TFW-AM9-97-001

TFW Monitoring Program

STATUS REPORT

For the period:
July 1, 1995 to June 30, 1997

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1. Introduction

A cornerstone of Washington's Timber-Fish-Wildlife (TFW) forest management system is adaptive management, the process of gathering and using scientific information to evaluate and improve management decisions. Monitoring is an important element of the adaptive management process that is necessary to determine whether the aquatic resource protection goals of the 1988 TFW Agreement are being achieved. The TFW Monitoring Program (TFW-MP) is a cooperative, inter-agency monitoring effort initiated in 1989 to fill the need for monitoring information in the TFW process. It focuses on assessing and monitoring channel and salmonid habitat conditions in streams on state and private forest land in Washington State, and evaluating the effectiveness of forest practices in meeting habitat and water quality goals. TFW Monitoring is a cooperative endeavor involving TFW participants (Washington Indian Tribes, timber producers, state resource agencies, and environmental organizations) and the TFW Cooperative Monitoring, Evaluation and Research Committee (CMER). Monitoring support and coordination is provided by the TFW-MP staff at the Northwest Indian Fisheries Commission (NWIFC) through a contract with the Washington Department of Natural Resources (WDNR) under the direction of the CMER's Monitoring Steering Committee (MSC). Most monitoring information is collected by TFW participants who design projects to meet local/regional processes and needs. The TFW-MP provides tools and services to assist and support these monitoring efforts. It also analyzes and disseminates monitoring information, and responds to the need for development of monitoring strategies as TFW management processes evolve over time.

This document reports on the activities of the TFW Monitoring Program during the biennium beginning July 1, 1995 and ending June 30, 1997. The TFW Monitoring Program has been focused in two major areas during this period: 1) providing services to help TFW cooperators successfully complete monitoring efforts, and 2) developing new tools and programs to initiate effectiveness monitoring in the TFW arena. A description and progress report on progress during the biennium is provided in section 2 of this report. Future directions for the program are discussed in Section 3.

2. Progress Report and Description of Accomplishments

For the purposes of this report, the work during the biennium has been divided into six tasks: cooperative monitoring services (2.1); testing and refinement of monitoring methods (2.2); development of the TFW effectiveness monitoring strategy (2.3); development of standard methods (2.4); a literature review on trend monitoring (2.5); and an investigation of factors influencing spawning and incubation habitat conditions (2.6). This section describes of the progress and accomplishments of the TFW Monitoring Program in each of the six areas.

2.1 Cooperative Monitoring Services to Assist TFW Participants

An important function of the TFW Monitoring Program is to provide services to assist the TFW organizations conducting monitoring. To produce monitoring information that TFW can use with confidence, successful monitoring studies must be well planned and implemented. This requires quality work at every step of the monitoring process, including study design, selection of parameters, collection of data, and analysis of results. The TFW Monitoring Program provides monitoring manuals, training, quality assurance , and database support to help TFW cooperators achieve quality results. Each of these aspects is discussed below.

2.1.1 TFW Monitoring Methods Manual Update and Distribution

The TFW Monitoring Program Manual is the reference tool for planning and conducting monitoring surveys. It contains detailed descriptions of standard monitoring data collection methods and procedures and provides detailed instructions on how to conduct stream surveys. It also contains information on study design, identifying stream segments, quality assurance, data analysis, and data archiving.

During the biennium we completed write-ups for the Spawning Habitat Availability and Spawning Gravel Scour surveys. We also began updating the TFW-MP Introduction, Segment Identification, Reference Point Survey, Habitat Unit Survey, Large Woody Debris Survey and Stream Temperature Survey for the 1997 training session, incorporating refinements based on evaluation of quality assurance results. Over 1000 copies of the 1994 version of the manual have been distributed to Washington TFW participants and interested parties throughout the United States and Canada.

2.1.2 Training

Two types of training are provided by the TFW monitoring program, training in the application of monitoring methods and training in the Watershed Analysis monitoring identification procedure.

<u>Monitoring Methods Training</u>
Thorough training of personnel conducting monitoring surveys is one of the basic elements of a successful monitoring project. The TFW-MP provides comprehensive training services to promote consistent application of TFW-MP methods throughout the state. These services are available through annual training workshops and on-site field training and assistance visits. Many experienced cooperators use these services year after year to ensure consistency in monitoring strategies, method application and data quality.

Instruction of standard methods and consistency in their application requires a high level of training commitment. Allen Pleus, the TFW-MP lead trainer, has been with the program for seven years and TFW-MP staff have 20 years of combined experience with the TFW methods. This has provided a high level of training consistency and quality.

The annual training workshops are conducted during the second week of June and the fourth week of July. Four days of training are provided in the June workshops to cover the Stream Segment Identification, Wadeable Stream Discharge Methods and the Reference Point, Habitat Unit, Large Woody Debris, and Stream Temperature Surveys. In 1995, a one day July workshop covered the Salmonid Spawning Gravel Composition Survey. In 1996, the July workshop expanded to three days to include training in the Salmonid Spawning Habitat Availability and Spawning Gravel Scour Surveys.

These workshops are designed to provided both basic instruction and hands-on experience in the survey methods. Volunteer instructors, guest speakers and assistants are an integral part of the training services the TFW Monitoring Program provides. These volunteers attend pre-workshop meetings and field training in preparation for the workshops. The 1997 June workshops used 22 volunteers in addition to the four TFW-MP staff members.

Evaluations from participants confirm the success of these workshops. Excerpts from the "what I liked best" comments include: "detailed review - covered a lot of information, answered a lot of questions;" "good to see things in real life;" "good hands-on examples of varied situations;" "the way she [the instructor] explained everything so clearly;" "great to hear from experienced field folks;" and "was actually learning about the Large Woody Debris Survey!!" Excerpts from the "general comments" include: "I have learned a lot and had a great time," and "thanks for a very thorough, helpful week. See you in July."

Demand for attendance at the workshops has grown rapidly (Table 1). In fact, demand has surpassed our ability to provide training to everyone who requests it. The ideal daily workshop size is 45 - 50 people. This number provides a good student-to-teacher ratio and a manageable group size at the stream training site. To maintain this optimal size, it was necessary in 1996 to give priority to TFW participants and those who are using our methods to collect field data the same season. In 1997, registration was closed two weeks prior to the June workshops, and over a month prior to the July workshops when daily registration hit the 60 applicant daily limits.

On-site field training and field assistance services are offered statewide throughout the year on an appointment basis. This service is most often used by those cooperators who cannot attend the annual workshops or require further training to address local watershed conditions. These visits provide individual training in all the survey methods covered at the workshops, plus assistance in study design development and implementation strategies. On-site training also provides an opportunity to focus on method application under local conditions. Many cooperators in the more remote areas of the state find this service to be one of the most valuable we offer.

Table 1. TFW Monitoring Program annual training workshop participation (number of people attended/registered by workshop).

	Workshops	1992	1993	1994	1995	1996	1997
June	Stream Segment Identification Method	?	?	36/46	44/54	50/75	50/70
	Reference Point and Large Woody Debris Surveys	?	?	22/34	43/54	46/64	49/69
	Habitat Unit Survey and Discharge Method	?	?	24/34	41/53	44/67	47/65
	Stream Temperature Survey	N/A	N/A	19/31	41/55	44/67	47/65
July	Spawning Gravel Composition Survey	N/A	?	36/50	37/62	32/58	45-50**
	Spawning Habitat Availability Survey	N/A	N/A	N/A	N/A	41/71	45-50**
	Spawning Gravel Scour Survey	N/A	N/A	N/A	N/A	40/66	45-50**
	Total # People/day	**55***	**89**	**137**	**206**	**303**	**327****

? registration/attendance figures not available; N/A workshop not offered; *estimated; **estimated as of 6/26

TFW-MP provided 16 on-site field training and assistance visits for a total of 87 people in 1995 and 9 visits for a total of 45 people in 1996 (Table 2). There have been five training visits conducted for a total of 21 people in 1997 to date. The reduction in number is a reflection of more people attending the workshops instead of requesting on-site visits and implementation of the prioritization structure due to increased demand for training and other services by TFW participants.

Table 2. Training assistance provided by the TFW Monitoring Program through annual workshop and on-site field assistance visits.

Training Services	**1995**	**1996**	**1997**
Workshops	206	303	327*
On-Site	87	45	21*
Total People/day	293	348	348*

*estimated as of 6/26/97

Watershed Analysis Monitoring Training

Training in Watershed Analysis monitoring is incorporated into the Watershed Analysis training sessions conducted several times a year by the Washington Department of Natural Resources (WDNR). TFW Monitoring Program staff (Amy Morgan, Allen Pleus and Dave Schuett-Hames) assisted the WDNR in designing the original training program for the Watershed Analysis Monitoring (WAM) module, providing the training, and modifying the training program over time in response to comments and changes in the schedule. WAM training consists of a brief introductory overview for the entire group on the first day, followed by a more intensive lecture and group exercise later in the week for people especially interested in monitoring. The group exercise involves developing monitoring objectives and sampling plans using causal mechanism reports and prescriptions from the Mashel Watershed Analyses.

During the past biennium, TFW Monitoring Program staff assisted with the monitoring training in six WDNR-sponsored training sessions (four regular sessions and two make-up session for people who completed training before the monitoring module was developed). The staff provided follow-up support and technical assistance to several Watershed Analysis teams developing Watershed Analysis Monitoring plans and assisted DNR in peer review of Watershed Analysis Monitoring Plans. The TFW-MP also conducted a project to evaluate the effectiveness of the Watershed Analysis monitoring module and provided recommendations for improvement (Report TFW-AM-9-96-003).

2.1.3 Quality Assurance Reviews

Quality Assurance (QA) Review services are offered on-site to individual cooperators to ensure and document consistent application of the TFW-MP standard methods by field crews. These services are available statewide throughout the year. Allen Pleus, the TFW-MP lead quality assurance reviewer, has conducted QA Reviews for the program since 1992. During this time, the QA Review system has developed into a rigorous and scientifically sound testing and evaluation format that provides insights into factors influencing monitoring variability. This system is unique among state and regional monitoring programs.

There are three goals for QA Review services: 1) to help cooperators collect data of the highest quality; 2) to provide feedback to the cooperator and the TFW Monitoring Program on factors affecting data quality and repeatability; and 3) to identify topics for projects to test and refine the methods.

A successful monitoring QA Plan includes both TFW-MP training, practice in application of the methods and techniques on study area streams, and a pre-season QA Review. Cooperators who have utilized these services have stated that it provides them with the highest level of confidence in the abilities of their crews, and the resulting data quality. This translates into confidence that baseline and trend monitoring studies depict accurate channel conditions or changes in those conditions over time. Demand for this service has started to increase as more cooperators recognize its value (Table 3).

Table 3. TFW Monitoring Program number of QA Reviews by survey type and year.

QA Review	1992	1993	1994	1995	1996	1997*	Total
Reference Point	2	1		1	2	1	7
Habitat Unit	5	5	3	2	3		18
LWD Level 1			1	1	4	1	7
LWD Level 2	5	2	3	2	1		13
Temperature	N/A			1	2		3
SG Comp - Collection	N/A	4	3	1	2		10
SG Comp - Processing	N/A	1	4	3	3		11
S Habitat Availability	N/A	N/A	N/A	N/A			0
SG Scour	N/A	N/A	N/A	N/A			0
Total	12	13	14	11	17	2	69

N/A means workshop was not offered.

QA Reviews are conducted in a respectful, supportive atmosphere. Cooperators are provided with detailed reports on strengths, weaknesses and recommendations for improving their application of the methods. Two types of QA Reviews are used: 1) replicate surveys; and 2) observational surveys.

Replicate surveys are conducted for the Reference Point, Habitat Unit, Large Woody Debris, and Spawning Habitat Availability Surveys. In a typical replicate survey, the cooperator and QA Review crews conduct the same survey on a well-defined section of stream within the cooperator's study area. Upon completion, the two crews meet and use a specially designed QA Review form to match and compare individual survey parameters and identify discrepancies. This process includes re-walking the testing section and discussing reasons for discrepancies.

Observational surveys are conducted for the Stream Temperature, Spawning Gravel Composition and Spawning Gravel Scour Surveys. In a typical observational survey, the QA crew uses a detailed checklist to document the consistency of cooperator crews in the methods being reviewed. A minimum of three complete applications are observed for each method, such as: a) temperature logger site installation; b) spawning gravel composition sample collection: c) spawning gravel sample processing; and d) scour monitor site insertions. Upon completion, any discrepancies identified and reasons for them are discussed.

2.1.4 Database/Data Requests

The TFW Monitoring Program maintains a statewide database of stream survey information collected by TFW cooperators. Amy Morgan works with TFW cooperators on data import, data archiving and data request services. Data entry and initial error-checking is completed by the cooperator. Then a digital copy of the data is forwarded to the NWIFC. After a subsequent round of error-checking, the information is imported into the database, which performs calculations on the data and generates a survey summary report of survey results. Copies of the summary reports are provided to the cooperator along with digital copies of the data, if desired. In addition, copies of the field forms and map locations of survey reaches are archived at the NWIFC. The Washington Department of Fish and Wildlife enters survey boundary locations into their GIS system for use by Watershed Analysis teams.

During the past biennium, the TFW Monitoring Program has undertaken development of a unified Oracle relational database for TFW monitoring survey data with the assistance of Anita Gilliam, NWIFC database manager. This system, known as AMBSYS, is now operational for Segment location, Reference Point Survey, Habitat Unit Survey, Large Woody Debris Survey and Spawning Gravel Composition Survey data. The AMBSYS system design is shown in Appendix A. New data that are received are input into this system using a spreadsheet pr database format data entry system. We are currently in the process of transferring existing data to the new system. Appendix B is a list of TFW Monitoring Surveys in the AMBSYS database sorted by Water Resource Inventory Area (WRIA). It shows the type of surveys conducted and the status of the information.

In other database-related work, a data archiving section for the manual has been completed that includes a packet sent to cooperators describing the information is needed to archive their data. Substantial progress has been made towards completing the archiving process for the entire database, so field forms and survey location descriptions are now available for nearly all surveys. We also have responded to requests for monitoring data, and have developed a data access policy to guide requests for digital copies of data for non-TFW purposes.

To improve communications with TFW participants, we developed and implemented a TFW Monitoring home page at the NWIFC web site (http://mako.nwifc.wa.gov). The home page contains a description of the program, a list of stream segments where surveys have been conducted, and copies of TFW Monitoring Program Reports. We are currently in the process of bringing the TFW Monitoring Program manual on-line.

2.2 Testing and Refinement of Methods

The method testing and refinement component of the TFW Monitoring Program is designed to answer questions about the variability associated with the application of new and existing survey methods. The following is a brief review of testing and refinement projects during 1996 and 1997. An historic review of TFW Monitoring Program projects to test and refine methods conducted between 1991 and 1995 is provided in Appendix C.

<u>1996</u>

- *Refinements*
- ◊ The standard shovel with stilling well can be an adequate substitute for the McNeil sampler when applied under conditions similar to those of the streams sampled (Schuett-Hames et al. 1996).
- ◊ Continued improvements in the annual training workshops format to standardize instruction and incorporate more participant hands-on practice.
- *Testing*
- ◊ Conducted a total of 17 QA Reviews on Reference Point, Habitat Unit, Large Woody Debris, Stream Temperature and Spawning Gravel Composition Surveys.
- ◊ Research on field comparisons of the McNeil sampler with three shovel-based methods used to sample spawning gravel composition.
- ◊ Preliminary analysis of Reference Point Survey QA Review data indicated significant variability in:

a) bankfull channel edge identification and protocol;
b) mean bankfull channel depth measurement protocol;
c) spherical densiometer equipment and protocol;
d) identification of 90^0 angle bankfull channel cross-sections in relation to a reference point

1997

- *Refinements*

◊ Continued improvements in the annual training workshop format to standardize instruction and incorporate more hands-on practice including:
  a) focus on 'basics' of each method;
  b) afternoon advanced practice and testing sessions;

◊ 1997 Update Addendum and training workshop instruction for the Stream Segment Identification Method including:
  c) new layering system, sorting structures and lumping/splitting rules for determining stream segment breaks;
  d) optional sub-segment identification system;
  e) updated Form 1

◊ 1997 Update Addendum and training workshop instruction for the Reference Point Survey including:
  f) emphasis on the default method for determining edges of the bankfull channel;
  g) new bankfull depth measurement protocol;
  h) procedure to establish cross-sections at a 90^0 angle in relation to off-channel reference points.

◊ 1997 Update Addendum and training workshop instruction for the Habitat Unit Survey including:
  i) habitat unit type simplification to the pool/riffle level. Cascades and tailouts (pool glides) are now instructed as sub-unit types in training workshop; and
  j) instruction on a default method for conditions where unit boundary indicators are vague or highly irregular.

◊ 1997 Update Addendum and training workshop instruction for the Spawning Gravel Composition Survey including:
  k) instruction on using the shovel spawning gravel sampler at the July training workshop.

- *Testing*

◊ Conducted a total of 2 QA Reviews to date on Reference Point and Large Woody Debris Surveys.

◊ Initial research and testing of spherical densiometer hemishperical arc of views, sample area overlap and equipment modification.

2.3 TFW Effectiveness Monitoring Plan Development

The TFW Policy Committee requested development of an effectiveness monitoring strategy for aquatic resources by TFW's Cooperative Monitoring, Evaluation and Research Committee (CMER) in June of 1996. The Monitoring Steering Committee (MSC) responded to this request, assigning Dave Schuett-Hames to work with the MSC on this project. A proposed effectiveness monitoring strategy was developed with funding from WFPA and presented to the TFW Operations Committee in November (Report TFW-AM9-96-007). The strategy document reviewed effectiveness monitoring programs from other states and provinces and proposed development of a custom effectiveness monitoring program due to the sophistication of the management systems (such as Watershed Analysis) in Washington State and the unique TFW cooperative forest management structure. Eight monitoring issues related to the effects of forest practices on aquatic resources were identified: 1) shade and stream temperature; 2) LWD recruitment; 3) mass wasting sediment input; 4) surface erosion sediment input; 5) fish passage; 6) hydrology; 7) forest chemicals; and 8) cumulative effects on aquatic resources. The strategy document proposed a cooperative implementation effort consisting of a core monitoring project funded by CMER, augmented by voluntary monitoring conducted by TFW participants. The TFW Monitoring Program was assigned the role of coordinating the program and providing an information clearinghouse, and the MSC was assigned the role of evaluating effectiveness and reporting results to CMER and the TFW Policy Committee.

Following presentation of the effectiveness monitoring strategy to the TFW Operations Committee, MSC received approval to proceed with development of a plan for the TFW effectiveness monitoring program and a CMER-funded pilot project based on the regional, multi-objective, watershed-based approach proposed in the strategy document. The draft TFW effectiveness monitoring and evaluation plan was developed with input and assistance from the MSC and mailed out to CMER for review and comment. It describes the program proposed by the TFW Monitoring Steering Committee to monitor and evaluate the effectiveness of forest practices on state and private forest land in Washington State and presents a cooperative implementation plan. The draft TFW effectiveness monitoring and evaluation program plan is available from NWIFC.

2.4 Development of Standard Methods

The goal of the TFW Monitoring Program during this period was to expand the suite of standard monitoring methods available for use by TFW participants. Work began by finalizing the standard methods for spawning gravel scour (Report TFW-AM-9-96-001) and spawning habitat availability (Report TFW-AM-9-96-002) and integrating these methodologies into the monitoring manual and training workshop.

Since then the emphasis in method development has focused on methods of monitoring channel conditions and input processes. Development of channel and input process monitoring methods will provide the capability for TFW participants to conduct integrated monitoring of changes in input processes and associated channel and habitat response. This capability is needed to conduct monitoring and evaluation of prescription effectiveness called for in voluntary Watershed Analysis Monitoring plans and to evaluate effectiveness of forest practices as described in the TFW Effectiveness Monitoring and Evaluation Program Plan.

Monitoring parameters and methods for channel features that respond to changes in the input of water, sediment and wood to the stream channel were reviewed through a contract (funded by WFPA) with Carlos Ramos, a graduate student at the University of California in Berkeley. His report identifies potential channel parameters (diagnostic features) responsive to changes in input factors and discusses methods for monitoring these features, and recommends sampling methods. The report on this project (TFW-AM9-9-006) is available from WDNR or NWIFC.

Next, methods for monitoring mass wasting and surface erosion were investigated. Carlos Ramos was also the contractor for these projects. These investigations involved a literature review of existing parameters and methods, followed by interviews with TFW cooperators. This information was used to identify and recommend monitoring parameters and methods. The reports for these projects are available from NWIFC.

Work was also initiated on standard methods for monitoring riparian conditions related to LWD recruitment and shade as part of our input process monitoring effort. This project was conducted by Devin Smith of the NWIFC and involved a literature review and interviews with practitioners to identify approaches to riparian monitoring, LWD recruitment models, monitoring parameters and potential monitoring methods. Additional work is planned to field test the proposed methods prior to finalization.

Finally, Amy Morgan of the NWIFC investigated habitat and channel monitoring methods for large rivers. The current TFW monitoring survey methods are most suitable for wadeable streams and are not suitable for large, deep rivers that do not provide easy access for field measurements. The purpose of this investigation was to evaluate the limitations of the current methods in large river situations, identify alternative methods to obtain information on current monitoring parameters, and recommend additional parameters and methods that are more suitable for characterizing changes in habitat and channel conditions in large rivers. The results of this project are attached in Appendix D.

2.5 Trend Monitoring Literature Review

Amy Morgan and Devin Smith conducted a review of existing information on monitoring trends in habitat and channel conditions in response to changes in watershed inputs. The purpose of this project was to assemble information and provide recommendations that provide guidance in: designing long-term trend monitoring studies, developing aquatic resource disturbance and recovery prognoses for Watershed Analysis monitoring plans, and in interpreting long-term monitoring results. The project involved a review of literature and interviews with people involved in long-term monitoring. The report on this project is available from NWIFC.

2.6 Factors Influencing Salmonid Spawning and Incubation Habitat

This project was a preliminary investigation of the relationship between spawning habitat conditions and geomorphic factors such as lithology, channel gradient and coarse sediment supply, conducted by Devin Smith with assistance from Bob Conrad, NWIFC biometrician. The purpose of this pilot project was to identify relationships that would be helpful in interpreting monitoring data on spawning habitat conditions and develop recommendations for further study of significant relationships. The preliminary results of the pilot project indicate that geology has a strong influence on spawning habitat characteristics, however the influence of gradient and coarse sediment supply were variable and no consistent patterns were evident. Recommendations for future investigation include: 1) reduce the number of parameters measured; 2) collect information at more sites in each lithology to verify the patterns identified in the pilot project; and 3) develop a more sophisticated approach to characterize sediment supply and routing. The results of this project are attached in Appendix E.

3. Future Direction

In the past biennium, the TFW Monitoring Program has undergone a transition in purpose and direction. We began the biennium as a program focused on providing tools and assistance to TFW cooperators assessing and monitoring salmonid habitat. By the end of the biennium our agenda has expanded to include development and coordination a TFW effort to monitor the effectiveness of forest practices and forest management systems. Continuing and improving the monitoring tools and services that we provide to TFW participants while beginning to implement the TFW Effectiveness Monitoring strategy are the challenges and opportunities we face in the coming two years.

3.1 Implementing the TFW Effectiveness Monitoring Strategy

The major task the TFW Monitoring Program needs to undertake in the coming two years is to complete development and begin implementation of the TFW Effectiveness Monitoring and Evaluation Plan. The main tasks involved are discussed below.

Effectiveness Monitoring Study Design Guidelines and Monitoring Methods. The TFW Effectiveness Monitoring and Evaluation Plan calls for site-scale evaluation of practice effectiveness and watershed-scale evaluation of resource response to multiple practices occurring under various forest management systems. Five priority areas have been identified, including mass wasting, surface erosion, riparian LWD recruitment, riparian shade and fish passage. Preparation work needs to occur in each of these areas before pilot monitoring projects can be implemented. Tasks include development of study design guidelines, standard monitoring methods, identification of monitoring situations, and development of pilot project proposals. The preparation work in these areas is scheduled to occur by the end of June 1998. At this time, the MSC will select pilot projects from the proposals, which will be implemented between July 1998 and June 1999. Table 4 shows the schedule of tasks for the biennium.

Table 4. Implementation tasks and timeline for the TFW effectiveness monitoring and evaluation strategy.

Tasks	Mass Wasting	Surface Erosion	Hydrology	LWD Recruitment	Thermal Energy	Chemical Input	Fish Passage	Habitat Alteration	Cumulative Effects
1. Preparation									
Study Design Guidelines	1	1	3	1	1	3	1	3	2
Situational Categories	1	1	3	1	1	3	1	3	2
Sampling Methods	1	1	3	1	1	3	1	3	2
Pilot Project Proposals	1	1	3	1	1	3	1	3	2
2. Pilot Projects									
Design Pilot Projects	1	1	3	1	1	3	1	3	2?
Implement Pilot Projects	2	2	3	2	2	3	2	3	2?
3. Full-scale Implement.	3	3	?	3	3	?	3	?	3
Identify TFW priorities	1	1	3	1	1	3	1	3	2

1= underway, complete by June 1998; 2= complete by June 1999; 3= after June 1999

A framework for cooperative efforts to assess and monitor trends in aquatic resources is needed to produce information that can be used to document regional and statewide trends in aquatic resource conditions (salmonid habitat and populations, and water quality). We propose to conduct regional meetings with cooperators to identify priority questions and issues, and to develop a cooperative strategy to collect information to answer aquatic resource trend questions.

CMER/MSC Effectiveness Information Bank. We need to design, build and begin operating the CMER/MSC effectiveness information bank, a central clearinghouse for effectiveness monitoring information, including both data and the analyzed results and conclusions of effectiveness monitoring studies. Development of the information bank will involve a number of steps, including: conceptual design to make it useful to users, construction of the information storage system, development of guidelines and criteria to identify suitable information, and development of outputs to TFW users.

Adaptive Management Process. The format and content of effectiveness monitoring reports needs to be determined. Three types of reports have been identified to address different information needs, 1) reports for policy representatives that evaluates management system effectiveness, 2) reports for field managers that evaluate the effectiveness of specific practices, and 3) reports for resource managers that documents trends in the condition of aquatic resources. A test of the adaptive management advisory committee process will be initiated when the results of the pilot monitoring projects become available.

3.2 Improving Monitoring Tools and Services for TFW Participants

Projects in this area include new method development, improvement of the TFW Monitoring Program Manual, training, database expansion and improvement, quality assurance, methods testing and refinement projects, and Watershed Analysis monitoring training.

New Method Development. Development of new monitoring methods in this biennium will focus on methods needed to conduct effectiveness monitoring, as discussed in the previous section.

