Appendix B

HDR Report on Potential Effects of the Proposed Seawater Desalination Project (Salt Balance Modeling)

Submitted as an Appendix to Attachment A of Irvine Ranch Water District's Comment Letter to Santa Ana Regional Water Quality Control Board Regarding the NPDES Permit Renewal for the Huntington Beach Seawater Desalination Project

(Updated 12/5/2019)

November 18, 2019

Potential Effects of Proposed Seawater Desalination Project

Irvine Ranch Water District

Irvine, California

November 18, 2019

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Executive Summary

Irvine Ranch Water District (IRWD or District) is responsible for managing recycled water quality to meet their user requirements and Regional Water Quality Control Board (RWQCB) permit conditions. This responsibility underscores the need to understand the potential effects from Orange County Water District (OCWD) distribution of desalinated seawater from Poseidon Water's proposed Huntington Beach Desalination Plant (Poseidon) on IRWD's recycled water quality. The purpose of this evaluation is to analyze the effects of recharging the Orange County Groundwater Basin (OCGWB) with desalinated ocean water on the Michelson Water Recycling Plant's (MWRP's) recycled water effluent for total dissolved solids (TDS), chloride, and boron. In addition, it evaluates the involuntary direct delivery to IRWD of HB Desalter supplies on the MWRP recycled water effluent.

This report evaluates ten scenarios to determine water quality impacts to IRWD's recycled water based on different sources and combination of flows. Thomas Harder and Company's (TH&C's) "Evaluation of Potential Effects of Proposed Seawater Desalination Project" (2019) groundwater study provided an estimate of groundwater TDS, chloride, and boron concentrations to IRWD's Dyer Road Well Field (DRWF) for all scenarios. HDR updated the 2015 Salt Balance Model and developed a 2019 Enhanced Salt Model to use the TH&C results to evaluate the associated impact to the MWRP recycled water effluent TDS, chloride, and boron for each scenario.

TH&C Model Development

IRWD retained the services of TH&C to estimate future groundwater quality impacts to DRWF under existing and baseline conditions and various combinations of recharging the groundwater basin with desalinated ocean water. TH&C's groundwater study (2019) used the Groundwater Flow and Solute Transport Model (GFSTM), which estimated TDS, chloride, and boron concentrations at DRWF on a monthly time step from 2020 through 2070. The study concluded that the scenarios that recharge of desalinated ocean water decreases the TDS and chloride concentrations and increases boron concentrations at DRWF. This result impacts the TDS, chloride, and boron levels in MWRP's effluent.

Salt Model Development

HDR updated IRWD's 2015 Salt Balance Model and developed a 2019 Enhanced Salt Model to evaluate the eight groundwater quality scenarios analyzed by TH&C and two Direct Delivery to IRWD scenarios. Direct Delivery to IRWD is based on the "Poseidon Max" scenario originally developed in the 2015 Recycled Water Salt Management Plan (RWSMP), in which Poseidon provides an involuntary direct delivery of potable water to IRWD at maximum available capacity.

To maintain consistency with the 2015 RWSMP report, each scenario was evaluated under two sets of baseline assumptions labeled as "Baseline A" and "Baseline B". As presented in **Table ES-1**, these baseline assumptions are used to estimate future water supplies and management decisions that have an effect on resulting MWRP effluent concentrations.

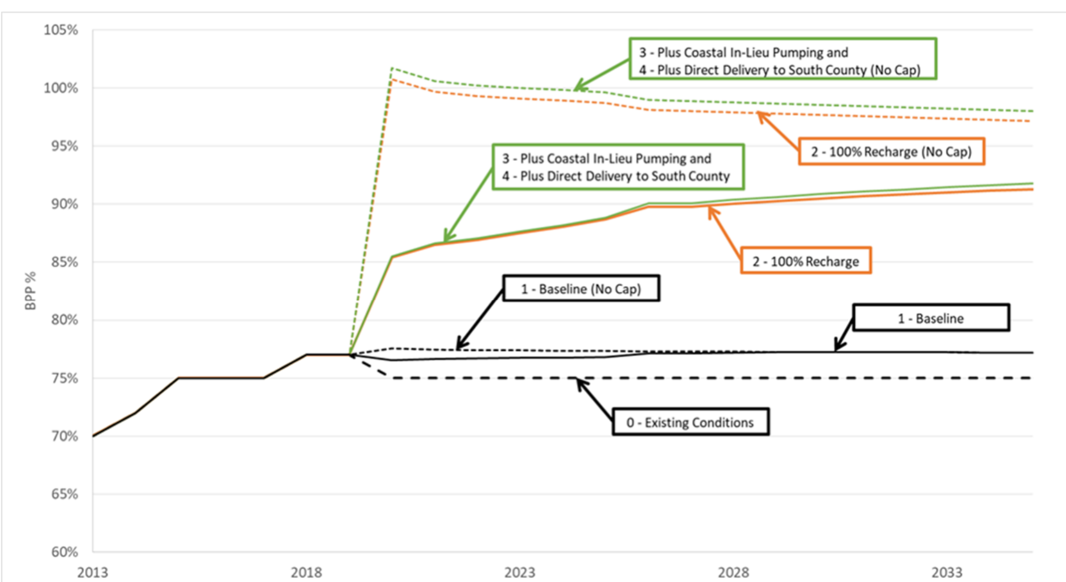
Table ES-1. Future Baseline Scenarios

No.	Parameter	Baseline A	Baseline B
1	Basin Pumping Percentage (BPP)	70% until 2024 75% after 2024	65%
2	In-Lieu Pumping Period	None	Every 7 years
3	Recycled Water (RW) Penalty	Expires in 2016	Never Expires
4	Diemer WTP's Water Quality	Historical median by month	85% Colorado River Water at 723 mg/L 15% State Water Project at 324 mg/L

Both the 2015 Salt Balance Model and the 2019 Enhanced Salt Model were modified to incorporate TH&C data for flow and water quality concentrations at DRWF. TH&C's monthly concentration data at DRWF (2020 to 2070) were then used as inputs for the two salt balance model tools.

TH&C's results are based on maintaining a groundwater balance, which required additional groundwater pumping to offset increased recharge. **Figure ES-1** shows IRWD's proportional share of their allowable demand that can be pumped (Basin Pumping Percentage (BPP)) grows from approximately 78% for Scenario 1 – Baseline to about 98% for Scenarios 2 through 4 with Poseidon recharge. Because it is unreasonable for IRWD to pump more than their demand, estimated increases in the BPP were capped before they were used in the Salt Balance modeling.

Figure ES-1. IRWD – Effective Basin Pumping Percentage (BPP %) – Baseline A



Scenario Identification

Ten scenarios were developed using various combination of flows, including GWRS Final Expansion, which increases production capacity from 100 MGD to 130 MGD (anticipated in year 2023), and the Poseidon production capacity of 50 MGD. The following summarizes the scenarios evaluated:

- Scenario 0 – Existing Condition (no GWRS Final Expansion or Poseidon)
- Scenario 1 – Baseline (GWRS Final Expansion Recharge, and No Poseidon)
- Scenario 2a and 2b – Direct Recharge (GWRS Final Expansion and Poseidon)
- Scenario 3a and 3b – Plus Coastal In-Lieu (Recharge GWRS Final Expansion and Poseidon + Coastal In-Lieu)
- Scenario 4a and 4b – Plus Direct Delivery to South County Delivery (Recharge GWRS Final Expansion and Poseidon + Coastal In-Lieu + South County Delivery)
- Scenario 5a and 5b – Direct Delivery to IRWD (Poseidon Direct Delivery to IRWD + Recharge GWRS Final Expansion + South County Delivery)

"Coastal In-Lieu" means desalinated water from Poseidon is directly delivered (via pipeline) to coastal cities in order to decrease groundwater pumping along the coast to mitigate seawater intrusion. "South County Delivery" means desalinated water from Poseidon is directly delivered (via pipeline) to participating South Orange County water districts, which may include Santa Margarita Water District, Moulton Niguel Water District, and/or El Toro Water District. "Direct Delivery to IRWD" means an involuntary direct delivery of Poseidon water to IRWD.

