Chapter 173-503 WAC

Cost Benefit Analysis

Maximum Net Benefit Analysis

& Least Burdensome Analysis

Instream Resources Protection Program—Lower and Upper Skagit Water Resources Inventory Area (WRIA 3 and 4)

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Executive Summary

The Washington State Department of Ecology is amending Chapter 173-503 WAC. The main features of this rule amendment include:

- creating reservations of a limited amount of water for specific future uses that are not subject to the existing instream flows
- establishing closures for tributaries
- defining conditions for future water right permitting

The rule amendment also changes previously interruptible water supplies into uninterruptible water supplies, and may reduce instream flow levels. It provides additional benefits to various out-of-stream water users, and also may reduce various environmental values.

This document includes three analyses:

- The cost benefit analysis which concludes that the probable benefit of the rule amendment is greater than the probable cost;
- The maximum net benefit analysis which concludes that the structure of the reservation will tend to maximize net benefits for water allocated to out of stream uses;
- The least burdensome alternative analysis which concludes that it is likely that the rule amendment is the least burdensome option for all those who are required to comply that will achieve the general goals of the authorizing statutes.

This analysis has been revised based on new data and comments received after the proposed rule amendment was filed.

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1. Introduction

Water availability is a critical issue in Washington and will become even more so as time passes. Decisions related to out-of-stream water use have been controversial: caught between the need to consider human demands for water and environmental impacts, especially the impacts on salmon populations.

1.1 History

The Washington State Department of Ecology (Ecology) adopted Chapter 173-503 WAC, *Instream Resources Protection Program—Lower and Upper Skagit Water Resources Inventory Area (WRIA 3 and 4)*, on April 14, 2001. The 2001 Skagit rule established the instream flow levels in WRIA 3 and 4, and made all future consumptive uses subject to this instream flow. The instream flow levels were established through scientific investigations that were conducted under a cooperative agreement between state, local and tribal governments in the Skagit River basin. A memorandum of agreement was signed by the City of Anacortes, Public Utility District Number 1 of Skagit County (Skagit PUD), Skagit County, Washington State (both the Department of Ecology and Department of Fish and Wildlife) and the Upper Skagit, Swinomish and the Sauk-Suiattle Indian Tribes. The agreement outlined actions that would provide for more coordinated management of water resources in the Skagit basin. Part of the agreement was to establish instream flows for the Skagit River. Ecology conducted rule-making that established the 2001 instream flow rule.

After the rule was adopted, it was challenged in *Skagit County v. Washington State Department of Ecology*. Ecology developed this rule amendment to address some of the issues related to the legal challenge.

1.2 Evaluation

Ecology developed this Cost Benefit Analysis (CBA), Maximum Net Benefit Analysis (MNBA) and Least Burdensome Analysis (LBA) as part of its rule adoption process. This document evaluates the following parts of the rule amendments.

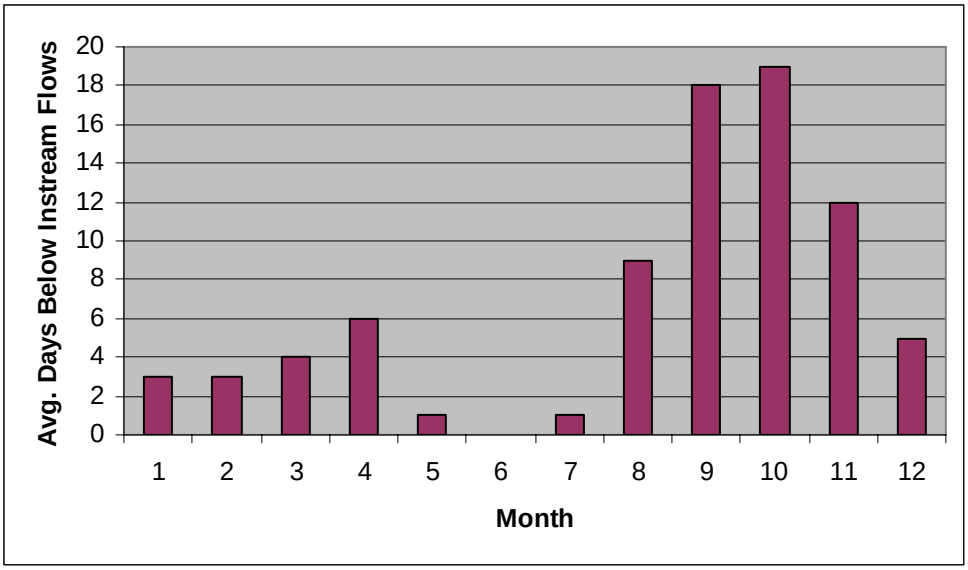
A. **Water reservations**: The new water reservations supersede the instream flows. The existing instream flow rule limits new water uses to 200 [cubic feet per second (cfs)]. This 200 cfs currently only provides an interruptible water supply because the instream flows are not met during several days in the year. This rule amendment proposes reservations that authorize withdrawals of uninterruptible water rights.
   - 3,564 acre-feet of water annually would be available for agricultural irrigation, and
   - 9,370,208 gallons per day would be available for domestic, municipal, commercial and industrial water supply.
   - 324,000 gallons per day would be available for stock watering purposes.
   - These reserved quantities of water represent approximately 25 cfs. The remaining 175 cfs of the 200 cfs would remain available for other users as

an interruptible supply. This part of the water is unchanged in its status and is, therefore, not analyzed.

Primary change: The amendment converts approximately 25 cfs of the interruptible water supply to an uninterruptible water source. This alters the usability of the water and changes its economic value. This change benefits upland water users.

Current rule baseline: Currently, any post 2001 ground water withdrawal, including permit-exempt wells in hydraulic continuity with the Skagit River or its tributaries, must curtail use during low flow periods. The data indicate it is highly likely that some future water users of the 200 cfs allocation of water provided in the existing instream flow rule would be subject to interruption throughout periods of the year, with significant periods of interruption during the months of August, September, and October. The accompanying graphic 1.2 shows the average number of days in each month where instream flows are not met. The figure shows that in certain months like September and October, the water users would have no water available to them. However, it is important to note that these data represent average monthly flows and as averages over a large period of record (62 years) there can be considerable daily deviation from this average. For instance, in 2005 there were 4 days in May, 19 days in June, and 14 days in July when instream flows were not being met. Thus, interruptions may be short in some years but longer in other years. Using 1987 as a model, interruptions could have lasted 144 days. Therefore, considering the water use patterns of domestic, commercial, industrial and agricultural uses, without costly storage, this 200 cfs cannot be a reliable water source for various water users.

Graph 1.2 Average Number of Days Below Instream Flows by Month



This is based on analysis of USGS data on Skagit River flows for the period of record 1941-2003.

Table 1.2 Daily Stream Flow Averages (2001-2005) used to construct probabilities

# USGS 12200500 SKAGIT RIVER NEAR MOUNT VERNON, WA					
Summary data: Days below instream flow					
	2001	2002	2003	2004	2005
Jan.	26	0	0	0	0
Feb.	27	0	0	0	9
March	28	0	2	0	25
April	26	0	0	3	4
May	5	0	9	2	4
June	3	0	3	0	19
July	11	0	4	0	14
Aug.	12	5	27	15	31
Sept.	26	26	30	0	29
Oct.	22	31	13	19	19
Nov.	6	19	5	0	0
Dec.	0	22	0	0	8
	192	103	93	39	162

For big public water purveyors such as the Skagit PUD and the City of Anacortes, these users could use interruptible water supplies as water storage may be viable or available, if these systems needed additional water (Greenberg, 2005 Appendix 3). However, for rural public water systems or exempt well users and irrigators, the storage may be too costly or even infeasible and, therefore, relying on an interruptible water supply would be difficult. This cost benefit analysis assumes that in the 20-year study period, public water purveyors have enough uninterruptible water supplies or water storage capacity to use interruptible water supplies. However, exempt well users and/or irrigators would find this interruptible water supply difficult because storing enough water for their uses when flows are not met is expensive. Storage would be important because they could be forced to curtail uses during a significant period of time earlier in the irrigation season.

Most users require a reliable year around water supply. Thus, most post 2001 water users should legally either connect to an uninterruptible public water supply, have a well and on-site storage, or obtain water from other uninterruptible sources.

Amendment Change: Under the new reservations, the forecast water demand for the next 20 years for most of the water users would be met without curtailment. Thus, the ability to use water during low flows should benefit most water users.

B. **Sub-basin closures**: Certain tributary sub-basins of the Skagit River in WRIAs 3 and 4 will be closed to further appropriation when the reservation for that particular sub-basin is fully allocated and used.

Primary Change: For most tributaries subject to closure in the rule amendment, the closures will not occur until several years into the future, as the projected water demand can be met by the reservation quantities and the pace of water development is anticipated to occur at a slower rate. In some sub-basins, such as the Nookachamps, Carpenter/ Fisher, and Hansen Creeks, growth is occurring at a faster rate and the projected demand for water exceeds the reservation quantities.

Current rule baseline: In these sub-basins, applicants may have obtained interruptible water.

Amendment Change: Tributary closures will occur when the reservations are fully allocated and used. Tributary closures will not reduce the remaining reservations and that water could still be used in other areas of the Skagit River basin which remain open. Tributary closures may, however, move the long term economic gain from the reservation from one sub-basin to another area. It is likely that Nookachamps, Carpenter/ Fisher, and Hansen Creeks sub-basins will be closed before other tributary basins, as the rate of development is projected to exceed the reserved water supplies.

Closures will affect applications in these sub-basins once the allowed water is allocated. For most areas in the Skagit basin, the reservations should be adequate to fulfill the expected future water needs for at least 20 years. If population can be used as an indicator of all growth, this could affect 10% to 13% of the volume of water in new applications.

Retained existing options: Those with existing water rights which predate the effective date of the instream flow rule, April 14, 2001 will not be affected by these closures.

Public water supplies from outside of the basin will likely be required to meet the maximum anticipated sub-basin demand. Presently, large public water systems such as the Skagit PUD provide water service in parts of these sub-basins. Over time, the Skagit PUD or other large public water systems should be able to provide service to most areas of the Nookachamps, Carpenter/ Fisher, and Hansen Creeks sub-basins.

Water may also be available through a purchase or transfer of existing water rights, through developing water from a water source that is not in hydraulic continuity with the Skagit River, or through approval of a mitigation plan. For those users that may eventually require future water from a specific closed sub-basin after the closure, any withdrawal would require continual mitigation, not just during low flow periods as was the case under the previous rule. This could necessitate water leasing or transfers of existing water rights,

moving the proposed location of a user or the development and implementation of a mitigation plan. Furthermore, users requiring water in a closed basin would also have the option of obtaining water supply from outside of the closed basin.

C. **Connecting to a public water supply:** The applicants seeking water rights for potable water supply must first demonstrate there is no service from an existing public water supply. If they can be served by the existing public water supply, Ecology cannot approve a water right request.

Primary Change: Connecting to a public water supply for potable water supply may create a cost for some users. This will only impose a substantive cost for users for which the cost of hooking up is greater than the cost of developing a new water source such as drilling a well.

Current rule baseline: Many water users already hook up. In some areas of the Skagit River basin hookups are already required. Given that new water would be interruptible under the current rule, connection costs are likely to be lower than the cost of a well and other development costs such as storage, in most instances. Most users that require reliable water supply for domestic uses are likely to have either already connected, already have a well and on-site storage, or already have obtained water through contracts or transfers.

Amendment Change: In some areas an applicant for an interruptible right might not have been required to demonstrate lack of service.

Retained existing options: For users seeking non-potable water supplies, they could obtain water under the reservations, develop an interruptible right with storage, or obtain a water right with an approved mitigation plan. Water may also be available through a purchase or transfer of existing water rights or approval of a mitigation plan as explained in "B" above. The Skagit County Critical Areas Ordinance also requires connections to public water systems under specific conditions. Consequently, for approximately 5%[1] of the parcels inside the public water supply system areas, this is not a new legal requirement.

D. **Reduced Flows**: The Skagit River and its tributaries will have reduced instream flows. During low flow periods the reduced flow may indirectly affect instream benefits such as ecosystem services, recreation, etc. Water users who raft, fish, watch birds, or depend on dilution for waste removal, may experience a minor impact. However, the amendment provides some controls that minimize this potential impact. Given the limited size of the reservation and the expected impact on streams (0.5% of the average September low flow), the basin closures, the hookup requirements, and the metering, the impacts of the reservations are unlikely to significantly impact

[1] Based on parcel data for Skagit County, see Appendix 5.

the long term sustainability of the fish population and will not result in any measurable reduction in aesthetic, navigational or recreation uses.

E. **Metering**: New water users will be required to meter their water use.

Current rule baseline: The requirement to meter water use was set in Chapter 173-173 WAC, a rule that already exists and costs were considered there. Water source metering under Chapter 173-173 WAC has only been required on water users withdrawing water authorized under water right permits, certificates and claims, and not for users using permit exempt ground water wells, except in locations with depressed or critical salmon stocks. WRIAs 3 and 4 have several depressed or critical salmon stocks.

Amendment Change: Despite the presence of depressed or critical salmon stocks in some areas of the basin, Ecology acknowledges that requiring water source meters changes current practices, regardless of the existing requirements. The change may result in costs to entities using permit exempt wells that may not have been previously required to meter. Users of new permit exempt well water will likely experience the "in pipeline" costs outlined in the SBEIS for Chapter 173-173 WAC in 2001.

However, the metering will help other users obtain water. Actual use may be less than the standard water use value in the amendment. When calculating what water is available for a new applicant, the actual use rather than the standard accounting value can be subtracted from the total available water to determine whether there is enough water for a new water user. The metering allows more accurate accounting of water use, which can result in more users having access to water from within the reservation. Thus, in the long term, metering can reduce costs to those who might otherwise be without water.

Retained existing options: This will not affect existing water right holders.

2. The cost benefit analysis

This cost benefit analysis is provided under RCW 34.05.328(d).

> *The analysis concludes that the probable benefits of the rule are greater than its probable costs, taking into account both the qualitative and quantitative benefits and costs and the specific directives of the statutes being implemented.*

The cost benefit analysis includes quantitative information where available, and qualitative information where reliable values for estimating the costs and benefits are not available.

2.1 Time Horizon

The costs and benefits associated with a rule depend on the time horizon used in the analysis. For this rule amendment, the cost benefit analysis uses a 20-year time horizon in order to analyze the costs and benefits. The reasons are:

1. The reliability of the probable benefits and costs estimations are determined by the accuracy of our forecast into the future. Theoretically, forecasts that use a shorter time period are more reliable. A long term horizon would significantly increase the uncertainty.
2. The reservation is designed to meet, at a minimum, the next 20 years of water demand.
3. Changes in water management policy are inevitable. Advances in science, population shifts, and changes in technology influence water management policy and create a dynamic process. This rule amendment is the direct result of such changes. In the long run, historical evidence shows that changes in how water is managed can be large. No rules can solve all future problems. It is likely that this rule will receive additional amendments in the future. The expected life time of this rule is 20 years, though it may be much shorter or longer. For example, this rule amendment makes the lifespan of the 2001 Skagit watershed management rule 5 years.

Therefore, with respect to various dynamic changes, this cost benefit analysis uses a 20-year time horizon to analyze the economic impacts of the rule amendment.

2.2 Baseline

This analysis covers the changes the rule amendment creates, given the existing legal setting. Therefore, this analysis evaluates changes to current water management policy for the Skagit River basin.

The current legal structure is defined by the 2001 Skagit watershed management rule and other applicable administrative rules and laws. Accordingly, this analysis takes the existing legal structure and its impact as a given, and then evaluates the economic impact based on likely changes to water management resulting from the rule amendment.

3. The Probable Benefits

This section presents the analysis of benefits from impacts due to the components of the rule amendment. The basis for this includes:

- The rule amendment, by providing a reservation of water, changes some previously interruptible water supplies to an uninterruptible source of water. This is a benefit to various water users.
- The water management portions of the rule amendment including tributary closure, monitoring, and public water supply hookup, are affiliated with the reservation in that they help to ensure efficient use, allow more access to the reserved water, and preclude long term damages. This helps to ensure that a net gain will actually occur. These constraints are, therefore, used to predict likely levels of use and estimate quantities by type of user. In other words, the reservations are evaluated based on the assumption that the water management portions of the rule will be applied.
- Water value is estimated for each type of use: rural public water system, exempt well users, the stockwatering users, the commercial and industrial users, and to the agricultural users.

Table 3.0a Water allocation by type of user and value based on OFM High Population

Forecast of Water Use by User	Estimated Quantity	Measure	Value Generated	Estimated Value of use
Agriculture	3564	Acre Feet	$ 3,800,000	$65/af/year
Large Public Water Purveyors Rural Public Water Systems Exempt Wells	10.3	mgd	$ 52,100,000	For 90% of water PV = $60,000 per lot minus the cost of development, for 10% of water, foregone value of agricultural land, $770 per acre.
Stock Watering	324,000	gpd	Unclear	Dairy: the dominant use, is in transition. Values are unclear.
Total Forecast Net Increase in Use: Domestic, Municipal, Commercial, Industrial, Stock	**25**	**cfs**	**$ 55,900,000**	

Table 3.0b Water allocation by type of user and value based on Skagit County Preferred Growth Rate Population

Forecast of Water Use by User	Estimated Quantity	Measure	Value Generated	Estimated Value of use
Agriculture	3564	Acre Feet	$ 3,800,000	$65/af/year
Skagit PUD, Anacortes, Rural Public Water Systems Exempt Wells	10.3	mgd	$ 29,100,000	For 90% of water PV = $60,000 per lot minus the cost of development, for 10% of water, foregone value of agricultural land, $770 per acre.
Stock Watering	324,000	gpd	Unclear	Dairy, the dominant use, is in transition. Values are unclear.
Total Forecast Use: Domestic, Municipal, Commercial, Industrial, Stock	**15**	**cfs**	$ 32,900,000	

Table 3.0 (a and b): the dollar value of the water varies depending on growth but the amount of water allocated by the rule does not vary. See tables 3.1 (a and b) for the rural PUD and exempt well populations served. Note Skagit PUD and Anacortes values are based on $65 per acre foot because the foregone value is from agriculture.

3.1 Direct Gains to Rural Public Water Systems and Exempt Wells

Amendment Change: The reservation of 9,370,208 gallons per day in uninterruptible water supply available for domestic, municipal, and commercial/industrial water supply uses generates an economic gain. This reservation provides benefits by allowing post 2001 applicants to avoid costs associated with interruptible water rights.

Baseline Costs: An interruptible water right provides water at a higher cost for users that need a reliable water supply. For water rights issued under the 2001 Skagit rule, the water for rural public water systems and for exempt wells is subject to the instream flow. Rural public water system and exempt well users are required to stop using water when the instream flow does not reach the levels set in WAC 173-503-040 (2). As shown in table 1, above, it is highly likely that these users will stop their water uses during periods of the year, especially in the months of August, September, and October. Under this circumstance, the potential rural public water system and exempt well users who need an uninterruptible supply may choose among the following options: water storage, abandoning the building lot, developing an approved mitigation project in conjunction with their water right application, or purchasing uninterruptible water rights. Each is costly.

1. **Water storage:** In some years, the instream flow may surpass the levels set in WAC 173-503-040 (2) and be available for a whole year. However, in order to be assured of sufficient water, rural public water system or exempt well users would need to store tens of thousands gallons of water. They would need enough to sustain three months water use before August since the uncertainty about the water availability in late summer and early fall is great. Moreover, depending

upon climatic conditions the need for stored water can stretch throughout other months in the year. Storage is costly. There is also a potential health problem for in-house use. This analysis assumes that a significant number of the potential exempt well users would find it uneconomical to store water for the period that their water use is interrupted.

