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Memo

To:	Brad Johnson, WRIA 35 Planning Unit Mimi Wainwright, Washington State Department of Ecology		
From:	John Koreny, HDR	Project:	WRIA 35, Asotin and Alpowa Creek Hydrogeology Evaluation
CC:	Kevin Lindsey, GSI Water Solutions, Inc. Ben Floyd, HDR		
Date:	June 29, 2009	Job No:	

RE: Response to Comments by Ecology on Draft "Asotin Creek and Alpowa Creek Hydrogeology Report" Dated May 8, 2009

Introduction

This memorandum responds to the comments prepared by Washington State Department of Ecology (Ecology) on the draft report titled, "Asotin Creek and Alpowa Creek Hydrogeology Report" dated May 8, 2009 and prepared by HDR, Inc. and GSI Water Solutions, Inc. Ecology's comments were transmitted by Mimi Wainwright, Ecology to John Koreny, HDR on June 5, 2009 by email and are titled, "State Caucus* Comments RE: Draft Asotin Creek & Alpowa Creek Hydrogeology Report, May 2009". Each comment is presented below in its original form along with a response to the comment and an explanation of how the draft report was modified, if appropriate, to publish the final report. We appreciate the comments and the opportunity to clarify and improve the final report.

Response to Comments

Comment 1

General: Assuming final version of this report will include much larger maps and tables, since portions of the ones in the currently draft are virtually impossible to read.

Response 1

Agree with comment. Report has been modified accordingly.

Comment 2

General: In some places your reference of "based on interviews with persons familiar with the area" are attributed and cited as such to Brad Johnson and Tim Simpson with Asotin PUD but in other places in the document individuals are not cited. Were others interviewed?

Response 2

Agree. Report text has been clarified.

Comment 3

General:
Cover Page – add Ecology grant number

Response 3

Agree. Report has been modified.

Comment 4
Introduction Chapter 2 last pp: Better to characterize this as a seepage run/stream flow profile instead of "gauging program".

Response 4
Report text has been modified as per comment.

Comment 5
Need for a new subsection
The third sentence on page 1-2, 2nd paragraph now reads,

> The deep basalt hydrostratigraphic unit (DBHU) has very limited use in the lower portion of the basin (less than 15 percent of all wells are solely completed in the DBHU), where it is located well below canyon bottoms and therefore probably has limited hydrologic connection with surface water in the lower portion of the Asotin Creek and Alpowa Creek basin.

This raises an important issue. Since a well completed in more than one aquifer interconnects those aquifers, then many arguments regarding the isolation of various interflow zones become irrelevant. As for the number of wells that are completed in more than one aquifer, I find conflicting information. In HDR's August 11, 2008 memo it states that 60 % of all wells are only completed in the SBHU, that very few wells penetrate the deeper aquifers, and that only 5% penetrate the IBHU and DBHU. The above quote from the recent report says that less than 15 percent of all wells are solely completed in the DBHU. So I don't know quite what to believe. What I do know is that the report should include a subsection addressing those wells that do interconnect hydrogeologic units and interflow zones and that section should discuss (1) wells screened or uncased wells across multiple basalt flows, and (2) wells that may have failed seals the create conduits across multiple basalt flows.

On a similar note, looking at the southwest portion of cross section A-A' (the left portion of the figure), I count 5 wells completed in both the IBHU and the DBHU. Unfortunately due to the poor quality of the image I cannot read the well numbers to look up the corresponding static water levels. My suggestion would be that you include the water levels for all of the wells on this cross section. Obviously whether or not the water levels in these wells are above or below the MBHU/DBHU contact will be one indication regarding how pumping the DBHU might affect the shallower systems.

Response 5
Comment noted. The information in the August 11, 2008 memo has been updated by the May 8, 2009 Report. Those wells that penetrate multiple basalt units are noted on Table 3-2 and on the Tables in Appendix B. HDR does not have information regarding failed well seals. Many of these comments are duplicated in the comments provided regarding Chapter 3. See response to Chapter 3 comments.

Comment 6
2.2.1: How was it determined which households received surveys? How many surveys were sent out?

Response 6
Residents at houses visited during the ground water level field work were asked to complete a household water use survey. Information was collected about household water use from those residents that were at home and willing to provide information. Surveys were conducted in person at the residents house. This is because our experience in prior similar studies indicating that the response rate from mailed surveys is very low. The houses selected for the ground water level field work were those with well logs and that were at the residence during the field survey dates.

Comment 7
2.2.1 – Should include statement about how households were selected for survey

Response 7
Report has been clarified.

Comment 8
2.2.1: The Water Use Survey Form referenced in Appendix A does not differentiate between surface and ground water use in the questions regarding lawn/garden irrigation, or in number of stock watered in winter or summer. How was this distinction made?

Response 8
The survey information only includes ground water use, not surface water use. All residents interviewed only use ground water.

Comment 9
2.2.2.1: The statement that households with 2 residents are consistent with retirees and seasonal homes appears to be based on conjecture, as the only data provided to substantiate this is that 6 out of 38 homes are occupied seasonally.

Response 9
Comment noted. It is our understanding that many houses in the Anatone area are used for seasonal or vacation homes and there are very few families with children in the area. This is based on discussions with area residents, Brad Johnson and other members of the Planning Unit.

