Preliminary Bottom-Up Model Runs with “As-Implemented” Conservation Measures

November 7, 2018

Background

- Original Bottom-Up analysis results published by HDR, Inc. in 2011
  - Modeling conducted by Todd Engineers
  - Part of EARIP process
  - EAA does not possess the archive of MODFLOW input files
  - Contacted HDR, but they were unable to produce the original MODFLOW files from 2011 runs
- EAA contracted with HDR in 2015 to conduct an alternative Bottom-Up analysis to evaluate potential for changing ASR leases to VISPO leases
  - HDR did have model archive for these runs
  - Files from this archive provided the starting point for EAA staff to reproduce Bottom-Up analysis with updated MODFLOW model

Background

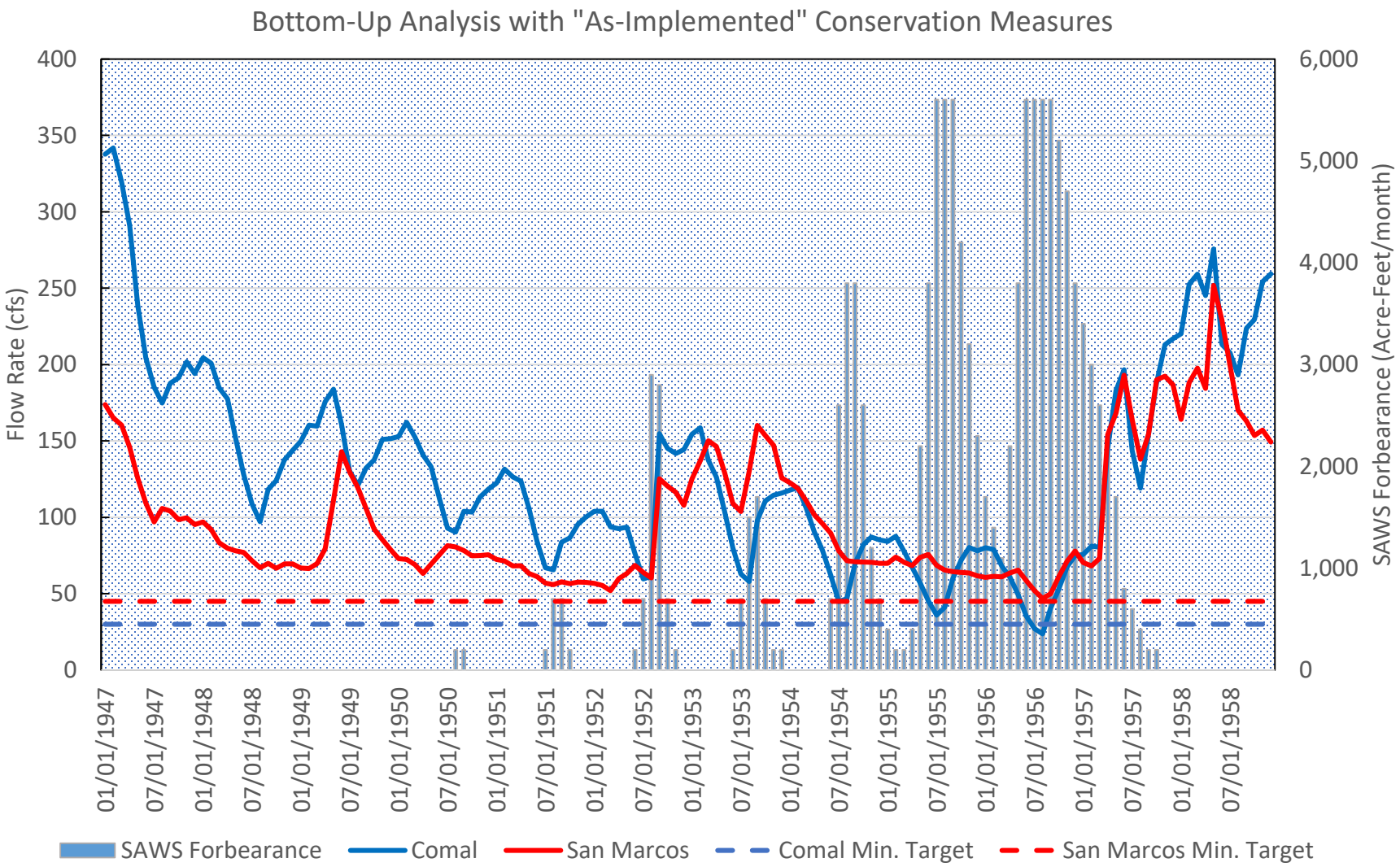
- In 2017, EAA Staff repeated HDR bottom-up analysis using the updated MODFLOW model (Liu, et al., 2017)
  - Minimum flow at Comal Springs, 29.7 cfs on Aug. 31, 1956
  - Minimum flow at San Marcos Springs, 48.1 cfs on Aug. 31, 1956

