EARIP Evaluation
of Recharge Alternatives
for Spring Flow Supplementation

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

SCOPE OF WORK

Guidance Items:

Guidance Item 1 – Review of the scientific work and literature

Analyze past evaluations of recharge, recharge and recirculation, and water storage options focusing on the Edwards Aquifer. Reference or cite in the resulting conceptual engineering and modeling work the various analyses examined and how they were incorporated.

Guidance Item 2 – Interface with the EARIP

The individual(s) responsible for the work will work through the Edwards Aquifer Recovery Implementation Program (EARIP) Program Manager, Additional Studies Workgroup, Funding/Financing Subcommittee and any other group established or requested by the EARIP Steering Committee related to this proposal. The product shall be completed in maximum of 12 months from the date of execution of the contract. The goal of the product is to develop a report that will serve as a decision assistance tool with respect to work done on recharge, recharge & recirculation, storage, and hybridized options of recharge and/or recirculation configurations covered in past evaluations, planning, and scientific works.

Guidance Item 3 – Modeling Tools

Use the State of Texas' approved groundwater flow model for the Edwards Aquifer (EAA MODFLOW), current Demand Management / Critical Period Management "DM/CPM" management module, and an aquifer "yield" placeholder of 340,000 acre-feet as a region-wide pumpage "floor."

Specific Scope of Work Tasks:

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.

Display the results of the established baseline as a graphic and a table substantively similar to the table below:

For Illustrative Purposes Only - Suggested Conceptual Results Display Table			
	Springflow	Baseline % time	Baseline mos below
Comal:	0 cfs	6.0%	30
	30 cfs	8.0%	54
	60 cfs	15.0%	87
	90 cfs	23.0%	103
	120 cfs	28.0%	274
San Marcos:	0 cfs	0.0%	0
	40 cfs	2.0%	16
	80 cfs	10.0%	97
	120 cfs	50.0%	160
	160 cfs	52.0%	171

The results should indicate, for each of the modeling baselines, the number of months and percentage of time period each spring system is below a given spring flow target discharge. The EARIP Expert Science Subcommittee is currently evaluating the necessary minimum spring flow level(s) required to protect and contribute to the recovery of Federally-listed endangered species associated with the Comal and San Marcos springs. In the meantime, while that evaluation is underway, use the following minimum spring flow targets or thresholds:

Spring Flow Targets			
Comal:	0 cfs	**San Marcos:**	0 cfs
	30 cfs		40 cfs
	60 cfs		80 cfs
	90 cfs		120 cfs
	120 cfs		160 cfs

Task 1.1 - The baseline should include full utilization of all Edwards Aquifer groundwater withdrawal permits (572,000 acre-feet) issued by the Edwards Aquifer Authority (EAA), as amended by the State of Texas in 2007 (S.B. 3) and include the Demand Management/Critical Period Management (DM/CPM) regimen incorporated in that same legislation through the period of record (Todd Engineers performed a similar task for EAA in 2008; TWDB performed a similar task in a different modeling environment in 2007).

Future scenarios developed in Task 3 will be compared to the baseline in order to facilitate a side by side evaluation of the benefit over baseline given the cost of that proposed option.

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) .

Task 2.1 – Consider the following source water rights for alternatives

- Surface water rights: unappropriated, marketable (as defined by Todd, 2008), flood flow
    - Off-channel storage options should be considered (for example, quarries, ring dikes, existing or proposed reservoirs, Type-1 structures, etc.) (HDR issued a technical memorandum for SAWS in 2003, additional work was prepared for EAA by EarthTech Inc in 2002)
- Groundwater rights: unused EAA unrestricted municipal, industrial, and irrigation permits. (Todd Engineers prepared an evaluation of this facet for EAA in 2008)
- Consider as an additional option all base irrigation rights, whether used or unused.

Task 2.2 – Use "recharge credits" derived during Task 3 as a supplemented source of recharge through a recirculation or storage option. Identify any changes resulting to source water amounts or infrastructure necessary to deliver those amounts.

Task 3 – **Develop conceptual projects and components** that combined have the ability to supplement spring flow through a repeat of the drought of record. These combinations will ideally provide the targeted level(s) of spring flow outlined in task 1 above. The combination of components and structures should be optimized to provide a given spring flow target at least cost.

