Chapter 173-503 WAC

Preliminary Cost Benefit Analysis

Preliminary Maximum Net Benefit Analysis

& Preliminary 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 proposing an amendment to Chapter 173-503 WAC. The main features of this proposed rule amendment include creating reservations of a limited amount of water for specific future uses that are not subject to the established instream flows, establishing closures for tributaries, and defining conditions for future water right permitting. The proposed rule amendment also changes previously interruptible water supplies into uninterruptible water supplies, and potentially reduces instream flow levels. It provides additional benefits to various out-of-stream water users, and also potentially reduces various environmental values.

This document includes three analyses:

- The preliminary cost benefit analysis which concludes that it is likely that the probable benefit of the proposed rule amendment is greater than its probable cost;
- The preliminary maximum net benefit analysis which verifies that it is likely that the proposed rule amendment will maximize net benefits within the constraints of the law;
- The preliminary least burdensome alternative analysis which concludes that it is likely that the proposed rule amendment is the least burdensome option that will achieve the general goals of the authorizing statutes.

This preliminary analysis will be revised based on new data and comments received after the proposed rule amendment is filed.

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 environmental impacts, especially the impacts on salmon populations, and human demands for water.

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 that outlined actions that would provide for more coordinated management of water resources in the Skagit basin. An important element 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, the existing rule was challenged in *Skagit County v. Washington State Department of Ecology.* This proposed rule amendment is a result of negotiations that took place after that challenge.

This document evaluates the following components of the proposed rule amendments.

A. Water reservations: The water reservations are not subject to the instream flows. The existing instream flow rule limits new water uses to 200 cfs. Under present conditions, this 200 cfs is only available as an interruptible water supply, as the instream flows are not met during several days in the year. This rule amendment proposes reservations that authorize withdrawals of up to 25 cfs as uninterruptible water rights.
   - 10 cfs would be available for agricultural irrigation, and
   - 15 cfs would be available for domestic, municipal, commercial and industrial water supply, and stockwatering uses.
   - 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.

   The major change made by the proposed rule amendment is to convert 25 cfs of the interruptible water supply to an uninterruptible water source.

   This alters the usability of the water and, therefore changes its economic value; this change is a benefit to water users. Currently any post 2001 ground water withdrawal, including permit-exempt wells in continuity with the Skagit River or its tributaries, is legally required to curtail use during low flow

periods. Under the proposed reservations, the future water needs of most users would be met without curtailment. Moreover, the ability to use water during low flows should be a benefit to users because most users require a reliable year around water supply. The existing regulatory framework only allows for interruptible new rights. Currently users that require a reliable water supply must either connect to an uninterruptible public water supply, have a well and on-site storage, or obtain water from other uninterruptible sources.

Comparing the minimum instream flows in WAC 173-503-040(2) with the 1941 to 2003 historical instream flow data measured at USGS station #12-2005-00, we can calculate the probability of the future water rights being interrupted, which is shown in table 1.

Table 1. The probability of the future water rights being interrupted

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.08	0.06	0.13	0.19	0.00	0.00	0.03	0.40	0.73	0.63	0.22	0.10

The data in table 1 show that it is highly likely that the future water users of this 200 cfs water will interrupt their water uses in August, September, and October. Especially in September and October, about 3/4 of September and 2/3 of October, the water users would have no water available to them. 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.

For big public water purveyors such as the Skagit PUD and the City of Anacortes), water storage may be viable or available (Greenberg, 2005). However, for rural public water systems or exempt well users and some irrigators, the storage may be too costly or even infeasible. This cost benefit analysis assumes that in the 20-year study period, public water purveyors have enough storage capacity for their interruptible water rights. However, exempt well users and irrigators would find this interruptible water supply difficult because they cannot store enough water for their uses in August, September, and October.

