REVISED WORKING DRAFT

CHEHALIS RIVER WATER RETENTION STRUCTURES

SCOPING DOCUMENT AND PROPOSED STUDIES

Prepared for:

Chehalis River Fish and Aquatics Work Group
Chehalis Basin Flood Authority

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November 10, 2009

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EXECUTIVE SUMMARY

Lewis County Public Utility District (Lewis PUD) retained EES Consulting (EESC) to conduct a preliminary engineering and environmental assessment of potential water retention facility options in the Chehalis River Basin. The first phase of this assessment determined that there may be potential benefits of investing in flood-retention facilities in the on the Upper Chehalis River and South Fork Chehalis River. This second phase was initiated to further evaluate the required environmental studies and develop a scoping document to guide future environmental assessments.

The environmental component of this Phase 2 includes:

- Compilation of the known information regarding environmental resources in the potential project area;
- Consultation with the resource agencies and the public;
- Presenting scoping of potential aquatic concerns to focus the important issues
- Prepare initial study plans for aquatic field studies to gather environmental information;
- Prepare a schedule for conducting environmental studies

This scoping document describes the data that has been obtained to date about the water quality, water quantity, fish and fish habitat resources in the project areas (existing information). It lists the data that is considered important but is currently missing (data gaps) and frames the important fish and aquatic issues, and the studies that would be required to support the environmental analysis of the potential project's effects.

Existing Information

The first step in developing the scoping document was developing a catalogue of existing information. A Work Group meeting was held in June to gather information from stakeholders on current data available for the basin. The Chehalis River Fish and Aquatics Work Group Work Group consists of members of the Flood Control Authority, Lewis PUD, state and federal agencies, the Chehalis Tribe, NGOs and other stakeholders within the Chehalis River basin. The purpose of the Work Group is to assist with filling data gaps and guide the investigations to support informed decisions regarding the project. In the meeting notice, attendees were requested to provide information on fish and aquatic resources that may be relevant and useful for making Project-related decisions.

Based on the information provided at the meeting and from public sources, EESC gathered existing water quality and quantity information from gages in the Chehalis watershed. In addition, EESC gathered the available information regarding fish distribution, species composition and abundance for the fish supported by the Chehalis River Basin. Runs of Chinook, coho, and chum salmon, along with steelhead and cutthroat trout, green and white sturgeon and a variety of other fish species are all species that can be found in the Chehalis River.

Data Gaps

Based on the catalogue of existing information, it was found that important data gaps exist for water quality in that existing continuous temperature monitoring is very limited in the areas of these potential projects and data was gathered on a monthly basis. Existing data may therefore not lend itself to rigorous analysis or to calibration and reliable performance of a water temperature model.

Data gaps also exist related to fish and fish habitat. Existing information regarding fish distribution, species composition and abundance is only sporadically available by species and location. The limiting factors report produced for WRIAs 22 and 23, which includes the Chehalis River System (Smith and Wegner 2001) stated:

> *Assessments regarding sedimentation, off-channel habitat, channel conditions (incision, aggradation, etc), water usage, water quality, salmonid escapement estimates, fish habitat use, stream flow, instream habitat components (pools, LWD, etc), riparian conditions, and landcover are some of the major categories where data are lacking.*

In addition, no instream flow studies have been conducted in the South Fork Chehalis or in the mainstem Chehalis River downstream of the proposed retention structures. Currently no information is available regarding connectivity or sedimentation in the areas that would be affected by the water retention structures.

Proposed Studies

Based on the review of existing information and the identification of data gaps, the following studies are proposed to complete the understanding of the fish and water quality issues related to the potential water retention facility options in the Chehalis River Basin:

1. Permitting, installing and monitoring new stream gages and analyzing the hydrological data.
2. Water quality modeling using CE-QUAL-W2 for temperature and dissolved oxygen (DO).
3. Fish Species Composition and Abundance Study
4. Comprehensive Fish Rearing Analysis
5. Impacts of Predatory Species on native fish species and Analysis of Habitat Gain/Loss of Predators in Potential Reservoirs
6. Post-project effects to green sturgeon (ESA-listed species)
7. Fish Barrier Analysis
8. Instream Flow Study
9. Connectivity Study
10. River Process Study (Large woody debris, gravel, and sediment transport)

The next steps to obtain the information still needed to evaluate the effects of the proposed water retention facilities on fish and water quality are to solicit additional information on the scope of the potential studies from agency representatives. Study plans, detailing specific methods, study timing and geographic areas will then be prepared by consultants and reviewed by agency

representatives prior to initiating the field studies. Field studies will likely be initiated in 2010 with some being completed in the fall and winter, and others continuing into 2011.

1.0 INTRODUCTION

Frequent flooding in the Chehalis River Basin has caused hardship and significant economic impacts to local residents. The most recent severe floods occurred in 2007 and again in 2009. These floods affected communities in Lewis, Grays Harbor and Thurston counties, and multiple shutdowns of Interstate 5 (I-5) inflicted region-wide harm. In addition, summertime water levels and temperatures have caused problems with fish and wildlife habitat.

Discussions are currently underway to address this long-standing problem and several alternatives are being explored. The U.S. Army Corps of Engineers (Corps) has considered building levees near I-5. While improved levees in specific areas may be part of the solution, levees alone will not provide a complete solution to address upstream and downstream flooding concerns. In addition, the Corps is studying raising the Skookumchuck Dam, which has the potential to alleviate flooding in the area northeast of Centralia.

Additional measures to further retain and reduce the flow of water from the Chehalis River are of particular interest, given the magnitude of recent flood events. The Chehalis Basin Flood Authority (established in 2008) is also beginning to examine potential flood control projects.

Lewis County Public Utility District (Lewis PUD) retained EES Consulting (EESC) to conduct a preliminary assessment of potential water retention facility options in the Chehalis River Basin. This assessment examined the following:

- The benefits of investing in flood-retention facilities on one or both of the Upper Chehalis River and South Fork Chehalis River;
- Whether potential flood-retention facilities have sufficient benefits to merit further discussion and analysis;
- The potential costs; and
- What studies are needed to inform decision making about the potential facilities?

The Chehalis River Fish and Aquatics Work Group (Work Group) consists of members of the Flood Control Authority, Lewis PUD, state and federal agencies, the Chehalis Tribe, NGOs and other stakeholders in the Chehalis River basin. The Work Group's purpose is to guide the investigations and assist in filling data gaps to support informed decisions regarding the Project.

Evaluations of the two potential retention facilities are still in the feasibility stage (Phase II). This document describes the fish and aquatic issues and the studies that would be required to support permitting and establishment of appropriate instream flows for such a project. The estimates of instream flows are preliminary; it is anticipated that they will be modified as a result of consultation with the Work Group and additional refinement or modification of the Project.

Additional investigations are being conducted regarding the geology and engineering needs and feasibility of these structures; the results of these investigations will be provided in separate reports to the Work Group. This draft report incorporates information and revisions from comments received at the Chehalis River Fish and Aquatics Work Group Kickoff Meeting held on June 25, 2009, and from supplementary information provided after the meeting.

Section 1.0 of this Scoping Document describes the potential water retention project. Section 2.0 describes the existing information that has been gathered regarding the water quantity, water quality, and fishery resources that would be affected by the facilities. Section 3.0 identifies those data gaps and areas where information is still needed in order to fully evaluate the effects of the project, and Section 4.0 lists the studies that are necessary to obtain the missing information. These studies, however, have not yet been approved by the Work Group.

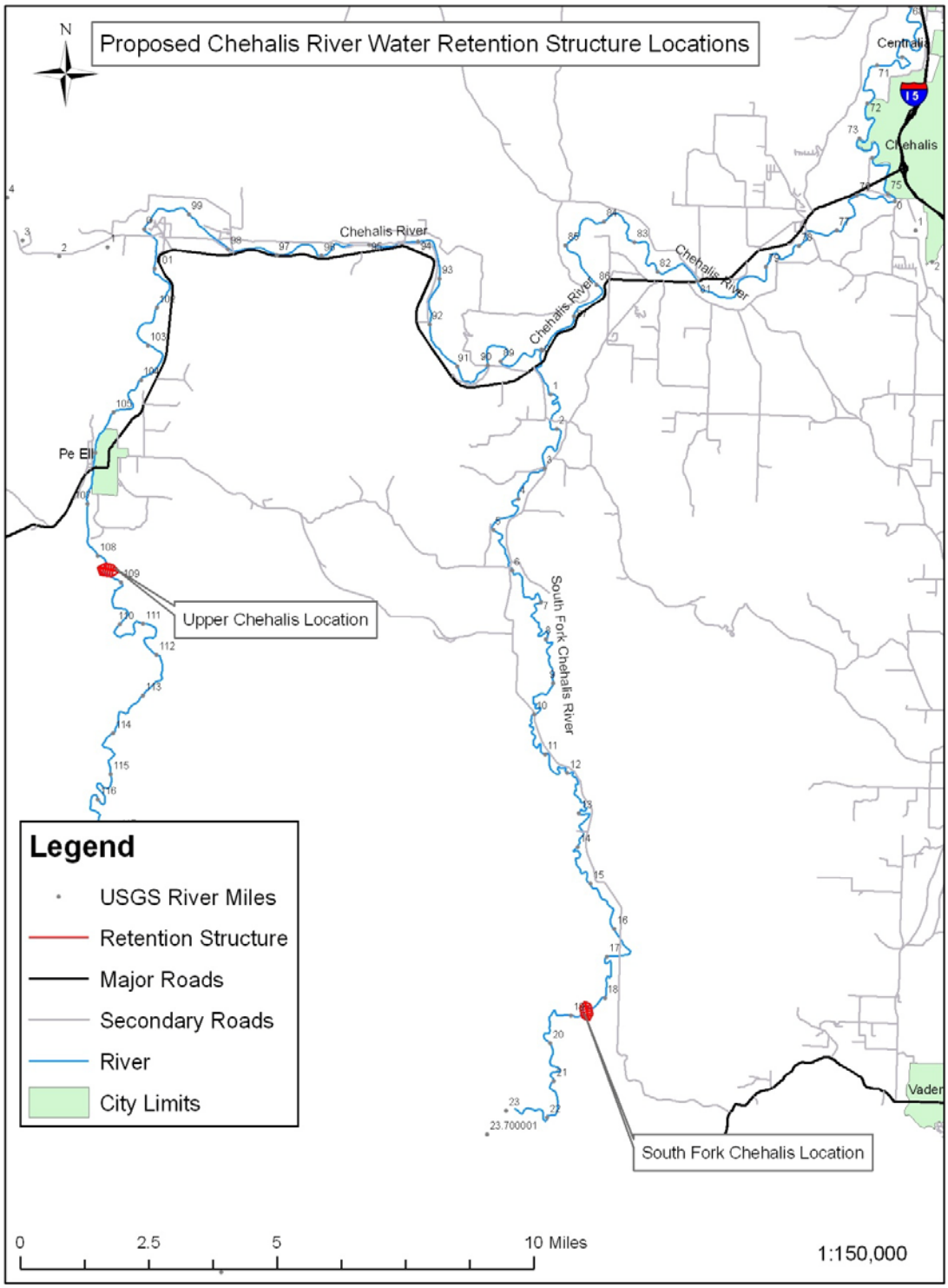


Figure 1
Proposed Location of Flood Retention Structures on the Chehalis River

1.1 Description of the Potential Flood Retention Facilities

As currently proposed, the potential water retention projects will consist of two storage reservoirs: the Upper Chehalis Reservoir, and the South Fork Chehalis Reservoir (Figure 1). Information on each retention facility is provided below.

As proposed, the retention facilities would capture water from flood events and release a portion of the retained waters during the low-flow summer period. ***Instream flow discharge requirements, and the timing and magnitude of releases, will be determined in consultation with the Work Group. Estimates of instream flows provided below, were selected for feasibility and illustration purposes only, and will be revised based upon the results of the studies and consultation.***

1.1.1 Upper Chehalis Reservoir

The proposed Upper Chehalis Reservoir would be located upstream of Pe Ell at approximately River Mile 108.3. The facility would provide flood relief to Pe Ell residents and downstream areas, including Doty, Dryad, Ceres, Adna, Chehalis, and Centralia, as well as communities farther downstream. Results of previous preliminary investigations by EESC, indicated that storage of 80,000 acre-feet (ac-ft) is necessary to be able to capture the peak flows at this point on the Chehalis River during an extreme storm event, such as the December 2007 storm.

If such a structure were built, WDOE would require a year-round minimum instream flow release from the facility in order to maintain downstream aquatic resources. A minimum flow release of 10 cubic feet/second (cfs), or 5% of the mean annual flow, was selected for illustrative purposes. A 5% minimum flow release amounts to about 7,240 ac-ft per year. The volume of the reservoir was calculated as:

- Average annual runoff 154,000 ac-ft
- Minimum instream flows 7,240 ac-ft
- Flood Storage 80,000 ac-ft
- Total Storage 226,760 ac-ft

The proposed project would allow water stored during the high flow months to augment low summer flows. The timing and extent of these releases would be determined in consultation with the Work Group. The following observations were made for this site:

1. Summer low flows in this section of the river naturally average approximately 20 cfs
2. From gage data, in the first 20 days of the flood of 2007, about 80,000 acre-ft passed this site.
3. The mean annual flow at this site is about 215 cfs

EESC determined that a storage reservoir with a maximum of 220,000 ac-ft of storage would be sufficient to meet the storage and flood control requirements.

1.1.2 South Fork Chehalis Reservoir

The proposed South Fork Reservoir facility would be located at approximately River Mile 18.5 on the South Fork of the Chehalis River. An estimate of average daily flows at the South Fork Chehalis River site was developed by area correlation from the daily average flow records at Grand Mound, based on a 22.49 miles^2 drainage area upstream of this water retention facility site. From previous analysis for the Project feasibility studies, it was determined that storage of 20,000 ac-ft would be necessary to capture the peak flows during an extreme storm event, such as the December 2007 storm.

If a reservoir were built at this location, WDOE would require a year-round minimum instream flow discharge. A minimum flow of 5 cfs, representing 7% of the mean annual flow, was selected for discussion purposes. The actual instream flow for this structure would be determined as a result of consultation with the Work Group and after appropriate studies were conducted. This example 7% minimum instream flow release amounts to about 3,600 ac-ft per year. Analyses of the gage and drainage area indicated that:

- Summer low flows in this section of the Chehalis River get as low as approximately 5 cfs on average.
- The total run-off at this site in an average year is about 50,600 ac-ft.
- From gage data, in the first 20 days the flood of 2007, about 20,000 ac-ft passed this site.
- The mean annual flow at this site is about 70 cfs.