2. **Abandoning the building lot**: In this scenario, the landowners cannot find an economical and technically feasible way to sustain their year round water use. The potential building lot is unbuildable in the 20-year period because of the lack of water. Thus, this piece of land is downgraded from a building lot into a piece of dry farmland. To quantify the probable benefits, which are equivalent to the cost savings, by using uninterruptible water right from the reservation, we assume that under the 2001 rule, 90% of the potential building plans using rural public water systems and exempt wells as their water sources would otherwise be abandoned due to lack of reliable water supplies. 10% of the property owners would otherwise transfer uninterruptible agricultural water rights to meet their water needs. If a building lot is abandoned, its property value will be downgraded to the value of non-irrigated farm real estate. The rule amendment would provide enough uninterruptible water to those property owners and would save their property from being unbuildable. The estimated cost saving range is from $29 to $52 million in the 20-year period (see Appendix 1).

3. **Purchasing uninterruptible water rights**: Purchase and transfer of uninterruptible water rights is one option for water users to obtain a water supply. In some areas rural public water system or exempt well owners can purchase agricultural farmland with uninterruptible water rights and transfer the uninterruptible water right for their domestic water supply. Where this is a viable option, the loss to the state will be the degradation of irrigated farmland into non-irrigated farmland. This scenario has not been commonly used in the past.[2] However, if water became a limiting factor, without this amendment, it is likely that more change of use applications would be submitted. Thus, the estimated share of these is allowed to vary from 0% to 50%. Based on only 10% of building lots using this strategy, the estimated cost saving is $73,000 for a forecast high growth rate or $41,000 for the SC preferred growth rate in the 20-year period (see Appendix 1)

   This method will not always be available and the transfer is contingent upon approval by Ecology. When a building plot is up-stream from the purchased right, moving the water right upstream may affect other water rights and may not be allowed under state water law. However, transfers may be subject to high transaction costs, including at a minimum, the cost of evaluating consumptive use, and at the high end, legal costs. Therefore, the $41,000 to $73,000 dollars benefit calculated in the appendix would be a lower limit on the reduced cost of transfers.

[2] There have been only 14 change of use applications for a total of 1.7 cfs, since 1984, and only 2 are still in the active application stage. There have been 4 approved, 3 for Darrington. The rest have either been approved or reverted to inactive status.

4. **Developing an approved mitigation plan**: the water right applicant can submit a mitigation plan to mitigate for their impact to instream flows with their water right application. To gain departmental approval, a mitigation plan must, at a minimum, show to the department's satisfaction that the proposed withdrawal with mitigation in place provides water-for-water mitigation and will not impair senior water rights, including instream flow rights, will not diminish water quality, and will not withdraw water from a legally closed source. The plan must include monitoring and reporting and provide mitigation for the duration of the water use. This method requires investigating the hydrogeology of the basin and can require hiring professionals to do the investigation and plan development. It is unlikely that many water users, especially individual homeowners or small businesses, could afford the expense of hiring such professionals. For instance, the cost of professional consulting services is about $100/hour. The time and services provided by a professional consultant to investigate and develop a mitigation proposal can represent a week to several weeks of consultant time, depending upon the complexity of the geology and water withdrawal method. This kind of mitigation may be too expensive for individuals or small companies. For instance, two recently approved mitigation plans in the Skagit River basin resulted were very costly. The Town of Hamilton's Little Carey's Creek mitigation plan cost over $750,000.[3] The estimated cost for mitigation by Skagit PUD at Marblemount is $27,500.[4]

The total gain would therefore be $29 to $52 million.[5]

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[3] Tim Bates, 5/1/06, Email.

[4] Ken Kukuk, 5/2/06, Email.

[5] Comment: Ecology has been told in comment that an avoided cost scenario is an inappropriate measure because water markets would arise in a scarcity situation and this would reduce the measure of the value of water. The water price for the buyer would then be the value marginal product of water in production, probably within agriculture, plus the cost of generating the transfer. Ecology can't use this estimate because there have been no such transfers. The water price to the seller would be the value marginal product of the water. This is a substantive issue for the analysis. The 10% of the land assigned a value based on a transfer underestimates the avoided cost because the cost of transferring the property right is not included. The 90% of land assigned a value based on development may be over valued. However, with out a fluid water market, the water is potentially a limiting factor. The minimal evidence on the cost of transfers indicates that there are two major components to the cost: First is the expense of estimating and documenting the amount of water that it is legal to transfer. Second is the legal cost of doing the transfer. The cost of transfer may include a long waiting period that ties up capital, legal costs from appeals by other water right holders, paperwork done by hydrogeologists, the applicant, the appellants, and the department, and finally the attorney and court cost of litigation that may have to be undertaken by the applicant and/or the Department of Ecology. Elsewhere in the state, anecdotal information on these transfer costs range from small costs (short term transfers in the Yakima basin) to large costs well above the price of the water to the seller (such as the Trend West case). Finally there is a large difference between the value of land in residential use and its value in agricultural use. Insofar as water may be the limiting factor, this difference is an indication of the value of water. The value of a change of use could, therefore, be very large. Despite this there has been no clamor for transfers. This is probably because Ecology has not enforced the interruptible status of water in a residential setting. People's willingness to pay is currently a function of their expectation that they will be able to obtain free water without interruption. However, Ecology must evaluate the rule change as if compliance existed because enforcement is a possibility in both the baseline and the new rule. Indeed, the controversy surrounding the rule is partly driven by the potential for interruption of water supplies for some parties. Given the uncertainty, Ecology used a Monte Carlo that

Is there sufficient water for this total gain to occur? The reserved water is enough for the 20 year forecast exempt well demand, for areas that are not expected to close, if the allocation is properly managed.

The 20 year demand: In maximizing net benefits, the risk is that insufficient water will be assigned to the highest valued uses. Therefore, Ecology used the Greenberg memos (2005)[6] upper limit approach to make some of the projections of applicant water use.

The population relying on exempt wells[7] is 8,441 in year 2000, and 17,501 in year 2025, from which we can derive the population number in 2005 is 9,766. From 2005 to 2025, an additional 7,735 people (2,975 households) might rely on exempt wells as their water source. Assuming 2.6 person households[8] and 350 gpd [gallons per day (gpd)] per exempt well (Rushton, 2004) with a 50% return flow, we can derive that from year 2005 to the year of 2025, the total additional water demand from exempt wells would be 0.81 cfs.

Table 3.1a Households by Type of Water User High Forecast

Forecast of household increase by type of water user					Population Increase	Household Increase
Type of Water User					2005 to 2025	
	2000	2005	2010	2025		
PUD Demand	7,484	8,630	11,228	15,259	6,629	2,550
Exempt Well Demand	8,441	9,766	12,768	17,501	7,735	2,975

Note: The values in the yellow boxes come from Greenberg 3/05 table 3. The household increase is based on 2.6, as household size.

Table 3.1b Households by Type of Water User Preferred Forecast[9]

Forecast of household increase by type of water user					Population Increase	Household Increase
Type of Water User					2005 to 2025	
	2000	2005	2010	2025		
PUD Demand	7,484	8,217	9,713	11,942	3,725	1,433
Exempt Well Demand	8,441	9,287	10,990	13,607	4,320	1,662

Note: The values in the green boxes come from Greenberg 3/05 table 4. The household increase is based on 2.6, as household size.

This analysis does not adjust the number of households based on the cost of developing water. It assumes that most developers would be unable to wait 20 years and would

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used a 0% to 50% range and that never-the-less left much of the change as a removal of a limiting factor to development.

[6] Joanne Greenberg PE and Karen Welch, HydroLogic Services Company, 1317 Chuckanut Dr., Bellingham, WA

[7] Greenberg 03/05, table 3, Appendix 3.

[8] Office of Financial Management, State of Washington, (2002). "Illustrative Household and Persons per Household Projections Using the Growth Management Act Population Projections: 2005 and 2010".

[9] Additional value accrues to uses outside Skagit County. Thus the tables underestimate total gain for the users.

make decisions about either purchasing water or developing the lot, absorbing the resulting cost.

For rural public water systems, if they currently have no water resource and will also rely on the reservation, by using the same method as individual exempt well users, we can derive that from year 2005 to the year of 2025, the total additional water demand from the reservation is about 0.69 cfs for 2,505 households (6,600 population) for the high population growth scenario and .36 cfs for 1,433 households (3,700 population) for the preferred population growth scenario.[10]

Is this much water available for the value to accrue? In the rule amendment, Ecology reserves approximately 15 cfs for domestic, commercial and industrial uses and stockwatering. Stock water uses is limited to 324,000 gpd. This reservation is greater than the anticipated upper limit water demand for rural exempt users during this 20 year time horizon, which is approximately 350 gallons per day of water. After subtracting out the expected rural public water system and exempt well uses, the reservation also can provide at least 7,316,112 gpd of uninterruptible water supplies for other domestic, commercial and industrial uses. This means that water use can increase in each type of use, more than is anticipated, and there will be sufficient water supply.

As a summary, the rule amendment will benefit rural public systems and potential exempt well owners. The total probable benefit to them would be $29 to $52 million in the 20-year period. The estimated avoided cost is sensitive to the assumption of 90% abandonment and 10% transfer of water. The range of forecast gain is from $23 million to $58 million, if the 10% transfer is allowed to vary from 0% to 50% and the population ranges from the preferred growth to the high growth scenario.

3.2 Large public water purveyors

The largest public water purveyors in WRIA 3 and 4 are the Skagit PUD #1 and the City of Anacortes. The reservation is designed to meet the year 2050 forecast demand in Greenberg, 3/05, Table 5, or 10.3 mgd, 9 of which is likely go to both large and rural purveyors. However the evaluation only covers the first 20 years of this use. These large public water purveyors would be able to appropriate and use an expected .33[11] to 6.2[12] cfs depending on the growth rate. This range is large. A forecast can be done using an intermediate value of 5.5 cfs or more uninterruptible water supplies under the rule amendment during the 20 year time horizon of the forecast. The large purveyors may not use all the water available within the 20 year forecast; however its availability provides more certainty. This certainty benefits them and the people they supply but the value is not estimated.

Large Public Water Systems		
cfs		5.5
days storage		144
Acre feet of storage or purchase offset		1,600
Value at $65/af	$	104,000

The value of the 5.5 cfs could be estimated using storage facilities or purchased

[10] Assuming an average use of 350 gpd. Only the water used during the time period when the interruptible water supply was available is counted in this, or about half.
[11] Greeberg, 9/05 table 2, 17% share of total Skagit County shortfall cfs.
[12] Greeberg, 9/05 table 2, 69% share of total Skagit County shortfall cfs.

agricultural water. Its primary value accrues when the interruptible supply would not be available. Large storage facilities cost a great deal and the average annual cost ($95 to $434) is greater than the cost of temporary use of agricultural water. Thus, the value of short term leases of agricultural water probably best reflects the savings of the large public water purveyors. The cost of foregone water from agriculture is estimated at the same price as the agricultural water supply value below, $65 per acre foot per year. Thus the most conservative value would be $104,000. The value is likely to be higher, if the purveyors were unable to obtain water and the use of property within their jurisdictions were affected.

Table 3.2 Estimating average costs of storage facilities

Ecology Publication Number 01-11-002							
Water Storage Task Force Report to the Legislature							
Construction Cost for Selected New Reservoirs in Washington and Other States							
Project Name	On/Off Channel	Total Cost	Dam Height	Storage AF	$/af	Annual $/af	Purpose/Use
In State							
Zintel Canyon Dam	On	$ 3,900,000	97	2,300	$ 1,695	$147.78	Flood Control
Wenatchee Heights #2 Reservoir	Off	$ 241,600	30	80	$ 3,020	$263.30	Irrigation
Rosa Wasteway 6 Reregulation Res.	Off	$ 863,000	18	65	$13,280	$1,157.81	Irrigation reregulation
Pine Hollow Reservoir	Off Proposed	$ 50,500,000	185	24,000	$ 2,145	$187.01	Irrigation Fish
Other States						$0.00	
Ritschard Reservoir Colorado	On	$ 32,000,000	122	66,000	$ 485	$42.28	Irrigation Municipal
Westminister Lake Colorado	Off	$ 3,700,000	31	955	$ 3,860	$336.53	Municipal
Eastside Reservoir California	Off	$ 2,100,000,000	280	800,000	$ 2,625	$228.86	Municipal Irrigation
	Off w/o outlier				$ 2,913	$253.93	
	Off				4986	$434.70	
	On				1090	$95.03	

In addition to this there would also be enough interruptible water supply in the 175 cfs for them to appropriate. The interruptible water may be useful to them because storage has been available to them (e.g., Judy reservoir). Thus, the uninterruptible water could result in savings on storage costs and assuming water could be stored in their existing storage facilities.

The level of savings from the uninterruptible water supply would depend on specific projects and the operation of the Judy reservoir or other storage, but this analysis does not have enough information to quantify this benefit. However, this will not impact the final conclusion of this cost benefit analysis.

3.3 Agricultural uses

The rule amendment reserves 3,564 acre-feet of uninterruptible water supply for irrigation. As discussed before, an interruptible water right cannot provide a reliable water source to agricultural water users because of their use pattern. The reserved water would effectively increase the irrigated farmland and the overall agricultural value, which is a benefit to the irrigators. Based on Greenberg's (2005) range, the 10 cfs may be translated into 2,260 acres of new irrigated farmland.

It is likely that water offered to agriculture in this area will be used by agriculture. Between 1997 and 2002 there was a substantial increase in the number of acres irrigated in Skagit, Snohomish, and Whatcom Counties. Based on Greenberg (2005), taking the 63% increase in Skagit County alone, the increase accounted for an additional 30 cfs of

withdrawals over a 5 year period. A small share of this increased withdrawal within Skagit County may have occurred in WRIAs 1 (Nooksack) and 5 (Stillaguamish) but the lion's share appears to be in the Skagit River basin. For Snohomish and Whatcom, the increased withdrawals constituted a reversal of a trend, but for Skagit County it merely continued a trend of growth.

Table 3.3A 1997 to 2002 - Census of Agriculture data on Irrigated Agriculture

Change in Irrigated Agriculture			
	Skagit	Snohomish	Whatcom
Acres added	6833	1328	5033
% change	63%	30%	19%
Added CFS required	30	6	22

Table 3.3B 1987 to 1997 - Census of Agriculture data on Irrigated Agriculture

Change in Irrigated Agriculture			
	Skagit	Snohomish	Whatcom
Acres added	3,477	-1,258	-2,976
% change	55%	-23%	-10%
Added CFS required	15	-6	-13

For Skagit County, based on Census of Agriculture data, this continues a long term trend.

Table 3.3.C Skagit County Data on Farms and Acres in Agriculture and irrigation

Census of Agriculture Data				
Skagit	2002	1997	1992	1987
Farms (number)	872	714	754	806
Land in farms (acres)	113,821	93,495	92,074	95,357
Irrigated land (farms)	226	165	149	145
Irrigated land (acres)	17,658	9,821	8,415	6,344

To quantify the probable benefit, it is important to know the unit price of water. Because no previous research investigates the unit agricultural water value in WRIA 3 and 4, this analysis transfers previous research results in other regions to calculate the probable benefit. This is a common practice used in environmental economics because of limited information.

This cost benefit analysis adopts the result of Huppert, et al (2004) for the value of water in agricultural applications -- $65 per acre-foot as the permanent water value. In developing this analysis, other research was identified that evaluated the value of water in agricultural applications. In one of its reports, the National Academy of Science (2004) concluded:

The range of the value of water in agricultural applications in the western US generally varies from values as low as $3 per acre-foot for low-value crops under conditions of

adequate water supplies (no water stress), to values in excess of $200 per acre-foot for high-value crops. Median values for most mixed cropping systems in the Pacific Northwest suggest that the agricultural value is in the $40 to $80 per acre-foot range.

One researcher (Olson, 2003) that investigated water market transactions said:

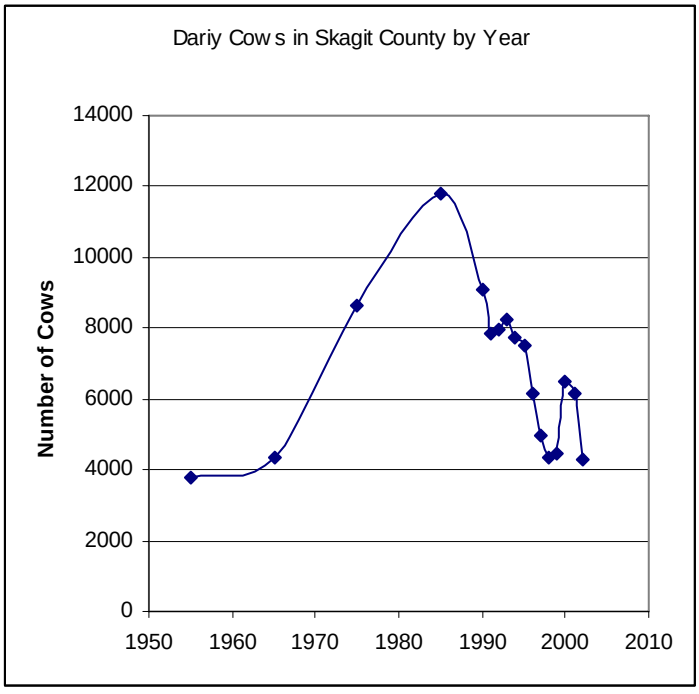
If the market value for water is assumed to be about $500 to $1,000 per acre-foot (capital value), then estimates of annualized values can be made given various assumptions about cost of capital interest/discount rates and the time period for commercial lending. For example, using a capital value range of $500-600, with a 7-8% interest/discount rate range, covering a conventional farm loan period of 15 years, the estimated value range would be between $54.90/acre-foot to $116.83/acre-ft. A mid-point estimate would be about $86.00/acre-ft.

Other research (Bernardo, et al, 1989) completed in 1989 concluded that the marginal values for a representative Columbia River basin crop mixture were inferred to be $46 per acre-foot when water was tightly restricted, but valued at only a few dollars per acre-foot when water available for crops was not restricted.

Therefore, a water value of $65 per acre-foot as a constant real value for the 20-year period is adopted since it falls well within the range provided by other research. This analysis assumes that, on average, one acre of irrigated farmland needs 1.58 acre feet of water each year. The analysis assumes a 6 month window for use of the 10 cfs each year. A higher quantity of water was forecast as desired by agriculture than is available (See Appendix 3, Table 6). Therefore, this analysis assumes that the appropriation will be applied rapidly. The value would then accrue to all new acres over the entire 20 year period. With all these parameters, the total probable benefit to the agricultural sector and the state of Washington would be $3.7 million.

3.4 Stockwatering

The rule amendment reserves 324,000 gpd of surface and ground water for future stockwatering uses. Also, incidental stock water uses have been defined to be part of the domestic water uses under this rule. Incidental stock watering is defined as sufficient water to care for small scale livestock operations. The reservation provides a benefit although this analysis does not have enough information to quantify it.



Dairy is a high value added activity. From our available data, over 70% of the stock in

Skagit County are dairy cows and 98% of the stock are cows. However, the general trend in the number of dairy cows has been to decline since it peaked in 1985.[13] Given this decline, water use in this sector is possibly declining as well. The value of the water use may not be declining given that milk production per cow is stable. However, sample dairy budgets provided by one conservation district indicate negative returns in dairy work.[14] The reserved water, based on 35 gallons per day,[15] is enough to provide for an increase in the dairy herd size that is more than twice the existing total herd size. While this increase is unlikely to occur in the 20 year period, dairy is none-the-less a high value added product. Not allowing for a rapid shift in this market may impose a risk that losses could occur. In any case, should the need not arise, the instream value would accrue to this reservation. There would be no cost and no gain.

