Quality Assurance Project Plan
for
TMDL Effectiveness Monitoring
and Water Quality Evaluation
in the Lower Yakima River

Prepared through the cooperative efforts of
Yakama Nation Environmental Management Program, Water Section,
and Washington State Department of Ecology, Environmental Assessment Program

July 2003

Publication No. 04-03-203

This plan is available on the Department of Ecology home page on the
World Wide Web at http://www.ecy.wa.gov/biblio/0403203.html

Approved by:	April 22, 2004
Chris Coffin, Monitoring Project Manager, Department of Ecology	Date
Approved by:	May 4, 2004
Cliff Kirchmer, Quality Assurance Officer, Department of Ecology	Date
Approved by:	April 22, 2004
Rob Plotnikoff, Supervisor Freshwater Monitoring Unit, Department of Ecology	Date
Approved by:	April 22, 2004
William Rice, Manager, Alliance Analytical Laboratory	Date

Table of Contents

Sections

Distribution List

Yakama Nation Environmental Management Program (YNEMP)

Washington State Department of Ecology

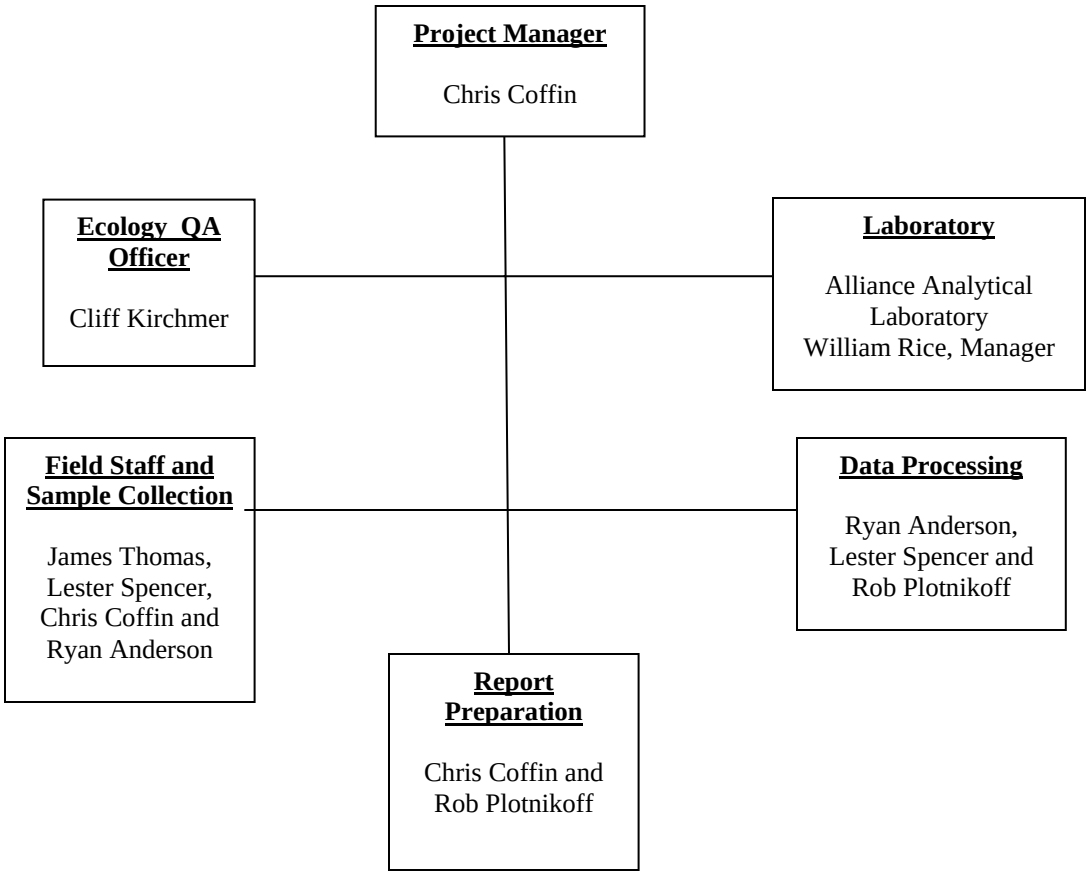
USEPA

Organization and Schedule

Personnel: Chris Coffin, Environmental Assessment Program, and Ryan Anderson, Water Quality Program, Washington State Department of Ecology (ECY):

James Thomas, Water Quality Specialist, and Lester Spencer, Water Quality Technician, Yakama Nation Environmental Management Program (YNEMP)

William Rice, Manager, Alliance Analytical Laboratory, LLC.



This project is an effectiveness monitoring phase of the Lower Yakima River Suspended Sediment and DDT TMDL. The objective of the Lower Yakima TMDL is to reduce sediment associated with irrigated agriculture, specifically during the irrigation season. Monitoring for this project will be scheduled to coincide with the irrigation season. If there are circumstances that shorten the irrigation season by a late startup or an early shut down of water delivery the number of biweekly sampling events will be appropriately reduced. With a normal irrigation season there will be a total of 14 to 15 sampling events. The exact total will be determined following the final schedule of irrigation start-up and shut down which is set by the irrigation districts and the Bureau of Reclamation. Those start and end dates are based on crop stage, weather and water availability; are subject to change; and are not absolutely determined until shortly before the control actions are initiated.

Sampling will be conducted biweekly on a Monday, Tuesday, or Wednesday. The specific weekday will be selected to accommodate shipment and lab schedule. Schedules in this document indicate sampling on a Tuesday but that may vary by one day in either direction. On any occasion that a biweekly sampling cannot occur, weekly sampling will be employed to maintain the total number of sampling events planned for the project. The 2002 sampling period ran from June 18, 2002, through mid-October and the 2003 sampling season is projected to run from the week of March 31st through mid-October.