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. For most areas in the Skagit basin, the reservations should be adequate to fulfill the expected future water needs for at least 20 years. However, in some sub-basins such as the Nookachamps, Fisher, Carpenter and Hansen Creeks, the projected demand for water exceeds the reservation quantities. 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. Public water supplies from outside of the basin will likely be required to meet the maximum anticipated sub-basin demand. 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. Presently, large public water systems such as the Public Utility District of Skagit County (Skagit PUD) provide water service in some 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, Fisher, Hansen and Carpenter sub-basins. Once the reservation water is allocated in a particular sub-basin, a basin closure will be in effect. 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.

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 or could lead to a change in the proposed location of a user. Furthermore, users requiring water in a closed basin would also have the option of obtaining water supply from out of the closed basin.

Those with existing water rights will not be affected by these closures.

C. Water right permitting: The proposal sets forth a framework for future water right permitting. The applicants seeking water rights 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 such a water right request.

Connecting to a public water supply could be a cost to 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. Connection costs are likely to be lower than the cost of a well and other development costs. 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 in other ways.

The Skagit County Critical Areas Ordinance also requires connections to public water systems under specific conditions. Consequently, for some areas this is not a new legal requirement. Identifying these areas will be part of the evaluation for the final Cost Benefit Analysis.

D. Reduced Flows: The Skagit River and its tributaries will have reduced instream flows. This will slightly reduce the amount of water in the river during low flow periods and could potentially indirectly affect instream benefits such as ecosystem services, recreation, etc. For water users that who do rafting, fishing and bird watching, or those dependent on dilution for waste removal, there could be a very minor impact. However, given the limited size of the reservation and the expected impact on streams, Ecology anticipates

that the propose rule amendment would have negligible impact on water users that depend on instream flow.

E. Metering: 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 certain locations with depressed or critical salmon stocks. WRIAs 3 and 4 have several depressed or critical salmon stocks. 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 is likely to be less than the accounting use outlined in the rule amendment proposal. 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 significantly reduces costs to those who might other wise be without water.

Ecology is developing and issuing this Preliminary Cost Benefit Analysis (CBA), Maximum Net Benefit Analysis (MNBA) and Least Burdensome Analysis (LBA) as part of its rule adoption process.

2. The preliminary cost benefit analysis

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

The preliminary conclusion is 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. The analysis is preliminary and will be revised as further data becomes available.

2.1 Time Horizon

The costs and benefits associated with a rule depend on the time horizon used in the analysis. For this proposed 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, and may result in misleading conclusions.
2. The future changes in water management policy are inevitable. The influence of the water management policy, advances in science, and technology are dynamic processes. This proposed 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, and no rules will last forever. 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, if this proposed rule amendment is adopted, the life time of the 2001 Skagit watershed management rule would be only 4 years. Therefore, a prolonged time horizon is not a preferred choice.

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

2.2 Baseline

This analysis covers the changes the proposed rule amendment creates, given the existing legal setting. Therefore this analysis will evaluate proposed 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. Costs and benefits associated with implementing other rules should have been considered when those rules (WACs) were developed and adopted. Laws (RCWs) are not subject to our review.

Accordingly, this analysis takes the existing legal structure and its impact on water users as a given, and then evaluates the change in the economic impact on water users based on likely changes to water management resulting from the proposed rule amendment.

3. The Probable Benefits

The proposed rule amendment, by providing a reservation of water, changes some previously interruptible water supplies (25 cubic feet per second) to an uninterruptible source of water. This is a benefit to various water users, but a cost to the overall environment. The water management portions of the proposed rule amendment, tributary closure, monitoring, and hookup, are affiliated with the reservation in that they help to ensure efficient use and preclude long term damages. The reservations are evaluated

based on the assumption that the water management portions of the rule will also be applied. Water value is determined by its specific use. Therefore this analysis will subdivide the probable benefit into subcategories to estimate the value of the reservations. These are the probable benefits to the rural public water system, exempt well users, the stockwatering users, the commercial and industrial users, and to the agricultural users.

3.1 Rural Public Water System and Exempt Well

For water rights issued under the 2001 Skagit rule, the water for rural public water systems and 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 in August, September, and October. Under this circumstance, the potential rural public water system and exempt well users who need an uninterruptible supply may choose water storage, abandoning the building lot, or purchasing uninterruptible water rights.

