Washington State Department of Ecology

Water Resources Program for the Walla Walla River Basin, Water Resources Inventory Area (WRIA) 32

Final Cost Benefit and Least Burdensome Analyses for Amendments to Chapter 173-532 WAC

Prepared by

Ecology's Water Resource Program

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EXECUTIVE SUMMARY

The Washington State Department of Ecology has amended chapter 173-532 WAC, Water Resources Program for the Walla Walla River basin, Water Resources Inventory Area (WRIA) 32. The key amendments include:

- Establishing instream flow water rights.
- Modifying seasonal surface waters closures.
- Closing the gravel aquifers, which are directly connected to surface water sources.
- Limiting future withdrawals during high flow periods to projects resulting in net environmental benefits.
- Managing future permit-exempt groundwater withdrawals[1] from the gravel aquifer, in "high density" areas by:
  - Limiting the total amount of water for domestic uses and irrigation of lawn and garden to 1,250 gallons per day (gpd) for one residence and 5,000 gpd for multiple residences in one development,
  - Requiring water-for-water mitigation[2] for outdoor watering from May 1 to November 30, and
  - Metering permit-exempt uses.
- Limiting stock watering based on parcel sizes, as follows:
  - 700 gpd on legal lots of ten acres or less,
  - 2,500 gpd on legal lots between ten and twenty acres, and
  - 5,000 gpd on legal lots of twenty acres and greater.
  - Require metering for stock watering within high density areas.
- Outside of high density areas permit exempt wells are allowed in accordance with RCW 90.44.050.

The document includes:

- The cost benefit analysis.
  This shows that it is sufficiently likely that the benefit of the rule amendment is greater than the cost.

- The least burdensome analysis demonstrating alternatives to the rule.
  This shows that it is sufficiently likely that the rule amendment is the least burdensome option for those required to comply with the rule amendment.

[1] "Permit-exempt groundwater uses" or "exempt wells" refer to certain groundwater withdrawals that are exempt from the permitting process under RCW 90.44.050. These withdrawals are limited to specific uses and, in some cases, maximum quantities. Although exempt from permitting, these withdrawals must still comply with Washington Water Code.

[2] "Water-for-water mitigation" means that an equivalent amount of water is provided to replace the water used, such as by transfer of existing valid water rights.

COST BENEFIT ANALYSIS

I. Introduction

The Walla Walla River basin poses unique water management challenges. The basin as a whole covers portions of both Oregon and Washington. This rule applies to the Washington portion of the basin. The basin is over-appropriated, that is, more water has been legally allocated, through water rights issued, than is naturally available. The water supply is unreliable for water users. Many holders of adjudicated[3] senior water rights (as early as the 1890s) are unable to exercise their rights from July to October.

Most of the summer flows in the Walla Walla have been diverted for irrigation. For about one hundred years, parts of the Walla Walla River were seasonally dried up, seriously impacting salmon and other fish. By 1999, bull trout and steelhead were listed as threatened species under the federal Endangered Species Act (ESA). The basin has achieved some success in improving flows for ESA-listed species. Three irrigation districts have a negotiated settlement agreement with the U.S. Fish and Wildlife Service to keep portions of their respective water rights in the river for fish. In addition, significant investment has been committed to restoring flows and increasing water reliability for users.

Water supply issues and challenges are intensifying, however. For more than 25 years (since the adoption of the rule in 1977), the basin experienced only limited growth. This is changing. The population and economic growth in Walla Walla County has been increasing in the past five to seven years, especially in the urban growth areas[4] and rural residential areas.[5] This adopted rule makes needed changes to the water management program in the basin.

A. History

In 1977, The Department of Ecology (Ecology) adopted the Water Resources Program rule, chapter 173-532 WAC, seasonally closing most streams and rivers and limiting future groundwater withdrawals because of the unavailability of water. Under the original rule, Ecology issued no new surface water rights except for uses that are non-consumptive[6] or are limited to the non-closure periods.

The 1977 rule required the protection of surface water rights from new groundwater withdrawals by requiring wells to be drilled where there is no connection between the groundwater and surface waters. In the early 1990s, Ecology determined, by assessing well data and basin hydrogeology, that the gravel aquifers are connected to surface waters in the basin. Since increased use from those aquifers will impair existing surface water rights, Ecology has issued no groundwater rights in the basin since 1996. However, no

[3] Adjudicated water rights are those that have been validated by review of the court.
[4] "Urban growth areas" are areas designated by cities for urban expansion.
[5] See Appendix 1. Population Forecasts for WRIA 32.
[6] "Non-consumptive water uses" cause no net loss to the water source.

restrictions have been imposed on permit-exempt groundwater withdrawals from the gravel or the basalt aquifers.

In 2000, local agencies and the community created a watershed planning unit and initiated the development of a watershed plan. The plan was to address the needs of the basin, including stream flow protection and restoration. The planning unit completed the watershed plan in May 2005, and Walla Walla and Columbia counties adopted the plan in June 2005.

Planning unit members spent considerable time discussing the issue of permit-exempt groundwater withdrawals. The planning unit recommended that sufficient water be available for rural development, consistent with Columbia and Walla Walla counties' comprehensive land use plans, in areas not currently served by public water supplies. The planning unit recommended that Ecology maintain the groundwater permit-exemption as currently implemented, with no restrictions. Ecology did not accept this recommendation, especially for areas with limited water supply experiencing increases in permit-exempt wells. Water right holders, the local community, the Tribes, and the Department of Fish and Wildlife share these concerns about the potential cumulative impacts of permit-exempt wells on stream flows and existing water rights.

The planning unit made recommendations to Ecology for the protection of instream flows and existing water rights, and for the proper management of future water allocations. The watershed planning unit, by unanimous vote recommended Ecology amend the original rule to include: instream flow levels, changes to existing stream closures, and providing for the use of winter and spring high flows for water storage projects that improve stream flows for salmon production. Unresolved issues, such as future permit-exempt groundwater use, needed further discussion. The amendments to Chapter 173-532 WAC are the result more than a year of consultation with the planning unit.

B. Description and Purpose of the Cost Benefit Analysis

The intent of a cost benefit analysis, as defined under RCW 34.05.328(d), is to:

> *"Determine 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 statute being implemented"*

The cost benefit analysis includes quantitative information, where available, and qualitative information, where the economic or physical science is unable to provide reliable values for benefits and costs.

C. Time Horizon

The costs and benefits associated with a rule depend on the time horizon used in the analysis. Changes in water management policy are inevitable. Advances in science, population shifts, changes in technology and socioeconomic needs influence water management policy and create a dynamic process. Historical evidence shows that

changes in how water is managed can be large. No rule can solve all future problems. It is also likely that this rule will receive additional amendments in the future.

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

The value of benefits and costs accruing in the future must be discounted because they are not as valuable as current costs and benefits. Ecology is using the social rate of time preference[7] (SRTP) to discount future dollars. This is based on the fixed return on inflation adjusted bonds (I bonds), sold by the US Treasury since 1998.[8] The SRTP is 2.1% annually. For the selected 20-year time span, this means that 20 annual payments of $1 are currently worth $16.50.[9] This is equivalent to multiplying the sum of the 20 annual increments by 0.83.

D. Baseline

The baseline is the current legal framework governing the administration and management of water resources in the basin. Prior water management in the Walla Walla River basin was defined by the 1977 rule [Chapter 173-532 WAC, Water Resources Program for the Walla Walla River Basin (WRIA 32)], and other applicable water resources laws and court cases.

E. Contents of the Document

The document contains the Cost Benefit Analysis. To measure the costs and benefits, this analysis takes the previous legal structure and its impact as a baseline. It then evaluates the likely effects from changes to how water is managed under the adopted rule.

The document also addresses the Least Burdensome Analysis. The Least Burdensome Analysis is required under RCW 34.05.328(1) (e) to demonstrate that the adopted rule is the least burdensome alternative for those required to comply with the rule.

II. Rule Amendments and Probable Impacts

A. General Description of the Rule Amendments

The key amendments include:

- Establishing instream flow water rights.
- Modifying seasonal surface waters closures.
- Closing the gravel aquifers, which are directly connected to surface water sources.

[7] See Appendix 2. Social Rate of Time Preference memo.
[8] Ibid.
[9] Present value for a 20 year flow of $1 per year beginning in year 0 = $\sum_{t=0}^{19} \frac{1}{(1+i)^t}$

- Limiting future withdrawals during high flow periods to projects resulting in net environmental benefits.
- Managing future permit-exempt groundwater withdrawals from the gravel aquifer, in "high density" areas by:
  - Limiting the total amount of water for domestic uses and irrigation of lawn and garden to 1,250 gallons per day (gpd) for one residence and 5,000 gpd for multiple residences in one development,
  - Requiring water-for-water mitigation for outdoor watering from May 1 to November 30, and
  - Metering permit-exempt uses.
- Limiting stock watering based on parcel sizes, as follows:
  - 700 gpd on legal lots of ten acres or less,
  - 2,500 gpd on legal lots between ten and twenty acres, and
  - 5,000 gpd on legal lots of twenty acres and greater.
  - Require metering for stock watering within high density areas.
- Outside of high density areas and in the Burbank area permit exempt wells are allowed in accordance with RCW 90.44.050.

Appendix 3 contains a summary of the changes to Chapter 173-532 WAC.

B. Establishing Instream Flow Rights

Rule amendment:

Under the adopted rule, monthly instream flow levels are established for the Walla Walla River, Mill Creek, North Fork Touchet River, and the Touchet River. Once the rule takes effect, instream flows become water rights with the priority date of the effective date of the rule. As water rights, instream flows must be protected from impairment by junior water rights and by all future changes and transfers of senior and junior water rights.

Current baseline:

When adopting the 1977 rule, Ecology recognized that all streams in the basin were over-appropriated from late spring to early fall. In other words, more water had been granted in water rights than naturally occurs during that period. Because of this, Ecology deferred establishing instream flows until storage projects become a "reality."

Although no instream flows have been set, Washington Water Code (Chapter 90.03 RCW) requires that Ecology make a finding of water availability before issuing new water rights. This finding must consider:

1) Whether sufficient water may be present to preserve and protect fish resources.
2) Whether a proposed appropriation would affect these resources and therefore must be denied.

Under this legal obligation, Ecology, in 1996, ceased issuing any new surface water rights in the basin to protect existing rights, and preserve and protect instream resources.

The Water Code also requires Ecology to make a determination that changes and transfers would not impair senior and junior water rights, including instream flow rights.

Primary change:
The setting of instream flows does not affect existing water rights. As stated above, the basin is over-allocated and water users are regulated based on adjudication decrees. [10]

Any applications for new surface water rights cannot meet the Water Code, Chapter 90.03 RCW, statutory tests because:

1. Water is not available.
2. Existing water rights may be impaired.
3. Approval of future withdrawals would not be in the public interest.