Based on this information, it was determined that a storage reservoir with a maximum of 40,000 ac-ft of storage would be sufficient to meet the storage and flood control requirements.

Evaluations of the potential two-reservoir Project are still in the feasibility stage (Phase II). This document describes the fish and aquatic issues, and the studies that would be required to support permitting and establishment of appropriate instream flows for the flood retention facilities, as currently envisioned. These estimates of instream flows are preliminary, and it is anticipated that they will be modified as a result of consultation with the Work Group (described below) and additional refinement or modification of the Project.

Additional investigations are being conducted regarding the geology and engineering needs and feasibility of these structures; the results of those investigations are being provided in separate reports to the Work Group.

1.2 Chehalis River Fish and Aquatics Work Group

The Chehalis River Fish and Aquatics Work Group Work Group consists of members of the Flood Control Authority, Lewis PUD, state and federal agencies, the Chehalis Tribe, NGOs and other stakeholders within the Chehalis River basin. The purpose of the Work Group is to assist with filling data gaps and guide the investigations to support informed decisions regarding the project. Consultation with the resource agencies ensures that they will receive the data they require to support environmental permitting, should either or both potential facilities move forward to design and construction.

Notice for the Work Group Kickoff meeting was distributed on May 27, 2009 and the meeting was held on June 25, 2009. In the meeting notice, attendees were requested to provide information on fish and aquatic resources that may be relevant and useful for making Project-related decisions. Since the meeting, Lewis PUD has received information from members of the Work Group and EESC has compiled the information for this revised draft scoping report. Despite these efforts, a number of data gaps remain and will need to be filled as the data are obtained.

1.3 Scoping Document and Proposed Study Plan

This Revised Scoping Document and Proposed Studies is provided as a **Working Draft** to the Work Group. It is intended to be a working document that will be augmented and modified with additional information as it is provided and/or collected.

This Scoping Document and Proposed Study Plan includes the following information for fish and water quality resources that would likely be affected by the construction of two impoundment structures in the Chehalis River Basin:

- Existing Information
- Identification of Limiting Factors and Data Gaps
- Issues (to be addressed by studies)
- Potential Initial Studies

Information regarding other resources affected by the proposed Project, such as wildlife and recreation, will be required if the Project moves forward.

2.0 EXISTING INFORMATION

The following sections describe the information gathered by EESC obtained from members of the Work Group.

2.1 Water Quality

A Chehalis River water retention project must meet the State of Washington's water quality standards. These include numeric standards for: temperature, dissolved oxygen (DO), total dissolved gas, pH, turbidity, bacteria, nutrients, and toxics. Additional narrative standards describe the desired water quality goal for the water body, and are used for pollutants for which numeric criteria are difficult to specify, such as those that offend the senses (e.g., color and odor).

Certain water quality parameters have been monitored in the Chehalis basin since the late 1950s. The Washington Department of Ecology (WDOE) lists 18 sampling stations in the Upper Chehalis River basin (WRIA 23), and nine in the Lower Chehalis River basin (WRIA 22). Of these stations, four are of interest in relation to this project (see Figure 2). Two of the stations in the Upper Chehalis River have been sampled from 1959 to the present (although not necessarily continuously): one near Porter (station #23A070), and one near Dryad (station #23A160) (see Figure 2). Parameters monitored at these long-term locations (sampled on a monthly basis) include:

- Dissolved oxygen (DO)
- Conductivity
- pH, alkalinity
- Turbidity
- Fecal coliform
- Nitrogen
- Phosphorus, and
- Water temperature (monitored continuously at these sites since 2002)

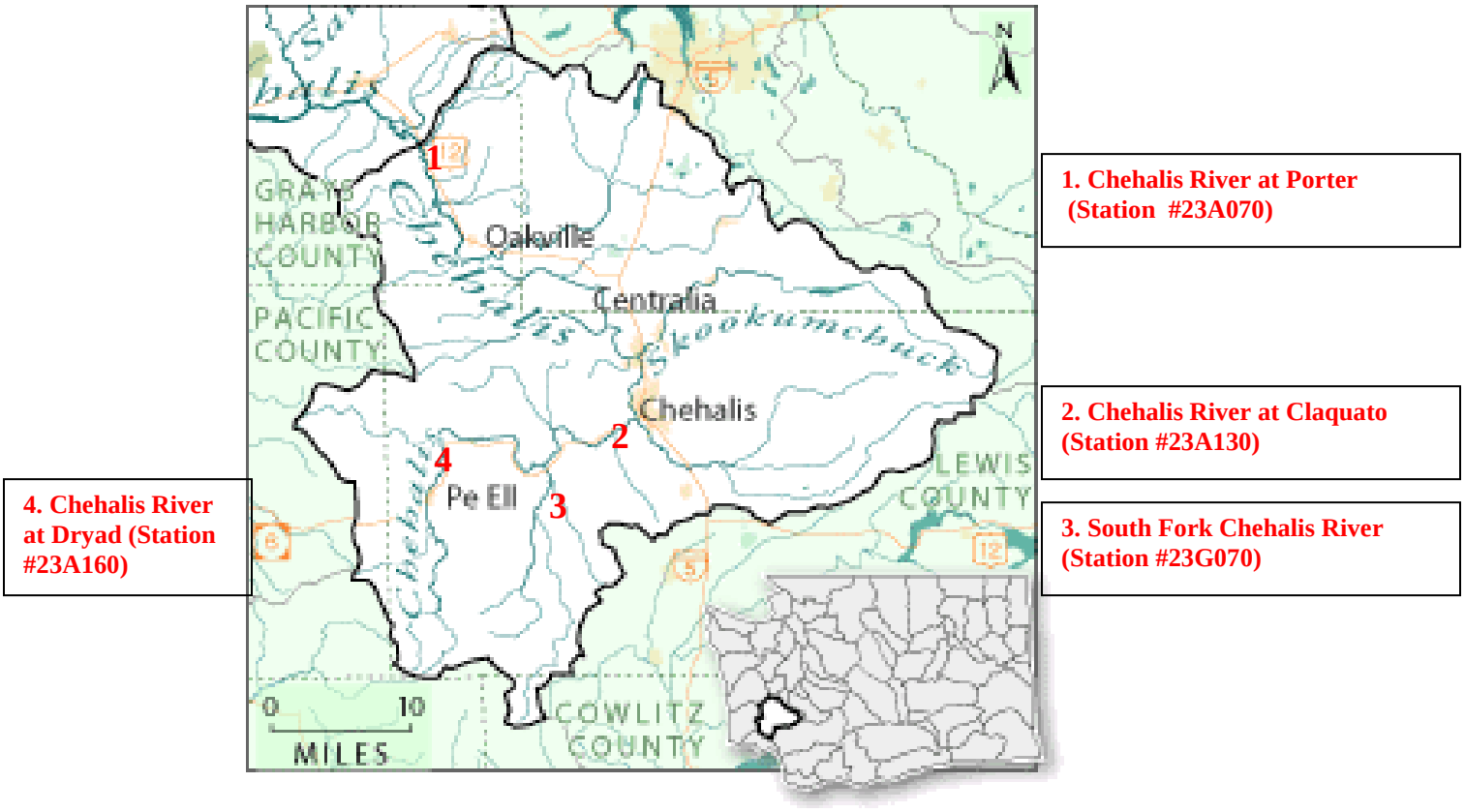


Figure 2
WDOE Monitoring Stations in the Upper Chehalis Basin (WRIA 23)

Another station located on the South Fork Chehalis River (Station #23G070), has been sampled monthly since 1997, and temperature monitoring began at that location in 2008. Another station on the Upper Chehalis River near Claquato was monitored in 1997, but has not had any continuous water temperature monitoring. Tables 1 through 5 summarize selected parameters from the WDOE water quality monitoring data for these four stations. These parameters provide important information about the baseline conditions in the potential project locations.

Table 1
Water Quality Monitoring of the Upper Chehalis River at Dryad 1959-2008

Water Quality Monitoring Station #23A160			
Parameter	**Average**	**Minimum**	**Maximum**
Dissolved oxygen (mg/l)	11.33	7.60	14.00
Conductivity (µS/cm)	68	40	96
pH	7.5	6.3	8.9
Turbidity (NTU)	7.3	0.7	650
Fecal coliform (#/100ml)	60	1	2800

Table 2
Water Quality Monitoring of the Chehalis River Near Porter 1959-2008

Water Quality Monitoring Station #23A070			
Parameter	**Average**	**Minimum**	**Maximum**
Dissolved oxygen (mg/l)	10.31	7.10	13.50
Conductivity (µS/cm)	83	41	180
pH	7.2	6.2	8.4
Turbidity (NTU)	6.6	0.6	80
Fecal coliform (#/100ml)	56	1	1300

Table 3
Water Quality Monitoring of the South Fork Chehalis River, 1997

Water Quality Monitoring Station #23G070			
Parameter	**Average**	**Minimum**	**Maximum**
Dissolved oxygen (mg/l)	10.53	7.90	12.50
Conductivity (µS/cm)	not available		
pH	7.3	7.0	7.7
Turbidity (NTU)	8.0	1.8	40
Fecal coliform (#/100ml)	190	23	540

Table 4
Water Quality Monitoring of the Upper Chehalis River Near Claquato 1997

Water Quality Monitoring Station #23A130			
Parameter	**Average**	**Minimum**	**Maximum**
Dissolved oxygen (mg/l)	10.18	7.50	12.00
pH	7.1	6.5	7.9
Turbidity (NTU)	9.9	2.3	45
Conductivity (µS/cm)	not available		
Fecal coliform (#/100ml)	127	19	730

Adequate dissolved oxygen is necessary for good water quality**.** The D.O. required under the Washington State standards is measured in milligrams per liter (mg/L). The allowable limit is determined by the needs of the dominant fish species present and ranges from a lowest 1-day minimum of 6.5 to 9.5 mg/L (WAC 173-201A-200 (1)(d)).

The pH for fresh water generally is required to be within the range of 6.5 to 8.5, with a human-caused variation of less than 0.2 units (WAC 173-201A-200 (1)(g)).
The water quality standards place limits on the amount that human activity may increase turbidity over normal levels in streams, so it is important to establish the baseline or background level.

Conductivity is a measure of the ability of water to pass an electrical current and is affected by the presence of inorganic dissolved solids. The conductivity of rivers in the United States generally ranges from 50 to 1500 µmhos/cm. Studies of inland fresh waters indicate that streams supporting good mixed fisheries have a range between 150 and 500 µhos/cm. Conductivity outside this range could indicate that the water is not suitable for certain species of fish or macroinvertebrates.

Water temperature is one of the most important criteria for aquatic life and is measured for purposes of the water quality standards by the 7-day average of the daily maximum temperatures (7-DADMax). The highest allowable 7-DADMax can range between 9° and 20°C (48.2° to 68°F) depending upon the species present and the purposes for which they use the waterbody. If natural temperatures are above the limits, human-caused increases are restricted (WAC 173-201A-200 (1)(c)).

Table 5
Water Temperature Monitoring in the Upper Chehalis River Basin (WRIA 23)

Year	Max. 7-day Mean Temp. (°C)	Date of Occurrence
Upper Chehalis at Dryad (Station #23A160)		
2008	22.8	8/15/08
2007	21.1	7/30/07
2006	24.9	7/24/06
2005	21.9	8/2/05
2004	24.3	7/26/04
2003	22.0	7/23/03
2002	21.7	8/12/02
South Fork Chehalis (Station #23G070)		
2008	24.0	8/15/08
Chehalis River near Porter (Station #23A070)		
2008	22.8	8/16/08
2007	22.1	8/2/07
2006	22.4	7/28/06
2005	22.7	7/30/05
2004	23.7	8/14/04
2003	24.1	7/29/03
2002	23.1	7/22/02
2001	22.3	8/11/01

WDOE conducted a study of temperature trends in tributaries of the Upper Chehalis River to establish a baseline prior to designating Best Management Practices (BMPs) to restore riparian conditions (Sargeant 2001). Temperature monitoring locations included:

- Black River
- Lincoln Creek
- South Fork Chehalis River
- Newaukum River
- Chehalis River above the Newaukum River

Of these, the stations of greatest interest in relation to the potential water retention projects are the South Fork Chehalis River and Chehalis River above Newaukum River (see Tables 6 and 7).

Table 6
WDOE South Fork Chehalis Temperature Data 1995-2000

Year	Dates Monitored Occurred	Days Exceeding 18.0 °C Out of Number of Days Monitored	Dates of First and Last Violation During Monitoring Period	Maximum Temperature	Maximum Number of Hours Temperature > 18.0°C and Dates
1995	6/10/95 - 10/1/95	88 of 114	6/10/95-9/21/95	26.5°C	329 hours (7/15-7/29)
1996	6/26/96 – 9/10/96	69 of 74	6/29/96-9/10/96	25.5 °C	332 hours (7/22-8/5)
1997	6/28/97 – 9/7/97	65 of 72	7/2/97-9/7/97	26.0 °C	829 hours (7/19-8/26)
1998	8/11/98– 9/20/98	41 of 41	8/11/98-9/20/98	26.2 °C	214 hours (8/28-9/6)*
1999	6/25/99 – 9/12/99	69 of 81	7/5/99-9/12/99	25.1 °C	283 hours (8/2-8/14)**
2000	6/22/00 – 9/27/00	76 of 98	6/25/00-9/21/00	25.1 °C	376 hours (7/27-8/12)

* Limited data set.
** Between July 26 and August 14, temperatures remained above 18.0 °C for 448 hours except for one hour on August 2 when the temperature was 17.98 °C.