For each scenario two different sets of Poseidon product water concentrations were estimated and labeled Poseidon water quality group "a" and Poseidon water quality group "b". **Table ES-2** presents a summary how the GWRS and Poseidon water supplies are used for each scenario. As shown, Scenario 0 includes 100 MGD of GWRS water while Scenario 1 uses 130 MGD of GWRS water. Scenarios 2 through 5 include 130 MGD of GWRS water and 50 MGD of Poseidon water allocated to various combinations of direct recharge, coastal in-lieu pumping, direct delivery to South County, and direct delivery to IRWD.

Table ES-2. Scenario Water Supply and Use

Description	GWRS Supply (MGD)	Poseidon Supply (MGD)	Direct Recharge (MGD)	Coastal In-Lieu Pumping (MGD)	Direct Delivery to IRWD (MGD)	Direct Delivery to IRWD (MGD)
0 - Existing	100	0	100	0	0	0
1 - Baseline	130	0	130	0	0	0
2 – Direct Recharge	130	50	180	0	0	0
3 – Plus Coastal In-Lieu	130	50	170	10	0	0
4 – Plus Direct Delivery to S. County	130	50	159	10	11	0
5 – Direct Delivery to IRWD	130	50	130	0	7	43

The concentrations associated with each water source are presented in **Table ES-3** along with the concentration of GWRS water for comparison. The TDS concentration is less than those presented in the draft Water Reliability Agreement Term Sheet (**Appendix A**, 2015), while the chloride and boron concentrations represents the mean and maximum concentrations in the Term Sheet. The TDS values (350 and 150 mg/L) were reduced from those in the term sheet (500 and 150 mg/L) because chloride has been estimated to be the controlling variable in a salt water reverse osmosis treatment process (Trussell Technologies, Inc, 2016). In other words, if the treatment process is designed to provide chloride at 100 mg/L, then a TDS level of at least 350 mg/L will follow.

Table ES-3. Enhanced Salt Model Concentrations Summary

Source Water	TDS (mg/L)	Chloride (mg/L)	Boron (mg/L)
GWRS	48	6	0.25
Poseidon Water Quality Group “a”	350	100	1.00
Poseidon Water Quality Group “b”	150	75	0.75

Recycled Water Quality Results

The District must monitor and manage recycled water quality in order to ensure it is suitable for customer use. In addition, MWRP’s running annual average (RAA) TDS effluent must be below the 720 mg/L RWQCB permitted limit. IRWD’s Salt Balance Model and Enhanced Salt Model are used as tools to make informed decisions regarding system operations. The modeling results for both water quality groups “a” and “b” and baselines A and B are shown in **Table ES-4** through **Table ES-6** for TDS, chloride, and boron, respectively. Based on modeling results, the following observations were made:

- Scenarios 2 through 4 lower the TDS and chloride concentrations in MWRP recycled water effluent while boron concentrations increase. This response is similar to the water quality concentrations estimated at DRWF by TH&C.
- Modeled TDS, chloride, and boron concentrations are larger for Poseidon water quality group "a" than Poseidon water quality group "b" alternatives.
- Modeled TDS, chloride, and boron concentrations are larger for Baseline B than Baseline A.
- All groundwater injection scenarios (Scenarios 2 through 4) did not exceed the permit and the recommended limits for TDS and chloride; all scenarios exceed the boron recommended limit identified by IRWD. RAA limits include:
    - RWQCB permitted recycled water quality limit is 720 mg/L for TDS
    - IRWD recommended recycled water quality limit is 150 mg/L for chloride
    - IRWD recommended recycled water quality limit is 0.5 mg/L for boron
- Direct potable use of desalinated water scenarios (Scenario 5) exceeds the IRWD recommended RAA water quality limits for chloride and boron.

Table ES-4. 2070 Average RAA TDS Concentrations at MWRP Effluent

	IRWD Salt Model - Baseline A			IRWD Salt Model - Baseline B		
Scenario	**mg/L**	**lbs/M**	**% Change**	**mg/L**	**lbs/M**	**% Change**
0 - Existing Conditions	675	4,916,000	NA	747	5,437,000	NA
1 - Baseline	630	4,586,000	0.00%	696	5,072,000	0.00%
WQ Group "a" - Poseidon TDS 350 mg/L						
2a - Direct Recharge	535	3,964,000	-15.05%	551	4,082,000	-20.90%
3a - Plus Coastal In-Lieu	552	4,089,000	-12.37%	568	4,211,000	-18.40%
4a - Plus Direct Delivery to S. County	541	4,010,000	-14.06%	555	4,113,000	-20.29%
5a - Direct Delivery to IRWD	702	5,115,000	11.53%	762	5,552,000	9.47%
WQ Group "b" - Poseidon TDS 150 mg/L						
2b - Direct Recharge	521	3,862,000	-17.24%	534	3,958,000	-23.30%
3b - Plus Coastal In-Lieu	540	4,002,000	-14.24%	554	4,103,000	-20.49%
4b - Plus Direct Delivery to S. County	537	3,975,000	-14.81%	549	4,070,000	-21.13%
5b - Direct Delivery to IRWD	586	4,270,000	-6.89%	645	4,695,000	-7.42%

NOTES:
1) Percent increase or decrease is with regards to Scenario 1 - Baseline.
2) Concentrations listed in this table represent the average running annual average (RAA) for TDS in year 2070.
3) Water quality (WQ) group "a" or "b" identifies the Poseidon water quality used during modeling.
4) mg/L = milligrams per liter; lbs/M = pounds per month; NA = not applicable

Table ES-5. 2070 Average RAA Chloride Concentrations at MWRP Effluent

Scenario	IRWD Salt Model - Baseline A			IRWD Salt Model - Baseline B		
	mg/L	lbs/M	% Change	mg/L	lbs/M	% Change
0 - Existing Conditions	153	1,112,000	NA	169	1,230,000	NA
1 - Baseline	148	1,078,000	0.00%	163	1,188,000	0.00%
WQ Group "a" - Poseidon Chloride 100 mg/L						
2a - Direct Recharge	143	1,058,000	-3.55%	151	1,119,000	-7.42%
3a - Plus Coastal In-Lieu	144	1,064,000	-3.02%	152	1,124,000	-6.99%
4a - Plus Direct Delivery to S. County	140	1,039,000	-5.27%	148	1,094,000	-9.51%
5a - Direct Delivery to IRWD	200	1,455,000	34.92%	216	1,575,000	32.60%
WQ Group "b" - Poseidon TDS 75 mg/L						
2b - Direct Recharge	141	1,045,000	-4.72%	149	1,103,000	-8.71%
3b - Plus Coastal In-Lieu	142	1,053,000	-4.02%	150	1,110,000	-8.11%
4b - Plus Direct Delivery to S. County	140	1,035,000	-5.67%	147	1,088,000	-9.96%
5b - Direct Delivery to IRWD	185	1,349,000	25.13%	199	1,450,000	22.12%

NOTES:
1) Percent increase or decrease is with regards to Scenario 1 - Baseline.
2) Concentrations listed in this table represent the average running annual average (RAA) for chloride in year 2070.
3) Water quality (WQ) group “a” or “b” identifies the Poseidon water quality used during modeling.
4) mg/L = milligrams per liter; lbs/M = pounds per month; NA = not applicable

Table ES-6. 2070 Average RAA Boron Concentrations at MWRP Effluent

Scenario	IRWD Salt Model - Baseline A			IRWD Salt Model - Baseline B		
	mg/L	lbs/M	% Change	mg/L	lbs/M	% Change
0 - Existing Conditions	0.433	3,150	NA	0.479	3,490	NA
1 - Baseline	0.465	3,390	0.00%	0.508	3,700	0.00%
WQ Group "a" - Poseidon Boron 1.0 mg/L						
2a - Direct Recharge	0.588	4,350	26.28%	0.650	4,810	27.91%
3a - Plus Coastal In-Lieu	0.567	4,200	21.86%	0.628	4,650	23.61%
4a - Plus Direct Delivery to S. County	0.540	4,000	16.09%	0.595	4,410	17.07%
5a - Direct Delivery to IRWD	0.878	6,390	88.65%	0.947	6,900	86.49%
WQ Group "b" - Poseidon Boron 0.75 mg/L						
2b - Direct Recharge	0.570	4,220	22.45%	0.628	4,650	23.65%
3b - Plus Coastal In-Lieu	0.552	4,090	18.60%	0.609	4,510	19.91%
4b - Plus Direct Delivery to S. County	0.535	3,960	14.87%	0.588	4,350	15.68%
5b - Direct Delivery to IRWD	0.733	5,340	57.49%	0.775	5,650	52.61%

NOTES:
1) Percent increase or decrease is with regards to Scenario 1 - Baseline.
2) Concentrations listed in this table represent the average running annual average (RAA) for Boron in year 2070.
3) Water quality (WQ) group “a” or “b” identifies the Poseidon water quality used during modeling.
4) mg/L = milligrams per liter; lbs/M = pounds per month; NA = not applicable

A permitted or recommended buffer, as defined herein, represents the difference between the estimated RAA concentration at MWRP effluent and the permitted or recommended water quality limit. **Table ES-7** through **Table ES-9** summarize the buffer estimated for both water quality groups “a” and “b” and Baselines A and B for TDS, chloride, and boron, respectively. Based on modeling results, the following observations were made when compared to the Baseline (Scenario 1):

- Scenarios 2 through 4 increases the TDS and chloride buffer in MWRP recycled water effluent while the boron buffer decreases.
- Scenario 5 decreases the TDS buffer for water quality group “a” and increases the TDS buffer for water quality group “b”. Scenario 5 decreases the chloride and boron buffer for both water quality groups “a” and “b”.