Table 1, Planned sampling schedule for 2003.

April 1, 15 and 29
May 13 and 27
June 10 and 24
July 8 and 22
August 15 and 19
September 2, 16 and 30
October 14 and 28*
*Irrigation season is normally over by this date. No samples will be taken if water is not available to growers.

Field data and water sample collection will be conducted by Chris Coffin (ECY), Ryan Anderson (ECY), James Thomas (YNEMP) and Lester Spencer (YNEMP). Whenever possible, at least one employee from each agency will be present during sampling.

Laboratory analyses for total suspended solids (TSS), total non-volatile suspended solids (TNVSS) and turbidity will be conducted by staff at Alliance Analytical Laboratory in Yakima, Washington. The lab is accredited by the Washington Department of Ecology for all analyses required for this project. Additional accredited laboratories may be utilized as needed.

Upon completion of the monitoring portion of this project and the associated data analyses, reports will be completed detailing the information collected for surface-water-quality in the Lower Yakima River. A report, prepared by Ecology, will specifically indicate whether the Lower Yakima is in compliance with the targets described in the Lower Yakima River Suspended Sediment and DDT TMDL. Discharge measurements will be obtained from the U.S. Geological Survey, U.S. Bureau of Reclamation and other resource as available. Discharge data will be collected to coincide with sample collection periods as closely as possible.

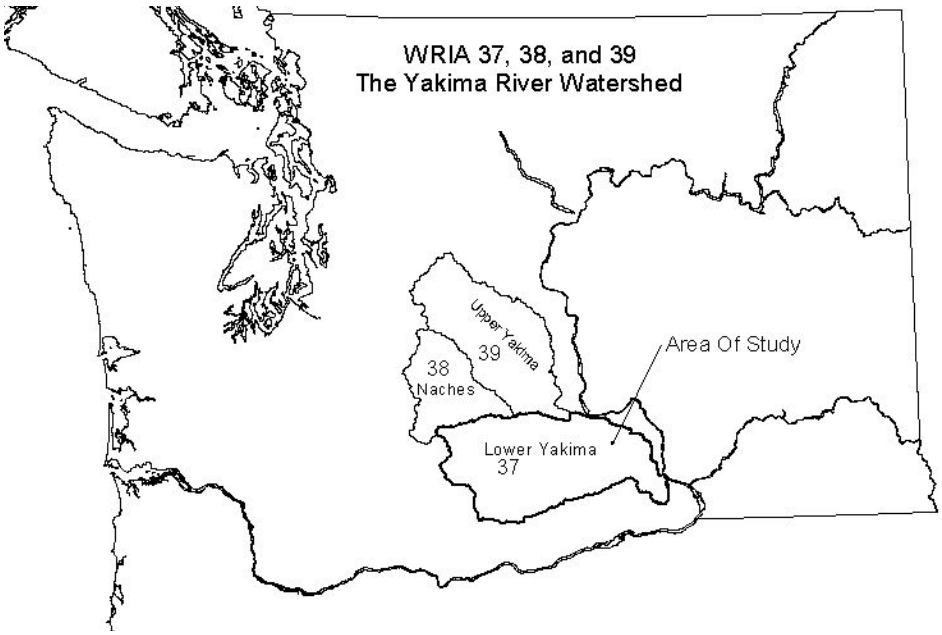
Budget

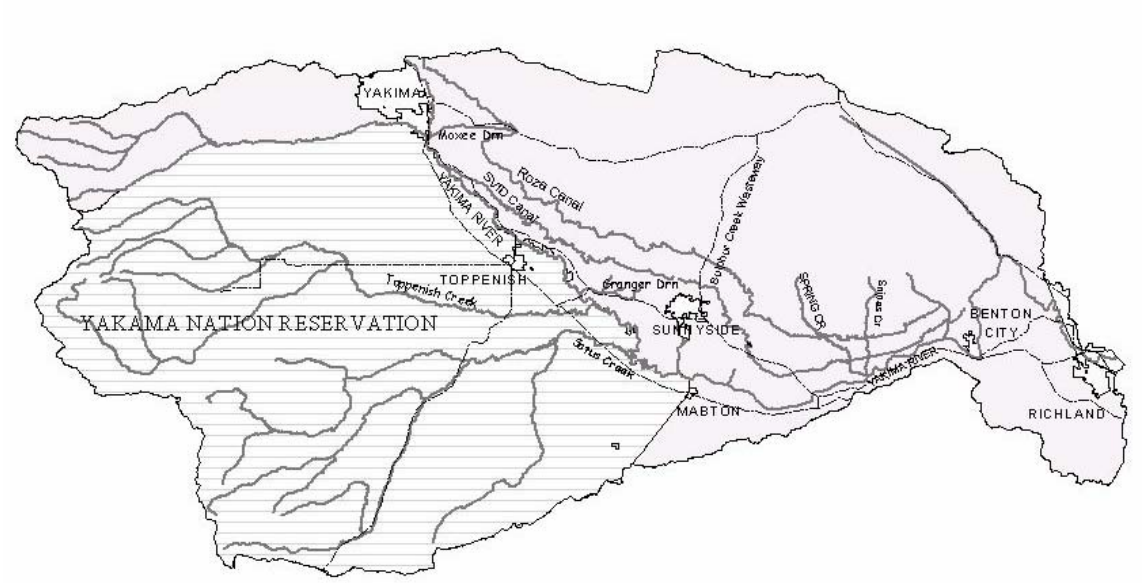
Lab Costs including sample analysis and QA…$5950.00
Vehicle Expenses……$900.00
Instrument maintenance and standards……...$200.00
Personnel…….0.35 FTE

