Modeling Drought Response Strategies

Austin Water Resources Planning Task Force

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Drought Response Strategies

- Drought response strategies were modeled for the purposes of exemplifying simulated net benefits on storage in lakes Buchanan and Travis under repeated drought conditions.
- Simulating several groupings or “tiers” can uncover strategy synergies or interferences.
- The tiered strategy models in this handout are based on task force request from the June 19, 2014 AWRPTF meeting. The tiered strategy groupings are not necessarily reflective of final task force recommendations.

Assumptions for Austin DCP Implementation

Projected Diversions in Thousand Acre-Feet (TAF) - Rounded to Nearest 0.5 TAF							
Stage	**Assumption: Modeled Highland Lakes Combined Storage Level Trigger (AF)**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Conservation Stage	Full to 1.4 MAF	155.0	158.0	159.5	161.0	162.5	164.0
Stage 1	1.4 MAF to 900,000	150.5	153.5	155.0	156.0	157.5	159.0
Stage 2	900,000 to 600,000	142.0	144.5	145.5	147.0	148.5	149.5
Stage 3	600,000 to 500,000	124.5	125.5	127.0	128.5	129.5	131.0
Interim*	500,000 to 400,000	109.0	110.0	111.0	112.0	113.0	114.5
Stage 4⁺	400,000 and below	99.5	100.5	101.0	102.5	103.5	104.5

***Includes conceptual "Interim" stage - potentially includes hand-watering only**

⁺Includes estimated reductions of indoor use correlating to community response to drought severity

Note: 1 acre-foot (AF) = 325,851 gallons

* As of 5/2014, estimates subject to change

Tier 1 Strategies

Strategy Description	Key Modeling Assumption	Model Implementation
Operating range of Lake Walter E. Long adjusted to allow for approx. 3' of drawdown before calling for LCRA stored water	Top 3,700 acre-feet of lake capacity is filled with local and run-of-river water only.	Start of simulation, June 2014
Longhorn Dam gate improvements to increase efficiency of downstream releases	6,000 acre-feet per year (afy) of improved release efficiency	June 2014
Increased Austin municipal conservation, beyond savings due to drought contingency stage implementation	Demands (previous page) are reduced by 5% in all stages	January 2015
Increase Austin municipal direct reuse, "Completing the Core"	1,800 afy in all DCP stages	January 2020

Incorporated into all three tier strategies is implementation of the DCP stages including the conceptual "interim" stage.

The key modeling assumption column for all three tier strategies is not necessarily reflective of the annual Highland Lakes storage savings. The Highland Lakes storage savings collectively from all strategies are shown graphically in the modeling results.

Tier 2 Strategies

Strategy Description	Key Modeling Assumption	Model Implementation
Capture local inflows in Lady Bird Lake, including from Barton Springs and Deep Eddy. "Excess flow" is diverted on Lady Bird Lake. Excess flow is simulated as water is not required for passage to downstream senior water rights and not needed to meet downstream LCRA environmental flow requirements.	Variable amount of excess flow is diverted per month, depending on hydrologic conditions	January 2016
Lake Austin Operations Operate Lake Austin within a 3' range to allow local flows to be captured rather than "spilled" downstream. Drought response emergency operational approach would be to let local usage draw the lake level down a few feet to be able to catch runoff from local storm events should they occur. Lake Austin operations are modeled only in the months of September through May when the combined storage of the Highland Lakes falls below 600,000 acre-feet.	Top 3' of Lake Austin is used for capturing local excess flow, approx. 4,500 acre-feet of lake capacity.	September through May only after Buchanan and Travis combined storage falls below 600,000 acre-feet

Incorporated into all three tier strategies is implementation of the DCP stages including the conceptual "interim" stage.