Setting instream flows does not change the prior policy of not issuing new surface water rights, except for storage projects with environmental benefits. Nor does setting instream flows change the mandate that existing water rights not be impaired by changes and transfers of water rights.

Therefore, establishing instream flow rights does not change the current situation and no cost will be analyzed.

Setting instream flows does not put water back into the streams. It does help protect existing flows and any restored flows in the future. Setting instream flows in fall, winter, and spring may benefit some recreational activities, such as rafting and fishing. These benefits are qualitative and quantitative and will be analyzed in Section III.

C. Modifying Existing Seasonal Surface Water Closures and Limiting Future Withdrawals

Rule amendment:
The surface water closures in the basin are modified. All streams and rivers are closed to new consumptive uses from either May 1 to November 30 or June 1 to November 30.[11] Overall, the closure will be one to two months longer than under the original rule.

Future permits to withdraw water will be limited to non-consumptive uses and storage projects providing environmental benefits. Withdrawals for storage projects are limited to where instream flows are established: the North Fork Touchet River, Touchet River, Walla Walla River and Mill Creek. No withdrawal for storage projects or other consumptive projects will be authorized in any other stream or river in the basin.

Baseline:
Under the previous regulatory framework set by statutes and the 1977 rule, Ecology issued no surface water rights in the basin, except for non-consumptive uses and those limited to taking water during the previous non-closure periods.

[10] "Regulated" means that water use under junior water rights (later priority date) must stop during periods of low-flow to allow more senior users their full measure. "Adjudication decrees" result from a court determination of the measure (extent) and the priority date of water rights drawing from a specific water source or system.
[11] See Appendix 4 Surface Water Closures.

Primary change:
The modification of the surface water closures does not change the administration of water rights. This includes the restriction on issuing water rights for year-round uses or for uses from late spring to early winter, and on changes or transfers of existing water rights.

Ecology has not issued water rights for storage projects for irrigation and commercial uses because the water supply is unreliable. (Usable flows occur only once in ten years.) The only storage projects permitted are those that improve instream flows. Therefore, the modification of the surface waters closures does not have an impact on future agriculture, business, or commercial uses.

There are benefits from the rule amendment. The additional protection of flows in small rivers and streams will benefit fish and wildlife, water quality, and existing water rights.

D. Closing the Gravel Aquifer

Adopted rule:
Under the adopted rule, the gravel aquifers connected to surface waters are closed year-round. The adopted rule provides an exception for future non-consumptive uses (i.e., geothermal heat pump) and permit-exempt groundwater withdrawals, under specific conditions.

Baseline:
Anyone proposing to withdraw groundwater was required to apply to Ecology for a water right permit, except for:

- Stock watering;
- Single or group domestic uses, not to exceed 5,000 gpd;
- Watering a lawn or noncommercial garden that is one half-acre or less in size; or
- Industrial use not to exceed 5,000 gpd.

New applications for groundwater are generally subject to the same requirements and conditions as surface water applications.

Under the original rule, new wells could not be drilled where there was continuity between the surface water and the groundwater aquifer. Studies have shown the direct connection between the gravel aquifer and the surface water sources in the basin. In response, Ecology stopped issuing any groundwater rights from the gravel aquifer in 1996. However, controls were not imposed on permit-exempt ground water withdrawals from the gravel aquifers.

Primary changes:
Closing the gravel aquifer is critical to the protection of existing water rights and protection of flows restored in rivers and streams through state, local and federal efforts and investment.

There is no change to future permitted groundwater withdrawals from the gravel aquifer.

Although the adopted rule provides exception to the gravel aquifer closure for some future permit-exempt groundwater withdrawals, some withdrawals will be affected. See discussion below.

E. Exceptions to the Gravel Aquifer Closure

Rule amendment:

The adopted rule closed the gravel aquifer but allows new uses of the groundwater permit exemption, with some limitations. This allowance is restricted, based on the zoned density. Use of the permit-exemption is also only allowed when hook-up to municipal water supply is not available in a timely and reasonable manner.

In areas with zoned density of one or more residences per ten acres (referred to as high density),[12] for wells accessing the gravel aquifer, the amendment:

- Allows only domestic uses and irrigation of lawn and garden and stock watering.
- Further limits the amount of water used under the exemption.
- Requires water-for-water mitigation for outdoor watering.
- Requires users to meter and report their water use.

In less dense areas, the Burbank area, and for permit-exempt groundwater withdrawals from the basalt aquifer, the availability and use of the permit exemption is unchanged.

Baseline:

Under RCW 90.44.050, no groundwater permit is required for stock watering, single or group domestic use not to exceed 5,000 gpd, industrial use not to exceed 5,000 gpd, or watering a lawn or noncommercial garden that is a half-acre or less in size. While Ecology has not issued new permits for groundwater withdrawals from the gravel aquifer for some years, permit-exempt groundwater withdrawals have not been regulated or controlled.

Primary changes:

1. Hook-up requirement

The rule does not increase the requirements of new development to hook up to municipal water systems. The City of Walla Walla requires hook-up to the public water system, if the system is located within 300 feet of the structure's property line. Also, any land division in the urban growth area which results in parcels smaller than five acres must connect to city water. The City of College Place has similar hook-up requirements in place. Although the rule amendment requires the hook-up to a municipal water supplier when timely and reasonable, this requirement is similar to existing local requirements. Therefore, the cost of hook-up cannot be attributed to the rule amendment.

[12] See Appendix 5 Map of Gravel Aquifer, High Density Areas, and Cities, WRIA 32.

2. Restrictions in high density areas

In areas with zoned density equal to or denser than one residence per ten acres (referred to as high density areas),[13] the exception is limited to domestic use, irrigation of lawn and garden (this outdoor use must be fully mitigated), and stock watering based on parcel size. The exception is not available to other uses.

a. Impacts on future domestic uses and irrigation of lawn and garden:

- The total amount of water for domestic uses and irrigation of lawn and garden must not exceed 1,250 gpd for one residence and 5,000 gpd for multiple residences in one development.

- The water for outdoor watering from May 1 to November 30, estimated at 1,000 gpd per residence and 4,000 gpd for multiple residences in one development, must be mitigated water-for-water.

- The homeowners must install a source meter, record the monthly water use from May 1 to November 30, and send the record to Ecology by December 31 of each year.

b. Impacts on future stock watering:

- 700 gpd on legal lots of 10 acres or less.

- 2,500 gpd on legal lots between 10 and 20 acres.

- 5,000 gpd on legal lots 20 acres and greater.

The quantity of water is based on 30 gpd per animal, and is consistent with the number of heads per acre capacity of the land for grazing. The added cost to future stock watering is only from the need to meter and report those uses within high density areas. In high density areas, there will be limited growth of stock. The local planning department stated that, based on its zoning code, stock in these areas will be limited to a few animals, such as horses, llamas, or cows, kept for personal pleasure.

c. Impacts on future business and commercial uses:

Within the WRIA, county and city zoning ordinances generally prohibit business activities outside commercially zoned areas. With some small exceptions, commercially zoned areas fall within the city limits of Walla Walla and College Place. The municipal water service area currently covers the city limits and most of the urban growth areas. Additionally, the water suppliers plan to provide service to the entire urban growth area within the next twenty years. Commercially zoned areas cover about one-third of the high density areas.

Some future business and commercial uses will be impacted in high density areas outside the municipal water service areas. The cost to these business and commercial uses will be quantified.

[13] Appendix 5 shows a map of the high density areas within WRIA 32.

3. Low density areas and the Burbank area

In areas where the zoned density is less than one residence per ten acres and in the Burbank area, the use of permit-exempt groundwater withdrawals is unchanged from the current regulatory framework with the exception of stock watering limitations outlined above.[14] Therefore, there are no additional costs incurred from this adopted rule to any future businesses wishing to use an exempt well in those areas.

F. Withdrawals for Storage Projects with Net Environmental Benefits

Rule amendment:

Future surface water or groundwater storage projects are limited to projects that would provide net environmental benefits, particularly those with emphasis on salmon production.

The adopted rule defines:

- Who may sponsor a project.
- How projects qualify.
- What technical review is required.
- Operation conditions for the projects.

The net environmental benefits of storage projects are determined by weighing any adverse impacts, caused by storing high flows and flood flows, against any benefits (i.e., more water during low flow conditions) that the stored water would provide.

Baseline

Under the prior regulatory framework set in statutes and the 1977 rule, Ecology issued surface water rights for underground and surface storage during the existing non-closure periods. Water rights permits are approved if they meet the statutory tests:

1. The use is beneficial.
2. Water is available.
3. The use does not impair existing water rights.
4. The use is in the public interest.

Water rights are subject to instream flow conditions, based on recommendation from the Department of Fish and Wildlife. Due to the unreliability of water supply, especially in early spring, Ecology has not approved water rights for storage projects for irrigation or other out-of-stream uses.

Primary change

The process created in the adopted rule limits surface water withdrawals for storage projects to specific areas where instream flows are established, to non-closure periods; and to projects providing net environmental benefit to salmonid population.

[14] Ecology in regards to stock watering limitations is unable to determine measurable impacts.

III. Calculation of Benefits and Costs

A. Probable Benefits

Benefits to water right holders from limiting exempt-well withdrawals in high density areas:

One calculates the probable benefit of protecting existing water rights using the potential impacts under the adopted rule versus impacts under the original rule. Most, if not all, of the amendments protect existing water rights. Closing the gravel aquifers to any further consumptive use, and managing permit-exempt wells will have a direct benefit to existing water right holders by protecting their rights and investments.

As stated above, the Walla Walla River basin has a limited water supply allocated according to the adjudication decrees. Many existing water right holders have to stop their diversions in the summer and early fall due to lack of flows in streams. In addition, the cumulative withdrawal from the gravel aquifer impacts surface waters and those dependent on it.

Appendix 1 presents the population of the WRIA and within the high density areas. Appendix 6 shows the number of wells in high density areas from 1993 and projected to 2025. There is a difference between projected housing based on the population projection (using the high growth rate projected by the Office of Fiscal Management) and the projected number of permit-exempt wells for domestic purposes. The difference may be due to several factors. We choose to use the higher of the two estimates, which is the number of wells, for estimating costs and benefits.

1. Benefits to water right holders from limits on permit-exempt withdrawals for irrigation of one-half acre of lawn and non-commercial garden (outdoor watering).

Under the baseline, the minimum gain to existing water right holders would accrue if all the new homes built over the next 20 years would have used moderate watering of the allowed one-half acre.

This analysis focuses on the benefit of limiting the impacts of irrigation of lawn and garden between May 1 and November 30. Currently under the exemption, up to one-half acre of lawn and garden can be irrigated. Under the rule amendment, outdoor water use is limited to 1,000 gpd per residence (the remaining 250 gpd is for in-house use and is mostly non-consumptive). Also, the 1,000 gpd needs to be fully mitigated by the user.