Table ES-7. 720 mg/L TDS RAA Permit Limit Buffer Comparison

Scenario	IRWD Salt Model - Baseline A		IRWD Salt Model - Baseline B	
	Average TDS Buffer (mg/L)	Percent Buffer Change (mg/L)	Average TDS Buffer (mg/L)	Percent Buffer Change (mg/L)
0 - Existing Conditions	45	NA	-27	NA
1 - Baseline	90	0% (0 mg/L)	24	0% (0 mg/L)
WQ Group "a" - Poseidon TDS 350 mg/L				
2a - Direct Recharge	185	105% (95 mg/L)	169	619% (146 mg/L)
3a - Plus Coastal In-Lieu	168	86% (78 mg/L)	152	544% (128 mg/L)
4a - Plus Direct Delivery to S. County	179	98% (89 mg/L)	165	600% (141 mg/L)
5a - Direct Delivery to IRWD	18	-80% (-73 mg/L)	-42	-280% (-66 mg/L)
WQ Group "b" - Poseidon TDS 150 mg/L				
2b - Direct Recharge	199	120% (109 mg/L)	186	690% (162 mg/L)
3b - Plus Coastal In-Lieu	180	99% (90 mg/L)	166	606% (143 mg/L)
4b - Plus Direct Delivery to S. County	183	103% (93 mg/L)	171	625% (147 mg/L)
5b - Direct Delivery to IRWD	134	48% (43 mg/L)	75	220% (52 mg/L)

NOTES:
1) Percent increase or decrease is with regards to Scenario 1 - Baseline.
2) Permitted running annual average (RAA) TDS Limit is 720 mg/L.
3) Water quality (WQ) group “a” or “b” identifies the Poseidon water quality used during modeling.
4) mg/L = milligrams per liter; NA = not applicable

Table ES-8. 150 mg/L Chloride RAA Recommended Limit Buffer Comparison

Scenario	IRWD Salt Model - Baseline A		IRWD Salt Model - Baseline B	
	Average Cl Buffer (mg/L)	Percent Buffer Change (mg/L)	Average Cl Buffer (mg/L)	Percent Buffer Change (mg/L)
0 - Existing Conditions	-2.7	NA	-18.8	NA
1 - Baseline	2.0	0% (0 mg/L)	-13.1	0% (0 mg/L)
WQ Group "a" - Poseidon Chloride 100 mg/L				
2a - Direct Recharge	7.2	268% (5 mg/L)	-1.0	92% (12 mg/L)
3a - Plus Coastal In-Lieu	6.4	228% (4 mg/L)	-1.7	87% (11 mg/L)
4a - Plus Direct Delivery to S. County	9.8	398% (8 mg/L)	2.4	118% (16 mg/L)
5a - Direct Delivery to IRWD	-49.7	-2633% (-52 mg/L)	-66.3	-406% (-53 mg/L)
WQ Group "b" - Poseidon Chloride 75 mg/L				
2b - Direct Recharge	9.0	356% (7 mg/L)	1.1	108% (14 mg/L)
3b - Plus Coastal In-Lieu	7.9	303% (6 mg/L)	0.1	101% (13 mg/L)
4b - Plus Direct Delivery to S. County	10.4	427% (8 mg/L)	3.1	124% (16 mg/L)
5b - Direct Delivery to IRWD	-35.2	-1895% (-37 mg/L)	-49.2	-275% (-36 mg/L)

NOTES:

1) Percent increase or decrease is with regards to Scenario 1 - Baseline.

2) IRWD recommended running annual average (RAA) Chloride Limit is 150 mg/L; see IRWD TM - Potential Impact of Ocean Desalination - Recommended Chlorine Limit (8/7/19).

3) Water quality (WQ) group “a” or “b” identifies the Poseidon water quality used during modeling.

4) mg/L = milligrams per liter; NA = not applicable

Table ES-9. 0.5 mg/L Boron RAA Recommended Limit Buffer Comparison

Scenario	IRWD Salt Model - Baseline A		IRWD Salt Model - Baseline B	
	Average B Buffer (mg/L)	Percent Buffer Change (mg/L)	Average B Buffer (mg/L)	Percent Buffer Change (mg/L)
0 - Existing Conditions	0.067	NA	0.021	NA
1 - Baseline	0.035	0% (0 mg/L)	-0.008	0% (0 mg/L)
WQ Group "a" - Poseidon Boron 1.0 mg/L				
2a - Direct Recharge	-0.088	-353% (-0.12 mg/L)	-0.150	-1767% (-0.14 mg/L)
3a - Plus Coastal In-Lieu	-0.067	-293% (-0.1 mg/L)	-0.128	-1494% (-0.12 mg/L)
4a - Plus Direct Delivery to S. County	-0.040	-216% (-0.07 mg/L)	-0.095	-1080% (-0.09 mg/L)
5a - Direct Delivery to IRWD	-0.378	-1190% (-0.41 mg/L)	-0.447	-5475% (-0.44 mg/L)
WQ Group "b" - Poseidon Boron 0.75 mg/L				
2b - Direct Recharge	-0.070	-301% (-0.1 mg/L)	-0.128	-1497% (-0.12 mg/L)
3b - Plus Coastal In-Lieu	-0.052	-250% (-0.09 mg/L)	-0.109	-1260% (-0.1 mg/L)
4b - Plus Direct Delivery to S. County	-0.035	-200% (-0.07 mg/L)	-0.088	-993% (-0.08 mg/L)
5b - Direct Delivery to IRWD	-0.233	-772% (-0.27 mg/L)	-0.275	-3331% (-0.27 mg/L)

NOTES:

1) Percent increase or decrease is with regards to Scenario 1 - Baseline.

2) IRWD recommended running annual average (RAA) Boron Limit is 0.5 mg/L; see IRWD TM - Potential Impact of Ocean Desalination - Recommended Boron Limit (8/7/19).

3) Water quality (WQ) group “a” or “b” identifies the Poseidon water quality used during modeling.

4) mg/L = milligrams per liter; NA = not applicable

1 Introduction

Recycled water use is an essential part of the water conservation effort in California, and Irvine Ranch Water District (IRWD or District) has been at the forefront of recycled water production and use for over half a century. IRWD's customers rely upon the District to produce a high quality product that meets RWQCB limits and is suitable for agricultural and landscape irrigation, industrial processes, dual-plumbed buildings, and cooling towers.

Chlorine contact basin at IRWD MWRP.

IRWD uses four surface reservoirs for seasonal storage to maximize recycled water use throughout the year; three of which are designated as Waters of the United States. This designation, under the EPA's Clean Water Rule, requires IRWD to meet more stringent salinity limits to discharge into these storage reservoirs. The District's Master Reclamation Permit R8-2015-0024, issued by the Santa Ana Regional Water Quality Control Board (RWQCB), establishes a 720 mg/L running annual average (RAA) limit for total dissolved solids (TDS) at IRWD's Michelson Water Recycling Plant (MWRP) discharge point. It is critical that salinity (measured as TDS) of incoming water sources be monitored and managed to maintain compliance with District's permit. In addition to meeting the TDS regulatory requirement, IRWD has a responsibility to maintain TDS, chloride and boron concentrations that meet or exceed the requirements of their recycled water customers.

