Upper Santa Ana River Integrated Model
Summary Report

Part 3 of 5: Figures (Part 2)

DRAFT

Prepared For: San Bernardino Valley Municipal Water District

April 29, 2020

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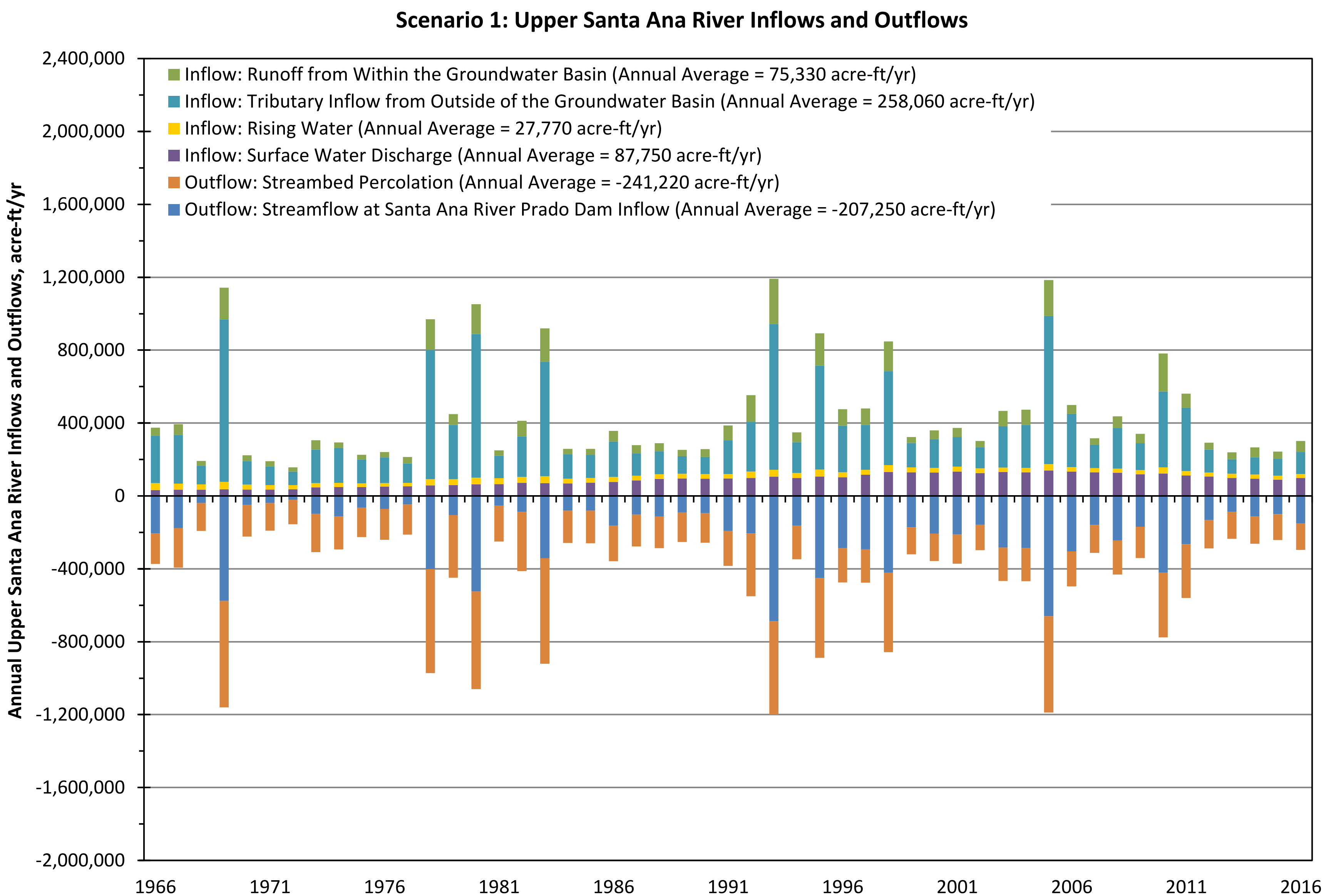


Figure 312

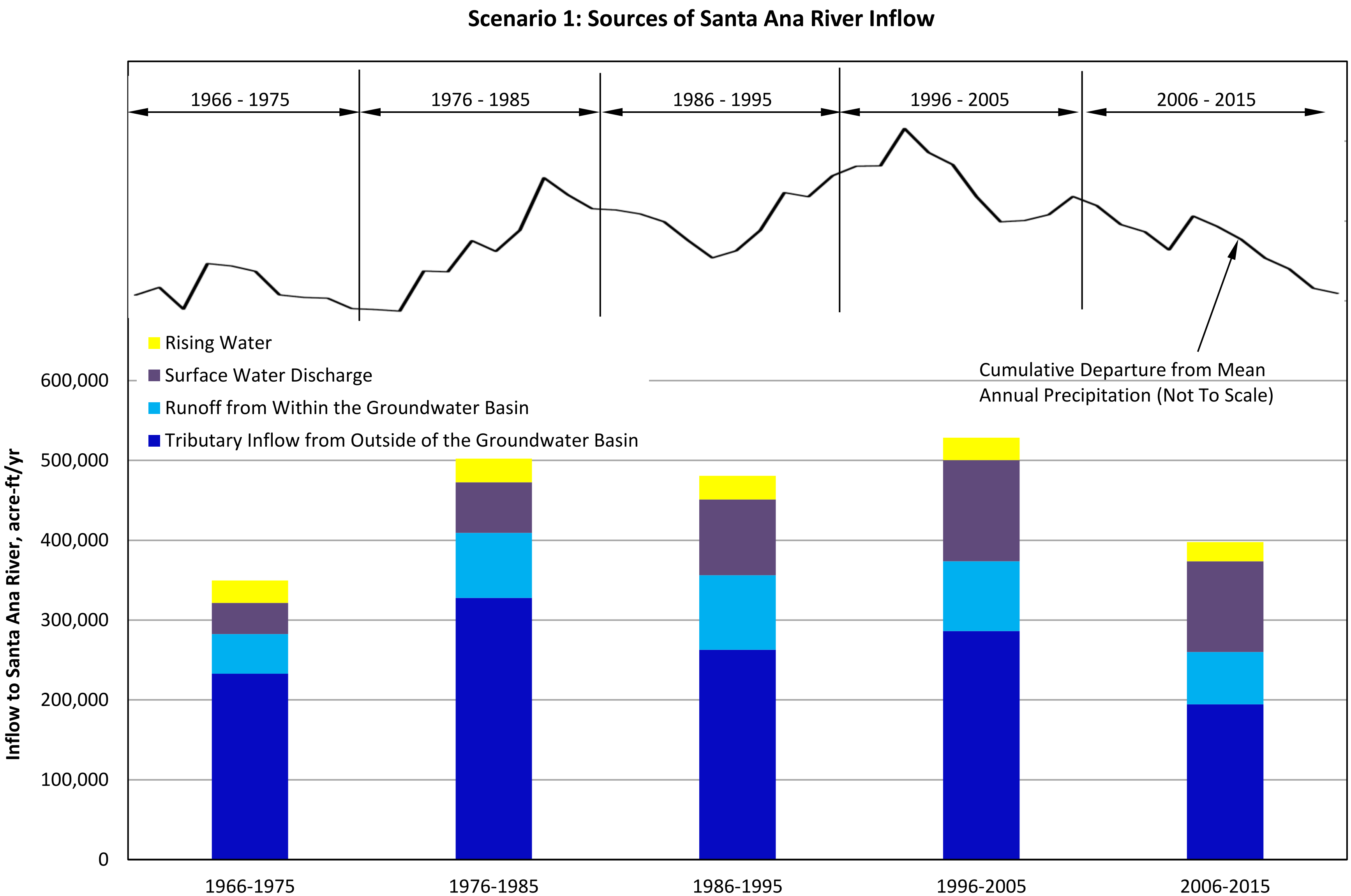

Scenario 1: Sources of Santa Ana River Inflow
1966 - 1975
1976 - 1985
1986 - 1995
1996 - 2005
2006 - 2015
Rising Water
Surface Water Discharge
Runoff from Within the Groundwater Basin
Tributary Inflow from Outside of the Groundwater Basin
Cumulative Departure from Mean Annual Precipitation (Not To Scale)
Inflow to Santa Ana River, acre-ft/yr
600,000
500,000
400,000
300,000
200,000
100,000
0
1966-1975
1976-1985
1986-1995
1996-2005
2006-2015

Figure 313

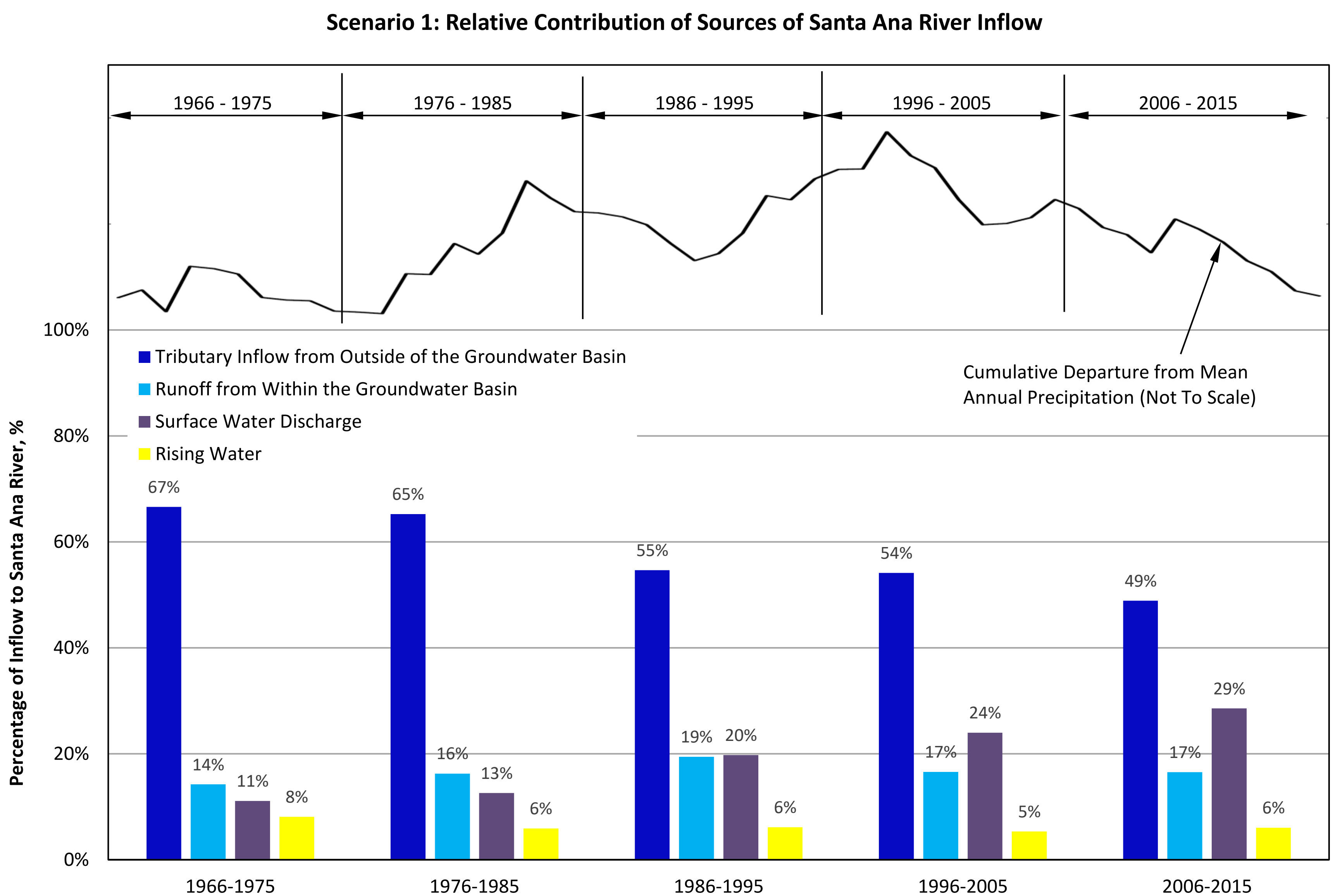
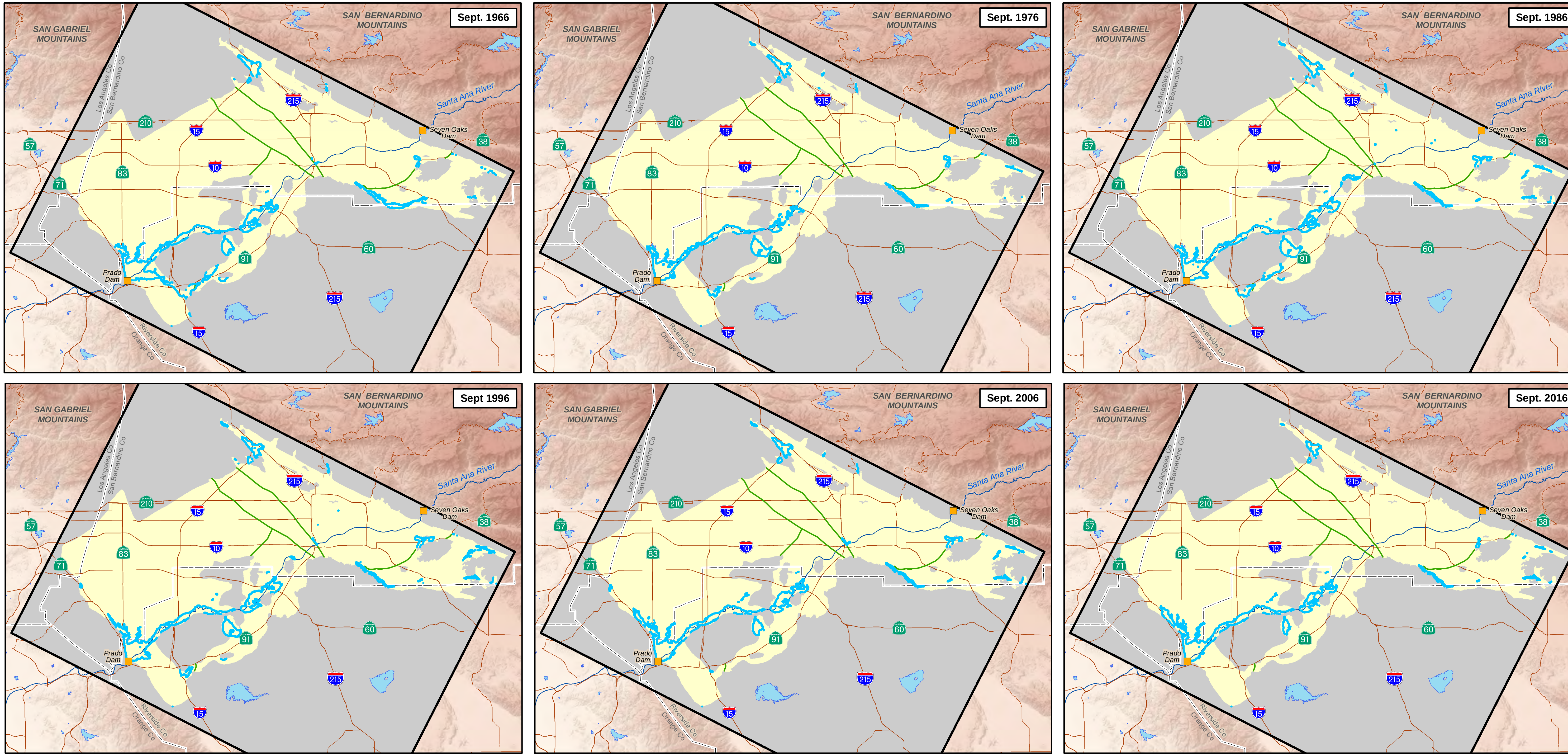

Scenario 1: Relative Contribution of Sources of Santa Ana River Inflow
1966 - 1975
1976 - 1985
1986 - 1995
1996 - 2005
2006 - 2015
Cumulative Departure from Mean Annual Precipitation (Not To Scale)
Tributary Inflow from Outside of the Groundwater Basin
Runoff from Within the Groundwater Basin
Surface Water Discharge
Rising Water
Percentage of Inflow to Santa Ana River, %
100%
80%
60%
40%
20%
0%
67%
14%
11%
8%
65%
16%
13%
6%
55%
19%
20%
6%
54%
17%
24%
5%
49%
17%
29%
6%
1966-1975
1976-1985
1986-1995
1996-2005
2006-2015

Figure 314



EXPLANATION

- Integrated SAR Model Boundary
- Active Model Area
- Inactive Model Area
- Depth to Shallow Groundwater Less Than 10 Feet
- Groundwater Basin Boundary
- Dam Location Used in Upper Santa Ana River Watershed Model

Scenario 1:
Evaluate Flow in the SAR and Identify Factors that May be Causing Reduced Flows

N

0 10 20

Miles

SCENARIO 1:
AVERAGE SHALLOW GROUNDWATER FOOTPRINT THROUGH TIME

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SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

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FIGURE 315

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

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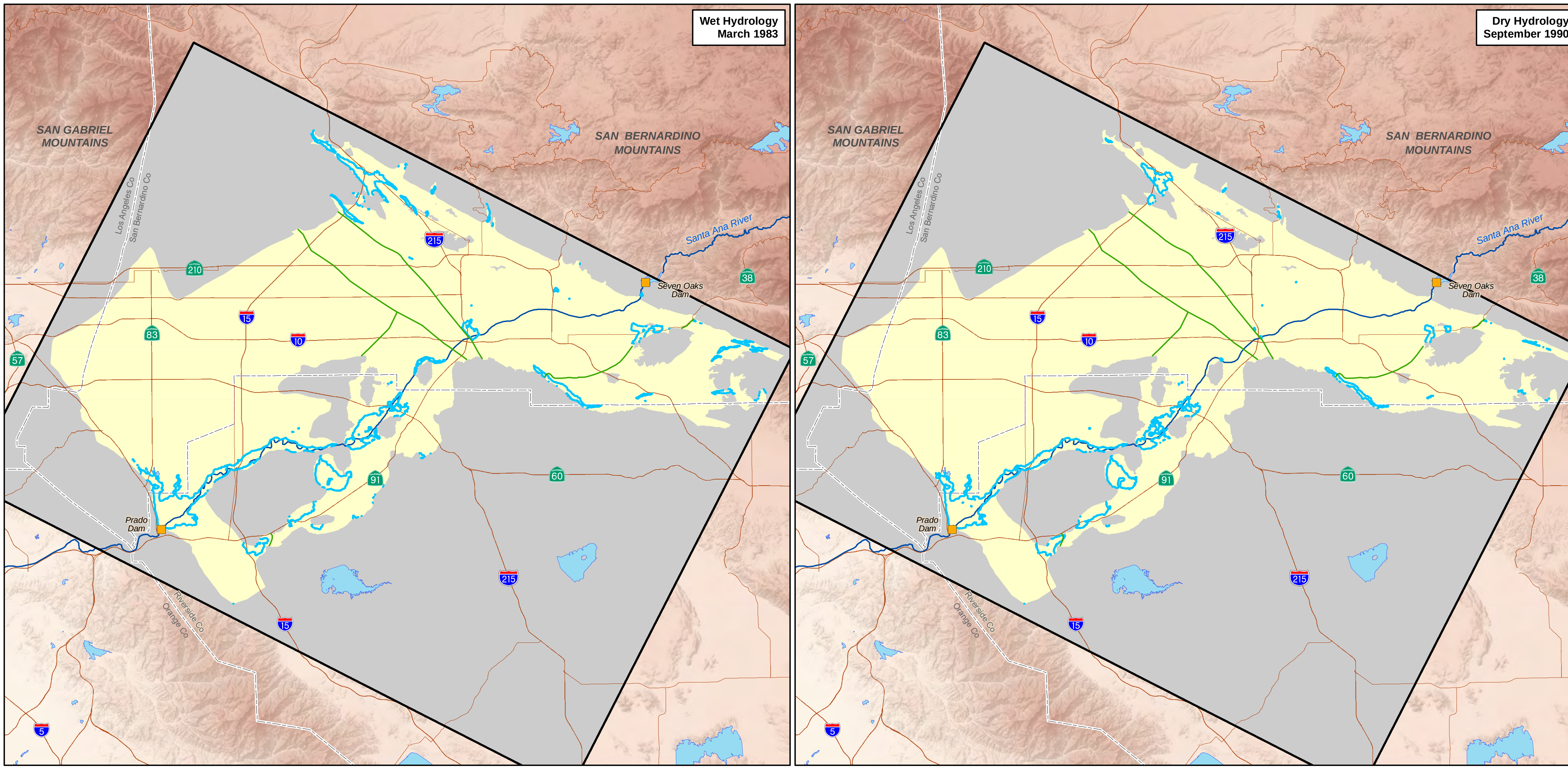

EXPLANATION

Integrated SAR Model Boundary

Active Model Area

Inactive Model Area

Depth to Shallow Groundwater
Less Than 10 Feet

Groundwater Basin Boundary

Dam Location Used in Upper
Santa Ana River Watershed Model

Scenario 1:
Evaluate Flow in the SAR and Identify
Factors that May be Causing
Reduced Flows

N

0 5 10

Miles

SCENARIO 1:
SHALLOW GROUNDWATER
FOOTPRINT
(DRY AND WET
HYDROLOGIC CONDITIONS)

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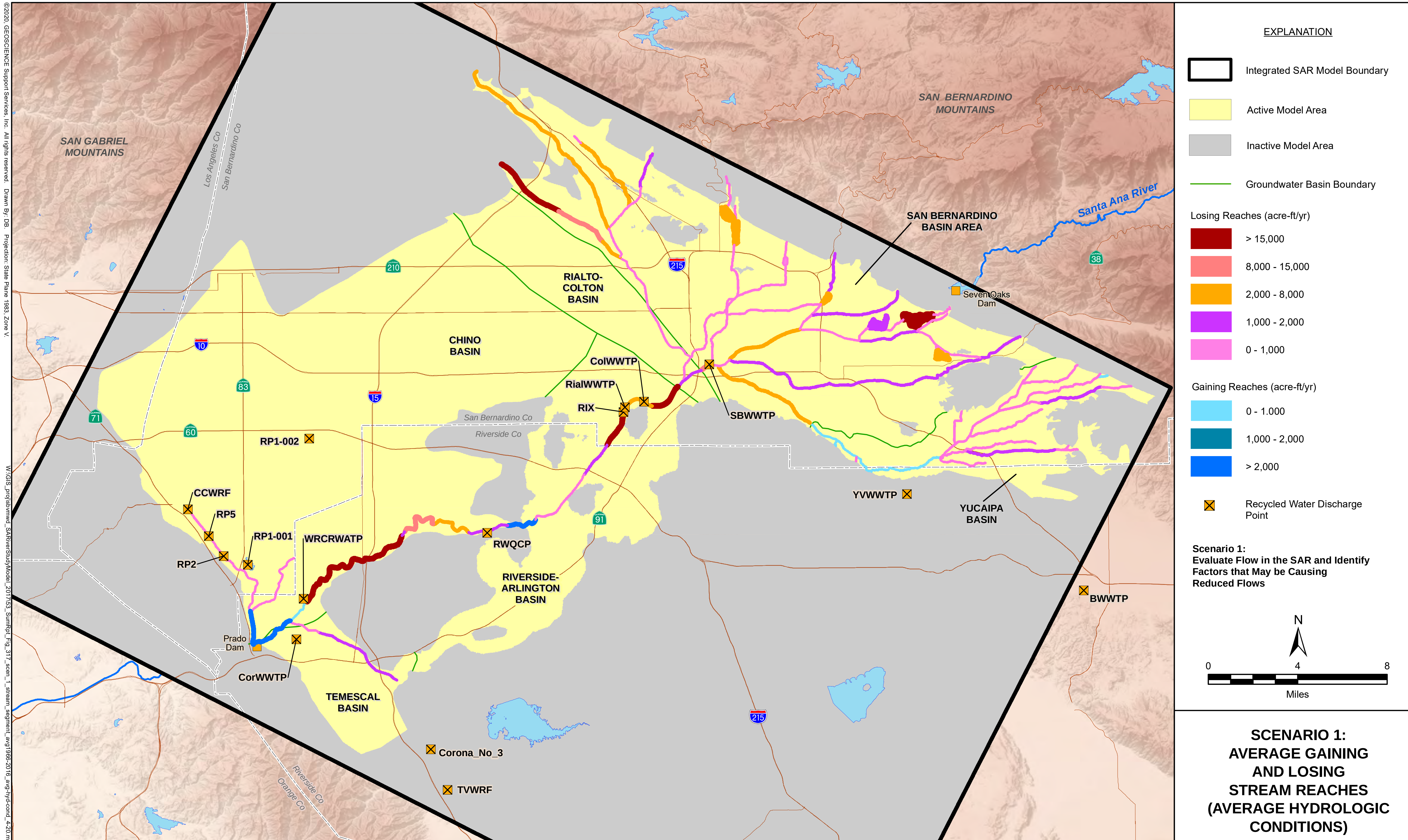

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SCENARIO 1: AVERAGE GAINING AND LOSING STREAM REACHES (AVERAGE HYDROLOGIC CONDITIONS)

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FIGURE 317

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

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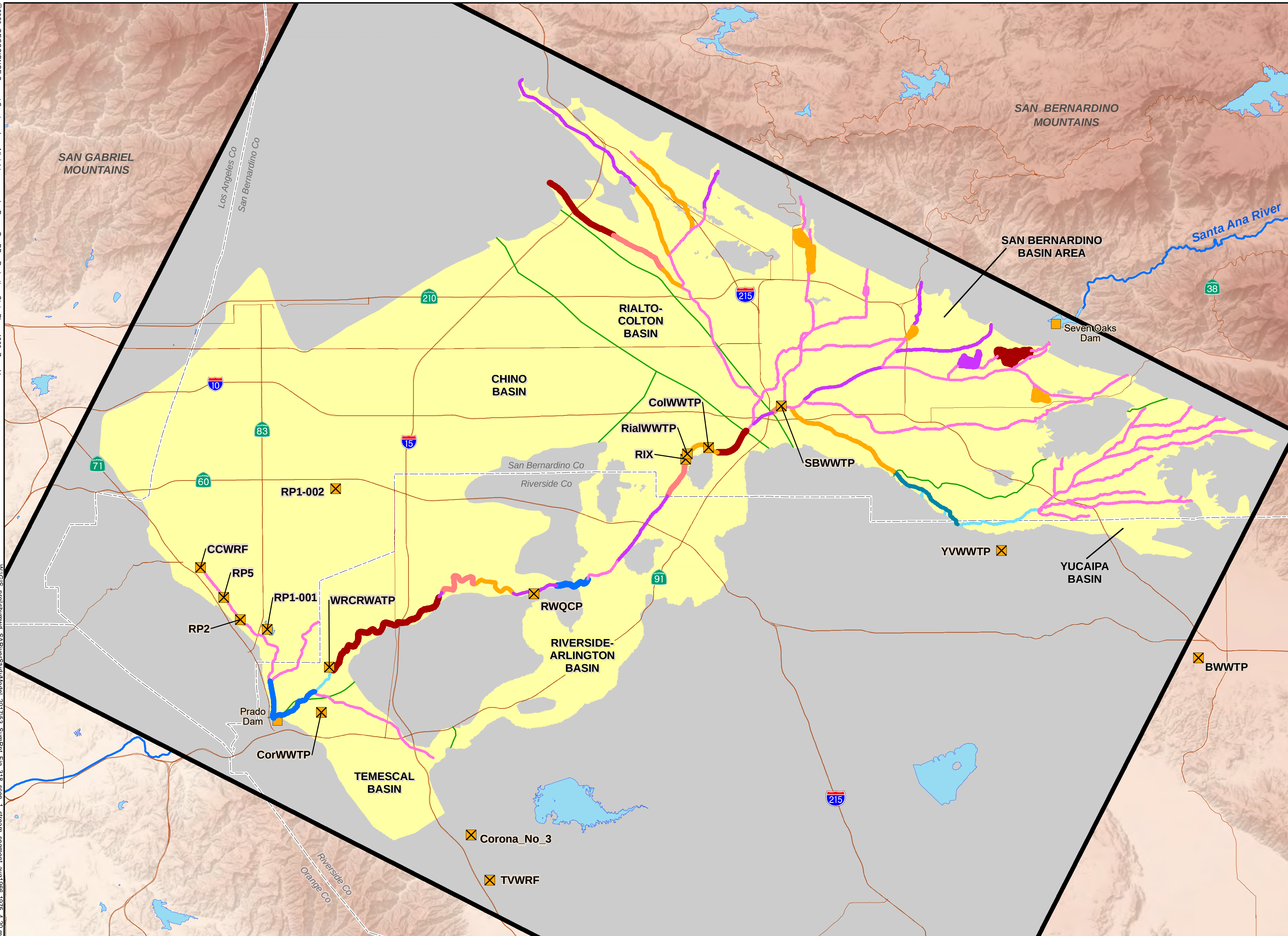

EXPLANATION

Integrated SAR Model Boundary

Active Model Area

Inactive Model Area

Groundwater Basin Boundary

Losing Reaches (acre-ft/yr)

> 15,000

8,000 - 15,000

2,000 - 8,000

1,000 - 2,000

0 - 1,000

Gaining Reaches (acre-ft/yr)

0 - 1,000

1,000 - 2,000

> 2,000

Recycled Water Discharge Point

Scenario 1:
Evaluate Flow in the SAR and Identify Factors that May be Causing Reduced Flows

N

0 4 8

Miles

SCENARIO 1: AVERAGE GAINING AND LOSING STREAM REACHES 1966 - 1975

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SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

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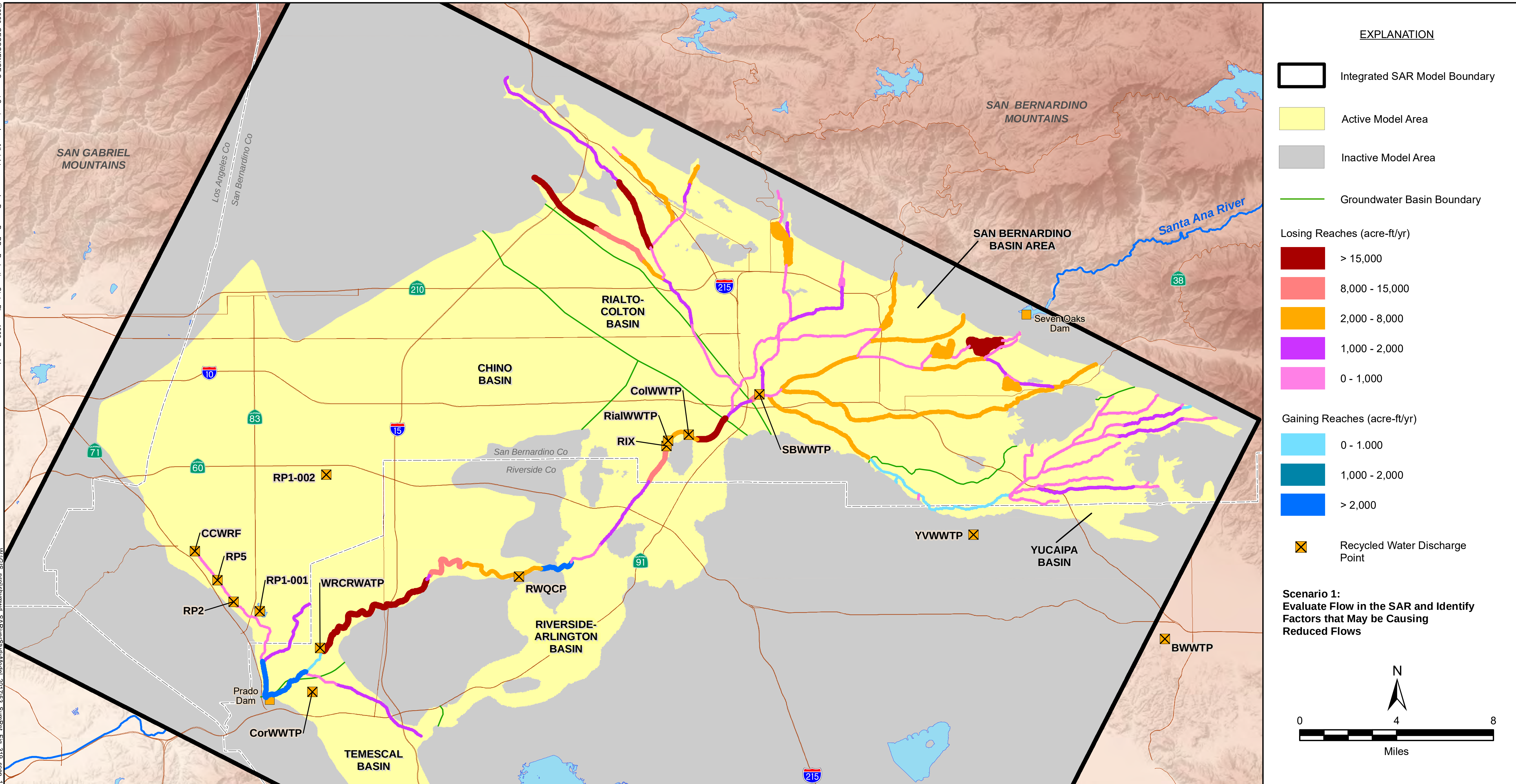
FIGURE 318

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

GEOSCIENCE



SCENARIO 1: AVERAGE GAINING AND LOSING STREAM REACHES 1976 - 1985

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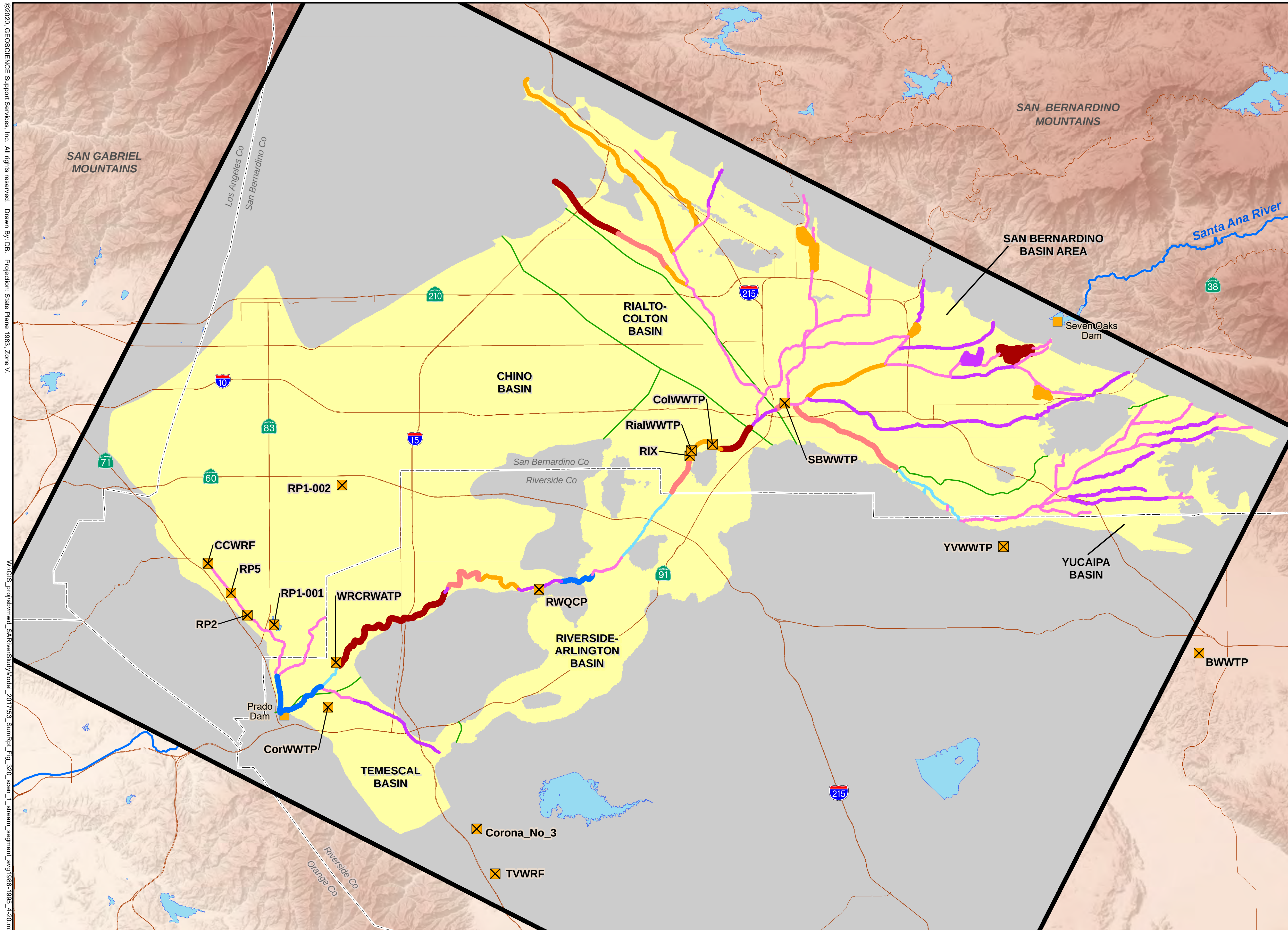

**SCENARIO 1:
AVERAGE GAINING
AND LOSING
STREAM REACHES
1986 - 1995**

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SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT **DRAFT** **FIGURE 320**

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

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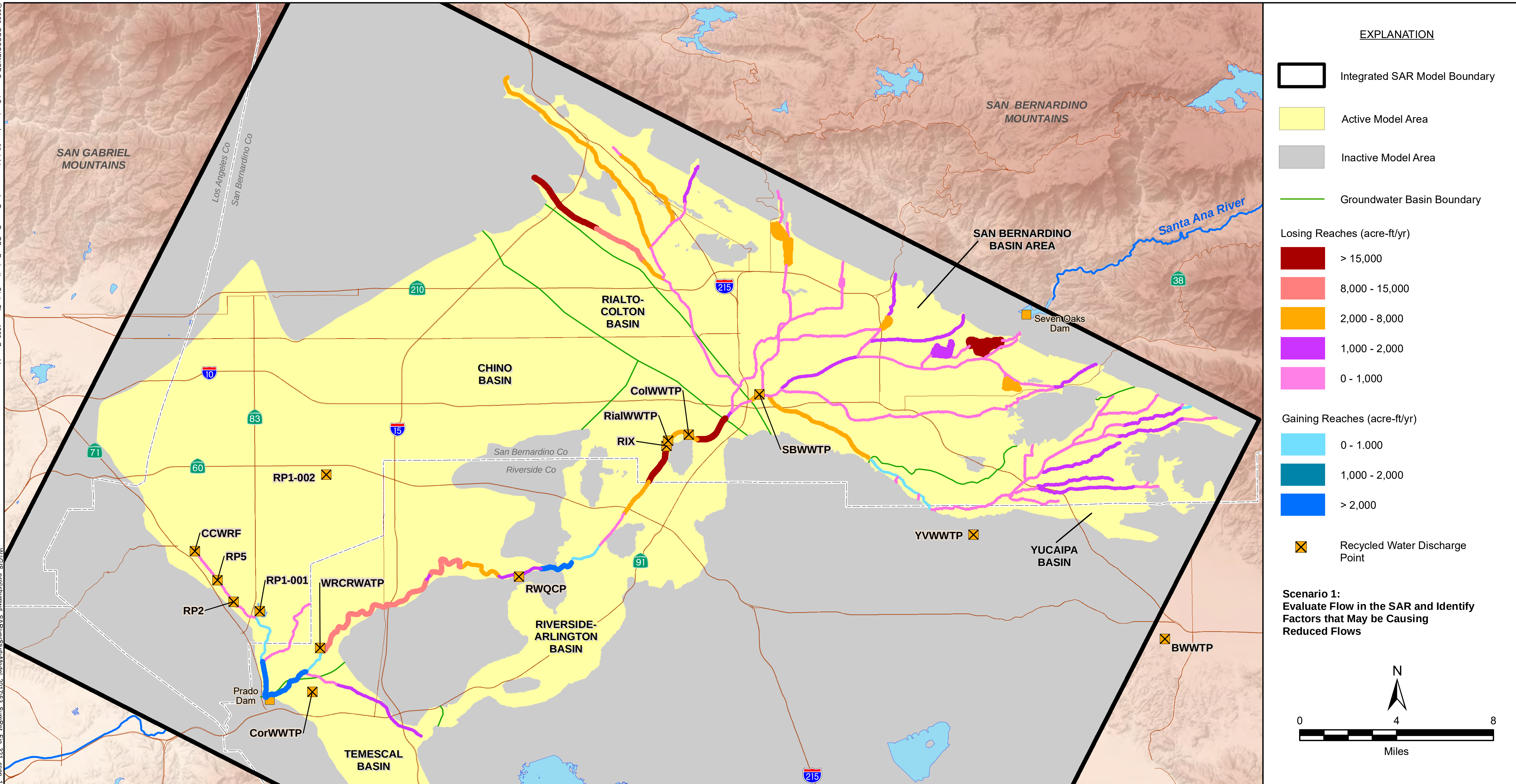

SCENARIO 1: AVERAGE GAINING AND LOSING STREAM REACHES 1996 - 2005

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SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT **DRAFT** **FIGURE 321**

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

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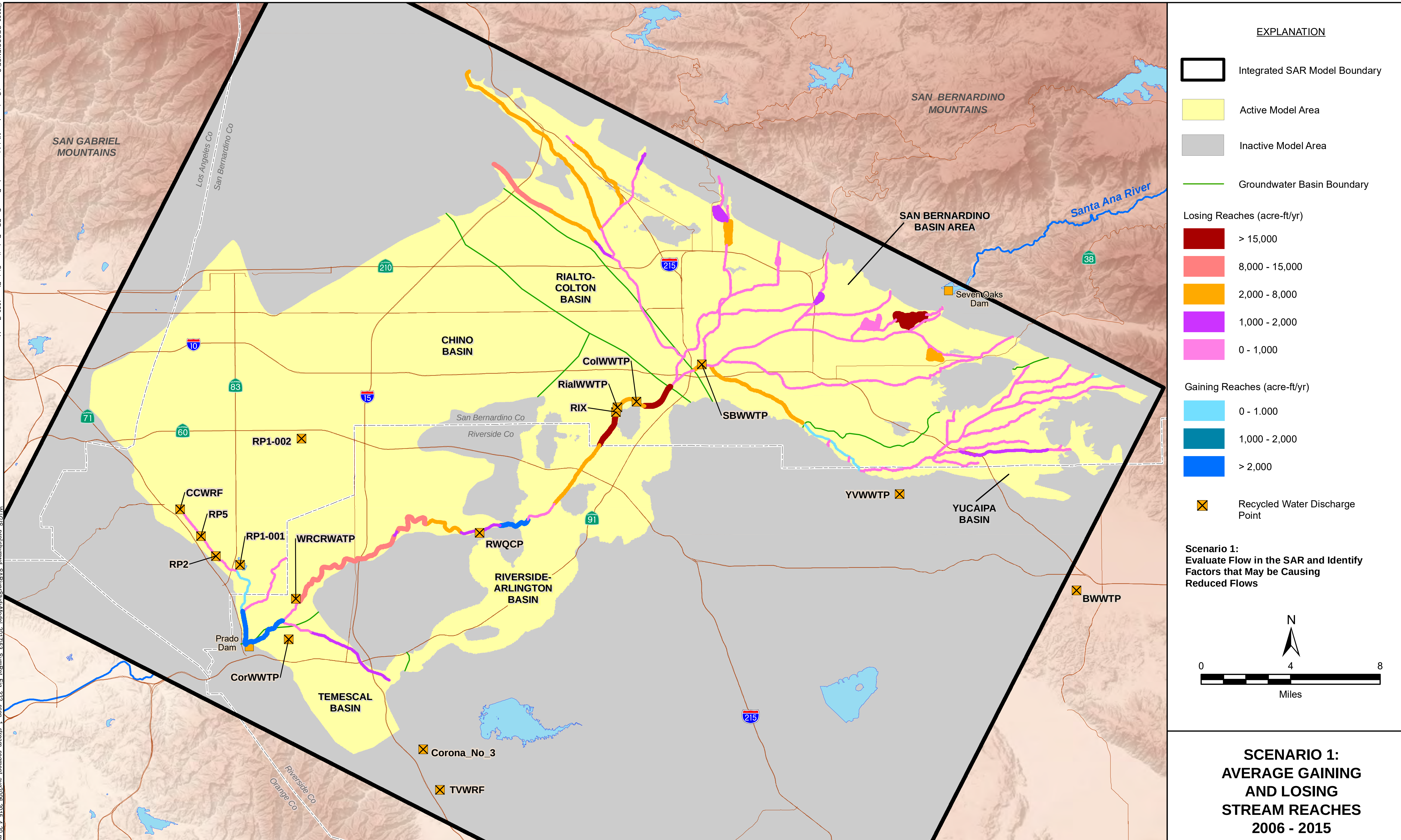

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UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

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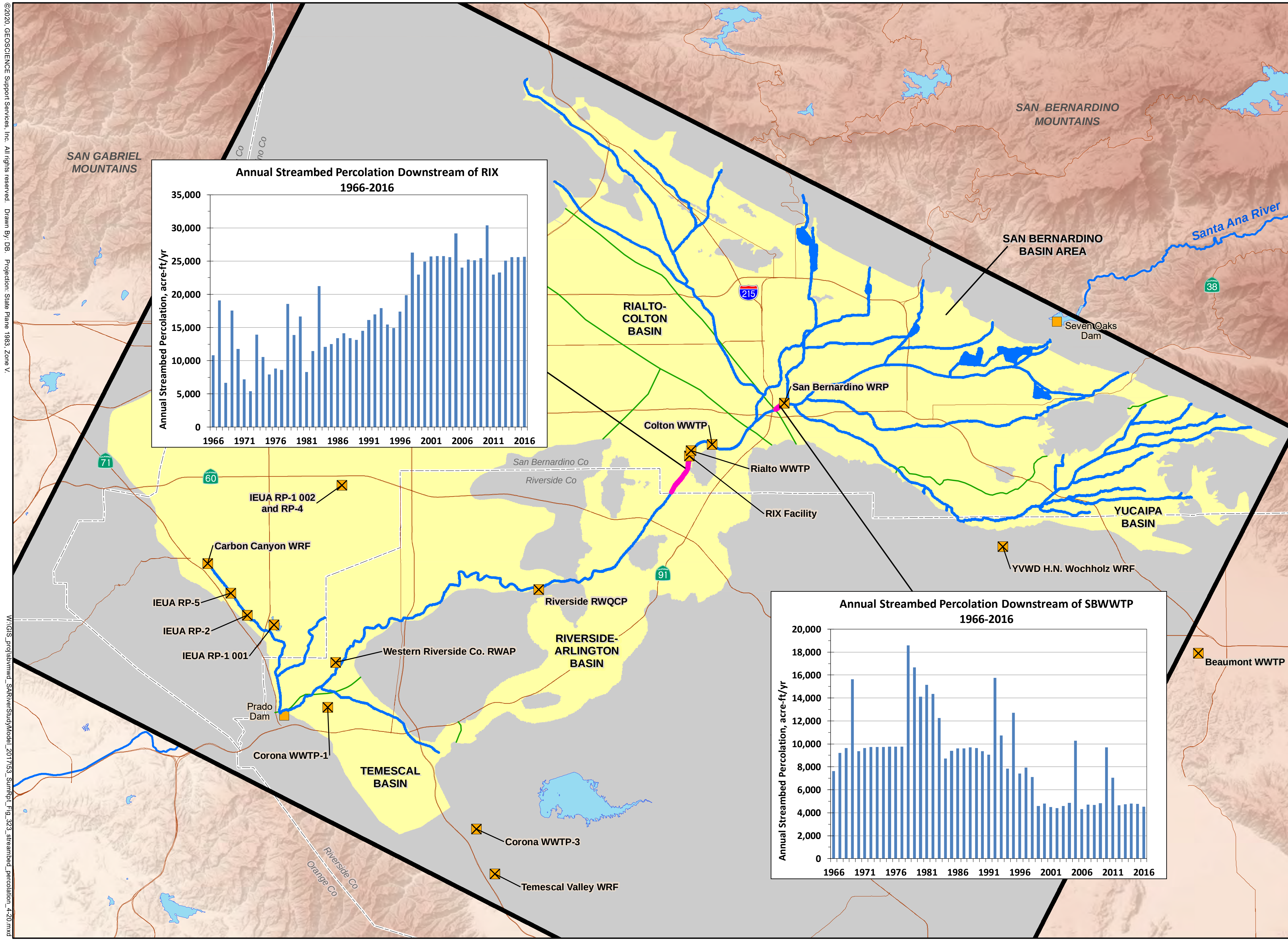
FIGURE 322

GEOSCIENCE



EXPLANATION

- Integrated SAR Model Boundary
- Active Model Area
- Inactive Model Area
- Groundwater Basin Boundary
- Selected Stream Reach
- Recharge Water Discharge Point Location

Scenario 1:
Evaluate Flow in the SAR and Identify Factors that May be Causing Reduced Flows

N

0 4 8
Miles

SCENARIO 1:
ANNUAL STREAMBED PROCOLATION IN SELECTED REACHES

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UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

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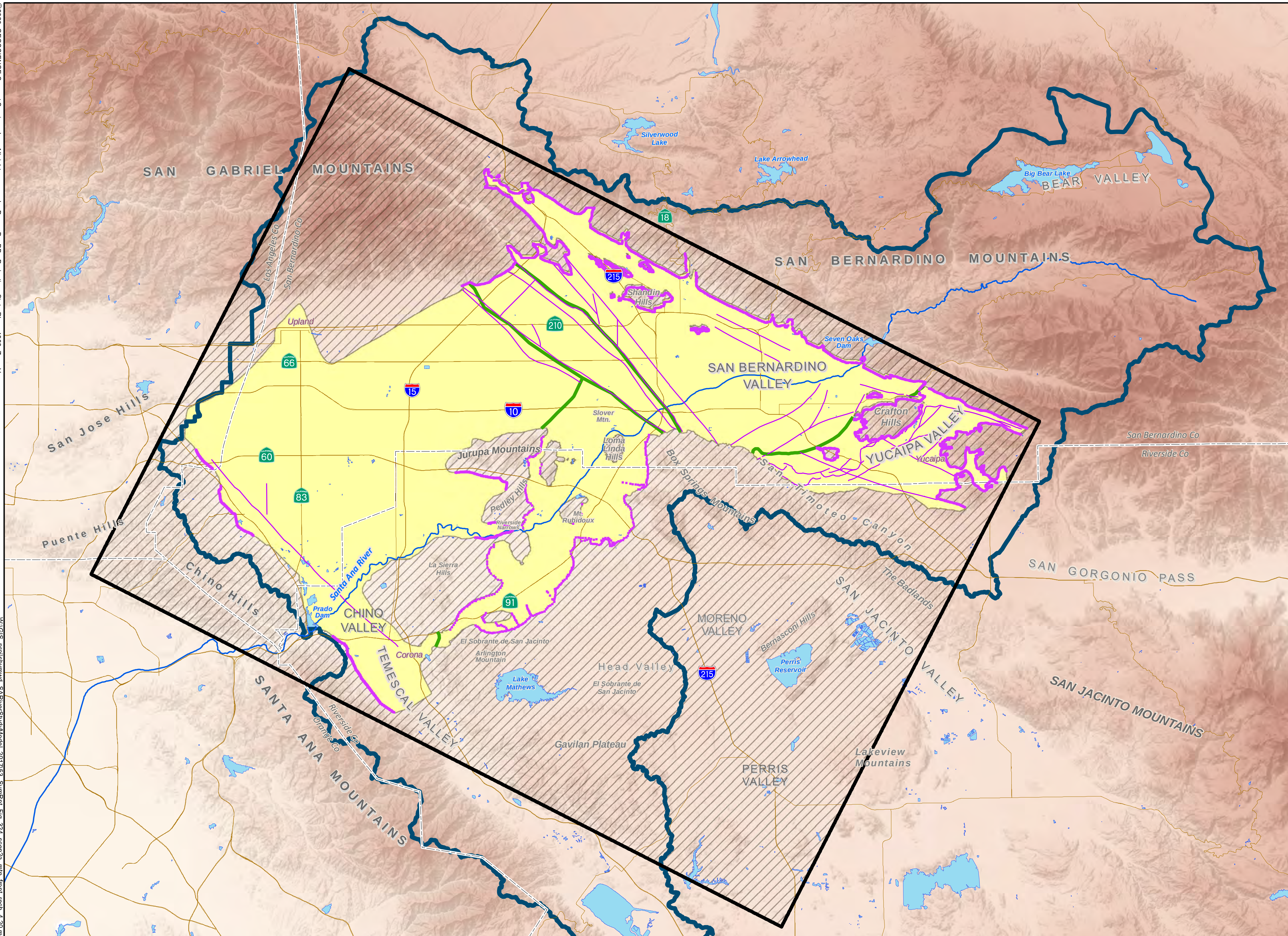
FIGURE 323

GEOSCIENCE



EXPLANATION

- Upper Santa Ana River Watershed Boundary
- Integrated SAR Model Boundary
- Active Model Area
- Inactive Model Area
- Location of Mountain Front Recharge
- Groundwater Basin Boundary
- Groundwater Flow Barrier

N

0 5 10

Miles

SCENARIO 2a (BASELINE): LOCATION OF RECHARGE FROM MOUNTAIN FRONT RUNOFF

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UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

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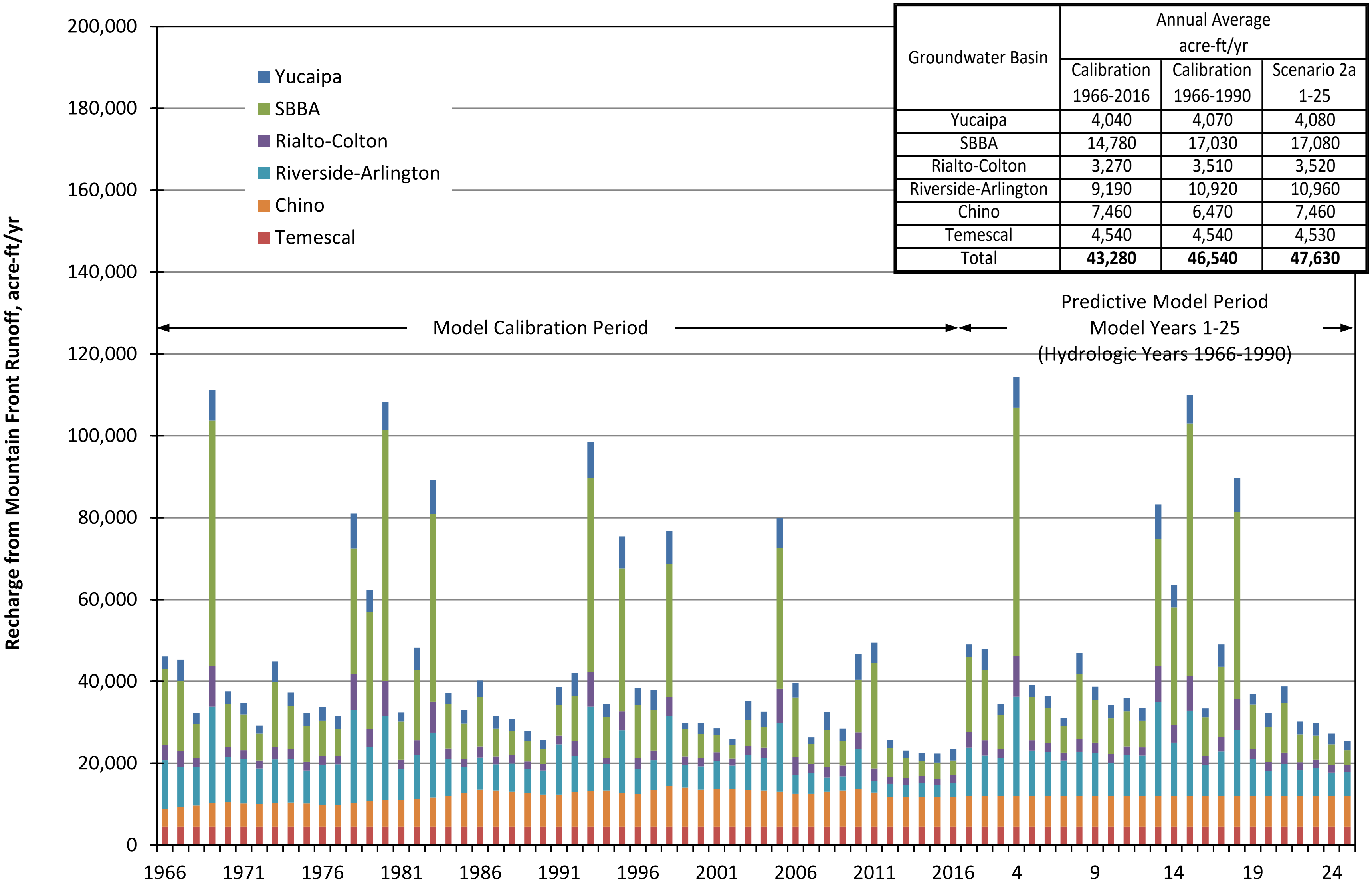
FIGURE 324

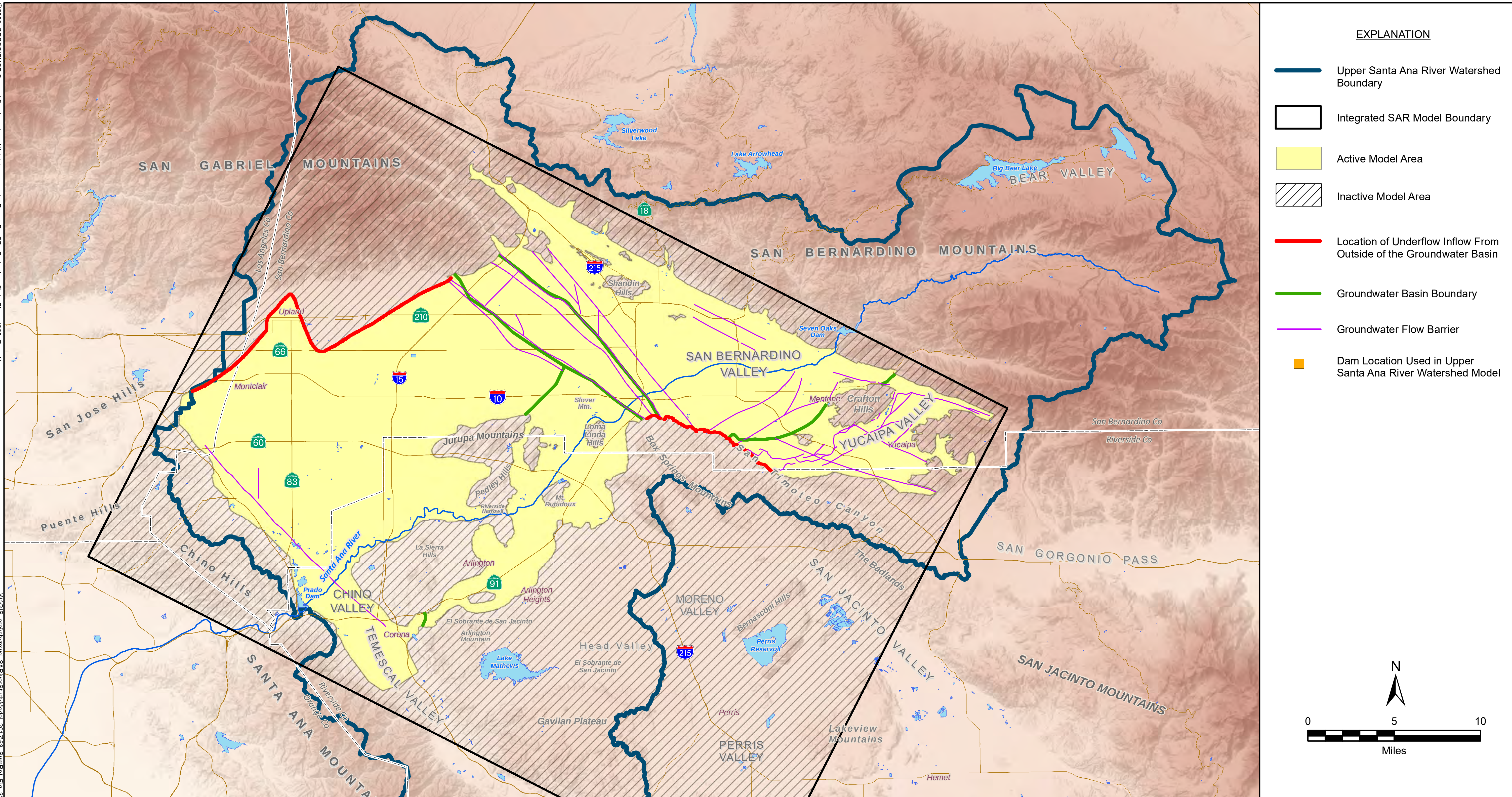
GEOSCIENCE

Scenario 2a (Baseline): Annual Recharge from Mountain Front Runoff



Groundwater Basin	Annual Average acre-ft/yr		
	Calibration 1966-2016	Calibration 1966-1990	Scenario 2a 1-25
Yucaipa	4,040	4,070	4,080
SBBA	14,780	17,030	17,080
Rialto-Colton	3,270	3,510	3,520
Riverside-Arlington	9,190	10,920	10,960
Chino	7,460	6,470	7,460
Temescal	4,540	4,540	4,530
Total	**43,280**	**46,540**	**47,630**

Figure 325



SCENARIO 2a (BASELINE): LOCATION OF UNDERFLOW INFLOW

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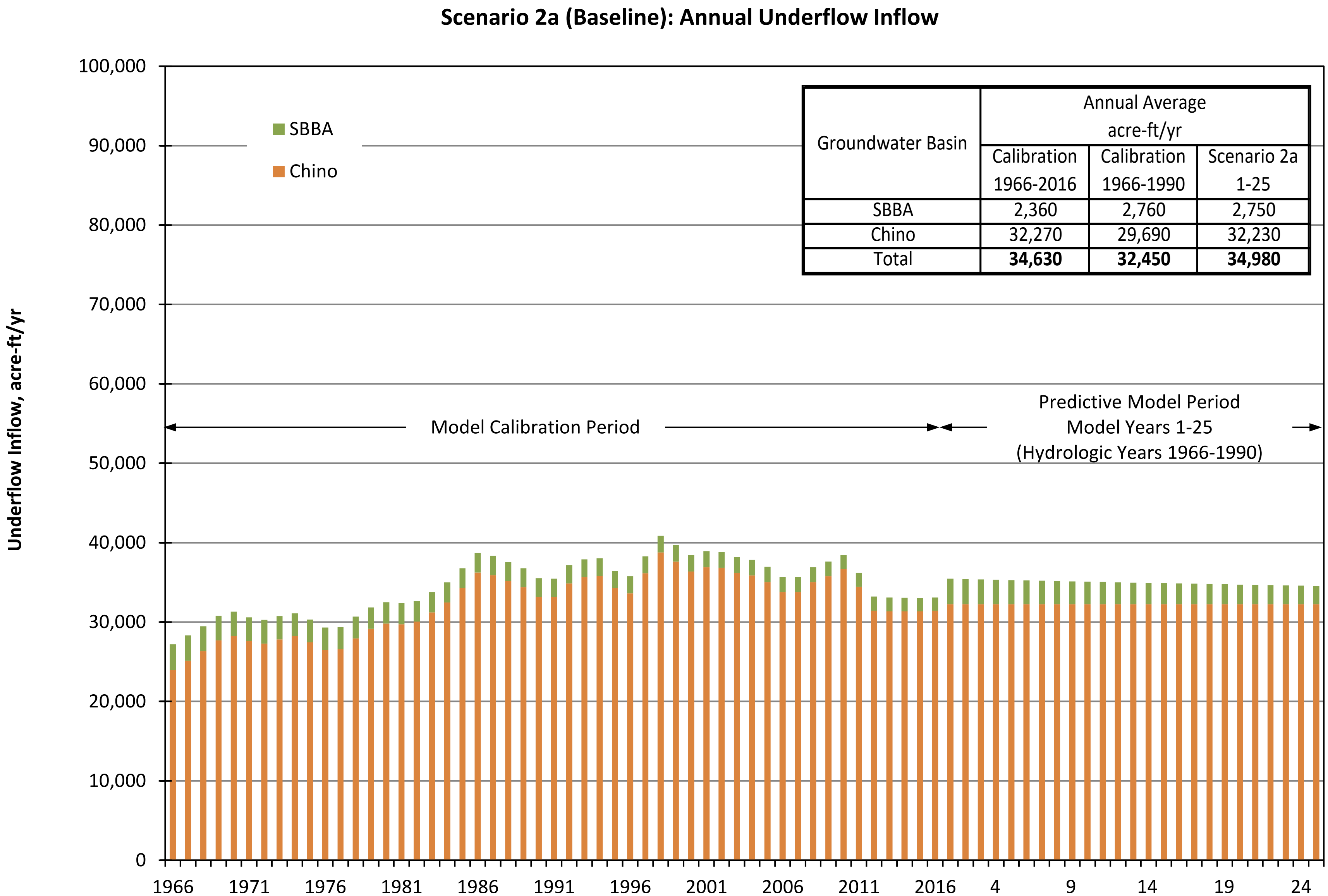
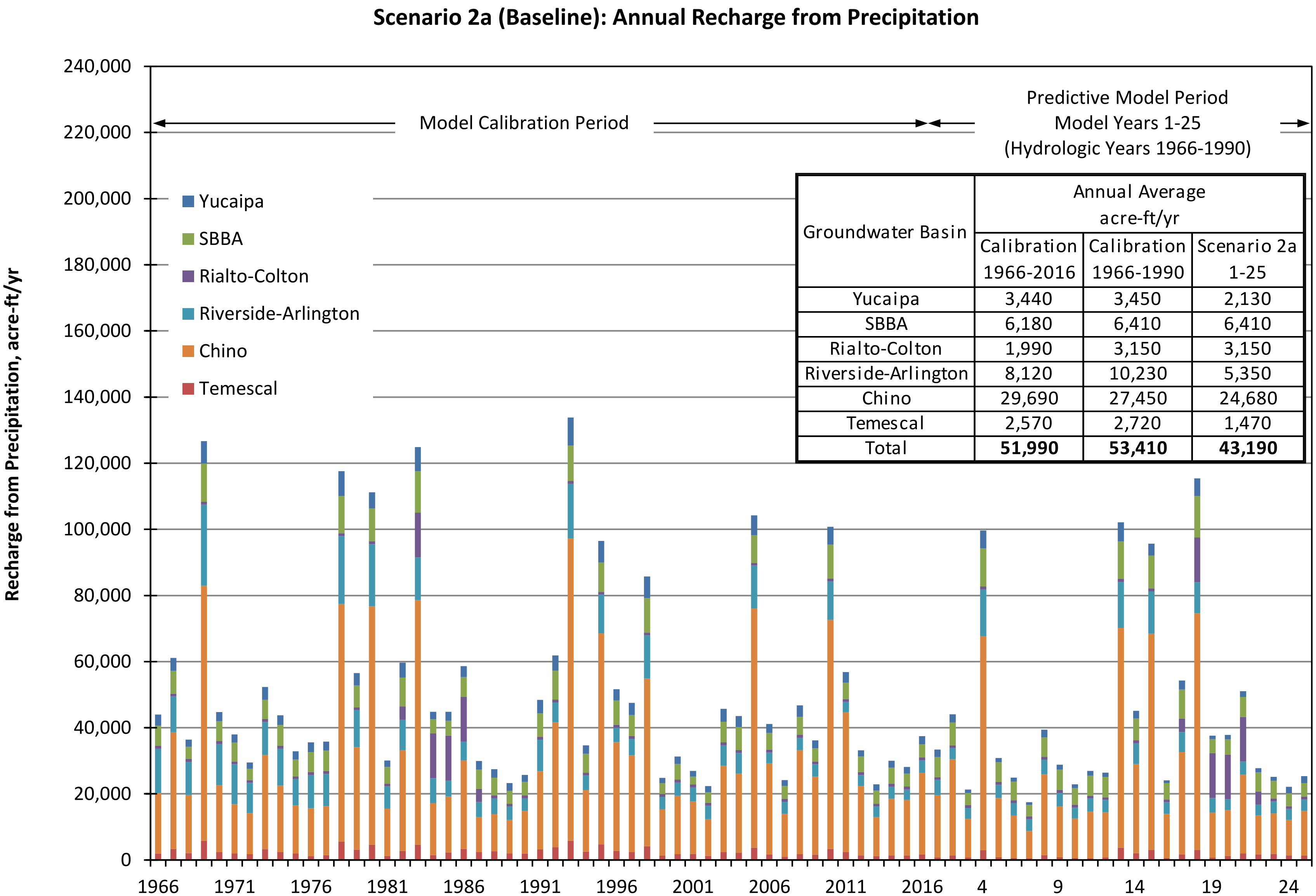

Scenario 2a (Baseline): Annual Underflow Inflow
SBBA
Chino
Groundwater Basin
Annual Average acre-ft/yr
Calibration 1966-2016
Calibration 1966-1990
Scenario 2a 1-25
SBBA 2,360 2,760 2,750
Chino 32,270 29,690 32,230
Total 34,630 32,450 34,980
Model Calibration Period
Predictive Model Period
Model Years 1-25
(Hydrologic Years 1966-1990)
Underflow Inflow, acre-ft/yr
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
1966
1971
1976
1981
1986
1991
1996
2001
2006
2011
2016
4
9
14
19
24

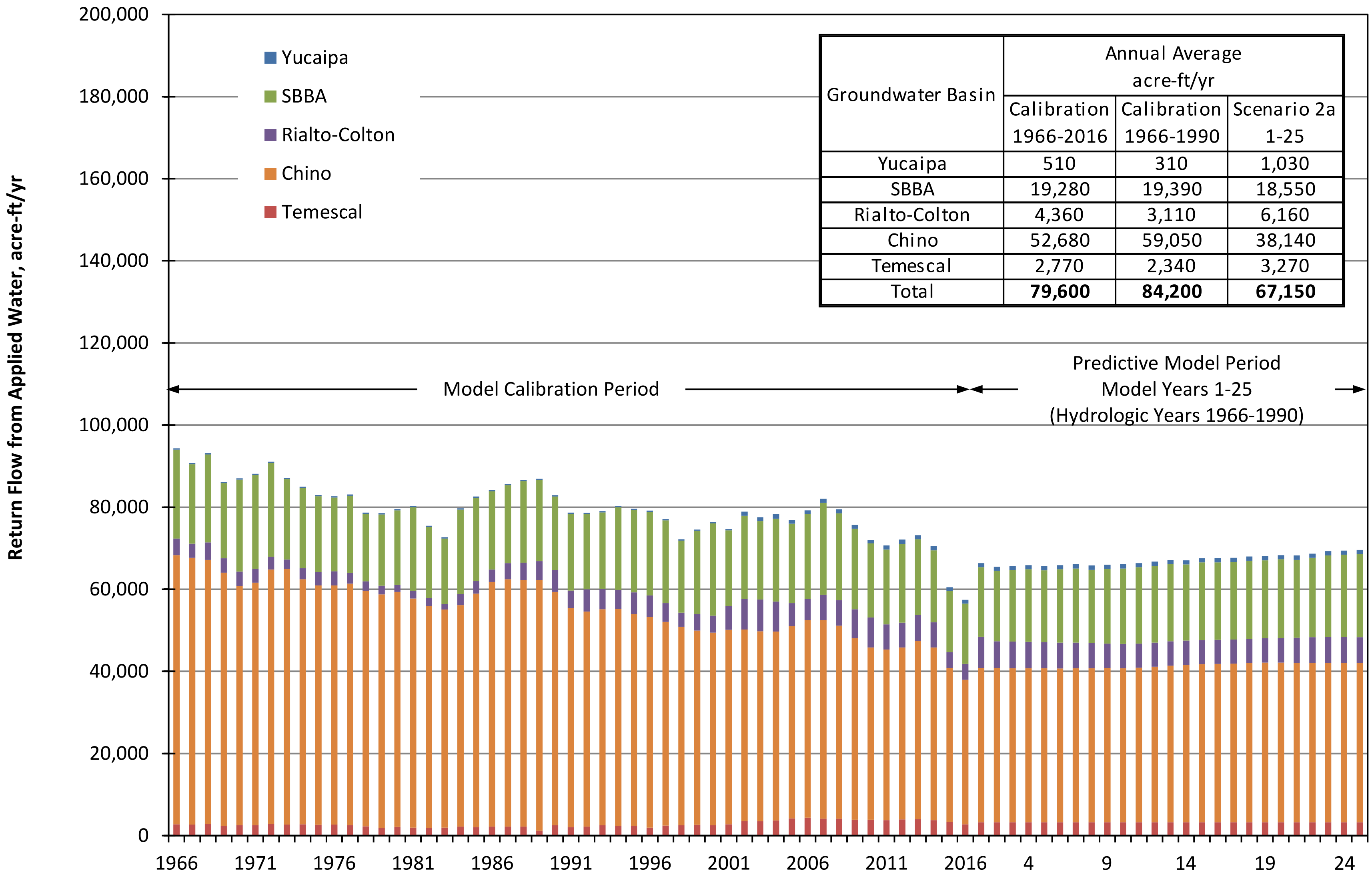
Figure 327



Groundwater Basin	Annual Average acre-ft/yr		
	Calibration 1966-2016	Calibration 1966-1990	Scenario 2a 1-25
Yucaipa	3,440	3,450	2,130
SBBA	6,180	6,410	6,410
Rialto-Colton	1,990	3,150	3,150
Riverside-Arlington	8,120	10,230	5,350
Chino	29,690	27,450	24,680
Temescal	2,570	2,720	1,470
Total	**51,990**	**53,410**	**43,190**

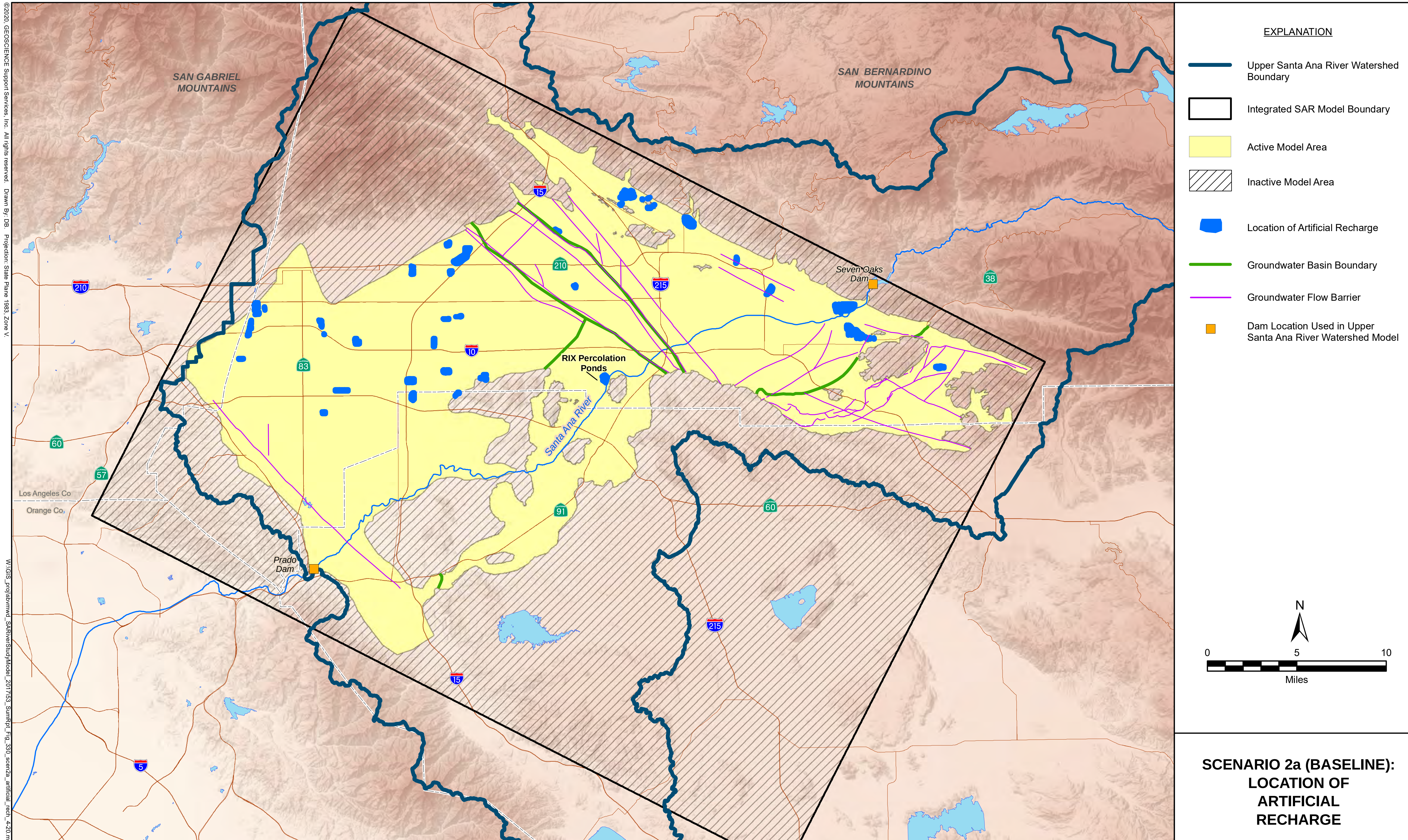
Figure 328

Scenario 2a (Baseline): Annual Return Flow from Applied Water



Groundwater Basin	Annual Average acre-ft/yr		
	Calibration 1966-2016	Calibration 1966-1990	Scenario 2a 1-25
Yucaipa	510	310	1,030
SBBA	19,280	19,390	18,550
Rialto-Colton	4,360	3,110	6,160
Chino	52,680	59,050	38,140
Temescal	2,770	2,340	3,270
Total	**79,600**	**84,200**	**67,150**

Figure 329



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SCENARIO 2a (BASELINE): LOCATION OF ARTIFICIAL RECHARGE

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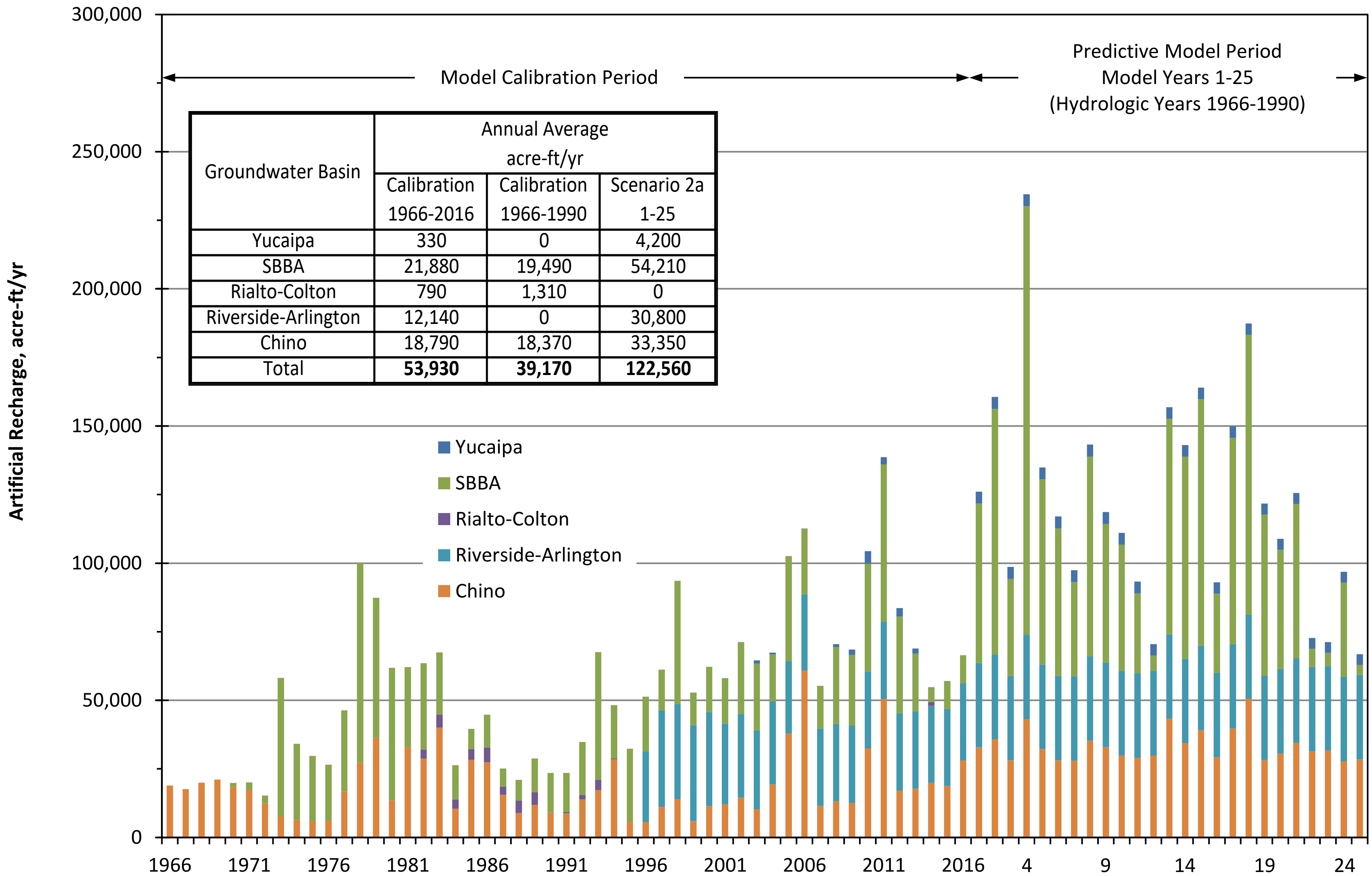
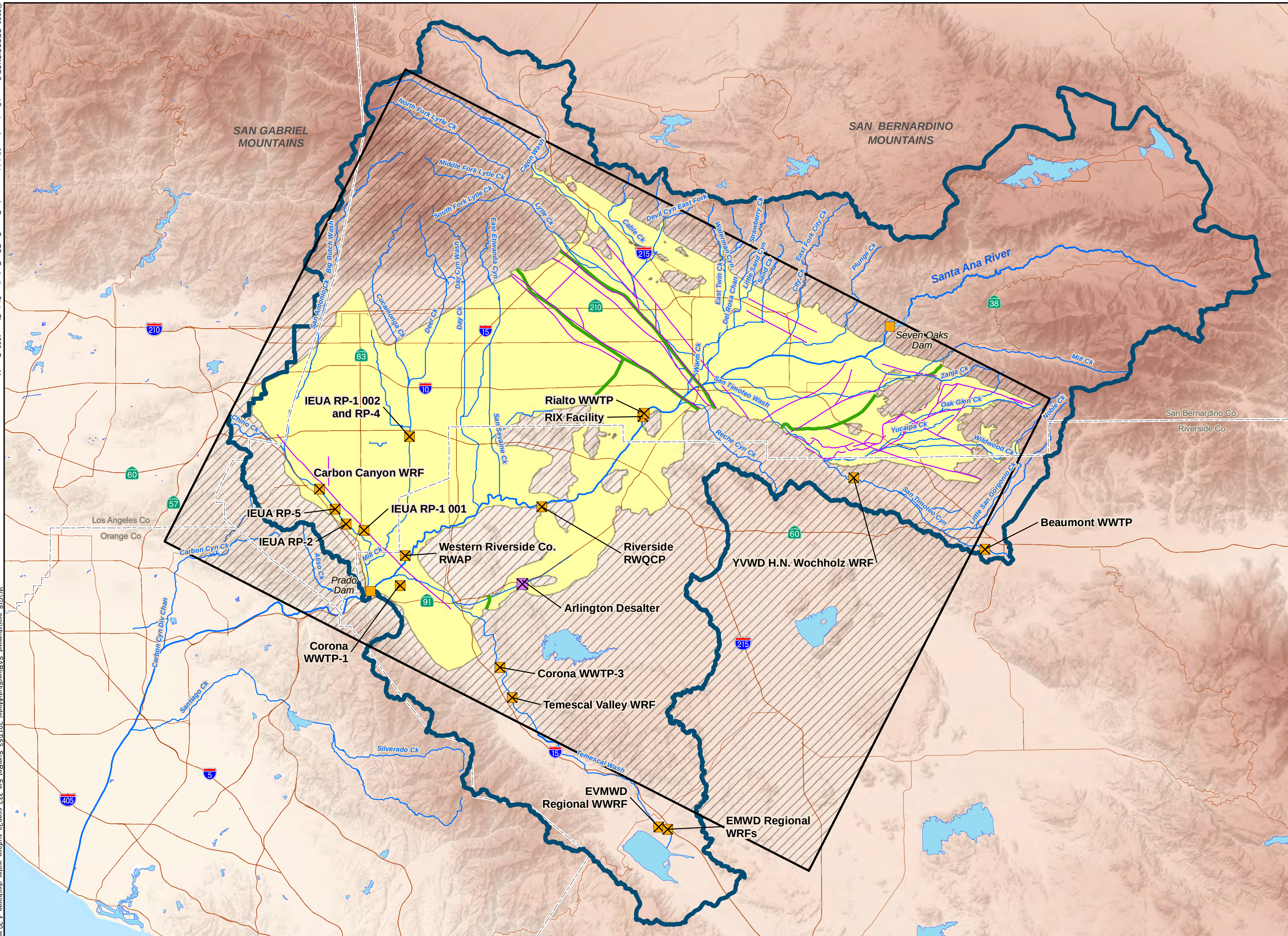
FIGURE 330

Scenario 2a (Baseline): Annual Artificial Recharge



Groundwater Basin	Annual Average acre-ft/yr		
	Calibration 1966-2016	Calibration 1966-1990	Scenario 2a 1-25
Yucaipa	330	0	4,200
SBBA	21,880	19,490	54,210
Rialto-Colton	790	1,310	0
Riverside-Arlington	12,140	0	30,800
Chino	18,790	18,370	33,350
Total	**53,930**	**39,170**	**122,560**

Figure 331



EXPLANATION

- Upper Santa Ana River Watershed Boundary
- Integrated SAR Model Boundary
- Active Model Area
- Inactive Model Area
- Groundwater Basin Boundary
- Groundwater Flow Barrier
- Recycled Water Discharge Point (https://www.waterboards.ca.gov)
- Desalination Plant Discharge Point (https://www.waterboards.ca.gov)

N

0 5 10

Miles

SCENARIO 2a (BASELINE): LOCATION OF SURFACE WATER DISCHARGE

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UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

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FIGURE 332

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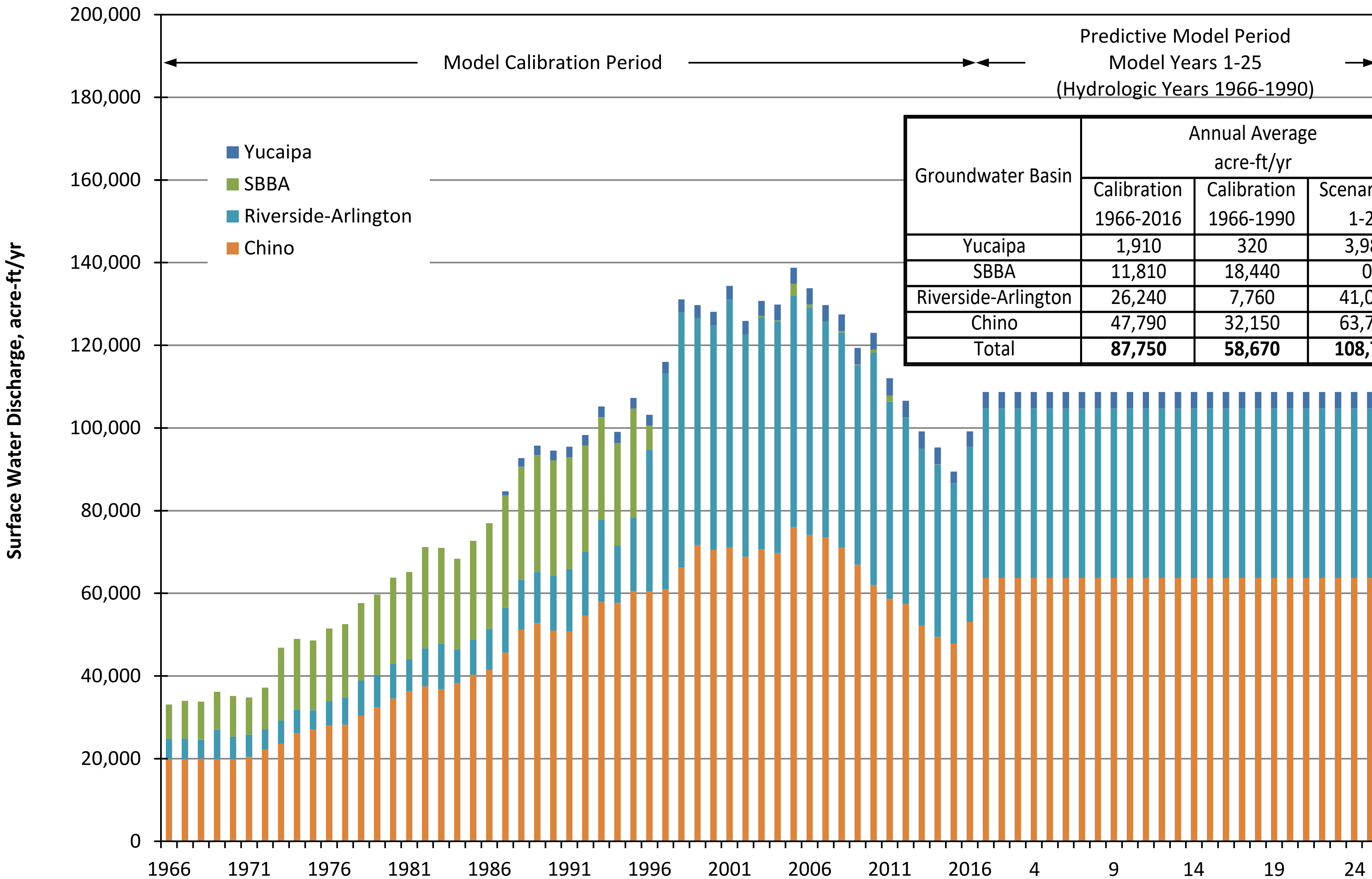
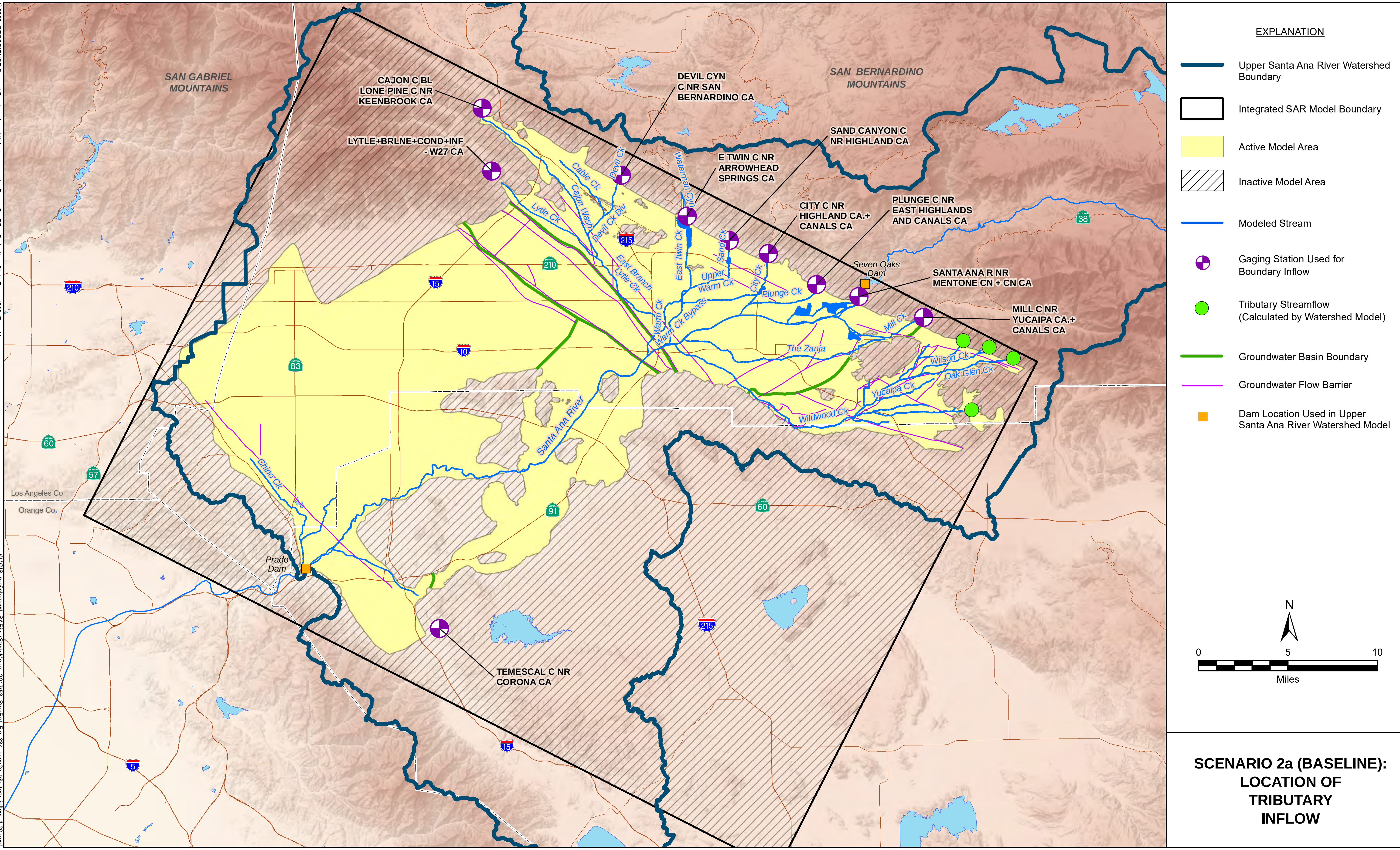
Scenario 2a (Baseline): Annual Surface Water Discharge



Groundwater Basin	Annual Average acre-ft/yr		
	Calibration 1966-2016	Calibration 1966-1990	Scenario 2a 1-25
Yucaipa	1,910	320	3,980
SBBA	11,810	18,440	0
Riverside-Arlington	26,240	7,760	41,020
Chino	47,790	32,150	63,740
Total	**87,750**	**58,670**	**108,740**

Figure 333



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SCENARIO 2a (BASELINE): LOCATION OF TRIBUTARY INFLOW

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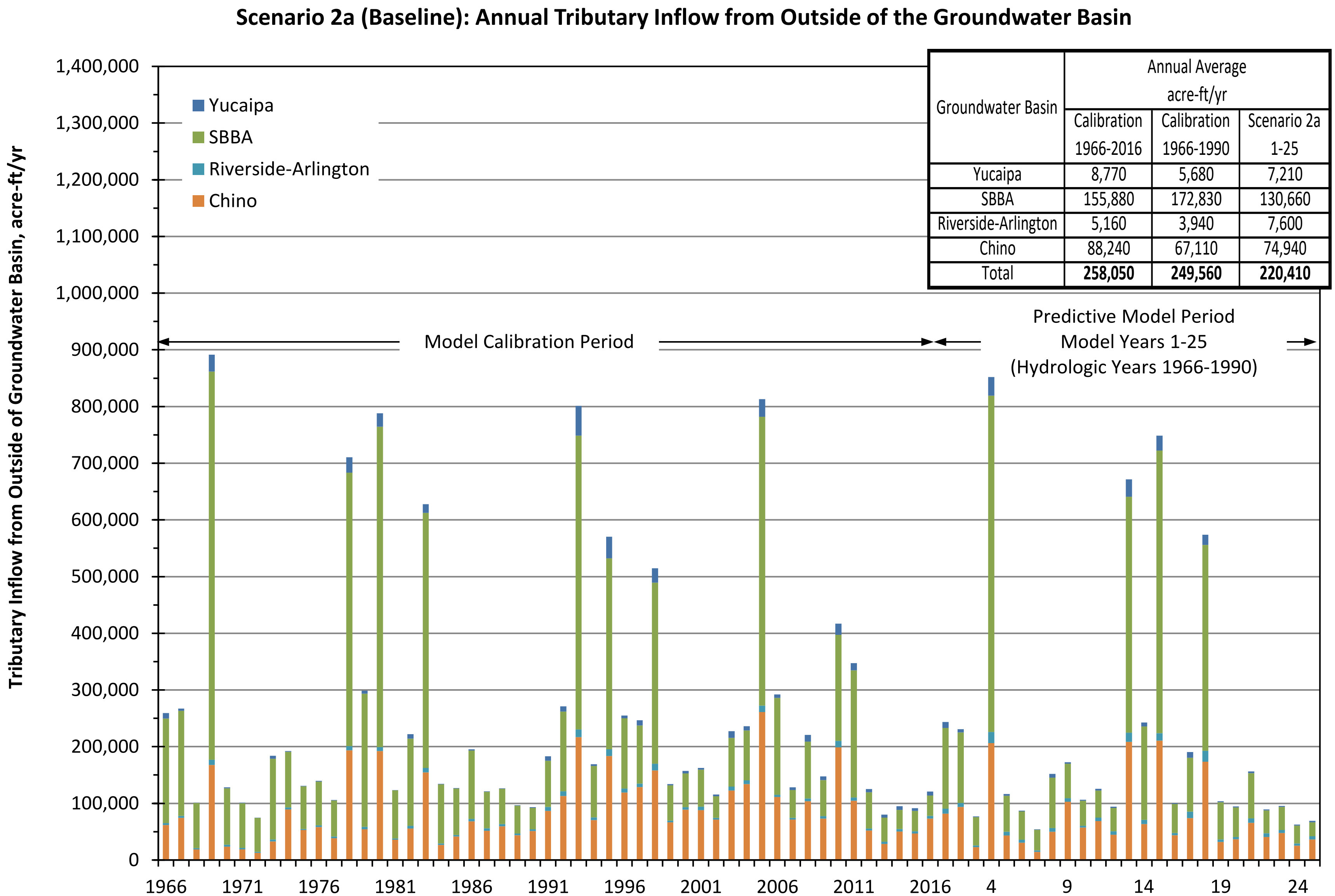
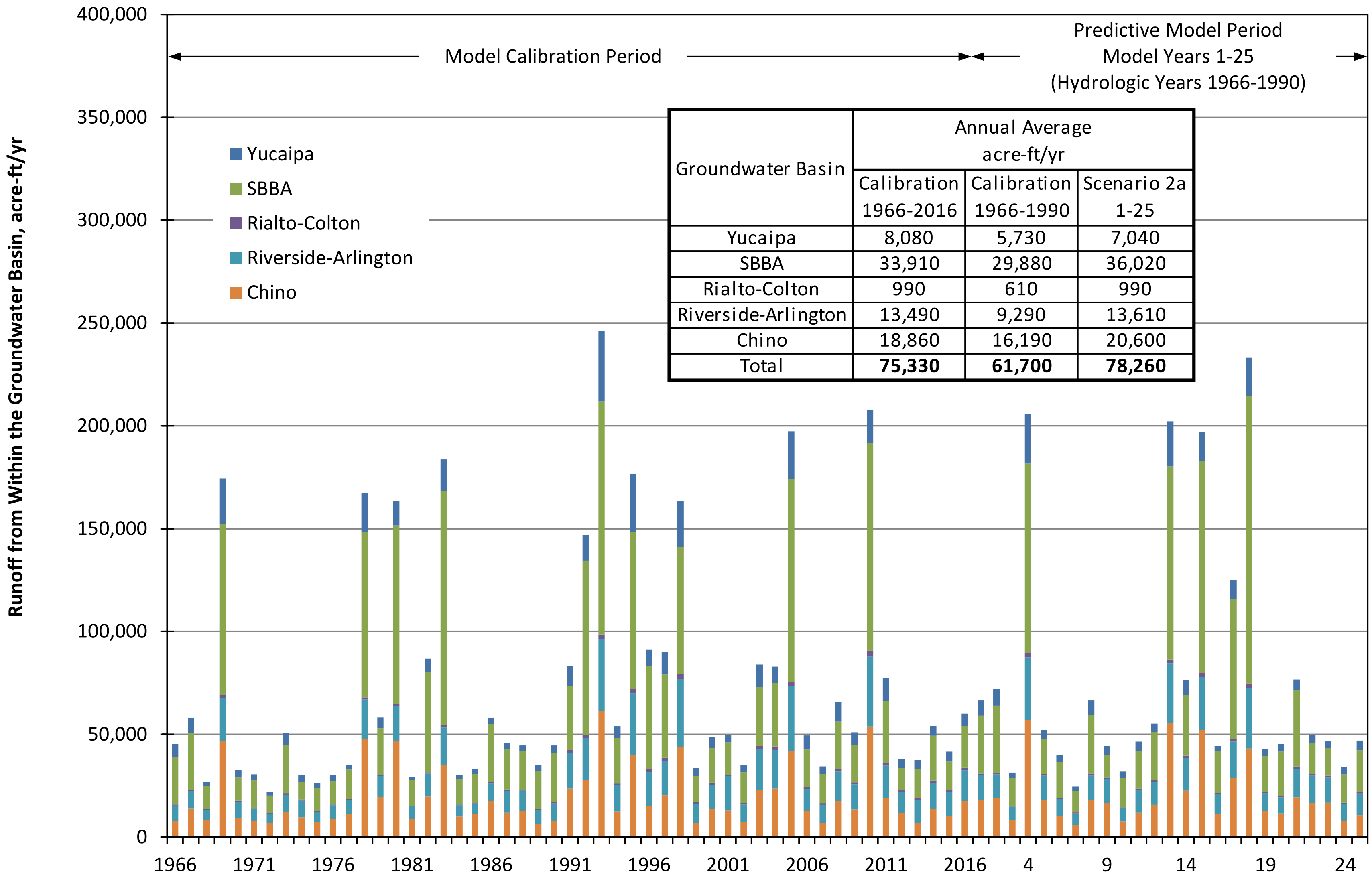
FIGURE 334



Groundwater Basin	Annual Average acre-ft/yr		
	Calibration 1966-2016	Calibration 1966-1990	Scenario 2a 1-25
Yucaipa	8,770	5,680	7,210
SBBA	155,880	172,830	130,660
Riverside-Arlington	5,160	3,940	7,600
Chino	88,240	67,110	74,940
Total	**258,050**	**249,560**	**220,410**

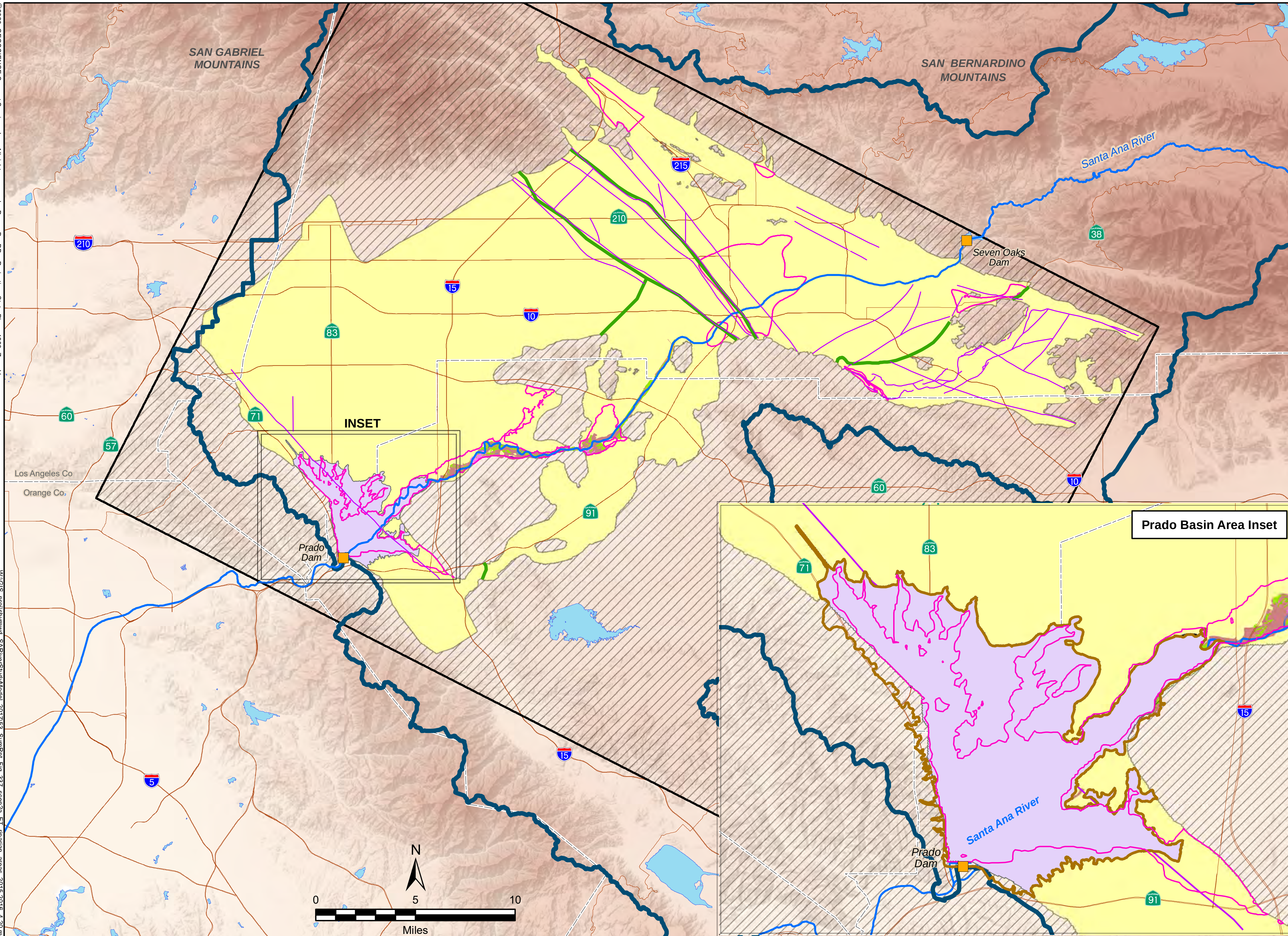
Figure 335

Scenario 2a (Baseline): Annual Runoff from Within the Groundwater Basin



Groundwater Basin	Annual Average acre-ft/yr		
	Calibration 1966-2016	Calibration 1966-1990	Scenario 2a 1-25
Yucaipa	8,080	5,730	7,040
SBBA	33,910	29,880	36,020
Rialto-Colton	990	610	990
Riverside-Arlington	13,490	9,290	13,610
Chino	18,860	16,190	20,600
Total	**75,330**	**61,700**	**78,260**

Figure 336



EXPLANATION

2015 Riparian Vegetation (Aspen)

- Deep-Rooted Riparian
- Giant Reed
- Managed Wetland
- Obligate Wetland
- Open Water
- Shallow-Rooted Riparian
- Transitional Riparian
- Unvegetated Sandy Wash
- 2016 Total Riparian Extent (WEI,2017)
- Area of Shallow Groundwater (<20 ft) (Sources:
  1. Chino Basin and Riverside-Arlington Area BGW, 2018 - Based on post-1999 water level data from NWIS, CA DWR, and perennial streams from the NHD.
  2. SBBA Area - Matti and Carson, 1991 - Based on highest water level from 1973-1983.
  3. Yucaipa Model Area - GEOSCIENCE, 2017 - Based on high water levels and extent of riparian vegetation)
- Upper Santa Ana River Watershed Boundary
- Integrated SAR Model Boundary
- Active Model Area
- Inactive Model Area
- Prado Basin Area (WEI, 2004)
- Groundwater Basin Boundary
- Groundwater Flow Barrier
- Dam Location Used in Upper Santa Ana River Watershed Model

SCENARIO 2a (BASELINE): LOCATION OF EVAPOTRANSPIRATION (2015-2016)

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UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

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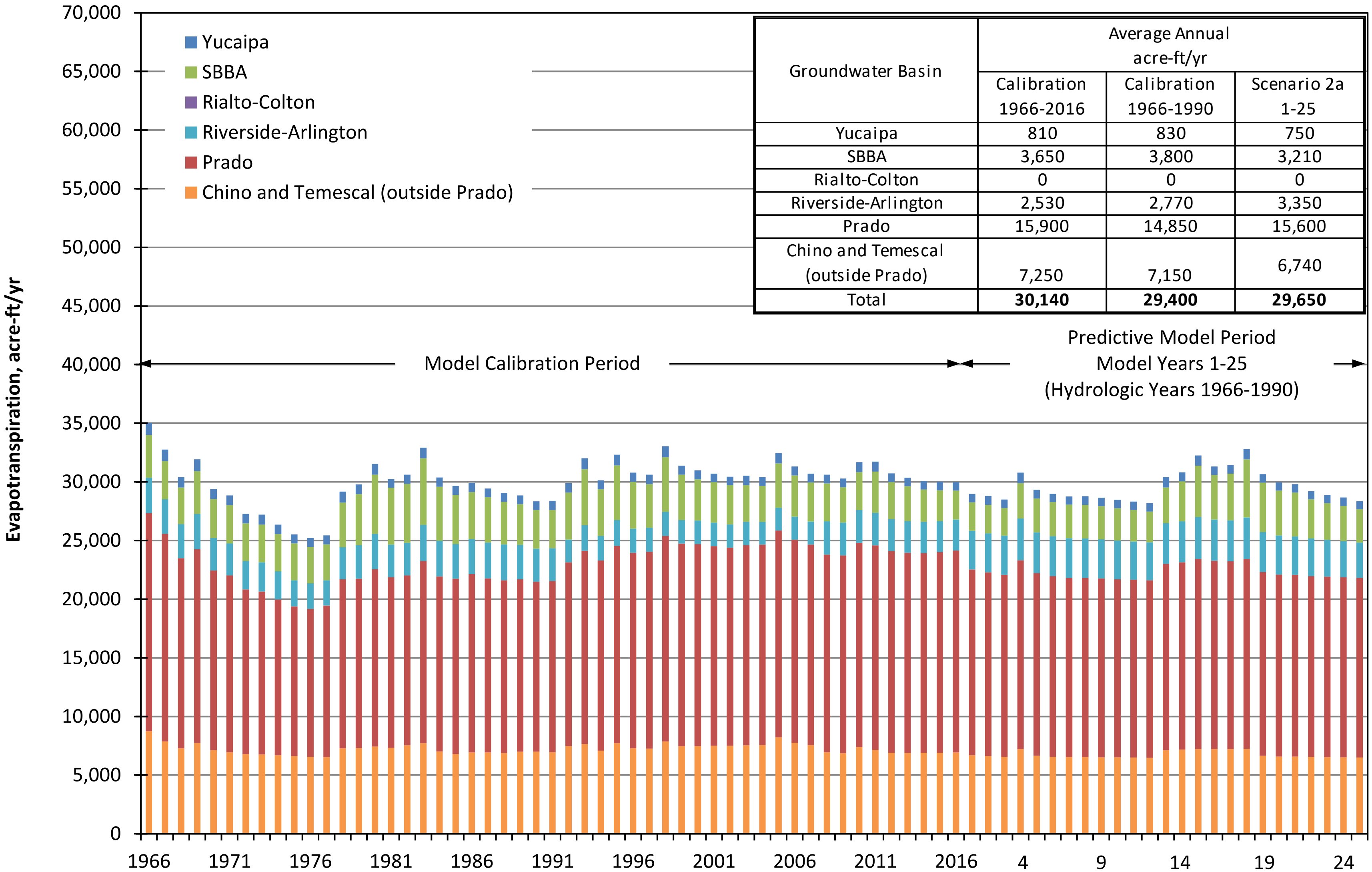
FIGURE 337

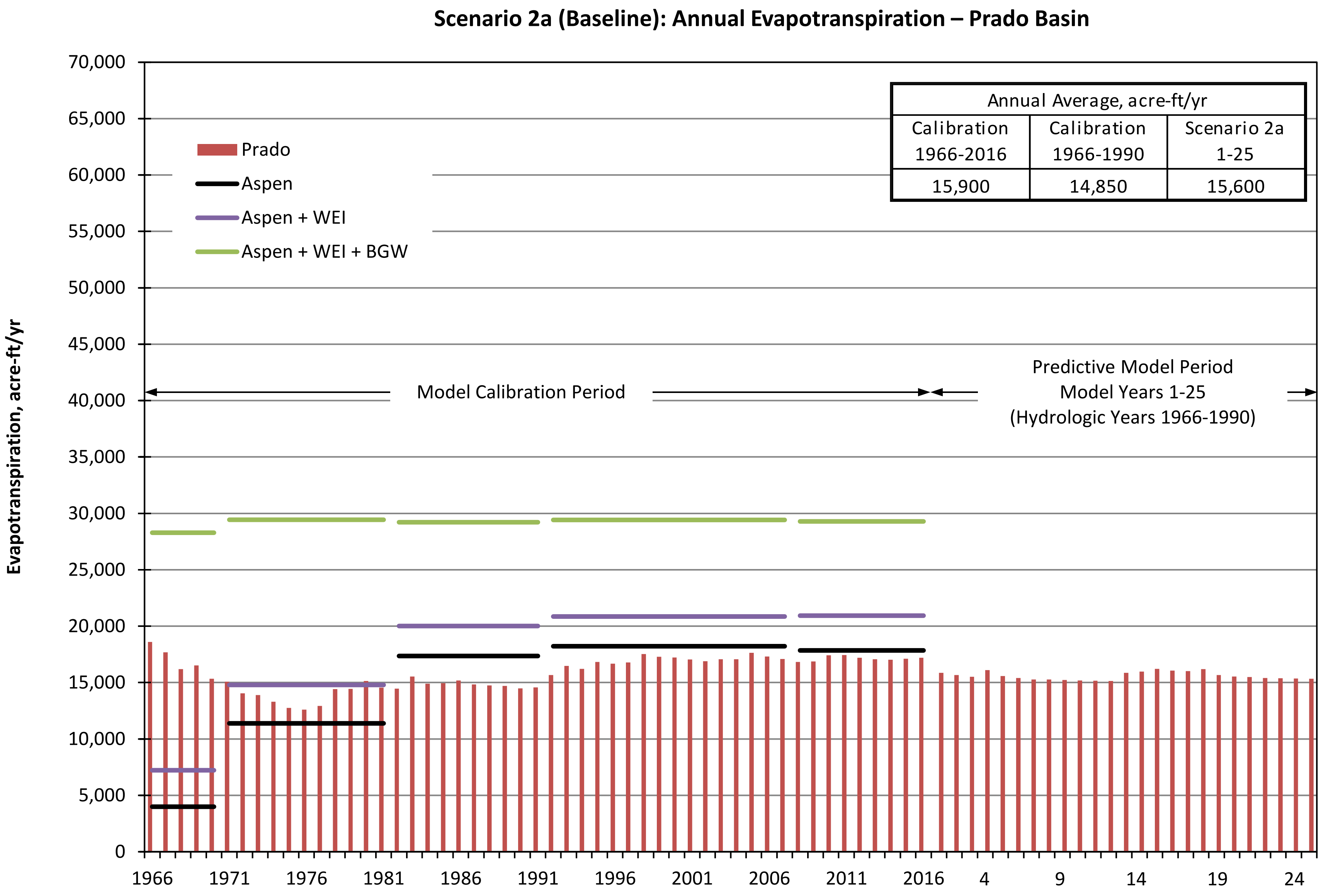
GEOSCIENCE

Scenario 2a (Baseline): Annual Evapotranspiration – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr		
	Calibration 1966-2016	Calibration 1966-1990	Scenario 2a 1-25
Yucaipa	810	830	750
SBBA	3,650	3,800	3,210
Rialto-Colton	0	0	0
Riverside-Arlington	2,530	2,770	3,350
Prado	15,900	14,850	15,600
Chino and Temescal (outside Prado)	7,250	7,150	6,740
Total	**30,140**	**29,400**	**29,650**

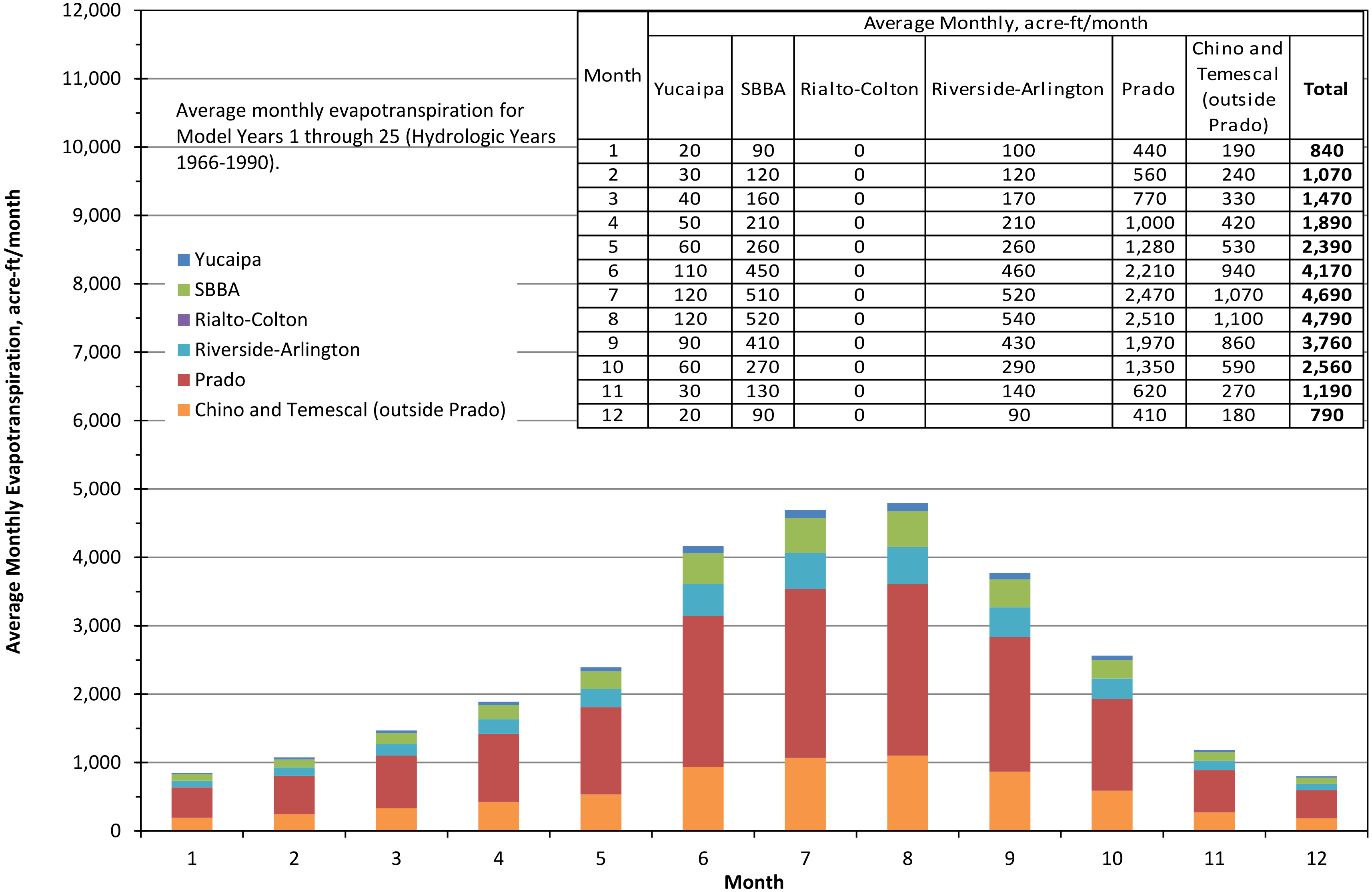
Figure 338



Annual Average, acre-ft/yr		
Calibration 1966-2016	Calibration 1966-1990	Scenario 2a 1-25
15,900	14,850	15,600

Figure 339

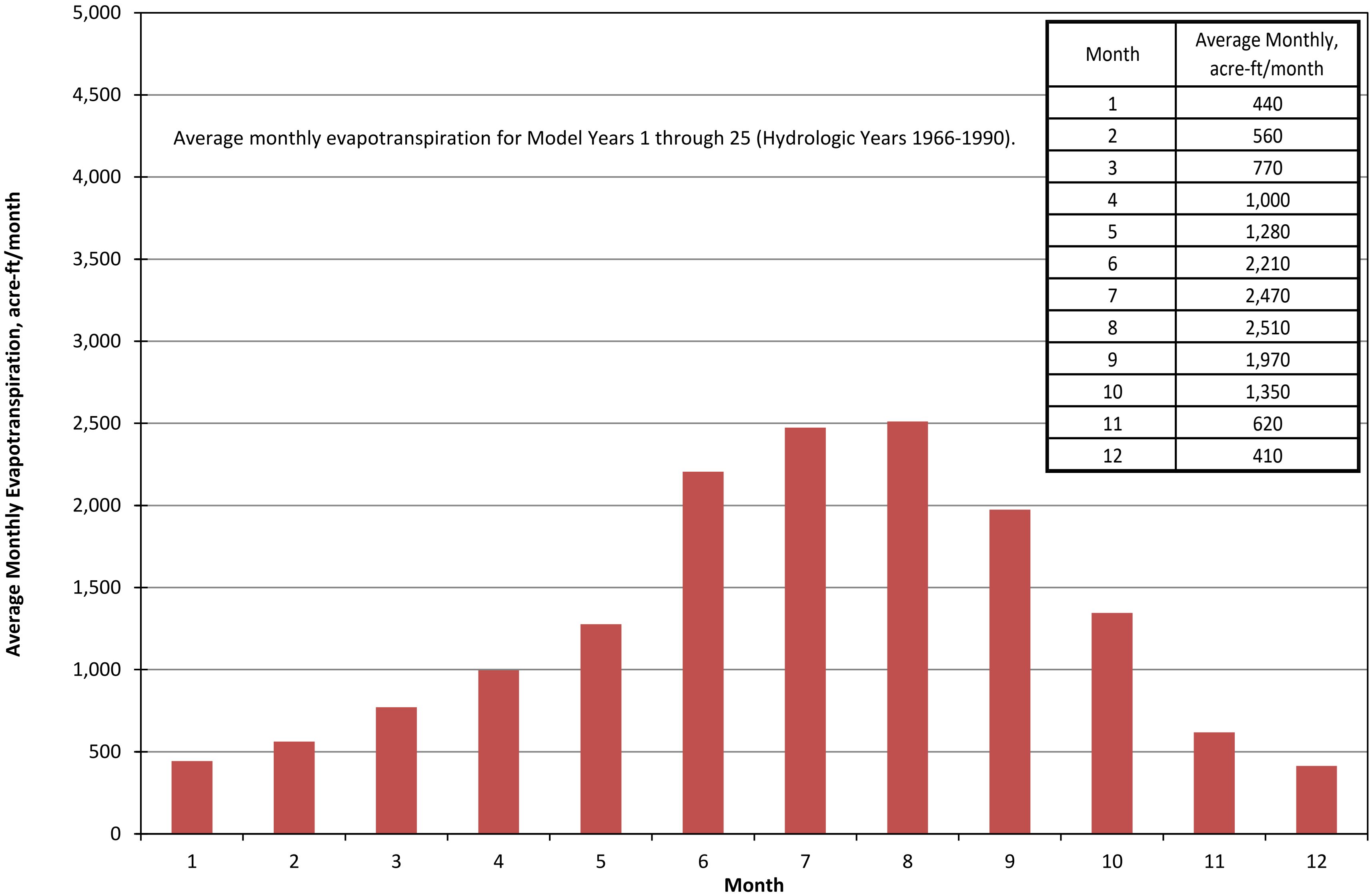
Scenario 2a (Baseline): Monthly Evapotranspiration – Integrated SAR Model Area



Month	Average Monthly, acre-ft/month						
	Yucaipa	SBBA	Rialto-Colton	Riverside-Arlington	Prado	Chino and Temescal (outside Prado)	**Total**
1	20	90	0	100	440	190	**840**
2	30	120	0	120	560	240	**1,070**
3	40	160	0	170	770	330	**1,470**
4	50	210	0	210	1,000	420	**1,890**
5	60	260	0	260	1,280	530	**2,390**
6	110	450	0	460	2,210	940	**4,170**
7	120	510	0	520	2,470	1,070	**4,690**
8	120	520	0	540	2,510	1,100	**4,790**
9	90	410	0	430	1,970	860	**3,760**
10	60	270	0	290	1,350	590	**2,560**
11	30	130	0	140	620	270	**1,190**
12	20	90	0	90	410	180	**790**

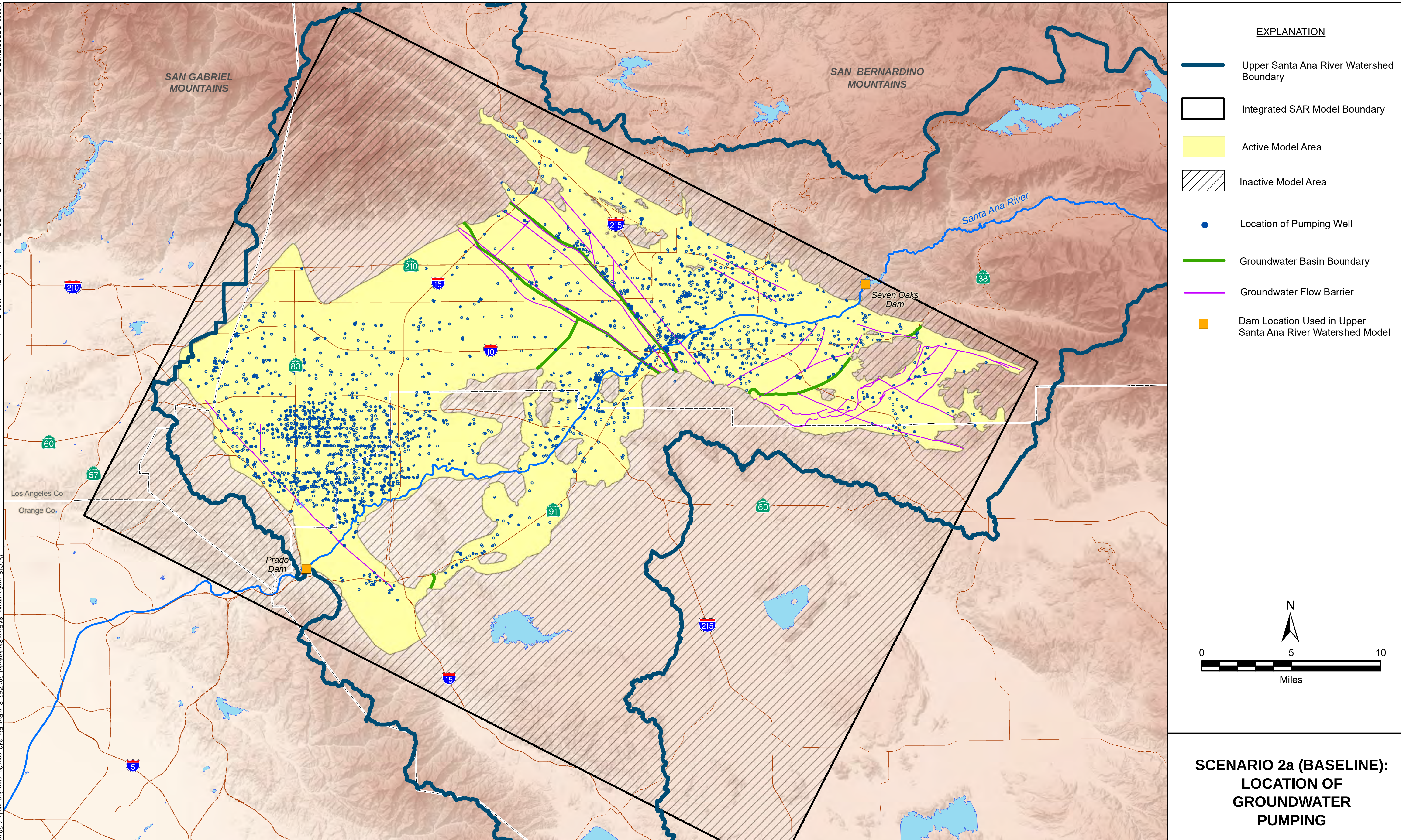
Figure 340

Scenario 2a (Baseline): Monthly Evapotranspiration – Prado Basin



Month	Average Monthly, acre-ft/month
1	440
2	560
3	770
4	1,000
5	1,280
6	2,210
7	2,470
8	2,510
9	1,970
10	1,350
11	620
12	410

Figure 341



SCENARIO 2a (BASELINE): LOCATION OF GROUNDWATER PUMPING

W:\GIS_projs\sbvmwd_SARiverStudyModel_2017\53_SumRpt_Fig_342_scen2a_pumping_wells_4-20.mxd

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

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FIGURE 342

GEOSCIENCE

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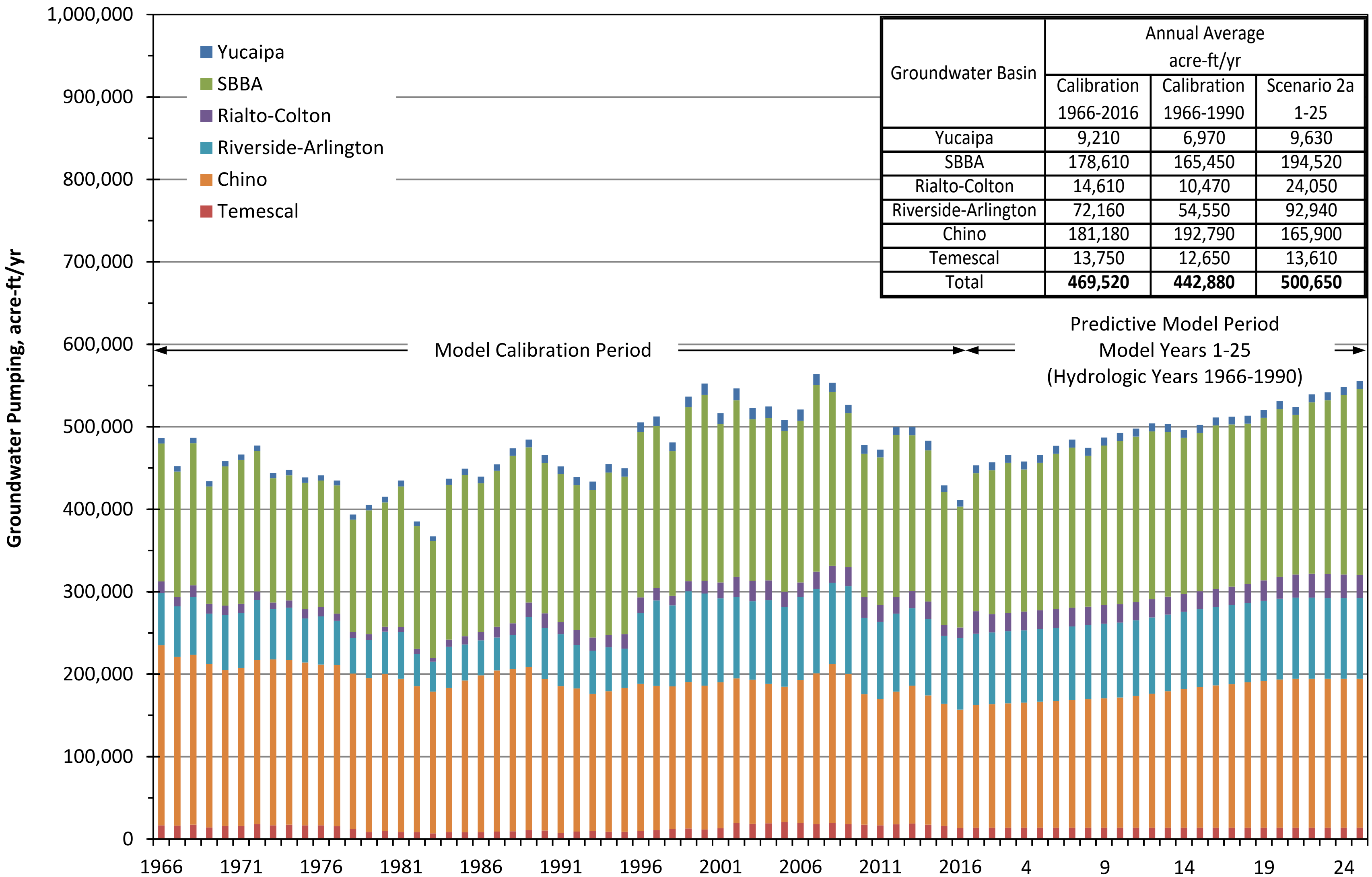
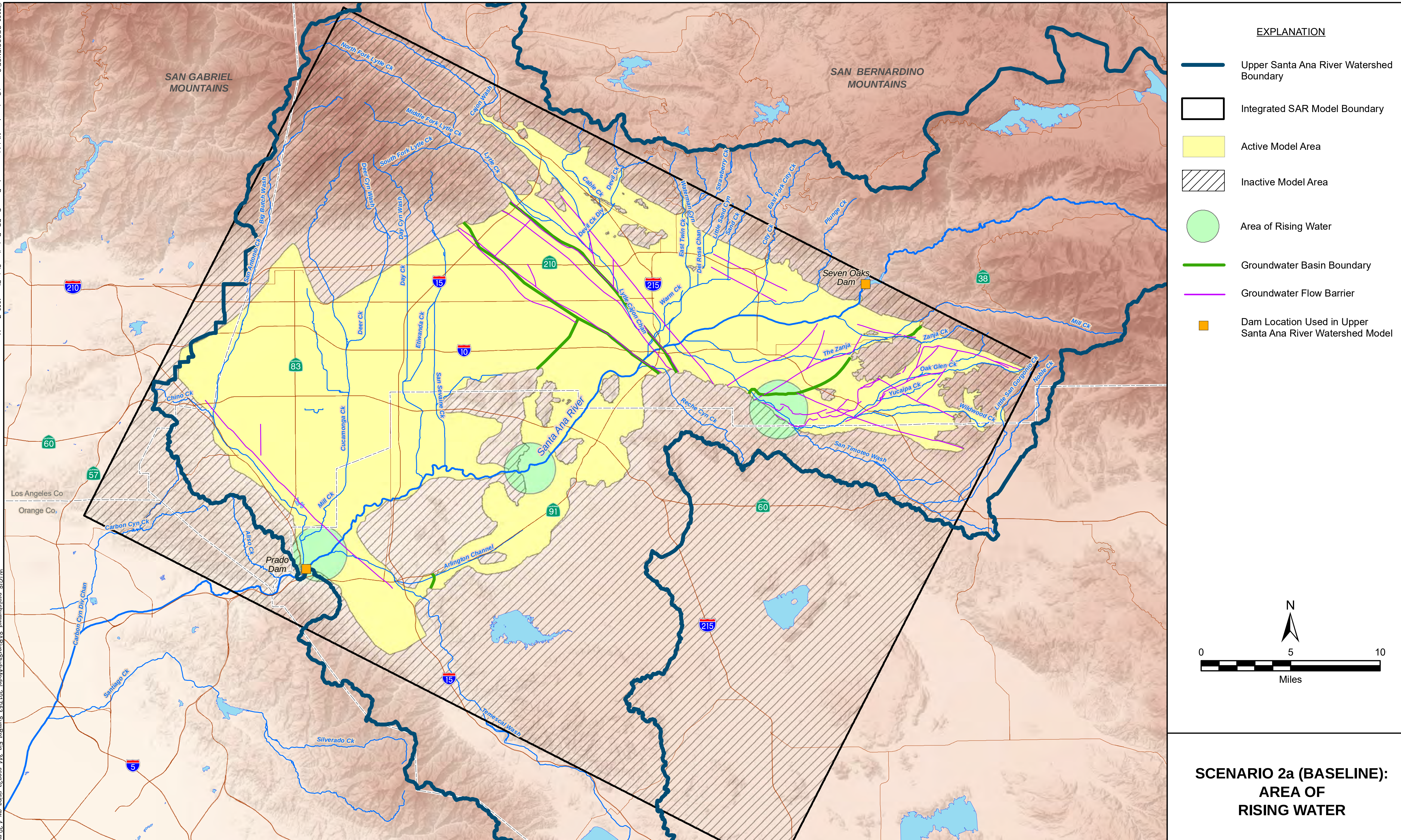
Scenario 2a (Baseline): Annual Groundwater Pumping



Groundwater Basin	Annual Average acre-ft/yr		
	Calibration 1966-2016	Calibration 1966-1990	Scenario 2a 1-25
Yucaipa	9,210	6,970	9,630
SBBA	178,610	165,450	194,520
Rialto-Colton	14,610	10,470	24,050
Riverside-Arlington	72,160	54,550	92,940
Chino	181,180	192,790	165,900
Temescal	13,750	12,650	13,610
Total	**469,520**	**442,880**	**500,650**

Figure 343



W:\GIS_projs\sbvmwd_SARiverStudyModel_2017\53_SumRpt_Fig_344_scen2a_rising_gw_4-20.mxd

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SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

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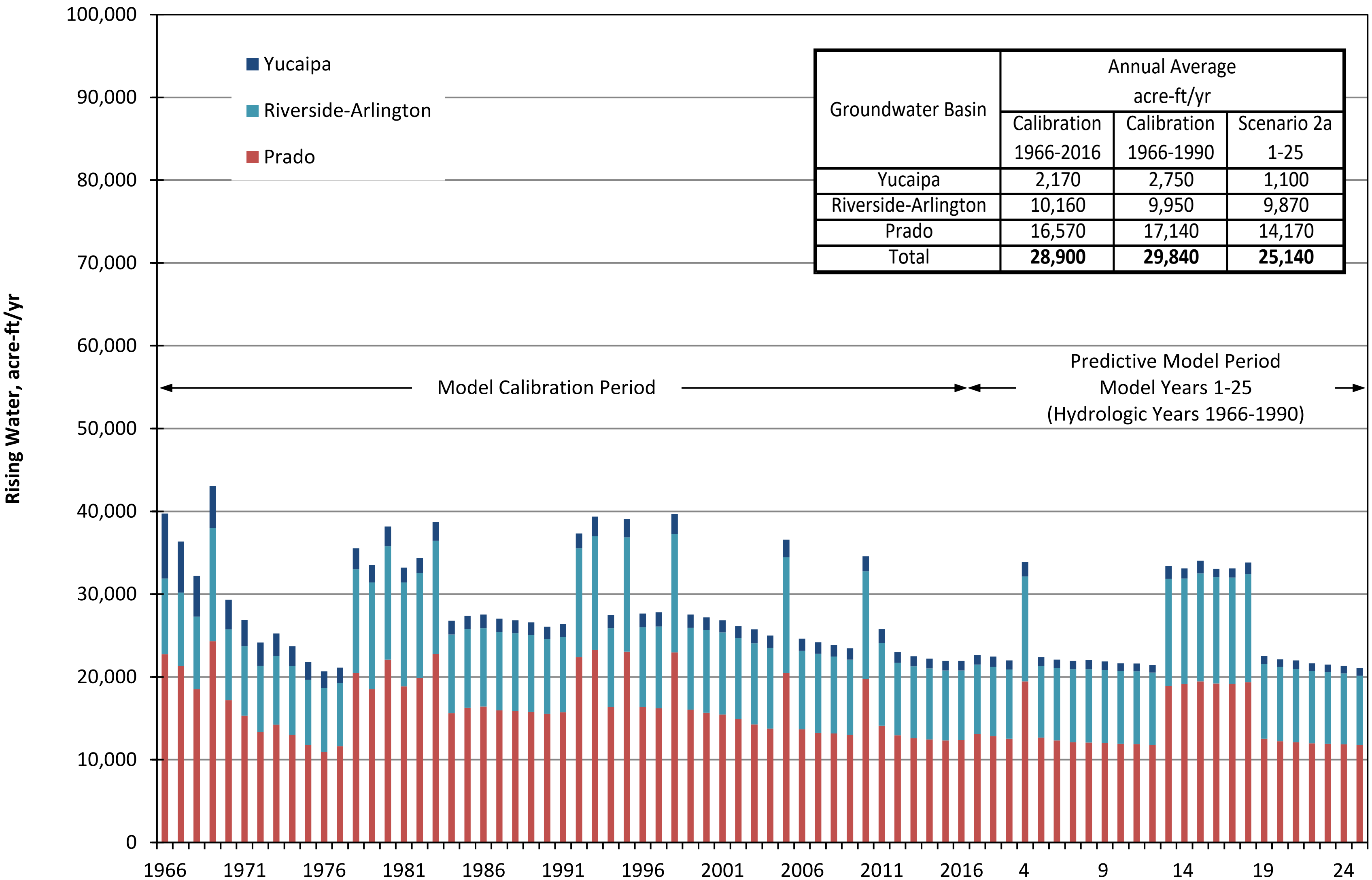
FIGURE 344

GEOSCIENCE

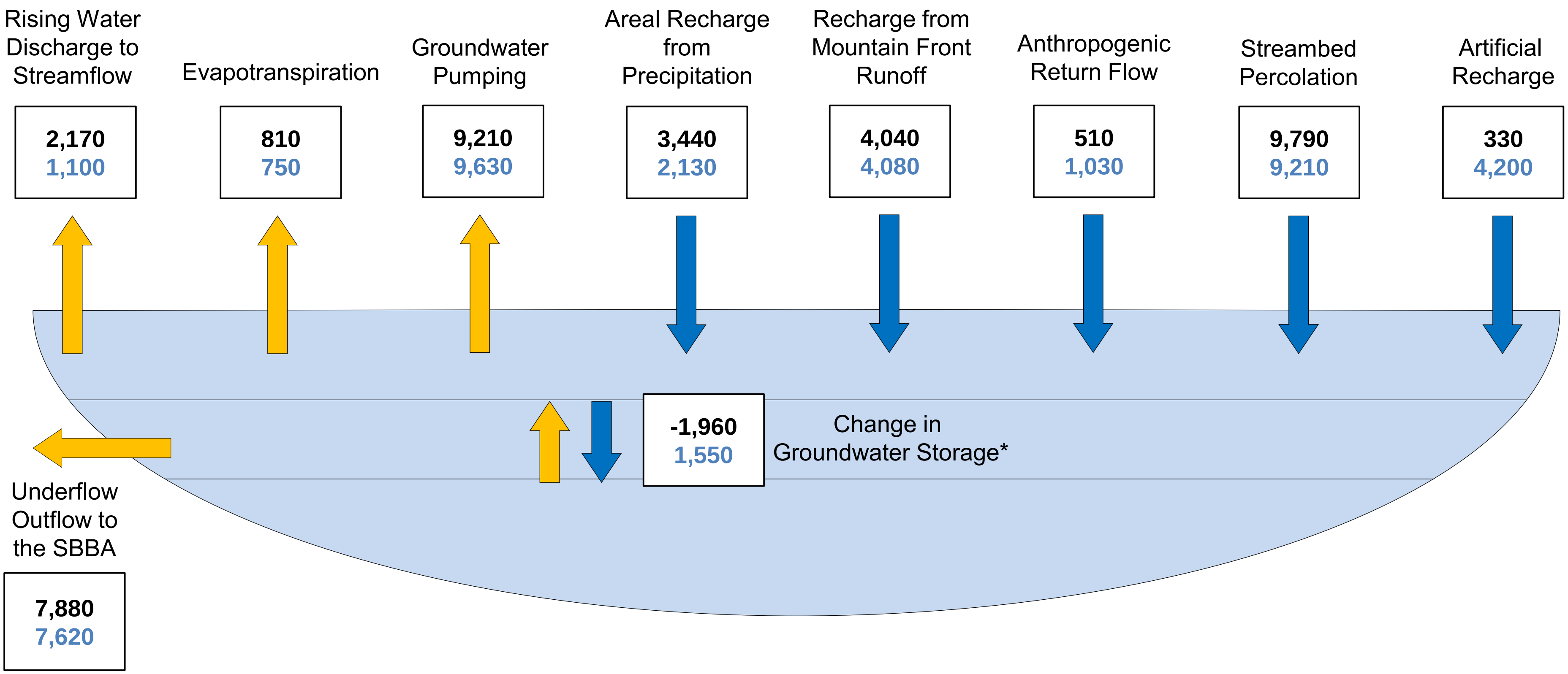
Scenario 2a (Baseline): Annual Rising Water



Groundwater Basin	Annual Average acre-ft/yr		
	Calibration 1966-2016	Calibration 1966-1990	Scenario 2a 1-25
Yucaipa	2,170	2,750	1,100
Riverside-Arlington	10,160	9,950	9,870
Prado	16,570	17,140	14,170
Total	**28,900**	**29,840**	**25,140**

Figure 345

X:\Projects\San_Bernardino_MUNI\31) Integreated_SAR_Model\(4)Technical_Memos\(8) Summary Report\Draft\Figures\Scenarios



Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2A (BASELINE)
AVERAGE ANNUAL
WATER BUDGET
YUCAIPA BASIN

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT
UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

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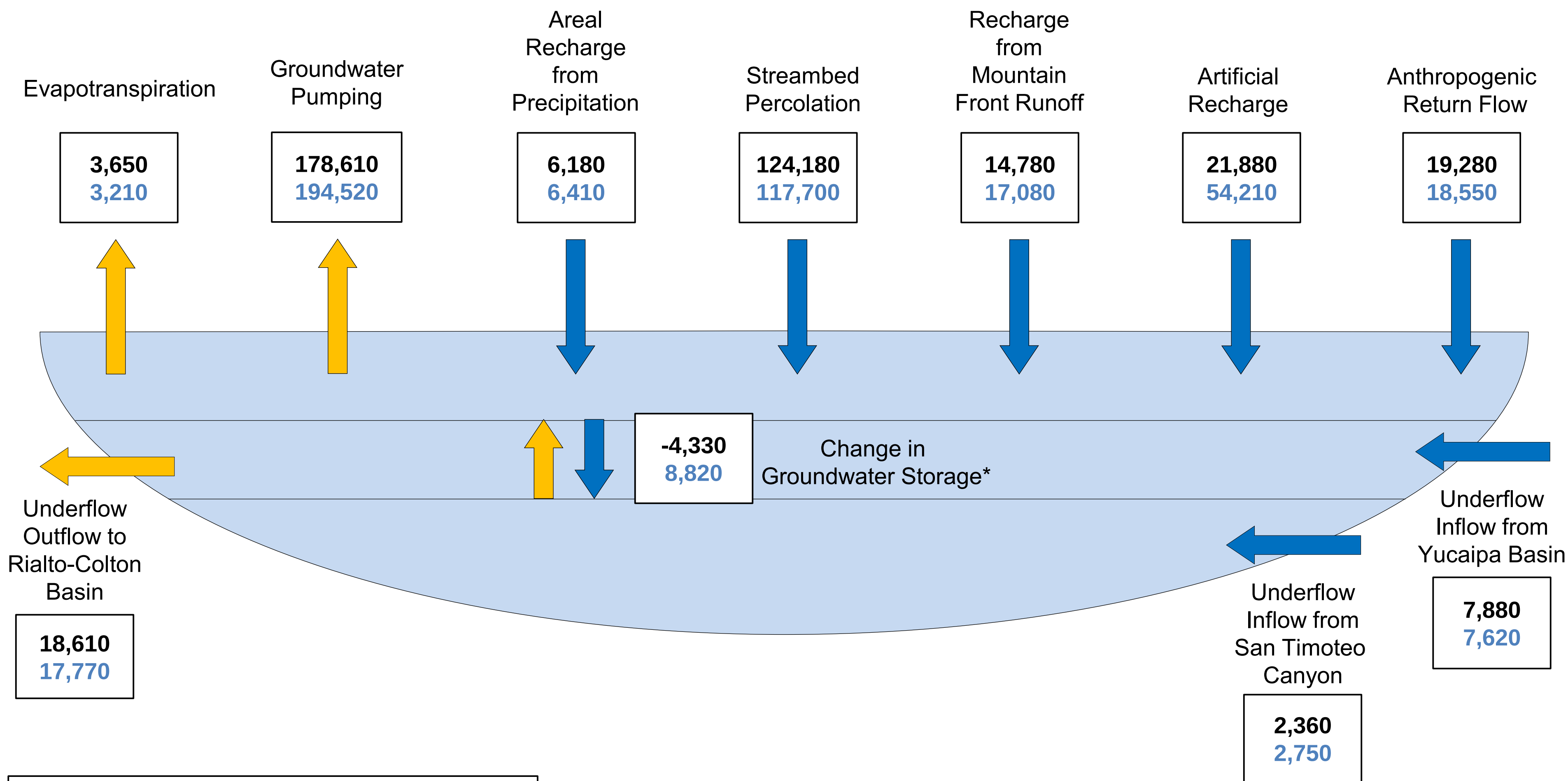
FIGURE 346

GEOSCIENCE

X:\Projects\San_Bernardino_MUNI\31) Integreated_SAR_Model\(4)Technical_Memos\(8) Summary Report\Draft\Figures\Scenarios



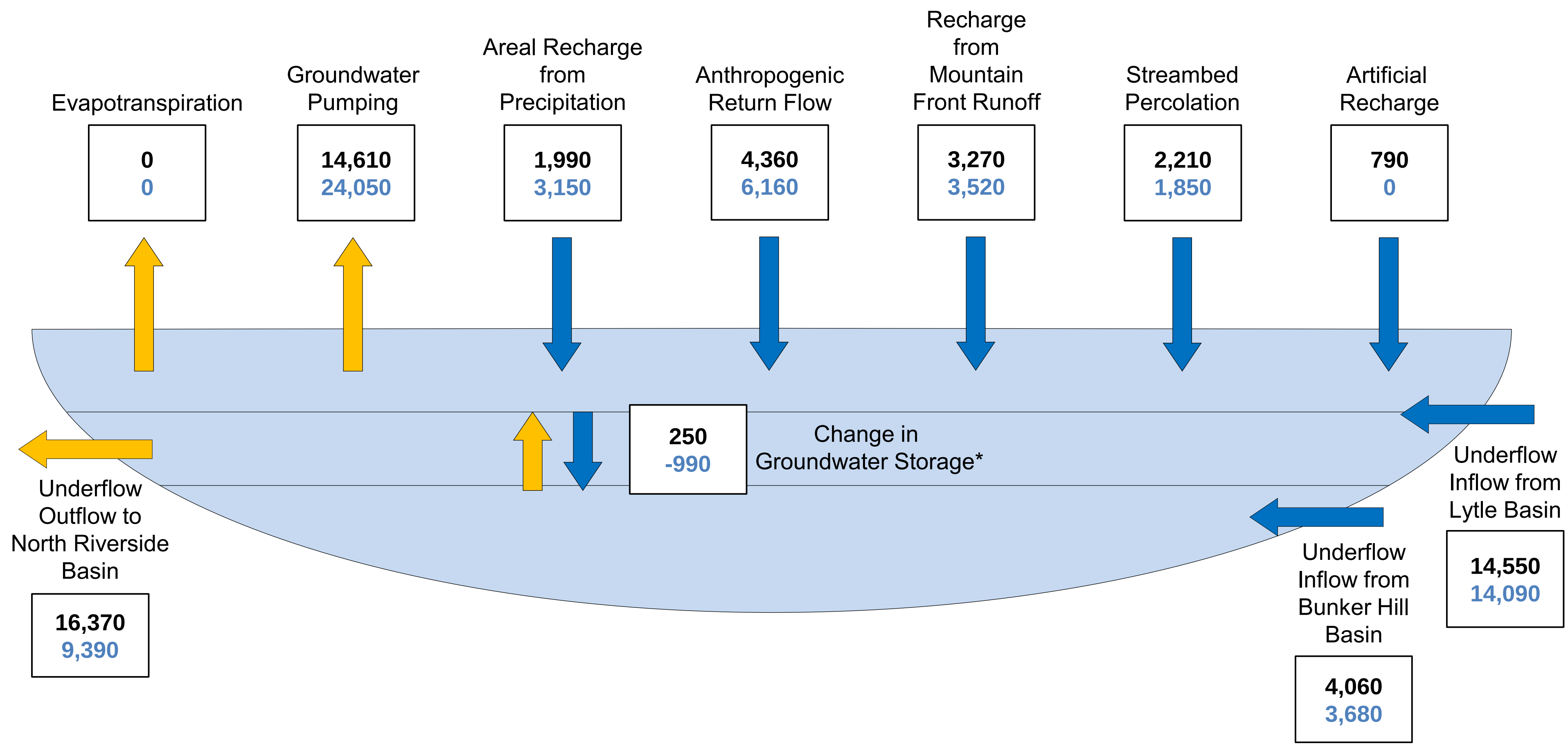
Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2A (BASELINE)
AVERAGE ANNUAL
WATER BUDGET
SBBA

10-Apr-20



Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2A (BASELINE)
AVERAGE ANNUAL
WATER BUDGET
RIALTO-COLTON BASIN

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT
UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

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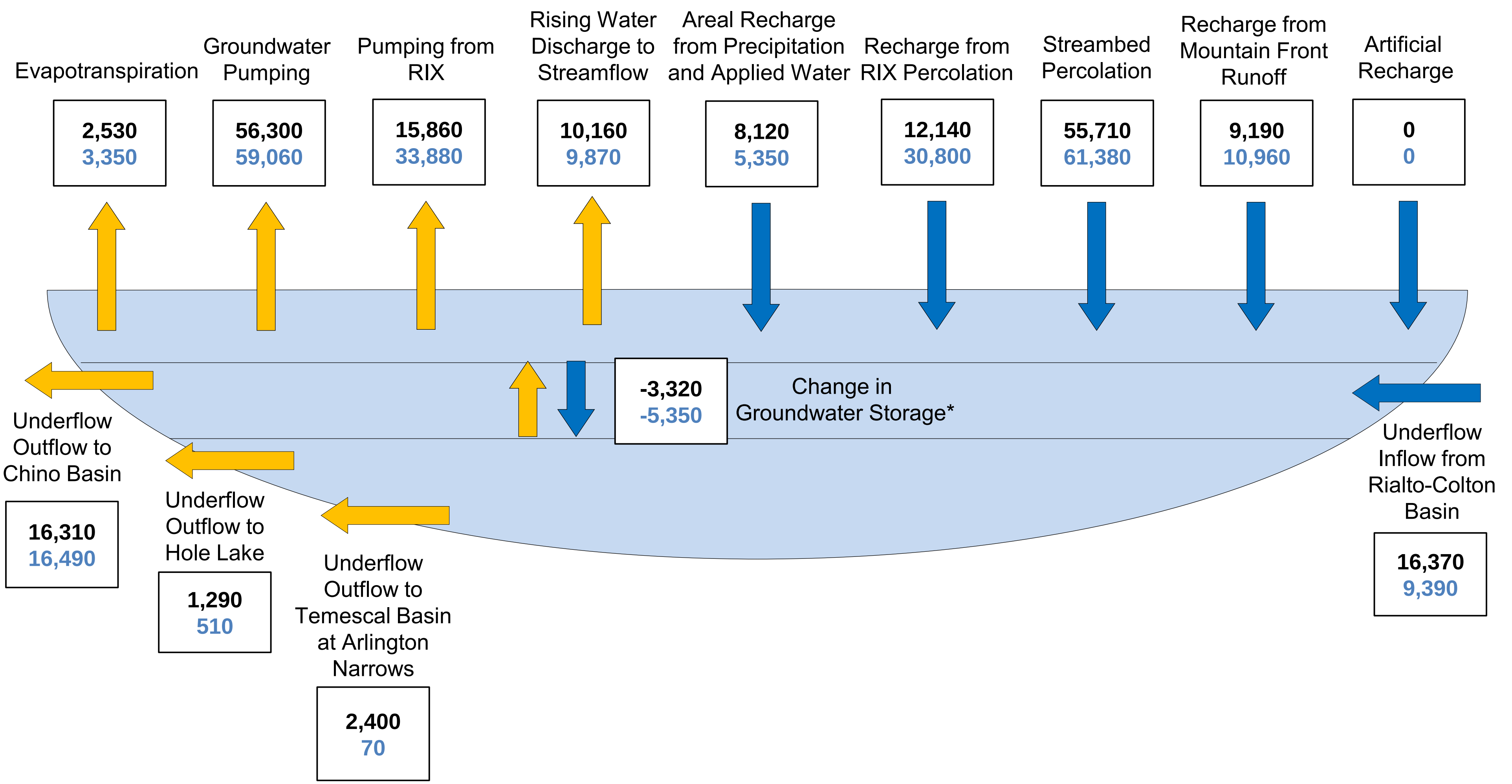
FIGURE 348

GEOSCIENCE

X:\Projects\San_Bernardino_MUNI\31\Integreated_SAR_Model\4\Technical_Memos\8\Summary Report\Draft\Figures\Scenarios



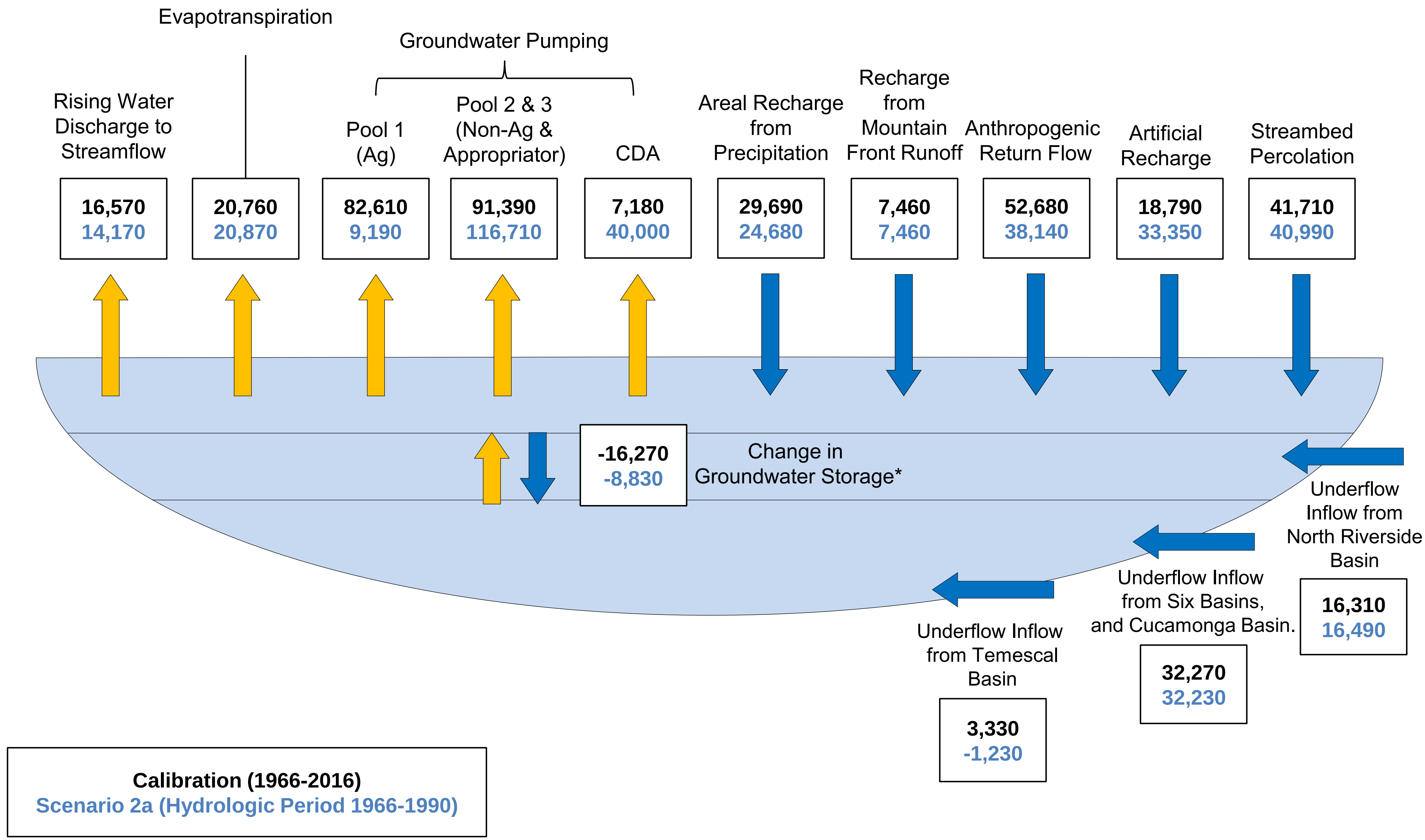
Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2A (BASELINE)
AVERAGE ANNUAL
WATER BUDGET
RIVERSIDE-ARLINGTON BASIN

10-Apr-20



All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2A (BASELINE)
AVERAGE ANNUAL
WATER BUDGET
CHINO BASIN

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

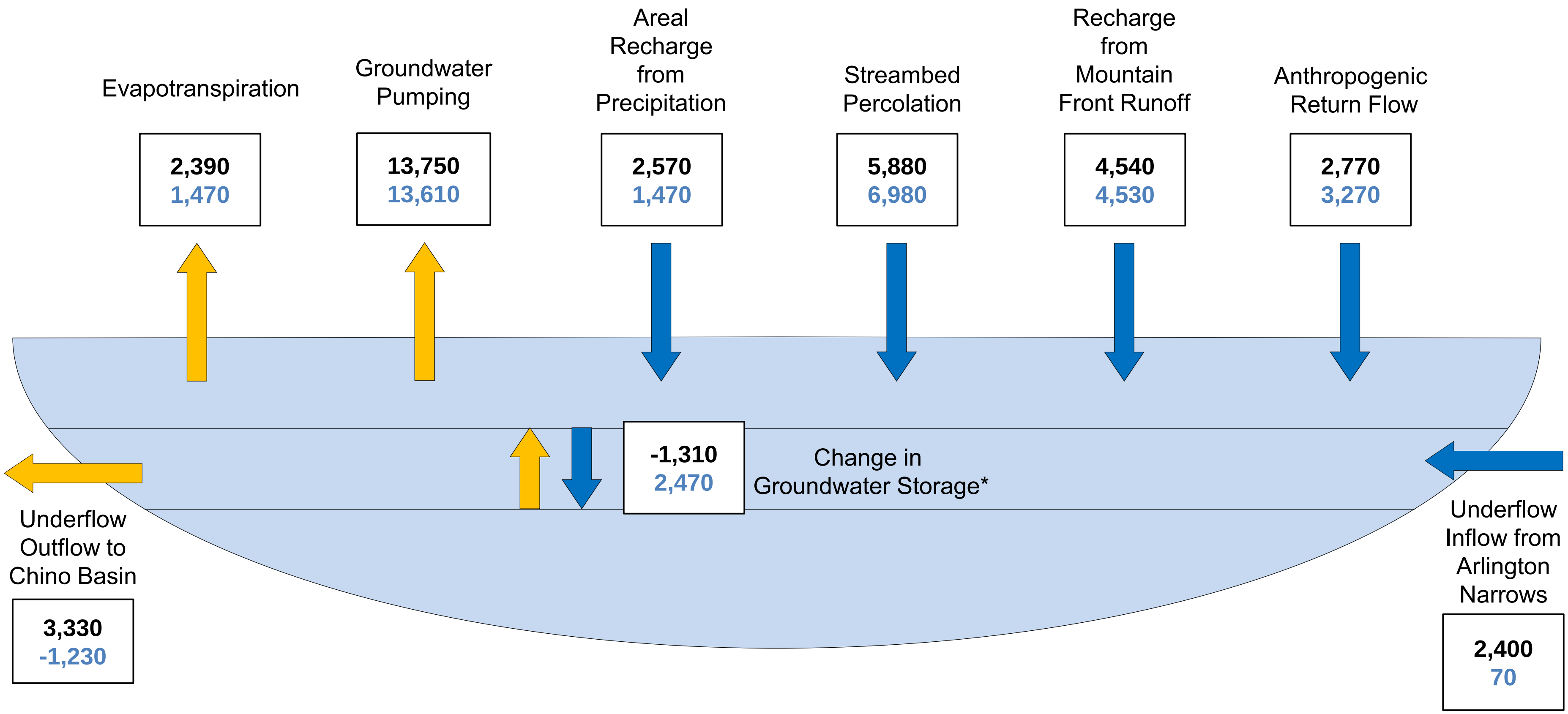
DRAFT

FIGURE 350

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

GEOSCIENCE

X:\Projects\San_Bernardino_MUNI\31) Integreated_SAR_Model\(4)Technical_Memos\(8) Summary Report\Draft\Figures\Scenarios



Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2A (BASELINE)
AVERAGE ANNUAL
WATER BUDGET
TEMESCAL BASIN

10-Apr-20

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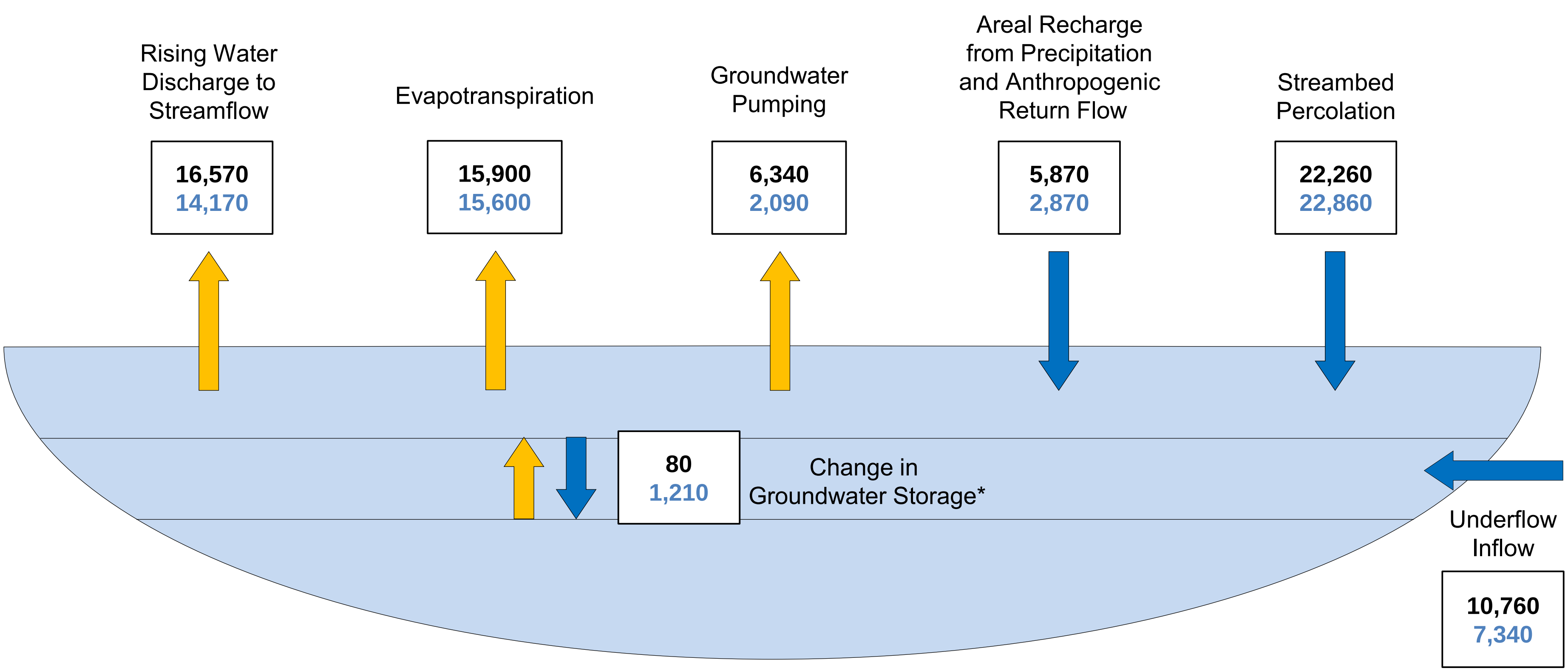
X:\Projects\San_Bernardino_MUNI\31) Integreated_SAR_Model\(4)Technical_Memos\(8) Summary Report\Draft\Figures\Scenarios



Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2A (BASELINE)
AVERAGE ANNUAL
WATER BUDGET
PRADO BASIN

10-Apr-20

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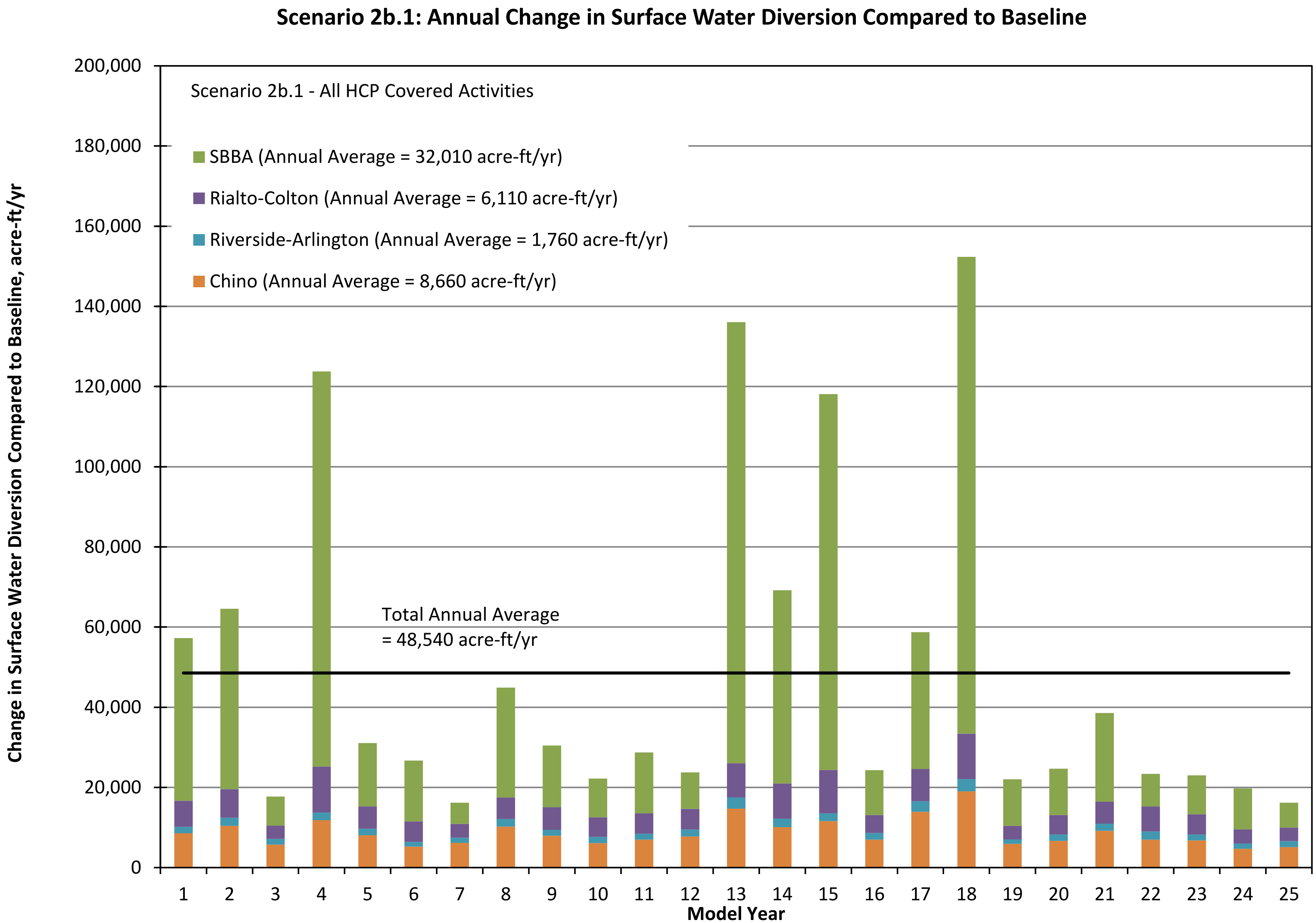


Figure 353

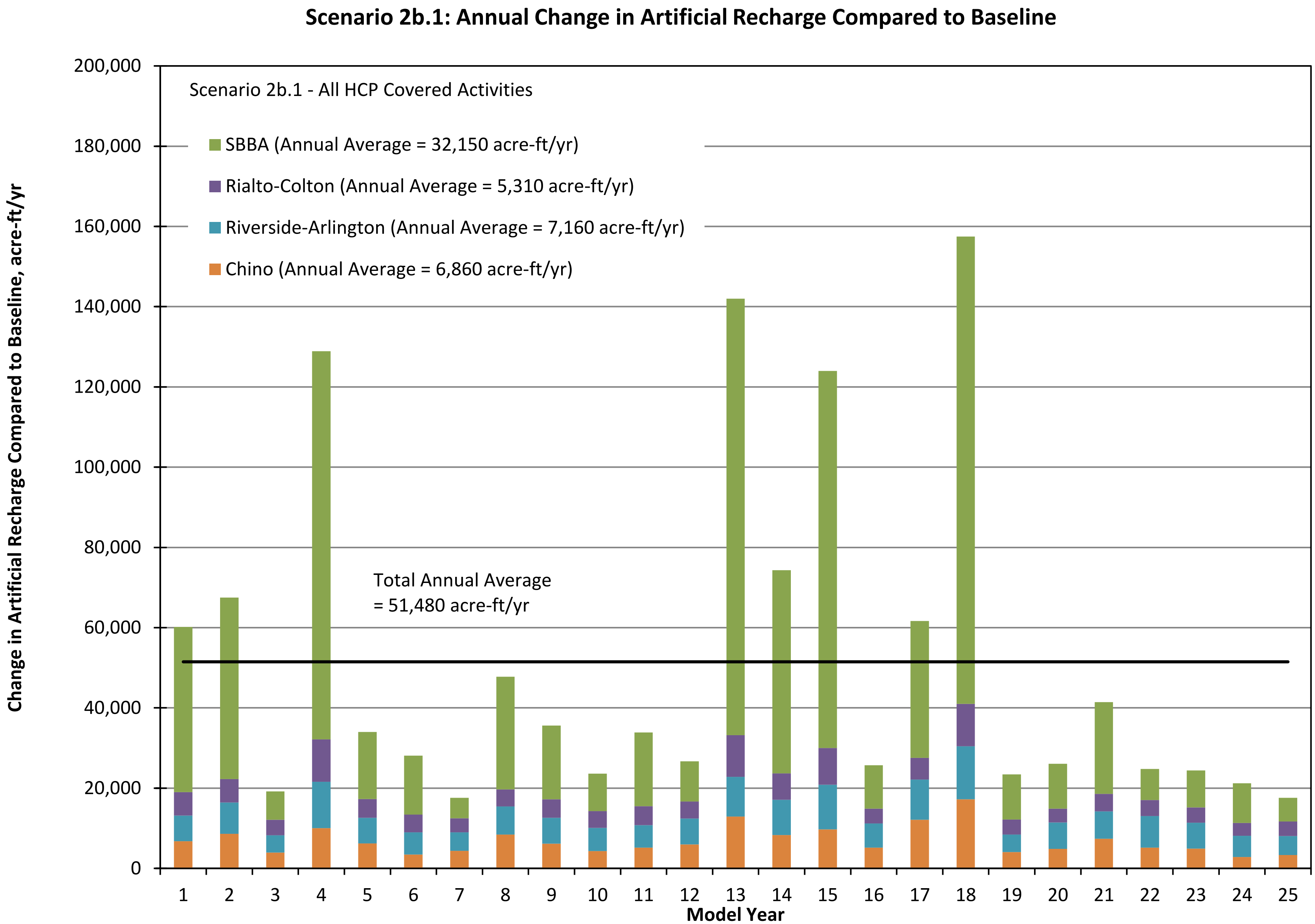

Scenario 2b.1: Annual Change in Artificial Recharge Compared to Baseline
Scenario 2b.1 - All HCP Covered Activities
SBBA (Annual Average = 32,150 acre-ft/yr)
Rialto-Colton (Annual Average = 5,310 acre-ft/yr)
Riverside-Arlington (Annual Average = 7,160 acre-ft/yr)
Chino (Annual Average = 6,860 acre-ft/yr)
Total Annual Average
= 51,480 acre-ft/yr
Change in Artificial Recharge Compared to Baseline, acre-ft/yr
Model Year
0
20,000
40,000
60,000
80,000
100,000
120,000
140,000
160,000
180,000
200,000
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

Figure 354

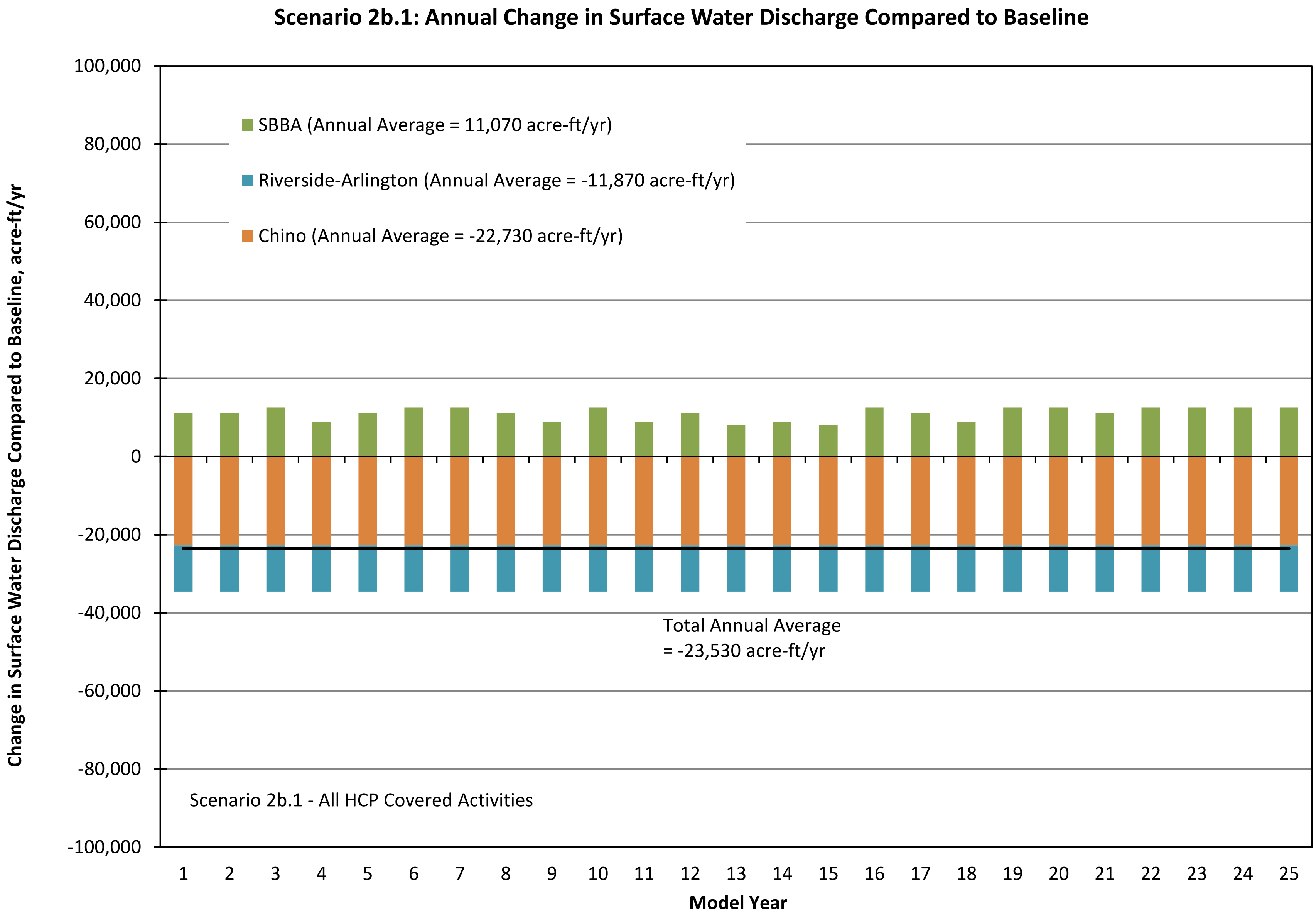
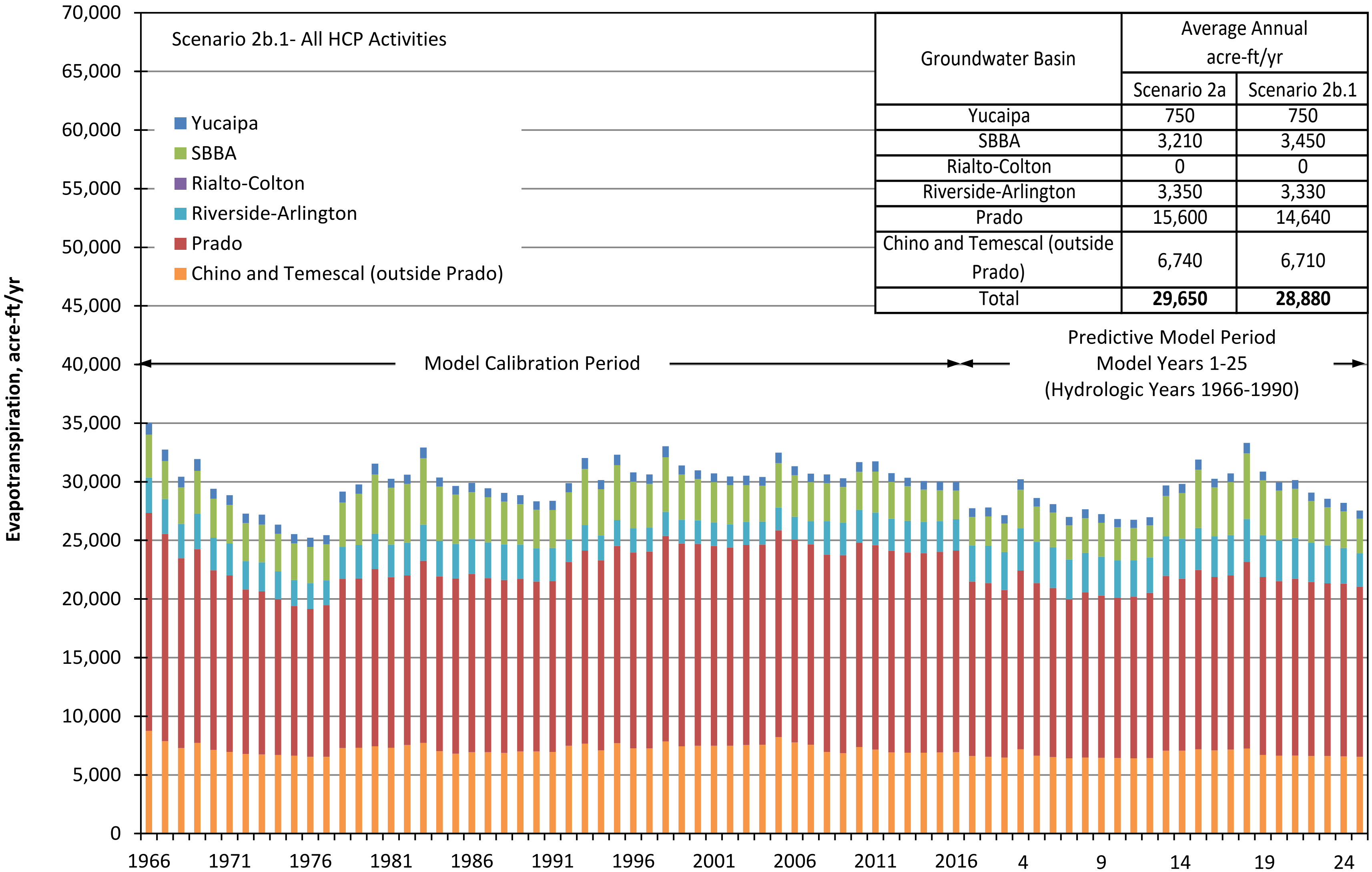

Scenario 2b.1: Annual Change in Surface Water Discharge Compared to Baseline
SBBA (Annual Average = 11,070 acre-ft/yr)
Riverside-Arlington (Annual Average = -11,870 acre-ft/yr)
Chino (Annual Average = -22,730 acre-ft/yr)
Total Annual Average
= -23,530 acre-ft/yr
Scenario 2b.1 - All HCP Covered Activities
Change in Surface Water Discharge Compared to Baseline, acre-ft/yr
Model Year
100,000
80,000
60,000
40,000
20,000
0
-20,000
-40,000
-60,000
-80,000
-100,000
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

Figure 355

Scenario 2b.1: Annual Evapotranspiration – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2b.1
Yucaipa	750	750
SBBA	3,210	3,450
Rialto-Colton	0	0
Riverside-Arlington	3,350	3,330
Prado	15,600	14,640
Chino and Temescal (outside Prado)	6,740	6,710
Total	**29,650**	**28,880**

Figure 356

DRAFT

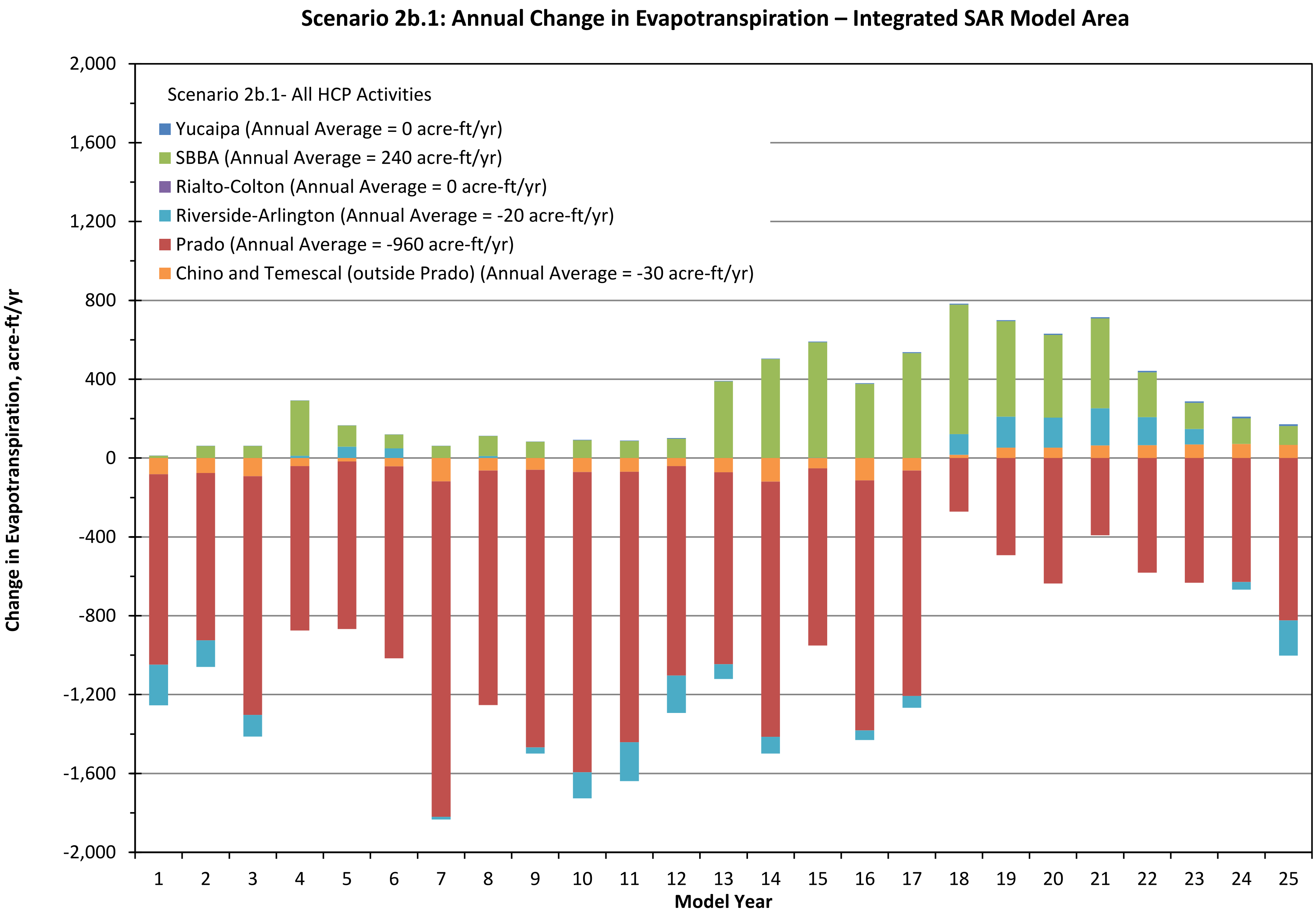
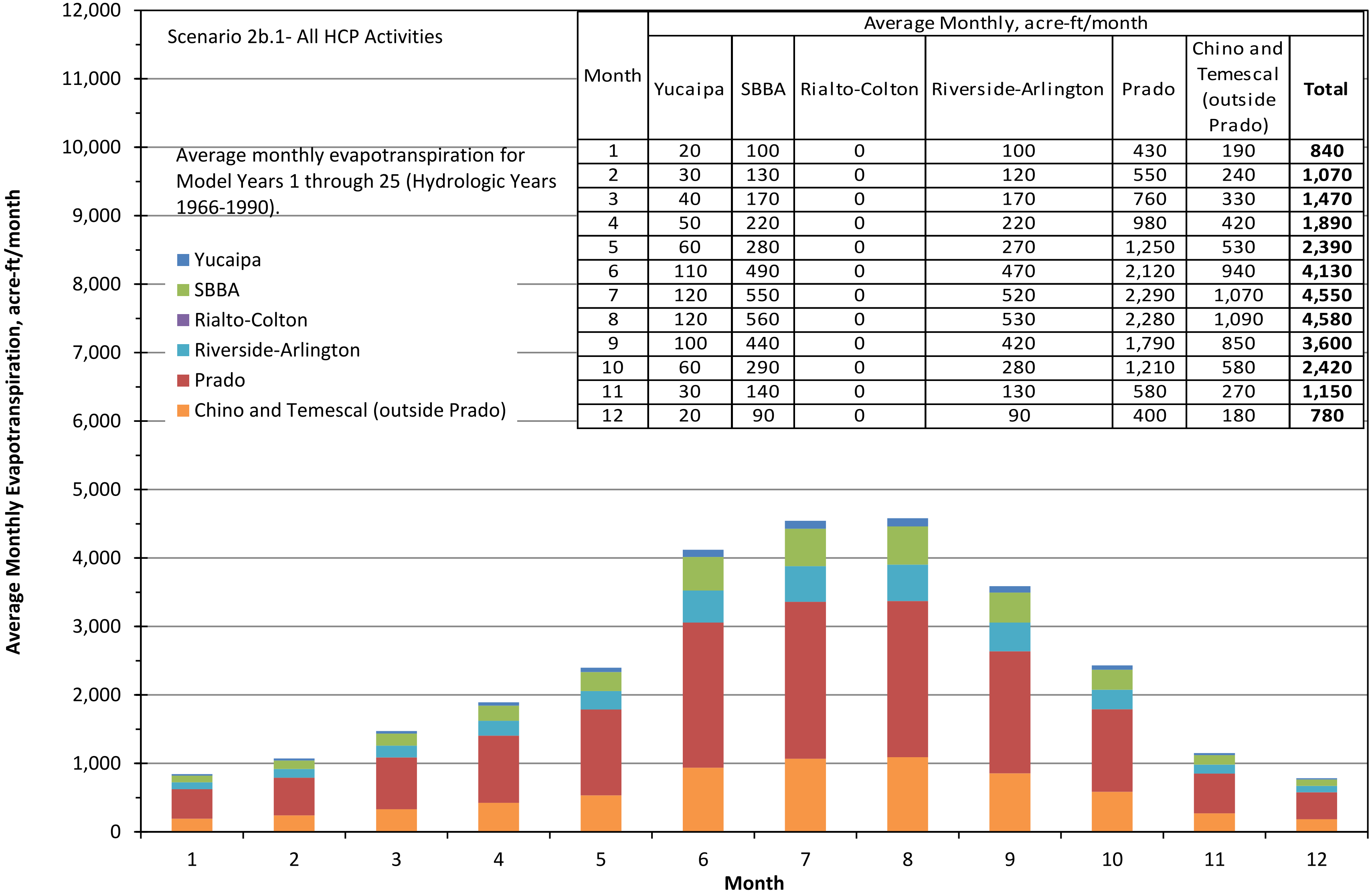


Figure 357

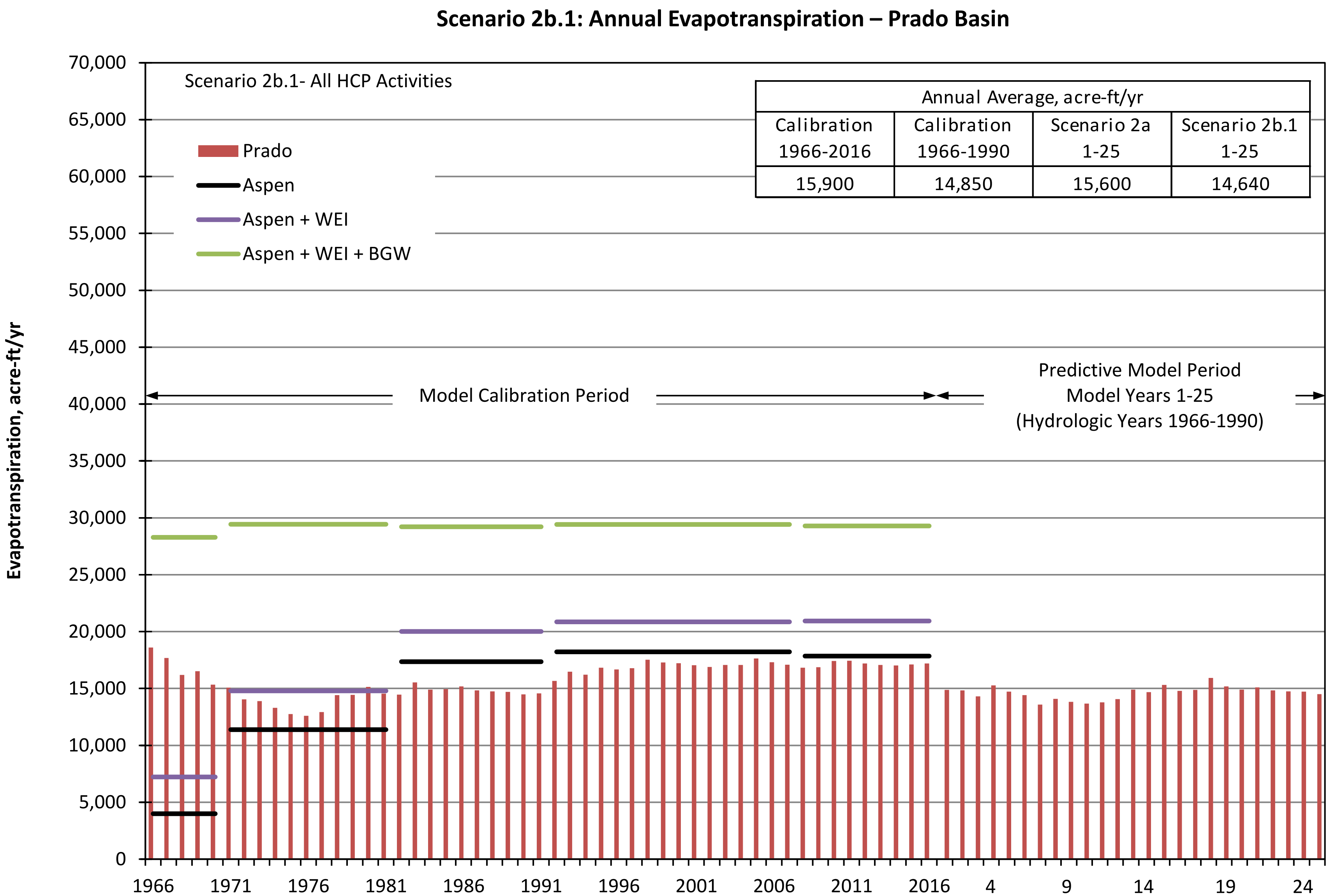
Scenario 2b.1: Seasonal Evapotranspiration – Integrated SAR Model Area



Month	Average Monthly, acre-ft/month						
	Yucaipa	SBBA	Rialto-Colton	Riverside-Arlington	Prado	Chino and Temescal (outside Prado)	**Total**
1	20	100	0	100	430	190	**840**
2	30	130	0	120	550	240	**1,070**
3	40	170	0	170	760	330	**1,470**
4	50	220	0	220	980	420	**1,890**
5	60	280	0	270	1,250	530	**2,390**
6	110	490	0	470	2,120	940	**4,130**
7	120	550	0	520	2,290	1,070	**4,550**
8	120	560	0	530	2,280	1,090	**4,580**
9	100	440	0	420	1,790	850	**3,600**
10	60	290	0	280	1,210	580	**2,420**
11	30	140	0	130	580	270	**1,150**
12	20	90	0	90	400	180	**780**

Figure 358

DRAFT



Annual Average, acre-ft/yr			
Calibration 1966-2016	Calibration 1966-1990	Scenario 2a 1-25	Scenario 2b.1 1-25
15,900	14,850	15,600	14,640

Figure 359

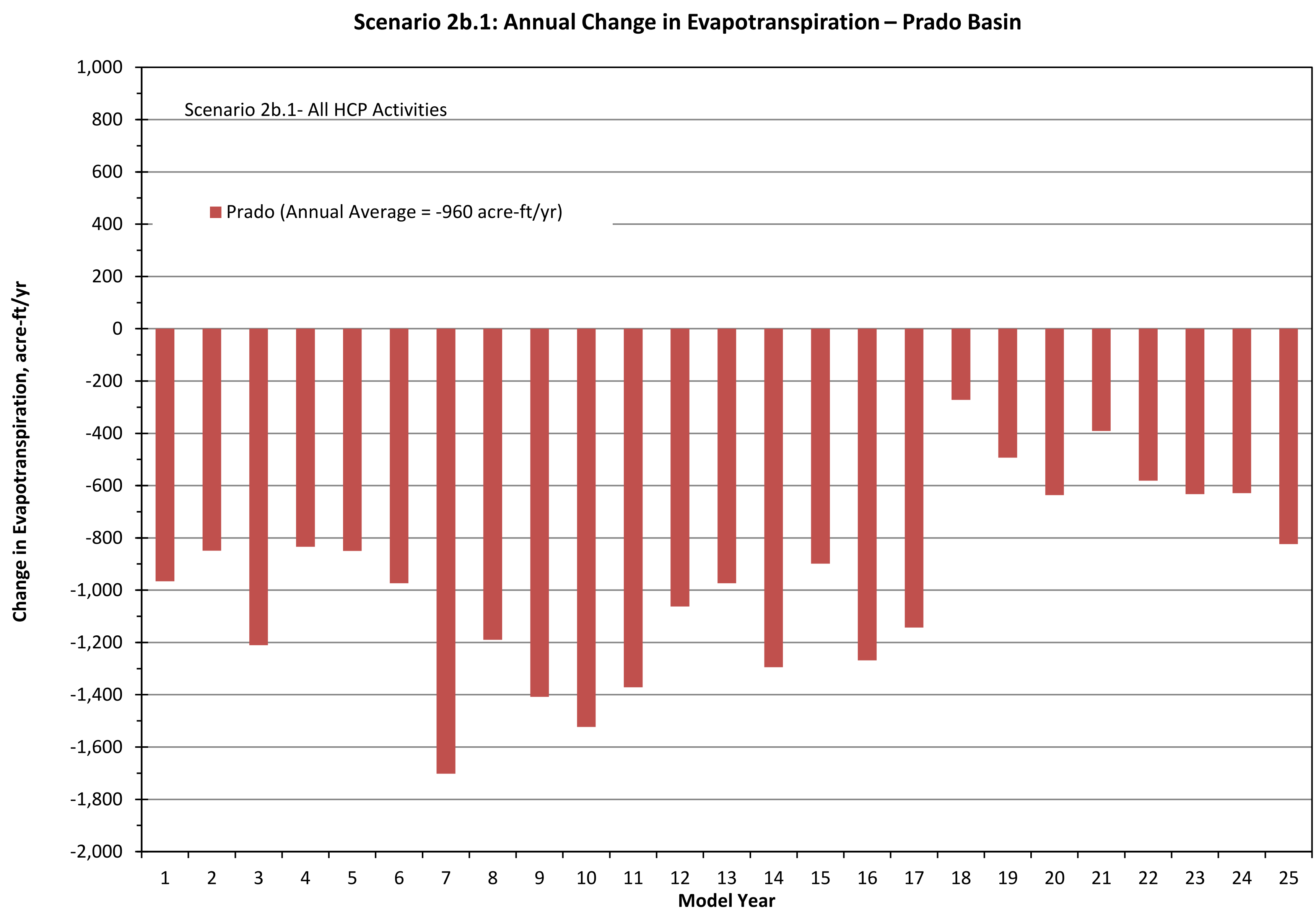
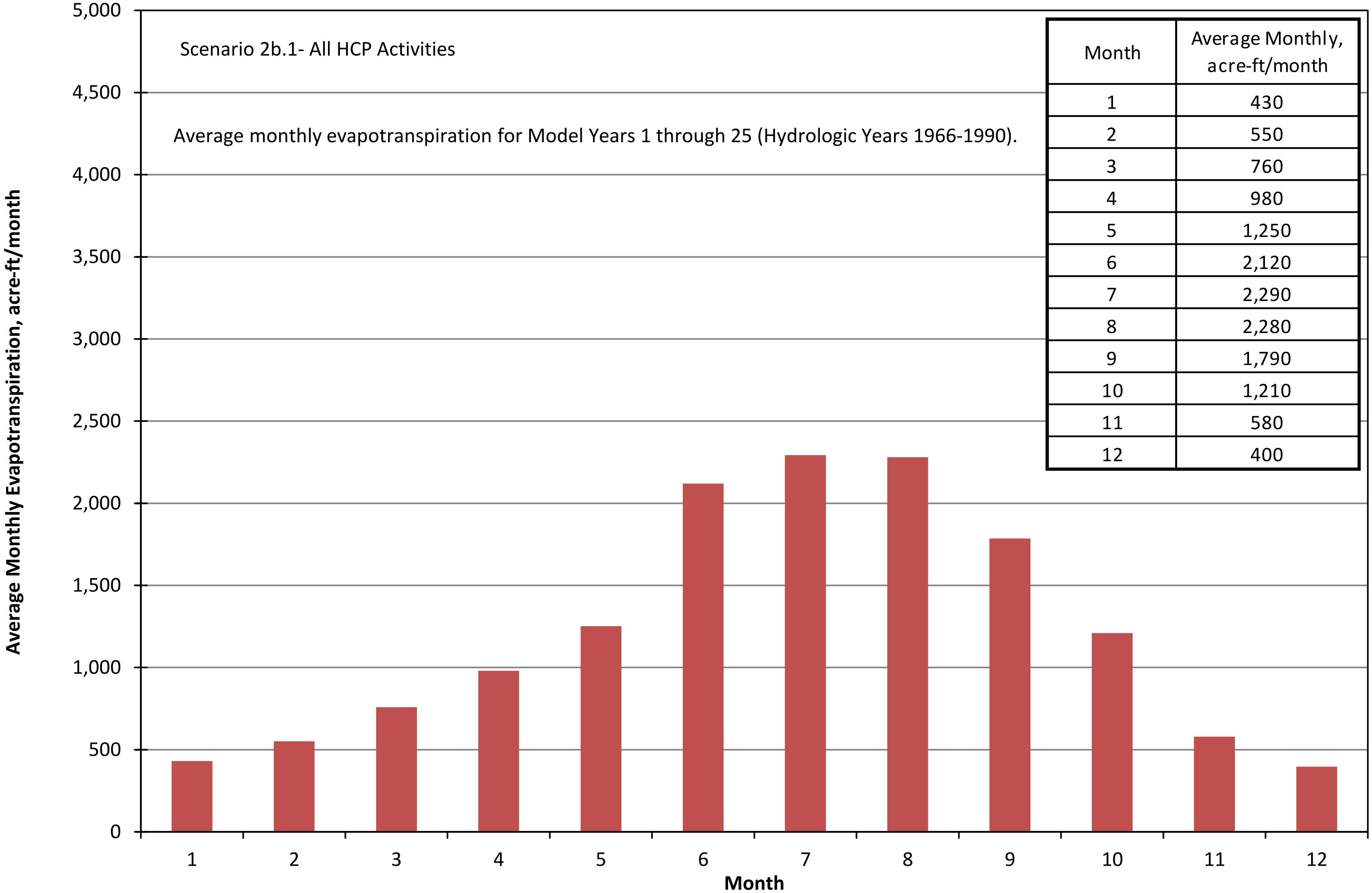

Scenario 2b.1: Annual Change in Evapotranspiration – Prado Basin
Scenario 2b.1- All HCP Activities
Prado (Annual Average = -960 acre-ft/yr)
Change in Evapotranspiration, acre-ft/yr
1,000
800
600
400
200
0
-200
-400
-600
-800
-1,000
-1,200
-1,400
-1,600
-1,800
-2,000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Model Year

Figure 360

Scenario 2b.1: Seasonal Evapotranspiration – Prado Basin



Month	Average Monthly, acre-ft/month
1	430
2	550
3	760
4	980
5	1,250
6	2,120
7	2,290
8	2,280
9	1,790
10	1,210
11	580
12	400

Figure 361

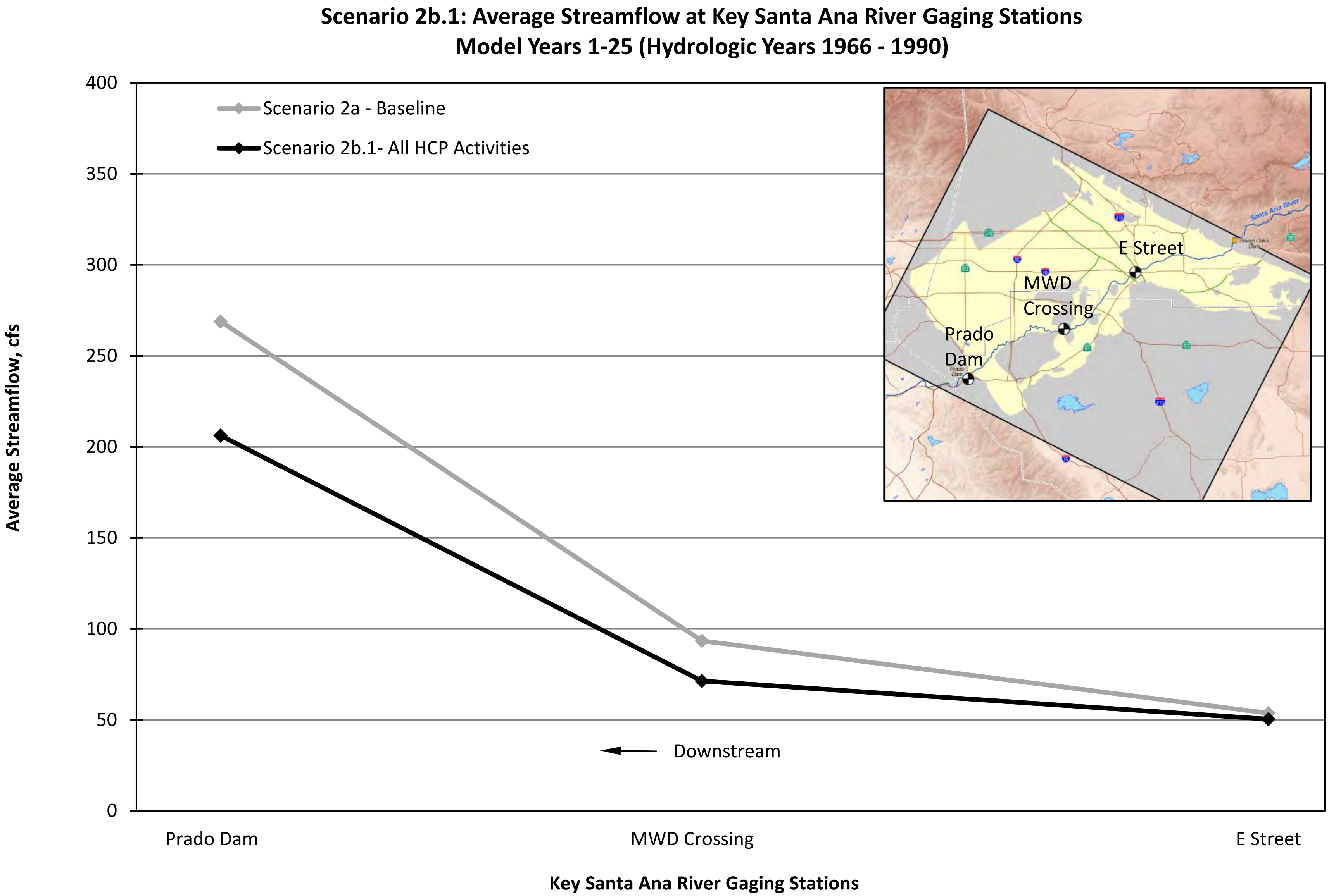

Scenario 2b.1: Average Streamflow at Key Santa Ana River Gaging Stations
Model Years 1-25 (Hydrologic Years 1966 - 1990)
Average Streamflow, cfs
400
350
300
250
200
150
100
50
0
Scenario 2a - Baseline
Scenario 2b.1- All HCP Activities
E Street
MWD
Crossing
Prado
Dam
Downstream
Prado Dam
MWD Crossing
E Street
Key Santa Ana River Gaging Stations

Figure 362

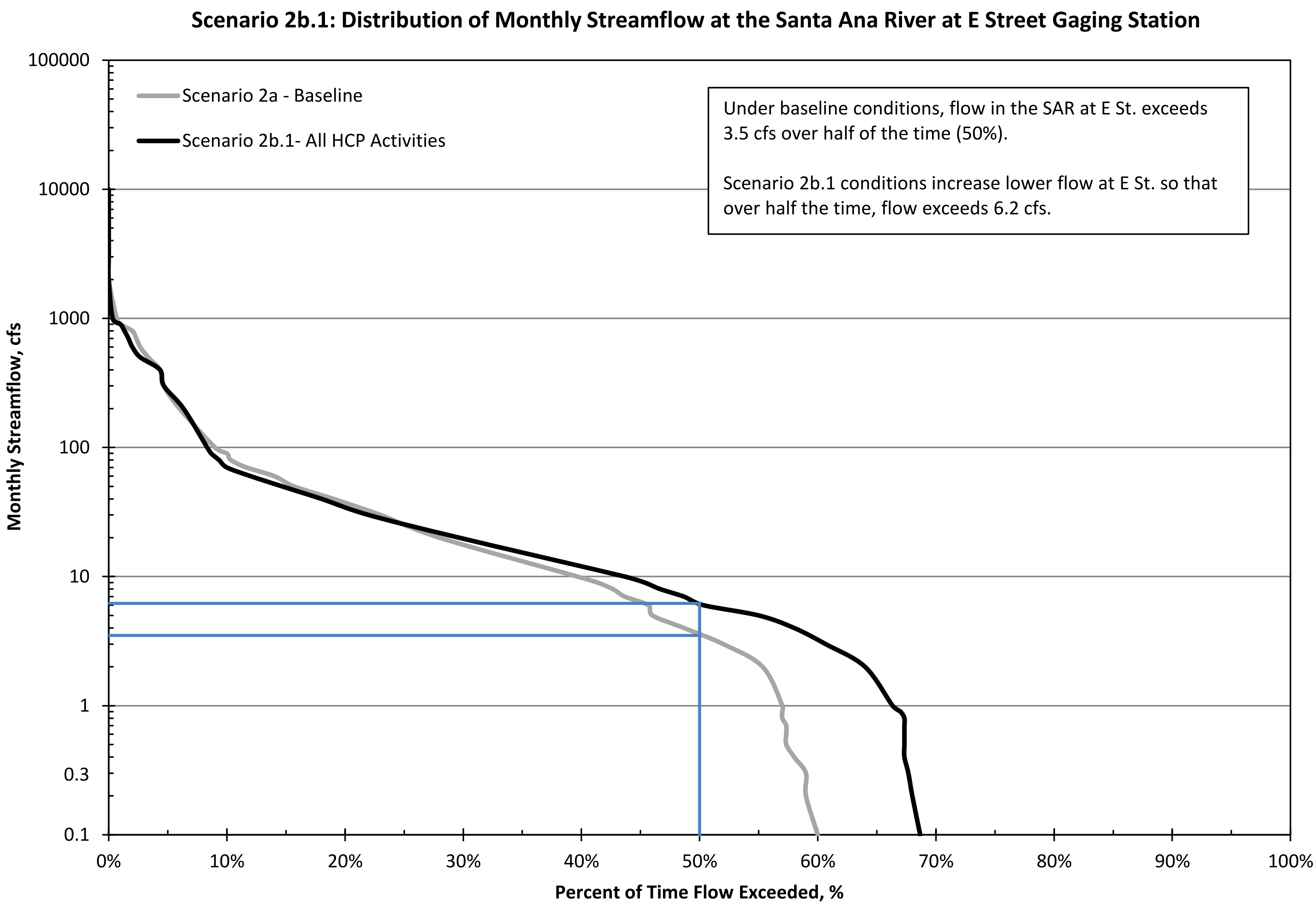

Scenario 2b.1: Distribution of Monthly Streamflow at the Santa Ana River at E Street Gaging Station
Scenario 2a - Baseline
Scenario 2b.1- All HCP Activities
Under baseline conditions, flow in the SAR at E St. exceeds 3.5 cfs over half of the time (50%).
Scenario 2b.1 conditions increase lower flow at E St. so that over half the time, flow exceeds 6.2 cfs.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.3
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 363

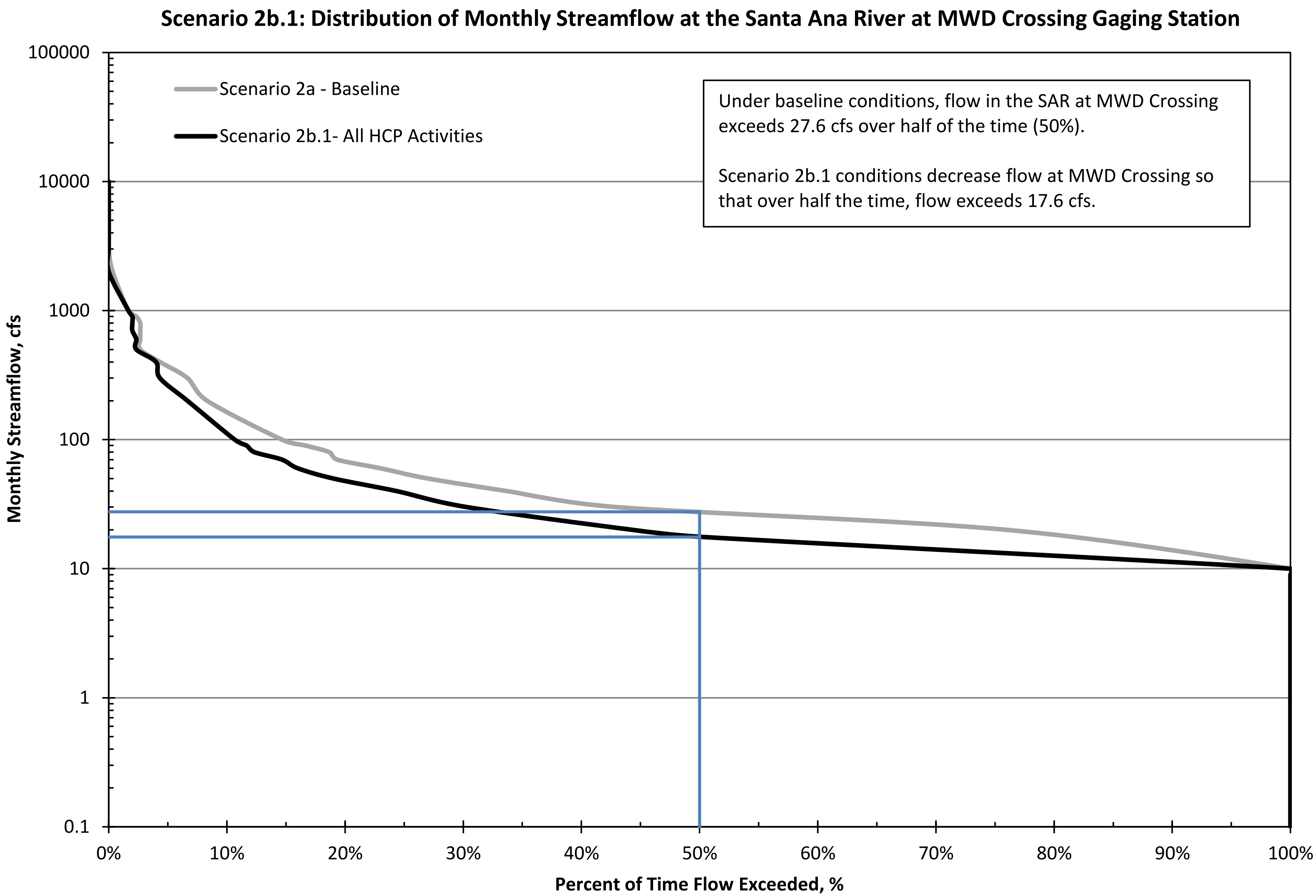

Scenario 2b.1: Distribution of Monthly Streamflow at the Santa Ana River at MWD Crossing Gaging Station
Scenario 2a - Baseline
Scenario 2b.1- All HCP Activities
Under baseline conditions, flow in the SAR at MWD Crossing exceeds 27.6 cfs over half of the time (50%).
Scenario 2b.1 conditions decrease flow at MWD Crossing so that over half the time, flow exceeds 17.6 cfs.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 364

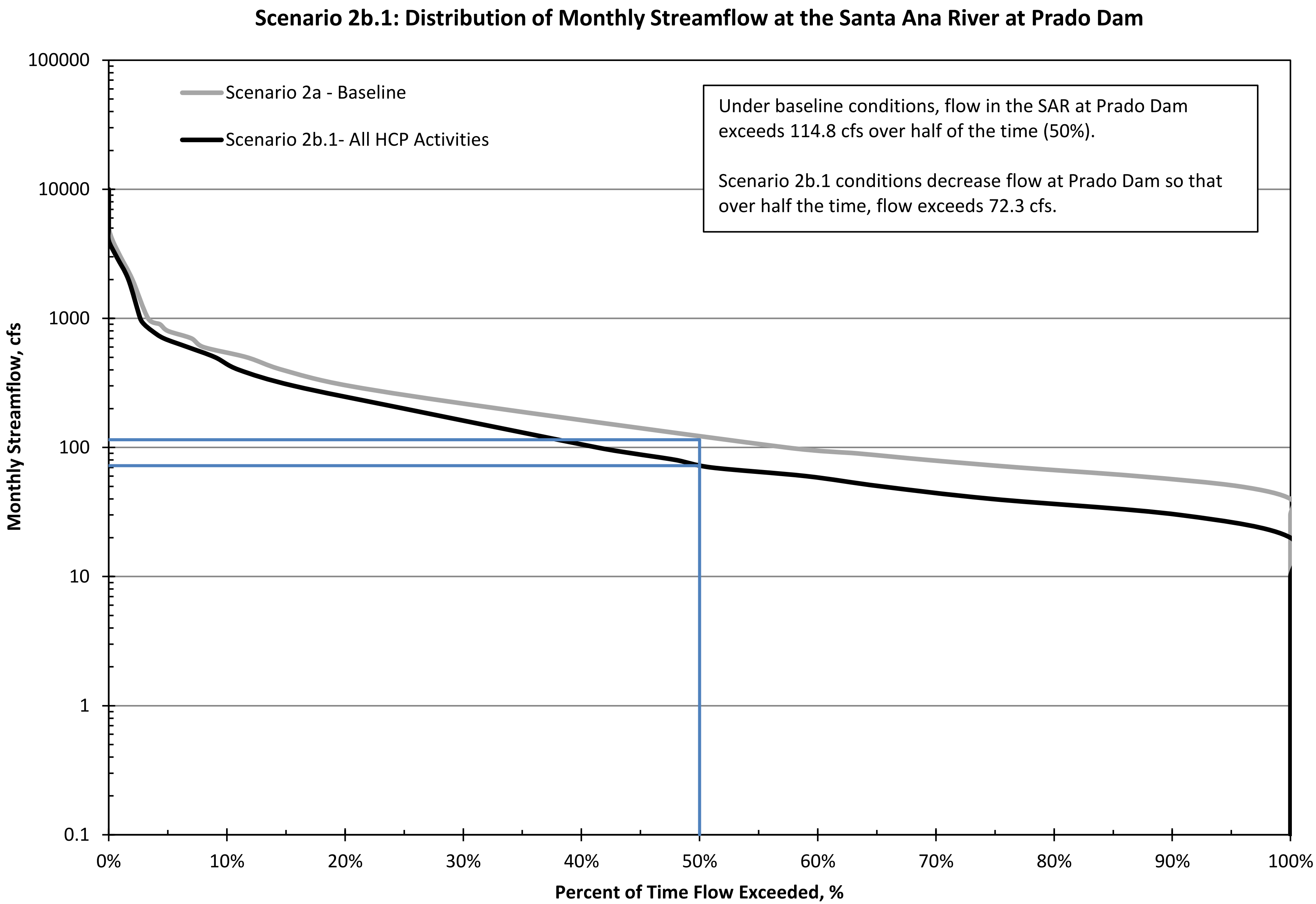
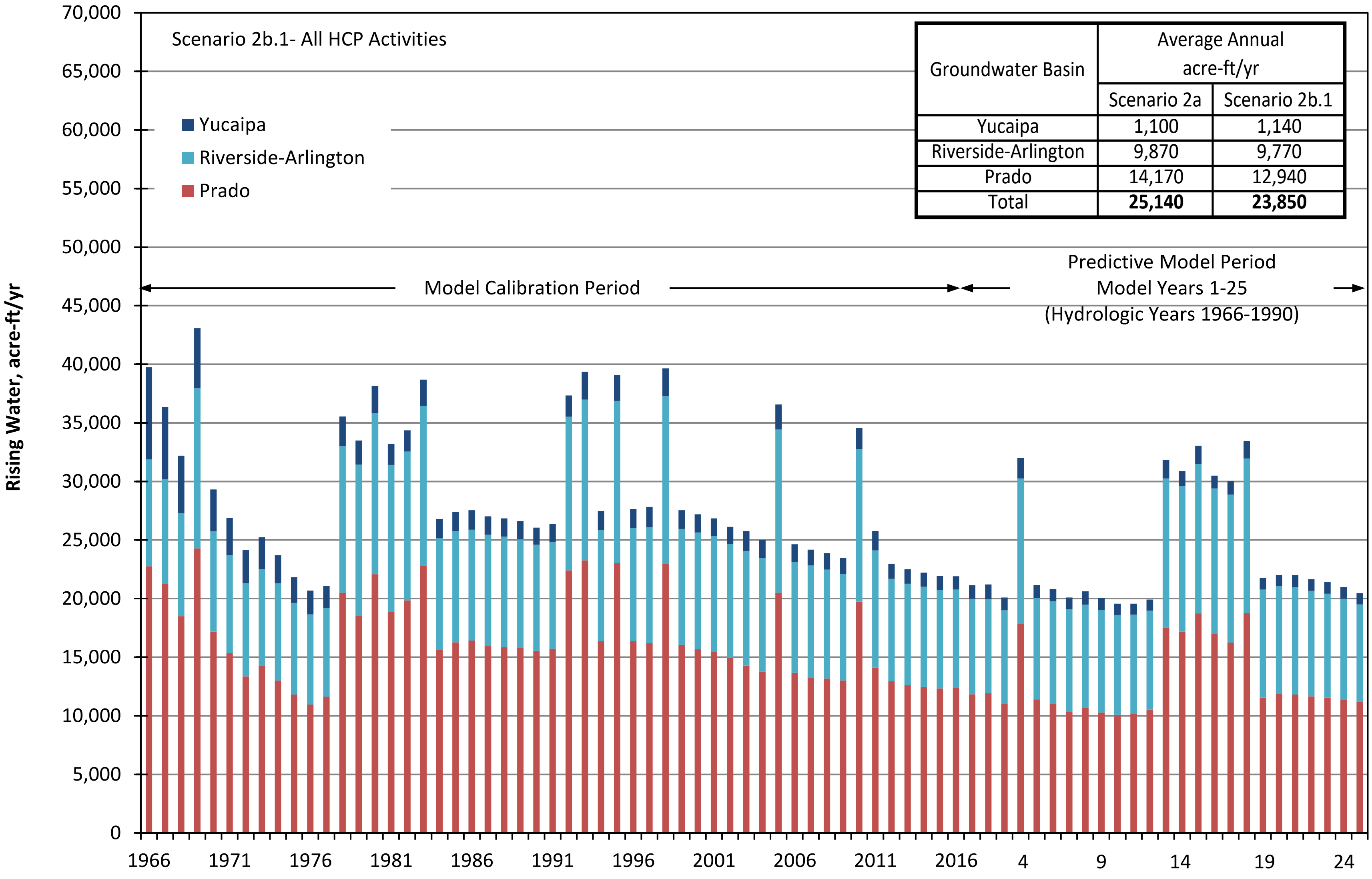

Scenario 2b.1: Distribution of Monthly Streamflow at the Santa Ana River at Prado Dam
Scenario 2a - Baseline
Scenario 2b.1- All HCP Activities
Under baseline conditions, flow in the SAR at Prado Dam exceeds 114.8 cfs over half of the time (50%).
Scenario 2b.1 conditions decrease flow at Prado Dam so that over half the time, flow exceeds 72.3 cfs.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 365

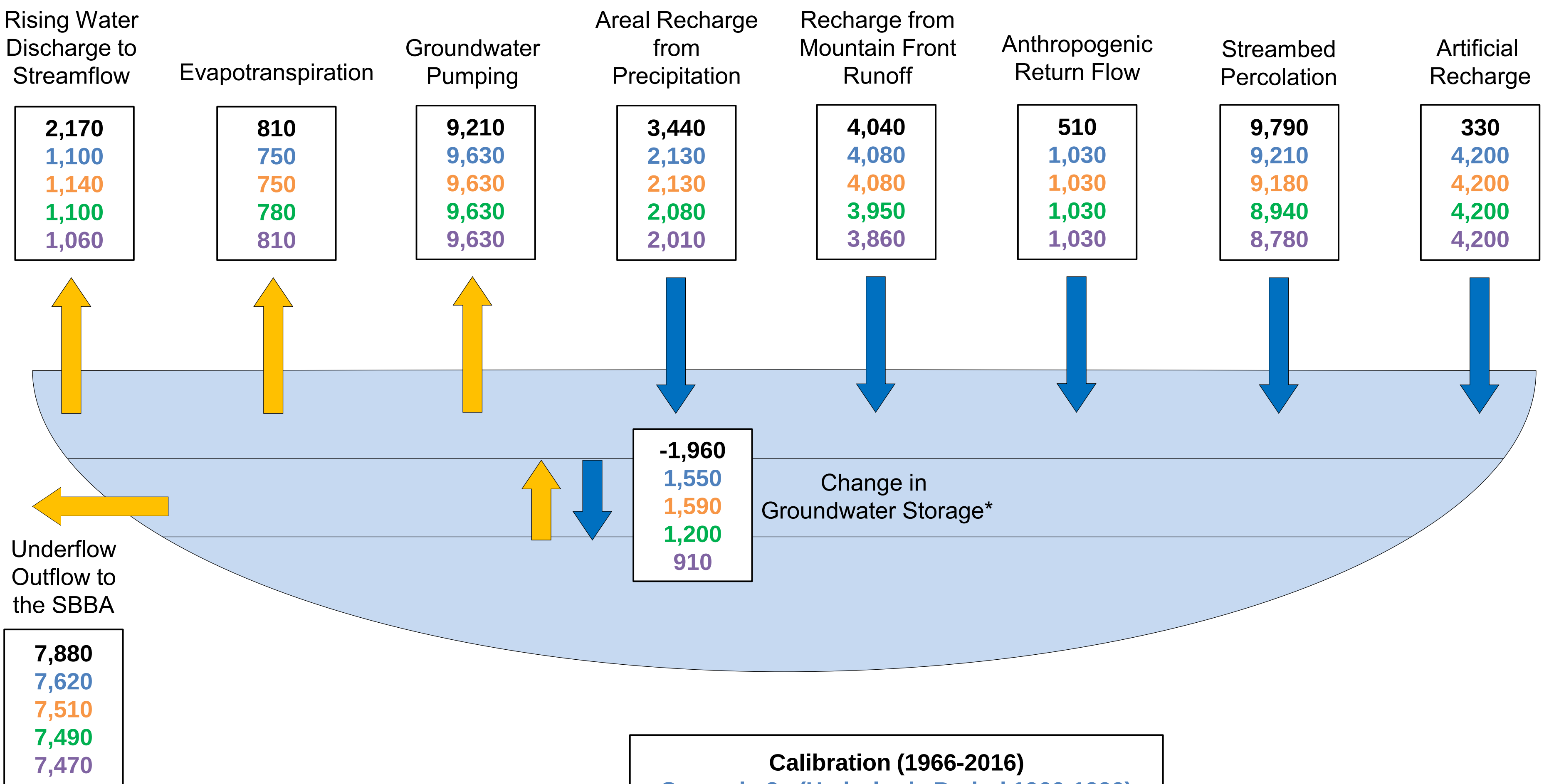
Scenario 2b.1: Annual Rising Water – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2b.1
Yucaipa	1,100	1,140
Riverside-Arlington	9,870	9,770
Prado	14,170	12,940
Total	**25,140**	**23,850**

Figure 366

X:\Projects\San_Bernardino_MUNI\31) Integreated_SAR_Model\(4)Technical_Memos\(8) Summary Report\Draft\Figures\Scenarios



Scenario 2a - Baseline
Scenario 2b.1 - All HCP Activities
Scenario 2b.2 - All HCP Activities (Climate Change Alternative 1)
Scenario 2b.3 - All HCP Activities (Climate Change Alternative 2)

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2b.1 (Hydrologic Period 1966-1990)
Scenario 2b.2 (Hydrologic Period 1966-1990)
Scenario 2b.3 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

**SCENARIOS 2B.1-2B.3
AVERAGE ANNUAL
WATER BUDGET
YUCAIPA BASIN**

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT
UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

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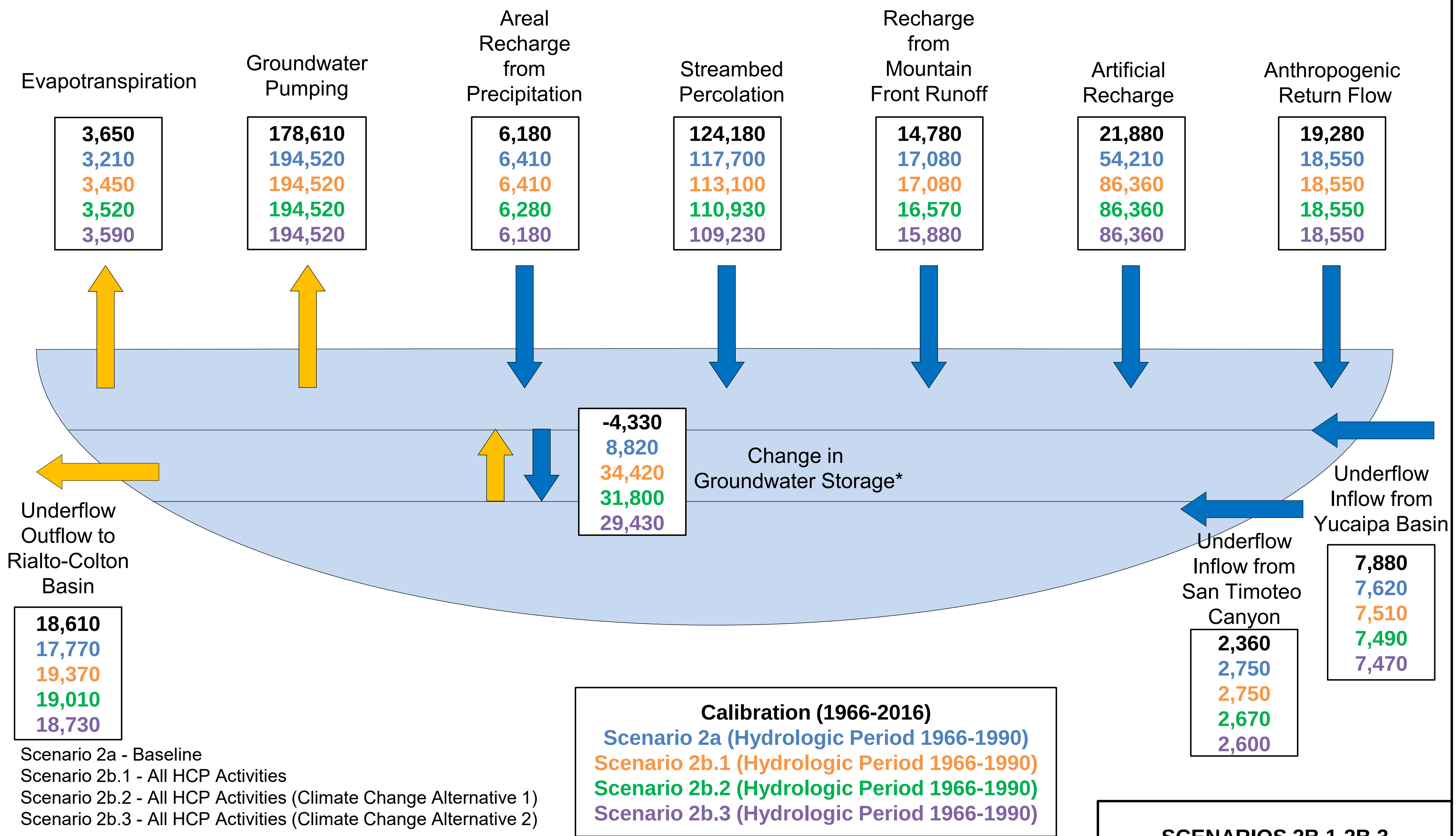
FIGURE 367

GEOSCIENCE

X:\Projects\San_Bernardino_MUNI\31) Integreated_SAR_Model\(4)Technical_Memos\(8) Summary Report\Draft\Figures\Scenarios



All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIOS 2B.1-2B.3
AVERAGE ANNUAL
WATER BUDGET
SBBA

10-Apr-20

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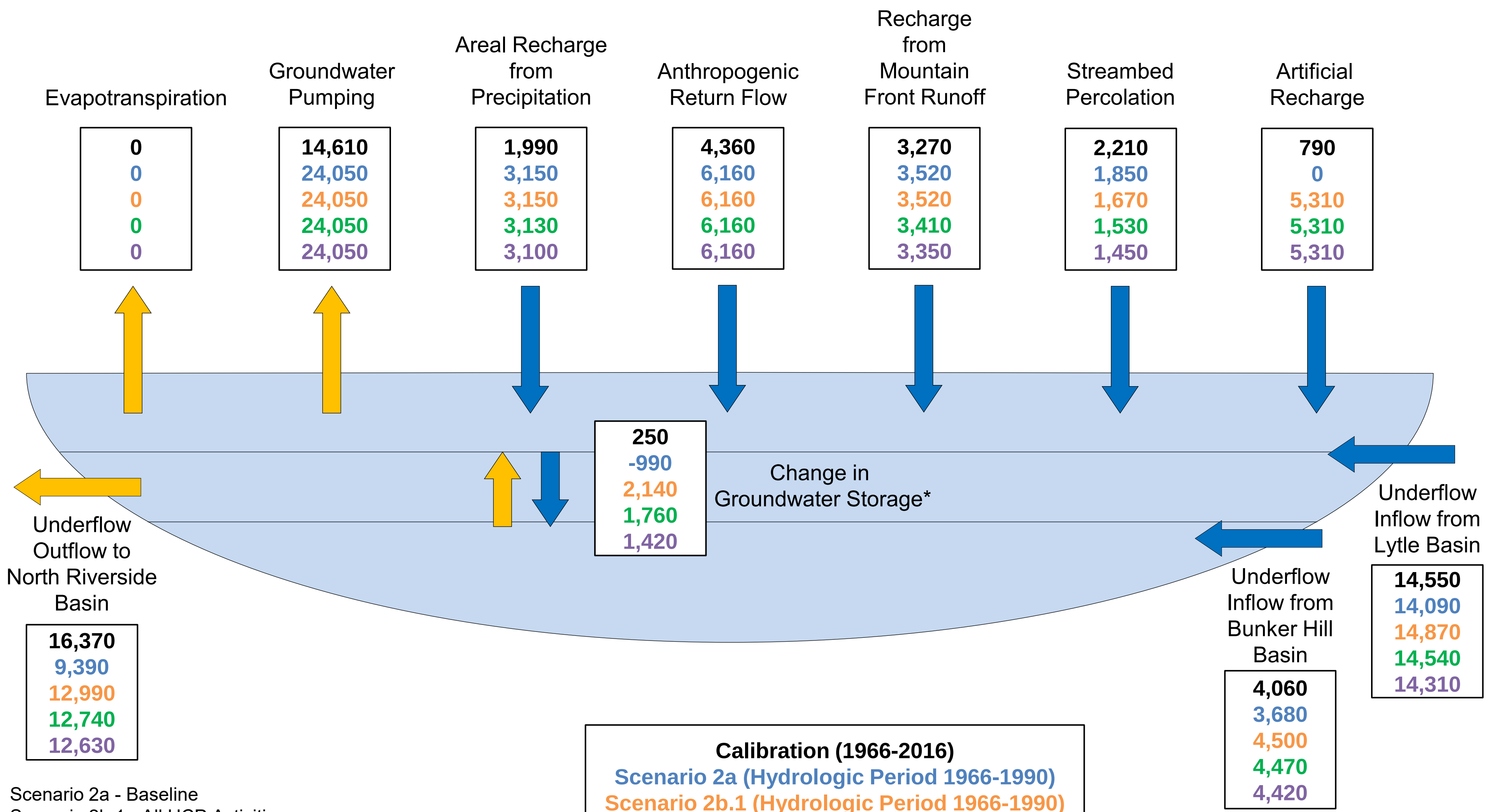


Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2b.1 (Hydrologic Period 1966-1990)
Scenario 2b.2 (Hydrologic Period 1966-1990)
Scenario 2b.3 (Hydrologic Period 1966-1990)

Scenario 2a - Baseline
Scenario 2b.1 - All HCP Activities
Scenario 2b.2 - All HCP Activities (Climate Change Alternative 1)
Scenario 2b.3 - All HCP Activities (Climate Change Alternative 2)

All values in acre-ft/yr

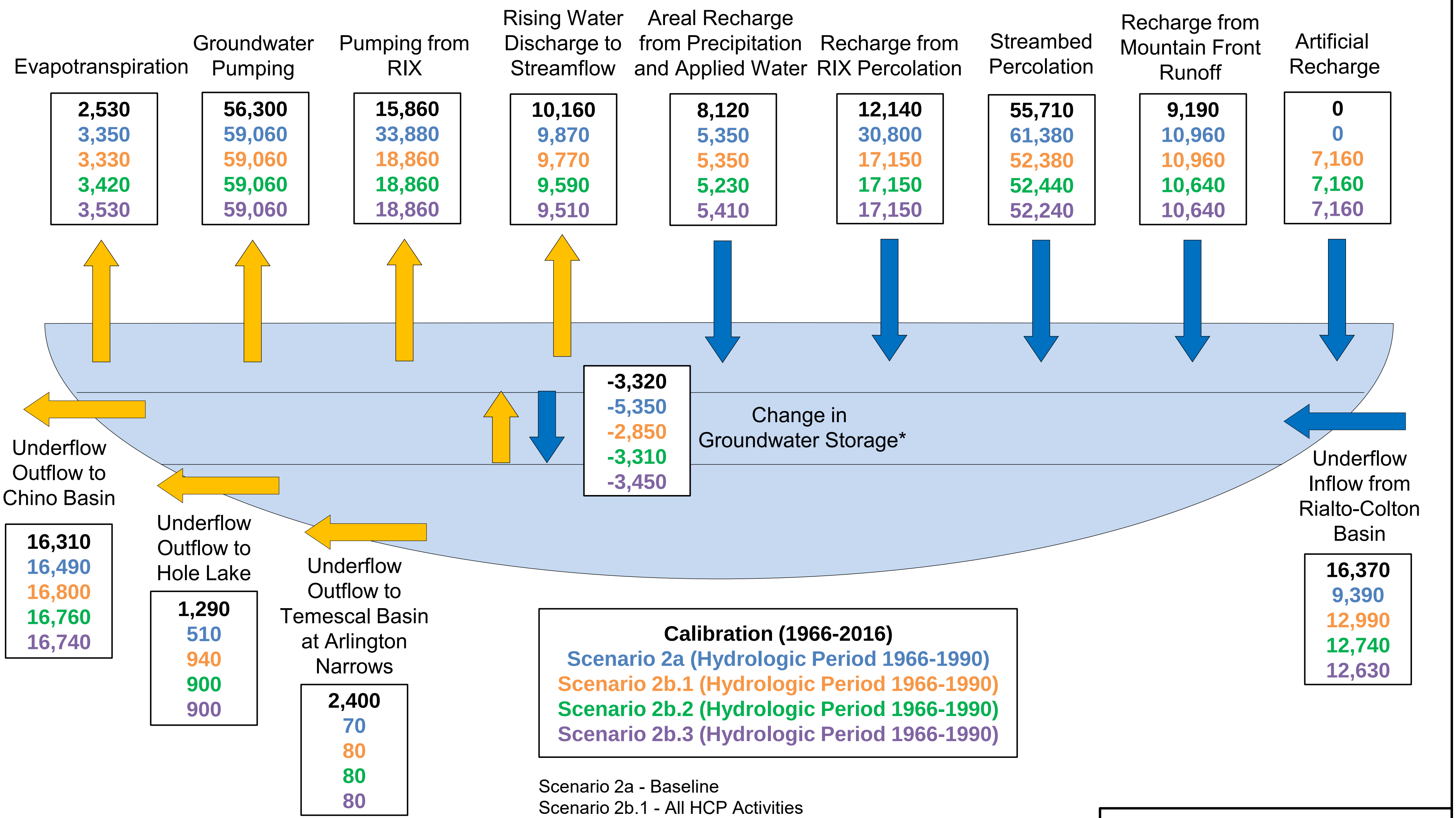
*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIOS 2B.1-2B.3
AVERAGE ANNUAL
WATER BUDGET
RIALTO-COLTON BASIN

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT **DRAFT** **FIGURE 369**
UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT
GEOSCIENCE

X:\Projects\San_Bernardino_MUNI\31)Integreated_SAR_Model\(4)Technical_Memos\(8) Summary Report\Draft\Figures\Scenarios



Scenario 2a - Baseline
Scenario 2b.1 - All HCP Activities
Scenario 2b.2 - All HCP Activities (Climate Change Alternative 1)
Scenario 2b.3 - All HCP Activities (Climate Change Alternative 2)

All values in acre-ft/yr

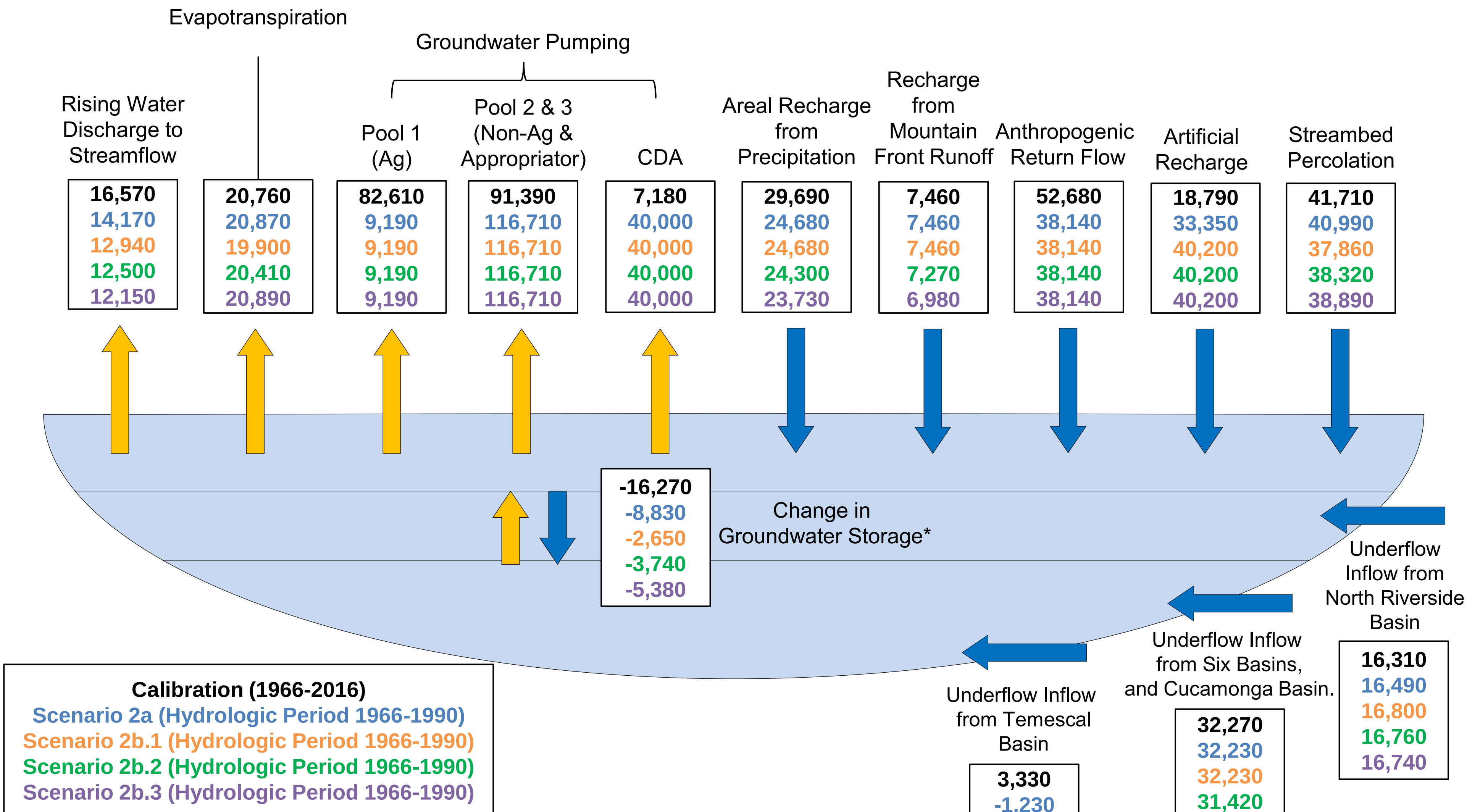
*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

**SCENARIOS 2B.1-2B.3
AVERAGE ANNUAL
WATER BUDGET
RIVERSIDE-ARLINGTON BASIN**

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT **DRAFT** **FIGURE 370**

GEOSCIENCE



Scenario 2a - Baseline
Scenario 2b.1 - All HCP Activities
Scenario 2b.2 - All HCP Activities (Climate Change Alternative 1)
Scenario 2b.3 - All HCP Activities (Climate Change Alternative 2)

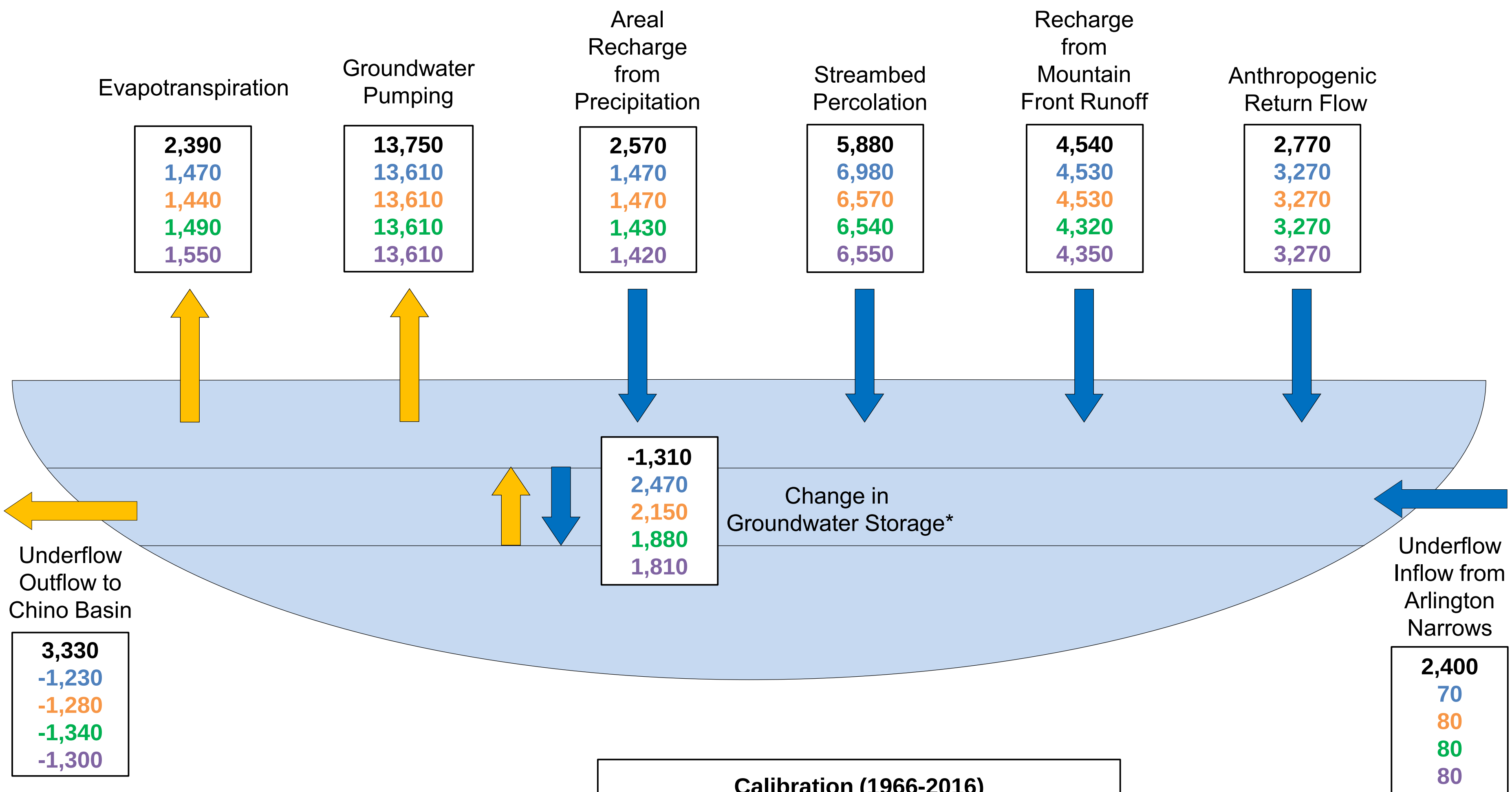
All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIOS 2B.1-2B.3 AVERAGE ANNUAL WATER BUDGET CHINO BASIN

X:\Projects\San_Bernardino_MUNI\31) Integreated_SAR_Model\(4)Technical_Memos\(8) Summary Report\Draft\Figures\Scenarios

10-Apr-20



Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2b.1 (Hydrologic Period 1966-1990)
Scenario 2b.2 (Hydrologic Period 1966-1990)
Scenario 2b.3 (Hydrologic Period 1966-1990)

Scenario 2a - Baseline
Scenario 2b.1 - All HCP Activities
Scenario 2b.2 - All HCP Activities (Climate Change Alternative 1)
Scenario 2b.3 - All HCP Activities (Climate Change Alternative 2)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

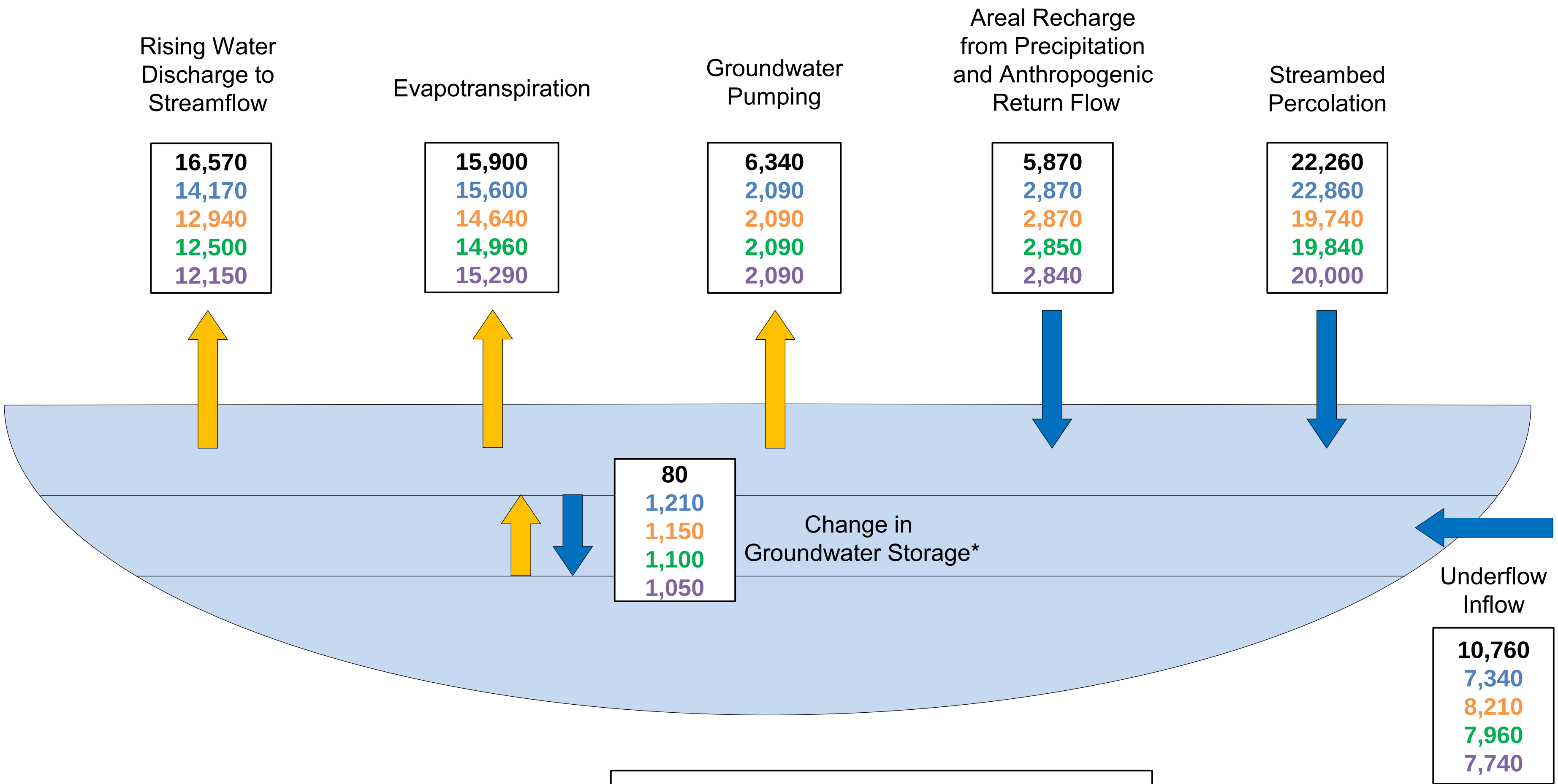
**SCENARIOS 2B.1-2B.3
AVERAGE ANNUAL
WATER BUDGET
TEMESCAL BASIN**

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT **DRAFT** **FIGURE 372**
UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

GEOSCIENCE

X:\Projects\San_Bernardino_MUNI\31) Integreated_SAR_Model\(4)Technical_Memos\(8) Summary Report\Draft\Figures\Scenarios



Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2b.1 (Hydrologic Period 1966-1990)
Scenario 2b.2 (Hydrologic Period 1966-1990)
Scenario 2b.3 (Hydrologic Period 1966-1990)

Scenario 2a - Baseline
Scenario 2b.1 - All HCP Activities
Scenario 2b.2 - All HCP Activities (Climate Change Alternative 1)
Scenario 2b.3 - All HCP Activities (Climate Change Alternative 2)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIOS 2B.1-2B.3
AVERAGE ANNUAL
WATER BUDGET
PRADO BASIN

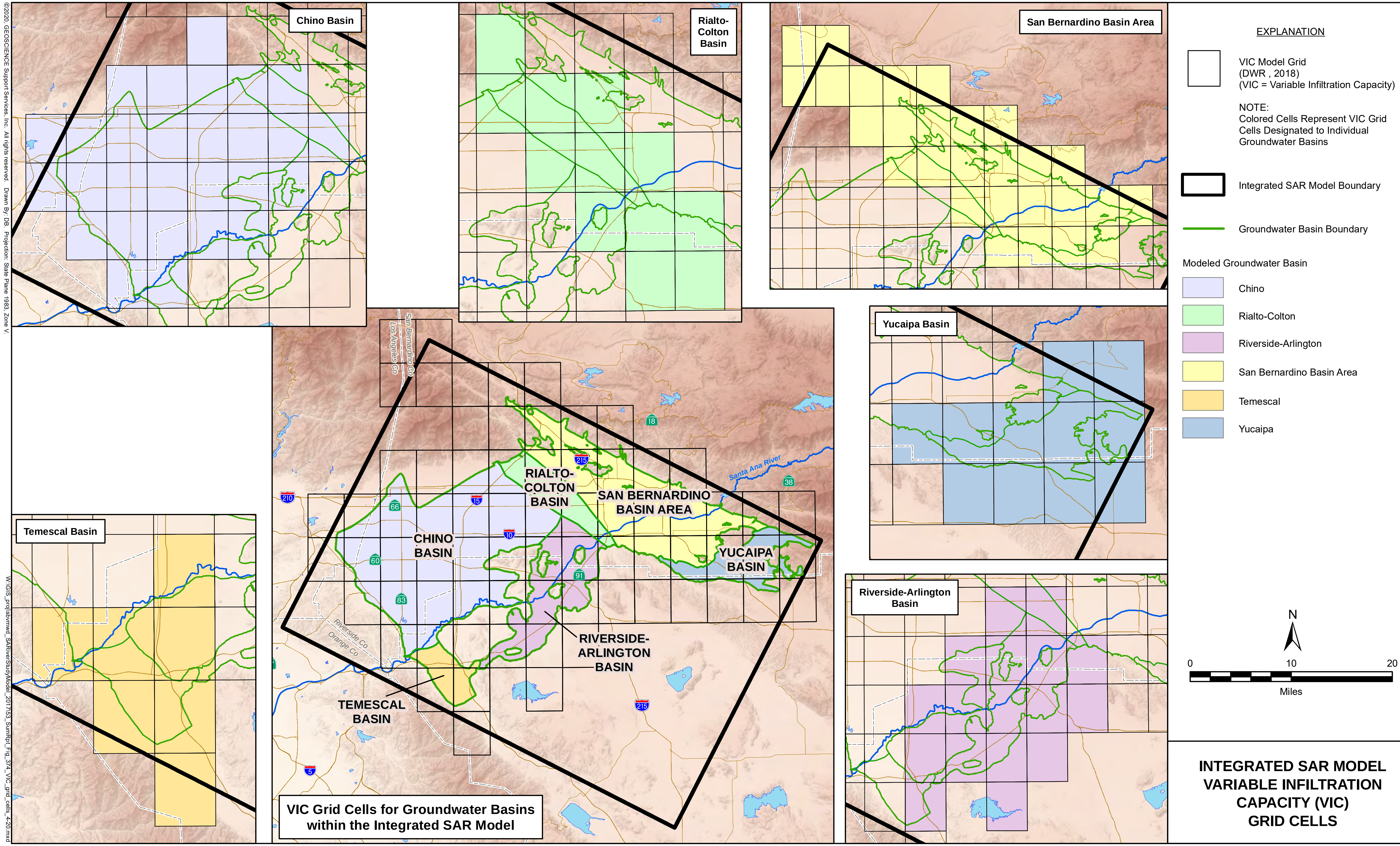
10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT
UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

DRAFT

FIGURE 373

GEOSCIENCE



10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

DRAFT

FIGURE 374

GEOSCIENCE

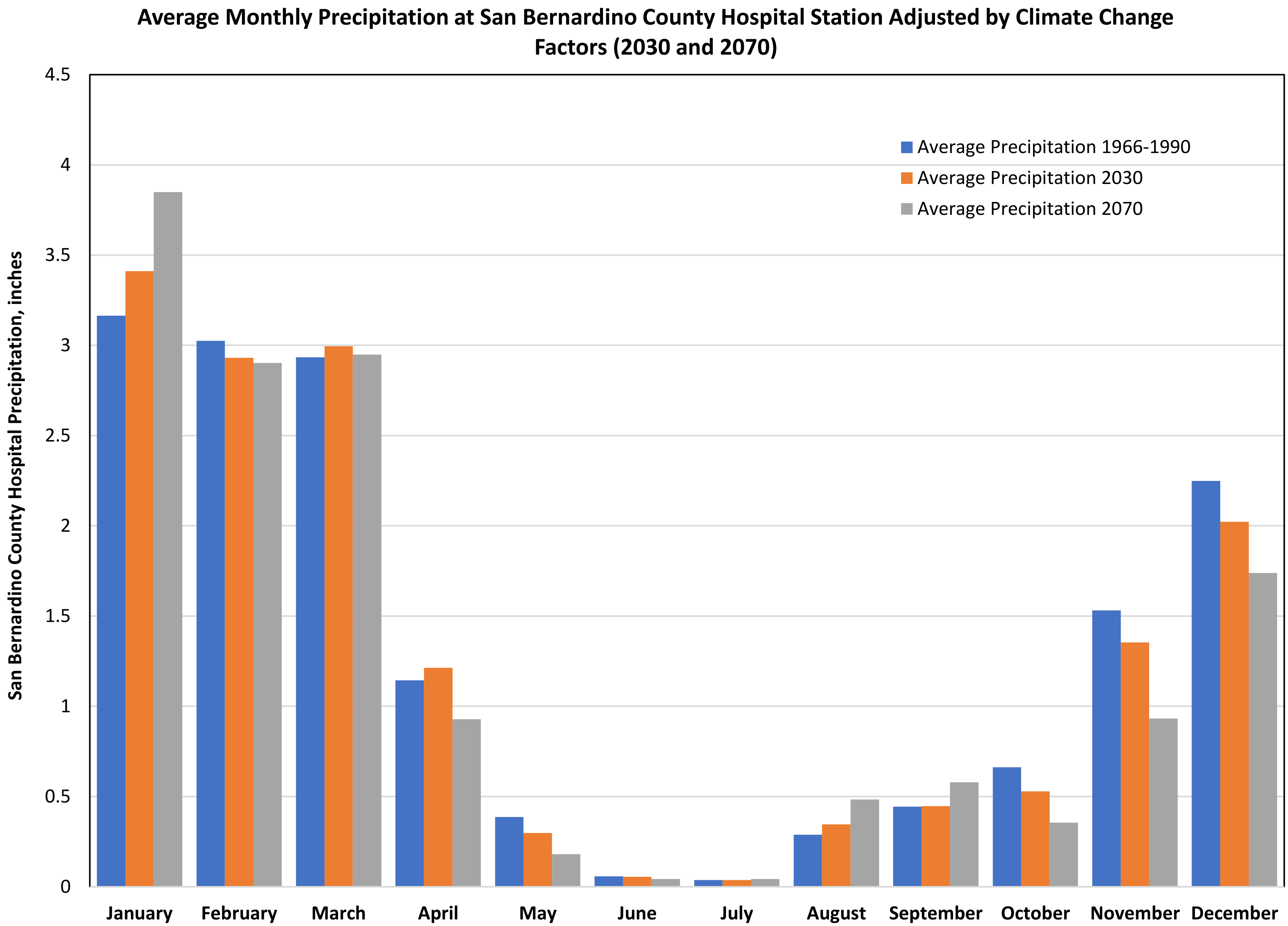

Average Monthly Precipitation at San Bernardino County Hospital Station Adjusted by Climate Change Factors (2030 and 2070)
San Bernardino County Hospital Precipitation, inches
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Average Precipitation 1966-1990
Average Precipitation 2030
Average Precipitation 2070
January
February
March
April
May
June
July
August
September
October
November
December

Figure 375

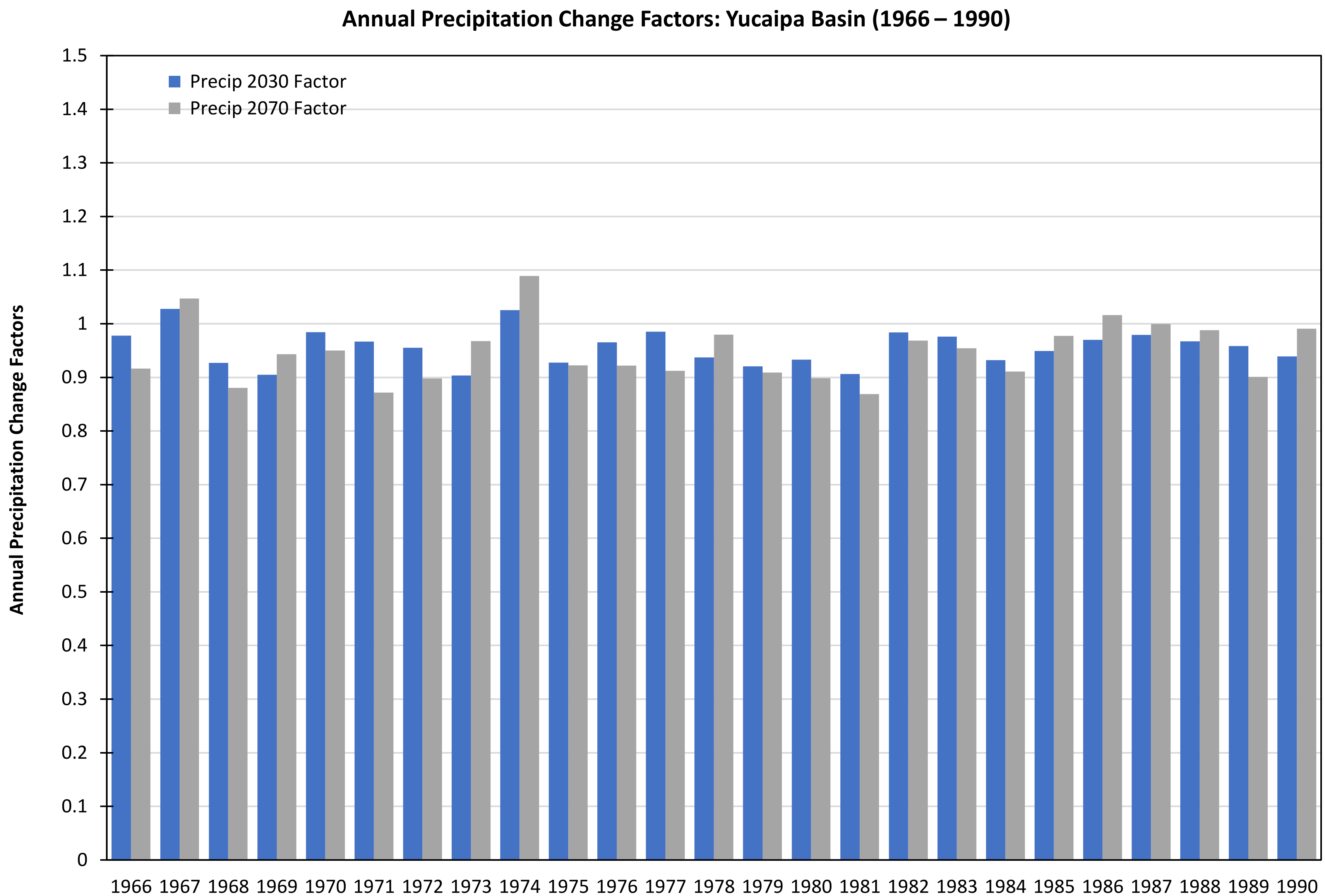

Annual Precipitation Change Factors: Yucaipa Basin (1966 – 1990)
Precip 2030 Factor
Precip 2070 Factor
Annual Precipitation Change Factors
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
1966 1967 1968 1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990

Figure 376

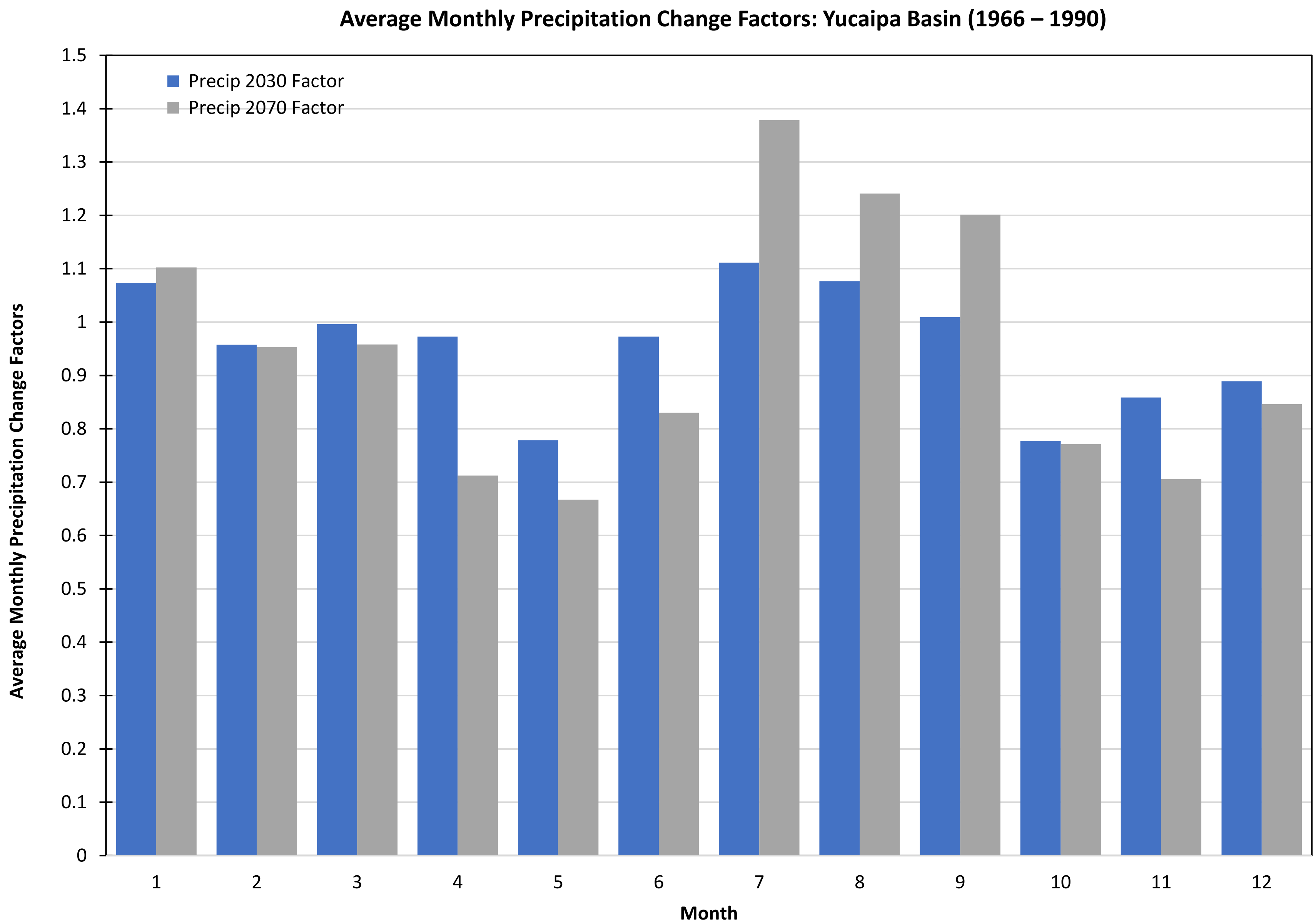

Average Monthly Precipitation Change Factors: Yucaipa Basin (1966 – 1990)
Precip 2030 Factor
Precip 2070 Factor
Average Monthly Precipitation Change Factors
Month
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1
2
3
4
5
6
7
8
9
10
11
12

Figure 377

DRAFT

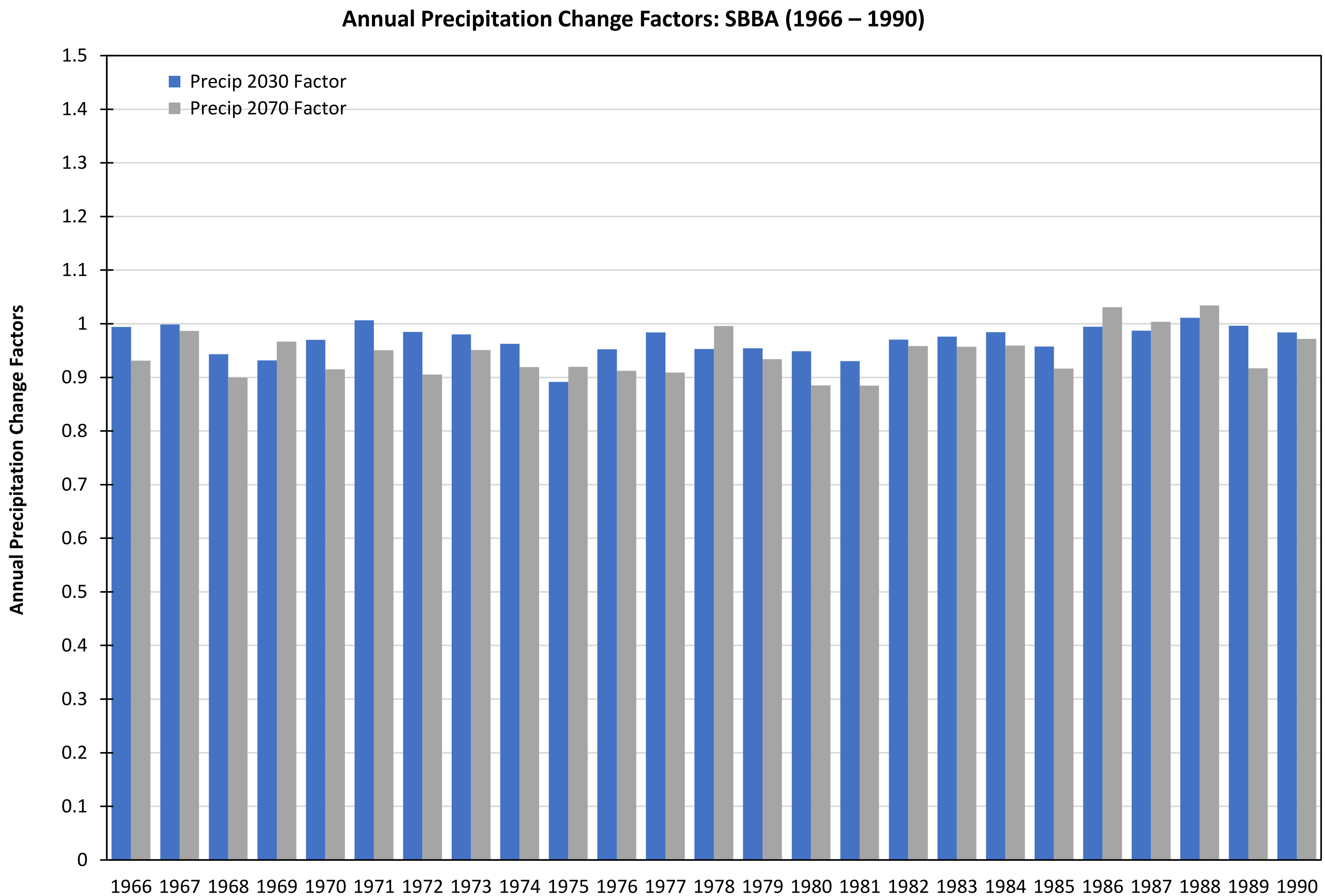


Figure 378

Average Monthly Precipitation Change Factors: SBBA (1966 – 1990)

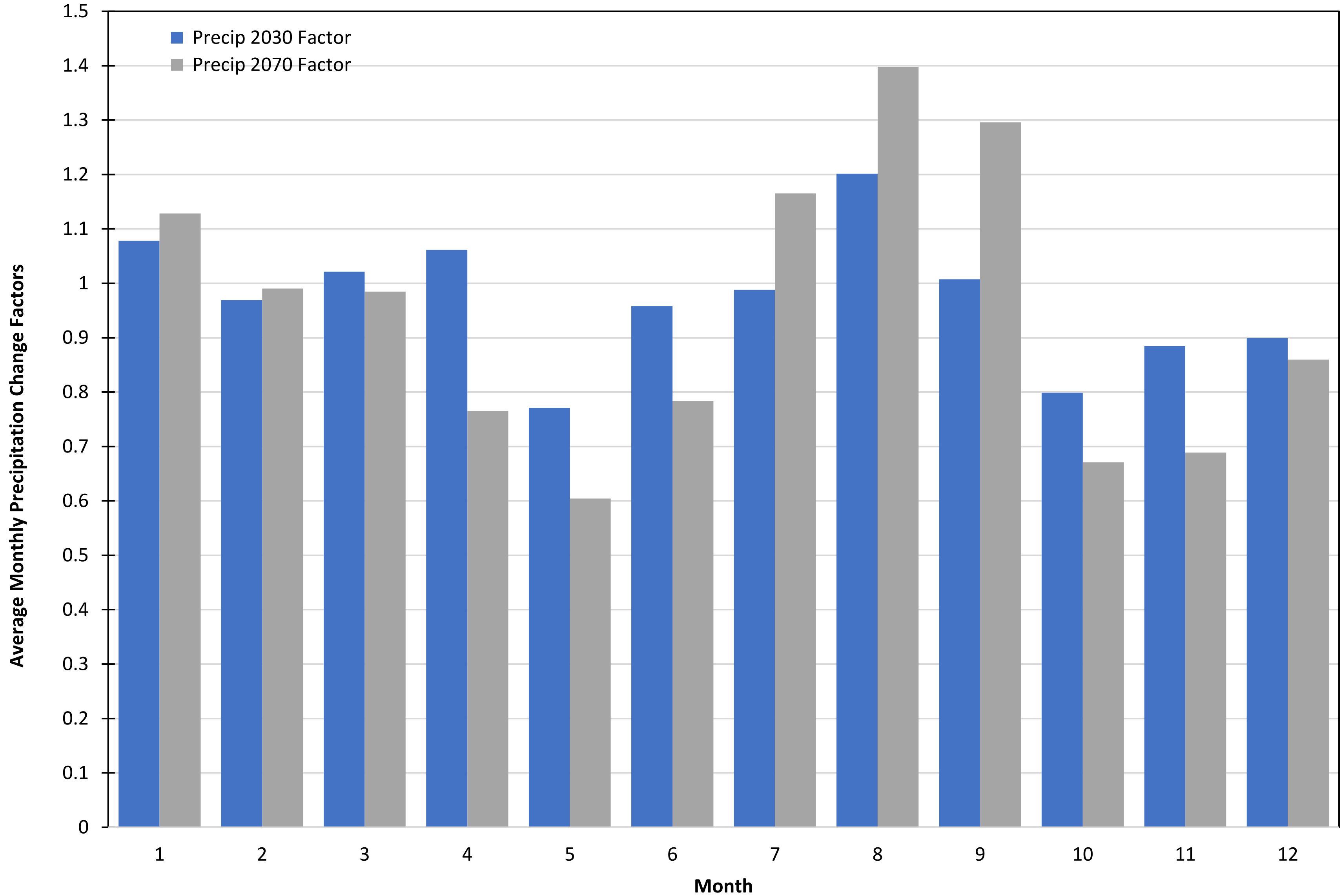


Figure 379

Annual Precipitation Change Factors: Rialto-Colton Basin (1966 – 1990)

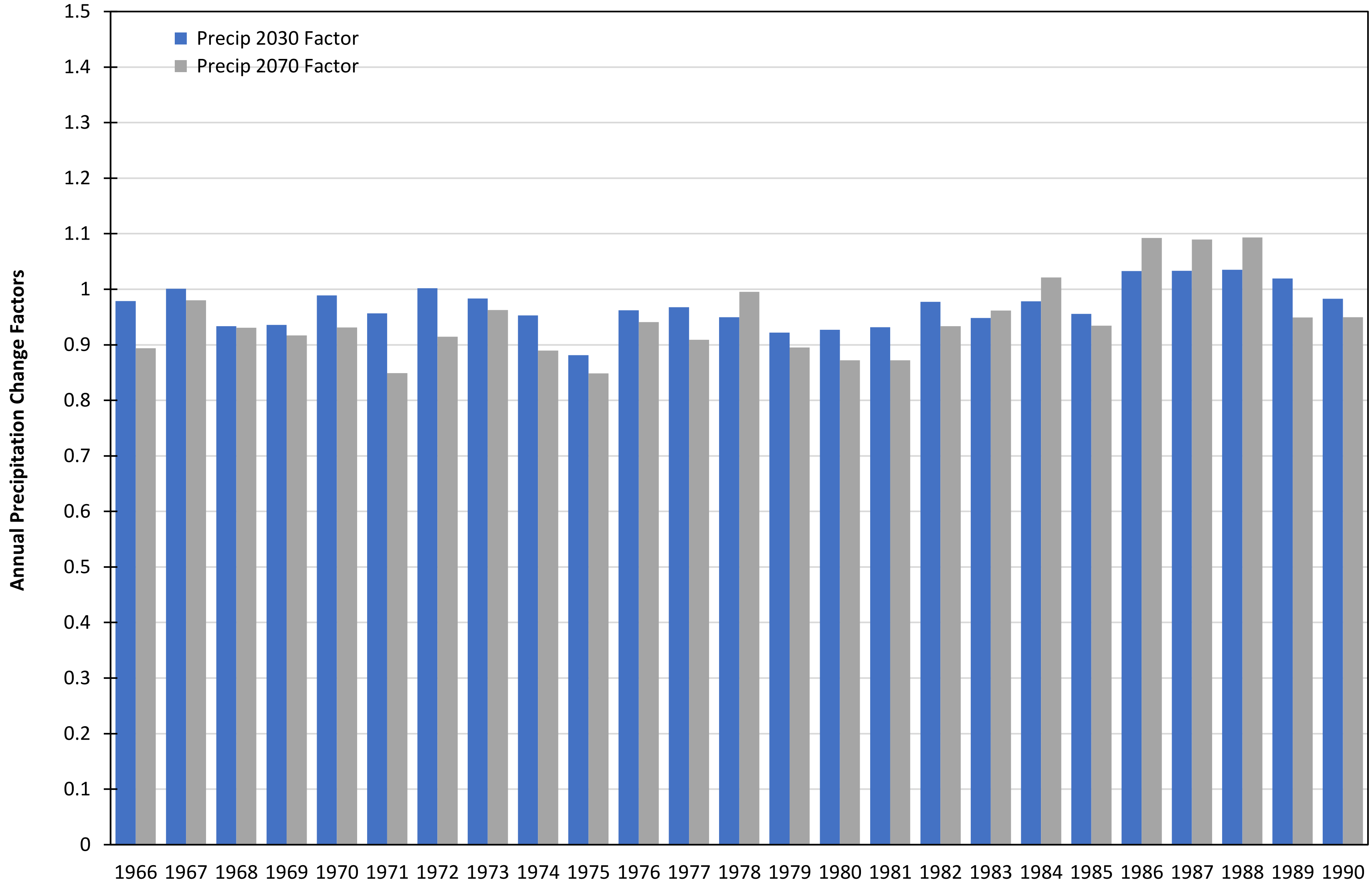


Figure 380

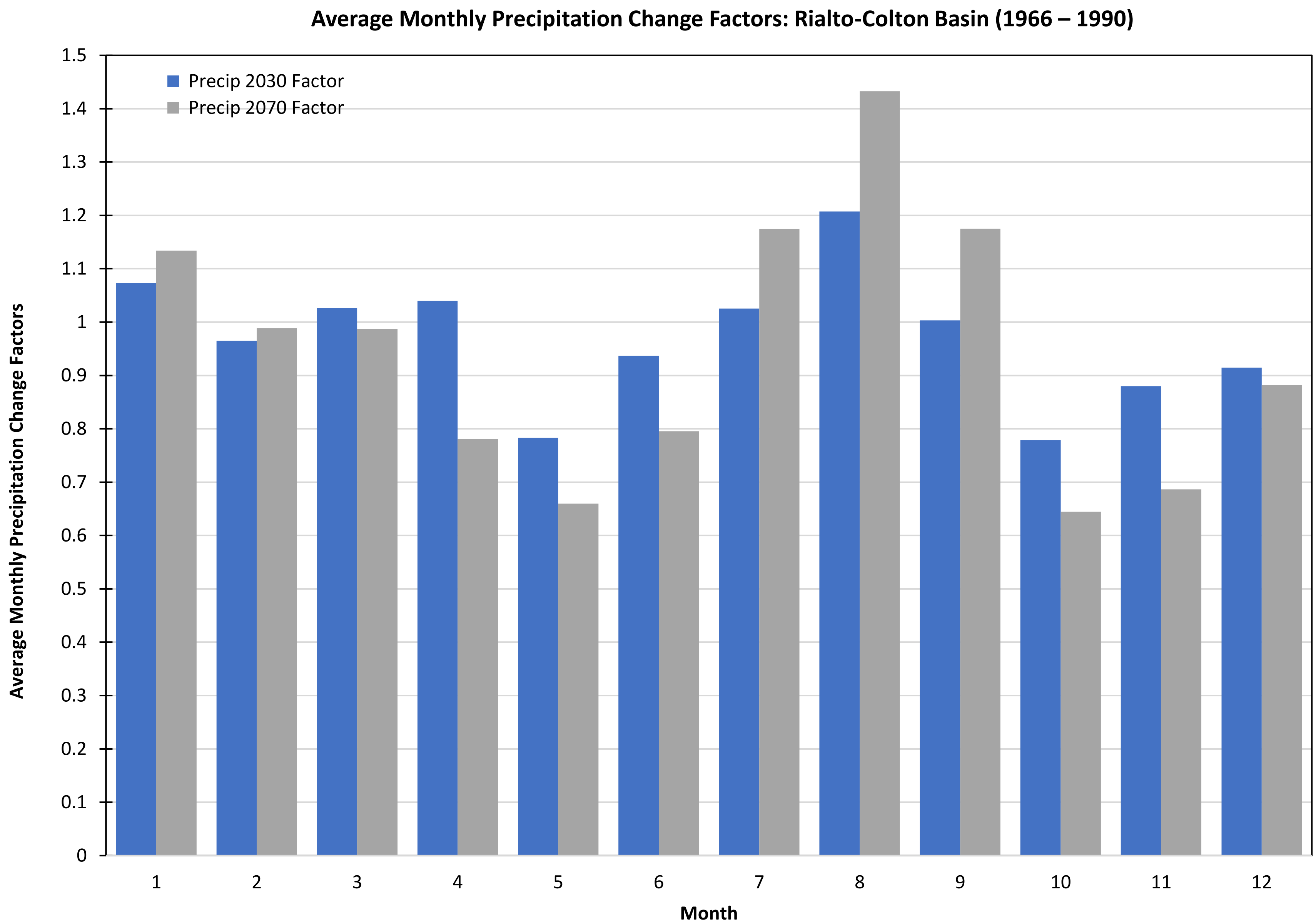

Average Monthly Precipitation Change Factors: Rialto-Colton Basin (1966 – 1990)
Precip 2030 Factor
Precip 2070 Factor
Average Monthly Precipitation Change Factors
Month
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
1
2
3
4
5
6
7
8
9
10
11
12

Figure 381

DRAFT

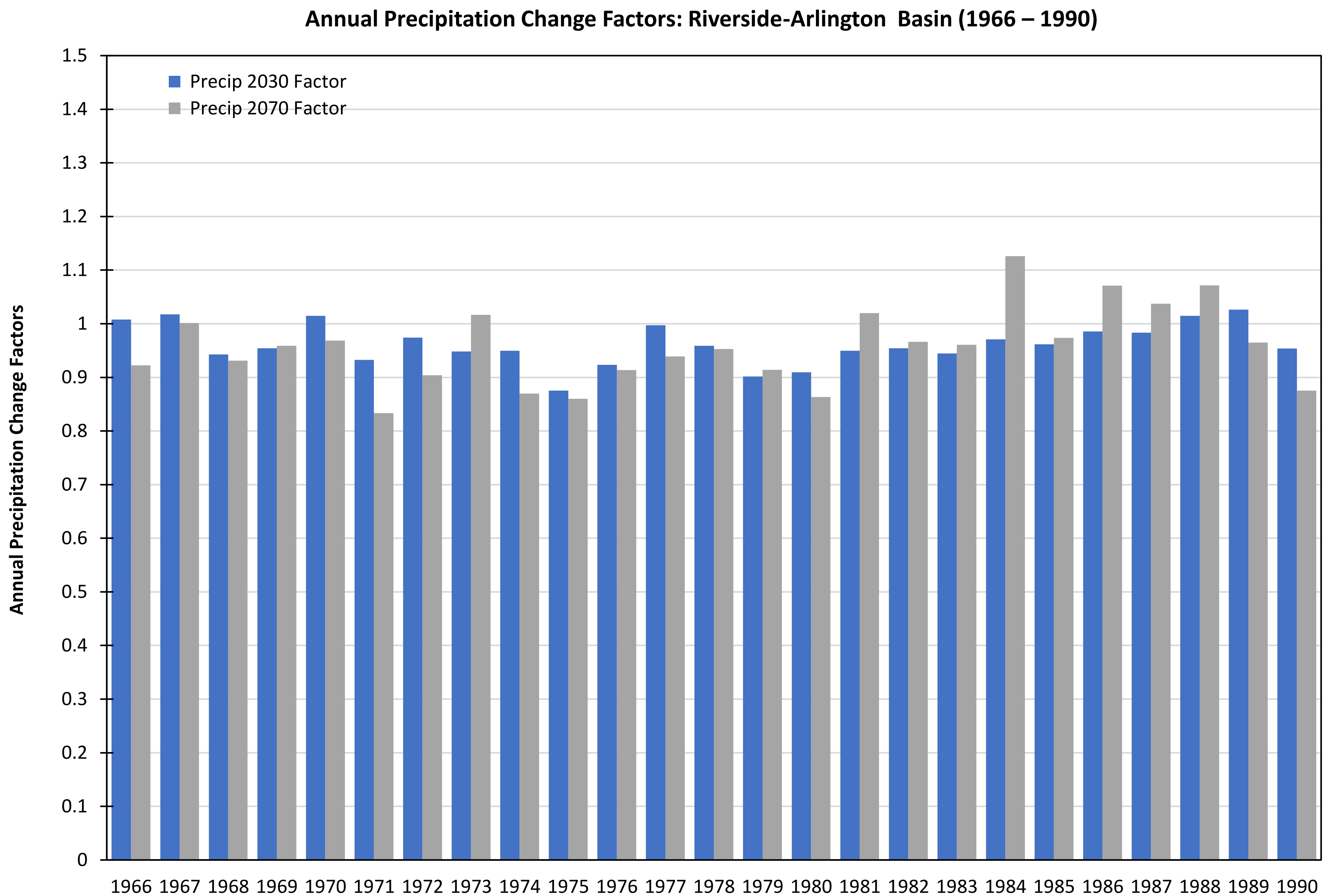


Figure 382

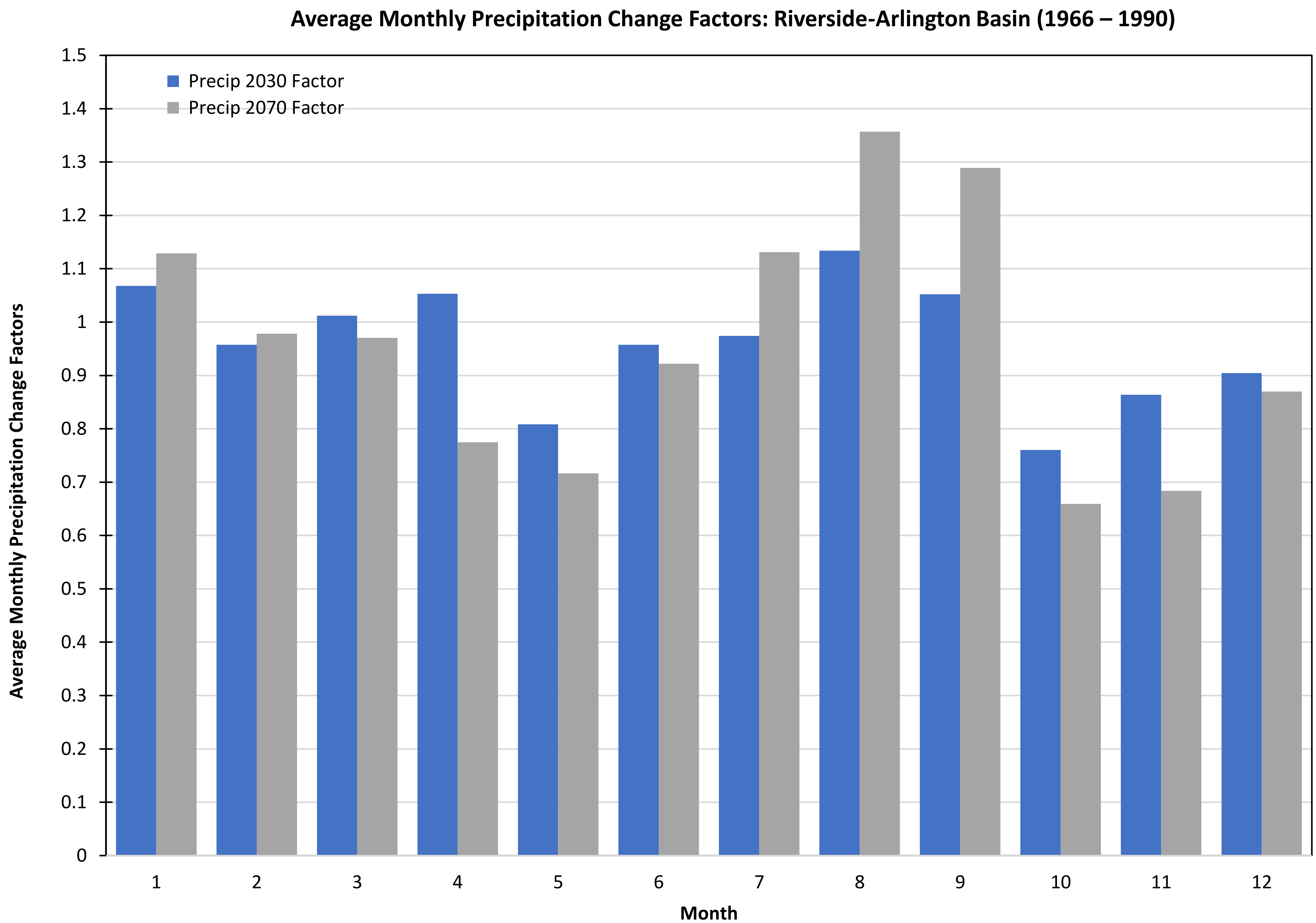

Average Monthly Precipitation Change Factors: Riverside-Arlington Basin (1966 – 1990)
Precip 2030 Factor
Precip 2070 Factor
Average Monthly Precipitation Change Factors
Month
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
1
2
3
4
5
6
7
8
9
10
11
12

Figure 383

DRAFT

Annual Precipitation Change Factors: Chino Basin (1966 – 1990)

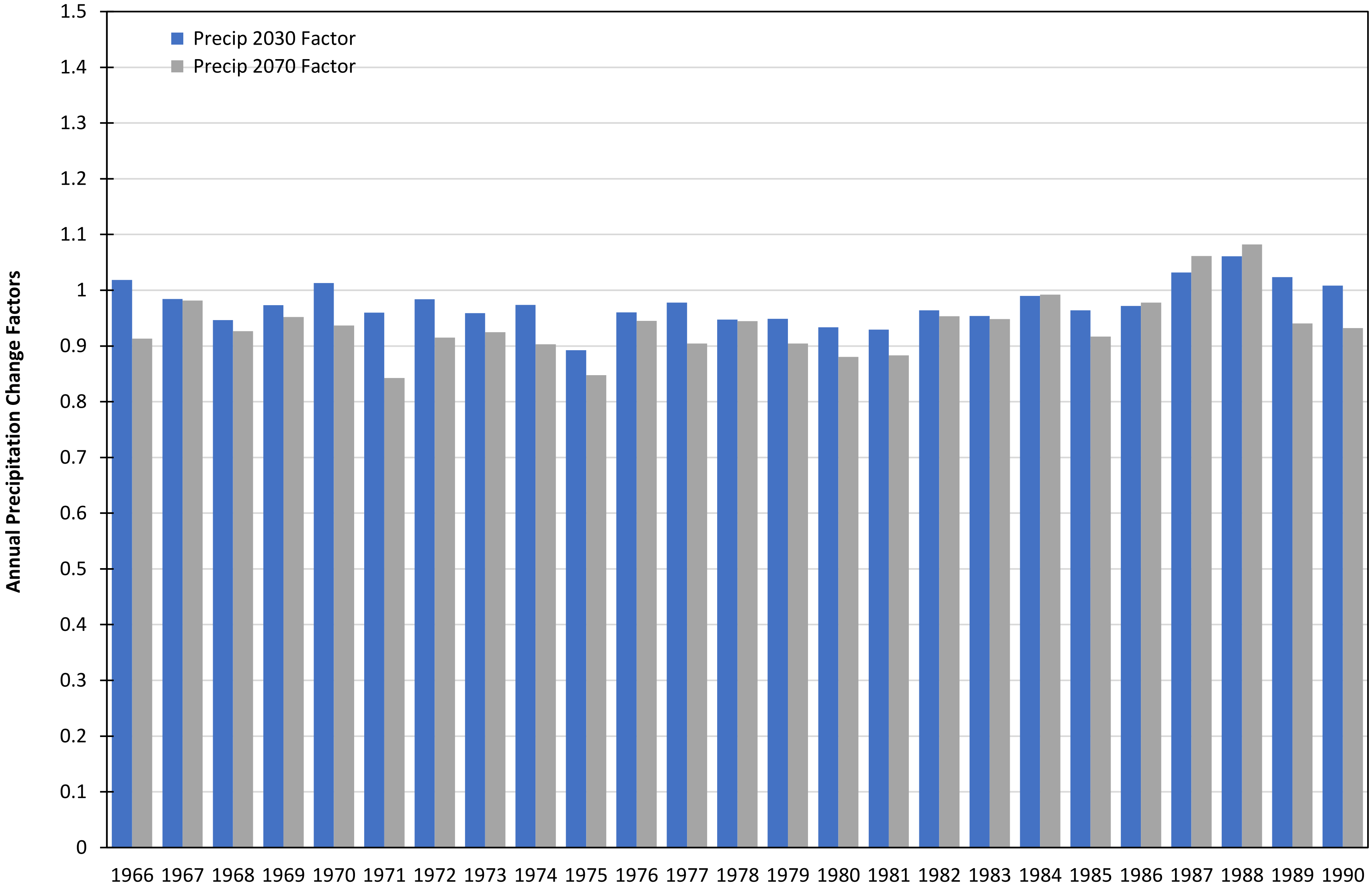


Figure 384

DRAFT

Average Monthly Precipitation Change Factors: Chino Basin (1966 – 1990)

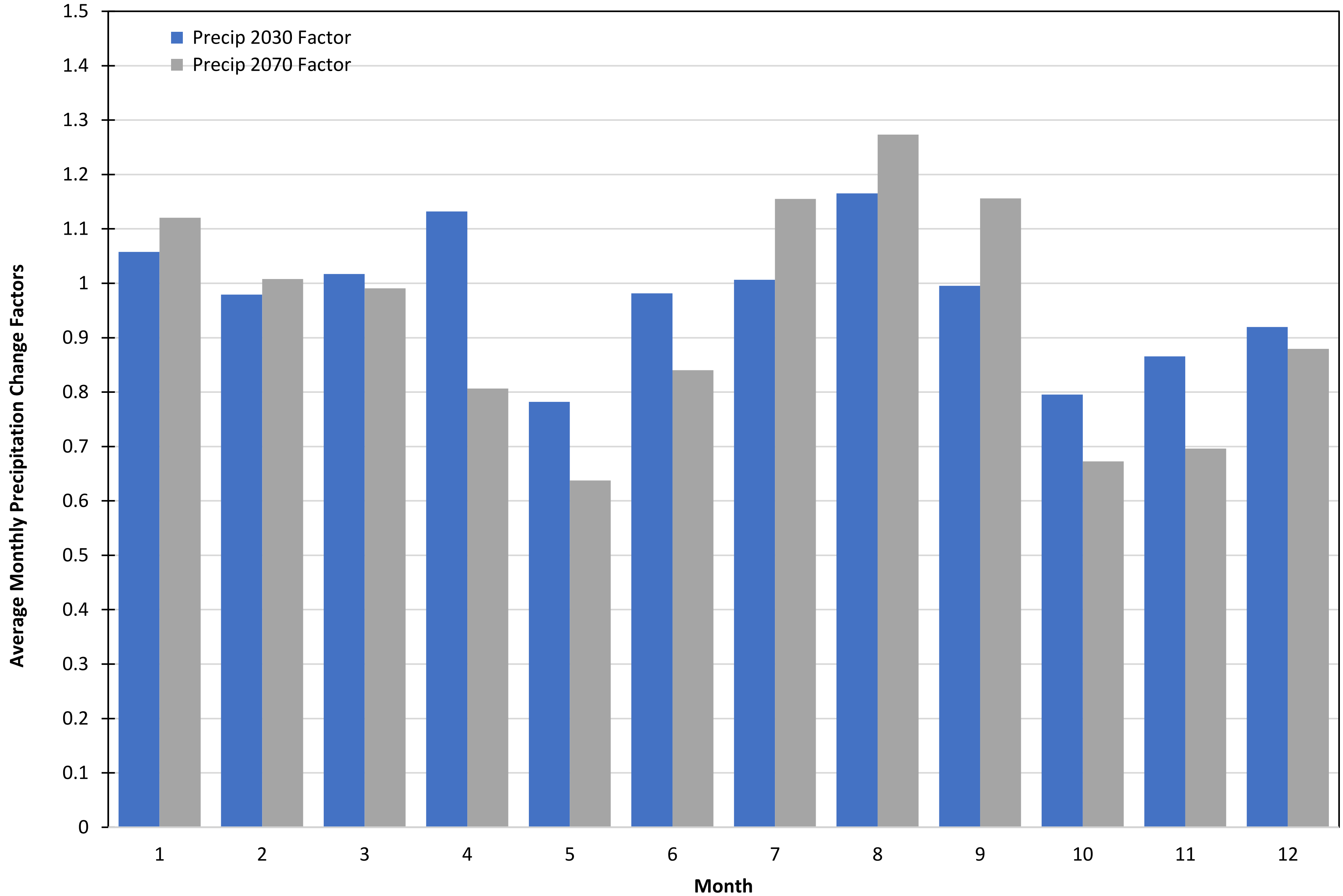


Figure 385

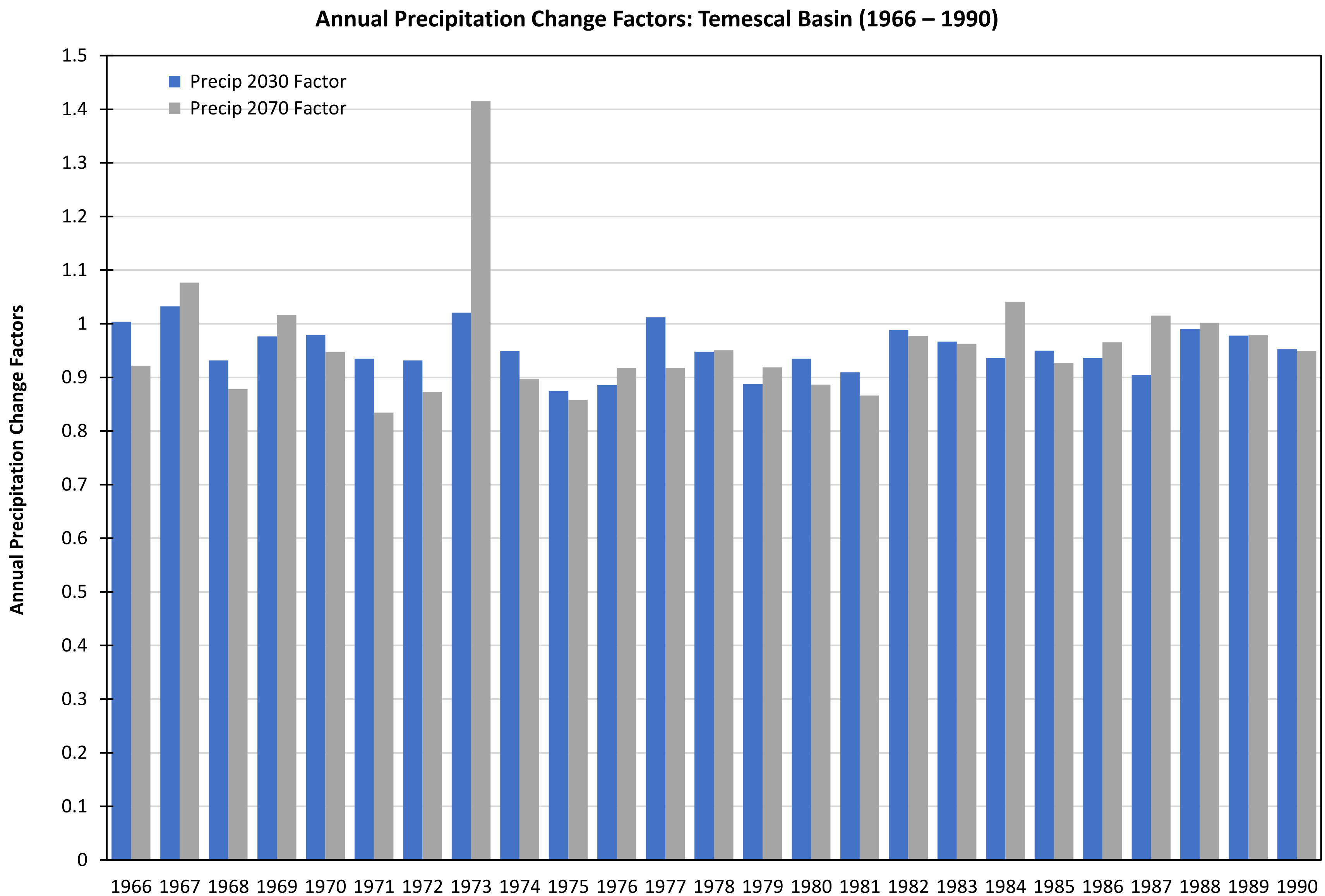

Annual Precipitation Change Factors: Temescal Basin (1966 – 1990)
Precip 2030 Factor
Precip 2070 Factor
Annual Precipitation Change Factors
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1966 1967 1968 1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990

