DRAFT

EARIP Evaluation
of Recharge Alternatives
for Spring Flow Supplementation

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Prepared for
Edwards Aquifer Recovery Implementation Program Steering Committee

CONSULTING SERVICES FOCUSED ON CONCEPTUAL ENGINEERING AND MODELING WORK SUPPORTING THE DECSION-MAKING PROCESS OF THE EDWARDS AQUIFER RECOVERY IMPLEMENTATION PROGRAM HABITAT CONSERVATION PLAN (HCP)

SCOPE OF WORK

The Edwards Aquifer Recovery Implementation Program (EARIP) has undertaken evaluation of recharge alternatives for spring flow supplementation. In pursuit of this effort, the EARIP issued a draft Scope of Work (SOW) to solicit proposals to provide technical assistance in conceptual engineering and modeling work to support the decision-making process of the EARIP Habitat Conservation Plan (HCP). This document constitutes a Draft SOW prepared by Southwest Research Institute® (SwRI) Division of Geosciences and Engineering (GED) in response to the solicitation by the EARIP.

The EARIP SOW is defined by three guidance items and five tasks. The guidance items are summarized as: (i) review of the scientific work and literature; (ii) interface with the EARIP; and (iii) modeling tools. These guidance items remain in the GED SOW.

The suggested tasks in the EARIP SOW are summarized as the following:

Task 1: Restate an appropriate baseline
Task 2: Further evaluate source water rights
Task 3: Develop conceptual projects and components
Task 4: Calculate spring flow and ancillary aquifer storage benefits
Task 5: Report summary and compilation

Tasks 1, 3, and 4 are strongly predicated on groundwater flow model predictions made with the Edwards Aquifer GAM (Lindgren et al., 2004). There is a concern that the Edwards Aquifer GAM was used by Todd Engineering (2008) for purposes that it was not intended (Green, 2009). Lindgren et al. (2004) note the purposes for which the GAM is intended (i.e., regional-scale water resource management) and applications for which the GAM is not appropriate (i.e., solute transport), but it does not specifically address

whether the GAM is appropriate for predicting the retention of groundwater in the Edwards Aquifer.

The execution of this project is recognized as vital to a thorough evaluation of viable options that could lead to optimal management of the Edwards Aquifer (including discharge from Comal and San Marcos springs). However, without an independent validation of the GAM's capability to accurately simulate groundwater retention, the results of Tasks 1, 3, and 4 will have unacceptably high levels of uncertainty. Given the importance of decisions that will be predicated on the outcome of these tasks, additional analyses should be undertaken to reduce this uncertainty to an acceptable level.

It is thus recommended that an independent analysis be performed to determine whether the Edwards Aquifer GAM adequately predicts groundwater retention in the Edwards Aquifer. The analysis would examine the relationship of precipitation and recharge events with changes in the potentiometric surface and spring discharge to determine how long recharged water remains in storage in the aquifer. The analysis would need to be spatially and temporally dependent. Results of the analysis would be compared with results of the GAM, thus providing an independent assessment of the capability of the GAM to predict groundwater retention in the Edwards Aquifer. Candidate approaches include correlation assessments, neural networks, and lumped parameter models.

There are three possible outcomes from the proposed analysis of groundwater retention.

(i) If the results are consistent with the GAM, then confidence in the GAM's ability to simulate groundwater retention in the Edwards Aquifer would be increased, thereby justifying the use of the GAM to predict groundwater retention from enhanced recharge projects and their effect on spring discharge.

(ii) If the results are not consistent with GAM, the GAM should be recalibrated to more accurately predict groundwater retention. If the GAM is successfully recalibrated, then the use of the GAM to simulate groundwater retention is justified.

(iii) If it is shown that the GAM cannot be successfully recalibrated to accurately predict groundwater retention in the Edwards Aquifer, then a major finding of the proposed project would be that the GAM should not be used to predict groundwater retention or for design of enhanced recharge projects in the Edwards Aquifer. A second major outcome would be an assessment of alternative approaches that may be used to predict the ability of the Edwards Aquifer to retain groundwater. It may be that correlation analyses, neural networks, or lumped parameter models would be recommended for use in simulating groundwater retention, recharge analysis, and spring discharge.

It is recommended that an additional task be added to the project proposed in the EARIP SOW to provide an independent assessment of the ability of the Edwards Aquifer GAM to accurately simulate groundwater retention in the Edwards Aquifer. This would be Task A and should be performed before Tasks 1, 3, and 4. Task 2 can be undertaken

concurrently with Task A. It is therefore recommended that the proposed SOW tasks be revised to the following:

Task A: Evaluate the capability of the GAM to simulate groundwater retention
Task 1: Restate an appropriate baseline
Task 2: Further evaluate source water rights
Task 3: Develop conceptual projects and components
Task 4: Calculate spring flow and ancillary aquifer storage benefits
Task 5: Report summary and compilation

The execution of Tasks 1, 3, and 4 in the EARIP SOW will need to be modified if it is demonstrated that the GAM is incapable of accurately simulating groundwater retention in the Edwards Aquifer. Although implementation of Tasks 1, 3, and 4 would differ based on the outcome of this assessment, the objectives of each task would remain the same.