Comment 10
2.2.2.1 – Should add reference to OFM statistic as a comparison

Response 10
Chapter 2 only reports the results of the field survey. Chapter 4 analyzes the data. We counted the population in the sub-basin, because the State census data is on a County-wide basis and cannot be used to count population in a sub-basin.

Comment 11
2.2.2.1: In 2.2.2., it is indicated that 52 households were surveyed, with 49 being residential. The total households referenced in 2.2.2.1 total 48. Numbers don't match.

Response 11
The report has been clarified.

Comment 12
2.2.2.2: It appears that the average of residential lawn size includes those households that do not have irrigated lawns. More appropriate to include only irrigated lawns in an average of "irrigated lawn size."

Response 12
A statistical average is the sum of the population divided by the number of individuals in a population.

$$AM = \frac{1}{n}\sum_{i=1}^{n} a_i .$$

A statistical average cannot exclude those members of the population that have a zero value, unless they are removed from the population that is being analyzed. In this case, the households that don't water their lawns still are part of the population of households that are using water and they help to explain the overall water use characteristics for the sub-basins. If we exclude the households without lawns from the average statistic for the population, then the statistic will be biased high.

Comment 13
2.2.2.2: Much of the water use assumptions were based on the survey of 52 households, which represents use on 14% of the project area households. How representative do you believe this survey to be?

Response 13
The survey included 52 households or about 14 percent of the population. We believe that this sample is large enough to provide information on water use practices, especially when it is supplemented with interviews from residents and other individuals knowledgeable regarding the area. An evaluation was not conducted to determine if the sample size was large enough to be statistically significant.

Comment 14
2.2.2.3: How were you able to distinguish between surface and groundwater use for livestock? The Water Use Survey Form did not clearly delineate between the two.

Response 14
Response: The residents interviewed were asked to quantify only ground water use, not surface water use.

Comment 15
2.2.2.3 – Comparing survey results concerning livestock management with NRCS staff to support would be appropriate here.

Response 15
The method used to evaluate the number of livestock is documented in the report.

Comment 16
2.3.1 – Cite QAPP; include in appendix.

Response 16
The QAPP that was prepared is included in Appendix E.

Comment 17
Section 2.3.2 Table 2-3 needs to include the date of the water level measurement for each well.

Response 17
The sampling dates are summarized in footnotes in the table.

Comment 18
Section 2.4 - Needs a discussion on the diurnal fluctuation of the streamflow in Asotin Creek. Document whether it was significant during the September seepage run. Two real-time gages are located on Asotin Creek. A rain event occurred on Sept 20/21. Flow increased by 9 cfs. Need to document which measurements occurred on which days of the seepage run.

Response 18
This information has been included in the report. Seepage fluctuation between sampling events was almost always less than 0.1 cfs and the total diurnal fluctuation during sampling was less than 1.0 to 1.5 cfs. The sampling dates are now referenced on the figures. The electronic file is available for further evaluation if needed.

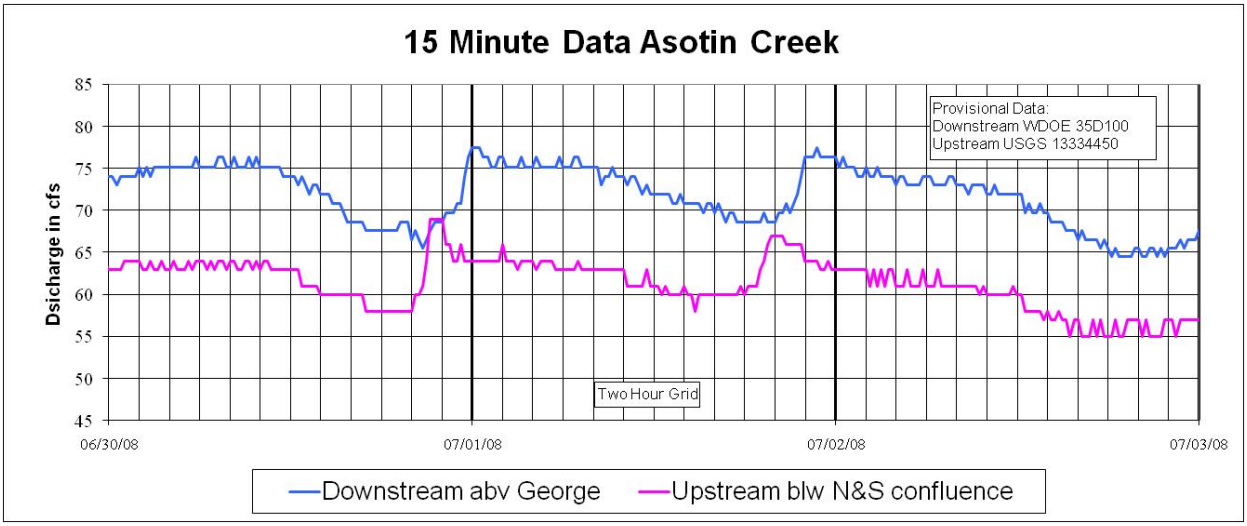
Comment 19
Page 2-4, Groundwater Level Results
Were any of the water levels in the wells measured on more than one day? If so, annotate and state what the change was. Also in Table 2-3 need to provide the date of the measurements.