Table 7
WDOE Chehalis River Above Newaukum River Temperature data 1995-2000

Year	Dates Monitored Occurred	Days Exceeding 18.0 °C Out of Number of Days Monitored	Dates of First and Last Violation During Monitoring Period	Maximum Temperature	Maximum Number of Hours Temperature > 18.0°C and Dates
1995	6/9/95-10/1/95	35 of 115	6/9/95-9/22/95	25.8°C	821 hours (7/11-8/14)
1996	6/29/96-7/13/96	15 of 15	6/29/96	25.7°C	Not available
1997	6/26/97-7/25/97	22 of 30	7/2/97	25.9°C	Not available
1997	8/13/97-9/7/97	26 of 26	8/13/97-9/7/97	25.0°C	Not available
1998	6/23/98-9/4/98	71 of 74	6/23/98-9/4/98	27.2°C	1451 hours (7/6-9/4)
1999	6/25/99-9/5/99	62 of 73	7/6/99-9/5/99	23.3°C	1045 hours (7/19-8/31)
2000	6/28/00-9/9/00	66 of 74	6/28/00-9/8/00	24.8°C	1001 hours (7/10-8/21)

The WDOE includes 241 water bodies in the Upper Chehalis (WRIA 23) on its list of impaired streams for 2008 (the 303(d) list); with 45 as impaired for temperature, 44 for dissolved oxygen, and 77 for fecal coliform (some water bodies may be listed for multiple impairments). Where water bodies do not meet water quality standards for a particular pollutant, Water Quality Improvement Projects, or TMDLs (Total Maximum Daily Loads) are established to determine

the amounts of pollutant loading that a given water body can receive and still meet water quality standards. Five Total Maximum Daily Load (TMDL) water quality improvement projects have been submitted in the Upper Chehalis:

- Black River Dissolved Oxygen, Phosphorus (1994)
- Black River Fecal Coliform (1994)
- Upper Chehalis River Dissolved Oxygen (2000)
- Upper Chehalis River Temperature (2001)
- Upper Chehalis River Fecal Coliform (2004)

Examples of data available from these TMDL reports are shown in Table 8 and Figure 3.

Table 8
Selected Parameters from the Upper Chehalis River TMDL study (Pickett 1994)

Date	Temp. (C)	pH	Conductivity (µS/cm)	DO (mg/l)	Alkalinity (mg/l)	Turbidity (NTU)	TSS (mg/l)	TDS (mg/l)
South Fork Chehalis River (RM 88.0)								
7/25/91	19.4	6.6	106	7.9				
7/25/91	19.6	6.6	98	8.4				
8/27/91	17.1	6.8	132	8.3		1.5		
8/27/91	17.1	7.8	118	8.4		1.5	2	79
8/28/91	16.0	7.2	131	8.1		1.6		
8/28/91	16.2	7.5	118	8.5		1.5	1	62
7/22/92	18.2	7.5		8.5				
8/4/92	19.5	7.4		6.8				
Elk Creek (RM 100.2)								
7/25/91	16.3	6.9	68	9.8				
8/27/91	14.7	7.7	76	9.2		3.2	6	73
8/28/91	14.4	7.5	74	10.0		4.3	4	57
7/22/92	16.7	7.7	77	9.7		2.5	5	
7/22/92	17.0	7.8	78	9.5	27.1	2.0	4	62
7/22/92	17.0	7.8	77	10.7	26.8	2.0	2	
8/4/92	17.2	7.6	79	9.1		2.5	1	
8/4/92	17.2	7.8	78	9.0	27.4	2.8	1	208
8/4/92	17.2	7.8	77	9.1	27.3	2.0	1	96

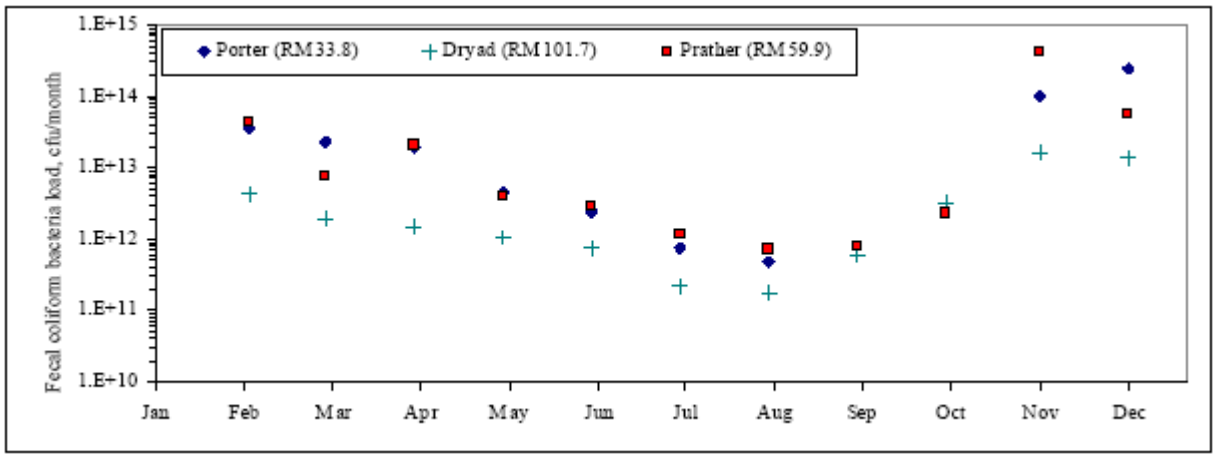


Figure 3
Seasonal Fecal Coliform Concentrations (90th Percentile) at Three Locations in the Upper Chehalis River 1994-2003 (from Ahmed 2004)

WDOE also monitors water quality in Grays Harbor. One location is at the mouth of the Chehalis River, with four other locations within the bay (Figure 4). Parameters monitored include:

- Temperature
- Salinity
- DO
- pH
- Bacteria
- Chlorophyll
- Nutrients

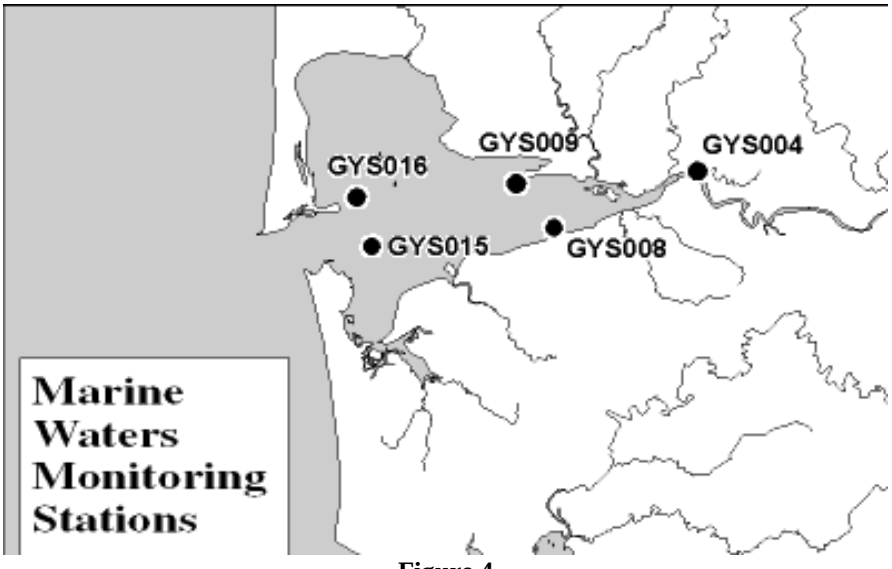


Figure 4
WDOE Marine Waters Monitoring Stations in Grays Harbor

The Chehalis River Council began a volunteer monitoring program in 2002, with two stations in the Upper Chehalis River (see Figure 5 and Table 9).

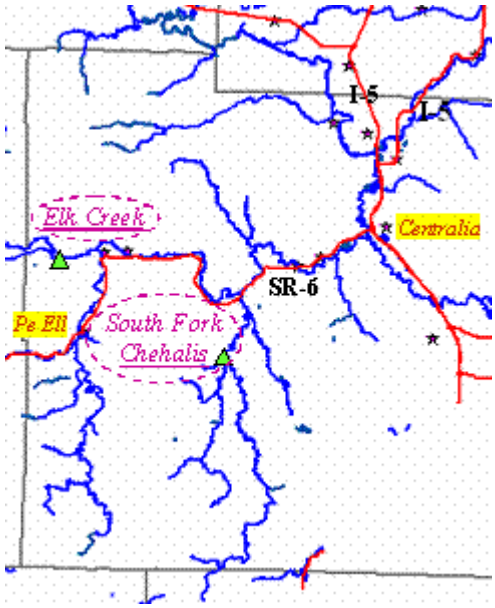


Figure 5
Chehalis River Council Monitoring Stations in the Upper Chehalis River

Thurston County monitors two locations on the Chehalis River near Rochester, but these are well downstream of the area where effects of these potential water retention projects could be discerned.

Additional data exist from a cooperative effort between WDOE, Grays Harbor College, the Chehalis Tribe, and the Chehalis Basin Partnership. Details of monitoring locations and parameters monitored were not available at the time of this writing. Summary information that was available from this source suggests that in addition to temperature, dissolved oxygen, and fecal coliform, turbidity and/or sedimentation may also be significant issues in the Upper Chehalis River, particularly in the Salzer and Stearns creek watersheds (Green et al. 2009).

Sedimentation in Stillman Creek may be an impairment resulting from landslides, due to failures from sidecast roads, particularly in West Fork Stillman, Upper Stillman, and Slide creeks (Smith and Wenger 2001). Landslides have also frequently occurred in the Upper Chehalis River, particularly in the Big, Thrash, and Sage creek watersheds, many originating from roads or recent timber harvest areas (Smith and Wenger 2001). Chronic sediment inputs from roads located near streams may contribute to stream sedimentation in Lower Stillman, Lost Valley, Halfway, and Slide creeks (Smith and Wenger 2001). Road erosion and streambank erosion may also contribute to sedimentation in the South Fork Chehalis River (Smith and Wenger 2001).

Table 9
Chehalis River Council Volunteer Monitoring Program Data for the Upper Chehalis River

Date	Water temp. (C)	DO (mg/l)	pH	Conductivity (µS/cm)	Fecal coliform (mean)
South Fork Chehalis River					
9/9/02	16.5	9.81	7.50	99.8	104
1/7/03	6.3	12.10	7.05	38.5	20
3/6/03	6.7	11.27	7.03	44.9	22
8/21/03	21.5	9.00	7.35	117.7	21
2/11/04	5.3	11.83	7.07	41.6	17
9/7/04	16.7	9.53	7.24	75.2	73
1/5/05	1.8	13.80	7.18	43.6	6
1/18/05	7.9	11.54	6.78	29.3	44
8/18/05	20.0	8.33	7.29	104.8	25
11/1/05	10.3	10.10	6.98	51.7	>400
1/24/06	7.3	11.03	7.01	40.5	22
Elk Creek					
9/9/02	12.1	9.83	7.47	59.8	100
1/7/03	6.1	11.35	6.91	34.7	6
3/6/03	6.1	11.56	6.81	33.1	19
8/21/03	14.8	8.75	7.45	64.1	13
2/11/04	5.0	11.84	6.74	31.9	2
9/7/04	13.3	9.32	7.22	60.2	20
1/5/05	1.9	13.71	7.12	34.3	4
1/18/05	7.8	11.12	6.50	29.1	13
8/18/05	15.7	8.94	7.34	63.8	56
11/1/05	10.0	10.50	6.55	44.9	185
1/24/06	7.1	11.41	6.87	32.8	5

2.2 Water Quantity

The Chehalis River basin is primarily a rainfall-driven hydrologic system with high flows occurring in the wet winter months and annual low flows occurring in the summer and early fall. Existing legal water rights in the Chehalis River exceed streamflow by as much as 400% (Smith and Wenger 2001). The low flow conditions are at their most critical during the months of July, August, and September.

The USGS has a network of stream gages within the Chehalis River watershed, many with long-term records. The mainstem Chehalis River has four gages that record discharge and four additional gages that only record water stage. The period of record for each of the three upper mainstem Chehalis River gages exceeds 50 years, while the Chehalis River at Satsop has only five years of record. In addition to the gages on the mainstem Chehalis River, the USGS operates gages on many of the larger tributaries. WDOE also operates three recording gages in the Chehalis River basin that have less than a five-year period of record. Figure 6 shows a map of the Chehalis River basin and the location of all of the USGS gage sites. Figures 7 through 9 display the annual hydrograph for USGS gages on the mainstem Chehalis River, which clearly show this trend in annual runoff.

