# SECTION 3: SELECTED SUBBASIN ASSESSMENT

## *3.1 INTRODUCTION*

### 3.1.1 SUBBASIN SELECTION RATIONALE

For five of the 30 subbasins, more detailed analyses of hydrology, water rights and water use, and fish habitat were undertaken. The five subbasins were chosen to represent the diversity of conditions in the Chehalis Basin in terms of basin size, historic and current land use, geography, climate, potential use of water resources, and geology (Table 3.1-1). Not all combinations of these factors could be realized with a choice of only five subbasins. Instead, selection was intended to maximize the diversity across the range of conditions present in the Chehalis watershed. All of the selected subbasins contain anadromous and resident salmonids, and four of the five have been extensively surveyed for fish habitat conditions and problems (Wampler, et. al. 1993). In addition to the diversity in subbasin characteristics, the amount and type of available information varied among these subbasins. Therefore, their selection also provided an example of variation in analytical methods and results.

The driving factors for selection of the 5 subbasins and desire to do more detailed analysis were water quantity related issues; hydrology and water rights/use. There was little that could be done in terms of more detailed water quality analysis. For those of the selected subbasins where median flows were available, pollutant yields were calculated. Otherwise the analysis was limited by available data. Detailed information for each of the subbasins is provided in Appendix C. Rather than repeating it in this section, summaries of the water quality analysis are provided to enhance comparisons.

The subbasins selected were:

- Chehalis River headwaters (#1),
- Lower Newaukum River (#7),
- Cloquallum Creek (#14),
- Mainstem Chehalis- Lower Reach-1 (#19), and
- Humptulips River (#25).

**Table 3.1-1**
**Attributes of 5 selected subbasins**

| Subbasin | Basin Size ($mi^2$) | Geography | Precip.[1] and UR[2] | Geology |
|---|---|---|---|---|
| Chehalis headwaters (#1) | 116 | Headwaters, mid-elevation | 89" (5) | Willipa Hills geologic zone |
| Newaukum (#5, 6, 7) | 156 | Cascade foothills | 52" (3-5) | glacial outwash-lower; volcanic-upper |
| Cloquallum Creek (#14) | 70.3 | low elevation; potential for aquifer to be close to surface | 68" (4) | glacial till-headwaters; glacial & alluvial-lower |
| Lower Mainstem Chehalis (#19) | 94 | Lowland valley floor | 59" (3-4) | alluvial valley floor, some glacial material; side slopes sedimentary rock |
| Humptulips (#25)[3] | 244.3 | Olympic Mountains, coastal & relatively wet | 127" (10) | volcanic-headwaters, Olympic mountain geology; alluvial & glacial drift-lower; |

[1]Source: Washington State Department of Natural Resources Mean Annual Precipitation GIS Layer (WDNR,1991)
[2]UR = Annual Mean unit runoff in $cfs/mi^2$ are shown in parenthesis.
[3]Splash dams and gravel mining were important past activities in the Humptulips.

**Table 3.1-2**
**Land use/ land cover area (acres) of 5 selected subbasins**

| Subbasin | Commercial | Agricultural | Forestry | Residential /urban | Other | Total |
|---|---|---|---|---|---|---|
| Chehalis headwaters (#1) | 62 | 2,268 | 71,055 | 474 | 128 | 73,988 |
| Newaukum (#5, 6, 7) | 113 | 17,217 | 80,228 | 1,023 | 1,141 | 99,722 |
| Cloquallum Creek (#14) | 135 | 1,480 | 41,435 | 913 | 1049 | 45,012 |
| Lower Reach 1 Chehalis (#19) | 197 | 2,979 | 47,770 | 1,892 | 554 | 60,365 |
| Humptulips (#25) | 30 | 2,146 | 153,107 | 725 | 375 | 156,383 |

Source: Washington State Department of Natural Resources (WDNR), 1990

# *3.2 SUBBASIN 1: CHEHALIS HEADWATERS*

## 3.2.1 GENERAL DESCRIPTION

The Upper Chehalis River (Subbasin #1) covers 116 $mi^2$ from the headwaters of the Chehalis to the confluence with Elk Creek near Doty, WA. The elevation ranges from 293 feet at the Elk Creek confluence to 3,134 feet in the Willapa Hills; mean basin elevation is 1,280 feet. The mean annual precipitation is about 89 inches (WDNR, 1991). Mean annual discharge measured at the USGS streamflow gage #12-020000, Chehalis near Doty, was 573 cfs. This translated into a unit runoff of approximately 5 $cfs/mi^2$; winter unit runoff averaged 11 $cfs/mi^2$, while summer

unit runoff was less than 1 cfs/mi$^2$. The primary land use for this subbasin is forestry with some agricultural and residential land uses along the river valley (Figure 3.2-1) (WDNR, 1990).

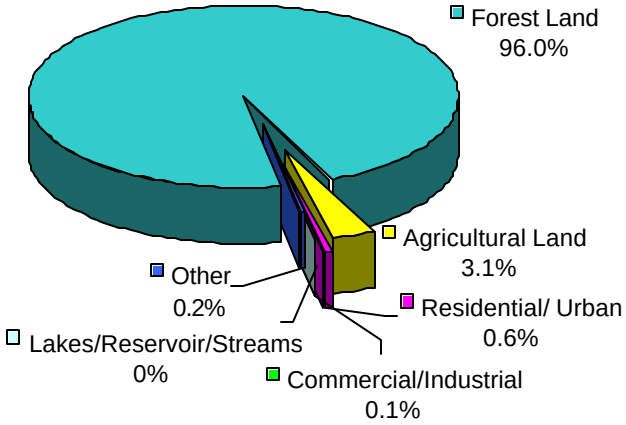


**Figure 3.2-1 Subbasin #1**
**Chehalis River Headwaters Land Use/Land Cover Summary**
Source: WDNR, 1990.

## 3.2.2 GEOLOGY AND HYDROLOGY

### Geology

The upper three-quarters of the basin is underlain by Eocene epoch basalt (Crescent formation) and tuff (consolidated pyroclastic rocks). A small area of Eocene epoch marine sedimentary rocks of the McIntosh formation is located in the southwest corner of the subbasin. The lower one-quarter of the basin is underlain by younger Eocene epoch marine sedimentary rocks (Lincoln Creek formation) with recent alluvial material in the valley floor.

### Ground Water Hydrology

Groundwater conditions in the area underlain by bedrock are not well studied, but minimal amounts of groundwater likely exist at depth in fractures in the rock. A shallow aquifer is likely present in the alluvial material in the valley floor.

### Surface Water Hydrology

The USGS has collected mean daily discharge near the mouth of Subbasin #1 at the Chehalis River near Doty (station #12-020000) from 1939 to the present. Prior to using these streamflow records to generate summary statistics, two factors were investigated: 1) climate variability over the period of record, and 2) the extent of upstream regulation and withdrawal of water.

The period of record used for this analysis was 1939-98 since post-1998 data are still regarded as provisional. The 1939-98 period included 29 years above the long-term annual average and 31 years below normal, based on a trend analysis of the longer record of streamflow at the Satsop River near Satsop (1929-98) gage. In addition, the 1939-1998 period included almost equal

years within each type of Pacific Decadal Oscillation phase (warm/dry, cool/wet). Therefore, the available streamflow data reflected the natural climate variability experienced in this region.

With regard to regulation and diversions/withdrawals of water, both the USGS's station remarks and Washington Department of Ecology's (WDOE) baseflow report (Sinclair and Pitz, 1999) stated that no regulations or diversions occur upstream of the gage. While it was likely that some withdrawals occur in the basin, the extent was deemed minor. The USFWS observed 7 water withdrawal pumps in Subbasin #1 during their 1992 habitat inventory (Wampler et.al, 1993); these pumps were located upstream and downstream of the Town of Pe Ell and along Rock Creek between the towns of Walville and McCormick. In addition, the WDOE GIS layer of dams statewide was reviewed and no dams were noted in Subbasin #1.

Since land use was predominantly forestry with no significant trend toward urbanization, and only minor diversions were occurring in Subbasin #1, the flow records, without adjustments, were determined to be representative of "undepleted flows". Monthly flow exceedance values were generated based on the actual time series of mean daily streamflow at station #12-020000; the 50% and 90% exceedance values are listed in Table 3.2-1, along with WDOE base/instream flows for the Chehalis River near Doty control point, coincident with the gage location.

**Table 3.2-1. Subbasin #1: Chehalis River Headwaters**
**Flow Exceedance Values**

| Month | Flow Exceedance Values[1] Chehalis River near Doty, 12-020000 | | | | WDOE 1975 Base/Instream flow[2] | |
|---|---|---|---|---|---|---|
| | 50% Exceedance (cfs) | 50% URO[3] cfs/mi$^2$ | 90% Exceedance (cfs) | 90% URO[3] cfs/mi$^2$ | 1st-14th (cfs) | 15th- month end (cfs) |
| October | 117 | 1.04 | 29 | 0.26 | 39 | 49 |
| November | 530 | 4.69 | 123 | 1.09 | 88 | 150 |
| December | 808 | 7.15 | 292 | 2.58 | 260 | 260 |
| January | 768 | 6.80 | 259 | 2.29 | 260 | 260 |
| February | 760 | 6.73 | 309 | 2.73 | 260 | 260 |
| March | 613 | 5.42 | 272 | 2.41 | 260 | 260 |
| April | 421 | 3.73 | 219 | 1.94 | 260 | 260 |
| May | 212 | 1.88 | 122 | 1.08 | 195 | 146 |
| June | 113 | 1.00 | 69 | 0.61 | 108 | 82 |
| July | 60 | 0.53 | 37 | 0.33 | 62 | 46 |
| August | 38 | 0.34 | 26 | 0.23 | 37 | 31 |
| September | 40 | 0.35 | 24 | 0.21 | 31 | 31 |

[1] Based on daily data from USGS Chehalis R near Doty station 12-020000; 1939-98; drainage area 113 mi$^2$
[2] WAC 173-522-020
[3] URO = unit runoff

## 3.2.3 WATER RIGHTS & WATER USE

Initially, a total of 48 water rights were tabulated in this subbasin; 47 surface water rights, of which two were permits and two were applications. The remaining right was a ground water certificate. The instantaneous amount of water allocated totals 12.47 cfs, with the two largest water rights designated for hydropower and municipal use. The hydropower right was the most senior right listed in the subbasin with a priority date of January 21, 1931.

Of the total allocated amount, 36% was designated for non-consumptive beneficial uses, such as hydropower and fish and wildlife propagation. Irrigation rights represented nearly 44% of the consumptive rights (28% of the total allocation) totaling 3.48 cfs. The associated annual volume limit of 223 acre-feet for irrigation was tabulated, however not all irrigation rights had volume limit entries in the Water Rights Allocation Tracking System (WRATS) database. Of the 375 acres classified for irrigation, 229.5 acres had no associated volume limit (61% of the total acres).

The most junior certificate in this subbasin held a priority date of April 6, 1982; two applications and one permit were junior to this right. The certificates senior to the 1975 base/instream flow represented 12.41 cfs.

The number of registered claims totaled 103; 67 were ground water claims and 35 were surface water claims. One claim was for both surface and ground water abstractions. The majority of these were primarily designated for general domestic use; eight claims have been filed for irrigation rights totaling 158 acres. Many of the claims also listed stock and irrigation as secondary and tertiary beneficial uses.

**Table 3.2-2. Subbasin #1: Chehalis River Headwaters**
**Initial Water Rights Summary by Primary Purpose[1]**

| Primary Purpose (# rights) | Allocated Amount (cfs) | Volume Limit (acre-feet) | Irrigated Acres |
|---|---|---|---|
| Consumptive Uses | | | |
| Commercial/Industrial (1) | 0.04 | 7.7 | 0 |
| Domestic Use (8) | 0.14 | 13.7 | 0 |
| Irrigation (24) | 3.48 | 194.4 | 330 |
| Municipal (4) | 3.84[2] | 412 | 0 |
| Stock (7) | 0.44 | 55.5 | 40 |
| **Subtotal** | **7.94** | **683.3** | **370** |
| Non-Consumptive Uses | | | |
| Hydropower (2) | 4.01 | 1 | 0 |
| Fish & Wildlife Propagation (2) | 0.52 | 0 | 0 |
| **Subtotal** | **4.53** | **1** | **0** |
| **TOTAL** | **12.47** | **272.3** | **370** |

(Includes Certificates, Permits, and Applications)
[1]Envirovision and Watershed Professionals Network assume no responsibility for the accuracy of the data provided by the Washington State Department of Ecology.
[2]Town of PeEll Water System Plan indicated that 0.5 cfs for one of the municipal rights will be certificated when 2 rights for 1.34 cfs are relinquished, resulting 2.5 cfs for Town of PeEll.

## Residential and Municipal Water Use

The Washington State Department of Health (WDOH) public water system data was obtained in September 1999. Two public water systems were identified in Subbasin #1 from this database; the Town of Pe Ell and a church. WDOH (1999) information for the Town of Pe Ell indicated there were 360 connections serving 600 people and 17 commercial customers.

The Town of Pe Ell held all the municipal water rights in this subbasin (totaling 3.84 cfs). According to the Water System Plan for the Town of Pe Ell (Summers, 1997), the total 1996 water demand, including losses, was 255,100 gallons per day (~0.4 cfs). The water demand for the 22 commercial connections within the municipality was roughly 0.01 cfs, and for the residential customers, the demand was 0.10 cfs. Water losses accounted for 73% of the withdrawals (27% efficiency), or 187,158 gallons per day (0.29 cfs). Future water conservation measures were anticipated to increase the system efficiency to 80% (reduce the water losses to 20% of the total demand), a more reasonable system efficiency than that experienced in 1996.

The investigation into the 3.84 cfs in municipal rights revealed interesting detail. One of the rights that Pe Ell held was a permit for 0.5 cfs that was issued on July 2, 1991. This permit gave the Town of Pe Ell the right to divert Chehalis River water (priority date - 1934) with the condition that two supplemental rights on Crim and Mahaffey Creeks totaling 1.34 cfs be relinquished, since the intakes were never constructed. The WRATS database did not reflect the potential relinquishment of these rights. In essence, the effective municipal rights totaled 2.5 cfs with seasonal restrictions. Under the remaining right for 2 cfs, diversion of water was restricted from May through October. Thus, the new 0.5 cfs right constituted the sole legal entitlement to

divert water in the dry season of the year. The 0.5 cfs amount, while less than the relinquished 1.34 cfs, was still higher than the average current withdrawal of 0.4 cfs. Anticipating increased system efficiencies, future withdrawals were projected to be 0.15 cfs by the year 2003.

The census data indicated the population of this subbasin was approximately 1,316 people in 1990. Using the Lewis County 17% average projected increase in growth from 1990 to the year 2000, the current population was estimated at 1,540. Subtracting those served by the Town of Pe Ell resulted in a total of 940 self-supplied water users. According to the WRATS database, there were eight rights designated for single domestic use and three rights listed as multiple domestic use, although the latter were not listed as the primary beneficial use. In this subbasin, WDOE assigned a rate of 0.01 cfs or 0.02 cfs, and a volume limit typically of 0.5 to 1 acre foot to a single domestic water right. The multiple domestic rights had a combined rate of 0.06 cfs, a portion of which was allocated for irrigation and/or stock watering. For purposes of this analysis, the total amount was assumed to be for domestic use. To estimate the number of households potentially served by these three rights, the rate of 0.02 cfs per household was used as recommended by WDOE (Fisher, C. Pers. Comm.). The multiple rights were assumed to serve roughly 3 homes. For the 8 single domestic rights, one water right was assumed to provide a supply to one household. Adding these to the 3 homes under the multiple domestic rights, resulted in 11 households, or 29 people (assuming 2.6 people/household), withdrawing water under a legal entitlement. The remaining 911 people were either covered under a claim or an exempt well. Using the average of 79 gallons per capita per day (gcd) (as computed for the Town of Pe Ell [Summers, 1997]), an estimated 0.11 cfs of water was used for domestic purposes under either a claim or an exempt well. For comparison, using the WDOH (1999) method for determining the daily water demand per residential unit and the Lewis County data for the number of people per household, the estimated water demand was 118 gcd (assuming most of the population resided in the area in which precipitation was about 75 inches); the 911 people would use an estimated 0.17 cfs for domestic supply.

Based on the WDOH method, the total current population of 1,540 required about 0.28 cfs or about 11% of the allocated water under the municipal and domestic water rights (using the amount of 2.5 cfs for the Town of Pe Ell). In other words, the allocation exceeds the estimated actual water use by 89%.

## Commercial and Industrial Water Use

In addition to the 17 commercial connections identified within the Pe Ell water service area, there was one water right held by Weyerhaeuser for commercial and industrial purposes. This right was for 20 gpm or 7.7 acre feet. Weyerhaeuser was also supplied water from the Town of Pe Ell (Gibbs & Olson, 1997). The remaining 16 connections could be serving all or a portion of the 50 parcels categorized in the Lewis County Assessor's database as retail or service. It is possible that some of the parcels were served by wells with claims or without the benefit of a water right. Exempt wells can use up to 5000 gallons per day for industrial water; however, there is no provision for commercial use of exempt wells listed in the Revised Code of Washington (RCW).

## Irrigation

Irrigation rights represented nearly 44% of the consumptive rights (3.48 cfs), with a volume limit of 250 acre-feet. Under these existing water rights, 370 acres of land can legally be irrigated. The computation of irrigation water requirements involves estimating crop consumptive use, effective precipitation, conveyance losses, and on-farm efficiencies.

At this Level 1 assessment, there were insufficient data to estimate the actual water use for irrigated croplands; the actual number of irrigated acres was unknown. It was possible, however, to examine the crop water requirements for the water righted acreage using regional climatic data and estimating efficiencies. Pasture/turf was used in this analysis since the crop water requirement was higher than most other crops grown in this area resulting in a higher estimate of the water use impact on the streamflows. This approach established an upper bound by assuming all the water-righted acres were currently irrigated.

The estimated average annual precipitation over Subbasin #1 was 89 inches (WDNR, 1991). Most of the irrigated lands likely occur at the lower end of the subbasin where the precipitation is less, on the order of 75 inches. By proximity, Centralia is relatively close to subbasin #1; however, the average annual precipitation at the Centralia climate station was only 46 inches. Since the precipitation in Subbasin #1 was substantially higher than at Centralia, the data from the Aberdeen climate station, mean annual precipitation 83 inches, was used to examine the crop consumptive use for subbasin #1.