1. Water storage: Although in some years, the instream flow may surpass the levels set in WAC 183-503-040 (2) and be available for a whole year, potential rural public water system or exempt well users also need to store tens of thousands gallons of water, enough to sustain their three months water use before August since they are uncertain about the water availability thereafter. The storage is costly and there is also a potential health problem for in-house use. This analysis does not expect that a significant number of the potential exempt well users would choose water storage for the period that their water use is interrupted.

2. Abandoning the building lot: In this scenario, the landowners cannot find an economic and technically feasible way to sustain their year round water use. The potential building lot is unbuildable in the 20-year period because of lack of water. Thus, this piece of land is downgraded from a building lot into a piece of dry farmland.

3. Purchasing uninterruptible water rights: the potential 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. This would result in a downgrade of irrigated farmland to dry farmland. This method will not always be available, especially when the building plot concerned is located up-stream because moving water upstream may not be permitted by Ecology if it affects other water rights.

Under the proposed rule amendment, if properly managed, the reserved water is enough for all the potential exempt wells in the 20-year time horizon. Therefore, the potential rural public water system or exempt well owners have no need to develop alternative water sources or abandon their building lot. This will result in cost savings, which is a benefit to them and to the state of Washington.

Based on recent research by Greenberg (2005), conservatively using a upper limit approach to make projections, the population relying on exempt wells is 8,441 in year 2000, and 17,501 in year 2025, from which we can derive the same population number in 2005 is 9,766. From 2005 to 2025, an additional 7,735 people (2,975 households) will rely on exempt wells as their water source. Assuming 2.6 persons per household[1] and 350 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 is about 0.81 cfs

For rural public water systems, if we assume they currently have no water resources available and will also rely on the reservation, by using the same method as individual the exempt well users, we can derive that from year 2005 to the year of 2025, the total additional water demand from reservation is about 0.69 cfs for 2,505 (6,629 in population) households.

In the proposed rule amendment, Ecology reserves 15 cfs for domestic, commercial and industrial uses and stockwatering. This reservation is greater than the anticipated upper limit water demand of 1.5 cfs. After subtracting out the expected rural public water system and exempt well uses, the reservation also can provide at least 5.5 cfs of uninterruptible water supplies for other domestic, commercial, industrial uses and stock watering uses. Even if stockwatering requires up to 1 cfs (See Appendix XXX) this means that water use can increase in each area slightly more than is anticipated, and there will be sufficient water supply.

To quantify the probable benefits, which is equivalent to the cost savings by using uninterruptible water right from the proposed reservation, we assume that under the 2001 rule, 50% 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 water source in August, September, and October; 50% of them would otherwise transfer uninterruptible agricultural water rights as their water sources.

1. Abandon building lot:
If a building lot is abandoned, its property value will be downgraded to the value of non-irrigated farm real estate. The proposed rule amendment would provide enough uninterruptible water to those property owners and would save their property from being unbuildable. In Appendix 1, this analysis calculates this benefit is about $28.8 million in the 20-year period.

2. Transfer water right:
If rural public water system and exempt well owners can appropriate uninterruptible water rights from irrigators as their water sources, then to the State of Washington, the loss will be the degradation of irrigated farmland into non-irrigated farmland. In the appendix, this analysis calculates this probable cost saving benefit is about $370 thousand in the 20-year period. However, the appropriation of uninterruptible agricultural water rights is not always available, and may be subject to high transaction costs. Further, if a

[1] 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".

transfer harms any other water right it may not occur. Therefore, the $370 thousand dollars benefit calculated in the appendix would be a lower limit.

As a summary, the proposed rule amendment will significantly benefit rural public system and potential exempt well owners, the total probable benefit to them would be about $29.2 million in the 20-year period. This value may be revised based on new information and public comment after the proposed rule amendment is filed.