Assumptions:

- Water duty (demand) for lawn and garden is about 4 acre-feet per acre.
- Irrigation will occur from May 1 to November 30.
- New exempt wells would number 38 to 57 per year,[15] with an average of 47.5 wells per year and 950 wells over 20 years.[16]

[15] Water Resources Well Log Projection for High Density Area in WRIA 32

[16] See Appendix 6 Estimated Exempt Wells in High Density Areas.

In 20 years, based on the above assumptions, the total amount of added annual water use to irrigate under the exemption would be:

(950 wells) x (½ acre / well) x (4 acre-feet / acre) = 1,900 acre-feet

Therefore, this rule amendment would avoid a total of 1,900 acre-feet of water withdrawn each year in the future through permit exempt wells.

Ecology determined the value of water in use on upland is $2,033 per acre foot (See Appendix 7). In other words, if a well stopped functioning or if someone was unable to obtain water they own, due to the effects of over use and falling water tables, then the average value of loss, as reflected by property sales, is $2,033 per acre foot. We caution that these are market sales of property, where the seller valued the land less than the market clearing price. Therefore this estimate may be low by comparison to the value in use that is not for sale. This produces conservative benefits as it underestimates them. Applying this same method to the costs also tends to underestimate them. However, both move in the same direction.

Using this conservative value and the assumptions above, the benefit to existing water right holders would be $3,862,700 over the next 20 years. The present value of this is **$3,206,000.**

2. Benefits to water right holders from protection from permit-exempt withdrawals for single or group domestic uses, up to 5,000 gpd (Maximum use).
Under the baseline, the minimum gain to existing water right holders will accrue if all the new homes built over the next 20 years would use the maximum 5,000 gpd which they are allowed.

Most in-house water use for domestic purposes (cooking, cleaning, laundering and sanitary purposes) does not exceed 250 gallons per residence. Other uses such as car washing, swimming pools, ponds, waterfalls, water slides, and many other incidental uses could use up to 4,750 gallons in one day. Typically, these uses are not year round and are limited to a few days during the summer months.

We are assuming these additional incidental uses of 4,750 gpd are limited to 60 days out of 210 days –May 1 to November 30. This is based on the assumptions that uses such as car washing, swimming pools, ponds, waterfalls, water slides and many other incidental uses are irregular. Under the adopted rule, Ecology allocates 1,000 gpd for outdoor use. This would mean that 3,750 gpd (4,750 gpd – 1,000 gpd) would not be withdrawn in the future from permit-exempt wells in the gravel aquifer, for other domestic uses. The maximum use for 47.5 residences per year is about 32 acre feet. For 950 residences, it is 656 acre feet annually. The benefit of this avoided loss to existing water right holders would be $1,333,650. The present value is **$1,106,900**.

3. Benefits to water right holders from restriction of permit-exempt withdrawals for commercial and business uses (Business Use Closure).

Ecology estimates up to five new businesses and commercial buildings per year in the high-density area could use a permit-exempt withdrawal of 5,000 gpd, or 5.6 acre-feet per year. The total amount of water for 20 years would be:

(20 years) x (5 businesses/year) x (5.6 acre-feet per year / business) =
560 acre-feet per year

Using $2,033 per acre foot upland value, the probable benefit from this protection is $1,138,500 with a present value of $**944,950**.

4. Benefits to water right holders from requiring water for water mitigation for outdoor use from May 1 to November 30.

This rule provides for outdoor watering from exempt wells through a mitigation process. This mitigation requires one-to-one water mitigation for all outdoor watering. We assumed that each of the 950 residences will use the full 1,000 gpd to irrigate lawn and gardens for 180 days each year (from May 1 to November 30). Approximately .55 acre-feet of water rights per residence is needed for mitigation. For all 950 residences, the combined mitigation needed is about 522.5 acre feet.

Based on WestWater Research and Ecology's valuation from past sales, a one acre foot water right can be permanently purchased for between $600 and $1000 an acre foot. Ecology uses an average value of $800 per acre foot for the purchase of water rights for mitigation. The water would therefore cost $440 per residence. In most cases, the processing cost of transferring the water right needs to be included. Processing fees can range from $10 to $500.[17] In addition, transfer costs can include fees for research, consultant, and legal services. The total transfer costs are estimated at $350 for these residential applications. This brings the total cost to $790 per household. Assuming the 950 residences are built at an even pace over the next 20 years, then the present value of the cost of this water is **$623,000**. While this is a cost for future outdoor water use in high density areas, it is a benefit for existing water right holders, who generate multi-million dollars to the local and state economy.

Benefits from limits on Exempt Wells	
Irrigation - one-half acre	$3,206,000
Group domestic - 5,000 gpd	$1,106,900
Permit-exempt - commercial business	$944,950
Mitigation for outdoor watering	$623,000
TOTAL	**$5,880,850**

The total benefit to existing water right holders from limiting exempt well withdrawals (1, 2, 3 and 4) would be **$5,880,850.**

[17] $50 Ecology's application processing fee. $500 Walla Walla Conservancy Board transaction fee (includes all costs associated with a water transfer)

Benefits to fish from protecting restored flows:

As stated early on, the Walla Walla River basin has limited water resources and most of the summer flows have been diverted for irrigation. Because of dewatering, some reaches have severely limited ability to support aquatic life during summer and fall months. The Walla Walla River historically supported significant runs of spring Chinook, summer steelhead, bull trout, and many other fish species. By 1999, steelhead and bull trout were federally listed as threatened.

Since 2000, changes in water management resulted in measurable flow improvement—the Walla Walla River was flowing in the summer time for the first time in 100 years. The water management changes resulted from a settlement agreement between the US Fish and Wildlife Service and three irrigation districts—Hudson Bay District Improvement Company and Walla Walla River Irrigation District in Oregon, and Gardena Farms Irrigation District # 13 in Washington State. In Washington, Gardena Irrigation District bypasses about 18 cubic feet per second (cfs). This water has been transferred, on a temporary basis, to the state trust water right program as an instream flow right.

In addition, significant financial investment has been committed to purchasing water rights for instream flows and to implement water conservation and efficiency measures. The purchased or conserved water is transferred to the stream as instream flow rights. These efforts have restored about 30 cfs in the Walla Walla River and other streams, at an approximate cost of **5.75 million**.

The Confederated Tribes of the Umatilla Indian Reservation expressed the need to have 50 cfs summer flows restored in the Walla Walla River within the next five to ten years. The restored flows are improving the quality and quantity of the habitat in the Walla Walla River basin. As a result of flow improvement in 2000, the Confederated Tribes of the Umatilla Indian Reservation began reintroduction of spring Chinook in the Walla Walla basin. In 2004, Chinook adults returned to the basin for the first time in decades.

Establishing instream flows does not put water in stream. Still, trust water rights for instream flows (acquired through leases, purchases, conservation, and efficiencies) and storage water from net environmental enhancement projects are protected by:

- Closing the gravel aquifer.
- Limiting the use of permit-exempt ground water.
- Requiring mitigation for consumptive outdoor use.
- Limiting future withdrawals in spring periods.

In the Walla Walla River basin, the key factors that affect fish populations are stream flows and temperature.

Based on a University of Washington study,[18] the value of each fish, of the first 1,000 returning adults, is $9,765. Information on the number of steelhead and/or bull trout recovered as a result of protecting additional flows is not available. We choose to use

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

information provided by the CTUIR in March 2005 regarding the number of Chinook adults expected to return in the spring of 2005. That number was estimated to be nearly 1000 adults. We are assuming that number will continue to return in the future with flow protection (provided by the rule) and flow/habitat improvement programs in place. The net benefit of protecting restored flows will be $9,765,000 minus the estimated costs ($5,750,000), or **$4,500,000.**

While protecting restored flows is not the only contributor to this benefit, without flows there will not be fish. Shortening the closure period protects trust water rights for instream flows (restored flows). Those restored flows will improve steelhead migration by extending the migration period by one to two months. It will also improve habitat for steelhead and bull trout spawning and rearing, and many other freshwater fish in the basin. The value of this benefit cannot be estimated because the population change is unknown.

Recreational benefits

Protecting existing and restored flows could have beneficial recreational effects. In general, more water in the river favorably impacts rafting, kayaking, canoeing, fishing, swimming, picnicking, camping, and hiking. The exact measure is difficult to determine. The quality of the experience and the impact of additional flows are a function of many factors including existing flows, the availability of other recreational opportunities, and so on.

Environmental enhancement projects (EEP) benefits

The benefits from environmental enhancement projects include increased summer flows, improvement in water temperature for fish, and increased habitat. Most of the benefits are accounted for within the economic benefit of protecting restored flows.

Other ecological benefits

There are other ecological benefits associated with the adopted rule. The most significant are improvements to habitat, stream temperatures, and other water quality parameters from protecting small streams and rivers and the gravel aquifers from further degradation. Unfortunately these values are difficult to quantify. It is reasonable to conclude, however, that many of the small streams in the upper part of the watershed will remain healthy under the adopted rule.

Total probable benefits

Benefits to water right holders from outdoor use restrictions	$3,206,000
Benefits to water right holders from residential restrictions	$1,106,900
Benefits to water right holders from business closures	$944,950
Mitigation for outdoor watering	$623,000
Benefits to fish from protecting restored flows	$4,500,000
TOTAL BENEFITS	**$10,380,850**

B. Probable Costs

Domestic water users:

It is estimated that 38 to 57 additional permit-exempt wells per year (950 wells over 20 years) will have the benefits of accessing groundwater for their domestic water needs and to irrigate lawn and garden within the high density areas.[19]

1. Limiting outdoor water use

The maximum amount of water, or 1,250 gpd per residence, is for both in-house and outdoor use. Based on water use for the basin, in-house use is about 250 gpd per residence.[20]

Outdoor water use is therefore limited to 1,000 gallons of water. This amount of water can irrigate about 1/12 acre of lawn.[21] The social cost to users of restricting residential outdoor water use by exempt wells from ½ acre of irrigated lawn and garden to 1/12 of an acre is approximately $1,000.[22] The total value of these homeowner social costs for the expected 950 homes would be $950,000, with a present value of **$788,500.**

2. Limiting residential uses

Under the adopted rule, the residential use of up to 5,000 gpd is limited to 1,250 gpd. The cost of this restriction is equal to the benefit calculated in A(2):[23]

(950 homes) x (32 acre-feet / home) x ($800 / acre foot) = $525,000

The present day value of this cost is **$436,000**.

3. Metering

The wells, serving the expected 950 homes, are all required to meter. The cost of a meter for small water systems (domestic uses and irrigation of lawn and gardens) is estimated to range from $300 to $400.[24] We choose to use $400 per meter. To ensure that we do not undervalue the cost, we also assume that each home will have its own well. The total cost for homeowners installing meters has a present value of **$315,400**.

