ATTACHMENT 3

M E M O R A N D U M

To: EARIP Steering Committee Members and Stakeholders

From: Robert L. Gulley
Program Manager

Date: June 7, 2010

Subject: Summary for Discussion Related to Agenda Item No. 4 - June 14-15, 2010 EARIP Meeting Agenda

At the June 14 and 15 meeting, the EARIP will have to address two significant issues related to getting water to the species during a drought of record. The first issue, how the EARIP should determine how much water will need to be in storage to supplement springflow during severe drought, was discussed under Agenda Item No. 3 of this agenda. The second issue involves the specific engineering options for actually storing the water to be used for supplementation and how to get that water to the springs during drought. Specifically, the EARIP needs to decide on June 14 and 15 which "programs" the EARIP should ask HDR to conduct further analysis on.

This summary provides detailed background on the programs, offers some suggestions, and sets up some "straw men" programs for discussion. This material is provided solely for facilitating and focusing the discussion, and **NOT** to advocate any particular position or to reject any position. However, it is essential that the EARIP comes to agreement on the way forward at this meeting, if at possible, in order to meet our deadlines.

Issue Statement:

What are the specific engineering options for actually storing the water to be used for supplementation and how do we get that water to the springs during drought?

The following is some background for addressing this issue, and some suggestions and "straw men" programs for discussion.

A. Selecting Engineering Solutions for Storing Water and Delivering It to the Springs

Our primary focus on June 14 and 15 should be in coming up with "programs" of engineered options for getting water to the springs during severe drought. As we have discussed previously, a "program" can simply be an engineered option, *e.g.*, a quarry along with a well field, an injection system and pipelines that will be able to provide adequate water to the springs to protect the species during a severe drought such as the drought of record. It can also be a combination of options meeting this objective, *e.g.*, a quarry, an ASR and three recharge structures and appurtenant pipelines and well fields.

HDR will evaluate up to five programs for getting water to the species during severe drought. In addition, HDR will analyze one “trade off” program -- a program that stores water that will be exchanged for pumping cuts during a severe drought. For the most part, with respect to the five programs, HDR will be completing any Task 4 work that has not been completed, performing a scale optimization run for each of the programs, and preparing a cost estimate for each program.

B. Process for Selecting the Programs

The adoption of a program or package of programs is a Tier 1 decision requiring consensus. If consensus is not obtained, an Issues Team will be selected. If the Issues Team cannot reach consensus on the program or a restatement of the program, a 75 percent vote of the Steering Committee will be required to carry forward a program. That vote would occur at the EARIP’s June 29 meeting.

The fact that a program is not carried forward does not eliminate it from further consideration and adoption later in the summer. It simply means that HDR will not perform additional analyses on the program.

C. Possible Programs for Further Analysis by HDR

A program should include elements that individually or collectively can be expected to provide a quantifiable benefit to springflow during severe drought that, alone or in conjunction with withdrawal reductions, is protective of the species. The options include, but are not necessarily limited to quarries, ASRs, R&R, off-channel storage, dry year option, and Type II recharge structures. Programs whose benefits to springflow during severe drought have yet to be quantified probably should not be included at this time in the programs for HDR's additional analysis due to time and budgetary constraints. Such programs would include, for example, Low Impact Development and brush management. They can, however, be considered in the decision-making process later this summer.

I strongly encourage you to develop programs for discussion on June 14 and 15. Because we have not had an opportunity to discuss in any detail what a program might look like, I describe two non-R&R programs and one trade off option as illustrations to assist you in developing a program. We also may wish to discuss and consider them if no other programs are offered by the Participants or to provide some alternatives to consider if consensus cannot be reach regarding programs brought forward by the Participants.

I offer these “straw men” solely for purposes of illustration and for stimulating discussion. I expect, if they are to be considered, that all of the elements will be discussed and negotiated. I am **NOT** advocating any particular element or rejecting any element that is not stated. R&R has been analyzed more completely by HDR, and the EARIP has spent more time discussing this option than the other options. Accordingly, I have addressed it separately in Sections D and E below.

In the first program, water from the Edwards Aquifer (*e.g.,* water from unused permits and/or 1.14(h) water) would be stored in one or more ASRs and injected or recharged near Comal and San Marcos springs at sites designed to provide the greatest benefit to those springs. The ASR would be sized to provide the flows determined to be protective by Dr. Hardy’s modeling. **For**

purposes of HDR's scale optimization runs, we should ask HDR to initially size the ASR assuming flow requirements initially used by Dr. Hardy for his model run.