Background and Problem Statement

The Yakima River Basin is one of the most intensively irrigated and agriculturally diverse areas in the United States (Rinella et. al., 1999). The lower reaches of the Yakima River extend 116.3 miles from the confluence with the Naches River to its mouth and has an average streambed slope of 7 ft/mile (Morace et. al., 1999). Several of the waterways within the basin convey agricultural runoff and drainage, livestock wastes, and sewage treatment plant effluent to the Yakima River main stem. Return flows from agricultural returns downstream from the city of Yakima contribute as much as 80 to 90 percent of the total flow in the lower main stem during the irrigation season (Morace et. al., 1999). It has been documented in a report by the USGS (Morace et. al., 1999) that "In the Yakima River, suspended sediment concentrations and turbidity increased in a downstream direction, coinciding with increased runoff from agricultural areas." Studies conducted in the mid to late 1970's indicate that irrigation practices directly affect suspended sediment concentrations and turbidity in the lower Yakima River and return drains from March through October (Joy and Patterson, 1997). Peak suspended sediment concentrations in the main stem occur in April through June when stream flows are high, snowmelt occurs, and irrigation of freshly tilled fields commences (Joy and Patterson, 1997).

Lower Yakima River TMDL Effectiveness Monitoring Project Area





Approximately 1,390 square miles of the lower basin, over 42%, lie within the Yakama Indian Reservation. Most of the basin is ceded lands of the Yakama Nation; a small area of the southeastern corner is ceded lands of the Walla Walla, Umatilla, and Cayuse Tribes (Joy and Patterson, 1999). The Yakama Nation does not recognize state authority to regulate water quality on the main stem Yakima River where it borders the reservation (i.e., from Ahtanum Creek at RM 106.9 to the Mabton-Sunnyside Bridge at RM 59.8).

The Yakima River basin fishery, especially the salmon fishery, was one of the largest contributors to the Columbia River salmon fishery before the 1900's. The salmon have an important game and commercial value, and hold cultural and religious significance to the people of the Yakama Nation. The Yakima River salmon population has rapidly declined since the onset of water diversion and land and resource development. From 50% to 100% of the water delivered to the lower basin from the Naches River and upper Yakima River is diverted for irrigation and hydropower generation during the irrigation season (Joy and Patterson, 1997). This has become a concern among fishery and water resource managers. The decrease in instream flow and increase in suspended sediments and turbidity in the lower Yakima basin has had detrimental effects on the salmon fishery. In 1994, diversion limits were put in place requiring at least 300 cubic feet per second (cfs) spill over the Sunnyside dam to provide flow to the lower Yakima River (Joy and Patterson, 1997). The lower river slowly recovers water through subsurface and surface returns; however, much of this water contains elevated levels of suspended sediment, pesticides, bacteria, and oxygen demanding substances (Joy and Patterson, 1997).

The Clean Water Act directs Ecology to perform a total maximum daily load (TMDL) analysis for all contaminated waters on the state's 303(d) list of impaired waterbodies. Ecology has determined that suspended sediment and associated turbidity and DDT represent key water quality impairments in the lower Yakima River. The control of suspended sediment generation and transport during the irrigation season will result in far-reaching water quality and fish habitat improvements in the Lower Yakima Basin. The Yakama Nation and the EPA have similar Clean Water Act responsibilities on the Yakama Reservation.

Based on USGS findings in the late 1980s and early 1990s it was determined that some species of bottom fish resident in the lower Yakima contained high levels of the organochlorine pesticide DDT and it's metabolites DDD and DDE. In 1993 the Washington Dept. of Health issued a fish consumption advisory on the lower Yakima River. It was believed that the pesticide was closely associated with sediment being washed from agricultural fields, primarily in the lower reaches of the Yakima River between the confluence of the Yakima and Naches Rivers and the community of Benton City. The Washington State Department of Ecology and the Yakama Nation

Environmental Protection Program monitored the Yakima River main stem during the irrigation seasons of 1994 and 1995. A technical report was completed using surface-water-quality monitoring data to determine a Total Maximum Daily Load (TMDL) for suspended sediment and DDT in the lower Yakima River main stem. The Lower Yakima River Suspended Sediment and DDT TMDL was submitted by Ecology and approved by the EPA in late 1998.

The TMDL was established with 5-year target increments over a period of 15 years. This monitoring project will address the first milestone of the TMDL, a fifth year target due in 2003 which calls for the following:

- Yakima River main stem will comply with the turbidity target of not more than a 5 NTU increase between the confluence of the Yakima and Naches Rivers (RM 116.3) and the Kiona gage at Benton City (RM 30), and,
- All drains and tributaries within the project area will comply with the 90th percentile turbidity target of 25 NTU at their mouths, especially Moxee Drain, Grainger drain, Sulphur Creek, and Spring Creek.

Beginning in 2002 the TMDL Effectiveness Monitoring Project was implemented in the main stem. The Washington State Department of Ecology joined with the Yakama Nation in a cooperative monitoring project to take surface-water parameter measurements and to collect surface-water samples from sites located above and below irrigation returns on the Lower Yakima River. This surface-water-quality monitoring project will run through the 2003 irrigation seasons. The 2002 data will be used as an indicator to irrigators, characterizing current conditions and demonstrating changes necessary to meet 2003 compliance goals.

Project Description

This study will measure turbidity and suspended sediment (SS) in the lower Yakima River and four major tributaries to determine whether turbidity levels within the main stem of the river and tributaries are in compliance with the fifth year target set by the Lower Yakima River Suspended Sediment and DDT TMDL. Monitoring data provided by the Roza-Sunnyside Board of Joint Control Water Quality Lab and the North Yakima Conservation District will also be analyzed to better determine if the major irrigation return drains within the lower Yakima are meeting target turbidities of 25NTU or below. These findings will be used to adjust TMDL implementation strategies, as needed, to comply with TMDL water quality goals. Other water quality parameters will be measured as ongoing surveillance of the water resources in the lower Yakima Basin.