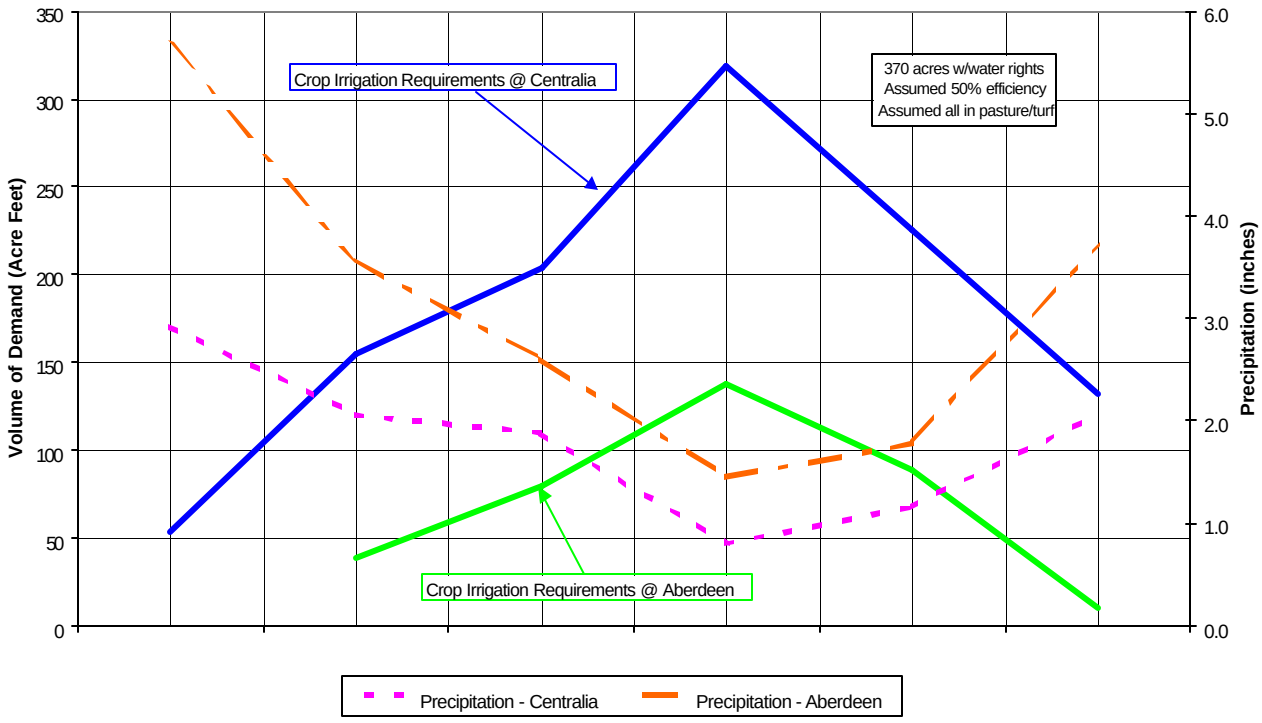


**Figure 3.2-2. Subbasin #1: Chehalis River Headwaters Monthly Irrigation Water Demand For Pasture/ Turf**

Source: WSU Cooperative Extension, *Irrigation Requirements for Washington – Estimates and Methodology*. Education Bulletin #1513

Figure 3.2-2 demonstrates the difference in crop irrigation requirements for the different precipitation amounts at Centralia and Aberdeen, assuming 370 acres pasture/turf irrigated with an efficiency of 50% (Bainbridge, R. Pers. Comm.). Over the irrigation season (from April or May to September), the total volume (area under the curve) of irrigation water demand using the Aberdeen climate data (424 acre feet) was closer to the volume limit (250 acre feet) associated with the irrigation rights than the Centralia climate data (1,088 acre feet). Note, however, that the annual volume limit tallied from the WRATS database did not include a value for all rights and, therefore, does not account for the total volume of irrigation water that has been allocated.

## Comparison of Streamflow and Allocated Water

Figure 3.2-3 compares the flows (50% and 90% exceedance) with the instream flows and the total allocated water for consumptive uses. In addition, the graph includes a line depicting the combined instream flow plus the instantaneous water right allocation (adjusted for the restrictions specified in the new permit issued to the Town of Pe Ell).

The 50% exceedance flow, or median flow, ranged from a low of 38 cfs in August to a high of 808 cfs in December. This means that, in August, 50% of the flows were higher than 38 cfs and the other half of the flows were less than 38 cfs. The 90% exceedance flows were lowest in September and highest in February, i.e. 90% of the flows were 24 cfs or greater and 309 cfs or greater, respectively. The instream flows used on this graph represent the average of the bimonthly base/instream flow values. The monthly average of the instream flows are lowest in August (34 cfs) September (31 cfs) and October (44 cfs).

Examining flows in August,

| | |
|---|---|
| 50% Exceedance Streamflow | = 38 cfs |
| 90% Exceedance Streamflow | = 26 cfs |
| Instream Flow | = 34 cfs |
| Instantaneous Water Right Allocation for all consumptive uses (adjusted for the Town of Pe Ell 1991 permit) | = 6.60 cfs |

While the water right allocation for human uses was a seemingly small amount of water, in most months streamflows were insufficient in this subbasin to supply all the needs for the fisheries resource as well as allow the full allocation of water for human uses. The 6.60 cfs total allocated amounts for consumptive uses includes both surface water and ground water abstractions and represented about 17% and 25% of the August median and 90% exceedance flows, respectively. Comparing the total of the surface and ground water allocated amounts to the streamflow painted the worst-case scenario because 100% hydraulic continuity was assumed. In this basin, however, there was only one ground water right so the totals were not too overstated.

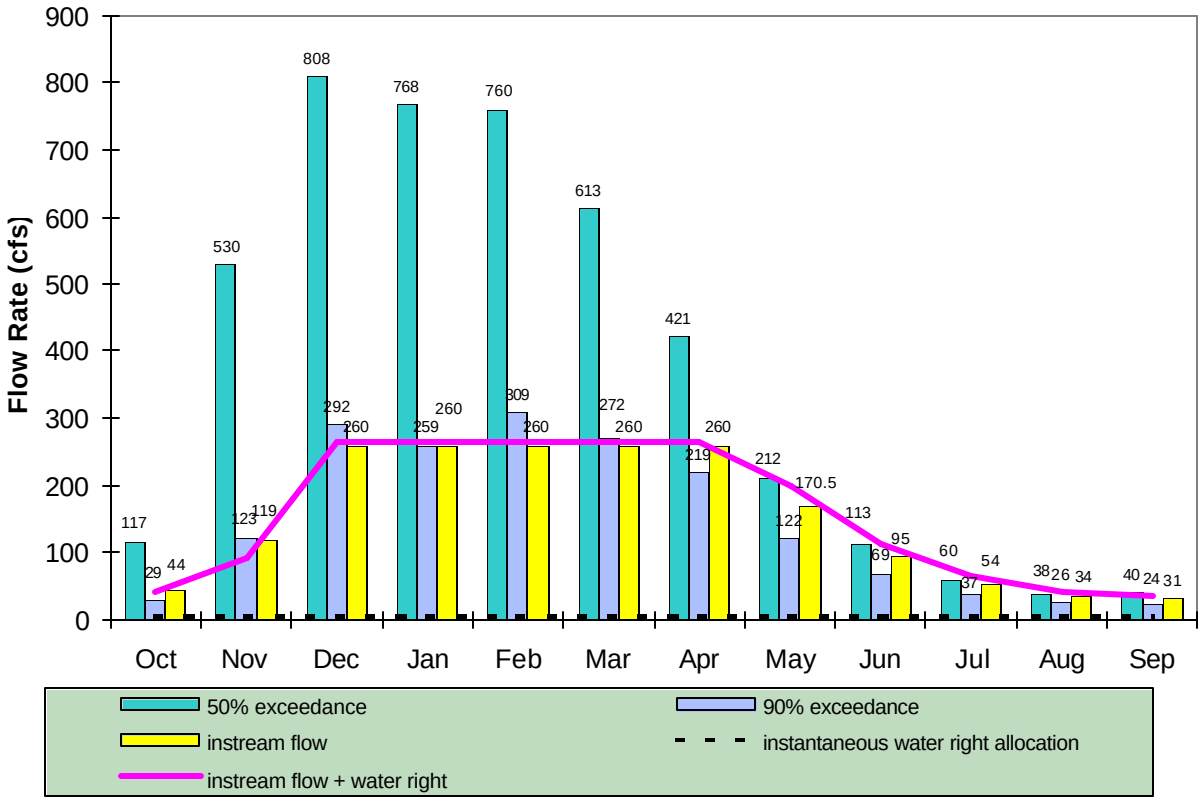


**Figure 3.2-3. Subbasin #1: Chehalis River Headwaters**
**Comparison of Streamflow and Allocated Water**

The flows at the 90% exceedance level were greater than the instream flows in November, December, February, and March. The instream flows were within 10% of the median flows (50% exceedance level) in the months of May, June, July, August, and September. In the absence of any withdrawals of water for human use, the 50% exceedance flows were insufficient to meet instream flow in 5 months of the year.

The consumptive portion of the allocated rights was about 25% to 28% of the two lowest monthly 90% exceedance flows. If half of the water were returned to the system, the effective consumptive portion of these rights would then be 12% to 14% of these same two low flows. (Note: A return flow of 50% is not uncommon for irrigation rights, but would be considered low for domestic/municipal rights which have return flows closer to 70%.) Given that streamflow measurements are usually accurate to within 10% of the true value of the flow, up to 4% could be conserved and "measured" in this subbasin. Due to this, the potential for streamflow enhancement by changing withdrawals/diversion patterns was determined to be limited in this subbasin compared to some of the other subbasins described in later sections.

**Table 3.2-3.**
**Summary Comparison of Water Rights and Water Use for Chehalis Headwaters.**

| Beneficial Use | Estimated Current Water Use (cfs) | Water Rights Allocation (cfs) |
|---|---|---|
| Domestic (water rights) | 0.003 - 0.005 | 0.14 |
| Domestic (exempt wells) | 0.11 - 0.17 | 3.5 [2] |
| Municipal | 0.4 | 2.5 |
| Commercial/Industrial | Unknown | 0.04 |
| Irrigation | ~424 acre feet[1] | 250 acre feet |

[1] Based on 370 legally irrigated acres of pasture/turf

[2]Exempt wells are entitled to withdraw up to 5000 gpd or ~0.01 cfs. There were roughly 350 homes being served by exempt wells or 350*0.01 cfs = 3.5 cfs.

### Summary of Water Allocation for Chehalis Headwaters

- Domestic use, as defined by with water rights, represents 4% of the water rights allocation.
- Municipal water use is 16 % of the water rights allocation.
- Irrigation of the acreage allotment under existing rights may require a higher annual volume than currently allocated. However, not all irrigation rights had annual volumes associated with them.
- Consumptive rights were 25 to 28 % of the lowest median monthly streamflows.
- An estimated 4 % could be conserved on "paper", therefore, the potential for flow enhancement is limited
- This is not a high priority subbasin for further analysis.

## 3.2.4 WATER QUALITY

Since a long-term ambient monitoring station is located in this subbasin, the water quality data record is very good. Although there have been occasional high temperatures measured, water quality is not considered to be in violation of any standards, and there are no 303(d) listings. However, the wet season TSS yield was the highest calculated, and close to three times higher than in other locations on the mainstem. TP and IN yields were near average.

## 3.2.5 FISH HABITAT/CHANNEL MODIFICATIONS/STOCKS

### Fish Habitat

The United States Department of Fish and Wildlife (USFWS) and the Washington State Department of Fish and Wildlife (WDFW) have completed two fish habitat surveys within this subbasin: A total of 28 stream miles were surveyed in *"Upper Chehalis"* subbasin. In this case, the Upper Chehalis included the upper Chehalis mainstem, upstream of the Rogers Creek confluence, the East and West Forks, and Thrash and Cinnabar Creeks. The most important problems identified were: stream canopy and streambank vegetation loss from forest practices (8 points and 13.9 miles) (West Fork, East Fork, and mainstem Chehalis), bank erosion (56 points and 7.8 miles) (Cinnabar Creek, EF Chehalis River), and debris torrent inputs to stream channels

(6 points). Few beaver dams were found at the time of the survey. Three water withdrawals were noted (Wampler et al., 1993).

A total of 42 miles were surveyed in *"Crim-Rock"* subbasin, which included the mainstem Chehalis from Rogers Creek downstream to Rainbow Falls, Crim, Big, Rock, and McCormick Creeks. The most important problems identified were: bank erosion (124 points and 19.6 miles) (lower Chehalis, McCormick Creek, Rock Creek, upper Crim Creek), streamside vegetation loss from agriculture and unknown causes (39 points and 12.1 miles) (lower Chehalis River, lower Rock Creek, lower McCormick Creek, mid-Crim Creek), and streamside canopy reduction from forest practices (7 points and 6.3 miles) (Crim Creek, Big Creek, upper Chehalis River). Beaver dams were noted in upper Rock and McCormick Creeks. A total of ten water withdrawals were noted as well as 3 miscellaneous pollution input sources (Wampler et al., 1993).

A portion of this subbasin was included in the *Chehalis Headwaters Watershed Analysis* (Weyerhaeuser, 1994). The analysis area included 44,920 acres in the Chehalis River headwaters, upstream of the Town of Pe Ell (Weyerhaeuser Co. 1994). Prior to 1930, splash dams were operated on the mainstem Chehalis above Fisk Falls, and below Crim Creek (Wendler and Deschamps, 1955). Between the 1960's and the 1970's, stream-cleaning operations removed Large Woody Debris (LWD) from most of the larger streams in this subbasin, except Cinnabar Creek (Weyerhaeuser Co., 1994).

Habitat concerns identified in the watershed analysis include the potential for warm summer temperatures to create adverse conditions for holding spring chinook in the mainstem Chehalis, as well as the potential for legal and illegal fishing to reduce numbers of adult chinook in the same reach, waiting to spawn. Warm summer temperatures also reduce the quality of summer rearing habitat for juvenile fish. Nearly half of the stream channels (47%) had canopy closures lower than that estimated to protect water temperature, including all of the mainstem Chehalis River, and portions of the East Fork, West Fork, and reaches of Crim, Thrash, and Cinnabar Creeks. The lower mainstem is wide enough to limit the degree to which riparian canopy can contribute to thermal reduction.

Riparian conditions were fairly good over most of the watershed, with mature, dense stands of mixed conifers and hardwoods present over much of the basin. At this time, tree sizes along some of the larger streams are too small to function effectively as LWD, although, long-term prospects are good. There is a general lack of in-channel LWD in this subbasin, which limits refuge habitat, holding pool frequency, and depth. This was identified as a problem in areas used by chinook as well as in areas used by coho and steelhead (Weyerhaeuser Co., 1994).

## Channel Modifications

The subbasin has a long history of commercial timber harvest by both railroad and truck systems. Channel impacts associated with these activities included splash dams operated prior to 1930 on the mainstem Chehalis above Fisk Falls, and below Crim Creek. In addition, stream-cleaning operations during the 1960's and the 1970's removed large woody debris (LWD) from most of the larger streams in this subbasin, except Cinnabar Creek (Weyerhaeuser, 1994).

Since that time, the number of activities directly altering channel form has been reduced. Current activities, which affect channel form, revolve around loss of riparian vegetation and channel armoring. USFWS/WDFW extensive surveys indicate that of 70 miles of channel surveyed, roughly 31 percent of the surveyed reach had a reduction in riparian canopy density associated with logging. Approximately 39 percent of the reach length surveyed exhibited erosion, and 3,800 feet of bank protection/riprap were observed. Approximately 3% of stream channel surveyed showed bank vegetation removal associated with agricultural activities, and an additional 19% of stream channel was reported with bank vegetation removal from unknown causes. Livestock had access to about 6 percent of the surveyed channel length (Wampler et al., 1993).

Approximately 4.7 miles of channel were evaluated on the 1990 orthophotos. Assessment of channel conditions included the urban/agricultural areas along the mainstem from 2 miles above Pe Ell to about 2 miles downstream from Pe Ell. The channel is bound by low hills on the west and level agricultural fields and town on the east. Table 3.2-4 presents the results of assessment of riparian conditions along this section of the river.

**Table 3.2-4**
**Aerial photo evaluation of riparian disturbance for portions of 5 subbasins.**

| Subbasin | Channel distance evaluated (mi) | Riparian area intact (%) | Riparian area altered (%) | Riparian area absent (%) |
|---|---|---|---|---|
| Upper Chehalis-1 | 4.7 | 31 | 66 | 3 |
| South Fork Newaukum-7 | 24.8 | 24 | 50 | 26 |
| Cloquallum-Wildcat Creek-14 | 7 | 17 | 71 | 12 |
| Middle Chehalis River-19 | 13.6 | 9 | 45 | 28 |
| Humptulips River- 25 | 9.9 | 36 | 55 | 9 |

As expected, riparian conditions on the right or east bank have been more severely affected by land use activities. In the area photo evaluated, 98 percent of the right bank possessed an altered riparian zone that commonly consists of a one to three tree wide strip. Clumps of trees, as well as barren areas, are also scattered in the reach assessed. The strip is often bordered by pasture, although the Town of Pe Ell borders approximately 3,000 feet of altered riparian zone.

Bank protection efforts in the Town of Pe Ell exist, but their extent cannot be determined from the photos. Spot bank protection within the town was noted in the USFWS/WDFW data summaries (Wampler et al., 1993). Two bridges cross the river in the area assessed, but they are both located in straight reaches and are not likely to have a significant affect on channel morphology.

## Fish Stocks

Detailed information of the fish stocks within the Chehalis headwaters subbasin is not available. General information of the fish stocks within the entire Chehalis watershed can be found in Appendix D: Technical Report for Fish Habitat/ Channel Modifications/ Stocks.

# *3.3 SUBBASIN 7: LOWER NEWAUKUM RIVER*

For purposes of examining water use, water allocation and comparing to streamflow, data from the two upstream subbasins #5, South Fork Newaukum, and #6, North Fork Newaukum, were included in this subbasin discussion.

## 3.3.1 GENERAL DESCRIPTION

The Newaukum River subbasin encompasses nearly 156 $mi^2$ from steep hills, up to 3,800 feet, and narrow valleys down to its confluence with the Chehalis River at 160 feet. The mean basin elevation is 960 feet. Mean annual precipitation is 52 inches over the three subbasins (WDNR, 1991). Mean annual discharge, measured at the USGS streamflow gage #12-025000, Newaukum River, was 502 cfs. This translated into a unit runoff of approximately 5 $cfs/mi^2$; winter unit runoff averaged 8 $cfs/mi^2$, while summer unit runoff was approximately 1 $cfs/mi^2$. The primary land use for this subbasin was forestry; the secondary uses of agriculture (17%) and residential (1%) occurred along the river valley (Figure 3.3-1) (WDNR, 1990).

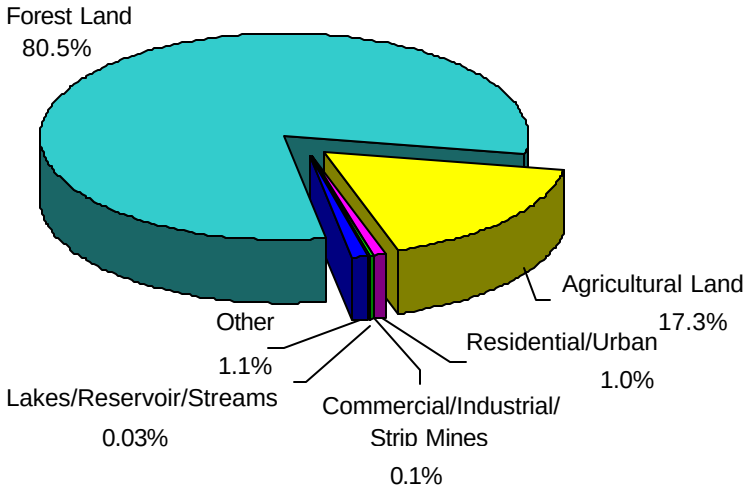


**Figure 3.3-1. Subbasin #5, 6, &7: Newaukum River Land Use/Land Cover Summary**
Source: WDNR, 1990

## 3.3.2 GEOLOGY AND HYDROLOGY

### Geology

The majority of the basin is underlain by glacial outwash from pre-Fraser glaciations (Logan Hill formation). This formation can exceed 150 feet in depth. Significant deposits of recent alluvium exist in the valley bottom of the South Fork. The depth of these deposits decreases with distance upstream.

## Ground Water Hydrology

The Logan Hill formation can hold significant amounts of groundwater, usually under confined conditions in the lower portions of the formation. It is generally not considered a surface aquifer (Garrigues et al., 1998). The aquifer associated with valley alluvial material is within 30 feet of the ground surface.