Represent the results of this task in tabular form substantially similar to the table below:

For Illustrative Purposes Only - Suggested Conceptual Results Display Table

Option A	Springflow	Baseline % time	Option A % time	Option A Improvement %	Baseline mos below	Option A mos below	Option A Improvement (mos)
Comal:	0 cfs	6.0%	4.2%	1.8%	30	14	16.00
	30 cfs	8.0%	5.0%	3.0%	54	26	28.00
	60 cfs	15.0%	8.0%	7.0%	87	54	33.00
	90 cfs	23.0%	10.0%	13.0%	103	77	26.00
	120 cfs	28.0%	16.0%	12.0%	274	167	107.00
San Marcos:	0 cfs	0.0%	0.0%	0.0%	0	0	0.00
	40 cfs	2.0%	0.8%	1.2%	16	5	11.00
	80 cfs	10.0%	7.0%	3.0%	97	52	45.00
	120 cfs	50.0%	16.0%	34.0%	160	103	57.00

Option B	Springflow	Baseline % time	Option B % time	Option B Improvement %	Baseline mos below	Option B mos below	Option B Improvement (mos)
Comal:	0 cfs	6.0%	0.0%	6.0%	30	9	21.00
	30 cfs	8.0%	1.2%	6.8%	54	15	39.00
	60 cfs	15.0%	5.3%	9.7%	87	26	61.00
	90 cfs	23.0%	7.2%	15.8%	103	38	65.00
	120 cfs	28.0%	9.1%	18.9%	274	94	180.00
San Marcos:	0 cfs	0.0%	0.0%	0.0%	0	0	0.00
	40 cfs	2.0%	0.0%	2.0%	16	3	13.00
	80 cfs	10.0%	6.2%	3.8%	97	21	76.00
	120 cfs	50.0%	28.0%	22.0%	160	86	74.00

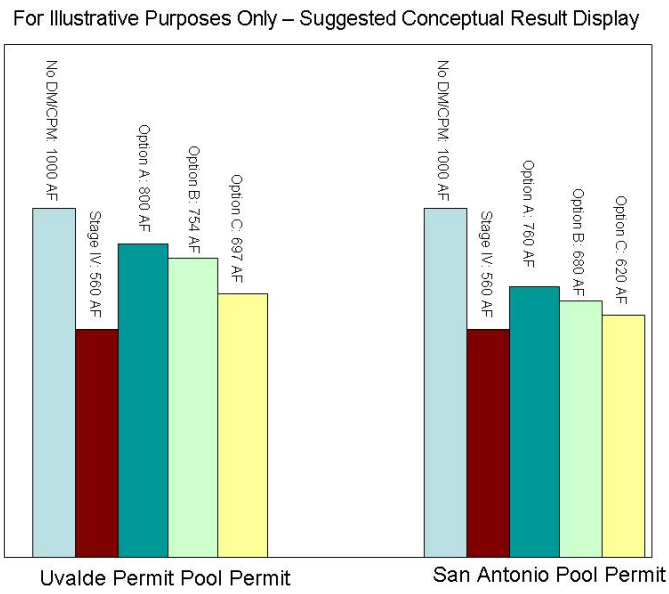
Option C…
Option D…

Task 3.1 - Evaluate recharge structures as stand alone component(s) to determine what volume of supply, if any, is necessary to maintain given spring flow targets without supplemental sources/recirculation (consider previous analyses by HDR (1991-2004); Trans Texas program in 1996; and Todd Engineers (2008) for EAA). Document improvement over the baseline from the recharge structure(s) as a stand-alone component.

Task 3.2 - Evaluate the Type-2 recharge structures analyzed in previous works and then supplement those structures through additional supplies, storage options, recirculation, or management strategies (i.e. timing of "pulses"), if those Type-2 structures alone do not meet the spring flow targets in task 1. Add any additional components in an incremental fashion and identify the increased benefit (i.e. fewer months below a certain spring flow target after adding a given component). Take into consideration options identified in all previous studies and analyses, including those feasibility studies being presently conducted by the U.S. Army Corps of Engineers.