Response 19
The wells were only sampled once as per the authorized scope of services. The sampling dates are provided in the footnotes on Table 2-3.

Comment 20
2.4.1.2: The assumed discharge rates for sprinkler types referenced appear to be in error. Pop-up landscaping sprinklers typically have discharge rates of 2-3 gpm but can vary greatly depending on nozzle size and discharge pressure; irrigation impact sprinklers mounted on handline risers, typical of that shown in Figure 2-23, will discharge at a rate of 4-6 gpm (assuming standard nozzle size of 5/32 – 11/64 & discharge psi of 40-50 psi).

Response 20
The report text has been clarified accordingly.

Comment 21
Page 2.4, Section 2.4 Seepage Run
This section needs a new subsection that analyzes the available continuous flow gauge data. As discussed during our recent meeting, those data suggest significant diurnal fluctuations and this has direct bearing on the flow measurements made by HDR. For example, the data from two of the gauges are as follows:



As these data are for July when snowmelt is not a factor, they suggest diurnal changes due to ET losses from riparian vegetation. If HDR measured flow at sites successively lower within a system over the course of a day and ET losses increased over the same period, then gains in that particular stretch may be masked by the countering effects of these two variables. Analyzing continuous flow records and explaining what time of day particular measurements were made for the various stream reaches should shed light on this. Similarly the points on the graphs in figures 2-13, 2-15, 2-17 and 2-19 should list the time of day those measurements were taken.

Response 21
See response to Comment 18.

Comment 22
HDR reported an estimate of 25 percent error in its flow measurements. This is significant and should be noted in the report. Also, it was mentioned that it rained one day when measurements were taken. If that is this case that also needs to be noted.

Response 22
Flow measurement error statistics are not cited in the report. We understand flow gaging to generally be accurate within a range of 5 to 15 percent as referenced for gaging stations classified as fair to good by the USGS, but we have not defined gaging error for this project.

Comment 23
2.4.1 – Is there a statistical error calculated?

Response 23
No, this was not calculated.

Comment 24
2.4.3.1: It is not valid to assume that irrigation occurring in close proximity to surface water is diverting from that source. There were only 2 irrigation systems operating during the seepage runs; could not the source for that irrigation be confirmed? It appears the assumption is that water for Chief Looking Glass Park is coming from Asotin Creek; there is no water use authorization for this purpose at this location. The source would appear to be from the City of Asotin municipal wells.

Response 24
The comment that the water for Chief Looking Glass Park is from deep basalt public supply wells is correct. We have adjusted the seepage run calculations and edited the report to reflect this correction.

Comment 25
2.4.3.4 last pp - "In the lower 7.2 miles of Charley Creek, cumulative gains attributed to ground water interactions totaled 0.1 cfs (Figure 2-19)." Looking at the graph estimate about a 2.4 cfs loss.

Response 25
This has been corrected.

Comment 26
2.4.3.6: Again, the irrigation diversion rate for this location appears to be in error. A standard rate for 20 impact heads would be in the range of 100 gpm (0.22 cfs).

Response 26
This has been corrected.

Comment 27
2.4.3.7 – WDFW commented on 20 May that Ten-mile creek has flows above the uppermost station; this should be noted.

Response 27
We measured flow in the middle and lower reach of Ten-mile Creek as per our approved scope of services. We have no information on flow in Ten-mile creek above the river reaches measured.

Comment 28
Page 2-11, 12 – Table 2-1: May be more accurate to only include actual irrigated lawns/gardens in "Average Irrigated Lawn Size". May be useful to footnote table to the fact that the survey results only reflect 14% of households in the basin, i.e. the estimated head of stock (2,728) is the total for only 14% of households in project area.

Table 2-1 – Coincidence or is the lawn size (sq ft) and number of livestock both 900 for Sam & Linda Heitstuman?

Response 28
The information in Table 2-1 is correct.

Comment 29
Page 2-20 (figure 2-2) & 21 figures – Bar graph depicts irrigated lawn sizes. Out of the number of all lawns (even those that are not irrigated; 20) nearly half are greater than 1001 square feet (18) and yet only pictures of no lawns and small lawns, are depicted. Should include example of large lawn. Number of household response (47) and number of households (48)????

Response 29
Figure 2-6 and Figure 4-4 shows examples of larger lawns. Figure 2-2 has been corrected to show the appropriate number of household responses and number of households.

Comment 30
Page 2-22, Figure 2-7: The number of responses for this dynamic is 29 households; a little more than half of the respondent total. This represents less than 10% of the households in the project area – is this actually statistically representative of the project area? The same question holds for the other survey parameters as well – household population, irrigated lawn size, etc.; is the survey results actually representative of the project area? If so, how is that conclusion arrived at?

Response 30
This section of the report presents only the results of the water use survey. The statistical significance or representativeness of the responses as compared to the amount of the overall population in the basin has not been evaluated. The water use survey data were only used to evaluate the general appropriateness of water use assumptions made about components of the household water balance in Chapter 4. The water use survey data shows that the assumption made about components of the household water balance (such as lawn size and frequency of irrigation) were appropriate and actually conservative.