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. These large public water purveyors would be able to appropriate 5.5 cfs or more uninterruptible water supplies under the proposed rule amendment. This is a benefit to them. 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 may save on storage costs and the interruptible supply is available for their existing storage capacity. 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 proposed rule amendment reserves 10 cfs uninterruptible water for agricultural uses. As discussed before, an interruptible water right cannot provide a reliable water source to agricultural water users because of their use pattern. The 10 cfs reserved water would effectively increase the irrigated farmland and the overall agricultural value, which is a benefit to the irrigators. Based on Greenberg (2005), the 10 cfs can be translated into 2,260 acres of new irrigated farmland.

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 U.S. 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-ft. (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-ft. to $116.83/acre-ft. A mid-point estimate would be about $86.00/acre-ft.

Another 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 proposed rule amendment retains surface and ground water for future stockwatering within the 15 cfs reservation. This is not for feedlots and other activities that are not related to normal grazing land uses. The reservation is provides a benefit although this analysis does not have enough information to quantify it. The reserved water, based on 12 gallons per day per cow or horse, is enough for more than 50,000 cows and horses. On the other hand, the 2002 livestock inventory of Skagit County, including feedlots,[2] is only 41,086. Therefore, it is likely that the reservation is enough for a 20-year period.

3.5 Total probable benefit

The total benefit of the proposed rule amendment is the sum of the probable benefits calculated from section 3.1 to section 3.4, as in table 3.5 below.

Table 3.5 Total Probable Benefit

Sources	Probable Benefit ($000,000)
Rural Public Water System and Exempt Wells	29.2
Large Public Water System	>0
Agricultural Reservation	3.7
Stockwatering Reservation	>0
Total	>32.9

[2] At the time of this writing Ecology cannot separate out the feedlots.

Table 3.5 shows that the probable benefit for the proposed rule amendment is more than $32.9 million in a 20-year time horizon.

4. The Probable Costs

The proposed 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 proposed rule amendment include metering, hookups, and closures in several sub-basins. These requirements are evaluated based on costs of compliance. There may also be environmental costs. The proposed 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

Metering is required under Chapter 173-173 WAC. However, for the exempt wells it is a new practice. Metering imposes costs in the form of buying the meter, installing the meter, and reading the meter. For new water rights, which are issued in the early part of the first 20 years, the metering will impose a net cost. For later water right applicants they may provide a benefit since it may delay denial of applications. This analysis evaluates the cost without regard to the possible benefits.

Meters range in cost from $60 to over $2,000, depending on the size, accuracy, and use. Installation costs $100 and up. Both together are expected to average $400. It is not clear how many expected new water rights should be treated as experiencing a new cost. This analysis assumes that 1/4 of the new rights for domestic purposes would have this as a new cost. This assumption requires further evaluation for the final analysis. Given these parameters the present value of the cost of installing metering is estimated to be around $1.4 million.

4.2 Hookups

Hooking up to a public water supply is often the lowest risk and lowest cost option for those to whom it is available. Further, in many areas of the Skagit basin that have public water supply, the requirement already exists. This makes it difficult to extrapolate a cost for the requirement.

This section evaluates the potential for costs for the remaining population for whom the proposed 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 much.

Under current conditions the options available to applicants include either hooking up to public water supply or having an interruptible well and providing both the well and storage. 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, some of that cost (all, in some cases) will likely 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. This will create an extra step for those wishing to obtain a water right.

Even if a water user happens to be in an 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 then the cost differential would in this instance be small.

The proposed rule amendment takes the existing cost situation of some of these water users and changes it to be a situation where they may be able to avoid the storage costs in "ii" above if and only if they are not able to hookup in a timely and reasonable manner. For these people, there may be an additional waiting period when they ask the public water supply if water will be available. The wait may create a cost that would partially offset this gain. Alternatively, they may not be able to opt for the interruptible plus storage option. In this latter case, they may experience the small differential cost. Ecology will be doing additional research on this to determine if there are cases where either scenario might occur.

4.3 Closures

In some sub-basins such as the Nookachamps, Fisher, Carpenter 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 of Skagit County (Skagit PUD) provide water service in some 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, Fisher, Hansen and Carpenter sub-basins. In cases where a public water supply is made available, then the cost of the closure will be equal to the cost of the hookups evaluated above. This 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 proposed 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 proposed 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.