## Surface Water Hydrology

The Newaukum River has been gaged in three locations: South Fork Newaukum River near Onalaska (12024000; 1944-49 and 1957-72), North Fork Newaukum River near Forest (12024500; 1961-66), and Newaukum River mainstem (12025000; 1929-31, 1942-81, and 1983-98) 4.1 miles upstream from its confluence with the Chehalis River. Prior to using these streamflow records to generate summary statistics, two factors were investigated: 1) climate variability over the period of record, and 2) the extent of upstream regulation and abstraction of water.

The mainstem Newaukum gage is located in Subbasin #7 and covers a longer period of record (1942-81 and 1983-98) than the gages on the forks. This period included 28 years for which the flows were above the long-term annual average and 27 years with below normal flows, based on a trend analysis of the longer record at the Satsop near Satsop gage (1929-98). In addition, the 1942-1998 period included almost equal years within each type of Pacific Decadal Oscillation phase (warm/dry, cool/wet). Therefore, the available streamflow data reflected the natural climate variability experienced in this region.

Since the early 1900's, the Cities of Chehalis and Centralia have diverted water from the North Fork Newaukum for municipal supply. Several sources noted municipal diversions in the Newaukum River system [USGS station remarks, WDOE (Sinclair and Pitz, 1999), and the Chehalis River Basin Action plan (Lewis County Conservation District, 1992)], however, the reported amount varied (5cfs, 7cfs, and 15cfs) among sources. Based on discussion with staff from both the City of Chehalis (Petrie, M. Pers. Comm.) and the City of Centralia (Clary, T. Pers. Comm.), and the 1997 Water System Plan (page II-2) for the City of Chehalis (Chehalis Public Works Department, 1997), the following information was ascertained:

**Table 3.3-1**
**Entities Diverting Above Gage on Mainstem Newaukum River (Subbasin #7)**

| City | NF Newaukum River Withdrawal Amount | Effective Dates |
|---|---|---|
| City of Chehalis | 3.31 MGD (3.1 cfs)[1] | 1914/15 to present |
| City of Centralia | 3.5 MGD (3.4 cfs)[2] | 1920/25 to Sept 1993 |

[1]Capacity of the gravity line (without pumping) from the River
[2]Limited by maximum pipeline capacity

Both diversion structures are located approximately 100 feet apart on the North Fork Newaukum River. The Cities have not kept systematic records of the daily diversion amount, therefore, the assumption was made to set withdrawals equal to the current maximum pipe capacity. This blanket assumption masks several cases, including periods when: 1) the pipelines may have been reconfigured, 2) the Cities have not diverted to the maximum pipe capacity, or 3) the river was

too low to withdraw the full pipe capacity; this detail was not accounted for at this level of analysis. Since September 1993, the City of Centralia has not used the North Fork Newaukum River for water supply but has relied entirely on production from the City's well fields (Clary, T. Pers. Comm.). In addition to the North Fork Newaukum River water source, the City of Chehalis has rights to use the Chehalis River as a supplemental source.

The WDOE GIS layer of dams in Washington identified one dam upstream of the gaging station in Sub-basin #7. This dam, located on Gheer Creek, a tributary to the South Fork Newaukum River near the Town of Onalaska, forms Carlisle Lake. The Washington Department of Wildlife (WDFW) built the dam in 1920 for recreational purposes. Neither the WDOE (Sinclair and Pitz, 1999) nor the USGS's station remarks noted regulation upstream of the Newaukum gage due to this dam. Beyond the municipal diversions previously discussed, both USGS's station remarks and WDOE (Sinclair and Pitz, 1999) rated the diversion degree as low. The USFWS cited 26 water withdrawal pumps and 3 suspected withdrawals during their 1992 habitat inventory (Wampler et. al., 1993). These pumps were primarily located along the mainstem and North Fork. The degree of settlement and the predominance of agricultural land usage along the Newaukum River Valley, however, lead to a concern regarding the cumulative effect of the minor diversions. This concern should lead to caution in the use of these flow numbers to represent "undepleted flow", particularly during summer irrigation months.

The daily streamflows recorded downstream of the diversions were adjusted by adding the municipal diversions (based on pipeline capacity) to the flows for the effective time periods noted above. For this Level 1 analysis, the Newaukum River flows and the addition of the easily quantifiable municipal diversions were assumed to be a first estimate of "undepleted flows". Monthly flow exceedance values were generated based on the deregulated daily flow values for this station; the 50%, and 90% exceedance values are listed in Table 3.3-2 along with the instream flows for the Newaukum River control point coincident with the gage location.

**Table 3.3-2**
**Flow Exceedance Values for Subbasin #7**

| Month | Flow Exceedance Values[1] USGS Gage #12-025000, Newaukum River near Chehalis | | | | WDOE 1975 Base / Instream flow | |
|---|---|---|---|---|---|---|
| | 50% Exceedance (cfs) | 50% URO[2] cfs/mi$^2$ | 90% Exceedance (cfs) | 90% URO[2] cfs/mi$^2$ | 1st-14th (cfs) | 15th to month end (cfs) |
| October | 95 | 0.61 | 48 | 0.31 | 43 | 54 |
| November | 451 | 2.91 | 104 | 0.67 | 91 | 150 |
| December | 746 | 4.81 | 284 | 1.83 | 250 | 250 |
| January | 781 | 5.04 | 293 | 1.89 | 250 | 250 |
| February | 745 | 4.81 | 335 | 2.16 | 250 | 250 |
| March | 612 | 3.95 | 300 | 1.94 | 250 | 250 |
| April | 444 | 2.86 | 247 | 1.59 | 250 | 250 |
| May | 244 | 1.57 | 141 | 0.91 | 210 | 160 |
| June | 151 | 0.97 | 92 | 0.59 | 118 | 90 |
| July | 84 | 0.54 | 54 | 0.35 | 68 | 52 |
| August | 56 | 0.36 | 40 | 0.26 | 38 | 35 |
| September | 59 | 0.38 | 39 | 0.25 | 35 | 35 |

[1] Based on deregulation (municipal diversion added back in) of daily data from the USGS station #12-025000 Newaukum R near Chehalis; 1929-31,42-81,82-98; drainage area 155 mi$^2$
[2] URO = unit runoff

## 3.3.3 WATER RIGHTS & WATER USE

According to the WRATS database, 234 water rights have been issued in subbasins #5, 6, and 7. The majority of the rights on file were designated as surface water withdrawals. The largest and most senior surface water entitlement was a 10 cfs right for municipal and commercial purposes. The next largest was a 5 cfs right for fish propagation. The two largest ground water rights were both for 600 gpm or 1.3 cfs; commercial and fish propagation were the primary beneficial uses for these rights.

The total amount of allocated water was 86.43 cfs, of which about 18.27 cfs was non-consumptive. Over 60% of the consumptive portion of the allocation has been designated for irrigation purposes. A total of 4,972 acres were associated with the water rights in this subbasin. The 42.06 cfs of irrigation rights were associated with 3,988 acres for which irrigation was designated the primary beneficial use; 984 acres were associated with rights (both consumptive and non-consumptive) for which irrigation was listed as a secondary or tertiary use.

**Table 3.3-3 Subbasins #5, 6, 7: Newaukum River**
**Water Rights Summary by Primary Purpose[1]**

| Primary Purpose (#rights) | Allocated Amount (cfs) | Volume Limit (acre feet) | Irrigated Land Acres |
|---|---|---|---|
| *Consumptive Uses* | | | |
| Commercial/Industrial (3) | 1.90 | 213 | 0 |
| Domestic (31) | 2.42 | 303 | 0 |
| Irrigation (143) | 42.06 | 5215 | 3988 |
| Municipal (7) | 11.75 | 210 | 20 |
| Stock (34) | 10.03 | 1103 | 934 |
| **Subtotal** | **68.16** | **7,044** | **4,942** |
| *Non-Consumptive Uses* | | | |
| Hydropower (1) | 0.07 | 0 | 1 |
| Recreation (3) | 0.41 | 11 | 5 |
| Fish & Wildlife Propagation (12) | 17.79 | 2963 | 24.5 |
| **Subtotal** | **18.27** | **2,974** | **30.5** |
| **TOTAL** | **86.43** | **10,018** | **4972.5** |

(Includes Certificates, Permits, and Applications)
[1]Envirovision and Watershed Professionals Network assume no responsibility for the accuracy of the data provided by the Washington Department of Ecology.

There were also 789 registered claims, most of which were assigned general domestic use from wells. Of the 718 ground water claims, 168 pre-date the 1945 ground water code; 11 of the 76 surface water claims pre-date the 1917 surface water code. However, 227 claims had no priority date listed in the database.

## Residential and Municipal Water Use

There were 48 water systems that had points of diversion within the subbasin boundaries serving a total of 22,259. The two largest systems were the City of Centralia, which serves 14,000 people, and the City of Chehalis, which serves 7,100 people; Centralia is located entirely outside of this subbasin and the majority of the residential areas of Chehalis are outside the boundary. There was one water right in the database in the name of the City of Chehalis for 10 cfs. The other six municipal rights were held by Thurston County, Town of Napavine, or Lewis County Water District #2. The City of Centralia did not appear to have a water right in this subbasin, however, Centralia's point of withdrawal on the WDOH database was listed in the subbasin, probably coinciding with a common law claim (dated 1912) for 4.8 mgd (7.44 cfs) from the NF Newaukum River (Summers, 1997). Under the City of Centralia in the WRATS database, one permit listed has been cancelled and one application has been rejected.

A small portion of Chehalis lies within Subbasin #7 but the majority lies within subbasins 8, 9, and 10. The Town of Napavine straddles subbasin 7 and 4, yet the point of diversion has been located in subbasin 4; Napavine supplies a population of 1,240.

The 1990 census data reported in the Chehalis Basin Action Plan (Lewis Conservation District, 1992) notes a population of about 10,000 living within the Newaukum River basin. Assuming the same anticipated average growth of 17% as in the rest of Lewis County (Census Data), the 2000 population should be about 11,700. Census data for 1990 obtained digitally from the Census Bureau was overlain with the subbasin boundaries and a substantially lower population of 6,240 was calculated for the Newaukum (the year 2000 estimate was 7,300). At this level of analysis, the conflict in the different data sources was not resolved. For 11,700 people, an estimate of demand, based on annual precipitation (WDOH, 1999) and assuming 2.6 people per household (Lewis County data), was calculated at 136 gcd or a total of 2.47 cfs. For 7,300 people, the demand was estimated at 1.54 cfs.

Estimating the population served by exempt wells in this subbasin was not attainable since there were 19 water rights for multiple domestic use and 46 public water systems which would need to be examined in detail to determine if any of the multiple rights were not associated with a public water system and, therefore, self-supplied. Instead, an estimate was determined of the number of self- supplied water users that either have an exempt well or may be under a multiple domestic right in subbasins 5, 6, and 7. The population supplied by public water systems and those under single domestic water rights were subtracted from the general population data. As mentioned previously, assumptions on public water system service area were made. It was assumed that all the connections for both the City of Centralia and Chehalis water systems were outside of the Newaukum River subbasin leaving an estimated 1,159 people in the basin served by small public water systems (with points of diversion within the subbasin). In addition, it was assumed that the service area for the 1,240 people served by one public water system (Town of Napavine) was within the subbasin boundary, even though the point of diversion was located outside the subbasin. Subtracting the public water system numbers from the 11,700 general population number resulted in roughly 9,300 people residing in the subbasin that either must have water rights or were using wells under the exempt status. There were 12 single domestic rights serving approximately 31 people. Subtracting from the 9,300 self supplied water users resulted in 9,269 people self-supplied under a multiple domestic right or under an exempt well. Based on the 136 gcd, this population would use approximately 1.95 cfs.

For purposes of comparison, this was bracketed by using the population of 7,300 obtained directly from the GIS census data. The latter resulted in 7,269 (~1.5 cfs). These estimates of use were based on residential water use and not on small non-commercial farms that have higher water use. Assuming all the withdrawals were hydraulically connected to the river system, exempt wells and the population that may be under multiple domestic rights in the Newaukum subbasin appeared to be cumulatively withdrawing less than 7% of the 90% exceedance flow and 5% of the median flow in September. The total residential demand in the basin was estimated between 1.5 cfs to 2.5 cfs, the latter of which was about 3% of the total allocated water and about 18% of the water allocated for municipal and domestic use.

## Commercial/Industrial

There were three water rights designated specifically for commercial and industrial use for which the allocated amount was 1.9 cfs with a volume limit of 213 acre-feet/year. An additional two rights listed commercial/industrial as a secondary use; the allocated amount was 0.43 cfs and 20.5 acre-feet annual limit. There were also 92 commercial/industrial connections served by public water systems, and 114 parcels with a designated land use code for commercial/industrial purposes. These two data sources compared favorably. It was possible that one non-residential public water system connection was supplying water to more than one commercial/industrial parcel.

## Irrigation

A total of 4,972 acres for potential irrigation were covered under 173 water rights in this subbasin. The volume limit of supply was 6,384 acre-feet, not all of which was allocated for these acres; some rights had other beneficial uses. In addition, 57 water rights listed no annual volume limitation. There were 1,100 parcels designated agricultural use in the Lewis County assessor's database covering about 14,263 acres of which roughly 24% were classified as "not cultivated." The WDNR reported 17,217 acres in agricultural use, for a difference of more than 20% compared to the assessor's information. According to the Lewis County Conservation District (Bainbridge, Rich, Pers. Comm.), peas and corn used to be grown in this basin, but the cannery will not be processing these crops after 2000. Most of the current irrigated land is now in pasture with efficiencies at 50% or lower (Bainbridge, Rich, Pers. Comm.). The number of acres that were actually being irrigated within this subbasin was unknown.

Assuming all 4,972 acres were irrigated in pasture/turf (the highest use), and using the climate and crop consumptive use data from Centralia, Washington, the total crop water demand was estimated at 14,629 acre feet at an efficiency of 50% (Figure 3.3-2). This was nearly 230% higher than the 6,384 acre-feet volume associated with the water rights. The assumption was that all irrigated acres in pasture resulted in an over-allocation of the volume limit. To keep within the legal annual volume limits of the water rights, a portion of the irrigated acres would have to be attributed to a crop type with significantly less consumptive use and/or better on-farm efficiencies than 50%.

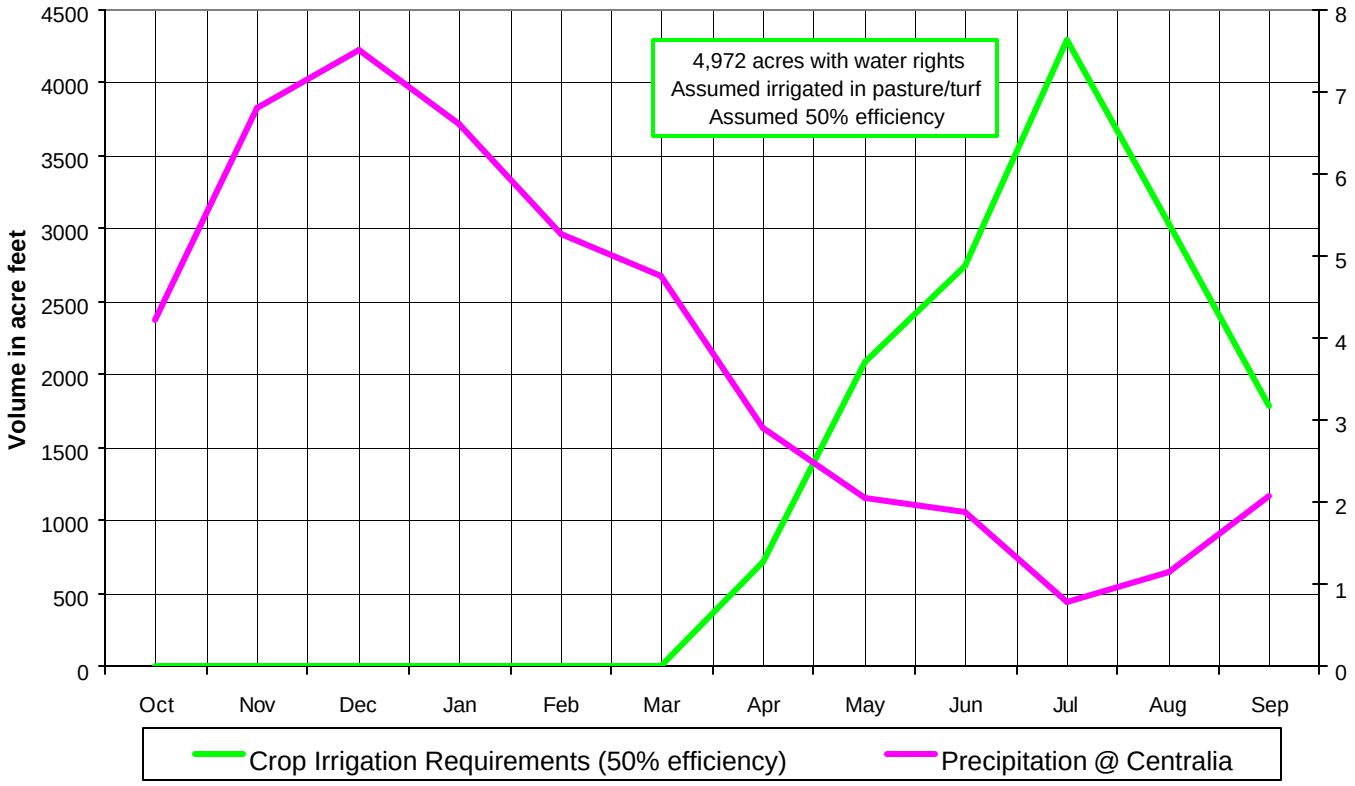


**Figure 3.3-2. Subbasins #5, 6, and 7: Newaukum River**
**Monthly Irrigation Water Demand**

Source: WSU Cooperative Extension, *Irrigation Requirements for Washington – Estimates and Methodology*. Education Bulletin #1513

Actual irrigation water use probably is lower than the allocated amount. An intensive field and aerial photo survey would be required to determine this. The above exercise, while incorporating several assumptions, was intended to provide an overview of the potential seasonal distribution of irrigation water use.

## Stock Watering

Based on farm plans from the NRCS (2000), there were approximately 830 dairy cows within this subbasin. The water needs for a dairy cow is about 20 gallons per day (WDOH, 1999), or 0.05 cfs for the 830 cows. The number of beef cattle was also estimated at 830 (NRCS, 2000). However, beef cattle use less water resulting in an estimated rate of ~.02 cfs. There were three large poultry farms in the Newaukum basin processing about 5 million chickens per year, resulting in an estimated use of .02 cfs. The number of other farm animals was not known. The total of these water uses was estimated at 0.09 cfs, which was less than 1% of the total allocated amount for stock watering. However, there were 934 acres that could be irrigated under the water rights listed for stock watering as a primary beneficial use.

## Comparison of Streamflow and Allocated Water

Figure 3.3-3 is a comparison of flows (50% and 90% exceedance), instream flows, and the total allocated water for consumptive uses. In addition, the graph includes a line depicting the combined instream flow plus the instantaneous water right allocation.

The 50% exceedance flow or median flow ranged from a low of 56 cfs in August to a high of 781 cfs in January. This means that in September, 50% of the flows were higher than 56 cfs and the other half of the flows were less than 56 cfs. The 90% exceedance flows were lowest in September and highest in February, i.e. 90% of the daily flows were 39 cfs or greater and 335 cfs or greater, respectively. The instream flows used on this graph represent the average of the bimonthly base/instream flow values. The monthly average of the instream flows are lowest in August (36.5 cfs), September (35 cfs), and October (48.5 cfs).