Figure 386

DRAFT

Average Monthly Precipitation Change Factors: Temescal Basin (1966 – 1990)

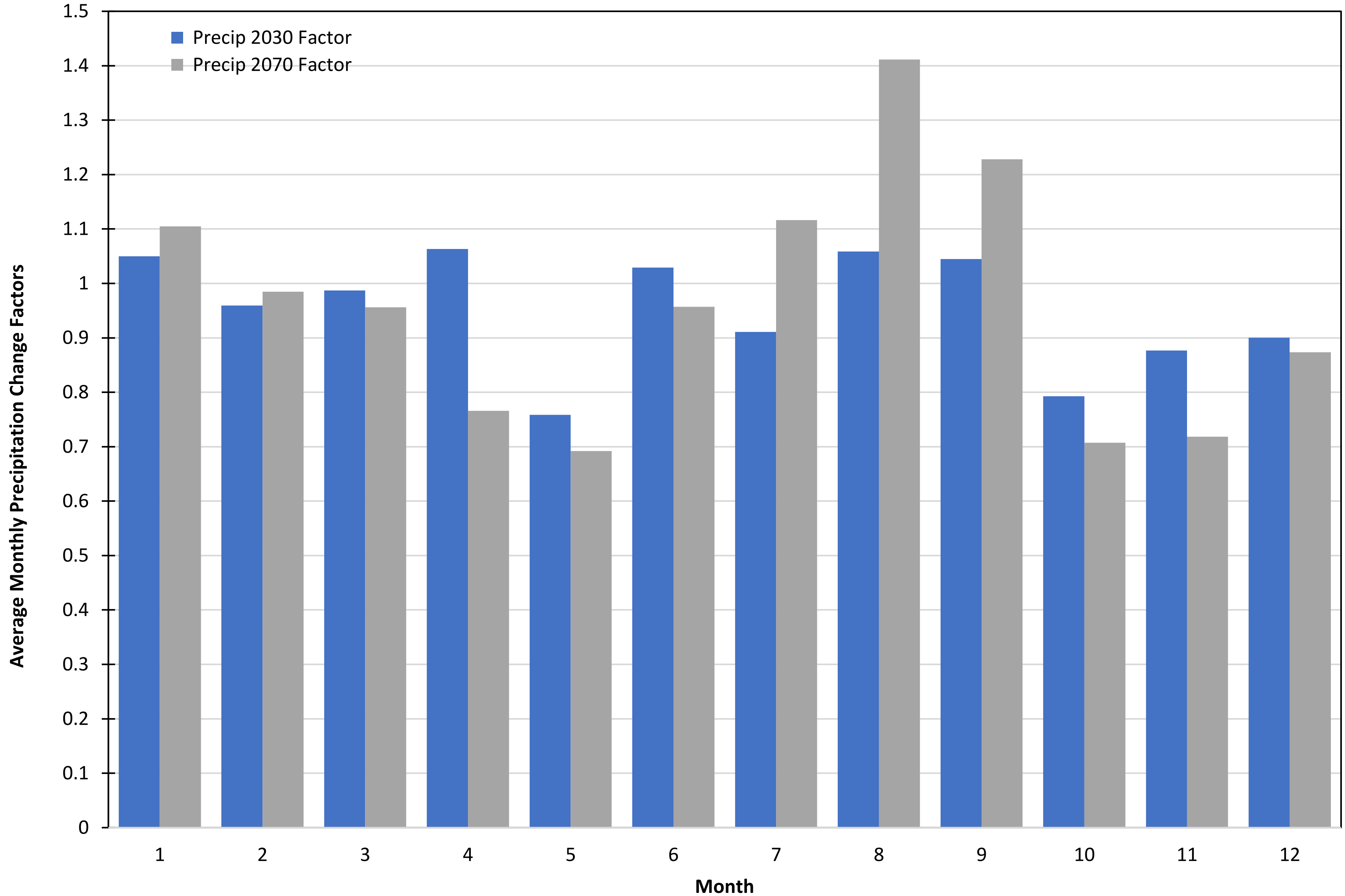


Figure 387

DRAFT

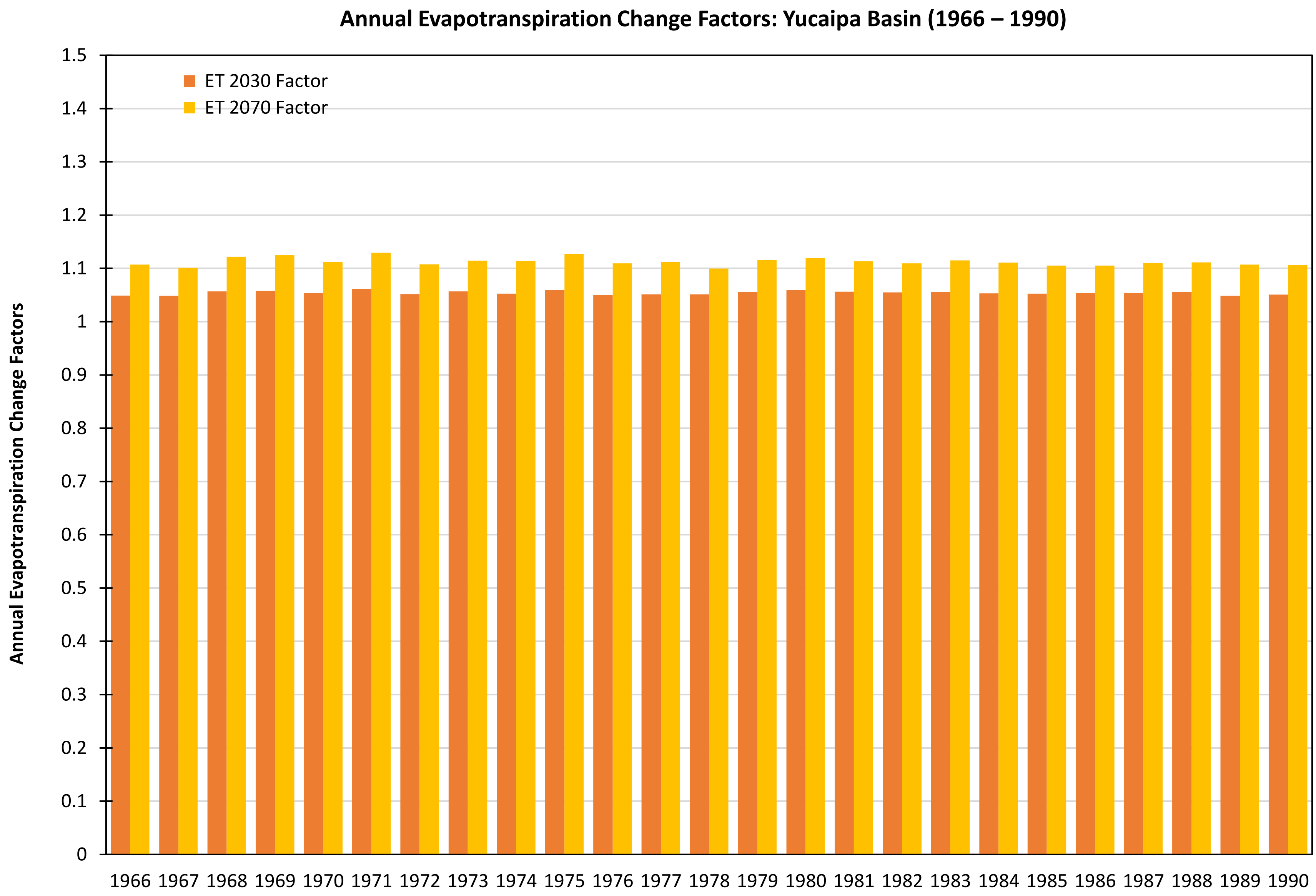


Figure 388

Average Monthly Evapotranspiration Change Factors: Yucaipa Basin (1966 – 1990)

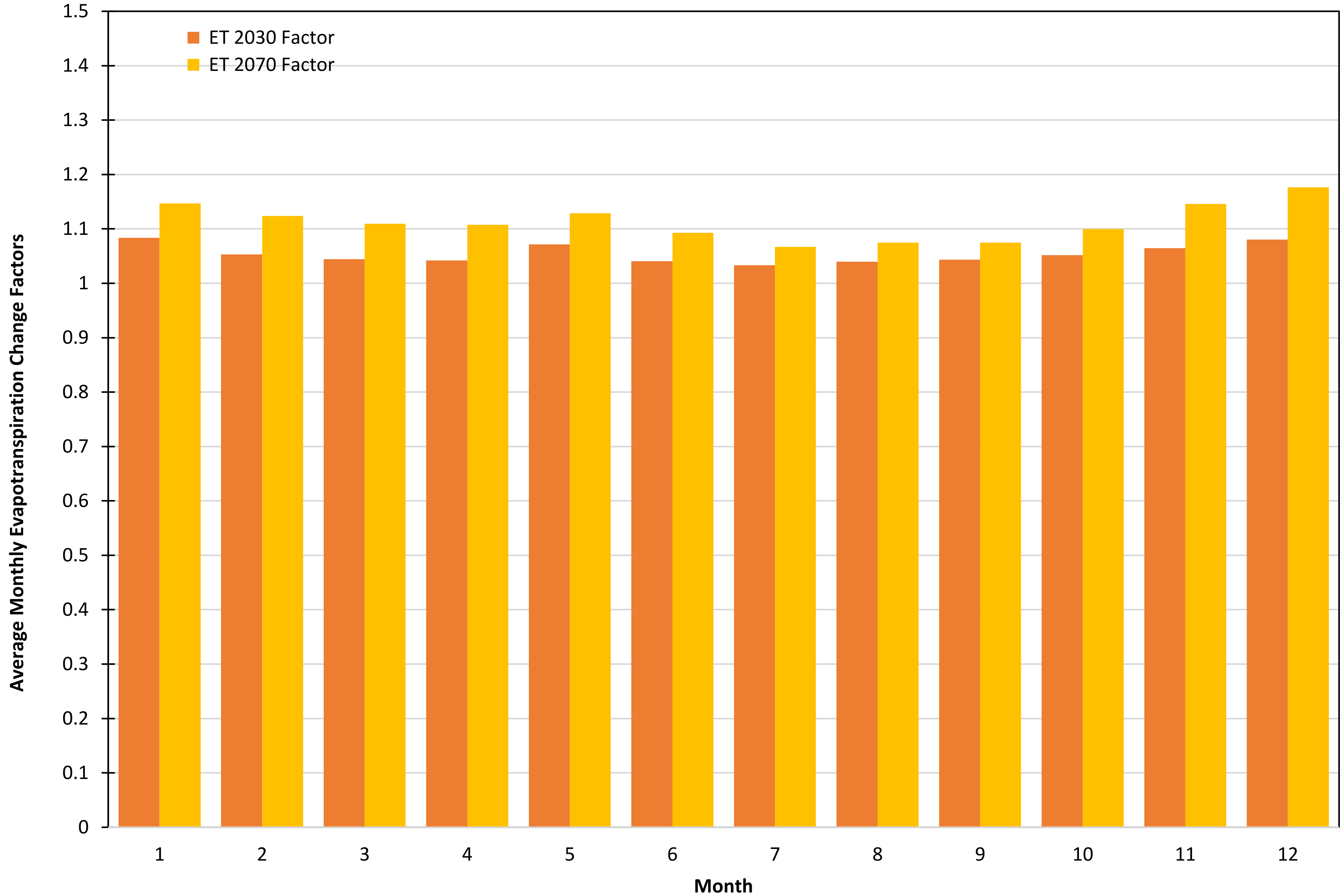


Figure 389

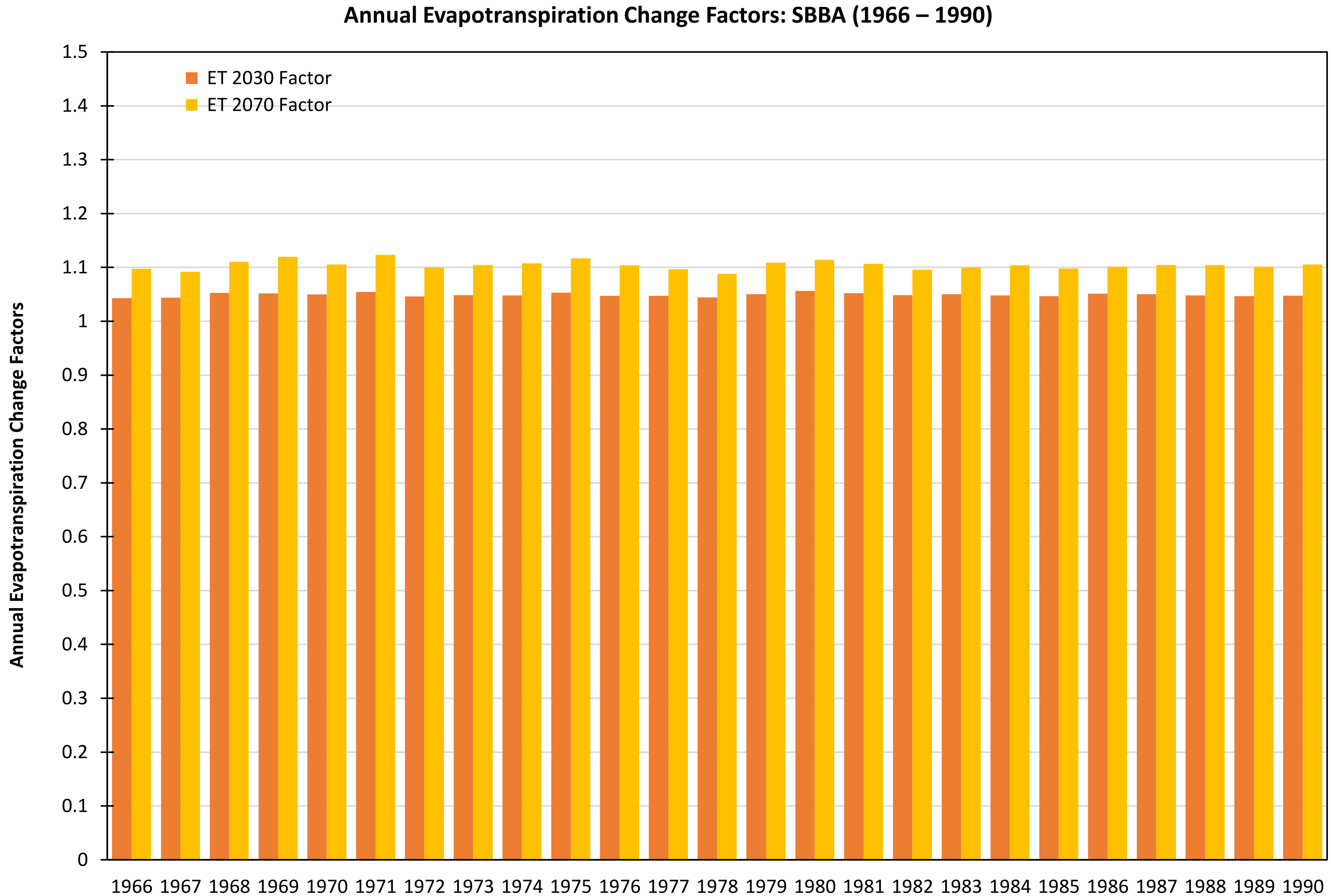

Annual Evapotranspiration Change Factors: SBBA (1966 – 1990)
ET 2030 Factor
ET 2070 Factor
Annual Evapotranspiration Change Factors
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1966 1967 1968 1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990

Figure 390

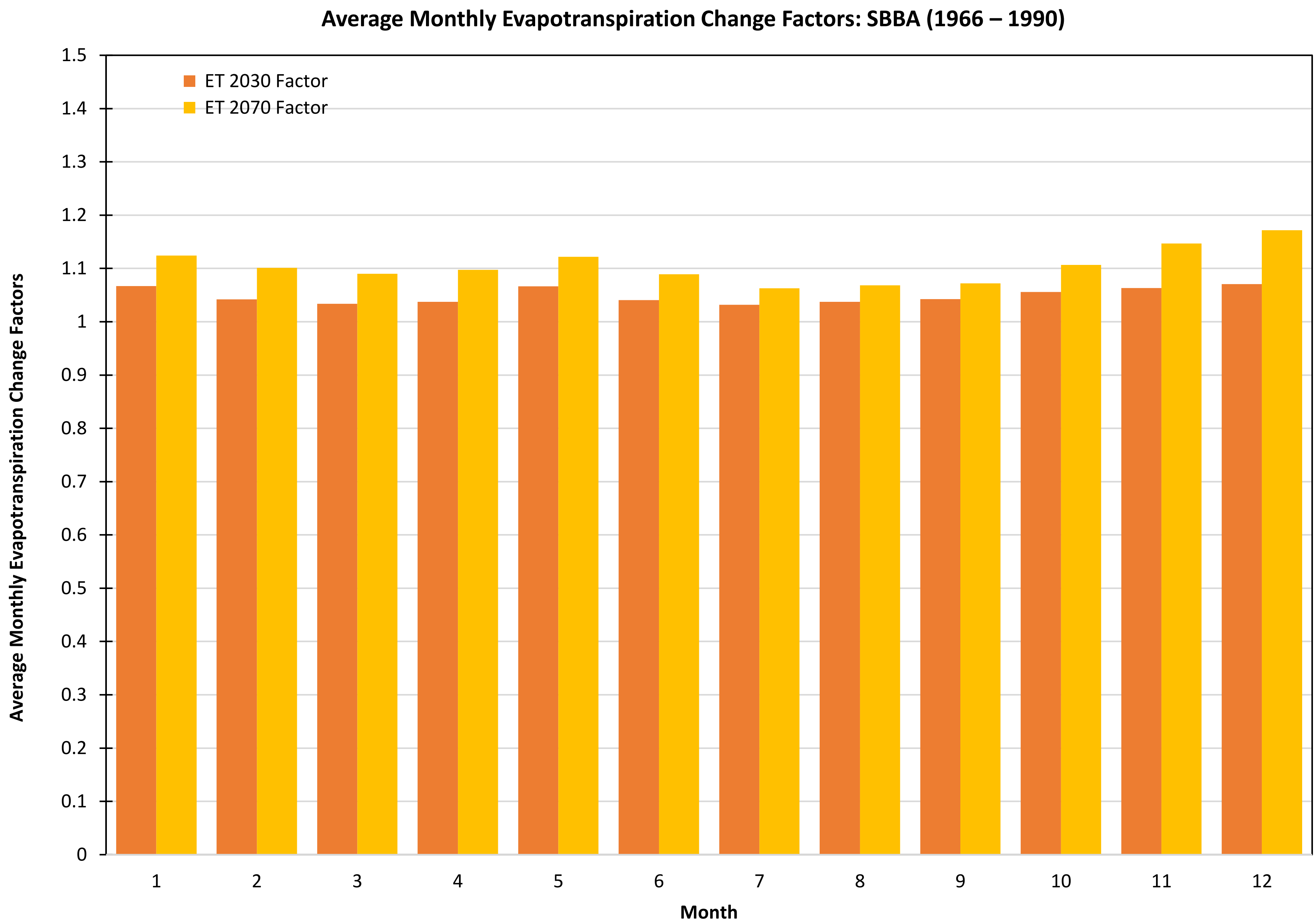

Average Monthly Evapotranspiration Change Factors: SBBA (1966 – 1990)
ET 2030 Factor
ET 2070 Factor
Average Monthly Evapotranspiration Change Factors
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1
2
3
4
5
6
7
8
9
10
11
12
Month

Figure 391

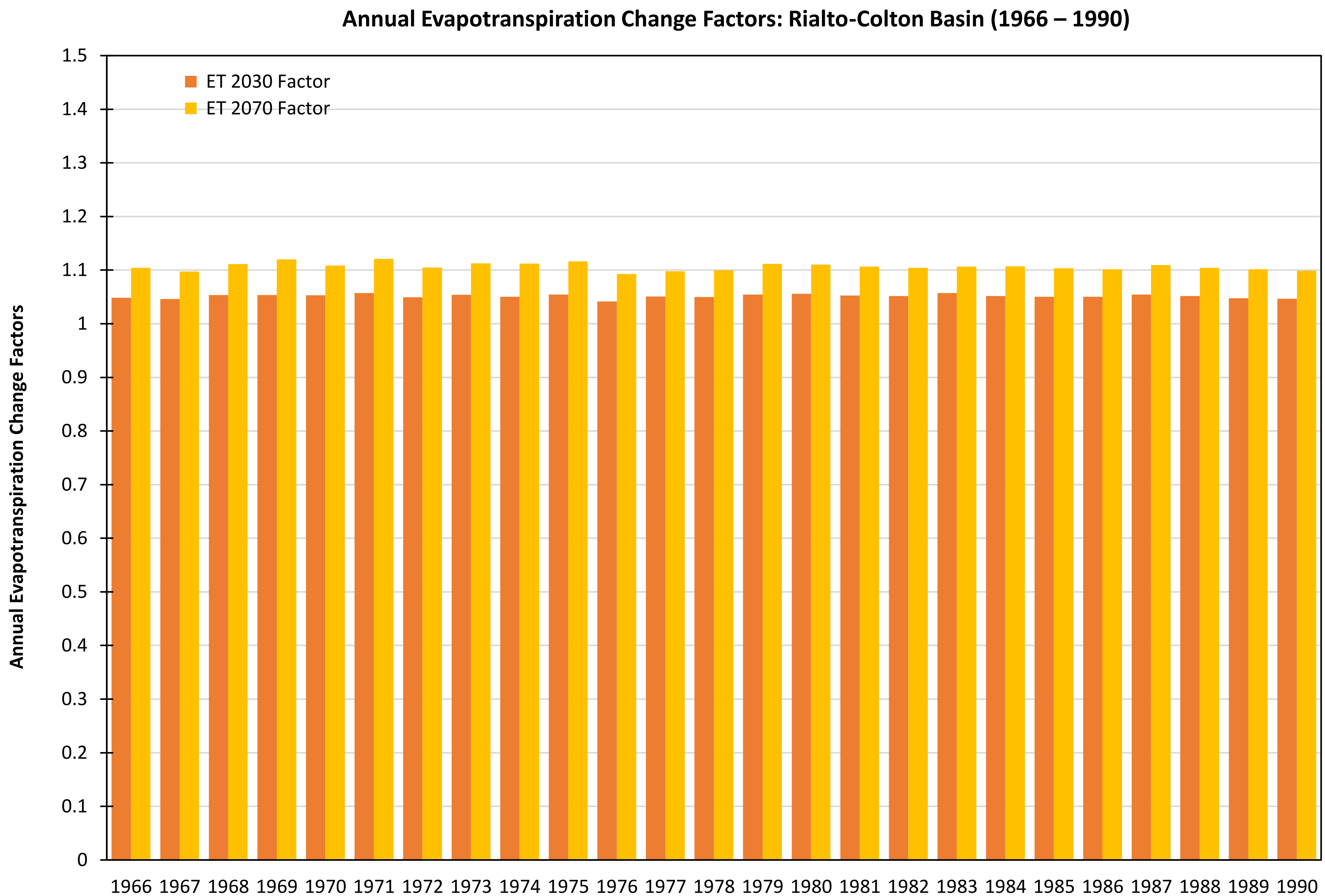

Annual Evapotranspiration Change Factors: Rialto-Colton Basin (1966 – 1990)
ET 2030 Factor
ET 2070 Factor
Annual Evapotranspiration Change Factors
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990

Figure 392

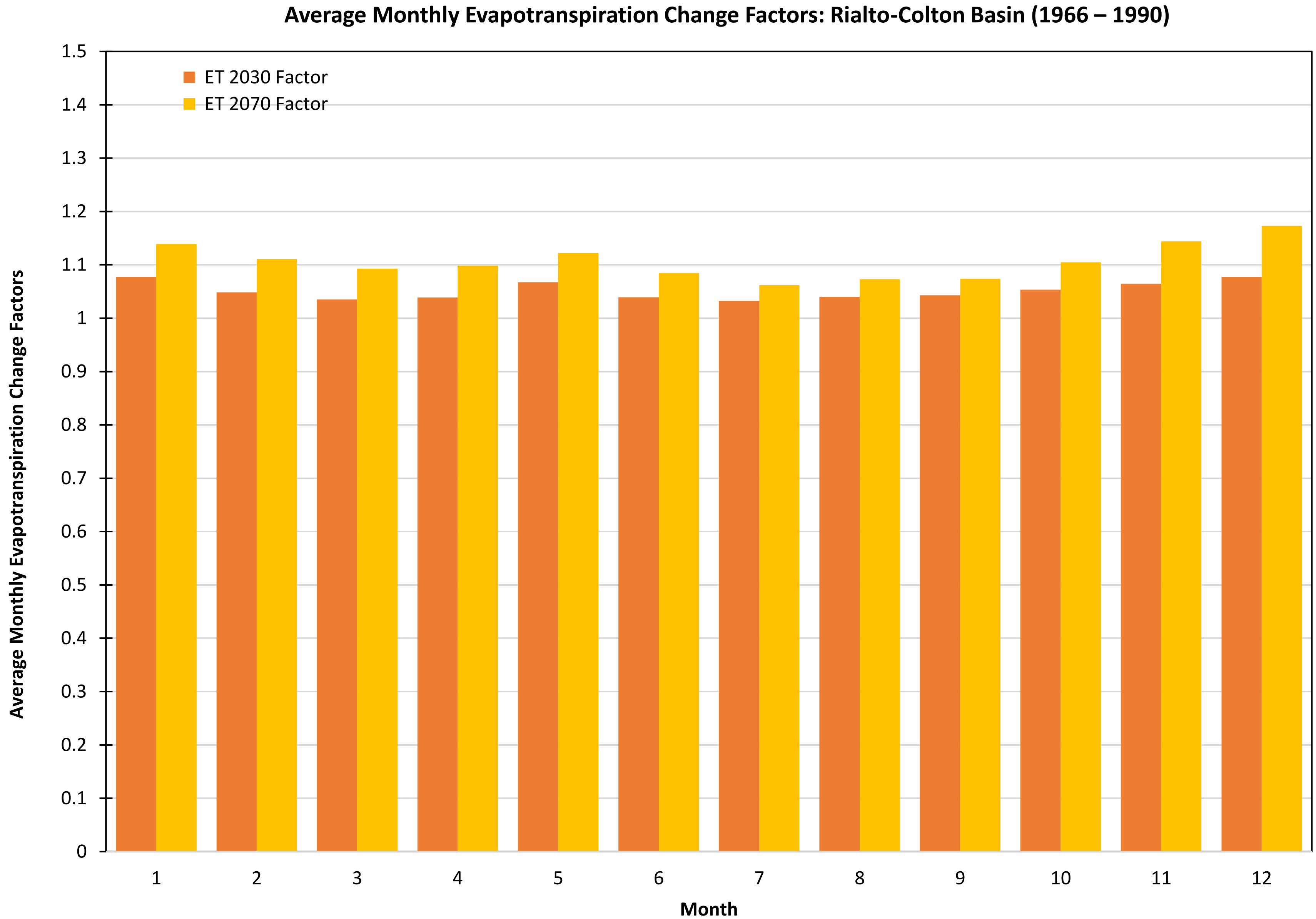

Average Monthly Evapotranspiration Change Factors: Rialto-Colton Basin (1966 – 1990)
ET 2030 Factor
ET 2070 Factor
Average Monthly Evapotranspiration Change Factors
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1
2
3
4
5
6
7
8
9
10
11
12
Month

Figure 393

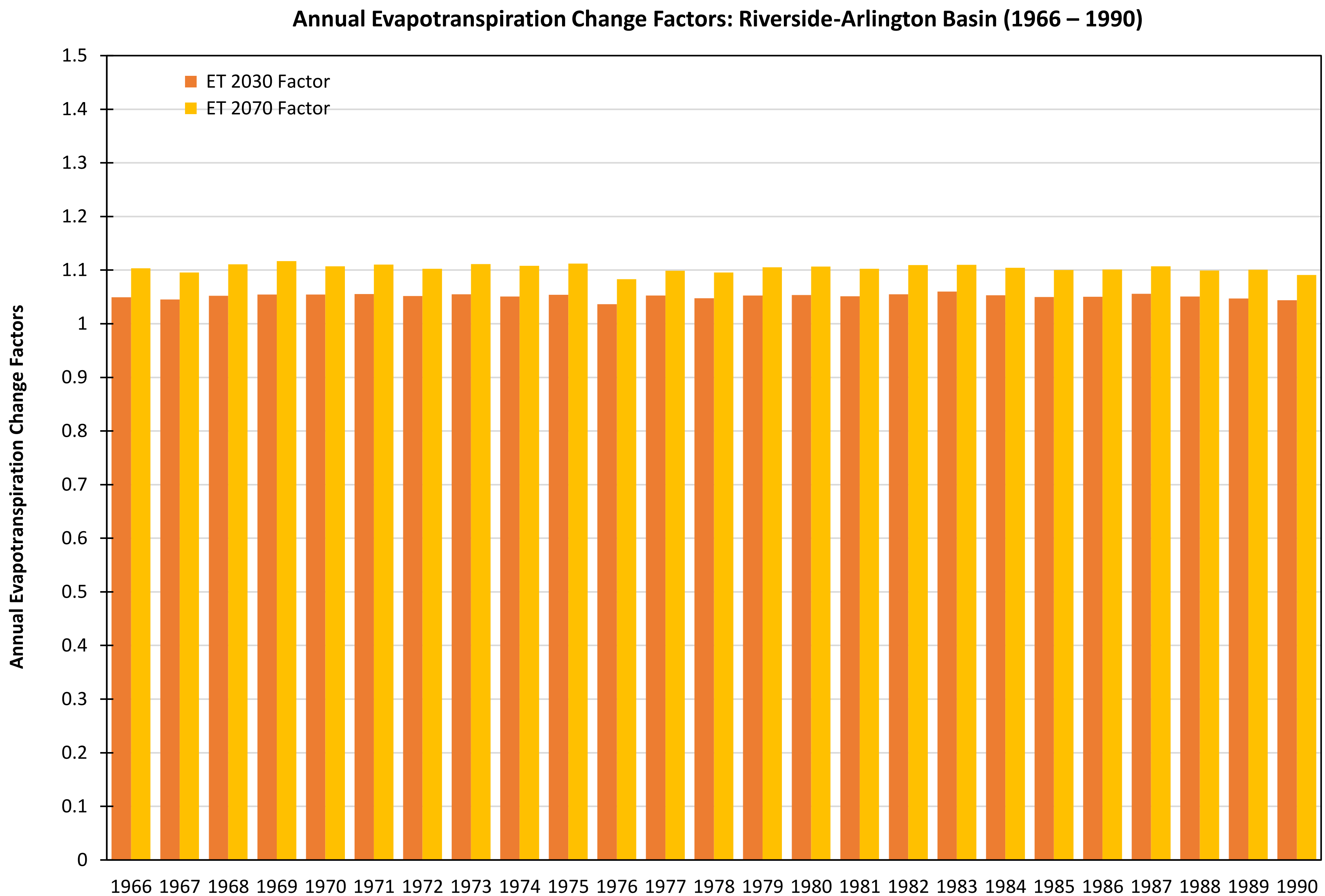

Annual Evapotranspiration Change Factors: Riverside-Arlington Basin (1966 – 1990)
ET 2030 Factor
ET 2070 Factor
Annual Evapotranspiration Change Factors
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1966 1967 1968 1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990

Figure 394

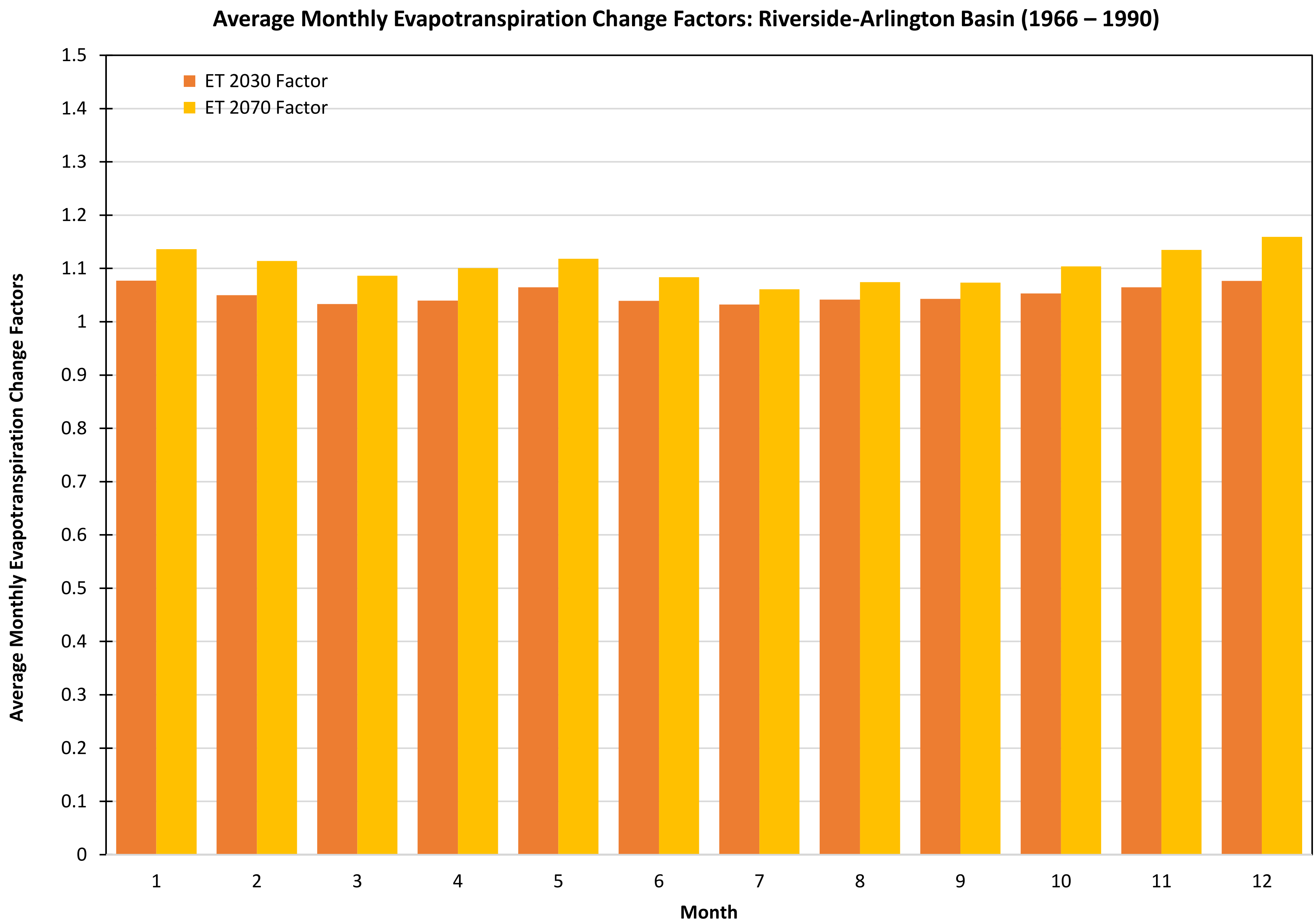

Average Monthly Evapotranspiration Change Factors: Riverside-Arlington Basin (1966 – 1990)
ET 2030 Factor
ET 2070 Factor
Average Monthly Evapotranspiration Change Factors
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1
2
3
4
5
6
7
8
9
10
11
12
Month

Figure 395

DRAFT

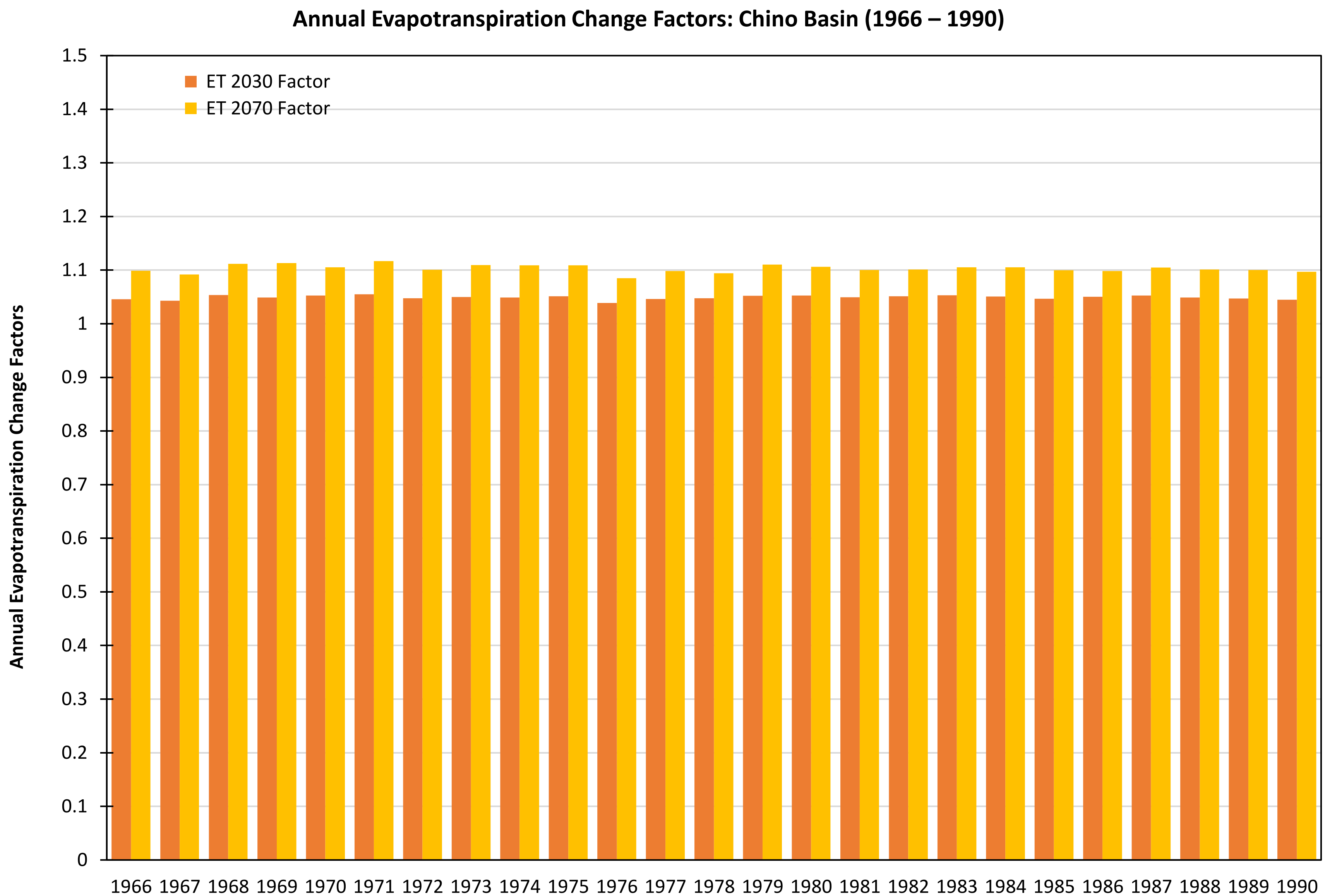


Figure 396

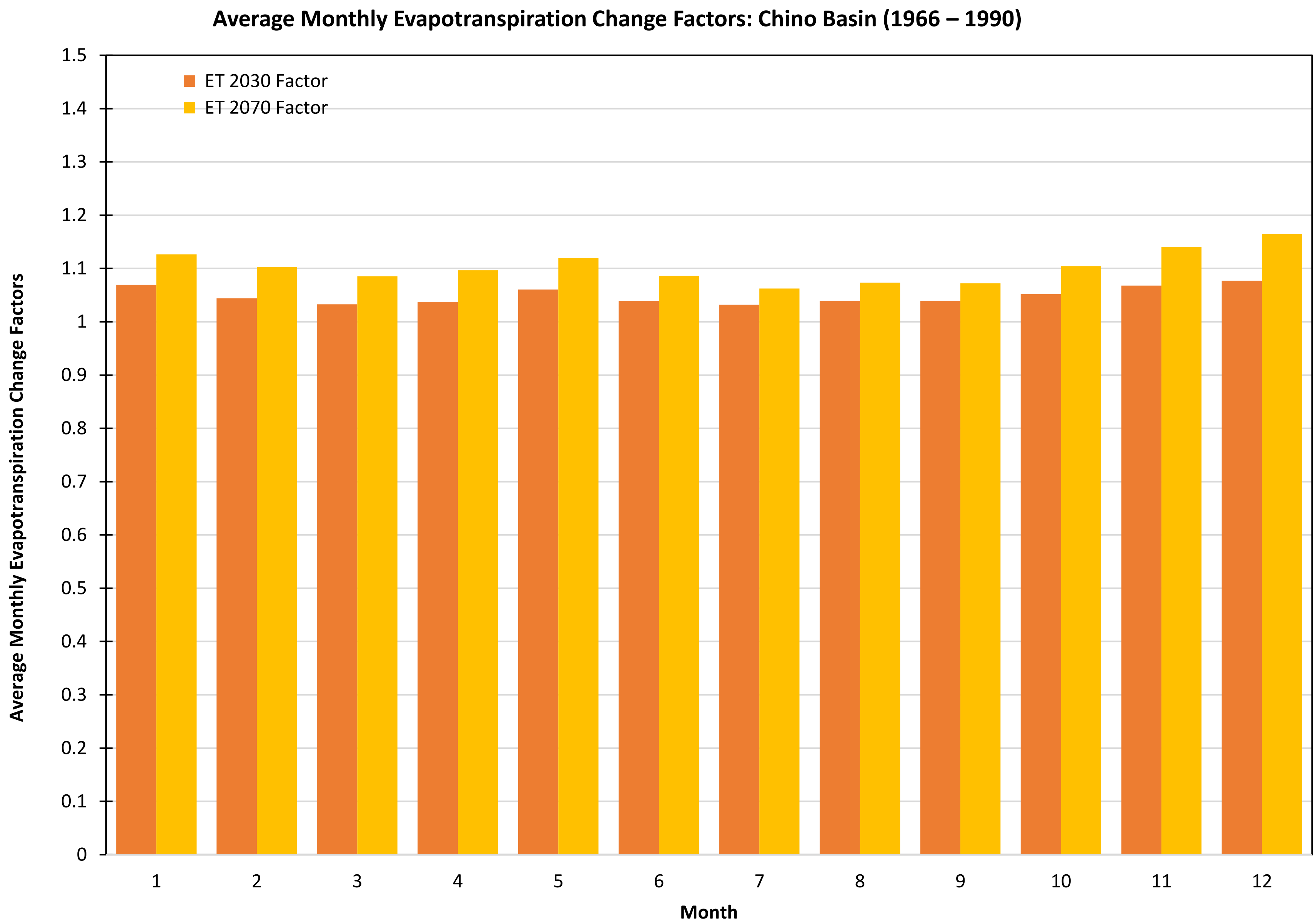

Average Monthly Evapotranspiration Change Factors: Chino Basin (1966 – 1990)
ET 2030 Factor
ET 2070 Factor
Average Monthly Evapotranspiration Change Factors
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1
2
3
4
5
6
7
8
9
10
11
12
Month

Figure 397

Annual Evapotranspiration Change Factors: Temescal Basin (1966 – 1990)

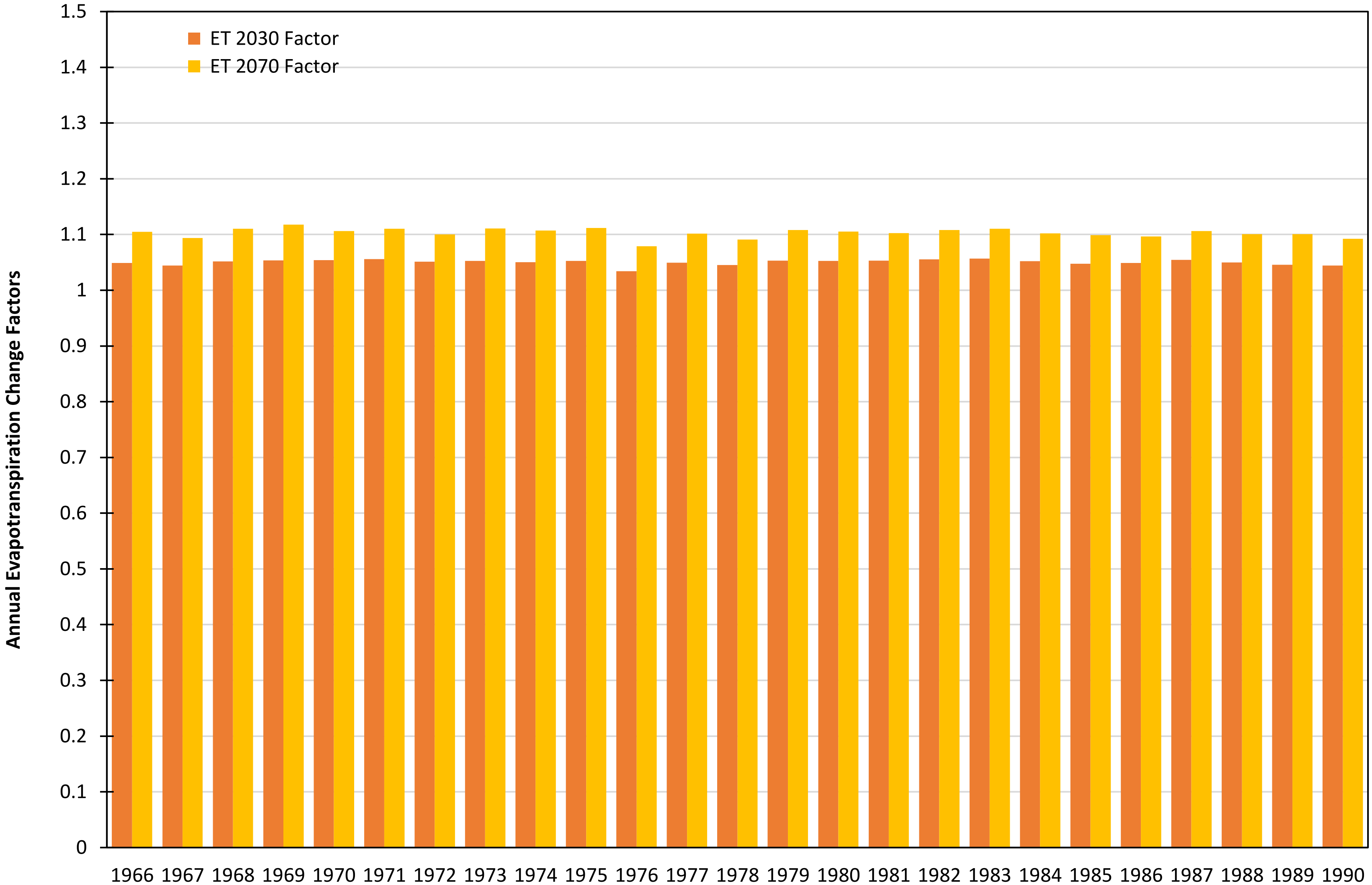


Figure 398

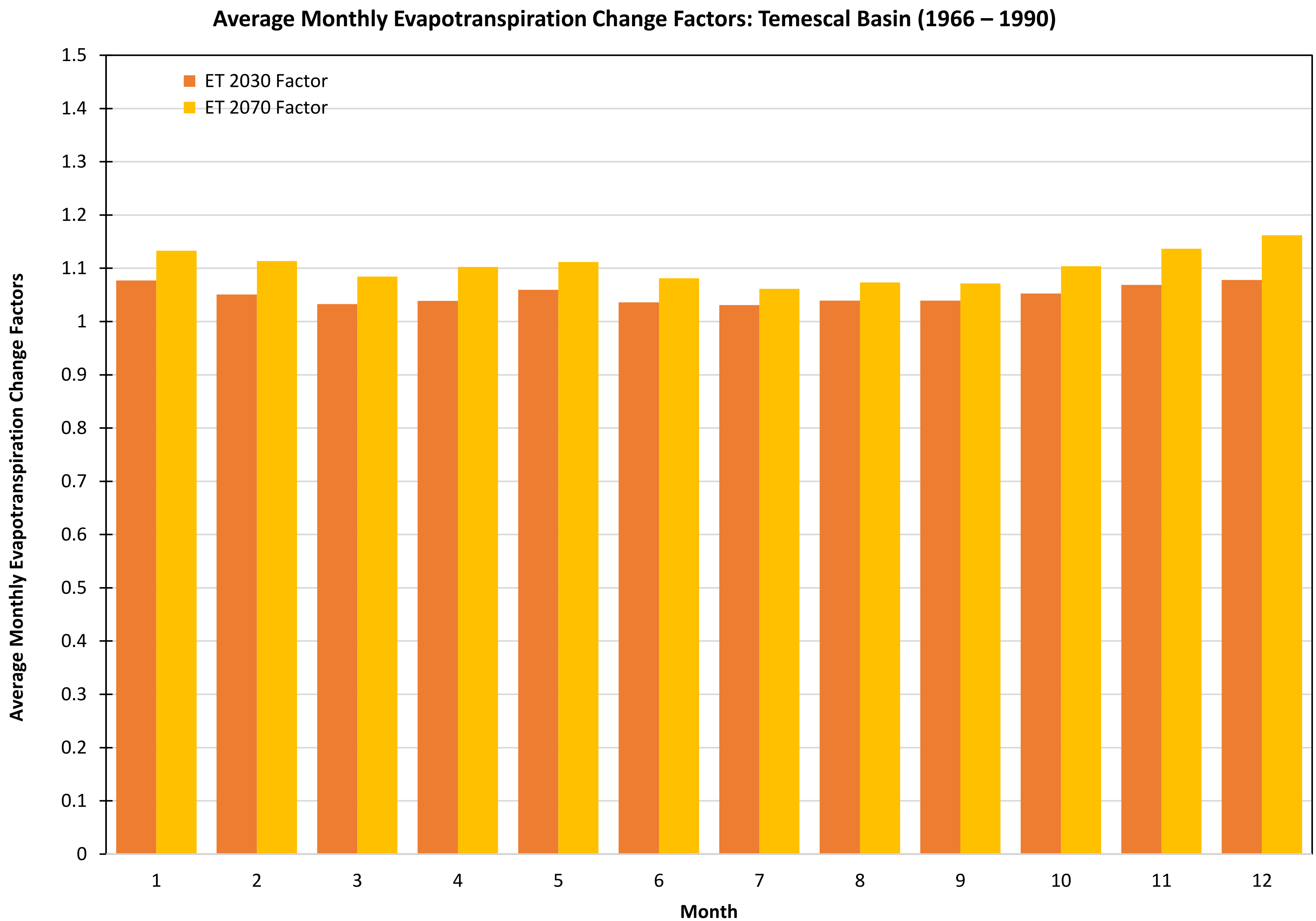
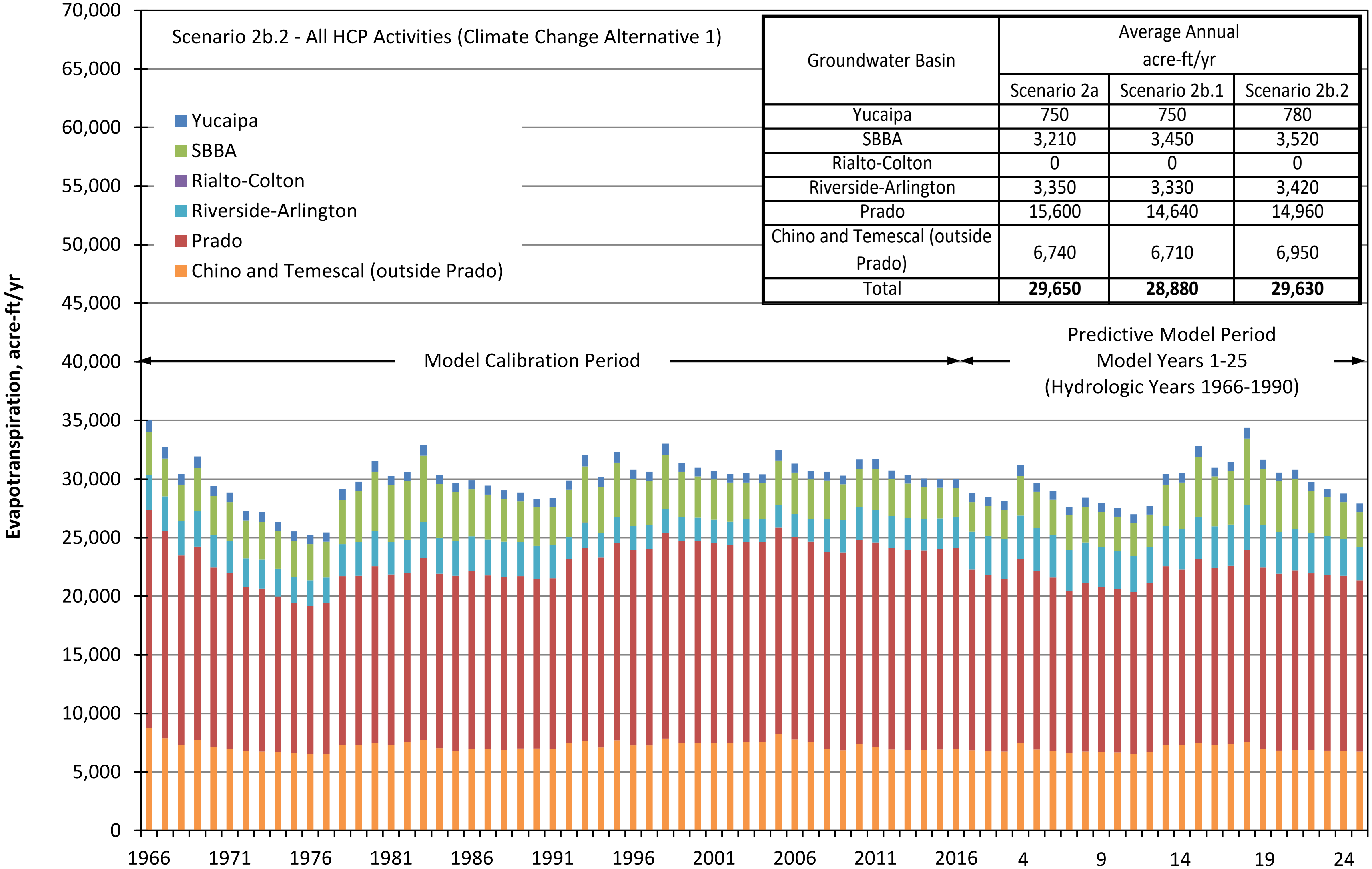

Average Monthly Evapotranspiration Change Factors: Temescal Basin (1966 – 1990)
ET 2030 Factor
ET 2070 Factor
Average Monthly Evapotranspiration Change Factors
Month
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
1
2
3
4
5
6
7
8
9
10
11
12

Figure 399

Scenario 2b.2: Annual Evapotranspiration – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr		
	Scenario 2a	Scenario 2b.1	Scenario 2b.2
Yucaipa	750	750	780
SBBA	3,210	3,450	3,520
Rialto-Colton	0	0	0
Riverside-Arlington	3,350	3,330	3,420
Prado	15,600	14,640	14,960
Chino and Temescal (outside Prado)	6,740	6,710	6,950
Total	**29,650**	**28,880**	**29,630**

Figure 400

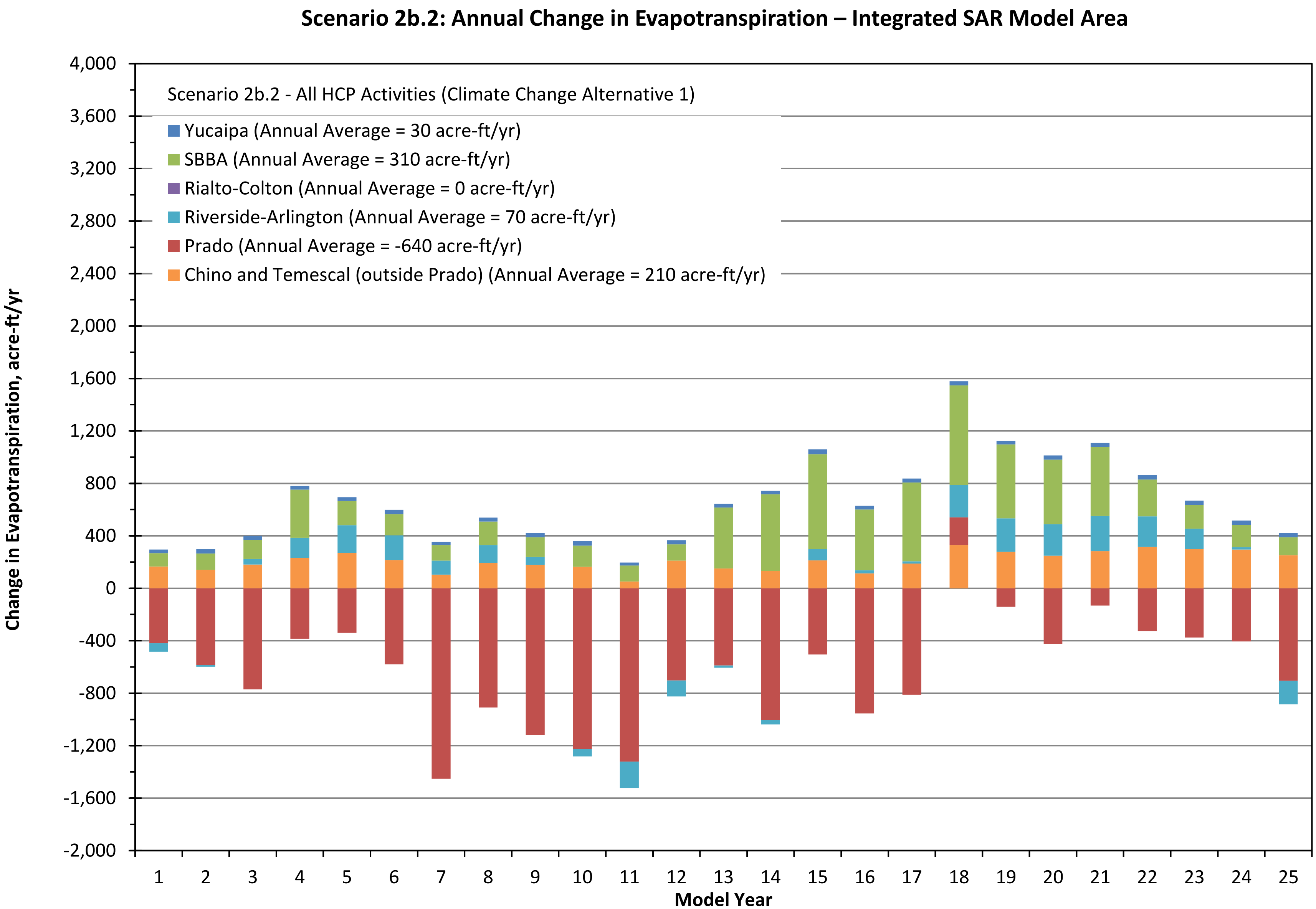
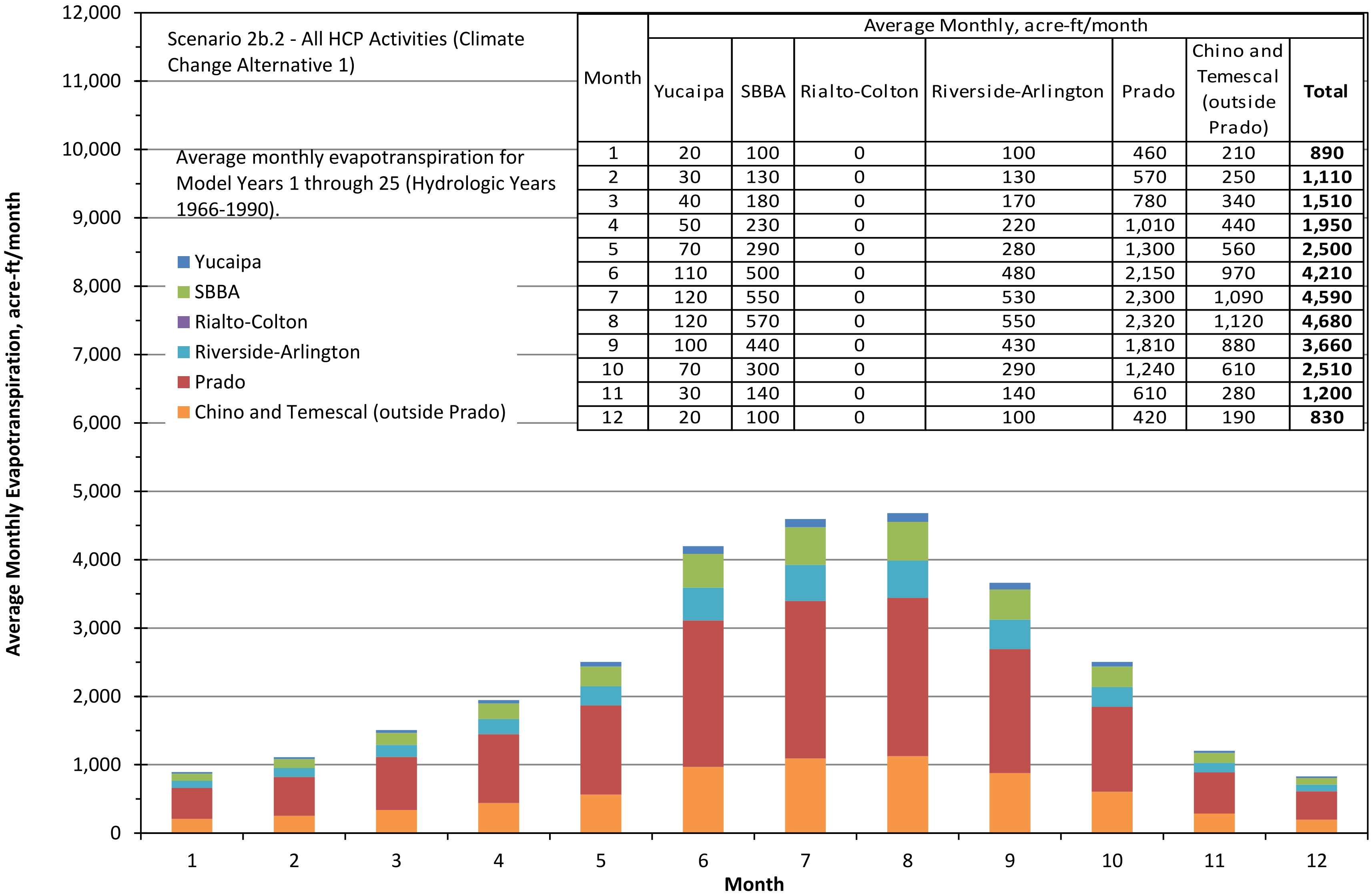

Scenario 2b.2: Annual Change in Evapotranspiration – Integrated SAR Model Area
Scenario 2b.2 - All HCP Activities (Climate Change Alternative 1)
Yucaipa (Annual Average = 30 acre-ft/yr)
SBBA (Annual Average = 310 acre-ft/yr)
Rialto-Colton (Annual Average = 0 acre-ft/yr)
Riverside-Arlington (Annual Average = 70 acre-ft/yr)
Prado (Annual Average = -640 acre-ft/yr)
Chino and Temescal (outside Prado) (Annual Average = 210 acre-ft/yr)
Change in Evapotranspiration, acre-ft/yr
4,000
3,600
3,200
2,800
2,400
2,000
1,600
1,200
800
400
0
-400
-800
-1,200
-1,600
-2,000
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
Model Year

Figure 401

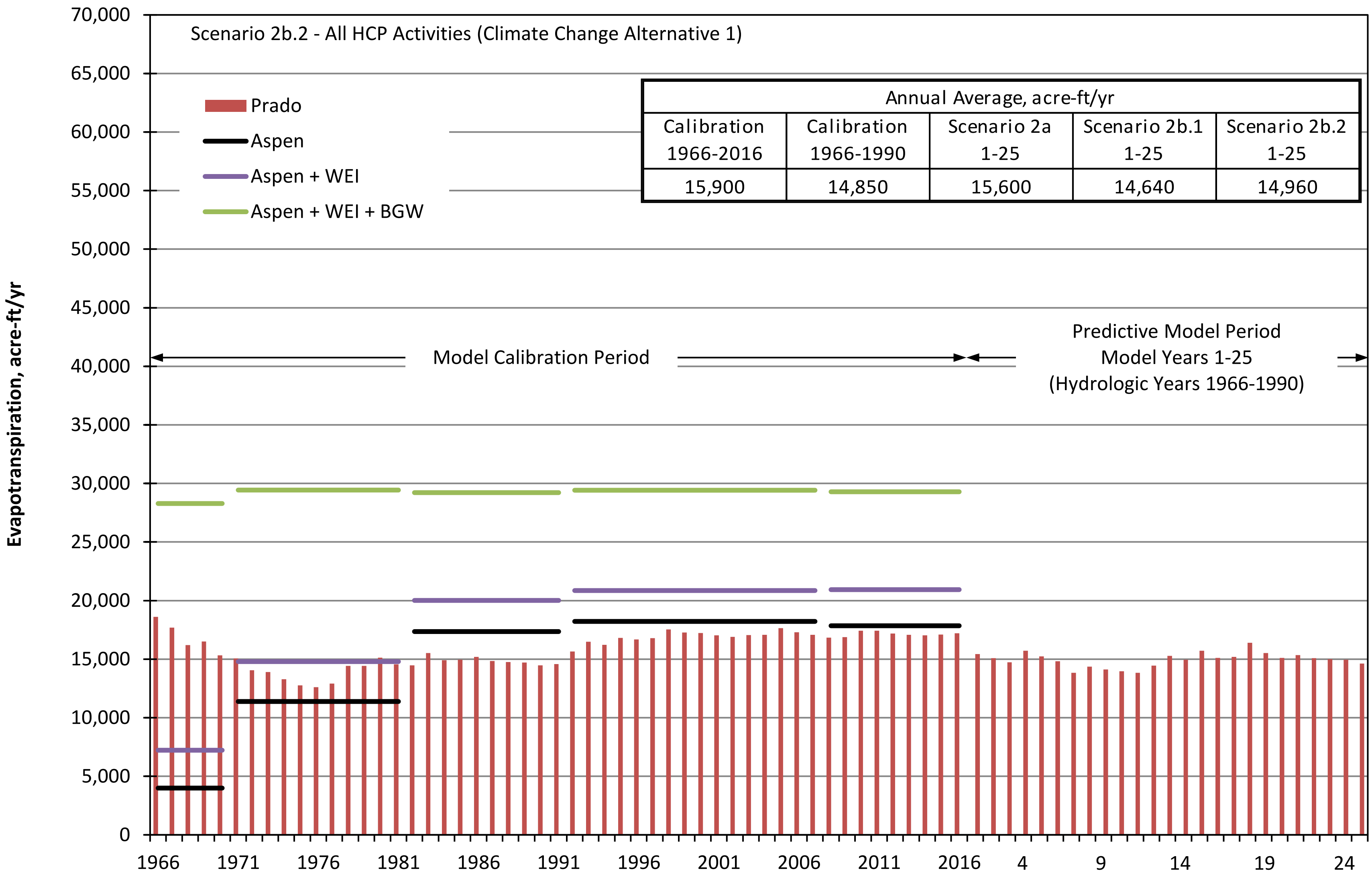
Scenario 2b.2: Seasonal Evapotranspiration – Integrated SAR Model Area



Month	Average Monthly, acre-ft/month						
	Yucaipa	SBBA	Rialto-Colton	Riverside-Arlington	Prado	Chino and Temescal (outside Prado)	**Total**
1	20	100	0	100	460	210	**890**
2	30	130	0	130	570	250	**1,110**
3	40	180	0	170	780	340	**1,510**
4	50	230	0	220	1,010	440	**1,950**
5	70	290	0	280	1,300	560	**2,500**
6	110	500	0	480	2,150	970	**4,210**
7	120	550	0	530	2,300	1,090	**4,590**
8	120	570	0	550	2,320	1,120	**4,680**
9	100	440	0	430	1,810	880	**3,660**
10	70	300	0	290	1,240	610	**2,510**
11	30	140	0	140	610	280	**1,200**
12	20	100	0	100	420	190	**830**

Figure 402

Scenario 2b.2: Annual Evapotranspiration – Prado Basin



Annual Average, acre-ft/yr				
Calibration 1966-2016	Calibration 1966-1990	Scenario 2a 1-25	Scenario 2b.1 1-25	Scenario 2b.2 1-25
15,900	14,850	15,600	14,640	14,960

Figure 403

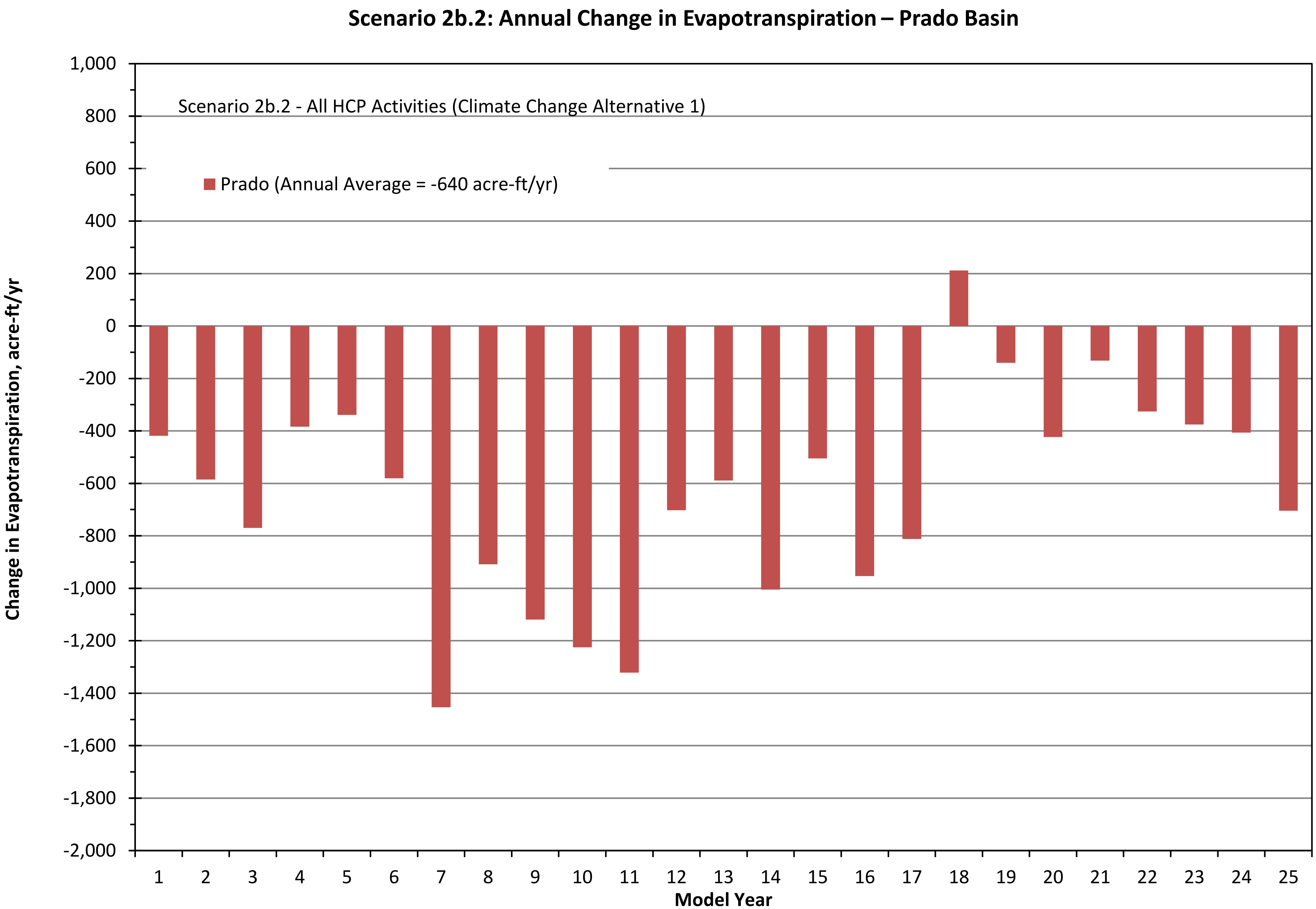
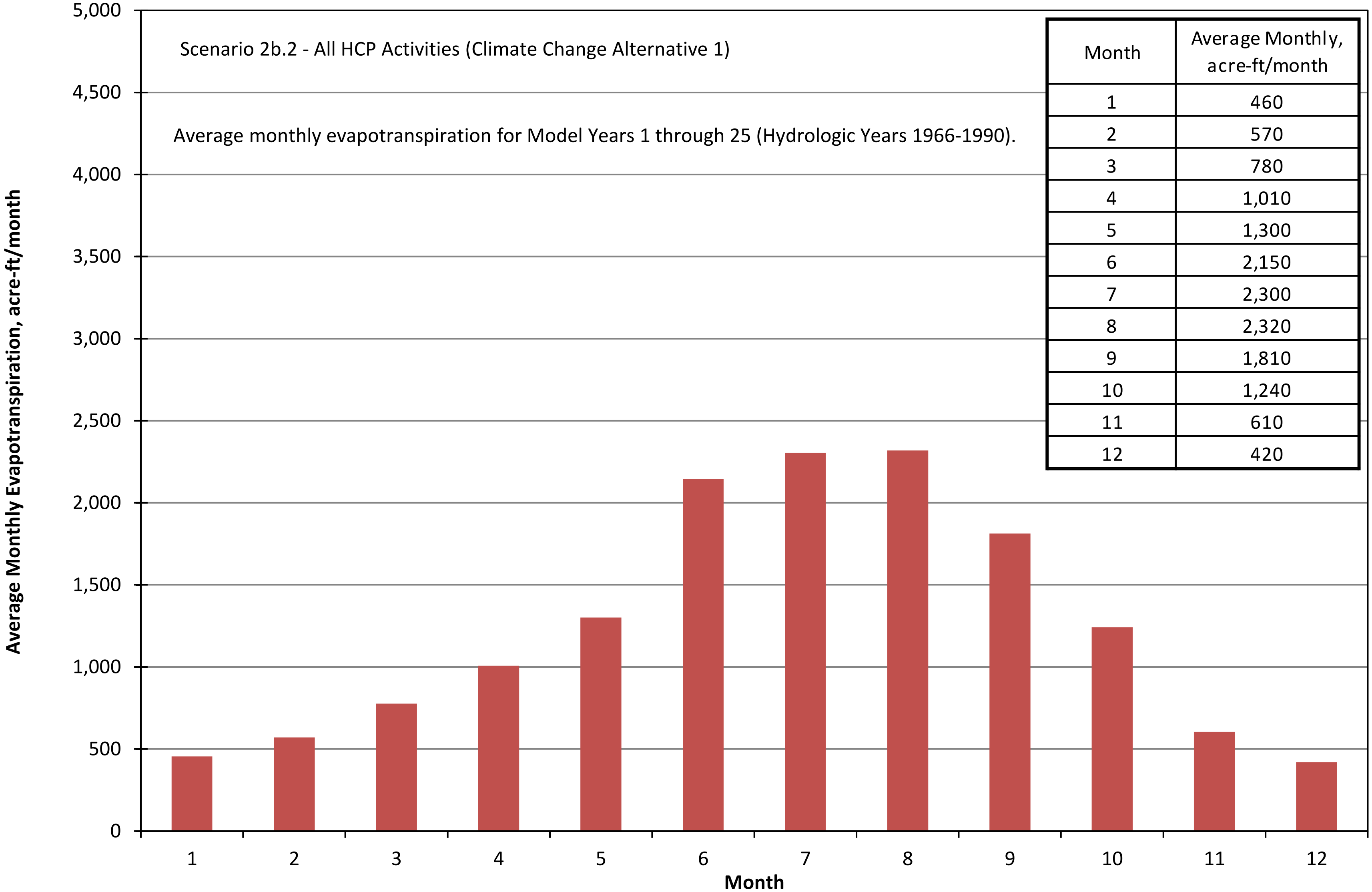

Scenario 2b.2: Annual Change in Evapotranspiration – Prado Basin
Scenario 2b.2 - All HCP Activities (Climate Change Alternative 1)
Prado (Annual Average = -640 acre-ft/yr)
Change in Evapotranspiration, acre-ft/yr
1,000
800
600
400
200
0
-200
-400
-600
-800
-1,000
-1,200
-1,400
-1,600
-1,800
-2,000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Model Year

Figure 404

Scenario 2b.2: Seasonal Evapotranspiration – Prado Basin



Month	Average Monthly, acre-ft/month
1	460
2	570
3	780
4	1,010
5	1,300
6	2,150
7	2,300
8	2,320
9	1,810
10	1,240
11	610
12	420

Figure 405

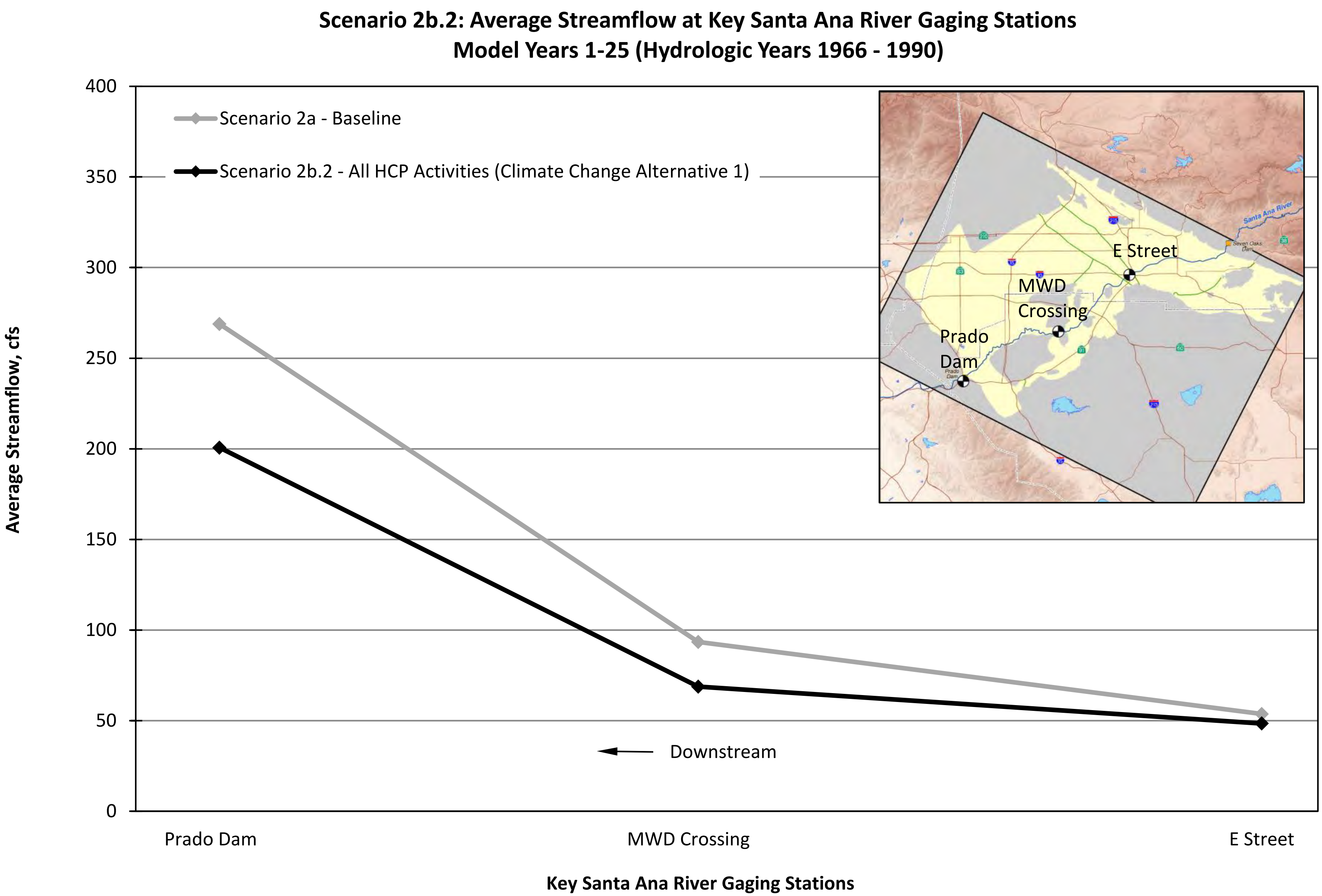

Scenario 2b.2: Average Streamflow at Key Santa Ana River Gaging Stations
Model Years 1-25 (Hydrologic Years 1966 - 1990)
Scenario 2a - Baseline
Scenario 2b.2 - All HCP Activities (Climate Change Alternative 1)
Average Streamflow, cfs
400
350
300
250
200
150
100
50
0
E Street
MWD
Crossing
Prado
Dam
Santa Ana River
Downstream
Prado Dam
MWD Crossing
E Street
Key Santa Ana River Gaging Stations

Figure 406

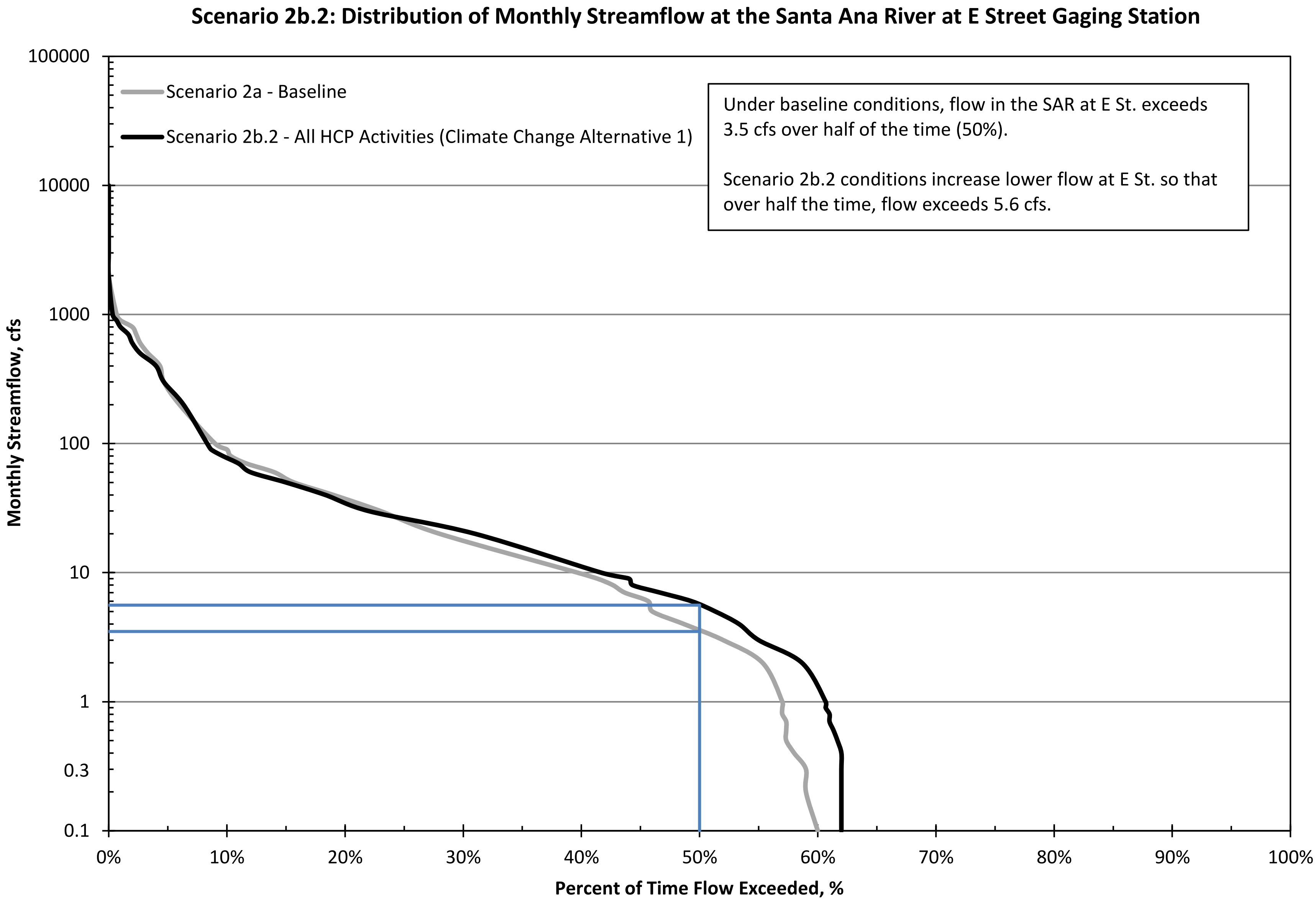

Scenario 2b.2: Distribution of Monthly Streamflow at the Santa Ana River at E Street Gaging Station
Scenario 2a - Baseline
Scenario 2b.2 - All HCP Activities (Climate Change Alternative 1)
Under baseline conditions, flow in the SAR at E St. exceeds 3.5 cfs over half of the time (50%).
Scenario 2b.2 conditions increase lower flow at E St. so that over half the time, flow exceeds 5.6 cfs.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.3
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 407

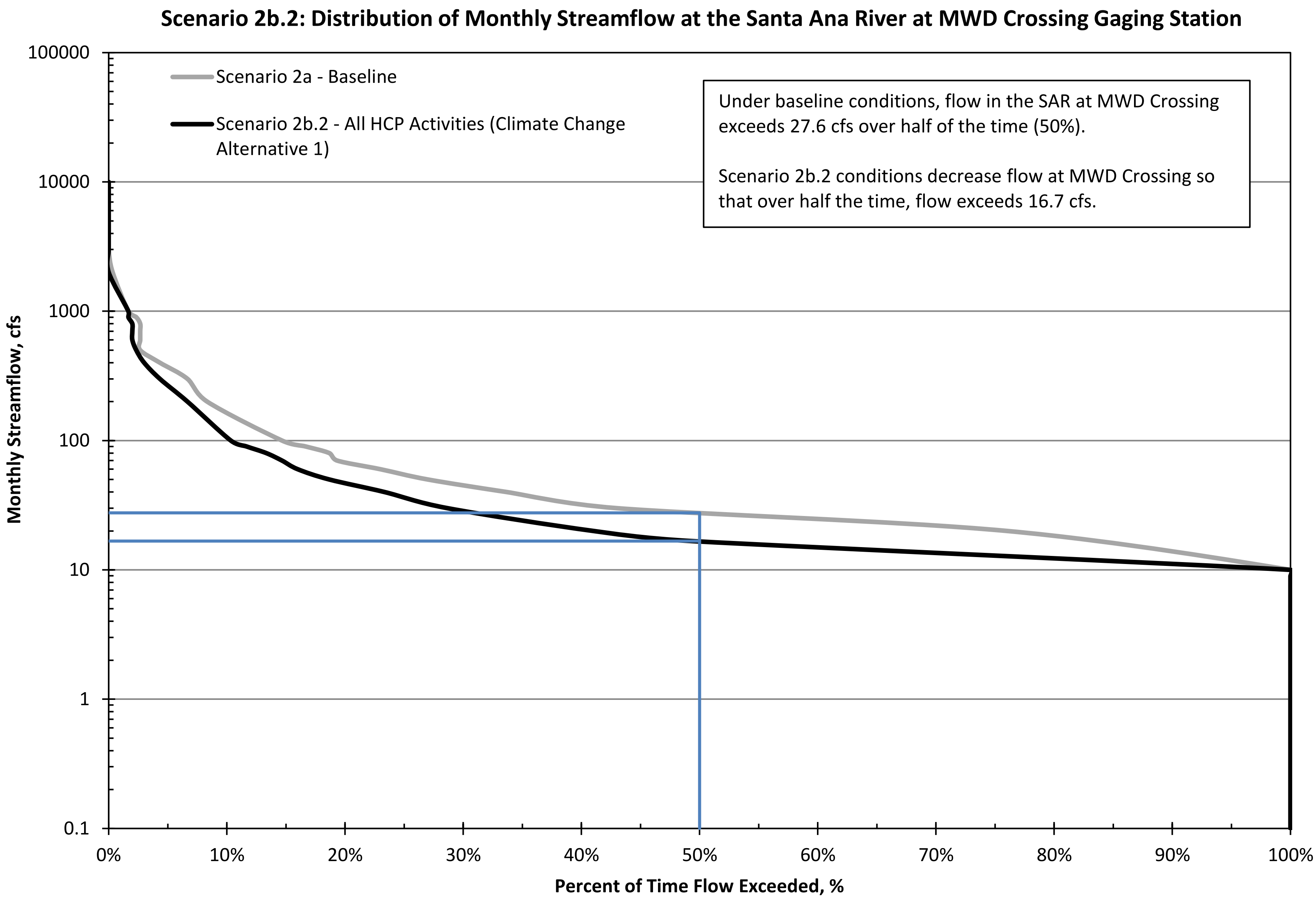

Scenario 2b.2: Distribution of Monthly Streamflow at the Santa Ana River at MWD Crossing Gaging Station
100000
10000
1000
100
10
1
0.1
Monthly Streamflow, cfs
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %
Scenario 2a - Baseline
Scenario 2b.2 - All HCP Activities (Climate Change Alternative 1)
Under baseline conditions, flow in the SAR at MWD Crossing exceeds 27.6 cfs over half of the time (50%).
Scenario 2b.2 conditions decrease flow at MWD Crossing so that over half the time, flow exceeds 16.7 cfs.

Figure 408

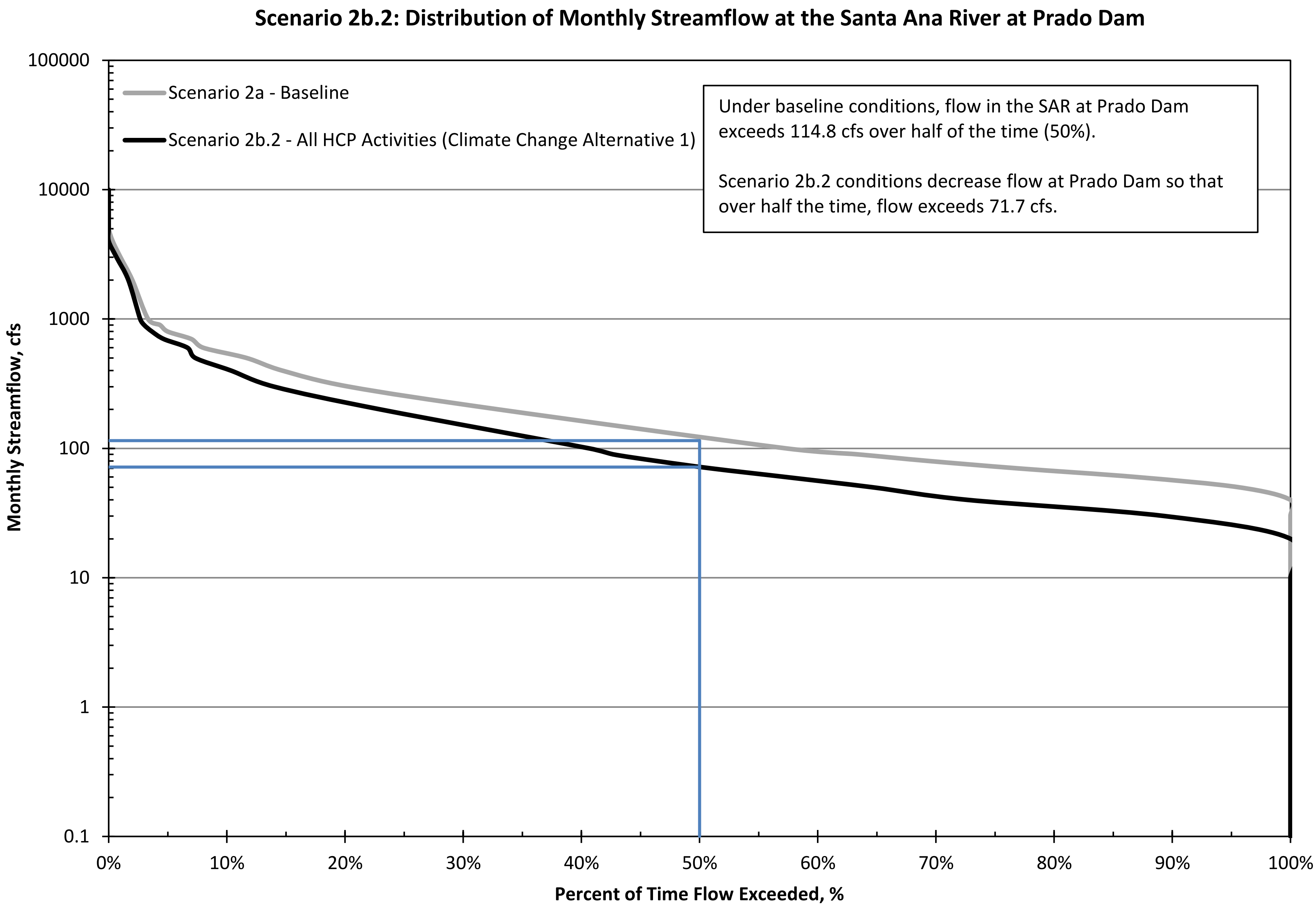
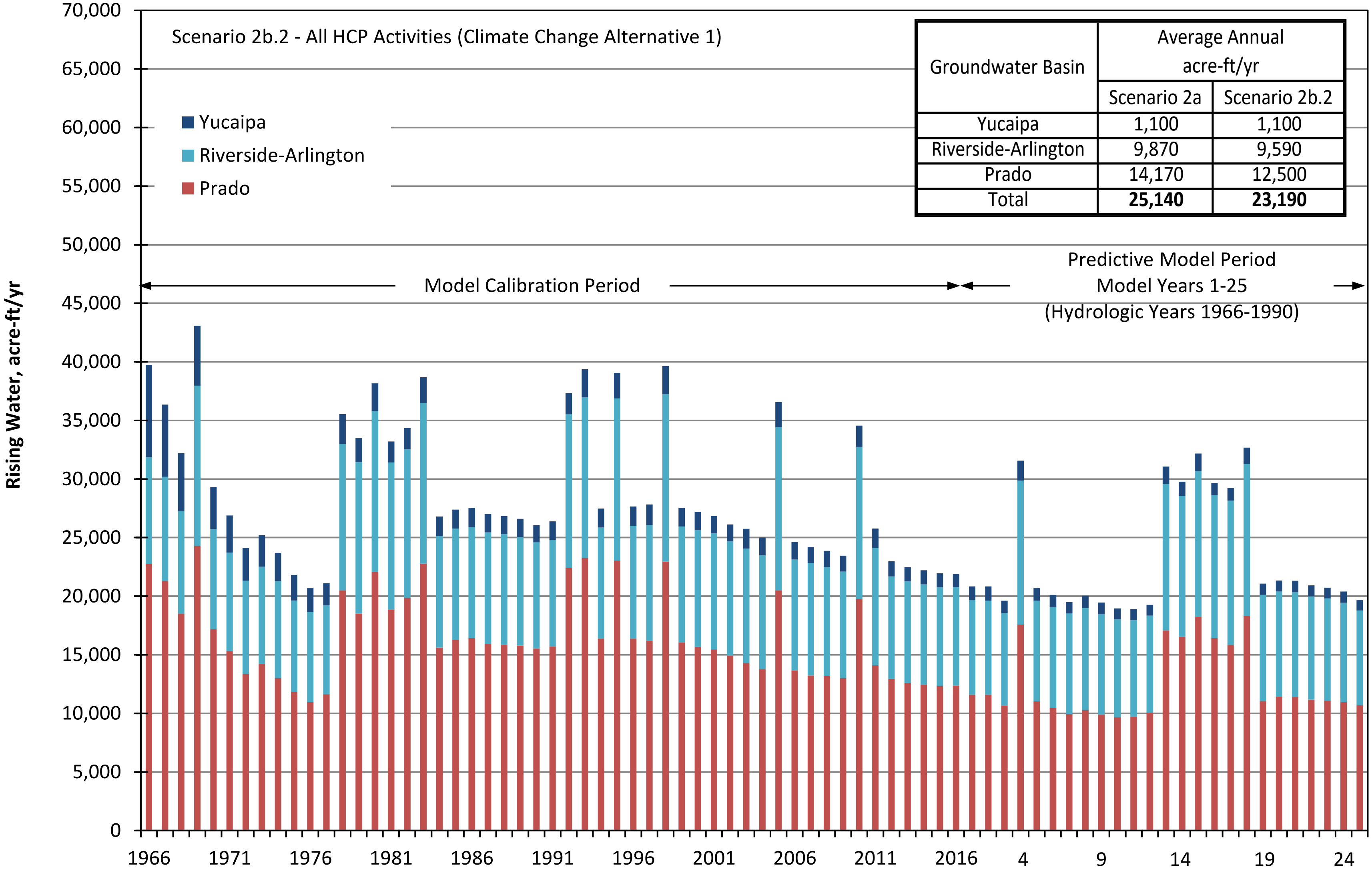

Scenario 2b.2: Distribution of Monthly Streamflow at the Santa Ana River at Prado Dam
Scenario 2a - Baseline
Scenario 2b.2 - All HCP Activities (Climate Change Alternative 1)
Under baseline conditions, flow in the SAR at Prado Dam exceeds 114.8 cfs over half of the time (50%).
Scenario 2b.2 conditions decrease flow at Prado Dam so that over half the time, flow exceeds 71.7 cfs.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 409

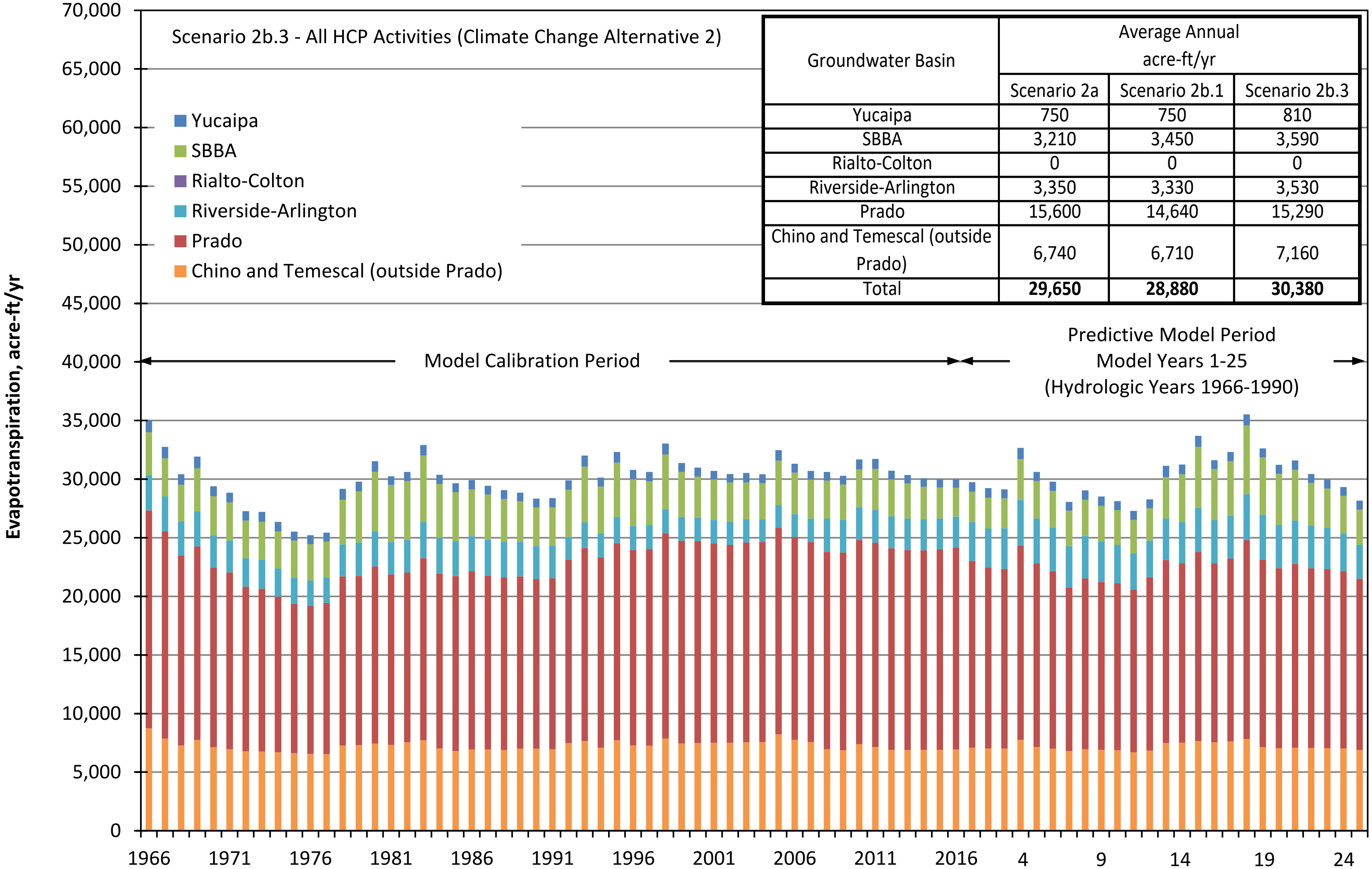
Scenario 2b.2: Annual Rising Water – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2b.2
Yucaipa	1,100	1,100
Riverside-Arlington	9,870	9,590
Prado	14,170	12,500
Total	**25,140**	**23,190**

Figure 410

Scenario 2b.3: Annual Evapotranspiration – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr		
	Scenario 2a	Scenario 2b.1	Scenario 2b.3
Yucaipa	750	750	810
SBBA	3,210	3,450	3,590
Rialto-Colton	0	0	0
Riverside-Arlington	3,350	3,330	3,530
Prado	15,600	14,640	15,290
Chino and Temescal (outside Prado)	6,740	6,710	7,160
Total	**29,650**	**28,880**	**30,380**

Figure 411

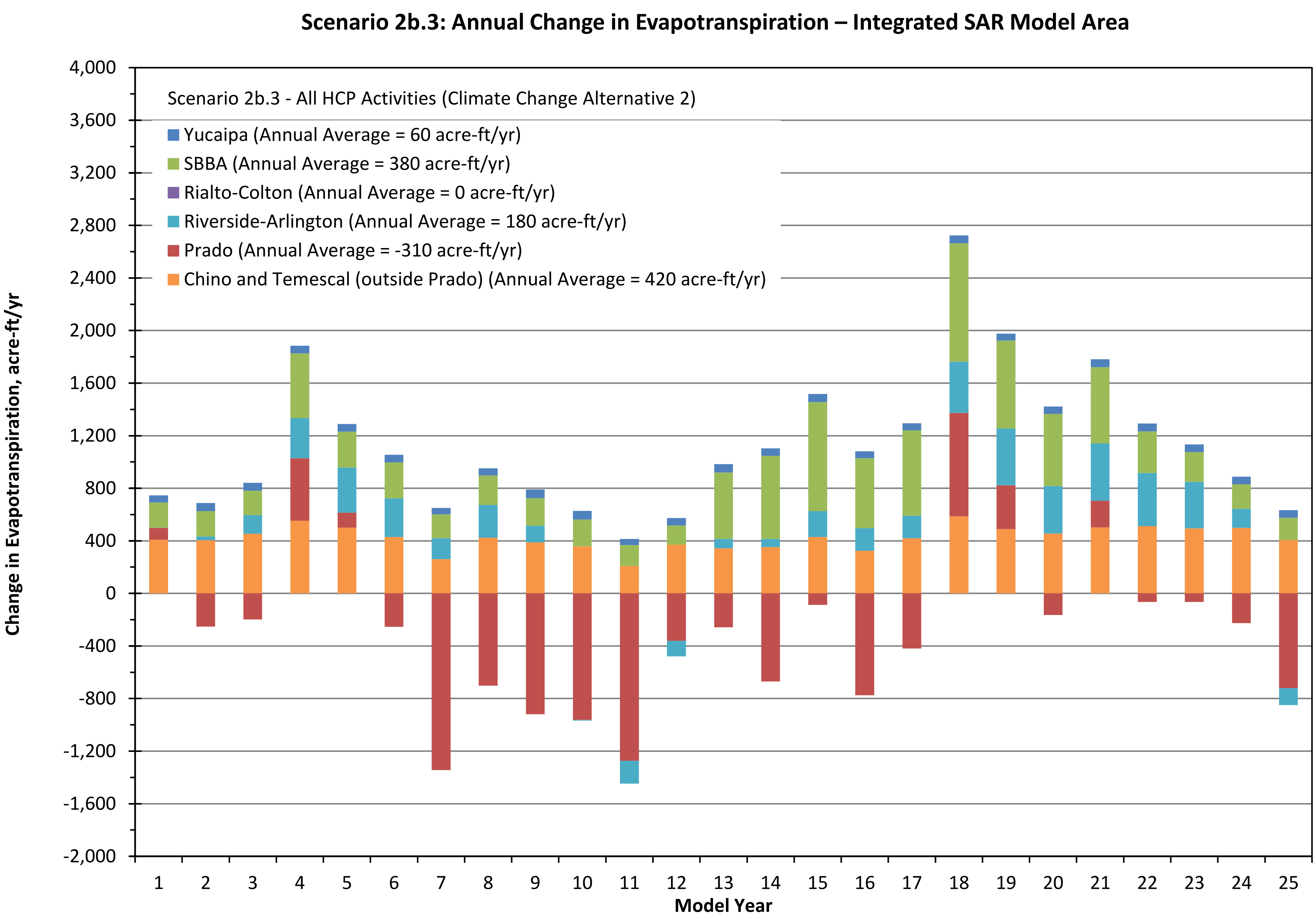
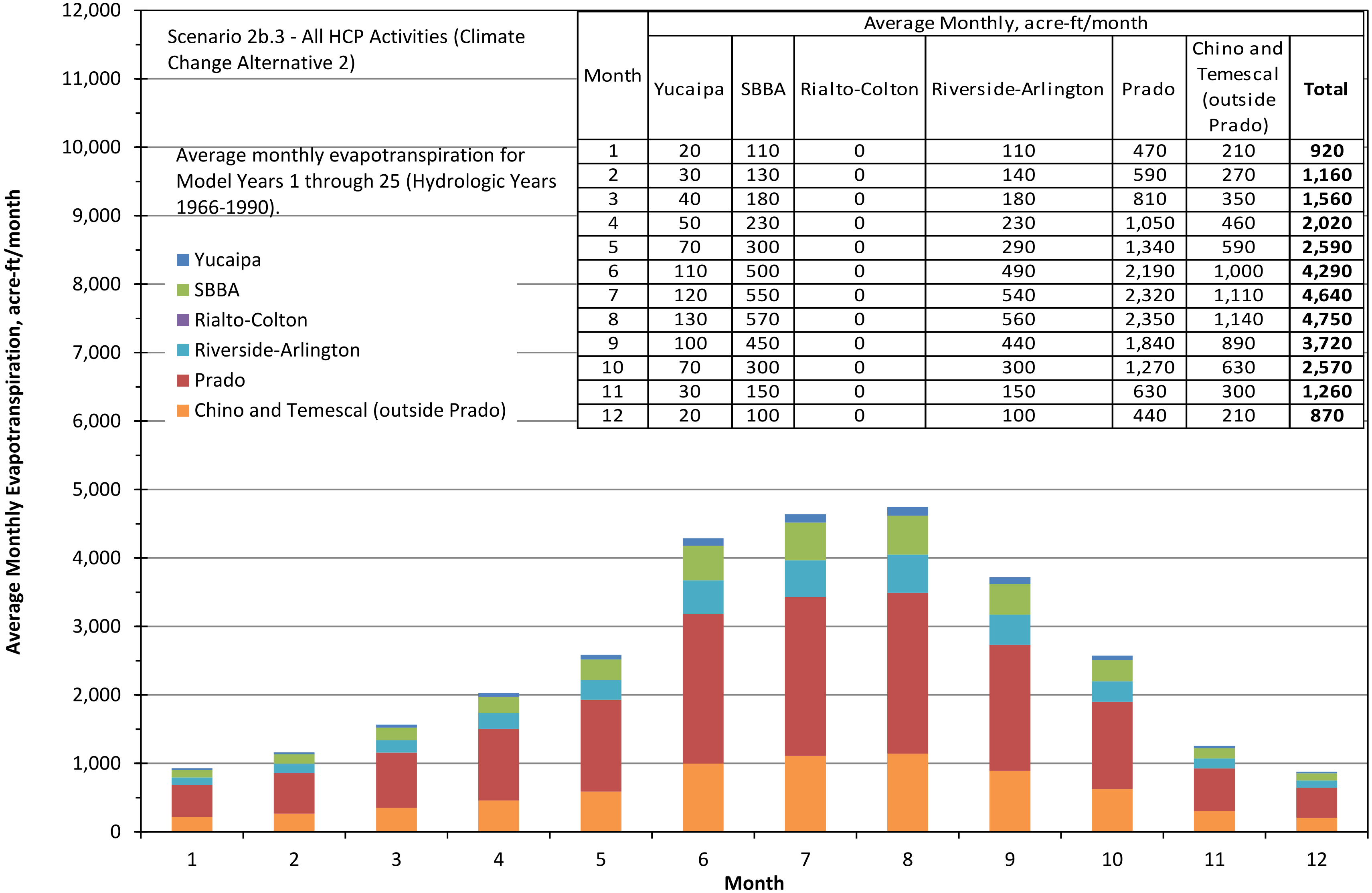

Scenario 2b.3: Annual Change in Evapotranspiration – Integrated SAR Model Area
Scenario 2b.3 - All HCP Activities (Climate Change Alternative 2)
Yucaipa (Annual Average = 60 acre-ft/yr)
SBBA (Annual Average = 380 acre-ft/yr)
Rialto-Colton (Annual Average = 0 acre-ft/yr)
Riverside-Arlington (Annual Average = 180 acre-ft/yr)
Prado (Annual Average = -310 acre-ft/yr)
Chino and Temescal (outside Prado) (Annual Average = 420 acre-ft/yr)
Change in Evapotranspiration, acre-ft/yr
4,000
3,600
3,200
2,800
2,400
2,000
1,600
1,200
800
400
0
-400
-800
-1,200
-1,600
-2,000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Model Year

Figure 412

Scenario 2b.3: Seasonal Evapotranspiration – Integrated SAR Model Area



Month	Average Monthly, acre-ft/month						
	Yucaipa	SBBA	Rialto-Colton	Riverside-Arlington	Prado	Chino and Temescal (outside Prado)	**Total**
1	20	110	0	110	470	210	**920**
2	30	130	0	140	590	270	**1,160**
3	40	180	0	180	810	350	**1,560**
4	50	230	0	230	1,050	460	**2,020**
5	70	300	0	290	1,340	590	**2,590**
6	110	500	0	490	2,190	1,000	**4,290**
7	120	550	0	540	2,320	1,110	**4,640**
8	130	570	0	560	2,350	1,140	**4,750**
9	100	450	0	440	1,840	890	**3,720**
10	70	300	0	300	1,270	630	**2,570**
11	30	150	0	150	630	300	**1,260**
12	20	100	0	100	440	210	**870**

Figure 413

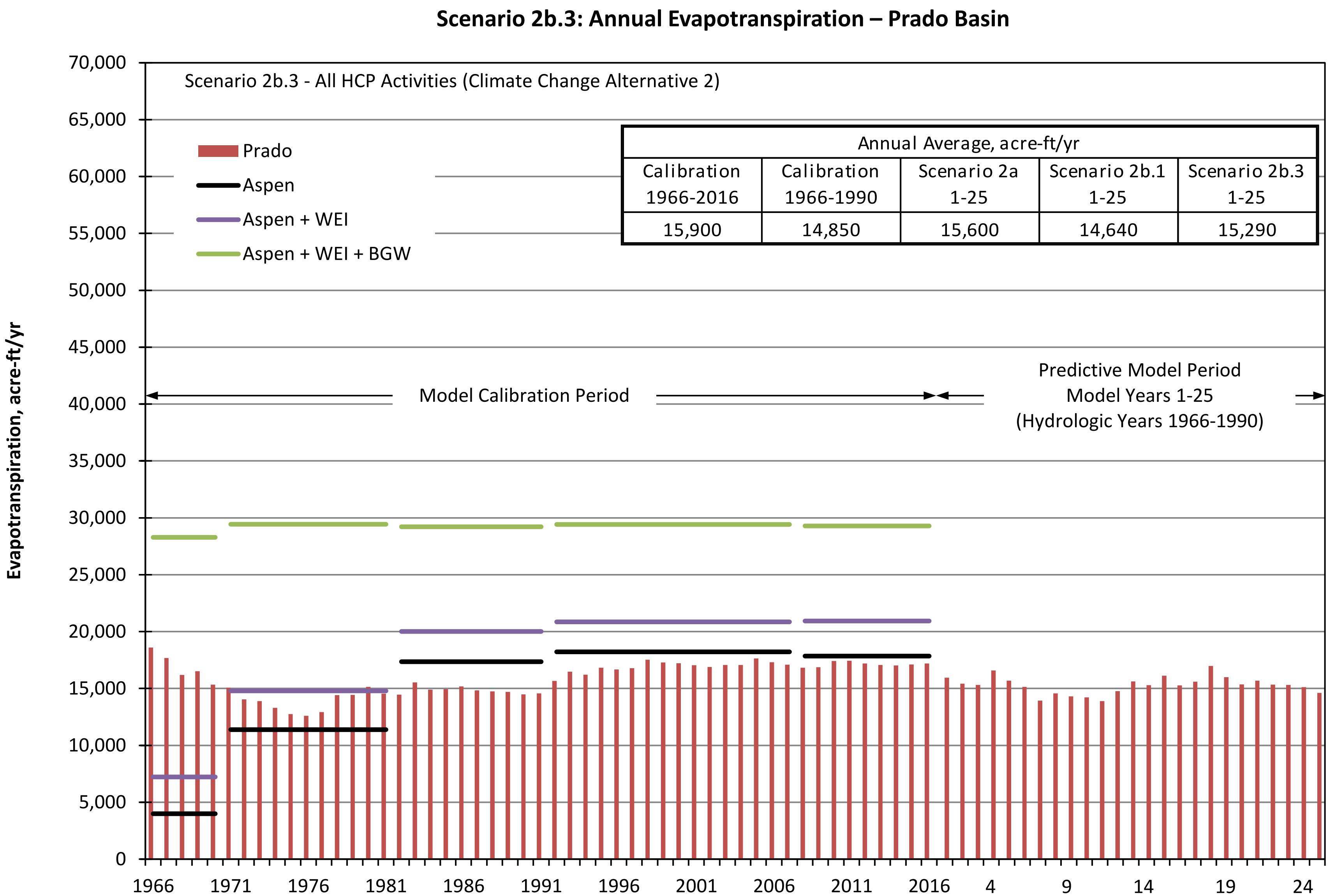

Scenario 2b.3: Annual Evapotranspiration – Prado Basin
Scenario 2b.3 - All HCP Activities (Climate Change Alternative 2)
Prado
Aspen
Aspen + WEI
Aspen + WEI + BGW
Annual Average, acre-ft/yr
Calibration 1966-2016
Calibration 1966-1990
Scenario 2a 1-25
Scenario 2b.1 1-25
Scenario 2b.3 1-25
15,900
14,850
15,600
14,640
15,290
Model Calibration Period
Predictive Model Period
Model Years 1-25
(Hydrologic Years 1966-1990)
Evapotranspiration, acre-ft/yr
70,000
65,000
60,000
55,000
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
1966
1971
1976
1981
1986
1991
1996
2001
2006
2011
2016
4
9
14
19
24

Figure 414

DRAFT

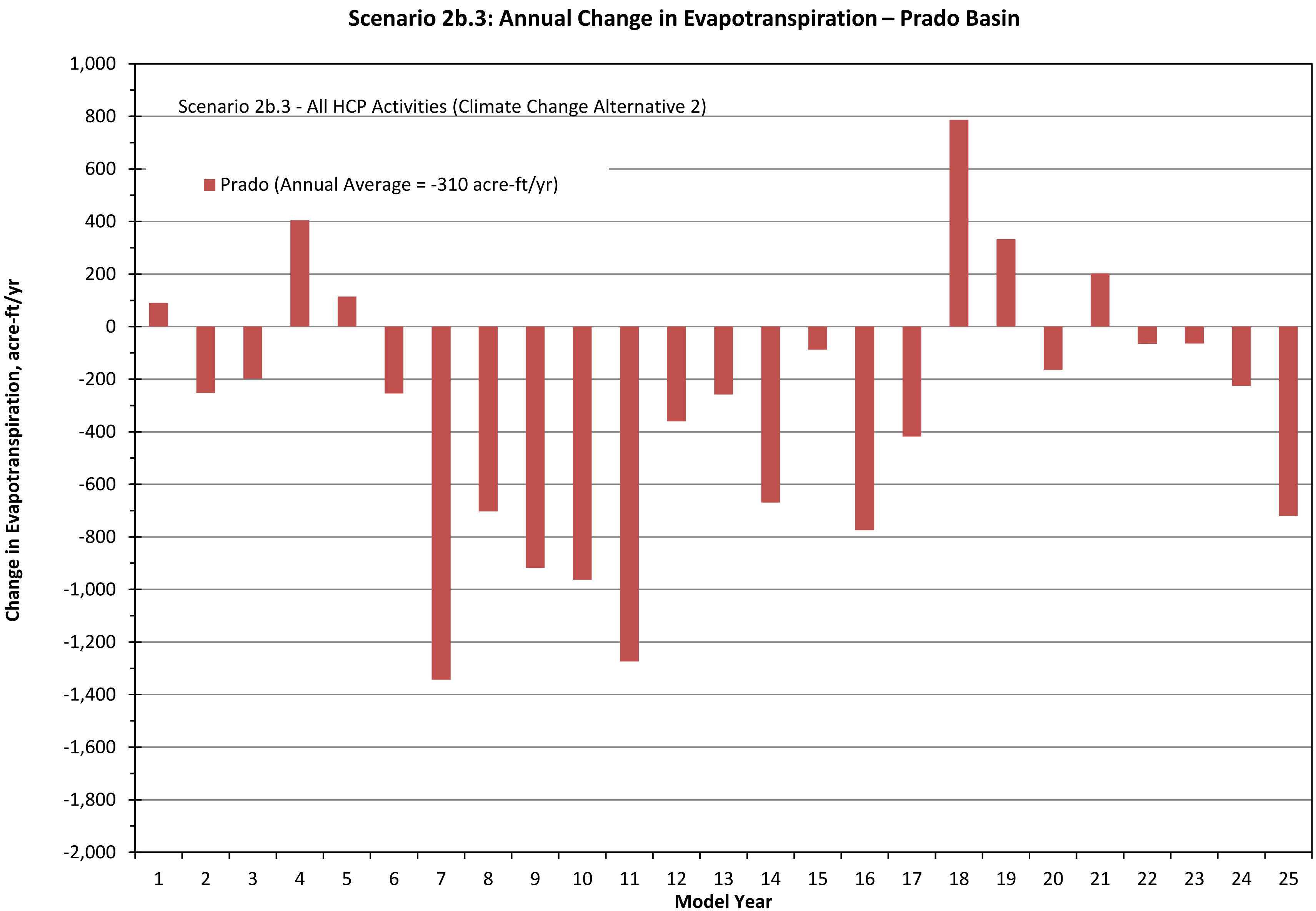
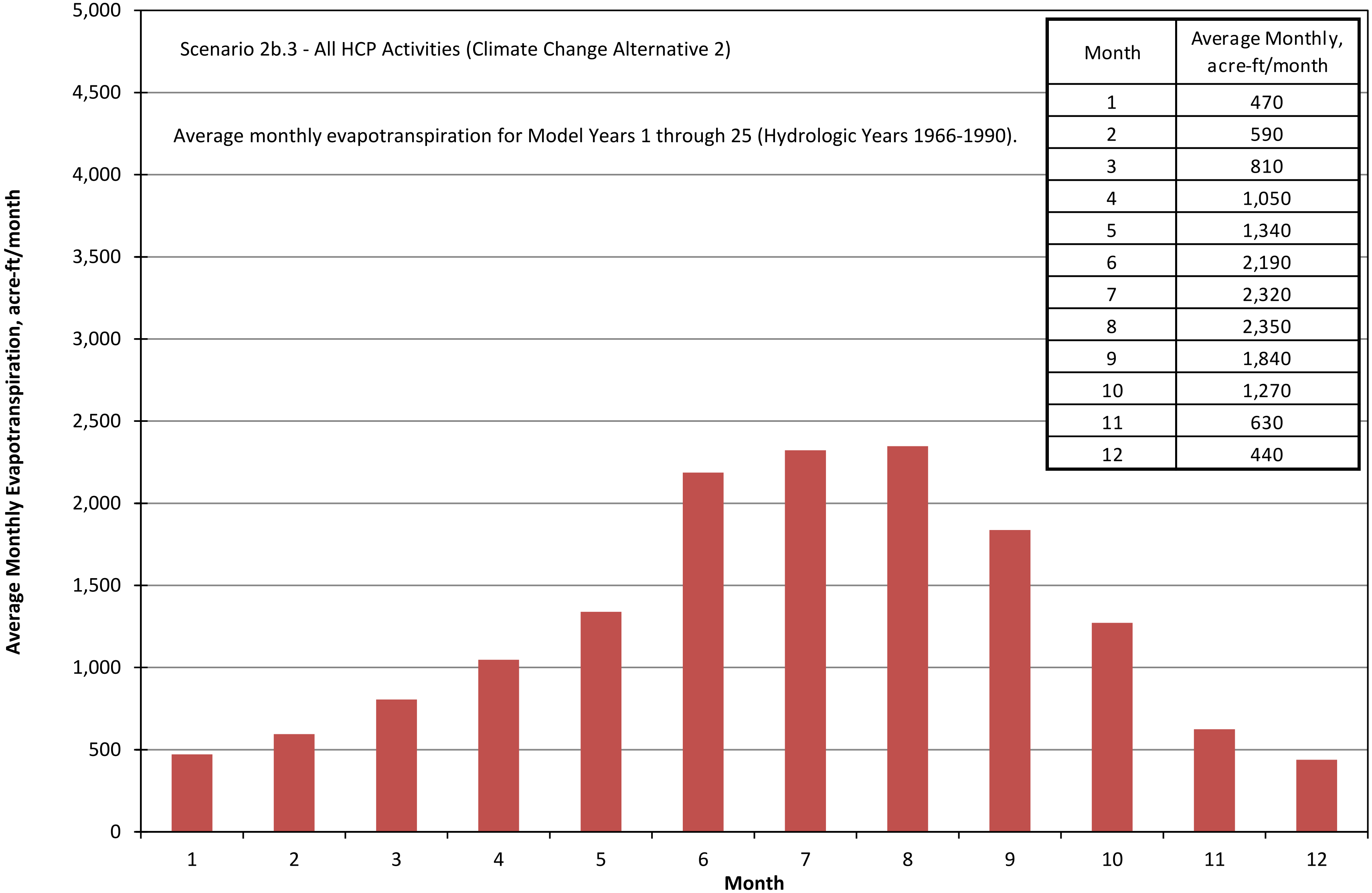


Figure 415

Scenario 2b.3: Seasonal Evapotranspiration – Prado Basin



Month	Average Monthly, acre-ft/month
1	470
2	590
3	810
4	1,050
5	1,340
6	2,190
7	2,320
8	2,350
9	1,840
10	1,270
11	630
12	440

Figure 416

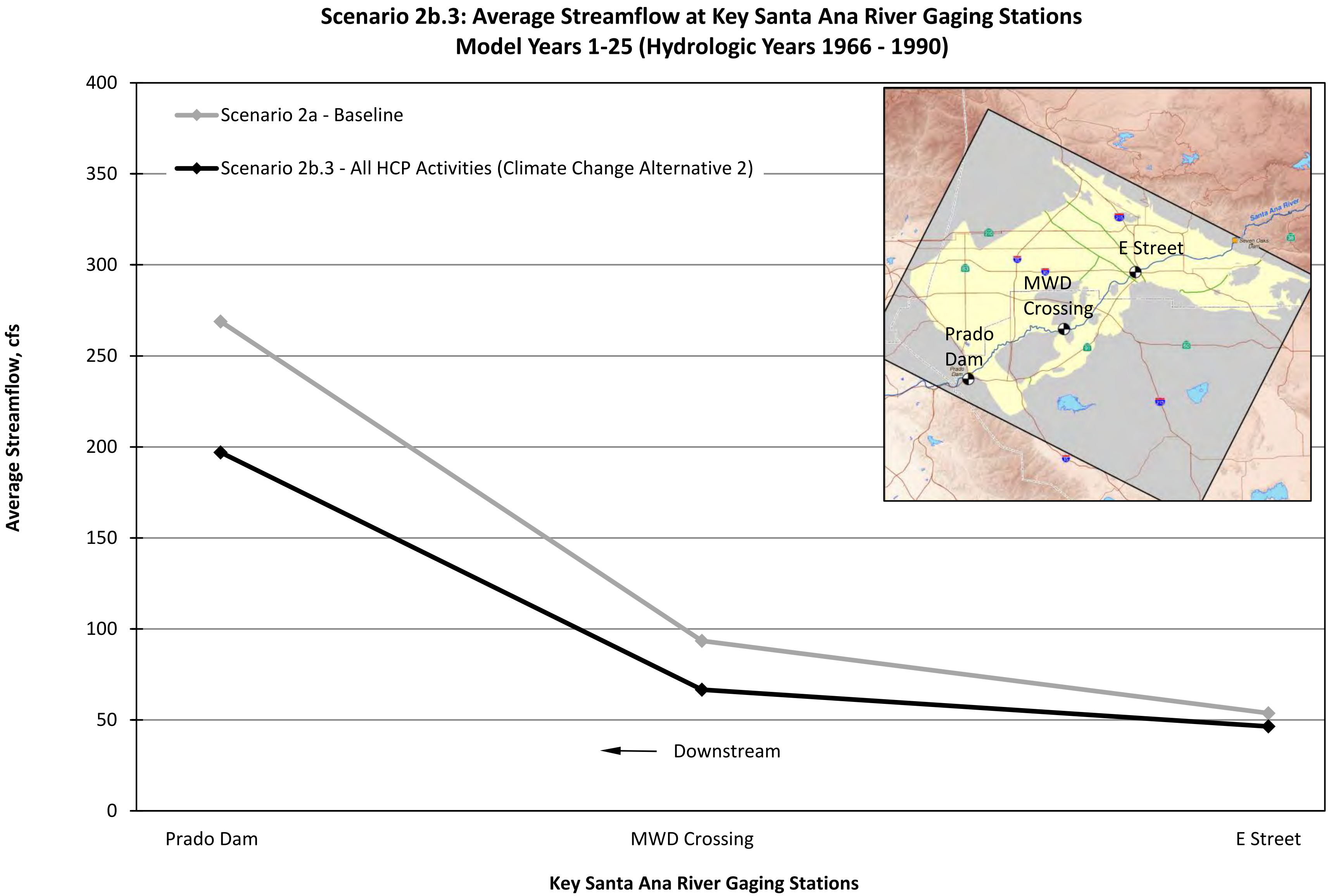

Scenario 2b.3: Average Streamflow at Key Santa Ana River Gaging Stations
Model Years 1-25 (Hydrologic Years 1966 - 1990)
Scenario 2a - Baseline
Scenario 2b.3 - All HCP Activities (Climate Change Alternative 2)
400
350
300
250
200
150
100
50
0
Average Streamflow, cfs
E Street
MWD
Crossing
Prado
Dam
Downstream
Prado Dam
MWD Crossing
E Street
Key Santa Ana River Gaging Stations

Figure 417

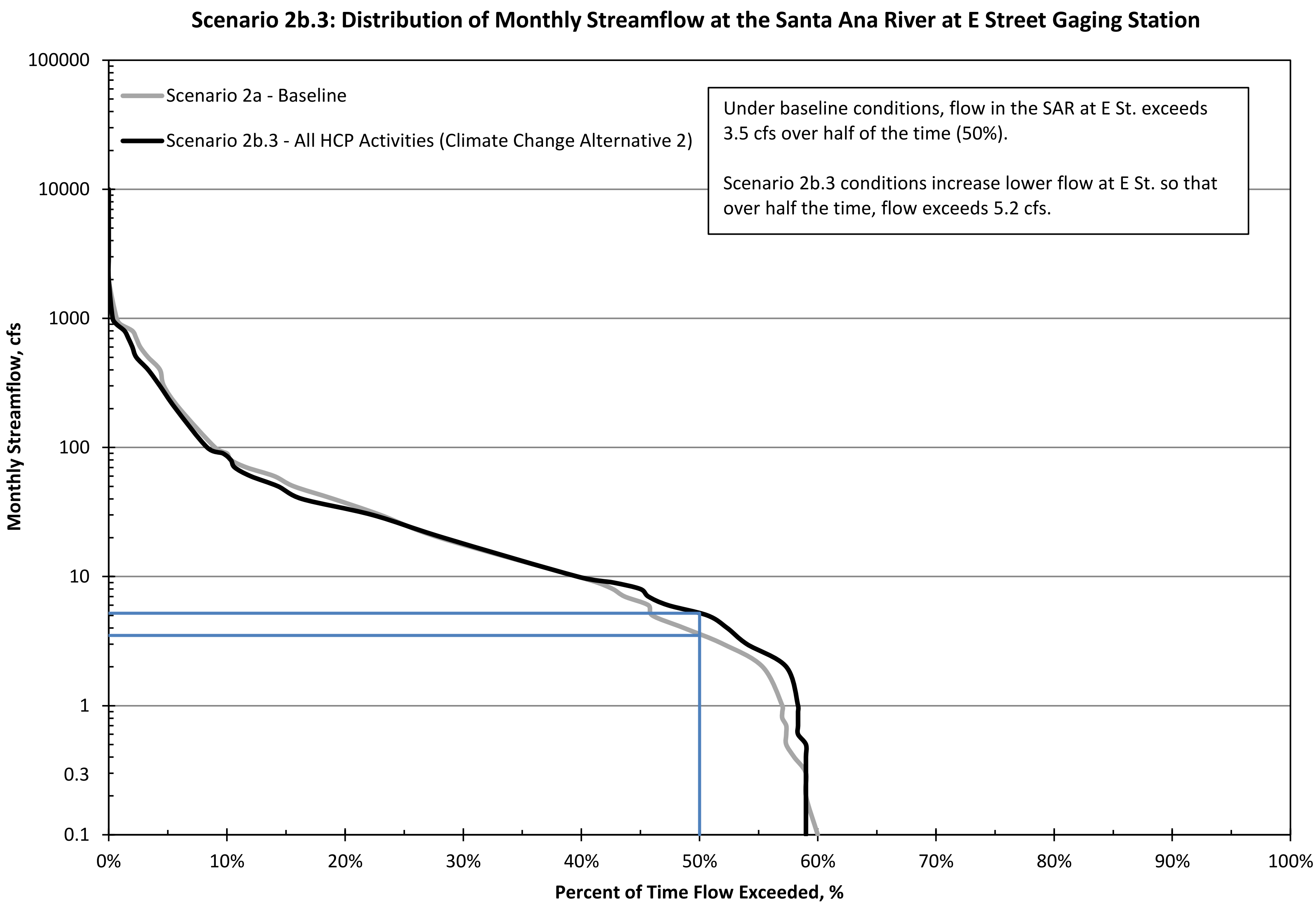

Scenario 2b.3: Distribution of Monthly Streamflow at the Santa Ana River at E Street Gaging Station
Scenario 2a - Baseline
Scenario 2b.3 - All HCP Activities (Climate Change Alternative 2)
Under baseline conditions, flow in the SAR at E St. exceeds 3.5 cfs over half of the time (50%).
Scenario 2b.3 conditions increase lower flow at E St. so that over half the time, flow exceeds 5.2 cfs.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.3
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 418

Scenario 2b.3: Distribution of Monthly Streamflow at the Santa Ana River at MWD Crossing Gaging Station

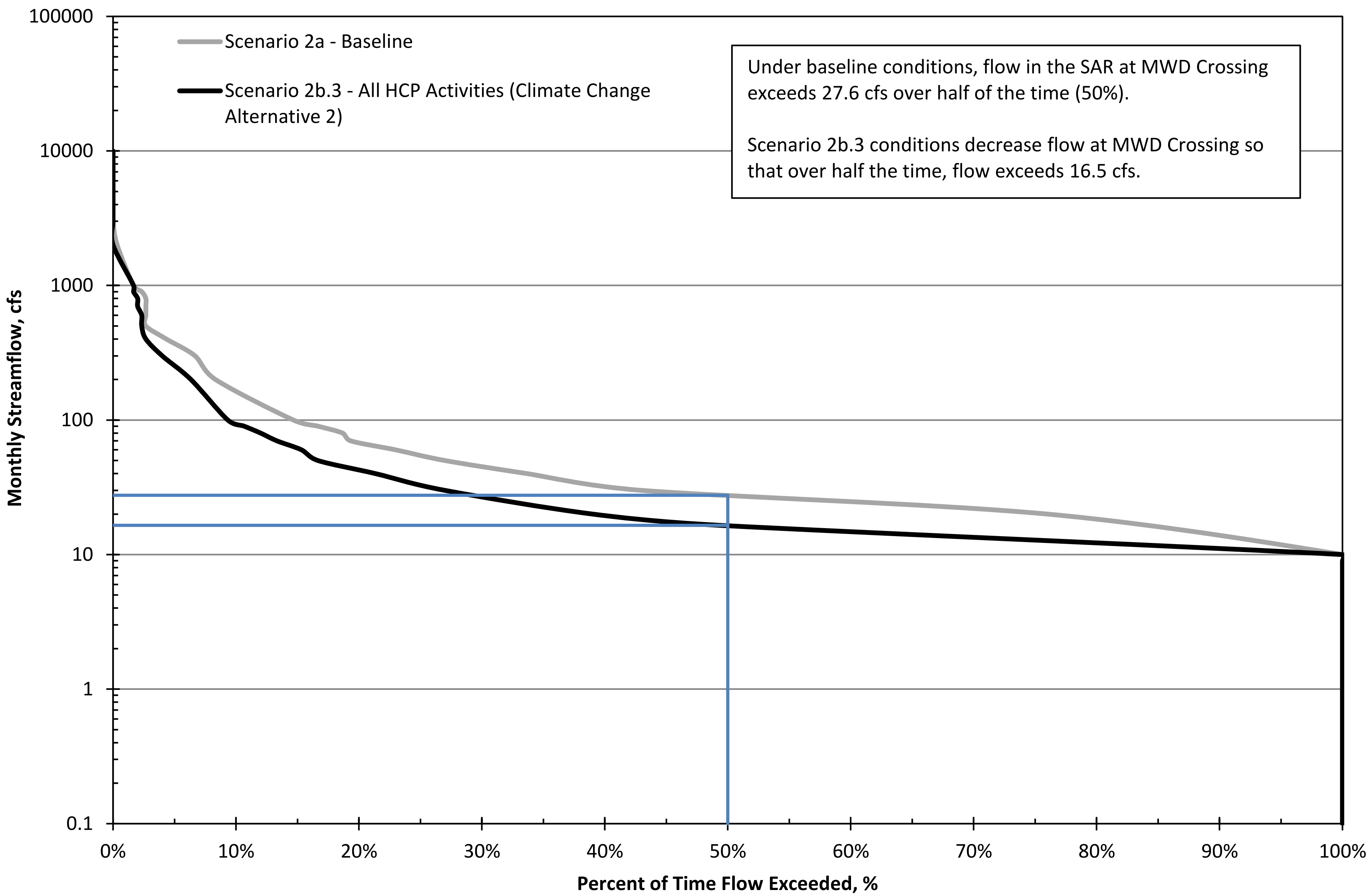


Figure 419

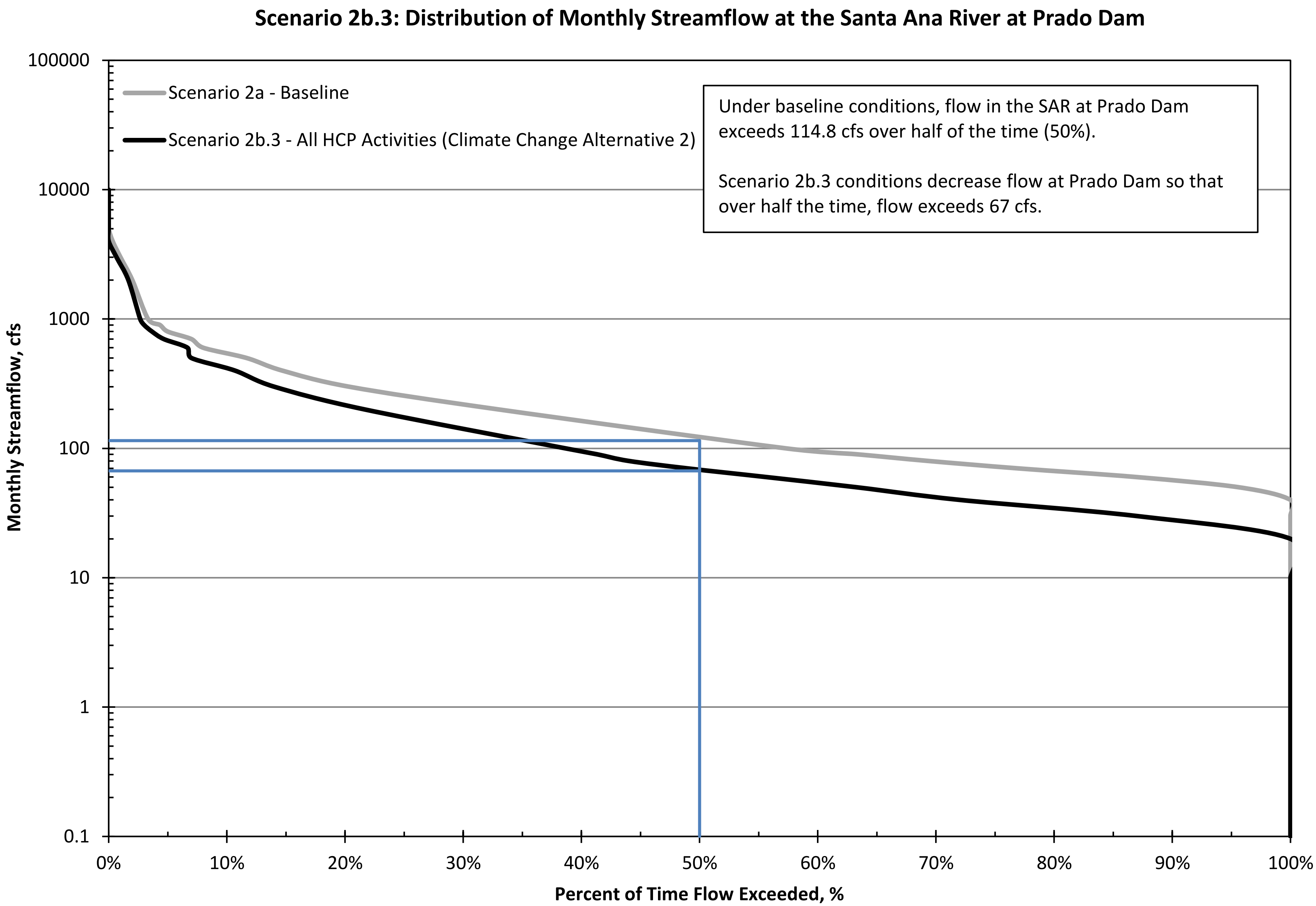
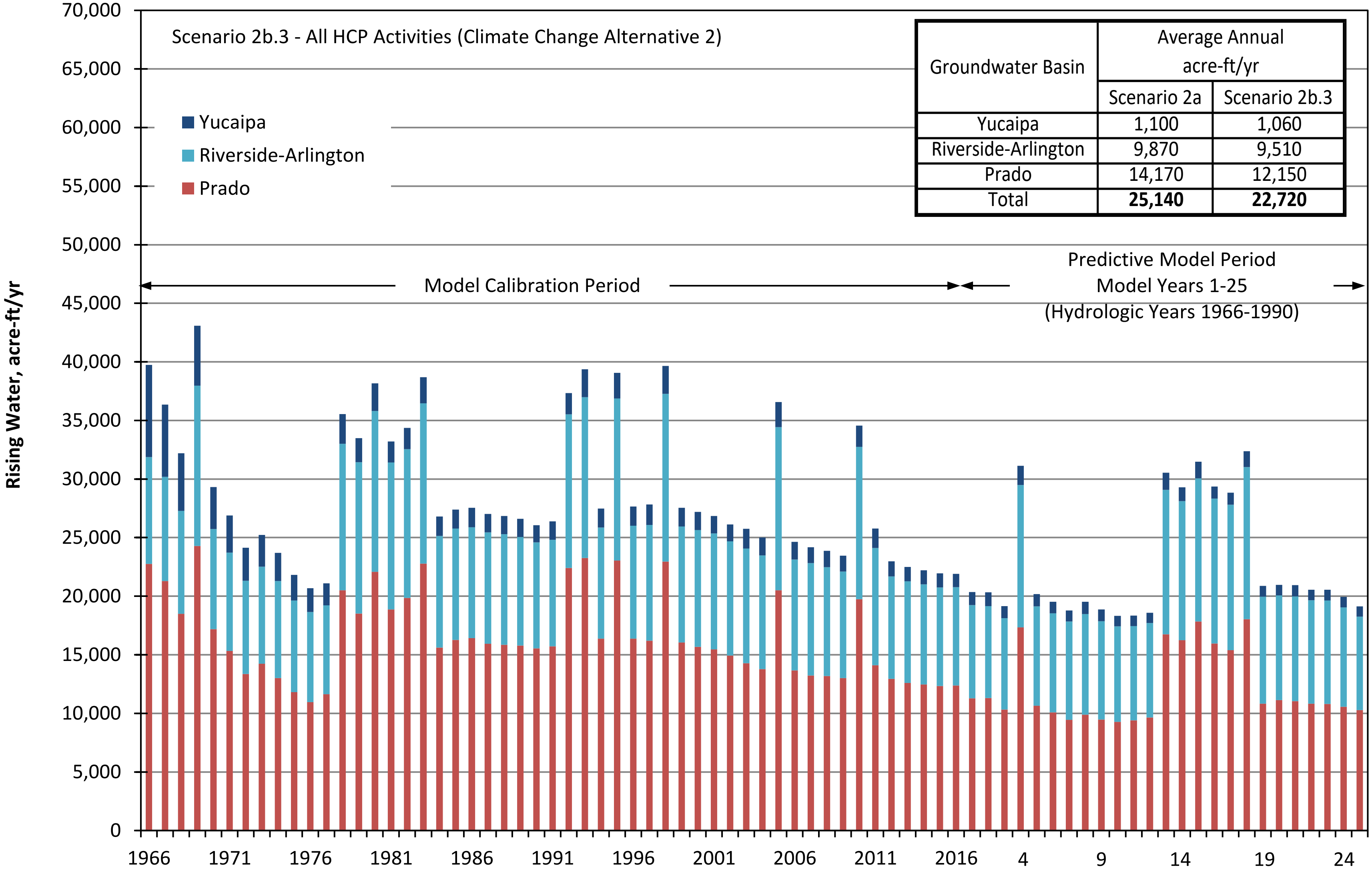

Scenario 2b.3: Distribution of Monthly Streamflow at the Santa Ana River at Prado Dam
Scenario 2a - Baseline
Scenario 2b.3 - All HCP Activities (Climate Change Alternative 2)
Under baseline conditions, flow in the SAR at Prado Dam exceeds 114.8 cfs over half of the time (50%).
Scenario 2b.3 conditions decrease flow at Prado Dam so that over half the time, flow exceeds 67 cfs.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 420

DRAFT

Scenario 2b.3: Annual Rising Water – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2b.3
Yucaipa	1,100	1,060
Riverside-Arlington	9,870	9,510
Prado	14,170	12,150
Total	**25,140**	**22,720**

Figure 421

SCENARIO 2c.1: LOCATION OF HCP COVERED ACTIVITIES

W:\GIS_projs\rivmod_SAR\RiverStudyModel_2017\53_SumRpt_Fig_422_Scen_2c1_HCP_activities_4-20.mxd

10-Apr-20

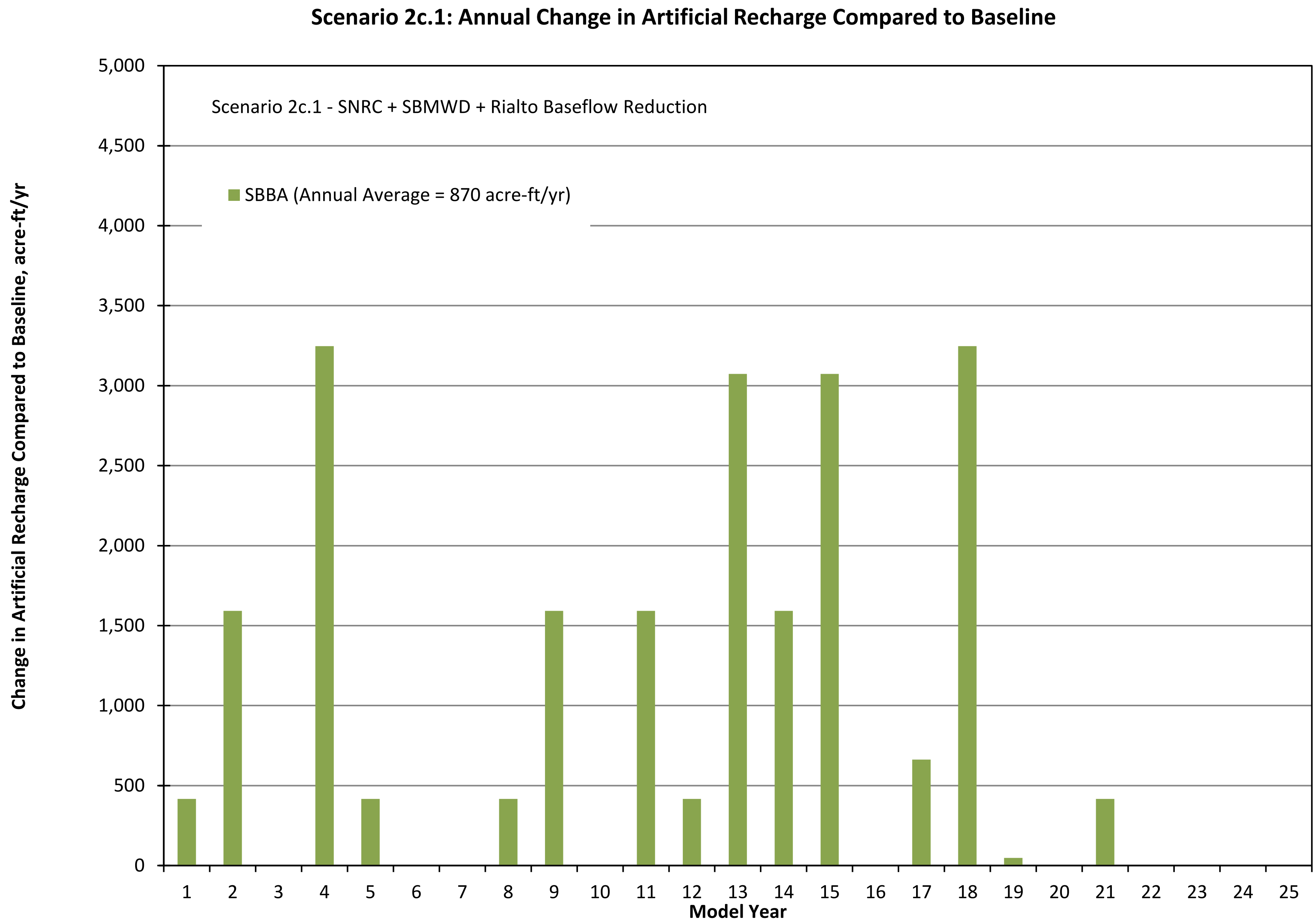

Scenario 2c.1: Annual Change in Artificial Recharge Compared to Baseline
Scenario 2c.1 - SNRC + SBMWD + Rialto Baseflow Reduction
SBBA (Annual Average = 870 acre-ft/yr)
Change in Artificial Recharge Compared to Baseline, acre-ft/yr
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Model Year

Figure 423

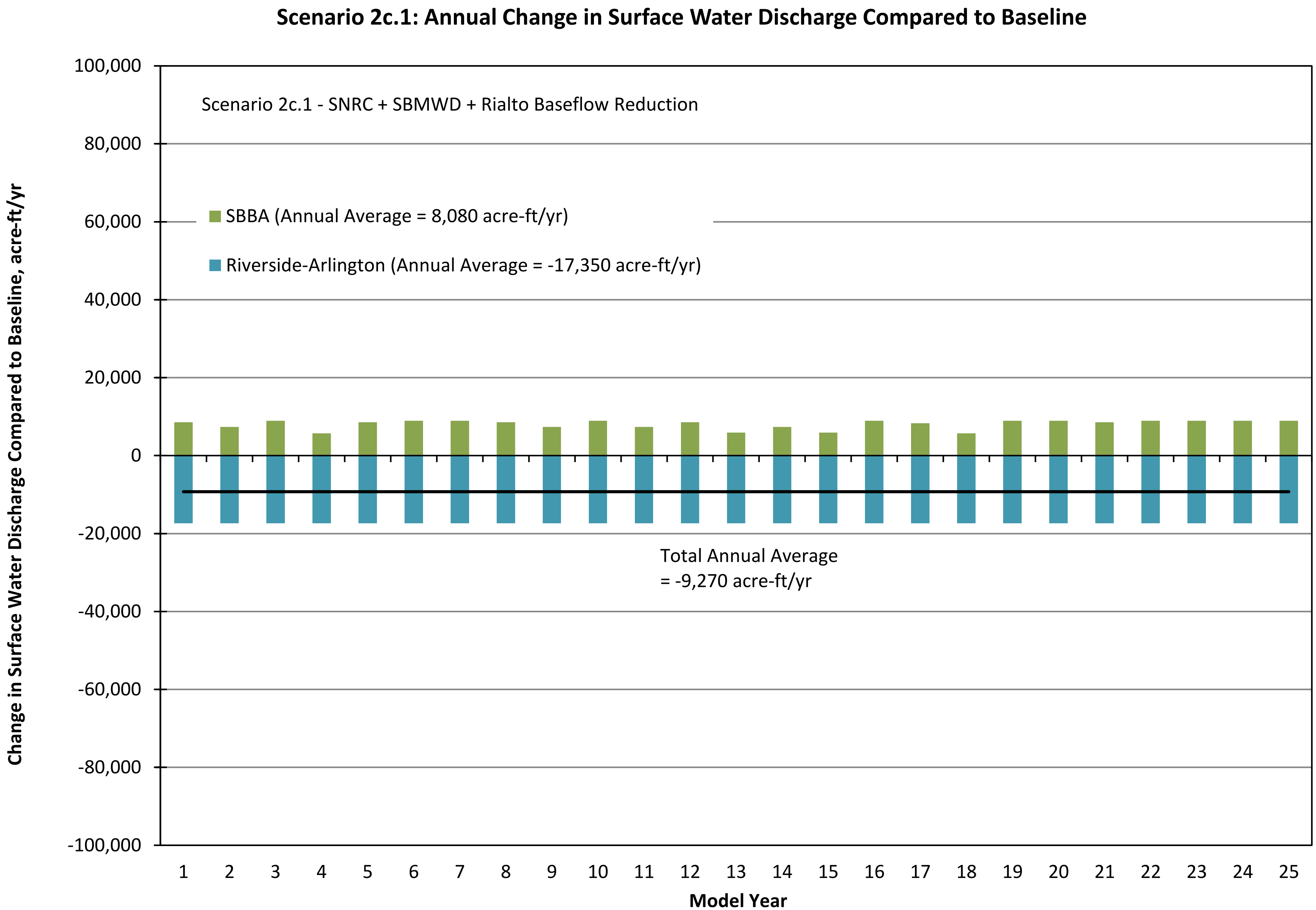
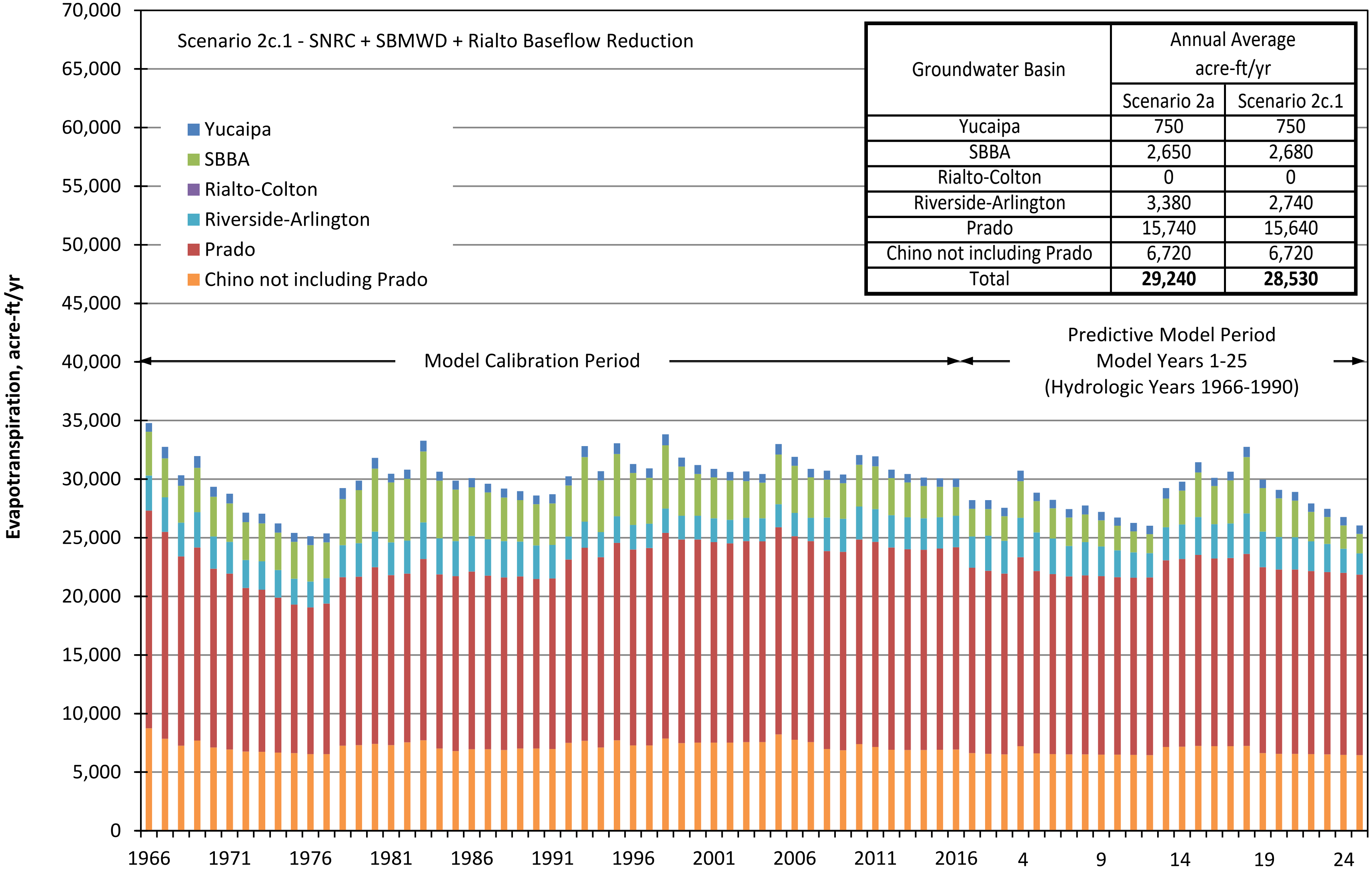

Scenario 2c.1: Annual Change in Surface Water Discharge Compared to Baseline
Scenario 2c.1 - SNRC + SBMWD + Rialto Baseflow Reduction
SBBA (Annual Average = 8,080 acre-ft/yr)
Riverside-Arlington (Annual Average = -17,350 acre-ft/yr)
Total Annual Average
= -9,270 acre-ft/yr
Change in Surface Water Discharge Compared to Baseline, acre-ft/yr
100,000
80,000
60,000
40,000
20,000
0
-20,000
-40,000
-60,000
-80,000
-100,000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Model Year

Figure 424

DRAFT

Scenario 2c.1: Annual Evapotranspiration – Integrated SAR Model Area



Groundwater Basin	Annual Average acre-ft/yr	
	Scenario 2a	Scenario 2c.1
Yucaipa	750	750
SBBA	2,650	2,680
Rialto-Colton	0	0
Riverside-Arlington	3,380	2,740
Prado	15,740	15,640
Chino not including Prado	6,720	6,720
Total	**29,240**	**28,530**

Figure 425

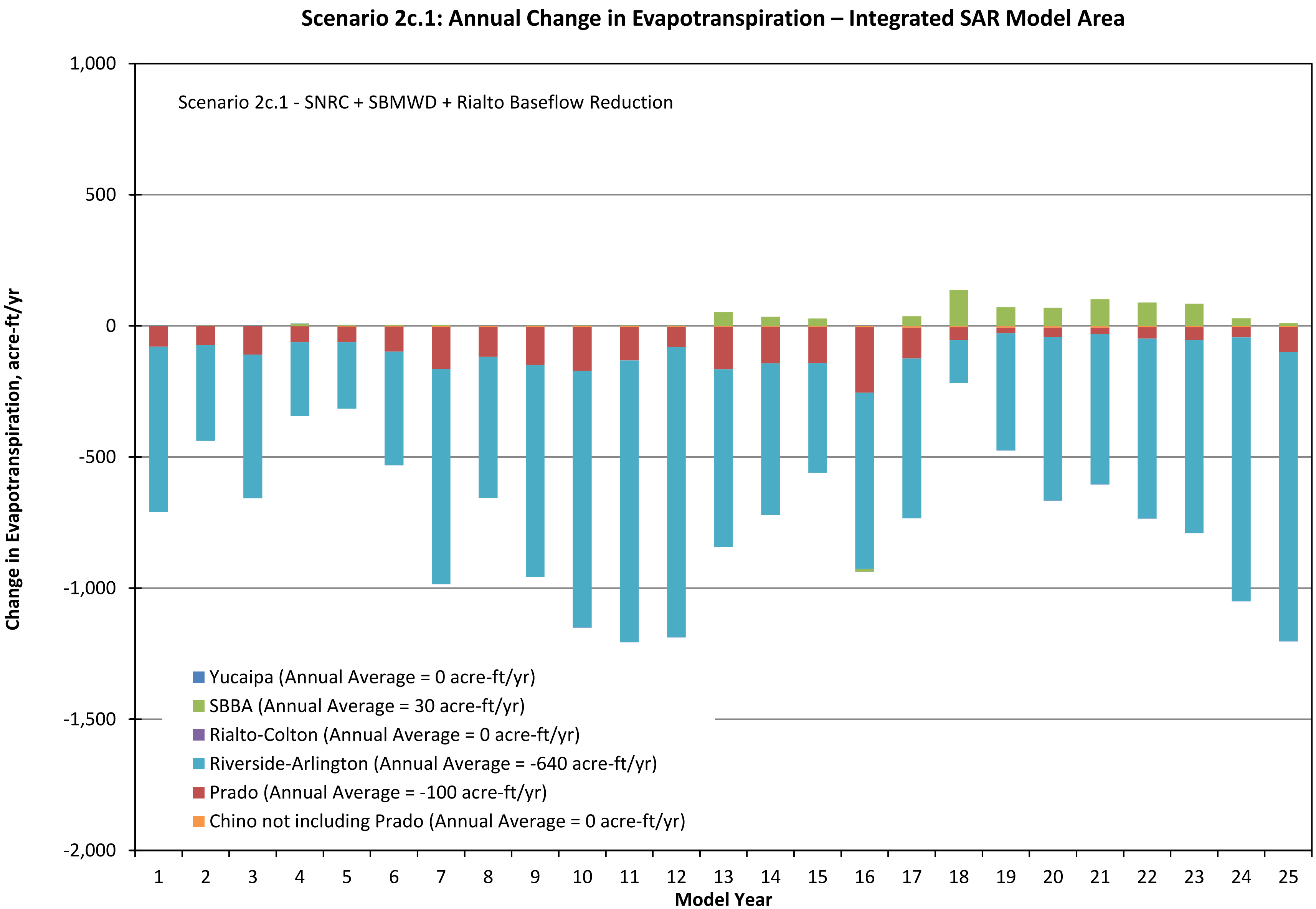
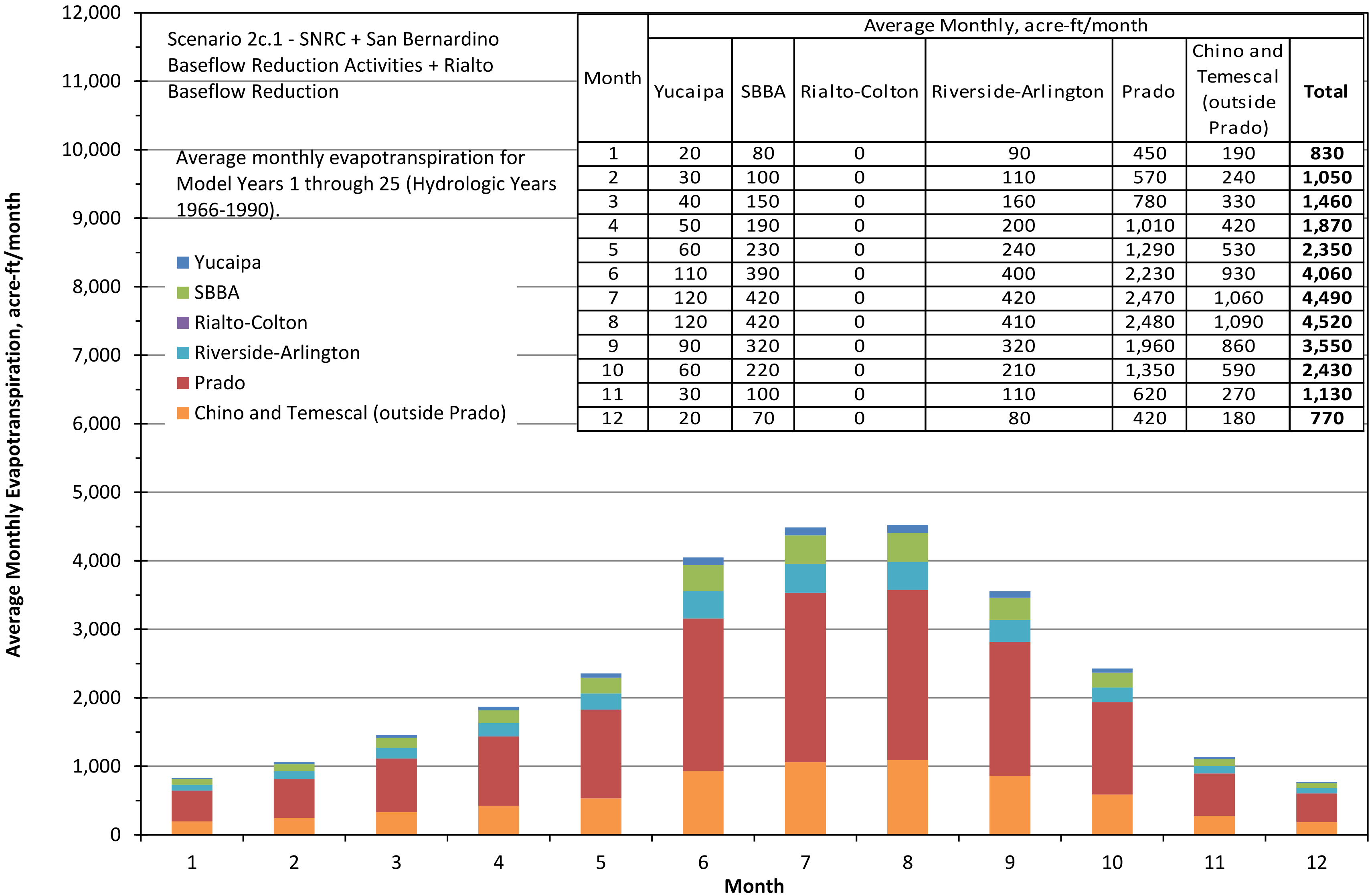

Scenario 2c.1: Annual Change in Evapotranspiration – Integrated SAR Model Area
Scenario 2c.1 - SNRC + SBMWD + Rialto Baseflow Reduction
Change in Evapotranspiration, acre-ft/yr
1,000
500
0
-500
-1,000
-1,500
-2,000
Yucaipa (Annual Average = 0 acre-ft/yr)
SBBA (Annual Average = 30 acre-ft/yr)
Rialto-Colton (Annual Average = 0 acre-ft/yr)
Riverside-Arlington (Annual Average = -640 acre-ft/yr)
Prado (Annual Average = -100 acre-ft/yr)
Chino not including Prado (Annual Average = 0 acre-ft/yr)
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
Model Year

Figure 426

Scenario 2c.1: Seasonal Evapotranspiration – Integrated SAR Model Area



Month	Average Monthly, acre-ft/month						
	Yucaipa	SBBA	Rialto-Colton	Riverside-Arlington	Prado	Chino and Temescal (outside Prado)	**Total**
1	20	80	0	90	450	190	**830**
2	30	100	0	110	570	240	**1,050**
3	40	150	0	160	780	330	**1,460**
4	50	190	0	200	1,010	420	**1,870**
5	60	230	0	240	1,290	530	**2,350**
6	110	390	0	400	2,230	930	**4,060**
7	120	420	0	420	2,470	1,060	**4,490**
8	120	420	0	410	2,480	1,090	**4,520**
9	90	320	0	320	1,960	860	**3,550**
10	60	220	0	210	1,350	590	**2,430**
11	30	100	0	110	620	270	**1,130**
12	20	70	0	80	420	180	**770**

Figure 427

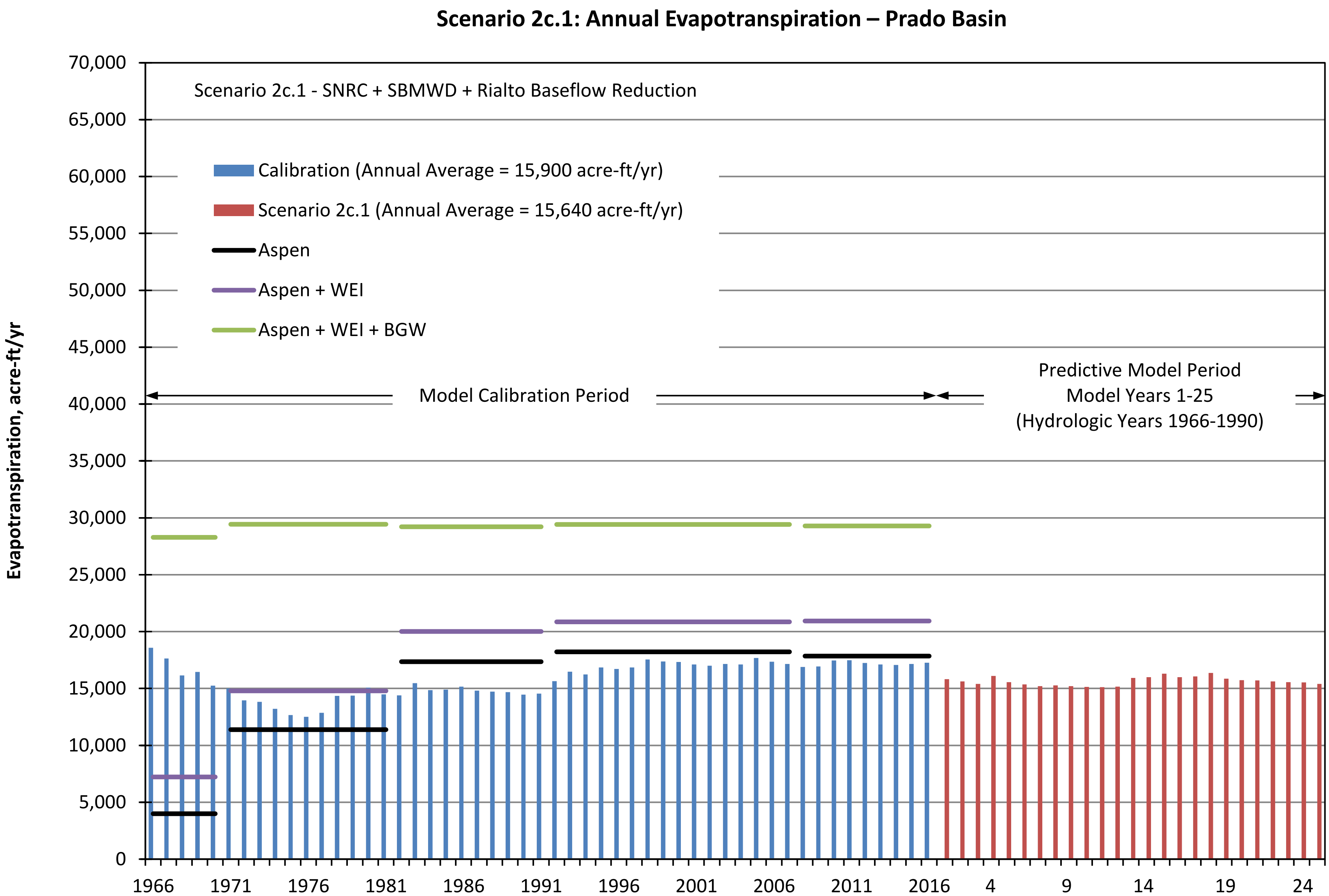

Scenario 2c.1: Annual Evapotranspiration – Prado Basin
Scenario 2c.1 - SNRC + SBMWD + Rialto Baseflow Reduction
Calibration (Annual Average = 15,900 acre-ft/yr)
Scenario 2c.1 (Annual Average = 15,640 acre-ft/yr)
Aspen
Aspen + WEI
Aspen + WEI + BGW
Model Calibration Period
Predictive Model Period
Model Years 1-25
(Hydrologic Years 1966-1990)
Evapotranspiration, acre-ft/yr
70,000
65,000
60,000
55,000
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
1966
1971
1976
1981
1986
1991
1996
2001
2006
2011
2016
4
9
14
19
24

Figure 428

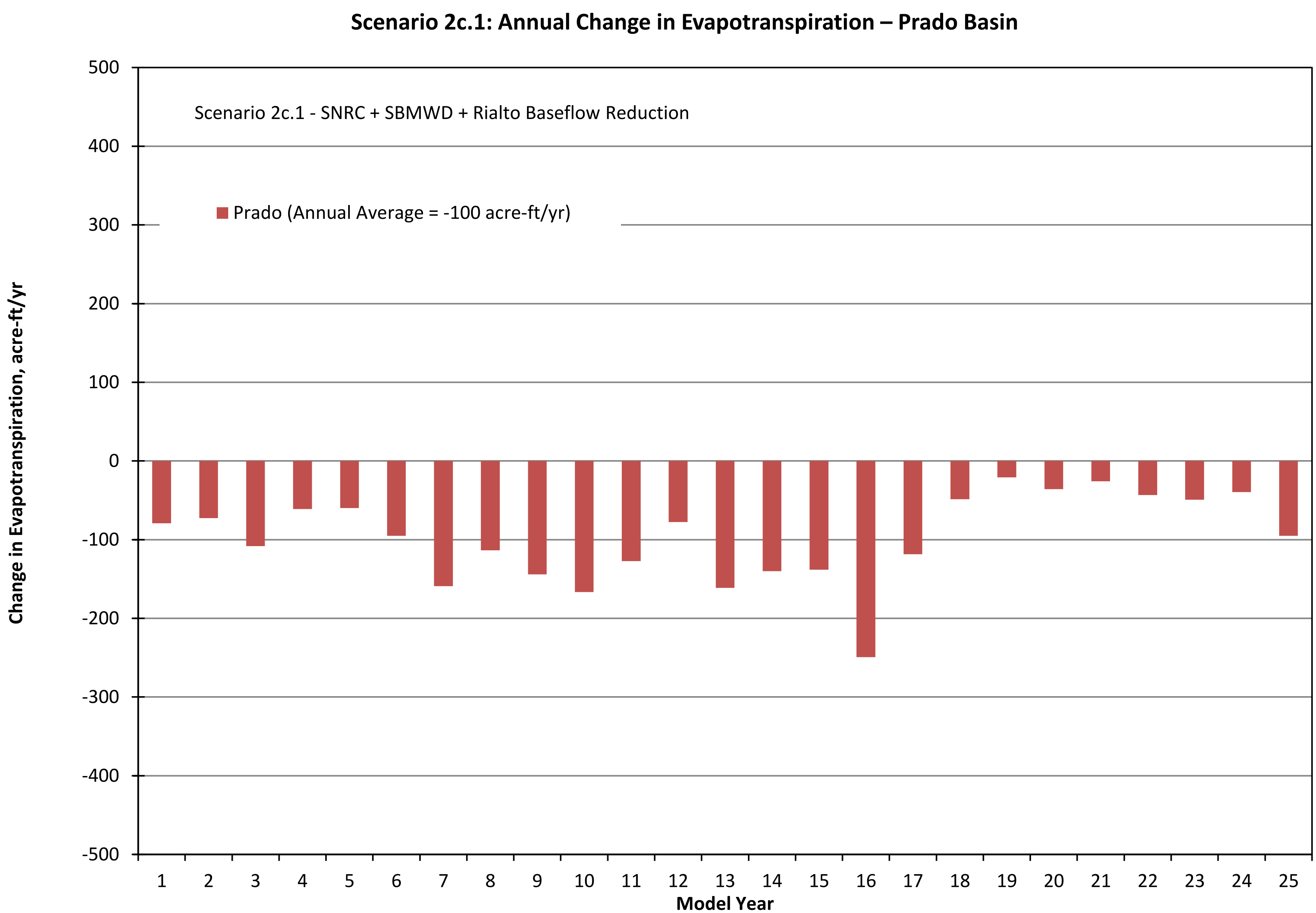
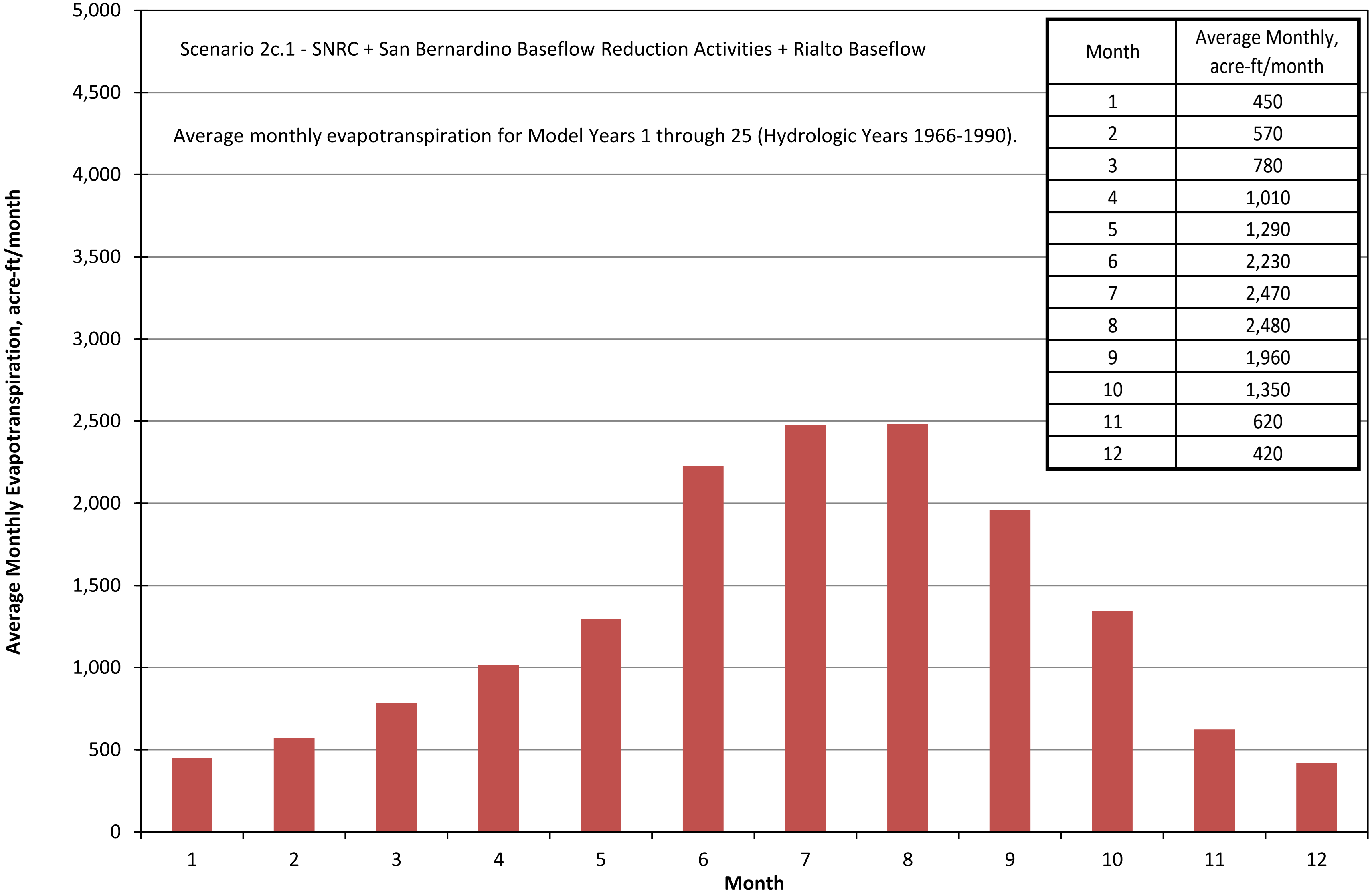

Scenario 2c.1: Annual Change in Evapotranspiration – Prado Basin
Scenario 2c.1 - SNRC + SBMWD + Rialto Baseflow Reduction
Prado (Annual Average = -100 acre-ft/yr)
Change in Evapotranspiration, acre-ft/yr
Model Year
500
400
300
200
100
0
-100
-200
-300
-400
-500
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

Figure 429

Scenario 2c.1: Seasonal Evapotranspiration – Prado Basin



Month	Average Monthly, acre-ft/month
1	450
2	570
3	780
4	1,010
5	1,290
6	2,230
7	2,470
8	2,480
9	1,960
10	1,350
11	620
12	420

Figure 430

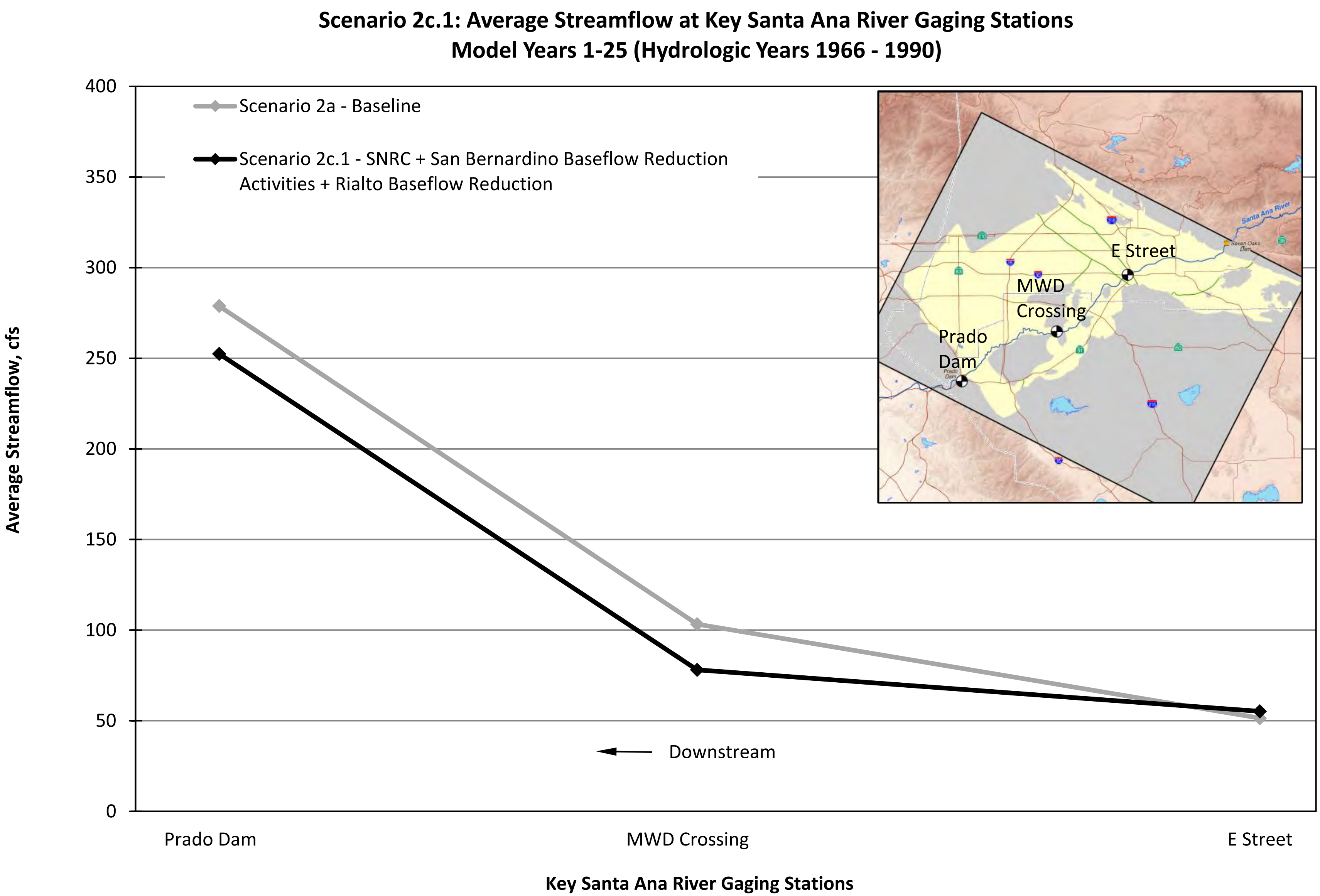

Scenario 2c.1: Average Streamflow at Key Santa Ana River Gaging Stations
Model Years 1-25 (Hydrologic Years 1966 - 1990)
Average Streamflow, cfs
400
350
300
250
200
150
100
50
0
Scenario 2a - Baseline
Scenario 2c.1 - SNRC + San Bernardino Baseflow Reduction Activities + Rialto Baseflow Reduction
E Street
MWD Crossing
Prado Dam
Santa Ana River
Downstream
Prado Dam
MWD Crossing
E Street
Key Santa Ana River Gaging Stations

Figure 431

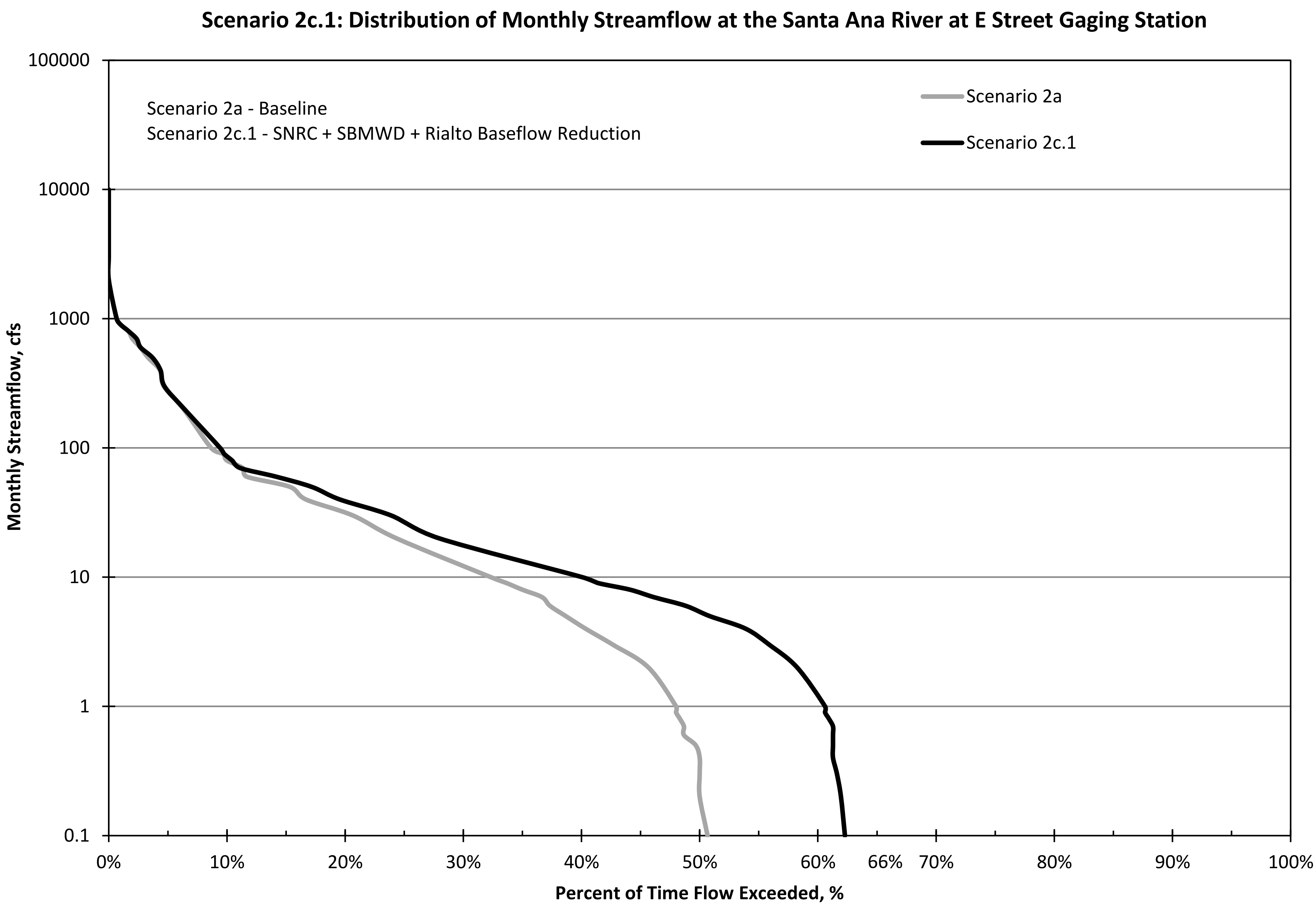

Scenario 2c.1: Distribution of Monthly Streamflow at the Santa Ana River at E Street Gaging Station
Scenario 2a - Baseline
Scenario 2c.1 - SNRC + SBMWD + Rialto Baseflow Reduction
Scenario 2a
Scenario 2c.1
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
66%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 432

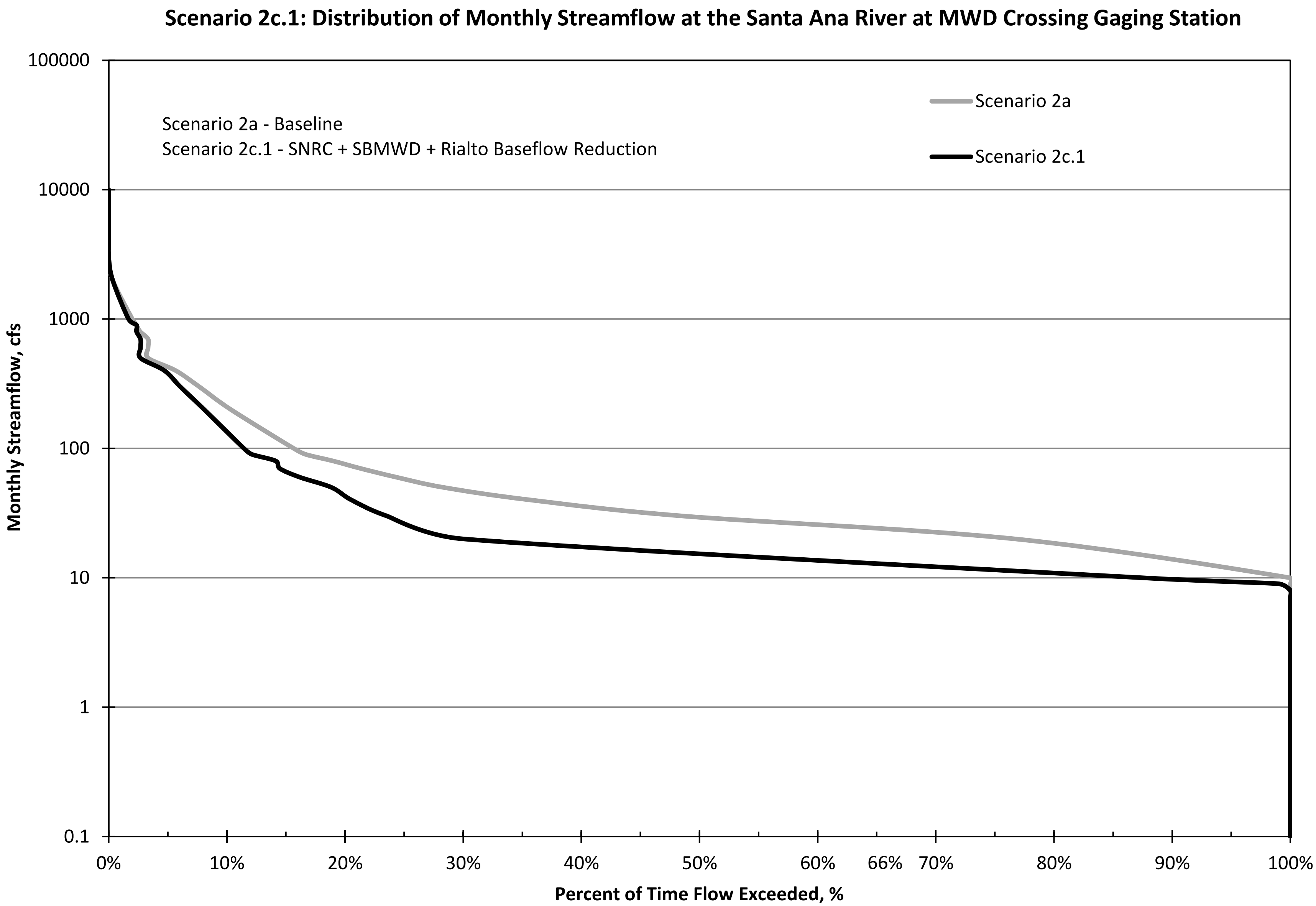

Scenario 2c.1: Distribution of Monthly Streamflow at the Santa Ana River at MWD Crossing Gaging Station
100000
10000
1000
100
10
1
0.1
Monthly Streamflow, cfs
Scenario 2a - Baseline
Scenario 2c.1 - SNRC + SBMWD + Rialto Baseflow Reduction
Scenario 2a
Scenario 2c.1
0%
10%
20%
30%
40%
50%
60%
66%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 433

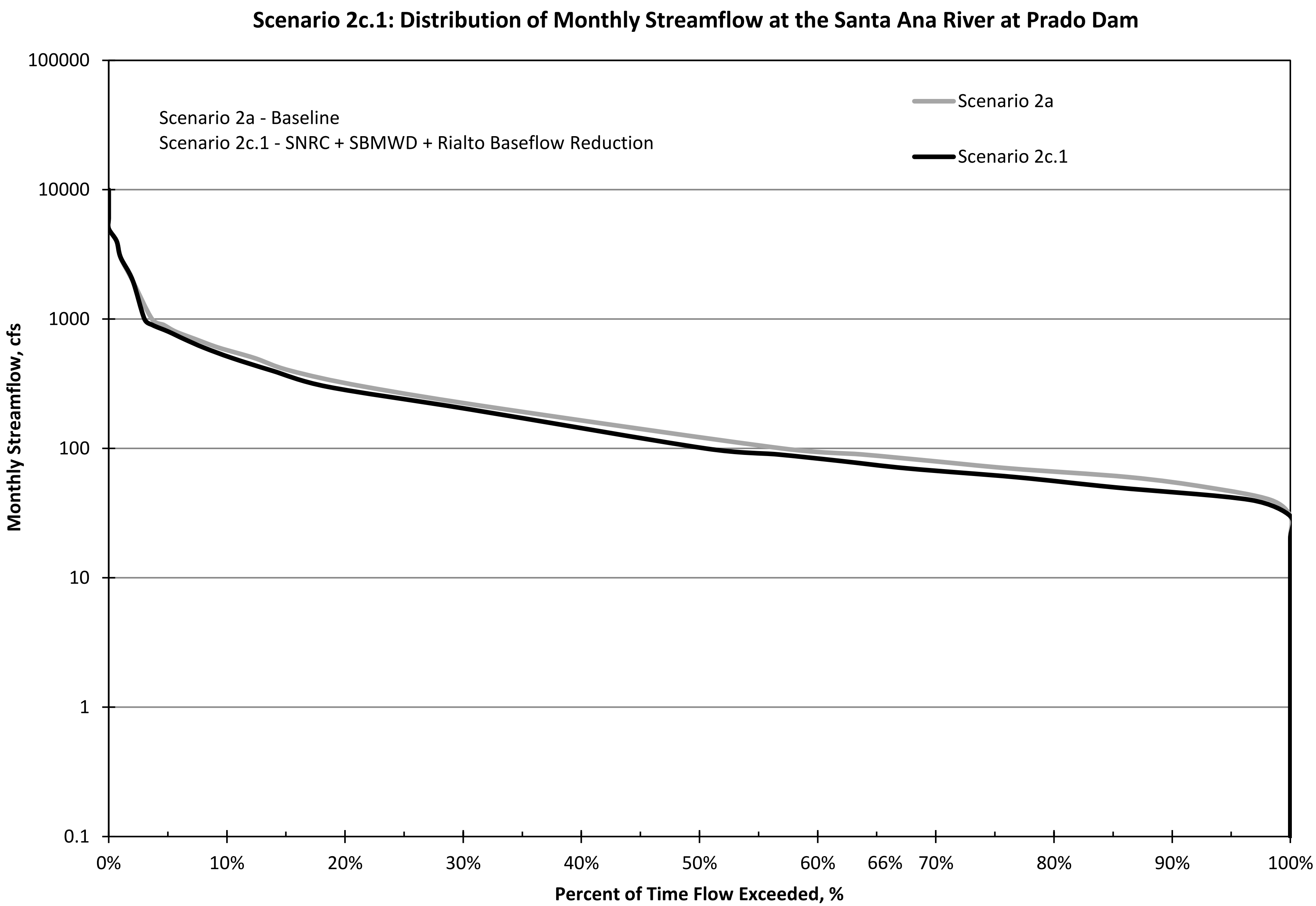
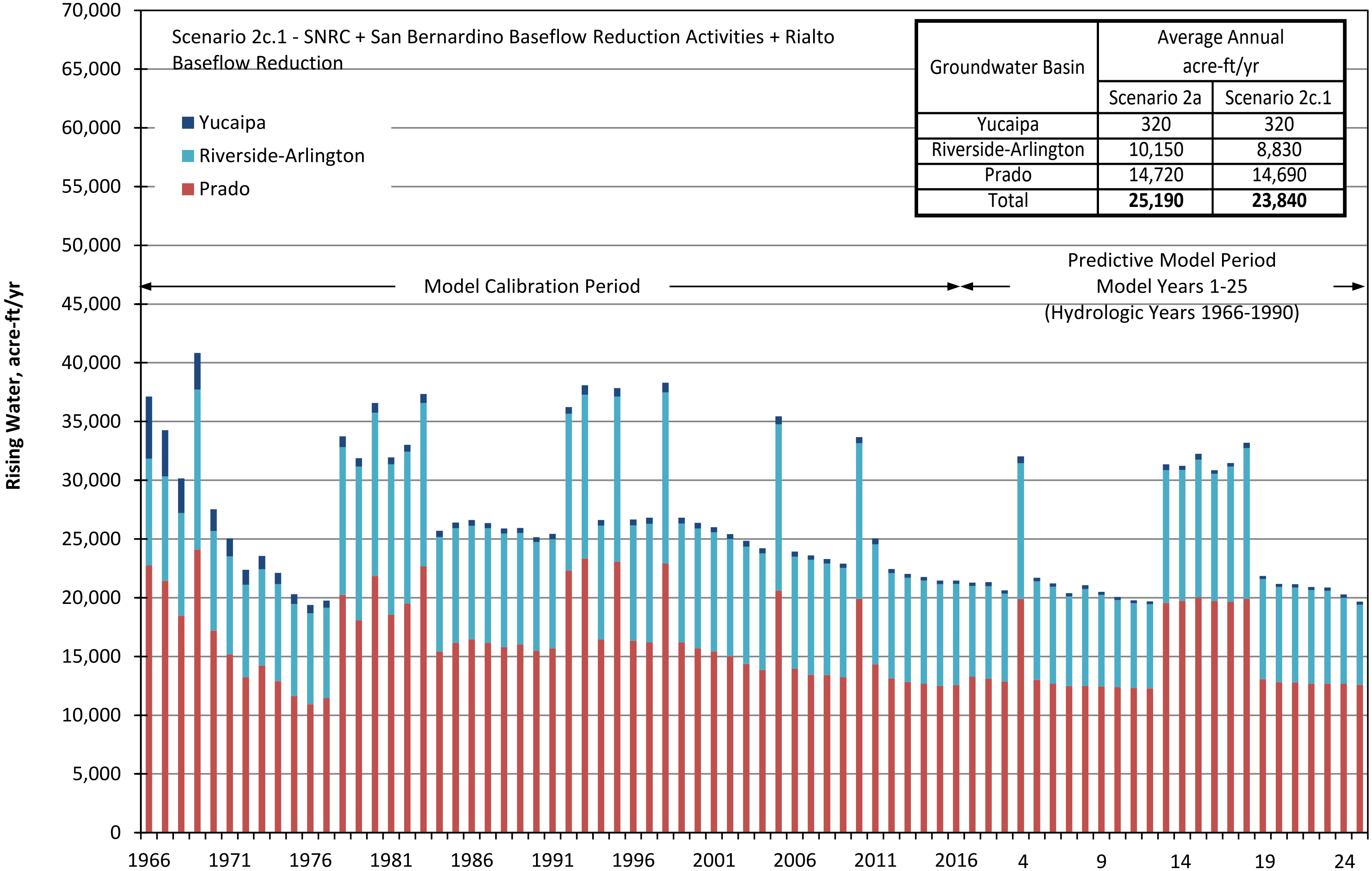

Scenario 2c.1: Distribution of Monthly Streamflow at the Santa Ana River at Prado Dam
Scenario 2a - Baseline
Scenario 2c.1 - SNRC + SBMWD + Rialto Baseflow Reduction
Scenario 2a
Scenario 2c.1
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
66%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

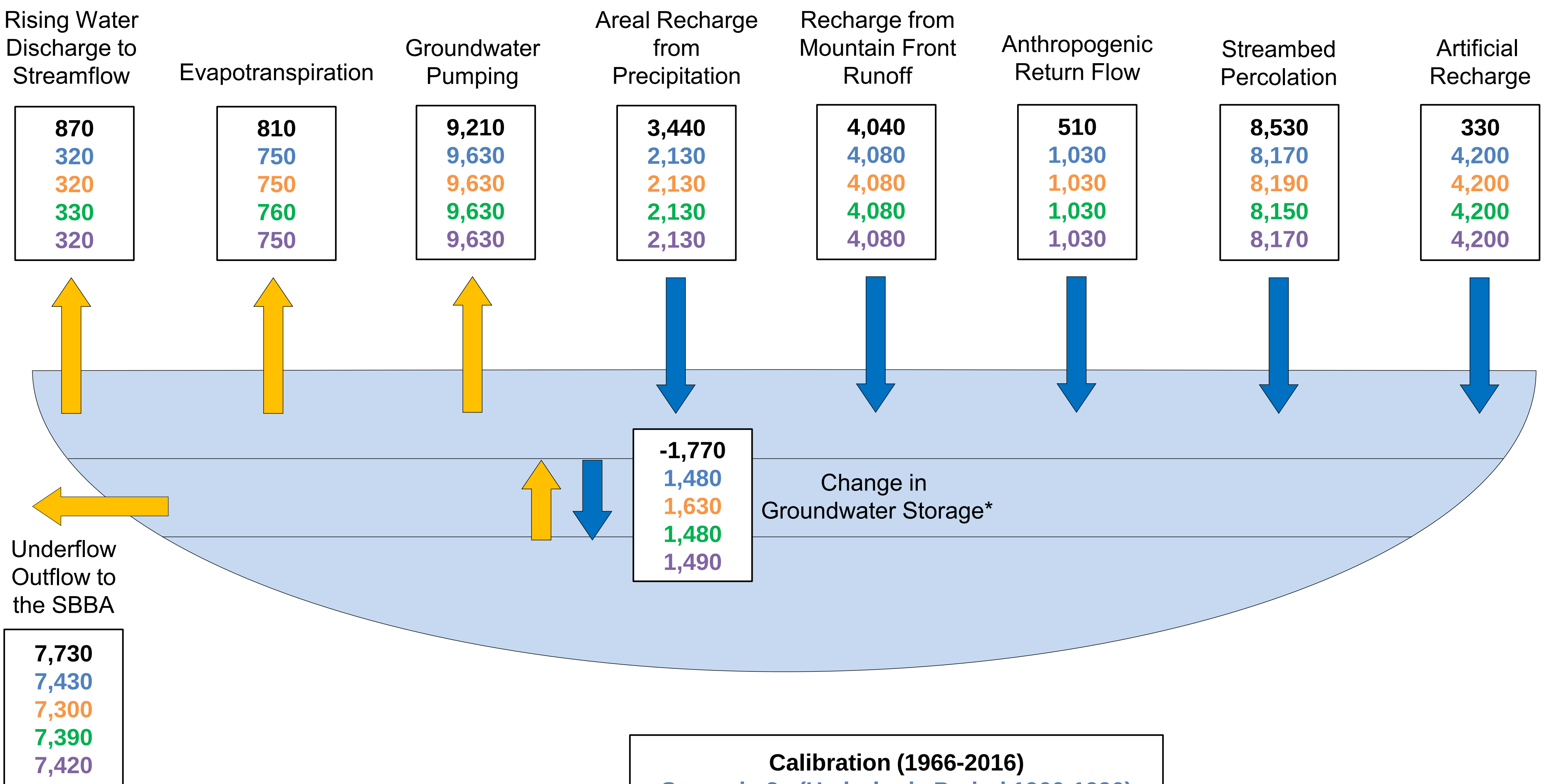
Figure 434

Scenario 2c.1: Annual Rising Water – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2c.1
Yucaipa	320	320
Riverside-Arlington	10,150	8,830
Prado	14,720	14,690
Total	**25,190**	**23,840**

Figure 435



Scenario 2a - Baseline
Scenario 2c.1 - SNRC + SBMWD + Rialto Baseflow Reduction
Scenario 2c.2 - SNRC + SBMWD Baseflow Reduction
Scenario 2c.3 - Rialto Baseflow Reduction

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2c.1 (Hydrologic Period 1966-1990)
Scenario 2c.2 (Hydrologic Period 1966-1990)
Scenario 2c.3 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIOS 2C.1-2C.3
AVERAGE ANNUAL
WATER BUDGET
YUCAIPA BASIN

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10-Apr-20

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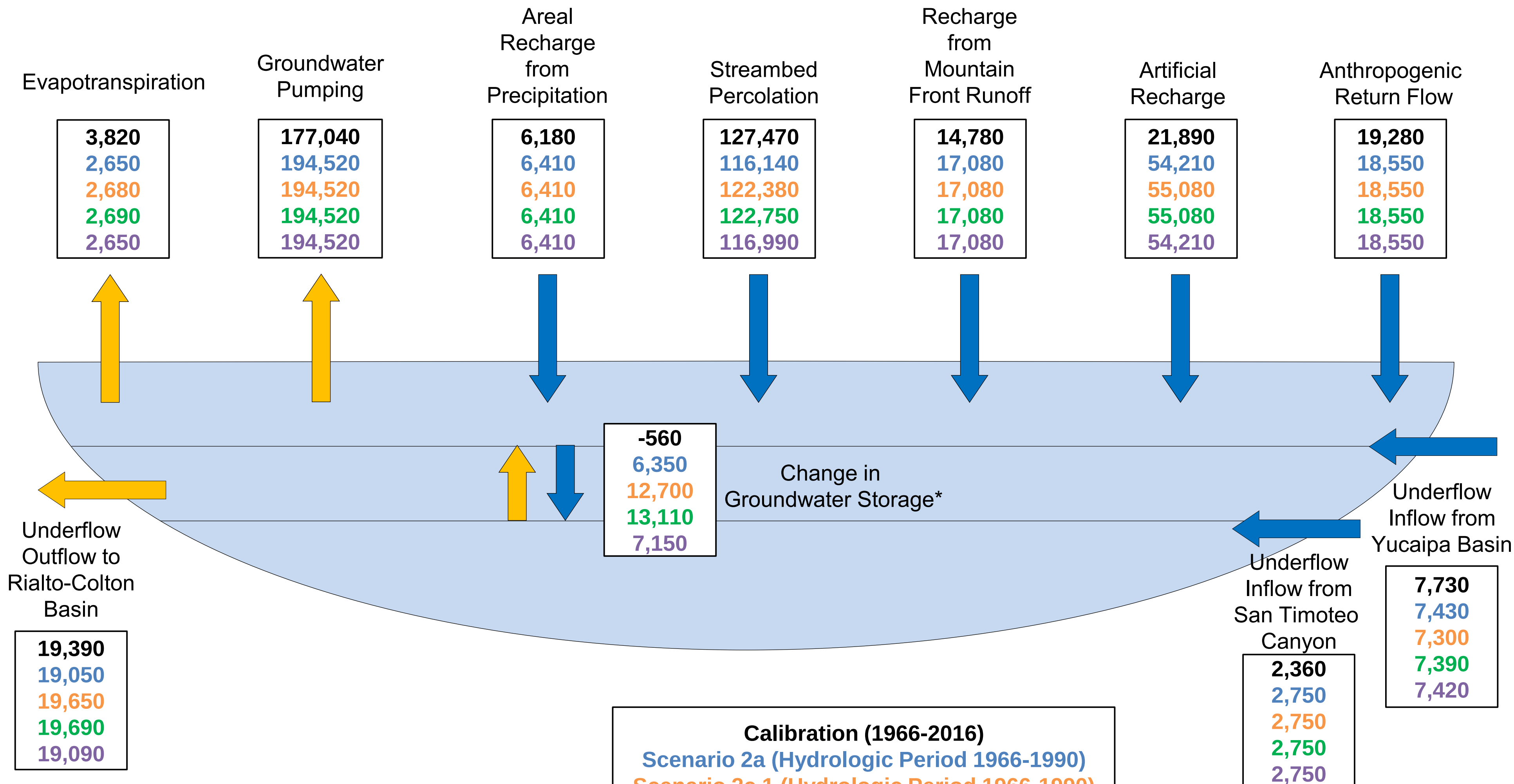

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2c.1 (Hydrologic Period 1966-1990)
Scenario 2c.2 (Hydrologic Period 1966-1990)
Scenario 2c.3 (Hydrologic Period 1966-1990)

Scenario 2a - Baseline
Scenario 2c.1 - SNRC + SBMWD + Rialto Baseflow Reduction
Scenario 2c.2 - SNRC + SBMWD Baseflow Reduction
Scenario 2c.3 - Rialto Baseflow Reduction
All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIOS 2C.1-2C.3 AVERAGE ANNUAL WATER BUDGET SBBA

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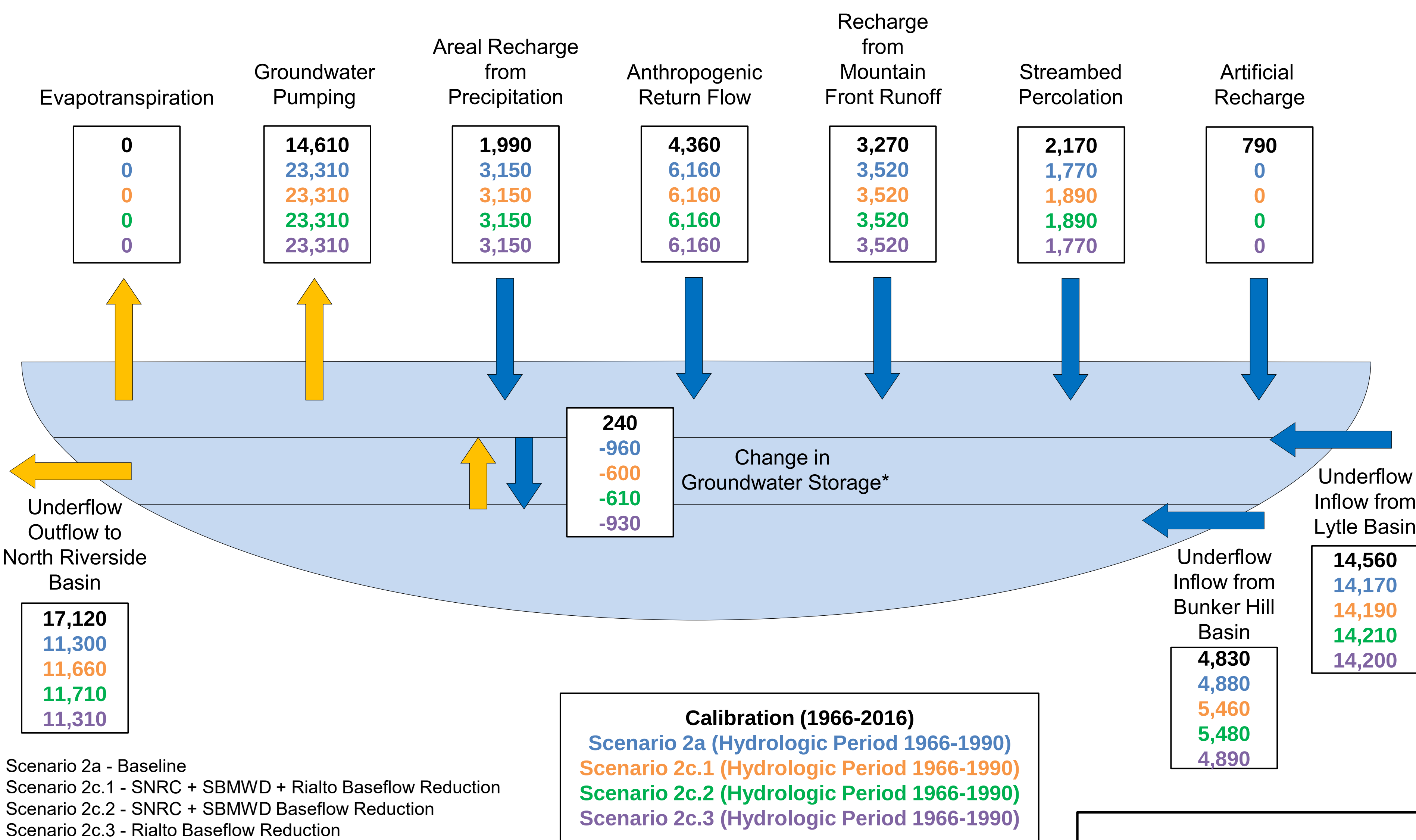

Scenario 2a - Baseline
Scenario 2c.1 - SNRC + SBMWD + Rialto Baseflow Reduction
Scenario 2c.2 - SNRC + SBMWD Baseflow Reduction
Scenario 2c.3 - Rialto Baseflow Reduction

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIOS 2C.1-2C.3 AVERAGE ANNUAL WATER BUDGET RIALTO-COLTON BASIN

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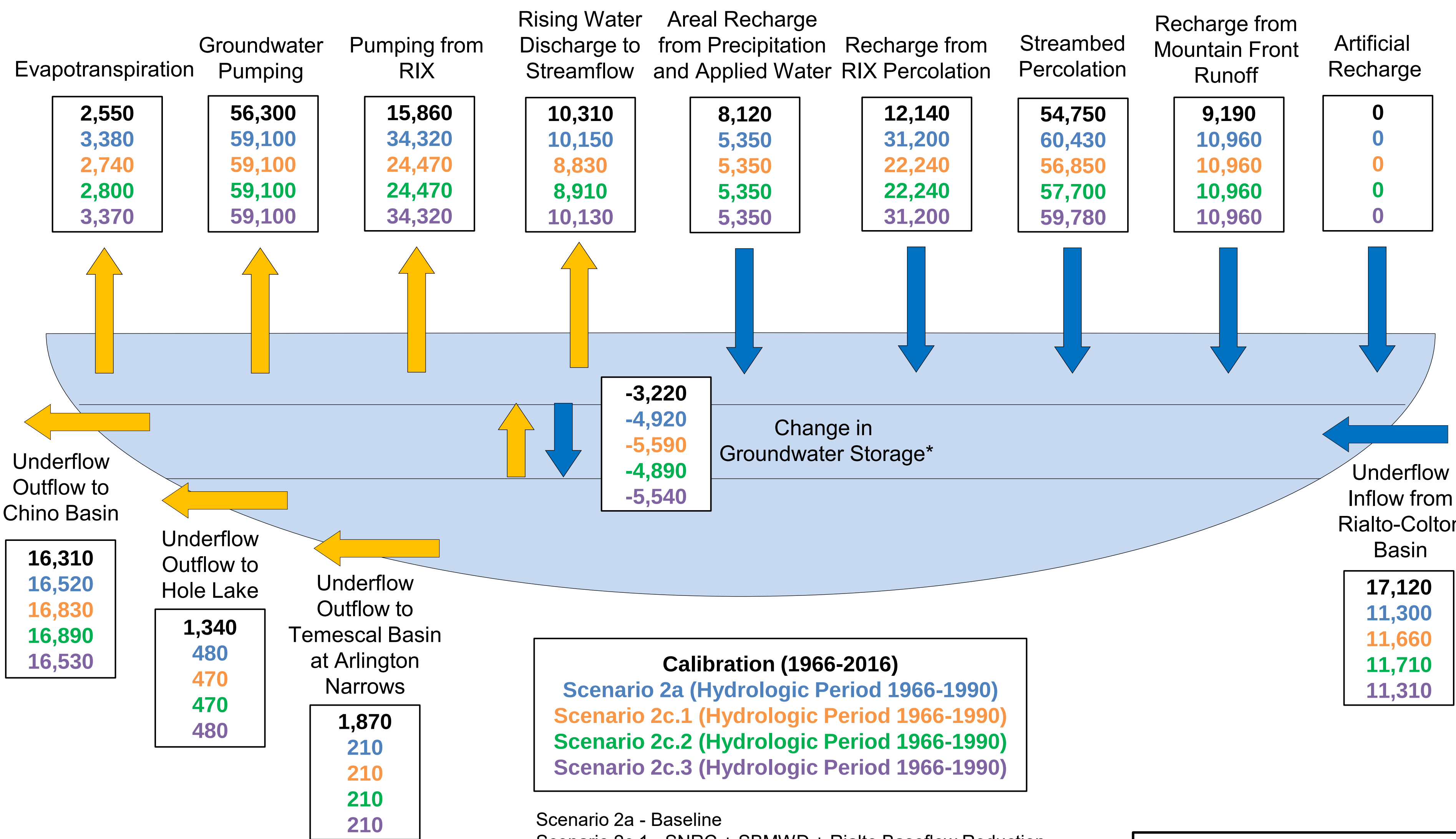


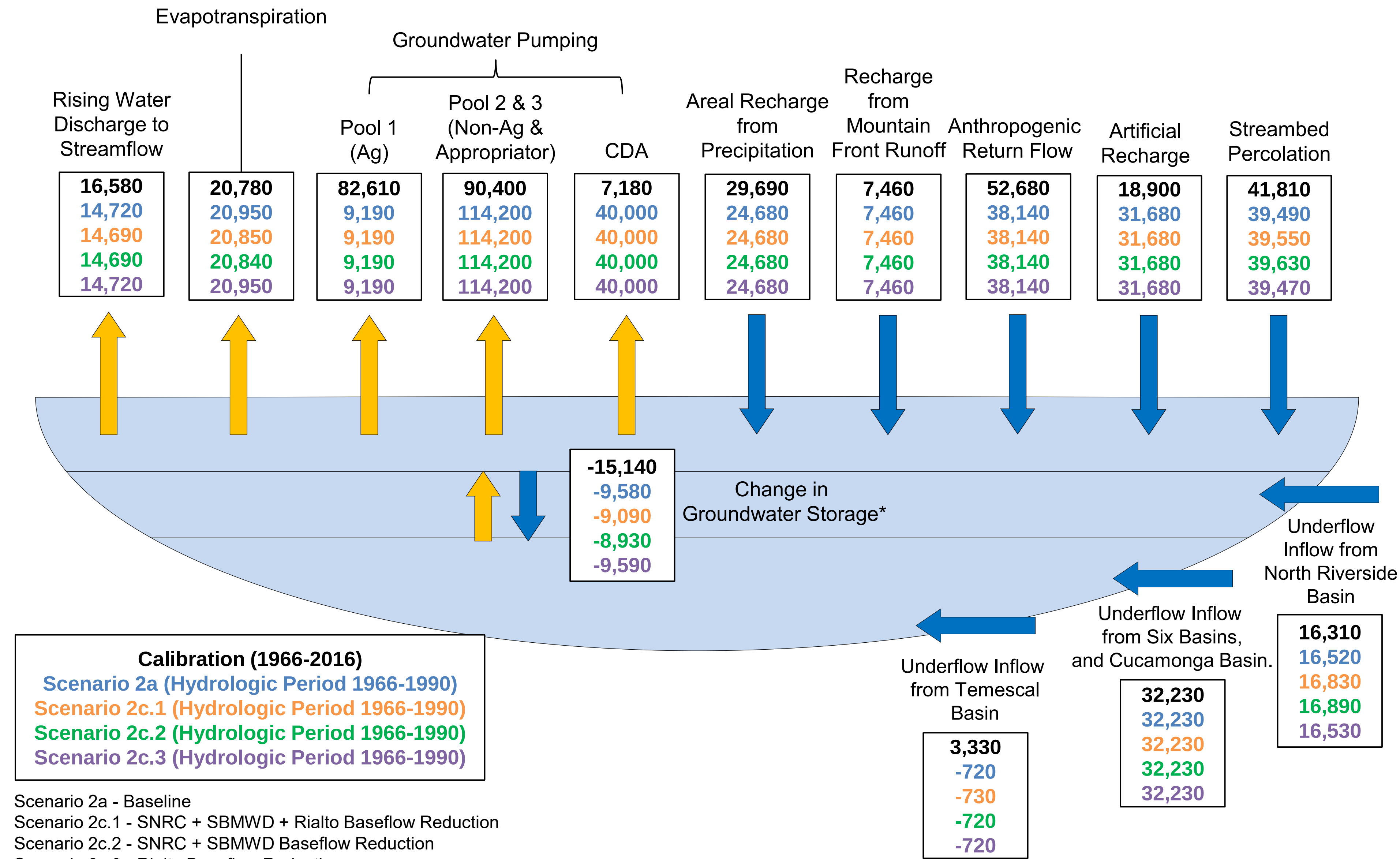
Scenario 2a - Baseline
Scenario 2c.1 - SNRC + SBMWD + Rialto Baseflow Reduction
Scenario 2c.2 - SNRC + SBMWD Baseflow Reduction
Scenario 2c.3 - Rialto Baseflow Reduction

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIOS 2C.1-2C.3
AVERAGE ANNUAL
WATER BUDGET
RIVERSIDE-ARLINGTON BASIN

10-Apr-20



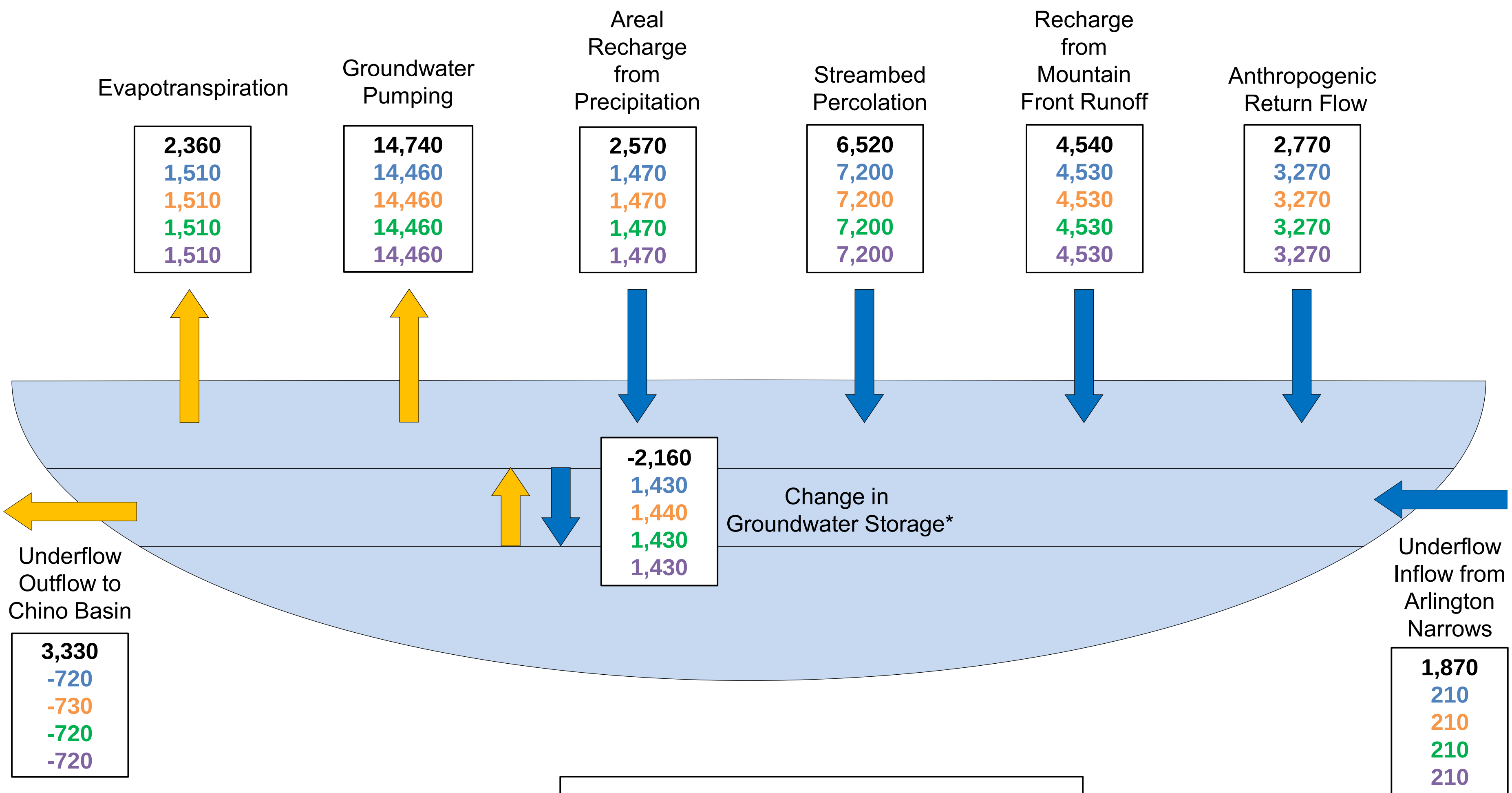
Scenario 2a - Baseline
Scenario 2c.1 - SNRC + SBMWD + Rialto Baseflow Reduction
Scenario 2c.2 - SNRC + SBMWD Baseflow Reduction
Scenario 2c.3 - Rialto Baseflow Reduction

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIOS 2C.1-2C.3 AVERAGE ANNUAL WATER BUDGET CHINO BASIN

10-Apr-20



Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2c.1 (Hydrologic Period 1966-1990)
Scenario 2c.2 (Hydrologic Period 1966-1990)
Scenario 2c.3 (Hydrologic Period 1966-1990)

Scenario 2a - Baseline
Scenario 2c.1 - SNRC + SBMWD + Rialto Baseflow Reduction
Scenario 2c.2 - SNRC + SBMWD Baseflow Reduction
Scenario 2c.3 - Rialto Baseflow Reduction

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIOS 2C.1-2C.3
AVERAGE ANNUAL
WATER BUDGET
TEMESCAL BASIN

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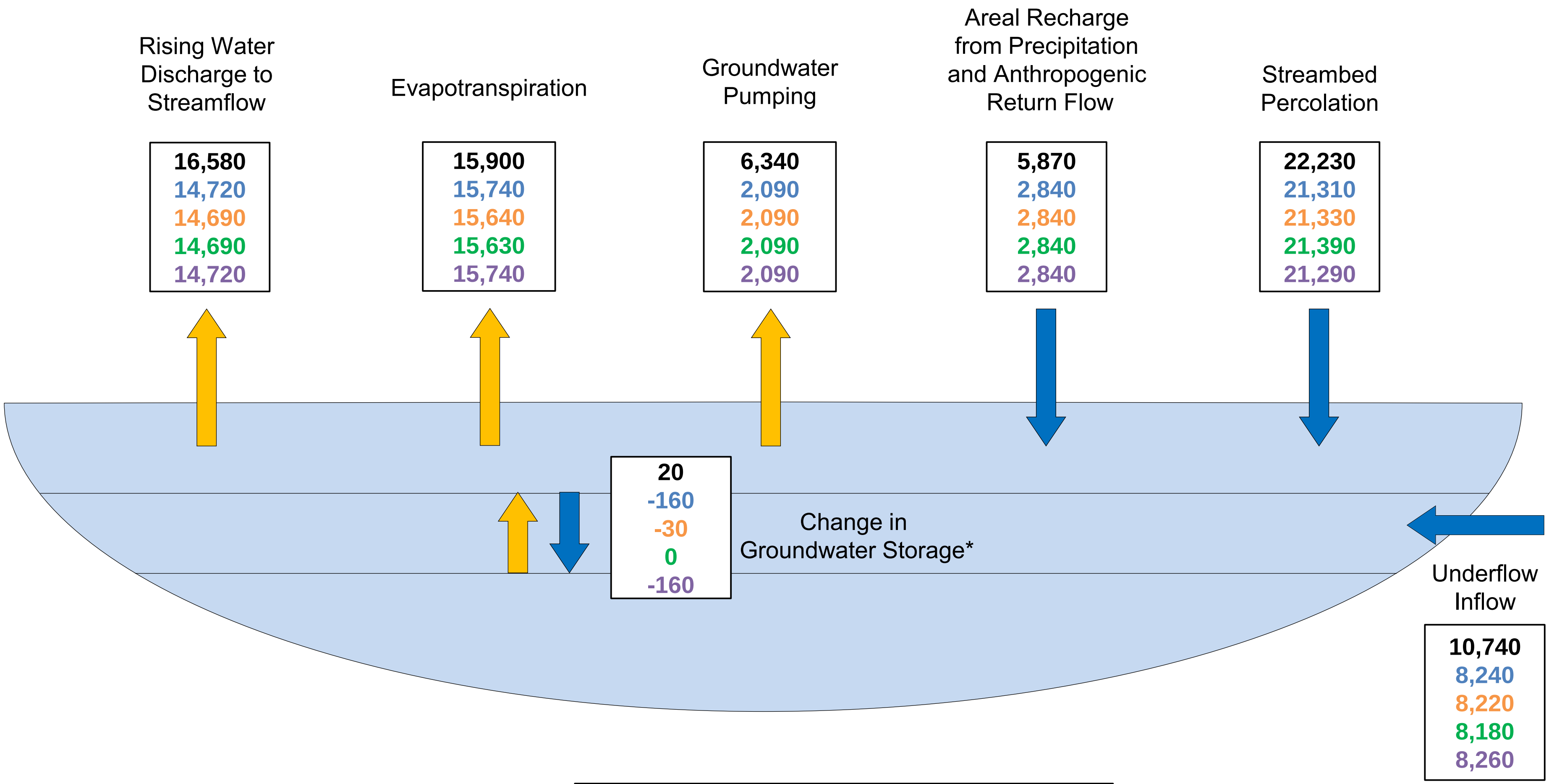

Scenario 2a - Baseline
Scenario 2c.1 - SNRC + SBMWD + Rialto Baseflow Reduction
Scenario 2c.2 - SNRC + SBMWD Baseflow Reduction
Scenario 2c.3 - Rialto Baseflow Reduction

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2c.1 (Hydrologic Period 1966-1990)
Scenario 2c.2 (Hydrologic Period 1966-1990)
Scenario 2c.3 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIOS 2C.1-2C.3
AVERAGE ANNUAL
WATER BUDGET
PRADO BASIN

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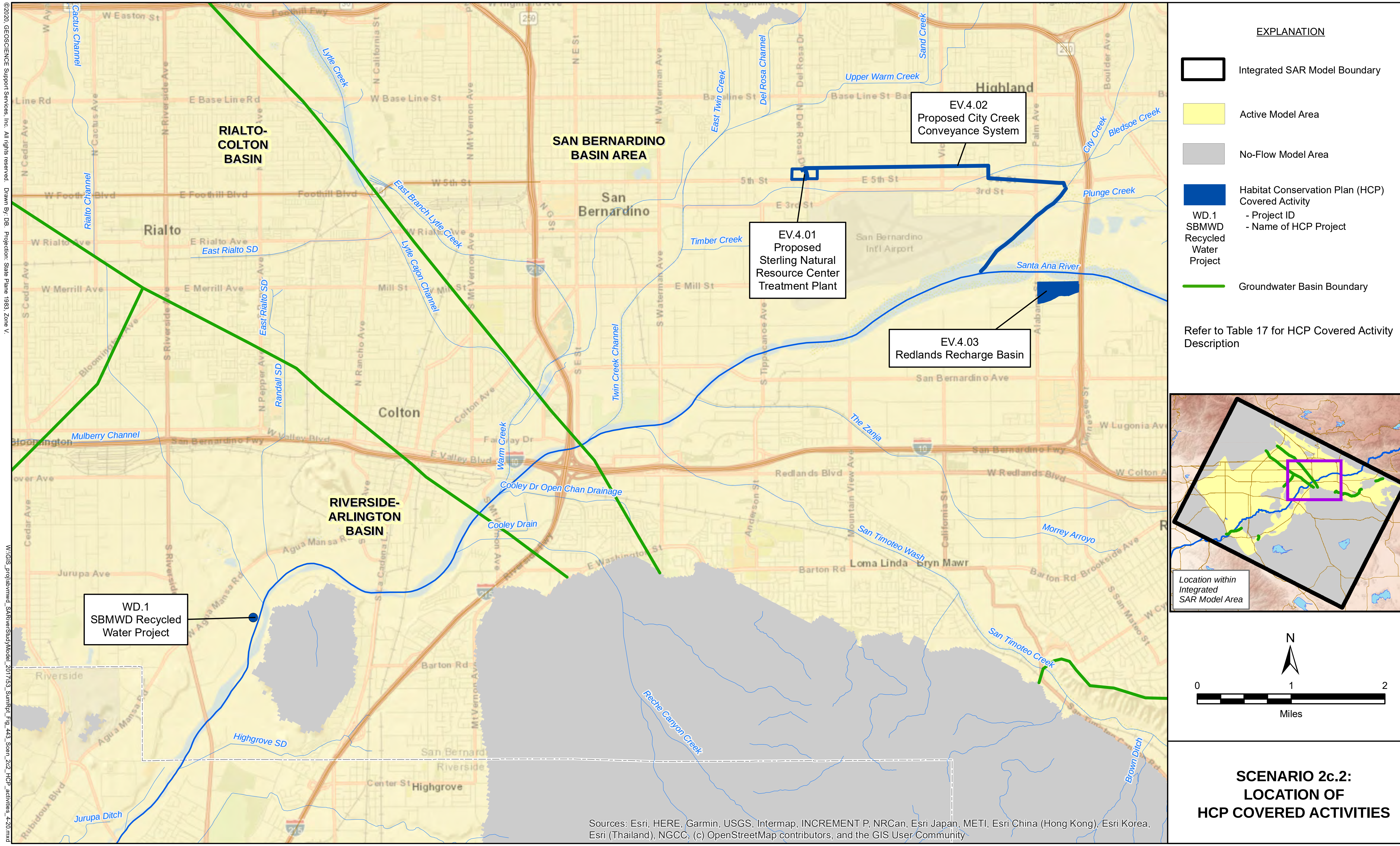
10-Apr-20



**SCENARIO 2c.2:
LOCATION OF
HCP COVERED ACTIVITIES**

10-Apr-20

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FIGURE 443

DRAFT

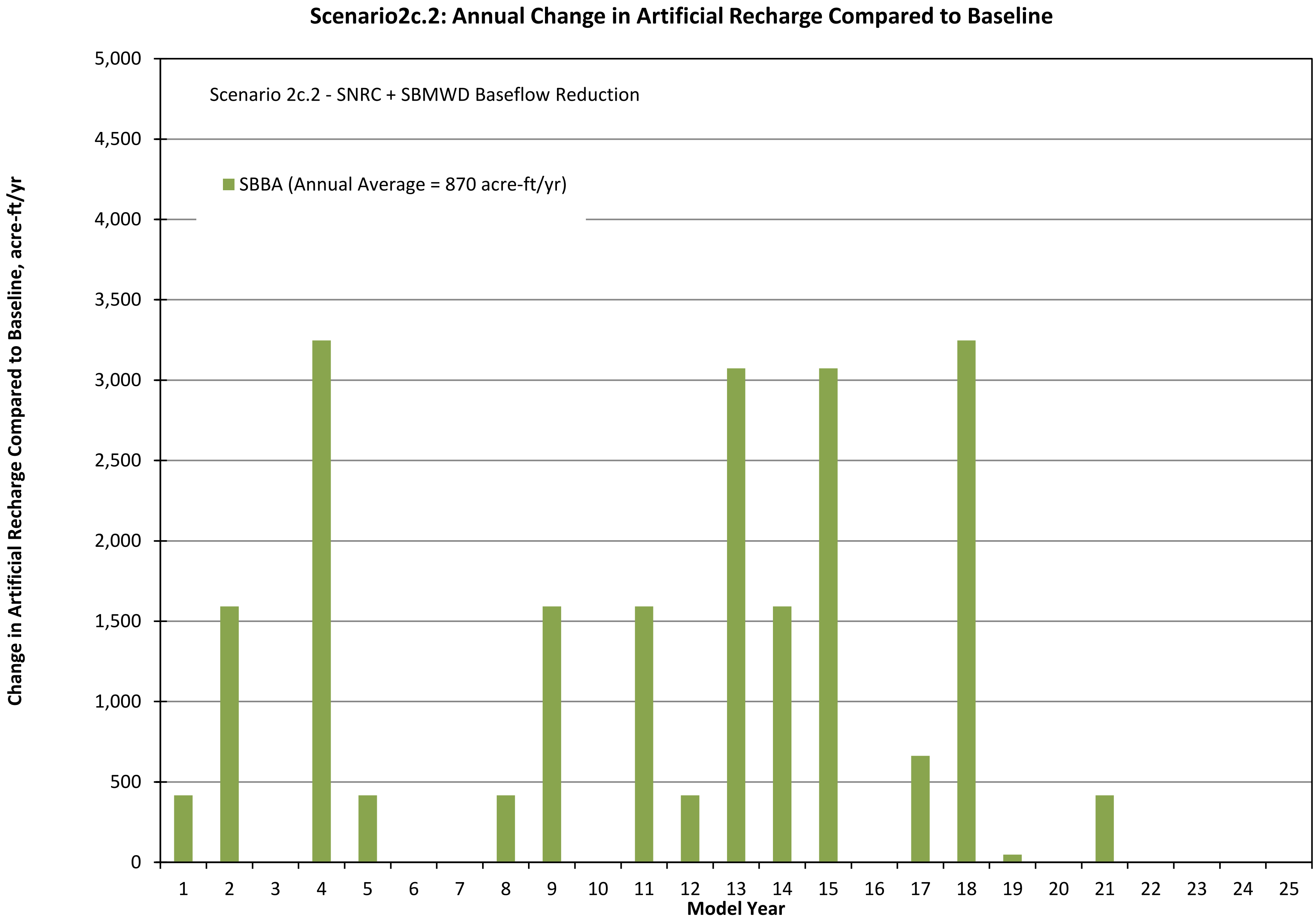


Figure 444

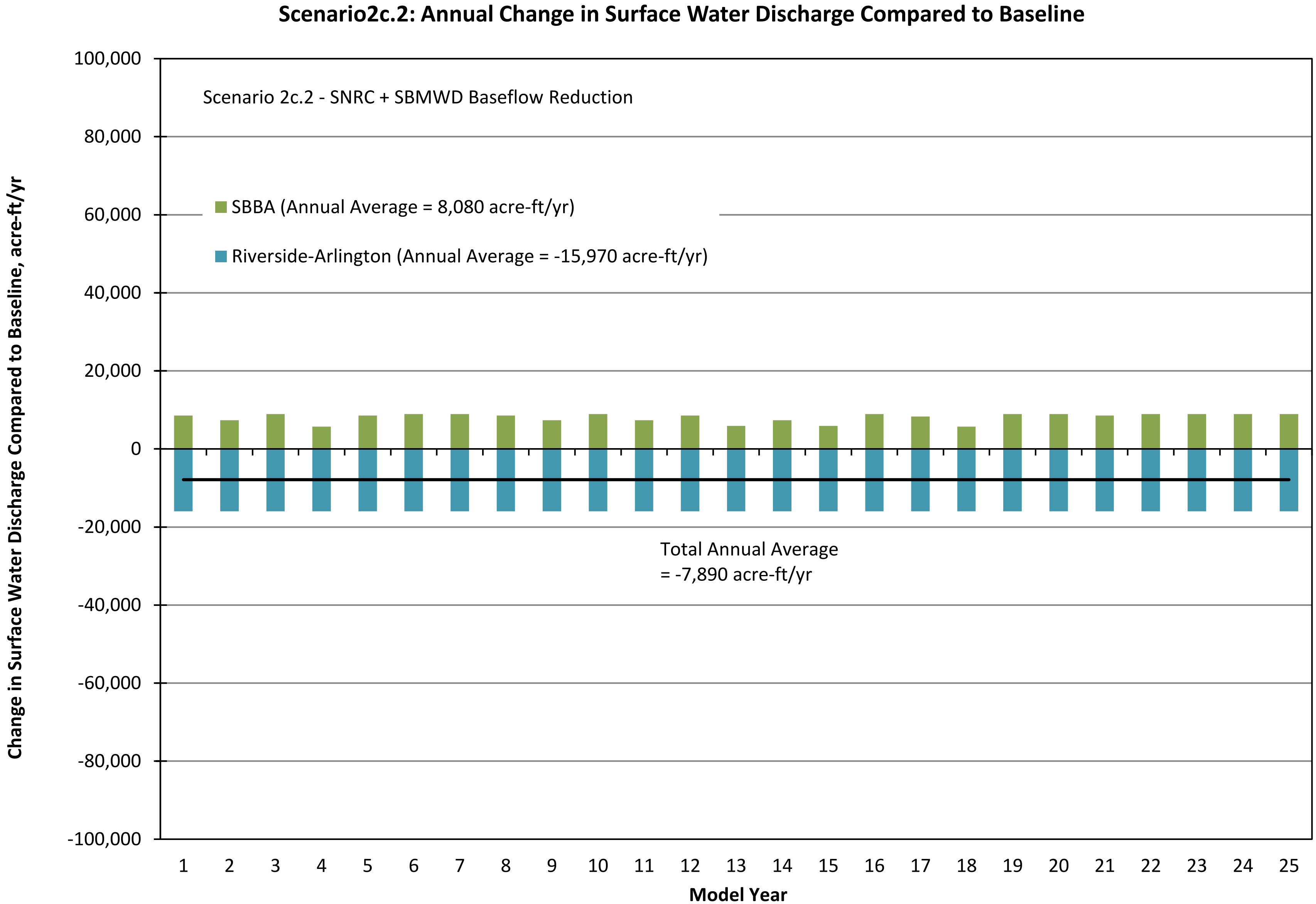
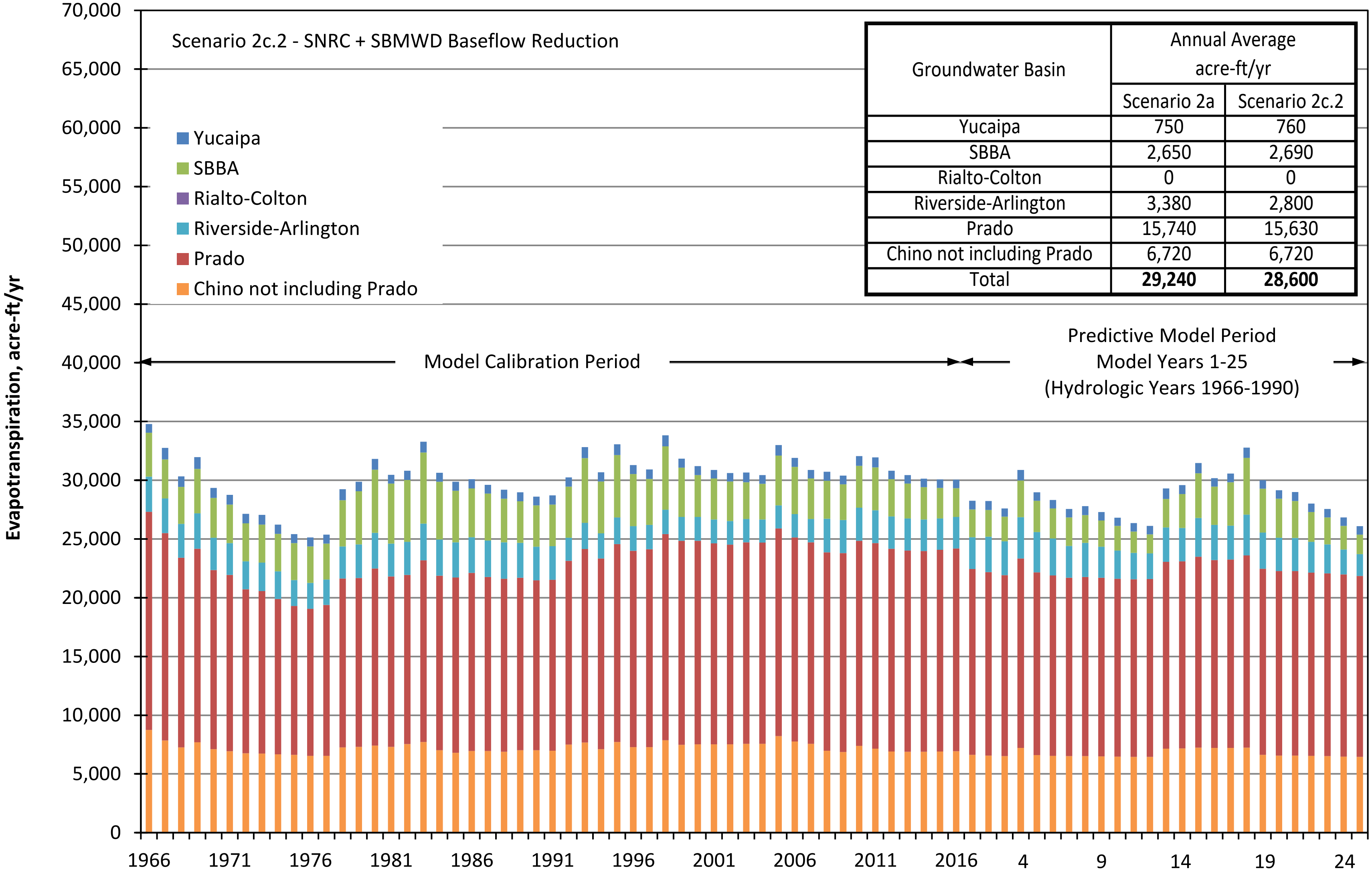

Scenario2c.2: Annual Change in Surface Water Discharge Compared to Baseline
Scenario 2c.2 - SNRC + SBMWD Baseflow Reduction
SBBA (Annual Average = 8,080 acre-ft/yr)
Riverside-Arlington (Annual Average = -15,970 acre-ft/yr)
Total Annual Average
= -7,890 acre-ft/yr
Change in Surface Water Discharge Compared to Baseline, acre-ft/yr
100,000
80,000
60,000
40,000
20,000
0
-20,000
-40,000
-60,000
-80,000
-100,000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Model Year

Figure 445

Scenario 2c.2: Annual Evapotranspiration – Integrated SAR Model Area



Groundwater Basin	Annual Average acre-ft/yr	
	Scenario 2a	Scenario 2c.2
Yucaipa	750	760
SBBA	2,650	2,690
Rialto-Colton	0	0
Riverside-Arlington	3,380	2,800
Prado	15,740	15,630
Chino not including Prado	6,720	6,720
Total	**29,240**	**28,600**

Figure 446

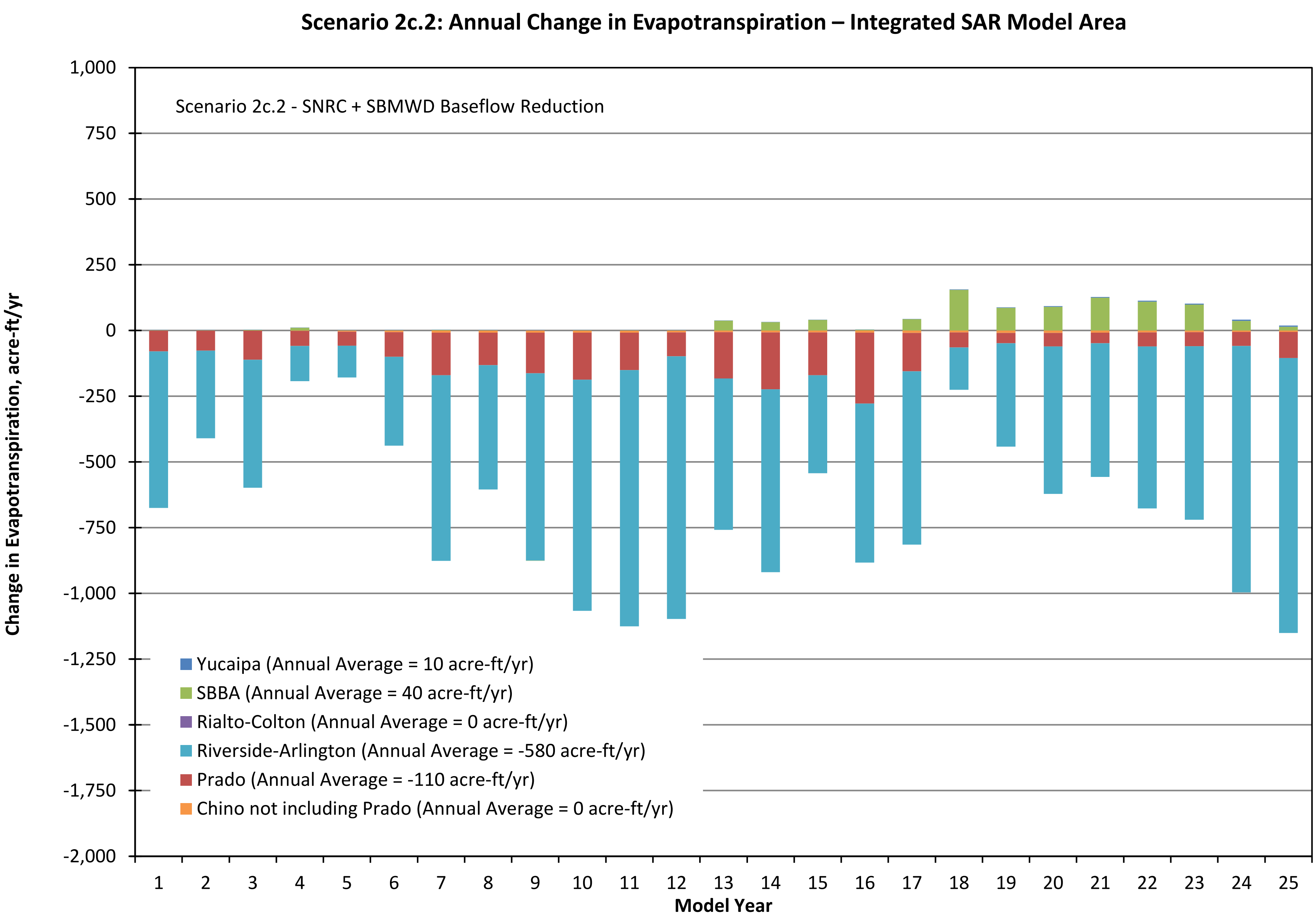
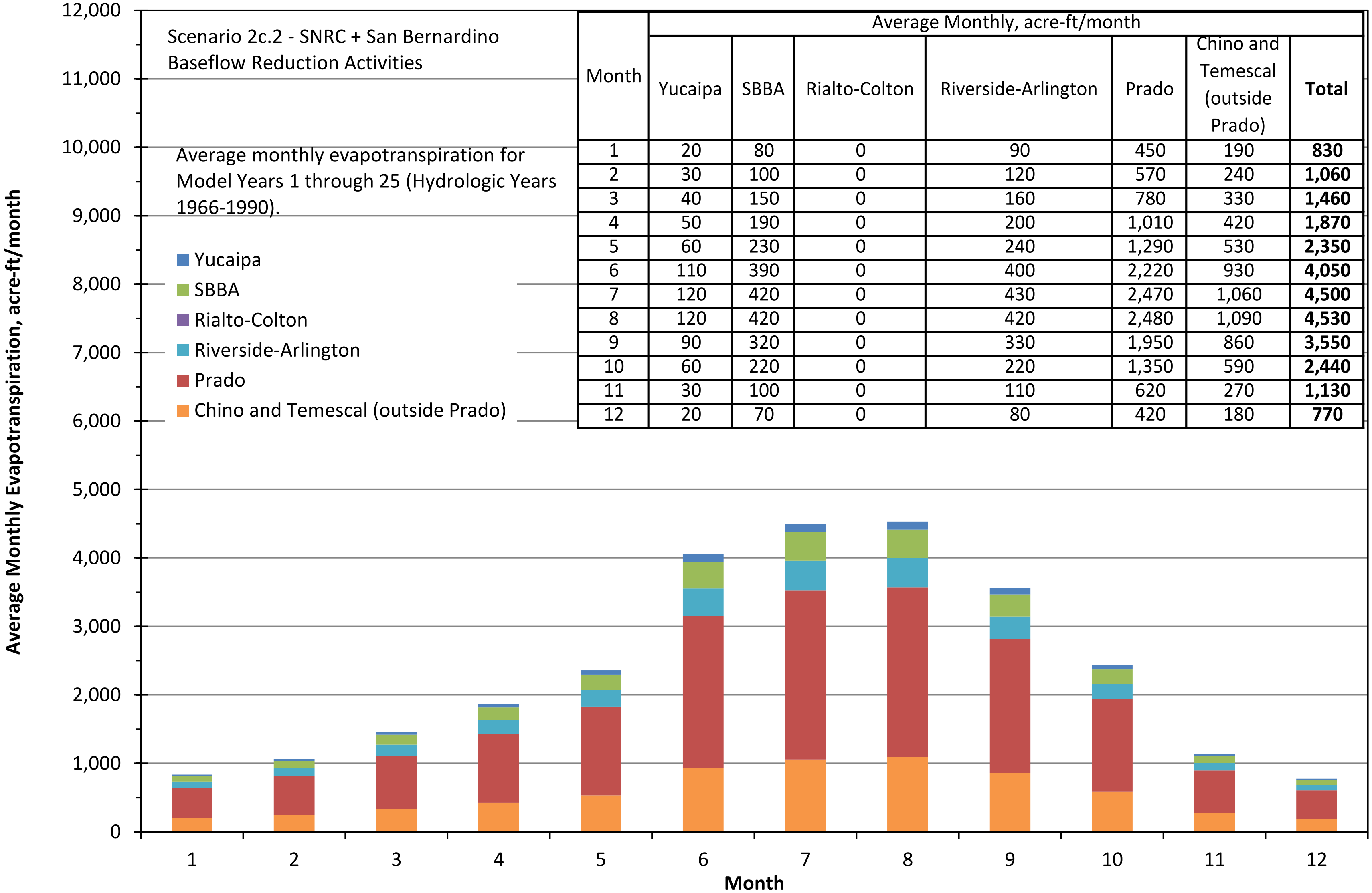

Scenario 2c.2: Annual Change in Evapotranspiration – Integrated SAR Model Area
Scenario 2c.2 - SNRC + SBMWD Baseflow Reduction
1,000
750
500
250
0
-250
-500
-750
-1,000
-1,250
-1,500
-1,750
-2,000
Change in Evapotranspiration, acre-ft/yr
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
Model Year
Yucaipa (Annual Average = 10 acre-ft/yr)
SBBA (Annual Average = 40 acre-ft/yr)
Rialto-Colton (Annual Average = 0 acre-ft/yr)
Riverside-Arlington (Annual Average = -580 acre-ft/yr)
Prado (Annual Average = -110 acre-ft/yr)
Chino not including Prado (Annual Average = 0 acre-ft/yr)

Figure 447

Scenario 2c.2: Seasonal Evapotranspiration – Integrated SAR Model Area



Month	Average Monthly, acre-ft/month						
	Yucaipa	SBBA	Rialto-Colton	Riverside-Arlington	Prado	Chino and Temescal (outside Prado)	**Total**
1	20	80	0	90	450	190	**830**
2	30	100	0	120	570	240	**1,060**
3	40	150	0	160	780	330	**1,460**
4	50	190	0	200	1,010	420	**1,870**
5	60	230	0	240	1,290	530	**2,350**
6	110	390	0	400	2,220	930	**4,050**
7	120	420	0	430	2,470	1,060	**4,500**
8	120	420	0	420	2,480	1,090	**4,530**
9	90	320	0	330	1,950	860	**3,550**
10	60	220	0	220	1,350	590	**2,440**
11	30	100	0	110	620	270	**1,130**
12	20	70	0	80	420	180	**770**

Figure 448

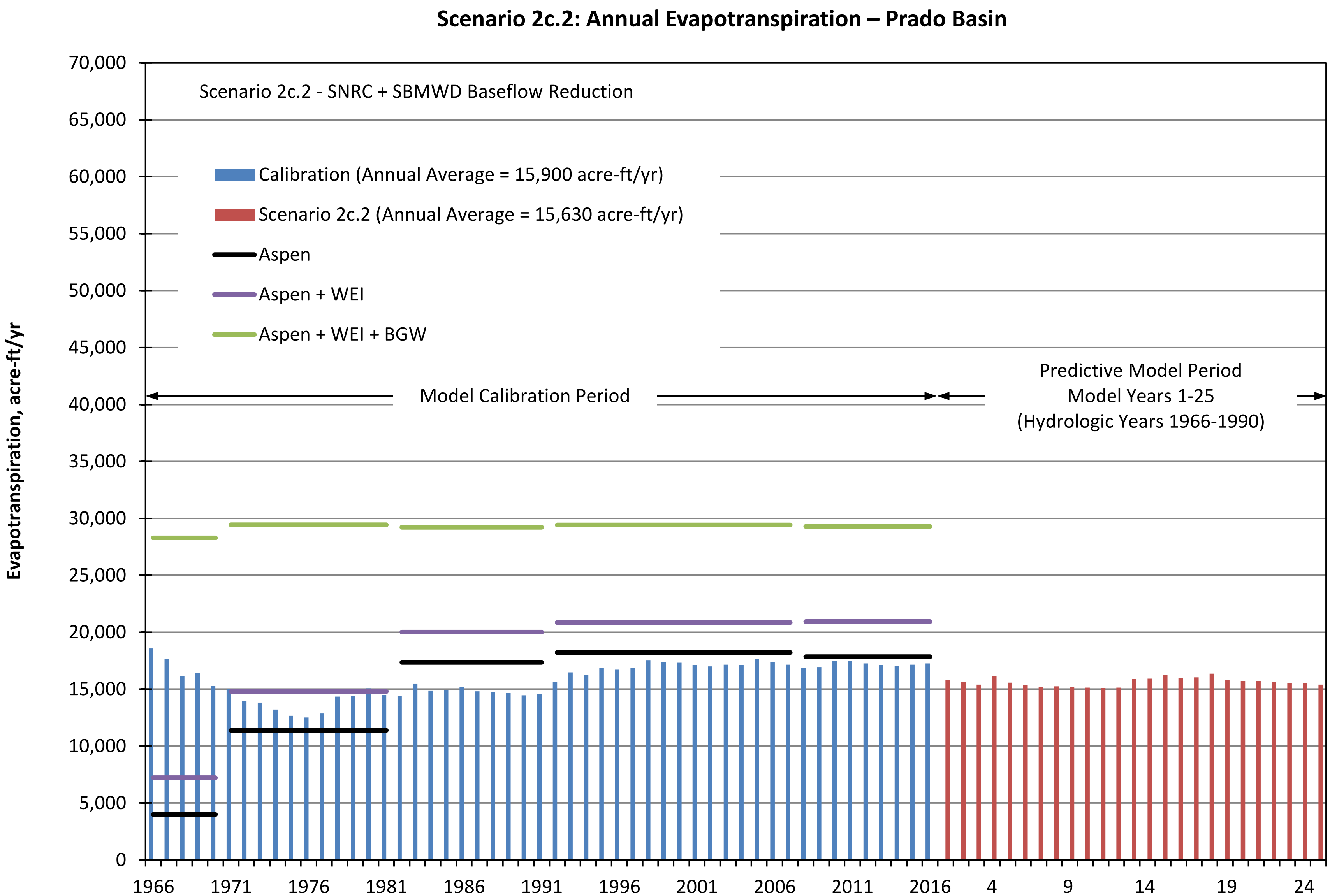

Scenario 2c.2: Annual Evapotranspiration – Prado Basin
Scenario 2c.2 - SNRC + SBMWD Baseflow Reduction
Calibration (Annual Average = 15,900 acre-ft/yr)
Scenario 2c.2 (Annual Average = 15,630 acre-ft/yr)
Aspen
Aspen + WEI
Aspen + WEI + BGW
Model Calibration Period
Predictive Model Period
Model Years 1-25
(Hydrologic Years 1966-1990)
Evapotranspiration, acre-ft/yr
70,000
65,000
60,000
55,000
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
1966
1971
1976
1981
1986
1991
1996
2001
2006
2011
2016
4
9
14
19
24

Figure 449

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Scenario 2c.2: Annual Change in Evapotranspiration – Prado Basin

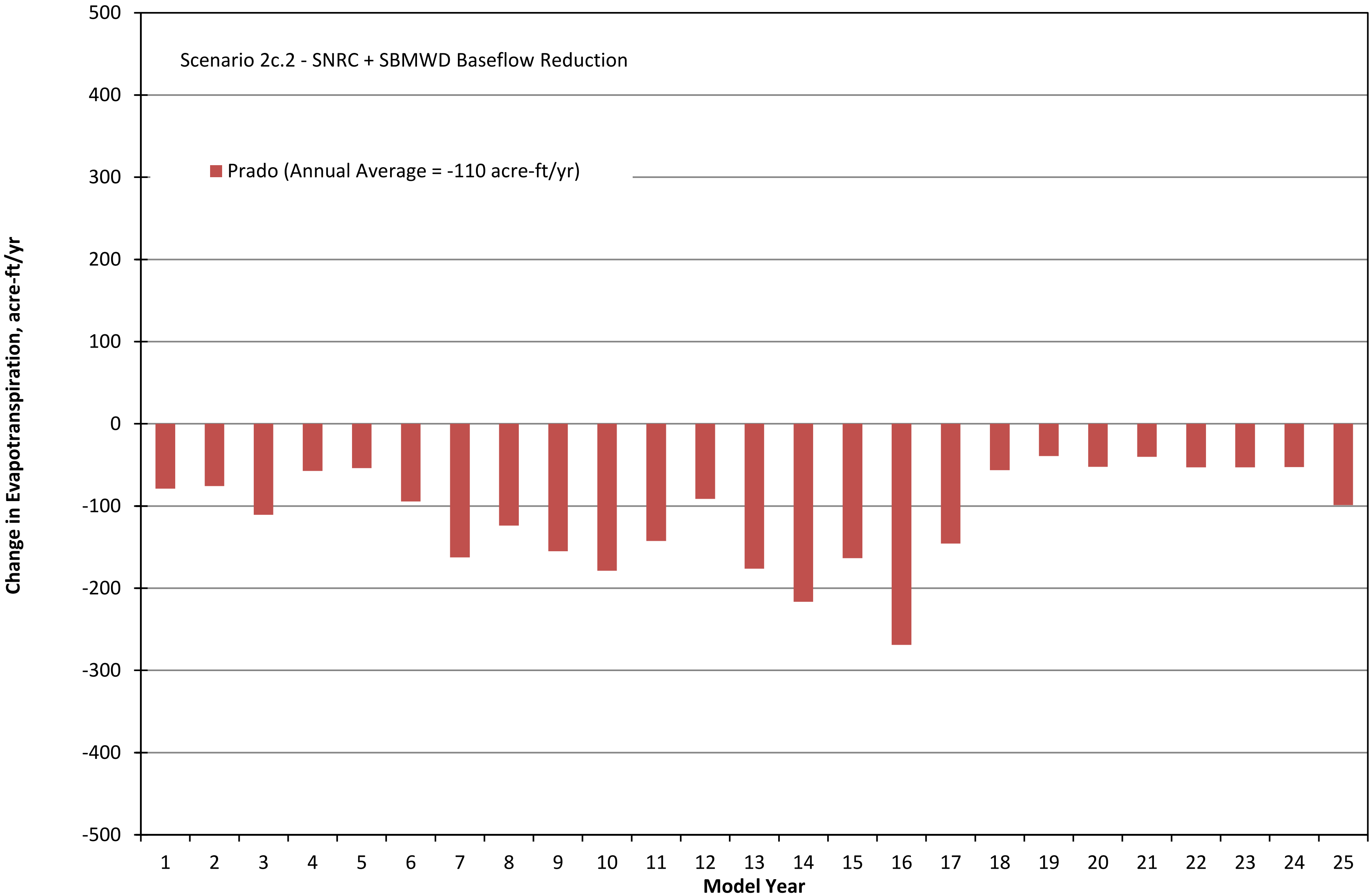
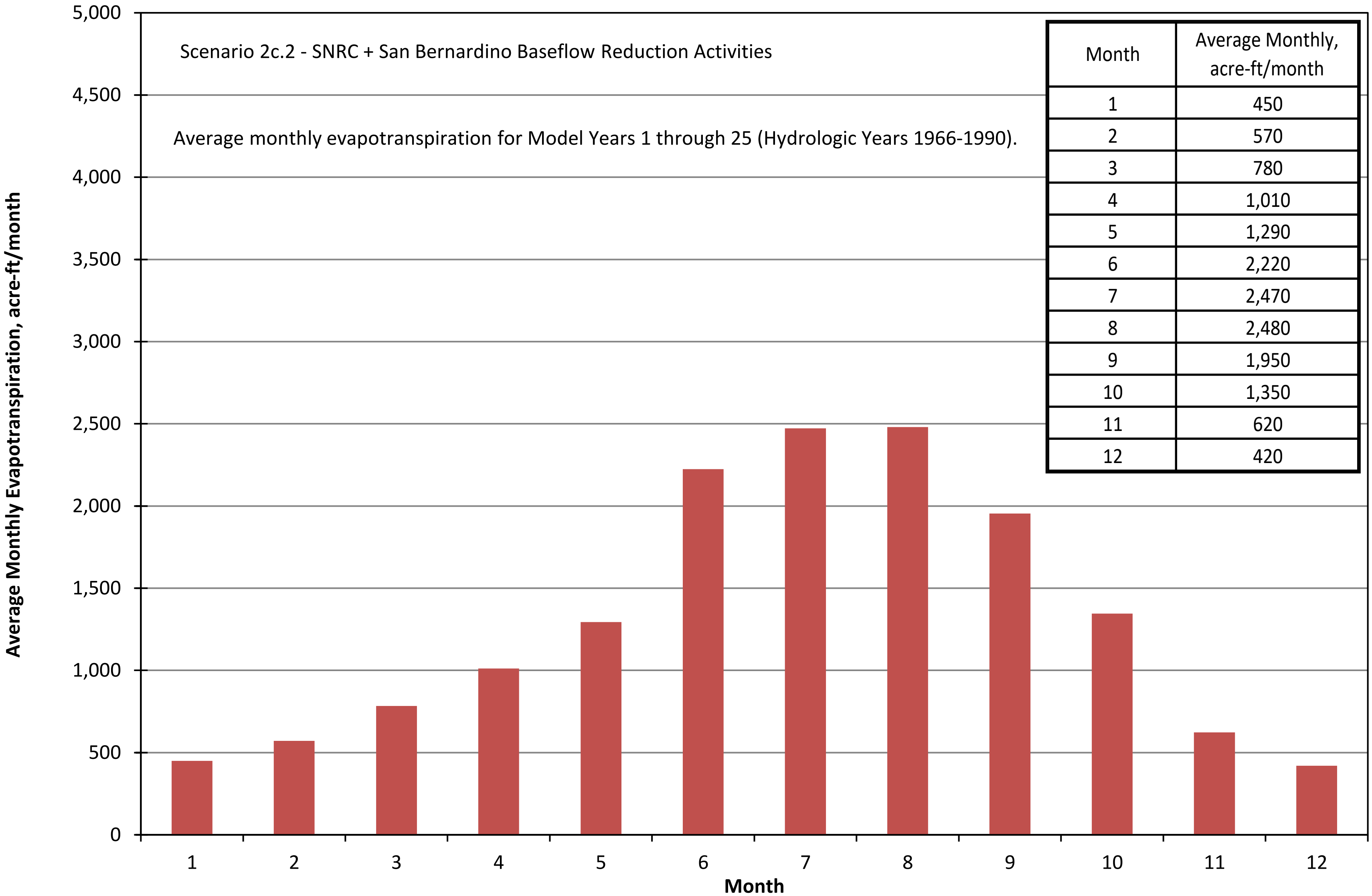


Figure 450

Scenario 2c.2: Seasonal Evapotranspiration – Prado Basin



Month	Average Monthly, acre-ft/month
1	450
2	570
3	780
4	1,010
5	1,290
6	2,220
7	2,470
8	2,480
9	1,950
10	1,350
11	620
12	420

Figure 451

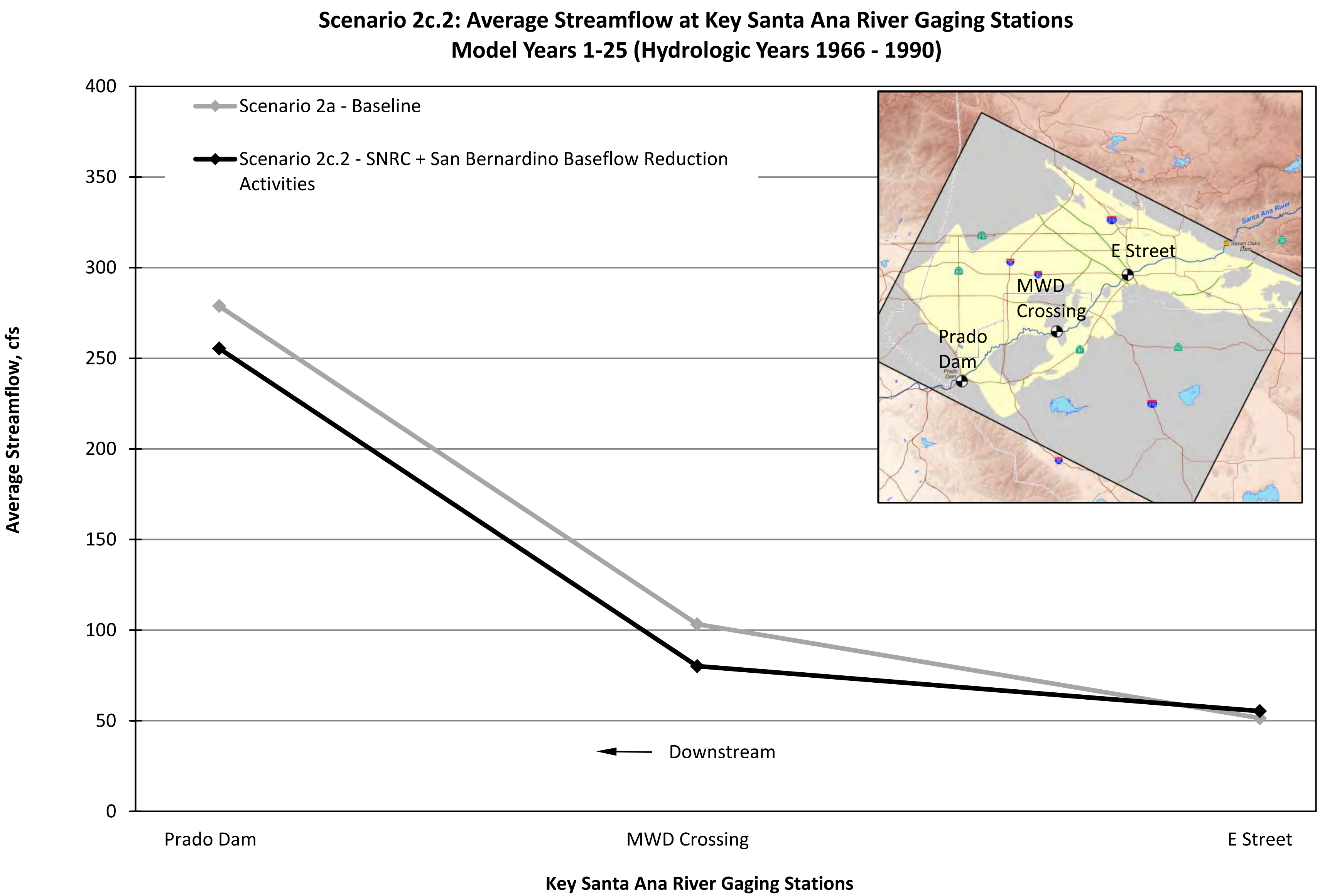

Scenario 2c.2: Average Streamflow at Key Santa Ana River Gaging Stations
Model Years 1-25 (Hydrologic Years 1966 - 1990)
Scenario 2a - Baseline
Scenario 2c.2 - SNRC + San Bernardino Baseflow Reduction Activities
E Street
MWD Crossing
Prado Dam
Downstream
Average Streamflow, cfs
0
50
100
150
200
250
300
350
400
Prado Dam
MWD Crossing
E Street
Key Santa Ana River Gaging Stations

Figure 452

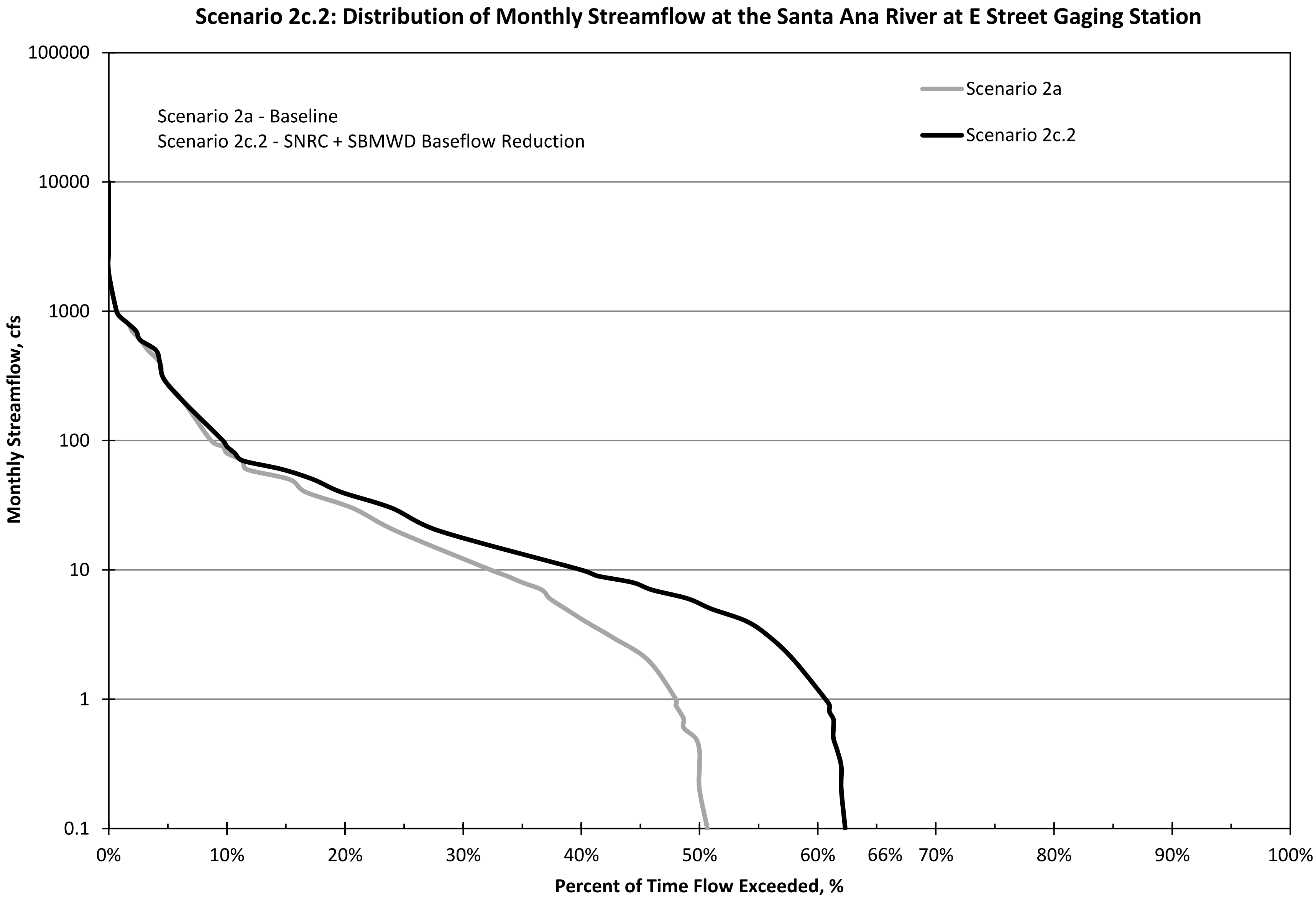

Scenario 2c.2: Distribution of Monthly Streamflow at the Santa Ana River at E Street Gaging Station
Scenario 2a - Baseline
Scenario 2c.2 - SNRC + SBMWD Baseflow Reduction
Scenario 2a
Scenario 2c.2
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
66%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 453

DRAFT

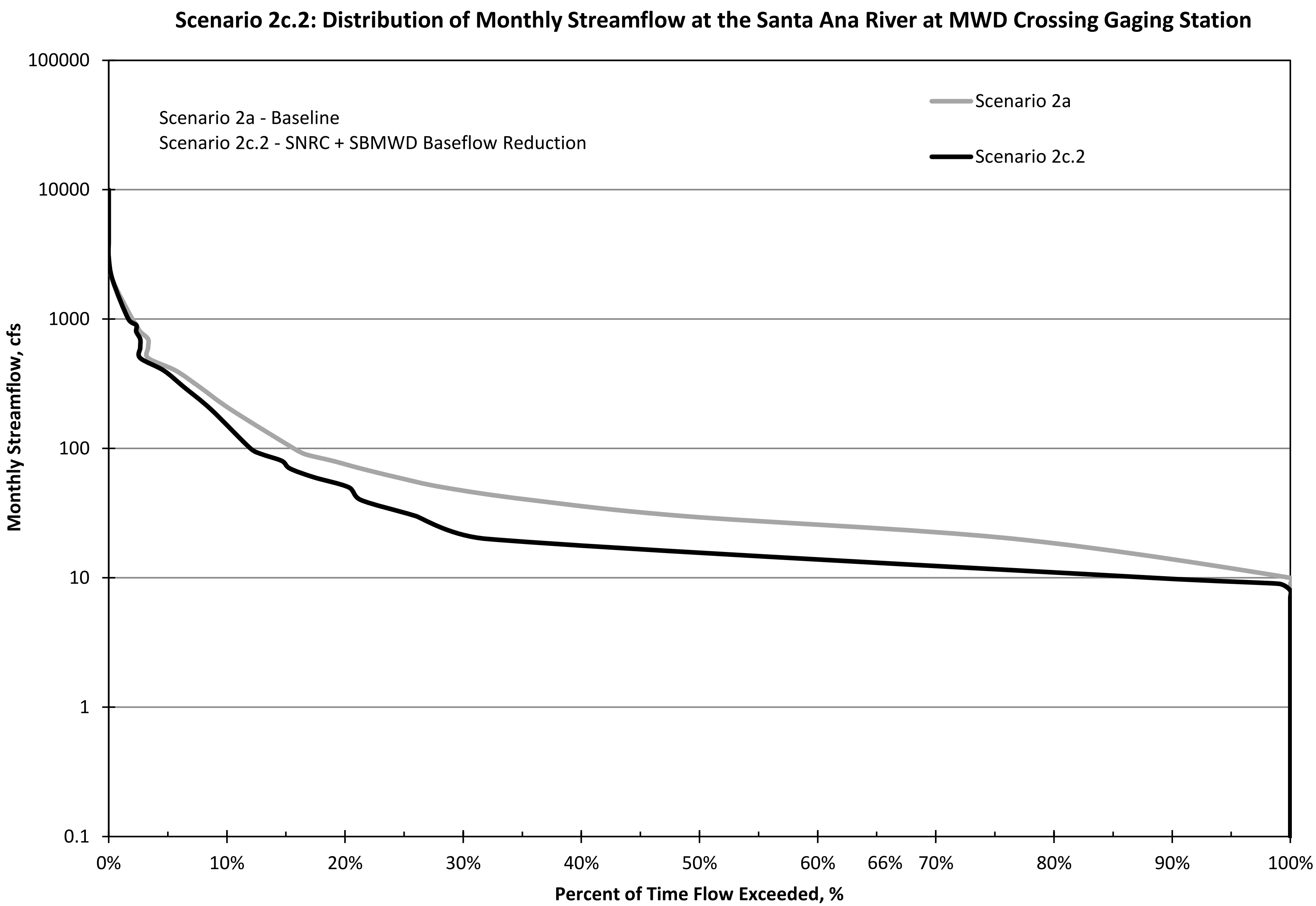


Figure 454

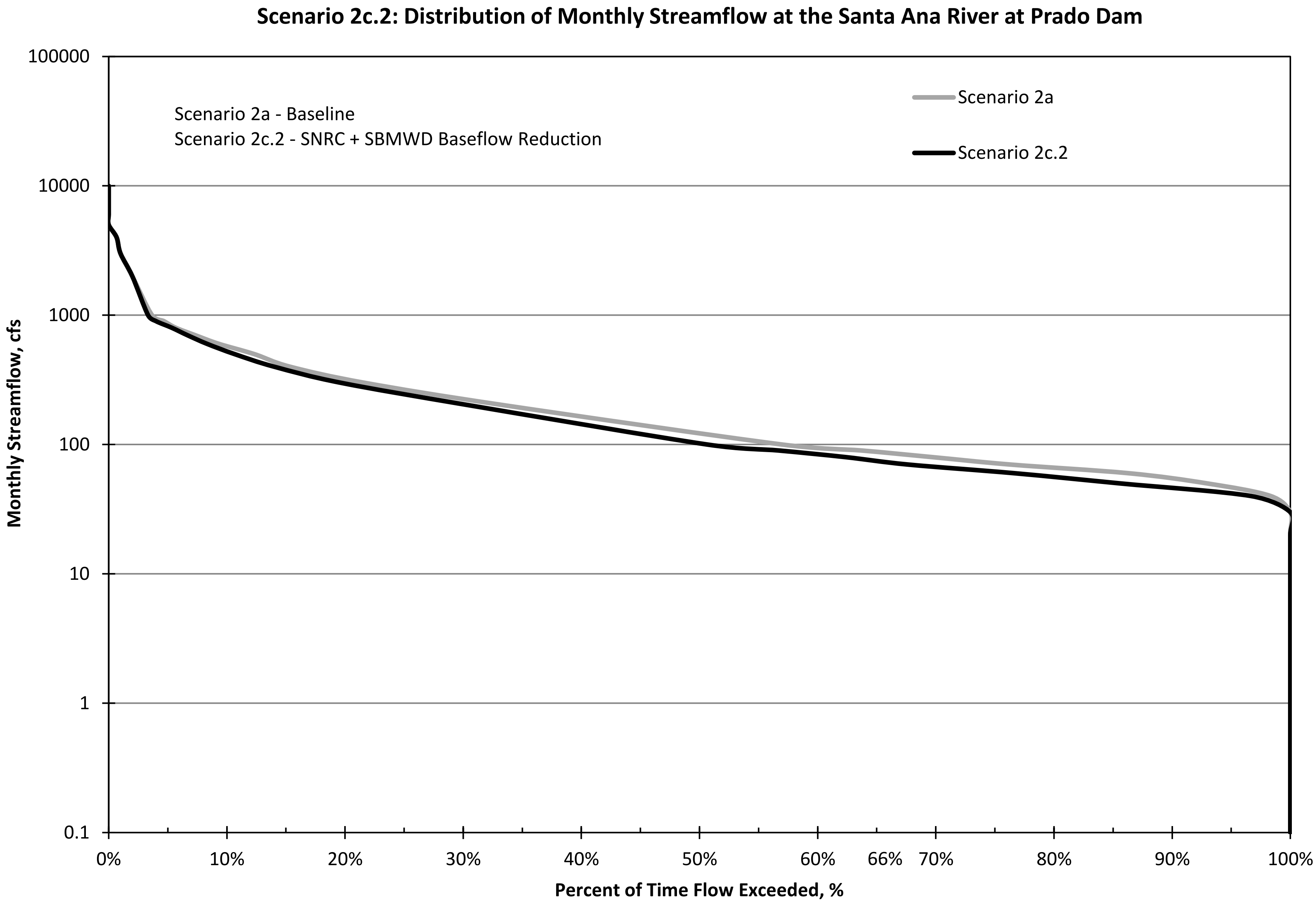
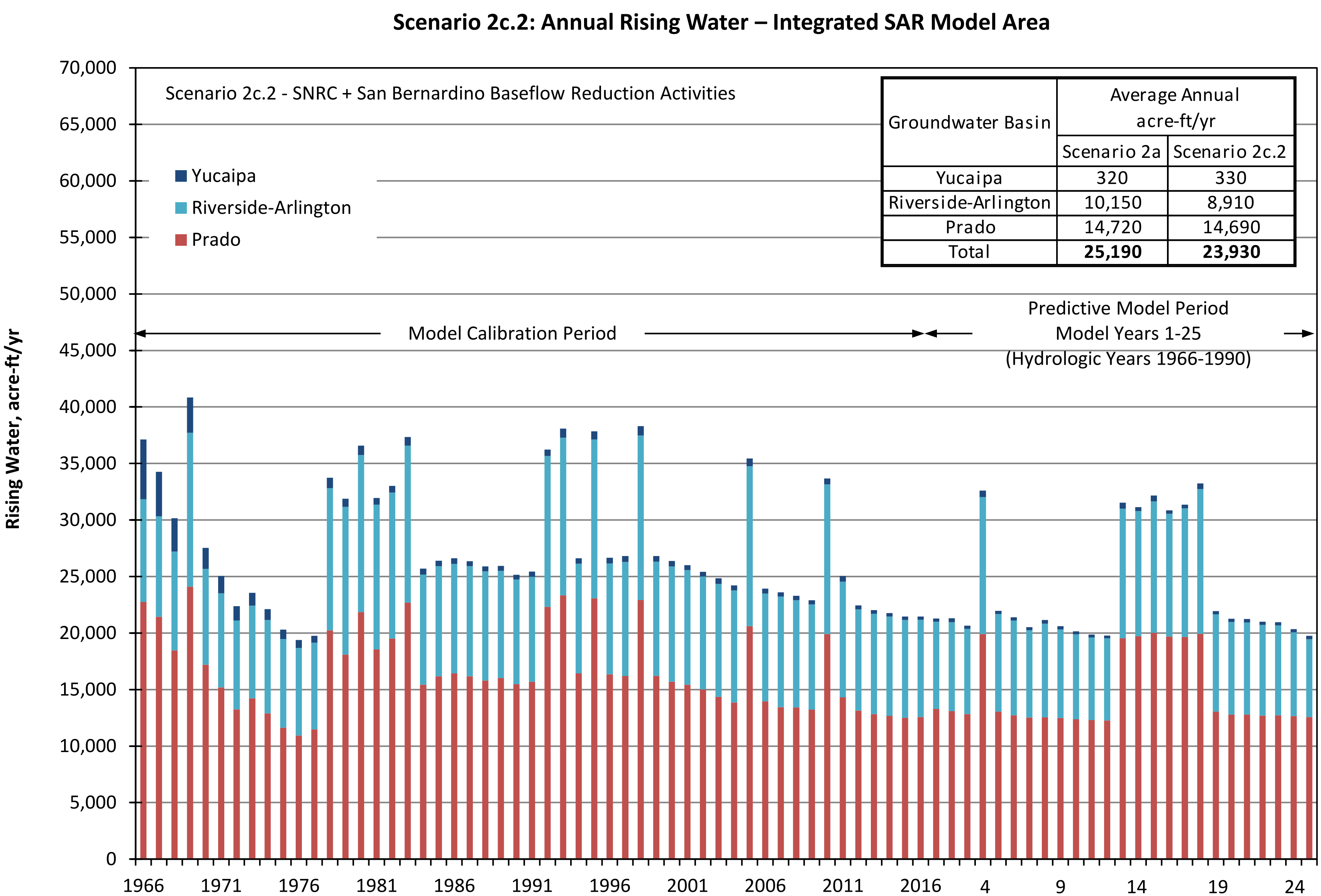
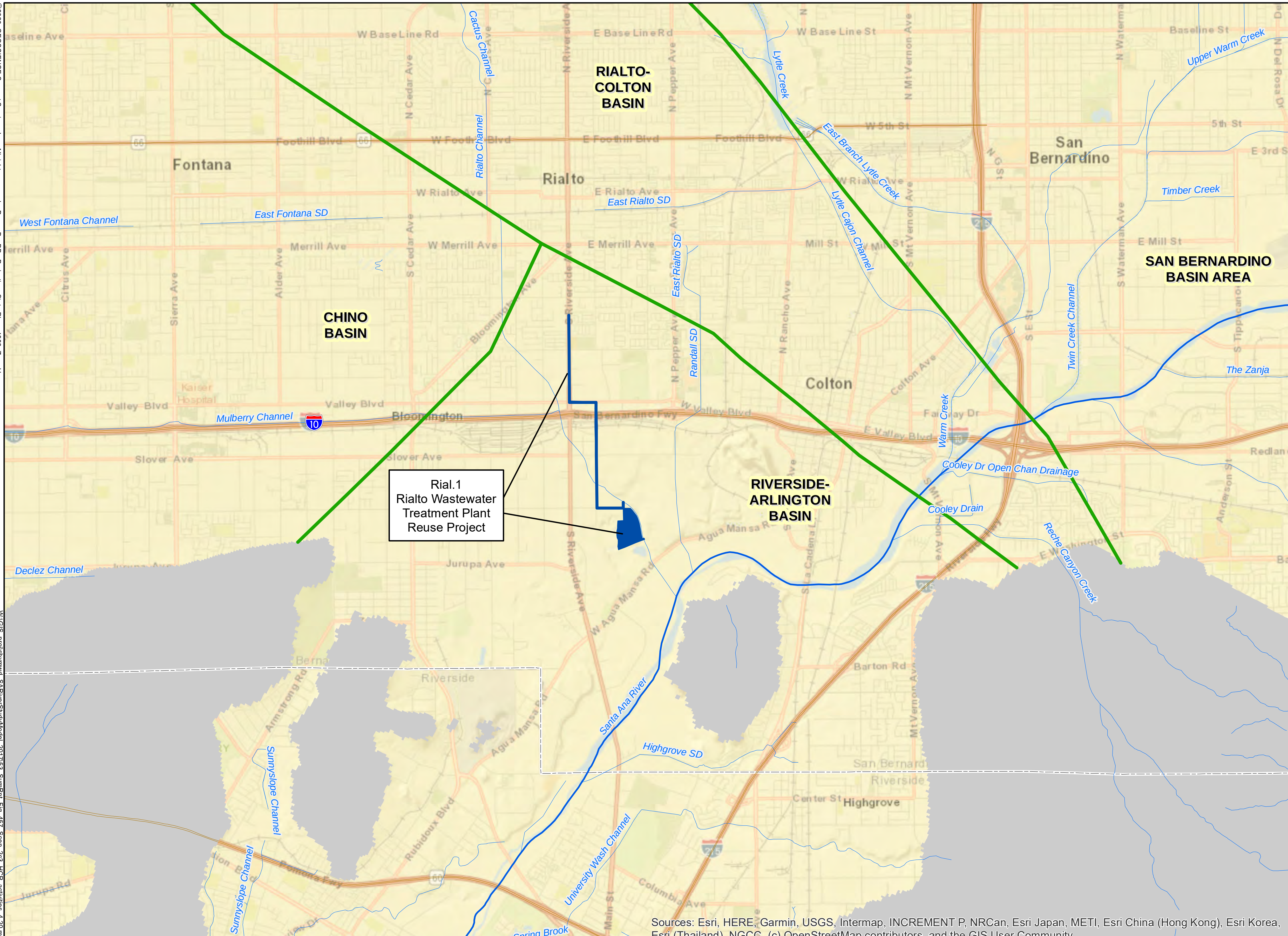

Scenario 2c.2: Distribution of Monthly Streamflow at the Santa Ana River at Prado Dam
Scenario 2a - Baseline
Scenario 2c.2 - SNRC + SBMWD Baseflow Reduction
Scenario 2a
Scenario 2c.2
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
66%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

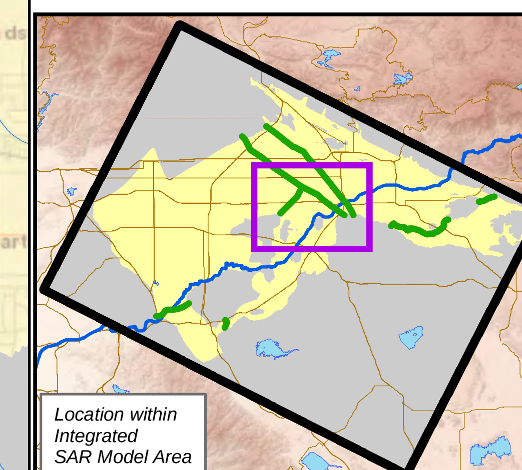
Figure 455



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2c.2
Yucaipa	320	330
Riverside-Arlington	10,150	8,910
Prado	14,720	14,690
Total	**25,190**	**23,930**

Figure 456





EXPLANATION

- Integrated SAR Model Boundary
- Active Model Area
- Inactive Model Area
- Habitat Conservation Plan (HCP) Covered Activity
  - Rial.1 Rialto WWTP Reuse Project
  - - Project ID
  - - Name of HCP Project
- Groundwater Basin Boundary

Refer to Table 17 for HCP Covered Activity Description

N

0 1 2

Miles

SCENARIO 2c.3: LOCATION OF HCP COVERED ACTIVITIES

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

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FIGURE 457

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

GEOSCIENCE

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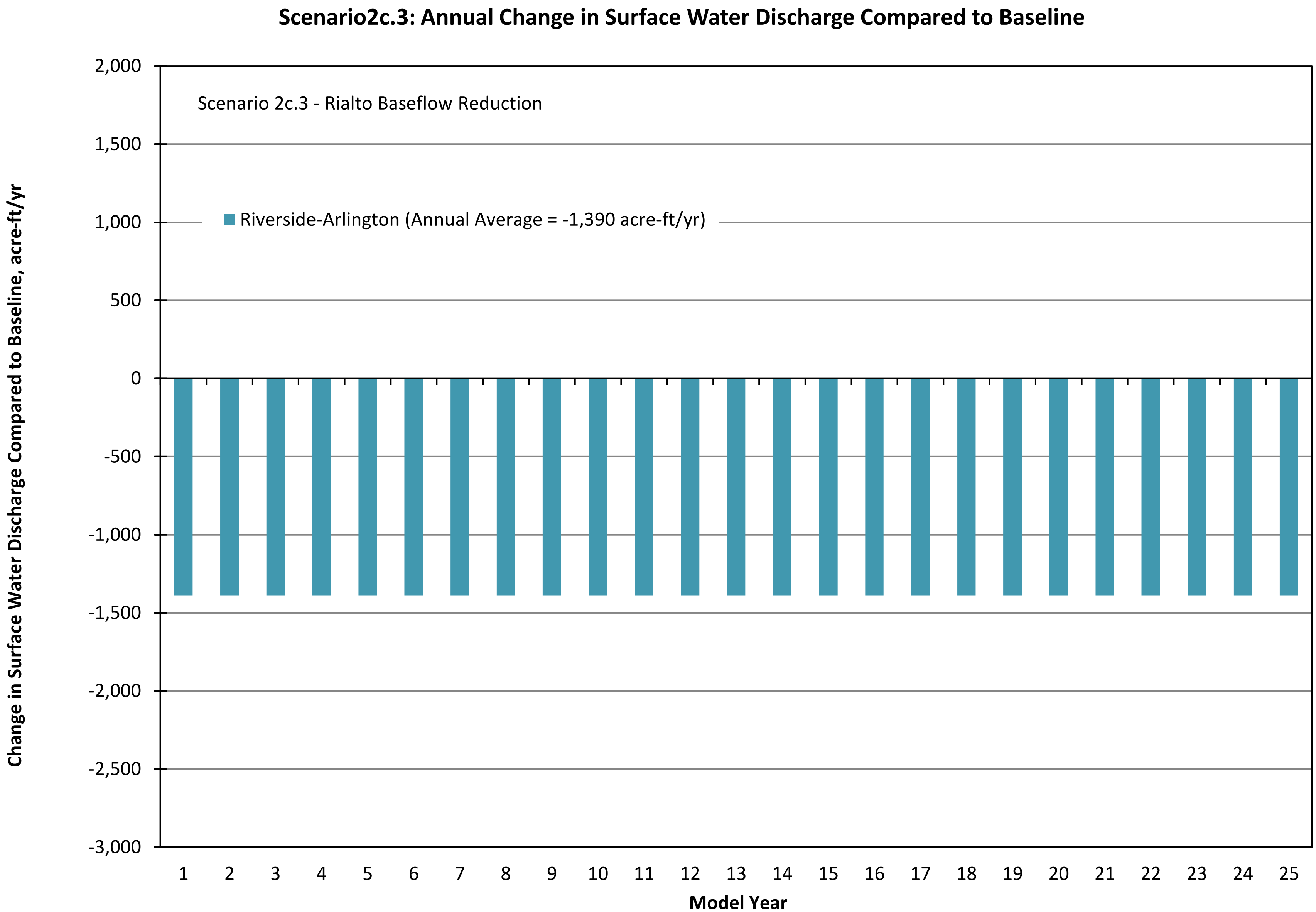


Figure 458

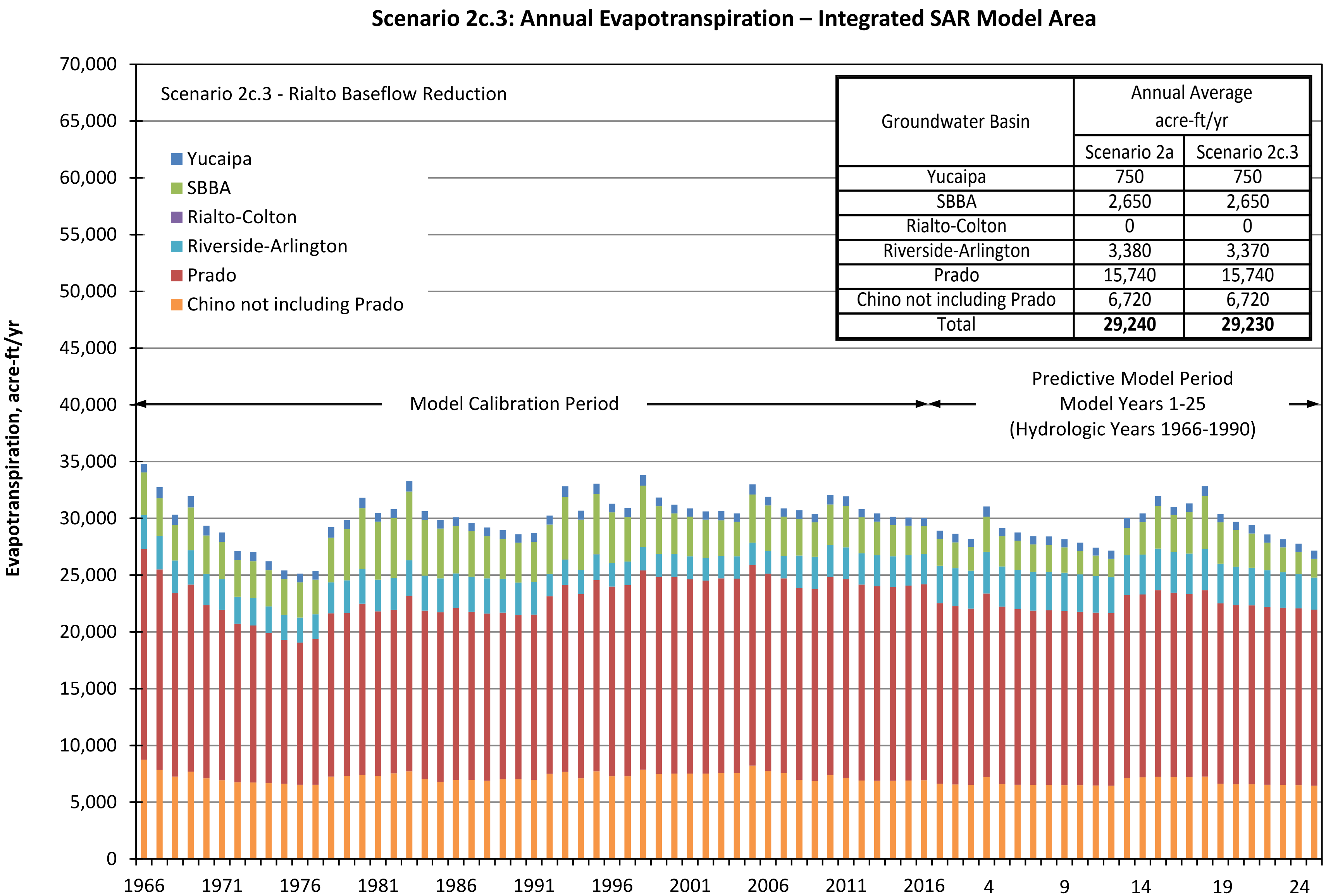

Scenario 2c.3: Annual Evapotranspiration – Integrated SAR Model Area
Scenario 2c.3 - Rialto Baseflow Reduction
Yucaipa
SBBA
Rialto-Colton
Riverside-Arlington
Prado
Chino not including Prado
Groundwater Basin
Annual Average acre-ft/yr
Scenario 2a
Scenario 2c.3
Yucaipa 750 750
SBBA 2,650 2,650
Rialto-Colton 0 0
Riverside-Arlington 3,380 3,370
Prado 15,740 15,740
Chino not including Prado 6,720 6,720
Total 29,240 29,230
Model Calibration Period
Predictive Model Period
Model Years 1-25
(Hydrologic Years 1966-1990)
Evapotranspiration, acre-ft/yr
70,000
65,000
60,000
55,000
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
1966
1971
1976
1981
1986
1991
1996
2001
2006
2011
2016
4
9
14
19
24

Figure 459

DRAFT

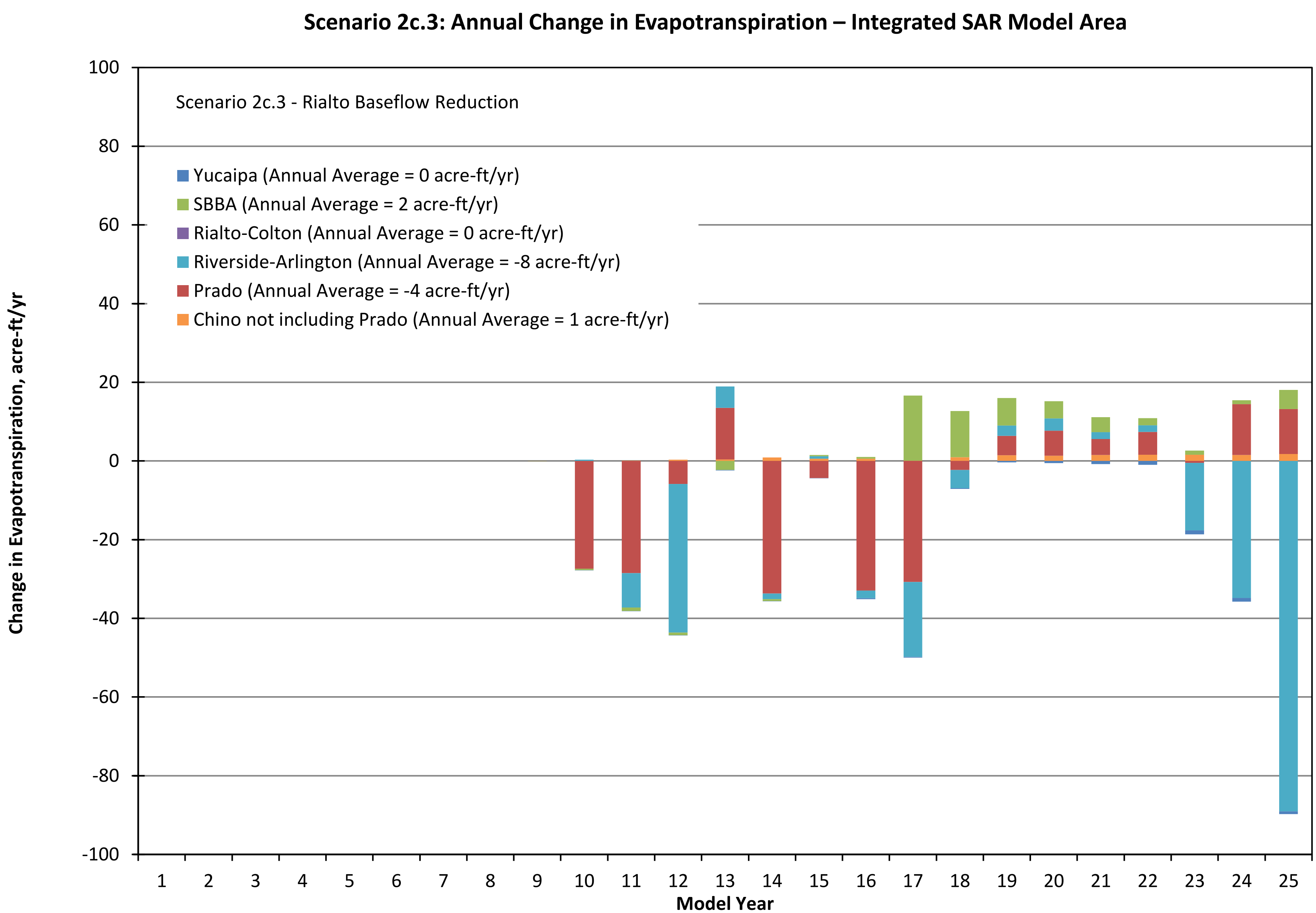


Figure 460

Scenario 2c.3: Seasonal Evapotranspiration – Integrated SAR Model Area

Scenario 2c.3 - Rialto Baseflow Reduction

Average monthly evapotranspiration for Model Years 1 through 25 (Hydrologic Years 1966-1990).