4. Mitigation for outdoor watering

This rule provides for outdoor watering from exempt wells through a mitigation process. This mitigation requires one-to-one water mitigation for all outdoor watering. Homeowners must maintain greenbelts around structures for fire protection. Therefore, we assumed that each of the 950 residences will use the full 1,000 gpd to irrigate lawn and gardens for 180 days each year (from May 1 to November 30). Approximately .55 acre-feet of water rights per residence is needed for mitigation. For all 950 residences, the combined mitigation needed is about 522.5 acre feet.

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[19] Water Resources Well Log Projection for High Density Area in WRIA 32

[20] Stevens, "Effect of price structure on residential demand" 1992.

[21] Walla Walla Community College estimates 1000 gallons can irrigate 3000 or more square feet.

[22] Zhang, Reich "A Methodological Case Study of the Cost of Restricting Outdoor Water Use by Exempt Wells." Northwest Journal of Business and Economics 2005.

[23] See supra p. 11.

[24] Survey of well drillers, pump installers, and Ecology's metering coordinator.

Based on WestWater Research (a consultant specialized in water valuation) and Ecology's valuation from past sales, one acre foot can be permanently purchased for between $600 and $1000 an acre foot (See Appendix 8). We have used an average value of $800 per acre foot for the purchase of water rights for mitigation. The water would therefore cost $440 per residence. In most cases, the processing cost of transferring the water right needs to be included. Processing fees can range from $10 to $500.[25] In addition, transfer costs for these residential applications would likely include fees for research, consultants, legal services, and application fees. The total transfer costs are estimated at $350 for this transaction size (.55 acre feet). This brings the total cost to $790 per household. Assuming the 950 residences are built at an even pace over the next 20 years, then the present value of the cost of this water is **$623,000.**

Note: Health requirements prohibit the use of surface water for domestic purposes unless it is extensively treated. Therefore, any purchased surface water rights will have to be transferred to a groundwater right and the residence or residential development will have to drill a well.

Stock watering:

Stock watering is allowable from permit-exempt wells under this rule. Within the gravel aquifer, stock watering is limited to 700 gpd on legal lot size of 10 acres or less, 2,500 gpd on legal lot size between 10 and 20 acres, and 5,000 gpd on legal lot size of 20 acres or greater. Based on USDA information, a large animal such as a cow uses 30 gallons a day per animal. Based on the county code of 2 cows per half acre it is unlikely any future farming operations would need more water than allocated under the rule. Metering is also required for stock watering in high density areas.

USDA census information in Walla Walla and Columbia counties indicate that livestock farms and production has been on the decline.[26] All current livestock operations already have water rights. Future stock watering in high density areas will more likely be limited to a few animals kept for family use (i.e., horses, llamas, and goats).

There is no indication that large stock watering operations plan to locate in high density areas in Walla Walla County. Therefore; there is no cost to stock watering (except meters) under the adopted rule.

Commercial and business:

The rule does not require the hook-up to a municipal water supplier unless the hook-up can be provided in a timely and reasonable manner. Therefore, the only cost to a small business is the cost of hooking up to the municipal systems within the service areas. This averages $3,500, plus pipe costs. The total cost is usually much less than the cost of drilling a well in the gravel (average cost $10,000, see below). Therefore in estimating the total cost of the rule no cost will be evaluated for businesses within the areas served by municipal water systems. This analysis focuses on those businesses that have no

[25] $50 Ecology's application processing fee. $500 Walla Walla Conservancy Board transaction fee (includes all costs associated with a water transfer)

[26] http://www.nass.usda.gov/census/census02/volume1/wa/st53_2_011_011.pdf

access to a municipal water supply and either need to drill a well in the basalt aquifer or purchase and transfer an existing water right.

To estimate the costs to future commercial and businesses this analysis compares the existing cost of drilling an exempt well in the gravel aquifer with the cost of drilling a well in the basalt, or purchasing and transferring an existing water right.

1. Cost of drilling a well in the gravel aquifer

The average cost of drilling is $35 per foot to the gravel aquifer. The gravel aquifer depth varies. Recently drilled wells have a depth between 100 and 300 feet, averaging 200 feet.[27]

Average total cost for a gravel aquifer well is $10,000, with $7,000 for drilling (200 feet x $35), and $3,000 for the pump and other associated costs (e.g., electrical, connection to the home). The information on the costs was obtained from a survey of drillers and home owners.

2. Cost of drilling a well in the basalt aquifer

Cost of drilling a well in the basalt aquifer is higher than a well in the gravel aquifer. The depth to the basalt aquifer in the high density areas averages 600 feet (based on Ecology's well logs and USGS study). The average cost of drilling in the basalt aquifer in high density areas is about $50 a foot.

The average total cost of drilling a well in the basalt is about $40,000, with $30,000 for the drilling ($50 x 600 feet) and $10,000 for pump and other equipment.[28] The additional costs to businesses under the amendment would be $30,000 (calculated by subtracting the cost of a gravel well from the cost of the basalt well—or $40,000 less $10,000). This is a capital investment and may be purchased with capital that would otherwise have been invested. Given that benefits are being discounted using a Social Rate of Time Preference, this value must be increased by an appropriate multiplier. This accounts for the principal plus the interest that would have accrued over a period of 20 years. With current interest rates of approximately 6% to 9% for business loans, a multiplier of 1.97 to 2.45 is appropriate. Ecology has selected an average multiplier of 2.2. Thus the added cost of the basalt well option increases to $66,000 per well.

3. Cost of purchasing existing water rights

Surface water and ground water rights are available in the high density areas. Surface water rights may be transferred to ground water from the gravel aquifer or to the trust water right program to mitigate the ground water withdrawal for outdoor use. The maximum allowed quantity, under the groundwater permit-exemption is 5,000 gallons a day. This is equal to 1,825,000 gallons, or 5.6 acre feet, per year.[29]

[27] Ecology well logs
[28] Survey of costs for drillers in Walla Walla area.
[29] 1 acre foot = 325,851 gallons, the amount of water required to cover 1 acre with water 1 foot deep.

One acre foot can be permanently purchased for $600 to $1000 an acre foot in the basin.[30] The average total cost of purchasing 5.6 acre-feet could be $6,000 ($800 x 5.6 acre feet equaling $4,480, and an additional $1,520 for recording, and professional services).

If the water right needs to be transferred, the water right transfer processing cost will also have to be added to the purchase cost. Processing fees for transferring a water right ranges from $10 to $500.[31] In addition, there may be other costs associated with the transfer of the water right such as research, consultants, and legal service fees. No specific data is readily available on these fees. However, based on conversation with consultants providing these services, the transaction cost for acquiring and transferring 5.6 acre feet of water could range from a few hundred dollars to a few thousand dollars, with an average of $1,500. The total cost of purchasing and transferring a water right is about $7,500.

Constructing a well would cost an additional $10,000. This is not added to the costs incurred by the amendment, as businesses would have to incur this same cost to establish an exempt well under existing regulations.

Ecology estimates the highest cost to businesses and other water users unable to hook-up to municipal water supply would be the additional cost of drilling a well to the basalt aquifer, which is $30,000. The lowest cost would be the cost of purchasing and transferring water rights, which is $7,500.

Historical data indicates up to seven businesses per year would be seeking water in the high density area over the next 20 years.[32] Ecology assumes they would choose the least cost option of $7,500—purchasing and transferring an existing water right. This is a capital investment and may be purchased with capital that would otherwise have been invested. Given that benefits are being discounted using a Social Rate of Time Preference, this value must be increased by an appropriate multiplier. This accounts for the principal plus the interest that would have accrued to that principal for a period of 20 years. With current interest rates of approximately 6% to 9% for business loans, a multiplier of 1.97 to 2.45 is appropriate. Ecology has selected the average 2.2 for this analysis. Thus the net cost increases to $2,310,000. Total present value of the cost to future commercial and business uses would be **$1,917,300**.[33]

[30] See the WestWater and Ecology's water valuation in Appendix 2.
[31] $50 is Ecology's application processing fee. $500 Walla Walla Conservancy Board transaction fee (includes all costs associated with a water transfer)
[32] This could include churches and schools.
[33] Note: This is a conservative cost estimate.

Total probable costs:

Summary of the Present Value of Costs	
Limiting outdoor watering (social welfare cost)	$788,500
Limiting residential uses	$436,000
Metering	$315,400
Mitigation for outdoor use	$623,000
Costs to businesses	$1,917,300
TOTAL COSTS	**$4,080,200**

IV. Cost Benefit Summary and Conclusion

Ecology has determined that the probable benefits of the adopted rule exceed the probable costs.

Some benefits could be quantified:
- The quantified benefit estimate is about $10 million from protection of water rights and restored flows over the next 20-year period.

The un-quantified benefits include:
- Additional protection of fish species, recreation values, and other ecological values.
- Environmental enhancement projects.

Some costs could be quantified:
- The present value costs for limiting water use, requiring metering, requiring mitigation of outdoor watering, and restricting businesses and commercial uses from the gravel aquifers in high density areas is $4.1 million.

Summary of Costs and Benefits		
	Benefits	**Costs**
Limiting outdoor watering	$3,206,000	$788,500
Limiting residential use	$1,106,900	$436,000
Restricting commercial and industrial	$944,950	$1,917,300
Mitigation for outdoor watering	$623,000	$623,000
Metering		$315,400
Fish	$4,500,000	
TOTALS	**$10,380,850**	**$4,080,200**

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…, 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."

One primary objective of the rule amendment is to provide greater protection of existing water rights in the basin, while satisfying other needs. The potential for loss of an existing water right through proliferation of permit-exempt wells could be extremely expensive for water right holders. People who hold water rights have an investment that must be protected. These are the people who currently comply with the existing rule by taking water only when they are allowed to do so.

To protect existing water rights, the adopted rule:

- Closes surface waters during water critical months.
- Closes the hydraulically connected gravel aquifer.
- Limits future withdrawals during high flow periods to projects resulting in net environmental benefits.

The adopted rule also addresses how future permit-exempt well withdrawals will be managed in the gravel aquifer. The rule limits future permit-exempt uses by type and amount and requires water-for-water mitigation for outdoor watering.

Ecology considered other alternatives for addressing the general goals and specific objectives for managing water in the Walla Walla River basin. In considering other alternatives, Ecology took into account instream flows 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 adopted rule is the least burdensome approach for those required to comply with the rule.

Ecology could have chosen not to amend the existing Walla Walla water resources rule. However, this would not effectively protect existing water rights and would contribute to the continual degradation of the flows and water quality in the basin. Ecology has identified locations where the cumulative impacts of future permit-exempt withdrawals would likely result in the impairment of existing water rights and investments in restoring instream flows. The cost of managing exempt wells in these identified areas (e.g., limiting future use; reporting, evaluating, and monitoring effects; and offsetting impacts through mitigation) is less than the cumulative cost of impacts on existing water rights, putting water back in streams and rivers, and efforts to improve water quality.