Comment 31
Page 3-9 Section 3.3.3.2
It has not been quantified in this report how much recharge occurs where individual interflows crop out at land surface versus thru vertical leakage. While vertical hydraulic conductivity (Kv) is lower than horizontal (Kh), it is not zero. Multiple heads zones stacked vertically (which the groundwater level data collected for this phase of the project verifies) will produce vertical leakage. Over a watershed-sized area, it adds up.

Response 31
Quantification of recharge is not within the authorized scope of services for this project. The other comments are noted.

Comment 32
Page 3-9 3.3.3.2 3rd full paragraph
The 2nd sentence now reads,

> Conversely, the small number of springs low in the project area suggests aquifer discharge to streams is less common on the down gradient of the headwaters areas.

The sentence as written would read better if you delete the words “on the”. However, more importantly since the seepage data for Alpowa Creek indicate significant gains not associated from springs, for example, this conclusion is unsubstantiated.

Response 32
The report has been revised as suggested.

Comment 33
Page 3-11, 3.4.2.2 3rd paragraph
The 4th sentence now reads,

> Wells in the shallow basalt likely will have little impact on these springs and the streams they feed.

Disagree with this statement. If recharge is reaching the SBHU, then it must be either discharging via springs or recharging down into the IBHU. Either way less water in the system due to groundwater pumping may very well result in less water in the creek.

Response 33
The sentence and the preceding sentences indicate that spring flow is more common in the headwater areas than in the lower portion of the basin. This is a valid conclusion. We agree that there is evidence of gains from ground water inflow on Alpowa Creek and this conclusion is also discussed in the report in Sections 2.4.4.6, 3.4.3.2, 3.5 and 5.2.2.

Comment 34
Page 3-12 Section 3.4.2.4
Direct discharge to streams is not the only measure of hydraulic continuity. Pumping a deep basalt well will induce vertical leakage that will reduce discharge to streams from the shallower units.

Response 34
The regional ground water levels in the basalt aquifer wells are much higher than Asotin Creek, and the seepage run data indicates little to no discharge from ground water to the creek. Therefore, there is likely to be little hydraulic connection between the basalt aquifers and the creeks. If there is little hydraulic connection, then pumping of the basalt aquifers by few domestic-exempt wells spread out over a large area is likely to have little influence on flow in the creek. An exception to this may be in the Anatone area, where wells may have an influence on the flow in the upper portion of Ten-mile Creek. However, water use even in this area is relatively low. In the Alpowa Creek basin, there are very few wells completed in the deep basalt aquifer and the aquifer is located well below the canyons. Therefore, it is reasonable to conclude that pumping in the deep basalt aquifer has little influence on the Alpowa Creek flow.

Comment 35
Page 3-12, top paragraph
The 6th sentence now reads,

> It appears that most wells in this area are completed several hundred ft below ground surface in interflow zones that may not be hydrologically connected with surface water because of laterally widespread dense basalt flow interiors.

Disagree with this statement. Looking at cross section A-A', more than half of the IBHU wells in the lower portion of the Asotin sub basin (the right side of the figure) appear to have open intervals in interflow zones that intersect or nearly intersect the stream channel nearby or somewhere downstream. That indicates that a hydraulic connection with the creek likely does exist.

Response 35
Cross-section A-A' shows only two wells completed in the IBHU that have open intervals that span through the top of the unit. Almost all wells have open intervals that are in the lower portion of the aquifer in interflow zones that are below the top of the unit. The image quality of the cross-section has been improved so that the open intervals can be more clearly observed in the report.

Comment 36
Pages 3-11 and 3-12, general comment regarding recharge
During our meeting Kevin Lindsey provided some useful hypotheses regarding where recharge to the geologic units comes from. Specifically he speculated that recharge to the Wanapum occurs along its western/upper extent within the study area, while recharge to the Grande Rhonde may occur along the Grand Rhonde River (as opposed to in the Blue Mountains). Even if this is conjecture based on limited evidence, this is useful to include here with appropriate qualifiers.

Response 36
We did not evaluate the recharge characteristics of each geologic basalt formation. We did evaluate the recharge characteristics of the hydrostratigraphic units and this information is presented in Section 3.4.2.

Comment 37
Page 3-12, 2nd paragraph
The last sentence now reads,

> Based on current knowledge, including field reconnaissance, these features more likely act as barriers to groundwater movement in the project area.

As pointed out by Kevin Lindsey during our meeting, the prevalence of faults in the Alpowa sub basin and the significant seepage gains in that creek suggest the faults and dikes are acting as conduits and not faults. Moreover, even if it was true that these act as barriers somewhere else within the study area, need to explain what was seen in the field that made you reach this conclusion.

Response 37
The report explains that faults may act either as flow barriers or preferential flow pathways, but that it is most likely that they act as flow barriers. This is because ground water in basalt aquifers usually flows through interflow zones tens of feet thick which have very high high hydraulic conductivity caused by open voids or vesicles in the interflow zone. Faults are likely to interrupt (not increase) the flow through these interflow zones. It is unlikely that faults form preferential flow pathways, because the rock within a fault zone tends to have fairly-low permeability fractures as compared to open-voids in an interflow zone. However, if a fault happens to cause an interflow zone to intersect with another interflow zone or a canyon wall or floor, then there could be a flow pathway. We don't think it is likely that dikes form flow pathways, because the rock within a dike is composed of low-permeability material as compared to interflow zones in basalt.