The 2002 livestock inventory of Skagit County, including feedlots,[16] is only 41,086. This includes livestock uses other than cows, which may increase. It is likely that the reservation is enough for a 20-year period.

3.5 Total probable benefit

The total benefit of the rule amendment is the sum of the probable benefits calculated from section 3.1 to section 3.4, as in Table 3.0 above and Graphic 3.5 a and b below.

Graphic 3.5a: Monte Carlo Range of Benefits High Growth Scenario

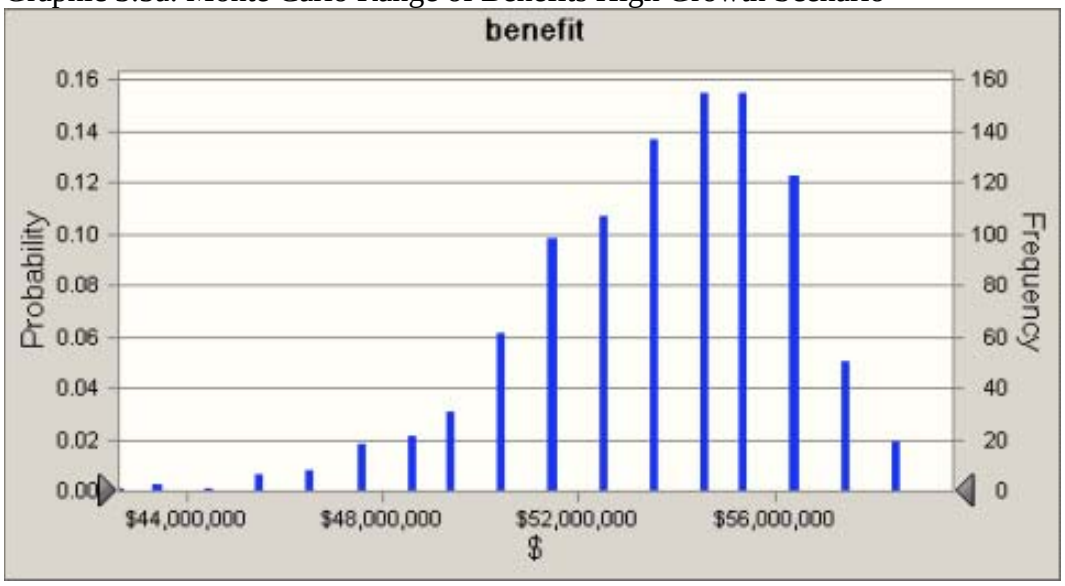
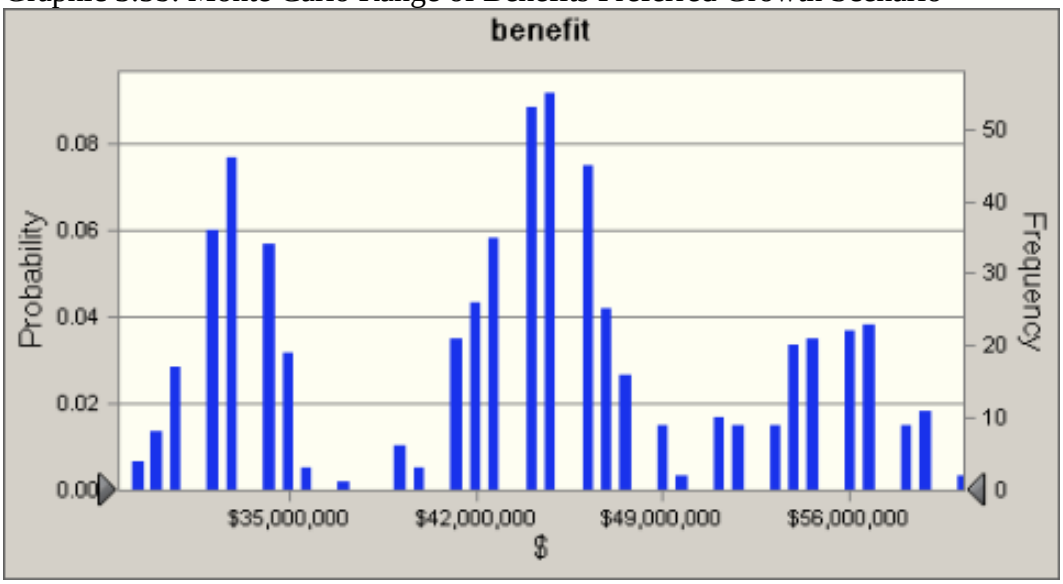


Table 3.0 shows a benefit of $54 million over 20 years. The range based on the high growth Monte Carlo[17] is $42 million to $59 million. The range based on the preferred

[13] 2002 Skagit County Ag Stats, WSU Cooperative Extension.
[14] http://www.snohomishcd.org/buffers.htm
[15] Jacque Klug, Ecology staff email.
[16] Note - feedlots can use it under changes. At the time of this writing Ecology cannot separate out the feedlots.
[17] A Monte Carlo depends on the distributions attached to the independent variables. It is a deterministic means of testing whether a final number is sensitive to shifts in the underlying assumptions. In both

growth Monte Carlo is from $28 to 59 million. The range is large and sensitive to assumptions about population and property impacts.

Graphic 3.5b: Monte Carlo Range of Benefits Preferred Growth Scenario



4. The Probable Costs

The rule amendment creates reservations and sets up a management system that should allow more users to obtain access to the water from the reservations. The management measures in the rule amendment include metering, hookups, and closures in several sub-basins. These requirements are evaluated based on costs of compliance. There are also environmental costs. The rule amendment re-allocates existing water resources. The more water used for out-of-stream purposes, the less water remains in the streams. Less water in the streams would also generate various costs to Washington.

4.1 Metering

Chapter 173-173 WAC requires metering.

Metering may result in costs to individuals and businesses using permit exempt wells that were not previously required to meter. Well meters are likely to generate the "in pipeline" costs outlined in the SBEIS for Chapter 173-173 WAC in 2001. Metering imposes costs in the form of buying, installing, and reading the meter.

For new permit exempt well water rights, which are issued in the early part of the first 20 years, the metering will impose a cost. For later water right applicants metering may provide a net benefit because it should postpone the day when Ecology must begin to deny applications and close some basins or sub-basins. This part of the analysis evaluates the cost without separating out the two sets of users. This avoids double

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models the range is sensitive to the assumption as the share of possible residential properties allocated to abandonment.

counting because the benefit to the later applicants is already counted under the exempt well benefits above.

Meters range in cost from $60 to over $2,000, depending on the size, accuracy, and use. Installation costs $100 and up. These costs depend on location and lot characteristics. This analysis assumes costs of $400 for the meter and $200 for the installation. It is not clear how many expected new water rights should be treated as experiencing a new cost. Chapter 173-173 WAC already requires metering in many instances. However, water source metering has only been required on water users withdrawing water authorized under water right permits, certificates and claims, and not for users using permit exempt ground water wells, except in locations with depressed or critical salmon stocks. WRIA 3 and 4 has several depressed or critical salmon stocks.[18] Thus, much of the basin would be affected. Despite the presence of depressed or critical salmon stocks, Ecology acknowledges that requiring water source meters changes current practices, regardless of the existing requirements. In order to generate a conservative analysis, Ecology assumes that 100% of the new rights for exempt wells for domestic purposes (2,975 wells),[19] would have this as a new cost. Finally, an exempt well for a single family home is exempt from metering. However, it is not clear what share of the exempt wells will serve only one home. Therefore, Ecology has not been able to net out the cost for these homes. The estimated number of affected wells for both scenarios is, therefore, high. Given these parameters, the present value of the cost of purchasing and installing metering ranges from $800,000 to $1.5 million depending on the growth rate. Part of this cost may accrue to Ecology as it has a grants program that covers a portion of the costs of installing water meters.

Metering estimate: Skagit County Preferred Population Growth Rate	
Estimated PV of cost of metering	$ 813,928
Basis for Estimate	
N of meter prices	*42*
Average Price	*$ 402.25*
Standard Deviation of Price	*330*
Estimated installation cost	*$ 200*
Estimated number of exempt domestic wells	*1,662*
PV multiplier average discount impact	*0.81*

Metering estimate: OFM High Population Growth Rate	
Estimated PV of cost of metering	$ 1,457,242
Basis for Estimate	
N of meter prices	*42*
Average Price	*$ 402.25*
Standard Deviation of Price	*330*
Estimated installation cost	*$ 200*
Estimated number of exempt domestic wells	*2,975*
PV multiplier average discount impact	*0.81*

4.2 Hookups

Hooking up to a public water supply is often the lowest risk and lowest cost option for those people needing potable water where such service is available. This makes it difficult to extrapolate a cost for the requirement.

[18] For maps of the affected areas, by species go to:
http://www.ecy.wa.gov/services/gis/maps/wria/sasi/sasi.htm
http://www.ecy.wa.gov/services/gis/maps/wria/number/wria3.htm
http://www.ecy.wa.gov/services/gis/maps/wria/number/wria4.htm
[19] See Table 3.1.

Approximately 83% of the acreage and 95% of the parcels[20] within public water supply areas are outside of the critical areas where hooking up is already required under Skagit County ordinance. This section evaluates the potential for costs for owners of parcels for whom the rule amendment may create a new requirement. These would be people in areas where it is not clear whether service is available in a timely and reasonable manner, and where it is not clear whether they already would be required to hook up, given existing requirements. Even in this setting their individual situation may not change appreciably.

Under current conditions the options available to applicants include either hooking up to a public water supply, having an interruptible well with substantial storage, or developing an approved mitigation plan as part of a water right application. Under the existing rule the costs are as follows.

i. The cost of connection to an existing system can range from $8,000 to $35,000 depending on the complexity. However, part of that cost (all, in some cases) may be returned via latecomer agreements.
ii. A well with storage can easily cost $40,000 to $50,000 depending on the depth of the well, geology and tank type.
iii. On-site storage for a low flow period can cost approximately $25,000-$30,000 by itself. For most water users, this makes connecting to the system the less expensive alternative.

The rule amendment allows an uninterruptible well and eliminates the storage cost for water users in "cost iii" if, and only if, they are not able to hookup in a timely and reasonable manner.

Even if a water user happens to be in a service area with a high water table, and happens to be located exactly the maximum distance from the water supply line and happens to need the smallest possible storage, then the hook up is still more likely to be cheaper. If it did cost more to hook up than drill a well with storage, the cost differential would, in this instance, be small.

Another potential cost is the difference between a monthly water service bill versus the cost of pumping the water, maintaining the storage system and the well. This is generally the cost that people look at when they decide to opt for a well. However, in this case the maintenance of a storage system and potentially a treatment system[21] to assure that the water is potable is quite high. Again, the relative cost is unclear. If the family uses 350 gallons per day, then the average water bill with a hookup would be $27.62 per month or $331.48 per year.[22] For the high end system with maintenance costing 10% of the

[20] 2,400 parcels, see table 3.1 for total, see Appendix 5 for parcels.
[21] Water stored for a long period of time (e.g. 141 days) may grow things in the tank, cistern, or pond. If treatment is needed it can range from simple chlorination to cleanout and treatment of the tank and filtration of the water.
[22] Based on a survey of the water rates for: Anacortes, Concrete, La Conner, Lyman, Hamilton, Skagit Co PUD – Alger, Skagit Co PUD – Cedargrove, Skagit Co PUD - Potlatch Beach, Skagit Co PUD Rockport, Skagit Co Water District #1, Skagit County PUD 1 Fidalgo, Skagit County PDU 1 Judy Res, Darrington Water System.

system, the cost could be as high as $5,000 per year. For the smaller, simple storage system (in cost iii) and a cost of 5% it would be approximately $1,250. Annual cost for mortgage interest (6%) on the capital expenditure for these same scenarios would range from $3,000 to $1,500. Thus, the ongoing cost for the storage scenario could be much higher.

There is another form of cost. There may be an additional waiting period. The waiting may come in two forms: 1) they are asking the public water supply if water will be available or 2) they are waiting for water to arrive at the property. If they are unable to hook up, then the first wait may create a cost that would partially offset the gain from not needing storage. In the second case, if hooking up happened to be more expensive, then they may not be able to opt for the interruptible plus storage option. In this latter case, they may experience a small net cost as well as waiting for development to be viable.

4.3 Closures

In sub-basins such as the Nookachamps, Carpenter/ Fisher and Hansen Creeks, the projected demand for water exceeds the reservation quantities. If population can be used as an indicator of potential demand, this could affect 10% to 13% of the new applications that come in after all the closures take place.

Public water supplies from outside of the basin will likely be required to meet the maximum anticipated demand. Presently, large public water systems such as the Public Utility District Number 1 of Skagit County (Skagit PUD) provide water service in parts of these sub-basins. Over time, the Skagit PUD or other large public water systems should be able to provide service to most areas of the Nookachamps, Hansen and Carpenter/ Fisher sub-basins. In cases where a public water supply is made available, then the cost of the closure will be equal to the net cost (if any) of the hookups evaluated above. Obtaining a connection may involve costs associated with waiting for supplies to come into an area.

If public water supplies are not made available, a water supply may be available through a purchase or transfer of existing water rights or approval of a mitigation plan. The cost of a water transfer is the value of the water in its alternative use plus the cost of the transaction needed to obtain it. If the water is moved out of agriculture, then the value may average $65 per acre foot. The transactions costs may double this cost.

Once the water is allocated in a particular sub-basin, a basin closure will be in effect.

Finally, the water resource available within the basin, through the reservations, is not reduced by the tributary closure. The remaining water will be available elsewhere. If the economic value of the water is the same in the tributary and elsewhere, then both the costs and the benefits of use shift from one place to another.

4.4 Ecological Costs

There are ecological costs associated with the rule amendment. The reservations will likely result in less water in rivers and streams. Theoretically, a reduction of instream flow in rivers and streams could yield a loss in habitat for fish, other ecological impacts,

and a reduction in the river's ability to assimilate waste. This could be an economic cost for entities relying on the river for waste assimilation, as well as a social cost to property owners adjacent to streams and rivers.

The most significant possible cost of the rule amendment is the cost of flow reduction on listed and critical species present in the WRIA 3 and 4. Fish stocks present in the basin include Chinook, Coho, Chum, Pink and Sockeye salmon, steelhead, bull trout and Sea-run Cutthroat Trout. Chinook salmon is listed as threatened under the Endangered Species Act (ESA).

A reduction in flow will likely reduce the habitat for both spawning and rearing. It may sometimes also cause further degradation of temperature, reduce downstream movement of fine sediment during high flows, and reduce salmon passage. The rivers and streams also provide habitat for other fish, birds that prey on aquatic life, and other aquatic creatures.

The per-fish value of a reduction in the adult migratory fish population at the end of 20 years is approximately $15,000,[23] thus a population reduction could be very expensive. However, both the average population impact and the potential for a population impact in a given year are unclear. For using this value, the impact would be affected by flows in the year that created the population of returning adult fish 20 years from the year the rule change goes into effect.

Table 4.4 Escapement in Skagit

Species	Avg. escapement even years	Avg. escapement odd years	Est. escapement 1997	Est. escapement 1998	Est. escapement 1999	Est. escapement 2000	Est. escapement 2001	State
Chum (Dog) salmon	47,000 - 140,000	4,000 - 46,000	10,000	120,875	34,311	22,321	45,000 (forecast)	healthy
Pink (Humpy) salmon	166,000	166,000	60,000		320,000		1-2 million	healthy
Coho (Silver) salmon	6,700 - 41,000	6,700 - 41,000		80,000	25,200	58,100	87,000 (forecast)	depressed
Chinook (King) salmon	summer/fall 14,900 (goal)	spring 3,000 (goal)	5,000	14,609	4,924	16,930	10,000	critical
Sockey (red fish) salmon	2,000	2,000		12,000	4,654	1,504	12,000 (forecast)	critical
	low	high						
Steelhead	3,000	6,500		7,448	7,870	3,780		
	2026	2025						
	239600	188200	75,000	234,932	396,959	102,635		
http://www.ac.wwu.edu/~jmcl/NatHist/salmon_SR_green.pdf								
download 3/9/06								

There are many factors that affect fish populations, of which stream flows are only one. Fish survival depends on flows, temperature, water quality, location of snags, ocean predation, climatic cycles, commercial fishing, etc. Most of these factors are difficult to predict with a sufficient degree of confidence. Therefore, cost estimates of the rule amendment on fish populations in WRIA 3 and 4 must be based on assumptions and averages. This analysis uses the years 1997 through 2000 to estimate an "average" run,

[23] Layton, David, Gardner Brown, & Mark Plummer, Valuing Programs to Improve Multi-Species Fisheries, University of Washington, April 1999

assuming a 0.5% loss.[24] If this habitat loss translates into a fish population reduction of 0.5% for Steelhead, Spring Chinook, Coho, and cutthroat then this loss would be on average 333 fish. The value being used is for a fish that arrives 20 years from now. If the 20th year is an average year then the expected loss is $5.3 million with a potential range from zero to $19 million. This value does not include any losses that may occur to the fresh water species.

4.5 Recreational Costs

There may be recreational costs associated with the reservation requirement in the rule amendment. A reduction in flow caused by surface and ground water uses may contribute to the costs. In general, less water in the river will negatively impact rafting, kayaking, canoeing, fishing, swimming, picnicking, camping and hiking. The exact magnitude is difficult to determine since the quality of the experience and the impact of less flows are functions of many factors including existing flows, availability of other recreational opportunities, etc.

Anecdotal evidence indicates that informal rafting, tubing, kayaking and canoeing are more frequent river uses. These uses may suffer from reduced instream flows if it reduces the quality of the outdoor experience. Unfortunately, no data exists on the quantity and location of recreational trips on the river. Therefore, quantitative analysis is not provided.

Streamside and shoreline uses such as camping, picnicking, hiking or swimming could theoretically suffer from a decrease in flow in surface water bodies. Reduced flows can impact the visual experience of users and reduce the quality of the visit. However, the reduction is likely to be moderate and it is unlikely to be a significant cost.

4.6 Costs to Existing Interruptible Permits

Existing holders of interruptible rights must curtail withdrawals when instream flows are not being met in the rivers and tributaries. To the extent that the rule amendment would increase additional uninterruptible withdrawals, the frequency of curtailment by existing rights will be increased compared to the rate without the rule. The exact cost will depend on the location and quantity of foregone withdrawals and the number of existing interruptible rights.

[24] Basis for 0.5%. Brad Caldwell, 3/15/06. Once every 10 years the loss could be as high as 2% but that would only happen if the fish are there and not reduced by bad ocean survival or high harvest or bad pollution. As such, 2% is a high figure for once every 10 years. In an average year it would be around 0.5 to 1% and in a good year close to zero percent. Also take into account that habitat loss doesn't always equal a loss of fish. Then, overall, the real fish loss would be on the order of 0.5% over all the years and streams. But that habitat loss would really only apply to the fish that have juveniles that would rear year round such as steelhead, spring Chinook, Coho, and Cutthroat. It would likely have no effect on the salmonids that spawn in late fall and are out to the ocean by spring such as Pink, Chum, and Fall Chinook. So for those last three fish species I would set the overall loss of habitat and fish as zero percent. Also Chinook don't spawn in small streams. Most of the streams listed with reserves are small streams and would not have spring or fall Chinook in them.

4.7 Non-Use Costs

Healthy rivers have been shown to have large and positive non-use value. Salmon are a cultural and spiritual source of inspiration and people have demonstrated their willingness to pay for salmon restoration without ever consuming the fish. These values are difficult to quantify. However, it is reasonable to conclude that they would depend on the ecosystem impacts. Thus, a reduction in instream flow could reduce the non-use values.

4.8 Implementation Costs

The rule amendment will involve implementation costs. These include the costs associated with providing technical and educational information for rule compliance, the costs associated with counties completing implementation agreements, and the additional costs associated with Ecology managing and accounting for the reservation. These costs are expected to be lower than managing the current ongoing issues created by litigation. The cost of enforcement is borne by the state and any intervening authority.