TFW Monitoring Program Manual. The methods manual is currently being updated and revised. The format of the manual will be changed from a single, bound monitoring manual containing all survey methods to a modular format with each method available as a separate, stand-alone document. As the number of methods is expanded over time, this format will reduce costs by making it unnecessary to reprint the entire manual when a method is added or changed. We also want to make the TFW monitoring manual available on-line at the TFW Monitoring Program web-site to provide instant access to the latest version of the manual.

The existing methods are currently being updating to incorporate changes suggested by testing and refinement projects and quality assurance results. This process will be completed for the Segment Identification, Reference Point, Habitat Unit, Large Woody Debris, Stream Temperature, Spawning Gravel Composition, Spawning Habitat Availability and Spawning Gravel Scour surveys in time for the training session in the summer of 1998. In the second half of the biennium, the methods manual will be expanded to include the new effectiveness monitoring methods under development, including mass wasting, surface erosion, riparian LWD recruitment, riparian shade, and fish passage.

Training. We need to expand our ability to provide training to the methods in response to increased interest in the annual training sessions. Training videos are one way of reaching people who cannot attend the sessions or are in remote locations. Another idea is to develop a network of trainers who can respond to requests for training in their regions or to requests from academic institutions. The training workshops need to be expanded to include training in study design and new methods as they are incorporated into the manual.

Database. Data collected in the past is currently being re-formatted and imported into the new AMBSYS database system. This process needs to be completed for the 1989-91 data. Work is also needed complete enhancements to the AMBSYS system to improve the ease of importing, maintaining and error-checking data. We need to develop databases, calculations and reports for several existing surveys, including stream temperature, spawning habitat availability, and spawning gravel scour. Database development and programming for the new effectiveness monitoring methods currently under development will also be needed. Development of the user data entry system currently being constructed in Access needs to be finished and the feasibility of providing on-line access to data should be investigated.

Quality Assurance. Quality Assurance Review procedures need to be developed for the new effectiveness monitoring methods.

Testing and Refinement of Methods. Following is an agenda for testing and refinement of the existing monitoring methods. Priorities need to be determined prior to implementation.

Stream Segment Identification Method

- Finalize '97 manual draft version of the Stream Segment Identification Method for distribution as a stand-alone document to facilitate individual refinements and production.

Reference Point Survey

- Finalize '97 manual draft version of the Reference Point Survey for distribution as a stand-alone document to facilitate individual refinements and production.
- Research, design and test Reference Point Survey methods including:
  a) modified spherical densiometer variability;
  b) bankfull channel edge identification method against various other methods using existing monumented bankfull channel cross-section information;
  c) method for field identification of bankfull channel edge.

Habitat Unit Survey

- Continue work on '97 manual draft version of the Habitat Unit Survey for distribution as a stand-alone documents to facilitate individual refinements and production.
- Analysis of QA Reviews (1994-96).
- Research the effects of changes in stream discharge flow on habitat unit identification and surface area measurement.
- Research new water slope measurement techniques to replace clinometer-based protocol for determining cascade unit types and reduce its flow-dependent nature.
- Research Habitat Unit Survey variability in relation to stream segments with mean gradients over 4%.
- Research boundary identification methods for complex pools with multiple scour depressions.

Large Woody Debris Survey

- Analysis of QA Reviews (1992-96).
- Continue work on '97 manual draft version of the Large Woody Debris Survey for distribution as a stand-alone document to facilitate individual refinements and production.

Stream Temperature Survey

- Analysis of QA Reviews (1995-96).
- Continue work on '97 manual draft version of the Stream Temperature Survey for distribution as a stand-alone document to facilitate individual refinements and production.

Spawning Gravel Composition Survey

- Analysis of QA Reviews (1993-96)
- Continue work on '97 manual draft version of the Spawning Gravel Composition Survey for distribution as a stand-alone document to facilitate individual refinements and production.
- Continue comparison testing of the McNeil and shovel with stilling well samplers using streams representing a greater diversity of sampling conditions.
- Continue testing variability of the volumetric processing methods for determining particle sizes less than smallest sieve size (0.106 mm).

Spawning Habitat Availability Survey

- Continue work on '97 manual draft version of the Spawning Habitat Availability Survey for distribution as a stand-alone document to facilitate individual refinements and production.
- Develop and test new QA Review formats

Spawning Gravel Scour Survey

- Continue work on '97 manual draft version of the Spawning Gravel Scour Survey for distribution as a stand-alone document to facilitate individual refinements and production.
- Develop and test new QA Review formats

Winter Habitat Survey

- Test and refine literature review monitoring method recommendations.

Large Rivers Survey

- Test and refine literature review monitoring method recommendations.

Watershed Analysis Monitoring Training. Consultation with Watershed Analysis practitioners is needed to evaluate whether the Watershed Analysis Monitoring Identification Process module should be revised and updated.

4. List of TFW Reports Produced During the Biennium

Report TFW-AM-9-96-001. Spawning gravel scour: a literature review and recommendations for a Watershed Analysis monitoring methodology. Dave Schuett-Hames, Bob Conrad and Allen Pleus.

Report TFW-AM-9-96-002. Salmonid spawning habitat availability: a literature review and recommendations for a Watershed Analysis monitoring methodology. Dave Schuett-Hames and Allen Pleus.

Report TFW-AM-9-96-003. Watershed Analysis monitoring: pilot project evaluation. Dave Schuett-Hames and Allen Pleus.

Report TFW-AM-6-96-004. Winter habitat utilization by juvenile salmonids: a literature review. Amy Morgan and Frank Hinojosa.

Report TFW-AM-9-96-005. Field comparison of the McNeil sampler with three shovel-based methods used to sample spawning substrate composition in small streams. Dave Schuett-Hames, Bob Conrad and Allen Pleus.

Report TFW-AM-9-96-006. Quantification of stream channel morphological features: recommended procedures for use in Watershed Analysis and TFW Ambient Monitoring. Carlos Ramos.

Report TFW-AM-9-96-007. Proposal for a TFW monitoring strategy to determine the effectiveness of forest practices in protecting aquatic resources. Dave Schuett-Hames, Nancy Sturhan, Kevin Lautz, Randy McIntosh, Mike Gough and Charlene Rodgers.

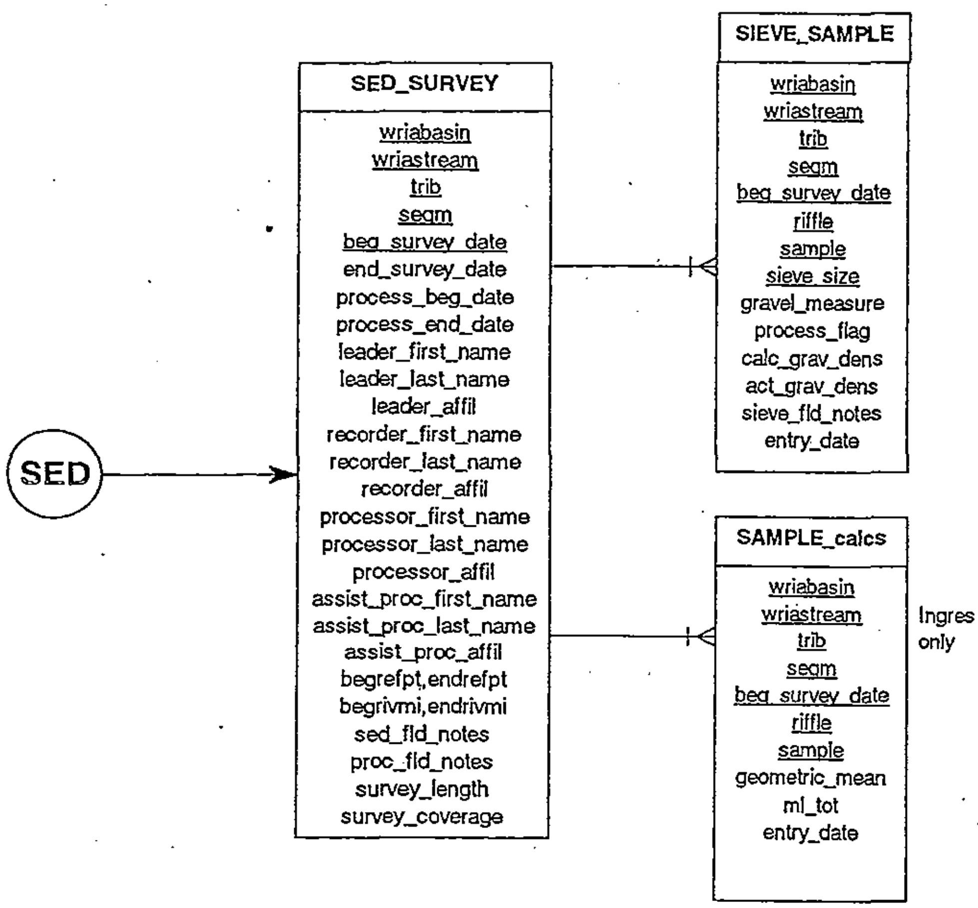
Appendix A

AMBSYS System Design

AMBIENT MONITORING DATABASE

MAIN DATABASE

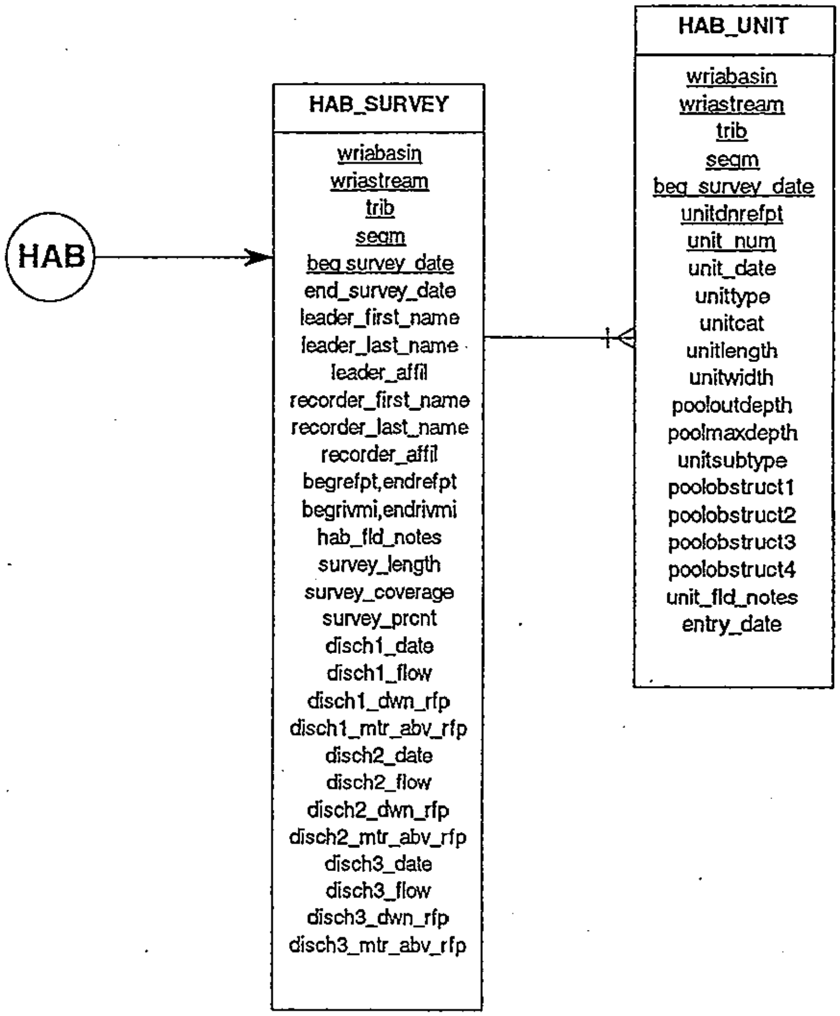
Note: underlined fields are keys



AMBIENT MONITORING DATABASE

MAIN DATABASE

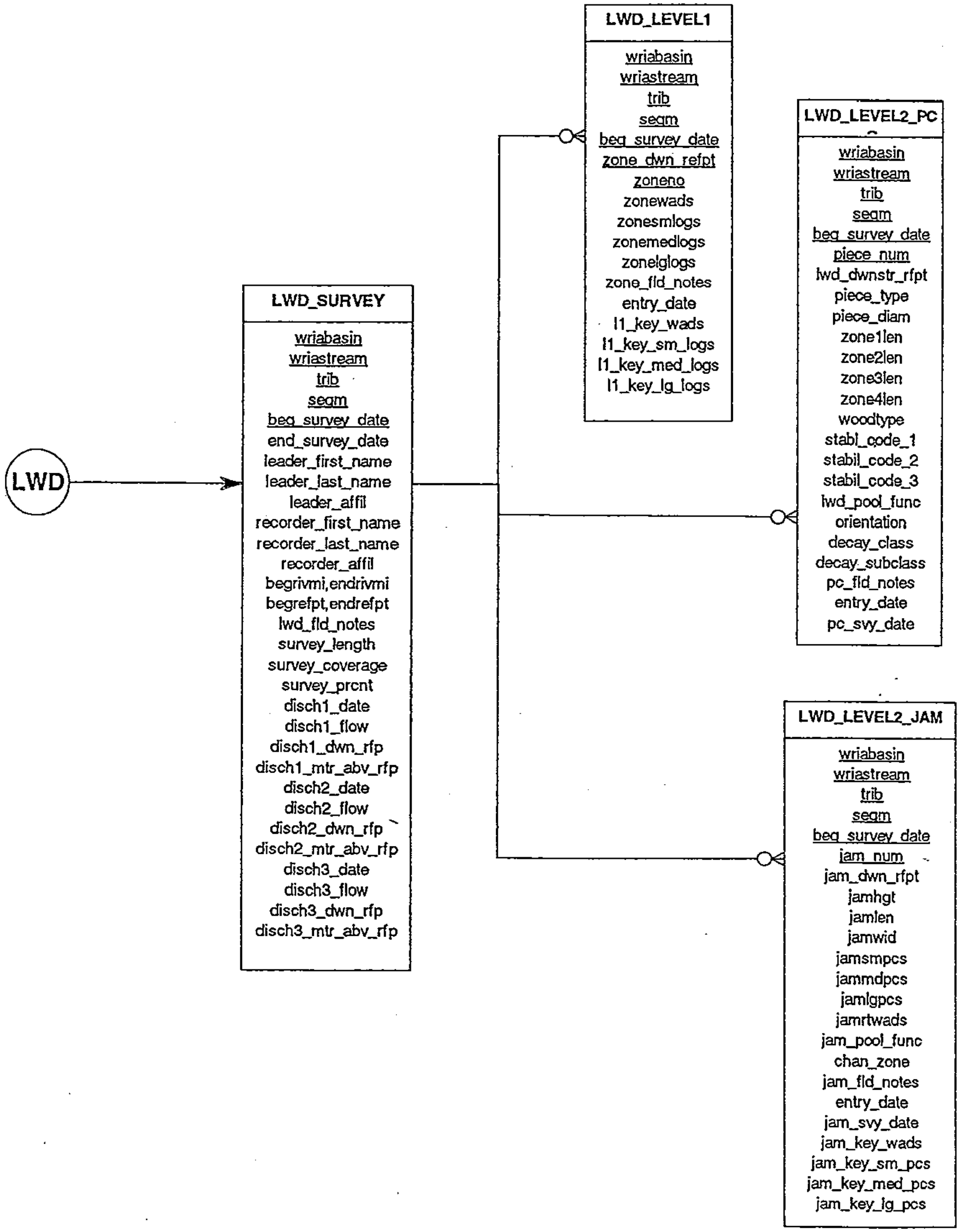
Note: underlined fields are keys



AMBIENT MONITORING DATABASE

MAIN DATABASE

Note: underlined fields are keys



AMBIENT MONITORING DATABASE

DATABASE LOOKUP TABLES

'89 - '94 LOOKUPS

wria_lookup
- wria
- trib
- strname
- basin_name

gravdens_lookup
- calc_grav_dens

pool_obs_lkup
- obstruct_code
- obstruct_desc

dec_cls_lookup
- dec_cls_code
- dec_cls_desc

gradient_lookup
- gradcat
- gradient_desc

confinement_lookup
- confcat
- confinement_desc

hab_unit_lkup
- unit_type_code
- unit_type_desc

unt_subtyp_lkp
- sub_type
- sub_type_code
- sub_type_desc

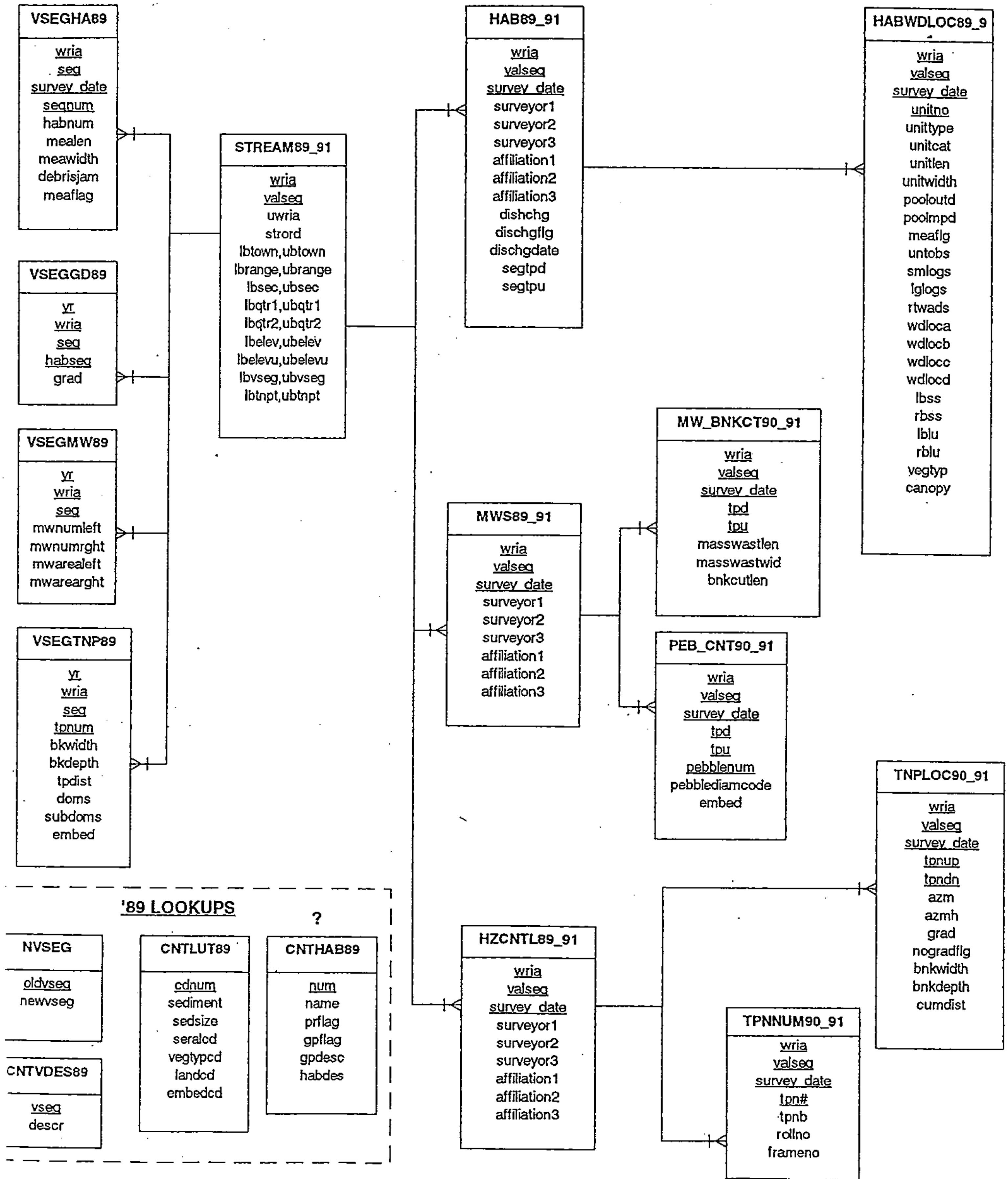
affil_lookup
- affil_name
- callera1(affil_code)

gm_ml_conv (Ingres only)
- sieve_size
- gravel_density
- gm_to_ml
- ml_to_gm

orient_lkup
- orient_code
- orient_desc

AMBIENT MONITORING DATABASE

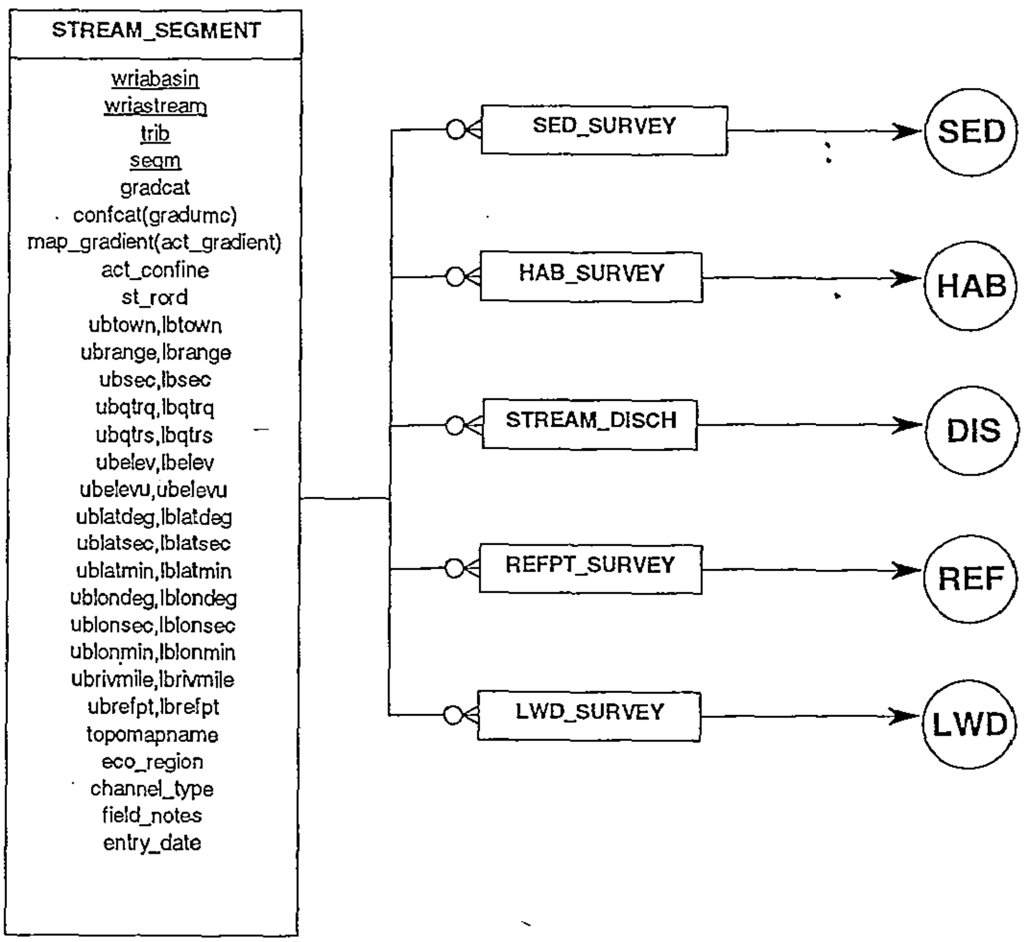
AUXILARY DATABASE (Ingres only)