In general, it is very difficult given current modeling techniques to quantify the impact to fish populations from a marginal reduction of instream flows. 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, Ecology has not attempted to quantify the costs of the proposed rule amendment on fish populations in WRIA 3 and 4. In general, Ecology believes that the reduction in flows associated with increased out-of-stream uses may result in a reduction in fish habitat during low flow conditions. The effect of a habitat reduction on other species may be beneficial both directly and indirectly through predator-prey relationships. However, no quantifiable data is available.

4.5 Recreational Costs

There may be some recreational costs associated with the reservation requirement proposed 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 proposed 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 number of existing interruptible rights.

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 very difficult to quantify, however, it is reasonable to conclude that they would depend on the ecosystem impacts. Theoretically, a reduction in instream flow will reduce the non-use values.

4.8 Implementation Costs

The proposed rule amendment will involve some 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. Ecology will be further evaluating these costs.

4.9 Cost Summary

The costs that have been estimated at the time of this proposal include metering costs of $1.7 million. These costs require additional evaluation.

In general, the limitation of current science, technology, and economic knowledge prevents us from making a useful estimation of the probable costs associated with the proposed rule amendment. However, the total reservation of 25 cfs is only 0.25% of the August and September instream flow set in WAC 173-503-040 (2).

5. Conclusion of the Cost Benefit Analysis

The proposed rule amendment was developed quickly under court order. The preliminary conclusion is that the probable benefits are likely to exceed the probable costs. There is sufficient likelihood that this will be the resulting determination that

Ecology can proceed with the proposal of the rule amendment. However, additional analysis is required with respect to both the benefits and costs. Ecology will accept comment on this preliminary work.

6. Preliminary 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."

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 proposed rule amendment based on discrete shifts in use. The usual method of deriving a maximum net benefit point based continuous variables 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 proposed rule amendment is constrained by the legal framework. Therefore, a maximum net benefit analysis 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 proposed rule amendment subdivides the whole reservation into three categories, the reservation for domestic, commercial 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 AF for 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, but the animals have a legal right to drink from the stream that is not subject to the analysis.

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 the upper limit for additional agricultural water demand is 66 cfs; however, the reservation is only enough for 10 cfs. Therefore agricultural use is the only use that is constrained.

Therefore, the proposed 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 proposed 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. Therefore, the stipulation that Ecology cannot grant an applicant water, 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 proposed rule amendment was developed quickly under court order. The preliminary conclusion is that it is likely that each of the components of the proposed rule amendment work together to maximize the net benefits of the water allocation. There is sufficient likelihood that this will be the resulting determination that Ecology can proceed with the proposal of the rule amendment. However, additional data may be collected and additional analysis is required. Ecology will accept comment on this preliminary work.

7. Preliminary 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 proposed rule amendment reduces burdens that take the form of lack of water availability. The proposed rule amendment provides a water reservation and requires compliance that assures efficient use of the water. The proposed 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.

The proposed rule amendment was developed quickly under court order. The preliminary conclusion is that the proposed rule amendment reduces the primary burden of the existing rule, intermittent availability of water. There is sufficient likelihood that this will be the resulting determination that Ecology can proceed with the proposal of the rule amendment. However, additional analysis is required. Ecology will accept comment on this preliminary work.

References

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3. Greenberg, Joanne, (2005), “Current and Projected Future Water Demands for Skagit County’s Domestic, Commercial, and Industrial Sectors” Hydrologic Services Company, March, 2005.

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5. National Research Council of the National Academies, (2004), “Valuing Ecosystem Services: Toward Better Environmental Decision-Making”. The National Academies Press.

6. Olson, D (2003). “Economic Analysis Methodology Illustration and Review: Estimating the Value of Water for Key Resource Sectors from the Mainstem Columbia River.

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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 proposed 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 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:

$$\frac{nNdV}{40(1+d)^{n+1}} \qquad \text{……..(4)}$$

Here assume 50% of building lots will be abandoned without uninterruptible water right.

