MEMORANDUM

To: ESHMC
Fr: B. Contor
Date: 22 February 2007

Re: Current Practices Scenario

This memo outlines IWRRI's proposed approach for the "Current Practices Scenario." This scenario was discussed in ESHMC meetings in September 2006 and January 2007. This proposal is outlined with careful consideration of the discussions in those meetings. It is expected, however, that there may not be consensus on all aspects of the proposal.

Comment [jk1]: We understand and concur.

1) The title of the scenario will be the "Current Practices Scenario." Its purpose will be to estimate what would be the effect on spring discharges and river gains and losses and ground water levels, if current practices and average hydrologic conditions were to prevail into the future.

Comment [jk2]: It is important to learn what will happen with ground water levels in the future. There are many stakeholders with wells that may need to be deepened if ground water levels continue to fall. This information is important to those water users and from a management standpoint.

~~It is acknowledged that current practices may not prevail into the future, and that past average hydrologic conditions may also not prevail. In this sense, the scenario may be unrealistic. However, this formulation of the scenario does offer the opportunity to consider the *implications* of current practices and allocations. Any combination of recharge and extraction would eventually result in the aquifer reaching an equilibrium water level, with corresponding equilibrium spring discharges and river interactions. This scenario offers the opportunity to consider whether the equilibrium level implied by current practices and allocations is an acceptable equilibrium, and how different this equilibrium is from current conditions. In this sense, the scenario may be useful.~~

Comment [jk3]: This paragraph is confusing and is not valid for all cases. Suggest deleting it.

Other scenarios will be completed to evaluate the effects of continuing trends in irrigation practices.

Comment [jk4]: I think we discussed and agreed to this.

2) The scenario will be based on the current conceptual model and water-budget calculation methods of ESPAM 1.1.

3) The scenario will be constructed to represent both an end point and the expected trajectory from the current condition to the end point (for each of 11 reaches). This means that the model runs will be transient runs and that the presentation of results will include representation of the expected timing of changes.

Comment [jk5]: Define these terms

4) The first twenty-two years of the model run will use the aquifer recharge estimates developed from ESPAM.EXE for the transient model calibration dataset from 1980 to 2002. Starting heads for the scenario simulation will be ~~derived from a preliminary model run~~the same as the starting heads used for the model calibration dataset. ~~The preliminary run will use the ending heads from model calibration (1 May 2002) and the synthetic extended data set discussed in the January 2007 ESHMC meeting, as described on page 5 of the memo "Summary_CurrentPracDiscussion_ESHMC_20070129.doc." This data set uses actual diversion and precipitation data where possible, and extracts data from the model calibration data set for other components of the~~

Comment [jk6]: Is this what is being proposed?

Comment [jk7]: Why not just use the same starting heads as the transient calibration run?

~~water budget.~~

5) The next four years (2003 to 2006) will use a synthetically-generated recharge dataset based on similar equivalent year data or actual data- as available. The modeled heads and river reach gains from the end of this preliminary run will be compared with observed heads from the most recent available data. If heads and river reach gains generally agree, the modeled heads will be accepted as starting heads for the scenario model runs. If there is gross discrepancy with observed heads, the preliminary run will be examined for blunders or faulty assumptions. The standard for whether heads and river reach gains "generally agree" will be the statistics of observed and modeled heads from the preliminary run, as compared to statistics of observed vs. modeled heads from model calibration.

Comment [jk8]: Is this what is being proposed?

Comment [jk9]: Need to examine reach gains in addition to gw heads. The reach gains tell you as much about how than the model is responding as the heads. It is important that the reach gain examination include a modification so that the sum of reach gains from Blackfoot to Milner be examined, since Minidoka to Milner has transitioned to a strongly-losing reach.

No further attempt will be made to adjust model inputs to match heads and river reach gains, for two reasons:

a) It was suggested in the January ESHMC meeting that head and river reach gain differences may be caused by imprecision in both the synthetic data and the model parameters, and that it may not be good practice to only adjust the data.

b) Even if starting heads are absolutely correct, the scenario at best can give only a qualitative sense of the trajectory because the scenario will not

incorporate the unknown future conditions that will dominate what actually occurs. Therefore, there is little justification to expend significant time and resources in refining starting heads

6) The following years (after 2006) will be based on the 1992 to 2006 years- using an index from historical natural flow data. This method is described below.