The goals for this effectiveness-monitoring project in the lower Yakima River Basin include:

1) Determining compliance with the 5th year TMDL target,
2) Determining if specific water quality parameters exceed appropriate tribal, state or federal standards,
3) Identifying reaches where water quality is impaired and,
4) Determining the status of critical elements of stream conditions relative to anadromous fish populations – specifically dissolved oxygen, temperature, pH, conductivity, turbidity, and total suspended solids.

The project area extends from the confluence of the Naches and Yakima Rivers (RM 116.3) downstream to the Kiona Bridge (RM 29.8). Initial monitoring to establish TMDL load allocations was conducted by the Washington State Department of Ecology and the Yakama Nation during the 1994 and 1995 irrigation seasons. This effectiveness monitoring project will attempt to duplicate sampling methods, site locations and data analysis techniques used in the initial TMDL monitoring however some sampling sites may change because of accessibility to the river or the unavailability of flow data at some locations.

Five sites along the main stem of the lower Yakima River and four sites at tributary mouths have been selected for sampling. The upstream river site, at the city of Yakima at the Yakima Avenue/Terrace Heights Bridge, will be used to determine background conditions. Three sites, Parker Bridge, Mabton Bridge and Euclid Bridge, are located within the project reach and one site, Kiona Bridge, is at the downstream end of the project area. The Kiona Bridge site is named in the TMDL as the downstream compliance point. Tributary sites near the mouths of Moxee Drain, Granger Drain, Sulphur Creek and Spring Creek will also be monitored to determine compliance with TMDL targets. Flow data at each of the sites will be collected using established Bureau of Reclamation, USGS or irrigation district gauges and, where necessary, accounting will be made for withdrawals by irrigation districts and/or discharge from drains or tributaries. Gauging stations are located on the lower Naches River near Yakima, the Yakima River below Roza Dam, the Yakima River near Parker, the Yakima River at the Euclid Bridge, and Yakima River at Kiona Bridge. There are also USBR gauges on Moxee Drain, Granger Drain, and Sulphur Creek. Staff gages and rating curves are provide by Sunnyside Valley Irrigation District for Spring Creek and its primary tributary, Snipes Creek. Evaluation of these sites will allow water resource managers to determine locations of greater impairment and make recommendations for improvement.

Flow measurements will be used to calculate loads (tons/day) for Total Suspended Solids and Suspended Fixed Solids. The results of these calculations
will allow comparisons of organic and inorganic fractions of the sediment load and facilitate the building of turbidity/sediment correlations.

The target pollutant of the Lower Yakima River TMDL is primarily inorganic sediment washed from agricultural fields. The sediment causes elevated turbidity and carries with it DDT and DDT metabolites. In 1995 these sediment loads in the main stem averaged over 300 tons/day. The organic fraction of the total load was found to be relatively small (1 to 3 percent). In Ecology's report from the 94-95 TMDL study the terms "total suspended solids" (TSS) and "suspended sediment" (SS) were used interchangeably because the organic fraction was considered relatively insignificant. In the current study conducted under this QAPP it will be assumed that the ratio between the organic and inorganic fractions has changed as agricultural sediment runoff has been reduced and aquatic growth has appeared to increase. To better characterize the inorganic fraction within the water column both TSS and fixed and volatile solids (FVS) will be measured. This will allow determination of the organic fraction. Adjusted turbidities based on the inorganic suspended sediment will be determined and reported where there is a significant difference from the organic/inorganic ratios found during the initial TMDL studies.

If monitoring indicates that Yakima River turbidity targets are not being met, Ecology's Water Quality Program and Ecology's partners in the Lower Yakima River Watershed will evaluate what additional implementation activities are necessary to achieve the targets and return the TMDL Implementation Plan to its schedule.

Data Quality Objectives

Water quality data is collected by Yakama Nation Environmental Management Program personnel and analyzed to assess the relative health of the water resources in the lower Yakima River Basin and to assist in understanding and quantifying impacts to water quality from adjacent land uses. Results from the measurements of pH, dissolved oxygen (DO), turbidity, and temperature will be compared to state (Table 2), federal and tribal standards. Water quality standards are being developed by the Yakama Nation for reservation lands for proposed implementation by the end of 2003.

Turbidity, specifically, will be measured to determine if the lower Yakima River between the confluence of the Yakima and Naches Rivers (RM 116.3), and Kiona Bridge (RM 30), is in compliance with state turbidity standards (Chapter 173-201A WAC) and is meeting the fifth year target in the Lower Yakima Suspended Sediment and DDT TMDL.

Table 2—Applicable State Water Quality Standards for Temperature, pH, Dissolved Oxygen and Turbidity [WAC 173-201A]

Parameter	Class A Waters (Excellent)
Temperature*	The Yakima River has a special temperature standard of 21ºC and shall not exceed this temperature due to human activities. When natural conditions exceed 18ºC no temperature increase will be allowed which will raise the receiving water temperature by greater than 0.3ºC.
pH	Shall be within the range of 6.5 – 8.5 with a human caused variation within the above range of less than 0.5 units.
Dissolved Oxygen*	Dissolved oxygen shall exceed 8.0 mg/L.
Turbidity	Shall not exceed 5 NTU over background turbidity when the background is 50 NTU or less, or have more than a 10 percent increase in turbidity when the background turbidity is more than 50 NTU.

*Proposed changes to the Washington State temperature and dissolved oxygen standards are under review and may be revised in the near future.

State water quality standards do not address suspended sediment or TSS except through its relationship with listed criteria or through narrative standards that address the affects that sediment may have on the defined beneficial uses for the particular class of waterbody.