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

$$\sum_{n=1}^{20} \frac{nNdV}{40(1+d)^{n+1}} \qquad \text{…….(5)}$$

where N=5,524, N is half of the projected household numbers that would be served by rural public water system or exempt wells; d=0.03, d is the real discount rate, real means without inflation; $V = V_1 - V_2$, V_1 =65,000 is the median building lot value[3], V_1=4,950 is

[3] From Realtor.com on 9/20/2005.

the farm land value of a five acre non-irrigated farm land[4]. Therefore, the total benefit is $28.8 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. 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[5]. Therefore, the total benefit is $370 thousand in the 20-year period.

The total value is therefore $29.2 million. Note figures are rounded to prevent overstating the significance of the values.

[4] From: 2004 Washington Agricultural Statistics.
[5] From: 2004 Washington Agricultural Statistics.

Appendix 2: Skagit County Livestock Inventory and Water Use

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: Memo from Greenberg

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 Proposed 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

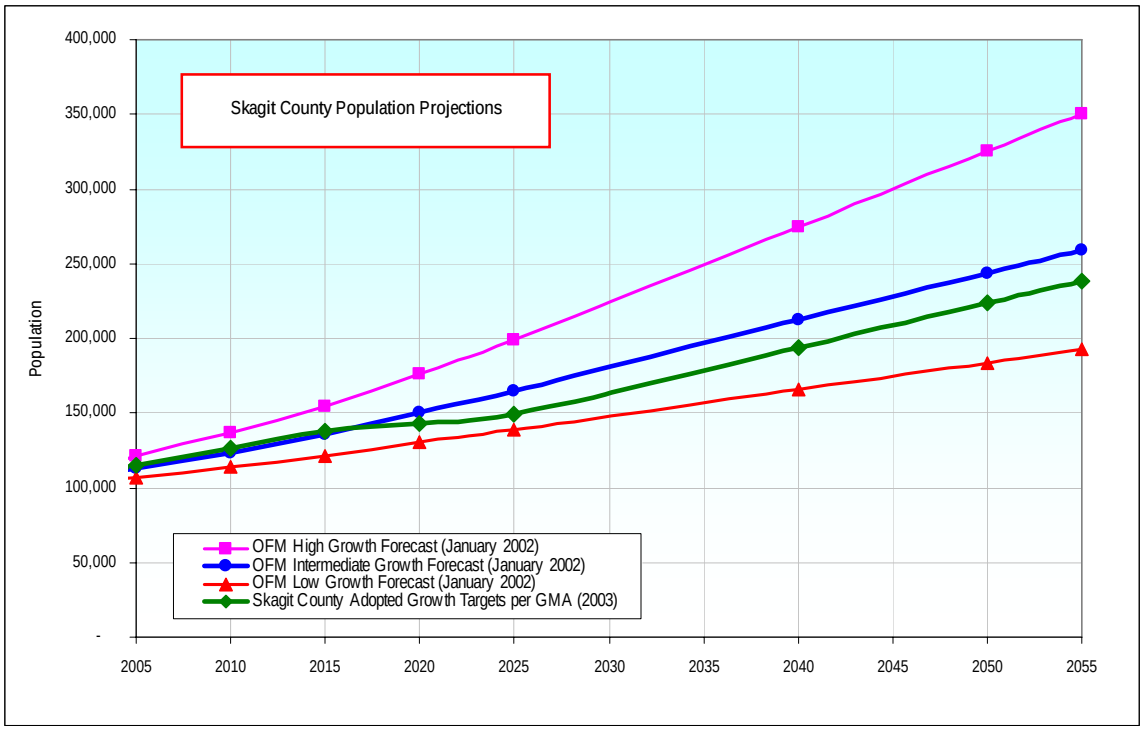

Figure 1: Skagit County Population Projections

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.