AMBIENT MONITORING DATABASE

MAIN DATABASE

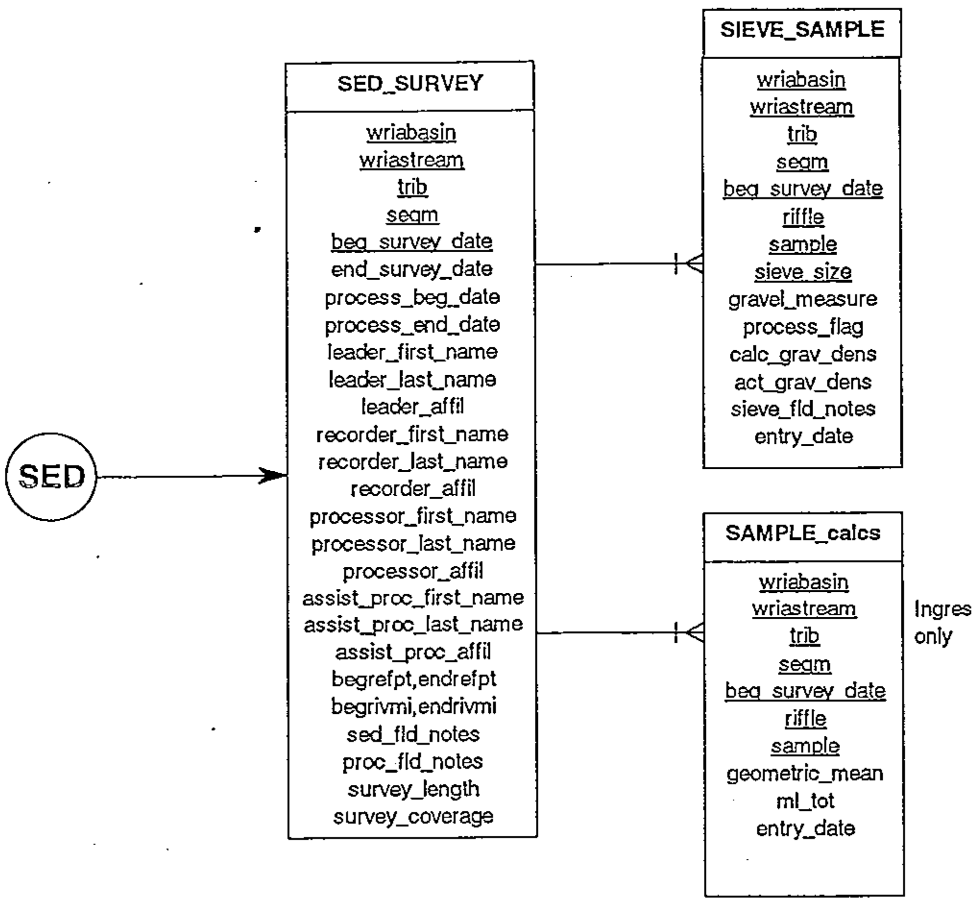
Note: underlined fields are keys



AMBIENT MONITORING DATABASE

MAIN DATABASE

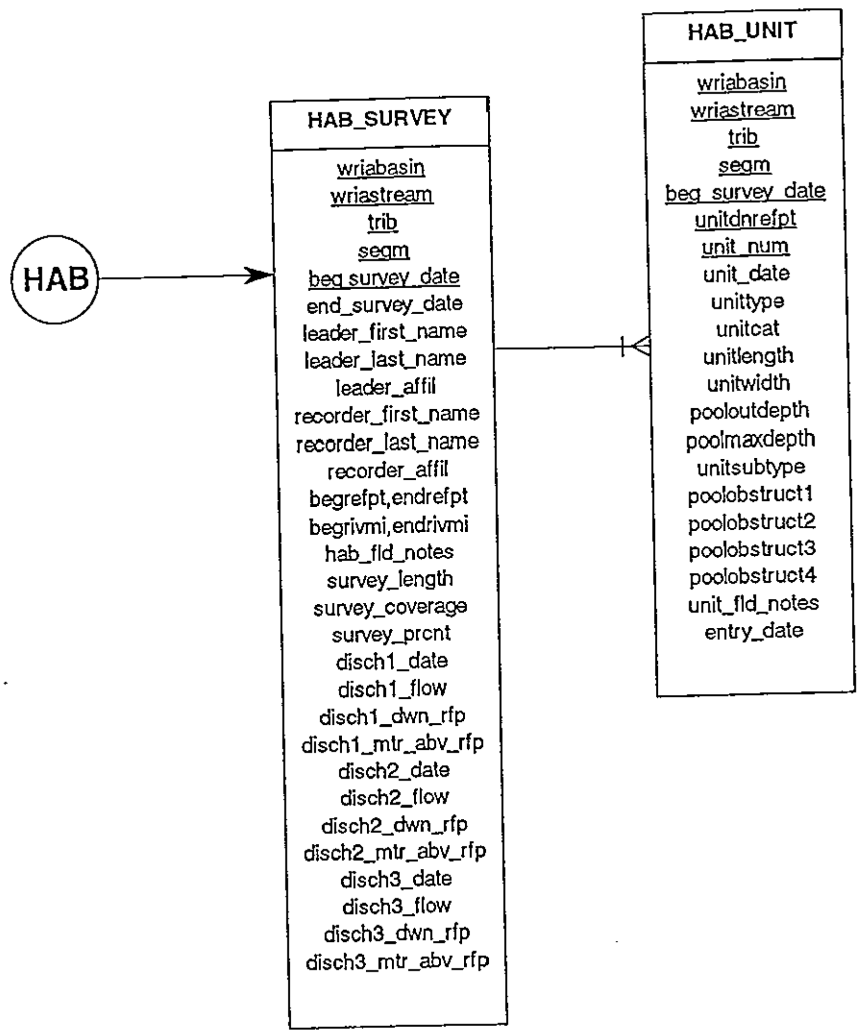
Note: underlined fields are keys



AMBIENT MONITORING DATABASE

MAIN DATABASE

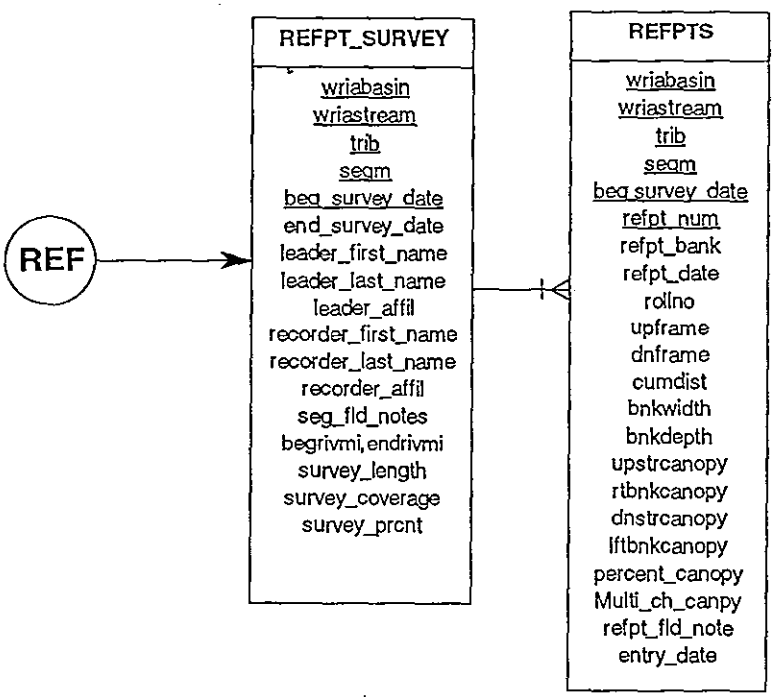
Note: underlined fields are keys



AMBIENT MONITORING DATABASE

MAIN DATABASE

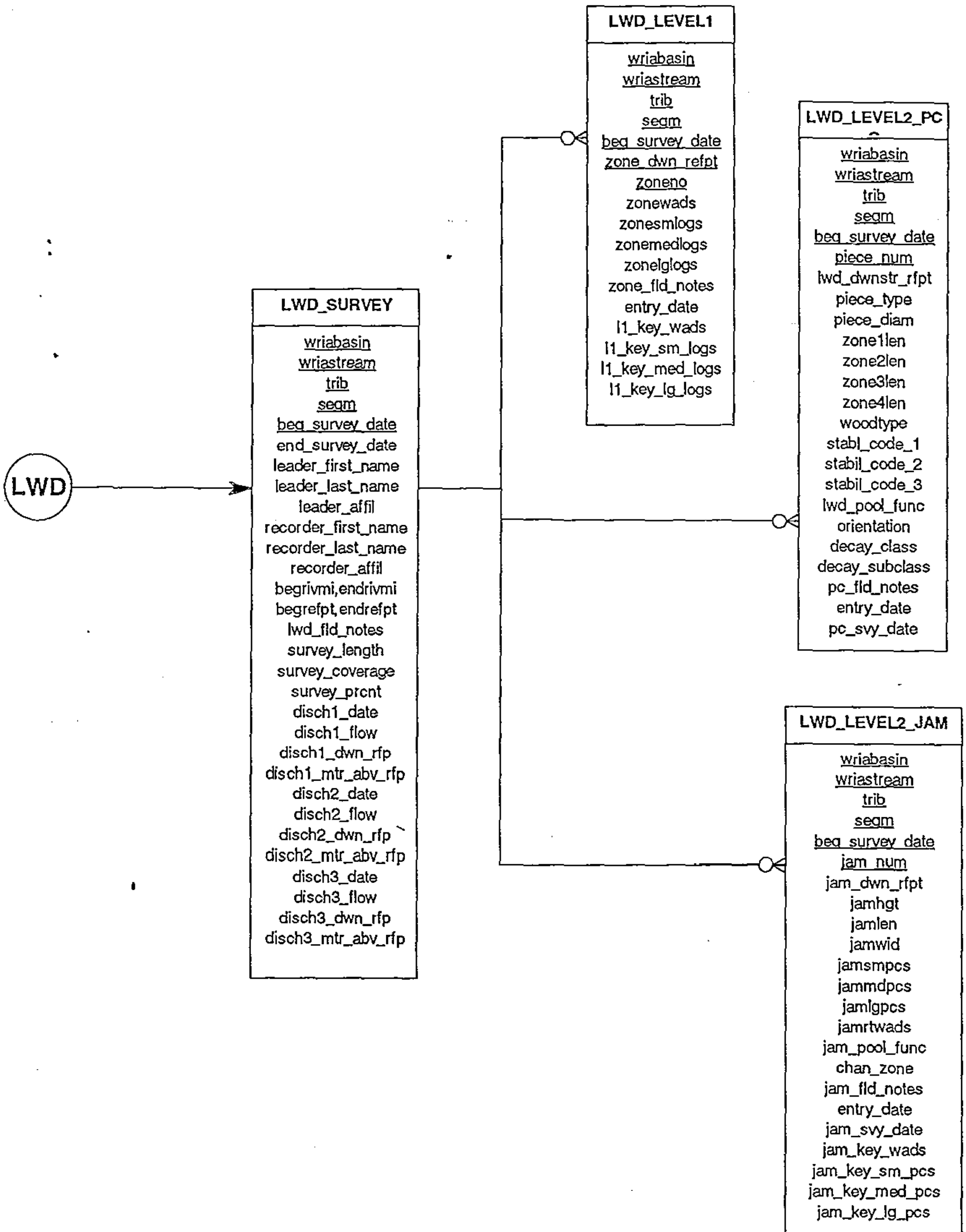
Note: underlined fields are keys



AMBIENT MONITORING DATABASE

MAIN DATABASE

Note: underlined fields are keys



AMBIENT MONITORING DATABASE

MAIN DATABASE

Note: underlined fields are keys

AMBIENT MONITORING DATABASE

DATABASE LOOKUP TABLES

'89 - '94 LOOKUPS

wria_lookup
- wria
- trib
- strname
- basin_name

gravdens_lookup
- calc_grav_dens

pool_obs_lkup
- obstruct_code
- obstruct_desc

dec_cls_lookup
- dec_cls_code
- dec_cls_desc

gradient_lookup
- gradcat
- gradient_desc

confinement_lookup
- confcat
- confinement_desc

hab_unit_lkup
- unit_type_code
- unit_type_desc

unt_subtyp_lkp
- sub_type
- sub_type_code
- sub_type_desc

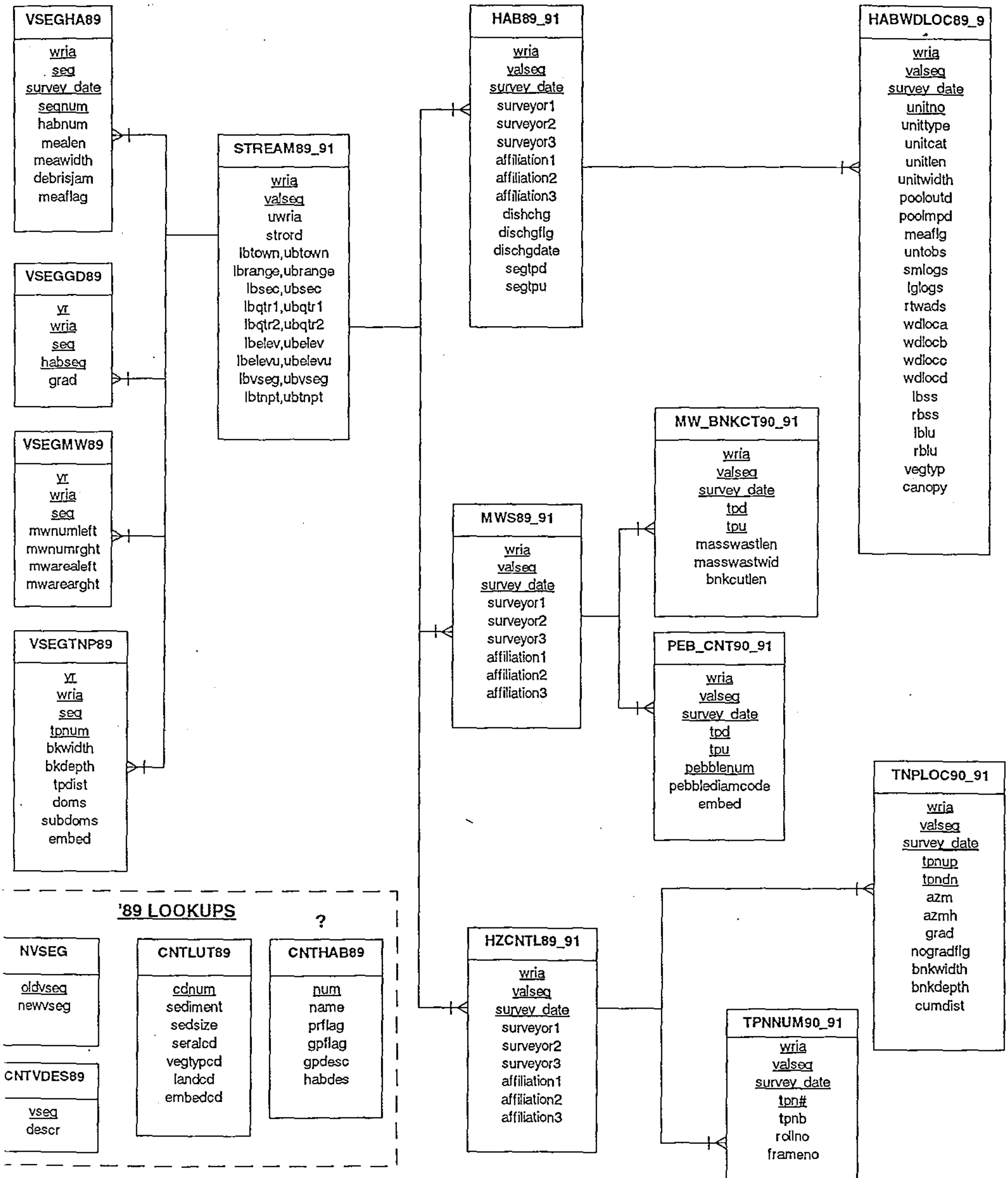
affil_lookup
- affil_name
- callera1(affil_code)

gm_ml_conv (Ingres only)
- sieve_size
- gravel_density
- gm_to_ml
- ml_to_gm

orient_lkup
- orient_code
- orient_desc

AMBIENT MONITORING DATABASE

AUXILARY DATABASE (Ingres only)



Appendix B

List of TFW Monitoring Surveys

Sorted by WRIA

WRIA	STREAM NAME	SEG #	RM (LOW)	RM (UPR)	SEG LEN (m)	SURVEY TYPE	SURVEY YEAR	DATA AFFIL.	SUM RPT	DATA BASE	FIELD FORM	GIS	USGS TOPO QUAD MAP	MAP ON FILE
1.0264	HUTCHINSON	F30	0.00	0.60	1071.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	ACME	YES
1.0264	HUTCHINSON	M20	0.60	0.80	263.0	R,H,L,M	1989	LUMMI	CSS		YES	YES	ACME	YES
1.0264	HUTCHINSON	V20	0.80	1.00	305.0	R,H,L,M	1989	LUMMI	CSS		YES	YES	ACME	YES
1.0264	HUTCHINSON	V10	1.00	1.60	807.0	R,H,L,M	1989	LUMMI	CSS		YES	YES	ACME	YES
1.0264	HUTCHINSON	V40	1.60	2.60	1667.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	ACME	YES
1.0464	CORNELL	F30	0.00	0.30	592.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	GLACIER	YES
1.0464	CORNELL	F40	0.30	1.20	1517.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	GLACIER	YES
1.0465	W CORNELL	U30	1.20	1.80	2107.0	R,H,L,M	1989	LUMMI	CSS		YES	YES	GLACIER	YES
1.0465	W CORNELL	V20	1.80	2.20	1114.9	R,H,L,M	1989	NWIFC	CSS		YES	YES	GLACIER, GROAT MTN.	YES
3.0352	MUDDY	M11	1.00	2.10	1707.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	HAMILTON	YES
3.0352	ALDER	M11	2.40	3.30	1369.0	R,H,M	1991	UWCSS	CSS	AMON91	YES	YES	HAMILTON	YES
3.0359	ALDER	M21	1.50	2.40	1365.6	R,H,M	1991	UWCSS	CSS	AMON91	YES	YES	HAMILTON	YES
4.0384	SAVAGE	F40	1.00	2.20	2093.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	GRANDY LAKE	YES
4.0384	SAVAGE	V10	2.20	3.50	1780.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	GRANDY LAKE	YES
4.0384	SAVAGE	V20	3.50	4.10	1007.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	GRANDY LAKE, GEE POINT	YES
4.0384	SAVAGE	H30	4.10	4.70	971.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	GEE POINT	YES
4.0786	ALL	M11	0.70	1.20	893.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	PRAIRIE MTN.	YES
4.0786	ALL	U31	1.20	1.50	427.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	PRAIRIE MTN.	YES
4.1148	CAMP	V11	0.00	0.70	1209.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	PUGH MTN.	YES
4.1148	CAMP	V41	0.70	1.50	1291.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	PUGH MTN.	YES
4.1148	CAMP	V42	1.50	1.90	639.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	PUGH MTN.	YES
4.1148	CAMP	V12	1.90	2.70	1231.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	PUGH MTN.	YES
4.1148	CAMP	V43	2.70	3.00	592.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	PUGH MTN.	YES
4.1157	PUMICE	M11	0.00	3.00	409.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	LIME MTN.	YES
4.1157	PUMICE	M21	0.30	1.00	1110.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	LIME MTN.	YES
4.1157	PUMICE	U41	1.00	1.60	995.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	LIME MTN.	YES
7.0291	TOLT	2	1.70	6.00	6264.0	S	1993	TULALIP		AMBSYS	YES	YES	CARNATION, LAKE JOY	YES
7.0291	NF TOLT	5	9.80	10.50	1126.0	S	1993	TULALIP		AMBSYS	YES	YES	LAKE JOY	YES
7.0300	STOSSEL	24	0.30	0.80	1107.0	S	1993	TULALIP		AMBSYS	YES	YES	LAKE JOY	YES
8.0368	MF TAYLOR	F31	3.00	3.70	1098.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	EAGLE GORGE	YES
8.0368	MF TAYLOR	F41	3.70	4.60	1440.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	EAGLE GORGE	YES
8.0369	SF TAYLOR	F41	0.00	0.70	1069.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	EAGLE GORGE	YES
9.0114	NEWAUKUM	V21	1.00	2.90	5228.4	R,H,L	1991	MUCKLE	NWIFC	AMON91	YES	YES	BLACK DIAMOND	YES
9.0201	CHARLEY	M10	0.10	0.60	761.0	R,H,L,M	1989	MUCKLE	CSS		YES	YES	EAGLE GORGE	YES
9.0201	CHARLEY	V10	0.60	1.30	1086.0	R,H,L,M	1989	MUCKLE	CSS		YES	YES	EAGLE GORGE, CYCLONE CR.	YES
9.0201	CHARLEY	V11	1.30	2.50	2003.0	R,H,L,M	1989	MUCKLE	CSS		YES	YES	CYCLONE CREEK	YES
9.0201	CHARLEY	V12	2.50	2.80	609.0	R,H,L,M	1989	MUCKLE	CSS		YES	YES	CYCLONE CREEK	YES
9.0201	CHARLEY	V13	2.80	3.40	581.0	R,H,L,M	1989	MUCKLE	CSS		YES	YES	CYCLONE CREEK	YES
9.0201	CHARLEY	V11	0.00	1.50	2391.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	EAGLE GRG, CYCLONE CR	YES
9.0201	CHARLEY	V21	1.50	2.00	892.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	CYCLONE CR.	YES
9.0201	CHARLEY	V12	2.00	3.00	1580.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	CYCLONE CR.	YES
9.0201	CHARLEY	V22	3.00	3.50	828.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	CYCLONE CR.	YES
9.0201	CHARLEY	H11	3.50	4.10	919.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	CYCLONE CR.	YES
9.0201A	CHARLEY TRIB	H31	0.00	0.40	614.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	CYCLONE CREEK	YES
9.0201A	CHARLEY TRIB	V10	0.40	0.60	339.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	EAGLE GORGE, CYCLONE CR.	YES
9.0206	CHARLEY TRIB	V21	0.00	0.50	920.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	CYCLONE CREEK	YES
9.0206	CHARLEY TRIB	H21	0.50	1.10	1624.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	CYCLONE CREEK	YES
9.0207	CHARLEY TRIB	H21	0.00	0.48	782.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	CYCLONE CREEK	YES
9.0222	CANTON	V20	0.00	1.20	1777.0	R,H,L,M	1989	MUCKLE	CSS		YES	YES	GREENWATER	YES
9.0222	CANTON	H20	1.20	2.70	2641.0	R,H,L,M	1989	MUCKLE	CSS		YES	YES	GREENWATER	YES
10.0080	CLEARWATER	2	1.10	2.30	2000.0	R,H,L	1993	MUCKLE		AMBSYS	YES	YES	CYCLONE CREEK	YES
10.0080	CLEARWATER	3	2.30	4.10	2600.0	R,H,L	1993	MUCKLE		AMBSYS	YES	YES	CYCLONE CR/BEARHEAD MTN	YES
10.0080	CLEARWATER	4	4.10	4.80	1600.0	R,H,L	1993	MUCKLE		AMBSYS	YES	YES	BEARHEAD MOUNTAIN	YES
10.0080	CLEARWATER	5	4.80	5.90	1700.0	R,H,L	1993	MUCKLE		AMBSYS	YES	YES	BEARHEAD MOUNTAIN	YES
10.0080	CLEARWATER	6	5.90	6.80	2100.0	R,H,L	1993	MUCKLE		AMBSYS	YES	YES	BEARHEAD MOUNTAIN	YES
10.0122	GREENWATER	V40	8.40	9.70	2340.0	R,H,L,M	1989	MUCKLE	CSS		YES	YES	NOBLE KNOB, SUN TOP	YES
10.0122	GREENWATER	V20	9.70	11.30	10937.0	R,H,L,M	1989	MUCKLE	CSS		YES	YES	NOBLE KNOB	YES
10.0122	GREENWATER	1	12.95	13.60	312.6	R,H,L	1992	MUCKLE	NWIFC	AMBSYS	NO	YES	NOBLE KNOB	YES
10.0122	GREENWATER	2	13.60	14.25	1112.3	R,H,L	1992	MUCKLE	NWIFC	AMBSYS	NO	YES	NOBLE KNOB	YES
10.0122	GREENWATER	3	14.25	15.46	792.5	R,H,L	1992	MUCKLE	NWIFC	AMBSYS	NO	YES	NOBLE KNOB	YES
10.0122	GREENWATER	4	15.46	16.50	619.3	R,H,L	1992	MUCKLE	NWIFC	AMBSYS	NO	YES	NOBLE KNOB	YES
10.0122	GREENWATER	5	17.00	18.25	2620.8	R,H,L	1992	MUCKLE	NWIFC	AMBSYS	NO	YES	NOBLE KNOB	YES
10.0122	GREENWATER	6	18.25	18.85	3614.2	R,H,L	1992	MUCKLE	NWIFC	AMBSYS	NO	YES	NOBLE KNOB	YES
10.0253	HUCKLEBERRY	V11	6.00	7.75		R,H	1990	MUCKLE		AMON90	YES		WHITE RIVER PARK, SUNRISE	YES
10.0550	IPSUT	H31	0.85	1.60	4141.2	R,H,L	1991	MUCKLE	NWIFC	AMON91	YES	YES	MOWICH LAKE	YES
11.0067	TANWAX	F31	0.00	2.70	6103.0	R,H,L,M	1990	NWIFC	CSS	AMON90	YES	YES	BALD HILL, HARTS LAKE	YES
11.0067	TANWAX	M21	2.70	4.70	1605.0	R,H,L,M	1990	NWIFC	CSS	AMON90	YES	YES	HARTS LAKE	YES
11.0086	OHOP	1	0.00	0.10	600.0	S	1993	NISQUAL		AMBSYS	YES	YES	EATONVILLE	YES
11.0086	OHOP	2	0.10	4.30	600.0	S	1993	NISQUAL		AMBSYS	YES	YES	EATONVILLE, TANWAX LK	YES
11.0086	OHOP	1T	0.30	1.00	600.0	T	1993	NISQUAL		DISK	YES	YES	EATONVILLE	YES
11.0086	OHOP	2T	2.30	3.00	600.0	T	1993	NISQUAL		DISK	YES	YES	EATONVILLE	YES
11.0086	OHOP	3	4.30	6.10	600.0	S	1993	NISQUAL		AMBSYS	YES	YES	EATONVILLE, TANWAX LK	YES
11.0086	OHOP	3T	6.20	8.80	600.0	T	1993	NISQUAL		DISK	YES	YES	TANWAX LAKE	YES
11.0092	LYNCH	4T	0.20	0.80	600.0	T	1993	NISQUAL		DISK	YES	YES	TANWAX LAKE	YES