Tier 3 Strategies

Strategy Description	Key Modeling Assumption	Model Implementation
Walter Long Off-Channel Storage (Enhanced Capacity) Assumes Decker power plant is offline when this strategy is in effect. During the simulation period LCRA stored water is not called for maintaining storage contents in Lake Long while the power plant is offline. Decker Creek inflows, Colorado River "excess flows", and reclaimed water are stored in Lake Long. Releases of stored water are made to Decker Creek to meet down basin demands and to meet LCRA instream flow and bay & estuary inflow requirements.	Top 25' of Lake Long is used for releasing to Decker Creek, approx. 23,400 acre-feet of lake capacity.	Both Tier 3 strategies are simulated anytime after January 1, 2016 when Buchanan and Travis combined storage falls below 420,000 acre-feet. Tier 3 strategies cease if combined storage recovers to 650,000 acre-feet. With regard to the Decker strategy, no decisions have been made regarding actual future operations of Decker power plant.
Indirect Potable Reuse – SAR to Lady Bird Lake Indirect reuse through Lady Bird Lake for augmenting potable water supply. Indirect reuse simulated as a constant monthly amount. Releases of stored water from Lake Long are made to offset decreased return flow discharge above the Bastrop gage.	20 Mgd, approx. 22,400 afy	

Incorporated into all three tier strategies is implementation of the DCP stages including the conceptual "interim" stage.

Baseline Modeling Assumptions

- Combined Storage initialized to 787,000 acre-feet, as observed on June 1, 2014
- All simulations begin June 1, 2014 and end January 1, 2024
- Dry/reference year demands when not simulating curtailment due to lake combined storage below 600,000 acre-feet, i.e., pro-rata curtailment due to a declaration of a drought worse than the drought of record (DWDR) by LCRA
- Austin municipal demand growth
- Austin municipal demands reduced according to Austin's DCP stages
- Other firm customer demands reduced initially by 20% under DWDR. Reduction by 30% below 500,000 acre-feet of combined storage.
- Interruptible stored water cutoff under DWDR
- LCRA WMP Emergency Order for cutoff of interruptible stored water if DWDR not in effect
- LCRA temporary amendments for additional diversion points of LCRA run-of-river rights below the Highland Lakes
- LCRA Emergency Order to reduce the spring instream flow requirement between Bastrop and Columbus from 500 to 300 cfs for 6-consecutive weeks
- Corpus Christi run-of-river diversion of 35,000 afy begins, July 2015

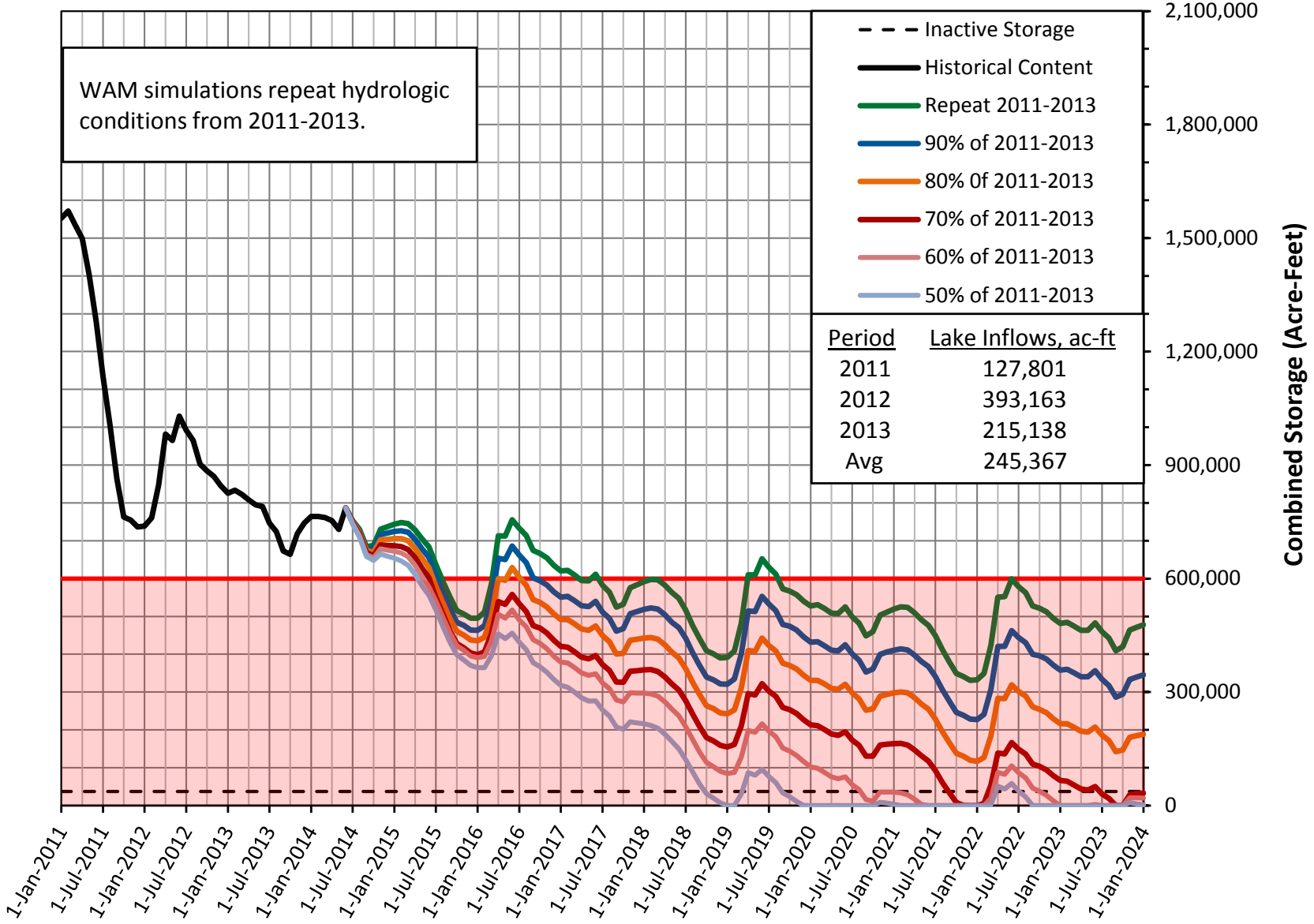
Baseline Modeling Assumptions (continued)