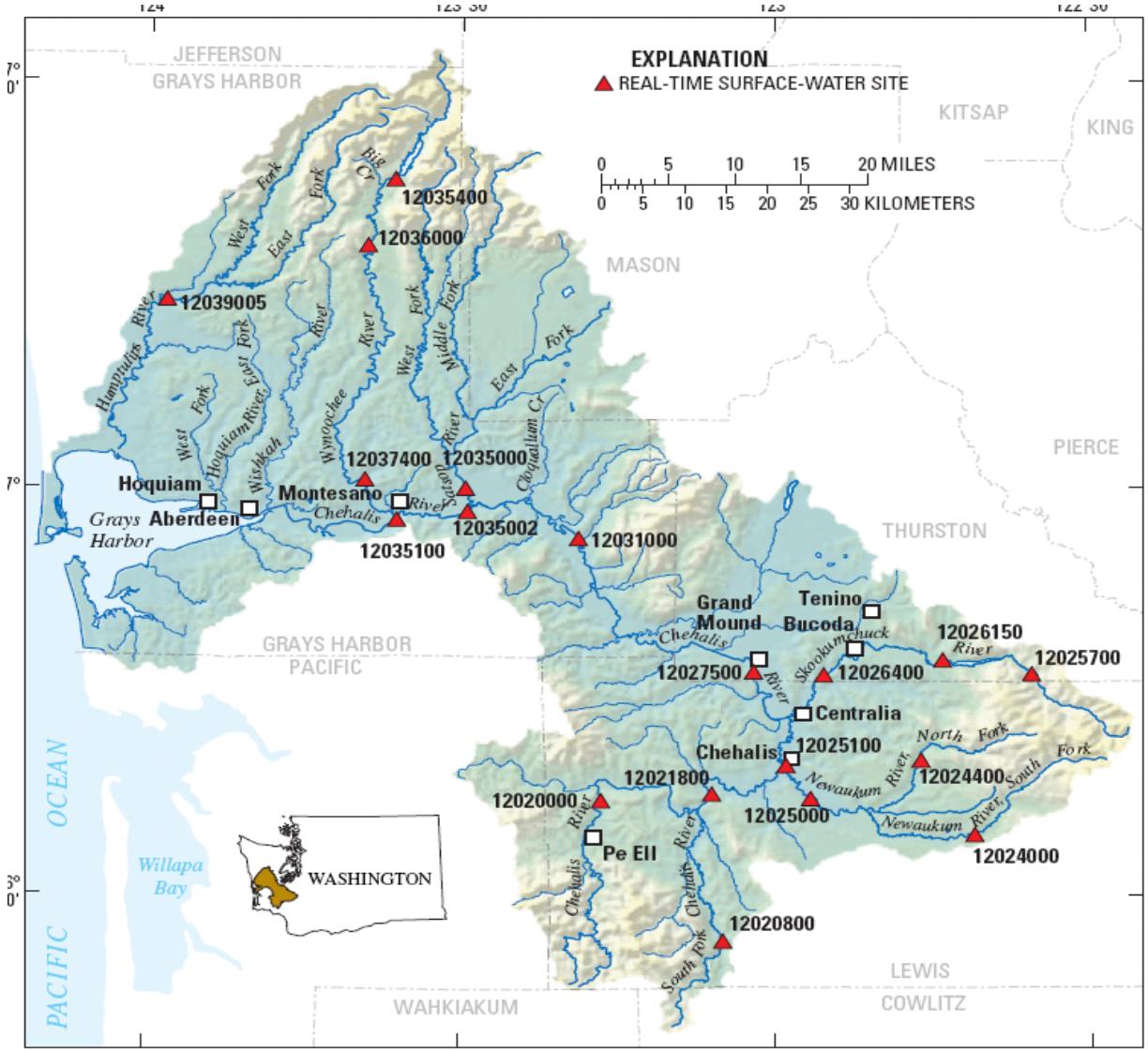


Figure 6
USGS Stream Gage Sites, Chehalis River Basin

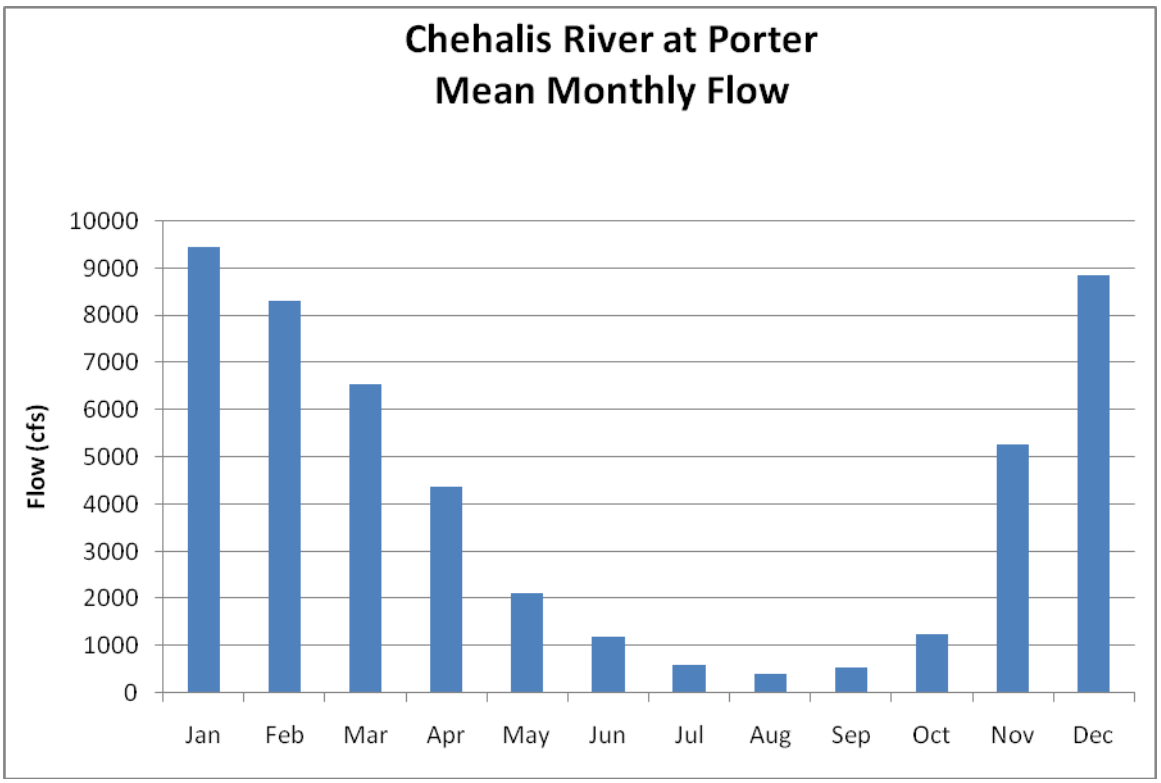


Figure 7
USGS Stream Gage Chehalis River at Porter (RM 33.3), Mean Monthly Flows

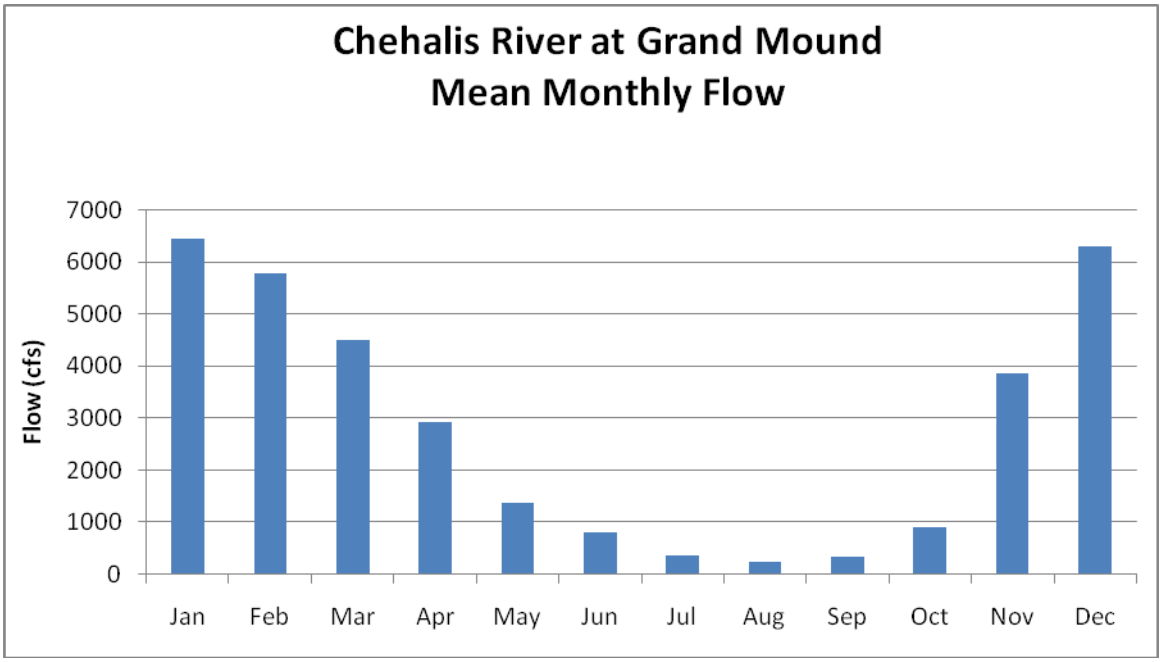


Figure 8
USGS Stream Gage Chehalis River at Grand Mound (RM 59.9), Mean Monthly Flows

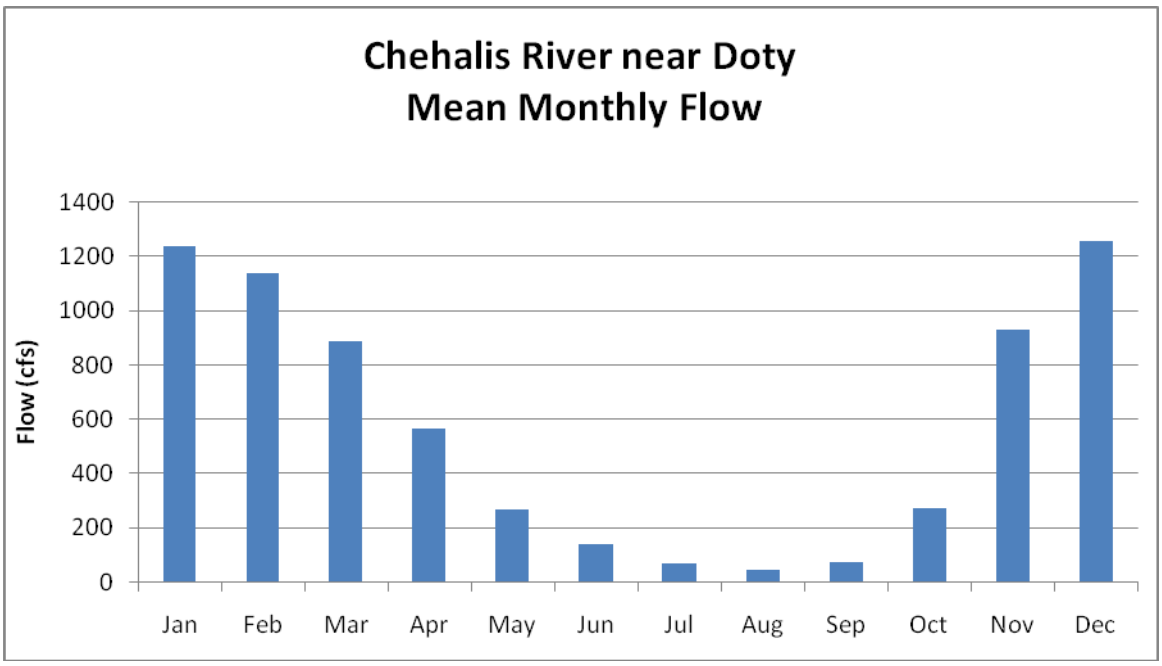


Figure 9
USGS Stream Gage Chehalis River Near Doty (RM 101.8), Mean Monthly Flows

The Chehalis River has a number of significant tributaries that contribute large amounts of water to the mainstem. Major tributaries enter the mainstem Chehalis River over nearly its entire length. Major tributaries and the river mile at which they enter the Chehalis River include:

- Wishkah River (RM 0.15)
- Wynoochee River (RM 13.0)
- Satsop River (RM 20.2)
- Black River (RM 47.0)
- Skookumchuck River (RM 67.0)
- Newaukum River (RM 75.4)
- South Fork Chehalis River (RM 88.3)

Table 10 lists mean monthly flow for the USGS gages on the mainstem Chehalis River as well as major tributaries.

Table 10
Mean Monthly Flows (cfs) of Major Chehalis River Basin Gages

USGS Gage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Chehalis at Porter	9460	8310	6560	4370	2110	1190	610	413	537	1240	5280	8870
Chehalis at Grand Mound	6430	5770	4500	2930	1380	810	378	243	340	910	3860	6290
Chehalis near Doty	1240	1140	891	569	269	144	69	46	76	273	931	1260
Wynoochee	2480	2150	1630	968	671	505	336	232	358	825	2250	2720
Satsop	4260	3780	3010	2070	1130	696	453	331	430	1150	3040	4290
Skookumchuck	753	657	539	392	222	151	98	81	122	138	357	709
Newaukum	1110	970	768	540	294	183	89	56	71	181	748	1060

2.3 Fisheries

2.3.1 Anadromous Stocks

The Chehalis River Basin supports runs of Chinook, coho, and chum salmon, along with steelhead and cutthroat trout, green and white sturgeon and a variety of other fish species. Numerous individual stocks of salmon, steelhead and trout have been identified throughout the basin. For this report, emphasis is on summarizing data regarding the Chehalis River mainstem and South Fork Chehalis River stocks.

2.3.1.1 Chinook Salmon

Spring, summer, and fall runs of Chinook *(Oncorhynchus tschawytscha)* utilize the Chehalis River Basin for spawning and rearing. The mainstem Chehalis supports runs of spring and fall Chinook. WDFW classified two stocks that utilize the mainstem Chehalis and its upper tributaries for spawning (WDFW 2002).

2.3.1.1.1 Run Size and Location

Escapement estimates are available from 1980 – 2006 (Table 11) and indicate that the average escapement in the Chehalis River basin over the period of record is 5,388 and 2,062 fall and spring Chinook, respectively. Escapement estimates were based on redd counts in spawning-intensive areas and supplemental index areas. The status of each stock was last evaluated by WDFW in 2002. These stocks were originally evaluated in 1992, and both stocks were initially classified as healthy. Escapement data indicated that the returns of spring and fall Chinook have remained steady without any major declines over this period of record.

Table 11
Chehalis River Chinook Stock Annual Escapement Data 1980-2006

Year	Spring Chinook	Fall Chinook
1980	200	Not-Available
1981	600	Not-Available
1982	610	Not-Available
1983	1128	Not-Available
1984	1157	Not-Available
1985	1999	Not-Available
1986	874	3348
1987	841	6124
1988	3106	7685
1989	2068	7837
1990	1567	2941
1991	1289	4516
1992	1813	4058
1993	1254	4037
1994	1403	2830
1995	2070	3797
1996	4305	7297
1997	4460	6701
1998	2283	4432
1999	1285	3946
2000	3135	4430
2001	2860	3804
2002	2598	5184
2003	3135	8746
2004	5034	8776
2005	2129	6231
2006	2481	6,426
Average	**2,062**	**5,388**

Source: SalmonScape 2009

Chehalis River Spring Chinook Stock

Spring Chinook from the Chehalis River stock spawn in the Skookumchuck, Newaukum, South Fork Chehalis, and mainstem Chehalis rivers. Spawning has been documented as low as RM 33.3 and as high as RM 113.4. WDFW (2002) identifies RM 33.3 – 67.0 and RM 81.3 – 113.4 as areas of spawning in the mainstem. Chehalis River spring Chinook spawning has also been documented in Elk (tributary to mainstem at RM 100.2) and Stillman (tributary to South Fork Chehalis at RM 5.1) creeks, and the Black River (tributary to the mainstem at RM 47.0). The Chehalis River Spring Chinook stock is a self-sustaining population with natural reproduction. Hatchery origin fish from the Cowlitz River were introduced to the Wynoochee River (tributary to the mainstem at RM 13.0) in the mid-1970s (WDFW 2002). Potential for hybridization between native and hatchery stocks exists due to this introduction.

Chehalis River Fall Chinook Stock

Chehalis River Fall Chinook spawning has been documented throughout the upper portion of the Chehalis River basin. Major spawning areas in the Chehalis basin are located upstream of the Satsop River. Spawning takes place on the Chehalis River mainstem from RM 28 – 67 and RM 88 – 108. The Black, Newaukum, and Skookumchuck rivers are regarded as areas of concentrated spawning. A majority of the upper Chehalis River basin hatchery Chinook are returning to the Skookumchuck River.