1.1 Salinity

Salinity is the concentration of dissolved mineral salts in water. The salts consist of several different types of compounds at varying concentrations. The term TDS, is used to describe the combination of all inorganic and organic content suspended in a liquid. This evaluation not only looks into the effects of TDS, but also two of its more concerning compounds—chloride and boron.

Example of bronzing due to high chloride (California Department of Food and Agriculture, 2016).

Increased levels of chloride can create problems for crop growers and landscapers by decreasing yields and causing leaf burn for highly sensitive plants, such as avocados, strawberries, and other landscaping. Generally, crops exposed to excess chloride may produce smaller leaves, have a decreased rate of growth, and experience a discoloration in leaf tips known as bronzing.

Boron is an essential part of plant life in relatively small amounts but can be a cause for concern when excess levels are found in irrigation water and soils. An excessive amount of boron can lead to yellowing leaves, known as chlorosis, and ultimately leaf death.

1.2 Project History

The 2015 RWSMP determined that IRWD's source water is the largest contributing factor to recycled water salinity. IRWD's Salt Balance Model, developed as part of the RWSMP, simulates the District's system from source water delivered to its customers in the sewersheds to treatment at various facilities and the distribution of recycled water to the non-potable system. The RWSMP provided the District with an increased understanding of the various salt contributions to their recycled water quality and the relative TDS impact due to system changes. It also emphasized the need for IRWD to monitor and manage the available TDS buffer in order to avoid exceeding the 720 mg/L permitted limit and allow for future water supply projects.

In 2017 an initial analysis was performed to understand the potential impact of desalinated ocean water injection into the groundwater basin on MWRP recycled water effluent. The 2017 study used an estimate of DRWF water quality developed by TH&C using an analytical model and resulted in the development of an Enhanced Salt Balance Model.

This 2019 study supersedes the 2017 study by including new scenarios identified in recent discussions between OCWD, various south Orange County water agencies, and the Huntington Beach Desalination Plant developer, Poseidon Water. The project used an updated Salt Balance Model, the 2019 Enhanced Salt Model, and TH&C's 2019 DRWF water quality estimates developed using a groundwater flow and transport model to estimate the impact of desalinated ocean water injection and direct conveyance on MWRP recycled water effluent TDS.

1.3 Project Goals

IRWD is responsible for managing recycled water quality to meet their user requirements and RWQCB permit conditions. This responsibility underscores the need to understand the effects from OCWD potential distribution of desalinated seawater from Poseidon Water's proposed Huntington Beach Desalination Plant (Poseidon) on IRWD's recycled water quality. The purpose of this study is to analyze the effects of recharging the OCGWB with desalinated ocean water or by direct delivery to IRWD on the MWRP's recycled water effluent for TDS, chloride, and boron. This report evaluates ten scenarios to determine water quality impacts to IRWD's recycled water based on different sources and combination of flows. TH&C's groundwater study (2019) provided DRWF water quality concentrations with various levels of recharge with desalinated ocean water. HDR utilized an updated Salt Balance Model and the 2019 Enhanced Salt Model to estimate the associated impact to the MWRP recycled water effluent TDS, chloride, and boron for each scenario.

1.4 Project Methodology

IRWD's 2015 Salt Balance Model was developed to perform a mass balance of flow and salinity loads throughout IRWD's service area from 2008 to 2035. It performs several detailed mass balances contained within a system-wide mass balance to model salt contributions (as TDS) throughout the District. The model includes numerous water supply sources, 18 sewersheds, 3 water user types, 4 treatment plants, 4 non-potable reservoirs, and numerous non-potable water users. IRWD's Salt Balance Model's ability to forecast TDS concentrations ends at year 2035. However, the TH&C's "Potential Effects of the Proposed Seawater Desalinated Project" groundwater study (2016) indicates TDS, chloride, and boron impacts resulting from desalinated ocean water injection stabilizes after this timeframe. In addition, the model simulates TDS, but does not have the ability to model chloride and boron. Finally, many of the model's complexities require significant data that are not expected to change in response to the injection of desalinated ocean water. Therefore, the 2015 Salt Balance model was updated and a 2019 Enhanced Salt Model was developed to utilize the DRWF estimates of groundwater quality provided by TH&C.

The 2019 Enhanced Salt Model extended the study period to December 2070 using TH&C (2019) estimates for the DRWF and by repeating other data from 2028 to 2035 when future developments are expected to be operational. Chloride and boron are included in the 2019 Enhanced Salt Model by using average historical ratios between TDS and chloride and TDS and boron. Simplified relationships were developed for the 2019 Enhanced Salt Model and calibrated to the updated Salt Balance model for source flows, treatment plant inflows and treatment plant outflows to model the impact of desalinated ocean water on the District's recycled water quality. With these additions, the 2019 Enhanced Salt Model and historical data are able to forecast TDS, chloride, and boron concentrations through December 2070.

1.5 Acronyms and Abbreviations

For ease of reference, this section provides a list of acronyms and abbreviations used frequently -throughout this report.

BPP	Basin pumping percentage
DRWF	Dyer Road Well Field
EFF	Effluent
GW	Groundwater
GWRS	Groundwater Replenishment System
INF	Influent
Poseidon	Poseidon Water's proposed Huntington Beach Desalination Plant
IRWD or District	Irvine Ranch Water District
IW	Injection well
LAWRP	Los Alisos Water Recycling Plant
lbs/M	Pounds per month

lbs	Pounds
MBIP	Mid-Basin Injection Project
mg/L	Milligrams per liter
MGD	Million gallons per day
MWD	Metropolitan Water District of Southern California
MWRP	Michelson Water Recycling Plant
OCGWB	Orange County Groundwater Basin
OCWD	Orange County Water District
RAA	Running Annual Average
R/C/I	Residential/Commercial/Industrial
RWQCB	Regional Water Quality Control Board
RWSMP	Recycled Water Salt Management Plan
SAR	Santa Ana River
SETIB	Southeast Talbert Injection Barrier
TDS	Total Dissolved Solids
TH&C	Thomas Harder and Company
TIB	Talbert Injection Barrier
WQ	Water quality
WTP	Water Treatment Plant

2 Project Background

This section provides background information regarding IRWD's Salt Balance Model, the Poseidon Ocean Desalination Project, and the TH&C Groundwater Injection Evaluation (2019).

2.1 IRWD's Salt Balance Model

IRWD's Salt Balance Model is a comprehensive mass balance model developed to track the movement of TDS to and from IRWD through year 2035. This model was built in Microsoft Excel to provide the User with transparency on the model's design and allow the User to perform as-needed modification.

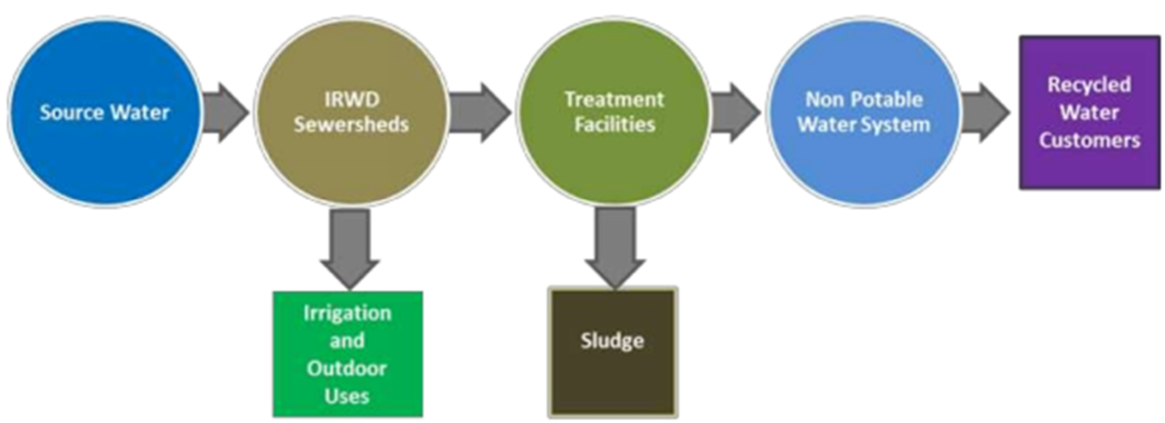
There are many source loads and sinks that contribute to the salinity in IRWD's recycled water including source supplies, water treatment, customer water use, and water storage. IRWD's Salt Balance Model was developed to analyze this complex system and perform a mass balance of flow and salinity loads for the IRWD service area. IRWD's Salt Balance Model concluded that source water is the largest contribution of salt and future water supplies and operational decisions can have a significant impact on the system's recycled water quality. Therefore, replacing local groundwater with desalinated ocean water could affect salt concentrations in MWRP effluent and eliminate IRWD's TDS buffer.