Examining flows in September,

| | |
|---|---|
| 50% Exceedance Streamflow | = 59 cfs |
| 90% Exceedance Streamflow | = 39 cfs |
| Instream Flow | = 35 cfs |
| Instantaneous Water Right Allocation for all consumptive uses | = 68.16 cfs |

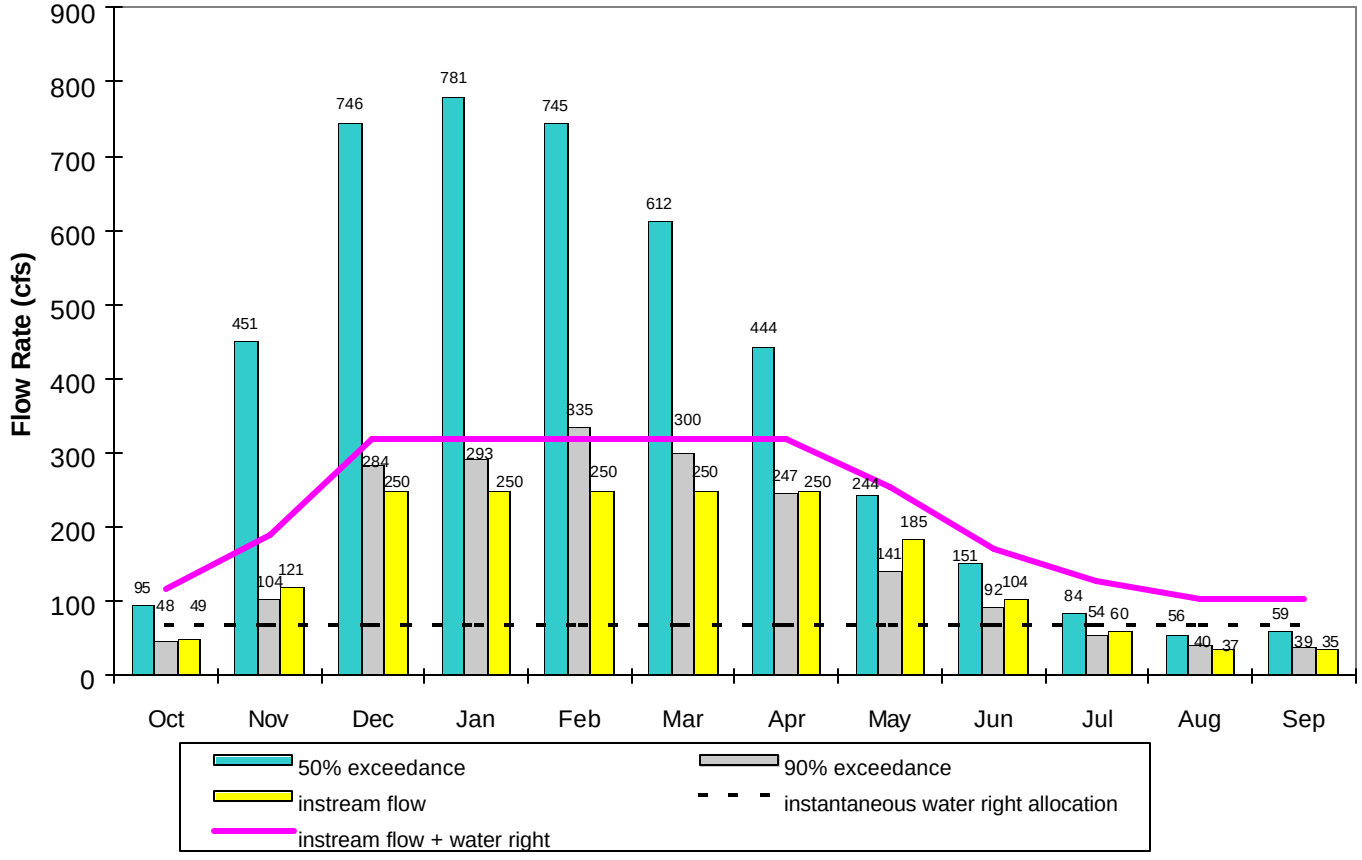


**Figure 3.3-3. Subbasin #5, 6, & 7: Newaukum River Comparison of Streamflow and Allocated Water**

Based on the median streamflows, this subbasin was over-allocated (combined water rights and instream flows) from May through October. At the 90% exceedance levels, the streamflows were insufficient to meet the water right allocation in four months of the year (July through October) with the maximum deficiency nearly 30 cfs. The combined instream flow and water rights allocation could only be supplied in one month (February) at the 90% exceedance level.

In the absence of water withdrawals/diversions, the deregulated flows (adjusted by adding the municipal diversions) were sufficient to meet the instream flows at the 50% exceedance levels throughout the year. At the 90% exceedance level, instream flows could not be met four months of the year and were very close in another four months.

The 68.16 cfs total allocated amounts for consumptive uses included both surface water and ground water abstractions. Direct comparison of the total allocated amounts to the streamflow represented the "worst case" scenario because 100% hydraulic continuity was assumed. Withdrawals under the 81 ground water rights in this basin would impact the flows in the Newaukum River to differing degrees dependent on depth of well, distance from the stream, and geology.

The consumptive portion of the allocated rights was over 120% of the lowest median streamflow. If half of the water were returned to the system, the effective consumptive portion of these rights would then be 60% of the lowest median flow. (Note: Return flows of 50% is not uncommon for irrigation rights, but would be considered low for domestic/municipal rights for which return flows are closer to 75%). The potential for streamflow enhancement exists in this basin since the water right allocation was substantial (45% to 121% of the median flows between June and October). A detailed mapping of the water rights to determine the rights actually being used and those that have been retired would bring the water rights allocation closer to the actual water use in the subbasin. In addition, an in-depth analysis of the ground water would help to determine the extent of the ground water right impacts on streamflows.

**Table 3.3-4.**
**Summary Comparison of Water Rights and Water Use for the Newaukum River.**

| Beneficial Use | Estimated Current Water Use (cfs) | Water Rights Allocation (cfs) |
|---|---|---|
| Domestic | 1.54 to 1.96 | 2.42 |
| Municipal | Unknown[1] | 11.75 |
| Commercial/Industrial | Unknown | 1.90 |
| Irrigation | >14,000 acre feet[2] | 6,384 acre feet |

[1]Due to out of basin transfers to Centralia and Chehalis and in-basin transfers from Napavine
2 Based on 4,972 legally irrigated acres in pasture/turf

## Summary of Water Allocation for Newaukum River

- Domestic use is as much as 81% of the water rights allocation.
- Irrigation has the potential to be very high and exceed the allocation, depending on the type of crops grown.
- Irrigation demand estimates need improvement in a Level 2 analysis.

- Potential for "paper" improvement is high since water right allocation is high relative to streamflows (45 - 120 % of median flows from June through October).
- This subbasin needs detailed mapping of water rights, field verification, and better knowledge of groundwater impacts, i.e. hydraulic continuity.

## 3.3.4 WATER QUALITY

A fair data record exists for this subbasin. There is no long term ambient monitoring station, but there has been recent monitoring covering a full year with some upstream data for comparison. This subbasin has violated both temperature and fecal coliform standards, and thus is included in the 303(d) list for these parameters. Average annual yields for TP and TSS were the lowest calculated, but IN yield was the second highest in the Chehalis, and similar to the highest yield measured in a comparison study of Puget Sound basins.

## 3.3.5 FISH HABITAT/ CHANNEL MODIFICATIONS/ STOCKS

### Fish Habitat

USFWS/WDFW extensive survey.

A total of 125 stream miles were surveyed for fish habitat conditions in the USFWS/WDFW "*Newaukum"* subbasin, which included Newaukum Creek; South Fork Newaukum, Lost, Kearney, Beaver, Bernier, and Frase Creeks; the Middle Fork Newaukum; the North Fork Newaukum, Lucas, and Mitchell Creeks. The most important habitat problems identified were:

- streamside vegetation loss from unknown causes (5 points and 42.9 miles)(Newaukum NF Newaukum, Lucas Creek, SF Newaukum),
- bank erosion (302 points and 28.8 miles) (Newaukum, MF Newaukum, NF Newaukum, SF Newaukum),
- stream canopy reduction and bank vegetation loss from forest practices (28 points and 17.23 miles) (upper NF Newaukum tributaries, Lucas Creek, SF Newaukum tributaries), and
- bank vegetation reduction and other damage from livestock (78 points and 13.9 miles) (SF Newaukum tributaries, MF Newaukum, lower North Fork Newaukum, Allen Creek).

Beaver dams were noted in Lucas Creek, portions of the middle Fork, and in some South Fork tributaries, but were not common in other subbasin streams at the time of the survey. A total of 33 known or suspected water withdrawals were noted, as well as 11 miscellaneous pollution input sources (Wampler et al., 1993).

A portion of this subbasin was included in ***The Upper North Fork and Upper South Fork Newaukum Watershed Analysis:*** (Weyerhaeuser Co, 1999). Analysis area included: the upper North Fork and upper South Fork Newaukum Rivers (50,235 acres). Low amounts of in-channel LWD were noted, primarily due to past management practices. Current shading levels were found to be on target for protection of water temperatures, except for the agricultural areas in the lower North Fork subbasin. Thirteen potential fish passage barriers at culverts were identified, as well as natural passage barriers in steeper sections of the main stems and their tributaries. Lack of in-channel LWD in some stream reaches has produced lowered pool depths and frequency, and lack of cover. Future recruitment potential for LWD was good over much of

these basins, and was identified as a problem in 20% of the riparian areas. Pool filling and deposition of fine sediments was noted in some channel types, and much of the watershed has fine sediments delivered from road erosion, and potentially delivered from areas with high hazard ratings for landslides.

## Channel Modifications

Historic channel modification activities include operation of splash dams prior to 1925 in the mainstem (one), the North Fork (two), and South Fork (two) (Wendler and Deschamps, 1955). By the mid 1940's, most of the subbasin had been logged and the valley bottom cleared for agricultural uses (Weyerhaeuser, 1999). In 1975, gravel mining operations in and near the stream channels in the Newaukum watershed were found to affect virtually every spawning reach (for chinook and chum) in the South Fork below the Town of Onalaska, as well as other parts of the North Fork and mainstem Newaukum (Phinney et al., 1975).

The primary impacts noted today are; loss of riparian vegetation associated with logging and agricultural uses, and channel erosion. The USFWS/WDFW extensive survey data summary for the subbasin covers 125 miles of stream and are tallied with subbasins 5 and 6 (North Fork and Upper Newaukum River). Of this distance, 12 percent was reported with a reduction in riparian density associated with logging, and 12 percent reported riparian vegetation loss associated with agriculture. A total of 34 percent of the surveyed area was classified as riparian vegetation loss due to unknown causes. Livestock had access to about 9 percent of the surveyed channel length. Channel erosion was reported over 23 percent of the surveyed reach, and riprap was reported over 4 percent of the area surveyed (Wampler et al., 1993).

Approximately 25 miles of channel were evaluated on the 1990 orthophotos. Assessment of channel conditions included the urban/agricultural areas along the mainstem South Fork from the mouth to just above Lost Creek. Table 3.2-4 presents the results of assessment of riparian conditions along this section of the river. Alteration usually involved clearing nearly to the channel edge for agricultural purposes, leaving a thin strip of vegetation. Approximately 24 percent of the channel length was bordered by a relatively intact riparian corridor. A total of ten bridges, including Interstate 5, cross the channel and roads run immediately adjacent to the channel for approximately 1 mile. It is probable that riprap exists in these areas. It appears that in general, the riparian corridor is more intact than that shown in 1944 photos of the area. Channel position does not appear to have changed a great deal since that time.

## Fish Stocks

Detailed information on the status of fish stocks within the South Fork Newaukum subbasin is not available. General information on the status of stocks within the entire Chehalis watershed is provided in Appendix D: Technical Report for Fish Habitat/ Channel Modifications/ Stocks.

# *3.4 SUBBASIN 14: CLOQUALLUM – WILDCAT CREEK*

## 3.4.1 GENERAL DESCRIPTION

The Cloquallum River Subbasin (#14) covers 70.3 $mi^2$ from the foothills near Lost Lake to its confluence with the Chehalis River in the Town of Elma. The elevation ranges from 16 feet to a high of 1,580 feet; mean basin elevation is 422 feet. The mean annual precipitation is about 68 inches (WDNR, 1991). Mean annual discharge measured at the USGS streamflow gage #12-032500, Cloquallum River at Elma, was 274 cfs which translated into a unit runoff of approximately 4 cfs/$mi^2$; winter unit runoff averaged 9 cfs/$mi^2$, while summer unit runoff was 1 cfs/$mi^2$. The primary land use for this subbasin was forestry with some agricultural and residential land uses along the river valley (Figure 3.4-1) (WDNR, 1990).

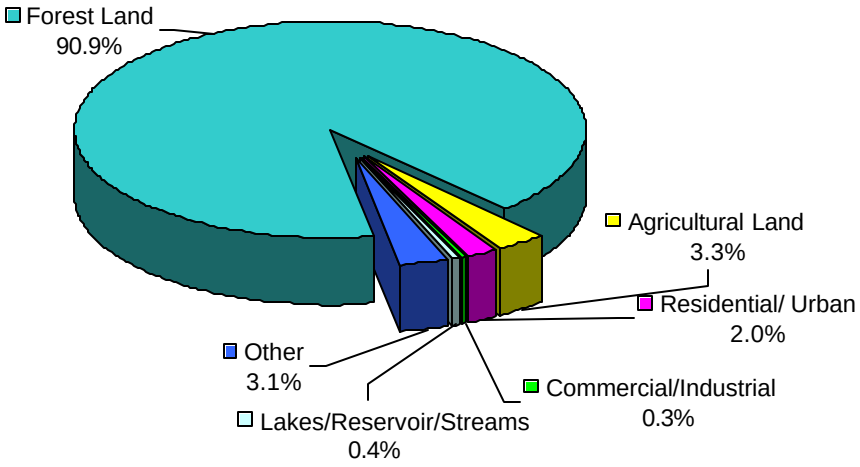


**Figure 3.4-1. Subbasin #14: Cloquallum River Land Use/Land Cover Summary**
Source: WDNR, 1990

## 3.4.2 GEOLOGY AND HYDROLOGY

### Geology

The upper two thirds of the basin are underlain by a mix of Vashon glacial deposits and marine sedimentary rocks. The glacial deposits consist primarily of till and are concentrated in the headwaters of the basin. The lower third of the basin is a mix of glacial deposits and recent alluvium.

### Ground Water Hydrology

A significant amount of groundwater is likely present in the lower portion of the basin associated with the Chehalis River valley. This aquifer is located within 20 feet of the ground surface. Groundwater conditions in the upper portion of the basin are less known.

## Surface Water Hydrology

The USGS collected mean daily discharge at the Cloquallum River at Elma (station #12032500) from 1942 to 1973. The station was located at river mile 1.9. While these records cover a few decades, record extension techniques were employed in an attempt to cover a period of record similar to the other basins and sufficient to reflect natural climate variability.

The Cloquallum River record was extended to cover the 1929-1998 period using long-term daily data from the adjacent basin gage, #12035000 Satsop River near Satsop, and monthly correlation equations.

The USGS station remarks for the Cloquallum River gaging station indicated that there were small diversions on minor tributaries and some regulation by a log pond on Wildcat Creek. In addition, Cloquallum Creek flows through Stump Lake, which may be providing some in-channel retention. Regulation from this lake and the log pond could be investigated in a Level 2 analysis. The WDOE rated the Cloquallum River record low in terms of the degree of regulation and diversions (Sinclair and Pitz, 1999). Based on the WDOE's GIS layer that spatially displays dams in Washington State, no dams were identified in the Cloquallum basin.

Monthly flow exceedance values were generated for this station based on the combined actual and synthetic daily streamflow values; the 50% and 90% exceedance values are listed in Table 3.4-1 along with the instream flows for the Cloquallum control point at the gage location. (These flows were considered estimates of undepleted flow that may require refinement in a Level 2 effort.)

**Table 3.4-1**
**Flow Exceedance Values for Cloquallum River, Subbasin #14**

| Month | Flow Exceedance Values[1] Gage #12-032500: Cloquallum R. at Elma | | | | WDOE 1975 Base / Instream flow | |
|---|---|---|---|---|---|---|
| | 50% Exceedance (cfs) | 50% URO[2] cfs/mi$^2$ | 90% Exceedance (cfs) | 90% URO[2] cfs/mi$^2$ | 1st-14th (cfs) | 15th to month end (cfs) |
| October | 53 | 0.81 | 24 | 0.36 | 27 | 30 |
| November | 238 | 3.62 | 60 | 0.91 | 52 | 88 |
| December | 421 | 6.40 | 173 | 2.63 | 150 | 150 |
| January | 449 | 6.82 | 200 | 3.04 | 150 | 150 |
| February | 417 | 6.34 | 205 | 3.12 | 150 | 150 |
| March | 322 | 4.89 | 176 | 2.67 | 150 | 150 |
| April | 209 | 3.18 | 125 | 1.90 | 150 | 150 |
| May | 112 | 1.70 | 74 | 1.12 | 118 | 92 |
| June | 69 | 1.05 | 50 | 0.76 | 70 | 55 |
| July | 41 | 0.62 | 34 | 0.52 | 43 | 34 |
| August | 30 | 0.46 | 24 | 0.36 | 29 | 24 |
| September | 29 | 0.44 | 23 | 0.35 | 24 | 24 |

[1] Based on 38 years of synthetic + 31 years of actual daily data from USGS station #12-032500: Cloquallum R at Elma; 1929-98; drainage area = 63.8 mi$^2$

[2] URO = unit runoff

## 3.4.3 WATER RIGHTS & WATER USE

There were 80 water rights on record for the Cloquallum River (Subbasin #14): 51 surface water rights and 29 ground water rights. Over half were designated for irrigation and another 28% were designated for domestic use. The municipal rights were all certificates assigned to the Town of McCleary. The total diversion/withdrawal rate of these municipal rights was 2.45 cfs, with a combined volume limitation of 1,633 acre-feet. All of the water rights listed in the WRATs database for this subbasin involved some degree of consumptive water usage; none were totally non-consumptive, i.e. hydropower, fish propagation etc.

The most senior water right held a priority date of August 19, 1930 for irrigation and domestic use purposes; the most junior water right certificate in the subbasin was dated September 22, 1989. Four applications were junior to this 1989 certificate. Twenty-five rights were junior to the 1975 base/instream flows set by the WDOE. The total instantaneous withdrawal rate associated with these rights was 9.8 cfs.

Of the 282 registered claims on file, 263 were associated with general domestic use, 7 each for irrigation and stock watering, and 5 had no associated purpose of use listed in the database. The

irrigation claims cover 363 acres of land. The majority of the claims were intended for ground water withdrawals (82%).

**Table 3.4-2. Subbasin 14: Cloquallum Creek**
**Water Rights Summary by Primary Purpose[1]**

| Primary Purpose (# rights) | Allocated Amount (cfs) | Volume Limit (acre feet) | Irrigated Land Acres |
|---|---|---|---|
| Commercial/Industrial (4) | 2.47 | 189.7 | 0 |
| Domestic (22) | 3.07 | 356.93 | 0 |
| Fire Protection (1) | 0.22 | 3 | 0 |
| Irrigation (45) | 8.52 | 617 | 659.5 |
| Municipal (3) | 2.45 | 1633 | 0 |
| Stock (5) | 0.55 | 76.6 | 39 |
| **TOTAL** | **17.28** | **2876.23** | **698.5** |

(Includes Certificates, Permits, and Applications)
[1]Envirovision and Watershed Professionals Network assume no responsibility for the accuracy of the data provided by the Washington State Department of Ecology.

