Hoko-Lyre Watershed (WRIA 19) Planning Unit

Hoko-Lyre Watershed Comprehensive Monitoring Plan

July 2005

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HOKO-LYRE WATERSHED
COMPREHENSIVE MONITORING PLAN

JULY 2005

Prepared for:

WRIA 19 Planning Unit

Lead Agency:
Clallam County
Department of Community Development

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Hoko-Lyre Watershed
Comprehensive Monitoring Plan
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CHAPTER 1.
INTRODUCTION

PURPOSE OF THE COMPREHENSIVE MONITORING PLAN

This Monitoring Plan is part of Phase 3 of the watershed management planning process outlined in Washington State's Watershed Planning Act (Revised Code of Washington (RCW) 90.82), for the WRIA 19 Planning Unit (Water Resource Inventory Area 19; the Hoko-Lyre Watershed). The Washington Department of Ecology approved supplemental funding for water quality projects as part of the planning process in the fall of 2004. The supplemental water quality grant provided funding for a benthic index of biological integrity (BIBI) study, which was performed in October 2004, and for development of a Comprehensive Monitoring Plan. This plan provides recommendations for monitoring watershed health and the effectiveness of watershed restoration efforts through the following steps:

- **Identify and document existing monitoring efforts in WRIA 19**—Available information about existing monitoring efforts will be documented. This will include water quality, water quantity (such as flow and water use), and habitat monitoring. Details will be included about who does the monitoring, where and how often the monitoring is performed, and the protocols used.
- **Summarize available monitoring data**—Monitoring data from entities currently conducting monitoring will be used to identify data gaps and parameters of concern for each subbasin.
- **Recommend monitoring programs and additional studies**—Prioritized recommendations for future monitoring activities are presented for low, moderate, and high funding scenarios. Monitoring programs and priorities are based on recommendations from the Watershed Plan, monitoring workshops, and stakeholder input.

It is anticipated that the monitoring plan will be implemented by the cooperative effort of regulatory agencies and interested parties. This group will form a Monitoring Work Group (MWG) and meet regularly to discuss plan implementation, achievements, and evaluation. Participation in the MWG, as well as the actual monitoring or sharing of data, will be voluntary. The MWG will not take the place of established federal, tribal, state, private monitoring programs; its primary function will be to coordinate collaboration whenever possible. The MWG will work cooperatively with the WRIA 19 Restoration Work Group (if the two are established as separate groups) to prioritize restoration needs and evaluate restoration project effectiveness. As funding is not currently secured for implementation of this plan, much of the organization is theoretical at this stage.

The MWG will not be responsible for, or authorized to administer or enforce, policies related to water quality, forest practices, or sensitive species. Rather, the MWG will provide regulatory agencies and organizations with some of the data used for planning, setting policy, enforcing regulations, and prioritizing restoration actions. The MWG also will assist with coordination of monitoring efforts. Groups that should be consulted for planning and data sharing include the following:

- Government Agencies:
  - Clallam County Department of Community Development
  - Clallam County Department of Health

  - Clallam County Public Utility District
  - Washington Department of Ecology
  - Washington Department of Natural Resources (WDNR)
  - Washington Department of Health
  - Washington Department of Fish and Wildlife (WDFW)
  - U.S. Forest Service
  - National Parks Service
- Other organizations
  - WRIA 19 Planning Unit
  - Clallam County Conservation District
  - Lower Elwha Klallam Tribe
  - Makah Tribe
  - Olympic Park Institute

WRIA 19 DESCRIPTION

The Hoko-Lyre Watershed includes all rivers and streams that drain into the Strait of Juan De Fuca along the western part of the north coast of the Olympic Peninsula. It extends from Neah Bay on the west to Freshwater Bay on the east. Hundreds of miles of streams flow through the watershed from the Olympic Mountains to the Strait of Juan de Fuca. The following are the largest of these streams:

- The Sekiu River
- The Hoko River
- The Clallam River
- The Pysht River
- Deep Creek
- The East and West Twin Rivers
- The Lyre River
- Salt Creek.

Lake Crescent lies within the WRIA 19 boundaries and is entirely surrounded by National Park lands.

WRIA 19 was first inhabited in Native American tribal villages along coastal areas. By the mid-1800s, European settlers began establishing communities in what is now Clallam County, with fur trading, canning, timber and wood products, and farming as the economic base. Commercial forestry remains the dominant land use in WRIA 19 today.

Changes in forest and riparian structure have led to concerns about water quality, habitat, and wildlife populations. Monitoring activities conducted by federal, tribal, state, and local agencies, research groups, and volunteer organizations in WRIA 19 have identified several problems associated with these characteristics. To date, the monitoring efforts of these groups have not been coordinated, nor have the results of monitoring been widely distributed. Although members of the local community have had

opportunities to respond to regulatory actions via public meetings, they generally have not had an opportunity to participate in prioritizing and formulating ongoing monitoring studies in the watershed.

GOALS AND OBJECTIVES

Representatives of local and state agencies, non-profit organizations, and local communities gathered at a workshop on January 6, 2005 to discuss monitoring achievements and goals for WRIA 19. The group reviewed current and historical monitoring activities and discussed goals, objectives, and strategies for future actions and data management. A follow-up workshop was held on March 30, 2005 to review a draft of the Comprehensive Monitoring Plan and to discuss recommendations. Minutes for these meetings are included in Attachment 1. Through the series of workshops, the WRIA 19 Planning Unit members developed the following vision statement for the monitoring plan:

> *To create a monitoring plan that defines a synergistic program for water quality and quantity, habitat, and biological monitoring that provides meaningful data for analyses, evaluation and management decisions. Monitoring performed under this plan will use comparable protocols to provide consistent, quality data. Programmatic evaluation will ensure that objectives and goals of this Monitoring Plan are being met and will include an adaptive management component.*

This vision will be realized through the systematic achievement of the following goals and objectives:

- **Goal:** Establish mechanism for data sharing and agency/organization collaboration.
  - **Objective:** The intent of this goal is to provide consistent, quality data to all agencies or interested parties for the purpose of education, planning, setting policy, collaborating efforts, enforcing regulations, and prioritizing restoration actions.
  - **Method:** This goal can be achieved by establishing a multi-stakeholder workgroup that distributes information via mailings, a website, and/or regular meetings.
- **Goal:** Improve understanding of historical watershed conditions.
  - **Objective:** The intent of this goal is to characterize historical undisturbed forest conditions in WRIA 19 to guide restoration goals for habitat and wildlife.
  - **Method:** This goal can be achieved by analysis of historical maps, aerial photos, documents, and anecdotal information from local historians or long-term residents. Additionally, analysis of marine-derived nutrients in old growth riparian trees or stumps can be used to estimate historical fish abundance.
- **Goal:** Determine the status and trends of water quality, water quantity, habitat, fish, and wildlife populations in WRIA 19.
  - **Objective:** The intent of this goal is to identify good and poor quality conditions throughout WRIA 19. Current data is fragmented and in some areas outdated.
  - **Method:** This goal can be achieved by continuing current monitoring efforts and expanding existing agency monitoring programs; or by implementing a comprehensive monitoring program that will span the entire WRIA.
- **Goal:** Determine how changes in riparian and upland conditions affect water quality, water quantity, habitat, fish and wildlife populations in WRIA 19.

  - **Objective:** The intent of this goal is to understand the effects of actions on natural resources. This information can be used to guide future planning and restoration decisions.
  - **Method:** This goal can be achieved by promoting or implementing effectiveness monitoring on watershed-scale actions (such as urban development) as well as reach-scale actions (such as restoration projects).

- **Goal:** Engage citizens, students, and organizations in local watershed activities
  - **Objective:** The intent of this goal is to educate citizens, local organizations, and students through monitoring activities that promote responsible watershed stewardship.
  - **Method:** This goal can be achieved by promoting the Clallam County Streamkeepers spawner survey program and implementing other monitoring programs in local schools such as Adopt-A-Stream. Additional monitoring activities could include stream walks and restoration monitoring.

This monitoring plan presents protocol options for the inventory and assessment component of a long-term monitoring program as an aid to the preservation and enhancement of watershed health.

CHAPTER 2.
CURRENT MONITORING ACTIVITIES

This chapter provides a brief description of monitoring efforts by numerous organizations in WRIA 19 that have been completed, are in progress, or are in planning. Current monitoring data has potential value for long-term trend analyses. Table 2-1 lists the current monitoring activities in each subbasin of the watershed. Results of these efforts are discussed in Chapter 3.

TABLE 2-1.
CURRENT MONITORING ACTIVITIES IN WRIA 19 (AS OF MARCH 2005).

Monitoring Entity	Project Title	Location	Parameter	Frequency/Date	Contact Person
Salt Creek Subbasin					
Clallam County Streamkeepers	BIBI survey	Salt Cr. mouth Salt Cr. @ Camp Hayden Park Rd. Salt Cr. ~150' downstream of WDFW#19-0010 Salt Cr. @end of Salt Creek Rd. downstream of WDFW#19-0014 Salt Cr. @585 Wasankari Rd.	Temperature, dissolved oxygen, conductivity, invertebrates	Yearly	Ed Chadd and Hannah Merrill: 360-417-2281
WRIA 19 Planning Unit	WRIA 19 Instream flow Study	Off Camp Hayden Park Rd just after creek diverges from Camp Hayden Road.	Instream flow	2004	Cynthia Carlstad: 206-443-3259
Ecology (proposed)	—	Near Camp Hayden Loop Road	Stream flow	Continuous, 15-minute intervals	John Summers: 360-407-6691
Ecology (Environmental Assessment Program (EAP))	—	Near Camp Hayden Loop Road	Turbidity	Continuous, 15-minute intervals	Bob Duffy
Ecology, Surfrider Foundation	BEACH	Salt Creek nearshore	Fecal coliform bacteria, enterococci		Lynn Schneider Ecology: 360-407-6543 Ian Miller Surfriders
WDFW	Salmonid Stock Inventory	Salt Creek	Coho—Redd count, total escapement, total smolts Salt Cr. independent winter steelhead—total escapement	Yearly	—
Lower Elwha Klallam Tribe	—	East Twin River	Smolt migration..... Coho spawning.....	Spring 4-6 times per site per season	Doug Morrill: 360-457-4012

TABLE 2-1 (continued).
CURRENT MONITORING ACTIVITIES IN WRIA 19 (AS OF MARCH 2005).

Monitoring Entity	Project Title	Location	Parameter	Frequency/Date	Contact Person
Lyre River Subbasin					
WRIA 19 Planning Unit	WRIA 19 Instream flow Study	WDNR campground on the east side of the river	Instream flow, using instream flow incremental methodology (IFIM)	2004	Cynthia Carlstad: 206-443-3259
WRIA 19 Planning Unit	WRIA 19 BIBI Study	(Upper) WDNR land, off gravel road below bridge (Lower) WDNR campsite, just downstream from IFIM site	Benthic index of biological integrity	Oct 2004	Cynthia Carlstad: 206-443-3259
Olympic National Park	Cutthroat Spawning Survey	Lyre River from outlet at Lake Crescent to confluence with Boundary Creek Boundary Creek to RM 2.0	Spawning survey	Every 7-10 days December – May	Phil Kennedy (360) 565-3077
Olympic National Park	Lyre River	Outlet at Lake Crescent, at bridge	Flow, water temperature, air temperature	Continuous	Bill Baccus (360) 565-3061
Ecology Environmental Assessment Program (EAP)	—	Boundary Creek	Macroinvertebrates and physical parameters	On hold—possible monitoring in 2005	Chad Wiseman: 360-407-6682
Ecology (proposed)	—	Near WDNR campground	Stream flow	Continuous, 15-minute intervals	John Summers: 360-407-6691
Lake Crescent Subbasin					
Olympic National Park	Lake Crescent Climate data	Weather station near Lake Crescent Lodge	Lake levels, precipitation, air temperature, lake temperature, barometric pressure, humidity, hourly visual images		Bill Baccus (360) 565-3061
Olympic National Park	Long-Term Ecological Monitoring Program	Several locations and depths throughout the lake	Basic water chemistry and clarity, zooplankton, chlorophyll and nutrients	monthly	Steve Fradkin (360) 928-9612
Olympic National Park	—	Several locations in Lake Crescent	Algal mats		Steve Fradkin (360) 928-9612

TABLE 2-1 (continued).
CURRENT MONITORING ACTIVITIES IN WRIA 19 (AS OF MARCH 2005).

Monitoring Entity	Project Title	Location	Parameter	Frequency/Date	Contact Person
Lake Crescent Subbasin (continued)					
Olympic National Park	Beardsley Trout Spawning Survey	Lake Crescent outlet	Spawning survey	Every 7-10 days Dec – May	Phil Kennedy (360) 565-3077
Olympic National Park	Lake Spawning Cutthroat Trout Spawning Survey	Lake Crescent outlet	Spawning survey	Every 7-10 days Dec – May	Phil Kennedy (360) 565-3077
Olympic National Park	Cutthroat Trout Spawning Survey	Barnes Creek, Piedmont Creek	Spawning survey	Every 7-10 days Dec – May	Phil Kennedy (360) 565-3077
Olympic Park Institute	—	Barnes Creek	Temperature, dissolved oxygen, pH, turbidity, nitrate, flow, habitat (large woody debris (LWD), cross sections, substrate)	Quarterly	Derek Staab: 360-928 3720
East Twin River Subbasin					
Ecology	Intensively Monitored Watershed	On Hwy 112 past East Twin River to Bear Creek Road/E. Twin Rd and turn left up dirt road for 0.4 miles. Turn left on Pangaea Trail Rd.	Water quantity, water quality, fish habitat, fish population Stream flow	Variable, beginning in 2004 15 min intervals, start 6/04	Bill Ehinger: 360-407-6416 John Summers: 360-407 6691
Ecology (proposed)	—	East Twin River	Turbidity	Continuous, 15-minute intervals	John Summers: 360-407-6022
WRIA 19 Planning Unit	WRIA 19 Instream flow Study	Upstream from the 112 bridge approximately 1500 feet	Instream flow	2004	Cynthia Carlstad: 206-443-3259
WRIA 19 Planning Unit	WRIA 19 BIBI Study	(Lower) J. Paul property, downstream from 2003 log placements (Upper) J. Paul property, above restoration work by the Lower Elwha Tribe	Benthic index of biological integrity	Oct 2004	Cynthia Carlstad: 206-443-3259

TABLE 2-1 (continued).
CURRENT MONITORING ACTIVITIES IN WRIA 19 (AS OF MARCH 2005).

Monitoring Entity	Project Title	Location	Parameter	Frequency/ Date	Contact Person
East Twin River Subbasin (continued)					
Streamkeepers	—	E Twin River Beach J. Paul property—River Mile 1.5	Temperature, dissolved oxygen, conductivity, salinity, including salinity stratification	8/03, 6/04, 7/04, 10/04	Josey Paul
WDFW	Salmonid Stock Inventory	—	Pysht/Twin/Deep coho—redd count, total escapement, smolts	Yearly	—
Lower Elwha Klallam Tribe	—	East Twin River	Smolt migration ..... Coho spawning	Spring 4-6 per site per season	Doug Morrill: 360-457 4012
Lower Elwha Klallam Tribe	Long term habitat monitoring	Mouth to 4,800 meters	Channel cross sections, substrate classifications (pebble counts)		Mike McHenry: 360-457 4012
West Twin River Subbasin					
Ecology	Intensively Monitored Watershed (IMW)	0.2 miles past W. Twin River on Hwy 112 ; turn left on dirt road. Sampling site is 0.3 miles up dirt road.	Water quantity, water quality	Variable, beginning in 2004	Bill Ehinger 360-407-6416
Ecology	IMW	Basin wide	Fish habitat, juvenile population	Variable, beginning in 2004	Bill Ehinger 360-407-6416
WRIA 19 Planning Unit	WRIA 19 Instream flow Study	Located off Hwy 112 on a small dirt road west of West Twin Creek.	Instream flow	2004	Cynthia Carlstad: 206-443-3259
WRIA 19 Planning Unit	WRIA 19 BIBI Study	(Lower) 200 yards downstream from the IFIM site (Upper) About 0.7 miles north on the 30 Rd (West Twin Road) from Pangea Trail Rd.	Benthic index of biological integrity	Oct ‘04	Cynthia Carlstad: 206-443-3259
Ecology EAP	—	West Twin River	Instream flow	15-minute intervals, begin June ‘04	John Summers: 360-407-6691

TABLE 2-1 (continued).
CURRENT MONITORING ACTIVITIES IN WRIA 19 (AS OF MARCH 2005).

Monitoring Entity	Project Title	Location	Parameter	Frequency/Date	Contact Person
West Twin River Subbasin (continued)					
Ecology (proposed)	—	West Twin River	Turbidity	Continuous, 15-minute intervals	John Summers: 360-407-6022
WDFW	Salmonid Stock Inventory	West Twin River	Fall chum—total escapement Pysht/Twin/Deep coho- redd count, total escapement, smolts	Yearly	—
Lower Elwha Klallam Tribe	—	West Twin River	Smolt migration..... Coho spawning.....	Spring 4-6 times per site per season	Doug Morrill: 360-457 4012
Deep Creek Subbasin					
Ecology	—	At bridge over Deep Creek	Water quantity, water quality, fish habitat, fish population	Variable, beginning in 2004	Bill Ehinger: 360-407-6416
WRIA 19 Planning Unit	WRIA 19 Instream flow Study	Approximately 0.5 miles upstream of Hwy 112.	Instream flow	2004	Cynthia Carlstad: 206-443-3259
WRIA 19 Planning Unit	WRIA 19 BIBI Study	(Lower) Gibson Ranch in reach with LWD placements (Upper) Upstream of first bridge on Gibson Ranch Road. Just downstream from second bridge	Benthic index of biological integrity	Oct '04	Cynthia Carlstad: 206-443-3259
Ecology EAP	—	Deep Creek	Stream flow	15-minute intervals, begin June '04	John Summers: 360-407-6022
Ecology (proposed)	—	Deep Creek	Turbidity	Continuous, 15-minute intervals	John Summers: 360-407-6022
WDFW	Salmonid Stock Inventory	—	Pysht/Twin/Deep coho- redd count, total escapement, smolts	Yearly	—
Lower Elwha Klallam Tribe	Deep Creek Restoration effectiveness monitoring	Deep Creek mouth to 6,900 meters	LWD loading, structure stability, pool development, gravel storage	—	Mike McHenry: 360-457-4012

TABLE 2-1 (continued).
CURRENT MONITORING ACTIVITIES IN WRIA 19 (AS OF MARCH 2005).