Task 3.3 - Propose and evaluate the most promising hybrids based on the body of existing evaluations and the analysis above to achieve given spring flow targets at least-cost.

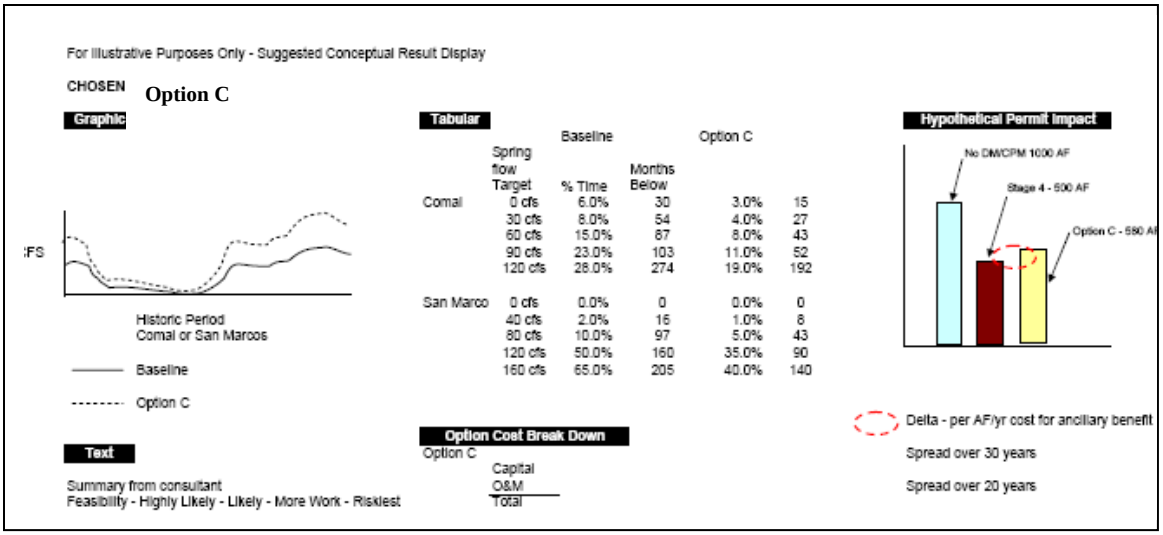
Task 4 – **Calculate spring flow and ancillary aquifer storage benefits** based on retention times reflected in the MODFLOW model. Determine the total capital costs and other costs (i.e. operations & maintenance) in both total and annualized cost per unit (acre-foot of spring flow and benefits through increased access to a hypothetical 1000 AF pumping permit). A graphical illustration of this concept is presented below:



In previous studies, "recharge credits" were identified as an additional water supply for consumption. Incorporate and use the current EAA Aquifer Recharge, Storage and Recovery permitting rules (Edwards Aquifer Authority Rules revised July 22, 2008 Subchapter "J") to guide this phase of the analysis. In this study, assume these "recharge credits" that would have supplemented supply are applied toward further storage or recharge for spring flow protection. Identify the cost of attaining a "recharge credit" for each conceptual hybridized option identified in Task 3. Revisit Task 2.2 above and identify or propose changes to recharge sources that would be supplemented or replaced if the "credits" applied to spring flow maintenance. Identify changes to components or structures in Task 3 necessary to adjust for the increased recharge source.

Task 5 – **Report summary and compilation.**

Task 5.1 - Using the consulting team's or individual's expertise and results from the tasks above, propose the top few optimal configurations of components, structures, storage, and management options for achieving supplementation of given spring flow target based on most improvement over baseline, feasibility considerations in implementation, and cost. A suggested illustrative example is shown below:



Task 5.2 – Outline other arrangements or configurations that were not chosen in task 5.1 for inclusion as an appendix to the report.

Task 5.3 – Prepare summarization arrangements in a format to facilitate inclusion in the Region L Regional Water Planning Group.

Task 5.4 – Prepare a written report, including an Executive Summary, data tables (including results from all computer simulations), and recommendations for implementation of various components. Maintain quarterly dialog meetings with EARIP's designated additional studies workgroup or alternate designation per guidance item two. Expect at minimum two final presentations on findings to the EARIP Steering Committee/Stakeholders as requested.