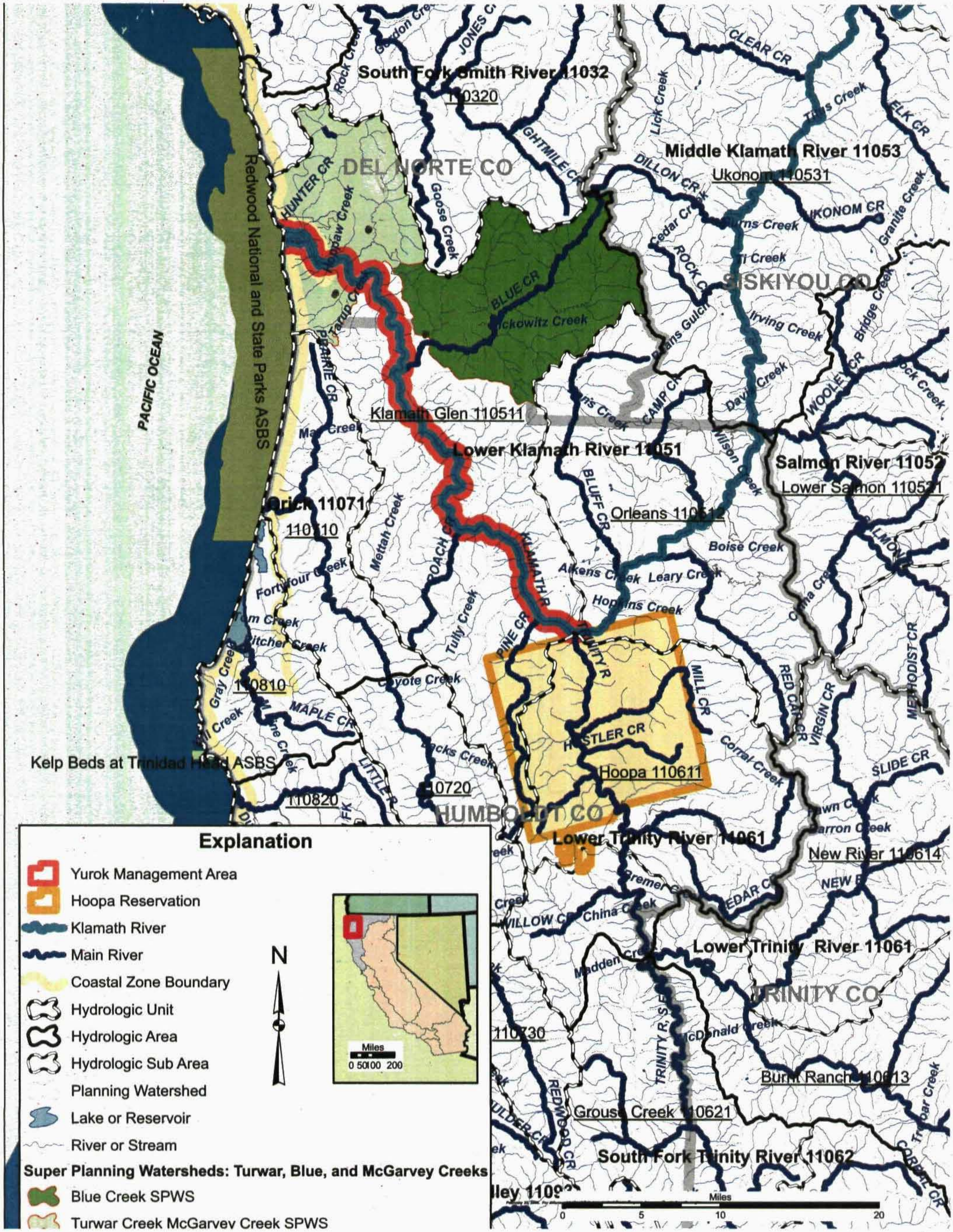


South Fork Smith River 11032
Middle Klamath River 11053
DEL NORTE CO
SISKIYOU CO
HUMBOLDT CO
TRINITY CO
PACIFIC OCEAN
Redwood National and State Parks ASBS
Klamath Glen 110511
Lower Klamath River 11051
Salmon River 11052
Orleans 110512
Hoopa 110611
Lower Trinity River 11061
New River 110614
Kelp Beds at Trinidad Head ASBS
110810
110820
110720
110730
Grouse Creek 110621
South Fork Trinity River 11062
BLUE CR
HUNTER CR
Goose Creek
BLUFF CR
Mettah Creek
Tully Creek
KLAMATH R
PINE CR
HOSTLER CR
MILL CR
TRINITY R
Boise Creek
Leary Creek
Irving Creek
CLEAR CR
IKONOM CR
ELK CR
VIRGIN CR
SLIDE CR
MAPLE CR
Coyote Creek
REDWOOD CR
WILLOW CR
China Creek
Fortyfour Creek
Corral Creek
Granite Creek
Bridge Creek
Explanation
Yurok Management Area
Hoopa Reservation
Klamath River
Main River
Coastal Zone Boundary
Hydrologic Unit
Hydrologic Area
Hydrologic Sub Area
Planning Watershed
Lake or Reservoir
River or Stream
Super Planning Watersheds: Turwar, Blue, and McGarvey Creeks
Blue Creek SPWS
Turwar Creek McGarvey Creek SPWS
N
Miles
0 50100 200
Miles
0 5 10 20

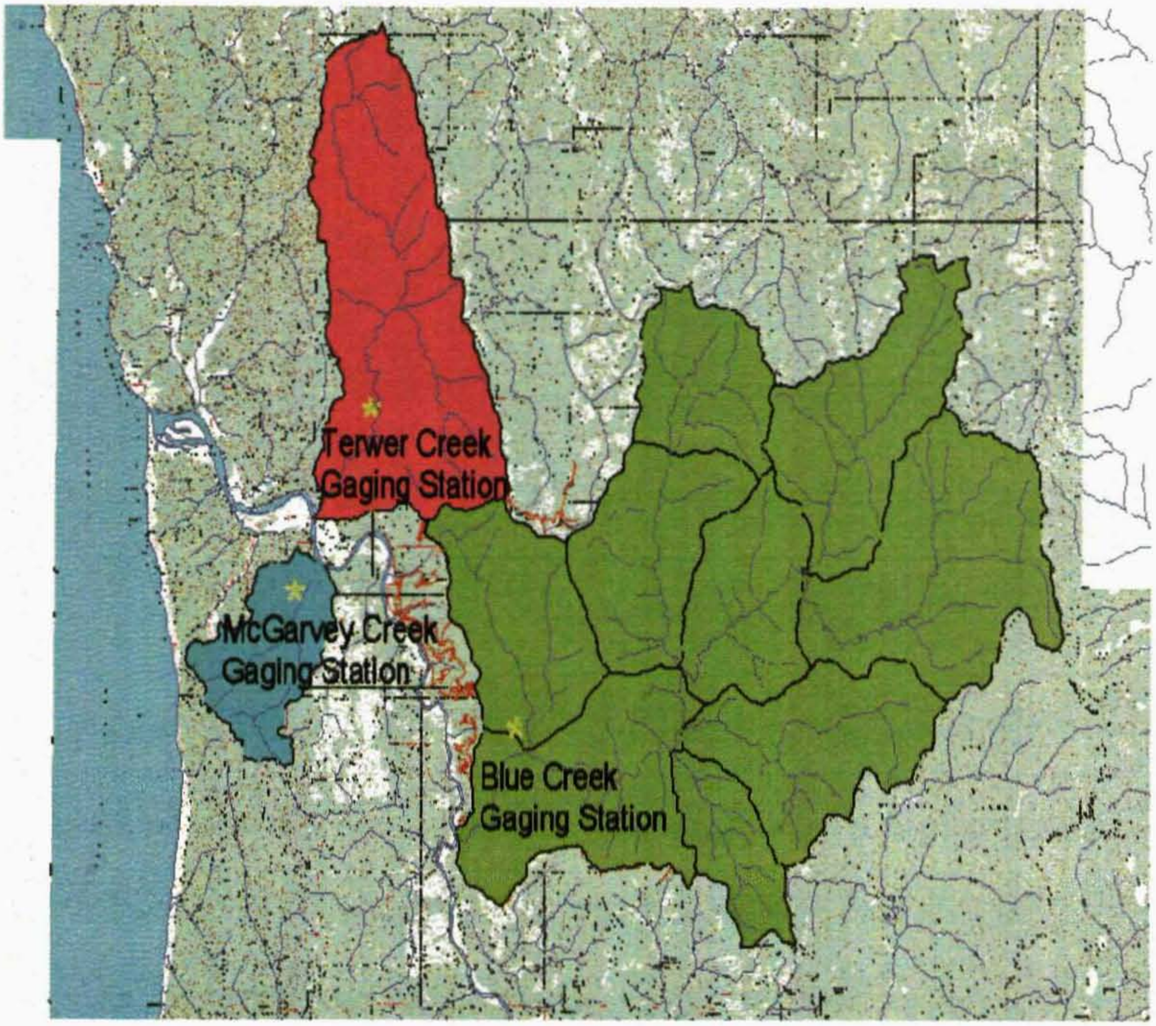


Figure 2. The map locates the three gaging stations within their respective watersheds within the Lower Klamath River Basin.