More details on IRWD's Salt Balance Model and the results of the scenarios can be found in the **Appendix F**.

2.1.1 Stages

The following section provides a brief overview of the design and structure of IRWD's Salt Balance Model, which consists of four main stages: Source Water, Sewersheds, Treatment Plants, and Non-Potable Water System. See **Figure 2-1** for a simplified process diagram of IRWD's recycled water system.

Figure 2-1. Contributing Sources and Losses of Salinity in Recycled Water



Source: IRWD Recycled Water Salt Management Plan, 2015

Stage 1 – Source Water. In the source water stage of IRWD's Salt Balance Model, all of the different sources of potable water are used to calculate salt load based on salinity concentrations and demand. The sources in this stage include imported potable water from State Water Project and Colorado River, local groundwater sources, local surface water sources, and potentially desalinated ocean water.

Stage 2 – Sewersheds. The sewershed stage calculates the salt loads from residential, commercial, institutional, and industrial users. In addition, this stage determines the amount of salt lost to irrigation/exfiltration during its use.

Stage 3 – Treatment Plants. The third stage simulates the treatment plant operations, where the salt loads reach each treatment plant as the water receives secondary and/or tertiary treatment. Not all of the treated sewage becomes a part of IRWD's recycled water supply. Sludge and scum associated with MWRP treatment process contains salts that are currently exported to wastewater treatment plants outside of the IRWD service area. Also, secondary treated water at Los Alisos Water Recycling Plant (LAWRP) may be sent to the ocean outfall if it cannot be utilized as recycled water. Finally, some of IRWD's sewersheds discharge to wastewater treatment plants located outside the IRWD service area.

Stage 4 – Non-Potable Water System. The non-potable system has four main sources including: tertiary treated recycled water from Stage 3, untreated (raw) imported water, non-potable groundwater from local wells, and a blend of these waters from IRWD's non-potable reservoirs. Non-potable water can enter back into the system through the sewershed level, but most of it is used for irrigation purposes.

2.1.2 Model Modes

The RWSMP provides greater detail on IRWD's Salt Balance Model development and operation than presented here. In general, the model runs under three different modes: Historical Measured, Historical Predictive, and Future Predictive. Each of these modes played a major role in the models development and functionality. Although they are important and served a major purpose in the model's progression and calibration, the Historical Measured and Historical Predictive modes are typically not used when analyzing an alternative using the Salt Balance Model.

2.1.3 RWSMP Baselines and Scenarios

IRWD's original Salt Balance Model was developed with two baselines, Baseline A and Baseline B, which extend from 2015 to 2035. As presented in **Table 2-1**, these baselines include planned projects that come online in future years and represent a range of realistic and plausible operating conditions that IRWD is likely to encounter.

Baseline A represents a best estimate of future conditions while Baseline B takes a more conservative approach. Differences in these baselines result from future estimates regarding the Basin Pumping Percentage, In-Lieu Pumping, Recycled Water Penalty, and the TDS concentration in imported supplies from the Diemer Water Treatment Plant (WTP). The In-lieu Pumping program allows IRWD to receive surface water from Metropolitan Water District of Southern California (MWD) in-lieu of pumping local groundwater supplies; Baseline B models an in-lieu period every seven years.

Table 2-1. Future Baseline Scenarios

No.	Parameter	Baseline A	Baseline B
1	Basin Pumping Percentage (BPP)	70% until 2024 75% after 2024	65%
2	In-Lieu Pumping Period	None	Every 7 years
3	Recycled Water (RW) Penalty	Expires in 2016	Never Expires
4	Diemer WTP's Water Quality	Historical median by month	85% Colorado River Water at 723 mg/L 15% State Water Project at 324 mg/L

2.1.4 Updated Salt Balance Model and 2019 Enhanced Salt Balance Model

In order to include the DRWF flow and concentration data developed by TH&C, an updated Salt Balance Model and a 2019 Enhanced Salt Model were developed. **Appendix E** provides a description of the updated and enhanced Salt Balance Models.

2.2 Poseidon Huntington Beach Desalination Project

Recharging desalinated ocean water to the groundwater basin can impact the MWRP effluent salinity depending on the supply amount, conveyance method, and point of entry. This change is mainly attributed to the concentration of TDS, chloride, and boron in desalinated ocean water compared to local groundwater sources. **Table 2-2** compares the Poseidon effluent TDS, chloride, and boron concentrations, which were proposed to OCWD in the Water Reliability Agreement Term Sheet (**Appendix A**, 2015), to the historic water quality of DRWF, imported MWD water, and the GWRS project.

Table 2-2. Historical and Projected Water Quality for Potable Water Supply Sources

Parameter	Units	Poseidon Projected Mean	Poseidon Projected Maximum	MWD Imported Historical Mean (2008-2014)	DRWF Historical Mean (2004-2015)	GWRS Historical Mean (2013)
TDS	mg/L	350	500	530	260	48
Chloride	mg/L	75	100	85	22	6
Boron	mg/L	0.75	1.0	0.14	0.18	0.25

Trussell Technologies, Inc. performed a study titled Review of Proposed Water Quality Requirements for the Huntington Beach Desalter (2016) that indicated chloride is the controlling variable in a salt water reverse osmosis treatment process. Therefore, water quality groups “a: and “b” presented in **Table 2-3** were developed in cooperation with OCWD and are analyzed in this report.

Table 2-3. Enhanced Salt Model Concentrations Summary

Source Water	TDS (mg/L)	Chloride (mg/L)	Boron (mg/L)
Poseidon Water Quality Group “a”	350	100	1.00
Poseidon Water Quality Group “b”	150	75	0.75
Poseidon Water Quality Group “c” [1]	NA	NA	0.50
Poseidon Water Quality Group “d” [1]	NA	NA	0.25

Notes: [1]Water quality groups “c” and “d” were analyzed for boron sensitivity only; see Section 3.2.2.

According to the proposed Term Sheet, OCWD would be responsible for distributing the desalinated ocean water produced from the Poseidon project under a 50-year take-or-pay contract. OCWD manages the OCGWB, from which the District withdraws groundwater through the DRWF and numerous other wells.

2.3 TH&C Groundwater Evaluation

IRWD retained the services of TH&C to evaluate future groundwater quality impacts at DRWF due to injection of desalinated ocean water in the groundwater basin. TH&C collected hydrogeological data (wells, groundwater level, groundwater quality, and model data) and applied a linked groundwater flow and transport model (GFSTM) to assess the injected water travel time and changes to the groundwater quality at DRWF. TH&C (2019) modeled eight scenarios; six injection scenarios, one scenario with GWRS Final Expansion recharge, and one existing condition scenario. The model runs estimated the potential desalinated ocean water impact to DRWF TDS, chloride, and boron. The GFSTM is configured as steady-state with respect to groundwater elevations and transient with respect to water quality. The analysis focuses on recharge and pumping to a 120-square mile Study Area that encompassed the DRWF and nearby existing and proposed injection wells. The potential impact of desalinated ocean water recharge to the Forebay and other recharge projects being considered by OCWD that are located outside the Study Area were not analyzed but may be addressed in future enhancements to the study.

2.3.1 Modeled Scenarios

The purpose of the TH&C’s modeled scenarios is to evaluate the potential impact on water quality in IRWD’s potable and recycled water supply at DRWF from additional recharge water supplied by Poseidon into the groundwater basin. See Section F.5.2 for a description of the scenarios.

3 Results

This section provides a summary of the TH&C (2019) results on DRWF concentrations and the impact to MWRP effluent using the Enhanced Salt Model for all scenarios.

3.1 Groundwater Results

Table 3-1 summarizes the results of the TH&C (2019) groundwater analysis for TDS, chloride, and boron concentrations from the DRWF water supply for water quality groups “a” and “b” and Baselines A and B, which are used in the Enhanced Salt Model analysis. The tabulated results reflect the average water quality that occurs in year 2070 at the DRWF ground water supply. TH&C provided additional data to determine the boron sensitivity at Dyer Road Well Field, which is reflected in the MWRP effluent results shown in Section 3.2.2; graphics for DWRF boron sensitivity are provided in **Appendix E**.