- Latest Colorado River Basin hydrology dataset from TCEQ is used. The hydrology dataset includes all years of the current drought except for 2014.
- The percent reductions of the 2011-2013 hydrology repeats adjusts stream flows at all gages in the basin by the stated percentage.
- LCRA's groundwater supply in Bastrop county is simulated as a source for meeting power plant demands on Lake Bastrop. LCRA groundwater is simulated as 5,000 afy, and increased to 10,000 afy if drought conditions exist in Bastrop county on January 1 of each year.
- LCRA instream flow and bay & estuary freshwater inflow requirements are reduced in the simulation by 20% and 30% when combined storage falls below 600,000 and 500,000 acre-feet, respectively.
- The Baseline and Strategy Tier simulations do not contain the LCRA Lower Basin Reservoir Project (LBRP). The reservoir is expected to be operational in 2017 and will be located upstream of Bay City.

Simulation Hydrology

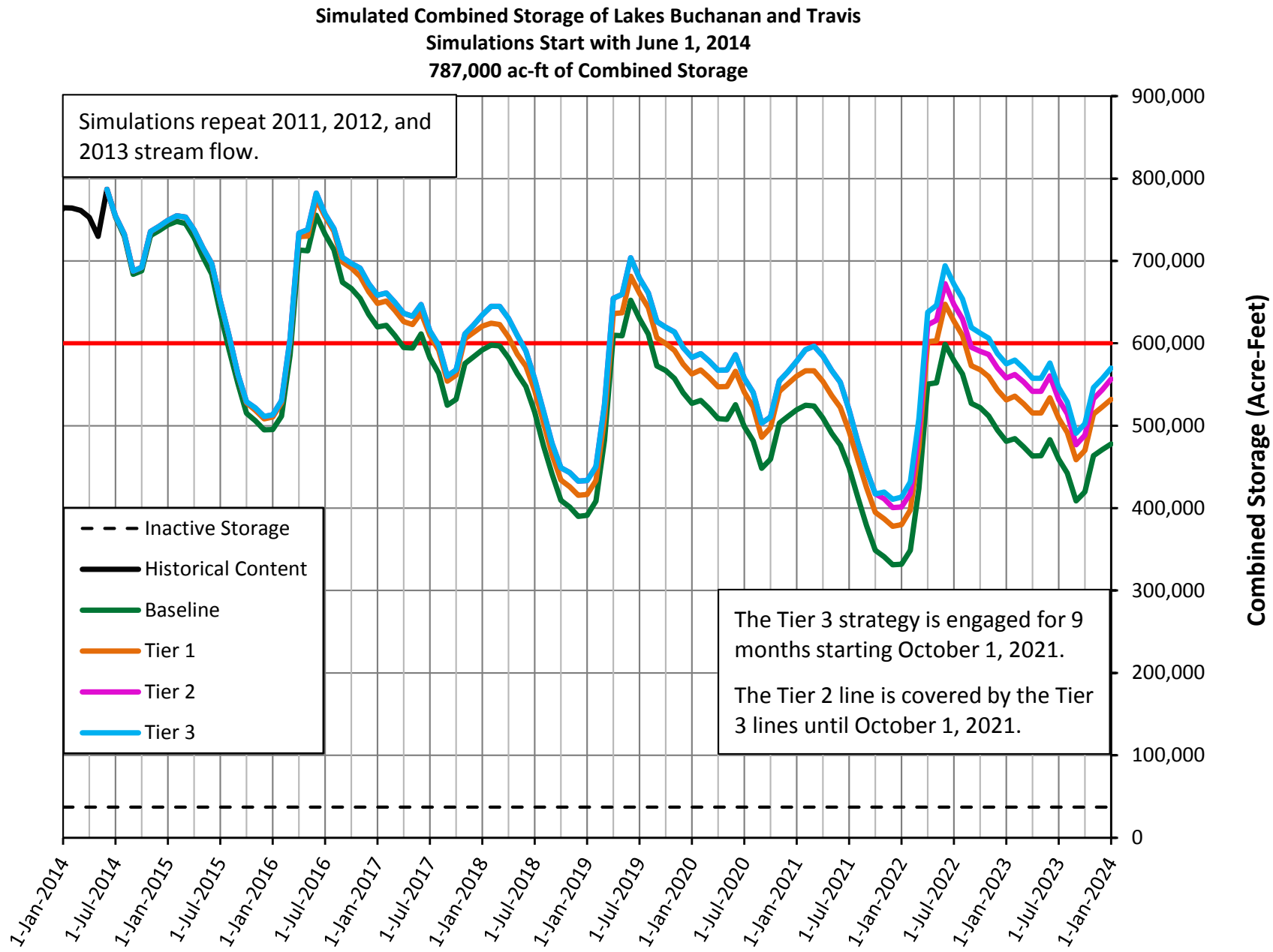
- The baseline and strategy tiers were simulated with two hydrologic conditions repeating for 9 full years. The following sequences begin with 2015:
  - 2011-2013 stream flow repeating
  - 70% of 2011-2013 stream flow repeating
- Hydrology for June-December 2014 is simulated by repeating the hydrology of June-December 2013. The 70% stream flow reduction is also applied.

Simulated Combined Storage of Lakes Buchanan and Travis
Baseline Simulation with June 1, 2014 Start



Incorporated into the Baseline result shown here, and all three tier strategies, is implementation of the Austin DCP stages including the conceptual “interim” stage.

