Recharge &Recirculation:
A “Basic System” to Increase Water Stored in the Edwards Aquifer for Spring Flow Protection.

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DESCRIPTION OF OPTION:

This is a description of one example of a “Basic System” of the Recharge & Recirculation Systems, focusing on use of the Edwards Aquifer itself as a storage unit, using well fields, short pipelines and recharge sites in the west and central area, with delivery of water to springs when needed through the Edwards Aquifer itself as a means of transmission.

This option takes advantage of the widely different hydraulic conductivities and storage characteristics found in different zones of the Edwards Aquifer (recharge zone and confined zone), and manages the aquifer by mounding water and increasing gradients in the recharge zone (variable storage area) to provide the needed springflows to Comal and San Marcos springs in time of drought.

Pumping from the well field to the recharge zone is allowed by a variety of permits, including use of the Sec. 1.14(h) permit that the EAA and springflow protecting entities may use, the regular unused EAA permits, recharge from a small number of Type 2 recharge structures, and the EAA recharge credit permit derived from previous recharge.

CONFIGURATION OF OPTION:

(1) Well field is placed in the high conductivity area of the Edwards Aquifer located so as to be as near the recharge zone as possible.
(2) A pipeline carries water from the well field to a recharge facility, designed to be as short a pipeline as possible to reach a low conductivity area of the Edwards Aquifer.
(3) The recharge facility or facilities (Type 2 Recharge Facility) is located in a low conductivity (high storativity) area of the Edwards Aquifer.
(4) Water is held in the variable storage area of the Edwards Aquifer by managing pumping from the well field during times of high aquifer levels to leave water available for flow through to the springs in times of low aquifer level s.

[Slide 5 – Map of Type 2 Recharge + pipeline/well field system recharge structures, optimal number and location(s) to be determined]

HOW IT WORKS:

The effect of moving water to the recharge zone is to increase the water stored in the “variable storage” (recharge zone) area of the Edwards Aquifer, thereby stacking the water so as to increase the gradient flowing out of the recharge zone into the high conductivity areas of the Edwards Aquifer leading to the springs at all times, including drought times.

[Slide 3 – Map showing the low conductivity zone ("variable storage area") of the Edwards and the high conductivity zone ("confined area") of the Edwards]

[Slide 6 – Cross-Section of a Type 2 showing the "variable storage" area, (Recharge Area), and "confined area" in cross-section] [Slide 7 – Cross-Section showing variable storage in unconfined Edwards. USGS.]

ROUGH ESTIMATE OF THE SIZE OF EDWARDS AQUIFER "VARIABLE STORAGE":

(1) For every 1' on the J-17 index well, there is roughly 35,000 af of Edwards storage. [USGS estimate]
(2) There has been 91' of variation in the level of J-17 during the period of record, going between 703' and 612' historically.
(3) The "variable storage" portion of the Edwards Aquifer that is subject to management in the western and central Edwards might be very roughly estimated at 1/3 of the total "variable storage", since we would not be able to use the entire geographical area or vertical area of the "variable storage" to manage Edwards levels and spring flows.

The result of (1) X (2) X (3) = approximately 1,060,000 ac-ft of "variable storage" in the west and central part of the Edwards Aquifer that is subject to management.

This is equivalent to about 2.7 "Canyon Lakes" (conservation storage = 382,000 ac-ft)

METHODS OF DELIVERY TO SPRINGS WHEN NEEDED IN DROUGHT:

FIRST ALTERNATIVE: CONTINUOUS FLOW
Calculations were done in the Todd Engineers analysis, ["Recharge and Recirculation, Edwards Aquifer Optimization Program, December 2008], of how much recharge needs to be brought continuously each year to any of nine recharge sites to maintain 40 cfs of spring flow at Comal Springs in the worst part of the drought of record – using each recharge site as the sole source of enhanced recharge. These calculations assume that the aquifer is being pumped to the maximum extent allowed by S.B. 3 as a "baseline." Similar calculations to those done for Comal Springs could be performed to give recharge needed at each recharge location to support minimum flows throughout the drought of record for San Marcos Springs. The aquifer conditions that support minimum Comal flows in the drought of record also support a certain level of minimum flow at San Marcos Springs in the drought of record.

