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July 29, 2004

Mr. Karl Dreher, Director  
Idaho Department of Water Resources  
1301 Orchard Street, Suite 200,  
Boise, ID 83340

Re: Response to B. Higgs comments on Big Lost River report

Dear Director Dreher:

Per your request, this letter provides the analysis of Drs. Gary Johnson and Dale Ralston of the Idaho Water Resources Research Institute (IWRRRI) of the letter and comments prepared by Brian Higgs based on his review of an IWRRRI report that deals with surface water impacts due to ground water pumping in the Big Lost River Valley. Dr. Roy Mink was an author of the subject report but did not participate in this analysis as he is presently working for the U.S. Department of Energy in Washington D.C. The report citation is:

Johnson, G., Ralston, D. and Mink, L., 1991, Ground-Water Pumping Impacts on Surface Water Irrigation Diversions From Big Lost River. Idaho Water Resources Research Institute, Moscow, Idaho, 54p.

As part of our analysis, we reviewed the following documents: 1) the subject report, 2) a letter from Brian Higgs to Karl Dreher dated July 19, 2004 along with the attached technical review comments and 3) the July 12, 2004 IDWR order relative to the delivery of water to several senior water-right holders in the Big Lost Valley. Our analysis is based in part on experience gained in studying ground water/surface water within the Big Lost Valley and other basins within Idaho since the 1960's (Dr. Ralston) and 1970's (Dr. Johnson).

#### Summary of the Report and Use of the Report by IDWR

The stated objectives of the subject report (p. 3) are as follows.

**General Objective:** to assess the impact of ground-water pumping on surface-water flows and to evaluate the alternatives for resolution of the conflict

#### **Specific Objectives:**

- To develop an understanding of the operation of the irrigation system in the Big Lost River Valley, and the historic changes that have occurred in that system
- To collect, assemble, and summarize the available and pertinent information on the water supply and irrigation diversions in the valley
- To relate changes in available water to changes in irrigation practices in the valley, especially the expansion of ground-water pumping

- As far as possible, to quantify the impact of ground-water pumping on surface water supply, and describe the limitations and assumptions associated with that determination, and
- To recommend a procedure or procedures for compensating surface water users for flows lost as a result of ground-water pumping.

The conclusions of the subject report (published in 1991) are as follows (pages 52-53).

- Flow of the Big Lost River is affected by weather and by long-term changes in the amount of consumptive water use in the valley.
- The consumptive water use has increased substantially in the last few decades due to an extension to full season irrigation and an expansion of the irrigated acreage.
- Ground-water pumping is largely used to supplement surface-water diversions, and ground-water pumping increases in years of low surface water supply.
- Ground-water pumping is largely used to supplement surface-water diversions, and ground-water pumping increases in years of low surface water supply.
- Ground-water recharge from surface water irrigation has diminished due to application over larger acreage and conversion to more efficient sprinkler application methods.
- Diminished recharge from surface water irrigation and increased ground-water withdrawals, together have caused a reduction in flow of the Big Lost River and consequently have depleted the supplies of surface water irrigators.
- Diversion records indicate that surface water diversions for irrigation have decreased in recent years. The magnitude of the depletion varies with the water year.
- The reliability of the diversion records, and consequently of the depletion estimates, is uncertain. Diversion depletion estimation procedures of this report, however, are probably the best available. With the available information it was not possible to proportion the amount of diversion depletion into components resulting from ground-water pumping and that caused by expansion of surface-water irrigated acreage.
- The impact attributable to ground-water pumping or expansion of surface water irrigated area varies with the year and proportion of the total irrigation water derived from pumping. Pumping is reduced in years of plentiful surface water supply; however, the recharge from surface water is probably diminished in those years (relative to pre-1960), due to application over larger cropped areas.

The recommendations of the subject report (published in 1991) are as follows (page 53).

- A cohesive organization of all water users in the basin could greatly contribute to development of water management strategies, and improve the effectiveness of implementation of the selected strategies.
- Relationships developed in this report provide a method that may be used for determining the magnitude of mitigation to damaged surface water users.
- Further investigation into changes in the irrigation practices and areas of the basin should be initiated. This research would help refine estimates of depletion and would further the understanding of the individual impacts of ground-water pumping and expansion of areas irrigated with surface water.
- Irrigation pumpage and diversions should be closely monitored in future years to refine the understanding of pumping impacts on diversions.

