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Memo

To:	Brad Johnson, Asotin PUD		
From:	John Koreny and Ben Floyd, HDR Kevin Lindsay, GSI	Project:	Asotin Creek and Alpowa Creek Hydrogeology Evaluation
CC:	Tim Simpson, Asotin PUD Mimi Wainwright, Ecology		
Date:	August 11, 2008	Job No:	79143

RE: Response to Ecology Comments on Phase I Hydrogeology Report

This memo summarizes and provides a response to the comments received from Ecology dated August 8, 2008 on the Asotin Creek and Alpowa Creek Phase I Hydrogeology Report dated June 28, 2008. We also note where revisions will be made to the final report in response to comments. Thank you for the opportunity to review and respond to comments and to improve the report.

Comments from Mr. Dave Nazy, Ecology

Comment 1a

I question several of the assumptions in the Phase 1 report and don't agree that the available data "shows that the DBHU is present well below the bottom of the canyon bottoms ***and is not in hydraulic connection to mainstem and tributary creeks****" (see page 3-9 of the Phase 1 report). The available "data" they seem to be referring to is their statement that the "flow interiors are relatively impermeable" (see page 2-9). I don't think their opinion constitutes data. Clearly the interflow zones are the most permeable and horizontal hydraulic conductivity in these zones likely far exceeds vertical hydraulic conductivities through the flow interiors. However, John Covert has looked at ground water elevations in deep basalt wells and has found that groundwater elevations in these wells are higher than adjacent creeks. Thus, there is an upward hydraulic gradient from the basalt toward the creeks.*

Response 1a

We agree that there is considerable uncertainty regarding the data and analysis regarding hydrologic connections with the deep basalt aquifer. Some of the uncertainty is acknowledged in the report on page 2-12 and 2-13 by using the words, "*likely*" and "*probably*" when describing the degree of hydrologic connection. We will add additional sentences in the report to emphasize uncertainty.

We are not confident that the existing data is sufficient to determine whether the hydraulic gradient between the deep aquifers and creeks have a positive (upward) gradient or negative (downward) gradient. We understand that the only information currently available is from regional topographic maps and well logs, so the vertical resolution on ground water level data is not very precise, especially if well locations are only approximately known (which is the case for almost all wells). For this reason, the report makes no conclusion on vertical gradients between creeks and the deep aquifer. Instead, the report presents information on the structural location of the formation, which seems to be below the creek beds, and our understanding regarding the vertical hydraulic conductivity of the deep basalt to infer that the creek is not likely to be hydrologically connected and the discharge zone is downgradient. Collection of ground water levels and measurement of the elevation at wells, if possible, along with measurement of seepage into the stream during a seepage run measurement will help to better understand the degree of connection. These tasks are proposed for Phase II.

A finding of ground water levels in a deep aquifer near the surface only means that the aquifer is confined and does not necessarily indicate that ground water is flowing to the surface. Ground water will flow to surface water if there is a upward hydraulic gradient (above the creek stage) and if there is a flow pathway (either the aquifer intersects the creek or there are fractures that allow water to move up to the creek). If there is no flow pathway, confined aquifers often do not discharge to surface water in the immediate location where their ground water pressure head rises near or above the ground surface and they may discharge to downgradient discharge zones. This is a well known and established scientific principle in the field of hydrogeology as documented in the standard hydrogeology texts (see Todd, 1980, pg. 42, Fig. 2-11, Driscoll, 1986, pg. 64-65, US Bureau of Reclamation, 2005, pgs. 127-136 and Domenico and Schwartz, 1980, pg. 47-48, 78-81).

We acknowledge that there is a large degree of uncertainty in the available data for this project, and that is why we have proposed additional Phase II data collection to perform a seepage run to determine where ground water is flowing into the creeks. We will revise the report to acknowledge the lack of data and uncertainty in this regard.

Comment 1b
These deeper units have very little surface exposure where HDR claims all the recharge to these deeper units is occurring. How does all this water get in but have no connection to the surface when these units have very little surface exposure? They need a better explanation and actual data would probably help.