1.3 Responsible Agency

Yurok Tribe Environmental Program (YTEP).

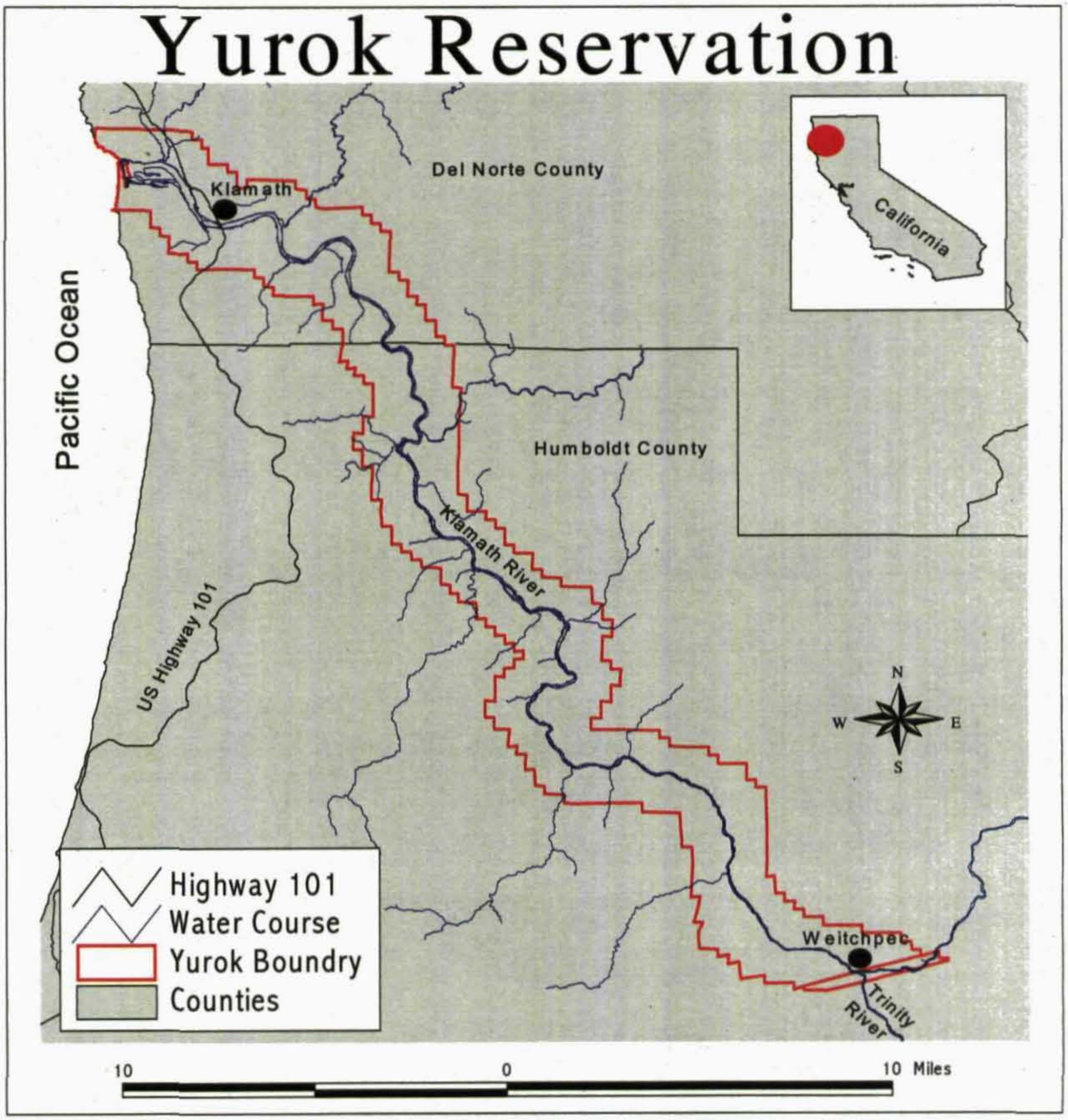
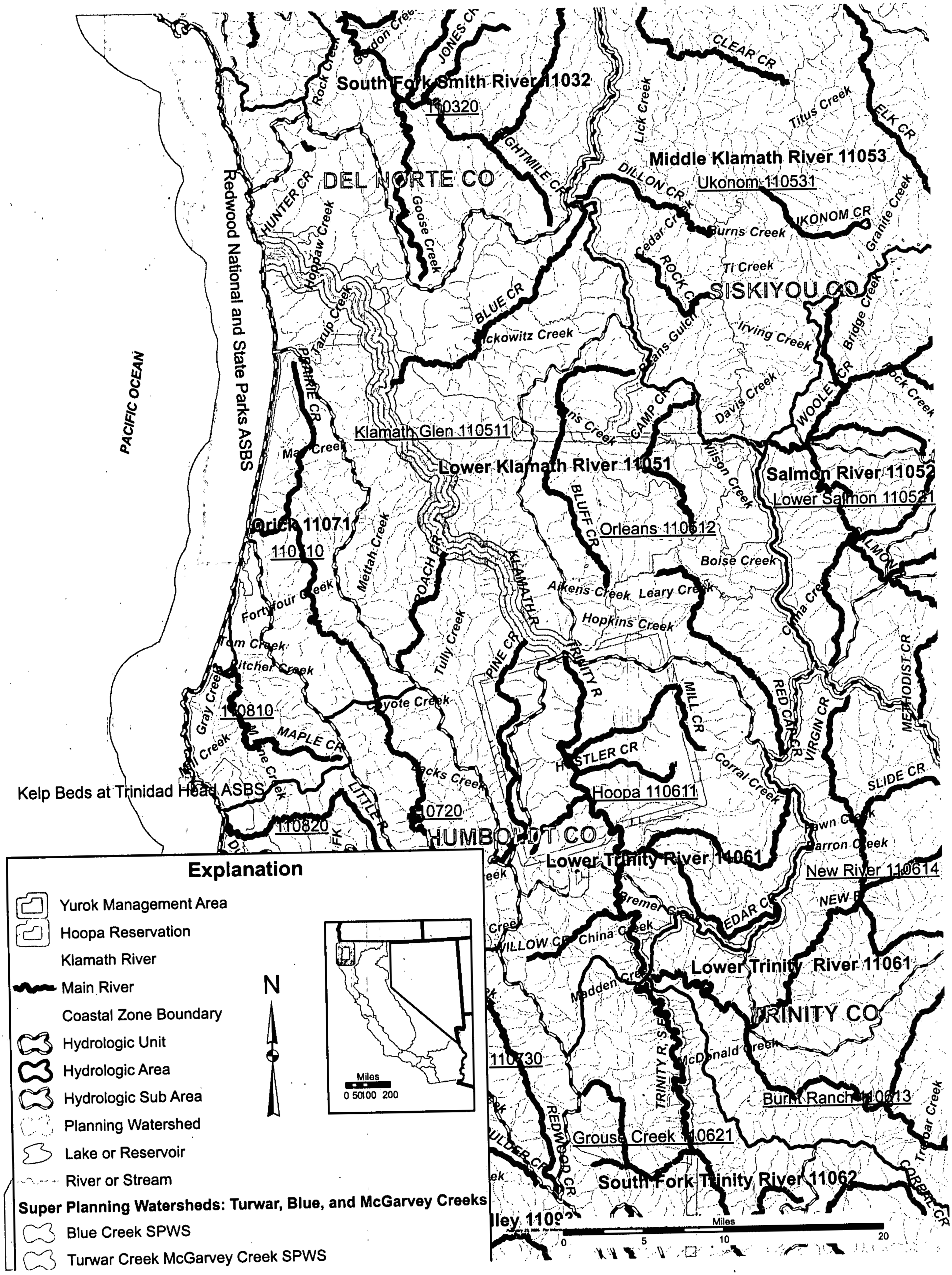


Figure1. Location of the Yurok Indian Reservation.