WRIA	STREAM NAME	SEG #	RM (LOW)	RM (UPR)	SEG LEN (m)	SURVEY TYPE	SURVEY YEAR	DATA AFFIL.	SUM RPT	DATA BASE	FIELD FORM	GIS	USGS TOPO QUAD MAP	MAP ON FILE
11.0096	TWENTYFIVE MILE	2	0.20	1.00	600.0	S	1993	NISQUAL		AMBSYS	YES	YES	TANWAX LK/LK KAPOWSIN	YES
11.0096	TWENTYFIVE MILE	5T	0.20	0.60	600.0	T	1993	NISQUAL		DISK	YES	YES	TANWAX LAKE	YES
11.0101	MASHEL	V11	14.40	16.40	4456.0	R,H,L,M	1990	NWIFC	CSS	AMON90	YES	YES	ASHFORD	YES
11.0101	MASHEL	1	0.20	0.30		S	1990	NISQUAL			YES		EATONVILLE	NO
11.0101	MASHEL	1	0.20	0.80		S	1991	NISQUAL			YES		EATONVILLE	NO
11.0101	MASHEL	2	2.00	3.00		S	1991	NISQUAL			YES		EATONVILLE	NO
11.0101	MASHEL	1	0.00	1.70	600.0	S	1993	NISQUAL		AMBSYS	YES	YES	EATONVILLE	YES
11.0101	MASHEL	6T	0.60	1.10	600.0	T	1993	NISQUAL		DISK	YES	YES	EATONVILLE	YES
11.0101	MASHEL	2	1.70	5.30	600.0	S	1993	NISQUAL		AMBSYS	YES	YES	EATONVILLE	YES
11.0101	MASHEL	7T	5.00	5.50	600.0	T	1993	NISQUAL		DISK	YES	YES	EATONVILLE	YES
11.0101	MASHEL	8	6.70	7.00	600.0	S	1993	NISQUAL		AMBSYS	YES	YES	ELBE	YES
11.0101	MASHEL	11T	7.60	7.90	600.0	T	1993	NISQUAL		DISK	YES	YES	ELBE	YES
11.0101	MASHEL	15T	11.40	11.70	600.0	T	1993	NISQUAL		DISK	YES	YES	ELBE	YES
11.0101	MASHEL	16	14.50	15.50	600.0	S	1993	NISQUAL		AMBSYS	YES	YES	ASHFORD	YES
11.0101	MASHEL	16T	14.60	14.90	600.0	T	1993	NISQUAL		DISK	YES	YES	ASHFORD	YES
11.0101	MASHEL	17T	15.60	15.90	600.0	T	1993	NISQUAL		DISK	YES	YES	ASHFORD	YES
11.0102	LITTLE MASHEL	8T	0.30	0.60	600.0	T	1993	NISQUAL		DISK	YES	YES	EATONVILLE	YES
11.0102	LITTLE MASHEL	9T	2.10	2.40	600.0	T	1993	NISQUAL		DISK	YES	YES	ELBE	YES
11.0103	MIDWAY	10T	0.00	0.30	600.0	T	1993	NISQUAL		DISK	YES	YES	ELBE	YES
11.0110	MASHEL RB TRIB	V11			205.0	R,H,L	1990		CSS	AMON90	NO		ASHFORD	NO
11.0110	MASHEL RB TRIB	V41			930.0	R,H,L,M	1990		CSS	AMON90	NO		ASHFORD	NO
11.0110	MASHEL TRIB	12T	0.10	0.40	600.0	T	1993	NISQUAL		DISK	YES	YES	ELBE	YES
11.0111	BEAVER	13T	0.50	0.80	600.0	T	1993	NISQUAL		DISK	YES	YES	ELBE	YES
11.0111	BEAVER	2	0.80	1.00	600.0	S	1993	NISQUAL		AMBSYS	YES	YES	ELBE	YES
11.0111	BEAVER	14T	2.30	2.60	600.0	T	1993	NISQUAL		DISK	YES	YES	ELBE	YES
11.0114	BUSYWILD	V11			1061.0	M	1990		CSS	AMON90	NO		ASHFORD	NO
11.0114	BUSYWILD	19T	0.10	0.40	600.0	T	1993	NISQUAL		DISK	YES	YES	ASHFORD	YES
11.0114	BUSYWILD	20T	4.10	4.40	600.0	T	1993	NISQUAL		DISK	YES	YES	ASHFORD	YES
11.0121	SF MASHEL	18T	15.60	15.90	600.0	T	1993	NISQUAL		DISK	YES	YES	ASHFORD	YES
13.0028	DESCHUTES	V10	48.00	51.00	5037.0	R,H,L,M	1989	SQUAXIN	CSS		YES	YES	NEWAUKUM LAKE	YES
13.0028	DESCHUTES	F31	36.50	38.10	3023.0	R,H,L,M	1990	SQUAXIN	CSS	AMON90	YES	YES	BALD HILL	YES
13.0028	DESCHUTES	F21	38.10	40.90	4042.0	R,H,L,M	1990	SQUAXIN	CSS	AMON90	YES	YES	BALD HILL	YES
13.0028	DESCHUTES	22	28.50	29.50		S	1992	SQUAXIN	AMSYS	AMBSYS	YES	YES	LK LAWRENCE, VAIL	YES
13.0028	DESCHUTES	20	31.00	33.30		S	1992	SQUAXIN	AMSYS	AMBSYS	YES	YES	LK LAWRENCE	YES
13.0028	DESCHUTES	19	33.30	35.30	3862.0	R,H,L,S	1992	SQUAXIN	NWIFC	AMBSYS	YES	YES	LK LAWRENCE	YES
13.0028	DESCHUTES	18	35.30	36.60	2615.0	R,H,L,S	1992	SQUAXIN	NWIFC	AMBSYS	YES	YES	BALD HILL, LK LAWRENCE	YES
13.0028	DESCHUTES	17	36.60	38.10		S	1992	SQUAXIN	AMSYS	AMBSYS	YES	YES	BALD HILL	YES
13.0028	DESCHUTES	16	38.10	39.10		S	1992	SQUAXIN	AMSYS	AMBSYS	YES	YES	BALD HILL	YES
13.0028	DESCHUTES	12	41.30	42.40	1939.0	R,H,L	1992	SQUAXIN	NWIFC	AMBSYS	YES	YES	BALD HILL	YES
13.0028	DESCHUTES	10	43.00	44.90	4697.7	R,H,L	1992	SQUAXIN	NWIFC	AMBSYS	YES	YES	BALD HILL, EATONVILLE	YES
13.0028	DESCHUTES	36	2.50	4.50		R,L,S,T	1995	SQUAXIN		AMBSYS	YES	YES	TUMWATER, MAYTOWN	YES
13.0028	DESCHUTES	31	15.00	17.50		R,L,S,T	1995	SQUAXIN		AMBSYS	YES	YES	EAST OLYMPIA	YES
13.0028	DESCHUTES	28	20.80	22.00		R,L,S,T	1995	SQUAXIN		AMBSYS	YES	YES	VAIL	YES
13.0028	DESCHUTES	22	28.50	29.50		R,L,S,T	1995	SQUAXIN		AMBSYS	YES	YES	LAKE LAWRENCE	YES
13.0028	DESCHUTES	19	33.00	35.70		RLSHT	1995	SQUAXIN		AMBSYS	YES	YES	LAKE LAWRENCE	YES
13.0057	FALL	F41	0.00	0.40	581.0	R,H,L,M	1990	SQUAXIN	CSS	AMON90	YES	YES	LAKE LAWRENCE	YES
13.0069	MITCHELL	V41	0.00	1.50	1588.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	BALD HILL	YES
13.0069	MITCHELL	V11	1.50	2.30	893.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	BALD HILL	YES
13.0069	MITCHELL	V21	2.30	2.70	303.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	BALD HILL	YES
13.0069	MITCHELL	V12	2.70	3.50	717.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	BALD HILL	YES
13.0069	MITCHELL	1	0.00	0.90		S	1992	SQUAXIN		AMBSYS	YES	YES	BALD HILL	YES
13.0072	MITCHELL TRIB	V21	0.00	0.10	126.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	BALD HILL	YES
13.0072	MITCHELL TRIB	V41	0.10	1.00	1449.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	BALD HILL	YES
13.0072	MITCHELL TRIB	V22	1.00	1.40	312.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	BALD HILL	YES
13.0073	MITCHELL TRIB	V41	0.00	0.40	493.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	BALD HILL	YES
13.0073	MITCHELL TRIB	V21	0.40	0.90	1135.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	BALD HILL	YES
13.0073	MITCHELL TRIB	H21	0.90	1.10	335.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	BALD HILL	YES
13.0073	MITCHELL TRIB	H31	1.10	1.20	138.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	BALD HILL	YES
13.0086	HUCKLEBERRY	M11	0.00	0.70	1099.0	R,H,L,M	1990	SQUAXIN	CSS	AMON90	YES	YES	BALD HILL	YES
13.0086	HUCKLEBERRY	V11	0.70	1.00	516.0	R,H,L,M	1990	SQUAXIN	CSS	AMON90	YES	YES	BALD HILL	YES
13.0086	HUCKLEBERRY	V31	1.00	1.30	497.0	R,H,L,M	1990	SQUAXIN	CSS	AMON90	YES	YES	BALD HILL	YES
13.0086	HUCKLEBERRY	M12	1.30	2.00	1031.0	R,H,L,M	1990	SQUAXIN	CSS	AMON90	YES	YES	BALD HILL	YES
13.0086	HUCKLEBERRY	V12	2.00	2.50	870.0	R,H,L,M	1990	SQUAXIN	CSS	AMON90	YES	YES	BALD HILL	YES
13.0086	HUCKLEBERRY	V13	2.50	2.70	314.0	R,H,L,M	1990	SQUAXIN	CSS	AMON90	YES	YES	BALD HILL	YES
13.0086	HUCKLEBERRY	1	0.00	0.30		S	1992	SQUAXIN		AMBSYS	YES	YES	BALD HILL	YES
13.0086	HUCKLEBERRY	2	0.30	0.50		S	1992	SQUAXIN		AMBSYS	YES	YES	BALD HILL	YES
13.0089	JOHNSON	M11	0.00	0.50	1192.0	R,H,L,M	1990	SQUAXIN	CSS	AMON90	YES	YES	BALD HILL	YES
13.0089	JOHNSON	1	0.00	0.70		S	1992	SQUAXIN		AMBSYS	YES	YES	BALD HILL	YES
13.0095	THURSTON	M11	0.00	0.60	783.0	R,H,L,M	1990	SQUAXIN	CSS	AMON90	YES	YES	BALD HILL	YES
13.0095	THURSTON	V21	0.60	1.10	1195.0	R,H,L,M	1990	SQUAXIN	CSS	AMON90	YES	YES	BALD HILL	YES
13.0095	THURSTON	1	0.00	0.50		S	1992	SQUAXIN		AMBSYS	YES	YES	BALD HILL	YES
13.0110	LTL DESCHUTES	1	0.00	0.80	1157.2	R,H,L	1992	SQUAXIN	NWIFC	AMBSYS	YES	YES	BALD HILL	YES
13.0123	LINCOLN	M21	0.00	1.90	3143.0	R,H,L,M	1990	SQUAXIN	CSS	AMON90	YES	YES	EATONVILLE/NEWAUKUM L/THE RCKS	YES
13.0124	LEWIS	V11	0.00	1.30	860.0	R,H,L,M	1990	SQUAXIN	CSS	AMON90	YES	YES	THE ROCKIES (RCKS)	YES

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13.0125	BUCK	V21	0.00	0.50	715.0	R,H,L,M	1990	SQUAXIN	CSS	AMON90	YES	YES	THE ROCKIES	YES
13.0126	W F DESCHUTES	V10	0.00	2.00	3629.0	R,H,L,M	1989	SQUAXIN	CSS		YES	YES	NEWAUKUM LAKE	YES
13.0128	WARE	V21	0.00	0.50	712.0	R,H,L,M	1990	SQUAXIN	CSS	AMON90	YES	YES	THE ROCKIES, NEWAUKUM LK	YES
13.0129	HARD	V20	0.00	0.50	869.0	R,H,L,M	1989	SQUAXIN	CSS		YES	YES	NEWAUKUM LAKE	YES
13.0130	MINE	V10	0.00	0.50	423.3	R,H,L,M	1989	SQUAXIN	CSS		YES	YES	NEWAUKUM LAKE	YES
13.0130	MINE	V20	0.50	0.80	644.0	R,H,L,M	1989	SQUAXIN	CSS		YES	YES	NEWAUKUM LAKE	YES
13.0138	MCLANE	F31	0.00	1.50	2448.0	R,H,L,M	1990	SQUAXIN	CSS	AMON90	YES	YES	SUMMIT LAKE, TUMWATER	YES
13.0138	MCLANE	M21	1.50	2.90	2171.0	R,H,L,M	1990	SQUAXIN	CSS	AMON90	YES	YES	SUMMIT LAKE	YES
13.0138	MCLANE	M11	2.90	4.20	1599.0	R,H,L,M	1990	SQUAXIN	CSS	AMON90	YES	YES	LITTLEROCK	YES
13.0138	MCLANE	H21	4.20	4.60	1531.0	R,H,L,M	1990	SQUAXIN	CSS	AMON90	YES	YES	SUMMIT LAKE, LITTLEROCK	YES
13.0138	MCLANE	6	2.50	3.40	1323.0	R,H,L,S	1993	SQUAXIN		AMBSYS	YES		SUMMIT LAKE, LITTLEROCK	YES
13.0139	SWIFT	4	1.10	1.70	874.0	R,H,L,S	1994	SQUAXIN		AMBSYS	YES		SUMMIT LAKE	YES
14.0001	PERRY	M21	0.00	0.30	715.0	R,H,L,M	1990	SQUAXIN	CSS	AMON90	YES	YES	SUMMIT LAKE	YES
14.0001	PERRY	M11	0.30	0.70	552.0	R,H,L,M	1990	SQUAXIN	CSS	AMON90	YES	YES	SUMMIT LAKE	YES
14.0001	PERRY	V31	0.70	0.90	276.0	R,H,L	1990	SQUAXIN	CSS	AMON90	YES	YES	SUMMIT LAKE	YES
14.0001	PERRY	1	0.00	0.80	714.0	R,H,L,S	1993	SQUAXIN		AMBSYS	YES		SUMMIT LAKE	YES
14.0001	PERRY	2	0.80	1.00	300.0	R,H,L	1994	SQUAXIN		AMBSYS	YES		SUMMIT LAKE	YES
14.0001	PERRY	5A	1.70	1.90	300.0	R,H,L	1994	SQUAXIN		AMBSYS	YES		SUMMIT LAKE	YES
14.0001	PERRY	5B	2.00	2.20	300.0	R,H,L	1994	SQUAXIN		AMBSYS	YES		SUMMIT LAKE	YES
14.0001	PERRY	7	3.40	3.60	300.0	R,H,L	1994	SQUAXIN		AMBSYS	YES		SUMMIT LAKE	YES
14.0002	PERRY TRIB	9	0.00	0.20	300.0	R,H,L	1994	SQUAXIN		AMBSYS	YES		SUMMIT LAKE	YES
14.0009	SCHNEIDER	F31	0.00	1.80	4079.0	R,H,L,M	1990	SQUAXIN	CSS	AMBSYS	YES	YES	SUMMIT LAKE	YES
14.0009	SCHNEIDER	1	0.00	1.00	2543.0	R,H,L,S	1993	SQUAXIN		AMBSYS	YES		SUMMIT LAKE	YES
14.0009	SCHNEIDER	2	1.20	1.40	300.0	R,H,L	1994	SQUAXIN		AMBSYS	YES		SUMMIT LAKE	YES
14.0009A	MCDONALD	14	0.10	0.30	300.0	R,H,L	1994	SQUAXIN		AMBSYS	YES		SUMMIT LAKE	YES
14.0010	COUNTY-LINE	8	0.20	0.40	800.0	R,H,L	1994	SQUAXIN		AMBSYS	YES		SUMMIT LAKE	YES
14.0012	KENNEDY	F30	0.30	0.70	938.0	R,H,L,M	1989	SQUAXIN	CSS		YES	YES	SUMMIT LAKE	YES
14.0012	KENNEDY	M20	0.70	1.50	2123.0	R,H,L,M	1989	SQUAXIN	CSS		YES	YES	SUMMIT LAKE	YES
14.0012	KENNEDY	M10	1.50	2.10	1701.0	R,H,L,M	1989	SQUAXIN	CSS		YES	YES	SUMMIT LAKE	YES
14.0012	KENNEDY	V10	2.10	2.30	609.0	R,H,L,M	1989	SQUAXIN	CSS		YES	YES	SUMMIT LAKE	YES
14.0012	KENNEDY	F11	0.00	0.30	372.0	R,H,L	1990	SQUAXIN	CSS	AMON90	YES	YES	SUMMIT LAKE	YES
14.0012	KENNEDY	1	0.00	0.20	400.0	R,H,L	1994	SQUAXIN		AMBSYS	YES		SUMMIT LAKE	YES
14.0012	KENNEDY TRIB	13	0.00	0.20	300.0	R,H,L	1994	SQUAXIN		AMBSYS	YES		SUMMIT LAKE	YES
14.0012	KENNEDY TRIB	63	0.10	0.20	518.0	R,H,L,S	1994	SQUAXIN		AMBSYS	YES		SUMMIT LAKE	YES
14.0012	KENNEDY	2	0.20	0.50	915.0	R,H,L	1994	SQUAXIN		AMBSYS	YES		SUMMIT LAKE	YES
14.0012	KENNEDY	3	0.50	1.40	1500.0	R,H,L,S	1993	SQUAXIN		AMBSYS	YES		SUMMIT LAKE	YES
14.0012	KENNEDY	4	1.40	2.20	1409.0	R,H,L,S	1994	SQUAXIN		AMBSYS	YES		SUMMIT LAKE	YES
14.0012	KENNEDY	7	2.80	4.00	1800.0	R,H,L,S	1993	SQUAXIN		AMBSYS	YES		KAMILCHE VALLEY	YES
14.0012	KENNEDY	8	4.00	4.20	300.0	R,H,L	1994	SQUAXIN		AMBSYS	YES		KAMILCHE VALLEY	YES
14.0012	KENNEDY	9	6.60	6.80	300.0	R,H,L	1994	SQUAXIN		AMBSYS	YES		KAMILCHE VALLEY	YES
14.0012	KENNEDY	10	7.10	7.30	300.0	R,H,L	1994	SQUAXIN		AMBSYS	YES		SUMMIT LK., KAMILCHE VY.	YES
14.0012	KENNEDY	2	0.20	0.50		S	1995	SQUAXIN		AMBSYS	YES		SUMMIT LAKE	YES
14.0013	KENNEDY TRIB	16	0.00	0.20	305.0	R,H,L	1994	SQUAXIN		AMBSYS	YES		KAMILCHE VALLEY	YES
14.0014	SUMMIT LAKE CR	41	0.20	0.40	300.0	R,H,L	1994	SQUAXIN		AMBSYS	YES		SUMMIT LK., KAMILCHE VY.	YES
14.0020	SKOOKUM	F31	0.00	6.10	10343.0	R,H,L,M	1990	SQUAXIN	CSS	AMON90	YES	YES	SUMMIT L./KAMILCHE VY/SHELTON	YES
14.0020	SKOOKUM	M21	6.10	6.80	2367.0	R,H,L,M	1990	SQUAXIN	CSS	AMON90	YES	YES	KAMILCHE VALLEY	YES
14.0020	SKOOKUM	M11	6.80	7.10	872.0	R,H,L,M	1990	SQUAXIN	CSS	AMON90	YES	YES	KAMILCHE VALLEY	YES
14.0020	SKOOKUM	5	6.60	7.80	1984.0	R,H,L,S	1993	SQUAXIN		AMBSYS	YES		KAMILCHE VALLEY	YES
14.0023A	SKOOKUM TRIB	M11	0.00	0.14	248.0	R,H,L	1990	SQUAXIN	CSS	AMON90	YES	YES	KAMILCHE VALLEY	YES
14.0029	MILL	1	2.60	3.80	1300.0	R,H,L,S	1993	SQUAXIN		AMBSYS	YES	YES	SHELTON	YES
14.0029	MILL	4	14.00	14.80	638.0	R,H,L,S	1993	SQUAXIN		AMBSYS	YES		SHELTON VALLEY	YES
14.0035	GOLDSBOROUGH	M11	0.40	4.10	6736.0	R,H,L,M	1991		CSS	AMON91	YES	YES	SHELTON, SHELTON VY	YES
14.0035	GOLDSBOROUGH	6	4.50	5.80	1600.0	R,H,L,S	1993	SQUAXIN		AMBSYS	YES	YES	NAWATZEL LK/SHELTON VY	YES
14.0035	SF GOLDSBOROUGH	11	10.80	11.20	618.0	R,H,L,S	1993	SQUAXIN		AMBSYS	YES		NAWATZEL LK., SHELTON VY.	YES
14.0049	JOHNS	2	0.50	1.40	1100.0	R,H,L,S	1994	SQUAXIN		AMBSYS	YES	YES	SHELTON, UNION	YES
14.0051	CRANBERRY	4	2.40	2.80	600.0	R,H,L,S	1994	SQUAXIN		AMBSYS	YES	YES	UNION	YES
14.0057	DEER	2	0.50	2.90	488.0	R,H,L,S	1993	SQUAXIN		AMBSYS	YES	YES	UNION, MASON LK.	YES
14.0067	MALANEY	1	0.20	0.50	620.0	R,H,L,S	1993	SQUAXIN		AMBSYS	YES	YES	SHELTON, UNION	YES
14.0069	CAMPBELL	1	0.00	1.20	743.0	S	1994	SQUAXIN		AMBSYS	YES	YES	SHELTON	YES
14.0069	CAMPBELL	1A	0.50	0.80	255.0	R,H,L	1993	SQUAXIN		AMBSYS	YES	YES	SHELTON	YES
14.0069	CAMPBELL	1B	0.80	1.00	488.0	R,H,L	1993	SQUAXIN		AMBSYS	YES	YES	SHELTON	YES
15.0203	BLACKJACK	F51	0.00	2.70		R,H,L,M	1989	NWIFC			YES	YES	BREMERTON WEST	YES
15.0209	ROSS	U11	0.00	1.00	2972.8	R,H,L,M	1991		NWIFC	AMON91	NO	YES	BREMERTON WEST	YES
15.0229	WILDCAT	1	4.10	4.30		L, S	1996	NWIFC	AMSYS	AMBSYS	YES	N0	WILDCAT LAKE	YES
15.0356	GAMBLE	V41	0.14	0.60	799.0	R,H,L,M	1990	NWIFC	CSS	AMON90	YES	YES	PORT GAMBLE	YES
15.0356	GAMBLE	M21	0.60	1.20	879.0	R,H,L,M	1990	NWIFC	CSS	AMON90	YES	YES	PORT GAMBLE	YES
15.0377	LITTLE ANDERSON	1	0.05	0.25	580.0	R,H,L	1993	USFWS		DISK	YES	YES	SEABECK	YES
15.0377	LITTLE ANDERSON	2	0.25	0.90	1260.0	R,H,L	1993	USFWS		DISK	YES	YES	SEABECK	YES
15.0377	LITTLE ANDERSON	3	0.90	1.50	1260.0	R,H,L	1993	USFWS		DISK	YES	YES	SEABECK	YES
15.0379	L ANDERSON TRIB	1	0.00	0.25	450.0	R,H,L	1993	USFWS		DISK	YES	YES	SEABECK	YES
15.0379	L ANDERSON TRIB	2	0.25	0.35	150.0	R,H,L	1993	USFWS		DISK	YES	YES	SEABECK	YES
15.0382	L ANDERSON TRIB	1	0.00	0.30	690.0	R,H,L	1993	USFWS		DISK	YES	YES	SEABECK, POULSBO	YES
15.0382	L ANDERSON TRIB	2	0.30	0.80	520.0	R,H,L	1993	USFWS		DISK	YES	YES	POULSBO	YES
15.0382	L ANDERSON TRIB	3	0.80	1.20	380.0	R,H,L	1993	USFWS		DISK	YES	YES	POULSBO	YES

WRIA	STREAM NAME	SEG #	RM (LOW)	RM (UPR)	SEG LEN (m)	SURVEY TYPE	SURVEY YEAR	DATA AFFIL.	SUM RPT	DATA BASE	FIELD FORM	GIS	USGS TOPO QUAD MAP	MAP ON FILE
15.0385	L ANDERSON TRIB	1	0.00	0.40	700.0	R,H,L	1993	USFWS		DISK	YES	YES	POULSBO	YES
15.0386	L ANDERSON TRIB	1	0.00	0.60	1100.0	R,H,L	1993	USFWS		DISK	YES	YES	POULSBO	YES
15.0389	BIG BEEF	M21	0.00	1.80	2868.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	SEABECK	YES
15.0389	BIG BEEF	1	0.10	1.30		R,H,L	1993	PNPTC		DISK	YES	YES	SEABECK	YES
15.0389	BIG BEEF	2	1.30	5.30		R,H,L	1993	PNPTC		DISK	YES	YES	SEABECK, WILDCAT LK	YES
15.0389	BIG BEEF	4	6.00	6.70		R,H,L	1993	PNPTC		DISK	YES	YES	WILDCAT LAKE	YES
15.0389	BIG BEEF	6	7.80	9.00		R,H,L	1993	PNPTC		DISK	YES	YES	WILDCAT LAKE	YES
15.0389	BIG BEEF	1	0.20	0.50		L, S	1996	NWIFC	AMSYS	AMBSYS	YES	NO	SEABECK	YES
15.0400	SEABECK	M10	0.30	1.30	2361.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	SEABECK, WILDCAT LK	YES
15.0400	SEABECK	M10	0.30	1.00	1340.9	R,H,L,M	1990	NWIFC	CSS	AMON90	YES	YES	SEABECK, WILDCAT LAKE	YES
15.0404	STAVIS CR	1	0.15	0.50	890.0	R,H,L	1993	USFWS		DISK	YES	YES	WILDCAT LK, HOLLY	YES
15.0404	STAVIS CR	2	0.50	1.40	1600.0	R,H,L	1993	USFWS		DISK	YES	YES	HOLLY, WILDCAT LK	YES
15.0404	STAVIS CR	3	1.40	1.50	300.0	R,H,L	1993	USFWS		DISK	YES	YES	WILDCAT LK	YES
15.0404	STAVIS CR	4	1.50	3.60	4450.0	R,H,L	1993	USFWS		DISK	YES	YES	WILDCAT LK, HOLLY	YES
15.0404	STAVIS CR	5	3.60	3.80	490.0	R,H,L	1993	USFWS		DISK	YES	YES	HOLLY	YES
15.0404	STAVIS CR	6	3.80	4.00	500.0	R,H,L	1993	USFWS		DISK	YES	YES	HOLLY	YES
15.0405	STAVIS TRIB	1	0.00	1.10	2040.0	R,H,L	1993	USFWS		DISK	YES	YES	HOLLY	YES
15.0405	STAVIS TRIB	2	1.10	1.70	800.0	R,H,L	1993	USFWS		DISK	YES	YES	HOLLY	YES
15.0405	STAVIS TRIB	3	1.70	2.00	480.0	R,H,L	1993	USFWS		DISK	YES	YES	HOLLY	YES
15.0405	STAVIS TRIB	4	2.00	2.10	100.0	R,H,L	1993	USFWS		DISK	YES	YES	HOLLY	YES
15.0406	STAVIS TRIB	1	0.00	0.50	640.0	R,H,L	1993	USFWS		DISK	YES	YES	HOLLY	YES
15.0406	STAVIS TRIB	2	0.50	0.80	500.0	R,H,L	1993	USFWS		DISK	YES	YES	HOLLY	YES
15.0407	BOYCE CR	1	0.10	0.40	600.0	R,H,L	1993	USFWS		DISK	YES	YES	HOLLY	YES
15.0407	BOYCE CR	2	0.40	0.70	620.0	R,H,L	1993	USFWS		DISK	YES	YES	HOLLY	YES
15.0407	BOYCE CR	3	0.70	1.00	810.0	R,H,L	1993	USFWS		DISK	YES	YES	HOLLY	YES
15.0407	BOYCE CR	4	1.00	1.60	1200.0	R,H,L	1993	USFWS		DISK	YES	YES	HOLLY	YES
15.0408	HARDING CR	1	0.00	0.30	600.0	R,H,L	1993	USFWS		DISK	YES	YES	HOLLY	YES
15.0408	HARDING CR	2	0.30	0.55	420.0	R,H,L	1993	USFWS		DISK	YES	YES	HOLLY	YES
15.0408	HARDING CR	3	0.55	0.65	280.0	R,H,L	1993	USFWS		DISK	YES	YES	HOLLY	YES
15.0408	HARDING CR	4	0.65	0.80	250.0	R,H,L	1993	USFWS		DISK	YES	YES	HOLLY	YES
15.0408	HARDING CR	5	0.80	1.00	400.0	R,H,L	1993	USFWS		DISK	YES	YES	HOLLY	YES
15.0409	HARDING TRIB	1	0.00	0.50	930.0	R,H,L	1993	USFWS		DISK	YES	YES	HOLLY	YES
15.0410	HARDING TRIB	1	0.00	0.35	570.0	R,H,L	1993	USFWS		DISK	YES	YES	HOLLY	YES
15.0412	ANDERSON CR	1				R,H,L	1994	USFWS		DISK	NO		HOLLY	NO
15.0412	ANDERSON CR	2				R,H,L	1994	USFWS		DISK	NO		HOLLY	NO
15.0412	ANDERSON CR	3				R,H,L	1994	USFWS		DISK	NO		HOLLY	NO
15.0412	ANDERSON CR	1	0.60	0.90		L, S	1996	NWIFC	AMSYS	AMBSYS	YES	NO	HOLLY	
15.0412	ANDERSON CR	2B	1.70	1.90		L, S	1996	NWIFC	AMSYS	AMBSYS	YES	NO	HOLLY	YES
15.0413	ANDERSON TRIB	1				R,H,L	1994	USFWS		DISK	NO		HOLLY	NO
15.0413A	ANDERSON TRIB	1				R,H,L	1994	USFWS		DISK	NO		HOLLY	NO
15.0414	ANDERSON TRIB	1				R,H,L	1994	USFWS		DISK	NO		HOLLY	NO
15.0414	ANDERSON TRIB	2				R,H,L	1994	USFWS		DISK	NO		HOLLY	NO
15.0414	ANDERSON TRIB	3				R,H,L	1994	USFWS		DISK	NO		HOLLY	NO
15.0414	ANDERSON TRIB	4				R,H,L	1994	USFWS		DISK	NO		HOLLY	NO
15.0414	ANDERSON TRIB	5				R,H,L	1994	USFWS		DISK	NO		HOLLY	NO
15.0414	ANDERSON TRIB	2	0.00	0.20		L, S	1996	NWIFC	AMSYS	AMBSYS	YES	NO	HOLLY	YES
15.0415	ANDERSON TRIB	1				R,H,L	1994	USFWS		DISK	NO		HOLLY	NO
15.0420	DEWATTO	M21	0.00	1.80	3428.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	LILLIWAUP	YES
15.0420	DEWATTO	M22	1.80	2.20	1389.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	LILLIWAUP	YES
15.0420	DEWATTO	M23	2.20	3.20	783.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	LILLIWAUP	YES
15.0424	SHOE	8	2.20	2.40		L, S	1996	NWIFC	AMSYS	AMBSYS	YES	NO	LILLIWAUP	YES
15.0446	TAHUYA	M11	11.60	13.70	3435.0	R,H,L,M	1990	NWIFC	CSS	AMON90	YES	YES	LAKE WOOTEN	YES
15.0446	TAHUYA	M21	13.70	22.60	14376.0	R,H,L,M	1990	NWIFC	CSS	AMON90	YES	YES	LK WOOTEN/HOLLY/WILDCAT LK	YES
15.0446	TAHUYA	U11	22.60	23.40	1268.0	R,H,L,M	1990	NWIFC	CSS	AMON90	YES	YES	WILDCAT LAKE	YES
15.0446	TAHUYA	1	15.10	15.30		L, S	1996	NWIFC	AMSYS	AMBSYS	YES	NO	HOLLY	YES
15.0454	LITTLE TAHUYA	1	0.00	1.40	2155.0	R,H,L	1992	PNPTC		DISK	YES	YES	LAKE WOOTEN	YES
15.0454	LITTLE TAHUYA	2	1.40	2.35	1500.0	R,H,L	1992	PNPTC		DISK	YES	YES	LAKE WOOTEN	YES
15.0454	LITTLE TAHUYA	1	0.00	1.40	2155.0	RHL	1993	PNPTC		AMBSYS	YES	YES	LAKE WOOTEN	YES
15.0454	LITTLE TAHUYA	2	1.40	2.35	1500.0	RHL	1993	PNPTC		AMBSYS	YES	YES	LAKE WOOTEN	YES
15.0459	ERDMAN	2	0.90	1.10		L, S	1996	NWIFC	AMSYS	AMBSYS	YES	NO	LAKE WOOTEN	YES
15.0495	BIG MISSION	1	0.00	0.60	1000.0	R,H,L	1992	PNPTC		AMBSYS	YES	YES	BELFAIR	YES
15.0495	BIG MISSION	2	0.60	1.30	1400.0	R,H,L	1992	PNPTC		AMBSYS	YES	YES	BELFAIR	YES
15.0495	BIG MISSION	3	1.30	1.50	700.0	R,H,L	1992	PNPTC		AMBSYS	YES	YES	BELFAIR	YES
15.0495	BIG MISSION	4	1.50	1.70	600.0	R,H,L	1992	PNPTC		AMBSYS	YES	YES	BELFAIR	YES
15.0495	BIG MISSION	5	1.70	2.30	1076.0	R,H,L	1992	PNPTC		AMBSYS	YES	YES	BELFAIR	YES
15.0495	BIG MISSION	6	2.30	3.00	1885.0	R,H,L	1992	PNPTC		AMBSYS	YES	YES	BELFAIR, LAKE WOOTEN	YES
15.0495	BIG MISSION	7	3.00	4.10	1800.0	R,H,L	1992	PNPTC		AMBSYS	YES	YES	BELFAIR, LAKE WOOTEN	YES
15.0495	BIG MISSION	8	4.10	5.80	3000.0	R,H,L	1992	PNPTC		AMBSYS	YES	YES	BELFAIR	YES
15.0495	BIG MISSION	1	0.00	0.60	1000.0	RHL	1993	PNPTC		DISK	YES	YES	BELFAIR	YES
15.0495	BIG MISSION	2	0.60	1.30	1400.0	RHL	1993	PNPTC		DISK	YES	YES	BELFAIR	YES
15.0495	BIG MISSION	3	1.30	1.50	700.0	RHL	1993	PNPTC		DISK	YES	YES	BELFAIR	YES
15.0495	BIG MISSION	4	1.50	1.70	600.0	RHL	1993	PNPTC		DISK	YES	YES	BELFAIR	YES
15.0495	BIG MISSION	5	1.70	2.30	1076.0	RHL	1993	PNPTC		DISK	YES	YES	BELFAIR	YES
15.0495	BIG MISSION	6	2.30	3.00	1885.0	RHL	1993	PNPTC		DISK	YES	YES	BELFAIR,LAKE WOOTEN	YES