Response 1b
Recharge likely occurs to the deep basalt in upland areas where the basalt is closest to or outcrops at the surface and the precipitation is highest. Part of this area is within the basin boundaries and part of it is outside of the basin boundaries. Within the project area, the deep basalt receives recharge from leakance through the upper units. The precipitation in these areas is higher than in the lower portions of the basin. Springs emanating from the upper units at locations where the units are dissected by canyons provide support for this conceptual model. We agree that some leakance also may be occurring lower in the basin through fractures or other basalt discontinuities. This is a fairly common understanding regarding recharge and discharge of regional basalt systems with exposures in upland plateaus that down dip into regional basins. We will clarify that downward vertical migration in the DBHU is also a source of recharge lower in the basin. We acknowledge that there is uncertainty in this conclusion and will modify the report to reflect the uncertainty.

Comment 1c
Also, what affect do all the uncased wells have that intersect the multiple basalt flows?

Response 1c
There are a total of about ~370 houses over the ~400 square mile study area. Table 2-1 of the report shows 60 percent of all wells are only completed in the upper-most basalt aquifer (SBHU). Very few wells penetrate the deeper aquifers and only five percent penetrate the IBHU and DBHU. So only a small percentage of the total wells could potentially penetrate multiple units. When drilling a domestic well, the well driller usually completes the well at the upper unit that produces a yield capable of supporting 5 to 10 gpm. Therefore, it is likely that the wells that penetrate deeper units are in areas where the upper units produce limited yields are not present. The facts above would tend to indicate that uncased wells are not a significant factor, but we acknowledge that they may provide some vertical leakance to the deep aquifer.

Comment 1d
It would also be helpful to know what drill cutting chemistry data they have that was used to describe the basalt stratigraphy. We need to see what actual data they have to support their assumptions.

Response 1d
No drill cuttings are available to our knowledge, as drill cuttings are not generally compiled and recorded by well drillers for domestic well installations. Acquiring drill cuttings is not part of the scope of Phase I.

Comment 2
Much of Chapter 3 is based on assumptions and again very little actual data. Yet this information is presented as fact.

Response to Comment 2
The water use analysis used standard methods that are well-accepted in the water resources planning industry. The assumptions and analysis methods are fully disclosed and were provided to Ecology in advance to obtain approval. The Phase I proposal described our methods and was reviewed and approved prior to initiating the work. We consulted with Ecology staff Mr. Bill Neve and Ms. Mimi Wainwright on the methods. HDR prepared four draft memos documenting various phases of the water use analysis (dated April 7, April 8, May 12, and June 12, 2008). Comments were received in an undated memo from Ecology in mid-April on the domestic use rates memos. We appreciated the input and an agreement was reached with Asotin PUD and Ecology during several telephone conversations on the approach that would be used to modify the method. We documented this revised approach in a memo back on April 22, 2008. Telephone conversations were conducted to consult on the agriculture and public supply water use survey methods described in the May 12 and June 12, 2008 memos. We also presented water use inventory methods and results to Ecology and the Planning Unit at the WRIA 35 meetings in May and July, 2008. In these meetings we were informed by Ms. Wainwright that consultation on the water use inventory methods was complete and Ecology would not be filing comments on the water use analysis. At that time, we understood that the analysis was acceptable.

Given the extensive consultation that has been conducted to date, we will not be able to revise the methods and results used for the water budget calculation since this work has already been completed. We stand by our work and believe it is appropriate and conforms with standard practices. We will revise the text to clear up the areas of confusion noted below. There is an opportunity for further revision within Phase II, if Ecology and the WRIA 35 Planning Unit desire, within the constraints of scope and budget.

Comment 2a
I do not believe that there is no outdoor water use in Anatone (yes I have been there). If this assumption is built into any future regulatory scheme, outdoor water use should be prohibited in this area.

Response to 2a
We completed a field tour and evaluated whether houses had irrigated lawns in the Anatone area. For almost all houses examined, the residences do not have watered lawns. Most houses are cabins that are visited infrequently during weekends and vacations. They are in pine woods on rocky soil with pine needles or forest under story on the ground. Snow is present during most years until early summer. Houses did not seem to have outdoor watering equipment. Residents interviewed in the area confirmed that lawn watering is not a standard practice. Based on this information, we concluded that lawn watering is likely not a significant factor. Given that the total water use for the entire basin is under 0.5 cfs, we don't think not including lawn watering in the houses in and around the Town of Anatone will make a difference in the results. If other data should be considered, please forward it to us for Phase II.