Table 3-1. TH&C Average Year 2070 Water Quality Results at DRWF

Scenario	Average Water Quality for Baseline A and B in Year 2070		
	TDS (mg/L)	Chloride (mg/L)	Boron (mg/L)
0	299	29.3	0.068
1	237	23.3	0.117
2a	155	21.8	0.258
2b	139	19.8	0.237
3a	175	22.8	0.234
3b	161	21.1	0.217
4a	163	19.0	0.203
4b	157	18.3	0.197
5a[1]	350	100	1.000
5b[1]	150	75	0.750

NOTES: [1] Scenario 5a & 5b were not evaluated by TH&C were modeled as direct delivery to IRWD.

3.2 Recycled Water Results

The Enhanced Salt Model results are summarized below in terms of forecasted recycled water RAA TDS and impact on IRWD’s TDS buffer. Individual RAA results for each scenario are provided graphically following the tables. Additional information on MWRP effluent results can be found in **Appendix D**. **Table 3-2** through **Table 3-4** present the tabulated scenario results of the average RAA concentration and associated salt load (in pounds per month (lb/M)) for TDS, chloride, and boron at MWRP effluent after long-term stabilization at DRWF has occurred.

Table 3-2. 2070 Average RAA TDS Concentrations at MWRP Effluent

Scenario	IRWD Salt Model - Baseline A			IRWD Salt Model - Baseline B		
	mg/L	lbs/M	% Change	mg/L	lbs/M	% Change
0 - Existing Conditions	675	4,916,000	NA	747	5,437,000	NA
1 - Baseline	630	4,586,000	0.00%	696	5,072,000	0.00%
WQ Group "a" - Poseidon TDS 350 mg/L						
2a - Direct Recharge	535	3,964,000	-15.05%	551	4,082,000	-20.90%
3a - Plus Coastal In-Lieu	552	4,089,000	-12.37%	568	4,211,000	-18.40%
4a - Plus Direct Delivery to S. County	541	4,010,000	-14.06%	555	4,113,000	-20.29%
5a - Direct Delivery to IRWD	702	5,115,000	11.53%	762	5,552,000	9.47%
WQ Group "b" – Poseidon TDS 150 mg/L						
2b - Direct Recharge	521	3,862,000	-17.24%	534	3,958,000	-23.30%
3b - Plus Coastal In-Lieu	540	4,002,000	-14.24%	554	4,103,000	-20.49%
4b - Plus Direct Delivery to S. County	537	3,975,000	-14.81%	549	4,070,000	-21.13%
5b - Direct Delivery to IRWD	586	4,270,000	-6.89%	645	4,695,000	-7.42%

1) Percent increase or decrease is with regards to Scenario 1 – Baseline.
2) Concentrations listed in this table represent the average running annual average (RAA) for TDS in year 2070.
3) Water quality (WQ) group "a" or "b" identifies the Poseidon water quality used during modeling.
4) mg/L = milligrams per liter; lbs/M = pounds per month; NA = not applicable

Table 3-3. 2070 Average RAA Chloride Concentrations at MWRP Effluent

Scenario	IRWD Salt Model - Baseline A			IRWD Salt Model - Baseline B		
	mg/L	lbs/M	% Change	mg/L	lbs/M	% Change
0 - Existing Conditions	153	1,112,000	NA	169	1,230,000	NA
1 - Baseline	148	1,078,000	0.00%	163	1,188,000	0.00%
WQ Group "a" - Poseidon Chloride 100 mg/L						
2a - Direct Recharge	143	1,058,000	-3.55%	151	1,119,000	-7.42%
3a - Plus Coastal In-Lieu	144	1,064,000	-3.02%	152	1,124,000	-6.99%
4a - Plus Direct Delivery to S. County	140	1,039,000	-5.27%	148	1,094,000	-9.51%
5a - Direct Delivery to IRWD	200	1,455,000	34.92%	216	1,575,000	32.60%
WQ Group "b" - Poseidon Chloride 75 mg/L						
2b - Direct Recharge	141	1,045,000	-4.72%	149	1,103,000	-8.71%
3b - Plus Coastal In-Lieu	142	1,053,000	-4.02%	150	1,110,000	-8.11%
4b - Plus Direct Delivery to S. County	140	1,035,000	-5.67%	147	1,088,000	-9.96%
5b - Direct Delivery to IRWD	185	1,349,000	25.13%	199	1,450,000	22.12%

1) Percent increase or decrease is with regards to Scenario 1 - Baseline.
2) Concentrations listed in this table represent the average running annual average (RAA) for Chloride in year 2070.
3) Water quality (WQ) group "a" or "b" identifies the Poseidon water quality used during modeling.
4) mg/L = milligrams per liter; lbs/M = pounds per month; NA = not applicable

Table 3-4. 2070 Average RAA Boron Concentrations at MWRP Effluent

Scenario	IRWD Salt Model - Baseline A			IRWD Salt Model - Baseline B		
	mg/L	lbs/M	% Change	mg/L	lbs/M	% Change
0 - Existing Conditions	0.433	3,150	NA	0.479	3,490	NA
1 - Baseline	0.465	3,390	0.00%	0.508	3,700	0.00%
WQ Group "a" - Poseidon Boron 1.0 mg/L						
2a - Direct Recharge	0.588	4,350	26.28%	0.650	4,810	27.91%
3a - Plus Coastal In-Lieu	0.567	4,200	21.86%	0.628	4,650	23.61%
4a - Plus Direct Delivery to S. County	0.540	4,000	16.09%	0.595	4,410	17.07%
5a - Direct Delivery to IRWD	0.878	6,390	88.65%	0.947	6,900	86.49%
WQ Group "b" - Poseidon Boron 0.75 mg/L						
2b - Direct Recharge	0.570	4,220	22.45%	0.628	4,650	23.65%
3b - Plus Coastal In-Lieu	0.552	4,090	18.60%	0.609	4,510	19.91%
4b - Plus Direct Delivery to S. County	0.535	3,960	14.87%	0.588	4,350	15.68%
5b - Direct Delivery to IRWD	0.733	5,340	57.49%	0.775	5,650	52.61%

1) Percent increase is with regards to Scenario 1 – Baseline.
2) Concentrations listed in this table represent the average running annual average (RAA) for Boron in year 2070.
3) Water quality (WQ) group "a" or "b" identifies the Poseidon water quality used during modeling.
4) mg/L = milligrams per liter; lbs/M = pounds per month; NA = not applicable

A permitted or recommended buffer, as defined herein, is the difference between the estimated RAA concentration at MWRP effluent and the permitted or recommended water quality limit. **Table 3-5** through **Table 3-7** summarize the impact to the permitted or recommended buffer and the percent reduction for each scenario compared to Scenario 1. The RWQCB limits IRWD MWRP recycled water effluent to a 720 mg/L TDS RAA. As previously stated, IRWD must maintain a reasonable TDS buffer, since this buffer can diminish quickly if left unmanaged. IRWD evaluated the recycled water quality requirements for both chlorine and boron within two individual Technical Memoranda dated August 7. 2019. IRWD's findings resulted in a recommended MWRP effluent water quality limit for both chloride and boron of 150 mg/L and 0.5 mg/L respectively. These limits are identified on **Table 3-6** through **Table 3-7** and on **Figure 3-1** through **Figure 3-12** associated with chloride and boron modeled scenario results. The TDS, chloride, and boron buffer enables IRWD to provide high-quality recycled water and to be flexible in their system operation. In many of the modeled scenarios, the identified TDS and chloride buffers were maintained, but the boron buffer was diminished in all scenarios that evaluated the distribution of desalinated ocean water.