Month	Average Monthly, acre-ft/month						
	Yucaipa	SBBA	Rialto-Colton	Riverside-Arlington	Prado	Chino and Temescal (outside Prado)	**Total**
1	20	80	0	100	450	190	**840**
2	30	100	0	130	570	240	**1,070**
3	40	140	0	170	790	330	**1,470**
4	50	180	0	220	1,010	420	**1,880**
5	60	220	0	270	1,300	530	**2,380**
6	110	380	0	470	2,230	930	**4,120**
7	120	420	0	520	2,490	1,060	**4,610**
8	120	420	0	540	2,510	1,090	**4,680**
9	90	320	0	430	1,980	860	**3,680**
10	60	210	0	290	1,360	590	**2,510**
11	30	100	0	140	630	270	**1,170**
12	20	70	0	90	420	190	**790**

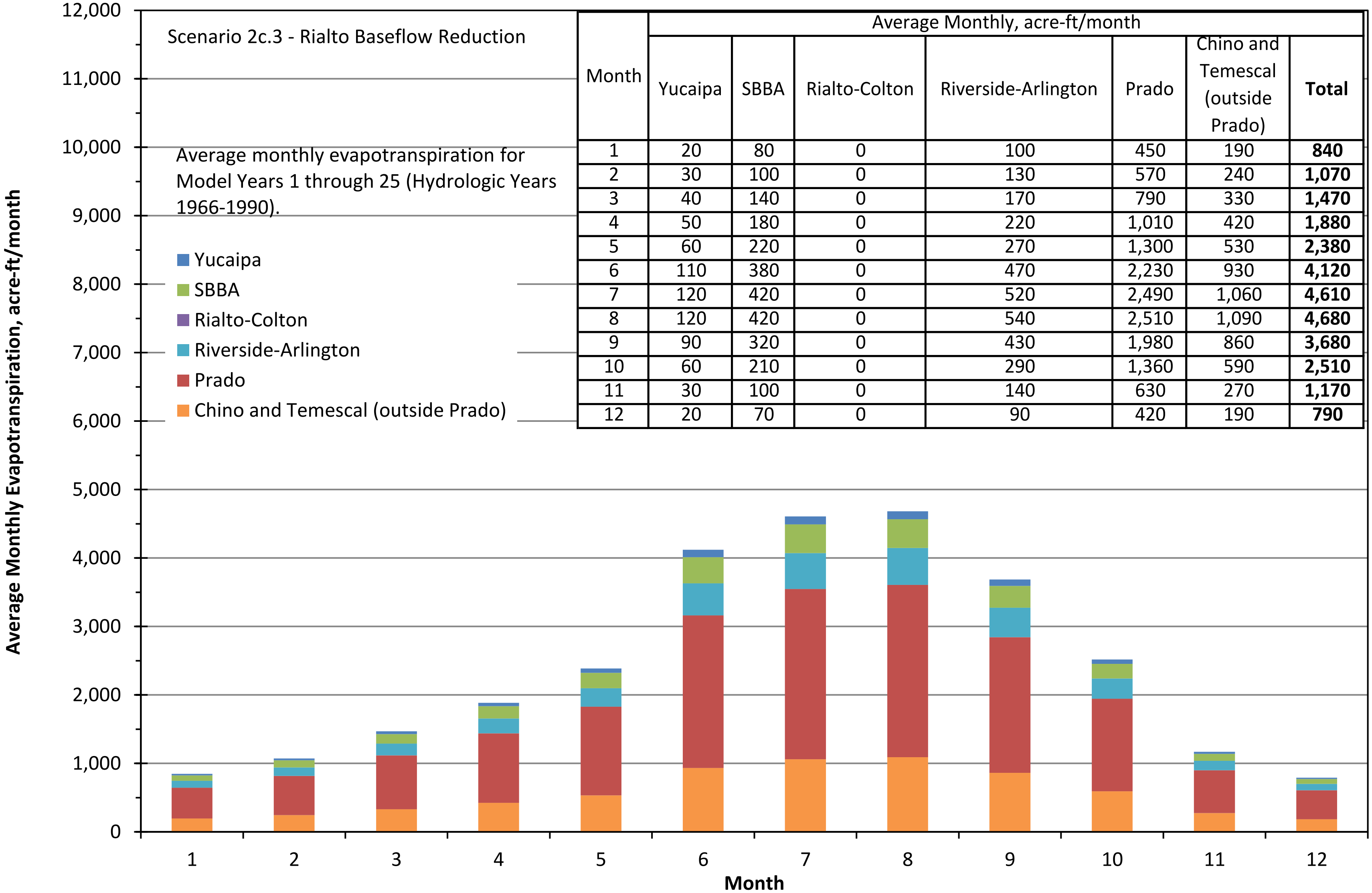


Figure 461

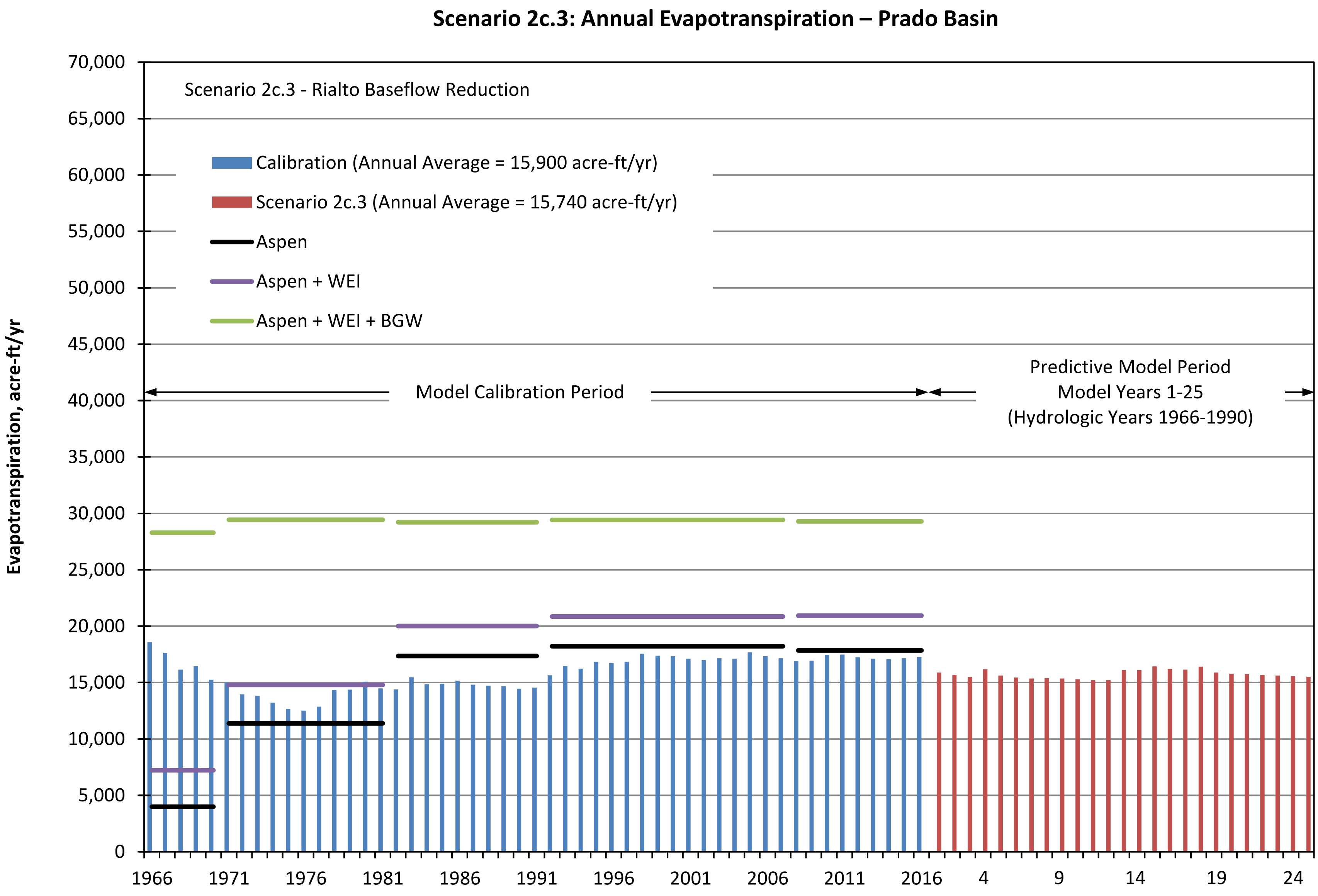

Scenario 2c.3: Annual Evapotranspiration – Prado Basin
Scenario 2c.3 - Rialto Baseflow Reduction
Calibration (Annual Average = 15,900 acre-ft/yr)
Scenario 2c.3 (Annual Average = 15,740 acre-ft/yr)
Aspen
Aspen + WEI
Aspen + WEI + BGW
Model Calibration Period
Predictive Model Period
Model Years 1-25
(Hydrologic Years 1966-1990)
Evapotranspiration, acre-ft/yr
70,000
65,000
60,000
55,000
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
1966
1971
1976
1981
1986
1991
1996
2001
2006
2011
2016
4
9
14
19
24

Figure 462

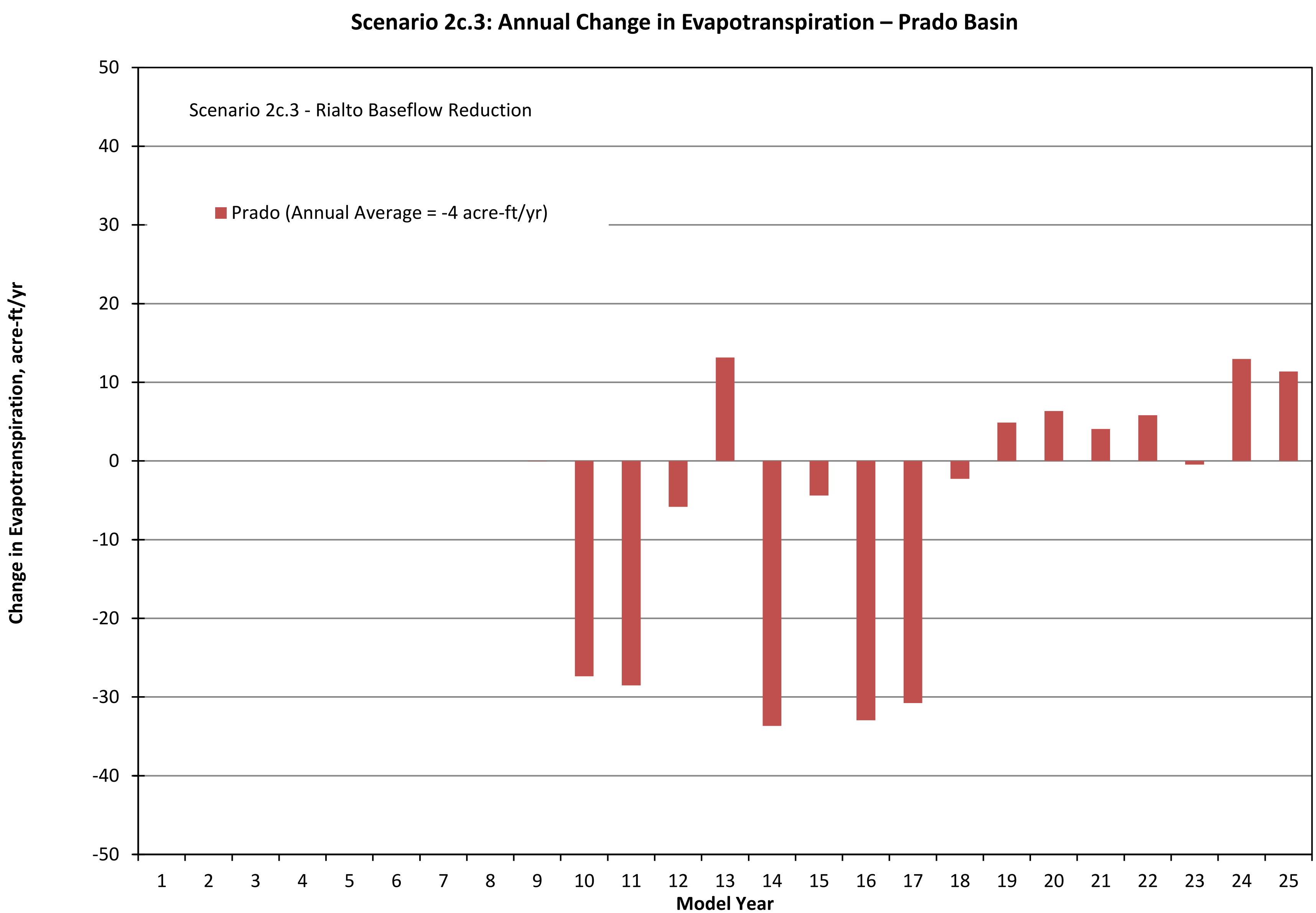
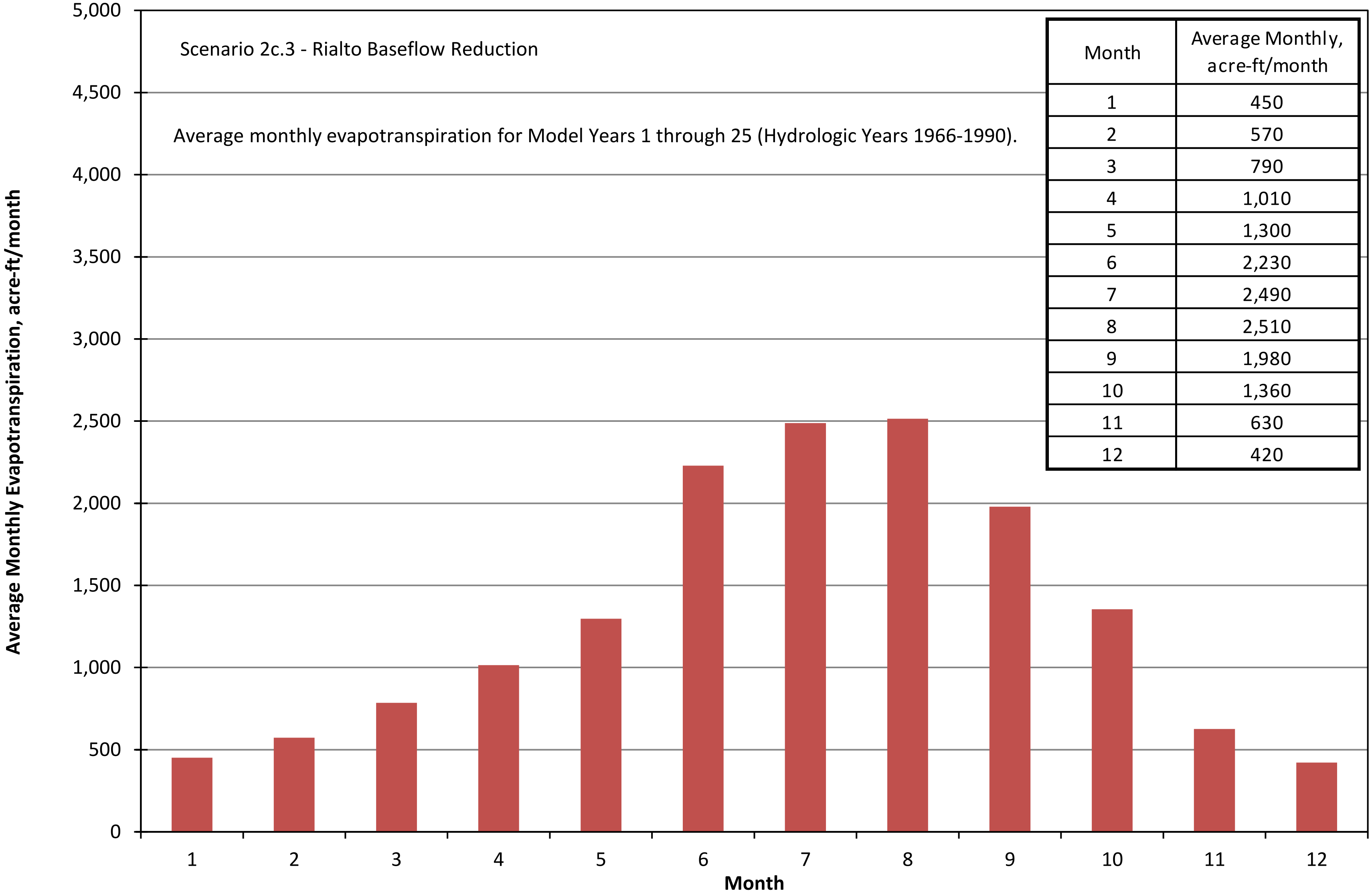

Scenario 2c.3: Annual Change in Evapotranspiration – Prado Basin
Scenario 2c.3 - Rialto Baseflow Reduction
Prado (Annual Average = -4 acre-ft/yr)
Change in Evapotranspiration, acre-ft/yr
50
40
30
20
10
0
-10
-20
-30
-40
-50
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Model Year

Figure 463

Scenario 2c.3: Seasonal Evapotranspiration – Prado Basin



Month	Average Monthly, acre-ft/month
1	450
2	570
3	790
4	1,010
5	1,300
6	2,230
7	2,490
8	2,510
9	1,980
10	1,360
11	630
12	420

Figure 464

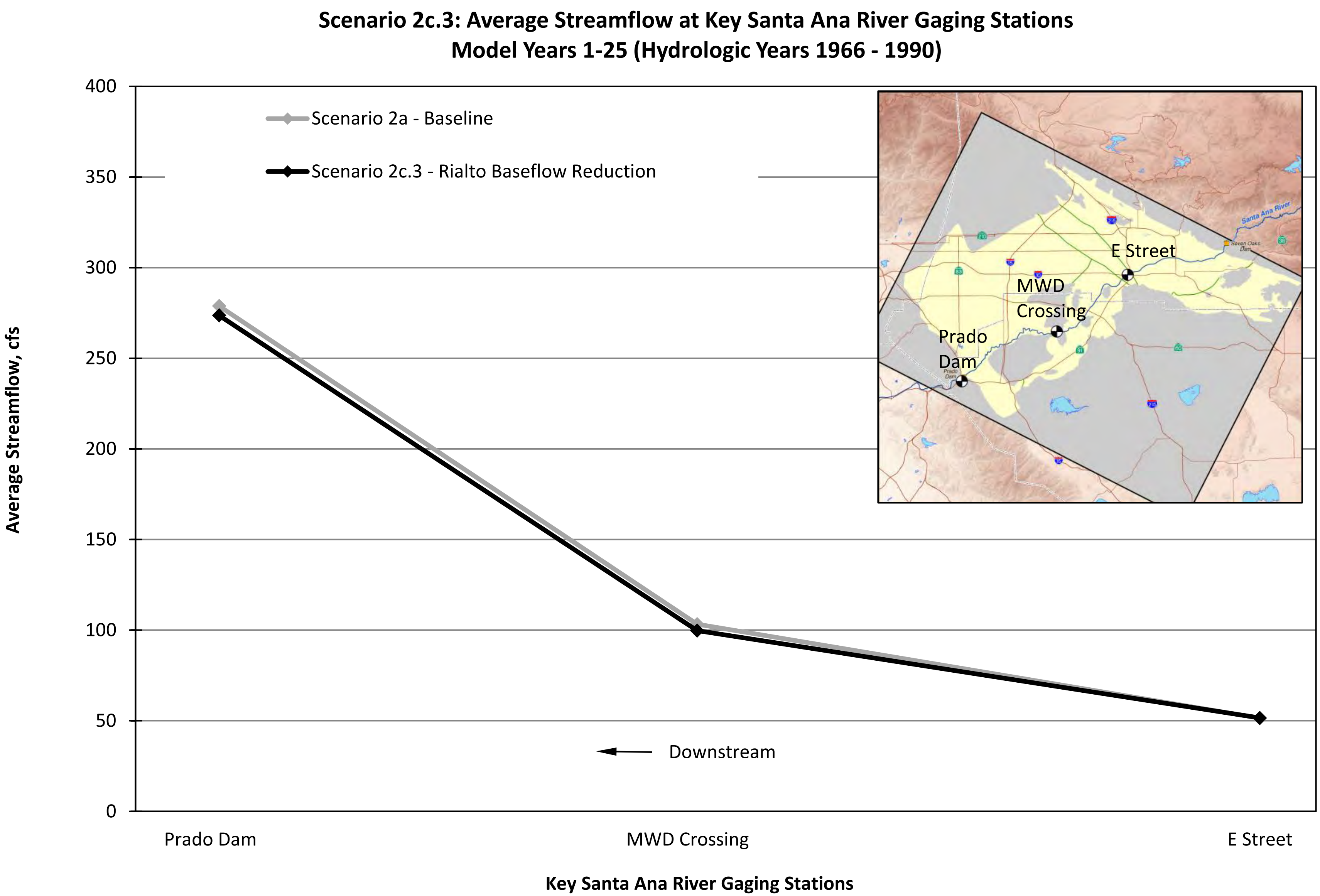

Scenario 2c.3: Average Streamflow at Key Santa Ana River Gaging Stations
Model Years 1-25 (Hydrologic Years 1966 - 1990)
Scenario 2a - Baseline
Scenario 2c.3 - Rialto Baseflow Reduction
Average Streamflow, cfs
400
350
300
250
200
150
100
50
0
E Street
MWD
Crossing
Prado
Dam
Downstream
Prado Dam
MWD Crossing
E Street
Key Santa Ana River Gaging Stations

Figure 465

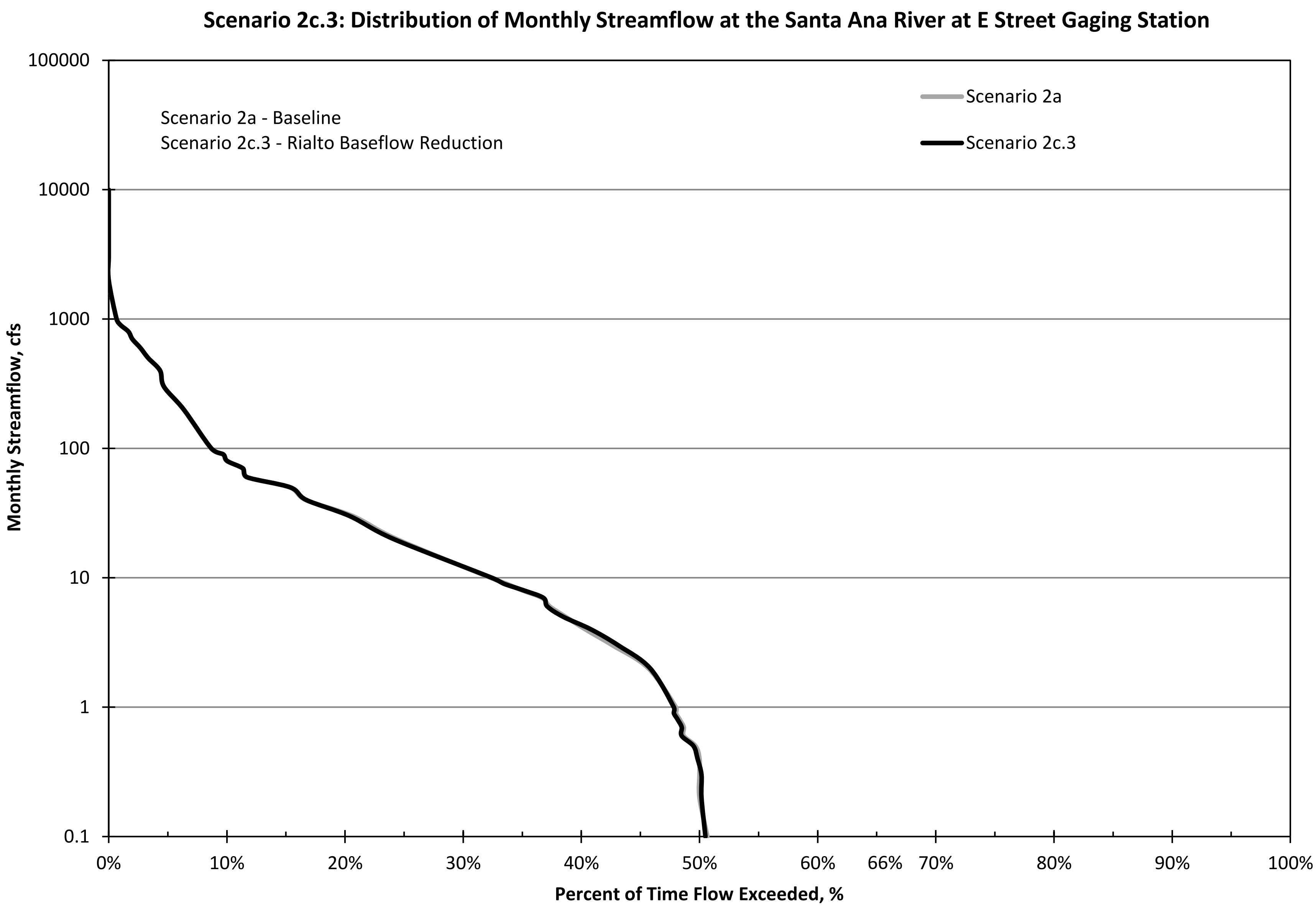

Scenario 2c.3: Distribution of Monthly Streamflow at the Santa Ana River at E Street Gaging Station
Scenario 2a - Baseline
Scenario 2c.3 - Rialto Baseflow Reduction
Scenario 2a
Scenario 2c.3
100000
10000
1000
100
10
1
0.1
Monthly Streamflow, cfs
0%
10%
20%
30%
40%
50%
60%
66%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 466

DRAFT

Scenario 2c.3: Distribution of Monthly Streamflow at the Santa Ana River at MWD Crossing Gaging Station

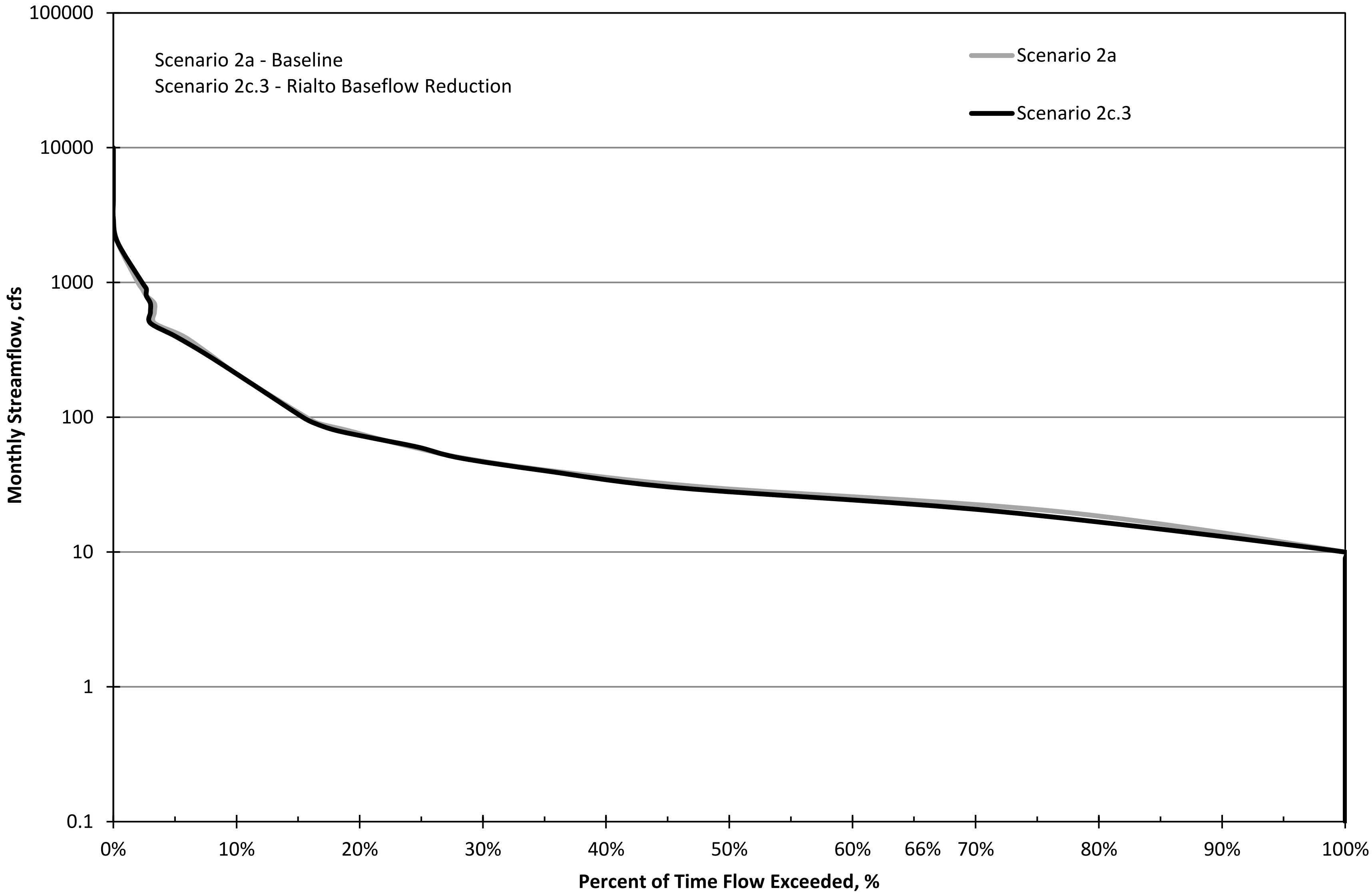


Figure 467

DRAFT

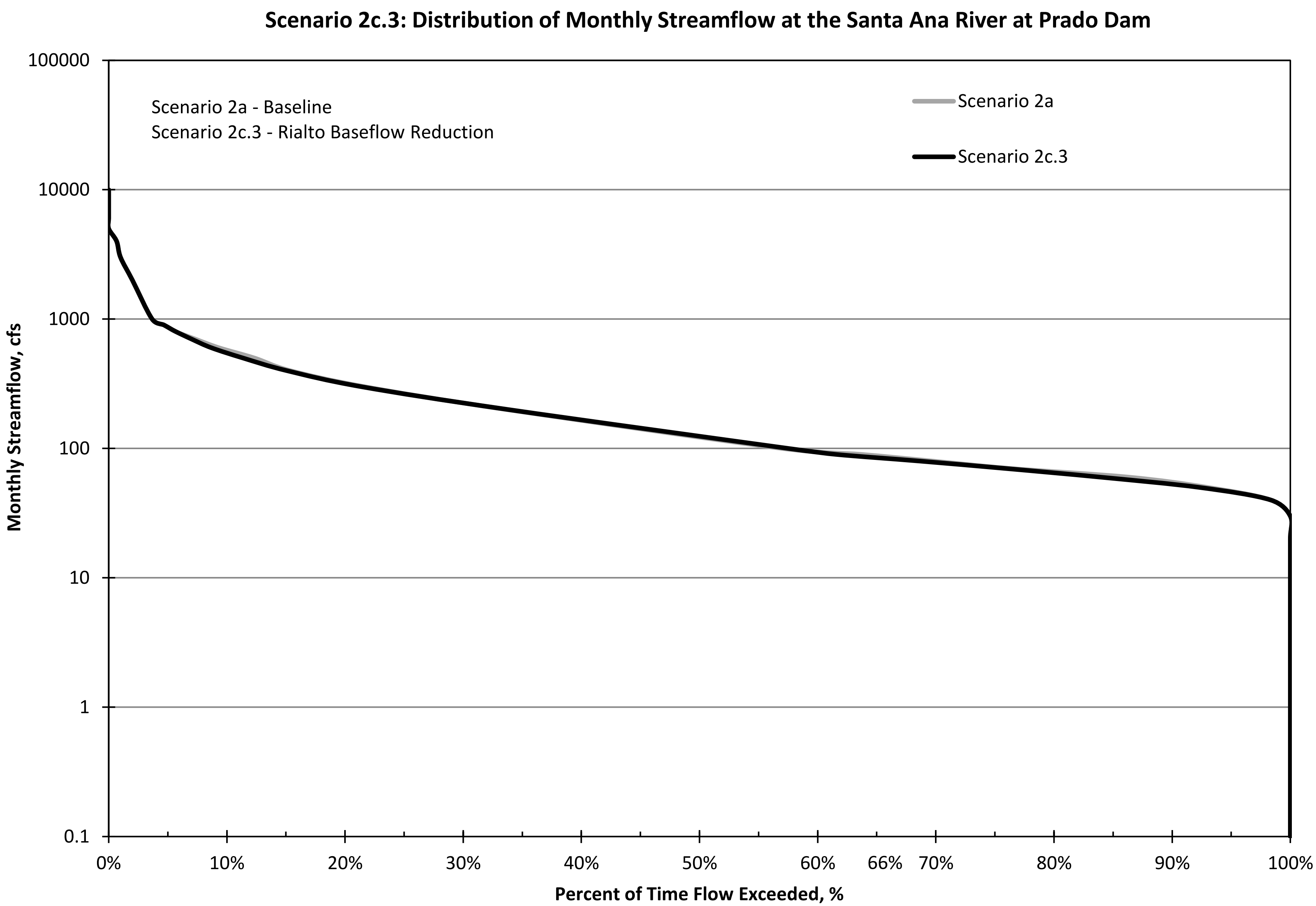


Figure 468

Scenario 2c.3: Annual Rising Water – Integrated SAR Model Area

Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2c.3
Yucaipa	320	320
Riverside-Arlington	10,150	10,130
Prado	14,720	14,720
Total	**25,190**	**25,170**

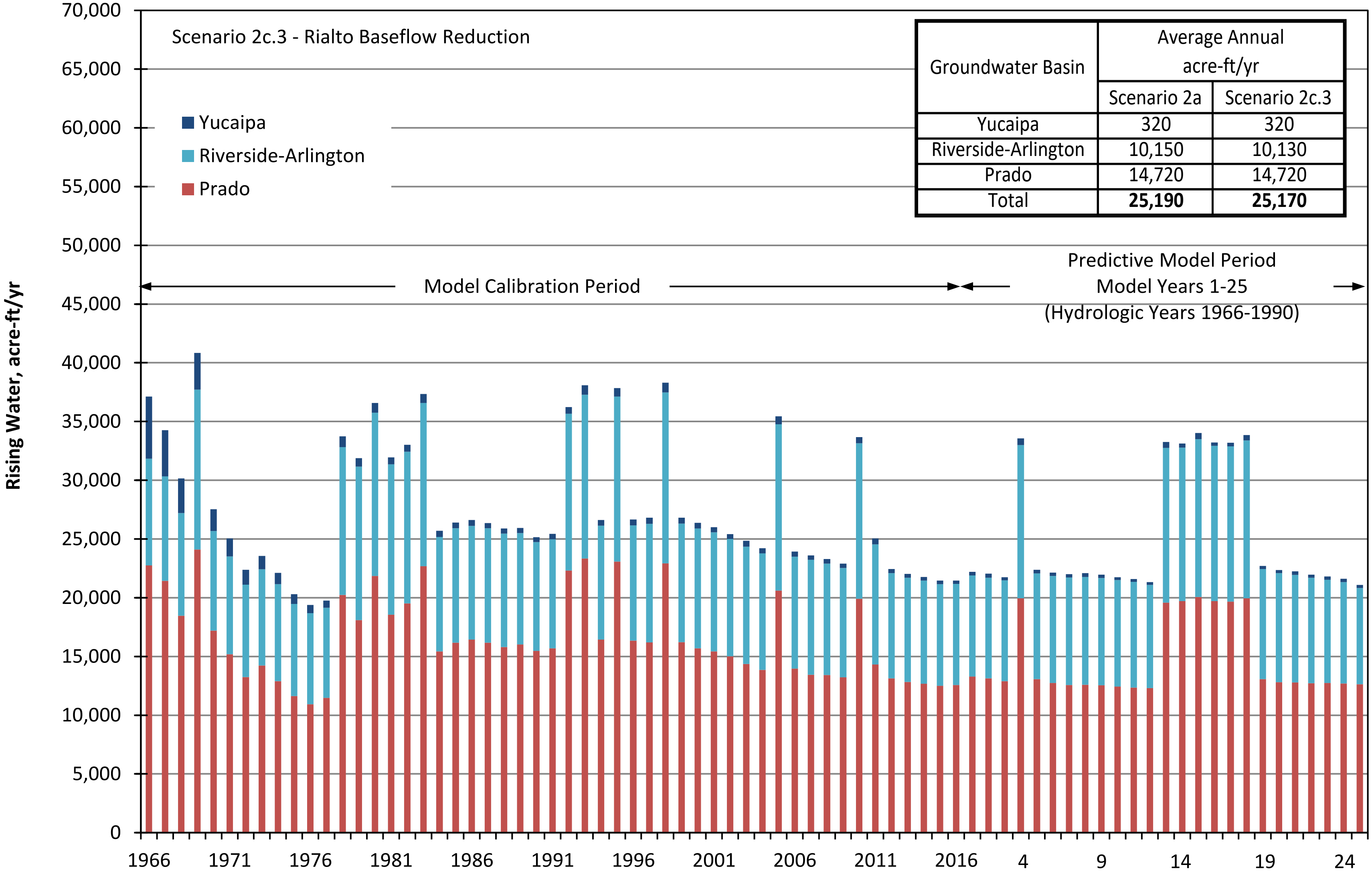
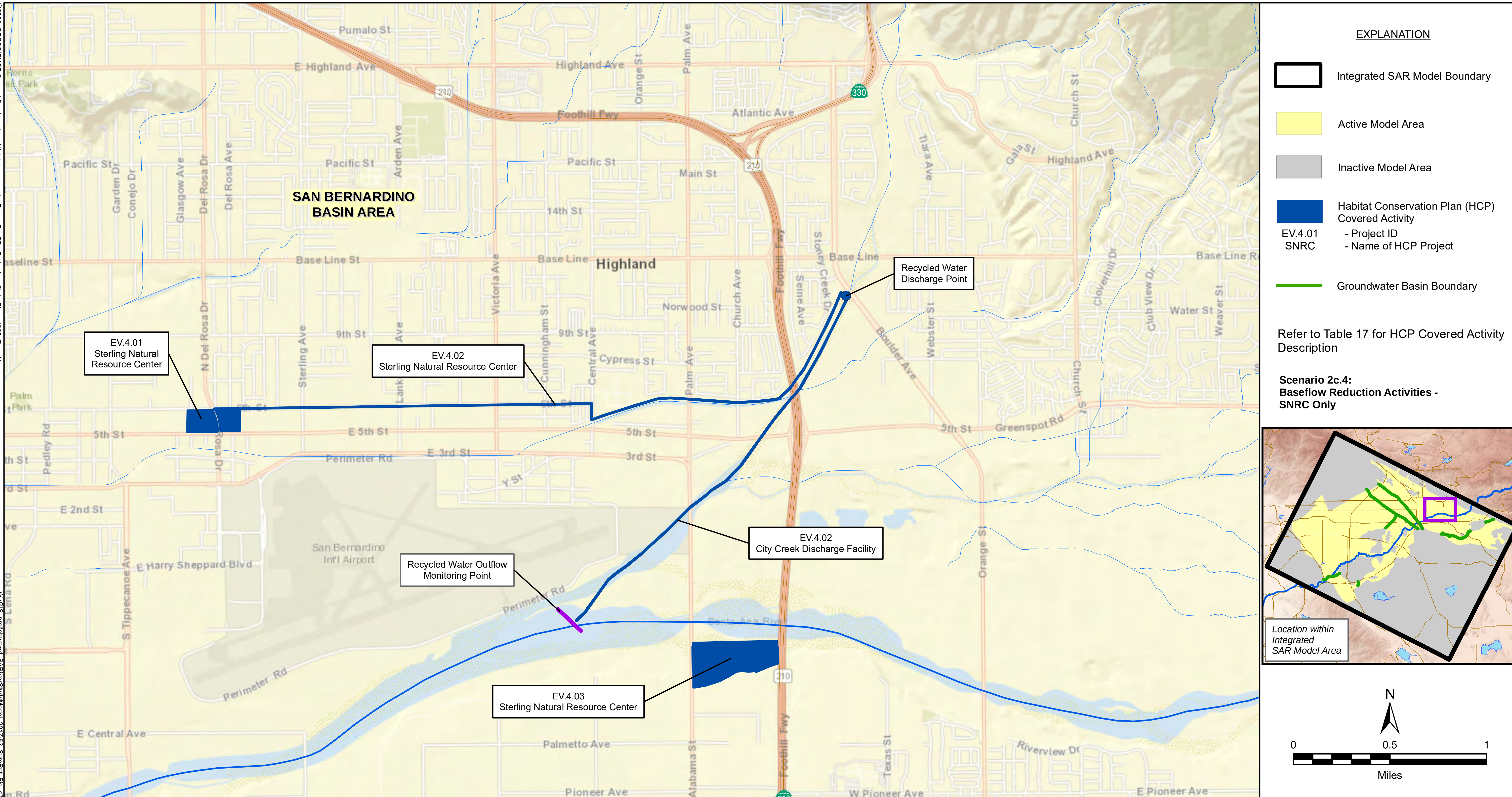


Figure 469



SCENARIO 2c.4
LOCATION OF
HCP COVERED ACTIVITIES

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10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

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FIGURE 470

GEOSCIENCE

Scenario 2c.4: Annual Change in Artificial Recharge Compared to Baseline

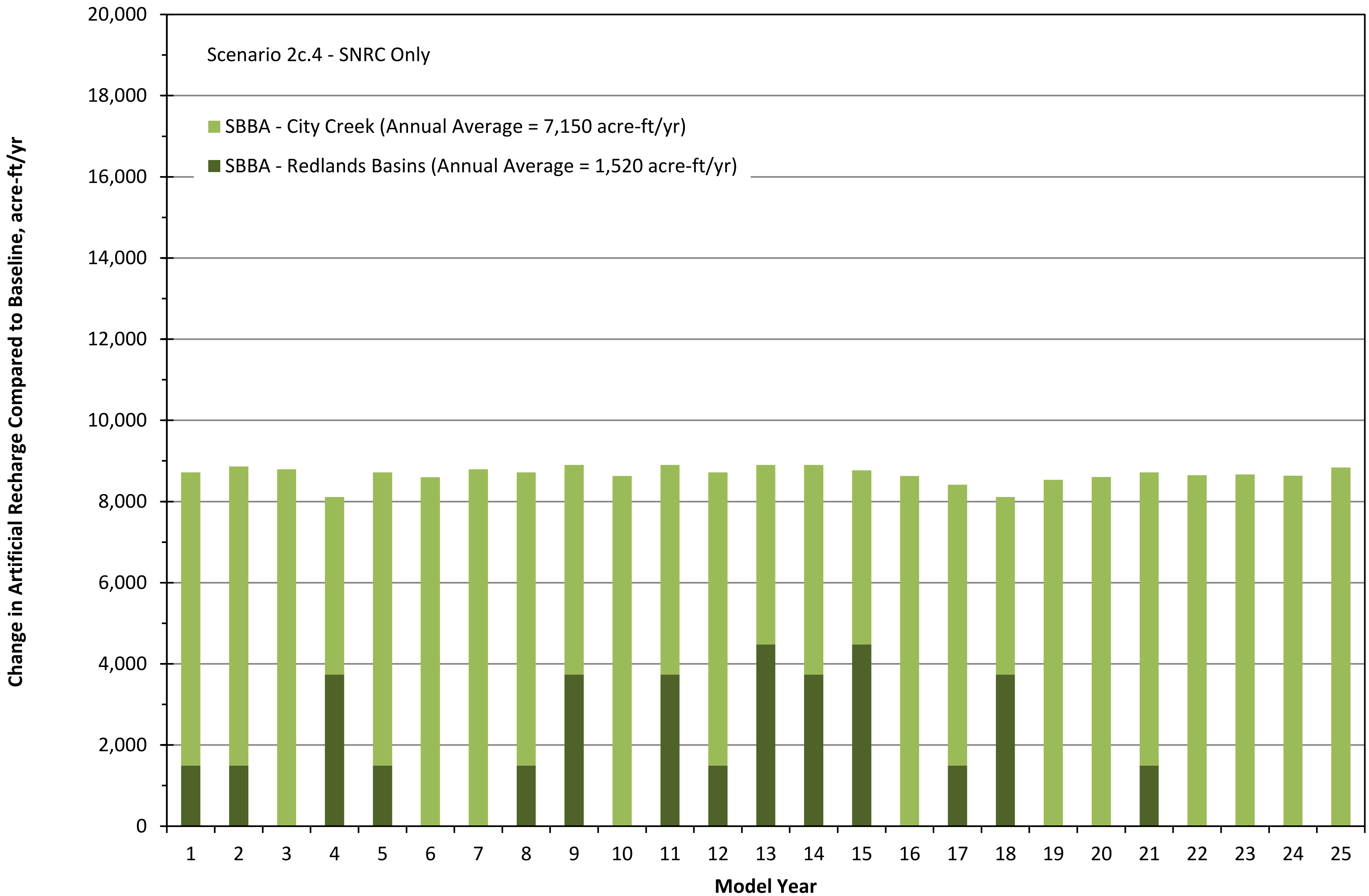


Figure 471

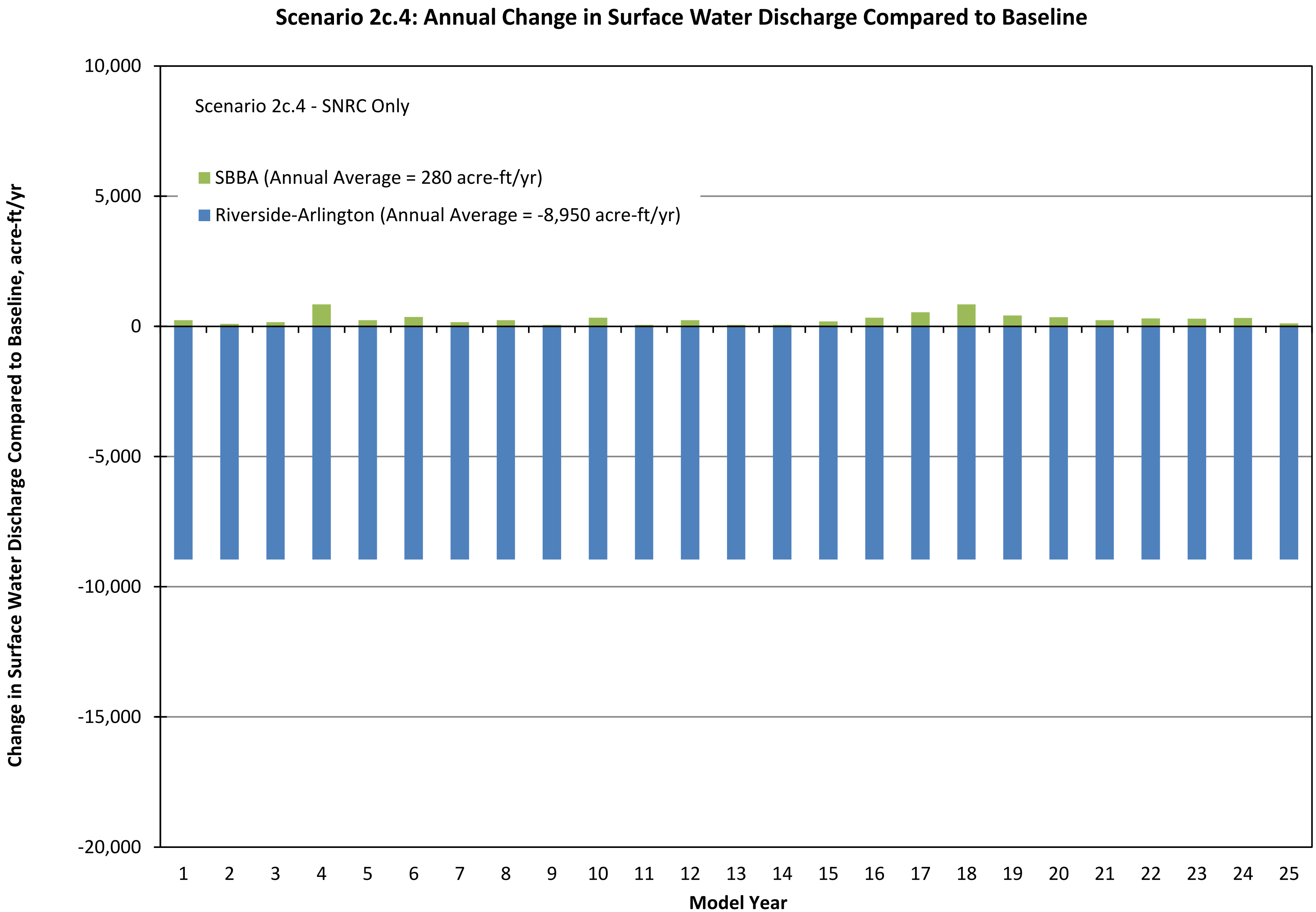
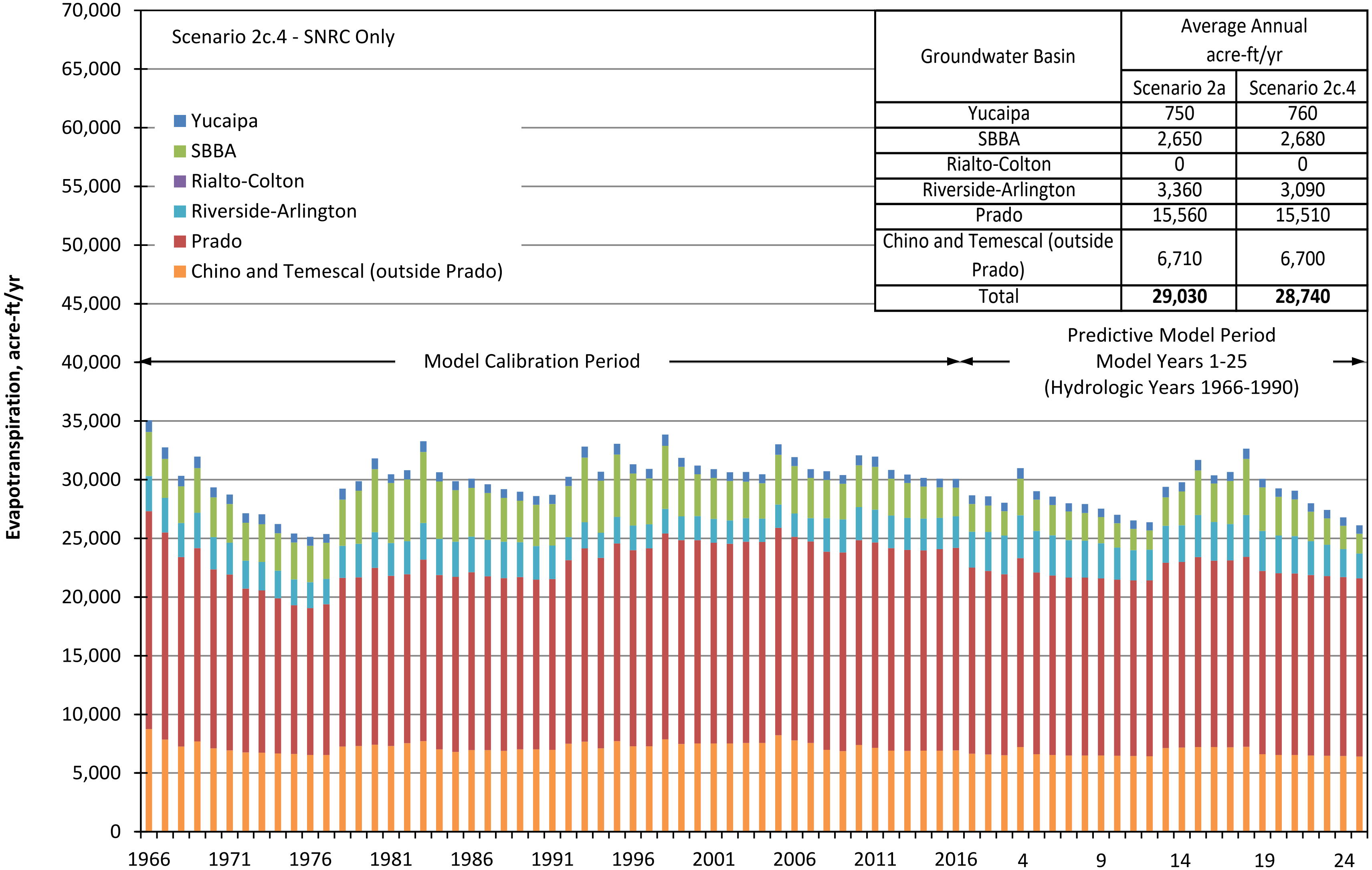

Scenario 2c.4: Annual Change in Surface Water Discharge Compared to Baseline
Scenario 2c.4 - SNRC Only
SBBA (Annual Average = 280 acre-ft/yr)
Riverside-Arlington (Annual Average = -8,950 acre-ft/yr)
Change in Surface Water Discharge Compared to Baseline, acre-ft/yr
10,000
5,000
0
-5,000
-10,000
-15,000
-20,000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Model Year

Figure 472

Scenario 2c.4: Annual Evapotranspiration – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2c.4
Yucaipa	750	760
SBBA	2,650	2,680
Rialto-Colton	0	0
Riverside-Arlington	3,360	3,090
Prado	15,560	15,510
Chino and Temescal (outside Prado)	6,710	6,700
Total	**29,030**	**28,740**

Figure 473

DRAFT

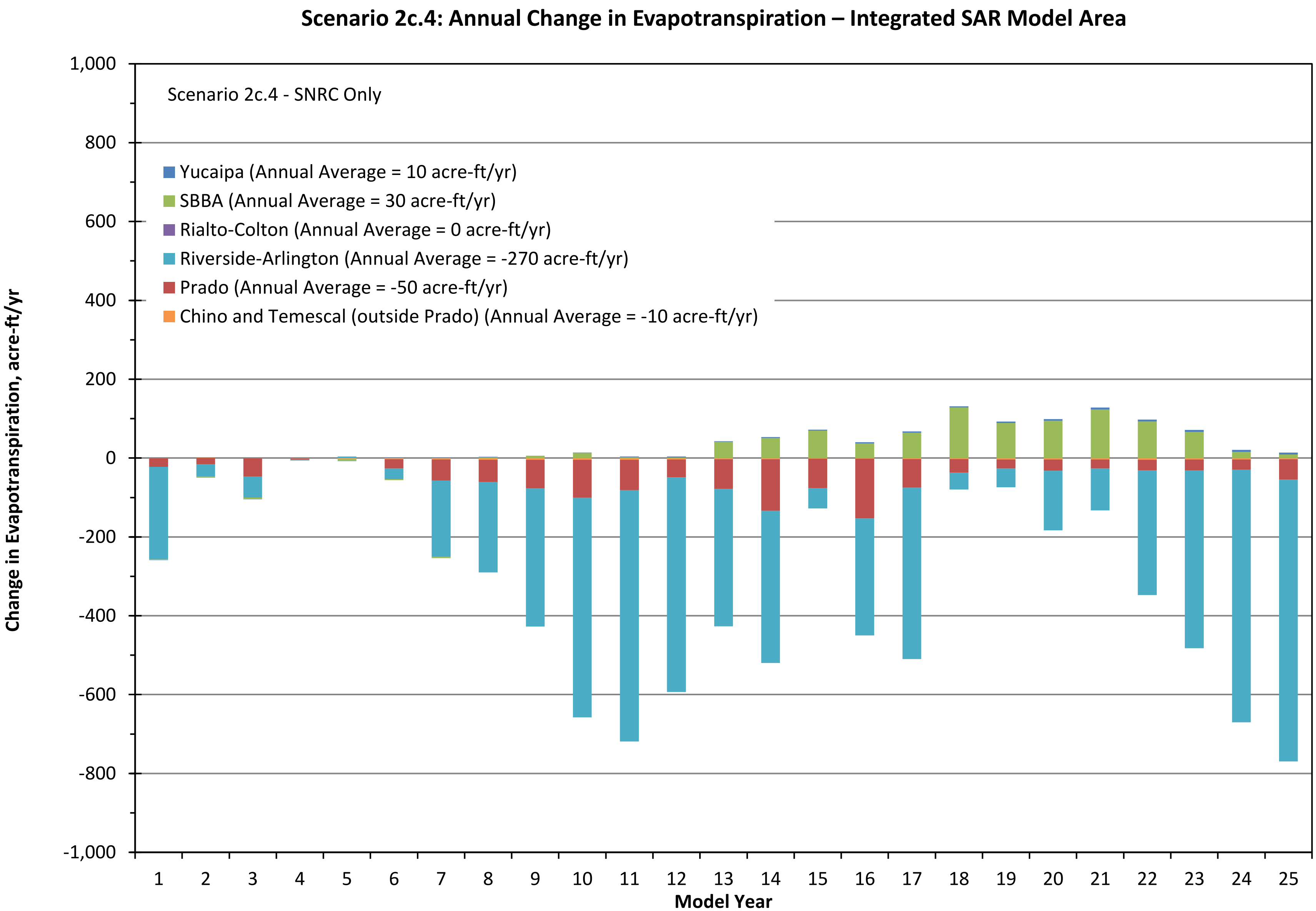
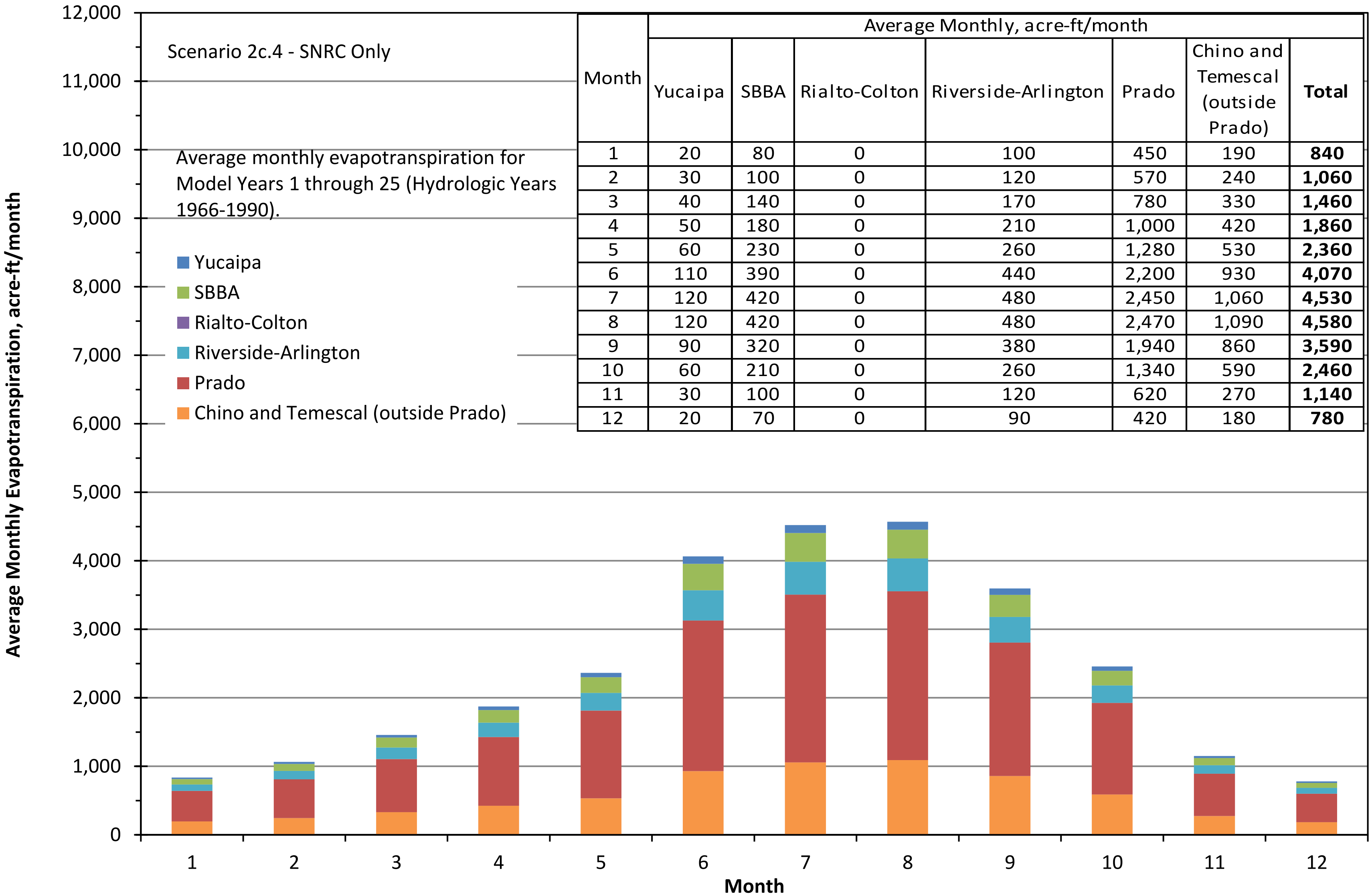


Figure 474

Scenario 2c.4: Seasonal Evapotranspiration – Integrated SAR Model Area



Month	Average Monthly, acre-ft/month						
	Yucaipa	SBBA	Rialto-Colton	Riverside-Arlington	Prado	Chino and Temescal (outside Prado)	**Total**
1	20	80	0	100	450	190	**840**
2	30	100	0	120	570	240	**1,060**
3	40	140	0	170	780	330	**1,460**
4	50	180	0	210	1,000	420	**1,860**
5	60	230	0	260	1,280	530	**2,360**
6	110	390	0	440	2,200	930	**4,070**
7	120	420	0	480	2,450	1,060	**4,530**
8	120	420	0	480	2,470	1,090	**4,580**
9	90	320	0	380	1,940	860	**3,590**
10	60	210	0	260	1,340	590	**2,460**
11	30	100	0	120	620	270	**1,140**
12	20	70	0	90	420	180	**780**

Figure 475

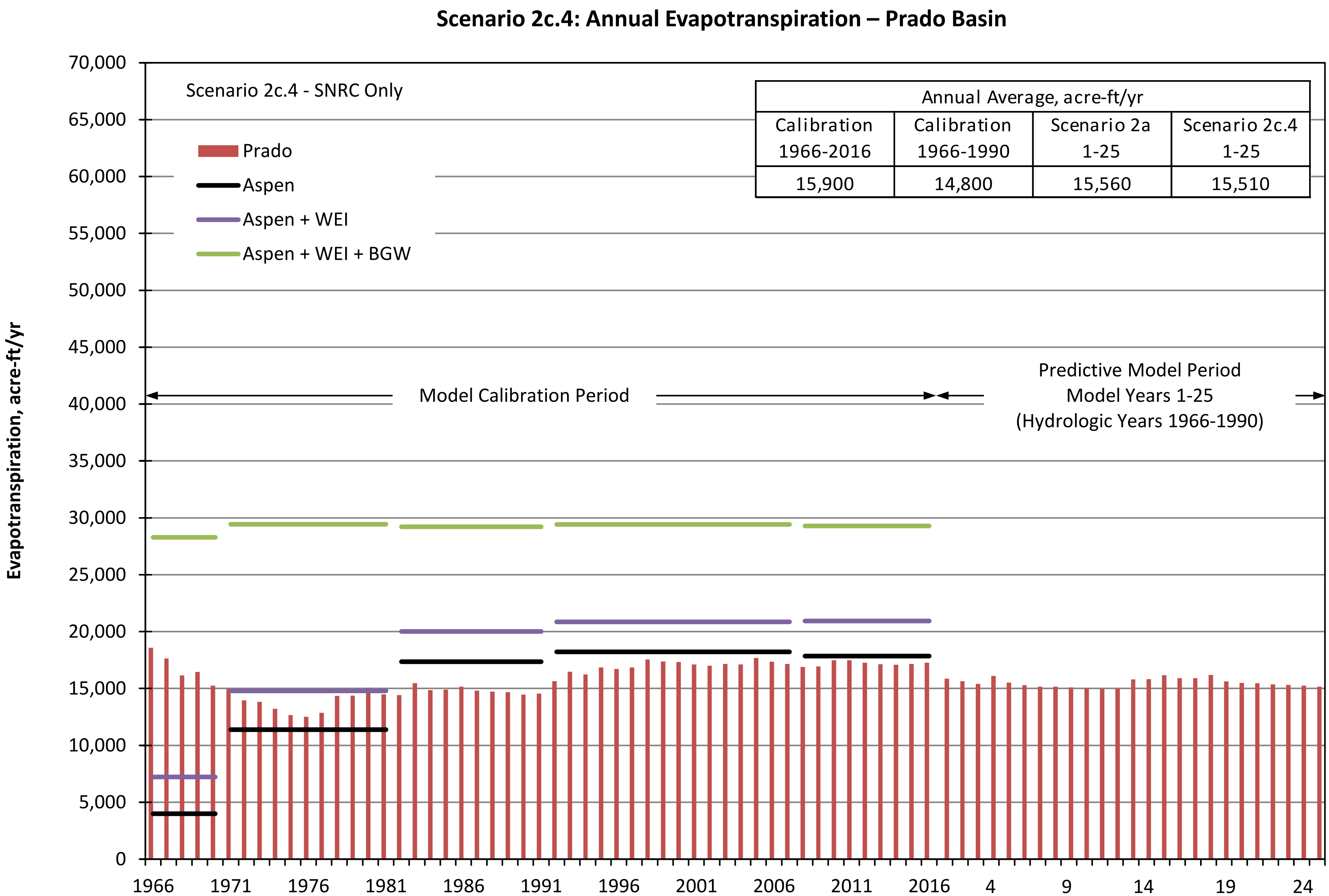

Scenario 2c.4: Annual Evapotranspiration – Prado Basin
Scenario 2c.4 - SNRC Only
Prado
Aspen
Aspen + WEI
Aspen + WEI + BGW
Annual Average, acre-ft/yr
Calibration 1966-2016
Calibration 1966-1990
Scenario 2a 1-25
Scenario 2c.4 1-25
15,900
14,800
15,560
15,510
Model Calibration Period
Predictive Model Period
Model Years 1-25
(Hydrologic Years 1966-1990)
Evapotranspiration, acre-ft/yr
70,000
65,000
60,000
55,000
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
1966
1971
1976
1981
1986
1991
1996
2001
2006
2011
2016
4
9
14
19
24

Figure 476

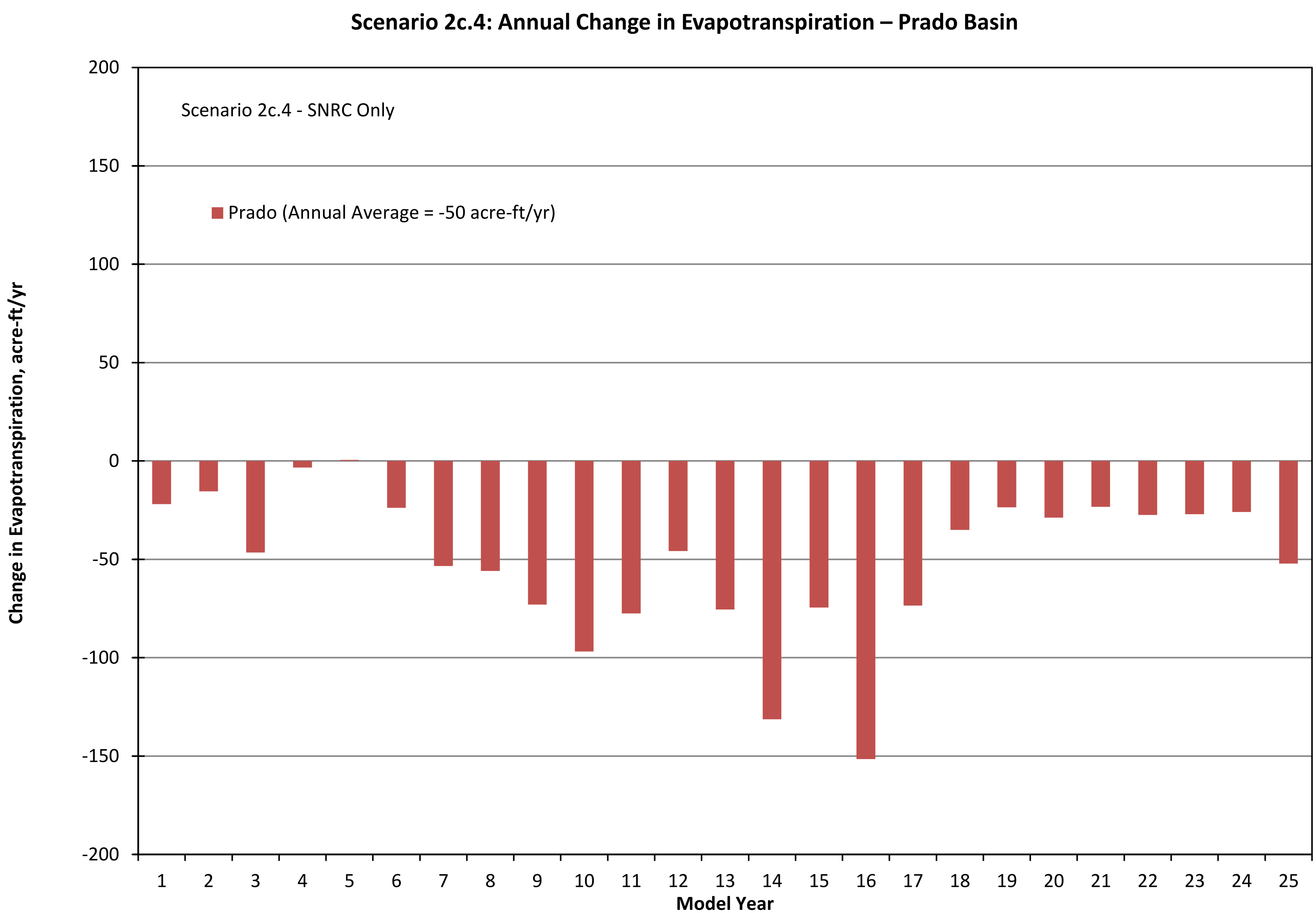
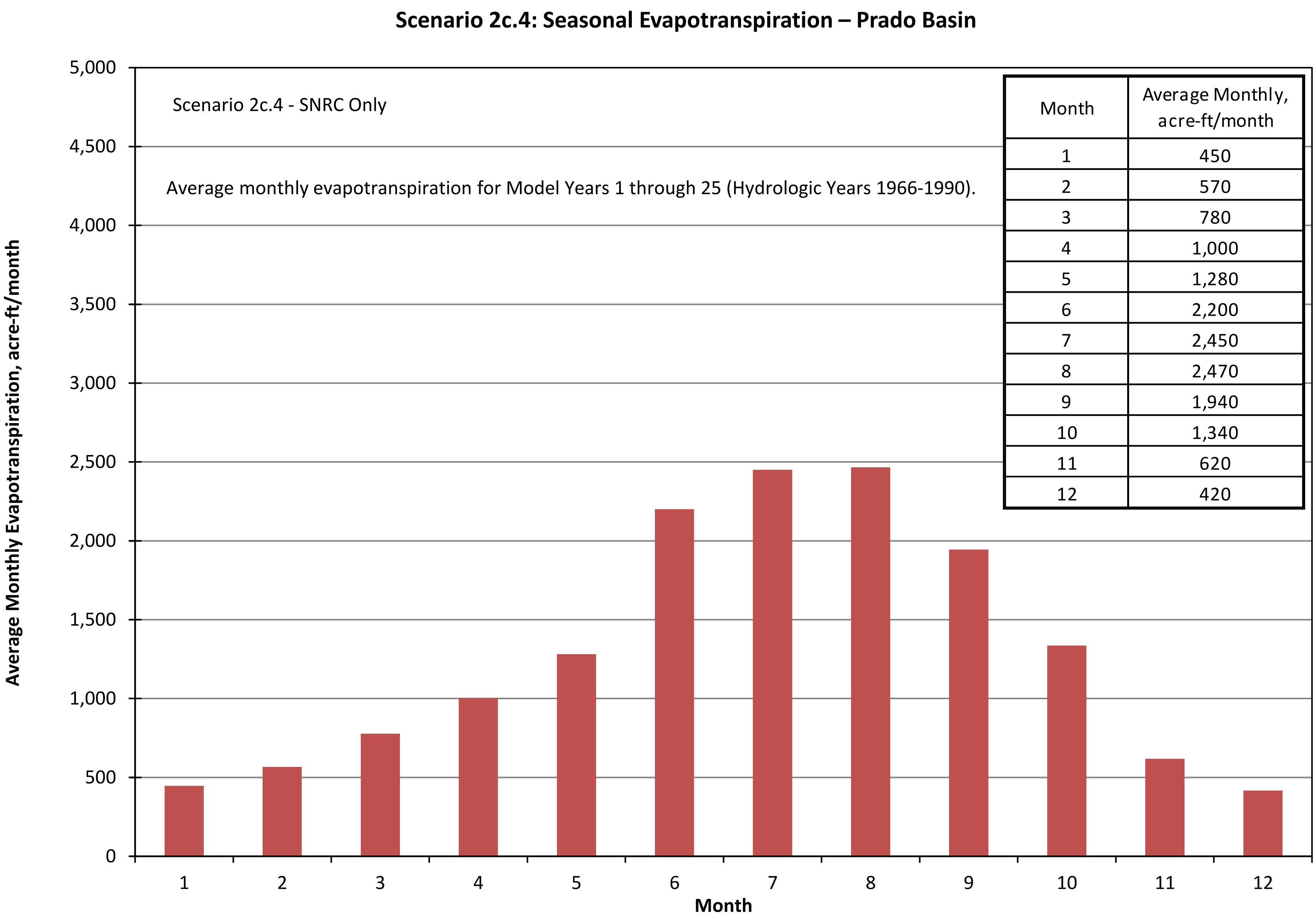

Scenario 2c.4: Annual Change in Evapotranspiration – Prado Basin
Scenario 2c.4 - SNRC Only
Prado (Annual Average = -50 acre-ft/yr)
Change in Evapotranspiration, acre-ft/yr
200
150
100
50
0
-50
-100
-150
-200
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
Model Year

Figure 477



Month	Average Monthly, acre-ft/month
1	450
2	570
3	780
4	1,000
5	1,280
6	2,200
7	2,450
8	2,470
9	1,940
10	1,340
11	620
12	420

Figure 478

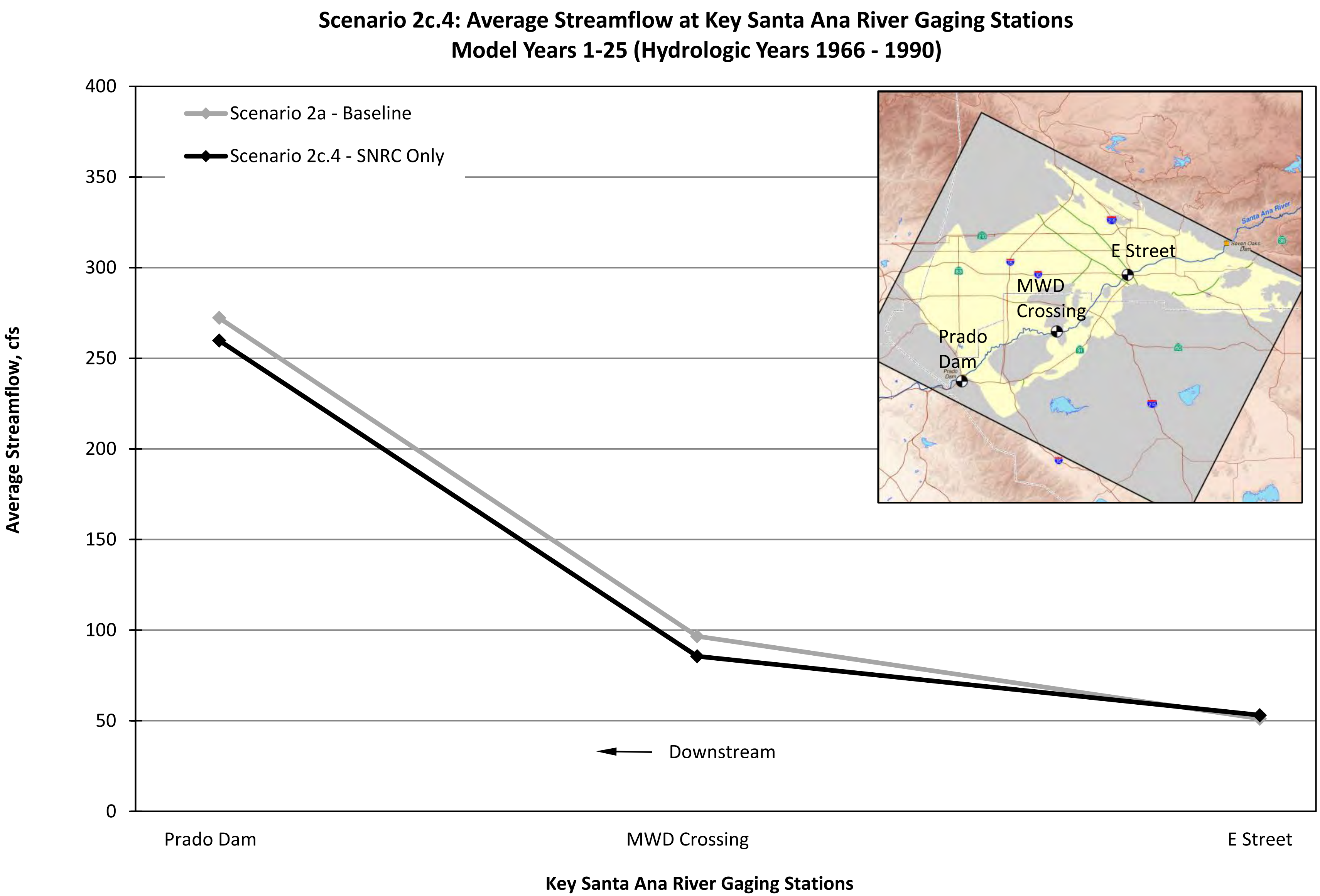

Scenario 2c.4: Average Streamflow at Key Santa Ana River Gaging Stations
Model Years 1-25 (Hydrologic Years 1966 - 1990)
Scenario 2a - Baseline
Scenario 2c.4 - SNRC Only
Average Streamflow, cfs
400
350
300
250
200
150
100
50
0
Downstream
Prado Dam
MWD Crossing
E Street
Key Santa Ana River Gaging Stations
E Street
MWD
Crossing
Prado
Dam
Santa Ana River

Figure 479

Scenario 2c.4: Distribution of Monthly Streamflow at the Santa Ana River at E Street Gaging Station

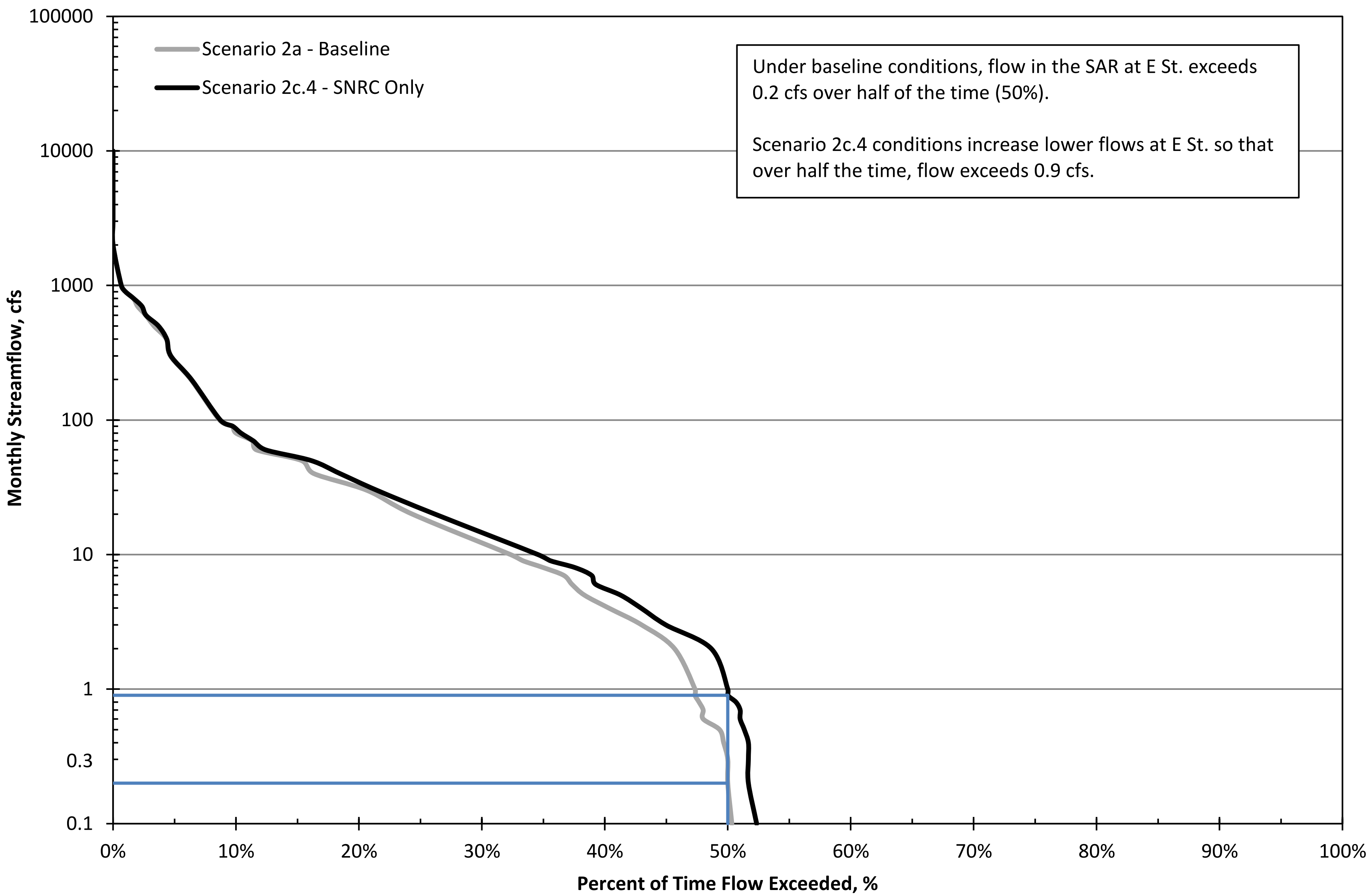


Figure 480

Scenario 2c.4: Distribution of Monthly Streamflow at the Santa Ana River at MWD Crossing Gaging Station

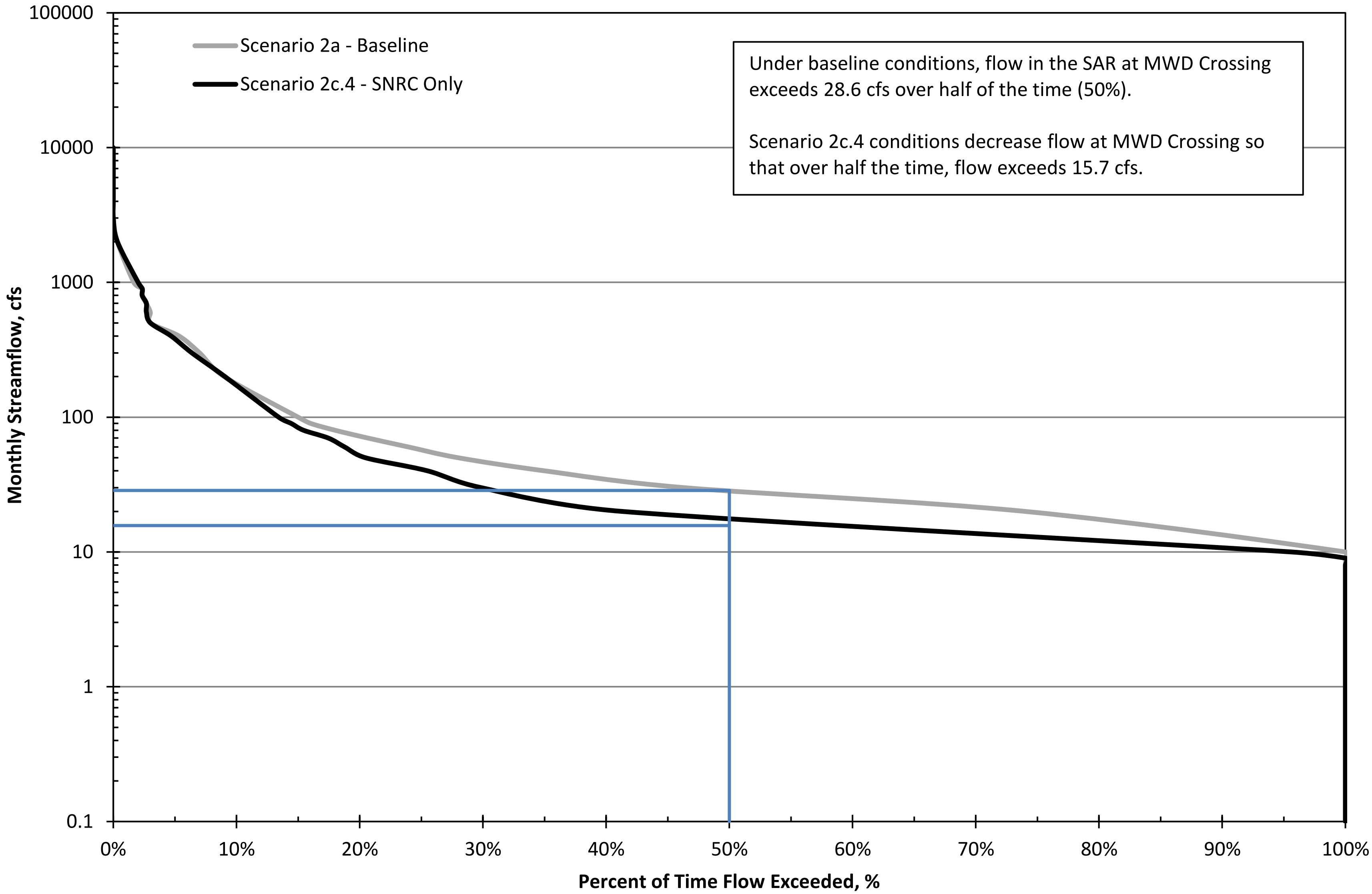


Figure 481

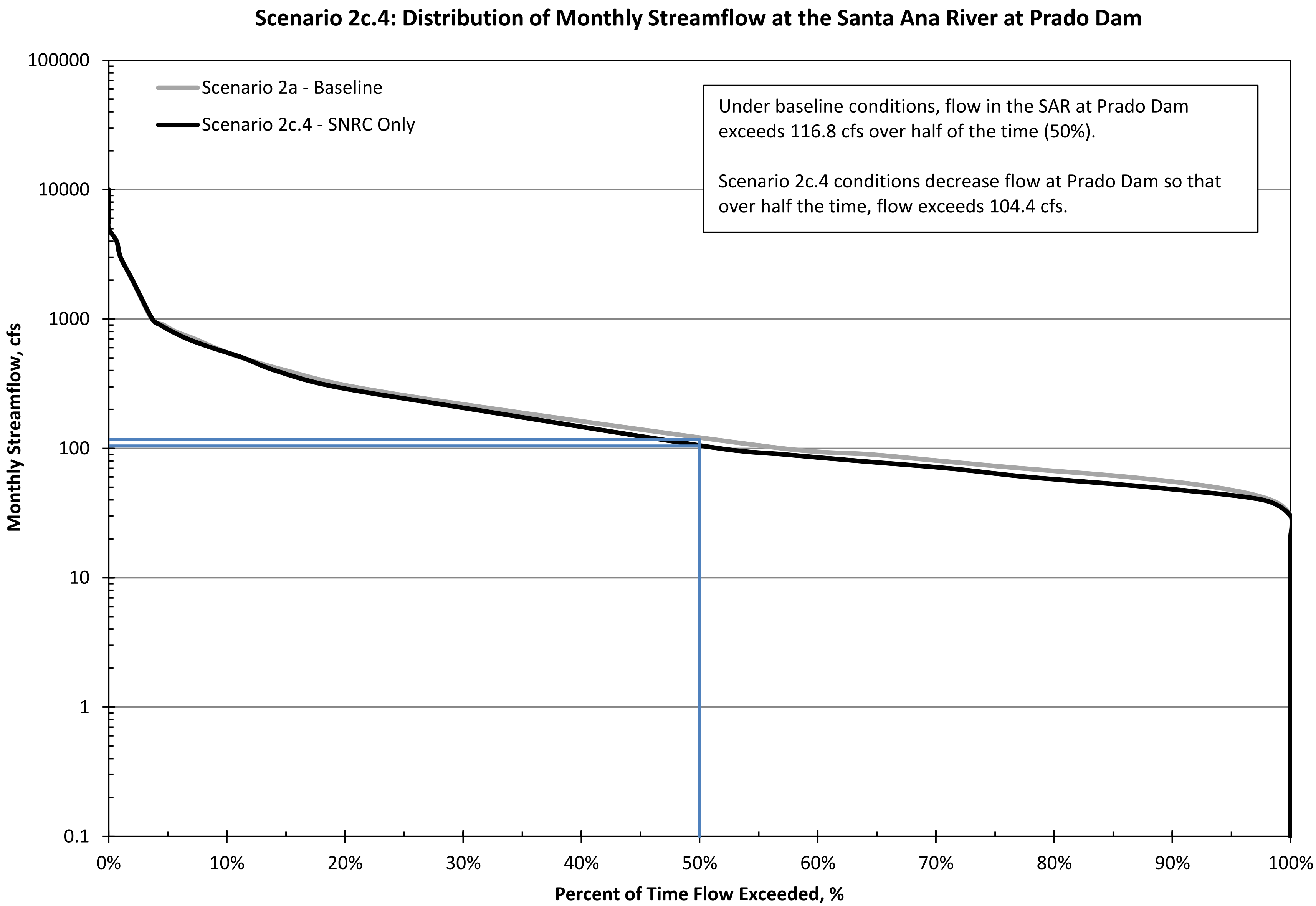
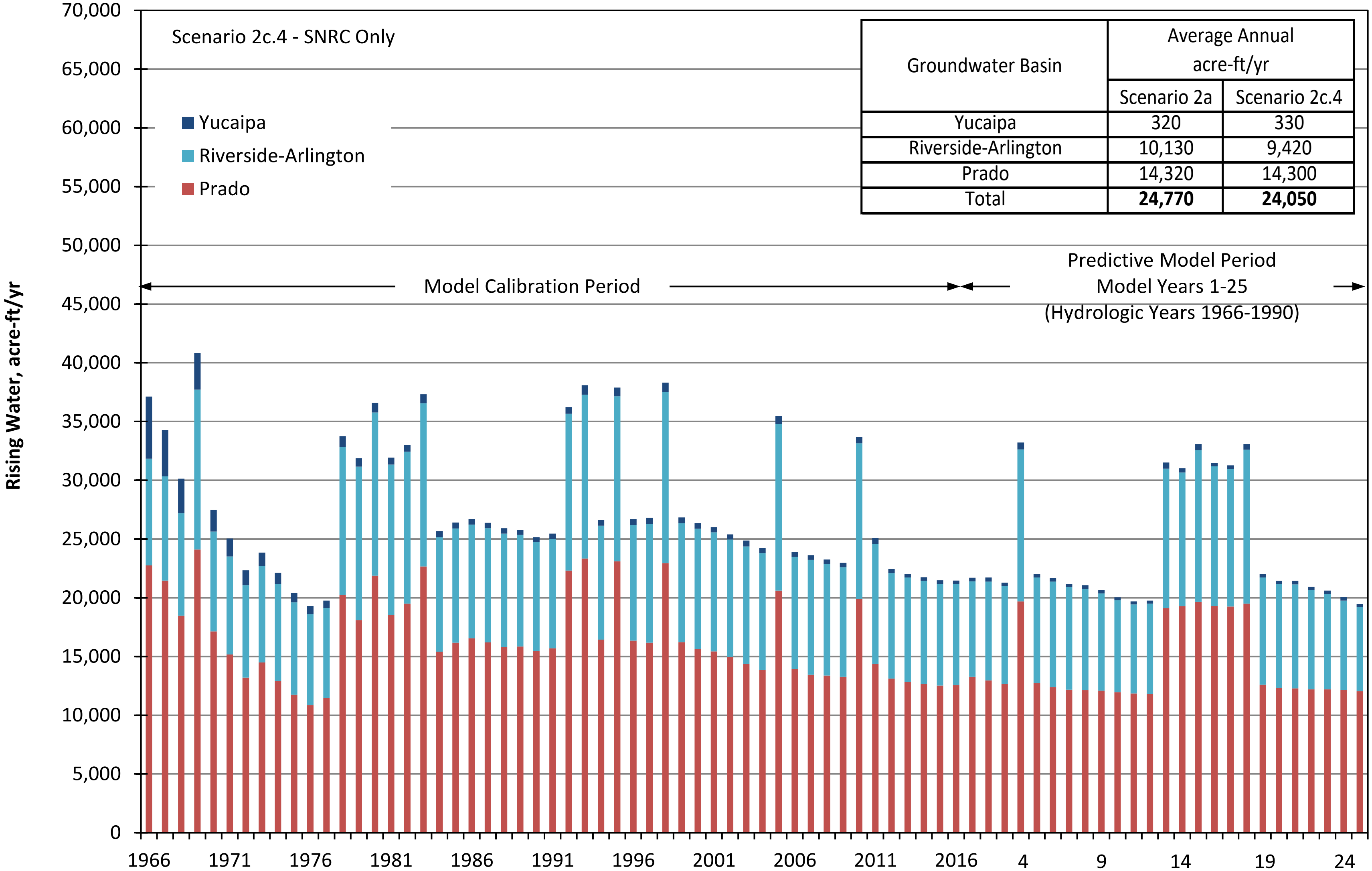

Scenario 2c.4: Distribution of Monthly Streamflow at the Santa Ana River at Prado Dam
Scenario 2a - Baseline
Scenario 2c.4 - SNRC Only
Under baseline conditions, flow in the SAR at Prado Dam exceeds 116.8 cfs over half of the time (50%).
Scenario 2c.4 conditions decrease flow at Prado Dam so that over half the time, flow exceeds 104.4 cfs.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 482

Scenario 2c.4: Annual Rising Water – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2c.4
Yucaipa	320	330
Riverside-Arlington	10,130	9,420
Prado	14,320	14,300
Total	**24,770**	**24,050**

Figure 483

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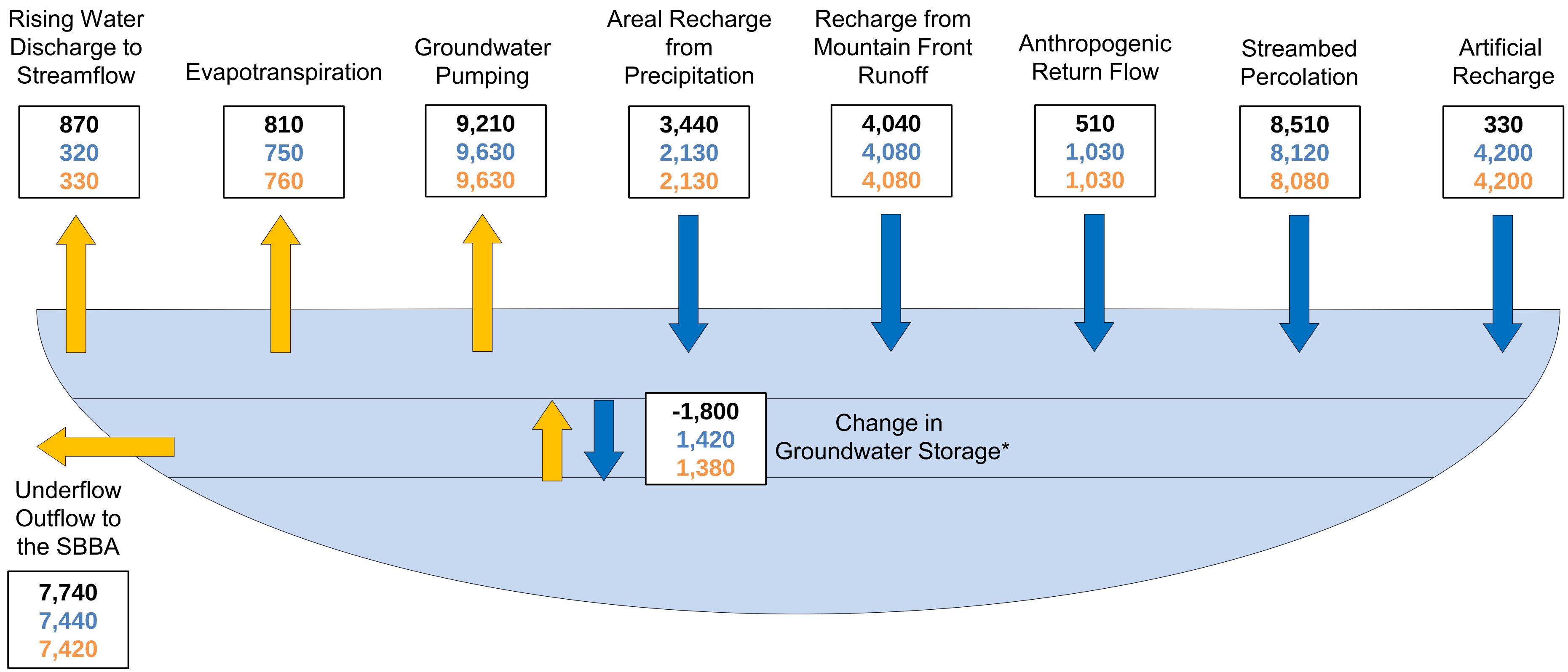

Scenario 2a - Baseline
Scenario 2c.4 - SNRC Only

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2c.4 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2C.4
AVERAGE ANNUAL
WATER BUDGET
YUCAIPA BASIN

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT
UPPER SANTA ANA RIVER INTEGRATED MODEL – SUMMARY REPORT

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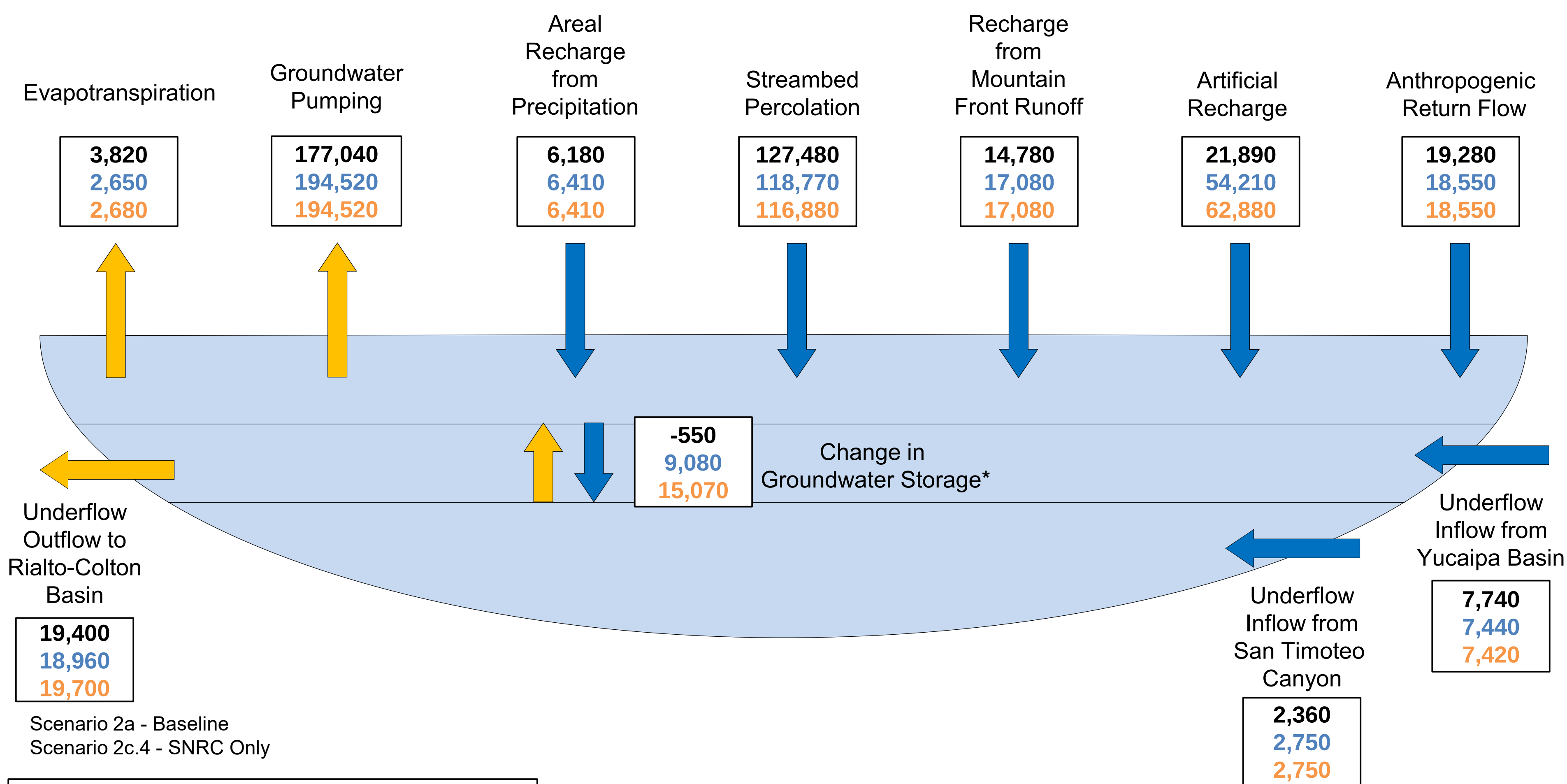
FIGURE 484

GEOSCIENCE



Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2c.4 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2C.4 AVERAGE ANNUAL WATER BUDGET SBBA

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10-Apr-20

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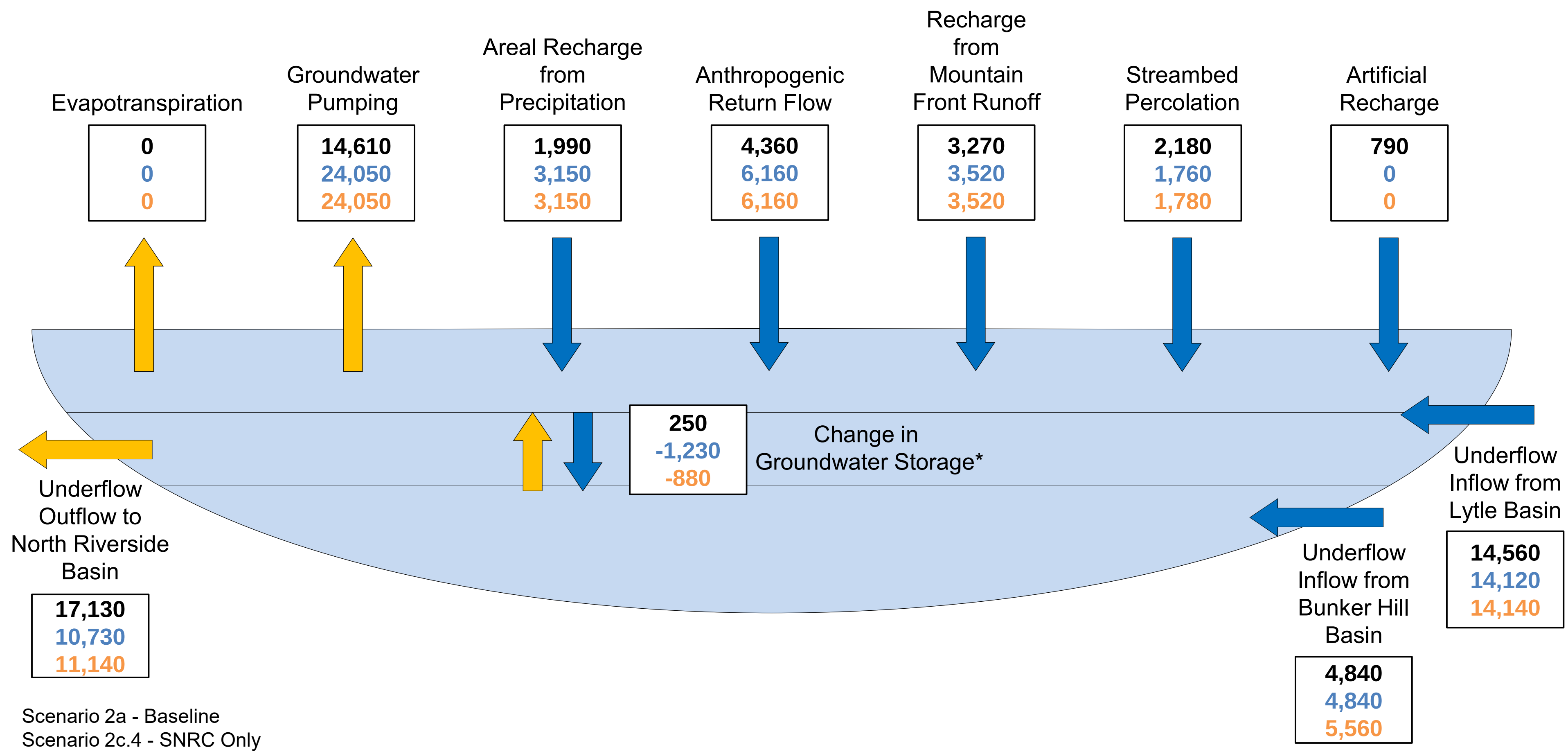


Scenario 2a - Baseline
Scenario 2c.4 - SNRC Only

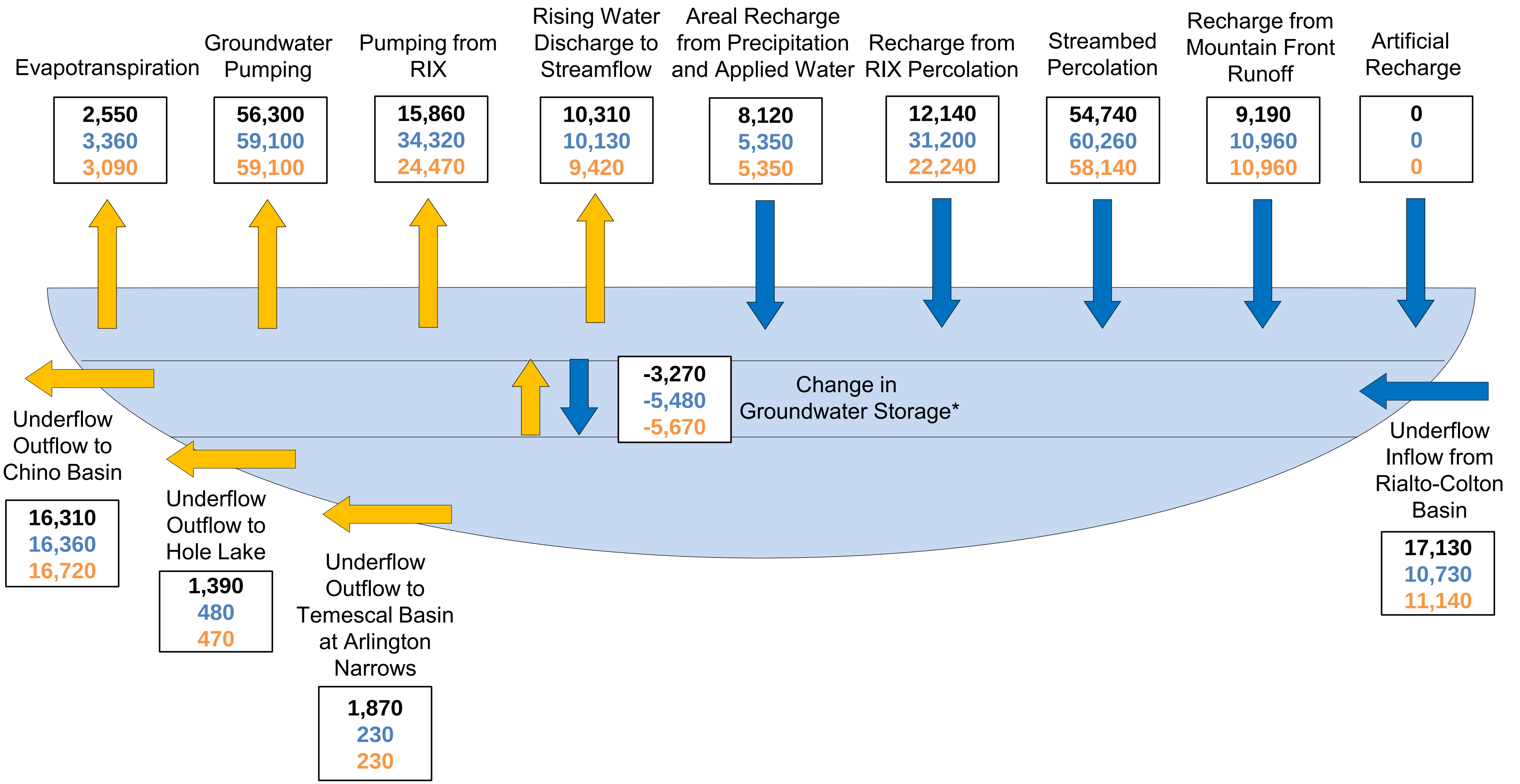
Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2c.4 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

**SCENARIO 2C.4
AVERAGE ANNUAL
WATER BUDGET
RIALTO-COLTON BASIN**

10-Apr-20



Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2c.4 (Hydrologic Period 1966-1990)

Scenario 2a - Baseline
Scenario 2c.4 - SNRC Only

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2C.4
AVERAGE ANNUAL WATER BUDGET
RIVERSIDE-ARLINGTON BASIN

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10-Apr-20

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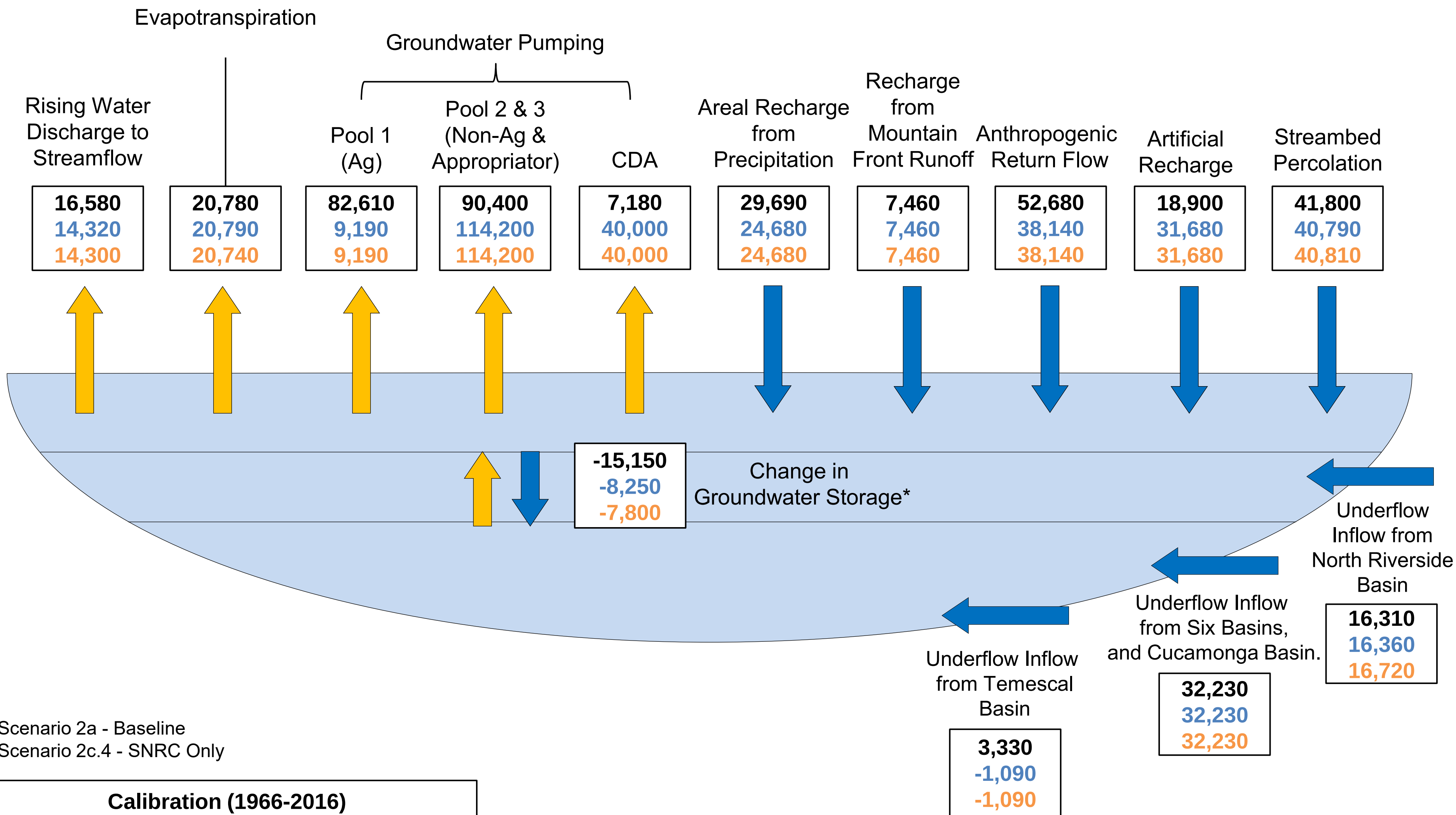

Scenario 2a - Baseline
Scenario 2c.4 - SNRC Only

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2c.4 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2C.4
AVERAGE ANNUAL
WATER BUDGET
CHINO BASIN

10-Apr-20

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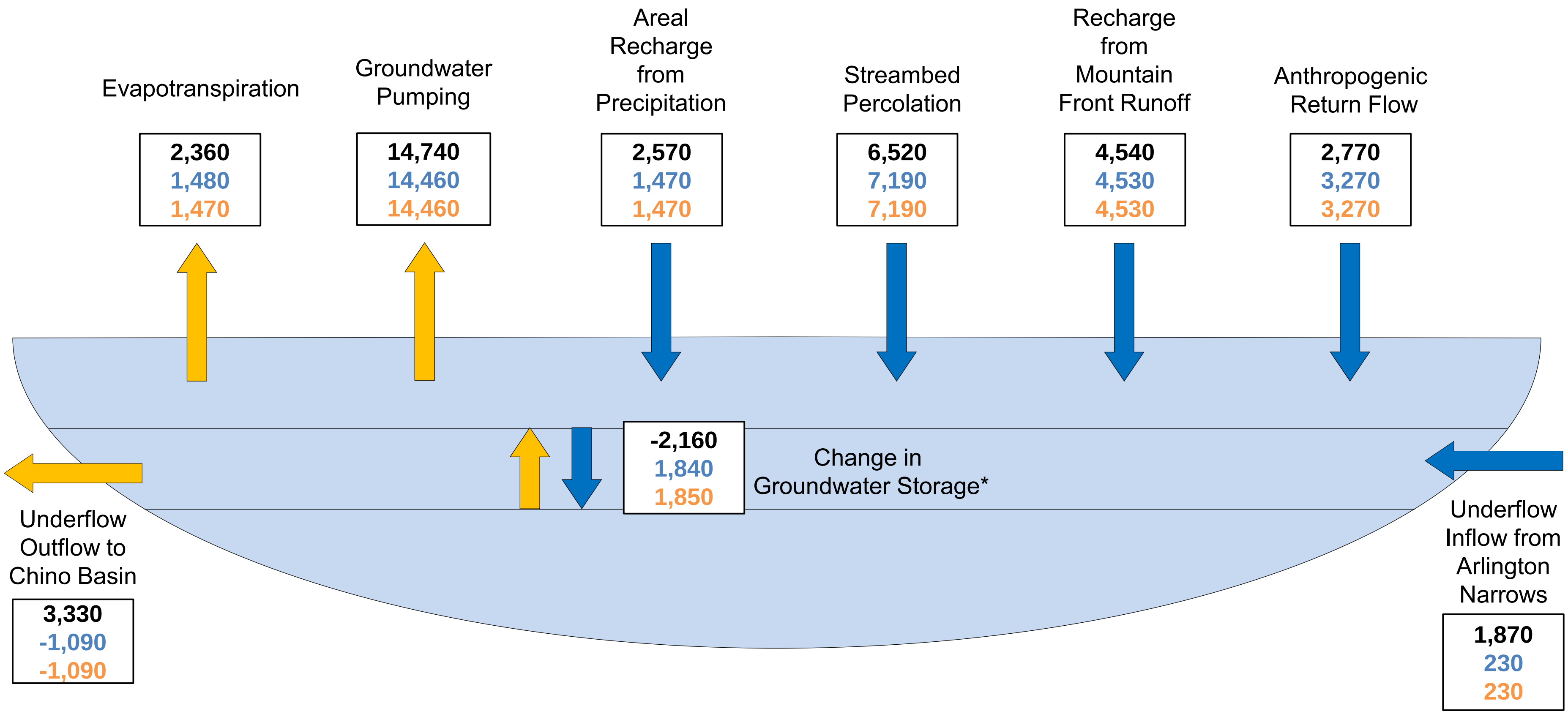


Scenario 2a - Baseline
Scenario 2c.4 - SNRC Only

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2c.4 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

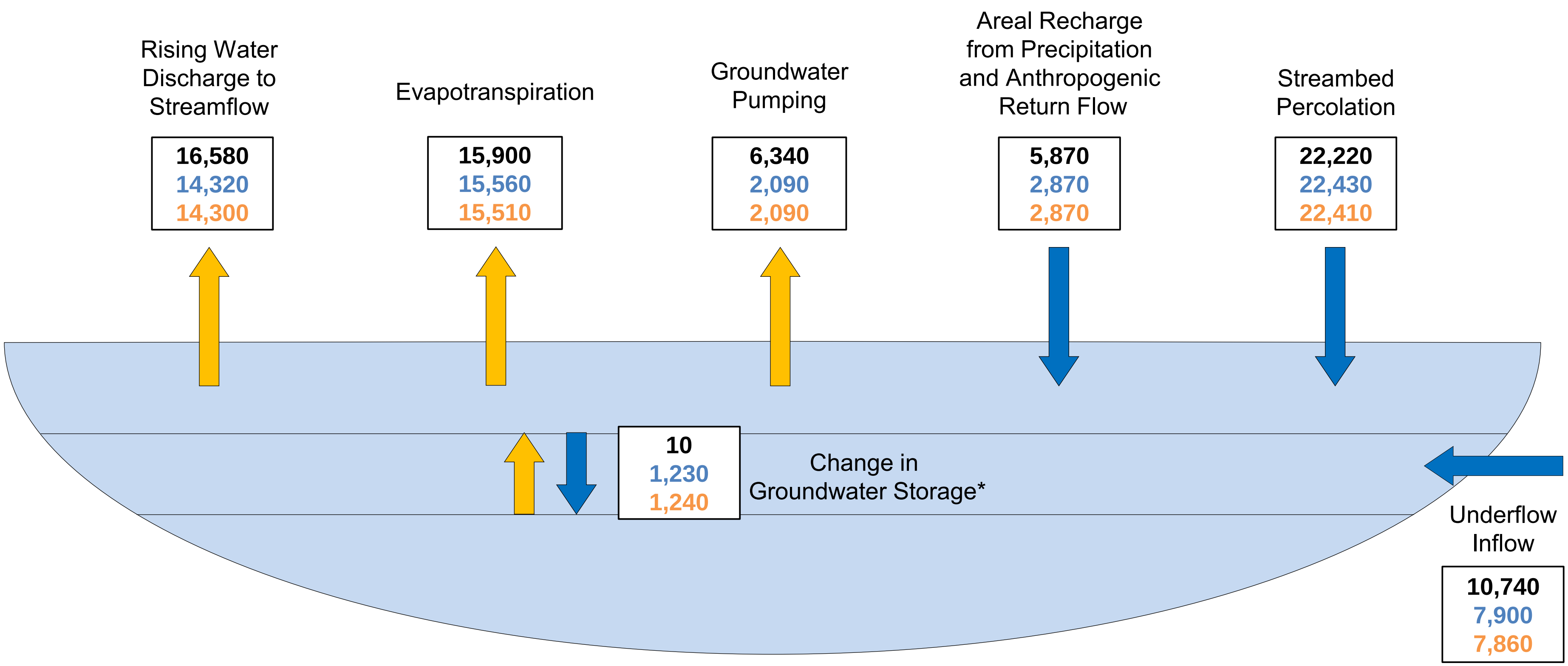
SCENARIO 2C.4
AVERAGE ANNUAL
WATER BUDGET
TEMESCAL BASIN

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT **DRAFT** **FIGURE 489**

UPPER SANTA ANA RIVER INTEGRATED MODEL – SUMMARY REPORT

GEOSCIENCE



Scenario 2a - Baseline
Scenario 2c.4 - SNRC Only

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2c.4 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2C.4
AVERAGE ANNUAL
WATER BUDGET
PRADO BASIN

10-Apr-20

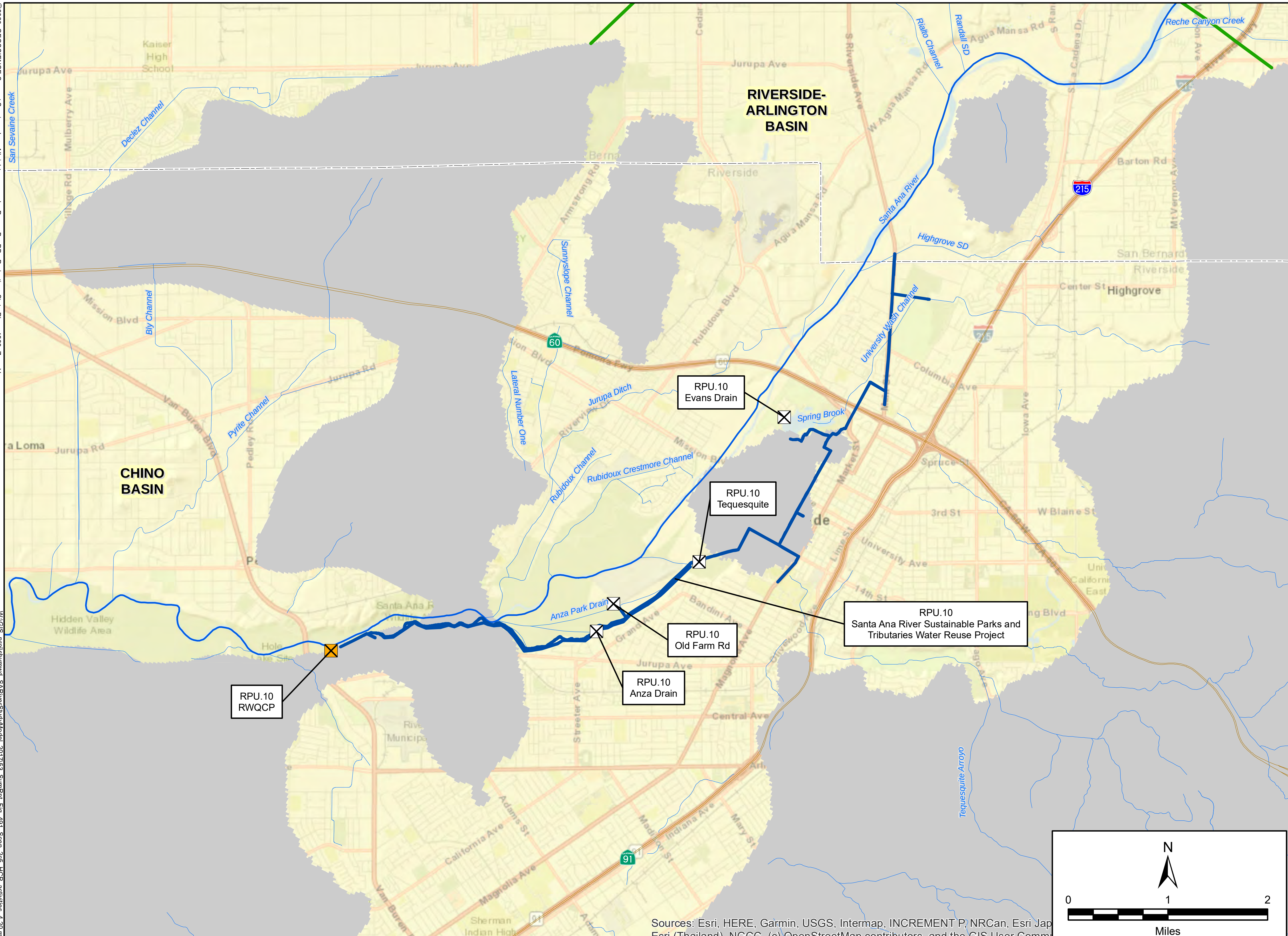
SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

DRAFT

FIGURE 490

UPPER SANTA ANA RIVER INTEGRATED MODEL – SUMMARY REPORT

GEOSCIENCE

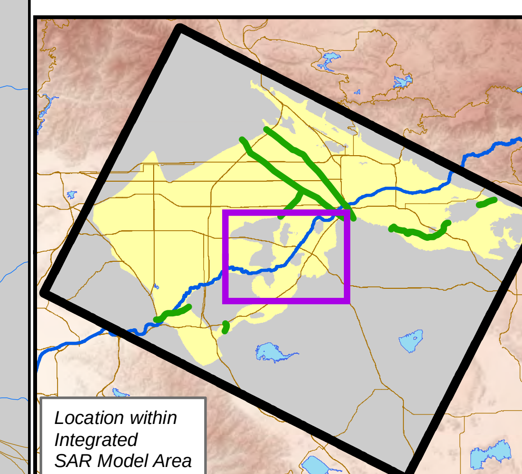


EXPLANATION

- Integrated SAR Model Boundary
- Active Model Area
- Inactive Model Area
- Habitat Conservation Plan (HCP) Covered Activity
  - RPU.10 Name
    - Project ID
    - Name of HCP Project
- Groundwater Basin Boundary
- Recycled Water Discharge Point (https://www.waterboards.ca.gov)
- Riverside RWQCP Discharge Location for Santa Ana Sucker Habitat (City of Riverside)

Refer to Table 17 for HCP Covered Activity Description

Scenario 2c.5:
Baseflow Reduction Activities - SAR Sustainable Parks and Tributaries Water Reuse Project



SCENARIO 2c.5
LOCATION OF
HCP COVERED ACTIVITIES

W:\GIS_projects\svmwd_SARiverStudyModel_2017\53_SumRpt_Fig_491_Scen_2c5_HCP_activities_4-20.mxd

10-Apr-20

DRAFT

FIGURE 491

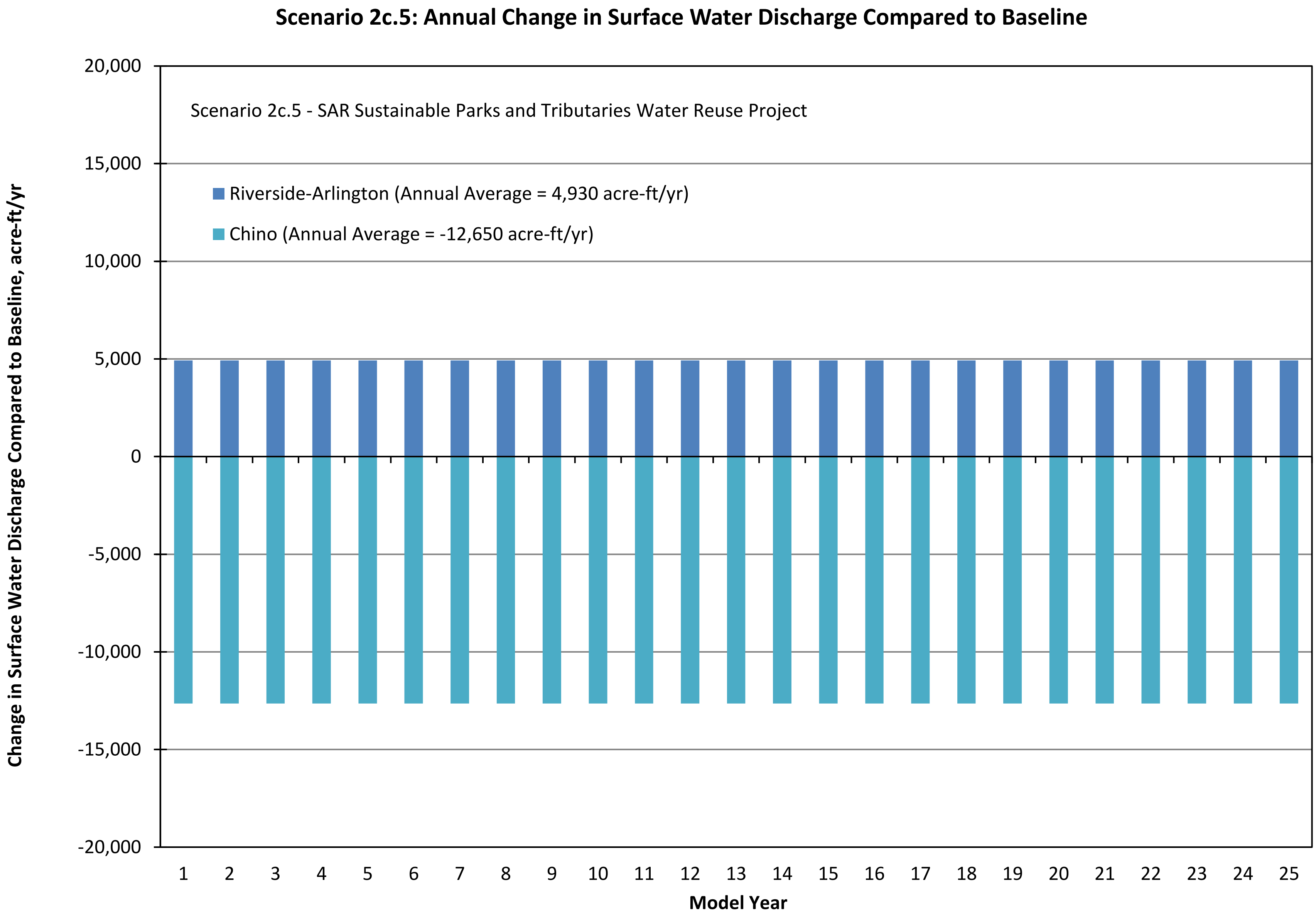
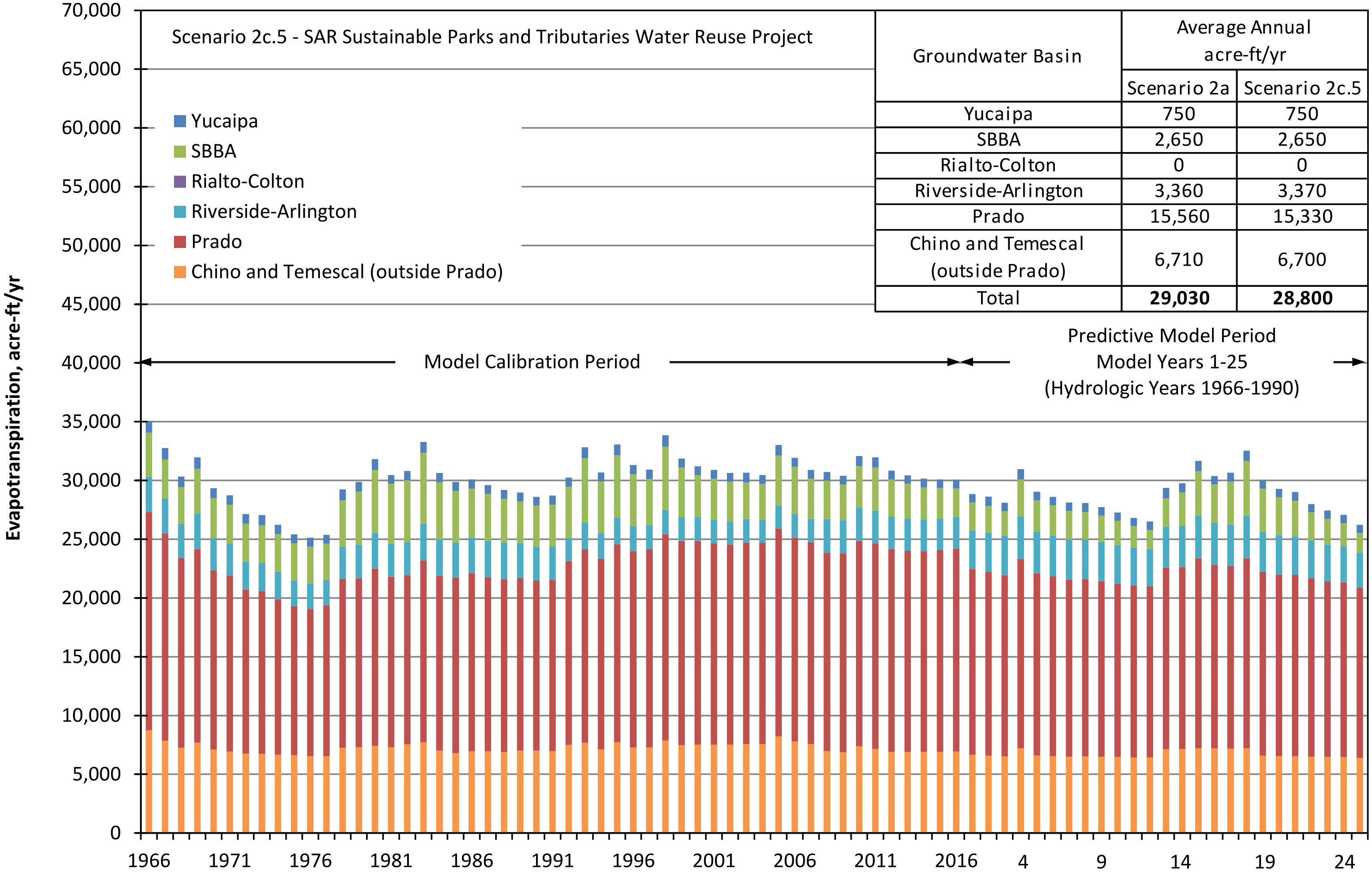

Scenario 2c.5: Annual Change in Surface Water Discharge Compared to Baseline
Scenario 2c.5 - SAR Sustainable Parks and Tributaries Water Reuse Project
Riverside-Arlington (Annual Average = 4,930 acre-ft/yr)
Chino (Annual Average = -12,650 acre-ft/yr)
Change in Surface Water Discharge Compared to Baseline, acre-ft/yr
20,000
15,000
10,000
5,000
0
-5,000
-10,000
-15,000
-20,000
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
Model Year

Figure 492

Scenario 2c.5: Annual Evapotranspiration – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2c.5
Yucaipa	750	750
SBBA	2,650	2,650
Rialto-Colton	0	0
Riverside-Arlington	3,360	3,370
Prado	15,560	15,330
Chino and Temescal (outside Prado)	6,710	6,700
Total	**29,030**	**28,800**

Figure 493

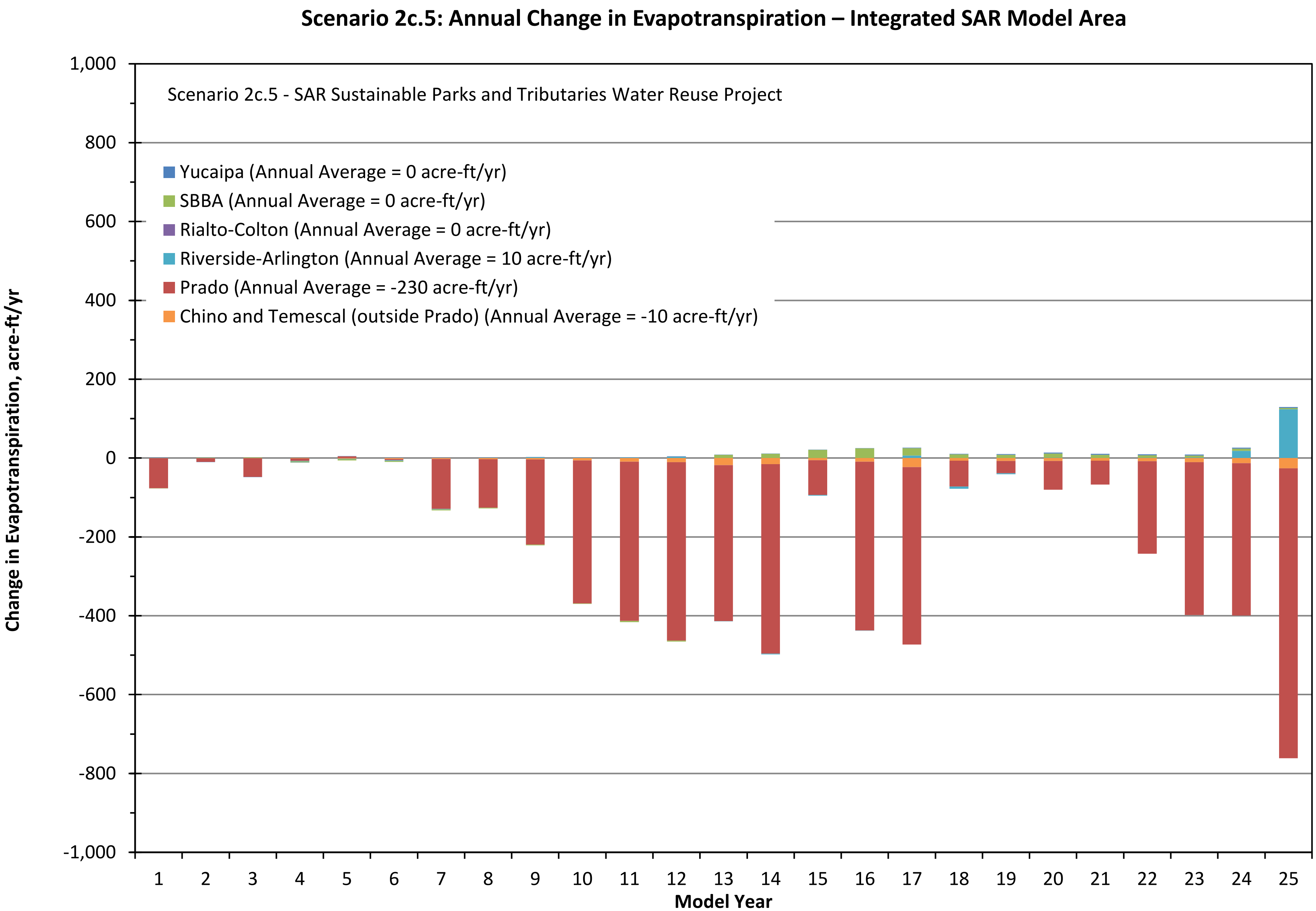
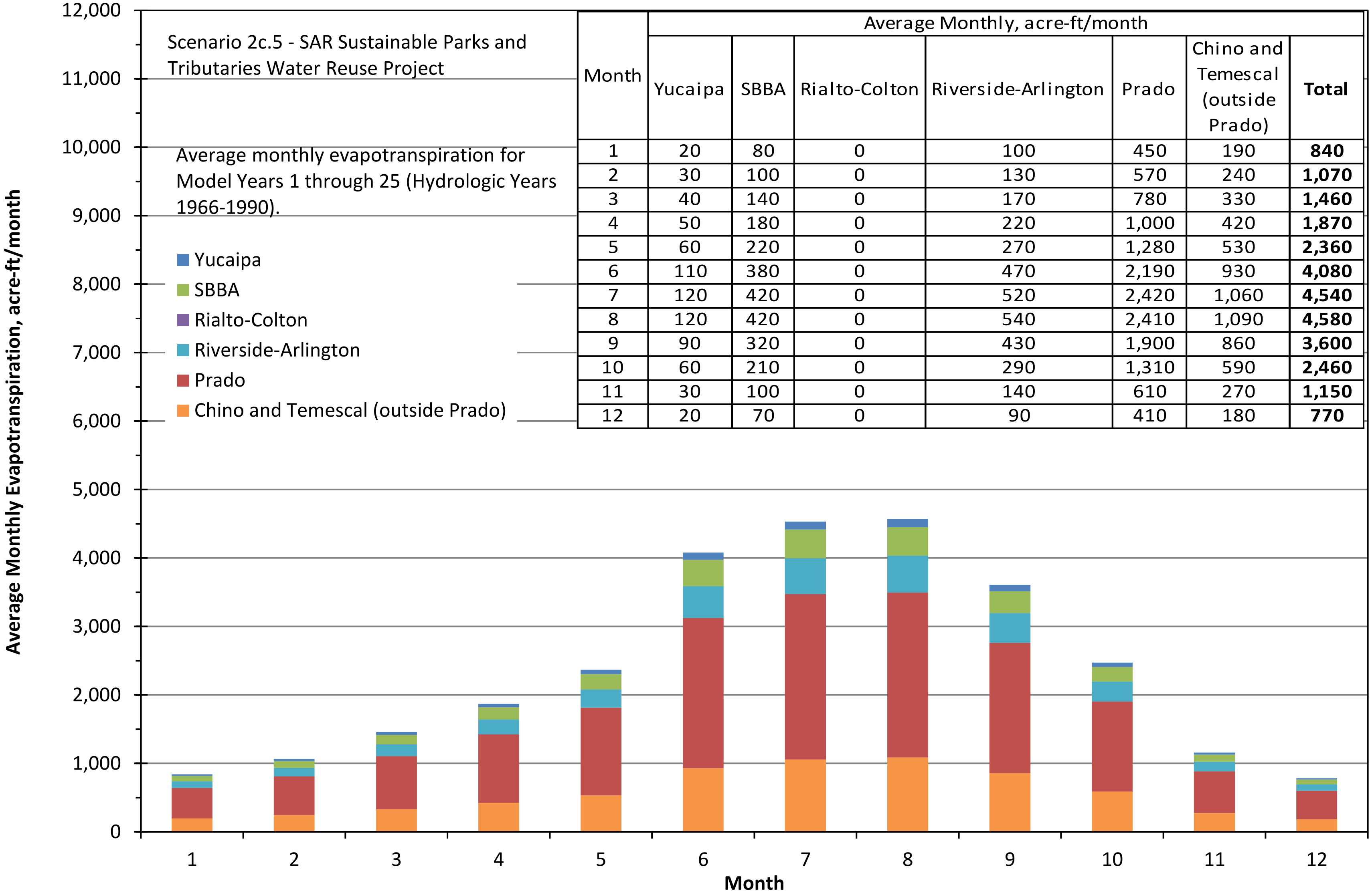

Scenario 2c.5: Annual Change in Evapotranspiration – Integrated SAR Model Area
Scenario 2c.5 - SAR Sustainable Parks and Tributaries Water Reuse Project
Yucaipa (Annual Average = 0 acre-ft/yr)
SBBA (Annual Average = 0 acre-ft/yr)
Rialto-Colton (Annual Average = 0 acre-ft/yr)
Riverside-Arlington (Annual Average = 10 acre-ft/yr)
Prado (Annual Average = -230 acre-ft/yr)
Chino and Temescal (outside Prado) (Annual Average = -10 acre-ft/yr)
Change in Evapotranspiration, acre-ft/yr
1,000
800
600
400
200
0
-200
-400
-600
-800
-1,000
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
Model Year

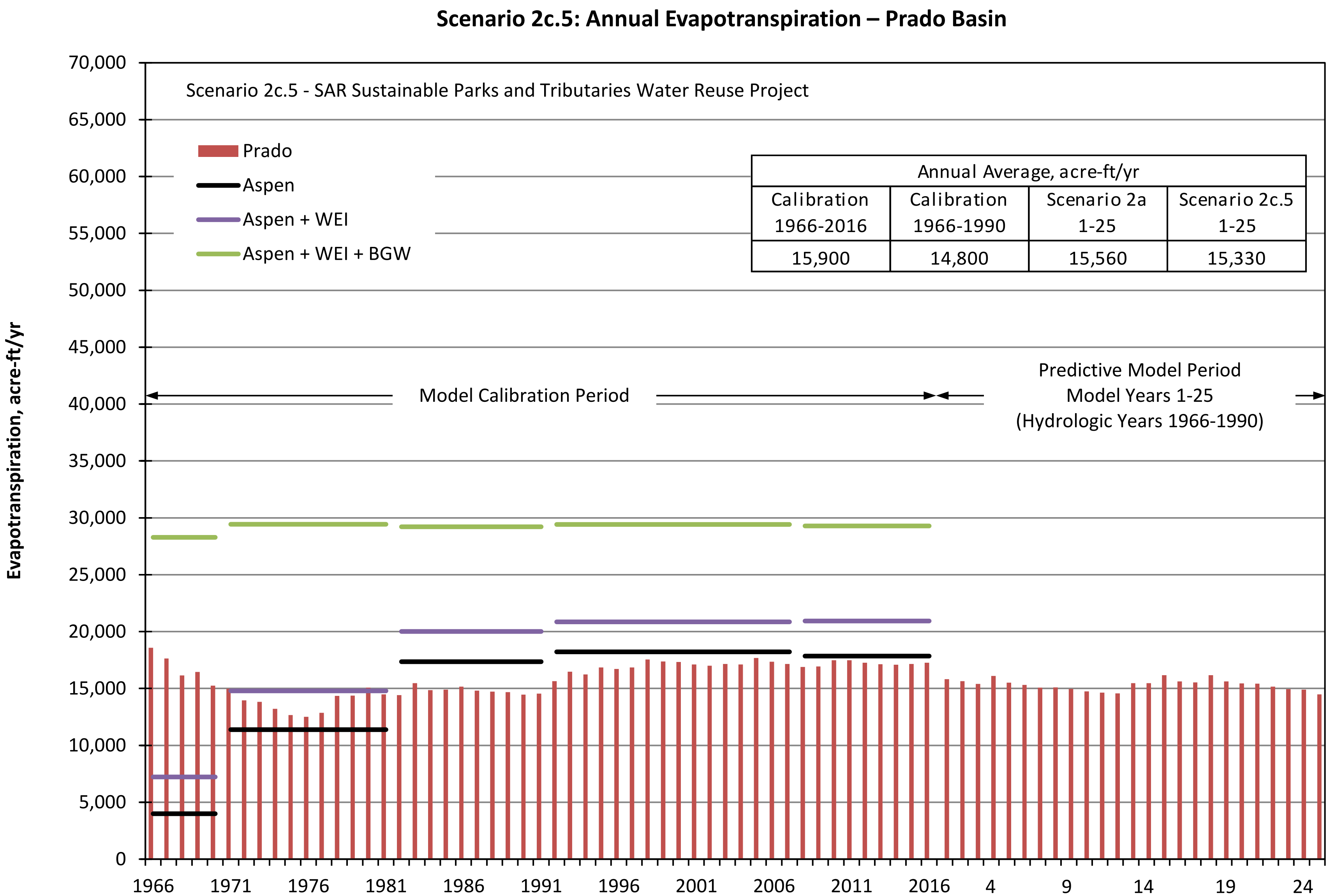
Figure 494

Scenario 2c.5: Seasonal Evapotranspiration – Integrated SAR Model Area



Month	Average Monthly, acre-ft/month						
	Yucaipa	SBBA	Rialto-Colton	Riverside-Arlington	Prado	Chino and Temescal (outside Prado)	**Total**
1	20	80	0	100	450	190	**840**
2	30	100	0	130	570	240	**1,070**
3	40	140	0	170	780	330	**1,460**
4	50	180	0	220	1,000	420	**1,870**
5	60	220	0	270	1,280	530	**2,360**
6	110	380	0	470	2,190	930	**4,080**
7	120	420	0	520	2,420	1,060	**4,540**
8	120	420	0	540	2,410	1,090	**4,580**
9	90	320	0	430	1,900	860	**3,600**
10	60	210	0	290	1,310	590	**2,460**
11	30	100	0	140	610	270	**1,150**
12	20	70	0	90	410	180	**770**

Figure 495



Annual Average, acre-ft/yr			
Calibration 1966-2016	Calibration 1966-1990	Scenario 2a 1-25	Scenario 2c.5 1-25
15,900	14,800	15,560	15,330

Figure 496

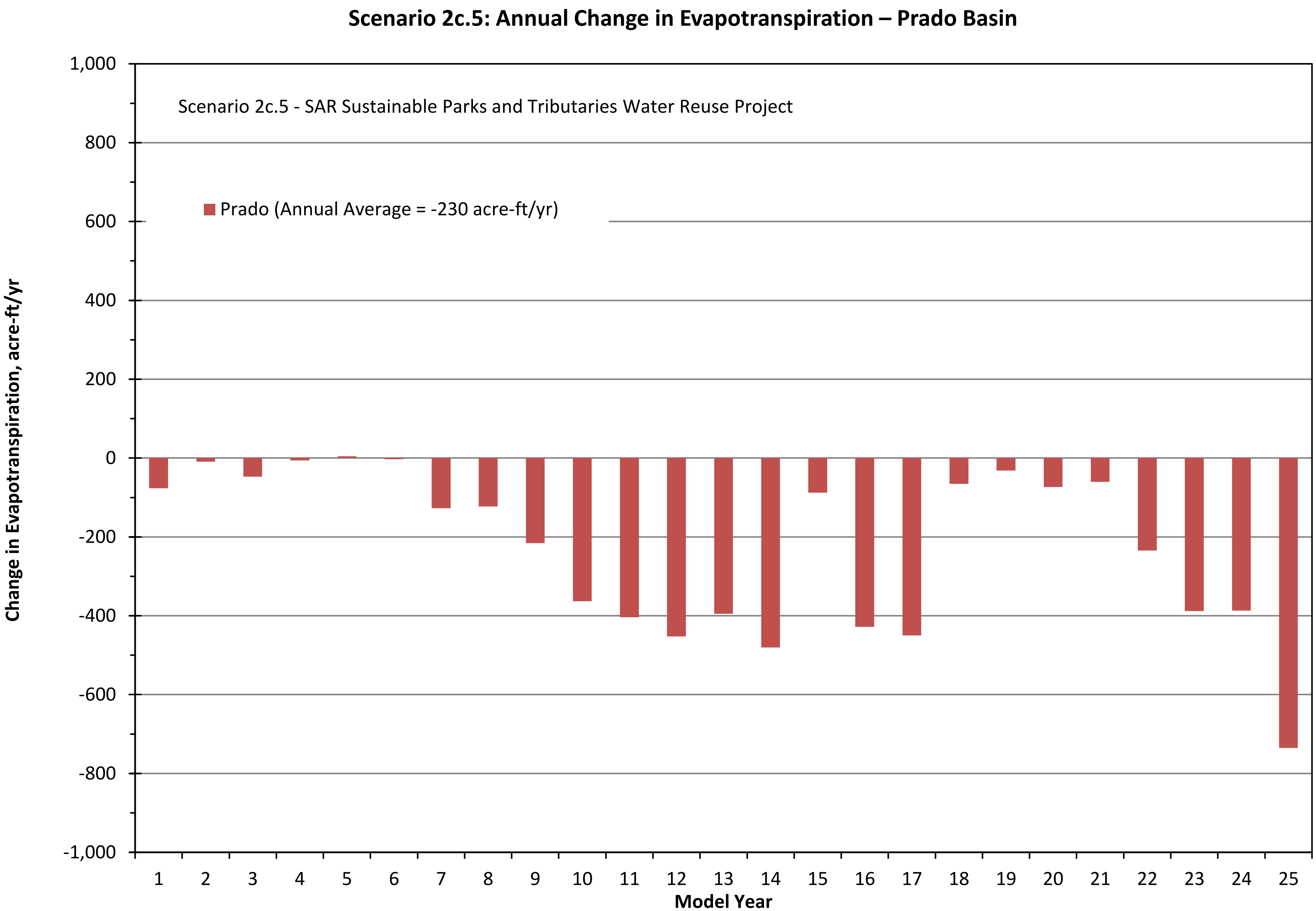
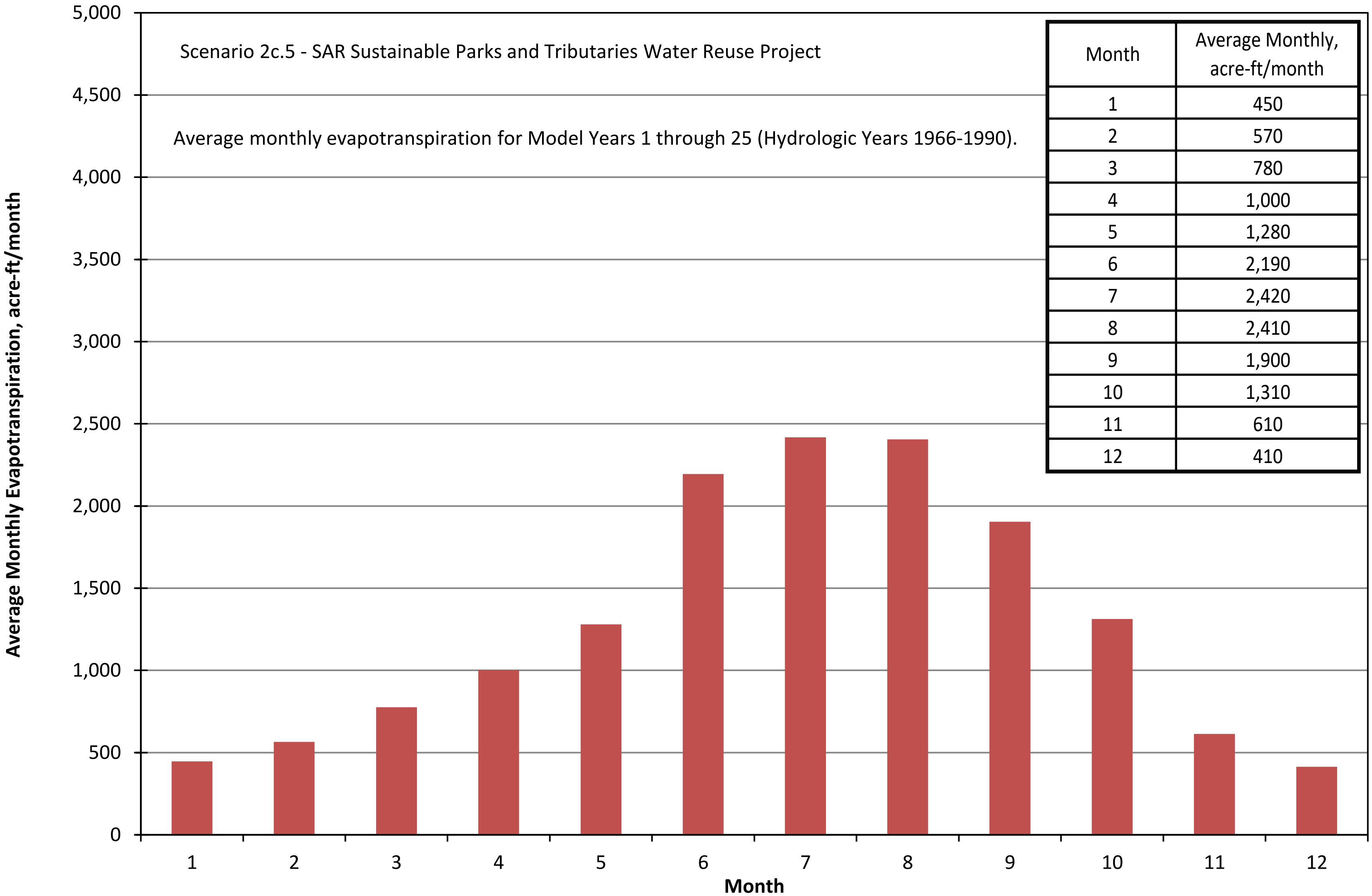

Scenario 2c.5: Annual Change in Evapotranspiration – Prado Basin
Scenario 2c.5 - SAR Sustainable Parks and Tributaries Water Reuse Project
Prado (Annual Average = -230 acre-ft/yr)
Change in Evapotranspiration, acre-ft/yr
1,000
800
600
400
200
0
-200
-400
-600
-800
-1,000
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
Model Year

Figure 497

Scenario 2c.5: Seasonal Evapotranspiration – Prado Basin



Month	Average Monthly, acre-ft/month
1	450
2	570
3	780
4	1,000
5	1,280
6	2,190
7	2,420
8	2,410
9	1,900
10	1,310
11	610
12	410

Figure 498

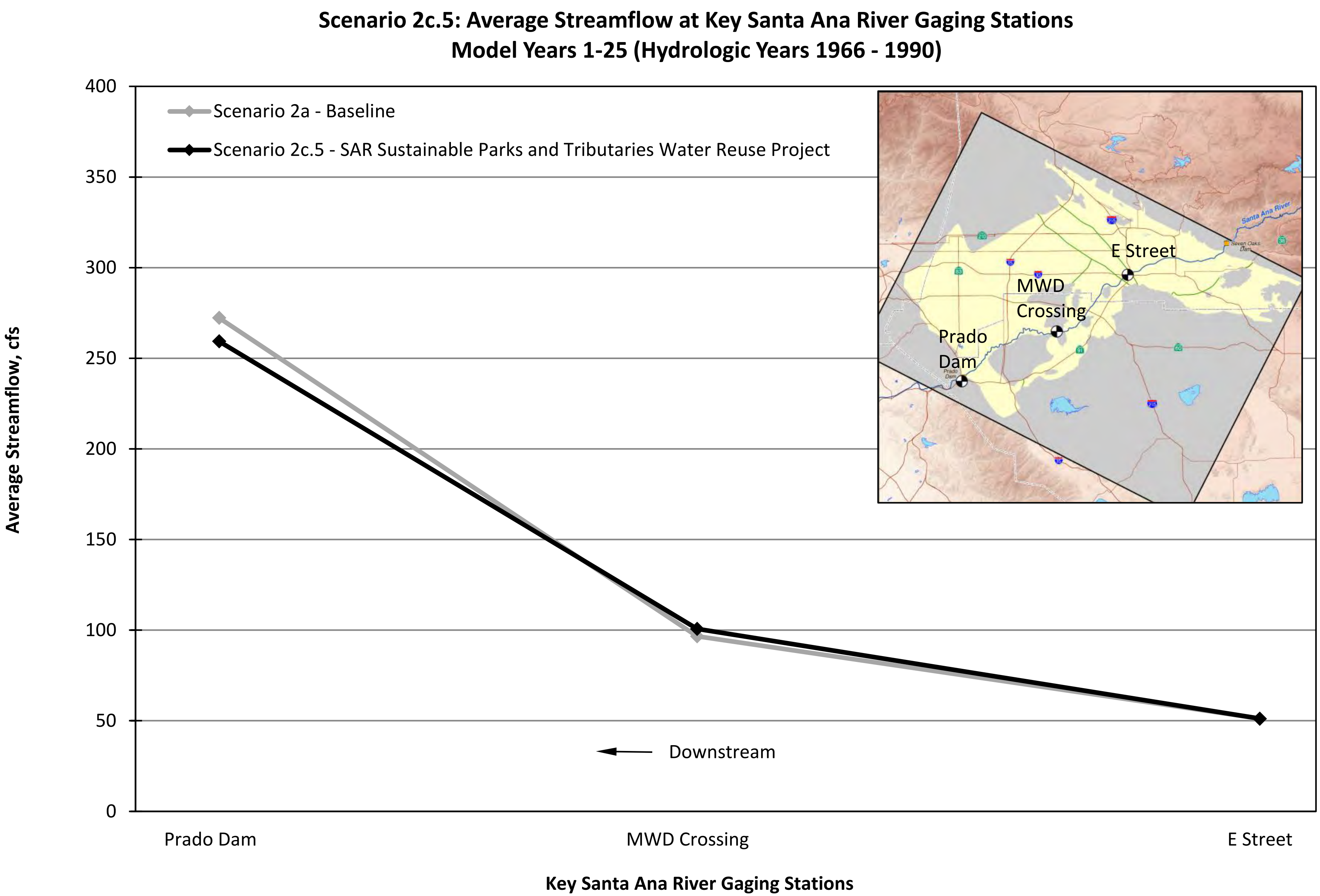

Scenario 2c.5: Average Streamflow at Key Santa Ana River Gaging Stations
Model Years 1-25 (Hydrologic Years 1966 - 1990)
Scenario 2a - Baseline
Scenario 2c.5 - SAR Sustainable Parks and Tributaries Water Reuse Project
Average Streamflow, cfs
400
350
300
250
200
150
100
50
0
Downstream
E Street
MWD
Crossing
Prado
Dam
Prado Dam
MWD Crossing
E Street
Key Santa Ana River Gaging Stations

Figure 499

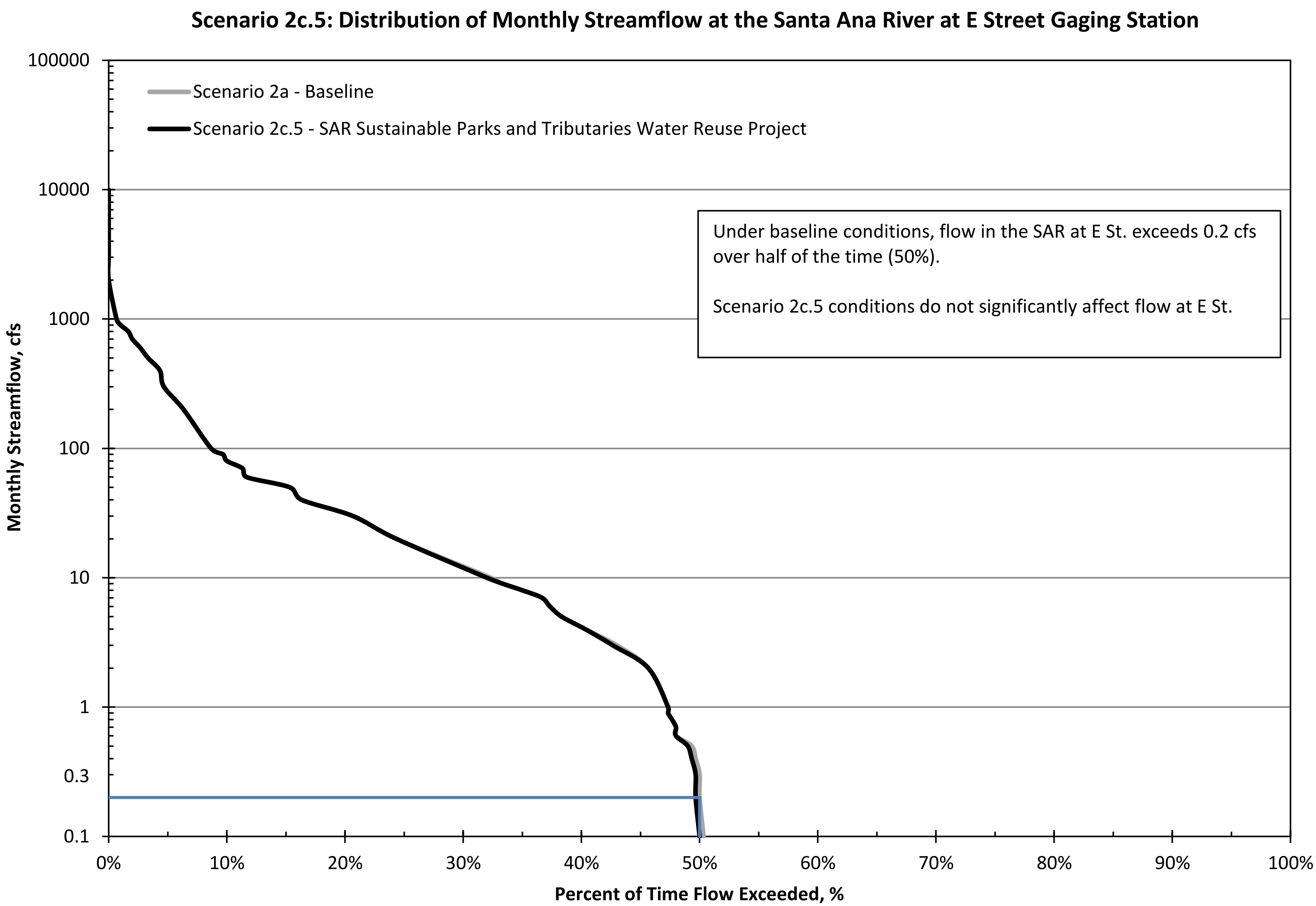

Scenario 2c.5: Distribution of Monthly Streamflow at the Santa Ana River at E Street Gaging Station
100000
10000
1000
100
10
1
0.3
0.1
Monthly Streamflow, cfs
Scenario 2a - Baseline
Scenario 2c.5 - SAR Sustainable Parks and Tributaries Water Reuse Project
Under baseline conditions, flow in the SAR at E St. exceeds 0.2 cfs over half of the time (50%).
Scenario 2c.5 conditions do not significantly affect flow at E St.
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 500

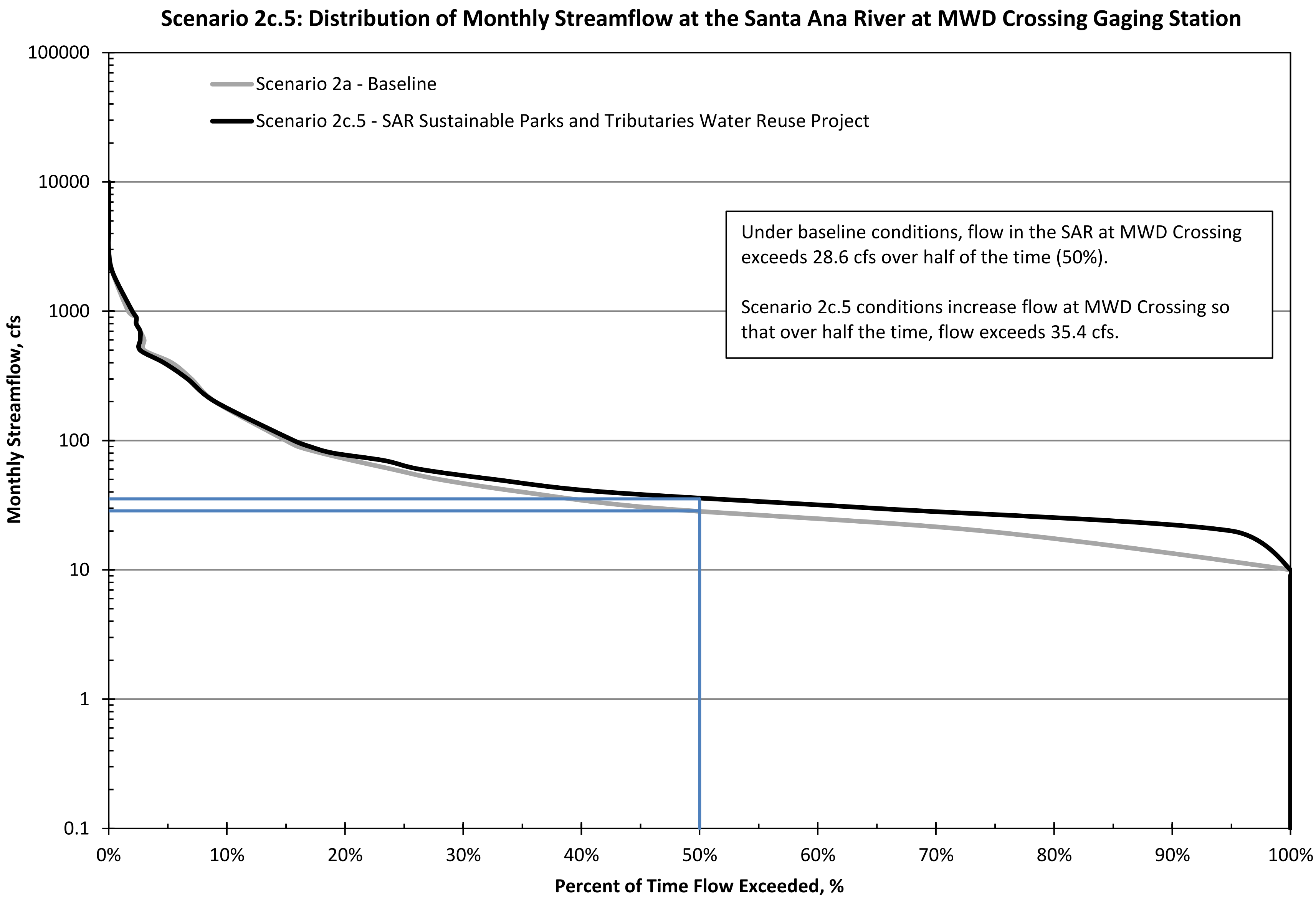

Scenario 2c.5: Distribution of Monthly Streamflow at the Santa Ana River at MWD Crossing Gaging Station
Scenario 2a - Baseline
Scenario 2c.5 - SAR Sustainable Parks and Tributaries Water Reuse Project
Under baseline conditions, flow in the SAR at MWD Crossing exceeds 28.6 cfs over half of the time (50%).
Scenario 2c.5 conditions increase flow at MWD Crossing so that over half the time, flow exceeds 35.4 cfs.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 501

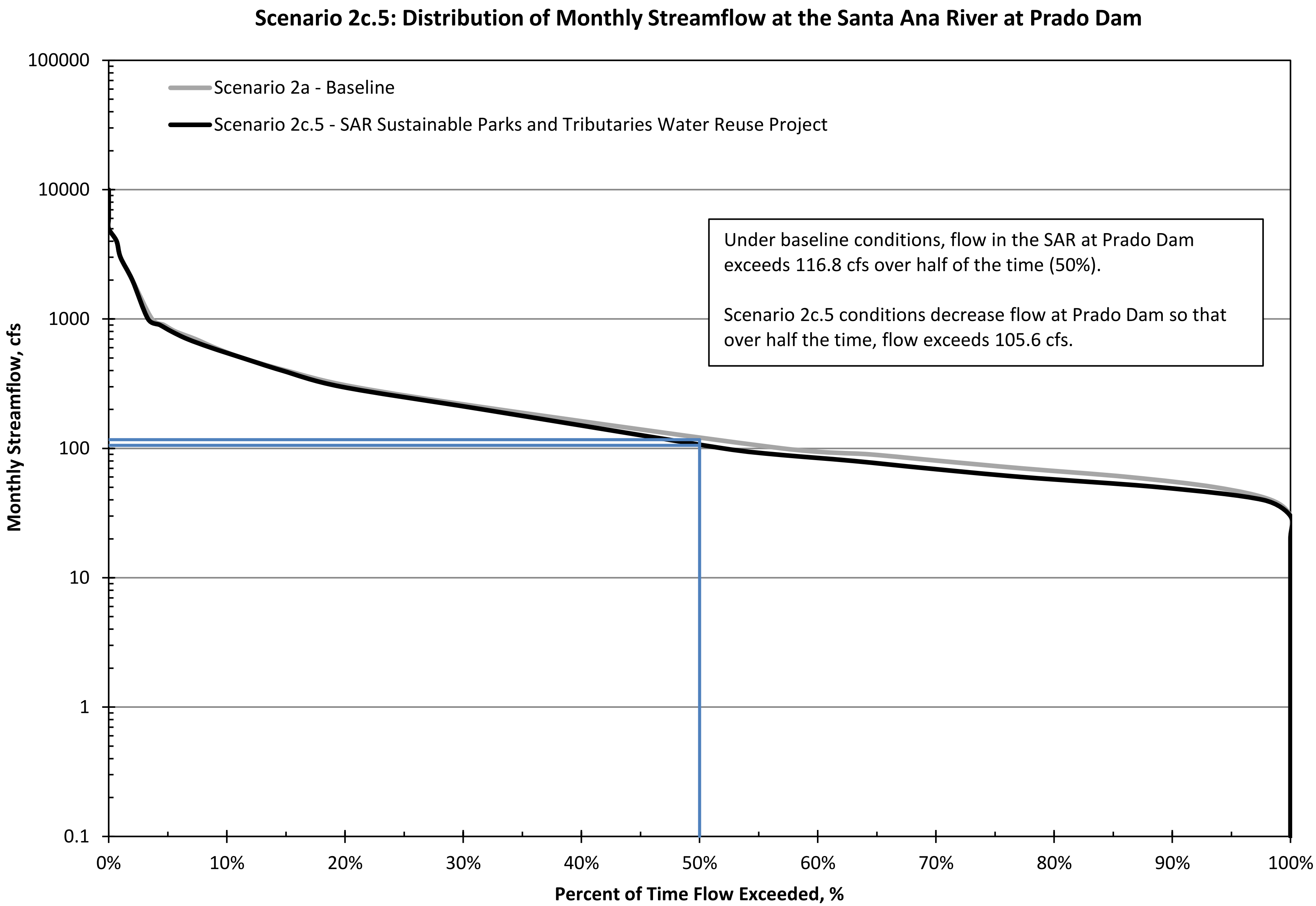
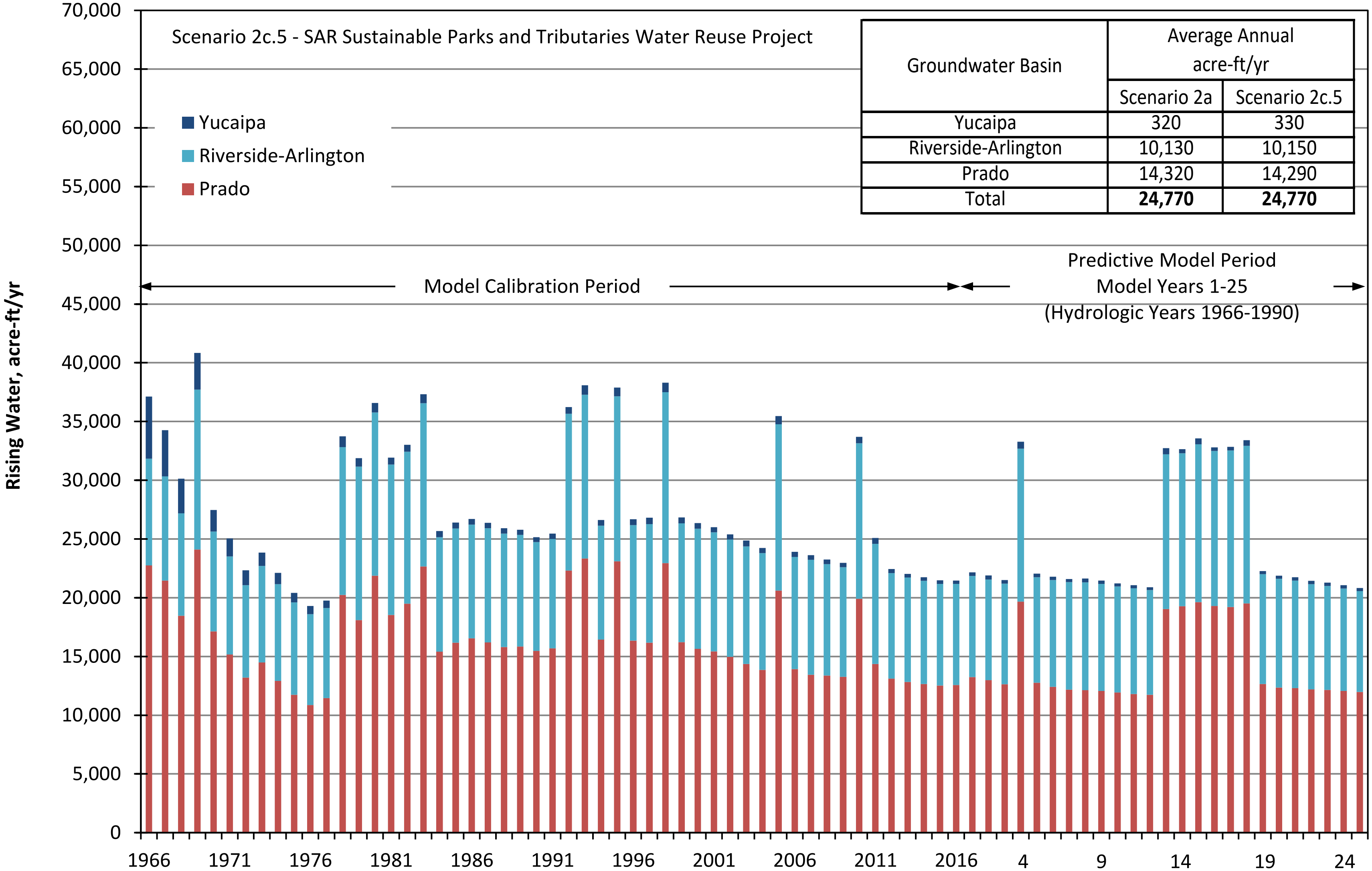

Scenario 2c.5: Distribution of Monthly Streamflow at the Santa Ana River at Prado Dam
100000
10000
1000
100
10
1
0.1
Monthly Streamflow, cfs
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %
Scenario 2a - Baseline
Scenario 2c.5 - SAR Sustainable Parks and Tributaries Water Reuse Project
Under baseline conditions, flow in the SAR at Prado Dam exceeds 116.8 cfs over half of the time (50%).
Scenario 2c.5 conditions decrease flow at Prado Dam so that over half the time, flow exceeds 105.6 cfs.

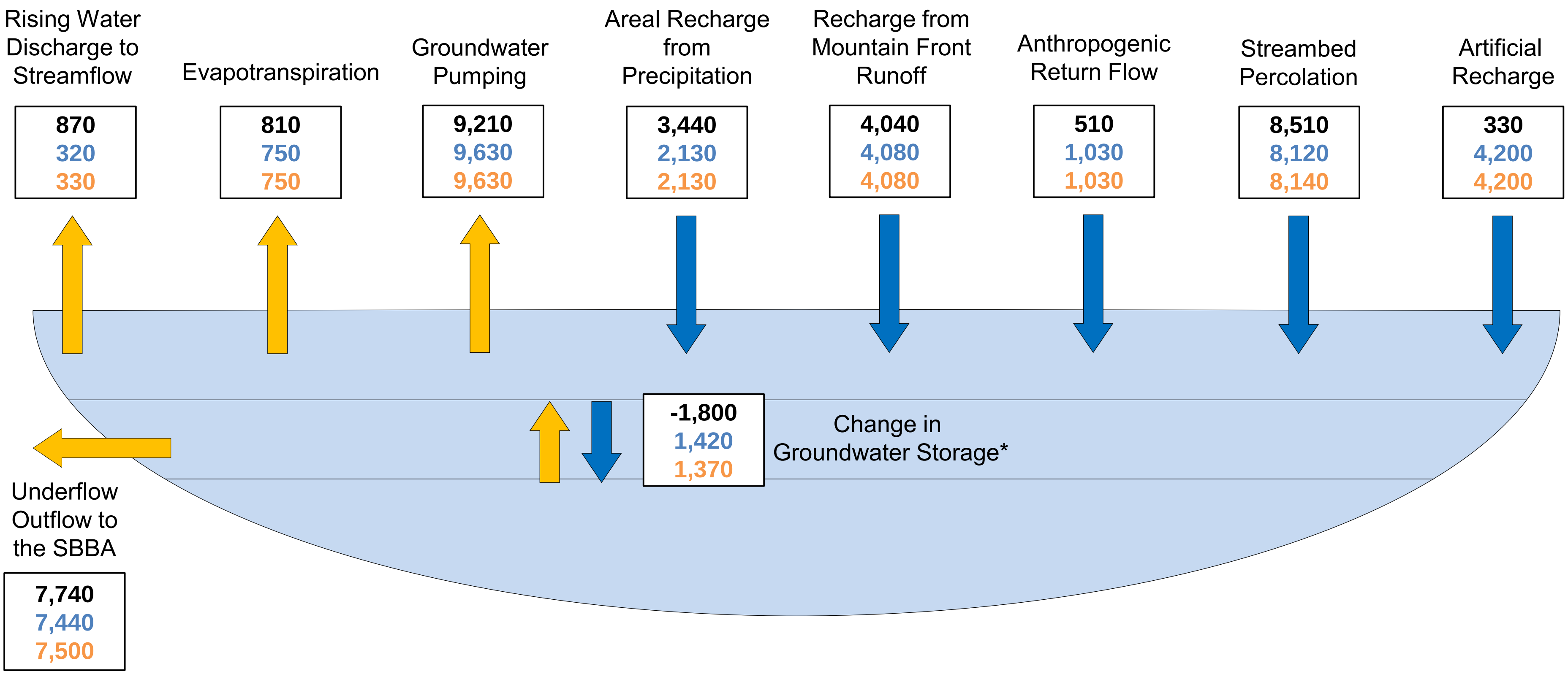
Figure 502

Scenario 2c.5: Annual Rising Water – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2c.5
Yucaipa	320	330
Riverside-Arlington	10,130	10,150
Prado	14,320	14,290
Total	**24,770**	**24,770**

Figure 503



Scenario 2a - Baseline
Scenario 2c.5 - SAR Sustainable Parks and Tributaries Water Reuse Project

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2c.5 (Hydrologic Period 1966-1990)

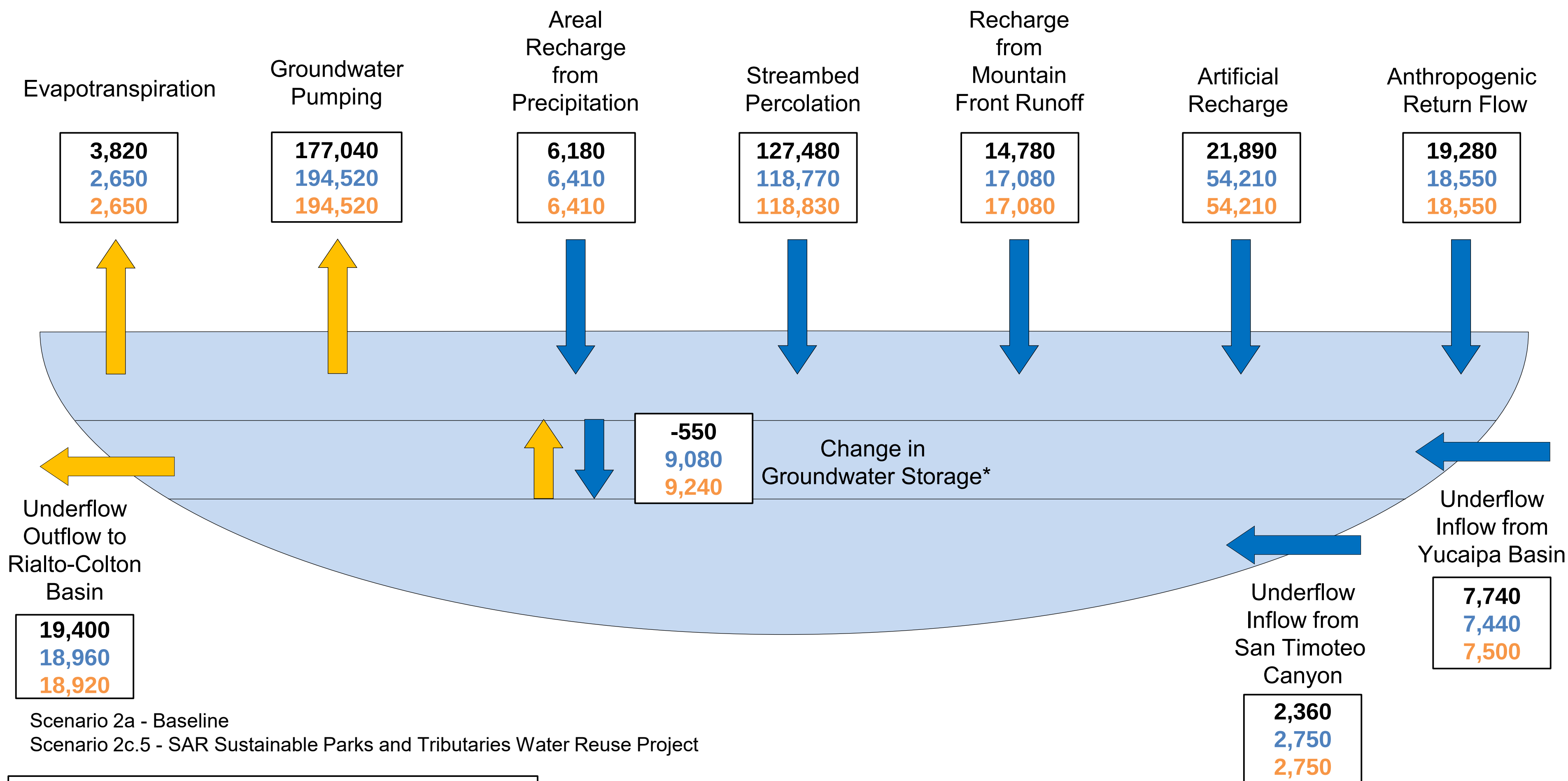
All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2C.5
AVERAGE ANNUAL
WATER BUDGET
YUCAIPA BASIN

X:\Projects\San_Bernardino_MUNI\31) Integrated_SAR_Model\(4)Technical_Memos\(8)Summary Report\Draft\Figures\Scenarios

10-Apr-20



Scenario 2a - Baseline
Scenario 2c.5 - SAR Sustainable Parks and Tributaries Water Reuse Project

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2c.5 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2C.5
AVERAGE ANNUAL WATER BUDGET
SBBA

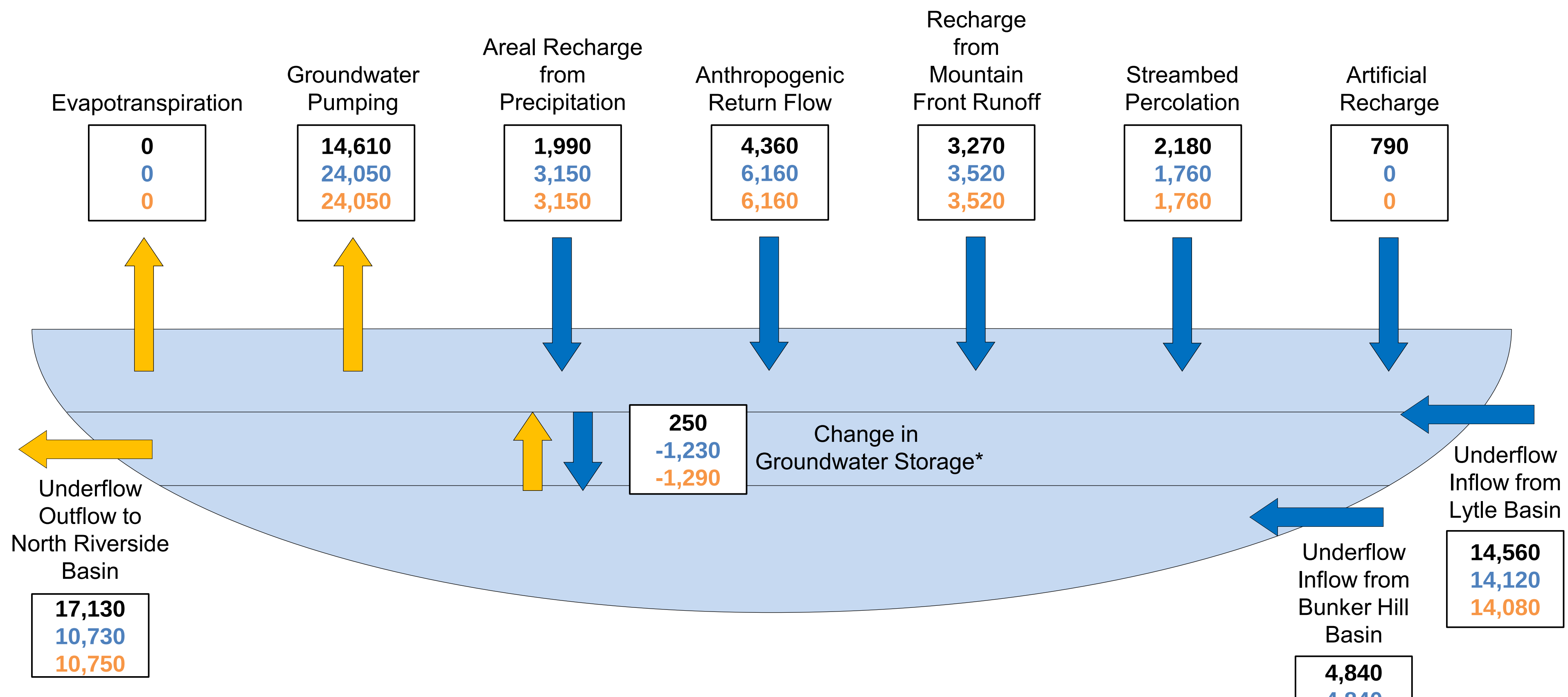
X:\Projects\San_Bernardino_MUNI\31)Integreated_SAR_Model\(4)Technical_Memos\(8)Summary Report\Draft\Figures\Scenarios

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT **DRAFT** **FIGURE 505**

GEOSCIENCE

X:\Projects\San_Bernardino_MUNI\31) Integreated_SAR_Model\(4)Technical_Memos\(8) Summary Report\Draft\Figures\Scenarios



Scenario 2a - Baseline
Scenario 2c.5 - SAR Sustainable Parks and Tributaries Water Reuse Project

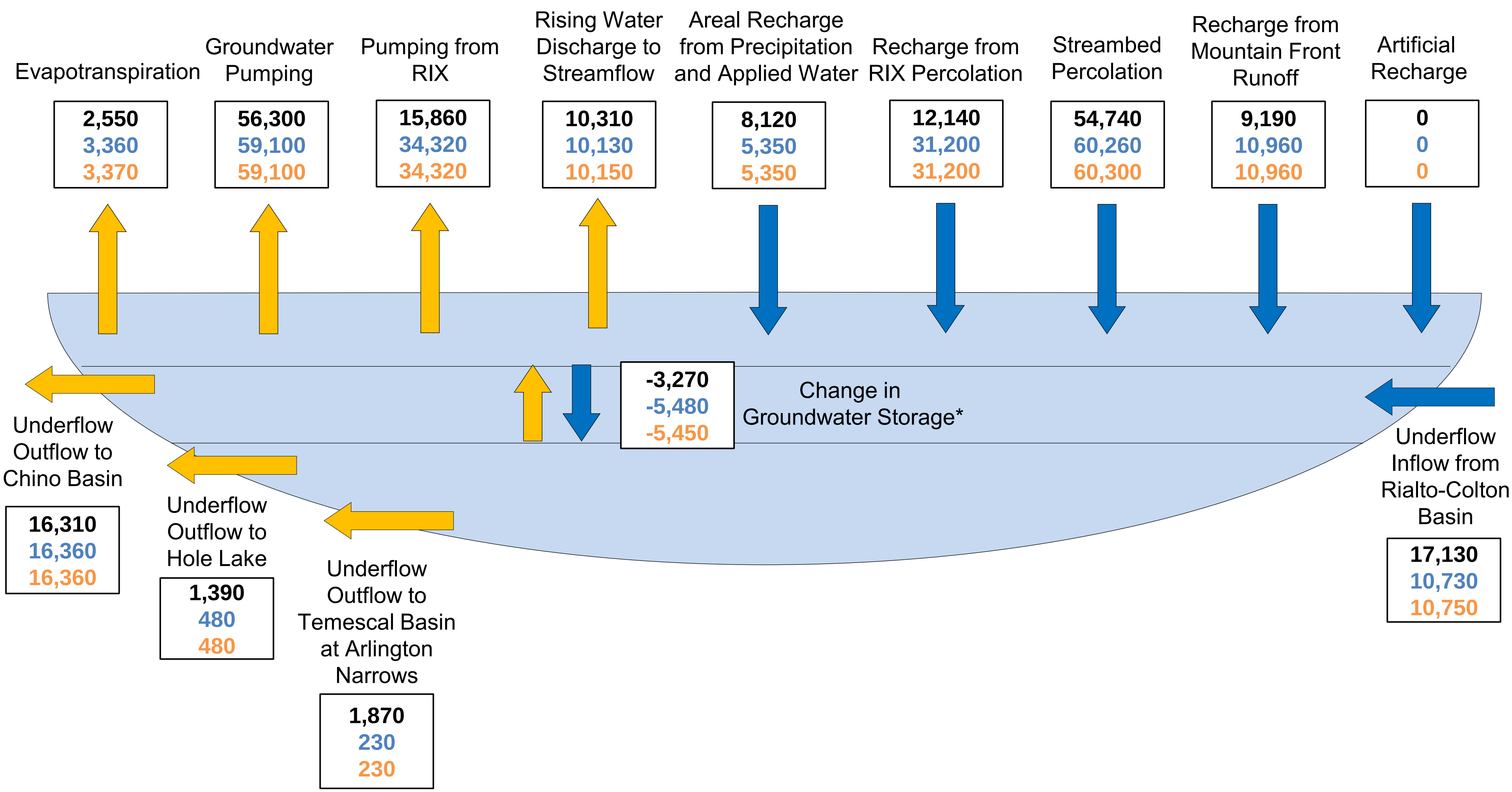
Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2c.5 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2C.5
AVERAGE ANNUAL
WATER BUDGET
RIALTO-COLTON BASIN

10-Apr-20



Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2c.5 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

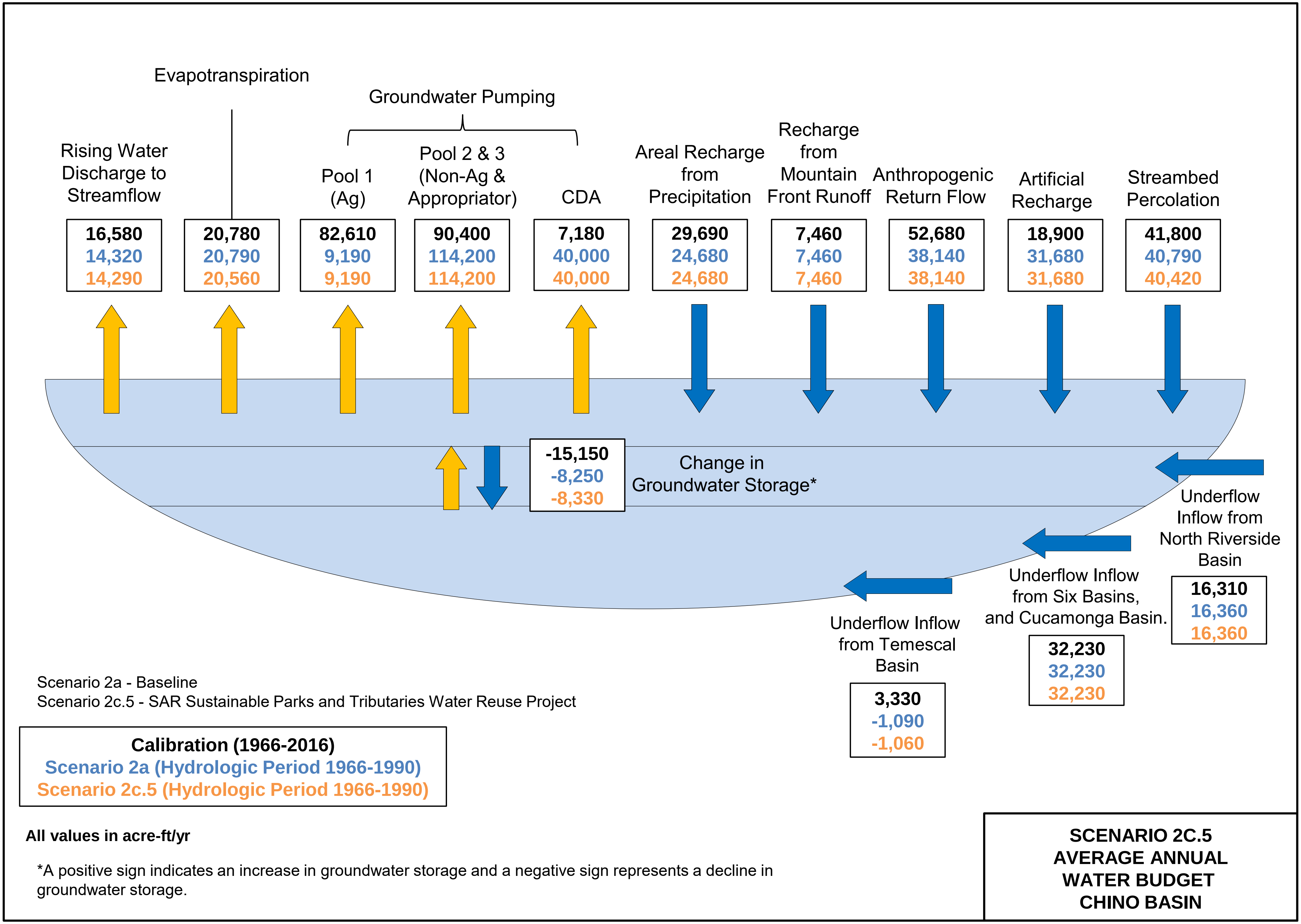
Scenario 2a - Baseline
Scenario 2c.5 - SAR Sustainable Parks and Tributaries Water Reuse Project

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2C.5
AVERAGE ANNUAL WATER BUDGET
RIVERSIDE-ARLINGTON BASIN

X:\Projects\San_Bernardino_MUNI\31) Integreated_SAR_Model\(4)Technical_Memos\(8)Summary Report\Draft\Figures\Scenarios

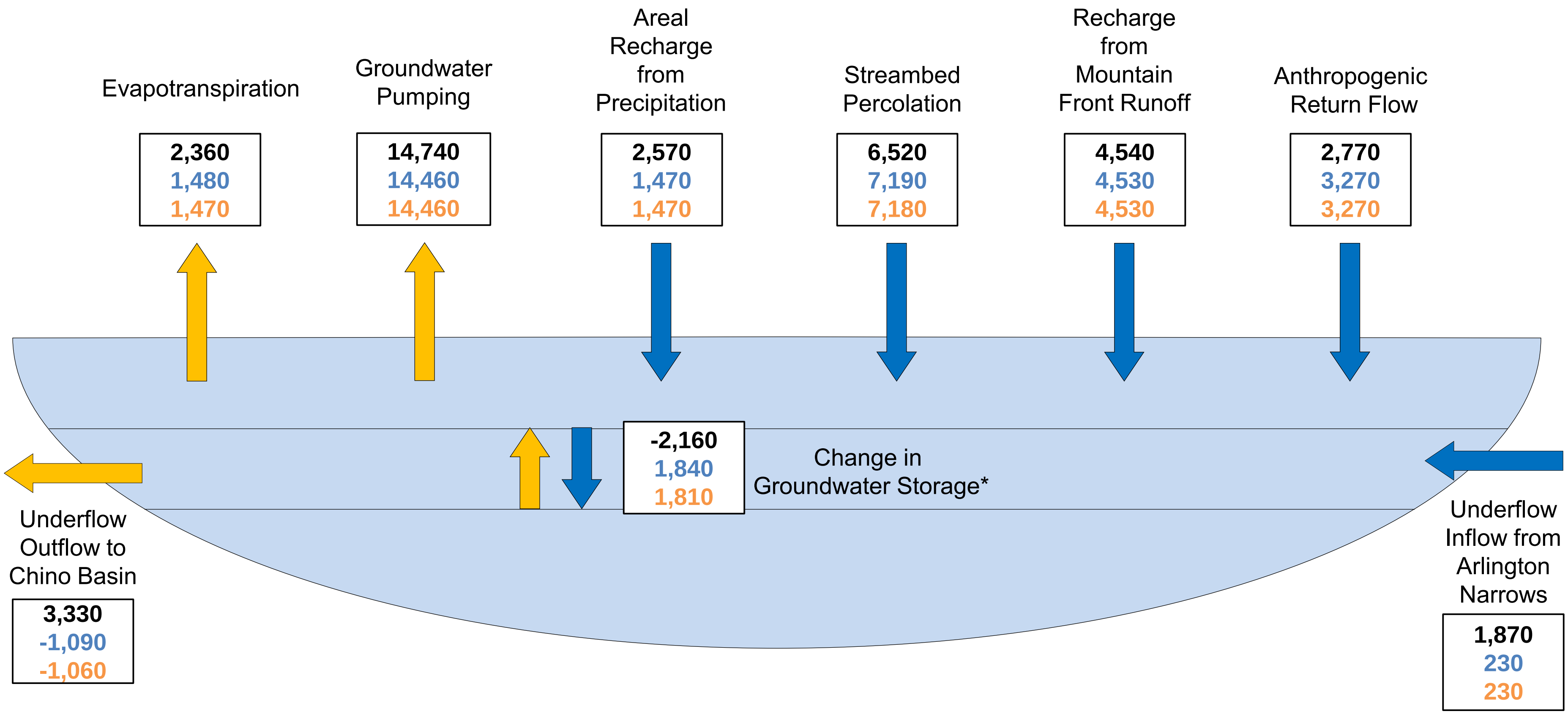
10-Apr-20



SCENARIO 2C.5 AVERAGE ANNUAL WATER BUDGET CHINO BASIN

X:\Projects\San_Bernardino_MUNI\31) Integreated_SAR_Model\(4)Technical_Memos\(8) Summary Report\Draft\Figures\Scenarios

10-Apr-20



Scenario 2a - Baseline
Scenario 2c.5 - SAR Sustainable Parks and Tributaries Water Reuse Project

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2c.5 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

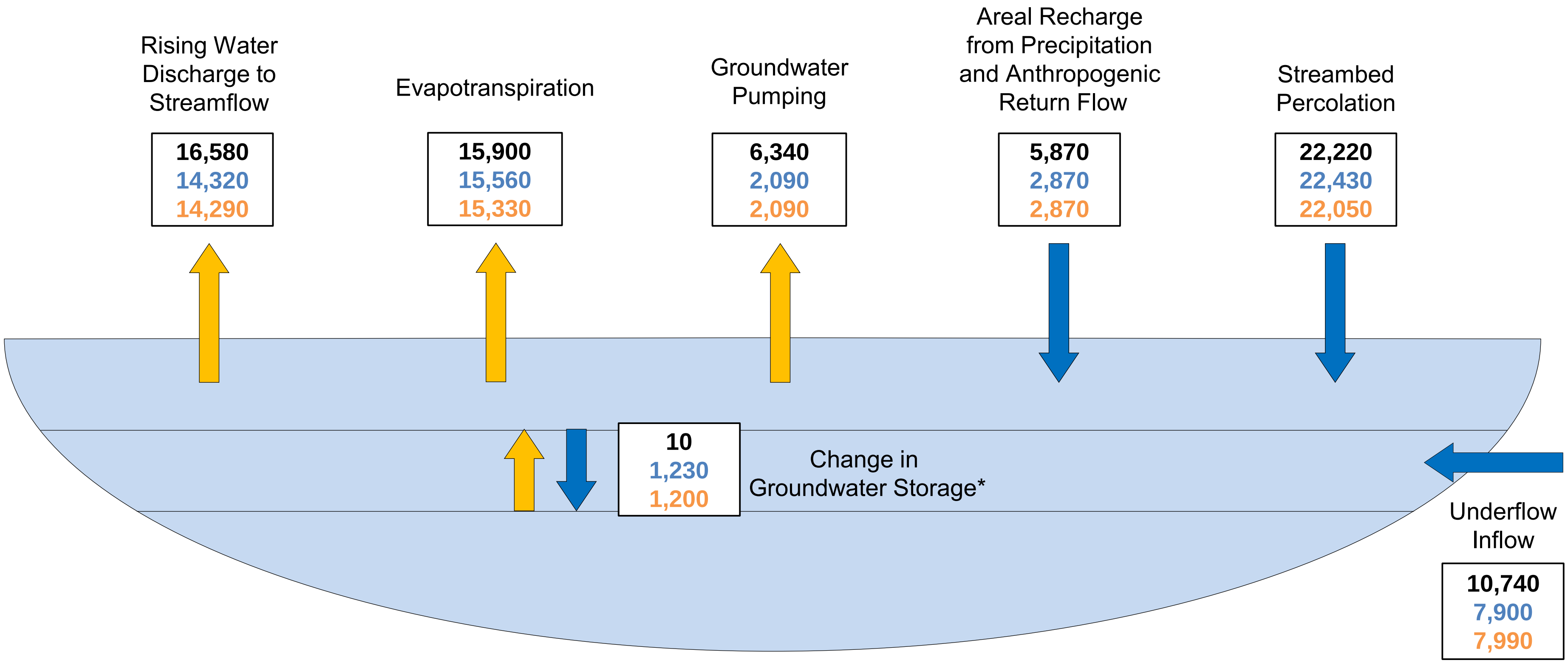
*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2C.5
AVERAGE ANNUAL
WATER BUDGET
TEMESCAL BASIN

X:\Projects\San_Bernardino_MUNI\31)Integreated_SAR_Model\(4)Technical_Memos\(8)Summary Report\Draft\Figures\Scenarios

10-Apr-20

X:\Projects\San_Bernardino_MUNI\31) Integreated_SAR_Model\(4) Technical_Memos\(8) Summary Report\Draft\Figures\Scenarios



Scenario 2a - Baseline
Scenario 2c.5 - SAR Sustainable Parks and Tributaries Water Reuse Project

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2c.5 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

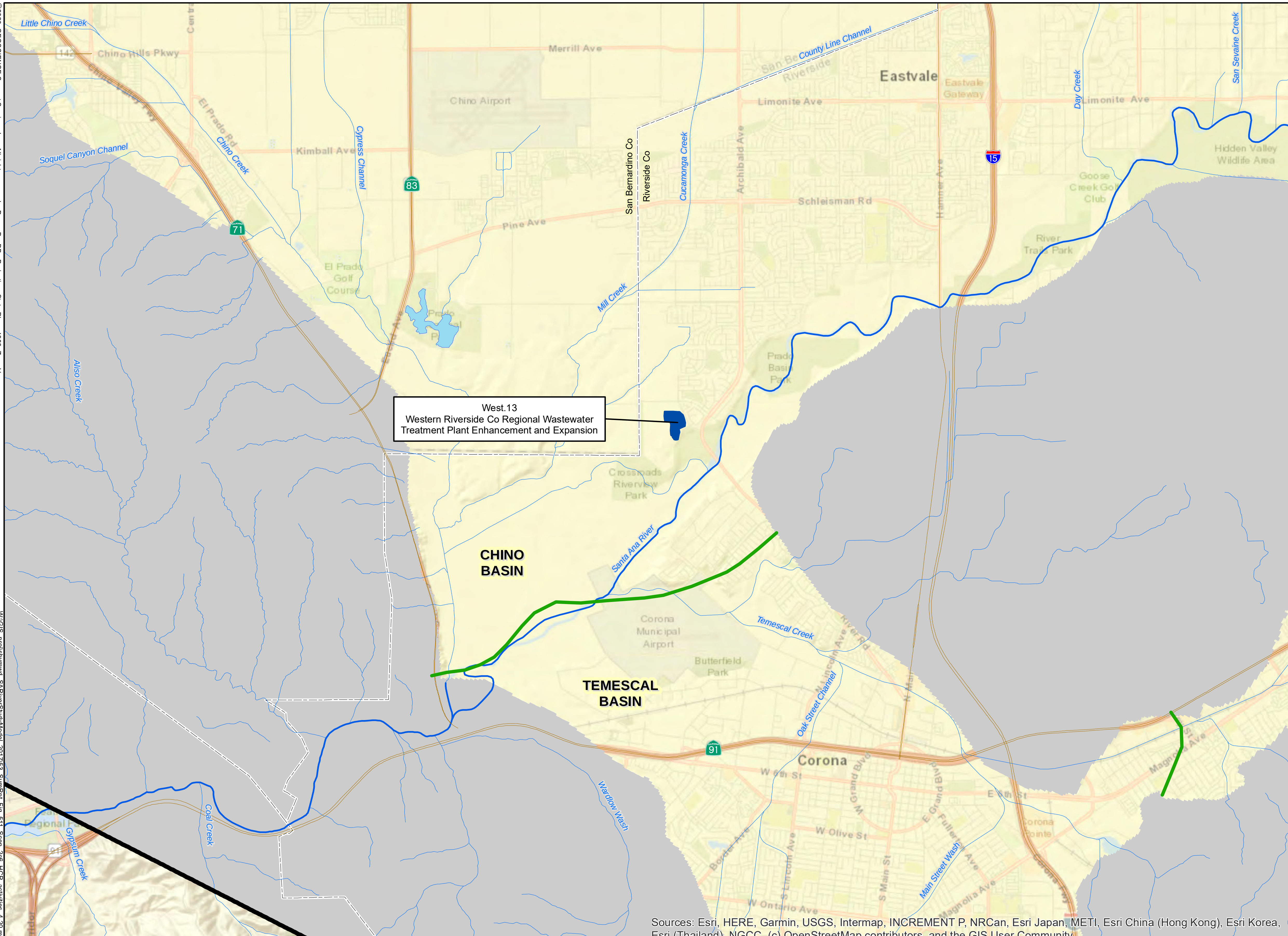
*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2C.5
AVERAGE ANNUAL
WATER BUDGET
PRADO BASIN

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT **DRAFT** **FIGURE 510**

GEOSCIENCE



W:\GIS_projs\bvmwd_SARiverStudy\Model_2017\53_SumRpt_Fig_511_Scen_2c6_HCP_activities_4-20.mxd

EXPLANATION

Integrated SAR Model Boundary

Active Model Area

Inactive Model Area

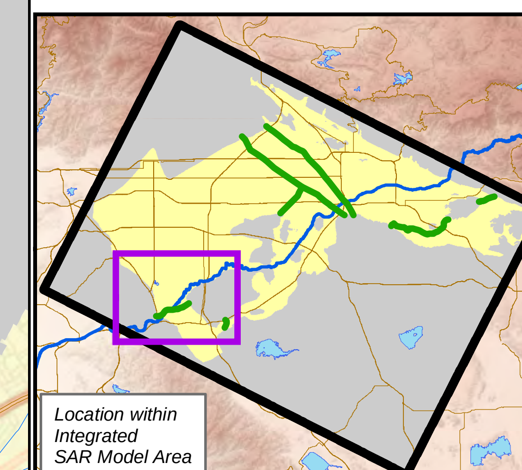
Habitat Conservation Plan (HCP) Covered Activity

West.13 - Project ID
Name - Name of HCP Project

Groundwater Basin Boundary

Refer to Table 17 for HCP Covered Activity Description

Scenario 2c.6:
Baseflow Reduction Activities - Western Riverside County Regional Wastewater Treatment Plant Enhancement and Expansion



SCENARIO 2c.6
LOCATION OF
HCP COVERED ACTIVITIES

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT **DRAFT** **FIGURE 511**

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

GEOSCIENCE

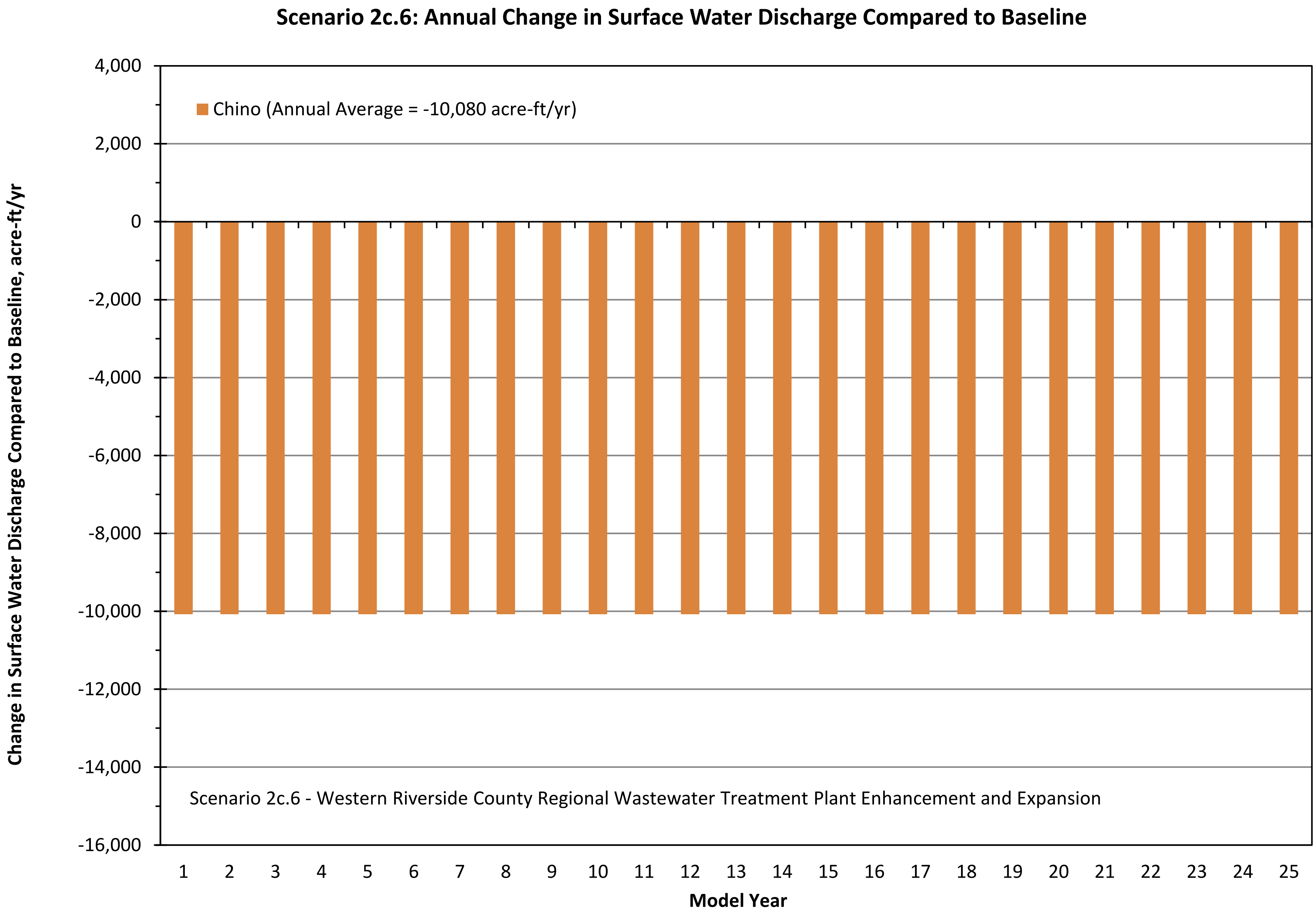
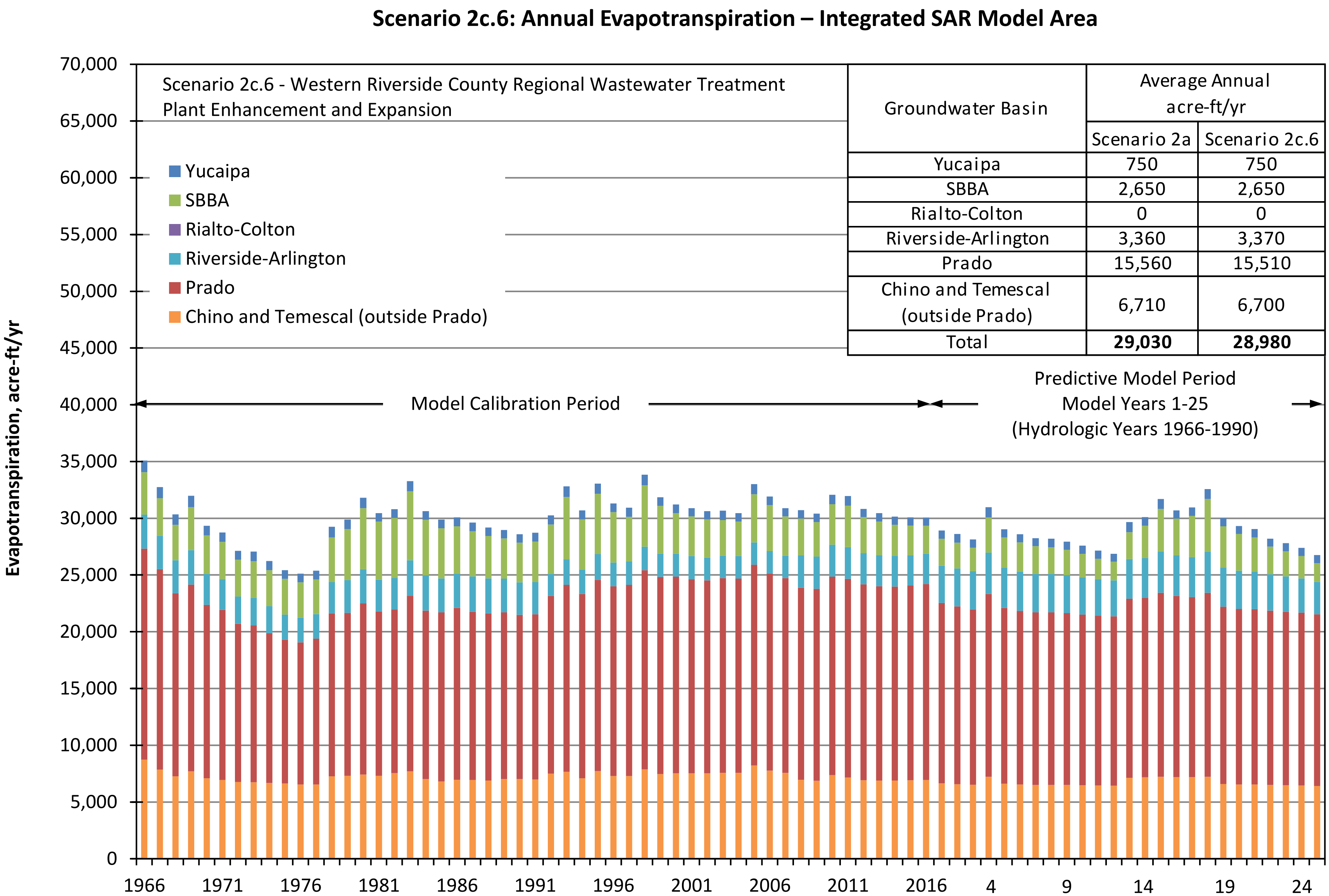

Scenario 2c.6: Annual Change in Surface Water Discharge Compared to Baseline
Chino (Annual Average = -10,080 acre-ft/yr)
Change in Surface Water Discharge Compared to Baseline, acre-ft/yr
4,000
2,000
0
-2,000
-4,000
-6,000
-8,000
-10,000
-12,000
-14,000
-16,000
Scenario 2c.6 - Western Riverside County Regional Wastewater Treatment Plant Enhancement and Expansion
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Model Year

Figure 512



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2c.6
Yucaipa	750	750
SBBA	2,650	2,650
Rialto-Colton	0	0
Riverside-Arlington	3,360	3,370
Prado	15,560	15,510
Chino and Temescal (outside Prado)	6,710	6,700
Total	**29,030**	**28,980**

Figure 513

Scenario 2c.6: Annual Change in Evapotranspiration – Integrated SAR Model Area

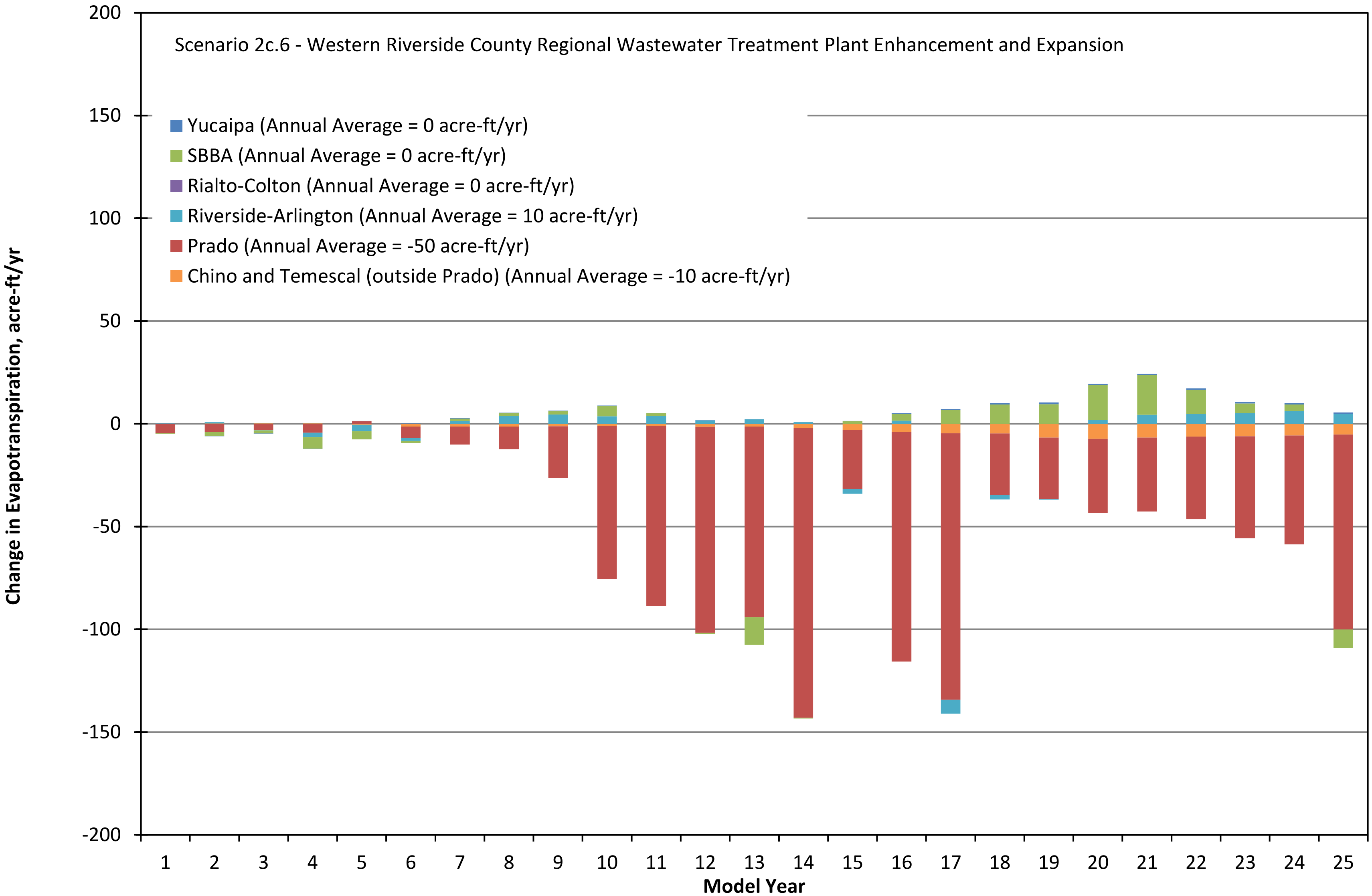
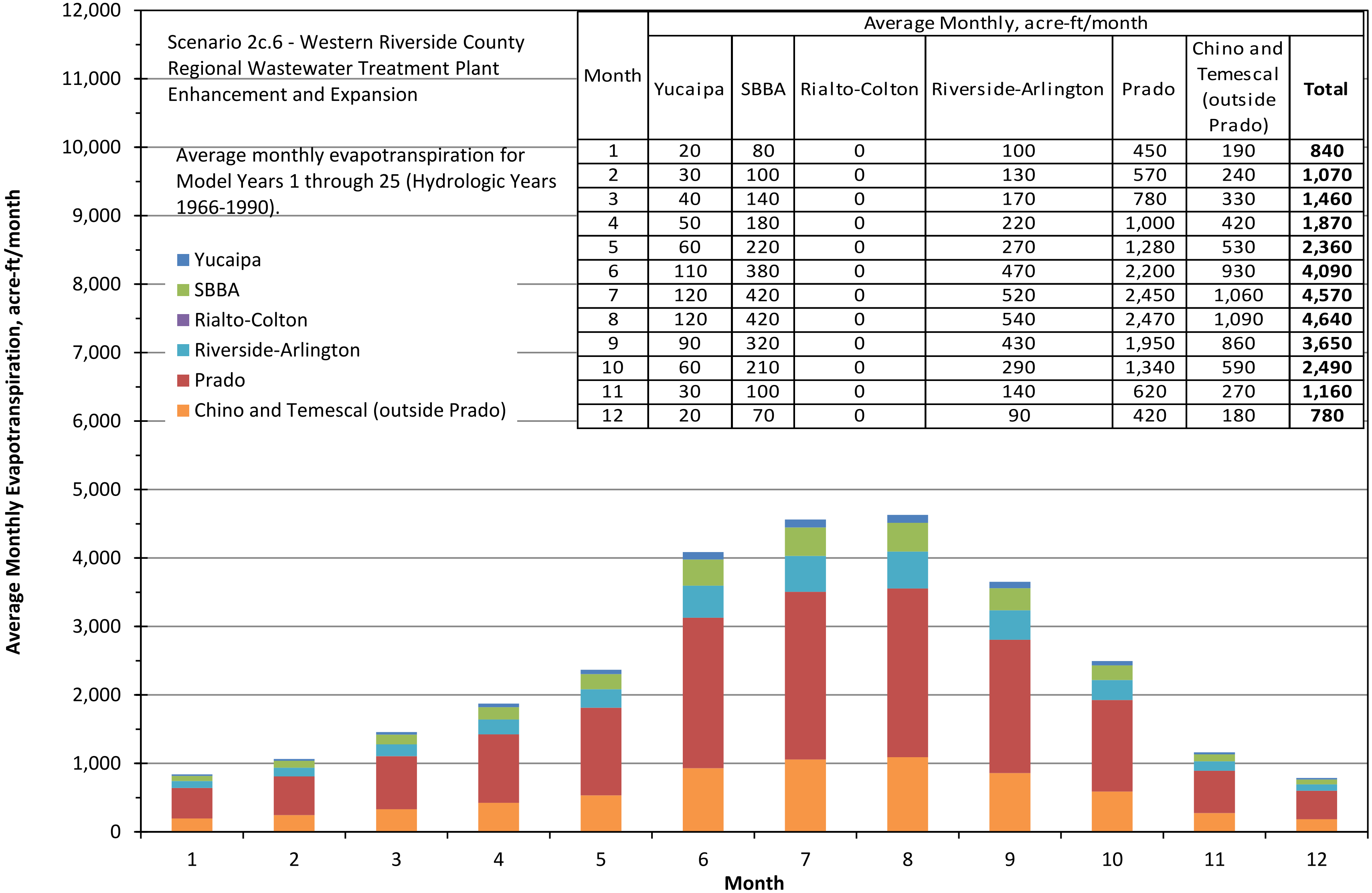


Figure 514

Scenario 2c.6: Seasonal Evapotranspiration – Integrated SAR Model Area



Month	Average Monthly, acre-ft/month						
	Yucaipa	SBBA	Rialto-Colton	Riverside-Arlington	Prado	Chino and Temescal (outside Prado)	**Total**
1	20	80	0	100	450	190	**840**
2	30	100	0	130	570	240	**1,070**
3	40	140	0	170	780	330	**1,460**
4	50	180	0	220	1,000	420	**1,870**
5	60	220	0	270	1,280	530	**2,360**
6	110	380	0	470	2,200	930	**4,090**
7	120	420	0	520	2,450	1,060	**4,570**
8	120	420	0	540	2,470	1,090	**4,640**
9	90	320	0	430	1,950	860	**3,650**
10	60	210	0	290	1,340	590	**2,490**
11	30	100	0	140	620	270	**1,160**
12	20	70	0	90	420	180	**780**

Figure 515

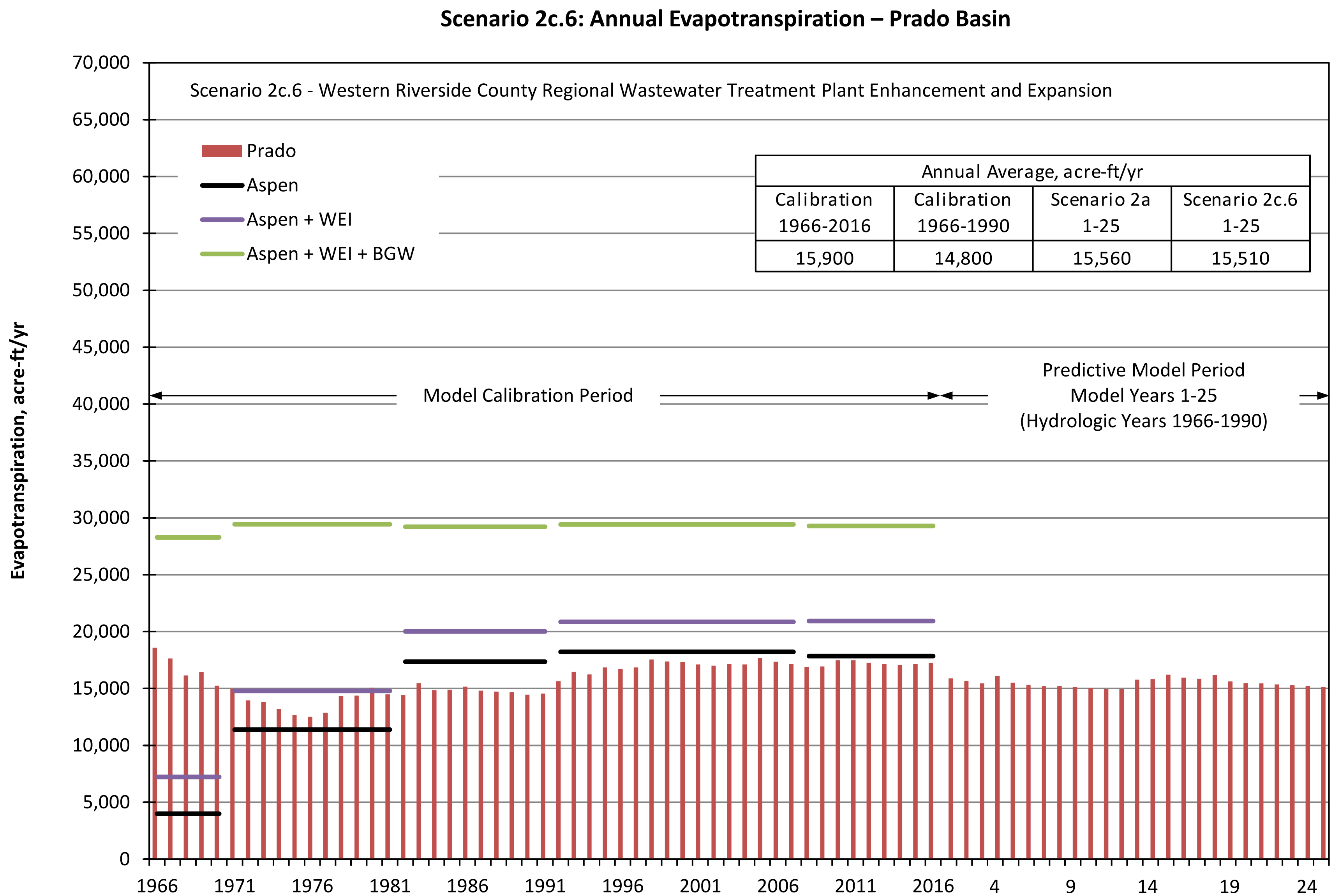

Scenario 2c.6: Annual Evapotranspiration – Prado Basin
Scenario 2c.6 - Western Riverside County Regional Wastewater Treatment Plant Enhancement and Expansion
Prado
Aspen
Aspen + WEI
Aspen + WEI + BGW
Annual Average, acre-ft/yr
Calibration 1966-2016
Calibration 1966-1990
Scenario 2a 1-25
Scenario 2c.6 1-25
15,900
14,800
15,560
15,510
Model Calibration Period
Predictive Model Period
Model Years 1-25
(Hydrologic Years 1966-1990)
Evapotranspiration, acre-ft/yr
70,000
65,000
60,000
55,000
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
1966
1971
1976
1981
1986
1991
1996
2001
2006
2011
2016
4
9
14
19
24

Figure 516

Scenario 2c.6: Annual Change in Evapotranspiration – Prado Basin

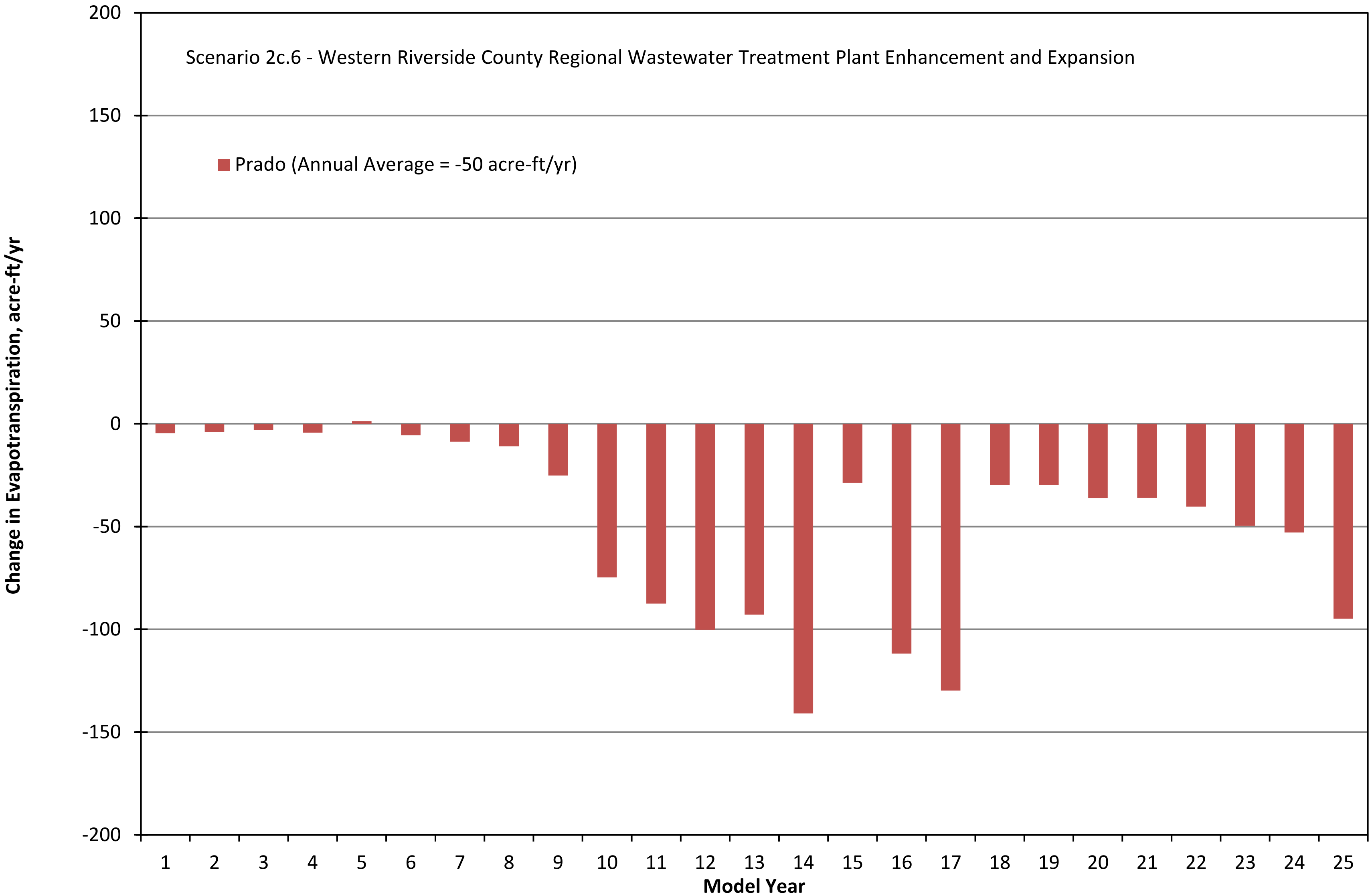
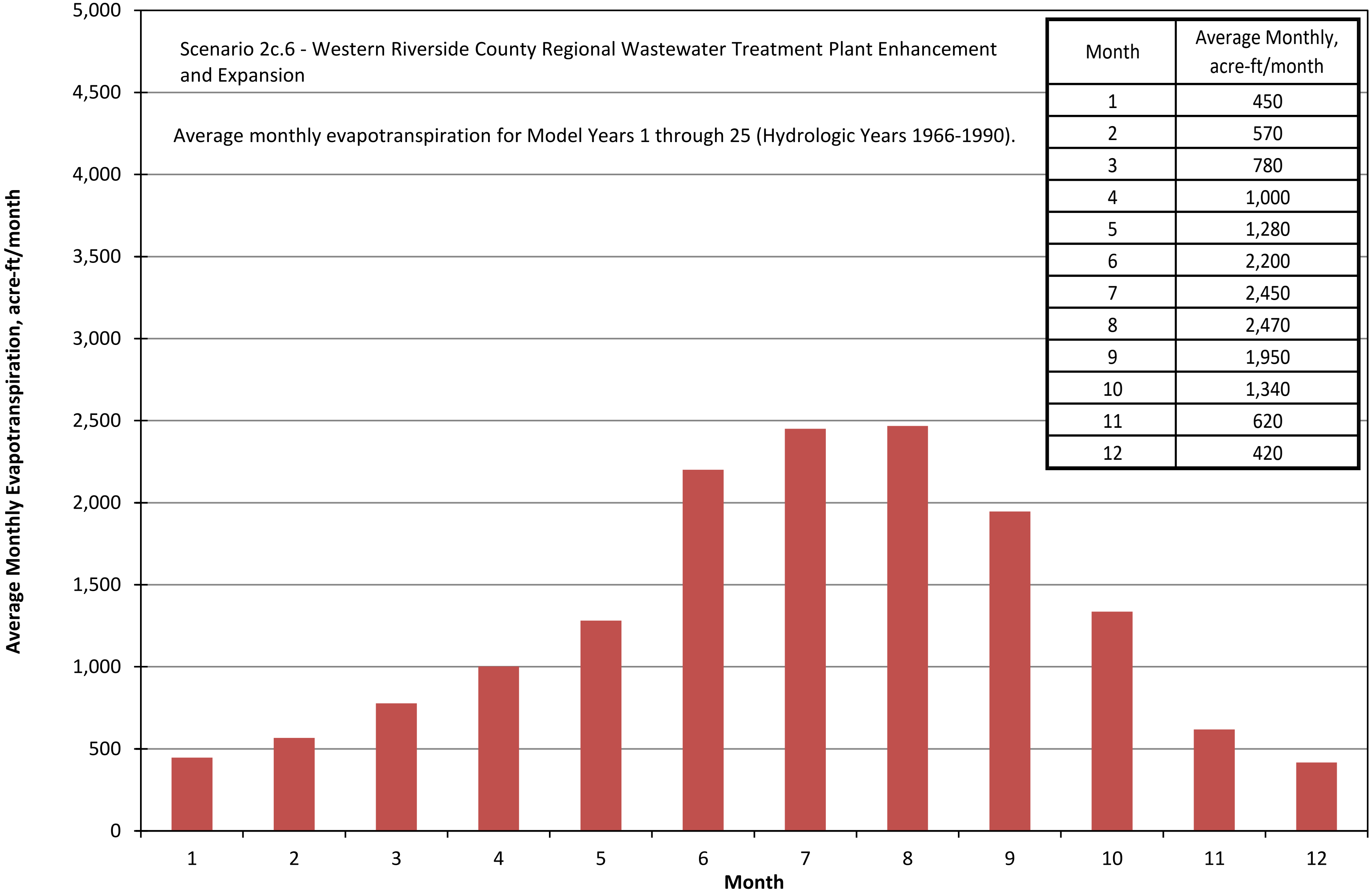


Figure 517

Scenario 2c.6: Seasonal Evapotranspiration – Prado Basin



Month	Average Monthly, acre-ft/month
1	450
2	570
3	780
4	1,000
5	1,280
6	2,200
7	2,450
8	2,470
9	1,950
10	1,340
11	620
12	420

Figure 518

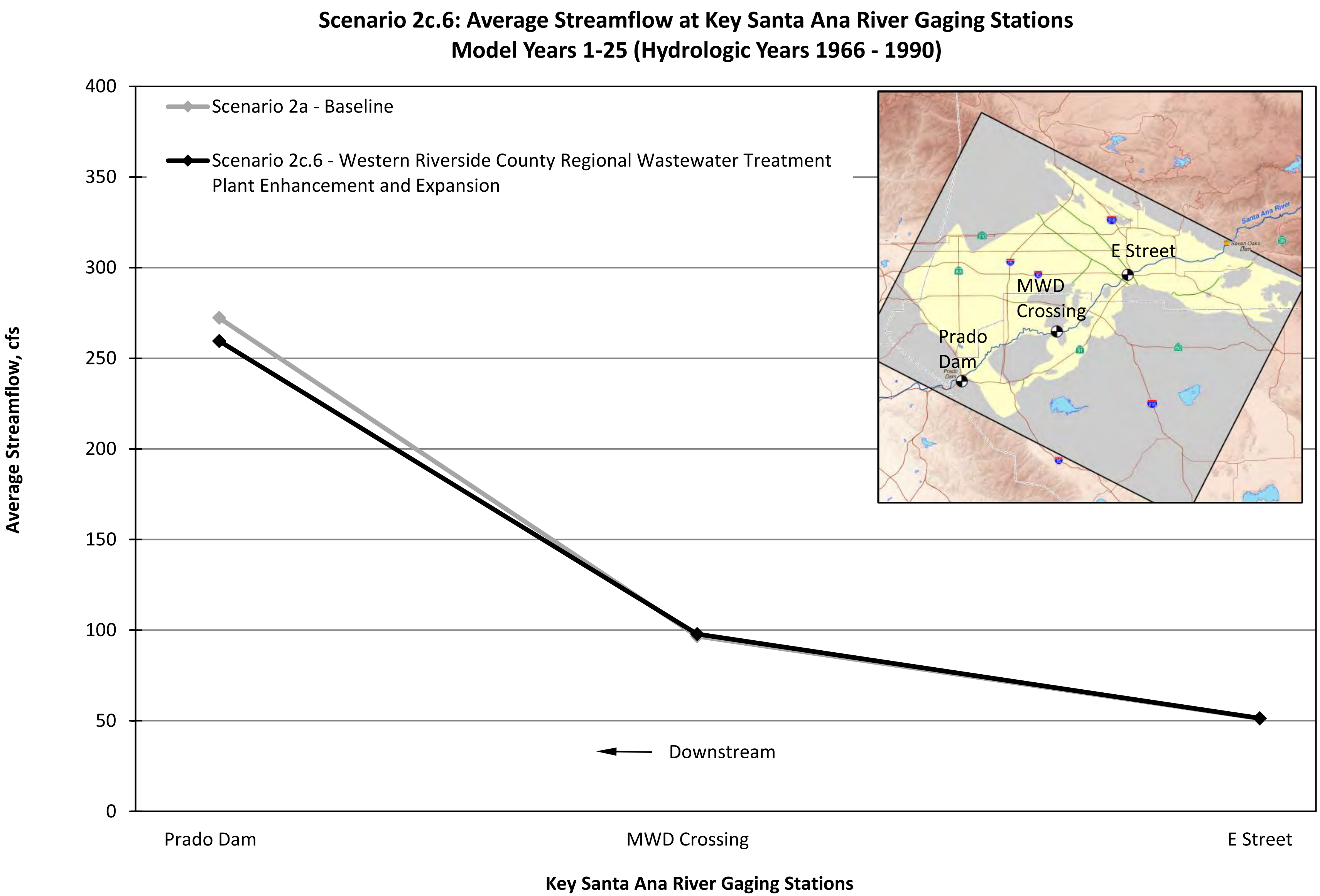

Scenario 2c.6: Average Streamflow at Key Santa Ana River Gaging Stations
Model Years 1-25 (Hydrologic Years 1966 - 1990)
Scenario 2a - Baseline
Scenario 2c.6 - Western Riverside County Regional Wastewater Treatment Plant Enhancement and Expansion
Average Streamflow, cfs
400
350
300
250
200
150
100
50
0
E Street
MWD Crossing
Prado Dam
Downstream
Prado Dam
MWD Crossing
E Street
Key Santa Ana River Gaging Stations

Figure 519

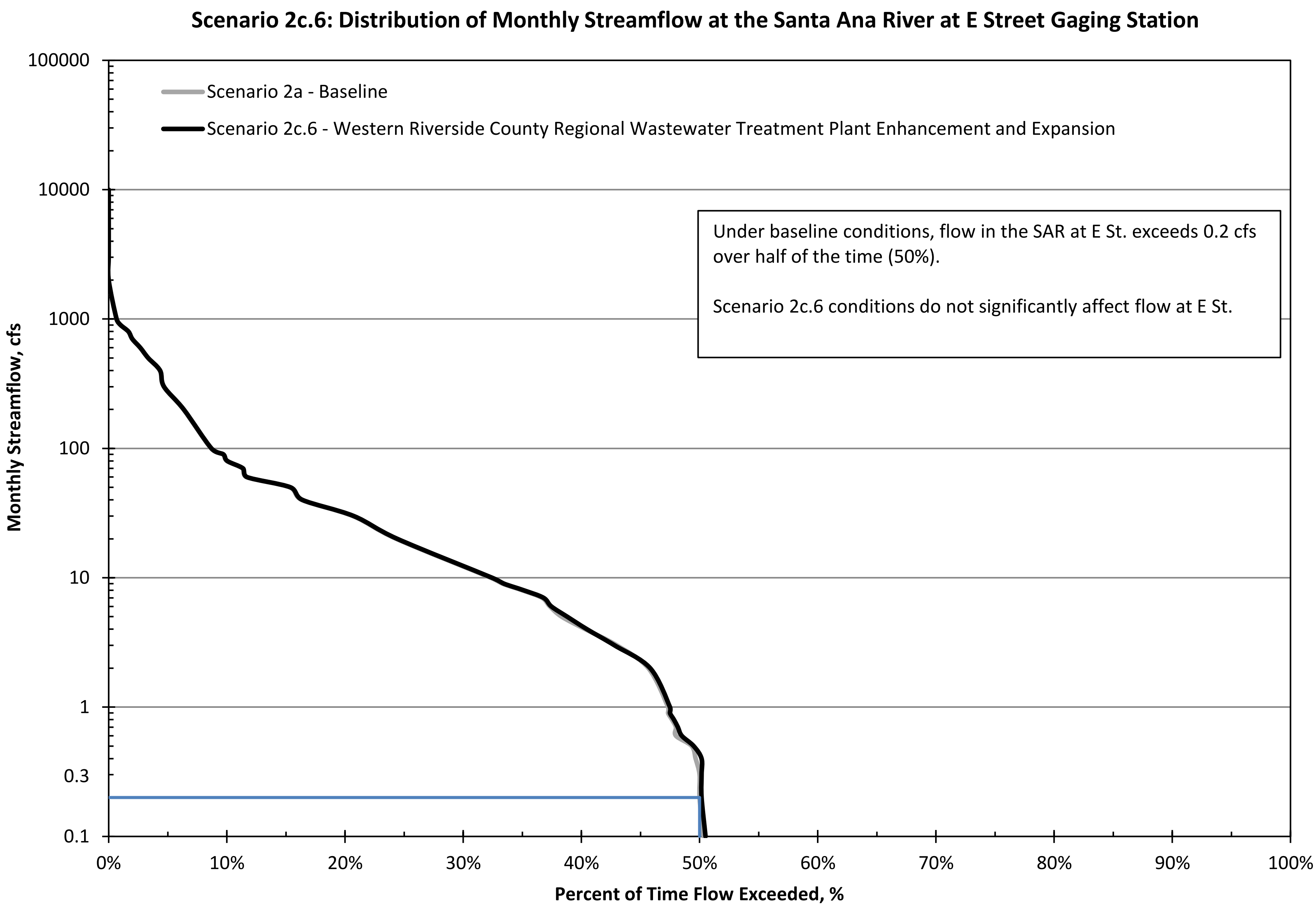

Scenario 2c.6: Distribution of Monthly Streamflow at the Santa Ana River at E Street Gaging Station
Scenario 2a - Baseline
Scenario 2c.6 - Western Riverside County Regional Wastewater Treatment Plant Enhancement and Expansion
Under baseline conditions, flow in the SAR at E St. exceeds 0.2 cfs over half of the time (50%).
Scenario 2c.6 conditions do not significantly affect flow at E St.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.3
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 520

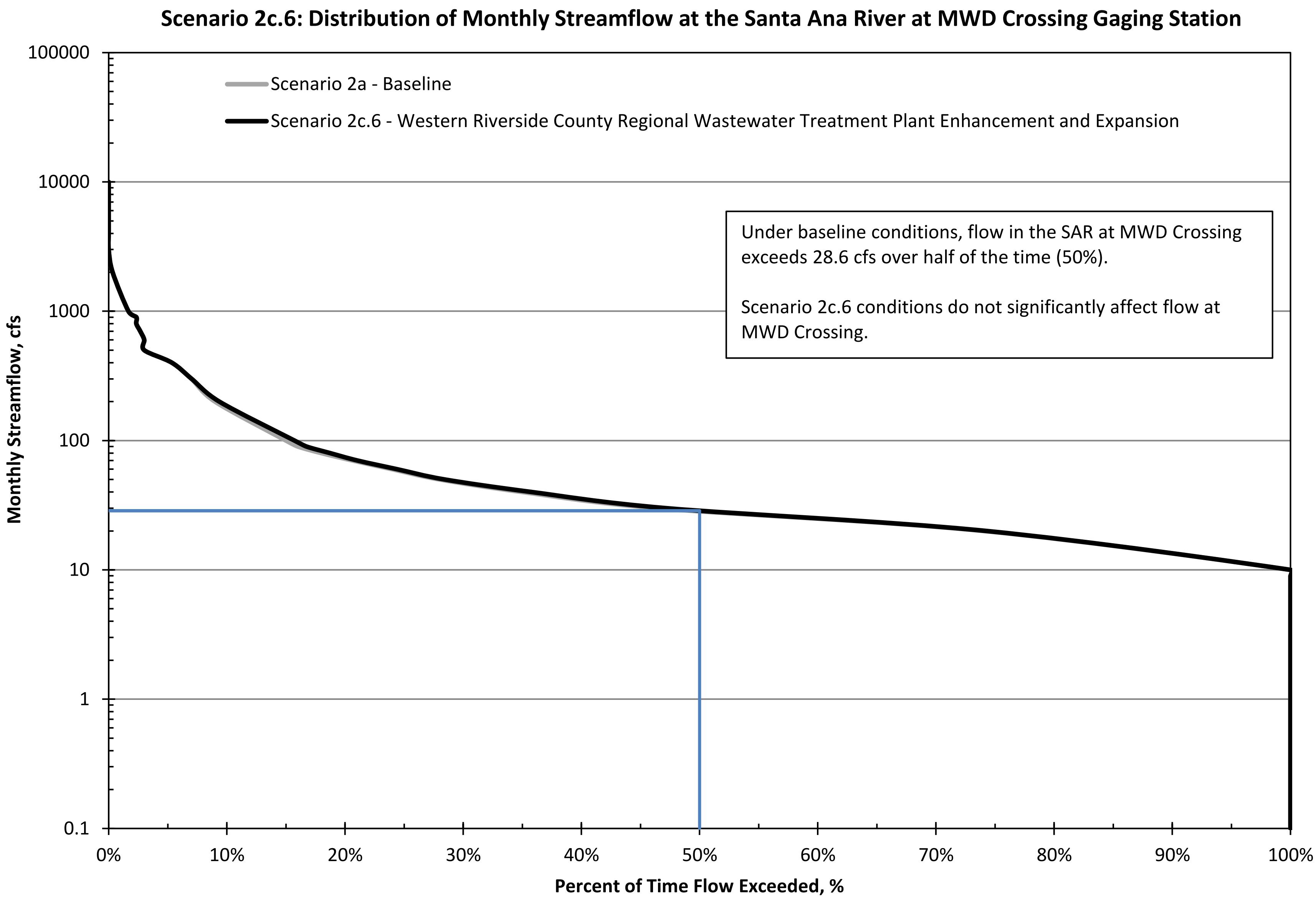

Scenario 2c.6: Distribution of Monthly Streamflow at the Santa Ana River at MWD Crossing Gaging Station
Scenario 2a - Baseline
Scenario 2c.6 - Western Riverside County Regional Wastewater Treatment Plant Enhancement and Expansion
Under baseline conditions, flow in the SAR at MWD Crossing exceeds 28.6 cfs over half of the time (50%).
Scenario 2c.6 conditions do not significantly affect flow at MWD Crossing.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 521

Scenario 2c.6: Distribution of Monthly Streamflow at the Santa Ana River at Prado Dam

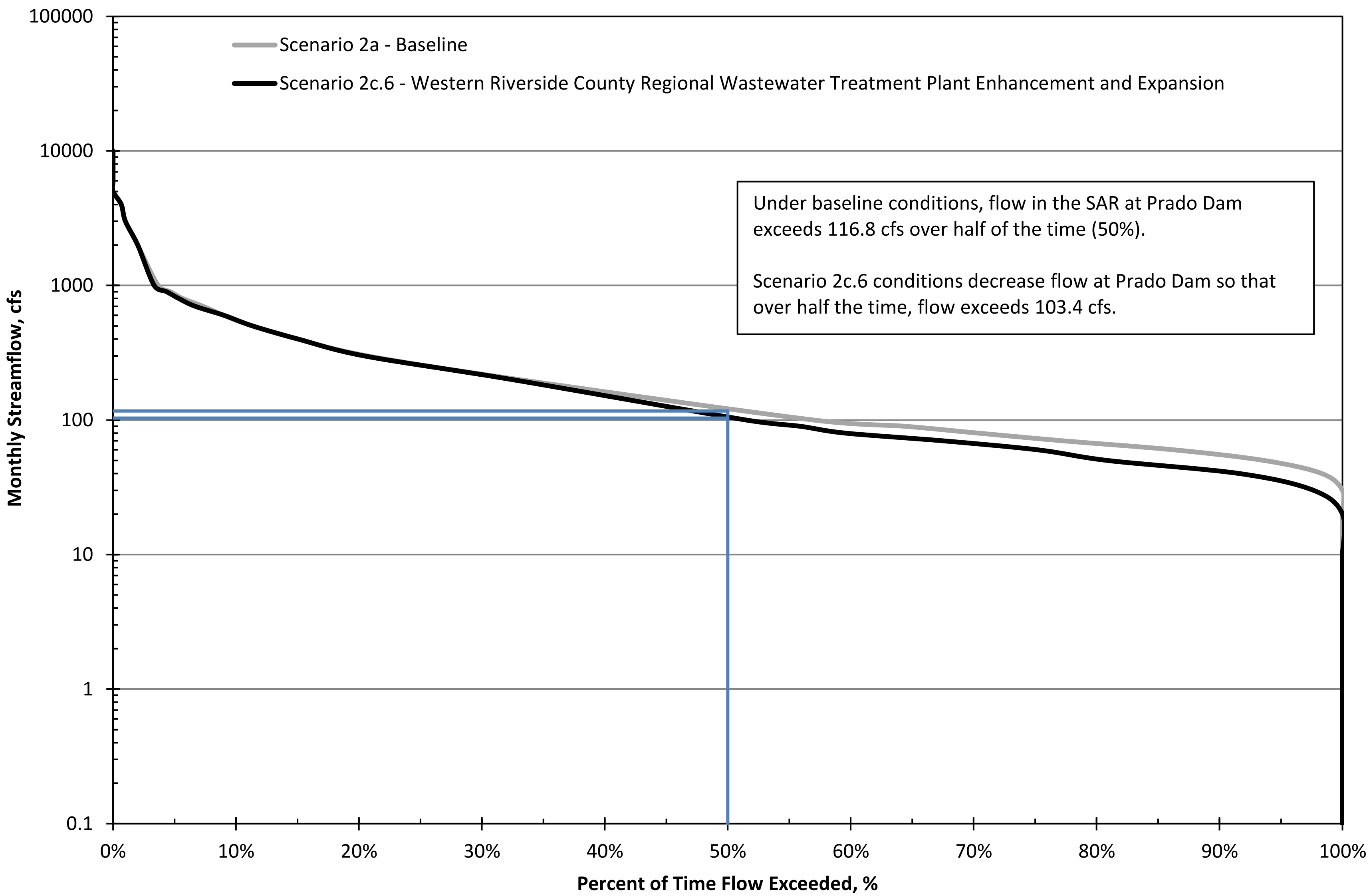
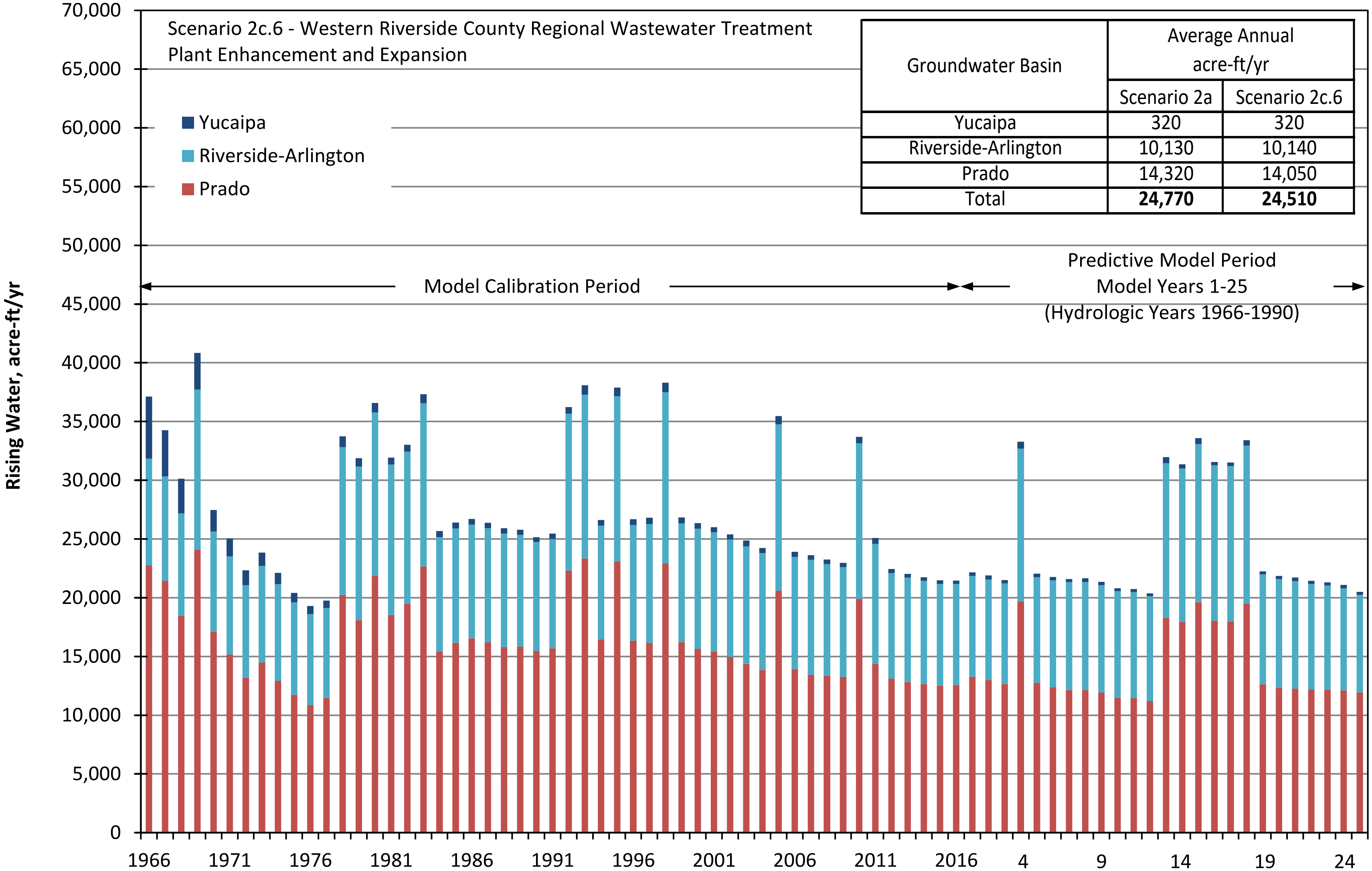


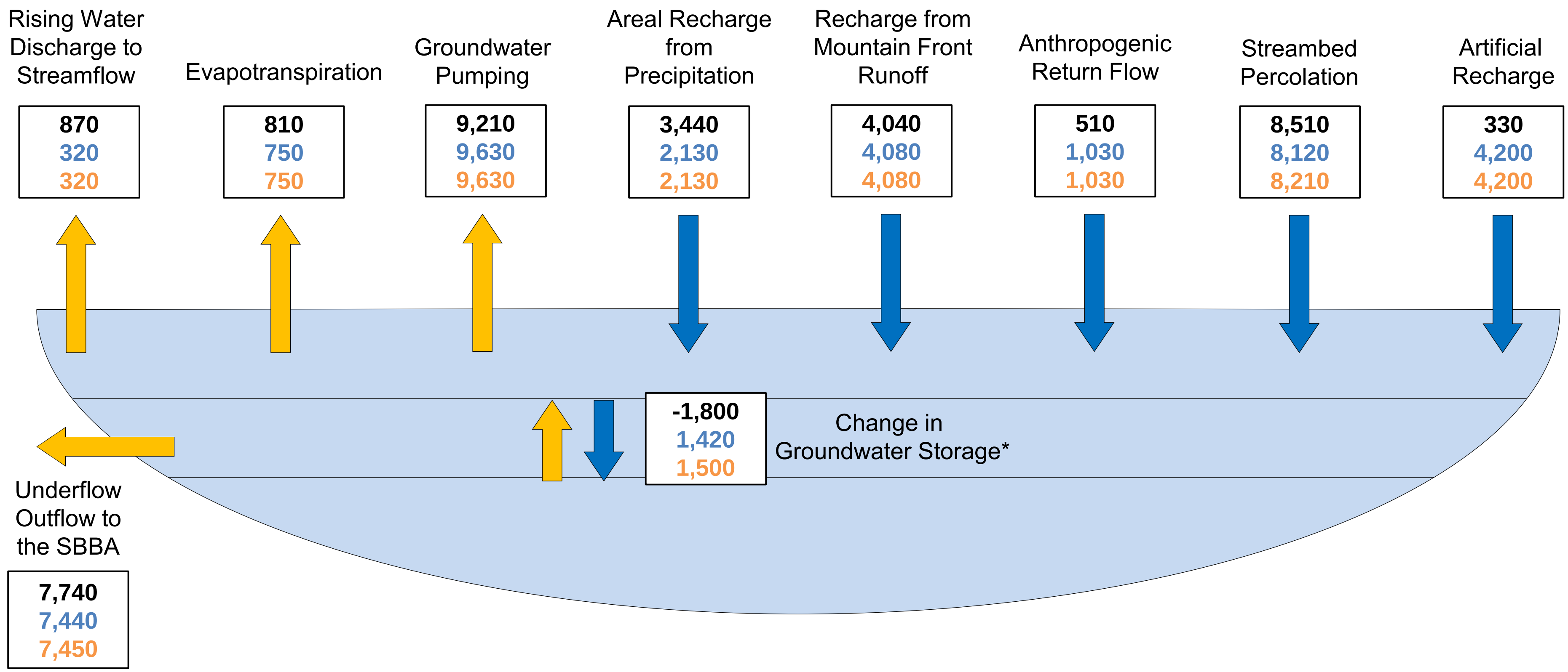
Figure 522

Scenario 2c.6: Annual Rising Water – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2c.6
Yucaipa	320	320
Riverside-Arlington	10,130	10,140
Prado	14,320	14,050
Total	**24,770**	**24,510**

Figure 523



Scenario 2a - Baseline
Scenario 2c.6 - Western Riverside County Regional Wastewater Treatment Plant Enhancement and Expansion

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2c.6 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2C.6
AVERAGE ANNUAL
WATER BUDGET
YUCAIPA BASIN

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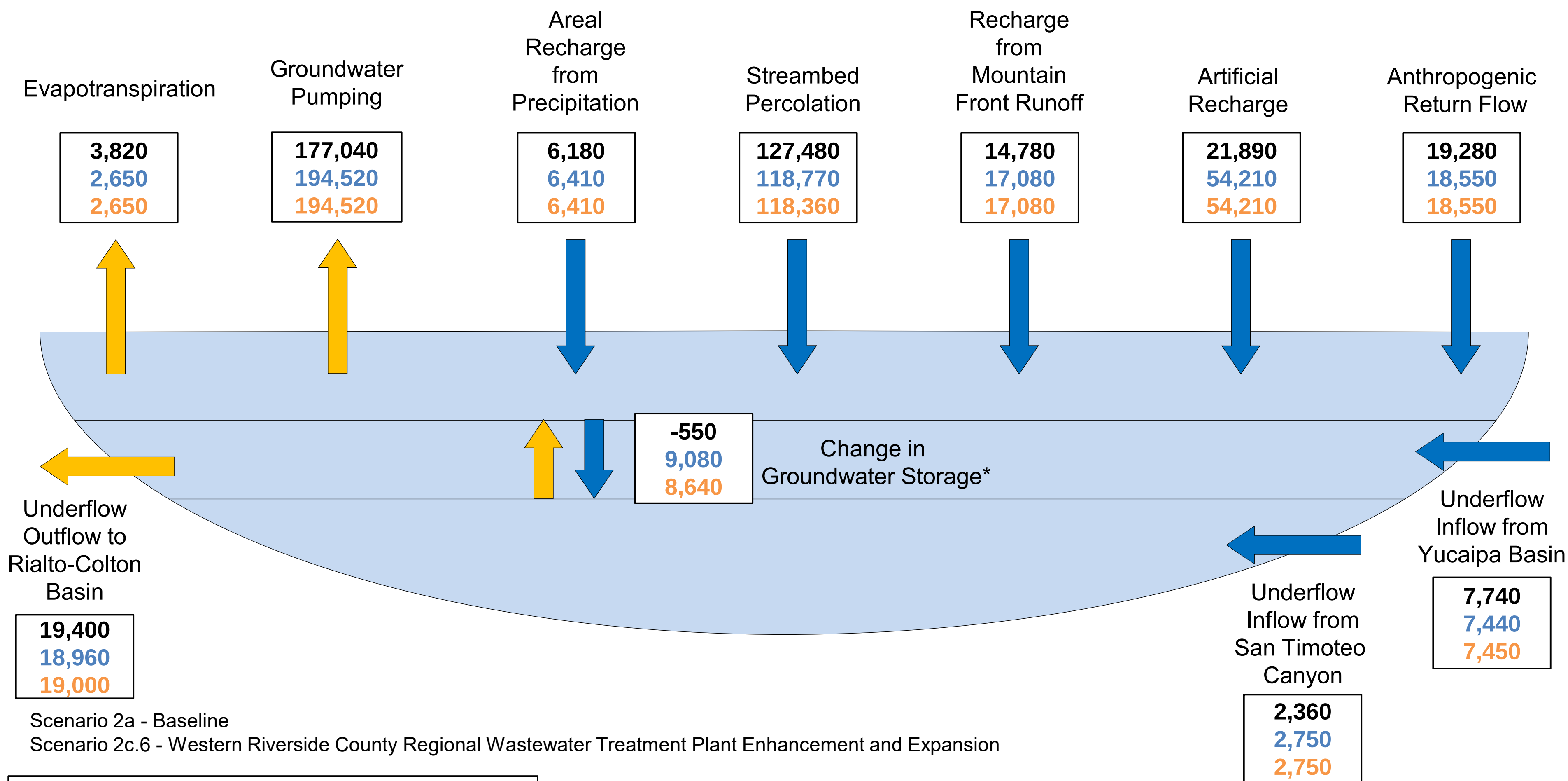

Scenario 2a - Baseline
Scenario 2c.6 - Western Riverside County Regional Wastewater Treatment Plant Enhancement and Expansion

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2c.6 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2C.6 AVERAGE ANNUAL WATER BUDGET SBBA

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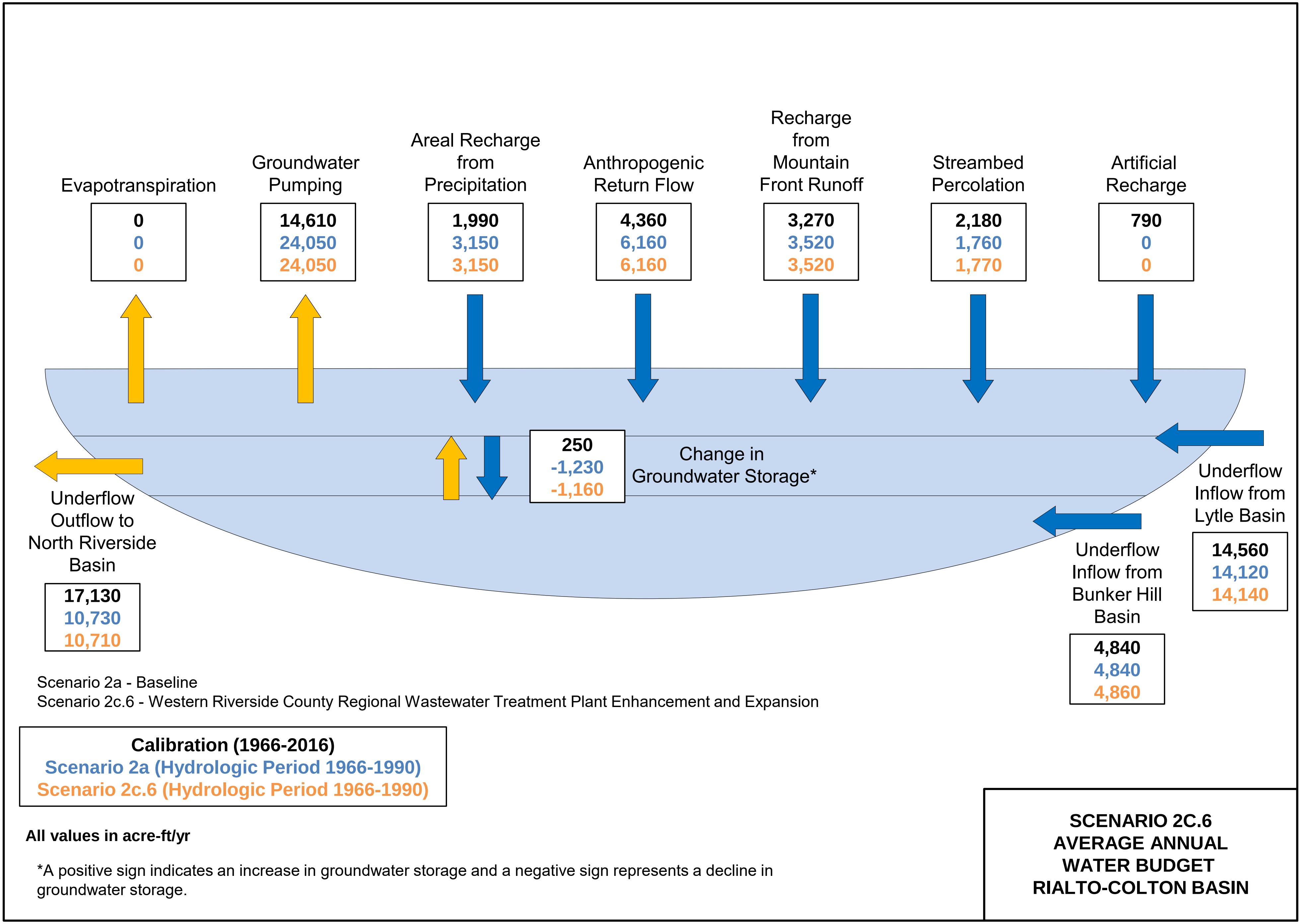
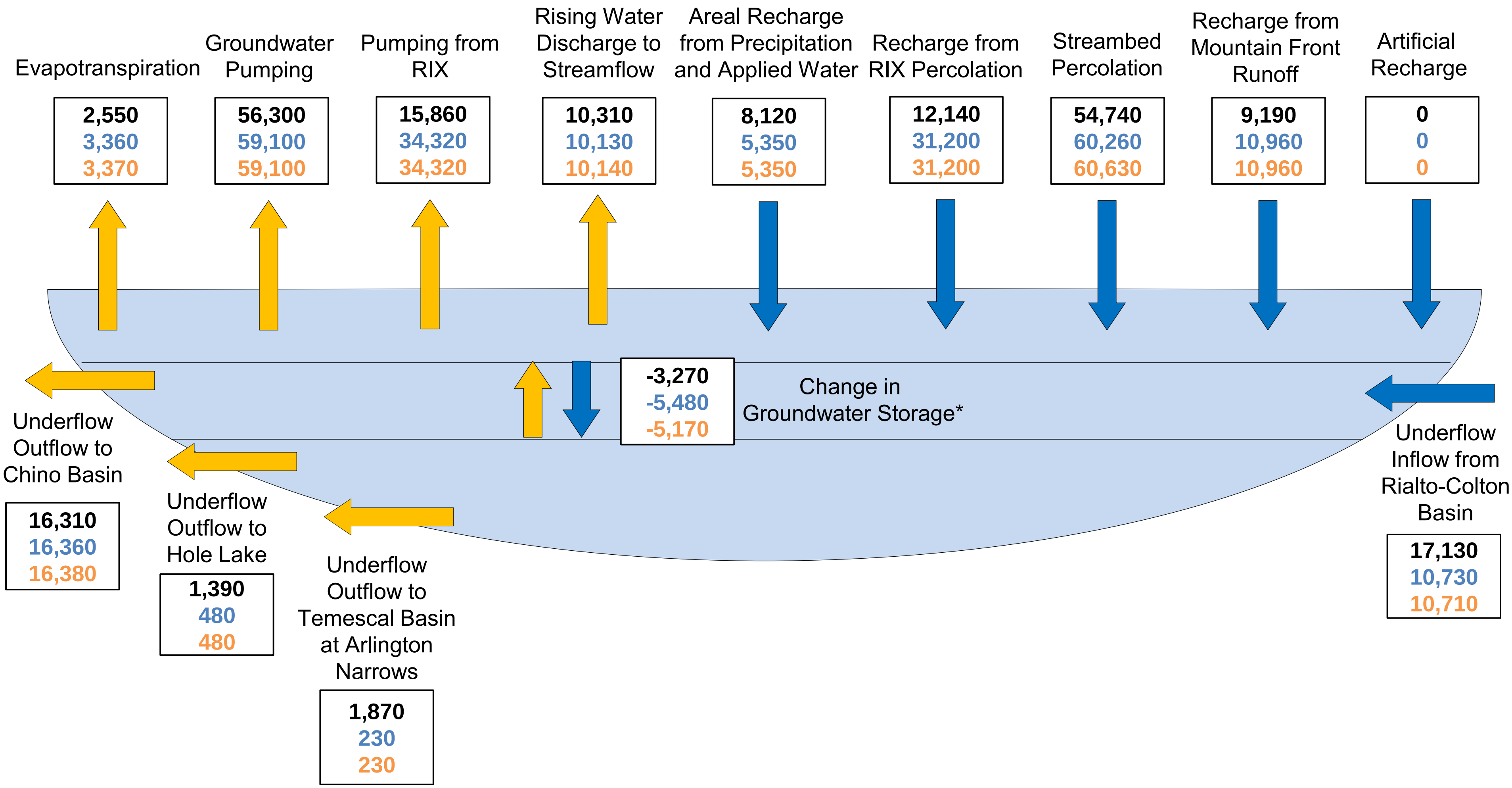

Evapotranspiration
0
0
0
Groundwater Pumping
14,610
24,050
24,050
Areal Recharge from Precipitation
1,990
3,150
3,150
Anthropogenic Return Flow
4,360
6,160
6,160
Recharge from Mountain Front Runoff
3,270
3,520
3,520
Streambed Percolation
2,180
1,760
1,770
Artificial Recharge
790
0
0
250
-1,230
-1,160
Change in Groundwater Storage*
Underflow Outflow to North Riverside Basin
17,130
10,730
10,710
Underflow Inflow from Lytle Basin
14,560
14,120
14,140
Underflow Inflow from Bunker Hill Basin
4,840
4,840
4,860
Scenario 2a - Baseline
Scenario 2c.6 - Western Riverside County Regional Wastewater Treatment Plant Enhancement and Expansion
Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2c.6 (Hydrologic Period 1966-1990)
All values in acre-ft/yr
*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.
SCENARIO 2C.6
AVERAGE ANNUAL
WATER BUDGET
RIALTO-COLTON BASIN

10-Apr-20



Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2c.6 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

Scenario 2a - Baseline
Scenario 2c.6 - Western Riverside County Regional Wastewater Treatment Plant Enhancement and Expansion

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2C.6 AVERAGE ANNUAL WATER BUDGET RIVERSIDE-ARLINGTON BASIN

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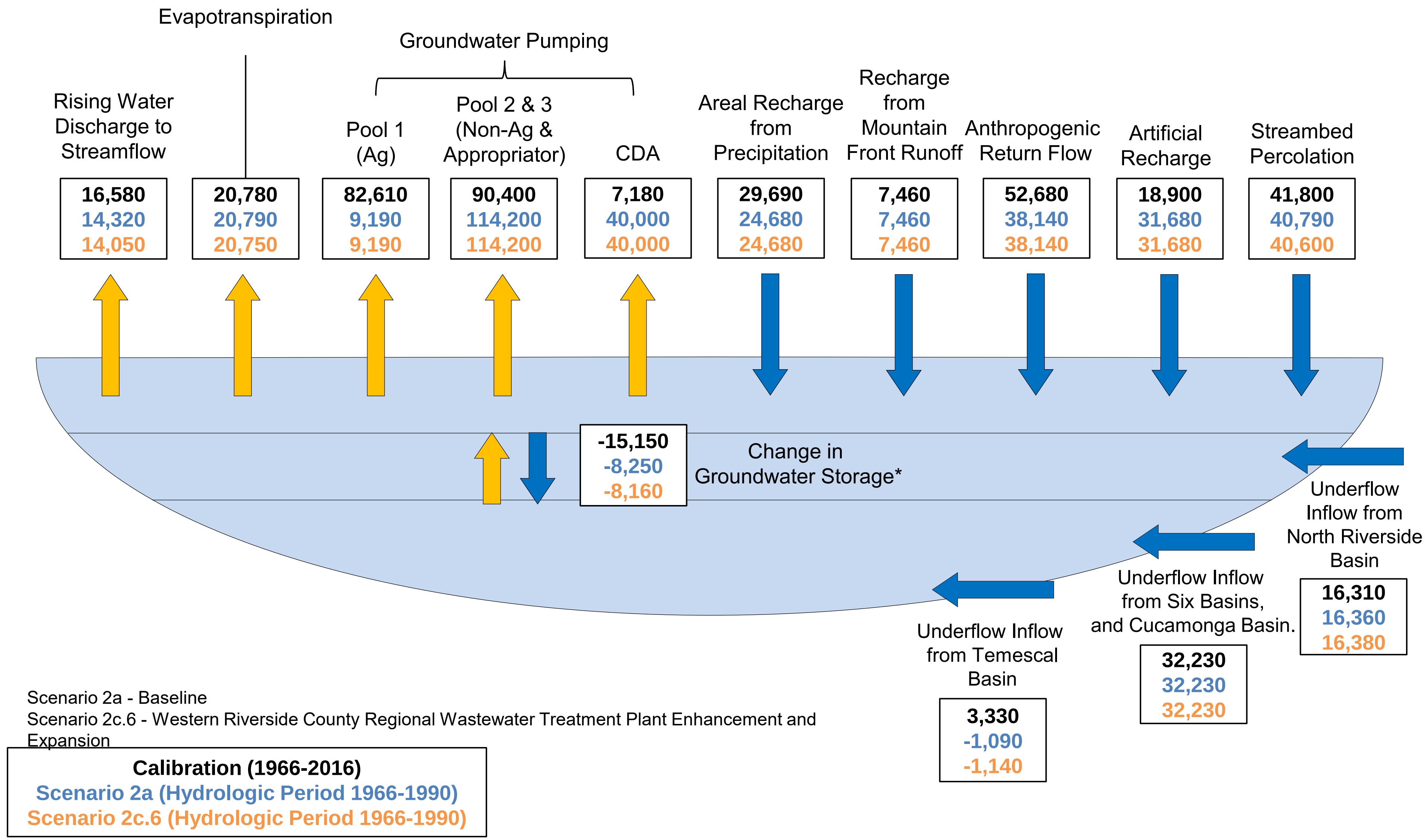


All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

**SCENARIO 2C.6
AVERAGE ANNUAL
WATER BUDGET
CHINO BASIN**

10-Apr-20

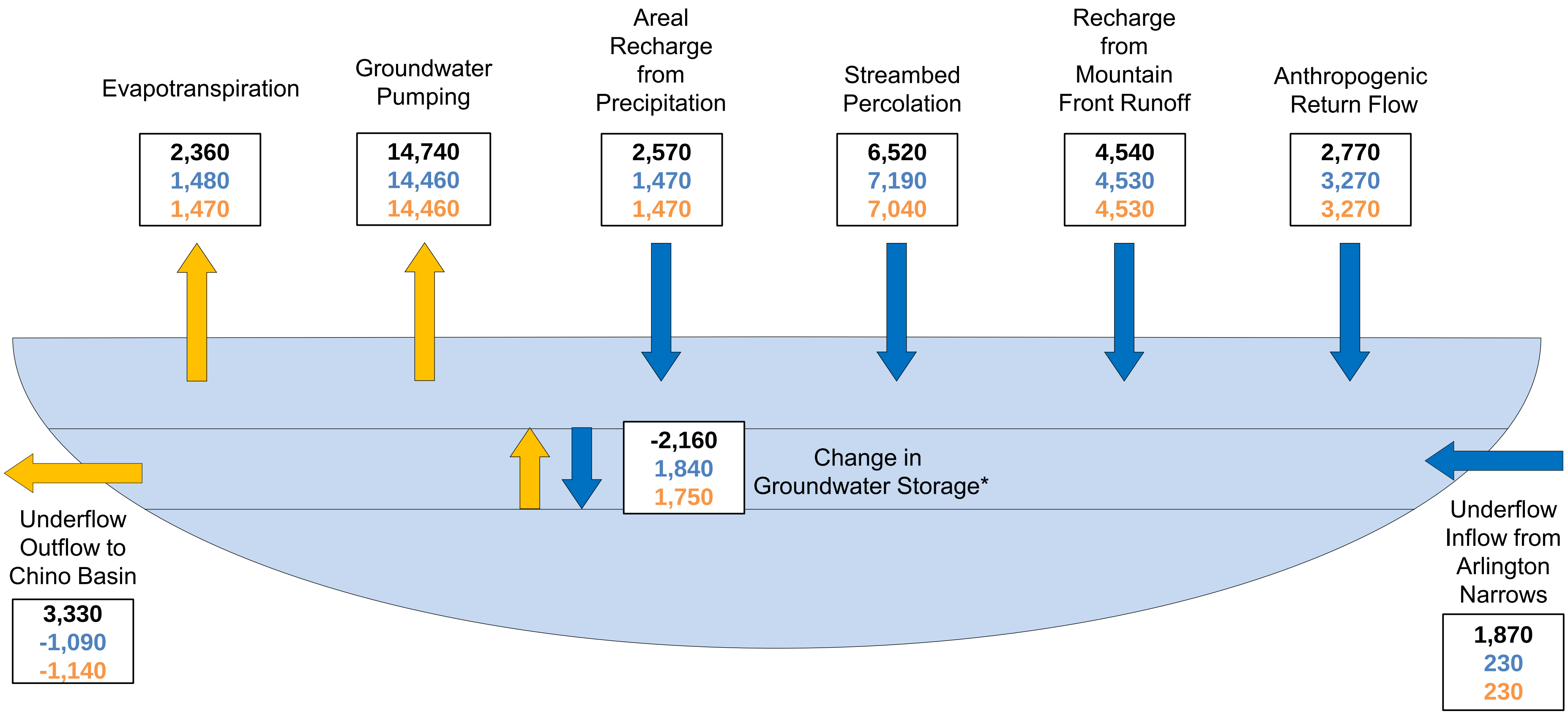
SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT **DRAFT** **FIGURE 528**

UPPER SANTA ANA RIVER INTEGRATED MODEL – SUMMARY REPORT

GEOSCIENCE

X:\Projects\San_Bernardino_MUNI\31) Integreated_SAR_Model\(4)Technical_Memos\(8)Summary Report\Draft\Figures\Scenarios

X:\Projects\San_Bernardino_MUNI\31) Integrated_SAR_Model\(4) Technical_Memos\(8) Summary Report\Draft\Figures\Scenarios



Scenario 2a - Baseline
Scenario 2c.6 - Western Riverside County Regional Wastewater Treatment Plant Enhancement and Expansion

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2c.6 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

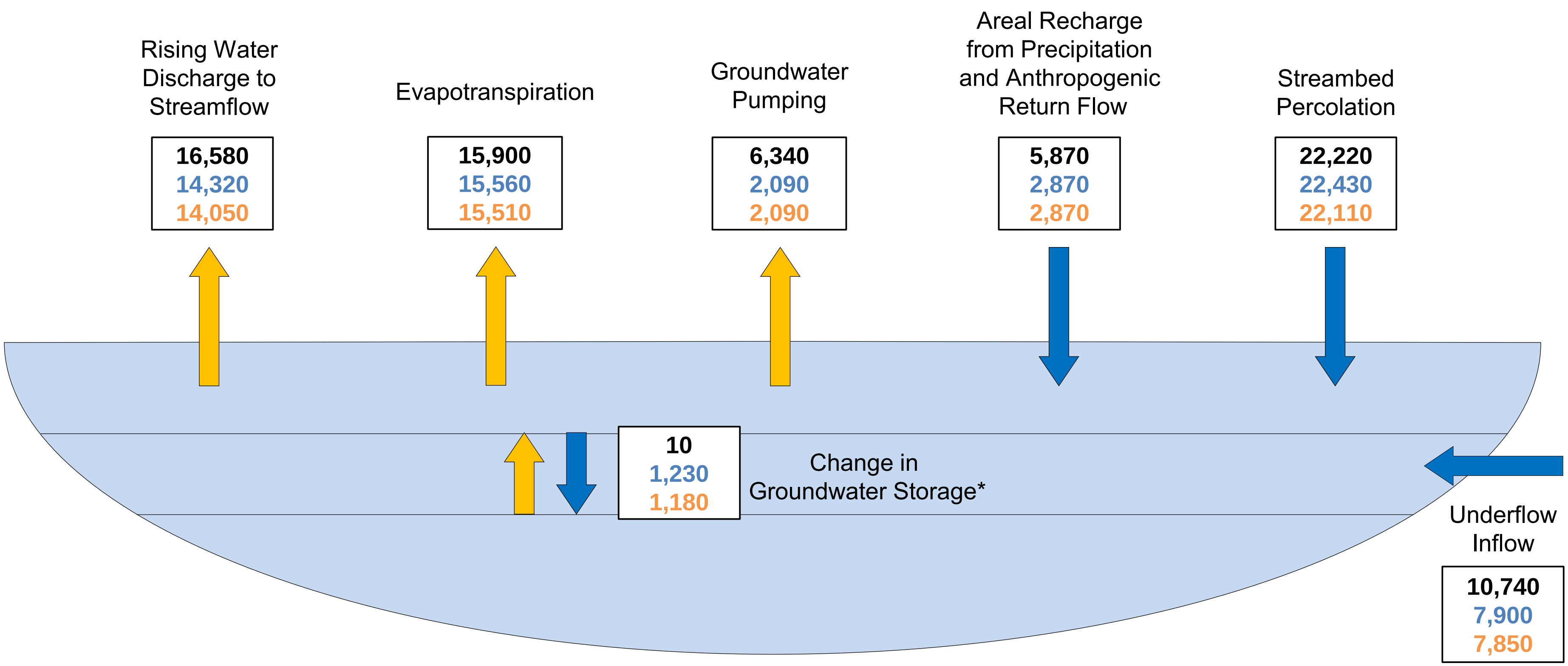
*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2C.6
AVERAGE ANNUAL
WATER BUDGET
TEMESCAL BASIN

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT **DRAFT** **FIGURE 529**
UPPER SANTA ANA RIVER INTEGRATED MODEL – SUMMARY REPORT

GEOSCIENCE



Scenario 2a - Baseline
Scenario 2c.6 - Western Riverside County Regional Wastewater Treatment Plant Enhancement and Expansion

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2c.6 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2C.6
AVERAGE ANNUAL
WATER BUDGET
PRADO BASIN

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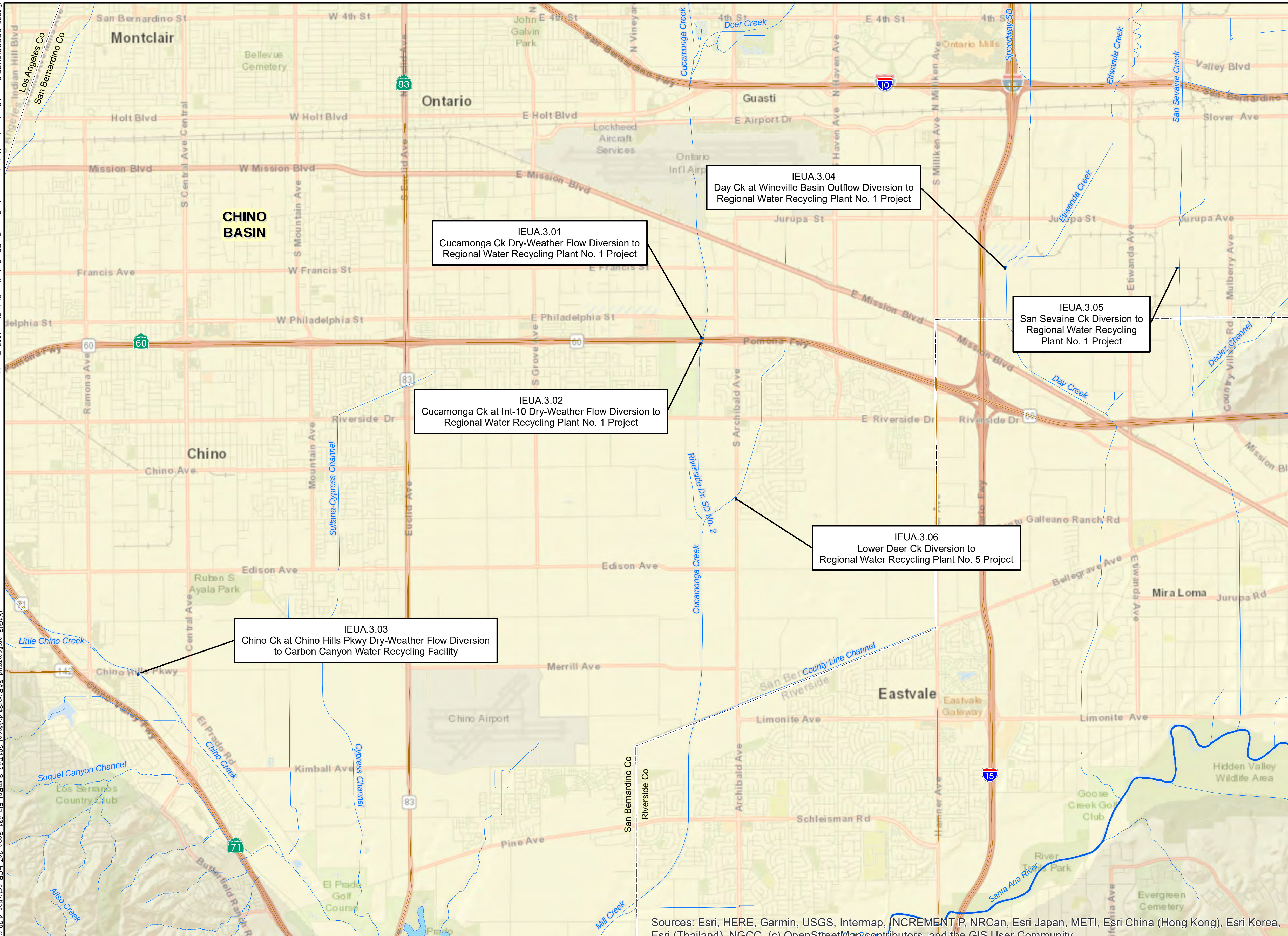
10-Apr-20



EXPLANATION

Integrated SAR Model Boundary

Active Model Area

Inactive Model Area

Habitat Conservation Plan (HCP) Covered Activity

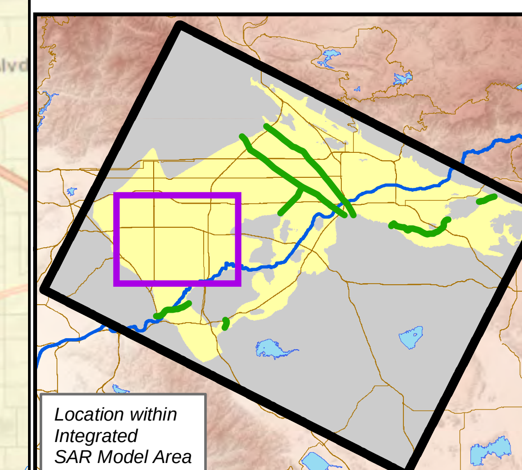
IEUA.3.05 - Project ID

Name - Name of HCP Project

Groundwater Basin Boundary

Refer to Table 17 for HCP Covered Activity Description

Scenario 2c.7:
Baseflow Reduction Activities -
IEUA Baseflow Reduction Activities



N

0 1 2

Miles

SCENARIO 2c.7
LOCATION OF
HCP COVERED ACTIVITIES

W:\GIS_projs\rmwd_SARiverStudyModel_2017\53_SumRpt_Fig_531_Scen_2c7_HCP_activities_4-20.mxd

10-Apr-20

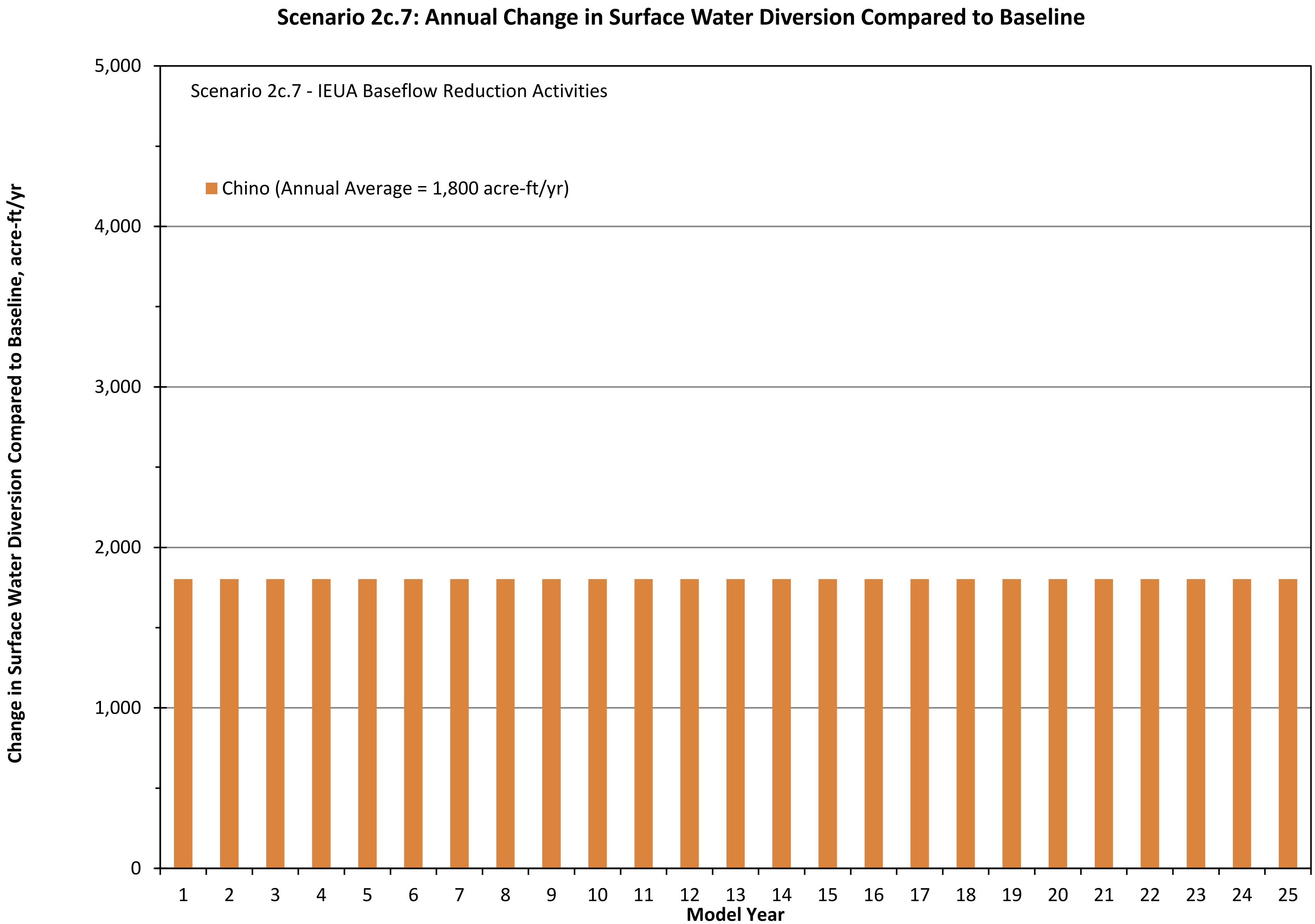
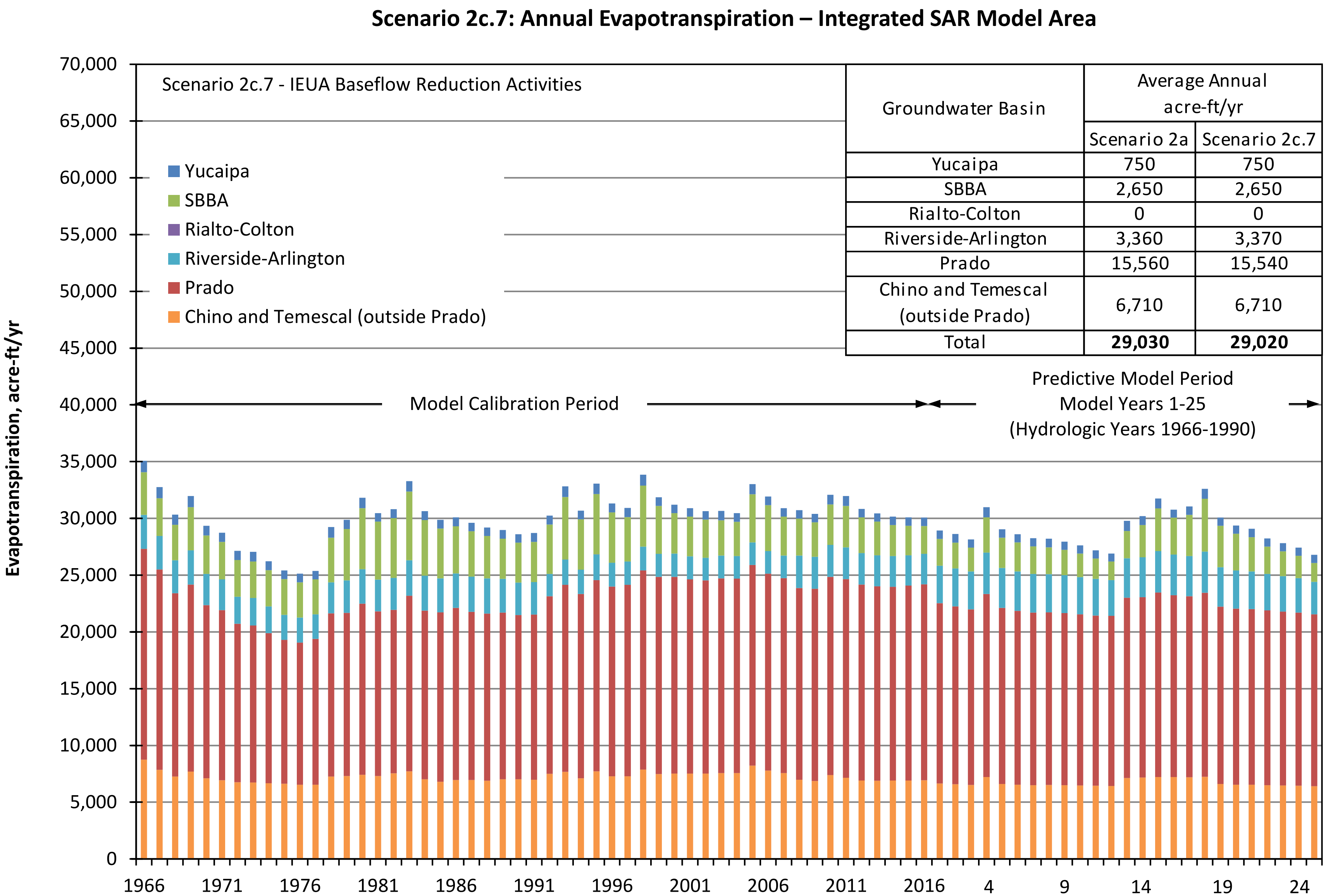

Scenario 2c.7: Annual Change in Surface Water Diversion Compared to Baseline
Scenario 2c.7 - IEUA Baseflow Reduction Activities
Chino (Annual Average = 1,800 acre-ft/yr)
Change in Surface Water Diversion Compared to Baseline, acre-ft/yr
Model Year
0
1,000
2,000
3,000
4,000
5,000
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

Figure 532



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2c.7
Yucaipa	750	750
SBBA	2,650	2,650
Rialto-Colton	0	0
Riverside-Arlington	3,360	3,370
Prado	15,560	15,540
Chino and Temescal (outside Prado)	6,710	6,710
Total	**29,030**	**29,020**

Figure 533

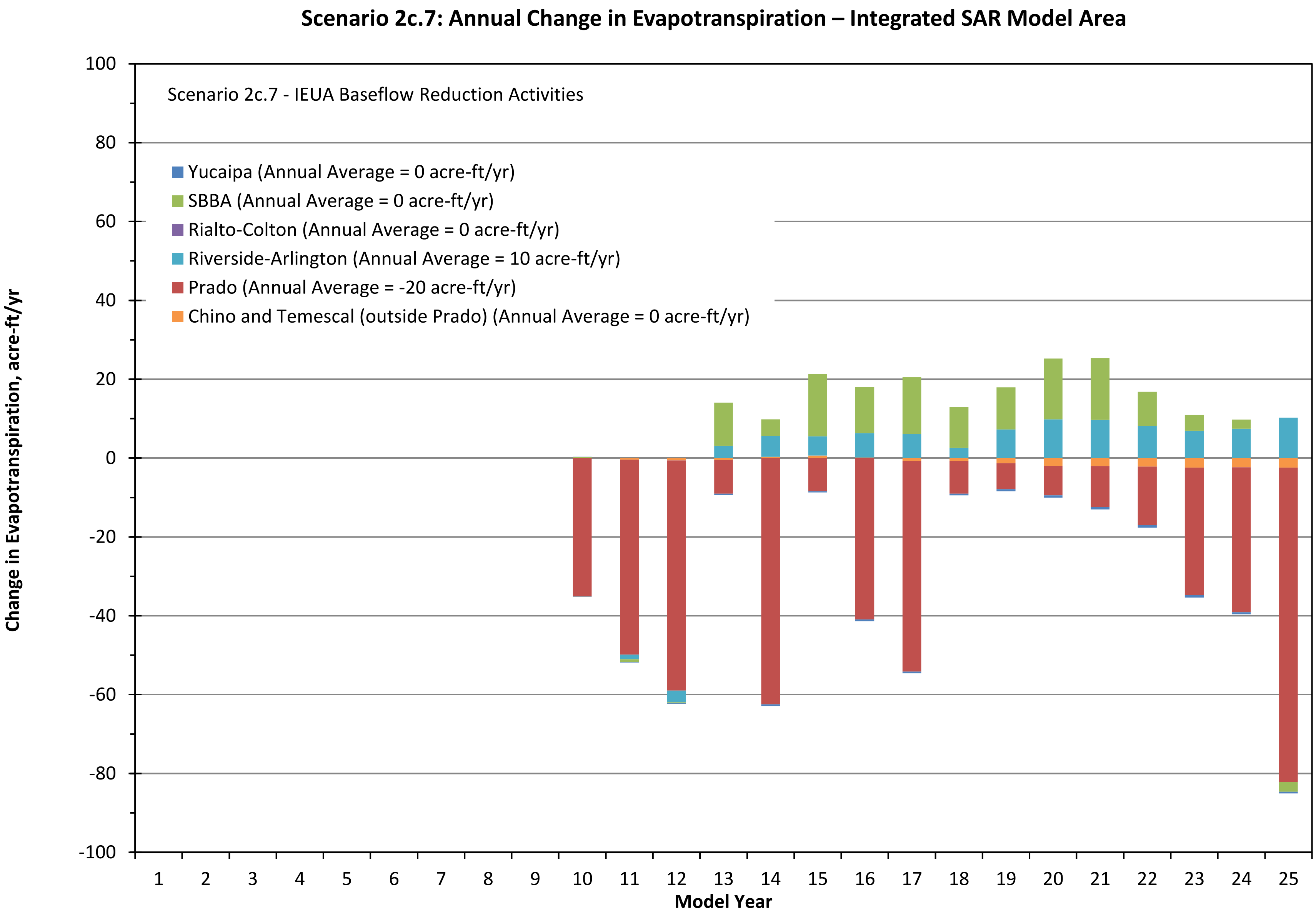
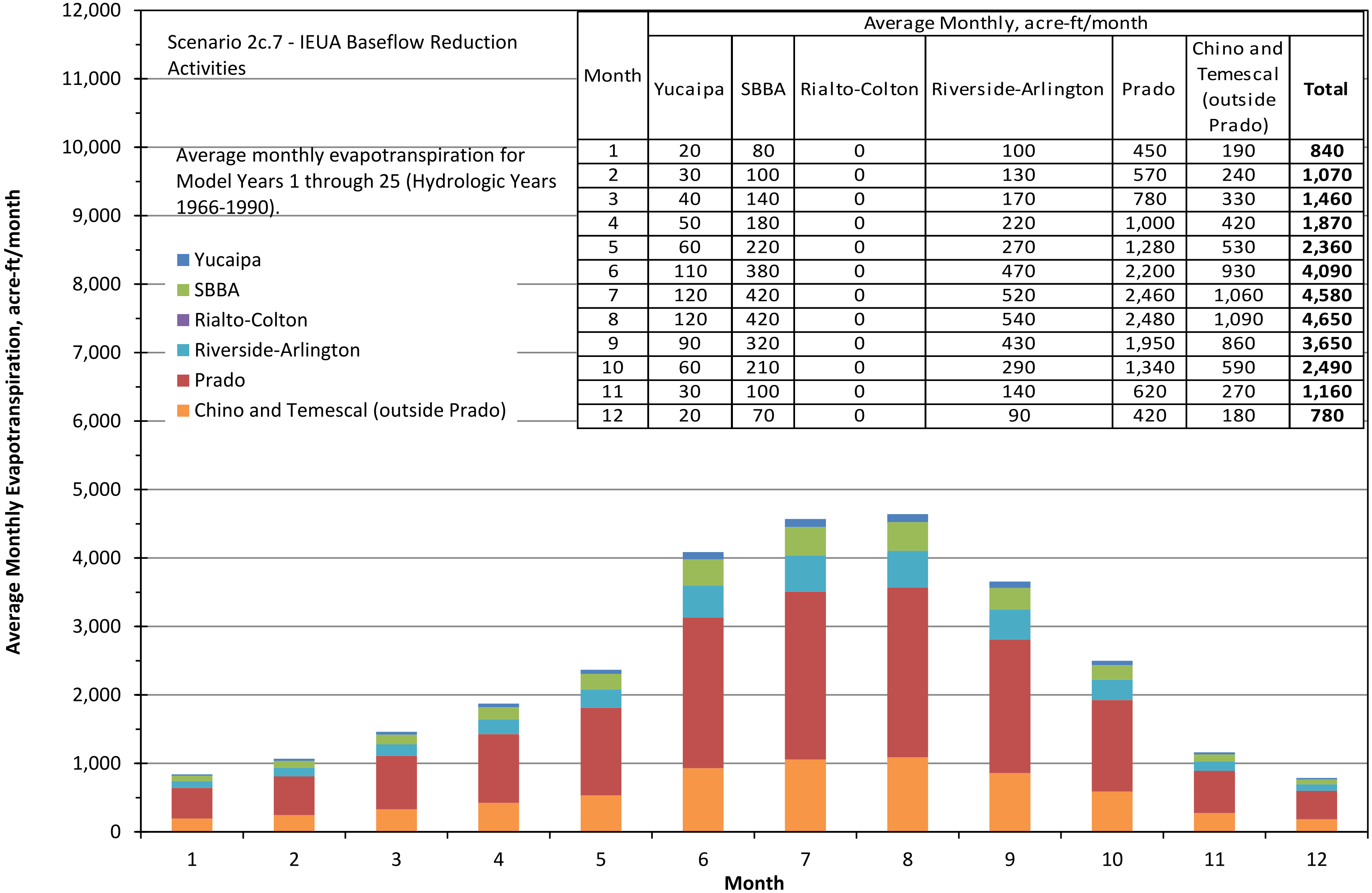

Scenario 2c.7: Annual Change in Evapotranspiration – Integrated SAR Model Area
Scenario 2c.7 - IEUA Baseflow Reduction Activities
Yucaipa (Annual Average = 0 acre-ft/yr)
SBBA (Annual Average = 0 acre-ft/yr)
Rialto-Colton (Annual Average = 0 acre-ft/yr)
Riverside-Arlington (Annual Average = 10 acre-ft/yr)
Prado (Annual Average = -20 acre-ft/yr)
Chino and Temescal (outside Prado) (Annual Average = 0 acre-ft/yr)
Change in Evapotranspiration, acre-ft/yr
Model Year
100
80
60
40
20
0
-20
-40
-60
-80
-100
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