- 2017 –repeat Bottom-Up analysis to evaluate new ASR leasing tier structure with trigger for Tier 2 (formerly Tiers 2 and 3) based on 10-yr average recharge below 500 kaf
  - Minimum flow at Comal Springs, 29.8 cfs
  - Minimum flow at San Marcos Springs, 48.0 cfs

2018—New Bottom-Up Analysis

- Bottom-Up analysis using “as-implemented” conservation measures
  - 40,000 af of VISPO forbearance distributed based on actual lease locations (more in Uvalde county compared to previous analyses)
  - 126,000 acre-feet of water stored in ASR
  - 50,000 af of ASR lease forbearance distributed based on actual lease locations (more of the irrigation portion in Uvalde county compared to previous analyses)
  - 6,000 af federal pumping (5,600 in Bexar; 400 in Hays)
  - 14,454 af domestic/livestock pumping
  - Minimum flow at Comal Springs, 23.8 cfs
  - Minimum flow at San Marcos Springs, 46.9 cfs

New Bottom-Up Analysis



Comal Min. Flow = 23.8 cfs

San Marcos Min. Flow = 46.9 cfs

New Bottom-Up Analysis:

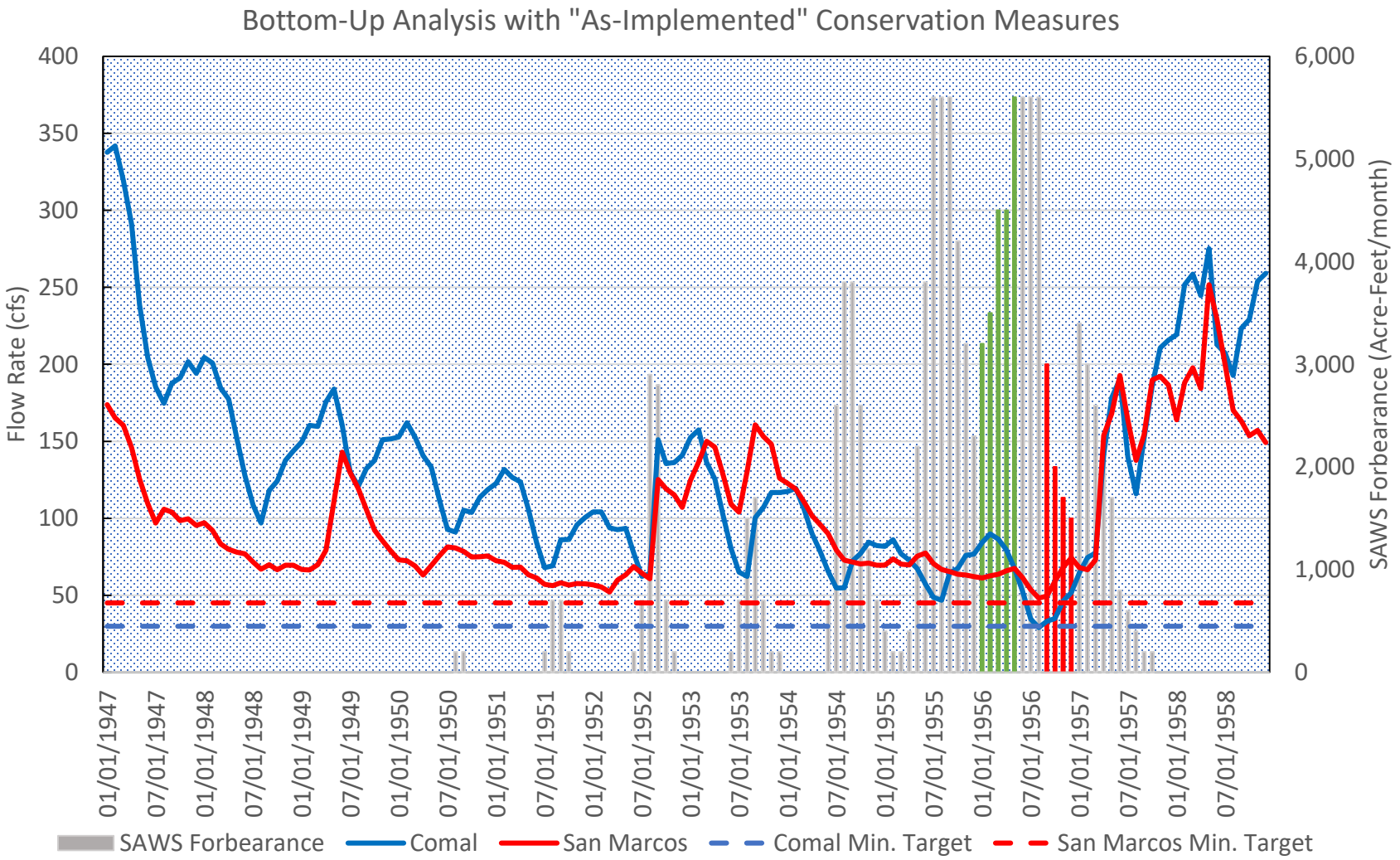
Why is minimum flow 6 cfs lower at Comal Springs compared to previous analyses?

