work Completed	October 2009
Laboratory Work Completed	December 2009
Environmental Information System (EIM) Data Set	
EIM Data Engineer	Scott Tarbutton
EIM User Study ID	SCTA0001
EIM Study Name	Dayton and Waitsburg TMDL Fine-Tuning
EIM Completion Due	January 2010
Final Report	
Author Lead	Scott Tarbutton
Schedule	
Draft Due to Supervisor	May 2010
Draft Due to Client/Peer Reviewer	June 2010
Draft Due to External Reviewer	July 2010
Final Report Due	September 2010

Laboratory Budget

Table 4. Laboratory budget for the 2009 supplemental study.

Parameter	Cost per Sample	Number of Field Samples	Cost
Fecal Coliform	23	12	276
Chlorophyll a	55	12	660
Ash Free Dry Weight	23	12	276
Total Persulfate Nitrogen	17	86	1462
Ammonia	13	86	1118
Nitrate/Nitrite	13	86	1118
Orthophosphate	15	86	1290
Total Phosphorus	35	86	3010
Total Organic Carbon	33	86	2838
Dissolved Organic Carbon	35	86	3010
Alkalinity	17	86	1462
Chloride	13	86	1118
Total Suspended Solids	11	86	946
Total Cost			**18,584**

The laboratory costs include a 50% discount for Manchester Environmental Laboratory.

Sampling and Measurement Procedures

Grab samples will be collected with pre-cleaned containers supplied by MEL and described in the MEL User's Manual (2008). Samples will be collected under EAP standard operating procedures (www.ecy.wa.gov/programs/eap/quality.html). Sample parameters, containers, volumes, preservation requirements, and holding times are summarized in Table 5. All samples for laboratory analysis will be stored on ice and delivered to MEL within 24 hours of collection via Horizon Air and MEL courier.

Field measurements will include conductivity, temperature, pH, and DO using a calibrated Hydrolab MiniSonde®. DO will also be collected and analyzed using the Winkler titration method. The accuracy of the 24-hour deployment Hydrolabs will be checked with an additional Hydrolab and the Winkler titration method. A minimum of three accuracy checks will be performed for each deployed Hydrolab over the course of the deployment. The field measurement methods will follow EAP standard operating procedures (www.ecy.wa.gov/programs/eap/quality.html).

Estimation of instantaneous flow measurements will follow the EAP protocol (Ecology, 2006). Flow volumes will be calculated from continuous stage height records and rating curves developed prior to, and during, the project. Stage height will be measured by a pressure transducer and recorded by a data logger every 15 minutes. All data loggers will be downloaded monthly. During the field surveys, streamflow will be measured at selected stations or staff gage readings will be recorded.

Periphyton field sampling protocols were adapted from the U.S. Geological Survey protocols (Porter et al., 1993).

Table 5. Containers, preservation requirements, and holding times for the 2009 samples.

Parameter	Sample Matrix	Container	Preservative	Holding Time
Fecal Coliform	Surface water, WWTP effluent, and runoff	250 or 500 mL glass/ poly autoclaved	Cool to 4 °C	24 hours
Chlorophyll a	Surface water and periphyton	1000 mL amber poly	Cool to 4 °C; 24 hrs to filtration	28 days after filtration
Total Organic Carbon	Surface water, WWTP effluent, and runoff	60 mL clear poly	1:1 HCl to pH<2; Cool to 4 °C	28 days
Dissolved Organic Carbon	Surface water, WWTP effluent, and runoff	60 mL poly with Whatman Puradisc™ 25PP 0.45µm pore size filters	Filter in field with 0.45µm pore size filter; 1:1 HCl to pH<2; Cool to 4 °C	28 days
Total Suspended Solids	Surface water, WWTP effluent, and runoff	1000 mL poly	Cool to 4 °C	7 days
Alkalinity	Surface water, WWTP effluent, and runoff	500 mL poly - no headspace	Cool to 4 °C; Fill bottle completely; Don't agitate sample	14 days
Chloride	Surface water, WWTP effluent, and runoff	500 mL poly	Cool to 4 °C	28 days
Total Persulfate Nitrogen	Surface water, WWTP effluent, and runoff	125 mL clear poly	H_2SO_4 to pH<2; Cool to 4 °C	28 days
Ammonia	Surface water, WWTP effluent, and runoff	125 mL clear poly	H_2SO_4 to pH<2; Cool to 4 °C	28 days
Nitrate/Nitrite	Surface water, WWTP effluent, and runoff	125 mL clear poly	H_2SO_4 to pH<2; Cool to 4 °C	28 days
Orthophosphate	Surface water, WWTP effluent, and runoff	125 mL amber poly with Whatman Puradisc™ 25PP 0.45µm pore size filters	Filter in field with 0.45µm pore size filter; Cool to 4 °C	48 hours
Total Phosphorus	Surface water, WWTP effluent, and runoff	60 mL clear poly	1:1 HCl to pH<2; Cool to 4 °C	28 days