Monitoring Entity	Project Title	Location	Parameter	Frequency/Date	Contact Person
Deep Creek Subbasin (continued)					
Lower Elwha Klallam Tribe	—	Deep Creek	Smolt migration Coho spawning	Spring 4-6 per site per season	Doug Morrill: 360-457 4012
Lower Elwha Klallam Tribe	Long term habitat monitoring	Deep Creek mouth to 6,900 meters	Channel cross sections, substrate classifications (pebble counts)	—	Mike McHenry: 360-457-4012
Pysht River Subbasin					
WRIA 19 Planning Unit	WRIA 19 Instream flow Study	Site located directly across the street from the Burdick's property (25293 Hwy 112) Site is just downstream of the Pysht River Restoration site.	Instream flow	2004	Cynthia Carlstad: 206-443-3259
WRIA 19 Planning Unit	WRIA 19 BIBI Study	(Upper) Bowlby Property, upstream of bank failures (Lower 1) Hammerquist/Porter Property (Lower 2) Lower IFIM site off Hwy 112	Benthic index of biological integrity	Oct '04	Cynthia Carlstad: 206-443-3259
Ecology (proposed)	—	Hwy 112 crossing	Stream flow	Continuous, 15-minute intervals	John Summers: 360-407-6691
Ecology (proposed through EAP)	—	Hwy 112 crossing	Turbidity	Continuous, 15-minute intervals	Bob Duffy
WDFW	Salmonid Stock Inventory	Pysht River	Fall chum total escapement Pysht independent winter steelhead total escapement Pysht/Twin/Deep coho redd count, total escapement, smolts	Yearly	—
Lower Elwha Klallam Tribe	—	Pysht River, Jim and Joe Creeks	Coho spawning	4-6 per site per season	Doug Morrill: 360-457 4012

TABLE 2-1 (continued).
CURRENT MONITORING ACTIVITIES IN WRIA 19 (AS OF MARCH 2005).

Monitoring Entity	Project Title	Location	Parameter	Frequency/ Date	Contact Person
Clallam River Subbasin					
WRIA 19 Planning Unit	WRIA 19 Instream flow Study	Approximately 1500 feet upstream of the 112 bridge Approximately 500 feet downstream of milepost 20 on Hwy 112	Instream flow	2004	Cynthia Carlstad: 206-443-3259
WRIA 19 Planning Unit	WRIA 19 BIBI Study	(Upper) WDNR Land upstream from Cain's Marine on 112 (Lower) Sadilek property	Benthic index of biological integrity	Oct '04	Cynthia Carlstad: 206-443-3259
Streamkeepers	—	West end of lagoon Between Bridge and W end Mouth of breached river (natural opening) Old pilings east of bridge East end of lagoon River at Weel Rd bridge Clallam Beach	Temperature, dissolved oxygen, conductivity, salinity, including salinity stratification.	8/03, 6/04, 7/04, 10/04	Josey Paul
Clallam County	—	Clallam River	Fish survival, prioritization of stream restoration projects	—	Carol Creasy: 360-417-2420
Ecology (proposed through EAP)	(proposed)	Clallam River	Turbidity	Continuous, 15-minute intervals	Bob Duffy
Ecology (proposed)	—	Near Hwy 112	Stream flow	Continuous, 15-minute intervals	John Summers: 360-407-6691
WDFW	Salmonid Stock Inventory	Clallam River	Clallam Coho—Redd count, total escapement Clallam W Steelhead—redds	Yearly	
Lower Elwha Klallam Tribe	—	Clallam River	Coho spawning	4-6 per site per season	Doug Morrill: 360-457 4012

TABLE 2-1 (continued).
CURRENT MONITORING ACTIVITIES IN WRIA 19 (AS OF MARCH 2005).

Monitoring Entity	Project Title	Location	Parameter	Frequency/ Date	Contact Person
Hoko River Subbasin					
WRIA 19 Planning Unit	WRIA 19 Instream flow Study	Site is located ¼ mile above milepost 3 on the Hoko/Ozette Road ~ 500 feet above the restoration site.	Instream flow	2004	Cynthia Carlstad: 206-443-3259
WRIA 19 Planning Unit	WRIA 19 BIBI Study	(Lower) State Park (Upper 2) Just upstream from confluence with Ellis Creek (Upper) At Makah Hatchery, just down from Browns Creek	Benthic index of biological integrity	Oct '04	Cynthia Carlstad: 206-443-3259
USGS, Makah Tribe	—	River Mile 5.3	Stream flow, plus rating curve	Continuous, real time	
Clallam County PUD	—	Groundwater in shallow wells adjacent to main stem, surface water from Olsen Creek	Turbidity, nitrate, temperature, fecal coliform, pH	—	Mike Kitz: 360-565-3216
Makah Tribe	—	Little Hoko and Johnson Cr	Salmon population estimates—smolt traps	Daily to weekly	Caroline Peterschmidt 360-645-3175
Makah Tribe	—	Hoko River, many reaches	Salmon population estimates—spawner survey, redd counts	Monthly during fall	Caroline Peterschmidt 360-645-3175
Makah Tribe	—	Hoko River, many reaches	Width, gradient, pool depth, barriers, LWD	Every 1 to 3 years	Jeff Shellberg: 360-645 3155
Makah Tribe	—	Hoko River, many locations	Temperature	Continuous June-Oct	Jeff Shellberg: 360-645 3155
WDNR, National Weather Service	—	Ellis Mountain	Climate Station: Temperature, precipitation, Relative humidity Wind speed	Continuous during summer fire season	

TABLE 2-1 (continued).
CURRENT MONITORING ACTIVITIES IN WRIA 19 (AS OF MARCH 2005).

Monitoring Entity	Project Title	Location	Parameter	Frequency/ Date	Contact Person
Hoko River Subbasin (continued)					
WDFW	Salmonid Stock Inventory	Hoko River	Fall chinook—spawning escapement, broodstock removal, total escapement W steelhead—total escapement Hoko coho—redds, total escapement, smolts	Yearly	
Lower Elwha Klallam Tribe	—	Hoko River	Coho spawning	4-6 per site per season	Doug Morrill: 360-457 4012
Lower Elwha Klallam Tribe	Long term habitat monitoring	Hoko River mouth to River Mile 3.5	Channel cross sections, substrate classifications (pebble counts)		Mike McHenry: 360-457-4012
Sekiu River Subbasin					
WRIA 19 Planning Unit	WRIA 19 Instream flow Study	Approximately 0.8 miles upstream from confluence with Carpenter Creek	Instream flow	2004	Cynthia Carlstad: 206-443-3259
WRIA 19 Planning Unit	WRIA 19 BIBI Study	(Upper) WDNR Land, 1/2 mile upstream of the high bridge/4000 road (Lower) IFIM site, 0.8 miles up from Carpenter Creek, upstream from transects	Benthic index of biological integrity	Oct '04	Cynthia Carlstad: 206-443-3259
Clallam County Streamkeepers	—	North Fork Sekiu mouth	—	—	Ed Chadd and Hannah Merrill: 360-417-2281
Makah Tribe	—	Sekiu River, many reaches	Salmon population estimates—spawner survey, redd counts	Monthly during fall	Caroline Peterschmidt 360-645-3175
Makah Tribe	—	Sekiu River, many reaches	Width, gradient, pool depth, barriers, LWD	Every 1 to 3 years	Jeff Shellberg: 360-645 3155

TABLE 2-1 (continued).
CURRENT MONITORING ACTIVITIES IN WRIA 19 (AS OF MARCH 2005).

Monitoring Entity	Project Title	Location	Parameter	Frequency/ Date	Contact Person
Sekiu River Subbasin					
Makah Tribe	—	Sekiu River, many locations	Temperature	Continuous June-Oct	Jeff Shellberg: 360-645 3155
WDFW	Salmonid Stock Inventory		Sekiu/Sail coho redds, total escapement	Yearly	
Ecology (proposed through EAP)	(proposed)	Sekiu River	Turbidity	Continuous, 15-minute intervals	Bob Duffy
Ecology (proposed)	—	Above tidal influence, downstream of Cascade Timberlands	Stream flow	Continuous, 15-minute intervals	John Summers: 360-407-6691

Note: List of monitoring activities is based on information offered by attendees of 1/06/05 workshop and personal communications. This table should be periodically updated to include any new activities.

WRIA 19 PLANNING UNIT

Instream Flow

Instream flow is the amount of flow that must remain in a stream to support a range of activities by various species of fish. Prior to the WRIA 19 watershed planning effort, limited information had been collected on the required instream flows for streams in the watershed.

As part of the WRIA 19 watershed planning effort, new instream flow studies are being conducted, using a modified "instream flow incremental methodology" (IFIM) (See Appendix E), for Salt Creek, the East Twin River, the West Twin River, Deep Creek, the Pysht River, the Clallam River, the Hoko River and the Sekiu River. The new studies will determine an appropriate point for measuring flows on each stream and will recommend flows to optimize fish potential for each. At the request of the WRIA 19 Planning Unit, Ecology has initiated efforts to install eight stream-flow gages in WRIA 19 (one already exists on the Hoko River). To date, three have been installed in conjunction with the Intensively Monitored Watershed (IMW) study, and the remaining five are to be installed in 2005. The new gages will be instrumental in long-term understanding of instream flow needs in WRIA 19.

A 1985 study of the Lyre River used the instream flow incremental methodology (IFIM) to assess instream flows. The Makah Tribe conducted instream flow studies using IFIM on the Hoko and Sekiu Rivers in 1985. These data are being reevaluated under the WRIA 19 Instream flow study.

Ecology and WDFW measured toe width to derive preliminary instream flow recommendations for chinook, coho, and chum salmon and steelhead trout spawning and rearing. In this approach, the "toe-width" of a stream is measured and put into an equation that yields a prediction of salmon and steelhead spawning and rearing flows. The "toe" of a stream refers to the point in the stream where the side of the stream meets the bottom. These measurements were taken for the following stream systems in WRIA 19:

- Bullman Creek
- Olsen Creek
- Jim Creek
- Joe Creek
- Deep Creek
- Murdock Creek
- Whiskey Creek
- Salt Creek
- Hoko River
- Little Hoko River
- Clallam River
- West Twin River

Benthic Index of Biological Integrity

The benthic index of biological integrity is a stream-health grading system based on aquatic insects found at monitoring sites, developed and calibrated at the University of Washington. The Planning Unit conducted a BIBI survey of major streams and rivers in WRIA 19 in October 2004. The goal for this survey was to generate information about the biological health of streams and rivers in WRIA 19. Objectives include the following:

- Developing an initial data set regarding the biological health at a location near the mouth of each sampled river or stream.
- Developing an initial data set regarding the biological health at an upstream site on each river or stream that is upstream of major human impacts. This site will be the reference site for each stream or river.
- Developing a set of biological data that can be compared across the WRIA to assess differences across the watershed.

Sampling locations were selected by BIBI sampling protocols, considering road access, landowner permission, and location within the subbasins. The survey included samples from eight of the major rivers in WRIA 19 (Salt Creek is regularly sampled by Clallam County Streamkeepers, and was therefore not sampled for this event). Each river was sampled at least in two locations: a site located as far downstream as possible, and a site as far above major human impacts as possible. A total of 19 sites were sampled.

WASHINGTON STATE DEPARTMENT OF ECOLOGY

Intensively Monitored Watersheds Study

The IMW project is designed to study the complex relationships controlling salmon response to habitat conditions by concentrating monitoring and research efforts at a few locations. The IMW study area includes the Strait of Juan de Fuca complex, specifically the East Twin River, West Twin River, and Deep Creek. The primary treatment for this watershed complex will be the addition of wood to a large portion of the channels accessible to anadromous fishes in Deep Creek and East Twin River. In addition, off-channel habitats will be developed at several locations. No treatments will be applied in West Twin River during the period of evaluation. Relatively little timber harvest or road construction will occur in these watersheds over the next decade. Therefore, interpreting the response of the fish to the restoration treatments at the watershed scale will not be complicated by other activities that might affect habitat condition (Bilby et al. 2004). The parameters to be measured are as follows:

- Water quality:
  - Temperature
  - Dissolved Oxygen
  - Total phosphorus
  - Soluble reactive

- pH
- Conductivity
- Total nitrogen, nitrate+nitrite nitrogen
- Ammonia-N
- Phosphorus
- Total suspended solids
- Dissolved organic carbon

- Water quantity:
  - Continuous stage and discharge
- Habitat:
  - Canopy cover
  - Woody debris tally, size and distribution
  - Substrate embeddedness
  - Channel slope, sinuosity, bearing
  - Water flow profile
  - Thalweg profile
  - Bar width
  - Pool-forming process
  - Backwater tally
  - Fish cover proportions
  - Human influence proportions
  - Wetted width
  - Channel confinement
  - Bank-full width
  - Width-depth ratio
  - Pool depth
  - Residual pool depths
  - Channel type
  - Substrate size, distribution and embeddedness
  - Bank angle, cover, stability
  - Riparian cover
  - Shading
  - Incised height
  - Channel confinement
- Climate:
  - Air temperature
  - Wind speed and direction
  - Relative humidity
  - Precipitation
- Fish:
  - Spawning (fish and redd counts
  - Parr
  - Smolts

Environmental Assessment Program, Boundary Creek Debris Torrent Study

In November 1990, a high rainfall event triggered a debris flow in the Boundary Creek area of the Lyre River subbasin. The debris flow traveled 2 miles, burying a road crossing and damming water flow in the upper main stem of Deep Creek. This dam broke hours later, releasing a flood wave that scoured the main stem to as much as 10 vertical feet from River Mile (RM) 12 to RM 2. It also removed logs from the channel and deposited a debris lobe downstream of the confluence with the East Fork. The changing flow from the deposit triggered an earth flow that then released about 3,000 cubic yards of fine sediments into the Lyre River (Shaw 1995; Smith 1999). This event caused significant loss of aquatic habitat complexity. Ecology's Environmental Assessment Program (EAP) is conducting a study of the macro invertebrate community structure in addition to several physical parameters to determine the long-term effects of the catastrophic event.

Beach Environmental Assessment, Communication and Health (BEACH) Program

The Washington Departments of Ecology and Health, together with county environmental health departments and volunteers, collaborated to form the Beach Environmental Assessment, Communication and Health Program (BEACH). Created in response to the federal Beach Act of 2000 to protect the users of marine waters, the program monitors water quality for bacteria that indicate the possibility of pollution from sewage treatment plant problems, boating waste, malfunctioning septic systems, and animal waste.

The BEACH program monitors surface and saltwater at selected public swimming beaches to ensure that water quality is adequate for swimming. Fresh water beaches are monitored biweekly during the summer for E. coli bacteria, pH, temperature, and conductivity. Saltwater beaches are monitored weekly during the summer for enterococci bacteria. The Salt Creek Recreational Area County Park is the sole monitoring station in WRIA 19 for this program. This program is in conjunction with the Surfriders Foundation. More information is available at:

http://www.ecy.wa.gov/programs/eap/beach/#BEACH_Program

Environmental Assessment Program, River and Stream Flow Monitoring

The Stream Hydrology Unit (SHU) of Ecology's Environmental Monitoring and Trends Section provides flow information in support of Ecology activities. SHU provides instantaneous stream flow for various in-stream actions. Three streams in WRIA 19 are currently monitored in this program: Deep Creek, East Twin River, and West Twin River. An additional five stream flow gages are scheduled to be installed in 2005 on Salt Creek, Lyre River, Pysht River, Clallam River, and Sekiu River. Table XX in Appendix X lists historical sites and dates of stream flow monitoring (To be added upon completion of Watershed Plan). More information is available at:

http://www.ecy.wa.gov/programs/eap/flow/shu_main.html

U.S. GEOLOGICAL SURVEY

To effectively assess the nation's surface-water resources, the U.S. Geological Survey (USGS) operates more than 7,000 stream-flow gauging stations, monitors lakes and reservoirs, makes periodic flow measurements on rivers and streams using standardized methods, and maintains the data from these stations in a national database. The data are published in annual data reports and are available on the internet. Much of the data also is available on a near real-time basis on the internet to cooperators, customers and the public. The USGS operates the longest-running flow gage in WRIA 19, on the Hoko River at RM 5.3. This gage has been in continuous operation since October 1995 and was operated seasonally from July 1962 to September 1974 and from June 1983 to September 1995. This gage is funded through a 50-percent cost share between the Makah Tribe and the USGS. More information is available at:

http://waterdata.usgs.gov/wa/nwis/uv?station=12043300.

WASHINGTON DEPARTMENT OF FISH AND WILDLIFE

Salmon Stock Inventory

The Salmon Stock Inventory (SaSI), formerly called the Salmon and Steelhead Stock Inventory (SASSI), was developed in 1992 through a collaborative effort by the WDFW and 20 Western Washington tribes. The inventory serves as a standardized, uniform approach to identifying and monitoring the status of salmonid stocks in Washington. Through the compilation of monitoring data and subsequent designation

of stock status, the inventory enables the prioritization of recovery efforts and the monitoring of future recovery actions. The WDFW produces regularly updated SaSI stock reports detailing stock status, definition, origin, and production type, along with the quantitative data on which the status ratings were based. The most recent inventory, completed in 2002, includes one chinook salmon run, four chum salmon runs, seven coho salmon runs, and seven steelhead runs in WRIA 19. Stock reports and associated maps for these salmonid stocks are available at:

http://wdfw.wa.gov/fish/sasi/intro.htm.

Salmon and Steelhead Habitat Inventory and Assessment Project

The Salmon and Steelhead Habitat Inventory and Assessment Project (SSHIAP) began in 1995 as a complement to SaSI. SSHIAP supports a spatial data system that characterizes salmonid habitat conditions and distribution of salmonid stocks in Washington at a scale of 1:24,000. The foundation of the SSHIAP data system is a cleaned and routed hydrography layer that provides a consistent spatial data foundation for integrating a wide variety of habitat information and for subsequent analyses. The SSHIAP data system quantitatively characterizes habitat conditions, incorporates a wide variety of information sources, and links habitat conditions and stock distribution with productivity modeling efforts. Washington Treaty Indian Tribes and WDFW are the co-managers of the SSHIAP program. The program currently covers WRIA 19. SSHIAP data may be viewed on SalmonScape, an interactive map-based web application (http://wdfw.wa.gov/mapping/salmonscape/). Data layers on SalmonScape include hydrography, fish distribution, the SaSI, barriers to fish passage, habitat characteristics such as stream gradient, and Ecosystem Diagnosis and Treatment model output. Data can be displayed over shaded relief maps or orthographic photos.

CLALLAM COUNTY

Streamkeepers

BIBI Monitoring

Streamkeepers has used the BIBI stream-health grading system on selected Clallam County streams since 1998. To provide a richer and more descriptive biological context for the various BIBI grading levels, Streamkeepers has refined and revised the system of grades originally used by the University of Washington and SalmonWeb. These organizations used a report-card-style system of five grades, which were intuitive and undefined. Since that time, further research has indicated correlations between BIBI scores and other signs of ecosystem health, to the point where more meaningful descriptions can be made of score clusters. Dr. James Karr, professor of aquatic sciences at the University of Washington and the developer of the BIBI grading system for the Puget Sound lowlands, has approved of this revision. Streamkeepers is currently monitoring several sites in WRIA 19, including Salt Creek, East Twin River, and Clallam River.