Table 3-5. 720 mg/L TDS RAA Permit Limit Buffer Comparison

Scenario	IRWD Salt Model - Baseline A		IRWD Salt Model - Baseline B	
	Average TDS Buffer (mg/L)	Percent Buffer Change (mg/L)	Average TDS Buffer (mg/L)	Percent Buffer Change (mg/L)
0 - Existing Conditions	45	NA	-27	NA
1 - Baseline	90	0% (0 mg/L)	24	0% (0 mg/L)
WQ Group "a" - Poseidon TDS 350 mg/L				
2a - Direct Recharge	185	105% (95 mg/L)	169	619% (146 mg/L)
3a - Plus Coastal In-Lieu	168	86% (78 mg/L)	152	544% (128 mg/L)
4a - Plus Direct Delivery to S. County	179	98% (89 mg/L)	165	600% (141 mg/L)
5a - Direct Delivery to IRWD	18	-80% (-73 mg/L)	-42	-280% (-66 mg/L)
WQ Group "b" - Poseidon TDS 150 mg/L				
2b - Direct Recharge	199	120% (109 mg/L)	186	690% (162 mg/L)
3b - Plus Coastal In-Lieu	180	99% (90 mg/L)	166	606% (143 mg/L)
4b - Plus Direct Delivery to S. County	183	103% (93 mg/L)	171	625% (147 mg/L)
5b - Direct Delivery to IRWD	134	48% (43 mg/L)	75	220% (52 mg/L)

1) Percent increase or decrease is with regards to Scenario 1 - Baseline.
2) Permitted running annual average (RAA) TDS Limit is 720 mg/L.
3) Water quality (WQ) group "a" or "b" identifies the Poseidon water quality used during modeling.
4) mg/L = milligrams per liter; NA = not applicable

Table 3-6. 150 mg/L Chloride RAA Recommended Limit Buffer Comparison

Scenario	IRWD Salt Model - Baseline A		IRWD Salt Model - Baseline B	
	Average Cl Buffer (mg/L)	Percent Buffer Change (mg/L)	Average Cl Buffer (mg/L)	Percent Buffer Change (mg/L)
0 - Existing Conditions	-2.7	NA	-18.8	NA
1 - Baseline	2.0	0% (0 mg/L)	-13.1	0% (0 mg/L)
WQ Group "a" - Poseidon Chloride 100 mg/L				
2a - Direct Recharge	7.2	268% (5 mg/L)	-1.0	92% (12 mg/L)
3a - Plus Coastal In-Lieu	6.4	228% (4 mg/L)	-1.7	87% (11 mg/L)
4a - Plus Direct Delivery to S. County	9.8	398% (8 mg/L)	2.4	118% (16 mg/L)
5a - Direct Delivery to IRWD	-49.7	-2633% (-52 mg/L)	-66.3	-406% (-53 mg/L)
WQ Group "b" - Poseidon Chloride 75 mg/L				
2b - Direct Recharge	9.0	356% (7 mg/L)	1.1	108% (14 mg/L)
3b - Plus Coastal In-Lieu	7.9	303% (6 mg/L)	0.1	101% (13 mg/L)
4b - Plus Direct Delivery to S. County	10.4	427% (8 mg/L)	3.1	124% (16 mg/L)
5b - Direct Delivery to IRWD	-35.2	-1895% (-37 mg/L)	-49.2	-275% (-36 mg/L)

1) Percent increase or decrease is with regards to Scenario 1 - Baseline.
2) IRWD recommended running annual average (RAA) Chloride Limit is 150 mg/L; see IRWD TM - Potential Impact of Ocean Desalination - Recommended Chlorine Limit (8/7/19).
3) Water quality (WQ) group "a" or "b" identifies the Poseidon water quality used during modeling.
4) mg/L = milligrams per liter; NA = not applicable

Table 3-7. 0.5 mg/L Boron RAA Recommended Limit Buffer Comparison

Scenario	IRWD Salt Model - Baseline A		IRWD Salt Model - Baseline B	
	Average B Buffer (mg/L)	Percent Buffer Change (mg/L)	Average B Buffer (mg/L)	Percent Buffer Change (mg/L)
0 - Existing Conditions	0.067	NA	0.021	NA
1 - Baseline	0.035	0% (0 mg/L)	-0.008	0% (0 mg/L)
WQ Group "a" - Poseidon Boron 1.0 mg/L				
2a - Direct Recharge	-0.088	-353% (-0.12 mg/L)	-0.150	-1767% (-0.14 mg/L)
3a - Plus Coastal In-Lieu	-0.067	-293% (-0.1 mg/L)	-0.128	-1494% (-0.12 mg/L)
4a - Plus Direct Delivery to S. County	-0.040	-216% (-0.07 mg/L)	-0.095	-1080% (-0.09 mg/L)
5a - Direct Delivery to IRWD	-0.378	-1190% (-0.41 mg/L)	-0.447	-5475% (-0.44 mg/L)
WQ Group "b" - Poseidon Boron 0.75 mg/L				
2b - Direct Recharge	-0.070	-301% (-0.1 mg/L)	-0.128	-1497% (-0.12 mg/L)
3b - Plus Coastal In-Lieu	-0.052	-250% (-0.09 mg/L)	-0.109	-1260% (-0.1 mg/L)
4b - Plus Direct Delivery to S. County	-0.035	-200% (-0.07 mg/L)	-0.088	-993% (-0.08 mg/L)
5b - Direct Delivery to IRWD	-0.233	-772% (-0.27 mg/L)	-0.275	-3331% (-0.27 mg/L)

1) Percent increase or decrease is with regards to Scenario 1 - Baseline.
2) IRWD recommended running annual average (RAA) Boron Limit is 0.5 mg/L; see IRWD TM - Potential Impact of Ocean Desalination - Recommended Boron Limit (8/7/19).
3) Water quality (WQ) group “a” or “b” identifies the Poseidon water quality used during modeling.
4) mg/L = milligrams per liter; NA = not applicable

Enhanced Salt Model TDS projections through 2070 for Baseline A are illustrated in **Figure 3-1** and **Figure 3-2**, while that for Baseline B are illustrated in **Figure 3-7** and **Figure 3-8**. The 720 mg/L RAA TDS limit is shown as a reference to identify the TDS buffer as the difference between the 720 mg/L limit and the forecasted long-term RAA TDS value after stabilization. As a reminder, Baseline B allows for periodic in-Lieu water supply that uses higher TDS imported MWD water in-lieu of local groundwater, which causes the periodic spikes in TDS. The change in the TDS buffer provides a representative measure of the impact from desalinated seawater injection. IRWD must carefully monitor and manage the TDS buffer to stay in compliance with the 720 mg/L limit, to provide customers with high quality water and to maintain flexibility in system operation.

Figure 3-3 and **Figure 3-4** display the resulting chloride RAA in MWRP effluent for Baseline A, while results for Baseline B appear on **Figure 3-9** and **Figure 3-10**. The IRWD recommended RAA chloride limit of 150 mg/L is shown for reference. The limit identifies the chloride buffer measured through the difference between the 150 mg/L limit and the forecasted long-term RAA chloride concentrations in MWRP effluent. The four graphs are used to represent all scenario results for Baseline A and B for each Poseidon desalinated ocean water chloride concentrations (100 and 75 mg/L).

Figure 3-5 and **Figure 3-6** display the resulting boron RAA in MWRP effluent for Baseline A, while results for Baseline B appear on **Figure 3-11** and **Figure 3-12**. The IRWD recommended RAA boron limit of 0.5 mg/L is shown for reference. The limit identifies the boron buffer measured through the difference between the 0.5 mg/L limit and the forecasted long-term RAA boron concentrations in MWRP effluent. The four graphs are used to represent all scenario results for Baseline A and B and each Poseidon desalinated ocean water chloride concentrations (1.0 and 0.75 mg/L).