The amount of water needed to attain a particular flow rate is substantially greater when a 340,000 acre-foot CPM floor is included in the assumptions compared to when a 320,000 acre-foot floor is used in the assumptions.[1] For example, if the flow requirements were 40 cfs at Comal and 52 cfs at San Marcos, approximately 223,000 acre-feet of storage capacity would be needed at a 340,000 acre-feet CPM floor and 145,000 acre-feet of storage capacity at a 320,000 acre-feet CPM floor. *See* Exhibit A to this Attachment 3.[2] The capacity needed at the 340,000 CPM floor may well exceed the technological and/or economic feasibility limits for an ASR. **Accordingly, the second scaling run should use the initial flow numbers used by Dr. Hardy and assume that the CPM floor is 320,000 acre-feet. The size of the other scaling runs would be based on discussions with Ed Oborny and Thom Hardy.**

The second program would be identical to the first program except that up to four Type II recharge structures would be included in the program. The Type II structures would be located to provide maximum benefit to springflow during drought.

Type II structures are generally effective tools for aquifer management. Moreover, these structures would provide additional water for storage, and provide more water to the Comal Springs during the early stages of drought. It may also provide at least some additional water later in the course of a prolonged drought, but the benefits, at this stage, are probably not significant.

In addition, to evaluating up to five programs, HDR will also evaluate one "trade off" option. For the "trade off" option, water from the Edwards Aquifer (*e.g.*, water from unused permits and/or 1.14(h) water) would be stored in an ASR, probably in Wilson County. The water from the ASR would be delivered to SAWS and/or Bexar Met in exchange for deeper cuts in pumping in Bexar County during Stage IV of Critical Period.

Triggers for the pumping cuts and the amount of such cuts would be developed by HDR. The efficiency of the pumping cuts in Bexar County in ensuring a particular modulated minimum

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[1] Reducing the CPM floor from 340,000 to 320,000 acre-feet not only reduces the amount of water required in storage but also shortens the length of any period of flat flows. *Cf.* Exhibits B and C to this Attachment 3.

[2] Exhibit A to this Attachment 3 shows the deficit and storage water needed to achieve modulated minimum springflows with different CPM floors. The "deficit" is the amount of water needed in the springs to ensure that the springs do not fall below a particular minimum during the drought of record. To obtain the amount of water that must be stored to provide the deficit amount, the deficit is multiplied by an "inefficiency" factor to account for the water that does not go to the springs after injection or recharge. This amount is assumed to be 1.7 for injection or recharge near the Comal Springs and 1.2 for injection near the San Marcos Springs. These factors are preliminary and are subject to revision as additional modeling of various scenarios is performed. This inefficiency factor does not account for losses due to evaporation if a quarry were used for storage or any water that might not be recovered from an ASR.

springflow during the drought of record would increase the amount of water needed in storage by a factor of 1.7. *See* Exhibit D to this Attachment 3 (HDR Presentation, June 4, 2010).

The efficiency of the pumping cuts in ensuring modulated minimum springflows at San Marcos Springs during the drought of record would increase the amount of water needed in storage by a factor of 13. *See* Exhibit D to this Attachment 3. Accordingly, it may not be feasible to use pumping cuts in Bexar County to attain protective flows at San Marcos Springs. A small quarry or ASR would be developed near the San Marcos Springs for storing water to trade-off for pumping cuts in Hays and Comal Counties.

D. The R&R Option

HDR provided a substantially complete analysis of the R&R option at the June 4 meeting of the Recharge Facility Feasibility Subcommittee (RFFS). This analysis included an update on the cost of the option. The HDR and Todd Engineering PowerPoints used for the June 4 meeting of the Recharge Facility Feasibility Subcommittee has been posted on the website under the January 14 meeting date for the EARIP and under on the RFFS page under the June 4 meeting. http://earip.tamu.edu/Meetings.aspx?MeetingType=EARIPMeetings

HDR will present a brief summary of this presentation. Thus, it is essential that you review the PowerPoint prior to the June 14 meeting.