Stream flow

Streamkeepers collected stream flow data on the nine major rivers in WRIA 19 during the summers of 2002 and 2003. These measurements were not continuous stream flow, but rather spot measurements. Data were collected at the following locations:

- Salt Creek Subbasin:
  - Coville Creek mouth (E. of Salt Creek)
  - Field Creek mouth (between Lyre and Whiskey)
  - Salt Creek @Camp Hayden Park Rd.
  - Salt Creek ~150 feet downstream of WDFW#19-0010
  - Salt Creek @ end of Salt Creek Rd., downstream of WDFW#19-0014
  - Salt Creek @585 Wasankari Rd.
  - Salt Creek mouth
  - Whiskey Creek mouth.
- Lyre River Subbasin:
  - Lyre River mouth
  - Lyre River at the Olympic National Park boundary
  - Susie Creek just above Lyre River
- Twin Rivers Subbasin:
  - E. Twin River mouth
  - E. Twin River @ 681 Pangea Tr.
  - Murdock Creek mouth (W. of Lyre R.)
  - W. Twin River mouth
- Deep Creek Subbasin:
  - Deep Creek mouth
- Pysht River Subbasin:
  - Jim Creek mouth (W. of Joe Creek)
  - Joe Creek mouth (W. of Deep Creek)
  - Middle Fork mouth
  - Green Creek jab Pysht River
  - Pysht River mouth
  - S. Fork Pysht River mouth
- Clallam River Subbasin:
  - Clallam River mouth
- Hoko River Subbasin:
  - Hoko River mouth
  - Little Hoko River mouth
- Sekiu River Subbasin:
  - Bullman Creek mouth
  - Olsen Creek mouth (W. of Sekiu River)
  - Sail River mouth
  - N. Fork Sekiu River mouth
  - S. Fork Sekiu River mouth
  - Sekiu River mouth
  - Snow Creek mouth
  - Village Creek mouth
  - Agency Creek mouth
  - Beach Creek mouth

Clallam County Public Utility District #1

To ensure that tap water is safe to drink, the U.S. Environmental Protection Agency (EPA) regulates the amount of contaminants in water provided by public water systems. Within Clallam County Public Utility District #1, two water districts serve the vicinity of WRIA; Island View and Clallam Bay/Sekiu,. Table 2-2 lists the contaminants that these districts monitor. Group A water systems are required to test

their water at least monthly for coliform bacteria, and at least annually for nitrates. Group B water systems must test their water at least once each year for coliform bacteria, and at least every three years for nitrates. Additional testing is required if there has been a contamination or other problem with a water system.

TABLE 2-2.
GROUNDWATER MONITORING BY WATER DISTRICT IN WRIA 19

District	Contaminant
Island View/LUD#9	Turbidity, lead, copper, chlorine, coliform bacterial, hardness, fluoride, arsenic
Clallam Bay/Sekiu	Nitrate, lead, copper, beta/photon emitters, alpha emitters, chlorine, coliform bacterial, hardness, fluoride, arsenic

Clallam County Department of Community Development

The Clallam River Habitat Assessment will be a systematic watershed-scale habitat assessment of the Clallam River, building upon existing information. This study will likely be initiated in the summer of 2005. Using its comprehensive assessment, the project will also develop a prioritized list of actions to alleviate limiting factors identified. The *WRIA 19 Limiting Factors Report* identified temperature, barriers, fine sediment, road density, riparian condition, barrier culverts, and lack of large woody debris (LWD) as factors limiting salmon production in the river. This project will lead to the most effective use of resources when implementing prioritized restoration actions within the watershed.

Clallam County Marine Resource Committee

The Clallam County Marine Resource Committee (MRC) was established by the Northwest Straits Commission as a result of the 1998 Northwest Straits Marine Conservation Initiative, which combines data-driven science with grassroots involvement by citizen groups in an effort to address the depletion of marine resources in the Strait of Juan de Fuca. Members of Clallam County's MRC are working to restore nearshore, intertidal and estuarine habitats, improve shellfish harvest areas, support salmon and bottomfish recovery and identify and urge establishment of marine protected areas. The MRC has conducted the following investigations:

- **Surf Smelt Spawning Habitat—**The purpose of this study was to document surf smelt spawning beaches along the Strait of Juan de Fuca. Sampling was conducted for three weeks in August 2000 and from the first week in April until the second week in September 2001. In 2000, a total of 15 beaches were sampled, totaling 20 miles. In 2001, 31 beaches from Sequim Bay to Neah Bay, totaling 41 miles, were sampled three times each for surf smelt spawn. The following beaches were sampled:
  - Salt Creek Subbasin: Freshwater Cove, Lyre-Whiskey, Butler Cove
  - Twins Subbasins: East and West Twin Rivers (2)
  - Deep Creek Subbasin: Deep Creek
  - Clallam River Subbasin: Eagle Point (2), Half-Mile beach, Clallam Bay (2)
  - Pysht River Subbasin East Pillar, Pillar Point, West Pillar, Jim Creek
  - Hoko River Subbasin Hoko Main Stem and East Hoko
  - Sekiu River Subbasin: Bullman Creek, Mitigation Beach, First, Second, and Third Beach,

- **Pacific Herring Spawning Habitat**—In 2002, potential herring spawning substrate was sampled to determine fish presence and use. Seven sites within the central and western Strait of Juan de Fuca were sampled once per month in January, February and March using WDFW herring spawn methodology (O'Toole 1995). Sites in WRIA 19 include Freshwater Bay, Crescent Bay, Whiskey Creek area, Pillar Point, Clallam Bay and the Sekiu river area. Vegetation surveys were also performed.
- **Juvenile Salmon and Forage Fish Preferential Use of Nearshore Kelp Habitats**—This study was conducted to quantify basic parameters of the use of kelp bed habitats by juvenile salmon and forage fish. Juvenile salmon and forage fish are known to be strongly associated with kelp beds along the Strait of Juan de Fuca, though the extent of use had not been quantified. Five sites along the Strait of Juan de Fuca were sampled from June through August 2001. Fish use was determined by snorkel survey and beach seining.

WASHINGTON DEPARTMENT OF NATURAL RESOURCES

The Washington Department of Natural Resources issues permits for timber harvest and associated activities and performs compliance inspections to ensure that the terms of the permit are met. Only a portion of forest practice permits is inspected for compliance, based on a prioritized list of site sensitivity. Visual observation of water quality and fish habitat are made during compliance inspections, though road best management practices are emphasized. In the Olympic Region, approximately 25 percent of permitted applications are inspected. The results of the regional inspections are not formally reported in a public document (J. Springer, personal communication).

OLYMPIC NATIONAL PARK

Olympic National Park (ONP) conducts extensive cutthroat trout spawning ground surveys in the Lyre River from the outlet of Lake Crescent downstream to Boundary Creek. Surveys are done every 7 to 10 days from December through May. ONP also performs cutthroat trout spawning surveys in Boundary Creek to about RM 2. ONP has also installed a continuous recording flow gage at the Lake Crescent outlet that monitors flow, water temperature and air temperature.

LOWER ELWHA KLALLAM TRIBE

The Lower Elwha Klallam Tribe tracks smolt migration every spring in Salt Creek, East Twin River, West Twin River, and Deep Creek. Coho spawning is monitored several times each season in Salt Creek, East Twin River, West Twin River, Deep Creek, Clallam River, Hoko River, Pysht River, Jim Creek, and Joe Creek. Long-term trend monitoring of channel morphology and substrate are monitored at East Twin River, Deep Creek, and the Hoko River every couple of years. Effectiveness monitoring of restoration efforts in Deep Creek includes structure stability, pool development, and gravel storage.

MAKAH TRIBE

The Makah Tribe monitors numerous parameters in its usual and accustomed hunting and fishing area, including the following

- Stream flow is measured in the Hoko River in partnership with the USGS.
- Spawner surveys and redd counts are performed on the Hoko and Sekiu Rivers each month during the fall.

- Smolt migration is measured weekly on the Little Hoko River and Johnson Creek (Hoko River).
- Physical habitat parameters such as width, gradient, pool depth, barriers, and LWD are measured on the Hoko River, the Sekiu River, and other streams every one to three years.
- Temperature is continuously measured on the Hoko and Sekiu Rivers and other streams from June to October.
- Turbidity (continuous) is proposed for monitoring on the Hoko River.
- The effectiveness of large woody debris (LWD) restoration efforts in Brownes Creek (Hoko River) and Sekiu River is monitored, including photo points, cross-sections, longitudinal surveys, pebble counts, LWD size and distribution, pool depth, etc.

CHAPTER 3.
MONITORING RESULTS

This chapter presents data summaries and results from current monitoring activities in WRIA 19.

WATER QUALITY

Surface Water

Elevated stream temperatures and turbidity, low dissolved oxygen, and degraded physical aquatic habitat are conditions of known impairment in WRIA 19. Where these parameters fail to meet state standards, they pose a threat to public and ecological health. Table 3-1 shows Ecology's water quality criteria for salmon spawning and rearing streams, all primary contact uses, and water supply uses.

TABLE 3-1.
SELECTED WATER QUALITY CRITERIA FOR CLASS AA SALMON SPAWNING AND REARING AQUATIC USE, ALL PRIMARY CONTACT USES, ALL WATER SUPPLY USES

Water Quality Parameter	Requirement
Fecal coliform	Shall not exceed a geometric mean value of 50 colonies/100 ml, and shall not have more than 10% of all samples obtained for calculating the geometric mean value exceeding 100 colonies/100 ml.
Dissolved Oxygen (DO)	Shall exceed 9.5 mg/L
Total Dissolved Gas	Shall not exceed 110 percent of saturation
Temperature	Shall not exceed 16.0°C due to human activities. When a water body's temperature is warmer than 16.0°C (or within 0.3°C (0.54°F) of the criteria) and that condition is due to natural conditions, then human actions considered cumulatively may not cause the 7-DADMax temperature of that water body to increase more than 0.3°C (0.54°F)
pH	6.5 to 8.5, with human-caused variation of less than 0.2 units
Turbidity	Shall not exceed 5 NTU (nephelometric turbidity units) over background when background is 50 NTU or less, or have more than a 10% increase in turbidity when the background turbidity is more than 50 NTU.
Toxic, Radioactive or Deleterious Materials	Specific criteria per Washington Administrative Code (WAC) 173-201A-(040-050)
Aesthetic Values	Shall not be impaired by the presence of materials or their effects, excluding those of natural origin, which offend the senses of sight, smell, touch, or taste.

Source: Chapter 173-201A WAC

Section 303(d) of the federal Clean Water Act requires states to develop a list of polluted water bodies every two years. Ecology revised the 303(d) listings for WRIA 19 in 2004. The updated list has six categories:

- Category 5: water quality standards have been violated
- Category 4A: waters with existing total maximum daily load (TMDL) limits
- Category 4B: waters with other pollution control plans
- Category 4C: waters that are impaired by a non-pollutant

- Category 2: waters of concern (there is no category 3)
- Category 1: waters that meet water quality standards

Sixteen locations in six water bodies are listed as Category 5 waters on the 2004 list. Temperature exceedances were identified at two locations on the Clallam River, four locations on Deep Creek, one on Green Creek (in the Pysht River Subbasin), two on the Little Hoko River, and three on the Sekiu River. Excessive fine sediments were identified at three locations in Deep Creek. Fecal coliform exceedances were identified at one location in the Strait of Juan de Fuca.

Four Category 4C listings were identified in WRIA 19: two on Salt Creek, one on the Lyre River, and one on Barnes Creek (in the Crescent Lake Subbasin). Twenty-five Category 2 listings were identified in WRIA 19; 20 for dissolved oxygen, two for temperature, and three for bioassessment. Forty-five Category 1 listings were identified in WRIA 19: 22 for fecal coliform, 13 for temperature, six for pH, three for dissolved oxygen, and one for total phosphorous.

303d listings for streams in WRIA 19 are discussed further in Appendix F of the Watershed Plan.

Groundwater Quality

Groundwater quality was evaluated as part of the technical assessment for the WRIA 19 Watershed Plan using existing studies and readily available water quality data, such as well logs and agency monitoring results. The most common parameters of concern in WRIA 19 are chloride and iron; sulfur odors have been identified in a few cases. Chloride is commonly used as an indicator of saltwater intrusion, and most studies addressing chloride concentrations focus on coastal areas. In addition, several wells attempted in shale have had unacceptably high chloride that might be attributable to connate water (water trapped in rock interstices at the time of its deposition). Iron comes from natural sources and can lead to aesthetic and maintenance problems at higher concentrations, though it does not represent a health risk. Although no elevated nitrate concentrations have been reported, elevated nitrate could occur locally due to either septic leachate or fertilizer applications. Overall, available data indicate that groundwater quality is generally good for the chemical constituents reviewed.

Nearshore Water Quality

Nearshore areas near Deep Creek, Butler Creek, the Pysht River, Pillar Point, Slip Point, Sekiu Point, Kydaka Point and an unnamed area between Pillar Point and Slip Point have all been categorized as "waters that meet tested standards," or Category 1 on the 2004 303(d) list for fecal coliform. However, there currently is no consistent water quality monitoring focused on defining nearshore water quality in WRIA 19.

Data Gaps and Parameters of Concern

Table 3-2 identifies parameters of concern and data gaps for each subbasin in WRIA 19, based on review of multiple technical documents, monitoring efforts, and local knowledge. Parameters of concern (P) were identified for water quality by comparing known conditions to Ecology's water quality criteria (see Table 3-1). Though a "P" is listed for certain parameters in each stream, it is not necessarily indicative of basin-wide conditions, as most data only represents a single sampling location. Therefore, data gaps for basin-wide conditions are implied and further investigation is warranted for parameters of concern that have been identified at single locations. Data gaps "G" represent areas where data is not currently available for the specific parameter. Priorities for future monitoring efforts were identified during the WRIA 19 Monitoring Workshop in March 2005.

TABLE 3-2.
WATER QUALITY DATA GAPS AND PARAMETERS OF CONCERN

Water Quality Parameter	Salt Creek	Lyre River	Lake Crescent	East Twin River	West Twin River	Deep Creek	Pysht River	Clallam River	Hoko River	Sekiu River	Priority
Surface Waters											
Temperature	*	P	G	*	P	P	P	P	P	P	High
Sediment/Turbidity	P	P	G	P	P	P	P	P	P	P	High
Chemicals and nutrients	G	G	G	G	G**	G	*	G	G	G	High
Dissolved Oxygen	P	P	G	P	P	P	P	P	P	P	High
pH	G	G	P	G	G**	G	G	G	G	G	Low
Conductivity	G	G	G	G	G**	G	G	G	G	G	Low
Groundwater											
Salinity	P	G	P	G	G	G	G	G	G	G	Low
Chloride	P	G	P	G	G	G	G	P	G	G	Low
Iron	G	P	G	G	G	G	G	P	G	G	Low
Sulfur	G	G	G	G	G	G	G	G	G	G	Low
Methane	G	G	G	G	G	G	G	G	G	P	Low
Turbidity	G	G	G	G	G	G	G	G	G	P	Low
Nearshore											
Fecal Coliform Bacteria	*	*	G	*	*	*	P	*	*	*	Moderate
Enterococci bacteria	*	*	G	*	*	*	*	*	*	*	Low

Codes:
P = Parameter of Concern; monitoring data shows conditions to be outside of Ecology's water quality criteria
G = Data Gap; no current data is available
* = Data indicates that conditions are within criteria
** = Currently monitored as part of the Intensively Monitored Watersheds project (Ecology), but data is not yet available.

In surface waters of the WRIA, temperature, turbidity, and dissolved oxygen have been identified as problems in most of the subbasins and are considered high priority for future monitoring activities. Data on chemical and nutrient inputs is largely absent, and is considered a high priority for future monitoring activities. Data on conductivity and pH is largely absent, and is considered a low priority for future activities.

Groundwater quality data is largely absent, and is considered low priority for future monitoring activities.

Nearshore water quality in WRIA 19 is mostly within Ecology criteria, except for the recently 303d listing for fecal coliform bacteria near Butler Creek in the Pysht Subbasin. Future monitoring is considered a moderate priority.

WATER QUANTITY

Numerous agencies have conducted stream flow measurements in WRIA 19 over the past 100 years. Stream flow locations and period of record for each agency are discussed in section XX of the Watershed Plan (To be added upon completion of Watershed Plan.

Ecology's Southwest Regional Office conducted the Surface Water Database project between 1986 and 1991 to measure flows at four locations in the Salt Creek Subbasin and one location each in the East Twin River, West Twin River, and Sekiu River subbasins. This program was initiated to help in the decision-making process for setting water rights and instream flows. Results may be used to better understand how stream flow has changed with increased residential development in the Salt Creek Subbasin, compared to the lack of development in the Twin Rivers Subbasin.

New instream flow studies are being conducted as part of the WRIA 19 watershed planning effort, using a modified IFIM approach, for Salt Creek, the East Twin River, the West Twin River, Deep Creek, the Pysht River, the Clallam River, the Hoko River and the Sekiu River. The new studies will determine an appropriate point for measuring flows on each stream and will recommend flows that would optimize fish potential.

Table 3-3 identifies parameters of concern and data gaps for each subbasin in WRIA 19, based on review of multiple technical documents, monitoring efforts, and local knowledge. Though instream flow recommendations are in development through the WA 2514 Watershed Planning process, there are currently no agency-sanctioned flow requirements for streams in WRIA 19 against which to compare existing conditions. However, it is recognized that exacerbated peak flows cause stream widening, which has been noted in some streams. Though it is not a quantitative assessment, "P" indicates where potential problems with peak flows may exist.

TABLE 3-3.
WATER QUANTITY DATA GAPS AND PARAMETERS OF CONCERN

Water Quantity Parameter	Salt Creek	Lyre River	Lake Crescent	East Twin River	West Twin River	Deep Creek	Pysht River	Clallam River	Hoko River	Sekiu River	Priority
Stream flow	G	G	NA	G**	G**	G**	G	G	*	G	High
Groundwater	*	*	NA	*	*	*	*	*	*	*	Low
Change in Peak, Base Flow	G	G	NA	G	P	G	G	G	G	G	High

Codes:
P = Parameter of Concern; observations indicate potential problems
G = Data gap; no current data is available
* = Data and observations indicate that conditions are not a concern
** = Currently monitored as part of the Intensively Monitored Watersheds project (Ecology), but data is not yet available.

Currently, flow data is being collected on the Hoko River by the Makah Tribe and the USGS in addition to Ecology's monitoring stations on the East Twin River, West Twin River, and Deep Creek through the Intensively Monitored Watersheds program. Data gaps ("G") represent areas where water quantity data is

not currently available. Priorities for future monitoring efforts were identified during the WRIA 19 Monitoring Workshop in March 2005.

Stream flow is not currently monitored in Salt Creek, Lyre River, Pysht River, Clallam River, or Sekiu River. Stream flow and identification of changes in base flow and peak flows is considered high priority for future monitoring activities.

HABITAT

Stream Habitat

Standards are difficult to quantify for physical stream habitat parameters, as they are highly specific to local conditions such as climate, geology, soils, and topography. Table 3-4 presents general standards for streams in Western Washington developed in 1996 by the fisheries section of the National Oceanic and Atmospheric Administration (NOAA Fisheries, known at that time as the National Marine Fisheries Service, or NMFS). These standards are beneficial because they are agency-recognized standards for Western Washington streams and present minimal conditions for healthy fish-bearing streams. An alternative to the NOAA Fisheries standards is to survey baseline conditions in WRIA 19 and monitor changes over time. This would account for local variability, but characterizing pristine conditions would be difficult because very few undisturbed areas remain.