WRIA	STREAM NAME	SEG #	RM (LOW)	RM (UPR)	SEG LEN (m)	SURVEY TYPE	SURVEY YEAR	DATA AFFIL.	SUM RPT	DATA BASE	FIELD FORM	GIS	USGS TOPO QUAD MAP	MAP ON FILE
15.0495	BIG MISSION	7	3.00	4.10	1800.0	RHL	1993	PNPTC		DISK	YES	YES	BELFAIR, LAKE WOOTEN	YES
15.0495	BIG MISSION	8	4.10	5.80	3000.0	RHL	1993	PNPTC		DISK	YES	YES	BELFAIR	YES
15.0496	BIG MISSION TRIB	1	0.00	0.80	1800.0	R,H	1992	PNPTC		DISK	YES	YES	BELFAIR	YES
15.0496	BIG MISSION TRIB	1	0.00	0.80	1800.0	RH	1993	PNPTC		AMBSYS	NO	YES	BELFAIR	YES
15.0498	BIG MISSION TRIB	1	0.00	1.70	2700.0	R,H	1992	PNPTC		DISK	YES	YES	LAKE WOOTEN	YES
15.0498	BIG MISSION TRIB	1	0.00	1.70	2700.0	RH	1993	PNPTC		AMBSYS	NO	YES	LAKE WOOTEN	YES
15.0499	BIG MISSION TRIB	1	0.00	0.20	340.0	R,H,L	1992	PNPTC		AMBSYS	YES	YES	BELFAIR	YES
15.0499	BIG MISSION TRIB	2	0.20	0.90	1600.0	R,H,L	1992	PNPTC		AMBSYS	YES	YES	BELFAIR	YES
15.0499	BIG MISSION TRIB	1	0.00	0.20	340.0	RHL	1993	PNPTC		DISK	NO	YES	BELFAIR	YES
15.0499	BIG MISSION TRIB	2	0.20	0.90	1600.0	RHL	1993	PNPTC		DISK	NO	YES	BELFAIR	YES
15.0500	BIG MISSION TRIB	1	0.00	0.40	810.0	R,H	1992	PNPTC		DISK	YES	YES	BELFAIR	YES
15.0500	BIG MISSION TRIB	1	0.00	0.40	810.0	RH	1993	PNPTC		AMBSYS	NO	YES	BELFAIR	YES
15.0503	UNION R	1				R,H,L	1994	USFWS		DISK	NO		BELFAIR	NO
15.0503	UNION R	2				R,H,L	1994	USFWS		DISK	NO		BELFAIR	NO
15.0503	UNION R	3				R,H,L	1994	USFWS		DISK	NO		BELFAIR	NO
15.0503	UNION R	4				R,H,L	1994	USFWS		DISK	NO		BELFAIR	NO
15.0503	UNION R	5				R,H,L	1994	USFWS		DISK	NO		BELFAIR	NO
15.0503	UNION R	6				R,H,L	1994	USFWS		DISK	NO		BELFAIR	NO
15.0503	UNION R	7				R,H,L	1994	USFWS		DISK	NO		BELFAIR	NO
15.0503	UNION R	8				R,H,L	1994	USFWS		DISK	NO		BELFAIR	NO
15.0505	COURTNEY	1	0.00	0.55	800.0	R,H,L	1992	PNPTC		AMBSYS	YES	YES	BELFAIR	YES
15.0505	COURTNEY	2	0.55	0.90	500.0	R,H,L	1992	PNPTC		AMBSYS	YES	YES	BELFAIR	YES
15.0505	COURTNEY	3	0.90	2.40	1500.0	R,H,L	1992	PNPTC		AMBSYS	YES	YES	BELFAIR	YES
15.0505	COURTNEY	1	0.00	0.55	800.0	R,H,L	1993	PNPTC		DISK	YES	YES	BELFAIR	YES
15.0505	COURTNEY	2	0.55	0.90	500.0	R,H,L	1993	PNPTC		DISK	YES	YES	BELFAIR	YES
15.0505	COURTNEY	3	0.90	2.40	1500.0	R,H,L	1993	PNPTC		DISK	YES	YES	BELFAIR	YES
15.0505	COURTNEY	4	2.26	2.85	953.0	R,H,L	1993	PNPTC		DISK	YES	NO	BELFAIR, WILDCAT LK	YES
15.0505A	COURTNEY TRIB	1	0.00	0.27	430.0	R,H,L	1994	PNPTC			YES	NO	BELFAIR (TRIB NOT ON MAP)	NO
15.0506	COURTNEY TRIB	1	0.00	0.31	500.0	R,H,L	1994	PNPTC			YES	NO	BELFAIR, WILDCAT LK	YES
15.0510	BEAR	1	0.00	0.20	385.0	R,H,L	1992	PNPTC		AMBSYS	YES	YES	BELFAIR	YES
15.0510	BEAR	2	0.20	0.50	662.0	R,H,L	1992	PNPTC		AMBSYS	YES	YES	BELFAIR	YES
15.0510	BEAR	3	0.50	1.65	1600.0	R,H+G34	1992	PNPTC		AMBSYS	YES	YES	BELFAIR, WILDCAT LK	YES
17.0012	BIG QUILCENE	1	0.00	0.10			1992	PNPTC		DISK	NO	YES	QUILCENE	YES
17.0012	BIG QUILCENE	2	0.10	0.60			1992	PNPTC		DISK	NO	YES	QUILCENE	YES
17.0012	BIG QUILCENE	3	0.60	2.80			1992	PNPTC		DISK	NO	YES	QUILCENE, MT. WALKER	YES
17.0034	SF TUNNEL	V41	1.50	2.40	714.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	MT. TOWNSEND	YES
17.0076	LTL QUILCENE	1	0.00	1.70	300.0	R,H,L	1992	PNPTC		DISK	YES	YES	QUILCENE, MT. WALKER	YES
17.0076	LTL QUILCENE	2	1.70	1.90	2107.0	R,H,L	1992	PNPTC		DISK	YES	YES	MT. WALKER	YES
17.0076	LTL QUILCENE	3	1.90	2.70	1300.0	R,H,L	1992	PNPTC		DISK	YES	YES	MT. WALKER	YES
17.0076	LTL QUILCENE	4	2.70	4.40	2500.0	R,H,L	1992	PNPTC		DISK	YES	YES	MT. WALKER	YES
17.0076	LTL QUILCENE	5	4.40	5.20	1387.0	R,H,L	1992	PNPTC		DISK	YES	YES	MT. WALKER	YES
17.0089	RIPLEY CR	1	0.00	0.90	1214.0	RHL	1993	PNPTC		DISK	YES	YES	MT. WALKER, UNCAS	YES
17.0089	RIPLEY CR	2	0.90	1.60	1300*	R	1993	PNPTC		AMBSYS	YES	YES	UNCAS	YES
17.0090	HOWE	1	0.00	0.50	800.0	R,H,L	1992	PNPTC		AMBSYS	YES	YES	MT WALKER, UNCAS	YES
17.0090	HOWE	1	0.00	0.50			1993	PNPTC			NO	YES	MT. WALKER, UNCAS	YES
17.0090	HOWE	2	0.50	0.60			1993	PNPTC			NO	YES	UNCAS	YES
17.0090	HOWE	3	0.60	1.00			1993	PNPTC			NO	YES	UNCAS	YES
17.0090	HOWE	4	1.00	1.50			1993	PNPTC			NO	YES	UNCAS	YES
17.0090	HOWE	5	1.50	1.70			1993	PNPTC			NO	YES	UNCAS	YES
17.0090	HOWE	6	1.70	2.00			1993	PNPTC			NO	YES	UNCAS	YES
17.0090	HOWE	7	2.00	3.00			1993	PNPTC			NO	YES	UNCAS	YES
17.0170	THORNDYKE CR	1	0.40	0.70	480.0	R,H,L	1993	USFWS		DISK	YES	YES	LOFALL	YES
17.0170	THORNDYKE CR	2	0.70	1.10	599.0	R,H,L	1993	USFWS		DISK	YES	YES	LOFALL	YES
17.0170	THORNDYKE CR	3	1.10	1.30	400.0	R,H,L	1993	USFWS		DISK	YES	YES	LOFALL	YES
17.0170	THORNDYKE CR	4	1.30	2.50	2400.0	R,H,L	1993	USFWS		DISK	YES	YES	LOFALL	YES
17.0170	THORNDYKE CR	5	2.50	3.00	1436.0	R,H,L	1993	USFWS		DISK	YES	YES	LOFALL	YES
17.0170	THORNDYKE CR	6	3.00	3.30	250.0	R,H,L	1993	USFWS		DISK	YES	YES	LOFALL	YES
17.0170	THORNDYKE CR	7	3.30	3.70	400.0	R,H,L	1993	USFWS		DISK	YES	YES	LOFALL	YES
17.0171	THORNDYKE TRIB	1	0.00	1.50	3100.0	R,H,L	1993	USFWS		DISK	YES	YES	LOFALL, QUILLENE	YES
17.0174	THORNDYKE TRIB	1	0.00	0.30	529.0	R,H,L	1993	USFWS		DISK	YES	YES	LOFALL	YES
17.0174	THORNDYKE TRIB	2	0.30	0.60	490.0	R,H,L	1993	USFWS		DISK	YES	YES	LOFALL	YES
17.0174	THORNDYKE TRIB	3	0.60	0.70	100.0	R,H,L	1993	USFWS		DISK	YES	YES	LOFALL	YES
17.0174A	THORNDYKE TRIB	1	0.00	0.10	200.0	R,H,L	1993	USFWS		DISK	YES	YES	LOFALL	YES
17.0174B	THORNDYKE TRIB	1	0.00	0.30	432.0	R,H,L	1993	USFWS		DISK	YES	YES	LOFALL	YES
17.0174C	THORNDYKE TRIB	1	0.00	0.10	100.0	R,H,L	1993	USFWS		DISK	YES	YES	LOFALL	YES
17.0174D	THORNDYKE TRIB	1	0.00	0.20	356.0	R,H,L	1993	USFWS		DISK	YES	YES	LOFALL	YES
17.0174D	THORNDYKE TRIB	2	0.20	0.30	100.0	R,H,L	1993	USFWS		DISK	YES	YES	LOFALL	YES
17.0179A	THORNDYKE TRIB	1	0.00	0.10	100.0	R,H,L	1993	USFWS		DISK	YES	YES	LOFALL	YES
17.0179B	THORNDYKE TRIB	1	0.00	0.20	400.0	R,H,L	1993	USFWS		DISK	YES	YES	LOFALL	YES
17.0181	SHINE CR	1	0.20	0.60	799.0	R	1993	USFWS		DISK	YES	YES	LOFALL	YES
17.0181	SHINE CR	2	0.60	1.00	713.0	R,H,L	1993	USFWS		DISK	YES	YES	LOFALL/PORT LUDLOW	YES
17.0181	SHINE CR	3	1.00	1.20	289.0	R,H,L	1993	USFWS		DISK	YES	YES	PORT LUDLOW	YES
17.0181	SHINE CR	4	1.20	1.30	248.0	R,H,L	1993	USFWS		DISK	YES	YES	PORT LUDLOW	YES
17.0181	SHINE CR	5	1.30	1.80	900.0	R,H	1993	USFWS		DISK	YES	YES	PORT LUDLOW	YES

WRIA	STREAM NAME	SEG	RM	RM	SEG	SURVEY	SURVEY	DATA	SUM	DATA	FIELD	GIS	USGS TOPO QUAD MAP	MAP
		#	(LOW)	(UPR)	LEN	TYPE	YEAR	AFFIL.	RPT	BASE	FORM			ON
					(m)									FILE
17.0181	SHINE CR	6	1.80	2.80	1810.0	R,H,L	1993	USFWS		DISK	YES	YES	PORT LUDLOW	YES
17.0181A	SHINE TRIB	1	0.00	0.10	228.0	R,H,L	1993	USFWS		DISK	YES	YES	PORT LUDLOW	YES
17.0182	SHINE TRIB	1	0.00	0.40	810.0	R	1993	USFWS		DISK	YES	YES	LOFALL	YES
17.0203	CHIMACUM	1	0.00	0.40		S	1996	W.O.S.	YES	AMBSYS	NO	NO	PORT TOWNSEND S.	NO
17.0203	CHIMACUM	2	0.40	1.20		S	1996	W.O.S.	YES	AMBSYS	NO	NO	PORT TOWNSEND S.	NO
17.0203	CHIMACUM	3	1.20	1.40		S	1996	W.O.S.	YES	AMBSYS	NO	NO	PORT TOWNSEND S.	NO
17.0219	SNOW	F21	0.60	2.00	39337.0	R,H,L,M	1990	NWIFC	CSS	AMON90	YES	YES	UNCAS	YES
17.0219	SNOW	F31	2.00	3.90	23020.0	R,H,L,M	1990	NWIFC	CSS	AMON90	YES	YES	UNCAS	YES
17.0219	SNOW	V41	3.90	5.00	22617.0	R,H,L,M	1990	NWIFC	CSS	AMON90	YES	YES	UNCAS	YES
17.0219	SNOW	V11	5.00	6.40	24704.0	R,H,L,M	1990	NWIFC	CSS	AMON90	YES	YES	UNCAS	YES
17.0219	SNOW	F41	0.60	3.80	441.2	R,H,L,M	1991	UWCSS	NWIFC	AMON91	YES	YES	UNCAS	YES
17.0219	SNOW	F3.1	3.80	4.40	6254.2	R,H,L,M	1991	UWCSS	NWIFC	AMON91	YES	YES	UNCAS	YES
17.0219	SNOW	V41	4.40	4.80	953.3	R,H,L,M	1991	UWCSS	NWIFC	AMON91	YES	YES	UNCAS	YES
17.0219	SNOW	0	0.00	0.50		R,H,L	1993	PNPTC		DISK	NO	YES	UNCAS	YES
17.0219	SNOW	1	0.50	3.50		R,H,L	1993	PNPTC		DISK	YES	YES	UNCAS	YES
17.0219	SNOW	2	3.50	4.90		R,H,L	1993	PNPTC		DISK	YES	YES	UNCAS	YES
17.0219	SNOW	3	4.90	6.40		R,H,L	1993	PNPTC		DISK	YES	YES	UNCAS	YES
17.0219	SNOW	0	0.10	0.50	847.0	RHLS	1994	PNPTC			YES		UNCAS	YES
17.0221	ANDREWS	1	0.00	0.37	590.0	R,H,L	1993	USFWS			YES		UNCAS	NO
17.0221	ANDREWS/CROCKER LK	2	0.37	0.82	729.0	R	1993	USFWS			YES		UNCAS	
17.0221	ANDREWS	3	0.82	2.09	1545.0	R,H,L	1993	USFWS			YES		UNCAS	
17.0221	ANDREWS	4	2.09	2.50	646.0	R,H,L	1993	USFWS			YES		UNCAS	
17.0245	SALMON	2	0.70	1.50			1992	PNPTC		DISK	NO	YES	UNCAS	YES
17.0245	SALMON	3	1.50	2.00	400*	R,H,L	1993	PNPTC		DISK	NO	YES	UNCAS	YES
17.0245	SALMON	4	2.00	2.20	765.0	R,H,L	1993	PNPTC		DISK	NO	YES	UNCAS	YES
17.0245	SALMON	5	2.20	3.50	2820.0	R,H,L	1993	PNPTC		DISK	NO	YES	UNCAS	YES
18.0160	MCDONALD	1	0.20	4.10	7100.0	R,H,L	1992	PNPTC		DISK	YES	YES	CARLSBORG	YES
18.0160	MCDONALD	2	4.10	4.90	1800.0	R,H,L	1992	PNPTC		DISK	YES	YES	CARLSBORG	YES
18.0160	MCDONALD	3	4.90	6.90	3465.0	R,H,L	1992	PNPTC		DISK	YES	YES	CARLSBORG	YES
18.0160	MCDONALD	3	4.90	6.90	3465.0	R,H,L	1993	PNPTC		AMBSYS	YES	YES	CARLSBORG	YES
18.0160	MCDONALD	4	6.90	7.90	2106.0	R,H,L	1993	PNPTC		AMBSYS	YES	YES	CARLSBORG	YES
18.0160	MCDONALD	5	7.90	8.50	1005.0	R,H,L	1993	PNPTC		AMBSYS	YES	YES	CARLSBORG	YES
18.0160	MCDONALD	6	8.50	9.40	830.0	R,H,L	1993	PNPTC		AMBSYS	YES	YES	CARLSBORG	YES
18.0160	MCDONALD	7	9.40	9.90	1600.0	R	1993	PNPTC		AMBSYS	YES	YES	CARLSBORG	YES
18.0173	SIEBERT	1	0.00	3.50	6264	R,H,L	1992	PNPTC		DISK		YES	YES	MORS
18.0173	SIEBERT	2	3.50	6.40	5000.0	R,H,L	1992	PNPTC		DISK	YES	YES	MORSE	YES
19.0020	WHISKEY	1	0.00	0.37	455.8	R,H,L	1992	LELWHA	NWIFC	AMBSYS	YES	YES	DISQUE	YES
19.0103	DEEP	1	0.10	2.10	4116.9	R,H,L	1992	LELWHA	NWIFC	AMBSYS	YES	YES	PYSHT	YES
19.0103	DEEP	2	2.10	2.60		R,H,L	1995	LELWHA		AMBSYS	YES	NO	PYSHT	YES
19.0103	DEEP	3	2.60	3.80		R,H,L	1995	LELWHA		AMBSYS	YES	NO	PYSHT	YES
19.0113	PYSHT	F30	1.00	8.60	2832.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	PYSHT, WEST OF PYSHT	YES
19.0113	PYSHT	V40	8.60	12.00	5254.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	WEST OF PYSHT	YES
19.0115	SF PYSHT	M20	0.00	2.00	3164.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	WEST OF PYSHT	YES
19.0115	SF PYSHT	M10	2.00	3.40	2330.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	WEST OF PYSHT	YES
19.0115	SF PYSHT	U20	3.40	5.30	2871.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	PYSHT, WEST OF PYSHT	YES
19.0115	SF PYSHT	3	5.00	6.20		R,H,L	1995	LELWHA		AMBSYS	YES		PYSHT	YES
19.0115	SF PYSHT	4	6.20	6.70		R,H,L	1995	LELWHA		AMBSYS	YES		PYSHT	YES
19.0115	SF PYSHT	3	3.90	4.20		R,H,L	1996	LELWHA		AMBSYS	YES	NO	PYSHT	YES
19.0120	GREEN	M20	0.00	1.40	3075.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	WEST OF PYSHT	YES
19.0120	GREEN	V20	1.40	2.70	256.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	WEST OF PYSHT	YES
19.0120	GREEN	V10	2.70	2.90	2330.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	WEST OF PYSHT	YES
19.0149	LITTLE HOKO	1				R,H,L	1994	LELWHA		AMBSYS	NO	NO	ELLIS MTN	NO
19.0149	LITTLE HOKO	1	0.00	1.80		H,L	1996	LELWHA		AMBSYS	YES	NO	ELLIS MTN	YES
19.0149	LITTLE HOKO	2	1.80	2.70		R,H,L	1996	LELWHA		AMBSYS	YES	NO	ELLIS MTN	YES
19.0149	LITTLE HOKO	3	2.70	4.00		R,H,L	1996	LELWHA		AMBSYS	YES	NO	ELLIS MTN	YES
19.0203	SEKIU	7	6.00	7.30		R,H,L	1996	MAKAH	AMSYS	AMBSYS	YES	NO	SEKIU RIVER	NO
19.0203	SEKIU	3	7.00	7.30		R,H,L	1996	MAKAH	AMSYS	AMBSYS	YES	NO	NEAH BAY	NO
19.0203	SEKIU	1T	2.80	2.80	50.0	T	1996	MAKAH	NO		YES	NO	SEKIU RIVER	NO
19.0203	SEKIU	MS1T	1.00	1.10	100.0	T	1996	MAKAH	NO		YES	NO	SEKIU RIVER	NO
19.0205	CARPENTER	1T	1.30	1.30	50.0	T	1996	MAKAH	NO		YES	NO	SEKIU RIVER	NO
19.0218	NF SEKIU	1T	9.30	9.30	50.0	T	1996	MAKAH	NO		YES	NO	NEAH BAY	NO
19.0223	SONNY BROOK	1T	0.50	0.50	50.0	T	1996	MAKAH	NO		YES	NO	UMBRELLA CR	NO
19.0227	OLSEN	1T	0.30	0.30	50.0	T	1996	MAKAH	NO		YES	NO	WAADAH IS	NO
19.0228	JANSEN	1T	0.30	0.40	100.0	T	1996	MAKAH	NO		YES	NO	WAADAH IS	NO
19.0234	SNOW	1T	0.30	0.30	25.0	T	1996	MAKAH	NO		YES	NO	NEAH BAY	NO
19.0235	SAIL R	1	0.20	0.40		R,H,L	1995	MAKAH	AMSYS	AMBSYS	YES	NO	NEAH BAY	NO
19.0235	SAIL R	1T	0.40	0.50	150.0	T	1996	MAKAH	NO		YES	NO	NEAH BAY	NO
19.0235	SAIL R	4	2.00	2.50		R,H,L	1995	MAKAH	AMSYS	AMBSYS	YES	NO	NEAH BAY	NO
19.0235	SAIL R	5	2.50	2.70		R,H,L	1995	MAKAH	AMSYS	AMBSYS	YES	NO	NEAH BAY	NO
20.0005	WAATCH	1T	3.50	3.50	50.0	T	1996	MAKAH	NO		YES	NO	NEAH BAY/MAKAH BAY	NO
20.0015	SOOES	2T	2.00	2.00	50.0	T	1996	MAKAH	NO		YES	NO	MAKAH BAY	NO
20.0015	SOOES	TS2T	3.00	3.00	50.0	T	1996	MAKAH	NO		YES	NO	MAKAH BAY	NO
20.0122	FLUHARTY	F51	0.00	0.90	2762.6	R,H,L,M	1991	QUILEUT	NWIFC	AMON91	YES	YES	GUNDERSON MTN.	YES
20.0145	MF DICKEY	M12	2.20	3.10	514.3	R,H,L,M	1991	QUILEUT	NWIFC	AMON91	YES	YES	GUNDERSON MTN.	YES