Ecology also considered allowing all future permit-exempt wells to withdraw water for outdoor use. Water is most needed for irrigation of commercial crops using existing water rights during low flow periods. The cumulative impacts of outdoor watering during low flow periods would be too high for the protection of senior water rights in the area. Ecology finds the adopted rule is the least burdensome for those required to comply.

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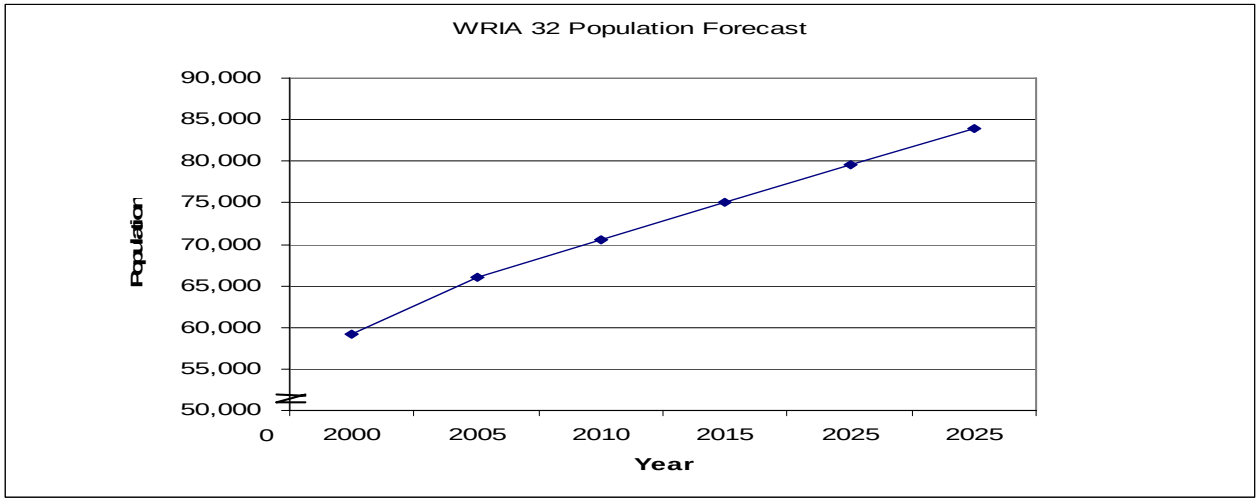
Appendix 1
Population Forecasts for WRIA 32

Office of Financial Management Forecast

	Low	Intermediate	High
Walla Walla County 2025	57,756	67,158	79,146
Columbia County 2025	3,154	4,092	4,859

	2000	2005	2010	2015	2020	2025
Walla Walla County	**55,180**	**61,872**	**66,153**	**70,354**	**74,779**	**79,146**
Columbia County	**4,064**	**4,217**	**4,420**	**4,700**	**4,786**	**4,859**
Walla Walla City	29,686	33,286	35,589	37,849	40,230	42,579
College Place	7,818	8,766	9,373	9,968	10,595	11,214
Dayton	2,655	2,755	2,888	3,070	3,127	3,174

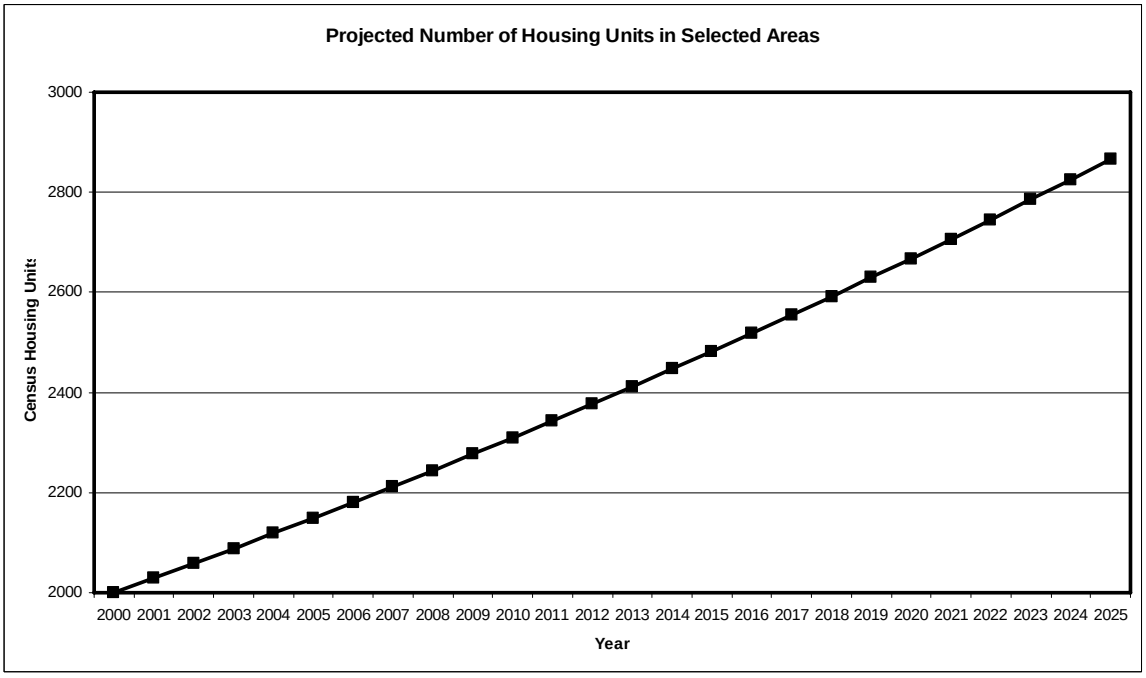


Population Estimates for Walla Walla County were taken from the http://www.ofm.wa.gov/pop/gma/projections.asp website. The estimates used were high estimates from a range of low, intermediate and high.

Population Estimates for Walla Walla City and College Place where calculated from the Walla Walla County forecast. The calculations can be found on the "Walla Walla estimates.xls" excel document.

Initial Dayton population was take from http://www.ofm.wa.gov/pop/april1/finalpop2006.pdf

Population of High Density Area



The affected area includes locations with all the following characteristics: (1) zoned 1 home per 10 acres or more dens, (2) overlying the gravel aquifer, and (3) where hook-up to municipal water supply is not available. The boundary of the gravel aquifer is drawn

using a map from in the 1995 watershed assessment done by Ecology and Pacific Groundwater Group. This boundary generally includes all of the zoning of interest around Walla Walla, College Place, and Touchet. The gravel aquifer is very limited and spotty in other areas zoned 1/10 or denser areas such as Burbank, Dayton, and Waitsburg. These areas rely mostly on gravel aquifer--population estimates do not include these areas.

2000 Census data available on Ecology's GIS data server was used to estimate existing housing units within the area of interest. This data includes census blocks and related tables that include population and number of housing units in each census block. Census blocks were selected that were outside the water service area of the City of Walla Walla and within the areas zoned 1 home per 10 acres or more. Zoning GIS data was provided by Walla Walla County. The water service area for the City of Walla Walla was provided by the City of Walla Walla.

The boundaries for zoning, gravel aquifer, census blocks, and water service area do not typically line up so there is some uncertainty with tallying up these numbers. For example, a zoning boundary may cut across a large census block and there was no easy way to count how many of the housing units within that block might be included in the zoning area of interest. Because of this, the entire block was used in the calculations. The same practice was used for the water service area and gravel aquifer.

A few of the census blocks seemed to indicate many more housing units than were apparent on the aerial photo. Because of this, and the uncertainty described above, the total number of housing units for all of census blocks were rounded down.

The total number of housing units for the area of interest for the year 2000 was 2000. Ecology then applied the high OFM growth rate of 1.45% out to the year 2025. This data is shown in the following table.

Year	HU	#/Year
2000	2000	29
2001	2029	29
2002	2058	30
2003	2088	30
2004	2119	31
2005	2149	31
2006	2180	32
2007	2212	32
2008	2244	33
2009	2277	33
2010	2310	33
2011	2343	34
2012	2377	34
2013	2412	35

Year	HU	#/Year
2014	2447	35
2015	2482	36
2016	2518	37
2017	2555	37
2018	2592	38
2019	2629	38
2020	2667	39
2021	2706	39
2022	2745	40
2023	2785	40
2024	2825	41
2025	2866	42
2026	2908	42

2007-2026 **696**

Appendix 2
Social Rate of Time Preference

November 24, 2006

TO: The File
FROM: Cathy Carruthers
SUBJECT: Social Rate of Time Preference (SRTP)

The social rate of time preference used to discount pure consumption tradeoffs over time is much discussed in the literature. This memo lays out a method for handling two issues.

1. When do we use a general SRTP?
2. What is the SRTP?
3. What do we do about discounting when there is a mix of consumption dollars and investment dollars.
4. How do we handle risk?

Using the SRTP:

The analyst can use a different rate when there is an indication that a different rate should be used.

Example 1: if the rule will require and affect investment only and will not generate any consumption benefits, then an investment-related interest rate could be used.

Example 2: the I bond rate below is for 30 year bonds. It is possible that a different interest rate should be used when the consumption shift takes place in a very short time.

The SRTP ≈ 2.1%:

The best indication of risk free, inflation adjusted SRTP for regulatory work would be an inflation adjusted government security. The table to the right indicates the range of rates for I Bonds[34] over the last 8 years, where bonds are purchased directly from the Department of Treasury. This would

Department of Treasury Data on I Bond Rates

DATE	FIXED RATES*	DATE	INFLATION RATES*	Annual Inflation	Annualized Rolling Average 1 Year Return on I Bonds
1-Nov-06	1.40%		**1.55%**	1.03%	2.43%
1-May-06	1.40%	1-May-06	0.50%		2.88%
1-Nov-05	1.00%	1-Nov-05	2.85%	2.33%	3.43%
1-May-05	1.20%	1-May-05	1.79%		2.67%
1-Nov-04	1.00%	1-Nov-04	1.33%	1.26%	2.26%
1-May-04	1.00%	1-May-04	1.19%		1.92%
1-Nov-03	1.10%	1-Nov-03	0.54%	1.16%	2.26%
1-May-03	1.10%	1-May-03	1.77%		2.86%
1-Nov-02	1.60%	1-Nov-02	1.23%	0.76%	2.56%
1-May-02	2.00%	1-May-02	0.28%		2.74%
1-Nov-01	2.00%	1-Nov-01	1.19%	1.32%	3.82%
1-May-01	3.00%	1-May-01	1.44%		4.69%
1-Nov-00	3.40%	1-Nov-00	1.52%	1.72%	5.22%
1-May-00	3.60%	1-May-00	1.91%		5.34%
1-Nov-99	3.40%	1-Nov-99	1.76%	1.31%	4.66%
1-May-99	3.30%	1-May-99	0.86%		4.16%
1-Nov-98	3.30%	1-Nov-98	0.86%	0.74%	4.09%
1-Sep-98	3.40%	1-Sep-98	0.62%		
			*semiannual rates		
Mean Rate	2.12%		1.27%	1.33%	3.51%
PV	187.76%				

[34] http://www.publicdebt.treas.gov/sav/sbirate2.htm

tend to indicate the SRTP for this period ranges between 1.0% and 3.6% with an average rate of 2.12%.