Data Quality Objectives

The majority of measurement methods and quality objectives will be consistent with the original QAPP (Swanson and Joy 2002). Alterations and additions in 2009 to FC methods and quality objectives reflect recommendations made in *Replicate Precision for 12 TMDL Studies and Recommendations for Precision Measurement Quality Objectives for Water Quality Parameters* (Mathieu, 2006). Table 6 is a summary of the measurement quality objectives for the field and laboratory parameters. The required reporting limits are also included.

Table 6. Summary of measurement quality objectives for the 2009 field and laboratory parameters.

Parameter	Method	**Accuracy** % deviation from true value	**Precision** Relative Standard Deviation (RSD)	**Bias** % deviation from true value	**Required Reporting Limits** Concentration units
Field					
Velocity*	Marsh McBirney Flow-Mate® Flowmeter	0.1 ft/s	0.1 ft/s	N/A	0.01 ft/s
pH*	Hydrolab Minisonde®	0.05 s.u	0.05 s.u	0.10 s.u	1 - 14 s.u.
Temperature*	Hydrolab Minisonde®	0.1 °C	0.025 °C	0.05 °C	1 - 40 °C
Dissolved Oxygen	Hydrolab Minisonde®	15	5%	5	0.1 - 15 mg/L
Specific Conductivity	Hydrolab Minisonde®	25	10%	5	1 µmhos/cm
Laboratory					
Fecal Coliform (MF)	SM 9222D	N/A	20% & 50%[1]	N/A	1 cfu/100 mL
Chlorophyll a	SM 10200H(3)M	N/A	20%	N/A	0.05 µg/L
Total Organic Carbon	SM 5310B	30	10%	10	1 mg/L
Dissolved Organic Carbon	SM 3510B	30	10%	10	1 mg/L
Total Suspended Solids	SM 2540D	20	15%	N/A	1 mg/L
Alkalinity	SM 2320	20	10%	N/A	5 mg/L
Chloride	EPA 300.0	15	5%	5	0.1 mg/L
Total Persulfate Nitrogen	SM 4500-NO_3^- B	30	10%	10	0.025 mg/L
Ammonia Nitrogen	SM 4500-NH_3^- H	25	10%	5	0.01 mg/L
Nitrate & Nitrite Nitrogen	SM 4500-NO_3^- I	25	10%	5	0.01 mg/L
Orthophosphate P	SM 4500-P G	25	10%	5	0.003 mg/L
Total Phosphorus	SM 4500PF	25	10%	5	0.005 mg/L

[1] Two-tiered: 50% of replicates ≤ 20% RSD; 90% of replicates ≤ 50% RSD

* As units of measure, not percentages

NA – not applicable

s.u. – standard unit

SM – standard method

EPA – U. S. Environmental Protection Agency

Quality Control

The 2009 collection of replicates, sample preservation, and sample transport time will be consistent with the original QAPP and EAP standard operating procedures to produce credible data. Table 7 is a summary of field and laboratory quality control procedures.

Table 7. Summary of field and laboratory quality control procedures for the Touchet River.