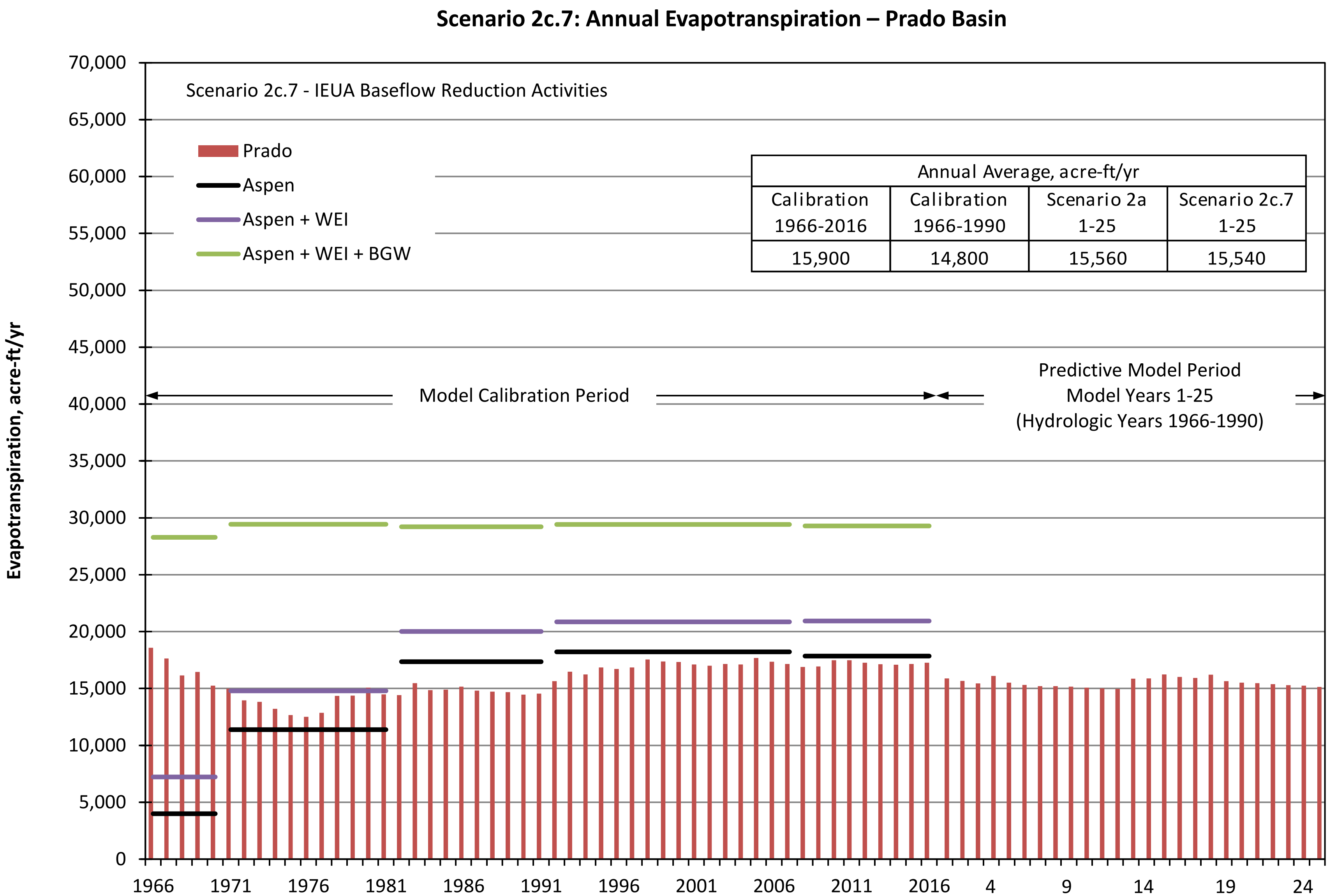
Figure 534

Scenario 2c.7: Seasonal Evapotranspiration – Integrated SAR Model Area



Month	Average Monthly, acre-ft/month						
	Yucaipa	SBBA	Rialto-Colton	Riverside-Arlington	Prado	Chino and Temescal (outside Prado)	**Total**
1	20	80	0	100	450	190	**840**
2	30	100	0	130	570	240	**1,070**
3	40	140	0	170	780	330	**1,460**
4	50	180	0	220	1,000	420	**1,870**
5	60	220	0	270	1,280	530	**2,360**
6	110	380	0	470	2,200	930	**4,090**
7	120	420	0	520	2,460	1,060	**4,580**
8	120	420	0	540	2,480	1,090	**4,650**
9	90	320	0	430	1,950	860	**3,650**
10	60	210	0	290	1,340	590	**2,490**
11	30	100	0	140	620	270	**1,160**
12	20	70	0	90	420	180	**780**

Figure 535



Annual Average, acre-ft/yr			
Calibration 1966-2016	Calibration 1966-1990	Scenario 2a 1-25	Scenario 2c.7 1-25
15,900	14,800	15,560	15,540

Figure 536

DRAFT

Scenario 2c.7: Annual Change in Evapotranspiration – Prado Basin

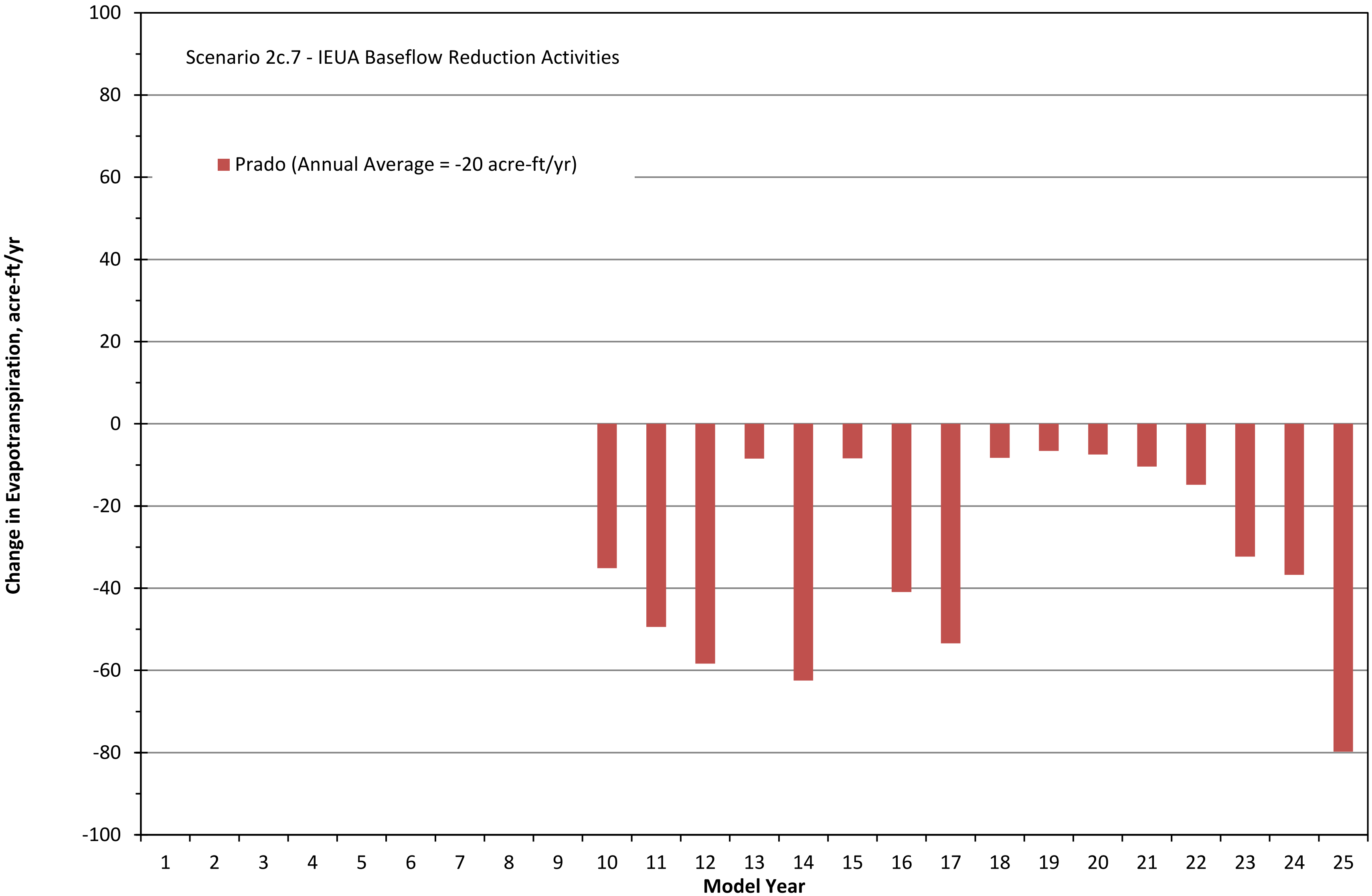
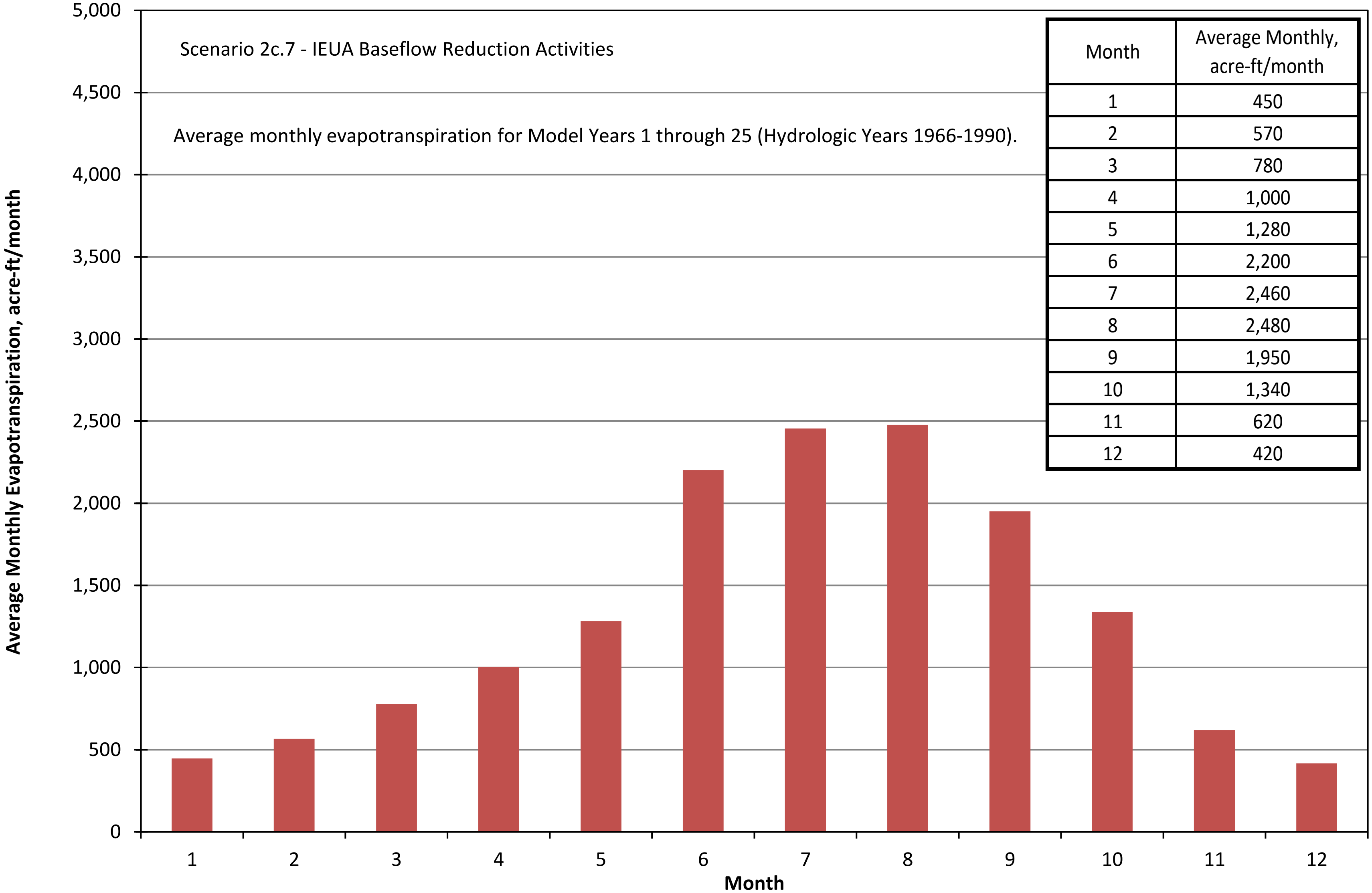


Figure 537

Scenario 2c.7: Seasonal Evapotranspiration – Prado Basin



Month	Average Monthly, acre-ft/month
1	450
2	570
3	780
4	1,000
5	1,280
6	2,200
7	2,460
8	2,480
9	1,950
10	1,340
11	620
12	420

Figure 538

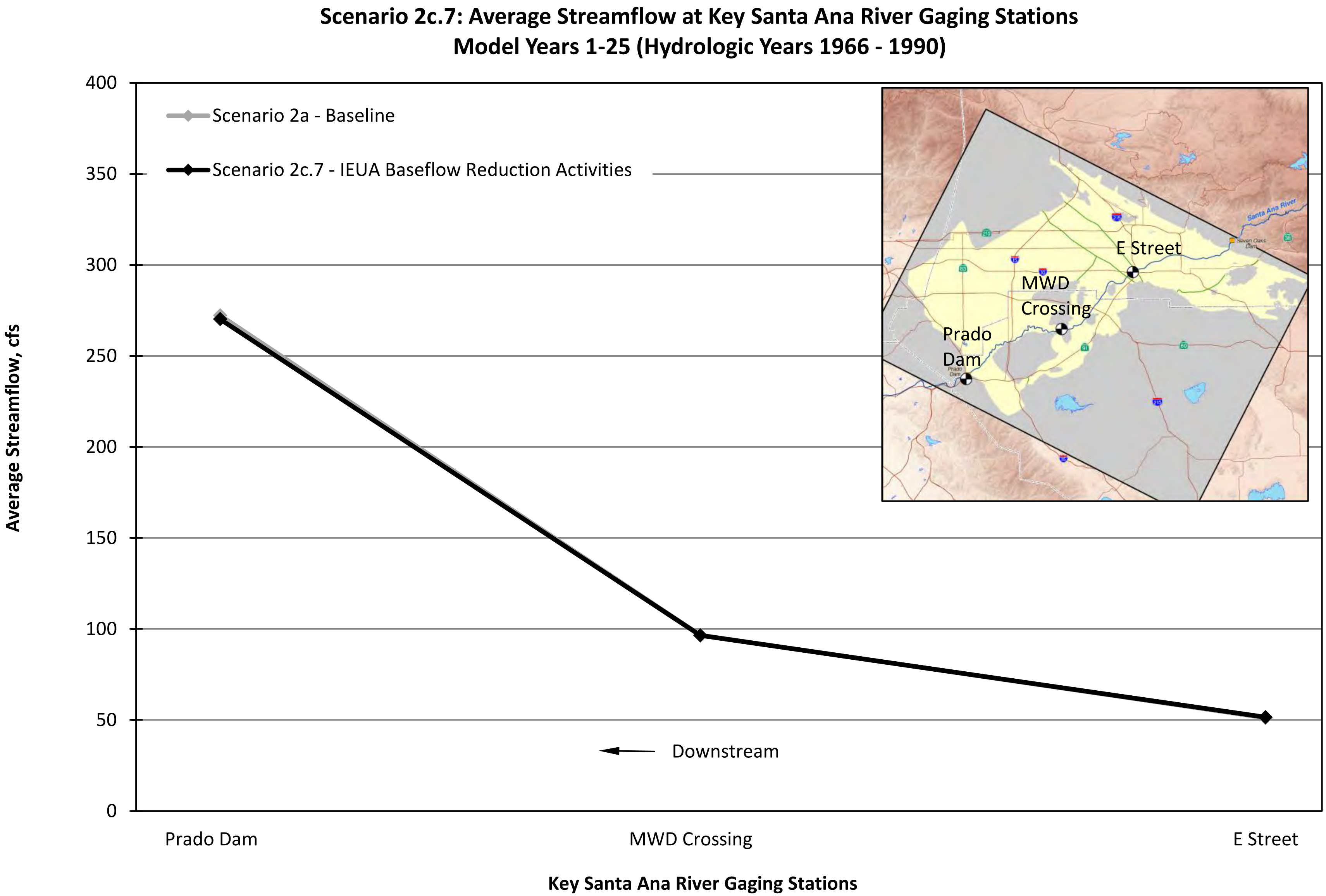

Scenario 2c.7: Average Streamflow at Key Santa Ana River Gaging Stations
Model Years 1-25 (Hydrologic Years 1966 - 1990)
Scenario 2a - Baseline
Scenario 2c.7 - IEUA Baseflow Reduction Activities
Average Streamflow, cfs
400
350
300
250
200
150
100
50
0
E Street
MWD
Crossing
Prado
Dam
Santa Ana River
Downstream
Prado Dam
MWD Crossing
E Street
Key Santa Ana River Gaging Stations

Figure 539

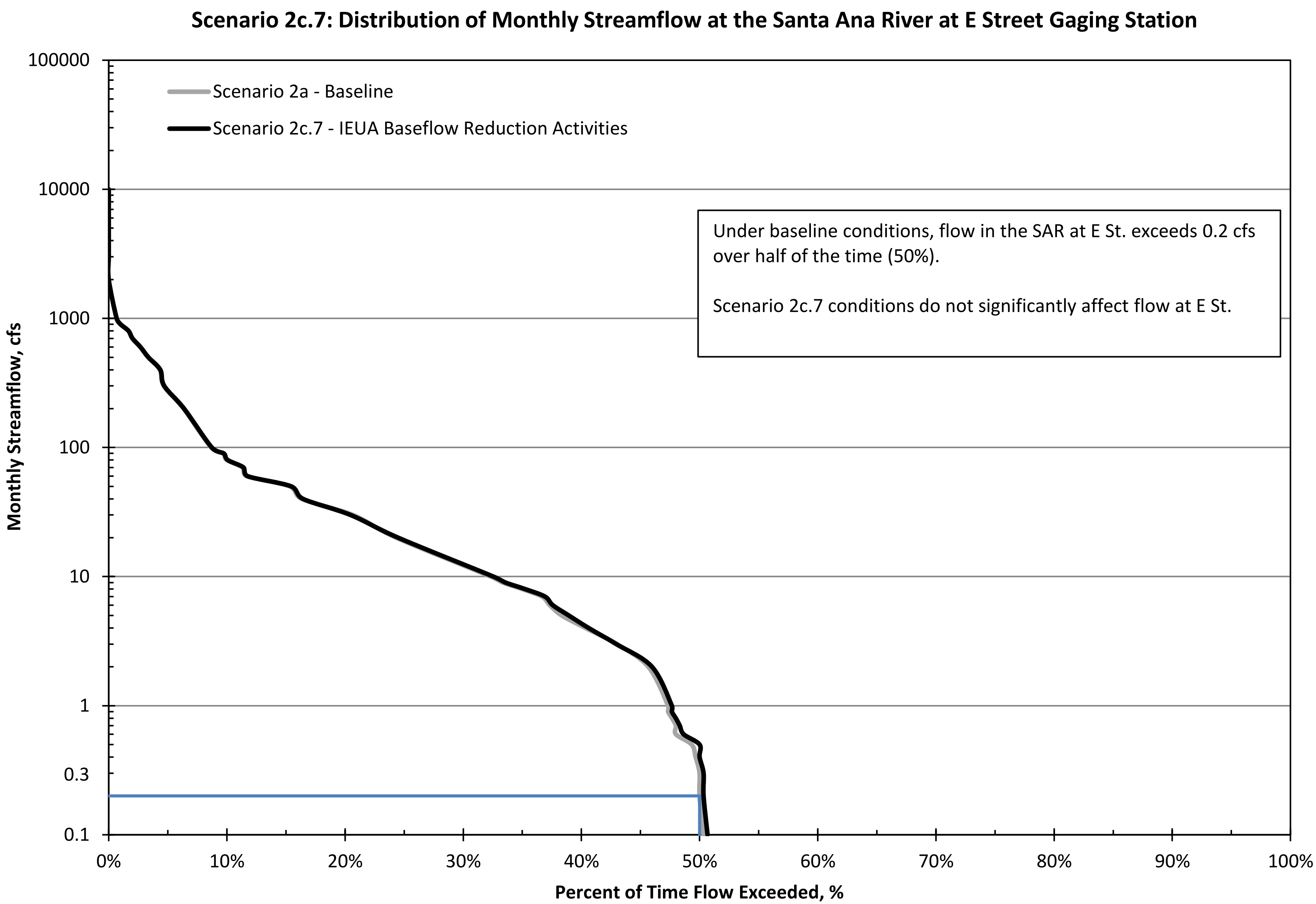

Scenario 2c.7: Distribution of Monthly Streamflow at the Santa Ana River at E Street Gaging Station
Scenario 2a - Baseline
Scenario 2c.7 - IEUA Baseflow Reduction Activities
Under baseline conditions, flow in the SAR at E St. exceeds 0.2 cfs over half of the time (50%).
Scenario 2c.7 conditions do not significantly affect flow at E St.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.3
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 540

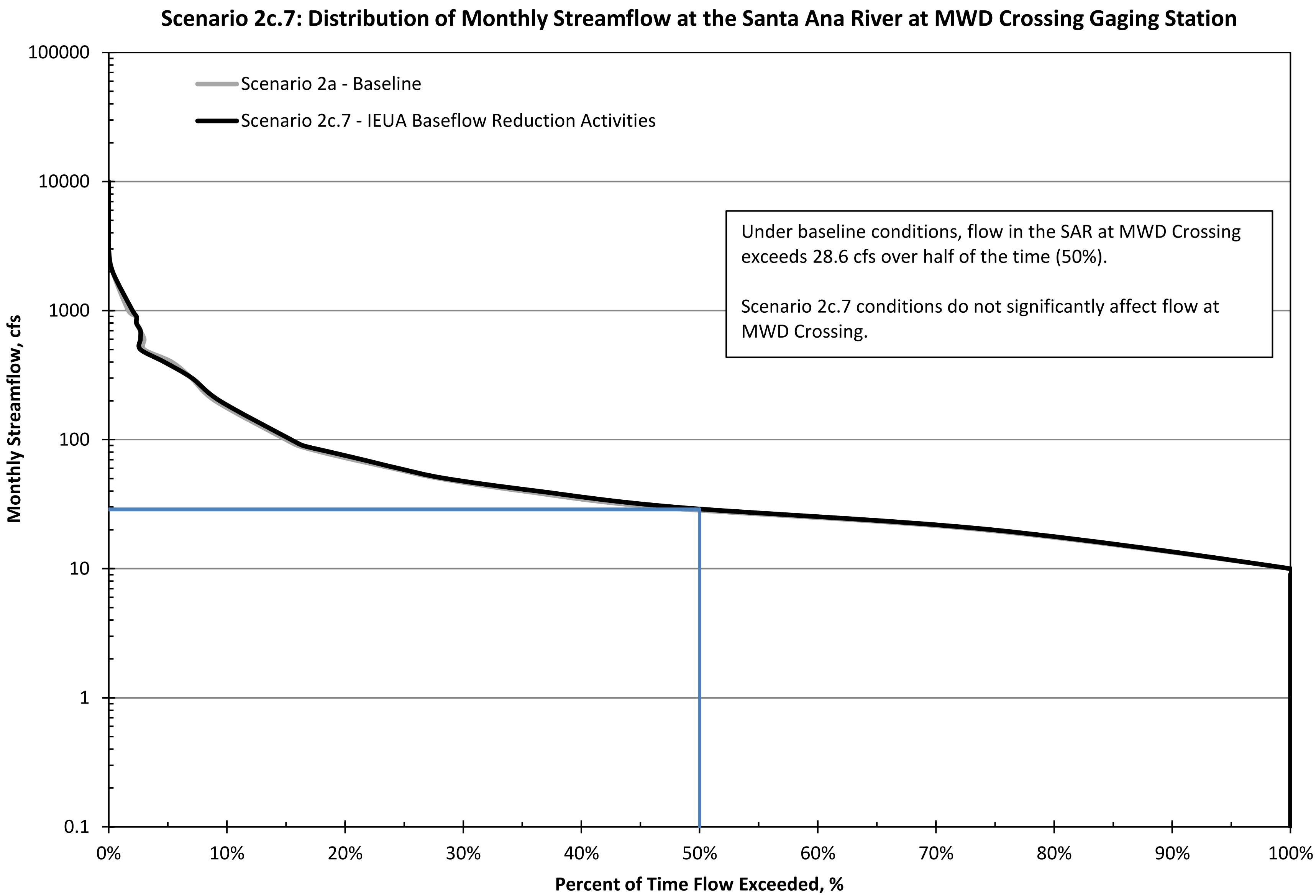

Scenario 2c.7: Distribution of Monthly Streamflow at the Santa Ana River at MWD Crossing Gaging Station
100000
10000
1000
100
10
1
0.1
Monthly Streamflow, cfs
Scenario 2a - Baseline
Scenario 2c.7 - IEUA Baseflow Reduction Activities
Under baseline conditions, flow in the SAR at MWD Crossing exceeds 28.6 cfs over half of the time (50%).
Scenario 2c.7 conditions do not significantly affect flow at MWD Crossing.
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 541

Scenario 2c.7: Distribution of Monthly Streamflow at the Santa Ana River at Prado Dam

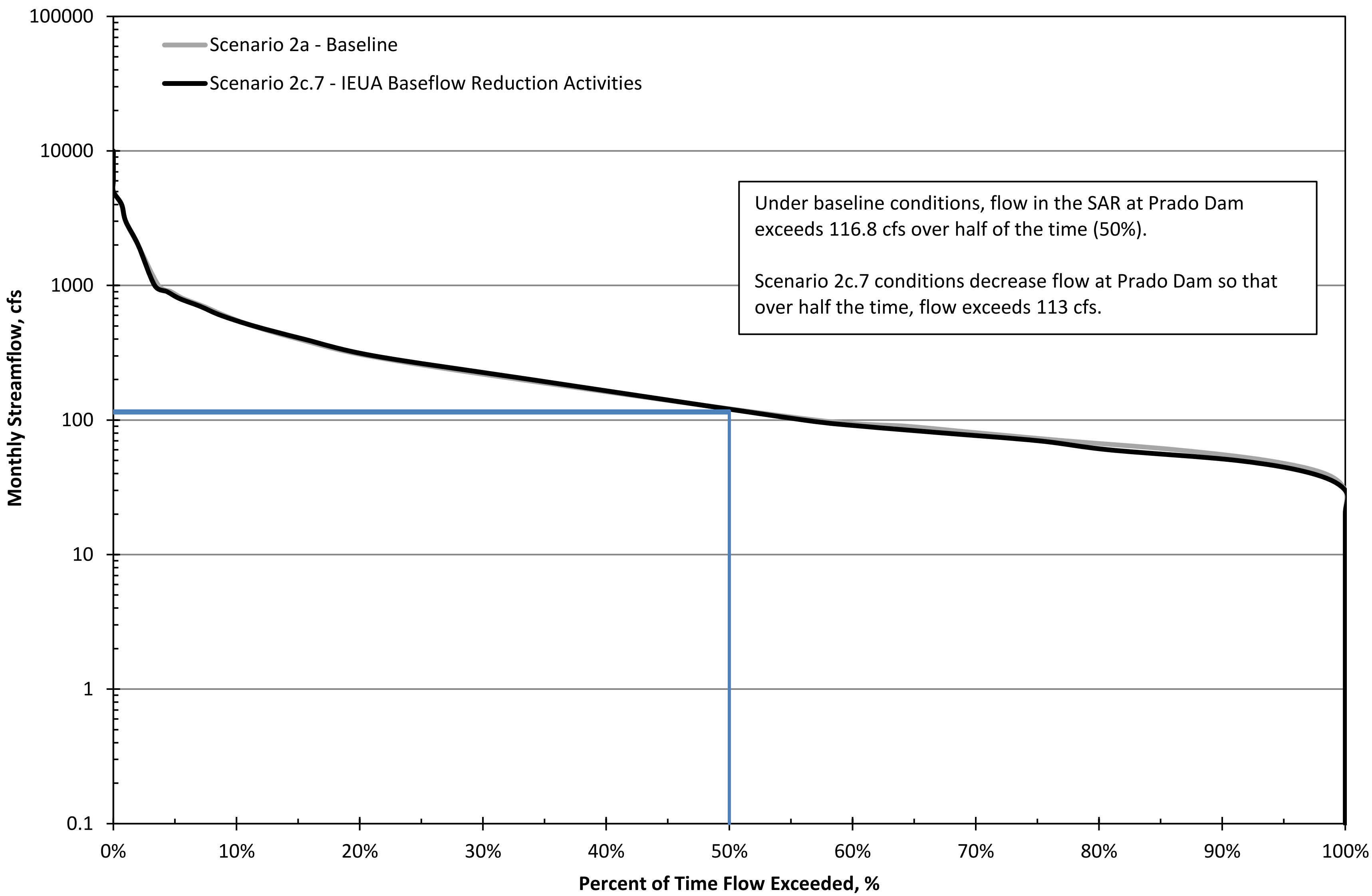
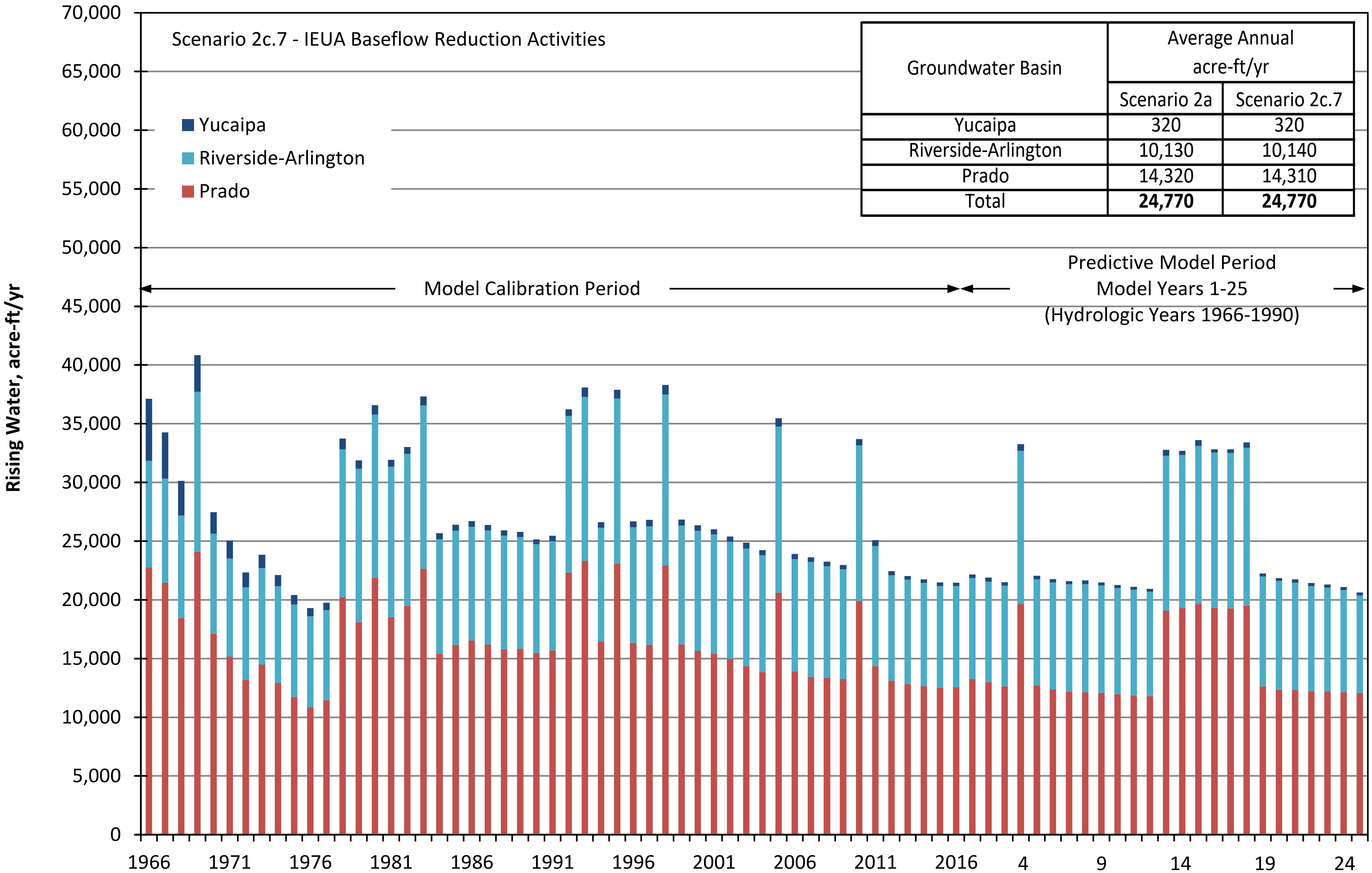


Figure 542

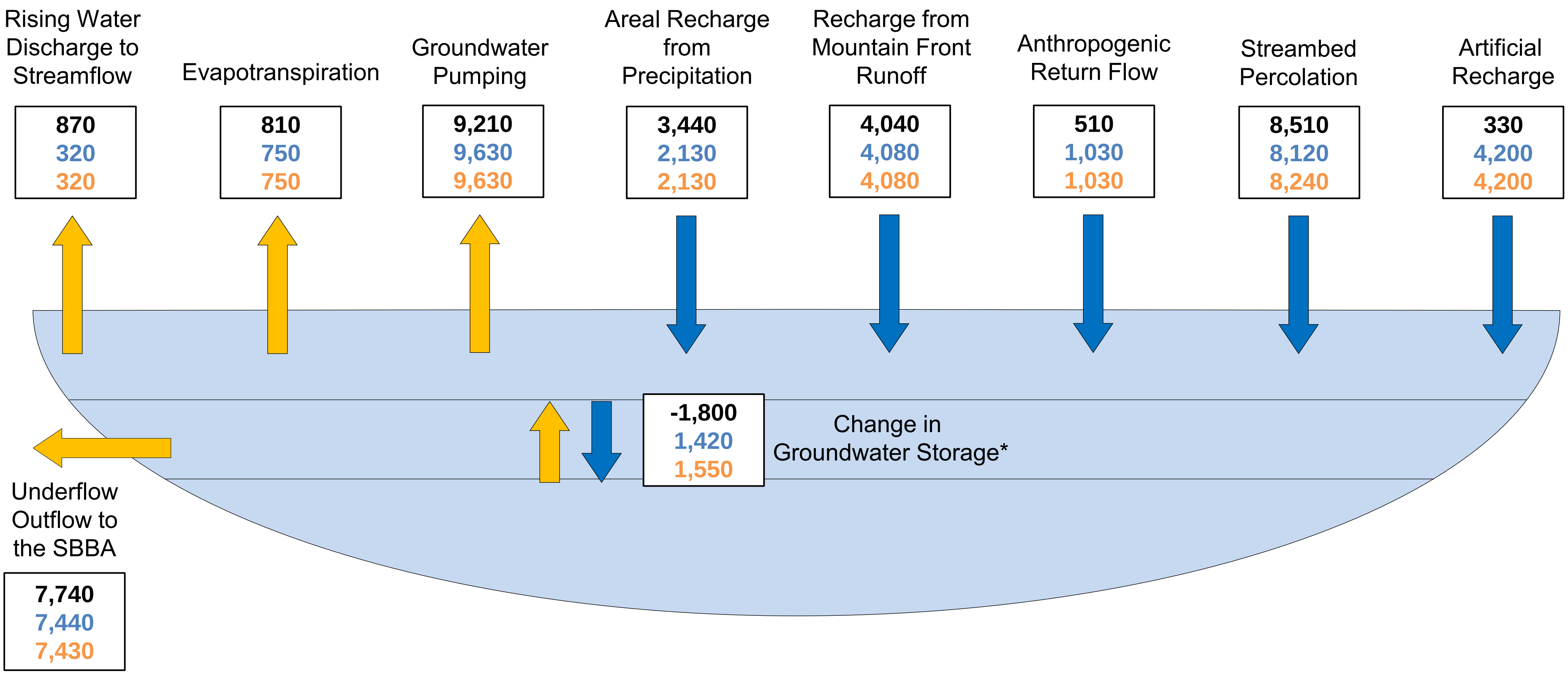
Scenario 2c.7: Annual Rising Water – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2c.7
Yucaipa	320	320
Riverside-Arlington	10,130	10,140
Prado	14,320	14,310
Total	**24,770**	**24,770**

Figure 543

X:\Projects\San_Bernardino_MUNI\31) Integreated_SAR_Model\(4)Technical_Memos\(8) Summary Report\Draft\Figures\Scenarios



Scenario 2a - Baseline
Scenario 2c.7 - IEUA Baseflow Reduction Activities

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2c.7 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2C.7
AVERAGE ANNUAL
WATER BUDGET
YUCAIPA BASIN

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT
UPPER SANTA ANA RIVER INTEGRATED MODEL – SUMMARY

DRAFT

FIGURE 544
GEOSCIENCE

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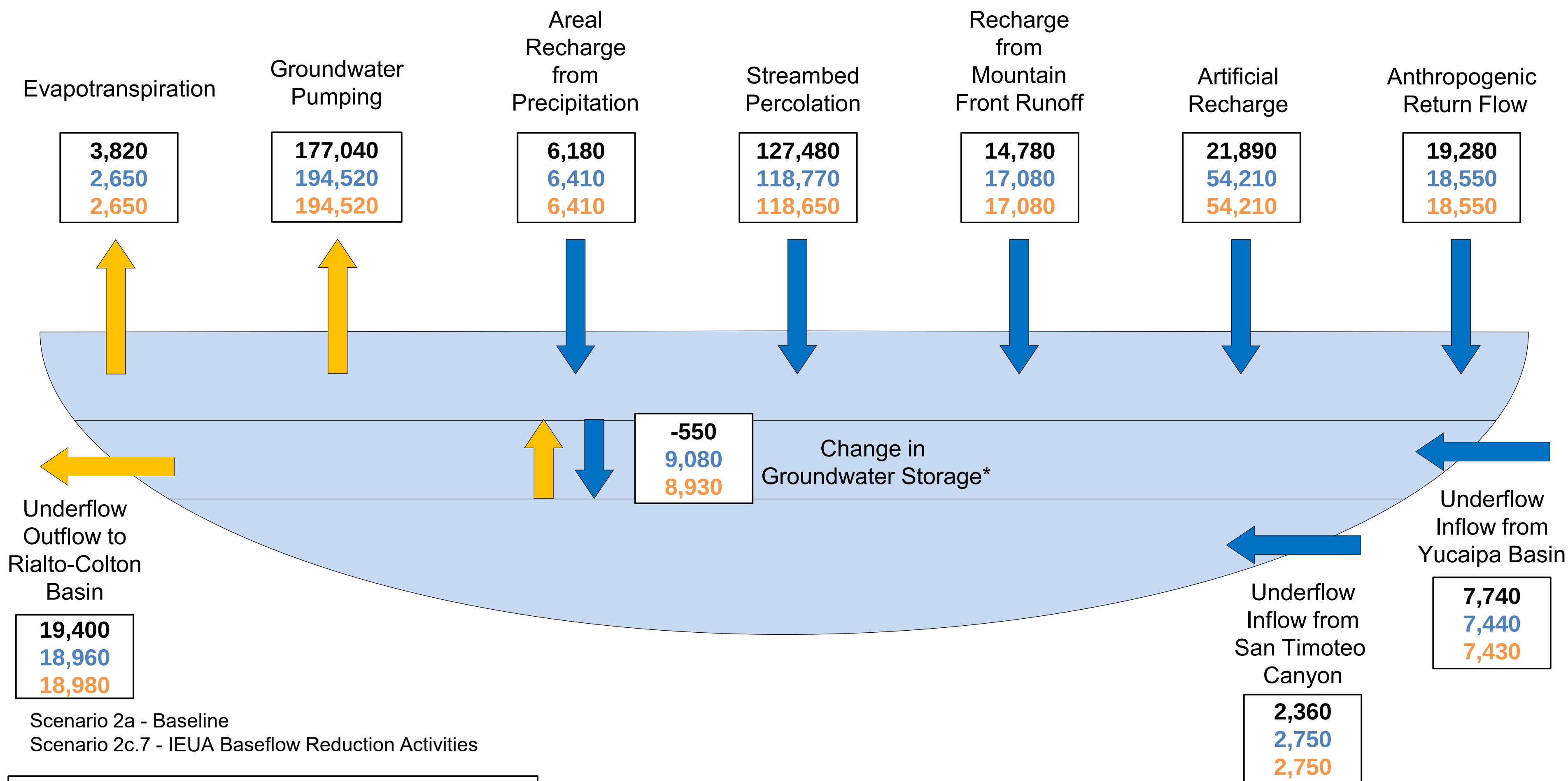


Scenario 2a - Baseline
Scenario 2c.7 - IEUA Baseflow Reduction Activities

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2c.7 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2C.7 AVERAGE ANNUAL WATER BUDGET SBBA

10-Apr-20

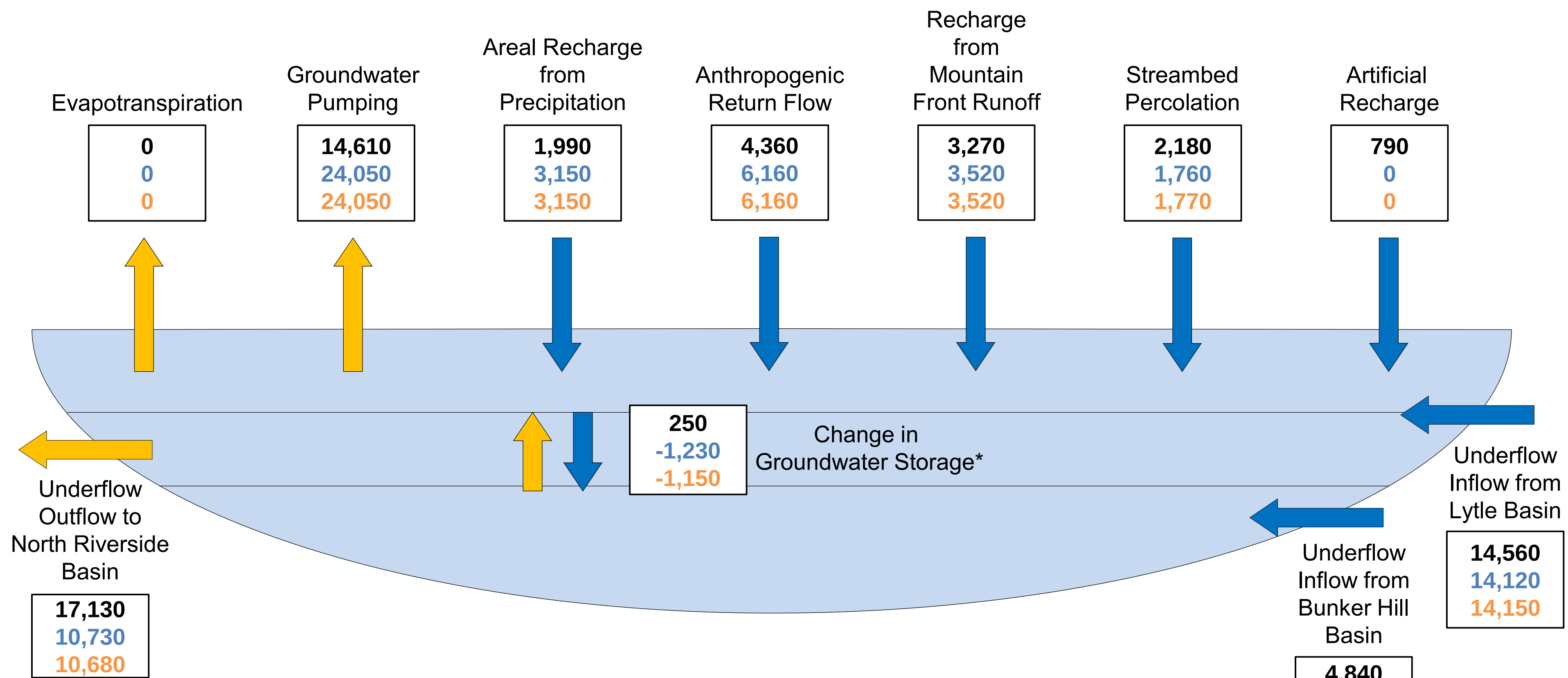
SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT
UPPER SANTA ANA RIVER INTEGRATED MODEL – SUMMARY

DRAFT

FIGURE 545

GEOSCIENCE

X:\Projects\San_Bernardino_MUNI\31) Integrated_SAR_Model\(4)Technical_Memos\(8)Summary Report\Draft\Figures\Scenarios



Scenario 2a - Baseline
Scenario 2c.7 - IEUA Baseflow Reduction Activities

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2c.7 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2C.7
AVERAGE ANNUAL
WATER BUDGET
RIALTO-COLTON BASIN

10-Apr-20

DRAFT

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT **FIGURE 546**
UPPER SANTA ANA RIVER INTEGRATED MODEL – SUMMARY

GEOSCIENCE

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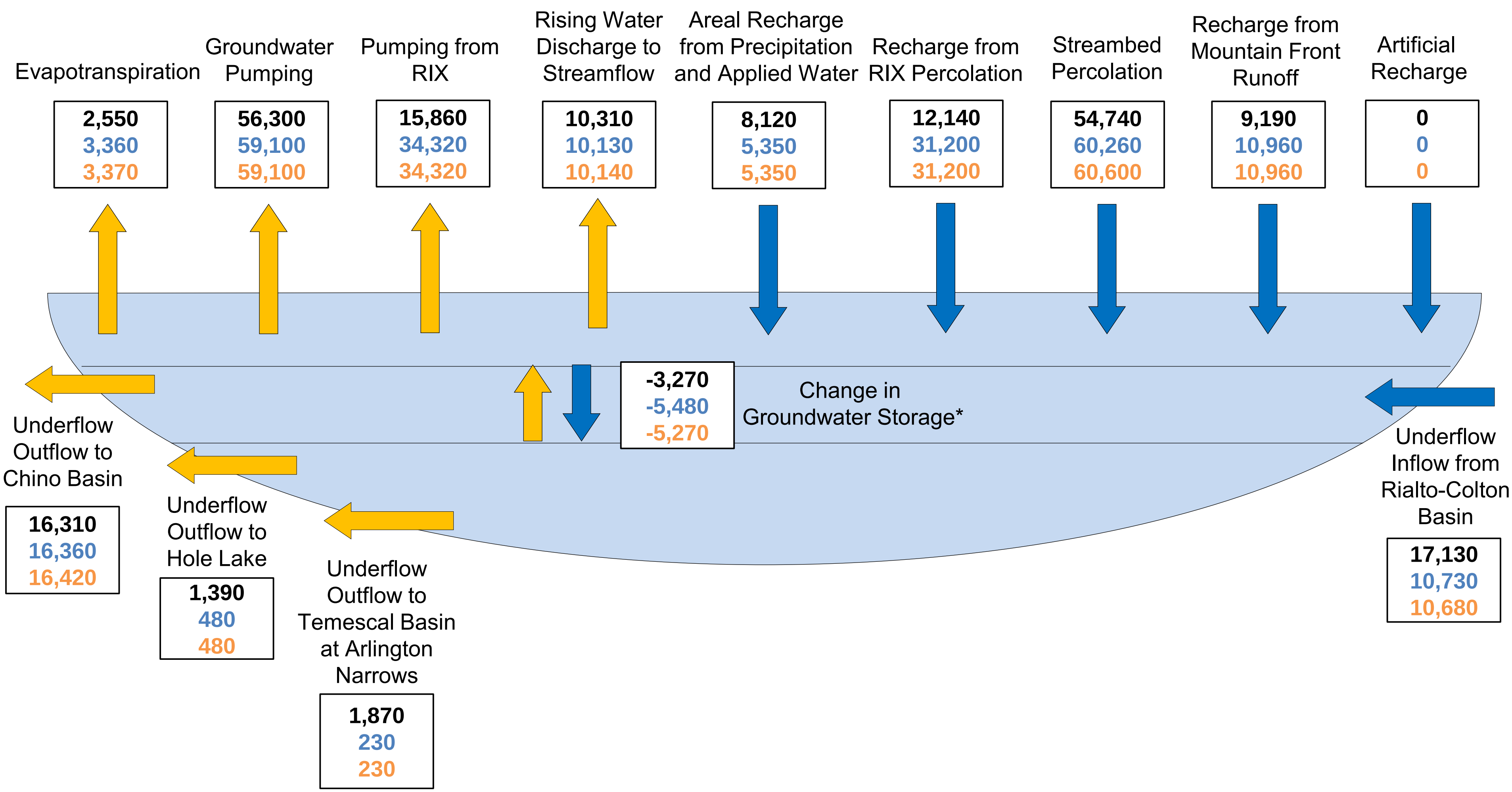

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2c.7 (Hydrologic Period 1966-1990)

Scenario 2a - Baseline
Scenario 2c.7 - IEUA Baseflow Reduction Activities

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2C.7
AVERAGE ANNUAL
WATER BUDGET
RIVERSIDE-ARLINGTON BASIN

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT **DRAFT** **FIGURE 547**
UPPER SANTA ANA RIVER INTEGRATED MODEL – SUMMARY

GEOSCIENCE

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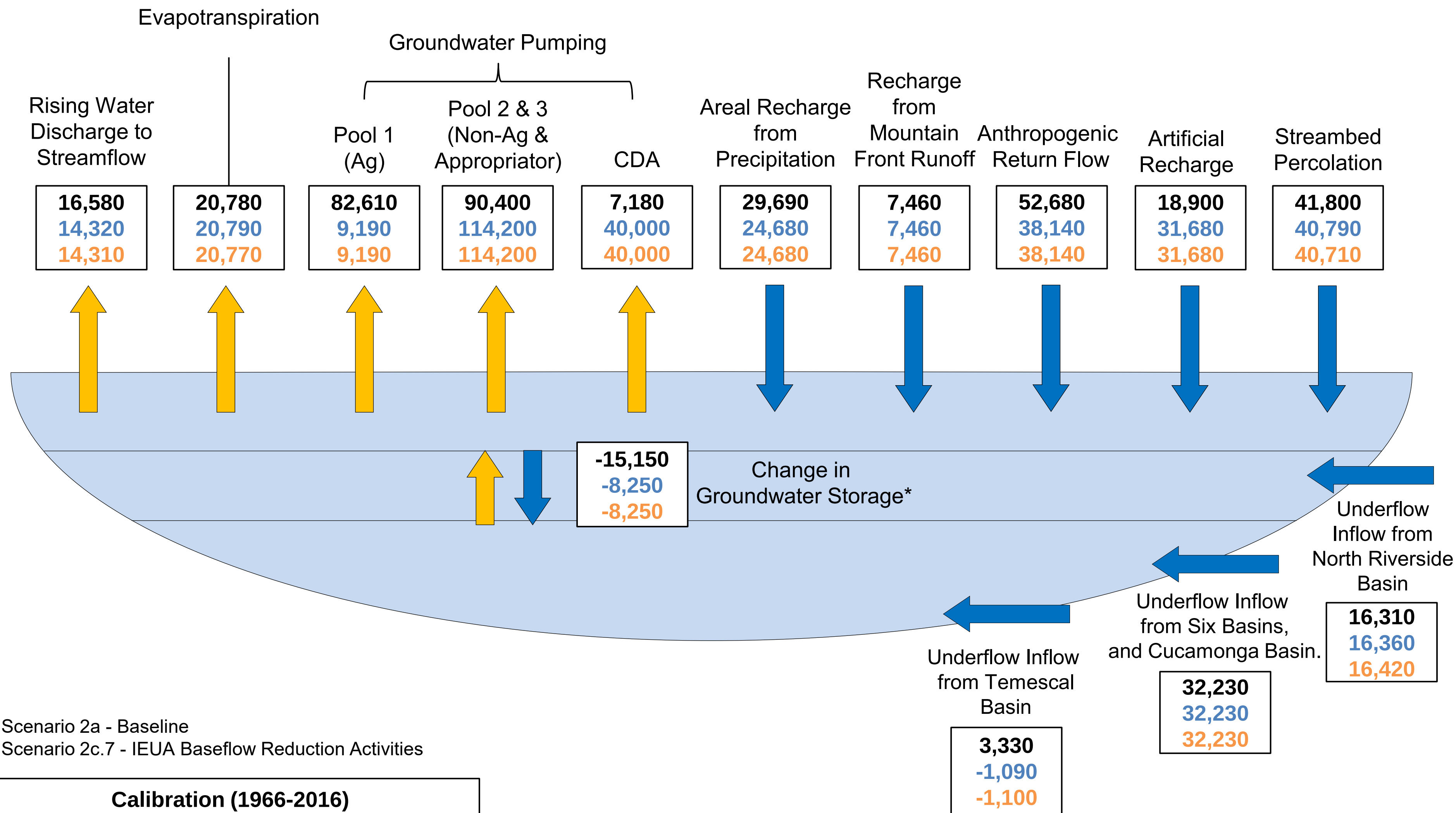


Scenario 2a - Baseline
Scenario 2c.7 - IEUA Baseflow Reduction Activities

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2c.7 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

**SCENARIO 2C.7
AVERAGE ANNUAL
WATER BUDGET
CHINO BASIN**

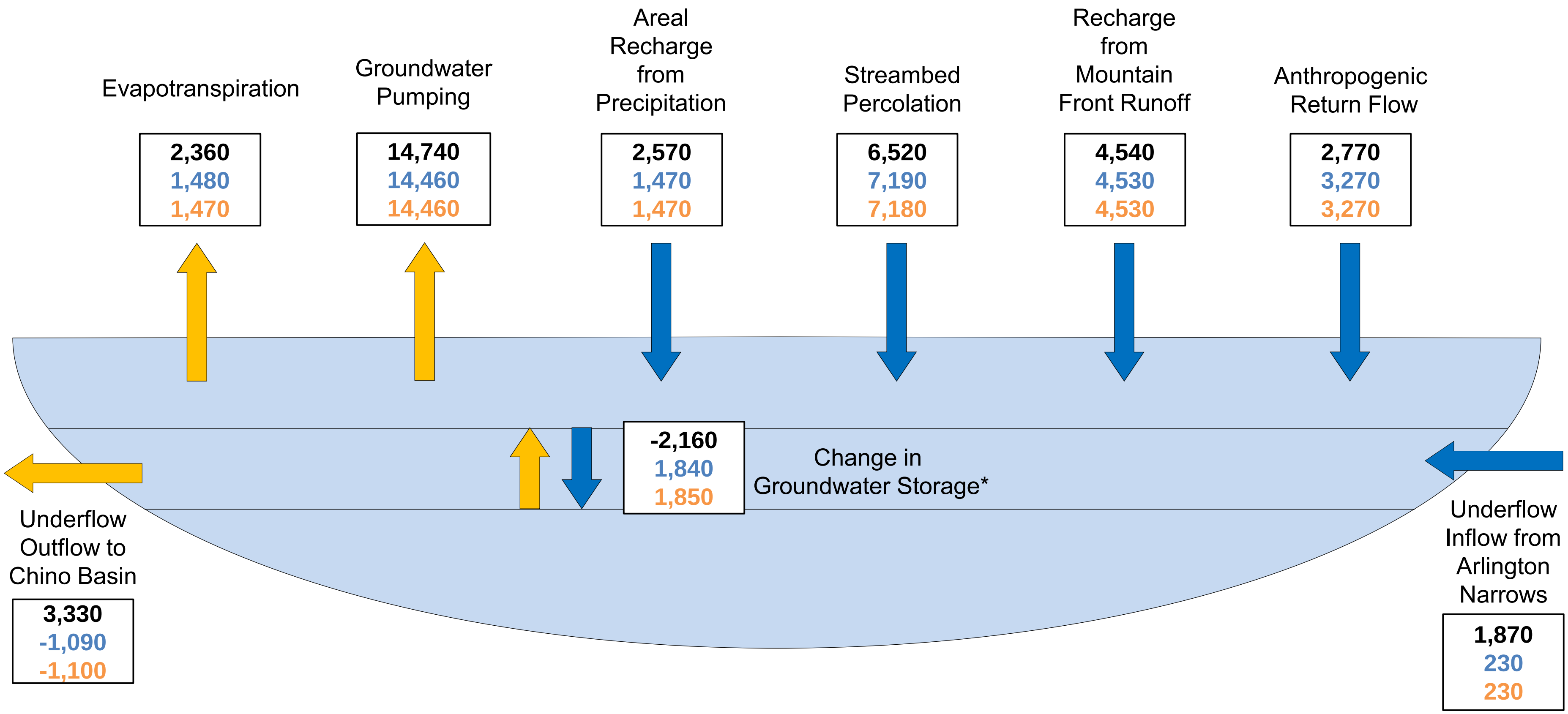
10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT **DRAFT** **FIGURE 548**

UPPER SANTA ANA RIVER INTEGRATED MODEL – SUMMARY

GEOSCIENCE

X:\Projects\San_Bernardino_MUNI\31) Integreated_SAR_Model\(4)Technical_Memos\(8) Summary Report\Draft\Figures\Scenarios



Scenario 2a - Baseline
Scenario 2c.7 - IEUA Baseflow Reduction Activities

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2c.7 (Hydrologic Period 1966-1990)

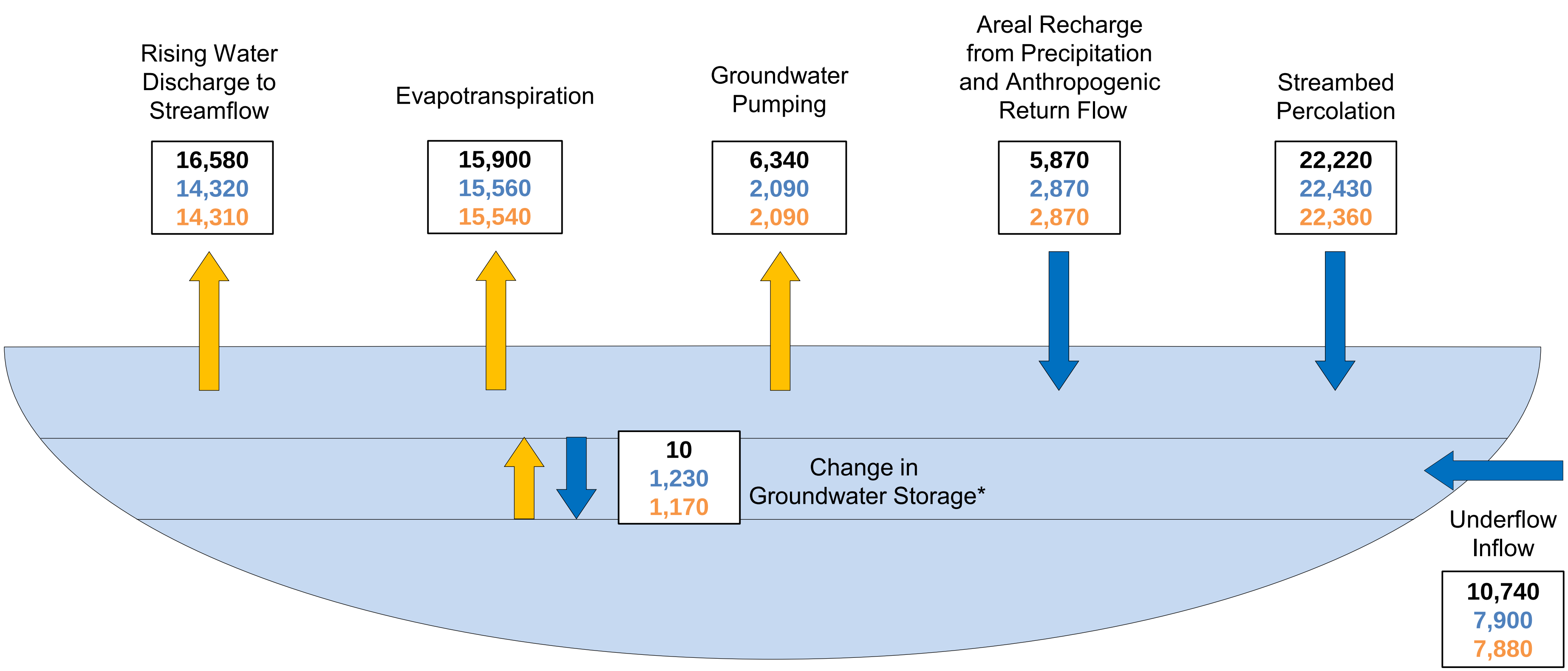
All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2C.7
AVERAGE ANNUAL
WATER BUDGET
TEMESCAL BASIN

10-Apr-20

X:\Projects\San_Bernardino_MUNI\31) Integreated_SAR_Model\(4)Technical_Memos\(8)Summary Report\Draft\Figures\Scenarios



Scenario 2a - Baseline
Scenario 2c.7 - IEUA Baseflow Reduction Activities

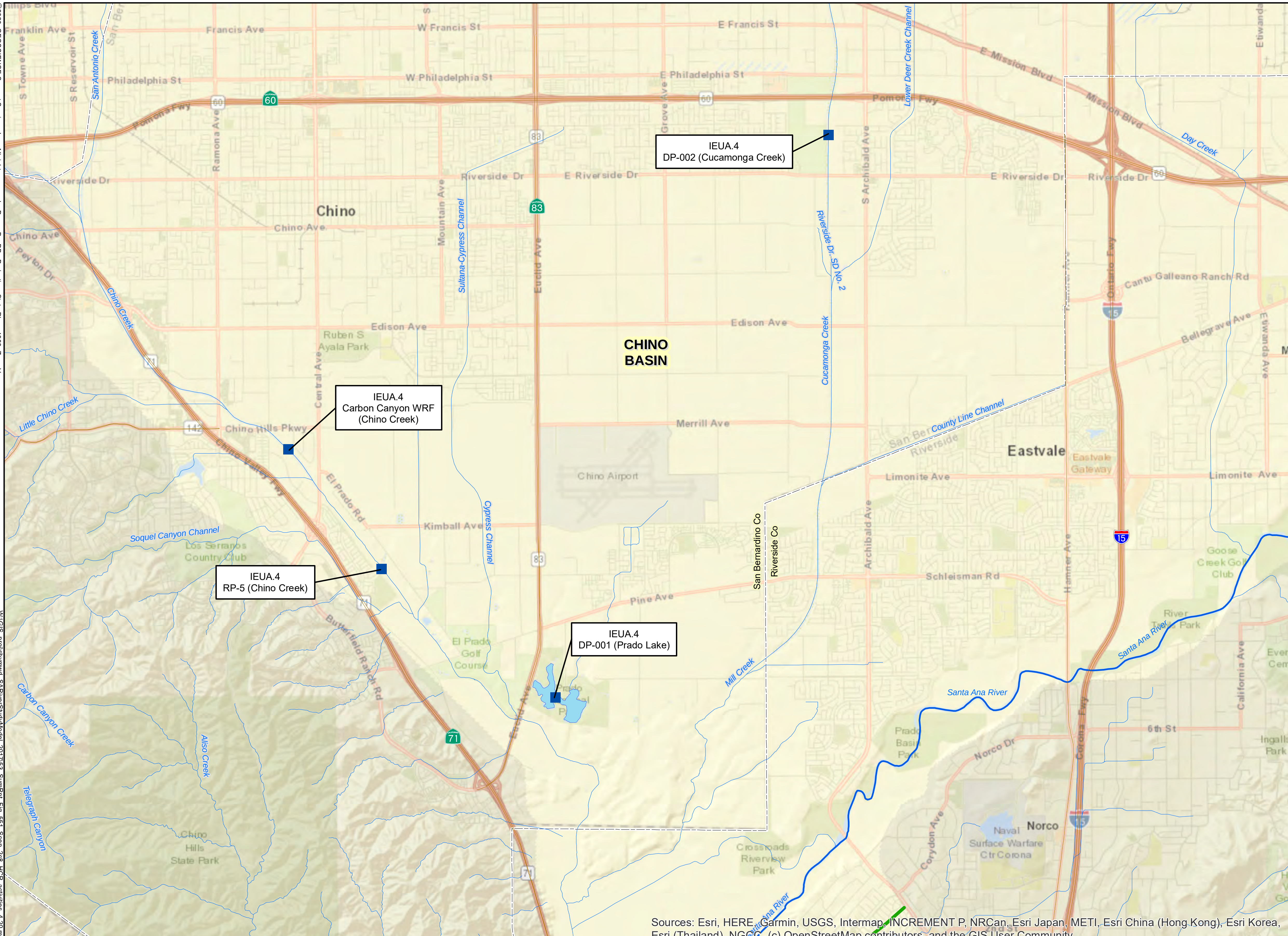
Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2c.7 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2C.7
AVERAGE ANNUAL
WATER BUDGET
PRADO BASIN

10-Apr-20



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EXPLANATION

Integrated SAR Model Boundary

Active Model Area

Inactive Model Area

Habitat Conservation Plan (HCP) Covered Activity

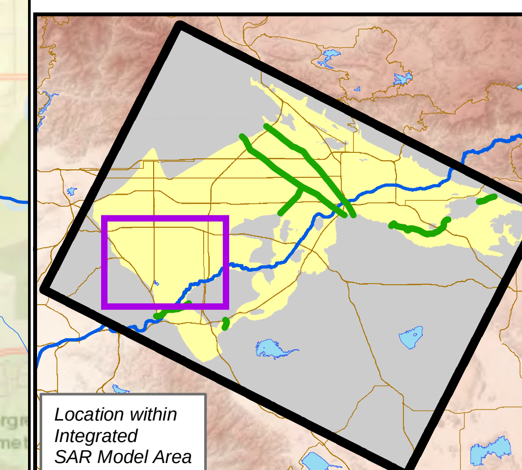
IEUA.4 - Project ID

Name - Name of HCP Project

Groundwater Basin Boundary

Refer to Table 17 for HCP Covered Activity Description

Scenario 2c.8:
IEUA Reduced Flow from WWTPs



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Miles

SCENARIO 2c.8
LOCATION OF
HCP COVERED ACTIVITIES

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

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FIGURE 551

GEOSCIENCE

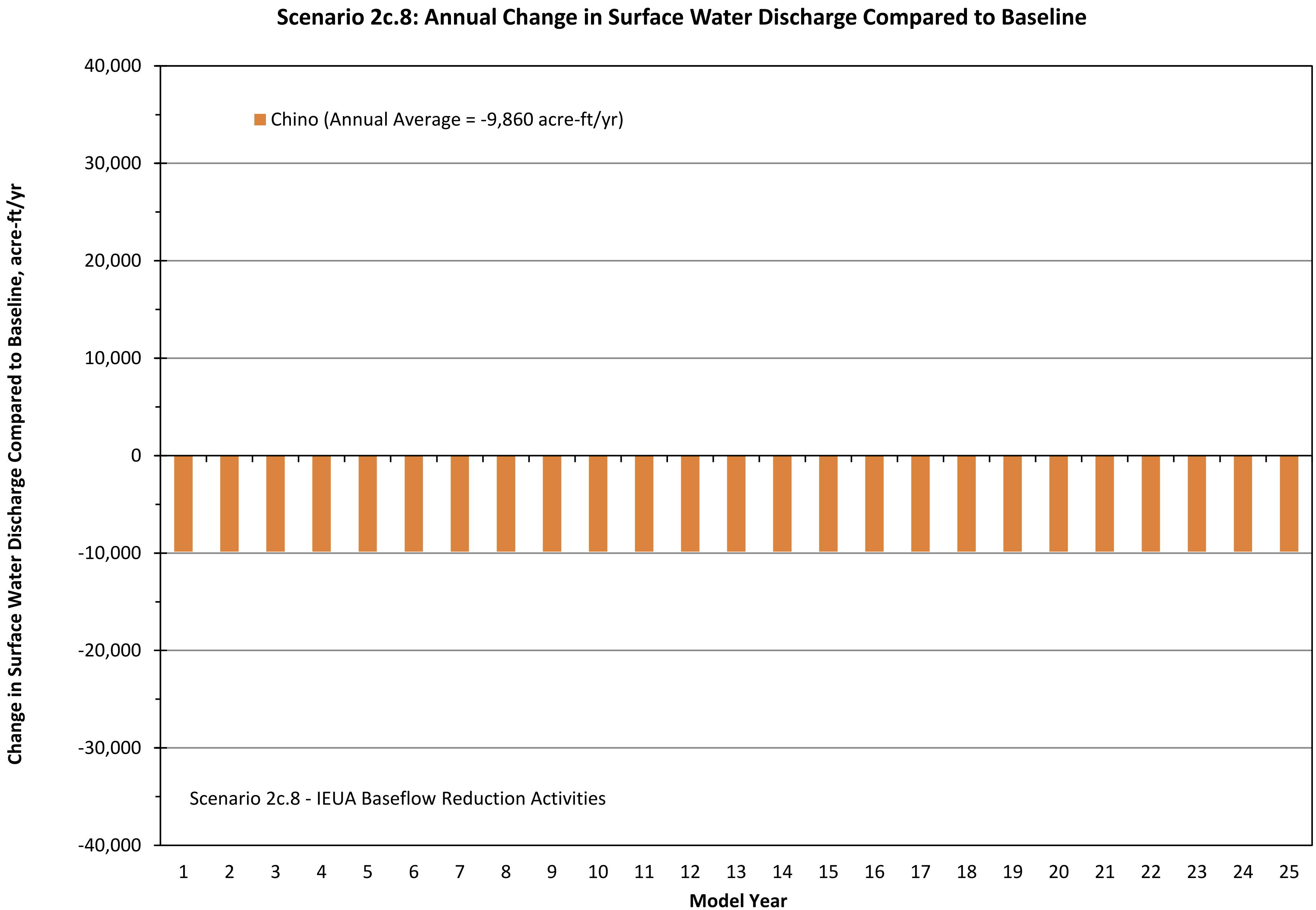
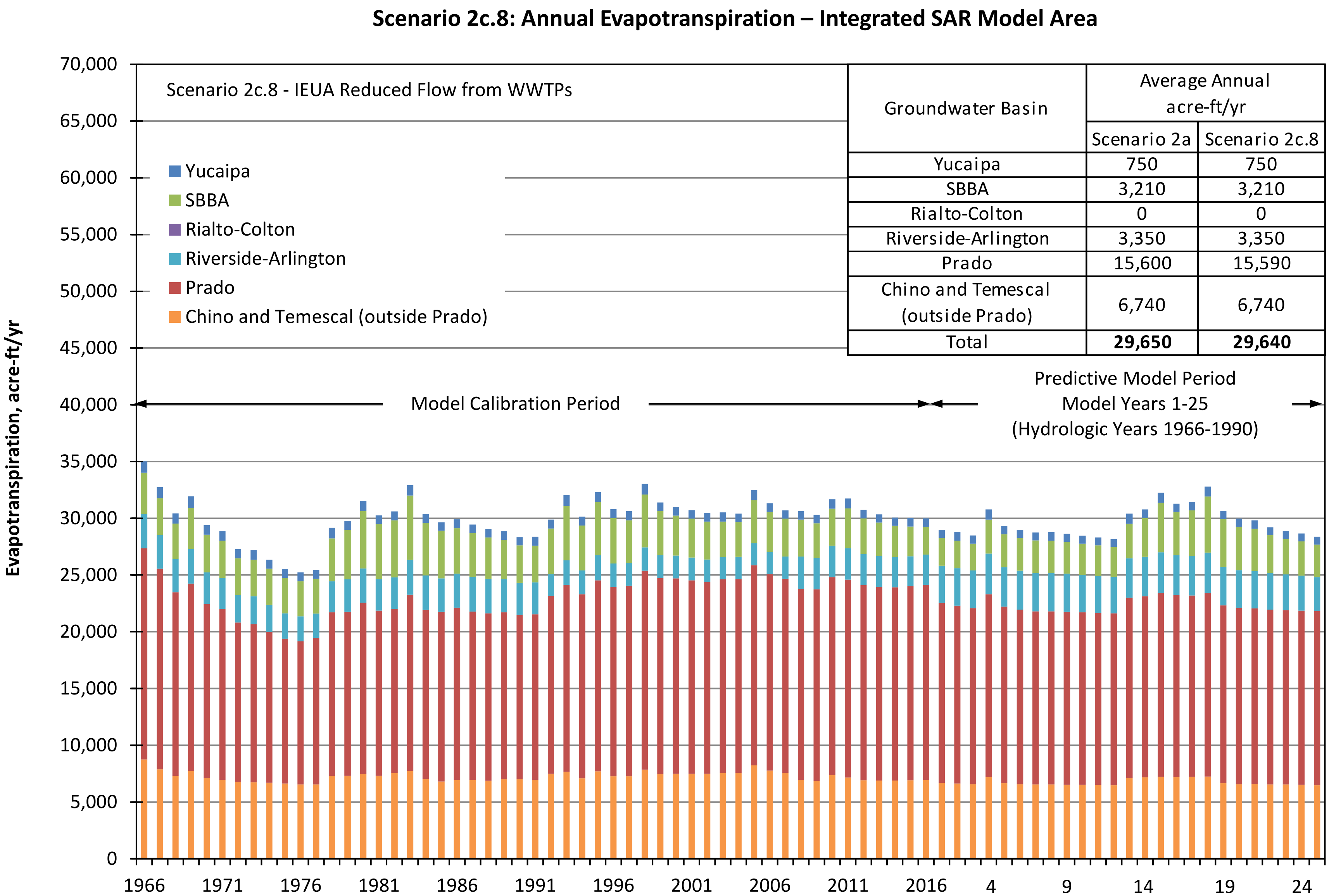

Scenario 2c.8: Annual Change in Surface Water Discharge Compared to Baseline
Chino (Annual Average = -9,860 acre-ft/yr)
Scenario 2c.8 - IEUA Baseflow Reduction Activities
Change in Surface Water Discharge Compared to Baseline, acre-ft/yr
40,000
30,000
20,000
10,000
0
-10,000
-20,000
-30,000
-40,000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Model Year

Figure 552



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2c.8
Yucaipa	750	750
SBBA	3,210	3,210
Rialto-Colton	0	0
Riverside-Arlington	3,350	3,350
Prado	15,600	15,590
Chino and Temescal (outside Prado)	6,740	6,740
Total	**29,650**	**29,640**

Figure 553

DRAFT

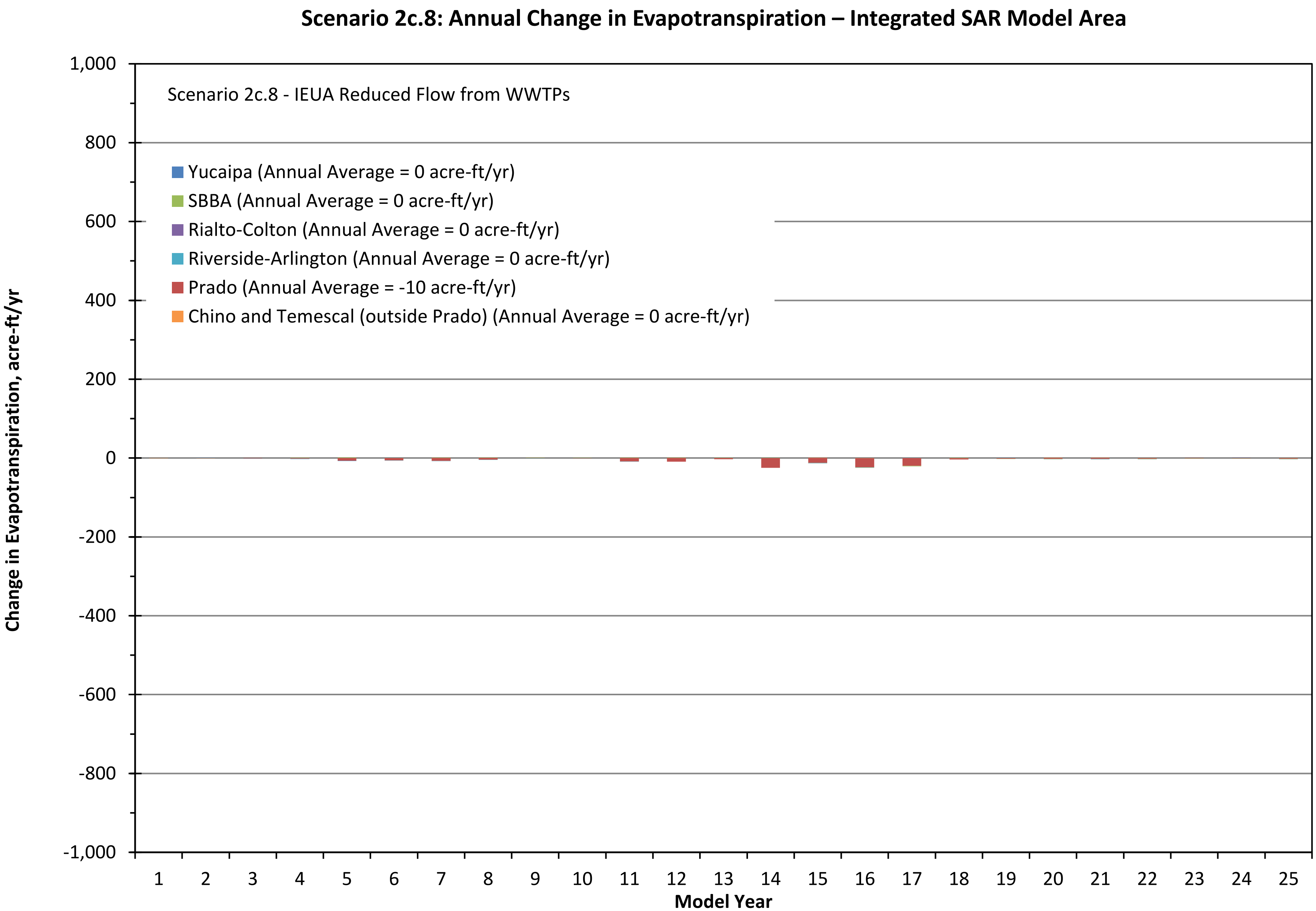
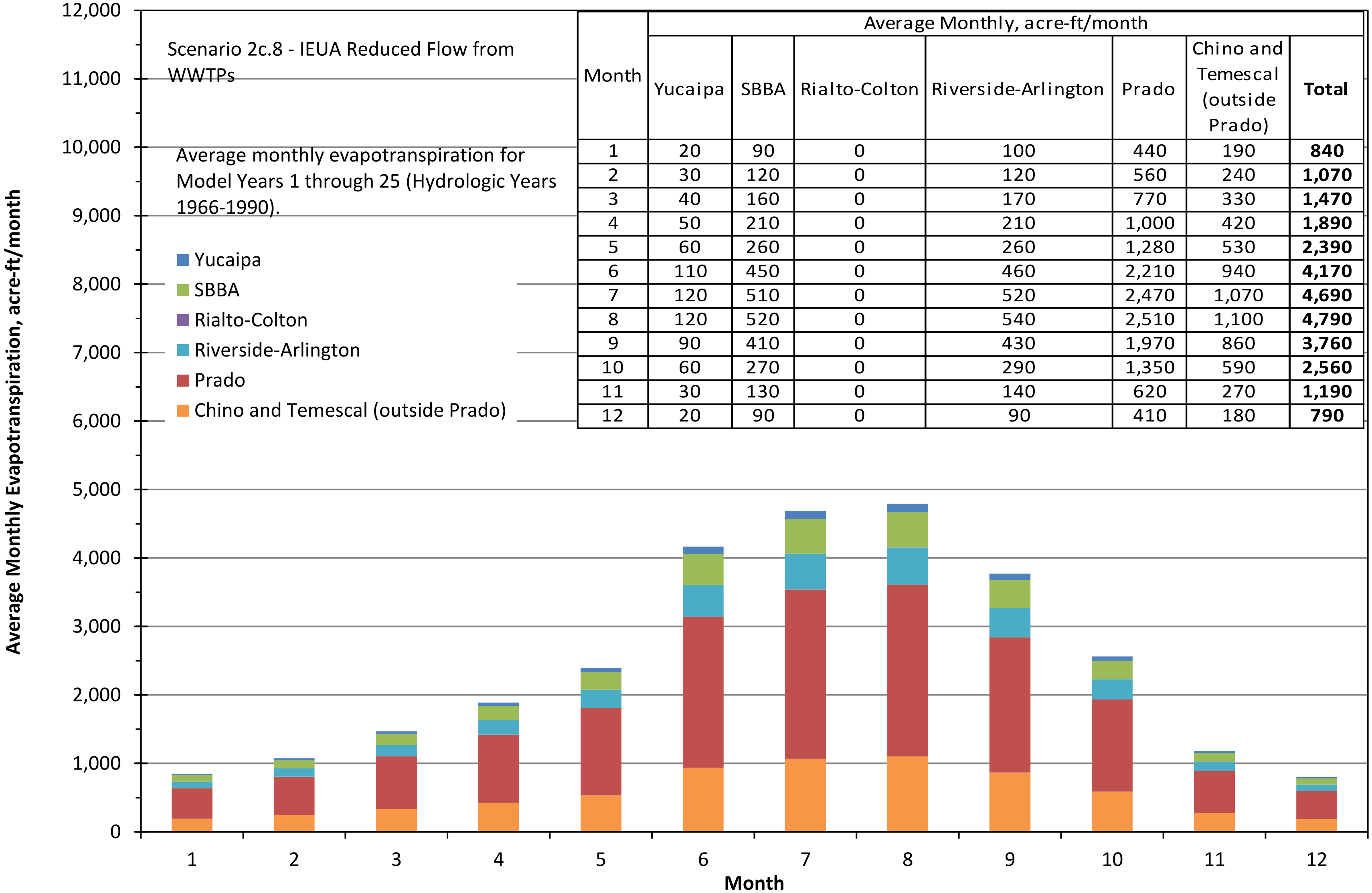


Figure 554

Scenario 2c.8: Seasonal Evapotranspiration – Integrated SAR Model Area



Month	Average Monthly, acre-ft/month						
	Yucaipa	SBBA	Rialto-Colton	Riverside-Arlington	Prado	Chino and Temescal (outside Prado)	**Total**
1	20	90	0	100	440	190	**840**
2	30	120	0	120	560	240	**1,070**
3	40	160	0	170	770	330	**1,470**
4	50	210	0	210	1,000	420	**1,890**
5	60	260	0	260	1,280	530	**2,390**
6	110	450	0	460	2,210	940	**4,170**
7	120	510	0	520	2,470	1,070	**4,690**
8	120	520	0	540	2,510	1,100	**4,790**
9	90	410	0	430	1,970	860	**3,760**
10	60	270	0	290	1,350	590	**2,560**
11	30	130	0	140	620	270	**1,190**
12	20	90	0	90	410	180	**790**

Figure 555

Scenario 2c.8: Annual Evapotranspiration – Prado Basin

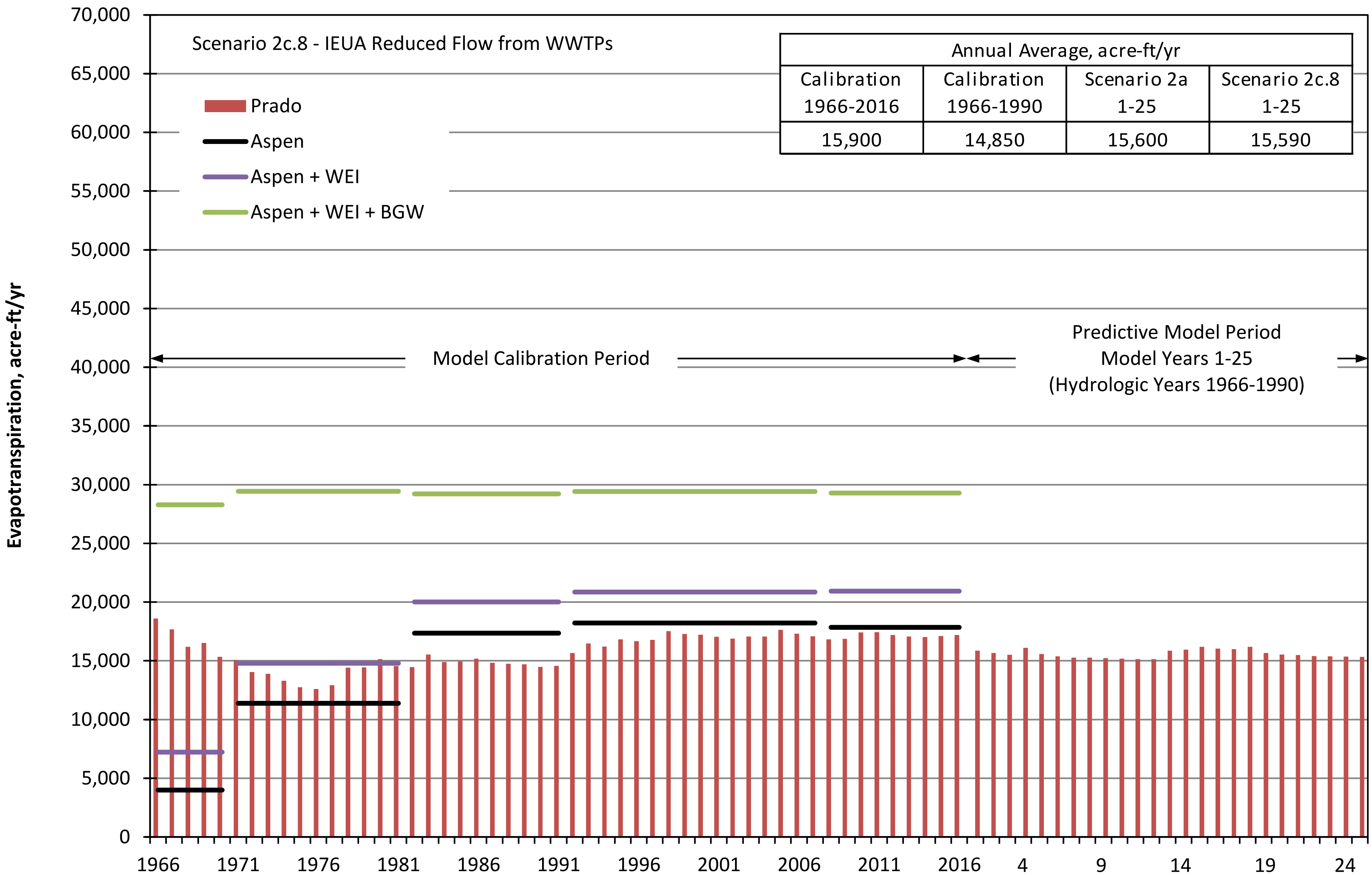


Figure 556

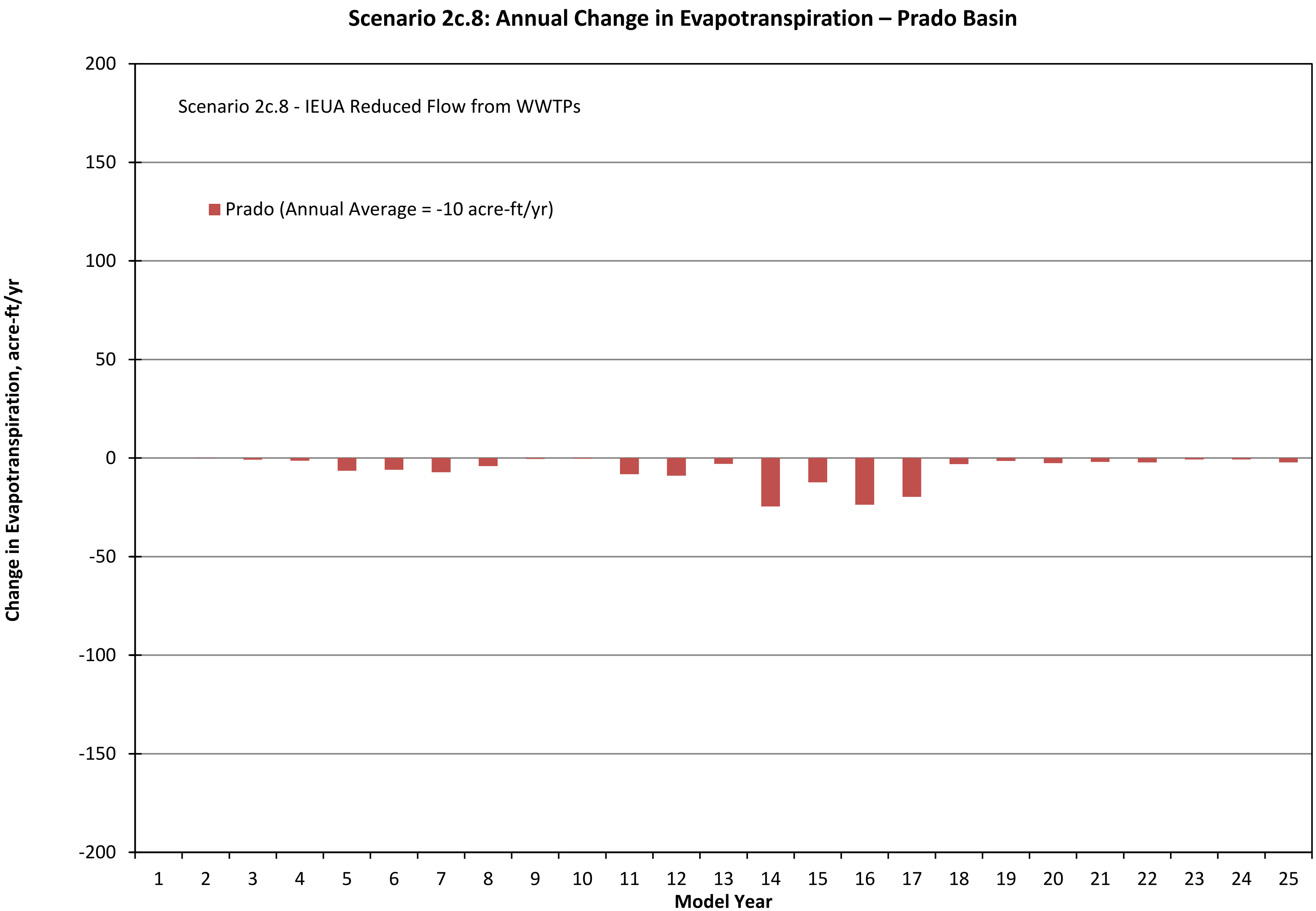
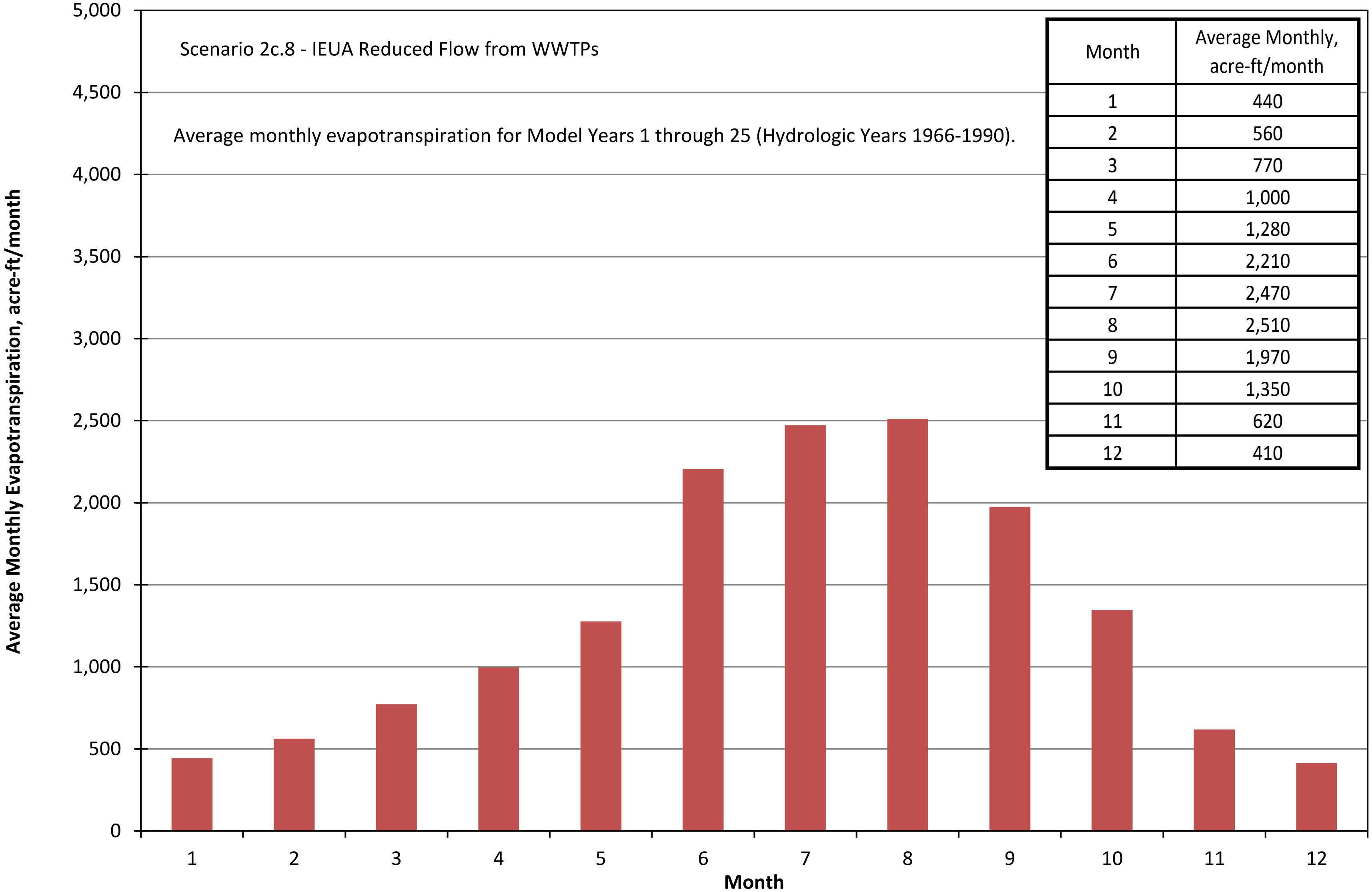

Scenario 2c.8: Annual Change in Evapotranspiration – Prado Basin
Scenario 2c.8 - IEUA Reduced Flow from WWTPs
Prado (Annual Average = -10 acre-ft/yr)
Change in Evapotranspiration, acre-ft/yr
200
150
100
50
0
-50
-100
-150
-200
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
Model Year

Figure 557

Scenario 2c.8: Seasonal Evapotranspiration – Prado Basin



Month	Average Monthly, acre-ft/month
1	440
2	560
3	770
4	1,000
5	1,280
6	2,210
7	2,470
8	2,510
9	1,970
10	1,350
11	620
12	410

Figure 558

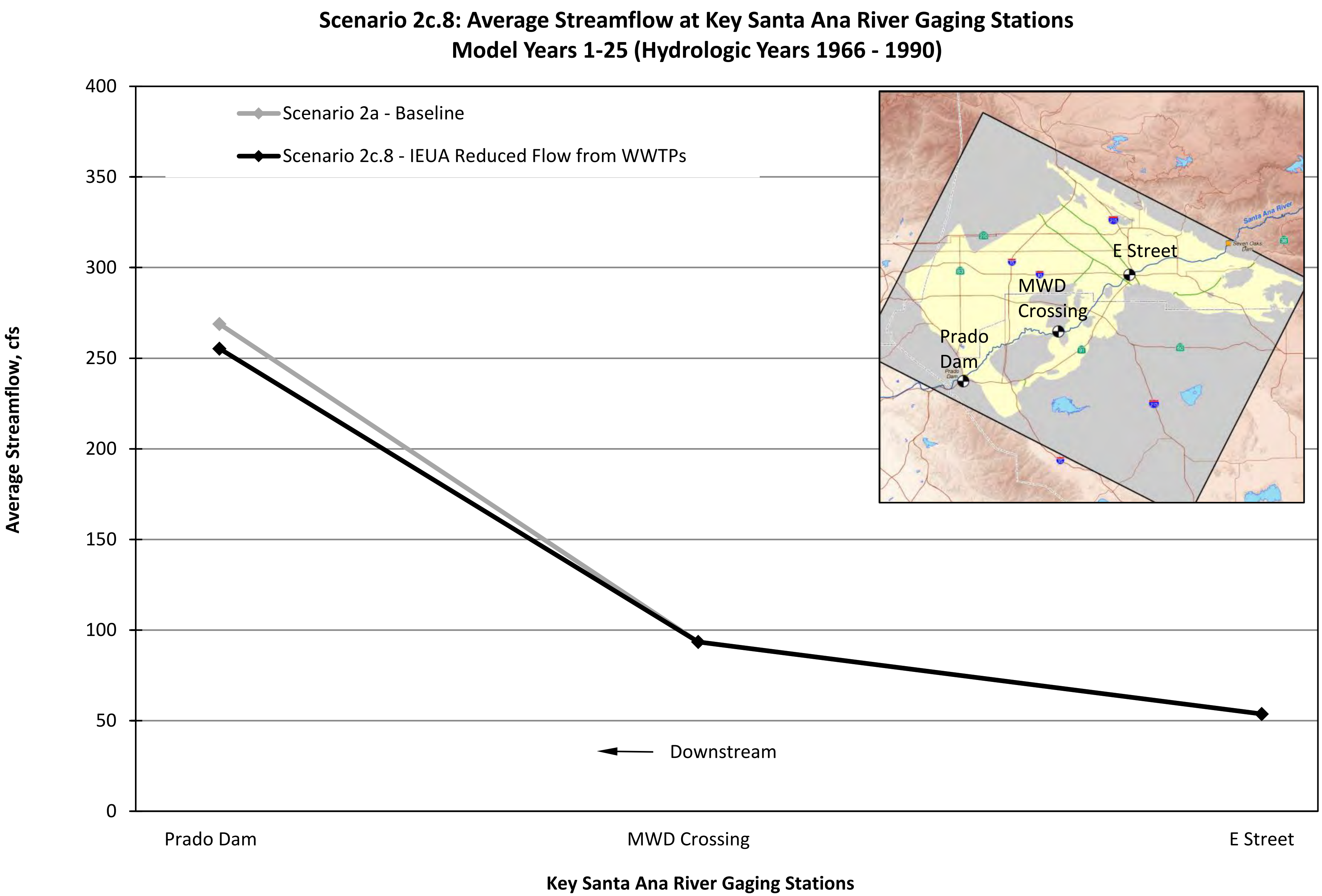

Scenario 2c.8: Average Streamflow at Key Santa Ana River Gaging Stations
Model Years 1-25 (Hydrologic Years 1966 - 1990)
Scenario 2a - Baseline
Scenario 2c.8 - IEUA Reduced Flow from WWTPs
Average Streamflow, cfs
400
350
300
250
200
150
100
50
0
E Street
MWD
Crossing
Prado
Dam
Downstream
Prado Dam
MWD Crossing
E Street
Key Santa Ana River Gaging Stations

Figure 559

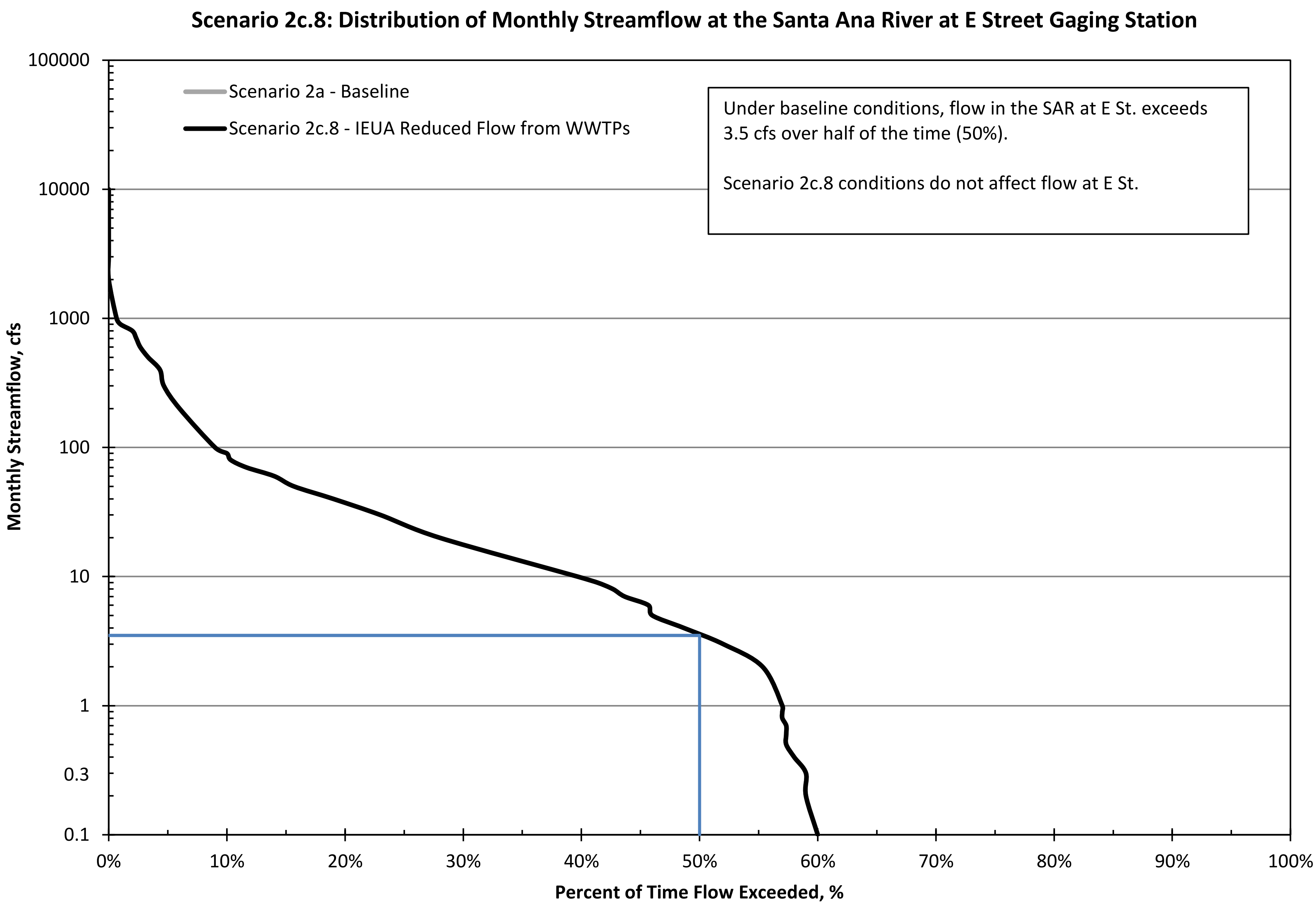

Scenario 2c.8: Distribution of Monthly Streamflow at the Santa Ana River at E Street Gaging Station
Scenario 2a - Baseline
Scenario 2c.8 - IEUA Reduced Flow from WWTPs
Under baseline conditions, flow in the SAR at E St. exceeds 3.5 cfs over half of the time (50%).
Scenario 2c.8 conditions do not affect flow at E St.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.3
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 560

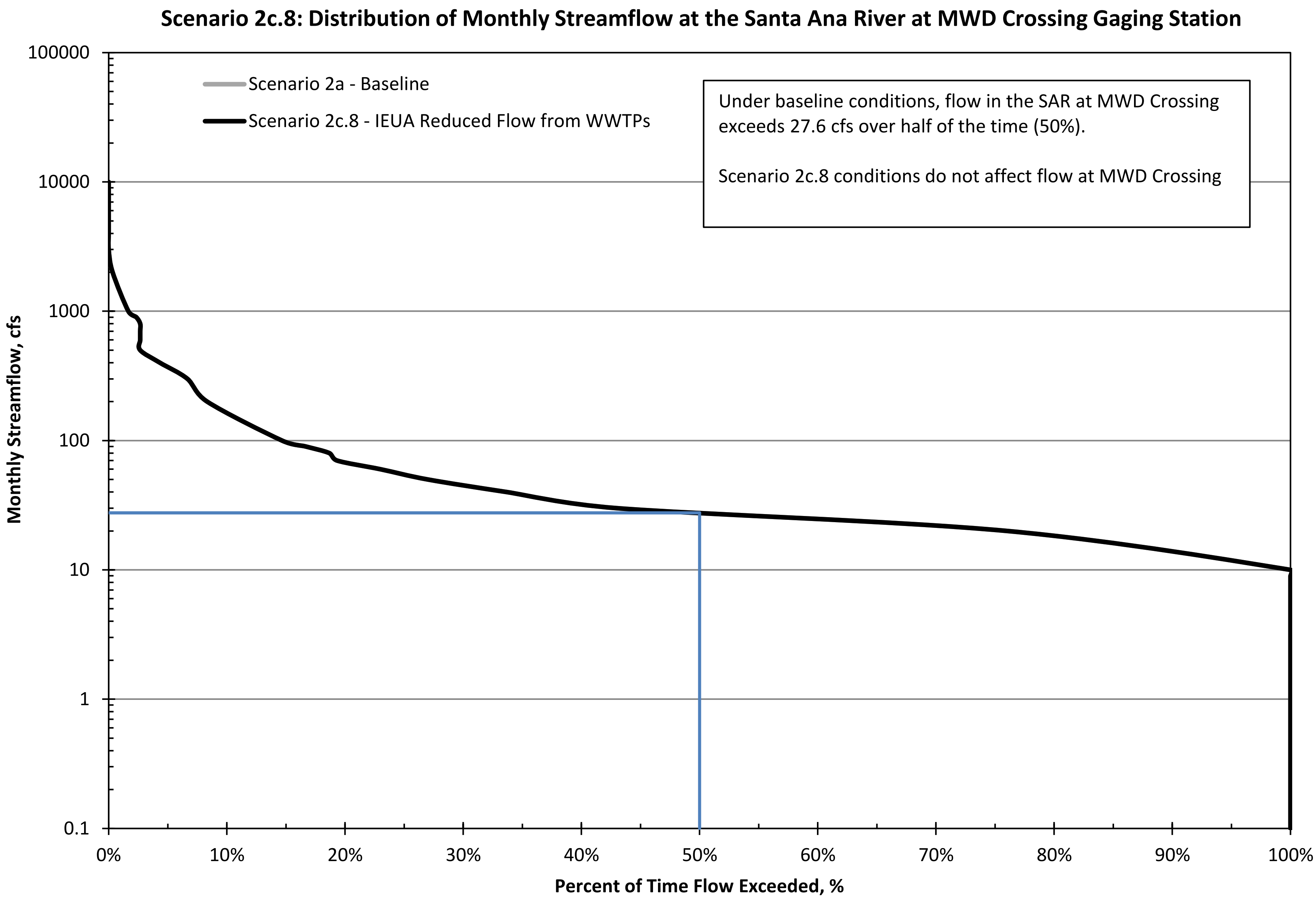

Scenario 2c.8: Distribution of Monthly Streamflow at the Santa Ana River at MWD Crossing Gaging Station
Scenario 2a - Baseline
Scenario 2c.8 - IEUA Reduced Flow from WWTPs
Under baseline conditions, flow in the SAR at MWD Crossing exceeds 27.6 cfs over half of the time (50%).
Scenario 2c.8 conditions do not affect flow at MWD Crossing
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 561

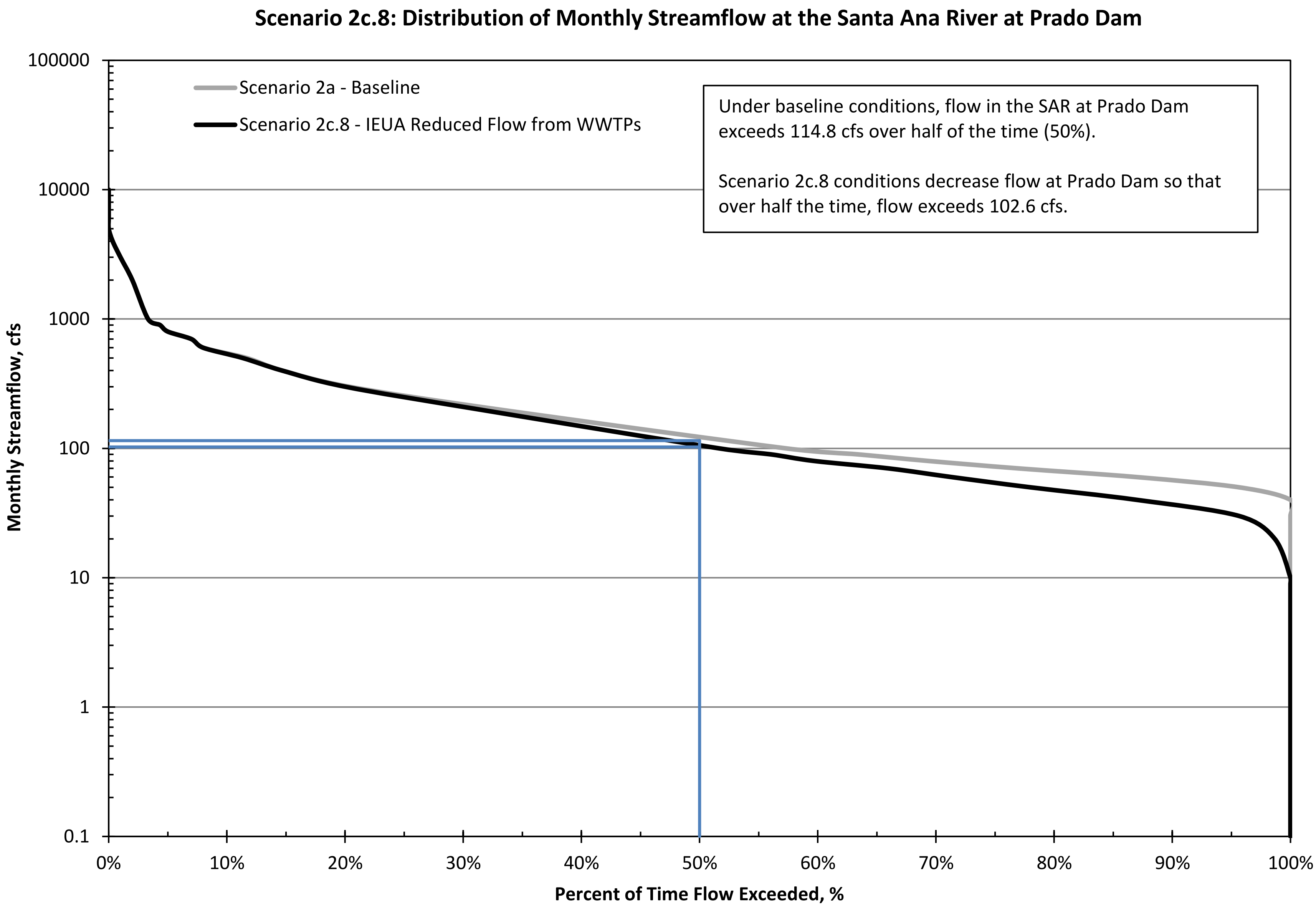
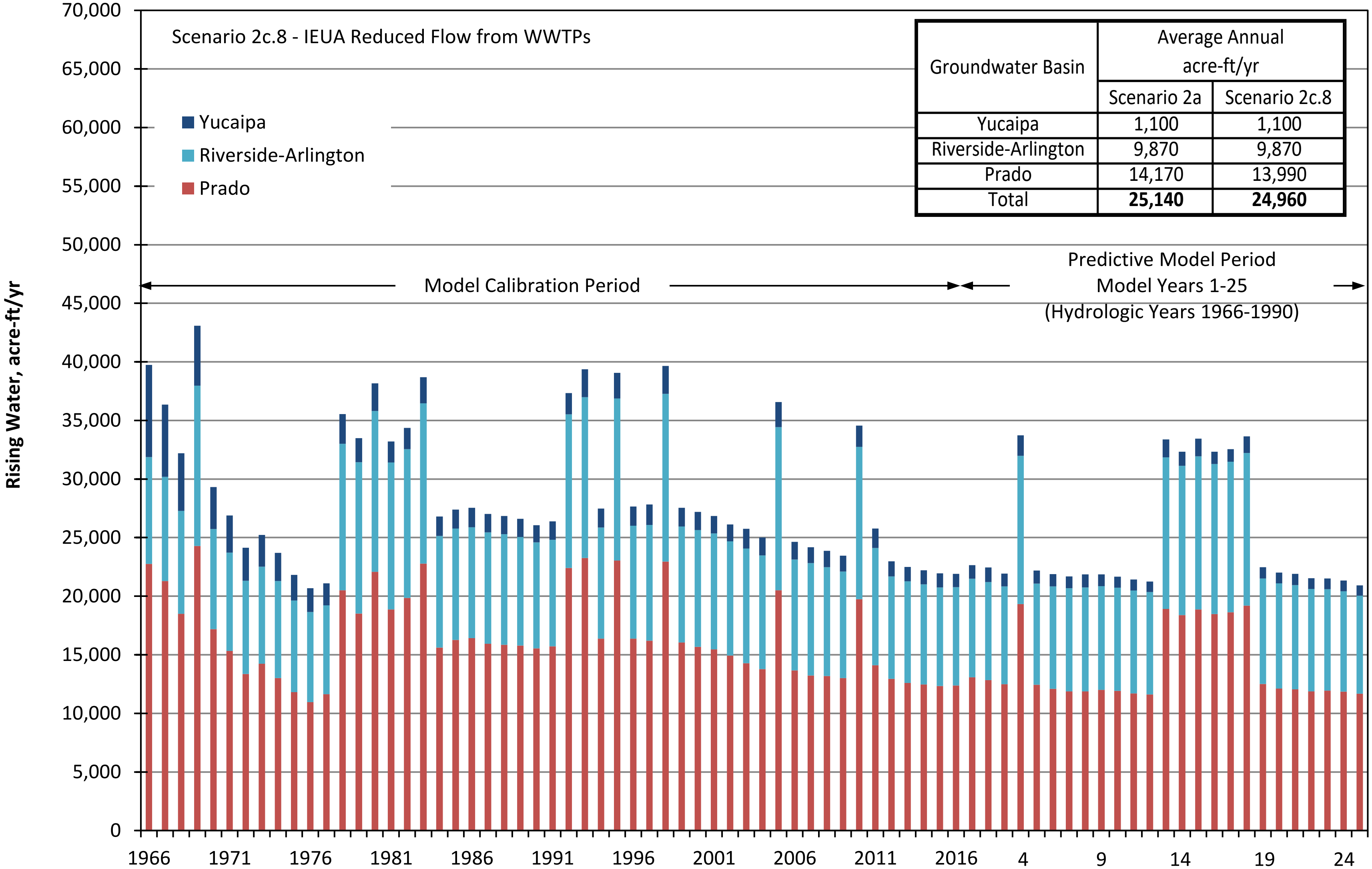

Scenario 2c.8: Distribution of Monthly Streamflow at the Santa Ana River at Prado Dam
Scenario 2a - Baseline
Scenario 2c.8 - IEUA Reduced Flow from WWTPs
Under baseline conditions, flow in the SAR at Prado Dam exceeds 114.8 cfs over half of the time (50%).
Scenario 2c.8 conditions decrease flow at Prado Dam so that over half the time, flow exceeds 102.6 cfs.
100000
10000
1000
100
10
1
0.1
Monthly Streamflow, cfs
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 562

Scenario 2c.8: Annual Rising Water – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2c.8
Yucaipa	1,100	1,100
Riverside-Arlington	9,870	9,870
Prado	14,170	13,990
Total	**25,140**	**24,960**

Figure 563

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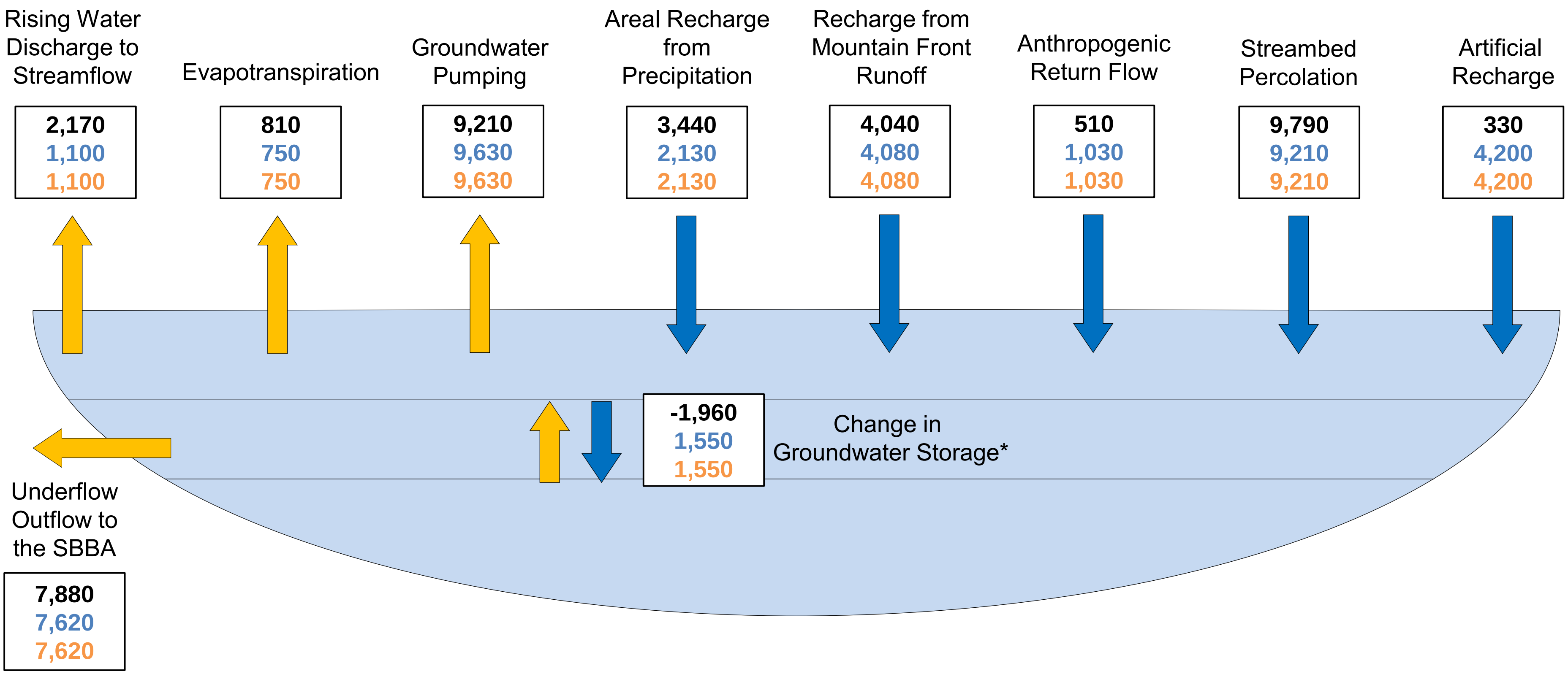

Scenario 2a - Baseline
Scenario 2c.8 - IEUA Reduced Flow from WWTPs

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2c.8 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2C.8
AVERAGE ANNUAL
WATER BUDGET
YUCAIPA BASIN

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT
UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

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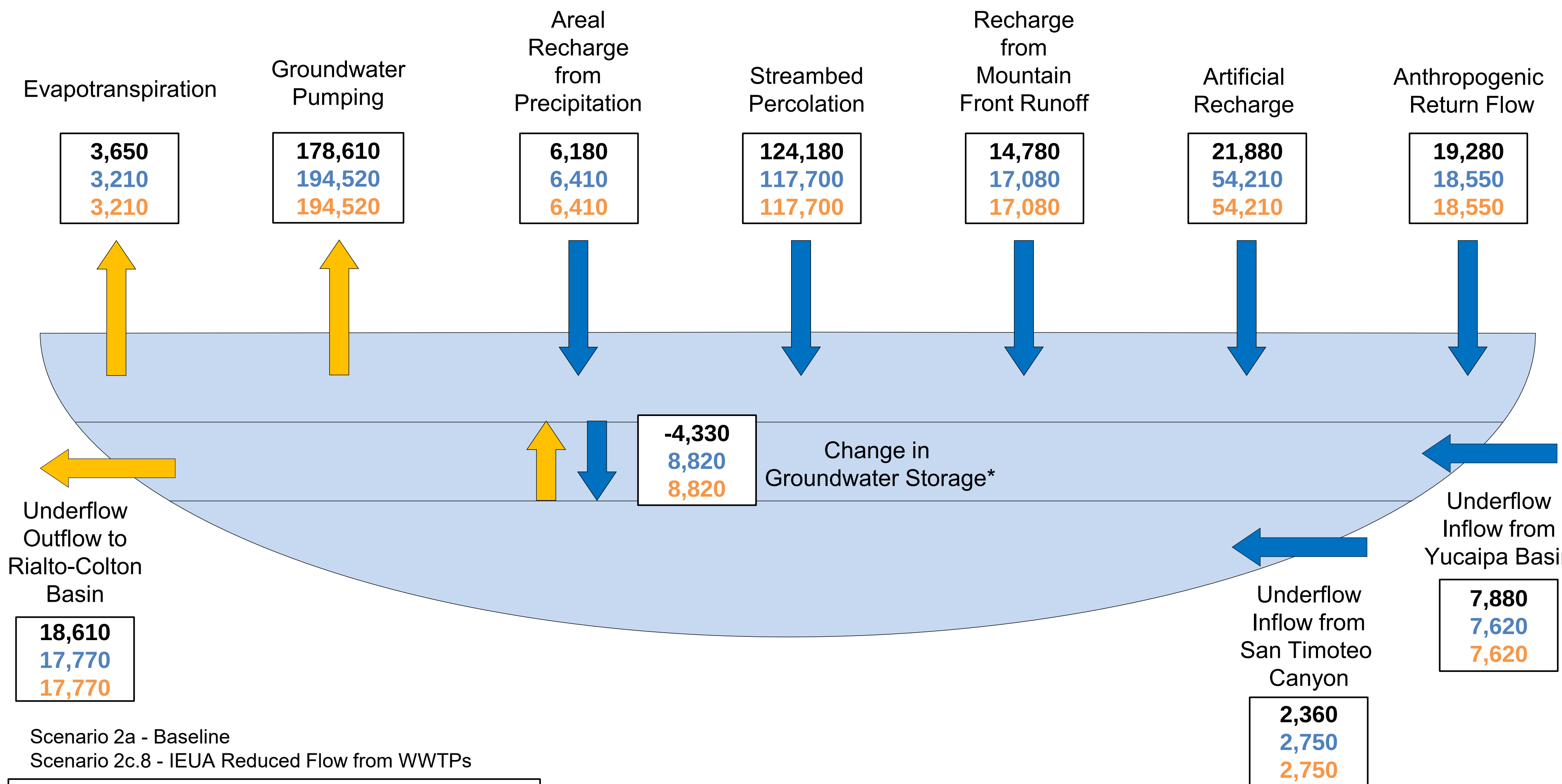
FIGURE 564

GEOSCIENCE



Scenario 2a - Baseline
Scenario 2c.8 - IEUA Reduced Flow from WWTPs

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2c.8 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2C.8
AVERAGE ANNUAL
WATER BUDGET
SBBA

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT
UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

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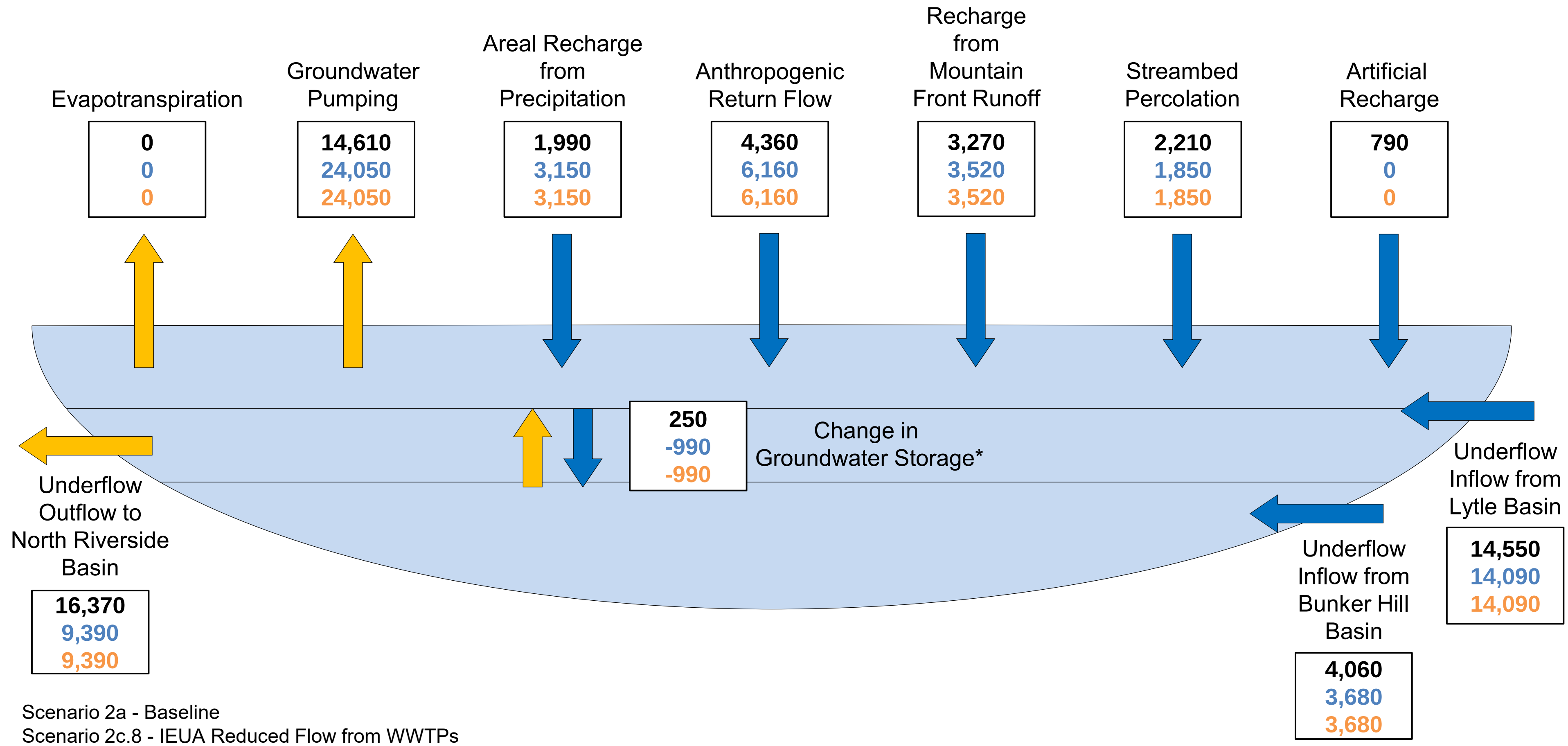
FIGURE 565

GEOSCIENCE



Scenario 2a - Baseline
Scenario 2c.8 - IEUA Reduced Flow from WWTPs

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2c.8 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2C.8 AVERAGE ANNUAL WATER BUDGET RIALTO-COLTON BASIN

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10-Apr-20

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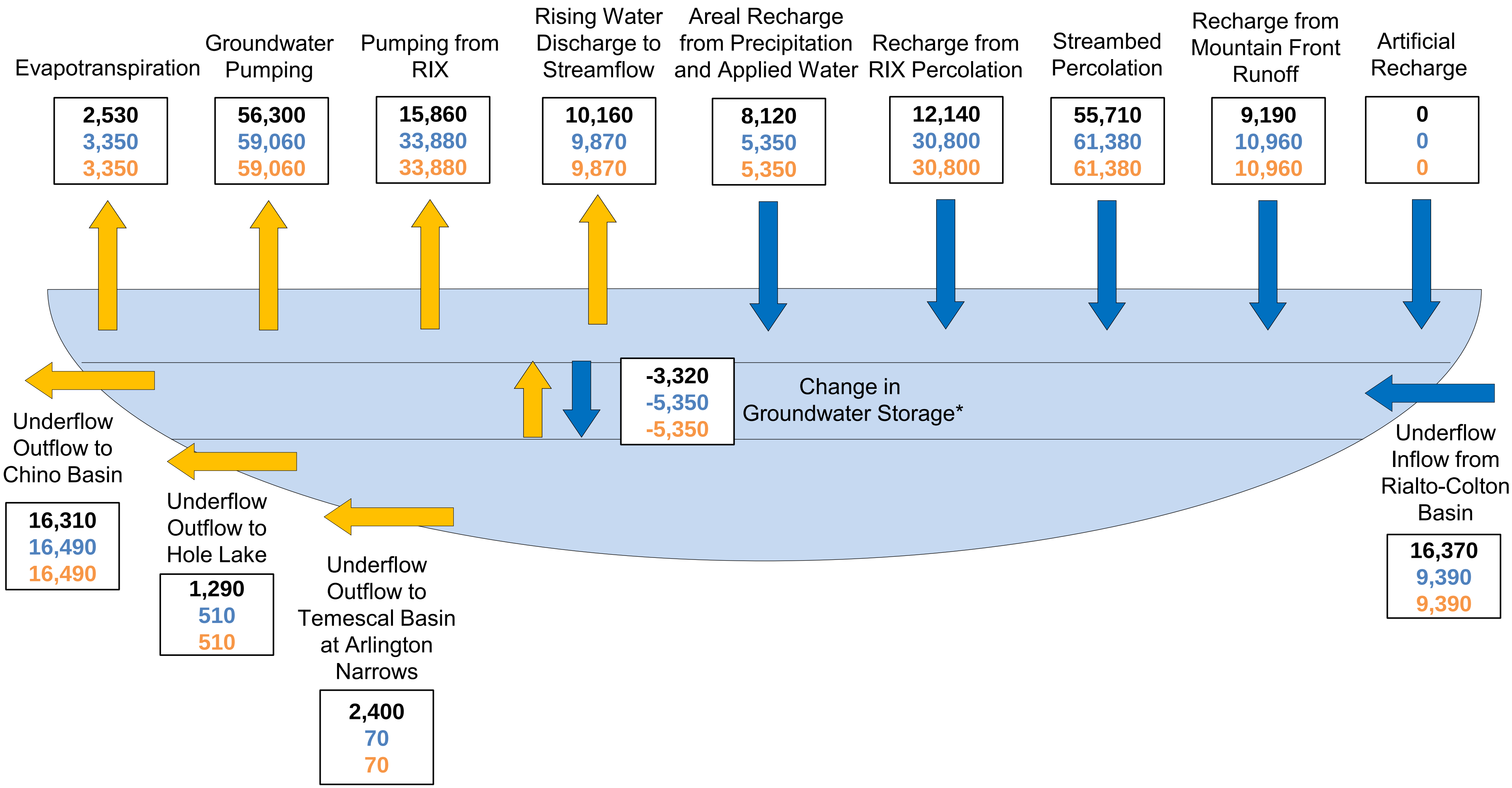

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2c.8 (Hydrologic Period 1966-1990)

Scenario 2a - Baseline
Scenario 2c.8 - IEUA Reduced Flow from WWTPs

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2C.8
AVERAGE ANNUAL
WATER BUDGET
RIVERSIDE-ARLINGTON BASIN

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT
UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

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FIGURE 567

GEOSCIENCE

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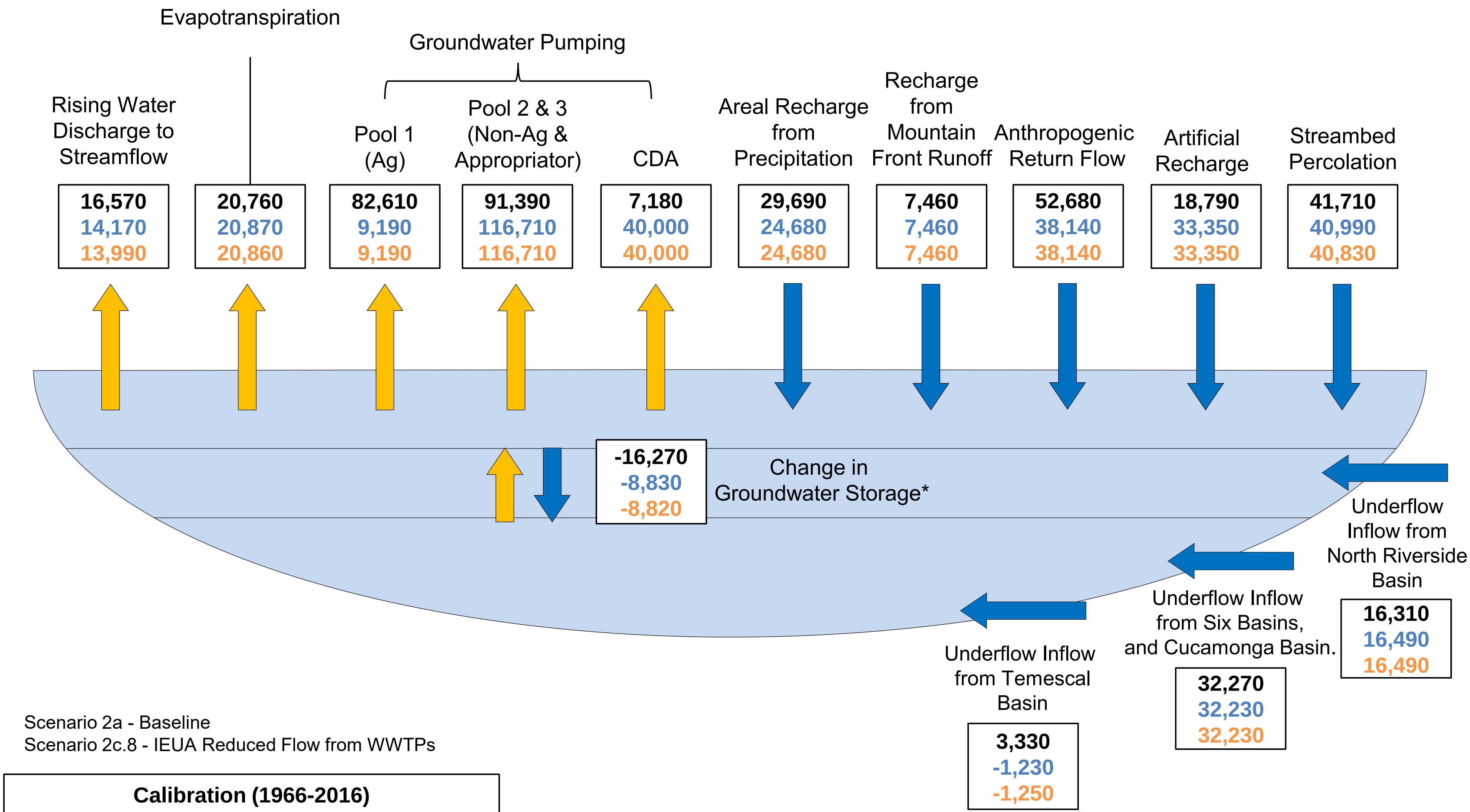

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2c.8 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2C.8
AVERAGE ANNUAL
WATER BUDGET
CHINO BASIN

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

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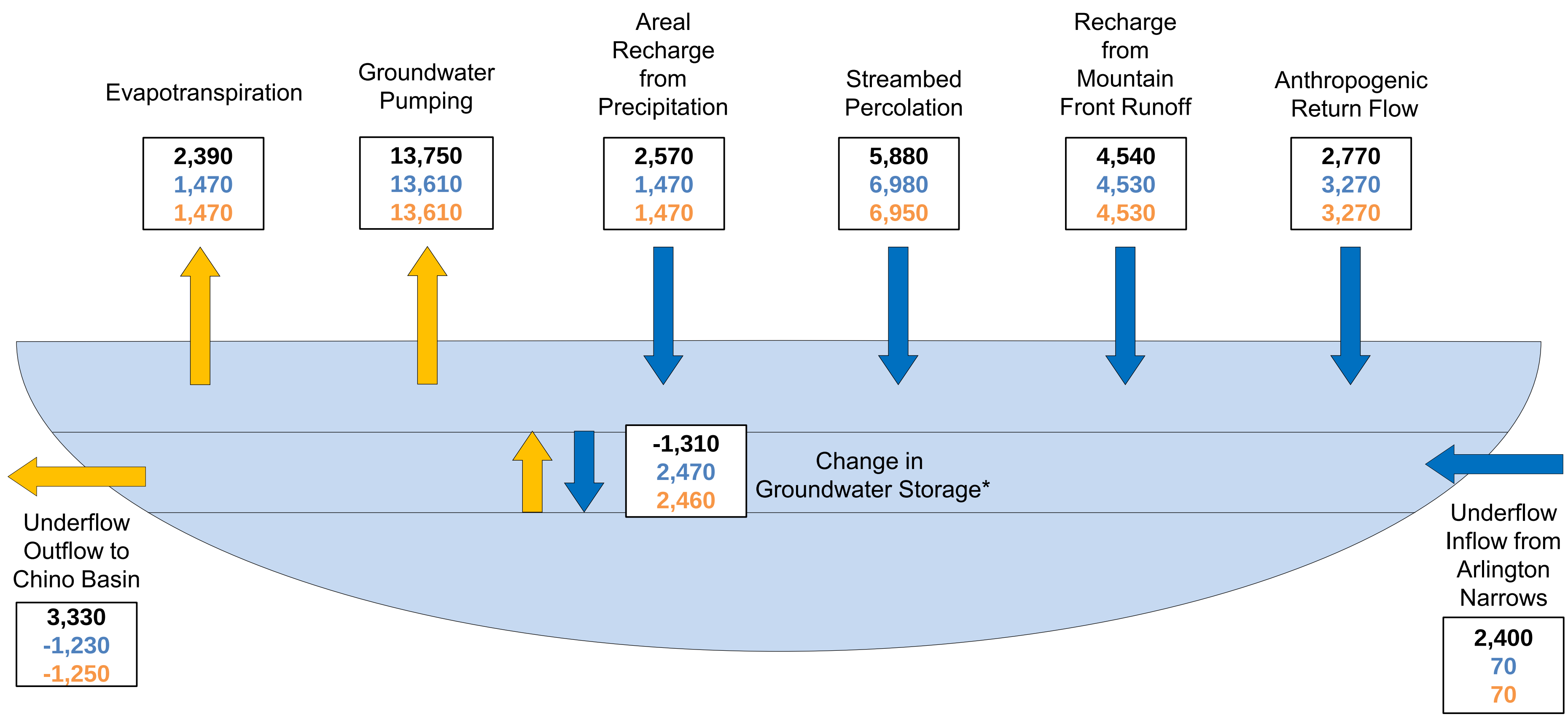
FIGURE 568

GEOSCIENCE



Scenario 2a - Baseline
Scenario 2c.8 - IEUA Reduced Flow from WWTPs

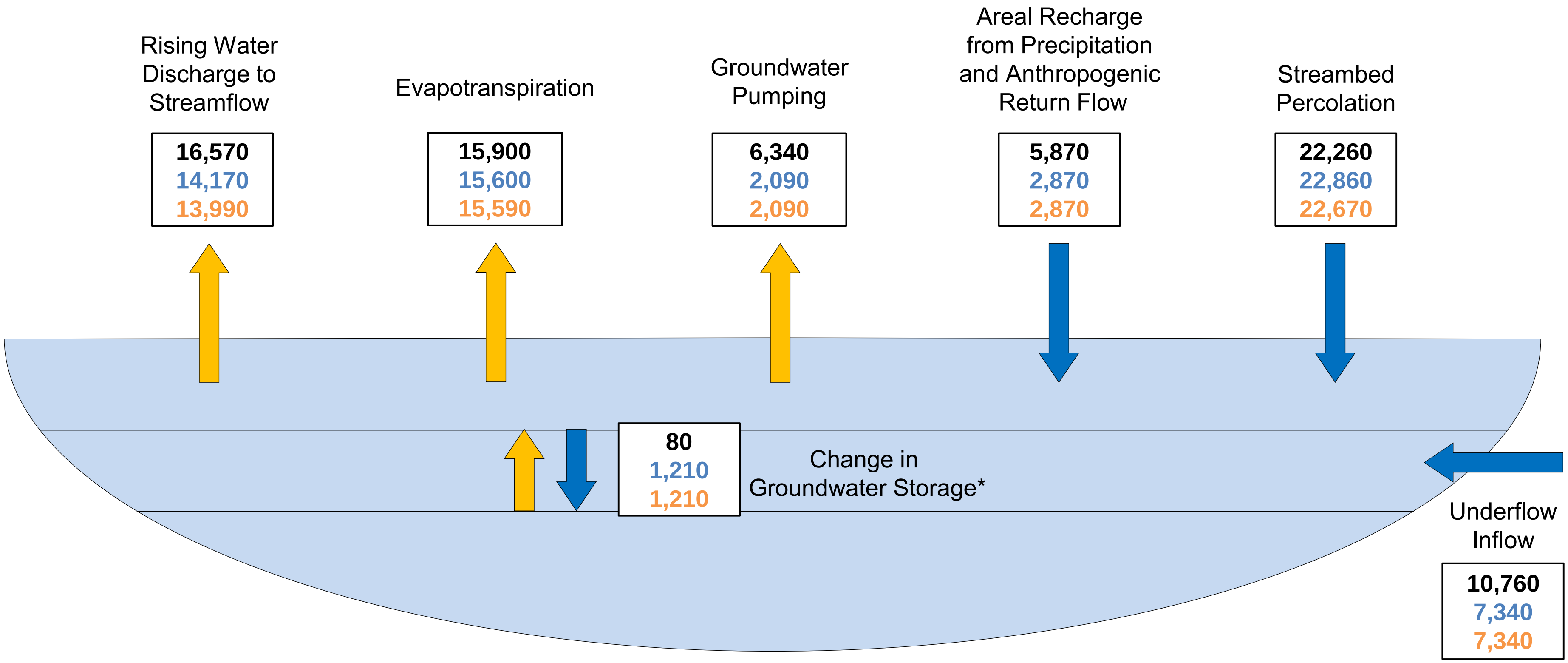
Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2c.8 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

**SCENARIO 2C.8
AVERAGE ANNUAL
WATER BUDGET
TEMESCAL BASIN**

X:\Projects\San_Bernardino_MUNI\31) Integreated_SAR_Model\(4)Technical_Memos\(8) Summary Report\Draft\Figures\Scenarios



Scenario 2a - Baseline
Scenario 2c.8 - IEUA Reduced Flow from WWTPs

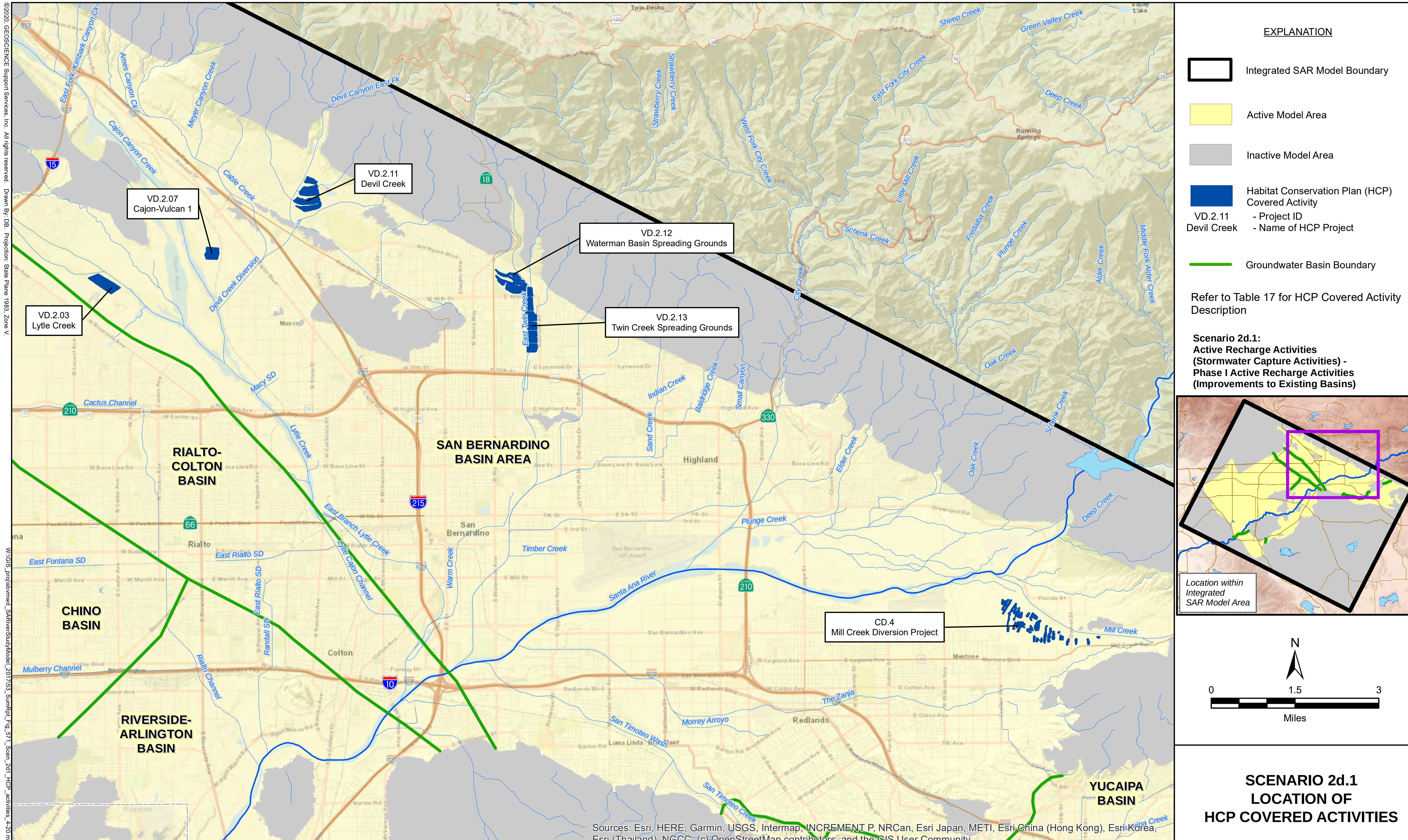
Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2c.8 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2C.8
AVERAGE ANNUAL
WATER BUDGET
PRADO BASIN

10-Apr-20



SCENARIO 2d.1
LOCATION OF
HCP COVERED ACTIVITIES

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

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FIGURE 571

GEOSCIENCE

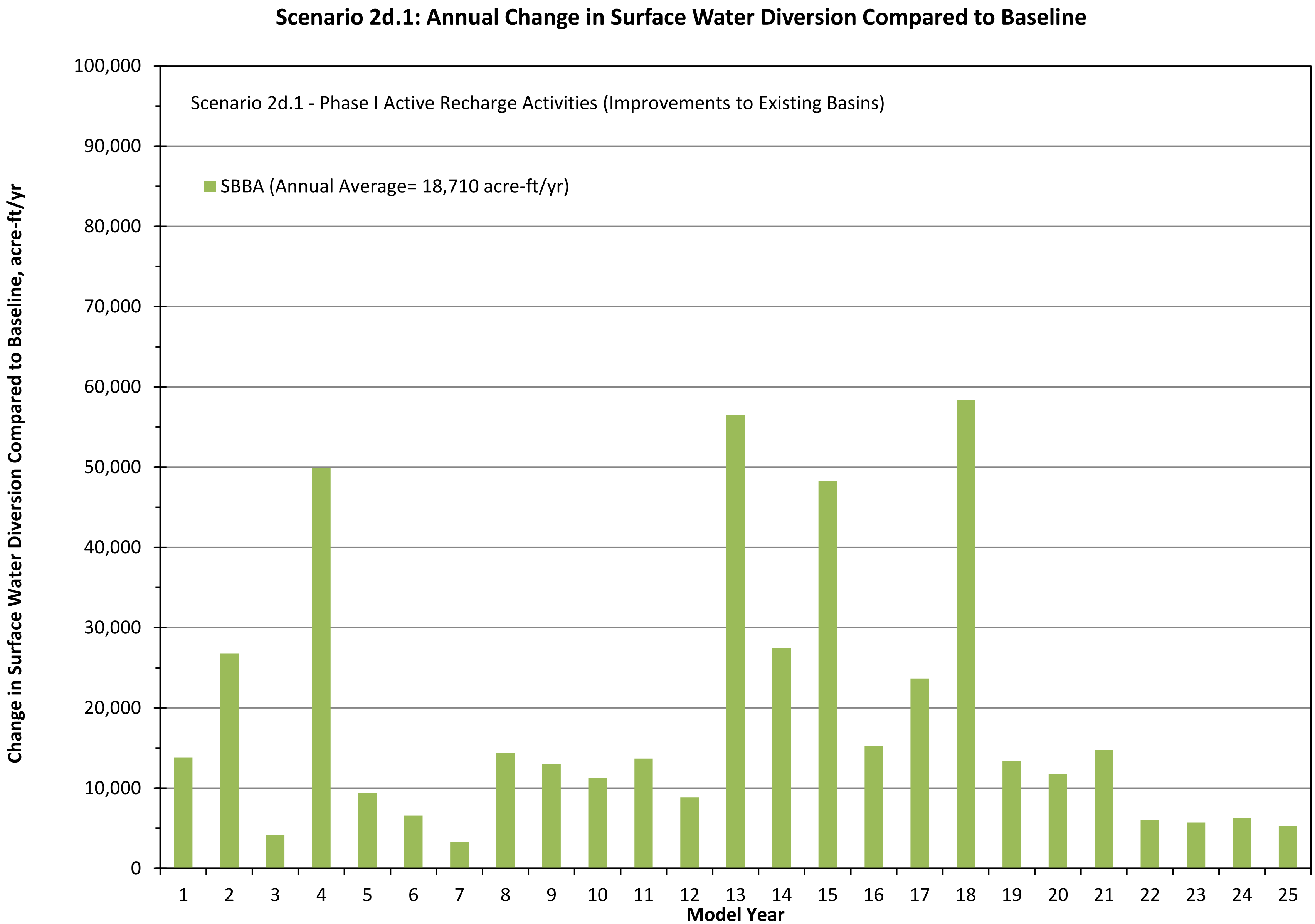

Scenario 2d.1: Annual Change in Surface Water Diversion Compared to Baseline
Scenario 2d.1 - Phase I Active Recharge Activities (Improvements to Existing Basins)
SBBA (Annual Average= 18,710 acre-ft/yr)
Change in Surface Water Diversion Compared to Baseline, acre-ft/yr
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Model Year

Figure 572

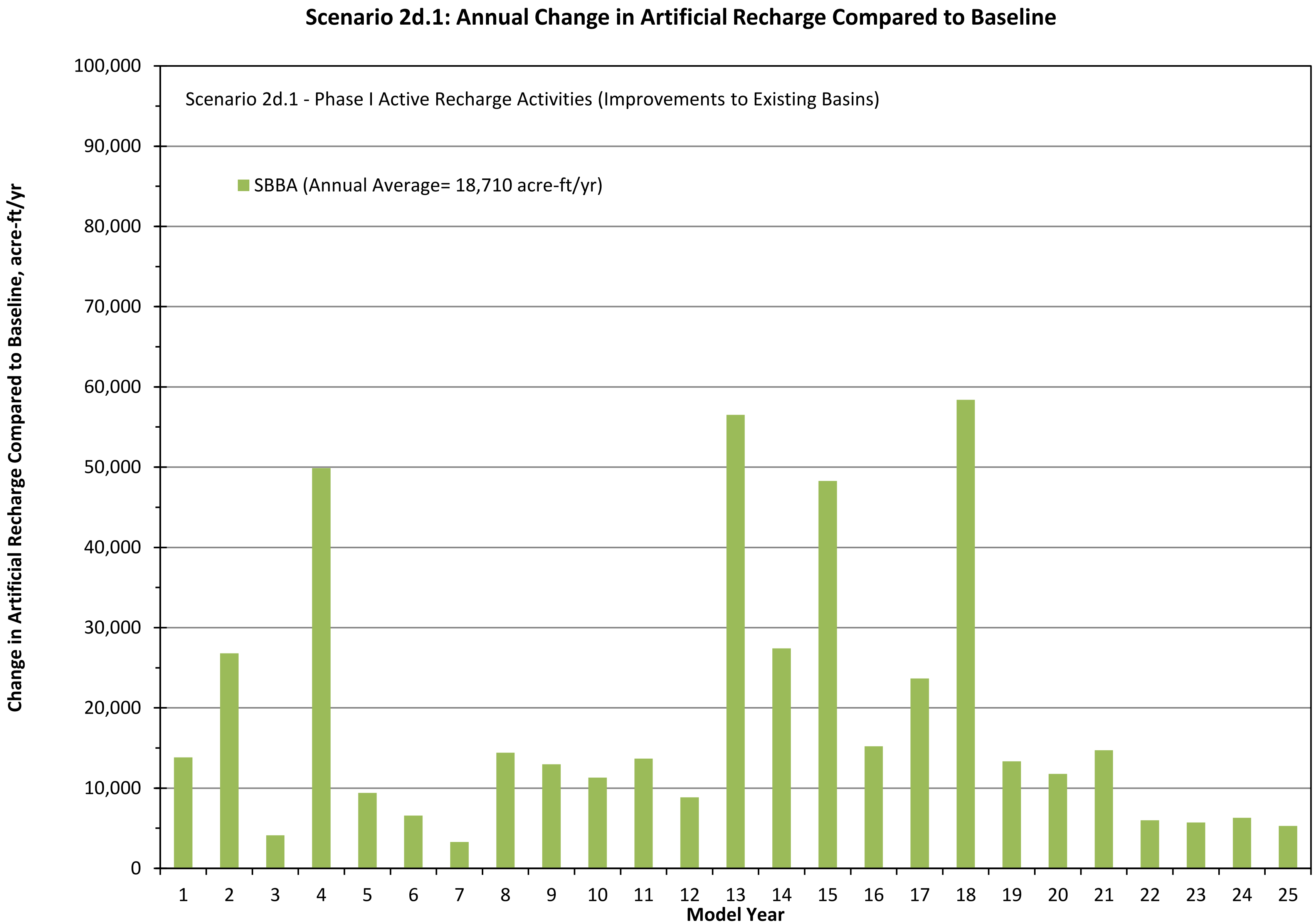
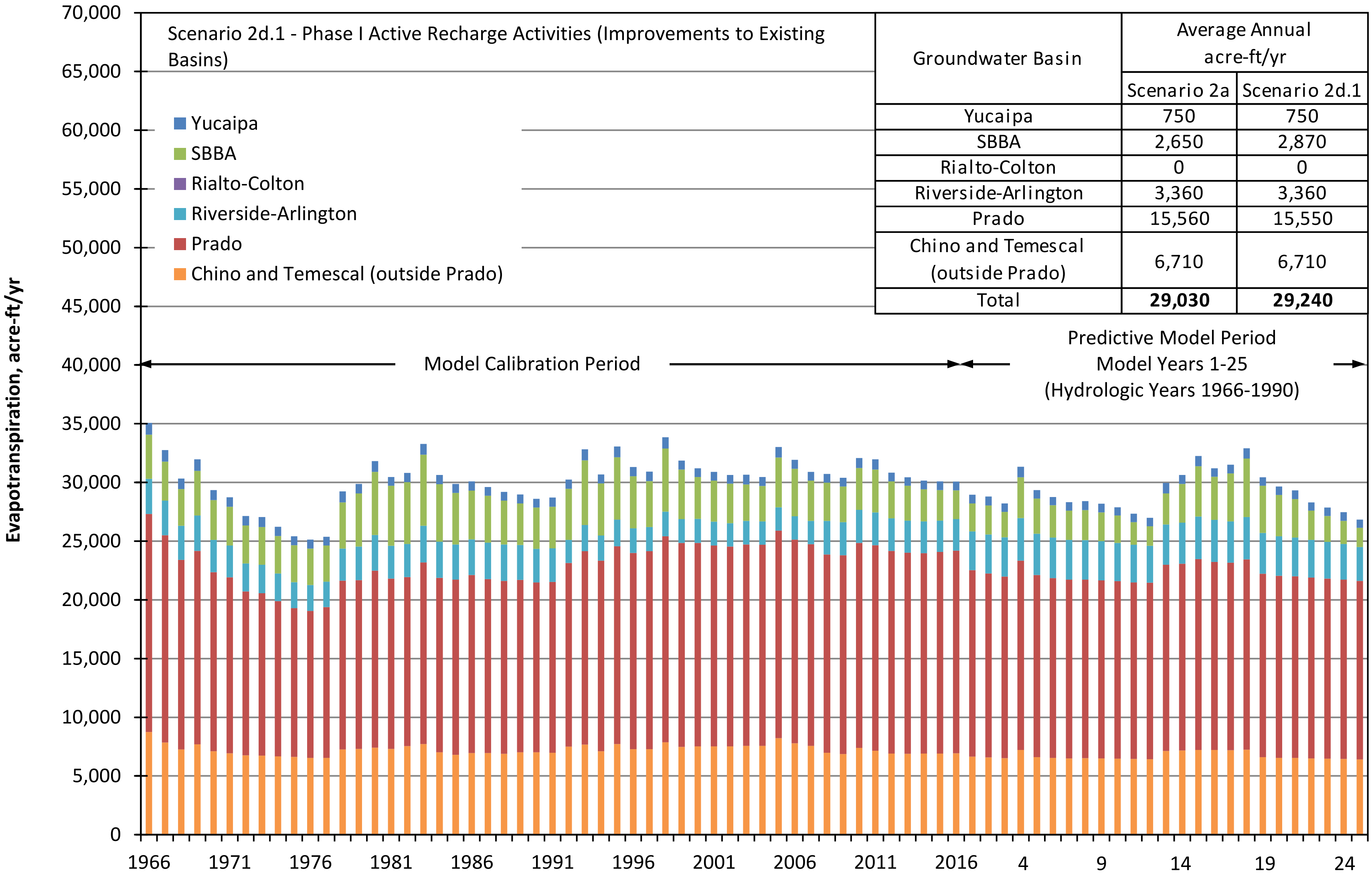

Scenario 2d.1: Annual Change in Artificial Recharge Compared to Baseline
Scenario 2d.1 - Phase I Active Recharge Activities (Improvements to Existing Basins)
SBBA (Annual Average= 18,710 acre-ft/yr)
Change in Artificial Recharge Compared to Baseline, acre-ft/yr
Model Year
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

Figure 573

Scenario 2d.1: Annual Evapotranspiration – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2d.1
Yucaipa	750	750
SBBA	2,650	2,870
Rialto-Colton	0	0
Riverside-Arlington	3,360	3,360
Prado	15,560	15,550
Chino and Temescal (outside Prado)	6,710	6,710
Total	**29,030**	**29,240**

Figure 574

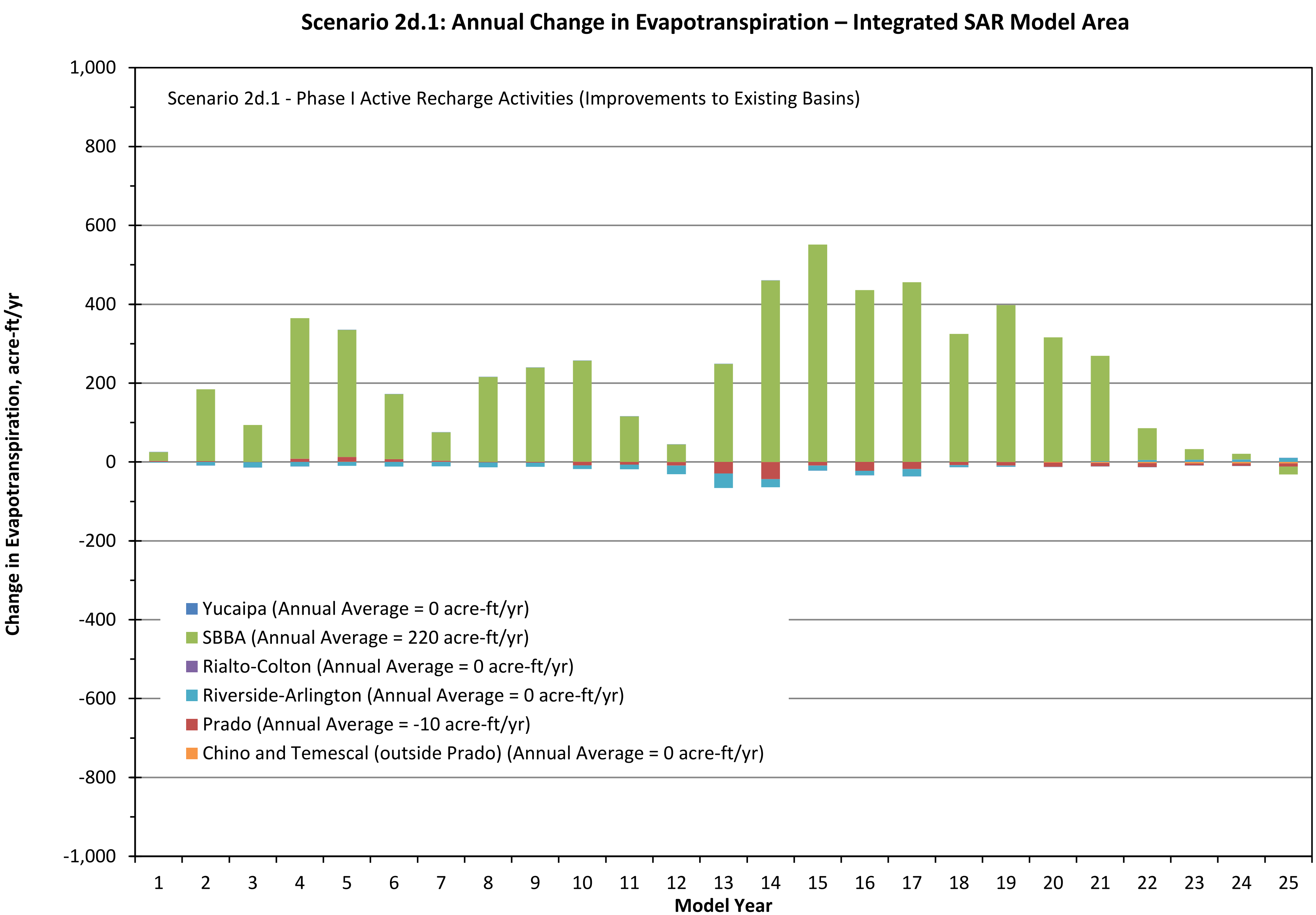
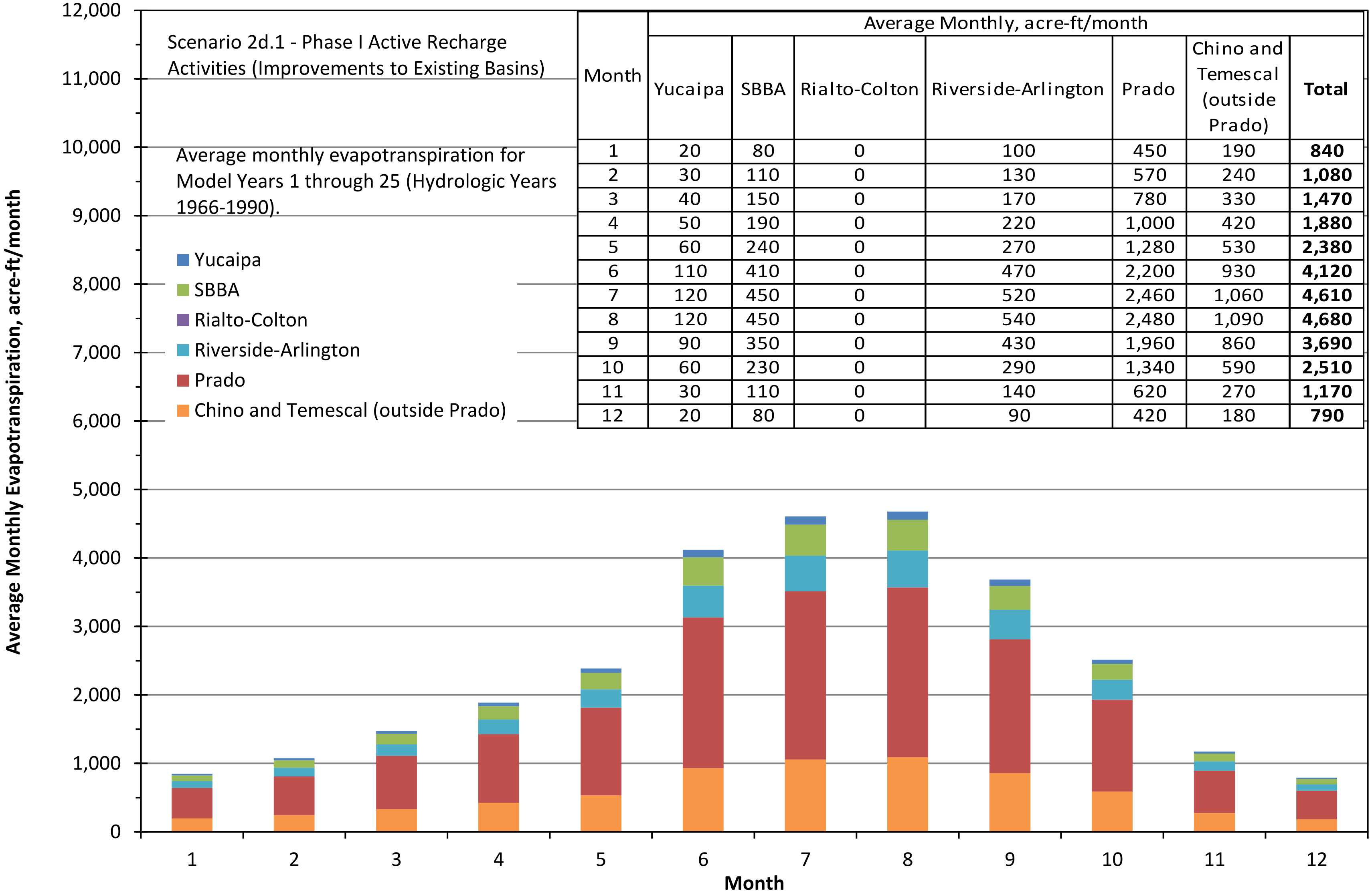

Scenario 2d.1: Annual Change in Evapotranspiration – Integrated SAR Model Area
Scenario 2d.1 - Phase I Active Recharge Activities (Improvements to Existing Basins)
Change in Evapotranspiration, acre-ft/yr
1,000
800
600
400
200
0
-200
-400
-600
-800
-1,000
Yucaipa (Annual Average = 0 acre-ft/yr)
SBBA (Annual Average = 220 acre-ft/yr)
Rialto-Colton (Annual Average = 0 acre-ft/yr)
Riverside-Arlington (Annual Average = 0 acre-ft/yr)
Prado (Annual Average = -10 acre-ft/yr)
Chino and Temescal (outside Prado) (Annual Average = 0 acre-ft/yr)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Model Year

Figure 575

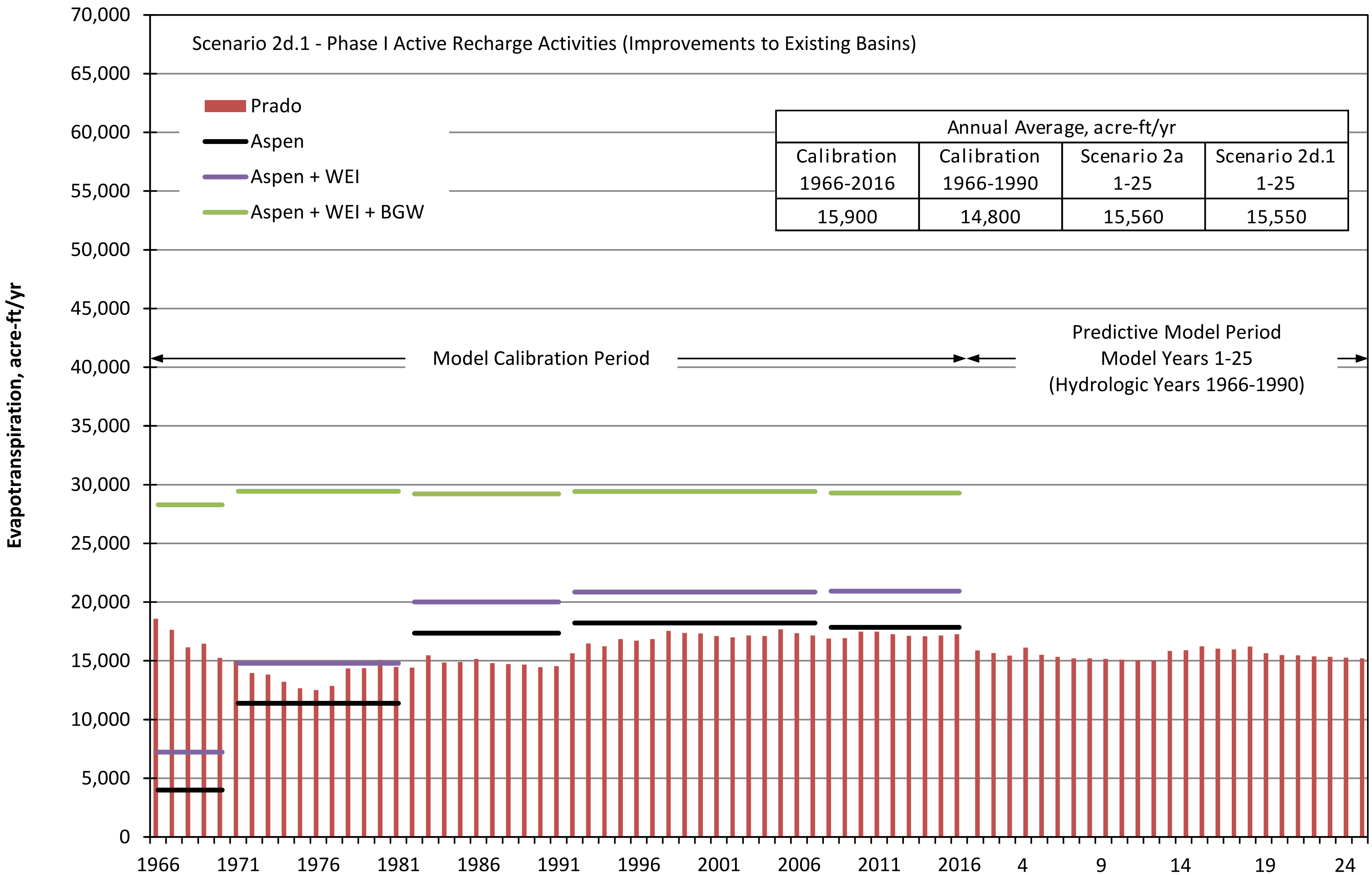
Scenario 2d.1: Seasonal Evapotranspiration – Integrated SAR Model Area



Month	Average Monthly, acre-ft/month						
	Yucaipa	SBBA	Rialto-Colton	Riverside-Arlington	Prado	Chino and Temescal (outside Prado)	**Total**
1	20	80	0	100	450	190	**840**
2	30	110	0	130	570	240	**1,080**
3	40	150	0	170	780	330	**1,470**
4	50	190	0	220	1,000	420	**1,880**
5	60	240	0	270	1,280	530	**2,380**
6	110	410	0	470	2,200	930	**4,120**
7	120	450	0	520	2,460	1,060	**4,610**
8	120	450	0	540	2,480	1,090	**4,680**
9	90	350	0	430	1,960	860	**3,690**
10	60	230	0	290	1,340	590	**2,510**
11	30	110	0	140	620	270	**1,170**
12	20	80	0	90	420	180	**790**

Figure 576

Scenario 2d.1: Annual Evapotranspiration – Prado Basin



Annual Average, acre-ft/yr			
Calibration 1966-2016	Calibration 1966-1990	Scenario 2a 1-25	Scenario 2d.1 1-25
15,900	14,800	15,560	15,550

Figure 577

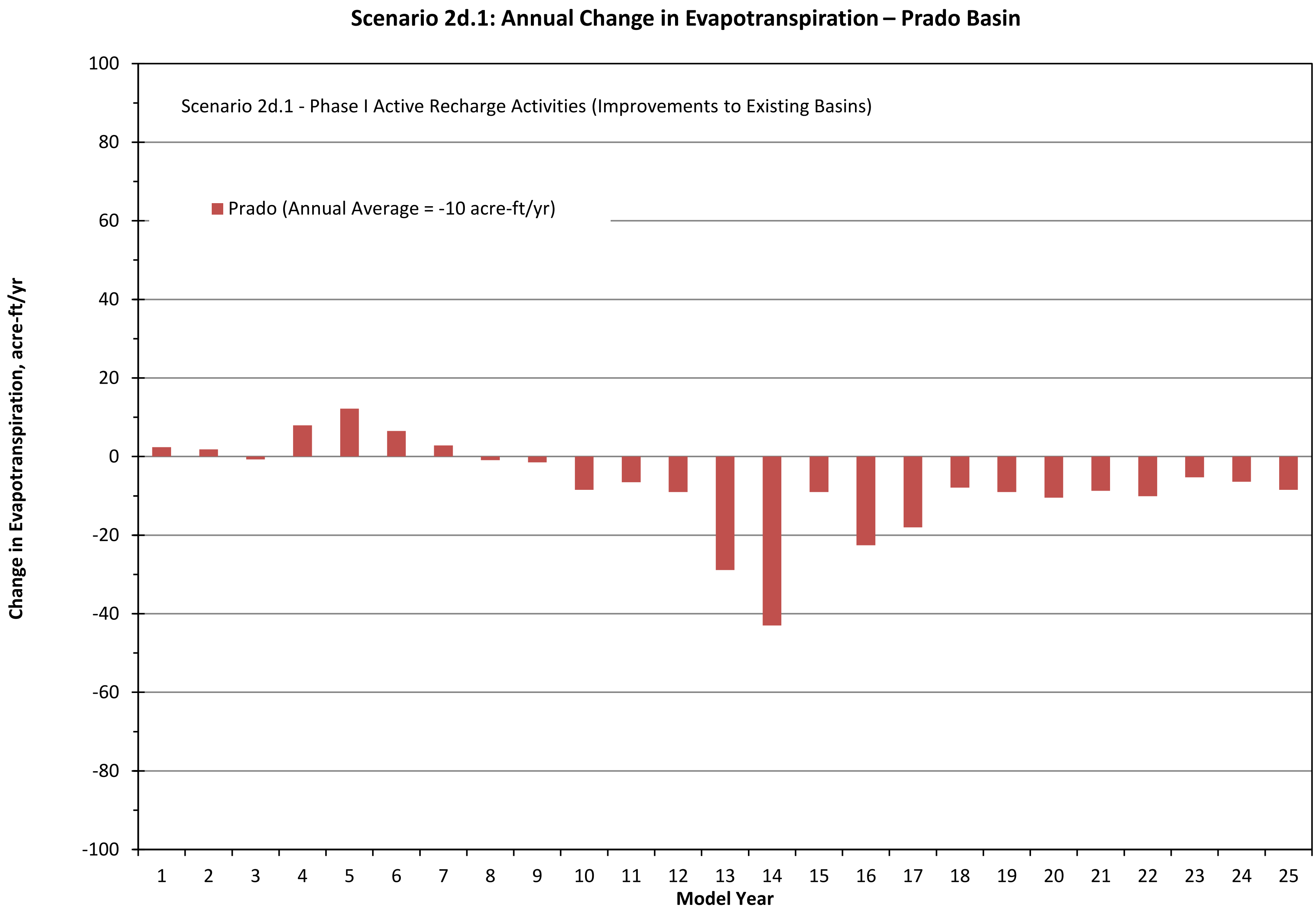
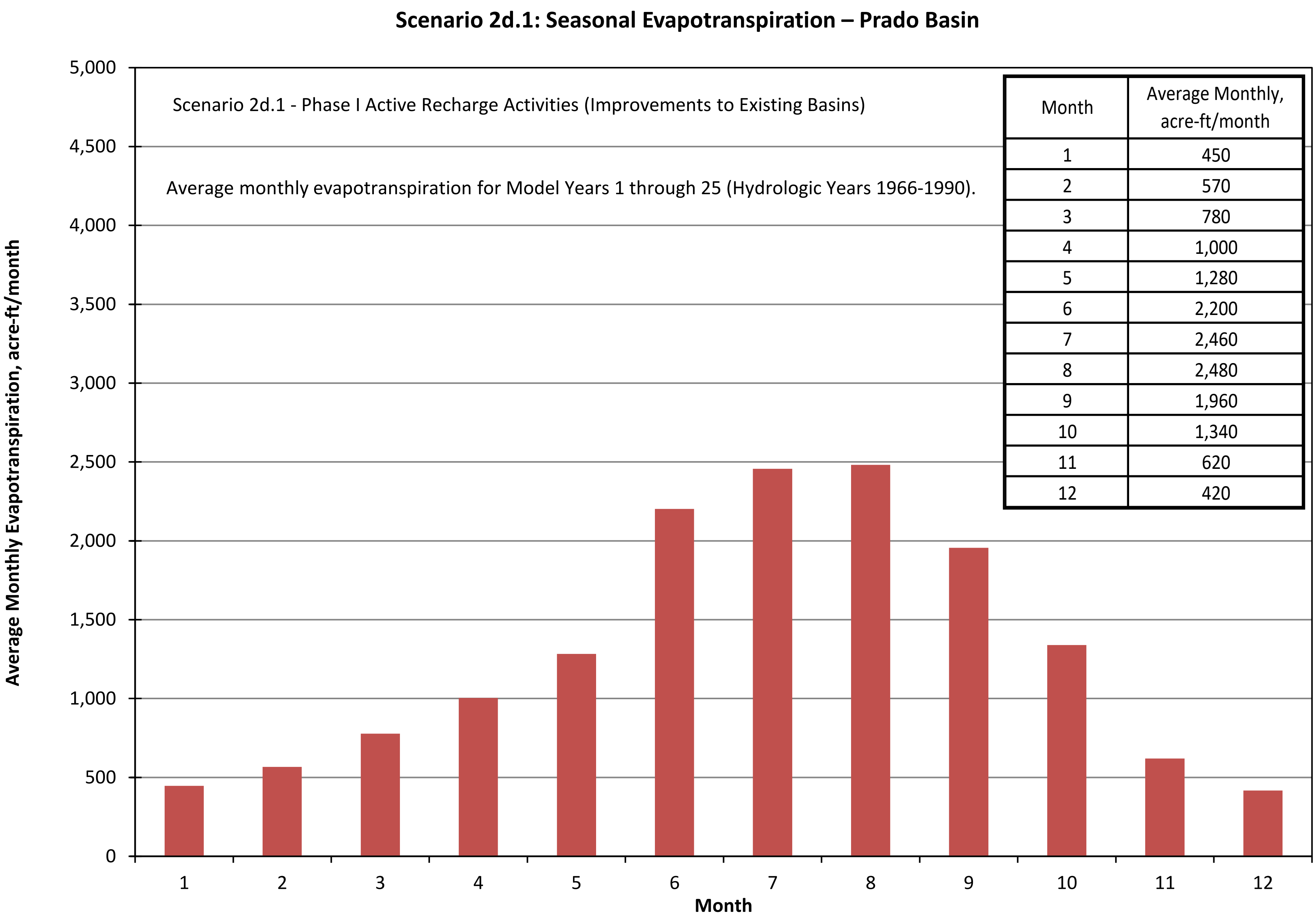

Scenario 2d.1: Annual Change in Evapotranspiration – Prado Basin
Scenario 2d.1 - Phase I Active Recharge Activities (Improvements to Existing Basins)
Prado (Annual Average = -10 acre-ft/yr)
Change in Evapotranspiration, acre-ft/yr
100
80
60
40
20
0
-20
-40
-60
-80
-100
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
Model Year

Figure 578



Month	Average Monthly, acre-ft/month
1	450
2	570
3	780
4	1,000
5	1,280
6	2,200
7	2,460
8	2,480
9	1,960
10	1,340
11	620
12	420

Figure 579

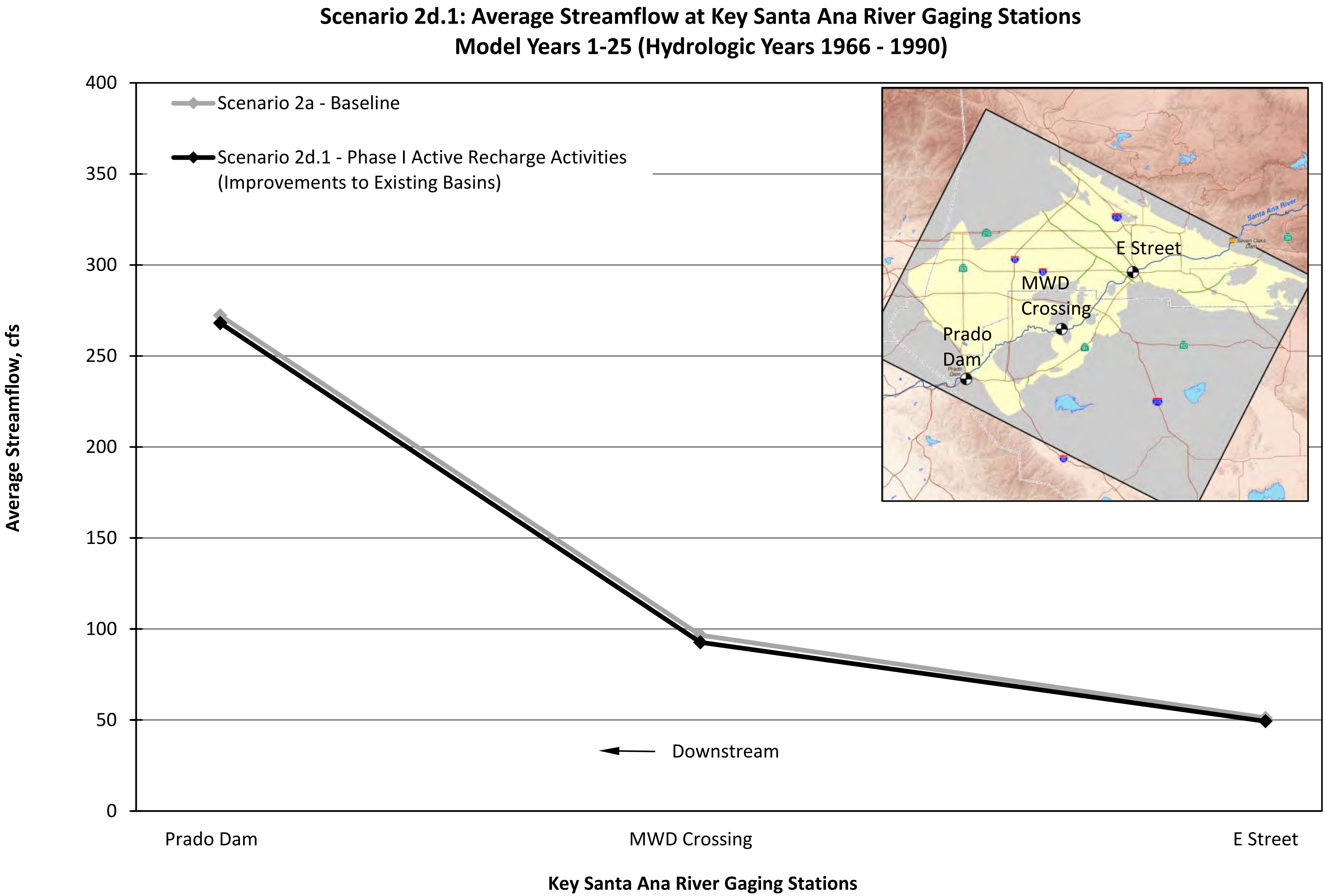

Scenario 2d.1: Average Streamflow at Key Santa Ana River Gaging Stations
Model Years 1-25 (Hydrologic Years 1966 - 1990)
Average Streamflow, cfs
400
350
300
250
200
150
100
50
0
Scenario 2a - Baseline
Scenario 2d.1 - Phase I Active Recharge Activities
(Improvements to Existing Basins)
E Street
MWD
Crossing
Prado
Dam
Downstream
Prado Dam
MWD Crossing
E Street
Key Santa Ana River Gaging Stations

Figure 580

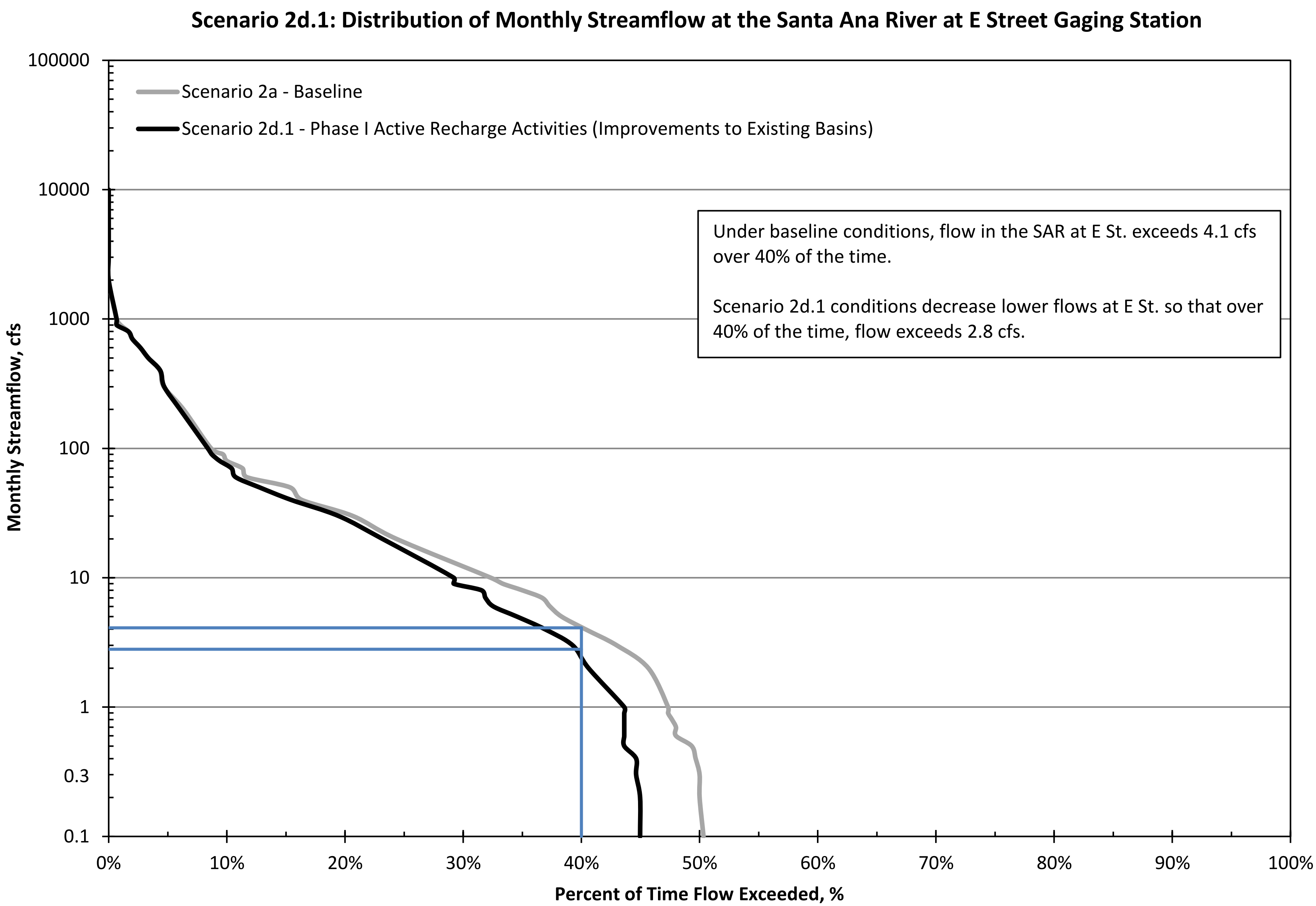

Scenario 2d.1: Distribution of Monthly Streamflow at the Santa Ana River at E Street Gaging Station
Scenario 2a - Baseline
Scenario 2d.1 - Phase I Active Recharge Activities (Improvements to Existing Basins)
Under baseline conditions, flow in the SAR at E St. exceeds 4.1 cfs over 40% of the time.
Scenario 2d.1 conditions decrease lower flows at E St. so that over 40% of the time, flow exceeds 2.8 cfs.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.3
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 581

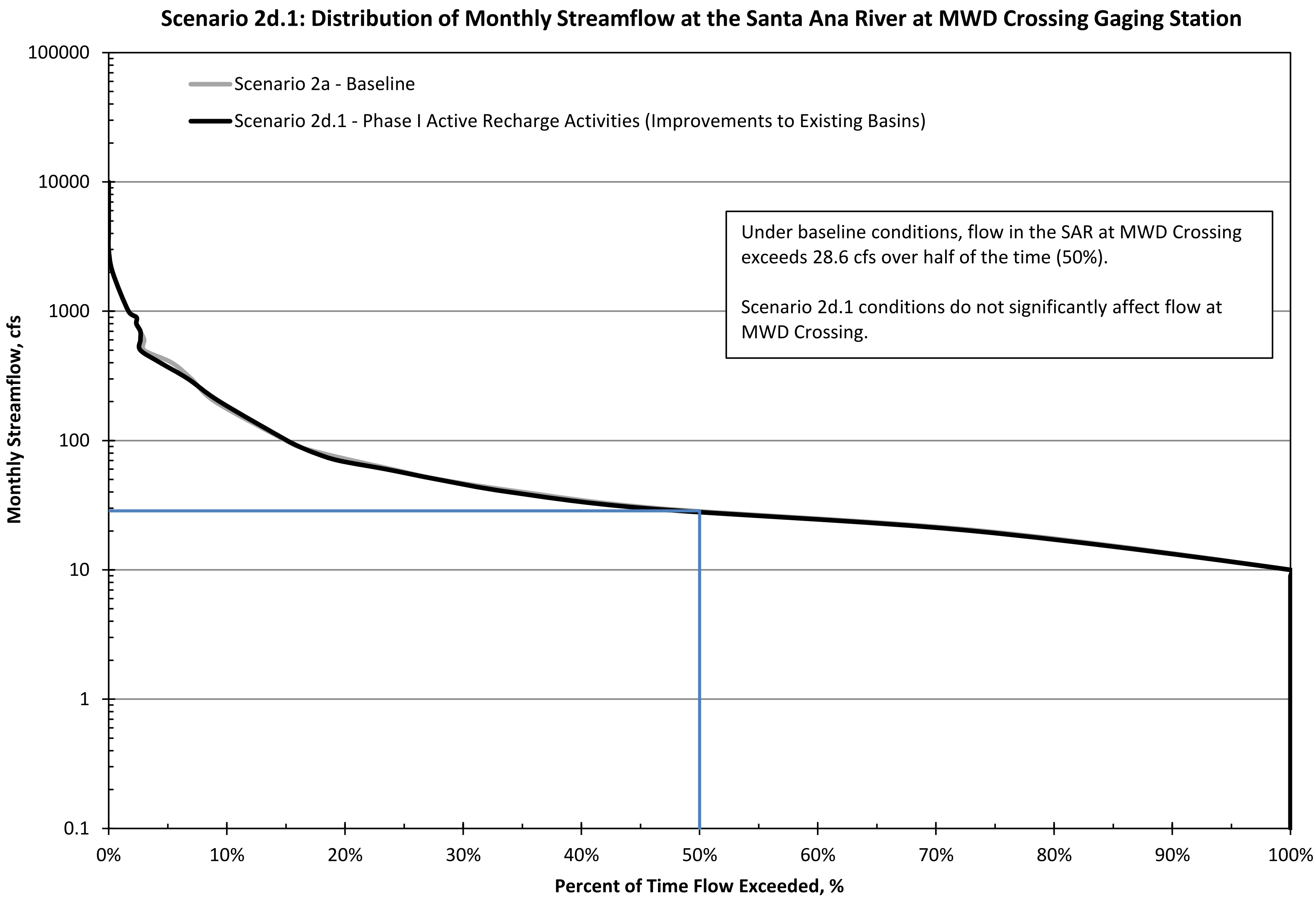

Scenario 2d.1: Distribution of Monthly Streamflow at the Santa Ana River at MWD Crossing Gaging Station
Scenario 2a - Baseline
Scenario 2d.1 - Phase I Active Recharge Activities (Improvements to Existing Basins)
Under baseline conditions, flow in the SAR at MWD Crossing exceeds 28.6 cfs over half of the time (50%).
Scenario 2d.1 conditions do not significantly affect flow at MWD Crossing.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 582

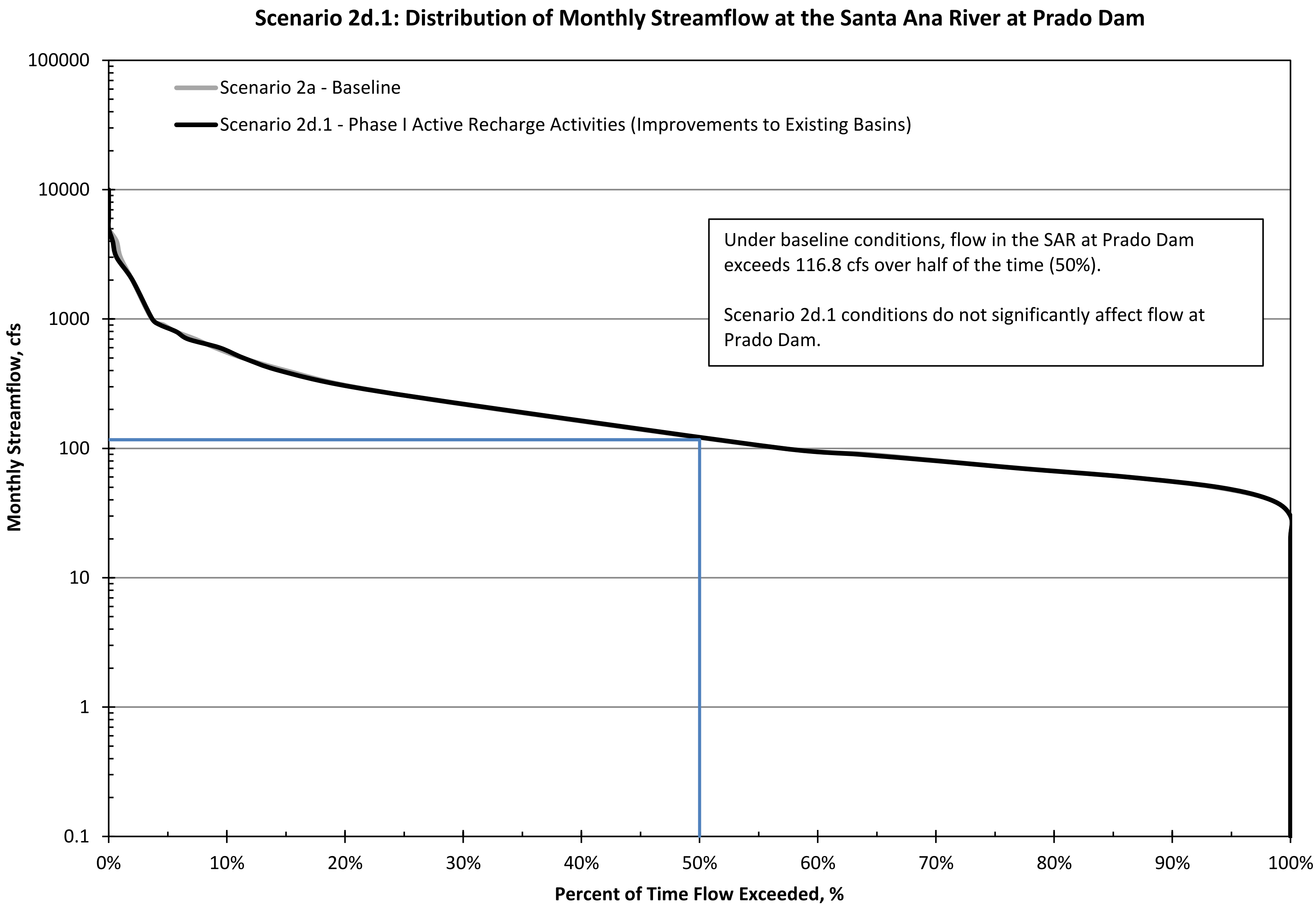
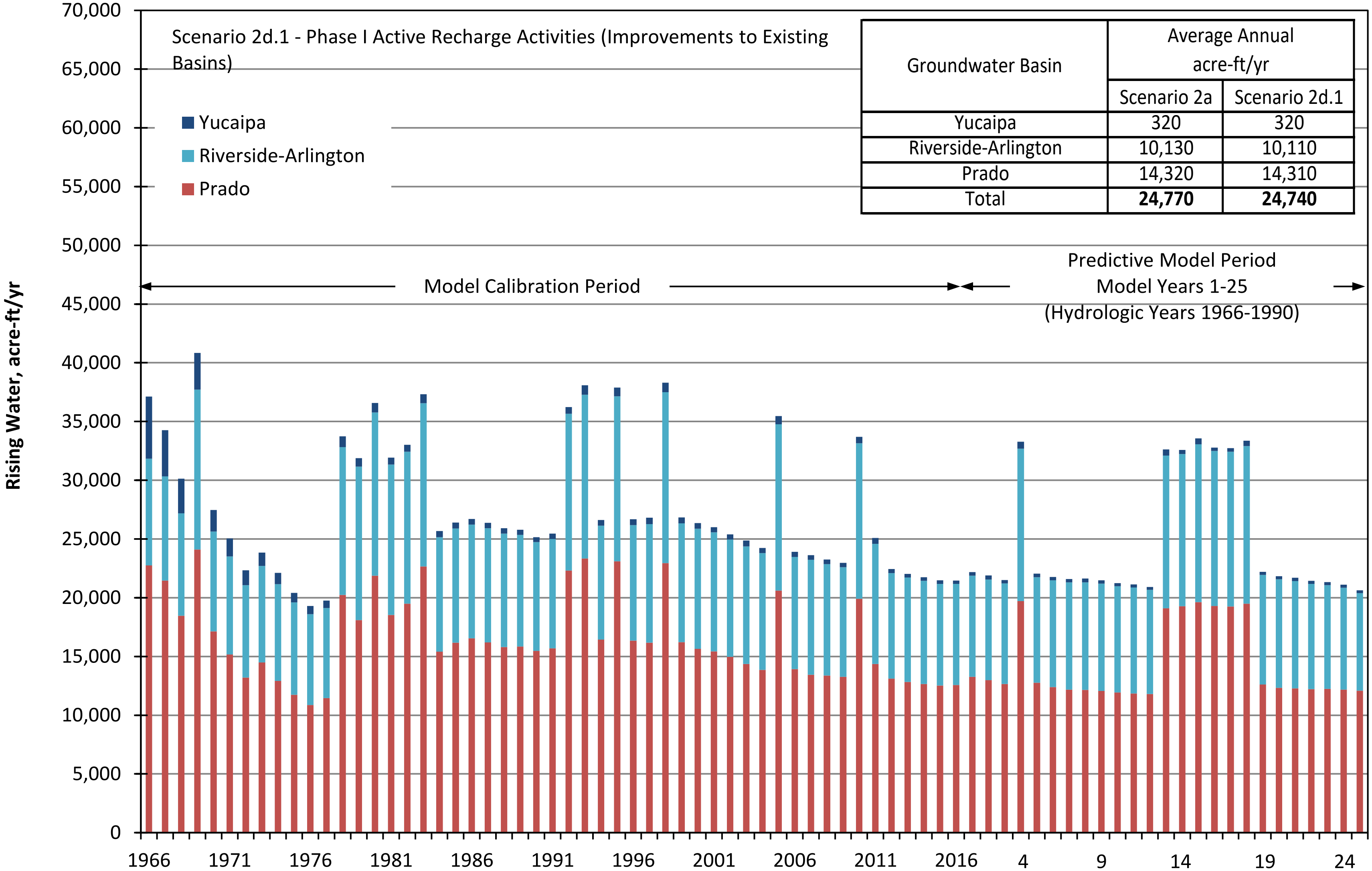

Scenario 2d.1: Distribution of Monthly Streamflow at the Santa Ana River at Prado Dam
Scenario 2a - Baseline
Scenario 2d.1 - Phase I Active Recharge Activities (Improvements to Existing Basins)
Under baseline conditions, flow in the SAR at Prado Dam exceeds 116.8 cfs over half of the time (50%).
Scenario 2d.1 conditions do not significantly affect flow at Prado Dam.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

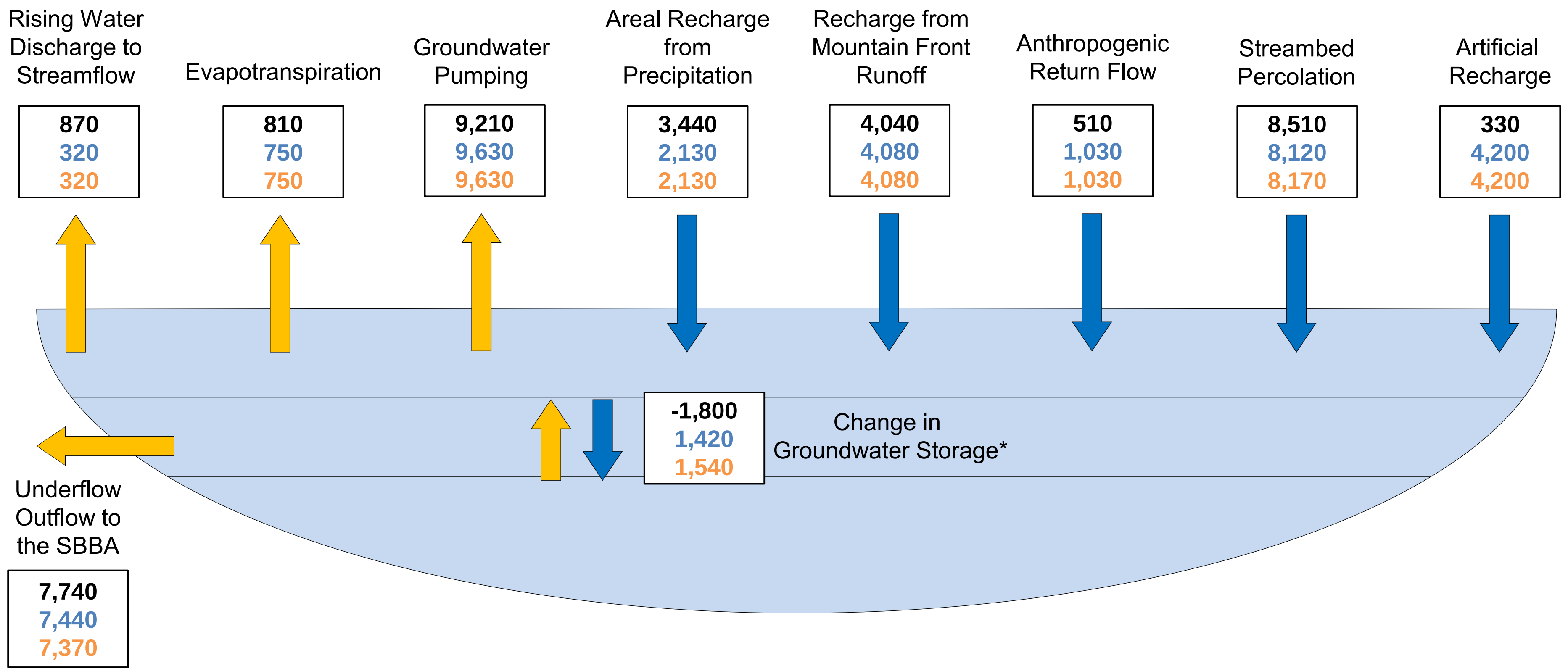
Figure 583

Scenario 2d.1: Annual Rising Water – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2d.1
Yucaipa	320	320
Riverside-Arlington	10,130	10,110
Prado	14,320	14,310
Total	**24,770**	**24,740**

Figure 584



Scenario 2a - Baseline
Scenario 2d.1 - Phase I Active Recharge Activities (Improvements to Existing Basins)

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.1 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.1
AVERAGE ANNUAL
WATER BUDGET
YUCAIPA BASIN

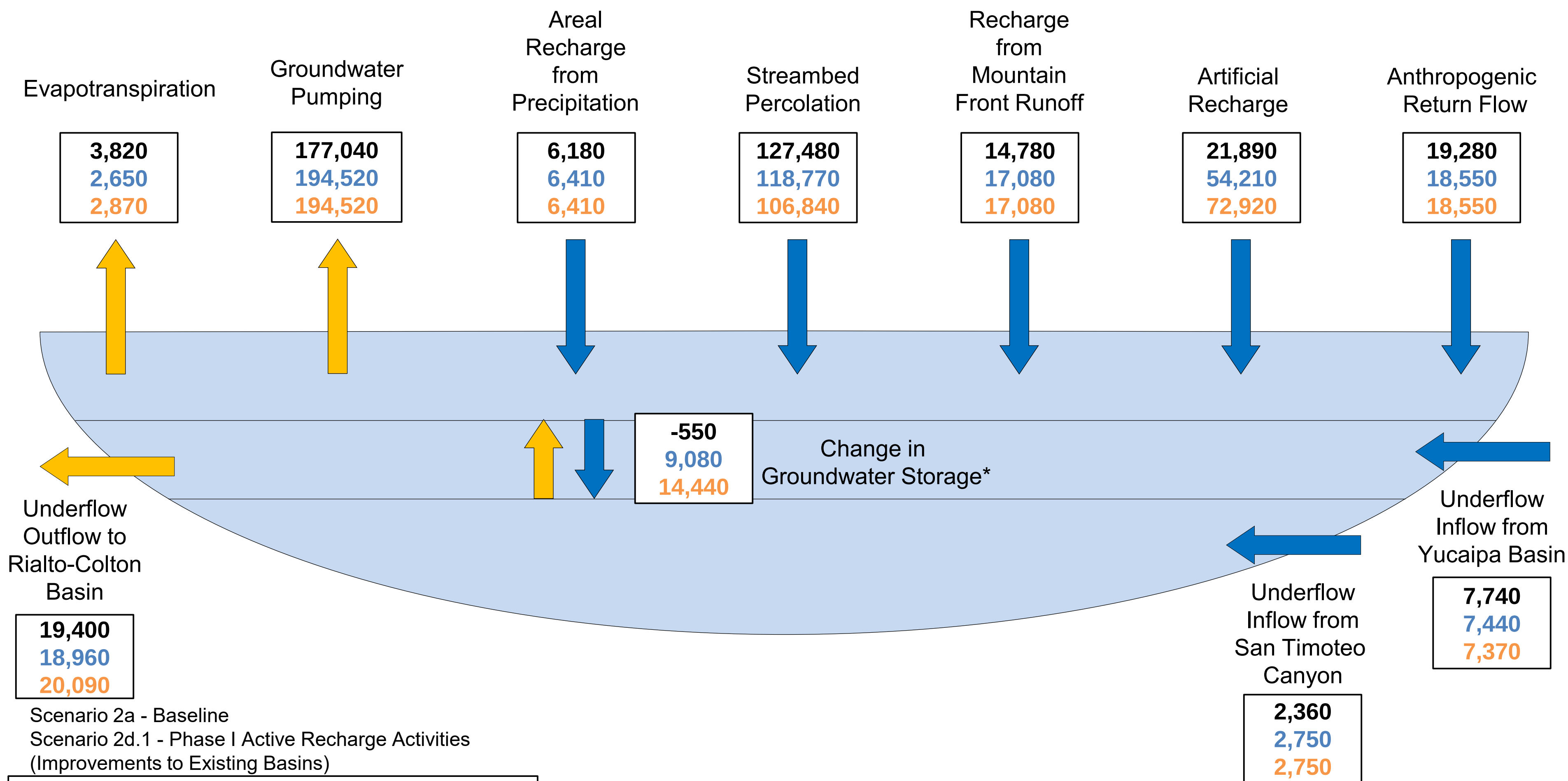
10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT
UPPER SANTA ANA RIVER INTEGRATED MODEL – SUMMARY REPORT

DRAFT

FIGURE 585

GEOSCIENCE



Scenario 2a - Baseline
Scenario 2d.1 - Phase I Active Recharge Activities (Improvements to Existing Basins)

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.1 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.1 AVERAGE ANNUAL WATER BUDGET SBBA

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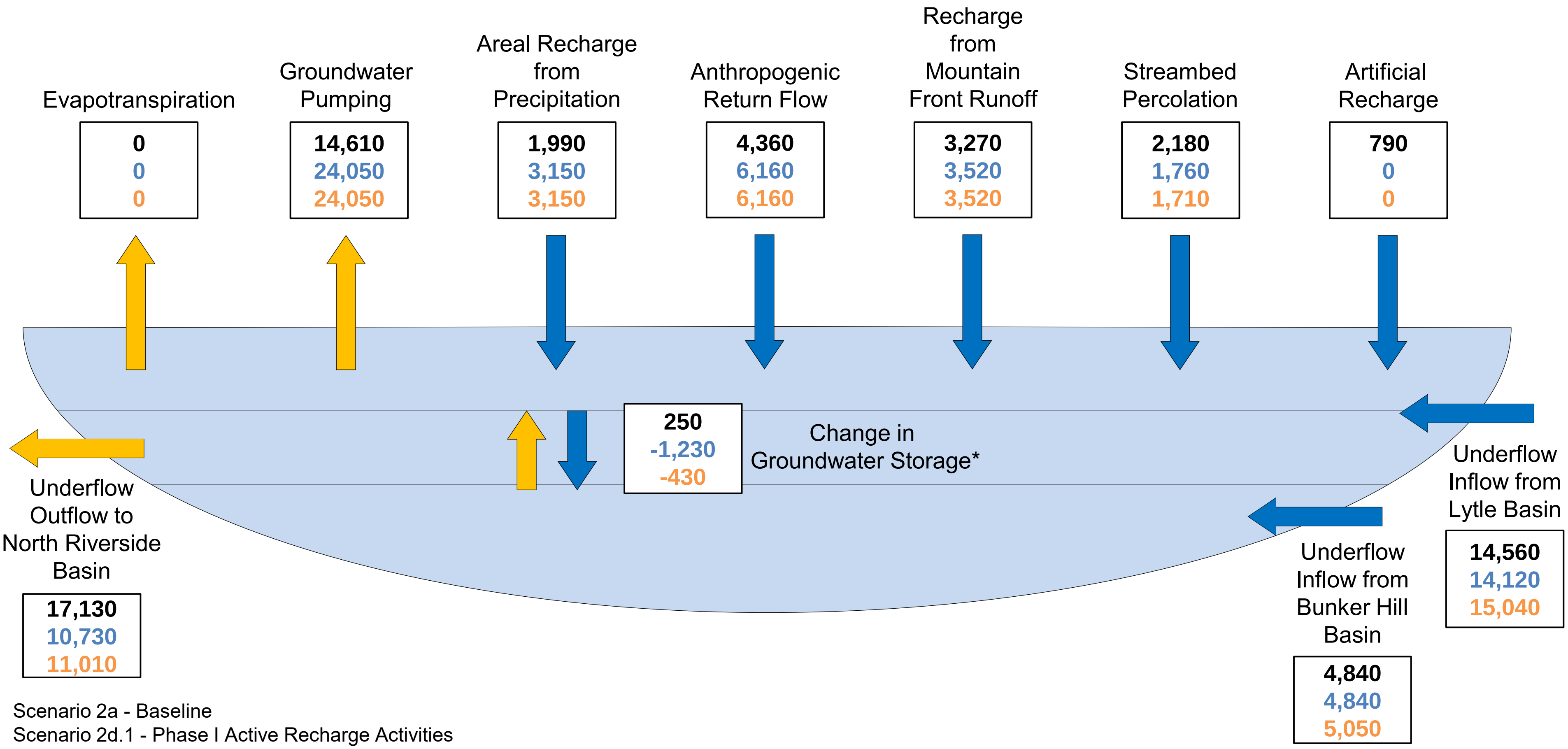
10-Apr-20



Scenario 2a - Baseline
Scenario 2d.1 - Phase I Active Recharge Activities (Improvements to Existing Basins)

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.1 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.1 AVERAGE ANNUAL WATER BUDGET RIALTO-COLTON BASIN

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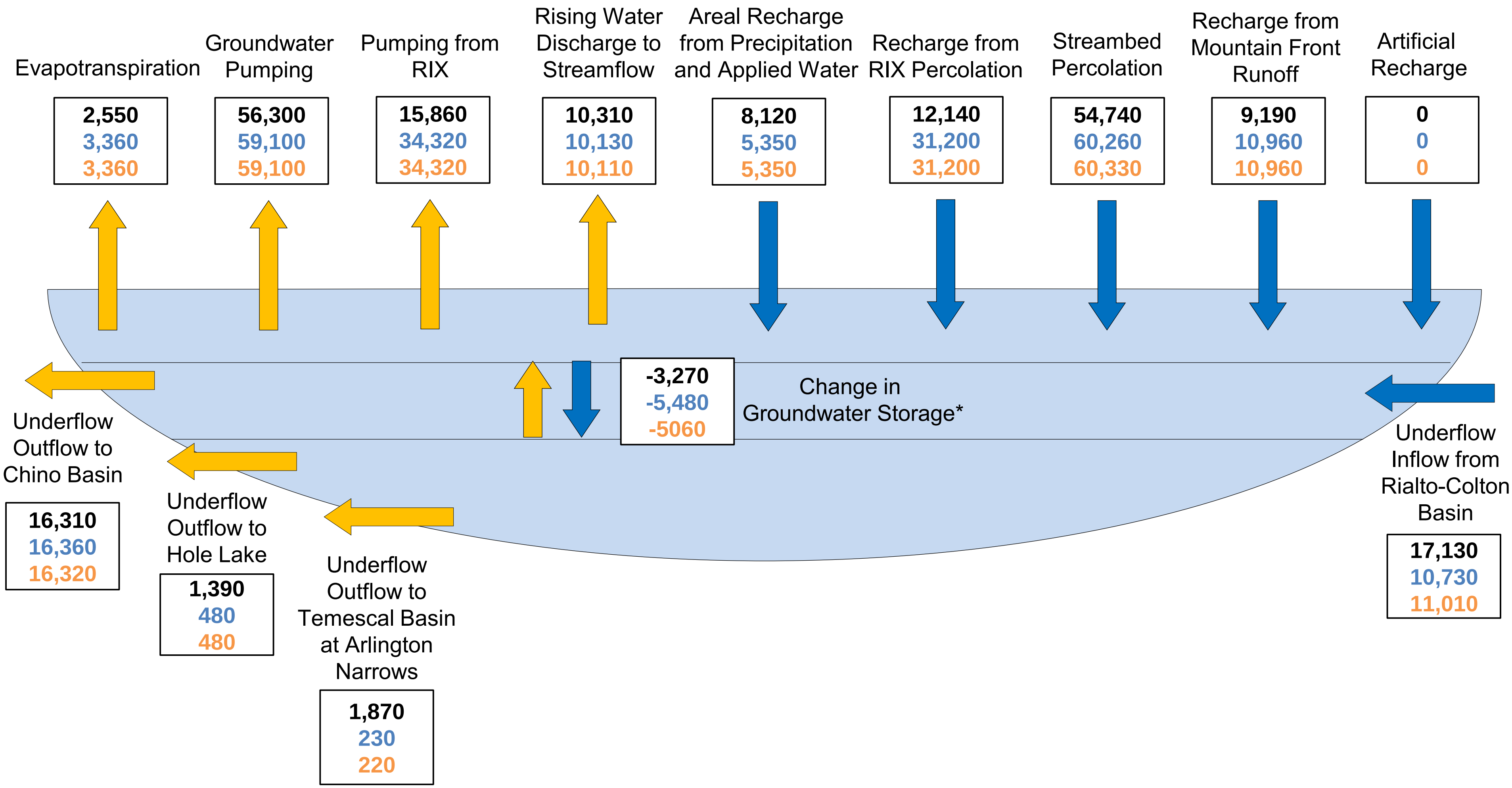
10-Apr-20



Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.1 (Hydrologic Period 1966-1990)

Scenario 2a - Baseline
Scenario 2d.1 - Phase I Active Recharge Activities (Improvements to Existing Basins)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.1 AVERAGE ANNUAL WATER BUDGET RIVERSIDE-ARLINGTON BASIN

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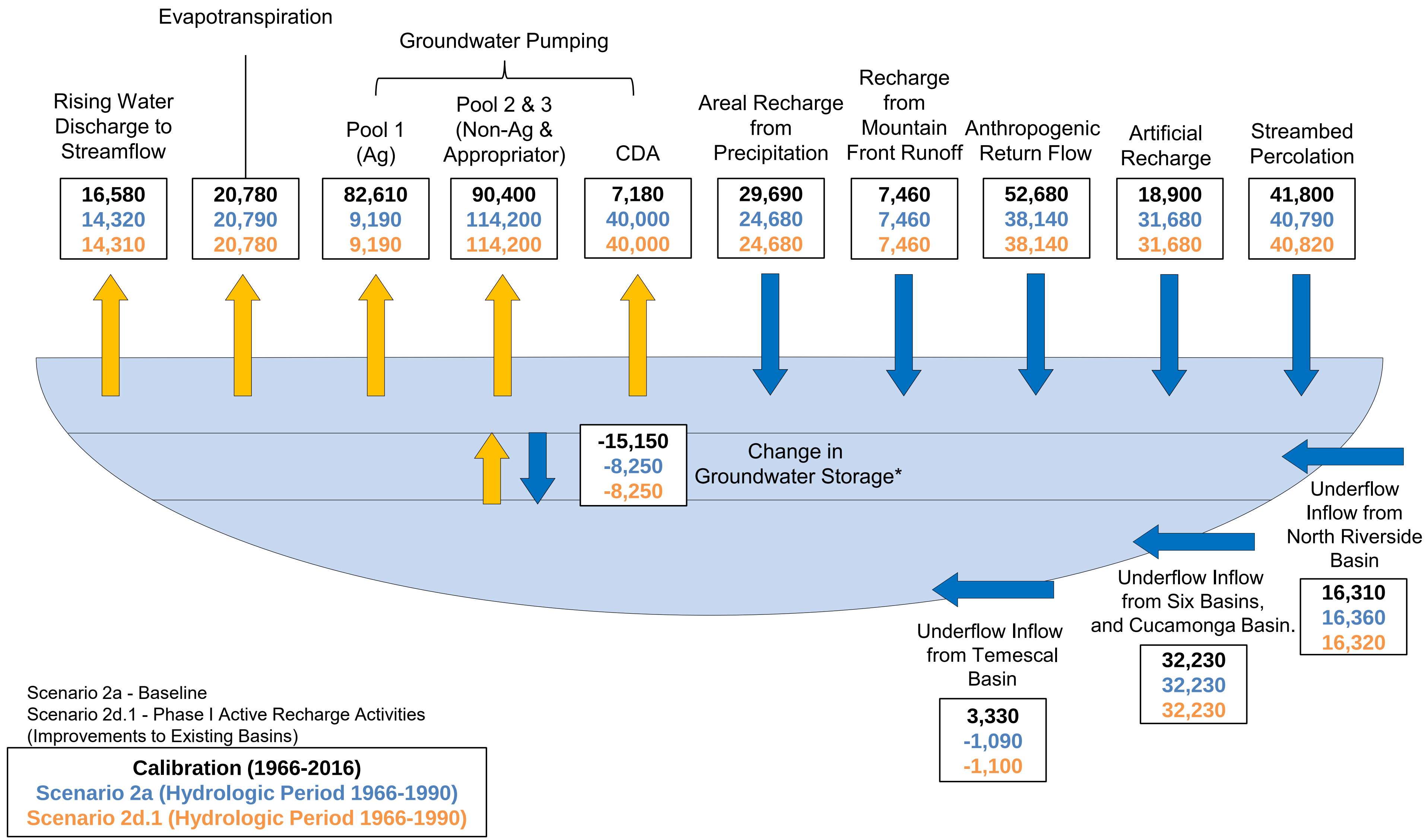
10-Apr-20



All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.1
AVERAGE ANNUAL
WATER BUDGET
CHINO BASIN

10-Apr-20

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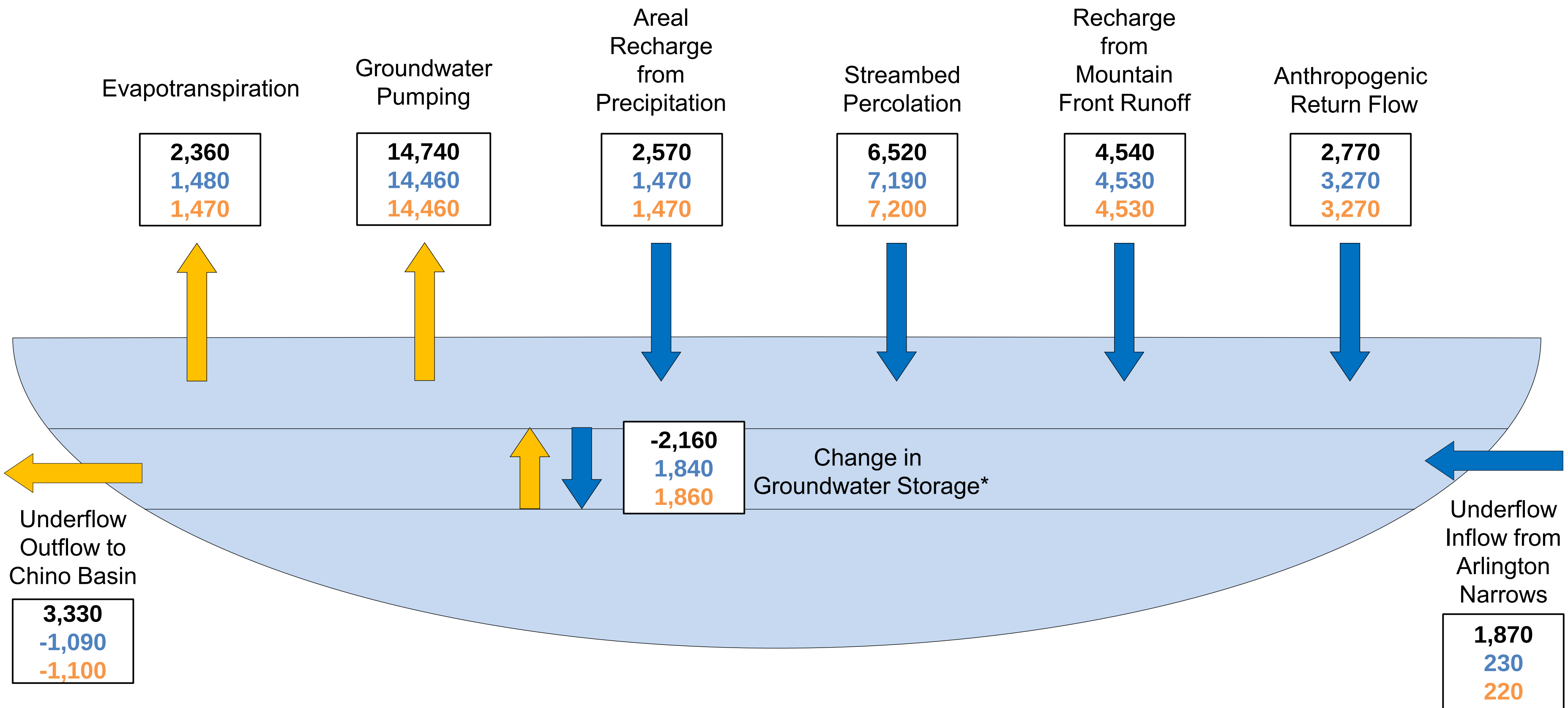

Scenario 2a - Baseline
Scenario 2d.1 - Phase I Active Recharge Activities
(Improvements to Existing Basins)

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.1 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.1
AVERAGE ANNUAL
WATER BUDGET
TEMESCAL BASIN

10-Apr-20

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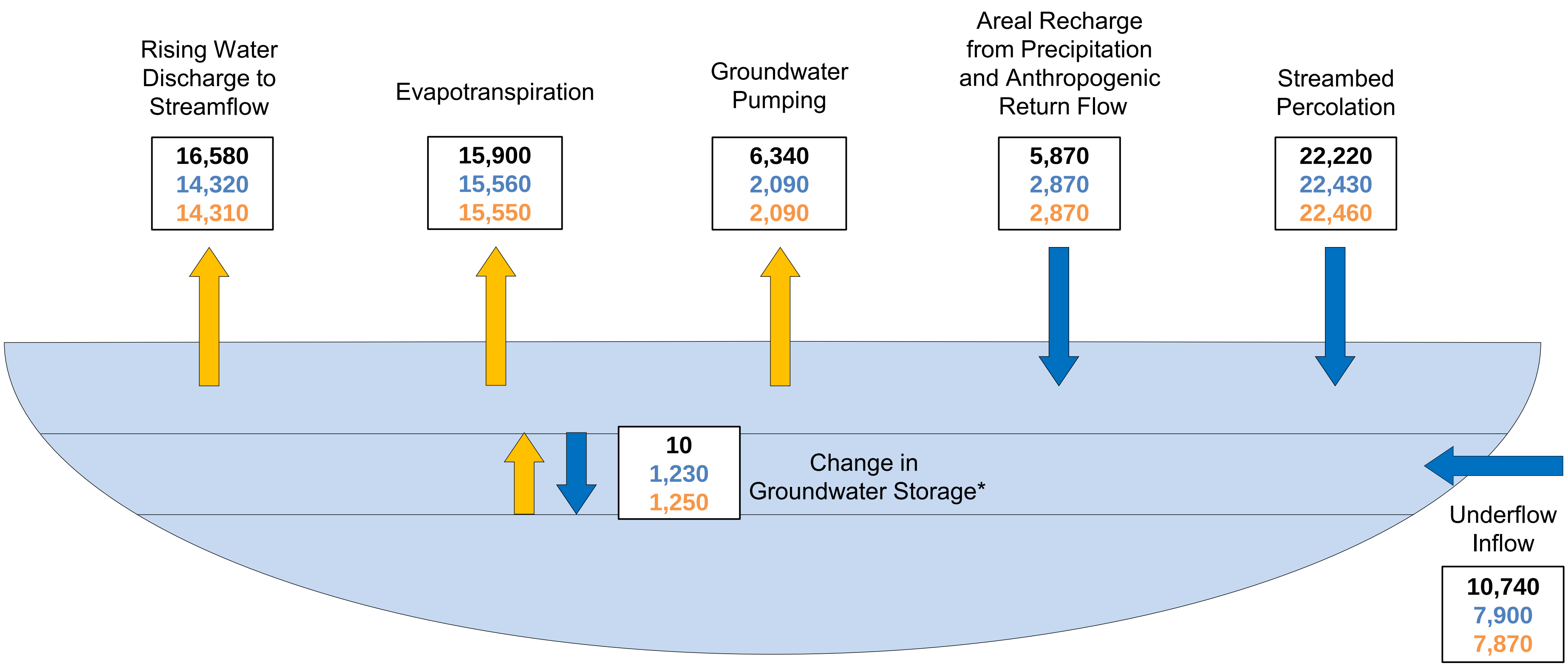


Scenario 2a - Baseline
Scenario 2d.1 - Phase I Active Recharge Activities (Improvements to Existing Basins)

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.1 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

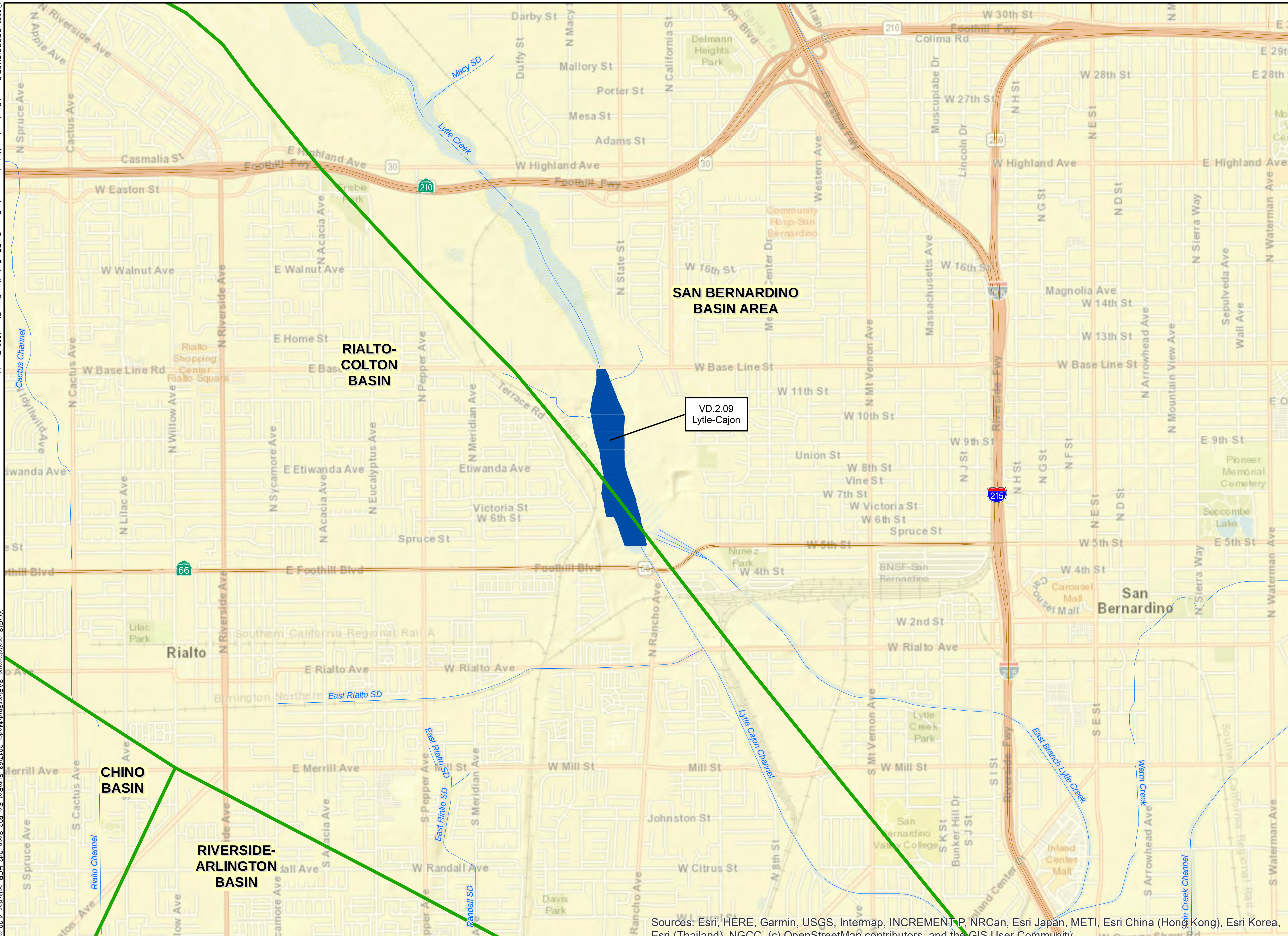
SCENARIO 2D.1
AVERAGE ANNUAL
WATER BUDGET
PRADO BASIN

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT **DRAFT** **FIGURE 591**

UPPER SANTA ANA RIVER INTEGRATED MODEL – SUMMARY REPORT

GEOSCIENCE



EXPLANATION

Integrated SAR Model Boundary

Active Model Area

Inactive Model Area

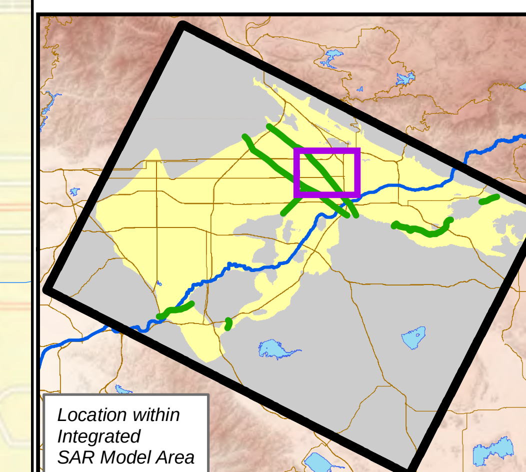
Habitat Conservation Plan (HCP) Covered Activity

VD.2.09 - Project ID
Lytle-Cajon - Name of HCP Project

Groundwater Basin Boundary

Refer to Table 17 for HCP Covered Activity Description

Scenario 2d.2:
Active Recharge Activities (Stormwater Capture Activities) - Phase II Active Recharge Activities (New Facilities) along Lytle Creek



N

0 0.5 1

Miles

SCENARIO 2d.2
LOCATION OF
HCP COVERED ACTIVITIES

W:\GIS_projects\mwd_SARiverStudyModel_201753_SumRpt_Fig_592_Scen_2d2_HCP_activities_4-20.mxd

10-Apr-20

DRAFT

FIGURE 592

GEOSCIENCE

DRAFT

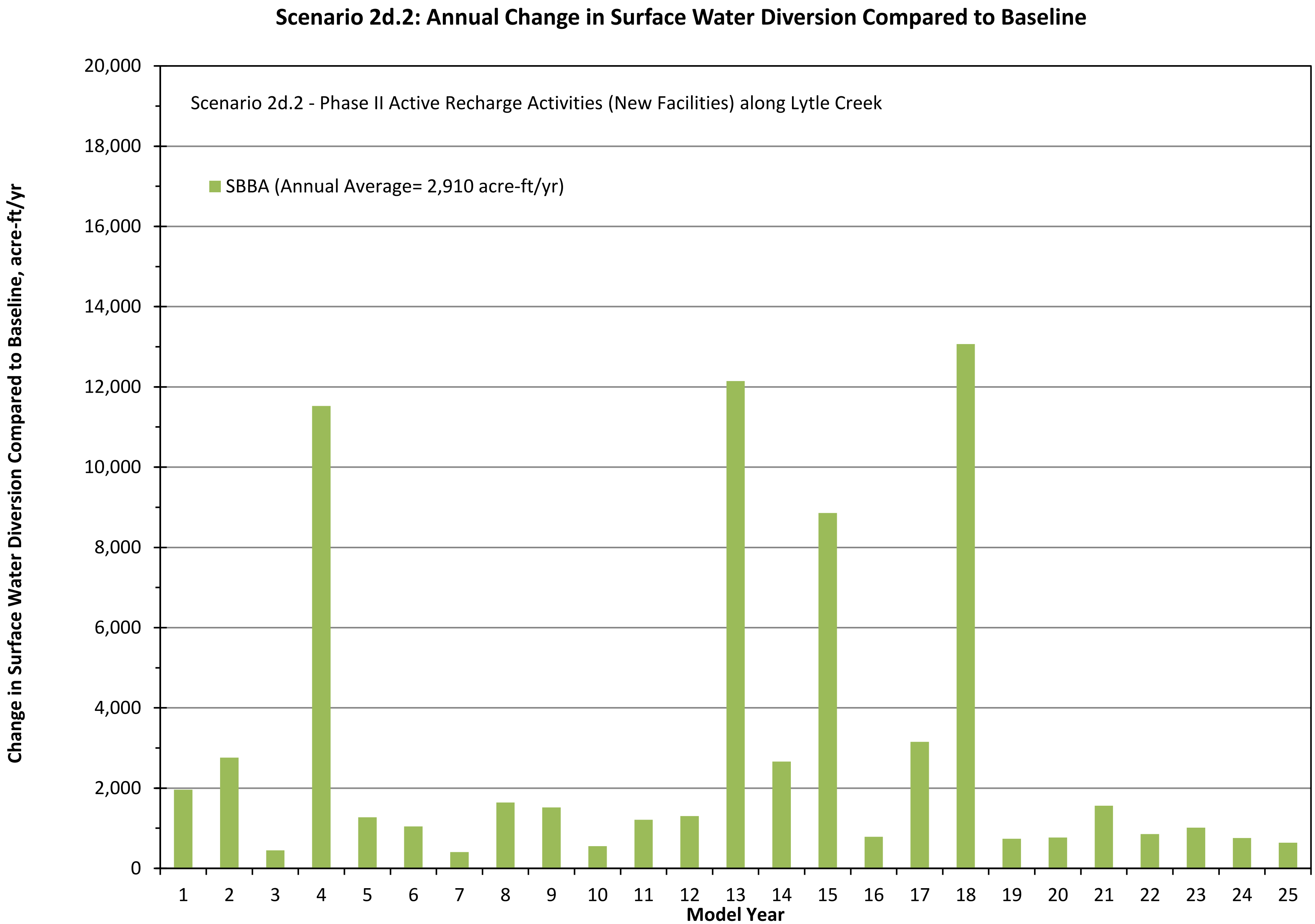


Figure 593

Scenario 2d.2: Annual Change in Artificial Recharge Compared to Baseline

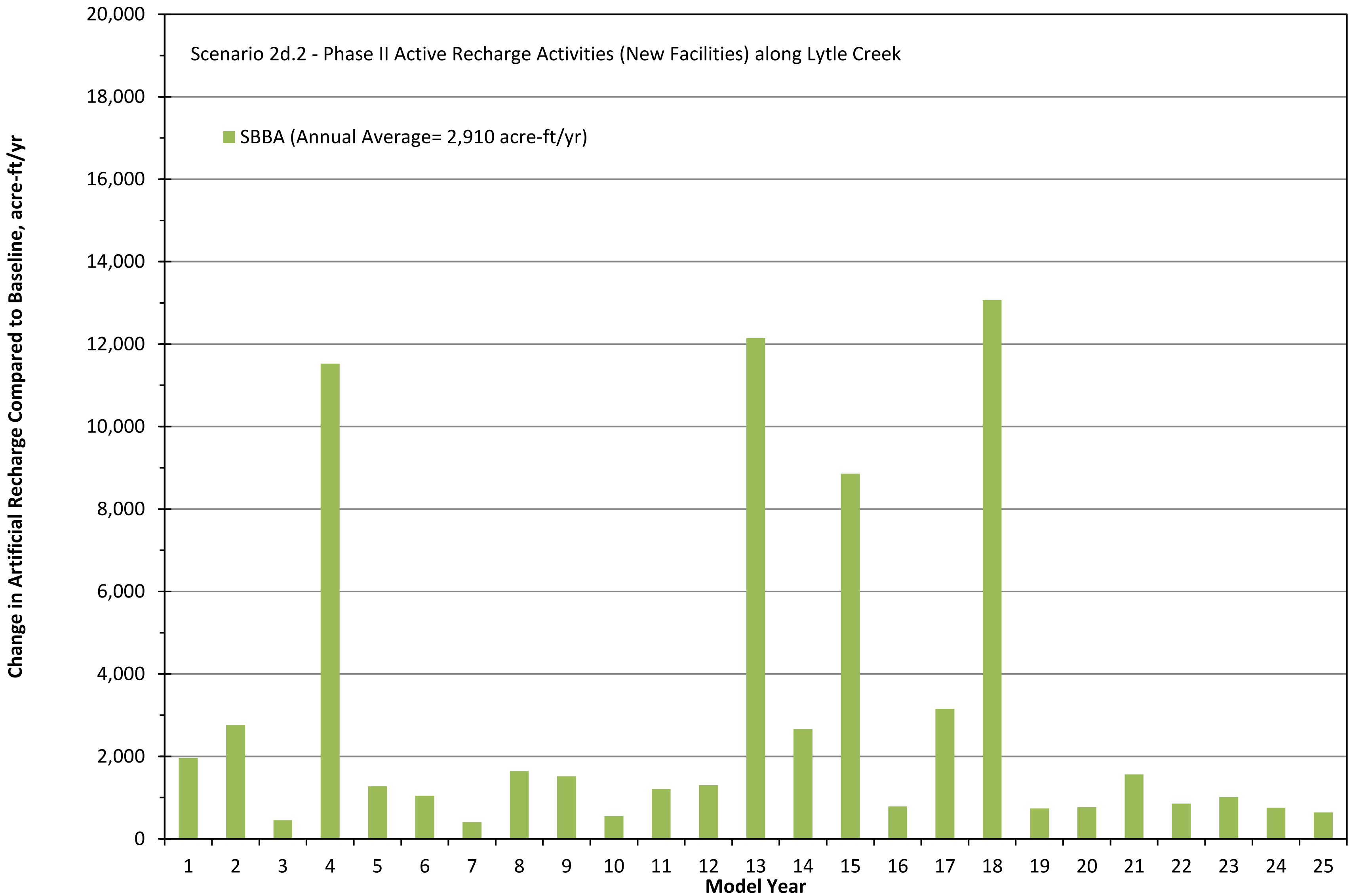
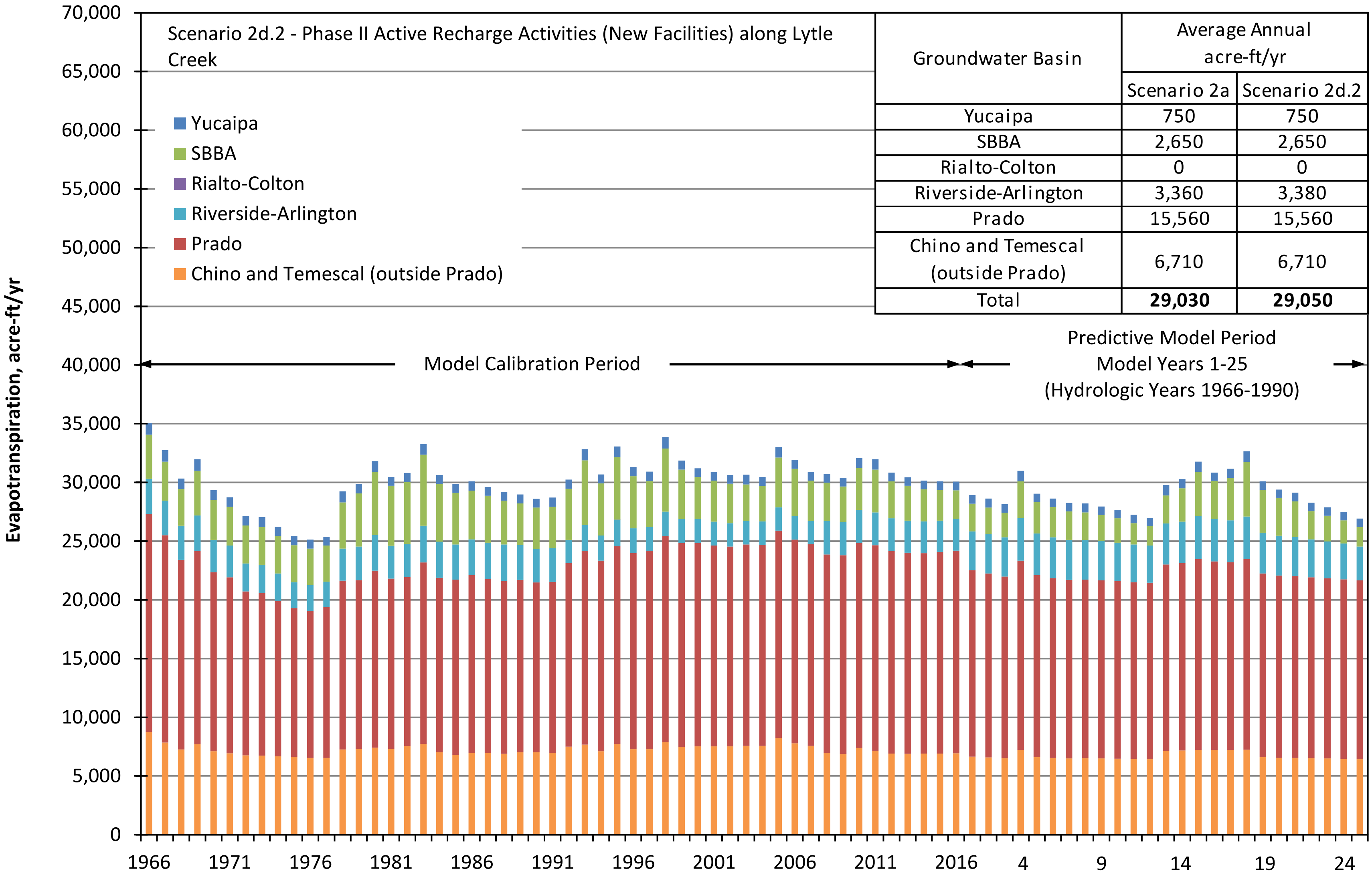


Figure 594

Scenario 2d.2: Annual Evapotranspiration – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2d.2
Yucaipa	750	750
SBBA	2,650	2,650
Rialto-Colton	0	0
Riverside-Arlington	3,360	3,380
Prado	15,560	15,560
Chino and Temescal (outside Prado)	6,710	6,710
Total	**29,030**	**29,050**

Figure 595

Scenario 2d.2: Annual Change in Evapotranspiration – Integrated SAR Model Area

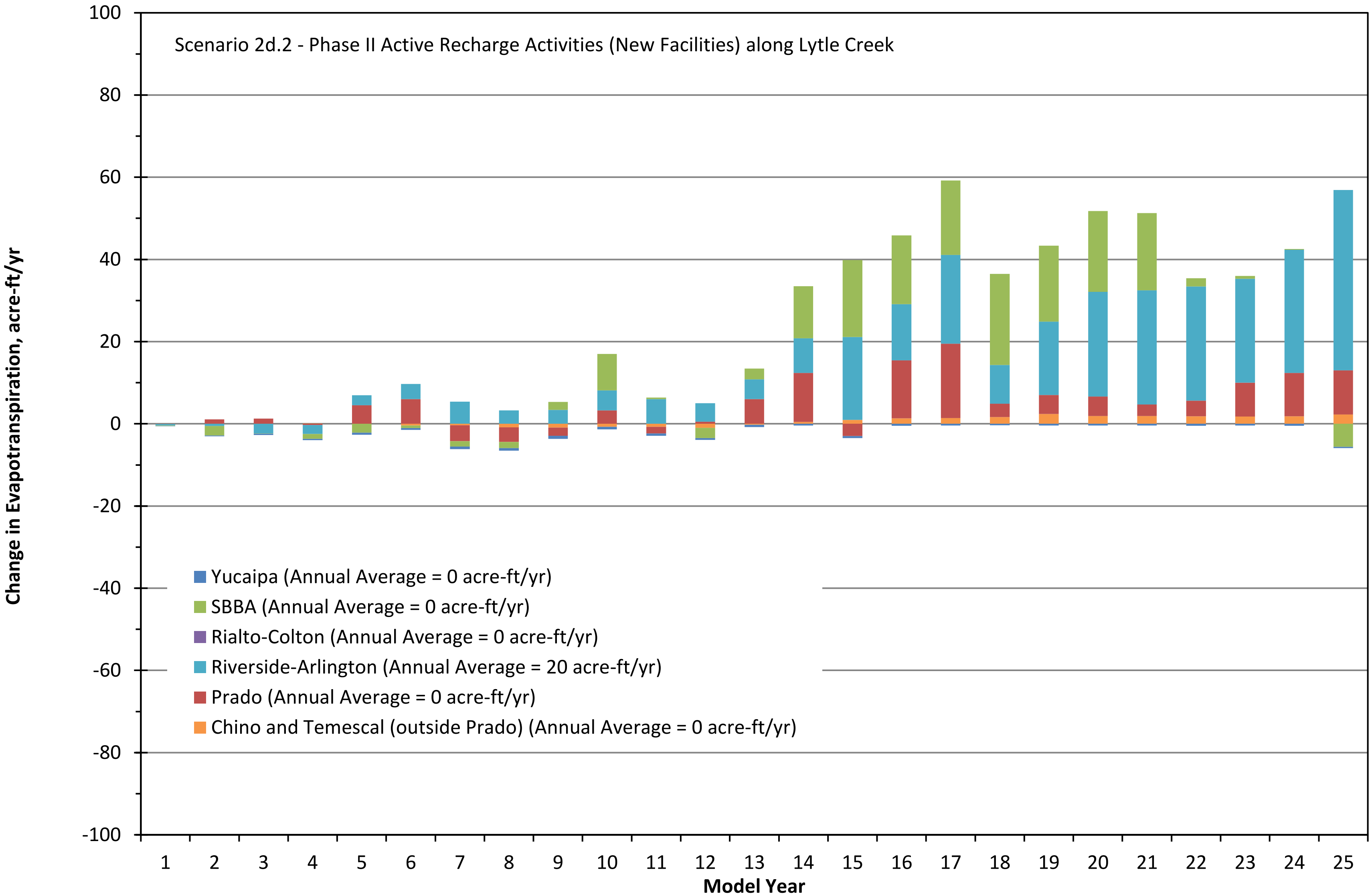
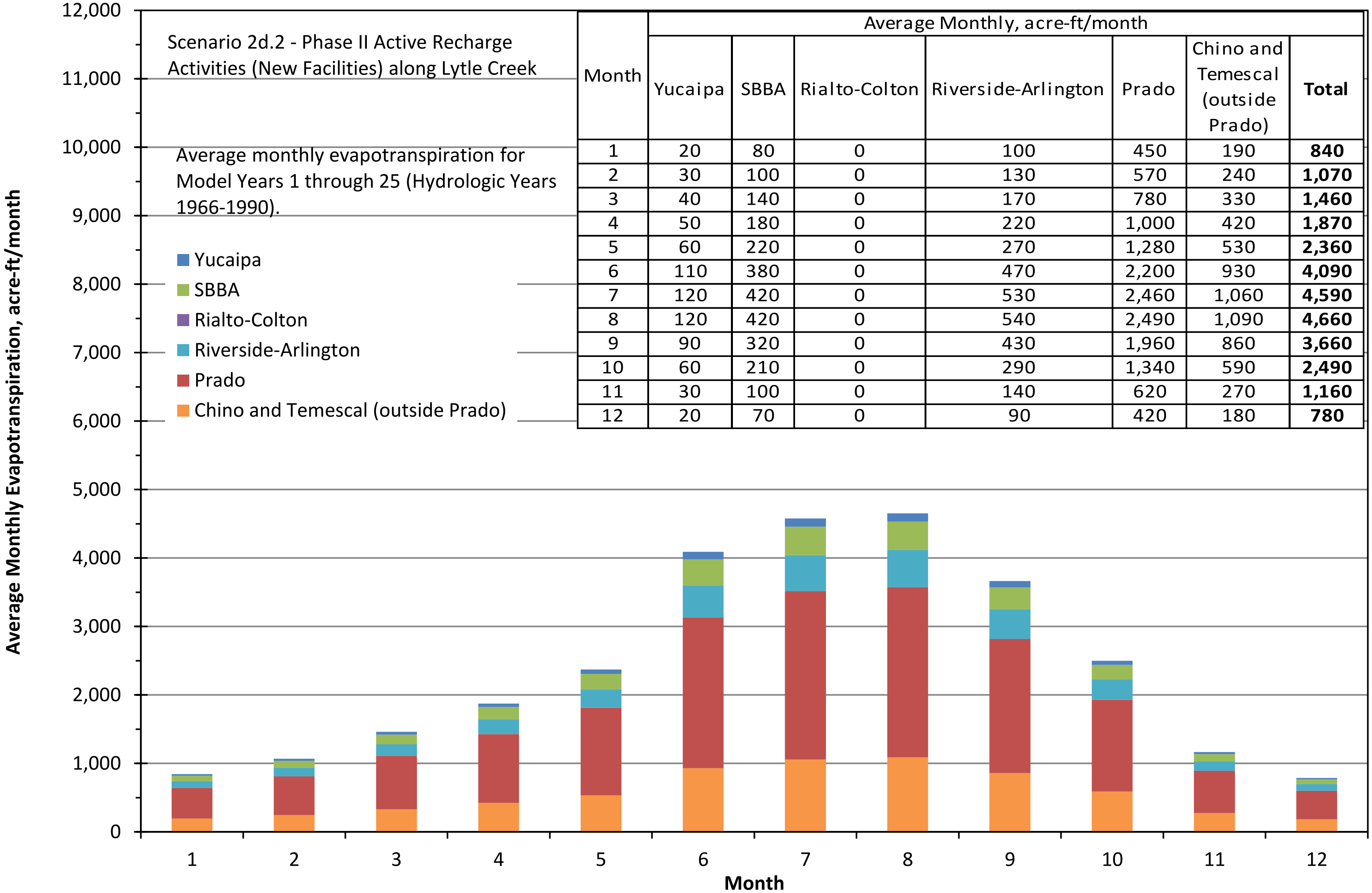


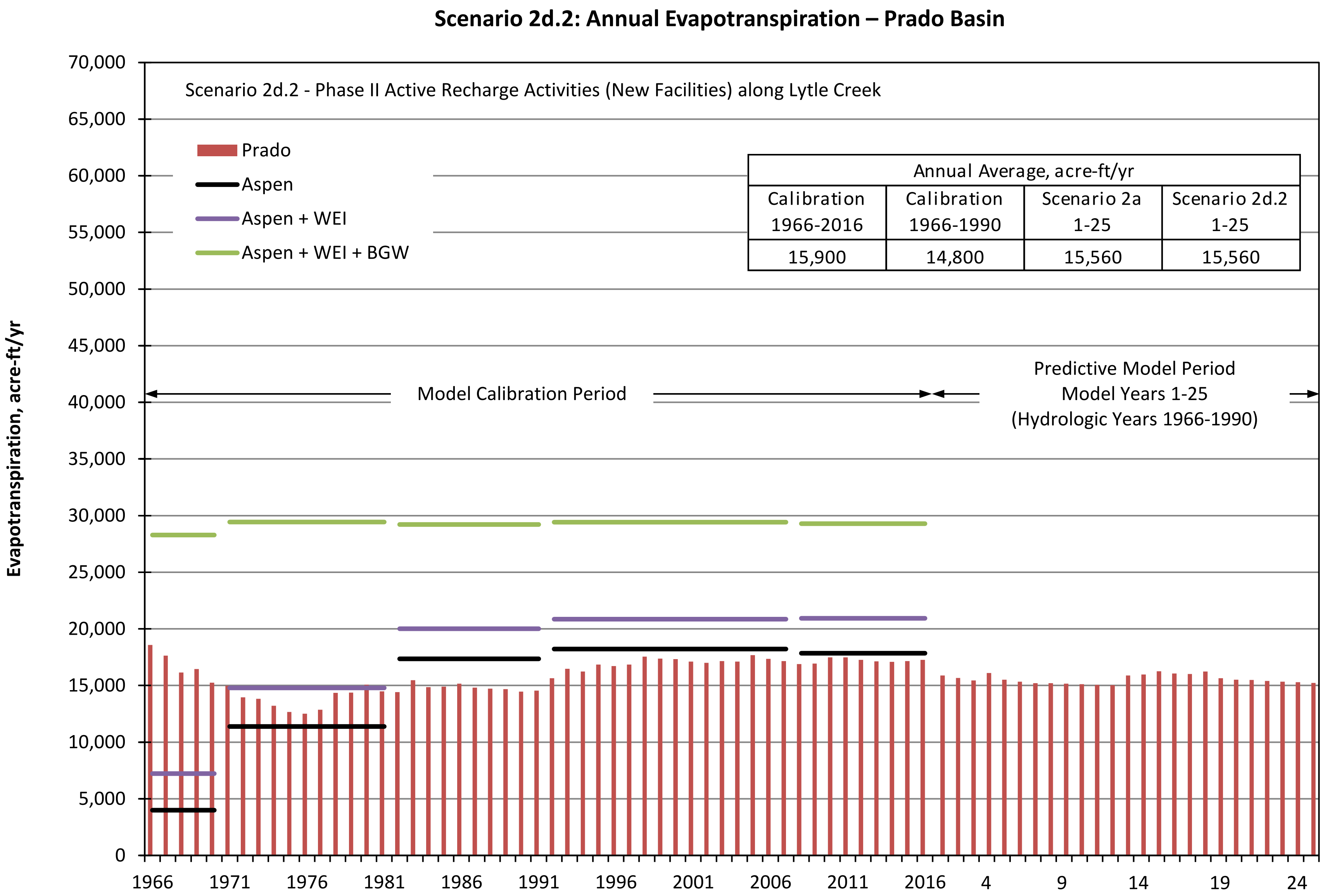
Figure 596

Scenario 2d.2: Seasonal Evapotranspiration – Integrated SAR Model Area



Month	Average Monthly, acre-ft/month						
	Yucaipa	SBBA	Rialto-Colton	Riverside-Arlington	Prado	Chino and Temescal (outside Prado)	**Total**
1	20	80	0	100	450	190	**840**
2	30	100	0	130	570	240	**1,070**
3	40	140	0	170	780	330	**1,460**
4	50	180	0	220	1,000	420	**1,870**
5	60	220	0	270	1,280	530	**2,360**
6	110	380	0	470	2,200	930	**4,090**
7	120	420	0	530	2,460	1,060	**4,590**
8	120	420	0	540	2,490	1,090	**4,660**
9	90	320	0	430	1,960	860	**3,660**
10	60	210	0	290	1,340	590	**2,490**
11	30	100	0	140	620	270	**1,160**
12	20	70	0	90	420	180	**780**

Figure 597



Annual Average, acre-ft/yr			
Calibration 1966-2016	Calibration 1966-1990	Scenario 2a 1-25	Scenario 2d.2 1-25
15,900	14,800	15,560	15,560

Figure 598

DRAFT

Scenario 2d.2: Annual Change in Evapotranspiration – Prado Basin

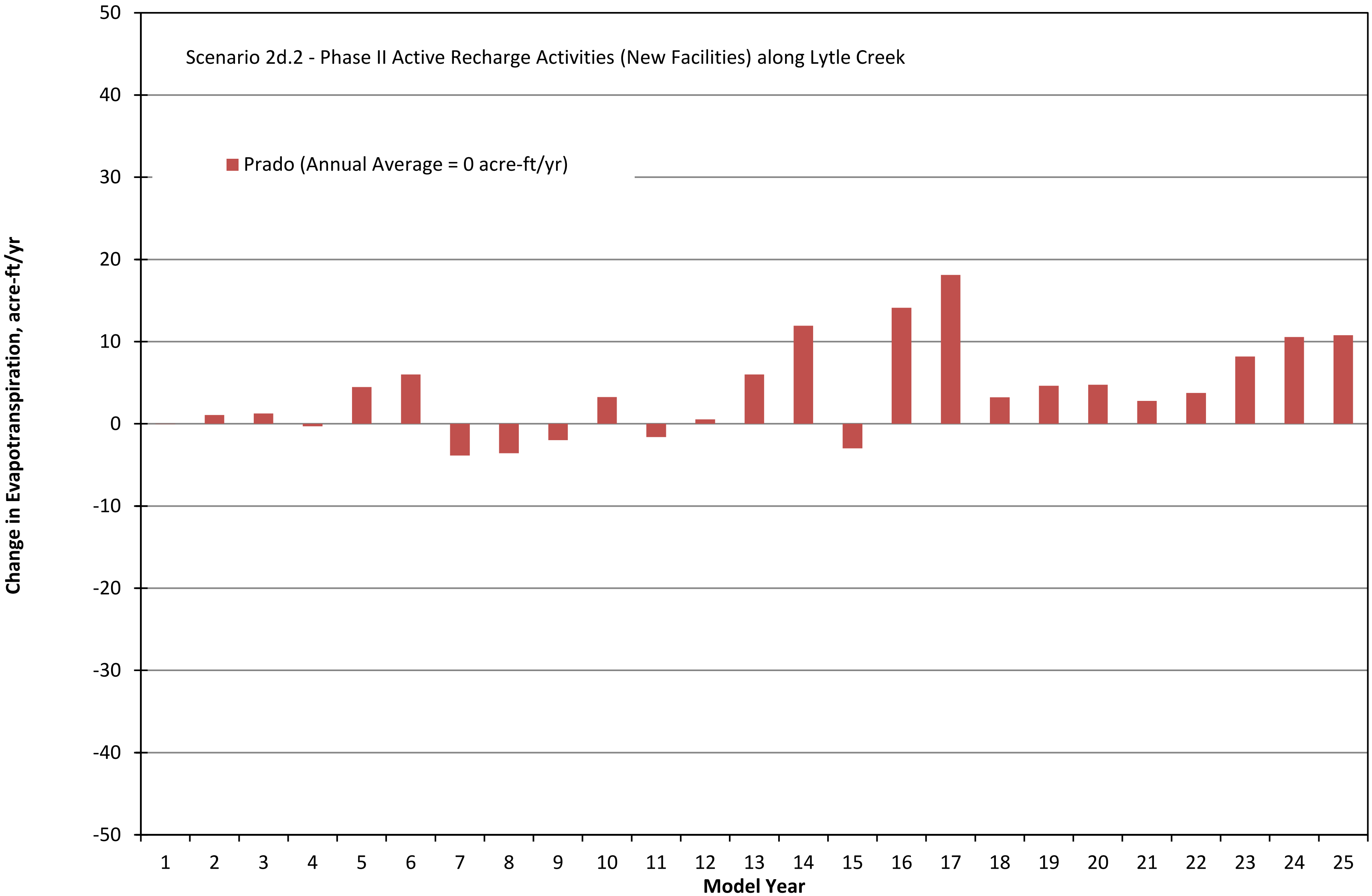
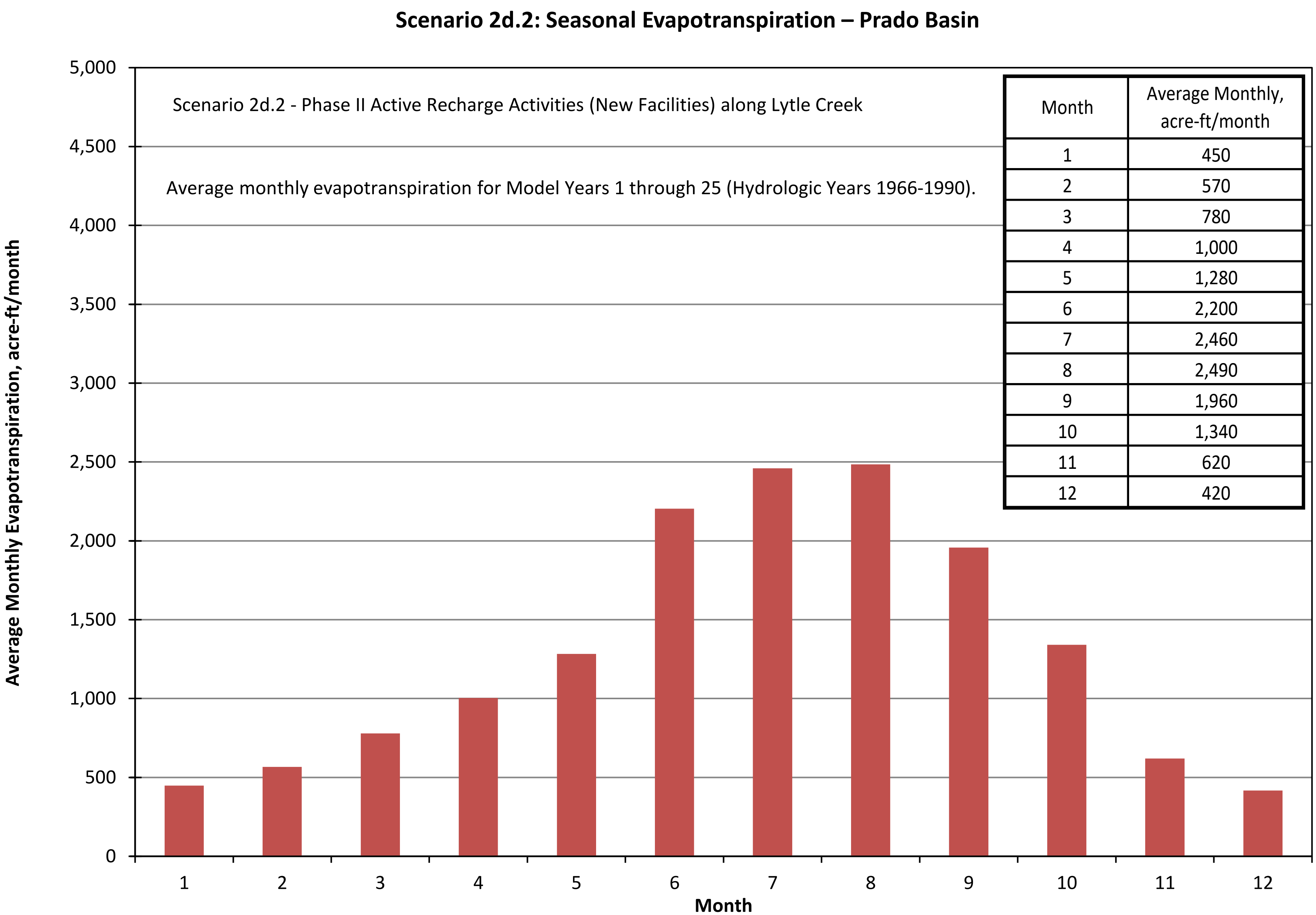


Figure 599



Month	Average Monthly, acre-ft/month
1	450
2	570
3	780
4	1,000
5	1,280
6	2,200
7	2,460
8	2,490
9	1,960
10	1,340
11	620
12	420

Figure 600

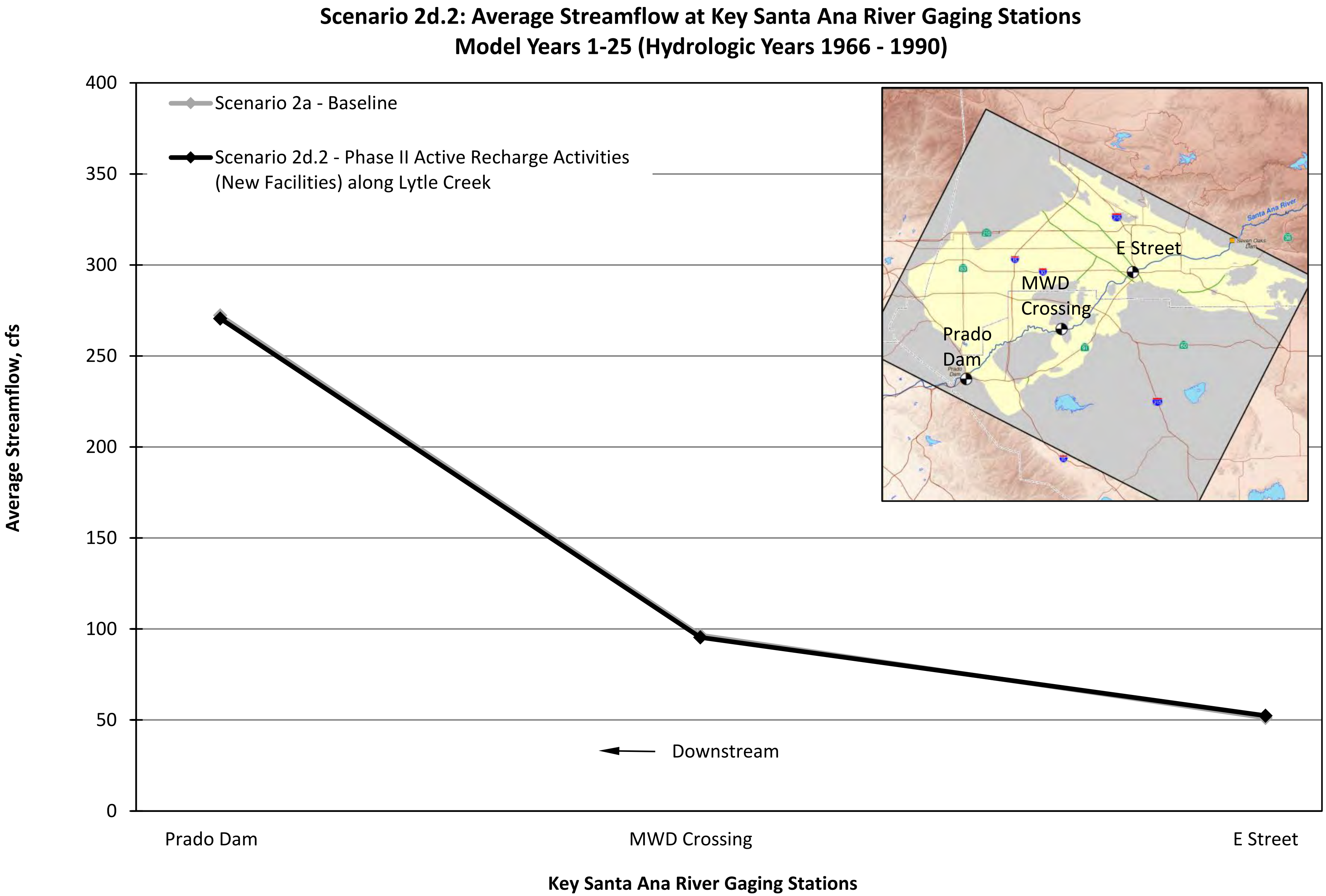

Scenario 2d.2: Average Streamflow at Key Santa Ana River Gaging Stations
Model Years 1-25 (Hydrologic Years 1966 - 1990)
Scenario 2a - Baseline
Scenario 2d.2 - Phase II Active Recharge Activities (New Facilities) along Lytle Creek
Average Streamflow, cfs
400
350
300
250
200
150
100
50
0
Downstream
E Street
MWD Crossing
Prado Dam
Santa Ana River
Prado Dam
MWD Crossing
E Street
Key Santa Ana River Gaging Stations

Figure 601

Scenario 2d.2: Distribution of Monthly Streamflow at the Santa Ana River at E Street Gaging Station

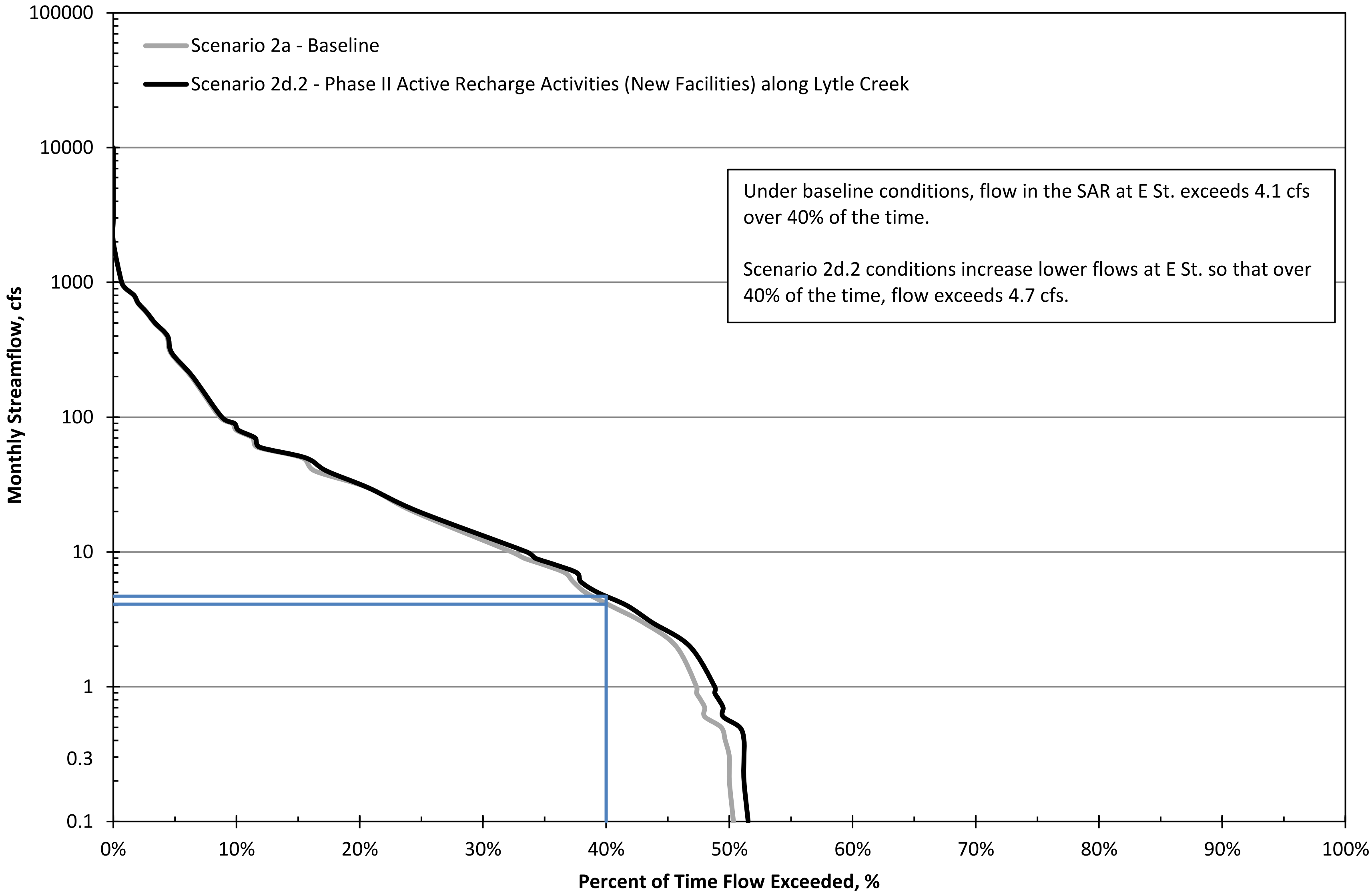


Figure 602

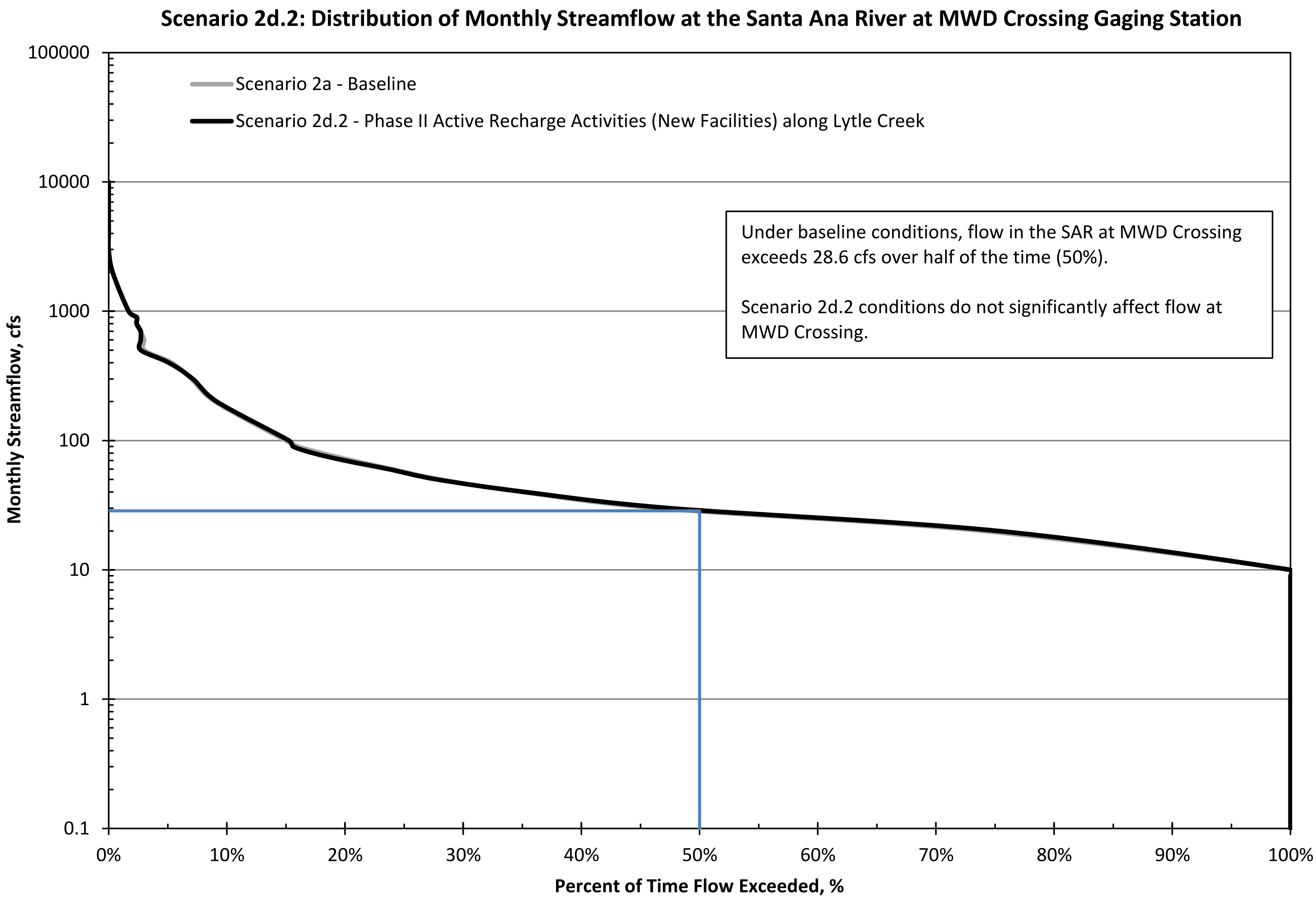

Scenario 2d.2: Distribution of Monthly Streamflow at the Santa Ana River at MWD Crossing Gaging Station
Scenario 2a - Baseline
Scenario 2d.2 - Phase II Active Recharge Activities (New Facilities) along Lytle Creek
Under baseline conditions, flow in the SAR at MWD Crossing exceeds 28.6 cfs over half of the time (50%).
Scenario 2d.2 conditions do not significantly affect flow at MWD Crossing.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 603

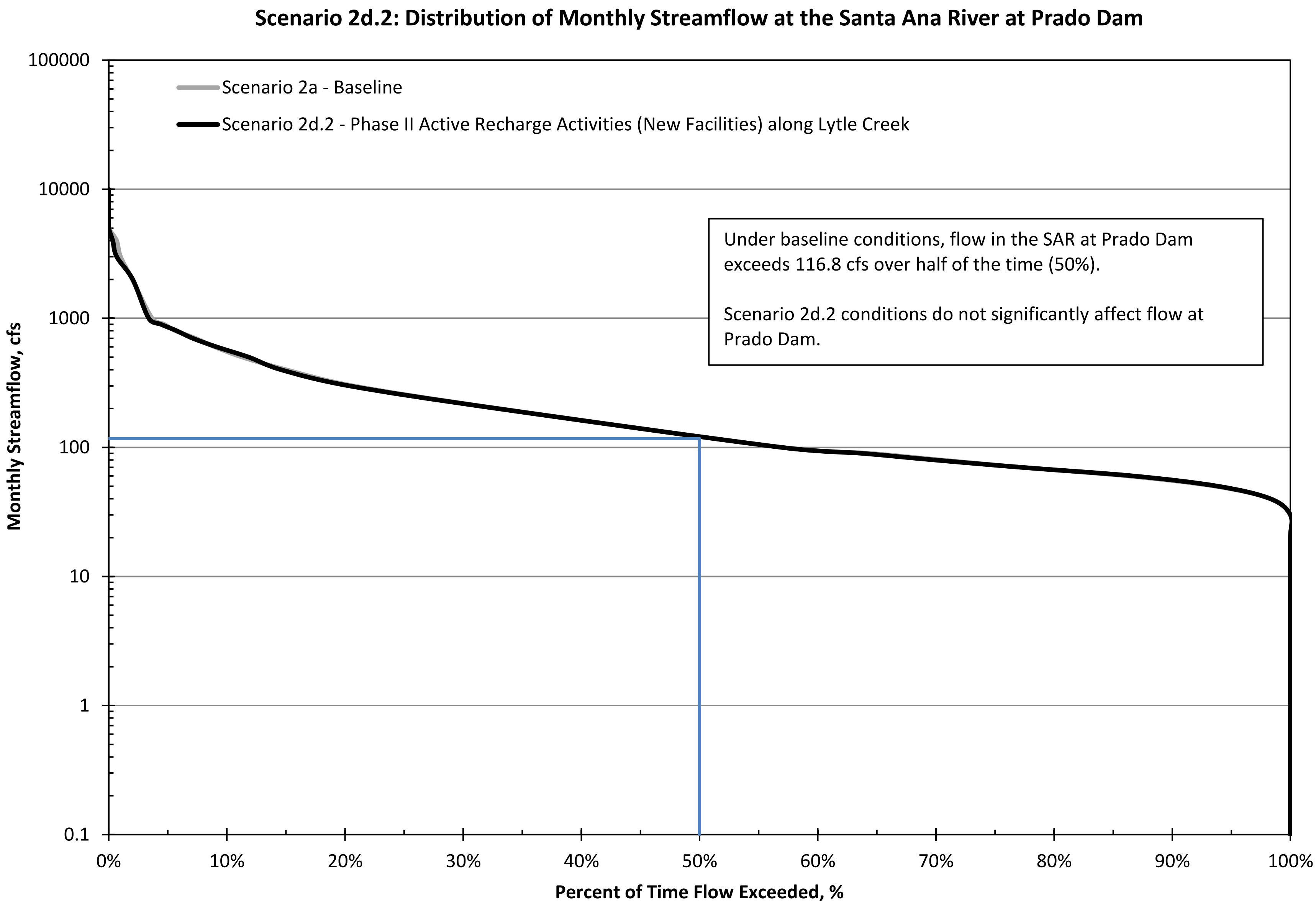
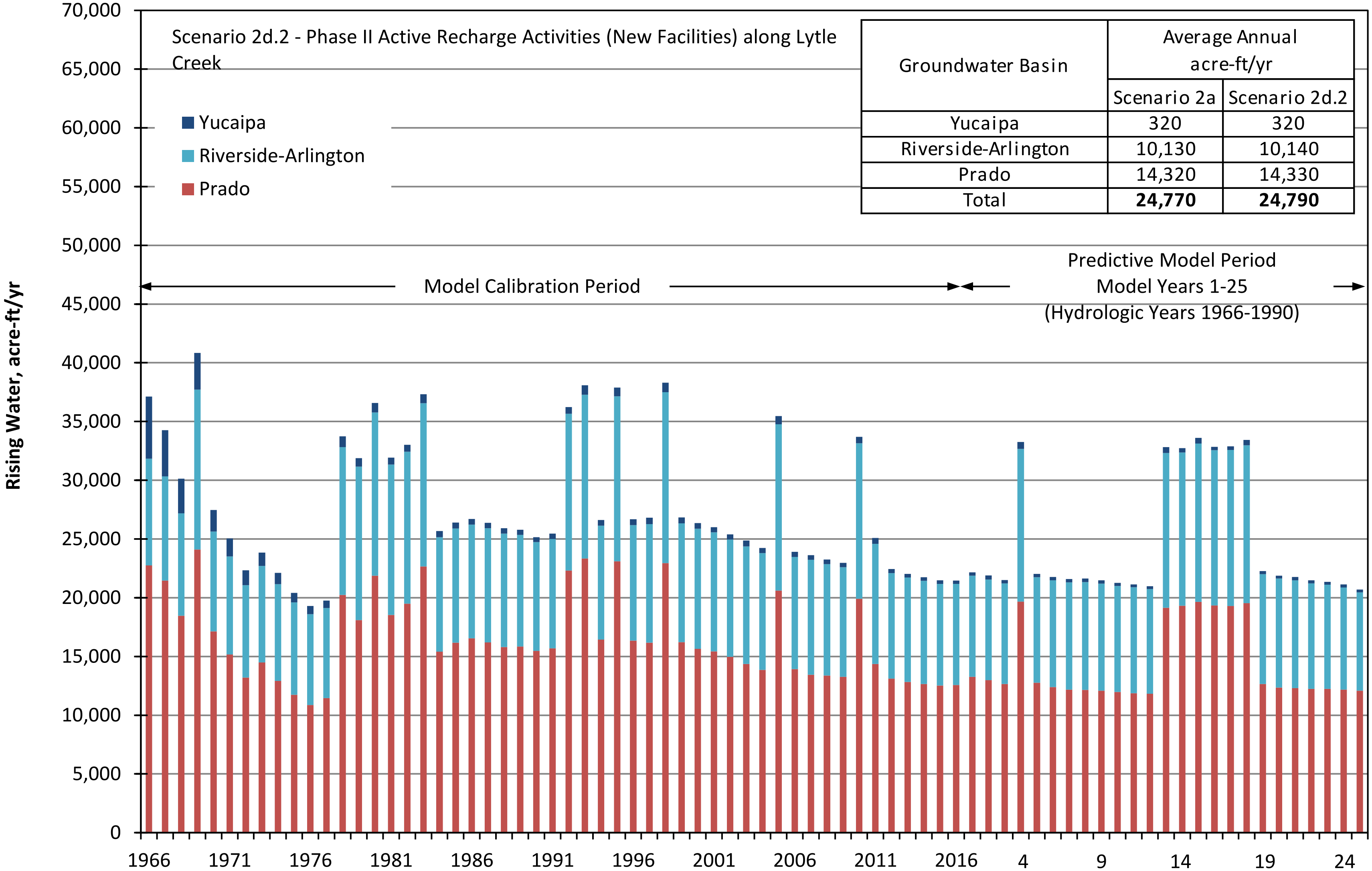

Scenario 2d.2: Distribution of Monthly Streamflow at the Santa Ana River at Prado Dam
Scenario 2a - Baseline
Scenario 2d.2 - Phase II Active Recharge Activities (New Facilities) along Lytle Creek
Under baseline conditions, flow in the SAR at Prado Dam exceeds 116.8 cfs over half of the time (50%).
Scenario 2d.2 conditions do not significantly affect flow at Prado Dam.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 604

Scenario 2d.2: Annual Rising Water – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2d.2
Yucaipa	320	320
Riverside-Arlington	10,130	10,140
Prado	14,320	14,330
Total	**24,770**	**24,790**

Figure 605

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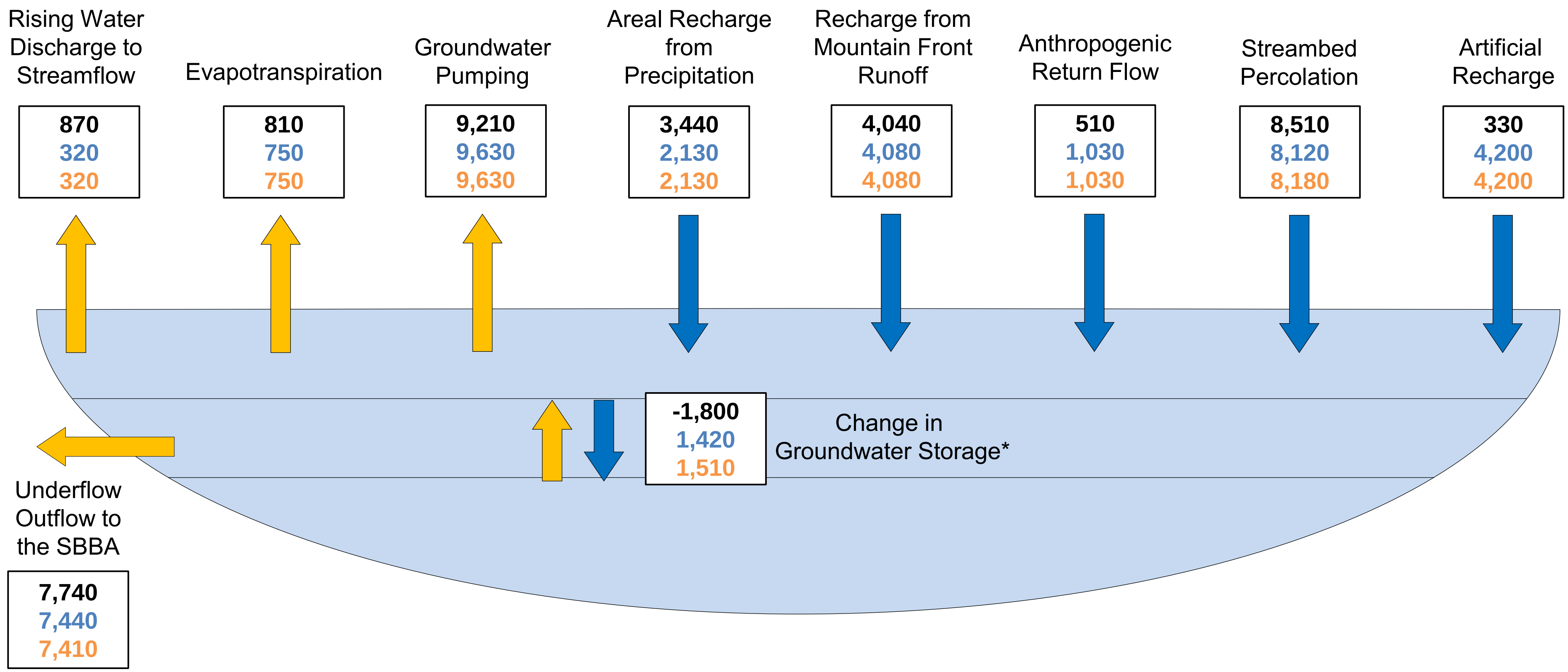

Scenario 2a - Baseline
Scenario 2d.2 - Phase II Active Recharge Activities (New Facilities) along Lytle Creek

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.2 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.2
AVERAGE ANNUAL
WATER BUDGET
YUCAIPA BASIN

10-Apr-20

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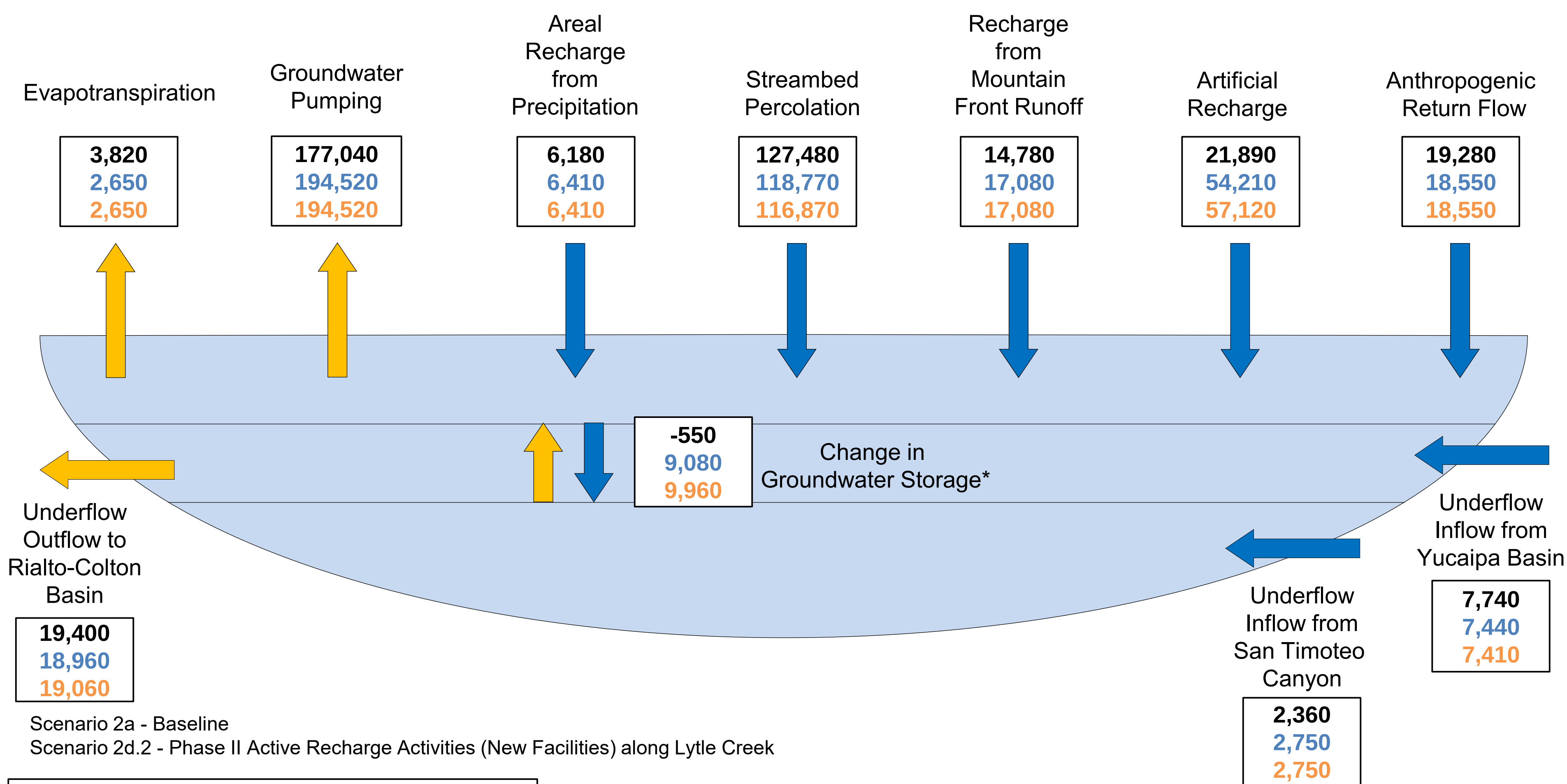

Scenario 2a - Baseline
Scenario 2d.2 - Phase II Active Recharge Activities (New Facilities) along Lytle Creek

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.2 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.2 AVERAGE ANNUAL WATER BUDGET SBBA

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT **DRAFT** **FIGURE 607**
UPPER SANTA ANA RIVER INTEGRATED MODEL – SUMMARY REPORT
GEOSCIENCE

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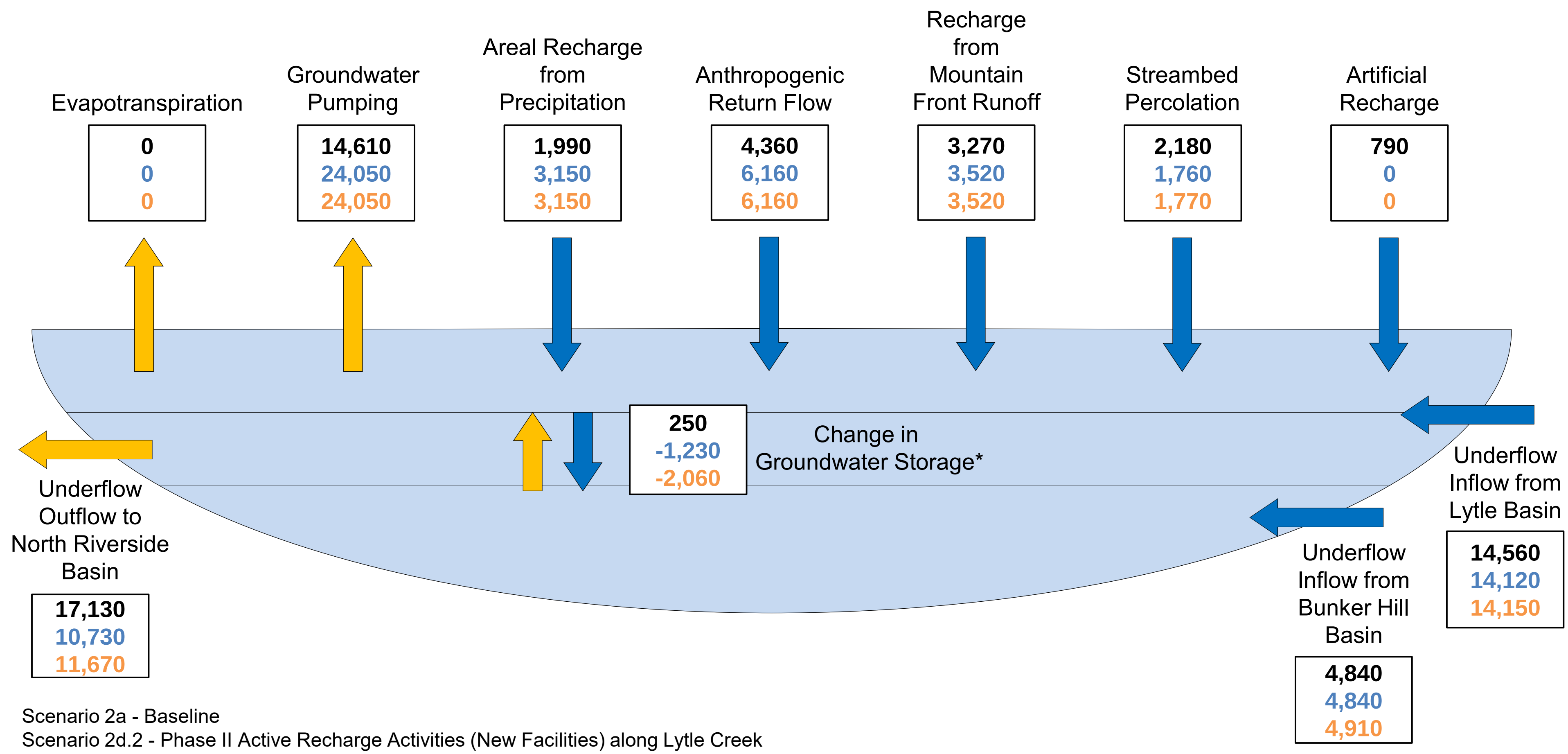


Scenario 2a - Baseline
Scenario 2d.2 - Phase II Active Recharge Activities (New Facilities) along Lytle Creek

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.2 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

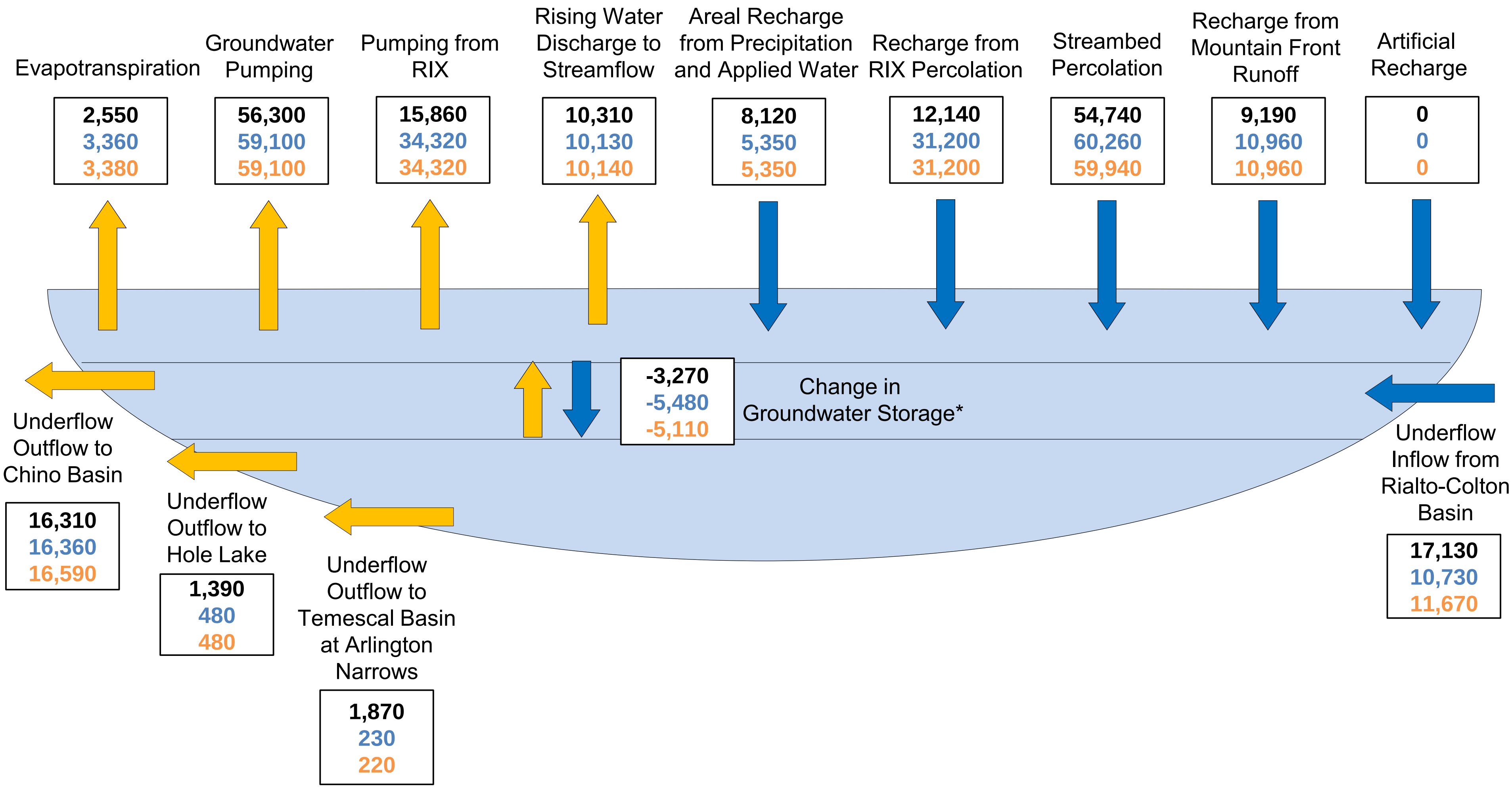
SCENARIO 2D.2
AVERAGE ANNUAL
WATER BUDGET
RIALTO-COLTON BASIN

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT **DRAFT** **FIGURE 608**

UPPER SANTA ANA RIVER INTEGRATED MODEL – SUMMARY REPORT

GEOSCIENCE



Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.2 (Hydrologic Period 1966-1990)

Scenario 2a - Baseline
Scenario 2d.2 - Phase II Active Recharge Activities (New Facilities) along Lytle Creek

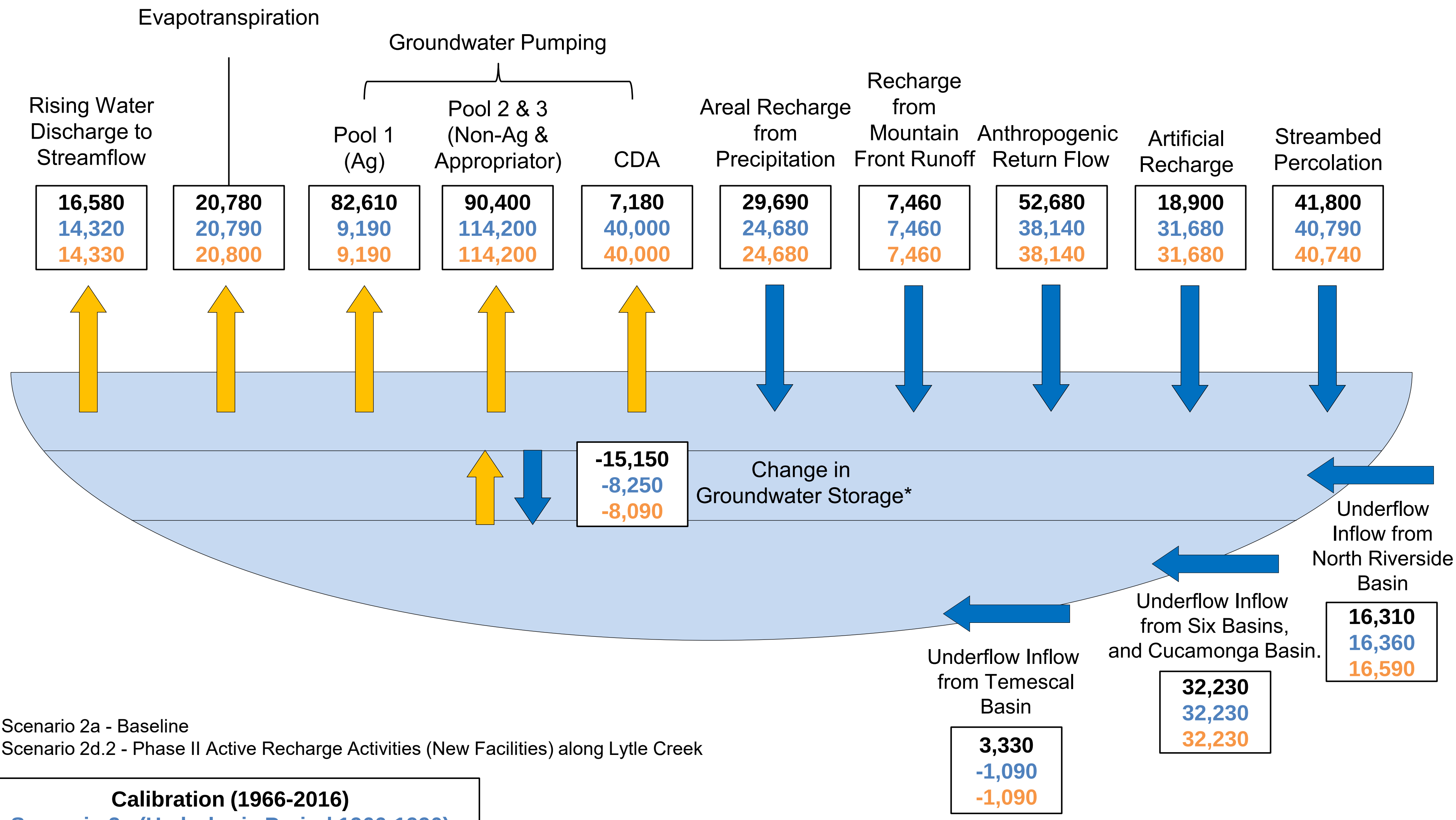
All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.2
AVERAGE ANNUAL WATER BUDGET
RIVERSIDE-ARLINGTON BASIN

X:\Projects\San_Bernardino_MUNI\31) Integreated_SAR_Model\(4)Technical_Memos\(8) Summary Report\Draft\Figures\Scenarios

10-Apr-20



Scenario 2a - Baseline
Scenario 2d.2 - Phase II Active Recharge Activities (New Facilities) along Lytle Creek

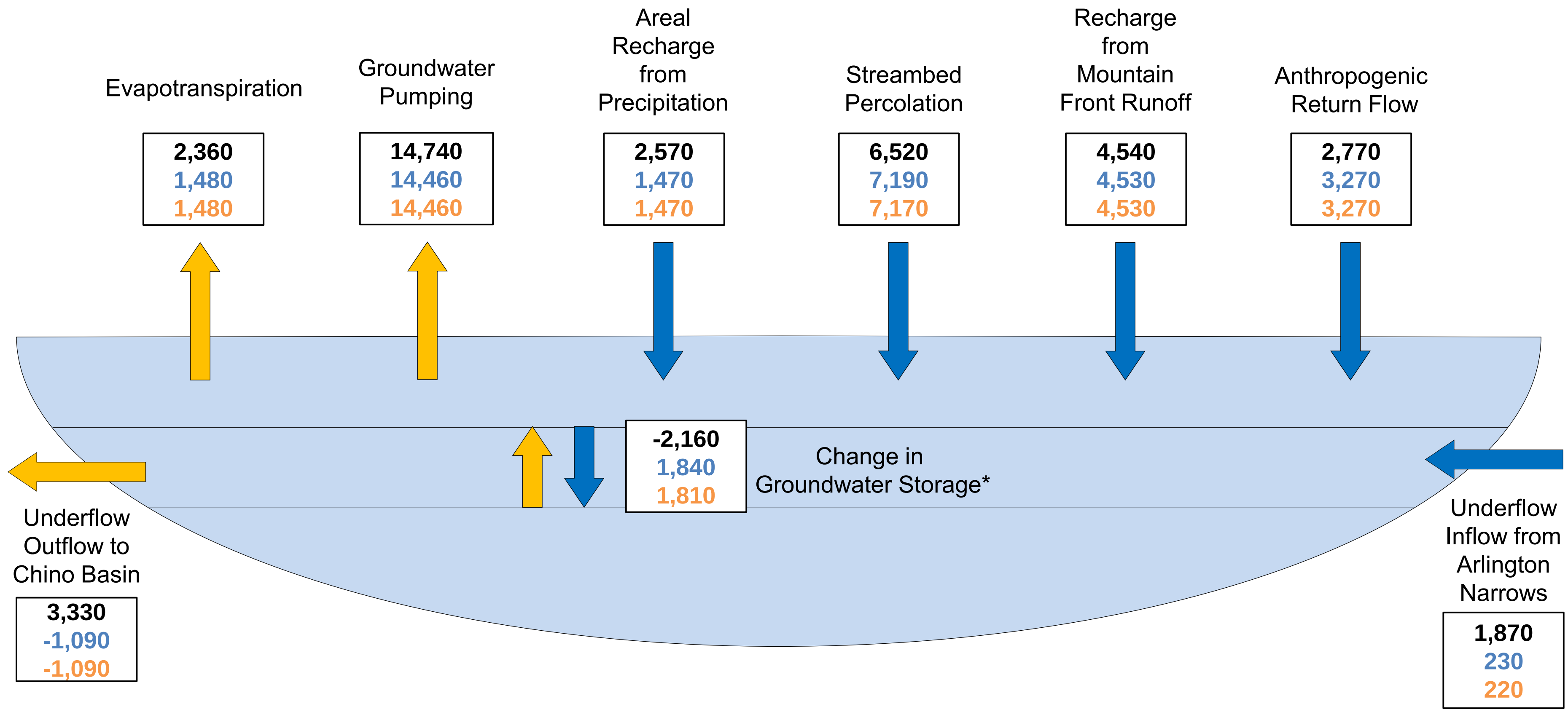
Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.2 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.2
AVERAGE ANNUAL
WATER BUDGET
CHINO BASIN