WRIA	STREAM NAME	SEG #	RM (LOW)	RM (UPR)	SEG LEN (m)	SURVEY TYPE	SURVEY YEAR	DATA AFFIL.	SUM RPT	DATA BASE	FIELD FORM	GIS	USGS TOPO QUAD MAP	MAP ON FILE
20.0146	SPIDDLE	M11	0.00	1.60	2020.6	R,H,L,M	1991	QUILEUT	NWIFC	AMON91	YES	YES	GUNDERSON MTN.	YES
20.0248	DOWANS	M21	0.00	2.10	3387.0	R,H,L,M	1990	NWIFC	CSS	AMON90	YES	YES	ANDERSON CR.	YES
20.0251	KAHKWA	1	0.50	0.90	600.0	L	1993	HOH		AMBSYS	YES	YES	INDIAN PASS	YES
20.0252	MOSQUITO	1	0.10	0.40	600.0	T	1993	HOH		DISK	F.1	YES	INDIAN PASS	YES
20.0254	OLALLIE	1	0.30	0.70	600.0	L	1993	HOH		AMBSYS	YES	YES	INDIAN PASS	YES
20.0255	INDIAN	1	0.30	0.70	600.0	T	1993	HOH		DISK	F.1	YES	INDIAN PASS	YES
20.0255	INDIAN	1	0.30	0.70	600.0	L	1993	HOH		AMBSYS	YES	YES	INDIAN PASS	YES
20.0257	HADES	1	0.10	0.40	600.0	T	1993	HOH		DISK	F.1	YES	INDIAN PASS, WINFIELD CR	YES
20.0257	HADES	1	0.10	0.40	600.0	L	1993	HOH		AMBSYS	YES	YES	INDIAN PASS, WINFIELD CR	YES
20.0430	NOLAN	1	1.00	1.40	600.0	T	1993	HOH		DISK	NO	YES	ANDERSON CREE+N433	YES
20.0437	ANDERSON	1			600.0	L	1994	HOH			NO		ANDERSON CREEK	YES
20.0442	WINFIELD	M10	0.00	3.20	6043.0	R,H,L,M	1989	HOH	CSS		YES	YES	WINFIELD CREEK	YES
20.0442	WINFIELD	1	0.20	0.50	600.0	T	1993	HOH		DISK	F.1	YES	WINFIELD CREEK	YES
20.0447	ELK	F31	0.00	1.10	1599.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	WINFIELD CREEK	YES
20.0447	ELK	F41	1.10	1.70	948.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	WINFIELD CREEK	YES
20.0447	ELK	M11	1.70	2.60	1446.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	WINFIELD CREEK	YES
20.0447	ELK	1			600.0	T	1994	HOH			NO		WINFIELD CREEK	YES
20.0448	ALDER	M10	0.70	1.80	1809.0	R,H,L,M	1989	HOH	CSS		YES	YES	WINFIELD CREEK	YES
20.0448	ALDER	F50	1.80	2.60	791.0	R,H,L,M	1989	HOH	CSS		YES	YES	WINFIELD CREEK	YES
20.0448	ALDER	1			600.0	L	1994	HOH			NO		WINFIELD CREEK	YES
20.0451	WILLOUGHBY	M10	0.00	0.30	762.0	R,H,L,M	1989	HOH	CSS		YES	YES	WINFIELD CREEK	YES
20.0451	EF WILLOUGHBY	V10	0.30	1.40	1689.0	R,H,L,M	1989	HOH	CSS		YES	YES	WINFIELD CREEK	YES
20.0451	WILLOUGHBY	M10	0.00	0.30			1990			AMON90	NO	YES	WINFIELD CREEK	YES
20.0451	WILLOUGHBY	1	0.10	0.40	600.0	T	1993	HOH		DISK	F.1	YES	WINFIELD CR	YES
20.0451	WILLOUGHBY	1			600.0	L	1994	HOH			NO		WINFIELD	YES
20.0452	WF WILLOUGHBY	V10	0.00	0.70	1077.0	R,H,L,M	1989	HOH	CSS		YES	YES	WINFIELD CREEK	YES
20.0458	ROCK	1	0.10	0.40	600.0	T	1993	HOH		DISK	F.1	YES	WINFIELD CR	YES
20.0458	"ROCK" (LINDNER)	1			600.0	L	1994	HOH			NO		WINFIELD	YES
20.0459	TOWER	M11	0.00	0.90	1437.0	R,H,L,M	1990		CSS	AMON90	NO	YES	SPRUCE MTN.	YES
20.0459	TOWER	1			600.0	L	1994	HOH			NO		SPRUCE MTN	YES
20.0462	MAPLE	F41	0.30	2.50	5751.0	R,H,L,M	1991	HOH	CSS	AMON91	YES	YES	SPRUCE MTN.	YES
20.0462	MAPLE	M11	2.50	3.50	1418.0	R,H,L,M	1991	HOH	CSS	AMON91	YES	YES	SPRUCE MTN.	YES
20.0462	MAPLE	V31	3.50	4.10	1653.0	R,H,L,M	1991	HOH	CSS	AMON91	YES	YES	SPRUCE MTN.	YES
20.0465	SPRUCE	F31	0.00	0.50	839.0	R,H,L,M	1990	HOH	CSS	AMON90	YES	YES	SPRUCE MTN.	YES
20.0466	OWL	M11	0.00	1.30	3171.0	R,H,L,M	1991	HOH	CSS	AMON91	YES	YES	SPRUCE MTN.	YES
20.0466	OWL	V11	1.30	2.80	4400.0	R,H,L,M	1991	HOH	CSS	AMON91	YES	YES	SPRUCE MTN.	YES
20.0466	OWL	1	0.10	0.40	600.0	T	1993	HOH		DISK	F.1	YES	SPRUCE MTN	YES
20.0470	CANYON	M11	0.00	1.00	1660.0	R,H,L,M	1990		CSS	AMON90	NO		SPRUCE MTN.	YES
20.0470	CANYON	1			600.0	L	1994	HOH			NO		SPRUCE MTN	YES
20.0470A	CANYON SPRINGS	F31	0.00	0.20	721.0	R,H,L,M	1990	HOH	CSS	AMON90	YES	YES	SPRUCE MTN.	YES
20.0471	IRON MAIDEN	F51	0.00	0.20	232.0	R,H,L,M	1990	HOH	CSS	AMON90	YES	YES	SPRUCE MTN.	YES
20.0475	FISHER	1	0.10	0.40	600.0	L	1994	HOH			NO		OWL MTN	YES
20.0476	SPLIT	F51	0.00	1.30	243.0	R,H,L,M	1990	HOH	CSS	AMON90	YES	YES	OWL MTN.	YES
20.0476	SPLIT	M11	1.30	2.80	219.0	R,H,L,M	1990	HOH	CSS	AMON90	YES	YES	OWL MTN.	YES
20.0476	SPLIT	1	0.10	0.50	600.0	T	1993	HOH		DISK	F.1	YES	OWL MTN	YES
20.0476	SPLIT	1			600.0	L	1994	HOH			NO		OWL MTN	YES
20.0477	LINE	1	1.00	1.40	600.0	T	1993	HOH		DISK	F.1	YES	OWL MTN	YES
20.0477	LINE	1			600.0	L	1994	HOH			NO		OWL MTN	YES
20.0478	HOOT	1			600.0	L	1994	HOH			NO		OWL MTN	YES
20.0481	SHELTER	F51	0.00	0.40	588.0	R,H,L,M	1990	HOH	CSS	AMON90	YES	YES	OWL MTN.	YES
20.0481	SHELTER	1	0.60	0.90	600.0	T	1993	HOH		DISK	F.1	YES	OWL MTN	YES
20.0481	SHELTER	1	0.60	0.90	600.0	L	1993	HOH		AMBSYS	YES	YES	OWL MTN	YES
20.0481	SHELTER	1	0.60	0.90	600.0	L	1994	HOH			NO		OWL MTN	YES
20.0483	MATSON	1	0.10	0.40	600.0	T	1993	HOH		DISK	F.1	YES	OWL MTN	YES
20.0483	MATSON	1	0.10	0.40	600.0	L	1993	HOH		AMBSYS	YES	YES	OWL MTN	YES
20.0484	CAMP	F41	0.00	0.40	718.0	R,H,L,M	1991	HOH	CSS	AMON91	YES	YES	OWL MTN.	YES
20.0484	CAMP	V21	0.40	0.60	345.0	R,H,L,M	1991	HOH	CSS	AMON91	YES	YES	OWL MTN.	YES
20.0484	CAMP	V31	0.60	1.60	1681.0	R,H,L,M	1991	HOH	CSS	AMON91	YES	YES	OWL MTN.	YES
20.0484	CAMP	1	0.40	0.90	600.0	T	1993	HOH		DISK	F.1	YES	OWL MTN	YES
20.0484	CAMP	1	0.40	0.90	600.0	L	1993	HOH		AMBSYS	YES	YES	OWL MTN	YES
20.0504	TWIN	M10	0.00	1.20	1588.0	R,H,L,M	1989	HOH	CSS		YES	YES	OWL MTN., SPRUCE MTN.	YES
20.0504	TWIN	F41	0.00	1.00	1924.0	R,H,L,M	1991	HOH	CSS	AMON91	YES	YES	OWL MTN, SPRUCE MTN	YES
20.0504	TWIN	1	0.30	0.60	600.0	L	1993	HOH		AMBSYS	YES	YES	OWL MTN	YES
20.0505	EAST TWIN	F50	0.00	0.70	764.0	R,H,L,M	1989	HOH	CSS		YES	YES	OWL MOUNTAIN	YES
20.0505	EAST TWIN	M11	0.00	0.90	1588.0	R,H,L,M	1990	HOH	CSS	AMON90	YES	YES	OWL MTN.	YES
20.0509	509	U11	0.00	0.60	997.0	R,H,L,M	1990	HOH	CSS	AMON90	YES	YES	OWL MTN.	YES
20.0509	509	1	0.70	1.00	600.0	T	1993	HOH		DISK	F.1	YES	OWL MTN	YES
20.0509	509	1	0.70	1.00	600.0	L	1993	HOH		AMBSYS	YES	YES	OWL MTN	YES
20.0509A	509 SPRINGS	F51	0.00	0.20	315.0	R,H,L,M	1990	HOH	CSS	AMON90	YES	YES	OWL MTN.	YES
20.0513	JACKSON	F41	0.00	0.80	450.0	R,H,L,M	1991		CSS	AMON91	NO	YES	OWL MTN.	YES
20.0513	JACKSON	V31	0.80	1.50	1318.0	R,H,L,M	1991		CSS	AMON91	NO	YES	OWL MTN.	YES
20.0513	JACKSON	1	0.10	0.40	600.0	T	1993	HOH		DISK	F.1	YES	OWL MTN	YES
20.0513	JACKSON	1	0.10	0.40	600.0	L	1993	HOH		AMBSYS	YES	YES	OWL MTN	YES
20.0524	COUGAR	F51	0.00	0.60	912.0	R,H,L,M	1990	HOH	CSS	AMON90	YES	YES	MT. TOM	YES

WRIA	STREAM NAME	SEG #	RM (LOW)	RM (UPR)	SEG LEN (m)	SURVEY TYPE	SURVEY YEAR	DATA AFFIL.	SUM RPT	DATA BASE	FIELD FORM	GIS	USGS TOPO QUAD MAP	MAP ON FILE
20.0530A	UNNAMED	F41	0.00	1.20	1893.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	MT. TOM	YES
21.0025	HURST	F30	0.00	2.00	6128.0	R,H,L,M	1989	QUINAUL	CSS		YES	YES	QUEETS	YES
21.0065	CHRISTMAS	M10	0.50	2.70	4391.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	CHRISTMAS CREEK	YES
21.0065	CHRISTMAS	M20	2.70	3.30	1409.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	CHRISTMAS CREEK	YES
21.0235	COAL	1	0.10	0.40	600.0	T	1993	HOH		DISK	F.1	YES	KLOOCHMAN ROCK	YES
21.0235	COAL	1	0.10	0.40	600.0	L	1993	HOH		AMBSYS	YES	YES	KLOOCHMAN ROCK	YES
21.0240	TSHLETSHY	F41	6.80	7.80	1397.5	R,H,L,M	1991	QUINAUL	NWIFC	AMON91	YES	YES	BOB CREEK	YES
21.0267	HARLOW	1A	0.40	0.80	600.0	T	1993	HOH		DISK	F.1	YES	KLOOCHMAN ROCK	YES
21.0267	HARLOW	1A	0.40	0.80	600.0	L	1993	HOH		AMBSYS	YES	YES	KLOOCHMAN ROCK	YES
21.0449	PRAIRIE	F21	0.00	1.30	2452.0	R,H,L,M	1990	QUINAUL	CSS	AMON90	YES	YES	LAKE QUINAULT WEST	YES
21.0449	PRAIRIE	M21	1.30	3.00	3304.0	R,H,L,M	1990	QUINAUL	CSS	AMON90	YES	YES	LAKE QUINAULT WEST	YES
21.0462	WILLABY	M11	0.00	0.10	649.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	LAKE QUINAULT E.	YES
21.0462	WILLABY	M21	0.10	0.20	260.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	LAKE QUINAULT E.	YES
21.0462	WILLABY	M12	0.20	0.50	507.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	LAKE QUINAULT E.	YES
21.0462	WILLABY	M22	0.50	1.20	1076.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	LAKE QUINAULT E.	YES
21.0462	WILLABY	M13	1.20	1.70	917.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	LAKE QUINAULT E.	YES
21.0462	WILLABY	V21	1.70	2.00	360.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	LAKE QUINAULT E.	YES
21.0469	ZIEGLER	V21	2.80	3.10	493.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	LAKE QUINAULT E.	YES
21.0469	ZIEGLER	U11	3.10	4.10	1550.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	LAKE QUINAULT E.	YES
22.0079	BRITTAIN	V31	0.00	0.70	1300.0	R,H,L,M	1990	ITT-RAY	CSS	AMON90	YES	YES	HUMPTULIPS	YES
22.0079	BRITTAIN	M11	0.70	1.30	764.0	R,H,L,M	1990	ITT-RAY	CSS	AMON90	YES	YES	HUMPTULIPS	YES
22.0079	BRITTAIN	F51	1.30	1.80	1317.0	R,H,L,M	1990	ITT-RAY	CSS	AMON90	YES	YES	HUMPTULIPS	YES
22.0079	BRITTAIN	M12	1.80	2.50	4241.0	R,H,L,M	1990	ITT-RAY	CSS	AMON90	YES	YES	HUMPTULIPS	YES
22.0079A	ELWOOD	V11	1.80	2.70	2637.0	R,H,L,M	1990	ITT-RAY	CSS	AMON90	YES	YES	HUMPTULIPS	YES
22.0261	SYLVIA	0	0.00	0.70		R	1994	MONTES.	NWIFC	AMONT2	NO		MONTESANO	NO
22.0261	SYLVIA	1	0.70	1.00		R	1994	MONTES.	NWIFC	AMBSYS	NO		MONTESANO	NO
22.0261	SYLVIA	2	1.00	2.10		R	1994	MONTES.	NWIFC	AMONT2	NO		MONTESANO	NO
22.0261	SYLVIA	3	2.10	3.00		R	1994	MONTES.	NWIFC	AMONT2	NO		MONTESANO	NO
22.0261	SYLVIA	4	3.00	3.40		R	1994	MONTES.	NWIFC	AMONT2	NO		MONTESANO	NO
22.0261	SYLVIA	5	3.40	4.00		R,H	1994	MONTES.	NWIFC	AMBSYS	NO		MONTESANO	NO
22.0261	SYLVIA	6	4.00	4.20		R,H	1994	MONTES.	NWIFC	AMBSYS	NO		MONTESANO	NO
22.0261	SYLVIA	7	4.20	4.70		R,H	1994	MONTES.	NWIFC	AMBSYS	NO		MONTESANO	NO
22.0261	SYLVIA	8	4.70	4.70		R,H	1994	MONTES.	NWIFC	AMBSYS	NO		MONTESANO	NO
22.0261	SYLVIA LAKE	9	4.70	5.60		R,H	1994	MONTES.	NWIFC	AMBSYS	NO		MONTESANO, PRICES PEAK	NO
22.0261	SYLVIA	10	5.60	6.00		R	1994	MONTES.	NWIFC	AMBSYS	NO		PRICES PEAK	NO
22.0261	SYLVIA	11	6.00	6.80		R,H	1994	MONTES.	NWIFC	AMBSYS	NO		PRICES PEAK	NO
22.0261	SYLVIA	12	6.80	8.20		R,H	1994	MONTES.	NWIFC	AMBSYS	NO		PRICES PEAK	NO
22.0261	SYLVIA	13	8.20	8.40		R	1994	MONTES.	NWIFC	AMBSYS	NO		PRICES PEAK	NO
22.0261	SYLVIA	14	8.40	9.80		R	1994	MONTES.	NWIFC	AMBSYS	NO		PRICES PEAK	NO
22.0261A	SYLVIA TRIB	1	1.00	1.80		R	1994	MONTES.	NWIFC	AMONT2	NO			NO
22.0261B	SYLVIA TRIB	1	0.00	0.50		R	1994	MONTES.	NWIFC	AMBSYS	NO			NO
22.0261D	SYLVIA TRIB	1	5.30	5.90		R	1994	MONTES.	NWIFC	AMONT2	NO		PRICES PEAK	NO
22.0262	SYLVIA TRIB	1	0.00	0.40		R	1994	MONTES.	NWIFC	AMBSYS	NO		MONTESANO	NO
22.0262	SYLVIA TRIB	2	0.40	0.70		R	1994	MONTES.	NWIFC	AMBSYS	NO		MONTESANO	NO
22.0262	SYLVIA TRIB	3	0.70	1.20		R	1994	MONTES.	NWIFC	AMBSYS	NO		MONTESANO	NO
22.0262	SYLVIA TRIB	4	0.70	0.90		R	1994	MONTES.	NWIFC	AMBSYS	NO		MONTESANO	NO
22.0263	SYLVIA TRIB	1	0.00	0.30		R	1994	MONTES.	NWIFC	AMBSYS	NO		MONTESANO	NO
22.0263	SYLVIA TRIB	2	0.30	0.30		R	1994	MONTES.	NWIFC	AMBSYS	NO		MONTESANO	NO
22.0264	EF SYLVIA	1	0.00	1.00		R,H	1994	MONTES.	NWIFC	AMBSYS	NO		PRICES PEAK	NO
22.0264	EF SYLVIA	2	1.00	1.70		R,H	1994	MONTES.	NWIFC	AMBSYS	NO		PRICES PEAK	NO
22.0264	EF SYLVIA	3	1.70	2.20		R,H	1994	MONTES.	NWIFC	AMBSYS	NO		PRICES PEAK	NO
22.0265	SYLVIA TRIB	1	0.00	0.50		R	1994	MONTES.	NWIFC	AMBSYS	NO		PRICES PEAK	NO
22.0400	UNNAMED	F51	0.00	0.50	698.0	R,H,L,M	1990	QUINAUL	CSS	AMON90	YES	YES	GRISDALE	YES
22.0400	UNNAMED	M21	0.50	1.50	1532.0	R,H,L,M	1990	QUINAUL	CSS	AMON90	YES	YES	GRISDALE	YES
23.0190	EF CHEHALIS R	7	0.30	0.50		R, L, S	1996	NWIFC		AMBSYS	YES	NO	ELOCHOMAN	YES
23.0288	HELM	M21	0.00	3.00	6309.0	R,H,L,M	1991	QUINAUL	NWIFC	AMON91	YES	YES	WYNOOCHEE VY SW	YES
23.0579	SHERMAN	1	1.00	1.20		R, L, S	1996	NWIFC		AMBSYS	YES	NO	CAPITOL PEAK	YES
23.0579	SHERMAN	2	5.40	5.70		R, L, S	1996	NWIFC		AMBSYS	YES	NO	LITTLE ROCK	YES
23.0581	LOST VALLEY	4	0.00	0.30		R, L, S	1996	NWIFC		AMBSYS	YES	NO	CAPITOL PEAK	YES
23.0661	MIMA FALLS	3	0.40	0.70		R, L, S	1996	NWIFC		AMBSYS	YES	NO	LITTLE ROCK	YES
23.1179	BIG CREEK	800	0.30	0.50		R, L, S	1996	NWIFC		AMBSYS	YES	NO	PE ELL/BOISTFORT/BOISTFORT PEAK	YES
23.1186	THRASH CREEK	400	1.00	1.30		R, L, S	1996	NWIFC		AMBSYS	YES	NO	ELOCHOMAN PASS	YES
23.1195	SAGE CREEK	150	0.20	0.50		R, L, S	1996	NWIFC		AMBSYS	YES	NO	ELOCHOMAN PASS	YES
24.0147	SALMON CR. TRIB	217	0.20	0.40		R, L, S	1996	NWIFC		AMBSYS	YES	NO	MONTESANO	YES
24.0161	VESTA TRIB	280	1.20	1.50		R, L, S	1996	NWIFC		AMBSYS	YES	NO	BROOKLYN/BLUE MTN	YES
24.0161	VESTA TRIB	282	1.50	1.80		R, L, S	1996	NWIFC		AMBSYS	YES	NO	BLUE MOUNTAIN	YES
24.0177	WF VESTA TRIB	409	0.30	0.50		R, L, S	1996	NWIFC		AMBSYS	YES	NO	MONTESANO	YES
24.0272	SF WILLAPA	M21	18.90	20.20	3044.6	R,H,M	1991		NWIFC	AMON91	YES	YES	NORTH NEMAH	YES
24.0439	CANYON	V41	0.70	1.30	971.5	R,H,M	1991		NWIFC	AMON91	YES	YES	NORTH NEMAH	YES
24.0439	CANYON	F41	1.30	1.80	1716.8	R,H,M	1991		NWIFC	AMON91	YES	YES	NORTH NEMAH	YES
24.0441	UNNAMED	M11	0.90	1.50	1307.0	R,H,M	1991		NWIFC	AMON91	YES	YES	NORTH NEMAH	YES
39.1081	TANEUM MAIN	F31	0.00	1.40	2277.0	R,H,L,M	1990	NWIFC	CSS	AMON90	NO	YES	THORP	YES
39.1081	TANEUM MAIN	M21	1.40	6.40	8194.0	R,H,L,M	1990	NWIFC	CSS	AMON90	NO		THORP, TANEUM CANYON	YES
39.1081	TANEUM MAIN	V41	6.40	8.40	3238.0	R,H,L,M	1990	NWIFC	CSS	AMON90	NO	YES	TANEUM CANYON, FROST MTN.	YES