[Slide 10 – Table shows amounts needed at any of 5 recharge sites to ensure 40 cfs minimum flow at Comal Springs throughout the drought of record.]

SECOND ALTERNATIVE: POSSIBLE REFINEMENT OF-CONTINUOUS FLOW STRATEGY:

Instead of pumping water from the well field in the high conductivity area to the low conductivity area all the time, consider the alternative of turning off a portion of the well field pumping during times when Comal Springs or San Marcos Springs are at or approaching critical low flows to provide greater flow at the springs. The high conductivity between the well field and the springs suggests a quick response at the springs and a more efficient management system for maintaining springflow regimes at all times, including the drought of record. This would require an operating strategy to determine how much and when to adjust well field pumping to get the additional water to the springs when they need it.

SOURCE WATERS FOR "BASIC SYSTEM":

The main sources of water for the option of using the Edwards Aquifer as a storage unit are:

1. Type 2 surface waters, estimated at 54,471 af/y (average) from five Type 2 sites.
2. Unused Regular EAA permits, estimated at 180,000 af/yr by EAA staff and subject to critical period reductions under S.B. 3.
3. Water pumped under Sec. 1.14(h), EAA Act, for springflow protection. This source water does not require compensation to be paid by the EAA.
4. Recharge credits from EAA = the sum of 1. + 2. + 3. less the waters discharging from aquifer storage as a function of time. This is the largest source of water of the four main sources and should be optimized as a source of water for aquifer management for springflow protection in critical times.

The water provided from these four main sources would be taken to recharge sites, instead of being pumped for consumptive use.

The reliability of the recharge from these water sources is greatest for the groundwater sources (EAA unused regular permits, EAA Sec. 1.14(h) permits, and EAA recharge credits) and least for the surface water sources (diversions to Type 2 recharge structures).

OTHER POSSIBLE SOURCE WATERS THAT COULD BE ADDED TO THE "BASIC SYSTEM" for Delivering Water to Springs When Needed:

1. Water stored in quarries
2. Water stored in ASR projects (non-Edwards)
3. Off-Channel surface storage
4. Brush control, if and when quantified for benefits to the Edwards Aquifer
5. Offsets that allow existing users to replace Edwards waters used with other waters, so that the replaced Edwards waters would be made available for aquifer management.
6. Such options as the Uvalde Pipeline could also supply water to recharge the Edwards Aquifer.

These "other" sources of water could be added to the "Basic System" of Recharge & Recirculation as needed to provide additional water for springflow protection, if and when needed. Cost estimation studies comparing costs and taking advantage of synergies could determine when these "other" sources of water are cost effective additions to the basic system.

COST ESTIMATES FOR R&R Edwards Storage Option – the "Basic System":

The major costs of the "Basic System" of the Edwards Aquifer Storage Option described above are "Capital" and "Maintenance & Operations" costs that can be summarized as follows:

(1) Capital Costs: costs of constructing well fields, pipelines, recharge structures, pump station, obtaining permits for source waters.

(2) Maintenance & Operations: costs of energy, and maintenance and operation of capital structures identified above.

Major benefits can be described in terms of meeting minimum spring flow regimes (cost per unit of minimum springflow in drought of record) with the “Basic System”, and in terms of consequential benefits to others (both Edwards Pumpers and Downstream Surface Water Users).

Add-ons to Basic System:

Major costs for “other” waters added to the “Basic System” (quarries, ASR, brush control, Uvalde Water line, offsets) could include capital and M&O costs for: well fields and pipelines to and from storage unit, cost of acquiring storage unit, recharge structures for delivery to springs (if needed), pump stations, and obtaining permits for source waters, and possible water quality treatment if water is to be brought directly to or to recharge sites very close to the springs.

SUMMARY:

The “Basic System” of Recharge and Recirculation involving use of the Edwards Aquifer as a storage unit, could be cost analyzed for what it would take to meet the minimum springflow requirements in time of the drought of record with just the “Basic System”.

Then this “Basic System” could be compared to what the costs would be for providing that same spring flow protection in time of the drought of record from increments of “other” sources, storage units and delivery systems to springs, in combinations with a modified (downsized or deleted) “Basic System” .

And the results could be compared to obtain an optimum system for protecting spring flows for the endangered species in the drought of record at the least cost and with the greatest reliability.