Spawning has been documented in Cedar and Stillman creeks, as well as the South Fork Chehalis River (WDFW 2002). Fall Chinook naturally reproduce and are considered a native population. Hatchery-raised fall Chinook were introduced to the Chehalis River basin from the early 1950s to the mid-1970s; the information regarding these releases is poor and hybridization potential exists (WDFW 2002).

Other Chehalis River Basin Chinook Stocks

The Chehalis basin supports a number of individual stocks of Chinook salmon. In addition to the stocks present in the upper Chehalis, the following stocks have been identified by WDFW (1993, 2002):

- Wishkah River Fall Chinook
- Wynoochee River Fall Chinook (Summer run)
- Satsop River Summer Chinook (Summer run)
- Satsop River Fall Chinook

2.3.1.1.2 Run Timing

Chehalis River Spring Chinook Stock

Chehalis basin spring Chinook enter the mainstem Chehalis from mid-February through July (Caldwell et al. 2004). Spring Chinook hold in deep pools for several months before spawning. Spawning begins in early September and ends about mid-October, with a peak of spawning activity in late September (WDFW 2002). Fry emerge between January and February and rear for approximately five to seven months before outmigrating (Caldwell et al. 2004).

Chehalis River Fall Chinook Stock

Fall Chinook enter the Chehalis River during the months of September and October. Spawning begins in mid-October and ends in early December (WDFW 2002). Fall Chinook fry begin to emerge in February. Most juveniles rear for approximately 90 days prior to outmigrating between April and mid-August (Caldwell et al. 2004).

2.3.1.1.3 Available Habitat and Limiting Factors

The WDOE and WDFW conducted an instream flow study using the Instream Flow Incremental Methodology (IFIM) in the Chehalis River Basin (Caldwell et al. 2004). One of the study sites selected for the IFIM was on the upper Chehalis River, at RM 110.9. Quality of spawning and rearing habitat as they relate to flow are displayed graphically in Figure 10.

The results from the study indicate that the maximum amount of Chinook spawning habitat is available at flows of 160 – 170 cfs, while the most Chinook rearing habitat coincides with a flow of 70 cfs.

Smith and Wenger (2001) identified limiting factors in the mainstem Chehalis River and Upper Chehalis River. These factors are not species-specific; rather, they are intended to describe how individual factors affect salmon habitat as a whole. The Chehalis Basin Partnership Habitat Work Group (CBPHWG) summarized the limiting factors with the highest potential to impact salmon habitat (2008). Brief descriptions of each limiting factor and its potential effects on fish habitat in the Chehalis River are listed below.

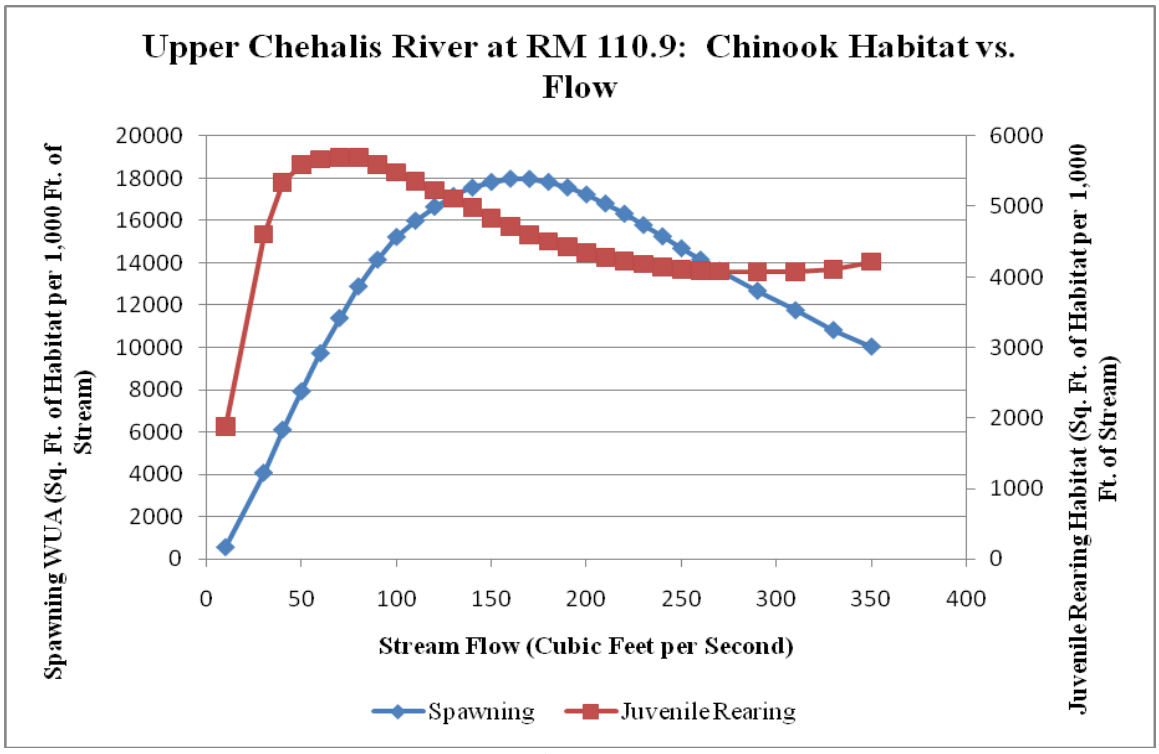


Figure 10
Chinook Habitat in the Upper Chehalis River vs. Streamflow
(from Caldwell et al. 2004)

Riparian Corridor

Approximately 105 miles of the mainstem Chehalis River were identified as having reduced shade canopy. Shade and a healthy riparian corridor benefit juvenile salmonids by providing cover from potential predators and lowering water temperature.

Water Quality

The Chehalis contains reaches listed on the WDOE 303(d) list of impaired waterways for the parameters of dissolved oxygen, temperature, and fecal coliform. Low levels of dissolved oxygen and elevated temperatures can have detrimental effects on salmon populations, and specific temperature ranges are required during egg incubation.

Floodplain

The floodplain was identified as a habitat-limiting factor for several reasons. The Chehalis River from RM 13 – 20 has lost some off-channel habitat. From RM 20 – 57, the channel is somewhat incised and the Chehalis River from RM 57 – 79 was identified as an incised reach. An incised channel cuts off access to rearing habitat in off-channel areas and can lead to decreased riparian vegetation and increased sediment loads. An incised river reach will not have access to its floodplain, which is important for energy and water dispersal during floods.

Large Woody Debris

Detailed data quantifying large woody debris (LWD) were not available at the time Smith and Wenger identified limiting factors in the Chehalis River basin. LWD, however, was identified as a habitat limiting factor. LWD will create slow-water rearing habitats near stream margins and in pools utilized by juvenile salmonids.

Water Quantity

Data from the Porter (RM 33.3) and the Grand Mound gages (RM 59.90) indicated poor water quantity conditions for the Chehalis River mainstem. The water rights in the Chehalis River exceed streamflow by as much as 400% (Smith and Wenger 2001). The IFIM study conducted by WDOE and WDFW documented the relationship between habitat availability and streamflow. Spawning habitat decreases rapidly as streamflows decrease below 160 – 170 cfs in the upper Chehalis River; rearing habitat experiences a similar decrease when streamflows drop below 70 cfs.

Sediment

The Chehalis River is subject to high sediment transport and mass wasting in certain reaches. High sediment transport can lead to poor egg survival, low levels of dissolved oxygen and low LWD recruitment. Excess fine sediment is known to negatively impact egg survival during incubation due to low levels of dissolved oxygen.

2.3.1.1.4 Annual Harvest

On an annual basis, two commercial gill-netting seasons take place: a Quinault Tribe Fall Chinook, and a non-Indian commercial season. The Chehalis Tribe also harvests Chinook on the Chehalis Reservation. Harvest data for 2006 – 2008 are presented in Table 12. No other data regarding recreational or commercial harvest were made available at this time.

Table 12
Grays Harbor Chinook Commercial Gillnet Catch 2006-2008

Year	Quinault Tribal Fall Commercial Gillnet Fishery	Non-Indian Commercial Gillnet Fishery
2006	1,686	No Retention
2007	1,681	161
2008	817	No Retention

Source: WDFW 2009

2.3.1.2 Coho Salmon

The Chehalis River Basin supports multiple stocks of coho salmon (*O. kisutch*). Individual stocks have been identified for the Wishkah, Wynoochee, Satsop and Chehalis rivers (WDFW 2002). This section will focus on the Chehalis River stock of coho.

2.3.1.2.1 Run Size and Location

Chehalis River coho escapement data are available from 1984 – 2004 (Table 13). The Chehalis River coho stock was classified as healthy in 1992. This classification was confirmed on a subsequent analysis of the stock in 2002. Chehalis River coho escapement averages 21,625 fish over this period of record.

Coho spawn throughout the Chehalis River basin, in more than 195 tributaries (WDFW 2002). Coho will spawn in the upper mainstem and East Fork Chehalis rivers. Concentrated coho spawning has been documented in the mainstem Chehalis River between RMs 103.7 – 106.2. Releases of hatchery coho took place annually from 1950 until 1970, and occurred sporadically in the late 1970s and 1980s. Seven hatcheries participated in the release of yearling coho during that time. The Chehalis River stock of coho is not considered native for this reason (WDFW 2002).

2.3.1.2.2 Run Timing

Coho enter the Chehalis River between October and December. Spawning begins in November, peaks in early December, and tapers off through February. There is a secondary peak in spawning activity in late January – early February; this peak is thought to be caused by non-hatchery fish returning that typically return later than hatchery fish (Caldwell et al. 2004). Coho eggs take 137 days to hatch at 2.2° C (Roberge et al. 2002). Fry emerge beginning in February. Coho juveniles will rear 1 – 2 years in their natal stream before outmigrating between mid-February and mid-June (Caldwell et al. 2004).

Table 13
Chehalis River Coho Salmon Annual Escapement 1984-2004

Year	Escapement
1984	46,362
1985	7,840
1986	8,357
1987	5,803
1988	22,108
1989	22,824
1990	10,768
1991	29,519
1992	13,584
1993	13,734
1994	4,442
1995	17,364
1996	30,695
1997	10,609
1998	15,493
1999	15,475
2000	21,968
2001	33,166
2002	42,268
2003	52,034
2004	29,720
Average	**21,625**

Source: SalmonScape 2009

2.3.1.2.3 Available Habitat and Limiting Factors

Coho utilize the upper Chehalis River and its tributaries to spawn. An IFIM study performed by WDOE and WDFW from 2001 to 2004 modeled habitat conditions in the upper Chehalis River at RM 110.9 at a range of flows (Caldwell et al. 2004). The results of the IFIM are presented in Figure 11. Further quantification of habitat availability in the Chehalis basin has not been conducted.

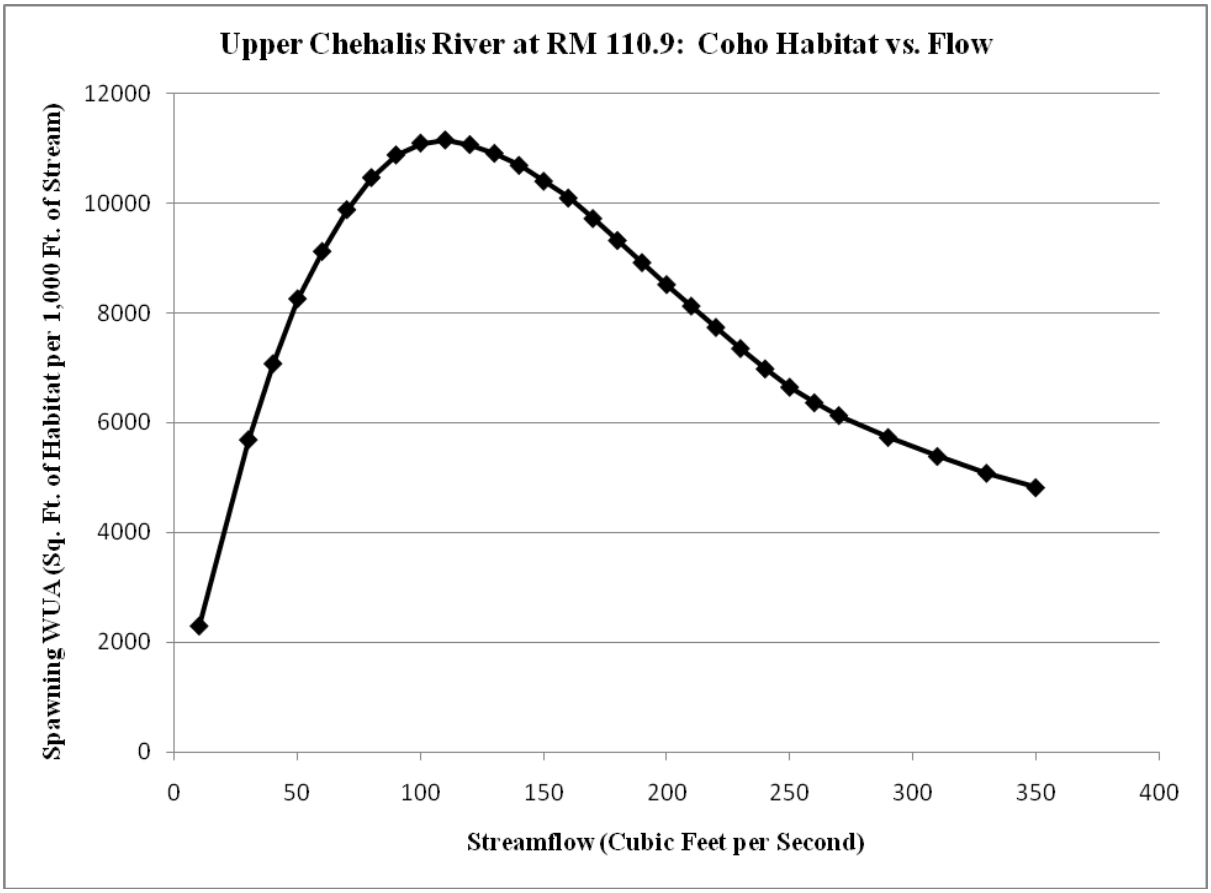


Figure 11
Coho Habitat in the Upper Chehalis River vs. Streamflow
(from Caldwell et al. 2004)

The study did not quantify rearing habitat in the upper Chehalis River. No information regarding the amount of rearing habitat available to coho could be located. Limiting factors for Coho include, but are not limited to, the same limiting factors discussed in Section 2.3.1.1.3 (Chinook Available Habitat and Limiting Factors).