4.9 Cost Summary

Total costs are estimated to range from $6 to $6.7 million. The costs that have been estimated include metering costs of $800,000 to $1.5 million and fish losses of $5.3 million. There may be additional losses to recreation including un-estimated sport fishing losses,[25] losses to interruptible permit holders (who do not opt to change their right to an uninterruptible permit), and non-use costs. Ecology does not expect to need new resources to manage the rule.

Table 4.9a Costs – High Population Forecast

Requirement	Cost
Metering	$ 1,457,000
Hookups	Possible for a few
Closures	Transfer of gain
Ecological/Fish	$ 5,245,000
Recreation	Unknown
Interruptible Permits	Unknown
Non Use Costs	Unknown
Implementation Costs	Reduced cost unclear
Total Costs	$ 6,702,000

Table 4.9a Costs – Preferred Population Forecast

[25] These fish losses were not counted in the fish values estimated above.

Requirement	Cost
Metering	$ 814,000
Hookups	Possible for a few
Closures	Transfer of gain
Ecological/Fish	$ 5,245,000
Recreation	Unknown
Interruptible Permits	Unknown
Non Use Costs	Unknown
Implementation Costs	Reduced cost unclear
Total Costs	$ 6,059,000

5. Conclusion of the Cost Benefit Analysis

The rule amendment was developed quickly under court order. The probable benefits of $32 to $55 million exceed the probable costs of $6 to $6.7 million by a substantial margin. Even if the estimated growth which drives benefits fails to occur and is cut in half and even if the highest estimated cost is under estimated and doubles, there is a net gain.

6. Maximum Net Benefit Analysis

The Water Resources Act of 1971 presents a declaration of "fundamentals for utilization and management of the waters of the state." One of these "fundamentals" requires Ecology to maximize the net benefits for the citizens of the state when it allocates water. To accomplish this generally requires an economic analysis called a "maximum net benefits analysis" (MNBA).

As in the "Policy Interpretive/ Statement—Maximum Net Benefits for Water Resource Allocations", Ecology will implement the maximum net benefits provision solely in the context of rule-making associated with allocations of water, including water availability assessments on a basin scale. Specifically, Ecology *will perform* a maximum net benefits analysis in the following situations:

> *"When it is developing a rule to create a "reservation" for a particular use or uses, as allowed by RCW 90.54.050(1), except in cases where the reservation is being established solely to ensure a reliable and safe supply of potable water to satisfy human domestic needs"*

This Maximum Net Benefit Analysis (MNBA) is based on the cost benefit analysis, and is under a variety of restrictions.

Ecology has analyzed the rule amendment based on discrete shifts in use. The usual method of deriving a maximum net benefit point based continuous variables. The continuous-framework derivation of the maximum net benefit is not viable in this case. For example, the doctrine of issuing new water rights in Washington is "first in order, first in right." But this doctrine is incompatible with a general maximum net benefit approach of issuing water rights according to its marginal value. The rule amendment is

constrained by the legal framework. A discrete MNBA was used because a MNBA in a continuous case is not viable.

The law also constrains the analysis regarding instream flows, permit exempt wells, and stockwatering. None of these uses are subject to the maximum net benefit analysis.

To achieve the maximum net benefit, the rule amendment subdivides the whole reservation into three categories: the reservation for domestic, commercial and industrial uses; the reservation for agricultural use; and the reservation for stockwatering. Because the marginal value is unavailable in each category due to "first in order, first in right", the average use value in each category must be used as a criterion to compare the water use values.

Various researchers have agreed that the average water value for municipal and industrial water is higher than the average value for other uses. Huppert, et al (2004) pointed out that:

In any given year, the value per acre feet (AF) for municipal and industrial (M&I) water will be greater than or equal to the value per AF for irrigation water.

Grouping Washington, Oregon, and Idaho and collectively calling this area the Pacific Northwest because of the similarities in land geography and water availability gives a range for M&I water values of $0/AF to $452/AF.

A National Academy of Sciences report (2004) concluded that the value of municipal water is between $34--$403/AF, and the value of industrial water is between $10-$1248/AF.

Thus, the average value of domestic, commercial and industrial uses is higher than the average value of agricultural use.

No previous research is available for the average value of stockwatering. Stock can drink directly from streams, but most stock use is from wells or surface water diversions. Therefore, the stockwatering amendment was necessary.

In the 20-year time horizon, as analyzed in the cost benefit analysis,

1. The reservation is enough for rural public water system and exempt wells;
2. The reservation and potential interruptible water right can provide enough water resources for the large public water purveyors;
3. The reservation is enough for stockwatering;
4. From Greenberg (2004), we derive an upper limit for additional agricultural water demand of 66 cfs; however, the reservation provides 10 cfs. Therefore, agricultural use is the only use that is constrained.

Therefore, the reservation satisfies the expected need for various uses that are not subject to the maximum net benefit analysis first, leaving instream flows at sufficient levels, water for exempt wells and domestic use, and water for stock. Then, the reservation

provides for high-value water uses, including non-exempt domestic, commercial and industrial uses second. Only the remaining water is left to agricultural use. This arrangement is consistent with the principle of maximum net benefit given the legal restrictions.

Requirements in the rule also move use toward efficient allocation and use.

Metering of new water rights will allow better accounting of actual water use and will allow Ecology to grant water rights based on actual use rather than higher estimated uses. The cost of metering is far less than the value of a water right. Average expected use is 350 gpd rather than the accounting level. Thus, metering may increase the number of exempt wells available by a factor of two. Therefore, metering will help to maximize the benefits of the water use.

There are often economies of scale in public water supply. Increased hookups to public water supply reduce the "per unit costs" of the distribution system. If only ½ the homes on a block were to hook up, the costs for each home for the pipe would be twice as high for each home that did hook up. Thus, as long as the public water supply system is operating in the declining average cost portion of its system development, then there will be per unit cost savings for water users. The stipulation that Ecology cannot grant applicants water for potable water supply if a hookup is available tends to improve the efficiency of the overall water supply. Further, multiple wells in a given area can cause all the wells to be driven deeper, causing unexpected costs. Therefore, this requirement is consistent with maximizing net benefits.

The rule amendment was developed quickly under court order. It is likely that each of the components of the rule amendment work together to maximize the net benefits of the water allocation.

7. Least Burdensome Analysis

RCW 34.05.328 (1)(e) requires Ecology to perform a Least Burdensome Analysis to:

> *"Determine, after considering alternative versions of the rule and the analysis required under (b), (c), and (d) of this subsection, that the rule being adopted is the least burdensome alternative for those required to comply with it that will achieve the general goals and specific objectives stated under (a) of this subsection."*

The rule amendment reduces burdens that take the form of lack of water availability. The rule amendment provides water reservations and requires compliance that assures efficient use of the water. The rule amendment mainly changes previously interruptible water supplies to uninterruptible water rights. The costs associated with the efficiency and information requirements are lower than the gain to the average individual water right applicant.

Ecology considered other alternatives for addressing future water needs in the Skagit River Basin, including instream water needs and out-of-stream water needs such as

domestic, municipal, commercial/industrial, stock watering and agricultural irrigation. Ecology has determined that the approach contained in the rule amendment is the least burdensome approach for those required to comply with the rule while achieving the general goals outlined in RCW 90.54 to protect instream resource values and provide for out-of-stream beneficial uses.

Ecology could have chosen not to amend the existing Skagit River instream flow rule. However, this approach provides for no future water supplies that are uninterruptible. Ecology has evaluated the costs that this imposes on property owners by having to transfer an existing water right, develop a well and storage or develop a mitigation plan to mitigate the impacts of their water use on instream flows. Ecology has determined that the benefits of providing a limited quantity of water for individuals and businesses needing out-of-stream uses can be obtained without significantly impacting the long term sustainability of fish populations. Therefore, benefits to water users reduce the burden imposed by the existing rule and this reduced burden outweighs the costs or burden associated with the requirements in the rule amendment.

Ecology has placed several conditions for users to access the reserved water to minimize the impact on instream resources. Ecology considered many alternatives and decided those contained in the rule amendment are the least burdensome method for water users while still minimizing the impact to fish resources.

- In order to further reduce the burden from potential loss of water use, Ecology decided to require most future water users to measure their water uses through water meters and report this information. Ecology chose this decision to account for water use using the most accurate water use information possible. Ecology evaluated the costs associated with this activity in the CBA, but also determined that it could result in the long-run of more water being available for future water users. Ecology is pursuing assistance from local entities to assist property owners in installing and reading meters to further reduce the burden those people required to comply with this condition.
- Ecology has also chosen to provide a recharge credit that will be made to the reservation from water users that treat their water through a septic system. Ecology recognizes that septic systems recharge water that has been withdrawn back to the basin. Therefore, a water credit of 50% of the water used under the reservations by septic users can be applied to the reservation, which can further extend the number of connections served by the reservation.
- For the final version of the rule the default water use value has been changed from 800 gallons per day for each domestic connection in the rule to 350 gallons per day in the final version to be closer to USGS estimates of water use per household in the region.

The rule amendment was developed quickly under court order. The purpose of doing the rule amendment was to reduce the primary burden of the existing rule, which is intermittent availability of water.

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Appendix 1: Calculations

For an asset (a piece of land) with a net value of V, V is equivalent to a sum of a net rent cash flow C_t in time t, t =1, 2,…, ∞. For a piece of land, the rent is assumed to be decided by the physical features, including the availability of water, of the property:

$$V = \sum_{t=1}^{\infty} C_t /(1+d)^t \qquad \text{……(1)}$$

Where d is the real discount rate.

Assuming $C_1 = C_2 = ... = C_t = ... = C$, then:

$$C = dV /(1+d) \qquad \text{……..(2)}$$

For an n-year period, the n-year cash flow is equivalent to a present value of

$$pV_n = \sum_{t=1}^{n} C /(1+d)^t$$

$$= \sum_{t=1}^{\infty} dV /(1+d)^{t+1} \qquad \text{…..……(3)}$$

1. Abandon the Building Lot

For WRIA 3 and 4, the rule amendment, as discussed in section 3.1, reserves enough water for all potential rural public water system and exempt wells in a 20-year period. If the number of these potential users is N, and the affected share is s, and assume their water demand increases gradually and in an equally timed pattern, then for year n, the present value of the cost saving (benefit) of avoiding abandoning building lot is:

$$\frac{nsNdV}{20(1+d)^{n+1}} \qquad \text{……..(4)}$$

Here assume 90% of building lots will be abandoned without uninterruptible water right.[26]

[26] Comment: Ecology has been told in comment that an avoided cost scenario is an inappropriate measure because water markets would arise in a scarcity situation and this would reduce the measure of the value of water. The water price for the buyer would then be the value marginal product of water in production, probably within agriculture, plus the cost of generating the transfer. Ecology can't use this estimate because there have been no such transfers. The water price to the seller would be the value marginal product of the water. This is a substantive issue for the analysis. The 10% of the land assigned a value based on a transfer underestimates the avoided cost because the cost of transferring the property right is not included. The 90% of land assigned a value based on development may be over valued. However, with out a fluid water market, the water is potentially a limiting factor. Anecdotal evidence on the cost of

For a 20-year period, the total benefit will be:

$$\sum_{n=1}^{20} \frac{nsNdV}{20(1+d)^{n+1}} \qquad \text{.....(5)}$$

where N=5,524. N is defined as the projected number of households that would be served by rural public water system or exempt wells, 90% of which would be abandoned; d=0.03, d is the real discount rate, real means the value inherently *accounts for* inflation; $V = V_1 - V_2$, V_1 =65,000 is the median building lot value[27], V_1=4,950 is the farm land value of a five acre non-irrigated farm land[28]. If population grows at the SC preferred growth rate N would drop to 3,094. Therefore, the total benefit is $29 million to $52 million in the 20-year period.

2. Transfer of uninterruptible agricultural water rights:

The calculation is also based on (5), with N=5,524, and d=0.05 but only the remaining 10% of the acreage is affected. However, assuming 1 acre of irrigated farm land needs 3 acre feet of irrigation water, and 1 acre foot of water is enough for the water needs of a household, V_1=1,100, is one third of average value per acre of irrigated farm real estate, and V_2 =330 is one third of average value per acre of non-irrigated farm real estate.[29] If population grows at the SC preferred growth rate N would drop to 3,094. Therefore, the total benefit is $41,000 to $73,800 in the 20-year period.

The total value is therefore between $29 million and $52 million. Note figures are rounded to prevent overstating the significance of the values.

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transfers indicates that there are two major components to the cost: First is the expense of estimating and documenting the amount of water that it is legal to transfer. Second is the legal cost of doing the transfer which may include a long waiting period that ties up capital, legal costs from appeals by other water right holders, paperwork done by the applicant, the appellants, and the department, and the cost of litigation that may have to be undertaken by the applicant and/or the Department of Ecology. Elsewhere in the state, these transfer costs range from small costs to costs well above the price of the water to the seller. There is a large difference between the value of land in residential use and its value in agricultural use. In-so-far as water may be the limiting factor this difference is an indication of the value of water. The value of a change of use could, therefore, be very large. Despite this there has been no clamor for transfers. This is probably because Ecology has not enforced the interruptible status of water in a residential setting. People's willingness to pay is a function of their expectation that they will be able to obtain free water. However, Ecology must evaluate the rule change as if compliance existed because enforcement is a possibility in both the baseline and the new rule. Given the uncertainty, Ecology used a Monte Carlo that used a 0% to 50% range and that never-the-less left much of the change as a removal of a limiting factor to development.

[27] From Realtor.com on 9/20/2005. Note this may not represent actual sales.

[28] From: 2004 Washington Agricultural Statistics.

[29] From: 2004 Washington Agricultural Statistics.

Appendix 2: Skagit County Livestock Inventory and Water Use

The data below indicates an increase of approximately 10% in water use by livestock over the 5 year period. Assuming this trend continues over a 20 year period, then this implies a 48% increase. This translates into approximately 0.7 cfs. Extrapolating from 5 years to 20 years may hold a risk of underestimating water use. Therefore, this figure is rounded up to 1 cfs. This 1 cfs is used to estimate how much water is left over from the 15 cfs, for the other uses.

Skagit County Livestock Inventory[1] and Water Use[2]

Inventory	1997	Water Use[3] (gal/day)	2002	Water Use[3] (gal/day)
Total cattle/calves	36,059	--	39,692	--
Milk cows	17,021	595,735	20,736	725,760
Other cows	19,038	228,456	18,956	227,472
Total horses	1,041	12,492	1,394	16,728
Total	37,100	**836,683**	41,086	**969,960**

[1] USDA, National Agricultural Statistics Service 2002 Census of Agriculture – County Data
[2] EPA Office of Water, *Manual of Individual and Non-Public Water Supply Systems*, May 1991
[3] Ave. 35 gal/day/dairy cow, 12 gal/day/other cow and horse

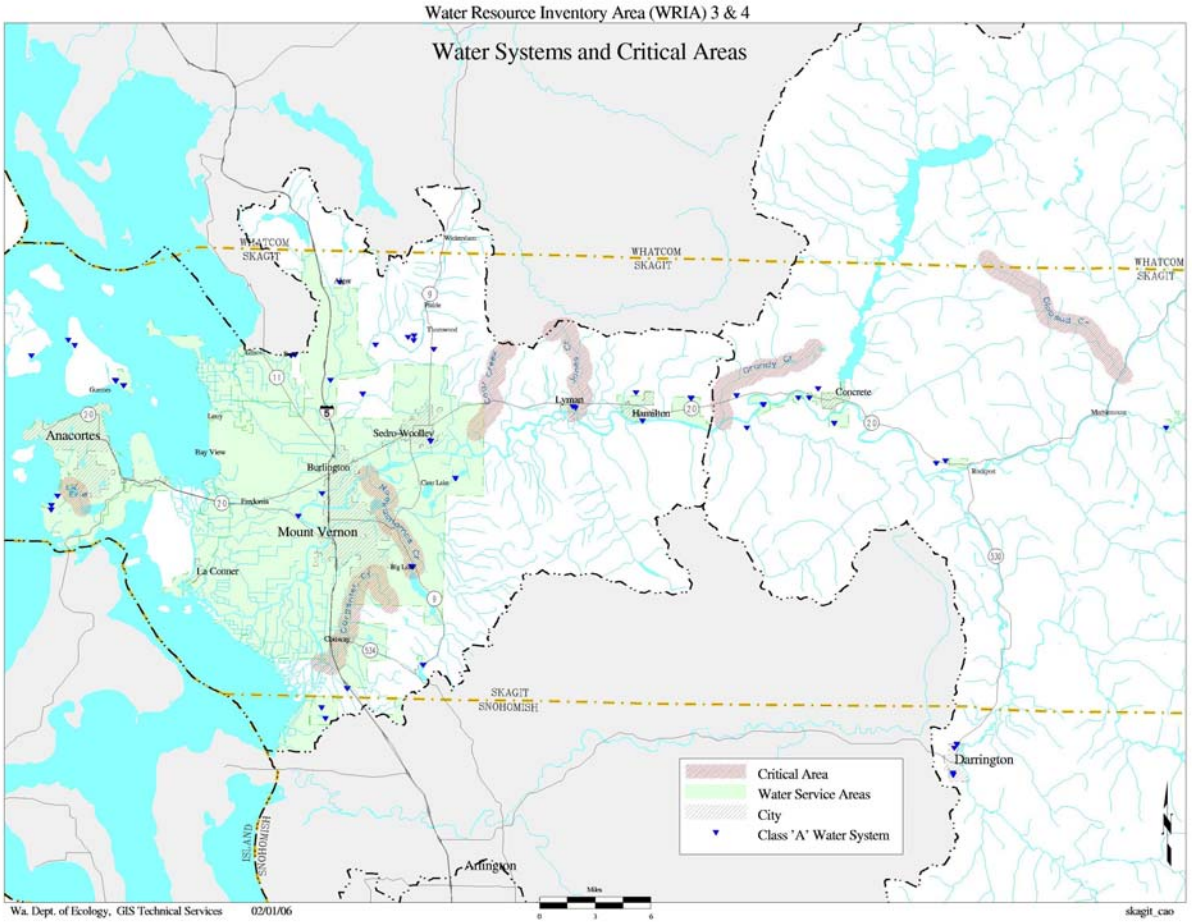
Appendix 3: Maps for Estimating Hookup to Group A and Critical Area Overlap

Within the affected portions of WRIAs 3 and 4, the hookup requirements will be limited by the willingness of the managers of those systems to allow hookups.

- People are unlikely to be allowed to hook up to nearby Group B wells.
- People are unlikely to be allowed to hook up to transient accommodation Group A wells.
- People are unlikely to be allowed to hook up to Group A wells for schools.

Thus, the potential for an impact from the hookup requirement, which Ecology is able to estimate, is limited to the Group A systems, listed in the database. The impacts in any Group A area is limited to areas that are not already required to hook up due to County ordinances for critical areas. So, ***the impact will only occur in the Group A areas, which are also outside of the critical areas below***.

Map A3.1: Map of River Systems (pink) subject to a County hookup requirement due to being in a critical area under Skagit County Cao 14.24.350.5.



Appendix 4: Memoranda from Greenberg

Note: this appendix is converted from pdf form and may not display or print properly for all computers

Memorandum

Date: September 22, 2005

To: Joe Mentor, Mentor Law Group

From: Joanne Greenberg, P.E. and Karen F. Welch

RE: Addendum 1, September 2005: Comparison of Future Water Demand under three Population Forecasts, Population Distribution for Ecology's SEPA Analysis and Estimated Future Agricultural Distribution

In accordance with the agreements made during recent negotiation meetings between Skagit County and the Department of Ecology, we have developed this addendum to our March 2005 reports submitted as part of the comments to the Skagit River Rule amendment. These reports were titled: *Current and Projected Future Water Demands for Skagit County's Domestic, Commercial, and Industrial Sectors* and *Current and Projected Future Water Demands for Skagit County's Irrigated Agriculture*.