10-Apr-20



Scenario 2a - Baseline
Scenario 2d.2 - Phase II Active Recharge Activities (New Facilities) along Lytle Creek

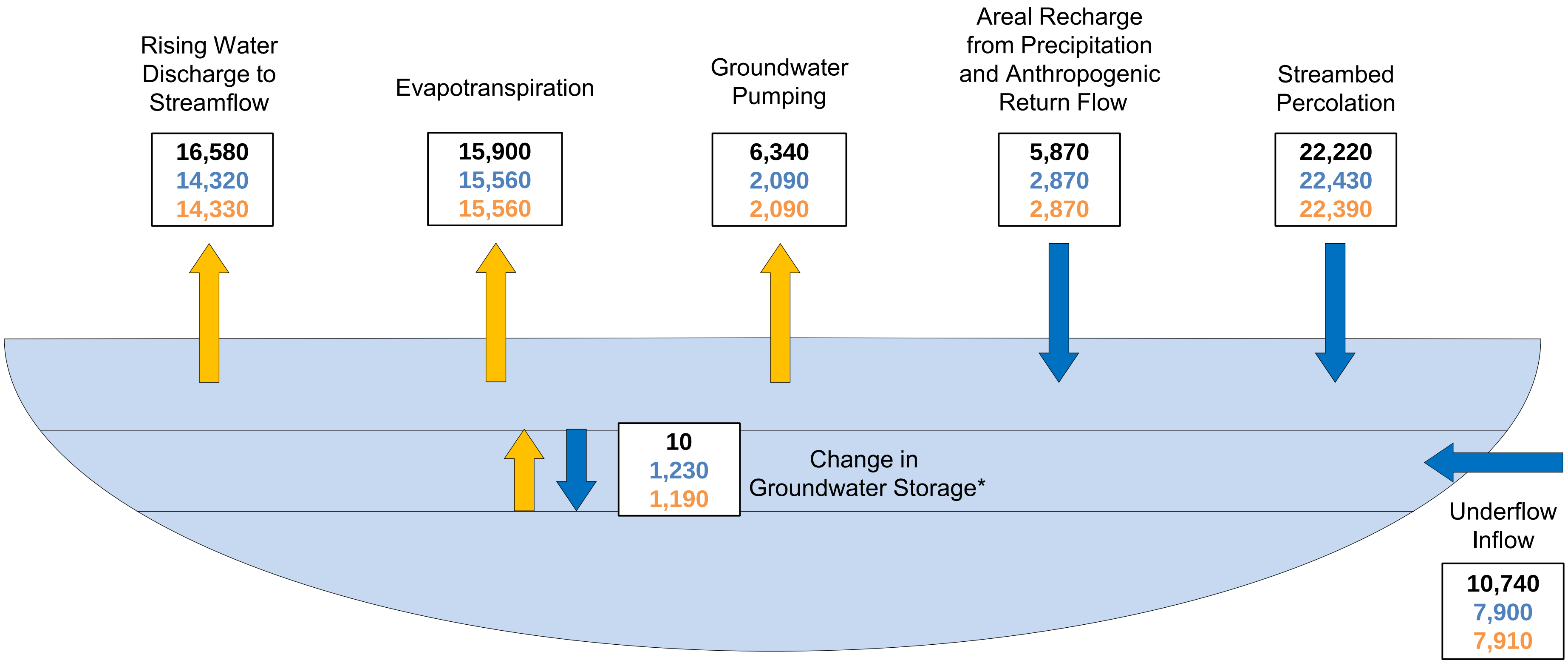
Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.2 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.2
AVERAGE ANNUAL
WATER BUDGET
TEMESCAL BASIN

10-Apr-20



Scenario 2a - Baseline
Scenario 2d.2 - Phase II Active Recharge Activities (New Facilities) along Lytle Creek

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.2 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.2
AVERAGE ANNUAL
WATER BUDGET
PRADO BASIN

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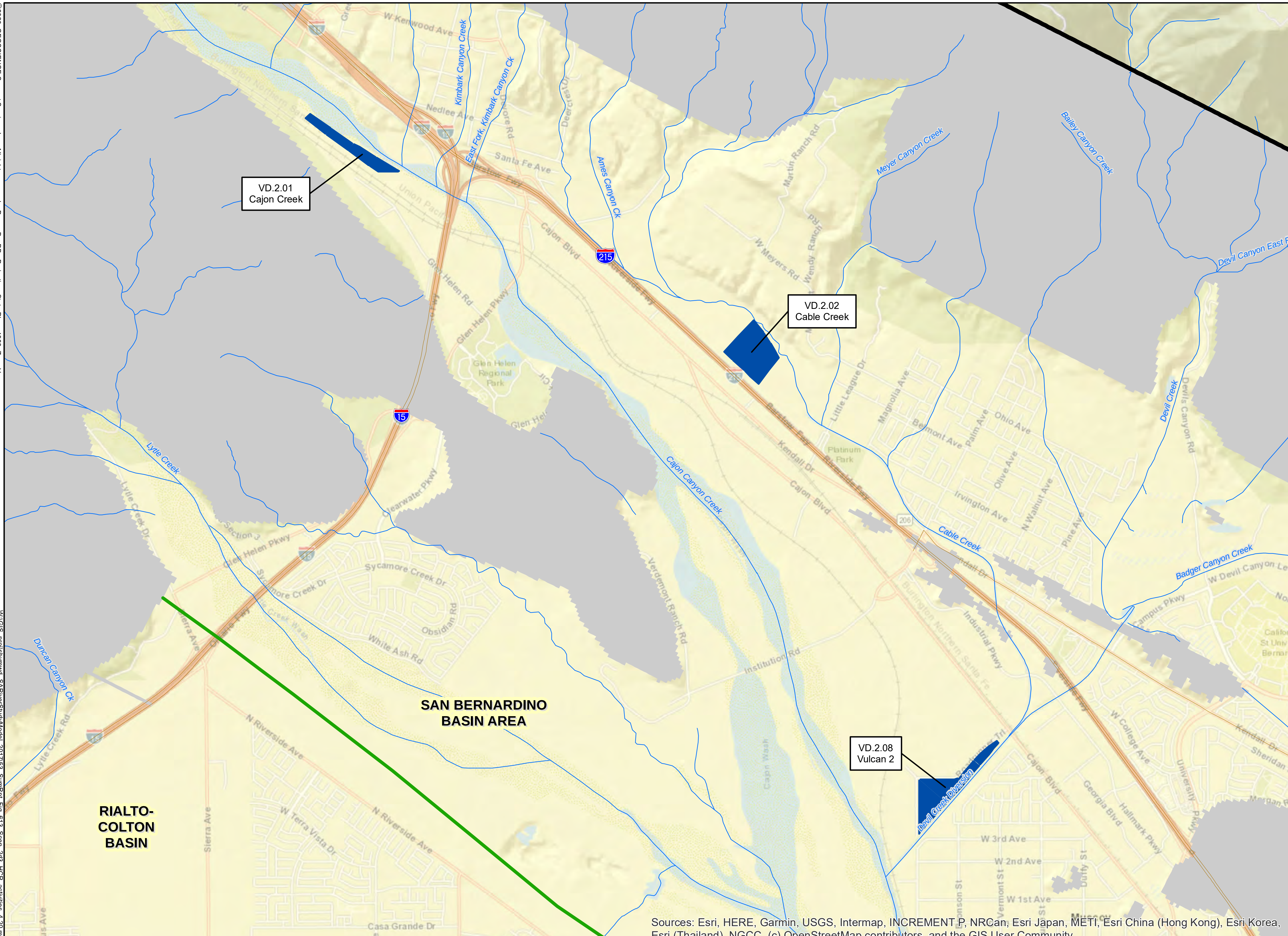
10-Apr-20

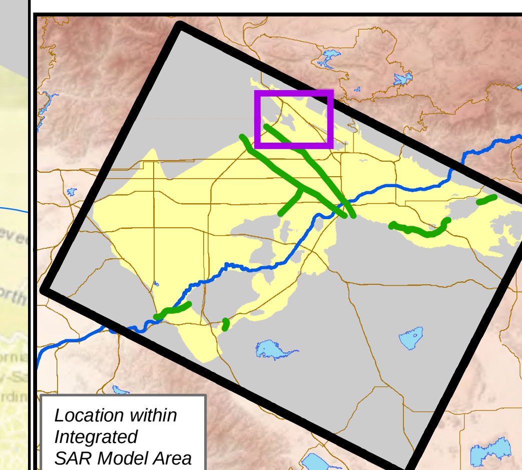


EXPLANATION

- Integrated SAR Model Boundary
- Active Model Area
- Inactive Model Area
- Habitat Conservation Plan (HCP) Covered Activity
  - VD.2.08 - Project ID
  - Vulcan 2 - Name of HCP Project
- Groundwater Basin Boundary

Refer to Table 17 for HCP Covered Activity Description

Scenario 2d.3:
Active Recharge Activities (Stormwater Capture Activities) - Phase II Active Recharge Activities (New Facilities) along Cajon Creek and Cable Creek



N
0 0.5 1
Miles

SCENARIO 2d.3
LOCATION OF
HCP COVERED ACTIVITIES

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10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

DRAFT

FIGURE 613

GEOSCIENCE

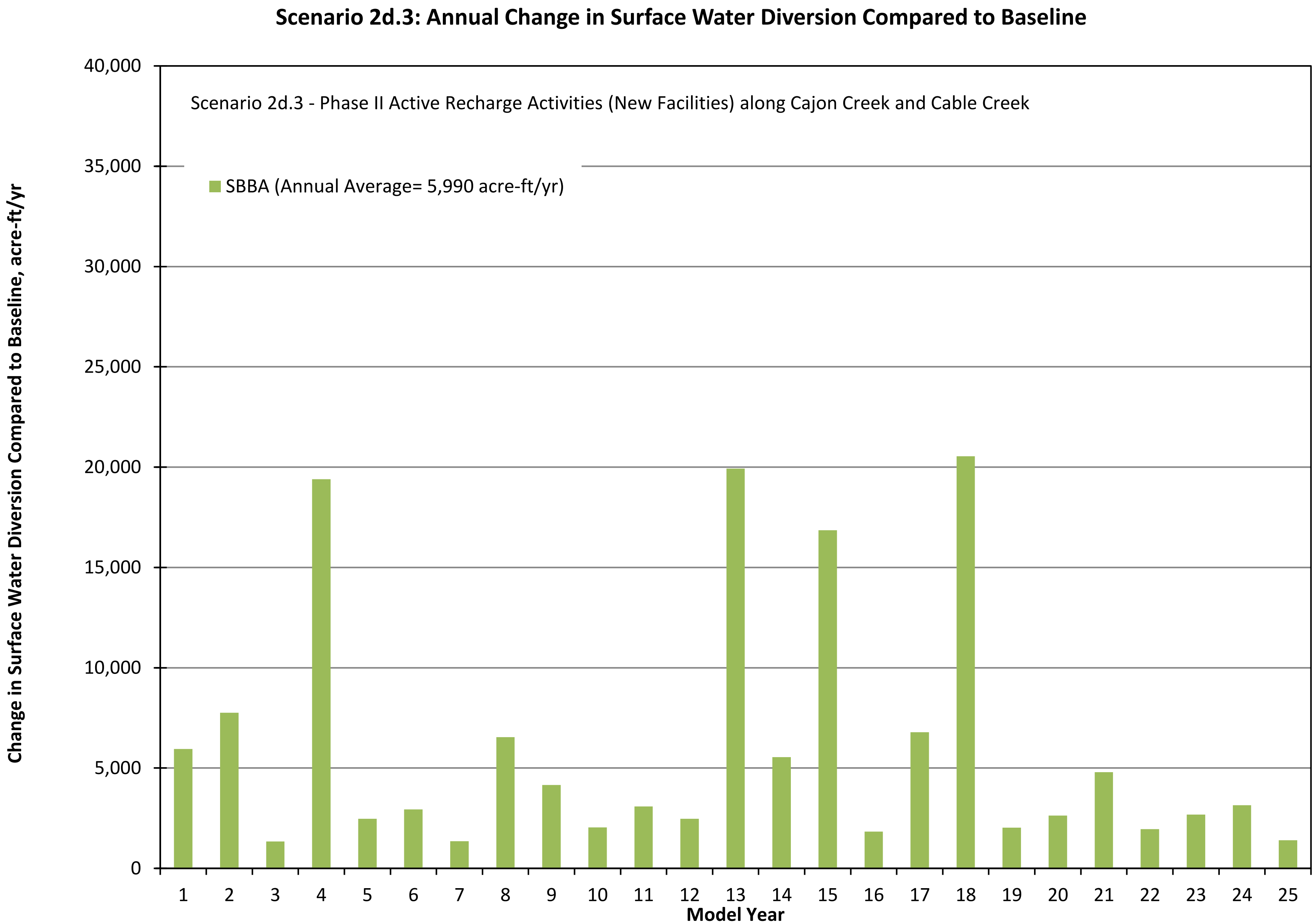

Scenario 2d.3: Annual Change in Surface Water Diversion Compared to Baseline
Scenario 2d.3 - Phase II Active Recharge Activities (New Facilities) along Cajon Creek and Cable Creek
SBBA (Annual Average= 5,990 acre-ft/yr)
Change in Surface Water Diversion Compared to Baseline, acre-ft/yr
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
Model Year

Figure 614

DRAFT

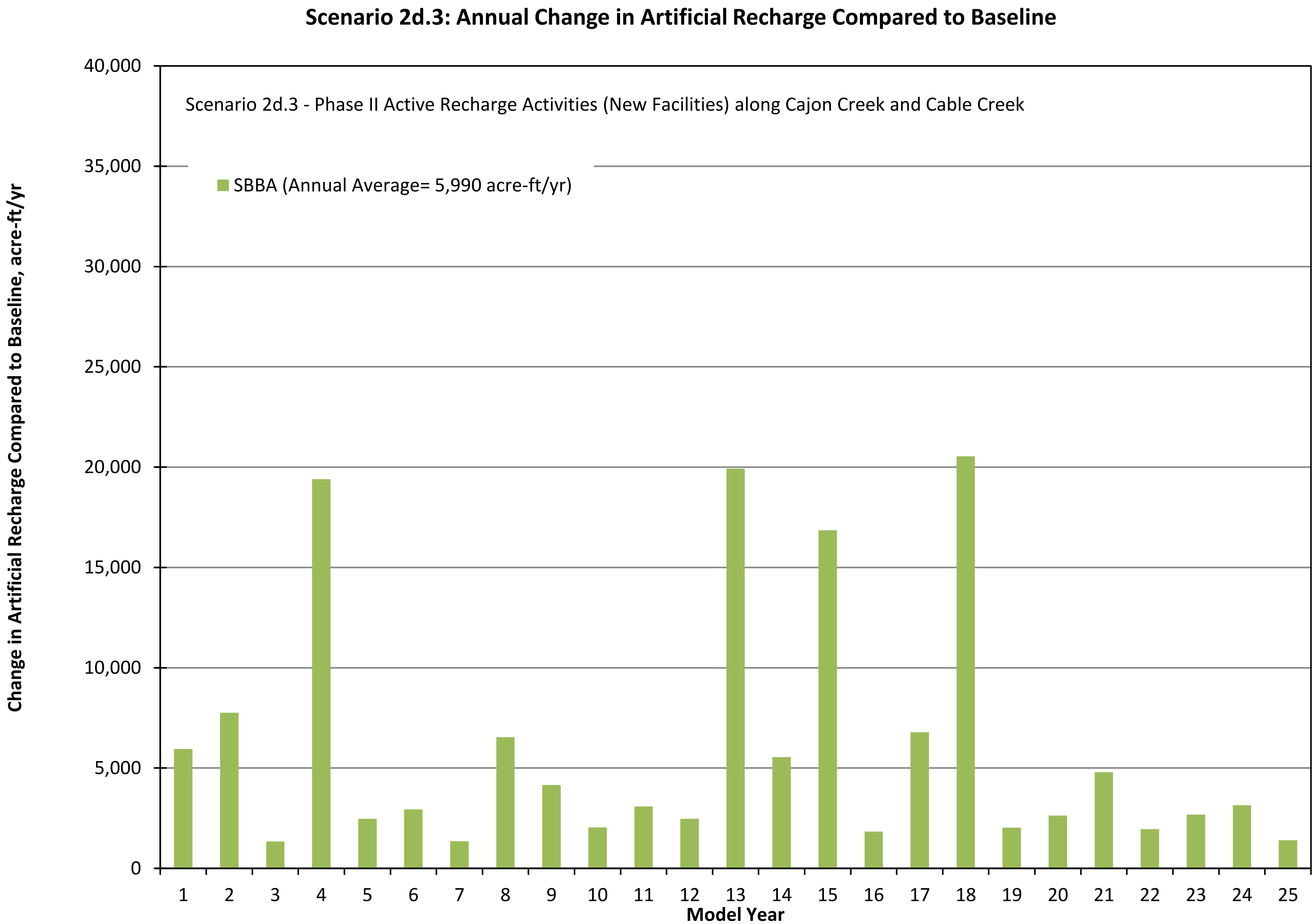
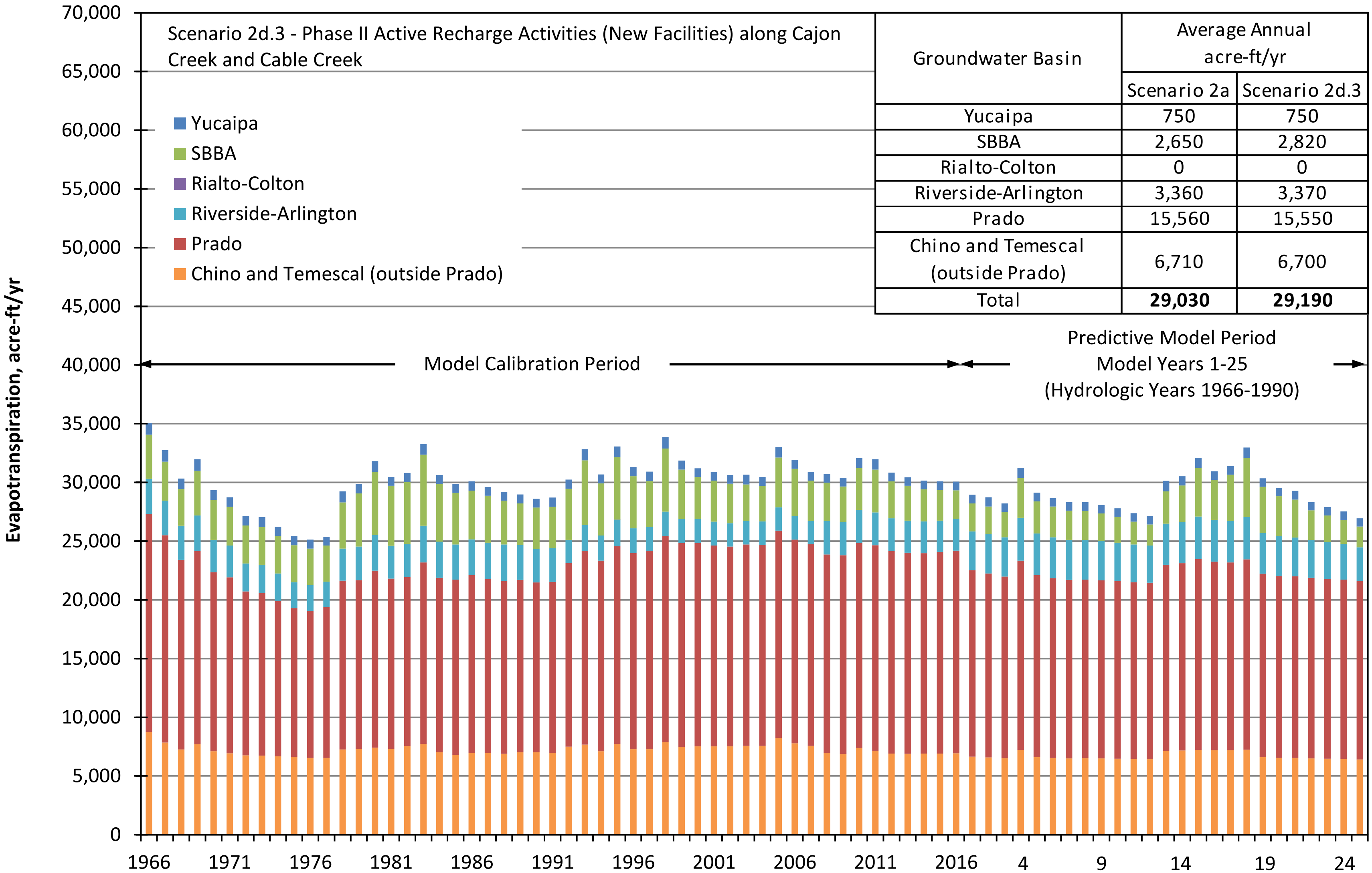


Figure 615

DRAFT

Scenario 2d.3: Annual Evapotranspiration – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2d.3
Yucaipa	750	750
SBBA	2,650	2,820
Rialto-Colton	0	0
Riverside-Arlington	3,360	3,370
Prado	15,560	15,550
Chino and Temescal (outside Prado)	6,710	6,700
Total	**29,030**	**29,190**

Figure 616

Scenario 2d.3: Annual Change in Evapotranspiration – Integrated SAR Model Area

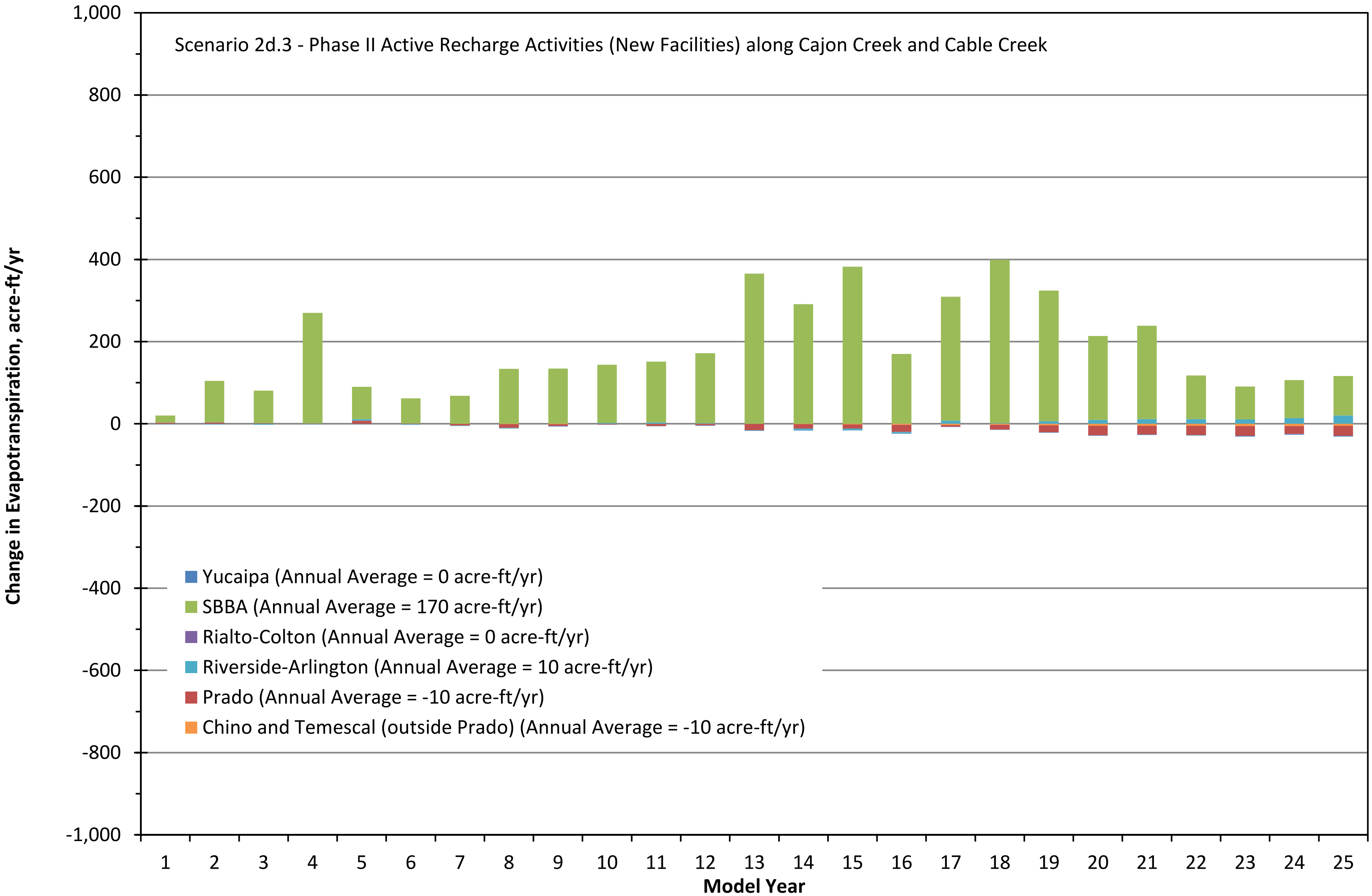
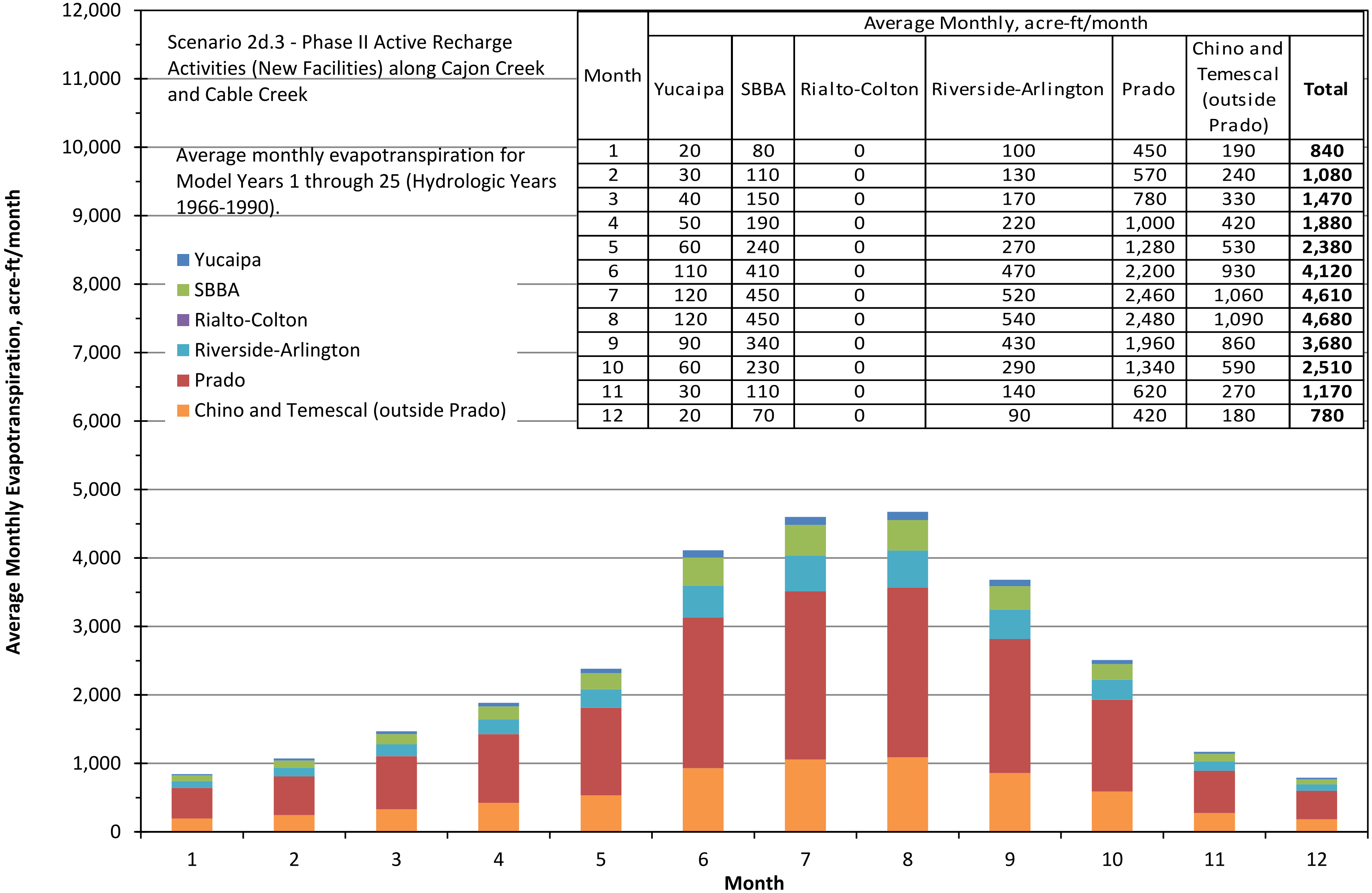


Figure 617

Scenario 2d.3: Seasonal Evapotranspiration – Integrated SAR Model Area



Month	Average Monthly, acre-ft/month						
	Yucaipa	SBBA	Rialto-Colton	Riverside-Arlington	Prado	Chino and Temescal (outside Prado)	**Total**
1	20	80	0	100	450	190	**840**
2	30	110	0	130	570	240	**1,080**
3	40	150	0	170	780	330	**1,470**
4	50	190	0	220	1,000	420	**1,880**
5	60	240	0	270	1,280	530	**2,380**
6	110	410	0	470	2,200	930	**4,120**
7	120	450	0	520	2,460	1,060	**4,610**
8	120	450	0	540	2,480	1,090	**4,680**
9	90	340	0	430	1,960	860	**3,680**
10	60	230	0	290	1,340	590	**2,510**
11	30	110	0	140	620	270	**1,170**
12	20	70	0	90	420	180	**780**

Figure 618

Scenario 2d.3: Annual Evapotranspiration – Prado Basin

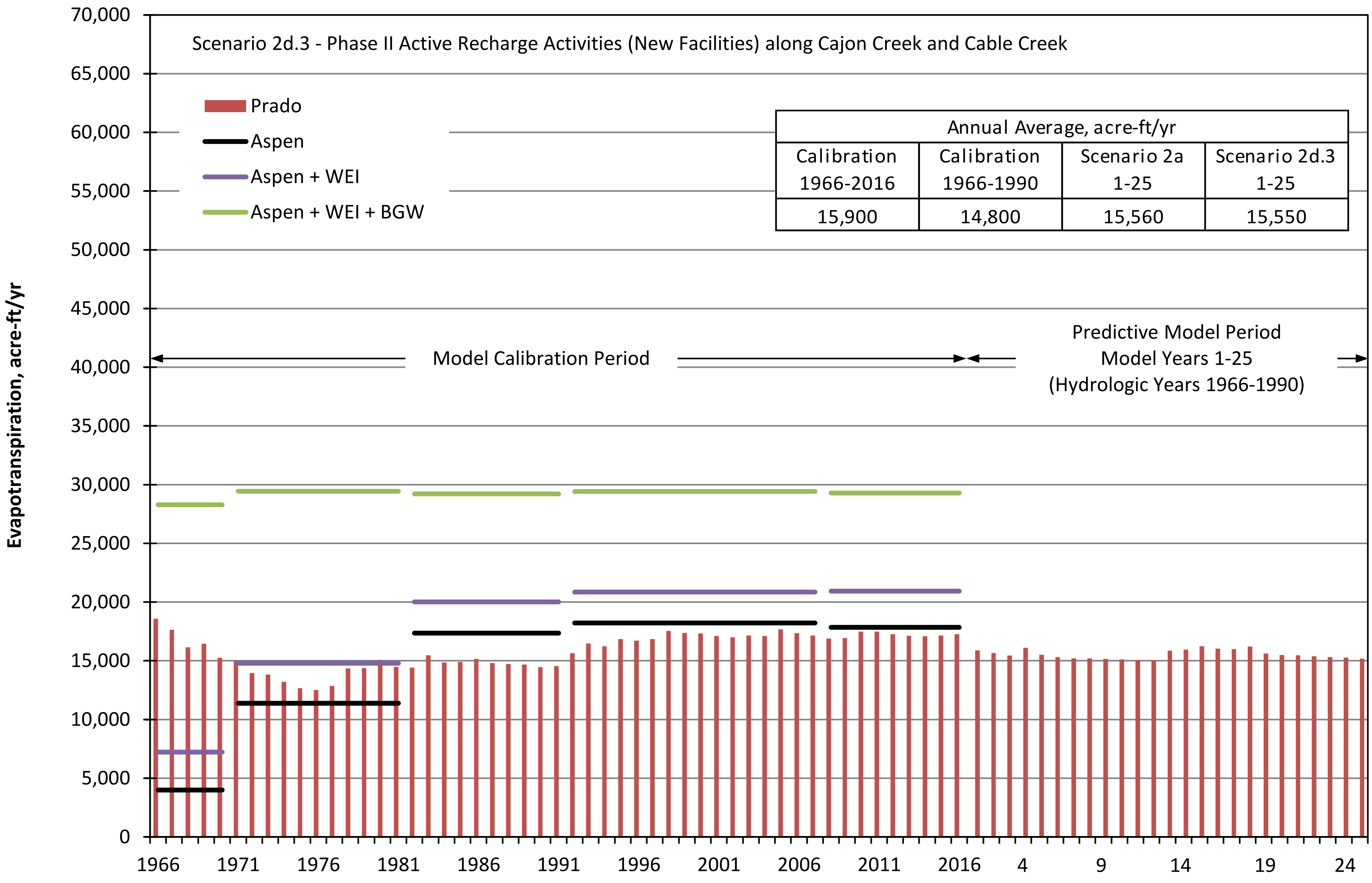


Figure 619

Scenario 2d.3: Annual Change in Evapotranspiration – Prado Basin

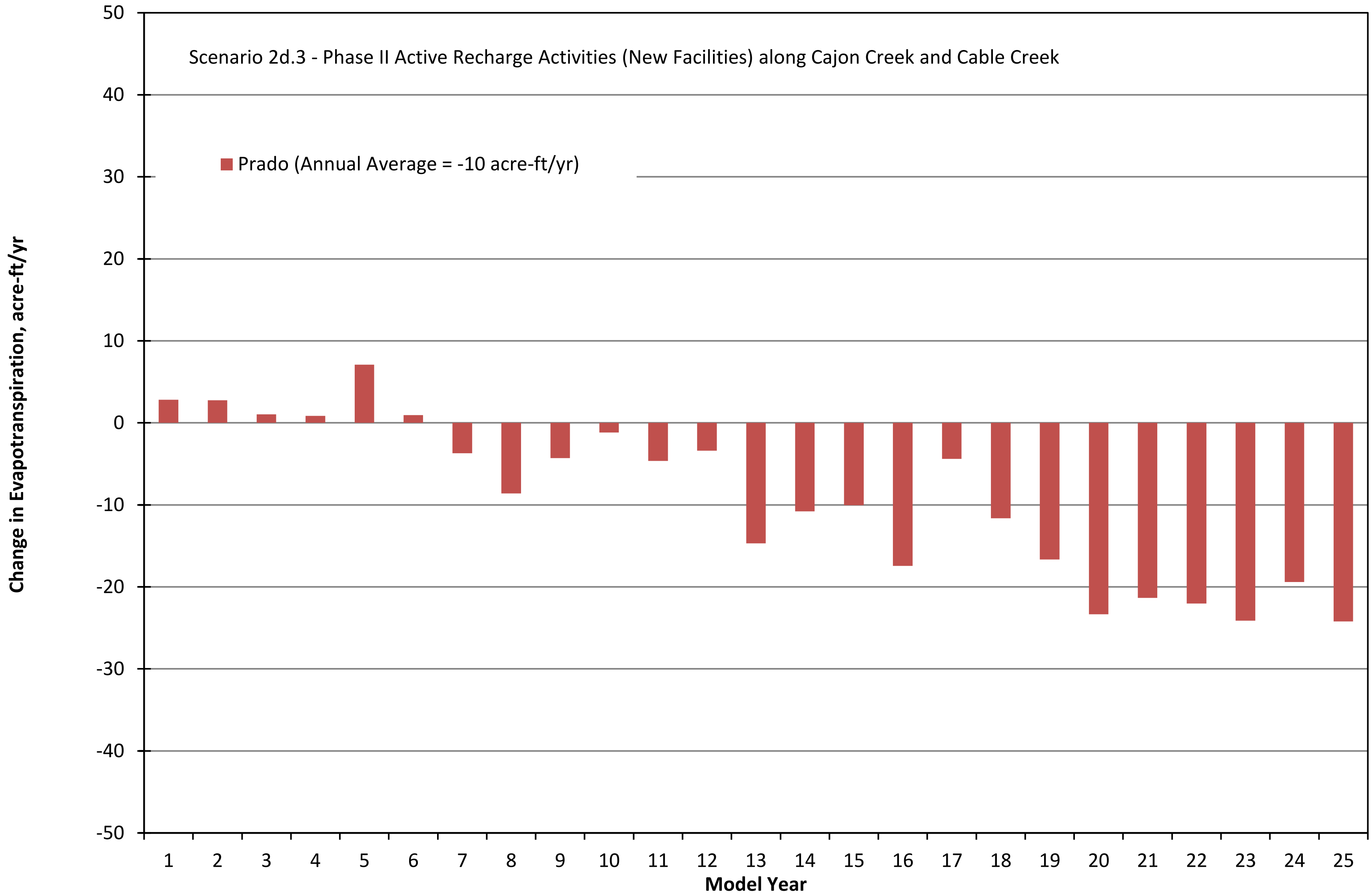
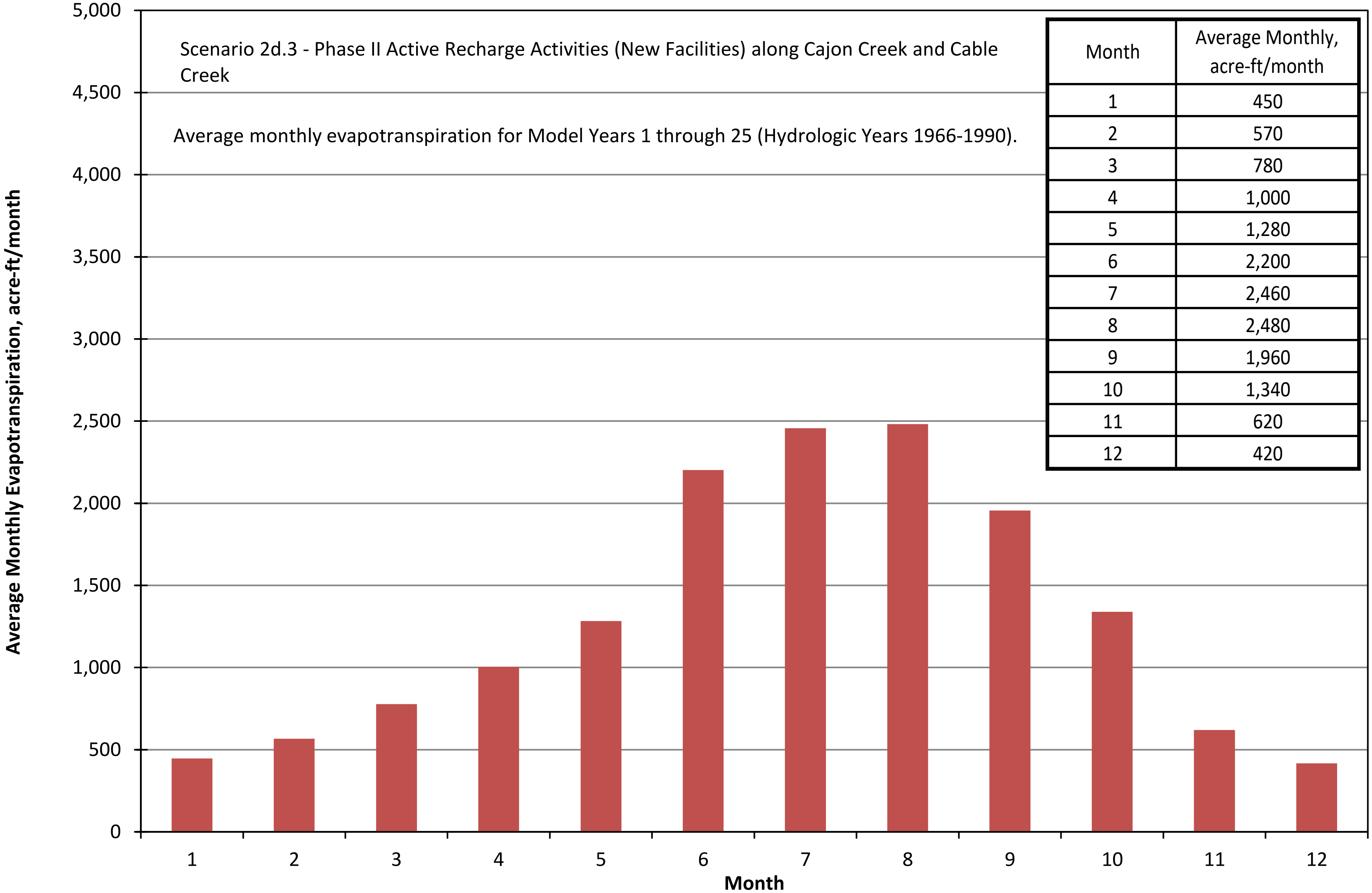


Figure 620

Scenario 2d.3: Seasonal Evapotranspiration – Prado Basin



Month	Average Monthly, acre-ft/month
1	450
2	570
3	780
4	1,000
5	1,280
6	2,200
7	2,460
8	2,480
9	1,960
10	1,340
11	620
12	420

Figure 621

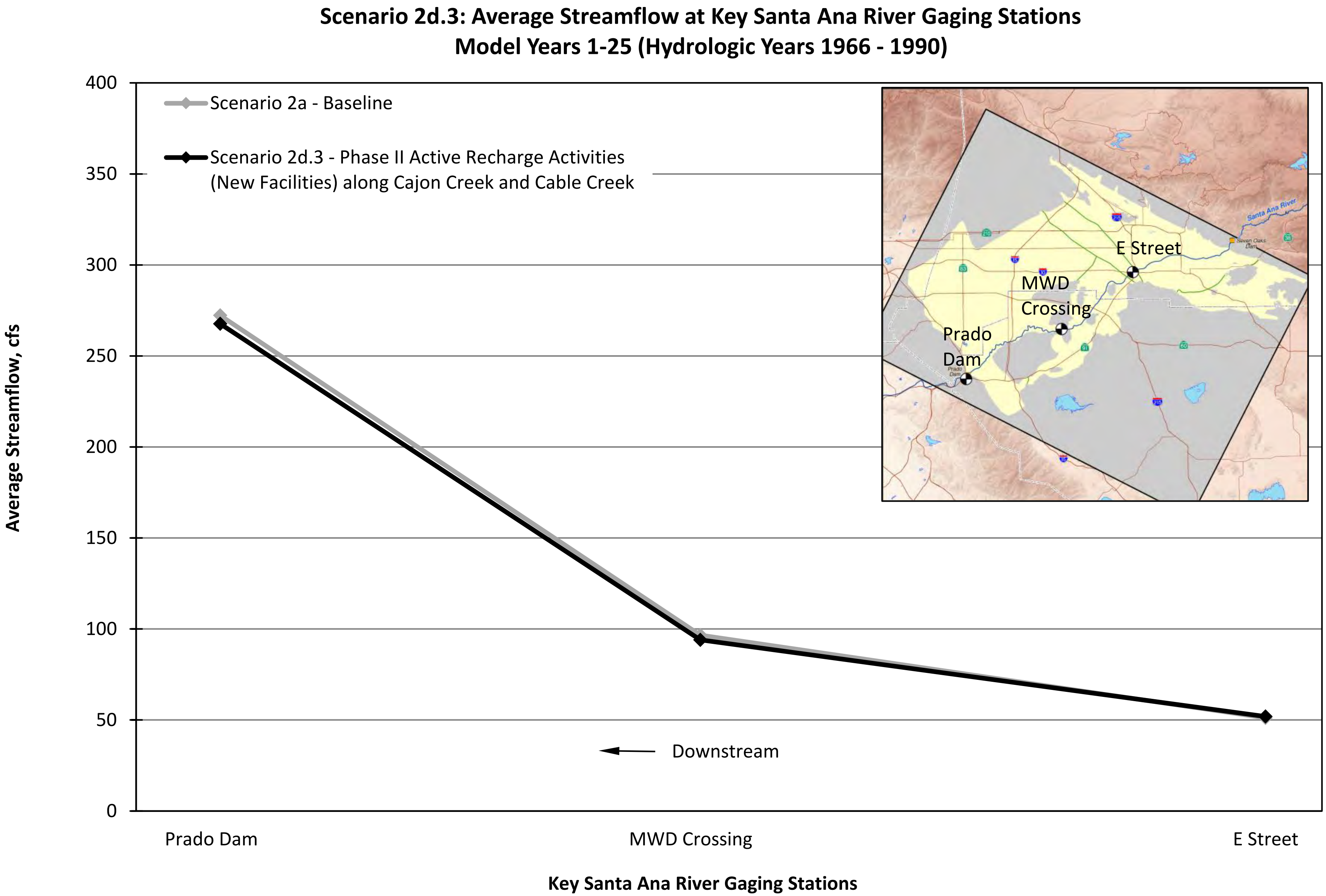

Scenario 2d.3: Average Streamflow at Key Santa Ana River Gaging Stations
Model Years 1-25 (Hydrologic Years 1966 - 1990)
Scenario 2a - Baseline
Scenario 2d.3 - Phase II Active Recharge Activities (New Facilities) along Cajon Creek and Cable Creek
Average Streamflow, cfs
400
350
300
250
200
150
100
50
0
E Street
MWD Crossing
Prado Dam
Santa Ana River
Downstream
Prado Dam
MWD Crossing
E Street
Key Santa Ana River Gaging Stations

Figure 622

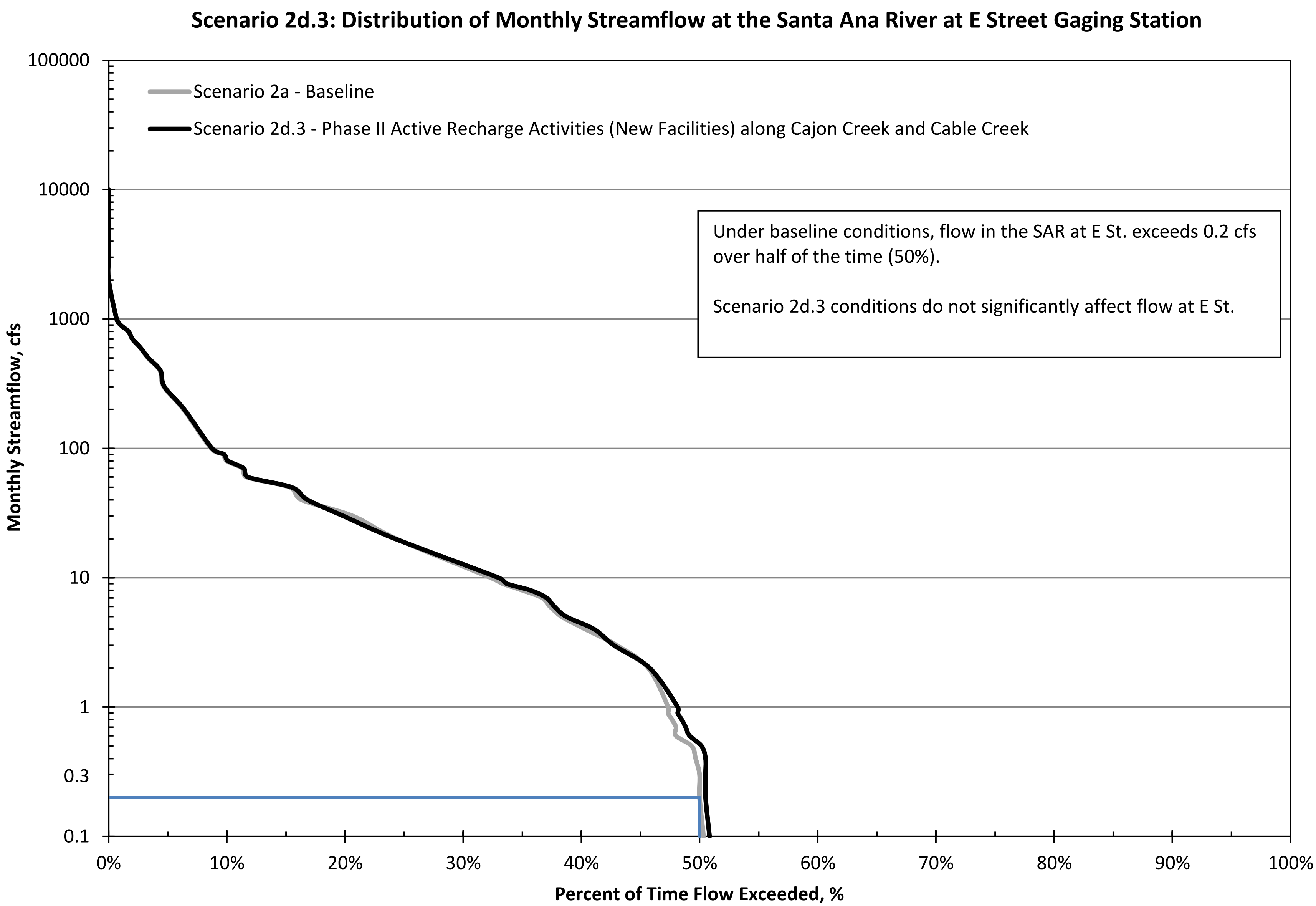

Scenario 2d.3: Distribution of Monthly Streamflow at the Santa Ana River at E Street Gaging Station
Scenario 2a - Baseline
Scenario 2d.3 - Phase II Active Recharge Activities (New Facilities) along Cajon Creek and Cable Creek
Under baseline conditions, flow in the SAR at E St. exceeds 0.2 cfs over half of the time (50%).
Scenario 2d.3 conditions do not significantly affect flow at E St.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.3
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 623

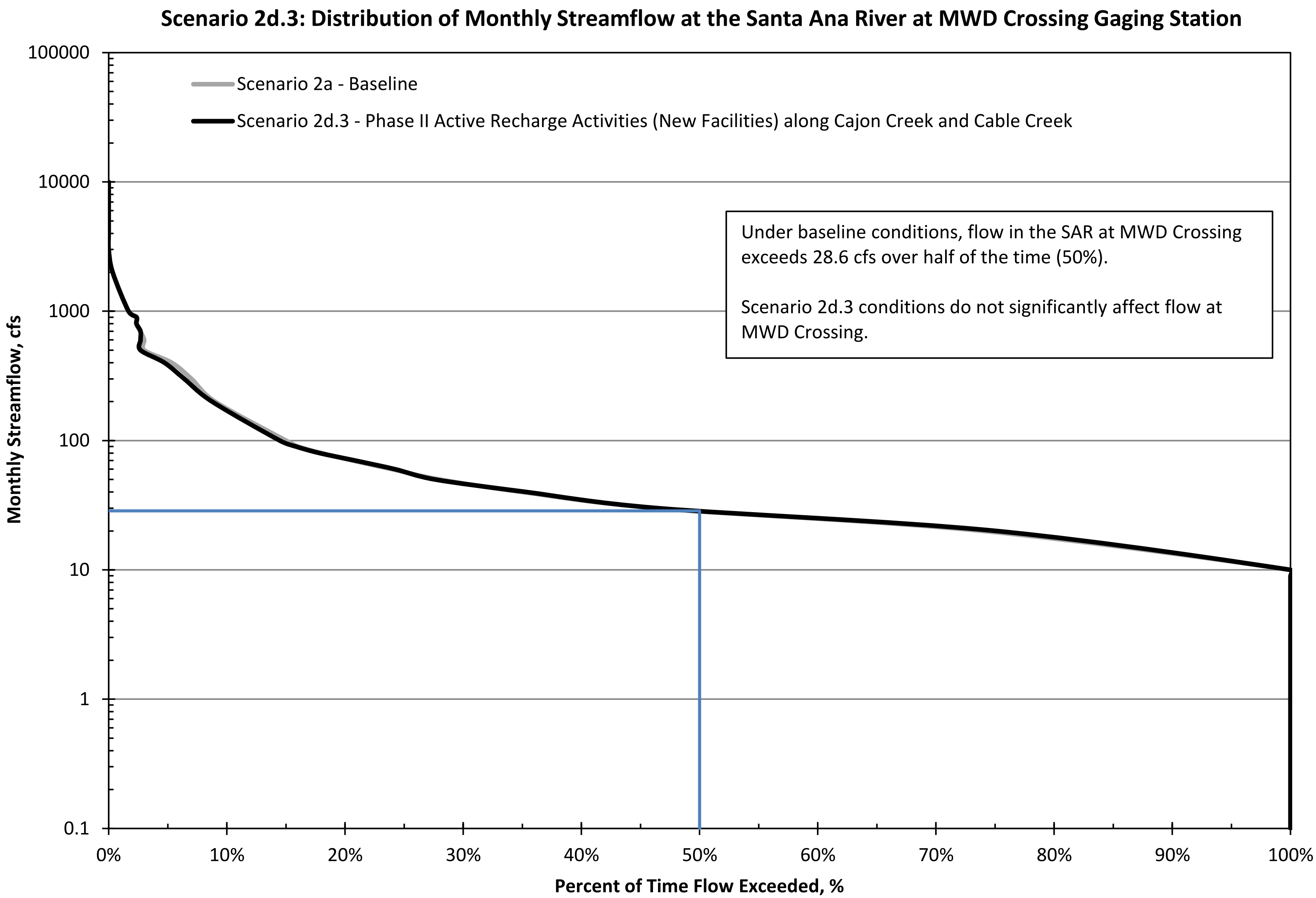

Scenario 2d.3: Distribution of Monthly Streamflow at the Santa Ana River at MWD Crossing Gaging Station
Scenario 2a - Baseline
Scenario 2d.3 - Phase II Active Recharge Activities (New Facilities) along Cajon Creek and Cable Creek
Under baseline conditions, flow in the SAR at MWD Crossing exceeds 28.6 cfs over half of the time (50%).
Scenario 2d.3 conditions do not significantly affect flow at MWD Crossing.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 624

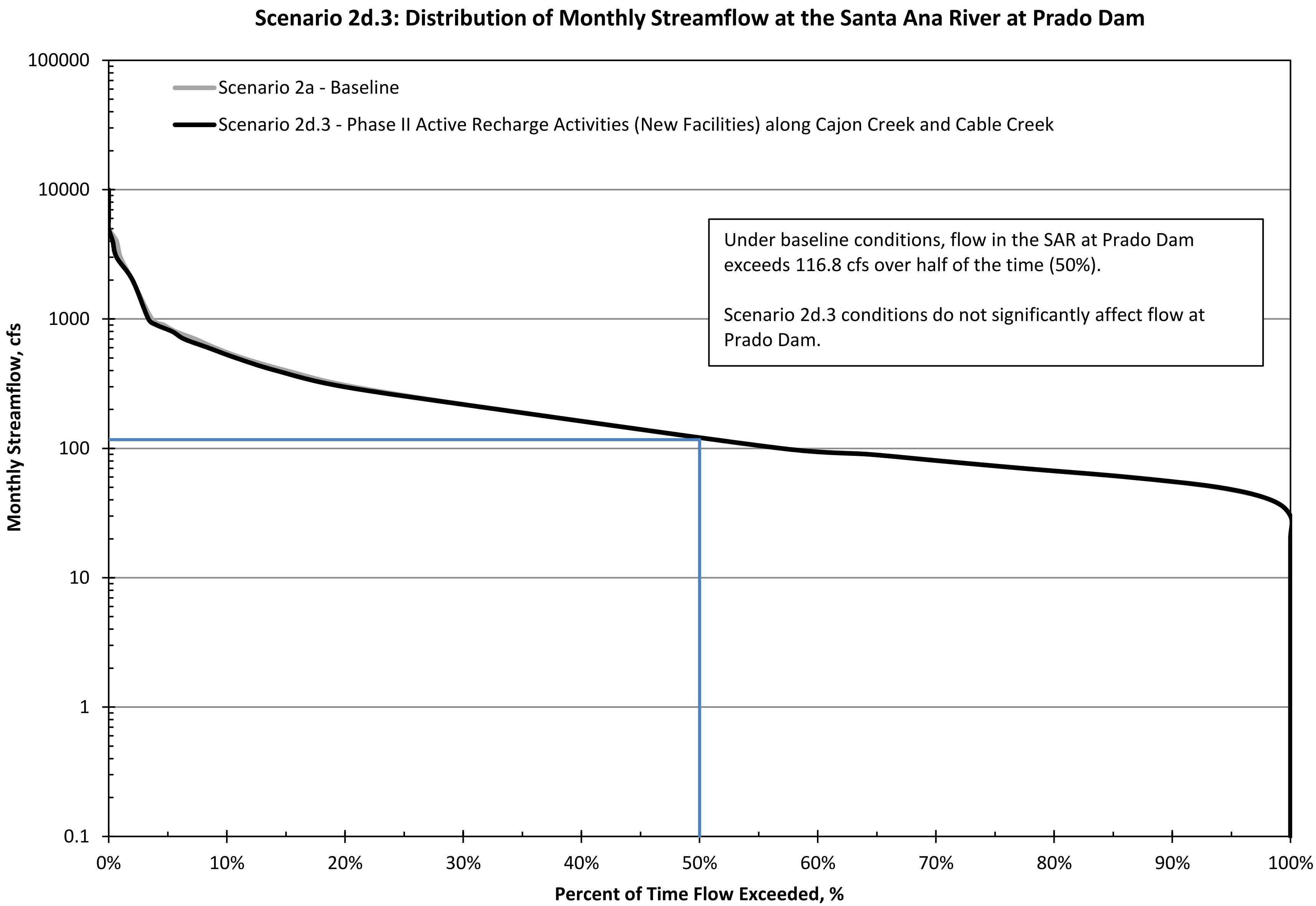

Scenario 2d.3: Distribution of Monthly Streamflow at the Santa Ana River at Prado Dam
Scenario 2a - Baseline
Scenario 2d.3 - Phase II Active Recharge Activities (New Facilities) along Cajon Creek and Cable Creek
Under baseline conditions, flow in the SAR at Prado Dam exceeds 116.8 cfs over half of the time (50%).
Scenario 2d.3 conditions do not significantly affect flow at Prado Dam.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 625

Scenario 2d.3: Annual Rising Water – Integrated SAR Model Area

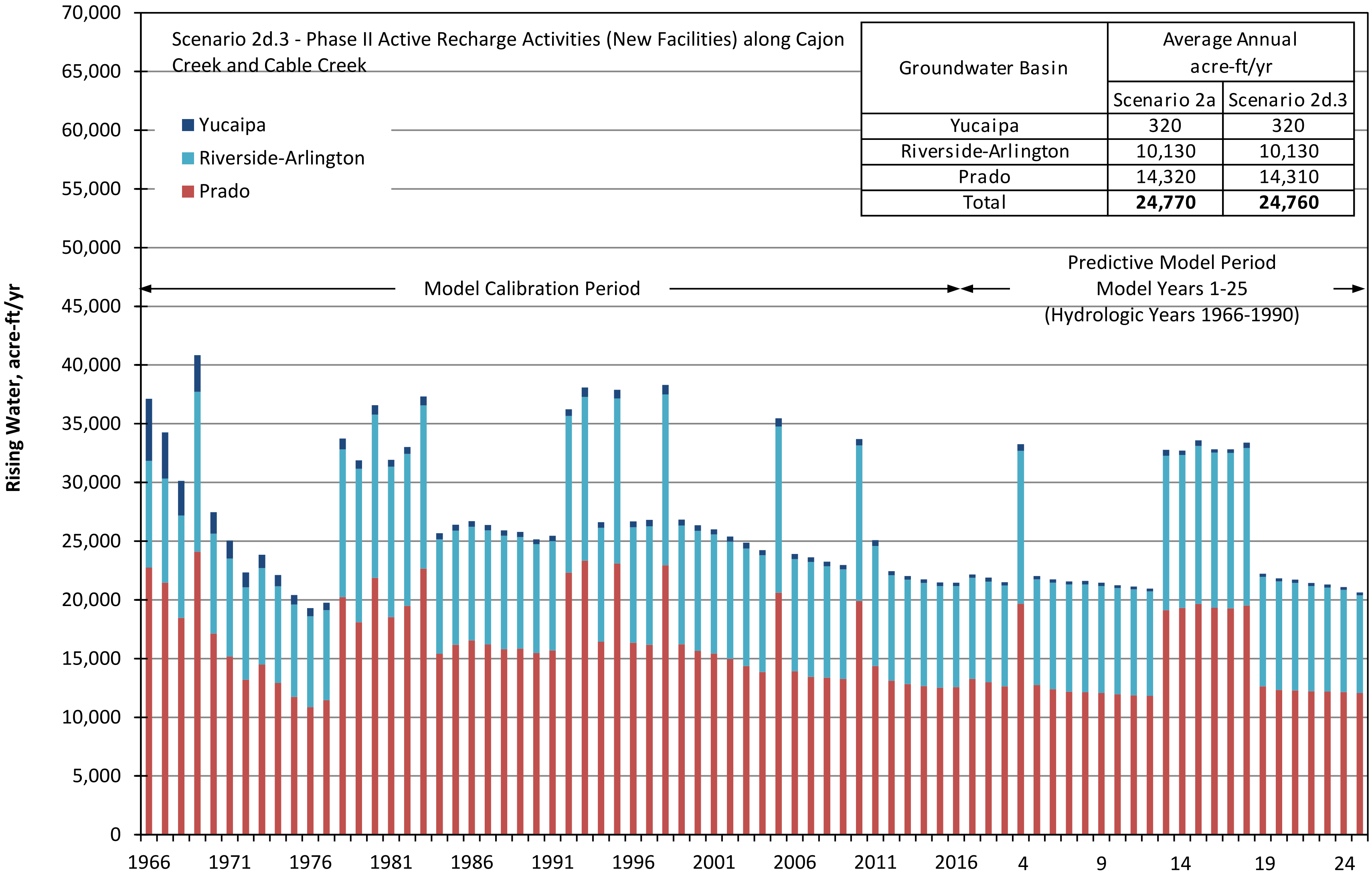


Figure 626

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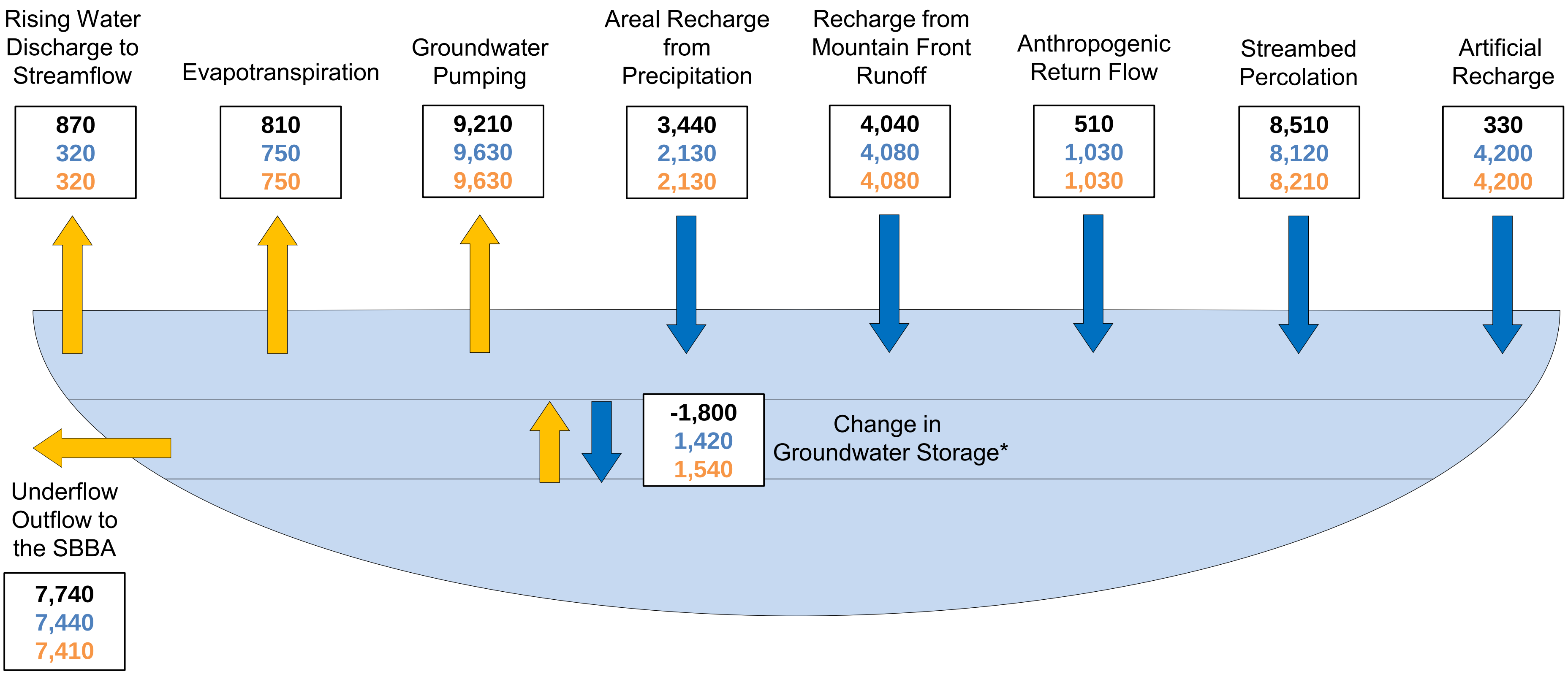


Scenario 2a - Baseline
Scenario 2d.3 - Phase II Active Recharge Activities (New Facilities) along Cajon Creek and Cable Creek

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.3 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

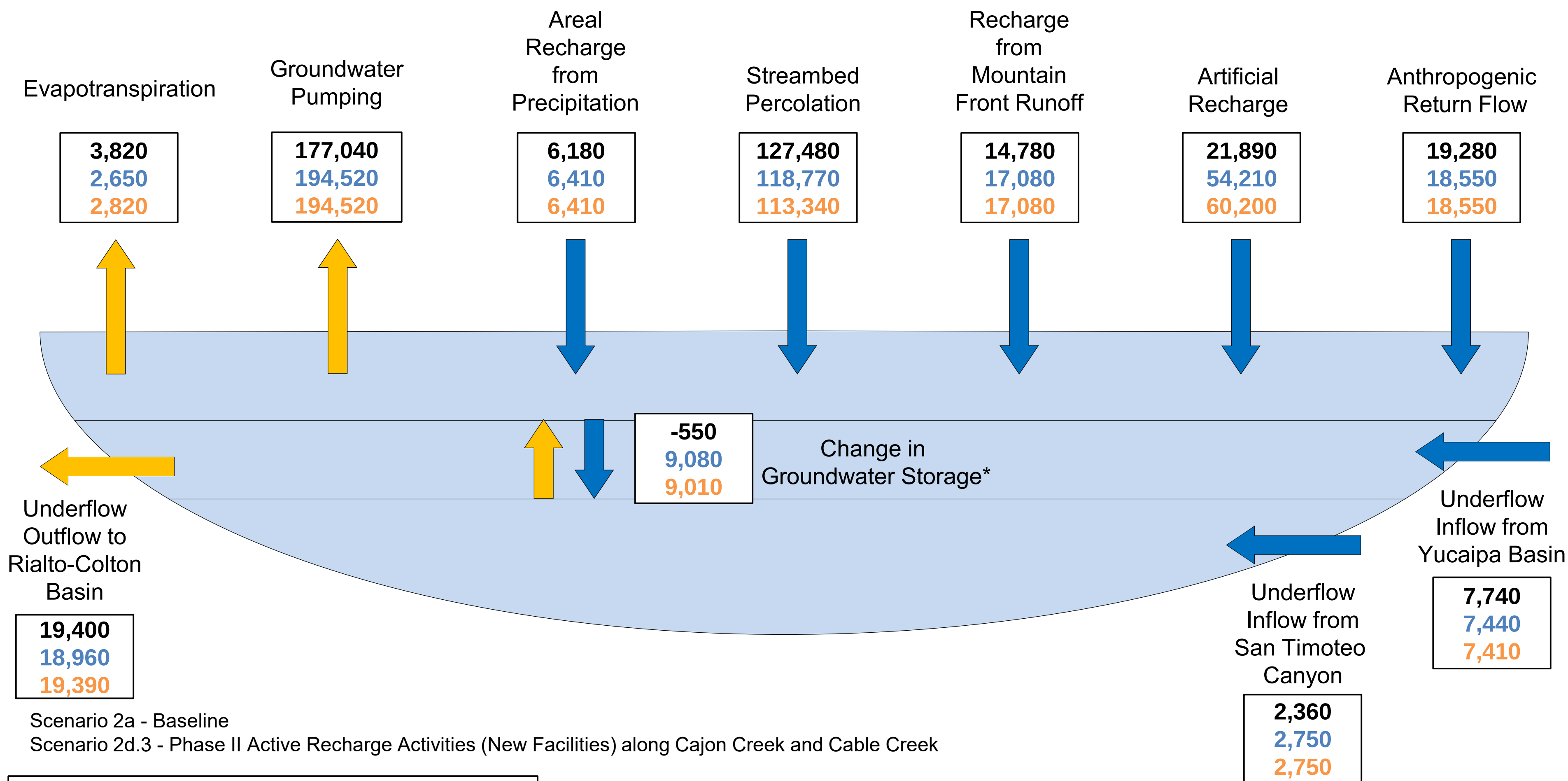
*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.3
AVERAGE ANNUAL
WATER BUDGET
YUCAIPA BASIN

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT **DRAFT** **FIGURE 627**
UPPER SANTA ANA RIVER INTEGRATED MODEL – SUMMARY REPORT

GEOSCIENCE



Scenario 2a - Baseline
Scenario 2d.3 - Phase II Active Recharge Activities (New Facilities) along Cajon Creek and Cable Creek

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.3 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.3 AVERAGE ANNUAL WATER BUDGET SBBA

10-Apr-20

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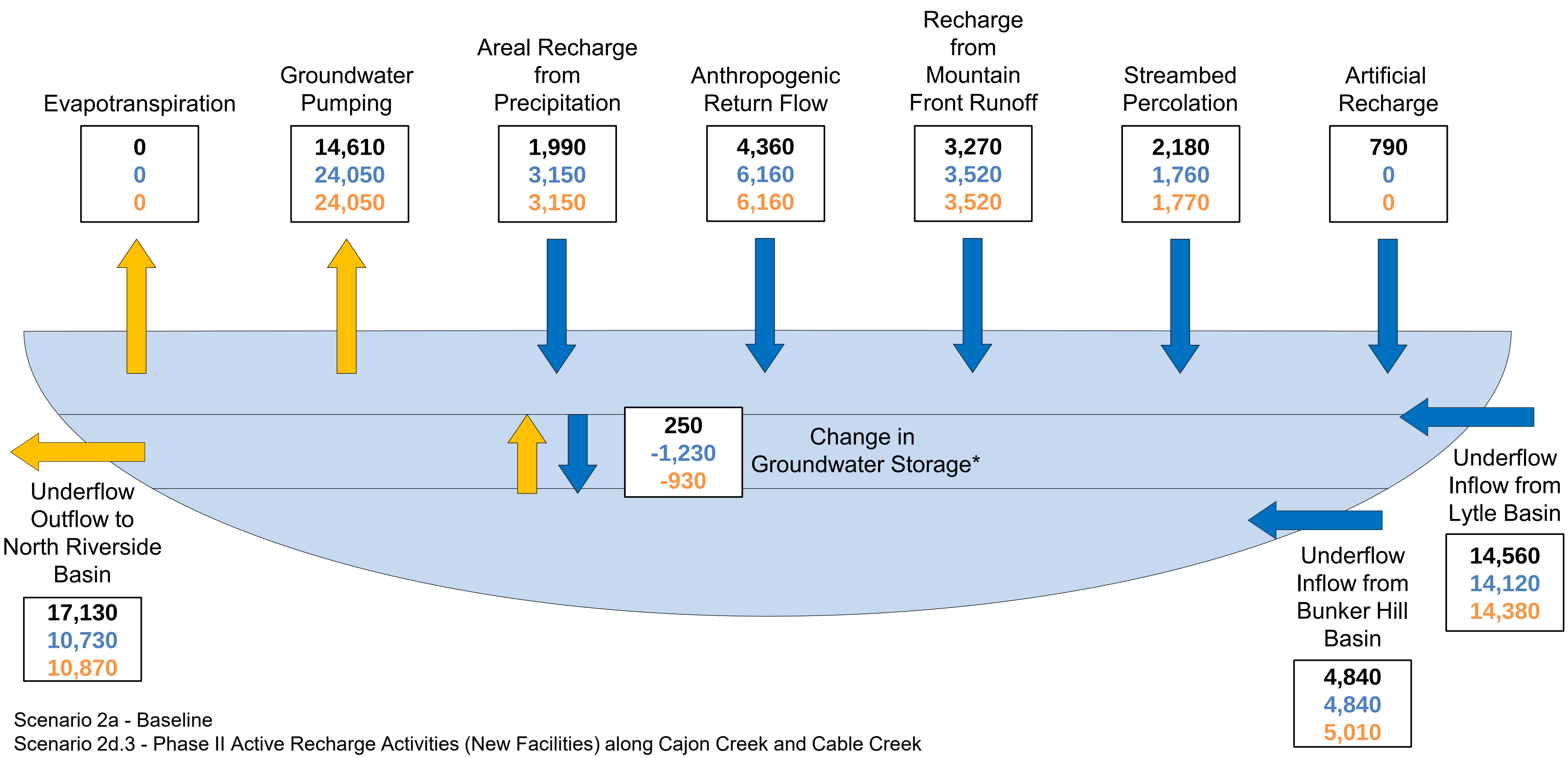


Scenario 2a - Baseline
Scenario 2d.3 - Phase II Active Recharge Activities (New Facilities) along Cajon Creek and Cable Creek

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.3 (Hydrologic Period 1966-1990)

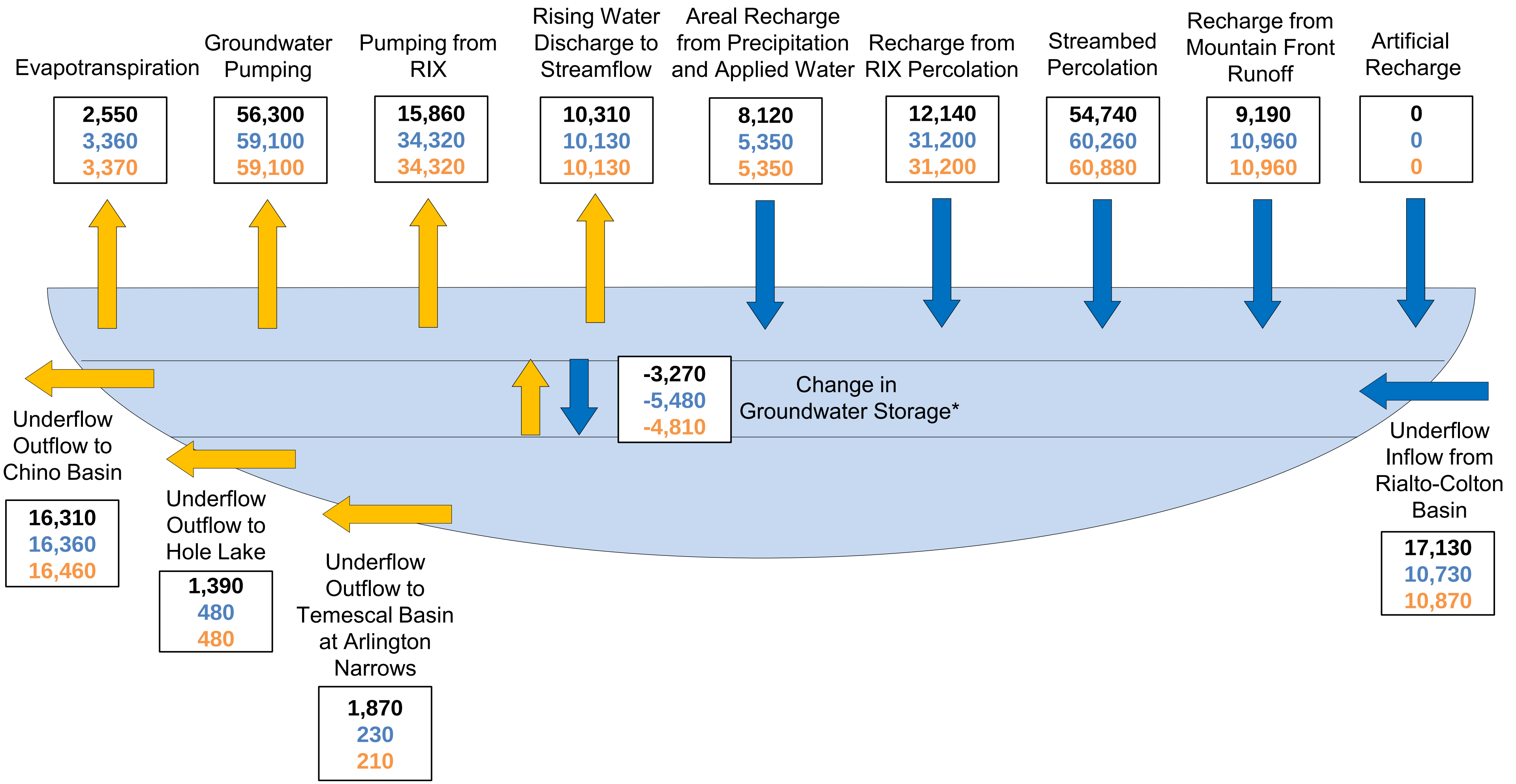
All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.3
AVERAGE ANNUAL
WATER BUDGET
RIALTO-COLTON BASIN

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT **DRAFT** **FIGURE 629**
UPPER SANTA ANA RIVER INTEGRATED MODEL – SUMMARY REPORT
GEOSCIENCE



Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.3 (Hydrologic Period 1966-1990)

Scenario 2a - Baseline
Scenario 2d.3 - Phase II Active Recharge Activities (New Facilities) along Cajon Creek and Cable Creek

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.3
AVERAGE ANNUAL WATER BUDGET
RIVERSIDE-ARLINGTON BASIN

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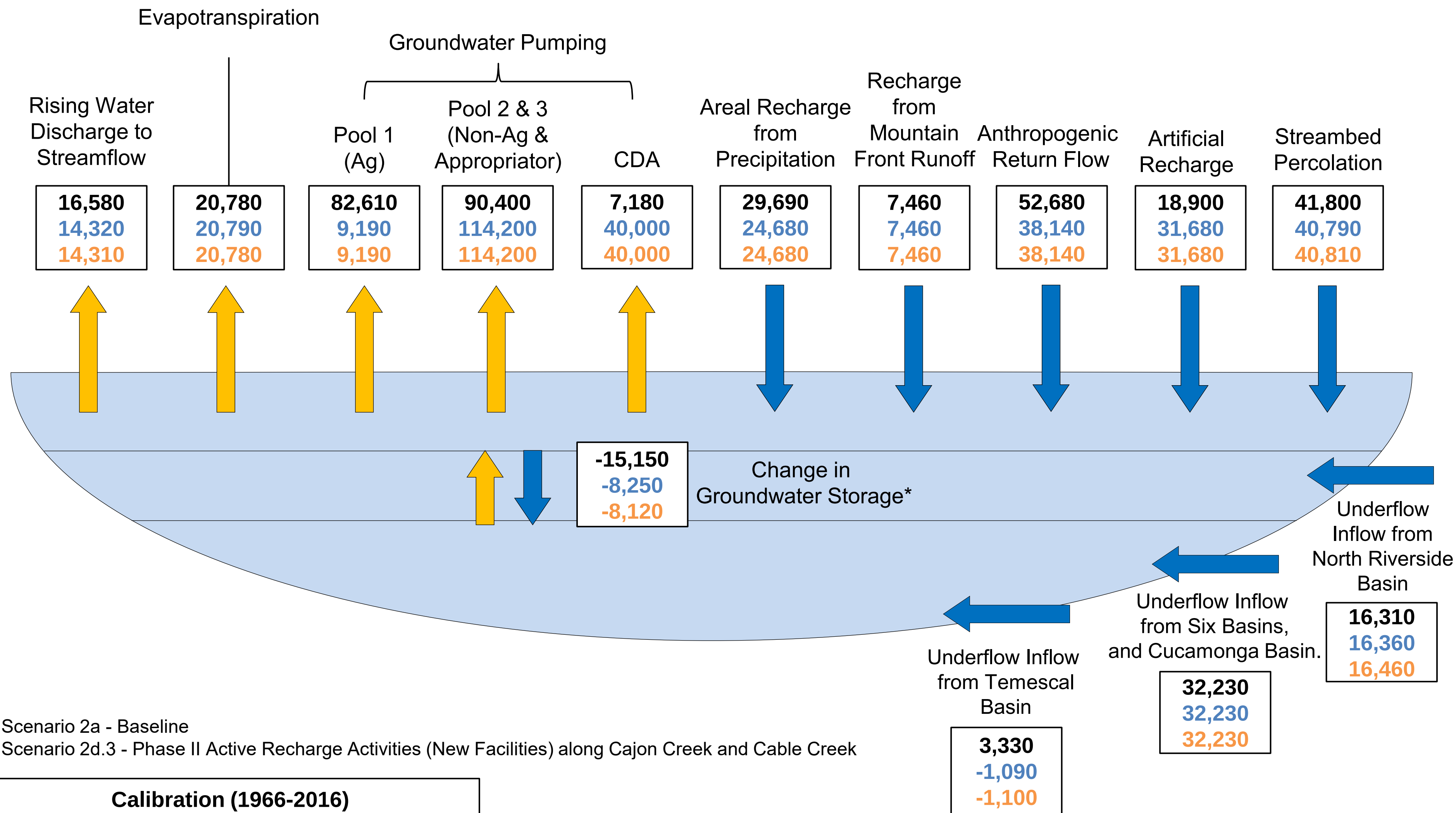
10-Apr-20



Scenario 2a - Baseline
Scenario 2d.3 - Phase II Active Recharge Activities (New Facilities) along Cajon Creek and Cable Creek

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.3 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.3
AVERAGE ANNUAL
WATER BUDGET
CHINO BASIN

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10-Apr-20

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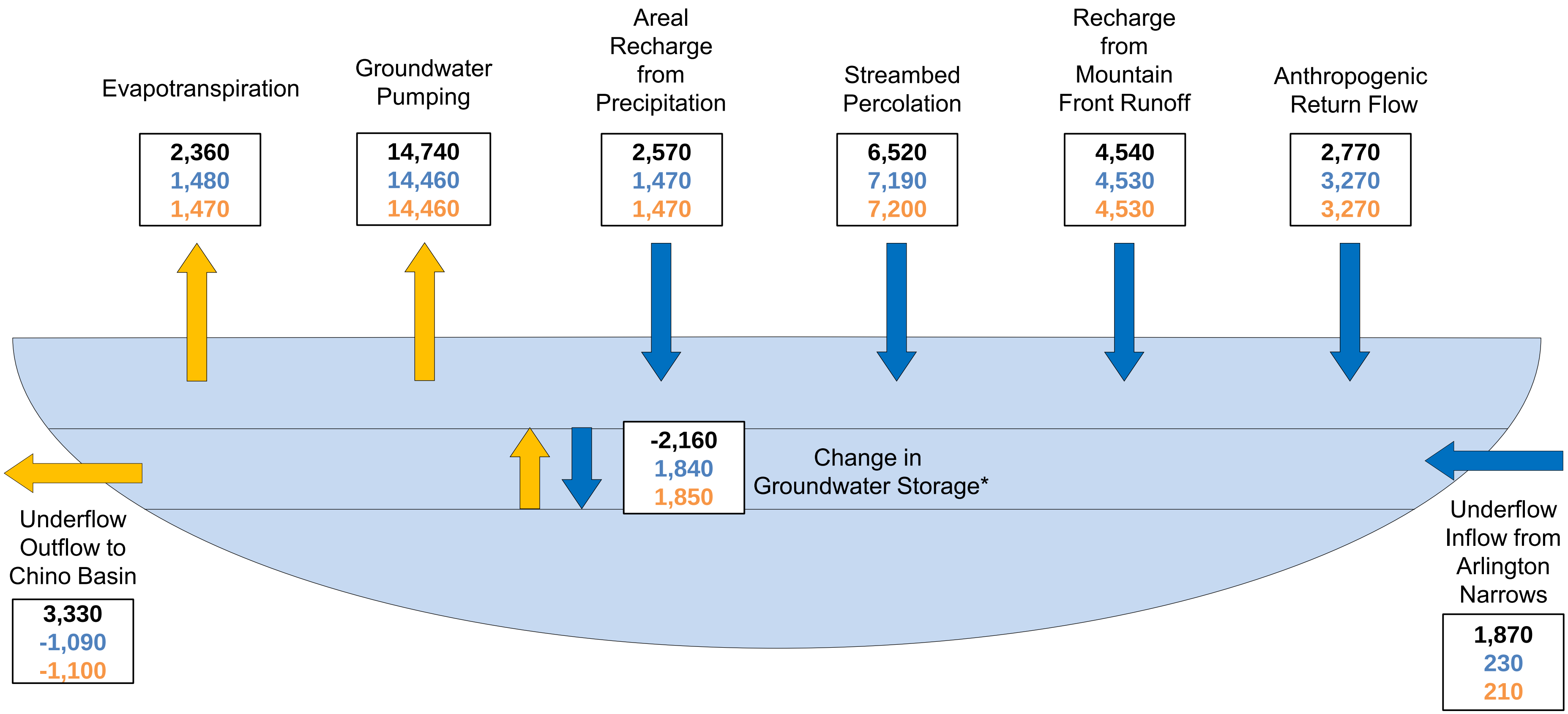

Scenario 2a - Baseline
Scenario 2d.3 - Phase II Active Recharge Activities (New Facilities) along Cajon Creek and Cable Creek

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.3 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.3
AVERAGE ANNUAL
WATER BUDGET
TEMESCAL BASIN

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT **DRAFT** **FIGURE 632**
UPPER SANTA ANA RIVER INTEGRATED MODEL – SUMMARY REPORT
GEOSCIENCE

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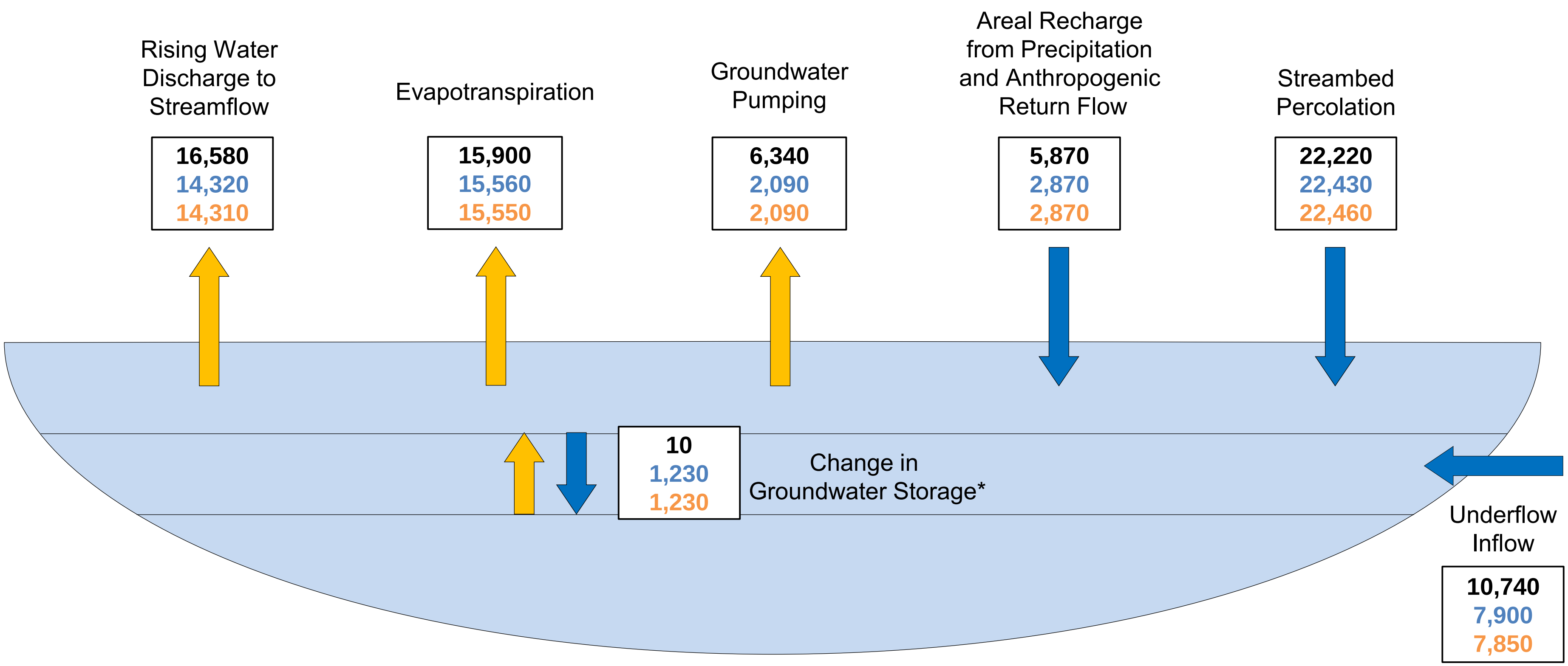


Scenario 2a - Baseline
Scenario 2d.3 - Phase II Active Recharge Activities (New Facilities) along Cajon Creek and Cable Creek

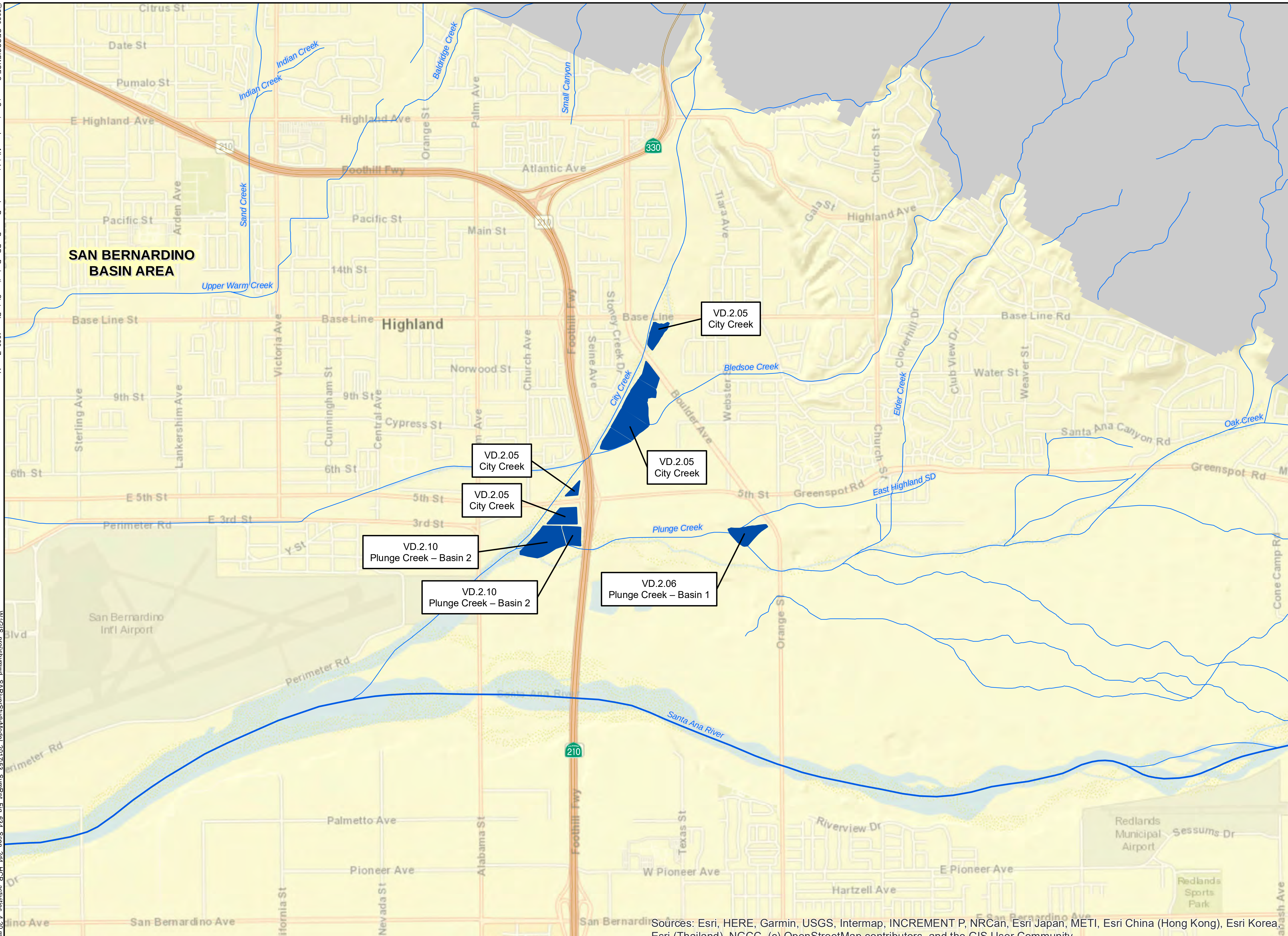
Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.3 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.3 AVERAGE ANNUAL WATER BUDGET PRADO BASIN

10-Apr-20



EXPLANATION

Active Model Area

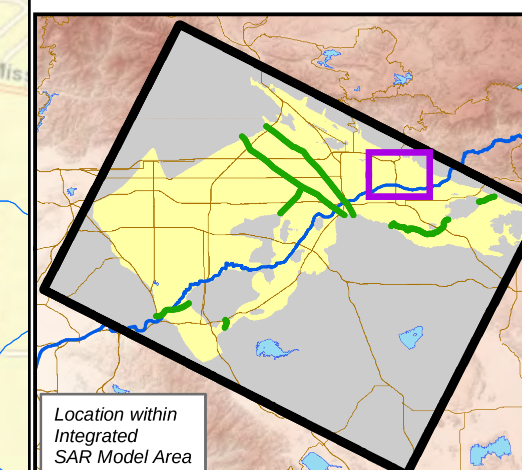
Inactive Model Area

Habitat Conservation Plan (HCP) Covered Activity
VD.2.05 - Project ID
City Creek - Name of HCP Project

Groundwater Basin Boundary

Refer to Table 17 for HCP Covered Activity Description

Scenario 2d.4:
Active Recharge Activities (Stormwater Capture Activities) - Phase II Active Recharge Activities (New Facilities) along City Creek, Plunge Creek, and Mill Creek



N
0 0.5 1
Miles

SCENARIO 2d.4 LOCATION OF HCP COVERED ACTIVITIES

10-Apr-20

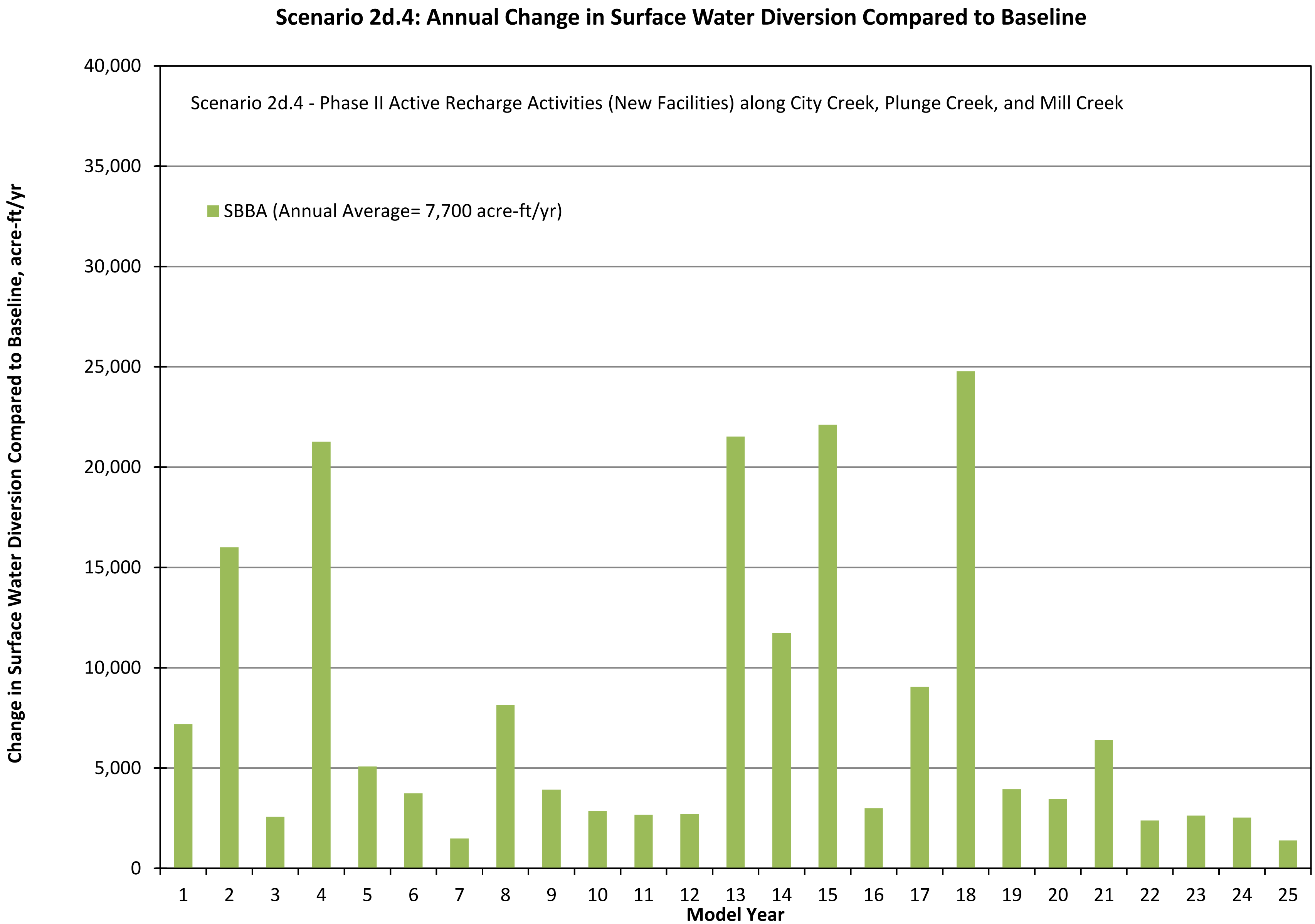

Scenario 2d.4: Annual Change in Surface Water Diversion Compared to Baseline
Scenario 2d.4 - Phase II Active Recharge Activities (New Facilities) along City Creek, Plunge Creek, and Mill Creek
SBBA (Annual Average= 7,700 acre-ft/yr)
Change in Surface Water Diversion Compared to Baseline, acre-ft/yr
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
Model Year

Figure 635

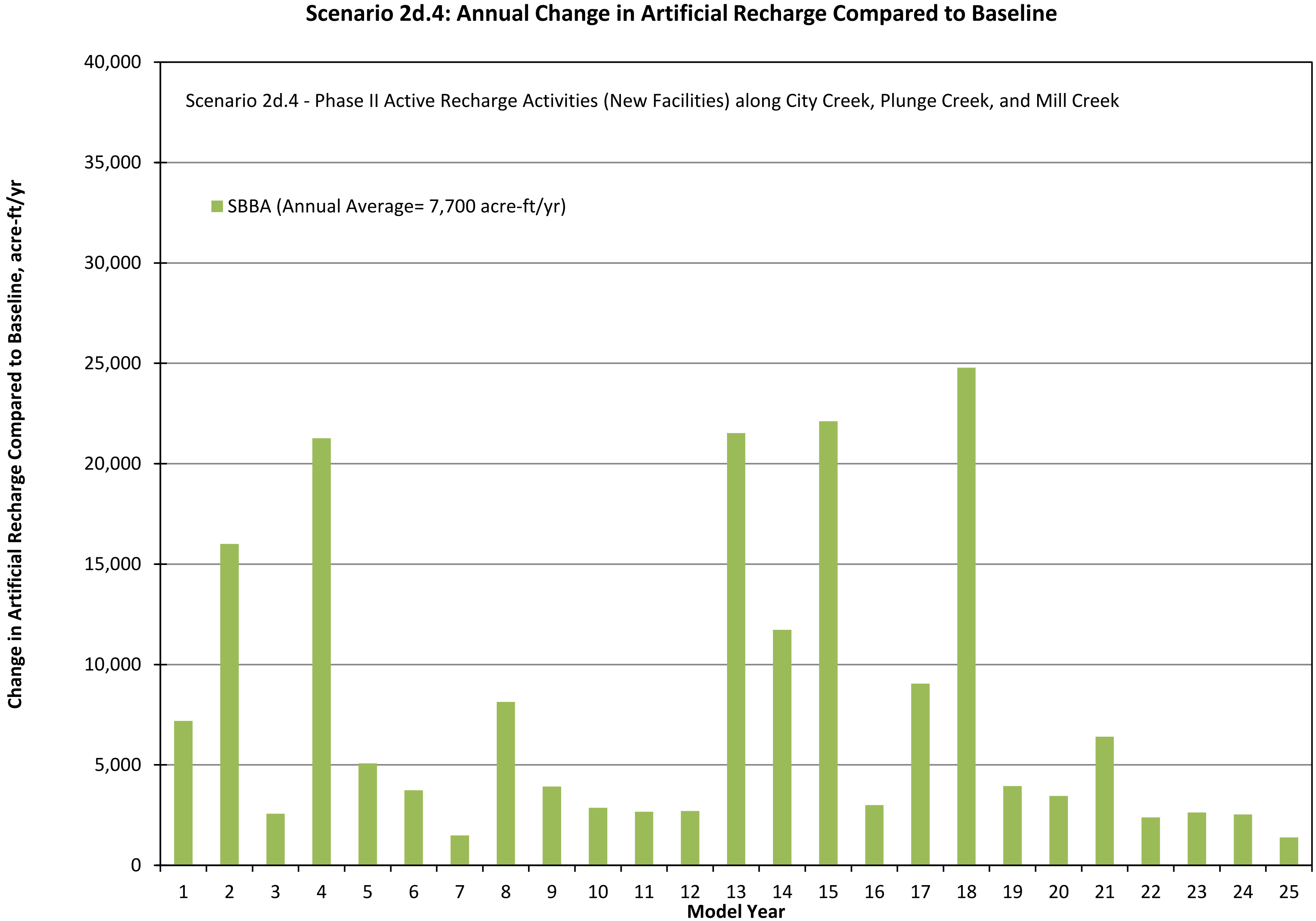
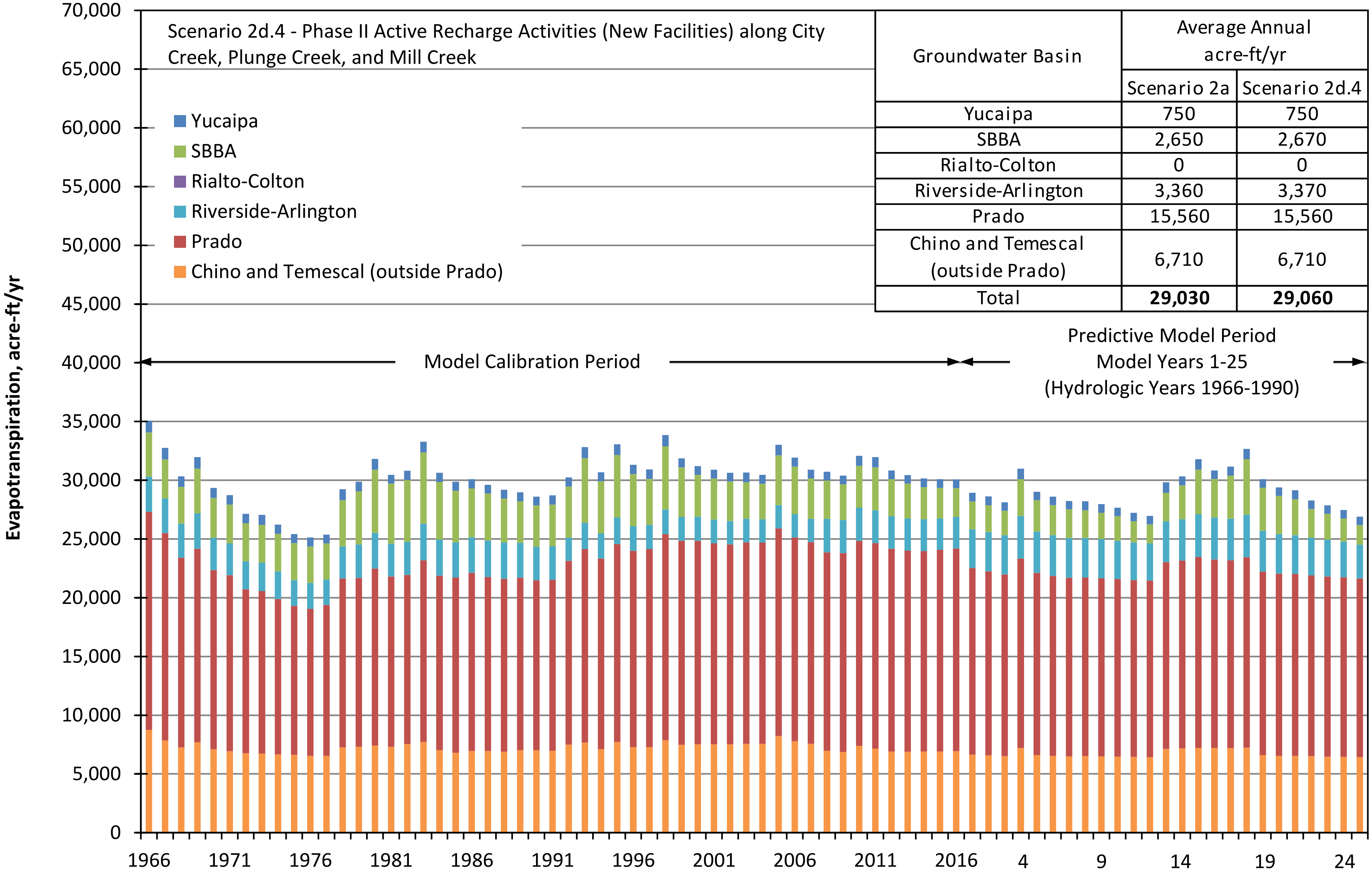

Scenario 2d.4: Annual Change in Artificial Recharge Compared to Baseline
Scenario 2d.4 - Phase II Active Recharge Activities (New Facilities) along City Creek, Plunge Creek, and Mill Creek
SBBA (Annual Average= 7,700 acre-ft/yr)
Change in Artificial Recharge Compared to Baseline, acre-ft/yr
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Model Year

Figure 636

Scenario 2d.4: Annual Evapotranspiration – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2d.4
Yucaipa	750	750
SBBA	2,650	2,670
Rialto-Colton	0	0
Riverside-Arlington	3,360	3,370
Prado	15,560	15,560
Chino and Temescal (outside Prado)	6,710	6,710
Total	**29,030**	**29,060**

Figure 637

DRAFT

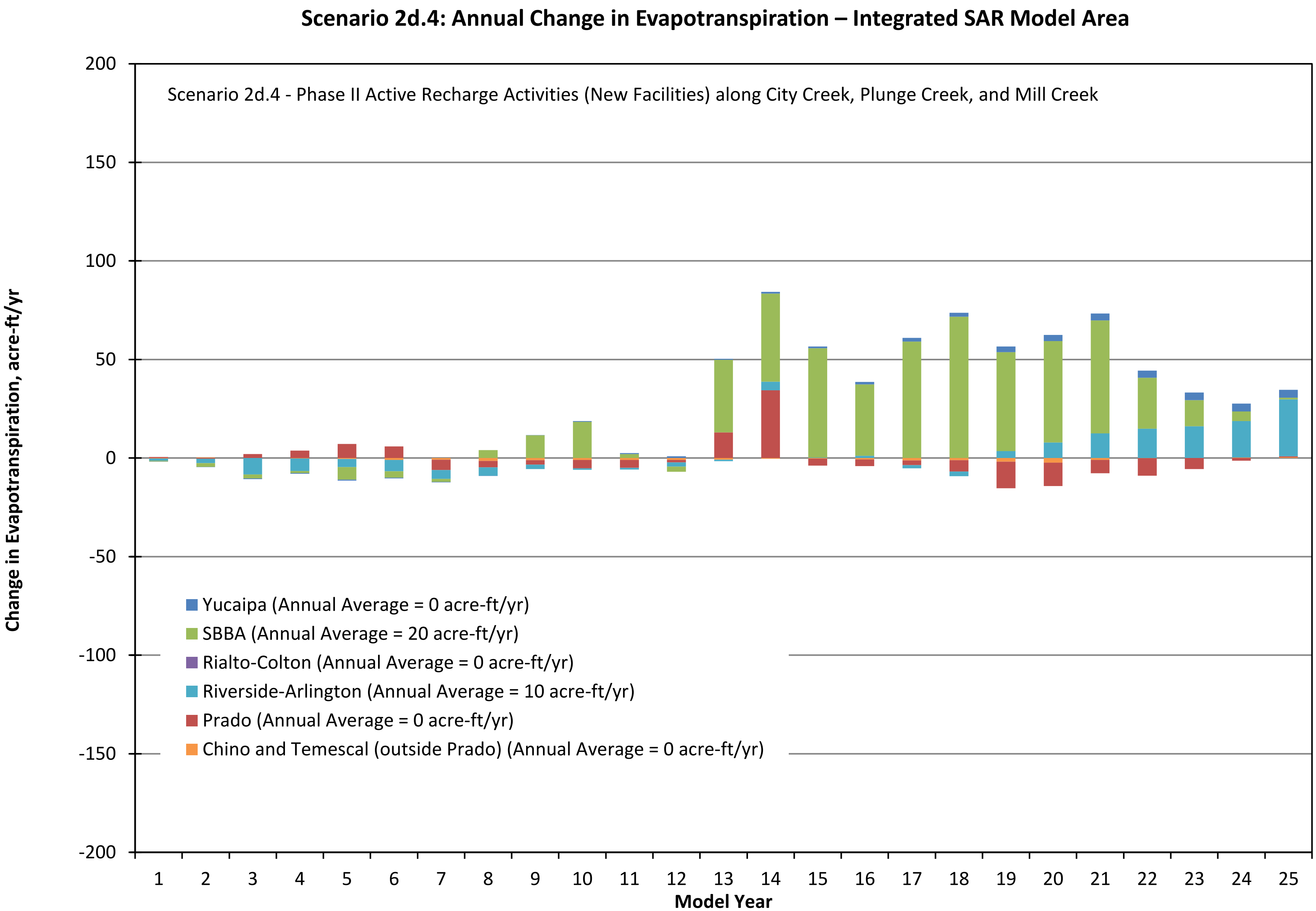
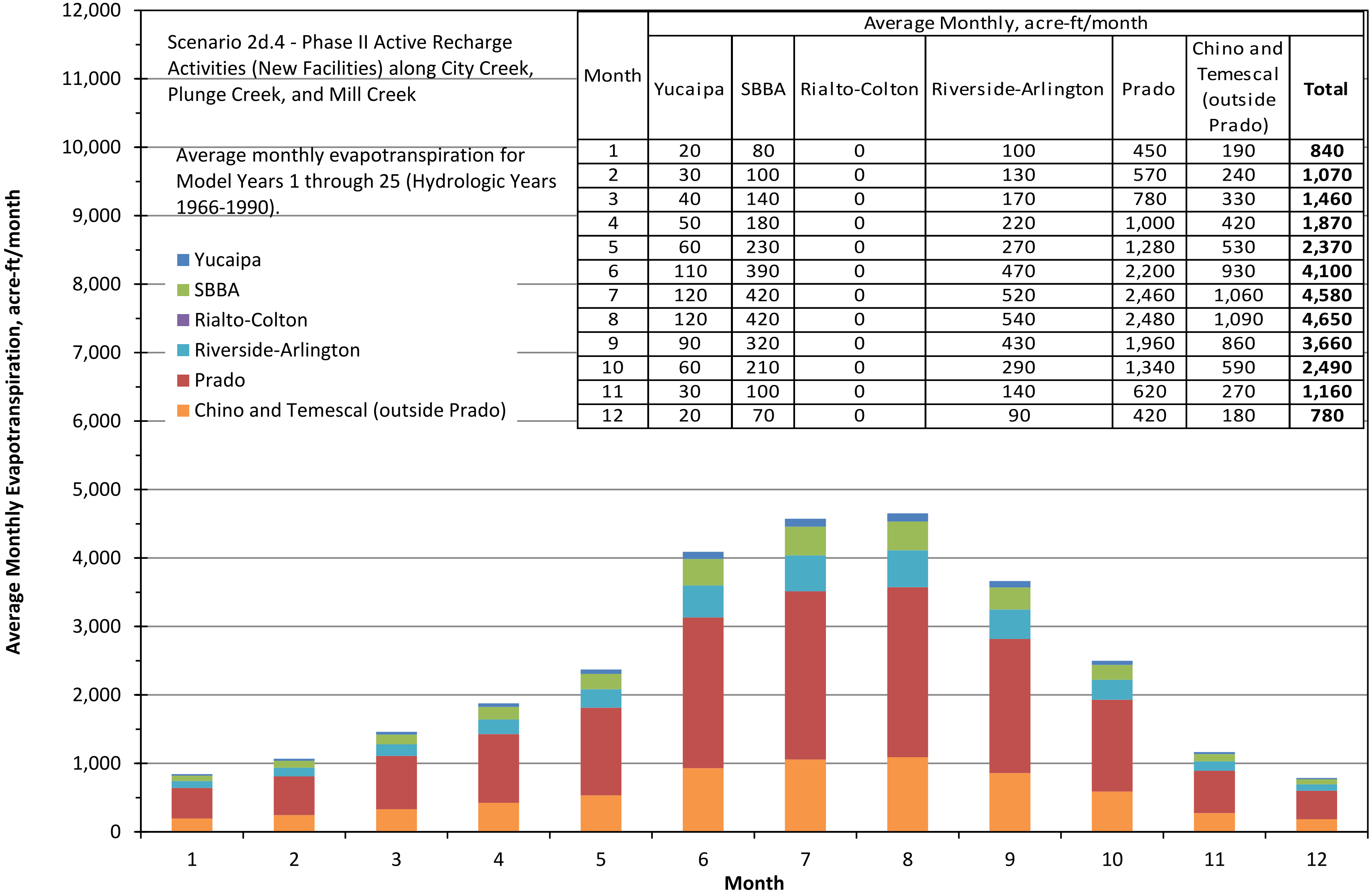


Figure 638

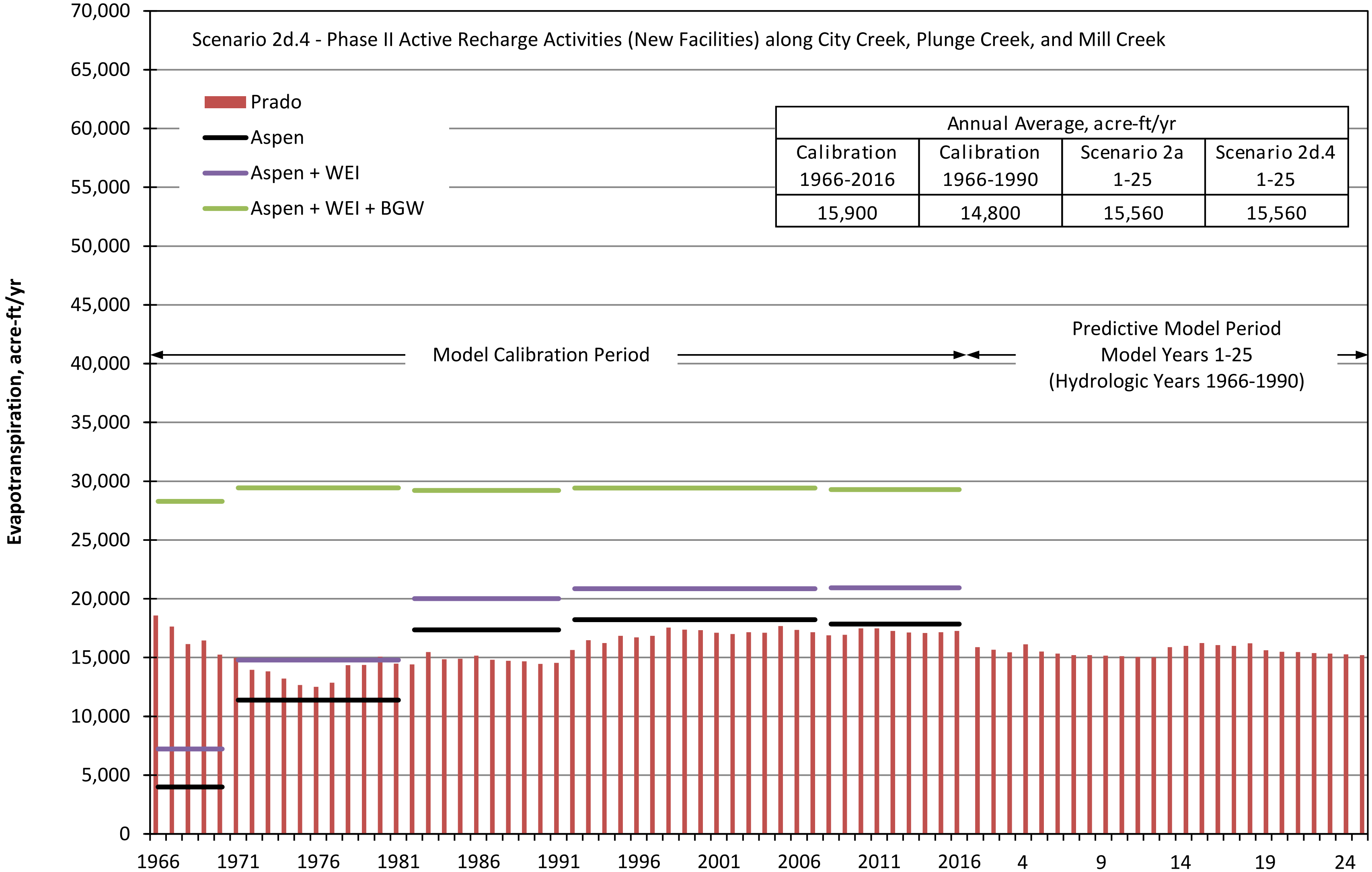
Scenario 2d.4: Seasonal Evapotranspiration – Integrated SAR Model Area



Month	Average Monthly, acre-ft/month						
	Yucaipa	SBBA	Rialto-Colton	Riverside-Arlington	Prado	Chino and Temescal (outside Prado)	**Total**
1	20	80	0	100	450	190	**840**
2	30	100	0	130	570	240	**1,070**
3	40	140	0	170	780	330	**1,460**
4	50	180	0	220	1,000	420	**1,870**
5	60	230	0	270	1,280	530	**2,370**
6	110	390	0	470	2,200	930	**4,100**
7	120	420	0	520	2,460	1,060	**4,580**
8	120	420	0	540	2,480	1,090	**4,650**
9	90	320	0	430	1,960	860	**3,660**
10	60	210	0	290	1,340	590	**2,490**
11	30	100	0	140	620	270	**1,160**
12	20	70	0	90	420	180	**780**

Figure 639

Scenario 2d.4: Annual Evapotranspiration – Prado Basin



Annual Average, acre-ft/yr			
Calibration 1966-2016	Calibration 1966-1990	Scenario 2a 1-25	Scenario 2d.4 1-25
15,900	14,800	15,560	15,560

Figure 640

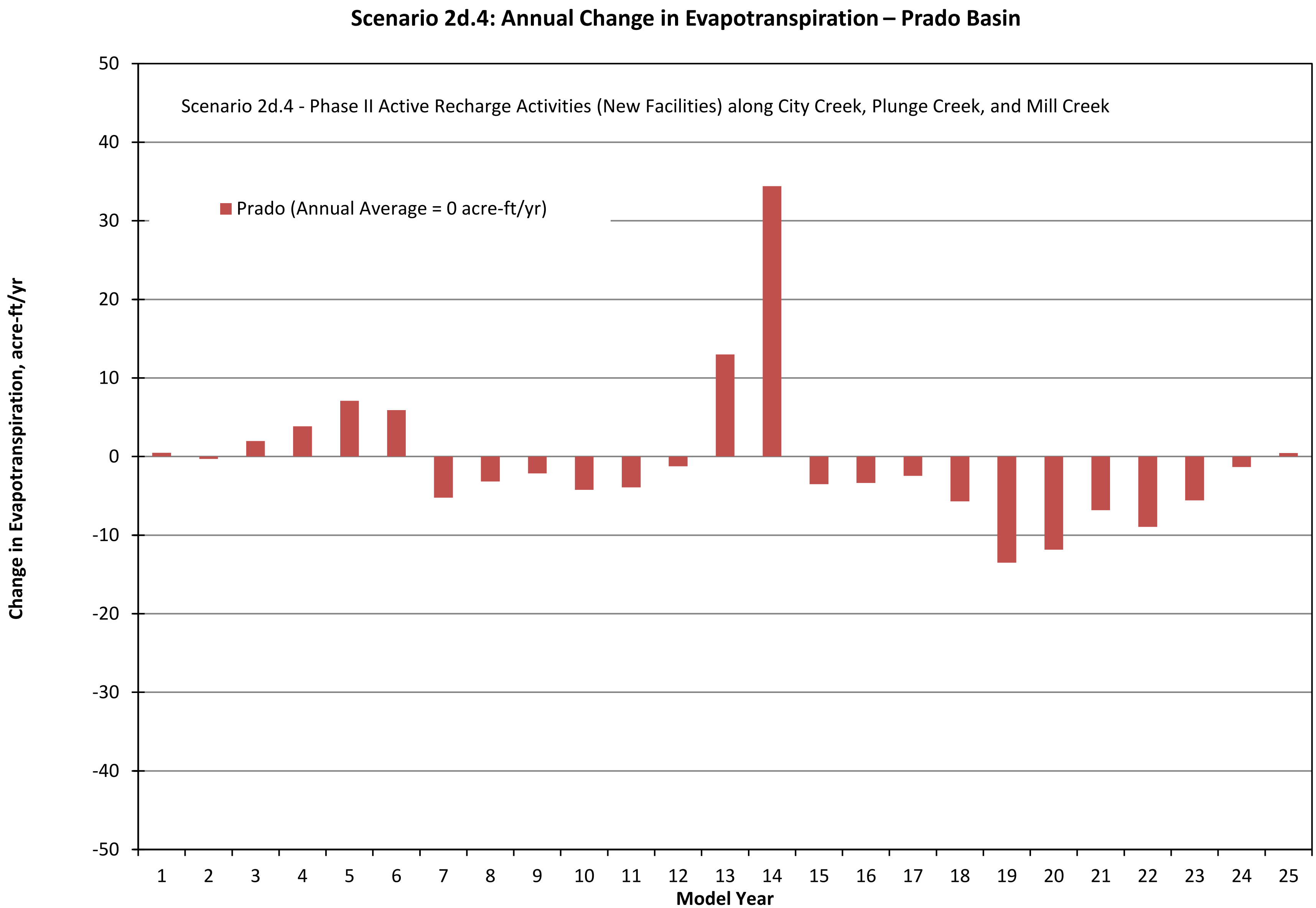
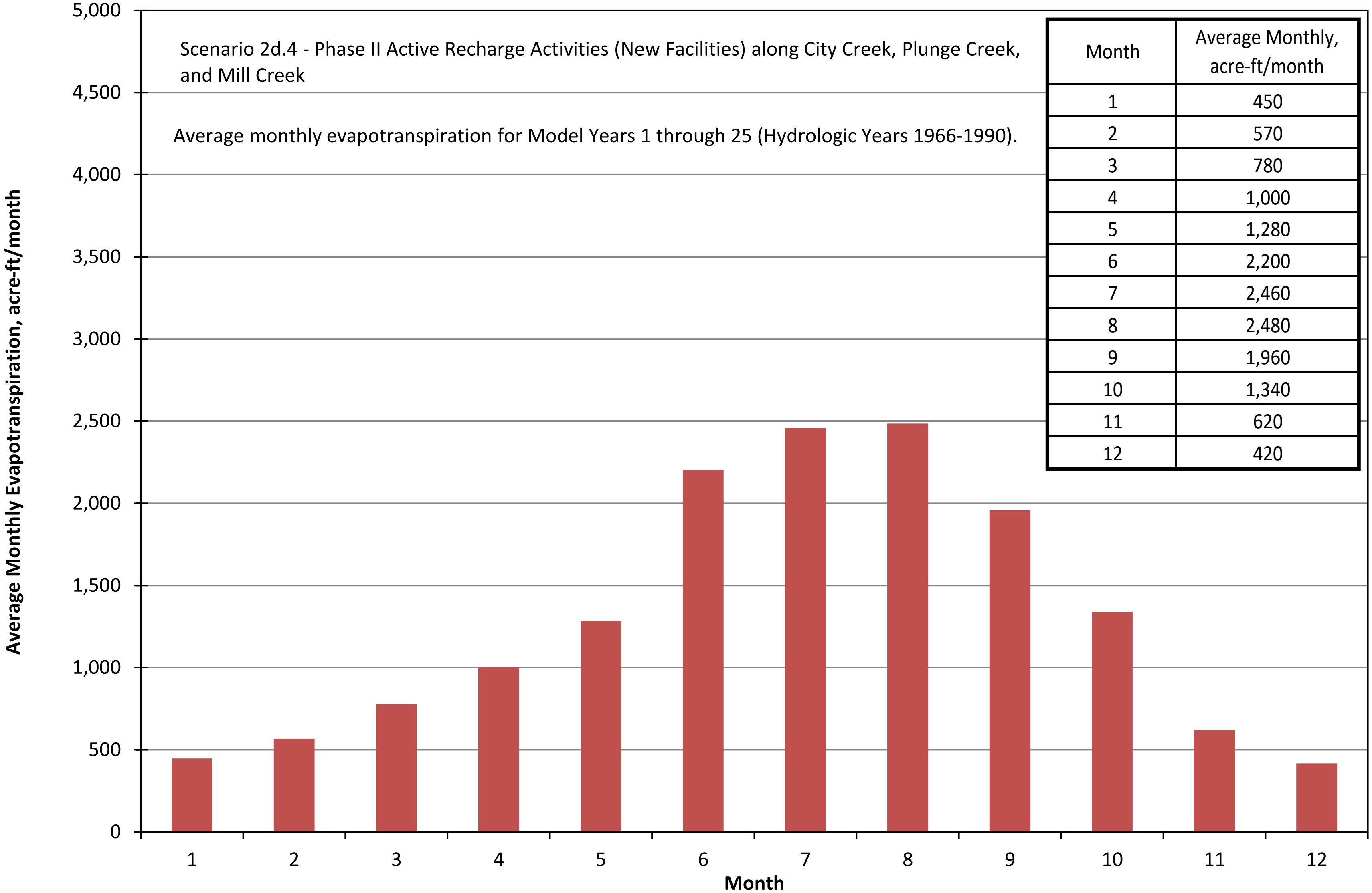

Scenario 2d.4: Annual Change in Evapotranspiration – Prado Basin
Scenario 2d.4 - Phase II Active Recharge Activities (New Facilities) along City Creek, Plunge Creek, and Mill Creek
Prado (Annual Average = 0 acre-ft/yr)
Change in Evapotranspiration, acre-ft/yr
Model Year
50
40
30
20
10
0
-10
-20
-30
-40
-50
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

Figure 641

Scenario 2d.4: Seasonal Evapotranspiration – Prado Basin



Month	Average Monthly, acre-ft/month
1	450
2	570
3	780
4	1,000
5	1,280
6	2,200
7	2,460
8	2,480
9	1,960
10	1,340
11	620
12	420

Figure 642

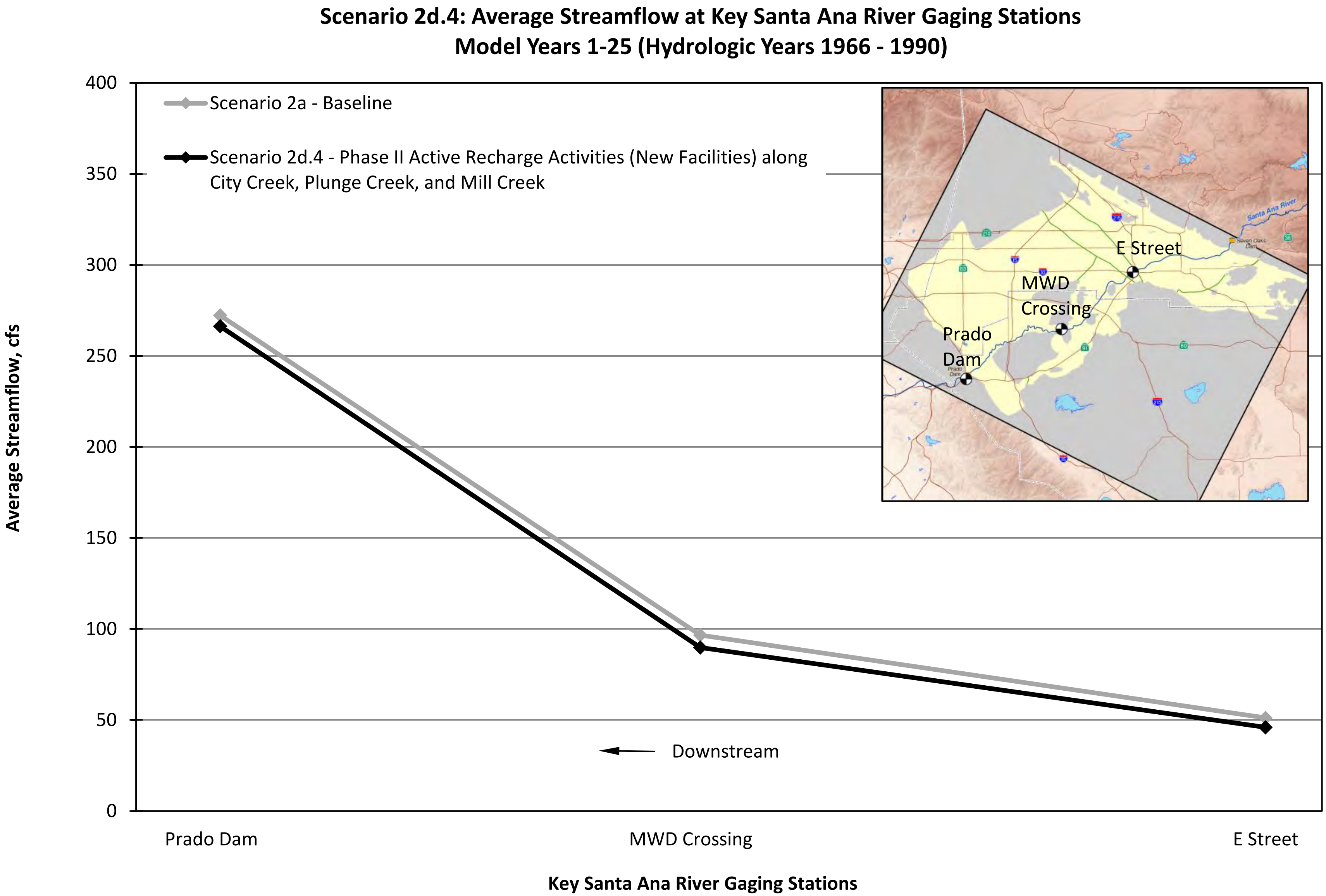

Scenario 2d.4: Average Streamflow at Key Santa Ana River Gaging Stations
Model Years 1-25 (Hydrologic Years 1966 - 1990)
400
350
300
250
200
150
100
50
0
Average Streamflow, cfs
Scenario 2a - Baseline
Scenario 2d.4 - Phase II Active Recharge Activities (New Facilities) along City Creek, Plunge Creek, and Mill Creek
E Street
MWD Crossing
Prado Dam
Downstream
Prado Dam
MWD Crossing
E Street
Key Santa Ana River Gaging Stations

Figure 643

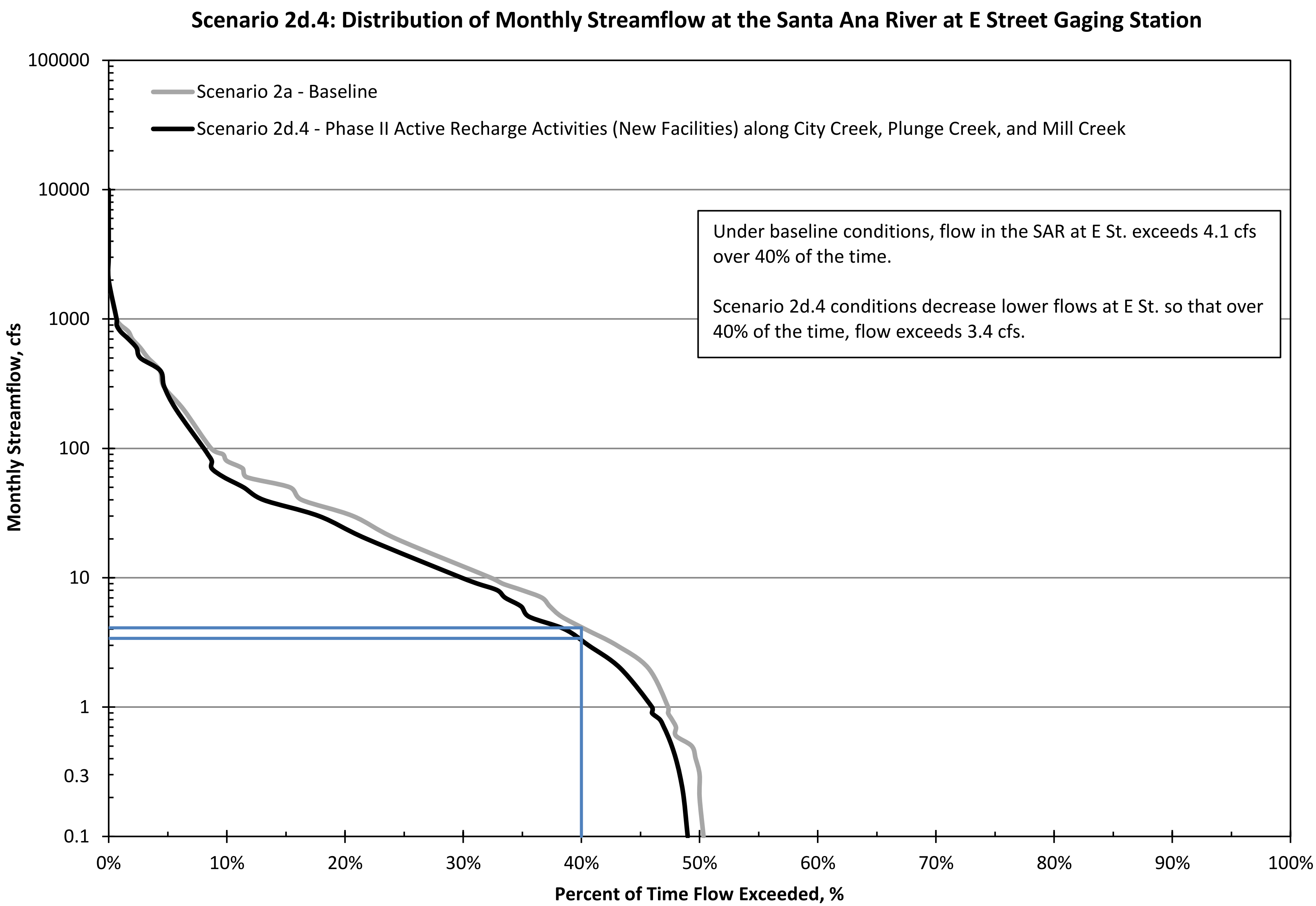

Scenario 2d.4: Distribution of Monthly Streamflow at the Santa Ana River at E Street Gaging Station
100000
10000
1000
100
10
1
0.3
0.1
Monthly Streamflow, cfs
Scenario 2a - Baseline
Scenario 2d.4 - Phase II Active Recharge Activities (New Facilities) along City Creek, Plunge Creek, and Mill Creek
Under baseline conditions, flow in the SAR at E St. exceeds 4.1 cfs over 40% of the time.
Scenario 2d.4 conditions decrease lower flows at E St. so that over 40% of the time, flow exceeds 3.4 cfs.
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 644

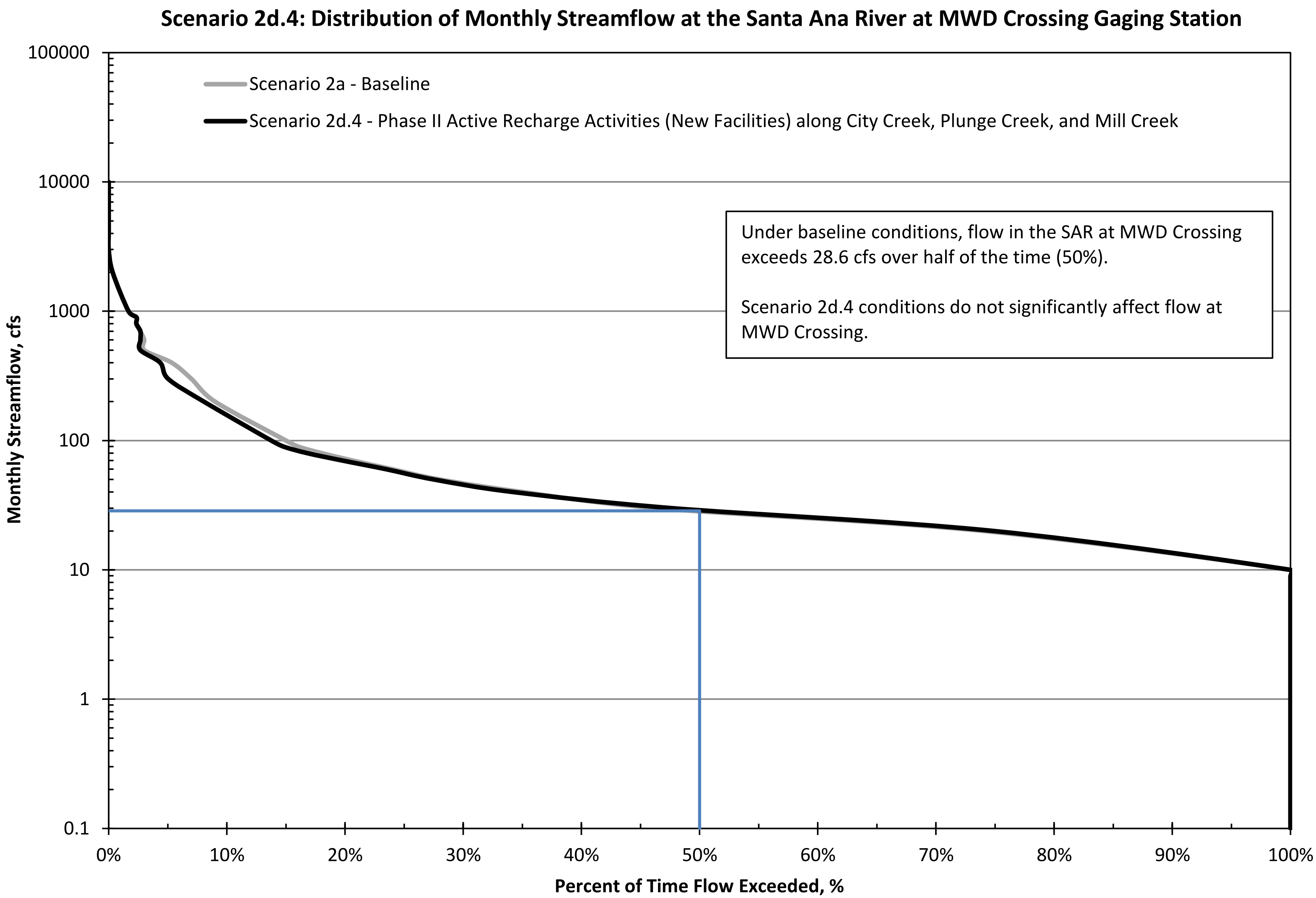

Scenario 2d.4: Distribution of Monthly Streamflow at the Santa Ana River at MWD Crossing Gaging Station
Scenario 2a - Baseline
Scenario 2d.4 - Phase II Active Recharge Activities (New Facilities) along City Creek, Plunge Creek, and Mill Creek
Under baseline conditions, flow in the SAR at MWD Crossing exceeds 28.6 cfs over half of the time (50%).
Scenario 2d.4 conditions do not significantly affect flow at MWD Crossing.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 645

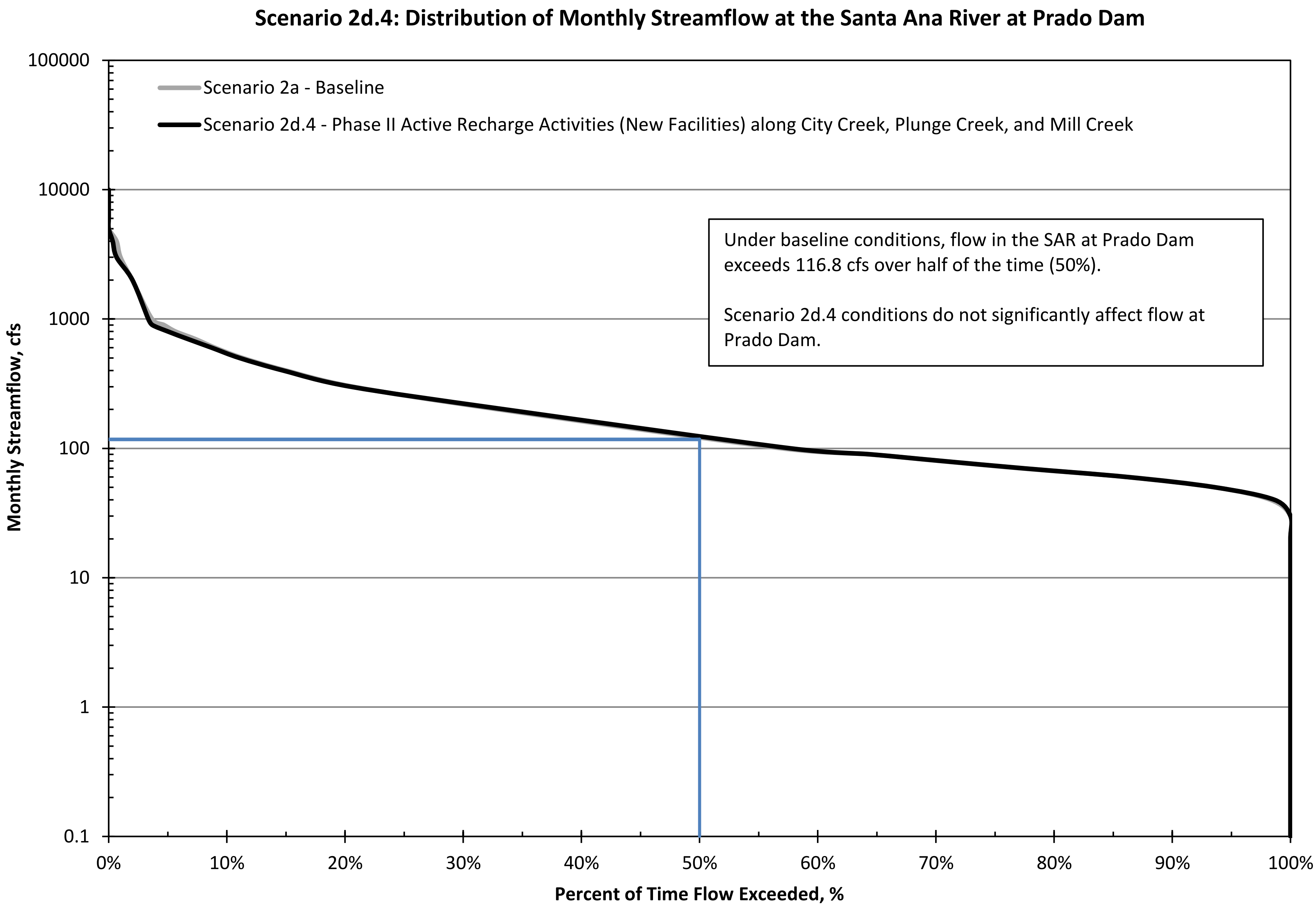

Scenario 2d.4: Distribution of Monthly Streamflow at the Santa Ana River at Prado Dam
Scenario 2a - Baseline
Scenario 2d.4 - Phase II Active Recharge Activities (New Facilities) along City Creek, Plunge Creek, and Mill Creek
Under baseline conditions, flow in the SAR at Prado Dam exceeds 116.8 cfs over half of the time (50%).
Scenario 2d.4 conditions do not significantly affect flow at Prado Dam.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 646

Scenario 2d.4: Annual Rising Water – Integrated SAR Model Area

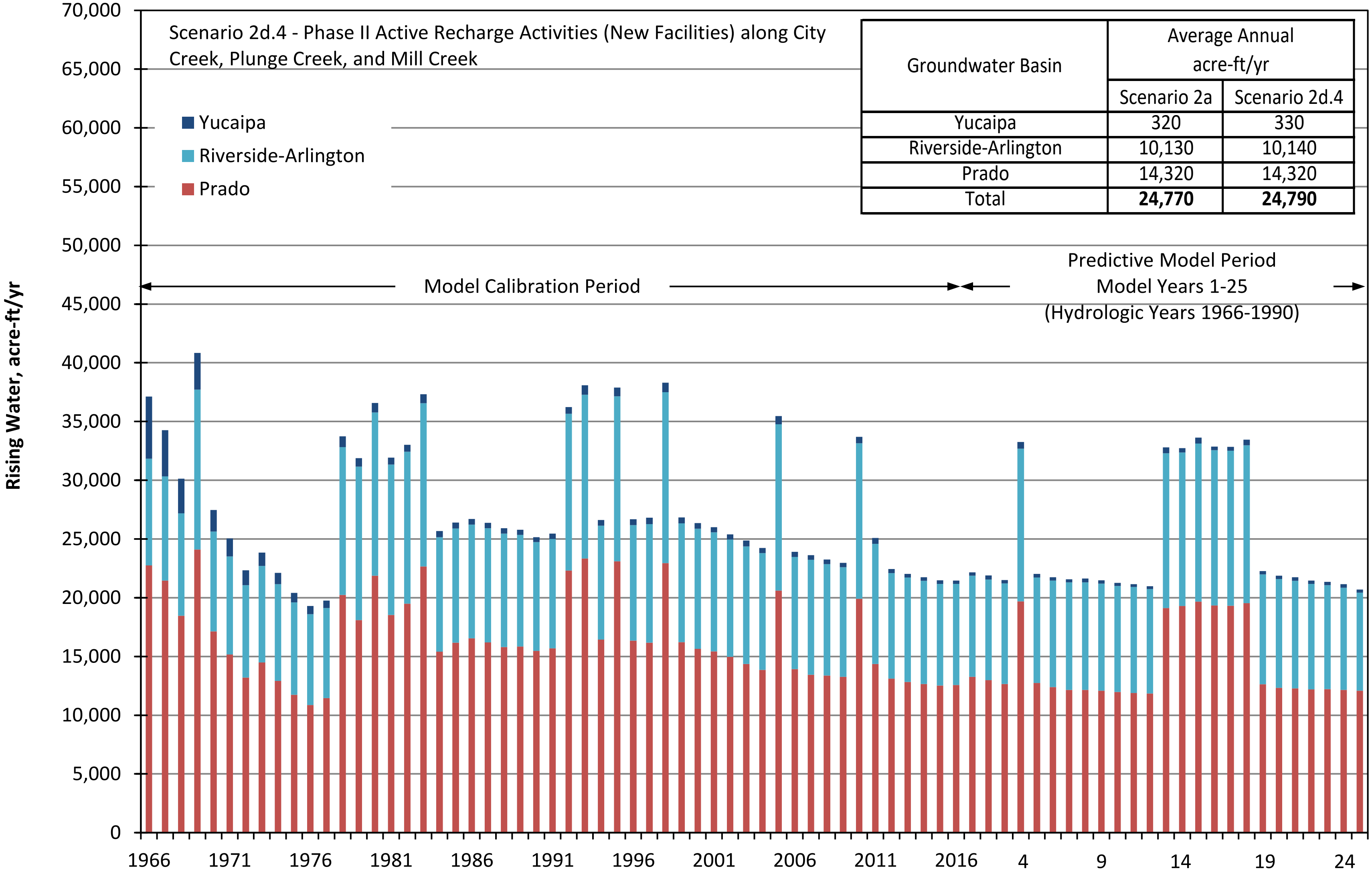


Figure 647

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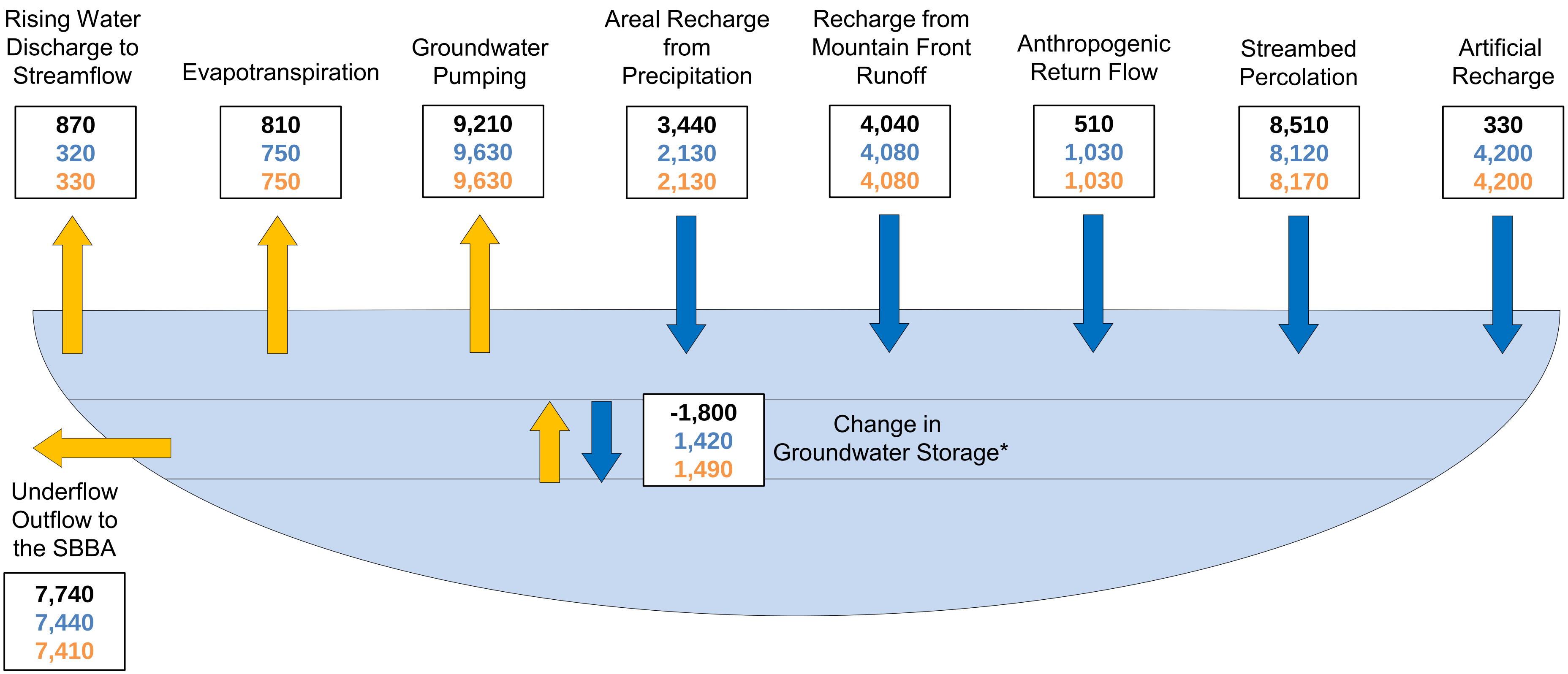

Scenario 2a - Baseline
Scenario 2d.4 - Phase II Active Recharge Activities (New Facilities) along City Creek, Plunge Creek, and Mill Creek

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.4 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.4
AVERAGE ANNUAL
WATER BUDGET
YUCAIPA BASIN

10-Apr-20

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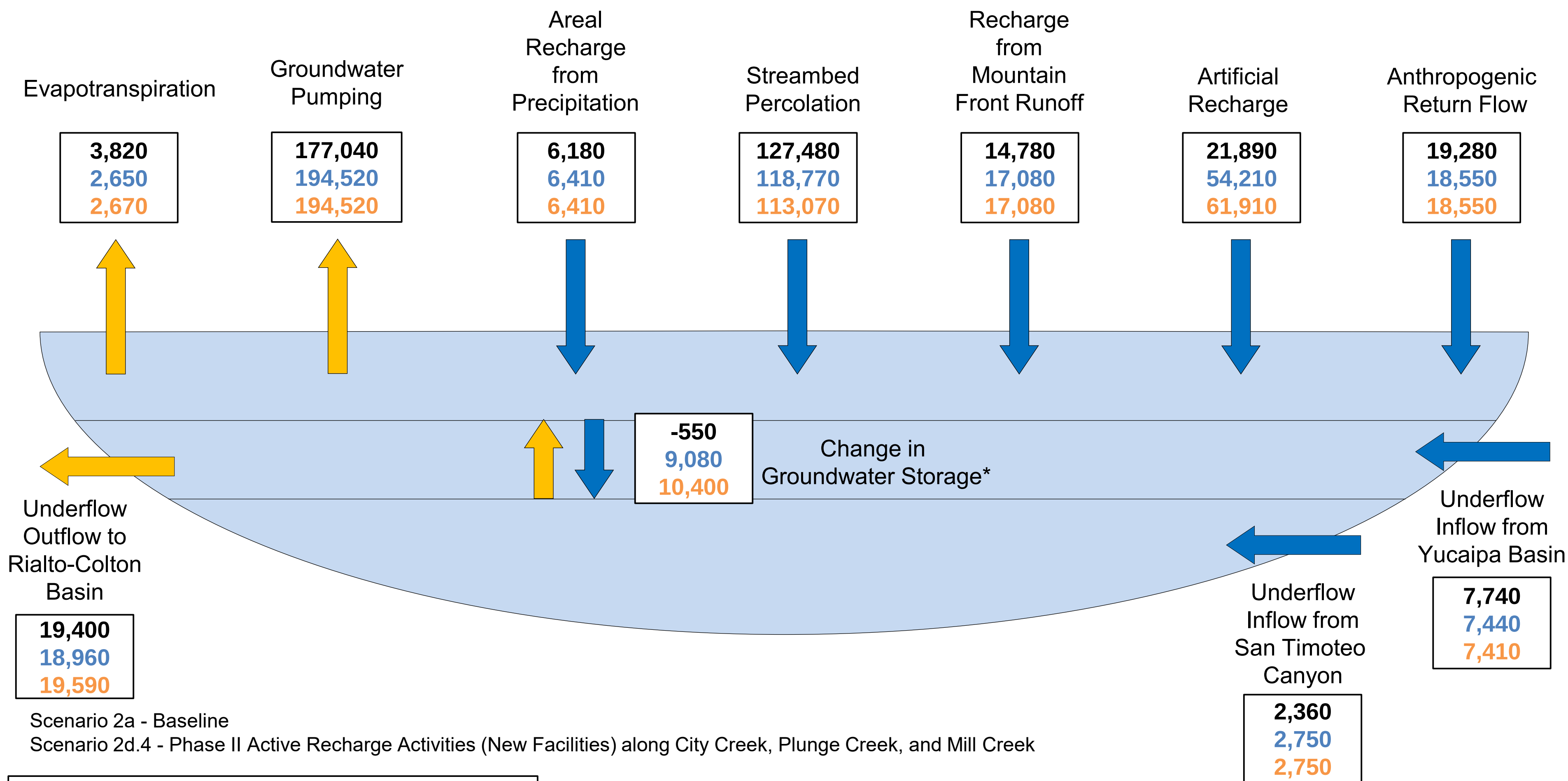

Scenario 2a - Baseline
Scenario 2d.4 - Phase II Active Recharge Activities (New Facilities) along City Creek, Plunge Creek, and Mill Creek

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.4 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.4 AVERAGE ANNUAL WATER BUDGET SBBA

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT **DRAFT** **FIGURE 649**

UPPER SANTA ANA RIVER INTEGRATED MODEL – SUMMARY REPORT

GEOSCIENCE

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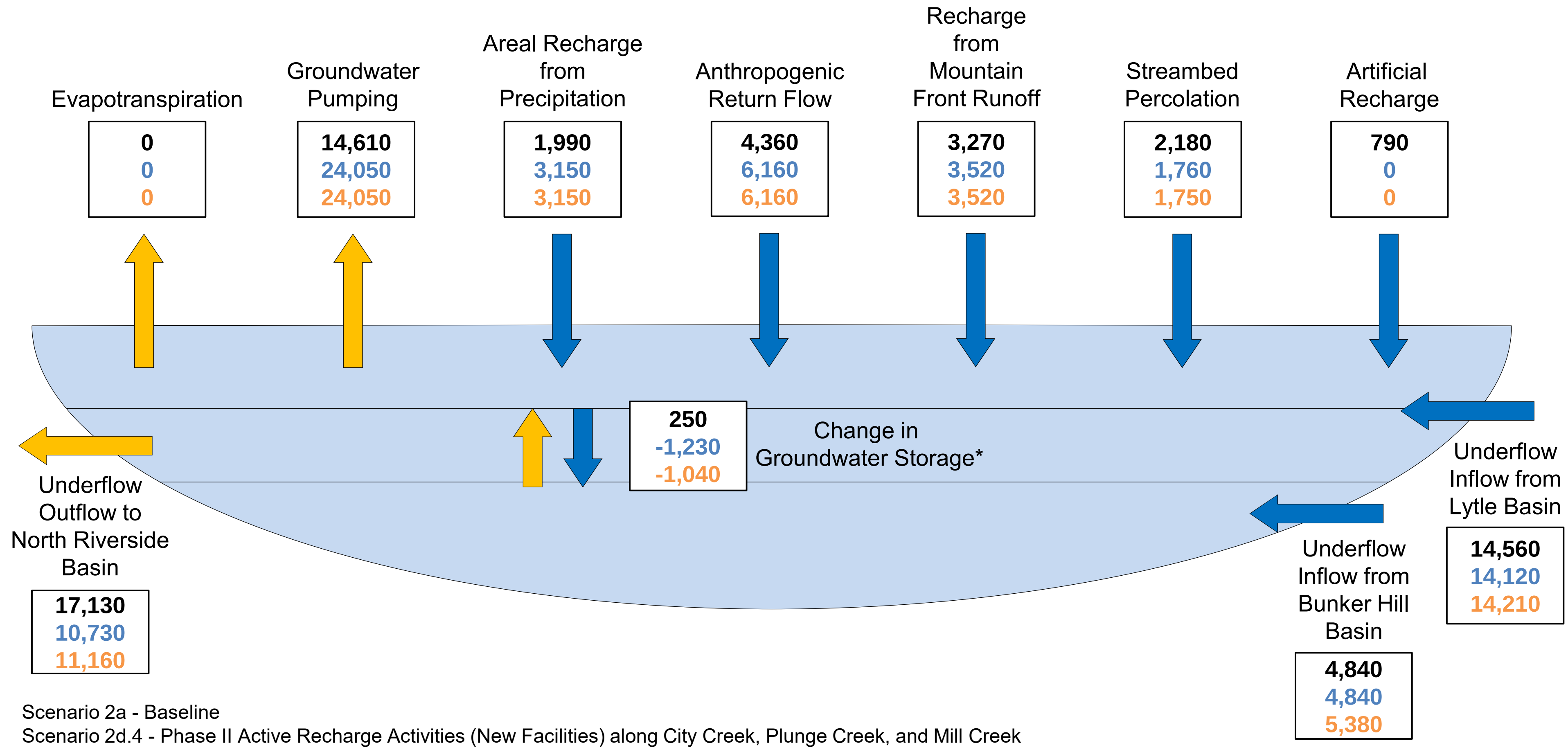


Scenario 2a - Baseline
Scenario 2d.4 - Phase II Active Recharge Activities (New Facilities) along City Creek, Plunge Creek, and Mill Creek

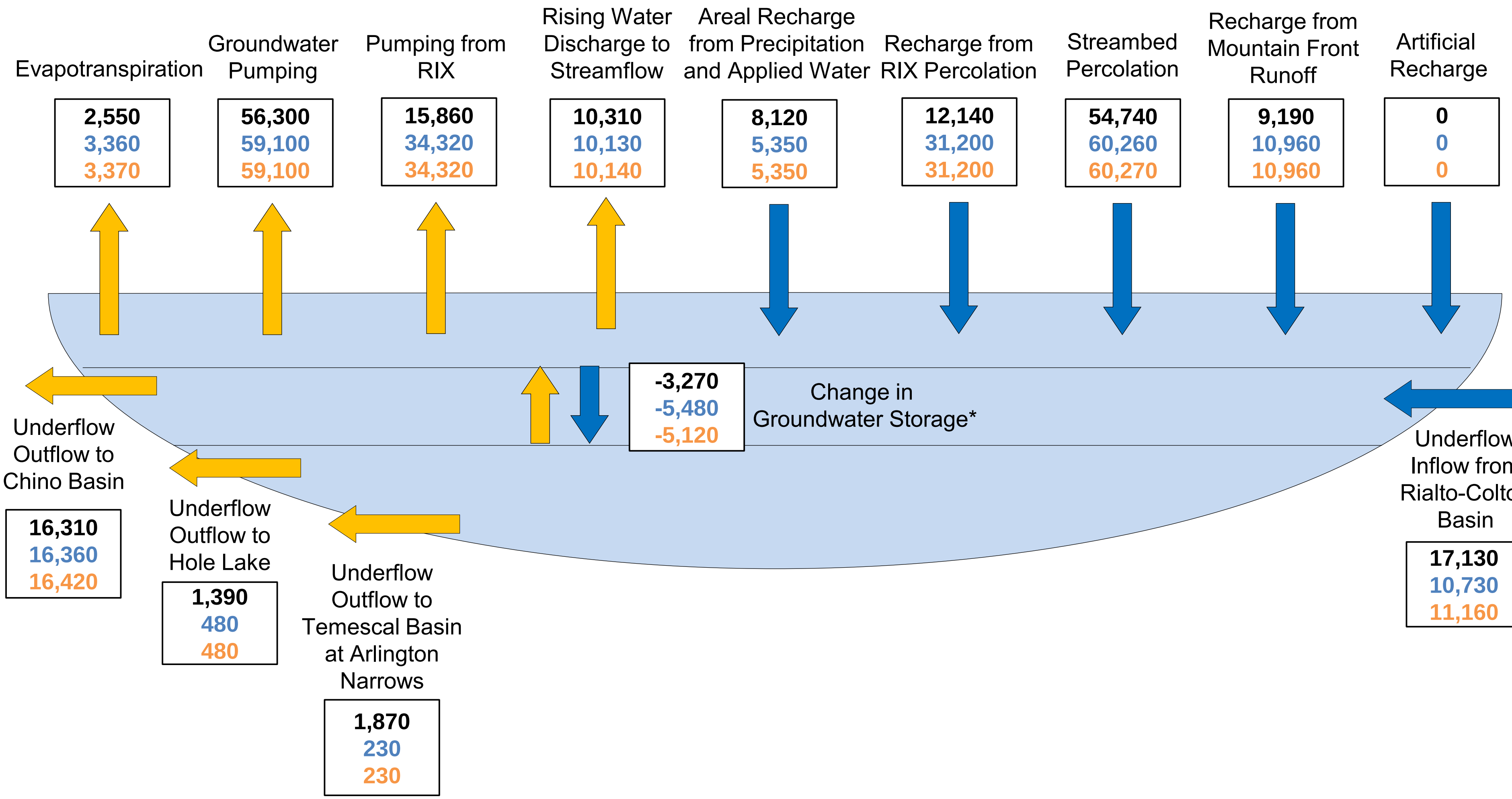
Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.4 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.4
AVERAGE ANNUAL
WATER BUDGET
RIALTO-COLTON BASIN

10-Apr-20



Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.4 (Hydrologic Period 1966-1990)

Scenario 2a - Baseline
Scenario 2d.4 - Phase II Active Recharge Activities (New Facilities) along City Creek, Plunge Creek, and Mill Creek

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.4
AVERAGE ANNUAL
WATER BUDGET
RIVERSIDE-ARLINGTON BASIN

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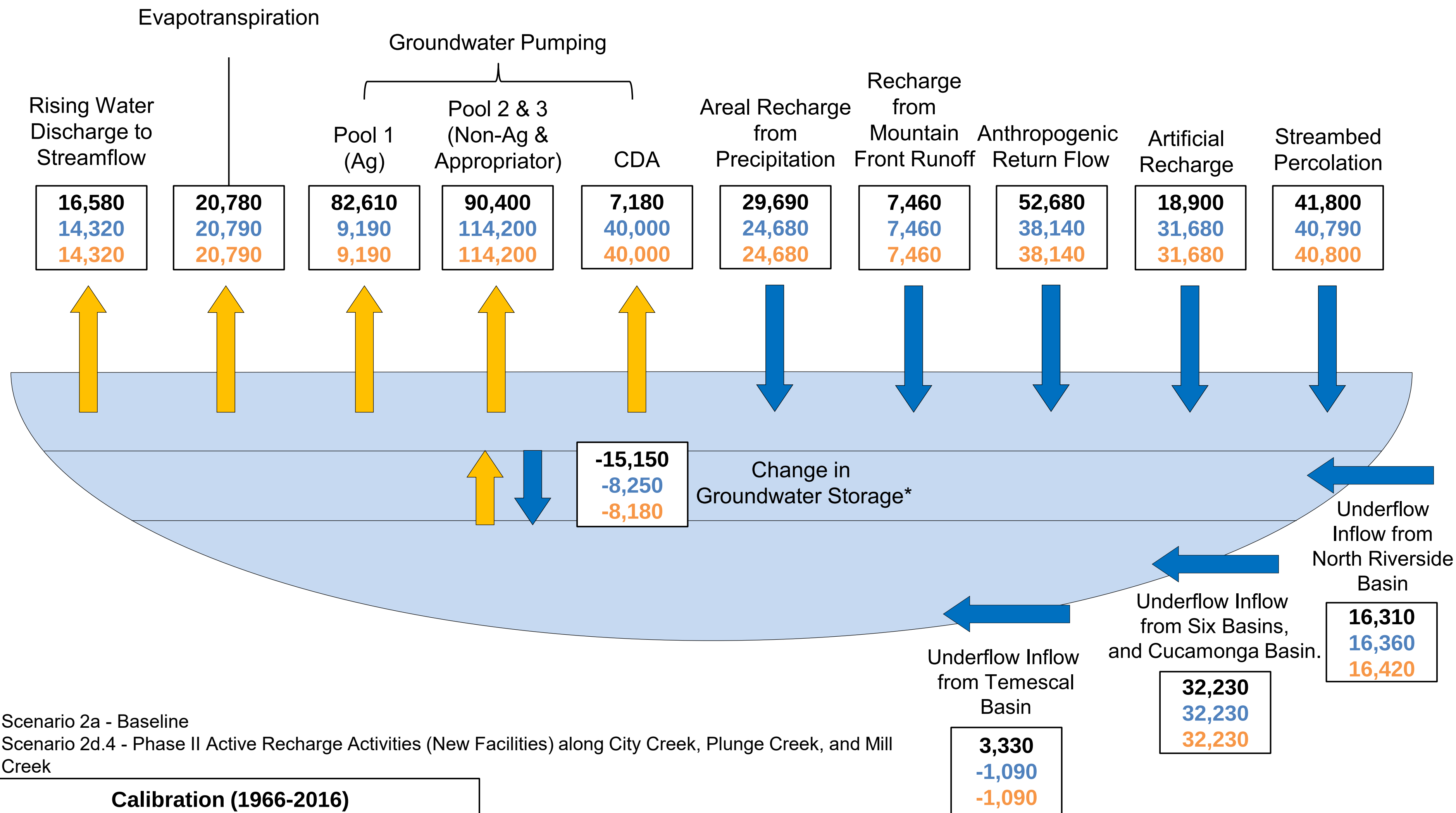
10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT **DRAFT** **FIGURE 651**
UPPER SANTA ANA RIVER INTEGRATED MODEL – SUMMARY REPORT

GEOSCIENCE



Scenario 2a - Baseline
Scenario 2d.4 - Phase II Active Recharge Activities (New Facilities) along City Creek, Plunge Creek, and Mill Creek

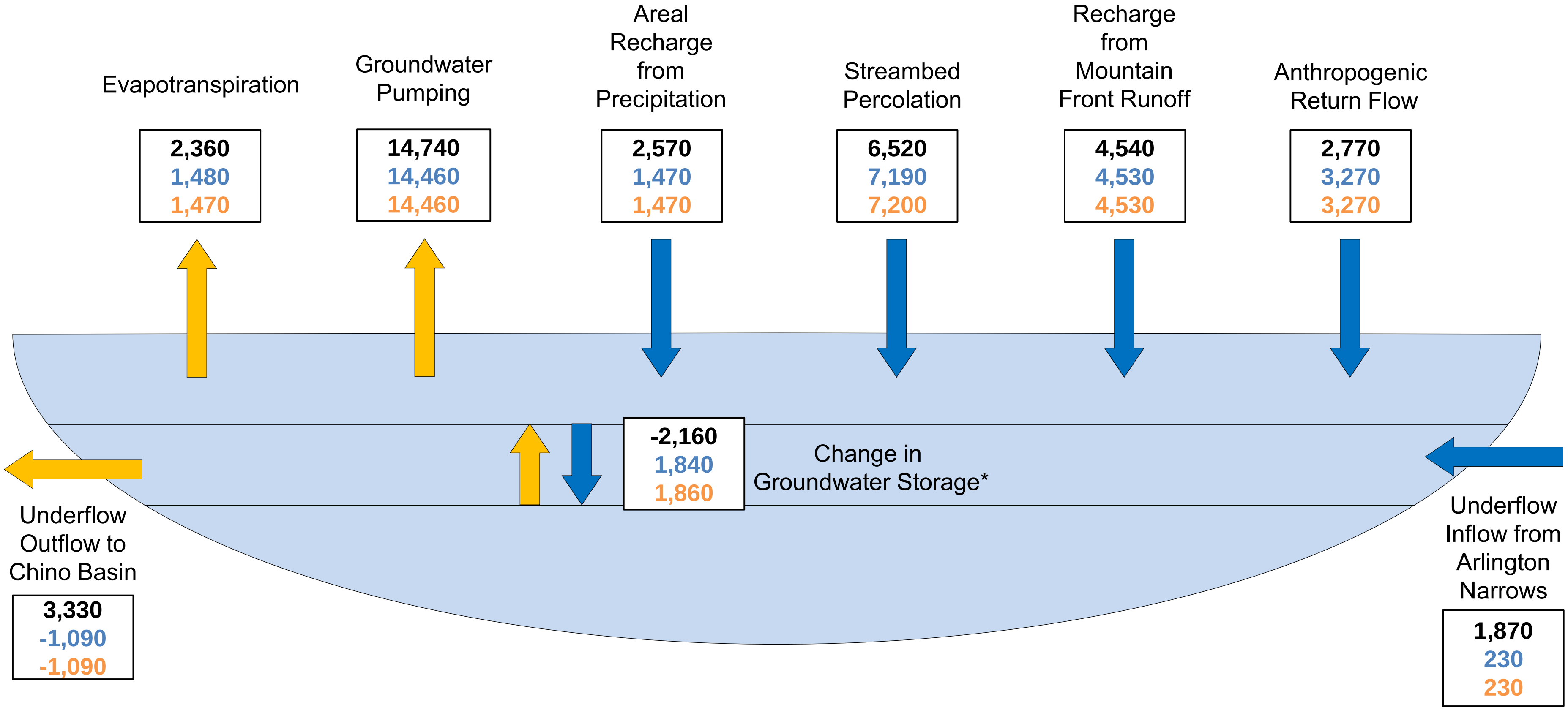
Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.4 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.4
AVERAGE ANNUAL
WATER BUDGET
CHINO BASIN

10-Apr-20



Scenario 2a - Baseline
Scenario 2d.4 - Phase II Active Recharge Activities (New Facilities) along City Creek, Plunge Creek, and Mill Creek

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.4 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.4
AVERAGE ANNUAL
WATER BUDGET
TEMESCAL BASIN

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10-Apr-20

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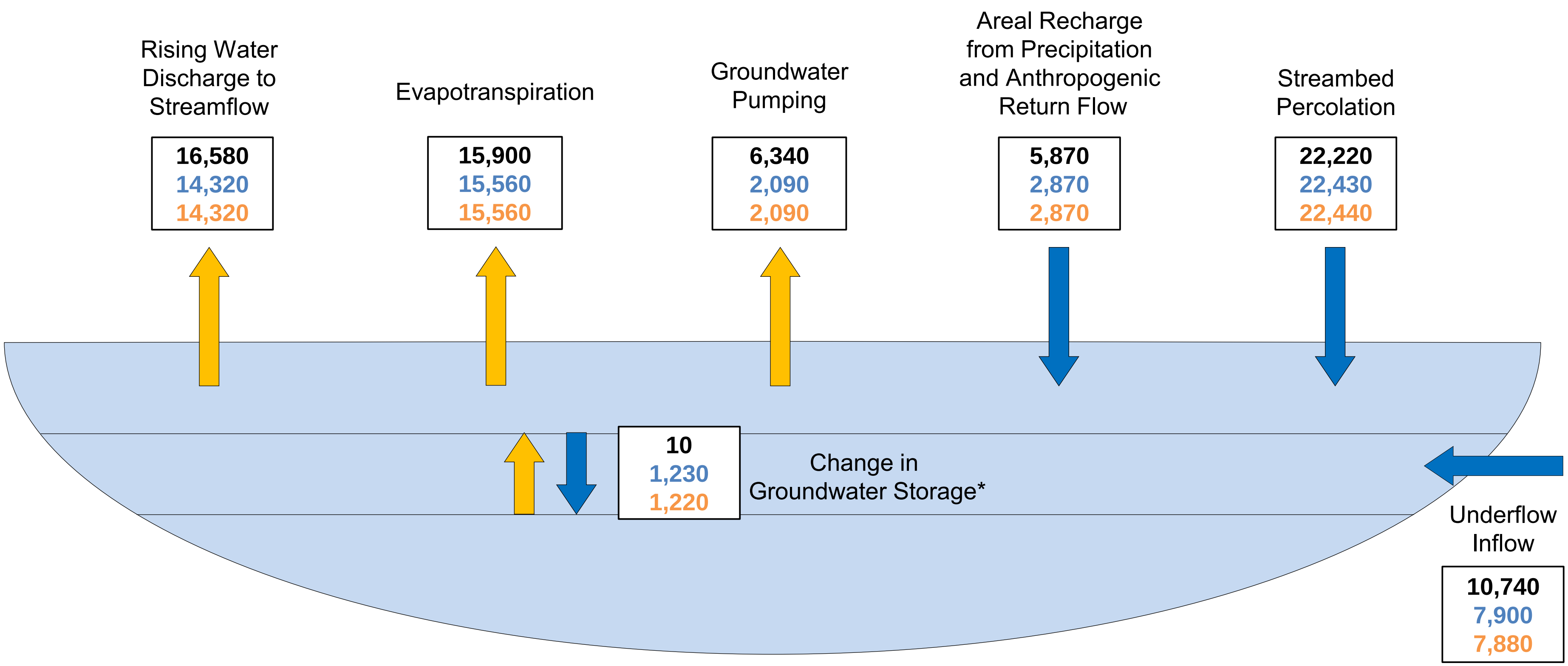


Scenario 2a - Baseline
Scenario 2d.4 - Phase II Active Recharge Activities (New Facilities) along City Creek, Plunge Creek, and Mill Creek

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.4 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

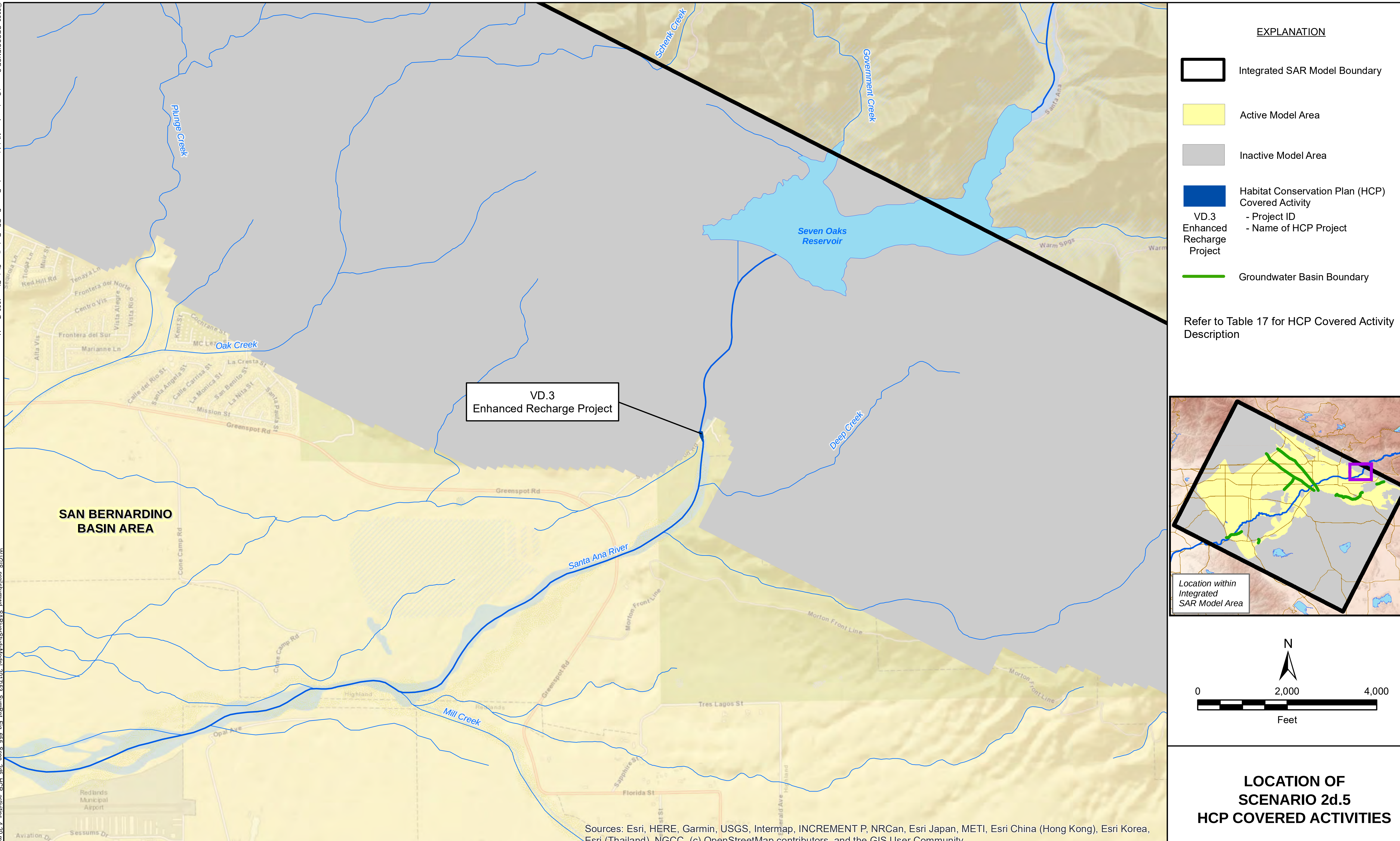
*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.4 AVERAGE ANNUAL WATER BUDGET PRADO BASIN

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT **DRAFT** **FIGURE 654**
UPPER SANTA ANA RIVER INTEGRATED MODEL – SUMMARY REPORT

GEOSCIENCE



LOCATION OF SCENARIO 2d.5 HCP COVERED ACTIVITIES

W:\GIS_projects\svmwd_SARiverStudyModel_201753_SumRpt_Fig_655_Scen_2d5_HCP_activities_4-20.mxd

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

DRAFT

FIGURE 655

GEOSCIENCE

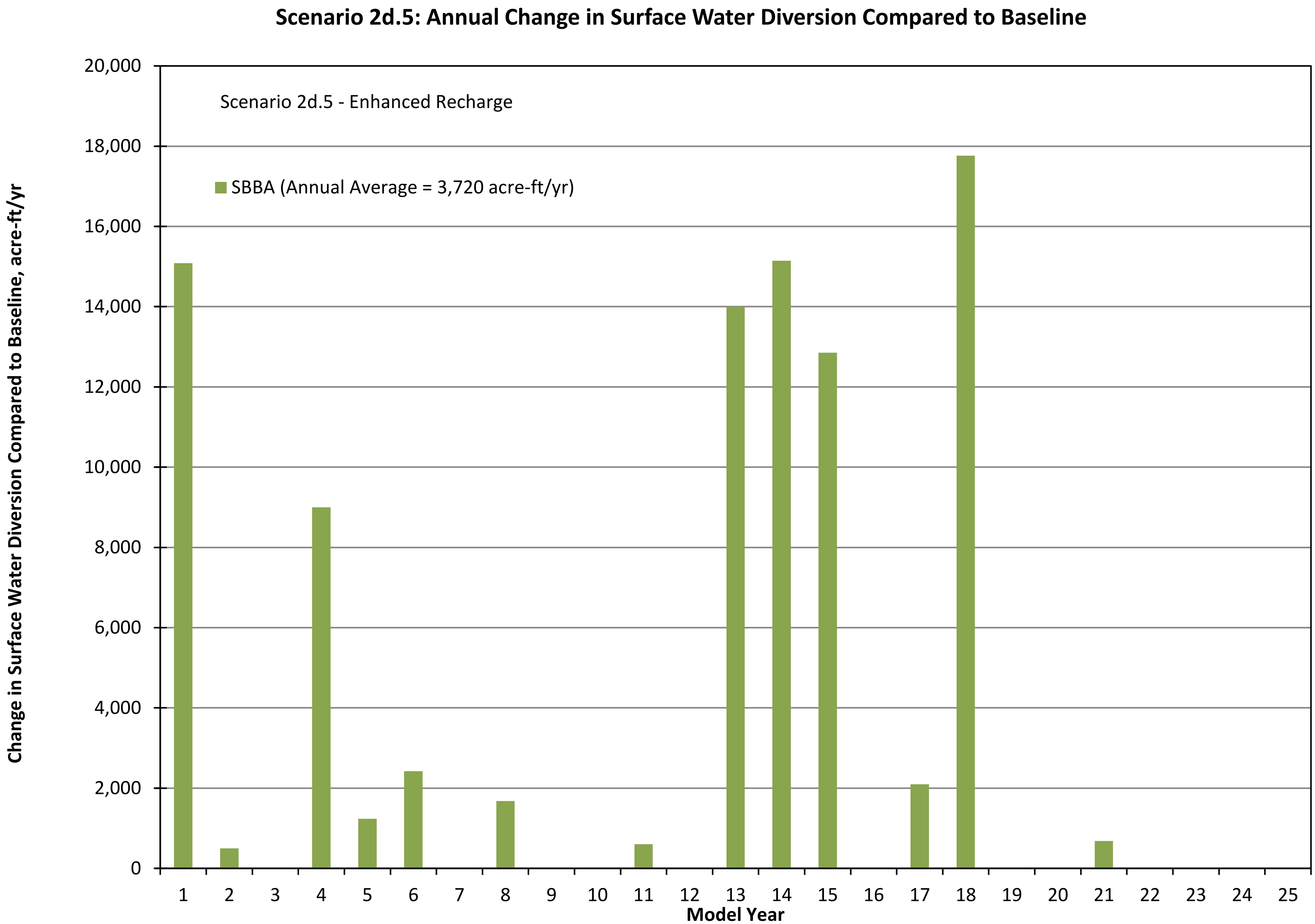

Scenario 2d.5: Annual Change in Surface Water Diversion Compared to Baseline
Scenario 2d.5 - Enhanced Recharge
SBBA (Annual Average = 3,720 acre-ft/yr)
Change in Surface Water Diversion Compared to Baseline, acre-ft/yr
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Model Year

Figure 656

DRAFT

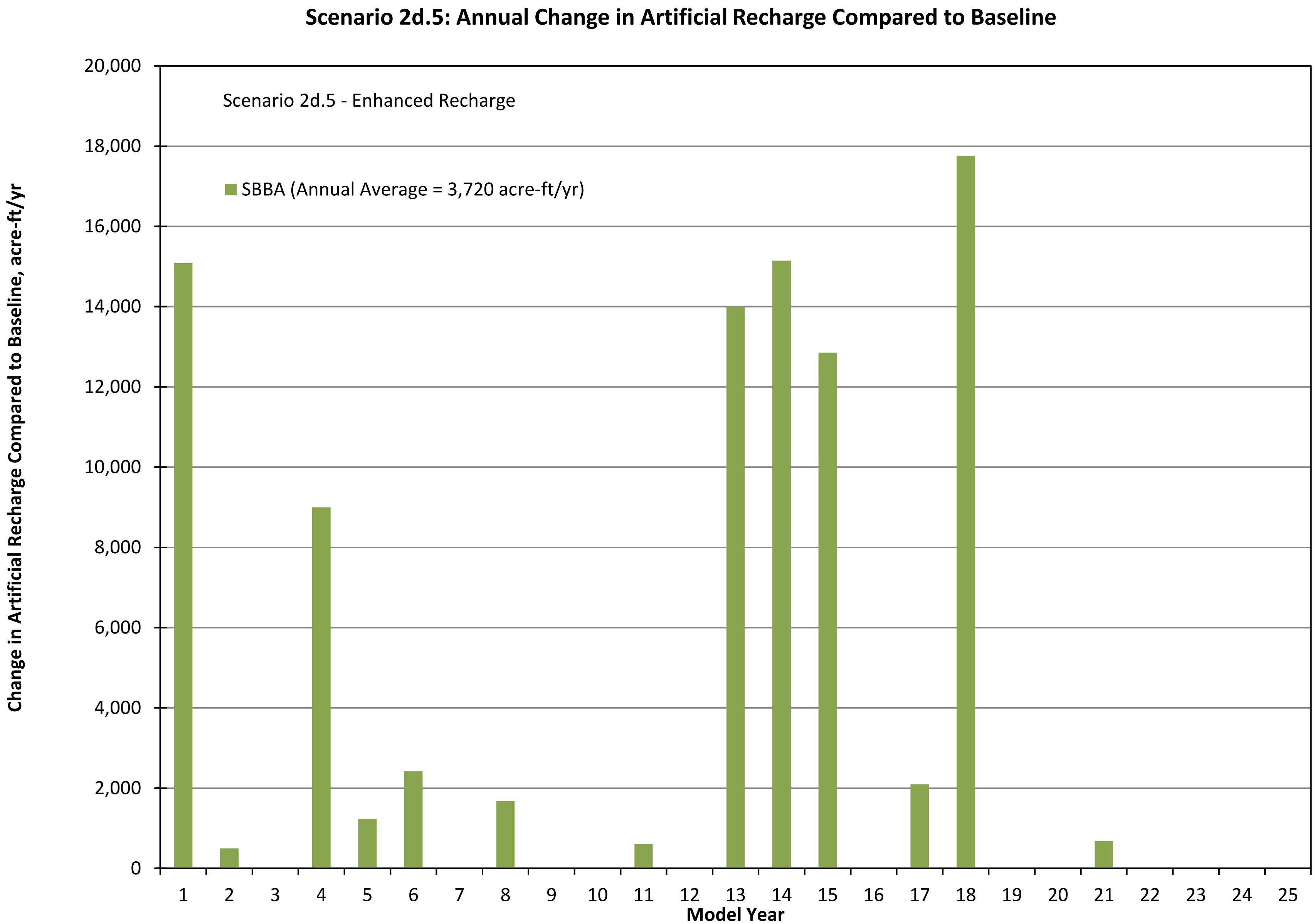
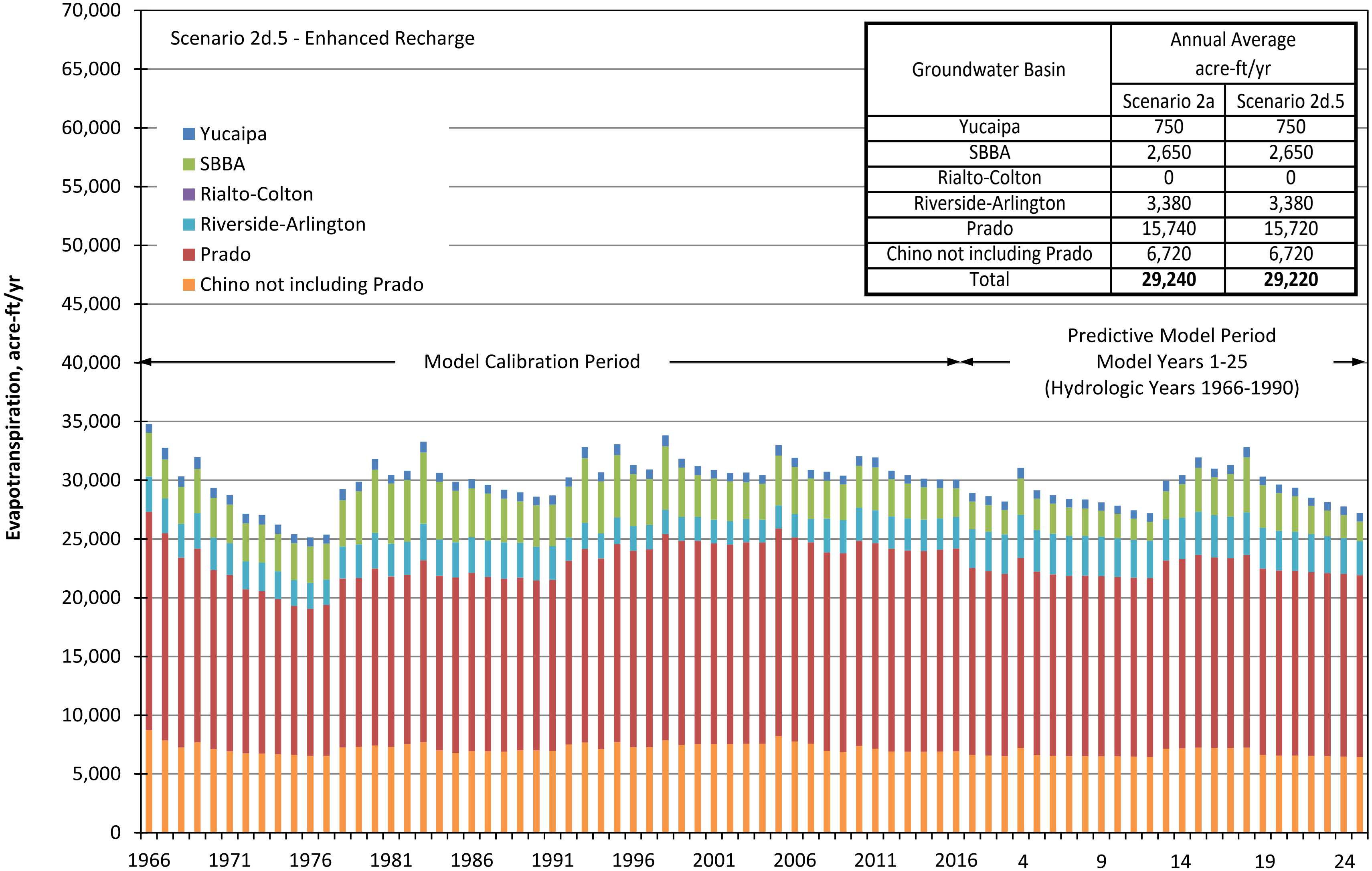


Figure 657

Scenario 2d.5: Annual Evapotranspiration – Integrated SAR Model Area



Groundwater Basin	Annual Average acre-ft/yr	
	Scenario 2a	Scenario 2d.5
Yucaipa	750	750
SBBA	2,650	2,650
Rialto-Colton	0	0
Riverside-Arlington	3,380	3,380
Prado	15,740	15,720
Chino not including Prado	6,720	6,720
Total	**29,240**	**29,220**

Figure 658

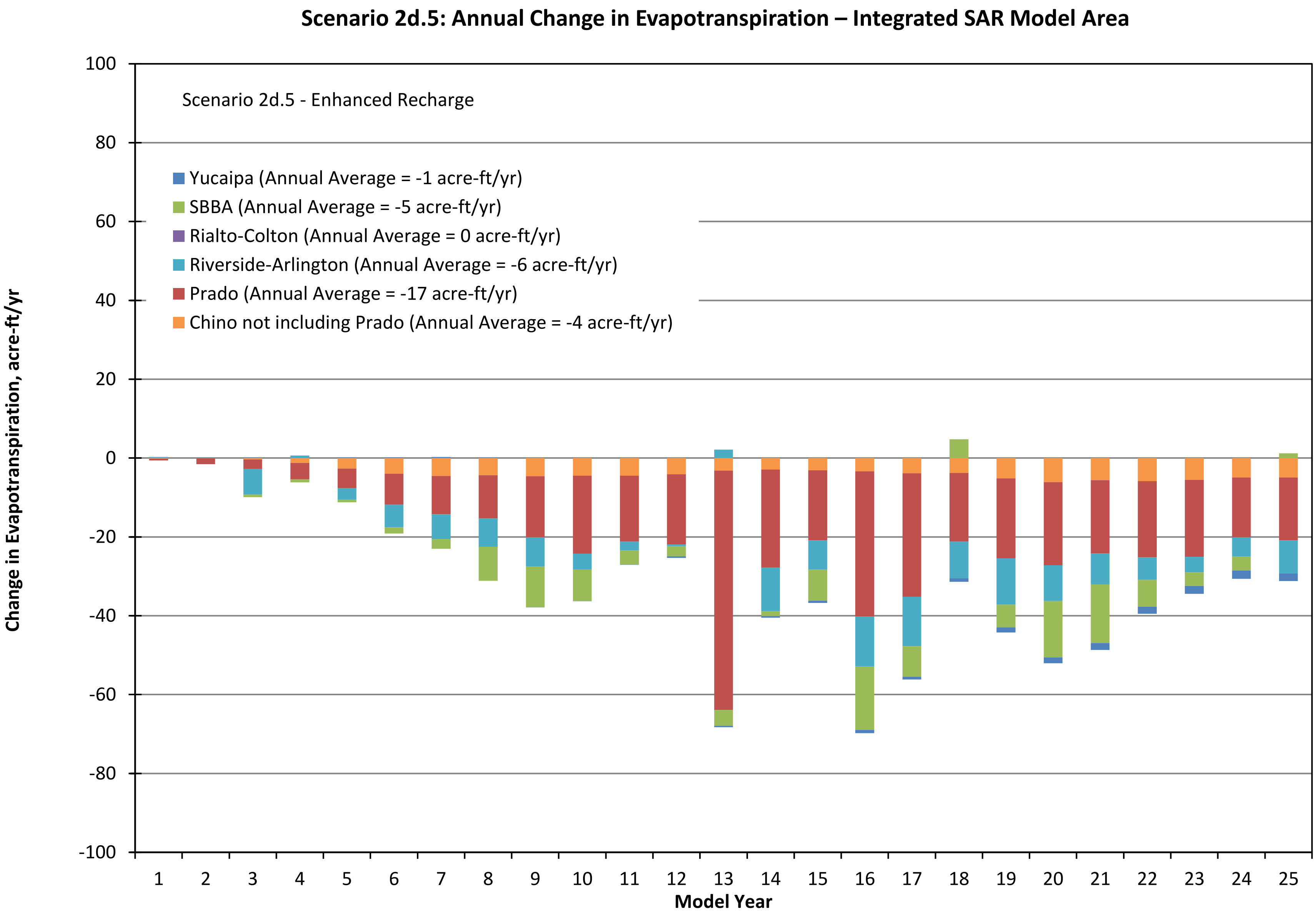
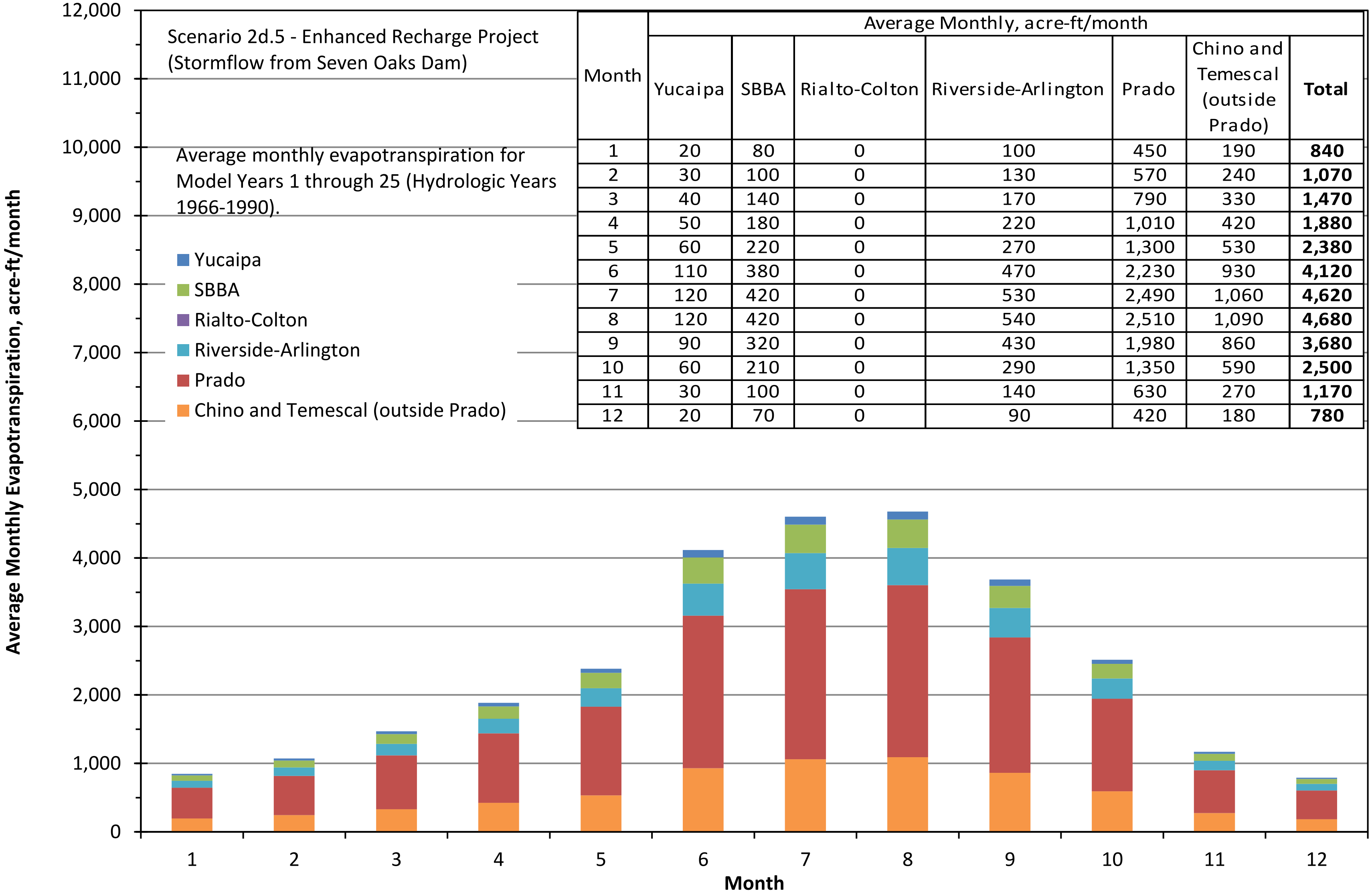

Scenario 2d.5: Annual Change in Evapotranspiration – Integrated SAR Model Area
Scenario 2d.5 - Enhanced Recharge
Yucaipa (Annual Average = -1 acre-ft/yr)
SBBA (Annual Average = -5 acre-ft/yr)
Rialto-Colton (Annual Average = 0 acre-ft/yr)
Riverside-Arlington (Annual Average = -6 acre-ft/yr)
Prado (Annual Average = -17 acre-ft/yr)
Chino not including Prado (Annual Average = -4 acre-ft/yr)
Change in Evapotranspiration, acre-ft/yr
100
80
60
40
20
0
-20
-40
-60
-80
-100
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
Model Year

Figure 659

Scenario 2d.5: Seasonal Evapotranspiration – Integrated SAR Model Area



Month	Average Monthly, acre-ft/month						
	Yucaipa	SBBA	Rialto-Colton	Riverside-Arlington	Prado	Chino and Temescal (outside Prado)	**Total**
1	20	80	0	100	450	190	**840**
2	30	100	0	130	570	240	**1,070**
3	40	140	0	170	790	330	**1,470**
4	50	180	0	220	1,010	420	**1,880**
5	60	220	0	270	1,300	530	**2,380**
6	110	380	0	470	2,230	930	**4,120**
7	120	420	0	530	2,490	1,060	**4,620**
8	120	420	0	540	2,510	1,090	**4,680**
9	90	320	0	430	1,980	860	**3,680**
10	60	210	0	290	1,350	590	**2,500**
11	30	100	0	140	630	270	**1,170**
12	20	70	0	90	420	180	**780**

Figure 660

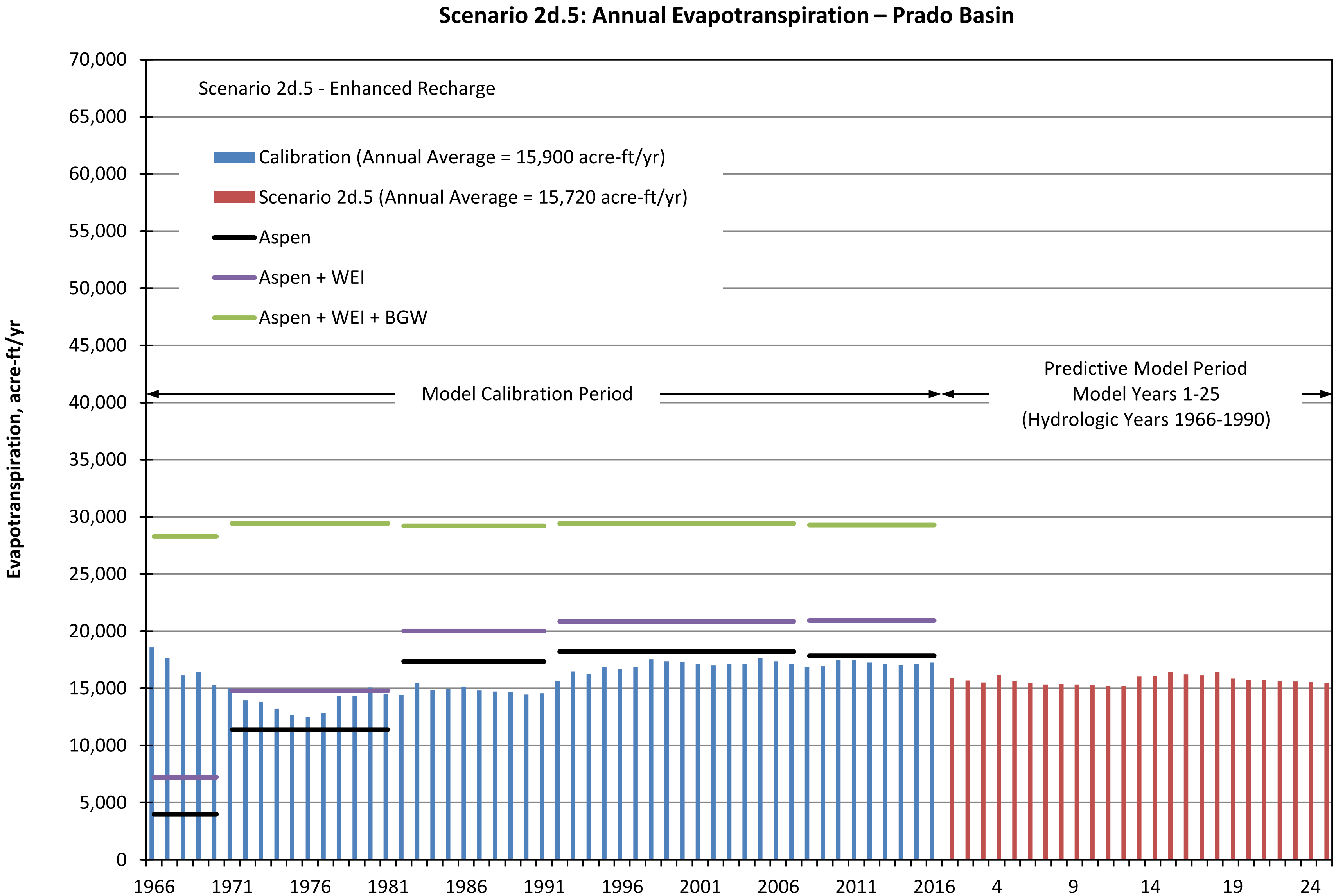

Scenario 2d.5: Annual Evapotranspiration – Prado Basin
Scenario 2d.5 - Enhanced Recharge
Calibration (Annual Average = 15,900 acre-ft/yr)
Scenario 2d.5 (Annual Average = 15,720 acre-ft/yr)
Aspen
Aspen + WEI
Aspen + WEI + BGW
Model Calibration Period
Predictive Model Period
Model Years 1-25
(Hydrologic Years 1966-1990)
Evapotranspiration, acre-ft/yr
70,000
65,000
60,000
55,000
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
1966
1971
1976
1981
1986
1991
1996
2001
2006
2011
2016
4
9
14
19
24

Figure 661

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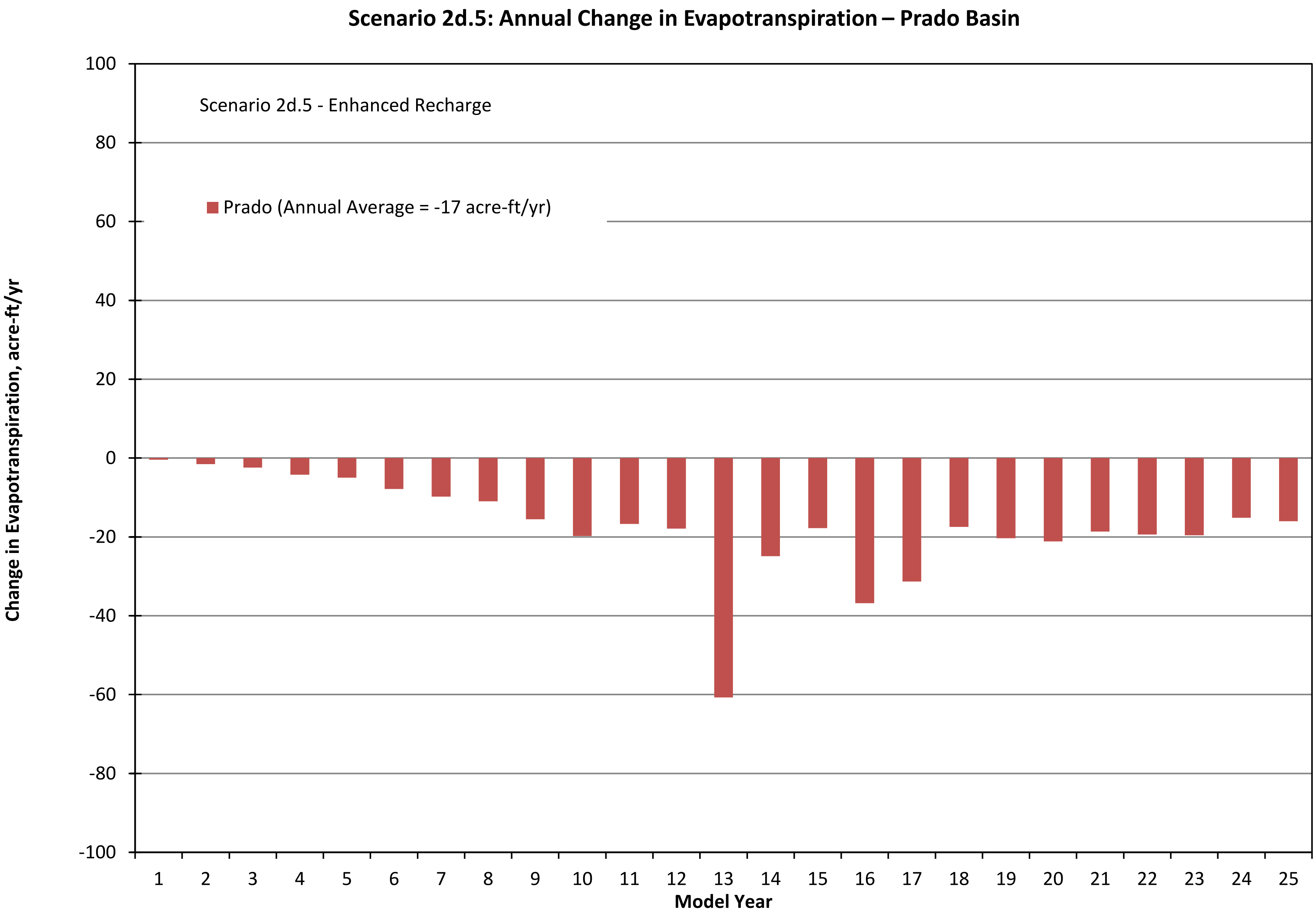
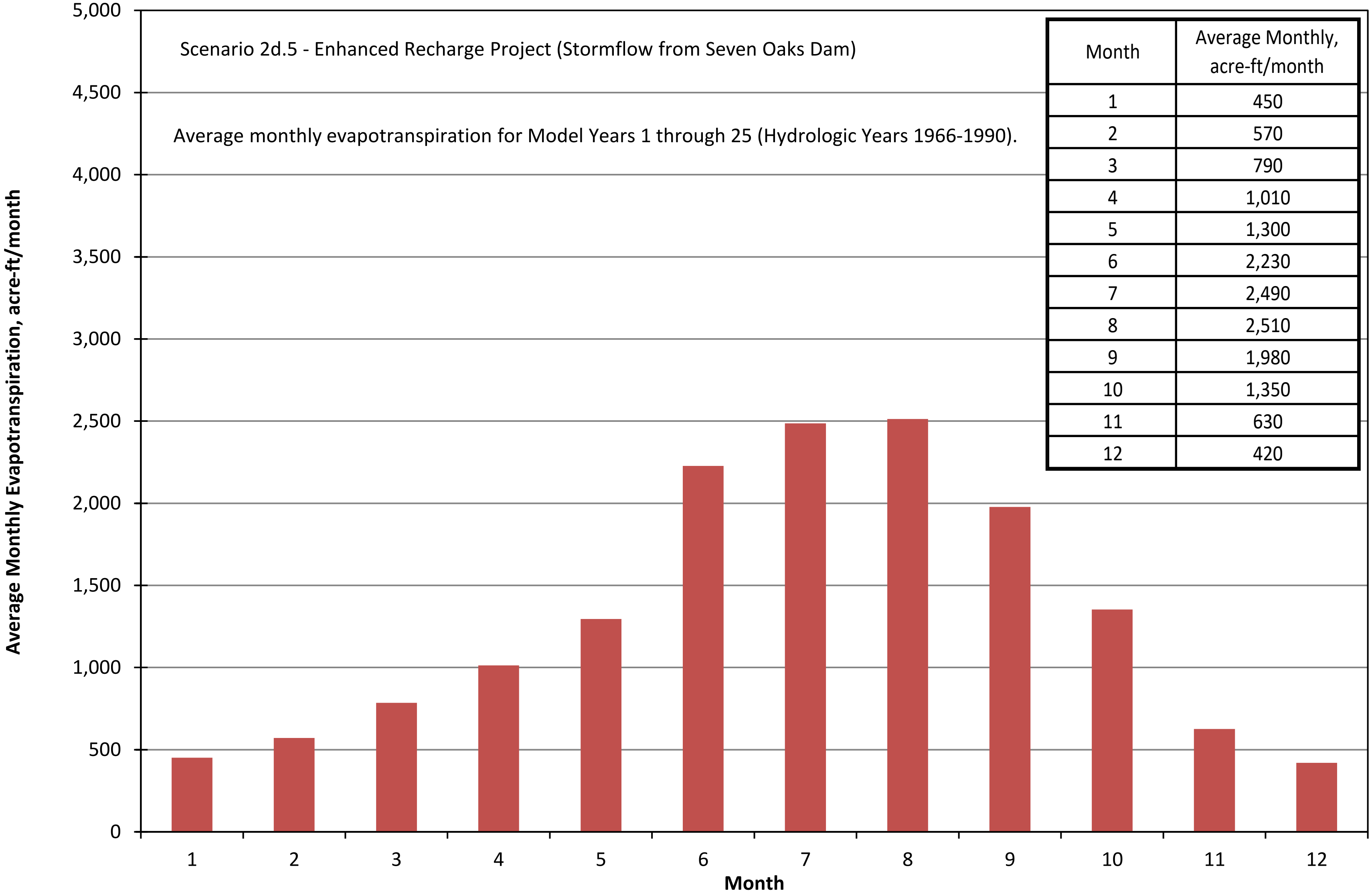


Figure 662

Scenario 2d.5: Seasonal Evapotranspiration – Prado Basin



Month	Average Monthly, acre-ft/month
1	450
2	570
3	790
4	1,010
5	1,300
6	2,230
7	2,490
8	2,510
9	1,980
10	1,350
11	630
12	420

Figure 663

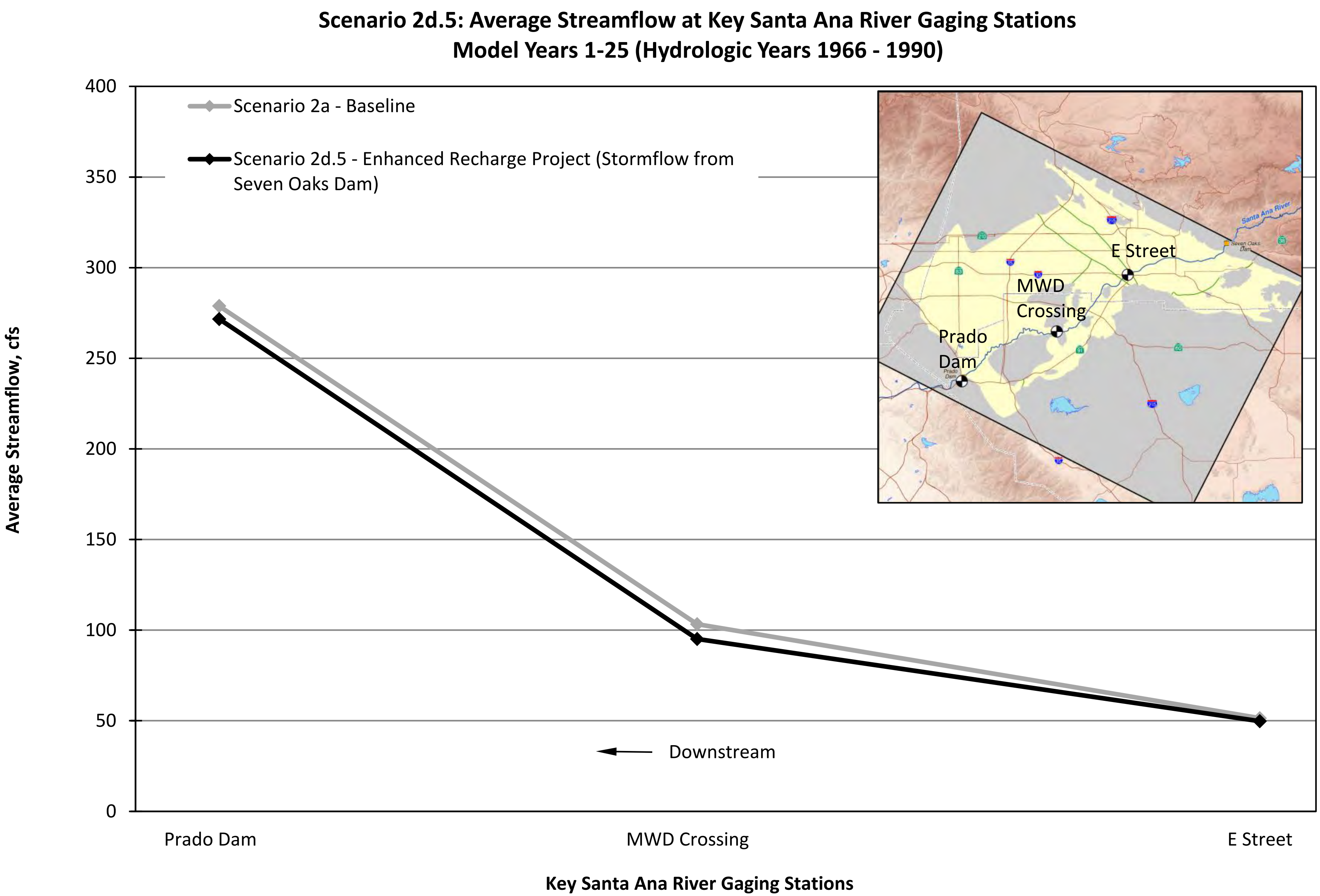

Scenario 2d.5: Average Streamflow at Key Santa Ana River Gaging Stations
Model Years 1-25 (Hydrologic Years 1966 - 1990)
Scenario 2a - Baseline
Scenario 2d.5 - Enhanced Recharge Project (Stormflow from Seven Oaks Dam)
400
350
300
250
200
150
100
50
0
Average Streamflow, cfs
E Street
MWD Crossing
Prado Dam
Downstream
Prado Dam
MWD Crossing
E Street
Key Santa Ana River Gaging Stations

Figure 664

Scenario 2d.5: Distribution of Monthly Streamflow at the Santa Ana River at E Street Gaging Station

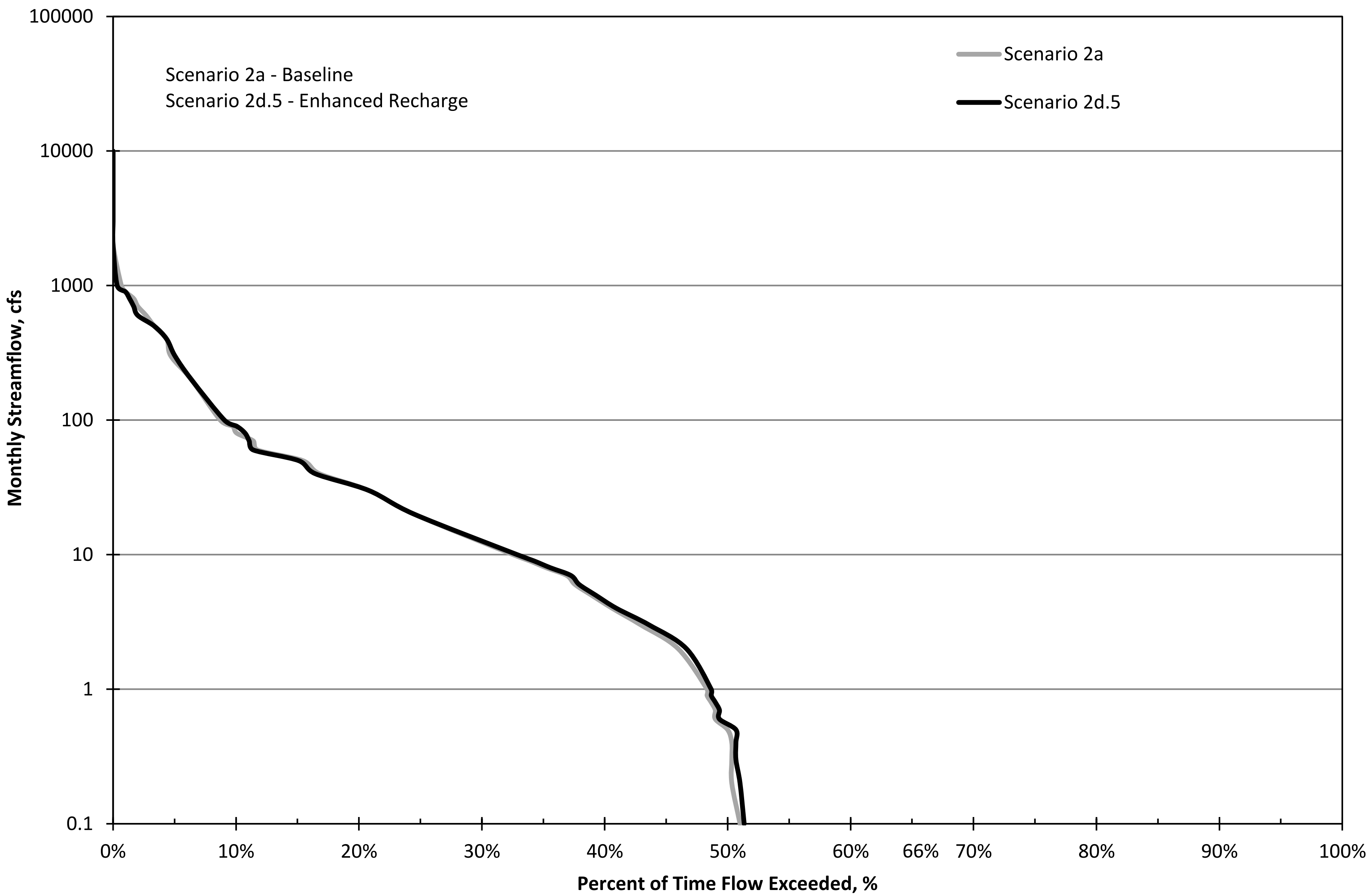


Figure 665

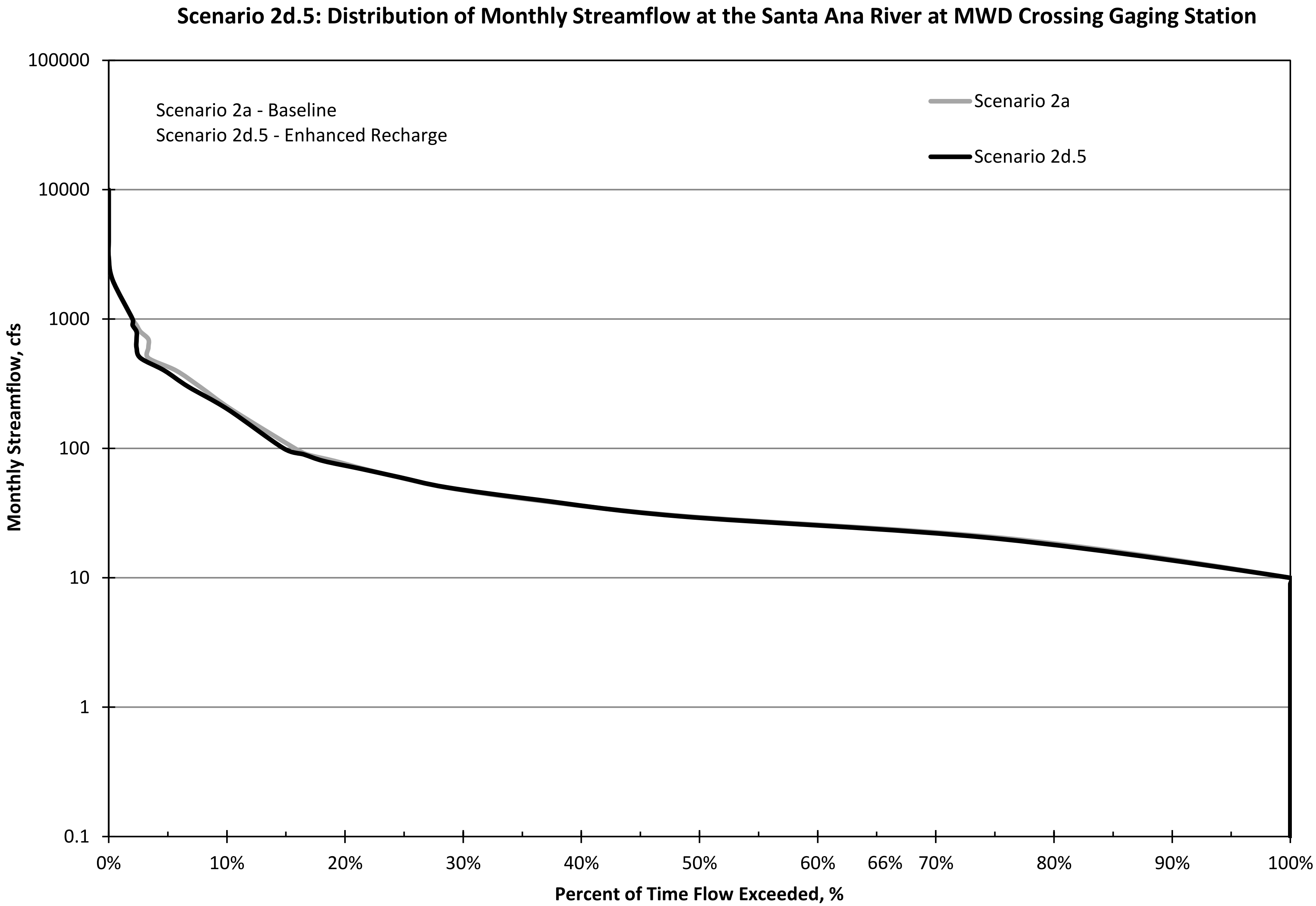

Scenario 2d.5: Distribution of Monthly Streamflow at the Santa Ana River at MWD Crossing Gaging Station
Scenario 2a - Baseline
Scenario 2d.5 - Enhanced Recharge
Scenario 2a
Scenario 2d.5
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
66%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 666

DRAFT

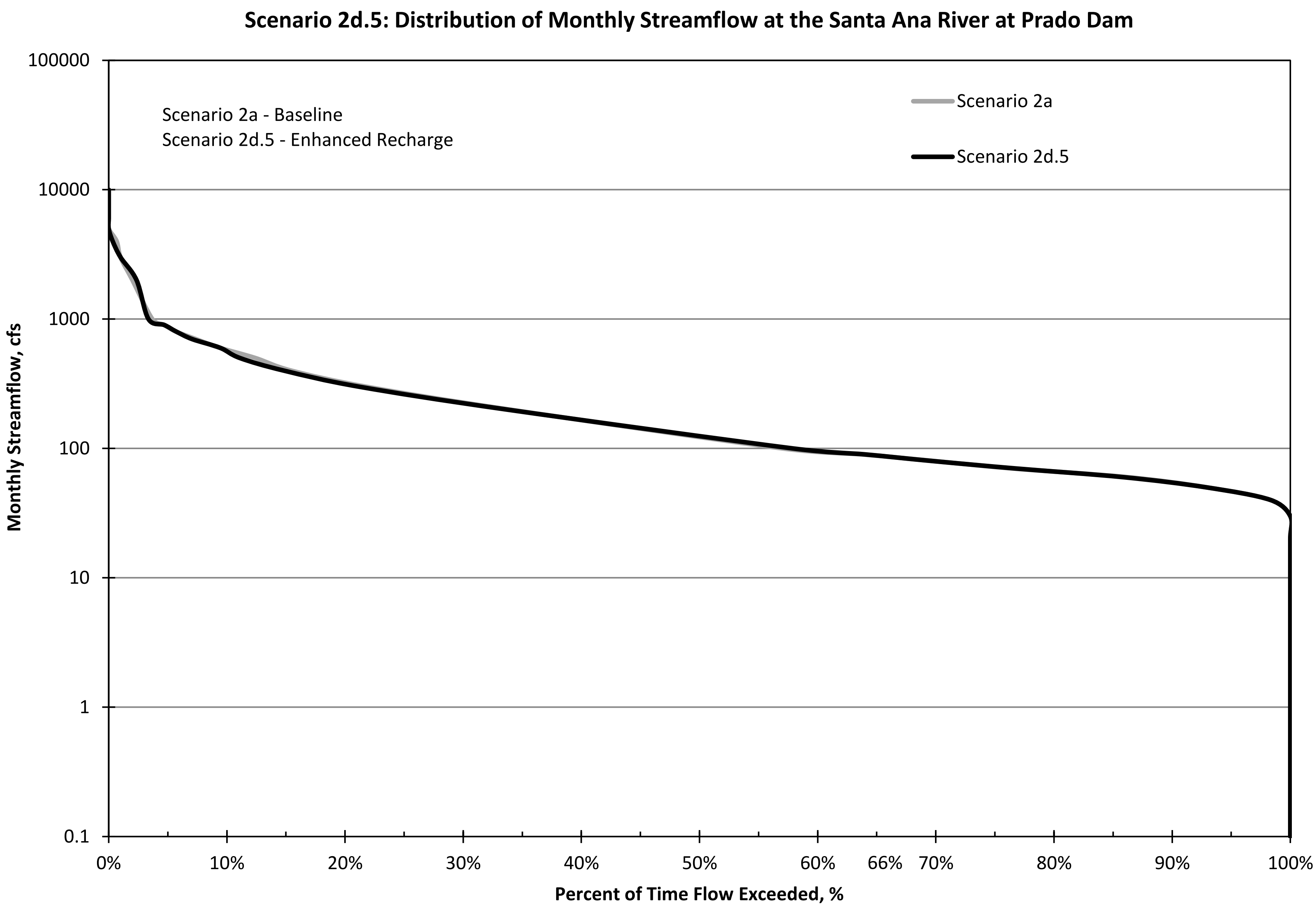
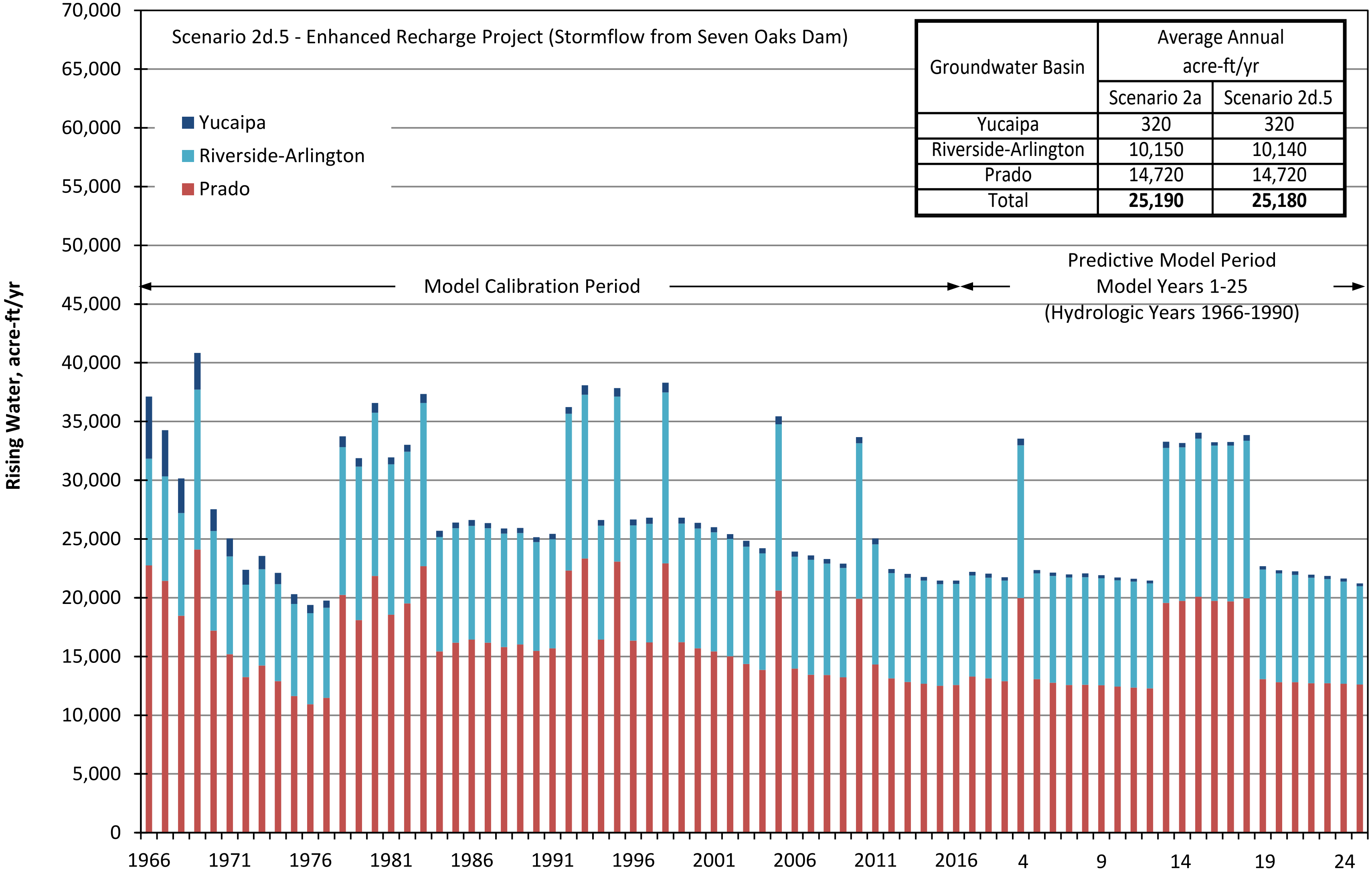


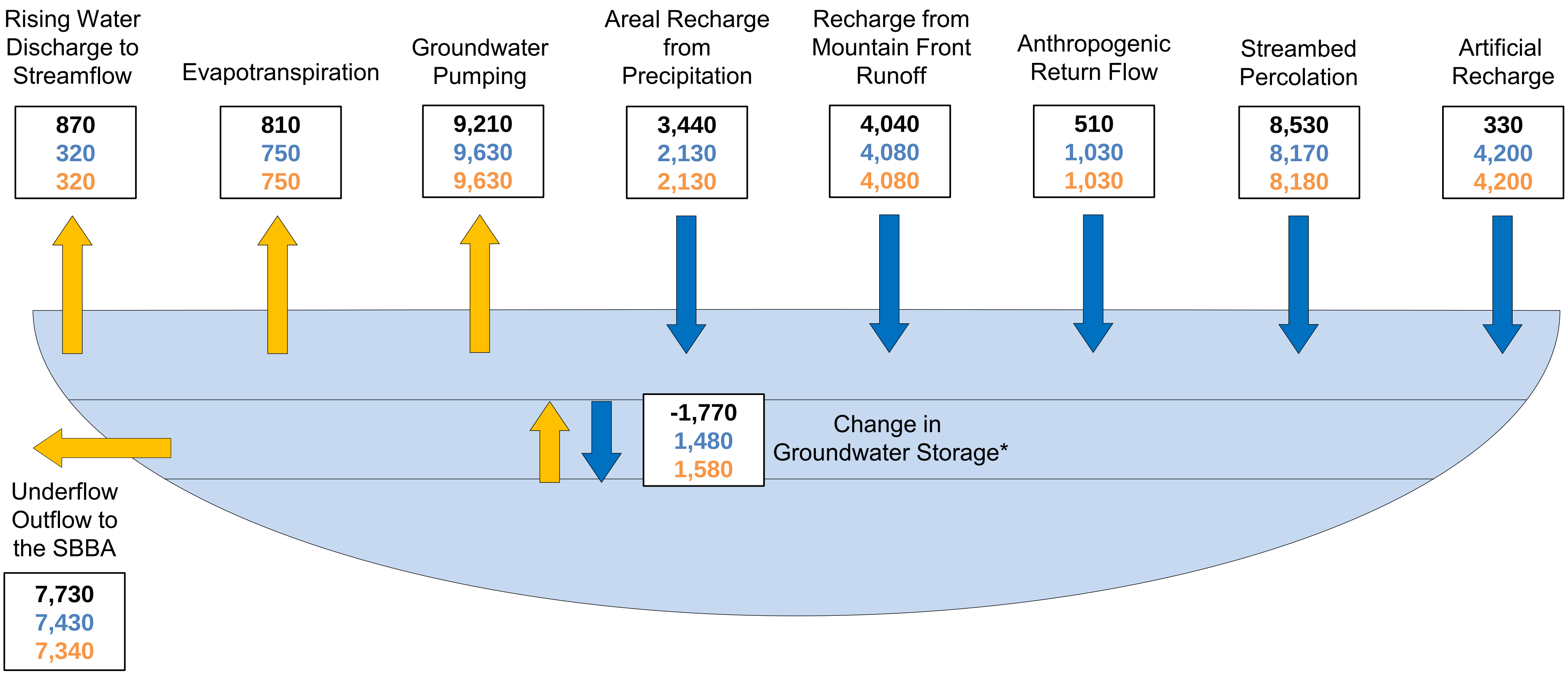
Figure 667

Scenario 2d.5: Annual Rising Water – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2d.5
Yucaipa	320	320
Riverside-Arlington	10,150	10,140
Prado	14,720	14,720
Total	**25,190**	**25,180**

Figure 668



Scenario 2a - Baseline
Scenario 2d.5 - Enhanced Recharge

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.5 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.5
AVERAGE ANNUAL
WATER BUDGET
YUCAIPA BASIN

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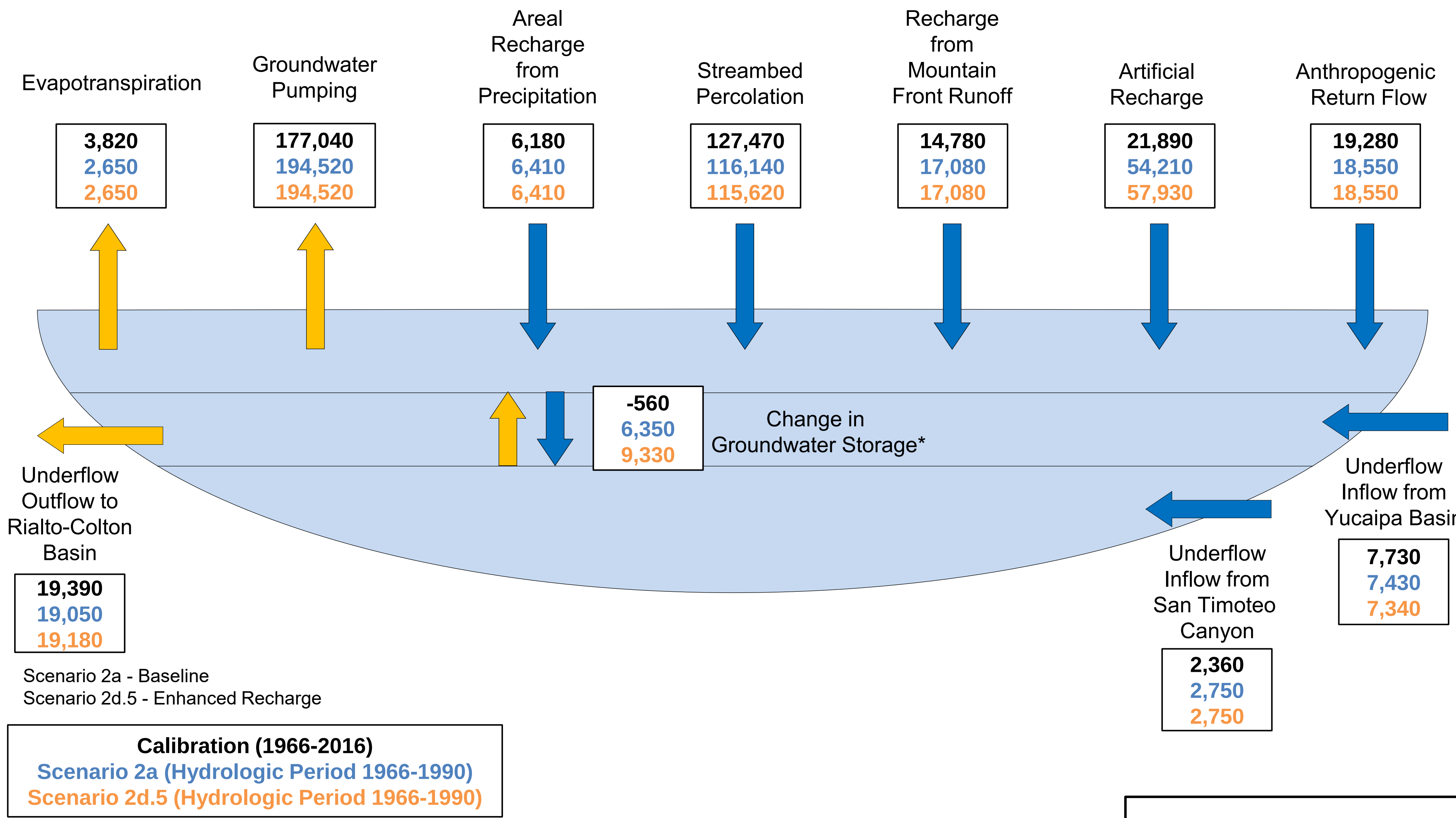
10-Apr-20

X:\Projects\San_Bernardino_MUNI\31) Integreated_SAR_Model\(4)Technical_Memos\(8)Summary Report\Draft\Figures\Scenarios



All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

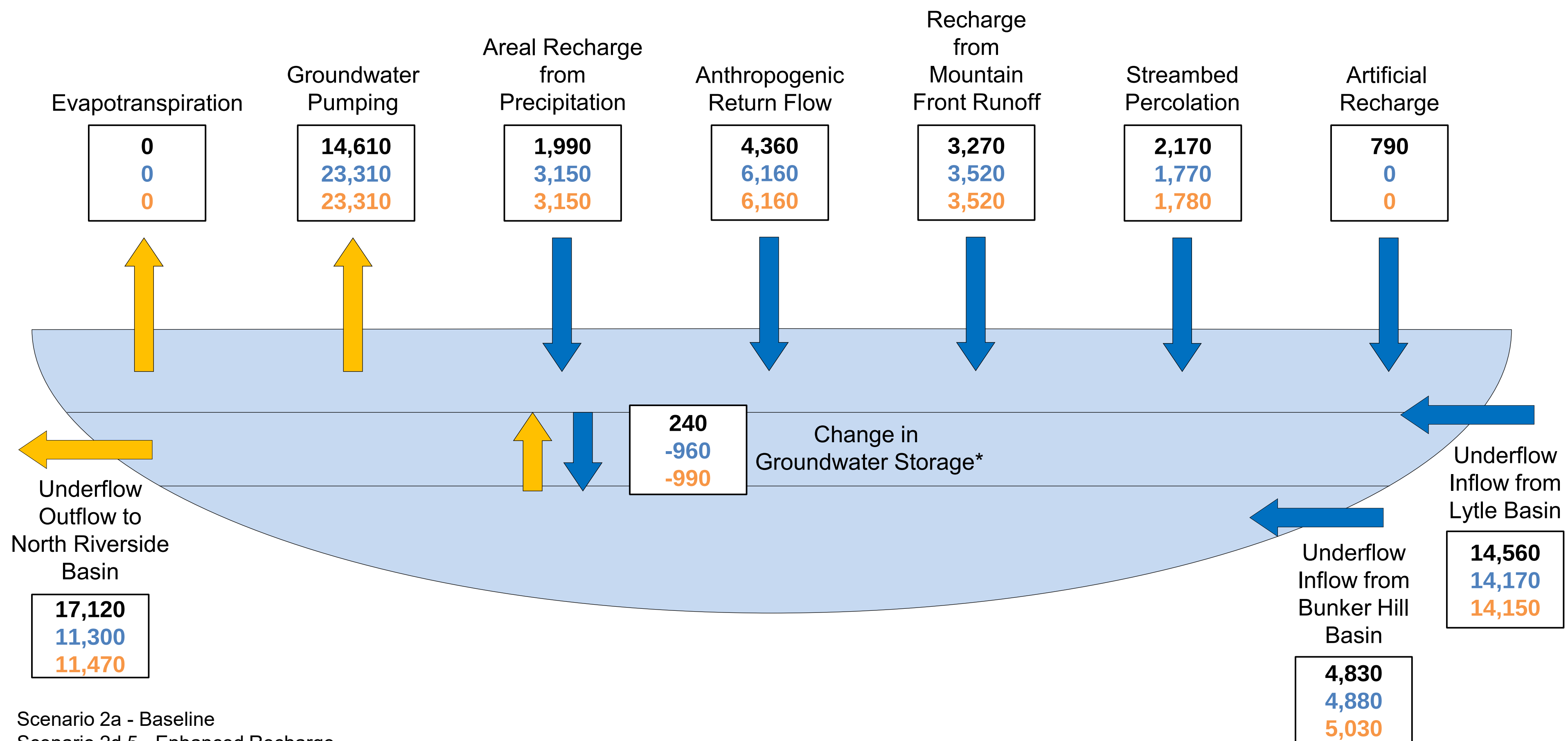
SCENARIO 2D.5 AVERAGE ANNUAL WATER BUDGET SBBA

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT **DRAFT** **FIGURE 670**

UPPER SANTA ANA RIVER INTEGRATED MODEL – SUMMARY REPORT

GEOSCIENCE



Scenario 2a - Baseline
Scenario 2d.5 - Enhanced Recharge

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.5 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.5
AVERAGE ANNUAL
WATER BUDGET
RIALTO-COLTON BASIN

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10-Apr-20

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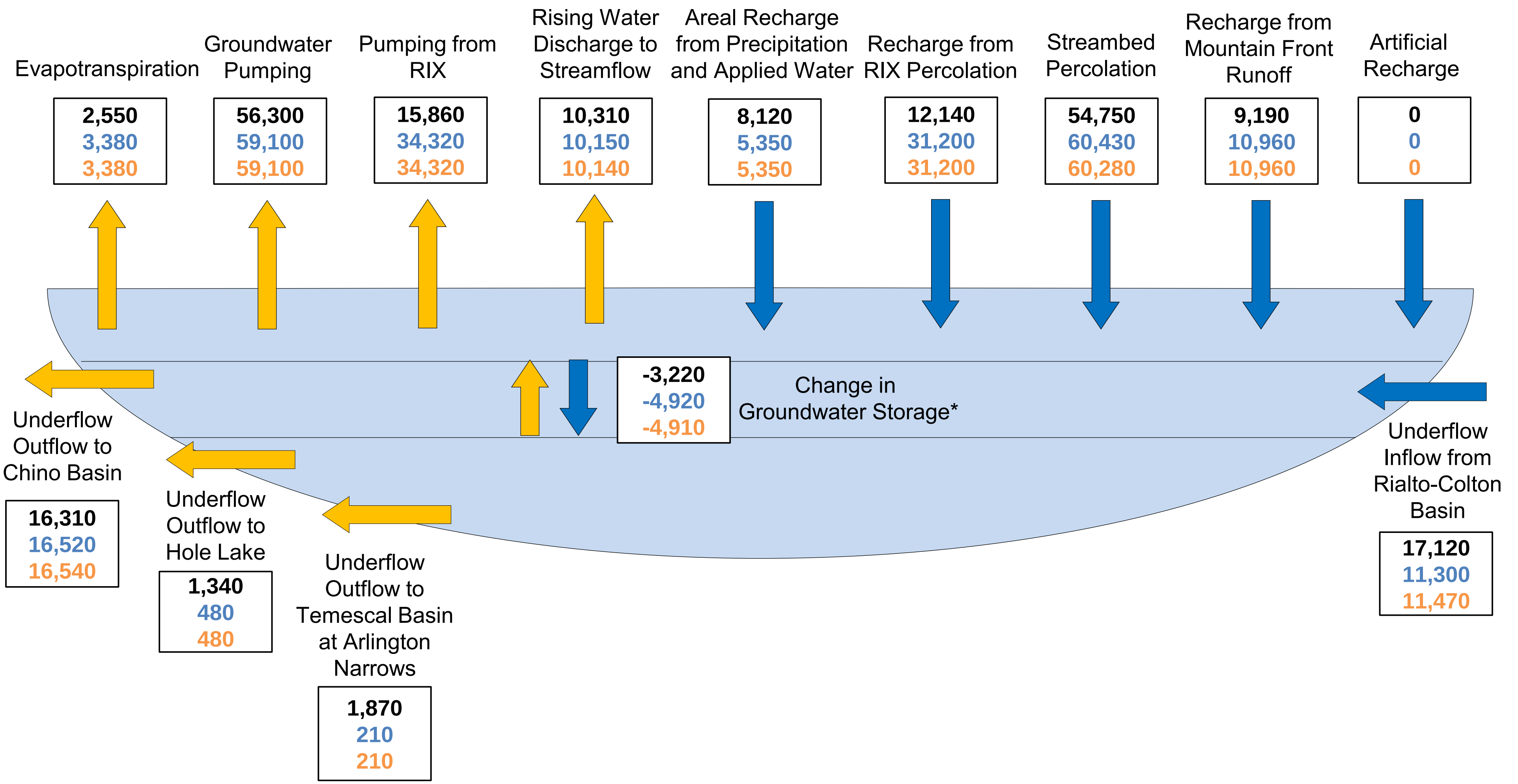

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.5 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

Scenario 2a - Baseline
Scenario 2d.5 - Enhanced Recharge

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.5
AVERAGE ANNUAL WATER BUDGET
RIVERSIDE-ARLINGTON BASIN

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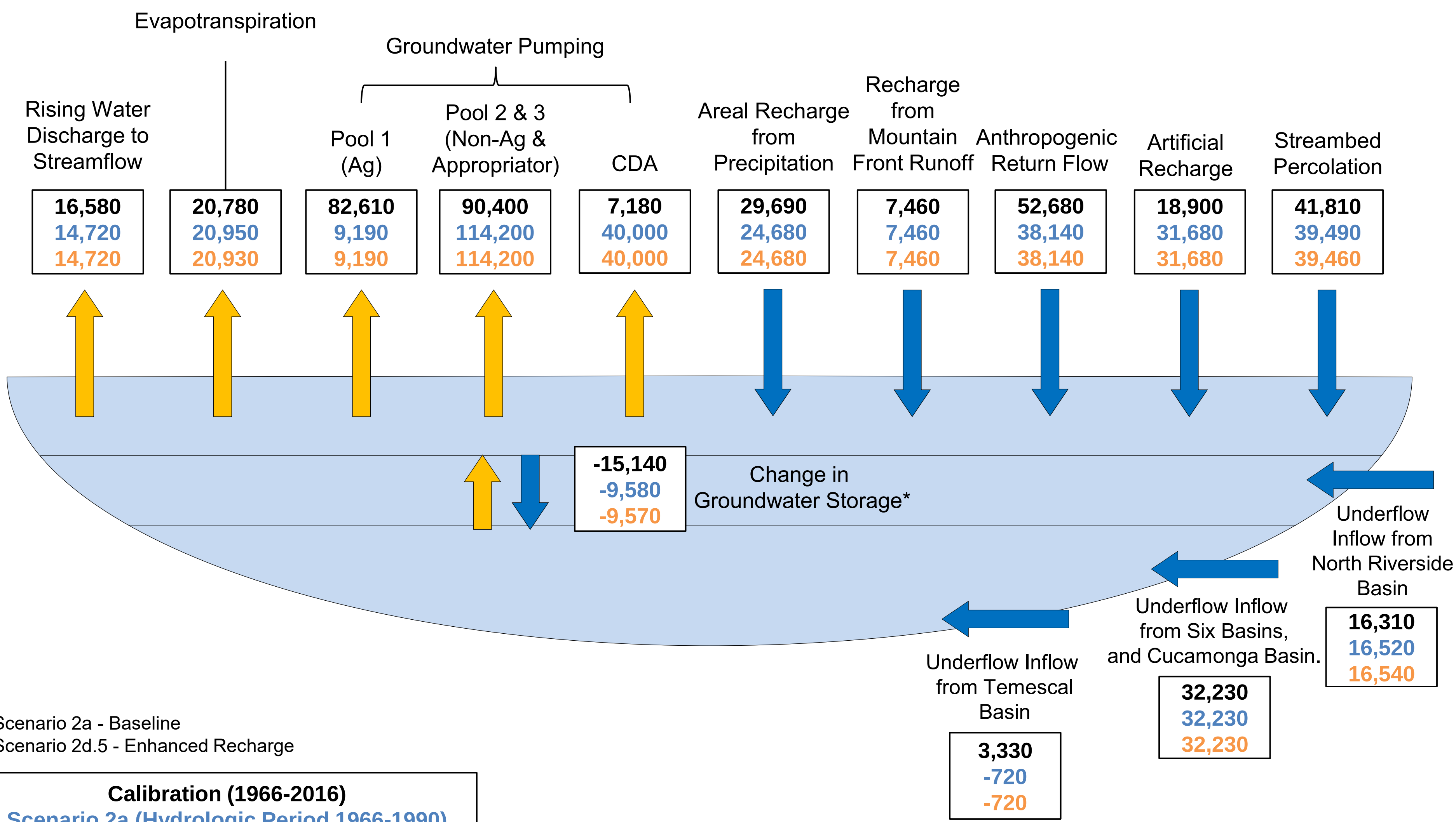

Scenario 2a - Baseline
Scenario 2d.5 - Enhanced Recharge

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.5 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.5 AVERAGE ANNUAL WATER BUDGET CHINO BASIN

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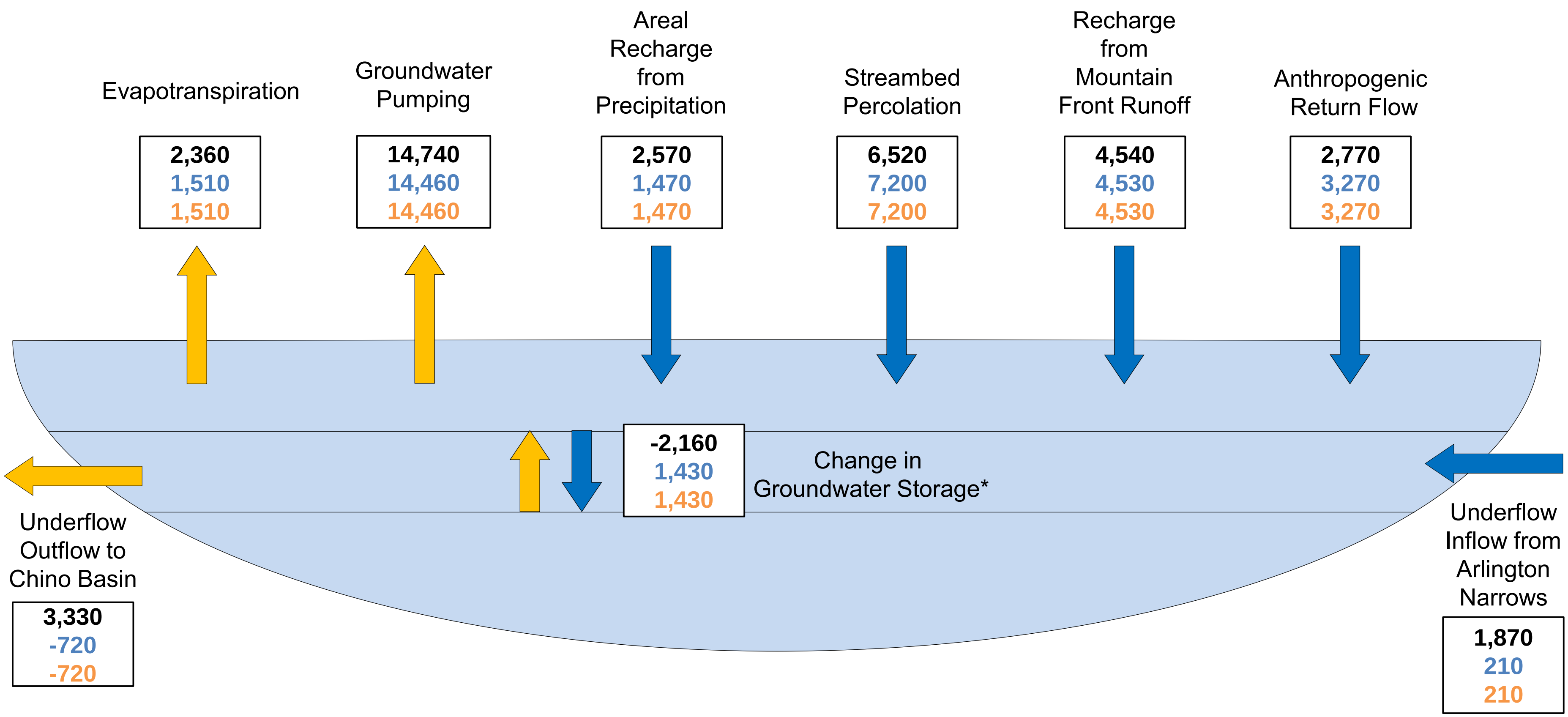
10-Apr-20



Scenario 2a - Baseline
Scenario 2d.5 - Enhanced Recharge

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.5 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.5 AVERAGE ANNUAL WATER BUDGET TEMESCAL BASIN

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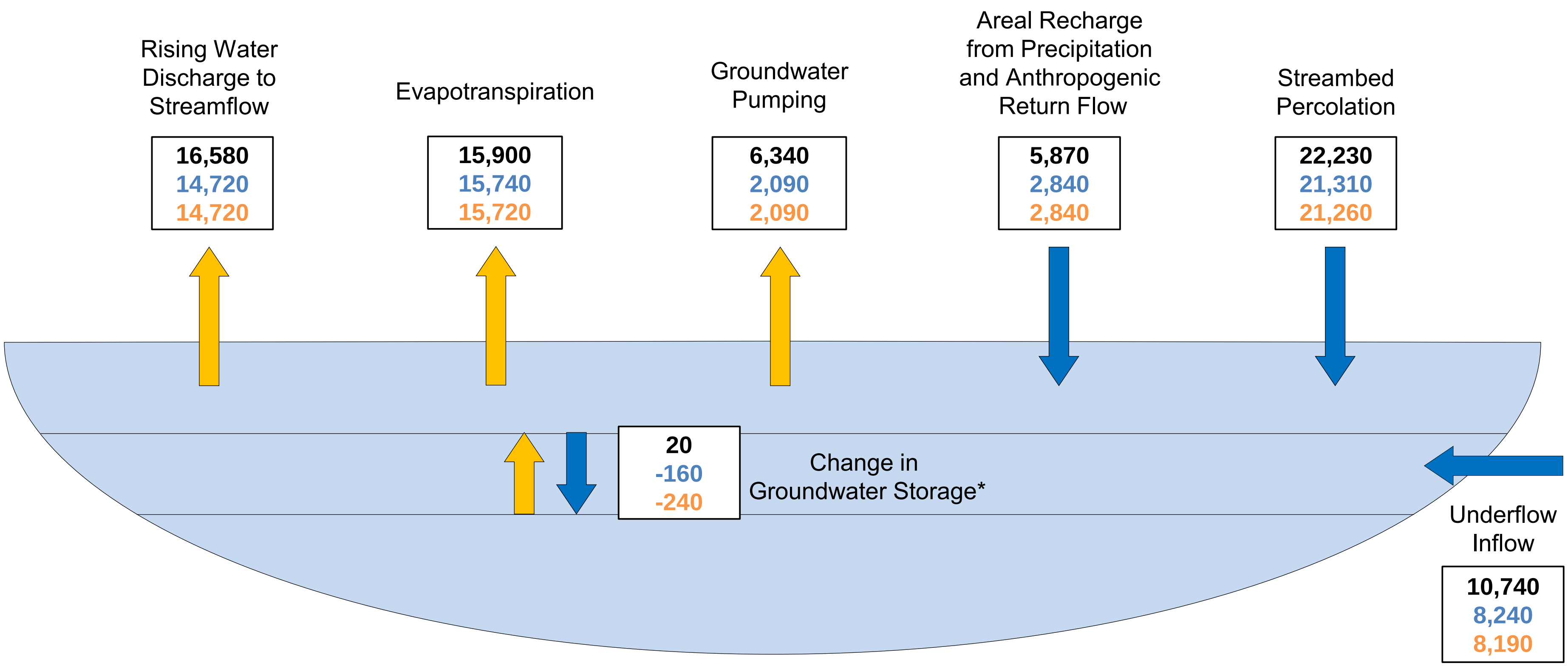
10-Apr-20



Scenario 2a - Baseline
Scenario 2d.5 - Enhanced Recharge

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.5 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.5
AVERAGE ANNUAL
WATER BUDGET
PRADO BASIN

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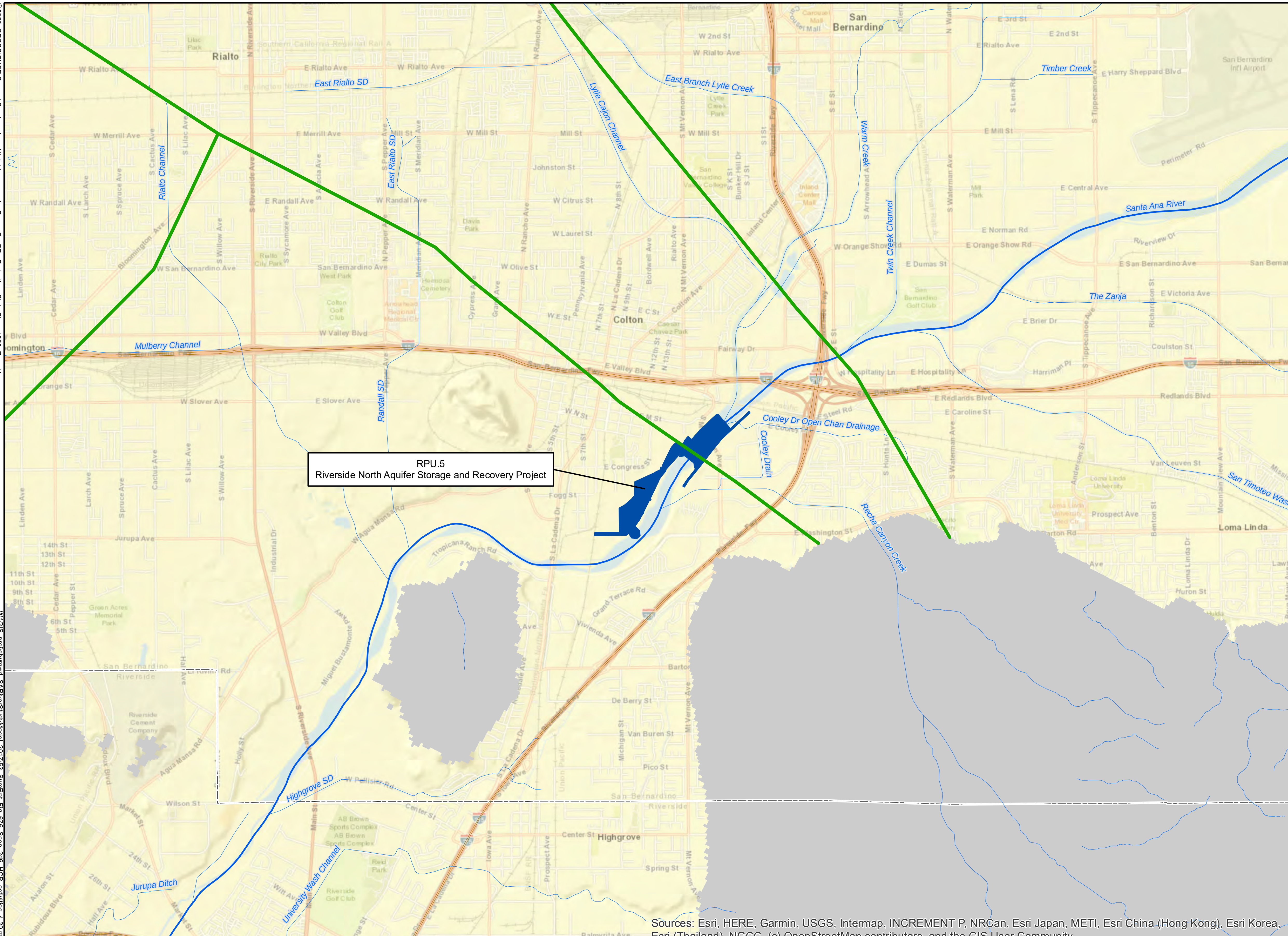
10-Apr-20



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EXPLANATION

Integrated SAR Model Boundary

Active Model Area

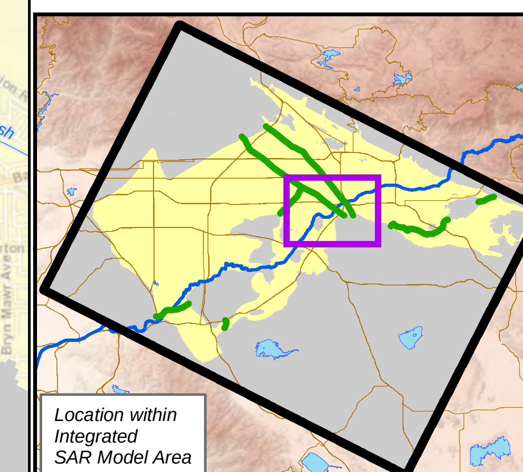
Inactive Model Area

Habitat Conservation Plan (HCP) Covered Activity
RPU.5 - Project ID
RNASRP - Name of HCP Project

Groundwater Basin Boundary

Refer to Table 17 for HCP Covered Activity Description

Scenario 2d.6:
Active Recharge Activities (Stormwater Capture Activities) - Riverside North Aquifer Storage and Recovery Project (revised)



N

0 0.5 1

Miles

SCENARIO 2d.6
LOCATION OF
HCP COVERED ACTIVITIES

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

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FIGURE 676

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

GEOSCIENCE

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Scenario 2d.6: Annual Change in Surface Water Diversion Compared to Baseline

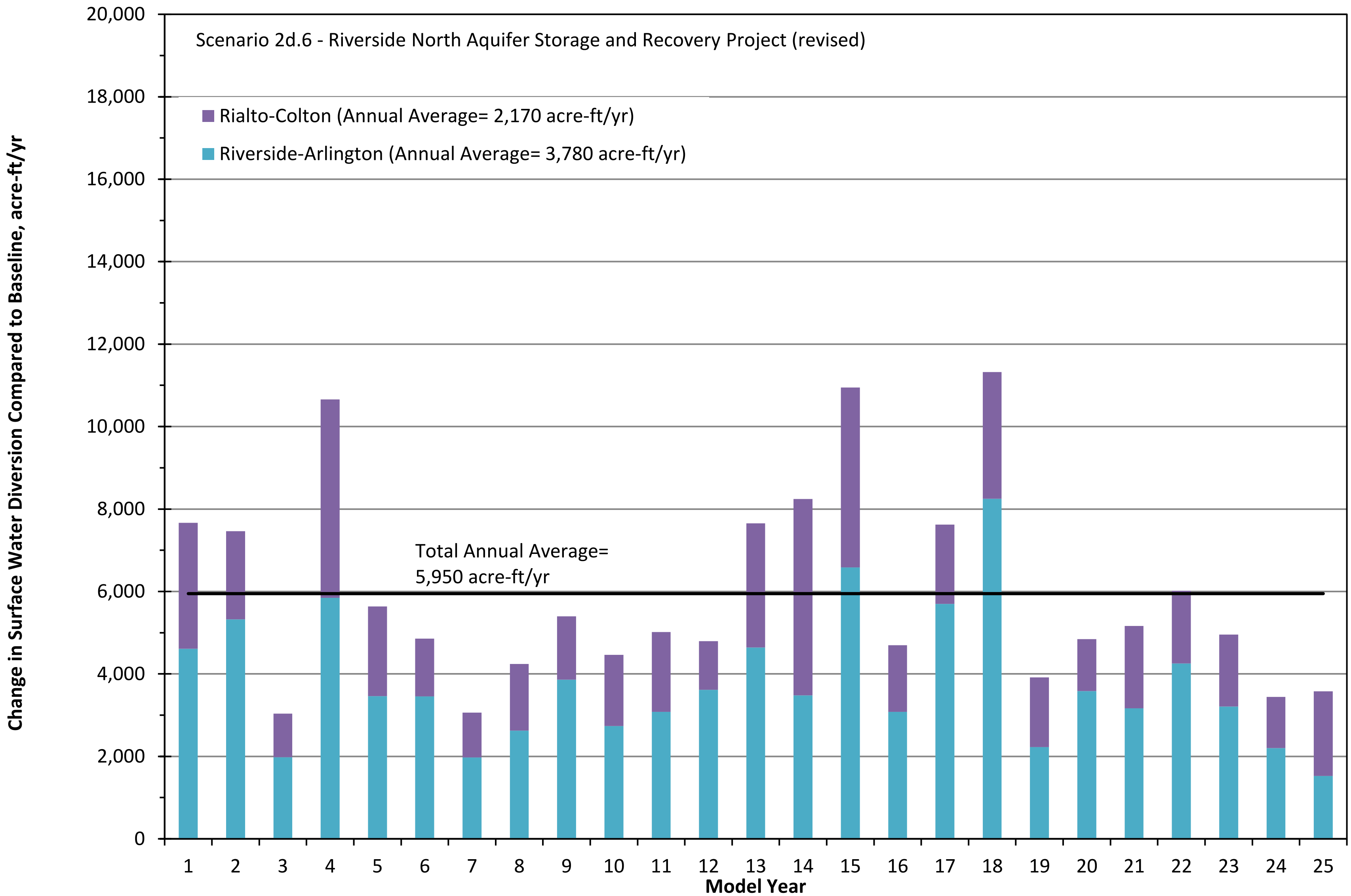


Figure 677

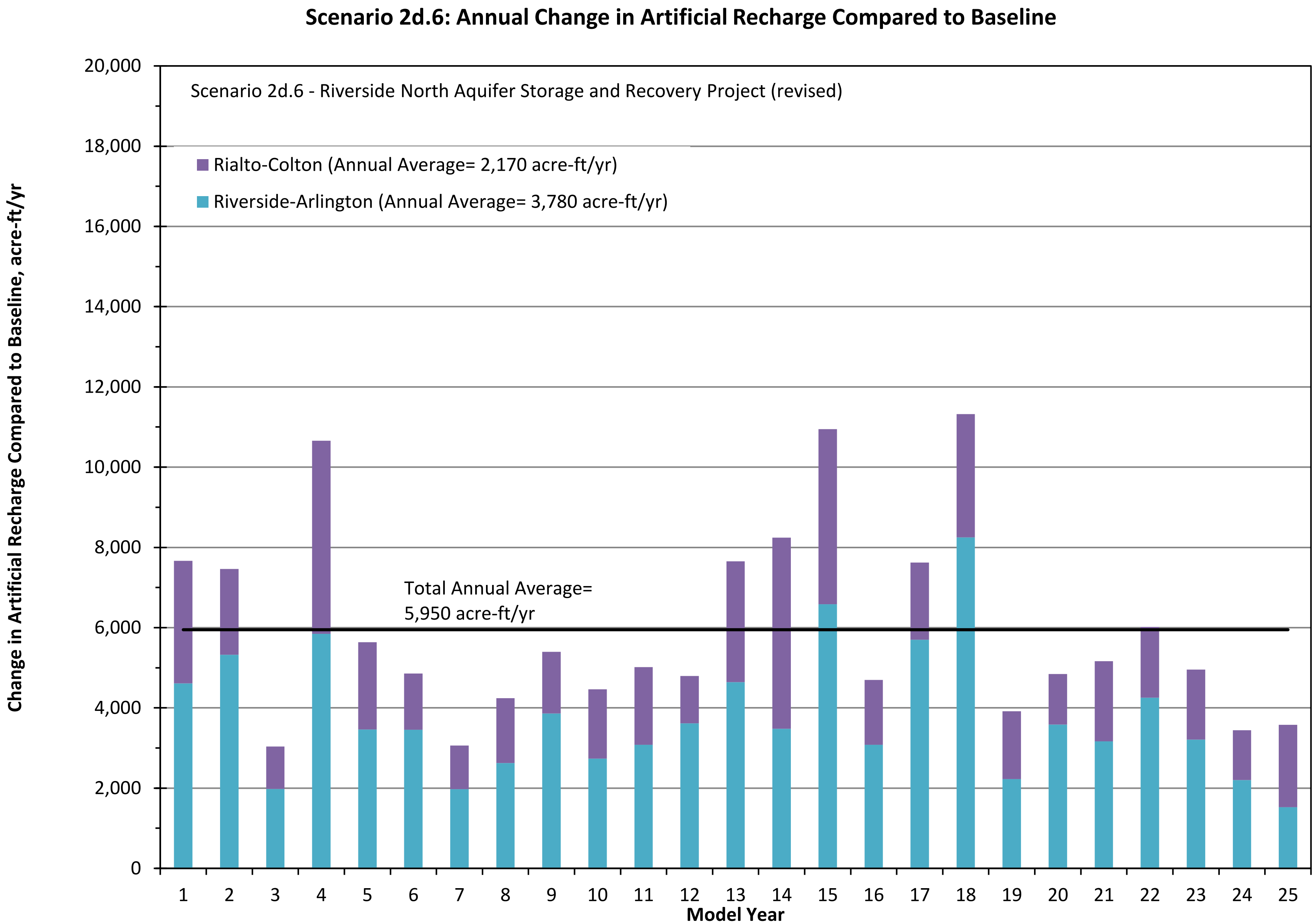
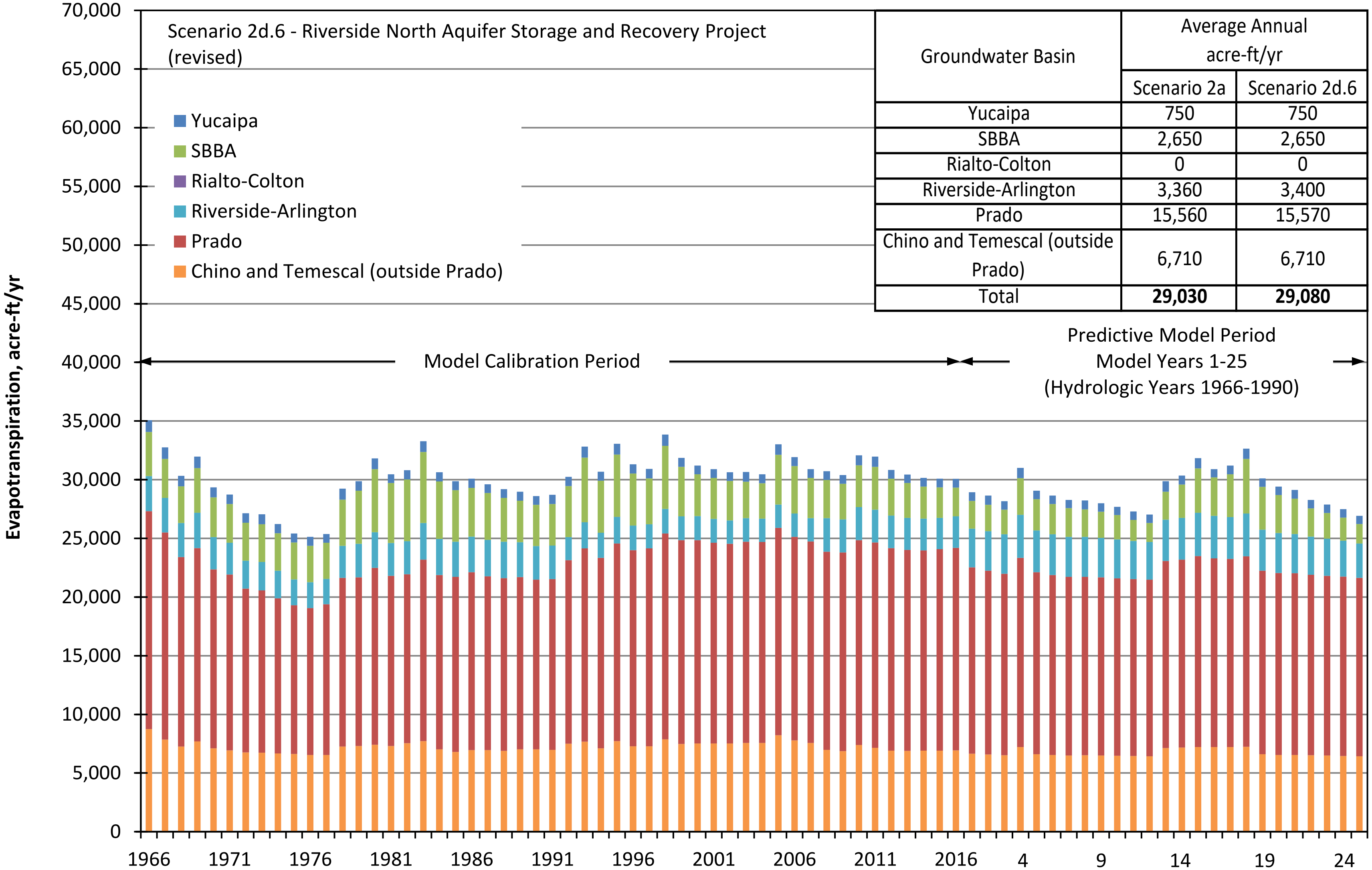

Scenario 2d.6: Annual Change in Artificial Recharge Compared to Baseline
Scenario 2d.6 - Riverside North Aquifer Storage and Recovery Project (revised)
Rialto-Colton (Annual Average= 2,170 acre-ft/yr)
Riverside-Arlington (Annual Average= 3,780 acre-ft/yr)
Total Annual Average=
5,950 acre-ft/yr
Change in Artificial Recharge Compared to Baseline, acre-ft/yr
Model Year
0
2,000
4,000
6,000
8,000
10,000
12,000
14,000
16,000
18,000
20,000
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

Figure 678

Scenario 2d.6: Annual Evapotranspiration – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2d.6
Yucaipa	750	750
SBBA	2,650	2,650
Rialto-Colton	0	0
Riverside-Arlington	3,360	3,400
Prado	15,560	15,570
Chino and Temescal (outside Prado)	6,710	6,710
Total	**29,030**	**29,080**

Figure 679

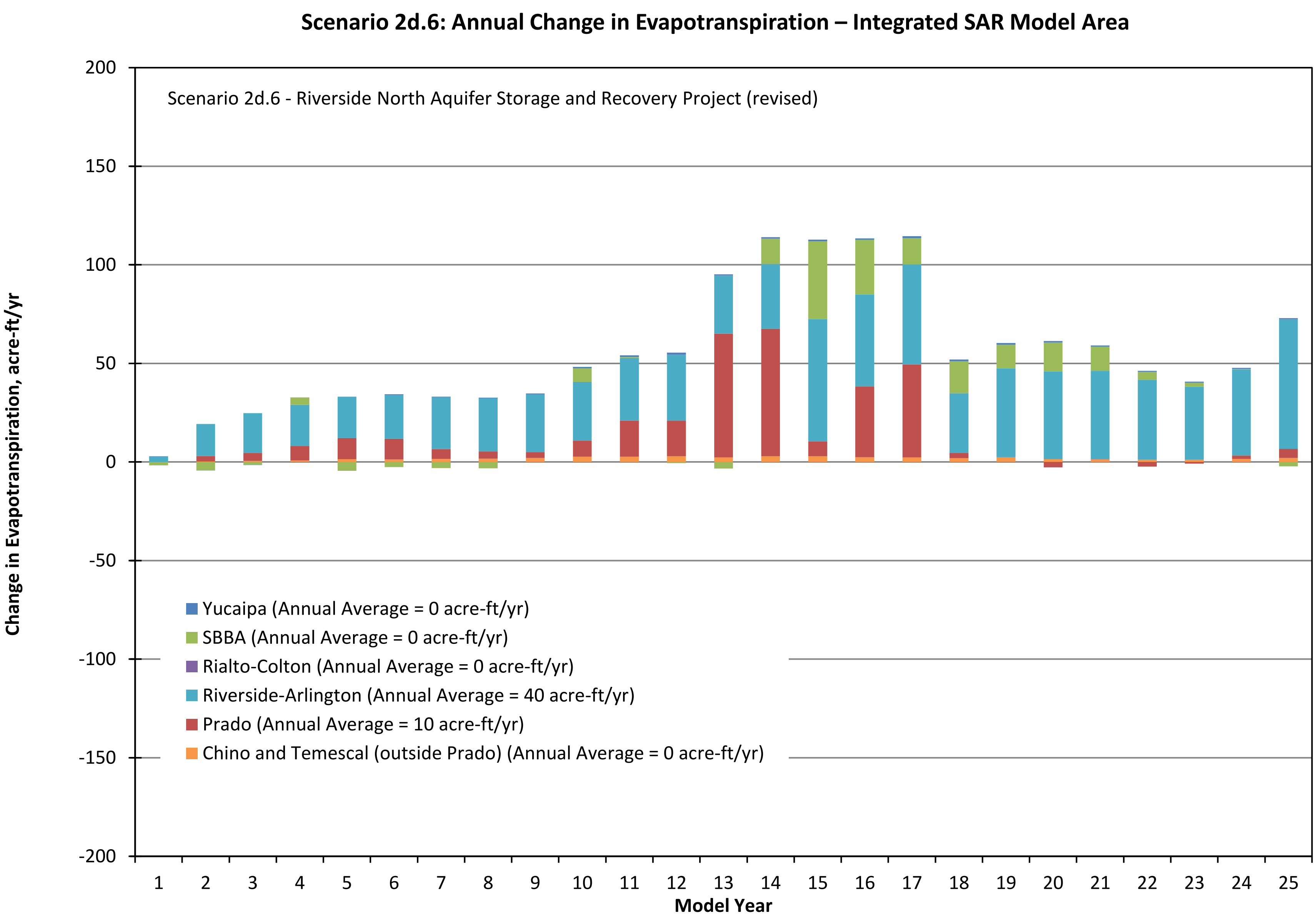
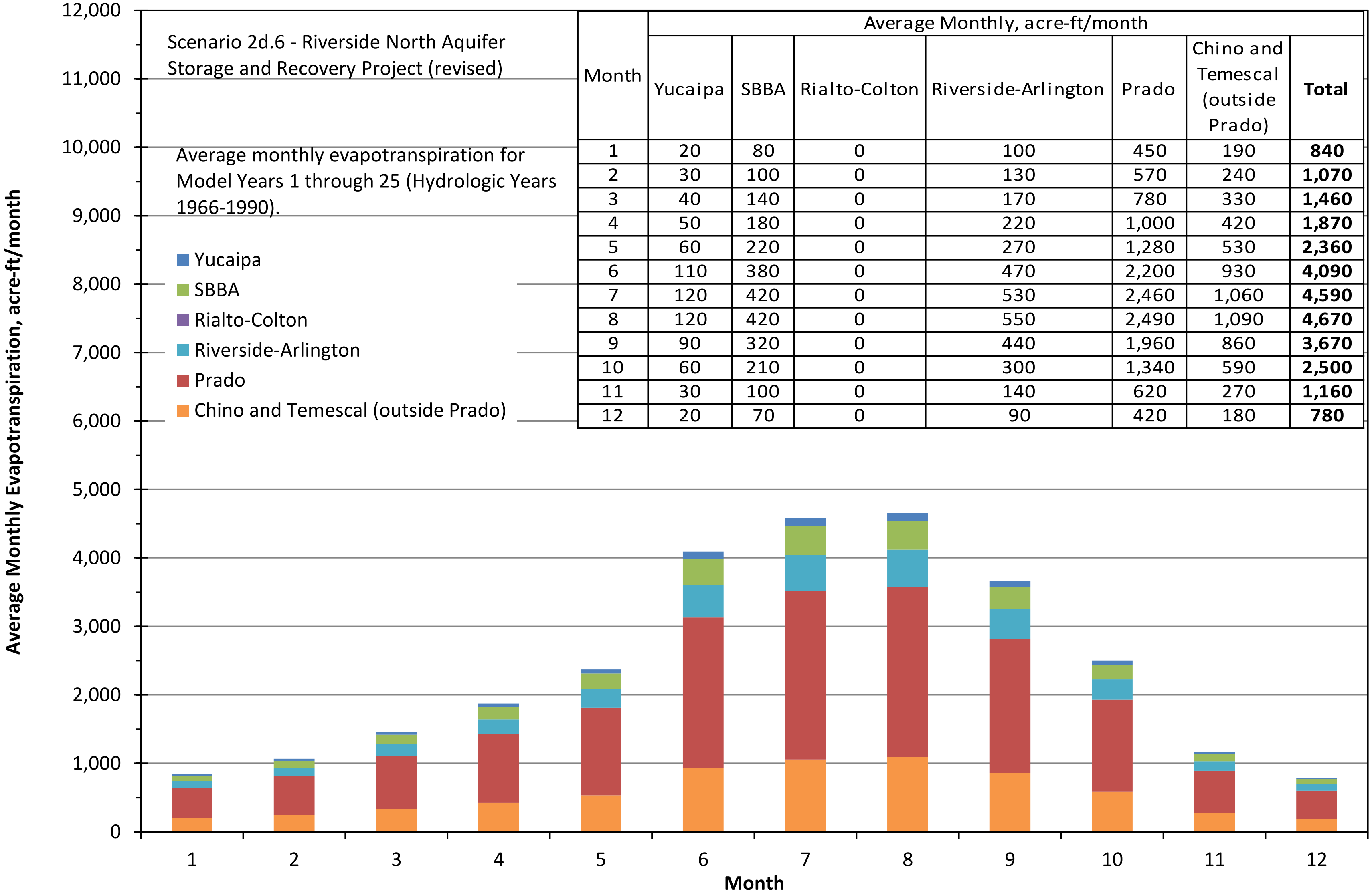

Scenario 2d.6: Annual Change in Evapotranspiration – Integrated SAR Model Area
Scenario 2d.6 - Riverside North Aquifer Storage and Recovery Project (revised)
200
150
100
50
0
-50
-100
-150
-200
Change in Evapotranspiration, acre-ft/yr
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
Model Year
Yucaipa (Annual Average = 0 acre-ft/yr)
SBBA (Annual Average = 0 acre-ft/yr)
Rialto-Colton (Annual Average = 0 acre-ft/yr)
Riverside-Arlington (Annual Average = 40 acre-ft/yr)
Prado (Annual Average = 10 acre-ft/yr)
Chino and Temescal (outside Prado) (Annual Average = 0 acre-ft/yr)

Figure 680

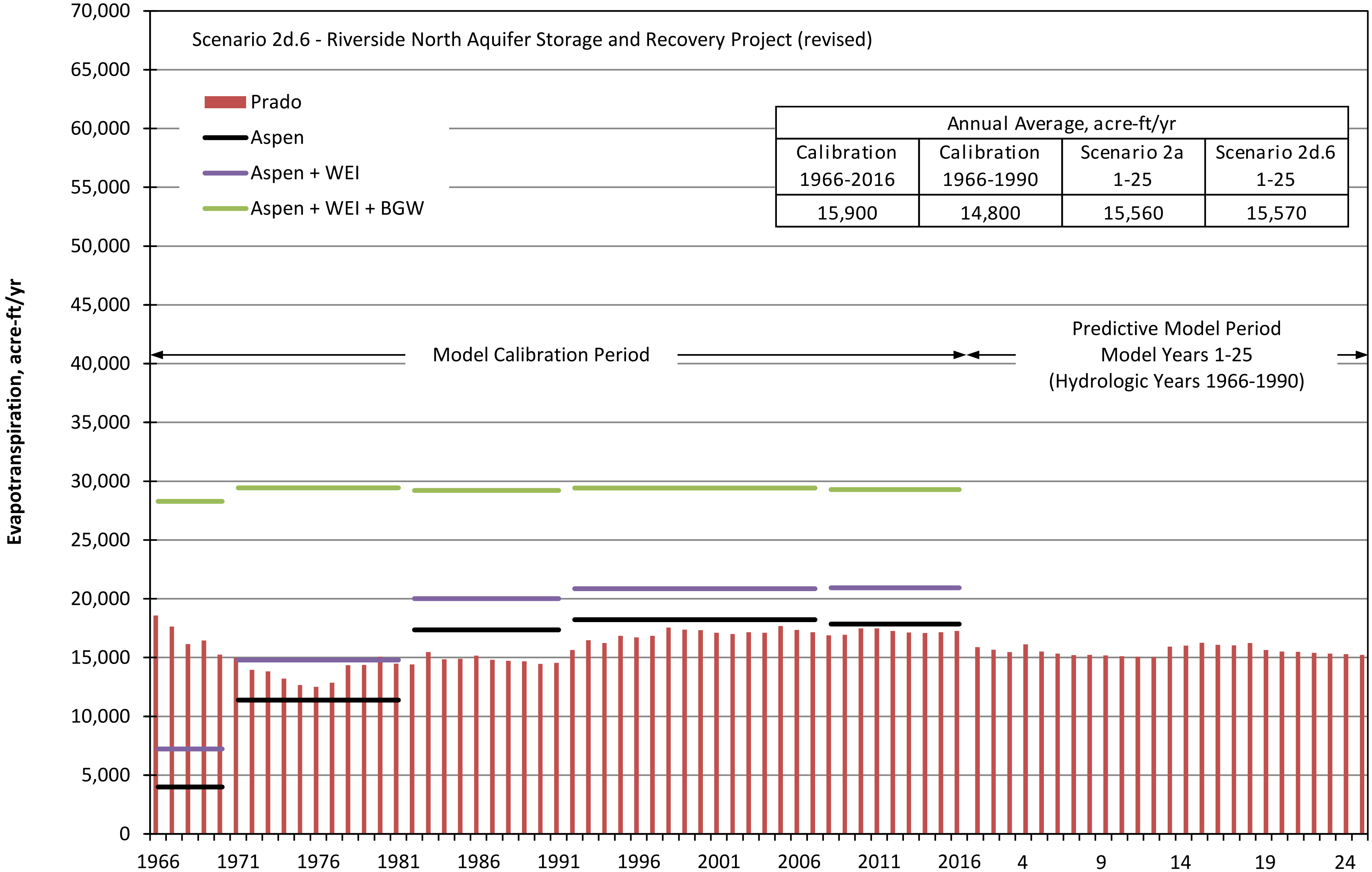
Scenario 2d.6: Seasonal Evapotranspiration – Integrated SAR Model Area



Month	Average Monthly, acre-ft/month						
	Yucaipa	SBBA	Rialto-Colton	Riverside-Arlington	Prado	Chino and Temescal (outside Prado)	**Total**
1	20	80	0	100	450	190	**840**
2	30	100	0	130	570	240	**1,070**
3	40	140	0	170	780	330	**1,460**
4	50	180	0	220	1,000	420	**1,870**
5	60	220	0	270	1,280	530	**2,360**
6	110	380	0	470	2,200	930	**4,090**
7	120	420	0	530	2,460	1,060	**4,590**
8	120	420	0	550	2,490	1,090	**4,670**
9	90	320	0	440	1,960	860	**3,670**
10	60	210	0	300	1,340	590	**2,500**
11	30	100	0	140	620	270	**1,160**
12	20	70	0	90	420	180	**780**

Figure 681

Scenario 2d.6: Annual Evapotranspiration – Prado Basin



Annual Average, acre-ft/yr			
Calibration 1966-2016	Calibration 1966-1990	Scenario 2a 1-25	Scenario 2d.6 1-25
15,900	14,800	15,560	15,570

Figure 682

Scenario 2d.6: Annual Change in Evapotranspiration – Prado Basin

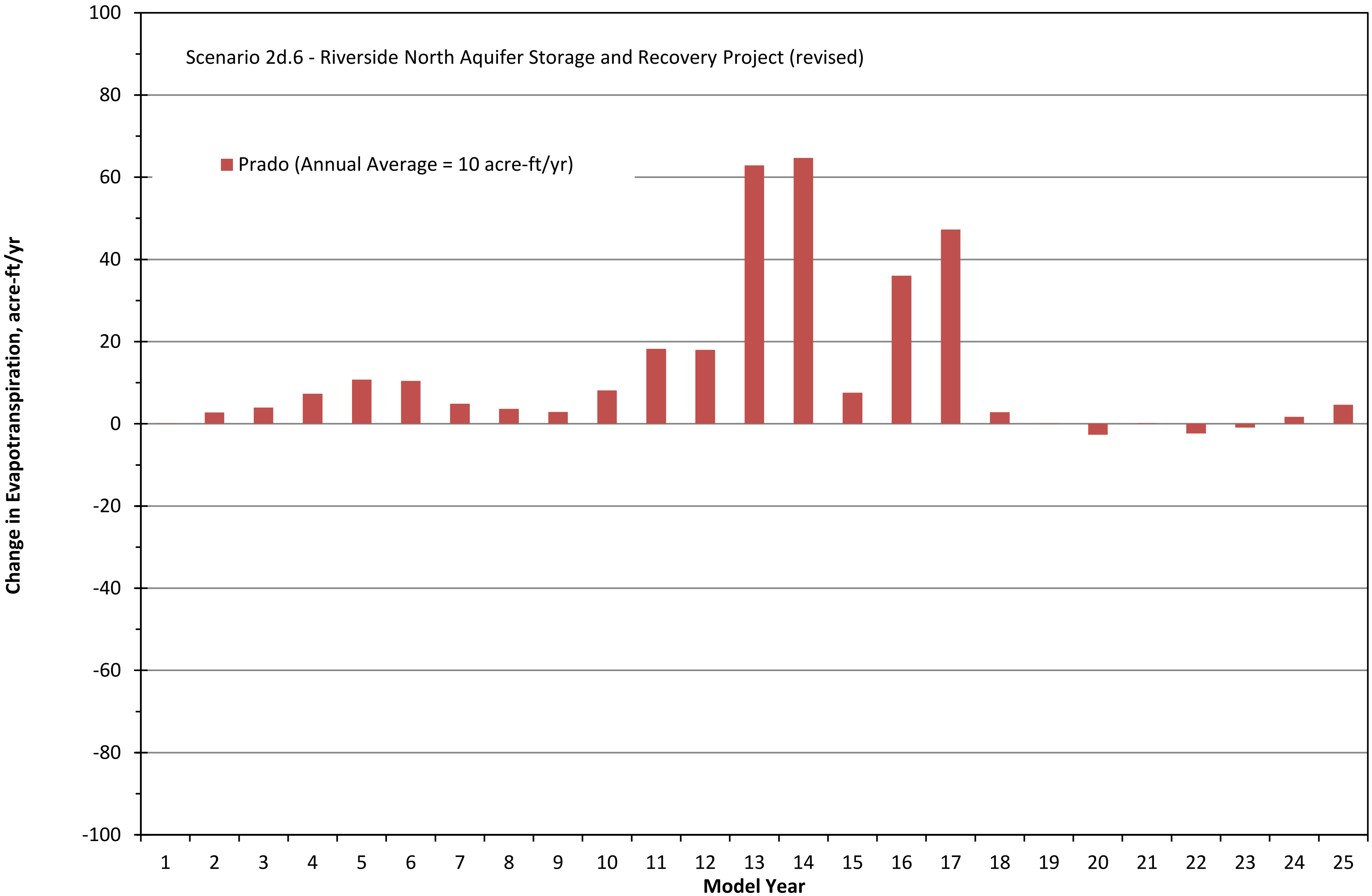
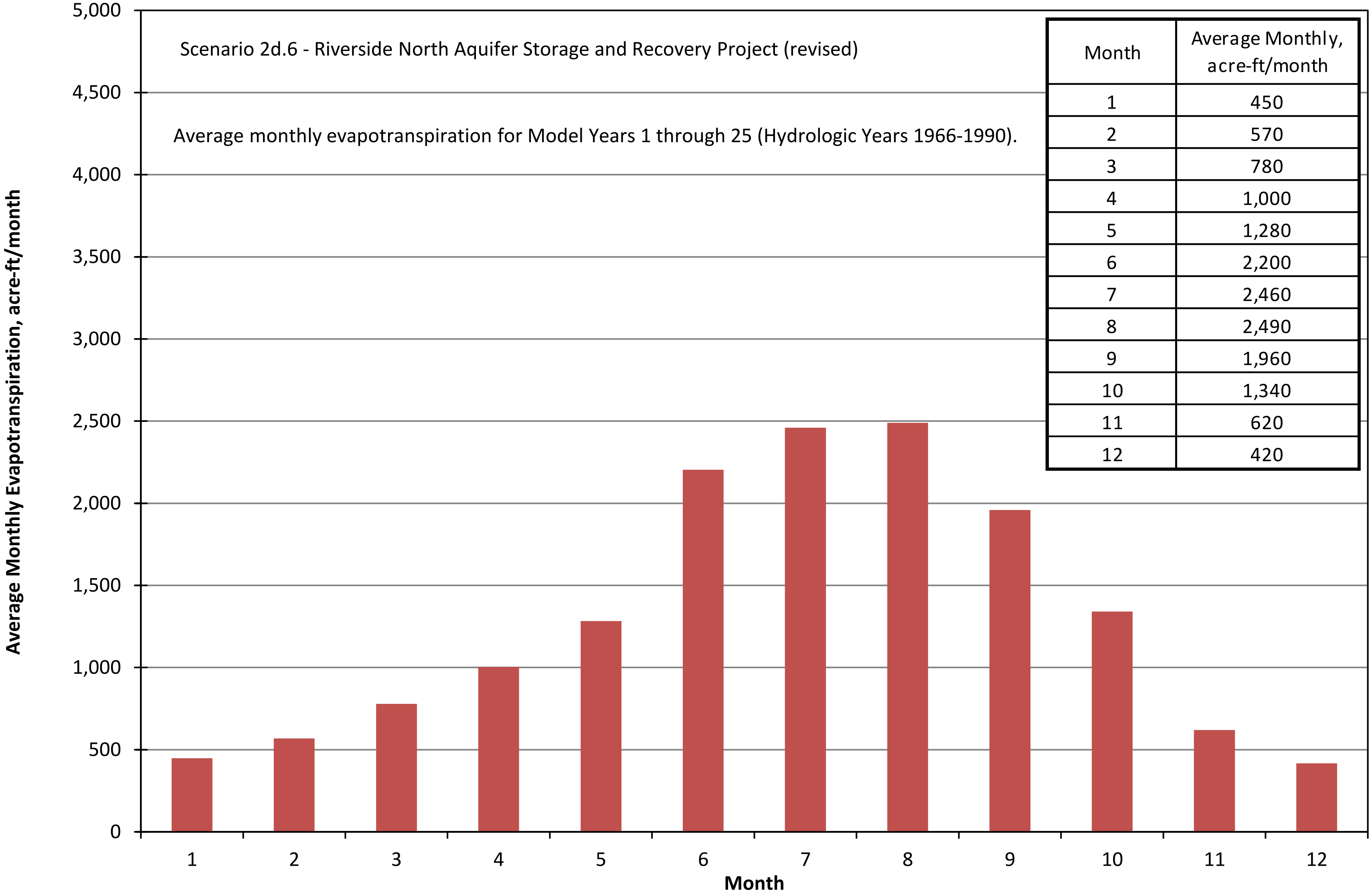


Figure 683

Scenario 2d.6: Seasonal Evapotranspiration – Prado Basin



Month	Average Monthly, acre-ft/month
1	450
2	570
3	780
4	1,000
5	1,280
6	2,200
7	2,460
8	2,490
9	1,960
10	1,340
11	620
12	420

Figure 684

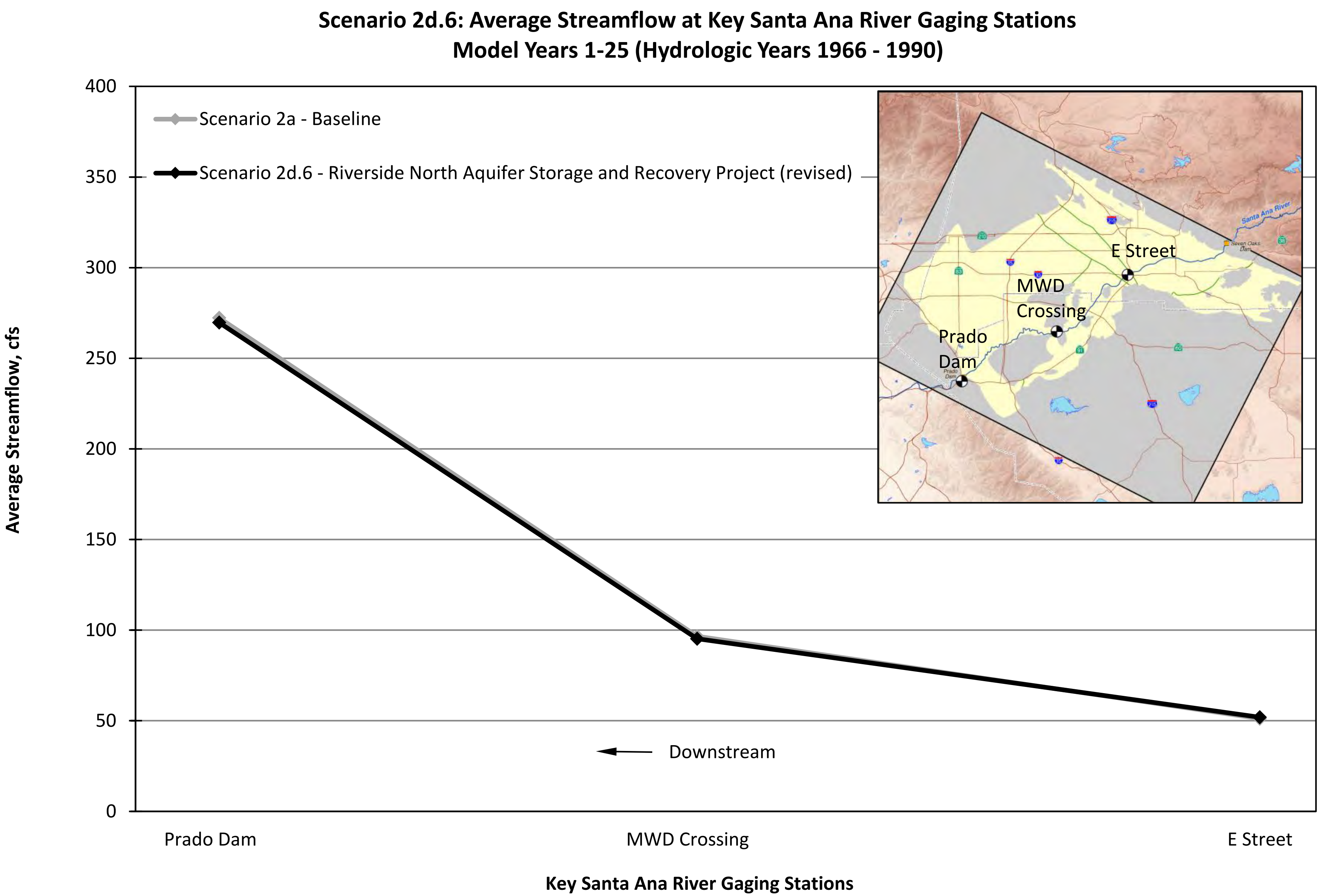

Scenario 2d.6: Average Streamflow at Key Santa Ana River Gaging Stations
Model Years 1-25 (Hydrologic Years 1966 - 1990)
Scenario 2a - Baseline
Scenario 2d.6 - Riverside North Aquifer Storage and Recovery Project (revised)
Average Streamflow, cfs
400
350
300
250
200
150
100
50
0
E Street
MWD Crossing
Prado Dam
Downstream
Prado Dam
MWD Crossing
E Street
Key Santa Ana River Gaging Stations

Figure 685

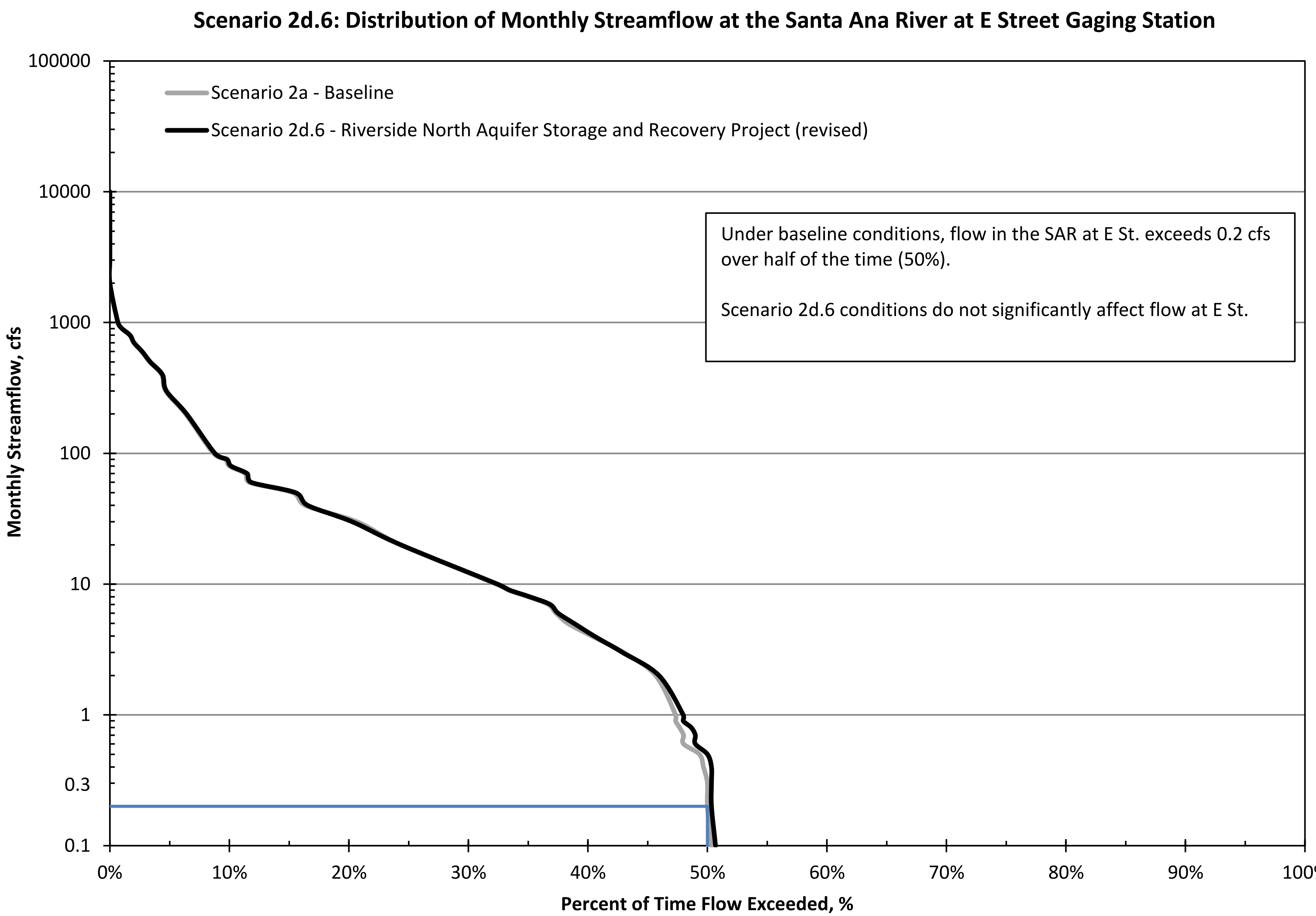

Scenario 2d.6: Distribution of Monthly Streamflow at the Santa Ana River at E Street Gaging Station
Scenario 2a - Baseline
Scenario 2d.6 - Riverside North Aquifer Storage and Recovery Project (revised)
Under baseline conditions, flow in the SAR at E St. exceeds 0.2 cfs over half of the time (50%).
Scenario 2d.6 conditions do not significantly affect flow at E St.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.3
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 686