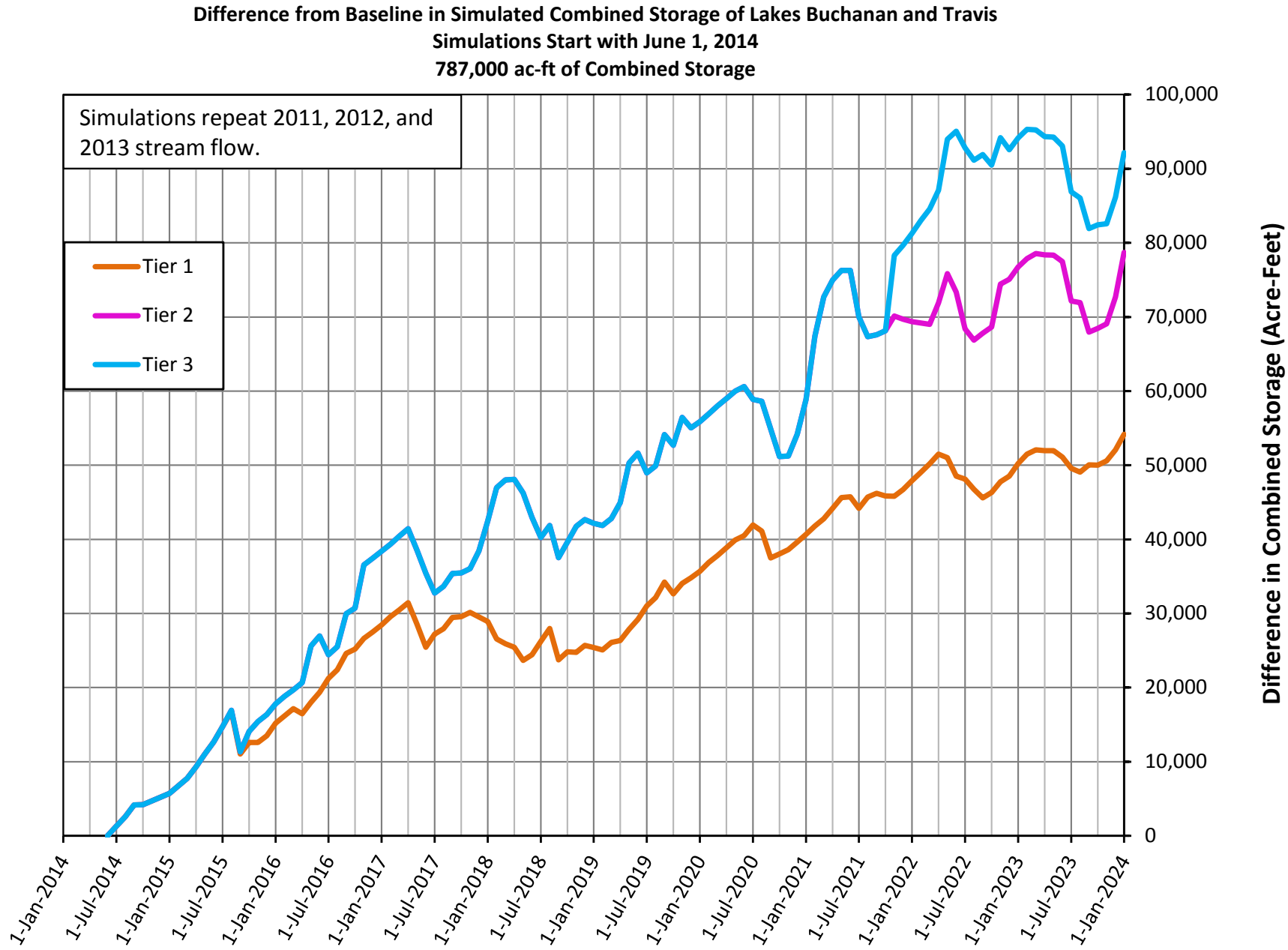
Results for Simulations with Repeat of 2011-2013 Stream Flow


Simulated Combined Storage of Lakes Buchanan and Travis
Simulations Start with June 1, 2014
787,000 ac-ft of Combined Storage
Simulations repeat 2011, 2012, and 2013 stream flow.
Inactive Storage
Historical Content
Baseline
Tier 1
Tier 2
Tier 3
The Tier 3 strategy is engaged for 9 months starting October 1, 2021.
The Tier 2 line is covered by the Tier 3 lines until October 1, 2021.
Combined Storage (Acre-Feet)
900,000
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
1-Jan-2014
1-Jul-2014
1-Jan-2015
1-Jul-2015
1-Jan-2016
1-Jul-2016
1-Jan-2017
1-Jul-2017
1-Jan-2018
1-Jul-2018
1-Jan-2019
1-Jul-2019
1-Jan-2020
1-Jul-2020
1-Jan-2021
1-Jul-2021
1-Jan-2022
1-Jul-2022
1-Jan-2023
1-Jul-2023
1-Jan-2024