## Residential and Municipal Water Use

The points of withdrawal for twenty public water systems were located in the Cloquallum River subbasin with a total of 972 connections or 2,083 people. The City of McCleary was listed as the largest purveyor of water serving 1,500. Outside of McCleary, there appeared to be 12 mobile home parks or other small residential systems. The remaining public water systems (7) served primarily commercial or industrial users with some associated residential use.

According to the Chehalis River Basin Action Plan (1992), the 1990 population in the Cloquallum River subbasin was approximately 3,000. The average projected rate of growth between 1990 and 2000 was 11% leading to an estimated year 2000 population of 3,330. As of September 1999, the public water systems in the subbasin supplied a population of 2,083; the difference of 1,247 was assumed to be self-supplied water users some of whom may have water rights. There were six single domestic rights providing water for about 15 people. The difference of 1,232 self-supplied water users (total self-supplied users less those covered under single domestic rights) were estimated to use about 0.24 cfs (127 gcd calculated using WDOH (1999)). An estimate of actual water use for the total population (applying 127 gcd) was approximately 0.66 cfs. The combined municipal and domestic water rights totaled 5.52 cfs, which means the estimated actual water use was about 12% of the total allocated water for this sector.

## Commercial and Industrial Water Use

Four commercial/industrial water rights were listed in the WRATS database with a total withdrawal rate of 2.47 cfs. Seven of the public water systems may be associated with this water use sector. In the Grays Harbor Assessor's database, 75 parcels covering roughly 309 acres of land were identified as commercial or industrial by land use code. Without knowledge of the specific enterprises, it is difficult to determine an estimate of actual water use.

## Irrigation

The total withdrawal/diversion rate of the irrigation water rights was 8.52 cfs; the associated volume limit and acreage covered was 617 acre feet and 660 acres, respectively. There were three additional rights with stock watering as the primary beneficial use and irrigation as a secondary use: volume limit of 76 acre-feet and 39 irrigated acres.

The Grays Harbor County assessor's database listed 17 parcels totaling 553.68 acres associated with agriculture. Additional irrigated acreage may be located in Mason County. Orthophotographs (WDNR, 1995) of the Mason County portion of the subbasin were reviewed and a few additional farms were noted. The Chehalis River Basin Action Plan states that the water righted acreage was around 400 and that about one-fourth were actually being irrigated (1992).

Assuming all 659.5 acres were irrigated in pasture/turf (the highest use) and using the climate and crop consumptive use data from Elma, Washington, the total crop water demand was estimated at 1,030 acre feet at an efficiency of 50%. This value is 47% higher than the 699 acre-feet volume associated with the water rights. Using field corn as the primary crop (lower consumptive use) for all the acres, the total crop water requirement was 580 acre-feet at 50% efficiency. The crop water requirements of pasture/turf and field corn bracket the high and lower end consumptive uses, as well as the water righted volume. Some vegetables such as peas, green beans, cucumbers, etc. have lower rates of crop consumptive use, however, according to the Lewis County Conservation District (Bainbridge, Rich, Pers. Comm.), the only irrigated crops in Grays Harbor County were corn and pasture.

Based on the estimate that one-fourth (165 acres) of the water righted acreage is actually irrigated, the crop irrigation requirement would be significantly less ranging from 145 acre feet (field corn @ 50% efficiency) to 258 acre feet (pasture @ 50% efficiency) (Figure 3.4-2). The efficiency of 50% is an assumed value based on discussions with Lewis Conservation District staff (Bainbridge, Rich, Pers.Comm.).

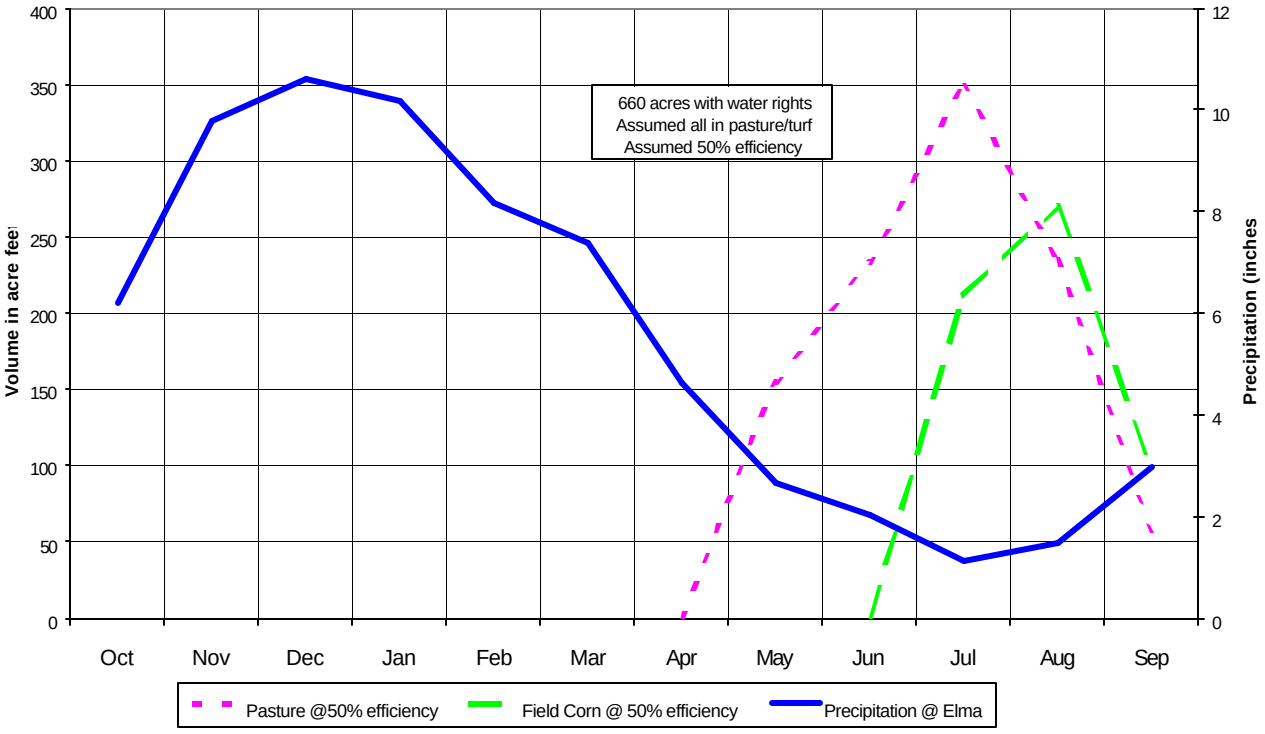


**Figure 3.4-2. Subbasin #14: Cloquallum Creek**
**Monthly Irrigation Water Demand**
Source: WSU Cooperative Extension, *Irrigation Requirements for Washington – Estimates and Methodology*. Education Bulletin #1513

## Comparison of Streamflow and Allocated Water

Figure 3.4-3 compares the streamflow (50% and 90% exceedance) with the instream flows and the total allocated water for consumptive uses. In addition, the graph includes a line depicting the combined instream flow plus the instantaneous water right allocation.

The 50% exceedance flow or median flow ranges from a low of 29 cfs in September, to a high of 449 cfs in January. This means that, in September, 50% of the flows were higher than 29 cfs and the other half of the flows were less than 29 cfs. The 90% exceedance flows were lowest in September and highest in February, i.e. 90% of the flows were 23 cfs or greater and 205 cfs or greater, respectively. The instream flows used on this graph represent the average of the bimonthly base/instream flow values. The monthly average of the instream flows are lowest in August (26.5 cfs), September (24 cfs), and October (28.5 cfs).

Examining flows in September,

| | |
|---|---|
| 50% Exceedance Streamflow | = 29 cfs |
| 90% Exceedance Streamflow | = 23 cfs |
| Instream Flow | = 24 cfs |
| Instantaneous Water Right Allocation for all consumptive uses | = 17.28 cfs |

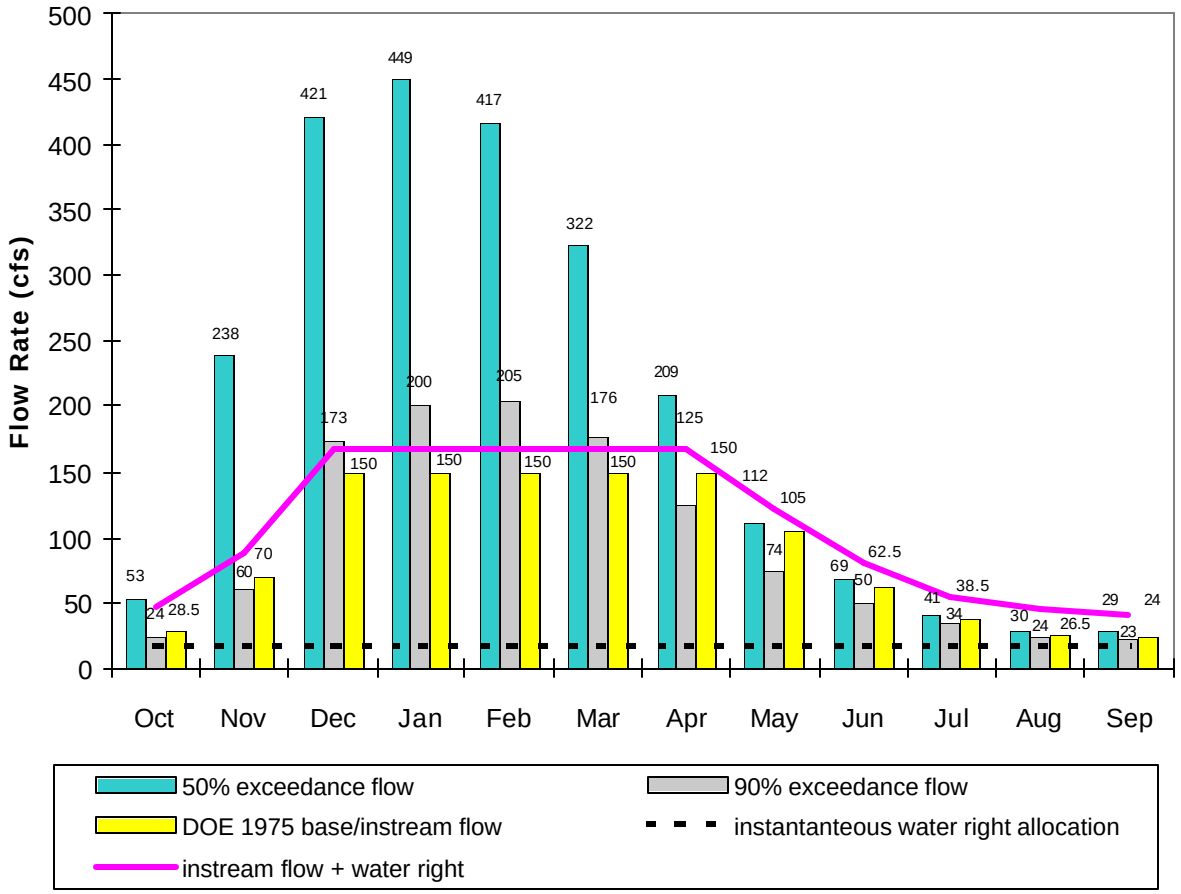


**Figure 3.4-3. Subbasin #14: Cloquallum Creek**
**Comparison of Streamflow and Allocated Water**

The median streamflow was insufficient to meet the water right allocation plus the instream flow in five months of the year, while the 90% exceedance flows were insufficient in eight months of the year. In the absence of human water use, the flows were sufficient to meet the instream flows at the 50% exceedance levels throughout the year; at the 90% exceedance level, instream flows could not be met eight months of the year.

The 17.28 cfs total allocated amount for consumptive use included both surface water and ground water abstractions. Direct comparison of the total allocated amounts to the streamflow represented the "worst case" scenario because 100% hydraulic continuity was assumed. Withdrawals under the 29 ground water rights in this basin impact the flows in the Cloquallum River to differing degrees dependent on depth of well, distance from the stream, and geology. The extent of the impact of ground water rights should be investigated further in the Level 2 Assessment.

The consumptive portion of the allocated rights was nearly 60% of the lowest median streamflow. If half of the water were returned to the system, the effective consumptive portion of these rights would then be 30% of the lowest instream flow. (Note: Return flows of 50% is

not uncommon for irrigation rights, but would be considered low for domestic/municipal rights for which return flows are closer to 75%). The potential for streamflow enhancement exists in this basin since the water right allocation was substantial (25% to 60% of the median flows between June and October). A detailed mapping of the water rights to determine the rights actually being used and those that have been retired would bring the water rights allocation closer to the actual water use in the subbasin. In addition, an in-depth analysis of the ground water would help to determine the extent of the ground water right impacts on streamflows.

**Table 3.4-3.**
**Summary Comparison of Water Rights and Water Use for Cloquallum Creek.**

| Beneficial Use | Estimated Current Water Use (cfs) | Water Rights Allocation (cfs) |
|---|---|---|
| Domestic | 0.36 | 3.07 |
| Municipal | 0.3 | 2.45 |
| Commercial/Industrial | Unknown | 2.47 |
| Irrigation | 145-258 acre feet[1] | 617 acre feet |

[1]Based on NRCS estimate that 1/4th of water righted acreage (165 acres) are actually being irrigated.

### Summary of Water Allocation for Cloquallum Creek

- Domestic use is 12 % of the water rights allocation.
- Municipal water use is 12 % of the water rights allocation.
- More than half the population is self-supplied.
- Consumptive water rights are 25 to 60 % of the lowest median streamflows.
- Potential for "paper" improvement is high since the allocation is high relative to streamflow and the estimated actual use is relatively low.
- Detailed mapping of water rights, field verification, and an investigation of hydraulic continuity is recommended for this subbasin.

## 3.4.4 WATER QUALITY

No monitoring of this subbasin has occurred since the 1970's. At that time there were no water quality violations noted.

## 3.4.5 FISH HABITAT/ CHANNEL MODIFICATIONS/ STOCKS

### Fish Habitat

A total of 94 stream miles were surveyed for fish habitat conditions in the *USFWS/WDFW extensive survey for* in their "*Newman – Cloquallum*" subbasin, including Newman, Vance, Cloquallum, Wildcat, Bush, Mox-Chehalis, and Sand Creeks. The most important habitat problems identified were: streamside vegetation loss from unknown causes (1 point and 41.8 miles) (widespread), excessive instream sediments (12 points and 16 miles) (Vance, Sand, Bush and upper Newman Creeks), bank erosion (173 points and 10.5 miles) (Cloquallum, Mox Chehalis and Wildcat Creeks), and bank riprap/artificial protection or dumping (108 points and 2.2 miles) (Wildcat, lower and mid-Cloquallum and Vance Creeks). Beaver dams were present in the basin in moderate numbers at the time of the survey. A total of 22 known and suspected

water withdrawals were noted, as well as 2 wastewater outfalls and 22 miscellaneous pollution input sources (Wampler et al., 1993). (Newman and Vance Creeks results are described in Subbasin #19.)

### Channel Modifications

Early historical activities that can affect the form of the current channel included two splash dams, each operated prior to 1935 in Wildcat Creek and Rock Creek (Wendler and Deschamps, 1955).

The USFWS/WDFW extensive surveys present data summaries for the Mox Chehalis, Vance Creek, and Cloquallum Creek subbasins together. These data indicate that of the 94 miles of channel surveyed in the three streams, 5 percent was reported with a reduction in riparian density associated with logging, and 4 percent reported riparian vegetation loss associated with agriculture. A total of 44 percent of the surveyed area was classified as riparian vegetation loss due to unknown causes. Livestock had access to about 9 percent of the surveyed channel length. Channel erosion was reported over 23 percent of the surveyed reach, and riprap was reported over 4 percent of the area surveyed (Wampler et al., 1993).

1988 photos were evaluated from the mouth of Cloquallum Creek up Wildcat Creek to below McCleary (approximately 7 miles). Wildcat Creek was selected for evaluation rather than the main stem of Cloquallum Creek due to a greater variety of land uses. The combination of Highway 8 and the Elma McCleary road have resulted in riparian clearing and bank protection efforts for much of the length of Wildcat Creek. In some cases, the roads appear to limit meander movement.

These roads, as well as landowner clearing, have resulted in a significant loss of riparian vegetation. Table 3.2-4 presents the results of riparian disturbance as assessed from the 1988 aerial photos.

### Fish Stocks

Detailed information on the status of fish stocks within the Cloquallum-Wildcat Creek subbasin is not available. General information on the status of stocks within the entire Chehalis watershed is provided in Appendix D: Technical Report for Fish Habitat/ Channel Modifications/ Stocks.

## *3.5 SUBBASIN 19: LOWER REACH 1 CHEHALIS RIVER*

### 3.5.1 GENERAL DESCRIPTION

The Chehalis River Mainstem (Lower Reach 1) (Subbasin #19) covers 94 $mi^2$ along the mainstem between Porter Creek and the Satsop River and passing through the Town of Elma. The elevation ranges from 10 feet to 1,814 feet with a mean basin elevation of 309 feet. Mean annual precipitation over the subbasin is 59 inches. Mean annual discharge for the short-term record measured at the USGS streamflow gage #12-033000, Chehalis River at South Elma was 5,057 cfs. This translated into a unit runoff of approximately 4 $cfs/mi^2$; winter unit runoff

averaged 7 cfs/mi$^2$, while summer unit runoff was <1 cfs/mi$^2$. The primary land use for this subbasin was forestry with some agricultural and residential land uses along the river valley (Figure 3.5-1) (WDNR, 1990). Although this subbasin does not represent an entire watershed or subwatershed, it was selected to represent mainstem water use/water rights activities.

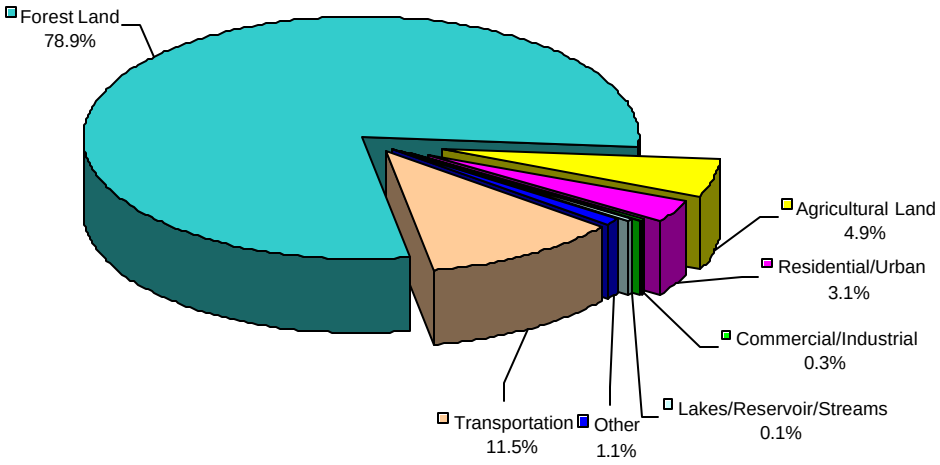


**Figure 3.5-1. Subbasin #19: Mainstem Chehalis River – Lower Reach 1 Land Use/Land Cover Summary**
Source: WDNR, 1990

## 3.5.2 GEOLOGY AND HYDROLOGY

### Geology

The Chehalis River valley floor is primarily alluvial material with pockets of glacial outwash. Hillslopes of the tributary streams are underlain by marine sedimentary rocks of the Lincoln Creek and Astoria formations. Alluvial material is mapped in the valley floor of Sand Creek.