We don't understand the meaning of the comment regarding a future regulatory scheme as a comment for this report, since our study and the report is only a technical evaluation of water use. We agree that recognition of future irrigation water use in this area should be accounted for as part of instream flow rulemaking.

Comment 2b

I*n other places, the circular logic used is completely unsupported and erroneous. For example on page 3-9 it states "The alluvial aquifer present in the very shallow deposits along the creek canyon bottoms is not used for a ground water supply because the aquifer is too thin to support a reliable ground water supply and because of the potential for seasonal fluctuations that may cause pump dewatering problems if the ground water level drops below the pump intake.* ***Therefore, we can conclude that ground water use in the alluvial aquifer is not affecting streamflow in the project area".*** *Contrary to their conclusion, whether or not someone is actually using the alluvial aquifer has nothing to do with the impacts that would result from withdrawing water from it. Clearly, any use of the alluvial aquifer would have an almost immediate impact to adjacent streamflow.*

Response to 2b

This section of the report refers to the well log survey that shows that there are no well logs completed in the shallow alluvial aquifers, therefore, there is no ground water use (see Table 2-1). We are presenting a hypothesis on why the alluvial aquifer was not used as a water supply in the text cited above. We acknowledge that this paragraph is probably confusing and will edit it so it references Table 2-1 and is more clear.

Comment 3

The recommendations in Chapter 4 and generally described in the proposed Phase 2 scope of work are not likely to provide much, if any, useful information and I question the value pursuing this work.

Response to 3

Ecology has already reviewed and accepted the scope of work for Phase II and we are under contract and have begun work. Phase II is designed to provide much of the data that seems to be recommended in Comment 1.

Comment 3a

For example, on page 4-1 they state "(low-flow stream flow gaging) should be conducted during the late summer or fall when stream flow is low and does not fluctuate appreciably. These types of flow conditions are most-advantageous to determine the percentage of ground water inflow to the creeks." I don't agree that measuring flow a few times at a few locations during low flow conditions is most advantageous to determine the percentage of groundwater flow to the creeks. Analysis of long-tern discharge data as well as characterizing groundwater elevations and flow directions would be much more useful. If it hasn't rained in 3-4 months and there is 15 cfs in the creek, how will measuring the creek a few times tell them what percentage of the creek is made up of groundwater discharge? By the way, if it is not groundwater discharge, where is the water coming from?

Response to 3a

A seepage run measurement performed at discrete reaches will provide information on the amount of ground water entering respective stream reaches. Completing this task from the headwater down to the lower reach will enables a determination of how much ground water is entering each successive downstream reach. This information is necessary to attempt to increase our understanding on the degree of interconnecting between the aquifers and the creeks in the middle and lower reaches of the watershed. This is a standard method used on many recent regional ground water investigations sponsored by Ecology (Chehalis Basin, Skagit River, Spokane River Basin, etc.). There are only several gages present with long-term records, and they can not be used to separate out the amount of ground water flowing into the upper reaches. We recommended collecting and analyzing additional long-term flow gaging data and Ecology requested that this task be removed from the Phase II scope.

Comment 3b
For some analysis of baseflow conditions on Asotin Creek please see:
http://www.ecy.wa.gov/biblio/99327.html The methods used in this report indicate that over 95% of streamflow is made up of baseflow in Asotin Creek during low flow conditions.

Response to 3b
This is useful information but the data does not provide information on how much ground water flows into which reach. The seepage run analysis will provide information on the amount of ground water that may be flowing into the lower reach.

Comment 3c
In addition, how are they going to account for the diurnal fluctuations in streamflow (that vary in time and location along the creek) and factor that into their seepage run analysis?