2.3.1.2.4 Annual Harvest

Two commercial fishing seasons take place on the lower Chehalis River and in Grays Harbor near its mouth: the Grays Harbor Quinault Tribal Fall, and the Grays Harbor non-Indian commercial fisheries. Harvest data from 2006 – 2008 are summarized in Table 14. No data regarding the recreational catch of coho on the Chehalis River could be located.

Table 14
Grays Harbor Coho Salmon Commercial Gillnet Catch 2006-2008

Year	Quinault Tribal Fall Commercial Gillnet Fishery	Non-Indian Commercial Gillnet Fishery
2006	6,415	583
2007	5,122	1,615
2008	5,493	7,199

Source: WDFW 2009

2.3.1.3 Chum Salmon

The fall run of Chum salmon (*O. keta*) that returns to Grays Harbor each year is divided into two stocks: the Humptulips River and Chehalis River fall chum.

2.3.1.3.1 Run Size and Location

The Chehalis River fall chum stock has been classified as not healthy since 2004. Escapement data are available from 1969 – 2003 (Table 15). Fall chum were so abundant during this period in the lower Chehalis River that escapement data are given in spawners per mile instead of total escapement.

Table 15
Chehalis River Chum Salmon Annual Escapement 1969-1986

Year	Escapement (Spawners/Mile)	Year	Escapement (Spawners/Mile)
1969	2,478	1987	2,415
1970	2,918	1988	14,489
1971	2,477	1989	2,437
1972	1,096	1990	2,589
1973	3,650	1991	4,472
1974	1,765	1992	5,414
1975	4,152	1993	4,735
1976	251	1994	7,718
1977	3,888	1995	3,926
1978	1,791	1996	3,659
1979	170	1997	3,330
1980	4,786	1998	10,680
1981	3,943	1999	3,684
1982	7,086	2000	2,313
1983	4,637	2001	2,765
1984	5,323	2002	13,695
1985	6,121	2003	10,438
1986	4,423		
Average		**4,563**	

Source: SalmonScape 2009

The majority of Chehalis chum stock spawns in lower tributary rivers (WDFW 2002). The Wynoochee, Satsop and Black rivers are tributaries to the Chehalis River, and the Hoquiam and Wishkah rivers flow directly into Grays Harbor. Lower concentrations of chum spawners have been documented in Cloquallum Creek and in the lower mainstem Chehalis River (WDFW 2002).

2.3.1.3.2 Run Timing

No data documenting run timing of Chehalis River fall chum could be located. Generally, fall chum along the West Coast migrate to spawning grounds sometime between August and September (Roberge et al. 2002). Spawning in the Chehalis River occurs from late October

through mid-December (WDFW 2002). Newly emergent chum fry within relative proximity to an estuary will outmigrate immediately.

2.3.1.3.3 Available Habitat and Limiting Factors

No data have been located that quantify the habitat available in the Chehalis River basin for chum salmon. Limiting factors for Chehalis River chum include, but are not limited to, the same limiting factors discussed in Section 2.3.1.1.3 (Chinook Available Habitat and Limiting Factors).

2.3.1.3.4 Annual Harvest

Two commercial fisheries harvest chum salmon from Grays Harbor near the mouth of the Chehalis River (catch data in Table 16 below for the years 2006-2008). The season coincides with the Chinook and coho fisheries in the same area. No data could be located documenting recreational harvest of chum in the Chehalis River.

Table 16
Grays Harbor Chum Salmon Commercial Gillnet Catch 2006-2008

Year	Quinault Tribal Fall Commercial Gillnet Fishery	Non-Indian Commercial Gillnet Fishery
2006	3,595	14
2007	598	118
2008	2,069	138

Source: WDFW 2009

2.3.1.4 Steelhead

Steelhead trout (*O. mykiss*) are distributed throughout the Chehalis River. Individual stocks of Chehalis River winter steelhead and summer steelhead have been identified (WDFW 2002).

2.3.1.4.1 Run Size and Location

No data enumerating escapement for summer steelhead are available. Winter steelhead escapement data are available from 1984 – 2006 (Table 17).

Table 17
Chehalis River Winter Steelhead Trout Escapement 1984-2006

Year	Escapement
1984	3,084
1985	2,818
1986	3,322
1987	3,682
1988	2,264
1989	2,392
1990	2,596
1991	1,694
1992	1,896
1993	1,762
1994	1,970
1995	1,730
1996	1,564
1997	1,913
1998	998
1999	2,620
2000	3,620
2001	2,794
2002	2,350
2003	1,991
2004	3,654
2005	2,710
2006	2,869
Average	**2,448**

Source: SalmonScape 2009

WDFW, 2002 cited an escapement goal of 2,700 winter steelhead annually. This goal has been reached nine times over the period of record (Table 17, above). The stock of Chehalis River winter steelhead was classified as healthy in 1992, and again in 2002. WDFW (2002) states that the fluctuation in spawner abundance is within the normal variation for the stock.

Winter steelhead trout in the Chehalis River are a native stock with wild production. Some hatchery steelhead from the Wynoochee River are released in tributaries to the upper Chehalis River Basin (i.e., Elk Creek). The stock of summer steelhead utilizing the Chehalis River has not been classified due to uncertainties about hatchery-reared steelhead reproduction in the wild (WDFW 2002).

2.3.1.4.2 Run Timing

Winter steelhead enter the Chehalis River between December and early June. Their distribution is thought to be similar to that of coho. Winter steelhead spawn from mid-February to mid-June, with fry emergence beginning in April. Most winter steelhead in the Chehalis basin rear for two years before outmigrating, starting in April and continuing through June (Caldwell et al. 2004).

Winter steelhead spawning has been documented in over 70 locations throughout the basin. The majority of spawning takes place in the mainstem Chehalis River, East and West Fork Chehalis rivers, and other smaller tributary creeks:

- Cloquallum Creek
- Porter Creek
- Rock Creek
- Crim Creek
- Cinnabar Creek
- Hanlan Creek
- Stillman Creek

Run timing of summer steelhead in the Chehalis River is typically between May and November. Summer steelhead spawn between mid-February and April of the following year (Caldwell et al. 2004). Summer steelhead spawning locations have not been documented in the Chehalis River (WDFW 2002). Outmigration of summer steelhead and the specifics of rearing behavior are not well known at this time. In general, steelhead outmigrate at 2-3 years (Quinn 2005).

2.3.1.4.3 Available Habitat and Limiting Factors

The IFIM performed by WDFW and WDOE in 2004 provided data relating available steelhead spawning and rearing habitat and streamflow for the upper Chehalis River (Figure 12).

The results of the study are not stratified based on seasonal or stock differences; rather, they represent the amount of habitat available to steelhead of any stock or seasonal run. No data could be located that quantifies the amount steelhead habitat in the lower mainstem Chehalis River.

2.3.1.4.4 Annual Harvest

No data quantifying recreational or commercial harvest of steelhead in the Chehalis River could be located.

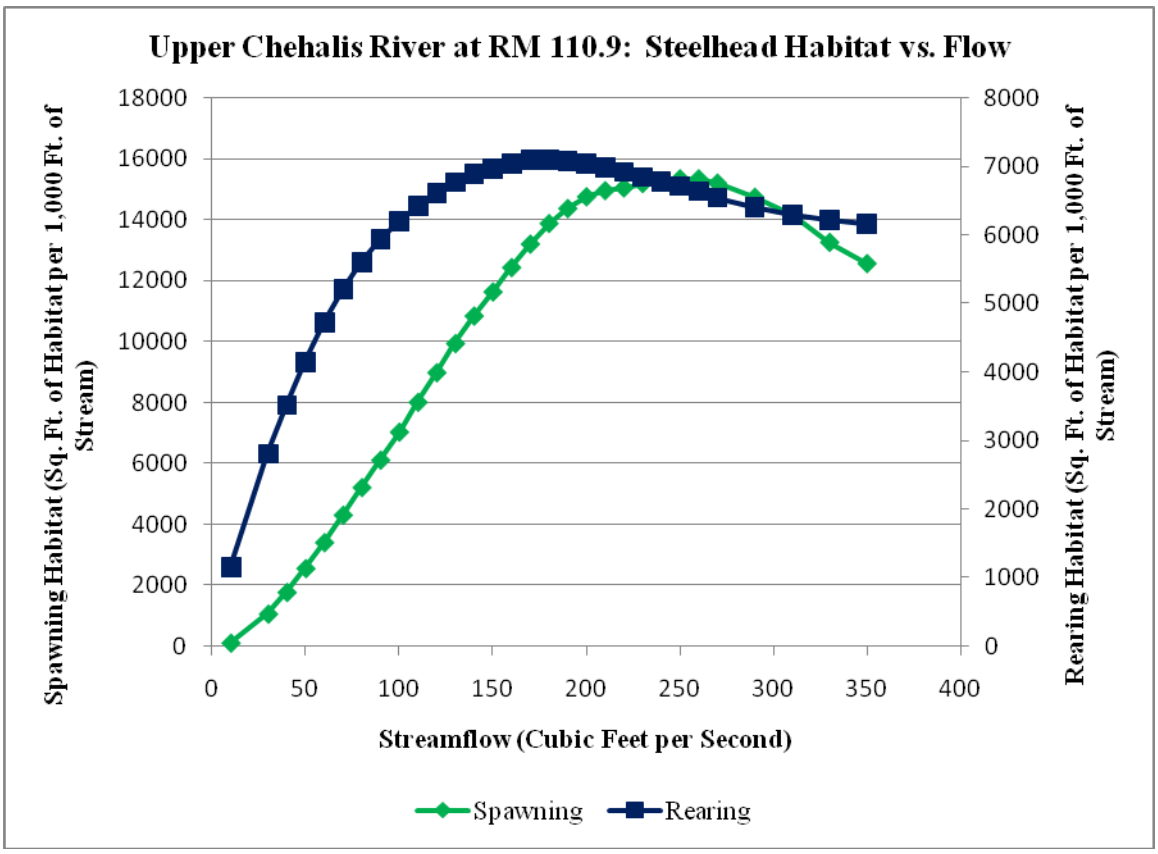


Figure 12
Steelhead Habitat in Upper Chehalis River vs. Streamflow
(from Caldwell et al. 2004)

2.3.1.5 Coastal Cutthroat Trout

Resident and anadromous forms of coastal cutthroat trout (*O. clarki clarki*) inhabit the Chehalis River. WDFW (2000) classified the Chehalis River stock of coastal cutthroat as the group inhabiting the Johns, Hoquiam, Wishkah, Wynoochee, Satsop, Black, Skookumchuck, Newaukum, and Chehalis rivers. The resident form of cutthroat exists both above and below anadromous barriers and in many lakes within the basin.

The Chehalis River stock of coastal cutthroat trout has been supplemented with a broodstock of cutthroat trout comprising Grays Harbor and Chehalis River stocks. WDFW (2000) classified the Chehalis River stock as a native population with composite production.

2.3.1.5.1 Run Size and Location

No escapement data for the Chehalis River stock of coastal cutthroat trout could be located. Information characterizing the location of coastal cutthroat spawning could not be located. Due to the existence of anadromous and resident forms, spawning likely takes place below and above anadromous barriers.

2.3.1.5.2 Run Timing

Anadromous forms of coastal cutthroat trout enter the Chehalis River from October through April. The majority of anadromous cutthroat spawn from January through mid-March (WDFW 2000). Fluvial resident cutthroat, which inhabit larger rivers and migrate to smaller tributaries to spawn, tend to spawn at the same time as anadromous cutthroat. Adfluvial cutthroat that live in lakes and return to tributaries to spawn, do not spawn until March through mid-April. Resident cutthroat spawn from February through mid-March (WDFW 2000).

No data could be located documenting the timing of anadromous cutthroat outmigration. Typically, coastal cutthroat juveniles rear for at least 1 to 2 years and outmigrate between ages 2 and 4 (Quinn 2005).

2.3.1.5.3 Available Habitat and Limiting Factors

No data could be located quantifying the amount of habitat available for coastal cutthroat utilization in the Chehalis River or its tributaries. Cutthroat trout limiting factors have not been identified for the Chehalis basin.

2.3.1.5.4 Annual Harvest

No data quantifying the recreational harvest of Chehalis River coastal cutthroat could be located.

2.3.1.6 Sturgeon

Green (*Acipenser medirostris*) and white sturgeon (*A. transmontanus*) both utilize Grays Harbor and the lower Chehalis River. Limited information about these populations is available.

2.3.1.6.1 Run Size and Location

No data documenting the spawning migration or escapement for white or green sturgeon could be located. White sturgeon do not spawn in the Chehalis system but are believed to move as far upstream as Rainbow Falls (approx. RM 97).

Southern Green sturgeon are listed as Threatened and Northern Green sturgeon are a species of concern under the Endangered Species Act. The Chehalis River is listed as critical habitat. Green sturgeon are thought to spawn in Grays Harbor and in the Chehalis River below Montesano. Green sturgeon are thought to be far less abundant than white sturgeon (Hiss and Knudsen 1993).

2.3.1.6.2 Run Timing

No data could be located pertaining to the run timing of either green or white sturgeon in the Chehalis River basin.

2.3.1.6.3 Available Habitat and Limiting Factors

Information regarding the amount of habitat available for sturgeon use in the Chehalis River could not be located.

2.3.1.6.4 Annual Harvest

Historical harvest records for sturgeon show a peak in commercial harvest in 1964, before a change in fishing regulations limited harvest rates. The data presented in Figure 13 is not species-specific and represents commercial harvest of both green and white sturgeon in thousands of pounds. No species-specific harvest data could be located.