DO, pH, and temperature data will be collected in the field using a Horiba Water Checker owned and maintained by the Yakama Nation Environmental Management Program and alternately with a Hydrolab Mini Sonde 4a owned and maintained by Ecology's Environmental Assessment Program. Periodically during the monitoring season side by side operation of these two units will be compared for consistency of data. On at least three occasions during the monitoring season, including once at the beginning and once at the end of the season, data comparisons will also be made to side-by-side sampling results obtained using Ecology's Ambient Monitoring Program equipment and published protocols (Ward, W.J., 2001). If variations are found that go beyond the measurement quality objectives (Table 3), protocols and instrumentation will be examined and changed, as necessary, to improve accuracy of the data.

To build into the monitoring system the consistency necessary to ensure that any variation observed in the data is actually due to water quality requires complete specification performance standards for all details of the system's operation. Precision and accuracy objectives are to utilize water quality monitoring equipment with precision

and accuracy levels high enough to produce data that will meet intended monitoring objectives.

All data will be collected with the highest accuracy practicable. The protocol for sample collection will be standardized for all monitoring sites. All equipment used to collect field data will be cleaned and properly calibrated using guidelines described by the manufacturer before use in the field.

Factory literature on the various pieces of equipment used in this project gives their respective expected levels of performance and abilities. It is acknowledged that these levels of performance are usually derived under controlled laboratory conditions. Operation in the field may lower the performance abilities of the equipment. Table 3 indicates the expected accuracy of the equipment used in the field for measuring pH, DO, temperature and conductivity. Accuracy in analysis for turbidity, TSS, and FVS using methods 2130B, 2540D, and 2540E respectively, are included in Table 3.

TABLE 3, Measurement Quality Objectives (MQOs**)**

Parameter	**Accuracy**
Temperature	± 0.2º C
pH	± 0.25 pH unit
Conductivity	±7.5%
Dissolved Oxygen	± 0.3 mg/L
Turbidity (SM2130B)	± 5% (NTU)
TSS (SM2540D)	± 2mg/L
FVS (SM2540E)	± 2mg/L

Because turbidity and sediment data will be used to compare background conditions against mid-reach and end-of-reach conditions and sampling protocols will be standardized throughout the project area, bias inherent in sampling and sample analysis will be minimized.

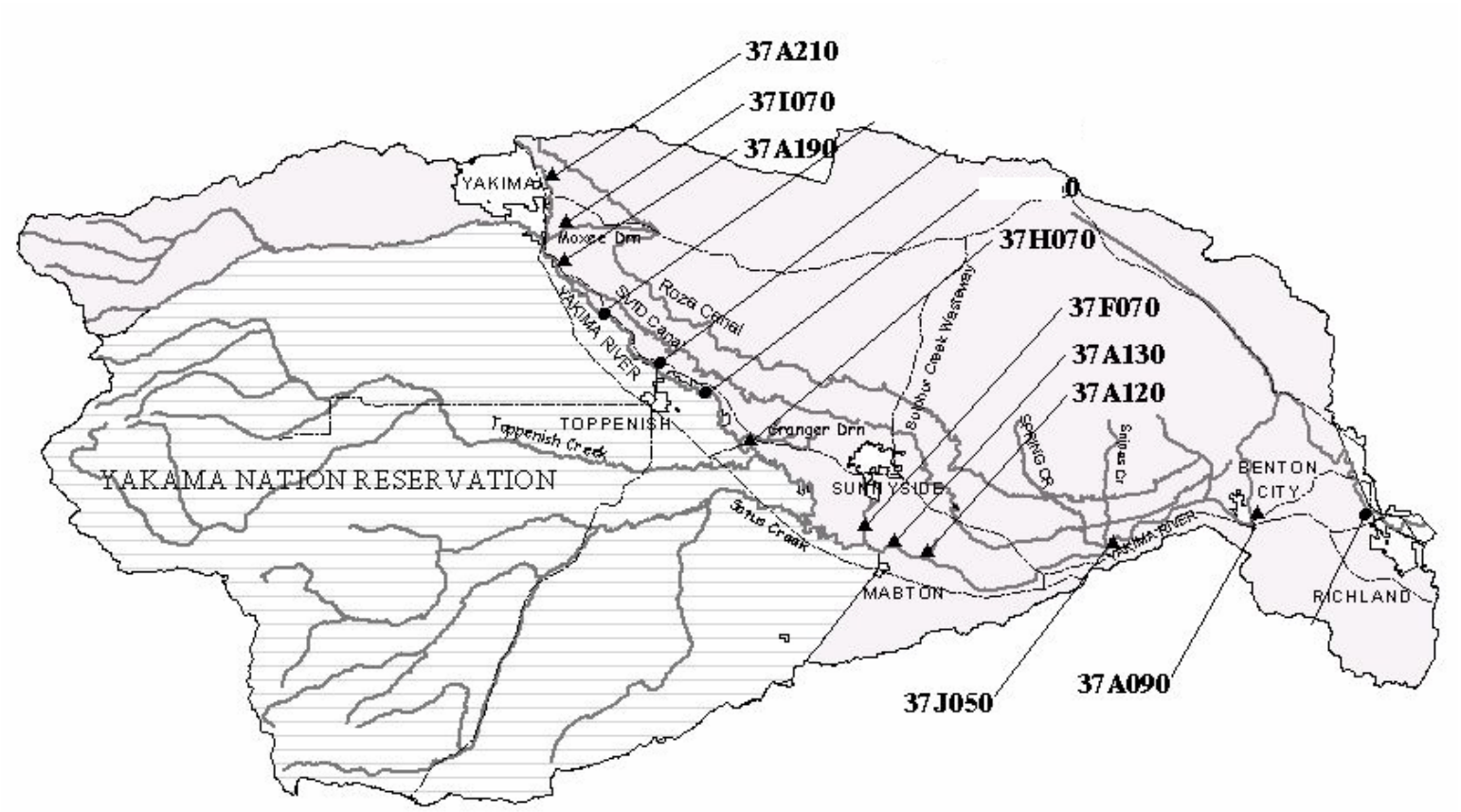
Sampling Design and Measurement

Several locations along the lower Yakima River have been selected as monitoring sites (Table 4). These sites were selected based upon location and accessibility. The upstream site at the Yakima Avenue/Terrace Heights Bridge in the city of Yakima is approximately 3 miles downstream of the confluence of the Yakima and Naches Rivers and is considered the background site. This monitoring project will run during the irrigation seasons from June 18 through mid-October of 2002 and March 31 through mid-October of 2003. If sampling opportunities are limited, additional monitoring may be required to ensure adequate data is obtained for analyses. Table 5 lists sites selected for sampling and field measurement.