TABLE 3-4.
WESTERN WASHINGTON STANDARDS FOR HEALTHY STREAMS

	Indicators	Properly Functioning	
Water Quality	Temperature	50-57ºF	
	Sediment/Turbidity	<12% fines (<0.85mm) in gravel, turbidity low	
	Chemical Contamination/nutrients	Low levels of chemical contamination from agricultural, industrial and other sources, no excess nutrients, no 303(d)-designated reaches	
Habitat Access	Physical Barriers	Any man-made barriers present in watershed allow upstream and downstream juvenile and adult fish passage at all flows	
Stream Habitat Elements	Substrate	Dominant substrate is gravel or cobble (interstitial spaces clear), or embeddedness <20%	
	Large Woody Debris (quantity of key pieces)	>80 pieces/mile >24”diameter >50 ft. length; and adequate sources of woody debris recruitment in riparian areas	
	Pool Frequency (channel width; # of pools/mile)	5 feet; 184 pools/mile 10 feet; 96 pools/mile 15 feet; 70 pools/mile 20 feet; 56 pools/mile	25 feet ; 47 pools/mile 50 feet; 26 pools/mile 75 feet; 23 pools/mile 100 feet; 18 pools/mile
	Pool Quality	pools >1 meter deep (holding pools) with good cover and cool water, minor reduction of pool volume by fine sediment	
	Off-Channel Habitat	Backwaters with cover, and low energy off-channel areas (ponds, oxbows, etc.)	
	Refugia (important remnant habitat for sensitive aquatic species)	Habitat refugia exist and are adequately buffered (e.g., by intact riparian reserves); existing refugia are sufficient in size, number and connectivity to maintain viable populations or sub-populations	

TABLE 3-4 (continued).
WESTERN WASHINGTON STANDARDS FOR HEALTHY STREAMS

	Indicators	Properly Functioning
Channel Condition & Dynamics	Width/Depth Ratio	<10
	Streambank Condition	>90% stable (i.e., on average, less than 10% of banks are actively eroding)
	Floodplain Connectivity	Off-channel areas are frequently hydrologically linked to main channel; overbank flows occur and maintain wetland functions, riparian vegetation and succession.
Flow/ Hydrology	Change in Peak/Base Flows	Watershed hydrograph indicates peak flow, base flow and flow timing characteristics comparable to an undisturbed watershed of similar size, geology and geography.
	Increase in Drainage Network	Zero or minimum increases in drainage network density from roads
Watershed Conditions	Road Density & Location	<2 mi/sq. mi., no valley bottom roads
	Disturbance History	<15% entire watershed with no concentration of disturbance in unstable or potentially unstable areas, and/or refugia, and/or riparian area; and for Northwest Forest Plan area (except adaptive management areas), ≥15% retention of late successional old growth in watershed
	Riparian Reserves	The riparian reserve system provides adequate shade, large woody debris recruitment, and habitat protection and connectivity in all subbasins, and includes known refugia for sensitive aquatic species (>80% intact), and/or for grazing effects; percent similarity of riparian vegetation to the potential natural community/composition >50%
Estuarine Conditions	Habitat Quantity/Quality	The estuarine system provides for adequate prey production, cover, and habitat complexity for both smolts and returning adults.
	Areal Extent	Estuary provides for most (i.e., greater than 80% intact) of its historical areal extent and diversity of shallow water habitat types including vegetated wetlands and marshes, tidal channels, submerged aquatic vegetation, tidal flats, and large woody debris.
	Hydrologic Conditions/Sediment/ Nutrient Input	Freshwater inflow and other hydrologic circulation patterns and sediment and nutrient inputs are similar to historical conditions.
Estuarine Water Quality	Dissolved Oxygen, Temperature, Nutrients, Chemical Contamination	Water quality standards for aquatic life protection met
	Sediments	Sediments have low levels of chemical contamination, especially of persistent aromatic hydrocarbons, heavy metals, or other compounds known to bio-accumulate.
	Non-Indigenous Exotic Species/Aquatic Nuisance Species	Exotic species that are non-indigenous and aquatic nuisance species are at low and decreasing levels and not interfering with estuarine system functions.

Source: NOAA Fisheries 1996. Matrix of Pathways and Indicators.

Both the NOAA Fisheries and baseline condition comparison are useful tools in measuring watershed health; however analysis of individual parameters is too narrow a scope to understand the big picture. The best measure of watershed health is in understanding the balance of river processes such as nutrient cycling, sediment transport and storage, riparian interactions, flow regime, and channel migration. These processes do not display constancy, but instead function in a dynamic equilibrium that, in stability and

disturbance, form habitats suited for sustaining fish and wildlife populations. The only way to understand the balance river process is through long-term monitoring of collective watershed health indicators.

Nearshore Kelp Bed Habitat

Shaffer (2002) indicates that kelp bed habitats are important for juvenile salmon and surf smelt. Salmon appear to prefer the middle kelp bed areas, possibly due to the optimal feeding and refuge conditions these areas offer. Further quantification of fish use of kelp habitats is needed to help define the relationship between juvenile salmon and forage fish and their use of nearshore kelp habitats. (Shaffer et al 2002a)

Data Gaps and Parameters of Concern

Stream Habitat

Table 3-5 identifies parameters of concern and data gaps for each subbasin in WRIA 19, based on review of multiple technical documents, monitoring efforts, and local knowledge. Parameters of concern (P) were identified for instream and riparian habitat by comparing known conditions to NOAA Fisheries 1996 "Matrix of Pathways and Indicators" for streams used by anadromous fish in Western Washington. Standards for healthy habitat conditions are shown in Table 3-4. Details for monitoring results in each subbasin can be found in Appendix H of the Watershed Plan. Though a "P" is listed for certain parameters in each stream, it is not necessarily indicative of basin-wide conditions, as most data only represents a single sampling location. Therefore, data gaps for basin-wide conditions are implied and further investigation is warranted for parameters of concern that have been identified at single locations. Data gaps "G" represent areas where data is not currently available for the specific parameter. Priorities for future monitoring efforts were identified during the WRIA 19 Monitoring Workshop in March 2005.

Documented stream habitat conditions across WRIA 19 show that barriers, substrate, LWD, riparian reserves, road density, and channel width-to-depth ratio are all high priorities for future monitoring activities. Off channel habitat, streambank stability, and floodplain connectivity are moderate priorities for future monitoring activities.

Nearshore Habitat

Based on a series of public workshops on nearshore issues presented in 2001 by the Clallam County Marine Resources Committee, the following information needs have been identified:

- Compile and synthesize existing nearshore data for baseline, including local knowledge.
- Model nearshore areas of the Strait of Juan de Fuca for circulation and water quality.
- Update surveys on red and green sea urchins.
- Define water quality thresholds for embayments of the Strait and priorities for management (e.g. nutrients, temperature, sedimentation, toxic chemicals).
- Define linkages between riverine systems and the nearshore (priority on sediment, nutrients, fecal coliform, and physical processes).
- Define and analyze applicability of different types of marine protected areas.

TABLE 3-5.
STREAM HABITAT DATA GAPS AND PARAMETERS OF CONCERN

Habitat Parameter	Salt Creek	Lyre River	Lake Crescent	East Twin River	West Twin River	Deep Creek	Pysht River	Clallam River	Hoko River	Sekiu River	Priority
Barriers	P	*	NA	P	*	P	P	P	P	P	High
Substrate	G	P	NA	P	P	P	P	G	P	*	High
LWD	P	P	NA	P	P	P	P	P	P	P	High
Pool Frequency	G	G	NA	*	*	P	G	G	P	P	High
Pool Depth	G	G	NA	P	P	P	P	G	P	P	High
Off Channel Habitat	P	G	NA	G	G	P	P	P	P	P	Moderate
Streambank Stability	P	G	NA	P	*	P	P	G	P	P	Moderate
Channel W:D Ratio	G	G	NA	P	P	P	P	G	P	P	High
Floodplain Connectivity	P	P	NA	*	*	P	P	P	P	P	Moderate
Road Density and Location	P	G	NA	G	G	P	P	P	P	P	High
Riparian Reserve	P	P	NA	P	P	P	P	P	P	P	High
Estuarine Quantity and Connectivity	P	P	NA	P	P	*	P	P	G	G	Moderate

Codes:
P = Parameter of Concern; monitoring data shows conditions to be outside of NOAA Fisheries habitat standards
G = Data Gap; no current data is available
NA = Not applicable
* = Data indicates that conditions are within NOAA Fisheries standards

- Define nearshore habitat use by juvenile salmonids and rockfish.
- Define kelp bed function within the Strait.
- Conduct long-term site specific monitoring for baseline data.
- Conduct an inventory of forage fish (Pacific herring, surf smelt, Pacific sand lance) spawning grounds to discover current and new sites.
- Research the “food chain” lower than baitfish (i.e. krill, plankton, shrimp).

FISH AND WILDLIFE

Fish

Salmonids

Though formal documentation is lacking, local historians tell of great fish runs early in the 20th century. The current status of salmonid populations in WRIA 19 is widely unknown. Of the 20 existing stocks, nine are believed to be healthy, two are believed to be depressed, and the remaining nine are unknown (See Table G-8 in Appendix G of the Watershed Plan). Fall chinook are no longer present in Deep Creek. For many stocks, information is insufficient to rate them. Many of these are historically small populations and could be especially vulnerable to any negative impacts. There is an immediate need to collect more information on them. WDFW has applied for funding through the Salmon Recovery Funding Board for fish use surveys in the nearshore waters.

Forage Fish

Herring

No herring spawning sites were detected in WRIA 19 during 2001 sampling. There are a number of possible reasons. First, the abundance of herring throughout Washington waters is directly related to stock health, and distribution and intensity of spawning activity is directly related to current stock biomass. If stocks are down (as they are now in many parts of Puget Sound) spawning activity will be lower. Second, many documented herring spawning sites in Puget Sound are not used every year. As a result, it may take years to detect a herring spawning ground, and once detected, it commonly takes several years of surveying to fully define its temporal and geographic extent. Two months of surveying in one year is not sufficient to determine whether an area is used by spawning herring. All survey sites should be sampled over a number of years to determine whether spawning occurs. Sampling time may be another possible reason for not detecting spawn; since the Strait of Juan de Fuca has not been extensively surveyed for herring spawn, timing of spawning activity is not known. Identifying herring spawning grounds is a high priority of local stewards and regional mangers if there is to be success in the long term management of nearshore resources and habitats of the Strait of Juan de Fuca. (Shaffer 2002).

Surf Smelt

Evidence of surf smelt spawning activity has been found in East Twin River, Deep Creek, Butler Cove, Clallam Bay, Half Mile Beach and the beach adjacent to the mouth of Bullman Creek. All of these but Deep Creek are newly documented surf smelt spawning sites. Natural variation appears to play an important role in forage fish spawning along the western Strait. Beaches sampled in the western Strait exhibited a change in substrate composition from sand to a sand/gravel mix more suitable for forage fish spawning. For the Strait, egg survival does not appear to be a factor driving spawning timing within the summer season. Variability in spawning timing suggests that spawning is not limited to sites with documented spawn. Repeated long term sampling is recommended. (Moriarity et al 2002)

Macroinvertebrates

Biological Index of Benthic Integrity is an excellent indicator of overall biological conditions, as it measure the number of tolerant and intolerant benthic species. BIBI sampling was performed in October 2004 at two locations in eight of the nine subbasins in WRIA 19 (Salt Creek is regularly sampled by the Clallam County Streamkeepers). The results will serve as baseline data for comparison with future sampling. Overall, the results show that the rivers in WRIA 19 have moderate to high biological integrity.

Amphibians

Few systematic surveys of amphibian populations have been conducted in Western Washington, and the current status of amphibian populations in WRIA 19 is unknown. Amphibians are excellent indicators of watershed health because of their sensitivity to land use changes and their close association with certain microhabitat characteristics. Because many amphibians live part of their lives in water and part on land, their survival depends not only on water quality but also on the physical make-up of both environments. Many species are closely associated with riparian habitats and water sources, relying on streams, ponds, and temporary waters for mating, egg deposition, and larval development. Due to their limited range, limited mobility, and sensitivity to water quality conditions, they are particularly responsive to alterations to riparian and aquatic habitats. As such, changes in the presence or abundance of a species within its known range may be an indication that land use activities are adversely affecting overall watershed health. There is no current monitoring data regarding abundance or population trends for amphibians in WRIA 19, though the following species are known to exist (2005 WDNR Washington Herp Atlas)

- Olympic torrent salamander—State Monitored Species, U.S. Fish and Wildlife Service (USFWS) Species of Concern
- Coastal tailed frog—State Monitored Species, USFWS Species of Concern
- Western toad—State Candidate for Listed Species of Concern
- Woodhouse toad—State Monitored species
- Pacific tree frog
- Western red-backed salamander
- Ensatina.

Birds

Birds serve as good indicators of watershed health. They are widely distributed, and different species vary in their sensitivity to physical, chemical, and biological threats. Avian species differ in where and how they nest, forage, and seek cover, so their presence and abundance can indicate the impacts of land use activities on water quality and other habitat characteristics. American dippers, for example, are indicative of nearshore health. Dippers forage primarily on macroinvertebrates and fish, which are sensitive to pollution and other changes in water quality. Consequently, reductions in the abundance of these food sources due to land use activities in a watershed may be observed in reductions in dipper abundance or reproductive success (Feck and Hall 2004). Bird species likely to occur in WRIA 19 are listed in Attachment 2.

Data Gaps and Parameters of Concern

Tables 3-6 and 3-7 identify parameters of concern and data gaps for each subbasin in WRIA 19, based on review of multiple technical documents, monitoring efforts, and local knowledge. For salmonid abundance, identified problems indicate stocks that are listed as “Depressed” or “Critical” in the WDFW 2002 Salmonid Stock and Inventory. Stocks whose status is unknown are identified as data gaps. A (*) symbol indicates that stocks have been identified as healthy.

TABLE 3-6.
SALMONID ABUNDANCE DATA GAPS AND IDENTIFIED PROBLEMS

	Salt Creek	Lyre River	Lake Crescent	East Twin River	West Twin River	Deep Creek	Pysht River	Clallam River	Hoko River	Sekiu River	Priority
Problem Identified	*	*	NA	CH	CH	CH	*	*	CK	*	High
Data Gaps[a]	*	CH, CO, WSH	NA	*	*	*	*	CH, WSH	CH	CH, WSH	High

a. Additional data gap identified for Mid and West Strait coastal cutthroat
Codes: CH = Chum salmon; CO = Coho salmon; CK = Chinook salmon; WSH = Winter steelhead
* = No problem or data gap identified

TABLE 3-7.
FISH AND WILDLIFE DATA GAPS AND PARAMETERS OF CONCERN

Fish and Wildlife Parameter	Salt Creek	Lyre River	Lake Crescent	East Twin River	West Twin River	Deep Creek	Pysht River	Clallam River	Hoko River	Sekiu River	Priority
Prey Species	G	G	G	G	G	G	G	G	G	G	High
Invertebrates	*	*	*	*	*	*	*	*	*	*	High
Amphibians	G	G	G	G	G	G	G	G	G	G	Moderate
Birds	G	G	G	G	G	G	G	G	G	G	Moderate

Codes:
P = Problem identified
G = Data gap identified
* = No problem or data gap identified

All salmonid abundance data gaps and problems identified are considered high priority for future monitoring efforts in WRIA 19. Aquatic invertebrates and other prey species are considered high priority for future monitoring activities. Amphibians and birds are considered moderate priority for future monitoring activities.

CHAPTER 4.
RECOMMENDATIONS

Recommendations were developed based on results of current monitoring activities that identified parameters of concern and data gaps. Implementation of these recommendations will require various levels of funding and landowner negotiation. The recommendations are divided into three potential funding scenarios—low, medium, and high—to guide future efforts and available funds. Funding and negotiating access are the greatest constraints of implementing this plan, and will require careful discussions and planning by all parties. The recommendations speak to the goals and objectives as stated in Chapter 1; consider the current activities and data results; and recommend activities to address data gaps and parameters of concern.

This plan recommends four different types of monitoring with varying funding scenarios in WRIA 19:

- Status and trends (Ambient Monitoring)
- Effectiveness monitoring
- Stream walk survey
- Observation and educational monitoring.

Status and trend monitoring is the observation of a parameter over time at a consistent location. An example would be to monitor stream flow at the mouth of the Hoko River for several years. Assumptions about trends cannot be made based on surrounding conditions, as this type of data does not correlate with any other variable.

Effectiveness monitoring employs before and after monitoring at the site of specific actions compared to a control site. An example would be to monitor pool depth and frequency at an LWD restoration site and at a control reach where no restoration activity occurred. This type of study is designed to attribute impacts (positive or negative) to reach-scale or watershed- scale actions such as agriculture; habitat restoration; residential and urban development; and logging activities.

Status/trends and effectiveness monitoring utilize rigorous statistical design, sampling protocols, data validation, and analysis. Status and trend monitoring is distinguished from effectiveness monitoring in that it does not identify cause and effect relationships. It is purely designed to determine current conditions and long-term trends.

Stream walk surveys are less quantitative than status/trends and effectiveness monitoring. This type of monitoring is designed to qualitatively characterize conditions for each stream and identify areas for potential restoration. This information will be used to help guide restoration efforts throughout the WRIA for the multitude of organizations and agencies that address water quality, habitat or fish and wildlife population concerns.

Observation and educational monitoring, like the stream walk surveys, are less quantitative than qualitative. These types of monitoring include individual observations of watershed conditions, such as fish presence. Educational monitoring would be based on informal student research by local schools or organizations.

LOW FUNDING LEVEL SCENARIO

The low funding level scenario outlines monitoring recommendations in the case that little funding is available to conduct the monitoring. The main objectives for this scenario are as follows:

- To promote communication and data sharing among entities that are currently conducting monitoring activities
- To engage local citizens, students, and other interested parties in watershed activities
- To continue current activities to ensure continuous record
- To expand current monitoring activities for prioritized parameters of concern and prioritized data gaps.

Additional tasks that can be completed relatively inexpensively include:

- BIBI monitoring
- Observation and educational monitoring
- Stream walk surveys
- Database management
- Salmonid smolt trapping
- Salmonid spawner surveys.

Communication and Data Sharing

Federal, state, and local agencies as well as tribes, landowners, non-profit organizations and individual citizens participate in monitoring in WRIA 19. However, little formal communication exists to coordinate efforts or share data. It is anticipated that a work group will form or a coordinator will be employed to facilitate communication and data sharing. Data provided should include information on the sponsoring organization, study design, sampling protocols, and quality control measures utilized. Regular distribution of information on planning, funding, and monitoring results will occur via meetings, a website, or mailings.

Current Monitoring Activities

Current monitoring activities are discussed in Chapter 2. Continuation of these activities is strongly encouraged to ensure continuous record of conditions for trend analysis.

Additional Monitoring

Several parameters of concern and data gaps have been identified in WRIA 19. Many of these are already monitored by several entities on select streams, such as temperature, fish abundance, and turbidity (see Table 2-1 for a complete list of current monitoring activities). As these parameters have been identified as high priorities in all nine coastal subbasins, it is recommended that monitoring be conducted on all nine streams. Because active programs are already in place, the cost to expand current efforts is considerably less than initiating a new monitoring program. Additional status and trend (ambient) monitoring of the following parameters is of highest priority:

- Water quality (specifically temperature, turbidity, dissolved oxygen)
- Stream flow

- Fish abundance.