South Fork Smith River 11032
110320
Middle Klamath River 11053
Ukonom 110531
DEL NORTE CO
SISKIYOU CO
Redwood National and State Parks ASBS
PACIFIC OCEAN
Klamath Glen 110511
Lower Klamath River 11051
Salmon River 11052
Lower Salmon 110521
Orleans 110612
Orick 11071
Hoopa 110611
Kelp Beds at Trinidad Head ASBS
110720
110820
110810
HUMBOLDT CO
Lower Trinity River 11061
New River 110614
TRINITY CO
110730
Burnt Ranch 110613
Grouse Creek 110621
South Fork Trinity River 11062
Clear Cr
Titus Creek
Elk Cr
Lick Creek
Dillon Cr
Ukonom Cr
Granite Creek
Burns Creek
Ti Creek
Rock Cr
Hunter Cr
Hoppaw Creek
Goose Creek
Blue Cr
Tarup Creek
Prairie Cr
Irving Creek
Bridge Creek
Camp Cr
Davis Creek
Wooley Cr
Bluff Cr
Boise Creek
Mettah Creek
Roach Cr
Klamath R
Aikens Creek
Leary Creek
Hopkins Creek
Tom Creek
Pitcher Creek
Tully Creek
Pine Cr
Trinity R
Mill Cr
Red Cap Cr
Virgin Cr
Methodist Cr
Gray Creek
Coyote Creek
Maple Cr
Hostler Cr
Corral Creek
Slide Cr
Darron Creek
Bremer Cr
Cedar Cr
New R
Willow Cr
China Creek
Madden Creek
McDonald Creek
Trinity R, S F
Redwood Cr
Explanation
Yurok Management Area
Hoopa Reservation
Klamath River
Main River
Coastal Zone Boundary
Hydrologic Unit
Hydrologic Area
Hydrologic Sub Area
Planning Watershed
Lake or Reservoir
River or Stream
Super Planning Watersheds: Turwar, Blue, and McGarvey Creeks
Blue Creek SPWS
Turwar Creek McGarvey Creek SPWS
N
Miles
0 50100 200
Miles
0 5 10 20

43

W.Q. (ATTACHED) CONTROL PLAN

YUROK TRIBE

Sampling and Analysis Plan For the Yurok Reservation

May 2003

Developed by The Yurok Tribe Environmental Program

P. O. Box 355 Orick, California 95555

Sampling and Analysis Plan for Bedload and Sediment in the Lower Klamath Watershed Basin

Yurok Tribe
PO Box 355
Orick, Ca 95555

May 27, 2003

Yurok Tribe Project Manager ____________________

Yurok Tribe QA Manager ______________________

For EPA use:

Approved by EPA Project Manager: Date:

_________________________ ____________________

Expedited Review? ☐ Yes ☐ No

Received by QA Office: Date:

__________________ ____________________

Reviewed by: Date:

__________________ ____________________

Approved: Date:

__________________ ____________________

Region 9 Quality Assurance Manager

1.0 Introduction

Yurok People have inhabited lands of the Lower Klamath and Trinity Rivers, as well as along the Pacific Coast extending from Little River to Wilson Creek, for thousands of years. These ancestral lands encompass an area of approximately 360,000 acres. The natural resources of the Klamath River, its surrounding lands, and the Pacific Ocean have been central to the lives of Yurok People since time immemorial; fulfilling subsistence, commercial, cultural, and ceremonial needs.

The Yurok Tribe is the largest aboriginal tribe in the state of California with approximately 4,100 enrolled members. With the passage of the Hoopa-Yurok Settlement Act (PL 100-850), the Tribe was able to exercise its powers as a sovereign nation for the first time since non-Indian contact. The present YIR is located in northwestern Humboldt and southwestern Del Norte Counties.

The Klamath River defines the very shape of the YIR. The Reservation consists of a 56,000-acre corridor of land extending for one mile from each side of the Klamath River between the Trinity River confluence and the Pacific Ocean. The segment of the Klamath River crossing Yurok Tribal lands is approximately 46 miles long, or about 16% of the total length of the Klamath River measured from the Pacific Ocean to the outlet of Upper Klamath Lake. The Reservation includes two disperse, separate populated areas, generally known as the Lower Reservation (area that surrounds the "lower" part of the Klamath River where it flows into the Pacific Ocean near Requa) and the Upper Reservation (area that surrounds the "up-river" portion of the Klamath River where the Trinity River flows into the Klamath River near Weitchpec). Approximately 960 people live on the Yurok Indian Reservation with the remaining tribal members living nearby in Humboldt and Del Norte counties.

The Lower Klamath Watershed is currently listed as an impaired waterbody for nutrients, low dissolved oxygen, and temperature (EPA 2002). A TMDL, or Total Maximum Daily Load is used in order to develop water quality standards. The TMDL establishes the allowable loadings or other quantifiable parameters for a waterbody and thereby provides the basis to establish water quality-based controls. These controls should provide the pollution reduction necessary for a waterbody to meet water quality standards.

1.1 Site Name or Sampling Area

Lower Klamath River watershed.

1.2 Site or Sampling Area Location

The geographic area for this study encompasses the Lower Klamath River Basin watershed within and adjacent to the Yurok Tribe Reservation in Humboldt and Del Norte counties (see Figure 1 and Figure 2).

Water Segment: Klamath River HU, Lower HA, Klamath Glen HSA

Pollutant: Sedimentation/Siltation

Decision: List

Weight of Evidence: This pollutant is being considered for placement on the section 303(d) list under section 3 of the Listing Policy. Under section 3 a single line of evidence is necessary to assess listing status.

Three lines of evidence are available in the administrative record to assess this pollutant. Two of these lines of evidence support placing this water body segment on the section 303(d) list. The narrative information, photos and study findings submitted supports the numerical information submitted in concluding that a sedimentation problem exists in this water body.

Based on the readily available data and information, the weight of evidence indicates that there is sufficient justification in favor of placing this water segment-pollutant combination on the section 303(d) list in the Water Quality Limited Segments category.

This conclusion is based on the staff findings that:
1. The data used satisfies the data quality requirements of section 6.1.4 of the Policy.
2. The data used satisfies the data quantity requirements of section 6.1.5 of the Policy.
3. There are 8 weekly averages out of 31 weeks of 7 consecutive day averages that exceeded the evaluation guideline for turbidity and this exceeds the allowable frequency listed in Table 3.2 of the Listing Policy.
4. Pursuant to section 3.11 of the Listing Policy, no additional data and information are available indicating that standards are not met.

SWRCB Staff Recommendation: After review of the available data and information, SWRCB staff concludes that the water body-pollutant combination should be placed on the section 303(d) list because applicable water quality standards are exceeded and a pollutant contributes to or causes the problem.

Lines of Evidence:

Numeric Line of Evidence Pollutant-Water

Beneficial Use: CO - Cold Freshwater Habitat

Matrix:	Water
Water Quality Objective/ Water Quality Criterion:	Basin Plan: The suspended sediment load and suspended sediment discharge rate of surface waters shall not be altered in such a manner as to cause nuisance or adversely affect beneficial uses. Turbidity shall not be increased more than 20 percent above naturally occurring background levels. Allowable zones of dilution within which higher percentages can be tolerated may be defined for specific discharges upon the issuance of discharge permits or waiver thereof. Water shall not contain substances in concentrations that result in deposition of material that causes nuisance or adversely affect beneficial uses.
Evaluation Guideline:	The evaluation guideline that has been used to help determine exceedance is from published-peer reviewed paper, Noggle (1978, cited in Meehan 1991) reported that suspended sediment concentrations of 300 mg/L caused reduced growth and feeding.
Data Used to Assess Water Quality:	When you consider the entire data set from the three creeks sampling locations the data only shows one exceedance of the evaluation guideline out of the 21 samples taken. The one Suspended Sediment Concentration (SSC) exceedance that was shown was on 12/14/02 at 12:45 at McGarvey Creek and the SSC was 307 mg/L. The other samples taken at McGarvey had an average of 231.5 mg/L for 12/14/02, 117 for the 1/13/ 03 Avg., and 8.39 mg/L for the April 2003 Avg. The Blue Creek location had an SSC average 5.05 mg/L for 4/28/03 and 9.97 mg/L average for samples taken on 12/9/03. The Turwar Creek only had samples on 4/29/03 with and average SSC of 3.46 mg/L (Yurok Tribe, 2003).
Spatial Representation:	Three sampling locations; Blue Creek, McGarvey Creek and Turwar Creek gauging stations are located in the Lower Klamath River Basin.
Temporal Representation:	The data were collected from only 6 days from 4 different months between 12/2002 and 12/2003. SSC Data was collected from the McGarvey Creek station on 12/14/02, 1/13/03, 4/4/03, and 4/30/03. Data were collected from this location between 12:28 pm and 13:45 pm on each of the respective sampling dates. SSC Data was collected from the Blue Creek Sampling location on 4/28/03 and 12/9/03. Data was collected from this location between 12:28pm on 4/28/03 and between 14:50 and 15:15pm on 12/29/03. SSC Data was collected from the Turwar location on 4/29/03 only between 12:00 and 12:20 pm.
Environmental Conditions:	Regional Water Board staff have long suggested that beneficial uses may be impaired in portions of the mainstem Klamath (particularly in the lower Klamath River) and tributaries to the Klamath River (Beaver Creek and tributaries to the Klamath below the confluence with the Trinity River have been specifically identified) due to excessive sediment loading and instream sediment conditions. Insufficient information was available in 2002 to make a listing determination. The Yurok Indian Reservation boundaries lie approximately one mile on either side of the Klamath River from the Pacific Ocean to the confluence with the Trinity River. The Yurok, Karuk, and Hoopa Tribes are very active throughout the Klamath basin in both fisheries and water quality monitoring efforts. The Yurok and Hoopa Tribe are actively pursuing approval of Clean Water Act authority from US EPA. Coordination among the Regional Water Board, State Water Board, the Tribes and US EPA is critical to successful development and implementation of TMDL's for the Klamath River basin.