Following are descriptions of the six tasks of the GED SOW. It is assumed that the three Guidance Items as specified in the EARIP SOW are still relevant to the proposed SOW.

Task A - Evaluate the capability of the GAM to simulate groundwater retention time in the Edwards Aquifer.

Task A.1 – Identify an approach for validating groundwater retention times simulated by the Edwards Aquifer GAM. A potential candidate is to relate high resolution precipitation measurements (i.e., NEXRAD) from both the Edwards Aquifer recharge and contributing zones to the resulting potentiometric surface and spring discharge. This alternative assessment of Edwards Aquifer groundwater retention may be in the form of a correlation analysis, a lumped parameter model, or neural network.

Task A.2 – Analyze retention in the Edwards Aquifer to identify (i) the relationship between precipitation and recharge, (ii) the relationship between recharge and potentiometric surface, and (iii) the relationship between recharge and spring discharge. Successful implementation of Task A.2 will provide insight into several key sources of uncertainty associated with management of the Edwards Aquifer: (i) the role that the Edwards Plateau has in recharging the Edwards Aquifer, (ii) the spatial and temporal distribution of recharge from the Trinity Aquifer to the Edwards Aquifer, (iii) the ability of the Edwards Aquifer to retain and store water, and (iv) the ability of the contributing zone to retain and store water that eventually recharges the Edwards Aquifer.

Task A.3 – Compare the results of Task A.2 with simulations of the Edwards Aquifer GAM. The capability of the Edwards Aquifer to retain groundwater as determined by the independent assessment will be compared with simulations of the GAM to ascertain the ability of the GAM to reasonably simulate the relationships among recharge, storage, and discharge in the Edwards Aquifer.

Task A.4 – Attempt to recalibrate the Edwards Aquifer GAM if the current calibration of the GAM does not adequately simulate the relationships among recharge, storage, and discharge in the Edwards Aquifer. Because the GAM does not explicitly represent conduit flow, recalibration to simulate rapid transient recharge events may not be possible; however, it may be that the GAM adequately simulates recharge, storage, and discharge on a time scale that is sufficient to evaluate recharge scenarios.

Task A.5 – If neither the current calibration of the Edwards Aquifer GAM nor the recalibration of the GAM reasonably simulates the relationships among recharge, storage, and discharge, determine if an alternative approach is better suited to be used to evaluate retention of groundwater in the Edwards Aquifer. If neither the current GAM, the recalibrated GAM, nor the alternative approach is capable of reasonably simulating the relationships among recharge, storage, and discharge, the EARIP Steering Committee will be advised that these models do not reasonably simulate Edwards Aquifer retention for the purposes of evaluating recharge scenarios.

Task 1: Restate an appropriate baseline that will allow for comparison of recharge, hybridized recharge variations, and/or recirculation for spring flow maintenance to be put into the context of current conditions. Task 1 will be implemented using the current GAM, a recalibrated version of the GAM, or the independent measure as determined during the execution of Task A, if appropriate and if feasible. The execution of Task 1 will parallel the description of Task 1 described in the EARIP SOW.

Task 2: Further evaluate source water rights in the basin of each structure or component (most recently evaluated by Todd Engineers with TRC/Brandes for EAA in 2008, previous work by HDR Engineering in 1991-2004, Trans-Texas Water Program through HDR in 1998). The execution of Task 2 will parallel the description of Task 2 described in the EARIP SOW.

Task 3: Develop conceptual projects and components that combined have the ability to supplement spring flow through a repeat of the drought of record. Task 3 will be implemented using the current GAM, a recalibrated version of the GAM, or the independent measure as determined during the execution of Task A, if appropriate and if feasible. The execution of Task 3 will parallel the description of Task 3 described in the EARIP SOW.

Task 4: Calculate spring flow and ancillary aquifer storage benefits based on retention times reflected in the current GAM, a recalibrated version of the GAM, or the independent measure as determined during the execution of Task A, if appropriate and if feasible. The execution of Task 4 will parallel the description of Task 4 described in the EARIP SOW.

Task 5: Report summary and compilation. The execution of Task 5 will parallel the description of Task 5 described in the EARIP SOW.

Schedule

The duration of the project is twelve months. Tasks A and 2 will be simultaneously initiated at the start of the project. The duration of Tasks A and 2 will be 4 months. Task 1 will start at the completion of Task A and will take 1.5 months. Tasks 3 and 4 will require 6 months to complete. The last 1.5 months of the project will be used to prepare the final results of the analyses and the final report.

References

Green, R.T., 2008. Peer-review comments on the 2008 Todd Engineering contract report to the Edwards Aquifer Authority on recharge and recirculation simulations of the Edwards Aquifer.

Lindgren, R.J., Dutton, A.R., Hovorka, S.D., Worthington, S.R.H., and Painter, S, 2004, Conceptualization and Simulation of the Edwards Aquifer, San Antonio Region, Texas: U.S. Geological Survey Scientific Investigations Report 2004-5277, 142p.

Todd Engineering with TRC/Brandes. 2008. Contract report to the Edwards Aquifer Authority on recharge and recirculation simulations of the Edwards Aquifer.