The purpose of this addendum is to present additional information in the following three areas:

1) Water demands for Skagit County under three growth scenarios for the 20-year, 35-year and 50-year planning horizons;
2) Distribution of population projections among subbasins for Ecology's SEPA Analysis, and;
3) Distribution of current agricultural acreage to apply to projected irrigated acreage.

1) Water Demand Estimates

A medium population growth forecast scenario has been calculated to add to the original analysis (High, Skagit GMA, and Low) and to project the demand for 2040 and 2055 so that 20-year, 35-year, and 50-year projections could be evaluated by the negotiating parties. The original projections were estimated for year 2010, 2025, and 2050. The methods used to develop water demand and deficits associated with the medium forecast and 2040 and 2055 projections are the same as those detailed in the aforementioned report.

Table 1: Population Forecasts for the High Growth, Medium Growth and Skagit County GMA Growth Scenarios

Total Skagit County Population Projections	2000	2025	2040[2]	2055[2]
OFM[1] High Estimate	102,979	198,992	274,583	350,174
OFM Medium Estimate	102,979	164,797	211,946	259,095
Skagit County Adopted GMA Targets	102,979	149,080	193,804	238,528

[1] OFM = Office of Financial Management

[2] 2040 and 2050 extrapolated for OFM using 2020-2025 projected growth rate and for GMA line extrapolated using 2% annual growth per Christensen

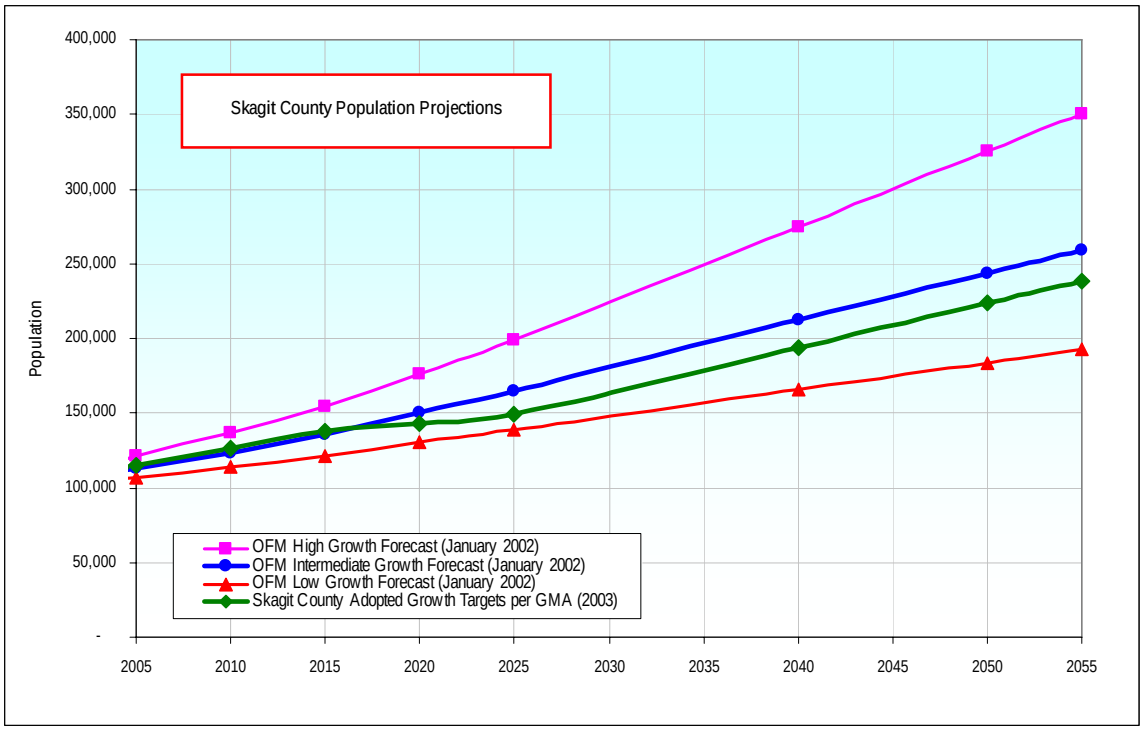


Figure 1: Skagit County Population Projections

Projected water demand for the population scenarios noted in Table 1 was calculated by applying per capita usage from documented data (Figure 2). Both Skagit PUD and the City of Anacortes have detailed water system plans with projected future water demand based on considerable analyses and metered data for some areas. If actual data were not available, general per capita demand was used from CWSPs, WSPs, and the DOH Water System Design Manual compiled assumptions from these sources are summarized in our March 2005 report.

Not all of the estimated future demand can be met under existing water rights (non interruptible and interruptible) held by purveyors. Comparison of future water demand to the existing water rights (Figure 3 and Table 2), reveals shortfalls.

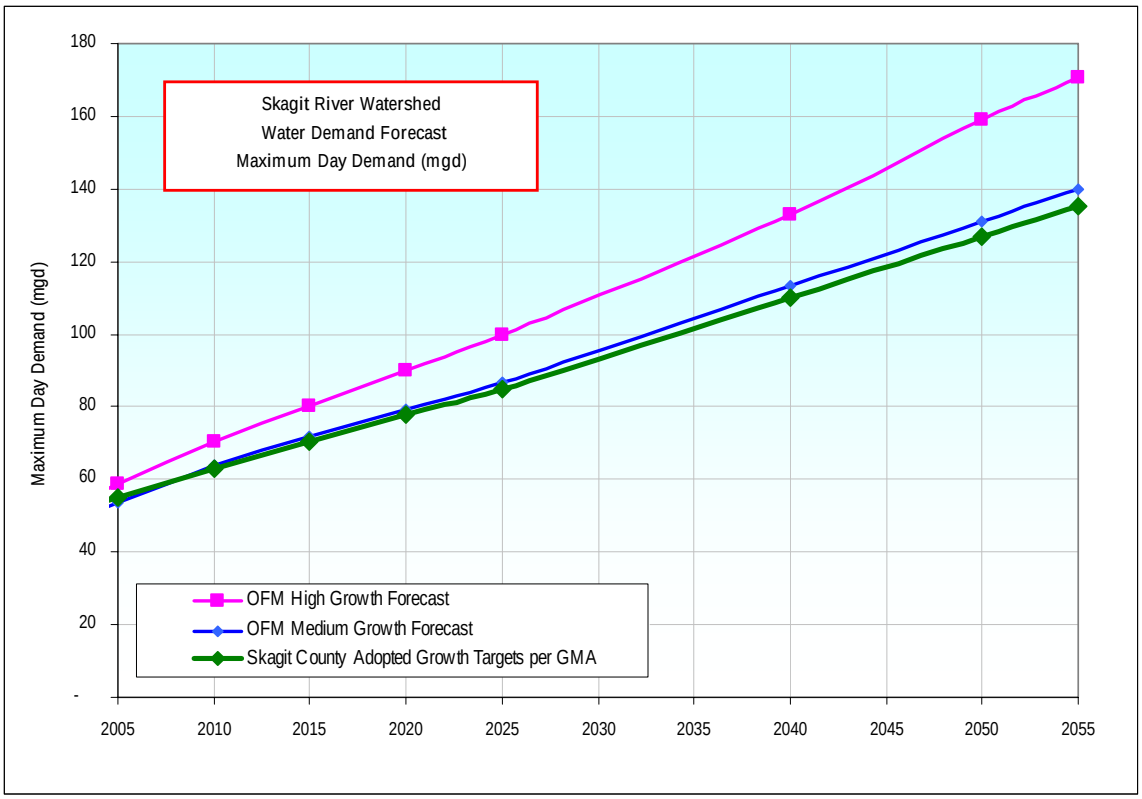


Figure 2: Skagit River Watershed Projected Water Demand for Domestic, Commercial, and Industrial Sectors: Maximum Day Demand

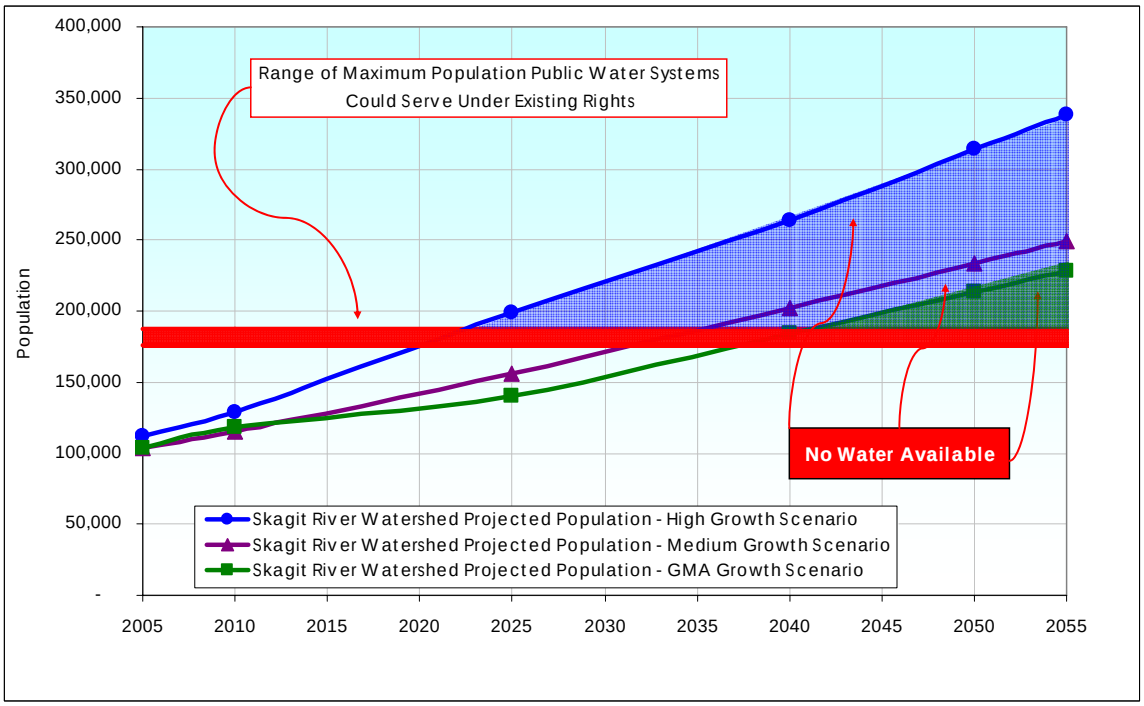


Figure 3: Skagit County Projected Population Compared to Population Served under Existing Systems' Water Rights

Table 2: Skagit County Projected New Domestic, Commercia,l and Industrial Water Demand Dependent on the Skagit River

	High Forecast			Medium Forecast			Skagit GMA Forecast		
	2025	2040	2055	2025	2040	2055	2025	2040	2055
Population Projections									
Total Skagit County Population	198,992	274,583	350,174	164,797	211,947	259,095	149,080	193,804	238,528
Portion of Population dependent on Skagit River Watershed[1]	189,737	264,130	338,270	156,084	202,487	248,887	140,616	184,631	228,646
Water Demand Projections - Maximum Day Demand (MGD)									
Skagit County Total Water Demand (MGD)	100	133	171	87	113	140	85	110	135
Public Water Shortfall or New Demand above water rights[2]									
New PUD Demand (MGD)	3.8	17.1	35.5	0.2	10.3	20.4	0.2	3.4	11.7
New Anacortes Demand (MGD)	0	0	11.5	0	0	2.1	0	0	2.1
New Exempt Well Demand (MGD)	1.7	3.1	4.8	0.8	1.1	1.4	1.0	1.2	1.3
TOTAL Skagit County Shortfall (MGD)	5	20	52	1	11	24	1	5	15
TOTAL Skagit County Shortfall (CFS)	9	31	80	2	18	37	2	7	23

[1] Population projection minus the estimates of local use in Samish Subbasin
[2] New Demand refers to demand above that held in water rights, both non interruptible and interruptible for the major purveyors, new future exempts minus those estimated in 2000

Out of County Water Demand

Skagit County purveyors currently serve rural and industrial water users outside of the County. The Water Systems Plans of both the PUD and Anacortes project increased service to their existing out of county customers; these projections were included Table 2. The new out-of-county rural demand for water presented in Table 3 is based on data in the Coordinated Water System Plans and represents the potential new rural out of county demand beyond that forecasted by the PUD or Anacortes. This demand may not reflect the current thinking in either Island or Snohomish Counties, but was discussed in the plans in early 1990's.

Table 3: Projected New out of County Water Demand Dependent on the Skagit River – for High Growth Scenario only

	Estimates of Projected New Water Demand Potentially Dependent on Skagit River Water[1] (MGD)					
	2010		2025		2050*	
	winter	*summer*	*winter*	*Summer*	*winter*	*summer*
Northwest Snohomish[4] County	0.2	0.9	0.2	1.0	0.2	1.3 (2.0 cfs)
Island County North[5] Whidbey & Camano Island	2.2	8.0	2.4	9.6	2.2	11.7 (18.2 cfs)
TOTAL for other counties (MGD)	2.4	8.9	2.6	10.6	2.4	13.0
TOTAL for other counties (cfs)	3.7	13.8	4.0	16.4	3.7	20.2

[4] Northwest Snohomish demand minus the portion projected to be served by Skagit PUD

[5] North Whidbey demand minus the portion projected to be served by Anacortes

2) Distribution of Projected Population Among Subbasins

The subbasin populations were refined based on the subbasin map prepared by Kim Berry, Skagit County GIS. In addition, the subbasins were aggregated for purposes of projecting where the future population might reside. Please note that certain areas were not included within the specified subbasins and are included as "Other Areas." We have included these areas for purposes of insuring we accounted for all of the year 2000 population. Table 4 shows the distribution of the year 2000 population by sub-basin. Subsequent analyses aggregated the sub-basins into groups. The groups were defined as follows:

- Upper Skagit – area upstream of all subbasins
- North Subbasins – the subbasins lying north of the Skagit River
- Middle Skagit – the area along the mainstem Skagit outside of the subbasin boundaries
- South Subbasins - the subbasins lying south of the Skagit River

  Lower Subbasins – the entire Nookachamps watershed, Fisher & Carpenter Creeks

  Lower Skagit – the area below the lowest subbasin and within Skagit River Basin.

Table 5 shows the year 2000 population by group and the high, medium, and Skagit GMA growth forecasts for years 2025, 2040, and 2055. Populations were distributed based on the current percentage of population within each group. Predicting spatial distribution of growth is extremely difficult and this analysis used the simplifying assumption that the current population distribution within groups can be used to predict the future population.

Table 4: Year 2000 Subbasin Population

Group Name	Subbasin Name	Subbasin Population	Group Total
Upper Skagit			8,327
North Subbasins	Hansen Creek	999	
	Coal Crk	268	
	Wiseman Crk	90	
	Tank Childs	175	
	Jones Creek	27	
	Mansser Crk	156	
	Red Cabin Crk	42	
	Muddy Creek	143	
	Carey's Creek	38	
	Alder Creek	30	
	Grandy Creek	327	
			2,295
Skagit Middle			3,222
South Subbasins	Salmon/Stevens Crk	108	
	Anderson/Parker Sorenson Crks	115	
	Gilligan Crk	61	
	Morgan Creek	119	
	Day Crk	122	
	Loretta Crk	14	
	Cumberland Cr	0	
	O'Toole Creek	0	
			539
Lower Skagit Subbasins	E. Fork Nookachamps	1,329	
	Main Stem Nookschamps	9,916	
	Carpenter Crk	1,458	
	Fisher Crk	536	
			13,239
Skagit Lower			50,527
	TOTAL IN SUBBASINS		78,149
Other Areas	Anacortes and Samish Area		21,329
	North areas		1,762
	Other areas		1,739
	GRAND TOTAL		102,979

Table 5: Skagit County Population Forecasts for 20, 35, and 50 years

Subbasin Name	2000 Population	Percent of Total	High Forecast			Medium Forecast			Skagit GMA Forecast		
			2025	2040	2055	2025	2040	2055	2025	2040	2055
Upper Skagit	8,327	8%	16,091	22,203	28,315	13,326	17,138	20,951	12,055	15,671	19,288
North Subbasins	2,295	2%	4,435	6,119	7,804	3,673	4,723	5,774	3,322	4,319	5,316
South Subbasins	539	0.5%	1,042	1,437	1,833	863	1,109	1,356	780	1,014	1,248
Lower Subbasins	13,239	13%	25,582	35,300	45,018	21,186	27,248	33,309	19,166	24,915	30,665
Middle Skagit	3,222	3%	6,226	8,591	10,956	5,156	6,631	8,107	4,664	6,064	7,463
Lower Skagit	50,527	49%	97,636	134,725	171,814	80,858	103,993	127,126	73,147	95,091	117,035
SUBTOTAL – Subbasins	78,149	76%	151,012	208,376	265,741	125,062	160,843	196,623	113,134	147,075	181,015
Other Areas within Skagit County Outside of Defined Subbasins											
West and North of Lower Skagit (includes Fidalgo Island and most of Samish)	21,329	21%	41,215	56,872	72,528	34,133	43,898	53,664	30,877	40,141	49,404
North of North Basins,	1,762	2%	3,405	4,698	5,992	2,820	3,626	4,433	2,551	3,316	4,081
Other	1,739	2%	3,360	4,637	5,913	2,783	3,579	4,375	2,518	3,273	4,028
TOTAL Skagit County	102,979	100%	198,992	274,583	350,174	164,797	211,947	259,095	149,080	193,804	238,528

3) Distribution of Potential Future Agricultural Acreage

At present, a distribution of where irrigated crops are grown is not available; therefore, an alternative method was needed to understand where the agricultural lands are situated within the County. The projections (Table 6) indicate that while agricultural land area may not increase, irrigated land is likely to increase. [Table 6 was extracted from *Current and Projected Future Water Demands for Skagit County's Irrigated Agriculture* (March 2005).] The current irrigated land was estimated at almost 15,000 acres. Future projections showed a range from 25,000 to 52,000 acres of irrigated agriculture. Irrigation water requirements associated with the current and projected irrigated acres for the month of July were added to Table 6. [Demand numbers correspond to Table 4 from the March 2005 report.]

Using the Mt. Vernon gage as the dividing point between "upstream" and "downstream" agricultural lands, the number of acres that were prime alluvial soils and zoned agriculture upstream of the gage was about 22,155 acres while downstream there were roughly 40,320 acres. This translates to about 35% of the agricultural lands situated upstream of the Mt. Vernon gage and 65% downstream.

Using the PUD pipeline near Sedro Woolley, only 16% of the agricultural lands lie upstream. Figure 4 displays the spatial distribution of irrigated acreage under current conditions and those projected for 2050.