Ambient Water Quality Monitoring (Status and Trends Monitoring)

- **Why?**—The purpose of this study is to assess the status of water quality in WRIA 19, identify long-term trends, and determine whether water quality at sampling sites exceeds water quality standards. There are no existing Ecology ambient water quality monitoring stations in WRIA 19, and the current understanding of water quality throughout is disconnected or outdated. The most recent update to Ecology's 303d list was based on information that was obtained from a variety of sources, mostly dating from the early-mid 1990's. Long-term ambient monitoring would allow a better understanding of water quality conditions across the WRIA.
- **Who?**—This effort would be implemented by WA Department of Ecology. The process by which sites are added is relatively simple, once funding is secured. Requests for new ambient monitoring sites are made to Ecology's WRIA 19 representative for approval, and are then forwarded to the Environmental Assessment Program (EAP) for implementation. Alternately, Clallam County Streamkeepers or other stakeholders could implement this program, however funding would need to be secured.
- **How?**
  - Ecology's protocols for water quality monitoring can be found at: www.ecy.wa.gov/biblio/0103036.html
  - The associated quality assurance project plan (QAPP) can be found at: www.ecy.wa.gov/biblio/0303200.html
  - Streamkeepers' protocols for ambient water quality monitoring and the associated QAPP can be found at: www.clallam.net/streamkeepers/index.asp
- **Where?**—To keep costs low, the Ecology ambient monitoring stations are generally located at bridge crossings. Samples are collected from the upstream side of the bridge or from the streambanks to ensure no bias by the bridge. In WRIA 19, this aspect will greatly restrict the options for sampling locations, as there are few bridges other than HWY 112. Alternative sampling locations, including sites in the lower portion of the watershed or at stream flow gages, will be considered if long-term funding and access are assured. This plan recommends that funding be secured to monitor water quality parameters in each of the nine subbasins.
- **What?**—Temperature, turbidity, dissolved oxygen are parameters of greatest concern, therefore it is recommended that they be monitored continuously instead of monthly.
  - Protocol for continuous temperature sampling can be found at: www.ecy.wa.gov/biblio/0303052.html.
  - Protocols for continuous turbidity monitoring and the associated QAPP are currently in development.

River and Stream Flow Monitoring (Status and Trends Monitoring)

- **Why?**—Changes in land use and forest structure may have contributed to changes in the hydrographic patterns in the streams of WRIA 19. Understanding stream flows is an integral element in determining the available in-stream resources (for fish) and the available out of stream resources (for people).

- **Who?**—The Stream Hydrology Unit (SHU) of Ecology's Environmental Monitoring and Trends Section provides flow information in support of two Department of Ecology (Ecology) activities. SHU provides timely and accurate instantaneous stream flow for various in-stream actions. Clallam County Streamkeepers does not currently monitor stream flow in WRIA 19, but has the capability.
- **How?**—Three types of stream gauges are used to collect stream flow data; telemetry, stand alone, and manual stage height. Each of these types has varying levels of effort and accuracy.
  - Ecology protocol for stream flow measurement can be found at: www.ecy.wa.gov/programs/eap/flow/flow_measurements_protocol_20may03.pdf
  - Streamkeepers follow stream flow protocols as recommended by the Timber Fish and Wildlife (TFW) Ambient Monitoring Program: Schuett-Hames, D., A. Pleus, L. Bullchild, and S. Hall. 1994. Timber-Fish-Wildlife Ambient Monitoring Program manual. Northwest Indian Fisheries Commission. TFW-AM9-94-001. WDNR #76. August.
- **What?**—Stream flow is to be measured (plus temperature if equipment is available or attainable).
- **Where?**—Stream flow gauges are recommended for all nine subbasins in WRIA 19. Stream flow is currently being measured in the Hoko River, East and West Twin Rivers, and Deep Creek. It is recommended that an additional five stream flow gages be installed to capture data for each major stream system in WRIA 19. Stream flow was historically monitored at several locations throughout the watershed, but are no longer active. If conditions are still favorable for a gage to be installed in these locations, a valuable comparison of historical and current stream flow could be made.

  Note: At the request of the WRIA 19 Planning Unit, Ecology is scheduled to install an additional five stream flow gages in 2005.

Anadromous Fish Abundance and Life-Stage Survival (Status and Trends Monitoring)

- **Why?**—The purpose of this study is to better understand why anadromous fish populations in WRIA 19 are declining, by understanding where and when the declines are happening. This can be determined by monitoring the fish populations at different life stages including smolts (out-migrating to sea), juveniles (freshwater stage), and spawner (returns from sea). As NOAA Fisheries develops a protocol for calculating viable salmonids populations, this data can be used to set goals for populations in WRIA 19 (McElhany et al., 2000).
- **Who?**—Several entities are capable of implementing this type of project, including Clallam County Streamkeepers, Makah Tribe, Lower Elwha Klallam Tribe, and Washington Department of Fish and Wildlife. Streamkeepers are capable of implementing spawning surveys using trained technicians and volunteers. Both Tribes are currently monitoring fish abundance at various stages (see Chapter 2). WDFW is working in conjunction with Ecology on the Intensively Monitored Watersheds project by monitoring fish abundance at several life stages (smolt, juvenile, and spawner). WDFW is currently applying for funding from the Salmon Recovery Funding Board (SRFB) to study fish use in the nearshore environment.
- **How?**—Protocols that are used to measure these parameters should be consistent with current efforts in each respective subbasin. The Tribes and WDFW should be consulted to coordinate methods and resources.

- **What?**—Parameters that should be measured include smolt production, juvenile abundance, and spawner surveys.
- **Where?**—This type of monitoring should occur at all nine subbasins in WRIA 19, in cooperation with current efforts to avoid duplications.

Biological Index of Benthic Integrity

- **Why?**—Biological Index of Benthic Integrity is an excellent indicator of overall biological conditions that has been used throughout Clallam County for years. To date, Clallam County Streamkeepers has implemented its monitoring program in Salt Creek and sporadically in Clallam River. In 2004, the WRIA 19 Planning Unit elected to have a comprehensive BIBI study of all the remaining streams. The results of that study will act as a baseline to which future results can be compared to detect long-term trends.
- **Who?**—This monitoring will likely be implemented by the Clallam County Streamkeepers.
- **When?**—Monitoring will take place annually in the month of October.
- **Where?**—To ensure consistency, monitoring locations should be consistent with the 2004 baseline survey (See Appendix XX –BIBI report) (To be added upon completion of Watershed Plan)
- **How?**—The 2004 survey was completed using the Streamkeepers collection protocol. This protocol can be found on the web at: www.clallam.net/streamkeepers/assets/applets/Benthic1.pdf
- **What?**—Monitoring of this type requires collection of aquatic insects.

Environmental Observation and Educational Monitoring

- **Why?**—Environmental education programs are designed to teach students basic principle of ecology using hands on and fun techniques. Educational programs can also teach students principles of good environmental stewardship and restoration.
- **Who?**—Environmental education programs could be implemented by local schools with assistance from Clallam County, Olympic Park Institute, the Adopt-A-Stream Foundation, Tribal representatives, or local land owners.
- **When?**—Ideally, students would follow a project or subject throughout the school year.
- **Where?**—Regular observations could take place on school grounds, or periodically at designated sites in the WRIA.
- **How?**—Students could collect information with basic, inexpensive equipment or by visual observation.
- **What?**—A wide variety of subjects could be studied, including climate data, bird species presence, riparian dynamics, hydrology, vegetation succession, or fish biology.

Stream walk Surveys

- **Why?**—Current restoration efforts in WRIA 19 are mostly done on reach-level scale (as opposed to watershed level scale). Though these projects make conditions better, the river processes that form habitat are out of balance. These processes must be considered in a holistic manner to ensure that the source of the problem is addressed

and to get the most benefit from the projects. By performing a complete survey of each stream in WRIA 19, the whole picture can be seen to better understand the problems and prioritize restoration efforts.

For example, a concern in WRIA 19 is peak flows that widen streams. Adding LWD certainly helps store sediment and create pools, but the channel remains wide and temperatures high. To remedy this problem, peak flows must be retained longer in the off channel habitats and riparian zones. By identifying off channel habitats that are currently disconnected and candidates for restoration, the process of channel formation will no longer be disrupted and instream restoration efforts more fruitful. More information on side channels and flood attenuation can be found in the Storage Study, Appendix XX (To be added upon completion of Watershed Plan.

- **Who?**—This type of survey is ideal for community participation. Citizens, volunteers, student interns, and local conservation corps are all highly trainable and eager candidates. Peninsula College, Washington Conservation Corps, Streamkeepers, and the Clallam Conservation District are great resources for relatively inexpensive project assistance.
- **When?**—Surveys should be performed in late spring or summer months when total canopy cover can be most accurately estimated. Surveys should be performed in the winter to assess conifer-only canopy coverage. Surveys should be performed annually.
- **Where?**—This type of survey should happen in each of the nine streams in WRIA 19, though only in the main stems and larger tributaries, such as the Little Hoko River.
- **How?**—A variety of sampling protocols exist for this type of survey, however it is not unreasonable to develop new protocols with the assistance of Clallam County Streamkeepers. Protocols to consider include:
  - Streamkeepers physical habitat field procedures and associated QAPP can be found at: www.clallam.net/streamkeepers/html/volunteer_handbook.htm
  - Hankins, D.G. and G.H. Reeves. 1988. Estimating total fish abundance and total habitat area in small streams based on visual estimation methods. Canadian Journal of Fisheries and Aquatic Sciences 45(5):834-844.

  Surveys of this type will require documentation, such as GIS points for notable features and photographs. Alternatively, much of this data could be obtained using aerial photos.
- **What?**—A preliminary list of recommended parameters to be measured for a riparian survey includes the following:
  - Barriers
  - Off channel habitat
  - Streambank stability
  - Riparian reserve
  - Canopy cover
  - Riparian roads.

  A preliminary list of recommended parameters to be measured for an instream survey includes the following:
  - LWD

- Pool frequency
- Residual pool depth
- Substrate class
- Sinuosity
- Channel width: depth ratio.

Database Management

Several agencies and organizations gather data that could support or complement studies by other groups, however there is currently no mechanism in place to share data among agencies and interested parties. There are several good options for depositing historical and current monitoring results and watershed information. Hard copies of reports and findings can be filed at local libraries. Electronic data can be stored and managed by any of the following entities:

- Washington Department of Ecology Environmental Information Management (EIM)
- SSHIAP
- Olympic Natural Resource Center
- Clallam County
- EPA Surf Your Watershed Environmental Websites
- EPA STORET.

See Attachment 3 for more details on each of these options. Initiation of a data repository is an important and relatively easy step for the WRIA 19 Planning Unit, as it does not require additional monitoring activity, but instead a collection of existing information. Data that is collected for this effort should include monitoring results from federal, state, and local agencies, tribes, non-governmental organizations, and academic research. In addition, the database should include each entity's policy, codes, planning documents, or compliance regulation such as WDNR forest practice permits, Clallam County Critical Areas Ordinance, Road Management and Abandonment Plans, and quality assurance procedures.

MODERATE FUNDING LEVEL SCENARIO

Under this funding scenario, activities identified for the low-funding scenario would be accomplished along with the collection of new data including:

- Expanded ambient water quality monitoring to cover the watershed more densely
- Anadromous fish life stage survival study
- Nearshore fish use
- Nutrient loads and cycling
- Groundwater quality monitoring.

Ambient Water Quality Monitoring (Status and Trends Monitoring)

- **Why?**—The purpose of this study is to assess the status of water quality in WRIA 19, identify long-term trends, and determine whether water quality at sampling sites exceeds water quality standards. The low funding scenario provides for monitoring of limited parameters at few locations (areas in the lower reaches). With additional

funding, monitoring locations can be sited farther up into the watershed to expand the coverage. It should be made clear again, that this type of monitoring does not establish a cause and effect relationship between land use actions and degraded conditions. It merely identifies long term trends in water quality at as many sites as possible.

- **Who?**—Same as low funding scenario
- **How?** -Same as low funding scenario
- **Where?**—Additional monitoring sites should be located in the middle and upper reaches of the subbasins to further understand the source of parameters of concern. The most sensible locations would be at the confluence of tributaries or at locations where problems have been identified.
- **What?** –the following parameters should be monitored, in order of importance.
  - Temperature
  - Turbidity
  - Dissolved oxygen
  - PH
  - Conductivity
  - Fecal coliform bacteria
  - Suspended Sediment Concentration (not total suspended solids, as this test is not appropriate for stream studies)
  - Phosphorus, total
  - Phosphorus, soluble reactive
  - Nitrogen, total
  - Nitrate plus nitrite
  - Ammonia
  - Chemicals associated with pesticide applications.

Anadromous Fish Abundance and Life-Stage Survival (Status and Trends Monitoring)

- **Why?**—The purpose of this study is to better understand why anadromous fish populations in WRIA 19 are declining, by understanding where and when the declines are happening. The low funding scenario provides for monitoring at few locations (areas in the lower reaches or at easily accessible sites). With additional funding, monitoring locations can be sited farther up into the watershed to expand the coverage. This can be determined by monitoring the fish populations at different life stages including smolts (out-migrating to sea), juveniles (freshwater stage), and spawner (returns from sea).
- **Who?**—Several entities are capable of implementing this type of project, including Makah Tribe, Lower Elwha Klallam Tribe, and Washington Department of Fish and Wildlife. Both Tribes are currently monitoring fish abundance at various stages (see Chapter 2). WDFW is working in conjunction with Ecology on the Intensively Monitored Watersheds project by monitoring fish abundance at several life stages (smolt, juvenile, and spawner). WDFW is currently applying for funding from SRFB to study fish use in the nearshore environment.

- **How?**—Protocols that are used to measure these parameters should be consistent with current efforts in each respective subbasin. The Tribes and WDFW should be consulted to coordinate methods and resources.
- **What?**—Parameters that should be measured include smolt production, juvenile abundance, and spawner surveys.
- **Where?**—This type of monitoring should occur at all nine subbasins in WRIA 19, in cooperation with current efforts to avoid duplications.

Nearshore Water Quality and Fish Use

(The following information was provided by WDFW.)

- **Why?**— Water quality is thought to be a key factor in defining fish use, as well as the top factor for restoration and preservation actions for salmon recovery. There currently is no consistent water quality monitoring focused on defining the nearshore water quality for fish habitat in WRIA 19.
- **Who?**—WA Department of Ecology, or Department of Fish and Wildlife
- **How?**— TidBits and YSI multi-probes are recommended monitoring equipment. Salinometers are recommended only if no other techniques are available. Titration is the recommended method of defining dissolved oxygen if YSI/multiprobes or Hobo equipment are not available.
- **What?**— Dissolved oxygen, temperature, salinity, pH, turbidity, density, and conductivity. If resources allow, total suspended solids, turbidity as well.
- **Where?**— Emphasis is placed primarily on fish use of nearshore areas, with an emphasis on river mouths. In order of priority: Pysht, Hoko, Salt Creek/Crescent Bay, East and West Twin Rivers, Clallam River/Clallam Bay, Lyre River, Sekiu River, and Deep Creek.
- **When?—**Monthly for all sites, weekly at top priority sites.

Groundwater Quality Monitoring

- **Why?**—Very little information is known about ground water quality in WRIA 19.
- **Who?**—Washington Department of Ecology
- **How?**—Ecology groundwater monitoring protocols
- **What?**—Parameters to be measured include water level, nitrate, specific conductivity, and bacteria.
- **Where?**—Ground water monitoring should be conducted in Salt Creek subbasin and Clallam River subbasins, where the densest population centers occur in WRIA 19. Additionally, groundwater should be monitored near agricultural areas where fertilizer or animal waste could contaminate groundwater aquifers.
- **When?—**Monitoring should take place quarterly or biannually (spring and fall).

Bird and Amphibian Presence and Abundance

- **Why?**—Birds and amphibians are particularly good indicators of watershed health due to their sensitivity to pollutants and stressed habitat conditions. Baseline data can be used to compare long-term trends

- **Who?**—Washington Department of Fish and Wildlife
- **How?**—WDFW protocols for bird and amphibian inventory
- **What?**—Inventory of amphibian species presence and abundance
- **Where?**—Riparian corridors throughout WRIA 19, as funding is available.
- **When?—** In accordance with specific protocols

HIGH FUNDING LEVEL SCENARIO

Under the low and moderate funding scenarios, status and trend monitoring would be used to identify problem areas and address data gaps. Under the high funding scenario, a more comprehensive view of baseline conditions is achieved through consistent protocols and random site selection (those involving surface water quality, habitat, climate, and fish counts). This single, coordinated effort would require significant communication and cooperation between all parties. It is recommended that the MWG hire a part of full time person responsible for project management. It is also recommended that MWG consult a professional statistician (available through Ecology, EPA, and private consulting) for sample design, data validation, and analysis.

Comprehensive Baseline Conditions (Status and Trends Monitoring)

- **Why?**—The purpose of this type of study is to develop a comprehensive baseline conditions understanding for water quality, quantity, habitat, and wildlife populations. Current data and monitoring efforts are disconnected and narrowly scoped, mostly driven by single parameters or subbasins. The initial set up of such a program would require a fair amount of effort to secure funding, find consensus on methods, and identify each entities level of participation. After initial negotiations, the collaborative process should promote greater efficiency for each entity as they can share resources and knowledge.
- **Who?**—This effort would require cooperation from Washington State Departments of Ecology, Fish and Wildlife, Health, and Natural Resources; Clallam County; Makah Tribe; Lower S'Klallam Tribe; Clallam Conservation District; US Forest Service; National Park Service; local citizens and landowners.
- **Where?**—The recommended approach for site selection to guarantee representative results is to use a random-stratified site selection process. This will not target specific areas and is designed to demonstrate representative results.
- **How?** An excellent study design for regional water quality, quantity, habitat, and wildlife assessment is EPA's Environmental Monitoring and Assessment Program (EMAP). EMAP was developed specifically to monitor and assess the status and trends of ecological resources, specifically by translating environmental monitoring data from multiple spatial and temporal scales into assessments of current ecological condition and forecasts of future risks to natural resources. Protocols for wadable streams developed by EMAP can be found on the web at http://www.epa.gov/emap/html/pubs/docs/groupdocs/surfwatr/field/ewwsm01.pdf
- **What?**—Parameters that are measured under the EMAP protocols include:
  - Water Quality
    - Turbidity
    - Suspended sediment concentration
    - Temperature

    - Dissolved oxygen
    - Conductivity
    - Nitrogen, phosphorus
  - Stream flow
  - Habitat Structure
    - Stream size
    - Channel gradient
    - Channel substrate size and type
    - Habitat complexity and cover
    - Riparian vegetation cover and structure
  - Wildlife
    - Fish assemblage
    - Vertebrate assemblage
    - Macroinvertebrate assemblages
    - Periphyton (algae, fungi, bacteria, protozoa).

Experimental Research (Effectiveness Monitoring)

- **Why?**—The purpose of this type of monitoring is to understand how land management activities—such as agriculture, residential/commercial development, timber harvest, and restoration—affect river processes, water quality, quantity, habitat, wildlife, and climate conditions. WDNR's Cooperative Monitoring Evaluation and Research (CMER) committee has researched this topic extensively, however no publications have been made available since 2000.
- **Who?**—Several different organizations (or a combination of) could potentially perform this type of study, including Clallam County, University of Washington, Ecology, Lower Elwha Klallam Tribe, Makah Tribe, WDNR (under the CMER program) or private landowners. The CMER committee is a monitoring, evaluation and research program established by the WDNR Forest Practices Board to ensure effective implementation of the recommendations contained in the Forests and Fish Report. CMER holds regular monthly meetings attended by CMER members, Scientific Advisory Group co-chairs, and any other interested parties.
- **Where?**
  - **Land Use**—Since the two most common land use changes in WRIA 19 are logging activities and human development, they would be the logical actions to evaluate. Many studies already exist demonstrating the effects of logging activities on habitat, fish, and wildlife populations, though few if any address the effects on fish populations. Most were small-scale studies conducted at a reach level, and did not evaluate effects on populations but on local abundance. Furthermore, no studies of this type have been conducted specifically in WRIA 19. Evaluation of land use effects require watershed-scale monitoring. Suggested locations for logging effectiveness monitoring include the Pysht, Clallam, Hoko, or Sekiu Rivers. All of these locations are experiencing significant logging activity. Salt Creek subbasin would be the recommended location to monitor the effects of human development, as it is the most densely populated and has the highest projected growth.