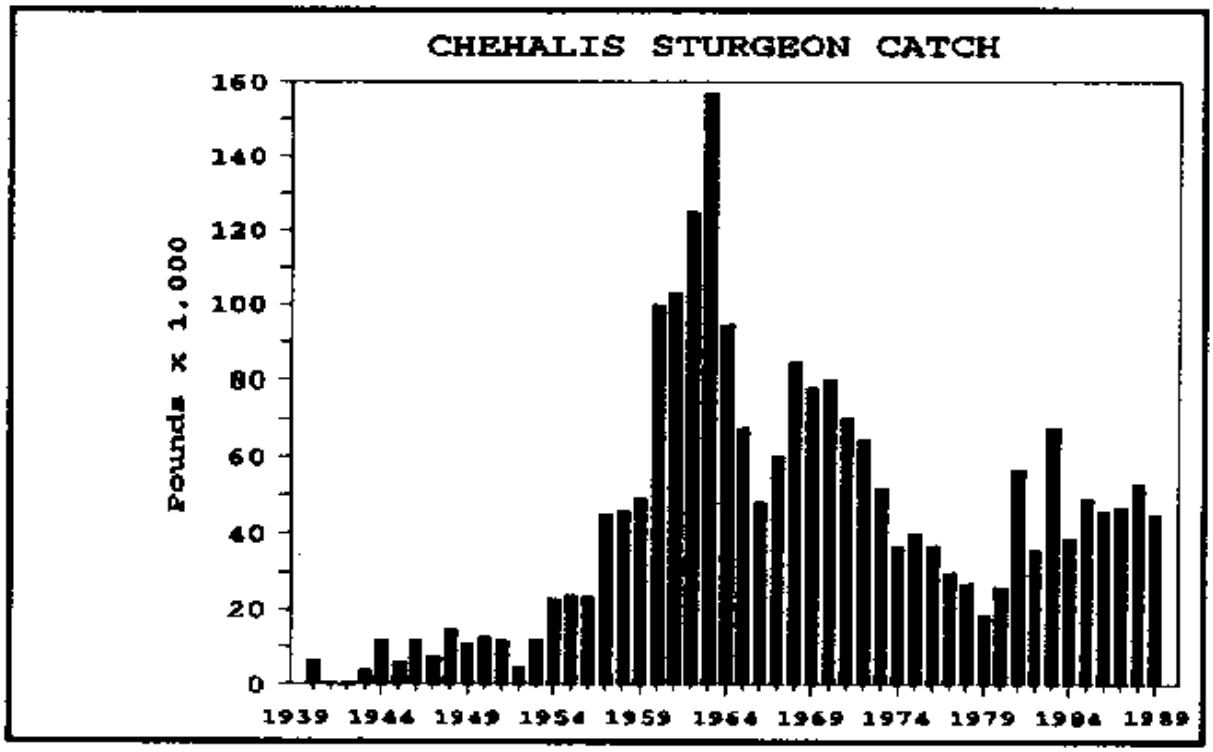


Figure 13
Chehalis Basin White and Green Sturgeon Commercial Landings (from Hiss and Knudsen 1993)

2.3.2 Resident Fish Stocks

A large number of resident fish inhabit the Chehalis River. Quinn (2005) states that 34 resident fish species inhabit the Chehalis River; the species are not separated based on anadromous or resident form, nor are they discussed in detail. No further information on resident fish in the Chehalis River could be located.

2.3.3 Anadromous Use in the Upper Chehalis River Basin

EESC conducted a preliminary assessment of upper extent of use by anadromous salmonids in the Chehalis River Basin. Additionally, the approximate number of miles currently being

utilized by anadromous salmonids, (at any life stage) that are above the location of the proposed projects was calculated. EESC used the WDFW program SalmonScape© for most of the analysis. SalmonScape© is a database that stores data collected in Washington State related to salmonid distribution, spawning, rearing, blockages, etc. Based on this initial analysis, anadramous salmonids do use the areas above the potential retention sites; potential mitigation and/or passage measures may have to be identified.

2.3.3.1 Upper Extent of Use

Table 18 details the upper limits of use for anadromous salmonids known to utilize the Chehalis River Basin. River miles are approximate and were calculated using USGS topographic maps and WDFW's SalmonScape© program. The upper extent of habitat utilized by anadromous fish is only described for species and specific runs that utilize the Chehalis River Basin upstream of tidal influence (e.g., the town of Porter).

Table 18
Chehalis River Upper Limit Status

	Approximate River Mile (RM)*	
Species	**Mainstem Chehalis**	**South Fork Chehalis**
Spring Chinook	East Fork (122)** West Fork (3.5)	15.3
Fall Chinook	118	15.3
Coho	East Fork (126.5)** West Fork (4.5)	26.7
Winter Steelhead	East Fork (126.5)** West Fork (4.0)	27.3
Fall Chum	47	-
*If above Porter (Tidal Influence)		
**E. Fork RM was made extension of mainstem		

Source: SalmonScape 2009

2.3.3.2 Anadromous Salmonid Use Above Proposed Projects

Tables 19 and 20 describe the approximate number of miles of habitat currently known to be utilized (at some life stage) by anadromous salmonids above the location of the proposed projects on the mainstem Chehalis and South Fork Chehalis rivers. River miles are approximate and were calculated using USGS topographic maps and WDFW's SalmonScape© program.

Table 19
Current Chehalis River Habitat Use by Anadromous Salmonids Upstream of Proposed Flood Retention Projects

Species	Creek	Approx. Miles Utilized Above Site (RM)
Spring Chinook	Mainstem (E. Fork & W. Fork)	17.1
	Total	**17.1**
Fall Chinook	Mainstem	9.6
	Total	**9.6**
Coho	Mainstem	11.18
	Lester Cr.	1.23
	Crim Cr.	3.5
	Hull Cr.	0.25
	Browns Cr.	0.45
	Big Cr.	1.95
	Trib to Big Cr.	0.24
	Roger Cr.	1.19
	Big Roger Cr.	1.2
	Alder Cr.	1.14
	Thrash Cr.	2.86
	Mack Cr.	0.26
	West Fork Chehalis	4.76
	Sage Cr.	0.82
	East Fork Chehalis	8.28
	George Cr.	1.97
	Other E. Fork Tribs	0.9
	Total	**42.18**
Winter Steelhead	Mainstem	11.26
	Lester Cr.	0.71
	Crim Cr.	7.48
	Big Cr.	1.94
	Alder Cr.	1.12
	Thrash Cr.	1.45
	Tributary to Thrash Cr.	0.44
	Mack Cr.	0.26
	West Fork Chehalis	4.03
	Sage Cr.	0.81
	East Fork Chehalis	7.6
	George Cr.	0.48
	East Fork Tributary	1.97
	Total	**39.55**

Table 20
South Fork Chehalis River Habitat Use Upstream of Proposed Project

Species	Creek	Approx. Miles Utilized Above Site (RM)
Coho	S. Fork Chehalis	8.14
	Trout Cr.	2.03
	Hanlan Cr.	2.49
	Total	**12.66**
Winter Steelhead	S. Fork Chehalis	9.02
	Trout Cr.	2.03
	Hanlan Cr.	2.58
	Tribs to S. Fork	0.83
	Total	**14.46**

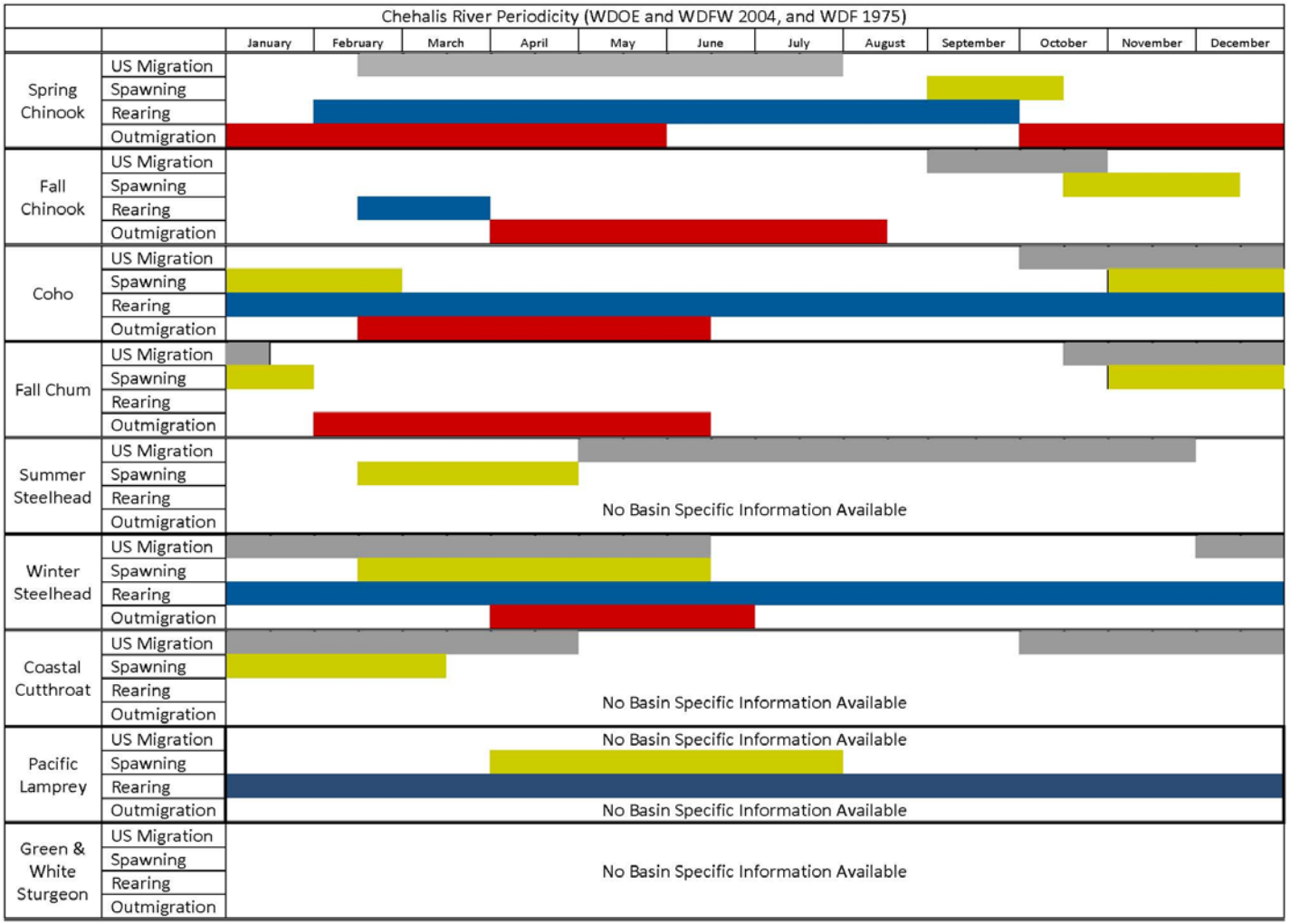
2.3.3.3 Periodicity

EESC has developed a periodicity table (Table 21) from the existing data that have been analyzed related to the Chehalis River. Further documentation and data related to the basin has been requested. If the analysis of these data modify this initial periodicity chart, EESC will make the requisite changes.

This report is focusing initial environmental tasks on scoping of riverine aquatic resources. Additional issues that will be addressed will also include the resources listed below.

- Wildlife
- Plants
- Threatened, Endangered, Sensitive Species
- Geology and Soils

Table 21
Chehalis River Periodicity Table (WDOE and WDFW 2004, WDF 1975)



3.0 DATA GAPS

Additional information is still needed in several areas in order to adequately evaluate the potential effects of the proposed water retention Project on the Chehalis River and South Fork Chehalis. The following sections describe the areas where information is still missing.

3.1 Water Quality

Historical stream temperature data do exist, but were not collected in all of the most useful locations to support relevant water temperature modeling. Monthly temperature measurements are not useful for modeling purposes because temperature varies widely throughout a day and throughout the seasons. Existing continuous temperature monitoring is very limited in the areas of these potential projects. Existing data may therefore not lend itself to rigorous analysis or to calibration and reliable performance of a water temperature model.

Existing data related to dissolved oxygen (DO) levels are limited to sampling on a monthly basis. DO, however, changes substantially at a much more frequent interval due to variations in temperature and flow. Continuous monitoring of DO at selected locations would be much more useful in assessing potential Project effects.

Due to the highly variable nature of stream sediment transport, increased sedimentation in streams is often extremely difficult to detect through in-stream measurements. In such cases, indirect assessment methods can be utilized to identify natural and anthropogenic sources of stream sediment. Surveys of landslides and road erosion could help quantify sediment delivery to streams.

3.2 Water Quantity

Even though stream gages exist on the mainstem Chehalis River near Doty and the South Fork Chehalis River, the watershed area of the proposed water retention structures are significantly different than that of the existing gages. It will be important to gather as much data from near the location of the retention dams so the site specific hydrology can be calculated as accurately as possible.

Although inflow to the mainstem Chehalis River from many of the major tributaries is documented by USGS records, additional analysis will be required to compute inflow as a percent of the mainstem flow for most months of the year. This hydrologic information will be required for analysis of water quality data and fish habitat data for much of the river downstream of the proposed retention structures.

3.3 Fisheries

3.3.1 Fish Distribution, Species Composition and Abundance

The limiting factors report produced for WRIAs 22 and 23, which includes the Chehalis River System (Smith and Wegner 2001) states:

> *One major impediment to assess the fish distribution and habitat conditions in these two WRIAs is the tremendous lack of detailed field information. While the Chehalis drainage is the second largest in Washington State (second to the Columbia River), only eight watershed analyses have been completed, and of those, two are in areas upstream of most anadromous salmonid production. Assessments regarding sedimentation, off-channel habitat, channel conditions (incision, aggradation, etc), water usage, water quality, salmonid escapement estimates, fish habitat use, stream flow, instream habitat components (pools, LWD, etc), riparian conditions, and landcover are some of the major categories where data are lacking.*

Existing information regarding fish distribution, species composition and abundance is only sporadically available by species and location. Additional information, both general and specific, is needed to appropriately address fisheries issues for this water retention project. Data gaps include, but may not be limited to:

- Number of spawners in potential inundation zones
- Specific spawning and incubation timing above and below the proposed retention structures
- Upstream movement of juveniles during periods of low flow or high temperature
- Impacts of predatory fish on native species in the potential inundation zone
- Limiting factors of target fish species.

3.3.2 Instream Flow Studies

WDFW and WDOE conducted four instream flow studies in the Chehalis basin. Three of these studies, however, were conducted on major tributaries to the Chehalis River (Satsop, Black, and Skookumchuck rivers) while one was conducted on the upper Chehalis River at the approximate site of the proposed mainstem impoundment (RM 110.9). No instream flow studies were conducted in the South Fork Chehalis or in the mainstem Chehalis River downstream of the proposed retention structures.