Table 4. Lower Yakima River Effectiveness-Monitoring Project Monitoring Sites.

Monitoring Sites	Station Number (Ecology)	River Mile (RM)
Yakima River @ Yakima Av/Terrace Hgts Bridge	37A210	113.2
Yakima River @ Parker Bridge	37A190	106.5
Yakima River @ Mabton/Sunnyside Bridge	37A130.	59.8
Yakima River @ Euclid Bridge	37A120	55.0
Yakima River @ Kiona Bridge	37A090	29.8
Moxee Drain @ Birchfield Road	37I070	1.4
Granger Drain @ Sheep barns in Granger	37H070	0.62
Sulphur Creek @ Holaday Road	37F070	0.33
Spring Creek near mouth	37J050	0.1

Additional information about some of these sites can be found at the following web site address: http://www.ecy.wa.gov/programs/eap/fw_riv/rv_main.html.



Lower Yakima River TMDL Effectiveness Monitoring Sites

Sample collection will be conducted biweekly throughout the monitoring period. If at any time biweekly sampling is not possible, weekly sampling will be temporarily employed to maintain the total number of samples planned for the project.

Supplies

Horiba Water Checker
2000 ml Nalgene plastic containers
Glass sample collection bottles
75' Rope
US-DH-81 Depth Integrated Suspended Hand Sampler with collection containers
US DH-59 Depth Integrated Suspended Hand Line Sampler with collection containers
US DH-76 Depth Integrated Suspended Hand Line Sampler with collection containers
Hydrolab Mini Sonde 4a

Field Procedures

All monitoring sites are located at bridges or at wadeble sections of the stream. Each monitoring site consists of a transect that is near perpendicular to the stream channel. The width of the channel is divided into sections that represent equal widths of the stream cross section. Ten or more vertical sampling points are selected for sample collection. Adjustments may be required due to obstructions and debris in the river below the sampling point. In this case, the sampling point is moved laterally in the direction of the nearest clear access to flowing water until a sample can be obtained.

Sampling will start at approximately 7 AM at the upstream end of the project area and work downstream. All sites will be monitored on the same day.

Samples will be collected with FISP (Federal Interagency Sedimentation Project) designed samplers that permit the retrieval of a depth and width integrated sample. The US-DH 59 and US-DH 76 are weighted samplers that are lowered into the current while attached to a rope tether to collect a depth integrated, isokinetic sample. The US-DH 76 is heavier than the US-DH 59 and is more suitable for fast moving water. The US-DH 76 can also accommodate a slightly larger sample bottle, if desired. The US-DH 81 sampler operates in the same manner as the others but is not weighted and is controlled using a hand held rod instead of a tether. The US-DH 81 is better suited for use on smaller creeks and drains where there is direct access to water of wading depth. The determination of which sampler to use will be at the discretion of the field crew after observing stream conditions. The US-DH 81 sampler is mounted to a two-liter plastic container that is used to collect and transport the water sample. When the US-DH 59 or US-DH 76 is used for sample collection, sub-samples (< pint) collected at each sampling vertical in the stream cross section will be composited into a two-liter plastic container. The equal-width-increment (EWI) sampling method is used for the collection of samples and is

described in greater detail by the U.S. Geological Survey (Wilde et al., 1999). The specific method and equipment used to collect a sample will be noted on the field data sheet.

Sub-sample collection bottles and two-liter transport bottles will be washed and rinsed with filtered, de-ionized water prior to sampling at all of the sampling sites. At each stream sampling site the bottles are rinsed with a representative sample of the site water and emptied before a sample is collected.

As part of the continuing water quality evaluation, but not as part of the effectiveness-monitoring project, YNEMP will measure water quality parameters (i.e. pH, temperature, DO, and conductivity) using a Horiba Water Checker. The probe of the Horiba is placed in the river at a place that is easily accessible (either off the side of the bridge or either bank) and as close to the bridge as practicable. This is to obtain measurements that will most likely represent those of the cross section of the monitoring site. Calibration is performed and measurements are taken per the instructions provided by the manufacturer with the equipment. Ecology will periodically measure temperature, conductivity, DO and pH using the protocols and methods established for the Freshwater Ambient Monitoring Program (Ward, 2001). A series of side-by-side checks using the YNEMP Horiba equipment and the Ecology equipment will be conducted as QA checks and used to determine if the respective datasets can be combined into a common database. Instruments found to produce consistently similar data may be used interchangeably during the project. This will allow monitoring to continue if any particular piece of equipment is unavailable. It is anticipated that a Hydrolab Mini Sonde 4a will be available and used during the 2003 monitoring season. QA comparisons with the other instrumentation will be performed prior to its deployment and use. Calibration and use of the Mini Sonde 4a will follow factory recommended protocols.

A field data sheet will be completed at each of the monitoring sites. The sheet will record the date, time of sampling, pH, conductivity, DO, water temperature, air temperature, barometric pressure, personnel present, person doing the water collection, general weather conditions and any comments pertinent to the event.