  - **Restoration—**In addition to evaluating land use changes, it is critical to evaluate effectiveness of restoration projects on habitat elements and wildlife populations. These projects are evaluated on a reach-scale.

- **When?**

  - **Land Use**—If the MWG decides to support an effectiveness monitoring study sponsored by the CMER group, it would have to be proposed for the 2006 work plan, as the 2005 work plan is already laid out. Otherwise, a logical alternative is to couple a study with Ecology's Intensively Monitored Watershed project. This project is evaluating three streams in WRIA 19 (East/West Twin Rivers and Deep Creek). Restoration effects on various parameters in the Deep and West Twin River will be compared with the control stream (East Twin River). Protocols for how and when to collect data should follow the sample design of the IMW. A major opportunity exists for WRIA 19 to expand the current IMW study to additional, more highly effected subbasins such as the Pysht or Sekiu. Such an expansion would be viewed favorable for funding by natural resource agencies as it would leverage upon the efforts already underway and provide much needed data.

  - **Restoration—**To effectively monitor restoration effectiveness, it is important to monitor before and after the project implementation. Depending on the nature of the project, post-implementation monitoring can last for several years.

- **How?**—This type of study incorporates a before-after/control-impact (BACI) design that enhances the ability to differentiate treatment responses from responses due to variables not directly affected by the treatment.

  - **Land Use**——Either the CMER protocols for habitat and wildlife population surveys or the EMAP sampling protocols (as applied by the IMW study) should be used depending on which study is supported by the MWG.

  - **Restoration—**For reach-scale effectiveness monitoring, protocols are recommended by the WA Salmon Recovery Funding Board: at http://www.iac.wa.gov/srfb/docs.htm

- **What?**—Parameters that should be measured include stream flow, channel conditions, water quality, habitat, fish and wildlife populations as guided by each respective study design.

ADDITIONAL STUDIES

Nutrient Loads and Cycling

Nitrogen, phosphorous, and sulfur are key essential nutrients for aquatic and riparian flora and fauna. These nutrients are derived from variety of sources, including the atmosphere, soil and bedrock, and the biological community within the ecosystem. Complex cycles of uptake and input are driven by physical and chemical interactions throughout the system. Natural and anthropogenic disturbances disrupt nutrient cycles by altering the nature of controlling processes (i.e., hydrologic regime, temperature, and biological community). For example, timber harvest in river corridors profoundly impacts nutrient cycling, although the severity of the impact depends on the logging technique used. In addition to logging, forest fertilization can dramatically increase stream nitrogen concentrations and alter nutrient inputs to the stream (McClain et al. 1998). Aside from forest inputs, spawning anadromous fish provide stream systems with marine-derived nutrients (MDN) not otherwise found in a freshwater system. It is widely

recognized that there is an important feedback loop between the amount of MDN returned to a stream during spawning and the success of subsequent invertebrate, fish, and vegetation populations. A comparative study of the impacts of logging techniques and intensity on nutrient cycles is feasible in WRIA 19, as the West Twin River will not be logged and will be monitored for nutrients as part of the Intensively Monitored Watersheds Project. For further information and sample studies, see:

> McClain, M.E., R.E Bilby, F. J. Triska. Nutrient Cycles and Responses to Disturbance in River Ecology and Management; Lessons from the Pacific Coastal Ecoregion by Naiman et al, 1998.

Estimating Historical Fish Abundance

Current salmonid stocks in WRIA 19 are modest in size, and many are getting smaller. Though anecdotal evidence suggests that salmon runs were historically much more abundant, there is little scientific evidence to show the rapid declines. However, it is possible to research past conditions by studying relics of historic times—specifically the soil and riparian old growth trees (or stumps). Anadromous fish bring marine-derived nutrients back to the freshwater streams when they return to spawn. These nutrients are enormously valuable to all living things in the riparian and instream zones, including riparian wildlife (bears, birds, insects) and vegetation. In fact, it is possible to analyze the nutrient composition of both soils and trees to estimate the historic abundance of anadromous fish and the role that marine derived nutrients have played in nourishing the riparian and instream habitats. An example of such a study is:

> Reimchen, T.E., DD. Mathewson, MD. Hocking, J. Moran, and D. Harris. Isotopic Evidence for Enrichment of Salmon-Derived Nutrients in Vegetation, Soil, and Insects in Riparian Zones in Coastal British Columbia. In Stockner, J., editor. 2003. Nutrients in salmonid ecosystems: sustaining production and biodiversity. American Fisheries Society, Symposium 34, Bethesda, Maryland.

CHAPTER 5.
FUNDING

Some of the preceding monitoring recommendations can be funded at least in part by the responsible agencies as part of their existing work plans (such as ambient water quality monitoring by Ecology). Outside of existing monitoring activities, funding is needed to implement the recommendations. Agencies or organizations interested in pursuing funding for future monitoring should work collaboratively with the (yet to be formed) Monitoring Work Group to prioritize efforts and resources. The process of prioritization would designate monetary resources based on the following criteria:

- Need for specific parameter monitoring to support legal requirements
- Identification/prioritization of needs, i.e., what information is needed to support
- Sustainable fish population evaluation and restoration
- Watershed health—evaluation and restoration
- Project justification and effectiveness
- Public awareness
- "Benefit/Cost" prioritization (or positive impacts and values)
- Holistic or watershed-wide priority indicators
- Creative proposals for specific needs
- Clear identification of costs and potential funding sources

Potential sources of funding are described in the following sections.

WASHINGTON DEPARTMENT OF ECOLOGY

The Department of Ecology's Water Quality Program administers three major funding programs that provide low-interest loans and grants for projects that protect and improve water quality in Washington State. Ecology acts in partnership with state agencies, local governments, and Indian tribes by providing financial and administrative support for their water quality efforts. As much as possible, Ecology manages the three programs as one; there is one funding cycle, application form, and offer list.

The three programs sharing guidelines, application, and funding cycle are:

- The Centennial Clean Water Fund (Centennial), which provides low-interest loans and grants for wastewater treatment facilities and fund-related activities to reduce nonpoint sources of water pollution.
- The State Revolving Loan Fund (SRF), which provides low-interest loans for wastewater treatment facilities and related activities, or to reduce nonpoint sources of water pollution.
- The Section 319 Nonpoint Source Grants Program (Section 319), which provides grants to reduce nonpoint sources of water pollution.

Examples of the type of projects that Ecology have funded in the past:

- Stream and salmon habitat restoration

- Watershed planning
- Water quality monitoring
- Wellhead protection
- Agricultural best management practices
- Local loan funds for water quality projects
- Acquiring wetland habitat for preservation
- Public information and education

The funding programs can provide funding to local governments, recognized Indian tribes, special purpose districts such as sewer, health, and conservation districts, not-for-profit groups.

Loans are available for up to 100 percent of eligible project costs. Only loans may be used for site-specific facilities planning, facilities design, constructing point source facilities land acquisition, installation of collection sewers, implementation projects on private property (e.g., best management practices for landowners), and side sewers

Grants for nonpoint source activities are available for up to 75 percent of eligible project costs. Grants for watershed and comprehensive basin planning are available for 75 percent of eligible project costs. Loans may be used to provide the grant match. Grants for constructing point source facilities are available only in cases of demonstrated financial hardship.

For more information, go to: http://www.ecy.wa.gov/programs/wq/funding/2006/or contact:

Jeff Nejedly
Department of Ecology
(360) 407-6566
jnej461@ecy.wa.gov

Brian Howard
Department of Ecology
(360) 407-6510
brho461@ecy.wa.gov

SALMON RECOVERY FUNDING BOARD

The SRFB administers two grant programs aimed at the protection and restoration of salmon habitat. These include the Salmon Recovery Grant Program and the Family Forest Fish Passage Program. The board is interested in funding riparian, freshwater, estuarine, nearshore, saltwater, and upland projects that protect existing high quality salmon habitats and restore degraded habitats to increase overall health and biological productivity. All applications must come through local lead entity groups that oversee fish habitat restoration for a particular watershed or region (i.e., applications should not be submitted directly to SRFB).

The purpose of this grant is the protection and restoration of salmon habitat and to support feasibility assessments for future projects and activities. Eligible applicants include municipal subdivisions (e.g., towns, park and recreation districts, and counties), tribal governments, private land owners, nonprofit organizations, and state agencies. Applicants must provide at least 15 percent matching funds in either cash or in-kind contributions. Grants are awarded annually and deadlines for information submitted by lead entities for 2005 are pending but should be determined at the April SRFB meeting, and will be posted on the SRFB website. Additional deadlines pertaining to the submission of information to individual lead entities may also apply. Program guidelines can be found online at

http://www.iac.wa.gov/Documents/Manuals&Forms/Manual_18.pdf

Contact Information:
Salmon Recover Funding Board
Natural Resources Building
1111 Washington Street
P.O. Box 40917
Olympia, WA 98504-0917
Voice (360) 902-2636; Fax (360) 902-3026 TDD (360) 902-1996
E-mail Salmon@iac.wa.gov

All applications for SRFB funding must go through the North Olympic Peninsula Lead Entity. For more information, go to:/www.noplegroup.org

WASHINGTON DEPARTMENT OF NATURAL RESOURCES

WDNR's Family Forest Fish Passage Program assists small forest landowners in complying with the forest and fish rules related to Road Maintenance and Abandonment Plans, by providing financial assistance in repairing or removing fish passage barriers. Only small forest landowners are eligible applicants. Small forest land owners are defined as a landowner who, at the time of submission of required documentation to the department, has harvested no more than an average timber volume of two million board feet per year during the previous three years and does not expect to harvest more than this volume during the next ten years. Exceptions to this can be made if this volume is exceeded due to estate taxes or other unforeseen circumstances. Only fish passage barriers on forestlands are eligible for funding. Applicants must provide a match requirement of either 25 percent of any costs associated with the removal or replacement of the barrier or $5,000, whichever is less. No match is required if the fish passage barrier was installed under an approved forest practices application or notification and an hydraulics approval. Grants are awarded on a biennial cycle and are based on a list of priority fish passages developed by the WDFW, WDNR, and local lead entity groups. Funding for the 2003-2005 biennium was awarded in April 2004 and January 2005; a budget request for the 2005-2007 biennium was submitted to the state legislature in summer 2004 and is currently pending. Up to $2 million are available for statewide distribution for the period of July 1st, 2003 through June 31st, 2005. Program guidelines can be found online at

http://www.iac.wa.gov/Documents/SRFB/Grants/FFFP_Program/fffpp_guidelines.pdf

Contact Information:
Washington Department of Natural Resources, Small Forest Landowner Office
Natural Resources Building
1111 Washington Street
P.O. Box 47012 Olympia, WA 98504-7012
Voice: (360) 902-1400; Fax: (360) 902-1428
Email: sflo@wadnr.gov

AMERICAN RIVERS-NOAA COMMUNITY-BASED RESTORATION PROGRAM PARTNERSHIP RIVER RESTORATION GRANTS

The purpose of the river restoration grants is to provide support for local communities that are utilizing dam removal or fish passages to restore and protect the ecological integrity of their rivers and improve freshwater habitats important to anadromous fish. Non-renewable grants will be given to assist in the technical application of two types of projects including (1) fish passage improvements (e.g., dam removal, fish ladders, nature like by-pass channels, culvert removal/retrofit) and (2) preliminary analysis essential to development of the project (e.g., engineering, design, sediment analysis). Funding awarded in the

Pacific Northwest will emphasize projects located in interior regions of Oregon, Washington, and Idaho. Grants are awarded biannually, with the deadline for the second cycle of fiscal year 2005 on April 1. Another cycle in the Fall with deadline of Nov 1. Funding will be awarded in July 2005. NOAA awarded $330,000 to American Rivers to distribute for river restoration projects in the Northeast, Mid-Atlantic, Northwest and California; the average grant award is expected to range from $5,000 to $25,000. Eligible applicants include individuals and organizations, including civic and conservation groups; state, local, and tribal governments, and other commercial and non-profit organizations.

Contact Information:
Peter Raabe
River Restoration Finance Associate
American Rivers
1025 Vermont Avenue, NW
Suite 720
Washington, DC 20005
Tel: (202) 347-7550 x3006; Fax: (202) 347-9240
Email: rivergrants@amrivers.org

ENVIRONMENTAL PROTECTION AGENCY

R-EMAP Project

EPA's R-EMAP projects will provide numerous small-scale ecological monitoring research opportunities across the wide biogeographic and political boundaries associated with the ten EPA Regional Offices. EPA typically sponsors one or two R-EMAP projects annually in each Region, with a focus on applications of the EMAP approach to local problems. EMAP will continue to use R-EMAP to complement the larger geographic assessments, and to provide us with additional opportunities to develop and test indicators and designs across the nation.

STAR Grants and Cooperative Agreements

National Center for Environmental Research's (NCER) Science to Achieve Results or STAR program funds research grants and graduate fellowships in numerous environmental science and engineering disciplines through a competitive solicitation process and independent peer review. The program engages the nation's best scientists and engineers in targeted research that complements EPA's own outstanding intramural research program and those of partners in other federal agencies. In addition, through this same competitive process, NCER periodically establishes large research centers in specific areas of national concern. At present, these centers focus on children's health, hazardous substances, particulate matter, and estuarine and coastal monitoring.

STAR research is funded through Requests for Applications (RFAs) that are derived from the Office of Research and Development (ORD) Strategic Plan and from research plans for specific topics developed by ORD. RFAs are prepared in cooperation with other parts of the Agency and concentrate on areas of special significance to the EPA mission. At present, STAR is focusing on the health effects of particulate matter, drinking water, water quality, global change, ecosystem assessment and restoration, human health risk assessment, endocrine disrupting chemicals, pollution prevention and new technologies, children's health, and socio-economic research. http://es.epa.gov/ncer/grants/

NATIONAL FISH AND WILDLIFE FOUNDATION GRANTS—COMMUNITY SALMON FUND

The National Fish and Wildlife Foundation (NFWF) has established local partnerships in many parts of western Washington through the Community Salmon Fund program to stimulate small-scale, voluntary action by community groups, in cooperation with landowners and businesses, to support salmon recovery on private property. Grants are administered by the Foundation.

The goals of the Community Salmon Fund are to:

- Fund habitat protection and restoration projects that have a substantial benefit to watershed health.
- Engage landowners, business owners and community groups to carry out these projects and care for them in the long run.
- Stimulate creativity and leadership among various constituencies to address conservation needs.
- Target constituencies that can be particularly helpful in salmon recovery, especially farmers, rural forest owners, suburban homeowners, and owners of businesses and industries.

Currently, Community Salmon Fund has 10 local partnerships in Western Washington, including King and Pierce Counties Community Salmon Funds.

http://www.nfwf.org/programs/csf.htm

CHAPTER 6.
ORGANIZATION

At this time, no specific governance structure or "steering committee" has been formed to implement a coordinated monitoring plan. It is anticipated that a "steering committee," such as a "WRIA 19 Watershed Monitoring Work Group" (MWG) would be established and would consist of representatives of watershed stakeholder organizations and private citizens (similar to the current Planning Unit, which oversaw the development of the Watershed Plan and Comprehensive Monitoring Plan). The MWG would work collaboratively with a Restoration Work Group (RWG), formed in conjunction with the MWG.

KEY INDIVIDUALS

The MWG is organized to provide guidance and public input on implementation of the Monitoring Plan, determine the focus and prioritization of projects, identify and secure funding sources, and make critical decisions if problems arise with either the projects or the health of the watershed. Key individuals, roles and responsibilities for conducting the monitoring are identified in Table 6-1. One individual could be responsible for multiple roles.

TABLE 6-1.
MONITORING PERSONNEL AND AREAS OF RESPONSIBILITY

Key Personnel Role	Role and Duties
Project Coordinator *name* *contact information*	Responsible for creation of monitoring manual, instructions, data sheets, QAPP, program organization, staff and volunteer recruitment, establishing training and data collection schedules and seeing that they are adhered to, recruiting agency specialists to assist the project, final data checks, analysis of results and report generation. Coordinates efforts with WRIA 19 RWG.
Statistician *name* *contact information*	Attend initial meetings of the MWG to understand the purpose of the study; draft study design to include sampling methods, locations, and sample sizes; outline how the statistical analysis can be used.
Monitoring Lead *name* *contact information*	Brings all necessary testing equipment to site and disseminates it to team members, reviews all monitoring sheets, returns all equipment to center and delivers data sheets to the data coordinator. Supervises and trains monitoring staff.
Monitoring Staff *name* *contact information*	Collects samples, performs testing, observes and gathers data according to the Standard Operating Procedures (SOPs) outlined in the monitoring instructions, and takes lab samples to lab.
Lab Analyst *name* *contact information*	Performs the more complex testing and laboratory analyses (selected lab should be approved by Clallam County Department of Health and WA Department of Ecology).
Quality Control Analyst *name* *contact information*	Uses a Hydrolab® or equivalent quality equipment to conduct duplicate testing which serves as quality control, transfers data to data coordinator.
GIS Specialist *name* *contact information*	Responsible for map generation, spatial data organization and assistance with generation and maintenance of database.
Data Coordinator *name* *contact information*	Checks completed data sheets, enters the results into the computer database, checks with hardcopy forms, and files the data sheets.

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ATTACHMENT 1.
WORKSHOP MEETING NOTES

Hoko-Lyre Watershed Comprehensive Monitoring Plan
July 2005

ATTACHMENT 1.
WORKSHOP MEETING NOTES

Hoko-Lyre (WRIA 19) Monitoring Workshop
Meeting Notes

January 6th, 2005, 1:00 – 3:30 p.m.

Clallam County Library

Attendance

Organization	Representative
Citizens:	Josey Paul, Peter Vanderhoof, Coleman Byrnes, Steve Bengtson, Sandy Bengtson
Clallam County:	Cathy Lear, Ann Soule, Andy Brastad
Clallam County Conservation District:	Clea Rome
WA DNR:	Mike Cronin
WA Ecology:	Bob Duffy
Lower Elwha Tribe:	Doug Morrill
Green Crow:	Harry Bell
Makah Tribe:	Jeff Shellberg, Stephanie Lucas
Merrill & Ring:	Joe Murray
National Park Service:	Pat Crain
Olympic Park Institute:	Derek Staab
Clallam County Streamkeepers:	Hannah Merrill
Consultants:	Cynthia Carlstad, April Magrane, Bob Wheeler, Andrea Petzel

Open

Bob Wheeler opened the meeting with introductions, followed by a brief overview of the workshop purpose and agenda.

The purpose of this workshop is to produce a comprehensive understanding of current monitoring efforts related to water quantity, water quality and habitat; identify and prioritize additional monitoring needs; and develop framework for Comprehensive Monitoring Plan (goals, objectives and recommendations).

State of the Waters Report

Ann Soule presented the Clallam County State of the Waters Report (2004). The Report was created to offer citizens a broad-brush understanding of water quality, habitat, and biological conditions for all major waterbodies in Clallam County. The water quality ratings were based on the Clallam County Water Quality Index, specifically created for this report and documented in the appendices. The

biological ratings were based on BIBI sampling, and the habitat ratings were more subjective based on existing data. Bob Duffy offered Department of Ecology services to reproduce additional copies of the report.