1.4 Project Organization

Title/Responsibility	Name	Phone Number
EPA Project Officer	Lorretta Vanegas	(415) 972-3433
Project Manager	Eric Brunton	(707) 834-2538
Staff	John Melvin	(707) 834-2534
Water Quality Control Coordinator	Ken Fetcho	(707) 834-1137
Hydrologist	Eric Brunton	(707) 834-2537
Quality Assurance Manager	Kevin McKernan	(707) 834-2536
Technician	Lavina Brooks	(707) 482-1350 ext. 369
Technician	TBA	TBA
Americorps Member	Shaina Meiners	(707) 834-2548
Americorp Member	Robin Tibbals	(707) 834-2548

1.5 Statement of Specific Problem

The purpose of establishing a sediment TMDL for the Klamath River is to identify the total load of sediment that can be delivered to the Klamath River and its tributaries without causing exceedence of water quality standards and to allocate the total load among the sources of sediment in the watershed. The load allocations, when implemented, are expected to result in the attainment of the applicable water quality standards for sediment for the Klamath River and its tributaries.

1.6 Site or Sampling Area Description

Three sites have been chosen as sediment sampling areas. The sampling areas are near gaging stations on Blue Creek, McGarvey Creek, and Terwer Creek are shown in Figure 1.

1.7 Operational History

1.7.1 Timber Management and Harvest History

Timber harvest activities currently account for the greatest percentage of erosion-related problems within the Lower Klamath sub-basin. According to Balance Hydrologics, Inc. (1995), "erosion related to poorly designed, abandoned or poorly maintained logging roads may be equal to or greater than all the sum of natural erosion processes occurring elsewhere in the basin."

Timber harvest has remained the main economic staple for the Lower Klamath sub-basin's portion. Commercial harvests began in the mid- to late- 1890's, but at that time only locally owned timber companies impacted the forest. Aerial photographs indicate that by the early- 1940's, clear-cutting had begun in many of the tributary watersheds. The advent of powerful hydraulic technologies allowed timber cutting to quickly spread across the Klamath Basin. A logging explosion took place in the late- 1960's. By 1969, nearly fifty percent of the Lower Klamath sub-basin had been logged. Between 1966 and 1969 alone, more than one-forth of the area of the entire Lower Basin was harvested. By 1994, nearly all of the remaining stands of old-growth had been removed (Lower Klamath River Sub-Basin Watershed Restoration Plan, 2000).

1.7.2 Road Construction

Information about the construction of logging roads within the Lower Klamath sub-basin was also gathered during the air photo analysis and has been compiled onto maps of the tributary watersheds. Interpretive data from these maps has been tabulated into Appendix-A. The vast majority of roads were constructed concurrent with the harvest operations that the roads supported. Appendix-A summarizes the history of road development for each watershed. The respective watershed maps are listed numerically along the left margin of the table.

1.7.3 Landslide History

During the air photo study, the locations of landslides were noted and transferred onto compilation maps, in accordance with their respective (photo-year) age ranges. The mapped information was then interpreted into tabulated data. All landslide data is quantitative, and has been generated through the laborious tallying of numbers of slides (by age category) that are located within the various watersheds. Landslide data has been divided into 2 parts, as shown in Appendix-B.

1.7.4 Non-Forestry Land Management History

While timber harvesting is the predominant land management activity in the Lower Klamath sub-basin, additional activities take place and/or are proposed for site-specific areas. These activities include livestock grazing, gravel mining, hydroelectric development and urbanization. While these activities are relatively minor in the context of the entire sub-basin, they potentially are having and could have a significant impact on sediment inputs within individual tributaries.

1.8 Previous Investigations/Regulatory Involvement

There has been very little investigation of sediment loading in the Lower Klamath Watershed Basin by any regulatory agency. Information regarding any sediment studies within the lower basin has not been made available or is non-existent.

1.9 Geological Information

Rocks that underlie the Lower Klamath River Basin have been divided into two main geological areas. The lowest portion of the basin from the river's mouth to Pecwan is comprised of what is known as the Franciscan Formation. The formation includes sedimentary and igneous rocks of a sub-marine origin (Lower Klamath River Sub Basin Watershed Restoration Program, 2000).

1.10 Environmental and/or Human Impact

Salmon are very susceptible to sediment pollution because they build their nests in stream bottoms (Everest et al., 1987). Fine sediment less than 0.85 mm can intrude into redds and smother eggs while sand-sized particles (<6.4 mm) tend to cap redds and prevent fry emergence. Logging has the potential to substantially elevate both coarse and fine sediment contributions to a stream. The ability of salmon to reduce fine sediment inside their nests is well recognized (Chapman, 1988). Large concentrations of adult salmon may actually help to alleviate high levels of fine sediment locally in the streambed through spawning activity. If the salmon population drops, this synergistic benefit is lost. Although a redd may have low fine sediment concentrations immediately after completion, fine silts and sand may intrude into the streambed during critical periods for egg and alevin survival.

There are many ways that activities contributing to sediment loading may interfere with the availability or quality of domestic water supplies. Elevated turbidity may exceed drinking water standards, requiring additional treatment. High bedload transport may overwhelm intake structures.

2.0 Project Data Quality Objectives

Data quality objectives (DQOs) are quantitative and qualitative criteria that establish the level of uncertainty associated with the set of data. DQOs indicate how sure YTEP is concerning the value of the data and what the analyses have determined them to be.

2.1 Project Task and Problem Definition

The Klamath River is host to many activities within the watershed that contribute to the amount of sediment in the river. Forest management activities in the watershed include timber harvesting and the network of roads used for timber harvesting. These activities disturb the soil within the basin contributing to sedimentation in the Klamath River.

Natural processes such as land slides and mass wasting of soil also contribute to sedimentation.

Suspended sediment concentration and bedload will be measured to calculate a total sediment discharge. The total sediment discharge will provide information to create a sediment budget for the Lower Klamath River watershed. The sediment budget will then be used to establish a sediment TMDL. The sediment TMDL will also allow YTEP and other agencies to track long-term trends in management and restoration activities.

2.2 Data Quality Objectives (DQOs)

The hypothesis formulated for this project is that the waters within the Lower Klamath River Basin have been impaired physically by land uses within the respective watersheds. This project is a preliminary investigation to determine the movement of sediment within the basin ultimately leading to the development of a sediment TMDL. The data quality objectives are as follows:

1. Develop a sediment budget from measured bedload and suspended sediment concentrations.
2. Evaluate the potential for developing suspended sediment rating curves.
3. Identify the relationship between turbidity and suspended sediment concentration.
4. Determine the contribution of suspended sediment from major storm events.

The analyses for suspended sediment and bedload must yield results that are of sufficient quality to be used in the development of the source analysis for the sediment budget and sediment TMDL. Therefore, data obtained should be of sufficient quality to be utilized to determine the relative contributions of sediment from surrounding sources at the time of sampling.

The data collected is intended to inform TMDL development and implementation and watershed analyses by providing monitoring data that can be compared to action levels for turbidity and suspended sediment concentrations found in applicable regulations and guidelines. Water quality objectives in the Yurok Tribe's Water Quality Control Plan (WQCP) Draft provide action levels for turbidity. The WQCP states that

"...Turbidity shall not exceed 5 NTU over background turbidity when the background turbidity is 50 NTU or less, or have more than a 10 percent increase in turbidity when the background is >50 NTU (Appendix-C). Suspended sediment load and suspended sediment rate of surface waters shall not be altered is such a manner as to cause nuisance or adversely affect beneficial uses (NCRWQCB, 1993) (Appendix-D). The Yurok Tribe Environmental Program has also proposed in their draft WQCP that "...Waters shall not contain suspended materials in concentrations that cause nuisance or adversely affect beneficial uses..." These qualitative and quantitative action levels provide a basis to conclude if the waters in the Klamath River have been impaired or not.