WRIA	STREAM NAME	SEG #	RM (LOW)	RM (UPR)	SEG LEN (m)	SURVEY TYPE	SURVEY YEAR	DATA AFFIL.	SUM RPT	DATA BASE	FIELD FORM	GIS	USGS TOPO QUAD MAP	MAP ON FILE
39.1081	TANEUM MAIN	V42	8.40	10.00	2596.0	R,H,L,M	1990	NWIFC	CSS	AMON90	NO		FROST MTN.	YES
39.1104	NF TANEUM	U11	0.00	0.80	1361.0	R,H,L,M	1990	NWIFC	CSS	AMON90	YES	YES	FROST MTN.	YES
39.1104	NF TANEUM	V41	0.80	2.00	1923.0	R,H,L,M	1990	NWIFC	CSS	AMON90	YES	YES	FROST MTN.	YES
39.1104	NF TANEUM	V11	2.00	2.50	1073.0	R,H,L,M	1990	NWIFC	CSS	AMON90	YES	YES	FROST MTN.	YES
39.1104	NF TANEUM	V42	2.50	4.20	3389.0	R,H,L,M	1990	NWIFC	CSS	AMON90	YES	YES	RONALD, FROST MTN. CLE ELUM	YES
39.1104	NF TANEUM	V44	7.50	7.80	768.0	R,H,L,M	1990	NWIFC	CSS	AMON90	YES	YES	RONALD, QUARTZ MTN.	YES
39.1104	NF TANEUM	V13	7.80	8.50	1769.0	R,H,L	1990	NWIFC	CSS	AMON90	YES	YES	QUARTZ MTN.	YES
39.1104	NF TANEUM	U21	8.50	9.10	932.0	R,H,L,M	1990	NWIFC	CSS	AMON90	YES	YES	QUARTZ MTN.	YES
39.1104	NF TANEUM	U22	9.10	10.60	2209.0	R,H,L,M	1990	NWIFC	CSS	AMON90	YES	YES	QUARTZ MTN.	YES
39.1104	NF TANEUM	U23	10.60	11.40	1415.0	R,H,L,M	1990	NWIFC	CSS	AMON90	YES	YES	QUARTZ MTN.	YES
39.1104	NF TANEUM	U12	11.40	12.70	1657.0	R,H,L,M	1990	NWIFC	CSS	AMON90	YES	YES	QUARTZ MTN., MOUNT CLIFTY	YES
39.1104	NF TANEUM	V12	4.20	5.50	2240.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	RONALD	YES
39.1104	NF TANEUM	V43	5.50	7.50	3102.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	RONALD/QUARTZ MTN	YES
39.1128	SF TANEUM	V41	0.00	1.70	3282.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	FROST MTN.	YES
39.1128	SF TANEUM	V11	1.70	2.10	1389.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	FROST MTN.	YES
39.1128	SF TANEUM	H20	2.10	2.60	819.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	FROST MTN.	YES
39.1128	SF TANEUM	V42	2.60	4.70	3361.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	FROST MTN., QUARTZ MTN.	YES
39.1128	SF TANEUM	V20	4.70	6.70	3182.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	QUARTZ MTN.	YES
39.1128	SF TANEUM	V12	6.70	7.70	1705.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	QUARTZ MTN.	YES
39.1351	MF TEANAWAY	F30	0.00	4.20	6869.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	TEANAWAY BUTTE	YES
39.1351	MF TEANAWAY	V40	4.20	5.50	925.1	R,H,L,M	1989	NWIFC	CSS		YES	YES	TEANAWAY BUTTE	YES
39.1378	WF TEANAWAY	F30	0.00	8.00	12272.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	TEANAWAY BT., CLE ELUM LK.	YES
39.1378	WF TEANAWAY	V41	8.00	8.80	1481.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	CLE ELUM LAKE	YES
39.1378	WF TEANAWAY	V31	8.80	9.20	588.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	CLE ELUM LAKE	YES
39.1378	WF TEANAWAY	V11	9.20	9.90	902.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	CLE ELUM LAKE	YES
39.1378	WF TEANAWAY	V42	9.90	10.80	803.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	CLE ELUM LAKE	YES
39.1378	WF TEANAWAY	V32	10.80	11.10	255.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	CLE ELUM LAKE	YES
39.1378	WF TEANAWAY	V43	11.10	11.60	842.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	CLE ELUM LAKE	YES
45.9999	MISSION	V41	0.00	2.50	4224.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	SWAUK PS./TIPTOP/MONIT.	YES
46.0125	MAD	U11	14.00	16.00	1152.0	R,H,L,M	1991	UWCSS	CSS	AMON91	YES	YES	SUGARLOAF PK./SILVER FLS	YES
49.0079	SALMON	1	3.85	4.25	1507.0	R,H,L	1994	COLVILLE	NWIFC	AMBSYS	NO	NO	OMAK	YES
49.0079	SALMON	2	4.25	8.50	12518.0	R,H,L	1994	COLVILLE	NWIFC	AMBSYS	NO	NO	OMAK, RUBY HILL	YES
49.0079	SALMON	3	8.50	10.45	1626.0	R,H,L	1994	COLVILLE	NWIFC	AMBSYS	NO	NO	RUBY HILL	YES
49.0079	SALMON	4	10.45	12.20	5406.0	R,H,L	1994	COLVILLE	NWIFC	AMBSYS	NO	NO	RUBY HILL	YES
49.0079	SALMON	5	12.20	13.30	3590.0	R,H,L	1994	COLVILLE	NWIFC	AMBSYS	NO	NO	RUBY HILL, CONCONULLY E.	YES
49.0079	SALMON	6	13.30	16.10	9798.0	R,H,L	1994	COLVILLE	NWIFC	AMBSYS	NO	NO	CONCONULLY EAST	YES
49.0139	OMAK	1	0.00	1.50		R,H	1992	COLVILLE		AMONT2	NO	YES	OMAK, THE POTHOLE	YES
49.0139	OMAK	2	1.50	3.00	1779.3	R,H	1992	COLVILLE	NWIFC	AMBSYS	NO	YES	THE POTHOLE	YES
49.0139	OMAK	3	3.00	5.00	2249.2	R,H	1992	COLVILLE	NWIFC	AMBSYS	NO	YES	THE POTHOLE, OMAK LK.	YES
49.0139	OMAK	4	5.00	9.00	2318.6	R,H,L	1992	COLVILLE	NWIFC	AMBSYS	NO	YES	OMAK LK	YES
49.0139	OMAK	5	12.20	12.20	2147.4	R,H	1992	COLVILLE	NWIFC	AMBSYS	NO	YES	CAMP SEVEN	YES
51.0046	NORTH STAR	F31	0.00	3.50	3391.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	STEPSTONE CREEK	YES
51.0046	NORTH STAR	M21	3.50	5.00	1503.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	STEPSTONE CREEK	YES
51.0046	NORTH STAR	M11	5.00	5.80	1131.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	STEPSTONE CREEK	YES
51.0046	NORTH STAR	V41	5.80	6.10	534.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	STEPSTONE CREEK	YES
51.0046	NORTH STAR	V11	6.10	6.70	1012.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	STEPSTONE CREEK	YES
51.0046	NORTH STAR	V21	6.70	7.10	532.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	STEPSTONE CREEK	YES
51.0046	NORTH STAR	V42	7.10	8.00	1436.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	STEPSTONE CREEK	YES
51.0046	NORTH STAR	V12	8.00	8.40	557.0	R,H,L,M	1990	NWIFC	CSS	AMON90	YES	YES	STEPSTONE CREEK	YES
51.0046	NORTH STAR	V43	8.40	8.60	614.0	R,H,L,M	1990	NWIFC	CSS	AMON90	YES	YES	STEPSTONE CREEK	YES
51.0046	NORTH STAR	V13	8.60	8.80	253.0	R,H,L,M	1990	NWIFC	CSS	AMON90	YES	YES	STEPSTONE CREEK	YES
51.0046	NORTH STAR	V22	8.80	9.00	214.0	R,H,L,M	1990	NWIFC	CSS	AMON90	YES	YES	MOSES MTN.	YES
51.0046	NORTH STAR	V14	9.00	9.20	381.0	R,H,L,M	1990	NWIFC	CSS	AMON90	YES	YES	MOSES MTN.	YES
51.0046	NORTH STAR	V44	9.20	9.40	439.0	R,H,L,M	1990	NWIFC	CSS	AMON90	YES	YES	MOSES MTN.	YES
51.0046	NORTH STAR	V15	9.40	9.50	385.0	R,H,L,M	1990	NWIFC	CSS	AMON90	YES	YES	MOSES MTN.	YES
51.0046	NORTH STAR	V23	9.50	9.70	706.0	R,H,L,M	1990	NWIFC	CSS	AMON90	YES	YES	MOSES MTN.	YES
51.0046A	UN NAMED TRIB	V11	0.00	4.00	616.0	R,H,L,M	1990	NWIFC	CSS	AMON90	YES	YES	MOSES MTN.	YES
52.0015	IRON	F41	0.00	0.74	1189.0	R,H,L,M	1991	COLVILLE	CSS	AMON91	YES		LOUIE CREEK	YES
52.0015	IRON	U11	0.74	3.14	3865.0	R,H,L,M	1991	COLVILLE	CSS	AMON91	YES		LOUIE CREEK	YES
52.0021A	LOUIE	U31	0.00		2108.0	R,H,L,M	1990	COLVILLE	CSS	AMON90	YES		LOUIE CREEK	YES
52.0021A	LOUIE	F41			2431.0	R,H,L,M	1990	COLVILLE	CSS	AMON90	YES		LOUIE CREEK	YES
52.0025	BRIDGE	F41	0.00	0.80	1226.2	R,H,L,M	1991	COLVILLE	NWIFC	AMON91	YES		LOUIE CREEK	YES
52.0025	BRIDGE	U21	0.80	2.80	3161.0	R,H,L,M	1991	COLVILLE	CSS	AMON91	YES		LOUIE CREEK	YES
52.0025	BRIDGE	V31	2.80	3.90	1762.0	R,H,L,M	1991	COLVILLE	CSS	AMON91	YES		LOUIE CREEK	YES
52.0025	BRIDGE	F21	3.90	5.70	2928.2	R,H,L,M	1991	COLVILLE	NWIFC	AMON91	YES		LOUIE CR., FROSTY MDW	YES
52.0025	BRIDGE	V11	5.70	8.10	3817.0	R,H,L,M	1991	COLVILLE	CSS	AMON91	YES		FROSTY MDW, CODY LK	YES
52.0031A	SF NANAMPKIN	F31			2464.0	R,H,L,M	1990	COLVILLE	CSS	AMON90	YES		CENTRAL PEAK	YES
52.0031A	SF NANAMPKIN	M11			2878.0	R,H,L,M	1990	COLVILLE	CSS	AMON90	YES		CODY BUTTE, CENTRAL PEAK	YES
52.0031A	SF NANAMPKIN	V11			9550.0	R,H,L,M	1990	COLVILLE	CSS	AMON90	YES		CENTRAL PEAK	YES
52.0038	TWENTY-FIVE MILE	V21			146.3	R,H,L,M	1991	COLVILLE	NWIFC	AMON91	YES		CODY BUTTE	YES
52.0040	TWENTY-THREE MILE	U41	0.00		1003.0	R,H,L,M	1991	COLVILLE	CSS	AMON91	YES		CODY BUTTE	YES
52.0042A	GOLD	F41	0.00		5158.0	R,H,L,M	1990	COLVILLE	CSS	AMON90	YES		BALD KNOB	YES
52.0042A	GOLD	V41			2094.0	R,H,L,M	1990	COLVILLE	CSS	AMON90	YES		BALD KNOB, STRAWBERRY MTN.	YES
52.0042A	WEST FORK GOLD	U31			7537.0	R,H,L,M	1990	COLVILLE	CSS	AMON90	YES		BALD KNOB	YES

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52.0042A	WEST FORK GOLD	U41			1070.0	R,H,L,M	1990	COLVILLE	CSS	AMON90	YES		THIRTEEN MILE CR/BALD KNOB	YES
52.0167	TWENTY -ONE MILE	F41			1492.0	R,H	1991	COLVILLE	NWIFC	AMON91	YES		THIRTEEN MILE CR	YES
52.0167	TWENTY -ONE MILE	V11			888.2	R,H,L	1991	COLVILLE	NWIFC	AMON91	YES		THIRTEEN MILE CR	YES
58.0016	SIX MILE	F41	0.00	0.30	471.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	FT. SPOKANE	YES
58.0016	SIX MILE	V21	0.30	1.10	1271.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	JOHNNY GEORGE MTN.	YES
58.0016	SIX MILE	V41	1.10	2.70	2597.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	JOHNNY GEORGE MTN	YES
58.0029	THIRTY MILE	F41	0.00	1.50	2405.5	R,H,L,M	1991	COLVILLE	NWIFC	AMON91	YES		CODY BUTTE	YES
58.0029	THIRTY MILE	V11	1.50	5.80	7065.5	R,H,L,M	1991	COLVILLE	NWIFC	AMON91	YES		CODY BUTTE	YES
58.0029	THIRTY MILE	F31	5.80	9.00	5219.1	R,H,L,M	1991	COLVILLE	NWIFC	AMON91	YES		CODY BUTTE	YES
58.0029	THIRTY MILE	U21	9.00	20.20	18038.0	R,H,L,M	1991	COLVILLE	NWIFC	AMON91	YES		CODY BUTTE, CODY LK	YES
58.0040	NF NANAMKIN	F41			2978.0	R,H	1991	COLVILLE	NWIFC	AMON91	YES		CODY BUTTE, CENTRAL PK.	YES
58.0040	NF NANAMKIN	U21			12477.0	R,H,L,M	1991	COLVILLE	NWIFC	AMON91	YES		CENTRAL PEAK	YES
58.0040	NF NANAMKIN	U22				R	1991	COLVILLE	NWIFC	AMON91	YES		CENTRAL PEAK	YES
58.0070	LYNX	F31			5197.0	R,H,L	1991	COLVILLE	NWIFC	AMON91	YES		MOON MTN.	YES
58.0133	ORAPAKEN	U21			1857.0	R,H,L,M	1991	COLVILLE	CSS	AMON91	YES		HUNTERS	YES
58.0143	ALDER	V11	0.00		2906.0	R,H,L,M	1991	COLVILLE	CSS	AMON91	YES		HUNTERS	YES
58.0143	ALDER	U11				R	1991	COLVILLE	NWIFC	AMON91	YES		HUNTERS	YES
58.0170	HUNTERS	V11	0.00		241.0	R,H,L,M	1990	SPOKAN	CSS	AMON90	YES		HUNTERS	YES
58.0170	HUNTERS	F31			8280.0	R,H,L,M	1990	SPOKAN	CSS	AMON90	YES		ADAMS MTN.	YES
58.0170	HUNTERS	F41			7041.0	R,H,L,M	1990	SPOKAN	CSS	AMON90	YES		HUNTERS, CEDONIA	YES
58.0356	HALL	V40			1746.0	R,H,L,M	1989	COLVILLE	NO		YES		SITDOWN MTN.	YES
58.0356	HALL	V11	0.00		1429.0	R,H,L,M	1991	COLVILLE	CSS	AMON91	YES		INCHELIUM	YES
58.0356	HALL	M21			11220.0	R,H,L,M	1991	COLVILLE	CSS	AMON91	YES		INCHELIUM	YES
58.0356	HALL	U11			5038.0	R,H,L,M	1991	COLVILLE	CSS	AMON91	YES		SITDOWN MTN.	YES
58.0356	HALL	U31			4913.0	R,H,L,M	1991	COLVILLE	CSS	AMON91	YES		LAFLEUR LK/SITDOWN MTN	YES
58.0356	HALL	V21			7117.0	R,H,L,M	1991	COLVILLE	CSS	AMON91	YES		INCHELIUM	YES
58.0356B	SITDOWN	U21			2013.0	R,H,L,M	1991	COLVILLE	CSS	AMON91	YES		LAFLEUR LK/SITDOWN MTN	YES
59.0516	BLUE	F51			3128.0	R,H,L,M	1991	COLVILLE	CSS	AMON91	YES		MCCOY LK., TURTLE LK.	YES
59.0516	BLUE	M11			3184.0	R,H,L,M	1991	COLVILLE	CSS	AMON91	YES		TURTLE LK.	YES
59.0516	BLUE	U21			3355.0	R,H,L,M	1991	COLVILLE	CSS	AMON91	YES		TURTLE LK.	YES
61.0124	ONION	F31	0.00		5675.0	R,H,L	1991	COLVILLE	NWIFC	AMON91	YES		ONION CREEK	YES
61.0124	ONION	V21			1050.0	R,H	1991	COLVILLE	NWIFC	AMON91	YES		ONION CREEK	YES
61.0151	SHEEP	F51	0.00		1103.0	R,H,L,M	1991	COLVILLE	CSS	AMON91	YES		NORTHPORT	YES
61.0151	SHEEP	V11			1856.0	R,H,L,M	1991	COLVILLE	CSS	AMON91	YES		NORTHPORT	YES
61.0198	DEEP	M11	0.00		884.0	R,H,L,M	1991	COLVILLE	CSS	AMON91	YES		NORTHPORT/BOUNDARY	YES
61.0198	DEEP	F41			583.0	R,H,L,M	1991	COLVILLE	CSS	AMON91	YES		BOUNDARY	YES
62.0547	TACOMA	M21	0.00	0.30	137.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	TACOMA PEAK	YES
62.0547	TACOMA	V11	0.30	1.00	320.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	TACOMA PEAK	YES
62.0547	TACOMA	V41	1.00	2.80	865.0	R,H,L,M	1989	NWIFC	CSS		YES	YES	TACOMA PEAK	YES
IDAHO	EVANS	F21			1808.3	R,H,L,M	1991	D'ALENE	NWIFC	AMON91				NO
IDAHO	NF ALDER	F31				R,H	1991	D'ALENE	NWIFC	AMON91				NO
IDAHO	BENEWAH	F41			454.8	R,H,L	1991	D'ALENE	NWIFC	AMON91				NO
IDAHO	BENEWAH	F41			7914.7	R,H,L	1991	D'ALENE	NWIFC	AMON91				NO
IDAHO	BENEWAH	F42			4369.0	R,H,L	1991	D'ALENE	NWIFC	AMON91				NO
IDAHO	BENEWAH	M11			1871.5	R,H,L	1991	D'ALENE	NWIFC	AMON91				NO
IDAHO	LAKE	M11			4171.8	R,H,L	1991	D'ALENE	NWIFC	AMON91				NO
IDAHO	WEST LAKE	M11			1424.9	R,H,L	1991	D'ALENE	NWIFC	AMON91				NO
IDAHO	BENEWAH	M21			1904.2	R,H,L	1991	D'ALENE	NWIFC	AMON91				NO
IDAHO	BOZARD	M21			3041.6	R,H	1991	D'ALENE	NWIFC	AMON91				NO
IDAHO	EVANS	M21			832.1	R,H,L	1991	D'ALENE	NWIFC	AMON91				NO
IDAHO	LAKE	M21			5074.6	R,H,L	1991	D'ALENE	NWIFC	AMON91				NO
IDAHO	WEST LAKE	M21			2975.5	R,H,L	1991	D'ALENE	NWIFC	AMON91				NO
IDAHO	BENEWAH	M22			3546.4	R,H,L,M	1991	D'ALENE	NWIFC	AMON91				NO
IDAHO	EVANS	M22			343.8	R,H,L	1991	D'ALENE	NWIFC	AMON91				NO
IDAHO	EVANS	U21			1182.4	R,H,L	1991	D'ALENE	NWIFC	AMON91				NO
IDAHO	LAKE	V11			2735.9	R,H,L	1991	D'ALENE	NWIFC	AMON91				NO
IDAHO	ALDER	V12			2917.8	R,H,L	1991	D'ALENE	NWIFC	AMON91				NO
IDAHO	EVANS	V21			1676.7	R,H,L	1991	D'ALENE	NWIFC	AMON91				NO
IDAHO	ALDER	V41			961.3	R,H,L	1991	D'ALENE	NWIFC	AMON91				NO
IDAHO	LAKE	V41			1450.8	R,H,L	1991	D'ALENE	NWIFC	AMON91				NO
IDAHO	ALDER	V42			7534.5	R,H,L	1991	D'ALENE	NWIFC	AMON91				NO

APPENDIX C

Historic Review of the TFW Monitoring Program

Testing and Refinement of Methods 1991-95.

The following is a brief historic review of the TFW Ambient Monitoring Program testing and refinement of methods, 1991-95.

<u>1991</u>

- *Testing*

◊ Conducted a total of 19 QA Review Habitat Unit replicate surveys.

◊ Analysis of the Valley Segment Classification System indicates it does not work well.

◊ Analysis of Habitat Unit Survey QA Review data indicated high variability in crew identification of habitat unit types.

◊

<u>1992</u>

- *Refinements*

◊ New August 1992 version of the TFW Ambient Monitoring Manual implementing modular design and improved reference structure.

◊ Eliminated sub-units of Pool, Riffle and Cascade habitat types.

◊ Added 'tailout' unit for cooperators who wanted to differentiate between pool and riffle 'glides'.

◊ Added minimum unit surface area and residual pool depth criteria to reduce variability associated with crew habitat unit lumping and splitting.

◊ Replaced Valley Segment Classification system with new 'Stream Segment Identification Module' based on tributary junction (relative basin area), gradient and confinement (Beechie and Sibley, 1990).

- *Testing*

◊ Conducted a total of 12 limited QA Reviews on Reference Point, Habitat Unit and Large Woody Debris Surveys.

◊ Preliminary analysis of QA Review replicate surveys indicated high variability, but they were not effective in isolating whether variability was associated with review protocols, crew application of the methods, inaccurate or imprecise methods, or due to complex natural background factors.

<u>1993</u>

- *Refinements*

◊ Developed basis for current QA Review methods that incorporated same day replicate surveys and individual parameter comparisons.

◊ New July 1993 version of the TFW Ambient Monitoring Manual including addition of new method sections for Salmonid Spawning Gravel Composition and Stream Temperature Surveys.

- *Testing*

◊ Conducted a total of 13 QA Reviews on Reference Point, Habitat Unit, Large Woody Debris, and Spawning Gravel Composition Surveys.

◊ Analysis of Habitat Unit Survey QA Review data (1991-93) indicated high variability in:

a) identification of riffle, cascade and tailout habitat unit types (pool bias);
b) surface area measurements across all unit types;
c) identification of 100 meter interval reference point boundaries

<u>1994</u>

- *Refinements*

◊ New August 1994 version of the TFW Ambient Monitoring Manual including addition of new Quality Assurance section.

◊ Improvements in the annual training workshops format to standardize instruction and incorporate more participant hands-on practice.
◊ Modification of the Habitat Unit Survey methods (August 1994 version), including:
  a) replacement of the "Measuring Lengths and Widths of Habitat Units" section with new section based on QA Review results;
  b) redesign of Form 3 to include spaces for recording of each length and width measurement to improve consistency in writing data and error checking calculations.
◊ QA Review methods improved to control for variability associated with replicate survey reach boundary identification based on off-channel reference points.

- *Testing*

◊ Conducted a total of 14 QA Reviews on Habitat Unit, Large Woody Debris and Spawning Gravel Composition Surveys.
◊ Test project conducted for water surface area measurement method.

<u>1995</u>

- *Refinements*

◊ Continued improvements in the annual training workshops format to standardize instruction and incorporate more participant hands-on practice.

- *Testing*

◊ Conducted a total of 14 QA Reviews on Habitat Unit, Large Woody Debris and Spawning Gravel Composition Surveys.
◊ Water surface area measurement method test project continued.

APPENDIX D

Methods for Monitoring Fish Habitat in Large Rivers: A Literature Review

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July 1997

Introduction

Problem Statement

The monitoring methods outlined in the TFW Ambient Monitoring Manual (Schuett-Hames et al. 1994) are designed to monitor salmonid habitat in small wadable streams (defined as those less than 20 meters bankfull width). Monitoring habitat in large rivers is also an important goal, but wading techniques are not useable in deep, swift water and the parameters being measured in small streams may not be appropriate for the larger scale of rivers. The TFW Monitoring Program needs to address this methodological issue and develop tools for monitoring.

Purpose

The purpose of this report is to review existing information on monitoring large rivers from the literature and interviews with practitioners. It will then evaluate the applicability of current TFW Monitoring Program parameters and measurement techniques to large river situations and identify alterations to the current methods to make them applicable to large rivers. It is assumed that the reader is familiar with or has access to the methods as presented in the TFW Monitoring Program Manual. Additional parameters and suggested methods for measurement are then presented.

Background Information on Salmonid Habitat in Large Rivers Channels

Large river channels

The characteristics of a river change from the headwaters to the mouth. The channel and associated features change via the interaction of discharge, channel width and depth, water velocity, substrate resistance and sediment transport capacity. This interaction is constantly changing and the variables adjusting to the changes in the other interrelated variables. Also, the gradient tends to decrease and topography tends to change to a less constrained channel with the development of a floodplain. As the slope decreases and the rate of flow increases, pools and smooth-flowing areas become progressively more common than they were in the turbulent headwater reaches (Ryder and Pesendorfer 1989).

Large rivers are defined here as having an average depth of greater than one meter and an average width of greater than twenty meters. They serve different habitat functions than the smaller streams, e.g., migration corridors, holding areas, and spawning habitat. And while there is often a flood plain with smaller, off-channel aquatic habitat associated with the larger channel, the concern of this literature review is to address the problems/challenges associated with measuring salmonid habitat parameters in deep and wide channels.

Important parameters of fish habitat in large river channels

Salmonid habitat use in large river systems varies with flow. During high flows juvenile salmonids tend to utilize areas along the margins of the river or in small tributaries or other off-channel and floodplain features, while during low flows the deep pools in the main channel are the preferred habitat for juveniles and migrating adults.

Salmonids use larger channels during migration, spawning, and summer rearing of juveniles. Several important habitat characteristics have been identified: large woody debris jams, discharge, habitat units (pools and riffles), water temperature, and spawning/incubation habitat (gravel) availability, composition and stability.

Large woody debris jams play an important role in large channels, controlling the local hydraulics which creates sediment deposition and scour areas. Jams have also been shown to offer refugia from high flow conditions, creating off-channel habitat as the sediment builds up upstream and the flow is diverted to either side of the emerging bar (Abbe and Montgomery 1996). The combination of these enhances habitat complexity.

Discharge is an issue of concern mostly in regulated rivers or in drier climates. Lowered discharge can reduce habitat complexity, leaving off-channel areas dry and disconnecting pools in the main channel. Reduced discharge over historical levels can also lead to gravel aggradation, with the river being unable to transport the sediment load in an efficient manner (Jay and Simenstad 1994).

Of the habitat units identified in the TFW Monitoring Program Habitat Unit Survey method, pools are an extremely important habitat feature of the large river, offering lower water velocity, cooler temperatures, and reduced visibility to predators (Lisle 1987). Other important habitat units include riffle crests (also known as pool tailouts) which are important as prime spawning areas for salmonids.

Increased water temperature affects salmonids on many levels, i.e., increased disease, altered migration timing, and accelerated or retarded maturation rates (Bjornn and Reiser 1991).

Current TFW Monitoring methodology offers methods for dividing the length of the channel into segments, monitoring discharge, habitat units, large woody debris, water temperature, spawning habitat availability/spawning gravel composition, and spawning gravel scour. We will examine current methods and then look to other parameters and methods of interest to address those needs that are not met by the current TFW monitoring methodology.

Application of 1994 TFW Monitoring parameters and methods to large rivers: limitations and alternative data collection procedures

In order to evaluate current TFW monitoring methods and their applicability to larger channels, we will examine whether those parameters still characterize the habitat offered in large channels, and whether the parameters measured by the method can be accurately and safely measured in large, unwadable channels. We will also suggest, where appropriate, alternative data collection procedures and equipment.

Segmenting

When working with large channels, segments can be delineated using gradient, confinement and tributary junctions as for smaller channels (see Stream Segment Identification Module for details). Specific concerns for large rivers center around two main issues: how to deal with long stretches of river that don't have any gradient or hydraulic breaks (what size of regular segment is recommended) and how to deal with multiple channel or braided sections.

Gosse (1963 - as cited in Sedell et al. 1989) also recommends an additional criteria be employed for inserting segment breaks: a bank coefficient or perimeter index. This ratio is high where there are many islands and irregular banks and can suggest segment breaks in long stretches of river that don't have gradient or hydraulic breaks or those with highly braided sections.

Field measurements to verify channel gradient will need to be done with different equipment than the stadia rod and clinometer suggested for wadable streams. Gradient can be measured with survey equipment, GPS or altimeter, magnified auto-level on shorter length reaches, and topographic maps for longer reaches.

Reference Points

The reference point survey as outlined in the TFW Monitoring Program Manual can be applied as written with a few exceptions. The recommended distance between reference points will need to increase from 100 meter reaches to a distance that is some multiplier of the channel width. As an example, 20 times the channel width for a 20 meter channel would yield a 400 meter reach which should more accurately represent the larger habitat units contained in the larger channel. The classic definition of a reach is 20 to 40 times the distance of the bankfull width (Leopold et al. 1964).

Bankfull Width and Depth

The methods by which bankfull width and depth are taken will need to be altered to include approaches not requiring wading the channel. Channel width can be measured using remote sensing methods. Depth measurements can be made using an acoustic device, a weighted cord or a laser device for measuring water depths. These can be deployed from a boat or other floating or spanning location.

Canopy Closure

Canopy closure is measured with a spherical densiometer from the middle of the bankfull channel as described in the Reference Point Survey. Canopy closure can not be measured with a densiometer from the middle of the bankfull channel in large rivers due to depth and water velocity. The draft Watershed Analysis Water Quality module provides guidelines for a method of estimating view to sky based on geometric considerations that can be applied to large rivers. Another possible method for estimating canopy coverage is to compare aerial photos of the site in question to reference canopy condition aerial photos (TFW Water Quality Steering Committee Memo 12/96, Watershed Analysis Riparian Function Assessment Module).