Parameter	Field Blanks	Field Replicates	Lab Check Standard	Lab Method Blanks	Lab Replicates	Matrix Spikes
Field						
Velocity	N/A	1/10 samples	N/A	N/A	N/A	N/A
pH	N/A	1/10 samples	N/A	N/A	N/A	N/A
Temperature	N/A	1/10 samples	N/A	N/A	N/A	N/A
Dissolved Oxygen	N/A	1/10 samples	N/A	N/A	N/A	N/A
Specific Conductivity	N/A	1/10 samples	N/A	N/A	N/A	N/A
Laboratory						
Fecal Coliform (MF)	N/A	1/event[1]	N/A	1/batch	1/batch	N/A
Chlorophyll a	N/A	1/10 samples	N/A	N/A	1/20 samples	N/A
Total Organic Carbon	1/survey	1/10 samples	1/batch	1/batch	1/20 samples	1/20 samples
Dissolved Organic Carbon	1/survey	1/10 samples	1/batch	1/batch	1/20 samples	1/20 samples
Total Suspended Solids	1/survey	1/10 samples	1/batch	1/batch	1/20 samples	N/A
Alkalinity	1/survey	1/10 samples	1/batch	1/batch	1/20 samples	N/A
Chloride	1/survey	1/10 samples	1/batch	1/batch	1/20 samples	N/A
Total Persulfate Nitrogen	1/survey	1/10 samples	1/batch	1/batch	1/20 samples	1/20 samples
Ammonia Nitrogen	1/survey	1/10 samples	1/batch	1/batch	1/20 samples	1/20 samples
Nitrate & Nitrite Nitrogen	1/survey	1/10 samples	1/batch	1/batch	1/20 samples	1/20 samples
Orthophosphate P	1/survey	1/10 samples	1/batch	1/batch	1/20 samples	1/20 samples
Total Phosphorus	1/survey	1/10 samples	1/batch	1/batch	1/20 samples	1/20 samples

[1] One sample will be taken at each Dayton WWTP event, so a field replicate will be taken during every sampling event.

Data Management Procedures

Field measurement data will be entered into a field book with waterproof paper in the field and then entered into EXCEL® spreadsheets as soon as practical after returning from the field. This database will be used for preliminary analysis and to create a table to upload data into Ecology's Environmental Information Management (EIM) System.

Sample result data received from MEL by Ecology's Laboratory Information Management System (LIMS) will be exported prior to entry into EIM and added to a cumulative spreadsheet for laboratory results. This spreadsheet will be used to informally review and analyze data during the course of the project.

All monitoring data will be available in EIM, via the internet, once the project data have been validated. The URL address for this geospatial database is: www.ecy.wa.gov/eim/index.htm. All data will be uploaded to EIM by the EIM data engineer after the data have been reviewed for quality assurance and finalized.

All spreadsheet files, paper field notes, and Global Information System device products created as part of the data analysis will be kept with the project data files.

Audits and Reports

Manchester Environmental Laboratory conducts performance and system audits for its procedures. Results of these audits are available upon request.

At the end of the 2009 study, the project results will be published in the Dayton and Waitsburg TMDL Fine-Tuning technical report and will contain at a minimum:

- Map of sampling locations.
- Summary table of data, as well as pertinent field notes.
- Discussion of data quality analysis and the significance of problems encountered.
- Evaluation of significant findings and recommendations for further action.

The final report will be prepared by September 2010.

Data Verification and Validation

Laboratory-generated data reduction, review, and reporting will follow the procedures outlined in the MEL Lab Users Manual (MEL, 2008). Lab results will be checked for missing and/or improbable data. Variability in lab duplicates will be quantified using the procedures outlined in the Lab Users Manual. Any estimated results will be qualified and their use restricted as appropriate. A standard case narrative of laboratory quality assurance/quality control results will be sent to the project manager for each set of samples.

Field staff will check field notebooks will be checked for missing or improbable measurements before leaving each site. Data entry will be checked by the field assistant against the field notebook data for errors and omissions. Missing or unusual data will be brought to the attention of the project manager for consultation.

Data received from LIMS will be checked for omissions against the "Request for Analysis" forms by the field lead. Field replicate sample results will be compared to quality objectives in Table 6. Data requiring additional qualifiers will be reviewed by the project manager.

After data validity and data entry tasks are completed, all field, laboratory, and flow data will be entered into EIM. EIM data will be independently reviewed by another EAP field assistant for errors at an initial 10% frequency. If significant entry errors are discovered, a more intensive review will be undertaken.

References

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Appendix. Glossary, Acronyms, and Abbreviations

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 quality standards, and are not expected to improve within the next two years.