Comment 38
Section 3.4.3.5
ASO315 is cased and sealed to 41' feet into 'firm basalt'. This basalt well has a shallow, high head static because it is hydraulically connected to the creek. At a relatively nearby location, groundwater in this confined aquifer (leaky confined) is discharging to the adjacent creek (likely in an area where the creek is eroding and down cutting into the aquifer). Don't have to surmise that its seal has failed.

Response 38
The report text has been modified to remove the phrase, "Either the seals in these wells have failed".

Comment 39
Page 3-13, last paragraph
The first two sentences indicate that the alluvial wells and the basalt wells have the same water levels. Doesn't that suggest a connection between the two aquifer systems? Similarly your last sentence says,

> The ground water data and the seepage run data indicate some hydraulic connection and gains between either the alluvial aquifer or the basalt aquifer and Alpowa Creek.

Replace the word “some” with “a” in this sentence, since it sounds like a significant connection may exist.

Response 39
The text has been revised.

Comment 40
Page 3-14 Section 3.4.3.3
It is incorrect to assert that there is no local hydraulic connection between vertically stacked aquifers. Again, Kv governs vertical leakage.

Response 40
Comment noted.

Comment 41
Page 3-15 Section 3.4.3.4
The static water level in ASO286 comes from a zone deeper than the total depth of well ASO805.

Response 41
Comment noted. The data indicate that both wells are within the same hydrostratigraphic unit.

Comment 42
Page 3-17, 2nd paragraph
The last sentence in this paragraph now reads,

> Water use in the Anatone area is very minor and the overall effects are likely to have an insignificant effect on creek flow as documented in the following chapter.

Firstly I would point out that part of this conclusion hinges on the assumption that all future water use in the Anatone area will exclude outside watering. Since we don’t know that will be the case that portion of this argument is not substantiated. Also I would point out that in the 3rd paragraph on page 3-11 you state,

> In the Anatone area, where strata dip to the northeast, a significant portion of the groundwater moving through this unit likely discharges into springs high on the walls of Tenmile Creek canyon which is outside the sub-basin.

Assuming this sentence is correct, would recommend changing the page 3-17 sentence to acknowledge water use in Anatone will affect surface water, just mainly in Tenmile Creek.

Response 42
The first sentence cited above has been removed. A sentence has been added to address the comment.

Comment 43
Section 3.5 Summary of Hydrogeologic Investigation The report fails to acknowledge that in some instances where no gain or very little gain or loss to a creek is occurring, this simply could be due to the fact that water levels in both the creek and aquifer happen to be about the same.

Response 43
The ground water levels in the regional basalt aquifers are generally much higher than the water level in the creek.

Comment 44
Also, given some of my concerns above I don’t believe statements like the following are substantiated:

Page 3-18, last sentence in paragraph in middle of page,

> Given this, the upper portions of the unit may have localized hydrologic connection to streams, while deeper portions of the unit may not be hydrologically connected to surface water.

Response 44
Comment noted.

Comment 45
Page 3-18, last sentence on page,

> Consequently any stream flow supported by this system will only be through springs on the canyon walls.

Response 45
Comment noted.

Comment 46
Page 3-19, second to last sentence on page,

> Although many of the wells are either shallow or deep, it is evident that the basalt aquifers are highly spatially and vertically discontinuous and, with the exceptions discussed above for Alpowa and the North Fork Asotin Creek (and in the Asotin Creek headwaters), there is very little evidence of hydraulic interaction between the basalt aquifers and the creek.

Response 46
Comment noted.

Comment 47
Table 3-2 indicates that ASO284 is upstream in section 10 with a static of 1821' and ASO285 is downstream in section 3 with a static of 1752' – the opposite of what is discussed in the text. At both of these wells, the static is within 30 feet of land surface – these are shallow, high head wells that are hydraulically connected to the nearby surface water.

Response 47
Comment noted.

Comment 48
Page 3-23 Table 3-2
Needs date of measurement and larger font size

Response 48
The 11 x 17 paper size limits the size of the font. Ground water level measurements are reported on Table 2-3 and the sample dates are presented in footnotes.

Comment 49
Pages 3-43 through 3-53, Figures 3-17 through 3-22
These figures would be much more useful if you used symbols for the wells that indicated what geologic units you thought each is completed in.

Response 49
Comment noted. This information is presented in Appendix B.

Comment 50
4.4.4.1 Lawn Watering – following reference should be qualified “”Based on interviews with persons familiar with the area, *generally* lawns in these sub-basins are limited….”

Response 50
Report text has been changed as requested.

Comment 51
4.1.1.1: Reference to average irrigated lawn size of about 2,500 sq ft., based on survey results. This average included households reporting no outside irrigation. A more appropriate result for “irrigated lawn size” would average just those households with irrigated lawns.

Response 51
See response to previous Comment 12.

Comment 52
4.1.1.1: It appears that the assumption is that all rural residential irrigation comes from wells. Is there any factual information to support this conclusion? Was consideration given to the possibility that surface water could be used in lieu of wells on some lawns?

Response 52
We inquired about this during our field water use survey and in conversations with Brad Johnson and members of the Planning Unit. It was our understanding that households almost always use wells to supply water for domestic use and lawn watering. Irrigation for non-domestic agricultural and stock watering was quantified by evaluating field surveys and water rights and was limited only to those areas served by ground water.