All surface-water samples collected in the field will be immediately sealed, labeled, and stored in ice for transport to the lab. Water samples will be transported as soon as practicable after sampling and stored in a cooler or refrigerator unit at the lab at 4ºC or lower until analysis. Analysis by the lab will be completed within 48 hours of collection.

Instrument Calibration

All equipment and instruments used for this project are calibrated in accordance with manufacturer's recommendations and directions. Standardizing solutions used to calibrate equipment will be those provided by the manufacturer or an approved substitute.

Equipment and instruments will be inspected prior to each day's sampling event. Calibration adjustments will be made as required. Measuring instruments will be calibrated prior to the sampling event and checked for calibration at the end of the sampling day.

Replicate samples will be collected to assess variability in field sampling and laboratory analysis. Replicate samples will be collected separately immediately following the collection of the primary sample using identical methods, equipment and personnel. One site will be randomly selected during each survey for replication sample collection. During this effectiveness-monitoring project, at least 10% of the water quality samples collected will be replicated to assess total variability in field sampling and laboratory analysis.

Laboratory Analysis

The laboratory will analyze field samples for Total Suspended Solids (TSS) using Standard Method 2540D, Suspended Fixed Solids (SFS) using Standard Method 2540E and turbidity using Standard Method 2130B. The filtered TSS sample will be measured (2540D) then subjected to ignition (2540E) to determine the ratio between organic and inorganic solids. The lab is accredited by the state of Washington for all procedures performed. The same lab will be employed throughout the project if possible. Other water quality parameters, such as pH and conductivity, may be measured in the laboratory upon request.

Table 5, Laboratory procedures.

Parameter	Sample Matrix	No. of Samples Per Daily Event	Expected Range of Results	Reporting Limit	Sample Prep Method	Analytical Method
pH	Water (Instream)	10	6.5 – 9.0 units	N/A	N/A	pH probe
Temperature	Water (Instream)	10	5 -30º C	N/A	N/A	Thermisters
Conductivity	Water (Instream)	10	30 – 500 µS	N/A	N/A	Conductivity bridge
Dissolved Oxygen	Water (Instream)	10	5 – 15 mg/L		N/A	Probe
Turbidity	Whole water	10	1 to 1000 NTU	0.05 NTU	Hold @ 4ºC up to 48 hrs	SM 2130B
Total Suspended Solids	Whole water	10	2 to1000 mg/L	1 mg/L	Hold @ 4ºC up to 7 days	SM 2540D
Total Non-volatile Suspended Solids	Whole water	10	1 to 50 mg/L	1 mg/L	Hold @ 4ºC up to 7 days	SM 2540E

Quality Control

All equipment and instruments used in the field will be inspected, cleaned, and calibrated before use. Faulty equipment will be replaced or repaired if required. Sample bottles are cleaned and triple rinsed before use. The DH-81, DH-59 and DH-77 are stored to prevent contamination or damage.

Field QC will consist of collecting replicate samples during each monitoring event. Replicates consist of a full sampling of one of the monitoring sites selected randomly. The primary sampling of all ten vertical locations (six at Yakima Ave. /Terrace Heights or Mabton/Sunnyside) on the river transect will be immediately followed by a replicate sampling using identical methods, equipment and personnel. Ten percent or more of the total number of water quality samples collected for this project will be replicated in order to assess variability in field sampling. Also ten percent or more of the sample analyses will be replicated in the lab to assess laboratory variability.

TABLE 6, QC Schedule

Parameter	Field Replicates	Check against standards	Laboratory
pH	1/day	2/day (pre & post)	
Conductivity	1/day	2/day (pre & post)	
Temperature	1/day	2/day (pre & post)	
Dissolved Oxygen	1/day	N/A	
Turbidity	1/day	N/A	1/day
TSS	1/day	N/A	1/day
TNVSS	1/day	N/A	1/day

The precision statistic used is the percentage of replicate pairs with a coefficient of variation (CV) less than 20%. For TSS and turbidity the Washington State Department of Ecology Ambient Monitoring Program has a quality assurance goal of 90% of the replicate pair CV less than 20% (Hopkins, 1994).

Data Acquisition Requirements

Historical data will be collected as needed for temporal comparisons. Reference material will be collected from Ecology's TMDL study and USGS reports.

Data Management

All field measurements are recorded on data sheets during collection. Data sheets include information of date, time, location, staff, and water quality parameters being collected. Notes are recorded for weather conditions, streamside vegetation, and any other specific information needed for sample analysis or data interpretation. Both Ecology and the Yakama Nation record all field data collectively. Data is stored in spreadsheet format on a PC using Microsoft Excel©. The original field data sheets and photo copies will be preserved and kept on file by Ecology and Yakama Nation respectively. The data will be analyzed and summarized accordingly as required to complete reports.

Audits and Reports

This project will include a written report prepared by Ecology to address compliance with turbidity requirements of the Lower Yakima Suspended Sediment and DDT TMDL. It will describe the project and include:

- A map of the study area showing sampling sites,
- Descriptions of field and laboratory methods,
- A discussion of data quality, estimates of precision and bias, and the significance of any problems encountered,
- A comparison with earlier studies and findings,
- An evaluation of significant finding including whether turbidity compliance goals are being met, and
- Recommendations for follow-up, as warranted.

A draft of this report will be reviewed by the project staff and Ecology's Environmental Assessment Program before being finalized and submitted to Ecology's Water Quality Program. Submittal date to the Water Quality Program is projected to be March 1, 2004.

The Water Quality Program will make a determination of what actions to take as a result of this report.

Assessment and Response Actions

The field leader will observe and assess team performance and will address any deviations in protocol and/or quality control measures. Any suspected deviations in data results will be investigated on a case-by-case basis to make a determination if it is a result of an analytical error, data management error or an error in the sample collection process.