Data generated and analyzed may *also* be used to identify characteristics of sediment transport. For instance, identifying trends in sediment transport and how it relates to the watershed conditions such as precipitation, runoff, and turbidity. Data shall be used to issue water quality warnings and recommendations to users if high concentrations of sediment are detected in tributaries surrounding the Klamath River. The Tribe may use data in developing water quality guidelines and a sediment TMDL. Data shall also be shared among regulatory agencies, EPA, and NCRWQCB. The analyses for bedload and suspended sediment concentration must yield results that are of sufficient quality to be utilized, along with data from future sampling projects, in the determination of representative "baseline" sediment concentrations in the Lower Klamath Basin.

2.3 Data Quality Indicators (DQIs)

The primary Data Quality Indicator (DQI) for collection of suspended sediment concentration (SSC) data under this project is comparability. Comparability is a measure of the degree to which different methods and data sets can be represented as similar. Comparability of the suspended sediment concentration data will be evaluated using replicate/duplicate samples gathered in the field.

Table 1 shows the precision and accuracy measurement range for the study parameters for suspended sediment analysis. A copy of the methods used to analyze suspended sediment concentration can be found in Appendix-E.

Table 1. ***Precision and Accuracy Measurement Range for Study Parameters***

Parameter	Units	Matrix	Method	AWRL	Precision	Accuracy At AWRLS (% Rec.)	Accuracy Of Lab Matrix spikes (% Rex.)	Laboratory Performing Analysis
SSC	Mg/L	Water	ASTM D3977-97 Test Method B	4	0-10 mg/L: 30 10-100 mg/L: 20 >100 mg/L: 10	NA	NA	Graham Mathews and Associates
Bedload	Mg/L	Soil	[1],(see footnote)	NA	NA	NA	NA	

Since sample collection is primarily storm event related, no goals have been set for completeness.

Representativeness will be determined by multiple sampling of designated tributary sampling sites. The sampling sites that have been selected were chosen because of their similarity to other watersheds and tributaries in the Lower Klamath Basin which allows the study to be applied to other similar watersheds. The tributaries where sampling will occur were also chosen because of their differences from one another as described in the physical habitat and riparian characteristics shown in Appendix-F. Over the course of

[1] Bedload discharge is solely descriptive because no specific sampling equipment or procedures are presently accepted as representative of the state-of-the-art. As this situation changes, details will be added to this project SAP (ASTM, 2002 online).

the winter, two sets of replicate samples will be collected upstream or downstream (within 100 yards) of four sites that are typical of streams sampled under this project.

2.4 Data Review and Validation

Data generated in the field or laboratory are reviewed before they are released internally or to an outside agency. Data are checked to determine whether all quality assurance objectives have been met (validating data).

2.5 Data Management

2.5.1 Suspended Sediment

For SSC, the initial weight of the sample bottle and empty crucible and final weight of the empty sample bottle and crucible are recorded on the Analysis Report. SSC is calculated using the following formula:

$$\text{SSC} = \frac{\text{Gross weight of crucible \& sediment} - \text{weight of crucible}}{\text{Gross weight of bottle \& sample} - \text{weight of bottle}} \quad \text{(ppm)}$$

The formula above yields sediment concentrations in ppm. The concentration is multiplied by a conversion factor from Table 1 of ASTM Method 3977-97 to convert values to mg/L.

SSC data on the Analysis Report are transcribed into a Microsoft Excel file. The formula functions of Excel are used to calculate SSC. The analyst compares the raw SSC data on the Analysis Report to the Excel file. Any discrepancies are corrected. The Microsoft Excel file is then transmitted to the Principal Investigator and a paper copy is attached to the Analysis Report.

To minimize transcription errors, there is a minimum handling of data. Data tracking is simplified, since the analyst, Quality Assurance Officer, and person responsible for transmitting the data consist of two people.

2.5.2 Bedload

For bedload transport rates, the initial weight of the sample bag and sample and final weight of the empty sample bag and sample are recorded on the Analysis Report in mg/L.

The bedload transport rate at a sample vertical may be computed by the following equation (USGS, Field Methods for Measurement of Fluvial Sediment, 1999):

$$R_i = Kmi/t_i \text{ (tons/day/foot)}$$

Where:

R_i = bedload transport rate, as measured by bedload sampler, at vertical I, in tons per day per foot
M_i = mass of the sample collected at vertical I, in grams
t_i = time the sampler was on the bottom at vertical I, in seconds; and
K = a conversion factor used to convert grams per second per foot into tons per day per foot (K = 0.381 for a 3 inch nozzle and K = 0.190 for a 6 inch nozzle)

Sample rates should be plotted on a graph of RATE versus WIDTH. The RATE should be expressed in units of weight per unit time per unit width. For conditions of reasonably constant discharge, the rates at each measurement vertical should be averaged for plotting, and a curve representing the lateral distribution of bedload transport rate across the channel (or channels) should be drawn. This curve should give insight into the true shape of the lateral distribution curve. The area under the curve then represents the total cross-section bedload transport rate, in weight per unit time.

Bedload data on the Analysis Report are transcribed into a Microsoft Excel file. The formula functions of Excel are used to calculate bedload. The analyst compares the raw bedload data on the Analysis Report to the Excel file. Any discrepancies are corrected. The Microsoft Excel file is then transmitted to the Principal Investigator and a paper copy is attached to the Analysis Report.

To minimize transcription errors, there is a minimum handling of data. Data tracking is simplified, since the analyst, Quality Assurance Officer, and person responsible for transmitting the data consist of two people. This part of the procedure is identical to that in the suspended sediment data management section.

3.0 Sampling Rationale

3.1 Sediment Sampling

Each sampling site is located at or near a gaging station on a tributary of interest. All sampling sites are located in creeks that support anadromous fish species. The gaging station sites were chosen based on the following hydrological factors:

- How well representative water quality and sediment data can be obtained and related to a stage-discharge rating for the site
- Uniform depth representation over a wide range of discharge rates
- Stability of the sampling cross section location

Suspended Sediment Concentration (SSC) and bedload will be collected as described in Section 6.4. Samples will be collected in various size stream channels, in response to storms that generate runoff. Therefore the sample matrix is ambient water. SSC and bedload are critical to the completion of this portion of the overall project.

4.0 Request for Analysis

Bedload samples will be analyzed at the Yurok Tribe Environmental Program Lab. Suspended sediment samples will be analyzed by Graham Mathews and Associates. Recovery time for results will depend on the lab schedule, number of samples submitted, matrix, and the level of QC performed. See Yurok Tribe QUAPP for further details concerning laboratory analysis and selection criteria (Section 13.0).

The number of sample containers used at each sampling event is dependant on the hydrologic conditions at the site. Small flows will require fewer samples and larger flows will require more samples and sampling containers. Field crews should be shown typical hydrographs or recorder charts of their stations or of nearby stations to help them understand the importance of timing their samples so that each samples yields maximum information (Edwards, 1999).

4.1 Analyses Narrative

The number of samples taken at each sampling location is dependent on the conditions of the stream during the sampling period. Bedload and suspended sediment samples will be taken at the same time during each storm sampling event. Duplicate samples will be taken at a cross section (typically 10% of all samples).

5.0 Field Methods and Procedures

The collection of suspended sediment and bedload samples are dependant on the conditions of the stream. If the stream is unwadable, different types of suspended sediment and bedload samplers will allow the samples to be collected from a cable-way or bridge rather than directly by wading in the stream.

5.1 Field Equipment

5.1.1 List of Equipment Needed

- Equipment
- Waterproof disposable gloves
- White labeling tape
- Clear tape
- Indelible (black) marker
- Sterile Mason Jars (quart size)
- 100-foot tape
- Field logbook
- Chain-of-Custody forms **(Appendix-G)**
- DH 81 and US D-74 depth-integrated samplers
- BMH-84 and Helly-Smith bedload samplers

5.1.2 Calibration of field Equipment

Calibration of sediment and bedload sampling equipment is not necessary. There are no procedures available for calibrating the equipment; however, to ensure that the sampling equipment is working properly, visual inspection for clogged orifices and cracks can be made to ensure that the equipment is functioning correctly.

5.2 Field Screening

Field screening methods are not applicable for this project and sampling methods.

5.3 Sediment Sampling

5.3.1 Suspended Sediment Sampling (Wadable Streams)

Suspended sediment samples in wadable streams will be collected using a pre-cleaned US DH-81 depth integrated sampler. The sampler will collect flow-weighted samples to a maximum recommended depth of 12 feet. The sampler can be used to a depth of 15 feet by collecting up to 1 liter of sample.

A cross-sectional suspended sediment sample will be obtained by the equal-width-increment (EWI) method. The EWI method requires a sample volume proportional to the amount of flow at each of several equally spaced verticals in the cross section (Edwards,1970). The number of vertical samples required for the EWI method depends on the distribution of concentration of flow in the cross section during the sampling period. A minimum of 10 verticals will be used for streams over five feet wide (Edwards,1970).