### Ground Water Hydrology

The Chehalis valley aquifer is well developed and in direct hydraulic connection with the river. Water is usually found within 10 to 20 feet of the ground surface. A smaller valley aquifer is also likely in the Sand Creek basin. Groundwater conditions in the sedimentary rock units are not well understood.

### Surface Water Hydrology

Subbasin #19 encompasses a reach of the mainstem Chehalis River and, as such, required slightly different treatment than the other four subbasins. Due to the complexity of regulation and extent of diversions upstream of the subbasin, undepleted streamflow estimates for this subbasin were not produced. Instead, the streamflow measured at the upstream end of the subbasin (Chehalis at Porter, 12031000) was used as inflow to the subbasin; water use upstream has depleted these flow values. Daily streamflow values for Cloquallum Creek and the Satsop River were added to the Chehalis River at Porter values to create a time series of all gaged flows draining to the Chehalis River just below Satsop confluence. These recorded flows were then

adjusted to account for the ungaged accretion flow generated within the subbasin boundaries in order to allow comparison to the in-basin water use. While the flows used in this analysis do not represent an undepleted value, they do represent the amount that has over time come into the subbasin and is "available" for instream and out-of-stream uses in this subbasin.

Accretion flow from the 94 $mi^2$ of ungaged drainage in Subbasin #19 (plus the 5.1 $mi^2$ below the gage on Cloquallum Creek) was estimated using a combination of unit runoff values and the relationship of flows at the USGS Gage #12-031000 (Chehalis at Porter). Mean monthly unit runoff values were generated from the 8 years of gage records available at the historic Chehalis River at south Elma station located mid-basin (USGS Gage #12-033000). These monthly unit values compared favorably to values from the longer-term base gages and therefore were used. Using a ratio of the mean monthly flow to the 50% and 90% exceedance flows at the Porter gage, exceedance values for the ungaged area in Subbasin #19 were derived. These values were then added to the appropriate calculated values from the gaged flow time series to represent flows available at the downstream end of Subbasin #19.

**Table 3.5-1**
**Flow Exceedance Values for Chehalis River Lower Reach 1**

| | Estimated Flow Exceedance Values[1] Downstream end of Subbasin #19 | | | | DOE 1975 Base / Instream flow | |
|---|---|---|---|---|---|---|
| Month | 50% Exceedance (cfs) | 50% URO[2] cfs/$mi^2$ | 90% Exceedance (cfs) | 90% URO[2] cfs/$mi^2$ | $1^{st}$-$14^{th}$ (cfs) | $15^{th}$ to month end (cfs) |
| October | 1,520 | 0.87 | 681 | 0.39 | 640 | 750 |
| November | 6,499 | 3.70 | 1,860 | 1.06 | 1305 | 2220 |
| December | 10,749 | 6.12 | 4,587 | 2.61 | 3800 | 3800 |
| January | 11,147 | 6.34 | 4,267 | 2.43 | 3800 | 3800 |
| February | 10,664 | 6.074 | 5,081 | 2.89 | 3800 | 3800 |
| March | 8,585 | 4.89 | 4,272 | 2.43 | 3800 | 3800 |
| April | 5,794 | 3.30 | 3,242 | 1.85 | 3800 | 3800 |
| May | 3,040 | 1.73 | 1,893 | 1.08 | 2910 | 2300 |
| June | 1,715 | 0.98 | 1,167 | 0.66 | 1750 | 1360 |
| July | 1,056 | 0.60 | 743 | 0.42 | 1085 | 860 |
| August | 736 | 0.42 | 548 | 0.31 | 680 | 550 |
| September | 796 | 0.45 | 555 | 0.32 | 550 | 550 |

[1] based on the addition of daily data from three gages USGS station #12-031000: Chehalis R. at Porter , Cloquallum #12-032500 and the Satsop R #12-035000 for coinciding record years 1955-72 and 75-99 + accretion flow to #19 outlet; drainage area = 1,757 $mi^2$

[2] URO = unit runoff

In addition to the unknown numerous water withdrawals, the streamflow records from the mainstem stations downstream of Skookumchuck River confluence (#12-027500 and #12-031000) were all affected by regulation from the Skookumchuck Reservoir, which was completed in 1971. This reservoir has a normal storage of 35,000 acre-feet and maximum

storage of 60,000 acre-feet. Level 2 efforts may need to investigate the operating scheme of the Skookumchuck dam and impacts on downstream streamflow records. For example, to what extent are releases in summer months augmenting low flows in Skookumchuck River itself and further downstream? How significant is the effect further downstream on the mainstem Chehalis River?

## 3.5.3 WATER RIGHTS & WATER USE

Of the 162 water rights that have been issued by WDOE in this subbasin, 51% (82 rights) listed the source of supply as surface water. The allocated amounts, however, were mostly associated with ground water withdrawals (51.4 cfs) compared to 20.2 cfs connected with the surface water rights. One small storage right (6 acre-feet) for fish propagation was listed in this subbasin. By number, 70% of the rights (114) were designated for irrigation, 17% for domestic use, and 7% for stock watering. By volume, 72% were allocated for irrigation while the allocation to municipal and stock watering beneficial uses was about 9% each.

The largest water right for this subbasin was a ground water application for irrigation in the amount of 1,600 gpm, or ~3.6 cfs. The largest surface water right was a certificate for 1.33 cfs, also for irrigation. The single commercial water right was the second largest right for 1,200 gpm, or ~2.7 cfs.

The most senior water right in the basin was dated January 1, 1910 for 150 gpm; the beneficial use assigned to this right was *right of way* and *general domestic*. A *municipal* right was the next most senior right dated March 1, 1912 for 260 gpm. There were 27 rights junior to the 1975 base/instream flows set by the WDOE; 17 certificates, 1 permit and 9 applications.

**Table 3.5-2. Mainstem Chehalis River – Lower Reach 1**
**Water Rights Summary by Primary Purpose**

| Primary Purpose (# rights) | Allocated Amount (cfs) | Volume Limit (acre feet) | Irrigated Land (acres) |
|---|---|---|---|
| *Consumptive Uses* | | | |
| Commercial/Industrial (1) | 2.78 | 480 | 0 |
| Domestic (27) | 3.61 | 1,679.6 | 0 |
| Irrigation (114) | 51.12 | 6,716.95 | 4,793.25 |
| Municipal (4) | 6.70 | 1,654 | 0 |
| Recreation (1) | 0.25 | 0 | 12 |
| Right of Way (1) | 0.33 | 9.34 | 0 |
| Stock (12) | 6.12 | 857.8 | 646 |
| ***Subtotal*** | ***70.91*** | ***11,397.69*** | ***5,453.25*** |
| *Non-Consumptive Uses* | | | |
| Fish Propagation (1) | 0.30 | 7 | 0 |
| Storage for FP (1) | 0 | 6 | 0 |
| ***Subtotal*** | ***0.30*** | ***13*** | ***0*** |
| **TOTAL** | **71.22** | **11,410.69** | **5,453.25** |

(Includes Certificates, Permits, and Applications)
[1]Envirovision and Watershed Professionals Network assume no responsibility for the accuracy of the data provided by the Washington State Department of Ecology.

The four municipal rights were in the name of the Town of Elma: 3 certificates (2,010 gpm or ~4.5 cfs) and 1 application (1,000 gpm or ~2.2 cfs). The annual volume limit for the certificates was 1,654 acre-feet.

There were 416 registered claims in this subbasin, 84% of which were designated for ground water withdrawals. The majority of the claims (368) were for general domestic purposes with the remaining claims split almost evenly between irrigation and stock water use. Of the claims to which a priority date was entered into the database, 97 ground water rights preceded the 1945 ground water code and 16 surface water rights held priority dates preceding the 1917 surface water code.

## Residential and Municipal Water Use

An estimation of the population and subsequent actual water use estimates in subbasin #19 was not possible at this level of analysis. Population data could not be extracted from the 1992 Chehalis Basin Action Plan since subbasin #19 was part of a larger subbasin in that report entitled "Lower Chehalis Basin." Also, population data in GIS format from Grays Harbor County were not available. Instead, population was roughly estimated from the assessors' databases to the extent possible. A partial estimate of water use was done based on the information that was available, including the WDOH public water system information and the assessors' parcel data.

There were 15 public water systems with their points of withdrawal within subbasin #19. The largest system was the City of Elma, serving 1,200 residential connections, supplying water to 3,000 people. There were an additional 122 residential connections serving 314 people. The per capita daily water use in this subbasin was estimated at 134 gallons using the precipitation-based method developed by the WDOH (1999). The estimated water use for the public water system population was roughly 0.7 cfs. The total allocation for municipal and multiple domestic rights was 9.94 cfs; the public water system use was roughly 7% of the total allocation.

Investigating the Grays Harbor and Thurston County assessors' databases, there were 1,765 single-family residential parcels that would house approximately 4,413 people. An additional 380 parcels were identified in the residential category, 50 in the 2 to 4 unit category (about 375 people), 16 multi-unit households (5+), and 6 mobile home parks. At this level, the number of units within each parcel for the latter two categories was unknown. Another 308 parcels were categorized as "other residential", which may include bare land or sheds etc. In summary, the parcel based method leads to an estimate of 2,145 parcels listing some type of residential designation.

There were 20 single domestic water rights for 0.37 cfs; the allocation for each was either 0.01 cfs or 0.02 cfs, with two exceptions; one right was for 0.03 cfs and the other for 0.07 cfs. Six multiple domestic rights totaled 3.23 cfs for the instantaneous diversion/withdrawal rate. The Washington Public Power Supply System held the largest of these for 1,007 gpm (~2.2 cfs) designated general domestic; this right was associated with the Satsop power plant. According to Energy Northwest, this right was reduced to 300 gpm in 1996 and redesignated for construction, restoration, domestic, and fire protection services, however, the WDOE database did not reflect this change at the time the data were obtained. The remaining 0.99 cfs in multiple domestic rights may cover some or all of the 15 public water systems.

Assuming 20 of the 1,765 residential parcels were supplied water under a single domestic right, the remaining 1,745 households were served either by a public water system and/or a multiple domestic right, or by a claim or an exempt well.

The average number of people per household in Grays Harbor and Thurston County was 2.5 and 2.55, respectively, or an estimated population of 4,457 living in single-family homes. Based on the public water system data, the mobile home parks were assumed to provide water to 113 people. The multi-unit household population was much more difficult to obtain; a very rough estimate of 250 people was calculated from the building values of single-family homes and multi-family units. This number was generated solely to provide a very rough estimate of exempt wells and should be refined using actual population data when it becomes available. Assuming the population residing in the multi-unit buildings and mobile home parks were served by a public water system and/or under a multiple domestic water right, it was possible to estimate the number of exempt wells as follows:

4,457 people in single-family homes and 2 to 4 unit dwellings
+ 738 people served by mobile homes and multi-unit residences
5,195 total population estimate (water use ~ 1 cfs)

-3,314 people served by a public water system
1,881 people were self-supplied under a water right, claim or exempt well
- 50 people were self-supplied with a single domestic water right
1,831 people self-supplied under a multiple domestic right, claim or exempt well
(1,831 people = 725 households using ~ 0.4 cfs)

Further analysis using the parcel-based method described in Section 3 can separate out the multiple domestic water users from the exempt wells or claims.

## Commercial/Industrial

There were 13 commercial connections served by public water systems in the WDOH database. Weyerhaeuser Company held the only commercial/industrial water right (1250 gpm or ~2.8 cfs) in this subbasin. Briggs Nursery, a commercial enterprise, had water rights under irrigation rather than commercial/industrial, therefore, it is addressed below.

## Irrigation

Water rights covered a total of 5,453 acres for irrigation. Nearly 12% of these were associated with water rights that listed stock water as a primary beneficial use. Of those rights with irrigation as the primary beneficial use, the instantaneous withdrawal/diversion rate was 51.12 cfs and the annual volume limit was 6,716.95 acre-feet. There were 114 irrigation rights with an average rate of 0.45 cfs. These small numerous irrigation rights were located throughout this subbasin.

Briggs Nursery, a public water system, may be the largest single user of irrigation water in this subbasin. The nursery held 13 water rights, four of which were applications. Two of the nine certificates listed stock water as the primary beneficial use with irrigation secondary; the point of diversion for one of these did not fall within Subbasin #19. Of the 12 water rights within Subbasin #19, the total instantaneous withdrawal rate was 5,105 gpm (~11.4 cfs), with an annual volume limit of 1,758.4 acre-feet. The acreage associated with these rights totaled 665 acres. There were three change documents for these rights, however, it was not possible to discern the nature of these changes by viewing the database alone. Examination of the actual water right documents would be necessary to clarify the current allocations for the nursery.

Figure 3.5-2 depicts estimated monthly water demand for the subbasin. Assuming all 5,453 acres with water rights were irrigated in pasture/turf and using the climate and crop consumptive use data from Elma, Washington, the total crop irrigation requirement, assuming a 50% efficiency, was estimated at ~16,000 acre feet, about half of which is needed in July and August. The remaining amount was spread over April, May, June, and September. Field corn would require about 30% the amount of water (4,800 acre feet) in the months of July, August, and September. The annual volume limit associated with the irrigated acreage was about 7,575 acre feet. This being less than half the 16,000 acre feet demand for pasture grass at 50% efficiency indicated that either large areas of crops with lower consumptive use and/or higher efficiencies would have to be used to keep within the volume limitation for the given number of acres.

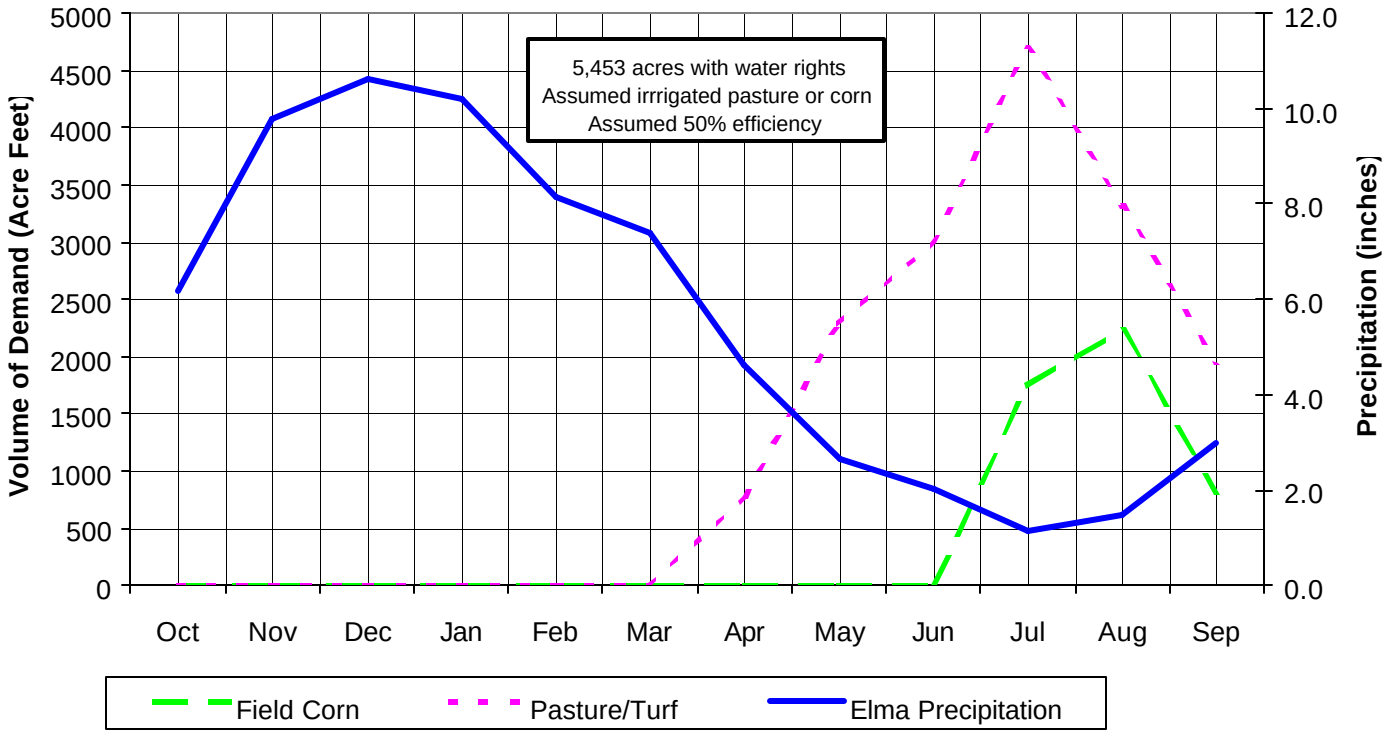


**Figure 3.5-2. Subbasin #19: Chehalis River Mainstem – Lower Reach 1**
**Monthly Irrigation Water Demand**

Source: WSU Cooperative Extension, *Irrigation Requirements for Washington – Estimates and Methodology*. Education Bulletin #1513

## Comparison of Streamflow and Allocated Water

Figure 3.5-3 is a comparison of the inflow to the basin (USGS Gage #12-031000) plus the accretion within the basin, at the 50% and 90% exceedance levels, instream flows, and the total allocated water for consumptive uses. In addition, the graph includes a line depicting combined instream flow plus the instantaneous water right allocation.

The 50% exceedance flow, or median flow, ranged from a low of 736 cfs in August, to a high of 11,147 cfs in January. This means that, in August, 50% of the flows were higher than 736 cfs and the other half of the flows were less than 736 cfs. The 90% exceedance flows were lowest in August and highest in February, i.e. 90% of the flows were 548 cfs or greater and 5,081 cfs or greater, respectively. The instream flows used on this graph represent the average of the bimonthly base/instream flow values. The instream flows are lowest in August (615 cfs), September (550 cfs), and October (695 cfs).

Examining flows in August,

| | |
|---|---|
| 50% Exceedance Streamflow | = 736 cfs |
| 90% Exceedance Streamflow | = 548 cfs |
| Instream Flow | = 615 cfs |

Instantaneous Water Right Allocation for all consumptive uses = ~71cfs

The combined water right allocation and instream flow were equal to or greater than the 90% exceedance flows in five months. By contrast, sufficient water was available to meet the water rights allocation and instream flows year-round at the 50% exceedance level. In the absence of human water use, instream flows cannot be met seven months of the year at the 90% exceedance level.