Scenario 2d.6: Distribution of Monthly Streamflow at the Santa Ana River at MWD Crossing Gaging Station

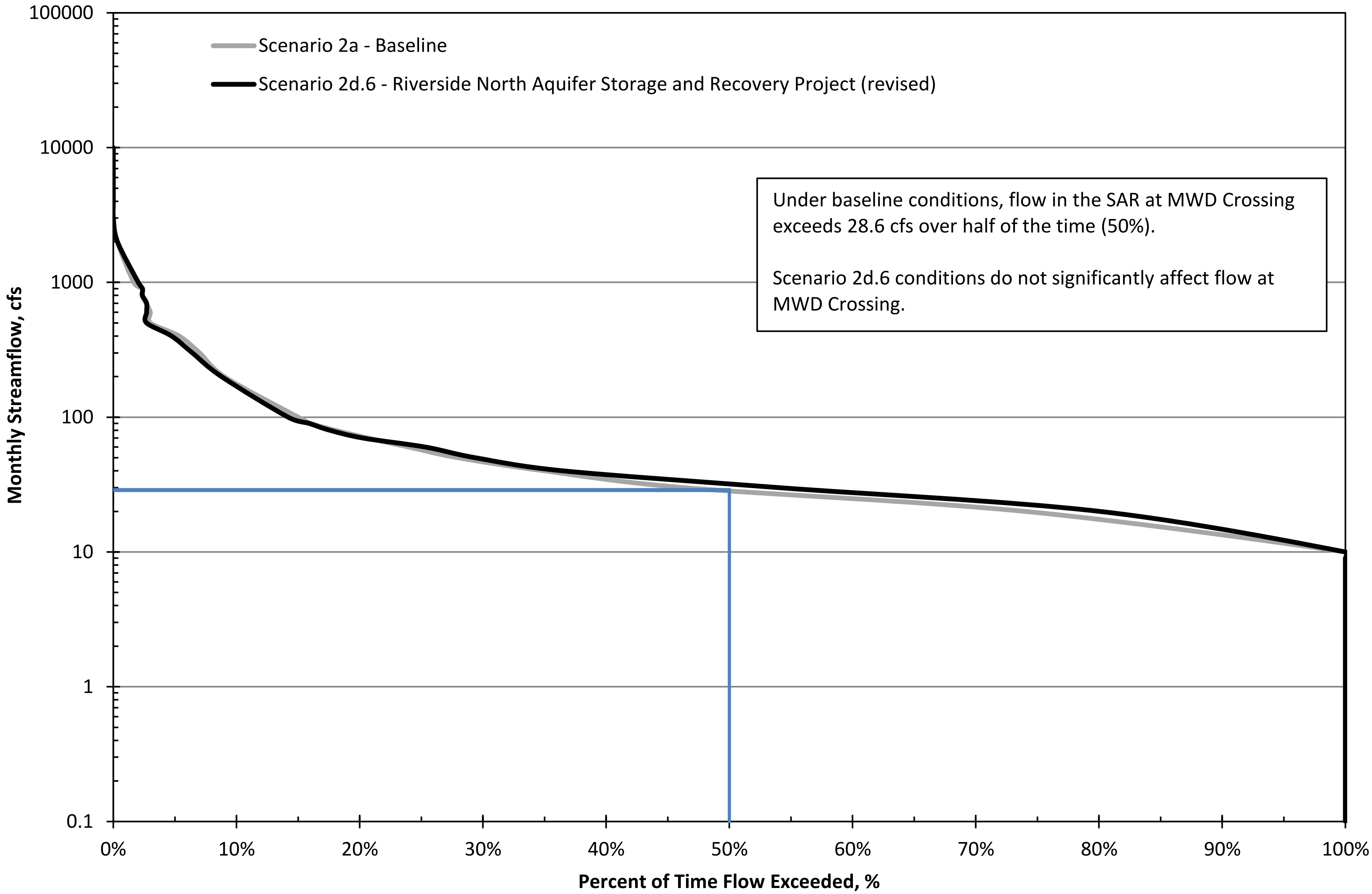


Figure 687

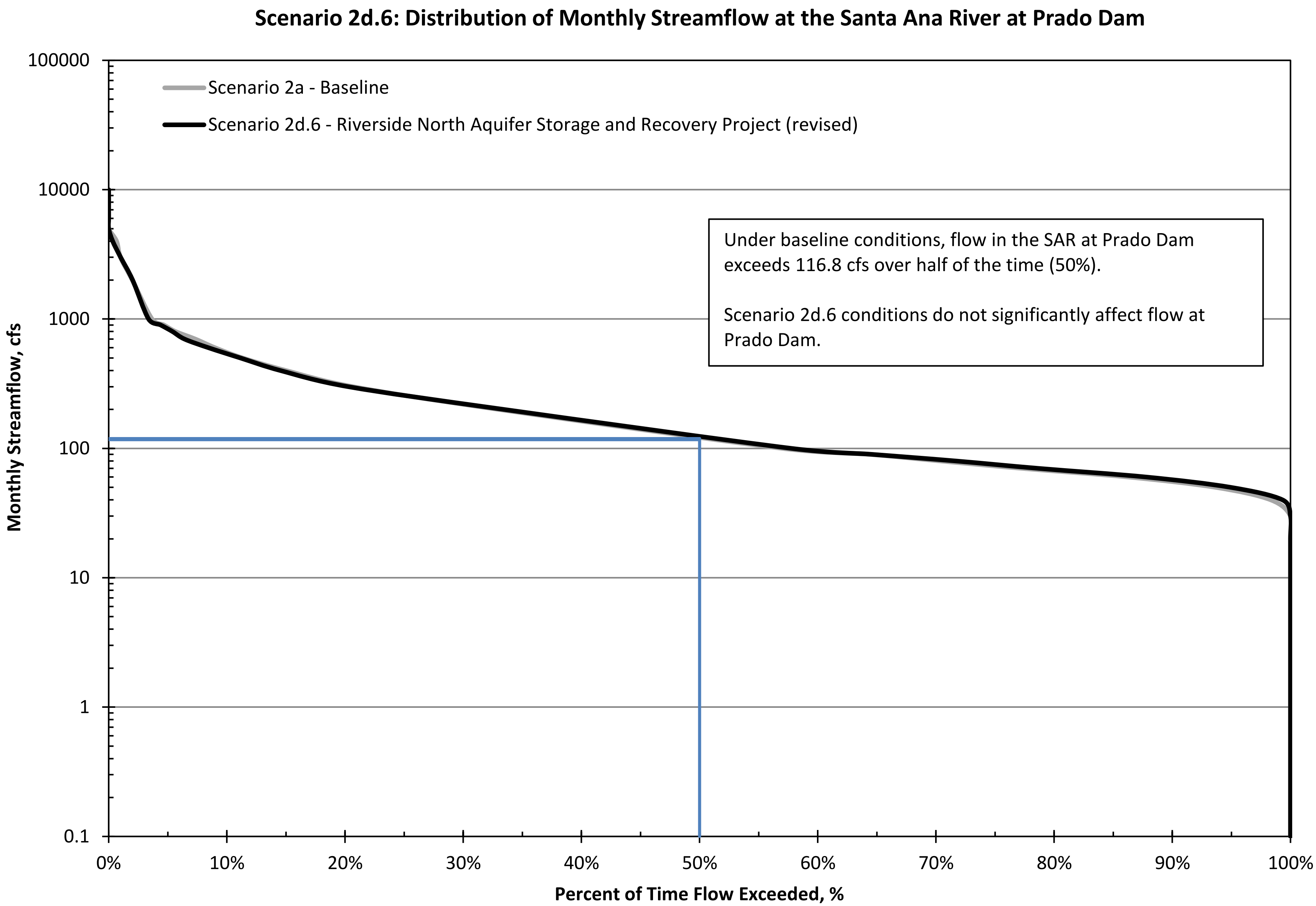
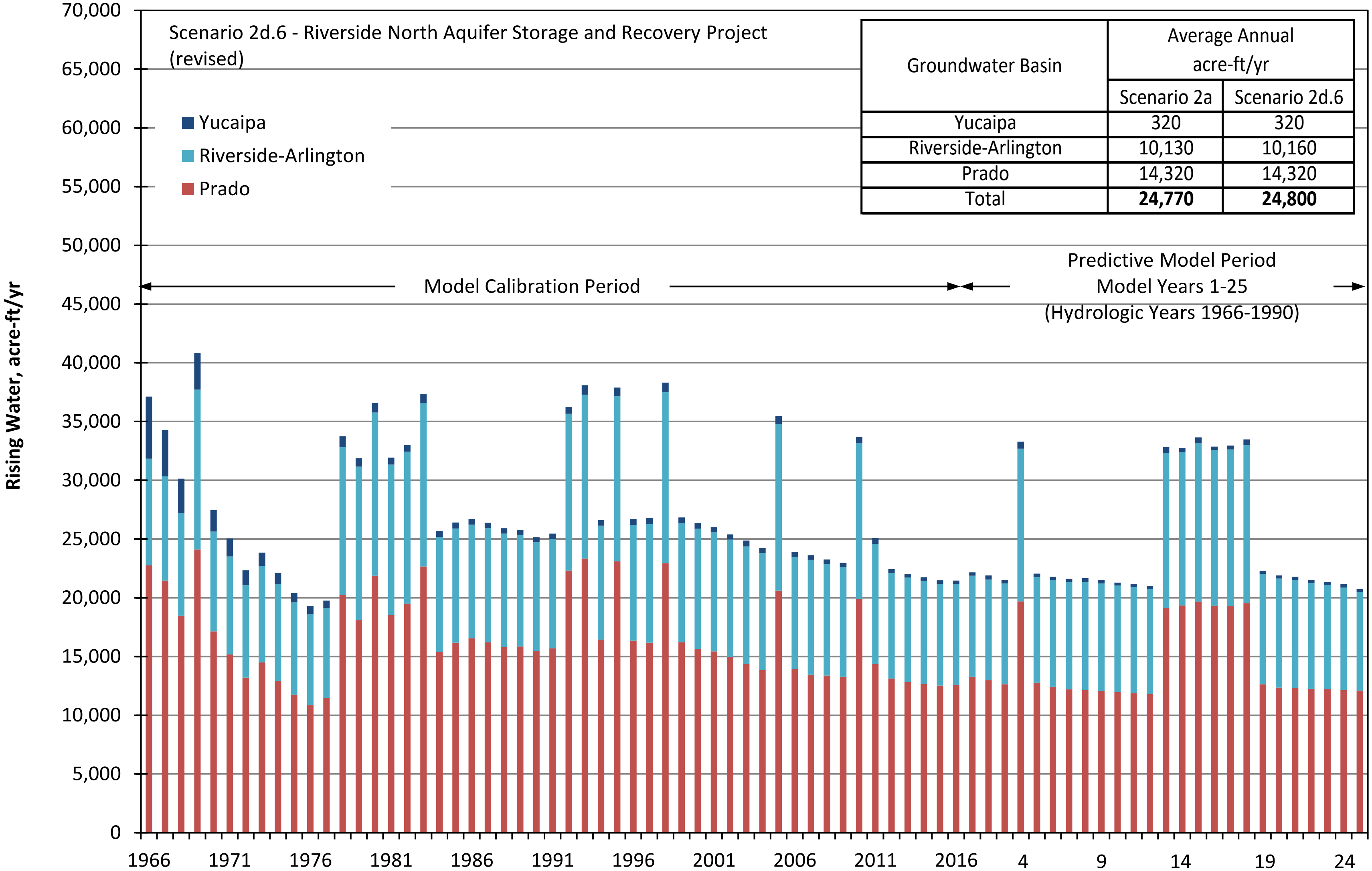

Scenario 2d.6: Distribution of Monthly Streamflow at the Santa Ana River at Prado Dam
Scenario 2a - Baseline
Scenario 2d.6 - Riverside North Aquifer Storage and Recovery Project (revised)
Under baseline conditions, flow in the SAR at Prado Dam exceeds 116.8 cfs over half of the time (50%).
Scenario 2d.6 conditions do not significantly affect flow at Prado Dam.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

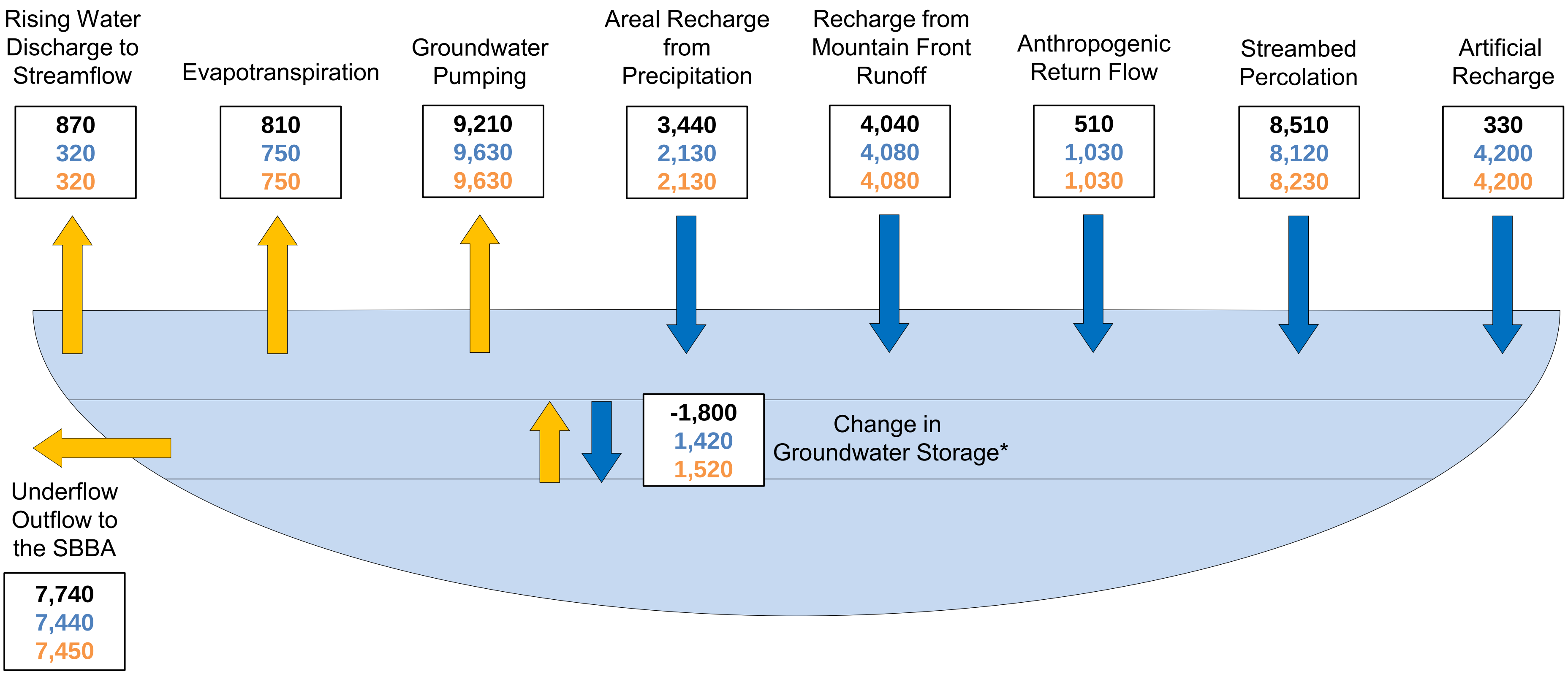
Figure 688

Scenario 2d.6: Annual Rising Water – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2d.6
Yucaipa	320	320
Riverside-Arlington	10,130	10,160
Prado	14,320	14,320
Total	**24,770**	**24,800**

Figure 689



Scenario 2a - Baseline
Scenario 2d.6 - Riverside North Aquifer Storage and Recovery Project (revised)

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.6 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.6
AVERAGE ANNUAL WATER BUDGET
YUCAIPA BASIN

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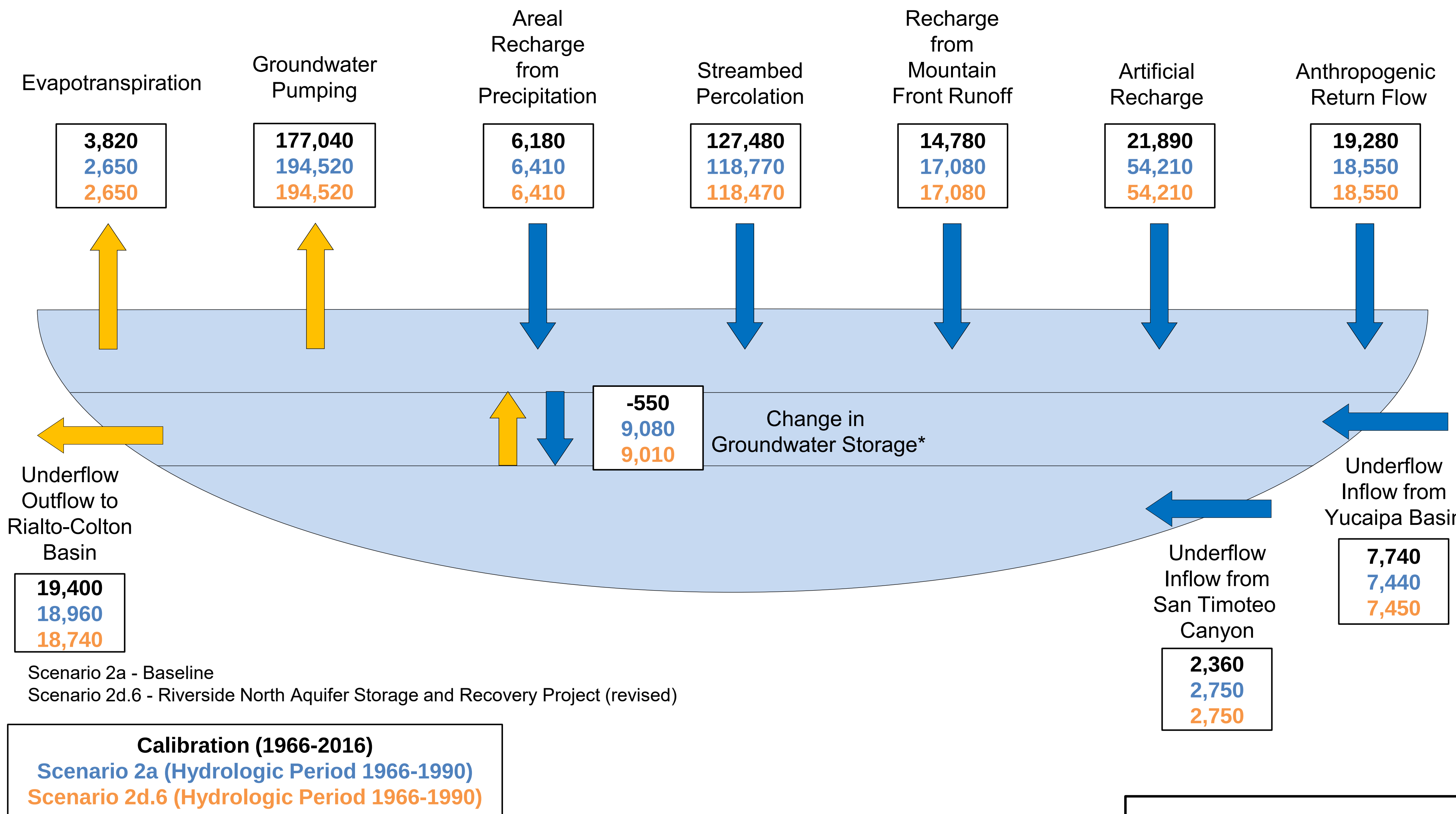

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.6 AVERAGE ANNUAL WATER BUDGET SBBA

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10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

UPPER SANTA ANA RIVER INTEGRATED MODEL – SUMMARY REPORT

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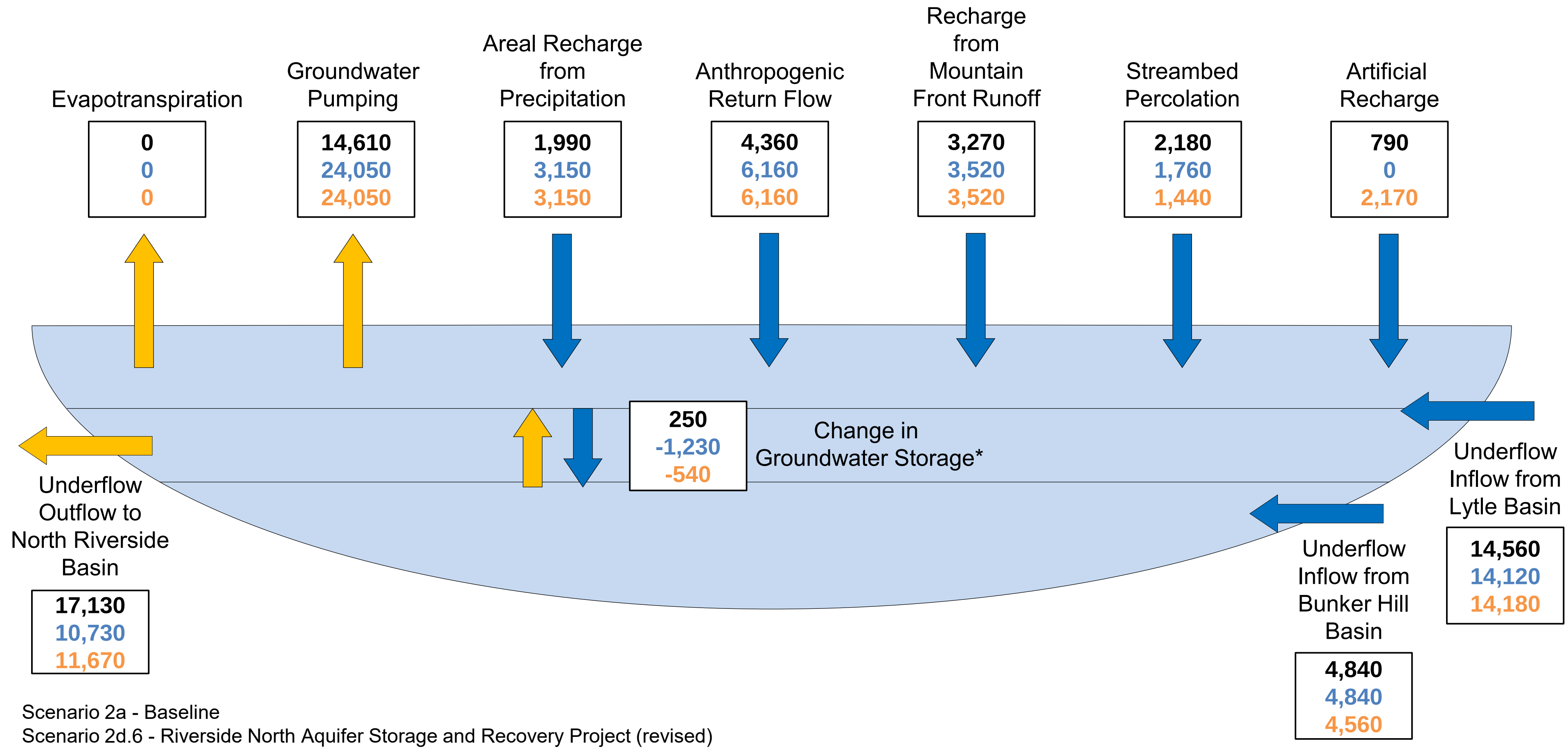
FIGURE 691

GEOSCIENCE



Scenario 2a - Baseline
Scenario 2d.6 - Riverside North Aquifer Storage and Recovery Project (revised)

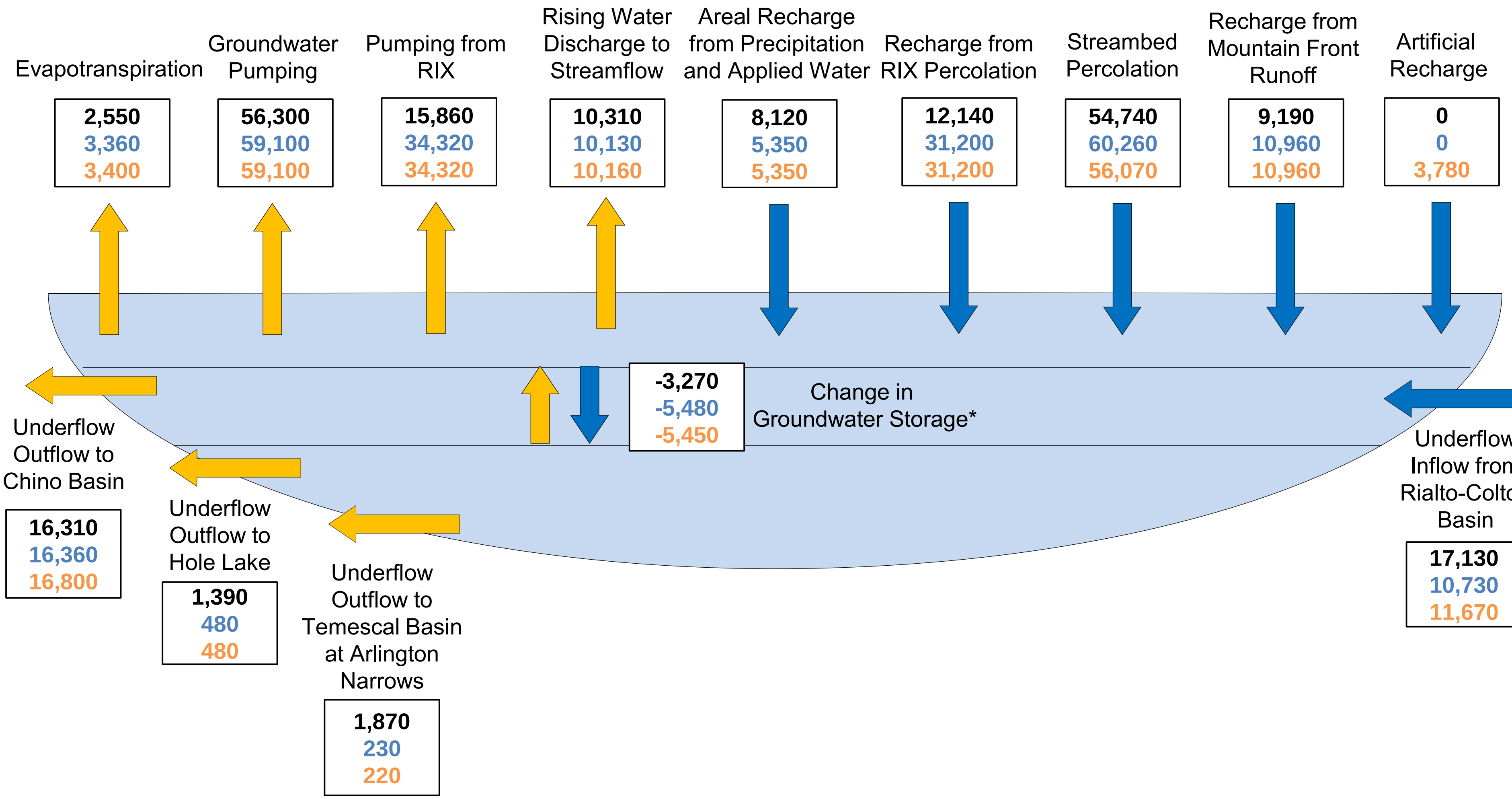
Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.6 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.6
AVERAGE ANNUAL
WATER BUDGET
RIALTO-COLTON BASIN

10-Apr-20



Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.6 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

Scenario 2a - Baseline
Scenario 2d.6 - Riverside North Aquifer Storage and Recovery Project (revised)

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.6
AVERAGE ANNUAL
WATER BUDGET
RIVERSIDE-ARLINGTON BASIN

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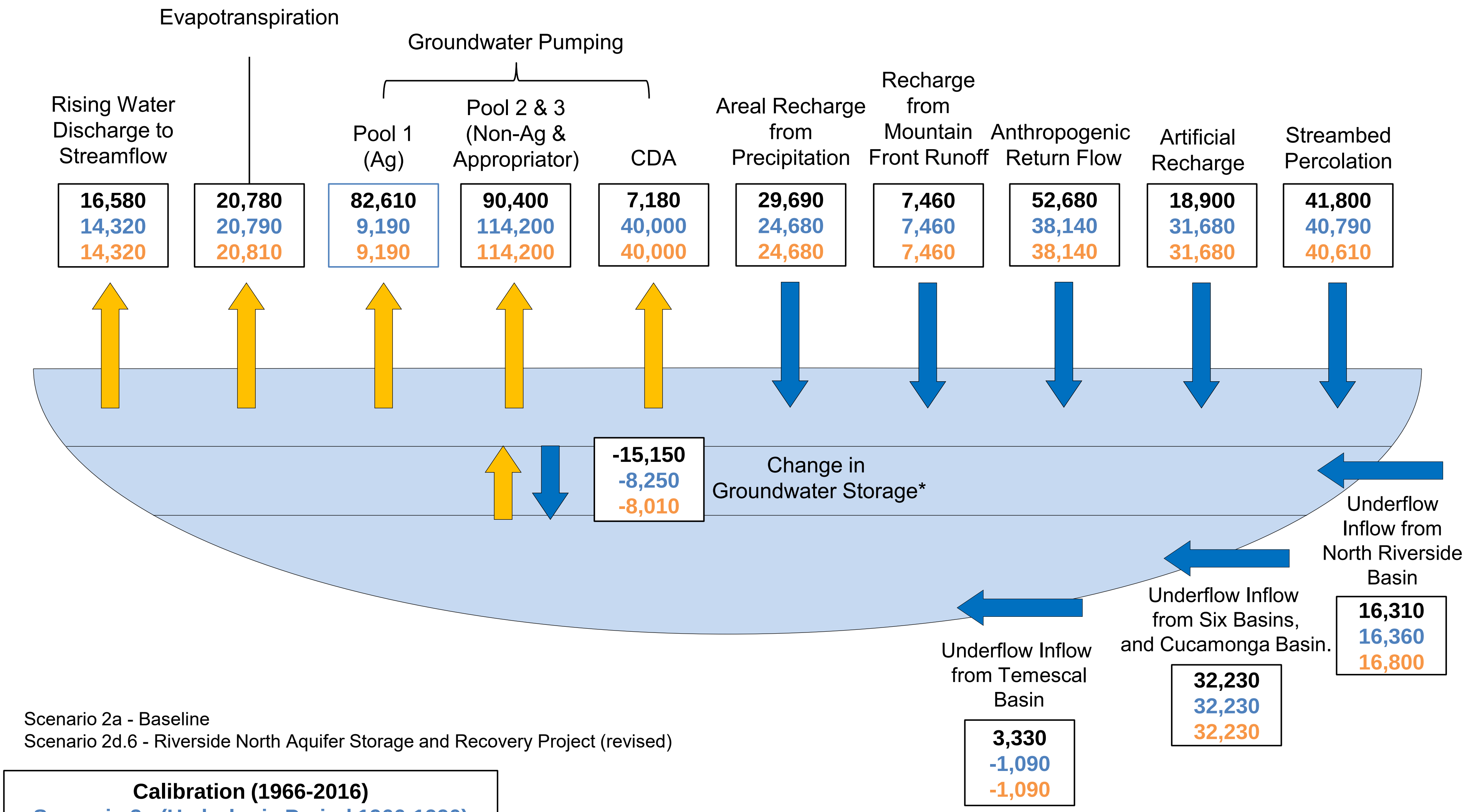


Scenario 2a - Baseline
Scenario 2d.6 - Riverside North Aquifer Storage and Recovery Project (revised)

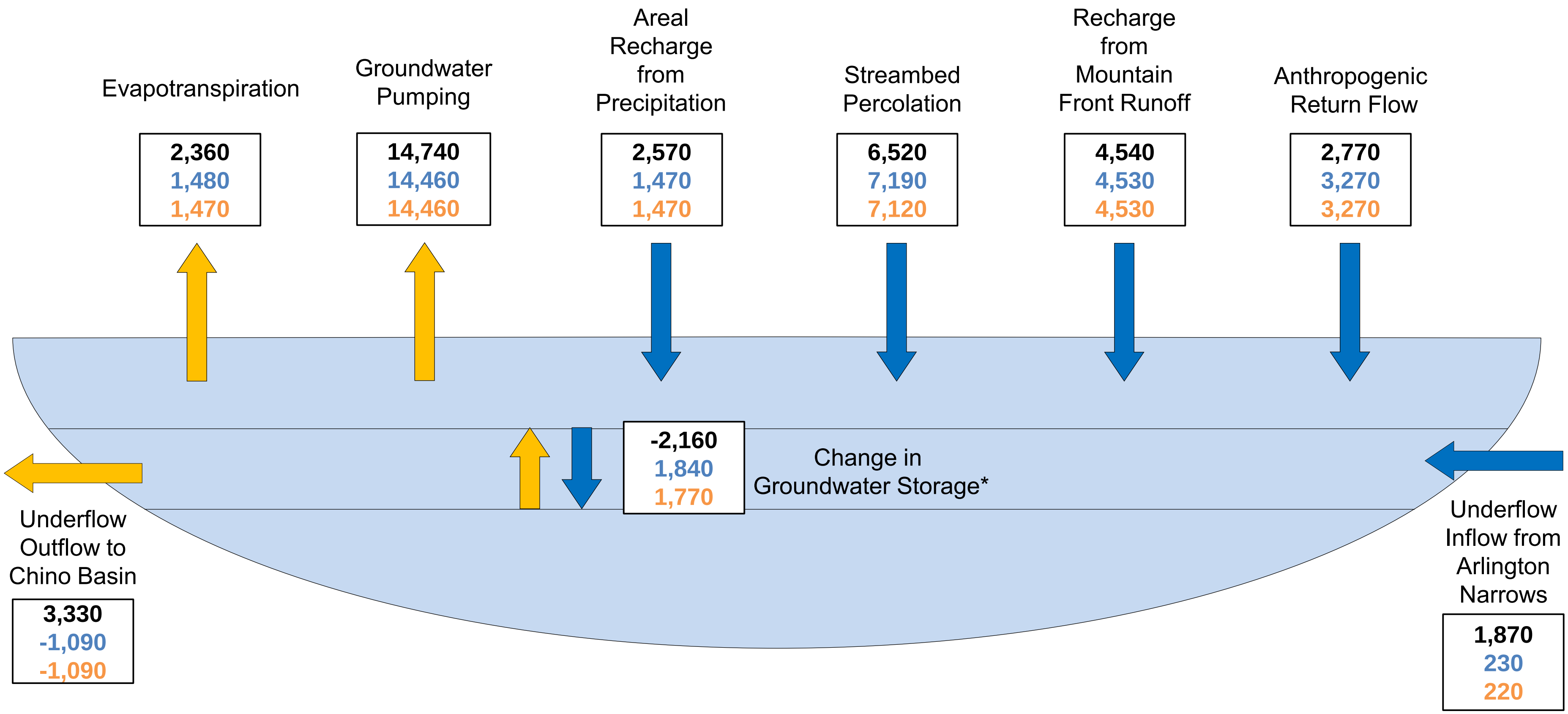
Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.6 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.6 AVERAGE ANNUAL WATER BUDGET CHINO BASIN

10-Apr-20



Scenario 2a - Baseline
Scenario 2d.6 - Riverside North Aquifer Storage and Recovery Project (revised)

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.6 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.6
AVERAGE ANNUAL
WATER BUDGET
TEMESCAL BASIN

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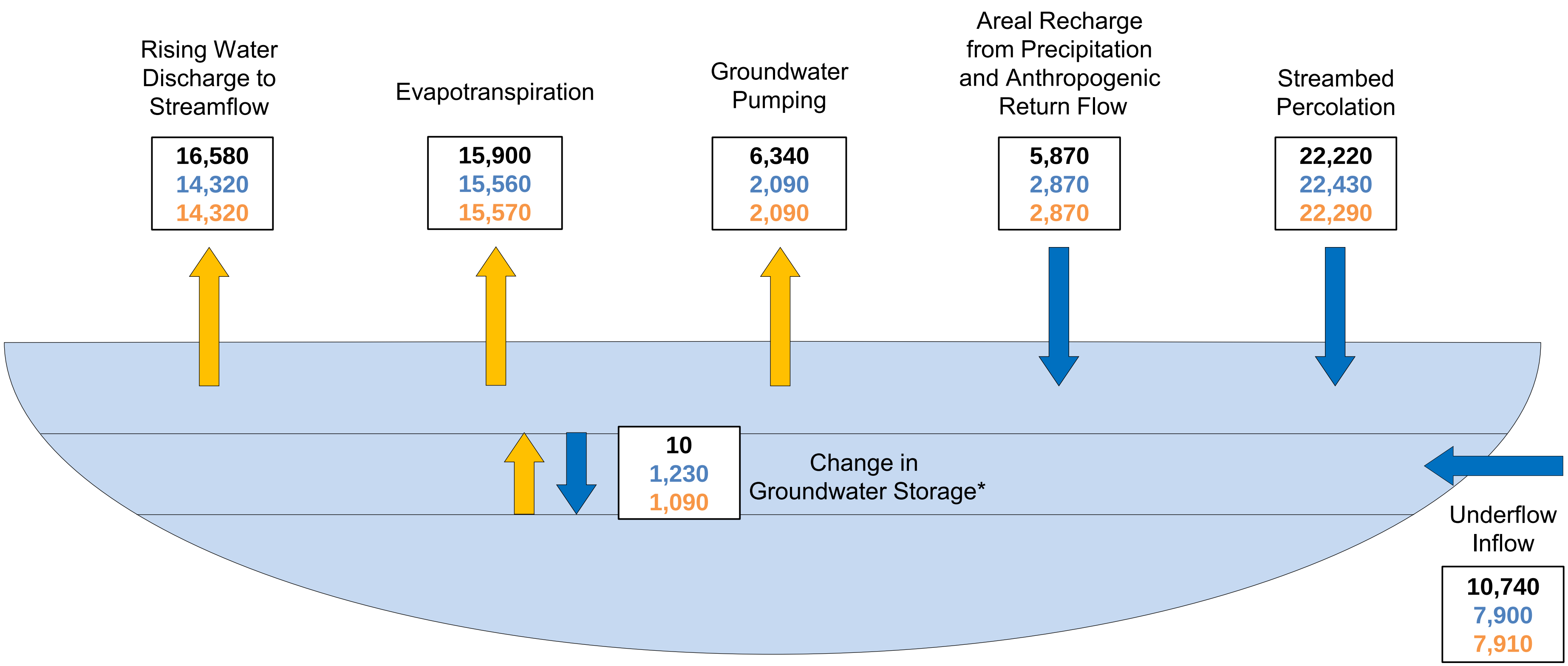


Scenario 2a - Baseline
Scenario 2d.6 - Riverside North Aquifer Storage and Recovery Project (revised)

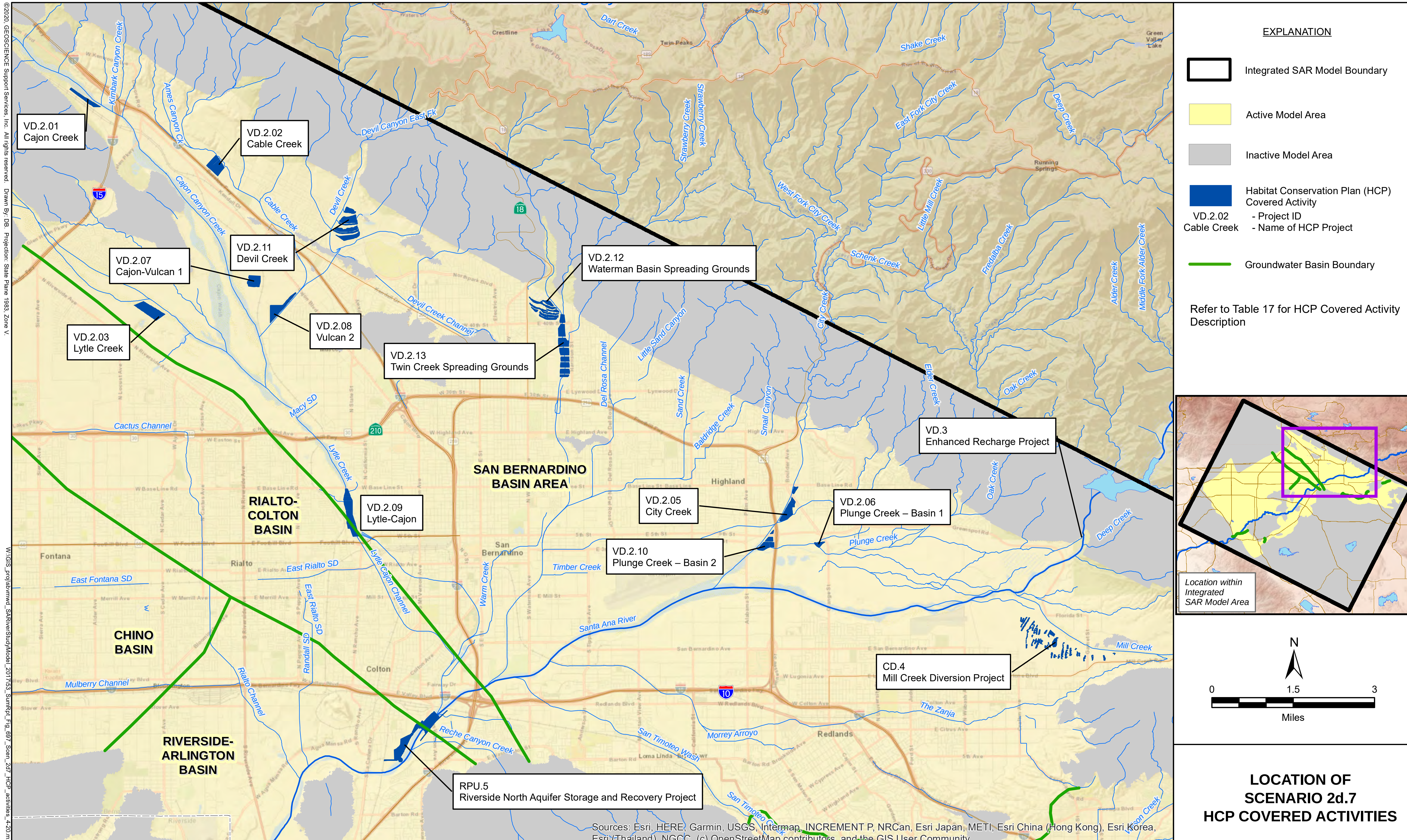
Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.6 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.6 AVERAGE ANNUAL WATER BUDGET PRADO BASIN

10-Apr-20



LOCATION OF SCENARIO 2d.7 HCP COVERED ACTIVITIES

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10-Apr-20

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FIGURE 697

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

GEOSCIENCE

Scenario 2d.7: Annual Change in Surface Water Diversion Compared to Baseline

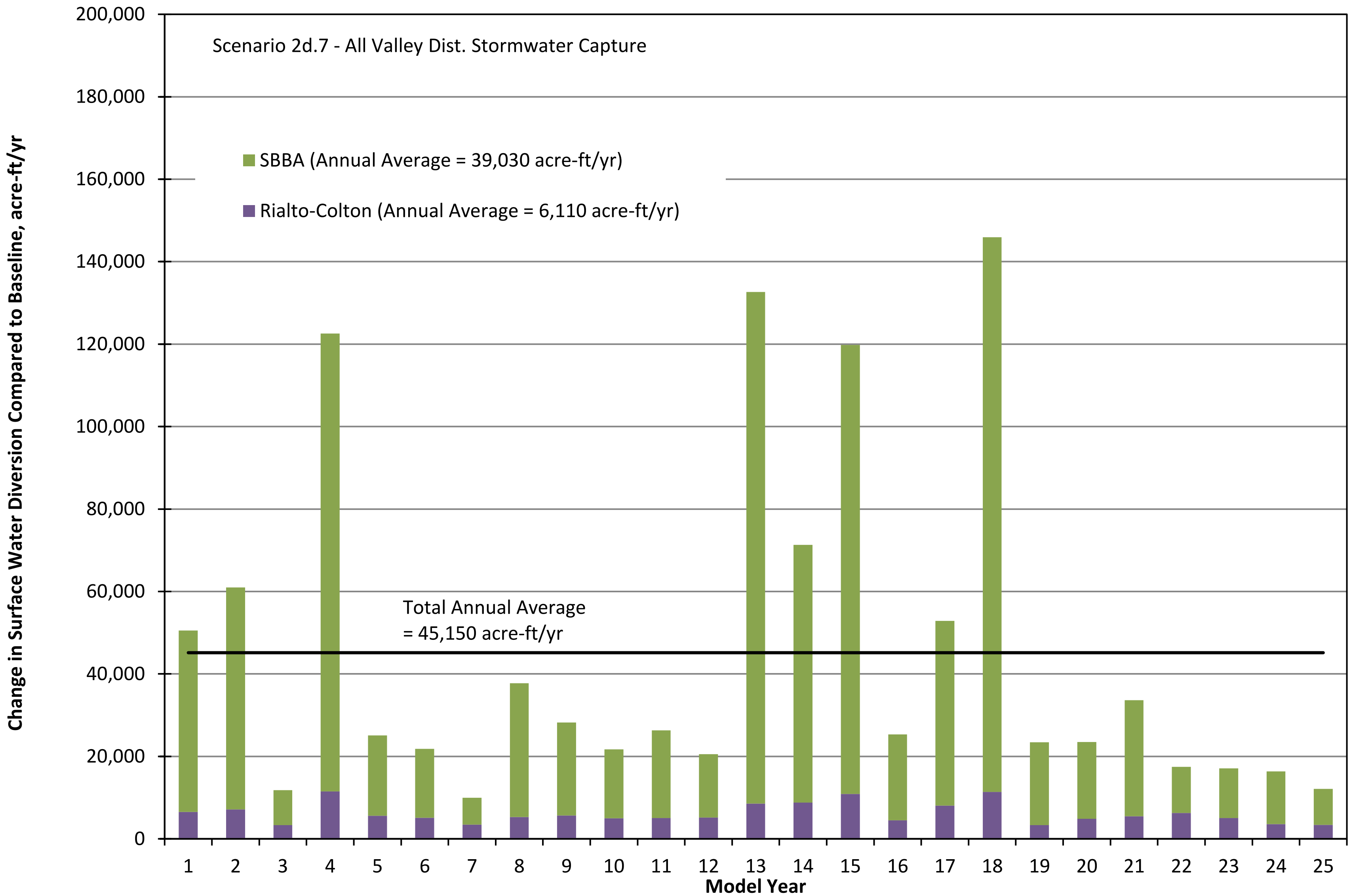


Figure 698

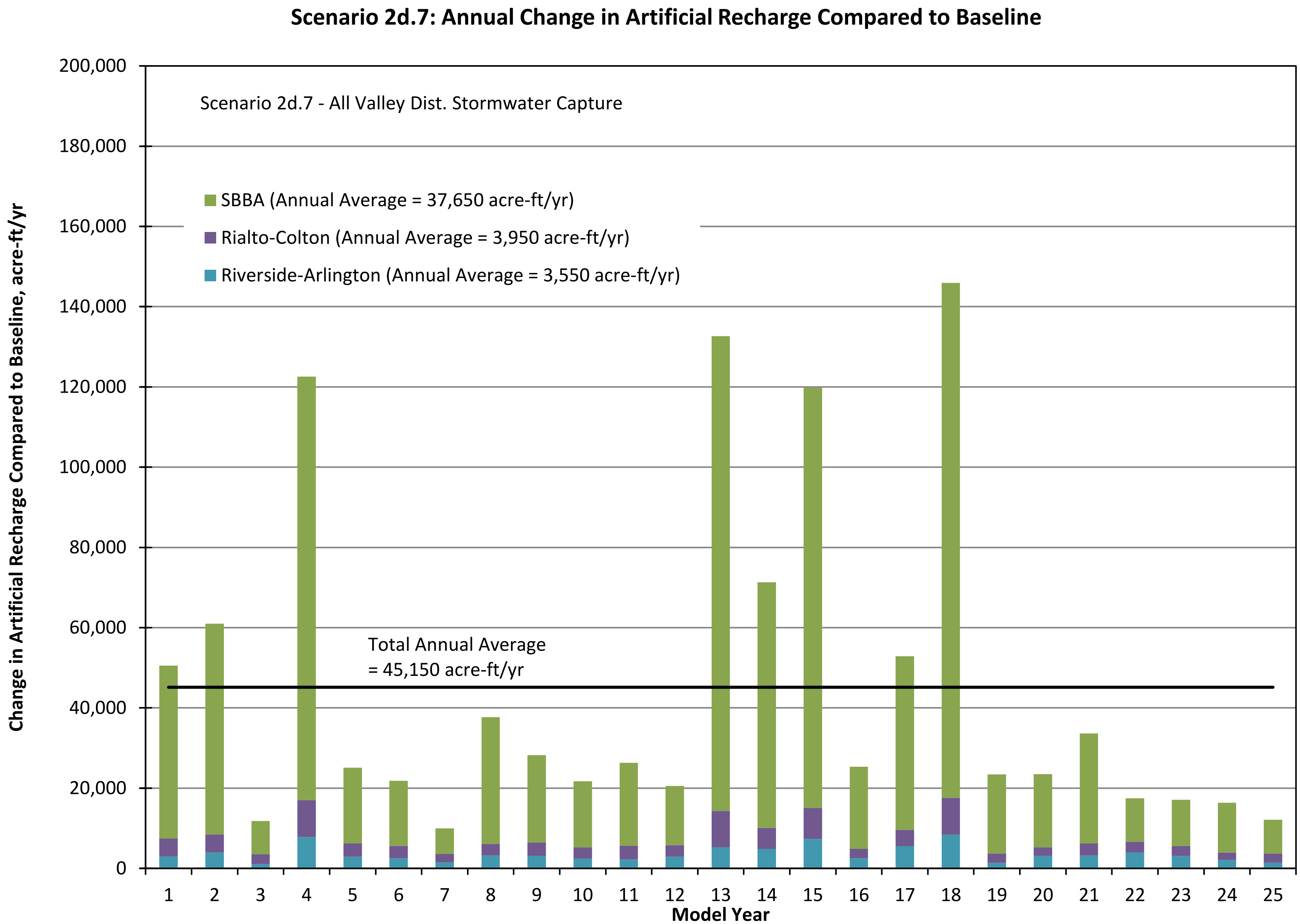
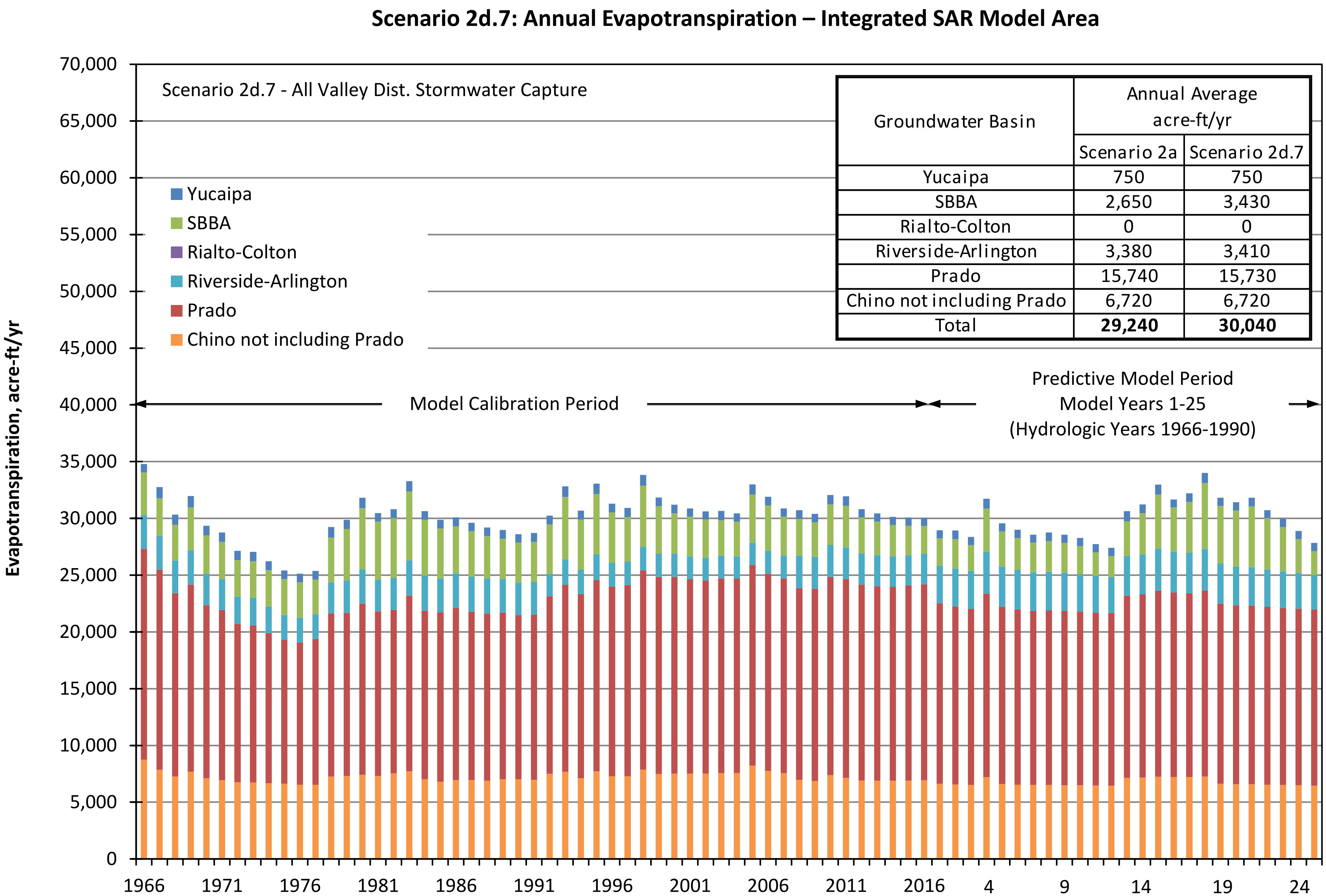

Scenario 2d.7: Annual Change in Artificial Recharge Compared to Baseline
Scenario 2d.7 - All Valley Dist. Stormwater Capture
SBBA (Annual Average = 37,650 acre-ft/yr)
Rialto-Colton (Annual Average = 3,950 acre-ft/yr)
Riverside-Arlington (Annual Average = 3,550 acre-ft/yr)
Total Annual Average
= 45,150 acre-ft/yr
Change in Artificial Recharge Compared to Baseline, acre-ft/yr
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Model Year

Figure 699



Groundwater Basin	Annual Average acre-ft/yr	
	Scenario 2a	Scenario 2d.7
Yucaipa	750	750
SBBA	2,650	3,430
Rialto-Colton	0	0
Riverside-Arlington	3,380	3,410
Prado	15,740	15,730
Chino not including Prado	6,720	6,720
Total	**29,240**	**30,040**

Figure 700

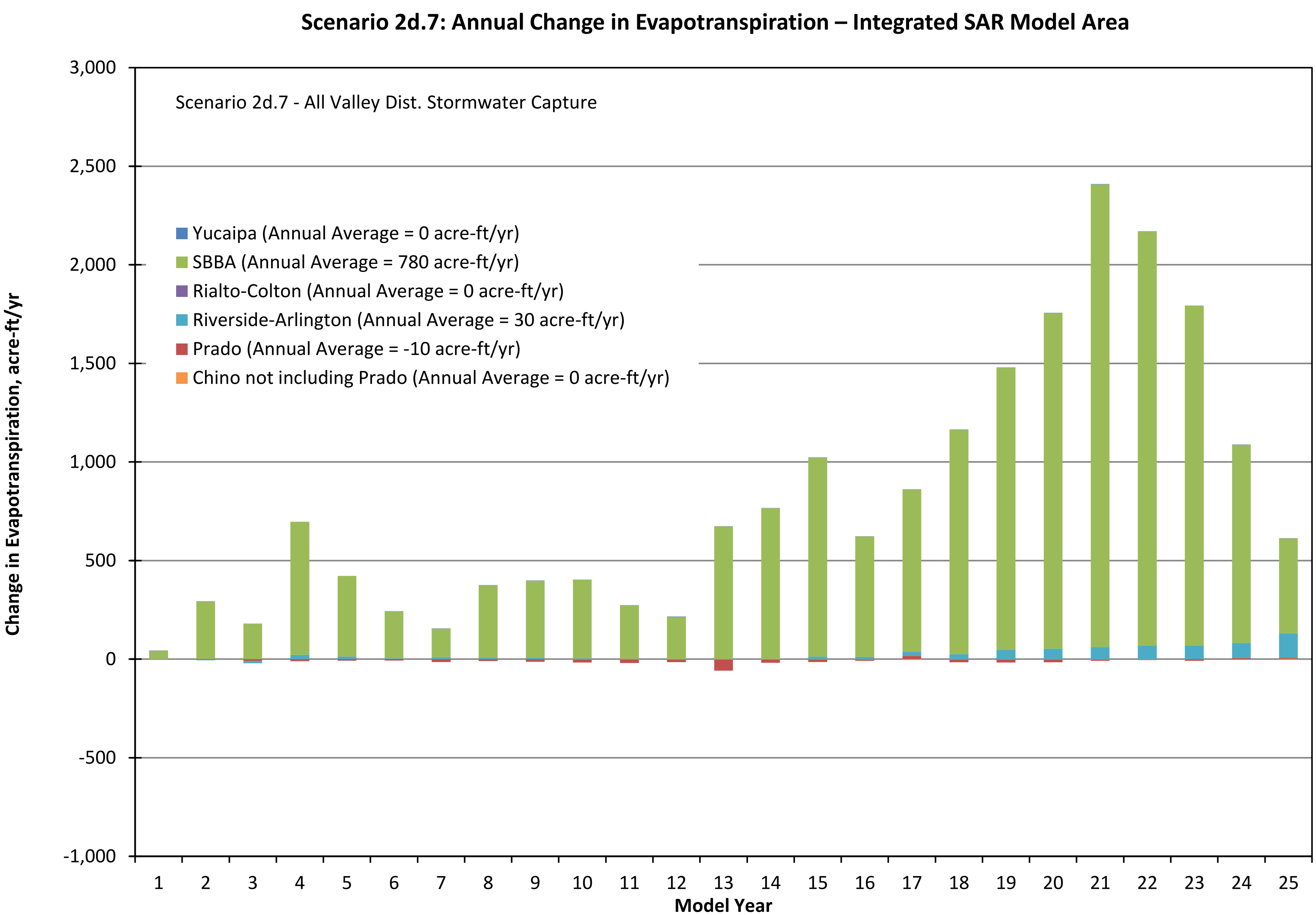
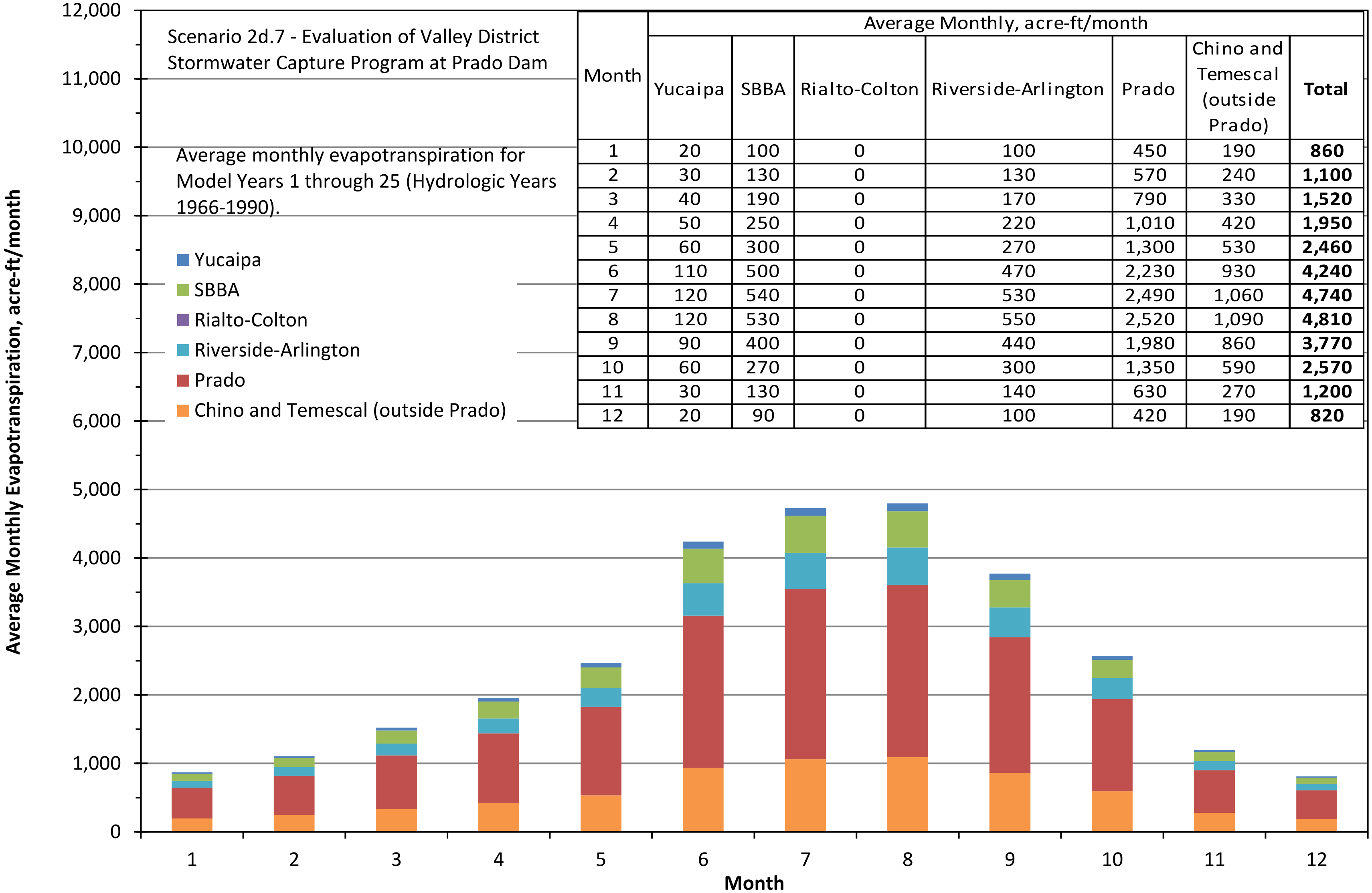

Scenario 2d.7: Annual Change in Evapotranspiration – Integrated SAR Model Area
Scenario 2d.7 - All Valley Dist. Stormwater Capture
Yucaipa (Annual Average = 0 acre-ft/yr)
SBBA (Annual Average = 780 acre-ft/yr)
Rialto-Colton (Annual Average = 0 acre-ft/yr)
Riverside-Arlington (Annual Average = 30 acre-ft/yr)
Prado (Annual Average = -10 acre-ft/yr)
Chino not including Prado (Annual Average = 0 acre-ft/yr)
Change in Evapotranspiration, acre-ft/yr
3,000
2,500
2,000
1,500
1,000
500
0
-500
-1,000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Model Year

Figure 701

Scenario 2d.7: Seasonal Evapotranspiration – Integrated SAR Model Area



Month	Average Monthly, acre-ft/month						
	Yucaipa	SBBA	Rialto-Colton	Riverside-Arlington	Prado	Chino and Temescal (outside Prado)	**Total**
1	20	100	0	100	450	190	**860**
2	30	130	0	130	570	240	**1,100**
3	40	190	0	170	790	330	**1,520**
4	50	250	0	220	1,010	420	**1,950**
5	60	300	0	270	1,300	530	**2,460**
6	110	500	0	470	2,230	930	**4,240**
7	120	540	0	530	2,490	1,060	**4,740**
8	120	530	0	550	2,520	1,090	**4,810**
9	90	400	0	440	1,980	860	**3,770**
10	60	270	0	300	1,350	590	**2,570**
11	30	130	0	140	630	270	**1,200**
12	20	90	0	100	420	190	**820**

Figure 702

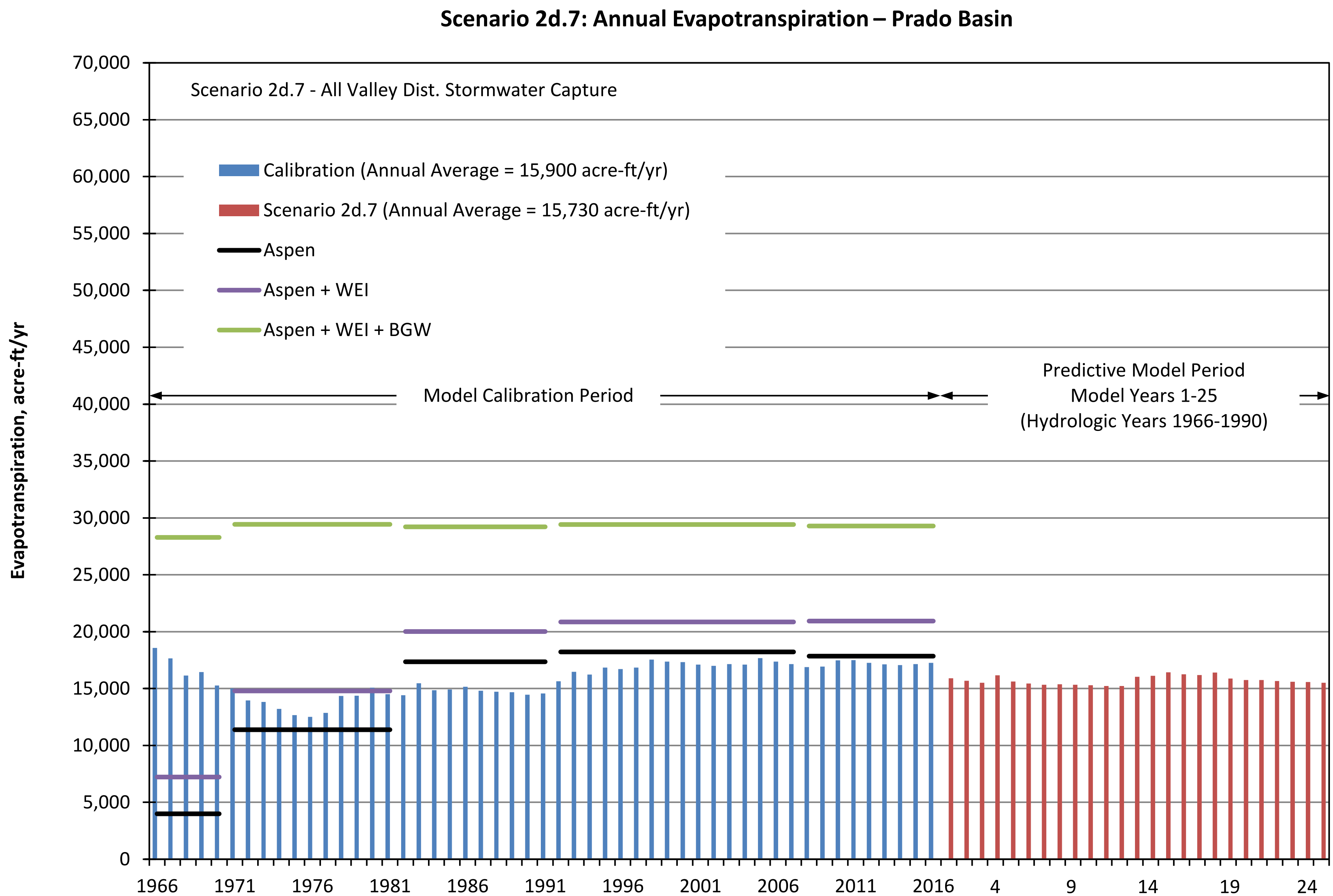

Scenario 2d.7: Annual Evapotranspiration – Prado Basin
Scenario 2d.7 - All Valley Dist. Stormwater Capture
Calibration (Annual Average = 15,900 acre-ft/yr)
Scenario 2d.7 (Annual Average = 15,730 acre-ft/yr)
Aspen
Aspen + WEI
Aspen + WEI + BGW
Model Calibration Period
Predictive Model Period
Model Years 1-25
(Hydrologic Years 1966-1990)
Evapotranspiration, acre-ft/yr
70,000
65,000
60,000
55,000
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
1966
1971
1976
1981
1986
1991
1996
2001
2006
2011
2016
4
9
14
19
24

Figure 703

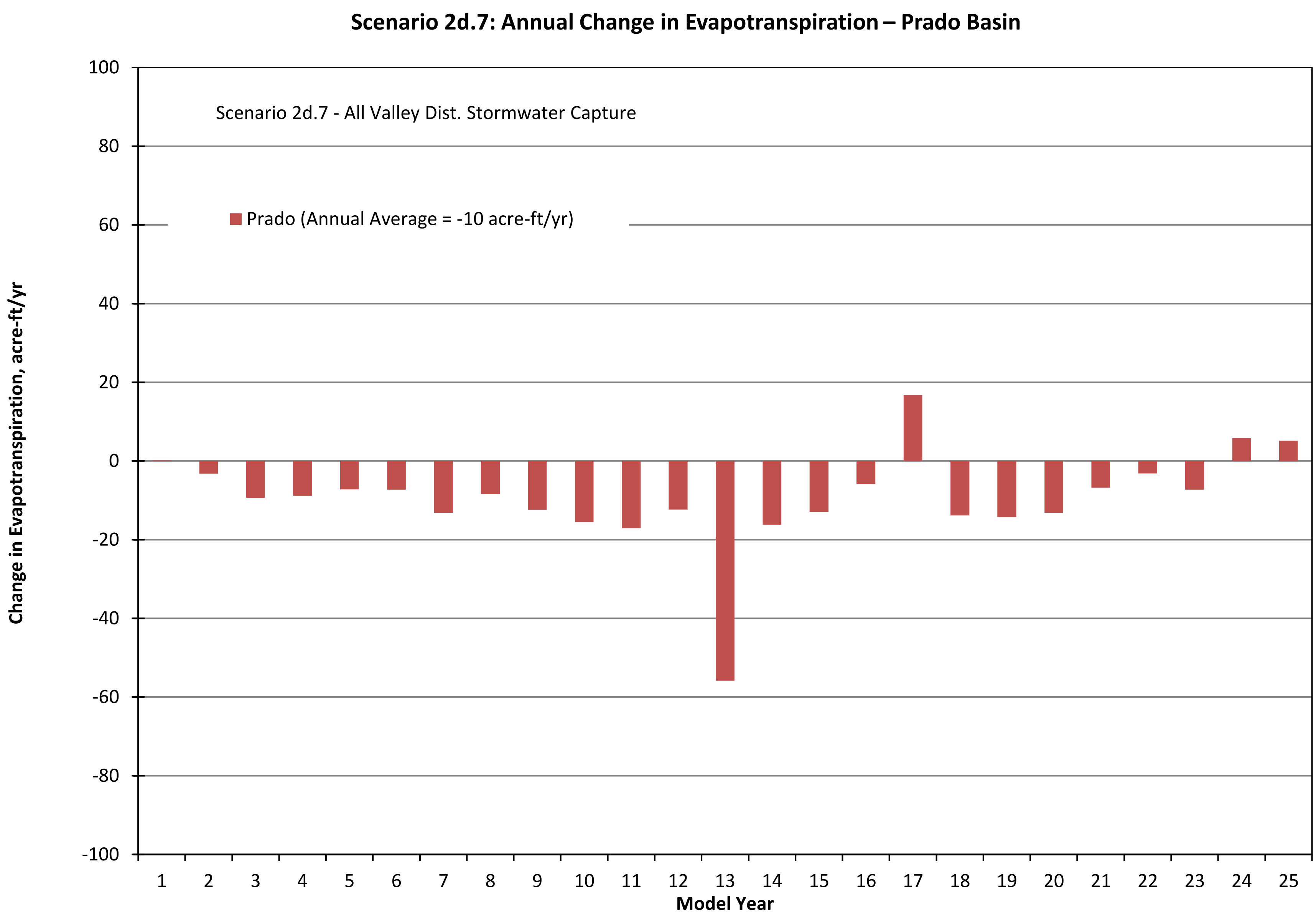
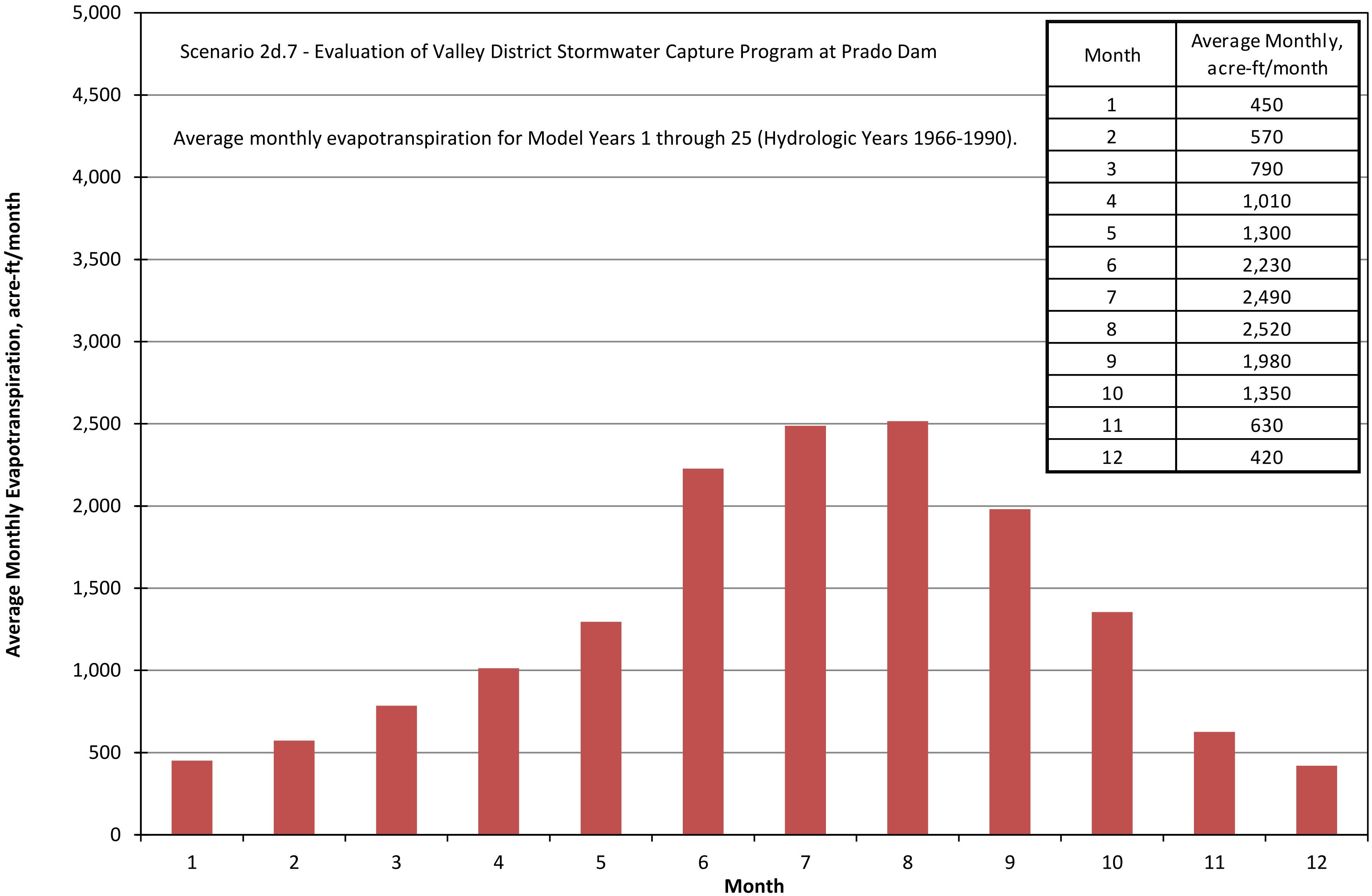

Scenario 2d.7: Annual Change in Evapotranspiration – Prado Basin
Scenario 2d.7 - All Valley Dist. Stormwater Capture
Prado (Annual Average = -10 acre-ft/yr)
Change in Evapotranspiration, acre-ft/yr
100
80
60
40
20
0
-20
-40
-60
-80
-100
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Model Year

Figure 704

Scenario 2d.7: Seasonal Evapotranspiration – Prado Basin



Month	Average Monthly, acre-ft/month
1	450
2	570
3	790
4	1,010
5	1,300
6	2,230
7	2,490
8	2,520
9	1,980
10	1,350
11	630
12	420

Figure 705

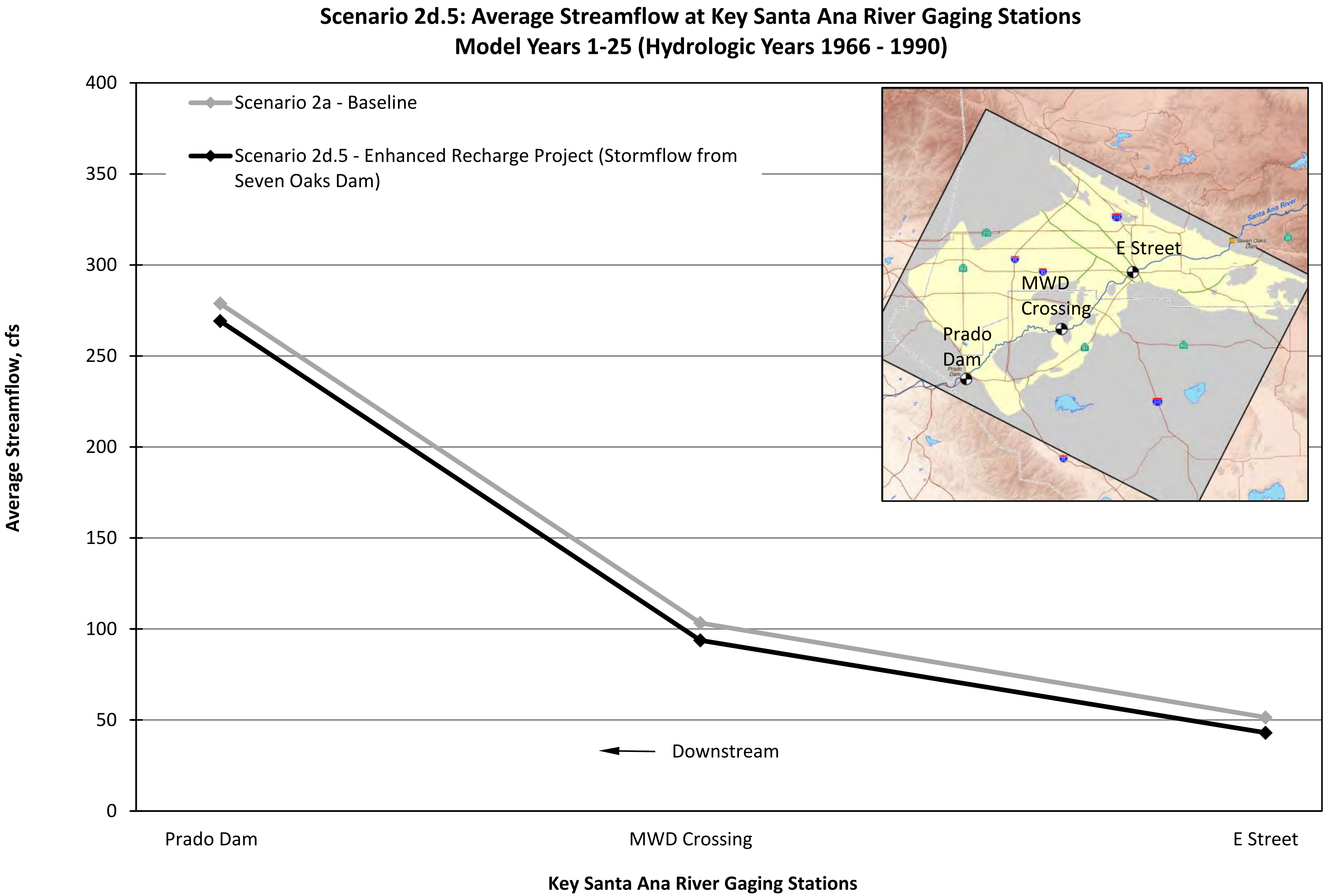

Scenario 2d.5: Average Streamflow at Key Santa Ana River Gaging Stations
Model Years 1-25 (Hydrologic Years 1966 - 1990)
Scenario 2a - Baseline
Scenario 2d.5 - Enhanced Recharge Project (Stormflow from Seven Oaks Dam)
Average Streamflow, cfs
400
350
300
250
200
150
100
50
0
E Street
MWD
Crossing
Prado
Dam
Downstream
Prado Dam
MWD Crossing
E Street
Key Santa Ana River Gaging Stations

Figure 706

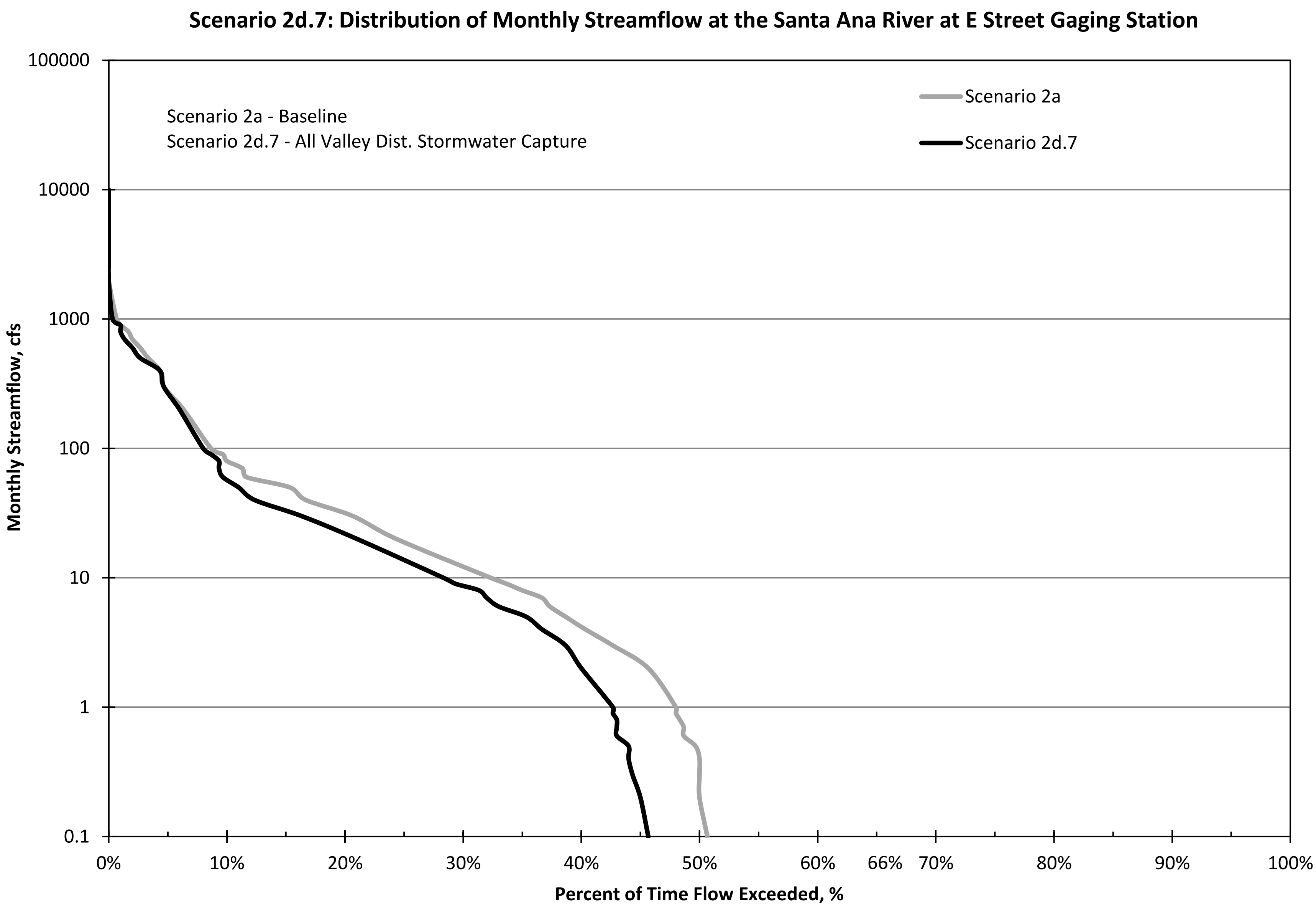

Scenario 2d.7: Distribution of Monthly Streamflow at the Santa Ana River at E Street Gaging Station
Scenario 2a - Baseline
Scenario 2d.7 - All Valley Dist. Stormwater Capture
Scenario 2a
Scenario 2d.7
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
66%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 707

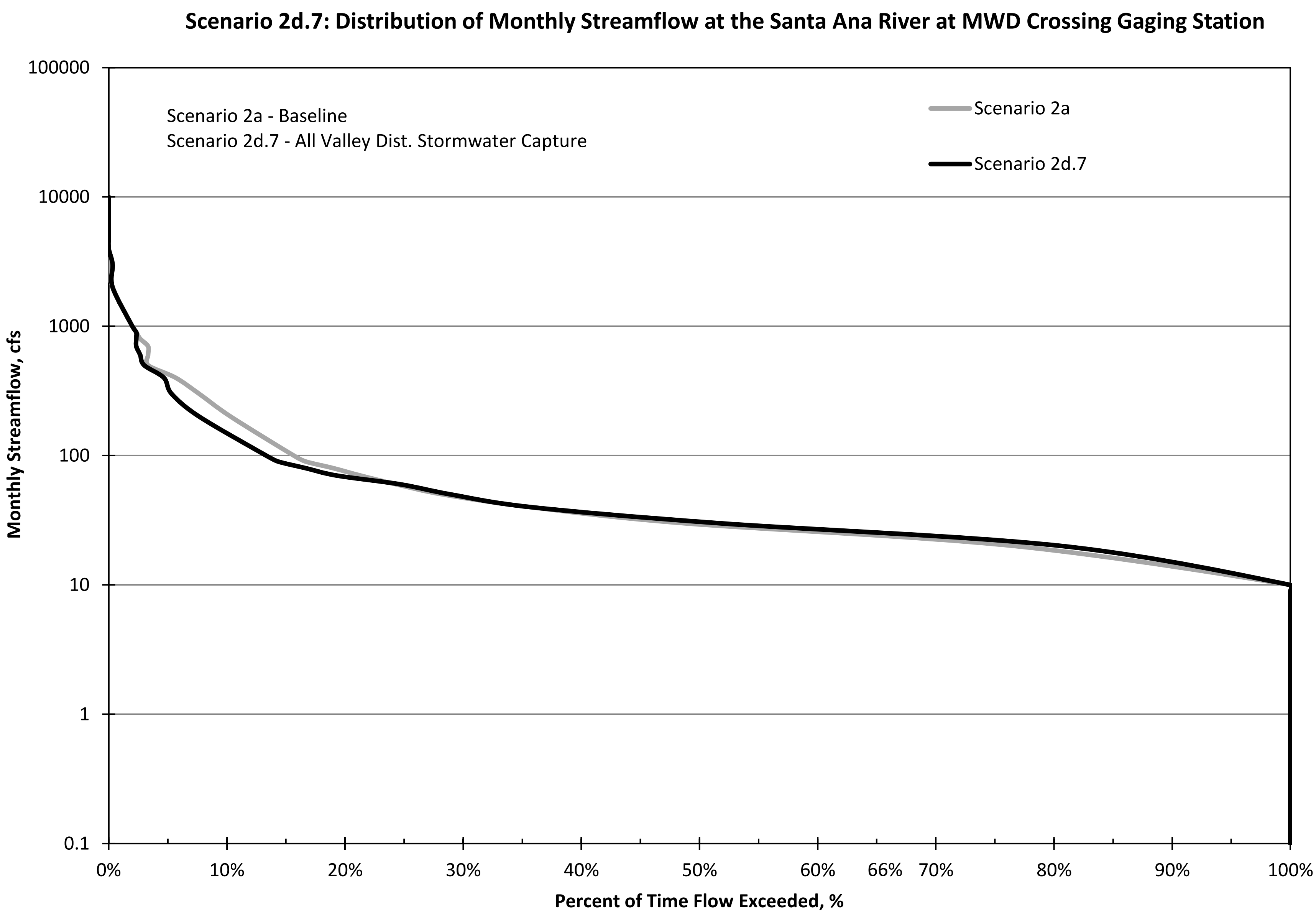

Scenario 2d.7: Distribution of Monthly Streamflow at the Santa Ana River at MWD Crossing Gaging Station
Scenario 2a - Baseline
Scenario 2d.7 - All Valley Dist. Stormwater Capture
Scenario 2a
Scenario 2d.7
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
66%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 708

Scenario 2d.7: Distribution of Monthly Streamflow at the Santa Ana River at Prado Dam

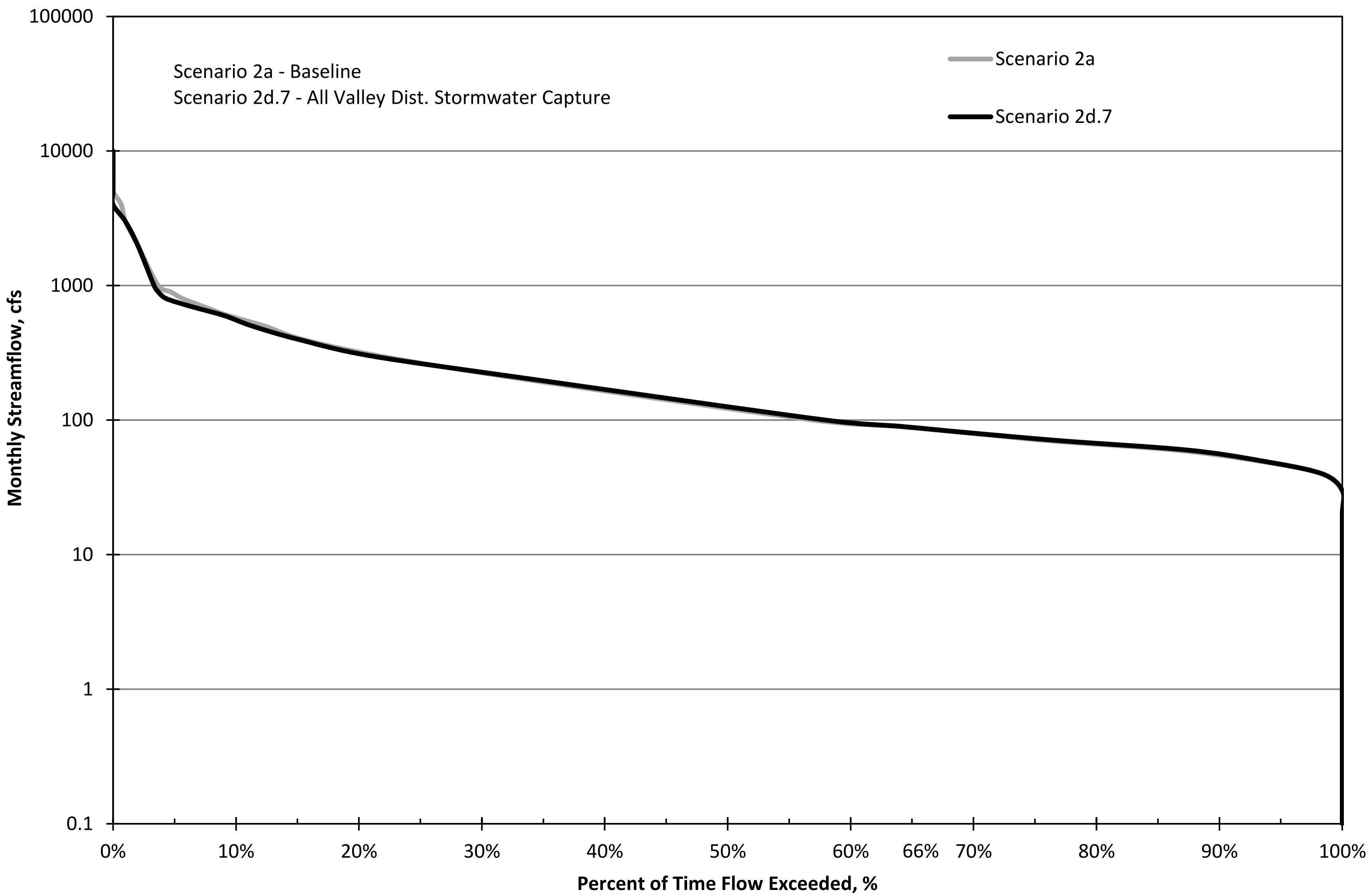
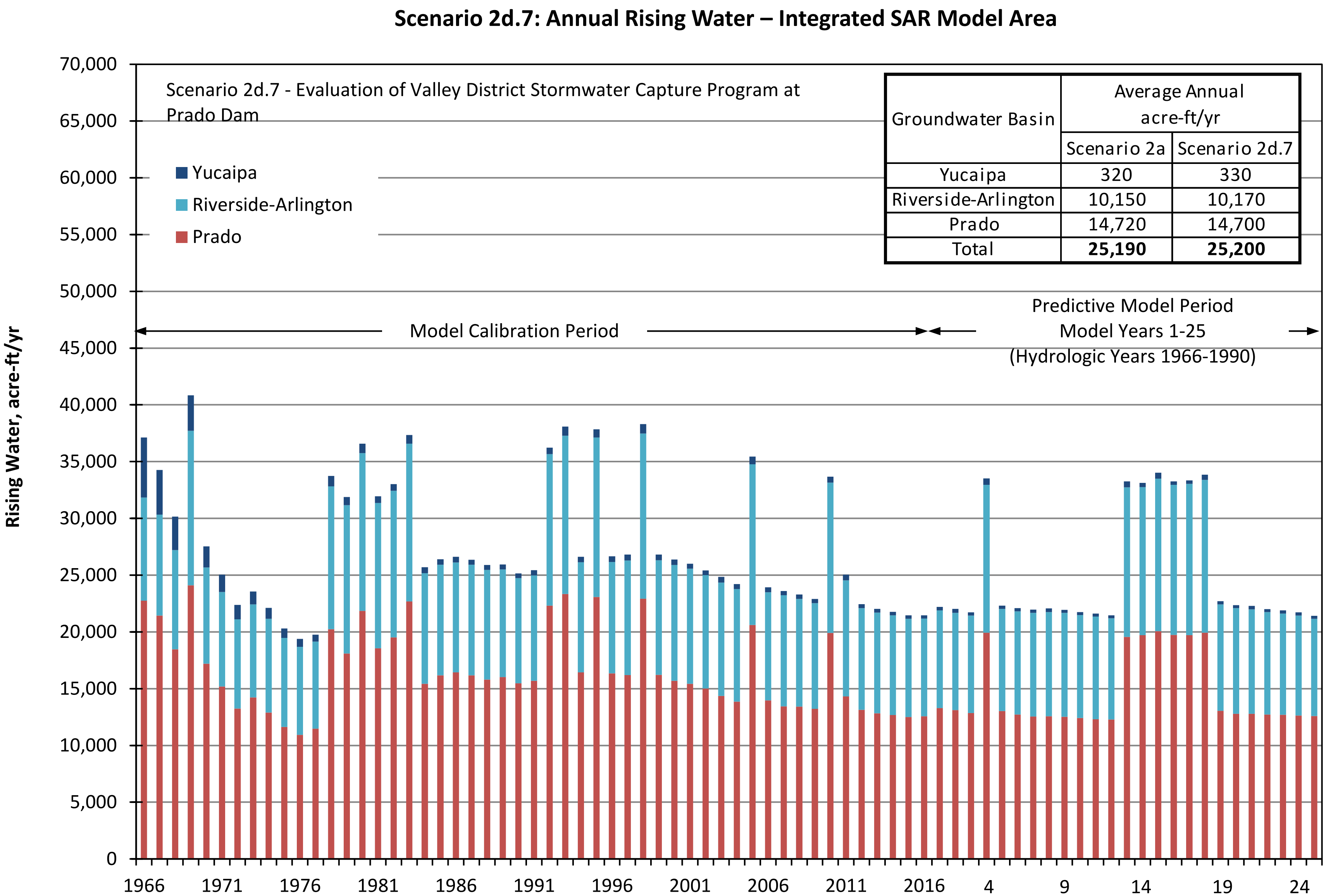


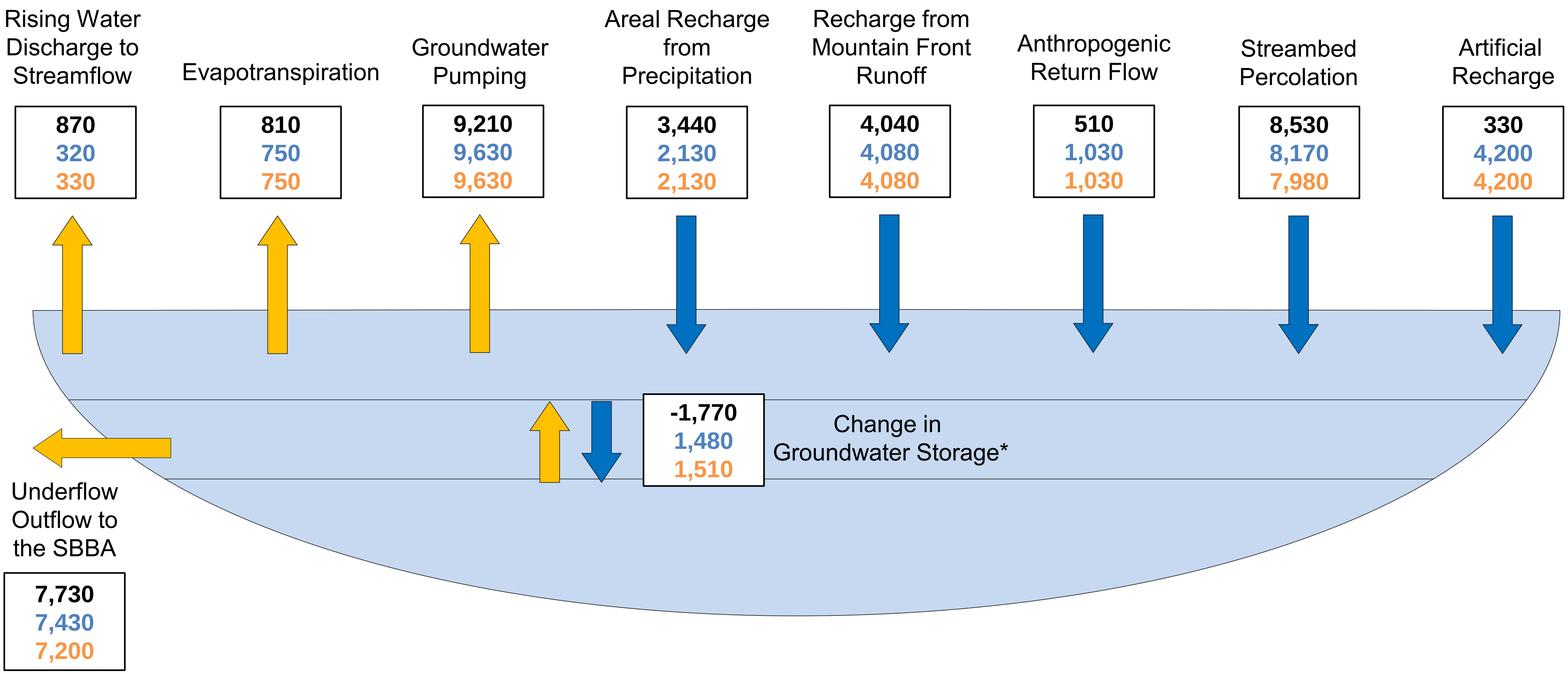
Figure 709



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2d.7
Yucaipa	320	330
Riverside-Arlington	10,150	10,170
Prado	14,720	14,700
Total	**25,190**	**25,200**

Figure 710

X:\Projects\San_Bernardino_MUNI\31) Integreated_SAR_Model\(4)Technical_Memos\(8)Summary Report\Draft\Figures\Scenarios



Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.7 (Hydrologic Period 1966-1990)

Scenario 2a - Baseline
Scenario 2d.7 - All Valley Dist. Stormwater Capture

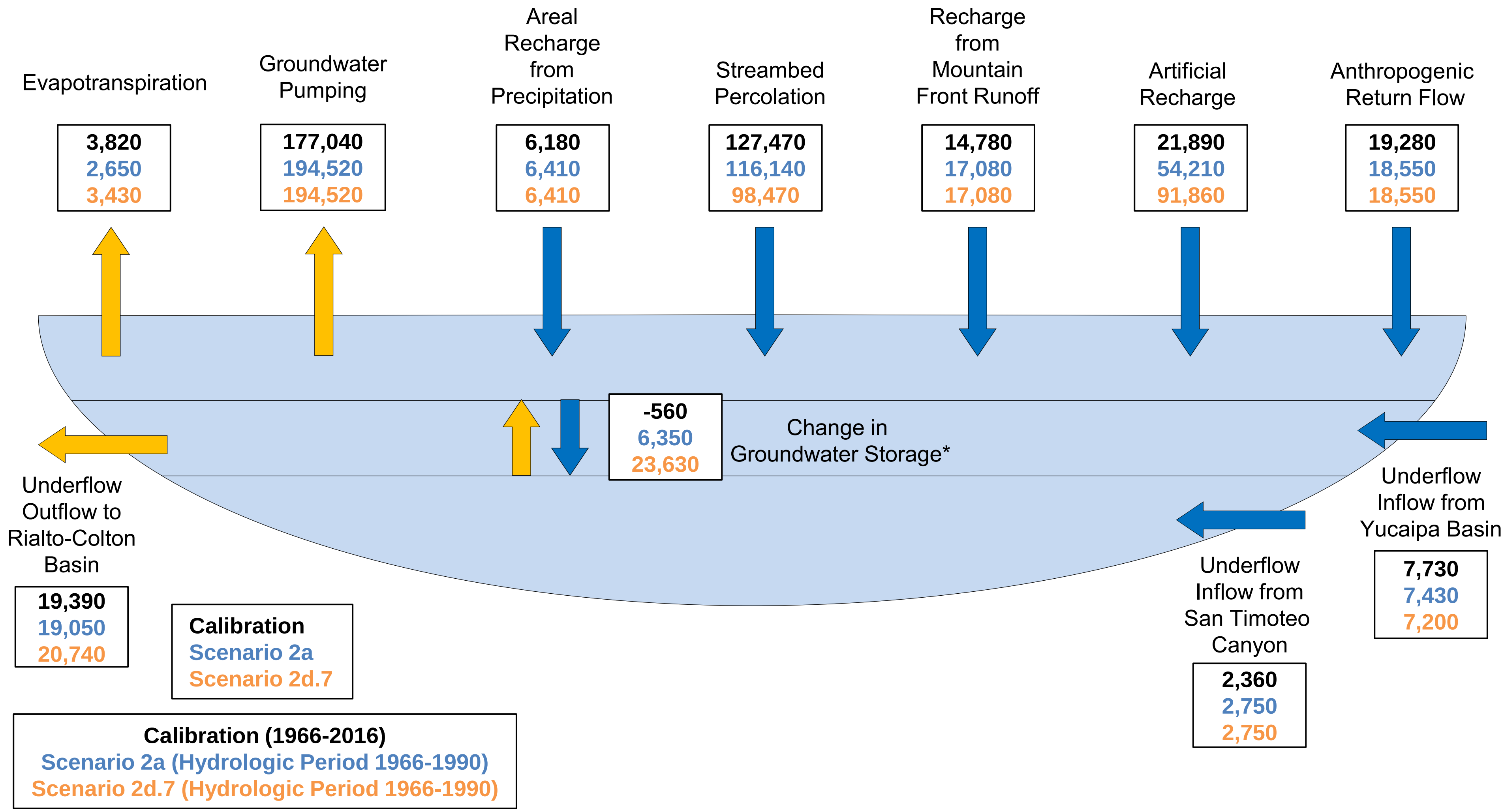
All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.7 AVERAGE ANNUAL WATER BUDGET YUCAIPA BASIN

10-Apr-20

X:\Projects\San_Bernardino_MUNI\31) Integreated_SAR_Model\(4)Technical_Memos\(8)Summary Report\Draft\Figures\Scenarios



Scenario 2a - Baseline
Scenario 2d.7 - All Valley Dist. Stormwater Capture

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

**SCENARIO 2D.7
AVERAGE ANNUAL
WATER BUDGET
SBBA**

10-Apr-20

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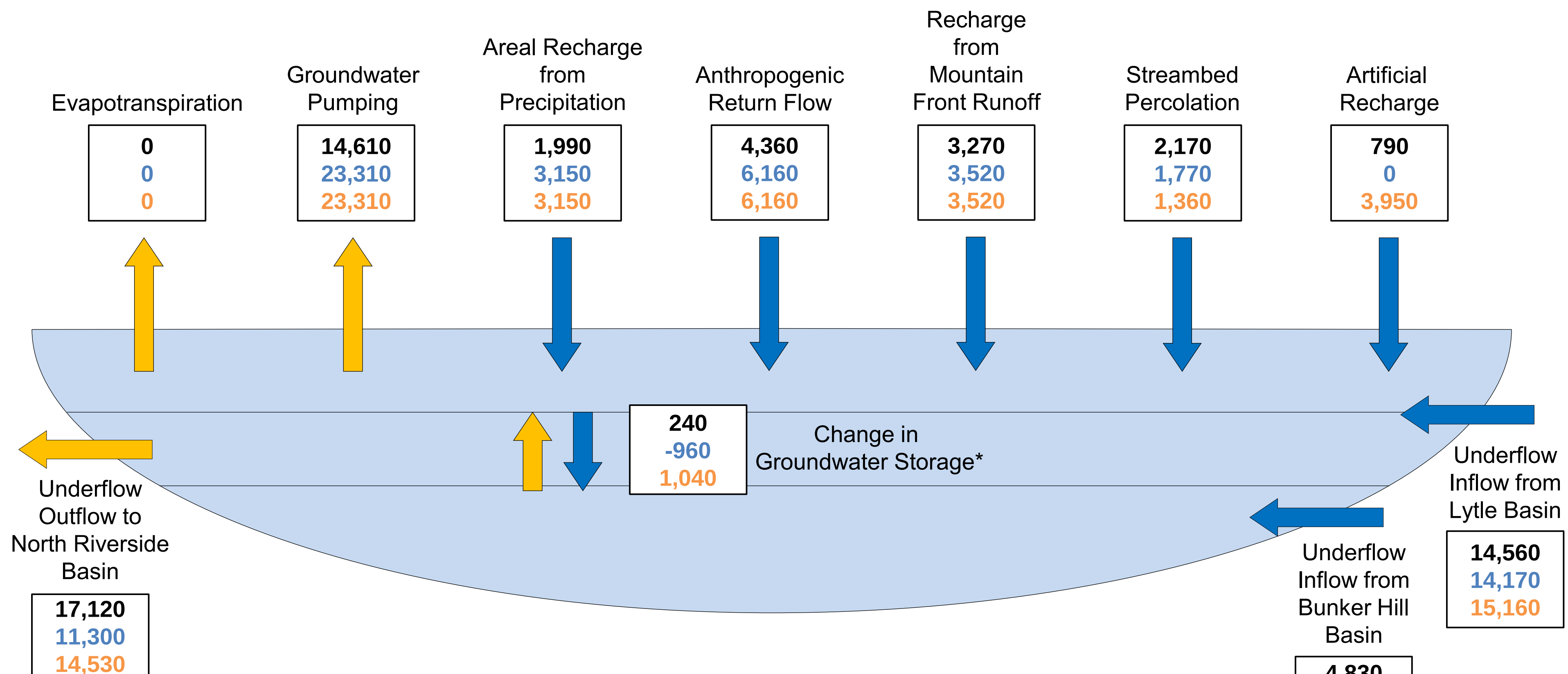

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.7 (Hydrologic Period 1966-1990)

Scenario 2a - Baseline
Scenario 2d.7 - All Valley Dist. Stormwater Capture

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.7
AVERAGE ANNUAL
WATER BUDGET
RIALTO-COLTON BASIN

10-Apr-20

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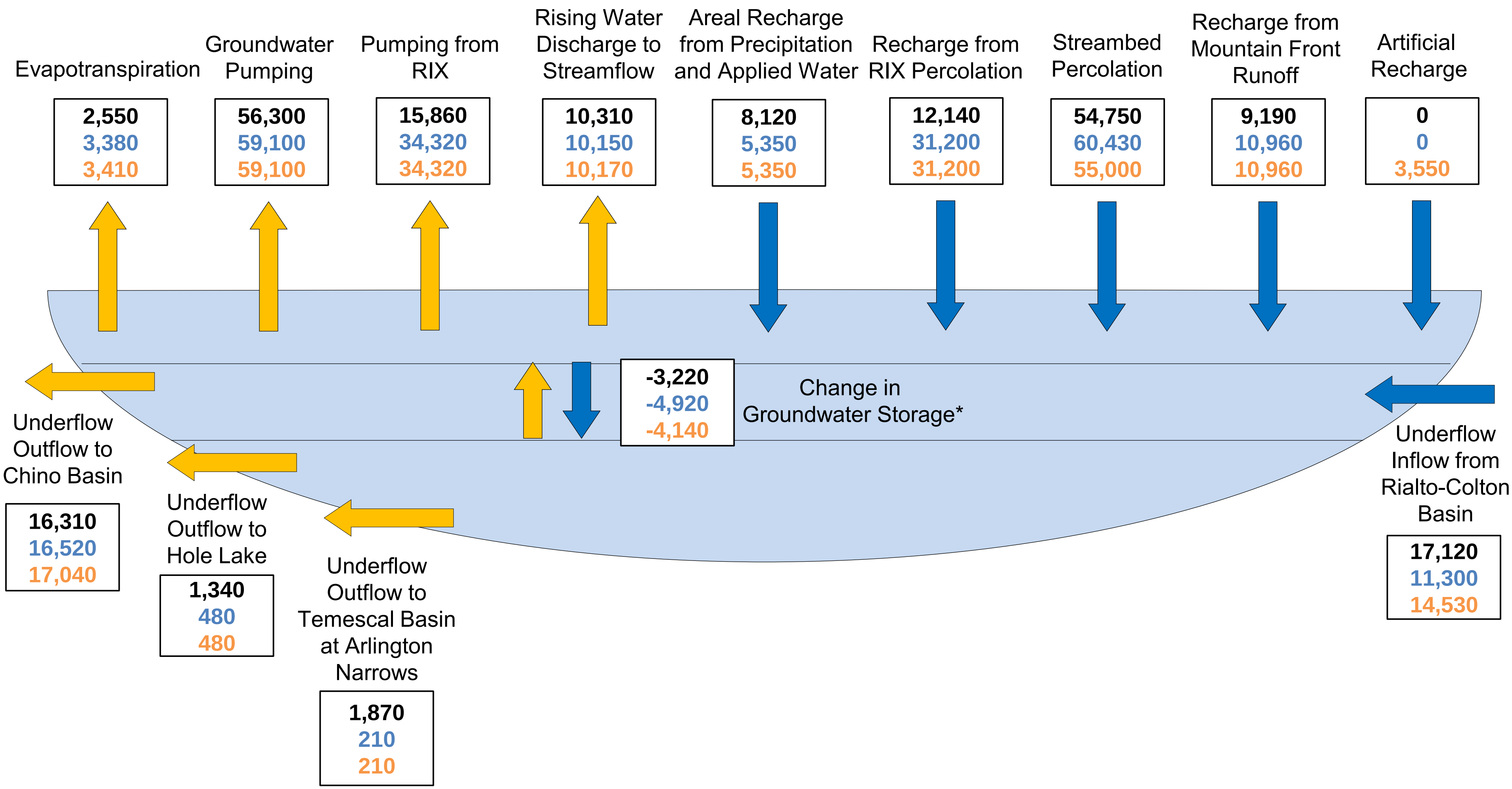


Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.7 (Hydrologic Period 1966-1990)

Scenario 2a - Baseline
Scenario 2d.7 - All Valley Dist. Stormwater Capture

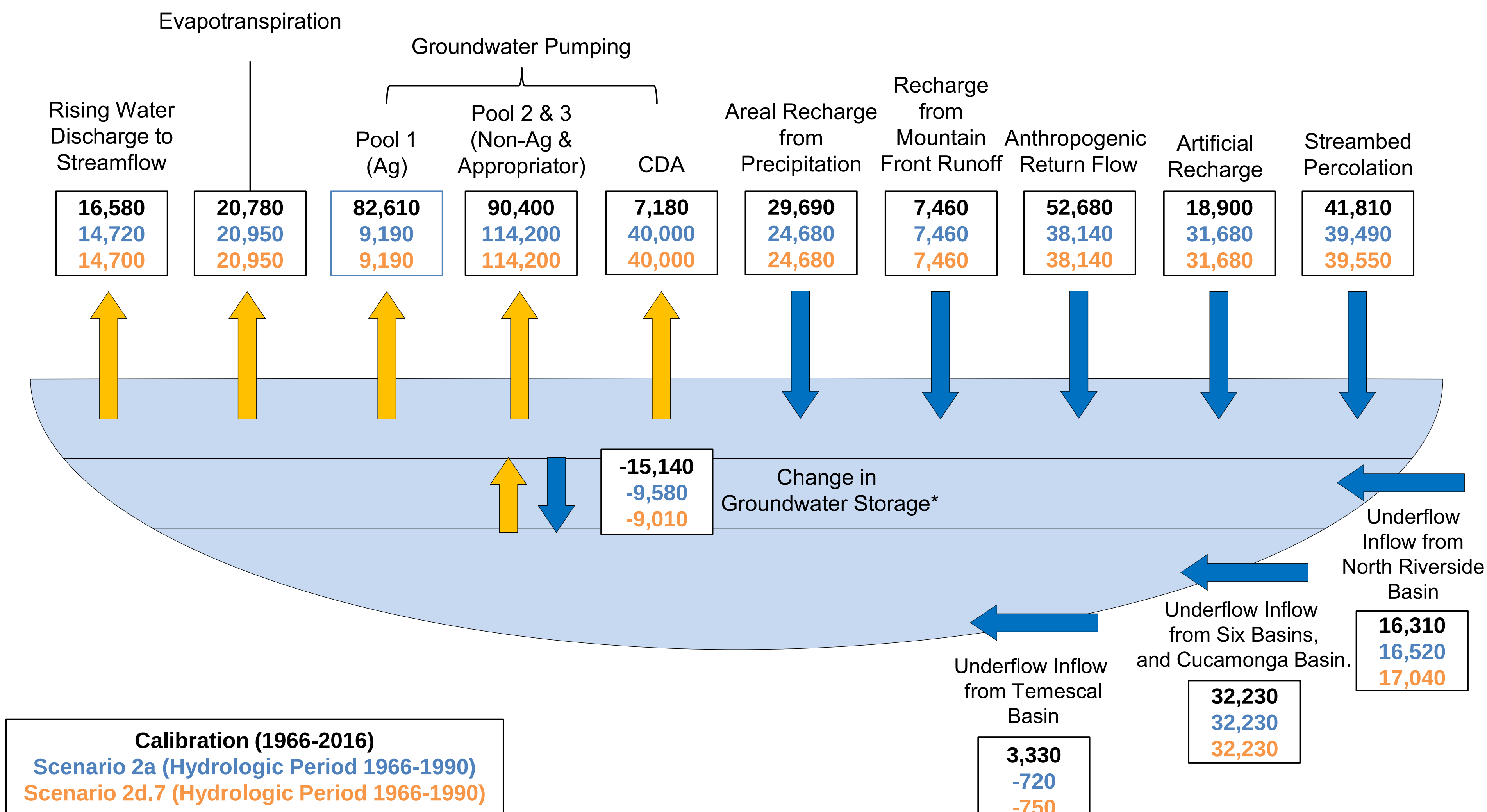
All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

**SCENARIO 2D.7
AVERAGE ANNUAL
WATER BUDGET
RIVERSIDE-ARLINGTON BASIN**

10-Apr-20

X:\Projects\San_Bernardino_MUNI\31)Integreated_SAR_Model\(4)Technical_Memos\(8)Summary Report\Draft\Figures\Scenarios



Scenario 2a - Baseline
Scenario 2d.7 - All Valley Dist. Stormwater Capture

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

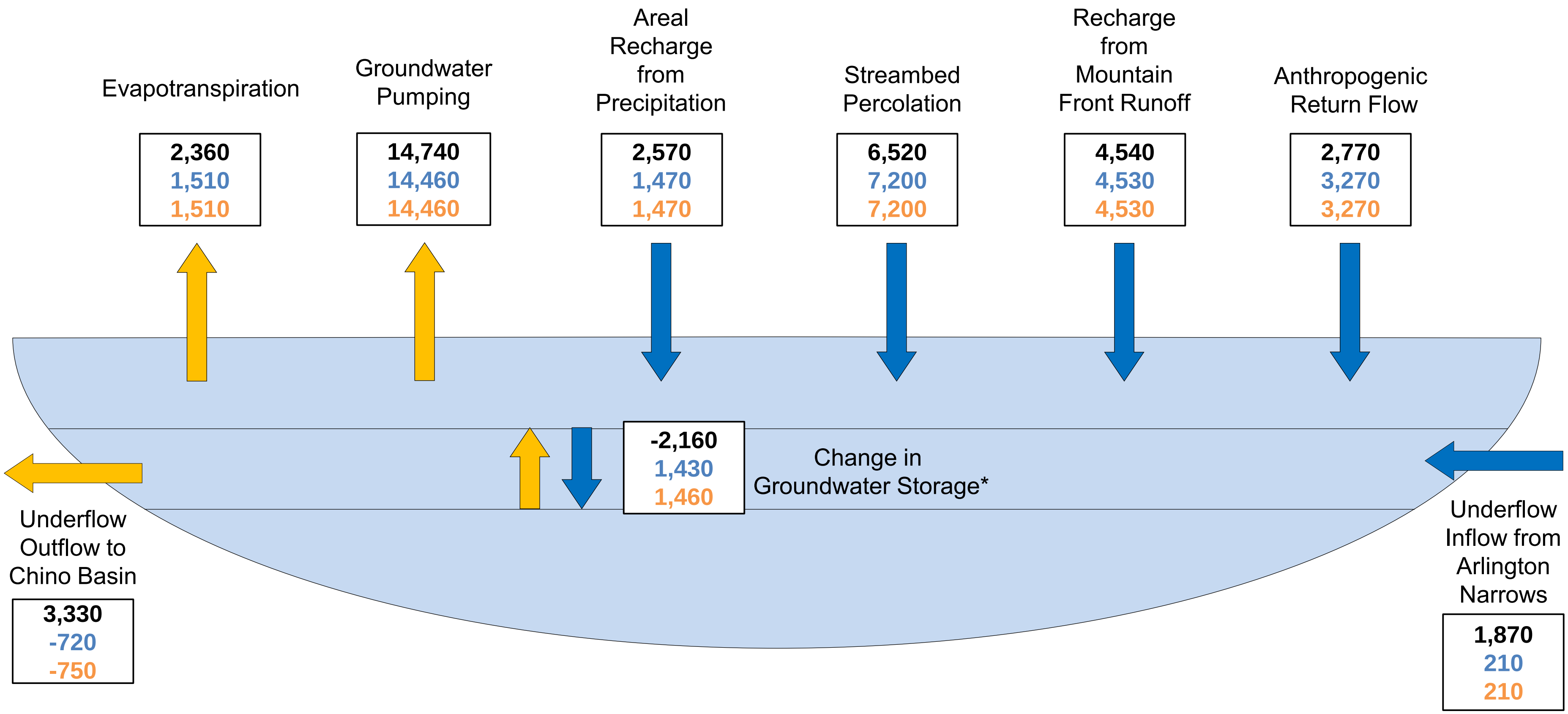
SCENARIO 2D.7
AVERAGE ANNUAL
WATER BUDGET
CHINO BASIN

10-Apr-20

DRAFT

GEOSCIENCE

X:\Projects\San_Bernardino_MUNI\31) Integreated_SAR_Model\(4)Technical_Memos\(8)Summary Report\Draft\Figures\Scenarios



Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2d.7 (Hydrologic Period 1966-1990)

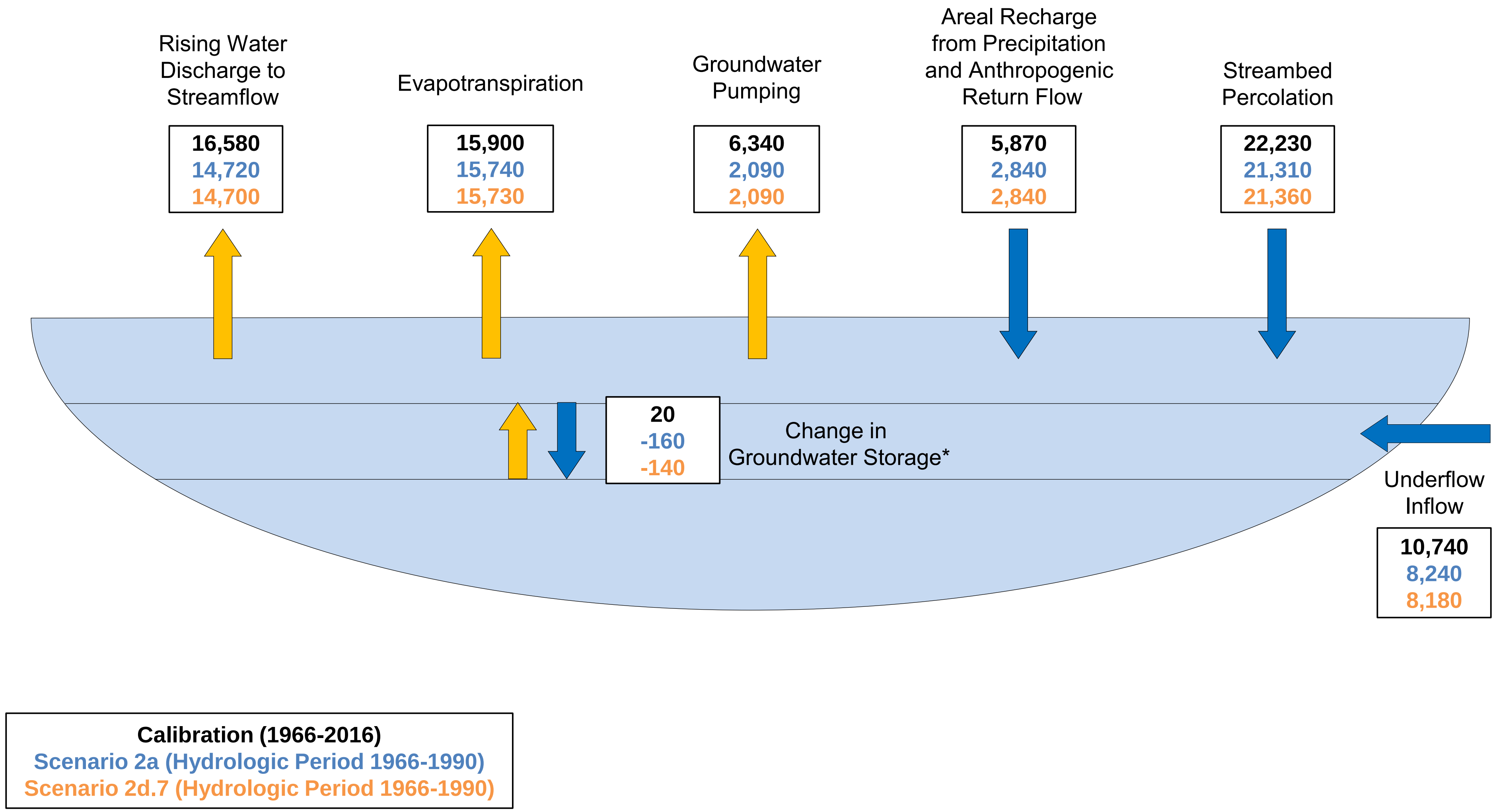
Scenario 2a - Baseline
Scenario 2d.7 - All Valley Dist. Stormwater Capture

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.7
AVERAGE ANNUAL
WATER BUDGET
TEMESCAL BASIN

10-Apr-20



Scenario 2a - Baseline
Scenario 2d.7 - All Valley Dist. Stormwater Capture

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2D.7 AVERAGE ANNUAL WATER BUDGET PRADO BASIN

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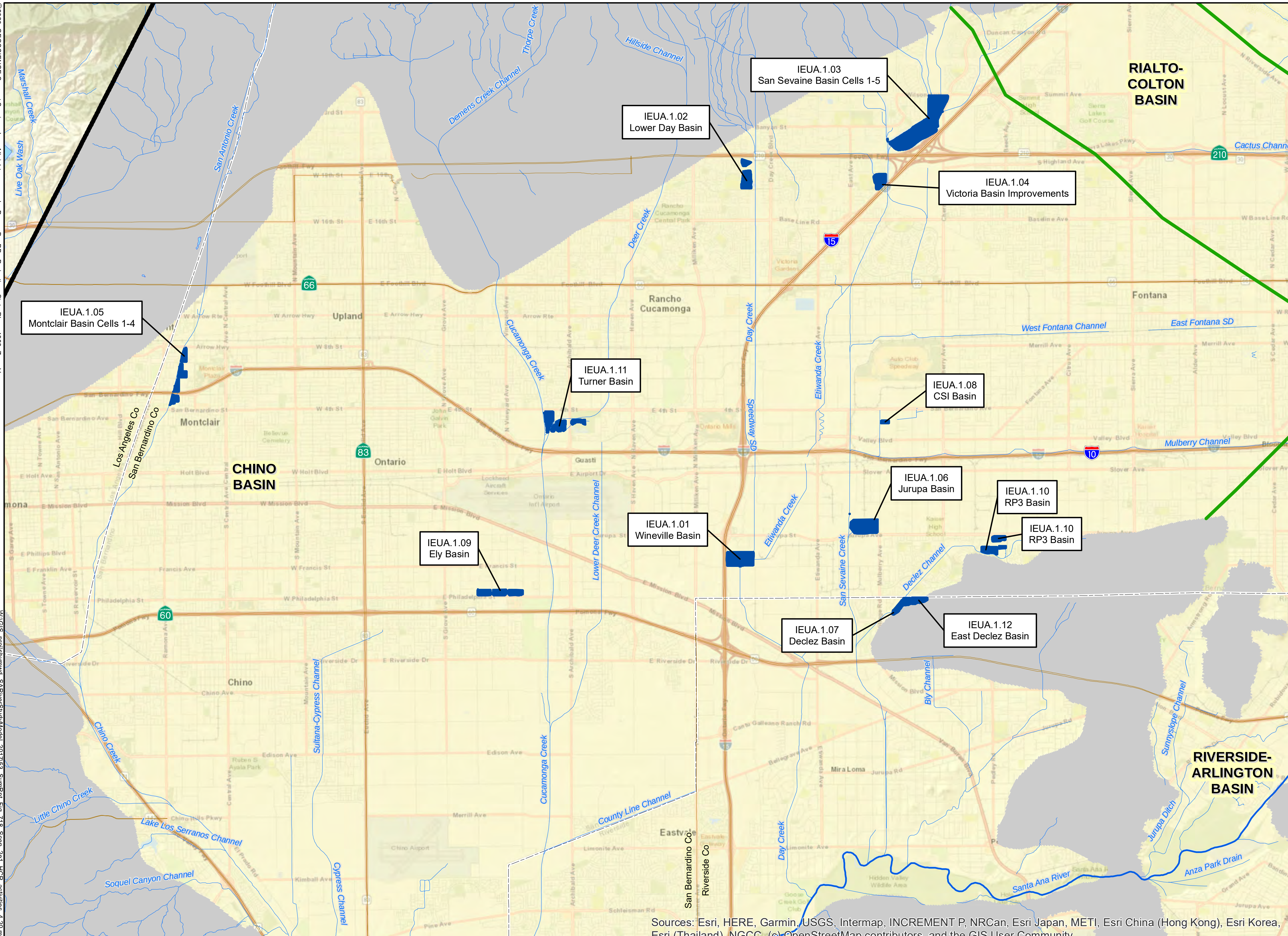
10-Apr-20



W:\GIS_projects\mwd_SARiverStudyModel_201753_SumRpt_Fig_718_Scen_2e1_HCP_activities_4-20.mxd

EXPLANATION

Integrated SAR Model Boundary

Active Model Area

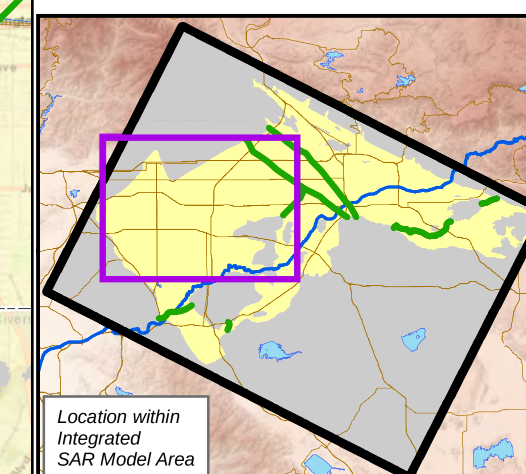
Inactive Model Area

Habitat Conservation Plan (HCP) Covered Activity
IEUA.1.08 - Project ID
CSI Basin - Name of HCP Project

Groundwater Basin Boundary

Refer to Table 17 for HCP Covered Activity Description

Scenario 2e.1:
IEUA Activities -
IEUA Stormflow Activities



N

0 1.5 3
Miles

SCENARIO 2e.1
LOCATION OF
HCP COVERED ACTIVITIES

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

DRAFT

FIGURE 718

GEOSCIENCE

DRAFT

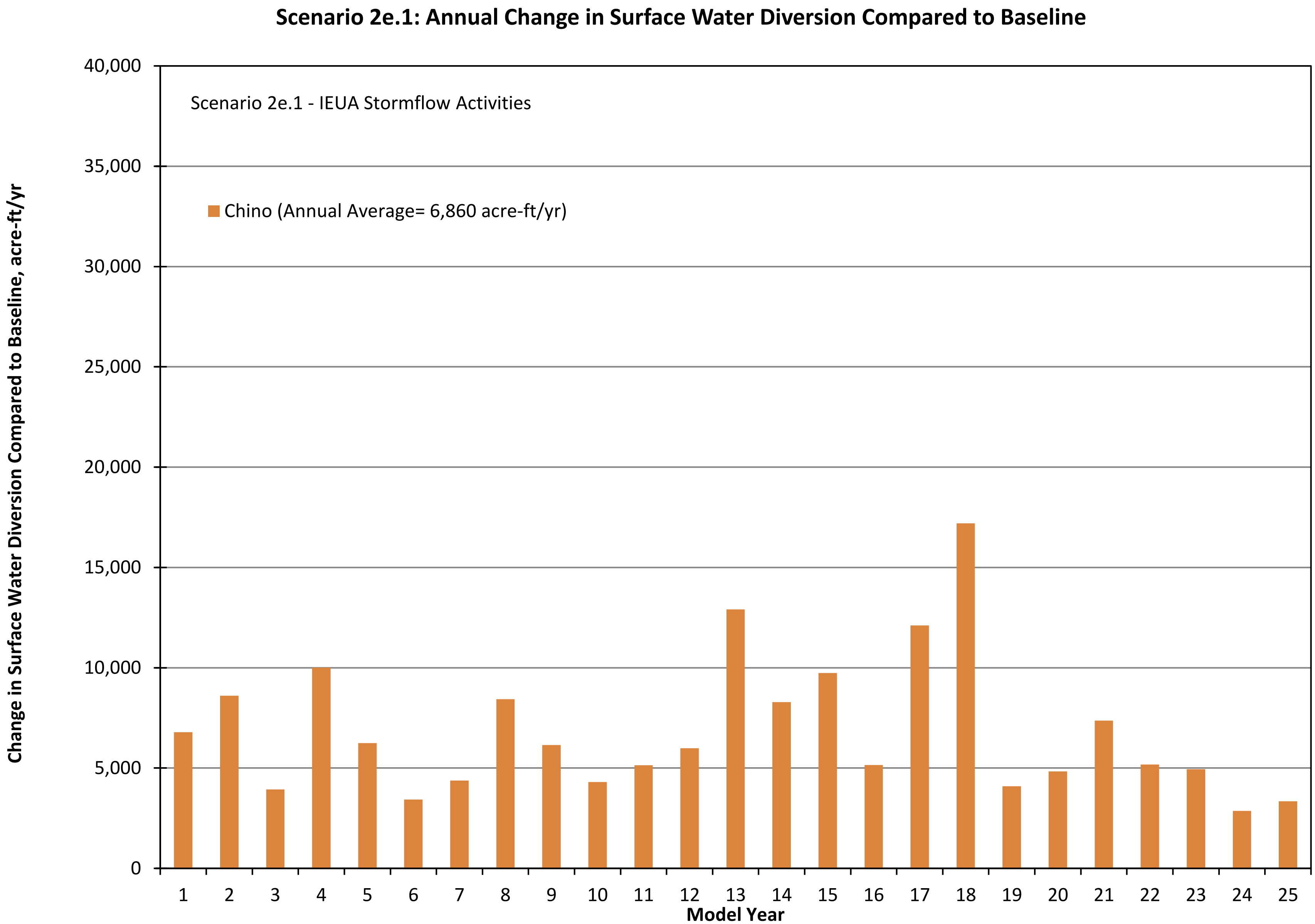


Figure 719

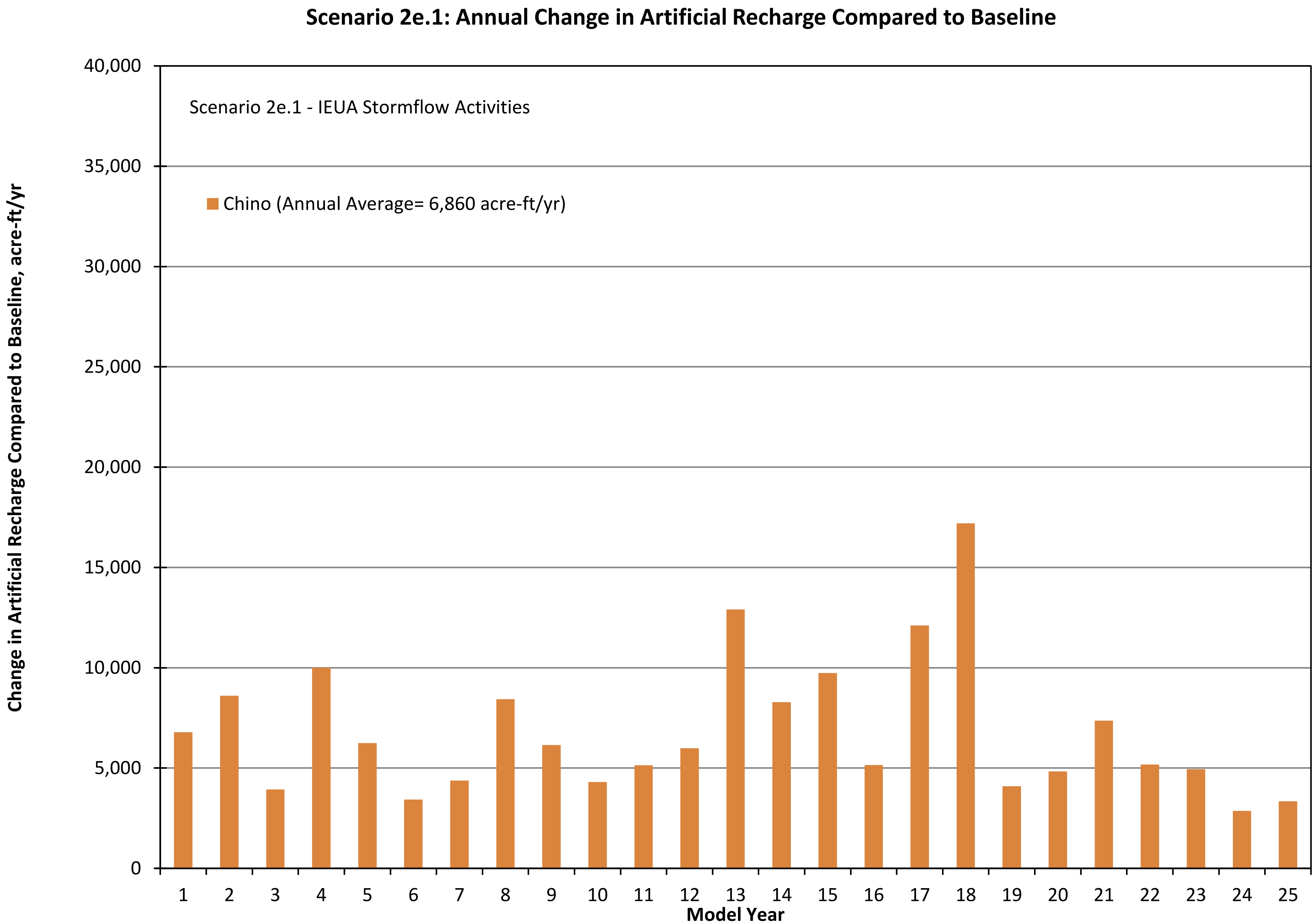
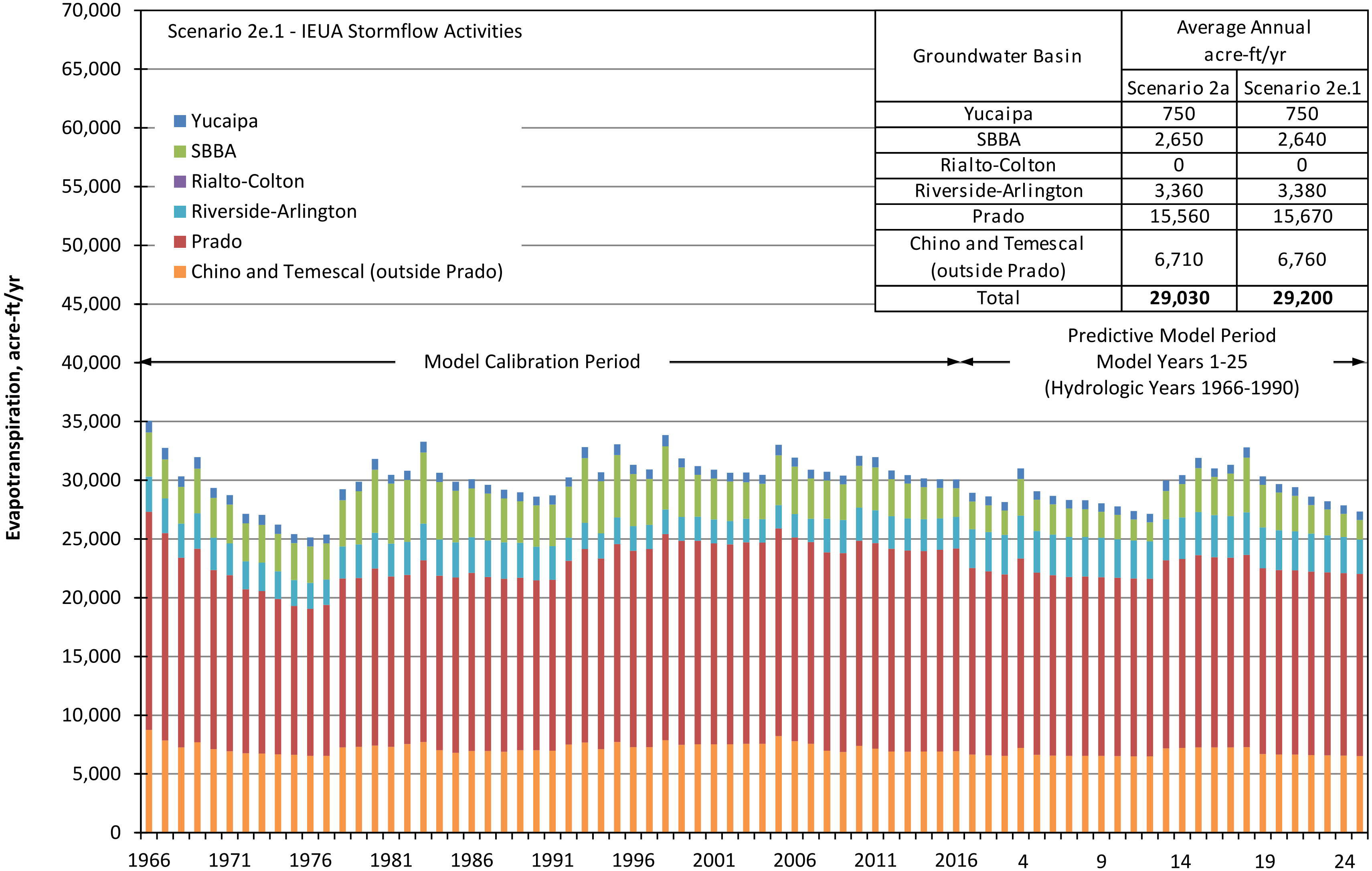

Scenario 2e.1: Annual Change in Artificial Recharge Compared to Baseline
Scenario 2e.1 - IEUA Stormflow Activities
Chino (Annual Average= 6,860 acre-ft/yr)
Change in Artificial Recharge Compared to Baseline, acre-ft/yr
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
Model Year

Figure 720

Scenario 2e.1: Annual Evapotranspiration – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2e.1
Yucaipa	750	750
SBBA	2,650	2,640
Rialto-Colton	0	0
Riverside-Arlington	3,360	3,380
Prado	15,560	15,670
Chino and Temescal (outside Prado)	6,710	6,760
Total	**29,030**	**29,200**

Figure 721

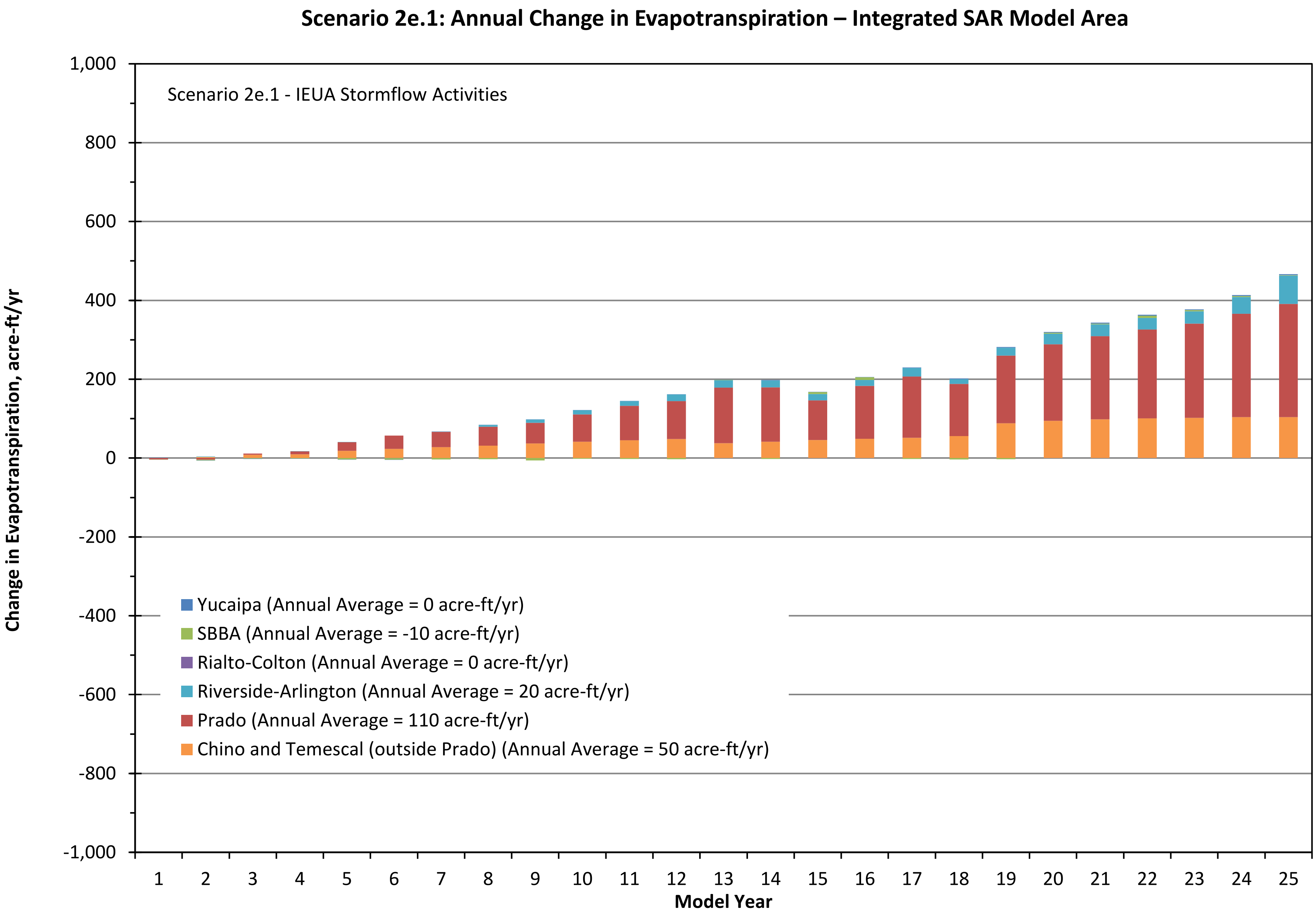
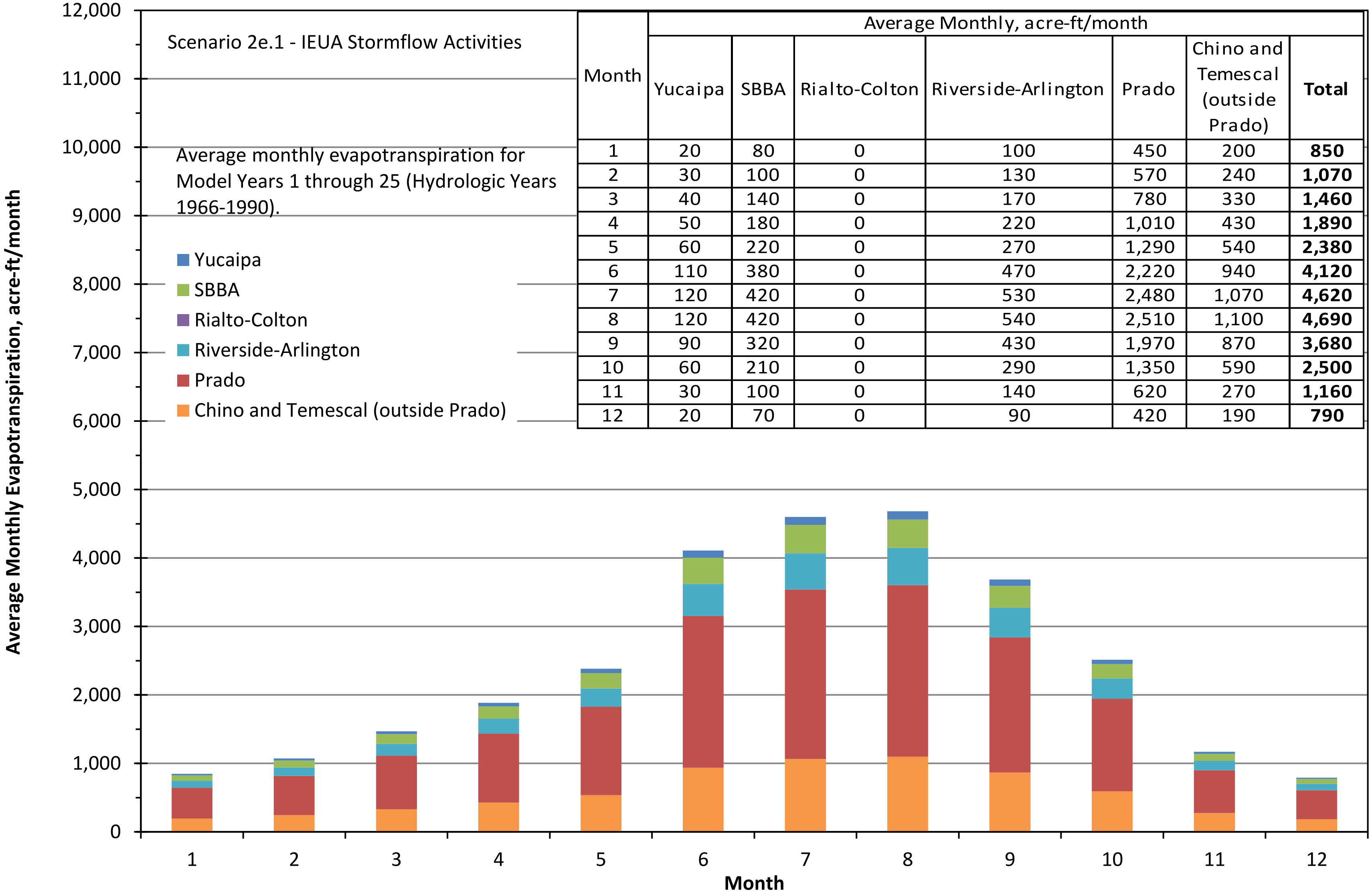

Scenario 2e.1: Annual Change in Evapotranspiration – Integrated SAR Model Area
Scenario 2e.1 - IEUA Stormflow Activities
Change in Evapotranspiration, acre-ft/yr
1,000
800
600
400
200
0
-200
-400
-600
-800
-1,000
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
Model Year
Yucaipa (Annual Average = 0 acre-ft/yr)
SBBA (Annual Average = -10 acre-ft/yr)
Rialto-Colton (Annual Average = 0 acre-ft/yr)
Riverside-Arlington (Annual Average = 20 acre-ft/yr)
Prado (Annual Average = 110 acre-ft/yr)
Chino and Temescal (outside Prado) (Annual Average = 50 acre-ft/yr)

Figure 722

Scenario 2e.1: Seasonal Evapotranspiration – Integrated SAR Model Area

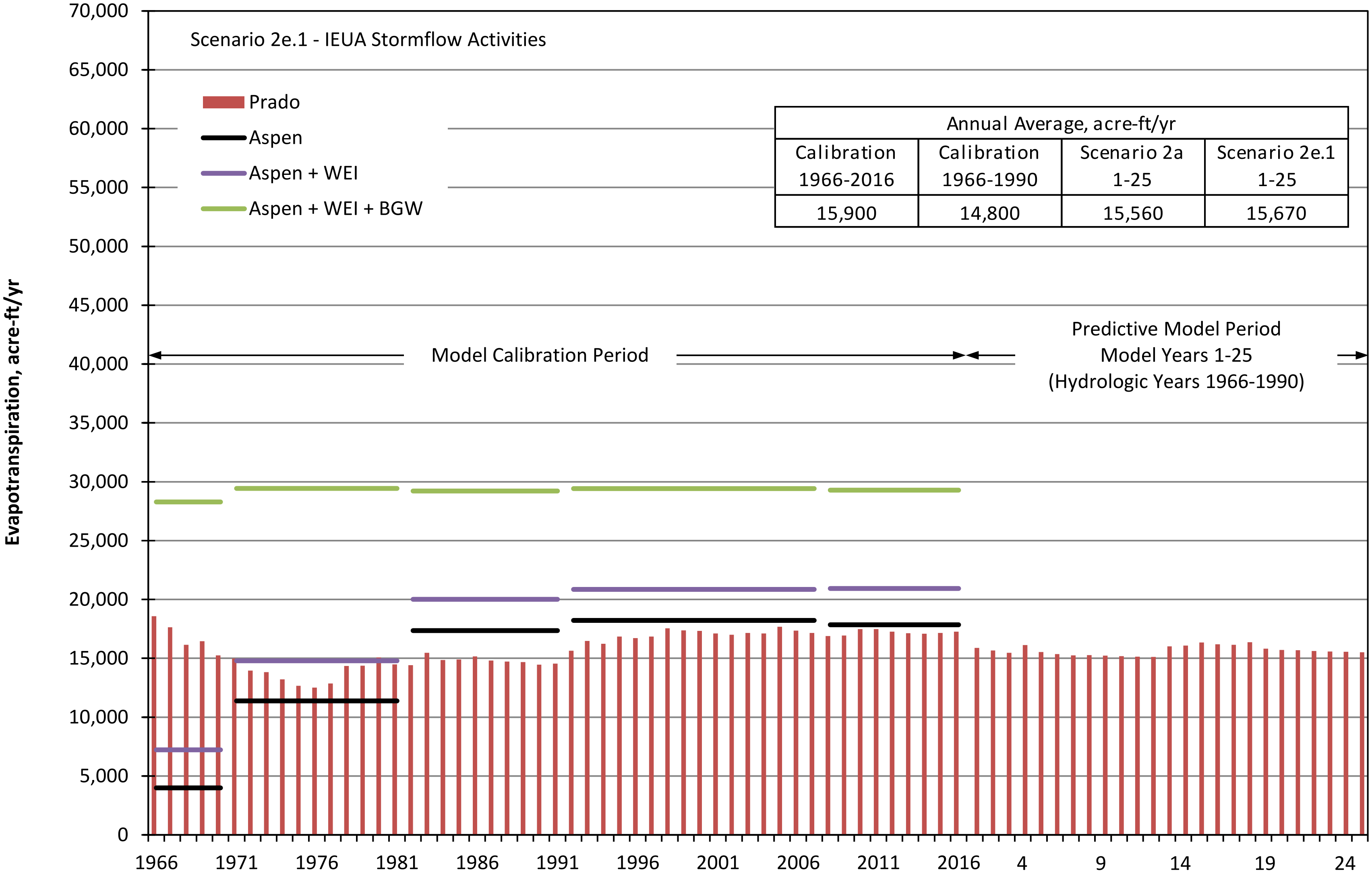


Month	Average Monthly, acre-ft/month						
	Yucaipa	SBBA	Rialto-Colton	Riverside-Arlington	Prado	Chino and Temescal (outside Prado)	**Total**
1	20	80	0	100	450	200	**850**
2	30	100	0	130	570	240	**1,070**
3	40	140	0	170	780	330	**1,460**
4	50	180	0	220	1,010	430	**1,890**
5	60	220	0	270	1,290	540	**2,380**
6	110	380	0	470	2,220	940	**4,120**
7	120	420	0	530	2,480	1,070	**4,620**
8	120	420	0	540	2,510	1,100	**4,690**
9	90	320	0	430	1,970	870	**3,680**
10	60	210	0	290	1,350	590	**2,500**
11	30	100	0	140	620	270	**1,160**
12	20	70	0	90	420	190	**790**

Figure 723

DRAFT

Scenario 2e.1: Annual Evapotranspiration – Prado Basin



Annual Average, acre-ft/yr			
Calibration 1966-2016	Calibration 1966-1990	Scenario 2a 1-25	Scenario 2e.1 1-25
15,900	14,800	15,560	15,670

Figure 724

DRAFT

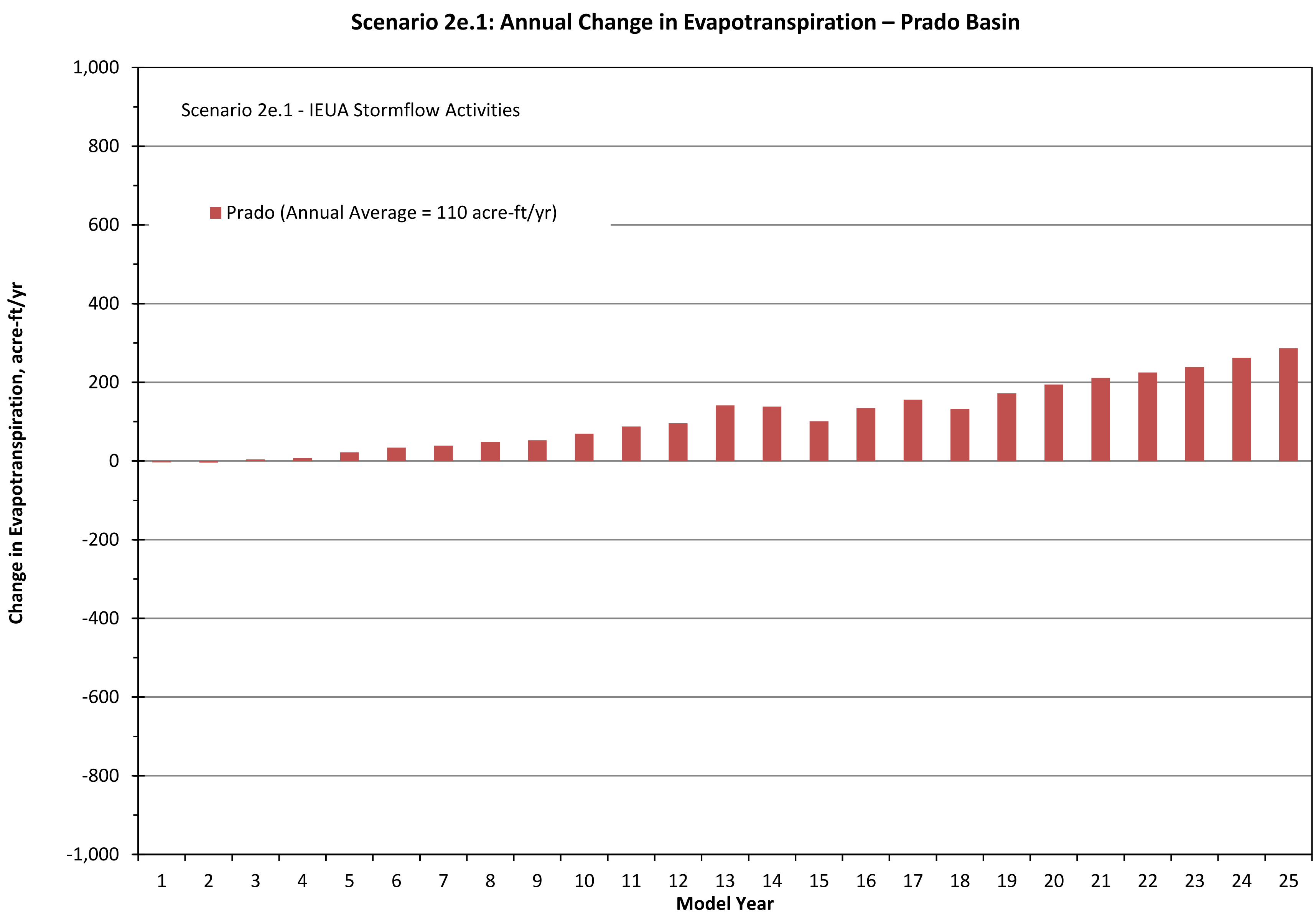
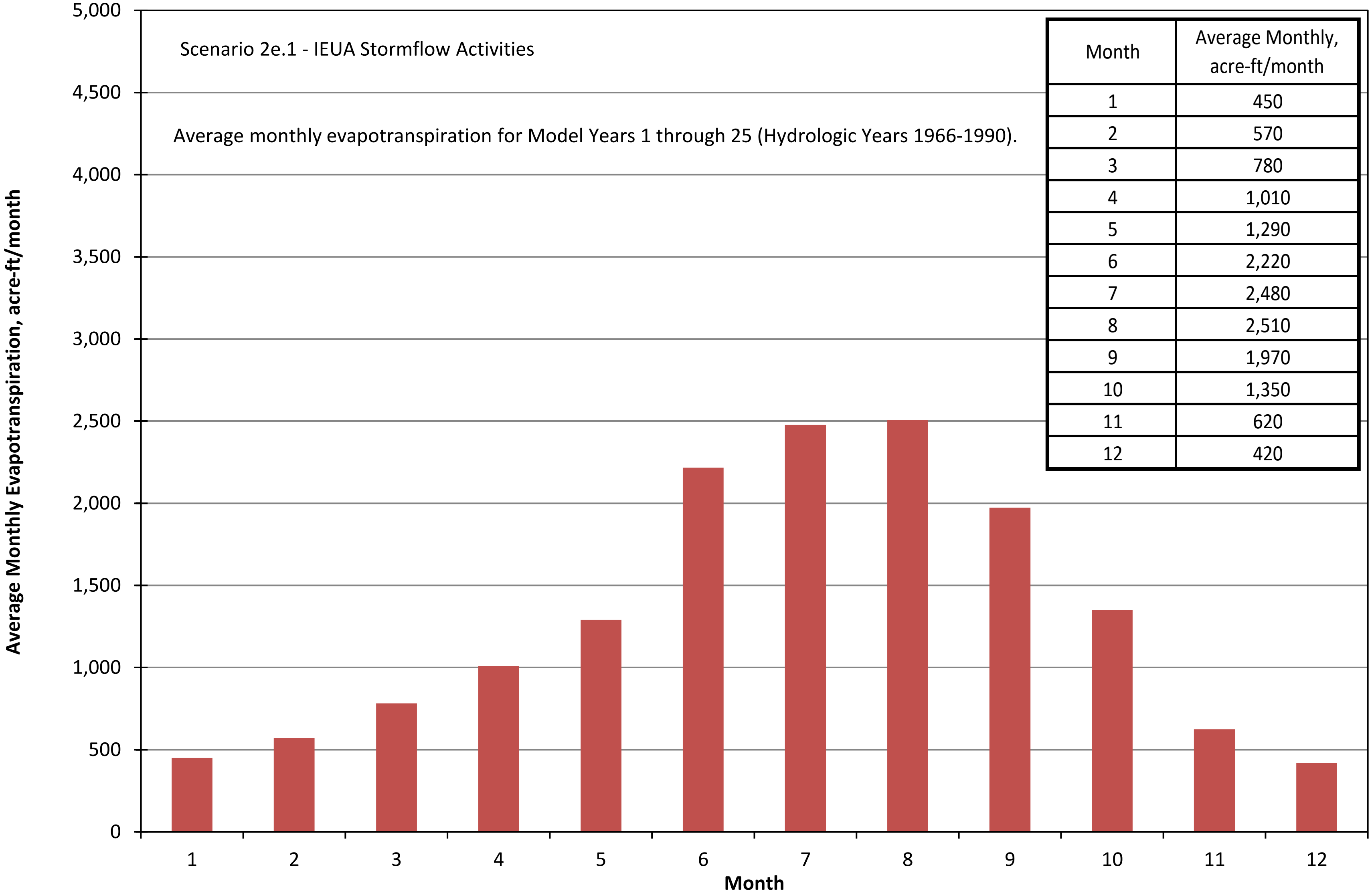


Figure 725

Scenario 2e.1: Seasonal Evapotranspiration – Prado Basin



Month	Average Monthly, acre-ft/month
1	450
2	570
3	780
4	1,010
5	1,290
6	2,220
7	2,480
8	2,510
9	1,970
10	1,350
11	620
12	420

Figure 726

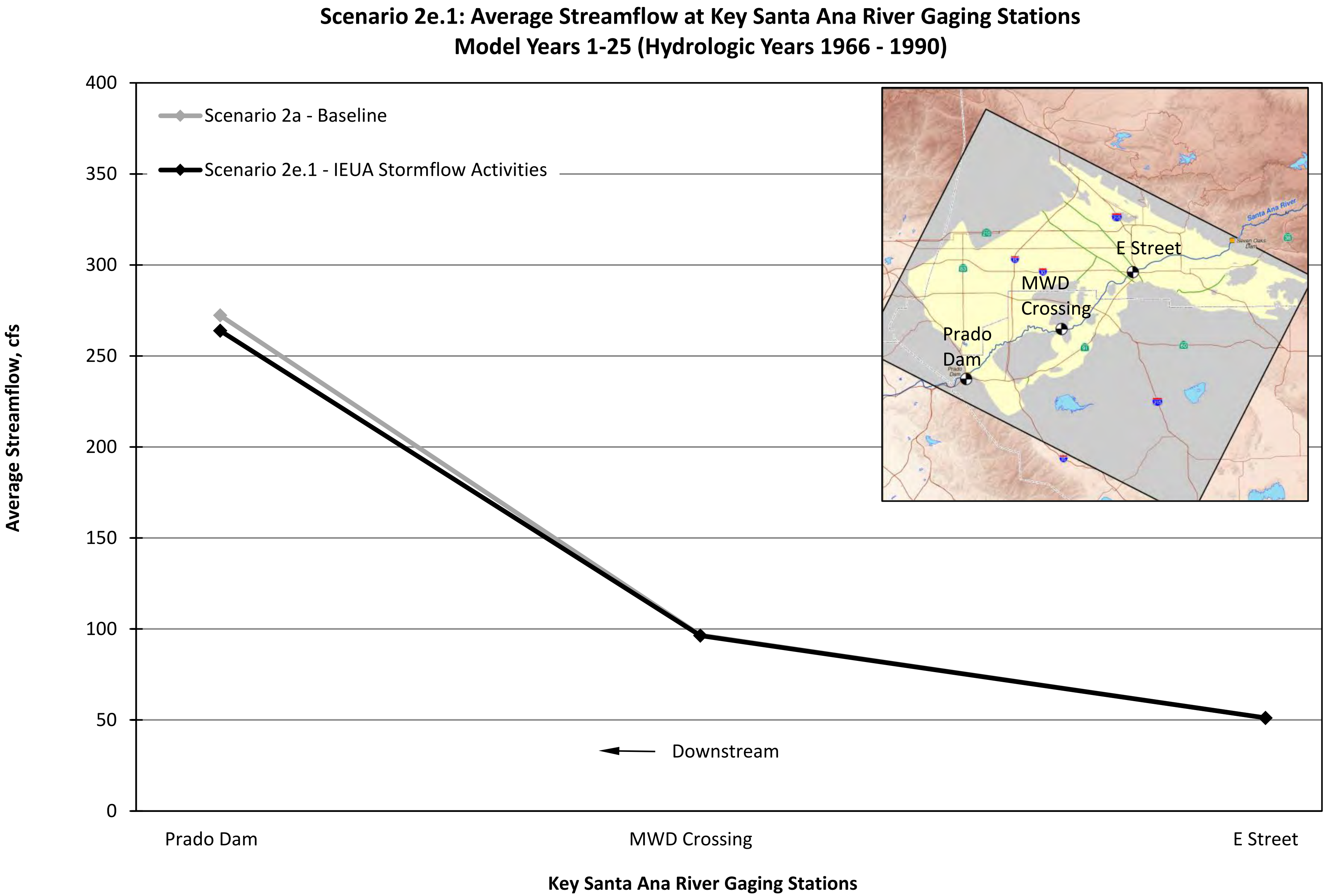

Scenario 2e.1: Average Streamflow at Key Santa Ana River Gaging Stations
Model Years 1-25 (Hydrologic Years 1966 - 1990)
Scenario 2a - Baseline
Scenario 2e.1 - IEUA Stormflow Activities
Average Streamflow, cfs
400
350
300
250
200
150
100
50
0
E Street
MWD
Crossing
Prado
Dam
Downstream
Prado Dam
MWD Crossing
E Street
Key Santa Ana River Gaging Stations

Figure 727

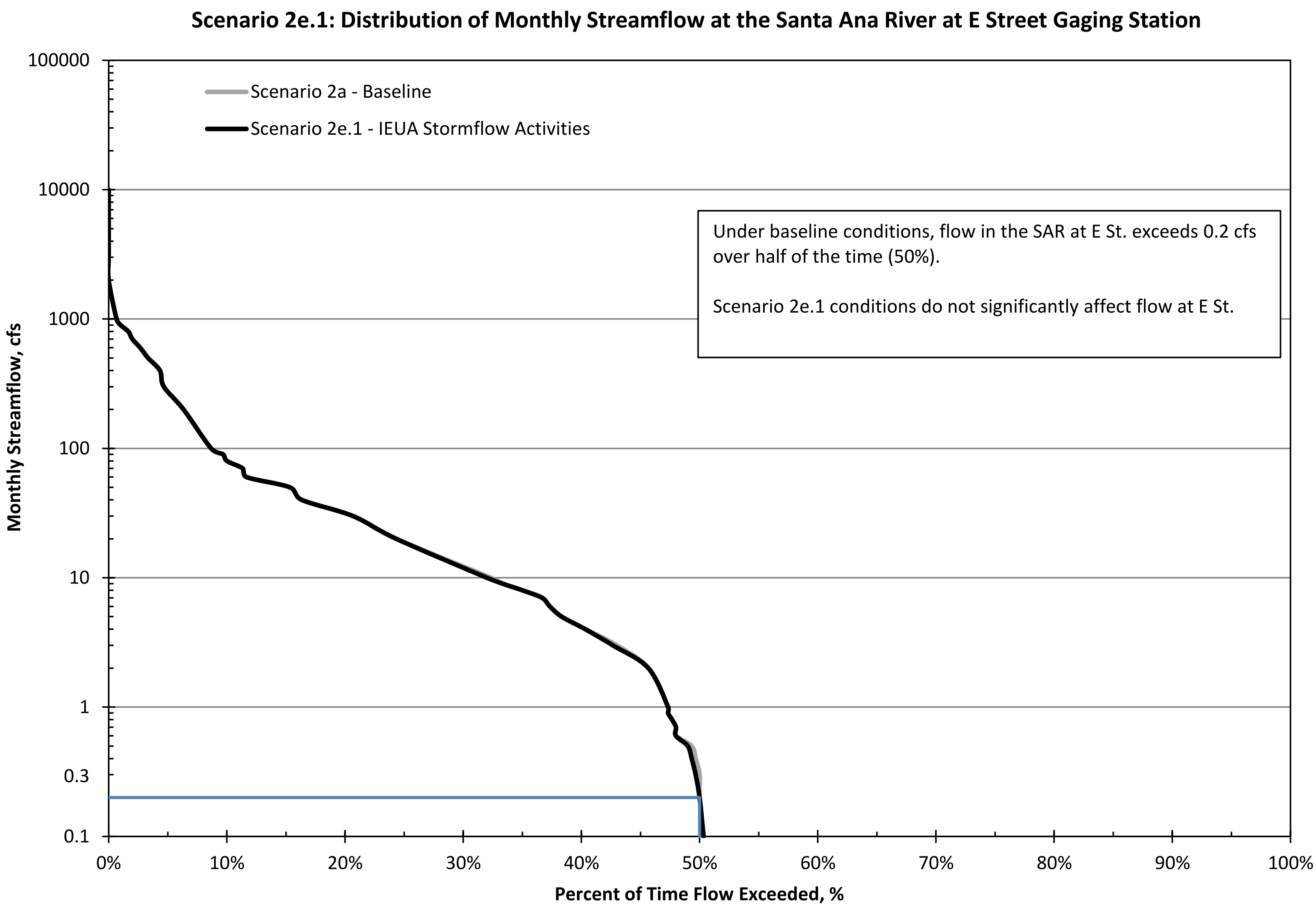

Scenario 2e.1: Distribution of Monthly Streamflow at the Santa Ana River at E Street Gaging Station
Scenario 2a - Baseline
Scenario 2e.1 - IEUA Stormflow Activities
Under baseline conditions, flow in the SAR at E St. exceeds 0.2 cfs over half of the time (50%).
Scenario 2e.1 conditions do not significantly affect flow at E St.
100000
10000
1000
100
10
1
0.3
0.1
Monthly Streamflow, cfs
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 728

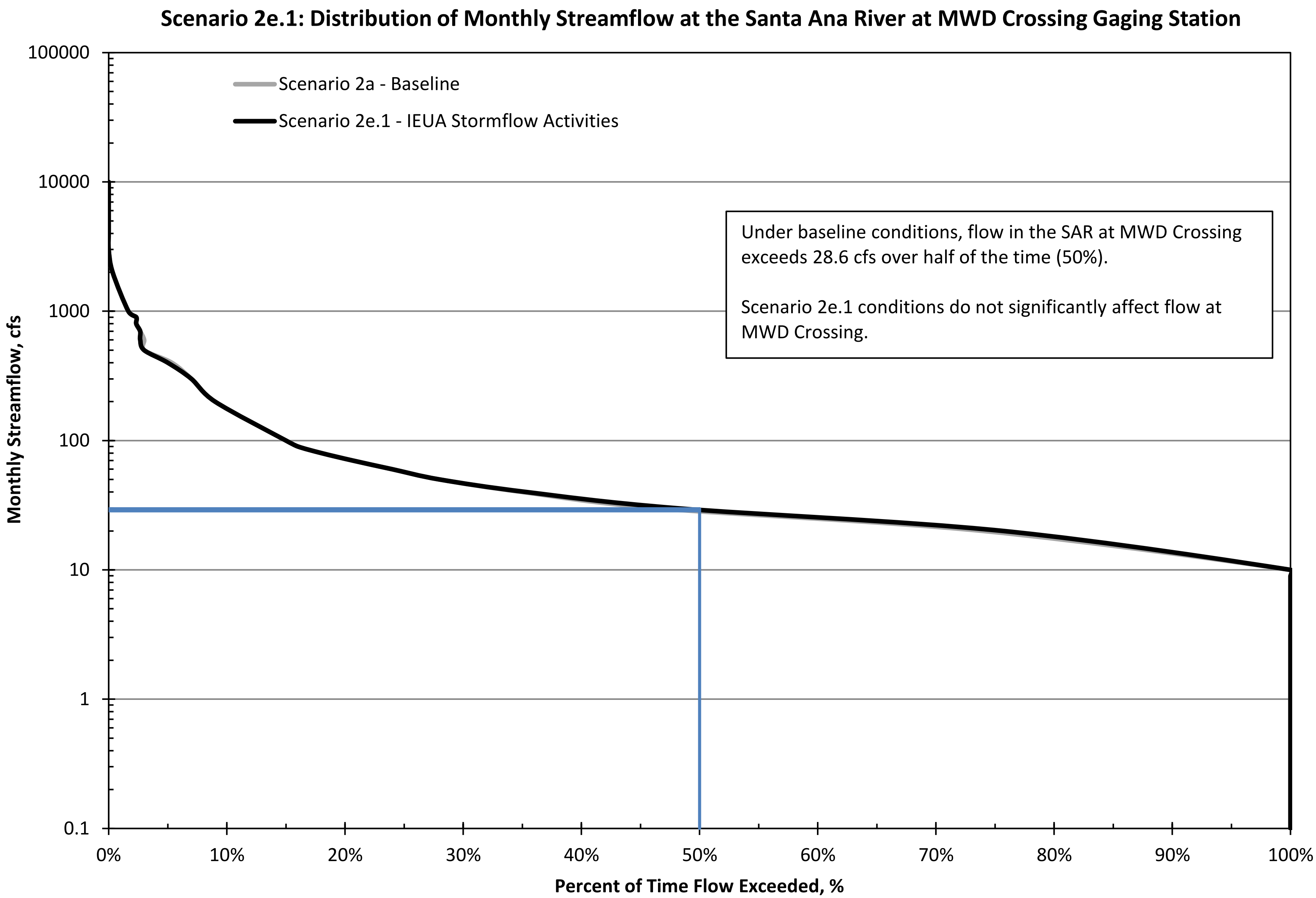

Scenario 2e.1: Distribution of Monthly Streamflow at the Santa Ana River at MWD Crossing Gaging Station
Scenario 2a - Baseline
Scenario 2e.1 - IEUA Stormflow Activities
Under baseline conditions, flow in the SAR at MWD Crossing exceeds 28.6 cfs over half of the time (50%).
Scenario 2e.1 conditions do not significantly affect flow at MWD Crossing.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 729

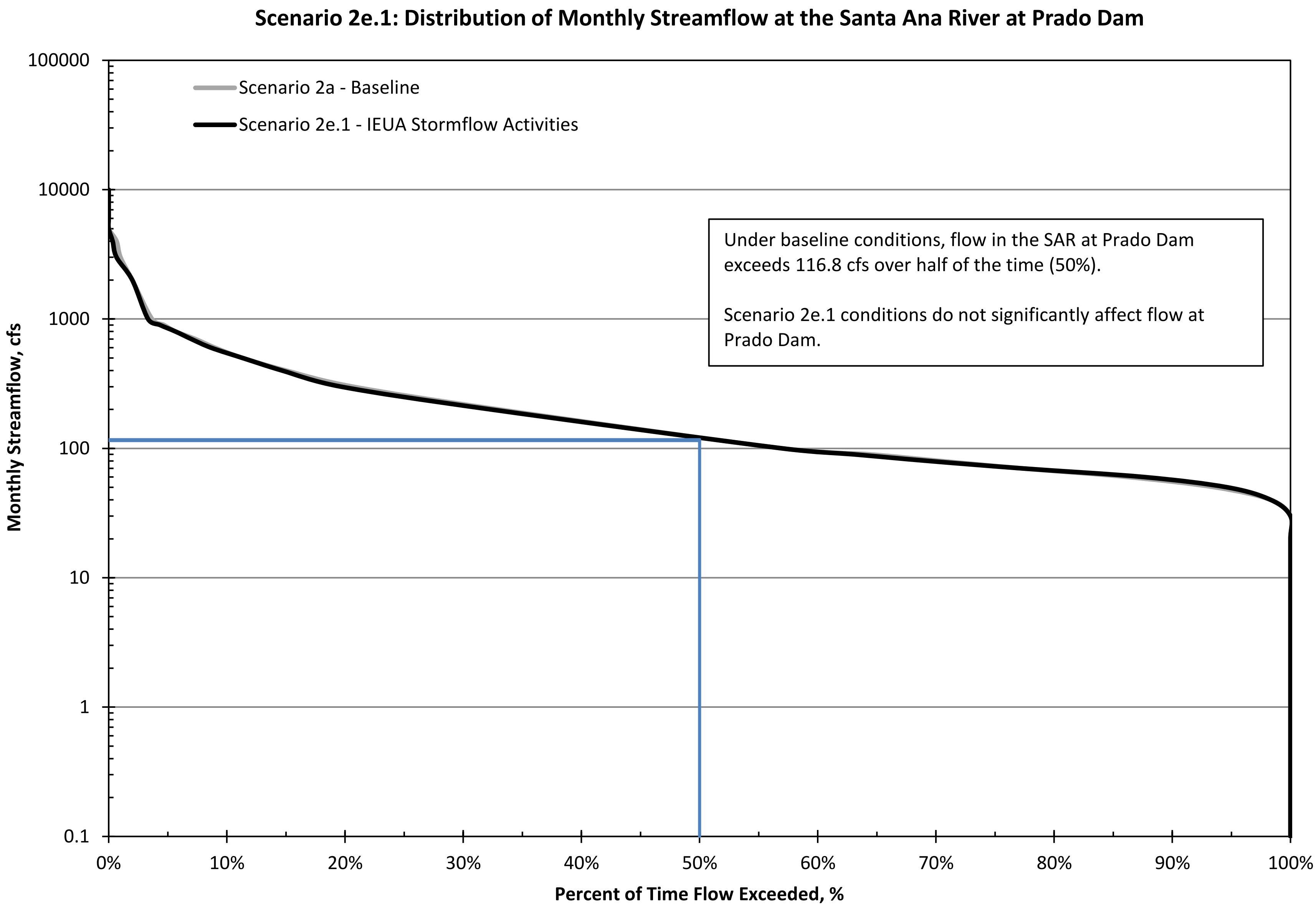
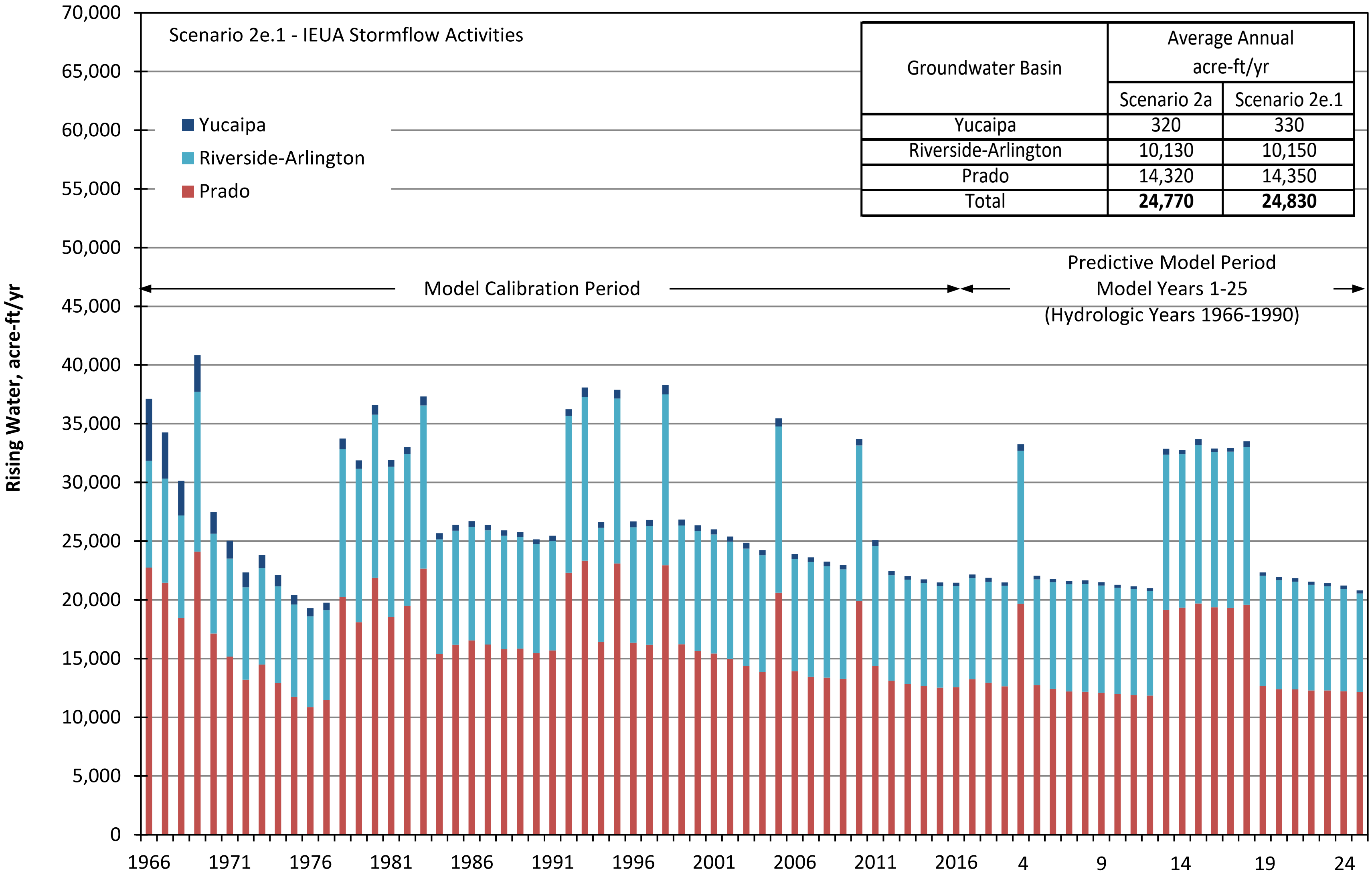

Scenario 2e.1: Distribution of Monthly Streamflow at the Santa Ana River at Prado Dam
Scenario 2a - Baseline
Scenario 2e.1 - IEUA Stormflow Activities
Under baseline conditions, flow in the SAR at Prado Dam exceeds 116.8 cfs over half of the time (50%).
Scenario 2e.1 conditions do not significantly affect flow at Prado Dam.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

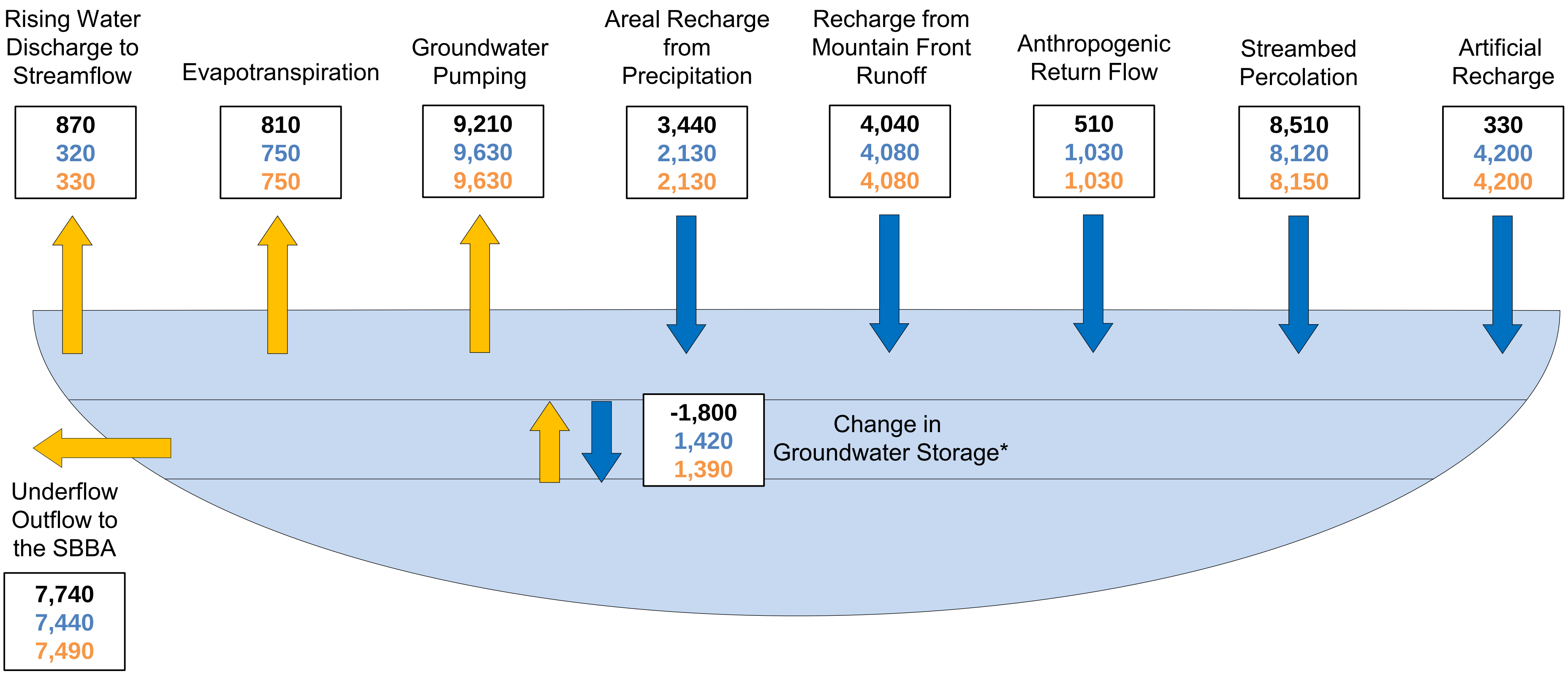
Figure 730

Scenario 2e.1: Annual Rising Water – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2e.1
Yucaipa	320	330
Riverside-Arlington	10,130	10,150
Prado	14,320	14,350
Total	**24,770**	**24,830**

Figure 731



Scenario 2a - Baseline
Scenario 2e.1 - IEUA Stormflow Activities

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2e.1 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2E.1 AVERAGE ANNUAL WATER BUDGET YUCAIPA BASIN

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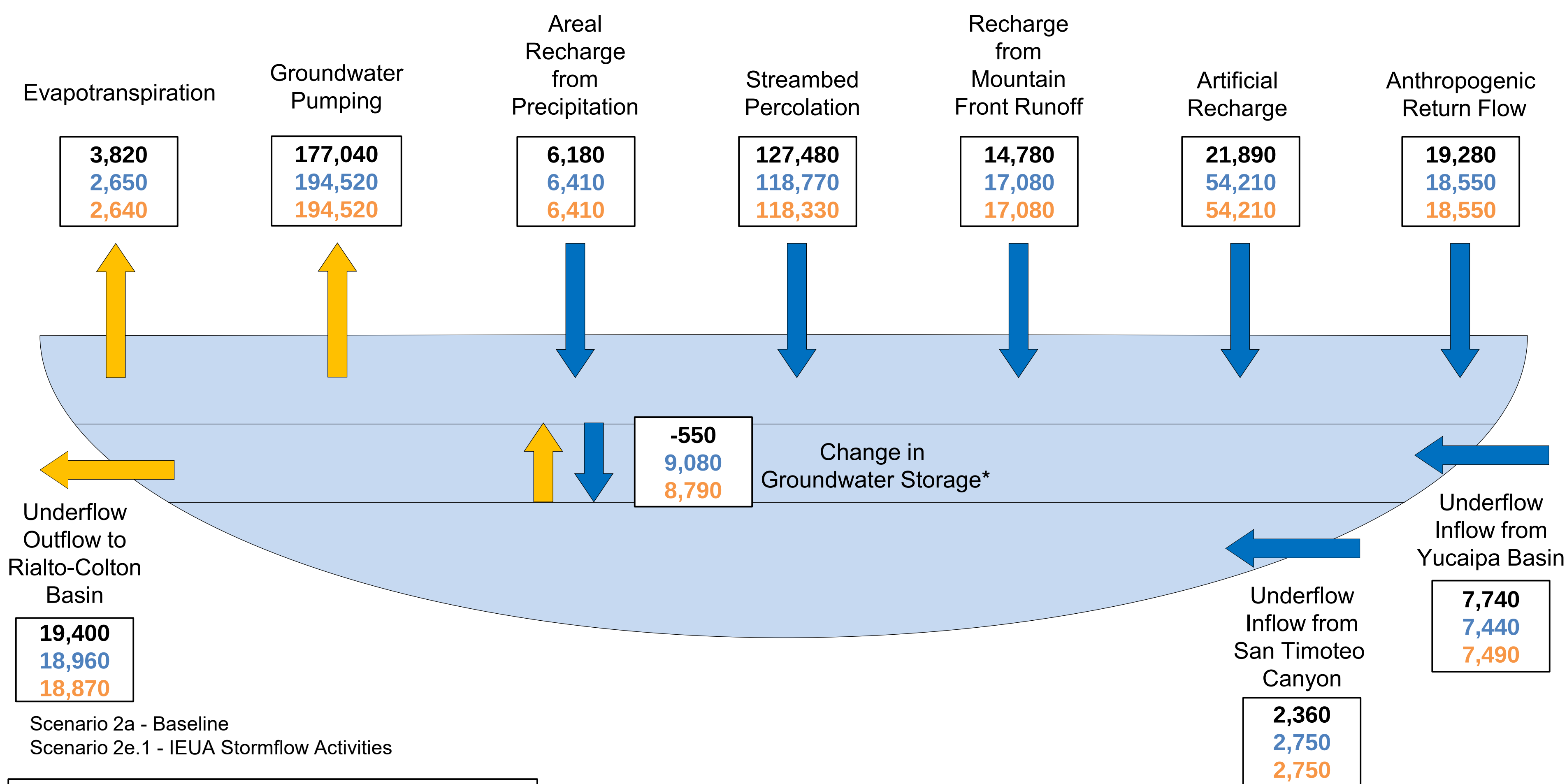


Scenario 2a - Baseline
Scenario 2e.1 - IEUA Stormflow Activities

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2e.1 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2E.1
AVERAGE ANNUAL
WATER BUDGET
SBBA

10-Apr-20

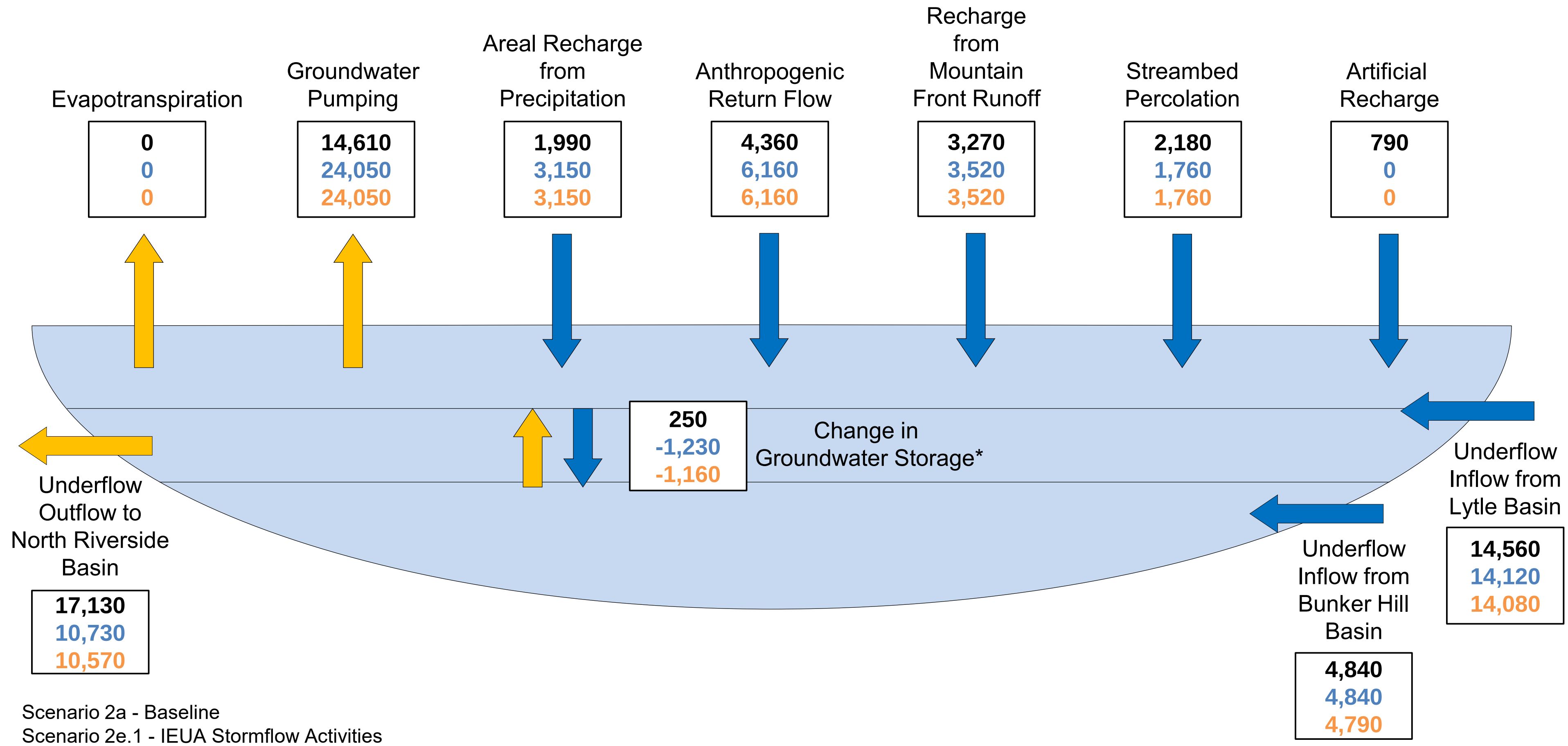
SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

DRAFT

FIGURE 733

UPPER SANTA ANA RIVER INTEGRATED MODEL – SUMMARY REPORT

GEOSCIENCE



Scenario 2a - Baseline
Scenario 2e.1 - IEUA Stormflow Activities

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2e.1 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2E.1
AVERAGE ANNUAL
WATER BUDGET
RIALTO-COLTON BASIN

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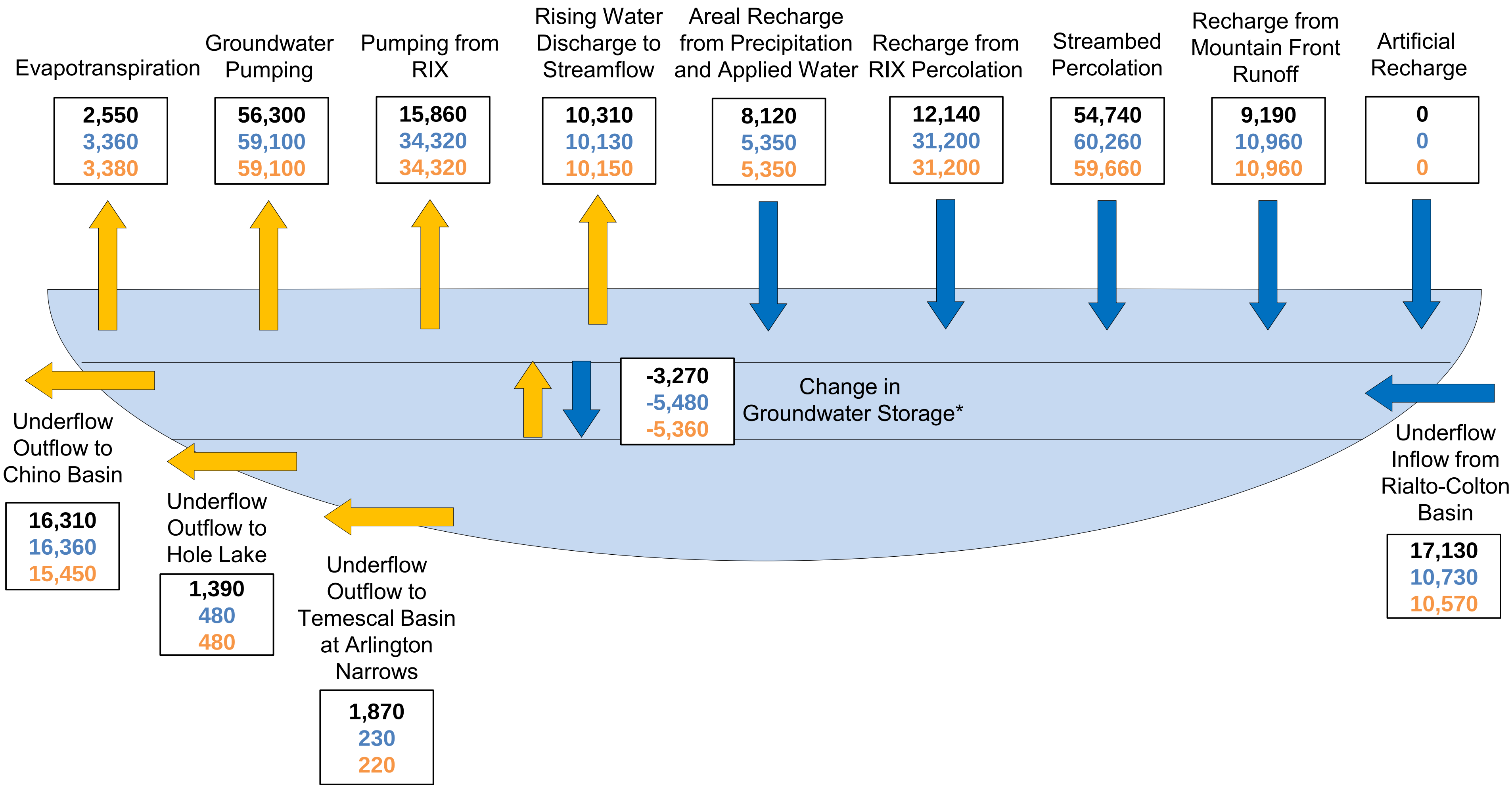

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2e.1 (Hydrologic Period 1966-1990)

Scenario 2a - Baseline
Scenario 2e.1 - IEUA Stormflow Activities

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2E.1
AVERAGE ANNUAL
WATER BUDGET
RIVERSIDE-ARLINGTON BASIN

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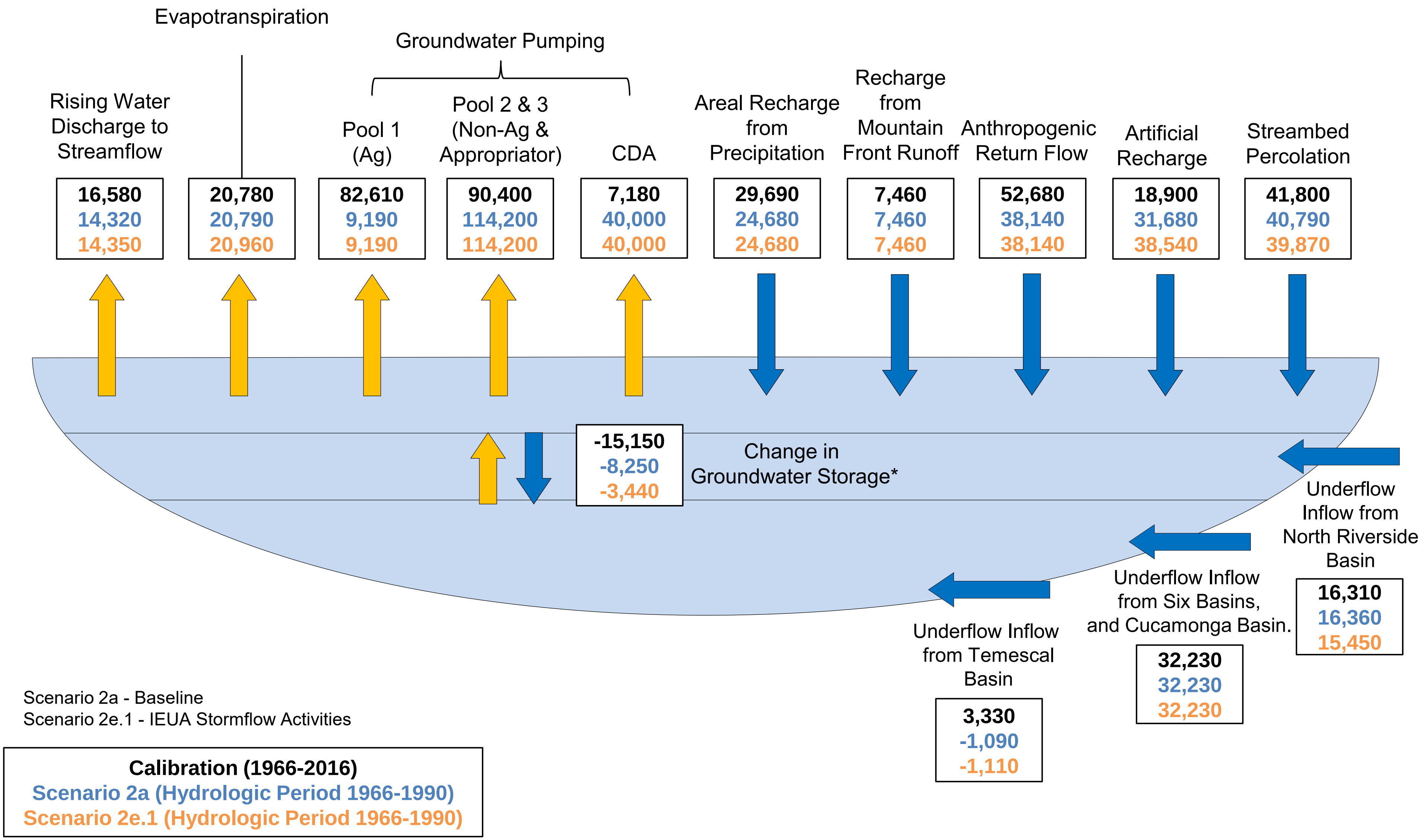

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2E.1
AVERAGE ANNUAL
WATER BUDGET
CHINO BASIN

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT
UPPER SANTA ANA RIVER INTEGRATED MODEL – SUMMARY REPORT

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FIGURE 736

GEOSCIENCE

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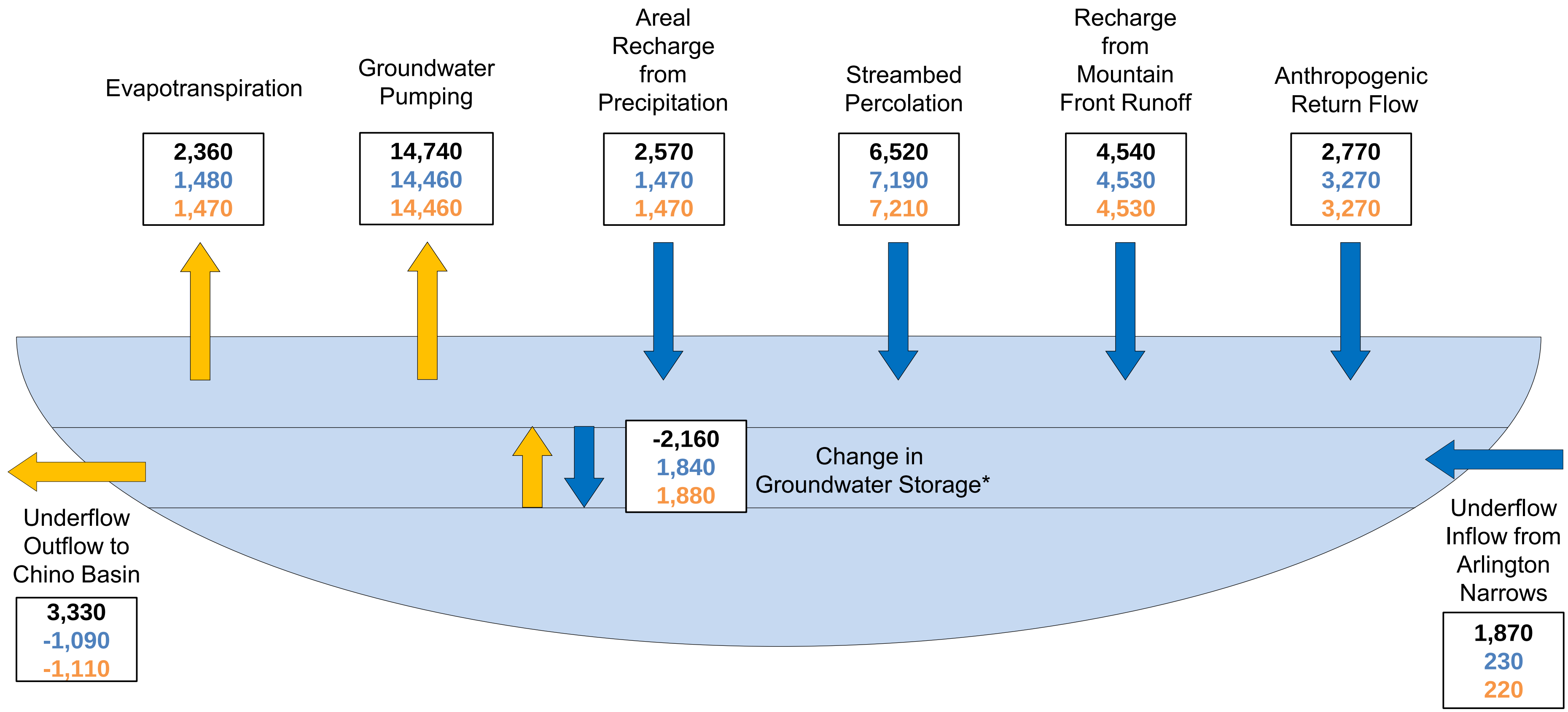


Scenario 2a - Baseline
Scenario 2e.1 - IEUA Stormflow Activities

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2e.1 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

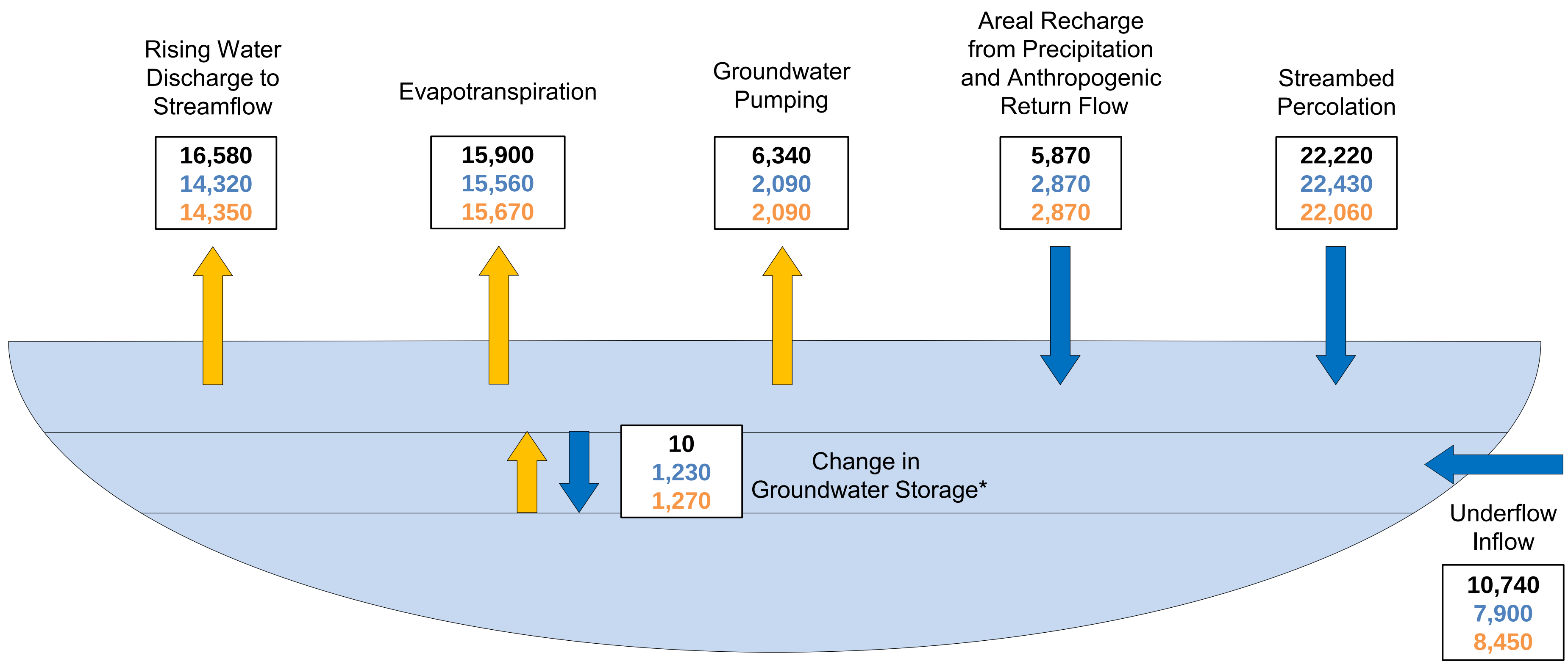
SCENARIO 2E.1
AVERAGE ANNUAL
WATER BUDGET
TEMESCAL BASIN

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT **DRAFT** **FIGURE 737**

UPPER SANTA ANA RIVER INTEGRATED MODEL – SUMMARY REPORT

GEOSCIENCE



Scenario 2a - Baseline
Scenario 2e.1 - IEUA Stormflow Activities

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2e.1 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2E.1
AVERAGE ANNUAL
WATER BUDGET
PRADO BASIN

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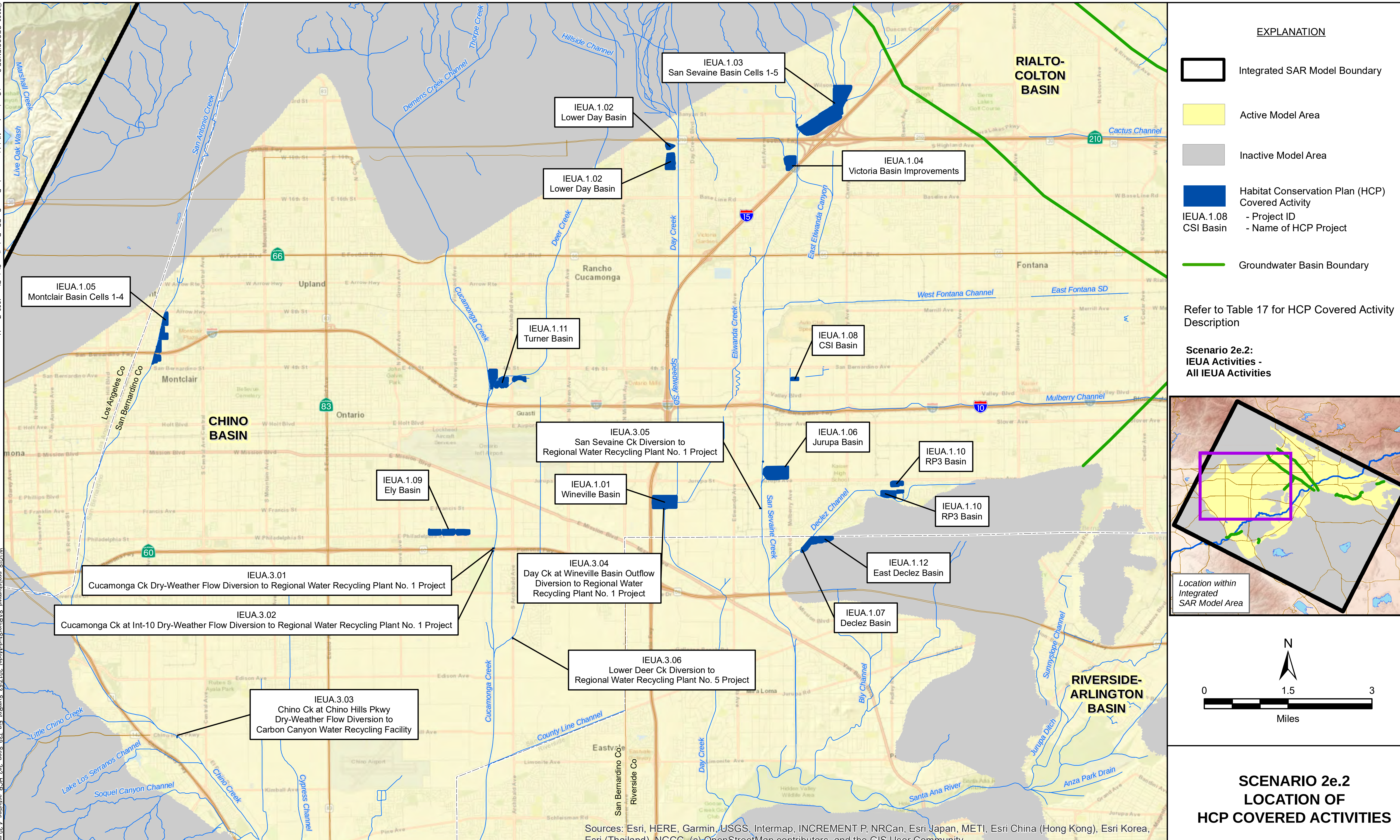

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SCENARIO 2e.2
LOCATION OF
HCP COVERED ACTIVITIES

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FIGURE 739

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

GEOSCIENCE

Scenario 2e.2: Annual Change in Surface Water Diversion Compared to Baseline

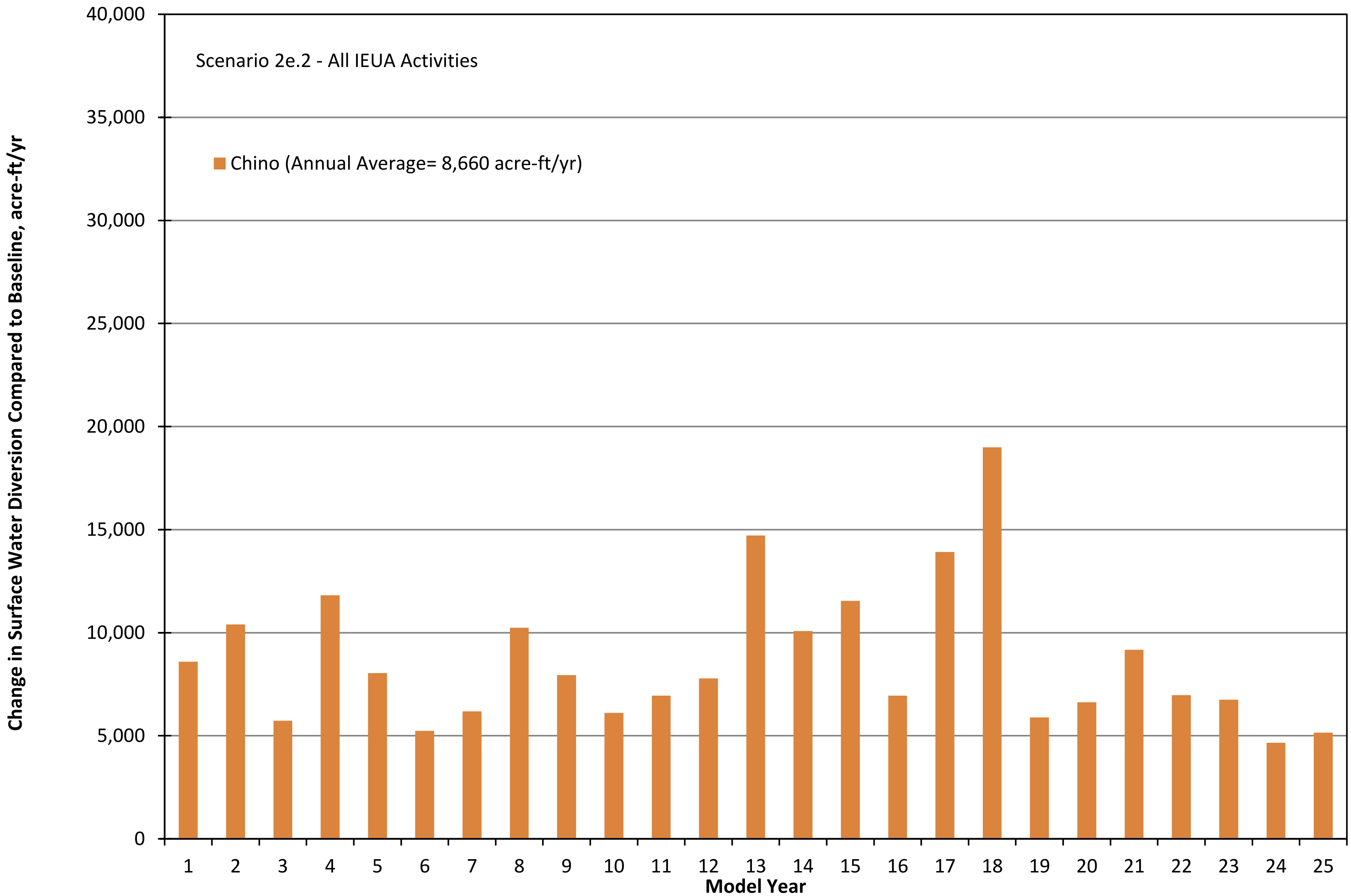

Figure 740

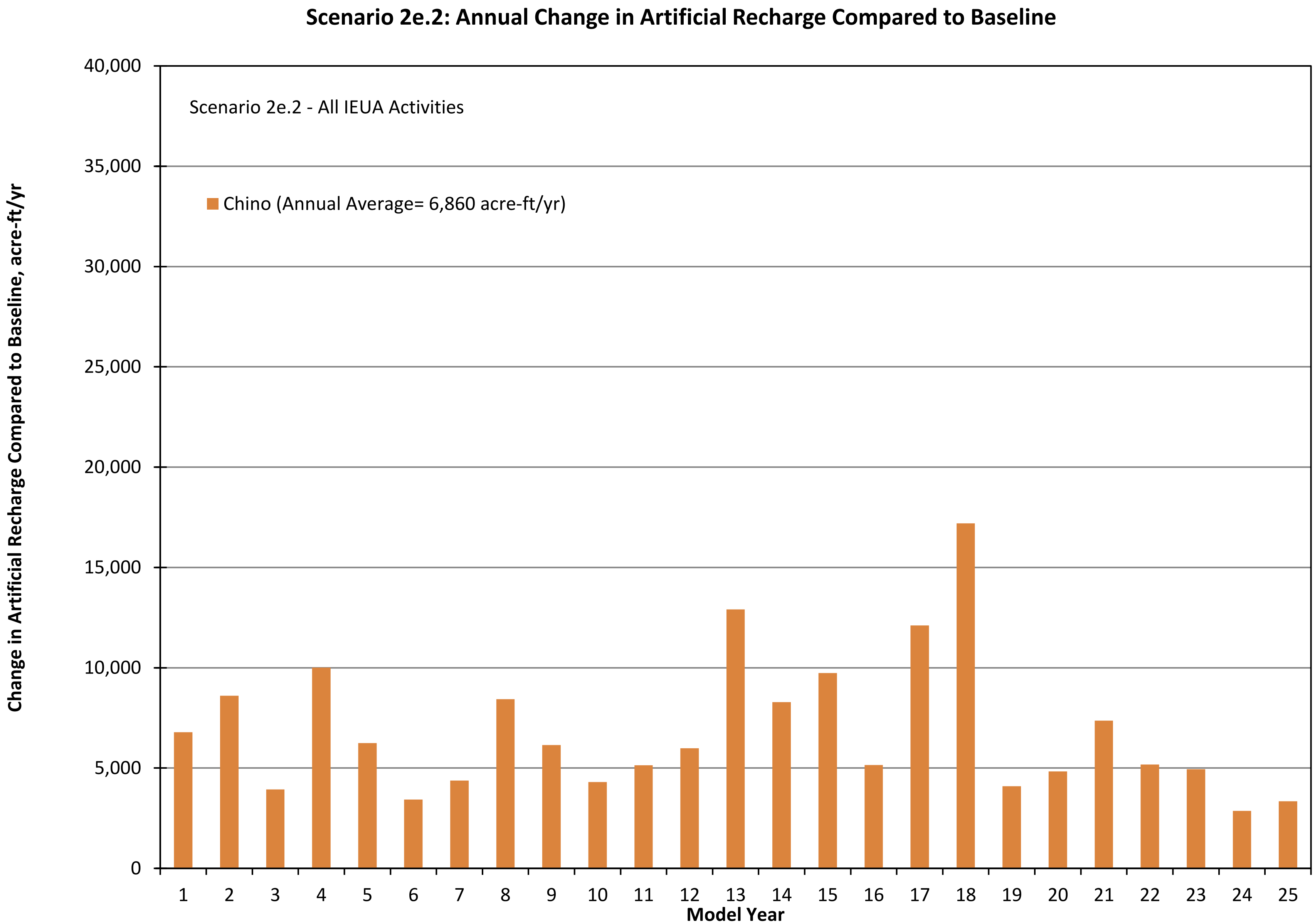
Scenario 2e.2: Annual Change in Artificial Recharge Compared to Baseline
Scenario 2e.2 - All IEUA Activities
Chino (Annual Average= 6,860 acre-ft/yr)
Change in Artificial Recharge Compared to Baseline, acre-ft/yr
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
Model Year

Figure 741

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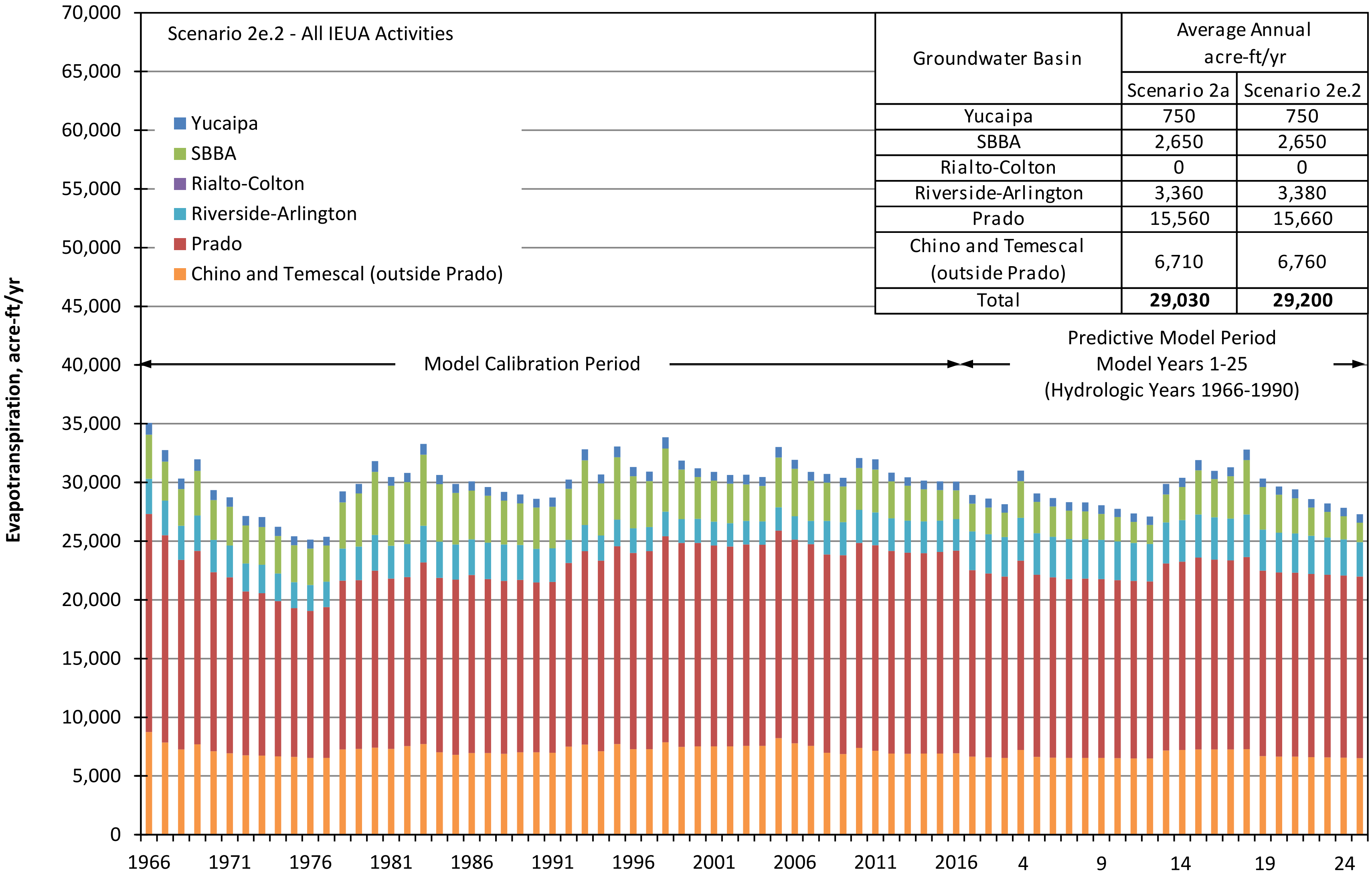
Scenario 2e.2: Annual Evapotranspiration – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2e.2
Yucaipa	750	750
SBBA	2,650	2,650
Rialto-Colton	0	0
Riverside-Arlington	3,360	3,380
Prado	15,560	15,660
Chino and Temescal (outside Prado)	6,710	6,760
Total	**29,030**	**29,200**

Figure 742

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Scenario 2e.2: Annual Change in Evapotranspiration – Integrated SAR Model Area

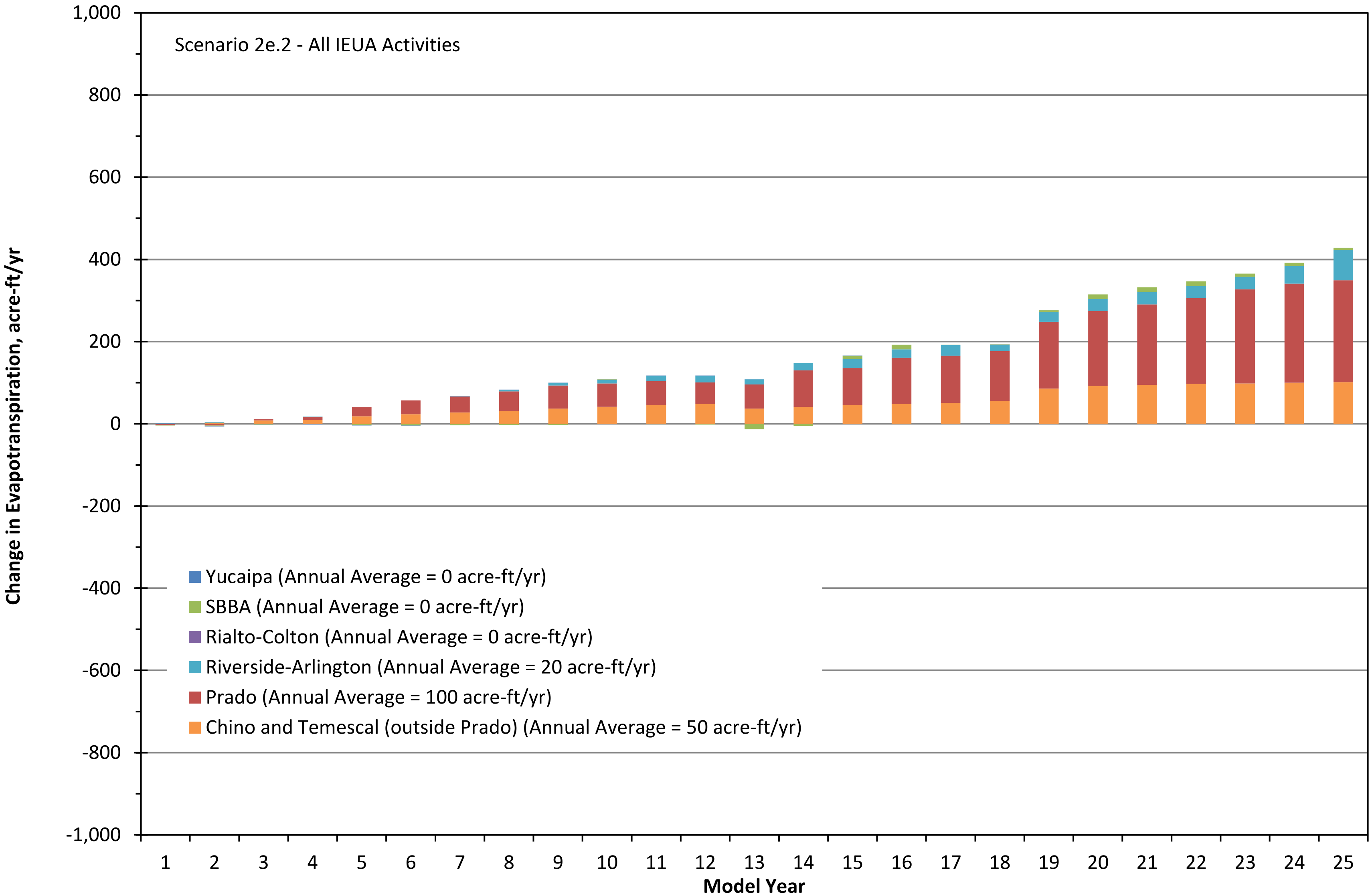

Figure 743

Scenario 2e.2: Seasonal Evapotranspiration – Integrated SAR Model Area

Scenario 2e.2 - All IEUA Activities

Average monthly evapotranspiration for Model Years 1 through 25 (Hydrologic Years 1966-1990).

Month	Average Monthly, acre-ft/month						
	Yucaipa	SBBA	Rialto-Colton	Riverside-Arlington	Prado	Chino and Temescal (outside Prado)	**Total**
1	20	80	0	100	450	200	**850**
2	30	100	0	130	570	240	**1,070**
3	40	140	0	170	780	330	**1,460**
4	50	180	0	220	1,010	430	**1,890**
5	60	220	0	270	1,290	540	**2,380**
6	110	380	0	470	2,220	940	**4,120**
7	120	420	0	530	2,470	1,070	**4,610**
8	120	420	0	540	2,500	1,100	**4,680**
9	90	320	0	430	1,970	870	**3,680**
10	60	210	0	290	1,350	590	**2,500**
11	30	100	0	140	620	270	**1,160**
12	20	70	0	90	420	190	**790**

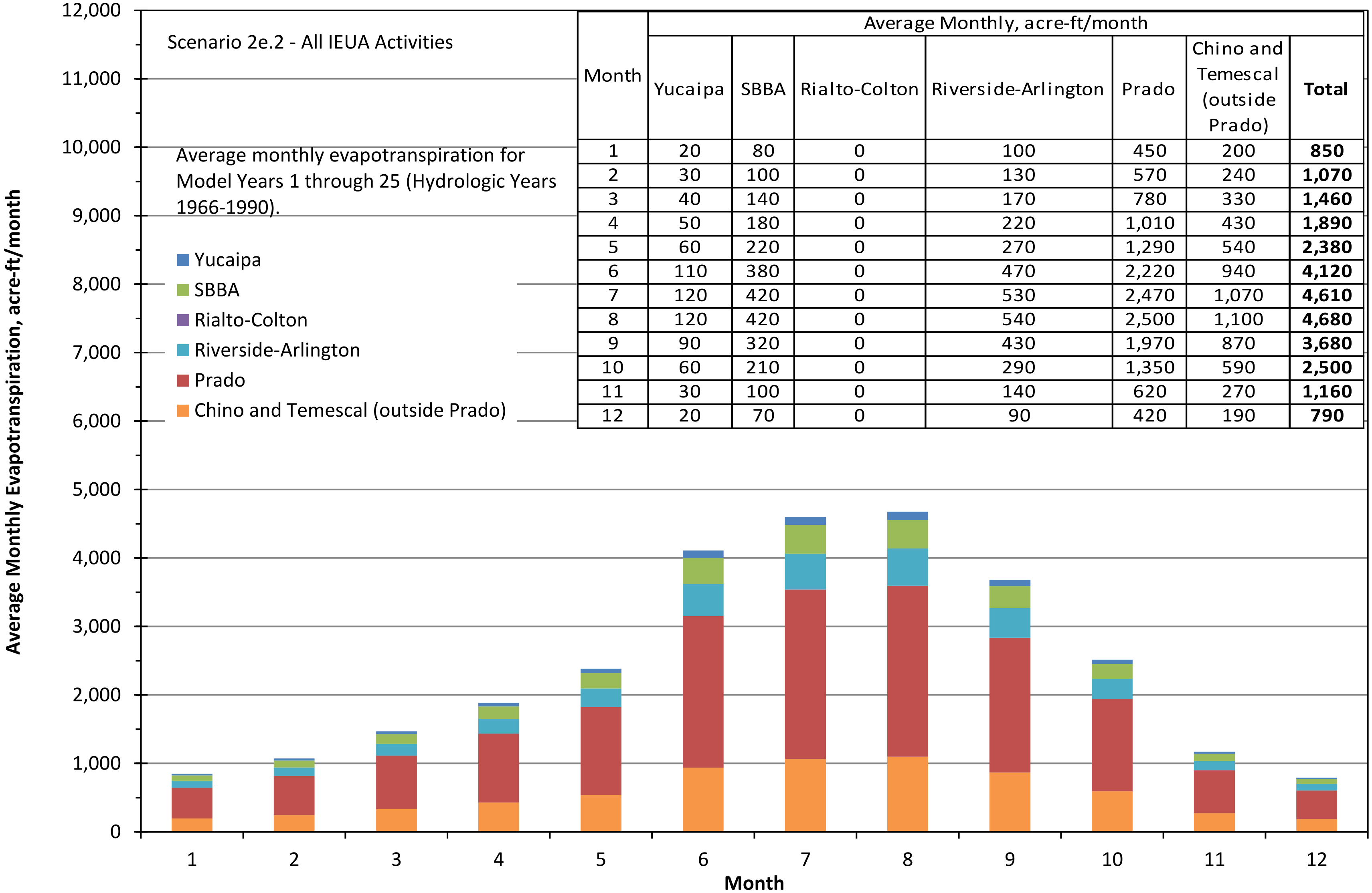

Figure 744

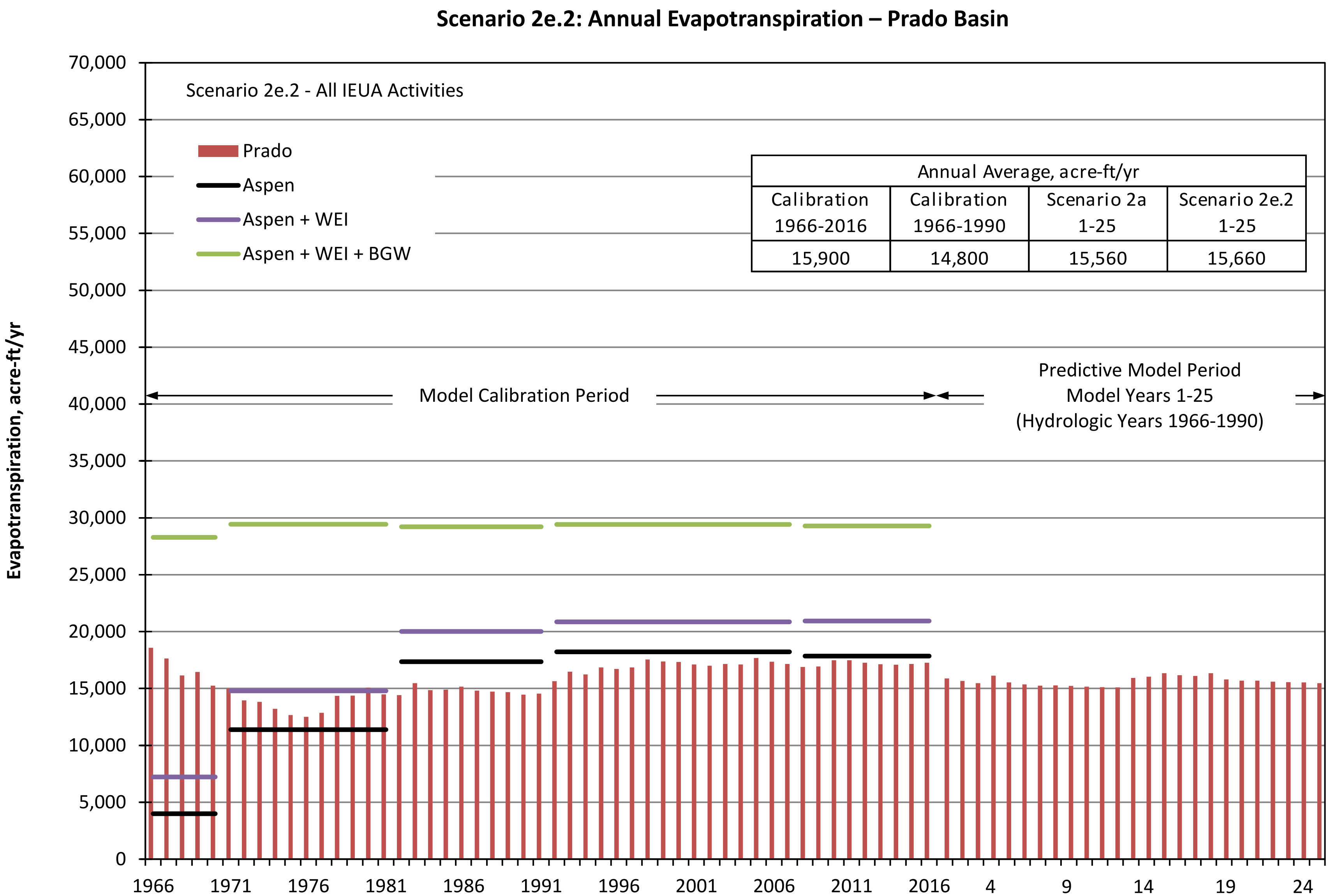
Scenario 2e.2: Annual Evapotranspiration – Prado Basin
Scenario 2e.2 - All IEUA Activities
Prado
Aspen
Aspen + WEI
Aspen + WEI + BGW
Annual Average, acre-ft/yr
Calibration 1966-2016
Calibration 1966-1990
Scenario 2a 1-25
Scenario 2e.2 1-25
15,900
14,800
15,560
15,660
Model Calibration Period
Predictive Model Period
Model Years 1-25
(Hydrologic Years 1966-1990)
Evapotranspiration, acre-ft/yr
70,000
65,000
60,000
55,000
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
1966
1971
1976
1981
1986
1991
1996
2001
2006
2011
2016
4
9
14
19
24

Figure 745

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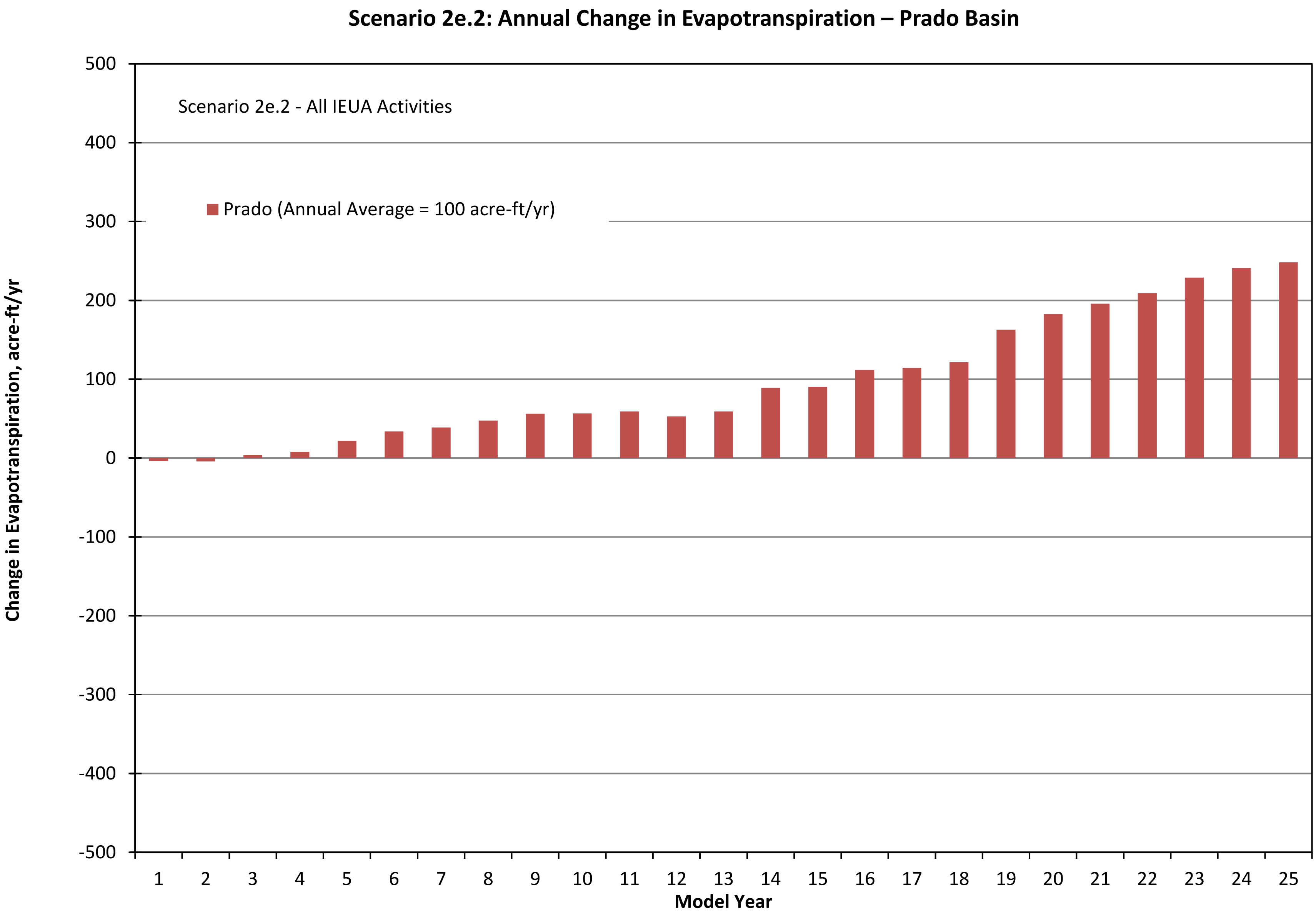
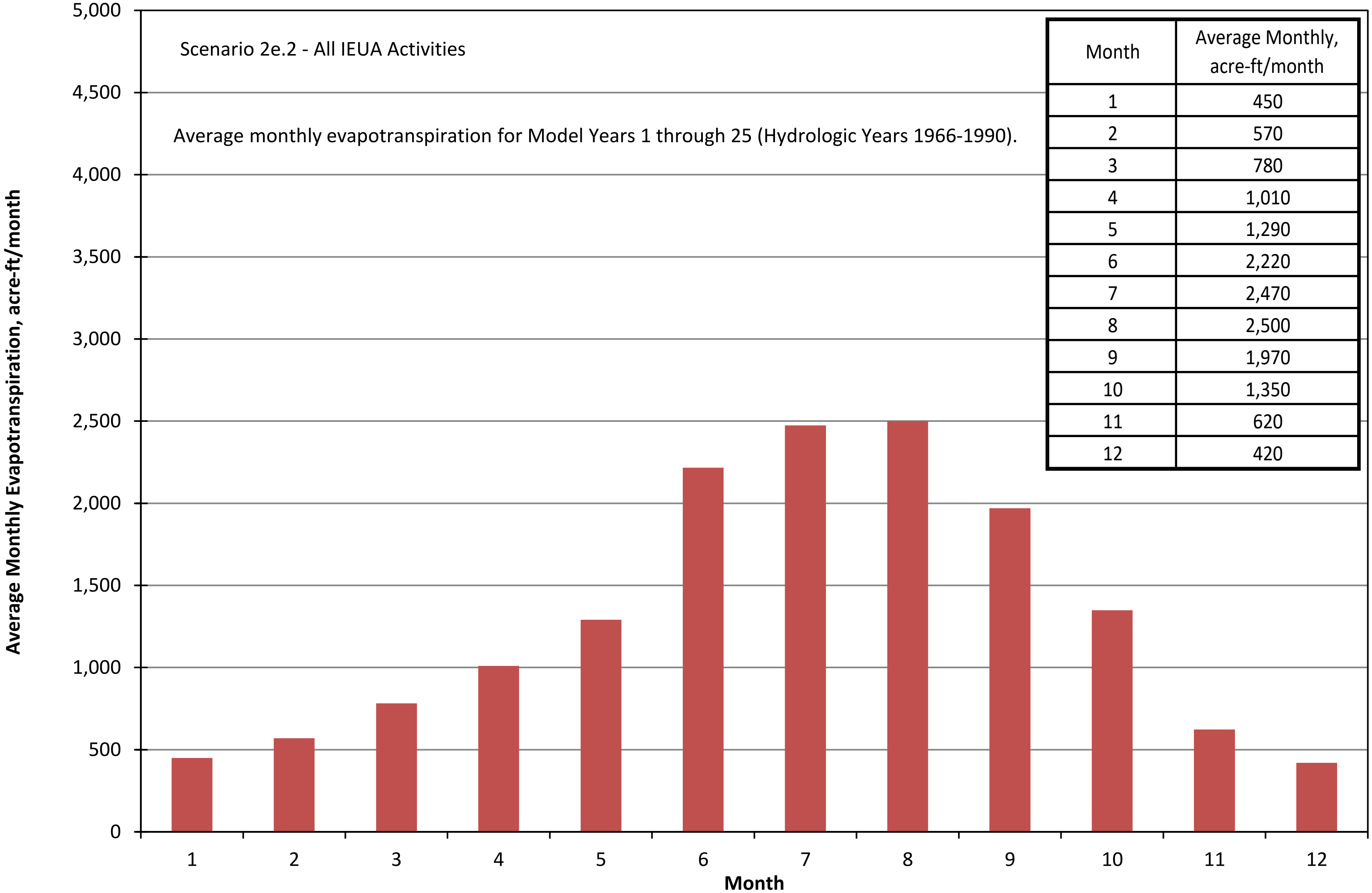


Figure 746

Scenario 2e.2: Seasonal Evapotranspiration – Prado Basin



Month	Average Monthly, acre-ft/month
1	450
2	570
3	780
4	1,010
5	1,290
6	2,220
7	2,470
8	2,500
9	1,970
10	1,350
11	620
12	420

Figure 747

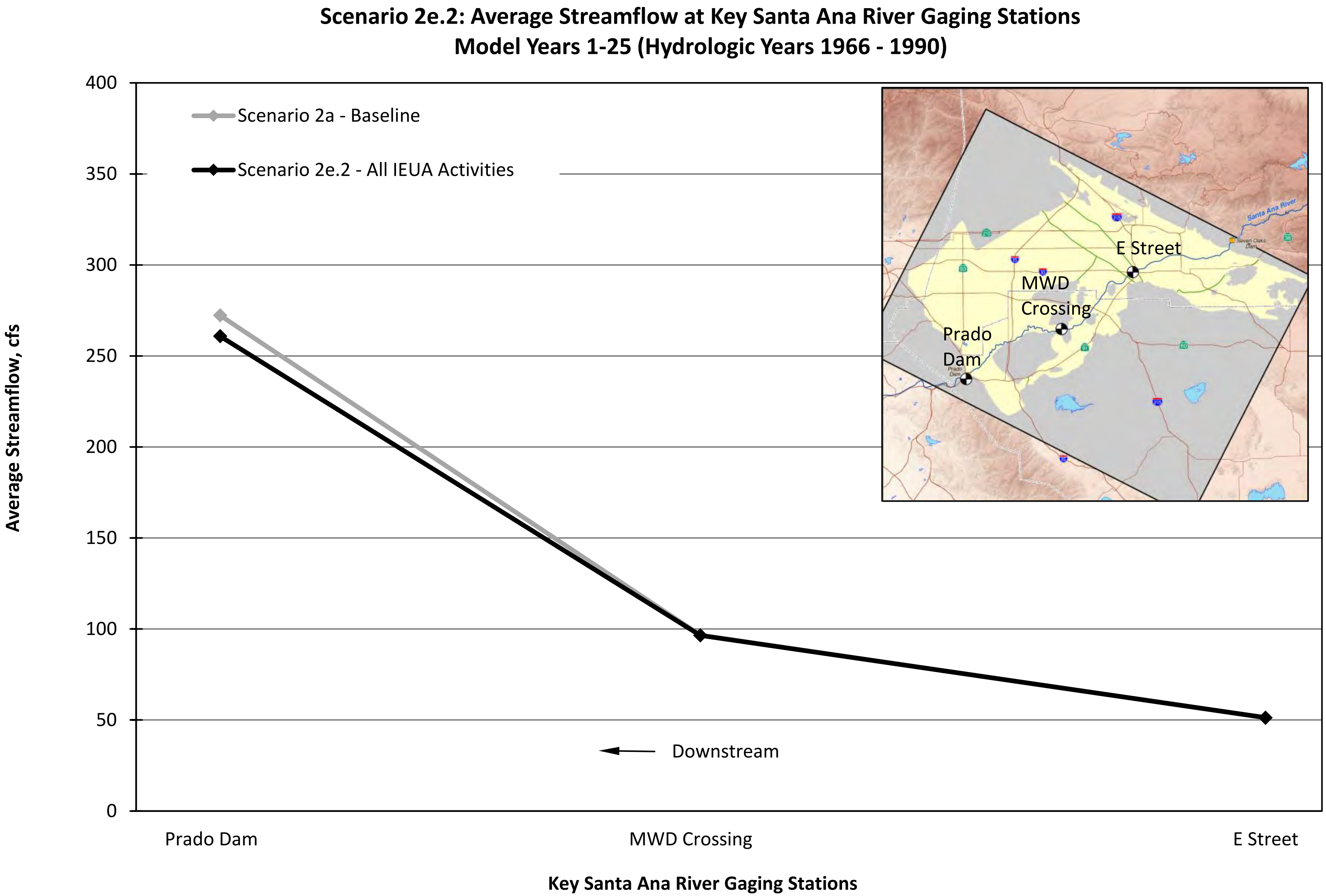

Scenario 2e.2: Average Streamflow at Key Santa Ana River Gaging Stations
Model Years 1-25 (Hydrologic Years 1966 - 1990)
Average Streamflow, cfs
0
50
100
150
200
250
300
350
400
Scenario 2a - Baseline
Scenario 2e.2 - All IEUA Activities
E Street
MWD
Crossing
Prado
Dam
Downstream
Prado Dam
MWD Crossing
E Street
Key Santa Ana River Gaging Stations

Figure 748

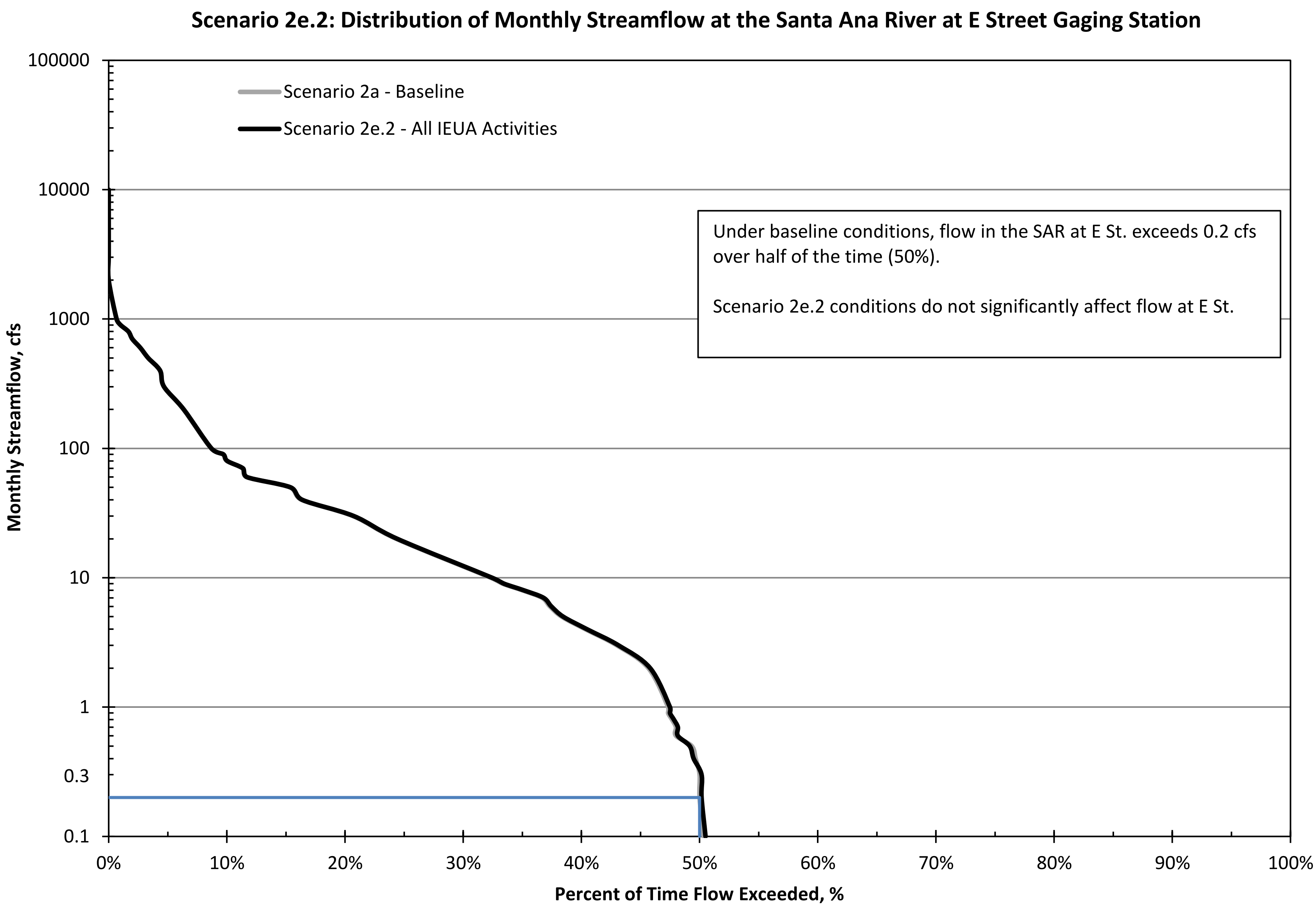

Scenario 2e.2: Distribution of Monthly Streamflow at the Santa Ana River at E Street Gaging Station
Scenario 2a - Baseline
Scenario 2e.2 - All IEUA Activities
Under baseline conditions, flow in the SAR at E St. exceeds 0.2 cfs over half of the time (50%).
Scenario 2e.2 conditions do not significantly affect flow at E St.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.3
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 749

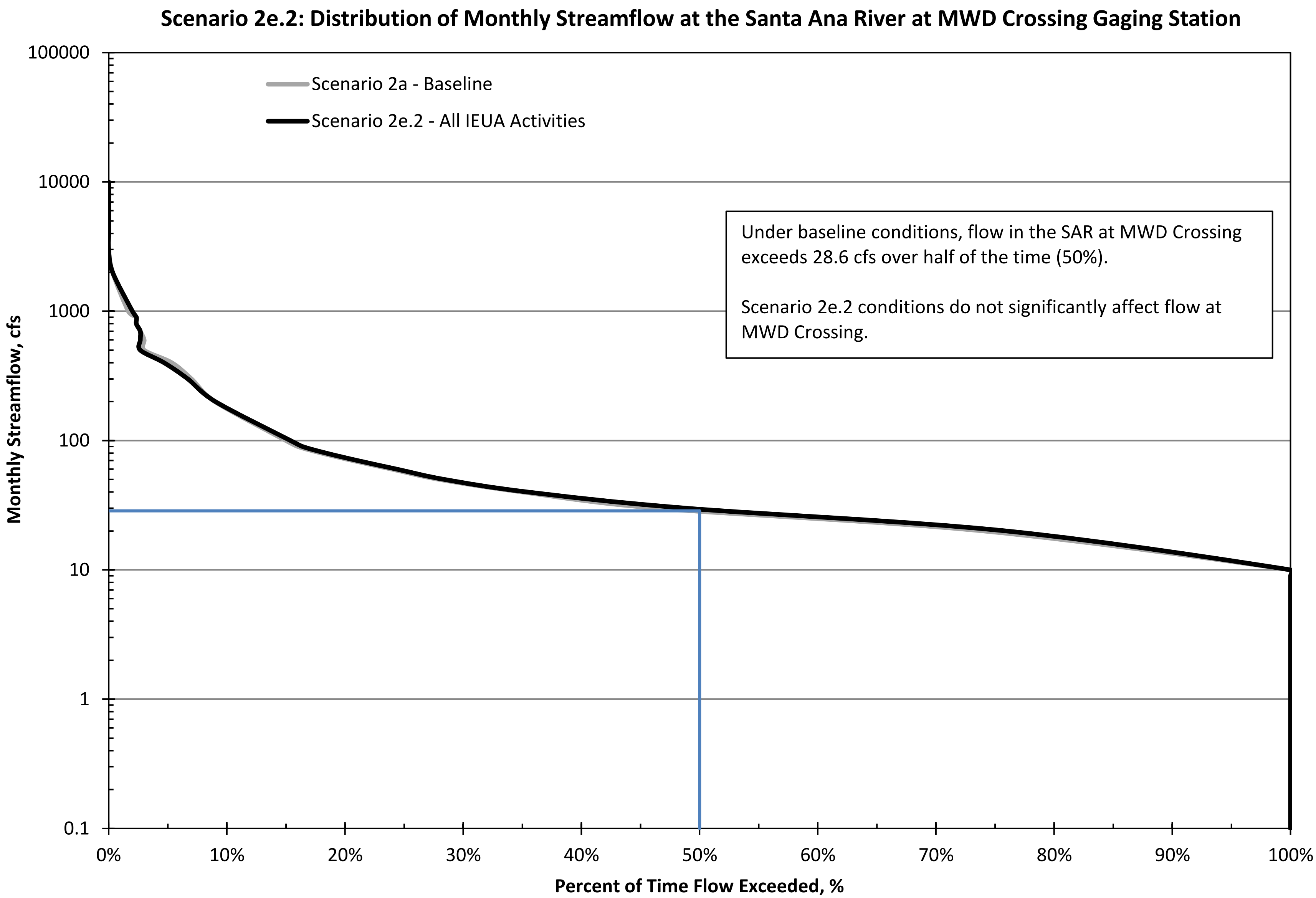

Scenario 2e.2: Distribution of Monthly Streamflow at the Santa Ana River at MWD Crossing Gaging Station
Scenario 2a - Baseline
Scenario 2e.2 - All IEUA Activities
Under baseline conditions, flow in the SAR at MWD Crossing exceeds 28.6 cfs over half of the time (50%).
Scenario 2e.2 conditions do not significantly affect flow at MWD Crossing.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 750

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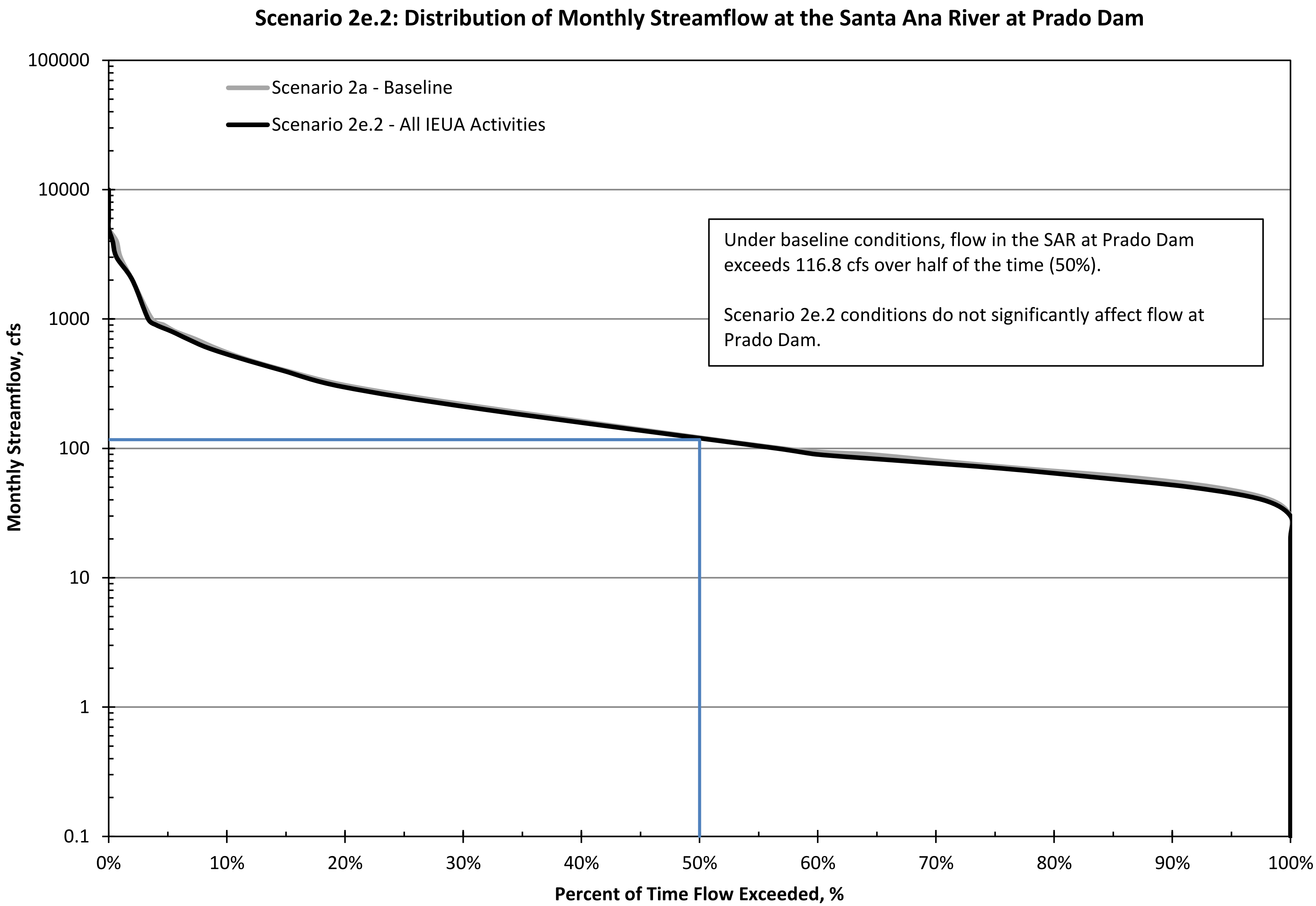
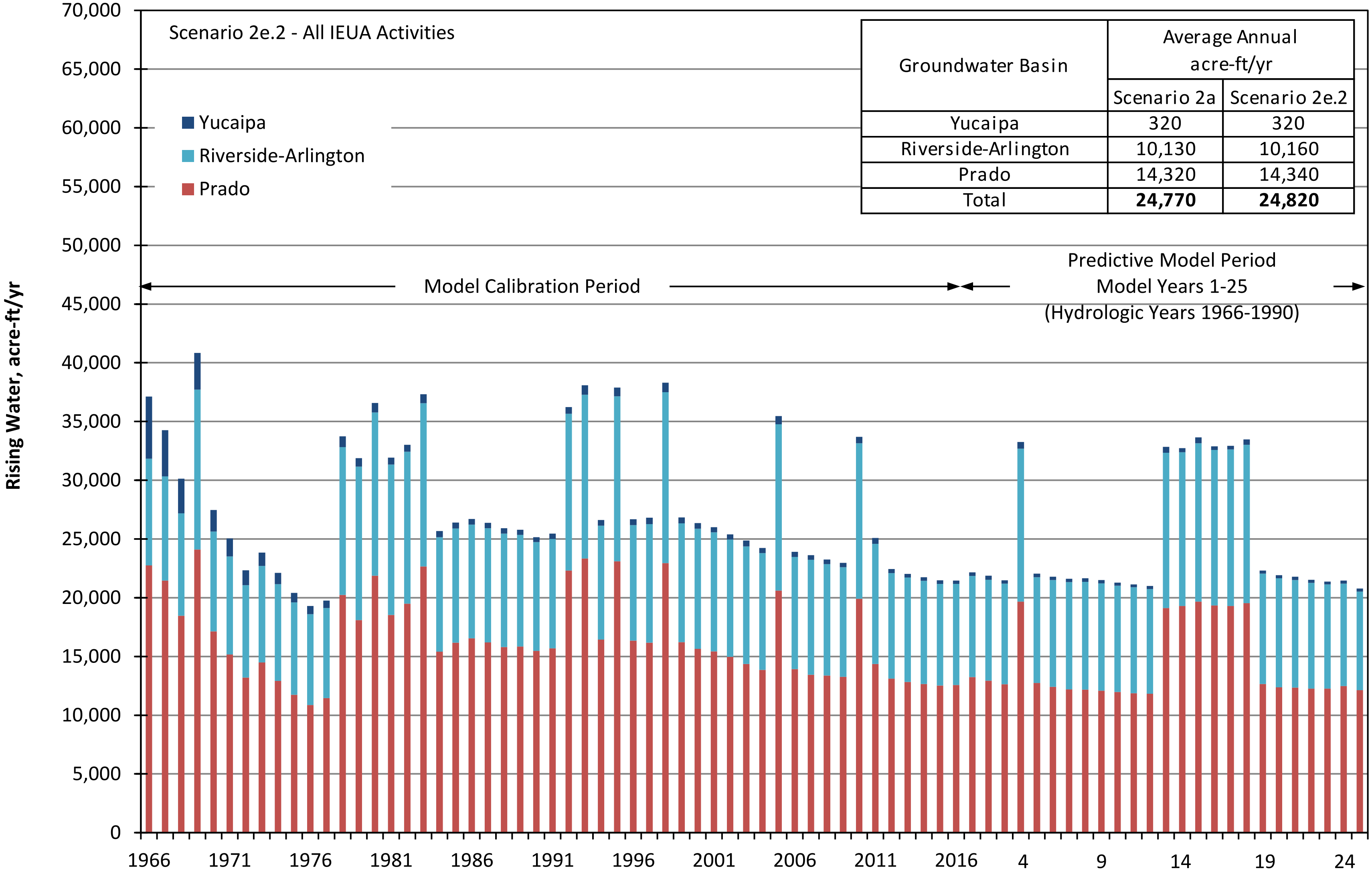


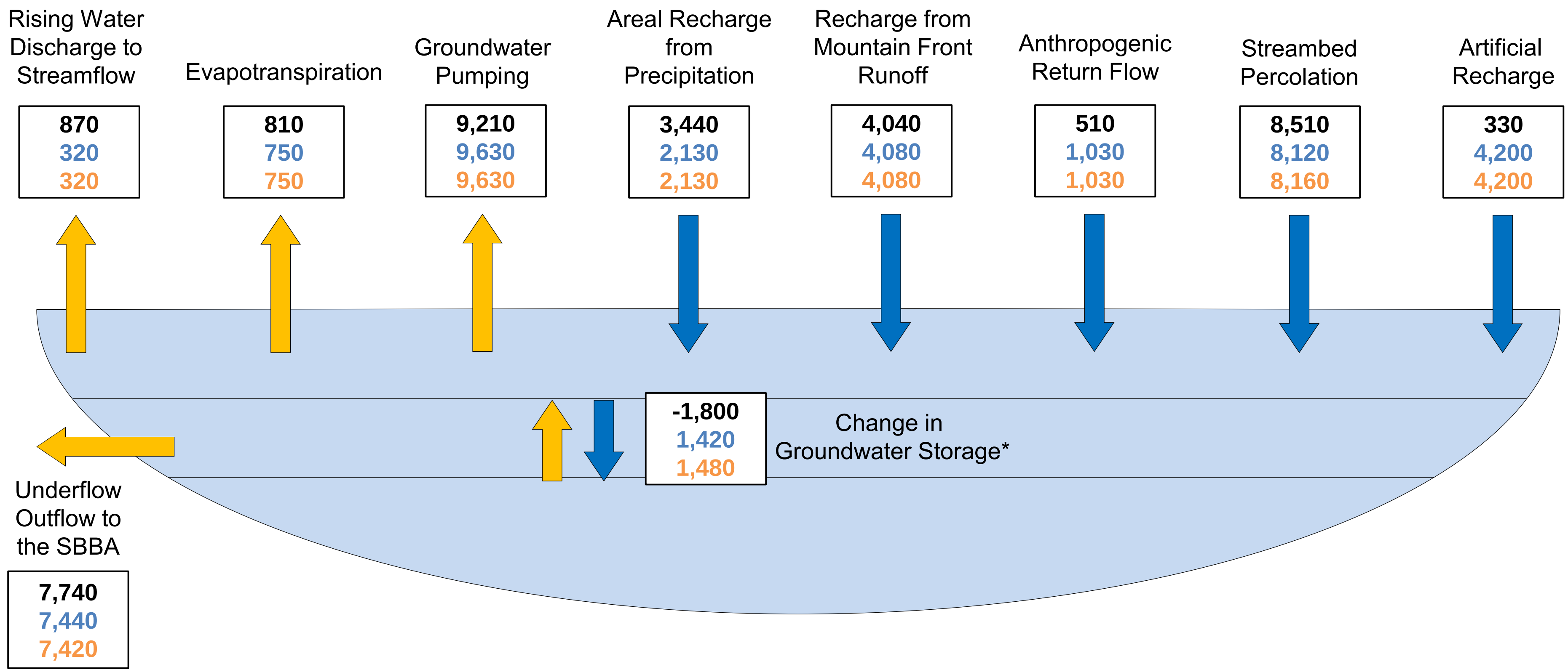
Figure 751

Scenario 2e.2: Annual Rising Water – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2e.2
Yucaipa	320	320
Riverside-Arlington	10,130	10,160
Prado	14,320	14,340
Total	**24,770**	**24,820**

Figure 752



Scenario 2a - Baseline
Scenario 2e.2 - All IEUA Activities

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2e.2 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2E.2 AVERAGE ANNUAL WATER BUDGET YUCAIPA BASIN

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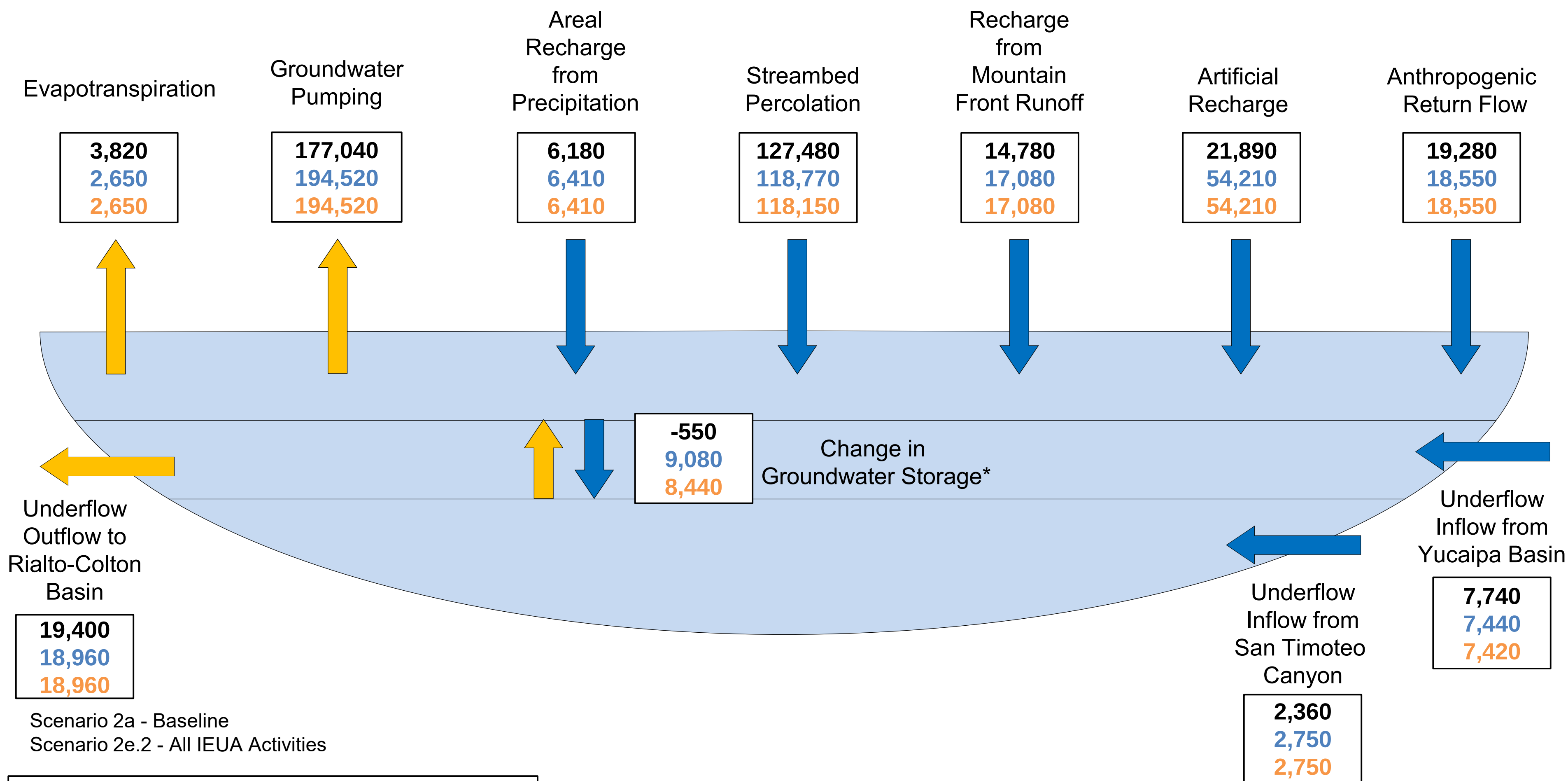

Scenario 2a - Baseline
Scenario 2e.2 - All IEUA Activities

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2e.2 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2E.2 AVERAGE ANNUAL WATER BUDGET SBBA

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT **DRAFT** **FIGURE 754**
UPPER SANTA ANA RIVER INTEGRATED MODEL – SUMMARY REPORT

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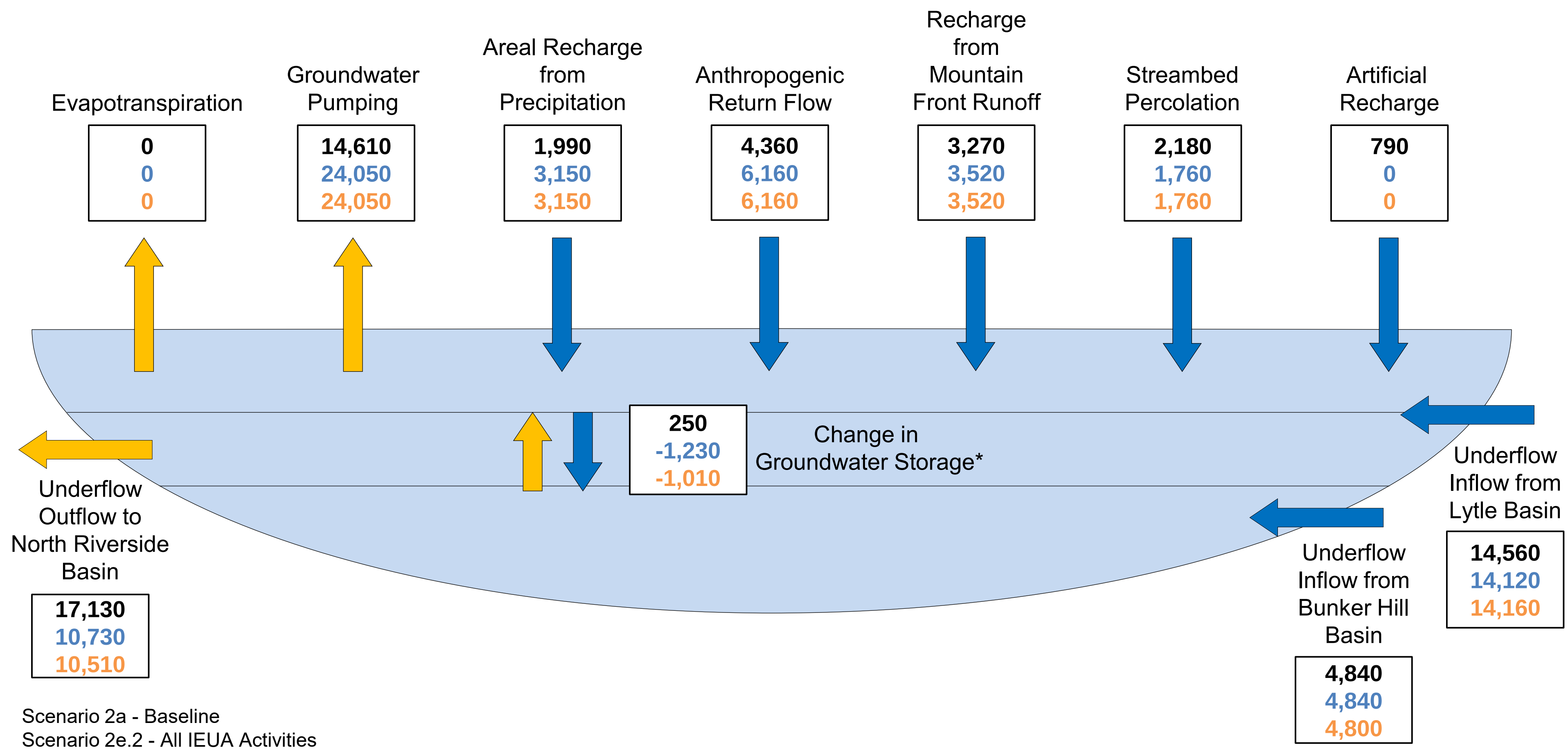


Scenario 2a - Baseline
Scenario 2e.2 - All IEUA Activities

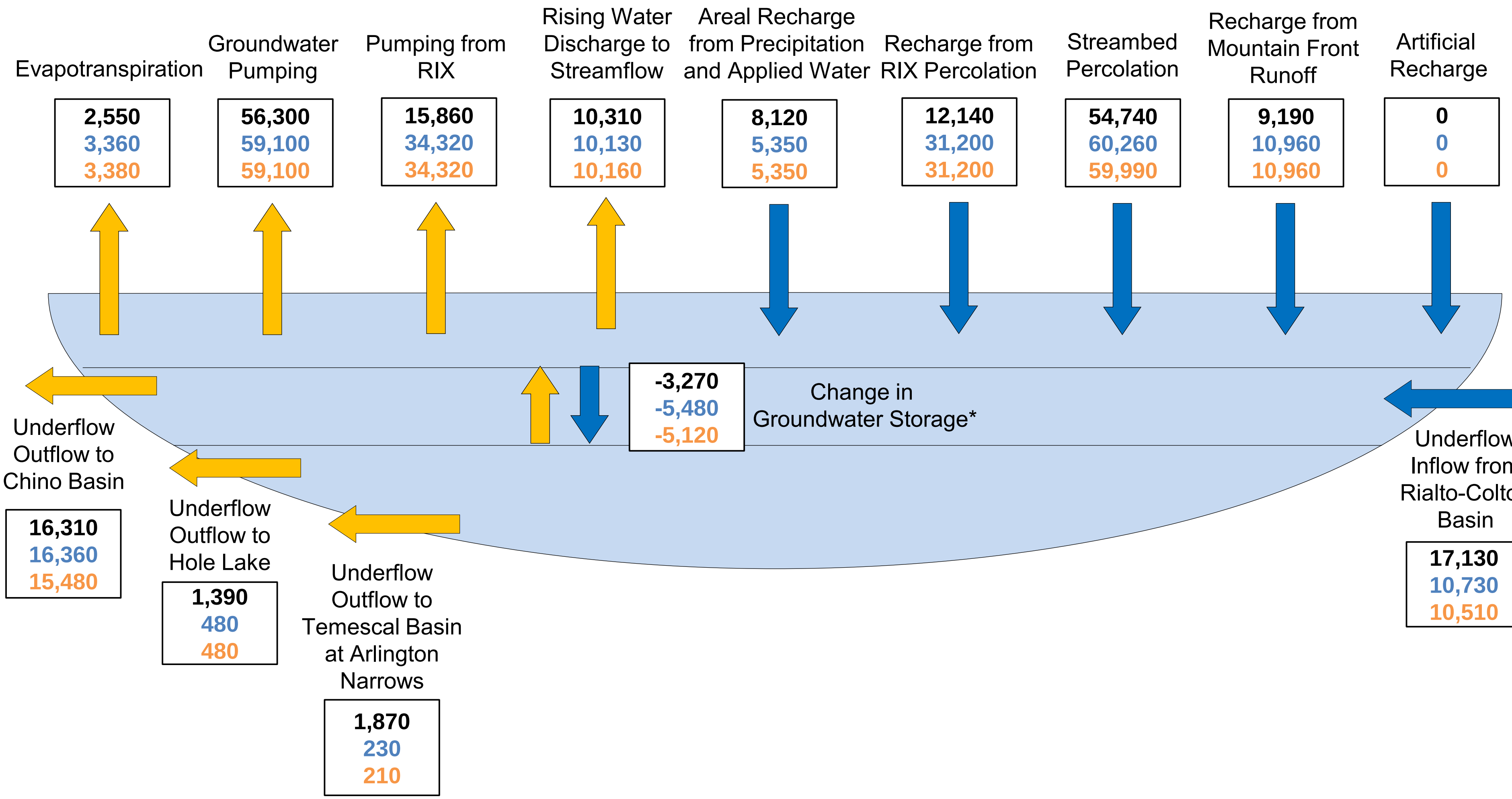
Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2e.2 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2E.2
AVERAGE ANNUAL
WATER BUDGET
RIALTO-COLTON BASIN

10-Apr-20



Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2e.2 (Hydrologic Period 1966-1990)

Scenario 2a - Baseline
Scenario 2e.2 - All IEUA Activities

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2E.2
AVERAGE ANNUAL WATER BUDGET
RIVERSIDE-ARLINGTON BASIN

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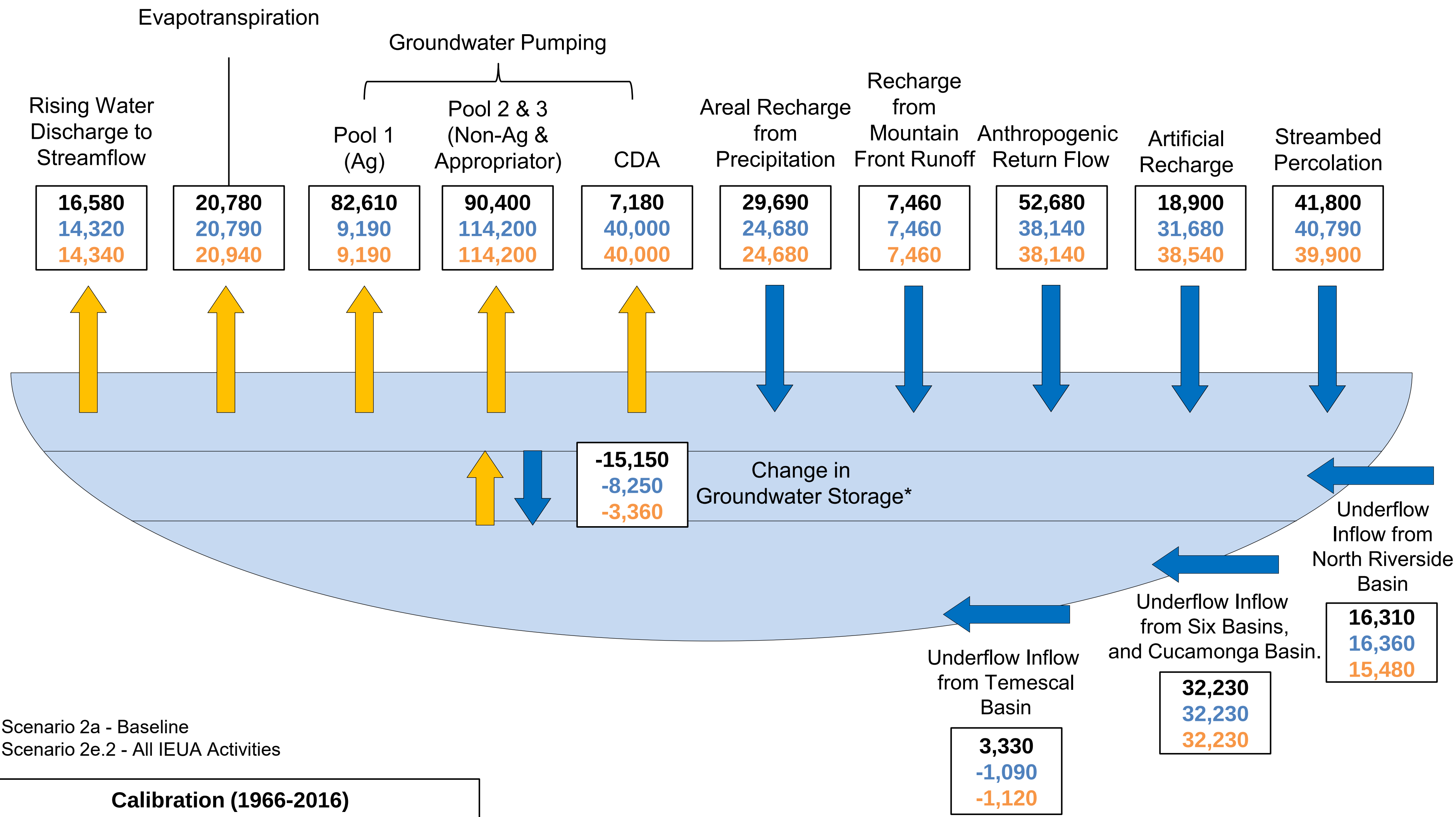


Scenario 2a - Baseline
Scenario 2e.2 - All IEUA Activities

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2e.2 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2E.2
AVERAGE ANNUAL
WATER BUDGET
CHINO BASIN

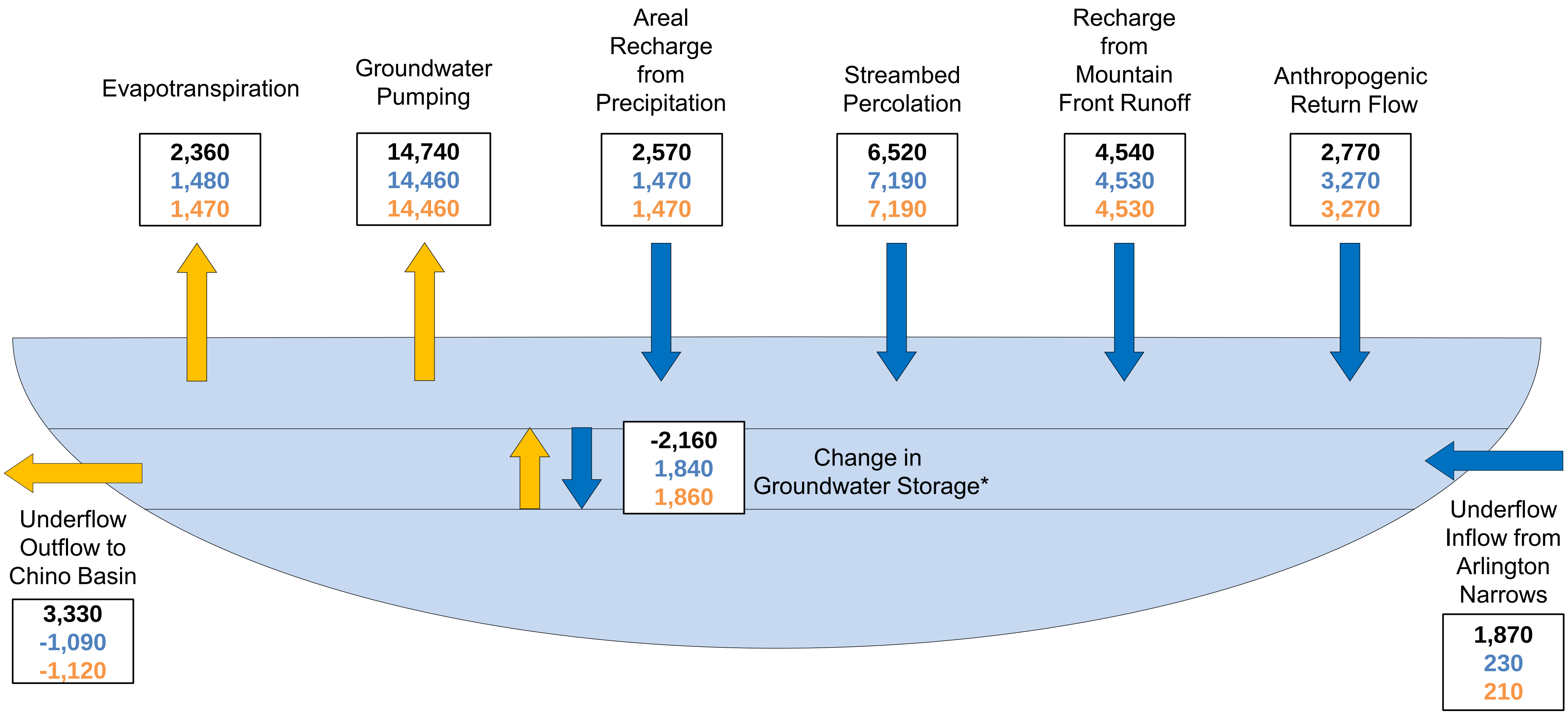
10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT
UPPER SANTA ANA RIVER INTEGRATED MODEL – SUMMARY REPORT

DRAFT

FIGURE 757

GEOSCIENCE



Scenario 2a - Baseline
Scenario 2e.2 - All IEUA Activities

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2e.2 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2E.2
AVERAGE ANNUAL
WATER BUDGET
TEMESCAL BASIN

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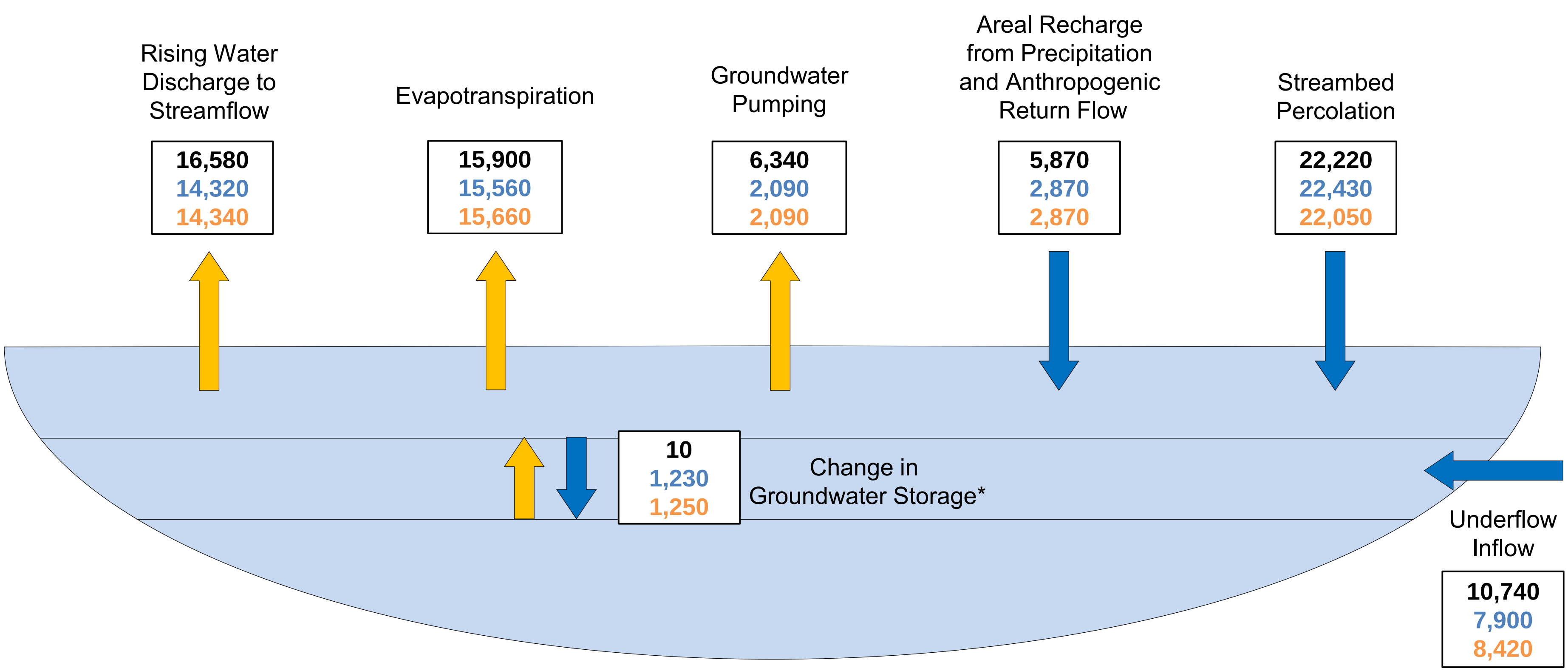


Scenario 2a - Baseline
Scenario 2e.2 - All IEUA Activities

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2e.2 (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2E.2
AVERAGE ANNUAL
WATER BUDGET
PRADO BASIN

10-Apr-20

EXPLANATION

Integrated SAR Model Boundary

Active Model Area

Inactive Model Area

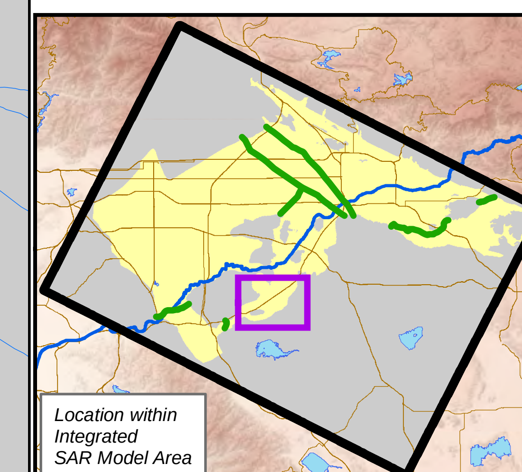
Habitat Conservation Plan (HCP) Covered Activity
- Project ID
- Name of HCP Project

West.6 Arlington Basin Water Quality Improvement Project

Groundwater Basin Boundary

Refer to Table 17 for HCP Covered Activity Description

Scenario 2f: Western's Victoria Recharge Basin Project



N

0 3,000 6,000

Feet

SCENARIO 2f LOCATION OF HCP COVERED ACTIVITIES

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

DRAFT

FIGURE 760

GEOSCIENCE

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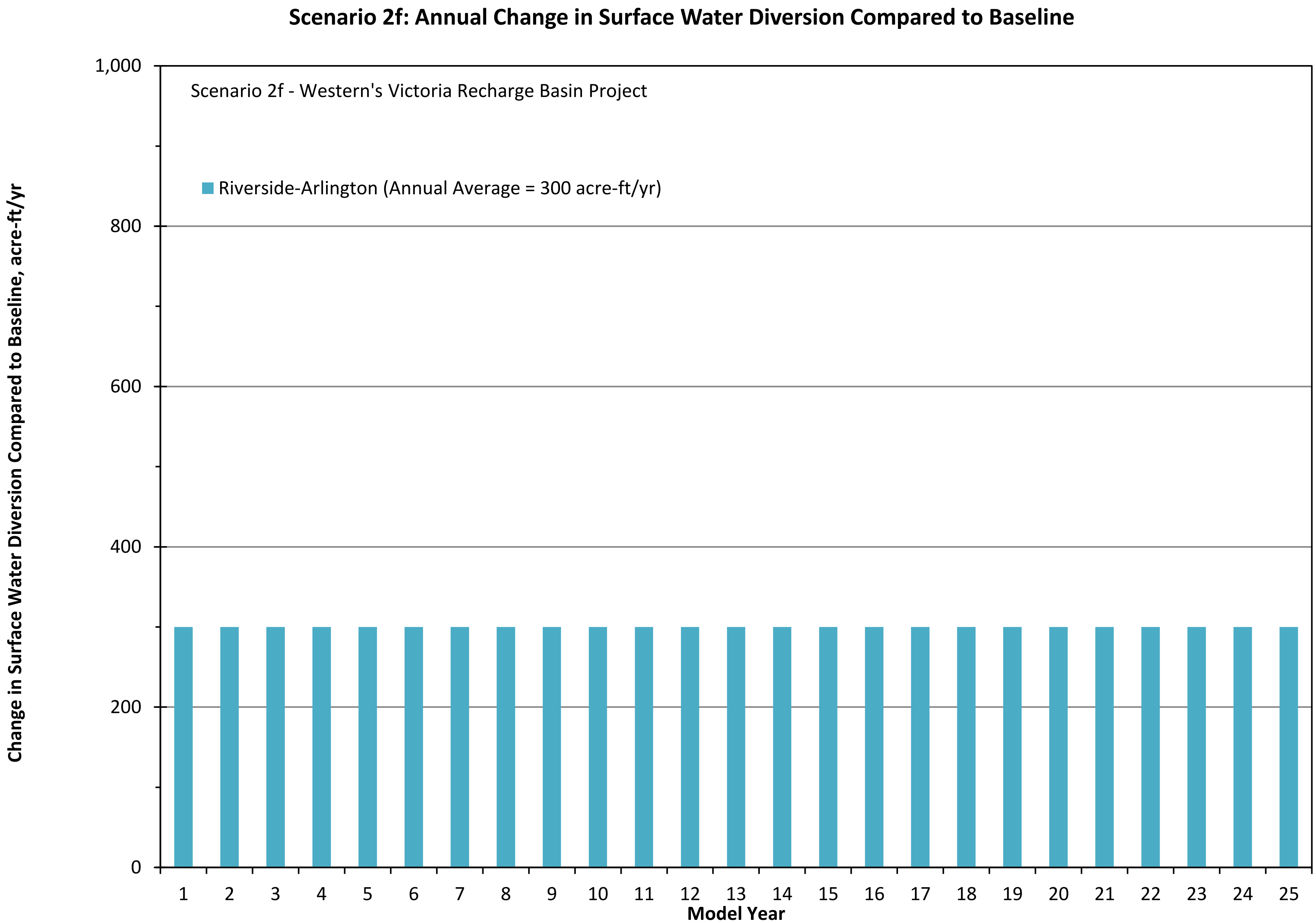


Figure 761

Scenario 2f: Annual Change in Artificial Recharge Compared to Baseline

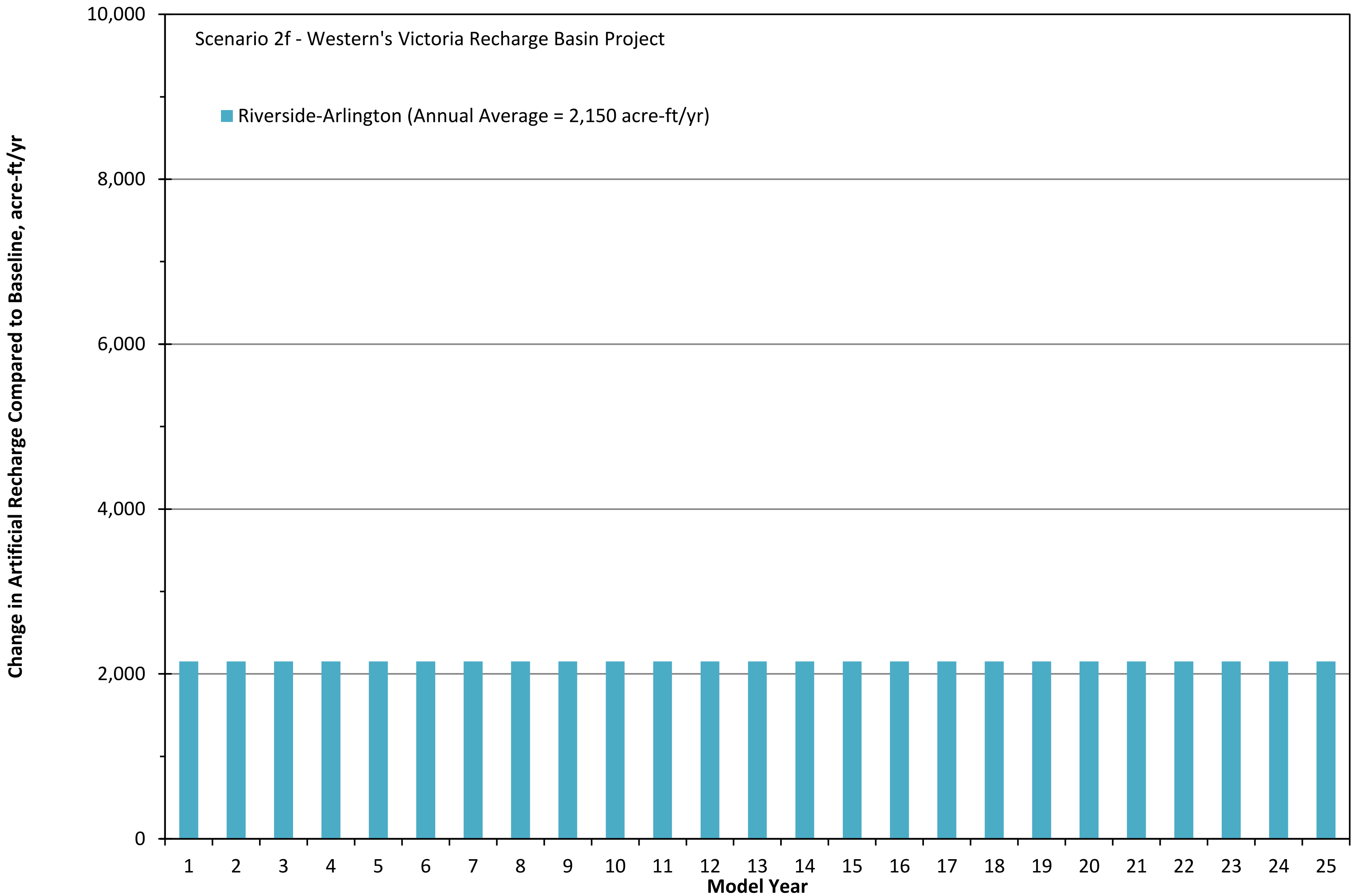
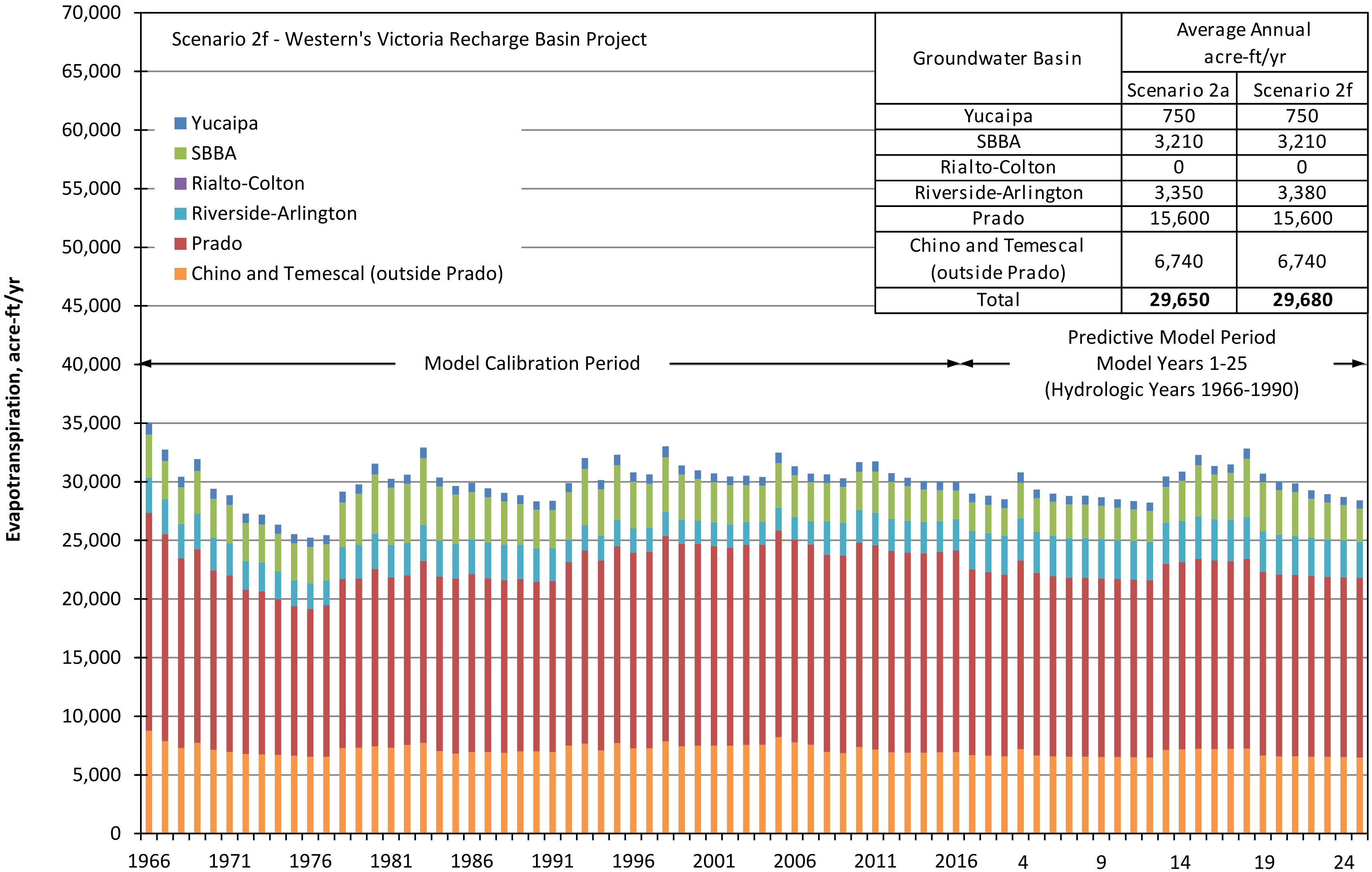


Figure 762

DRAFT

Scenario 2f: Annual Evapotranspiration – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2f
Yucaipa	750	750
SBBA	3,210	3,210
Rialto-Colton	0	0
Riverside-Arlington	3,350	3,380
Prado	15,600	15,600
Chino and Temescal (outside Prado)	6,740	6,740
Total	**29,650**	**29,680**