3.3.3 Connectivity

Connectivity can refer to migration routes remaining intact over the length of a river or to lateral connectivity to side channel or off channel areas that may become isolated. Low summer flows can cause passage and connectivity problems in areas where typically the width/depth ratio is high. In streams that experience high-flow events, a channel can become over-widened. If this occurs, summer low flows can compound problems in such streams, as depths become too shallow to allow effective upstream passage. Increasing stream flows to such reaches during the dry period can result in increased stream depths, which can sometimes ameliorate shallow conditions. If low-flow conditions exist, which hamper access and prevent connectivity between adjacent habitats, measuring the change in connectivity associated with potential increases in summer low flows may become a possible mitigation measure.

Connectivity to side channels and off channel rearing may be negatively affected by summer low flow conditions or by a reduction in the magnitude or frequency of higher flow events that connect the river to off channel habitat in the winter. Off channel habitat may function as a

refuge from high velocities in the main channel for rearing fish and may be important habitat to consider during critical times of the year. Currently no information is available regarding connectivity in the areas that would be affected by the water retention structures.

4.0 POTENTIAL ISSUES AND CONCERNS

A number of issues regarding the effects the water retention facilities would have on fish and water quality must be understood in order to evaluate their impacts. State and Federal agencies require specific information in order to meet their obligations under the State Environmental Policy Act (SEPA), and the National Environmental Policy Act (NEPA) to evaluate project effects before permits could be issued. This section describes the issues for which agencies have expressed concern and issues that are routinely addressed on this type of project.

4.1 Water Quality

Water quality in the mainstem Chehalis and South Fork Chehalis rivers would be affected by the potential water retention projects. The following issues and concerns regarding these effects are yet unanswered.

4.1.1 Temperature

The following questions remain with respect to water temperature for these potential projects:

- How much of a cooling effect in the mainstem Chehalis and South Fork Chehalis rivers could result from increased summer flows due to the release of water from the proposed water retention structures?
- How much of an effect (warming or cooling) in the mainstem Chehalis and South Fork Chehalis rivers could result from moderating the peaks of high winter storm events?
- How much warming would occur in the waters impounded on the mainstem upper Chehalis River and on the South Fork Chehalis River?
- Would impounded waters exhibit temperature stratification, and if so, what would be the likely effects on fish habitat in the reservoirs, and downstream water temperatures? How would that vary depending on what layer(s) water is released from?
- Would changes in temperature translate to effects on fish productivity, and if so, what could be potential benefits and impacts on fish populations?

4.1.2 Dissolved Oxygen

Issues relevant to DO include:

- How might DO levels be affected in reservoir waters due to the proposed impoundments on the mainstem upper Chehalis and the South Fork Chehalis rivers?
- Would impounded waters exhibit DO stratification, potentially affecting fish habitat in the reservoirs?
- Would spill from the reservoirs affect DO in the river downstream of the impoundments?
- How would DO be likely to affect fish productivity, and what could be potential benefits and impacts on fish populations?

4.1.3 Sedimentation

Potential questions for the sedimentation analysis may include the following:

- What is the relative sediment contribution of mass wasting to streams in the watershed?
- How much mass wasting is natural versus management related?
- What is the relative sediment contribution of road erosion to streams in the watershed?
- What is the relative sediment contribution of forest harvest and skid trail related erosion to streams in the watershed?
- What is the sediment contribution from the natural background rate of erosion to streams in the watershed?
- What is the sediment contribution from stream bank erosion? How much of this is natural versus anthropogenic?
- What sediments are likely to be trapped in the proposed impoundments and what sediments are likely to be transported downstream of the proposed impoundments?
- How would the change in sediment contribution and transport potentially benefit and impact fish populations?
- Would changes in instream sedimentation result in any changes to stream geomorphology downstream, such as incisement or bank cutting?

4.2 Water Quantity

Concerns about water quantity will be of major importance to analyzing other impacts related to fisheries, water quality, sediment transport, and habitat connectivity. Potential changes in stream flow, both seasonally and daily, will be a major issue to consider. Project effects on peak flows, bankfull flows, and low flows will be of particular interest to all parties. Water quantity questions include:

- How much will peak flood flows be reduced at all downstream locations?
- How much will summer flows increase at downstream locations with release of water from the retention structures?
- How will different scenarios for water retention and release benefit and impact water quality and habitat downstream of the retention structures?

4.3 Fisheries

4.3.1 Fish Species Composition and Abundance

Consultation with the Work Group will be required to determine the desired approach to gathering the information that is still required to address project-related impacts on fish. Relevant questions include:

- Which areas within the mainstem Chehalis River and the South Fork are important for fish production?

- What species should be the focus of the investigations?
- How should the effects of incremental increases in streamflow on fish populations be evaluated?

4.3.2 Fish Habitat – Instream Flow

Several potential questions related to fish habitat should be addressed:

- How much summer rearing and spawning habitat for priority species (e.g., Chinook and coho salmon and steelhead trout) would be gained in the mainstem Chehalis and South Fork Chehalis rivers as a result of increased summer flows released from the proposed projects?
- How much would winter rearing and spawning habitat be changed in the mainstem Chehalis and South Fork Chehalis rivers as a result of removing the peaks from high winter storm events?
- How much rearing and spawning habitat currently available would be lost due to the proposed impoundment structures on the mainstem upper Chehalis River and the South Fork Chehalis River?

4.3.3 Connectivity

Questions regarding connectivity include:

- Currently, are there many locations in the Chehalis River where migration is hampered by low flow conditions or high water temperatures?
- Would additional flow released from the water retention structures during the low-flow period improve connectivity?
- How is connectivity to side channel and off channel habitat affected by flow both in summer and winter?

4.3.4 Inundation Zone

Questions regarding the inundation zone may include:

- How much spawning and rearing habitat (per species) could potentially be impacted by the reservoirs behind retention structures in the river and tributaries upstream of the structures?
- What are the relative fish composition, abundance and use of the habitat in the inundation areas compared to other areas of the river?
- Will the inundation zone allow fish access to habitats where barriers currently exist?
- What additional habitat is created for the fish species with access to the reservoir?
- What additional habitat is created for the fish species with access to the reservoir?

4.3.5 Ramping

Operation and scheduling of flow releases from the proposed retention structures could have a variety of impacts (both negative and positive) on fish and fish habitat downstream of the structures. Potential impacts could include:

- Increased flows to keep redds watered
- Increased flows to mitigate the effects of freezing temperatures
- Stranding or dewatering of salmon or steelhead redds
- Stranding of rearing fish during downramping

5.0 PROPOSED DRAFT STUDIES

The following studies are proposed to gather the missing data described in Section 3.0 and to address the important issues described in Section 4.0.

5.1 Water Quality Studies

5.1.1 Temperature

In order to answer questions regarding water temperature, a well-documented and accepted water temperature model, such as CE-QUAL-W2, would be employed to model temperatures both with and without the proposed structures. The proposed reservoirs and the Chehalis and South Fork Chehalis rivers below the impoundments would be divided into river reaches for modeling purposes. Agencies would be consulted regarding potentially critical temperature issues or specific locations of concern. The following tasks would be involved in conducting the water temperature studies:

- Agency consultation and agreement on river reaches and locations of interest.
- Existing temperature data will be utilized to the extent possible, but continuous recording temperature sensors may be deployed to monitor temperatures at major tributaries and between significant modeling reaches.
- Physical parameters for each modeling reach will be estimated from maps and GIS data, supplemented with any field data available.
- The model would be calibrated with temperature data collected in the field.
- The model would be run with new reach parameters based on expected project characteristics and representative project operational parameters.
- Comparison of water temperatures at selected locations of interest with and without the structures.

5.1.2 Dissolved Oxygen

Water quality modeling using CE-QUAL-W2 would answer questions regarding dissolved oxygen (DO). Agencies would be consulted regarding potentially critical issues or specific locations of concern. Strategic locations would be selected for continuous monitoring of DO. If monitoring data so indicates, water quality modeling could then be pursued for the proposed reservoirs and the Chehalis and South Fork Chehalis rivers below the proposed retention structures. The following tasks would be involved in conducting the dissolved oxygen studies:

- Agency consultation and agreement on river reaches and locations of interest.
- Continuous recording sensors may be employed to collect DO at major tributaries and between significant modeling reaches.
- Physical parameters for each modeling reach will be estimated from maps and GIS data, supplemented with any field data available.
- Model will be calibrated with water quality data collected in the field.

- Model run with new reach parameters based on expected project extent and representative project operational parameters.
- Comparison of water quality parameters at selected locations of interest with and without the project.

5.2 Water Quantity Analysis

Preliminary analysis of the long-term Chehalis River gage records and major tributaries indicates that significant inflow occurs throughout the basin. It will be important to quantify this inflow in several segments of the river in order to fully establish the fisheries and water quality impacts of project operation. Much of the analysis can be completed with the existing data. Additional year-round data will need to be collected at critical sites, particularly the Upper Chehalis and South Fork Chehalis River water retention sites. Specific tasks relevant to water quantity include:

- Task 1: Document water quantity data needs for Instream Flow and Water Quality studies
- Task 2: Permit, install and monitor new stream gages as necessary for the studies and project
- Task 3: Integrate existing hydrology for specific IFIM and Water Quality sites

5.3 Fisheries

EESC has conducted an initial scoping meeting with the natural resource agencies, Chehalis Tribe, and other non-governmental organizations. EESC has reviewed publicly accessible data and those data provided by the agencies to EESC related to the Chehalis River Basin. We have requested further documentation from state and federal agencies that indicated after the initial kickoff meeting that they have additional relevant data.

The studies listed below are those requested at the Work Group kickoff meeting. EESC compiled the list from the agency, tribal, and NGO requests. Complete study plans for individual studies cannot be specifically developed until further data are available, site-specific assessments occur, and the agencies, tribes, and NGOs have reviewed draft study plans and agreed upon protocols. What follows is a list of the potential studies along with the major tasks for each proposed study.

Fisheries Study 1—Fish Species Composition and Abundance Study

- Review existing data
- Asses the amount of utilization by both anadromous and resident species above the potential projects
- Determine the extent and concentration of spawning and rearing by native species
- Assess the amount of utilization by both anadromous and resident species below the projects

Fisheries Study 2—Comprehensive Rearing Analysis

- Review existing data and conduct field studies as necessary
- Determine the extent of upstream movement by juveniles past proposed project locations

- Assess the extent of tributary use by rearing juveniles in areas above proposed projects
- Assess the extent of use of the river below the project for juvenile rearing

Fisheries Study 3—Impacts of Predatory Species on Natives and Analysis of Habitat Gain/Loss of Predators in Potential Reservoirs

- Comprehensive literature review of predators present in the Chehalis including density and range
- Field verification of predator presence
- Integrate predator species into instream flow study to determine current habitat availability and potential amount gained or lost as a result of the projects

Fisheries Study 4—Post-Project Effects to Green Sturgeon (ESA-Listed Species)

- Comprehensive literature review of current Chehalis River utilization by green sturgeon
- Integrate green sturgeon into instream flow study to determine current rearing habitat availability and potential amount gained or lost as a result of the projects

Fisheries Study 5—Barrier Analysis

- Review existing data related to fish barriers on the mainstem and South Fork Chehalis
- Field verification of potential barriers
- Analysis of areas of concern upstream of potential projects

5.4 Instream Flow Study

- Habitat Assessments: Habitat gain/loss on mainstem Chehalis River (above the tidal area) and the South Fork Chehalis rivers (Year 1). Studies to quantify accessible habitat above proposed retention structures in the mainstem and accessible tributaries (Year 2).

- Study Reach segmentation: Instream flow study reaches will primarily be segmented based on differences in hydrology, habitat type and fish use. Existing data would indicate approximately 7 study reaches may be necessary between the proposed retention structures and Porter based on documented increases in flow of 15% to 40% from tributaries. Although critical areas of fish use have not been identified and detailed habitat surveys and have not been completed, it is likely that many of the important characteristics identified by fish use and habitat type criteria will be incorporated in the river reaches segmented with hydrology criteria.

- Habitat Surveys: Habitat surveys will be conducted within project affected areas to determine relative abundance of major habitat types. This information will be used to determine appropriate transect weighting and is critical to generate accurate results from the instream flow study.

- Critical Habitat Evaluation: Specific areas within the Chehalis basin may be viewed as critical to spawning or rearing success of one or more fish species. Critical habitat will be

identified during the fisheries investigations and, if warranted, additional study reaches or transects may be evaluated to determine impacts to critical habitat.

- Species and Life Stages: Instream flow results will include impacts to all life stages for Chinook, coho, and chum salmon, steelhead trout, lamprey (ocean and fresh water life histories), and rainbow and coastal cutthroat trout (resident life histories).

- Comparison of habitat values: Pre-project (existing) will be compared to potential post-project (proposed) flow conditions.

5.5 Connectivity Study

The connectivity study would evaluate how the change in flow regime would affect connectivity of habitats:

- Between mainstem and major tributaries (with an emphasis on Black and Skookumchuck rivers)
- Between mainstem and important side channels
- Between upstream and downstream of critical adult migration reaches

5.6 River Process/Sediment Transport Study

- Analysis of pre- and post-project Large Woody Debris (LWD) transport
- Quantify pre-and post-project gravel transport
- Analysis of pre and post project erosion and sedimentation quantities and areas

6.0 NEXT STEPS

The following steps will need to be completed to successfully move the evaluation process forward and initiate the necessary studies.

- Consult with resource agencies and the public
- Present scoping of potential aquatic concerns to focus the important issues
- Prepare initial study plans for aquatic field studies to gather environmental information
- Prepare a schedule for conducting environmental studies

Environmental studies to address the potential impacts for the retention structures are complex and will require detailed methods in the study protocols, site visits to select specific study areas and transects, and scheduling of multiple studies to gather information at appropriate times and flow levels. Given the level of detail necessary in the study plans, the number of issues of concern to the resource agencies, the need for consultation and agreement by the agency representatives, and the length of affected river downstream of the proposed retention structures, completing study plans is a relatively complex and costly task.

Until the study plans have been completed and reviewed by agency representatives, it will not be possible to determine an accurate cost to complete the environmental studies nor a final schedule to implement the study plans. Protocols for certain studies will likely dictate that the field work should be started in early Spring and continue into the Fall. Other studies are best conducted during the summer low-flow period and yet other studies will be conducted based on the specific life history of different aquatic species. Given the constraints listed above it is important to complete the development of study plans in a timely manner if the actual environmental studies will be undertaken in 2010.

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