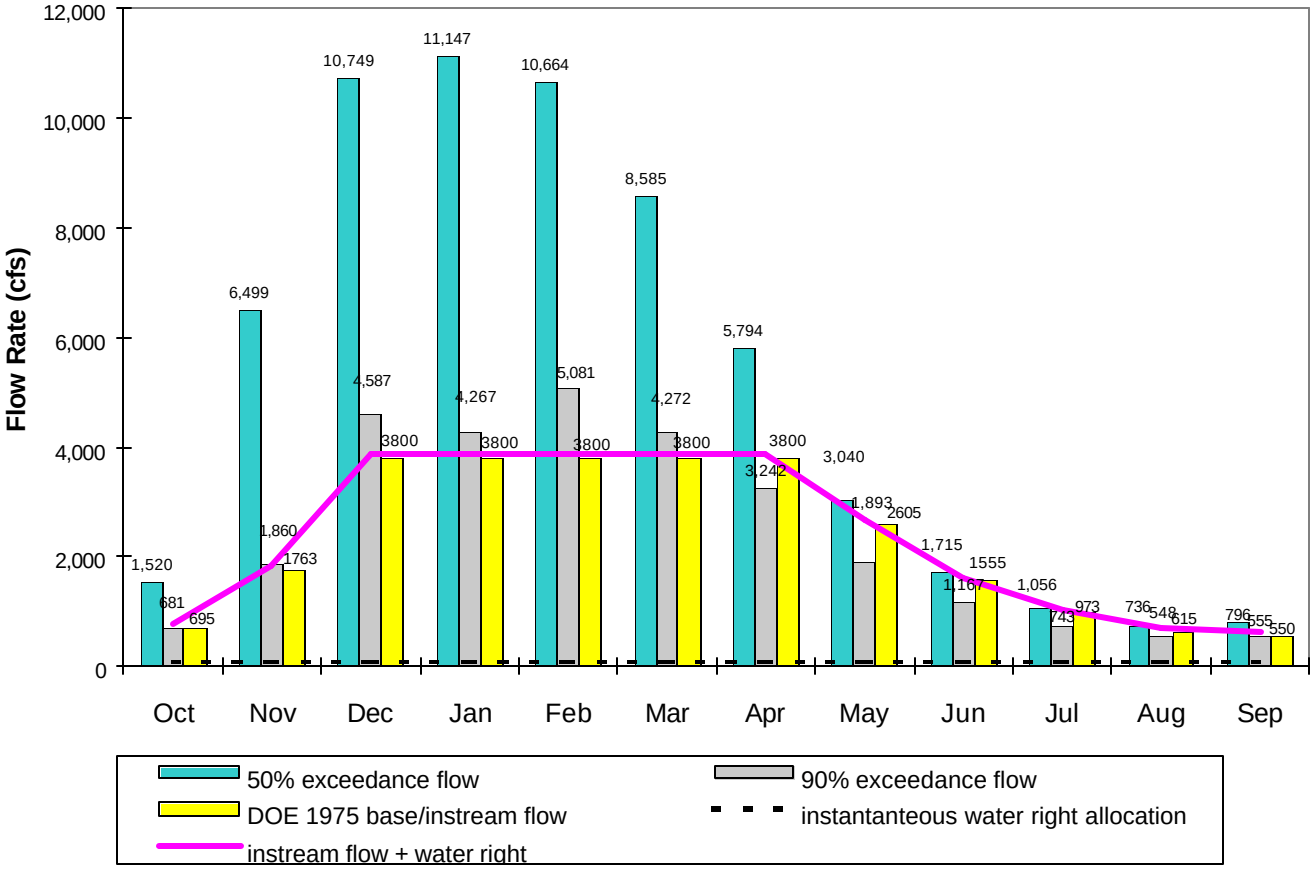


**Figure 3.5-3. Subbasin #19: Chehalis River Mainstem - Lower Reach 1 Comparison of Streamflow and Allocated Water**

The 71 cfs total allocated amounts for consumptive use included both surface water and ground water abstractions. Direct comparison of the total allocated amounts to the streamflow represents the "worst case" scenario because it assumes 100% hydraulic continuity. Withdrawals under the 29 ground water rights in this basin impact the flows in the Chehalis River around Elma to differing degrees, depending on depth of well, distance from the stream, and geology.

The consumptive portion of the allocated rights was 10% of the median and 13% of the 90% exceedance flows in August, the lowest flow month. If half of the water were returned to the system, the effective consumptive portion of these rights would then be 5% and 6.5%,

respectively. (Note: A 50% return efficiency is not uncommon for irrigation rights, but would be considered low for domestic/municipal rights which have return efficiencies closer to 75%.)

Given that streamflow measurements are usually accurate to within 10% of the true value of the flow, conservation efforts would not result in measurable increases in streamflow in this subbasin. Due to this, the potential for streamflow enhancement by changing withdrawal/diversion patterns was determined to be limited in this subbasin compared other subbasins described in this report.

**Table 3.5-3.**
**Summary Comparison of Water Rights and Water Use for the Chehalis River Mainstem.**

| Beneficial Use | Estimated Current Water Use (cfs) | Water Rights Allocation (cfs) |
|---|---|---|
| Domestic | 0.46 [1] | 3.61 |
| Municipal | 0.62 | 6.7 |
| Commercial/Industrial | Unknown | 2.78 |
| Irrigation | 4,800 to 16,000 acre feet | 7,575 acre feet |

[1]Estimated domestic use includes those that fall within exempt well category

### Summary of Water Allocation for Chehalis River Mainstem

- Domestic water use is approximately 13 % of the water rights allocation.
- Municipal use is approximately 9 % of the water rights allocation.
- Many small irrigation rights are distributed throughout this subbasin.
- Consumptive portion of rights is approximately 10 % of lowest median flows.
- Conservation efforts are not likely to result in measurable streamflow increases in this subbasin.
- This subbasin is not a priority for further analysis.

## 3.5.4 WATER QUALITY

No monitoring station exists within this subbasin. Data from the Montesano station located approximately 7 miles downstream was used for the analysis. The water quality data set for the Montesano station is fairly complete and extends from October 1977 through September 1992. It is listed for temperature and fecal coliform violations. Yields (based on extrapolations of flow data) were low for TP and TSS, but the highest measured for IN in the Chehalis. For perspective, the IN yield was second only to the Samish River in the 21 stream and river basins studies in a Puget Sound wide study.

## 3.5.5 FISH HABITAT/ CHANNEL MODIFICATIONS/ STOCKS

### Fish Habitat

This subbasin includes the mainstem Chehalis River between the Satsop River and Porter Creek, including Workman Delezene, Newman, and Vance Creeks. USFWS extensive survey data for the mainstem Chehalis River is presented in Appendix D.

*USFWS/WDFW extensive survey*. A total of 42 stream miles were surveyed in their "*Workman Delezene*" subbasin, including portions of Workman, Delezene, and Eaton Creeks, and two unnamed tributary creeks. The most important habitat problems identified included:

- stream canopy reduction from forest practices (1 point and 23.3 miles) (Workman, Delezene, Eaton Creeks),
- excessive sediments in streambed (1 point and 16.2 miles) (Workman, mid- and lower Delezene, upper Eaton Creeks),
- stream canopy reduction from agriculture (9 points and 3.3 miles) (upper Eaton, lower Delezene, lower Workman), and
- bank erosion (53 points and 0.3 miles) (Workman and Delezene Creeks).

Beaver dams were fairly widespread across this subbasin at the time of the survey. A total of 4 known or suspected water withdrawals and 6 known or suspected pollution input sources were also noted (Wampler et al., 1993).

Habitat survey results for Vance and Newman Creeks were summarized with Cloquallum Creek, our (Subbasin #14).

## Channel Modifications

This subbasin comprises the Chehalis River mainstem from the Satsop River confluence upstream to the Porter Creek confluence. Also included are Workman, Delezene, Mox Chehalis, and Sand Creeks.

USFWS/WDFW extensive surveys summarize results for 110 miles of the Chehalis River mainstem surveyed, from the mouth to about the confluence with the Black River. The data indicate that about 5 percent of the length surveyed had reduced stream canopy due to logging and 73 percent had a reduction due to agriculture. Livestock had access to about 7 percent of the channel network. Erosion was noted over 22 percent of the surveyed area, and 7 percent of the channel was protected by some measure (usually riprap) (Wampler et al., 1993).

Approximately 13.6 miles of channel from Porter to the mouth of the Satsop River were assessed using 1988 photos. Table 3.2-4 presents the results of assessment of riparian conditions along this section of the river. Not surprisingly, the riparian forest in this area has been considerably altered over the long course of human activities. The channel is spanned by 4 bridges in this reach and is closely paralleled by roads or railroad grades for approximately 7,000 feet.

These features, as well as agricultural activities, can limit meander movement and isolate side channels or sloughs. An investigation of the mainstem Chehalis between the Satsop and Wynoochee Rivers found 28 sites where former off-channel areas, sloughs, and side channels were still in existence, but had been isolated from the main river channel by past land use actions (Ralph et al., 1994). This type of land use action has likely occurred in this reach of the Chehalis, but to determine the degree of alteration and the strength of the connection between land use and channel alteration would require a more detailed study than that associated with Level 1.

### Fish Stocks

Detailed information on the status of fish stocks within the Middle Chehalis River subbasin is not available. General information on the status of stocks within the entire Chehalis watershed is provided in Appendix D: Technical Report for Fish Habitat/ Channel Modifications/ Stocks.

# *3.6 Subbasin 25: Humptulips River*

## 3.6.1 GENERAL DESCRIPTION

The Humptulips River Subbasin (#25) covers 244 $mi^2$, from the headwaters of the Humptulips River to the confluence with Grays Harbor. The elevation ranges from sea level to a high of 4,397 feet in the Olympic Mountains; mean basin elevation is 722 feet. The mean annual precipitation is about 127 inches (WDNR, 1991). Mean annual discharge measured at the USGS stream gage (#12039000, Humptulips River near Humptulips), was 1,337 cfs. This translated into a unit runoff of approximately 10 $cfs/mi^2$; winter unit runoff averaged 18 $cfs/mi^2$, while summer unit runoff was 3 $cfs/mi^2$. The primary land use for this subbasin was forestry with some agricultural and residential land uses along the river valley (Figure 3.6-1) (WDNR, 1990).

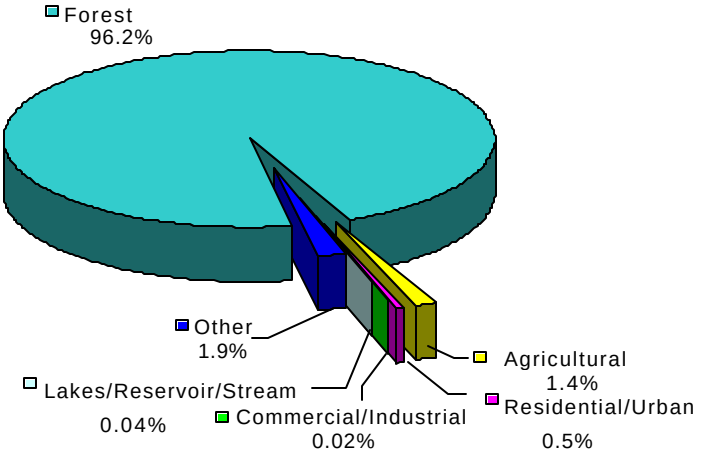


**Figure 3.6-1. Subbasin #25: Humptulips River**
**Land Use/Land Cover Summary**
Source: WDNR, 1990

## 3.6.2 GEOLOGY AND HYDROLOGY

### Geology

The upper portion of the basin above the community of Humptulips is underlain by Eocene epoch volcanic rocks of the Crescent formation. In the lower portion of the basin, old glacial deposits and alluvial material of varying age can be found.

## Groundwater Hydrology

Little groundwater information is available for the Humptulips, but a well developed aquifer is likely present in the glacial and alluvial material in the lower portion of the basin.

## Surface Water Hydrology

The USGS collected mean daily discharge at the Humptulips station (#12039000) from 1933 to 1935 and 1942 to 1979. The station was located mid-way up the Humptulips at river mile 24.8. While these records covered numerous years, record extension techniques were employed in attempt to cover a period of record similar to the other basins and representative of natural climate variability.

The Humptulips River record was extended using the Wynoochee River (#12035500) gage records to fill in the seven years from 1935 to 1942. The Humptulips River record could not be extended to cover the 1980 to 1998 period using the Wynoochee River data because this later period was influenced by regulation of the Wynoochee reservoir (completed in 1972).

The majority of years (32 of the 46) within the 1933-1979 period experienced the conditions of a cool/wet Pacific Decadal Oscillation (PDO) phase, however, the cyclical phases can have both above normal and below normal years. Based on the longer record at the Satsop near Satsop gage (1929-98), the 1933-79 period included 23 years of flows above the long-term annual average and 25 years below normal. Therefore, the available streamflow data reflected both wet and dry conditions even though they occur during a predominantly cool/wet PDO phase.

Since land use was predominantly forestry (primarily National Forest ownership), with no development in the watershed above the gage, and the USGS (station remarks) and WDOE (Sinclair and Pitz, 1999) both reported no regulation or diversions upstream of the gage, the extended records were representative of "undepleted flows".

Monthly flow exceedance values were generated for this station based on the actual and synthetic daily streamflow values; the 50% and 90% exceedance values are listed in Table 3.6-1 along with the instream flows for the Humptulips control point coincident with the gage location.

**Table 3.6-1**
**Flow Exceedance Values for Humptulips River Subbasin #25**

| Month | Flow Exceedance Values[1] Gage #12-039000: Humptulips R. near Humptulips | | | | WDOE 1975 Base/Instream Flow | |
|---|---|---|---|---|---|---|
| | 50% Exceedance (cfs) | 50% URO cfs/mi$^2$ | 90% Exceedance (cfs) | 90% URO cfs/mi$^2$ | 1$^{st}$-14$^{th}$ (cfs) | 15$^{th}$ to month end (cfs) |
| October | 575 | 4.42 | 169 | 1.30 | 205 | 250 |
| November | 1,490 | 11.46 | 506 | 3.89 | 390 | 600 |
| December | 2,055 | 15.81 | 906 | 6.97 | 600 | 600 |
| January | 1,700 | 13.08 | 676 | 5.20 | 600 | 600 |
| February | 1,621 | 12.47 | 759 | 5.84 | 600 | 600 |
| March | 1,380 | 10.62 | 682 | 5.25 | 600 | 600 |
| April | 1,000 | 7.69 | 605 | 4.65 | 600 | 600 |
| May | 683 | 5.25 | 420 | 3.23 | 600 | 500 |
| June | 400 | 3.08 | 247 | 1.90 | 400 | 325 |
| July | 256 | 1.97 | 157 | 1.21 | 265 | 215 |
| August | 187 | 1.44 | 119 | 0.92 | 170 | 170 |
| September | 216 | 1.66 | 129 | 0.99 | 170 | 170 |

[1]Based on 7 years synthetic data and 39 years daily data from USGS station #12-039000, Humptulips R near Humptulips; 1933-79 drainage area was 130 mi$^2$

## 3.6.3 WATER RIGHTS & WATER USE

### Water Rights

A total of 30 water rights were tabulated in this subbasin: 17 surface water rights; 11 ground water rights; and 2 storage rights. Of the surface water rights, there were 15 certificates, 1 permit, and 1 application. The City of Ocean Shores holds a permit for the largest diversion from the Humptulips River (20 cfs); this right would constitute an out-of-basin diversion and thereby a 100% loss to the system. A private individual holds the only surface water application on record, which is intended for fish propagation. Ten of the eleven ground water rights were certificates; the remaining one was an application for general domestic use by the Washington State Baptist Convention.

The instantaneous amount of water allocated totals 86.55 cfs, of which 57.14 cfs was for non-consumptive uses (fish propagation). Five of the six surface water right certificates for fish propagation were held by the WDFW. The two storage rights for 469 acre-feet were also for fish and wildlife propagation.

The most senior water right (priority date of July 20, 1923) was designated for power and commercial/industrial use in the amount of 2.25 cfs, filed by the Oriental Lumber Company. The portion allocated for power could not be determined from the WRATS database. The most junior certificate in this subbasin had a priority date of July 24, 1979; two applications were junior to this right. The certificates senior to the 1975 base/instream flow represented 86 cfs (29 cfs of the consumptive rights).

Of the five largest water rights in the Humptulips River subbasin, three were for fish propagation (55 cfs total). The second largest right was for 20 cfs of multiple domestic use by the City of Ocean Shores. The fifth right was the most senior right discussed above.

Of the total allocated amount, 66% was designated for non-consumptive beneficial uses (fish and wildlife propagation). Irrigation rights represented nearly 14% of the consumptive rights (5% of the total allocation) totaling 3.99 cfs with an annual volume limit of 486.25 acre-feet. Of the 308.75 acres classified for irrigation, 54 acres were not assigned a volume limit in the WRATS database (WDOE 2000).

The number of registered claims in the Humptulips subbasin totaled 242, of which 211 were ground water claims and 31 were surface water claims. Only 8 claims were designated for irrigation purposes, 6 for stock watering, 4 unknown uses, and the remaining 224 indicated the primary beneficial use as general domestic. The largest claim in terms of irrigated land was for 730 acres; the total irrigated acres under the registered claims equaled 2,012. Many of these claims also listed stock and irrigation as secondary and tertiary beneficial uses.

**Table 3.6-2. Subbasin #25: Humptulips River Water Rights Summary by Primary Purpose[1]**

| Primary Purpose (# Rights) | Allocated Amount (cfs) | Volume Limit (acre feet) | Irrigated Land (acres) |
|---|---|---|---|
| Consumptive Uses | | | |
| Domestic (7) | 20.64 | 47.5 | 0 |
| Fire Protection (1) | 2.22 | 0 | 0 |
| Irrigation (12) | 3.99 | 486.25 | 308.75 |
| Power/Commercial/Industrial (1) | 2.25 | 0 | 0 |
| Right of Way (1) | 0.22 | 93 | 0 |
| Stock (1) | 0.09 | 6.4 | 0 |
| **Subtotal** | **29.41** | **633.15** | **308.75** |
| Non –Consumptive Uses | | | |
| Fish Propagation (7) | 57.14 | 394 | 0 |
| Storage for Wildlife & Fish Propagation | | 469 | 0 |
| **Subtotal** | **57.14** | **863** | **0** |
| **TOTAL** | **86.55** | **1,496.15** | **308.75** |

(Includes Certificates, Permits, and Applications)

[1]Envirovision and Watershed Professionals Network assume no responsibility for the accuracy of the data provided by the Washington State Department of Ecology.

## Residential and Municipal Water Use

There were ten public water systems with points of withdrawal in the Humptulips River subbasin, all of which were relatively small. The residential population served by these systems was 80, with 34 residential connections. Fifty-eight of the 80 people lived within mobile home parks and the remaining 22 people were associated with commercial enterprises.

In this subbasin, there were seven domestic rights for 20.64 cfs. The largest was a 20 cfs multiple domestic right allocated to the City of Ocean Shores, an out-of-basin diversion. Of the remaining six rights (0.64 cfs), one was a single domestic water right for 0.02 cfs and the other five were multiple domestic water rights. One of the five smaller multiple domestic rights was held by the Olympic National Forest for 0.1 cfs and was most likely associated with the Campbell Tree Grove Campground. This campground was listed as federally owned in the WDOH public water system list and served 1 non-residential connection.

Of the remaining four multiple domestic rights, with a total withdrawal rate of 0.52 cfs, three were tied reasonably well to the following public water systems: Timberview Mobile Home Park (population 25, residential connections 12); Warren Dahl (population 33, residential connections 11); and Riverview Recreation Area with 15 non-residential connections. At this level of analysis, the latter was an assumption since the only information available was the location of the system withdrawal in Township 20 North Range 10 West Section 7, which coincided with an irrigation/general domestic water right in the same section. The fourth multiple domestic right, Copalis Water Fund Inc., could not be specifically identified with a public water system since there were none that identified a point of withdrawal in the same section.

According to the county assessor's database, there were 308 single-family parcels, 1 unit of 2 to 4 households, and 3 mobile home parks. At least two of the mobile home parks appeared to be covered by water rights. The third mobile home park was not identified as a public water system, however, the water right in the name of the Copalis Water Fund Inc. may cover this use. Assuming this was the third mobile home park, the parcels that appeared to have no water rights totaled 310 (307 of the single-family households and an assumed 3 unit household (2-4 unit category)). These 310 households appeared to be covered by claims or exempt wells. Applying the Grays Harbor average people per household of 2.5, there were 775 people using water under exempt wells or claims. Assuming 119 gcd (WDOH, 1999) for self-supplied water users, the total water use for this population was estimated at roughly 0.14 cfs.