- "As-Implemented" VISPO and irrigation portion of ASR leases assigns a greater portion of the forbearance to Uvalde County, which tends to have less benefit compared to forbearance in Bexar and Medina counties
- However, most of the difference appears to be due to the inclusion of 6,000 acre-feet of federal exempt pumping, which, it appears, was not included in previous bottom-up analyses

What can be done to make up the difference

- Interlocal contract with SAWS, Exhibit E, provides recommended SAWS forbearance schedule for a repeat of the drought of record, but assigns a Staff Work Group authority to make adjustments to the schedule
- EAA and SAWS convened a Staff Work Group meeting in September to make a revised forbearance schedule
- Re-ran Bottom-Up analysis with revised SAWS forbearance schedule
  - Minimum flow at Comal Springs, 29.1 cfs
  - Minimum flow at San Marcos Springs, 48.1 cfs

Results with Revised SAWS Forbearance



Comal Min. Flow = 29.1 cfs

San Marcos Min. Flow = 48.1 cfs

Bottom-Up Analysis with Actual Enrolled VISPO Leases

- Actual VISPO enrollment is 40,921 acre feet
- Re-ran Bottom-Up analysis with the additional 921 acre feet of VISPO forbearance
  - Minimum flow at Comal Springs, 29.6 cfs
  - Minimum flow at San Marcos Springs, 48.3 cfs

Long-term Flow Requirements

HCP References to *Flow Related Objectives* for Comal Springs

TABLE 4-2
LONG-TERM AVERAGE AND MINIMUM TOTAL COMAL DISCHARGE MANAGEMENT OBJECTIVES

Description	Total Comal Discharge (cfs)[a]	Time-step
Long-term average	225	Daily average
Minimum	30 [b]	Daily average

[a]Assumes a minimum of a 50-year modeling period that includes the drought of record
[b]Not to exceed six months in duration followed by 80 cfs (daily average) flows for 3 months.

?????

After reaching lowest modeled flow in 1956, it was 8 months before 3 consecutive months of flow greater than 80 cfs

225 cfs = 162,890 af/yr

HCP References to *Flow Related Objectives* for San Marcos Springs

TABLE 4-13
LONG-TERM AVERAGE AND MINIMUM TOTAL SAN MARCOS DISCHARGE OBJECTIVES

Description	Total San Marcos Discharge (cfs)[a]	Time-step
Long-term average	140	Daily average
Minimum	45[b]	Daily average

[a] Assumes a minimum of a 50-year modeling period that includes the drought of record

[b] Not to exceed six months in duration followed by 80 cfs (daily average) flows for 3 months.

After reaching lowest modeled flow in 1956, it was 8 months before 3 consecutive months of flow greater than 80 cfs

140 cfs = 101,355 af/yr

HCP Source for *Flow Related Objectives* for Long-term Average Springflow?