Time Spent at Various Combined Storage Levels

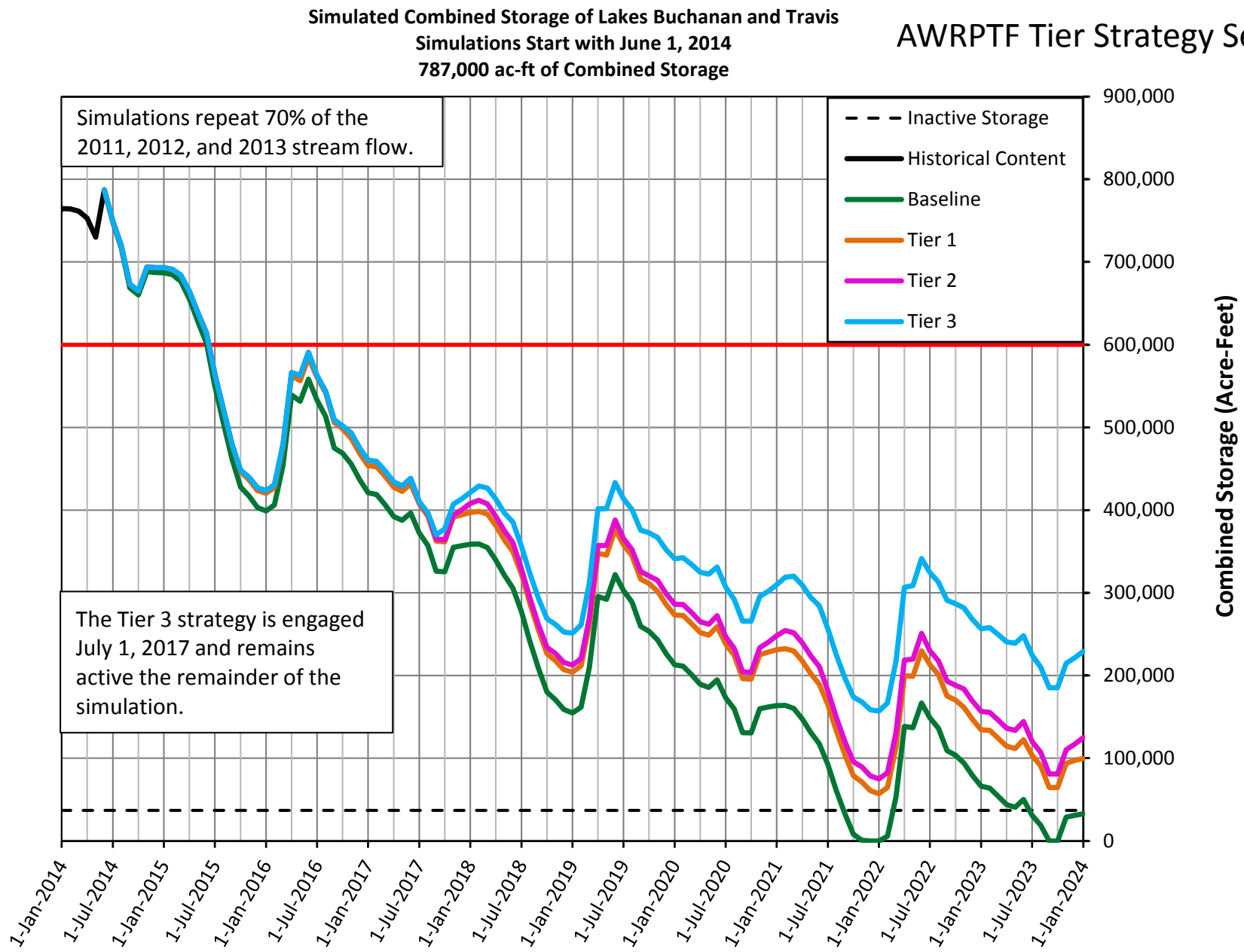
	Baseline	Tier 1	Tier 2	Tier 3
Storage		*Number of Months*		
At or Abv. 600k	32	49	52	55
500 - 599k	45	47	48	47
400 - 499k	31	15	16	14
Blw. 400k	8	5	0	0
	116	116	116	116