Clean Water Act: A federal act passed in 1972 that contains provisions to restore and maintain the quality of the nation's waters. Section 303(d) of the Clean Water Act establishes the TMDL program.

Conductivity: A measure of water's ability to conduct an electrical current. Conductivity is related to the concentration and charge of dissolved ions in water.

Designated uses: Those uses specified in Chapter 173-201A WAC (Water Quality Standards for Surface Waters of the State of Washington) for each waterbody or segment, regardless of whether or not the uses are currently attained.

Diel: A 24-hour period, usually encompassing 1 day and 1 night.

Dissolved oxygen: A measure of the amount of oxygen dissolved in water.

Fecal coliform (FC): That portion of the coliform group of bacteria which is present in intestinal tracts and feces of warm-blooded animals as detected by the product of acid or gas from lactose in a suitable culture medium within 24 hours at 44.5 plus or minus 0.2 degrees Celsius. Fecal coliform bacteria are "indicator" organisms that suggest the possible presence of disease-causing organisms. Concentrations are measured in colony forming units per 100 milliliters of water (cfu/100 mL).

Load allocation: The portion of a receiving waters' loading capacity attributed to one or more of its existing or future sources of nonpoint pollution or to natural background sources.

Loading capacity: The greatest amount of a substance that a waterbody can receive and still meet water quality standards.

Nonpoint source: Pollution that enters any waters of the state from any dispersed land-based or water-based activities, including but not limited to atmospheric deposition, surface water runoff from agricultural lands, urban areas, or forest lands, subsurface or underground sources, or discharges from boats or marine vessels not otherwise regulated under the NPDES program. Generally, any unconfined and diffuse source of contamination. Legally, any source of water pollution that does not meet the legal definition of "point source" in section 502(14) of the Clean Water Act.

Nutrients: Substance such as carbon, nitrogen, and phosphorus used by organisms to live and grow. Too many nutrients in the water can promote algal blooms and rob the water of oxygen vital to aquatic organisms.

pH: A measure of the acidity or alkalinity of water. A low pH value (0 to 7) indicates that an acidic condition is present, while a high pH (7 to 14) indicates a basic or alkaline condition. A pH of 7 is considered to be neutral. Since the pH scale is logarithmic, a water sample with a pH of 8 is ten times more basic than one with a pH of 7.

Point source: Sources of pollution that discharge at a specific location from pipes, outfalls, and conveyance channels to a surface water. Examples of point source discharges include municipal wastewater treatment plants, municipal stormwater systems, industrial waste treatment facilities, and construction sites that clear more than 5 acres of land.

Pollution: Such contamination, or other alteration of the physical, chemical, or biological properties, of any waters of the state. This includes change in temperature, taste, color, turbidity, or odor of the waters. It also includes discharge of any liquid, gaseous, solid, radioactive, or other substance into any waters of the state. This definition assumes that these changes will, or is likely to, create a nuisance or render such waters harmful, detrimental, or injurious to (1) public health, safety, or welfare, or (2) domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or (3) livestock, wild animals, birds, fish, or other aquatic life.

Surface waters of the state: Lakes, rivers, ponds, streams, inland waters, salt waters, wetlands and all other surface waters and watercourses within the jurisdiction of Washington State.

Synoptic surveys: Surveys in which data are collected simultaneously or over a short period of time.

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 provided.

Wasteload allocation: The portion of a receiving water's loading capacity allocated to existing or future point sources of pollution. Wasteload allocations constitute one type of water quality-based effluent limitation.

Watershed: A drainage area or basin in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.

Acronyms and Abbreviations

Following are acronyms and abbreviations used frequently in this report.

cfs	Cubic feet per second
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
RM	River mile

TMDL	Total Maximum Daily Load (water cleanup plan)
WAC	Washington Administrative Code
WRIA	Water Resources Inventory Area
WWTP	Wastewater treatment plant

Units of Measurement

°C	degrees centigrade
cfs	cubic feet per second
dw	dry weight
mgd	million gallons per day
mg/L	milligrams per liter (parts per million)
mL	milliliters
s.u.	standard units
µS/cm	microsiemens per centimeter, a unit of conductivity