Comment 53
4.1.1.1: Not clear how effective precipitation was calculated for purposes of this estimate. The Washington State Irrigation Guide, for Pomeroy, lists total precipitation at 15.50 inches, with effective precipitation at 6.57 inches. The figures that were calculated in this section were 12.66 inches, with 11.94 inches of effective precipitation. It would appear that the effective precipitation calculations are in error on the high side.

Response 53
Potential effective precipitation is the amount of precipitation available to meet crop demand. Actual effective precipitation is the amount of precipitation that actually went to meet crop demand. The Washington State Irrigation Guide (Appendix A) references actual effective precipitation at about 6.6 inches from Pomeroy. Our report in Table 4-2 references potential effective precipitation from Lewiston. We believe that it is more accurate to compute the effective precipitation using precipitation data from Lewiston because it is more representative of the precipitation that is occurring in the project area. Pomeroy tends to be slightly hotter and drier than Lewiston and the other portions of the project area. We have revised Table 4-2 to show actual effective precipitation from the Lewiston precip. recording station, which is about 7.3 inches. A copy of the revised table is shown below.

Table 4-2 Average Monthly Precipitation, 1948 to 2007, from the Lewiston WSO AP, Idaho weather station.

Month	Crop ET (in.) [1]	Average Total Precip (in) [2]	Potential Effective Precip. (in) [3]	Actual Effective Precip Used to Meet Crop Demand (in) [4]
January	0.00	1.21	1.14	0.00
February	0.00	0.88	0.84	0.00
March	0.72	1.07	1.01	0.72
April	2.88	1.23	1.16	1.16
May	4.32	1.52	1.42	1.42
June	5.88	1.36	1.27	1.27
July	7.56	0.60	0.57	0.57
August	5.88	0.71	0.67	0.67
September	3.48	0.75	0.71	0.71
October	0.72	1.00	0.95	0.72
November	0.00	1.19	1.12	0.00
December	0.00	1.14	1.08	0.00
Total	31.44	12.66	11.94	7.25

Notes:

1. Crop ET data from Agrimet Lake Bryan - Rice Bar Station for pasture grass.
2. Precip. data from Lewiston, ID Coop Station (105241), Western Regional Climate Center.
3. Potential effective precipitation computed according to USDA Publication 1275 method.
4. Actual effective precipitation is the amount of potential effective used to meet the crop demand.

Comment 54

4.1.1.1: Using the assumptions in this section, with the exception of effective precipitation which was drawn from the Washington Irrigation Guide for Pomeroy:

- 1/12 acre (3,600 sq ft)
- Irrigation season of April – September (182 days)
- Irrigation efficiency of 75%
- Pasture ET of 2.62 acre-feet.
- Effective precipitation of 6.57 inches (Washington Irrigation Guide – Pomeroy)

(a) 2.62 / .75 = 3.49 acre-feet per acre; 41.9 acre-inches
(b) 41.9 – 6.57 = 35.35 inches per acre total irrigation requirement (2.95 acre-feet per acre)
(c) 2.95 ac/ft = 961,258 total gallons
(d) 961,258 gallons / 182 days = 5282 gallons per day per acre
(e) 5282 gallons / 12 = 440 gallons per day per 1/12 acre (averaged per day from April 1 to September 30)

When the 190 gpd for in-house use is added, the annual average is 410 gpd, as compared with the averaged value of 381 gallons per day entered in this section. The WIG also has a higher net irrigation requirement (2.67 vs. 2.62) than that used, and a 75% irrigation efficiency factor reflects new, well maintained irrigations systems that may not be representative of the systems in the project area.

Response 54

We used a 75 percent irrigation efficiency at the recommendation of Bill Neve with Ecology and this was agreed to by the Planning Unit and Ecology as documented in the project memos summarized in our response to the Phase I report comments.

There are several factors that likely cause a difference between the 410 gpd water use statistic computed in the Ecology comment above versus the 381 gpd water use statistic in the report:

- In the comment above, effective precipitation should be subtracted from crop ET prior to computing the on-farm delivery requirement.

  Total Demand = (Crop ET- Effective Precipitation)/Field Efficiency
- The Agrimet data shows a growing season of more than 180 days for many years since 2003. For example, the 2003 growing season is 226 days. This would make the average daily water use statistic in the report slightly smaller in comparison to the statistic cited above.
- The actual effective precipitation we used was 7.3 inches based on the Lewiston precipitation data using the method in USDA Publication 1275 as compared to the 6.6 inches of actual effective precipitation cited in the comment above reportedly from the Washington State Irrigation Guide for Pomeroy. See our response to Comment 53.

These factors are likely to cause the small difference between the average annual household water demand of 381 gpd cited in the report and the 410 gpd rate cited in the comment above. We believe our methods are appropriate. Please note that the difference between 381 gpd and 410 gpd is less than 8 percent, which we believe is insignificant.

Comment 55

Page 4-2, first complete bulleted item on page (beginning with the words "Lawn watering "I believe this is saying that the aggregate water duty for lawn watering is 85%. If I am correct I think you should actually say this.