The IDWR cited the subject report on page 2 of the July 12, 2004 order relative to the Big Lost River Valley. This portion of the order describes the results of the stream depletion analysis based on the regression equation. "The estimated depletion to the Big Lost River determined using the regression equation was 13,000 acre-feet of surface water, or approximately 28 percent of the estimated annual volume of ground water diverted... The report did not specifically quantify the portion of the depletion caused solely by ground water diversions." Later on page 2, is the following statement. "The Department quantified the portion of the depletion caused solely by ground water diversions to be 13 percent of the volume of ground water diverted during an average year."

#### Analysis of the Higgs Comments

In his July 19, 2004 letter, Brian Higgs states the following.

"The conclusion of my review is that the methodology employed by the IWRI was not adequate to determine the impacts of groundwater pumping on the flow in the Big Lost River. It is impossible to discover that hypothesis without groundwater elevations, water table maps, flow nets, seepage runs, pumping tests to determine aquifer characteristics, and a myriad of other available data collection and analysis. None of which is even referenced in the report."

Hydrologic analysis within the subject report is based on review and analysis of Big Lost River stream flow (three locations) plus surface water and ground water irrigation diversion records (mass-balance approach). Analysis of these data over an extended period of time allowed quantification of the combined impacts of ground water pumping and changed surface water irrigation practices. We believe that this approach is the most efficient and effective method to detect temporal variations in relationships among these factors on a basin-wide basis. Collection and analysis of the list of information

provided by Brian Higgs may be useful in quantifying impacts from an individual ground water user on an individual surface water user but would not effectively address the stated objectives. These data (identified by Higgs) could be combined into a computer model that represents the combined surface water - ground water system. However, we believe that a numerical modeling approach could not have been performed within time and funding constraints, and that the confidence in results may not be improved relative to the approach used in the subject report.

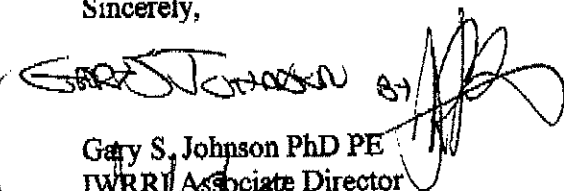
Our responses to Mr. Higgs' specific comments are presented below. We have referenced his comments to the subject report in the same manner as Mr. Higgs.

- Page 1
  - 1<sup>st</sup> paragraph, 2<sup>nd</sup> sentence -- Editorial comment not related to the issue
  - 2<sup>nd</sup> paragraph, 1<sup>st</sup> sentence -- Editorial comment not related to the issue
  - Items #2 and #3 -- Editorial comment not related to the issue
- Page 2
  - Item #4 -- We agree that irrigation is small compared to the total volume of water in the basin. Crosthwaite and others (1970) estimated the average annual water yield to be 470,000 acre-feet with about 109,000 acre-feet of evapotranspiration. However, this has little relevance to the issue of the effects of ground water pumping on surface water flows.
- Page 3
  - 1<sup>st</sup> sentence and Item #5 -- A simple water balance indicates that consumptive withdrawal of ground water within the portion of the Big Lost Valley must lower ground water levels and thus impact the river. It is an accepted hydrologic fact that ground water pumping affects stream flow in areas where streams are hydrologically connected with the aquifer. "No impact" development of ground water is impossible. Mr. Higgs' comment that there is not "any information concerning a water budget" in the report is simply incorrect.
- Page 4
  - 1<sup>st</sup> paragraph -- This comment is an additional discussion of the alternative to using a mass-balance approach for meeting the objectives of the subject report. We believe that the approach used in the subject report was, and is still, the best way to address the problem within the data, funding, and time constraints. Although the data identified by Mr. Higgs are useful in better understanding the basin hydrology, they do not directly address the primary objective of the report.

- Item #8 – We stand by our comment that the diversion depletion estimates presented in the subject report are the best available. Mr. Higgs did not identify a source of better estimates.
- Page 53 (noted as page 6)
  - Item #9 – The text in item #9 does not refer to precipitation and Figure 6 does not include pumping.
- Conclusions section
  - Paragraph 1 – Editorial comment.
  - Paragraph 2 – Editorial comment.
  - Paragraph 3 – The plot referenced in this paragraph is not available for our review. However, the IDWR has plotted river and ground water profiles for multiple periods showing interconnection of the river and aquifer at some locations. The locations of hydraulic connection between the river and aquifer do change with time, with more separation in dry periods.

We conclude that none of the comments provided by Brian Higgs bring the conclusions of the subject report in serious question. We still believe that the material provided in the report provides a very useful support for conjunctive management of surface and ground water in the Big Lost River Valley. Please contact either of us if you have any questions. Thank you.

Sincerely,



Gary S. Johnson PhD PE  
IWRRRI Associate Director



Dale R. Ralston PhD PE PG  
IWRRRI Acting Director