Table 6: Current and Projected Future Irrigated Acres and Water Demand in Skagit County

Crop Type	Skagit River Watershed Irrigated Acreage	2050 Irrigated Agriculture Low End	2050 Irrigated Agriculture High End
Irrigated Acreage			
Orchard Fruits	183	311	646
Raspberries	884	1,500	3,120
Blueberries	443	752	1,564
Strawberries	127	216	448
Cucumbers	2,785	1,913	3,978
Miscellaneous Vegetables	720	4,035	8,394
Potatoes	3,283	5,571	11,588
Nurseries	4,912	8,336	17,338
Hay, Grass Silage, Alfalfa, Corn Silage	1,238	2,100	4,370
Wheat	142	241	501
Barley	15	25	53
Total Acres	14,732	25,000	52,000
Irrigation Water Demand			
Irrigation Requirement (cfs)	88	149	310
Additional Requirement above current (cfs)	-	61	222

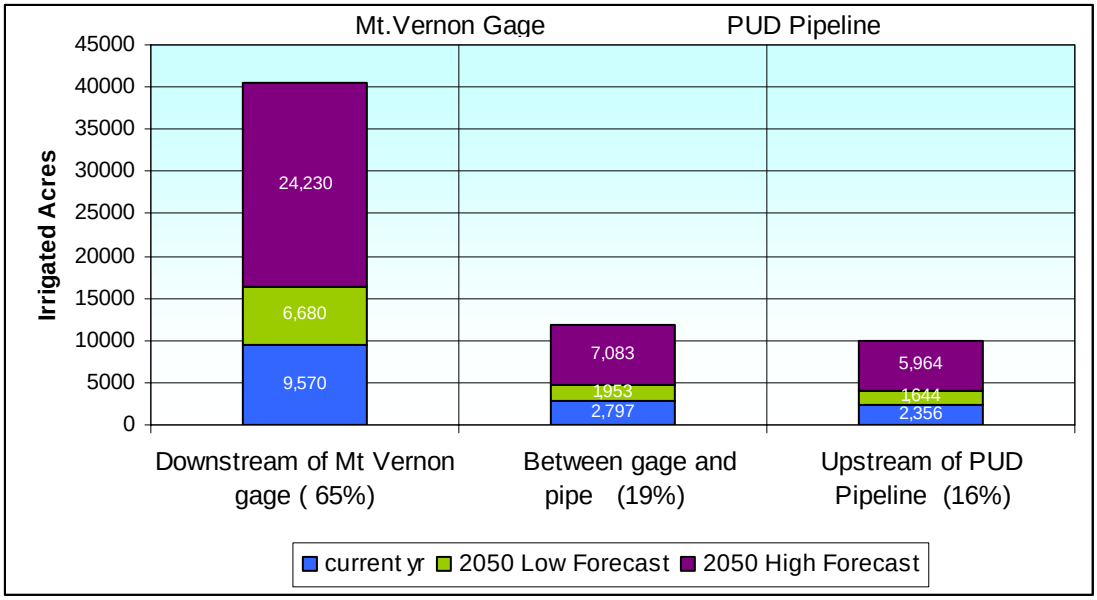


Figure 4: Spatial Distribution of Current and Projected Irrigated Acres in Skagit County

CURRENT AND PROJECTED FUTURE WATER DEMANDS FOR SKAGIT COUNTY'S DOMESTIC, COMMERCIAL, and INDUSTRIAL SECTORS

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March 2005

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Current and Projected Water Demands for Skagit County's Domestic, Commercial, and Industrial Sectors

Of fundamental concern to Skagit County is the availability of a safe and reliable supply of water to accommodate future growth. This report presents future domestic, commercial, and industrial water demand over a 50-year planning horizon for Skagit County and areas of Island and Snohomish Counties where Skagit County utilities currently supply and expect to supply water from the Skagit River. By comparing these demands to existing sources of water and water rights, we were able to determine the amount of future surface and ground water withdrawals within WRIAs 3 and 4 (excluding the Samish Sub-Basin) that will be necessary to satisfy future water demands.

Projections of future water demand rely heavily on population projections. Planning for a reliable water supply over a 50-year planning horizon requires a conservative approach. Therefore, in the face of uncertain population projections, we selected the Office of Financial Management high population forecasts as the basis of the water demand estimates. For reference, we also provide estimates for a preferred growth scenario based on the Skagit County adopted Growth Management Act Target population projections.

In 2000, the demand for water from sources within the Skagit River Watershed was estimated at 42.6 cfs (27.5 million gallons per day (mgd)) in the winter and 72.3 cfs (46.7 mgd) during peak summer usage. The projected future (2050) water demand ranges from 146.2 cfs (94.3 mgd) for average day demand and 246.1 cfs (158.8 mgd) for maximum day demand under the high growth scenario. The water demand for Skagit County Adopted GMA growth targets is lower by about 20%.

Not all of this future demand can be met under existing water rights held by purveyors. When future water demand is compared to the existing water rights, a shortfall is expected to occur just prior to the year 2025 for the high growth scenario and around 2040 for the preferred growth projection. Additional water sources will be required to provide a reliable supply to the forecasted population which could exceed 300,000 people by 2050 under the high growth scenario. New water demand in Skagit County, above that which is covered by existing water rights, is expected to reach 61.2 cfs (39.6 mgd) by 2050 under the high growth scenario and 15.8 cfs (10.2 mgd) under the preferred growth scenario. The portion of this that would serve additional exempt wells could approach 6.2 cfs (4 mgd) by 2050 (high scenario) or 2 cfs (1.2 mgd) under the preferred growth scenario.

The Department of Ecology's proposed Skagit River Instream Flow Rule Amendment would set aside an uninterruptible domestic reserve of approximately 1.657 cfs or 1.1 mgd divided among 25 sub-basins above the instream flow control point at Mt. Vernon. This reserve would only supply a small percent of the expected growth. In aggregate, the reservation of 1.657 cfs allows for domestic supply to 5,604 people (based on Department of Health recommended residential per capita water use figures) or 4% of the 126,000 people expected to need additional water rights under the high scenario. Under the preferred growth scenario the reserve would only serve 16% of the 35,000

people.

Of fundamental concern to Skagit County is the availability of a safe and reliable supply of water to accommodate future growth. This report presents future domestic, commercial, and industrial water demand over a 50-year planning horizon for Skagit County and areas of Island and Snohomish Counties where Skagit County utilities currently supply and expect to supply water from the Skagit River. By comparing these demands to existing sources of water, we were able to determine the amount of future surface and ground water withdrawals within WRIAs 3 and 4 (excluding the Samish Sub-Basin) that will be necessary to satisfy future water demands

At the cornerstone of water supply forecasting is population forecasting. The Office of Financial Management (OFM) develops low, intermediate, and high population forecasts for each County. In 2003, the Skagit County Growth Management Act (GMA) Steering Committee with the help of consultants completed an in-depth analysis of the OFM January 2002 population projections[1]. As a result of this process, they adopted (Skagit Countywide Planning Policy 1.1) target growth projections for 2015 just above the OFM medium level and for 2025 at a level between the medium and low estimates.

While Skagit County GMA targets represent the preferred growth scenario, predicting growth patterns is difficult and experience has shown that forecasts are often off the mark. Planning for a reliable water supply over the longer 50-year planning horizon requires a conservative approach to account for the inaccuracies in forecasting. Therefore, we have selected OFM high population forecasts as the basis of the water demand estimates. For reference, we have also provided estimates for the preferred growth scenario based on Skagit County's adopted projections. With this in mind, the results from the high growth scenario will be the focus of discussion while preferred growth results will be inserted periodically for comparison, but not always elaborated upon.

To understand whether or not the existing sources can meet the future demand, we compared the instantaneous diversion rates held under water rights to the projected service demand on an individual basis for the two largest purveyors, the Skagit PUD and the City of Anacortes, and in aggregate for rural purveyors. To determine the exempt well population expected to require an additional source of water supply, the projected population that could be served by the Skagit PUD, the City of Anacortes, rural public water systems and single and multiple domestic water right holders was subtracted from the total projected population dependent on Skagit River water. Please note that this analysis is not a detailed water demand or system analysis for entities within the region. Instead, it offers gross estimates of future water demand for planning purposes. The Skagit PUD and the City of Anacortes' public water systems were reviewed only in terms of capacity under current water rights; this analysis did not address installed facility capacity for either entity. We did not allow facilities to be the limiting factor, instead we simply assumed that facilities could be expanded and compared legal rights for water to the future demand for water.

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[24] U.S. Census Bureau. 2000 Census Data. Average Household Size in Skagit County.

[25] Wayne B. Solley. *Estimates of Water Use in the Western United States in 1990 and Water Use Trends 1960-1990*. U.S.G.S Report to the Western Water Policy Advisory Commission, August , 1997, page 7.

[26] Oad, Ramchand and Michael DiSpigno. *Water Rights to Return Flow from Urban Landscape Irrigation*. Journal of Irrigation and Drainage Engineering. July/August 1997, pp. 293-299.

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a. Projected Shortfalls

When future water demand dependent on the Skagit River Watershed is compared to the existing water rights, a shortfall is expected to occur just prior to the year 2025 (Figure 1, Table 1 and Table 2) for the high growth scenario and around 2040 for the preferred growth projection. Additional water sources will be required to provide a reliable water supply to the forecasted population which could exceed 300,000 people by 2050 (Table 3) under the high growth scenario.

New water demand, above that which is covered by existing water rights, is expected under the high growth scenario to reach 61.2 cfs (39.6 mgd) by 2050 (Table 1). The portion of this that would serve additional exempt wells could approach 6.2 cfs (4 mgd) by 2050 or 6% of the total projected demand. New Skagit PUD demand (above water righted amount) is expected to reach 46.1 cfs (29.8 mgd) which represents 79% of the total by 2050. The City of Anacortes' new demand is estimated at 8.9 cfs (5.8 mgd) or 15% of the total. Around 9% of Skagit County's rural population is currently served by individual exempt wells and is expected to remain similar up to 2050 (Table 3).

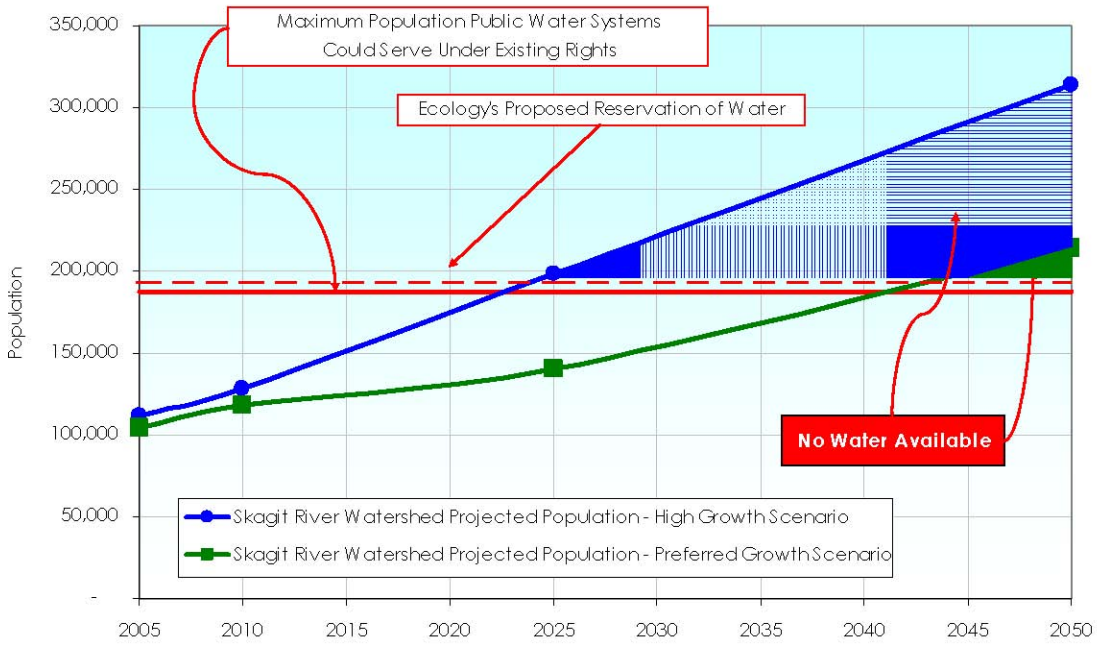

Figure 1: Skagit County Projected Population Compared to Population Served under Existing Systems' Water Rights.

To determine how much of the future population would be affected by the shortages, we assumed that the deficit would be split among the sectors in the same proportion as the demands. Using this approach, 31.5 cfs (20.3 mgd) or approximately half of the new demand would be required to serve the domestic needs of projected growth within the Skagit River Watershed. In terms of residential service, this shortfall translates to approximately 105,000 new people by 2050 that would not be able to be served under the PUD's and Anacortes' existing water rights. An estimated 21,000 additional people would need to rely on exempt wells. Additional water rights are needed to accommodate these 126,000 people by 2050. For the preferred growth scenario, this number drops to around 35,000 people (28% of the high growth projections).

The Skagit River Instream Flow[2] was established in 2001 and the associated rule clearly states that all water uses including future exempt wells will be junior to the instream flow. The Department of Ecology (Ecology) has since proposed a rule amendment that would set aside an uninterruptible domestic reserve of approximately 1.657 cfs or 1.1 mgd divided among 25 sub-basins above the instream flow control point, which is the USGS Gage Station #12-200500, Skagit River near Mt. Vernon. Exempt well withdrawals would now be limited by this reservation.

The proposed reserve would supply only a small percent of the expected growth. In aggregate, the reservation of 1.657 cfs allows for domestic supply to approximately 5,604 people based on 800 gallons per household as recommended by the Department of Health[3] and 38% return flow (net of inside and outside summer return flow estimates as documented in Section 3b). The 5,604 people comprise 4% of the new demand expected by 2050 for the high growth scenario and 16% for the preferred scenario.

In the proposed reservation, Ecology has used 350 gallons per day per residence or business and 175 gallons per day per residence or business if the dwelling is using an on-site septic system which assumes a 50% return flow[4]. Based on Ecology's assumptions (including 50% return flow for all but the Lower Skagit sub-basin), the reservation would serve roughly 13,600 people, still only 11% of the 126,000 expected to need additional water rights under the high scenario. Under the preferred growth scenario the reserve would supply around 39% of the 35,000 using Ecology's water use assumptions.

Use of Ecology's reserve is restricted spatially to the 25 administrative sub-basins above Mt. Vernon. To fully understand how much of the future exempt well population could be served by Ecology's reserve, the spatial distribution of the exempt wells must be known. Our estimates reflect only the aggregate population expected to rely in exempt wells and not the spatial distribution. Further analysis is necessary to understand the full effect of the reservation taking into account the spatial component.

Thirty cfs (19 mgd) of new demand represents water requirements for in county commercial and industrial uses and out of county wholesale customers as forecasted in the water system plans for the PUD[5] and Anacortes[6]. Anacortes and the PUD, currently supply water to and/or project some increase in service to areas outside Skagit County (North Island County & North Snohomish). These areas

could request that service be expanded beyond the current customer base or forecasted amounts. Potential expansion of service to rural areas outside of the County would require an estimated additional 20.2 cfs (13 mgd) by 2050 (Table 1).

While some of the future demand for the Skagit PUD and the City of Anacortes can be met through optimizing operational strategies of storage rights in Judy Reservoir and the interties, it is possible that new source development strategies may be required to serve a portion of the projected demand. Without conducting a reservoir operation study, we assumed that the interruptible rights could be used in full in conjunction with storage in Judy Reservoir.

Given the comparison of the projected demand to non-interruptible and interruptible water rights (Table 2), Skagit PUD could experience peak summer shortages as early as 2025 and average day demand (ADD) shortages by 2050. The Skagit PUD's water system plan[2] discusses the likelihood of 2020 deficits under the ADD. The City of Anacortes' WSP[3] shows a surplus through 2020 in terms of water rights for their high scenario demand forecast; they do not have projections out to year 2050.

Table 1: Projected New Domestic, Commercial, and Industrial Water Demand Dependent on the Skagit River Watershed - High Growth Scenario

	Estimates of Projected New Water Demand[1] (MGD)						
		2010		2025		2050*	
		winter	*summer*	*winter*	*Summer*	*winter*	*summer*
Additional Exempt[2] (Non-PWS) Skagit County	0.06	0.8	0.1	1.7	0.3	4.0 (6.2 cfs)	
New Demand for Skagit PUD[1]				3.8	1.2	29.8 (46.1 cfs)	
New Demand for City of Anacortes[1]						5.8 (8.9 cfs)	
New Demand for Rural PWS[3]						Assumed 0	
TOTAL for Skagit County (MGD)	0.1	0.8	0.1	5.5	1.5	39.6	
TOTAL for Skagit County (cfs)	0.1	1.3	0.21	8.1	2.4	61.2	
Northwest Snohomish[4] County	0.2	0.9	0.2	1.0	0.2	1.3 (2.0 cfs)	
Island County North[5] Whidbey & Camano Island	2.2	8.0	2.4	9.6	2.2	11.7 (18.2 cfs)	
TOTAL for other counties (MGD)	2.4	8.9	2.6	10.6	2.4	13.0	
TOTAL for other counties (cfs)	3.7	13.8	4.0	16.4	3.7	20.2	
GRAND TOTAL (MGD)	2.5	9.7	2.7	16.1	3.9	52.6	
GRAND TOTAL (cfs)	3.9	15.1	4.3	25.0	6.1	81.4	

[1] New Demand refers to demand above that held in water rights, both non interruptible and interruptible; based on the OFM high forecast. Includes industrial, commercial, wholesale projections within Skagit PUD & Anacortes service areas.

* Extrapolated by consistently applying the 2020 to 2025 OFM high estimate growth rate over the additional 25 year period

[2] Exempt (non-PWS) refers to rural population not served by Skagit PUD, City of Anacortes, rural PWS or DM/ DS water rights

[3] Rural PWS refers to small water systems and individual water rights for domestic multiple or domestic single purpose; No deficit applies because it was assumed that the systems were built out to the water righted allocation in 2050

[4] Northwest Snohomish demand minus the portion projected to be served by Skagit PUD

[5] North Whidbey demand minus the portion projected to be served by Anacortes

Table 2: Summary of Supply Excess or Shortages for Skagit PUD and City of Anacortes – High Growth Scenario

	Capacity Based on Water Rights (mgd)	Supply Excess or Shortage[1] (mgd)						
			2010		2025		2050	
			ADD[2]	*MDD*[3]	*ADD*	*MDD*	*ADD*	*MDD*
Skagit PUD								
Non Interruptible	27.5	11.2	0.5	4.2	-12.0	-9.5	-38.0	
All Water Rights	35.8	19.5	8.8	12.5	-3.8	-1.2	-29.8	
City of Stanwood/ Camano Island	Can Skagit PUD supply?	yes	possibly		no	no	no	
City of Anacortes								
Non Interruptible	54.9	29.5	16.8	19.8	2.2	0.6	-26.6	
All Water Rights	75.8	50.4	37.7	40.6	23.1	21.4	-5.8	
Island County North	Can Anacortes supply?	yes	yes	yes	possibly		no	

[1] Shortages are defined as demand in excess of water rights and are synonymous with the term new demand in Table 1

[2] ADD = Average day demand assumed to represent winter water demand

[3] MDD = Maximum day demand assumed to represent summer water demand

The process of estimating future water demands is no simple task because it involves reconciling data from many different and often conflicting sources. Population projections through 2025 were obtained from the Washington State Office of Financial Management (OFM) and from Skagit County. Additional information was compiled from the Coordinated Water System Plans (CWSP) for each county and the individual Water

System Plans (WSPs) for the major purveyors. Most of the CWSPs were completed in the early 1990s and contained population projections through either 2020 or 2040 based on pre-Census 2000 data. In addition, changes have occurred in service areas since the writing of the CWSPs leaving population and water demand projections outdated. For this analysis, we updated the Skagit County population and water demand estimates in the Skagit County Coordinated Water System Plan based on new OFM estimates, Skagit County adopted GMA growth targets, and new service information.

The water supply capacity for Skagit PUD and Anacortes was determined based on both non-interruptible water rights and interruptible water rights per information available in the water system plans as well as the 1996 Memorandum of Agreement[7]. The interruptible water rights were considered only in total as if they were available at all times. While management of Judy Reservoir and the use of interties between the two purveyors could allow access to the water held under interruptible rights during much of the time, assuming the water is available all the time may overstate the water supply. It was not possible, however, to address interruptible water rights in full detail as part of this analysis since it would require a more in-depth investigation of the operations of Judy Reservoir.