Comment [jk10]: Is this what is being proposed?

7) The candidate pool for generating the scenario input data will be model calibration data from model years 1992 through ~~2001~~ 2006 ~~(May 1992 through April 2002)~~. No adjustments will be made to data ~~and no synthetic data will be included in the candidate pool.~~

Comment [jk11]: We also need to use the 2002 to 2006 data for the scenario input data. If we don't then we are missing the most important years that tell us the most about how the system responds during dry periods. If we synthetically generate these years- and compare them to the observed head and reach gain data, then there should be no problem in using the 2002 to 2006 years in the future. This is very important. If it is necessary to wait to update and recalibrate the model to 2007 data to run this scenario using data to 2007- then I think we should wait. **There is little point to revising the Base Case Scenario without including 2002 to 2006 data in the revision.**

It was suggested in the January 2007 meeting that damage to infrastructure was repaired quickly in 1997, and that much of the reduced diversions that year were actually due to reduced demand from wet weather rather than infrastructure damage. Based on this discussion, 1997's diversions and water use are accepted as representative of the actual hydrologic condition and therefore included in the candidate pool.

Comment [jk12]: Agree

Years earlier than 1992 are excluded because earlier years are expected to be less representative of current practices. The selection of 1992 as a cut-off date is based on the September 2006 ESHMC discussion, where it was

suggested that much of the conversion to sprinklers that has occurred on the plain appears to have been completed prior to 1992.

Comment [jk13]: Agree. The years prior to 1992 could be used if the irrigation efficiency parameter in ESPAM.EXE was adjusted- but the method suggested here is fine.

8) Two indices will be used to guide selection of years from the candidate pool. It appears that two major factors drive the water budget; natural hydrologic conditions, and reservoir storage (with its impact on irrigator behavior and diversion decisions). An irrigation-season index comprising April – October natural flow at Heise will be used as a proxy for natural hydrologic conditions. A wintertime index (November – March natural flow at Heise) will be used as a proxy for available storage.

Comment [jk14]: We have developed a more-robust indicator of natural inflow to the Upper Snake that includes natural flow at Heise, natural flow at Henry's Fork, Portneuf and Blackfoot inflow. I will forward to Bryce via Rick in case you want to use it.

Comment [jk15]: What period of record will you use for these indices. I assume you are generating a long-term record and will use the entire sequence- is this right?

Comment [jk16]: Do you have monthly storage data for all of the reservoirs?

Wintertime natural flow at Heise is proposed instead of more direct indices for storage because natural flow at Heise will be unaffected by administrative or water-use changes that may have affected the storage and carryover conditions that would be associated with a given natural hydrologic condition. These administrative and water-use changes include changes in rental pool rules and operations, the use of the rental pool for flow augmentation, and any changes in water use that may be associated with operation of new hydropower facilities.

Comment [jk17]: Would it be better to use the beginning of season storage data? The multiple-year reservoir operations effects may not be captured in the winter Heise flow data. You can factor out rental pool leases if you want- but they are not a large component of carryover- especially during dry years. The winter natural flow at Heise metric includes the effect of rental pool and reservoir operations anyway if you are naturalizing for storage effects.

To use the two indices, each year from the candidate pool will be assigned a value for each index. A given model year will use the corresponding irrigation-season index and the preceding wintertime index (model year 1992

will use the irrigation season index from April 1992 – October 1992 and the wintertime index from November 1991 – March 1992).

9) From the candidate pool, a number of groups of model years will be assembled according to the following criteria:

   a) Each group will have an average value of each index as close as possible to 1.0.

   b) Where possible, years will be selected in consecutive blocks.

   c) Years later in the candidate pool will be selected preferentially, to best incorporate the most recent practices and technology.

   d) Where duplicate years must be added to a group (or selected years must be omitted) to balance the indices, an effort will be made to not over-represent extremely wet or extremely dry years.

   e) An effort will be made to not over-represent any one year (the series "w,x,y,z" would be preferred to the series "x,x,x,z" even if they had the same average for both indices).

   a) By the time of the March 2007 ESHMC meeting, IWRRI will attempt to have constructed a number of possible groups of years by the above criteria.