Analysis of Species Requirements
in Relation to Spring Discharge Rates
and Associated Withdrawal Reductions
and Stages for Critical Period Management
of the Edwards Aquifer

Report to the Steering Committee
for the Edwards Aquifer Recovery Implementation Program

The Edwards Aquifer Area Expert Science Subcommittee
for the Edwards Aquifer Recovery Implementation Program

December 28, 2009

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Task 1: Analyze species requirements in relation to spring discharge rates

Results: Based on the analyses described in the body of this report, the Edwards Aquifer Area Expert Science Subcommittee has determined the following spring discharge rates in association with the assumptions presented herein are necessary for the long-term survival of the aquatic communities of the Comal and San Marcos springs, in particular the federally listed species.

Comal Springs Flow Regime:

- **Long-term average: 225 cubic feet per second**
- **6-month average: 75 cubic feet per second**
- **1-month average: 30 cubic feet per second with no flow below 5 cubic feet per second**

San Marcos Springs Flow Regime:

- **Long-term average: 140 cubic feet per second**
- **6-month average: 75 cubic feet per second**
- **1-month average: 60 cubic feet per second with no flow below 52 cubic feet per second**

Long-term average springflow results from HDR 2011 analyses

Table ES-1.
Selected Springflow Statistics in Cubic Feet per Second (1947-2000)

Spring	Statistic	Baseline (348K+)	VISPO	VISPO + Conservation	VISPO + Conservation + SAWS ASR	VISPO + Conservation + SAWS ASR + Stage V
Comal	Minimum Month	0	0	0	15	27
	~~Minimum 6-~~ Month Moving ~~Average~~	0	0	0	31	39
	Long-Term Average	178	182	186	195	196
San Marcos	Minimum Month	2	16	19	49	51
	~~Minimum 6-~~ Month Moving ~~Average~~	12	25	29	53	53
	Long-Term Average	153	153	154	154	155

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Issues with Modeling Long-Term Average Springflows

- Updated MODFLOW model was not calibrated to the long-term period of 1947-2000 used in original analyses
- Mass balance constraints dictate that long-term average spring flows cannot exceed long-term average recharge minus long-term average pumping
- With substantially similar recharge and pumping inputs as the 2011 analysis, we do not expect results of a long-term run with updated model to differ significantly
- Results would likely be a few cfs lower due to inclusion of federal pumping

A mass balance look at long-term average flows

- Combined long-term minimum flow objectives for Comal and San Marcos Springs totals 264,000 acre-feet
- Long-term average for all other springs is ~80,000 acre-feet
- Long-term average recharge is ~750,000 acre-feet
- Long-term recharge minus minimum long-term springflows leave available ~406,000 acre-feet available for long-term average pumping, which is ~30,000 acre-feet above average pumping for past 10 years
- Modeling that allows for 582,000 acre-feet of total pumping in non-drought years, almost guarantees the model results will not meet long-term flow objectives for both Comal and San Marcos Springs

Issues with Modeling Long-Term Average Springflows

- Rather than dedicate staff time to recalibrate the updated model to better match long-term period, can we simply stipulate that the updated model will do no better at matching long-term flow objective simply due to mass balance constraints when we assume full permitted pumping even in wet years?
- Is it possible to reconsider long-term average flow objectives in light of Phase 1 experience?
  - 225 cfs objective at Comal Springs is equal to Stage 1 trigger
  - 140 cfs objective at San Marcos is 46 cfs above Stage 1 trigger
- What does experience of recent drought tell us?

Real Springflow Averages 2001—2017

- 2001—2017 average
  - Comal Springs: 301 cfs
  - San Marcos Springs: 194 cfs
- Driest 10 years, 2006—2015
  - Comal Springs: 254 cfs
  - San Marcos Springs: 162 cfs
- Driest 7 years, 2009—2015
  - Comal Springs: 225 cfs
  - San Marcos Springs: 157 cfs

Real Springflow Averages 2001—2017

- 1947—1958 modeled Drought-of-Record with all bottom-up layers
  - Comal Springs: 130 cfs
  - San Marcos Springs: 100 cfs

- 2001—2017 actual combined with 1947—1958 modeled Drought-of-Record with all bottom-up layers
  - Comal Springs: 230 cfs
  - San Marcos Springs: 155 cfs

- Can we use real-world experience to demonstrate long-term springflow objectives?

Questions?
Discussion?