Response 55

We are not sure what is meant by the terminology, "aggregate water duty". We assumed a 75 percent delivery efficiency. For the remaining 25 percent, 10 percent was assumed to be loss due to wind evaporation and 15 percent was assumed to be return flow. This was per the recommendations by Bill Neve of Ecology during Phase I of the project and follows the method of the Ecology guidance document cited in the report. The text on page 4-2 has been clarified with respect to the percentage of consumptive and non-consumptive use water.

Comment 56

4.1.1.3: "Based on interviews with persons familiar with the area, many houses are on lots with rocky soil and do not have lawns. Houses with lawns are typically under watered and brown lawns are common during July to September." Appears that subjective conclusions are being drawn from anecdotal information. If used, should be sourced. Is data available to support these conclusions?

Response 56

The information is based on personal observations during field visits and interviews with residents during field water use surveys and interviews with Brad Johnson and other members of the Planning Unit. The source is referenced in a footnote.

Comment 57

4.1.1.5: Again, subjective conclusions are being drawn from antidotal (sic) information. There is no specific data supplied to support the conclusion that rural residential use is less than that within the Asotin PUD service area.

Response 57

We agree that actual data regarding average lawn size or watering frequency for the Asotin PUD was not available. Our conclusion is based on our own personal observations during field visits and interviews with

Tim Simpson of Asotin PUD. During the field visits in the summer, it was clear that lawns in the Alpowa and Asotin Creek sub-basin were smaller and browner than lawns in the Asotin PUD service area. The information also comes from interviews with Tim Simpson, the manager of Asotin PUD. Tim Simpson is directly involved with water use planning so the information conveyed during the interview is directly relevant. The source of the information is not anecdotal, since it comes from personal observation and from interviews with persons that are directly experienced in water use in the project area. We believe that the result of the calculation that shows household water use within 25 percent water use for the Asotin PUD service area is appropriate and justified. Also, the comparison between the computed household use rates and the Asotin PUD service area rates subject was discussed many times during Phase I of the project and Ecology and the Planning Unit agreed on the household water use rates used for the report.

Comment 58

4.3: "Based on interviews with persons familiar with the area…" Appears that subjective conclusions are being drawn from anecdotal information. Is not sourced. Is there any actual data to support these conclusions?

Response 58

The quote in the comment above is not found in Section 4.3. It is from Section 4.1.1.5 and the persons referenced are cited in a footnote. The persons referenced as interview sources in Section 4.3 are also referenced in a footnote. The actual data used to support the conclusions in Section 4.3 are explained in the second paragraph of the section and include detailed water rights and field mapping.

Comment 59

4.3, 1st pp last sentence – a cross check with NRCS or Ag Stats would be appropriate here to document

Response 59

The conclusion that total irrigated agricultural land is relatively small in the project sub-basins is based on evaluation of water rights and follow-up field mapping of irrigated lands. This data is more accurate than the NRCS or Department of Agricultural statistics which are for entire Counties and are not available for the individual project sub-basins.

Comment 60

4.3: If the objective was to determine how much ground water was being used for irrigation and stock watering, why was the analysis limited to trying to associate water rights with irrigated ground, rather than evaluating all irrigated lands in the project area irrespective of water rights/claims? The method used may underestimate the actual amount of ground water withdrawn for these purposes.

Response 60

Irrigation requires a water right, except for the situations allowed under the domestic use exemption. Therefore, it is reasonable to assume that landowners that are pumping and applying water for these authorized purposes have a water right. We did not identify land that was being irrigated that did not have a water right. Stock watering use was determined by estimating the total stock in the basin, not by the water rights. This method was discussed in advance and agreed to by the Planning Unit and Ecology as documented in our response to the Ecology comments on the Phase I Report.

Comment 61

4.3.1: It is stated that a total of 91 acres are irrigated with ground water irrigation rights, with 245 acre-feet being "used". This equates to 2.69 acre-feet per acre.

- The term "used" is not defined. Not clear whether this refers to consumptive use or total withdrawal.
- Based on Tables 4-15, 4-16 and 4-17, it would appear that the 245 acre-foot figure refers to total withdrawal. Adding up water use from these tables results in a total of 273.9 acres feet. The number referenced in 4.3.1 is 245 acre-feet. Why the discrepancy?

- Table 4.1 references ET from the Agrimet station at Lake Bryan at 2.62 acre-feet per acre. How then, with an efficiency factor of 75%, is the use figure of 2.69 acre-feet per acre arrived at (assuming the term "used" refers to total withdrawal
- A total withdrawal rate of 2.69 acre-feet per acre is extremely low. The Washington State Irrigation Guide would suggest a total irrigation requirement of approximately 3.57 acre-feet per acre for alfalfa/pasture in this area. A net irrigation requirement (consumptive use) would approximate the 2.6 acre-feet per acre.
- **It would appear that the annual water quantity use estimates for both agricultural and residential lawn irrigation in the project area are underestimated.**

Response 61

Responses to the individual comments are provided below. Please note that the assumptions use to develop the water budget (Agrimet data, lawn size, livestock, effective precipitation, irrigation efficiency, etc.) were already documented and agreed to by Ecology and the Planning Unit as part of Phase I of the project as documented in our response to Ecology comments on the Phase I Report.

First Bullet
The term "used" corresponds to the estimated pumping demand from agricultural use.