Response to 3c
There should not be a diurnal flow fluctuation in late September to early October when the seepage run will be conducted because the snowpack is melted out by this time. We will monitor the existing continuous flow gage in each basin to evaluate whether diurnal shifts are occurring and make corrections if needed. We will conduct the seepage run in discrete reaches and monitor continuous flow gages to avoid flow shifts that could cause error in the analysis. Please note that we recommended installation of additional continuous flow gages in an effort to enable these kinds of detailed flow evaluations and Ecology requested that continuous flow gaging and analysis be removed from the Phase II scope.

Comments from Mr. John Covert, Ecology

Comment 4
Page 1-1
Report says DBHU probably has limited hydrologic connection with Asotin and Alpowa Creeks.

Wells located along the Asotin Creek valley floor are identified (in the Appendix A) as being completed within the N2 R2, R2 N1, and N1 basalt units and have shallow, high heads (typically less than 100 ft bgs) and significantly above the confluence with the Snake R. Either these wells are miss-identified (lithologically) or some percentage of the flow in the DBHU is hydraulically connected to the watershed. There are no well logs cited in Appendix A that suggest the DBHU within the Asotin drainage has heads dramatically below the floor of the watershed. Deep municipal wells in the Clarkston area do have heads that reflect a Snake River connection. Those wells are located adjacent to the Snake River and outside of the tributary's drainage.

Response to Comment 4
Please see response to Comment 1a.

Comment 5
Page 2-9
Report says recharge to CRBG aquifers likely occurs where individual flows crop out at or are very near the surface.

Vertical leakage from the overlying to underlying basalt units can not be ruled out as a source of recharge to the lower units. The DBHU in particular is only exposed in very limited area within the watershed yet it is inferred that it is saturated throughout its extent within the watershed. Certainly Kh > Kv, but over a large area like a watershed, Ql can add up.

Response to Comment 5
The report has recognized that vertical leakance may occur. See the second paragraph on page 2-12. We will add more discussion on this. The DBHU is quite widespread at and near the surface adjacent to the two watersheds, seems likely that much of the water in it is coming from outside the basin. We will clarify this.

Comment 6
Page 2-10
Report says folds, faults and dikes are inferred to form local barriers to groundwater flow.

No evidence is offered to back up this notion. These features could just as easily be conduits for groundwater flow. Without detailed studies, this is pure conjecture.

Response to Comment 6
We agree that either could be the case, depending on the situation, and this is stated on page 2-12, 2nd paragraph. We will modify page 2-10 to reflect this understanding.

Comment 7
Page 2-29, Figure 2-15
How were the locations of the feeder dikes displayed on the cross-section determined? How were hydrostratigraphic unit thicknesses determined?

Chapter 2 offers no discussion of how the various lithologic units were identified in the well logs. Wells are attributed to being open to various units in Appendix A but there is no mention of geochemical sampling or other diagnostic tests being performed to support the work cited in Appendix A. Regional DNR mapping used to develop Figures 2-11 and 2-13 provide little subsurface control.

Individual tables in Appendix A need to be labeled to facilitate use.

Response to Comment 7
Locations of feeder dikes were determined from field trips and geologic structure maps and inference using professional judgment. The unit thicknesses were determined from field trips, outcrops, geologic maps, well logs as available and regional correlation to unit thicknesses in the same nearby formation. The methods are explained on pages 2-1 to 2-3. We will clarify this method further. Professional judgment was used to differentiate the flow units based on observations during the field trip and prior experience with the CRBG units. Geochemical sampling or other diagnostic tests are not possible as well cuttings are not available and such work is outside of our scope of services. A more-detailed topographic map was used to develop Figures 2-11 to 2-13, the topographic base is not shown here to make the figure readable. We will label the tables in Appendix A.

References

Domenico P.A., and F.W. Schwartz, 1980. Physical and Chemical Hydrogeolgy, Wiley & Sons, New York.

Driscoll, F., 1986. Ground Water and Wells. Johnson Well Screen Co., Minneapolis, MN.

Todd, D.K., 1980. Ground Water Hydrology. Wiley & Sons, New York.

U.S. Bureau of Reclamation, 2005. Ground Water Manual, University of the Pacific Press, Honolulu, HI.