The following steps in Appendix-H outline the suspended sediment data collection protocol for wadable streams:

5.3.2 Suspended sediment sampling (Non-wadable streams)

To sample depths greater than can be waded, wading rod extensions will be added to the sampler allowing sampling to take place from a bridge or boat. Suspended sediment samples in non-wadable streams will be collected from a cable and reel sampler (US D-74). The US D-74 is designed to be suspended from a bridge crane or cableway by means of a standard hanger bar and cable-and-reel system. The US D-74 has a streamlined cast bronze body 24 inches long that completely closes the sample container. The sampler accommodates round quart-sized mason jars. An adapter is available for the sampler that allows smaller plastic containers to be used if necessary.

The protocol for collecting suspended sediment samples using the US D-74 sampler from a cable-and-reel system is similar to the protocol steps described in Appendix-H for suspended sediment sampling in wadable streams.

5.3.3 Bedload Sampling (Wadable Streams)

Bedload samples in wadable streams will be collected using the US BLH-84 bedload sampler[2]. A process known as the single width increment method (SWE method) will be used to collect bedload samples. Starting at one bank and proceeding to the other, collect one sample per vertical at 20 evenly spaced verticals in the cross section, return to the bank, and repeat the process. At each vertical, the sampler is placed in the stream with the opening of the sampler facing upstream. The usual sampling strategy should be to define the mean transport rate at a series of lateral locations, often equally spaced. For this strategy, samples from different verticals must not be composited (USGS, 1990). Pressure is placed on the sampler to ensure there is no movement when sampling. The time of the sampling period, (retention time (Rt)) is recorded starting when the sampler is placed on the streambed. The time the sampler is left on the bottom should be equal for all verticals in a given cross section. The time the sampler is left on the bottom need not be the same for both cross sections collected. The samples are collected at the midpoint of the evenly spaced increments. Samples collected in this manner can be composited for analytical purposes; however, a better understanding of the local bedload transport characteristics is gained if each vertical sample is analyzed individually. The proper labels and forms will be filled out accordingly during and after the sampling event.

5.3.4 Bedload Sampling (Non-wadable Streams)

Bedload sample collection from non-wadable is completed by using the Helly-Smith cable suspended sampler. A copy of the SOP is provided in Appendix-I.

5.4 Water Sampling

Measuring flow, stage height, turbidity and temperature at the gaging stations will assist in building a relationship to create a TMDL for the Lower Klamath River Basin. A data logger (Waterlog 350) will continuously measure temperature, stage, and turbidity every fifteen minutes. Turbidity will indicate the clarity of the water and the amount of suspended solids in the tributaries.

[2] The following procedures should be noted and are also applied to bedload sampling in non-wadable streams.

5.4.1.1 Water-Level Measurements

Flowrate measurements will be taken during storm events that produce flowrates that have not previously been recorded. See Appendix-J for the SOP. Flowrate measurements and stage height measurements will be used to build a relationship to calculate the sediment transport rate. The sediment transport rate will assist in creating a sediment budget and sediment TMDL. All gaging stations will be monitored and adjusted as necessary. If a gaging station is reading 0.05 feet higher or lower than the reading on the staff plate, then the Waterlog 350 will be adjusted accordingly to match the staff plate reading.

5.5 Decontamination Procedures

It is assumed that the equipment used for suspended sediment and bedload sampling will not contain any harmful chemical or biological residue, therefore only deionized water will be used to clean sampling equipment strictly for the purpose of washing away residual sediment and bedload material.

6.0 *Sample Containers, Preservation and Storage*

The number of sample containers, volumes, and materials are listed in Section 4.0. The containers are pre-cleaned and will not be rinsed prior to sample collection.

6.1.1 Suspended Sediment Samples

Samples are collected in a 1 quart mason jars for the DH-81 and US D-74. Containers are numbered on the cap and bottle using an indelible marker. Bottles have been pre-washed in the laboratory, using the following procedure:

1. Discard previous sample.
2. Rinse with tapwater.
3. Wash with brush with a laboratory detergent.
4. Rinse with tapwater, drain and cap.

The preservation requirements and permissible holding times are listed in Table 3.

Table 3. Preservation and Maximum Holding Times of Water Samples for Laboratory Analysis

Measurement	Preservation Method	Maximum Holding Time
Suspended Sediment Concentration (SSC)	Cool 4°C	*7 days*

6.1.2 Bedload Samples

Bedload samples will be transferred from the sampler mesh basket to a cloth drawstring bag for storage and transportation. The samples will not require preservatives or cooling. The sampler does have to use caution when transferring the sample from the basket to the bag; any spilled material will result in an unusable sample.

6.2 Water Samples

Water samples will not be collected, stored, nor preserved. The instruments at each gaging station do not require the collection of a water sample, however, the instruments are submerged in the tributary allowing data to be collected every fifteen minutes.

7.0 Disposal of Residual Materials

In the process of collecting environmental samples at the sediment collection sites, residual materials will be disposed of on site. The sampling event is strictly to acquire samples for concentration measurement only and it is assumed that the sediment and bedload samples are inert and are not contaminated.

8.0 Sample Documentation and Shipment

8.1 Field Notes

8.1.1 Field Logbooks

Field procedures relevant to sample collection and field activities will be recorded during sampling events in permanently bound write-in-the-rain notebooks. Field logbooks will document where, when, how, and from whom any vital project information was obtained. Logbook entries will be complete and accurate enough to permit reconstruction of field activities. The following information will be entered in a bound field notebook at the time of sampling:

- Project name and number
- Sampler's name or initials
- Time and date of sample collection
- Station number and location
- Sample number
- Indicator parameter measurements
- Depth below water surface from which water sample is taken
- Estimated flow and gage height readings at the adjacent staff gage
- Current weather conditions
- Evidence of recent precipitation
- General field conditions

8.1.2 Photographs

Photographs will be taken at the sampling locations and at other areas of interest on site or sampling area. They will serve to verify information entered in the field logbook. For each photograph taken, the following information will be written in the logbook or recorded in a separate field photography log:

- Time, date, location, and weather conditions
- Description of the subject photographed
- Name of person taking the photograph

8.2 Labeling

All samples collected will be labeled in a clear and precise way for proper identification in the field and for tracking in the laboratory. A copy of the sample label is included in Appendix-K. The samples will have preassigned, identifiable, and unique numbers. At a minimum, the sample labels will contain the following information: Name of person taking the sample, station location, date of collection, analytical parameter(s), and method of preservation. Every sample, including samples collected from a single location but going to separate laboratories, will be assigned a unique sample number.

8.3 Sample Chain-Of-Custody Forms and Custody Seals

A chain-of-custody record will accompany all sample shipments for analyses. A copy of the form is found in Appendix-G. The COC form is combined with the request for analyses form. Form(s) will be completed and sent with the samples for each laboratory and each shipment (i.e., each day). Proper distribution of the forms is found in the "Instructions for Sample Shipping and Documentation" guidance document. If multiple coolers are sent to a single laboratory on a single day, form(s) will be completed and sent with the samples for each cooler.

The chain-of-custody form will identify the contents of each shipment and maintaining the custodial integrity of the samples. Generally, a sample is considered to be in someone's custody if the sample is either in someone's physical possession, in someone's view, locked up, or kept in a secured area that is restricted to authorized personnel. Until the samples are shipped, the custody of the samples will be the responsibility of YTEP. The sampling team leader or designee will sign the chain-of-custody form in the "relinquished by" box and not date, time, and air bill number.

The sample numbers for all rinsate samples, reference samples, laboratory QC samples, and duplicates will be documented on this form (see section 10.0). A photocopy will be made for YTEP's master files.

A self-adhesive custody seal will be placed across the lid of each sample. A copy of the seal is found in Appendix-K. The shipping containers in which samples are stored (usually a sturdy picnic cooler or ice chest) will be sealed with self adhesive custody seals any time they are not in someone's possession or view before shipping. All custody seals will be signed and dated.

8.4 Packaging and Shipment

All sample containers will be placed in a strong-outside shipping container (a steel-belted cooler). The following outlines the packaging procedures that will be followed for low concentration samples.

1. When ice is used, pack it in zip-locked, double plastic bags. Seal the drain plug of the cooler wit fiberglass tape to prevent melting ice from leaking out of the cooler.

2. The bottom of the cooler should be lined with bubble wrap to prevent breakage during shipment.

3. Check screw caps for tightness and, if not full, mark the sample volume level of liquid samples on the outside of the sample bottles with indelible ink.