Second Bullet
Tables 4-15, 4-16 and 4-17 reference total agricultural water use (livestock and irrigation). The text cited in Section 4.3.1 of 245 acre-feet is only for irrigation water use. The total water use referenced in these tables is cited in the following section.

Third Bullet
The comment references a calculation of 2.69 computed total water use from 245 acre-feet used over 91 acres from Section 4.3.1 and compares to Table 4.1 that shows total ET of 2.62 ft. The calculation for total water use is based on crop ET (31 inches) minus effective precipitation (7 inches) with a remaining crop demand of 24 inches divided by field efficiency at 75 percent equals 32 inches or 2.7 ft (see Response to Comment 53 for data). This results in about 2.7 ft of consumptive use. Note that Table 4.1 shows the crop ET without effective precipitation.

Fourth Bullet
The Washington State Irrigation Guide (WSIG) suggests 32.1 inches or 2.67 ft per year for net pasture grass ET and this includes effective precipitation at Pomeroy. We did not use this source of data, because it was our understanding that Agrimet provided more realistic and current crop ET data. Agrimet data from the Lake Bryan-Rice Bar station was used. Agrimet data for the Lake Bryan-Rice Bar station shows 31.4 inches or 2.61 ft pasture grass ET without effective precipitation and accounting for effective precipitation at 7.3 inches results in 24.1 inches or 2.0 ft crop ET.

Fifth Bullet
The method used is appropriate. The following conservative assumptions were employed to avoid underestimate water use. Pasture and lawn ET is assumed to be at a constant rate for the entire project area, based on the crop ET rate for the lowest elevation location in the basin. In reality, lawns and pasture higher in the basin will use less water. The lawn size of 3,600 square feet is larger than the average lawn size of about 2,500 square feet. Livestock water use is assumed to be 100 percent consumptive use with year-round residence. A high irrigation efficiency of 75 percent was used. Return flow of only 15 percent of total water use was estimated.

Comment 62
4.3.2: The Water Use Survey results show 2,728 head of stock associated with 14% of the households in the project area (Table 2-2). In this section, an estimated total of 1,900 head of livestock were used as being representative of the entire project area. Why the discrepancy?

Response 62
The total count of stock in the basin was estimated by a field survey of individuals that were known to raise livestock. This was completed by Brad Johnson and Duane Bartels. The total estimated count of livestock was 1,900 head. The report has been revised to reflect this understanding.

Comment 63
4.3.2, 2nd pp, 3rd sentence – delete "conservatively" unless you can cite literature to the contrary

Response 63
The word "conservatively" has been removed from the text.

Comment 64
4.3.3: Was the possibility of lands having both surface and ground water rights considered?

Response 64
Only ground water use and rights were considered. Surface water use was not evaluated, as per the authorized scope of services for the project.

Comment 65
Page 4-8, Sections 4.4.1 and 4.4.2
I cannot tell if the assumption in this analysis is that all future use in the Anatone area will exclude outdoor water use. If that I the case there is a flaw in the logic. Even if there is no outdoor water use in Anatone currently, this very well may change during the next 50 years. This is import (sic) since consumptive use of the outdoor portion of water use is much (sic).

Response 65
The assumption is that future water use associated with future development will be similar to the current water use for the entire project study area. This assumption was agreed to by Ecology and the Planning Unit as part of Phase I of this study as documented in the various project memos and in our response to the Phase I comments.

Comment 66
Page 4-31 – Not really useful to include winter (snow on the ground) pictures of residences to depict water use???

Response 66
The pictures referenced show that many of the houses in the Anatone area are in forested areas with fir and pine trees. It is not possible to grow a lawn under these conditions. It also is relevant to show that this area is under snow for much of the year because Anatone is at a very high elevation compared to the lower portions of the basin. We did not take pictures during our other trips to the area in the summer.

Comment 67
5.3.1: The annual ground water withdrawals for both residential use and agricultural irrigation estimated in this section are calculated incorrectly, which resulted in underestimating the ground water withdrawn in the project area. Errors in these baseline estimates in turn impact the calculations which follow, such as estimates of future use, return flows, consumptive use, etc.

Response 67
We do not know what the comment is referring to specifically. Please refer to our responses above for specific details identified in Ecology's Chapter 4 comments. We believe that the water use analysis is appropriate and the assumptions are conservative. If Ecology is disagreeing with the fundamental assumptions in the water balance, please note that these assumptions were already agreed to between Ecology and the Planning Unit as part of Phase I of the project as documented in our response to Ecology's Phase I comments.

Comment 68
5.3.1 – Alpowa Creek gauging shows average summer/fall low flows approaching 1 cfs (2007). Current use approaches 0.5 cfs indicating that future growth in this basin should be carefully considered. Also the blanket statement ,"This information shows that water use is not a significant factor with regards the potential for stream flow depletion from water use for the projected 50-year growth scenario" is presumptive especially when several streams currently experience summer/fall low flows.

Response 68
The 80 percent (drier) monthly-average flow for Alpowa Creek is between 4 to 5 cfs. The estimated ground water use for the projected 50-year growth scenario for Alpowa Creek is about 0.5 cfs. This water use will be from many basalt aquifer wells located throughout the lower basin. We believe that the statement referenced in the comment is appropriate.