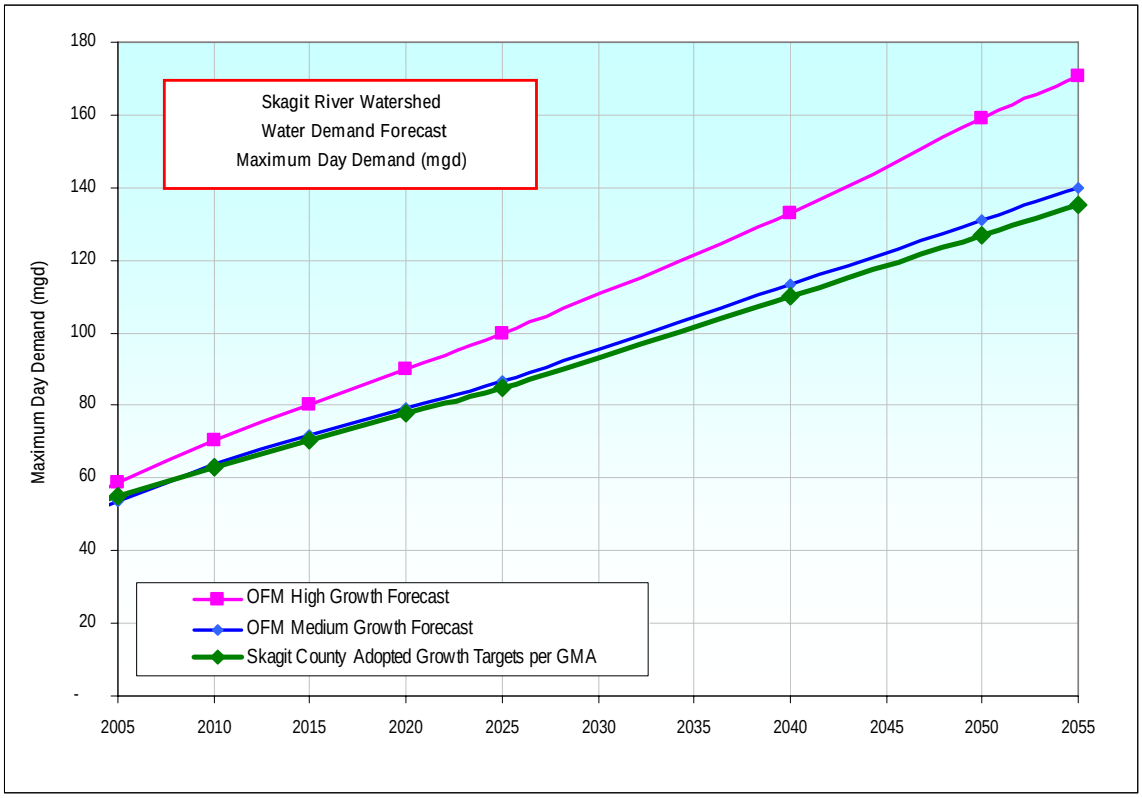

Figure 2: Skagit River Watershed Projected Water Demand for Domestic, Commercial, and Industrial Sectors: Maximum Day Demand