4. Secure bottle/container tops with clear tape and custody seal all container tops.

5. Affix sample labels onto the containers in bubble wrap to prevent breakage.

6. Wrap all glass sample containers in bubble wrap to prevent breakage.

7. Each ice chest will be securely taped shut with fiberglass strapping tape, and custody seals will be affixed to the front, right and back of each cooler.

YTEP's sample custodian will maintain the following records and information:

- Sampling contractor's name (YTEP)
- Name and location of the site or sampling area
- Case or Regional Analytical Program (RAP) number
- Total number(s) by estimated concentration and matrix of samples shipped to each laboratory
- Carrier, air bill number(s), method of shipment (priority next day)
- Shipment date and when it should be received by lab
- Irregularities or anticipated problems associated with the samples
- Whether additional samples will be shipped or if this is the last shipment.

9.0 Quality Control

Since the analytes of interest are sediment concentration, no equipment blanks, trip blanks, split samples or spiked samples will be collected in the field. As noted in EPA method 160.2, accuracy (bias) data cannot be obtained on actual samples.

The quality assurance objectives will be updated on a monthly basis for this particular project and laboratory. Following analysis of replicates, the analyst will transfer replicate values from the Microsoft Excel file to a quality control chart, also on Excel, on a weekly basis. The formula function of Excel will be used to calculate precision, using the formulas below. The analyst will compare results of the quality control chart to the goals to ensure that the analysis is in control.

9.1 Field Quality Control Samples

Background samples, field screening samples, confirmation samples will not be necessary for this project because there in no method available to perform these tests in the field.

9.1.1 Assessment of Field Variability (Field Duplicate or Co-located Samples)

To determine variability in the sampling process, field duplicates will be collected at 10% of all sampling sites and a minimum of 1 per sampling event. A sampling event is defined as a 24-hour sampling period by a sampling team. Field duplicates will be identified on the sample list with the same station name as the sample being duplicated with the time of collection one minute after the time of collection of the duplicated sample.

9.2 Laboratory Quality Control Samples

Graham Mathews and Associates will perform laboratory quality control checks. Laboratory QC checks include instrument calibration and replicate analysis. Laboratory replicates will be analyzed for 10% sediment samples submitted to calculate the precision of the analysis. The samples to be replicated are chosen at random and are at the low, medium and high range. The replicate analysis is conducted by carrying two aliquots through the entire process and analyzing the two aliquots consecutively.

10.0 Field Variances

As conditions in the field may vary, it may become necessary to implement minor modifications to sampling as presented in this plan. When appropriate, the QA Office will be notified and a verbal approval will be obtained before implementing the changes. Modifications to the approved plan will be documented in the sampling project report.

11.0 Field Health and Safety Procedures

A copy of the field health and safety procedures can be found in Appendix-L.

12.0 References

Chapman, D.W. 1988. Critical review of variables used to define effects of fines in redds of large salmonids. Trans. Am. Fish. Soc. 117: 1-21.

Everest, F.H., R.L. Beschta, J.C. Scrivener, K.V. Koski, J.R. Sedell, and C.J. Cedarholm. 1987. Fine sediment and salmonid production: a paradox. p. 98-142 In: E. Salo and T. Cundy (ed). Streamside management and forestry and fishery interactions. University of Washington, College of Forest Resources, Contribution 57, Seattle, WA.

Edwards, T.K., G.D. Glysson 1999. United States Geological Survey, *Field Methods for Measurement of Fluvial Sediment.*

USGS, 1990. OFFICE OF SURFACE WATER TECHNICAL MEMORANDUM NO. 90.08.

Appendix-C

YUROK TRIBE

Draft
Water Quality Control Plan
For the Yurok Indian Reservation

January 2003

Pesticide concentrations, individually or collectively, shall not exceed the lowest detectable levels, using the most recent detection procedures available. There shall be no detectable increase in pesticide concentrations found in bottom sediments. There shall be no detectable increase in bioaccumulation of pesticides in aquatic life. Background levels shall be considered to be non-detect if baseline levels have not been established.

Since many of these pesticides do not have established standards and because Tribal member fish consumption far exceeds the national average upon which standards are developed, the Yurok Tribe maintains that there be no detectable levels of pesticides in any of the water bodies under its jurisdiction. This policy is consistent with other jurisdictions and community concerns creating a zero tolerance policy towards pesticide use within Northern California (e.g. Hoopa Valley Tribe, Karuk Tribe of California,Trinity County, and Lohontan Region 6).

pH

The pH shall conform to those listed in Section 3.5. In fresh waters with designated beneficial uses of COLD or WARM, changes in normal pH levels shall not exceed 0.5 pH units. For all other waters of the region, the pH shall not be depressed below 6.5 nor raised above 8.5[1].

Phosphates

Levels of phosphorous in any water body shall not be increased by human related activity above the levels consistent with preservation of the specified beneficial uses.

Radioactivity

[1] pH levels adopted from State of California's North Coast Region and Karuk Tribe's Department of Natural Resources Water Quality Control Plan (2002)

Radionuclides shall not be present in concentrations which are deleterious to human, plant, animal, or aquatic life nor which result in the accumulation of radionuclides in the food web to an extent which presents a hazard to human, plant animal, or aquatic life.

Sediment

The suspended sediment load and suspended sediment discharge rate of surface waters shall not be altered in such a manner as to cause nuisance or adversely affect the water for beneficial uses.

Settleable Materials

Waters shall not contain substances in concentrations that result in deposition of material that causes nuisance or adversely affect beneficial uses.

Suspended Materials

Waters shall not contain suspended materials in concentrations that cause nuisance or adversely affect beneficial uses.

Taste and Odor

Waters shall not contain taste or odor producing substances in concentrations that impart undesirable taste and odors to flesh or other edible products of aquatic origin, or that cause nuisance or adversely affect beneficial uses.

Temperature

For waters designated COLD, the temperature shall not be altered in a way that will impact this beneficial use.

For waters designated COLD, the temperature shall not be increased by more than 5 degrees Fahrenheit above the natural temperature at any time or place. In order to support beneficial uses and tribal trust resources associated with COLD waters, a maximum temperature of 21 degrees Centigrade[1] and a maximum seven-day average of 15.5 degrees Centigrade[1] will be applied to the mainstem Klamath.

Toxicity

All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life. Compliance with this objective will be determined by use of indicator organisms, analysis of species diversity, population density, growth anomalies, bioassays of appropriate duration and/or other appropriate methods as specified by the Yurok Tribe.

Turbidity

Waters shall be free of changes in turbidity that cause nuisance or adversely affect the water for beneficial uses. Allowable zones of dilution within which higher percentages can be tolerated may be defined for specific discharges upon the issuance of discharge permits or waiver thereof.

Turbidity shall not exceed 5 NTU over background turbidity when the background turbidity is 50 NTU or less, or have more than a 10 percent increase in turbidity when the background is >50 NTU[1].

Volume

The volume of all waters shall not be altered unless it can be demonstrated to the satisfaction of the Yurok Tribe Environmental Program that such an alteration in volume does not adversely affect the water quality and fisheries needed to protect the beneficial uses. In particular, waters designated CUL, MGR, and NAV shall not have their water volumes altered as to impair these beneficial uses.

Other Chemical Constituents

---

[1] Temperature levels adopted from Karuk Tribe Department of Natural Resources Water Quality Control Plan (2002)

[1] Turbidity levels adopted from the State of Washington as specified in Bash J., Berman C., Bolton S. Effects of Turbidity and Suspended Solids on Salmonids (2001)

Groundwaters used for domestic or municipal supply shall not contain concentrations of chemical constituents in amounts which adversely affect such beneficial use.

3.4 Water Quality Objectives for Ground Water, Narrative Criteria

In general groundwater standards and criteria will be the same as those for surface waters. The beneficial uses specified for those waters derived from ground water sources will dictate the specified standards which apply.

Groundwaters shall not contain chemical constituents, toxicants, radioactivity, pesticides or substances which produce tastes or odors in concentrations that produce detrimental physiological responses in human, plant, animal or aquatic life associated with designated beneficial uses. Groundwaters used for domestic or municipal supply shall not contain concentrations in excess of the maximum contaminant limits set forth in EPA's Safe Drinking Water Act.

3.5 Specific Use Numerical Criteria

The Tribe adopts the following water quality standards for the following designated uses for specific Tribal water bodies: The Tribe adopts the following water quality

Appendix-G

Graham Mathews and Associates

Lab Analysis Request Form

Bottle Number	Date Sampled	Time Sample Taken	Sample ID 4-5 Letters	Sample Type DIS or Grab	Field Rep? (y/n)	Analyses Requested Turb or SSC	Gage Height	Remarks

Samples Collected By: ____________________ Date/Time____________________

Samples Relinquished By: ____________________ Date/Time____________________

Samples Received By: ____________________ Date/Time____________________

Appendix-H

SOP for the use of the US DH-81 and US D-74

1. Sites should be established prior to planned storm sampling, with site selection considerations based on access, local hydraulics, and high-flow sampling access. If possible, have a fiberglass tape left at sampling section so that same stations are used each time.