Mixed consumption and investment rates without risk:

The following formula will allow the foregone consumption due to reduced investment to be factored into present value calculations.

$$\sum_{t=0,n} \frac{k_t}{(1+s)^t} = \frac{k(1+s)}{s}$$

Where k_t is return on capital in time t and s is the social rate of time preference and n is infinite, this yields the following multipliers for year 0 investment requirements in a rule.

If the expected time horizon for reinvestment is not long the formula could be substituted for the table.

Years of Foregone Return	
Assumes principal intact	
after year	20
Pre Tax Return on Capital	Multiplier using SRTP
1%	1.16
2%	1.32
3%	1.48
4%	1.65
5%	1.81
6%	1.97
7%	2.13
8%	2.29
9%	2.45
10%	2.62
11%	2.78
12%	2.94
13%	3.10
14%	3.26
15%	3.42
16%	3.59
17%	3.75
18%	3.91
19%	4.07
20%	4.23

Evidence from AAA bonds:

Corporate bonds for a sector, with ratings of AAA could generally be regarded as low risk by comparison with other corporate offerings.

Federal Reserve Board Historic Data			
Moody's investor service			Real Return
1998	6.53	1.48%	5.05%
1999	7.05	2.62%	4.43%
2000	7.62	3.43%	4.19%
2001	7.08	2.63%	4.45%
2002	6.49	1.51%	4.98%
2003	5.66	2.31%	3.35%
2004	5.44	2.54%	2.90%

The AAA bond rate for real returns has been declining for the same period and now offers a real return of 2.9% for November 2004. This is not a riskless return.

Environmental Risk:

Interest rates could be adjusted to reflect probable risk. Risk of failure of environmental investment (such as a lack of an expected impact on a fishery) should be modeled directly by using ranges rather than through imbedding risk in the interest rate. This is now easy to do, using a Monte Carlo or other sensitivity test.

Appendix 3
Summary of the Changes to Chapter 173-532 WAC

Section	Summary of Change	Net Effect Requiring Analysis
Amendatory Section 010	Amended to add reference to Chapter 90.82 RCW	*N/A*, change made for consistency with existing statute.
	Clarified geographical boundary of basin	*N/A*, change made to clarify existing language in rule.
	Moved Section 110, Regulation review, to the beginning of text	*N/A*, change made to clarify existing language in rule.
Amendatory Section 020	Replaced definition of "baseflow" to "instream flow"	*N/A*, change made for consistency with existing statute.
	Amended definitions of "consumptive use" and "Nonconsumptive use"	*N/A*, change made for consistency with court cases.
	Modified portion of the definition for "Domestic use."	*N/A*, change made for consistency with 2005 Attorney General Opinion, interpreting RCW 90.44.050.
	Added definition of "Environmental enhancement project"	*See* analysis for new Section 055, where term is used.
	Deleted definition of zone of direct hydraulic continuity	*N/A*, change made for consistency with existing law and court cases.
	Deleted definition for "Municipal water supply system" and replaced it with the statutory definition of "Municipal water supplier." RCW 90.03.015.	*N/A*, change made for consistency with 90.03.015 RCW.
	Added term and definition of "planning unit"	*N/A*, identify who is referred to in Sections 030, 050, and 055
	Amended definition of "Water right."	*N/A*, changed to clearly state that instream flows are defined by statute as water rights.
	Added term and definition of "Withdrawal"	*N/A*, added to clarify its use in rule
New Section 025	Established stream management units for four stream management points	*See* analysis for Section 030
Amendatory Section 030	Changed title from "Base flows" to "Establishment of instream flows."	*N/A*, change made for consistency with existing statutory law.
	Original rule deferred establishment of base flows (instream flows) until later time. Adopted rule establishes monthly instream flow values for four management units in basin established in 025.	Under the original and amended regulatory framework only appropriations for above and below ground storage projects that benefit salmon population are allowed and will be subject to protection of instream flows. This is consistent with the purpose of these storage projects.
Amendatory Section 040	Original rule seasonally closed most rivers and streams in the basin and future well withdrawals within the "zone of direct hydraulic continuity" (see original Section 050 for groundwater restrictions).	Consistent with the prior legal framework, laws and the original rule, no new water rights have been issued. Also transfers and changes were limited to those actions that would not impair existing senior and junior water rights. The adoption of instream flow as a junior water right does not change the current requirement, which could result in denial of changes and transfers whenever existing water rights, including instream flows are affected.
	Adopted rule seasonally closes tributaries of the Walla Walla (between Stateline and Detour Road at MP5) and Mill Creek (between confluence with the Walla Walla to the headwaters) from June 1 to November 30. All other surface waters in the basin will be closed from May 1 to November 30	Overall the closure is extended to one month from what it was under the orignal rule.
	Adopted rule closes the gravel aquifer from future appropriations. Exceptions are provided for non-consumptive uses and future permit-exempt groundwater withdrawals under conditions spelled out in 050.	Consistent with the previous regulatory framework set by statutes and the 1977 rule, and the determination by Ecology that gravel aquifer is connected to surface water sources, no groundwater rights have been issued from the gravel aquifer. No additional impact is expected. Adopted rule has an impact on future permit-exempt groundwater in high density areas. See 050.

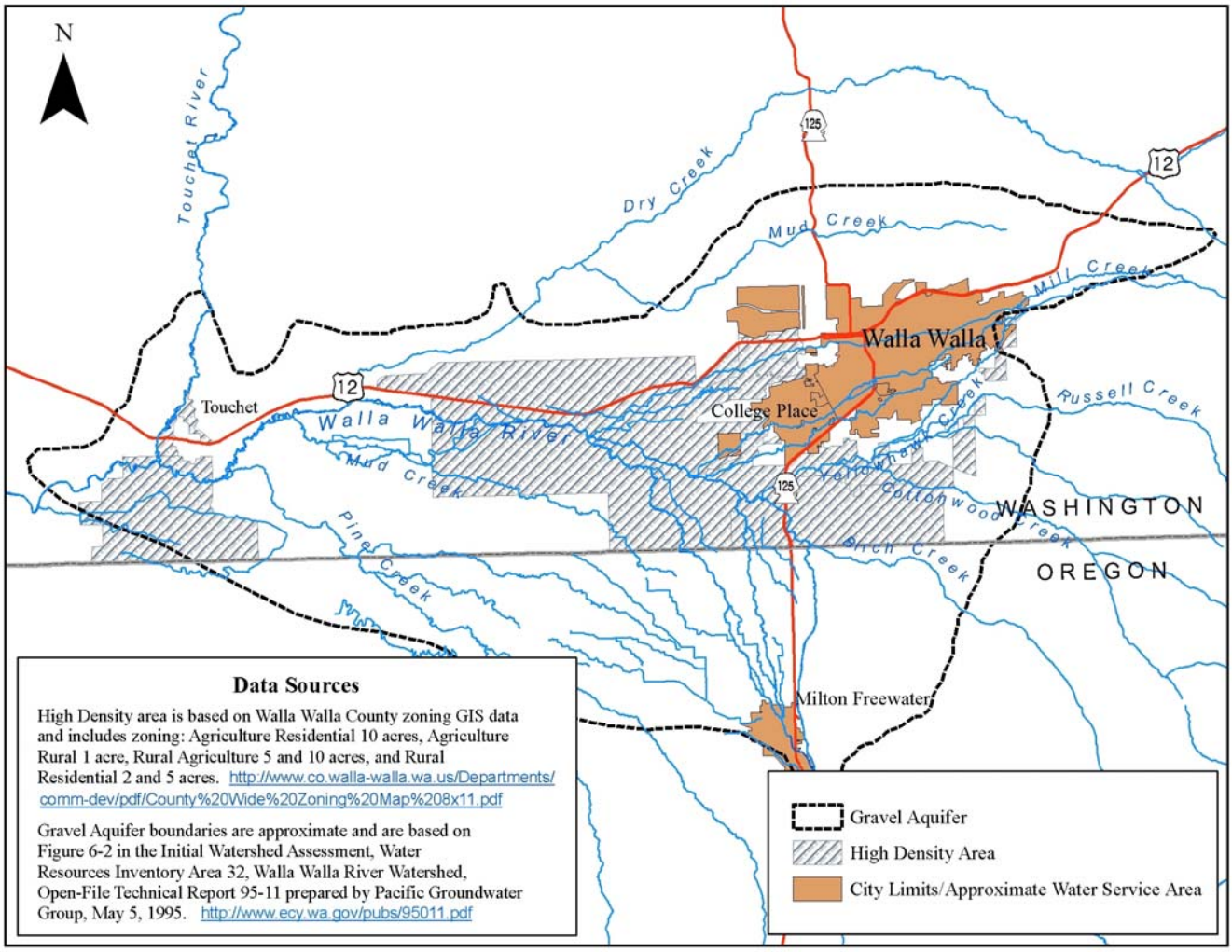
	Adopted rule limits surface withdrawal during non-closure period to actions described in WAC 173-532-045—non-consumptive and environmental enhancement storage projects	This does not change the prior restrictions on issuance of new water rights and allowing only non-consumptive projects and storage projects during the non-closure periods and in certain locations.
New Section 045	Added Section to specify permissible permitting actions.	*See* analysis done for Section 040, regarding limitations on future withdrawals made during non-closure period. See analysis done for Section 055, regarding restriction and procedural requirements for environmental enhancement projects.
Amendatory Section 050	Deleted all original text in this section, pertaining to future groundwater permitting. Section in adopted rule addresses future permit-exempt well uses in the gravel aquifer.	*See* analysis of Section 040 for effects on future groundwater permits.
	Adopted rule distinguishes areas between high density and low density areas based on the Walla Walla County zoning code. - Use of exempt wells in areas that have a zoned density of one residence per ten acres or more—high density--is limited to future domestic use and watering of lawn and noncommercial garden. The total amount of water is limited to a daily use of 1,250 gallons per residence. 4 and more residences are limited to 5,000gpd	Future permit-exempt groundwater for industrial purposes in high-density area will need to connect to a municipal water supply, acquire a new right, drill a well in the basalt, or locate in low density areas. See outdoor use mitigation requirement below.
	Adopted rule provides an exception to the closure for future stock watering from the gravel aquifer. Water use limits are based on the capacity of the land: --700 gpd on a tax parcel size of 10 acres or less, --2,500 gpd on a tax parcel size between 10 and 20 acres, and --5,000 gpd on a tax parcel size 20 acres and greater.	*N/A*, No real measurable effect due to low likelihood of significant future stock watering from the gravel aquifer, especially in high density areas. The quantities, proposed by a local stock water user are adequate for the size of the parcel. Feedlots and other activities not related to normal grazing land uses are not allowed under this exception.
	Adopted rule requires metering and reporting of all future exempt wells in the high-density area.	Cost of meter installation, maintenance and reporting – residences and stockwatering
	Adopted rule requires water-for-water mitigation from may 1 to November 30, for any outdoor water use from the gravel aquifer in high density areas.	Administrative cost and acquisition cost of mitigation.
New Section 055	Adopted rule outlines process for approval of future Environmental Enhancement Projects (EEP).	Administrative cost of additional procedural safeguards.
	In addition to existing statutory requirements, future permits for EEP must satisfy conditions listed in this section, including review and recommendation by other entities.	Resulting benefit of increased protection of existing water rights.
060	Adopted rule deletes entire section	N/A, original section expired—on October 1, 1984.
070	Adopted rule deletes entire section. No specific restrictions on basalt aquifer are included in rule. Original rule limited cumulative withdrawals from the basalt aquifer to 125,000 acre-feet.	N/A, not enough is known about the basalt aquifer to determine whether 125,000 acre feet is a reasonable limit to protect the aquifer from being depleted. This is a concern expressed by the cities and Ecology. Better protection needs to be put in place, once more is known.
080	Evaluation of new groundwater applications	N/A duplicate what is in statute under RCW 90.03.290.
Amendatory Section 090	Adopted rule deletes original enforcement terms and replaces with new terms	N/A, modified for consistency with statutory changes made since original rule was adopted
110	Section moved to WAC 173-532-010, Purpose.	N/A, moved to front of document to provide clarity.
New Section 120	Adopted rule adds map with WRIA boundary and four stream management points	N/A, provided for visual purpose