It appears that R&R is capable of making some contribution to springflow at Comal Springs during the drought of record.[3] The analysis of R&R as currently configured has not established that it can provide minimum continuous springflow (*i.e.*, the Comal Springs still go dry) or that it can maintain a springflow of 30 cfs which we agreed would be an initial benchmark for Comal Springs. Scale optimization runs, perhaps with different triggers for cutting down pumping from the well field, would be needed to answer these questions.

R&R does not provide substantial additional springflow at the San Marcos Springs during the drought of record. Thus, R&R probably cannot be a stand-alone option. Thus, the R&R option will probably need to be paired with an ASR, quarry, or other option to protect San Marcos Springs. Depending upon the results of future analysis, R&R also may have to be combined with other engineered solutions in order to provide protective springs flows at Comal Springs.

The total project costs are estimated to be approximately $910,000,000 with O&M costs of approximately $82 to $89 million/year. Exhibits E and F to this Attachment 3 (HDR Presentation, June 4, 2010).

First, I believe we should take up the question of whether or not we want HDR to conduct the scale optimization runs for R&R to determine if it can provide protective springflows at Comal Springs.

Second, if we want HDR to conduct the scale optimization runs, then we need to decide what options need to be added to R&R to protect San Marcos Springs.

[3] *See below* "VII. Todd Engineers Analysis of the Drought of Record."

<u>Third</u>, then we need to decide, if HDR determines that R&R alone is not adequately protective of Comal Springs during the drought of record, whether we want to create a program for further analysis by HDR that combines R&R with other options to provide protective springflows at Comal Springs.

E. Todd Engineers' Analysis of the Drought of Record.

In the Todd Engineers' analysis of R&R, the number of months without flow at Comal Springs and the number of months below 30 cfs depend on the assumptions used regarding the drought of record. Todd Engineers examined the effects of R&R on the drought of record using two different assumptions.

The MODFLOW model simulates the historical hydrograph between January 1, 1947, and December 31, 2000. The model assumes that 1947 was preceded by an average year and simulates the effects of a particular scenario between 1947 and 2000. Using this assumption, the model begins abruptly and does not capture the recharge that actually preceded the onset of the model. The model, therefore, may not capture the benefits of recharge that may have been available prior to January 1947.

Todd Engineers compensated for this potential bias in the MODFLOW model by appending the drought of record part of the historical hydrograph onto the model in January 2001 and in effect, running the model for the drought of record twice. The years immediately preceding 2001 were average-to-high years for the Aquifer.[4] Accordingly, by running the model a second time, you can simulate what the effects of a scenario might be during the drought-of-record if such a drought is preceded by an average year and if it begins following a period of relatively wet years.

Not surprisingly, when you do this, the simulated effects of S.B. 3 or R&R (or for that matter any other regime imposed on the historical hydrograph) are quite different. In the "first" drought of record (1947 through 1957), R&R reduces the number of months that Comal Springs cease flowing from 35 months to 12 months. In the "second" drought of record (2001 through 2011 in the model) R&R reduces the number of months that Comal Springs cease flowing from 18 months to 2 months (note the baseline for Drought 2 (18 months) is also different from Drought 1 (35 months). Exhibit G to this Attachment 3 (Todd Engineering Presentation, June 4, 2010).

In the "first" drought of record (1947 through 1957), R&R reduces the number of months that Comal Springs is below 30 cfs from 48 months to 22 months. In the "second" drought of record (2001 through 2011 in the model) R&R reduces the number of months that Comal Springs is below 30 cfs from 31 months to 5 months. Exhibit H to this Attachment 3 (Todd Engineering Presentation, June 4, 2010).

Bear in mind that the number of months a particular scenario is below a flow target is not necessarily the best or appropriate measure of the scenarios protectiveness. The better measure is the biological effect of the time below the target. There is likely to be a significant biological difference between being below 30 cfs for 5 months over 10 years and being below that target for 5 consecutive months during a 10 year period. Similarly, the "number of months below a

[4] According to Sam Vaugh, the EAA Hydrogeologic Data Report indicates that 1997-2000 recharge was 75 vpercent greater than 1943-46 recharge.

flow target" statistic begs the question of how far the modeled result was below that target – a statistic that can have significant biological impact.

I have asked Robert Mace to evaluate the approach to analyzing the drought of record used by Todd Engineers and to give us a brief report on June 14. If we are going to use the Todd Engineers' approach for R&R we will need to use the same approach for evaluating the other options. My initial evaluation suggests the amount of the storage water for an ASR or quarry would be significantly less using the Todd Engineers' approach.