A summary of our analysis resulting in projected regional domestic, commercial, and industrial water requirements is described below; supporting information and more detail for each County supplied by water from the Skagit River Basin follows.

a. Population and Purveyors

The OFM county growth projections[8], available in 5-year increments from 2000-2025, were obtained for three different growth scenarios: high, intermediate, and low (Figure 2). The three growth scenarios are intended to represent a reasonable range of expected population growth. The high forecast was used in this analysis to serve as the upper limit on growth. For perspective, Skagit County's adopted GMA growth targets[9] available for 2015 and 2025 were also used. The Skagit County GMA targets were 74% of the OFM high estimates in the year 2025. Year 2050 OFM estimates were extrapolated by applying the 2020 to 2025 growth rate over the additional 25-year period; an annual growth rate of 2% was used to extrapolate Skagit County GMA 2025 targets to 2050 10.

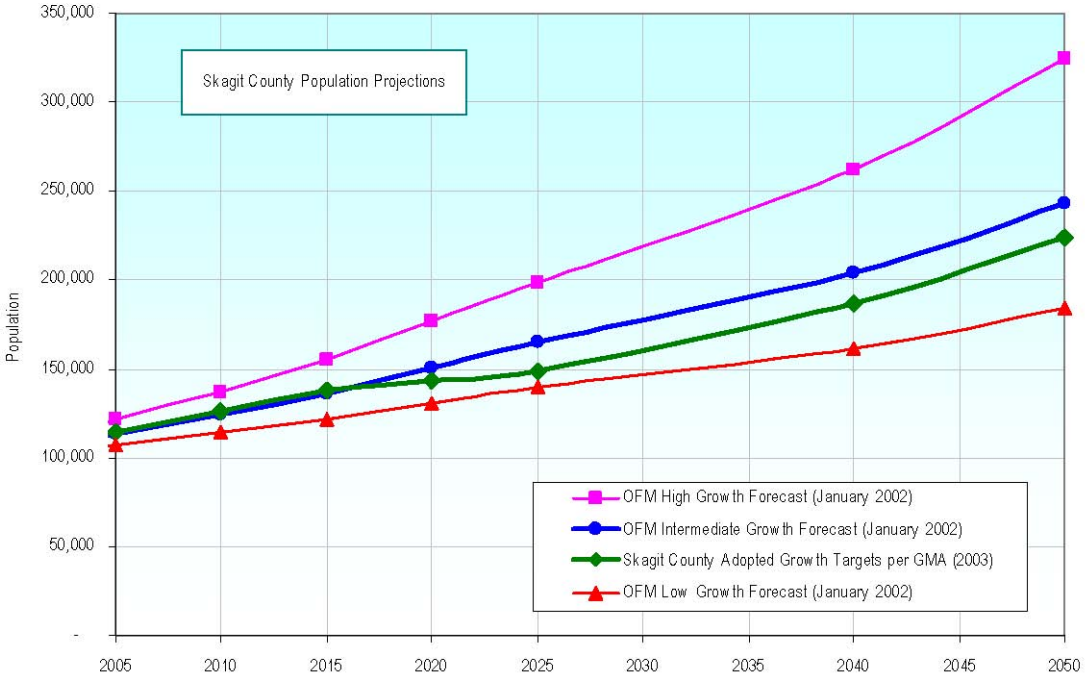

Figure 2: The Range of Population Projections for Skagit County

Since planning for a reliable water supply over a 50-year planning horizon requires a conservative approach, we selected OFM high population as the basis of the water demand estimates. Water demand estimates for the preferred growth scenario based on the Skagit County's adopted GMA targets was also undertaken for comparison.

Prior to calculating water demand for these growth scenarios, an additional analysis was conducted to determine how much of Skagit County's population relies on Skagit River water. Most of the County's land drains to the Skagit River with the exclusion of three areas. Two of the three are not within the WRIA 3/ 4 boundary: an area bordering Snohomish County encompassing the upper Pilchuck, Deer, and North Fork Stillaguamish drainages and an area bordering Whatcom County north of the Towns of Lyman and Hamilton. It was assumed that these areas support very little of Skagit County's population since they are primarily forested private lands or under National Forest ownership and the area just west of the I-5 corridor is within the PUD Cultus Mountain Supply area11. The third area located north and west of the Skagit River's north fork drains directly to Samish Bay, Padilla Bay and Fidalgo Island bays. This area supports a significant population however, with the exclusion of the Samish River Sub-Basin, these people are primarily served with public water from the Skagit River[11].

Based on Census 2000 data12, the population in the Samish Sub-Basin was 8% of the Skagit County total population. Assuming that future growth will occur proportionally, we projected under the high growth scenario that 25,759 people would live in the Samish River Sub-Basin by year 2050; under the preferred growth scenario the estimate was 17,725 people. However, some of these people currently use Skagit River water serviced by the PUD and more will in the future.

Few public water systems in the Samish Sub-Basin are expanding or have room under existing water rights to serve growth. Based on estimates made in 200113, the PUD serves 246 people in the Samish Sub-Basin and operates the Alger system (serving approximately 184 people in 2000). Future growth will likely occur along the I-5 corridor and/or near the southern border of the basin; the Sedro Woolley urban growth area extends into the Thomas Creek portion of the Samish Sub-Basin. Since PUD infrastructure exists in both of these areas, it is likely that the PUD could supply the bulk of future growth in the Samish with Skagit River water. In fact, 23% of the Skagit portion of the Samish River Sub-Basin falls under the PUD's future service area[10]. While the PUD's water system plan14 does forecast increased service to the Samish Basin, it is included in the aggregate rural estimates supplied by its Judy Reservoir system and not listed explicitly for the Samish.

With this in mind, future PUD expansion to the Samish Sub-Basin was estimated by assuming that 80% of future growth would be accommodated within urban areas based on Skagit County's target15. The urban areas could be served by public water16, which for the Samish Sub-Basin would be Skagit PUD. The rural Samish Sub-Basin population was assumed served by local Samish River sources and subtracted from the Skagit County population estimates. The resulting population was termed Skagit River watershed population to signify the dependence on sources from within the Skagit River watershed.

Once the projected population was determined, the growth was distributed amongst the purveyors to compare projected demand to source water. The population projections were disaggregated according to likely purveyor i.e. City of Anacortes, Skagit PUD, rural public water system, single and multiple domestic water rights, or exempt wells (see Section 4 for details). The additional population expected to rely on exempt wells was defined as those not served by any of the following: Skagit PUD, the City of Anacortes, rural public water systems and single and multiple domestic water right holders. In other words, exempt wells would serve a population defined by the difference between the total projected population in Skagit County and relying on Skagit River water and the sum of those served by the entities/water rights defined above.

The Skagit County total population projections for 2000, 2010, 2025, and 2050 under the high growth scenario are summarized in Table 3 along with the portion expected to be served by Skagit River water; Table 4 presents the same information for the preferred growth scenario. In addition, the Skagit River Watershed population projections are broken down by purveyor. Based on our approach, which allocated population to each entity per information in their water system plans, the PUD and Anacortes service accounted for 83% of new growth expected by 2050 (or approximately 181,000 people of the expected 218,500 between 2000 and 2050 under the high scenario). Rural population growth was estimated to be less than 20% of total Skagit River watershed population, which is consistent with the Skagit County Comprehensive Plan target17.

Table 3: Skagit County Historic and Future Population Projections and Percent of Population Served by Purveyors – High Growth Scenario

	2000	2010	2025	2050*
Total Skagit County Population –OFM High Estimate	102,979	137,054	198,992	324, 977
Portion of Population dependent on water from the Skagit River Watershed[1]	95,246	128,781	189,737	313,725
Population Projected to be Served by:				
Skagit PUD [2]	60,938 (64%)	82,449	126,876	213,650 (68%)
City of Anacortes [3]	17,971 (19%)	21,925	29,690	46,020 (15%)
Rural Public Water Systems [4]	7,484 (8%)	11,228	15,259	24,260 (8%)
Single Domestic Water Right Holders[5]	412 (0.4%)	412	412	412 (<0.1%)
Remaining Population assumed Served by Exempt Wells[6]	8,441 (9%)	12,768	17,501	29,382 (9%)

* Extrapolated by consistently applying the2020 to 2025 OFM high estimate growth rate over the additional 25 year period

[1] OFM high total Skagit County population estimates minus the local Samish Sub-Basin use

[2] PUD water system plan adjusted to current OFM estimates

[3] Anacortes' water system plan high case scenario adjusted to current OFM estimates

[4] Assuming full build out in 2050 to the water righted annual volume limit per WRATs; 2010 & 2025 based on rural population proportion in 2000

[5] Determined from the water righted annual volume limit per WRATs no growth assumed

[5] Calculated as the remainder of projected Skagit River Watershed population – public water service – other domestic water rights

Table 4: Skagit County Historic and Future Population Projections and Percent of Population Served by Purveyors – Preferred Growth Scenario

	2000	2010	2025	2050*
Total Skagit County Population – GMA Targets	102,979	126,126	149,080	223,620
Portion of Population dependent on water from the Skagit River Watershed[1]	95,246	118,027	140,616	213,975
Population Projected to be Served by:				
Skagit PUD [2]	60,938 (64%)	75,875	87,887	135,993 (64%)
City of Anacortes [3]	17,971 (19%)	21,036	26,768	38,343 (18%)
Rural Public Water Systems [4]	7,484 (8%)	9,713	11,942	24,260 (11%)
Single Domestic Water Right Holders[5]	412 (0.4%)	412	412	412 (<0.1%)
Remaining Population assumed Served by Exempt Wells[6]	8,441 (9%)	10,990	13,607	15,027 (7%)

* Extrapolated by applying an annual growth rate of 2% over the additional 25 year period

[1] GMA total Skagit County population estimates minus the local Samish Sub-Basin use

[2] PUD water system plan adjusted to GMA estimates

[3] Anacortes' water system plan base case scenario

[4] Assuming full build out in 2050 to the water righted annual volume limit per WRATs; 2010 & 2025 based on rural population proportion in 2000

[5] Determined from the water righted annual volume limit per WRATs no growth assumed

[5] Calculated as the remainder of projected Skagit River Watershed population – public water service – other domestic water rights

b. Projected Water Demand

Projected water demand for the population noted in Tables 3 and 4 was calculated by applying per capita usage from documented data. Both Skagit PUD and the City of Anacortes have detailed water system plans with projected future water demand based on considerable analyses and metered data for some areas. If actual data were not available, general per capita demand was used from CWSPs, WSPs, and the DOH Water System Design Manual[18]; compiled assumptions from these sources are summarized below.

Summary of per capita water use assumptions:

- PUD: 82 gallons per capita per day (gpcd) winter and 156 gpcd summer derived by dividing the projected demand by the projected population using information in their water system plan[19]
- Anacortes: 65 gpcd winter and 130 gpcd summer derived by dividing the

projected demand by the projected population using information in their water system plan[20]

- Potential future supply outside Skagit County by PUD or Anacortes: 100 gpcd winter and 200 gpcd summer per CWSP[21] averages and a 2.0 peaking factor[18].
- Rural public water systems: 100 gpcd winter and 240 gpcd summer assuming an average annual allocation of 0.5 ac-ft/year per household under multiple domestic water rights[22]
- Single domestic water right holders: 100 gpcd winter and 590 gpcd summer for an average annual allocation of 1 ac-ft/year and assuming one dwelling unit per right[22].
- Exempt wells: 100 gpcd winter and 308 gpcd to represent summer demand (based on 800 gallons per day for MDD[23] and 2.6 people per household[24]).
- Return flows for exempt wells were assumed to be 85%[25] for in-house use and 15%[26] for outside irrigation. This results in a net return flow of 38% during summer and 85% during winter.
- Under the proposed reservation, Ecology has used 350 gallons per day per residence or business and 175 gallons per day per residence or business if the dwelling is using an on-site septic system.

The average day demand (ADD) was assumed to represent the winter water demand and the maximum day demand (MDD) the summer demand. Table 5 and Figure 3 present a comparison of total water demand for 2000, 2010, 2025, and 2050 under both scenarios. Detailed water demand by purveyor and sector follows in Section 4.

Table 5: Comparison of Water Demand for the High Growth and Preferred Growth Scenarios

	2000	2010	2025	2050
High Growth Scenario				
Total Skagit County Population –OFM High Estimate	102,979	137,054	198,992	324,977
Portion of Population dependent on water from the Skagit River Watershed[1]	95,246	128,781	189,737	313,725
Total Skagit River Water Demand (MGD) Maximum Day Demand	47	71	100	159
SHORTFALL of Public Water or NEW Demand above Water Rights (MGD)	0	0	3.8	35.6
New Exempt Well Demand (MGD)	_	0.8	1.7	4.0
Preferred Growth Scenario				
Total Skagit County Population –Skagit County Adopted GMA Targets	102,979	126,126	149,080	223,620
Portion of Population dependent on water from the Skagit River Watershed[2]	95,246	118,027	140,616	213,975
Total Skagit River Water Demand (MGD) Maximum Day Demand	47	63	85	127
SHORTFALL for Public Water or NEW Demand above Water Rights (MGD)	0	0	0	9
New Exempt Well Demand (MGD)	_	0.5	1.0	1.3

[1] OFM high scenario total Skagit County population estimates minus the local Samish Sub-Basin use
[2] Skagit County Adopted GMA Target population estimates minus the local Samish Sub-Basin use

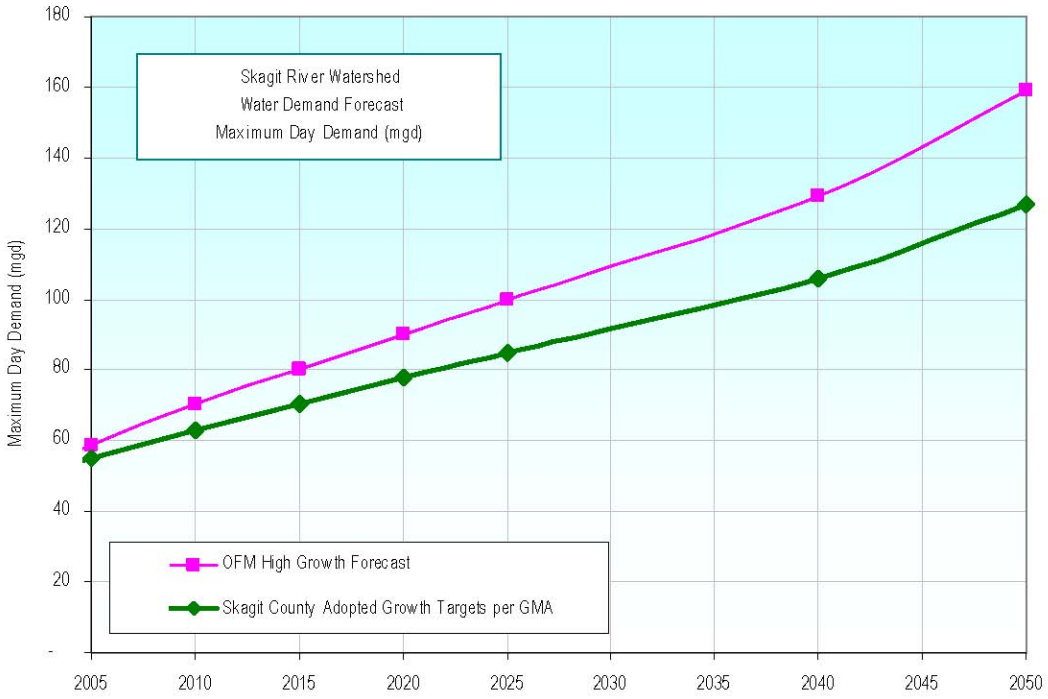

Figure 3: Skagit River Watershed Projected Water Demand for Domestic, Commercial, and Industrial Sectors.

a. Background on Distribution of Growth

In the Skagit PUD's water system plan, the projected population served in each time period was calculated based on pre-2000 Census data. These numbers were adjusted downward to account for the 2000 Census, which was lower than the projected high growth projections and just under the projected intermediate case.

The City of Anacortes' water system plan did not have projected population documented but projected water sales for domestic supply purposes. The City of Anacortes water system plan identified 5,200 residential accounts or, using 2.6 persons per household, service to 13,520 people in and around Anacortes. This number however, was less than the Census 2000 population for the City (14,557) consequently the population projection was adjusted using 2000 Census data with a 2.2% annual growth under the high scenario[27] to achieve their 2020 projections. The 2.2% annual growth rate was also used in this analysis to estimate population for 2025 and 2050. In addition, Anacortes provides wholesale water to the Town of La Conner, the Shelter Bay Community, and the Swinomish Tribe. Total residential Skagit County population served by the City was derived by adding the Census 2000 data for these three communities to the Anacortes Census data.

The population beyond the service areas of the Skagit PUD or the City of Anacortes was assumed to represent rural growth. The rural growth was divided into those served by small water systems, single domestic water rights, and those served by exempt wells. Data on rural public water systems (PWSs) is sparse. Consequently, the estimates presented here are based on the CWSP, the Department of Health (DOH) public water system database[28], and the extraction of multiple domestic water rights from the Department of Ecology's water rights database (WRATs)[29]. Water rights for the small systems are often listed under an individual persons name rather than the water association and, therefore, could not be readily identified and matched with a PWS in the DOH database. We assumed multiple domestic rights represented all of the small public water systems as well as situations where one well serves more than one house yet is not defined as a PWS.

For small cities, Concrete, Hamilton, and Lyman, and larger or expanding rural public systems as referenced in the CWSP, an estimate of

future potential population served was developed by assuming 2.6 persons per household30 for each of the approved connections listed in the DOH database. The capacity under the water rights held by these entities was also investigated as a check on this method. The estimate of population served under the aggregated annual volume limit for the water rights compared favorably to the first method.

Since it was not possible to review approved connections for the numerous remaining small rural systems in Skagit County, the sum of multiple domestic water rights were used as a surrogate. Instantaneous diversion rates and annual volume limits were tallied for the remaining multiple domestic water rights (excluding those already discussed). The approach used in this analysis assumes no deficit under these rural systems rather that they will be built out to the full use of their current water right allocation by 2050. The population served in 2050 was determined from the total water right volume limit by assuming Ecology had assigned 0.5 ac-ft per household for each multiple domestic right. For example, if the annual volume limit were 3 acre feet, then six houses could be served by that right. Each household was allotted 100 gpcd for winter and 240 for summer assuming 2.6 people per household. That equates to 260 gallons per household in winter and 624 gallons per household in summer.

Domestic single rights were naturally assumed to serve one household with an annual volume limit of one ac-ft, the most common allocation by Ecology (in WRATS) for this classification of rights in WRIAs 3 & 4.

Forty-three of the 260 rights investigated showed more than one purpose. For the 14 of these that listed multiple domestic usages with other purposes, we assumed one acre foot per year for the domestic portion of the right and therefore service to two households. Twenty-nine rights listed single domestic use along with another use and were assumed to serve one household. In addition, two general domestic rights held by the Department of Fisheries and Puget Sound Energy were assumed to serve staff housing at their respective facilities. Based on the facilities available at the Baker River Hydroelectric facility operated by Puget Sound Energy and the Fish Hatchery it was assumed that these domestic general rights would serve approximately 400 people.

The remaining population was assumed to require their water supply to come from a future exempt well with a maximum day demand of 800 gallons per day per residence31 per the DOH water system design manual. Winter demand was assumed to be 260 gpd per residence and summer demand was assumed at 800 gpd per residence. The majority of the rural population served by exempt wells also has private septic systems. Much of the water used by people in residences with on-site septic systems returns to recharge ground water. Return flows for exempt wells were assumed to be 85%32 for in-house use and 15%33 for outside irrigation. This results in a net return flow of 38% during summer and 85% during winter.