Appendix 4
Surface Water Closures

	Stream Management Unit							
	Mill Creek MP 1 (Mill Creek at Kooskooskie), USGS Gage. No. 14013000,		Walla Walla River MP 5a (Walla Walla River at Detour Road), Department Gage No. 32A100		North Fork Touchet River, MP 6a (North Fork Touchet above Dayton), Department Gage No. 32E050		Touchet River MP 11 (Touchet River at Bolles), Department Gage No. 32B100	
Month	CFS		CFS		CFS		CFS	
January	110		250		95		150	
February	125		250		95		150	
March	150		350		125		200	
April	150		350		125		200	
May	125		250		125	CLOSED	200	CLOSED
June	100	CLOSED	CLOSED		95	CLOSED	125	CLOSED
July	53	CLOSED	CLOSED		65	CLOSED	74	CLOSED
August	41	CLOSED	CLOSED		53	CLOSED	48	CLOSED
September	41	CLOSED	CLOSED		51	CLOSED	56	CLOSED
October	48	CLOSED	CLOSED		63	CLOSED	82	CLOSED
November	100	CLOSED	CLOSED		95	CLOSED	150	CLOSED
December	110		250		95		150	

Appendix 5
Map of Gravel Aquifer, High Density Areas and Cities, WRIA 32

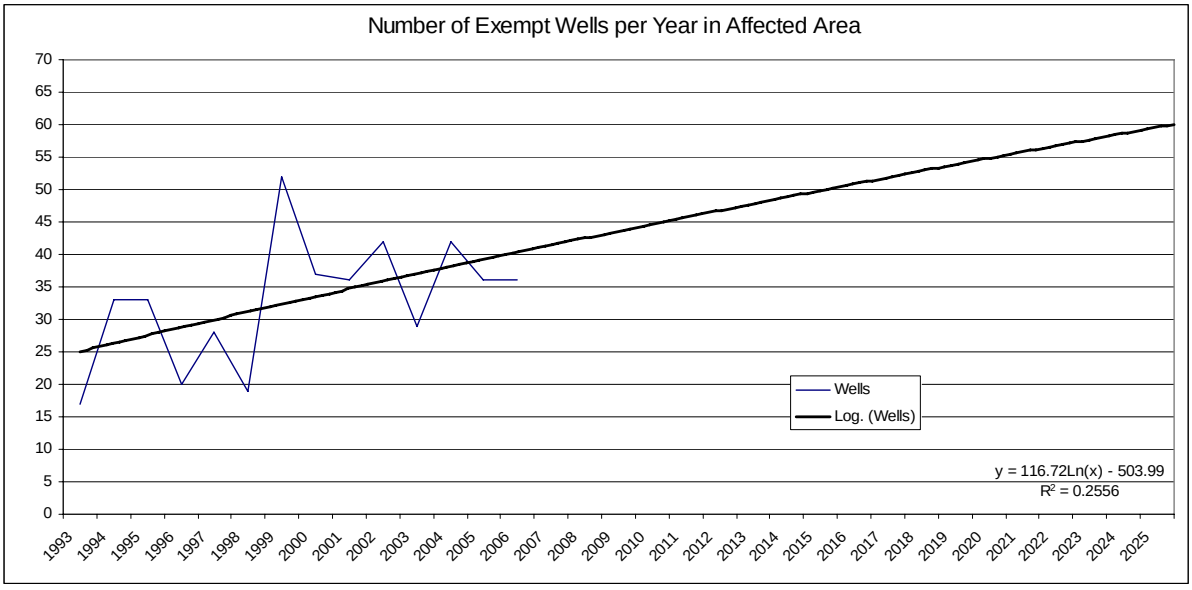
Map identifying the boundaries of the gravel aquifer, the cities of Walla Walla and College Place, the Touchet area, and high density areas (areas zoned one residence in ten acres or denser).



Appendix 6
Estimated Exempt Wells in Affected Area

Exempt Wells Drilled in WRIA 32 from 1993 to 2006			
Year	**Wells drilled in WRIA 32**	**Wells drilled in Walla Walla County portion of WRIA 32**	**Wells drilled in Columbia County portion of WRIA 32**
1993	**28**	**24**	**4**
1994	**74**	**61**	**13**
1995	**87**	**70**	**17**
1996	**70**	**52**	**18**
1997	**69**	**55**	**14**
1998	**40**	**32**	**8**
1999	**90**	**81**	**9**
2000	**56**	**51**	**5**
2001	**57**	**53**	**4**
2002	**58**	**55**	**3**
2003	**53**	**46**	**7**
2004	**78**	**71**	**7**
2005	**69**	**60**	**9**
2006	**71***	**68***	**3***
Total	**900**	**779**	**121**
Annual Average	**64**	**56**	**9**

Number of Wells in High Density Areas



The area of concern is defined as areas that are zoned 1 home per 10 acres or more, that overlie the gravel aquifer. The boundary of the gravel aquifer was drawn using a map from in the 1995 watershed assessment done by Ecology and Pacific Groundwater Group. This boundary generally includes all of the zoning of interest around Walla Walla, College Place, and Touchet so there really are no areas zoned 1/10 or denser that do not overlie the gravel aquifer except near Burbank, Dayton, and Waitsburg.

Wells were selected based on the criteria that the driller stated on the notice of intent to drill that no water right was required for the proposed well. Thus, it is assumed that the majority of the wells represent permit-exempt wells. Data of this type is only available for wells drilled since 1993. It should be noted that the 1993 and 2006 data are not for full years so the total for these two years may be lower.

Wells were generally located in GIS using the quarter-quarter section identified on the well log. Wells were plotted as points using the centroid for the subject quarter-quarter section for each well.

Zoning GIS data was provided by Walla Walla County. The water service area for the City of Walla Walla was provided by the City of Walla Walla.

An area, just south of the City of Walla Walla is within the Urban Growth Boundary but outside of the City's water service area. There were several wells drilled in this area. We include these wells in the analysis.

Appendix 7
Water Value Upland in Walla Walla (with associated capital)

Data Selection: The Walla Walla Assessor web site lists sales going back approximately three years. Ecology collected data on sales of parcels without buildings from 2005 to the present: parcel number, township, range, sale date, sale price, type (use) of acres, the seller, the buyer, types of uses such as irrigated, waste, dry, range, timber and other. This gave Ecology 59 transactions involving a total of 81 parcels. Using GIS and aerial photos the parcels were plotted and analyzed for road access, distance to the nearest town and distance to Walla Walla.

Regression Result: The dollar value of the sales was regressed on the acreage in different uses, the year of the sale (5 for 2005, 6 for 2006, 7 for 2007), the existence of an adjacent road, and 1/distance to Walla Walla, 1/distance to the nearest town.

Of these variables, the important variables for this analysis are the value of land with irrigation water and the value of land without irrigation water. The difference between these two is a value that accrues to water and any capital enhancements for use of the water. The estimators for these two variables are both statistically significant and they are statistically significantly different from each other. In other words the range of the 95% confidence interval for the estimators doesn't over lap at the high end of dry acreage values and the low end of irrigated acreage.

The reader should be cautious in using this regression to other uses because there are missing variables. The Adjusted R Square is .71, which means only 70% of the variation in prices is explained by the regression. However, the F statistic is high and indicates the regression is actually explaining the variance covered by the regression. Further the dry acreage and irrigate acreage estimators stayed very close to their final values as variables were stepwise deleted from the regression (including the intercept, 2 parcels that may drain to the Snake, and the distance without using it as a divisor[35]). Finally, water may could vary with other variables we don't have, such as utilities, since power is generally required for pumps, unless they are driven by a generator. However, many dry parcels that are on roads will also have electricity. Therefore the value is more likely to show up in that estimator.

The difference between the two estimators is $6,675 per acre. Conversations with irrigation system providers indicates that irrigation systems will cost at least $1,000 per acre but that $2,000 per acre should cover most instances, if you don't include a well and pumping for small agricultural parcels. These should not be included because any user of transferred water will also require these and because a well usually serves many acres. Therefore Ecology subtracted out $2,000 per acre to account for irrigation system capital costs. The remaining $4,675 per acre was divided by 2.3 acre feet of consumptively used water, which is the amount that could be transferred. **This gives an average value of**

[35] Distance ranges from 1 to a high number. Dividing it into 1 forces the variable to run from 0 to 1 and reverses the effect of the variable.

$2,033 per acre foot for water in use on upland. In other words, if a well stopped functioning or if someone was unable to obtain water they own, due to the effects of over use and falling water tables, then the average value of loss, as reflected by property sales, is $2,033 per acre foot. We caution that these are market sales of property, where the seller valued the land less than the market clearing price. Therefore this estimate may be low by comparison to the value in use that is not for sale.