2. Upon arriving at site, record gage height and time (24hr clock).

3. Determine if it is safe to collect depth-integrated sample (DIS).

4. Attach extension handles to DH-81 sampler as necessary to collect DIS. Fit ~~pint~~ *quart* bottle into sampler and make sure it is properly seated and that nozzle is not clogged.

5. Divide stream into 10-20 verticals for DIS method, sampling at stations on tape, if possible. Lower sampler vertically into flow at a uniform rate, reversing immediately upon touching bottom. Raise sampler at same rate as lowering. Move to next vertical and repeat. Continue across entire width of wetted channel.

6. The sample bottle must be 60-90% full after a complete pass. If the sample bottle is more than 90% full, discard sample, rinse bottle, and collect another sample at a slightly faster rate. If the sample bottle is less than 60% full, repeat the sample collection (another full cross section) at a rate that will not overfill sample bottle. One may also use a second bottle or even multiple bottles to collect a single cross channel sample. Sample bottles will be composited in the lab.

7. Remove sample bottle. Tightly cap sample bottle. Store in ice chest or refrigerator until transferred to lab for processing.

8. Record the following information in a field log book for each sample:

   Date, Time, Site, Gage Height, Sampler used (DH-81, DH-48, DH-59, D-74), sample type (DIS), # of verticals sampled, stations sampled if tape is available, Bottle #, # of bottles (if multiple bottles are used), and any general notes as to weather, unusual site conditions, etc.

9. Record the following information on the bottle label using an indelible marker and attach to the bottle cap and cover label using clear adhesive tape:

   Name, Station, Date, Analysis, Location, Refrigeration Y or N, Sample Number, and Remarks.

10. Every 10 samples, a second pass at the same site should be made (10% of the samples will have a replicate) using identical stations or procedures. The purpose of the replicate is for QC documentation.

Appendix-I

Bedload Sampling SOP

1. Visually inspect Helley-Smith bedload sampler or equivalent for damage. Replace parts or repair damage as necessary.
2. Anchor surveyor's tape tautly across the stream at desired sampling site perpendicular to the direction of streamflow and attach to pins on either side of the stream.
3. Measure discharge at the site in accordance with the SOP in Appendix-J.
4. Divide stream cross-section into 15 to 20 sample sections of equal width.
5. Lower the Helley-Smith sampler or its equivalent to the streambed at the first sample point. Keep sampler on the streambed for a timed duration of 15 seconds and retrieve sampler from the water. Repeat procedure across the traverse.
6. Transfer composited sample into an appropriately labeled cloth bag.
7. Place the cloth bag in a plastic bag for protection.
8. Fill out all necessary field forms, custody forms, analysis request forms, etc. prior to leaving site.

Appendix-J

Flowrate SOP

Measuring Stream Discharge with the AquaCalc and the Price AA or Pygmy Meter

Attaching the Flow Meter to the Wading Rod

1. Remove the flow meter from its storage case
2. Attach the flow meter to the wading rod by slipping the flow meter attachment end over the wading rod nub and tightening the screw on the flow meter with a straight slot screwdriver. **(Making sure the flow meter is perpendicular with the flow meter)**
3. Attach the electrical wire that is connected to the wading rod to the flow meter and tighten the nut gently with a pair of pliers

Attaching the AquaCalc to the Wading Rod

1. Remove the AquaCalc from its storage case
2. Attach the AquaCalc to the top of the wading rod with the Velcro
3. Attach the AquaCalc's 8 pin connector "pig tail" to the cable that is mounted on top of the wading rod

Field Testing the Instrumentation

1. Turn on the AquaCalc and hit **Enter** when the Date and Time is displayed
2. Press the **go to Transect #** and enter an unused and available transect number
3. Hit the **Next Observe** key to select any observation but #1
4. Spin the cups on the current meter and press the **Measure** key
5. The timer will immediately start and then restart after the first revolution of the cups. After the first revolution, the counter will show revolutions.
6. Visually count the revolutions
7. Compare this to the amount counted by the AquaCalc
8. If the AquaCalc does not match you visual count refer to the *Troubleshooting* chapter in the owner's manual

Spin Testing the Flow Meter

1. Give the current meter a rapid spin in still air and record the time until the cups stop spinning.

USGS spin tests for Price Type AA and Pygmy meters are shown in the following table:

Meter	Normal Spin	Minimum Spin
Price "AA"	4 min	1.5 min
Pygmy	1.5 min	0.5 min

Measuring stream discharge across a transect

(This SOP will be set up to perform a simple 6 tenths wading measurement, good for stream depths below 2.5 feet. For streams with a depth greater than 2.5 feet consult the Owner's Manual for changing the AquaCalc setting to calculate the 2 tenths and 8 tenths measurements.)

1. Secure the tape measurer or Kevlar tag line to one side of the stream bed (trees work good or use a metal stake)
2. Carefully walk across the stream and secure the tape or tag line on the other side of the stream bed so that the transect is perpendicular to the stream.
3. Determine what the stream width is and divide by 25
4. This will determine what your sampling interval will be
5. Turn on the AquaCalc
6. Press the **Go To Transect #** key and select the Transect # that has been assigned to the stream you are measuring at (see cheat sheet on back of AquaCalc)
7. If there are existing measurements in the rest of the transect's stations, you can erase them by pressing and holding the **Erase** key for three seconds while in Observation #1.
8. Repeatedly press the **Previous Observe** key to go to Observation #1 in the AquaCalc
9. Establish the Edge-of-Water (EOW) in the AquaCalc. No measurements can be made at Station #1. Just press the **Set Distance** key and enter the number that is on the measuring tape or tag line that coincides with the EOW
10. If you are at a wall or a vertical bedrock edge, enter the depth at the wall by pressing the **Set Depth** key and entering the stream depth from the top of the water to the bottom of the wall and then press the **Enter** key **(do not press the Measure key at this observation point)**
11. Press the **Next Observe** key to move to Station #2.
12. Move to your first measurement location in the stream.
13. Press the **Set Distance** key. Enter the distance from the measuring tape or tag line.
14. Press the **Set Depth** key (by pressing the Set Depth instead of Enter the AquaCalc will automatically enter the distance and ready the AquaCalc to accept the Depth) Enter the depth of the stream at your location
15. Push the rubber button on the wading rod handle that will allow you to adjust the flow meter to its correct height. Slide the rod up or down to match the rod height inscribed on the wading rod handle with the correct stream depth.
16. Press the **Measure** key. The AquaCalc will immediately start counting revolutions after the first revolution and display the running mean velocity.
17. When the AquaCalc has satisfactorily completed its measurement the **Measurement Complete** screen will appear, showing counts, elapsed time and velocity for the measurement.
18. Press the **Enter** key to continue
19. Press the **Next Station** key to move to the next station

20. Move to your next measurement location and repeat the previous steps for each station in the transect
21. After completing the measurement at the last station, press **Next Station** key and enter the ending EOW location as read on the tape or tag line and input a depth of zero.
22. In the case of ending the transect at a vertical wall or bedrock, enter the ending distance at the wall and the depth at the wall as usual, but ***add a station following the wall with a depth of zero.*** The distance you enter in this next station is not critical, so long as it is greater than zero. It is helpful to use a distance beyond the closing wall location.
23. Press the **Calculate Discharge** key and record this number in the logbook in the gaging station box
24. Enter the Gage Height and the Staff Height into the AquaCalc. (For these purposes the stage height displayed on the data logger at the gaging station will be used for the gage height and the water level at the graduated Staff plate will be the staff height.)
25. Press the **Menu** key
26. Press the **Enter** key to scroll to Set Gage HT.
27. Press the **+/-** key and enter the height displayed on the data logger.
28. Press the **Enter** key
29. Press the **+/-** key and enter the water height on the graduated Staff plate
30. Press the **Enter** key
31. Turn off the AquaCalc by holding down the **OFF** key for a couple of seconds
32. Detach the AquaCalc and current meter from the wading rod and put them in their protective cases
33. Do not close the lid on the current meter so it can air dry, when you return to the office rinse with tap water and dry off with the supplied yellow cloth

Appendix-K

Yurok Tribe Environmental Program CONTAINER LABEL		
Name:_______________	Analysis: SSC or BLC	Sample Number: # # # # #
Station:_____________	Location: ____________	Remarks:_________________
Date:_______________	Refrigerate? Y / N	

Yurok Tribe Environmental Program CUSTODY SEAL		
Relinquished By:_____________	Date / Time:_______	Sample Number: # # # # #
Received By: ______________	Date / Time:_______	Remarks:__________________ _