9) From the groups of candidate years, the three groups with the best combination of both indices will be selected. It is unclear which index might be more useful in identifying an "average" condition; consequently, an effort

Comment [jk18]: I understood the method up to this point. After this point-I am confused and can not follow the logic. What groups are you referring to? How do you plan to use the 1992 to 2006 data and the natural Heise inflow record?

Comment [jk19]: What does this mean?

Comment [jk20]: I don't understand this.

Comment [jk21]: Why would any balancing be necessary?

Comment [jk22]: What does "over-represented" mean?

Comment [jk23]: I don't understand

will be made to satisfy both and to compromise neither; having both indices near one would be preferred over having one index almost exactly one and the other significantly different from one. Similarly, to avoid a bias, a group where one index was a little high and one was a little low would be preferred to a group where both indices were high or both were low.

10) From each of the three "best" groups as described above, an "average" year will be constructed by calculating the mean of the well term for all the years in the group. These three average years will be considered to be equally valid; each will be considered a different attempt to represent the average stress associated with the hypothetical continuation of continued practices and average hydrologic conditions into the future.

Three transient model simulations will be made, using each of the three average years. For each, the single average stress will be applied every year, repeated out into the future. This corresponds to what has been previously referred to as the "single trace" method, though another name such as the "time-constant recharge" or "smooth curve" method may be more accurate.

11) Two types of variability or uncertainty will be reported under this method. The first will be the uncertainty associated with different best attempts to create a data set corresponding to "average" conditions; it will be the range in final

Comment [jk24]: This is confusing to me. Isn't the method as follows:
1) Compile the aquifer recharge computed for the thirty stress periods for the 92 to 2006 period. This is the base data that will be used to create a synthetic record.
2) Compile the natural hydrologic flow (i.e. Heise flow) from the early 1900s to 2006. Compute a two-year or three-year average (or whatever you want to use for serial correlation factors). Assign a frequency distribution for each year from early 1900s to 2006.
3) Perform the same procedure on the 92 to 2006 base data. Rank it and determine a frequency distribution.
4) Create a synthetic data set by assigning the closest frequency from the 92 to 2006 base data set to the frequency distribution to the 1900s to 2006 natural hydrologic index dataset.
5) Done.

Comment [jk25]: I don't understand- I thought we were going to run a time series of varying aquifer stresses based on historical indexing. How will you get the effects from wet and dry years using this method?

Comment [jk26]: I don't understand

Comment [jk27]: Variability and uncertainty are two different things. Which do you mean?

values for the three runs, for each reach. The second will be a report of the historical variability that has been observed in the reach gains and spring discharges themselves, for each reach.

12) The "time-constant recharge" method is proposed over the "multiple traces" method for the following reasons:

a) It helps bound the uncertainty associated with the selection of input data.

b) It avoids issues associated with human and hydrologic autocorrelation.

c) It avoids the issues associated with the fact that the candidate pool cannot contain the full variability that would be expected of the future time series.

d) The historical data tend to indicate changing patterns of variability. Including these in the scenario report will remind the reader of the possibility that hydrologic variability is changing, which synthetic results would not be able to indicate.

Comment [jk28]: That is not uncertainty. Uncertainty would be the range in the input parameters that create the original recharge distribution.

Comment [jk29]: What does this mean?

Comment [jk30]: Why would we want to do this? How is the variability in measured flow correlated with uncertainty in the model results. These two seem unrelated to me. Additionally, the variability in the spring flow and reach gains are biased by the declining trends in the data and the seasonality of the data. Variability usually refers to the variation around a mean. It is not appropriate for a time series of flow where there is a declining trend. In the case of the reach gains and spring flows- there is much less variability when considering a declining trend than if you calculated the variability around the mean. Are you going to look at seasonal variability- six month variability- annual variability? If we are aggregating data into 6-month blocks- then the variability is partially an artifact of the data aggradation.

Comment [jk31]: I am not sure I understand the method- so it is difficult for me to comment on these conclusions. I will try to comment below based on my best understanding so far. Please excuse me if I make a mistake.

Comment [jk32]: I don't understand this. The method seems to call for averaging of input data. If that is correct- then the data will have the same uncertainty- whether averaged or not averaged.

Comment [jk33]: Same comment- isn't any potential error still in the original data?

Comment [jk34]: This does not seem correct. You have 11 years of original data from '92 to '02 and 15 years from '92 to '06. This method does not change that fact and does not add more base years.

Comment [jk35]: I don't understand this.