The estimates of population using the water rights allocation were assumed to represent conditions in the year 2050 resulting in roughly 29,380 people served by exempt wells by the year 2050 (High Growth Scenario) and 24,620 served under rural public water systems (Table 3). Growth under rural public water system service was assumed to be in proportion to the 2000 distribution of service outside of the PUD and Anacortes. The population using a water supply under single domestic water rights was assumed constant at the 2000 level since new water rights have probably not been issued since.

b. Skagit County

i. Water Rights

The non-interruptible water rights for Skagit PUD #1 total 42.6 cfs while the corresponding rights for the City of Anacortes are 85 cfs (Table 6). Including the pending right on the Skagit River (per MOA, 1996), the most that Skagit PUD could withdraw is 55.4 cfs (35.8 MGD). The PUD has several additional pending rights on Cultus Mountain streams that total 39.81 cfs (25.74 mgd); these pending rights were not included at this time. Anacortes has an additional right, subject to the Lower Skagit Instream Flow Rule, that brings the total supply to almost 118 cfs (75.83 mgd).

Table 6: Water Rights Held by Skagit PUD #1 and the City of Anacortes

Entity	Sources	Instantaneous Diversion Rate (cfs)	Instantaneous Diversion Rate (MGD)	Interruptible
Skagit PUD	Salmon, Gilligan, Turner, Mundt Creek	31.69	20.48	Yes, Cultus Mtn. Instream Flow
Skagit PUD	Sedro Woolley & Ranney Wells	10.9	7.04	No
Skagit PUD *(pending but Agreed on in 1996 MOA)*	Skagit River pumping plant	12.8	8.28	Yes
Skagit PUD *(pending/new)*	Salmon, Gilligan, Turner, Mundt Creek	[39.81]	[25.74]	Yes, Cultus Mtn. & Lower Skagit Instream Flow
Skagit PUD TOTAL (without pending/new rights)	Cultus Mountain streams, Skagit River and wells	55.4	35.8	Some
City of Anacortes	Skagit River	70	45.24	No

City of Anacortes	Skagit River	15	9.70	No
City of Anacortes	Skagit River	32.30	20.88	Yes, Subject to Lower Skagit Instream Flow
City of Anacortes TOTAL	Skagit River	117.54	75.83	Some
PUD & Anacortes Total	Skagit River	172.94	111.63	_____
Sources: 1996 Memorandum of Understanding Regarding Utilization of Skagit River Basin Water Resources for Purposes of Instream and Out of Stream Uses. Signed by City of Anacortes, PUD#1 of Skagit County, Skagit County Commissioners, Upper Skagit Tribe, Swinomish Indian Tribe, Sauk-Suiattle Tribe, Washington Departments of Ecology and Fish and Wildlife.				

ii. Water Demand- High Growth Scenario

Table 7 displays a summary of the current and projected water demands by sector for the Skagit PUD #1 and the City of Anacortes as well as the projected rural water demand for WRIAs 3&4 (excluding Samish River Sub-Basin).

For 2050, the MDD for the Skagit PUD is 65.6 MGD (101.6 cfs) [Table 7], which is higher than the PUD's ability to supply water under existing rights and agreements (currently limited to 55.4 cfs); this results in a shortage of 29.8 mgd or 46 cfs. The MDD for the City of Anacortes is 81.58 MGD (126.5 cfs) resulting in a shortage of 5.8 mgd or 9 cfs when compared to both the interruptible and the non-interruptible rights. These shortages are highlighted in Tables 1 and 2 and represent the new demand or additional water supply that the large systems could expect under the high growth scenario.

iii. Water Demand- Preferred Growth Scenario

Table 8 displays the detail of the current and projected water demands for the preferred growth scenario. Demand estimates are given by sector for the Skagit PUD #1 and the City of Anacortes as well as the projected rural water demand for WRIAs 3&4 (excluding Samish River Sub-Basin).

Table 7: Current & Projected Water Demand served by Skagit PUD #, City of Anacortes and Projected Rural Domestic Demand (MGD) - High Growth Scenario

	2000	2010				2025	2050+		
		ADD	*MDD*	*ADD*	*MDD*	*ADD*	*MDD*	*ADD*	*MDD*
Skagit PUD* (MGD)									
Residential	3.87	7.36	5.64	10.72	9.19	17.46	17.52	33.29	
Commercial	1.99	3.78	2.50	4.75	3.48	6.60	5.63	10.70	
Industrial	0	0.00	4.00	4.00	5.00	5.00	5.00	5.00	
Farm	0.40	0.76	0.47	0.90	0.61	1.15	0.90	1.71	
Municipal	0.26	0.49	0.33	0.63	0.47	0.88	0.75	1.43	
Wholesale	0.09	0.17	0.09	0.17	0.09	0.17	0.09	0.17	
Irrigation/other	0.27	0.51	0.54	1.03	1.09	2.07	2.41	4.58	
City of Stanwood	0	0.00	0.59	1.18	0.82	1.80	1.33	2.66	
Whatcom County	0	0.00	0.35	0.67	0.35	0.67	0.35	0.67	
Estimate of Unaccounted	0.97	1.84	1.83	2.96	2.26	3.76	3.04	5.35	

for Water								
TOTAL PUD Demand	7.85	14.91	16.34	27.01	23.36	39.56	37.02	65.56
Emergency Reserve for Anacortes per JOA[1]	6.06	6.06	7.75	7.75	10.50	10.50	17.06	17.06
City of Anacortes[#] (MGD)								
Residential/ Commercial	1.91	2.87	2.42	3.64	3.12	4.68	4.84	7.25
Industrial	12.30	18.45	17.34	26.02	24.24	36.36	36.73	55.10
Wholesale in County	1.45	2.18	1.63	2.45	1.79	2.69	2.60	3.89
Wholesale to Island County[2]	2.81	4.22	3.69	5.53	5.58	8.37	9.63	14.45
Estimate of Unaccounted for Water	0.24	0.37	0.33	0.50	0.46	0.68	0.59	0.89
Total City Demand	18.70	28.09	25.41	38.14	35.19	52.78	54.39	81.58
Rural Public Water Systems and Exempt Wells (MGD)								
Total Rural PWS Demand [3]	0.75	1.80	1.12	2.69	1.53	3.66	2.43	5.82
Total Single Domestic Water Righted Demand[4]	0.04	0.24	0.04	0.24	0.04	0.24	0.04	0.24
Total Exempt Well Demand[5]	0.13	1.61	0.19	2.44	0.26	3.34	0.44	5.61
Total of Rural Public Water Systems & Exempt Wells	0.92	3.65	1.35	5.37	1.83	7.24	2.91	11.67
TOTAL SKAGIT RIVER WATER DEMAND (MGD)[6]	27.47	46.65	43.1	70.52	60.38	99.58	94.32	158.81
TOTAL SKAGIT RIVER WATER DEMAND (cfs)	42.6	72.3	66.8	109.3	93.6	154.4	146.2	246.1

+ Extrapolated by consistently applying the 2020 to 2025 OFM high estimate growth rate over the additional 25 year period

* Based on PUD Water System Plan adjusted to current OFM estimates; PUD projections covered projected population at 82 gpcd winter and 156 gpcd summer

Based on Anacortes Water System Plan High Case projections adjusted to current OFM estimates and extrapolated beyond 2020; Anacortes projections covered projected population at 65 gpcd winter and 130 gpcd summer

[1] JOA is Joint Operating Agreement between Anacortes and Skagit PUD

[2] City of Oak Harbor and the Whidbey Naval Air Station

[3] Refers to rural public water systems built out to full water right allocations in 2050; Demand is based on 100 gpcd winter and 240 summer

[4] Demand is based on 100 gpcd winter and 590 summer for single domestic water rights per WRATs & no increase in single domestic rights

[5] Exempt well demand based on winter = 100 gpcd and summer = 540 gpcd and associated return flows of 85% winter and 38% summer

[6] Total Demand = PUD + City + Rural PWS + single domestic + exempts

Table 8: Current and Projected Water Demand served by Skagit PUD #1 and City of Anacortes and Projected Rural Domestic Demand (MGD) - Preferred Growth Scenario

	2000		2010		2025	2050+		
	ADD	*MDD*	*ADD*	*MDD*	*ADD*	*MDD*	*ADD*	*MDD*
Skagit PUD* (MGD)								
Residential	3.87	7.36	5.54	10.47	7.21	13.71	11.15	21.21
Commercial	1.99	3.78	1.59	3.03	2.22	4.20	3.59	6.82
Industrial	0	0.00	4.00	4.00	5.00	5.00	5.00	5.00
Farm	0.40	0.76	0.30	0.57	0.39	0.73	0.57	1.09
Municipal	0.26	0.49	0.21	0.40	0.30	0.56	0.48	0.91
Wholesale	0.09	0.17	0.09	0.17	0.09	0.17	0.09	0.17
Irrigation/other	0.27	0.51	0.34	0.66	0.69	1.32	1.54	2.92
City of Stanwood	0	0.00	0.59	1.18	0.82	1.80	1.33	2.66
Whatcom County	0	0.00	0.35	0.67	0.35	0.67	0.35	0.67
Estimate of Unaccounted for Water	0.97	1.84	1.43	2.33	1.62	2.68	1.93	3.32
TOTAL PUD Demand	7.85	14.91	14.44	23.48	18.69	30.84	26.03	44.77
Emergency Reserve for Anacortes per JOA[1]	6.06	6.06	7.75	7.75	10.50	10.50	17.06	17.06
City of Anacortes# (MGD)								
Residential/ Commercial	1.91	2.87	2.10	3.15	2.54	3.82	3.44	5.15
Industrial	12.30	18.45	12.30	24.87	23.09	34.63	34.75	52.13
Wholesale in County	1.45	2.18	1.45	2.06	1.58	2.37	2.23	3.34
Wholesale to Island County[2]	2.81	4.22	3.69	4.66	4.50	6.76	7.77	11.66
Estimate of Unaccounted for Water	0.24	0.37	0.33	0.46	0.35	0.53	0.46	0.69
Total City Demand	18.70	28.09	19.87	35.20	32.06	48.11	48.64	72.97
Rural Public Water Systems and Exempt Wells (MGD)								
Total Rural PWS Demand[3]	0.75	1.80	0.97	2.33	1.19	2.87	2.43	5.82
Total Single Domestic Water Righted Demand[4]	0.04	0.24	0.04	0.24	0.04	0.24	0.04	0.24

Total Exempt Well Demand[5]	0.13	1.61	0.16	2.10	0.20	2.60	0.23	2.87
Total of Rural Public Water Systems & Exempt Wells	0.92	3.65	1.17	4.67	1.43	5.71	2.7	8.93
TOTAL SKAGIT RIVER WATER DEMAND (MGD)[6]	27.47	46.65	35.48	63.35	52.18	84.66	77.37	126.67
TOTAL SKAGIT RIVER WATER DEMAND(cfs)	42.6	72.3	53.8	98.2	80.9	131.2	119.9	196.3

+ Extrapolated by consistently applying 2% annual growth rate over the additional 25 year period

* Based on PUD Water System Plan adjusted to GMA estimates; PUD projections covered projected population at 82 gpcd winter and 156 gpcd summer

Based on Anacortes Water System Plan Base Case projections adjusted to GMA estimates and extrapolated beyond 2020; Anacortes projections covered projected population at 65 gpcd winter and 130 gpcd summer

[1] JOA is Joint Operating Agreement between Anacortes and Skagit PUD

[2] City of Oak Harbor and the Whidbey Naval Air Station

[3] Refers to rural public water systems built out to full water right allocations in 2050; Demand is based on 100 gpcd winter and 240 summer

[4] Demand is based on 100 gpcd winter and 590 summer for single domestic water rights per WRATs & no increase in single domestic rights

[5] Exempt well demand based on winter = 100 gpcd and summer = 540 gpcd and associated return flows of 85% winter and 38% summer

[6] Total Demand = PUD + City + Rural PWS + single domestic + exempts

c. Northwest Snohomish County

The Skagit County CWSP, Northern Snohomish County CWSP[34], and Skagit PUD's WSP all discuss the potential for an intertie between Skagit PUD and the City of Stanwood. To our knowledge there have been no further plans made in this regard, however it is still considered a potential source alternative for the City of Stanwood. The City is also developing additional local groundwater sources. Based on information in the Northern Snohomish CWSP, the City is not expected to face a deficit. However, the City has been approached by surrounding communities to supply additional water. Based on these factors, we have included in this analysis projected population (Table 9) and projected water demand (Table 10) for four expanding water systems near and including the City of Stanwood. Snohomish County Planning Department[35] developed growth targets for cities and unincorporated areas which were used as a check on the CWSP projected values in the Stanwood and unincorporated surroundings.

Table 9: Northwest Snohomish County Projected Population for Four Focus Areas[1]

Focus area systems	2000	2010	2025	2050*
City of Stanwood	5,247	6,172	8,699	13,009
Wilderness Ridge	659	915	1,020	1,196
Tatoosh Water Co	338	474	604	826
Meadow Ridge	403	622	747	962
Total	8,647	10,193	13,095	15,993

[1] Source: Snohomish CWSP (1991) Table VIII-3

*2050 extended by consistently applying the 2020 to 2025 growth rate over the additional 25 yr period

Table 10: Projected Water Demands – Northwest Snohomish County Focus Areas[1]

Focus Area Systems	Water Requirements (MGD)								
		2000		2010		2025		2050	
		Winter	*Summer*	*Winter*	*Summer*	*Winter*	*Summer*	*Winter*	*Summer*

City of Stanwood	0.50	1.32	0.59	1.56	0.83	2.08	1.23	2.93
Wilderness Ridge	0.08	0.18	0.09	0.23	0.09	0.29	0.12	0.34
Tatoosh Water Co	0.03	0.09	0.04	0.12	0.06	0.22	0.08	0.32
Meadow Ridge	0.04	0.10	0.06	0.16	0.06	0.24	0.09	0.33
Total (MGD)	0.65	1.69	0.78	2.07	1.04	2.83	1.53	3.92
Total (cfs)	1.01	2.62	1.21	3.21	1.61	4.39	2.37	6.08

[1] Source: Snohomish CWSP (1991) Table VIII-3

d. Island County

The City of Anacortes currently serves the largest water users on Whidbey Island, the City of Oak Harbor and the Whidbey Naval Air Station. The projections for the City of Anacortes (in the Skagit County Section above) account for both current and future use of these two water systems (Table 7). However, Whidbey Island will need additional water imported and the Island County Coordinated Water System Plan (CWSP)[36] calls for increased service from the City of Anacortes to the area from central Whidbey Island and north. The Skagit CWSP only discusses service to the northern portion of the Island. Anacortes' WSP projects additional demand from Oak Harbor and the naval station growing at a rate of 2.4% annually for the base case to 3.4% high case.

Camano Island currently has wells and several small water systems. Island County CWSP proposes the City of Stanwood develop an additional supply to serve Camano Island. The only way for the Skagit PUD #1 to be involved is through an intertie with the City of Stanwood and a subsequent connection to Camano Island. Camano Island is also considering other supply alternatives.

Given this information, the North Whidbey Island and potentially the central areas are the most likely candidates for future water needs to be supplied by the Skagit River. Camano Island could also need additional water. Demand estimates were developed from the projected population and assumptions about per capita water use at 100 gpcd for winter and 200gpcd for summer.

Population estimates for Island County (Table 11) involved both the permanent resident population estimated by OFM and the summer seasonal population reported in the Island County CWSP[16]. The water demand numbers (Table 12) for summer reflect both the increase in water use and the increase in population.

The Island County regions of North Whidbey and Camano Island were brought forward into Table 1. Some of this increased demand was forecasted in the Anacortes WSP. The portion brought forward as new demand is that amount above what the City projected to serve. Camano Island was included because the City of Stanwood could be a purveyor to convey water to them via Skagit PUD. North Whidbey represents the Island County portion that is served by the City of Anacortes.

Table 11: Island County Population based on OFM High Estimates

Island County Region	Island County Population Projections[1]							
		2000		2010		2025		2050*
		winter	*Summer*[2]	*Winter*	*summer*	*winter*	*summer*	*winter*	*summer*
North Whidbey	34,348	34,848	42,390	43,010	57,130	57,870	84,771	85,750
Central Whidbey	9,303	12,603	11,481	15,301	15,473	19,813	22,959	28,284
South Whidbey	14,312	21,212	17,662	26,132	23,804	33,844	35,321	48,463
Camano Island	13,596	20,496	16,779	24,879	22,614	31,914	33,555	45,152
Total	71,559	89,159	88,312	109,322	119,021	143,441	176,607	207,649

[1] Distributed to regions based on current percentage

[2] Based on summer seasonal population per Island County Planning

*2050 extended by consistently applying the 2020 to 2025 growth rate over the additional 25 yr period

Table 12: Island County Projected Water Demand

Island County Region	Water Requirements (MGD)[1]							
		2000		2010		2025		2050	
		winter	*summer*	*winter*	*summer*	*winter*	*summer*	*winter*	*summer*
North Whidbey	3.43	6.97	4.24	8.60	5.71	11.57	8.48	17.15
Central Whidbey	0.93	2.52	1.15	3.06	1.55	3.96	2.30	5.66
South Whidbey	1.43	4.24	1.77	5.23	2.38	6.77	3.53	9.69
Camano Island	1.36	4.10	1.68	4.98	2.26	6.38	3.36	9.03
Total (MGD)	7.16	17.83	8.83	21.87	11.90	28.68	17.66	41.53
TOTAL (cfs)	11.09	27.64	13.69	33.89	18.44	44.47	27.37	64.37

[1] Based on winter = 100 gpcd and summer = 200 gpcd.

A variety of resources were used to determine the current domestic, commercial, and industrial water demand for Skagit County and areas potentially requiring water from the Skagit River Watershed. In some cases, the different data sources did not agree with each other. In these cases, we used the most current estimate or the local estimate as documented in the report.

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Appendix 5 Basis for Hookup Assumptions

		CAO_NAME						
SYSTEMNAME	Data	Carpenter Creek	Coal Creek	Jones Creek	Lake Erie	Nookachamps Creek	(blank)	Grand Total
ANACORTES, CITY OF	Sum of ACRES							
	Count of PNUMBER				218		9625	9843
BLANCHARD EDISON WATER ASSN. INC.	Sum of ACRES							
	Count of PNUMBER						753	753
DEL MAR COMMUNITY SERVICE INC	Sum of ACRES							
	Count of PNUMBER				145		469	614
GUEMES ISLAND WATER COMPANY INC	Sum of ACRES							
	Count of PNUMBER						506	506
HAMILTON WATER DEPARTMENT	Sum of ACRES							
	Count of PNUMBER						425	425
LA CONNER WATER DEPT	Sum of ACRES							
	Count of PNUMBER						890	890
LEIF ERIKSON REC ASSOC	Sum of ACRES							
	Count of PNUMBER						29	29
LYMAN WATER DEPARTMENT	Sum of ACRES							
	Count of PNUMBER			169			110	279
SAMISH FARMS WATER ASSN	Sum of ACRES							
	Count of PNUMBER						940	940
SHELTER BAY COMMUNITY INC	Sum of ACRES							
	Count of PNUMBER						956	956
SKAGIT CO WATER DISTRICT #1	Sum of ACRES							
	Count of PNUMBER						241	241
SKAGIT COUNTY PUD 1 FIDALGO	Sum of ACRES							
	Count of PNUMBER						1407	1407
SKAGIT COUNTY PUD 1 JUDY RES	Sum of ACRES							
	Count of PNUMBER	751	122			1043	30417	32333
(blank)	Sum of ACRES							
	Count of PNUMBER						11	11
Total Sum of ACRES								
Total Count of PNUMBER		751	122	169	363	1043	46779	49227
						Use this number	0.950271193	
						Conservative bias against the rule		