Storage		*Percent of Total Months*		
At or Abv. 600k	28%	42%	45%	47%
500 - 599k	39%	41%	41%	41%
400 - 499k	27%	13%	14%	12%
Blw. 400k	7%	4%	0%	0%
	100%	100%	100%	100%


Difference from Baseline in Simulated Combined Storage of Lakes Buchanan and Travis
Simulations Start with June 1, 2014
787,000 ac-ft of Combined Storage
Simulations repeat 2011, 2012, and 2013 stream flow.
Tier 1
Tier 2
Tier 3
Difference in Combined Storage (Acre-Feet)
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
1-Jan-2014
1-Jul-2014
1-Jan-2015
1-Jul-2015
1-Jan-2016
1-Jul-2016
1-Jan-2017
1-Jul-2017
1-Jan-2018
1-Jul-2018
1-Jan-2019
1-Jul-2019
1-Jan-2020
1-Jul-2020
1-Jan-2021
1-Jul-2021
1-Jan-2022
1-Jul-2022
1-Jan-2023
1-Jul-2023
1-Jan-2024

Results for Simulations with 70% Repeat of 2011-2013 Stream Flow

AWRPTF Tier Strategy Set

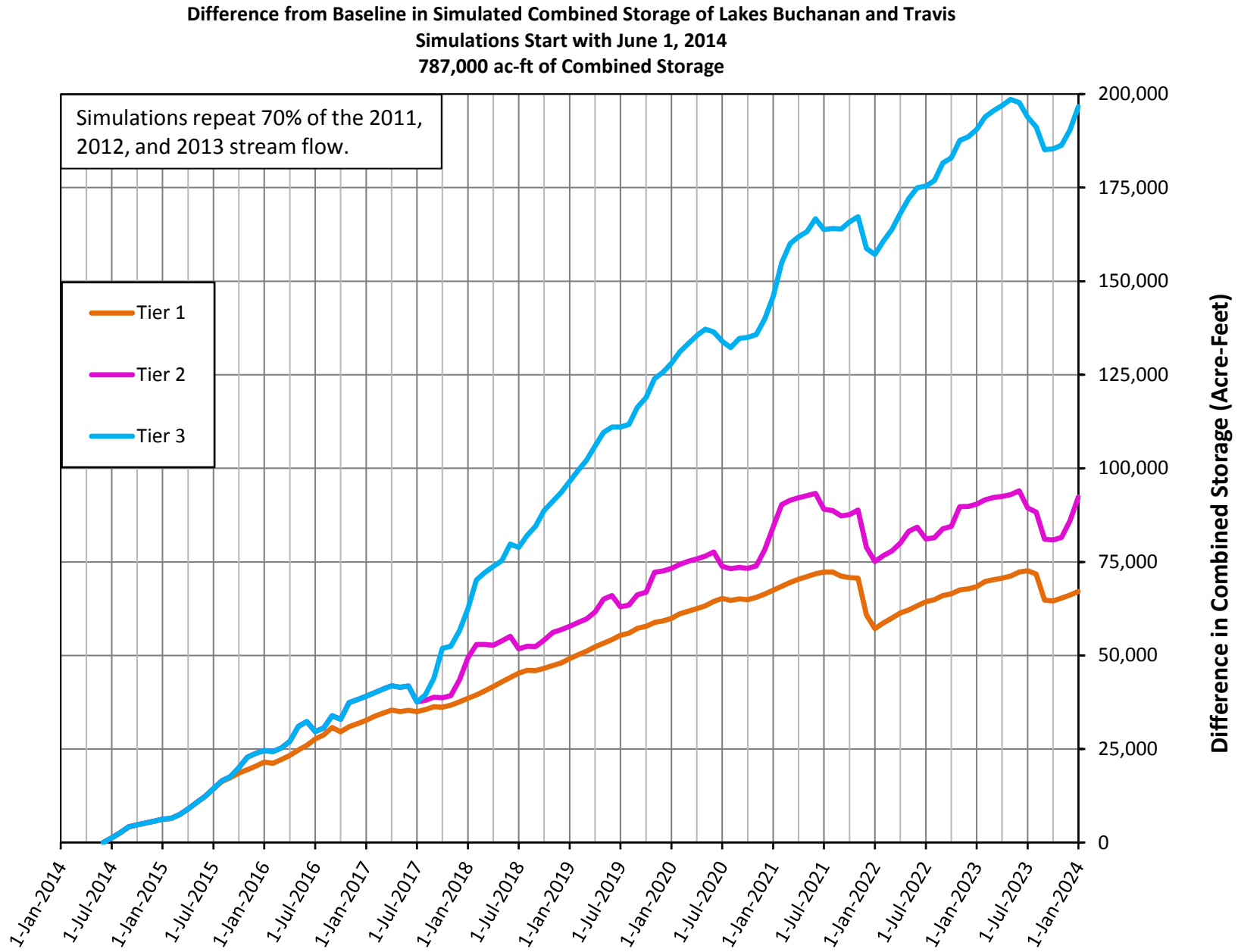


Time Spent at Various Combined Storage Levels

AWRPTF Tier Strategy Set

	Baseline	Tier 1	Tier 2	Tier 3
Storage	*Number of Months*			
At or Abv. 600k	13	13	13	13
500 - 599k	7	8	9	9
400 - 499k	13	17	20	27
Blw. 400k	83	78	74	67
	116	116	116	116

Storage	*Percent of Total Months*			
At or Abv. 600k	11%	11%	11%	11%
500 - 599k	6%	7%	8%	8%
400 - 499k	11%	15%	17%	23%
Blw. 400k	72%	67%	64%	58%
	100%	100%	100%	100%


Difference from Baseline in Simulated Combined Storage of Lakes Buchanan and Travis
Simulations Start with June 1, 2014
787,000 ac-ft of Combined Storage
Simulations repeat 70% of the 2011, 2012, and 2013 stream flow.
Tier 1
Tier 2
Tier 3
200,000
175,000
150,000
125,000
100,000
75,000
50,000
25,000
0
Difference in Combined Storage (Acre-Feet)
1-Jan-2014
1-Jul-2014
1-Jan-2015
1-Jul-2015
1-Jan-2016
1-Jul-2016
1-Jan-2017
1-Jul-2017
1-Jan-2018
1-Jul-2018