SUMMARY OUTPUT						
Regression Statistics						
Multiple R	0.88					
R Square	0.77					
Adjusted R Square	0.71					
Standard Error	319148					
Observations	59					
ANOVA						
	df	*SS*	*MS*	*F*	*Significance F*	
Regression	10	1.69611E+13	1.7E+12	16.65	1.93175E-12	
Residual	49	4.99091E+12	1.02E+11			
Total	59	2.1952E+13				
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Yr of sale	-41319	23418	-1.76	0.0838945	-88378	5741
Acre dry	869	221	3.92	0.0002717	424	1313
Acre irrg	7544	1579	4.78	0.0000165	4371	10716
Acre waste	878	2648	0.33	0.7415810	-4443	6199
Acre range	515	246	2.10	0.0413442	21	1010
Acre timber	712	1142	0.62	0.5360495	-1583	3007
Acre other	3555	589	6.04	0.0000002	2372	4738
Road?	166945	124341	1.34	0.1855754	-82927	416817
1/d2WW	2946026	556077	5.30	0.0000028	1828548	4063505
1/D2T	-660354	248157	-2.66	0.0105030	-1159045	-161663
Dif Dry and Irr	$6,675					
Irr capital	$2,000					
Water alone	$4,675					
AF/acre	2.3	Source: Bill Neve, ECY: USDA National Agriculture Statistics Service, (1997)				
$/AF	$2,033					

Appendix 8
Water Right Valuation for the Walla Walla Basin

WestWater Research Sales Valuation of Walla Walla basin

Previous Water Right Sales in the Walla Walla Basin

Year	State	Transaction Type	Total Price	Acre-Feet	$/AFT
1999	WA	Purchase	$9,000	14	$667
2000	WA	Purchase	$1,026,000	1,541	$666
2004	WA	Purchase	$65,405	131	$500

Ecology

PERMANENT TRANSACTIONS

RANGE 1995-2007	$214-$1675
AVERAGE 1995-2007	$594

Appendix 9: Fish Values Research

Summary of the benefits resulting from increased fish

Fish are valued by people and are essential to the ecosystem. Their value in some uses is very high, and if the rule amendment reduced fish populations, the cost could be large.

Willingness to Pay: The value people put on fish

People place a value on fish populations in Washington based on their individual perspective. Sport and commercial fishermen have a direct use value for the fish. The commercial fishermen catch fish for sale and the fish contribute directly to income. Fishermen catch fish for recreation and for food. Buyers have a value based on the food value of fish and the availability of substitutes. Many people also have a value associated with knowing that the fish populations will exist at a greater level than current levels or than current long term trends would indicate.

Willingness to pay also depends on to the status of the fish population. Willingness to pay is very high for the first fish saved. These fish are the breeding stock that maintain or restore an entire population. Willingness to pay once there are sufficient fish to provide support for the rest of the ecosystem, including man, have a lower value. Thus the total value of the fish populations increases at a decreasing rate as the fish population itself increases. At the highest populations, where a sizeable share of the fish populations are used as human food, the value of each additional fish caught is simply its value at dockside.

Estimating Willingness to Pay for Fish Populations

A willingness to pay survey of Washington households conducted in 1998[36] indicated that people would be willing to pay approximately $10.5 million over a 20 year period to avoid a loss of an additional 1000 Columbia Migratory Fish that would occur in the 20th year.[37]

The survey is based on a hypothetical 20 year program that people pay for on a monthly basis and which creates an increase in the fish population which is measured by the increase in the 20th year. The survey generated two sets of values for the fish population increase: a baseline flat fish population status quo and a baseline declining fish population status quo. People were willing to pay more for improvements in fish populations when the survey was based on the assumption that the fish populations were declining. People were not willing to pay as much when the survey was based on the assumption that the fish populations were stable at 1998 levels. The $10.5 million value is from the lower of two sets of dollar values. These values are based on the assumption

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

[37] This present value estimate is based on the interest rate for inflation free bonds or 2.9% based on average I bond rates.

that the fish populations are stable at 1998 levels. Based on other local programs to save the fish, the lower dollar values, which assume increases from a baseline 1998 fish population, are appropriate.

The values are limited by the fact that the Department of Natural Resources Forest Practices Rule and the Surface Water Quality rule have already moved forward toward implementation.[38]

The formula is:

> Value = [(percent of fish beta*(0-LN(final percent change)/Pbeta)) -(percent of fish beta*(0-LN(5 percent)/Pbeta))]. [39]

The recent DNR rules were forecast to have an impact on the regulatory environment and thus the fish. The estimated impact was approximately a 5% impact on the fish populations. The value from this 5% has already been used for rules that were expected to increase the population. This rule would remove some unclear part of that gain.[40]

Public Comment on Contingent Value Surveys

One commenter for the Surface Water Quality Rule indicated:

> "Public opinion surveys on "willingness to pay" for environmental amenities can provide useful information but should be used with caution because they often overstate the "value" the public really is willing to pay if asked for actual cash contributions or additional taxes. For example, public opinion polls consistently show strong support for improved education, even in areas where school levies fail or pass only by narrow margins. Similarly, where large numbers of people are given convenient opportunities to make voluntary contributions or elect to pay higher rates for popular environmental causes, e.g. wildlife protection or renewable, the percentage of people who actually elect to make additional contributions usually is considerably smaller than the number who express support for those causes in public opinion polls. We suggest that the CBA put its use of "willingness to pay" surveys into context by mentioning these phenomena and citing studies on the limitations of such surveys."

There have indeed been many criticisms leveled at Contingent Valuation Method (CVM). These are nicely covered in Hausman [1993].[41] The National Oceanographic and Atmospheric Administration also convened a very select panel of experts, including

[38] The prior analyses used the initial 5.3% of the estimated value.
[39] The Beta and Pbeta are based on the nonlinear results in the Layton, Brown, Plummer (99) paper in footnote 2.
[40] The survey asked people to value increases in the fish populations that would occur in 20 years. If a rule saves a fish for the final 20th year population then that fish can't be counted twice. Only additional increases in habitat, creating additional fish population can be called an increase.
[41] Jerry Hausman, Ed., Contingent Valuation: A Critical Assessment, Elsevier Science Publishers, 1993.

Nobel winners, who were also critical of the method.[42] The Contingent Valuation used in this analysis was structured to address the problems noted by the NOAA Panel. Further, Ecology has used the lower of the two values available from the study. Ecology could have applied the values from the study to all fish, however, Ecology has been more conservative in that it took an additional unnecessary step and applies the contingent value only to fish that are not harvested. The Entiat fish studied in the plan are returning spawners.

Value of Commercially Harvested Fish

Harvested fish are valued at $.39 per pound. The present value for 20 years of catching one fish each year is $65.[43]

An increase in the number of fish would not only result in an increased population 20 years from now but also in an increased harvest in the intervening years. These fish are generally valued based on the ex-vessel price.

From the mid 1980's to the turn of the century, salmon harvests in Washington dropped by a factor of about 3½ (based on 3-year running averages of 26,028 tons/year in 1985-1987 down to 7,168 tons/year in 1999-2001). Revenues drop even more strongly, by a factor of almost 9, from $69,100,000/year in 1987-1989 down to $7,766,000/year in 1999-2001. A closer inspection reveals an important fact about prices for Washington salmon. On a year-to-year basis, there is a general tendency for an increase in harvest to be associated with a decrease in price, and vice-versa. This is what basic principles of supply and demand would suggest. A longer horizon, however, gives a different picture, as both harvests and prices have fallen (see following figure).

[42] Kenneth Arrow, Robert Solow, Paul R. Portney, Edward E. Leamer, Roy Radner, Howard Sherman, Report of the NOAA Panel on Contingent Valuation,

[43] The increase is assumed to be caught each year for 20 years and is valued at $0.39 price/Lb x 13 pounds average weight.

This reflects the fact that increased imports from Alaska and Chile, as well as a greater quantity of farmed salmon, have more than made up for the decrease in local harvests. The result has been that Washington harvests are an ever-smaller portion of the supply in the state. This in turn means that local harvests have an every-smaller influence on local prices.

This complicates the calculation of what is to be gained by the increased harvests that might accompany increased stock abundance. It is possible that prices will fall even further. On the other hand some people are eating less salmon because of concerns for the fish and the wild supply, if it grew sufficiently, might out compete imports and farming. But a more neutral projection would be to carry current average prices forward. Given the role of supplies from outside the state, it would be unrealistic to project a significant increase in prices.

The next question is the increased volume of harvest that a recovery would allow. There can be no direct translation from increased abundance to increased harvest. If harvests are an extremely low fraction of total returns of adult fish, they can be increased by a greater percentage than the increase in abundance itself. On the other hand, the commingling of wild and hatchery fish leads to the imposition of lower harvests so as to protect the wild runs, and may prevent the realization of much gain in harvest.

Value in Sport Fishing

The value of sport caught fish is based on the value of a fishing day for one individual. The value of salmon fishing of $61.27 would be an appropriate estimate of value for any decreases in salmon fishing days generated by this rule amendment.

Value of a Fishing Day indexed to 2003				
Type of Fishery	Source	Value per fishing day	Location	Estimation Method
Coldwater	Brown and Plummer (1979)	$ 66.77	WA	HTC
		$ 119.48	OR	HTC
	Vaughan and Russell (1982)	$ 40.41	US	TC
		$ 52.67		
		$ 55.71	US	CV
	Miller and Hay (1984)	$ 55.71	ID	TC
	Sorg *et al.* (1985)	$ 27.64	ID	CV
		$ 45.17	ID	TC
	Brown and Hay(1987)	$ 24.75	US	CV
	Wade *et al* . (1988)	$ 28.90	CA	TC
Salmon	Matthews and Brown (1970)	$ 175.13	WA	CV
	Crutchfield and Schelle (1978)	$ 45.85	WA	CV
	Brown, Sorhus, and Gibbs (1980)	$ 61.27	WA	TC
		$ 101.70	OR	TC
Trout	USFWS (1980)	$ 26.03	ID	CV
		$ 29.19	US	CV
	Vaughan and Russell (1982)	$ 42.75	US	TC
	Waddington, Boyle, and Cooper (1994)	$ 37.99	WA	TC
Saltwater	Rowe et al. (1985)	$ 90.80	Pacific Coast	TC
Warmwater	Vaughan and Russell (1982)	$ 25.84	US	TC
		$ 35.38		
		$ 39.80	US	CV
	Sorg *et al.* (1985)	$ 21.12	ID	CV
		$ 46.60	ID	TC
	Hay (1988)	$ 20.34	NW	CV
Table drawn from Gardner Brown and Mark Plummer, Fisheries Benefits of Five Department of Ecology Rules, 1997. All citations are in that document.				
TC means Travel Cost				
HTC means Hedonic Travel Cost				
CV means Contingent Valuation				

Changes in the Fish Population

The Plan considers efforts to avoid extirpating endangered species. Chapter 7 of the Management Plan[44] considers treatment options expected to increase fish populations for Chinook by a total of 102 adults. Current abundance of this population is estimated at 237 adults. The plan is for full implementation of all options and therefore no fish impact. If this does not occur and fish losses result from the water rights, then those losses could have a high value based on the foregone uses above.

[44] Entiat Water Resource Inventory Area (WRIA) 46 Management Plan, October 2004, Chelan County Conservation District, Chapter 7.