Current and Historic Monitoring Activities

At this point, the group was asked to document current and historical monitoring activities both on a questionnaire and on maps posted around the room. Each entity was given unique identifiers so that their project locations would not be confused with another. After about 30 minutes, each organization was asked to describe the projects in terms of timing, scope, but not results. A comprehensive list of monitoring activities has been compiled and is attached.

303(d) listings

Very briefly, the current 303(d) listings were reviewed and identified on figures.

Vision Statement

The following vision statement was presented to the group:

> "To create a Comprehensive Watershed Monitoring Plan that coordinates current monitoring efforts in water quality, water quantity, and habitat; identifies and prioritizes additional needs; provide guidance for cooperative implementation; identifies options for database management that would allow free and easy access by all interested parties."

Group comments:

- Include actions or outcomes specifically regarding fish and human health
- Should be a dynamic plan with an adaptive management element
- "Coordination" is inappropriate, as it suggests a directed action. This plan should not direct or dictate actions, but instead encourage cooperation and identify priorities.
- Needs to be comparable data, protocols, strive for consistent collection and presentation of data
- Prevent duplication of efforts

Goals

The following goals were presented to the group:

- Determine and/or identify basin's overall status and trends
- Identify high quality water bodies
- Identify and track causes of problems including quality, quantity and habitat by monitoring biological, physical, and chemical indicators
- Work proactively to avoid 303(d) listing and ESA listings
- Data management, analyses, and access
- Communication

Group comments:

- Develop balance for water quality and quantity for human needs and activities
- Continue to evolve understanding historical conditions versus current conditions
- Identify critical runs (not listed) – avoid extirpation of and better understand trends and conditions of runs

Monitoring Objectives

The following monitoring objectives were presented to the group:

- Identify, select and document monitoring protocols and data formats
- Reduce costs by using common information
- Define problem areas and needed activities
- Share skills and equipment when possible
- When possible, utilize existing database available to all parties for free and easy access by citizens
- Meet all agency reporting needs

Group comments:

- Determine and separate background conditions versus land use impacts

Data Needs:

The following questions were presented to the group:

- What is the minimum data required to
  - Meet goals and objectives?
  - Assess watershed health?
  - Evaluate restoration success?
  - Identify source of known problems?

Group comments:

- To accurately assess watershed health, long term analysis is required using existing data as a basis of comparison for future studies.
- Effectiveness monitoring is required to evaluate restoration success. This data should be readily shared with other organizations.

Monitoring Parameters:

The following parameters were suggested for monitoring to measure impacts of human activity

- Water Quality (temperature, sediment / turbidity, chemical contamination / nutrients)
- Habitat Access (physical barriers)
- Stream Habitat Elements – (substrate, LWD quantity of key pieces, pool frequency, pool quality, off channel habitat, refugia)

- Channel conditions and dynamics – (width / depth ratio, streambank stability, floodplain connectivity)
- Flow / hydrology – (change in peak / base flows, increase in drainage network)
- Watershed conditions – (road density and location, disturbance history, riparian reserves)
- Estuarine conditions – (habitat quantity / quality, aerial extent, hydrologic conditions / sediment/ nutrient input)
- Estuarine water quality – (dissolved oxygen, temperature, nutrients, chemical contamination, sediments, exotic species that are non-indigenous aquatic nuisance species)
- Biological indicators – (fish, Invertebrates, bats, birds, amphibians)

No additional comments were made regarding the monitoring parameters.

Methods of Data Collection

The WRIA 19 Comprehensive Monitoring Plan will recommend the development of a Quality Assurance Project Plan (QAPP - DOE Publication 04-03-030) to ensure consistent collection methods and quality of data.

No additional comments were made regarding the use of a DOE QAPP.

Data Management

Data management is a key issue regarding the successful implementation of a multi-agency Monitoring Plan.

Group comments:

- The overall consensus was that the data should be centralized, easily accessible, and checked for quality assurance.
- There should be a GIS component to locate monitoring activities and results.
- Some suggestions for the housing of a database include WA Department of Ecology EIM, Clallam County, SSHIAP, UW College of Forest Resources, ONRC, EPA or a new webpage specifically for WRIA 19 data and links.
- Each entity should be responsible for entering own data
- Consult a statistician to evaluate data

Options for all these suggestions will be pursued for final Plan recommendations.

Plan Recommendations

Group comments:

- A stable staff and funding source for monitoring should be identified to provide consistent quality data for analysis.

- An individual should be employed to assure quality control; manage database; and coordinate, support, and advise a cooperative WRIA 19 monitoring work group.

The workshop was completed at 3:30. The comments and information received will be included in the development of a Draft WRIA 19 Comprehensive Monitoring Plan. A draft version will be available for review by all attendees and interested parties. A second workshop for finalizing recommendations will be held in spring of 2005.

Hoko-Lyre (Wria 19) Monitoring Workshop Ii
Meeting Notes

March 30th, 2005

PORT ANGELES LIBRARY

Attendance

Organization	Representative
Chamber of Commerce	Bill Drath
Citizens:	Josey Paul, Coleman Byrnes, Margaret Owens
Clallam County:	Cathy Lear, Carol Creasey
Ecology:	Christine Hempleman, John Summers, Casey Clishe
Green Crow:	Harry Bell
Makah Tribe:	Gwen Bridge, Steph Lucas
Merrill & Ring:	Joe Murray
NOTAC	Carol Johnson
Streamkeepers:	Hannah Merrill
Consultants:	Cynthia Carlstad, Jennifer O'Neal, April Magrane, Bob Wheeler, Andrea Petzel

Open

Bob Wheeler opened the meeting and made introductions all around. There were two goals for this workshop, 1) to introduce the draft Monitoring Plan, and 2) to compile additional information and input on recommendations and priorities from all the attendees. First, April Magrane from Tetra Tech presented the draft Monitoring Plan, and then the group split into two breakout sessions to discuss priorities and recommendations for monitoring projects.

April approached the Monitoring Plan by first collecting existing data from both previous and on-going monitoring studies. In order to make recommendations, that information was then analyzed using criteria from the Department of Ecology, and the National Marine Fisheries Services' (NOAA Fisheries) Matrix of Pathways and Indicators. Based on her analysis, April identified the following data gaps and parameters of concern:

- Data Gaps: representative baseline conditions, salmon stock status, viable salmon populations, nutrient cycling, disconnected off-channel habitat and barriers.
- Parameters of Concern: temperature, turbidity, sedimentation, and dissolved oxygen.

The Monitoring Plan recommends four types of monitoring programs:

1. Status and trends – to determine current conditions and long-term trends.
2. Effectiveness monitoring – to identify cause and effect relationships between actions and watershed response.
3. Stream walk surveys – to characterize conditions in each stream and identify areas for potential restoration.
4. Observation and educational monitoring – including individual observations, school group research, and other informal data gathering formats.

Funding

Funding levels were grouped into categories of low, moderate, or high. Recommendations in the funding section of the Monitoring Plan were nested so that the low-funded programs were incorporated into the moderate funding recommendations as follows:

Low Funding Recommendations:

- Communication and data sharing
  - Work group communication
  - Database management
- Priority parameters of concern and data gaps:
  - Ambient water quality monitoring (status and trends)
  - Stream flow (status and trends)
  - Biological index of benthic integrity
- Additional monitoring activities:
  - Biological index of benthic integrity
  - Climate conditions
  - Stream walk surveys

Moderation Funding Recommendations (low-funding recommendations plus below)

- Ambient water quality (status and trends)
- Anadromous fish abundance and life stage survival (status and trends)
- Nearshore fish use

High Funding Recommendations (low and medium funding recommendations plus below)

- Comprehensive baseline conditions (status and trends)
- Effectiveness monitoring

Additional Studies

- Nutrient loads and cycling
- Amphibian surveys
- Bird surveys

Possible sources of funding include, but are not limited to:

- Washington Department of Ecology
- Washington Salmon Recovery Funding Board
- US Environmental Protection Agency
- National Fish and Wildlife Foundation
- Washington Department of Natural Resources

- American Rivers
- Clallam County
- In-kind or matching donations from business and industry

Implementation

A high priority is to hire a Watershed Steward to oversee the implementation of the Monitoring Plan. Possible roles and responsibilities include:

- Project Coordinator
- Statistician
- Monitoring Lead
- Monitoring Staff
- Lab Analyst
- Quality Control analyst
- GIS Specialist
- Data Coordinator

Although it's a list of many job functions, it's possible that one person could fulfill several of these roles.

Recommendations for Next Steps

- Finalize Monitoring Plan.
- Form a work group that meets regularly.
- Hire a watershed steward.
- Initiate data repository and management.

Questions

Cathy Lear asked if April had a sense of time in terms of putting the next steps together. In other words, when could the Planning Unit expect results? April replied that a lot depends on finding a source of funding, but she can set up a tentative schedule based on anticipated funds.

> ***Action Item:*** *April will develop a tentative schedule of results based on different levels of available funding.*

Joe Murray said he didn't see any indication that the draft Monitoring Plan addressed how much hatchery fish stocks affects habitat. To him, the Monitoring Plan seems like it's focused on land use, but it also needs to take into consideration fishing/catch numbers. April agreed that fish harvest should be taken into consideration, and Bob added that if the information isn't readily available, it can be identified as a data gap and can become a recommendation for the Monitoring Plan.

> ***Action Item:*** *April will research the potential impacts of hatchery fish stocks on habitat and incorporate her findings into the Monitoring Plan.*

Harry Bell commented that spawner surveys and smolt trapping are done by a lot of people to count fish stocks and the relationship between the two methods might be a good way to get a grasp on stock status in specific reaches. Jennifer O'Neal added that the Intensively Monitored Watershed program should have a framework for that type of study.

> ***Action Item:*** *April will incorporate spawner surveys and smolt trappings into the Monitoring Plan.*

Colman Byrnes suggested tagging studies that will show some of the catch numbers. He knows that the state does some tagging studies, as do the tribes. Cynthia asked the Makah representatives if they could look at their tagging studies and make sure they are all captured in the Monitoring Plan. Stephanie Lucas agreed to have Caroline Peterschmidt review that section of the Monitoring Plan and get back to April.

> ***Action Item:*** *April will follow up with Caroline Peterschmidt and Steph Lucas to find information on Makah tagging studies.*

Joe asked if any thought had been given to validation monitoring; validation monitoring would take effectiveness monitoring the next step further and answer the question "did it help the fish"? Jennifer answered that what's presented today is a watershed–wide monitoring program as opposed to a reach-level monitoring program, which is really what Joe is asking about. Depending on the level of funding, it is possible to do monitoring on both scales.

Harry Bell noted that using amphibians as a measure of watershed health is a fairly common monitoring consideration, as long as it's focused on riparian-dependent amphibians. But in the Monitoring Plan there was a switch to monitoring bird populations, which seems like a big change to him. Harry's concern is that by looking at birds, which aren't always riparian-dependent, we would be moving towards monitoring land-use. April assured Harry that there are specific birds that can be monitored as indicators of stream health, without ramifications on land-use. April also asked Harry if he could suggest any protocols to get a good understanding of amphibian monitoring. Harry answered that CMER has a protocol and is out looking at sites right now.

Colman Byrnes added that he has done amphibian surveys and has some books on surveying. In addition, Olympic National Park did some amphibian census work and although it's probably primarily data, they might have protocols listed in the report as well.

Cathy added that using indicator species is a good idea, as long as we rely on factors independent of riparian conditions that might impact some amphibian populations. World-wide, populations of amphibians are declining and nobody knows why. There's a bigger, more global picture that could be the cause for decline that's far outside our sphere of influence. April suggested that monitoring amphibians would then be considered status and trends monitoring, rather than cause and effect.

> ***Action Item:*** *April will create a list of riparian-dependent bird species that can be monitored.*

> ***Action Item:*** *April will follow up with Harry Bell and Colman Byrnes for CMER protocols for amphibian monitoring.*

Cynthia thanked for everybody for their comments. She reminded everybody that there's a fine line between enough and not enough detail, and a lot of logistics remain to be worked out. There are the realities of getting monitoring work done and sometimes funding dictates what can be accomplished, so the group should keep those considerations in mind.

The group was divided in half to do breakout sessions to discuss recommendations for 1) Water Quantity, Habitat, Water Quality, Fish and Wildlife, and; 2) Funding and Feasibility,

Report from Breakout Sessions

The group looked at each of the five flip charts and gave an overview of their discussion and recommendations as follows:

Water Quantity

- Write a narrative to better explain the tables.
- Tables need footnotes that further clarify the basis of problems identified and data gaps.
- Streamflow is a high priority.

Habitat

- Acknowledge that all parameters are interrelated.
- Monitor LWD, pool frequency and pool depth together. It's a high priority to fix and monitor the function of LWD in relation to those parameters.
- High priority to fix barriers; improve the function of LWD and remove anthropogenic barriers.
- Low priority to monitor the function of road-riparian reserve and LWD.
- Road density parameter is a high priority.
- Riparian reserve parameter is a high priority.
- A suggested "package" of parameters to monitor: temperature, conductivity, salinity, pH, DO, turbidity, suspended solids and fine sediments.
- Additional physical habitat parameters; cross-sections of channel width/depth, LWD (quantity, size and composition), pool width/depth ratio and frequency, substrate size and composition.

Water Quality

- Add nitrate.
- Consider exempt wells as part of the groundwater category.
- Need a baseline study to compare for the future.
- Cite where the areas identified as "problems" came from.
- Temperature, sediment/turbidity, chemicals/nutrients, and dissolved oxygen were all identified as high priority parameters.

Fish and Wildlife

- Add bull trout.
- Spawner surveys and smolt trapping are high priorities.
- Which streams will be most affected by drought?
- Invertebrates are a high priority.

- Can Streamkeepers expand its BIBI efforts to WRIA 19 for status and trend monitoring now that we have a baseline study?

Funding and Feasibility

- Website with links to agency websites that have data concerning our area.
- Priorities for a Watershed Steward: public outreach, and formatting agency data into a readable format.
- Coordinate a yearly report concerning WRIA 19 conditions.
- DNR Forest Practices specific monitoring project versus what the WRIA 19 Monitoring Plan – who does what? Monitoring should be coordinated, possibly with the Tribes acting as a liaison.
- No recommendation for compliance monitoring.
- The Makah could possibly assist the DNR to increase monitoring capacity on the landscape. It's something the Makah have thought about, but haven't yet pursued.
- Create a partnering recommendation for the Tribes and DNR, but this might be outside our scope.

Wrap-up

Bob Wheeler thanked everybody for the comments and participation and reminded the group to submit any comments or changes on the *draft* Monitoring Plan to Andrea Petzel by April 15th.

ATTACHMENT 2.
BIRDS POTENTIALLY FOUND IN WRIA 19

Hoko-Lyre Watershed Comprehensive Monitoring Plan
July 2005

ATTACHMENT 2.
BIRDS POTENTIALLY FOUND IN WRIA 19

Wildlife and Habitat Relationships in Oregon and Washington (Johnson and O'Neil 2001) identifies two habitat types in WRIA 19; westside lowlands conifer-hardwood forest and westside riparian-wetlands. The following bird species are commonly found within these two habitat types:

- Northern spotted owl—State Listed Endangered Species
- Snowy plover—State Listed Endangered Species
- Marbled murrelet—State Listed Threatened Species
- Common loon—State Listed Sensitive Species
- Great blue heron—State Monitored Species
- Black oystercatcher—State Monitored Species
- Western grebe—Candidate for State Listed Species of Concern
- Northern goshawk—Candidate for State Listed Species of Concern
- Golden eagle—Candidate for State Listed Species of Concern
- Common murre—Candidate for State Listed Species of Concern
- Cassin's auklet—Candidate for State Listed Species of Concern
- Tufted puffin—Candidate for State Listed Species of Concern
- Vaux's swift—Candidate for State Listed Species of Concern
- Pileated woodpecker—Candidate for State Listed Species of Concern
- Streaked horned lark—Candidate for State Listed Species of Concern
- Purple martin—Candidate for State Listed Species of Concern
- Ancient murrelet
- Western bluebird
- Trumpeter swan
- Tule greater white-fronted goose
- Brant
- Northern Pintail
- Readhead
- Greater scaup
- Lesser scaup
- Harlequin duck
- Willet
- Marbled godwit
- Red knot

- Rock sandpiper
- Long-tailed duck
- Black scooter
- Surf scooter

ATTACHMENT 3.
DATABASE MANAGEMENT OPTIONS

Hoko-Lyre Watershed Comprehensive Monitoring Plan
July 2005

ATTACHMENT 3.
DATABASE MANAGEMENT OPTIONS

WASHINGTON DEPARTMENT OF ECOLOGY ENVIRONMENTAL INFORMATION MANAGEMENT PROGRAM

The Environmental Information Management System (EIM) is the Department of Ecology's main database for environmental monitoring. It includes water quality data, TMDLs, long-term monitoring, and short-term monitoring (fresh water, saltwater, and groundwater). EIM contains records on physical, chemical, and biological analyses and measurements. Supplementary information about the data (metadata) is also stored, including information about environmental studies, monitoring locations, and data quality. This page also includes external links to websites with data from other organizations such as EPA and USGS. This information is available on the Internet at:

http://www.ecy.wa.gov/services/as/iip/eim/about.htm.

EIM Features

- A Searchable Database—Search over 1.4 million environmental records from nearly 9,000 monitoring locations throughout and adjoining Washington State. Access data from over 350 studies including information about where samples were collected, study details, and data quality.
- Search by Map—Search for environmental data by navigating a map of Washington state.
- Search and Download—Conduct a custom search for environmental datasets by form or by map, then download for analysis.
- Ready-made Downloads—Download ready-made datasets from the following categories:
  - Studies: Download data from 350-plus environmental studies.
  - Parameter: Access statewide data for 5400-plus parameters such as mercury, E. coli, and water temperature.
  - WRIA: Get monitoring results for entire watersheds or Water Resource Inventory Areas.
  - County: Get monitoring results for entire Washington state counties.

OLYMPIC NATURAL RESOURCES CENTER

The Olympic Natural Resources Center (ONRC), located on the Olympic Peninsula in Forks, Washington, was established by the Washington State Legislature, as part of the University of Washington, acting on recommendations made by the Commission on Old Growth Alternatives for Washington's Forest Trust Lands. The mission of the ONRC is to "conduct research and education on natural resource management practices which integrate ecological and economic values." Research conducted by the center focuses on forestry and marine issues including threatened and endangered species, active management of riparian habitat and watersheds, stand and landscape management for biodiversity, long-term soil productivity, estuaries, marine-terrestrial interactions, and shellfish enhancement. The ONRC campus is also used for educational purposes with a number of university

courses held there each year. The deans of the College of Forest Resource and College of Ocean and Fisheries Sciences, who receive guidance from an advisory board appointed by the governor, oversee the Center. The ONRC also administers a clearinghouse for biological and geospatial data for the Olympic Peninsula from a variety of Federal, State, and Local, Private and NGO, tribal, collegiate, and individual sources.

CLALLAM COUNTY WEBSITE

The Clallam County website (www.clallam.net) offers a variety of information and services. It currently contains interactive maps and watershed facts such as water quality, fish presence, and habitat features. These pages could easily be expanded. Database management is also an option through Clallam County, as they already service a database for the Streamkeepers. The database management capabilities of Clallam County Information Technology Department are currently under expansion, and provide the following services:

- Information systems support
- Hardware & Software design and acquisition
- Local Area Network support
- Wide Area Network services
- Web Hosting & Design Services
- Secure Internet access
- E-mail
- Remote data access
- Document imaging
- Video conferencing
- Telephone & voice mail
- GIS support
- Copy machine acqusition
- Faxing services

For more information, call (360) 417-2346, or email web_it@co.clallam.wa.us.