1-Jan-2019
1-Jul-2019
1-Jan-2020
1-Jul-2020
1-Jan-2021
1-Jul-2021
1-Jan-2022
1-Jul-2022
1-Jan-2023
1-Jul-2023
1-Jan-2024

Observations

- As strategies increase combined storage, firm demands and environmental flow requirements can increase. The benefit of the strategy can be measured in:
  - absolute gain in combined storage, and
  - the number of months spent at levels:
    - above the trigger for pro-rata reductions and implementing Austin's DCP stages, and
    - at higher levels of environmental flow maintenance
- The 70% stream flow scenario results in combined storage below 500,000 acre-feet for most of the simulation. Includes assumption pro-rata curtailment reduces instream flow and bay & estuary inflow requirements by 30% at these levels.

Observations (Continued)

- In the model, excess flow capture on Lake Austin, Lady Bird Lake, and at the river pump station for Lake Long increases as the combined storage in the Highland Lakes falls and firm customer demands and environmental flow requirements are curtailed.

- In the model, excess flow capture on Lake Austin, Lady Bird Lake, and indirect potable reuse through Lady Bird Lake work synergistically with operation of Lake Long as an excess flow storage and release facility. Releases from Lake Long increase the number of months when upstream flows can be counted as excess. Likewise, Lake Long releases offset the decrease in return flows below Longhorn Dam due to indirect potable reuse.

Other Considerations

- Certain assumptions were made in the modeling regarding water right permitting and priority order consideration of stream flows. Modifying operations of existing water rights may require application for a water right amendment at TCEQ.