An alternative approach was to use the population data from to the Chehalis Basin Action Plan (1992). The reported 1990 population in the Humptulips River subbasin from that document was approximately 3,600 with 1,200 units from Ocean Shores. Assuming the county average of 2.5 people per household, the 1,200 units housed 3,000 people. The remaining 600 people would be the 1990 population within subbasin #24. The average projected rate of growth between 1990 and 2000 was 11%, leading to an average projected year 2000 population of 666. As of September 1999, the public water systems in the subbasin supplied a population of 80; the difference of 586 was assumed to be self-supplied water users, some of whom may have water rights. There were six single domestic rights providing water for about 15 people. The difference of 571 self-supplied water users (total self-supplied users less those covered under

single domestic rights) was estimated to use about 0.11 cfs (119 gcd calculated using WDOH (1999)). An estimate of actual water use for the total population (applying 119 gcd) was approximately 0.12 cfs. The combined municipal and domestic water rights total 3.52 cfs (excluding the 20 cfs out-of-basin allocation), which means the estimated actual water use was about 3% of the total allocated water for this sector. Using the first approach, the actual use was about 4% of the total allocated water for residential use.

## Commercial and Industrial Water Use

By water right, there were three commercial/industrial water users in this subbasin: Graham Shake Company, Oriental Lumber Company, and Polson Logging Company. Based on the public water system information, there were three stores (two were grocers), one restaurant, and two campgrounds. There were no records of actual use of any of these entities, however, the water right amount associated with the three forest products industries total 4.69 cfs; 4.47 cfs for which volume limits were not indicated. The continuous use of 4.47 cfs was calculated to be 3,236 acre-feet per year. Adding the 93 acre-feet restriction on the remaining 100 gpm water right, the total legal entitlement was 3,329 acre feet/year for commercial/industrial use.

One of the campgrounds, Campbell Tree Grove Campground, was noted as federally owned. WDOH listed it as a public water system with 1 connection; a water right of 0.1 cfs was on file with WDOE. The campground is located in Olympic National Forest (T23N R8W S15).

## Irrigation

Irrigation rights represented nearly 14% of the consumptive rights, or 3.99 cfs with a volume limit of 486.25 acre-feet. Under these existing water rights, 309 acres of land can legally be irrigated (the assessor's database indicated 479 acres in agricultural land). The computation of irrigation water requirements involves estimating crop consumptive use, effective precipitation, conveyance losses, and on-farm efficiencies.

At this assessment level, there was insufficient data to estimate the actual water use for irrigated croplands; the actual number of irrigated acres was unknown. It was possible, however, to examine the crop water requirements for the water righted acreage using regional climatic data and estimating efficiencies. Pasture/turf was used in this analysis since the crop water requirement was higher than most other crops grown in this area resulting in a higher estimate of the water use impact on the streamflows. Using this approach, an upper bound was established given that all the water righted acres were irrigated.

Aberdeen was the closest climate station for which crop consumptive use has been estimated (Washington Irrigation Guide, 1991). While the Humptulips subbasin mean annual precipitation was significantly higher than the 83 inches at Aberdeen, most of the irrigated agriculture was likely to occur at the lower end of the basin where precipitation levels would more closely approximate those measured in Aberdeen.

Figure 3.6-2 demonstrates the estimated differences in irrigation water requirements, assuming 50% and 60% efficiency for the 309 acres of irrigated pasture. The total volume of the irrigation water demand from April to September (area under the curve) from the river (using the Aberdeen climate data,) ranged from 295 acre-feet/year to 354 acre-feet/year depending on the efficiency

assumed. The annual volume limit associated with the irrigation rights totaled 486.25 acre-feet, or over 132 acre-feet per year more than the total demand of pasture/turf at 50% efficiency.

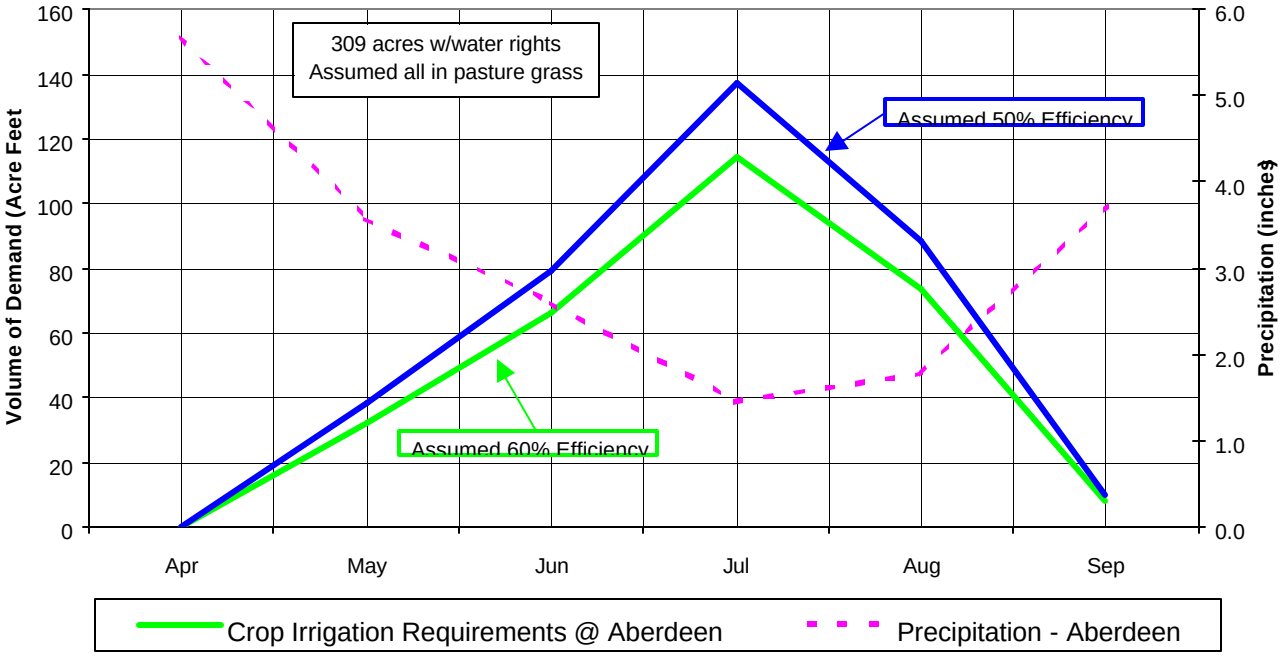


**Figure 3.6-2. Subbasin #25: Humptulips River**
**Monthly Irrigation Water Demand for Pasture/Turf**
Source: WSU Cooperative Extension, *Irrigation Requirements for Washington – Estimates and Methodology*. Education Bulletin #1513

## Comparison of Streamflow and Allocated Water

Figure 3.6-3 is a comparison of flows (50% and 90% exceedance), instream flows, and the total allocated water for consumptive uses. In addition, the graph includes a line depicting combined instream flow plus the instantaneous water right allocation.

The 50% exceedance flow, or median flow, ranged from a low of 187 cfs in August to a high of 2,055 cfs in December. This means that in August, 50% of the flows were higher than 187 cfs and the other half the flows were less than 187 cfs. The 90% exceedance flows were also lowest in August and highest in December, i.e. 90% of the flows were 119 cfs or greater and 906 cfs or greater, respectively. The instream flows used on this graph represented the average of the bimonthly base/instream flow values. The monthly average of the instream flows are lowest in August (170 cfs) September (170 cfs) and October (average of 230 cfs).

Examining flows in August,

| | |
|---|---|
| 50% Exceedance Streamflow | = 187 cfs |
| 90% Exceedance Streamflow | = 119 cfs |
| Instream Flow | = 170 cfs |
| Instantaneous Water Right Allocation for all consumptive uses | = 29.4 cfs |

At the 50% exceedance level, the streamflow was sufficient to meet the combined water right allocation and instream flows in all but two months, July and August. There was insufficient water available at the 90% exceedance flows to supply all of the water right allocations and the instream flow needs in eight months of the year, April through November. Without the water rights allocations, instream flows were met year-round at the 50% exceedance level and in six months of the year at the 90% exceedance level.

The median flows (at the 50% exceedance level) were greater than the instream flows in the winter/ spring months (November through April). For the summer and fall months, the instream flows were much closer to the median of the flows (July and August were within 10%). In these months, even absent of withdrawals of water for human use, the flows were insufficient to meet the instream flow.

The 29.4 cfs total allocated amount for consumptive uses included both surface water (17 rights) and ground water rights (11). Direct comparison of the total allocated amounts to the streamflow represented the "worst case" scenario because 100% hydraulic continuity was assumed. Withdrawals under the 11 ground water rights in this basin impact the flows in the Humptulips River to differing degrees dependent on depth of well, distance from the stream, and geology.

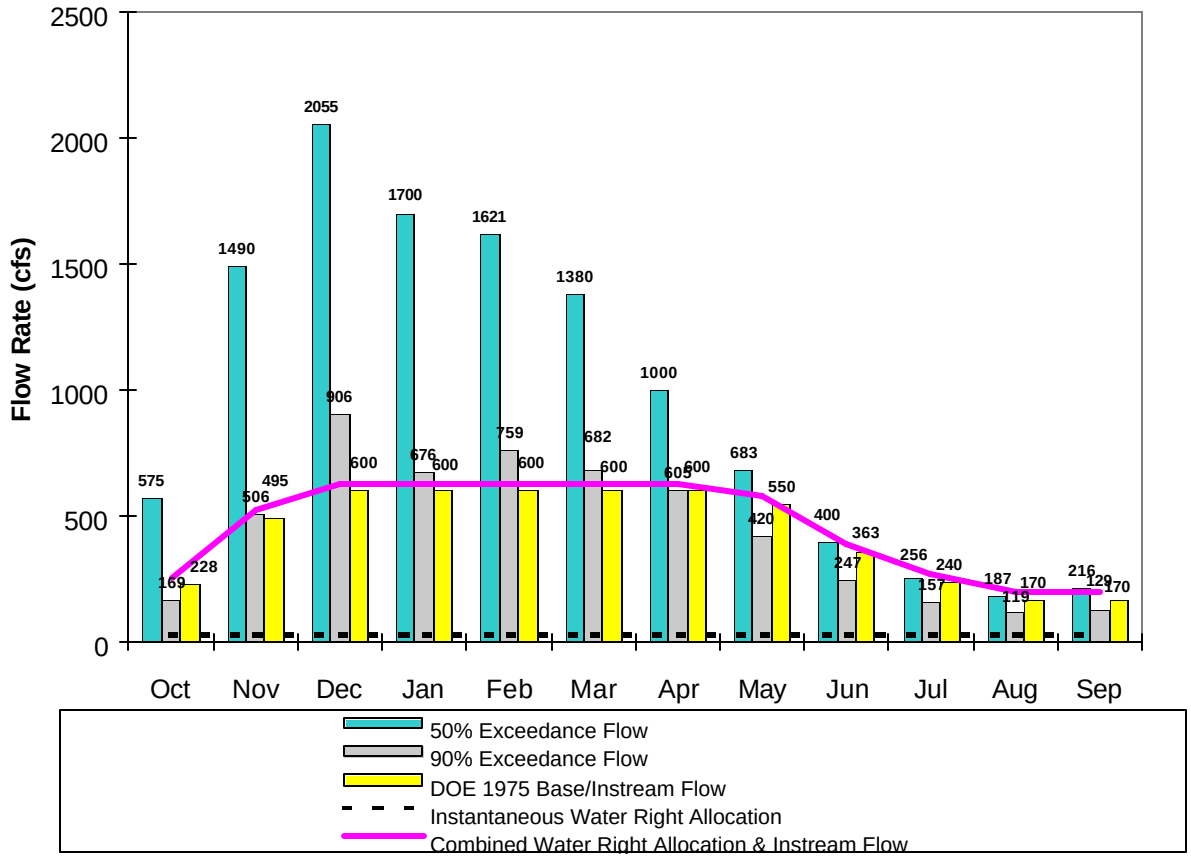


**Figure 3.6-3. Subbasin #25: Humptulips River**
**Comparison of Streamflow and Allocated Water**

The consumptive portion of the allocated rights (29.41 cfs) was 16% and 25% of the lowest monthly median and 90% exceedance streamflows, respectively. Assuming half of the water was returned to the system, the effective consumptive portion of these rights was then 8% and 12.5% of the median and 90% exceedance flows in the lowest month of August. (Note: A 50% return efficiency is not uncommon for irrigation rights, but would be considered low for domestic/municipal rights which have return efficiencies closer to 75%.)

Since the ground water rights represent 10% of the total number of rights, the effective consumptive use would actually by something less than 12.5%. Given that streamflow measurements are usually accurate to within 10% of the true value of the flow, conservation efforts would not result in measurable increases in streamflow in this subbasin. Due to this, the potential for streamflow enhancement by changing withdrawals/diversion patterns was determined to be limited in this subbasin compared to subbasins #7 and #14, and therefore, further analysis here should be given a lower priority.

**Table 3.6-3.**
**Summary Comparison of Water Rights and Water Use for the Humptulips River.**

| Beneficial Use | Estimated Current Water Use (cfs) | Water Rights Allocation (cfs) |
|---|---|---|
| Domestic | 0.12 to 0.14 | 0.64 |
| Ocean Shores | 0 | 20 |
| Commercial/Industrial | Unknown | 2.25 |
| Irrigation | 295 to 354 acre feet | 486.3 acre feet |

### Summary of Water Allocation for Humptulips River

- Domestic use is approximately 20 % of the water rights allocation.
- Irrigation rights represent approximately 14 % of the consumptive rights.
- The consumptive portion of rights is 16 to 25 % of the lowest median flows.
- Conservation efforts are not likely to result in measurable streamflow increases.
- This subbasin is not a priority for further analysis.

## 3.6.4 WATER QUALITY

The water quality station in the Humptulips is located nearly 24 miles upstream of the mouth. The record for this station extends back to the 1970's. Temperature and fecal coliform standards have been exceeded at this station, thus it is included in the 303(d) list for these problems. The average annual TP and TSS yields were the highest measured in this study, while the IN yield was lowest. As noted in the hydrology analysis, this subbasin has the highest unit runoff at least two times higher than what was estimated at the other four subbasins described above. Since TP and TSS are closely associated with runoff, the high yields calculated may be an artifact of this characteristic.

## 3.6.5 FISH HABITAT/ CHANNEL MODIFICATIONS/ STOCKS

### Fish Habitat

Fish habitat has been assessed in the East Fork and WF Humptulips Rivers upstream of their confluence as part of the *East/West Humptulips watershed analysis* (Dieu and Martin, 2000; Martin and McConnell, 2000). Spawning gravels were found in adequate amounts in the anadromous zones. Substrate embeddedness was found to be high in O'Brien Creek and the West Fork Humptulips. The relative amount of pool habitat available for summer rearing was high in both upper mainstems and in several tributaries with anadromous fish. Amounts of instream LWD were adequate in many tributaries, especially those upstream of historic splash dam locations. Instream LWD amounts were found to be low in portions of the West Fork and larger portions of the East Fork. Loss of LWD-associated habitat as a result of channel flushing and reduced inputs of LWD was identified as a concern for the lower portions of the channel network. A reduction in the rate of bank erosion was also identified as a key objective in areas where the river channel is confined by terraces. Summer water temperatures were determined to cause risk to juvenile steelhead and chinook, especially in the lower reaches of the East and West Forks.

Collins and Dunne (1986) estimated that gravel removal in the Humptulips River between RM 16 and RM 28, between the late 1950's and 1985, caused the river bed to lower, with an estimated rate of 0.1 foot/year. Harvest rates in Grays Harbor County were adjusted after 1986, and the current gravel harvest rate is lower than the rate during that period. Also, WDFW now encourages gravel pit location outside of active stream channels. Current gravel harvest rates, and currently acceptable instream locations, are not known.

### Channel Modifications

The Humptulips has an extensive history of splash dams, with over thirty dams reported in operation between 1900 and the 1930's. Stream channels were scoured of both gravel and instream LWD as a result of dam operations, and severe bank erosion of downstream areas converted to orchards and farmland was common (Van Syckle, 1981). In conjunction with dam operations, the liberal use of dynamite altered channel conditions by removing boulders and bedrock obstructions (Wendler and Deschamps, 1955).

Following dam removal, stream cleaning, gravel mining, and riparian vegetation loss have also affected channel conditions. Gravel mining occurred on at least 24 gravel bars on the mainstem Humptulips between 1955 and 1983. Gravel harvest rate exceeded the replenishment rate during this period (Collins and Dunne, 1986).

Although shifts in general channel position likely did not occur, changes in channel form have been documented. Maps made of the river in the mid 19$^{th}$ century display a river that is wider and less sinuous (15%) than today (Collins and Dunne, 1986). Collins and Dunne surmise that this is consistent with a river in transition from a gravel rich braided system to a more meandering river with less gravel. This transition is aided by land use changes within the riparian corridor. Historical changes in the size of the channel migration zone (CMZ) have also been quantified (Martin et al., 1998). Over the past 47 years, the CMZ was largest for both forks of the river in the 1950 or 1968 photos (Martin et al 1998). This tends to follow the pattern of

many western Washington channels, which were altered in the 1940 into the 1960's but are now moving toward a pre- alteration condition. Bank erosion, however, is still prevalent in mainstem reaches in the lower river where the river cuts into confining glacial terraces (Martin et al., 1998).

More recent channel modifications include 0.95 miles of dike, which affects natural meander patterns along the mainstem at river mile 7. The dike is associated with the Ocean Beach Road Bridge. Sections of riprap along the mainstem include 5,300 feet of rock downstream of the Highway 101 bridge, and 300 feet near river mile 23.3.

There is no USFWS/WDFW extensive survey for this watershed, as discussed for the other selected subbasins. Analysis of 9.9 miles of channel from the Highway 109 bridge to near Copalis Crossing and about one and one half miles above and below the Community of Humptulips was undertaken using 1988 photos. No changes in channel position due to modifications was noted, however for approximately 2 miles, the river runs immediately adjacent to roadways or railroad tracks. These features may impact meander patterns or exacerbate erosion downstream. In general, riparian impacts are more associated with silvicultural rather than agricultural practices due to the lack of agricultural activity in the subbasin. Table 3.2-4 presents the results of assessment of riparian conditions along this section of the river.

### Fish Stocks

Detailed information on the status of fish stocks within the Middle Chehalis River subbasin is not available. General information on the status of stocks within the entire Chehalis watershed is provided in Appendix D: Technical Report for Fish Habitat/ Channel Modifications/ Stocks.

## *3.7 CONCLUSIONS*

If there is a conclusion that can be drawn from detailed assessment of these five subbasins, it is that generalizations of water quantity, quality, and fisheries should not be made across the entire basin. Assessment by subbasin is the appropriate scale. However, this analysis provided a few general considerations that may be extrapolated to the remainder of the basin.

- In subbasins where agricultural use is high, over allocation of water supplies may be more common. However, agricultural land also represents the area where the differences between allocated water and actual water use are likely to be high, and where this difference is most difficult to estimate. However, from a water quality and fisheries perspective these subbasins can also be problematic in terms of oxygen and temperature. Due to the relationship between these water quality parameters and flow, addressing water quality issues should be the first priority, since water "found" through an analysis of actual use would still be required for instream use to prevent further water quality degradation.
- Subbasins undergoing rapid development that also have high agricultural use should be prioritized for detailed water rights analysis. This should include quantifying actual water use in agricultural areas and quantifying exempt wells and setting up a method for tracking this use over the long term.

- The analysis of subbasins that were predominately forest indicates that instream flow targets for some basins should be re-examined since these targets are not met, or just barely met, by the naturally existing streamflows.
- The comparison of flows to the consumptive portion of allocated flows in the subbasins revealed where potential exists for streamflow enhancement by changing withdrawal/diversion patterns. Potential for streamflow enhancement exists in subbasins where the water right allocation was substantial. These basins would benefit from a detailed mapping of water rights to identify alternatives for streamflow enhancement water management strategies.