If errors in sampling techniques are identified, they will be addressed by the field leader and adjustments will be made. Adjustments made in the field or deviations from established protocols will be noted on the field data sheets.
Analytical errors in data management will be addressed by the project manager and quality control officer. Recalculation of data will result if necessary.

Data Review, Validation, and Verification

All field data will be reviewed internally by the Project Leader. Data input into database will be compared to that on field sheets to insure that:

- Information has been accurately transcribed.
- Any qualifiers with the data are identified.
- Corrections and adjustments are made as required.
- Established protocols have been followed.

The lab will verify all data before reporting the results to the project lead. The project lead will be responsible for the review of lab data and narratives for errors or omissions. Data validation will be done by the project lead using professional judgment as to whether the lab followed the procedures in this QAPP and the laboratory Quality Assurance Manual and that the requirements for this project have been met.

Data Quality Assessment and Reconciliation with Data Quality Objectives

After the data have been validated, the following steps will be conducted to assess the data quality prior to preparing the report:

- Review of the data quality objectives and the sampling design
- Conduct a preliminary data review
- Apply statistical tests as needed to assess quality assurance
- Draw conclusions from the data

The success of turbidity reduction efforts in the Lower Yakima River TMDL are focused on a compliance, or evaluation point on the mainstem river. This location is the core ambient monitoring station known as "Yakima River @ Kiona (RM30)". Water quality data has been gathered at this location during the construction of the TMDL model in 1994 and 1995 and, as well, in this study that began in 2002 and will end after the 2003 monitoring season. The interval for water quality data collection coincides with the irrigation season, beginning in April and ending in October. Compliance with the TMDL targets will be based on results from data gathered in the 2003 monitoring.

Determination for difference in turbidity concentration at RM30 on the Yakima River over the five year period in which pollution abatement plans were implemented will be tested. A Type I, fixed effects ANOVA model will be used, assuming that distributions for each set of data from earlier (1994/1995) and later (2002/2003) sampling is normally distributed or can be normalized using a numerical transformation. The normality assumption will be determined using a Q-Q Plot (probability plot) and evaluated visually before proceeding with the parametric test. Should the data be non-normally distributed

in each population and variances heterogeneous, then the Kruskal-Wallis test will be used. This is a non-parametric test used alternately in place of ANOVA and is as powerful in discriminating differences between populations.

Additionally, the original TMDL stipulated that no more than a 5 NTU (Nephelometric Turbidity Unit) difference would occur between the upper Yakima River background station (confluence with the Naches River at RM116.3) and the lower station at RM30 (Kiona Bridge). The comparison of data collected from 2002 and 2003 efforts between these two stations will be made using a Type I, one tailed fixed effects ANOVA model. A significant difference between these two stations where turbidity data was collected should be no more than 5 NTU. The source of any continuing pollution problem will be identified through further examination of turbidity concentrations at tributaries and drains.

Several drains and tributaries were sampled in 2002 and 2003 for turbidity analysis. Each of these drains was to comply with a 90^{th} percentile target, not to exceed 25 NTU's with the mean turbidity to be below 25 NTU in the 2003 season. Each set of data from individual tributaries and drains will be analyzed using descriptive statistics that identify 10^{th}, 25^{th}, median, 75^{th}, and 90^{th} percentiles. Any of these sampling locations that exceeds the 90^{th} percentile for turbidity observations for either 2002 or 2003 data collection periods will be reported to the Watershed Lead and TMDL Lead for modification of the Detailed Implementation Plan (DIP).

References

Hopkins, B., D. Clark, M. Schlender, and M. Stinson, 1985. Basic water monitoring program, fish tissue and sediment sampling for 1994. Washington State Department of Ecology, Water Quality Investigations Section. Olympia, WA. 43 pp.

Joy, J. and B. Patterson. 1997. A Suspended Sediment and DDT Total Maximum Daily Load Evaluation Report for the Yakima River. Washington State Department of Ecology. Environmental Assessment Program. Publication #97-321. Olympia, Washington.

Morace, J.L., G.J. Fuhrer, J.F. Rinella, S.W. McKenzie, and others. 1999. Surface-Water-Quality Assessment of the Yakima River Basin in Washington: Overview of Major Findings, 1987-91. U.S. Geological Survey, Water Resources Investigations Report 98-4113. Portland, Oregon.

Rinella, J.F., S.W, McKenzie, J.K. Crawford, W.T. Foreman, G.J. Fuhrer, and J.L. Morace. 1999. Surface-Water-Quality Assessment of the Yakima River Basin, Washington: Distribution of Pesticides and Other Organic Compounds in Water, Sediment, and Aquatic Biota, 1987-91.USGS Water-Supply Paper 2354-B.Denver, CO.

United States Bureau of Reclamation (USBR) Yakima Project Water Programs. 2002. Yakima Hydromet DAYFILES Data Access. http://mac1.pn.usbr.gov/yakima/index.html.

Ward, W.J. 2001. Stream Sampling Protocols for the Environmental Monitoring and Trends Section. Washington State Department of Ecology. Environmental Assessment Program. Publication #01-03-036. Olympia, Washington.

Wilde, F.D., Radtke, D.B., Gibs, J, and Iwatsubo, R.T., eds., Collection of water samples: U.S. Geological Survey, Techniques of Water-Resource Investigations, Book 9, Chapter A4.

Webster, J. and R. George. 2001. Quality Assurance and Control Plan for Water Quality Monitoring Program. Confederated Tribes of the Umatilla Indian Reservation (CTUIR). Environmental Planning and Rights Protection Program. Pendleton, Oregon.

Yakama Nation/U.S. Geological Survey. 1989-1993. Quality Assurance Plan for the Yakama Nation – USGS Cooperative Study of the Quality of Groundwater in the Toppenish Basin, Yakama Indian Reservation, Washington. Water Quality Report #90-8992-1.