Discharge

The discharge measurement technique described in the Habitat Unit Survey is specifically designed for wadable streams. It involves wading across the stream with a flow meter while taking measurements at regular intervals. This can become a safety concern in deeper, swifter water (average water depths equal to or exceeding one meter or shallower if very swift). There are several possible alternatives for obtaining discharge information in large rivers. Check with agencies such as U.S. Geological Survey (or their water resources web page at http://water.usgs.gov) or Washington Department of Ecology to find out if they have an existing gauging station on the river of interest; or take the measurement from boat, bridge or cableway via USGS methods (USGS 1982). Discharge is a suggested measurement for Watershed Analysis, and most other regulatory actions that apply to large rivers.

Habitat Units

It is more difficult to distinguish adjacent habitat units in a large channel due to the difficulty of using the riverbed as a visual guide to determine boundaries. The technique for taking surface area measurements presented in the Habitat Unit Survey is still valid, although some alteration may be needed in the measuring device or technique if access to one side or all of the unit is limited. The first distinctions to be made when measuring habitat units is distinguishing pools from riffles. To qualify as a pool a unit needs to have a residual pool depth that is at least 5% of the bankfull width. New methods need to be tested for measuring depth in deep swift water. Depending on the local conditions, stadia rods, depth sounders, weighted tapes, or laser depth finders designed for water penetration could be used. The accuracy of these tools for these conditions is unknown and needs to be tested. Using an acoustic hydrographic mechanism or digital elevation mapping to create an underwater topographic map are also options that need to be tested for accuracy, applicability, and cost effectiveness within the range of conditions often encountered in larger channels.

Large Woody Debris

TFW Monitoring Program's Large Woody Debris Survey for measuring large woody debris by volume and zone doesn't work well for large channels due to safety and access issues. Even though many of the pieces may be associated with channel edges or islands, safety and access concerns could significantly skew the replicability of the data collected with this method. In order to address the functionality of LWD in large channels, monitoring efforts in large channels should focus on LWD jams (greater than 10 pieces) or pieces whose length is equal to or greater than bankfull width.

A method which depends on visual estimation of the number of pieces of wood and the function served by large woody debris jams would be quicker, and easier to perform. However, the replicability of such a method would need to be carefully evaluated. Also identifying functional pieces would provide important information about the jam. Functional pieces or key pieces tend to be large trees with root wads attached which provide a stabilizing or anchoring function. These pieces then act to "rack" or trap other pieces forming large woody debris jams (Abbe and Montgomery 1996).

For large jams, remote sensing is also a possibility for use in monitoring. Low elevational aerial photos or videography can allow wood counts and capture important function information, e.g., side channel formation, which might not be gathered in the field due to access problems (Ellis and Woitowich 1989).

Temperature

Measuring water temperature in large channels can be done by using the current TFW Stream Temperature Survey methodology with only a few alterations. However, it is possible that temperature monitoring on larger rivers is already being done by the Department of Ecology or a TFW Cooperator; check with the Washington Department of Ecology. Temperature data is useful for Watershed Analysis and evaluating compliance with water quality standards. If the water depth is greater than 2-3 m in depth, there will probably be thermal stratification and the depth at which the instrument is placed will need to be carefully calculated.

Gravel Composition/Spawning Habitat Availability

The current method for measuring gravel composition and the method for measuring spawning habitat availability are both problematic for use in deep water areas due to their reliance on easy access to the riverbed (Schuett-Hames and Pleus 1996). Certain aspects of the two methods are still useable, though, and can be combined to look at the issue of spawning gravel, its location, its quantity, and its quality.

Quantification of spawning gravel can be done to only a cursory level when the riverbed is not readily accessible. A riffle crest inventory could be done for a less intensive survey, locating and counting sites of potential spawning habitat. Historic spawning sites could be used to locate sampling sites for a more intensive survey (quality of the gravel is less of an issue due to the sites showing past use, so that determining whether the site would qualify as potential spawning habitat would not be necessary). These two surveys, though, answer different questions, with the riffle crest inventory attempting to answer the question of the potential quantity of spawning habitat present in the system and the historical site survey answering the question of what quantity of spawning habitat is present in the historically utilized sites. A survey would yield a count of potential spawning sites, according to criteria established in the literature, present in the system. An historical site survey would yield data on the number and location of sites being used by the salmonids in the system.

Once the sites have been located and inventoried, characterization of dominant and subdominant substrate particle size would take place (if possible). Some gravel sampling could be done with the current method on exposed bars/riffle crests at low flow. Characterizing the particle sizes composing a riverbed and the percentage of the total volume comprised by each is useful for characterizing the quality of potential spawning gravel. If sampling for composition across a transect, the population from which sampling occurred could be described as all sites with a water depth less than x meters.

Spawning Gravel Scour

The current Spawning Gravel Scour Survey methodology measures scour by inserting scour chains into the riverbed. This is not feasible in deep water but may be possible in shallow areas of large rivers, such as riffle crests at low flows.

Additional parameters and data collection methods potentially useful in large rivers

Additional parameters and data collection methods have been suggested in the literature or by practitioners as being of potential use for characterizing salmonid habitat in large river channels. Included here are some of those most pertinent to Pacific Northwest regional and anadromous salmonid habitat concerns. The parameters have been divided into two sections, in-channel features and out-of-channel features.

In-channel

Significant impediments to salmonid migrations can be either a natural feature, e. g., a waterfall or they can be structures put into place for human uses. Collecting information on the nature and extent of any migration blockages is useful for establishing the limiting factors on a salmonid population. The type of data collected about these impediments would be mostly descriptive, with additional measurements made of the distance between the water surface above and below the obstruction, and the length of time a human structure has been in place.

Out of channel features

Riparian or riverside vegetation is of interest for its role in maintaining bank stability, and channel edge habitat. Parameters that could be used to characterize the riparian area are: the percentage of the mainstem channel in contact with the riparian forest, vegetation types and densities, buffer zone width, channel migration zone, floodplain area, bank stabilization or hardening efforts and riparian forest stand age. These types of surveys can be done from aerial photos except for vegetation types, densities, and stand age which require field surveys.

Remote Sensing Methods Useful for Data Collection

Remote sensing methods are ideally suited to overcoming the access and safety concerns associated with deep swift rivers. As shown in Table 1, though, not all of the parameters currently measurable with TFW Monitoring Methodology can be measured via remote sensing, nor is every method suited for measuring every parameter.

Table 1. Parameters suited to measurement by remote sensing methods

Parameter to be monitored	Aerial Photos	VideoMapping	Digital Elevation Mapping	Satellite Images
Channel width	X	X	X	scale dependent
Channel depth			X	
Habitat units	X	X	X	
Large woody debris	X	X		scale dependent
Spawning habitat availability	X	X		

It is important to have a knowledge of different remote sensing methods and their applicability to monitoring salmonid habitat in large rivers. Following is a brief description of some different methods that may be useful for that purpose.

<u>Aerial Photography</u>

Low elevation aerial photographs are well suited for monitoring some parameters. Bank erosion, sediment load, vegetation patterns along banks, locations and size of log jams, and in some conditions, bottom materials and surface water characteristics can be identified and monitored for changes. Aerial photos can be produced using black and white or color infrared (CIR) film and many different photographic techniques. The type of technique used would be dependent on which parameters were of interest. Measurements can be estimated from aerial photos if ground panels have been used, however accuracy rarely approaches 90% (Greentree and Aldrich 1976). As with all remote sensing methods, expense is a concern. The factors that affect the costs of producing aerial photos are: (1) air distance to the stream, (2) the number of streams and distance between streams to be photographed, (3) the length of the stream, (4) the scale of photography, (5) the number of criteria and photo techniques to evaluate habitat, and (6) the number of ground checks required to validate photo classes and to obtain additional data (Greentree and Aldrich 1976).

<u>VideoMapping</u>

VideoMapping is an array of images produced from flying over a watercourse at a chosen elevation. It involves a complex array of equipment that is flown over an area by either a fixed wing aircraft or a helicopter. This technology is ideal for monitoring linear features, thereby being better suited to less sinuous channels. The video is time stamped and ortho corrected by an on-board system. The products of the flight are a video tape and digital files of the video images. With special software and a frame-grabber card for a personal computer, the video images can be viewed on a computer (486 or better), and any frame retrieved from the digital files. These can then be queried for the x, y, and z coordinates of any selected point (except those obscured by vegetation or water surface) or manipulated in a variety of ways. Images can be imported into a Computer Aided Design (CAD) program and maps or mosaics of several images produced.

VideoMapping can be used to monitor channel changes over time such as bank erosion or recovery, riparian corridor growth/regrowth, formation and change of gravel bar locations or large woody debris jams, and to overcome the access and safety constraints associated with high flows and flooding. It is not suitable for monitoring gravel composition, spawning gravel scour, or other riverbed features as it cannot consistently capture images below the water's surface at the required resolution.

Digital Elevation Mapping

Digital elevation mapping is very similar to videomapping. In addition to the other equipment described above, a scanning laser is employed as well, which gives topographic information at a more accurate level. This also allows for the production of channel cross-section maps to be generated as one of the products.

Airborne hydrographic surveying is also available for underwater topographic surveys. The Larsen 500 Scanning Lidar Bathymeter is flown over the area to be surveyed at an altitude of 500 meters. Infrared and blue/green laser pulses scan the water's surface and bottom across a 270 meter swath with depth penetrations up to 40 meters.

Satellite Imagery

Satellite images cover a wide area, allowing (depending on scale) a viewer a watershed wide view. The resolution is currently too coarse, as shown in Table 2, to be useful for detailed parameter measurement, but the technology is changing quickly toward a finer resolution.

Table 2. Comparison of Aerial and Satellite Ortho Images (from Thorpe 1996)

	Aerial Orthophoto Imagery	**Satellite Orthorectified Imagery**
Resolution	3" to 1 meter	1 to 30 meters
Bits per pixel	8	11
NMAS accuracy	1" = 20' to 1" = 1,000'	1" = 200' to 1" = 2,000'
Cloud cover	None	Sometimes
Leaf cover	Little	Often
Cost per square mile	$1,000 to $70	$100 to $1
Cost per screenful	$9 to $27	$39 to $348
Availability	3 to 12 months	3 days to 6 weeks
Current sales channel	from cities or counties	Internet

Conclusion

Remote sensing can be used to monitor some parameters of salmonid habitat under certain conditions. Table 3 compares the methods described above in terms of general applicability to monitoring salmonid habitat.

Table 3. Remote sensing method comparison

Image Generation Method	**Resolution of Image**	**Amount of Coverage**	**Cost of Comparable Coverage**
Aerial Photos	Medium	Medium	High
Video Mapping	High	Low	Low
Digital Elevation Mapping	High	Low	High
Satellite Imagery	Low	High	Low

Selection of methods for monitoring salmonid habitat characteristics in large deep channels is based upon many considerations; the parameters to be measured, sampling strategy, timing of the sampling, the size of the area to be covered, and the resources available. Information presented here can be used to identify potential methods, given the study design criteria. There is a need, however, to design, test and compare methods for use in large deep channels. A comparison of remote sensing data and field collected data for certain specific parameters would be extremely useful for anyone designing a monitoring plan.

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APPENDIX E

Results of a Pilot Project Investigating the Influence of Lithology and Other Factors on Salmonid Spawning and Incubation Habitat

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5. Introduction

Interpretation of salmonid habitat monitoring data suffers from a lack of information on the influence of watershed and channel conditions on important spawning and incubation habitat parameters. Productive spawning and incubation habitat requires a sufficient quantity of gravel that is of suitable size for the construction of redds, and that is relatively free of fine sediment (Platts and Megahan 1975; Platts et al. 1989). Past research has documented some effects of watershed and channel factors on the availability and particle size composition of gravel deposits throughout a stream system, but a method for interpreting spawning and incubation habitat conditions in the context of these factors has yet to be developed.

The physical properties of a watershed and the sediment supplied to stream channels exert a dominant influence on the availability and composition of spawning gravel deposits (Collins and Dunne 1990). Duncan and Ward (1985) found a correlation between the percentage of a basin composed of sedimentary rock and the amount of fine sand, silt and clay particles in spawning gravel. In streams draining watersheds with mixed geologies, resistant basaltic rocks dominated spawning riffles because soft sedimentary sandstone broke down more quickly. Increases in sediment can increase spawning habitat in systems where gravel supply is naturally limited, but can destabilize habitat in sediment rich systems (Collins and Dunne 1990). Typically, bed material becomes finer following sediment inputs (Lisle 1982). Additionally, erosion associated with land-use activities often generates predominately fine material (Klingeman 1981), which can infiltrate riffles and degrade spawning habitat.

Instream factors, including gradient, stream power and large woody debris (LWD) loading can also have an important impact on the availability and composition of spawning gravel deposits. Sediment size typically decreases in a downstream direction due to abrasion and weathering during transport, and a reduction in stream power and transport competence in lower gradient channels (Dunne et al. 1981). In the Stillaguamish River Basin, Benda et al. (1992) observed that low gradient channels (< 2%) on recent terraces had 46% more channel area in spawning gravel than reaches with steeper gradients and higher stream power further upstream. Buffington (1995) observed that channels with abundant LWD had the greatest amount of variability in substrate size and hydraulic conditions, contributing to spawning habitat diversity. Channels with low levels of LWD often had substrate too large for salmonid spawning and little diversity in spawning habitat.

The purpose of this pilot study was to explore the effects of basin lithology, stream gradient, and sediment supply on salmonid spawning habitat in order to improve interpretation of habitat monitoring results. Field data on surface substrate size and spawning gravel composition at likely spawning sites, and the abundance of spawning-sized substrate in the bankfull channel were collected on streams throughout Washington State. These data were analyzed to identify factors that might improve interpretation of spawning habitat monitoring data and suggest directions for more focused research.

6. Methods

Streams were stratified primarily according to basin lithology, and secondarily according to gradient and sediment supply. Additionally, LWD pieces were counted and sorted into categories based on diameter and location in the channel (Schuett-Hames et al. 1994a). LWD information was not used to stratify sites, but was collected to help interpret the results of the analysis.

Watersheds were selected from three lithology types in Washington state: (1) the volcanic lithologies of southwest and eastern Washington; (2) the glacial lithologies of Puget Sound and northwest Washington; and (3) the sedimentary lithologies of southwest and northwest Washington. Geology maps available in Watershed Analyses and from the Washington Department of Natural Resources were used to select watersheds dominated by a single lithology type. The lithology types were verified in the field, and individual streams that flowed through aberrant rock types were excluded.

For each lithology type, individual stream reaches were stratified into gradient categories of 1-2% and 2-4% based on information taken from Watershed Analysis maps or calculations from USGS topographic maps. Gradients were also surveyed in the field with a clinometer. When the field surveys yielded different results than map gradients (which was common), the gradient taken in the field was used. Stream segments were also stratified into high or low sediment supply categories based on mass wasting information taken from Watershed Analyses, knowledge of local workers, and field observations. Unfortunately, there was no systematic method for incorporating bank erosion and surface erosion processes into the stratification process, and the transport and breakdown of sediment in the channel was not carefully considered.

Sites were screened out if they were too difficult to access or did not contain enough spawning gravel to sample. Altogether, data were collected from 20 stream segments: eight on tributaries of the Chehalis River draining basalt on the east side of the Willapa Hills and the south side of the Black Hills; eight on the Kitsap Peninsula draining glacial materials; and four on tributaries of Vesta Creek and Little North River, which drain marine sediments the west side of the Willapa Hills. Table 1 contains a stratified list of the study sites.

Table 1. Study site locations stratified by basin lithology, sediment supply, and gradient.

Basin Lithology	Low Sediment Supply Sites 1-2%	Low Sediment Supply Sites 2-4%	High Sediment Supply Sites 1-2%	High Sediment Supply Sites 2-4%
Basalt	Sherman Creek Mima Creek Trib	Sherman Creek Lost Valley Creek	EF Chehalis River Thrash Creek	Big Creek Sage Creek
Glacial	Tahuya River Wildcat Creek	Erdman Creek Shoe Lake Drainage	Big Beef Creek Big Anderson Creek	Big Anderson Creek Big Anderson Cr Trib
Sedimentary	Vesta Creek Trib	Vesta Creek Trib	WF Vesta Creek	Salmon Creek Trib

Spawning habitat was characterized by collecting data for several habitat characteristics in a study reach within each identified stream segment. Study reaches were typically between 300 m and 500 m, but one study reach was as short as 190 m. Table 2 contains a list of each habitat parameter and the measure used to quantify it. The distributions of the data for each habitat parameter within each lithology were compared pair-wise using the Kolmogorov-Smirnov (KS) test. All three possible comparisons (basalt to glacial, basalt to sedimentary, and glacial to sedimentary) were tested. A brief description of the data collection method for each parameter follows, and the results of the statistical analysis are provided in the next section.

Table 2. Spawning habitat parameters and measures calculated from them.

Habitat Parameter	Measure
Spawning gravel particle size composition	geometric mean diameter of particle sizes
Spawning gravel fine sediment levels	percent of particles < 0.85 mm
Surface substrate particle size composition	median particle size (D_{50}) from pebble count
Small spawning gravel availability	percent surface substrate between 8 - 64 mm
Large spawning gravel availability	percent surface substrate between 65 - 128 mm
Total spawning gravel availability	percent surface substrate between 8 - 128 mm

Spawning gravel particle size composition and spawning gravel fine sediment levels were determined from bulk substrate samples. Samples were collected on suitable spawning sites (riffle crests or patches of gravel) with a McNeil sampler and processed using volumetric methods (Schuett-Hames et al. 1994b). Geometric mean particle size was calculated using the method of moments (Young et al. 1991), and the level of fine sediments was calculated as the percentage of particles less than 0.85 mm diameter by volume. Additionally, at each bulk sampling location, between 60 and 75 pebbles were tallied into size categories using the pebble count method (Wolman 1954). From these data, the median grain size (D_{50}) was calculated as a measure of surface substrate composition and an index of stream power.

The availability of appropriately-sized spawning gravel was determined by setting up transects perpendicular to the bankfull channel at 20 meter intervals. Each transect was divided into sections on the basis of the dominant size class (more than 50 % of the surface by area) of the surface material, and the length of each section was recorded. All of the substrate in the bankfull channel along the transect was assigned a dominant size class. Spawning habitat availability was calculated as the percentage of the bankfull channel dominated by material from 8 mm to 128 mm, 8 mm to 64 mm, and 65 mm to 128 mm.

7. Results

The results of the statistical analysis are discussed separately for the differences between the three lithologies and differences between the gradient and sediment supply sub-groups within each of the lithologies.

7.1 Differences Between Lithologies

Substantial differences were observed in the spawning habitat characteristics between the three lithologies. Spawning habitat in the sedimentary lithology was significantly different from that of the glacial and basalt lithologies for all six of the spawning habitat parameters analyzed. Spawning habitat in glacial and basalt lithologies were significantly different from each other for four of the six parameters (GMPS, D_{50}, large spawning gravel and small spawning gravel). For all three lithologies, each spawning habitat parameter is discussed individually below.

7.1.1 Geometric Mean Particle Size (GMPS)

The most evident difference between the lithologies is the much greater concentration of GMPS values in the range from 0 to 6 mm for the sedimentary lithology compared to the basalt and glacial lithologies; 71% of the samples from the sedimentary lithology have GMPS values in this range compared to only 19% and 14% for the basalt and glacial lithologies, respectively. The sedimentary lithology has the smallest modal GMPS category (> 0 to 2 mm) and the glacial lithology has the largest modal GMPS category (> 12 to 14 mm). The KS tests comparing the distributions resulted in significant differences ($P < 0.01$) for all three pairs of possible lithology comparisons.

7.1.2 Percent Fine Sediment (< 0.85 mm)

The most evident difference between the lithologies is that the majority of the samples from the basalt and glacial lithologies (63% and 65%, respectively) have percent fine sediment values ≤ 18%, while no samples from the sedimentary lithology (0%) have percent fine sediment values ≤ 18%. The sedimentary lithology has the largest modal percent fine sediment category (> 60% to 63%). The modal category of the basalt and glacial lithologies is > 12% to 15%. The KS tests indicated that the distributions of the data for the basalt and glacial lithologies are not significantly different from each other ($P = 0.35$) but the sedimentary lithology is significantly different from the other two ($P < 0.01$).

7.1.3 Median Grain Size (D_{50})

The most evident difference between the lithologies is the much greater concentration of the samples with D_{50} values ≤ 12 mm in the sedimentary lithology (38%) compared to the basalt (0%) and glacial (3%) lithologies. There is also a much greater concentration of D_{50} values ≥ 36 mm in the glacial lithology (71%) compared to the basalt (6%) and sedimentary (0%) lithologies. The glacial lithology has the largest modal D_{50} category (>40 to 42 mm) and the basalt lithology has the smallest modal D_{50} category (>14 to 16 mm). The KS tests comparing the distributions resulted in significant differences ($P < 0.01$) for all three pairs of possible lithology comparisons.

7.1.4 Small Spawning Gravel Availability (8-64 mm)

The most evident difference between the lithologies is the much greater prevalence of transects with no gravel (0%) in the 8-64 mm range in the sedimentary lithology (18%) compared to the basalt (3%) and glacial (3%) lithologies. Otherwise, there are no large differences between the distributions. The modal category of small spawning gravel for the basalt and glacial lithologies is > 50% to 55% and > 45% to 50%, respectively. The model category for the sedimentary lithology is 0%. The KS tests comparing the distributions resulted in significant differences ($P < 0.08$) for all three pairs of possible lithology comparisons.

7.1.5 Large Spawning Gravel Availability (65-128 mm)

The most evident difference between the lithologies is the much greater prevalence of transects with no gravel (0%) in the 65-128 mm range in the sedimentary lithology (84%) compared to the basalt (42%) and glacial (36%) lithologies. The distributions of the data for the basalt and glacial lithologies are very similar. The modal category of percent large spawning gravel for all three lithologies is 0%. The next most prevalent category is > 5% to 10% for the basalt and glacial lithologies (16% and 11%, respectively) and > 20% to 25% for the sedimentary lithology. The KS tests comparing the distributions resulted in significant differences ($P < 0.01$) for all three pairs of possible lithology comparisons.

7.1.6 Total Spawning Gravel Availability (8-128 mm)

The most evident difference between the lithologies is the much greater prevalence of transects with no gravel (0%) in the 8-128 mm range in the sedimentary lithology (16%) compared to the basalt (2%) and glacial (1%) lithologies. The distributions of the data for the basalt and glacial lithologies are very similar. The modal category of percent total spawning gravel is > 60% to 65% for the basalt lithology and > 50% to 55% for the glacial lithology. The modal category for the sedimentary lithology is 0%. The KS tests indicated that the distributions of the data for the basalt and glacial lithologies are not significantly different from each other ($P = 0.57$) but the sedimentary lithology is significantly different from the other two ($P < 0.01$).

7.2 Differences Between Gradient and Sediment Supply Sub-groups

Although there were statistically significant differences in spawning habitat characteristics between lithologies, no meaningful patterns were observed in the data for the gradient and sediment supply sub-groups. Due to small sample sizes and the large spread of the data, no statistical tests were used to compare the distributions of the sub-groups.

7.2.1 GMPS

The GMPS distributions for the sub-groups within each lithology are quite variable for the basalt and glacial lithologies. The distributions of these data for the glacial sub-groups are especially broad. The distributions of the sub-group data within the sedimentary lithology are the narrowest.

7.2.2 Percent Fine Sediment

The percent fine sediment distributions for the sub-groups within each lithology are quite variable for all three lithologies. In the sedimentary lithology, the distributions of the two high supply sub-groups are generally to the right of the distributions of the two low supply sub-groups (i.e., they are distributed among categories with larger fine sediment values). The opposite trend is evident in the basalt and glacial lithologies. Whether these are true trends or just an artifact of the stream segments sampled needs to be investigated further with additional sampling of other stream segments.

7.2.3 Median Grain Size (D_{50})

The D_{50} distributions for the sub-groups within each lithology are quite variable for all three lithologies, especially for the glacial lithology.

7.2.4 Small Spawning Gravel Availability (8-64 mm)

The distributions of the percentage of small spawning gravel (8-64 mm) data for the sub-groups within each lithology are quite variable for all three lithologies. In the sedimentary lithology, the majority of the transects with no gravel in the 8-64 mm size range occurred in the low gradient/high sediment supply sub-group.

7.2.5 Large Spawning Gravel Availability (65-128 mm)

The distributions of the percentage of large spawning gravel (65-128 mm) data for the sub-groups within each lithology are not as dissimilar as they are for the other parameters. The distribution of the data in the high gradient/high sediment supply sub-group is different from the others in that it has a smaller percentage of the no large spawning gravel (0%) category than the other sub-groups in both lithologies. The distributions of the data for the sub-groups in the sedimentary lithology are all very similar.

7.2.6 Total Spawning Gravel Availability (8-128 mm)

The distributions of the data within the sub-groups are similar for both the basalt and glacial lithologies. The distributions of the data within the sub-groups for the sedimentary lithology are similar except for the low gradient/high sediment supply sub-group in which the majority (11 of the 14) of samples with no spawning gravel occurred.

8. Conclusions and Recommendations

Several conclusions and recommendations can be drawn from the data collected and analyzed in this pilot project. The statistical analysis indicates that conclusions should be drawn separately for the differences found between lithologies and the differences found between gradient and sediment supply sub-groups within each lithology.

8.1 Differences Between Lithologies

8.1.1 Conclusions

1. Significant differences were observed among the basalt, glacial, and sedimentary lithologies, with the most persistent differences observed for the sedimentary lithology. Clearly, lithology type plays an important role in controlling spawning habitat characteristics.

8.1.2 Recommendations

1. A larger number of segments should be randomly selected in each lithology to verify the result.
2. A wider variety of lithologies within and outside of the three broad lithology categories used here should be sampled to explore other possible differences between lithology types.
3. Similar results obtained for all six parameters, so it would make sense to narrow down to one or two to reduce sampling time and effort. Using the parameters for spawning gravel availability would be the best choice for stream segments randomly selected throughout a watershed.

8.2 Differences Between Gradient/Sediment Supply Sub-groups

8.2.1 Conclusions

1. No clear patterns were observed in the sub-group data. The small number of segments sampled for each sub-group and the simplistic means of stratifying streams by sediment supply may have prevented the detection of meaningful trends.

8.2.2 Recommendations

1. Collect data from a greater number of stream segments for each sub-group, so statistical tests can be run on the data.
2. Develop a more sophisticated system for stratifying stream segments. The system should account for all possible sources of course and fine sediment in the managed forest environment, including bank erosion, mass wasting and surface erosion. It should also account for differences in sediment transport and storage in order to effectively stratify stream segments. The use of sediment budgeting techniques (Dietrich et al. 1982) should be explored for this purpose.

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