Figure 763

DRAFT

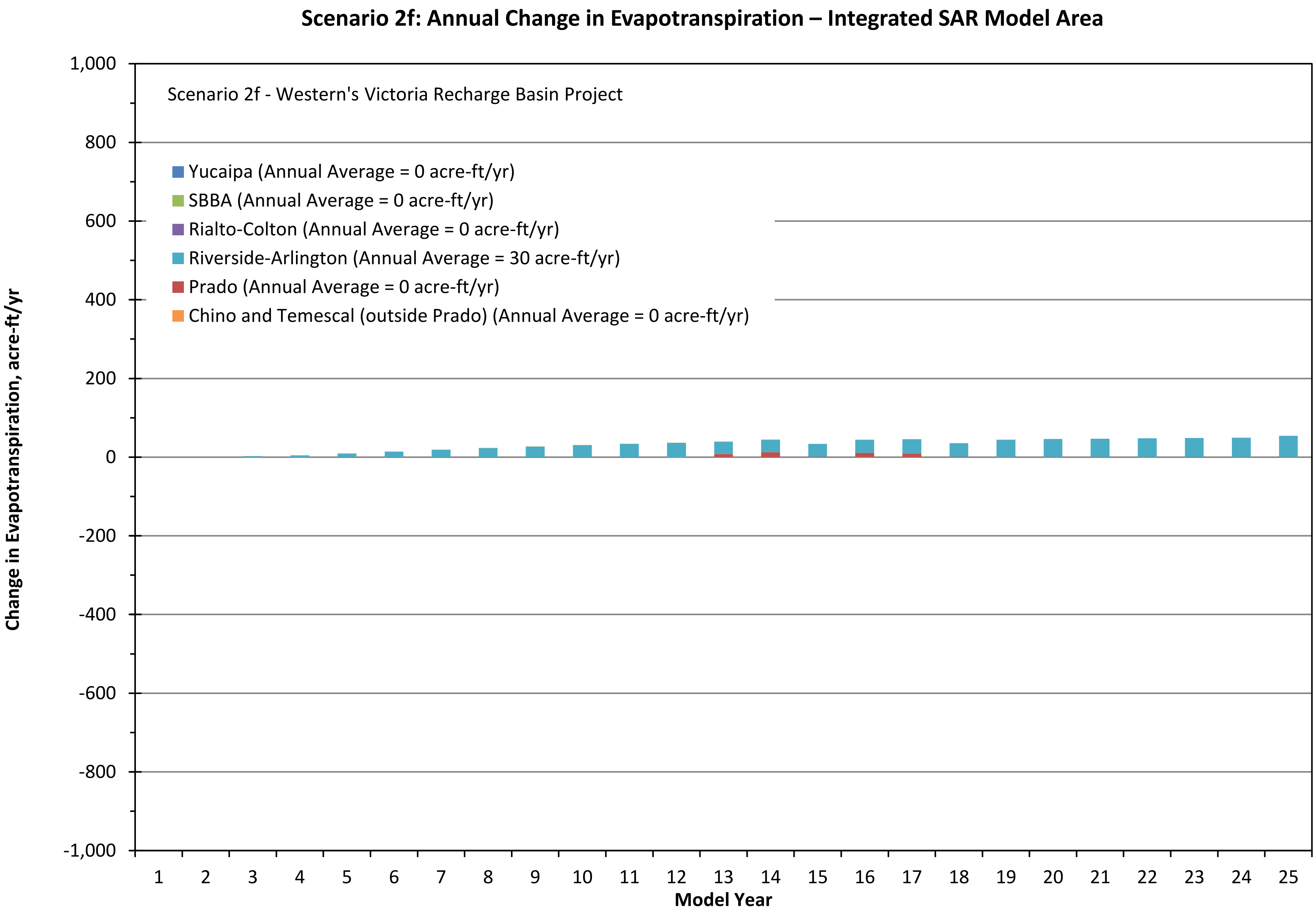
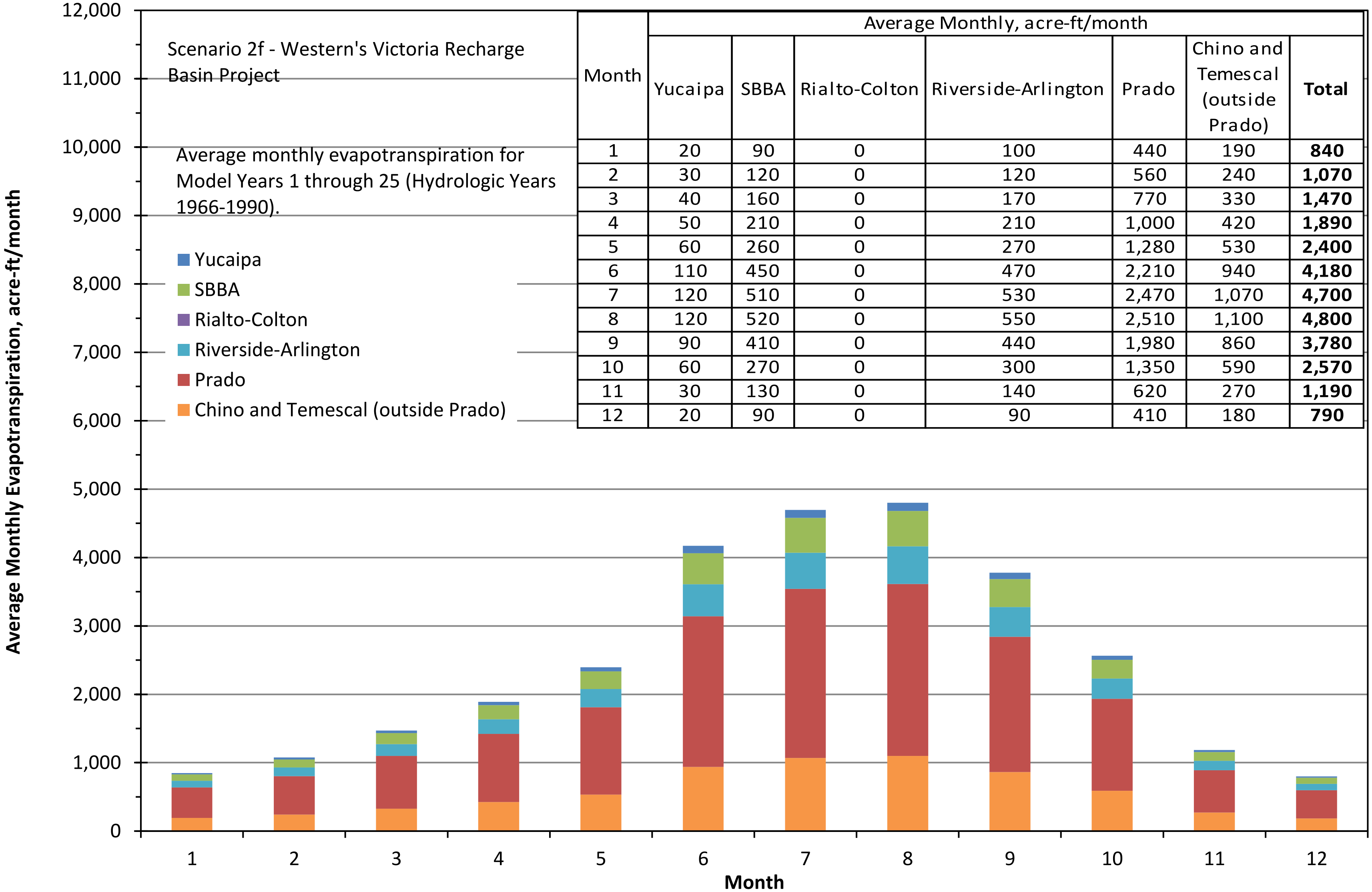


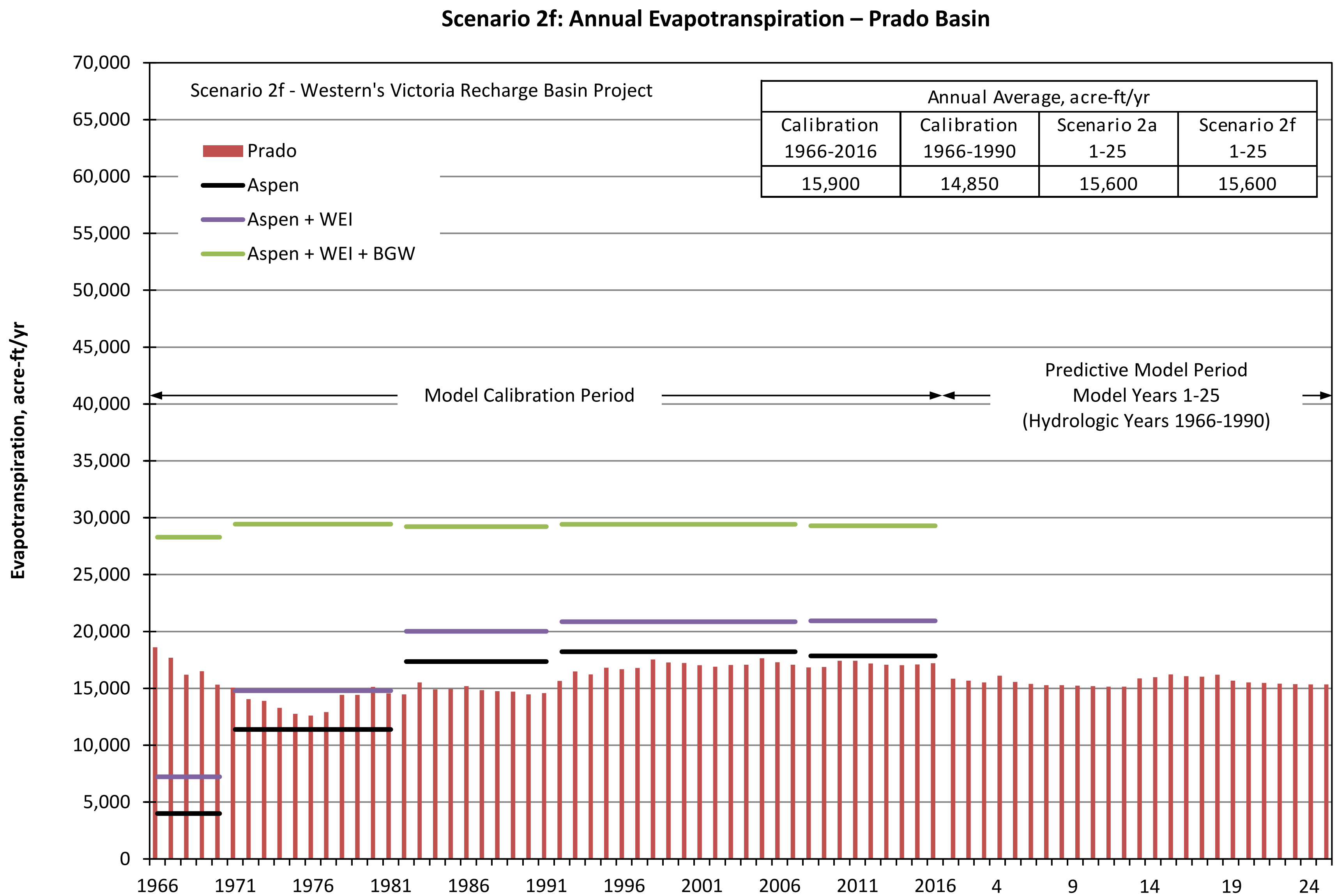
Figure 764

Scenario 2f: Seasonal Evapotranspiration – Integrated SAR Model Area



Month	Average Monthly, acre-ft/month						
	Yucaipa	SBBA	Rialto-Colton	Riverside-Arlington	Prado	Chino and Temescal (outside Prado)	**Total**
1	20	90	0	100	440	190	**840**
2	30	120	0	120	560	240	**1,070**
3	40	160	0	170	770	330	**1,470**
4	50	210	0	210	1,000	420	**1,890**
5	60	260	0	270	1,280	530	**2,400**
6	110	450	0	470	2,210	940	**4,180**
7	120	510	0	530	2,470	1,070	**4,700**
8	120	520	0	550	2,510	1,100	**4,800**
9	90	410	0	440	1,980	860	**3,780**
10	60	270	0	300	1,350	590	**2,570**
11	30	130	0	140	620	270	**1,190**
12	20	90	0	90	410	180	**790**

Figure 765



Annual Average, acre-ft/yr			
Calibration 1966-2016	Calibration 1966-1990	Scenario 2a 1-25	Scenario 2f 1-25
15,900	14,850	15,600	15,600

Figure 766

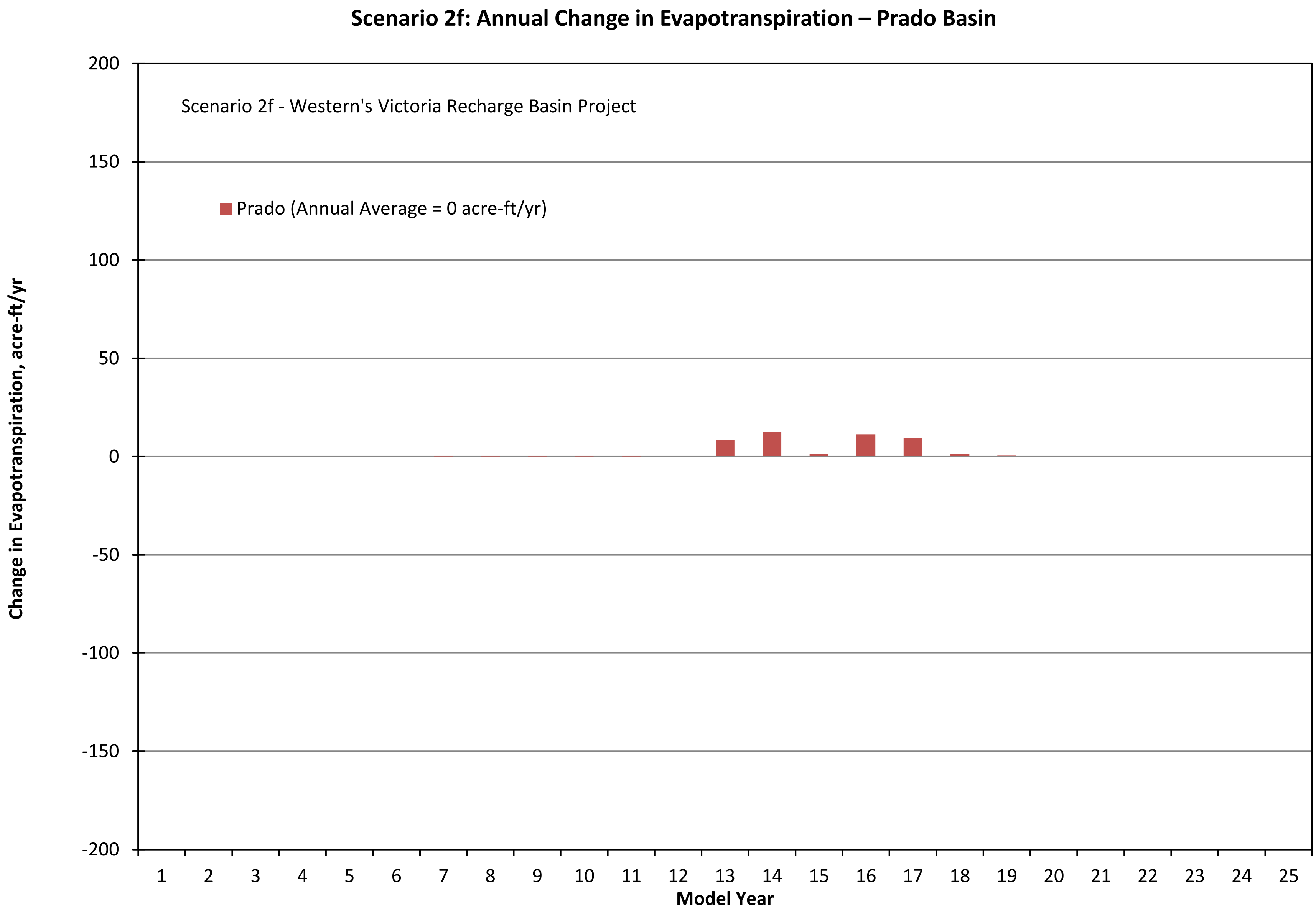
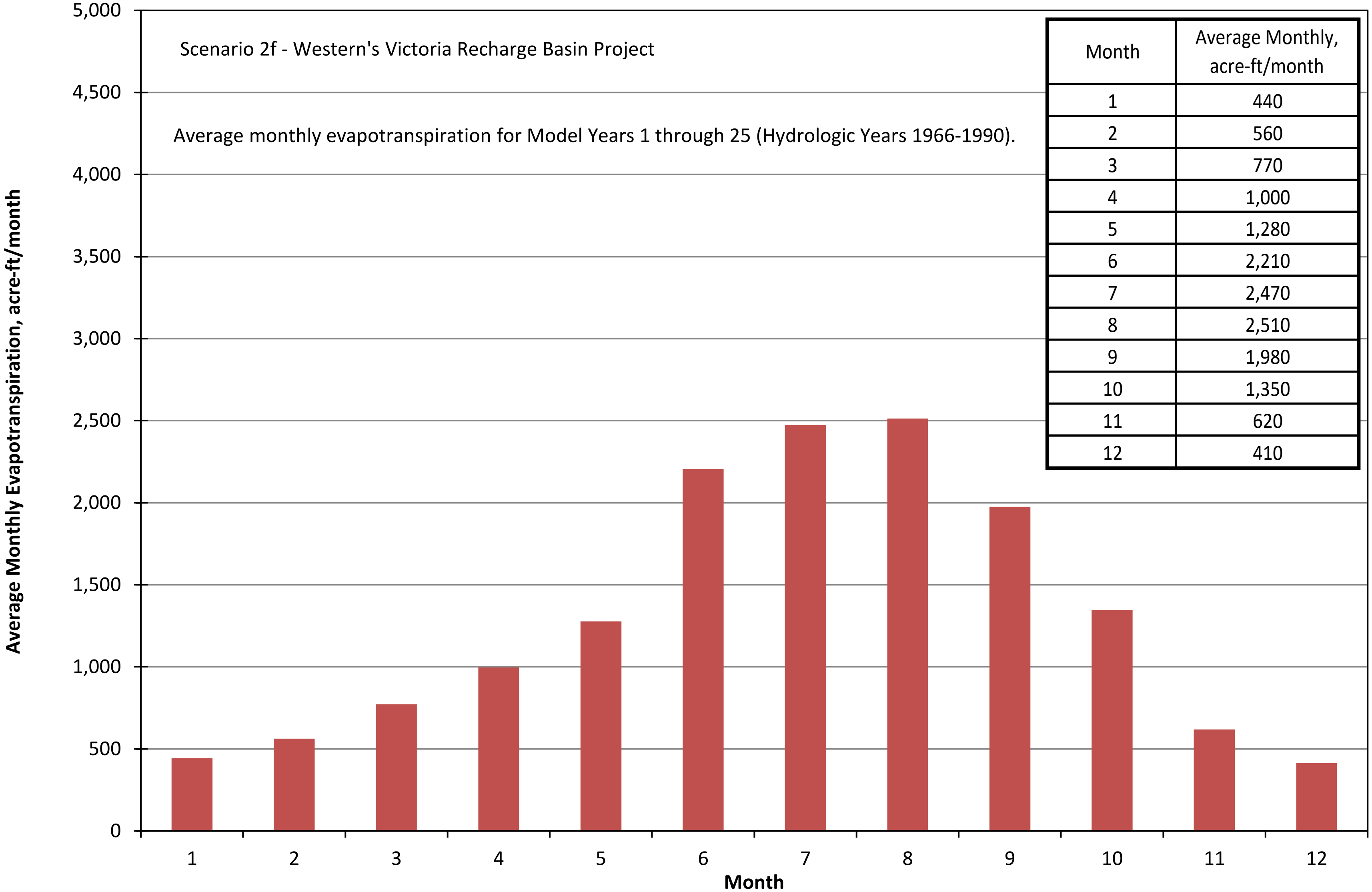

Scenario 2f: Annual Change in Evapotranspiration – Prado Basin
Scenario 2f - Western's Victoria Recharge Basin Project
Prado (Annual Average = 0 acre-ft/yr)
Change in Evapotranspiration, acre-ft/yr
200
150
100
50
0
-50
-100
-150
-200
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
Model Year

Figure 767

Scenario 2f: Seasonal Evapotranspiration – Prado Basin



Month	Average Monthly, acre-ft/month
1	440
2	560
3	770
4	1,000
5	1,280
6	2,210
7	2,470
8	2,510
9	1,980
10	1,350
11	620
12	410

Figure 768

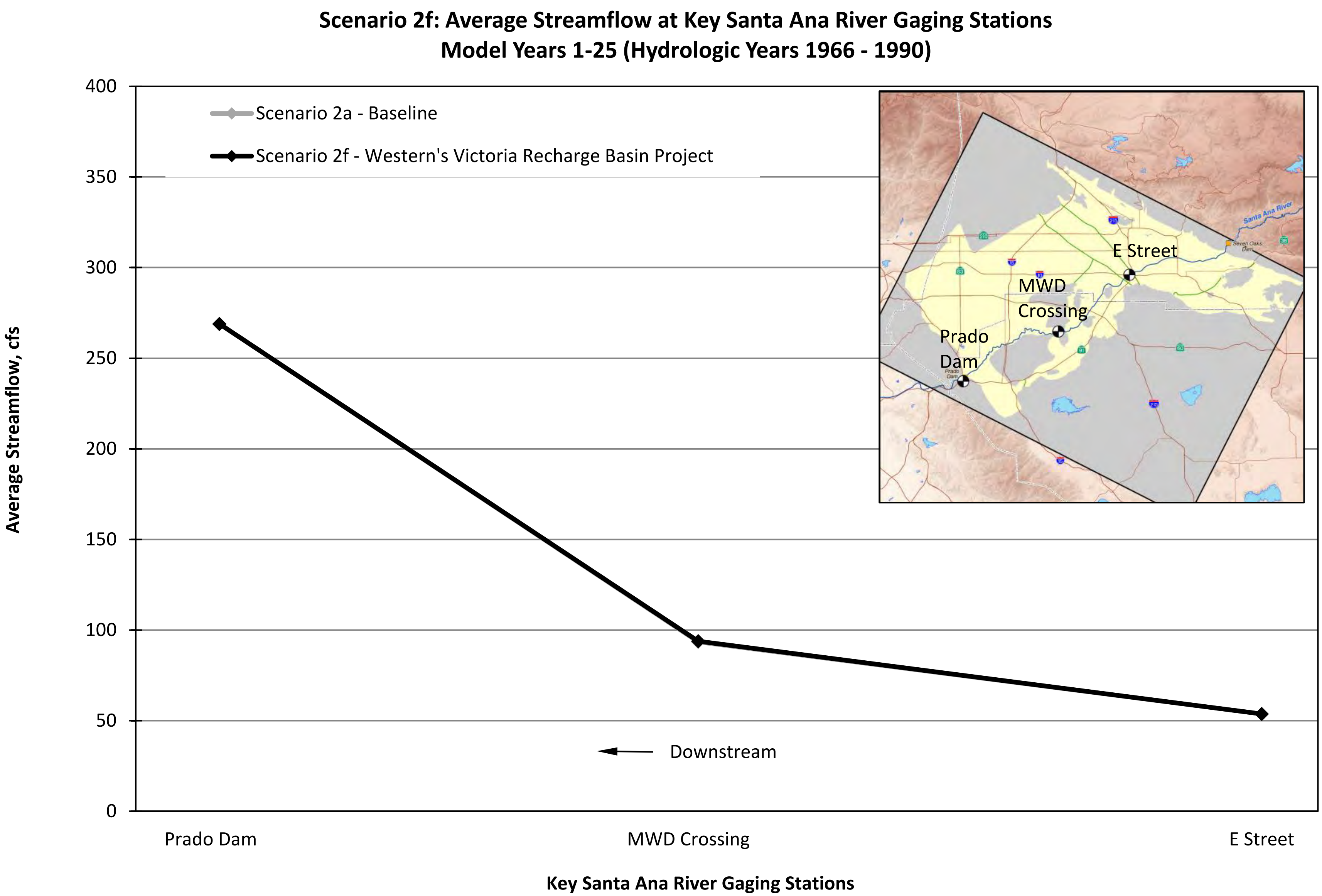

Scenario 2f: Average Streamflow at Key Santa Ana River Gaging Stations
Model Years 1-25 (Hydrologic Years 1966 - 1990)
Scenario 2a - Baseline
Scenario 2f - Western's Victoria Recharge Basin Project
Average Streamflow, cfs
400
350
300
250
200
150
100
50
0
E Street
MWD
Crossing
Prado
Dam
Downstream
Prado Dam
MWD Crossing
E Street
Key Santa Ana River Gaging Stations

Figure 769

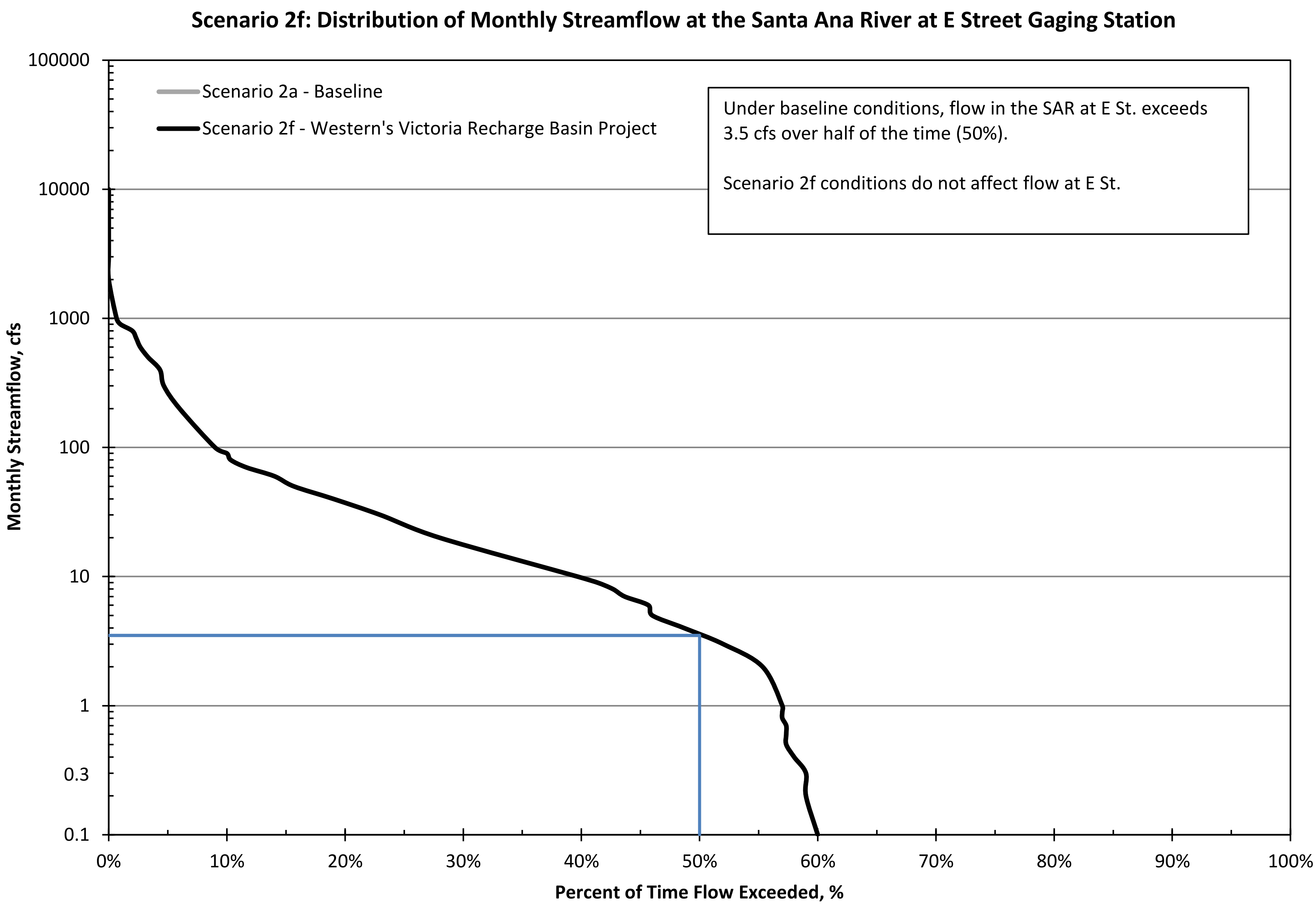

Scenario 2f: Distribution of Monthly Streamflow at the Santa Ana River at E Street Gaging Station
Scenario 2a - Baseline
Scenario 2f - Western's Victoria Recharge Basin Project
Under baseline conditions, flow in the SAR at E St. exceeds 3.5 cfs over half of the time (50%).
Scenario 2f conditions do not affect flow at E St.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.3
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 770

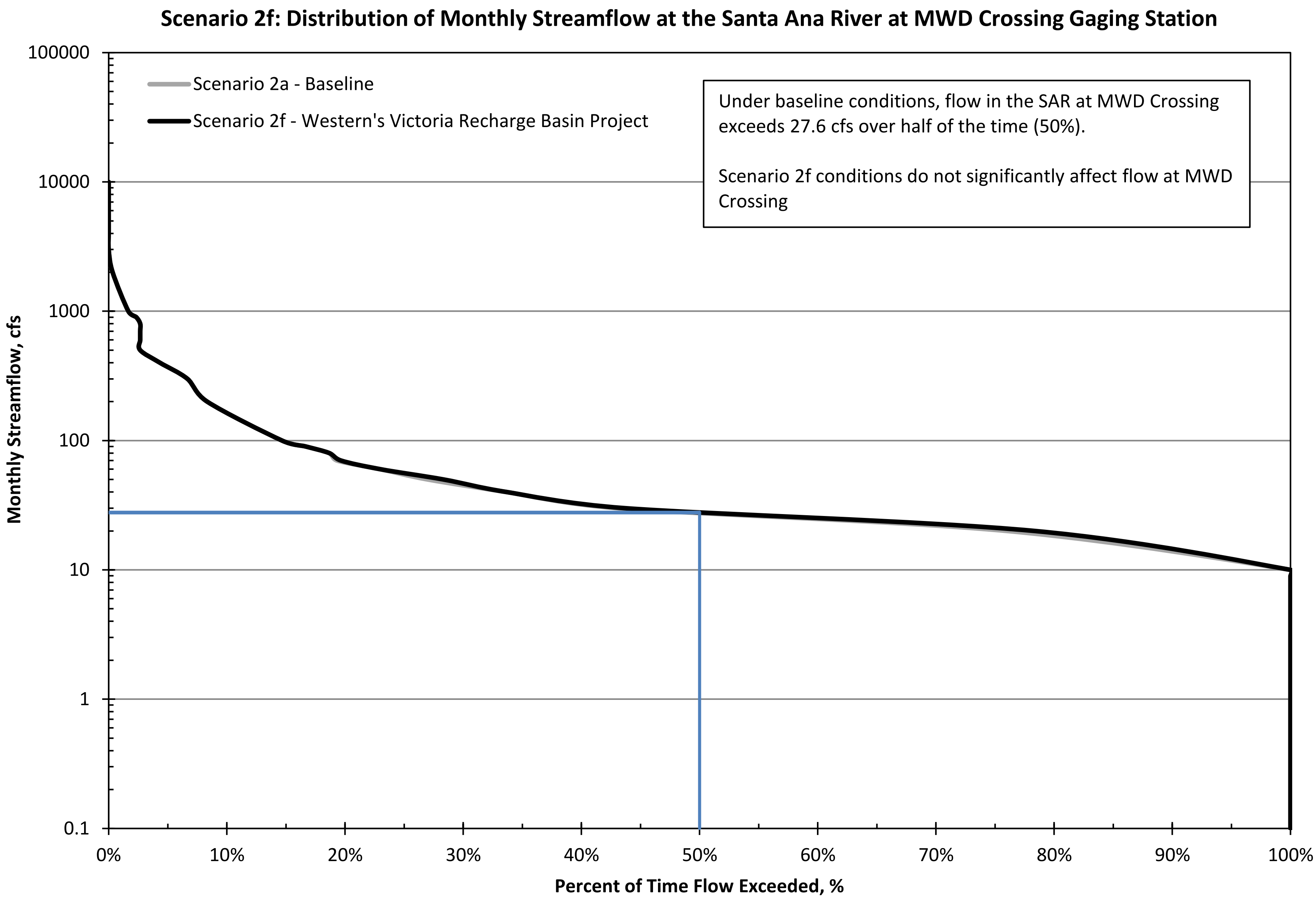

Scenario 2f: Distribution of Monthly Streamflow at the Santa Ana River at MWD Crossing Gaging Station
100000
10000
1000
100
10
1
0.1
Monthly Streamflow, cfs
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %
Scenario 2a - Baseline
Scenario 2f - Western's Victoria Recharge Basin Project
Under baseline conditions, flow in the SAR at MWD Crossing exceeds 27.6 cfs over half of the time (50%).
Scenario 2f conditions do not significantly affect flow at MWD Crossing

Figure 771

DRAFT

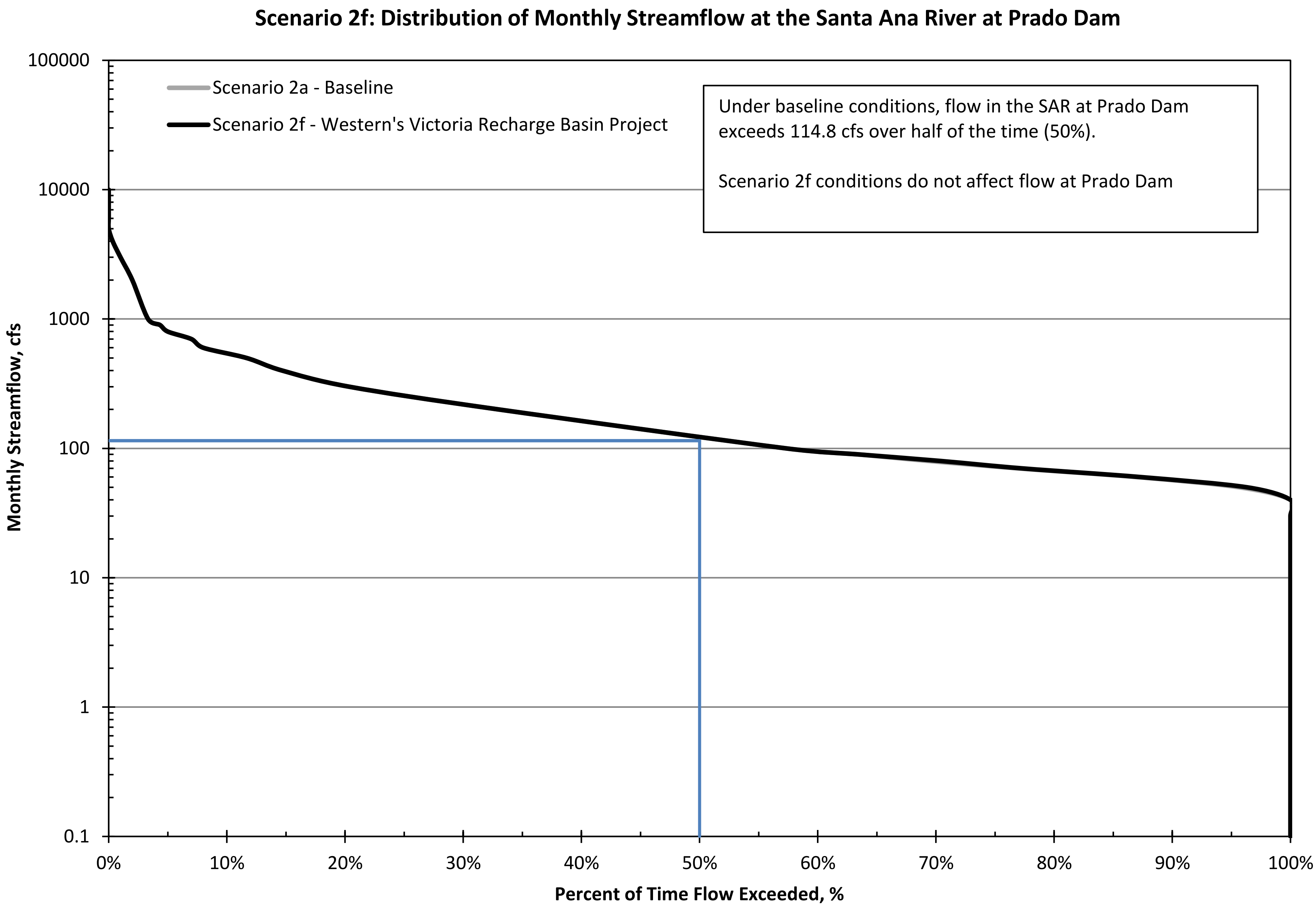
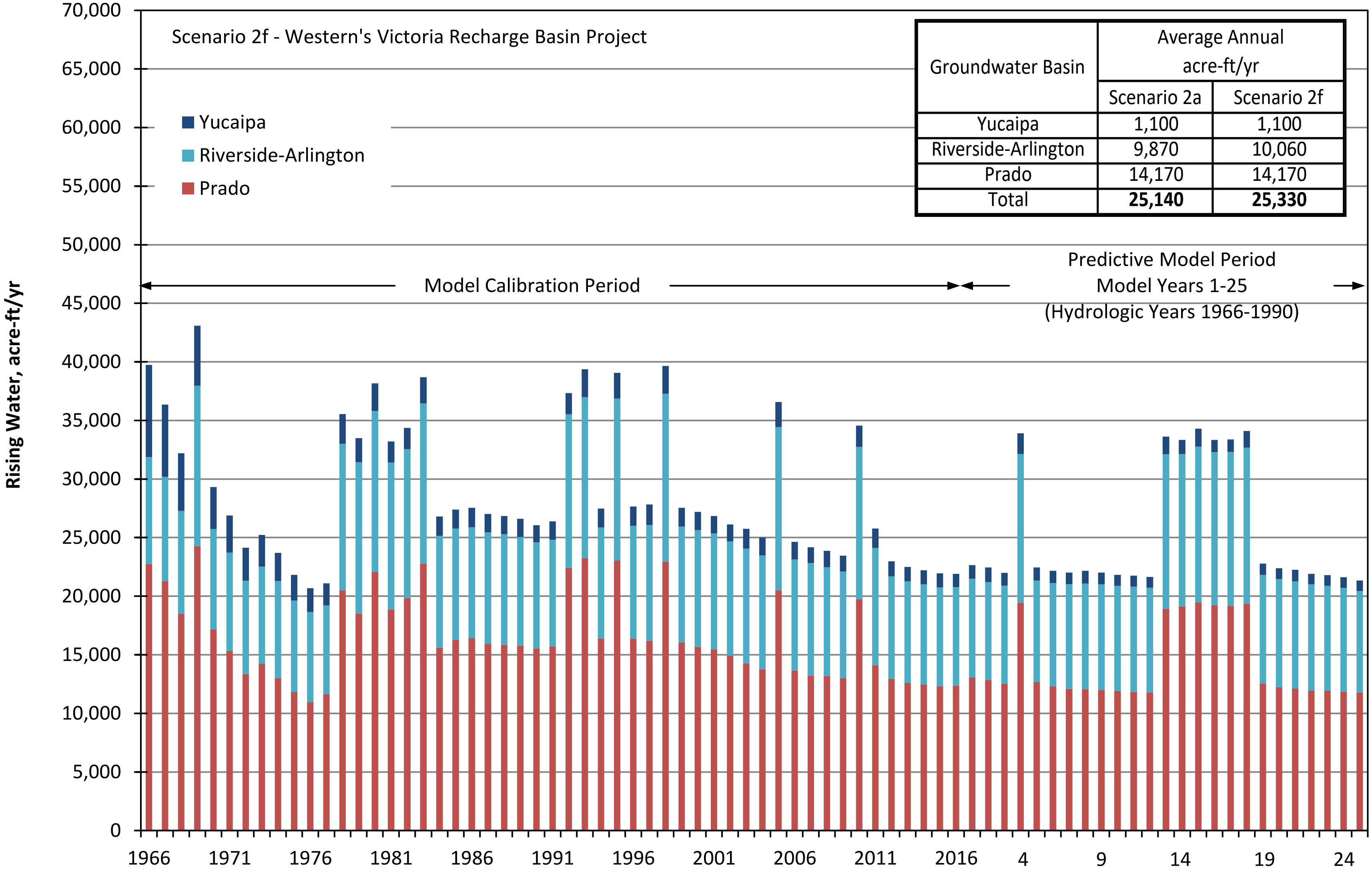


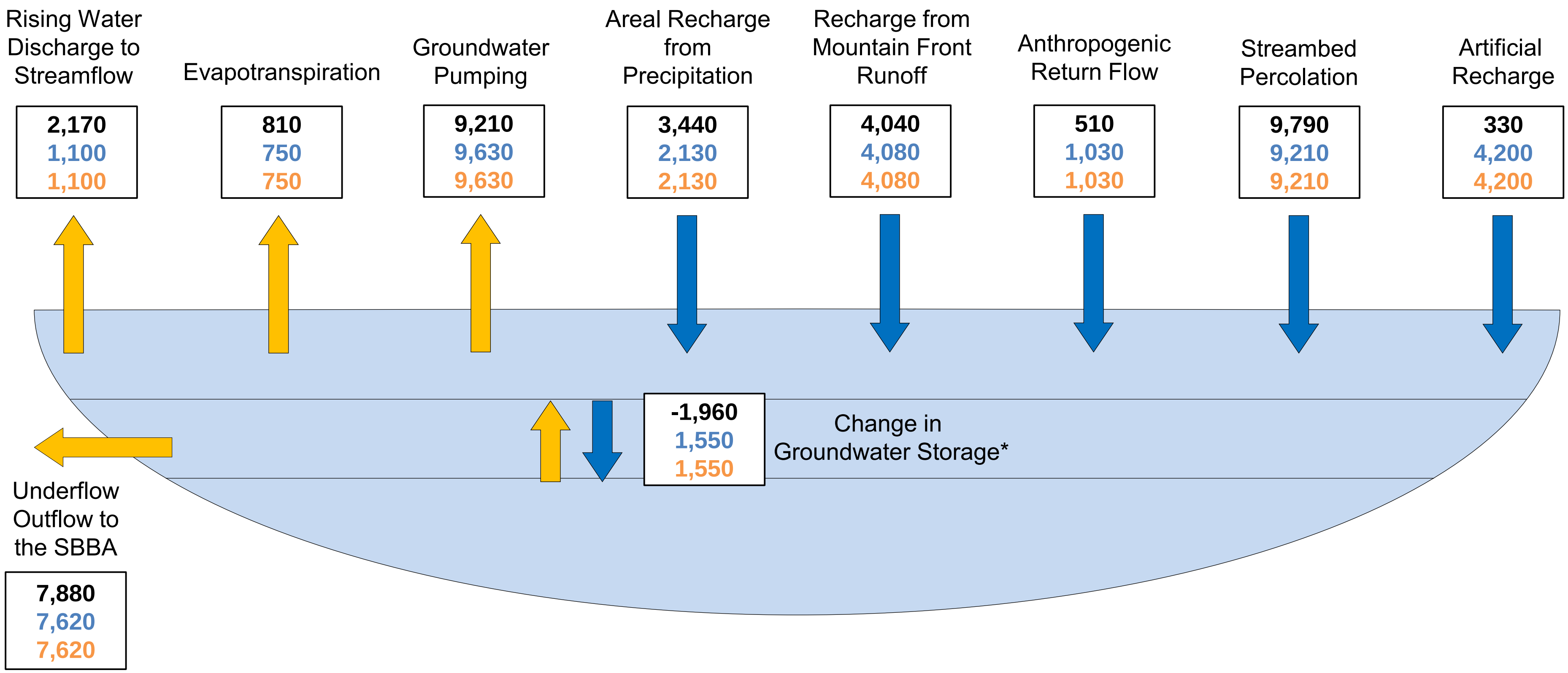
Figure 772

Scenario 2f: Annual Rising Water – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2f
Yucaipa	1,100	1,100
Riverside-Arlington	9,870	10,060
Prado	14,170	14,170
Total	**25,140**	**25,330**

Figure 773



Scenario 2a - Baseline
Scenario 2f - Western's Victoria Recharge Basin Project

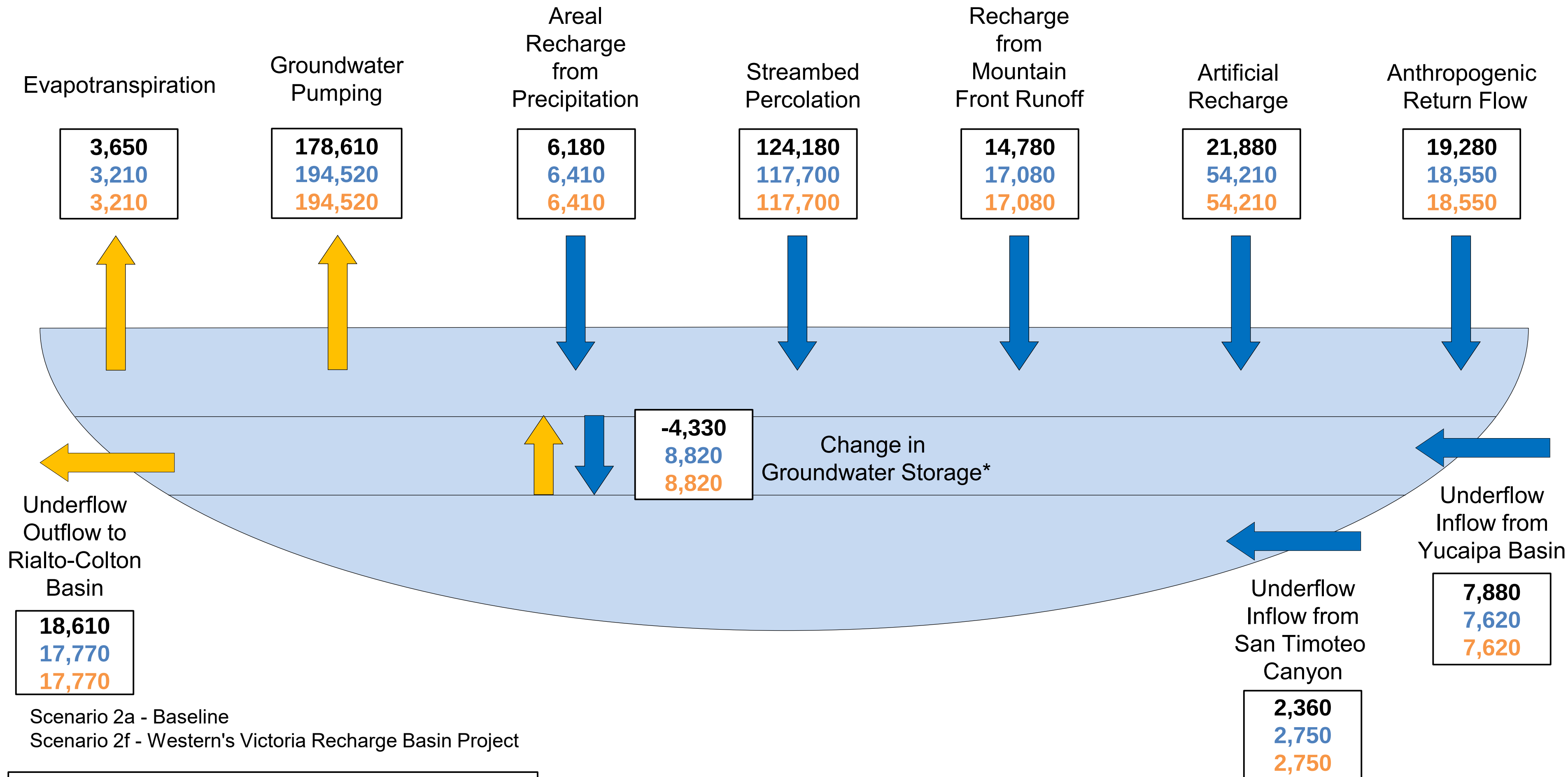
Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2f (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2F
AVERAGE ANNUAL
WATER BUDGET
YUCAIPA BASIN

10-Apr-20



Scenario 2a - Baseline
Scenario 2f - Western's Victoria Recharge Basin Project

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2f (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2F AVERAGE ANNUAL WATER BUDGET SBBA

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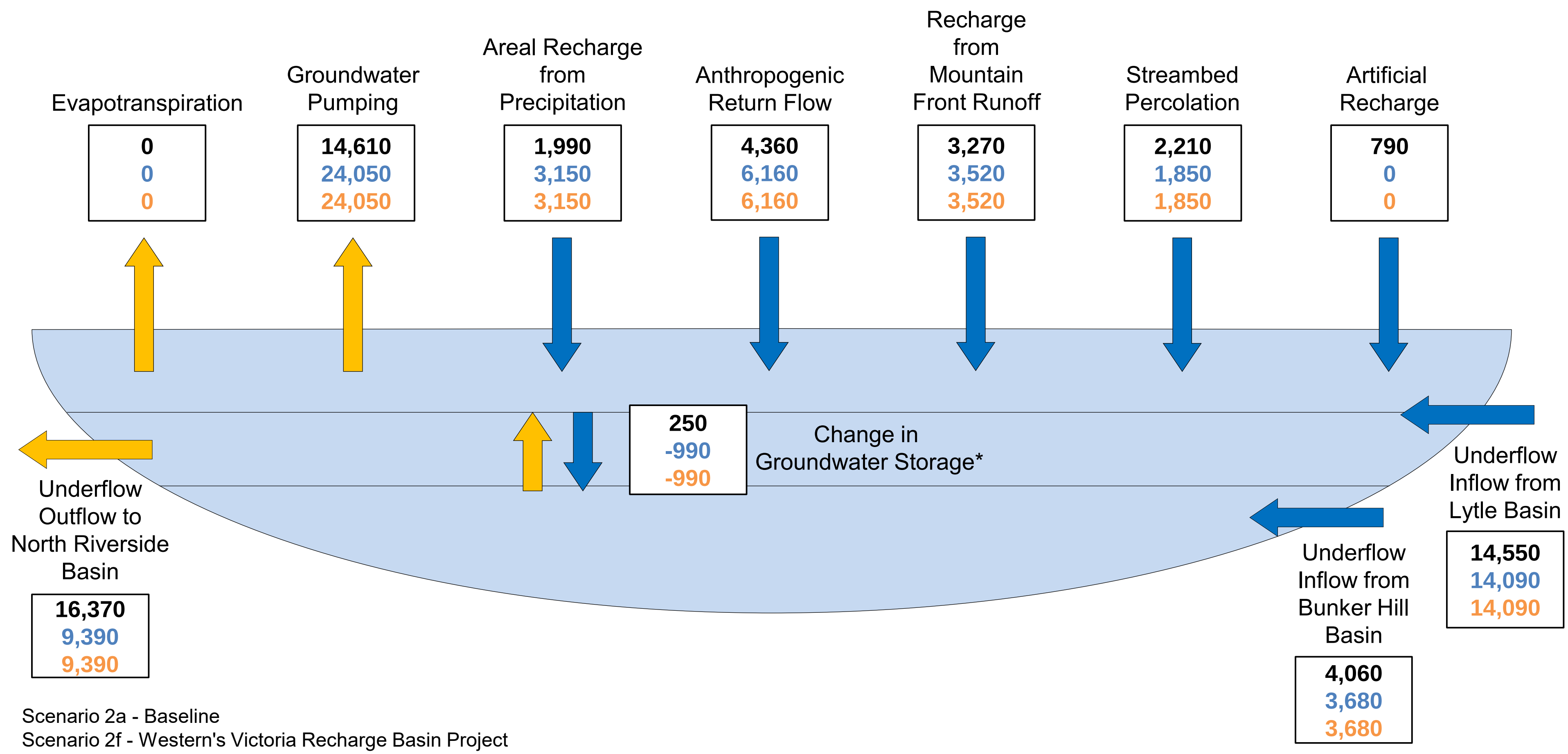

Scenario 2a - Baseline
Scenario 2f - Western's Victoria Recharge Basin Project

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2f (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2F
AVERAGE ANNUAL
WATER BUDGET
RIALTO-COLTON BASIN

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT **DRAFT** **FIGURE 776**
UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

GEOSCIENCE

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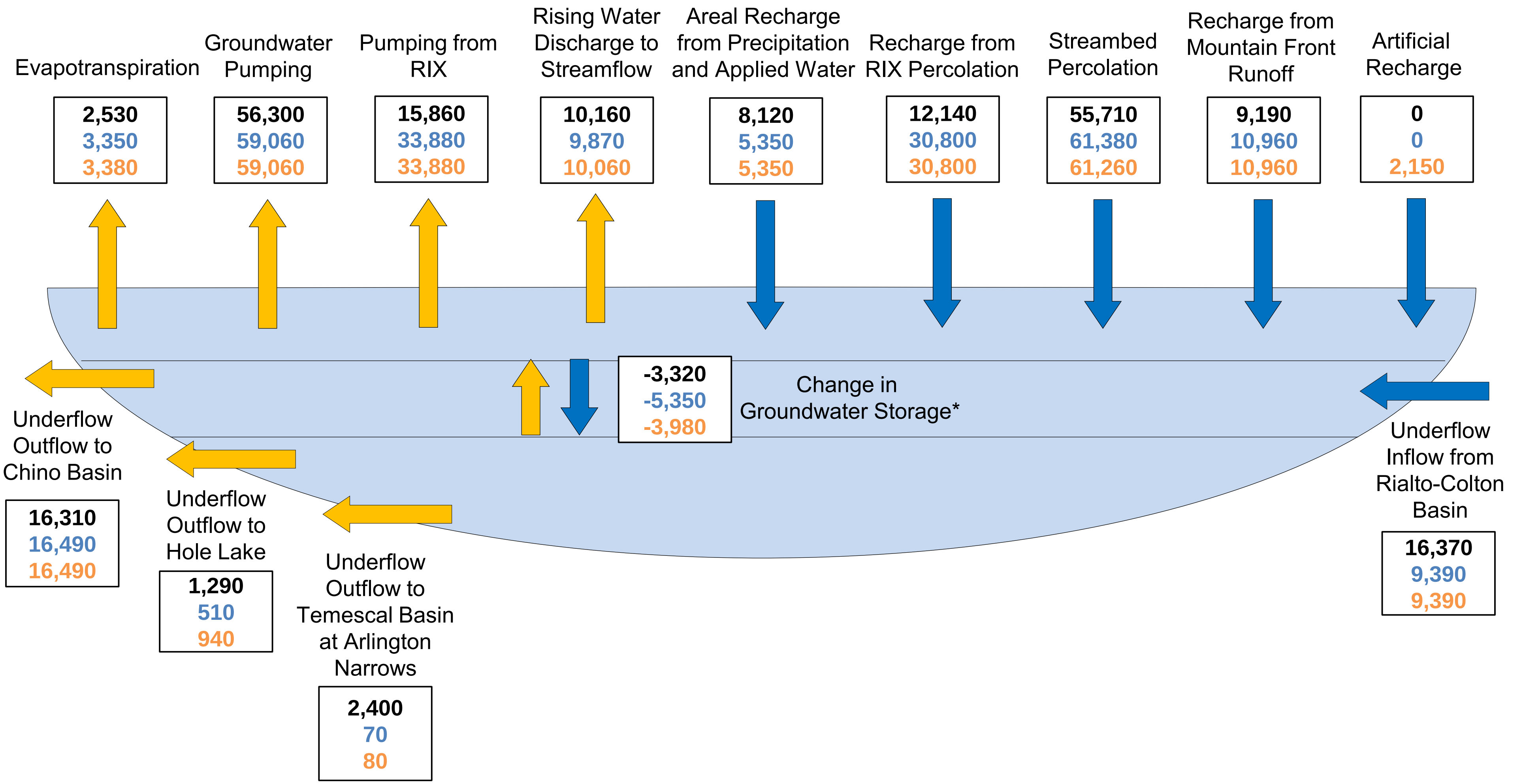


Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2f (Hydrologic Period 1966-1990)

Scenario 2a - Baseline
Scenario 2f - Western's Victoria Recharge Basin Project

All values in acre-ft/yr

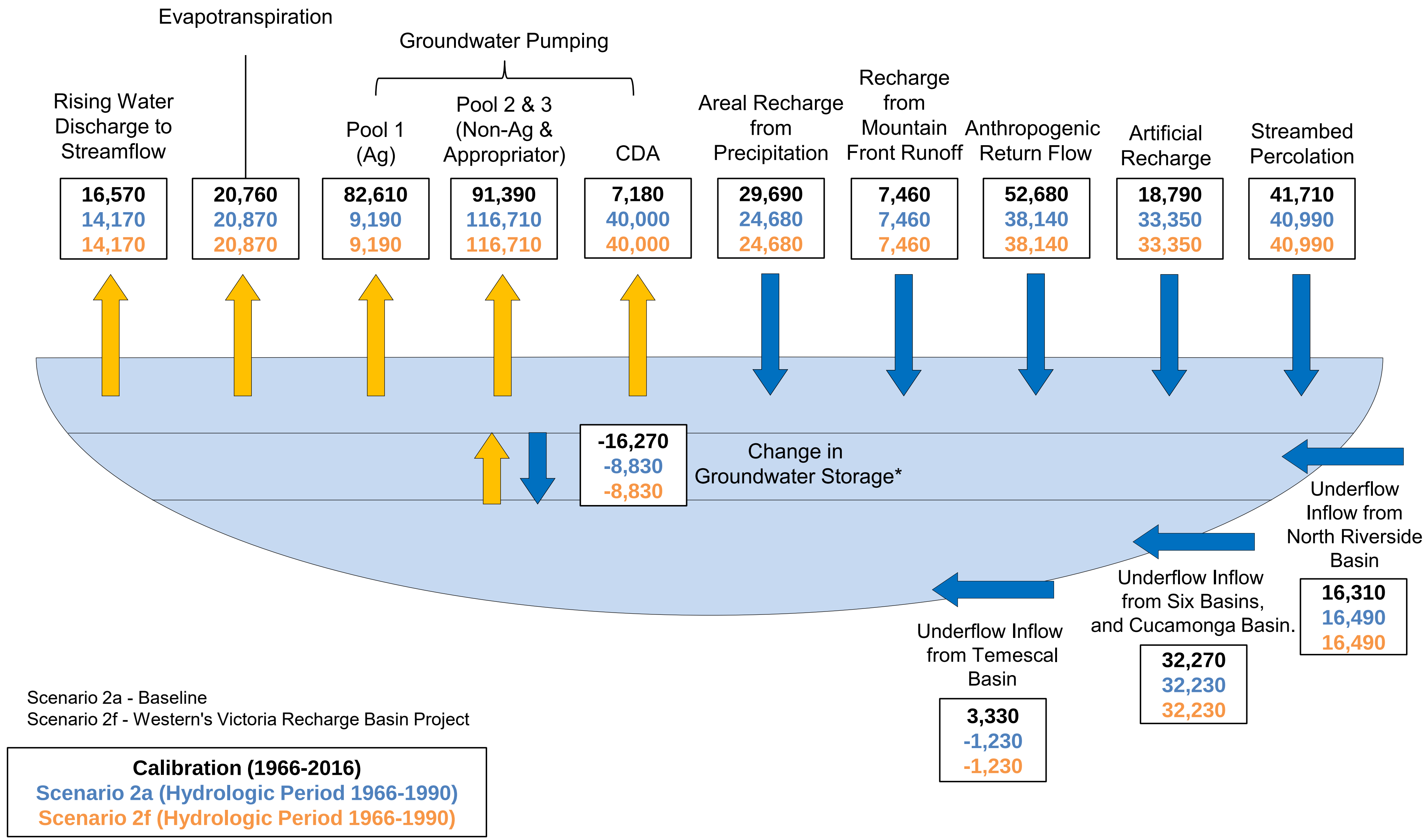
*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2F
AVERAGE ANNUAL
WATER BUDGET
RIVERSIDE-ARLINGTON BASIN

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT **DRAFT** **FIGURE 777**
UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

GEOSCIENCE



All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2F AVERAGE ANNUAL WATER BUDGET CHINO BASIN

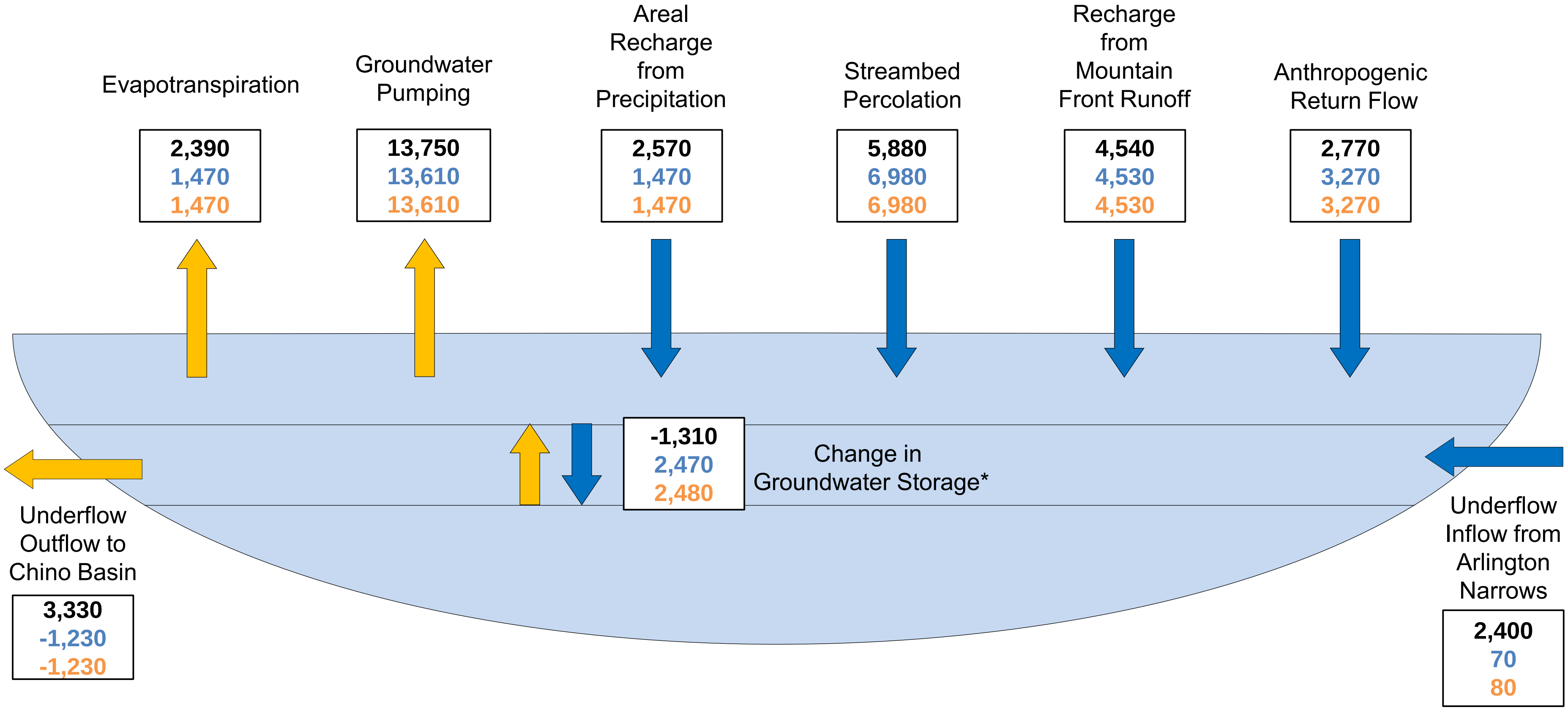
10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT | **DRAFT** | **FIGURE 778**

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

GEOSCIENCE

X:\Projects\San_Bernardino_MUNI\31) Integreated_SAR_Model\(4)Technical_Memos\(8) Summary Report\Draft\Figures\Scenarios



Scenario 2a - Baseline
Scenario 2f - Western's Victoria Recharge Basin Project

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2f (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2F
AVERAGE ANNUAL
WATER BUDGET
TEMESCAL BASIN

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

DRAFT

FIGURE 779

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

GEOSCIENCE

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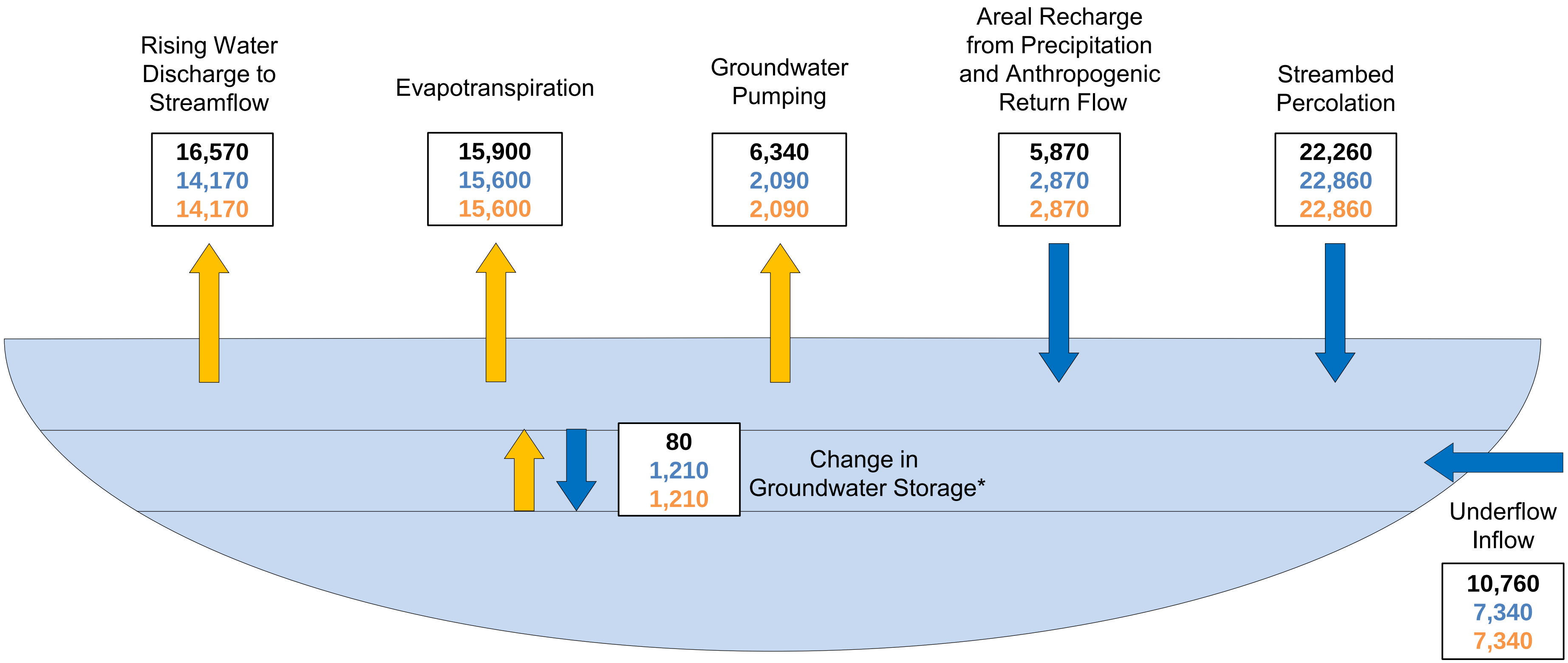


Scenario 2a - Baseline
Scenario 2f - Western's Victoria Recharge Basin Project

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2f (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2F AVERAGE ANNUAL WATER BUDGET PRADO BASIN

10-Apr-20

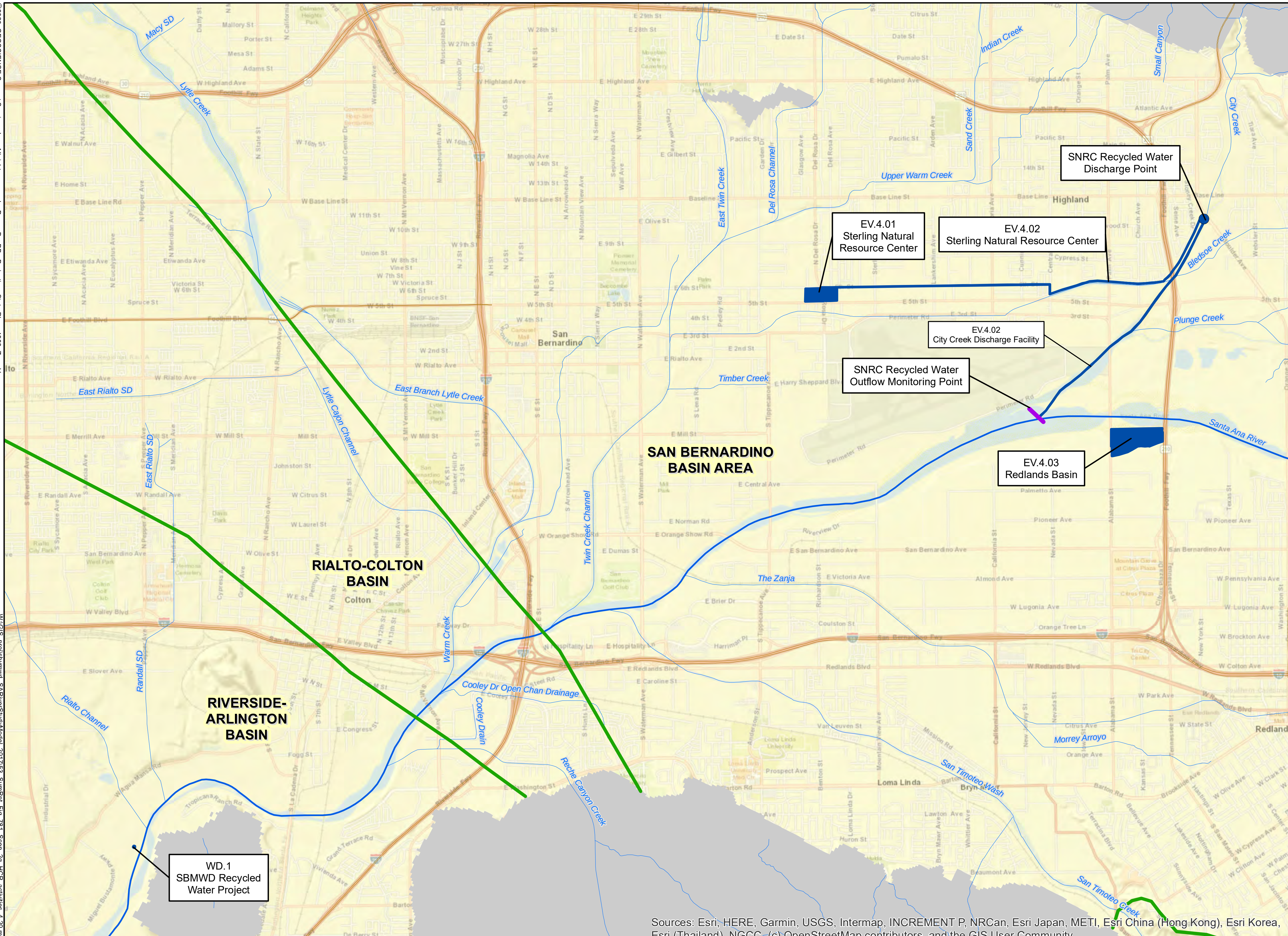
SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

DRAFT

FIGURE 780

GEOSCIENCE



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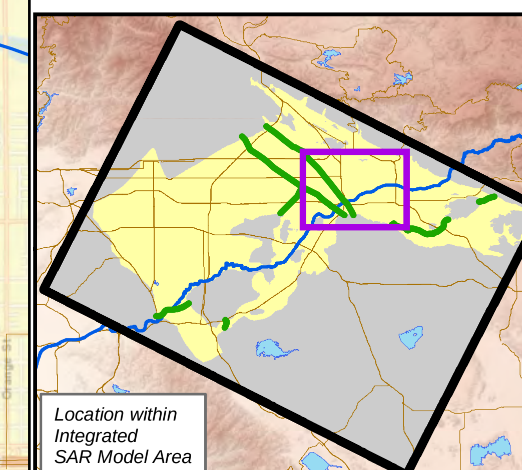
EXPLANATION

- Integrated SAR Model Boundary
- Active Model Area
- Inactive Model Area
- Habitat Conservation Plan (HCP) Covered Activity
  - EV.4.01 - Project ID
  - Sterling NRC - Name of HCP Project
- Groundwater Basin Boundary

Refer to Table 17 for HCP Covered Activity Description

Scenario 2g:
Clean Water Factory – 5 MGD from Clean Water Factory to Redlands Basins (CWF + SNRC)



N

0 4,000 8,000
Feet

SCENARIO 2g
LOCATION OF
HCP COVERED ACTIVITIES

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

DRAFT

FIGURE 781

GEOSCIENCE

DRAFT

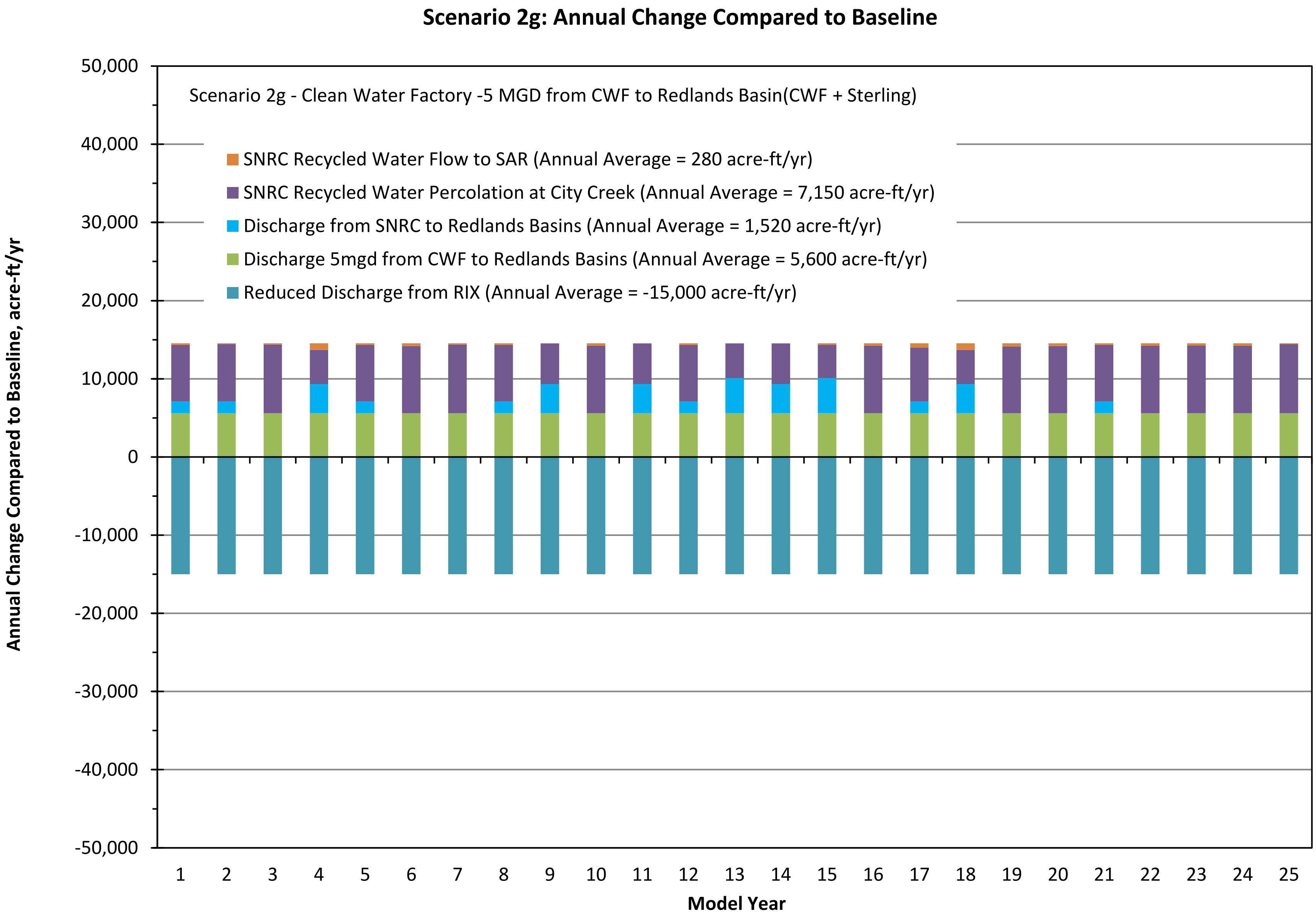
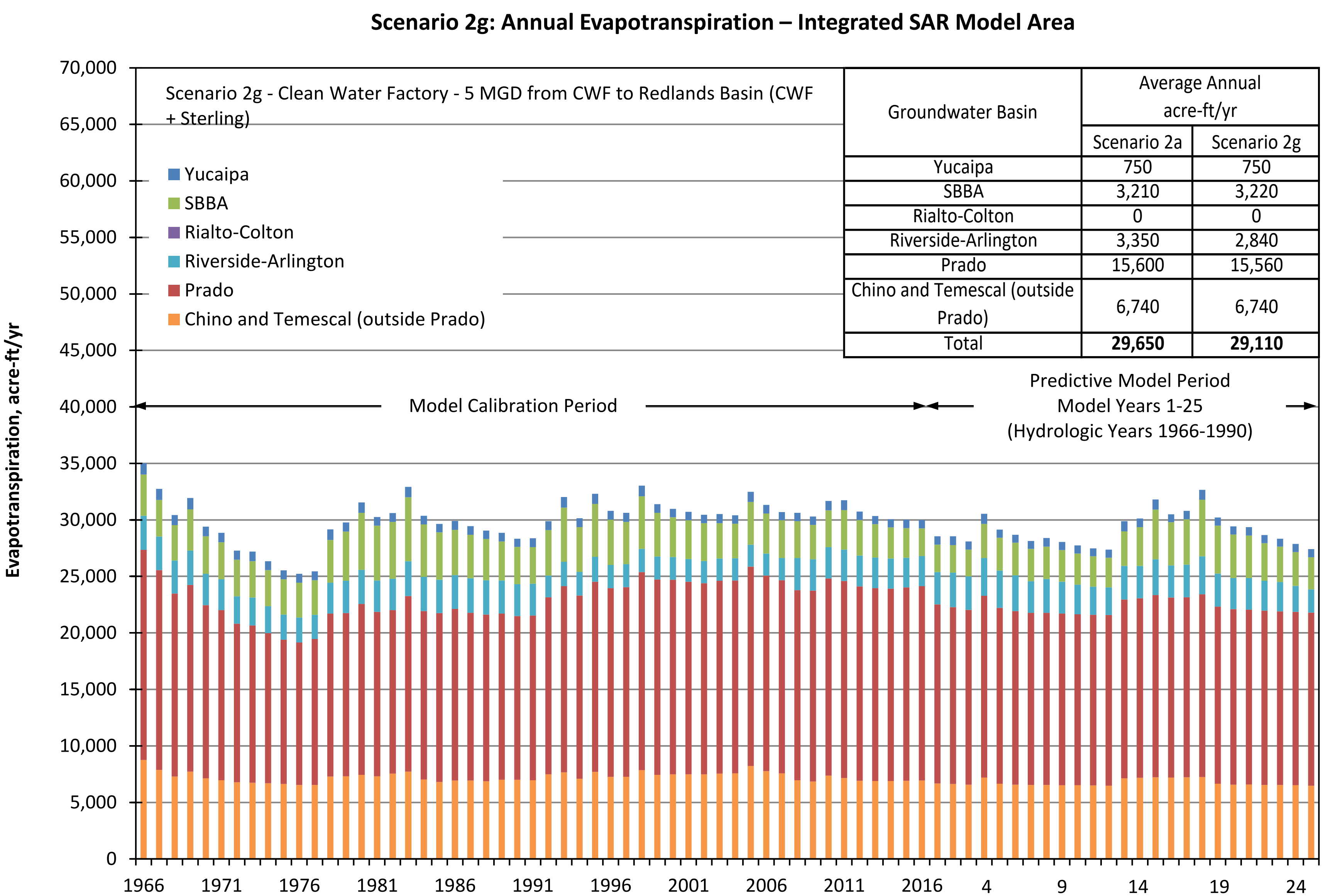


Figure 782



Groundwater Basin	Average Annual acre-ft/yr Scenario 2a	Average Annual acre-ft/yr Scenario 2g
Yucaipa	750	750
SBBA	3,210	3,220
Rialto-Colton	0	0
Riverside-Arlington	3,350	2,840
Prado	15,600	15,560
Chino and Temescal (outside Prado)	6,740	6,740
Total	**29,650**	**29,110**

Figure 783

Scenario 2g: Annual Change in Evapotranspiration – Integrated SAR Model Area

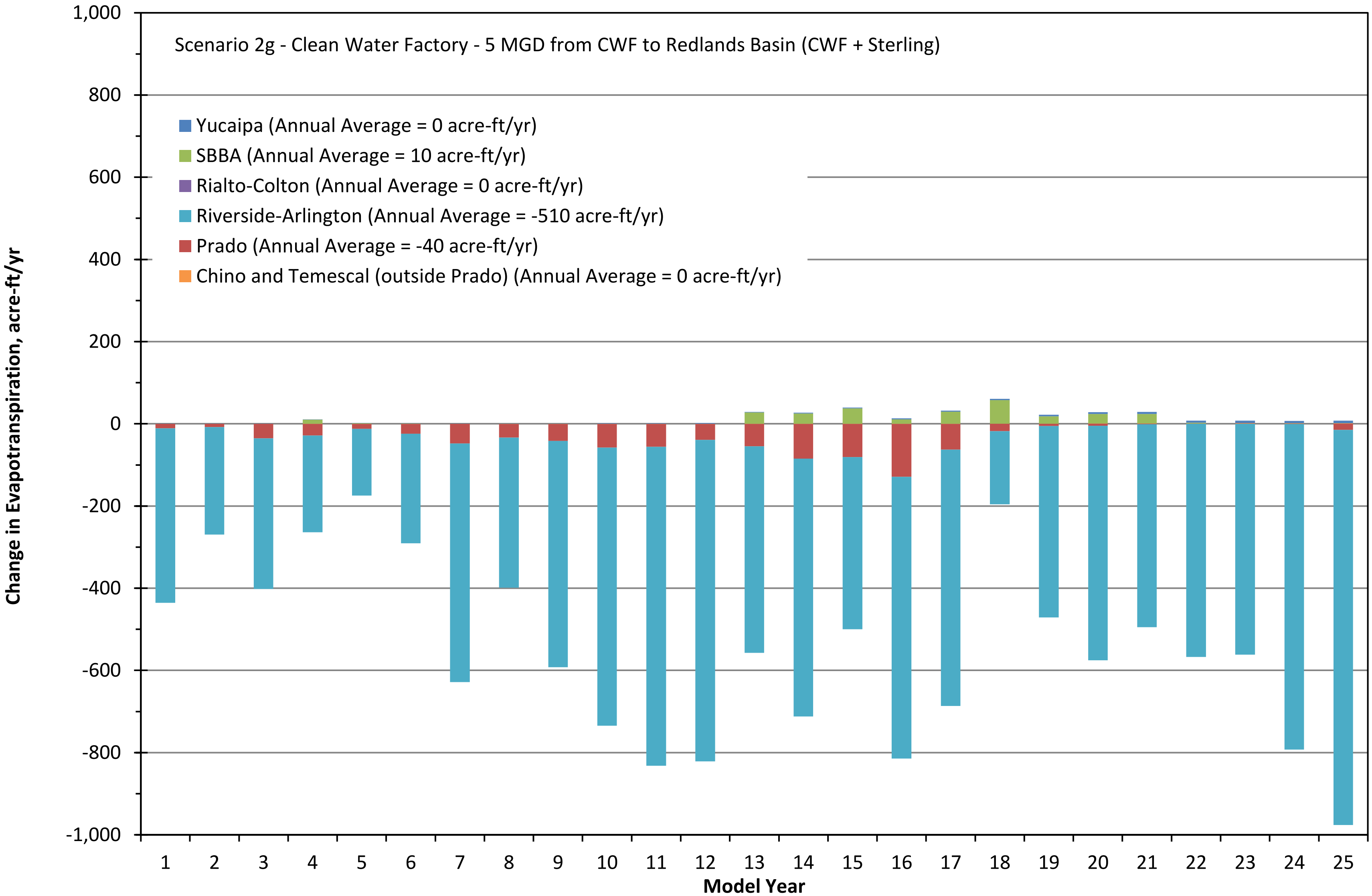
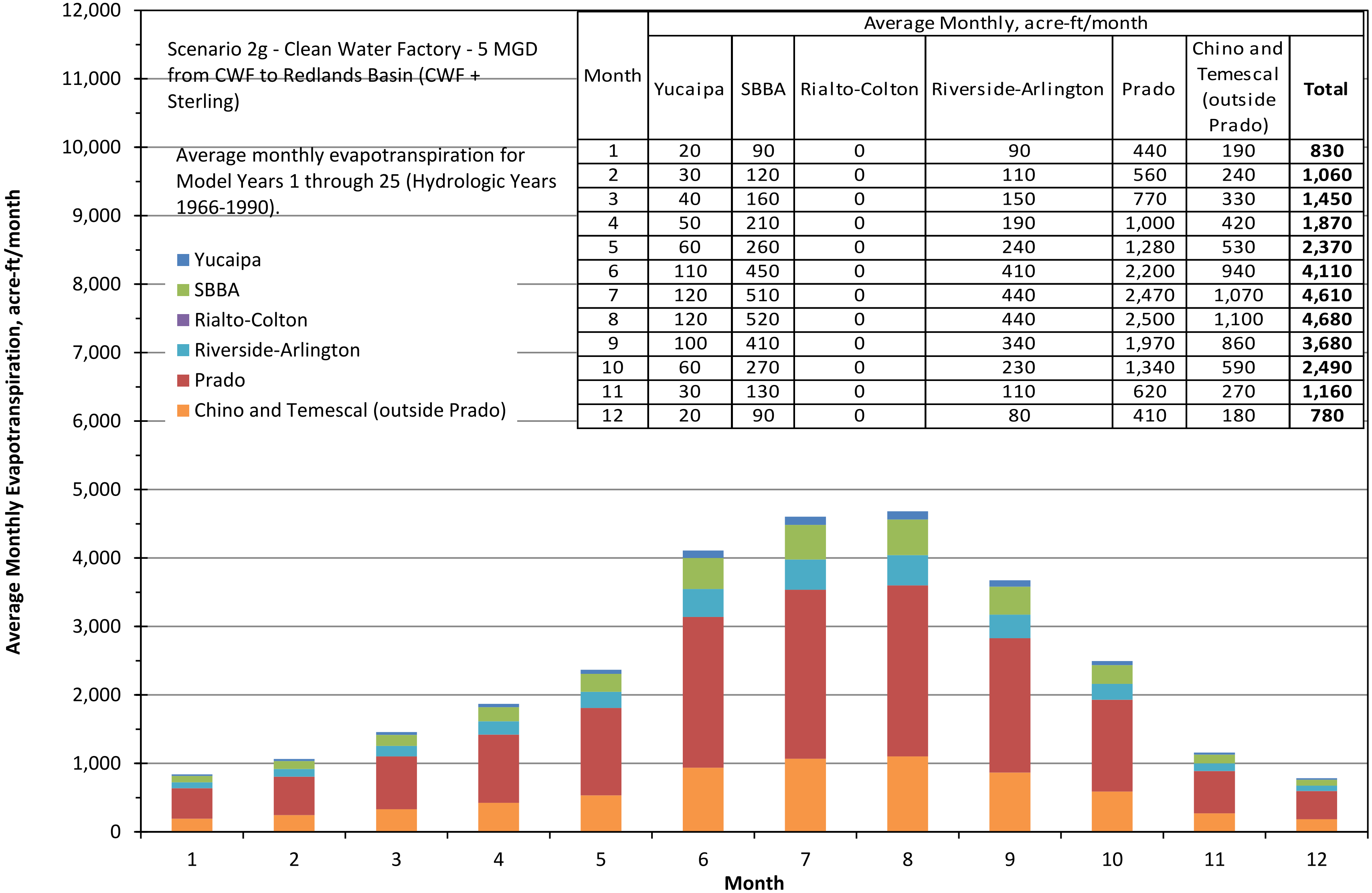


Figure 784

Scenario 2g: Seasonal Evapotranspiration – Integrated SAR Model Area

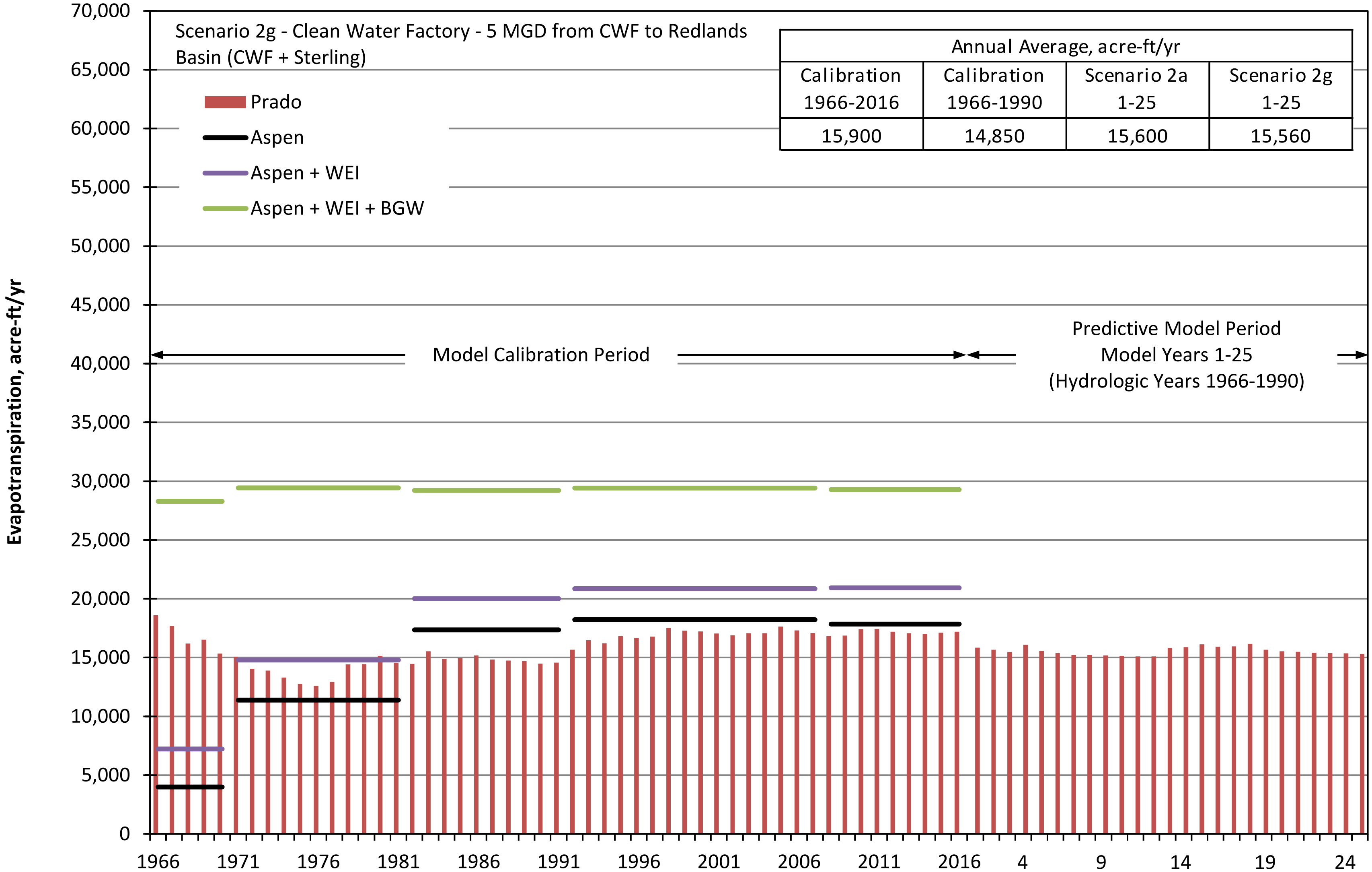


Month	Average Monthly, acre-ft/month						
	Yucaipa	SBBA	Rialto-Colton	Riverside-Arlington	Prado	Chino and Temescal (outside Prado)	**Total**
1	20	90	0	90	440	190	**830**
2	30	120	0	110	560	240	**1,060**
3	40	160	0	150	770	330	**1,450**
4	50	210	0	190	1,000	420	**1,870**
5	60	260	0	240	1,280	530	**2,370**
6	110	450	0	410	2,200	940	**4,110**
7	120	510	0	440	2,470	1,070	**4,610**
8	120	520	0	440	2,500	1,100	**4,680**
9	100	410	0	340	1,970	860	**3,680**
10	60	270	0	230	1,340	590	**2,490**
11	30	130	0	110	620	270	**1,160**
12	20	90	0	80	410	180	**780**

Figure 785

DRAFT

Scenario 2g: Annual Evapotranspiration – Prado Basin



Annual Average, acre-ft/yr			
Calibration 1966-2016	Calibration 1966-1990	Scenario 2a 1-25	Scenario 2g 1-25
15,900	14,850	15,600	15,560

Figure 786

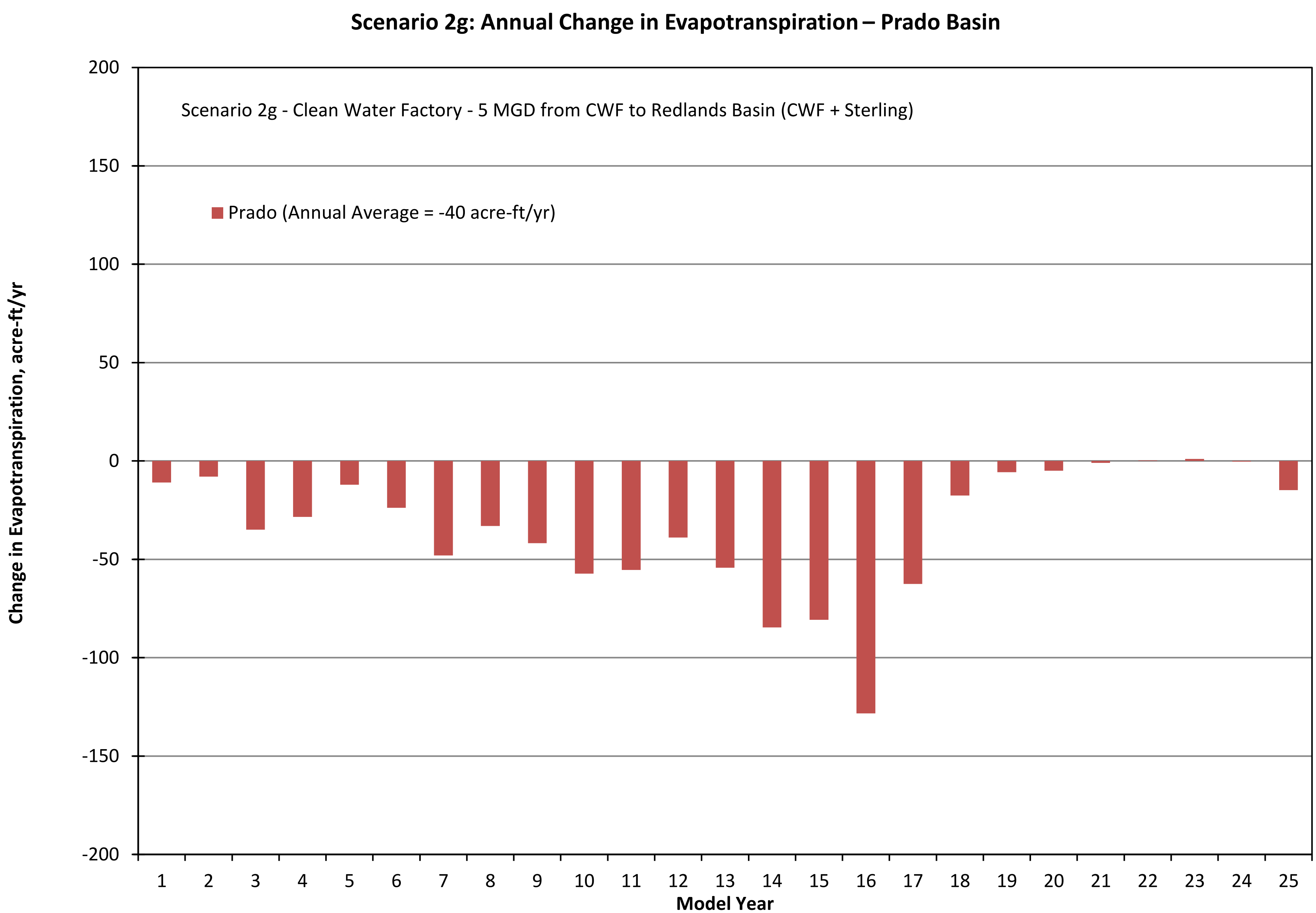
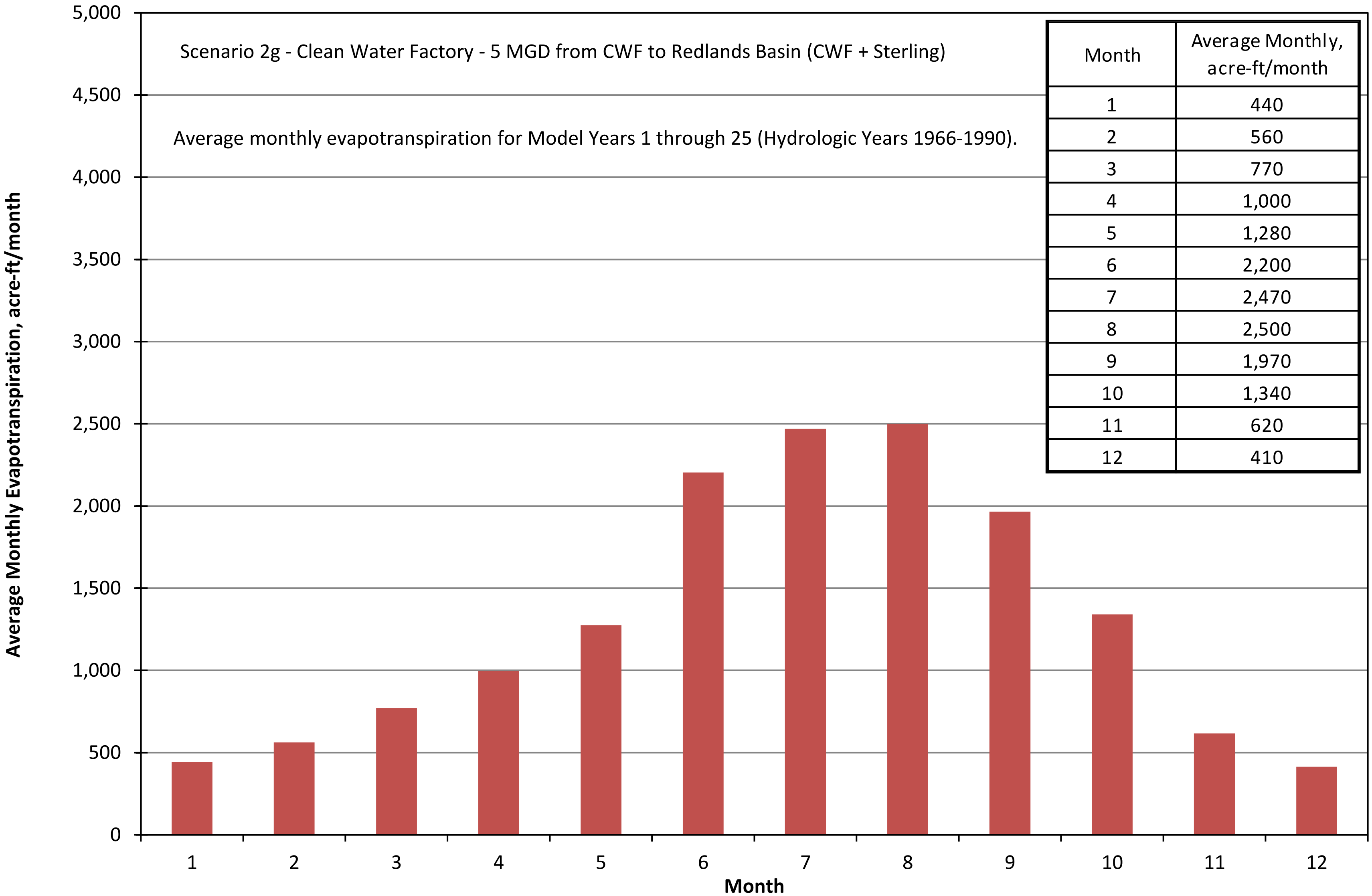

Scenario 2g: Annual Change in Evapotranspiration – Prado Basin
Scenario 2g - Clean Water Factory - 5 MGD from CWF to Redlands Basin (CWF + Sterling)
Prado (Annual Average = -40 acre-ft/yr)
Change in Evapotranspiration, acre-ft/yr
200
150
100
50
0
-50
-100
-150
-200
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
Model Year

Figure 787

Scenario 2g: Seasonal Evapotranspiration – Prado Basin



Month	Average Monthly, acre-ft/month
1	440
2	560
3	770
4	1,000
5	1,280
6	2,200
7	2,470
8	2,500
9	1,970
10	1,340
11	620
12	410

Figure 788

Scenario 2g: Average Streamflow at Key Santa Ana River Gaging Stations
Model Years 1-25 (Hydrologic Years 1966 - 1990)

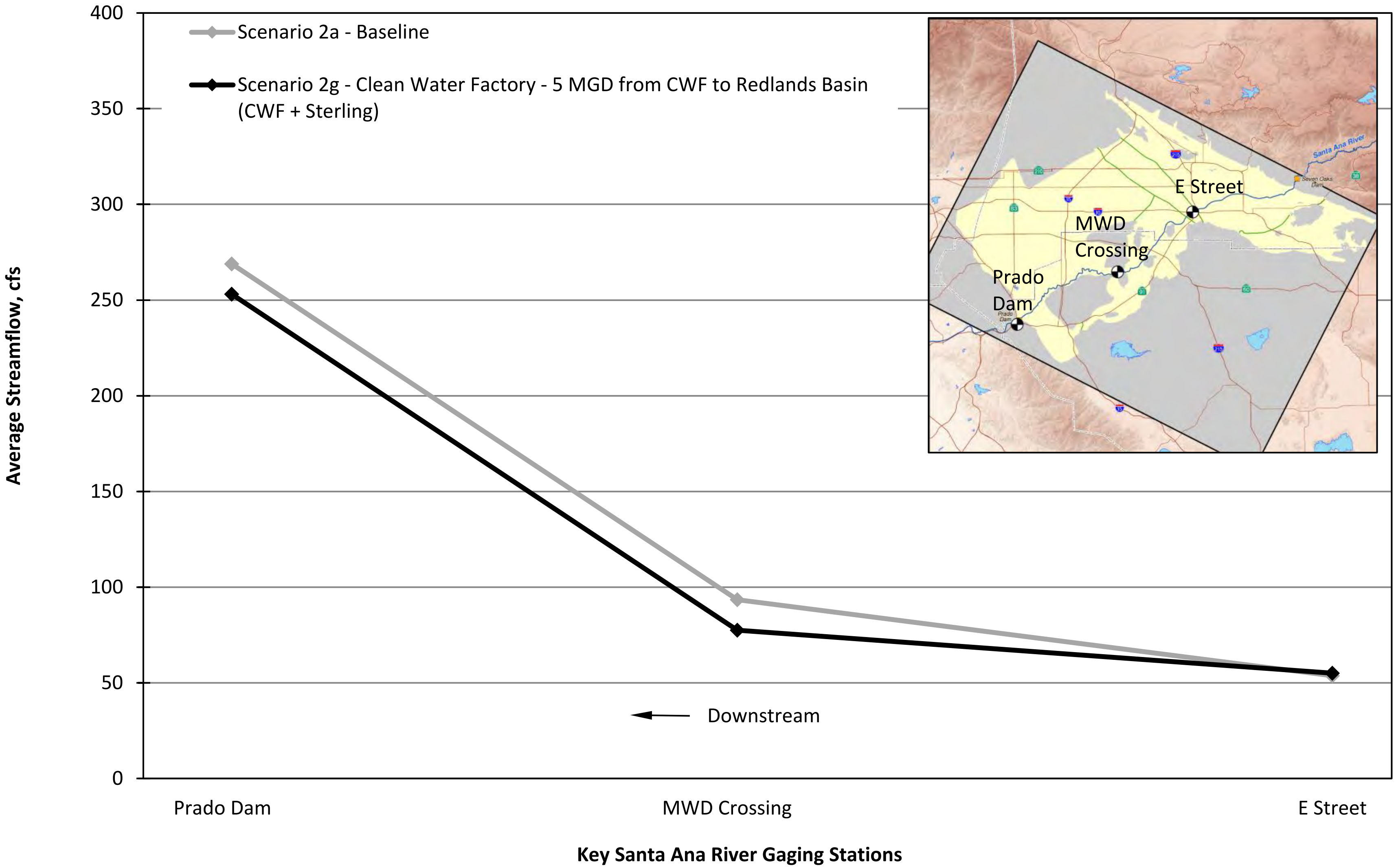


Figure 789

DRAFT

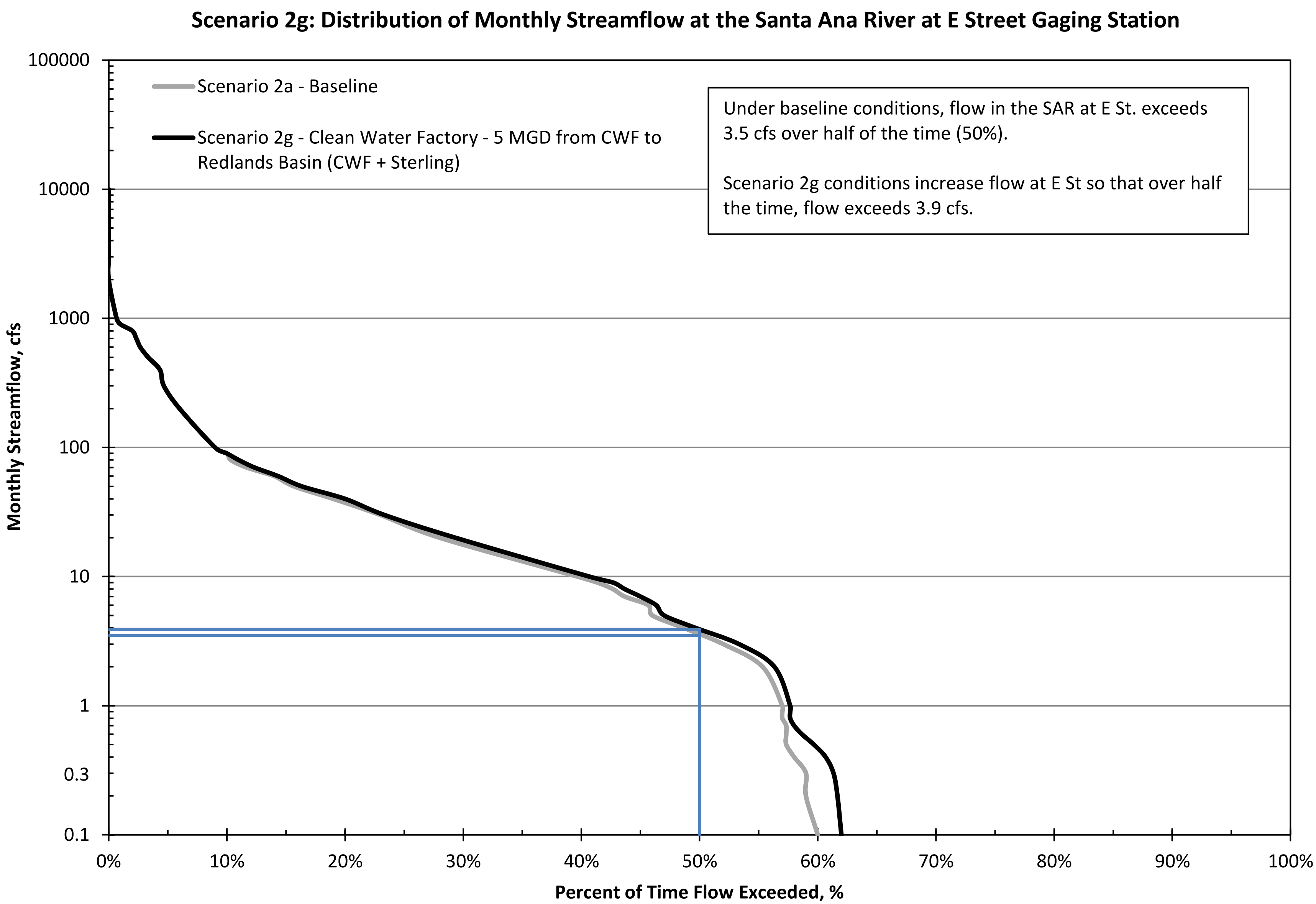


Figure 790

DRAFT

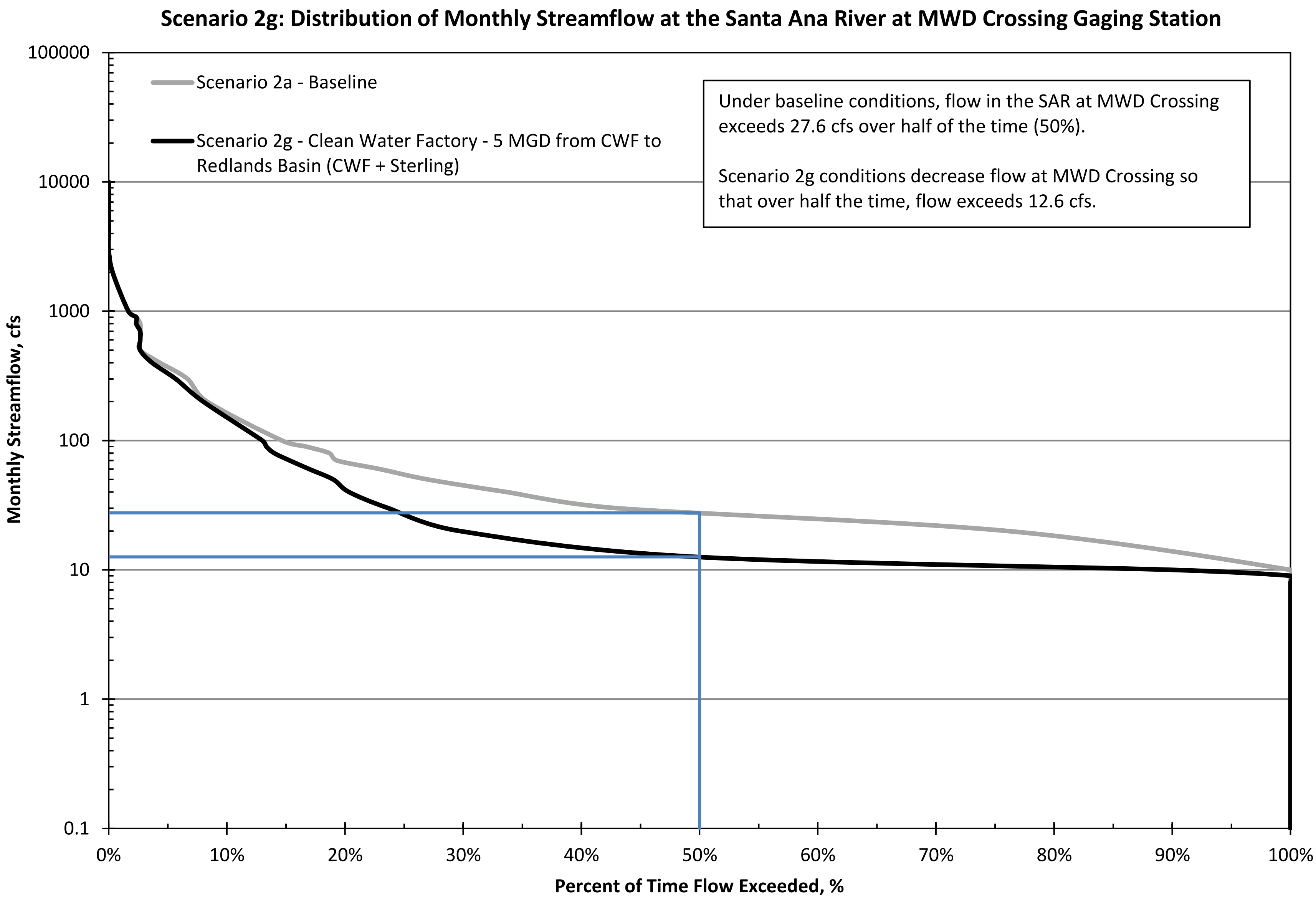


Figure 791

DRAFT

Scenario 2g: Distribution of Monthly Streamflow at the Santa Ana River at Prado Dam

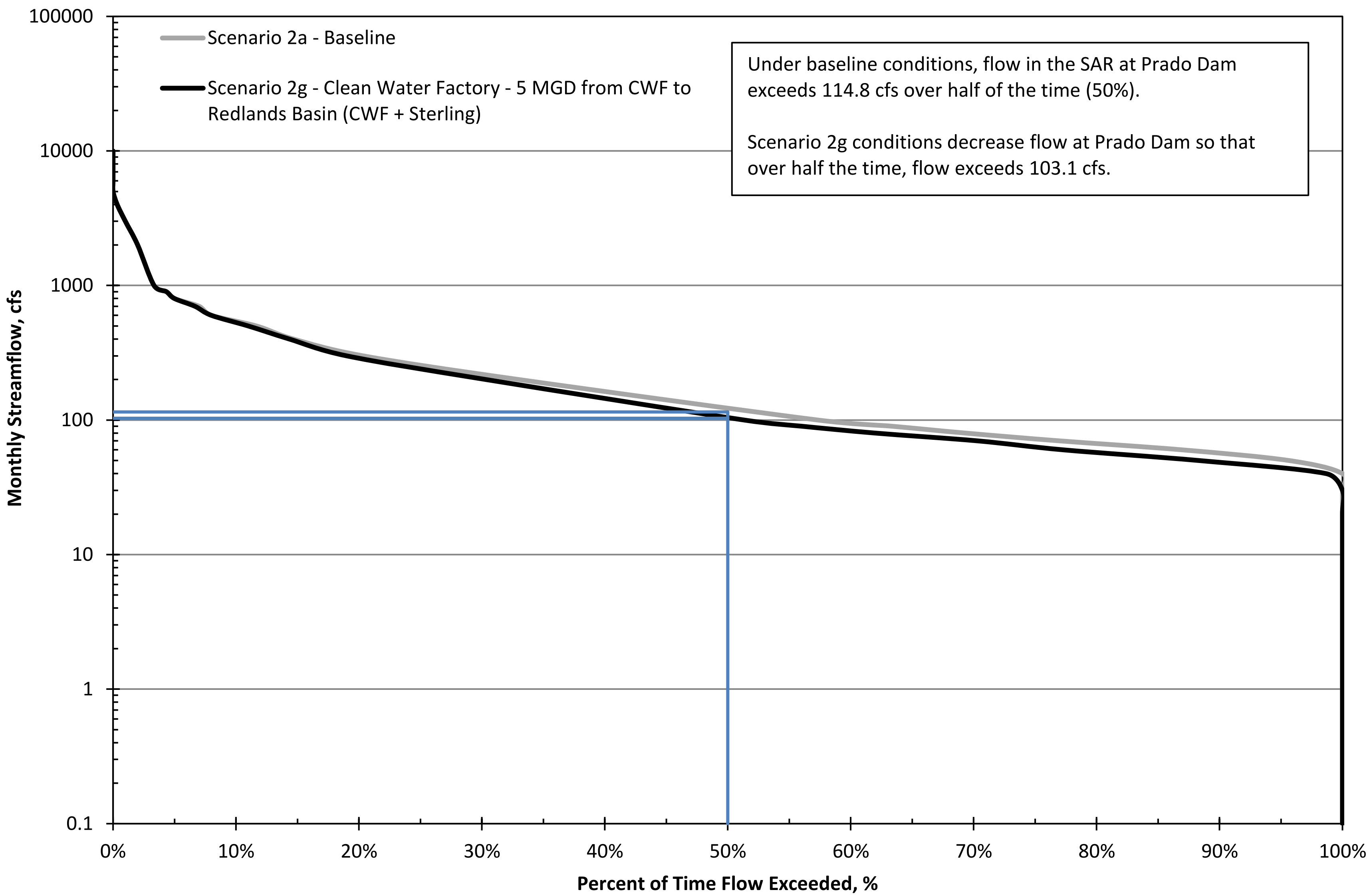
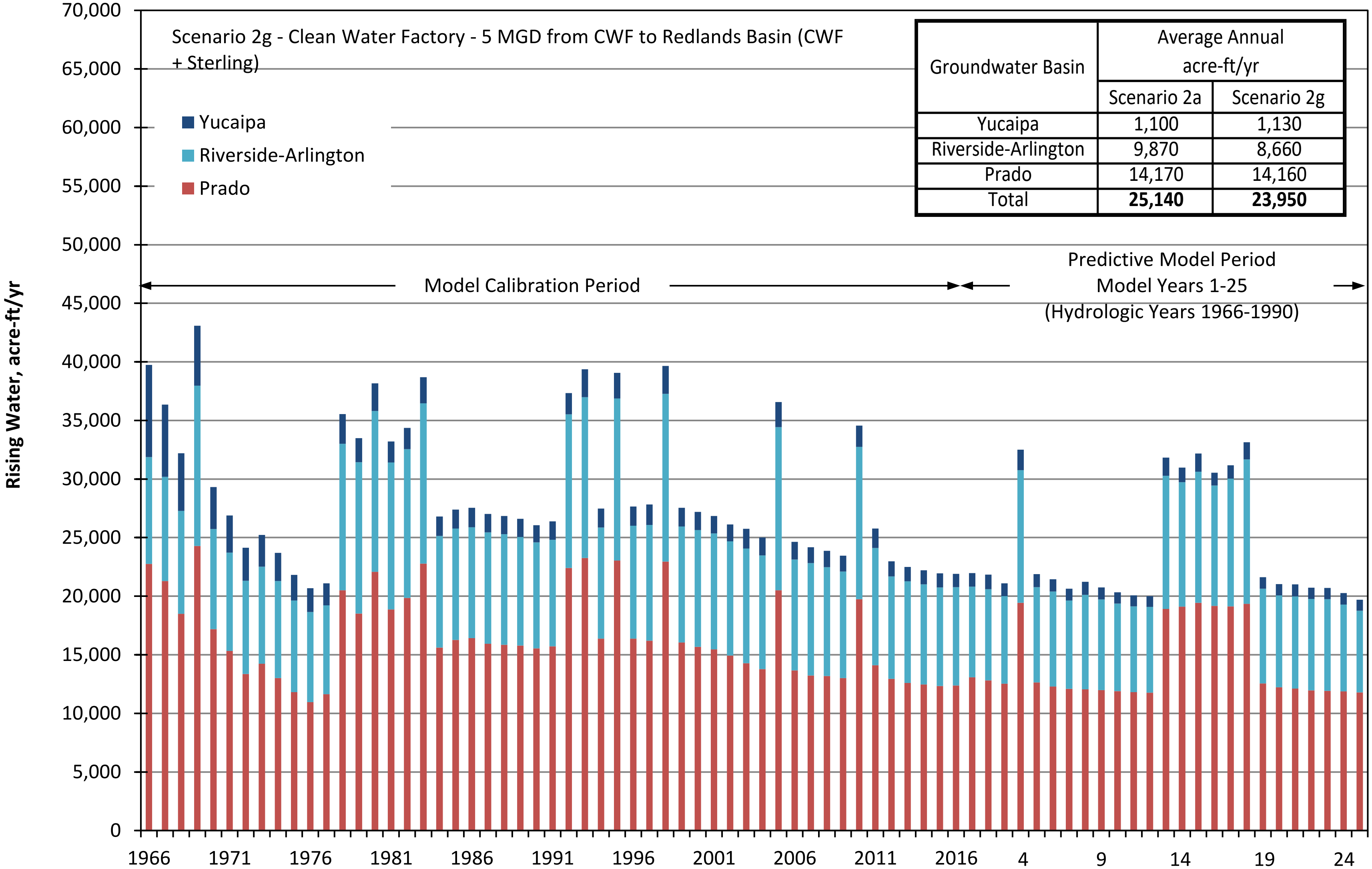


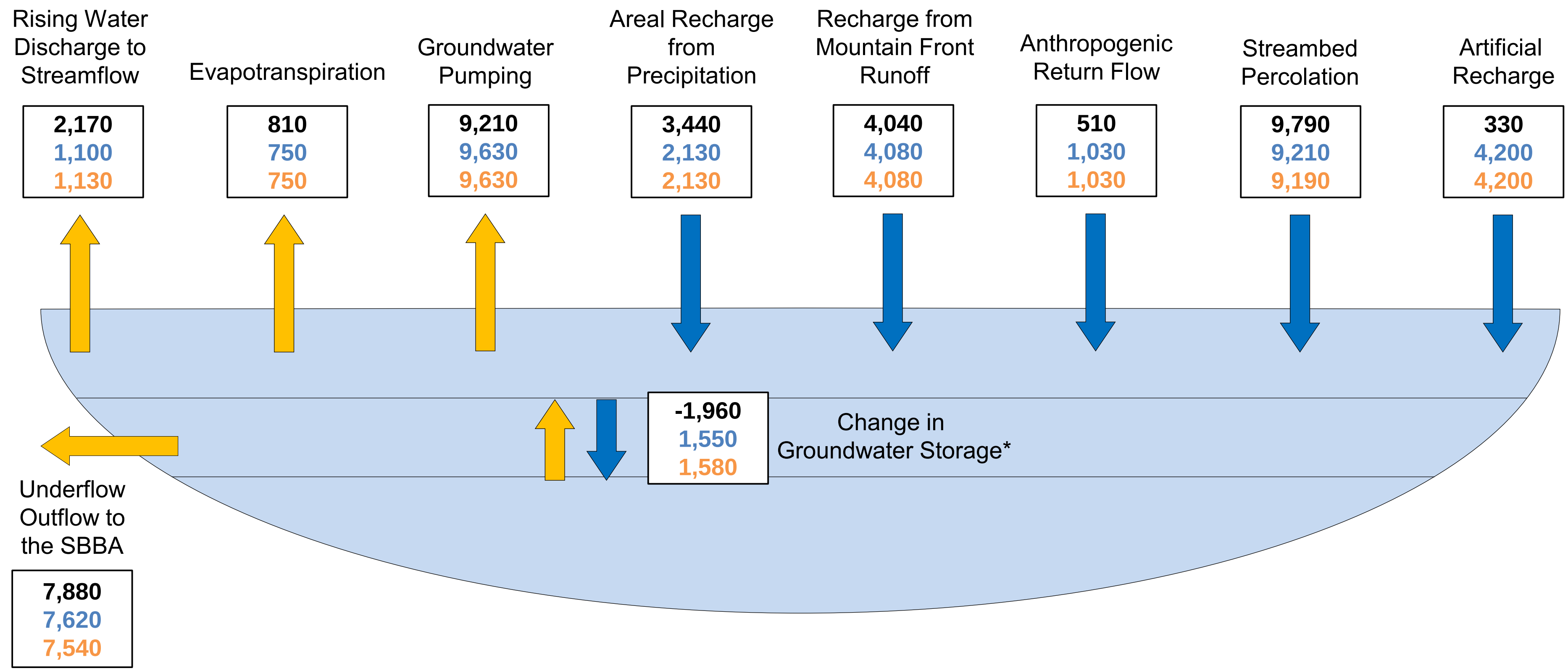
Figure 792

Scenario 2g: Annual Rising Water – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2g
Yucaipa	1,100	1,130
Riverside-Arlington	9,870	8,660
Prado	14,170	14,160
Total	**25,140**	**23,950**

Figure 793



Scenario 2a - Baseline
Scenario 2g - Clean Water Factory - 5 MGD from CWF to Redlands Basin (CWF + Sterling)

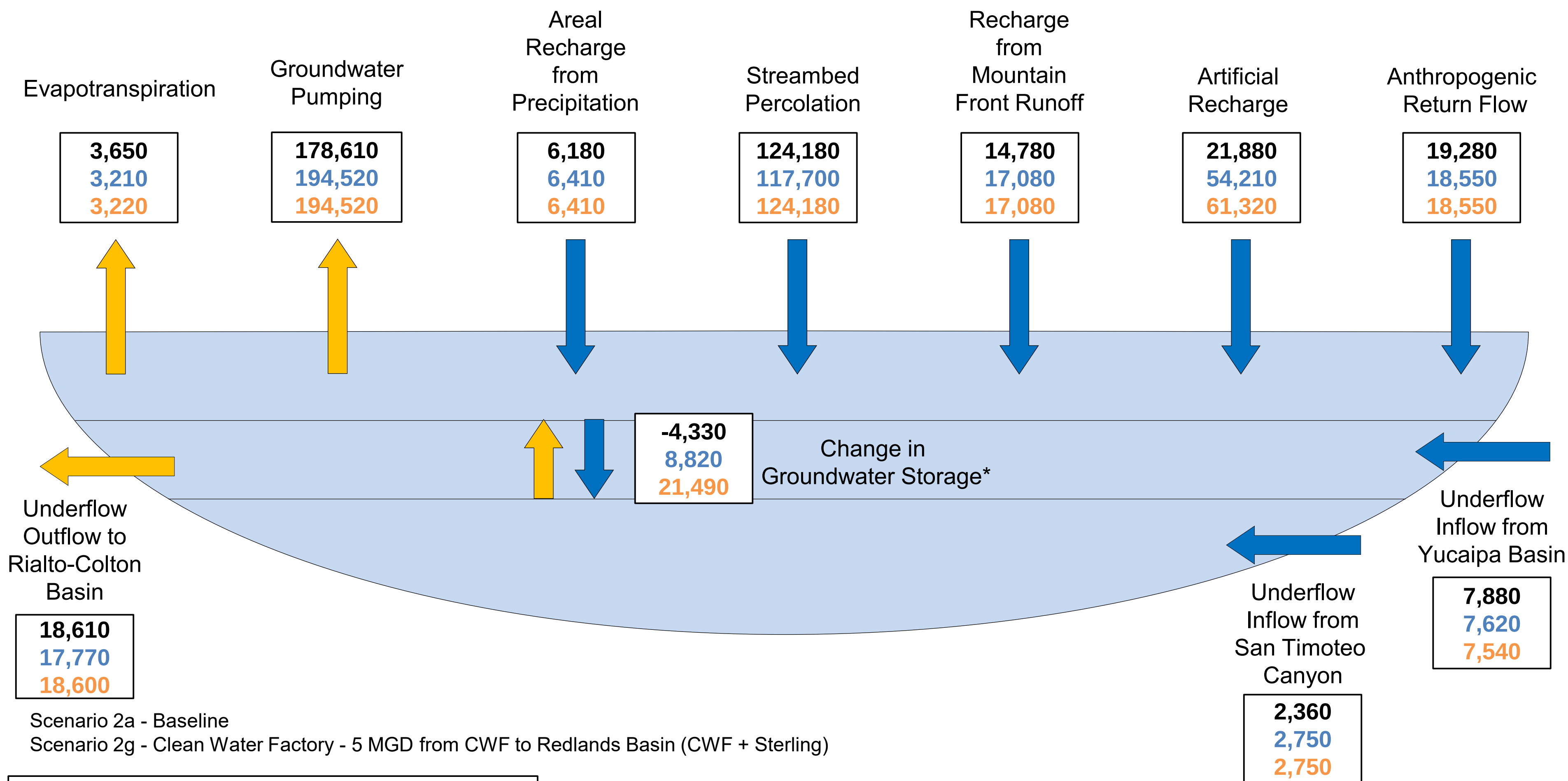
Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2g (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2G
AVERAGE ANNUAL
WATER BUDGET
YUCAIPA BASIN

X:\Projects\San_Bernardino_MUNI\31) Integreated_SAR_Model\(4)Technical_Memos\(8) Summary Report\Draft\Figures\Scenarios



Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2g (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2G AVERAGE ANNUAL WATER BUDGET SBBA

10-Apr-20

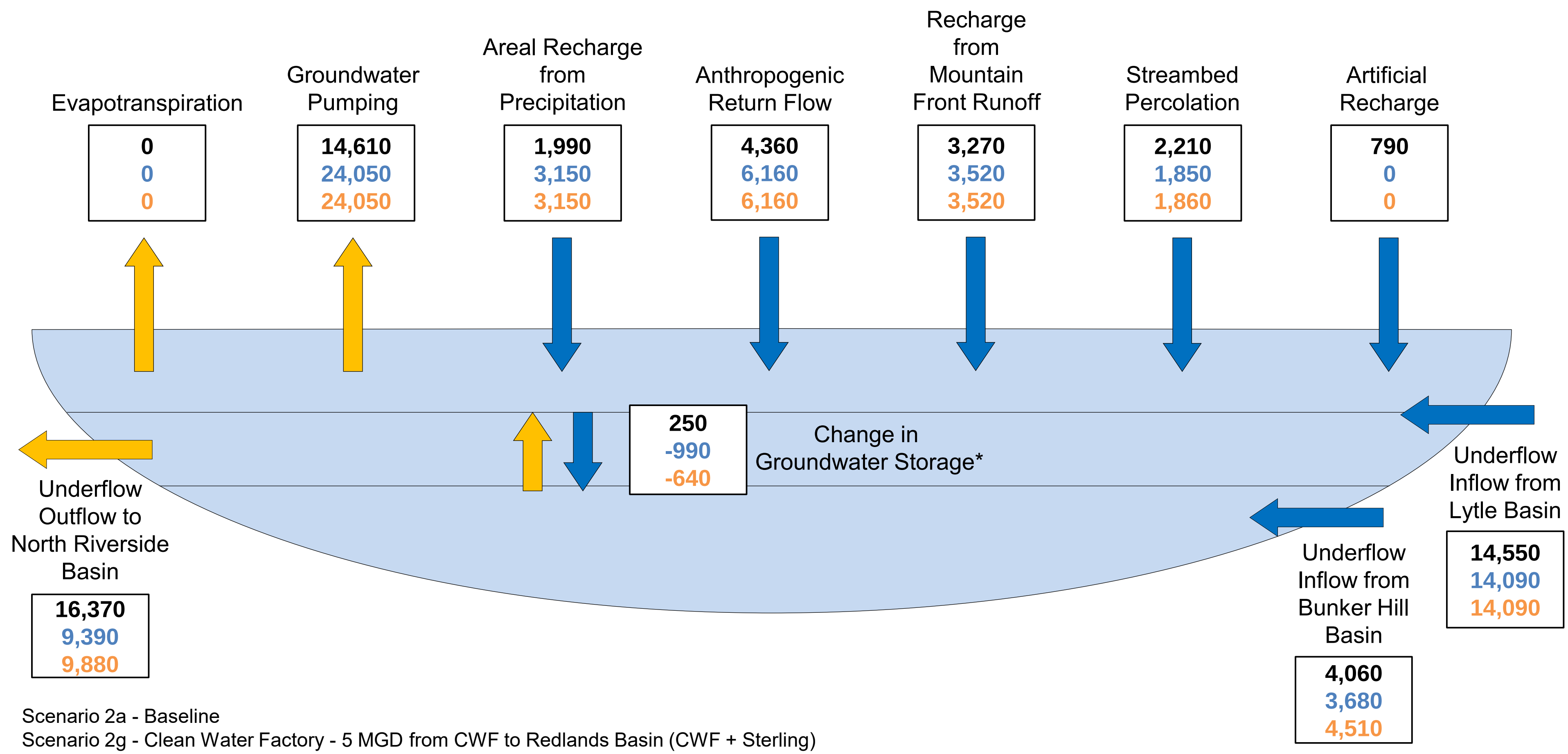
SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

DRAFT

FIGURE 795

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

GEOSCIENCE



Scenario 2a - Baseline
Scenario 2g - Clean Water Factory - 5 MGD from CWF to Redlands Basin (CWF + Sterling)

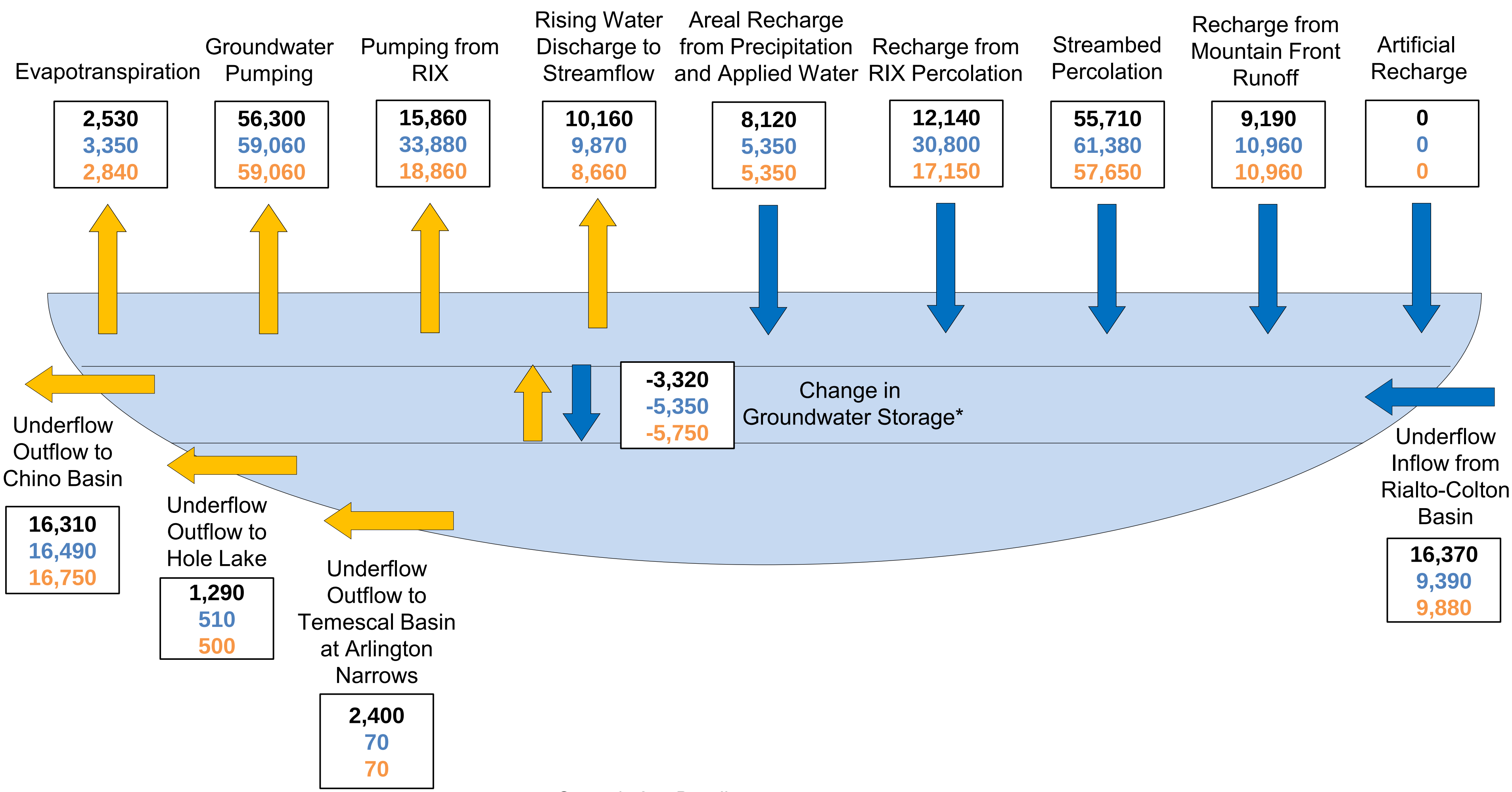
Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2g (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2G AVERAGE ANNUAL WATER BUDGET RIALTO-COLTON BASIN

10-Apr-20



Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2g (Hydrologic Period 1966-1990)

Scenario 2a - Baseline
Scenario 2g - Clean Water Factory - 5 MGD from CWF to Redlands Basin (CWF + Sterling)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2G
AVERAGE ANNUAL
WATER BUDGET
RIVERSIDE-ARLINGTON BASIN

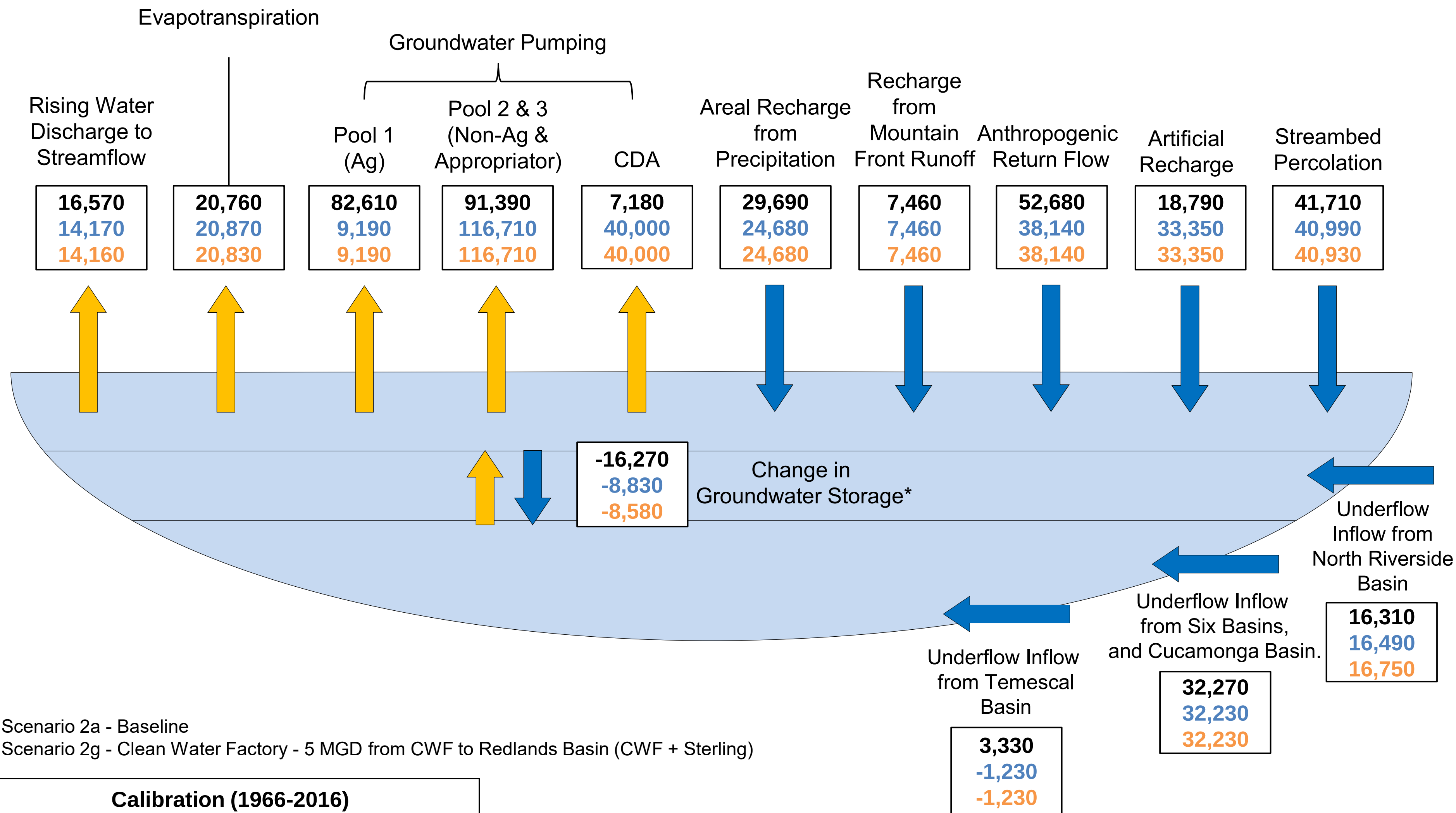
X:\Projects\San_Bernardino_MUNI\31) Integreated_SAR_Model\(4)Technical_Memos\(8) Summary Report\Draft\Figures\Scenarios

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT **DRAFT** **FIGURE 797**
UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

GEOSCIENCE

X:\Projects\San_Bernardino_MUNI\31) Integreated_SAR_Model\(4)Technical_Memos\(8) Summary Report\Draft\Figures\Scenarios



Scenario 2a - Baseline
Scenario 2g - Clean Water Factory - 5 MGD from CWF to Redlands Basin (CWF + Sterling)

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2g (Hydrologic Period 1966-1990)

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2G AVERAGE ANNUAL WATER BUDGET CHINO BASIN

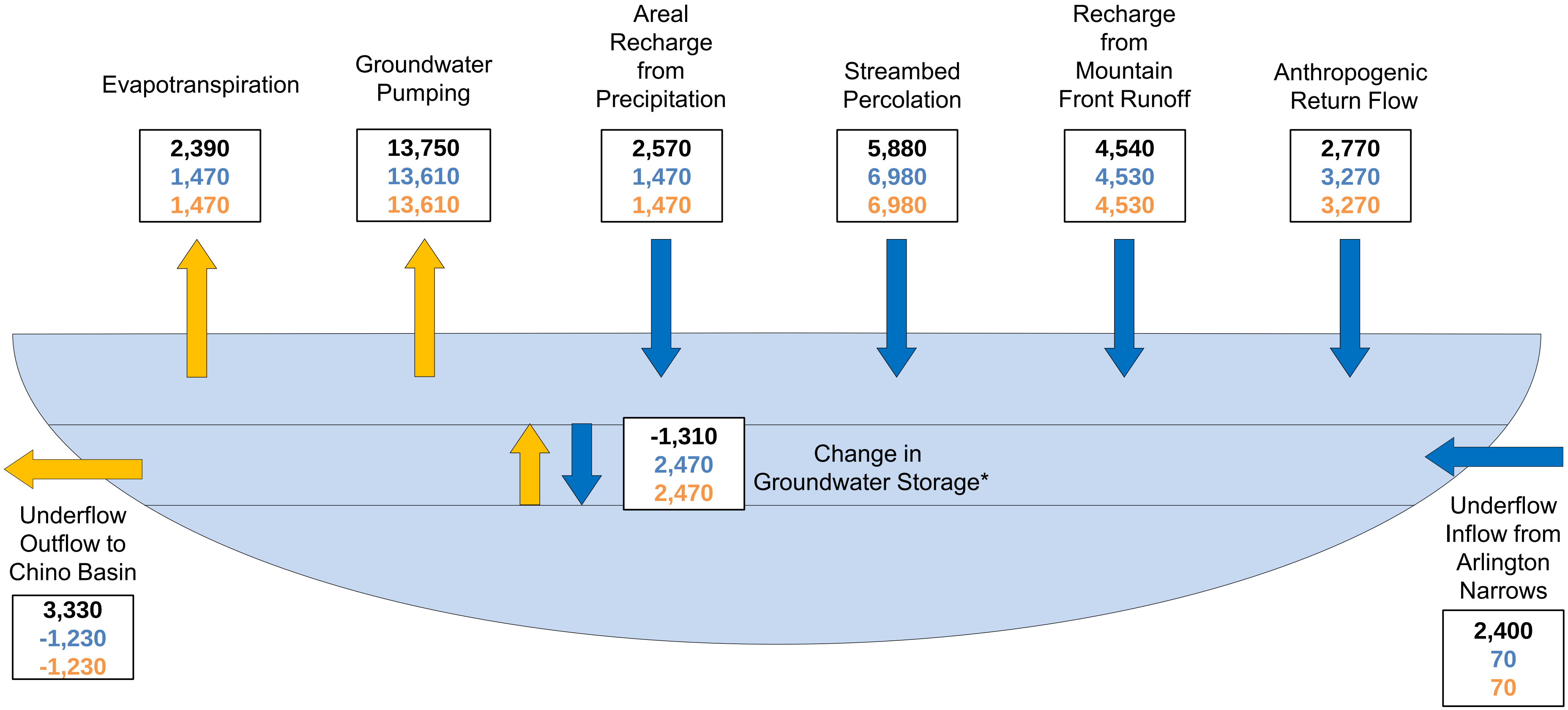
10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT **DRAFT** **FIGURE 798**

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

GEOSCIENCE

X:\Projects\San_Bernardino_MUNI(31)\Integrated_SAR_Model(4)\Technical_Memos(8)\Summary Report\Draft\Figures\Scenarios



Scenario 2a - Baseline
Scenario 2g - Clean Water Factory - 5 MGD from CWF to Redlands Basin (CWF + Sterling)

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2g (Hydrologic Period 1966-1990)

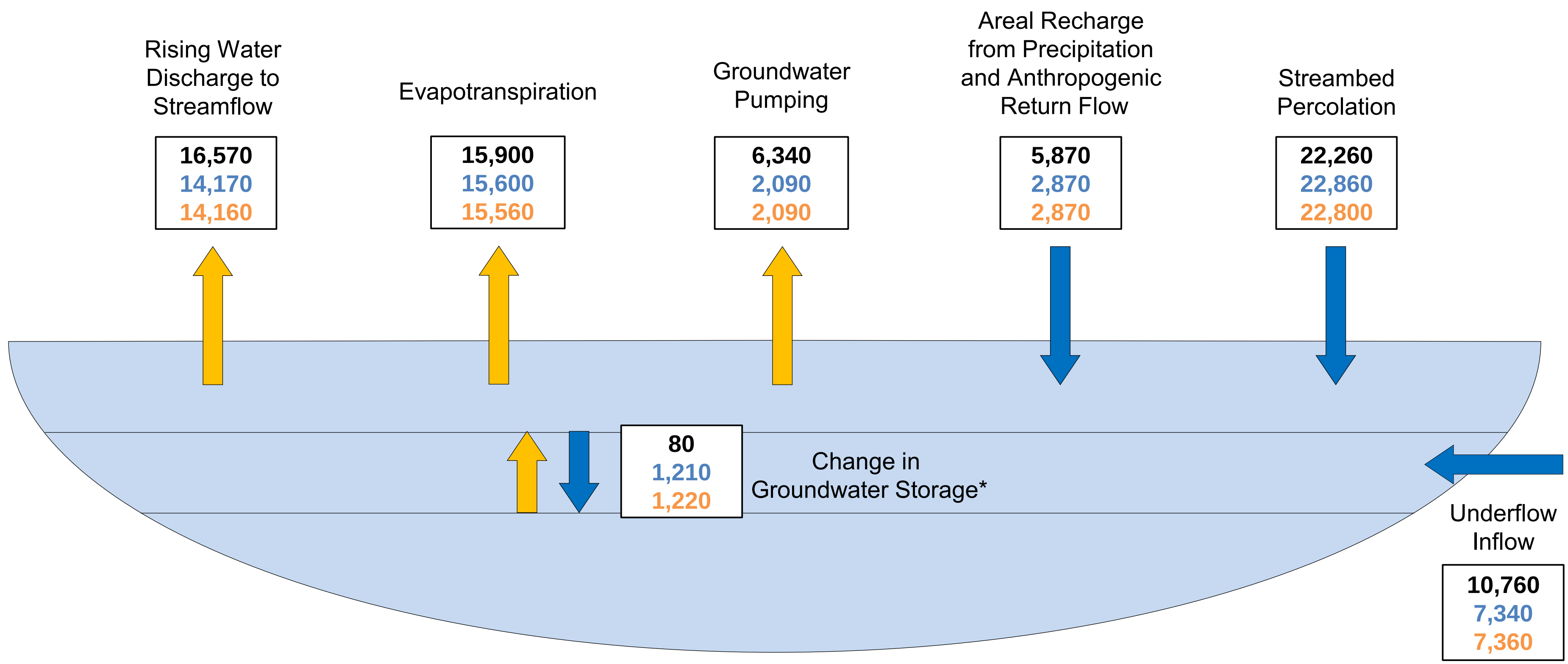
All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2G
AVERAGE ANNUAL
WATER BUDGET
TEMESCAL BASIN

10-Apr-20

DRAFT



Scenario 2a - Baseline
Scenario 2g - Clean Water Factory - 5 MGD from CWF to Redlands Basin (CWF + Sterling)

Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2g (Hydrologic Period 1966-1990)

All values in acre-ft/yr

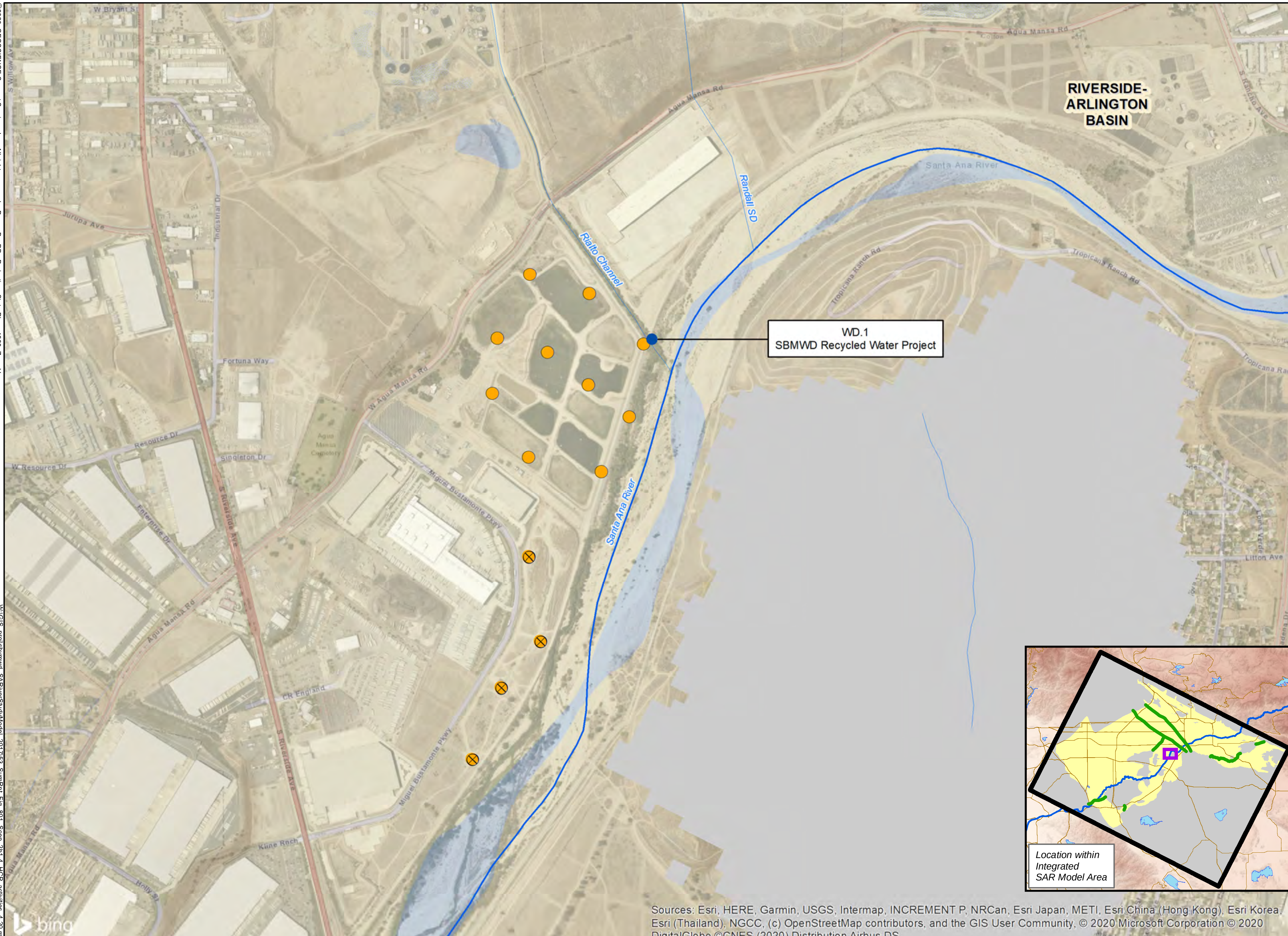
*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2G AVERAGE ANNUAL WATER BUDGET PRADO BASIN

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT **DRAFT** **FIGURE 800**
UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

GEOSCIENCE



EXPLANATION

Integrated SAR Model Boundary

Inactive Model Area

Habitat Conservation Plan (HCP) Covered Activity
WD.1 - Project ID
SBMWD Recycled Water Project - Name of HCP Project

RIX Extraction Well

RIX Expansion Well

Groundwater Basin Boundary

Refer to Table 17 for HCP Covered Activity Description

Scenario 2h.1 = RIX High Pulse Event

Scenario 2h.2 = Extended RIX Shutdown

Scenario 2h.3 = 18.5 MGD RIX Discharge, Including 2.8 MGD Overextraction

Scenario 2h.4 = 18.5 MGD RIX Discharge, Including 6 MGD Overextraction

N

0 1,000 2,000
Feet

SCENARIO 2h
RIX OPERATIONAL SCENARIOS
LOCATION OF HCP COVERED ACTIVITIES

W:\GIS_projs\sbvmwd_SARiverStudyModel_2017\53_SumRpt_Fig_801_Scen_2h1-4_HCP_activities_4-20.mxd

10-Apr-20

DRAFT

FIGURE 801

GEOSCIENCE

DRAFT

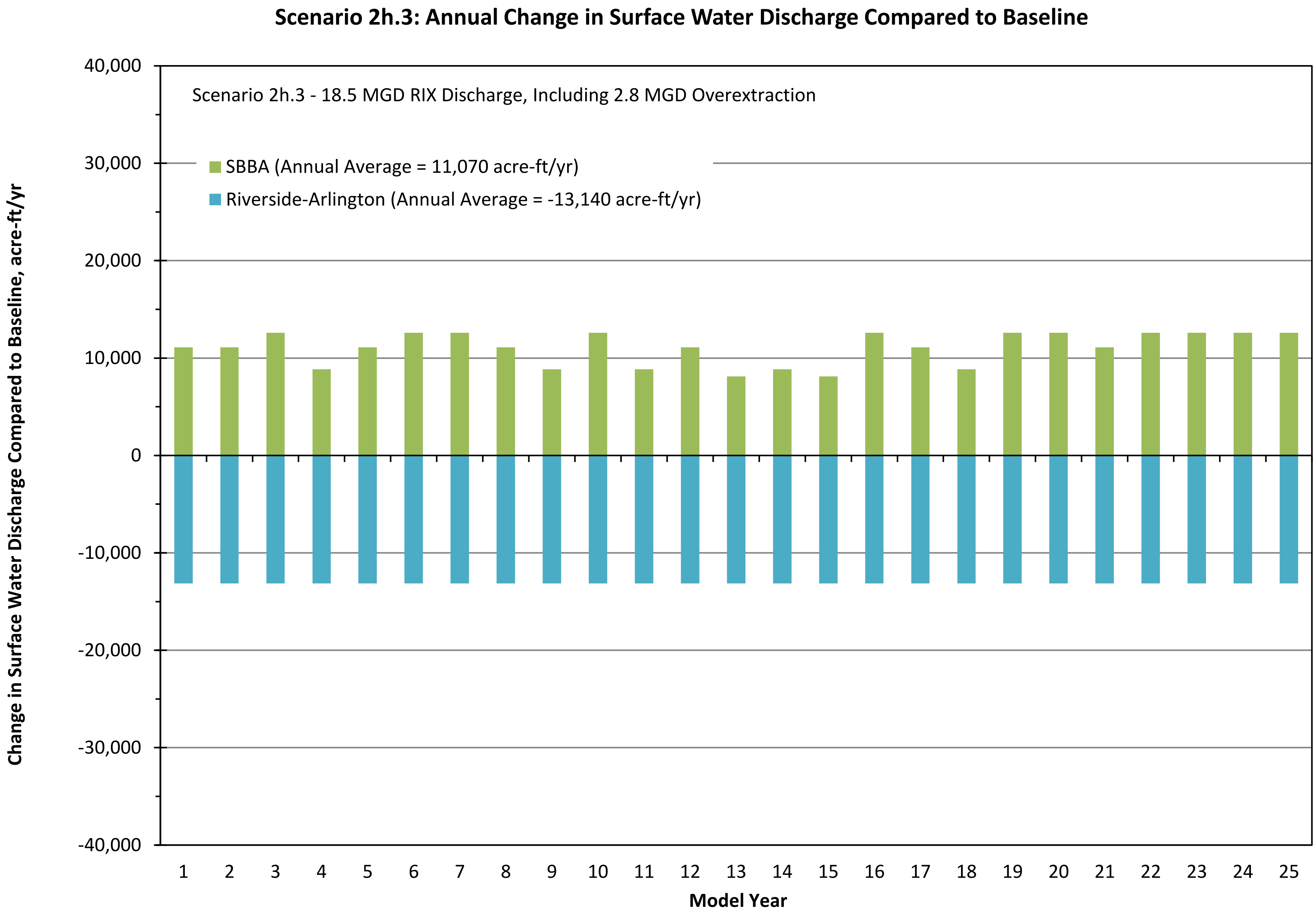


Figure 802

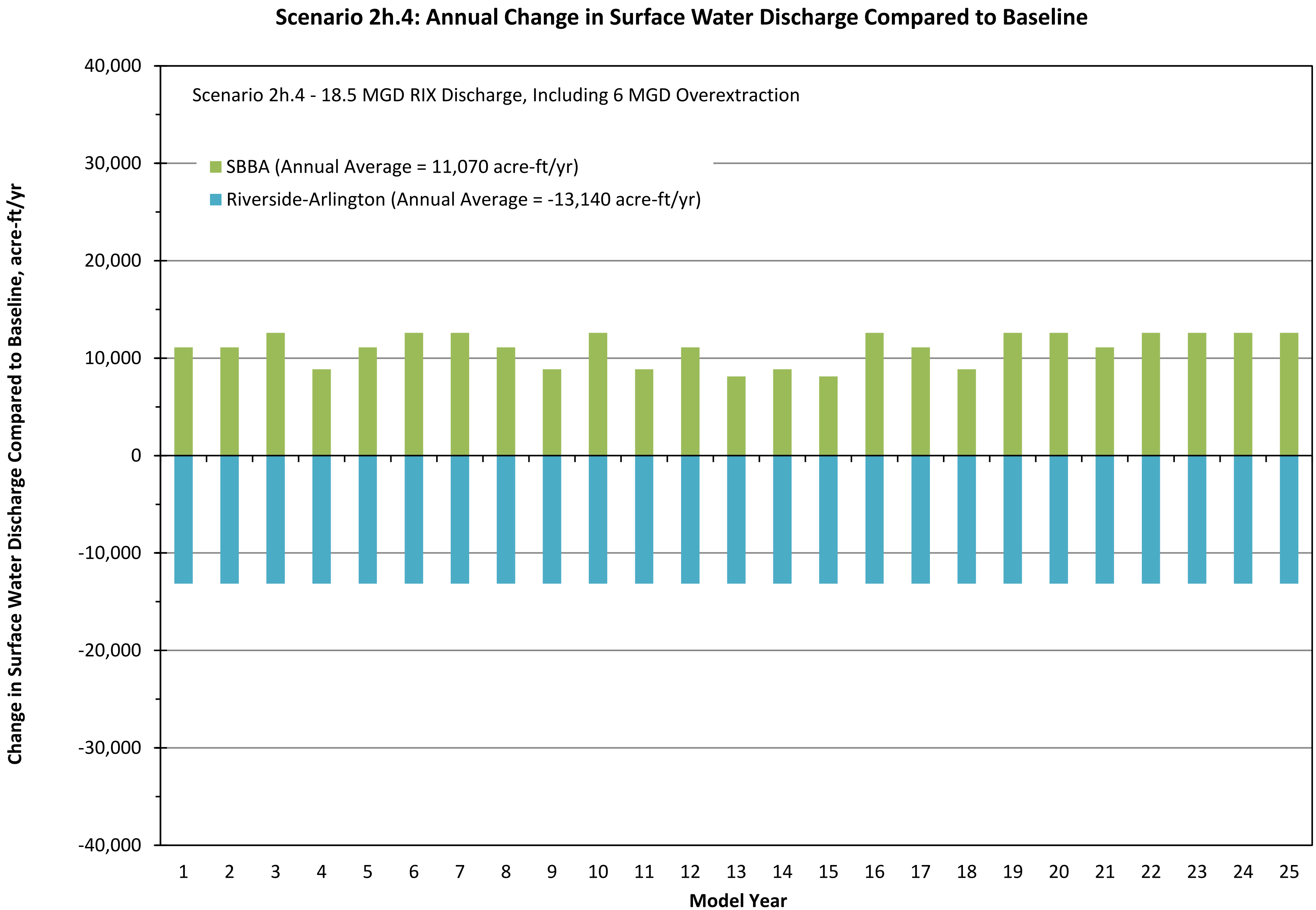
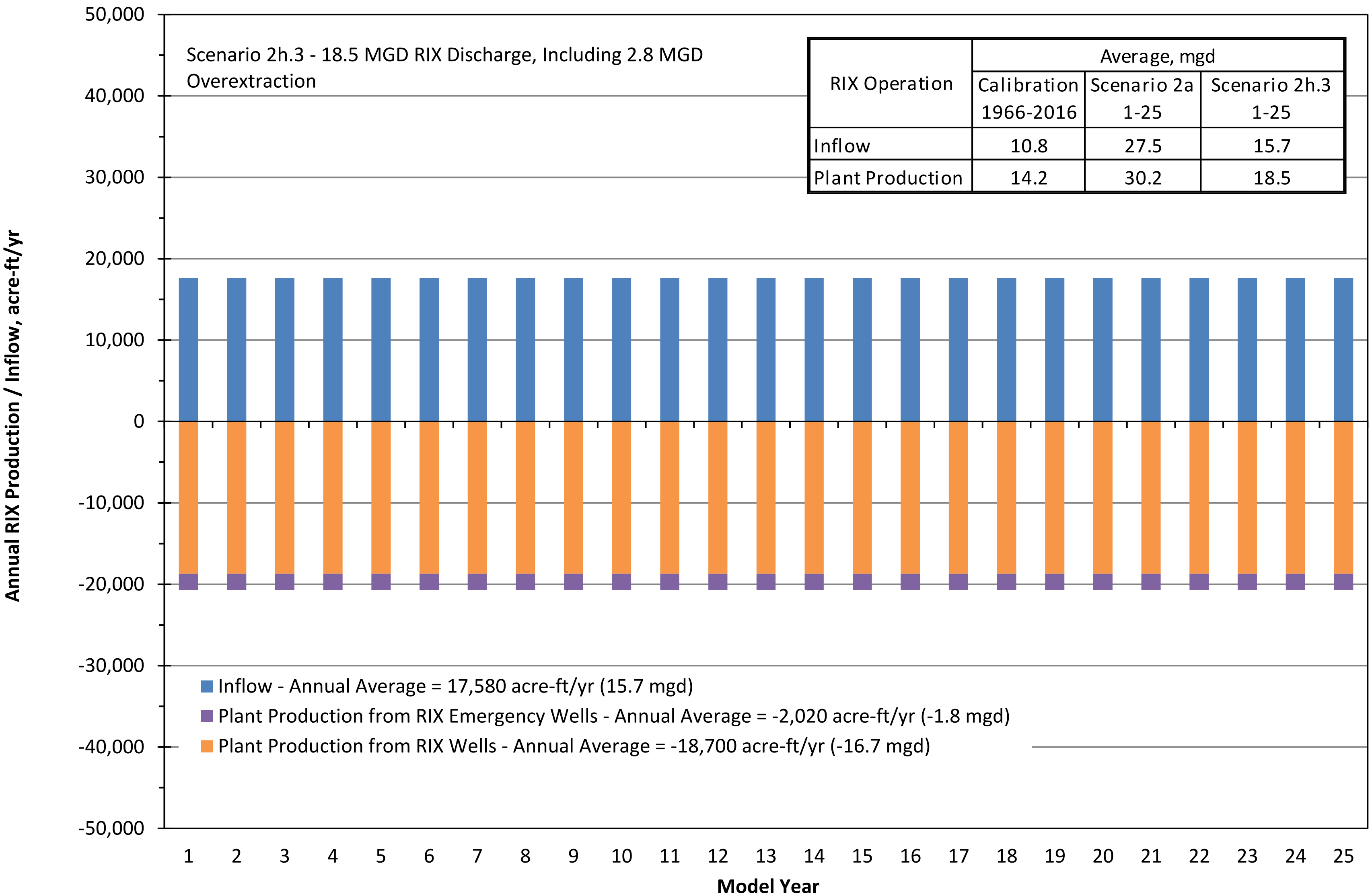

Scenario 2h.4: Annual Change in Surface Water Discharge Compared to Baseline
Scenario 2h.4 - 18.5 MGD RIX Discharge, Including 6 MGD Overextraction
SBBA (Annual Average = 11,070 acre-ft/yr)
Riverside-Arlington (Annual Average = -13,140 acre-ft/yr)
Change in Surface Water Discharge Compared to Baseline, acre-ft/yr
40,000
30,000
20,000
10,000
0
-10,000
-20,000
-30,000
-40,000
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
Model Year

Figure 803

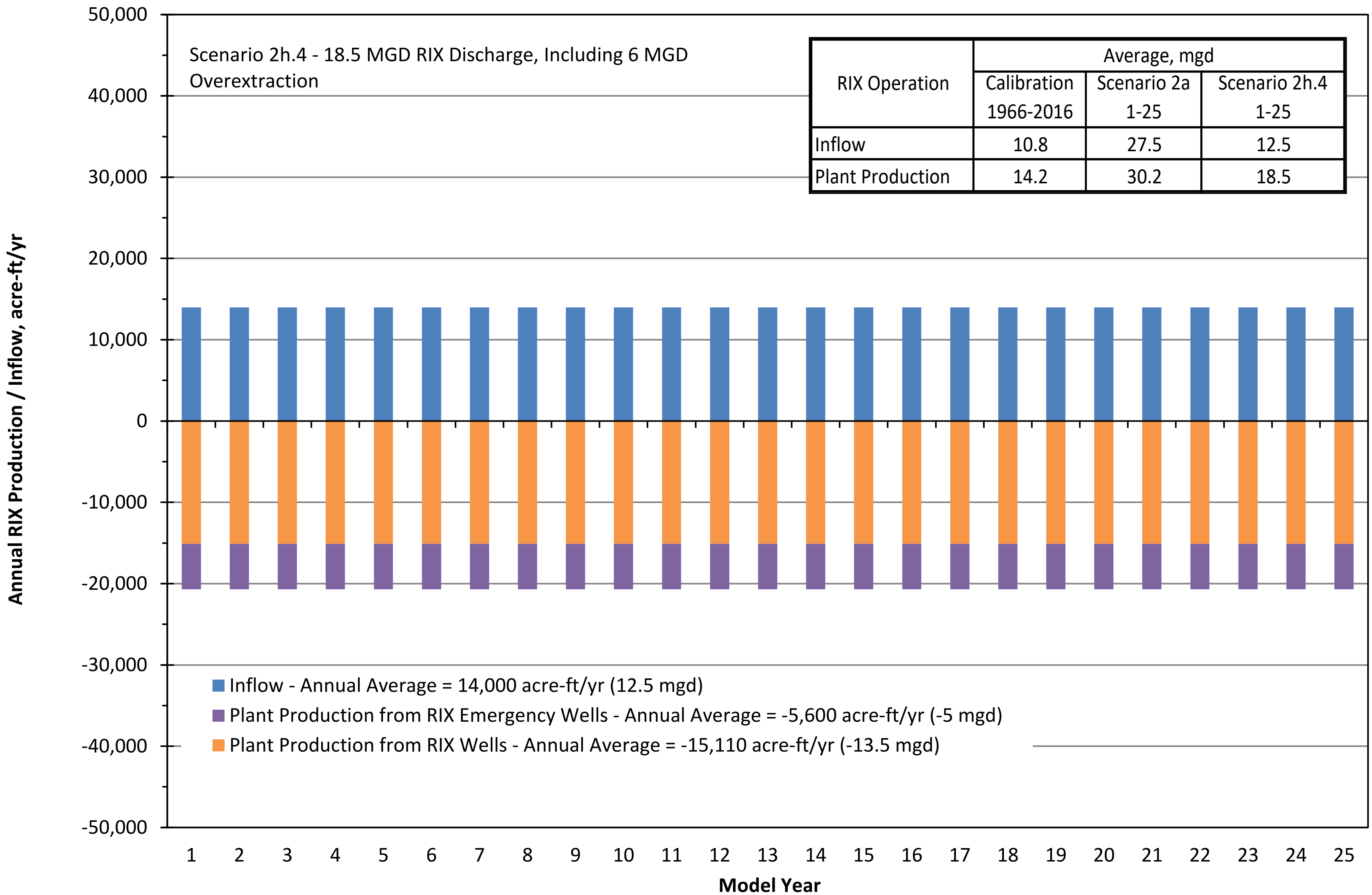
Scenario 2h.3: RIX Operational Assumptions



RIX Operation	Average, mgd		
	Calibration 1966-2016	Scenario 2a 1-25	Scenario 2h.3 1-25
Inflow	10.8	27.5	15.7
Plant Production	14.2	30.2	18.5

Figure 804

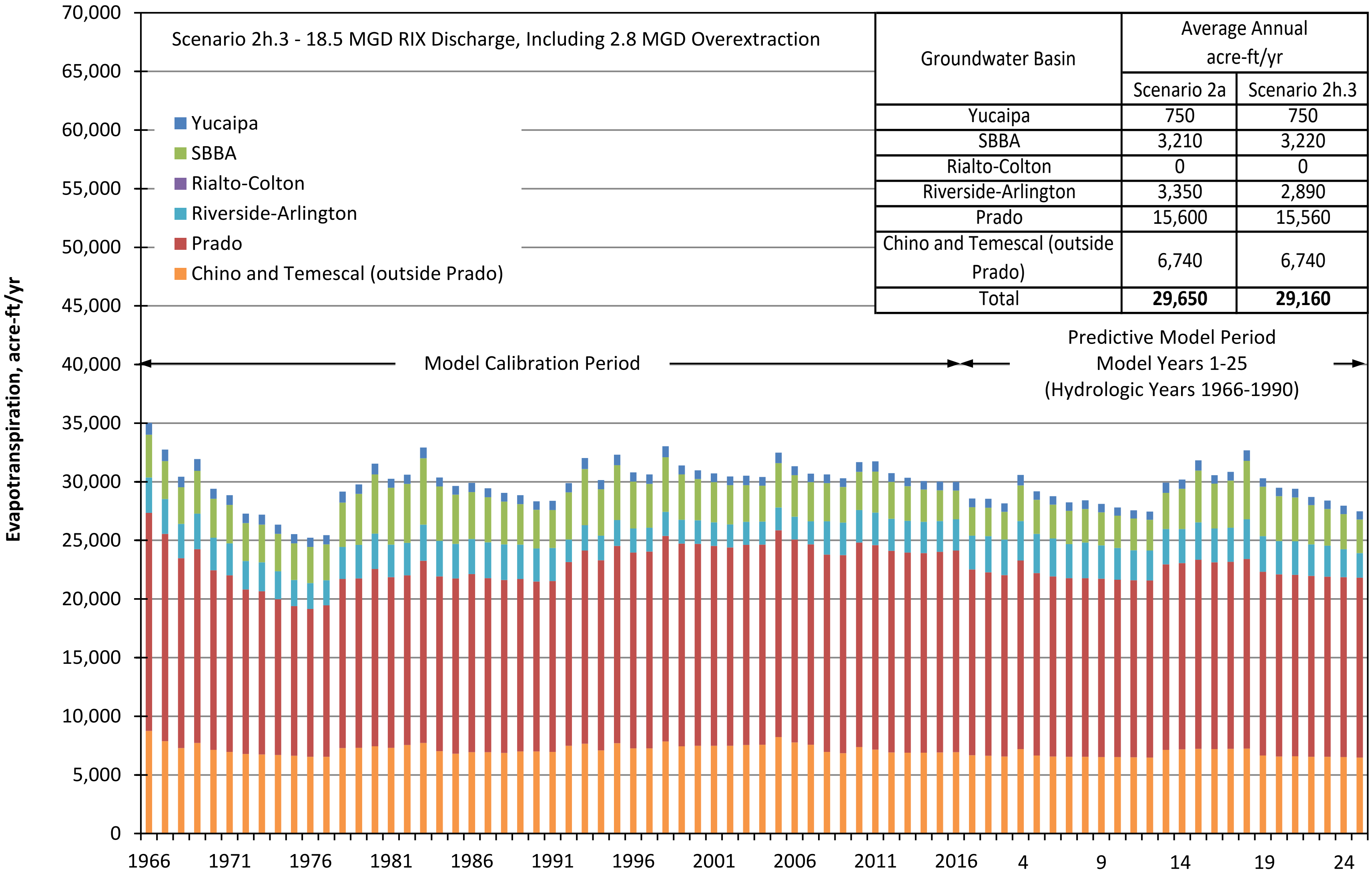
Scenario 2h.4: RIX Operational Assumptions



RIX Operation	Average, mgd		
	Calibration 1966-2016	Scenario 2a 1-25	Scenario 2h.4 1-25
Inflow	10.8	27.5	12.5
Plant Production	14.2	30.2	18.5

Figure 805

Scenario 2h.3: Annual Evapotranspiration – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2h.3
Yucaipa	750	750
SBBA	3,210	3,220
Rialto-Colton	0	0
Riverside-Arlington	3,350	2,890
Prado	15,600	15,560
Chino and Temescal (outside Prado)	6,740	6,740
Total	**29,650**	**29,160**

Figure 806

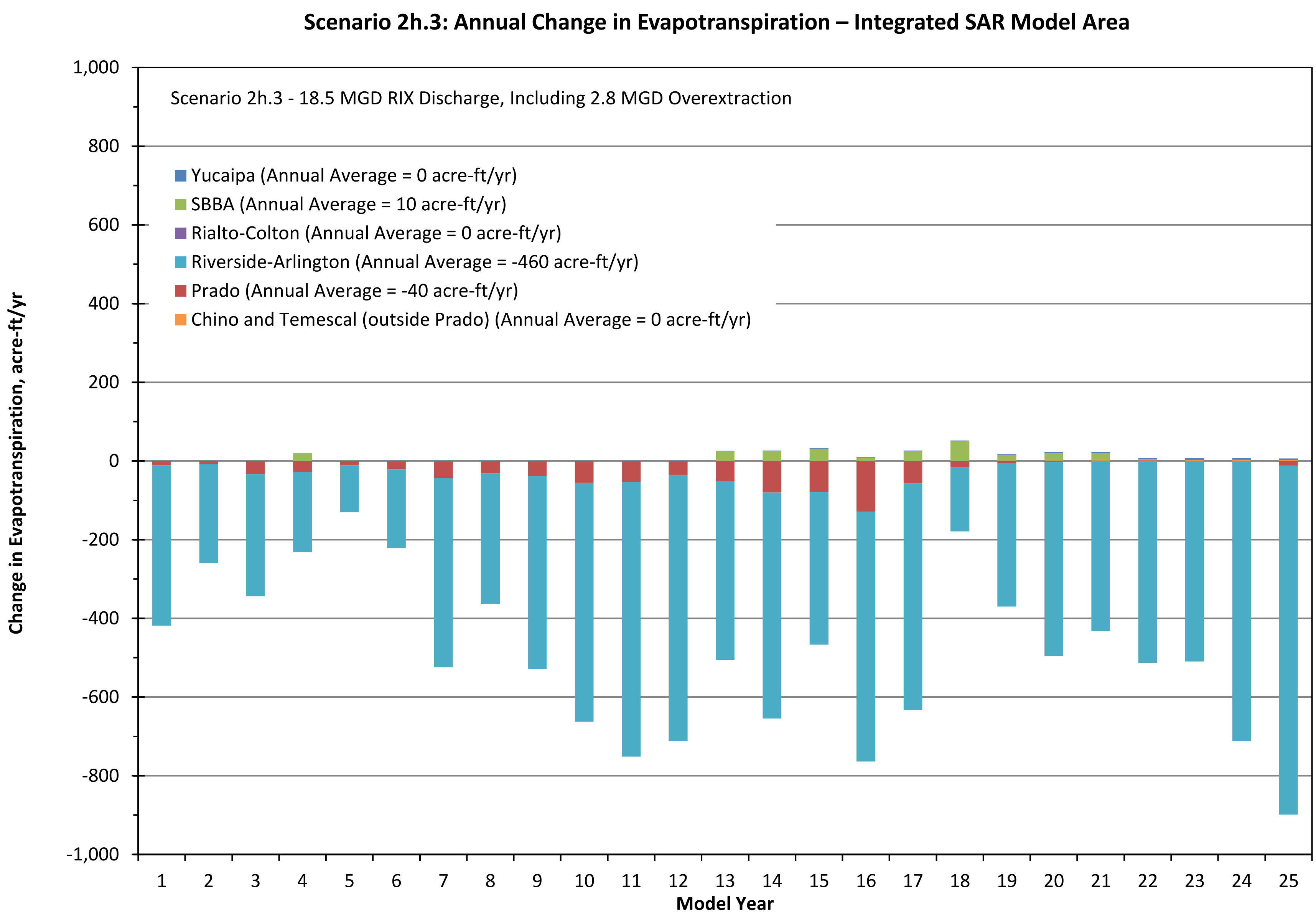
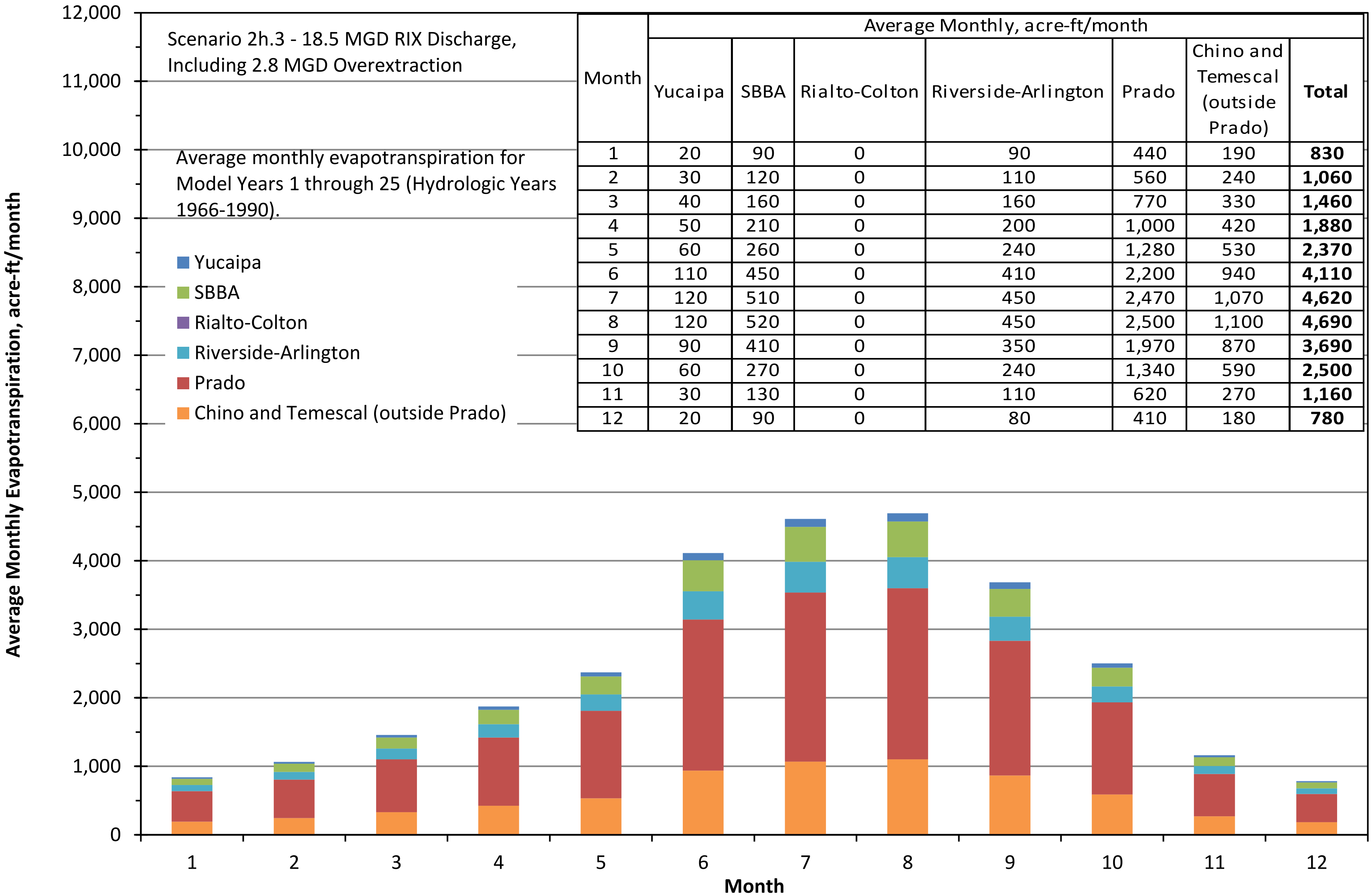

Scenario 2h.3: Annual Change in Evapotranspiration – Integrated SAR Model Area
Scenario 2h.3 - 18.5 MGD RIX Discharge, Including 2.8 MGD Overextraction
Yucaipa (Annual Average = 0 acre-ft/yr)
SBBA (Annual Average = 10 acre-ft/yr)
Rialto-Colton (Annual Average = 0 acre-ft/yr)
Riverside-Arlington (Annual Average = -460 acre-ft/yr)
Prado (Annual Average = -40 acre-ft/yr)
Chino and Temescal (outside Prado) (Annual Average = 0 acre-ft/yr)
Change in Evapotranspiration, acre-ft/yr
1,000
800
600
400
200
0
-200
-400
-600
-800
-1,000
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
Model Year

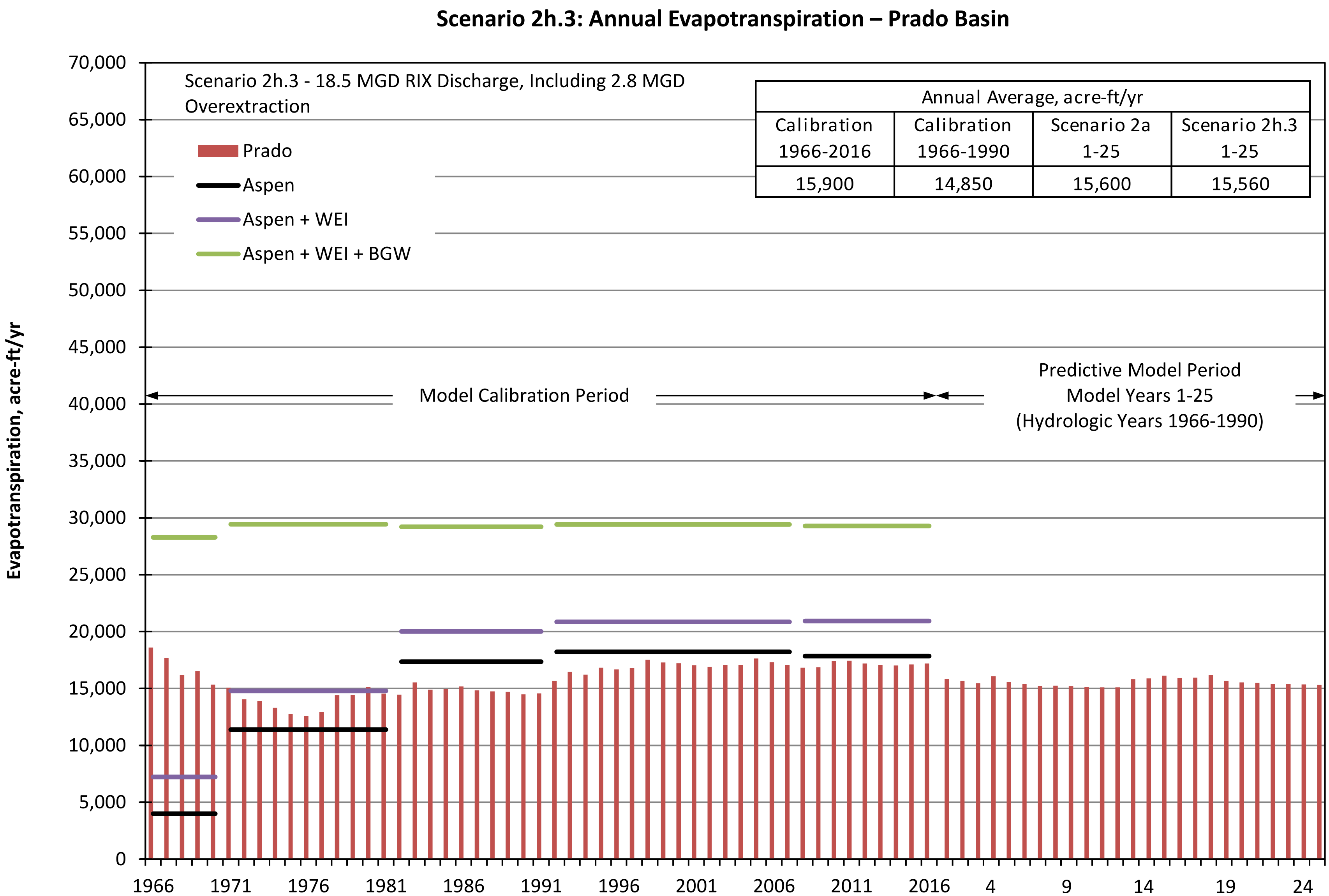
Figure 807

Scenario 2h.3: Seasonal Evapotranspiration – Integrated SAR Model Area



Month	Average Monthly, acre-ft/month						
	Yucaipa	SBBA	Rialto-Colton	Riverside-Arlington	Prado	Chino and Temescal (outside Prado)	**Total**
1	20	90	0	90	440	190	**830**
2	30	120	0	110	560	240	**1,060**
3	40	160	0	160	770	330	**1,460**
4	50	210	0	200	1,000	420	**1,880**
5	60	260	0	240	1,280	530	**2,370**
6	110	450	0	410	2,200	940	**4,110**
7	120	510	0	450	2,470	1,070	**4,620**
8	120	520	0	450	2,500	1,100	**4,690**
9	90	410	0	350	1,970	870	**3,690**
10	60	270	0	240	1,340	590	**2,500**
11	30	130	0	110	620	270	**1,160**
12	20	90	0	80	410	180	**780**

Figure 808



Annual Average, acre-ft/yr			
Calibration 1966-2016	Calibration 1966-1990	Scenario 2a 1-25	Scenario 2h.3 1-25
15,900	14,850	15,600	15,560

Figure 809

DRAFT

Scenario 2h.3: Annual Change in Evapotranspiration – Prado Basin

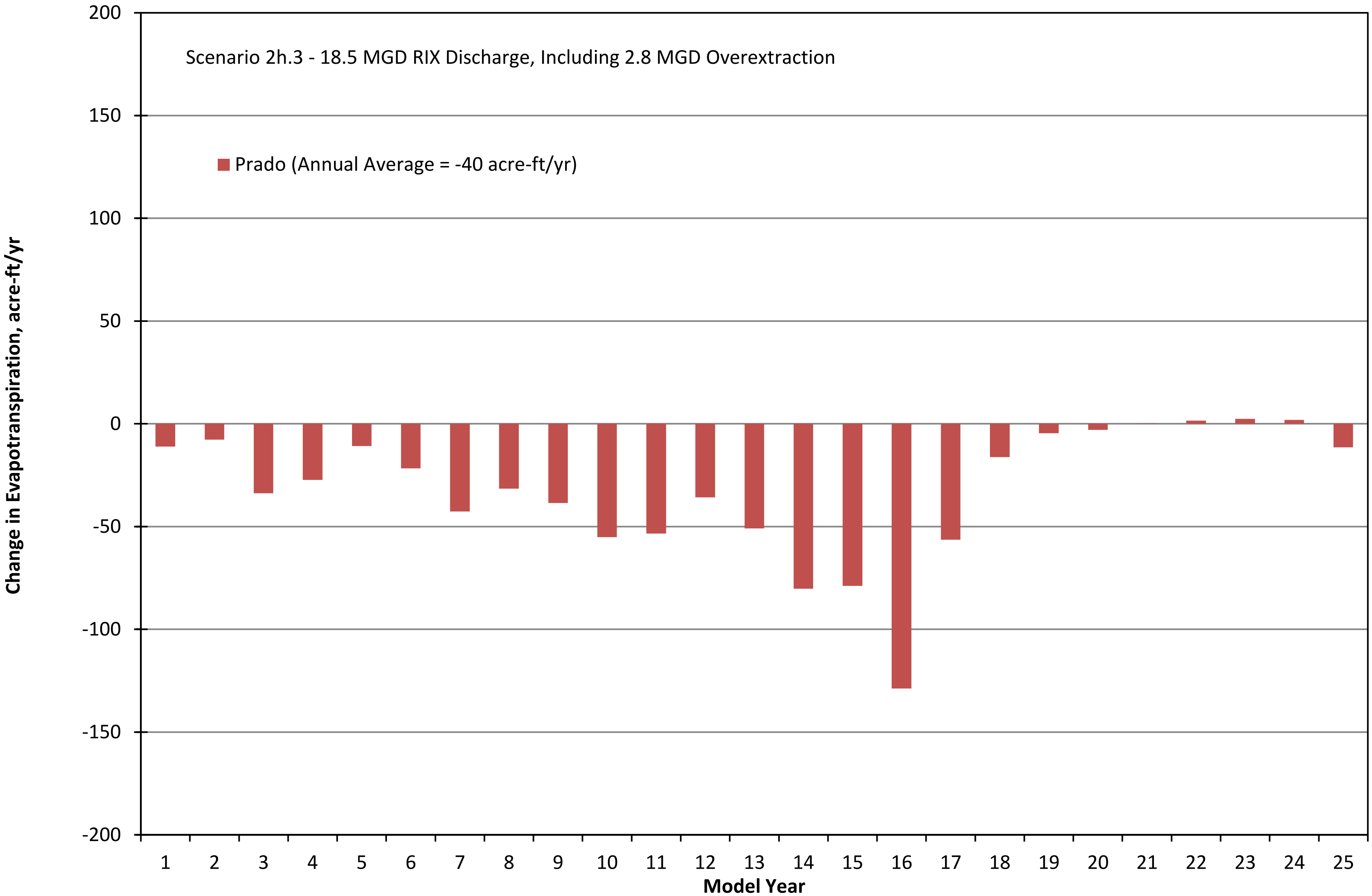
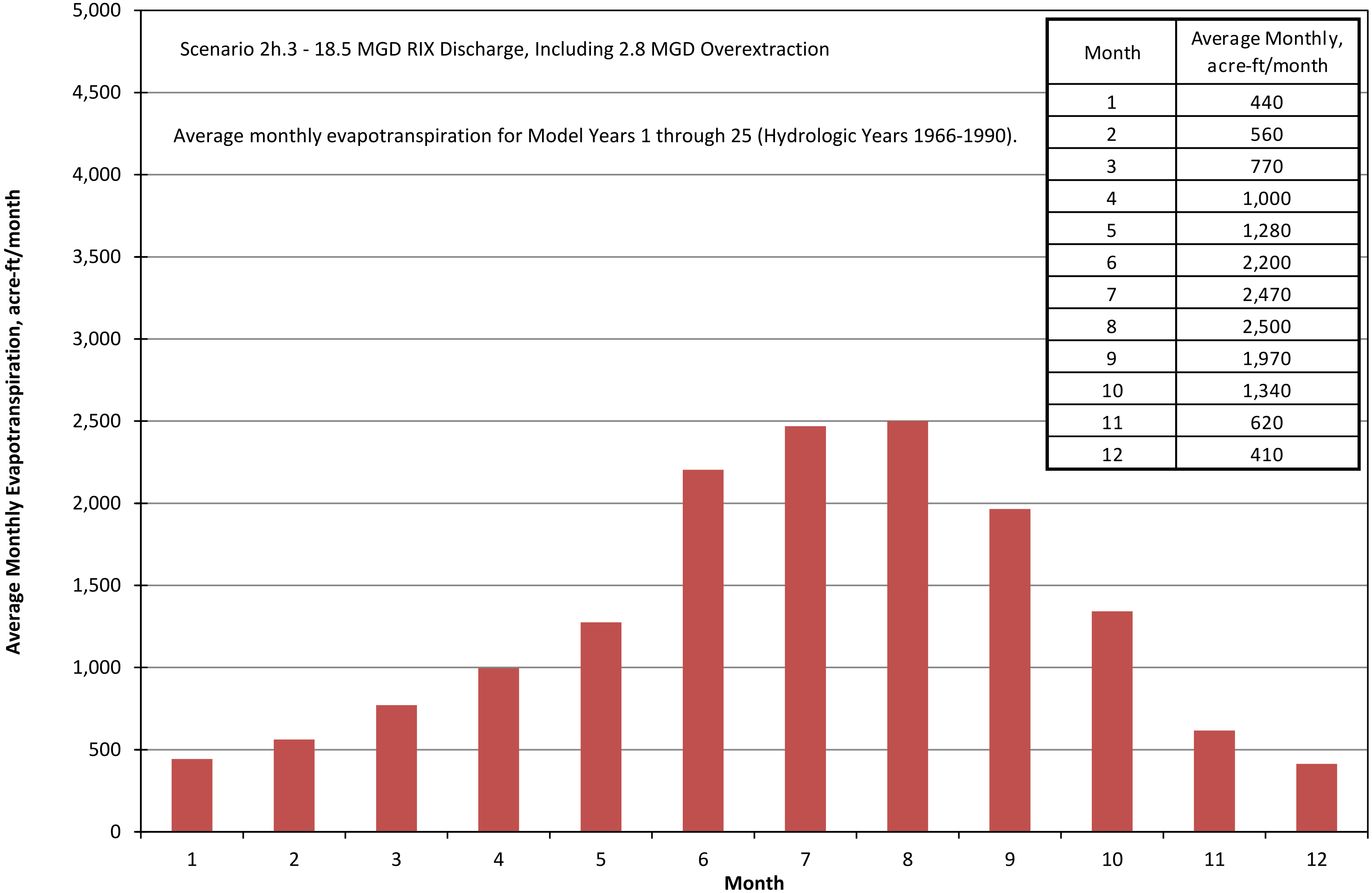


Figure 810

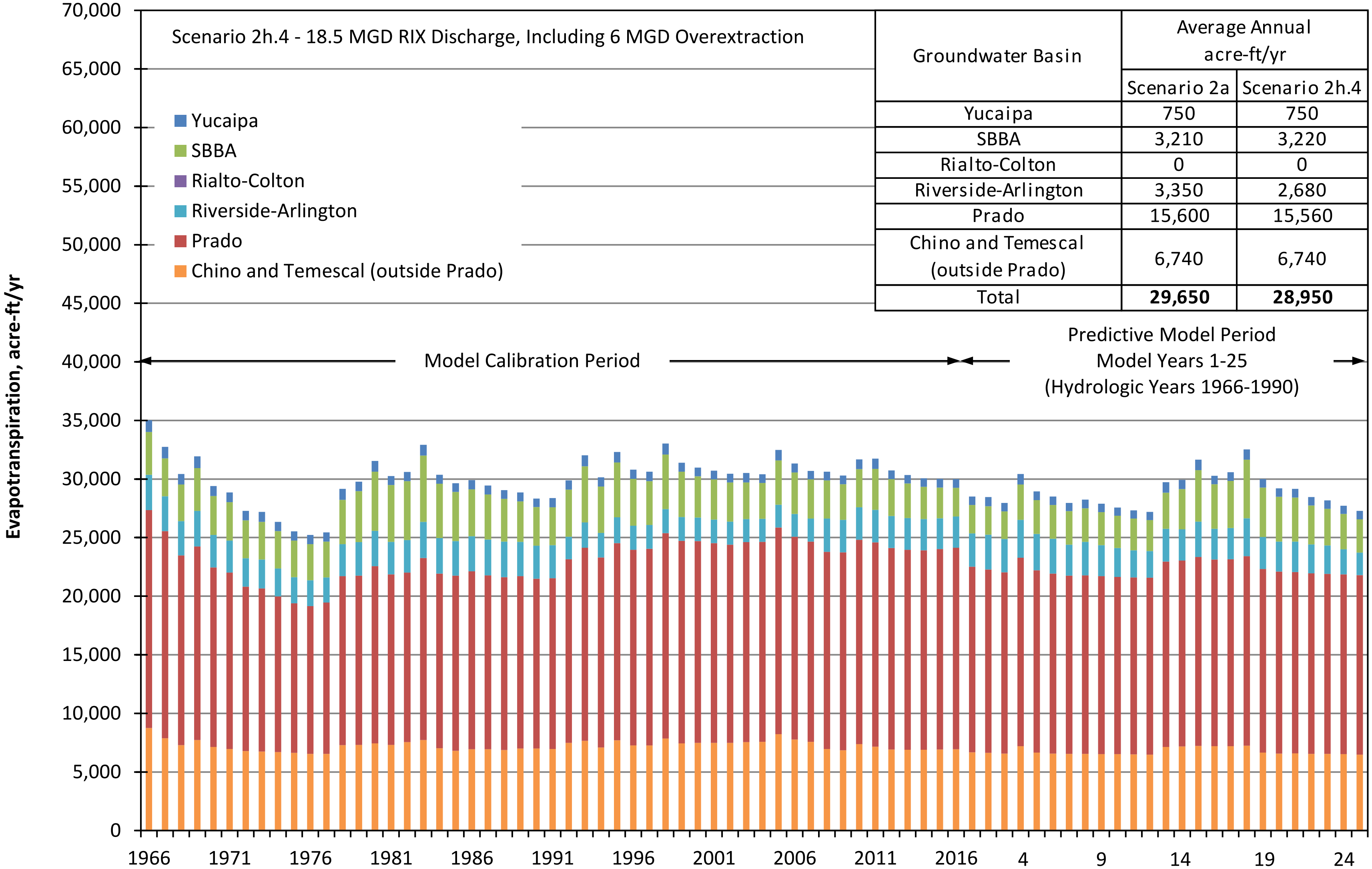
Scenario 2h.3: Seasonal Evapotranspiration – Prado Basin



Month	Average Monthly, acre-ft/month
1	440
2	560
3	770
4	1,000
5	1,280
6	2,200
7	2,470
8	2,500
9	1,970
10	1,340
11	620
12	410

Figure 811

Scenario 2h.4: Annual Evapotranspiration – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2h.4
Yucaipa	750	750
SBBA	3,210	3,220
Rialto-Colton	0	0
Riverside-Arlington	3,350	2,680
Prado	15,600	15,560
Chino and Temescal (outside Prado)	6,740	6,740
Total	**29,650**	**28,950**

Figure 812

DRAFT

Scenario 2h.4: Annual Change in Evapotranspiration – Integrated SAR Model Area

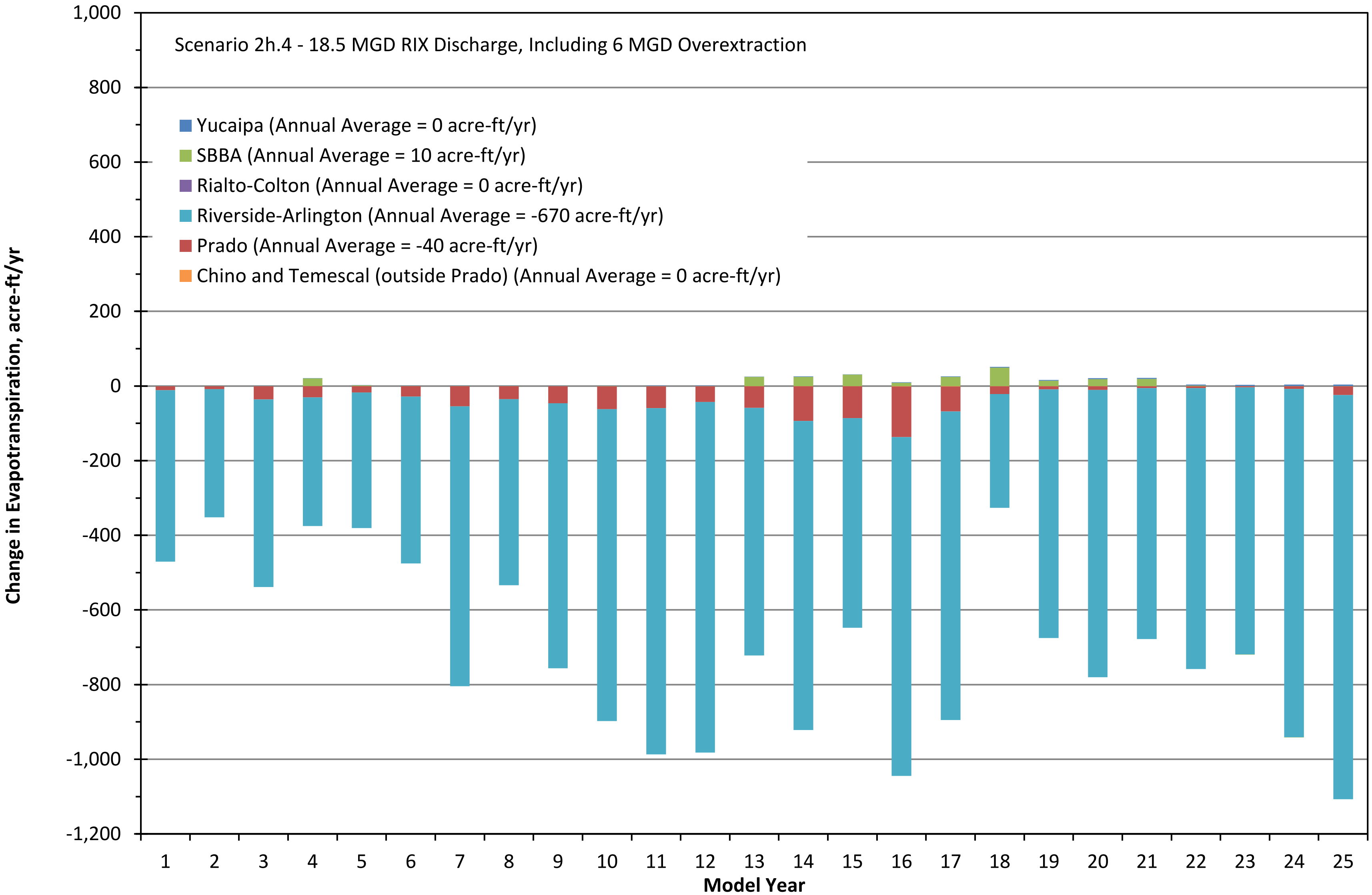
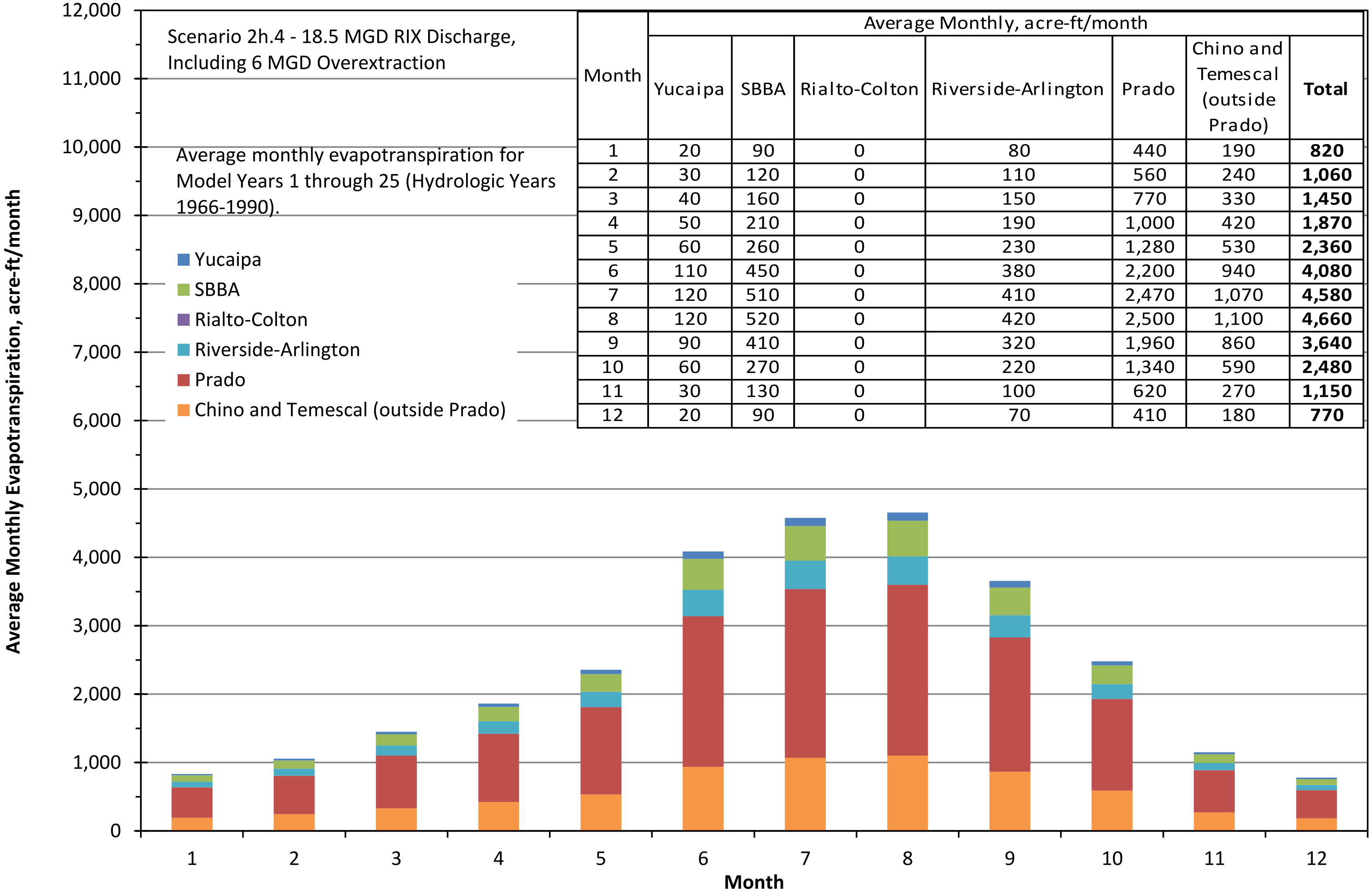


Figure 813

Scenario 2h.4: Seasonal Evapotranspiration – Integrated SAR Model Area



Month	Average Monthly, acre-ft/month						
	Yucaipa	SBBA	Rialto-Colton	Riverside-Arlington	Prado	Chino and Temescal (outside Prado)	**Total**
1	20	90	0	80	440	190	**820**
2	30	120	0	110	560	240	**1,060**
3	40	160	0	150	770	330	**1,450**
4	50	210	0	190	1,000	420	**1,870**
5	60	260	0	230	1,280	530	**2,360**
6	110	450	0	380	2,200	940	**4,080**
7	120	510	0	410	2,470	1,070	**4,580**
8	120	520	0	420	2,500	1,100	**4,660**
9	90	410	0	320	1,960	860	**3,640**
10	60	270	0	220	1,340	590	**2,480**
11	30	130	0	100	620	270	**1,150**
12	20	90	0	70	410	180	**770**

Figure 814

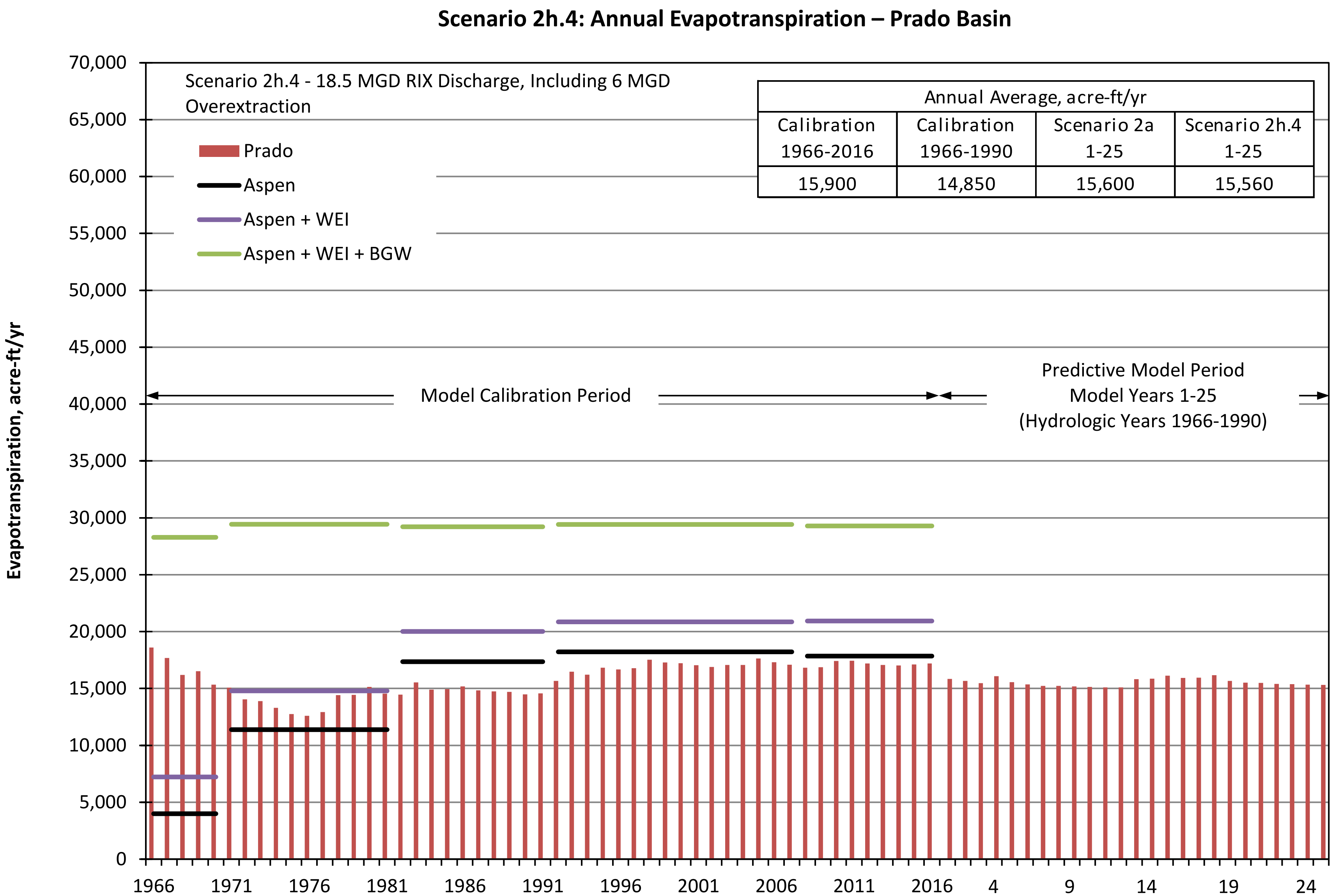

Scenario 2h.4: Annual Evapotranspiration – Prado Basin
Scenario 2h.4 - 18.5 MGD RIX Discharge, Including 6 MGD Overextraction
Prado
Aspen
Aspen + WEI
Aspen + WEI + BGW
Annual Average, acre-ft/yr
Calibration 1966-2016
Calibration 1966-1990
Scenario 2a 1-25
Scenario 2h.4 1-25
15,900
14,850
15,600
15,560
Model Calibration Period
Predictive Model Period
Model Years 1-25
(Hydrologic Years 1966-1990)
Evapotranspiration, acre-ft/yr
70,000
65,000
60,000
55,000
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
1966
1971
1976
1981
1986
1991
1996
2001
2006
2011
2016
4
9
14
19
24

Figure 815

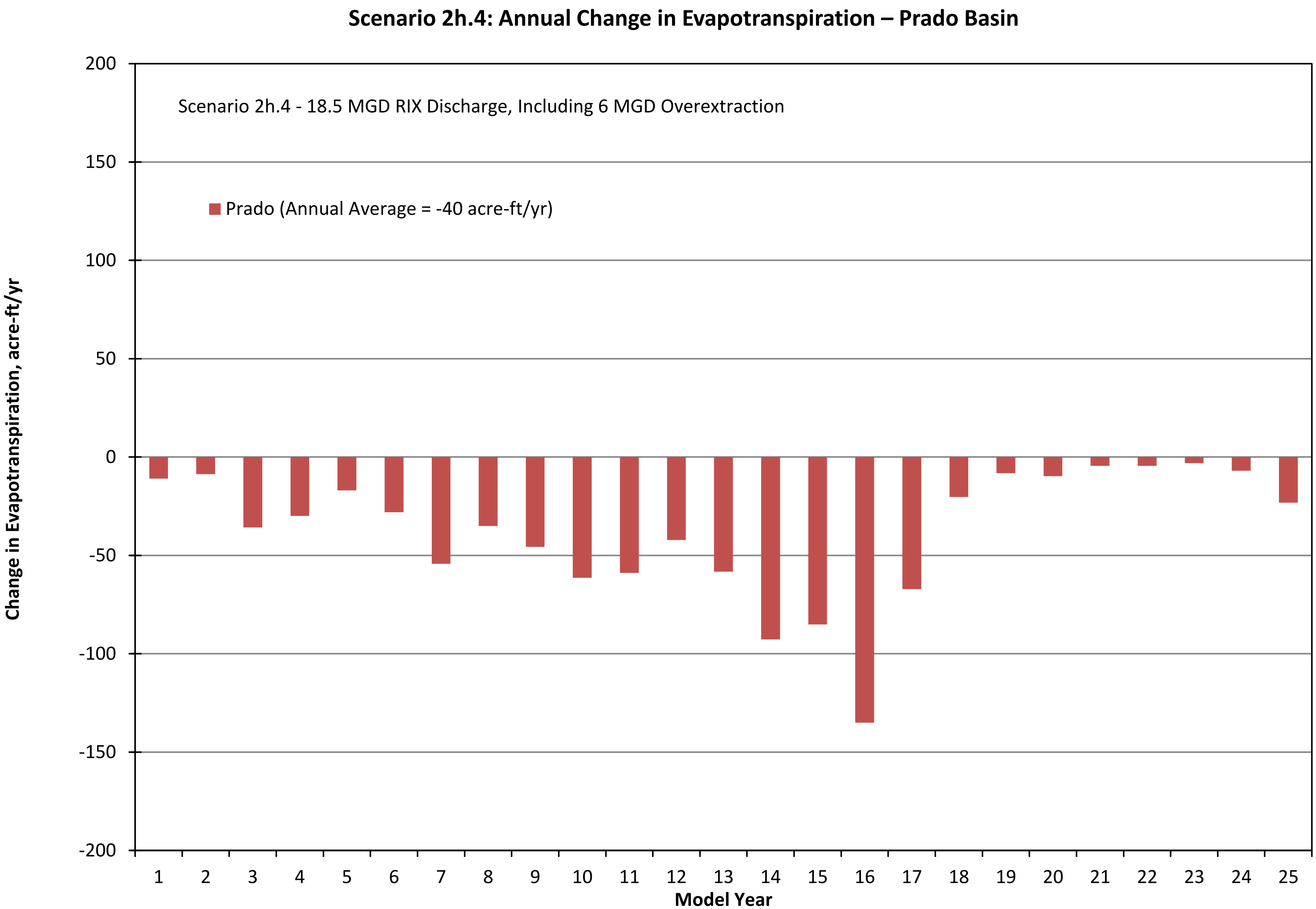
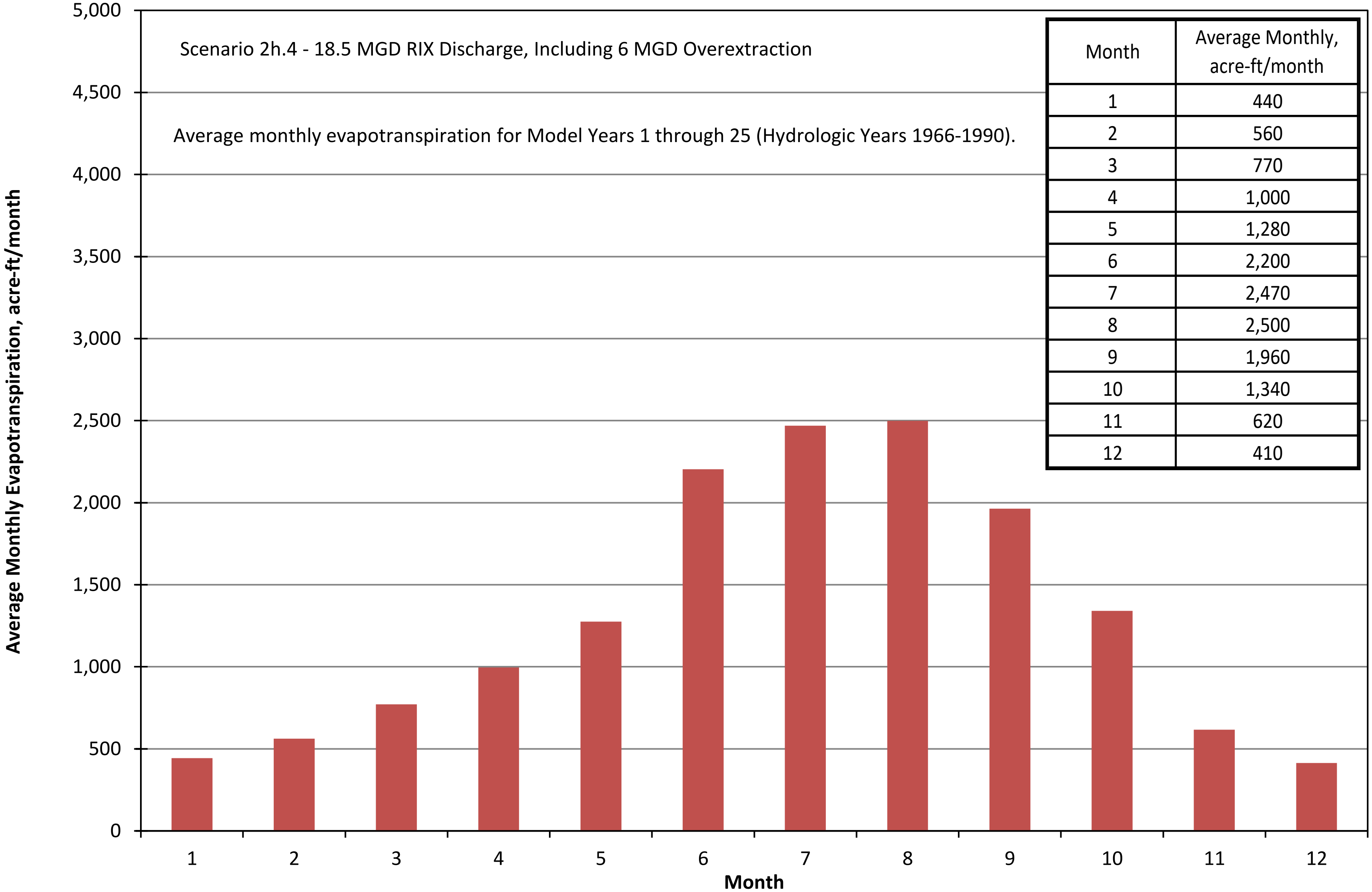

Scenario 2h.4: Annual Change in Evapotranspiration – Prado Basin
Scenario 2h.4 - 18.5 MGD RIX Discharge, Including 6 MGD Overextraction
Prado (Annual Average = -40 acre-ft/yr)
Change in Evapotranspiration, acre-ft/yr
200
150
100
50
0
-50
-100
-150
-200
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
Model Year

Figure 816

Scenario 2h.4: Seasonal Evapotranspiration – Prado Basin



Month	Average Monthly, acre-ft/month
1	440
2	560
3	770
4	1,000
5	1,280
6	2,200
7	2,470
8	2,500
9	1,960
10	1,340
11	620
12	410

Figure 817

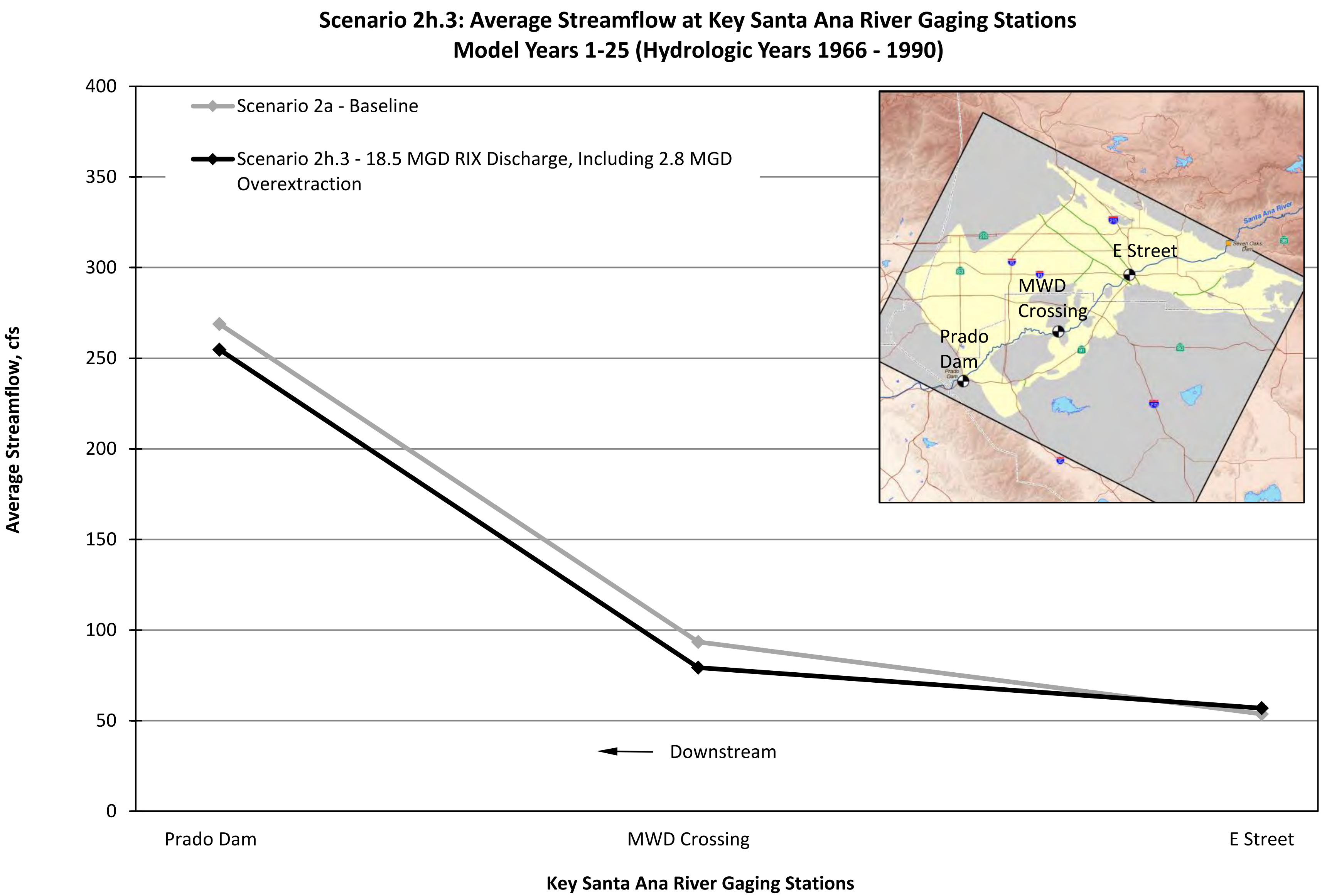

Scenario 2h.3: Average Streamflow at Key Santa Ana River Gaging Stations
Model Years 1-25 (Hydrologic Years 1966 - 1990)
Scenario 2a - Baseline
Scenario 2h.3 - 18.5 MGD RIX Discharge, Including 2.8 MGD Overextraction
Average Streamflow, cfs
400
350
300
250
200
150
100
50
0
E Street
MWD Crossing
Prado Dam
Downstream
Prado Dam
MWD Crossing
E Street
Key Santa Ana River Gaging Stations

Figure 818

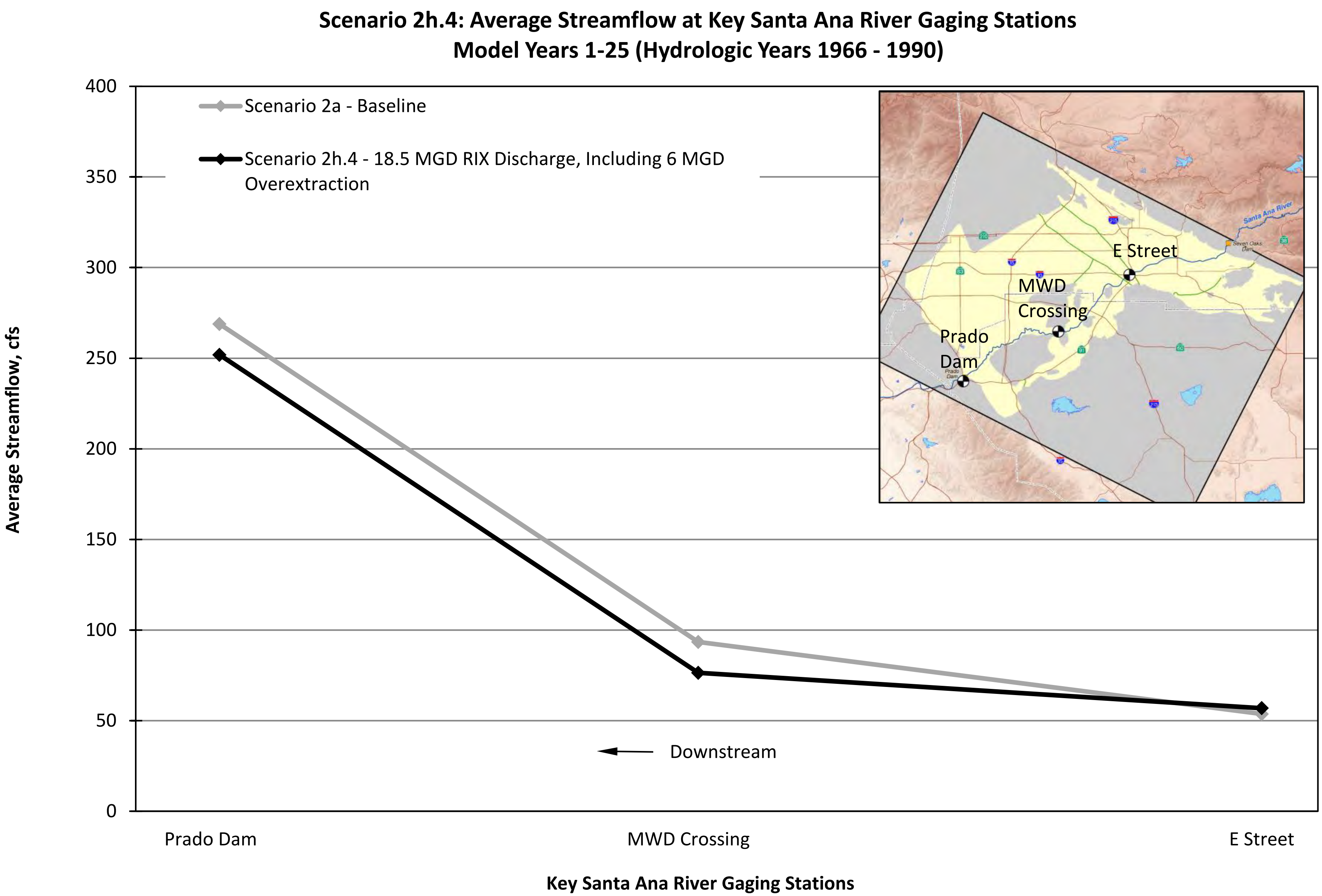

Scenario 2h.4: Average Streamflow at Key Santa Ana River Gaging Stations
Model Years 1-25 (Hydrologic Years 1966 - 1990)
Scenario 2a - Baseline
Scenario 2h.4 - 18.5 MGD RIX Discharge, Including 6 MGD Overextraction
400
350
300
250
200
150
100
50
0
Average Streamflow, cfs
E Street
MWD Crossing
Prado Dam
Downstream
Prado Dam
MWD Crossing
E Street
Key Santa Ana River Gaging Stations

Figure 819

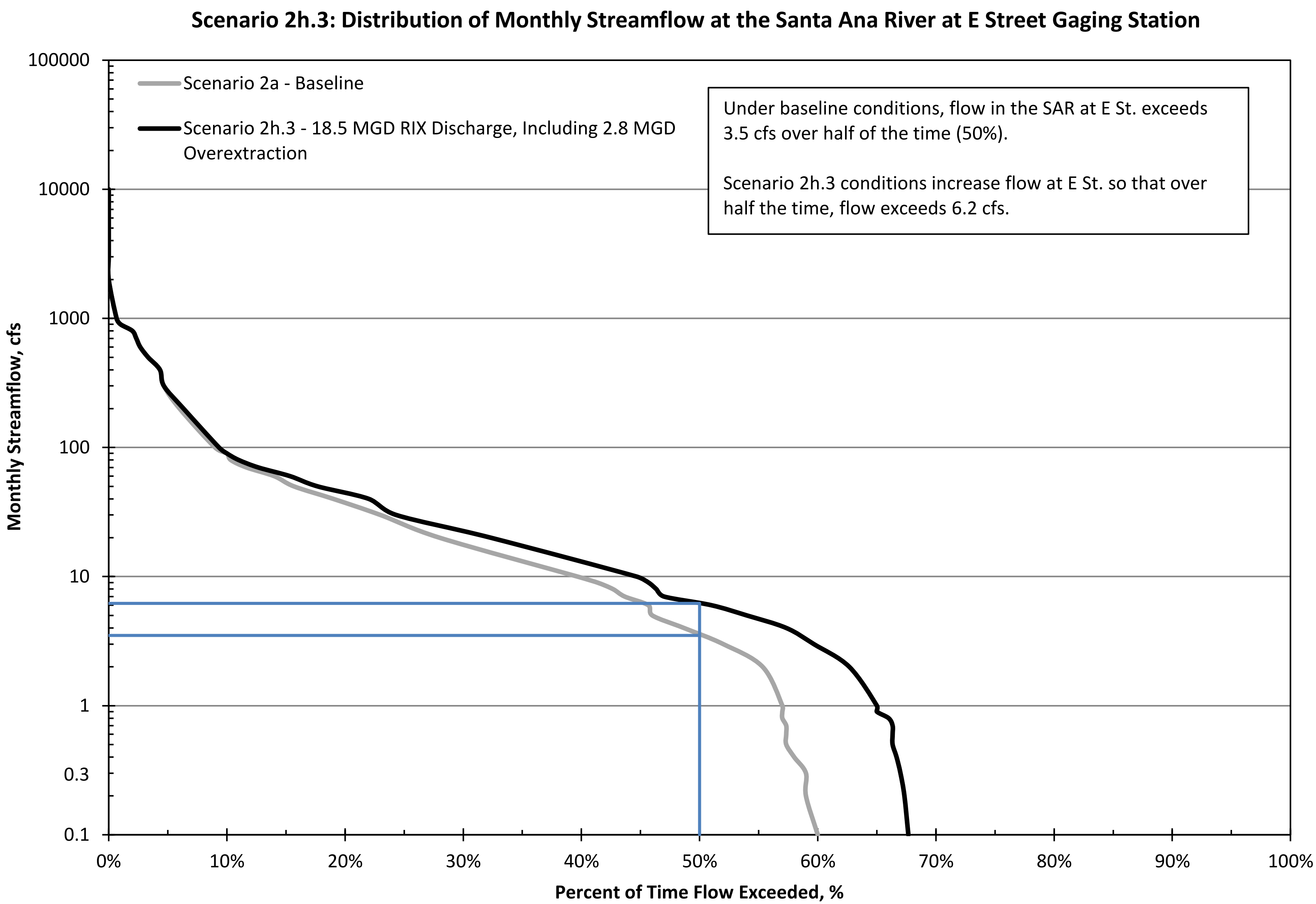

Scenario 2h.3: Distribution of Monthly Streamflow at the Santa Ana River at E Street Gaging Station
Scenario 2a - Baseline
Scenario 2h.3 - 18.5 MGD RIX Discharge, Including 2.8 MGD Overextraction
Under baseline conditions, flow in the SAR at E St. exceeds 3.5 cfs over half of the time (50%).
Scenario 2h.3 conditions increase flow at E St. so that over half the time, flow exceeds 6.2 cfs.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.3
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 820

DRAFT

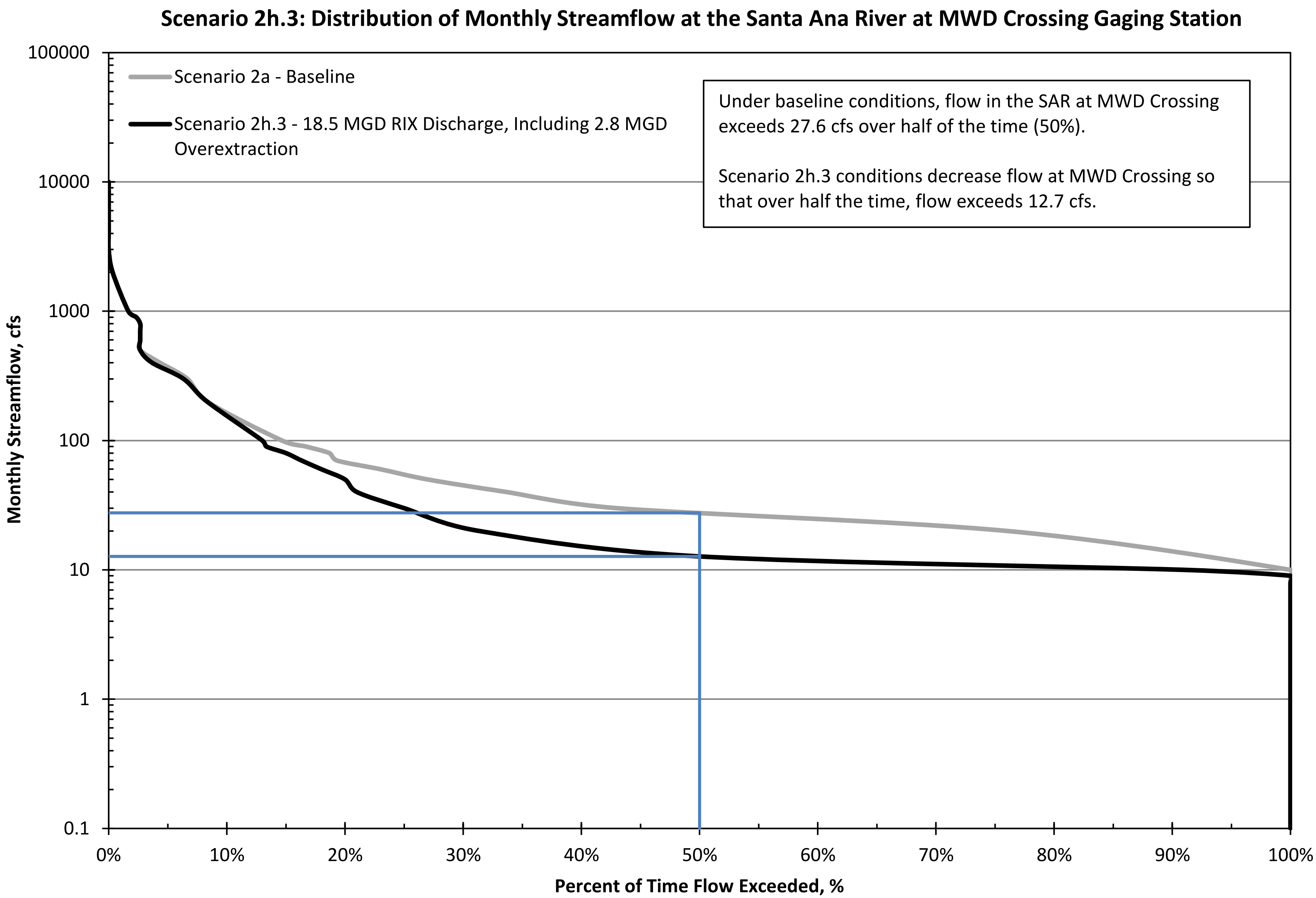


Figure 821

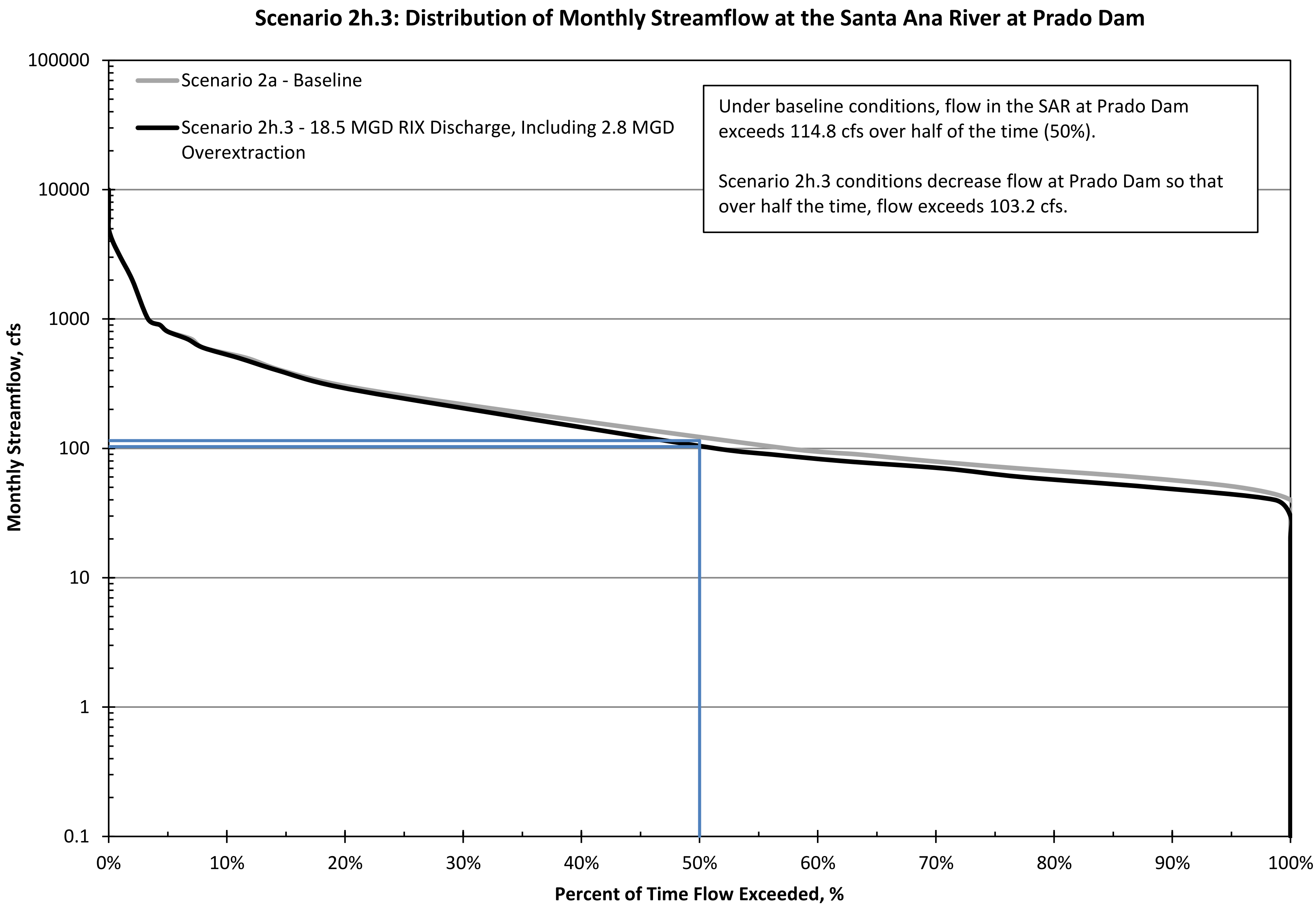

Scenario 2h.3: Distribution of Monthly Streamflow at the Santa Ana River at Prado Dam
Scenario 2a - Baseline
Scenario 2h.3 - 18.5 MGD RIX Discharge, Including 2.8 MGD Overextraction
Under baseline conditions, flow in the SAR at Prado Dam exceeds 114.8 cfs over half of the time (50%).
Scenario 2h.3 conditions decrease flow at Prado Dam so that over half the time, flow exceeds 103.2 cfs.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 822

DRAFT

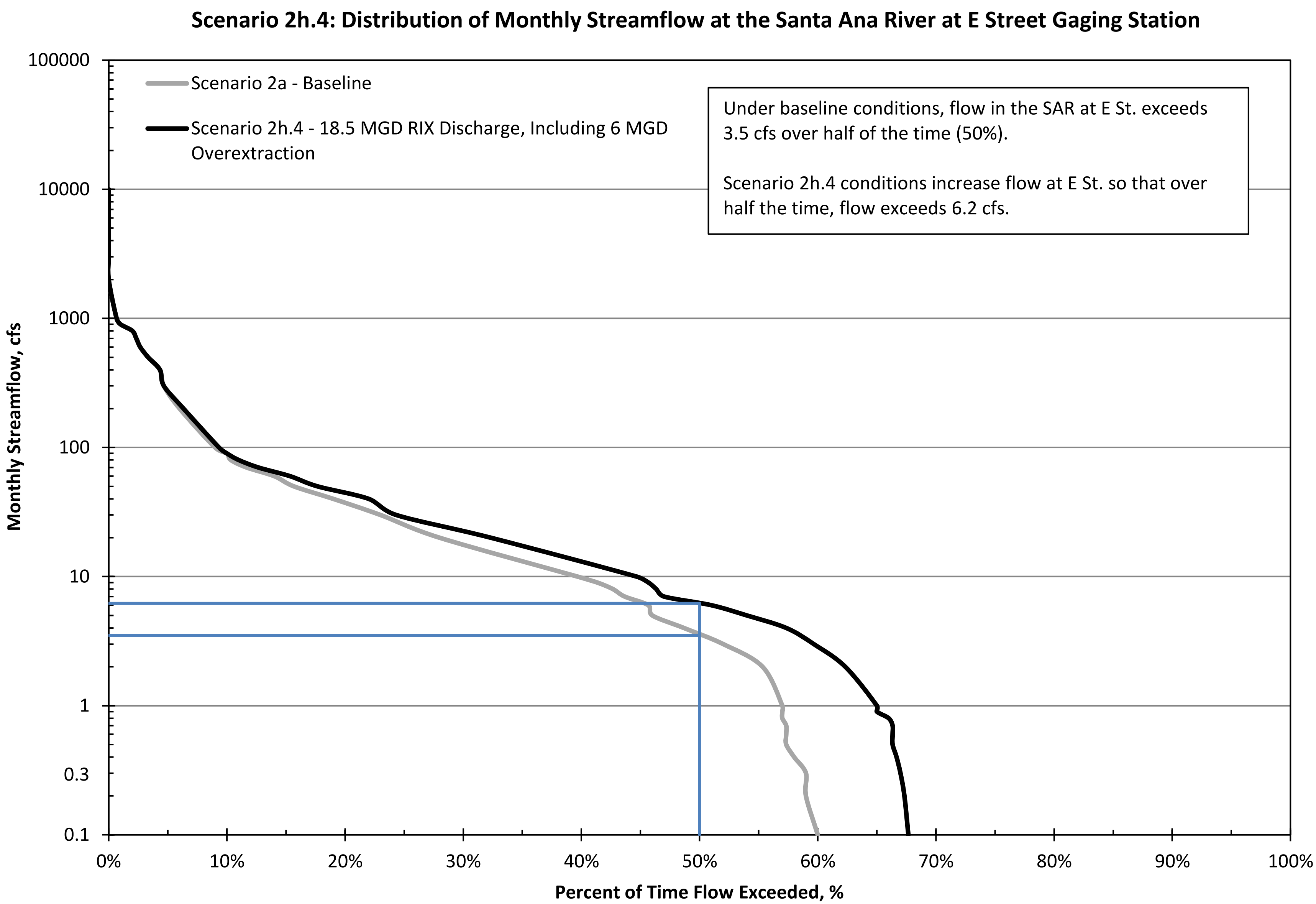


Figure 823

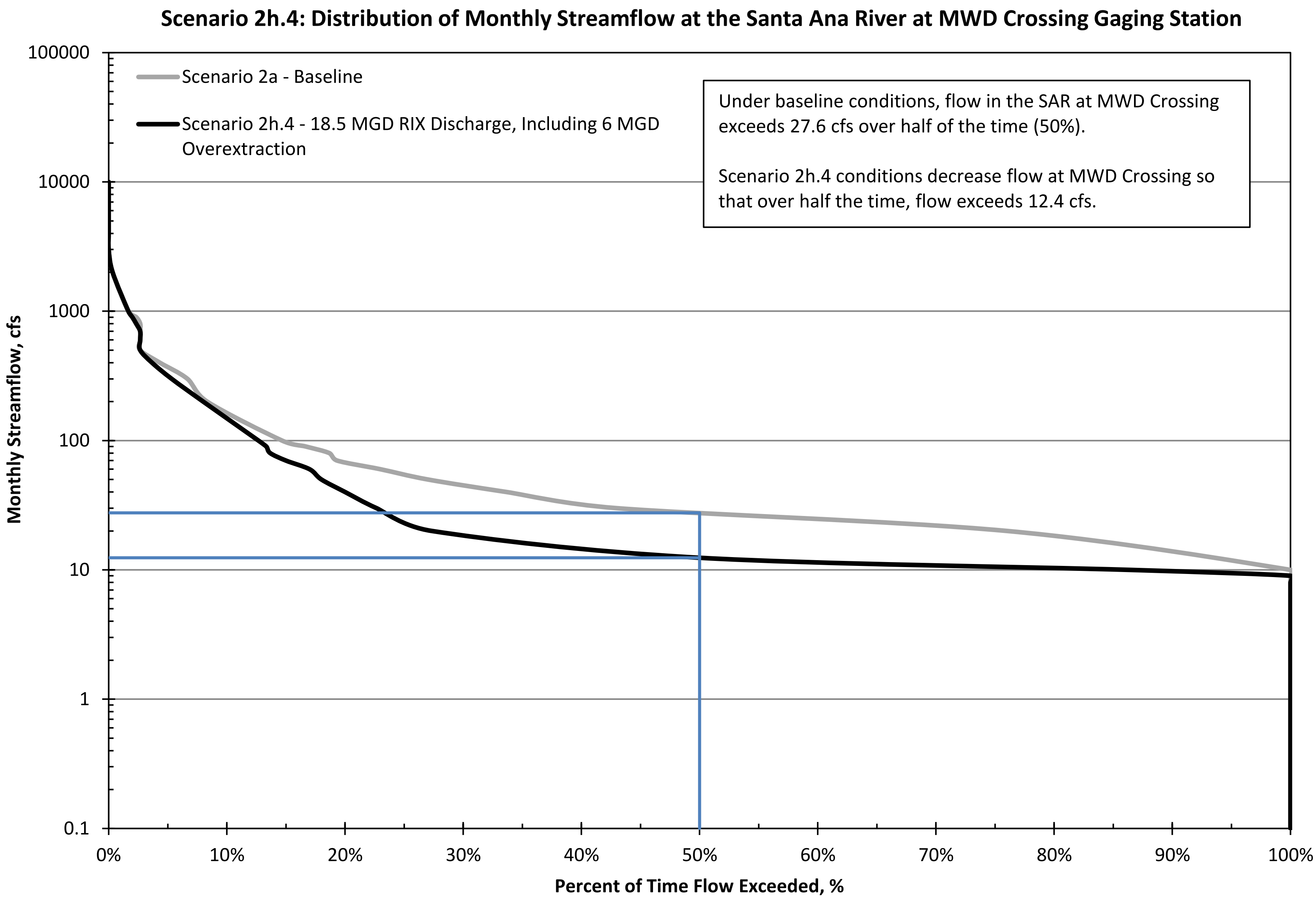

Scenario 2h.4: Distribution of Monthly Streamflow at the Santa Ana River at MWD Crossing Gaging Station
Scenario 2a - Baseline
Scenario 2h.4 - 18.5 MGD RIX Discharge, Including 6 MGD Overextraction
Under baseline conditions, flow in the SAR at MWD Crossing exceeds 27.6 cfs over half of the time (50%).
Scenario 2h.4 conditions decrease flow at MWD Crossing so that over half the time, flow exceeds 12.4 cfs.
100000
10000
1000
100
10
1
0.1
Monthly Streamflow, cfs
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 824

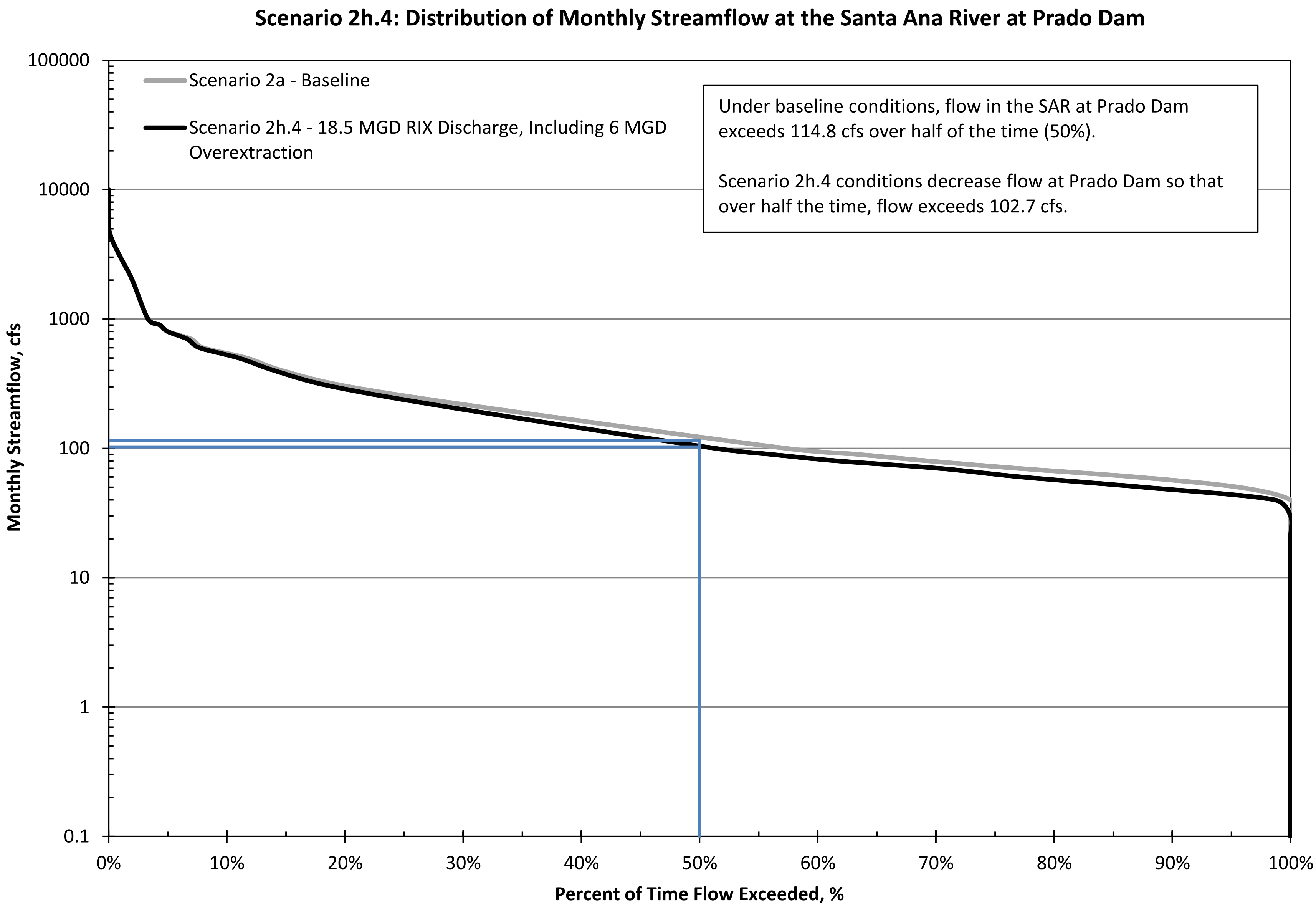
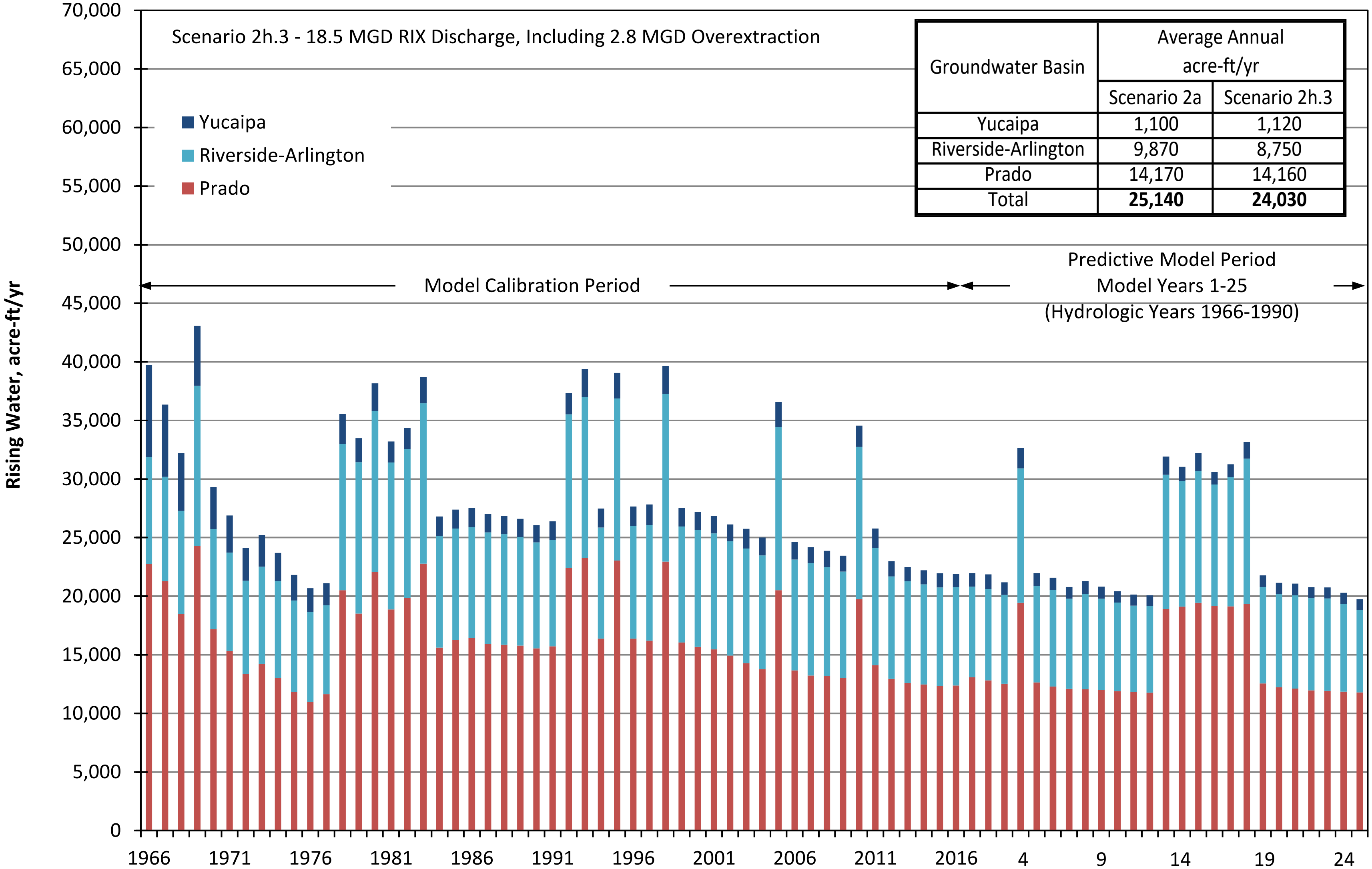

Scenario 2h.4: Distribution of Monthly Streamflow at the Santa Ana River at Prado Dam
Scenario 2a - Baseline
Scenario 2h.4 - 18.5 MGD RIX Discharge, Including 6 MGD Overextraction
Under baseline conditions, flow in the SAR at Prado Dam exceeds 114.8 cfs over half of the time (50%).
Scenario 2h.4 conditions decrease flow at Prado Dam so that over half the time, flow exceeds 102.7 cfs.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 825

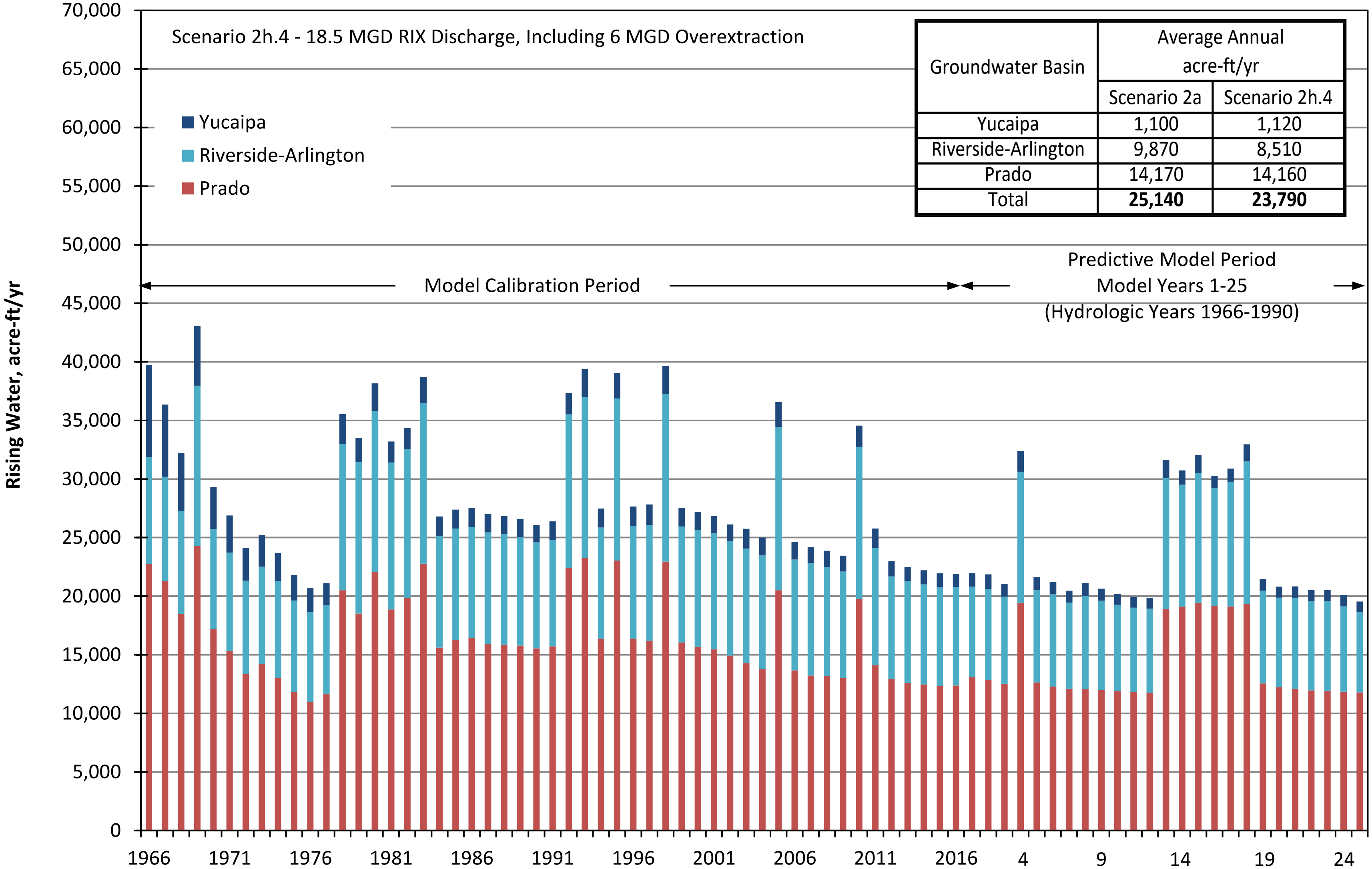
Scenario 2h.3: Annual Rising Water – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2h.3
Yucaipa	1,100	1,120
Riverside-Arlington	9,870	8,750
Prado	14,170	14,160
Total	**25,140**	**24,030**

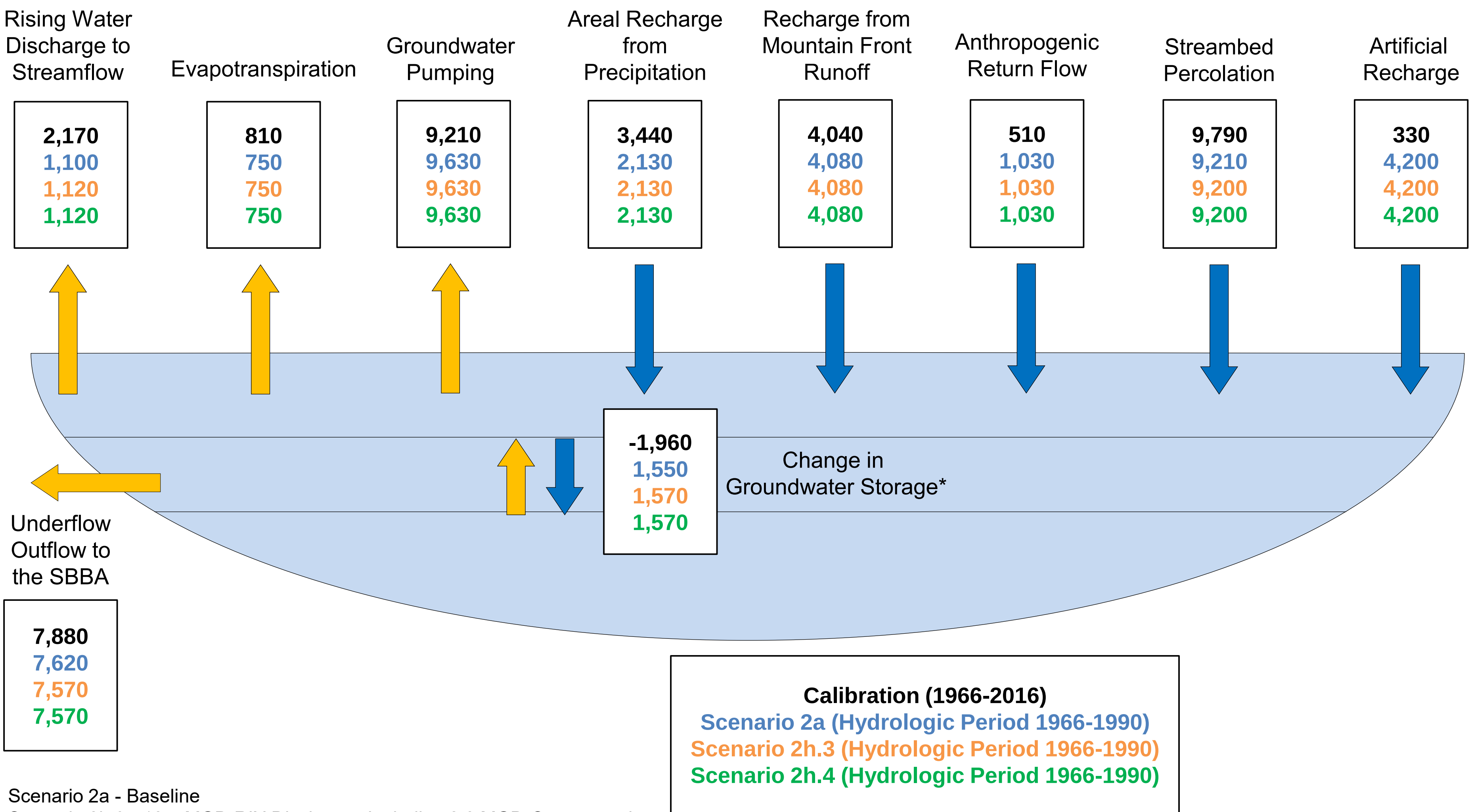
Figure 826

Scenario 2h.4: Annual Rising Water – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 2h.4
Yucaipa	1,100	1,120
Riverside-Arlington	9,870	8,510
Prado	14,170	14,160
Total	**25,140**	**23,790**

Figure 827



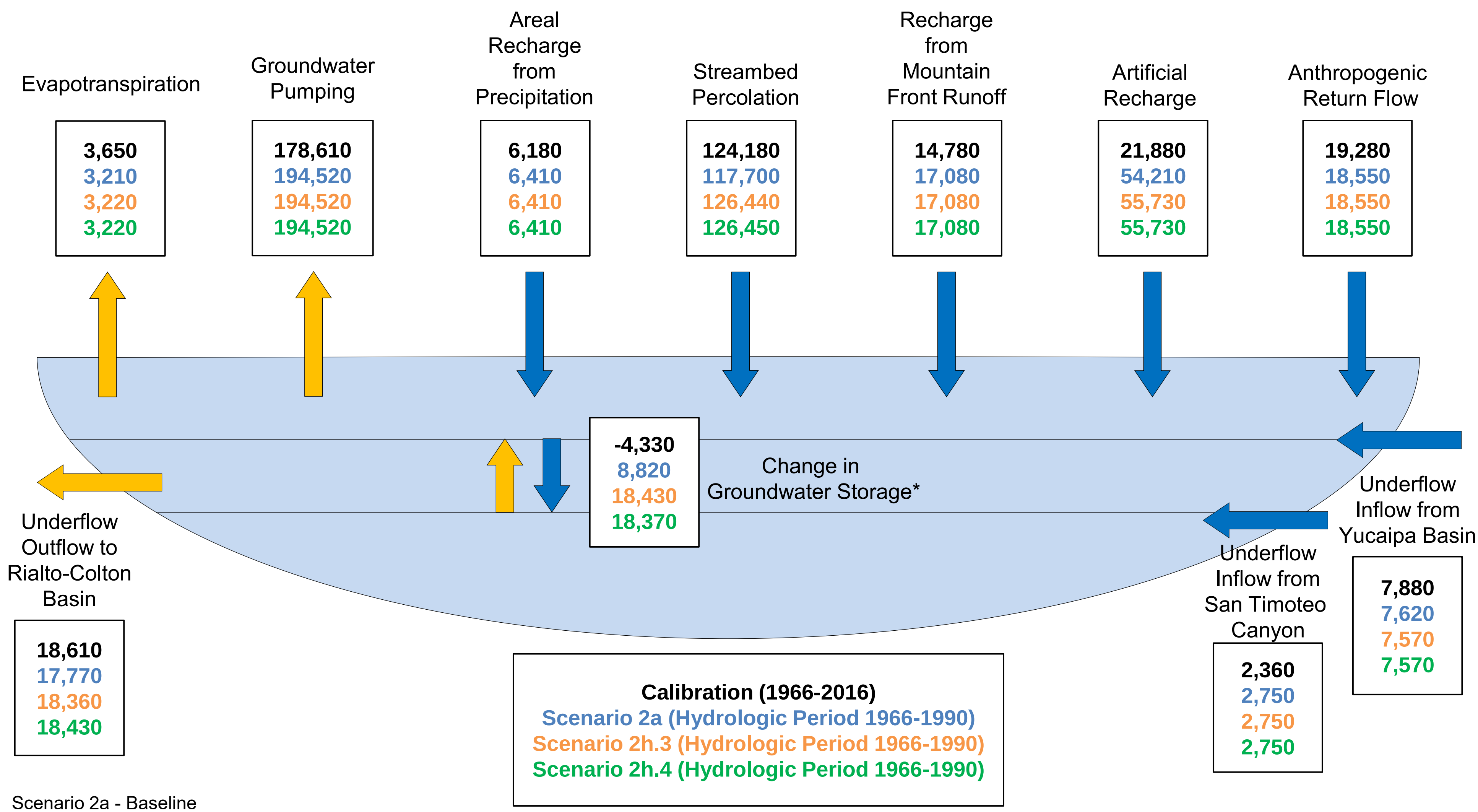
Scenario 2a - Baseline
Scenario 2h.3 - 18.5 MGD RIX Discharge, Including 2.8 MGD Overextraction
Scenario 2h.4 - 18.5 MGD RIX Discharge, Including 6 MGD Overextraction

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2H AVERAGE ANNUAL WATER BUDGET YUCAIPA BASIN

10-Apr-20



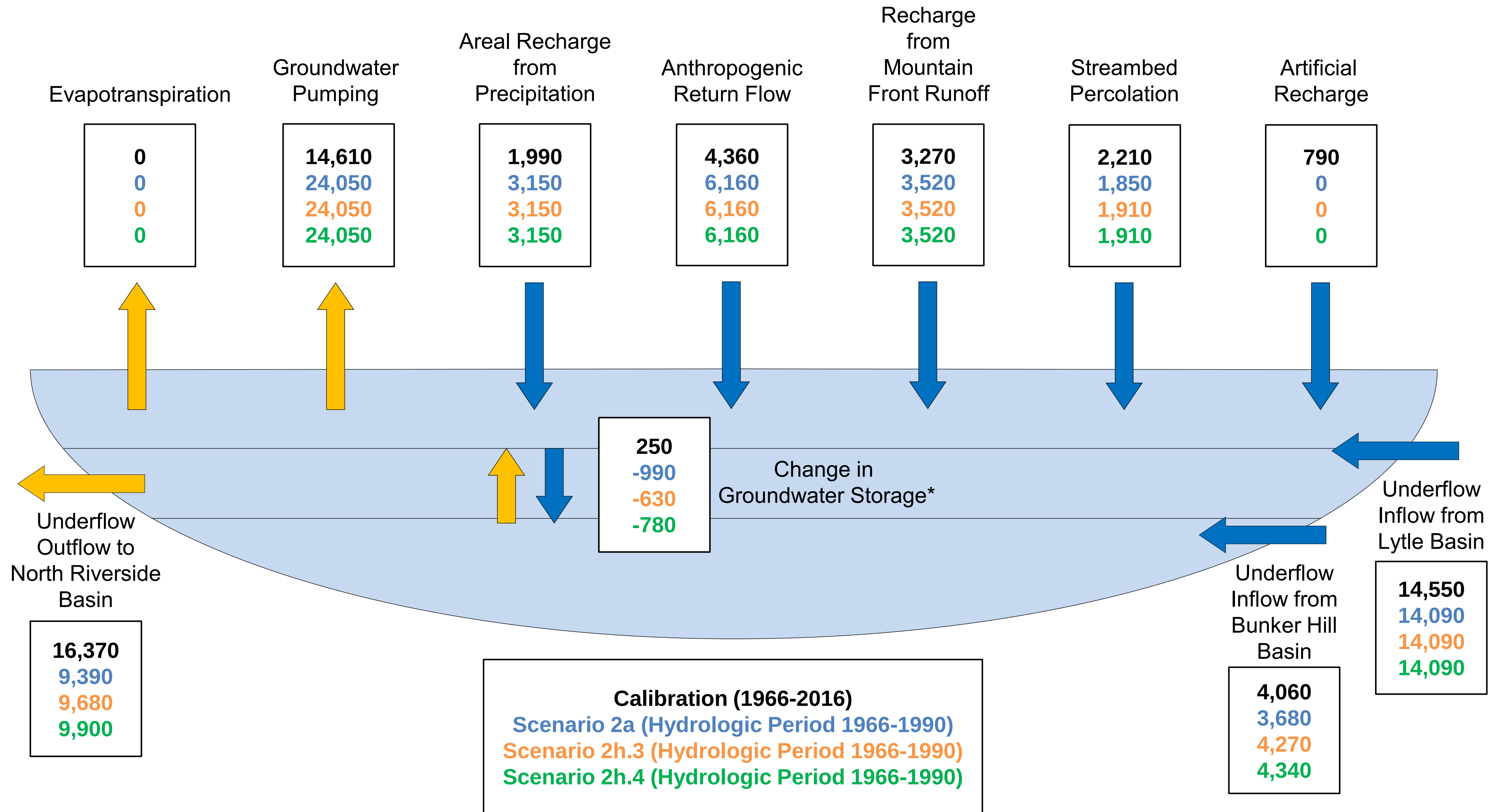
Scenario 2a - Baseline
Scenario 2h.3 - 18.5 MGD RIX Discharge, Including 2.8 MGD Overextraction
Scenario 2h.4 - 18.5 MGD RIX Discharge, Including 6 MGD Overextraction

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2H AVERAGE ANNUAL WATER BUDGET SBBA

10-Apr-20



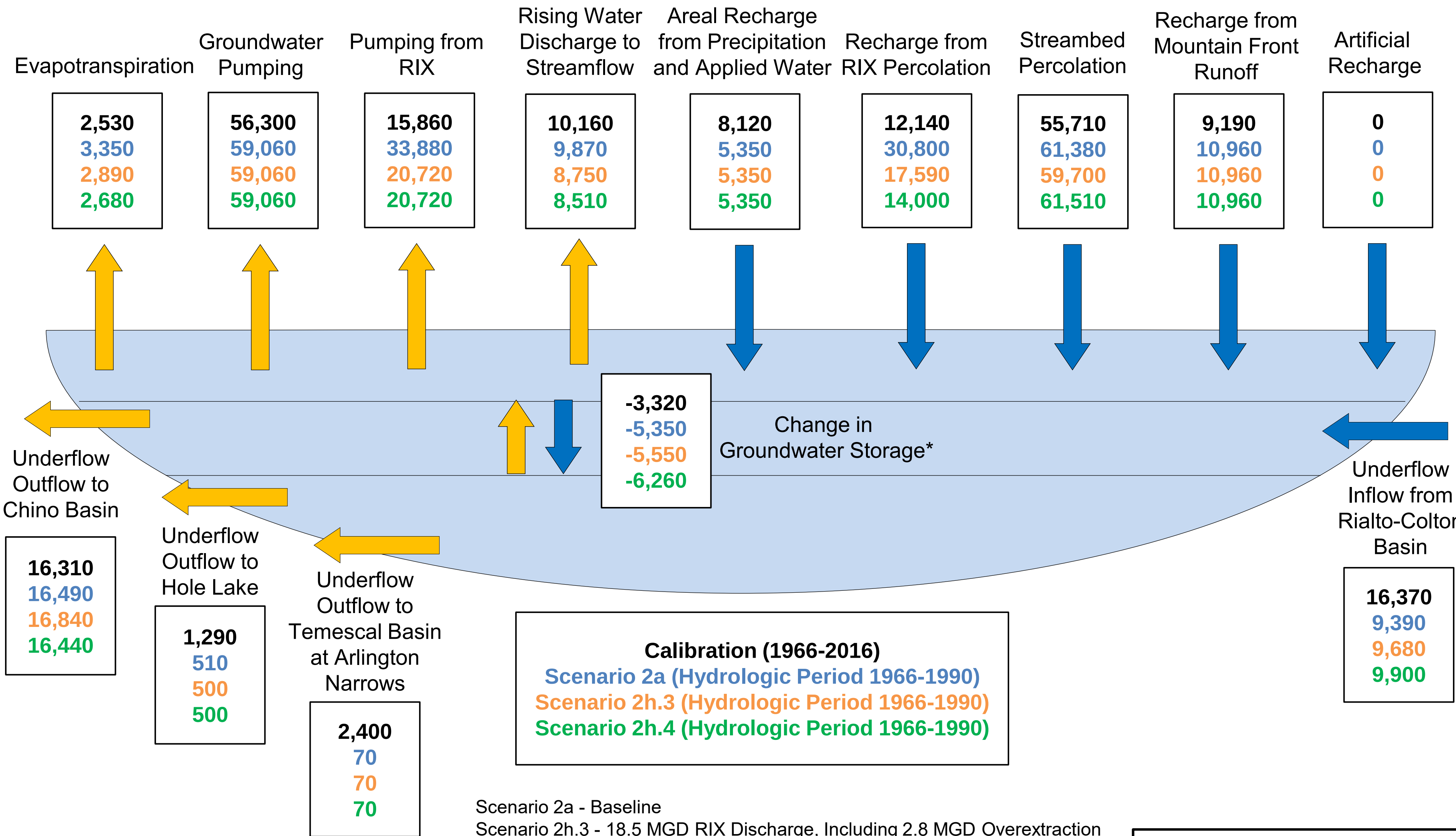
Scenario 2a - Baseline
Scenario 2h.3 - 18.5 MGD RIX Discharge, Including 2.8 MGD Overextraction
Scenario 2h.4 - 18.5 MGD RIX Discharge, Including 6 MGD Overextraction

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2H
AVERAGE ANNUAL
WATER BUDGET
RIALTO-COLTON BASIN

10-Apr-20



Scenario 2a - Baseline
Scenario 2h.3 - 18.5 MGD RIX Discharge, Including 2.8 MGD Overextraction
Scenario 2h.4 - 18.5 MGD RIX Discharge, Including 6 MGD Overextraction

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2H AVERAGE ANNUAL WATER BUDGET RIVERSIDE-ARLINGTON BASIN

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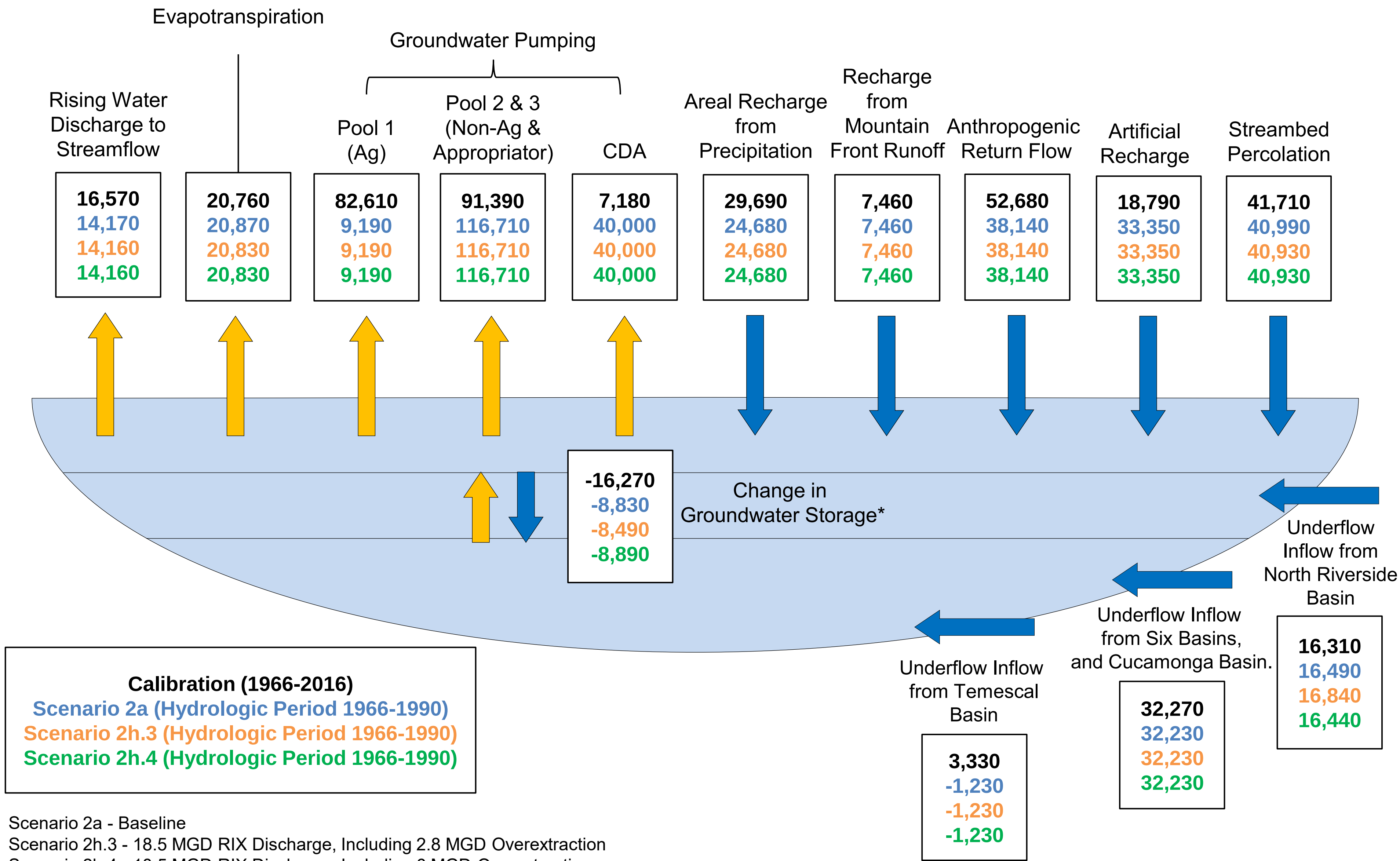


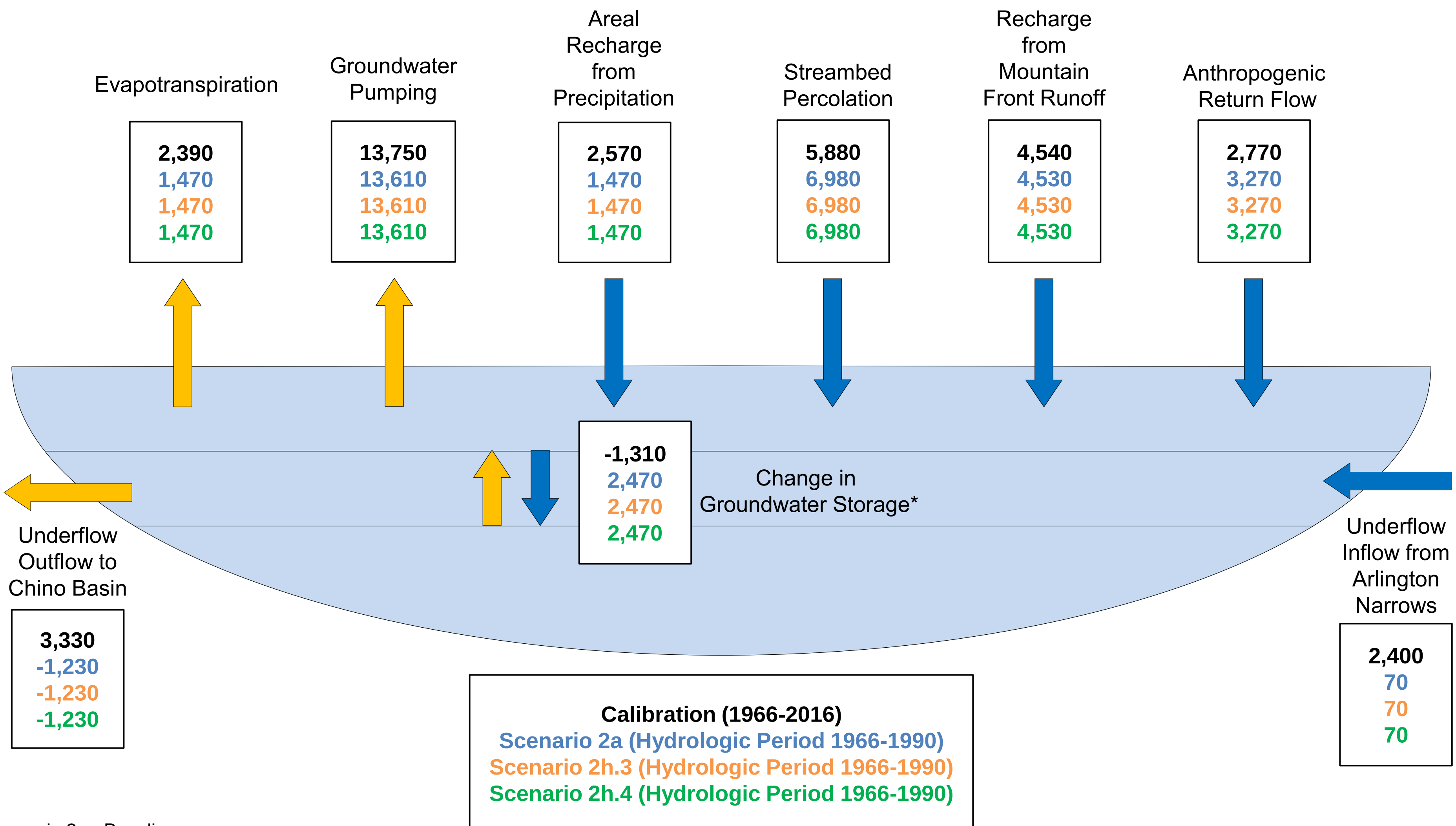
Scenario 2a - Baseline
Scenario 2h.3 - 18.5 MGD RIX Discharge, Including 2.8 MGD Overextraction
Scenario 2h.4 - 18.5 MGD RIX Discharge, Including 6 MGD Overextraction

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2H
AVERAGE ANNUAL
WATER BUDGET
CHINO BASIN

10-Apr-20



Scenario 2a - Baseline
Scenario 2h.3 - 18.5 MGD RIX Discharge, Including 2.8 MGD Overextraction
Scenario 2h.4 - 18.5 MGD RIX Discharge, Including 6 MGD Overextraction

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 2H AVERAGE ANNUAL WATER BUDGET TEMESCAL BASIN

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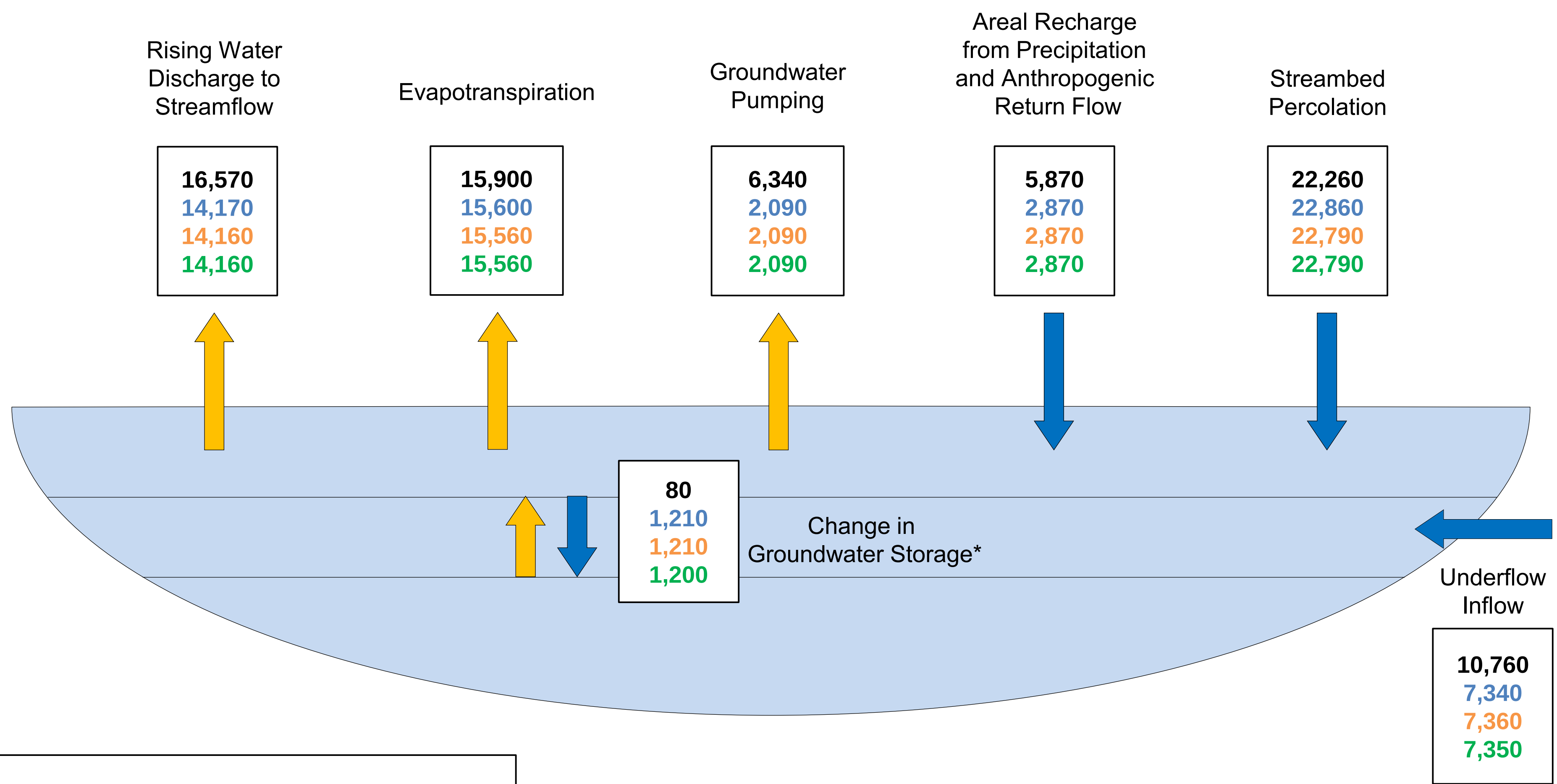


Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 2h.3 (Hydrologic Period 1966-1990)
Scenario 2h.4 (Hydrologic Period 1966-1990)

Scenario 2a - Baseline
Scenario 2h.3 - 18.5 MGD RIX Discharge, Including 2.8 MGD Overextraction
Scenario 2h.4 - 18.5 MGD RIX Discharge, Including 6 MGD Overextraction

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

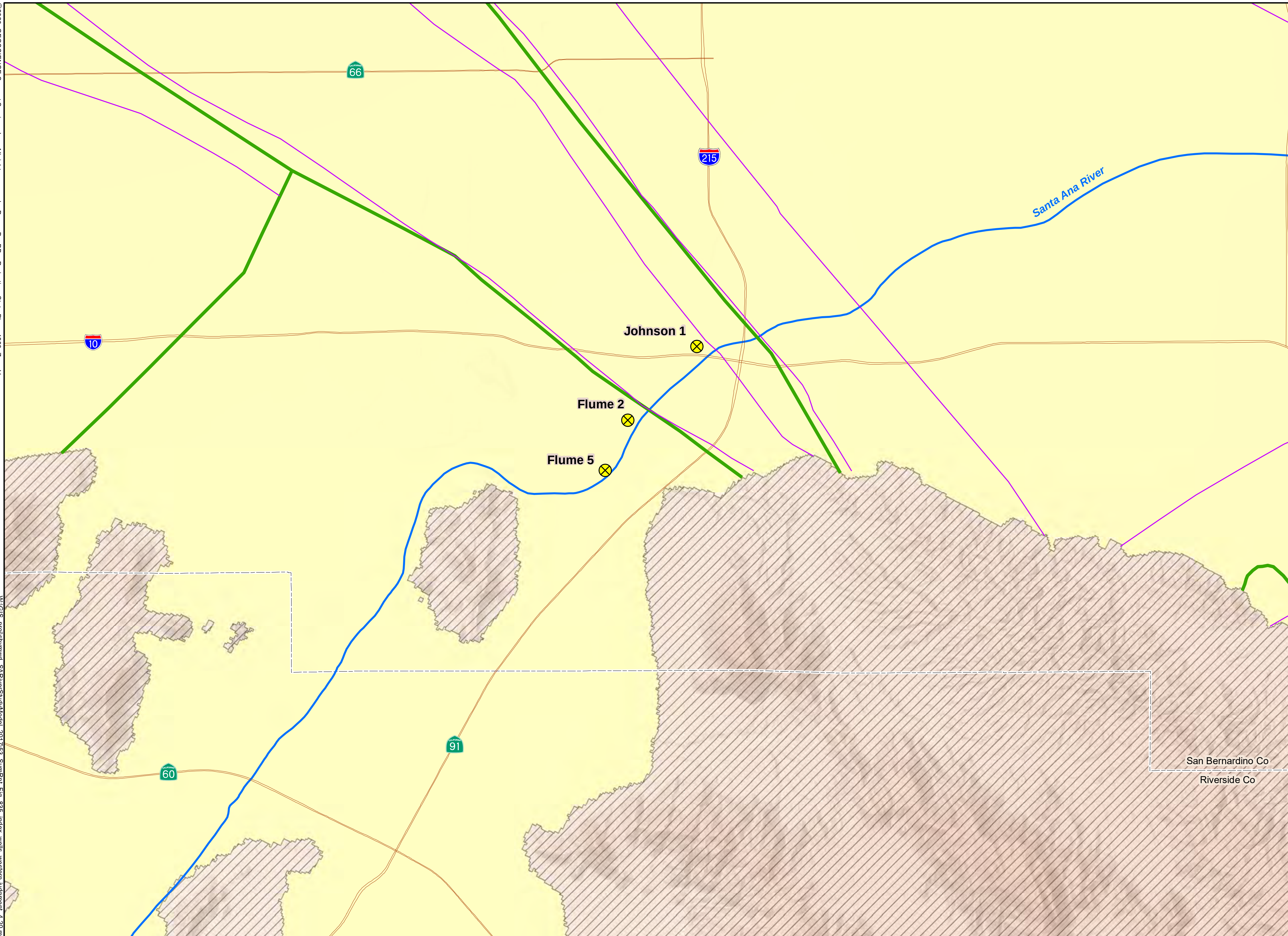
SCENARIO 2H
AVERAGE ANNUAL
WATER BUDGET
PRADO BASIN

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT **DRAFT** **FIGURE 834**

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

GEOSCIENCE



EXPLANATION

Integrated SAR Model Boundary

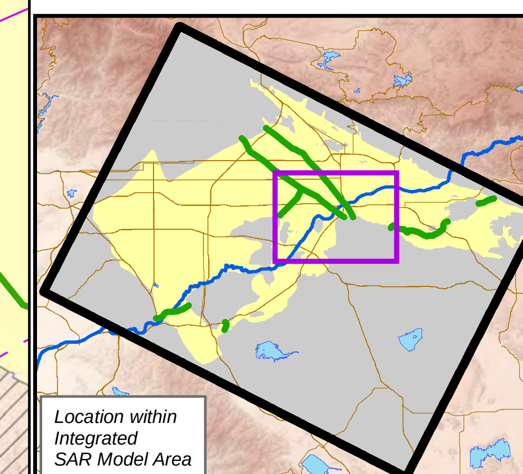
Active Model Area

Inactive Model Area

1969 Western Judgment Index Well

Groundwater Basin Boundary

Groundwater Flow Barrier



N

0 1 2

Miles

LOCATION OF WESTERN JUDGMENT INDEX WELLS

W:\GIS_projs\sbvmwd_SARiverStudyModel_2017\53_SumRpt_Fig_835_index_wells_western-judgment_4-20.mxd

10-Apr-20

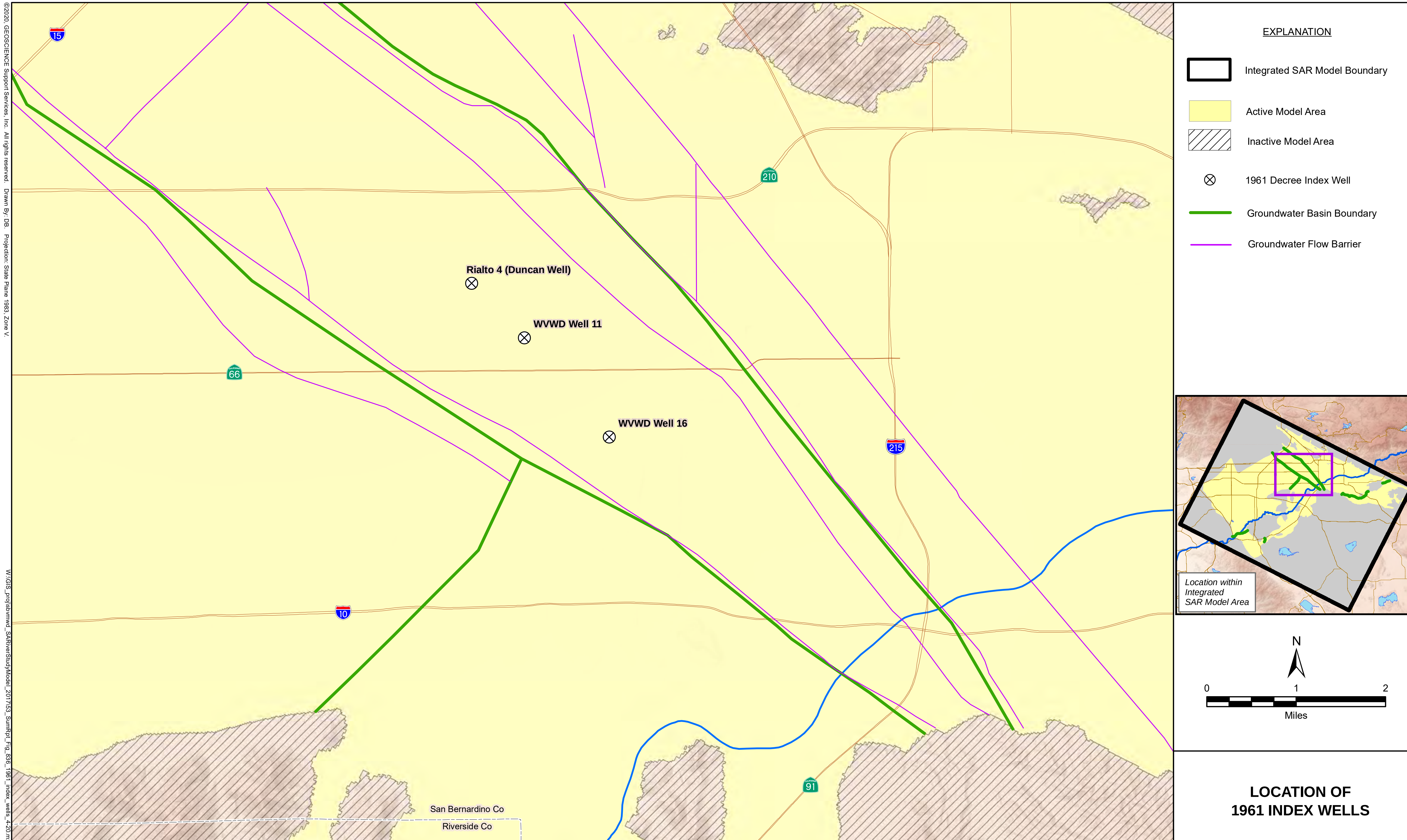
SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

DRAFT

FIGURE 835

GEOSCIENCE



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10-Apr-20

LOCATION OF 1961 INDEX WELLS

DRAFT

FIGURE 836

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

GEOSCIENCE

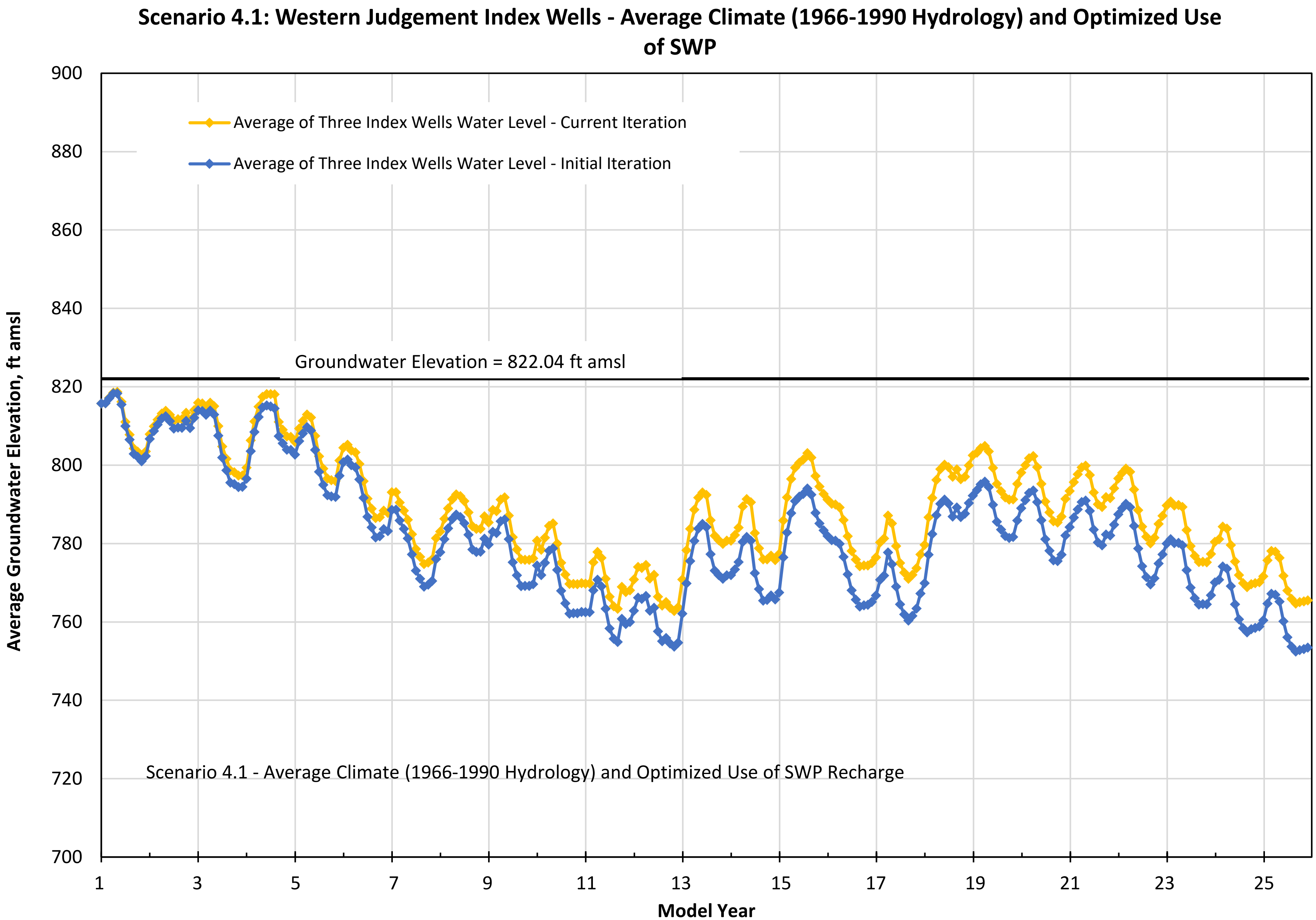
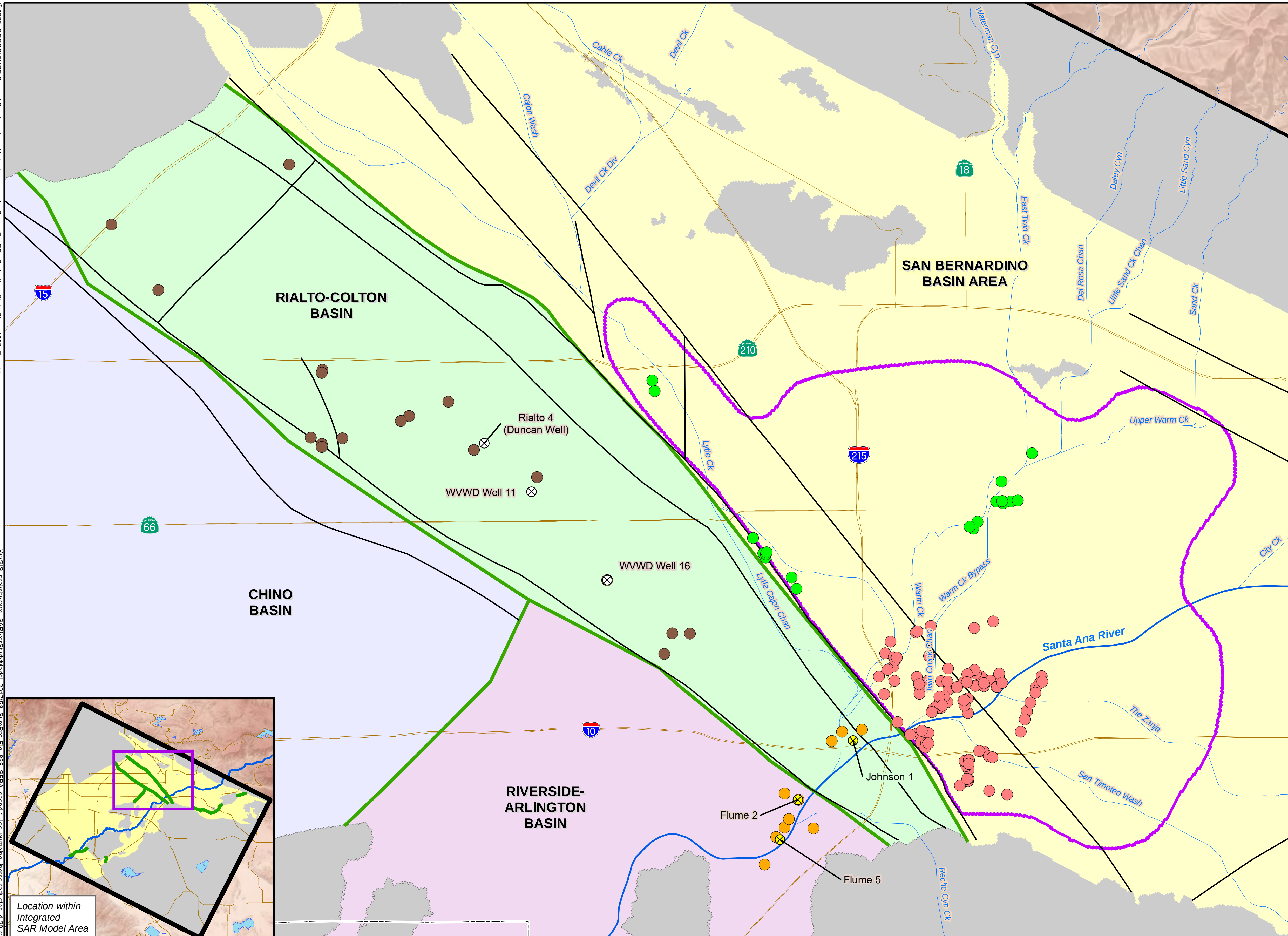

Scenario 4.1: Western Judgement Index Wells - Average Climate (1966-1990 Hydrology) and Optimized Use of SWP
Average of Three Index Wells Water Level - Current Iteration
Average of Three Index Wells Water Level - Initial Iteration
Groundwater Elevation = 822.04 ft amsl
Scenario 4.1 - Average Climate (1966-1990 Hydrology) and Optimized Use of SWP Recharge
Average Groundwater Elevation, ft amsl
900
880
860
840
820
800
780
760
740
720
700
1
3
5
7
9
11
13
15
17
19
21
23
25
Model Year