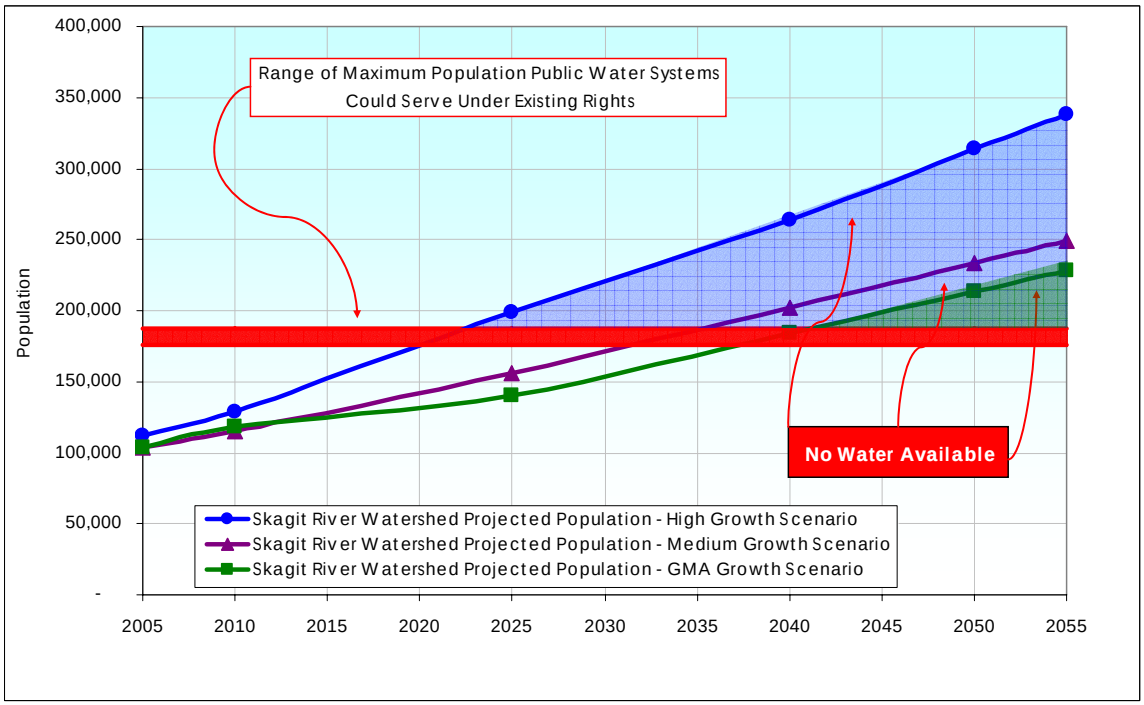

Figure 3: Skagit County Projected Population Compared to Population Served under Existing Systems' Water Rights

Statements Made for the Purpose of Settlement
September 16, 2005

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

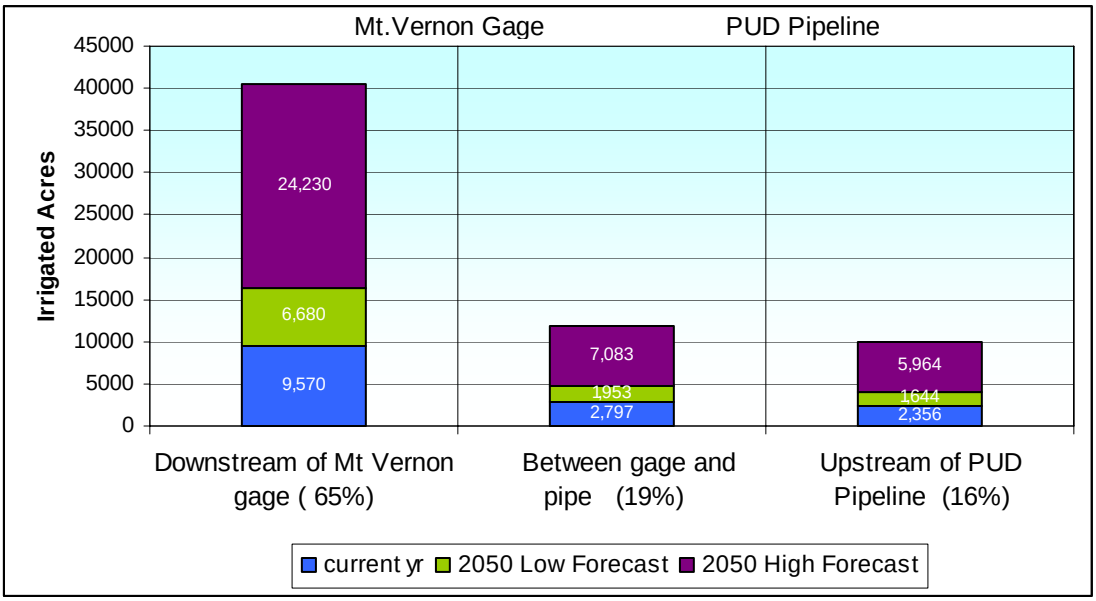

Figure 4: Spatial Distribution of Current and Projected Irrigated Acres in Skagit County