EPA

Surf Your Watershed

One of the features of Surf Your Watershed is the Environmental Website database. Anyone with environmental information sites can add a URL to the database, and provide several ways to sort and view what's in the database. This can be a repository for monitoring data, or a location for links to each agency's pertinent information. This site offers free searches for text, database, or gis data. It is also a forum for public or private comments and public discussions. http://www.epa.gov/watershed/envsites/
GIS data can be stored and accessed through EPA's EPA's Office of Research and Development (ORD). The ORD has developed a scientific environmental information management system (EIMS) that stores, manages, and delivers descriptive information (metadata) for data sets, databases, documents, models, multimedia, projects, and spatial information. The EIMS design also provides a repository for scientific documentation that can be easily accessed with standard Web browsers to place a virtual library on the desktop of EPA staff and others with Internet access. http://www.epa.gov/eims/?p=surf

STORET

STORET (short for STOrage and RETrieval) is a repository for water quality, biological, and physical data and is used by state environmental agencies, EPA and other federal agencies, universities, private

citizens, and many others. The original STORET was developed in the 1960s, and today the system continues to serve as EPA's principal repository for marine, freshwater, and biological monitoring data. STORET is currently used by a variety of groups, including federal agencies, states, tribes, local governments, academic groups, watershed and volunteer monitoring organizations, and the public. STORET is a useful data management tool for any organization that collects water quality monitoring information. Agencies and individuals can use STORET to query and access data available in the national repository. STORET is a powerful tool because it makes data collected in a geographic location by multiple agencies available in one database. Organizations that enter data into STORET maintain control by managing the data in a local copy of the database. Agencies can then export finalized data and provide them to EPA for inclusion in the national Data Warehouse. For more information, go to:

http://www.epa.gov/STORET/

ATTACHMENT 4.
ALTERNATIVE SAMPLING PROTOCOLS

Hoko-Lyre Watershed Comprehensive Monitoring Plan
July 2005

ATTACHMENT 4.
ALTERNATIVE SAMPLING PROTOCOLS

WASHINGTON DEPARTMENT OF FISH AND WILDLIFE

Salmon and Steelhead Habitat Inventory and Assessment Program (SSHIAP)

Inventory and Monitoring of Salmon Habitat in the Pacific Northwest—Directory and Synthesis of Protocols for Management/Research and Volunteers in Washington, Oregon, Idaho, Montana, and British Columbia. Johnson, D. H., N. Pittman, E. Wilder, J. A. Silver, R. W. Plotnikoff, B. C. Mason, K. K. Jones, P. Roger, T. A. O'Neil, C. Barrett. 2001. Washington Department of Fish and Wildlife, Olympia, Washington.

http://wdfw.wa.gov/hab/sshiap/inventorymonitor.pdf

This document reflects an effort to establish a consistent format for the collection of salmonid habitat data across the Pacific Northwest for use by volunteers and management/research personnel across the region. The recommended protocols are subdivided by the specific types of habitat projects.

Table 5 in this document outlines the recommended protocols for various types of projects, including assessment of off channel habitat, spawning gravel, large woody debris, and floodplain restoration. Recommended protocols for fish counting surveys (spawners, juvenile, smolts) are embedded within each project type. A similar document is being produced by WDFW exclusively for fish counting protocols. The recommendations for this document will be published.

TIMBER FISH AND WILDLIFE MONITORING PROTOCOLS

http://www.nwifc.wa.gov/TFW/documents.asp?#mmm

Habitat Survey

Pleus, A.E., D. Schuett-Hames, and L. Bullchild. 1999. TFW Monitoring Program method manual for the habitat unit survey. Prepared for the Washington State Dept. of Natural Resources under the Timber, Fish, and Wildlife Agreement. TFW-AM9-99-003. WDNR #105. June.

LWD Survey

Schuett-Hames, D., A.E. Pleus, J. Ward, M. Fox, and J. Light. 1999. TFW Monitoring Program method manual for the large woody debris survey. Prepared for the Washington State Dept. of Natural Resources under the Timber, Fish, and Wildlife Agreement. TFW-AM9-99-004. WDNR #106. June.

Spawning Gravel Composition

Schuett-Hames, D., R. Conrad, A. Pleus, and M. McHenry. 1999. TFW Monitoring Program method manual for the salmonid spawning grave composition survey. Prepared for the Washington State Dept. of Natural Resources under the Timber, Fish, and Wildlife Agreement. TFW-AM9-99-006. WDNR #108. March.

Spawning Gravel Scour Survey

Schuett-Hames, D., B. Conrad, A.E. Pleus, and K. Lautz. 1999. TFW Monitoring Program method manual for the salmonid spawning gravel scour survey. Prepared for the Washington State Dept. of Natural Resources under the Timber, Fish, and Wildlife Agreement. TFW-AM9-99-008. WDNR #110. December.

Spawning Habitat Availability Survey

Schuett-Hames, D., A.E. Pleus, and D. Smith. 1999. TFW Monitoring Program method manual for the salmonid spawning habitat availability survey. Prepared for the Washington State Dept. of Natural Resources under the Timber, Fish, and Wildlife Agreement. TFW-AM9-99-007. WDNR #109. November.

Stream Segment Identification

A.E. Pleus and D. Schuett-Hames. 1998. TFW Monitoring Program method manual for stream segment identification. Prepared for the Washington State Dept. of Natural Resources under the Timber, Fish, and Wildlife Agreement. TFW-AM9-98-001. WDNR #103. May.

Stream Temperature Survey

Schuett-Hames, D., A.E. Pleus, E. Rashin, and J. Matthews. 1999. TFW Monitoring Program method manual for the stream temperature survey. Prepared for the Washington State Dept. of Natural Resources under the Timber, Fish, and Wildlife Agreement. TFW-AM9-99-005. WDNR #107. June.

Stream Discharge

A.E. Pleus. 1999. TFW Monitoring Program method manual for wadable stream discharge measurement. Prepared for the Washington State Dept. of Natural Resources under the Timber, Fish, and Wildlife Agreement. TFW-AM9-99-009. WDNR #111. June.

Reference Point

A.E. Pleus and D. Schuett-Hames. 1998. TFW Monitoring Program method manual for the reference point survey. Prepared for the Washington State Dept. of Natural Resources under the Timber, Fish, and Wildlife Agreement. TFW-AM9-98-002. WDNR #104. May.

SALMON RECOVERY FUNDING BOARD

http://www.iac.wa.gov/srfb/monitoring.htm

Fish Passage

Crawford, B. 2004. Protocol for monitoring effectiveness of fish passage projects (culverts, bridges, fishways, log jams, dam removal, debris removal). Prepared for the Interagency Committee for Outdoor Recreation, Washington Salmon Recovery Funding Board. SRFB MC-1. Available online at:

http://www.iac.wa.gov/Documents/SRFB/Monitoring/MC-1_Fish_Passage_Projects.pdf

In-Stream Habitat

Crawford, B. 2004. Protocol for monitoring effectiveness of in-stream habitat projects (channel reconfiguration, deflectors, log and rock control weirs, roughened channels, and woody debris removal). Prepared for the Interagency Committee for Outdoor Recreation, Washington Salmon Recovery Funding Board. SRFB MC-2. Available online at:

http://www.iac.wa.gov/Documents/SRFB/Monitoring/MC-2_Instream_Habitat_Projects.pdf

Riparian Planting

Crawford, B. 2004. Protocols for monitoring effectiveness of riparian planting projects. Prepared for the Interagency Committee for Outdoor Recreation, Washington Salmon Recovery Funding Board. SRFB MC-3. Available online at:

http://www.iac.wa.gov/Documents/SRFB/Monitoring/MC-3_Riparian_Planting_Projects.pdf

Riparian Livestock Exclusion

Crawford, B. 2004. Protocols for monitoring effectiveness of livestock exclusion projects. Prepared for the Interagency Committee for Outdoor Recreation, Washington Salmon Recovery Funding Board. SRFB MC-4. Available online at:

http://www.iac.wa.gov/Documents/SRFB/Monitoring/MC-4_Livestock_Exclusion_Projects.pdf

Constrained Channel

Crawford, B. 2004. Protocol for monitoring effectiveness of constrained channels (dike removal/setback, riprap removal, road removal/setback, landfill removal). Prepared for the Interagency Committee for Outdoor Recreation, Washington Salmon Recovery Funding Board. SRFB MC-5. Available online at:

http://www.iac.wa.gov/Documents/SRFB/Monitoring/MC-5_Constrained_Channels.pdf

Channel Connectivity

Crawford, B. 2004. Protocol for monitoring effectiveness of channel connectivity, off channel habitat, and wetland restoration projects. Prepared for the Interagency Committee for Outdoor Recreation, Washington Salmon Recovery Funding Board. SRFB MC-6. Available online at:

http://www.iac.wa.gov/Documents/SRFB/Monitoring/MC-6_Channel_Connectivity_Projects.pdf

Spawning Gravel

Crawford, B. 2004. Protocol for monitoring effectiveness of spawning gravel projects. Prepared for the Interagency Committee for Outdoor Recreation, Washington Salmon Recovery Funding Board. SRFB MC-7. Available online at:

http://www.iac.wa.gov/Documents/SRFB/Monitoring/MC-7_Spawning_Gravel_Projects.pdf

Instream Diversions

Crawford, B. 2004. Protocol for monitoring effectiveness of instream diversion projects (irrigation diversion dams, water treatment plants, pipes, ditches, head gates, hydropower penstocks). Prepared for

the Interagency Committee for Outdoor Recreation, Washington Salmon Recovery Funding Board. SRFB MC-8. Available online at:

http://www.iac.wa.gov/Documents/SRFB/Monitoring/MC-8_Instream_Diversion_Projects.pdf

Habitat Protection

Crawford, B. and J. Arnett. 2004. Protocol for monitoring effectiveness of habitat protection projects (land parcel biodiversity health). Prepared for the Interagency Committee for Outdoor Recreation, Washington Salmon Recovery Funding Board. SRFB MC-10. Available online at:

http://www.iac.wa.gov/Documents/SRFB/Monitoring/MC-10_Habitat_Protection_Projects.pdf

Habitat Restoration

Crawford, B. 2004. Field sampling protocols for effectiveness monitoring of habitat restoration and acquisition projects. Prepared for the Interagency Committee for Outdoor Recreation, Washington Salmon Recovery Funding Board. Available online at:

http://www.skagitwatershed.org/pdf/monitoring/method_texts/field_sampling_protocols.pdf.

U.S. FOREST SERVICE

Aquatic Riparian Effectiveness Monitoring Program/PACFISH/INFISH Monitoring Program

Aquatic and riparian effectiveness monitoring program and PACFISH/INFISH monitoring program. 2004. Effectiveness monitoring for streams and riparian areas within the Pacific Northwest: stream channel methods for core attributes. Available online at:

http://www.reo.gov/monitoring/watershed/docs/2004-Final-AREMP-PIBO-Core-Attributes-Stream-Sampling-Protocol.pdf

This document describes a protocol standardization effort between the Aquatic Riparian Effectiveness Monitoring Program and the PACFISH/INFISH monitoring program. The core set of attributes in this document are collected by both programs and are described in the literature as being important in defining physical habitat conditions and their relationship with aquatic species. Described here are the minimum number of measurements, the frequency of the measurement, and the location of the measurements to ensure consistent data collection efforts, however actual tools and techniques are left to the discretion of the individual programs.

The Forest Service does have additional protocols for survey and monitoring projects, many of which were developed under the Northwest Forest Plan. These protocols vary by region and many are species specific. Additional information on specific sampling procedures can be obtained by contacting regional Forest Service offices.

U.S. FISH AND WILDLIFE SERVICE

Starr, R.R. and T. McCandless. 2001. Stream and Riparian Habitats Rapid Assessment Protocol. U.S. Fish and Wildlife Service, Chesapeake Bay Field Office, Annapolis, MD.

This document describes comprehensive stream and riparian corridor assessment and inventory protocol for use by trained professionals to rapidly identify, assess, and prioritize stream corridor conditions. The

protocol provide a relative ranking of streams, based on stream stability and riparian and in-stream habitat assessment. Parameters measured include aggrading and degrading bed stability, stream stability evolutionary trend, bank height ratio, rooting depth, root density, bank angle, surface protection, in-stream cover, epifaunal cover, velocity/depth regimes, shading, water appearance, nutrient enrichment, riparian vegetation zone characteristics, riparian zone nutrient uptake, and bank vegetation. These protocol do not address reference conditions or performance standards, however the authors conclude that they may be useful in identifying these baselines for stream enhancement and restoration projects as well as monitoring changes in the physical stream environment.

Habitat Evaluation Procedure

U. S. Fish and Wildlife Service. 1980. Habitat as a basis for environmental assessment. Division of Ecological Services, Department of the Interior, Washington D. C. 101-ESM. Available online at:

http://policy.fws.gov/ESMindex.html

U. S. Fish and Wildlife Service. 1980. Habitat Evaluation Procedures. Division of Ecological Services, Department of the Interior, Washington D. C. 102-ESM. Available online at:

http://policy.fws.gov/ESM102.pdf

U. S. Fish and Wildlife Service. 1980. Standards for the development of habitat suitability index models for use with Habitat Evaluation Procedures. Division of Ecological Services, Department of the Interior, Washington D. C. 102-ESM. Available online at:

http://policy.fws.gov/ESM103.pdf

Habitat Evaluation Procedures (HEP) are a quantitative methodology for determining the quality and quantity of habitat available for a wildlife species, and is based on the assumption that habitat for a selected species can be described in terms of a Habitat Suitability Index (HSI). HSIs can be used to monitor the changes in habitat quality in one location over time, or to compare the differences between habitat quality in multiple locations at the same time. These documents describe the rational and methodology behind a habitat based assessment for use in impact assessment and project planning. ESM-101 addressed the justification for a habitat based technique and discusses the conceptual approach to habitat assessment. ESM-102 describes how the concepts in the first document can be implemented in a standardized procedure for conducting habitat evaluations in the field. This consists of the quantification of two primary variables including (1) habitat suitability indices (HSI), and (2) the total area of available habitat. ESM-103 provides guidance for development of habitat models. Collectively the three documents serve as a useful tool for habitat evaluations. HEP methodology was developed primarily for application to terrestrial and inland aquatic ecosystems but are equally applicable to estuarine systems.

U.S. ENVIRONMENTAL PROTECTION AGENCY

MacDonald, L. H., A. W. Smart, and R. C. Wissmar. 2001. Monitoring guidelines to evaluate effects of forestry activities on streams in the Pacific Northwest and Alaska. Prepared for Region 10, U. S. Environmental Protection Agency, Seattle, Washington. EPA 910/9-91-001. Available online at:

http://www.epa.gov/cgi-bin/claritgw

This document provides guidance for designing water quality monitoring projects and selecting monitoring parameters. Sampling procedures, study design, and statistical analysis are addressed. Selection of monitoring parameters is defined as a function of the designated water uses, management activities, sampling frequency, monitoring costs, access, and physical environment. Parameters addressed

are grouped into 6 categories including physical and chemical constituents, flow, sediment, channel characteristics, riparian, and aquatic organisms. For each parameter, the definition, relationship to designated uses, response to management activity, measurement concepts, standards, current uses, and assessment are discussed.

Barbour, M. T., J. B. Stribling, J. Gerritsen, and J. Karr. 2001. Biological criteria: technical guidance for streams and small rivers, revised edition. U. S. Environmental Protection Agency, Washington D. C.

The purpose of this document is develop and use biocriteria for streams and small rivers. It is designed for water resource managers and biologists familiar with biological survey techniques and the guidance document "Rapid bioassessment protocols for use in streams and rivers: benthic macroinvertebrates and fish" (Plafkin et al. 1989) and is to be used in conjunction with that document. The biosurvey/biocriteria process provides a way to measure the condition of water resources in terms of their attainment or nonattainment of biological integrity (i.e., the most robust aquatic community expected under natural conditions unimpaired by human activities), serving as a benchmark for water resource protection and management.

Lazorchak, J. M., B. H. Hill, D. K. Averill, D. V. Peck, and D. J. Klemm, editors. 2000. Environmental monitoring and assessment program-surface waters: Field operations and methods for measuring ecological conditions of non-wadable rivers and streams. U. S. Environmental Protection Agency, Cincinnati, Ohio.

This document describes procedures for collecting data, samples, and information about biotic assemblages, environmental measures, and attributes of non-wadable streams and rivers for evaluating their health and biological integrity. The procedures presented are intended for use in field studies sponsored by the U. S. Environmental Protection Agency Environmental Monitoring and Assessment Program (EMAP). Development and testing of the protocol were based on standard and accepted methods, adapted to EMAP sampling requirements, and on sample sites in the mid-Atlantic region and Oregon, and are thus widely applicable to a range of environmental conditions. Parameters discussed include water chemistry, physical habitat, benthic macroinvertebrate assemblages, aquatic vertebrate assemblages, fish tissue contaminants, periphyton assemblages, and sediment community metabolism. This document describes field implementation and related logistical information including example field data forms and checklists of supplies and equipment needed for each field task.

Lazorcheck, J. M., D. J. Klemm, and D. V. Peck, editors. 1998. Environmental monitoring and assessment program-surface waters: field operations and methods for measuring ecological conditions of wadable streams. U. S. Environmental Protection Agency, Washington, D. C.

This document provides information equivalent to that described above for non-wadable streams. These methods are intended to be used by U. S. Environmental Protection Agency regional, enforcement, and research programs engaged in inland, estuarine, and marine water quality and permit compliance monitoring, and status and/or trends monitoring for the effects of impacts on aquatic organisms. Biological field and laboratory data protocol are addressed.

Kaufman, P. R., P. Levine, E. G. Robison, C. Seelinger, and D. V. Peck. 1999. Quantifying physical habitat in wadable streams. U. S. Environmental Protection Agency, Washington D. C.

This document describes concepts, rational, and analytical procedures for characterizing physical habitat in wadable streams, based on methods used by the U. S. EPA Environmental Monitoring and Assessment Program (EMAP). Parameters including gradient, sinuosity, substrate size and stability, habitat complexity and cover, woody debris size and abundance, residual pool dimensions and frequency,

riparian vegetation cover and structure, anthropogenic disturbances, and channel-riparian interactions. Development of these protocol were based on several hundred streams monitored in Oregon and the Mid-Atlantic region.

Wetlands

Methods for Evaluating Wetland Condition. U. S. Environmental Protection Agency, Health and Ecological Criteria Division and Wetlands Division. Individual modules available online at:

http://www.epa.gov/waterscience/criteria/wetlands/

The EPA is preparing a set of technical documents to give states and tribes "state-of-the-science" information that will help them develop biological assessment methods to evaluate both the overall ecological condition of wetlands and nutrient enrichment (one of the primary stressors on many wetlands). The 20 modules are a starting point to help states and tribes establish biological and nutrient water quality criteria specifically refined for wetlands. The modules include: an introductory, administrative, and study design module, and modules that provide guidance on wetland plants, macroinvertebrates, algae, amphibians, birds, nutrient enrichment, classification, land-use characterization and volunteer monitoring. Additional modules will be added to this series.