Figure 837



EXPLANATION

- Integrated SAR Model Boundary
- Inactive Model Area
- Groundwater Basin
- Pressure Zone
- Groundwater Basin Boundary
- Groundwater Flow Barrier
- Production Well With Increased Pumping (Pumpage Transferred from Wells Subject to 1969 Western Judgment)
- Production Well With Decreased Pumping (Subject to 1969 Western Judgment)
- Production Well With Decreased Pumping (Subject to Land Subsidence Reduction)
- Production Well With Decreased Pumping (Subject to 1961 Decree)
- 1961 Decree Index Well
- 1969 Western Judgment Index Well

Scenario 4.1: Average Climate (1966-1990 Hydrology) and Optimized Use of SWP Recharge

N

0 1.25 2.5
Miles

SCENARIO 4.1: LOCATION OF PUMPING INCREASES AND REDUCTIONS

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10-Apr-20

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FIGURE 838

GEOSCIENCE

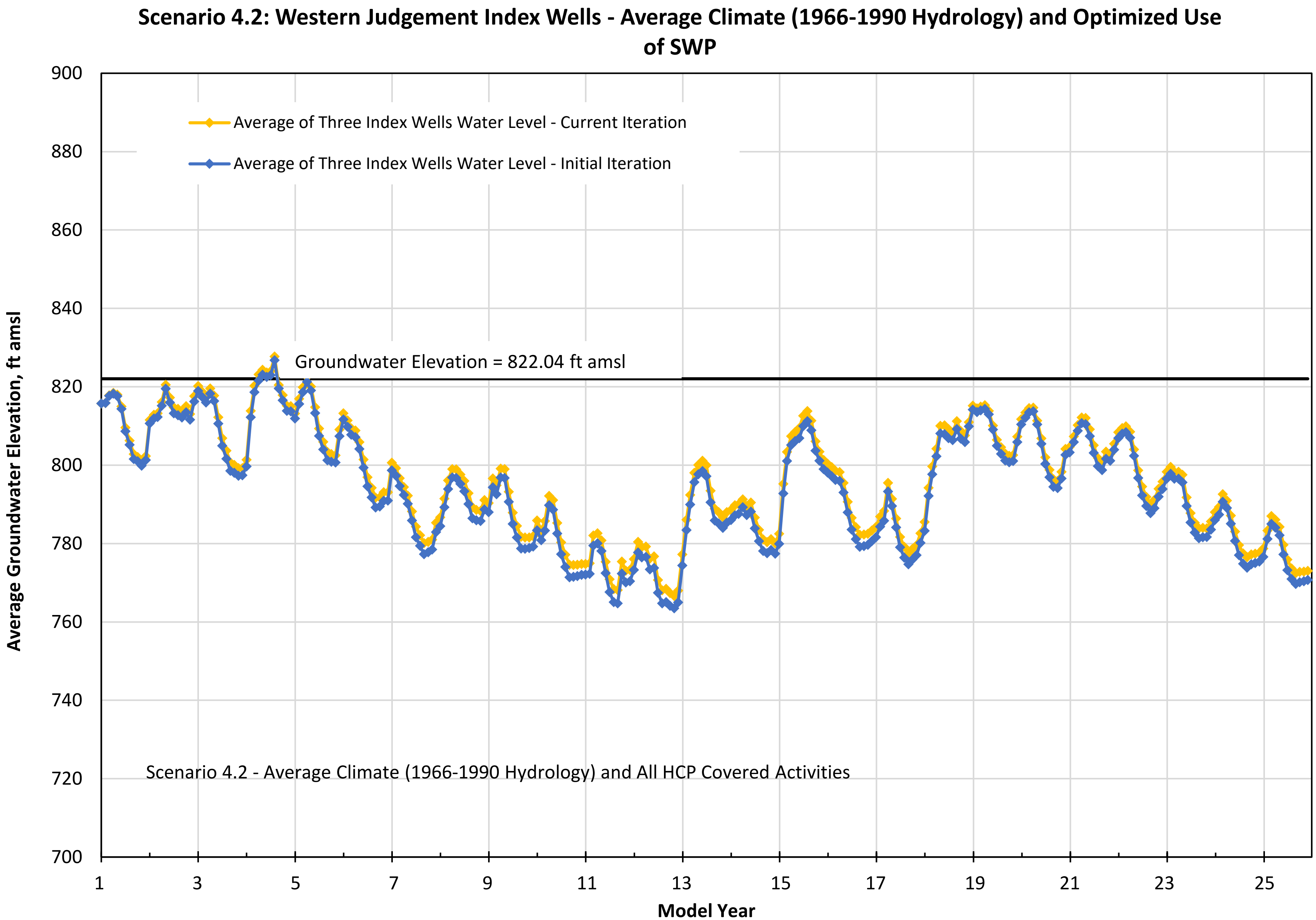
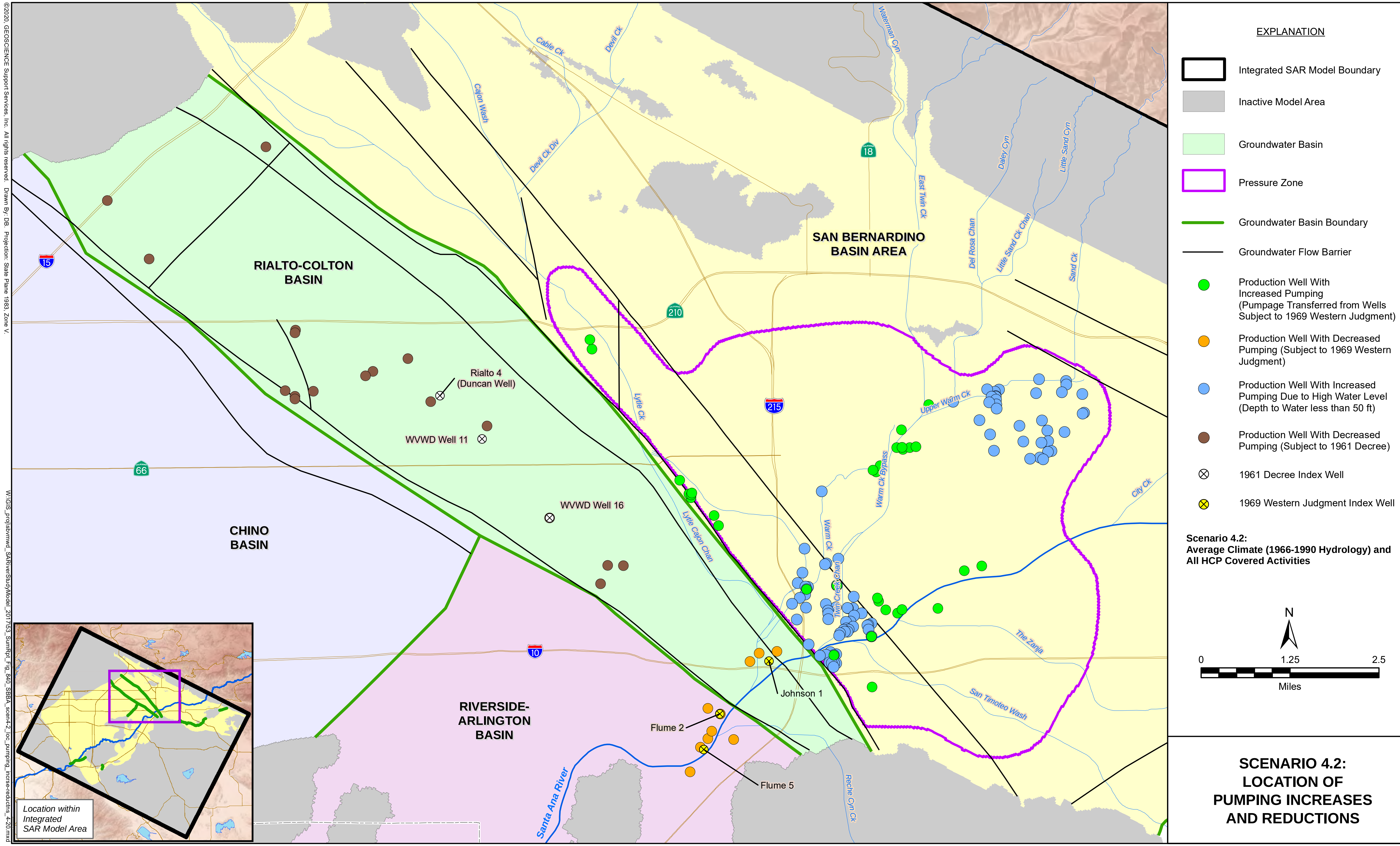

Scenario 4.2: Western Judgement Index Wells - Average Climate (1966-1990 Hydrology) and Optimized Use of SWP
Average of Three Index Wells Water Level - Current Iteration
Average of Three Index Wells Water Level - Initial Iteration
Groundwater Elevation = 822.04 ft amsl
Scenario 4.2 - Average Climate (1966-1990 Hydrology) and All HCP Covered Activities
Average Groundwater Elevation, ft amsl
Model Year
900
880
860
840
820
800
780
760
740
720
700
1
3
5
7
9
11
13
15
17
19
21
23
25

Figure 839



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10-Apr-20

SCENARIO 4.2: LOCATION OF PUMPING INCREASES AND REDUCTIONS

DRAFT

FIGURE 840

GEOSCIENCE

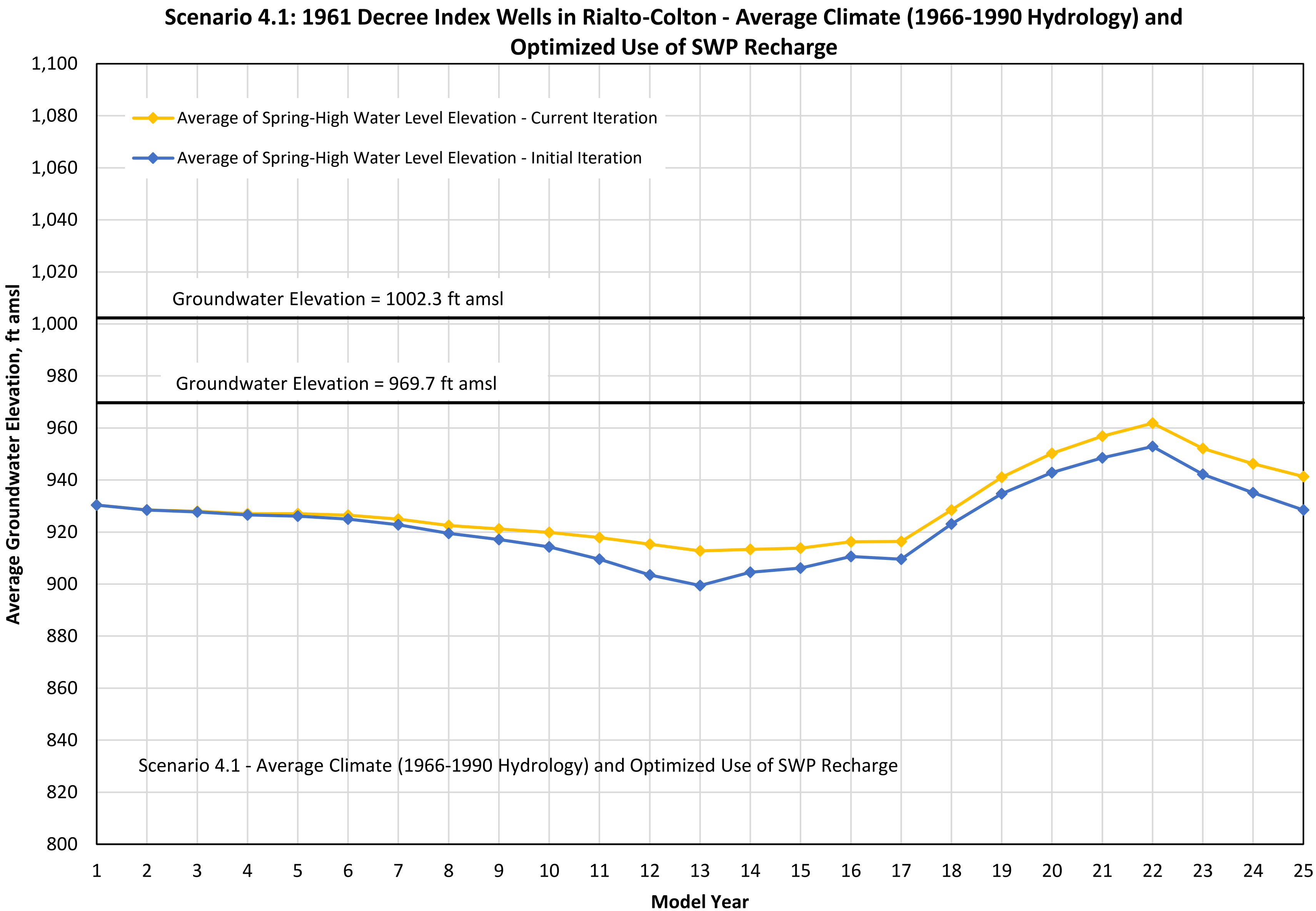

Scenario 4.1: 1961 Decree Index Wells in Rialto-Colton - Average Climate (1966-1990 Hydrology) and Optimized Use of SWP Recharge
Average of Spring-High Water Level Elevation - Current Iteration
Average of Spring-High Water Level Elevation - Initial Iteration
Groundwater Elevation = 1002.3 ft amsl
Groundwater Elevation = 969.7 ft amsl
Scenario 4.1 - Average Climate (1966-1990 Hydrology) and Optimized Use of SWP Recharge
Average Groundwater Elevation, ft amsl
Model Year
1,100
1,080
1,060
1,040
1,020
1,000
980
960
940
920
900
880
860
840
820
800
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

Figure 841

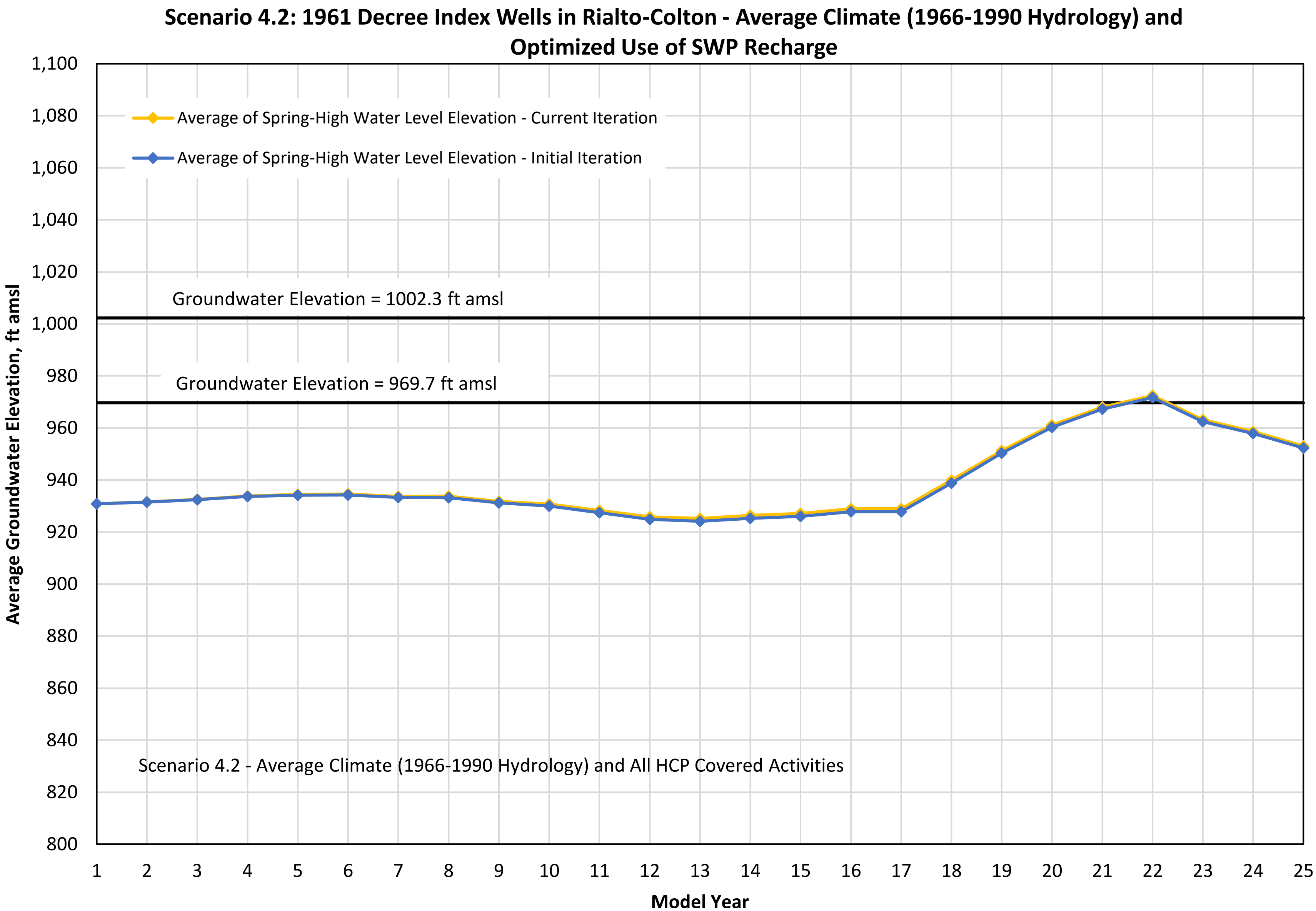
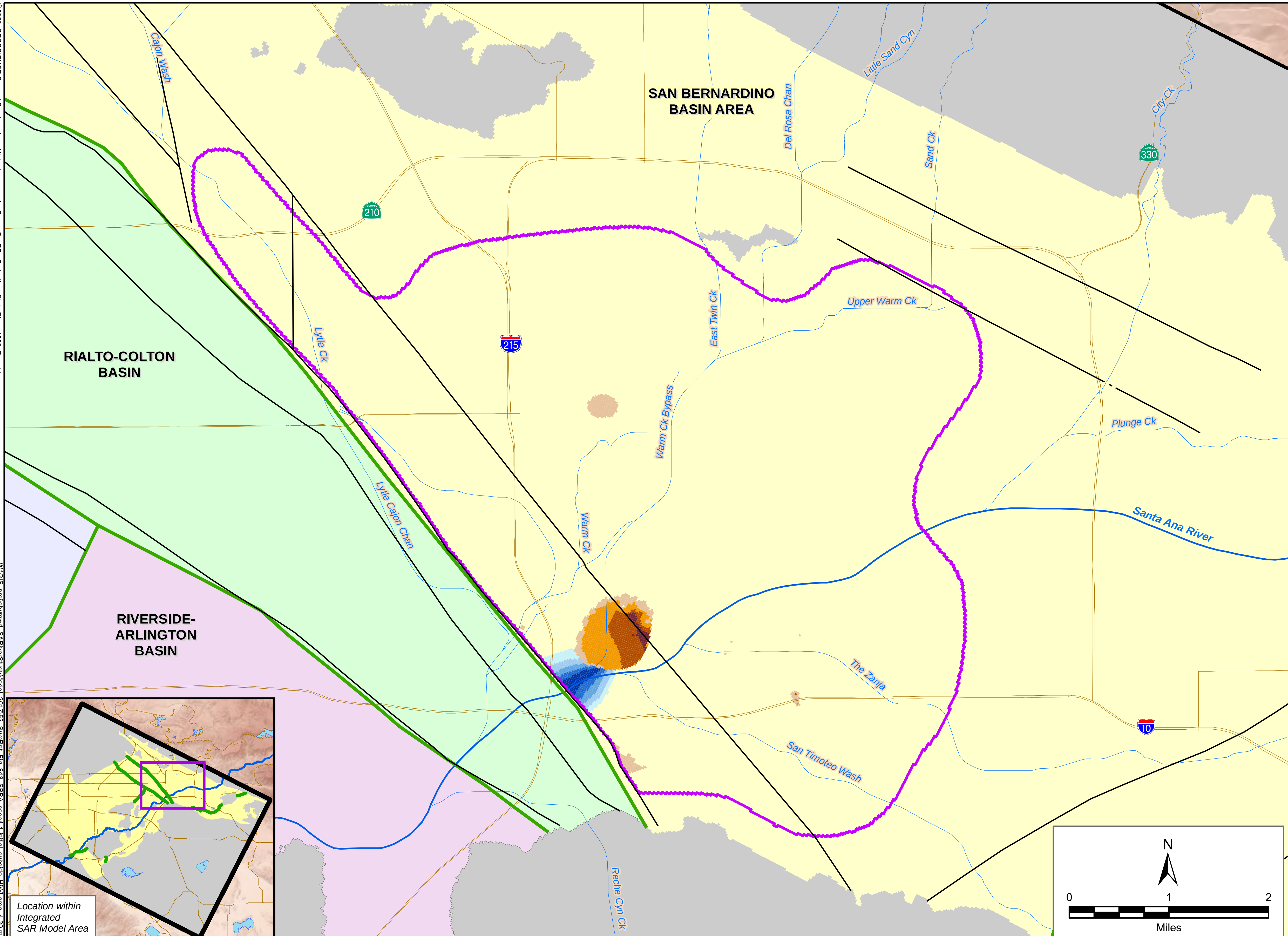

Scenario 4.2: 1961 Decree Index Wells in Rialto-Colton - Average Climate (1966-1990 Hydrology) and Optimized Use of SWP Recharge
Average of Spring-High Water Level Elevation - Current Iteration
Average of Spring-High Water Level Elevation - Initial Iteration
Groundwater Elevation = 1002.3 ft amsl
Groundwater Elevation = 969.7 ft amsl
Scenario 4.2 - Average Climate (1966-1990 Hydrology) and All HCP Covered Activities
Average Groundwater Elevation, ft amsl
Model Year
1,100
1,080
1,060
1,040
1,020
1,000
980
960
940
920
900
880
860
840
820
800
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

Figure 842



EXPLANATION

- Integrated SAR Model Boundary
- Inactive Model Area
- Groundwater Basin
- Pressure Zone
- Groundwater Basin Boundary
- Groundwater Flow Barrier

Depth Below Land Subsidence Threshold (ft) (September 1990)

- 0 - 10
- 10 - 20
- 20 - 25
- >25

Depth to Water (ft) (March 1983)

- 0 - 10
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50

Scenario 4.1:
Average Climate (1966-1990 Hydrology) and Optimized Use of SWP Recharge

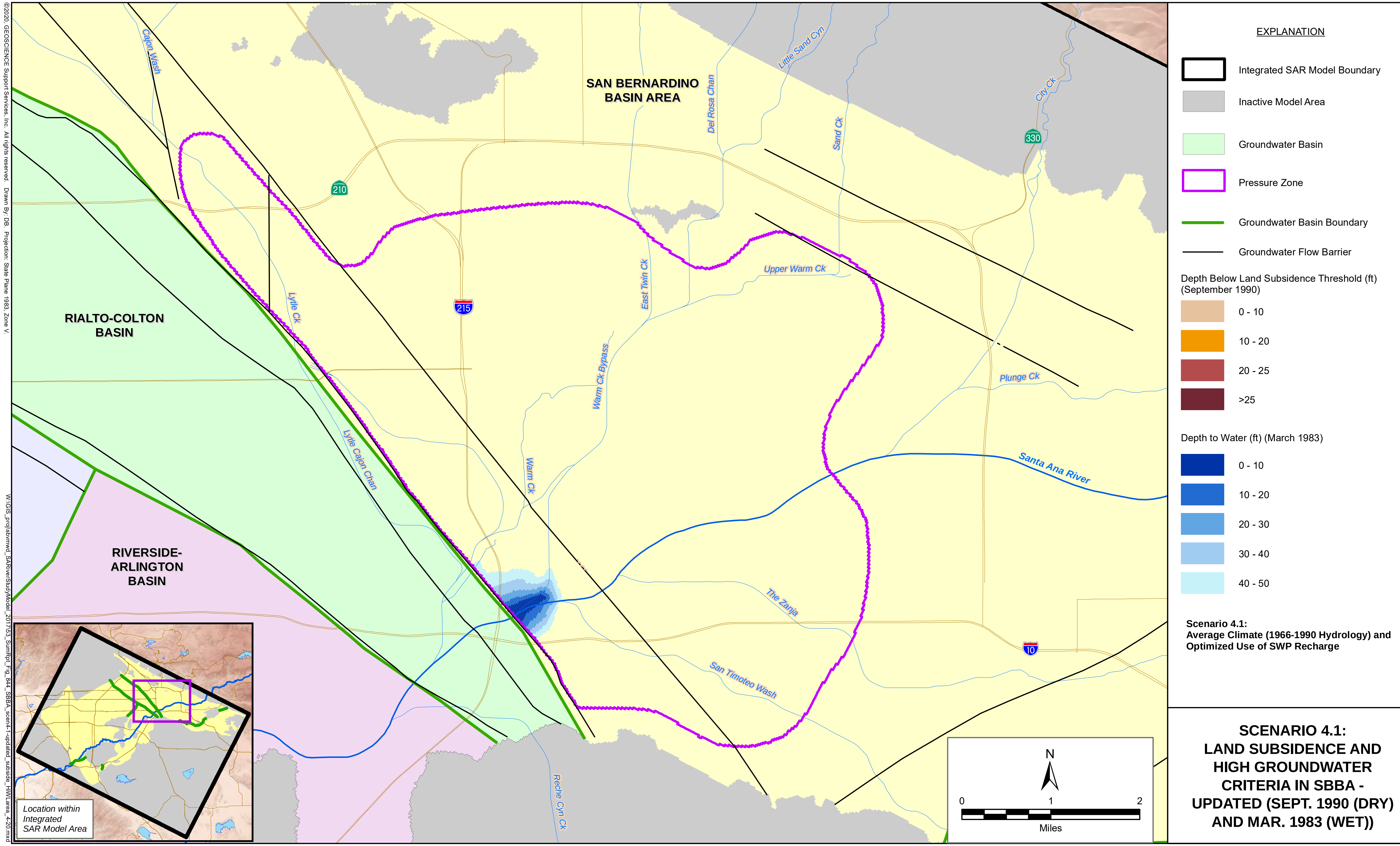
SCENARIO 4.1: LAND SUBSIDENCE AND HIGH GROUNDWATER CRITERIA IN SBBA - INITIAL (SEPT. 1990 (DRY) AND MAR. 1983 (WET))

10-Apr-20

DRAFT

FIGURE 843

GEOSCIENCE



**SCENARIO 4.1:
LAND SUBSIDENCE AND
HIGH GROUNDWATER
CRITERIA IN SBBA -
UPDATED (SEPT. 1990 (DRY)
AND MAR. 1983 (WET))**

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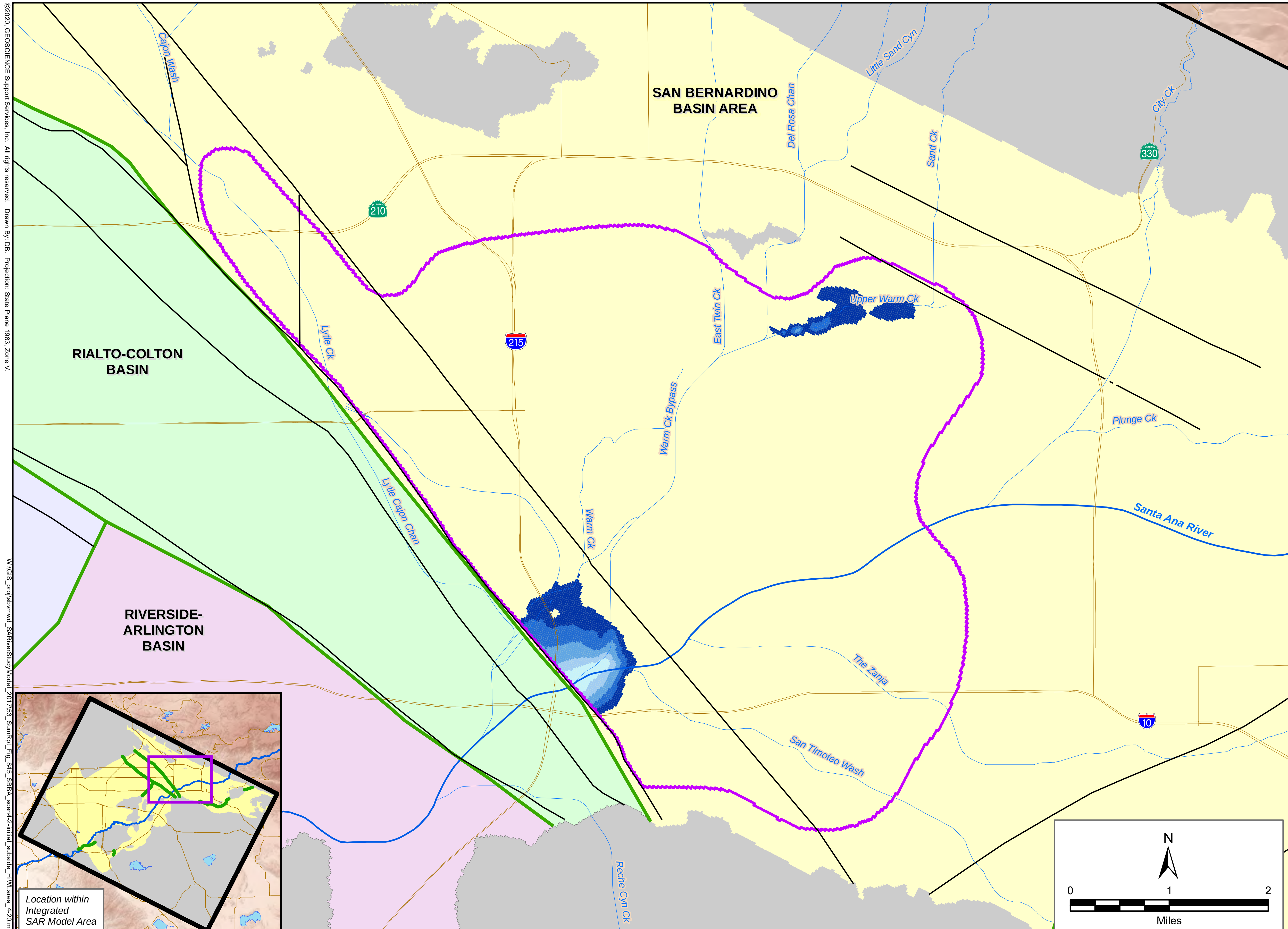
10-Apr-20

DRAFT

FIGURE 844



SCENARIO 4.2: LAND SUBSIDENCE AND HIGH GROUNDWATER CRITERIA IN SBBA - INITIAL (SEPT. 1990 (DRY) AND MAR. 1983 (WET))

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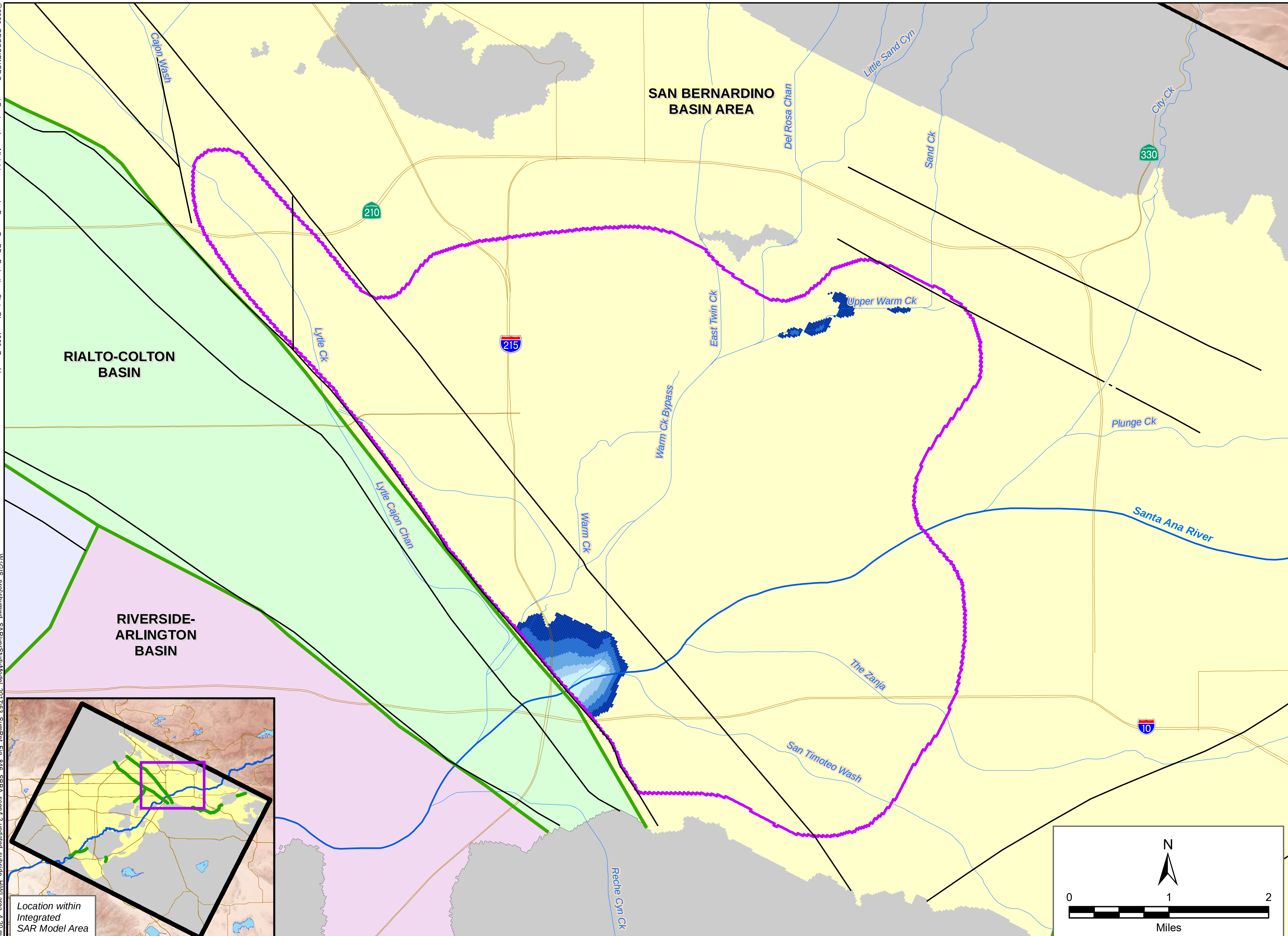
10-Apr-20



EXPLANATION

- Integrated SAR Model Boundary
- Inactive Model Area
- Groundwater Basin
- Pressure Zone
- Groundwater Basin Boundary
- Groundwater Flow Barrier

Depth Below Land Subsidence Threshold (ft) (September 1990)

- 0 - 10
- 10 - 20
- 20 - 25
- >25

Depth to Water (ft) (March 1983)

- 0 - 10
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50

Scenario 4.2:
Average Climate (1966-1990 Hydrology) and All HCP Covered Activities

NOTE: No Groundwater Level Below Land Subsidence Threshold

SCENARIO 4.2: LAND SUBSIDENCE AND HIGH GROUNDWATER CRITERIA IN SBBA - UPDATED (SEPT. 1990 (DRY) AND MAR. 1983 (WET))

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT **DRAFT** **FIGURE 846**

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

GEOSCIENCE

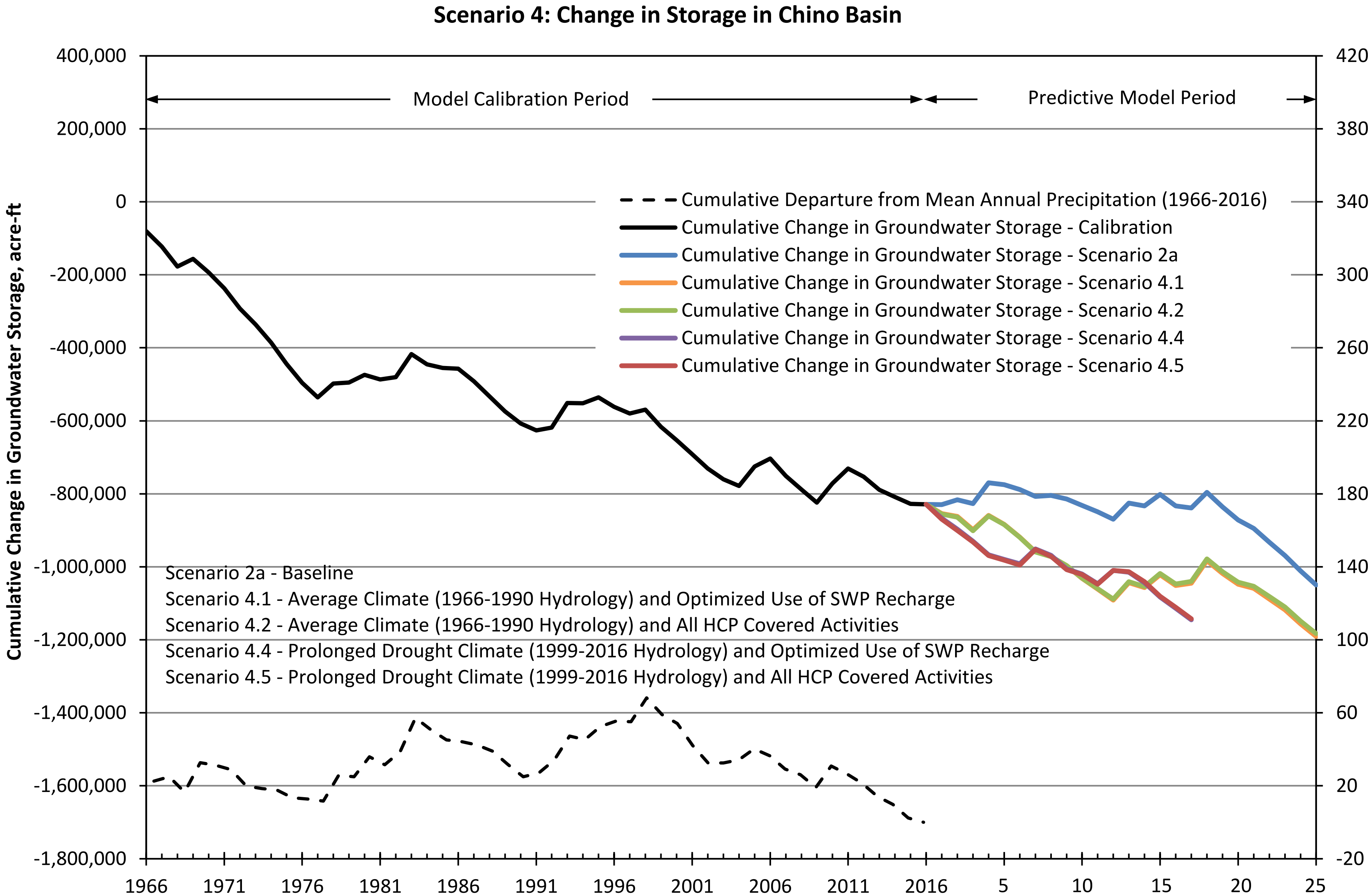

Scenario 4: Change in Storage in Chino Basin
Model Calibration Period
Predictive Model Period
Cumulative Departure from Mean Annual Precipitation (1966-2016)
Cumulative Change in Groundwater Storage - Calibration
Cumulative Change in Groundwater Storage - Scenario 2a
Cumulative Change in Groundwater Storage - Scenario 4.1
Cumulative Change in Groundwater Storage - Scenario 4.2
Cumulative Change in Groundwater Storage - Scenario 4.4
Cumulative Change in Groundwater Storage - Scenario 4.5
Scenario 2a - Baseline
Scenario 4.1 - Average Climate (1966-1990 Hydrology) and Optimized Use of SWP Recharge
Scenario 4.2 - Average Climate (1966-1990 Hydrology) and All HCP Covered Activities
Scenario 4.4 - Prolonged Drought Climate (1999-2016 Hydrology) and Optimized Use of SWP Recharge
Scenario 4.5 - Prolonged Drought Climate (1999-2016 Hydrology) and All HCP Covered Activities
Cumulative Change in Groundwater Storage, acre-ft
Cumulative Departure from Mean Annual Precipitation, inches
400,000
200,000
0
-200,000
-400,000
-600,000
-800,000
-1,000,000
-1,200,000
-1,400,000
-1,600,000
-1,800,000
420
380
340
300
260
220
180
140
100
60
20
-20
1966
1971
1976
1981
1986
1991
1996
2001
2006
2011
2016
5
10
15
20
25

Figure 847

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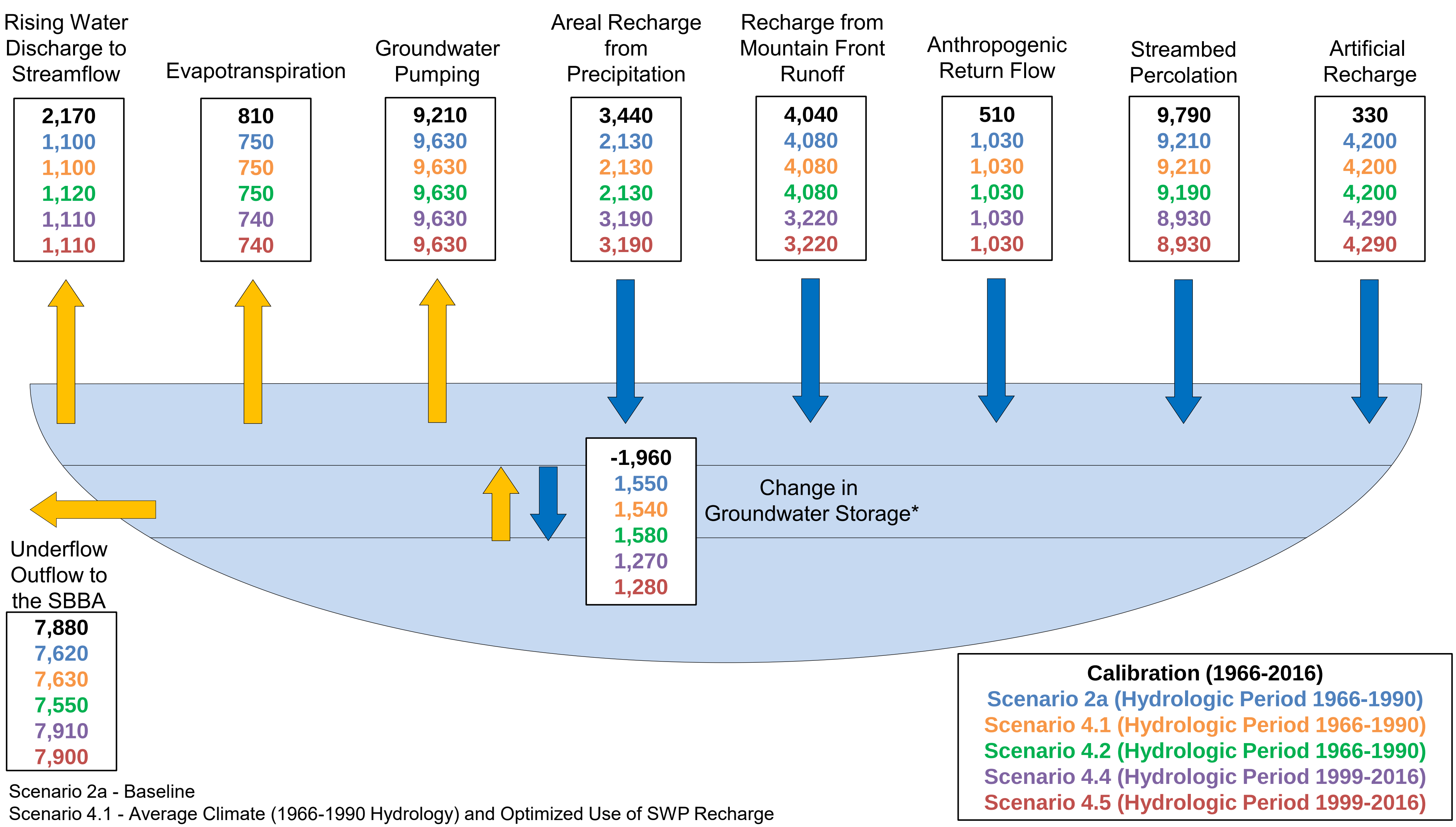

Scenario 2a - Baseline
Scenario 4.1 - Average Climate (1966-1990 Hydrology) and Optimized Use of SWP Recharge
Scenario 4.2 - Average Climate (1966-1990 Hydrology) and All HCP Covered Activities
Scenario 4.4 - Prolonged Drought Climate (1999-2016 Hydrology) and Optimized Use of SWP Recharge
Scenario 4.5 - Prolonged Drought Climate (1999-2016 Hydrology) and All HCP Covered Activities

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 4
AVERAGE ANNUAL
WATER BUDGET
YUCAIPA BASIN

10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT **DRAFT** **FIGURE 848**

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

GEOSCIENCE

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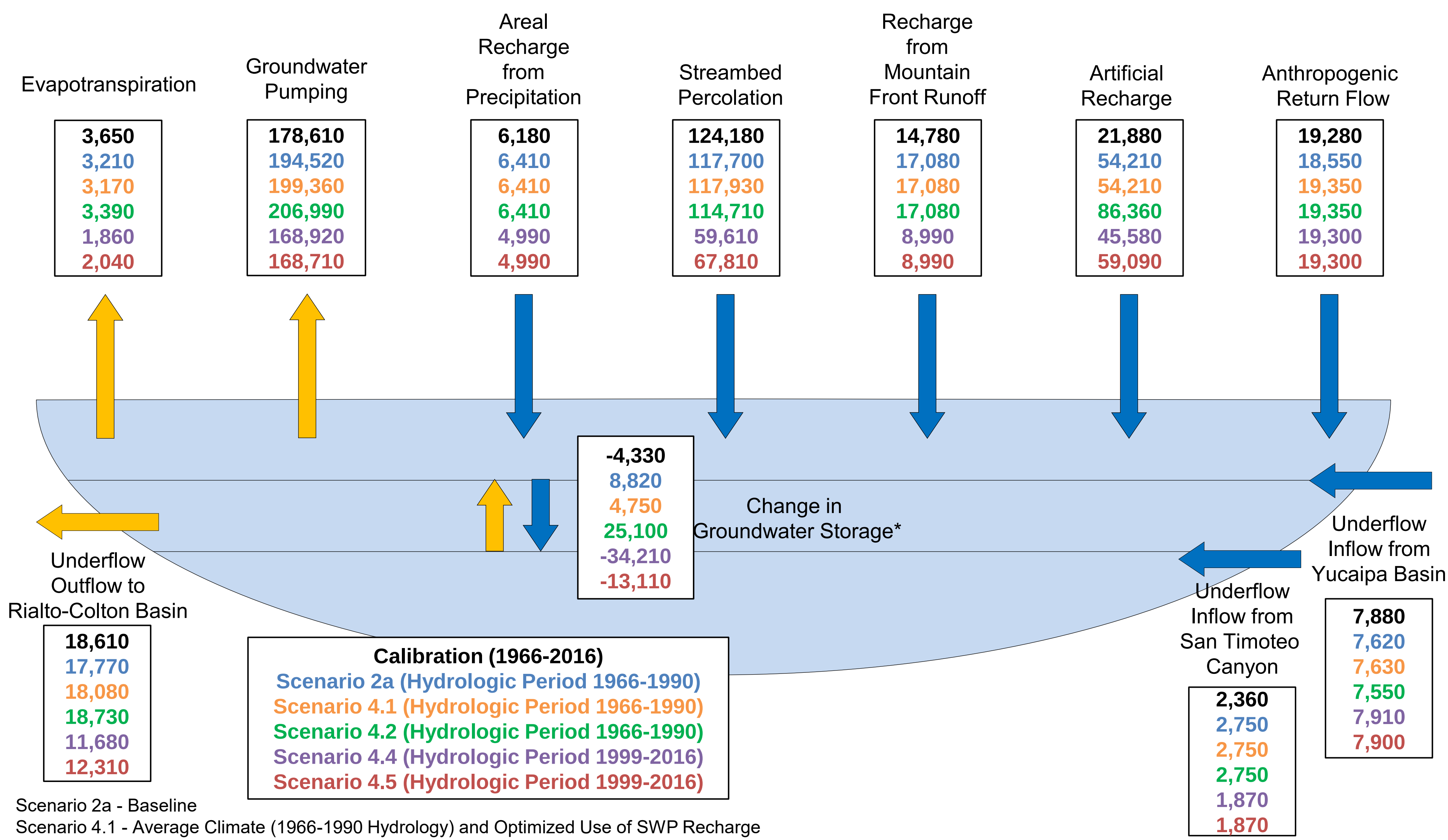


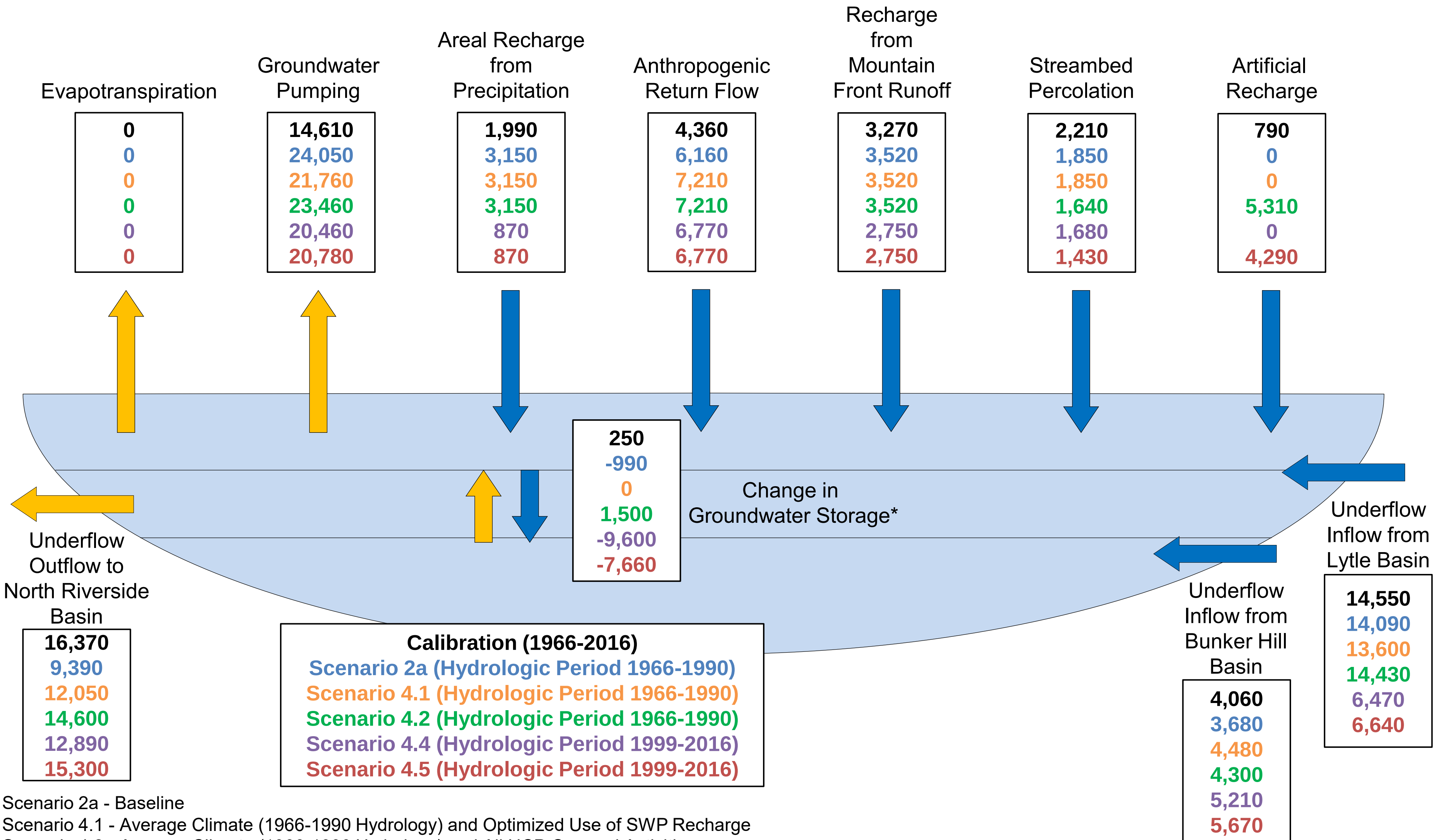
Scenario 2a - Baseline
Scenario 4.1 - Average Climate (1966-1990 Hydrology) and Optimized Use of SWP Recharge
Scenario 4.2 - Average Climate (1966-1990 Hydrology) and All HCP Covered Activities
Scenario 4.4 - Prolonged Drought Climate (1999-2016 Hydrology) and Optimized Use of SWP Recharge
Scenario 4.5 - Prolonged Drought Climate (1999-2016 Hydrology) and All HCP Covered Activities

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 4
AVERAGE ANNUAL
WATER BUDGET
SBBA

10-Apr-20



Scenario 2a - Baseline
Scenario 4.1 - Average Climate (1966-1990 Hydrology) and Optimized Use of SWP Recharge
Scenario 4.2 - Average Climate (1966-1990 Hydrology) and All HCP Covered Activities
Scenario 4.4 - Prolonged Drought Climate (1999-2016 Hydrology) and Optimized Use of SWP Recharge
Scenario 4.5 - Prolonged Drought Climate (1999-2016 Hydrology) and All HCP Covered Activities

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

**SCENARIO 4
AVERAGE ANNUAL
WATER BUDGET
RIALTO-COLTON BASIN**

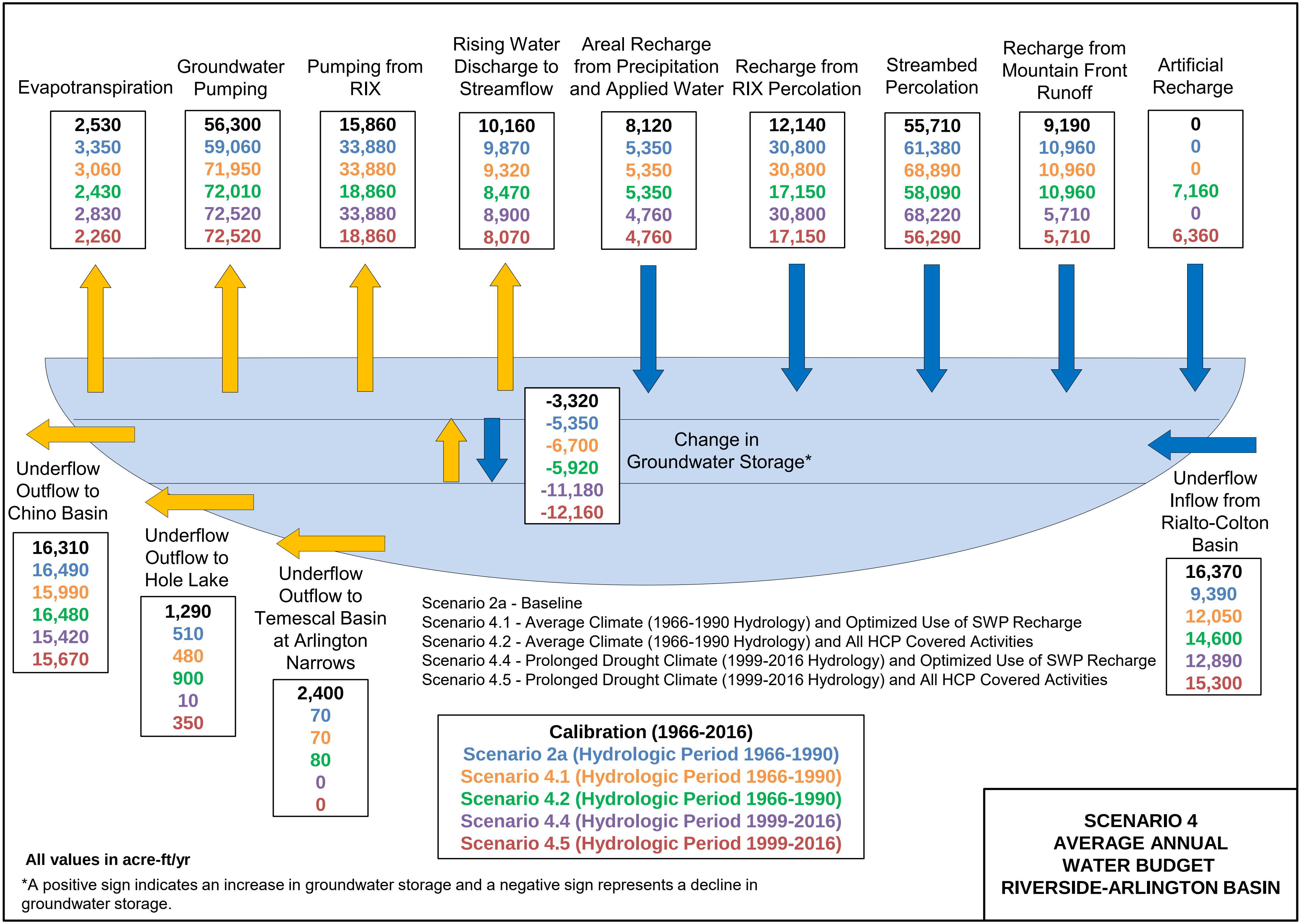
10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT **DRAFT** **FIGURE 850**

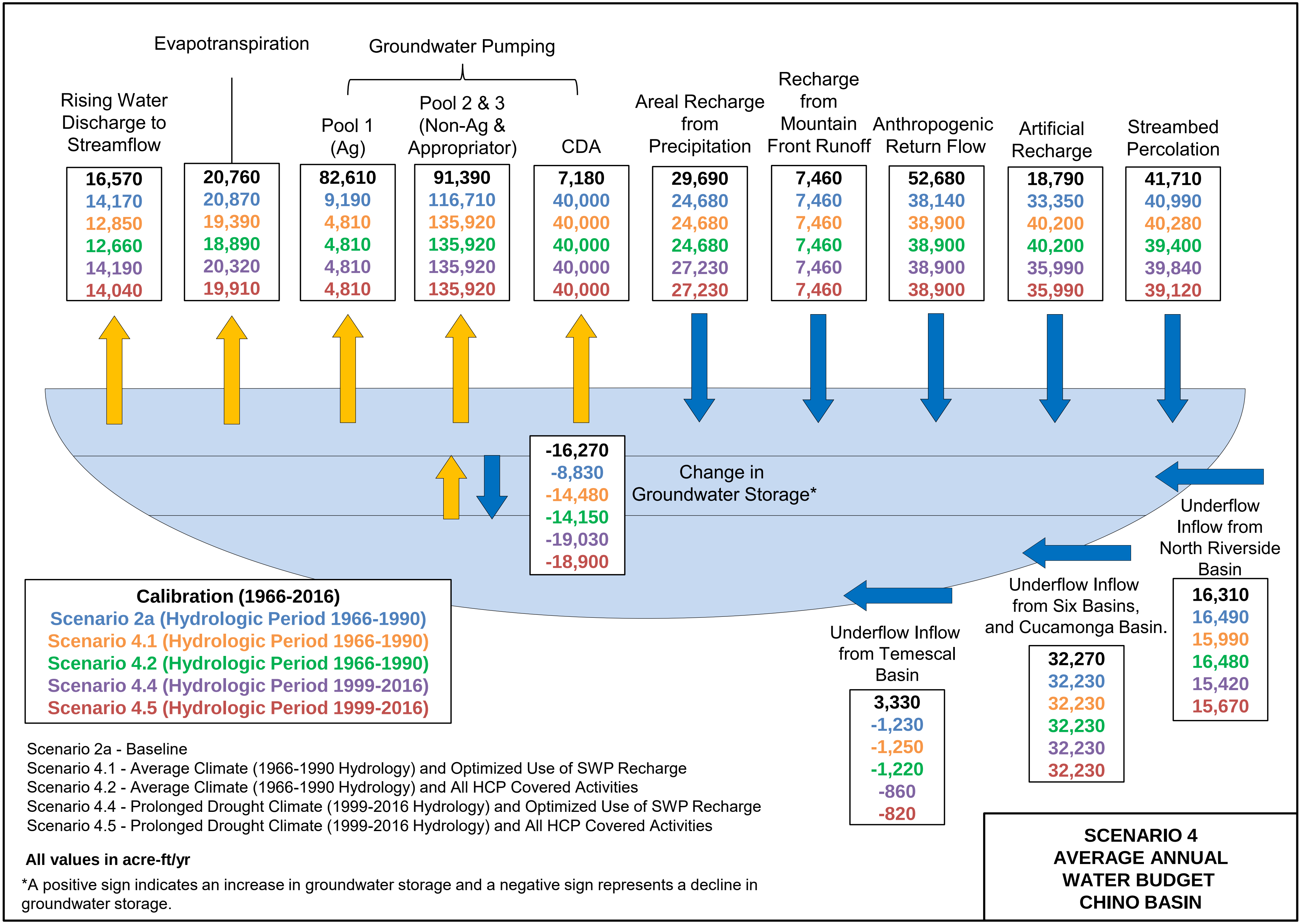
UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

GEOSCIENCE

X:\Projects\San_Bernardino_MUNI\31) Integreated_SAR_Model\(4)Technical_Memos\(8) Summary Report\Draft\Figures\Scenarios



SCENARIO 4
AVERAGE ANNUAL WATER BUDGET
RIVERSIDE-ARLINGTON BASIN



Evapotranspiration
Groundwater Pumping
Rising Water Discharge to Streamflow
16,570
14,170
12,850
12,660
14,190
14,040
20,760
20,870
19,390
18,890
20,320
19,910
Pool 1 (Ag)
82,610
9,190
4,810
4,810
4,810
4,810
Pool 2 & 3 (Non-Ag & Appropriator)
91,390
116,710
135,920
135,920
135,920
135,920
CDA
7,180
40,000
40,000
40,000
40,000
40,000
Areal Recharge from Precipitation
29,690
24,680
24,680
24,680
27,230
27,230
Recharge from Mountain Front Runoff
7,460
7,460
7,460
7,460
7,460
7,460
Anthropogenic Return Flow
52,680
38,140
38,900
38,900
38,900
38,900
Artificial Recharge
18,790
33,350
40,200
40,200
35,990
35,990
Streambed Percolation
41,710
40,990
40,280
39,400
39,840
39,120
-16,270
-8,830
-14,480
-14,150
-19,030
-18,900
Change in Groundwater Storage*
Underflow Inflow from North Riverside Basin
16,310
16,490
15,990
16,480
15,420
15,670
Underflow Inflow from Six Basins, and Cucamonga Basin.
32,270
32,230
32,230
32,230
32,230
32,230
Underflow Inflow from Temescal Basin
3,330
-1,230
-1,250
-1,220
-860
-820
Calibration (1966-2016)
Scenario 2a (Hydrologic Period 1966-1990)
Scenario 4.1 (Hydrologic Period 1966-1990)
Scenario 4.2 (Hydrologic Period 1966-1990)
Scenario 4.4 (Hydrologic Period 1999-2016)
Scenario 4.5 (Hydrologic Period 1999-2016)
Scenario 2a - Baseline
Scenario 4.1 - Average Climate (1966-1990 Hydrology) and Optimized Use of SWP Recharge
Scenario 4.2 - Average Climate (1966-1990 Hydrology) and All HCP Covered Activities
Scenario 4.4 - Prolonged Drought Climate (1999-2016 Hydrology) and Optimized Use of SWP Recharge
Scenario 4.5 - Prolonged Drought Climate (1999-2016 Hydrology) and All HCP Covered Activities
All values in acre-ft/yr
*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.
SCENARIO 4
AVERAGE ANNUAL
WATER BUDGET
CHINO BASIN

10-Apr-20

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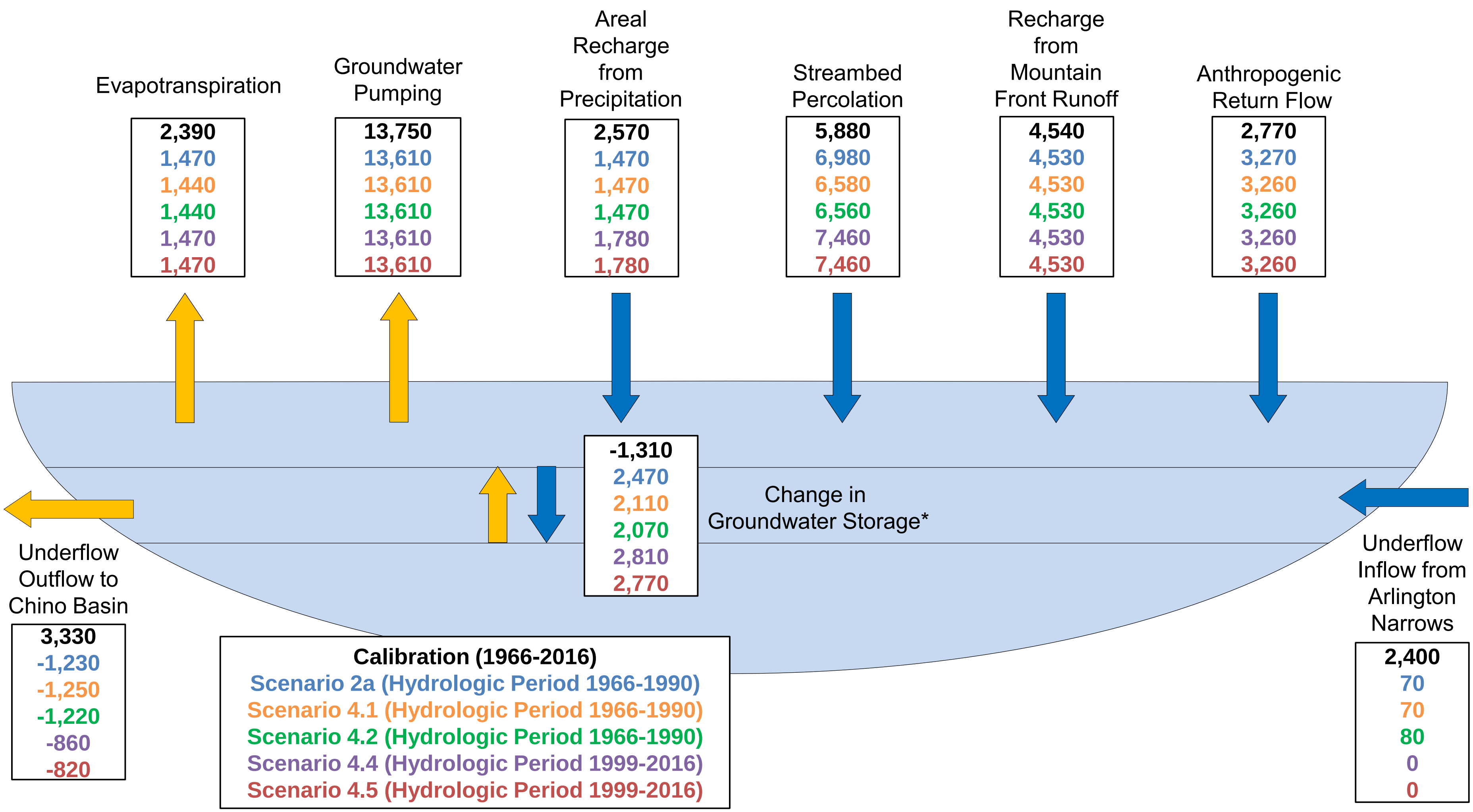

Scenario 2a - Baseline
Scenario 4.1 - Average Climate (1966-1990 Hydrology) and Optimized Use of SWP Recharge
Scenario 4.2 - Average Climate (1966-1990 Hydrology) and All HCP Covered Activities
Scenario 4.4 - Prolonged Drought Climate (1999-2016 Hydrology) and Optimized Use of SWP Recharge
Scenario 4.5 - Prolonged Drought Climate (1999-2016 Hydrology) and All HCP Covered Activities

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 4
AVERAGE ANNUAL
WATER BUDGET
TEMESCAL BASIN

10-Apr-20

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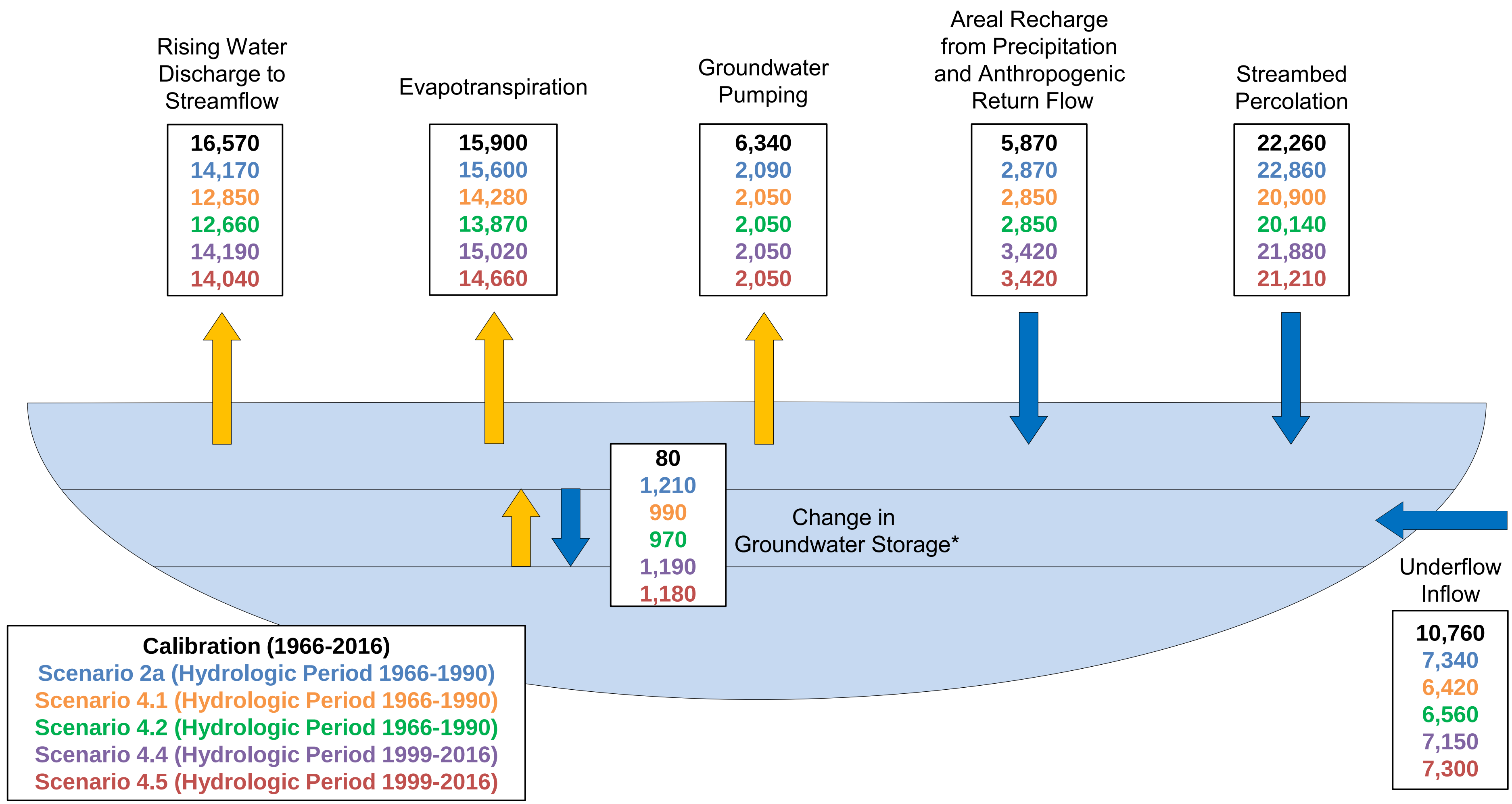


Scenario 2a - Baseline
Scenario 4.1 - Average Climate (1966-1990 Hydrology) and Optimized Use of SWP Recharge
Scenario 4.2 - Average Climate (1966-1990 Hydrology) and All HCP Covered Activities
Scenario 4.4 - Prolonged Drought Climate (1999-2016 Hydrology) and Optimized Use of SWP Recharge
Scenario 4.5 - Prolonged Drought Climate (1999-2016 Hydrology) and All HCP Covered Activities

All values in acre-ft/yr

*A positive sign indicates an increase in groundwater storage and a negative sign represents a decline in groundwater storage.

SCENARIO 4
AVERAGE ANNUAL
WATER BUDGET
PRADO BASIN

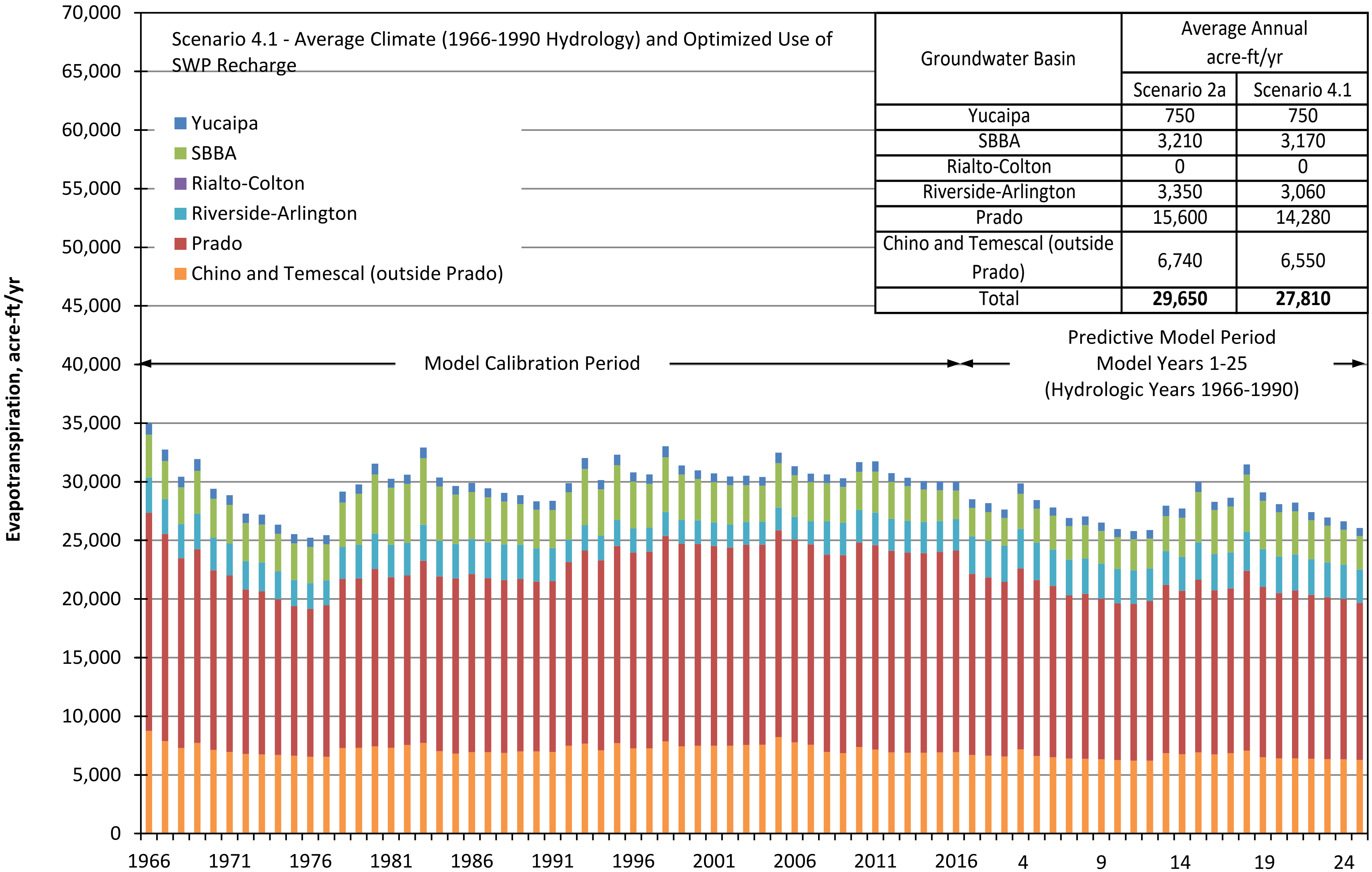
10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT **DRAFT** **FIGURE 854**

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

GEOSCIENCE

Scenario 4.1: Annual Evapotranspiration – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 4.1
Yucaipa	750	750
SBBA	3,210	3,170
Rialto-Colton	0	0
Riverside-Arlington	3,350	3,060
Prado	15,600	14,280
Chino and Temescal (outside Prado)	6,740	6,550
Total	**29,650**	**27,810**

Figure 855

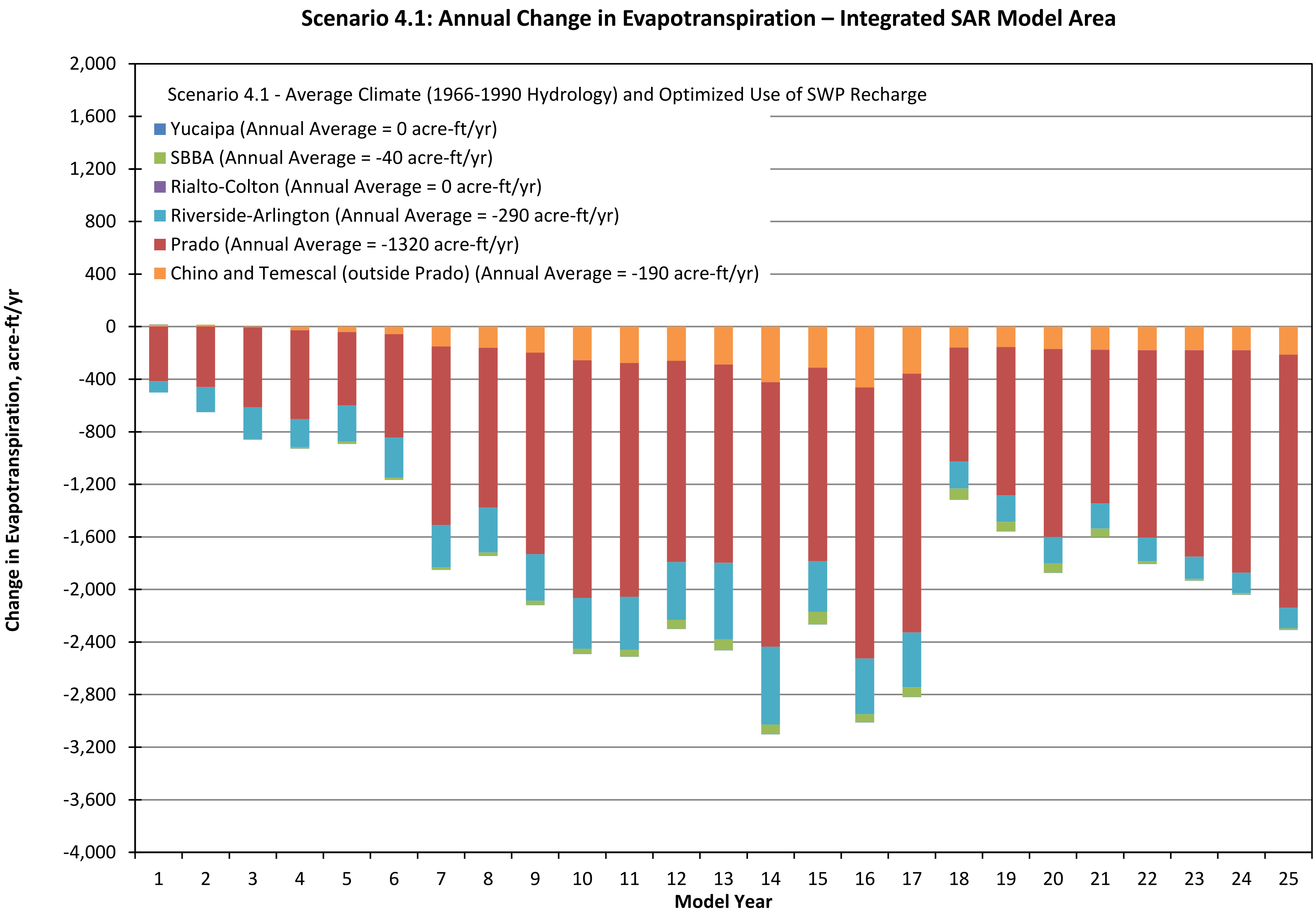
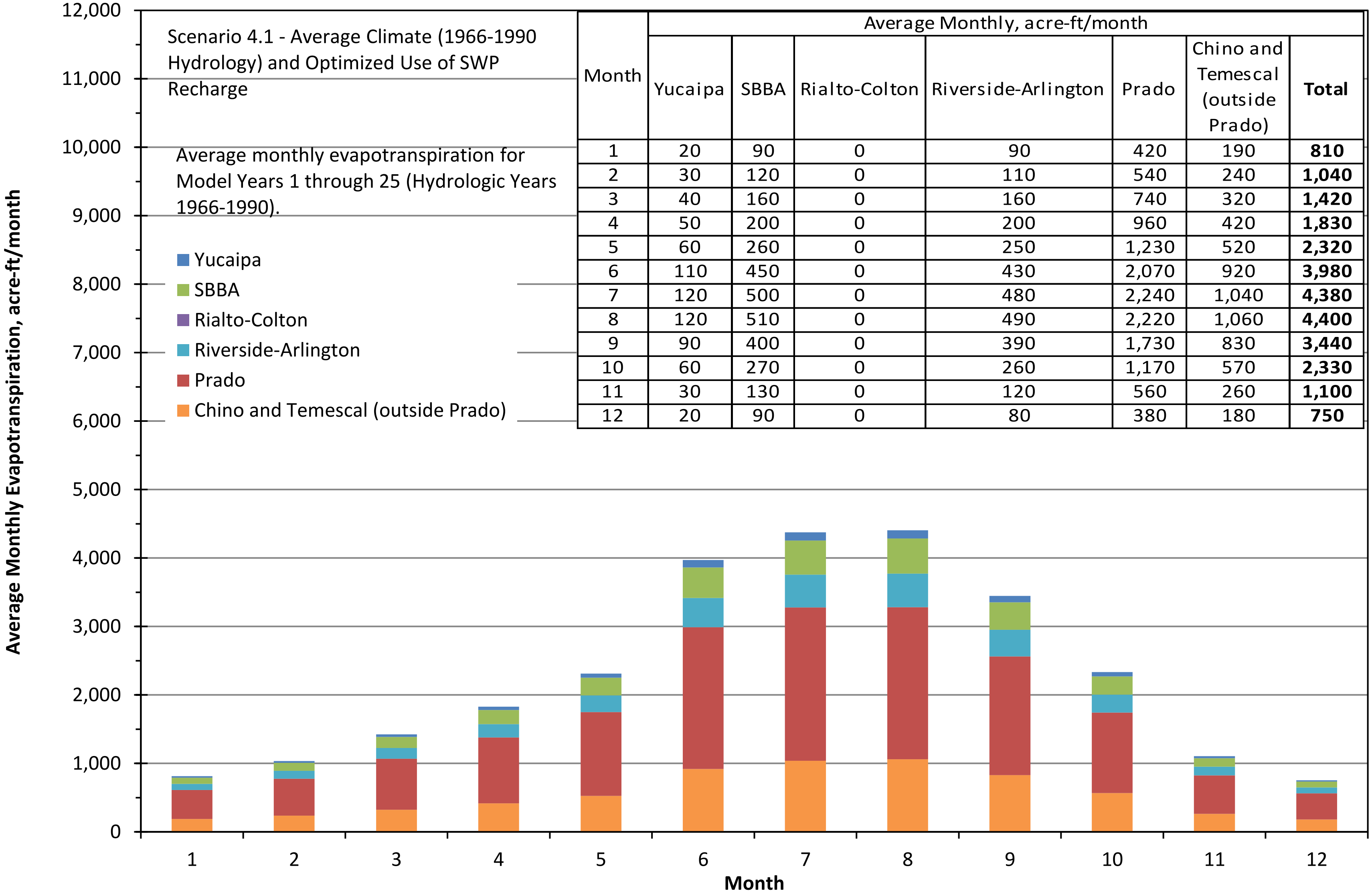

Scenario 4.1: Annual Change in Evapotranspiration – Integrated SAR Model Area
Scenario 4.1 - Average Climate (1966-1990 Hydrology) and Optimized Use of SWP Recharge
Yucaipa (Annual Average = 0 acre-ft/yr)
SBBA (Annual Average = -40 acre-ft/yr)
Rialto-Colton (Annual Average = 0 acre-ft/yr)
Riverside-Arlington (Annual Average = -290 acre-ft/yr)
Prado (Annual Average = -1320 acre-ft/yr)
Chino and Temescal (outside Prado) (Annual Average = -190 acre-ft/yr)
Change in Evapotranspiration, acre-ft/yr
2,000
1,600
1,200
800
400
0
-400
-800
-1,200
-1,600
-2,000
-2,400
-2,800
-3,200
-3,600
-4,000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Model Year

Figure 856

Scenario 4.1: Seasonal Evapotranspiration – Integrated SAR Model Area



Month	Average Monthly, acre-ft/month						
	Yucaipa	SBBA	Rialto-Colton	Riverside-Arlington	Prado	Chino and Temescal (outside Prado)	**Total**
1	20	90	0	90	420	190	**810**
2	30	120	0	110	540	240	**1,040**
3	40	160	0	160	740	320	**1,420**
4	50	200	0	200	960	420	**1,830**
5	60	260	0	250	1,230	520	**2,320**
6	110	450	0	430	2,070	920	**3,980**
7	120	500	0	480	2,240	1,040	**4,380**
8	120	510	0	490	2,220	1,060	**4,400**
9	90	400	0	390	1,730	830	**3,440**
10	60	270	0	260	1,170	570	**2,330**
11	30	130	0	120	560	260	**1,100**
12	20	90	0	80	380	180	**750**

Figure 857

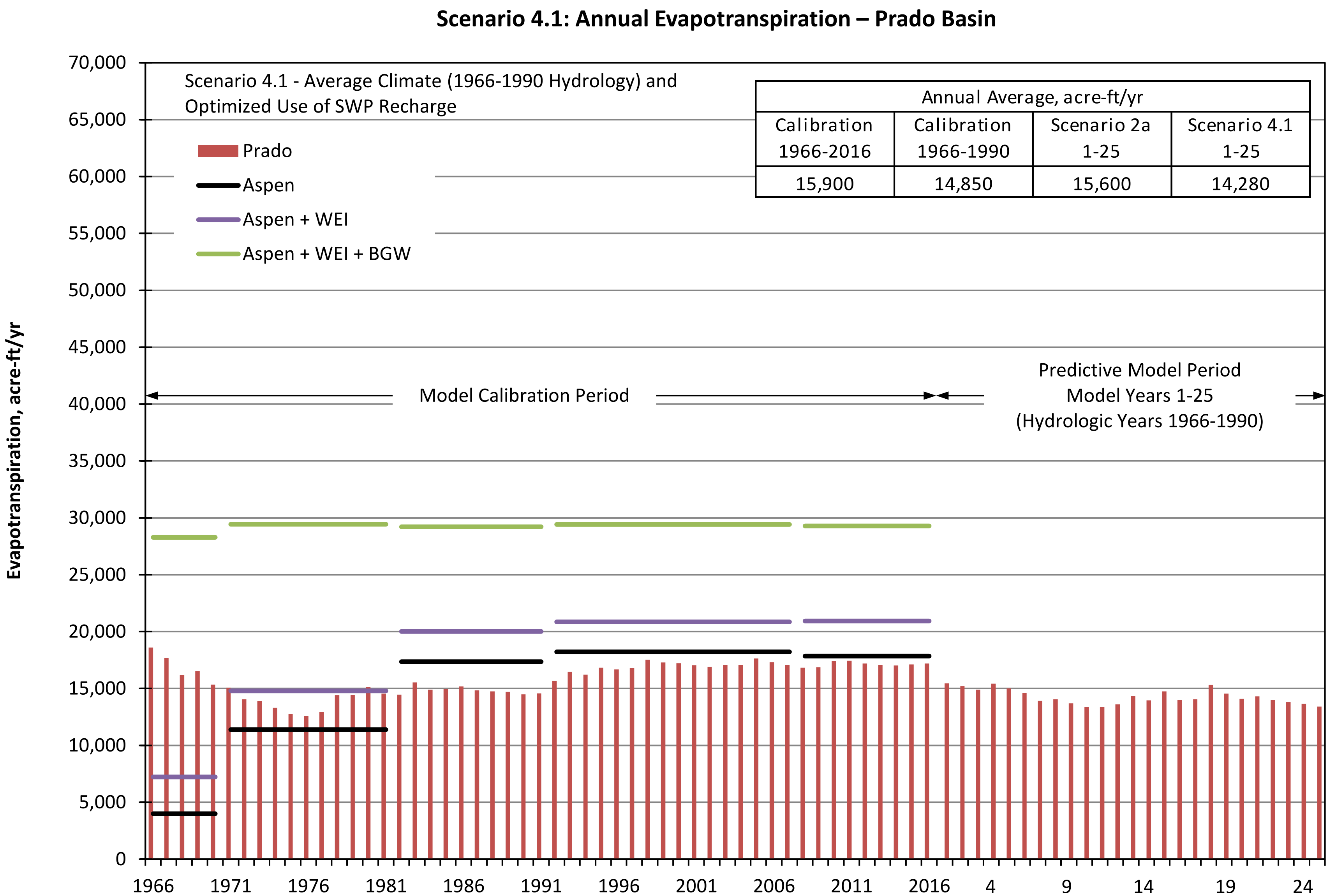

Scenario 4.1: Annual Evapotranspiration – Prado Basin
Scenario 4.1 - Average Climate (1966-1990 Hydrology) and
Optimized Use of SWP Recharge
Prado
Aspen
Aspen + WEI
Aspen + WEI + BGW
Annual Average, acre-ft/yr
Calibration 1966-2016
Calibration 1966-1990
Scenario 2a 1-25
Scenario 4.1 1-25
15,900
14,850
15,600
14,280
Model Calibration Period
Predictive Model Period
Model Years 1-25
(Hydrologic Years 1966-1990)
Evapotranspiration, acre-ft/yr
70,000
65,000
60,000
55,000
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
1966
1971
1976
1981
1986
1991
1996
2001
2006
2011
2016
4
9
14
19
24

Figure 858

Scenario 4.1: Annual Change in Evapotranspiration – Prado Basin

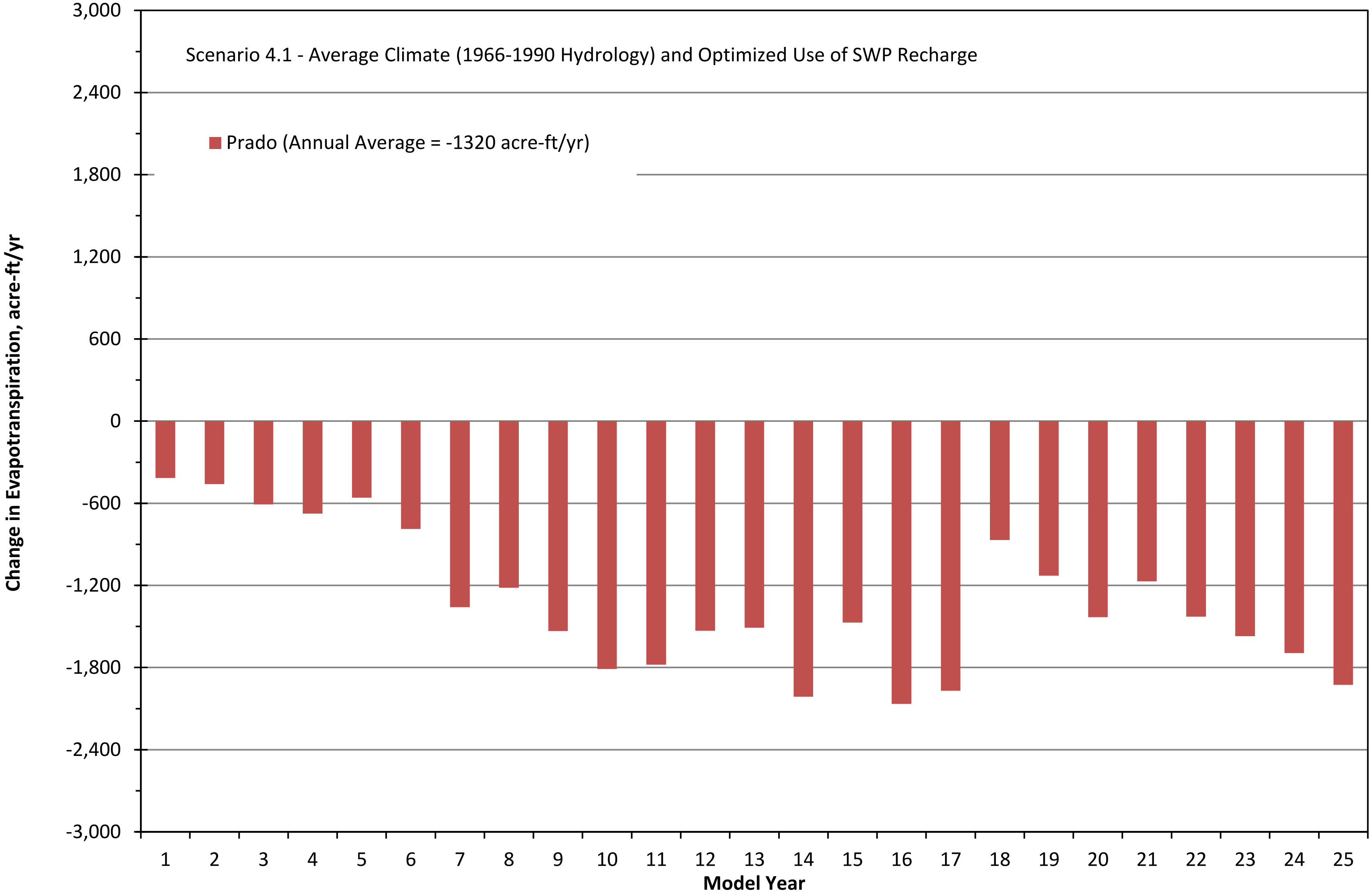
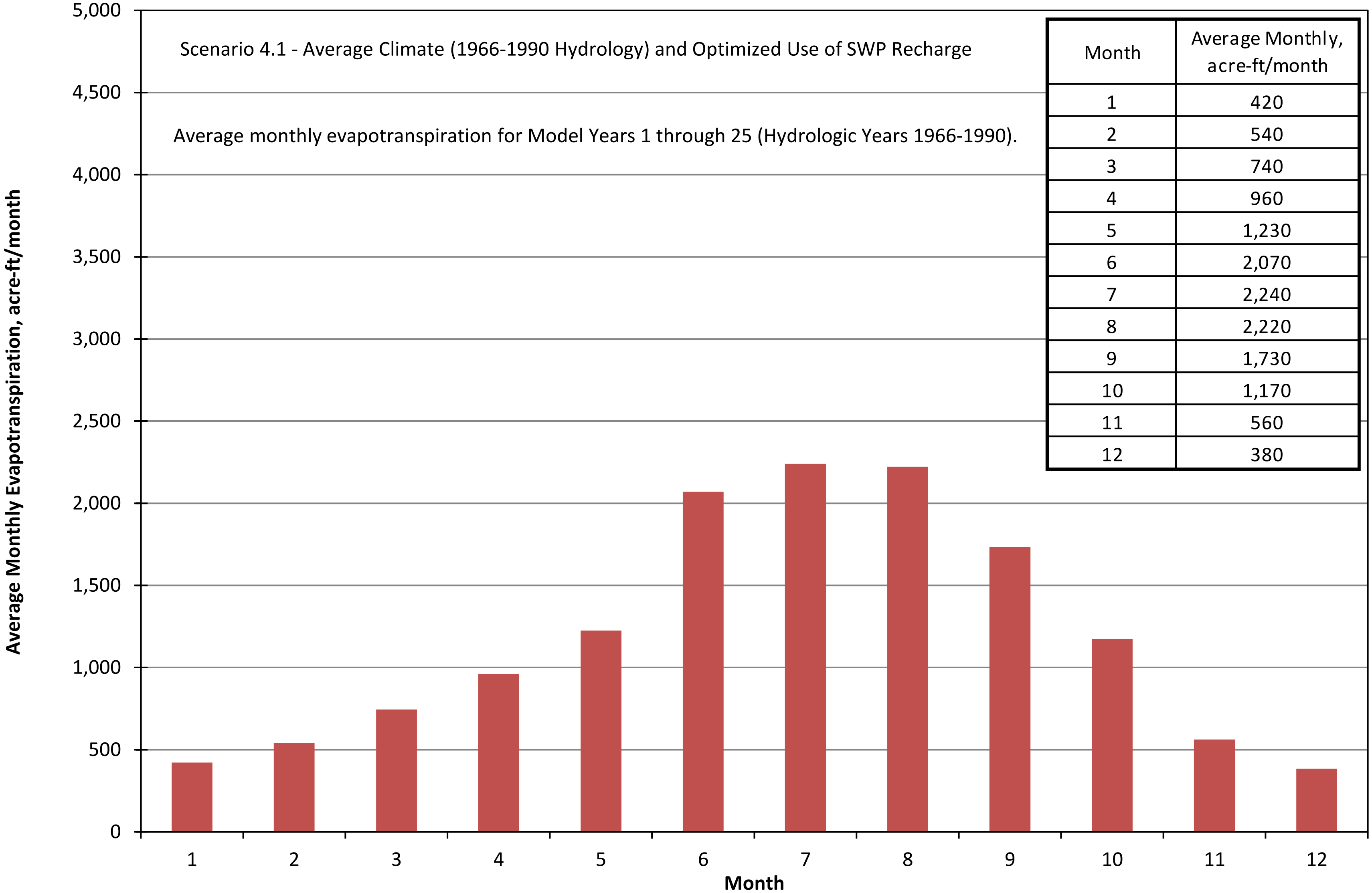


Figure 859

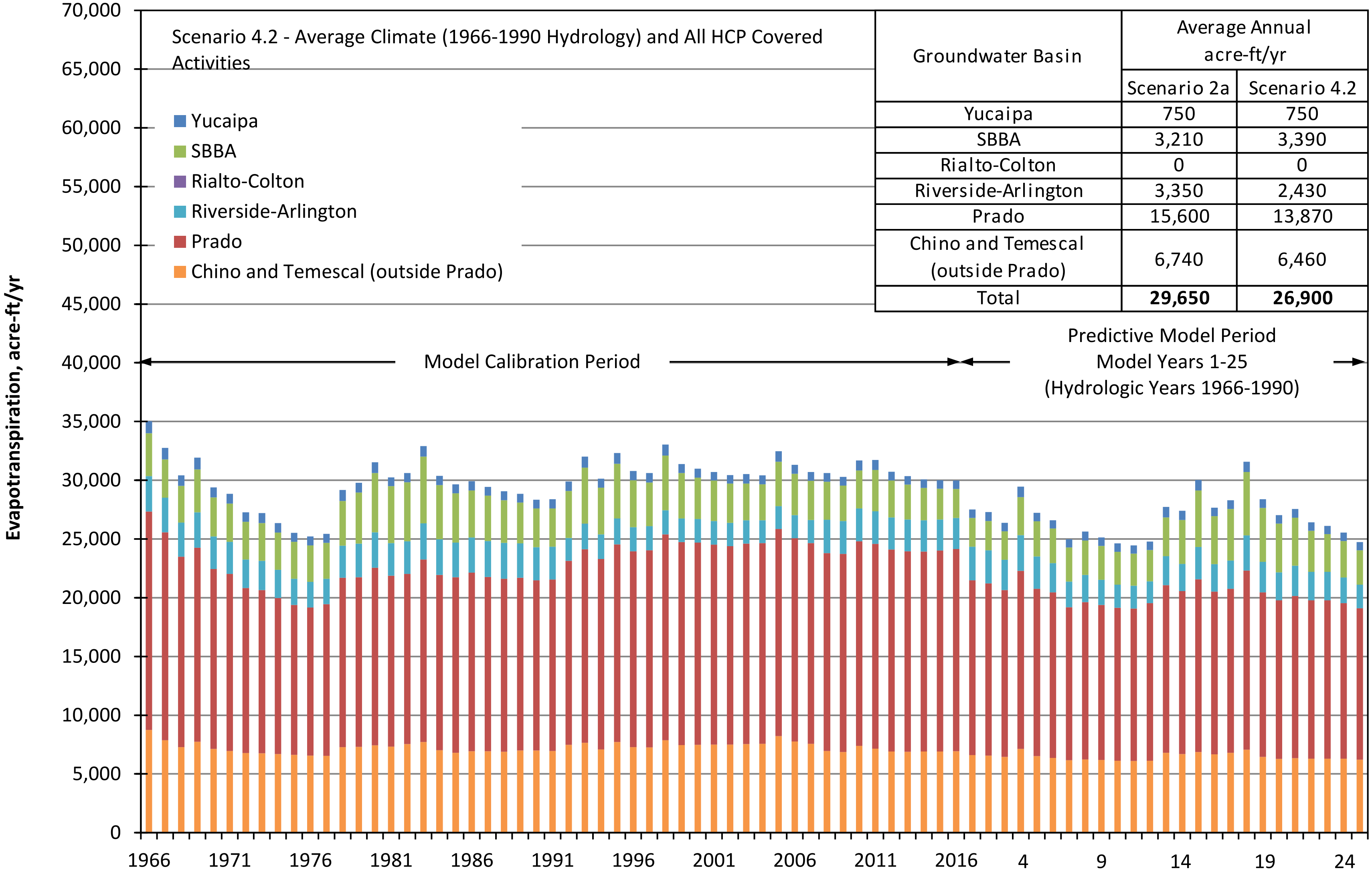
Scenario 4.1: Seasonal Evapotranspiration – Prado Basin



Month	Average Monthly, acre-ft/month
1	420
2	540
3	740
4	960
5	1,230
6	2,070
7	2,240
8	2,220
9	1,730
10	1,170
11	560
12	380

Figure 860

Scenario 4.2: Annual Evapotranspiration – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 4.2
Yucaipa	750	750
SBBA	3,210	3,390
Rialto-Colton	0	0
Riverside-Arlington	3,350	2,430
Prado	15,600	13,870
Chino and Temescal (outside Prado)	6,740	6,460
Total	**29,650**	**26,900**

Figure 861

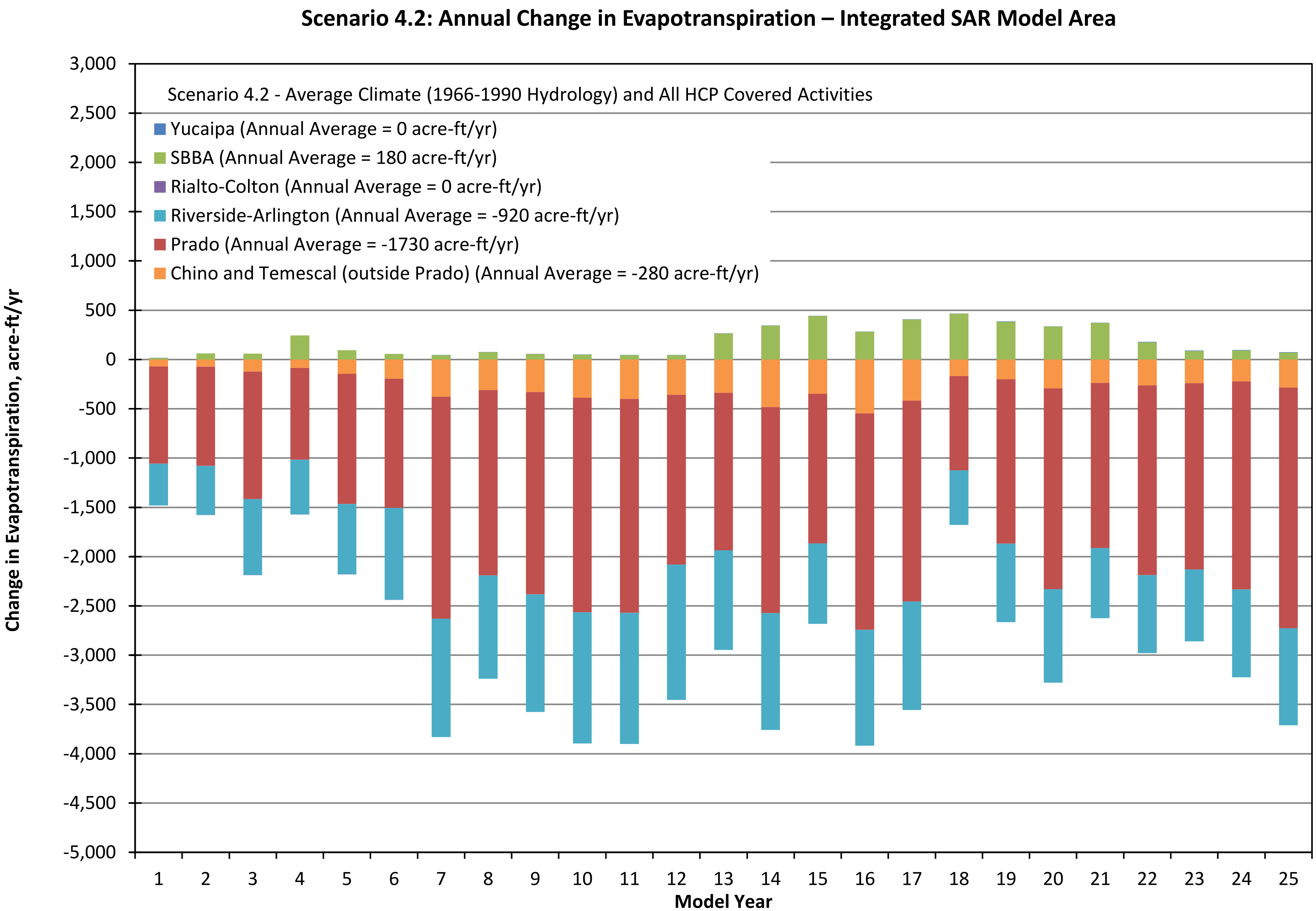
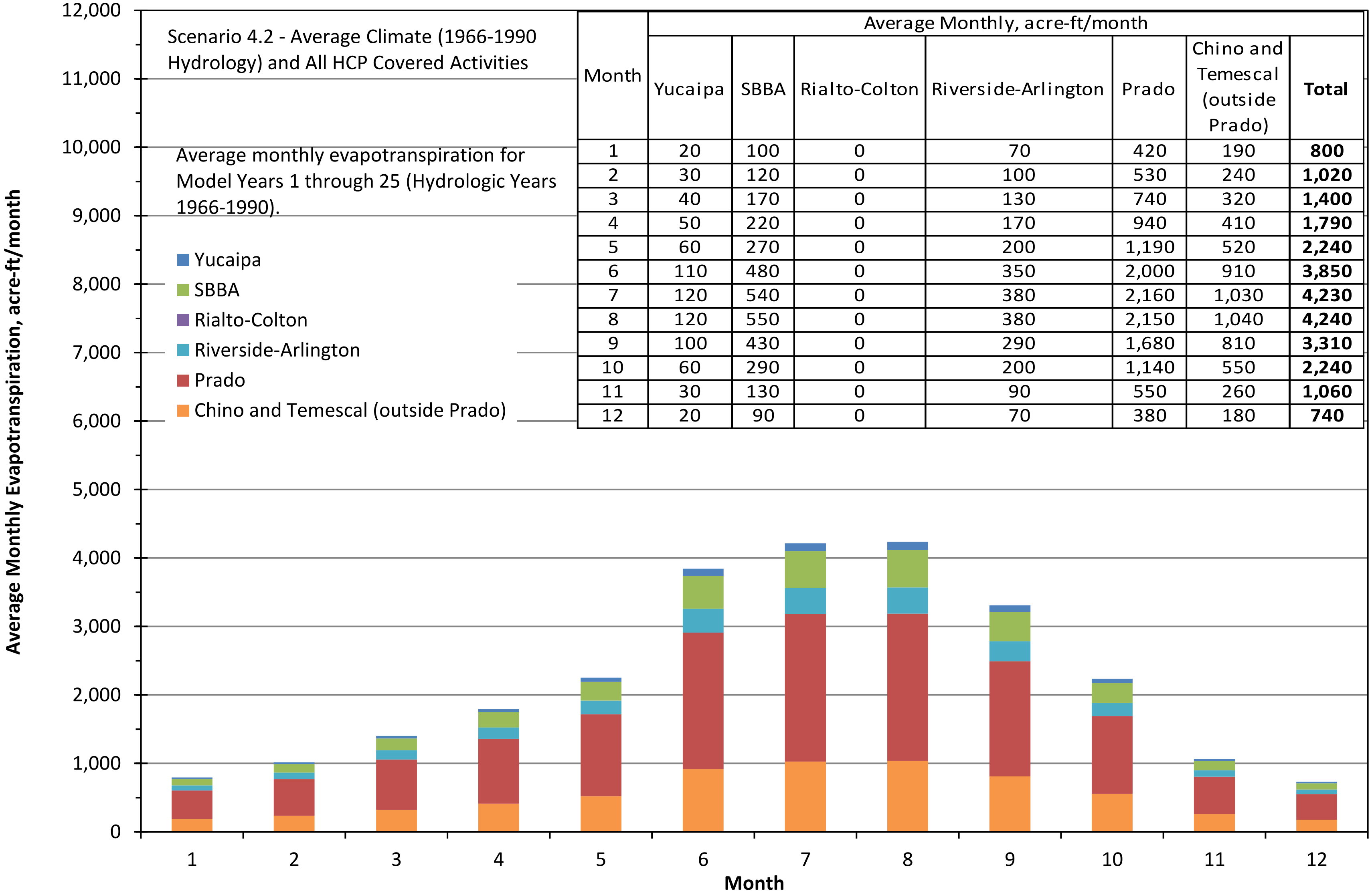

Scenario 4.2: Annual Change in Evapotranspiration – Integrated SAR Model Area
Scenario 4.2 - Average Climate (1966-1990 Hydrology) and All HCP Covered Activities
Yucaipa (Annual Average = 0 acre-ft/yr)
SBBA (Annual Average = 180 acre-ft/yr)
Rialto-Colton (Annual Average = 0 acre-ft/yr)
Riverside-Arlington (Annual Average = -920 acre-ft/yr)
Prado (Annual Average = -1730 acre-ft/yr)
Chino and Temescal (outside Prado) (Annual Average = -280 acre-ft/yr)
Change in Evapotranspiration, acre-ft/yr
3,000
2,500
2,000
1,500
1,000
500
0
-500
-1,000
-1,500
-2,000
-2,500
-3,000
-3,500
-4,000
-4,500
-5,000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Model Year

Figure 862

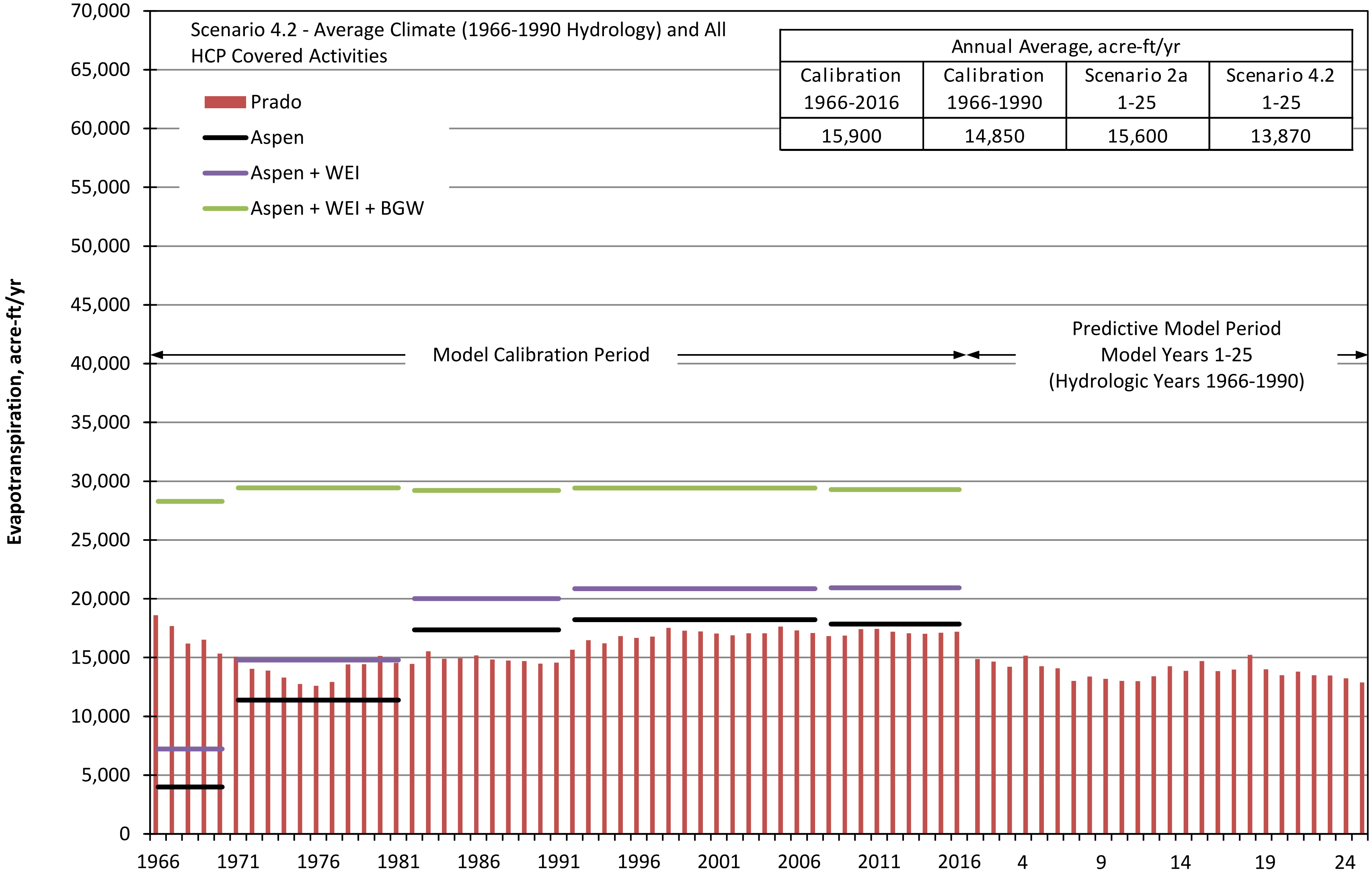
Scenario 4.2: Seasonal Evapotranspiration – Integrated SAR Model Area



Month	Average Monthly, acre-ft/month						
	Yucaipa	SBBA	Rialto-Colton	Riverside-Arlington	Prado	Chino and Temescal (outside Prado)	**Total**
1	20	100	0	70	420	190	**800**
2	30	120	0	100	530	240	**1,020**
3	40	170	0	130	740	320	**1,400**
4	50	220	0	170	940	410	**1,790**
5	60	270	0	200	1,190	520	**2,240**
6	110	480	0	350	2,000	910	**3,850**
7	120	540	0	380	2,160	1,030	**4,230**
8	120	550	0	380	2,150	1,040	**4,240**
9	100	430	0	290	1,680	810	**3,310**
10	60	290	0	200	1,140	550	**2,240**
11	30	130	0	90	550	260	**1,060**
12	20	90	0	70	380	180	**740**

Figure 863

Scenario 4.2: Annual Evapotranspiration – Prado Basin



Annual Average, acre-ft/yr			
Calibration 1966-2016	Calibration 1966-1990	Scenario 2a 1-25	Scenario 4.2 1-25
15,900	14,850	15,600	13,870

Figure 864

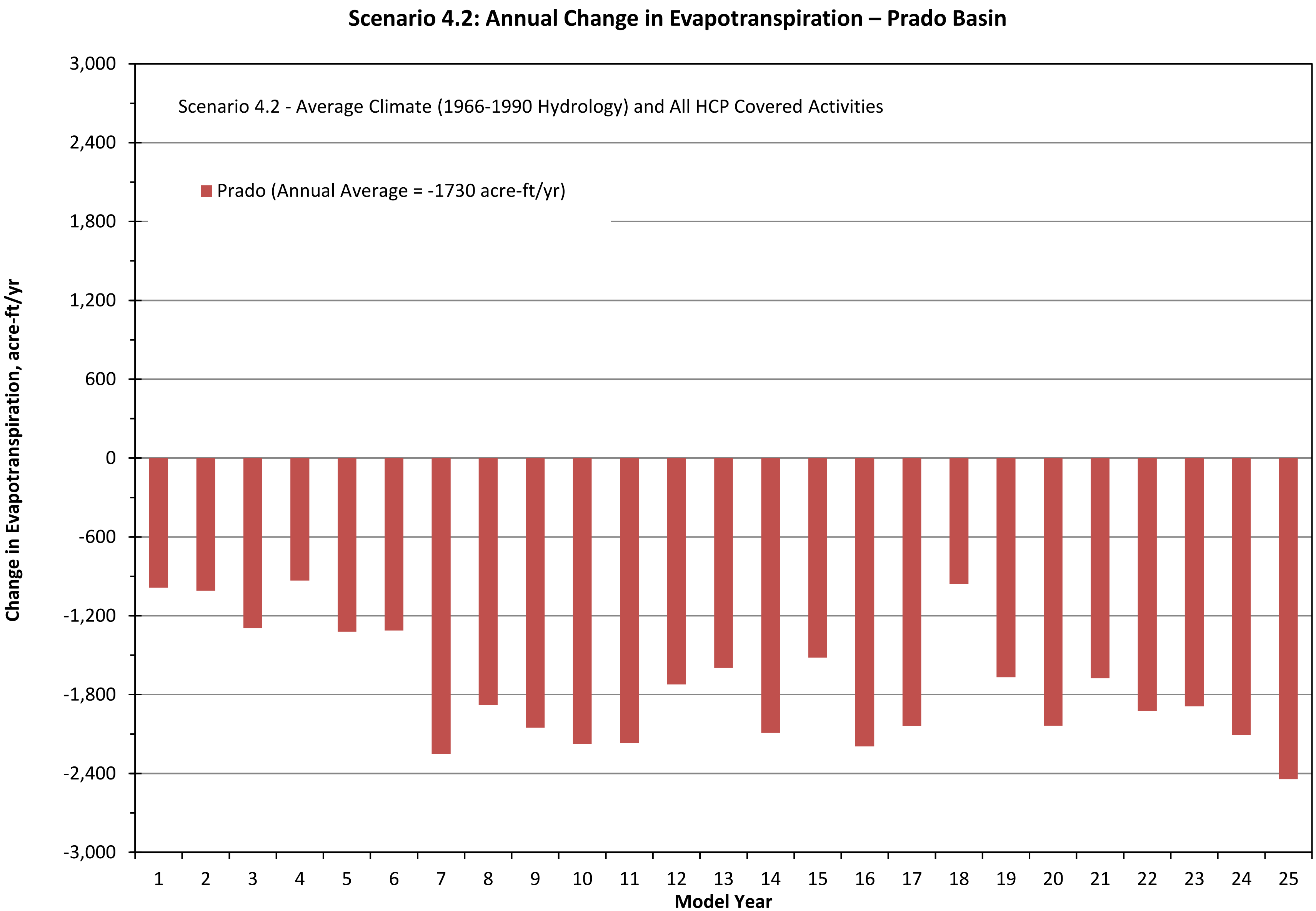
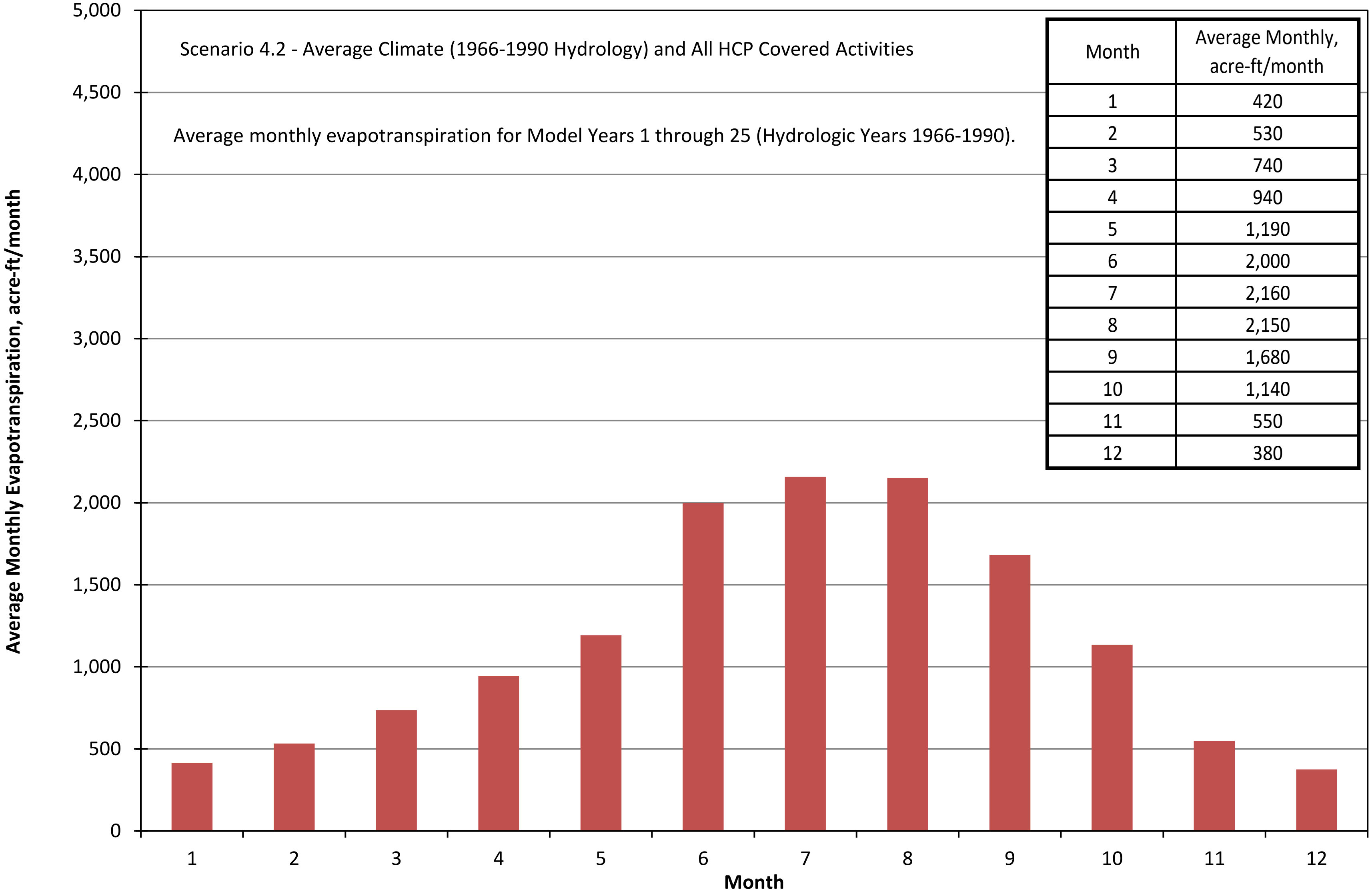

Scenario 4.2: Annual Change in Evapotranspiration – Prado Basin
Scenario 4.2 - Average Climate (1966-1990 Hydrology) and All HCP Covered Activities
Prado (Annual Average = -1730 acre-ft/yr)
Change in Evapotranspiration, acre-ft/yr
3,000
2,400
1,800
1,200
600
0
-600
-1,200
-1,800
-2,400
-3,000
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
Model Year

Figure 865

Scenario 4.2: Seasonal Evapotranspiration – Prado Basin



Month	Average Monthly, acre-ft/month
1	420
2	530
3	740
4	940
5	1,190
6	2,000
7	2,160
8	2,150
9	1,680
10	1,140
11	550
12	380

Figure 866

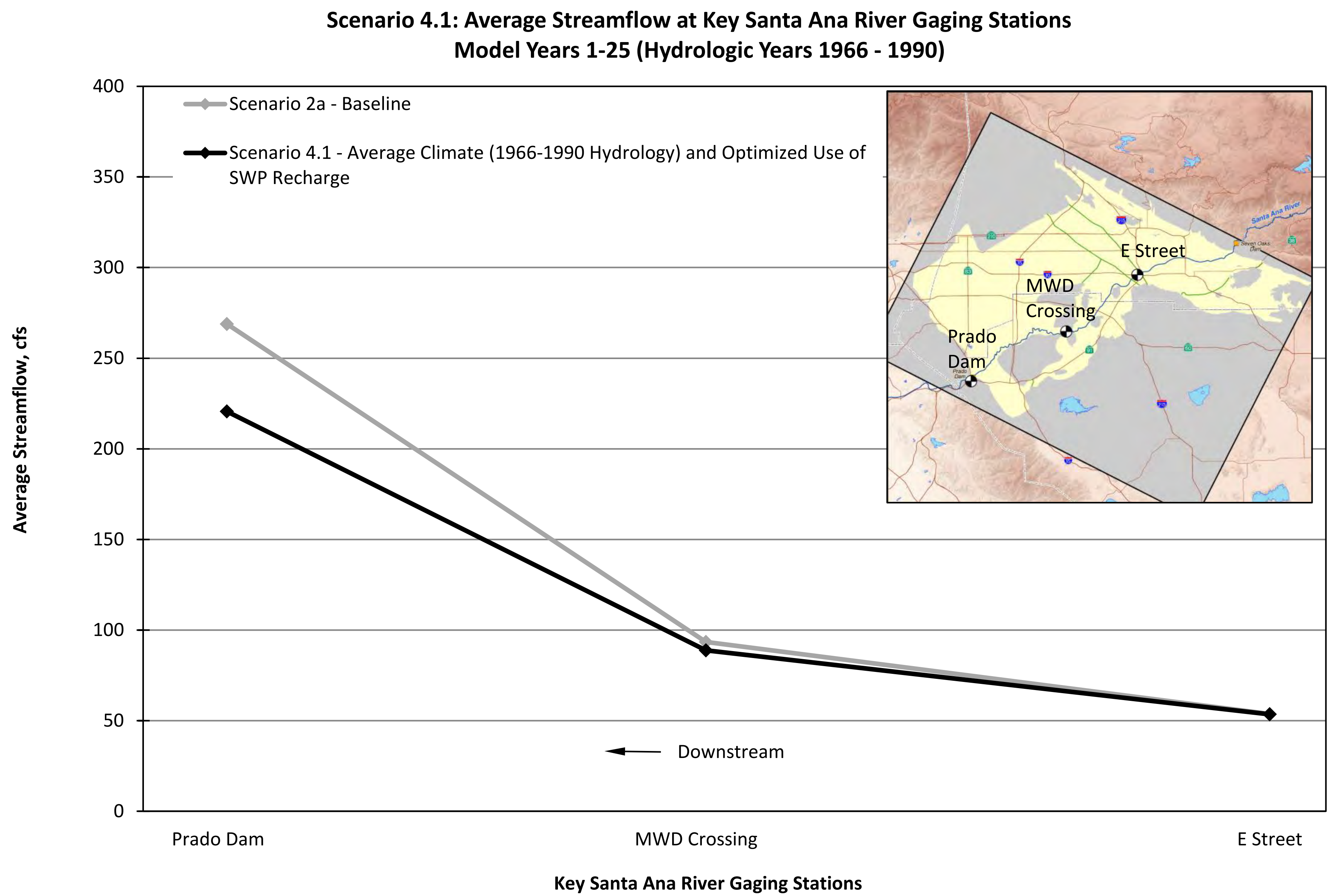

Scenario 4.1: Average Streamflow at Key Santa Ana River Gaging Stations
Model Years 1-25 (Hydrologic Years 1966 - 1990)
Scenario 2a - Baseline
Scenario 4.1 - Average Climate (1966-1990 Hydrology) and Optimized Use of SWP Recharge
Average Streamflow, cfs
400
350
300
250
200
150
100
50
0
Downstream
Prado Dam
MWD Crossing
E Street
Key Santa Ana River Gaging Stations
E Street
MWD
Crossing
Prado
Dam

Figure 867

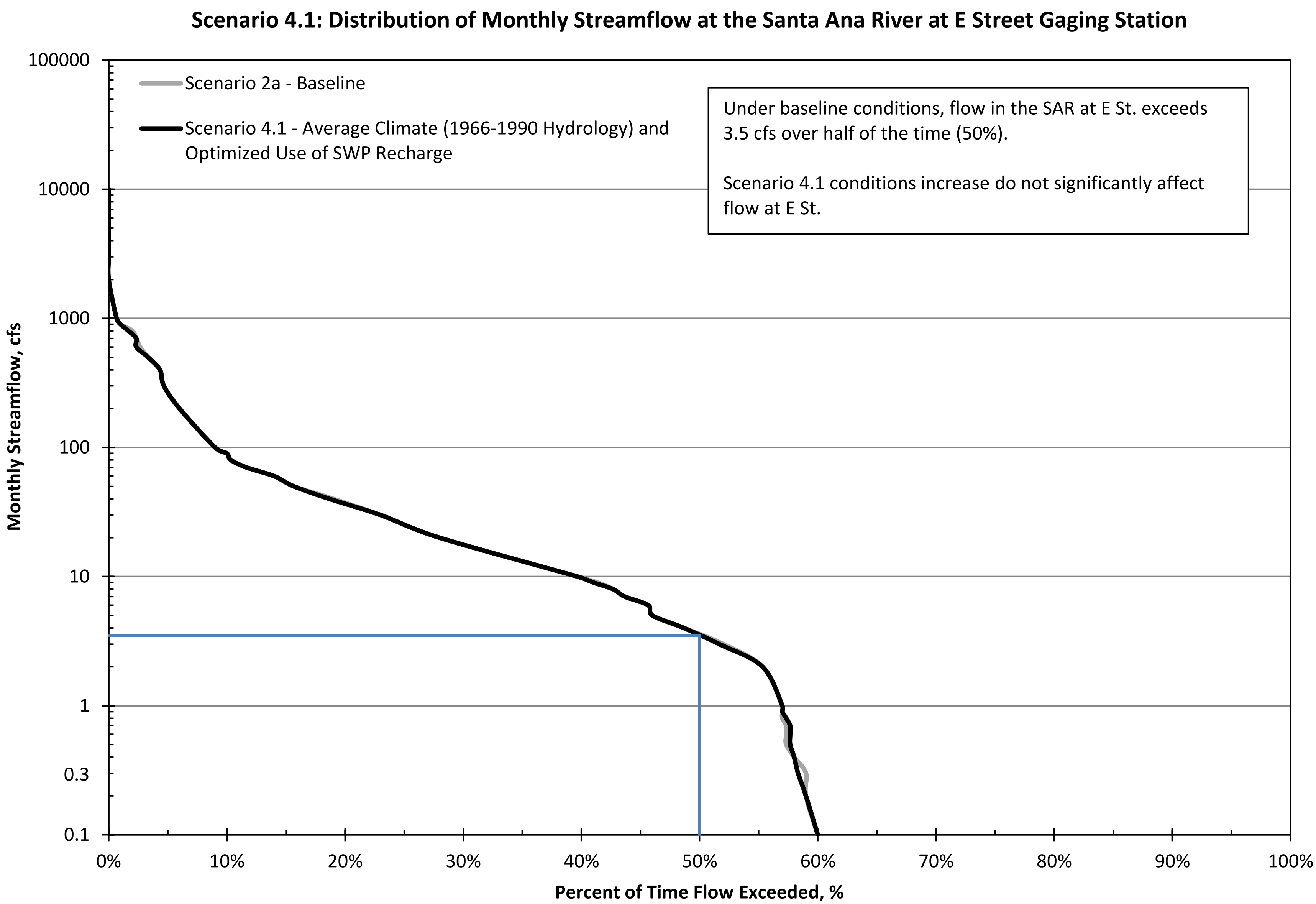

Scenario 4.1: Distribution of Monthly Streamflow at the Santa Ana River at E Street Gaging Station
100000
10000
1000
100
10
1
0.3
0.1
Monthly Streamflow, cfs
Scenario 2a - Baseline
Scenario 4.1 - Average Climate (1966-1990 Hydrology) and Optimized Use of SWP Recharge
Under baseline conditions, flow in the SAR at E St. exceeds 3.5 cfs over half of the time (50%).
Scenario 4.1 conditions increase do not significantly affect flow at E St.
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 868

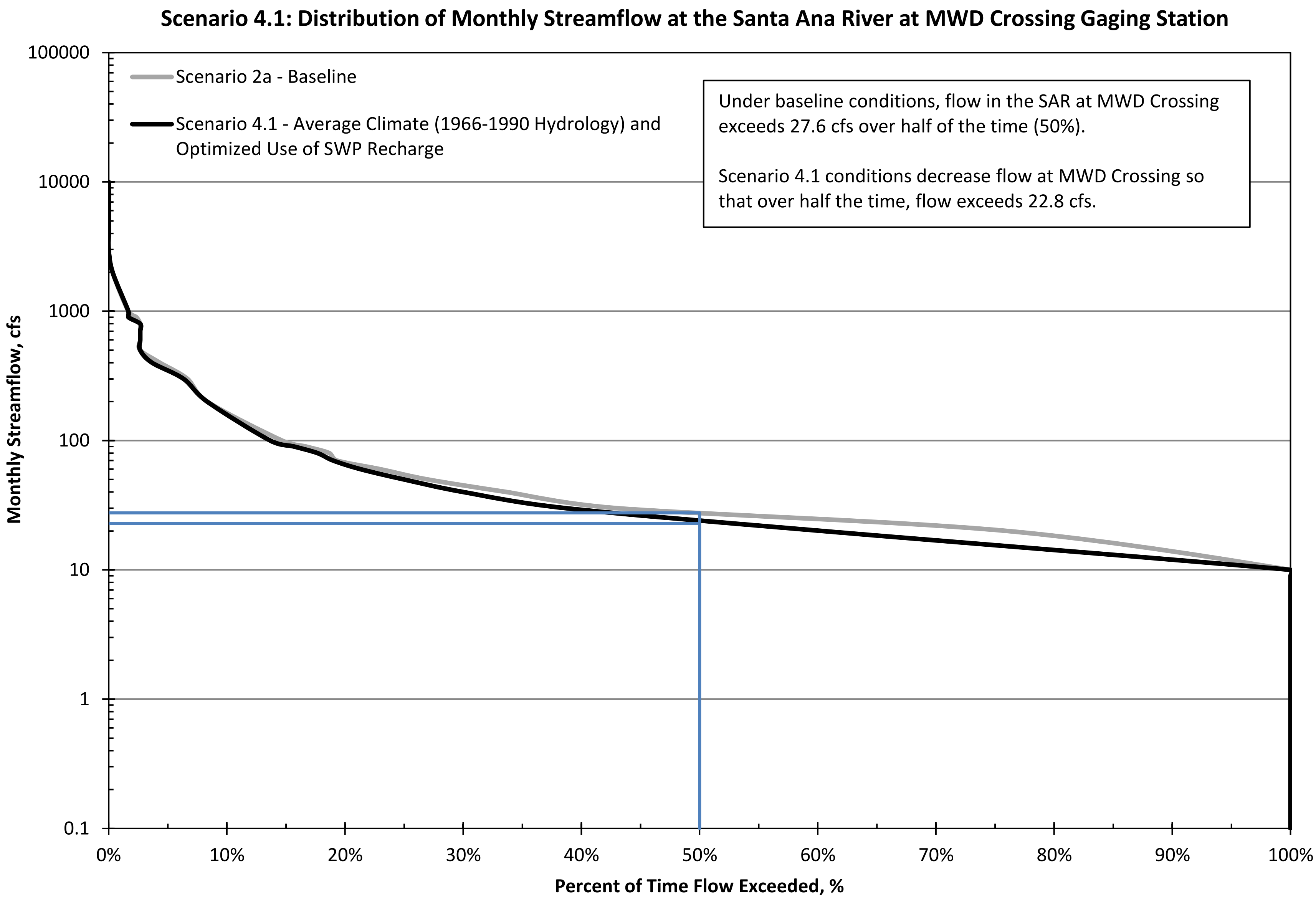

Scenario 4.1: Distribution of Monthly Streamflow at the Santa Ana River at MWD Crossing Gaging Station
Scenario 2a - Baseline
Scenario 4.1 - Average Climate (1966-1990 Hydrology) and Optimized Use of SWP Recharge
Under baseline conditions, flow in the SAR at MWD Crossing exceeds 27.6 cfs over half of the time (50%).
Scenario 4.1 conditions decrease flow at MWD Crossing so that over half the time, flow exceeds 22.8 cfs.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 869

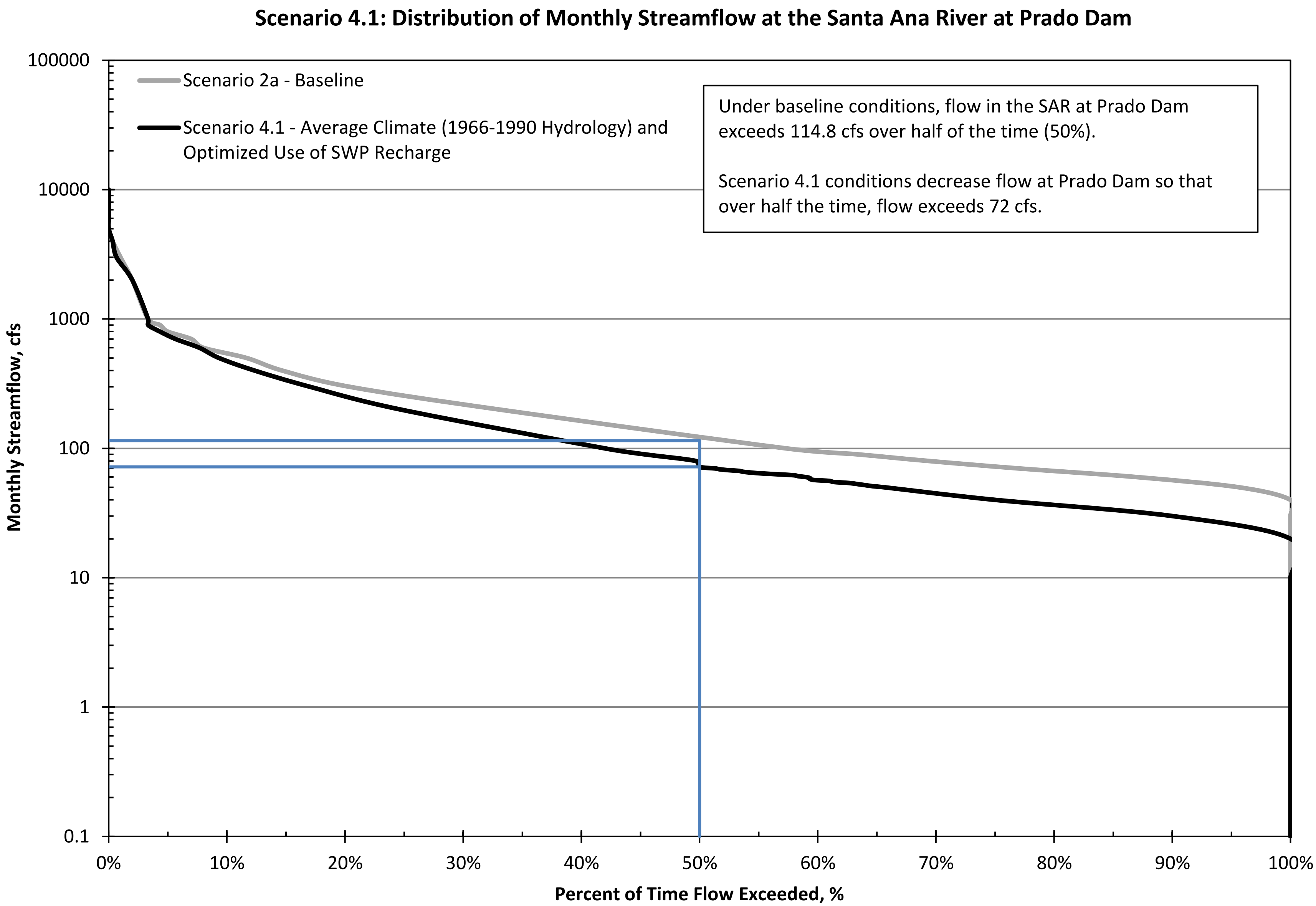

Scenario 4.1: Distribution of Monthly Streamflow at the Santa Ana River at Prado Dam
Scenario 2a - Baseline
Scenario 4.1 - Average Climate (1966-1990 Hydrology) and Optimized Use of SWP Recharge
Under baseline conditions, flow in the SAR at Prado Dam exceeds 114.8 cfs over half of the time (50%).
Scenario 4.1 conditions decrease flow at Prado Dam so that over half the time, flow exceeds 72 cfs.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 870

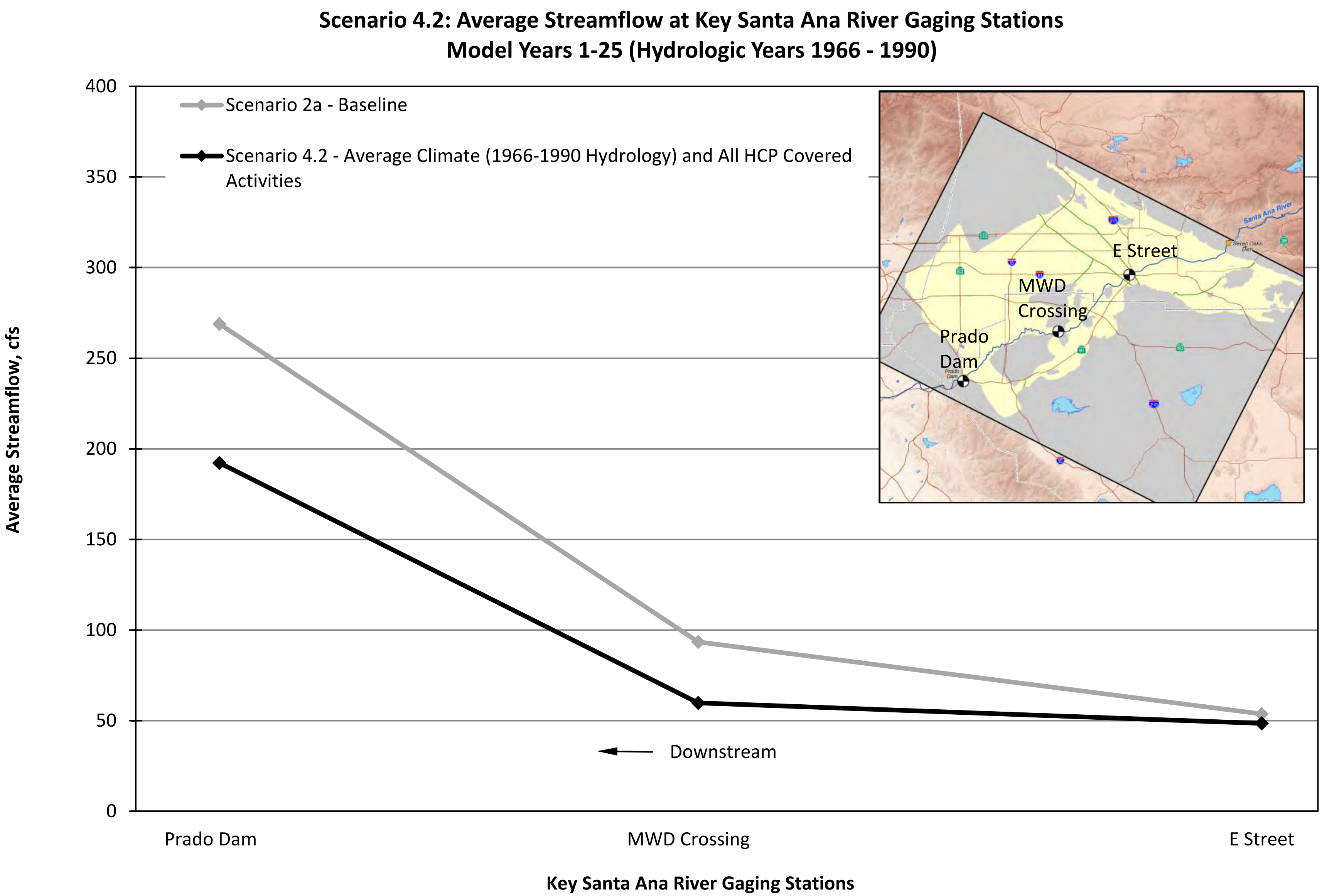

Scenario 4.2: Average Streamflow at Key Santa Ana River Gaging Stations
Model Years 1-25 (Hydrologic Years 1966 - 1990)
Scenario 2a - Baseline
Scenario 4.2 - Average Climate (1966-1990 Hydrology) and All HCP Covered Activities
Average Streamflow, cfs
0
50
100
150
200
250
300
350
400
E Street
MWD Crossing
Prado Dam
Downstream
Prado Dam
MWD Crossing
E Street
Key Santa Ana River Gaging Stations

Figure 871

DRAFT

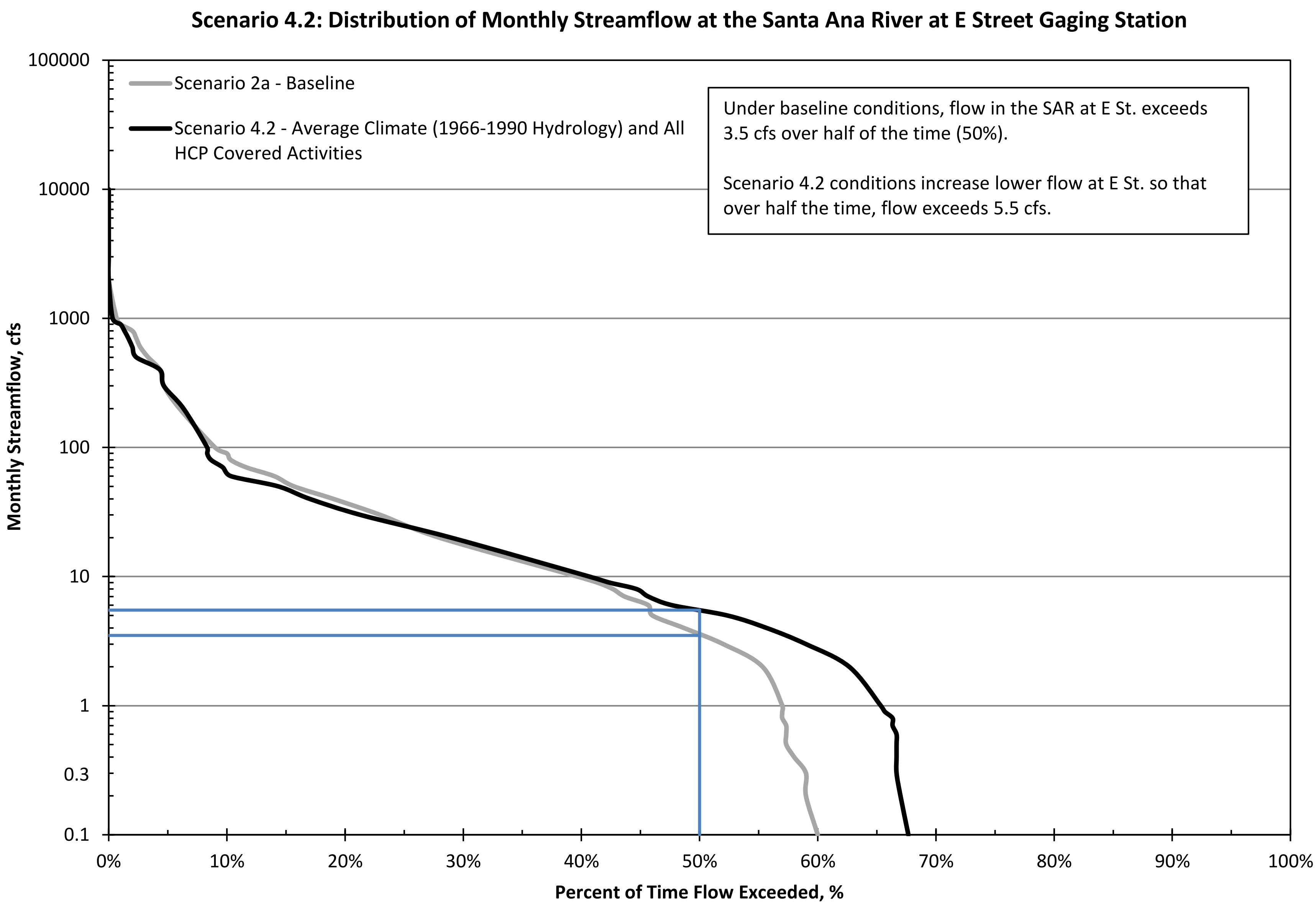


Figure 872

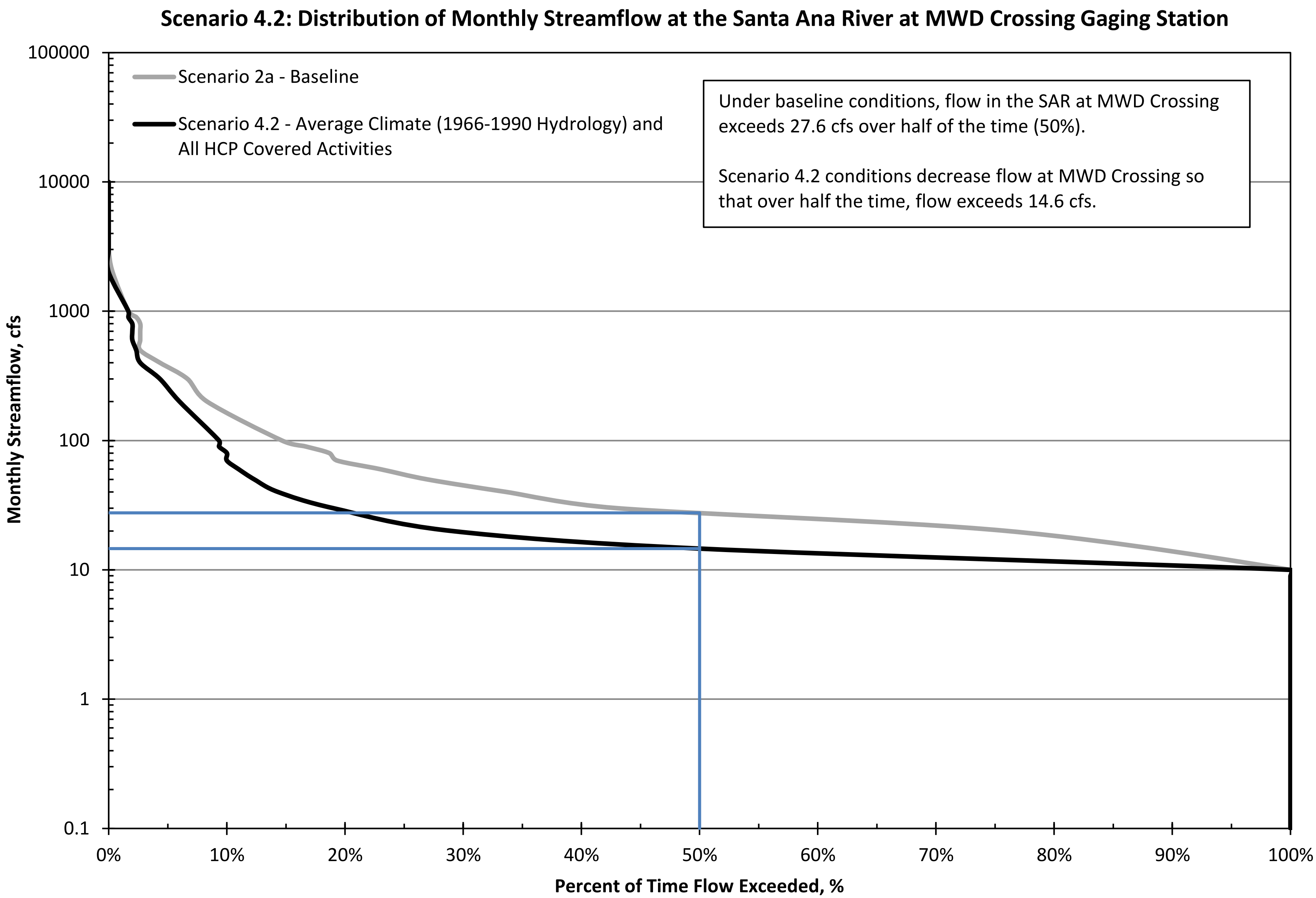

Scenario 4.2: Distribution of Monthly Streamflow at the Santa Ana River at MWD Crossing Gaging Station
Scenario 2a - Baseline
Scenario 4.2 - Average Climate (1966-1990 Hydrology) and All HCP Covered Activities
Under baseline conditions, flow in the SAR at MWD Crossing exceeds 27.6 cfs over half of the time (50%).
Scenario 4.2 conditions decrease flow at MWD Crossing so that over half the time, flow exceeds 14.6 cfs.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 873

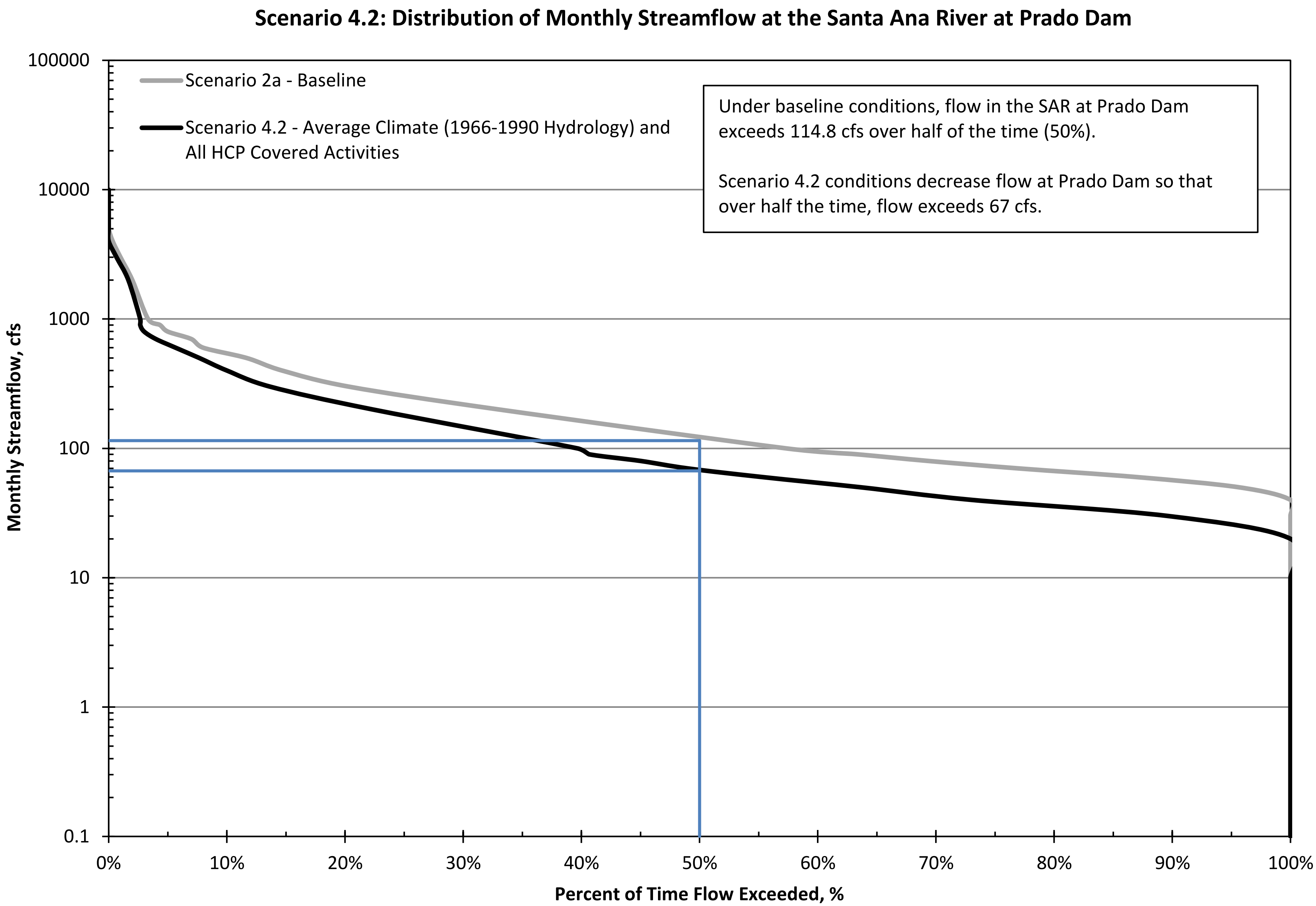
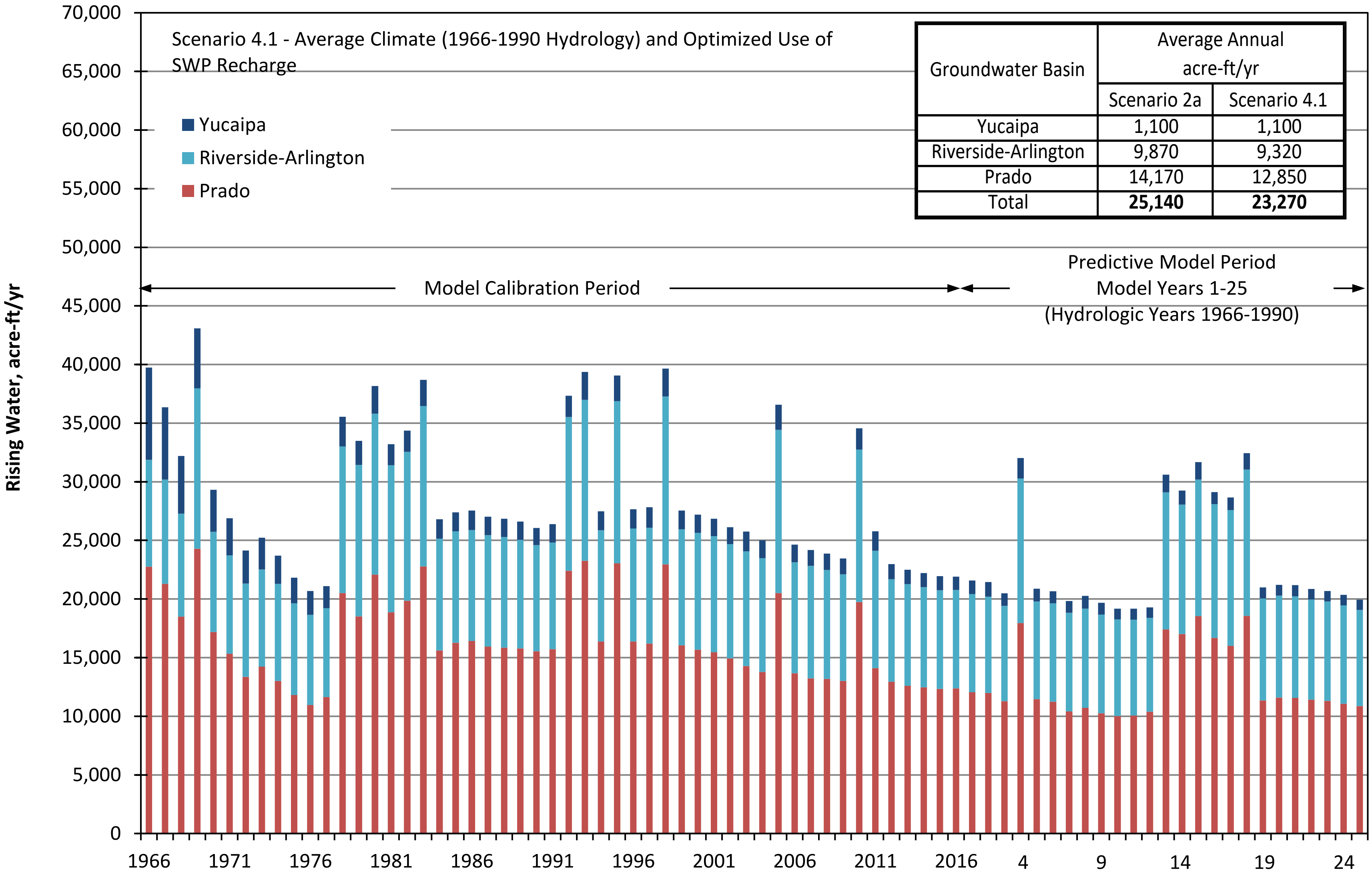

Scenario 4.2: Distribution of Monthly Streamflow at the Santa Ana River at Prado Dam
Scenario 2a - Baseline
Scenario 4.2 - Average Climate (1966-1990 Hydrology) and All HCP Covered Activities
Under baseline conditions, flow in the SAR at Prado Dam exceeds 114.8 cfs over half of the time (50%).
Scenario 4.2 conditions decrease flow at Prado Dam so that over half the time, flow exceeds 67 cfs.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 874

DRAFT

Scenario 4.1: Annual Rising Water – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a	Scenario 4.1
Yucaipa	1,100	1,100
Riverside-Arlington	9,870	9,320
Prado	14,170	12,850
Total	**25,140**	**23,270**

Figure 875

Scenario 4.2: Annual Rising Water – Integrated SAR Model Area

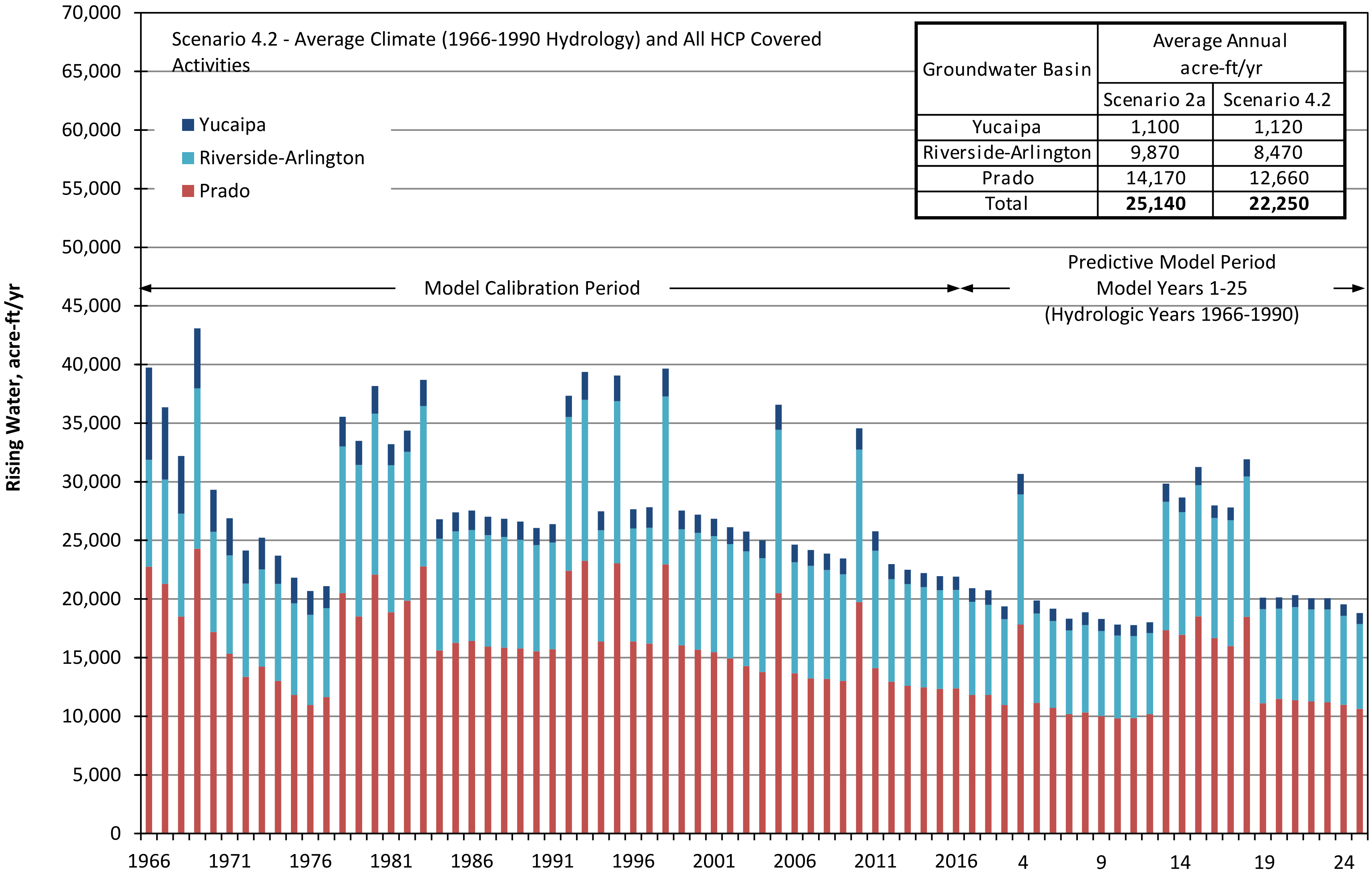


Figure 876

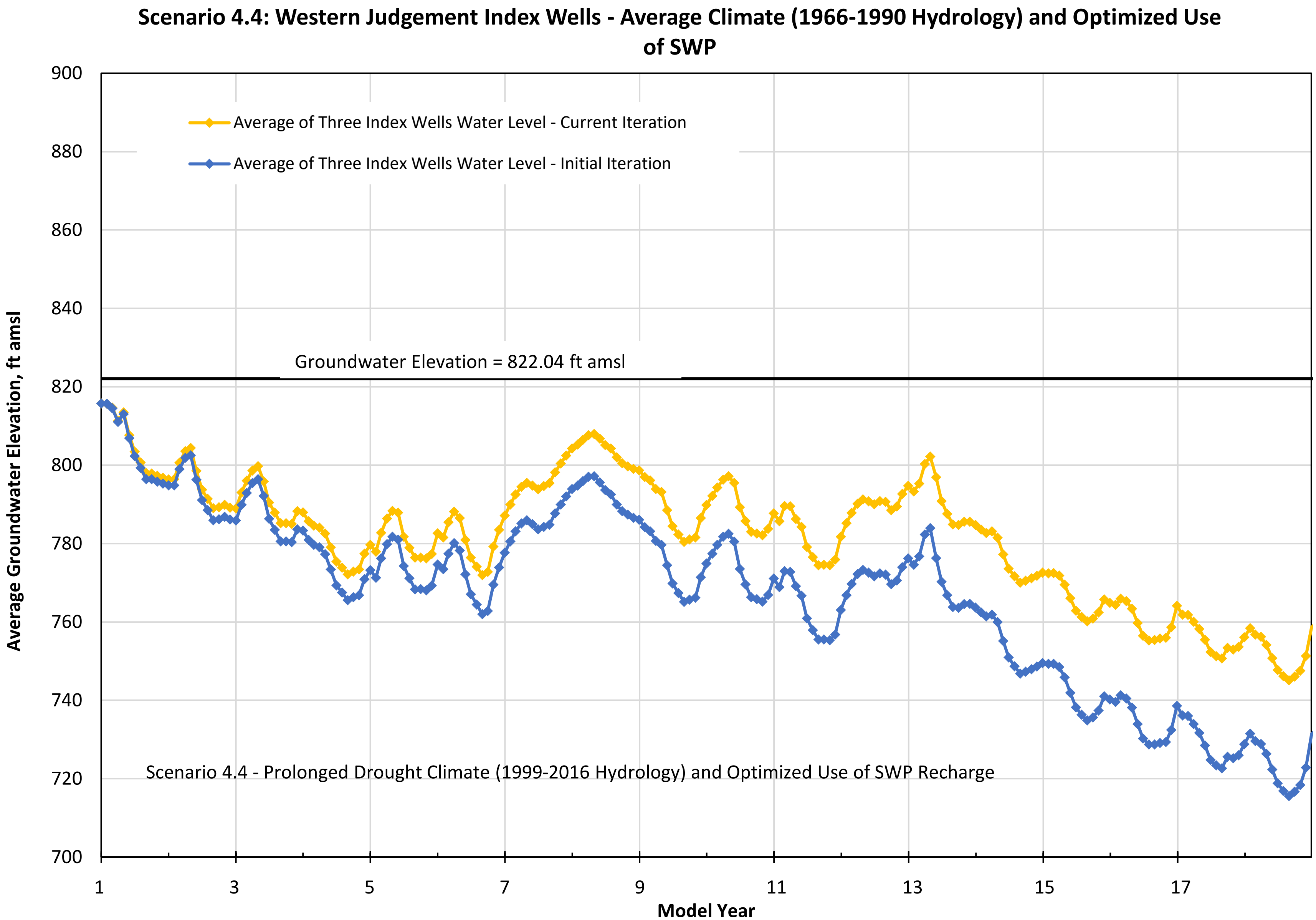

Scenario 4.4: Western Judgement Index Wells - Average Climate (1966-1990 Hydrology) and Optimized Use of SWP
Average of Three Index Wells Water Level - Current Iteration
Average of Three Index Wells Water Level - Initial Iteration
Groundwater Elevation = 822.04 ft amsl
Scenario 4.4 - Prolonged Drought Climate (1999-2016 Hydrology) and Optimized Use of SWP Recharge
Average Groundwater Elevation, ft amsl
900
880
860
840
820
800
780
760
740
720
700
1
3
5
7
9
11
13
15
17
Model Year

Figure 877

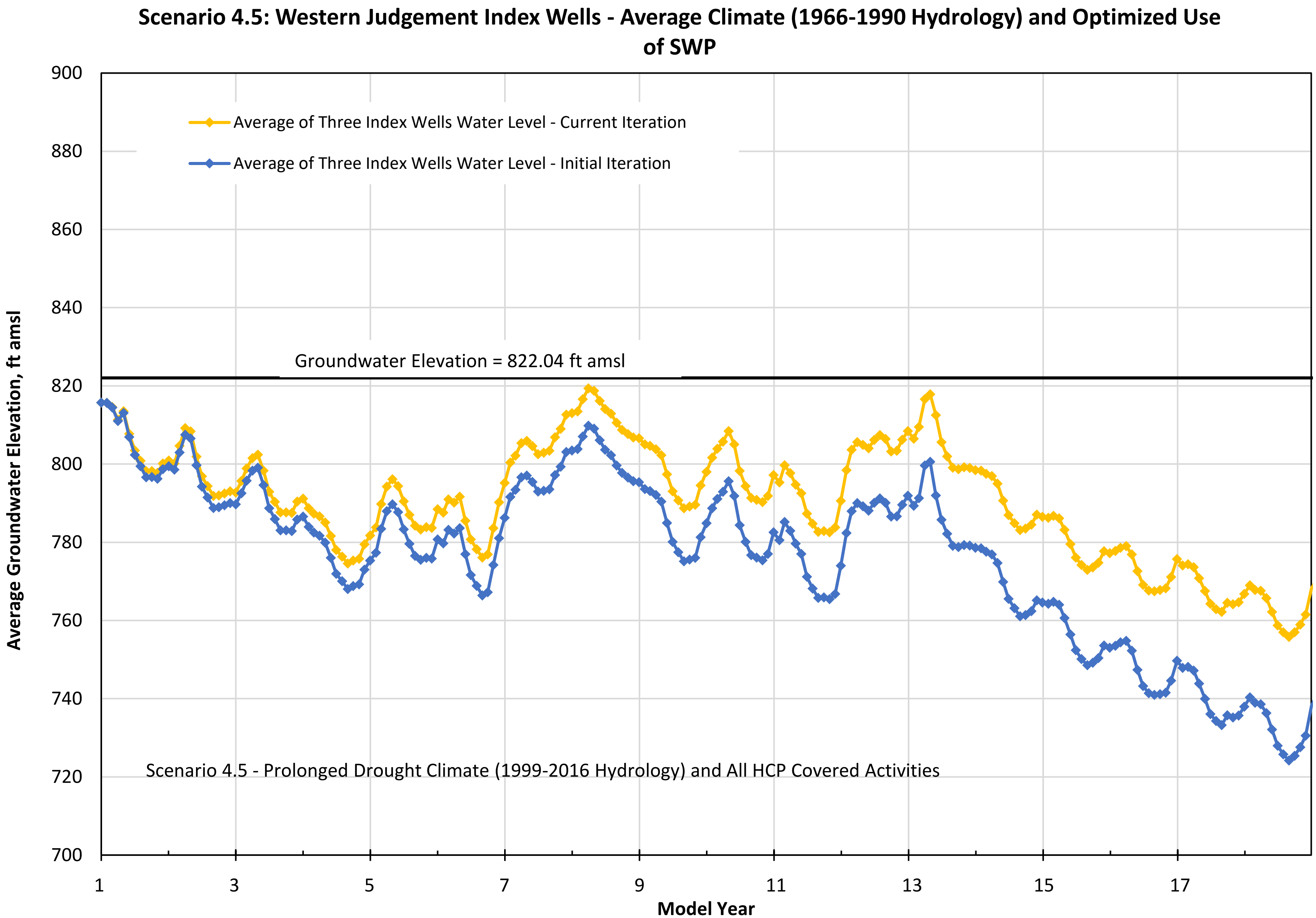
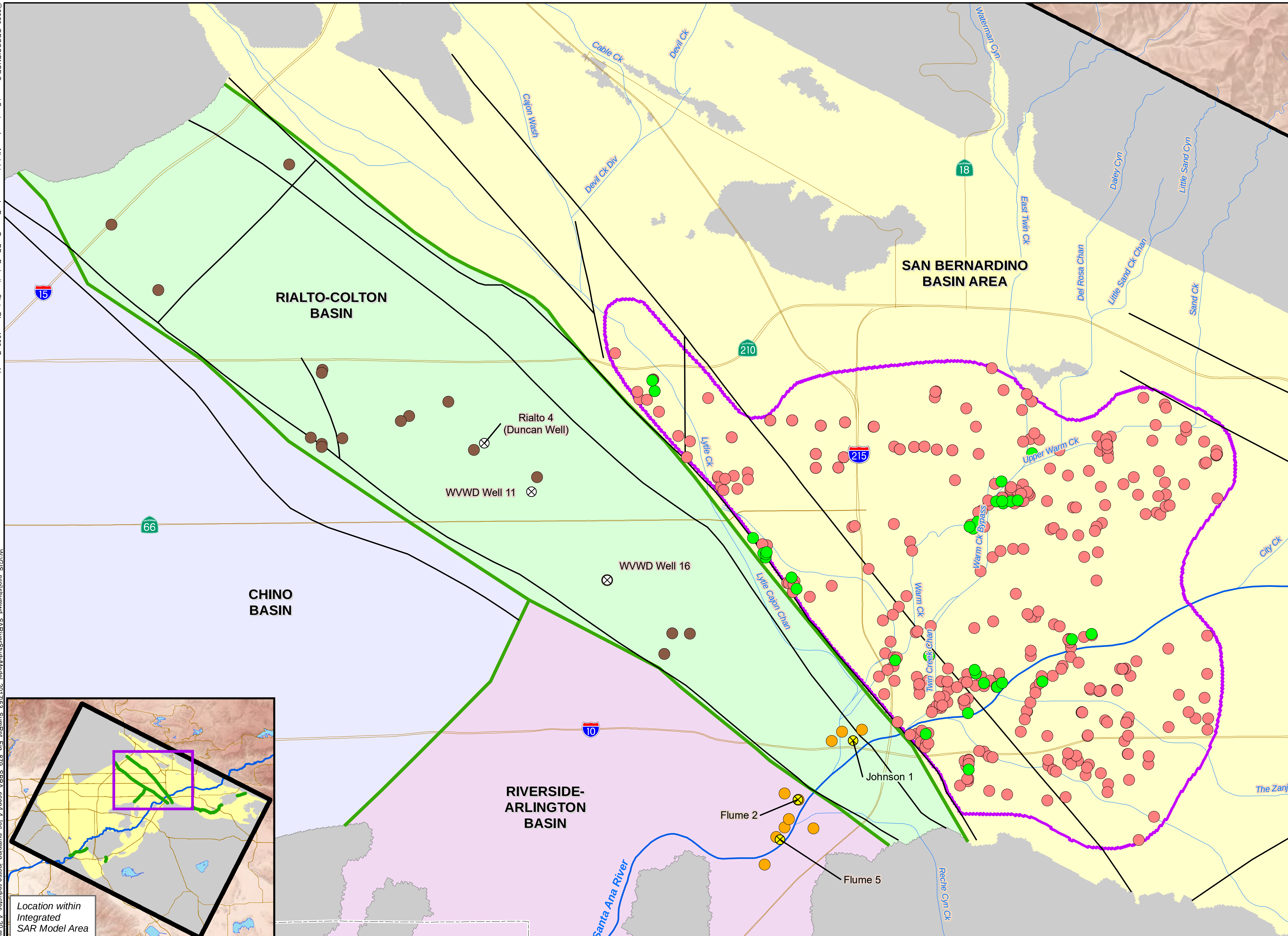

Scenario 4.5: Western Judgement Index Wells - Average Climate (1966-1990 Hydrology) and Optimized Use of SWP
Average of Three Index Wells Water Level - Current Iteration
Average of Three Index Wells Water Level - Initial Iteration
Groundwater Elevation = 822.04 ft amsl
Scenario 4.5 - Prolonged Drought Climate (1999-2016 Hydrology) and All HCP Covered Activities
Average Groundwater Elevation, ft amsl
900
880
860
840
820
800
780
760
740
720
700
1
3
5
7
9
11
13
15
17
Model Year

Figure 878



EXPLANATION

- Integrated SAR Model Boundary
- Inactive Model Area
- Groundwater Basin
- Pressure Zone
- Groundwater Basin Boundary
- Groundwater Flow Barrier
- Production Well With Increased Pumping (Pumpage Transferred from Wells Subject to 1969 Western Judgment)
- Production Well With Decreased Pumping (Subject to 1969 Western Judgment)
- Production Well With Decreased Pumping Due to Subsidence
- Production Well With Decreased Pumping (Subject to 1961 Decree)
- 1961 Decree Index Well
- 1969 Western Judgment Index Well

Scenario 4.4: Prolonged Drought Climate (1999-2016 Hydrology) and Optimized Use of SWP Recharge

N

0 1.25 2.5

Miles

SCENARIO 4.4: LOCATION OF PUMPING INCREASES AND REDUCTIONS

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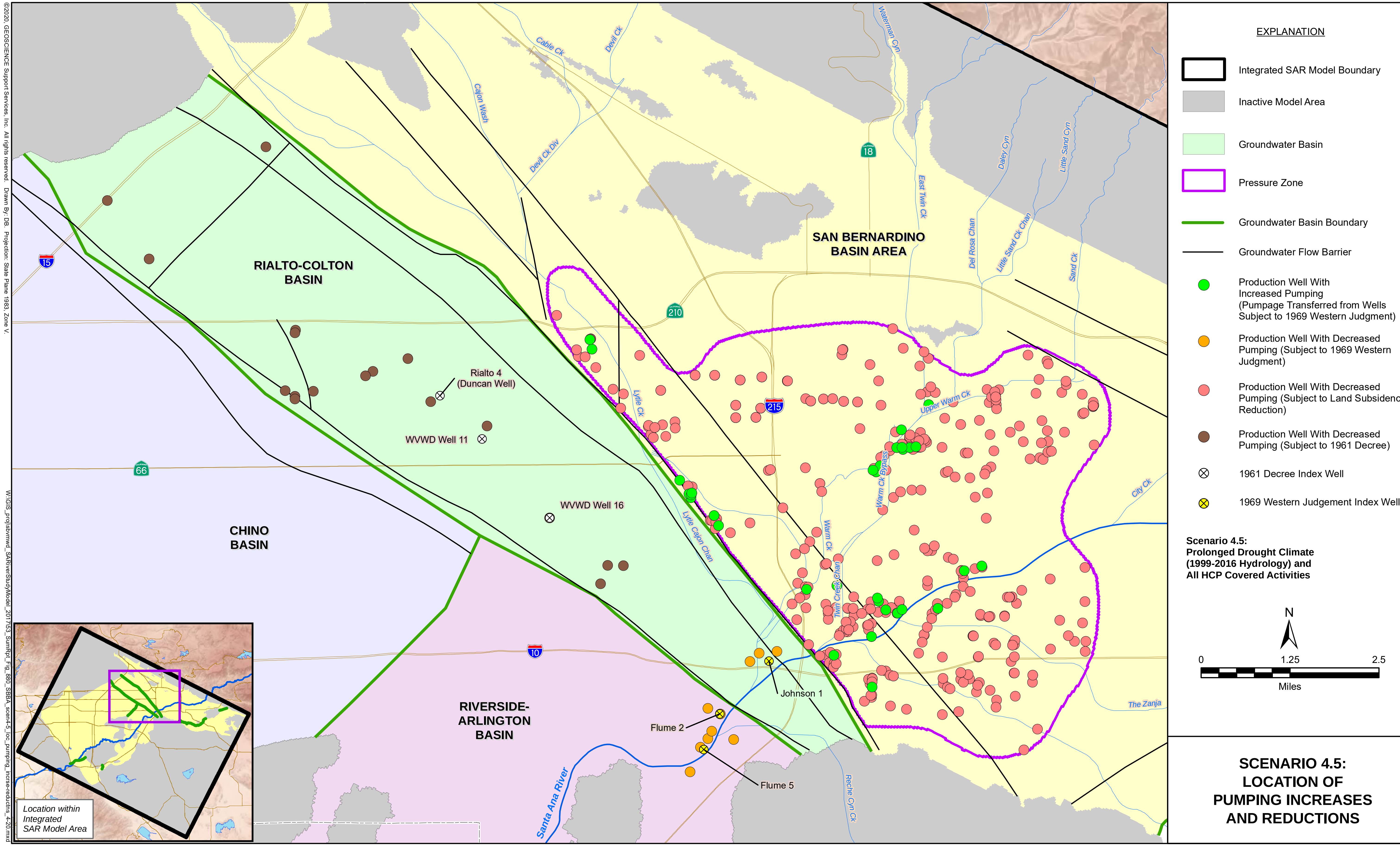
FIGURE 879



10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

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FIGURE 880

GEOSCIENCE

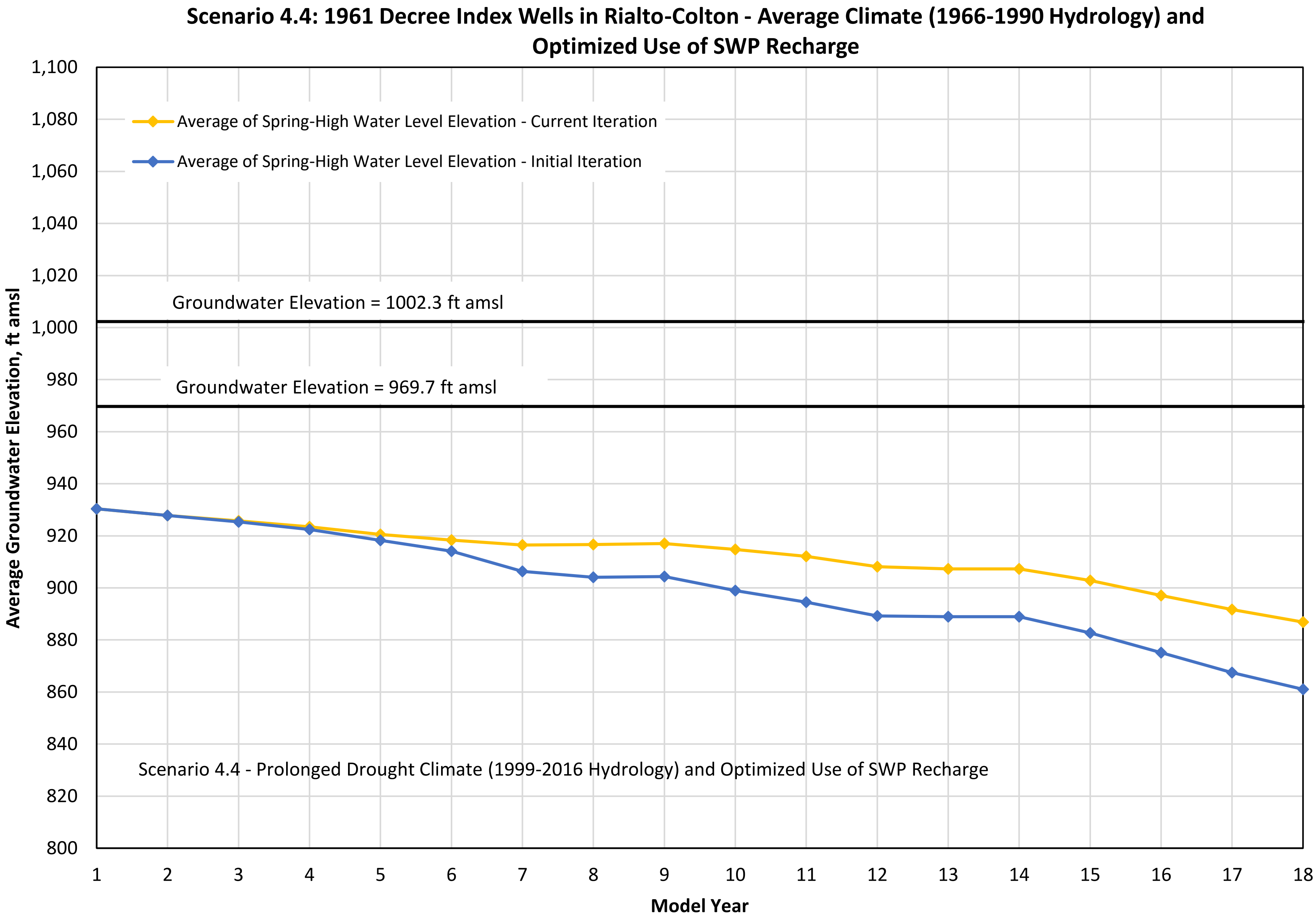

Scenario 4.4: 1961 Decree Index Wells in Rialto-Colton - Average Climate (1966-1990 Hydrology) and Optimized Use of SWP Recharge
Average of Spring-High Water Level Elevation - Current Iteration
Average of Spring-High Water Level Elevation - Initial Iteration
Groundwater Elevation = 1002.3 ft amsl
Groundwater Elevation = 969.7 ft amsl
Scenario 4.4 - Prolonged Drought Climate (1999-2016 Hydrology) and Optimized Use of SWP Recharge
Average Groundwater Elevation, ft amsl
1,100
1,080
1,060
1,040
1,020
1,000
980
960
940
920
900
880
860
840
820
800
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
Model Year

Figure 881

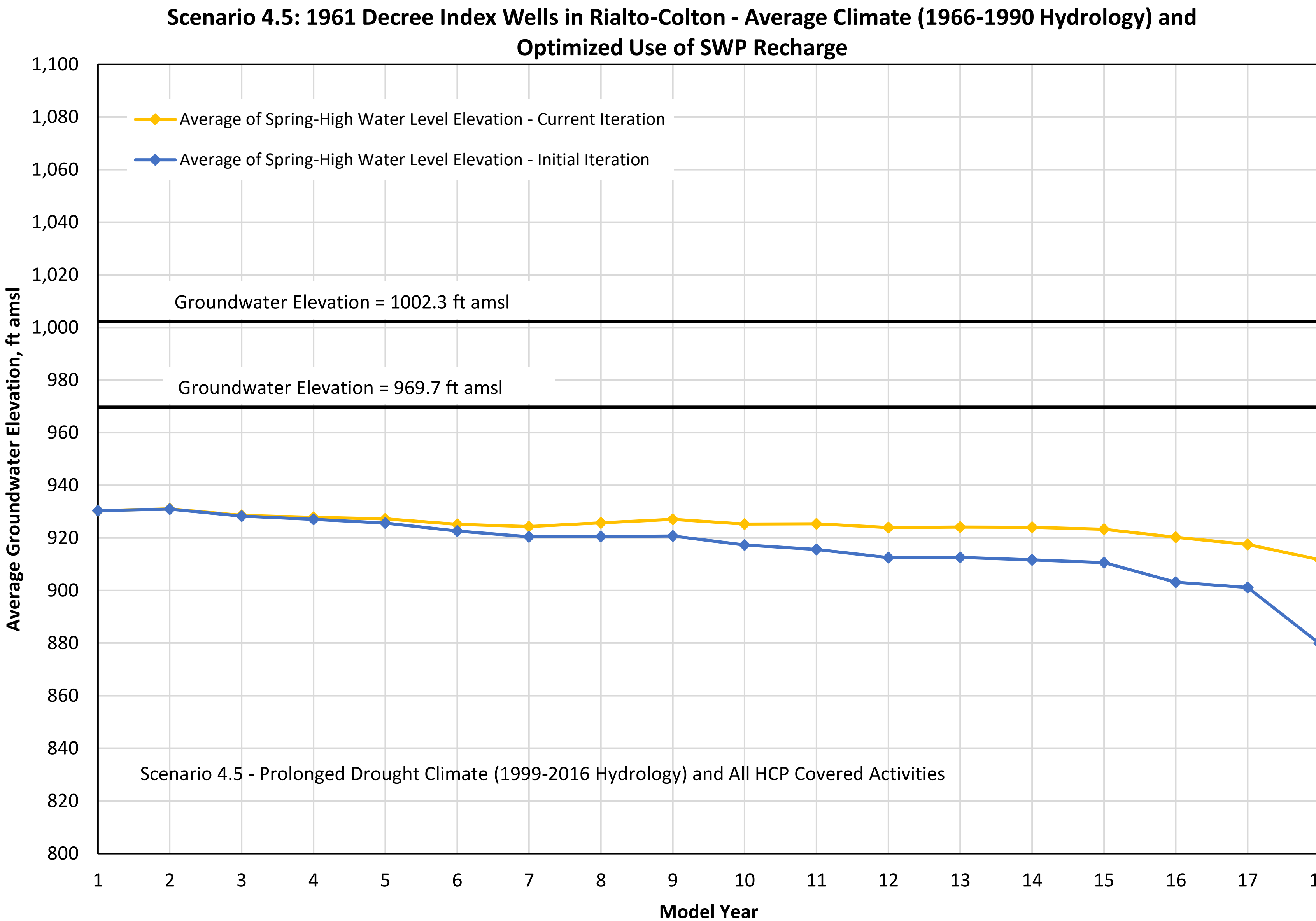
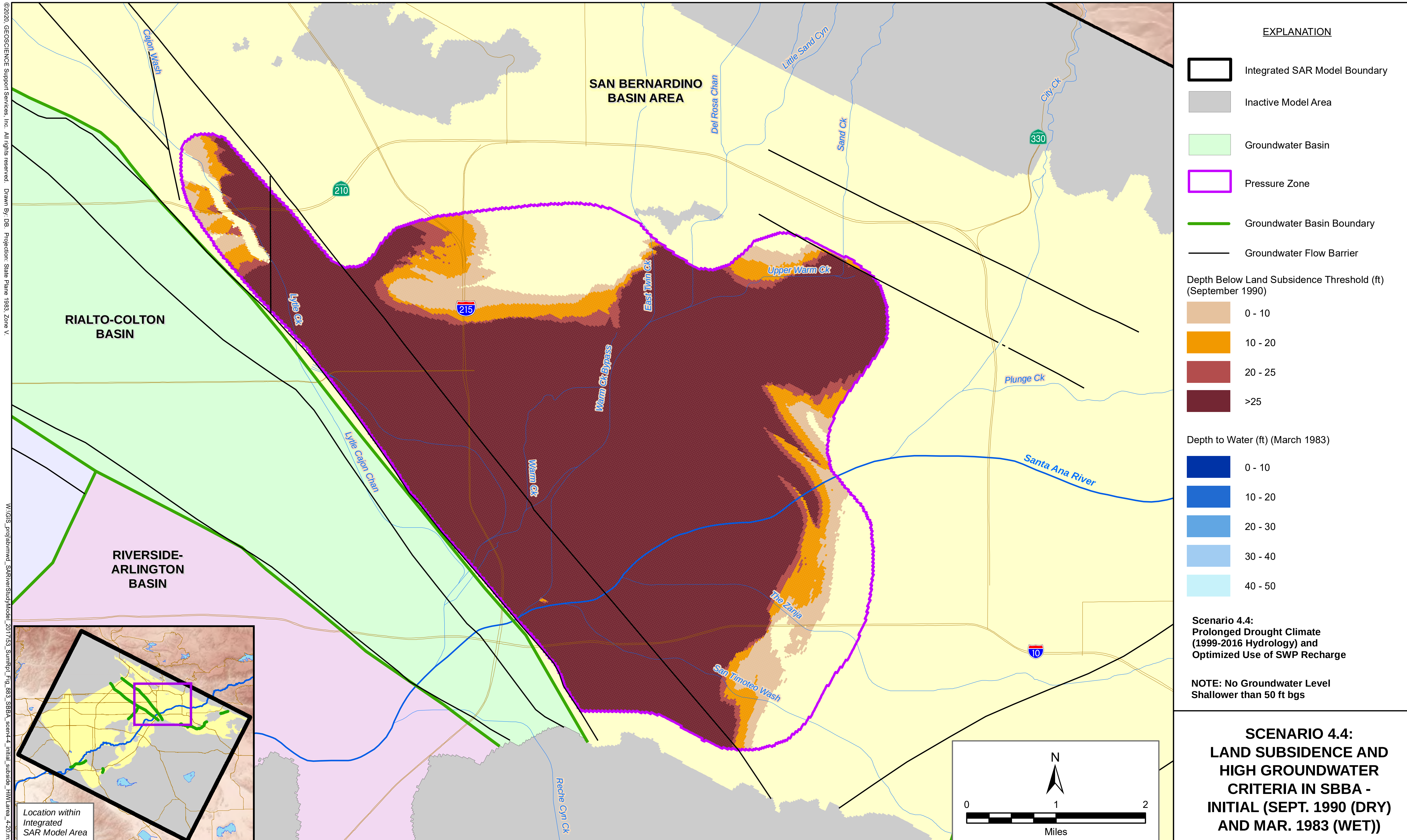

Scenario 4.5: 1961 Decree Index Wells in Rialto-Colton - Average Climate (1966-1990 Hydrology) and Optimized Use of SWP Recharge
Average of Spring-High Water Level Elevation - Current Iteration
Average of Spring-High Water Level Elevation - Initial Iteration
Groundwater Elevation = 1002.3 ft amsl
Groundwater Elevation = 969.7 ft amsl
Scenario 4.5 - Prolonged Drought Climate (1999-2016 Hydrology) and All HCP Covered Activities
Average Groundwater Elevation, ft amsl
Model Year
1,100
1,080
1,060
1,040
1,020
1,000
980
960
940
920
900
880
860
840
820
800
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18

Figure 882



SCENARIO 4.4: LAND SUBSIDENCE AND HIGH GROUNDWATER CRITERIA IN SBBA - INITIAL (SEPT. 1990 (DRY) AND MAR. 1983 (WET))

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SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

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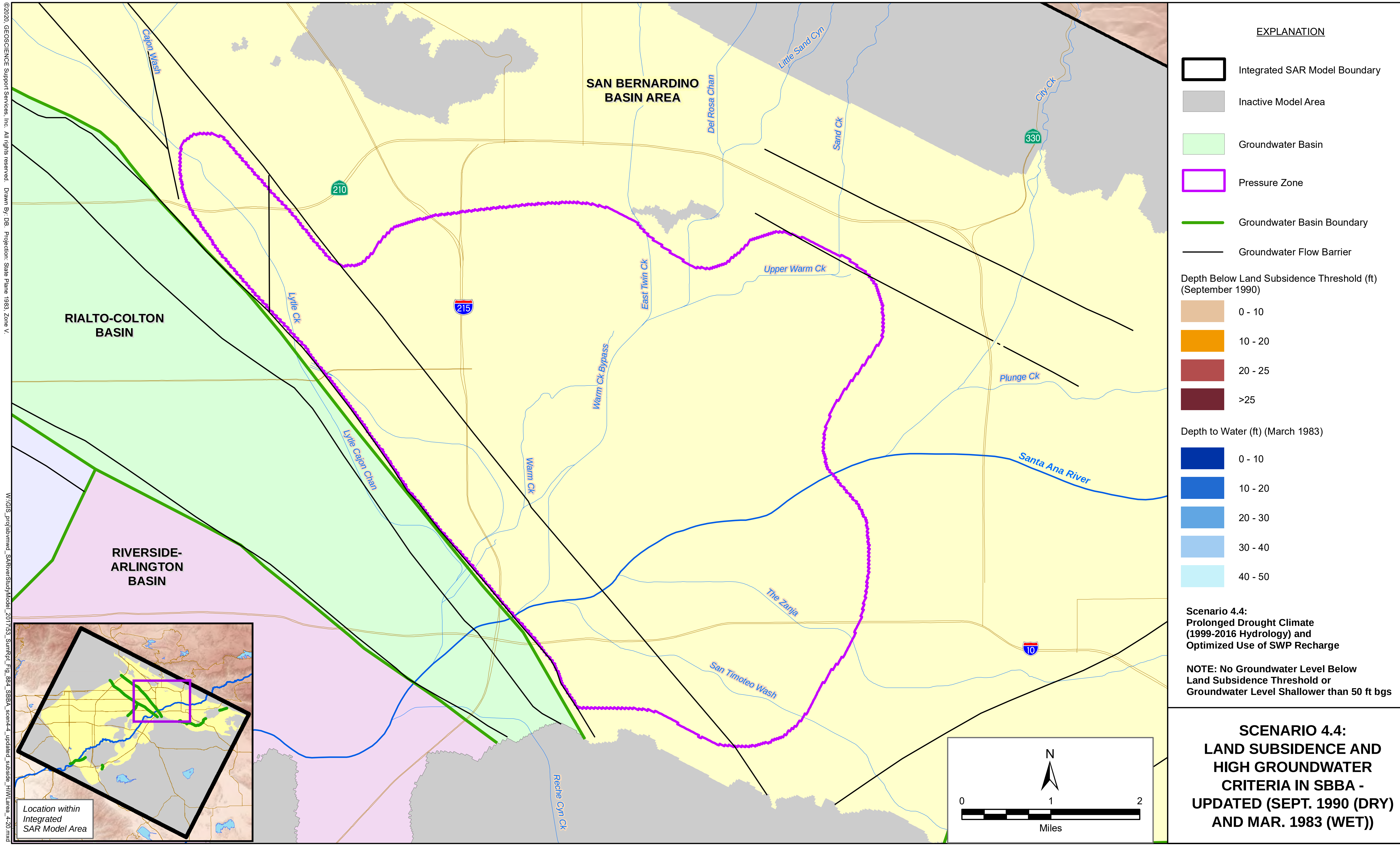
FIGURE 883

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT



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SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

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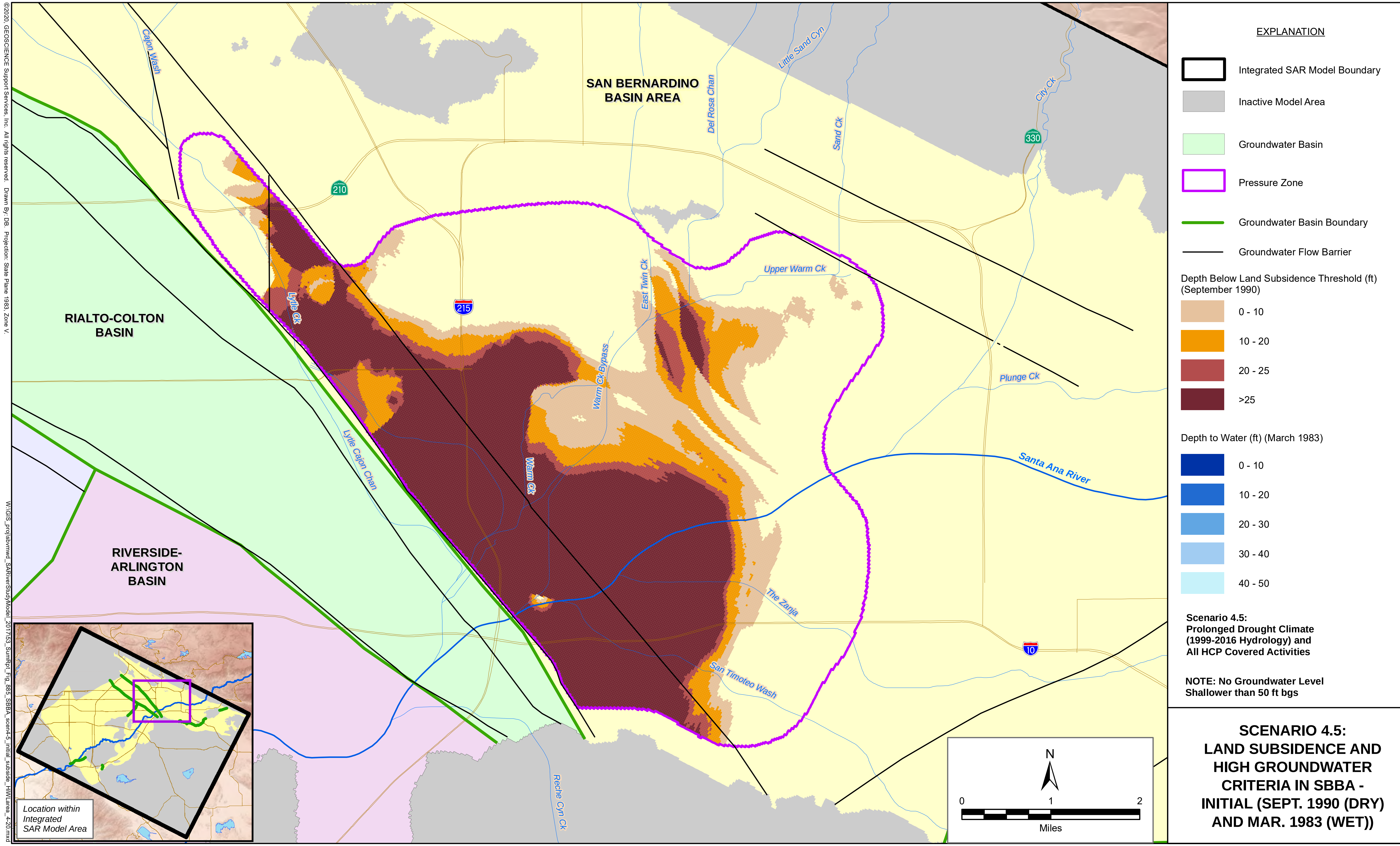
FIGURE 884

GEOSCIENCE



SCENARIO 4.5: LAND SUBSIDENCE AND HIGH GROUNDWATER CRITERIA IN SBBA - INITIAL (SEPT. 1990 (DRY) AND MAR. 1983 (WET))

10-Apr-20

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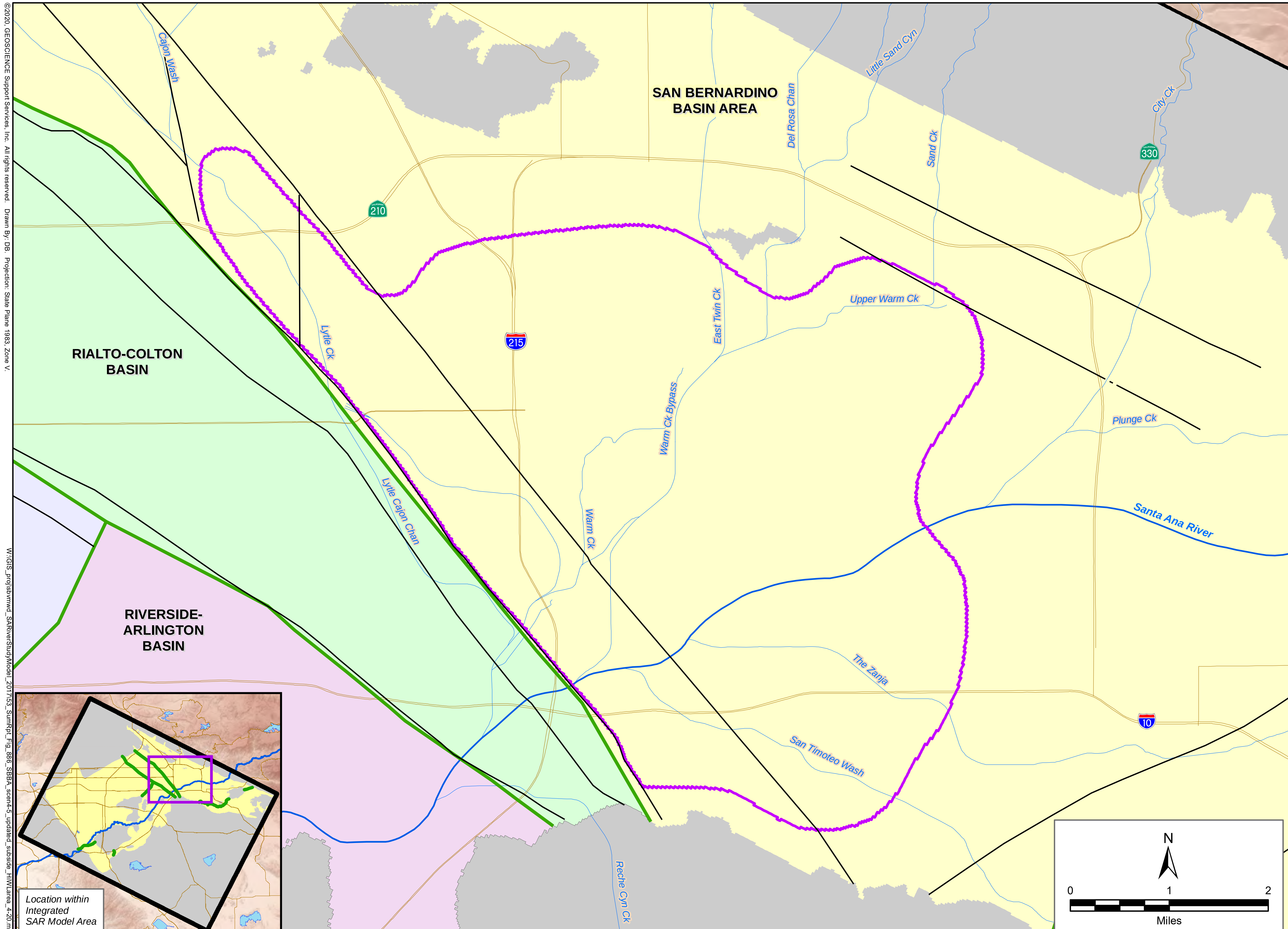
FIGURE 885

GEOSCIENCE



EXPLANATION

- Integrated SAR Model Boundary
- Inactive Model Area
- Groundwater Basin
- Pressure Zone
- Groundwater Basin Boundary
- Groundwater Flow Barrier

Depth Below Land Subsidence Threshold (ft)
(September 1990)

- 0 - 10
- 10 - 20
- 20 - 25
- >25

Depth to Water (ft) (March 1983)

- 0 - 10
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50

Scenario 4.5:
Prolonged Drought Climate (1999-2016 Hydrology) and All HCP Covered Activities

NOTE: No Groundwater Level Below Land Subsidence Threshold or Groundwater Level Shallower than 50 ft bgs

SCENARIO 4.5: LAND SUBSIDENCE AND HIGH GROUNDWATER CRITERIA IN SBBA - UPDATED (SEPT. 1990 (DRY) AND MAR. 1983 (WET))

W:\GIS_projects\mwd_SARiverStudy\Model_2017\53_SumRpt_Fig_886_SBBA_scen4-5_updated_subside_HWLarea_4-20.mxd

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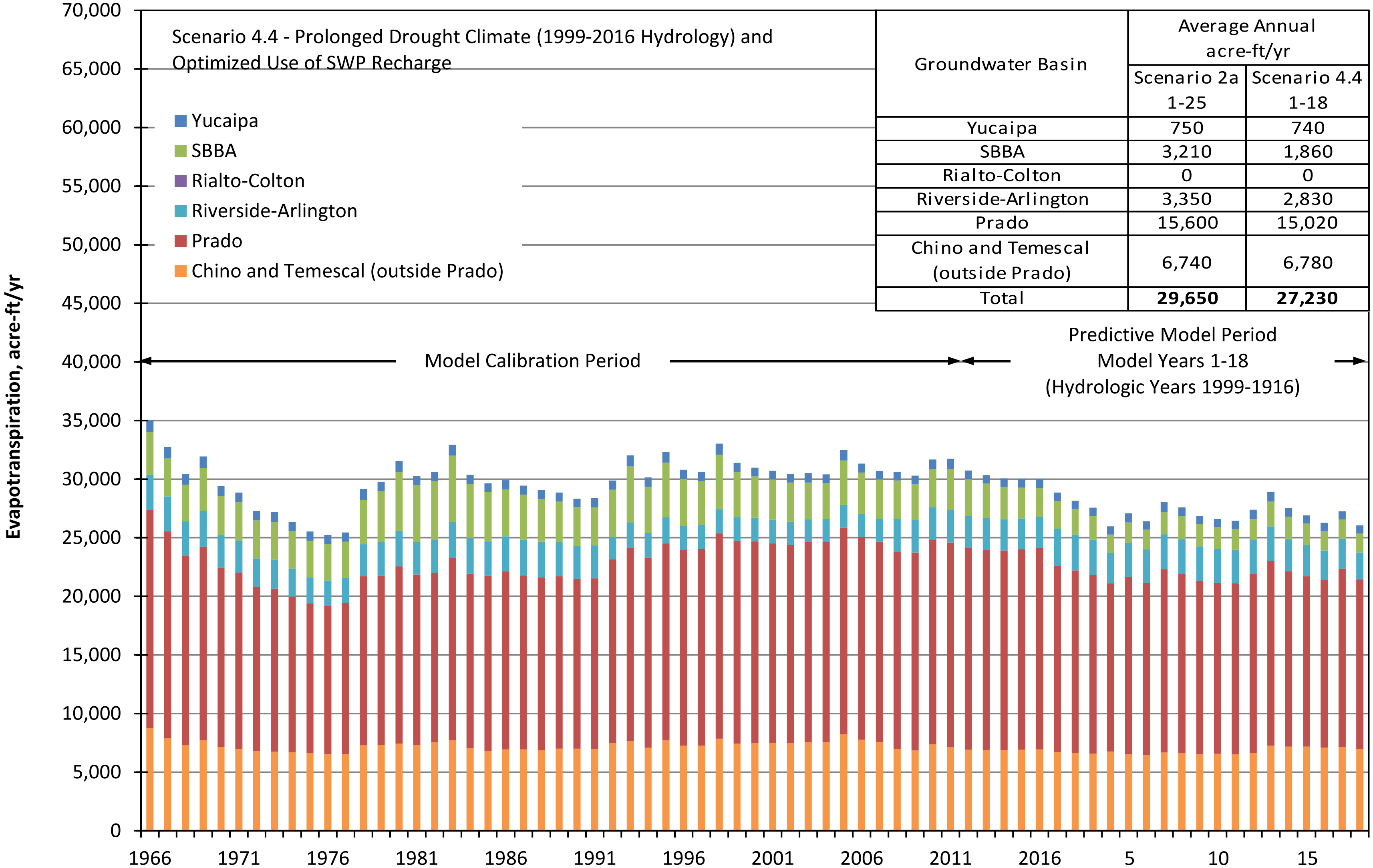
FIGURE 886

GEOSCIENCE

Scenario 4.4: Annual Evapotranspiration – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr Scenario 2a 1-25	Average Annual acre-ft/yr Scenario 4.4 1-18
Yucaipa	750	740
SBBA	3,210	1,860
Rialto-Colton	0	0
Riverside-Arlington	3,350	2,830
Prado	15,600	15,020
Chino and Temescal (outside Prado)	6,740	6,780
Total	**29,650**	**27,230**

Figure 887

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Scenario 4.4: Annual Change in Evapotranspiration – Integrated SAR Model Area

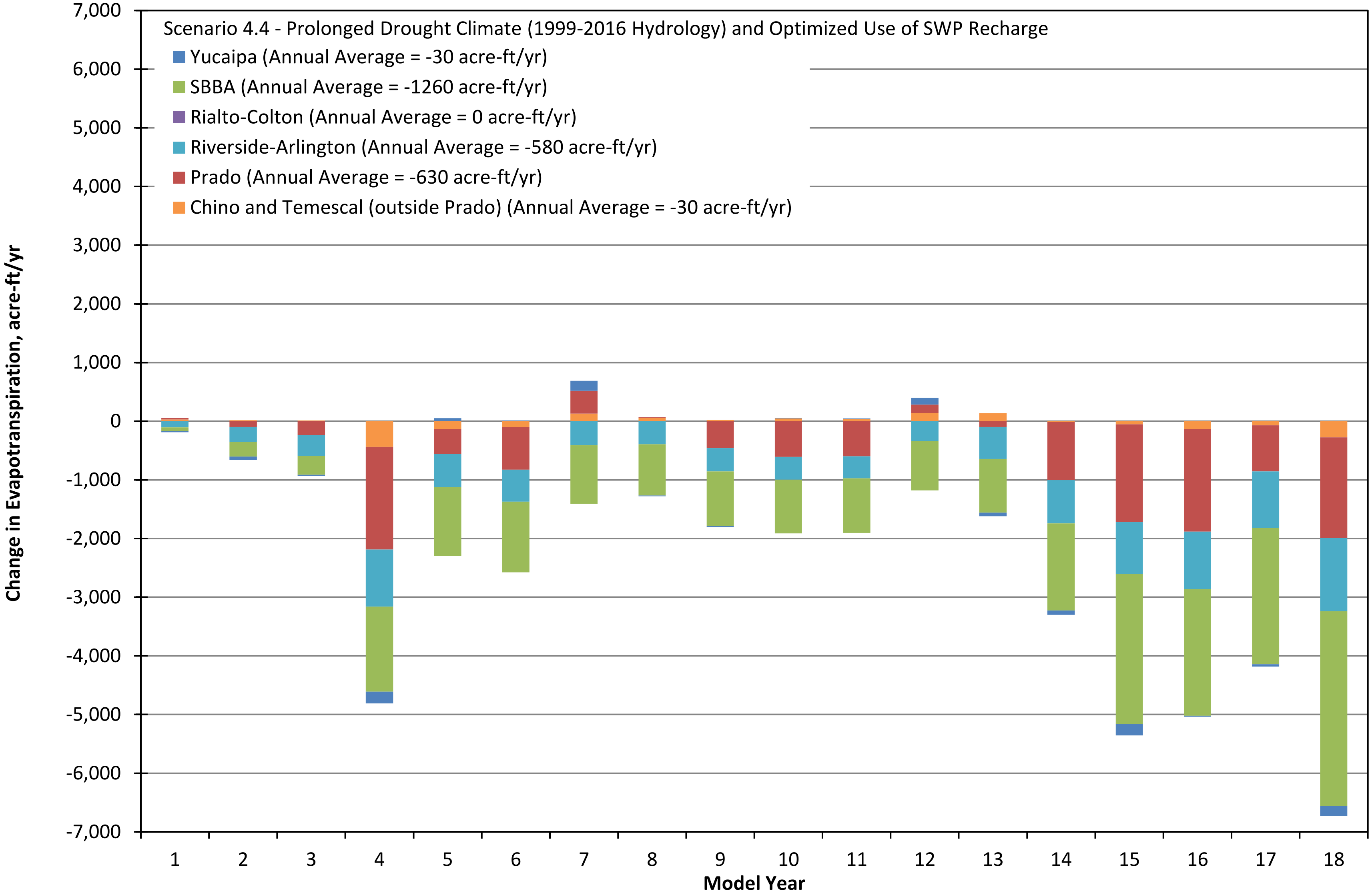
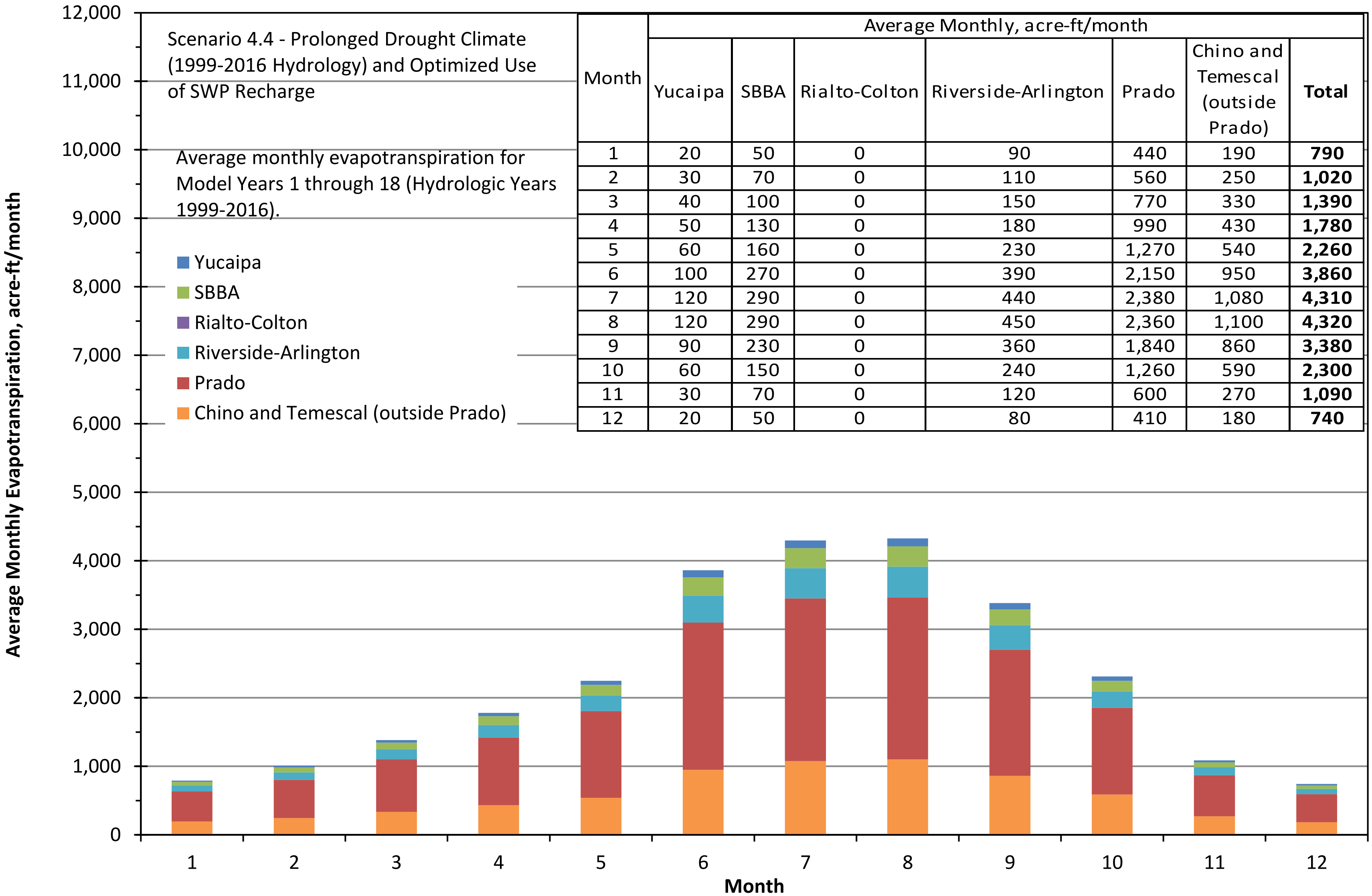


Figure 888

Scenario 4.4: Seasonal Evapotranspiration – Integrated SAR Model Area



Month	Average Monthly, acre-ft/month						
	Yucaipa	SBBA	Rialto-Colton	Riverside-Arlington	Prado	Chino and Temescal (outside Prado)	**Total**
1	20	50	0	90	440	190	**790**
2	30	70	0	110	560	250	**1,020**
3	40	100	0	150	770	330	**1,390**
4	50	130	0	180	990	430	**1,780**
5	60	160	0	230	1,270	540	**2,260**
6	100	270	0	390	2,150	950	**3,860**
7	120	290	0	440	2,380	1,080	**4,310**
8	120	290	0	450	2,360	1,100	**4,320**
9	90	230	0	360	1,840	860	**3,380**
10	60	150	0	240	1,260	590	**2,300**
11	30	70	0	120	600	270	**1,090**
12	20	50	0	80	410	180	**740**

Figure 889

Scenario 4.4: Annual Evapotranspiration – Prado Basin

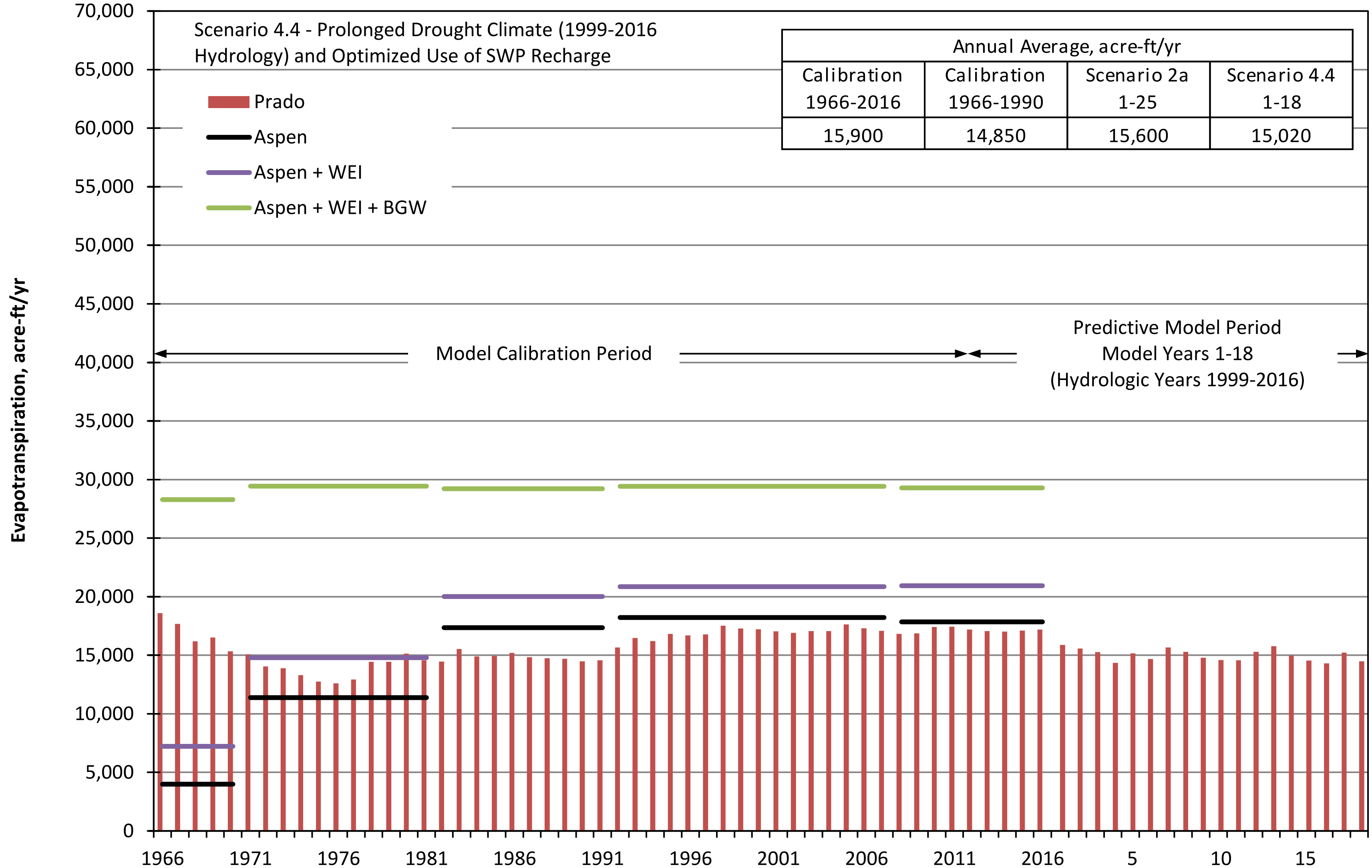


Figure 890

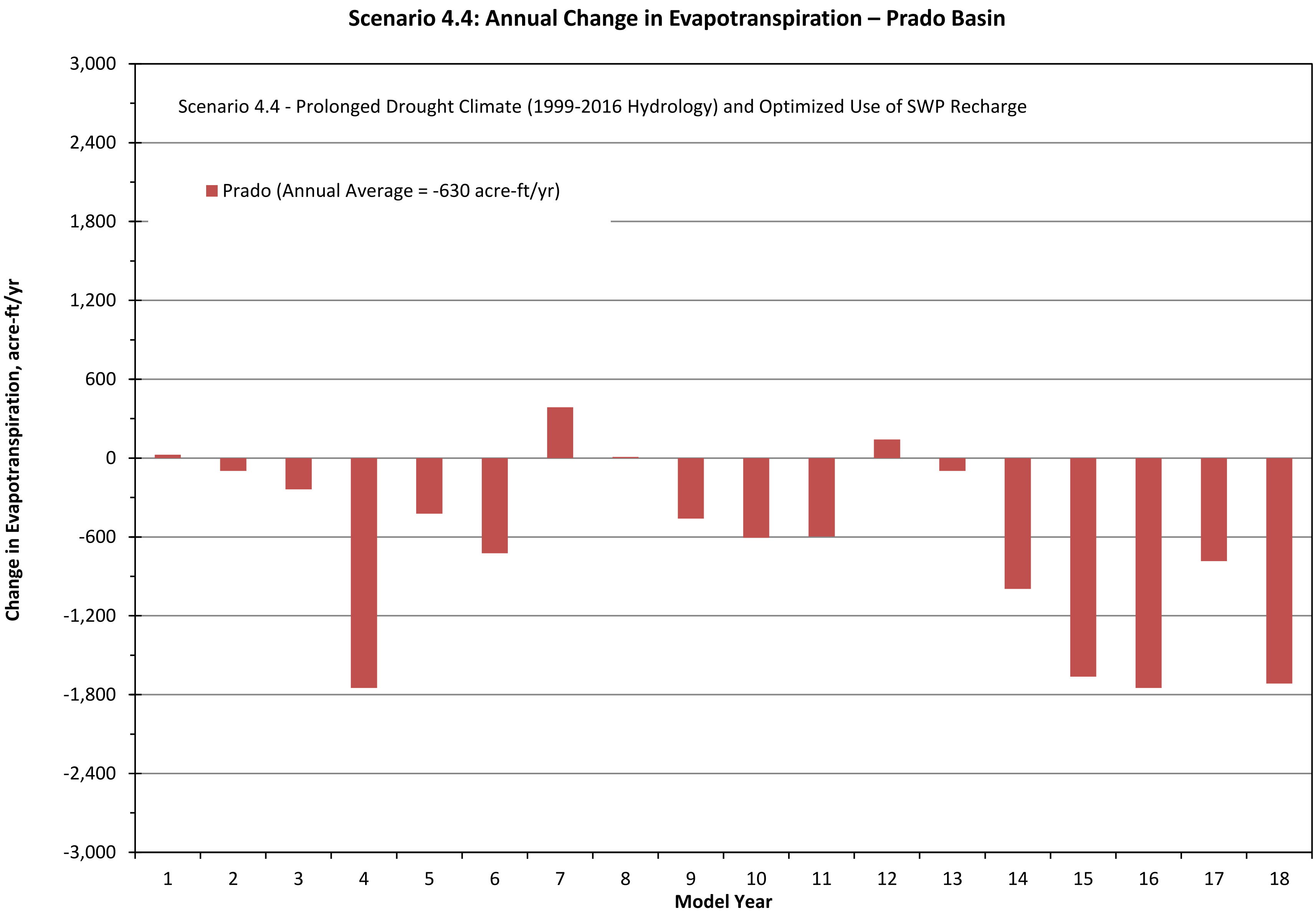
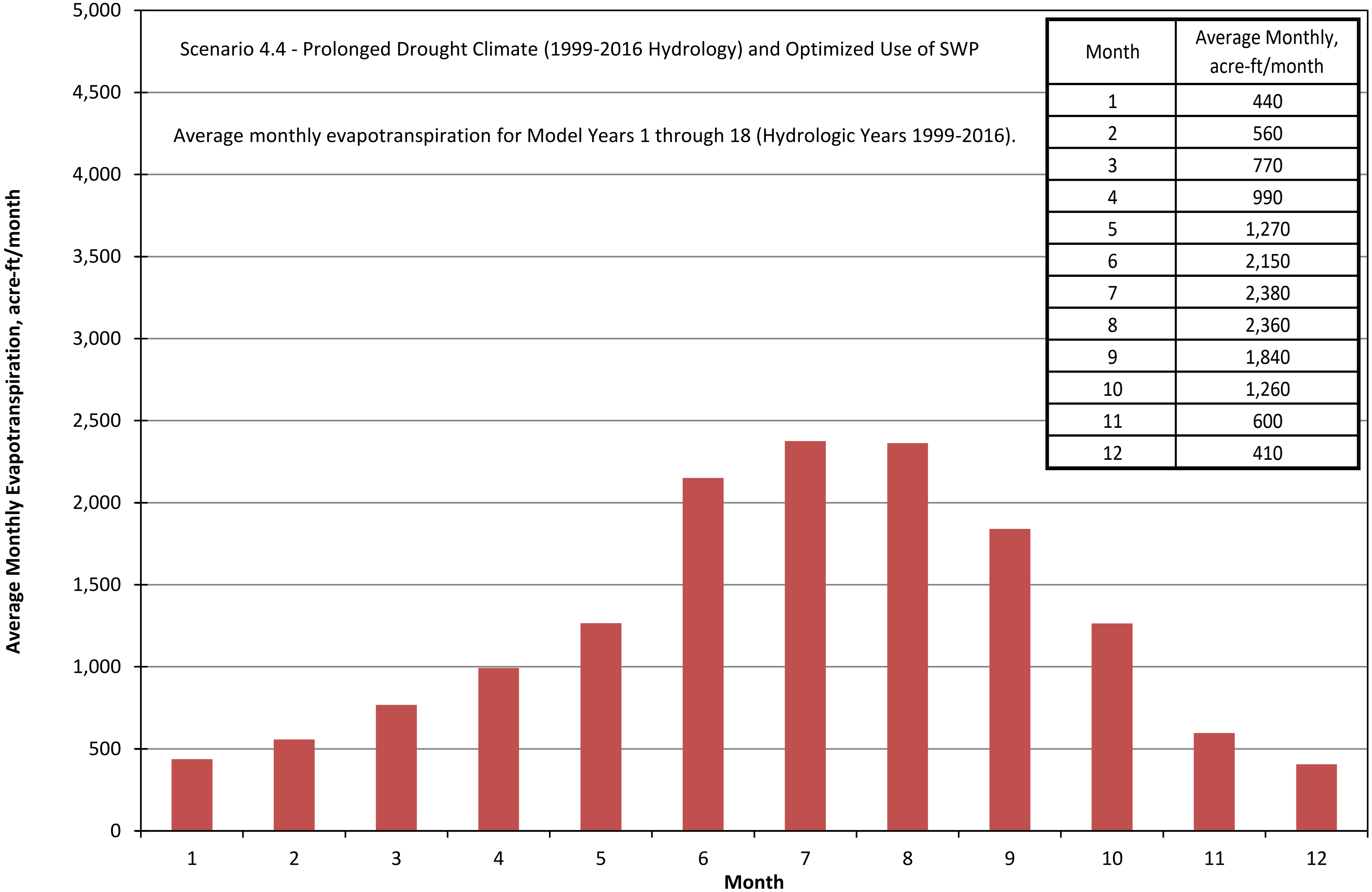

Scenario 4.4: Annual Change in Evapotranspiration – Prado Basin
Scenario 4.4 - Prolonged Drought Climate (1999-2016 Hydrology) and Optimized Use of SWP Recharge
Prado (Annual Average = -630 acre-ft/yr)
Change in Evapotranspiration, acre-ft/yr
3,000
2,400
1,800
1,200
600
0
-600
-1,200
-1,800
-2,400
-3,000
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
Model Year

Figure 891

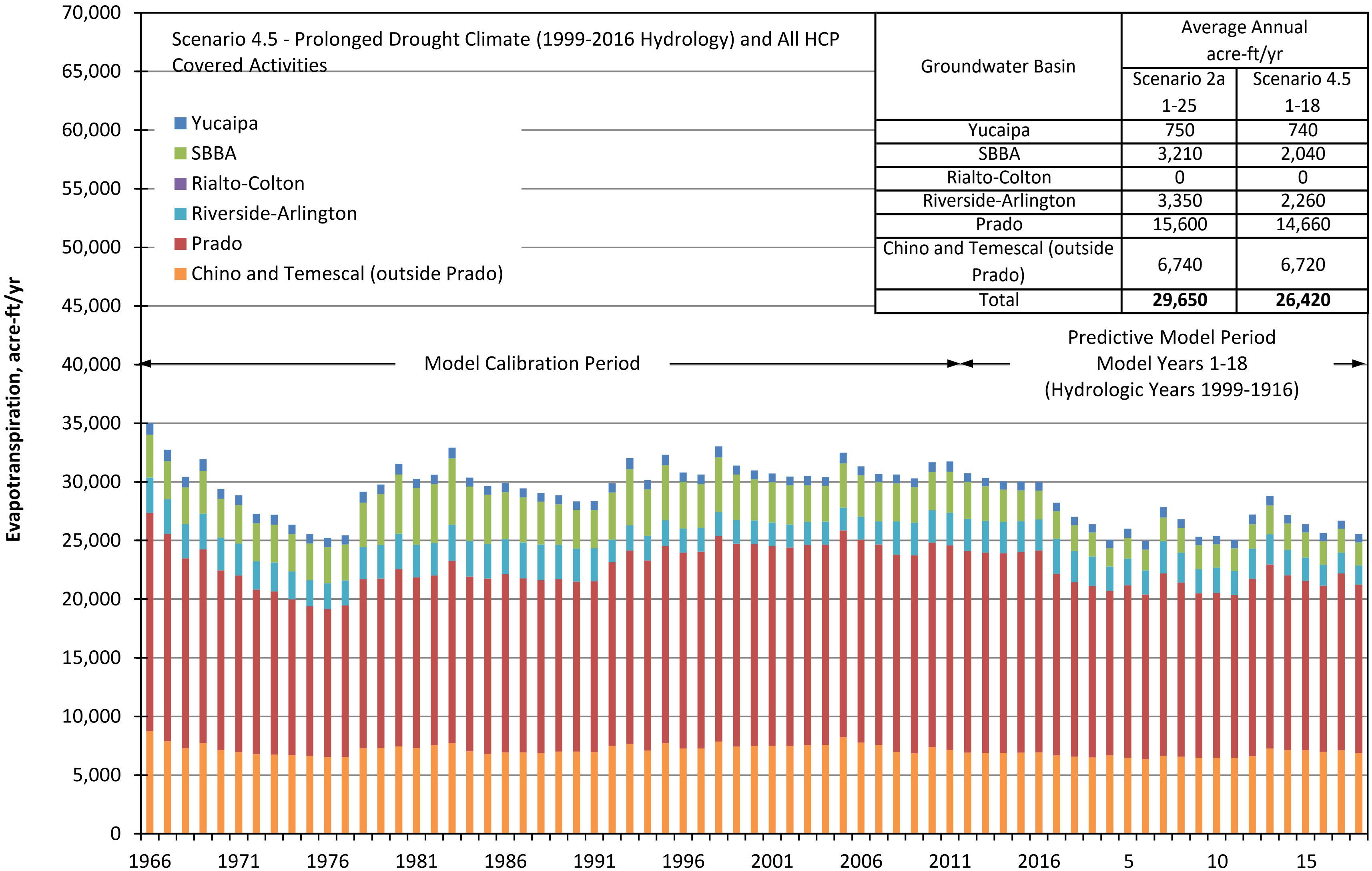
Scenario 4.4: Seasonal Evapotranspiration – Prado Basin



Month	Average Monthly, acre-ft/month
1	440
2	560
3	770
4	990
5	1,270
6	2,150
7	2,380
8	2,360
9	1,840
10	1,260
11	600
12	410

Figure 892

Scenario 4.5: Annual Evapotranspiration – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr Scenario 2a 1-25	Average Annual acre-ft/yr Scenario 4.5 1-18
Yucaipa	750	740
SBBA	3,210	2,040
Rialto-Colton	0	0
Riverside-Arlington	3,350	2,260
Prado	15,600	14,660
Chino and Temescal (outside Prado)	6,740	6,720
Total	**29,650**	**26,420**

Figure 893

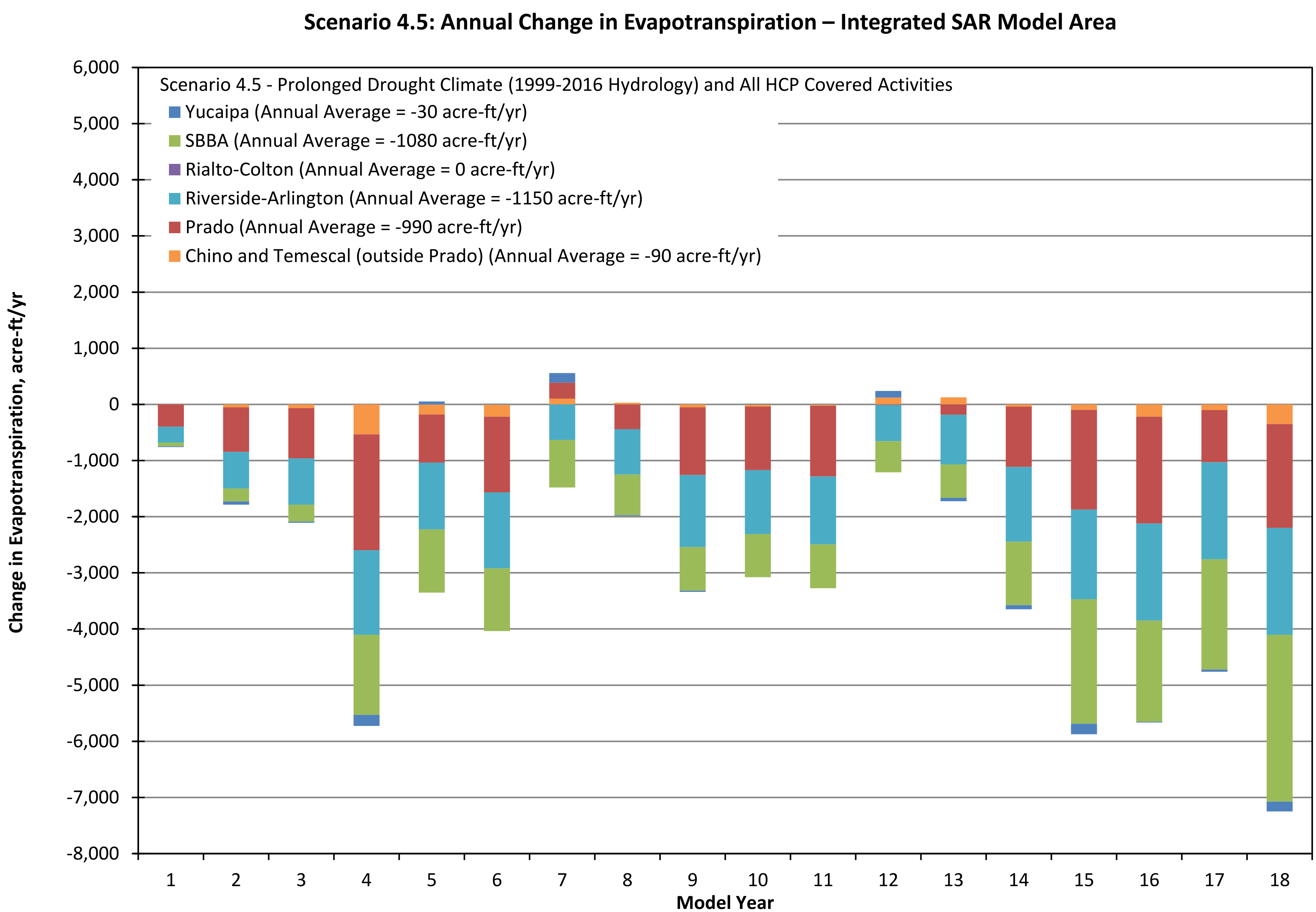
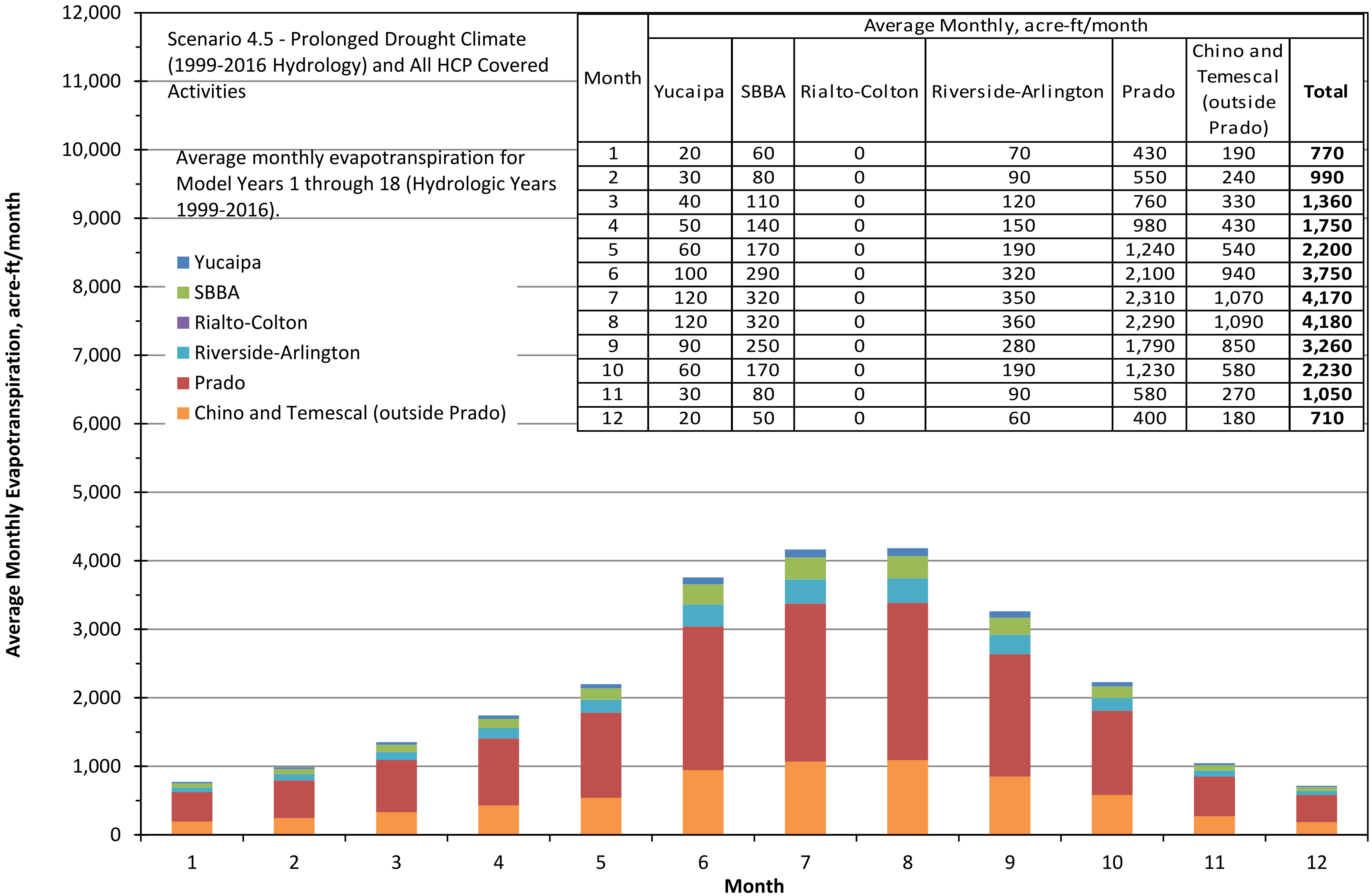

Scenario 4.5: Annual Change in Evapotranspiration – Integrated SAR Model Area
Scenario 4.5 - Prolonged Drought Climate (1999-2016 Hydrology) and All HCP Covered Activities
Yucaipa (Annual Average = -30 acre-ft/yr)
SBBA (Annual Average = -1080 acre-ft/yr)
Rialto-Colton (Annual Average = 0 acre-ft/yr)
Riverside-Arlington (Annual Average = -1150 acre-ft/yr)
Prado (Annual Average = -990 acre-ft/yr)
Chino and Temescal (outside Prado) (Annual Average = -90 acre-ft/yr)
Change in Evapotranspiration, acre-ft/yr
6,000
5,000
4,000
3,000
2,000
1,000
0
-1,000
-2,000
-3,000
-4,000
-5,000
-6,000
-7,000
-8,000
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
Model Year

Figure 894

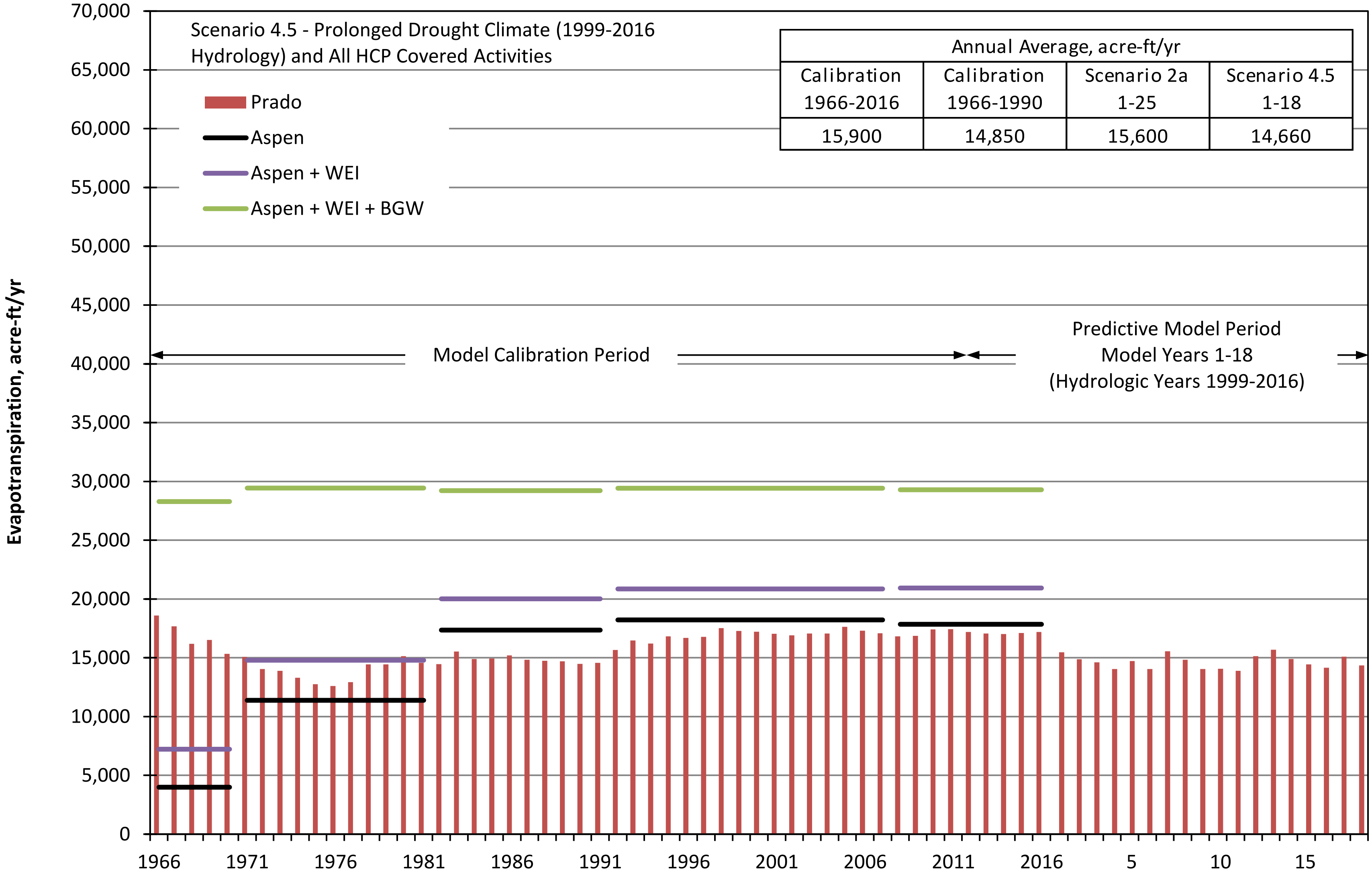
Scenario 4.5: Seasonal Evapotranspiration – Integrated SAR Model Area



Month	Average Monthly, acre-ft/month						
	Yucaipa	SBBA	Rialto-Colton	Riverside-Arlington	Prado	Chino and Temescal (outside Prado)	**Total**
1	20	60	0	70	430	190	**770**
2	30	80	0	90	550	240	**990**
3	40	110	0	120	760	330	**1,360**
4	50	140	0	150	980	430	**1,750**
5	60	170	0	190	1,240	540	**2,200**
6	100	290	0	320	2,100	940	**3,750**
7	120	320	0	350	2,310	1,070	**4,170**
8	120	320	0	360	2,290	1,090	**4,180**
9	90	250	0	280	1,790	850	**3,260**
10	60	170	0	190	1,230	580	**2,230**
11	30	80	0	90	580	270	**1,050**
12	20	50	0	60	400	180	**710**

Figure 895

Scenario 4.5: Annual Evapotranspiration – Prado Basin



Annual Average, acre-ft/yr			
Calibration 1966-2016	Calibration 1966-1990	Scenario 2a 1-25	Scenario 4.5 1-18
15,900	14,850	15,600	14,660

Figure 896

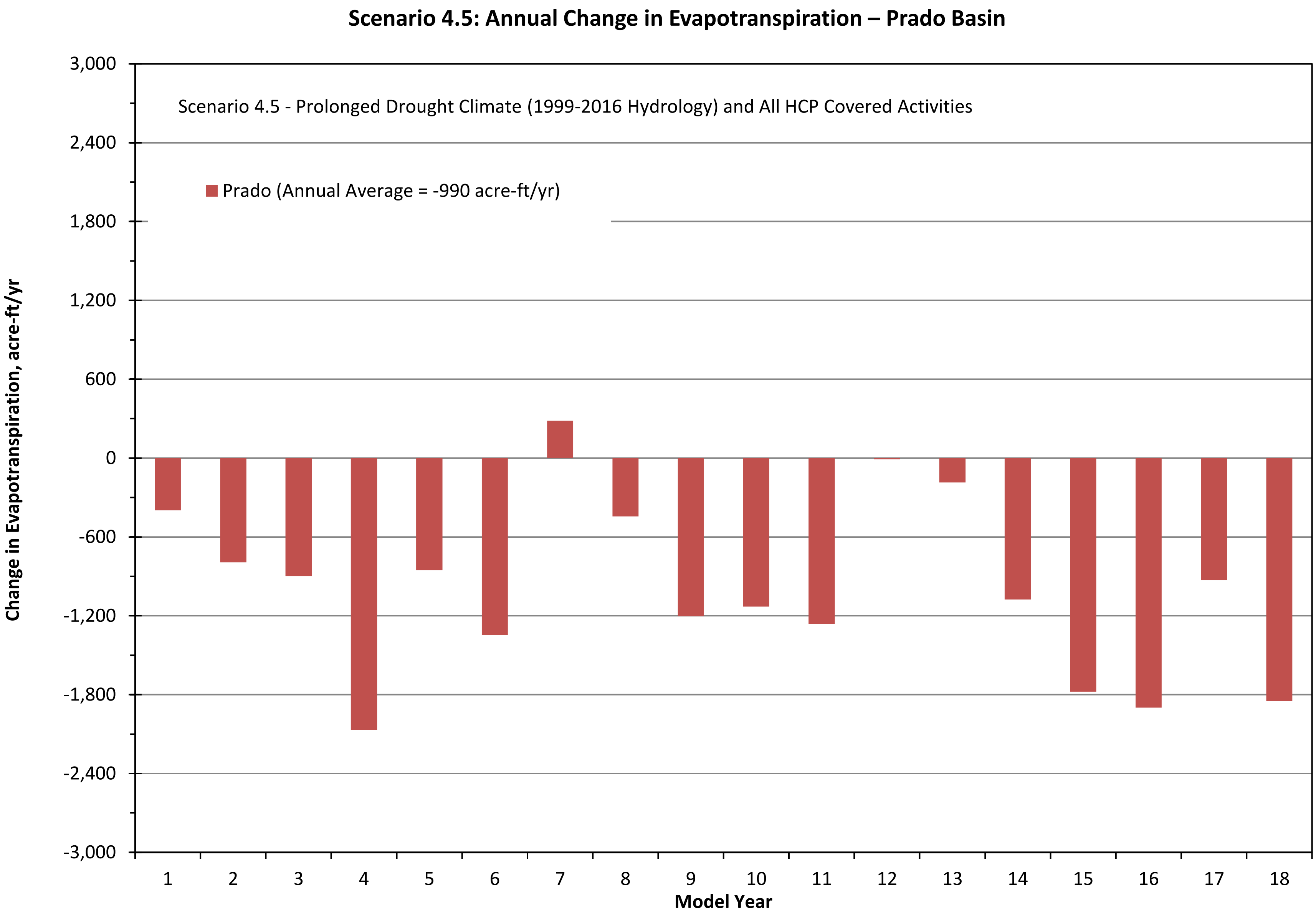
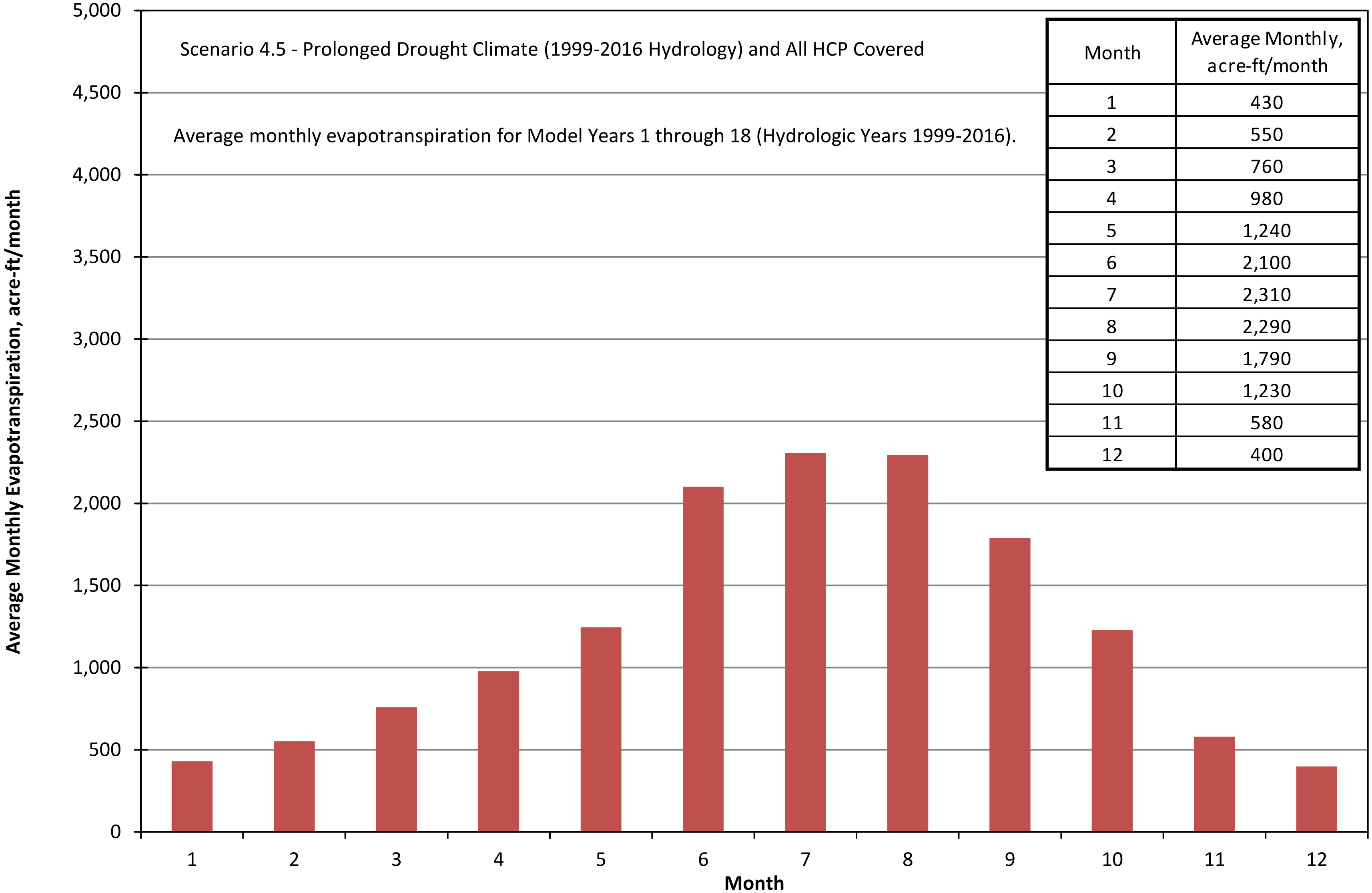

Scenario 4.5: Annual Change in Evapotranspiration – Prado Basin
Scenario 4.5 - Prolonged Drought Climate (1999-2016 Hydrology) and All HCP Covered Activities
Prado (Annual Average = -990 acre-ft/yr)
3,000
2,400
1,800
1,200
600
0
-600
-1,200
-1,800
-2,400
-3,000
Change in Evapotranspiration, acre-ft/yr
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
Model Year

Figure 897

Scenario 4.5: Seasonal Evapotranspiration – Prado Basin



Month	Average Monthly, acre-ft/month
1	430
2	550
3	760
4	980
5	1,240
6	2,100
7	2,310
8	2,290
9	1,790
10	1,230
11	580
12	400

Figure 898

Scenario 4.4: Average Streamflow at Key Santa Ana River Gaging Stations
Model Years 1-18 (Hydrologic Years 1999 - 2016)

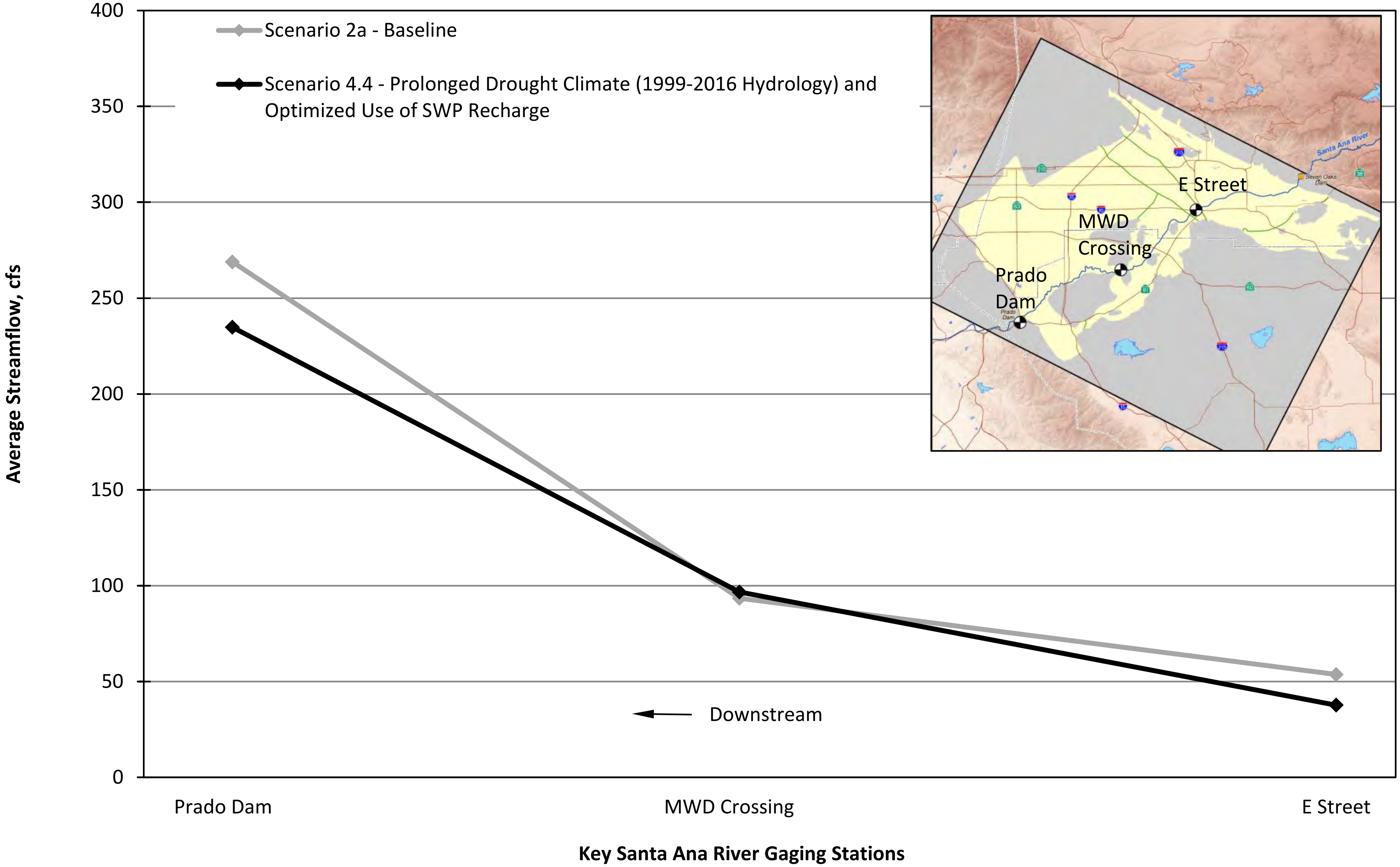


Figure 899

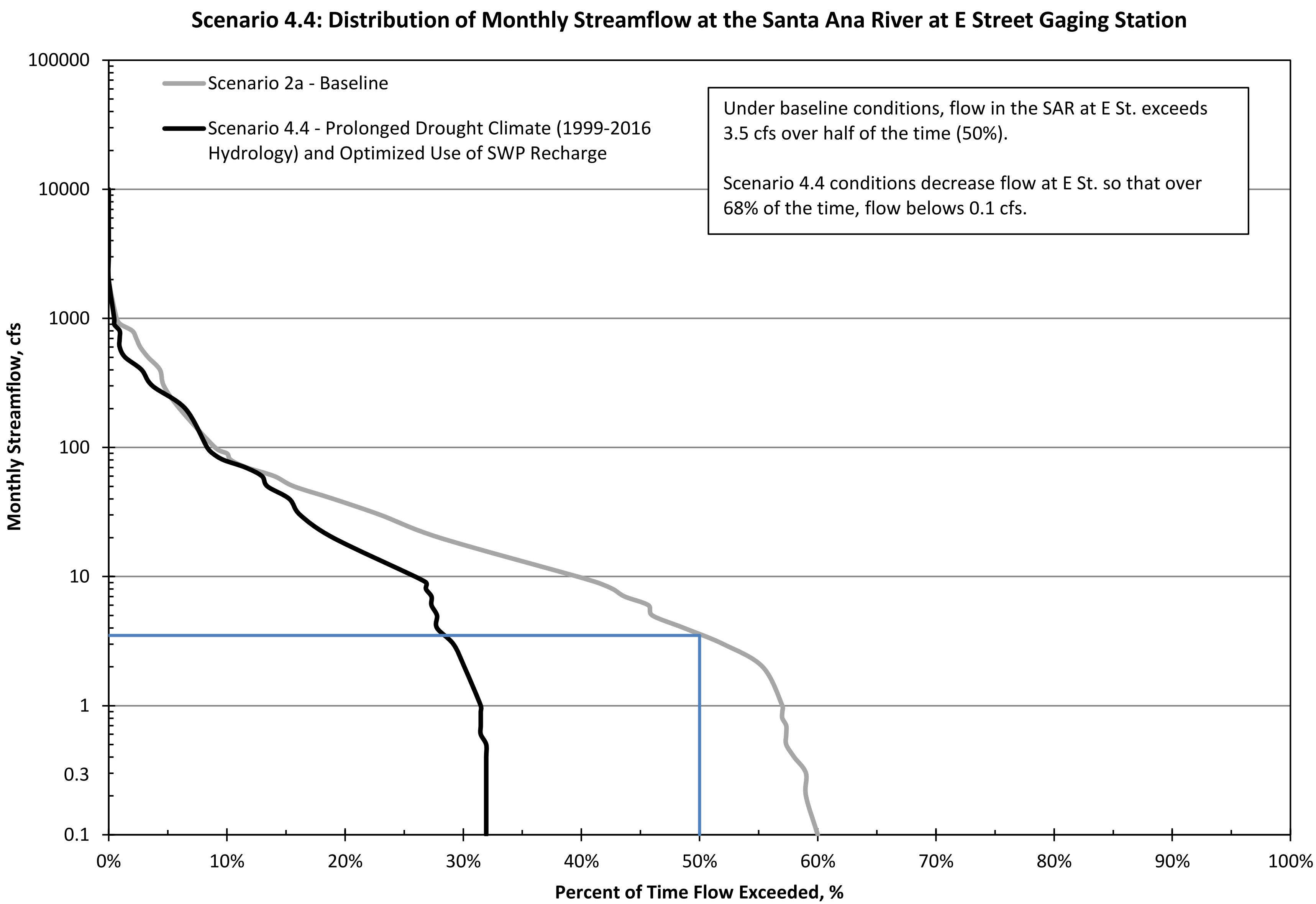

Scenario 4.4: Distribution of Monthly Streamflow at the Santa Ana River at E Street Gaging Station
Scenario 2a - Baseline
Scenario 4.4 - Prolonged Drought Climate (1999-2016 Hydrology) and Optimized Use of SWP Recharge
Under baseline conditions, flow in the SAR at E St. exceeds 3.5 cfs over half of the time (50%).
Scenario 4.4 conditions decrease flow at E St. so that over 68% of the time, flow belows 0.1 cfs.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.3
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 900

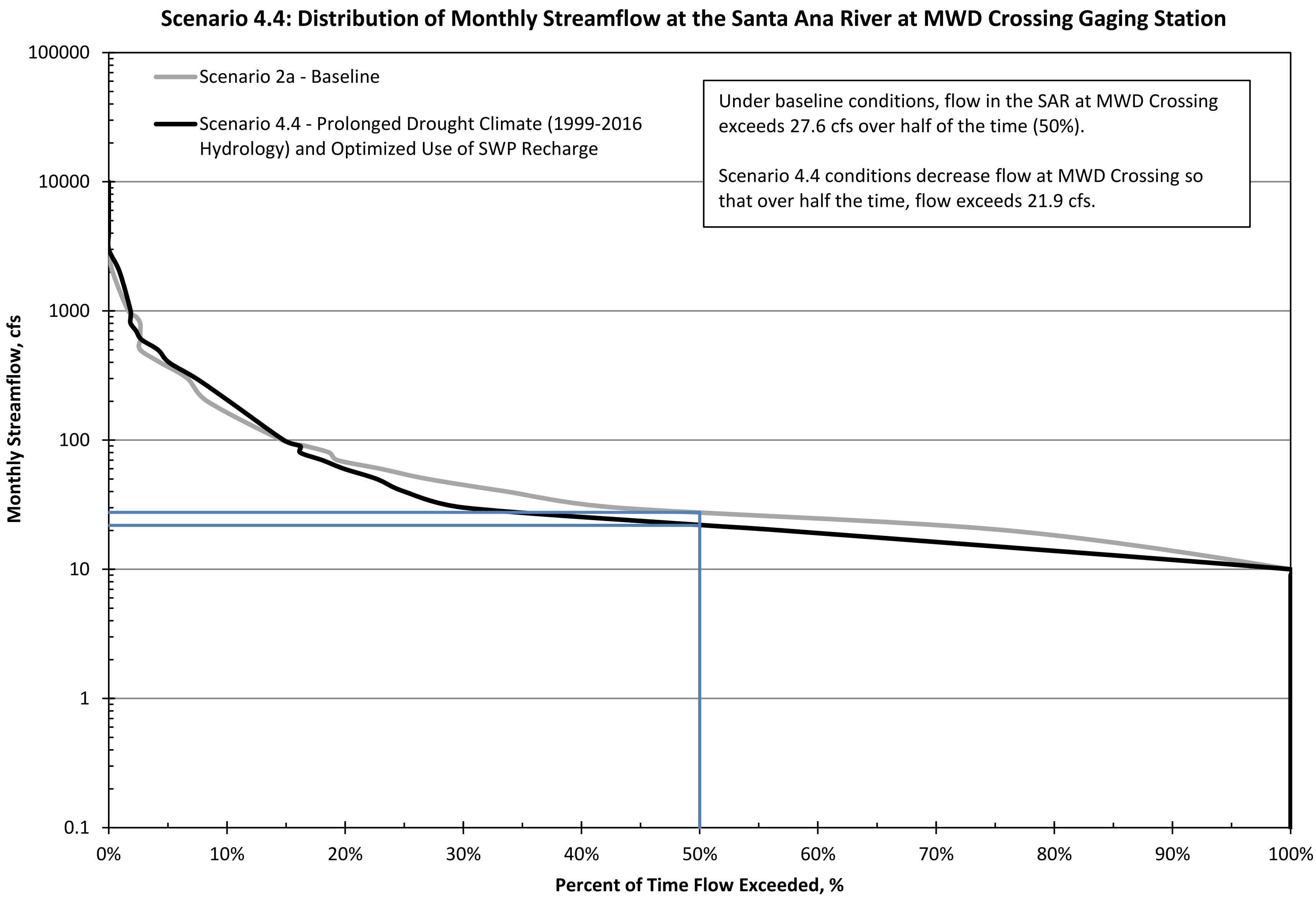

Scenario 4.4: Distribution of Monthly Streamflow at the Santa Ana River at MWD Crossing Gaging Station
Scenario 2a - Baseline
Scenario 4.4 - Prolonged Drought Climate (1999-2016 Hydrology) and Optimized Use of SWP Recharge
Under baseline conditions, flow in the SAR at MWD Crossing exceeds 27.6 cfs over half of the time (50%).
Scenario 4.4 conditions decrease flow at MWD Crossing so that over half the time, flow exceeds 21.9 cfs.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 901

DRAFT

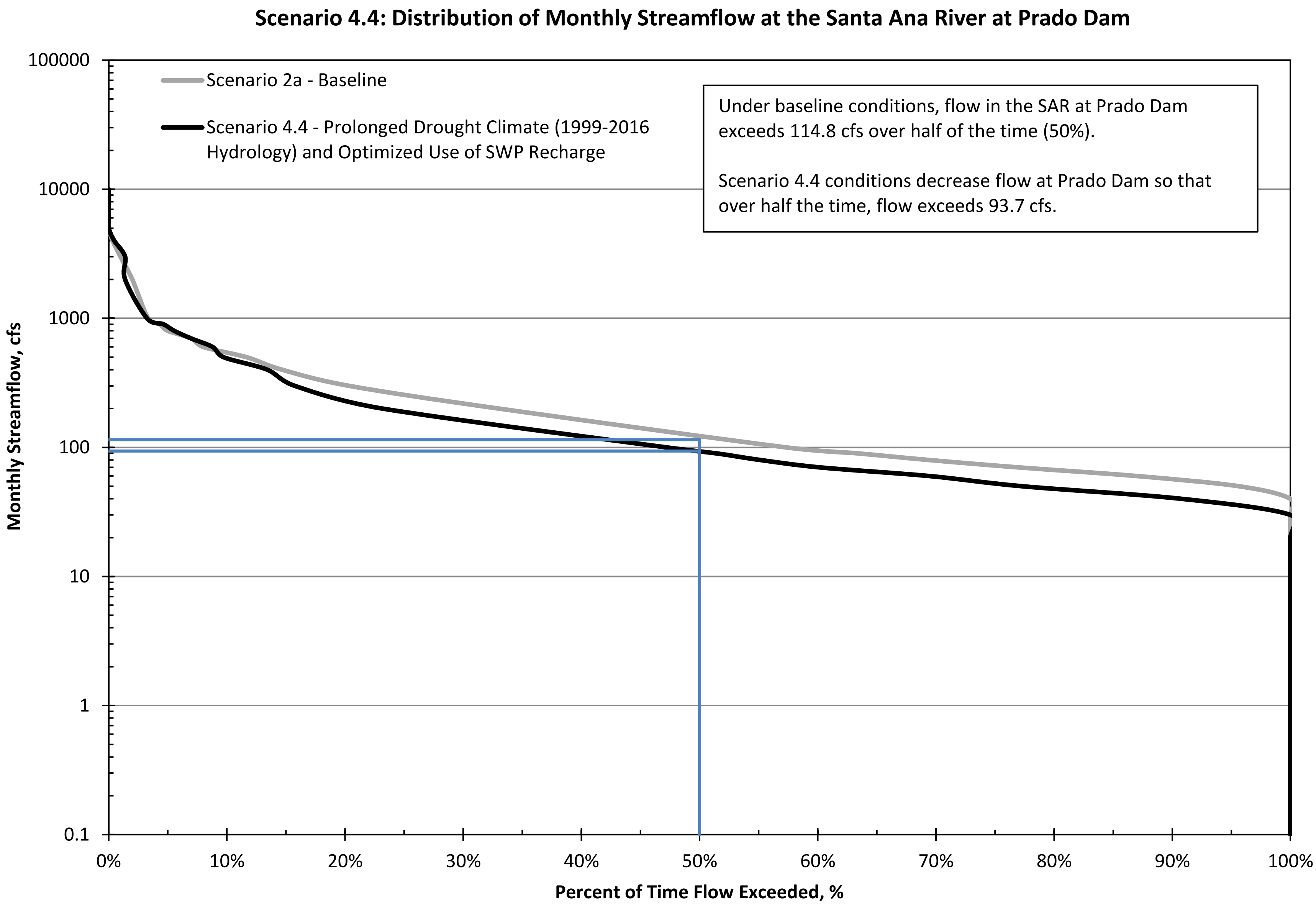


Figure 902

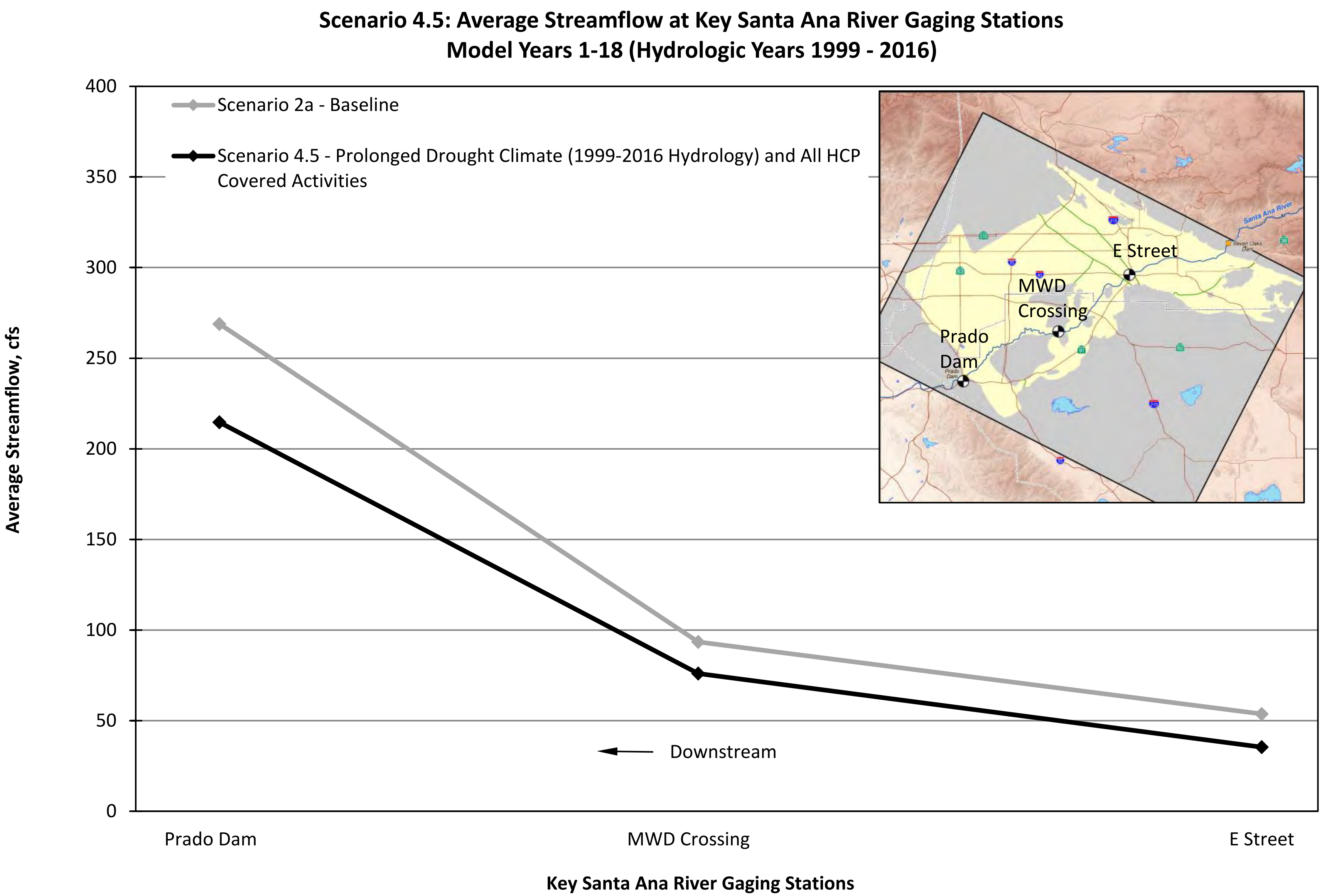

Scenario 4.5: Average Streamflow at Key Santa Ana River Gaging Stations
Model Years 1-18 (Hydrologic Years 1999 - 2016)
400
350
300
250
200
150
100
50
0
Average Streamflow, cfs
Scenario 2a - Baseline
Scenario 4.5 - Prolonged Drought Climate (1999-2016 Hydrology) and All HCP Covered Activities
E Street
MWD
Crossing
Prado
Dam
Santa Ana River
Downstream
Prado Dam
MWD Crossing
E Street
Key Santa Ana River Gaging Stations

Figure 903

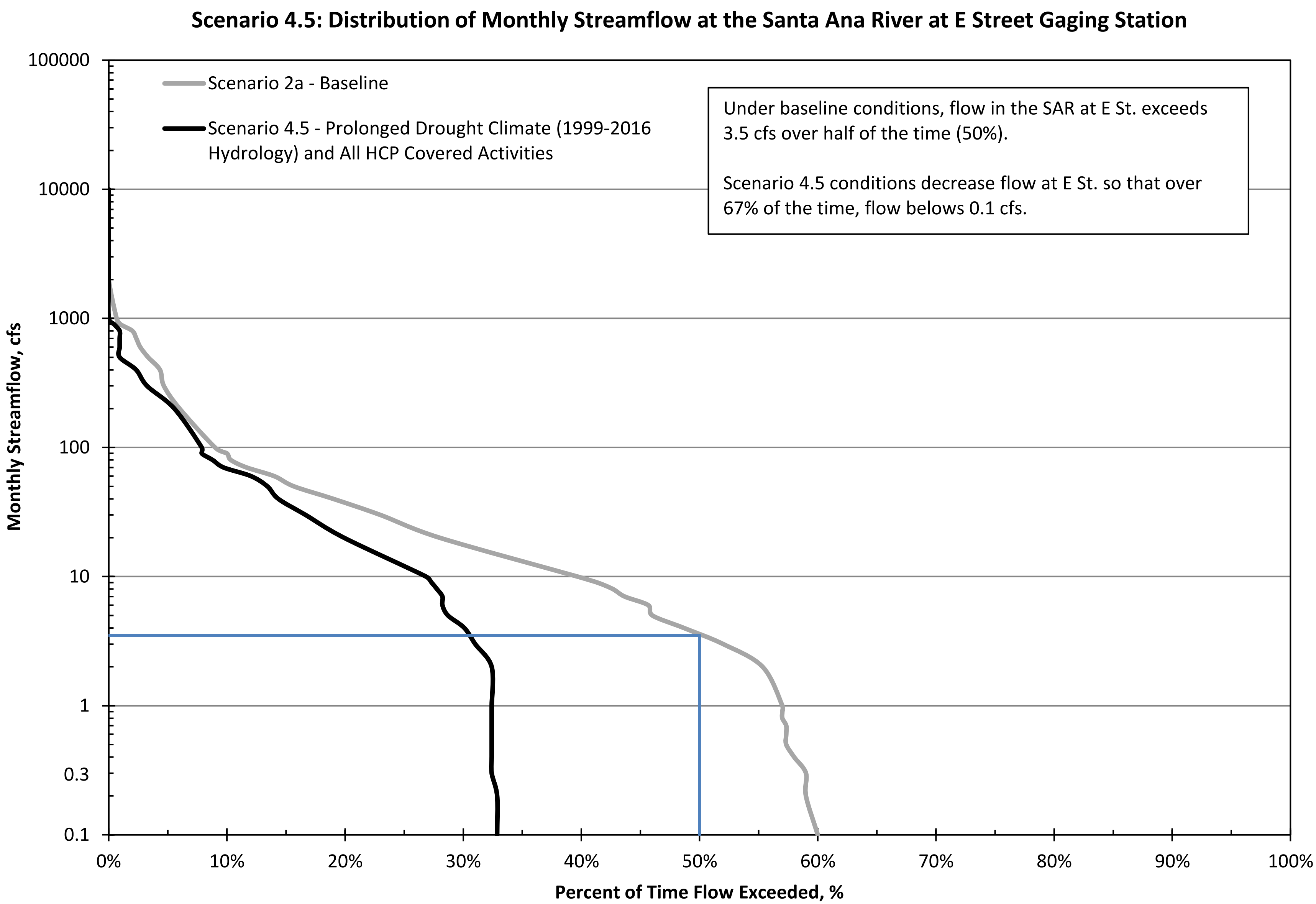

Scenario 4.5: Distribution of Monthly Streamflow at the Santa Ana River at E Street Gaging Station
Scenario 2a - Baseline
Scenario 4.5 - Prolonged Drought Climate (1999-2016 Hydrology) and All HCP Covered Activities
Under baseline conditions, flow in the SAR at E St. exceeds 3.5 cfs over half of the time (50%).
Scenario 4.5 conditions decrease flow at E St. so that over 67% of the time, flow belows 0.1 cfs.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.3
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 904

DRAFT

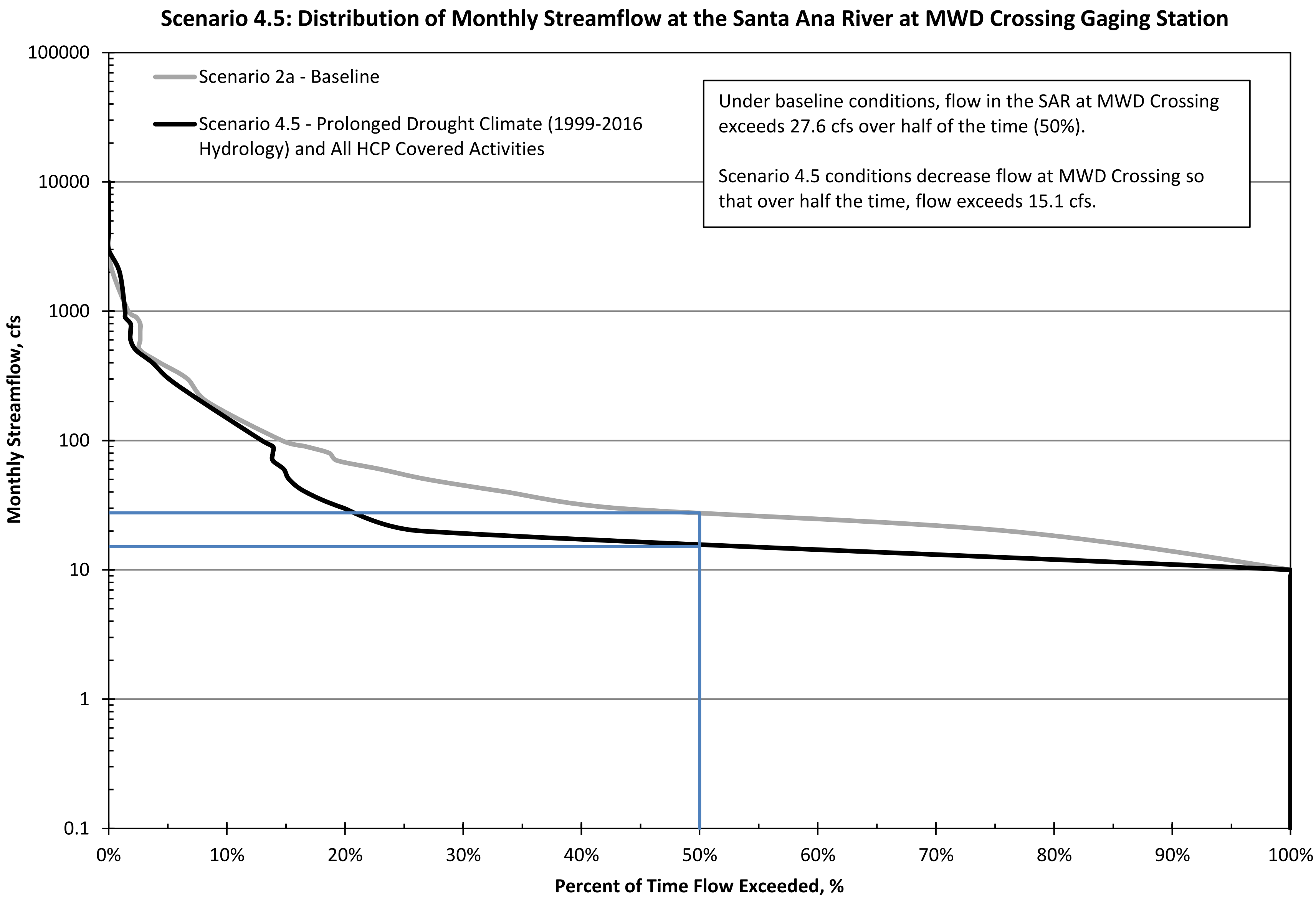


Figure 905

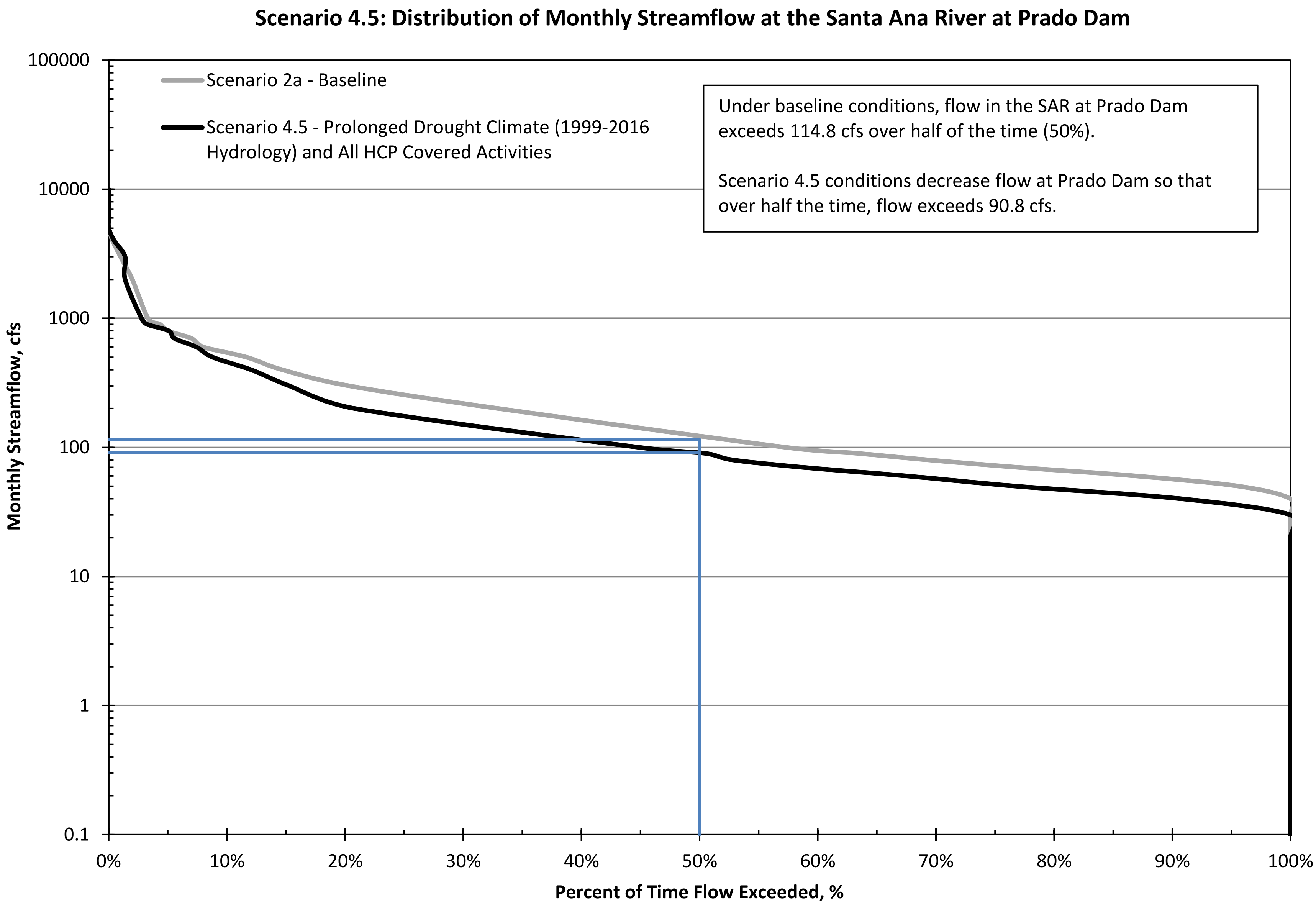

Scenario 4.5: Distribution of Monthly Streamflow at the Santa Ana River at Prado Dam
Scenario 2a - Baseline
Scenario 4.5 - Prolonged Drought Climate (1999-2016 Hydrology) and All HCP Covered Activities
Under baseline conditions, flow in the SAR at Prado Dam exceeds 114.8 cfs over half of the time (50%).
Scenario 4.5 conditions decrease flow at Prado Dam so that over half the time, flow exceeds 90.8 cfs.
Monthly Streamflow, cfs
100000
10000
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Exceeded, %

Figure 906

DRAFT

Scenario 4.4: Annual Rising Water – Integrated SAR Model Area

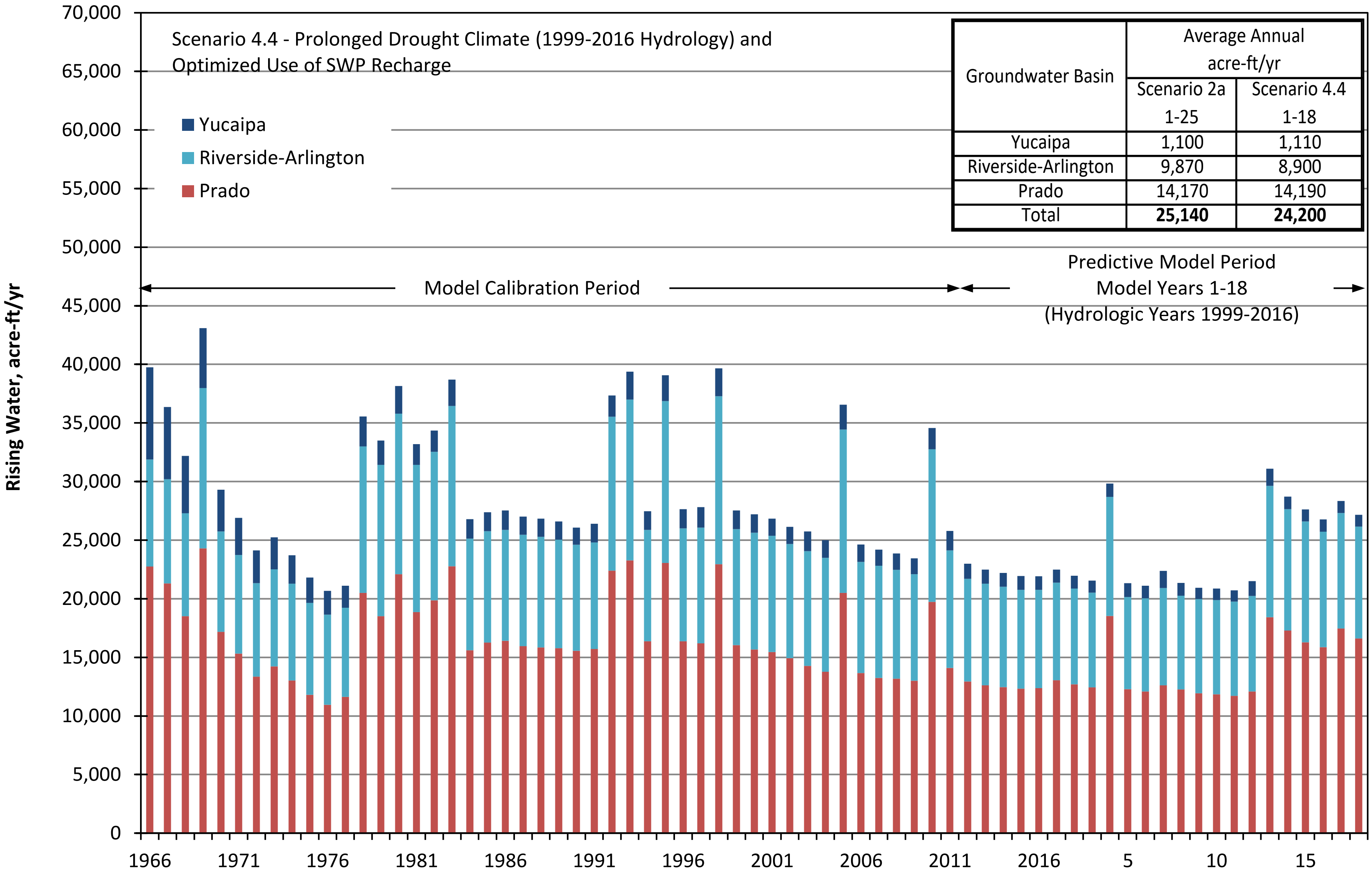


Figure 907

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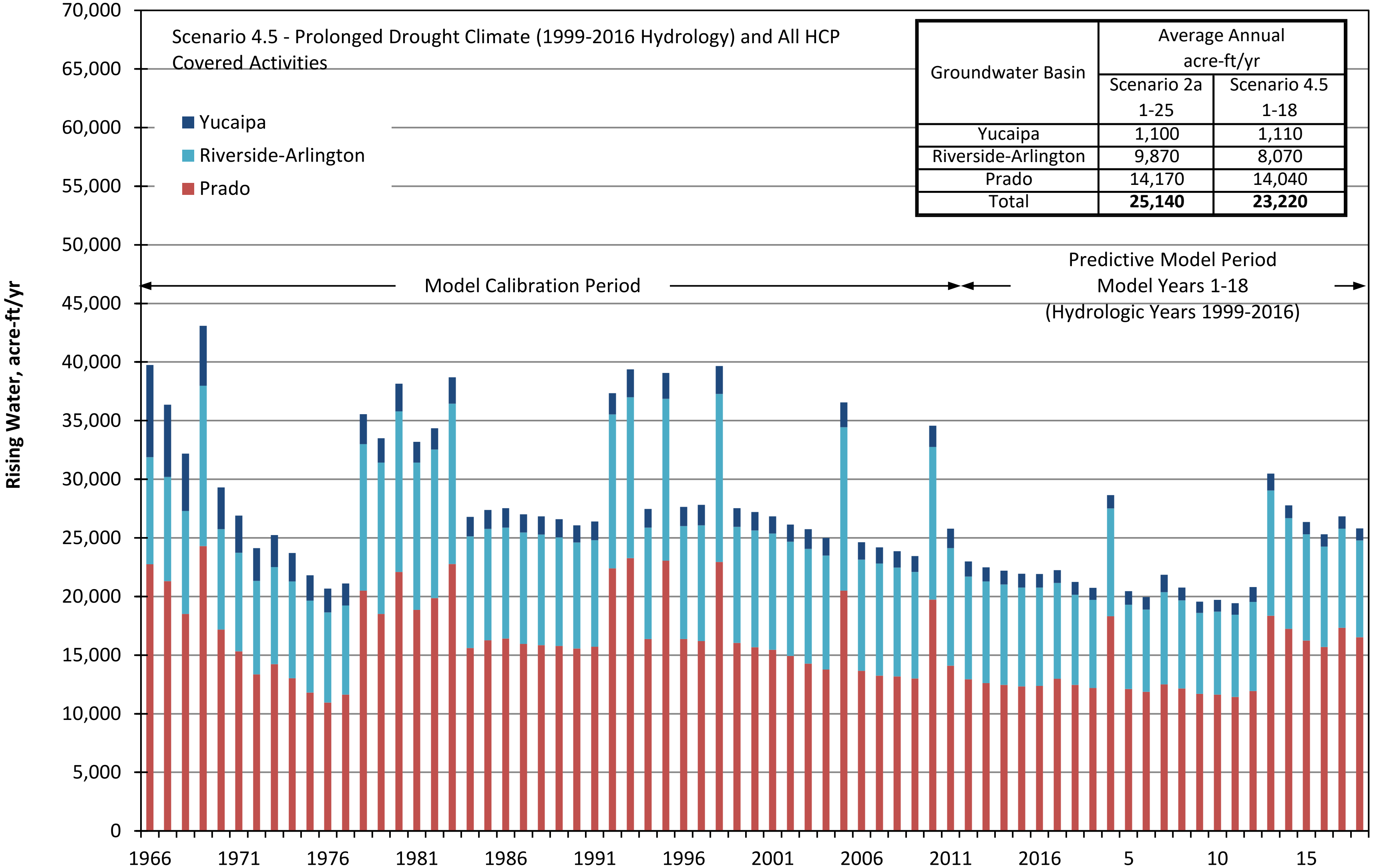
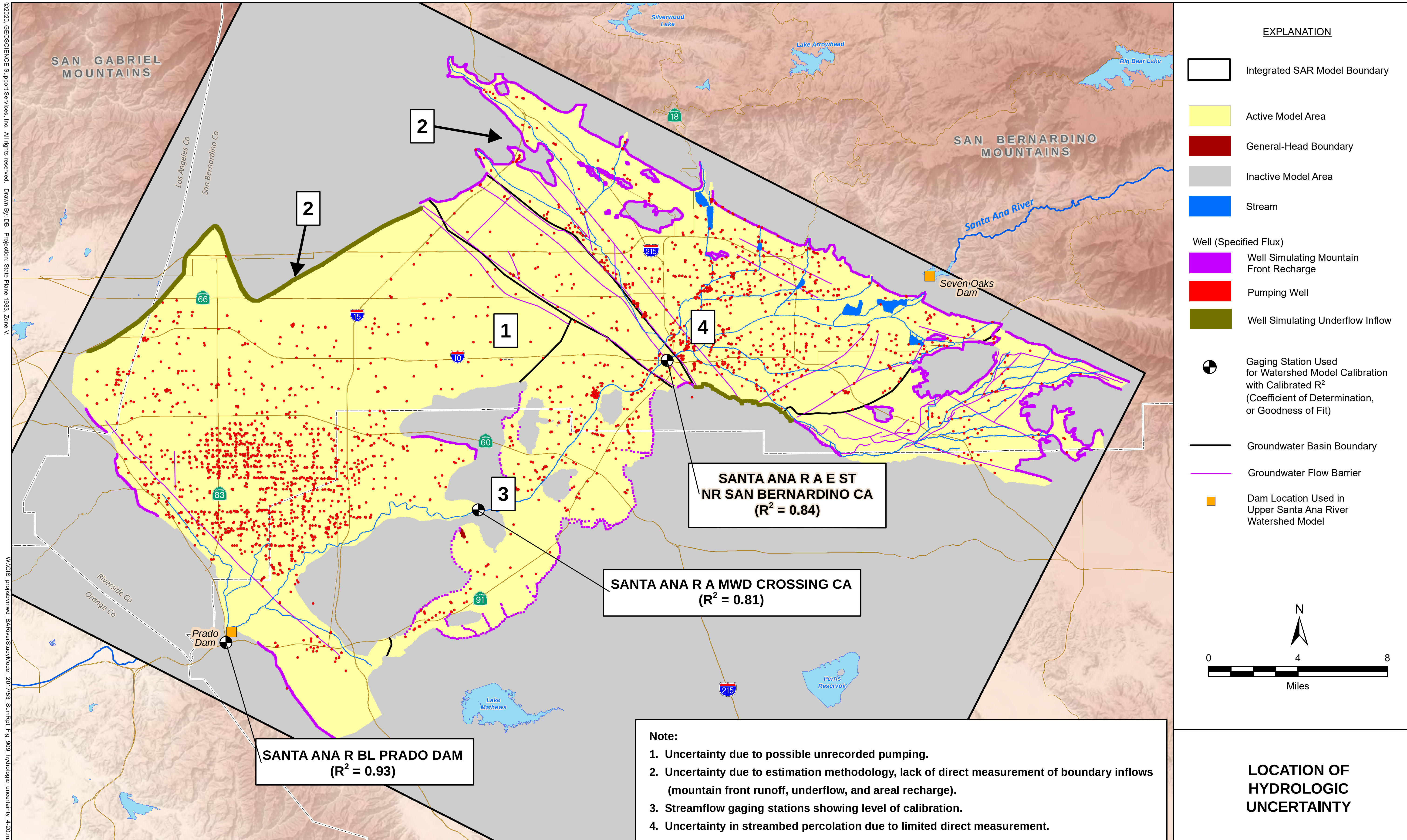
Scenario 4.5: Annual Rising Water – Integrated SAR Model Area



Groundwater Basin	Average Annual acre-ft/yr	
	Scenario 2a 1-25	Scenario 4.5 1-18
Yucaipa	1,100	1,110
Riverside-Arlington	9,870	8,070
Prado	14,170	14,040
Total	**25,140**	**23,220**

Figure 908



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10-Apr-20

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

UPPER SANTA ANA RIVER INTEGRATED MODEL - SUMMARY REPORT

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FIGURE 909

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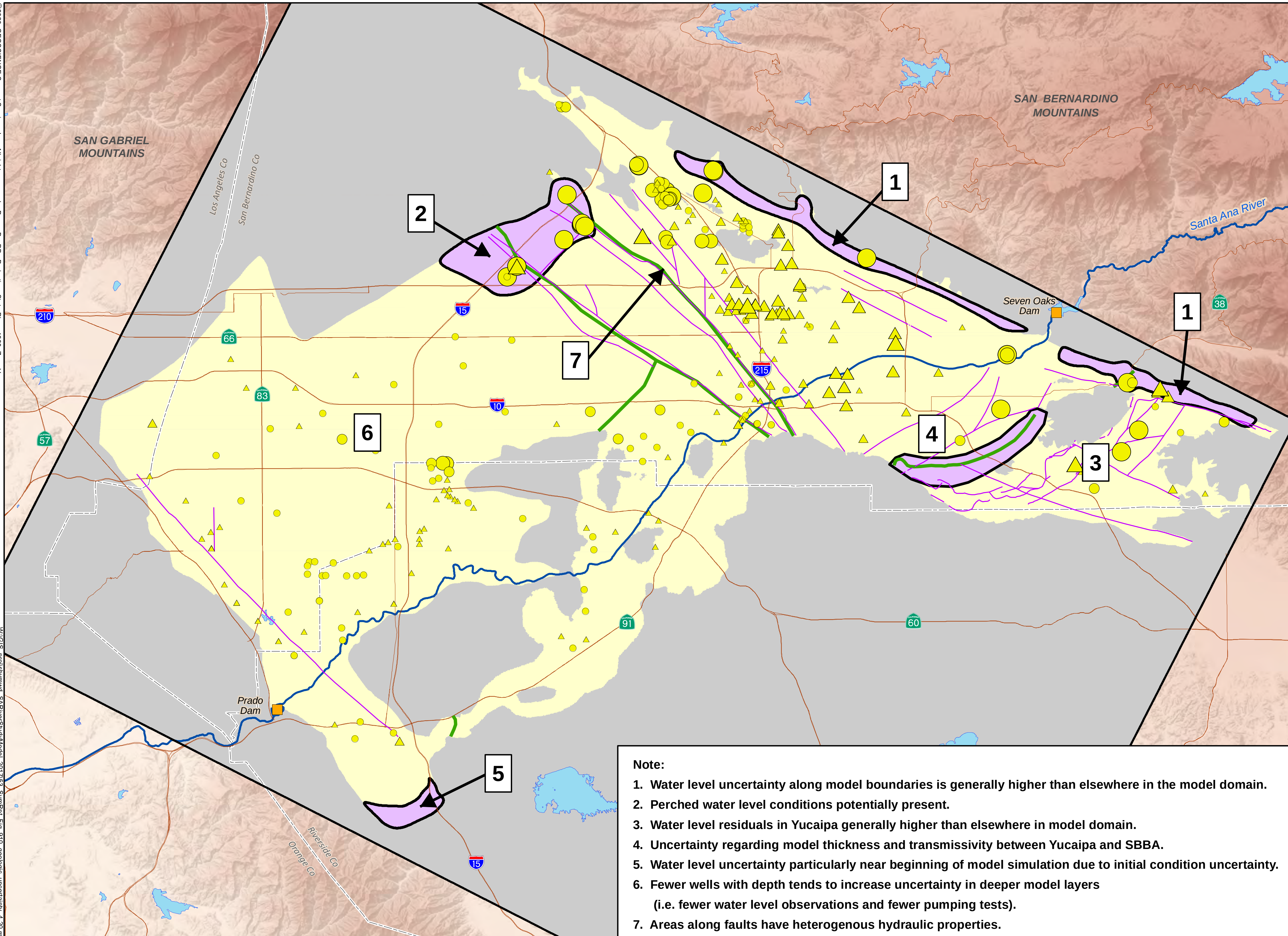

EXPLANATION

Integrated SAR Model Boundary

Active Model Area

Inactive Model Area

Area of Geologic Uncertainty (See Table below)

Average Water Level Residuals (ft)

Model Over-Estimation:
- <-75
- -75 - -50
- -50 - -25
- -25 - 0

Model Under-Estimation:
- 0 - 25
- 25 - 50
- 50 - 75
- >75

Groundwater Basin Boundary

Groundwater Flow Barrier

Dam Location Used in Upper Santa Ana River Watershed Model

N

0 4 8

Miles

Note:
1. **Water level uncertainty along model boundaries is generally higher than elsewhere in the model domain.**
2. **Perched water level conditions potentially present.**
3. **Water level residuals in Yucaipa generally higher than elsewhere in model domain.**
4. **Uncertainty regarding model thickness and transmissivity between Yucaipa and SBBA.**
5. **Water level uncertainty particularly near beginning of model simulation due to initial condition uncertainty.**
6. **Fewer wells with depth tends to increase uncertainty in deeper model layers (i.e. fewer water level observations and fewer pumping tests).**
7. **Areas along faults have heterogenous hydraulic properties.**

AREAS OF GEOLOGIC UNCERTAINTY

 Drawn By: DB. Projection: State Plane 1983, Zone V.

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10-Apr-20

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FIGURE 910

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