Figure 3-1. MWRP Effluent RAA TDS for Water Quality Group “a” – Baseline A

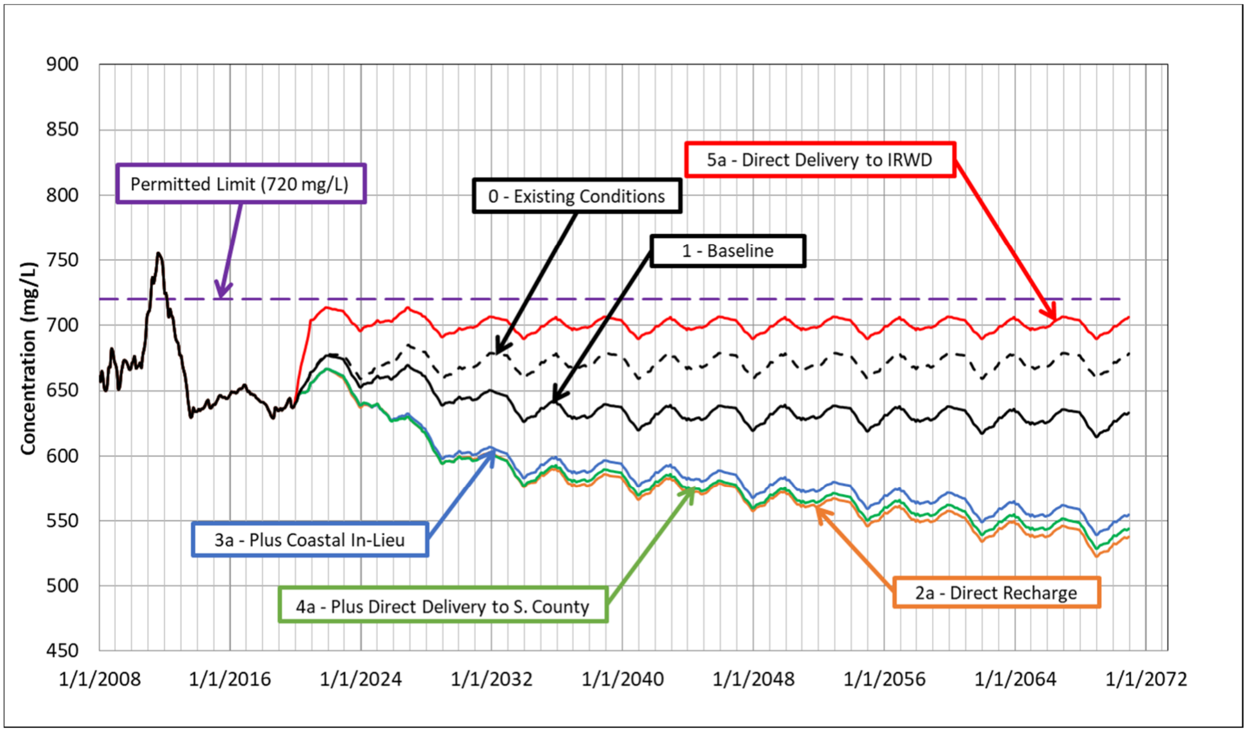


Figure 3-2. MWRP Effluent RAA TDS for Water Quality Group “b” – Baseline A

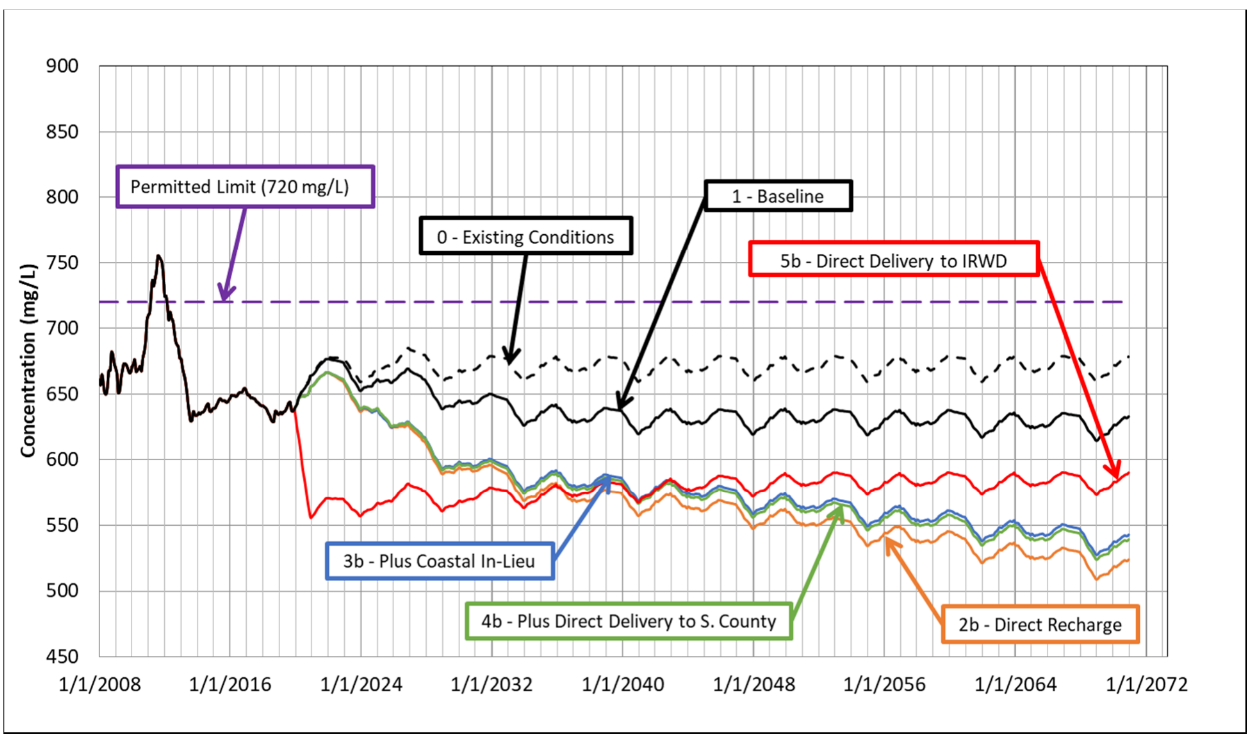


Figure 3-3. MWRP Effluent RAA Chloride for Water Quality Group "a" – Baseline A

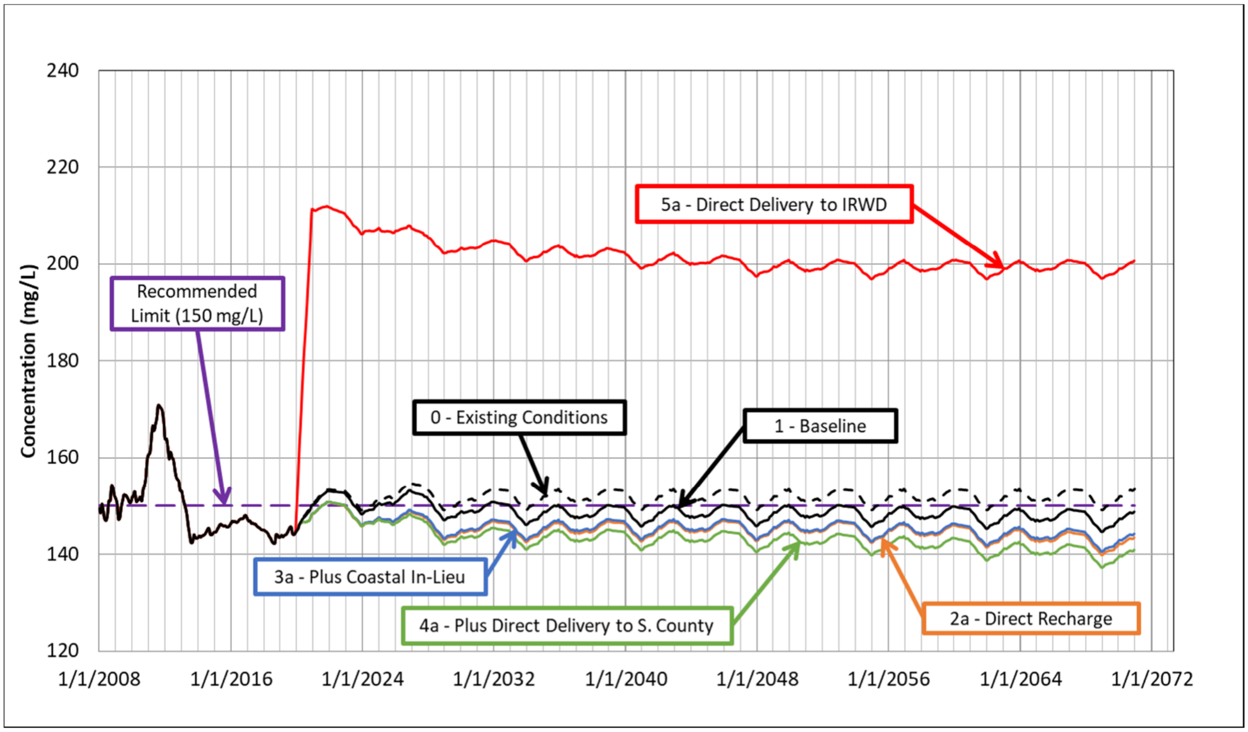


Figure 3-4. MWRP Effluent RAA Chloride for Water Quality Group "b" – Baseline A

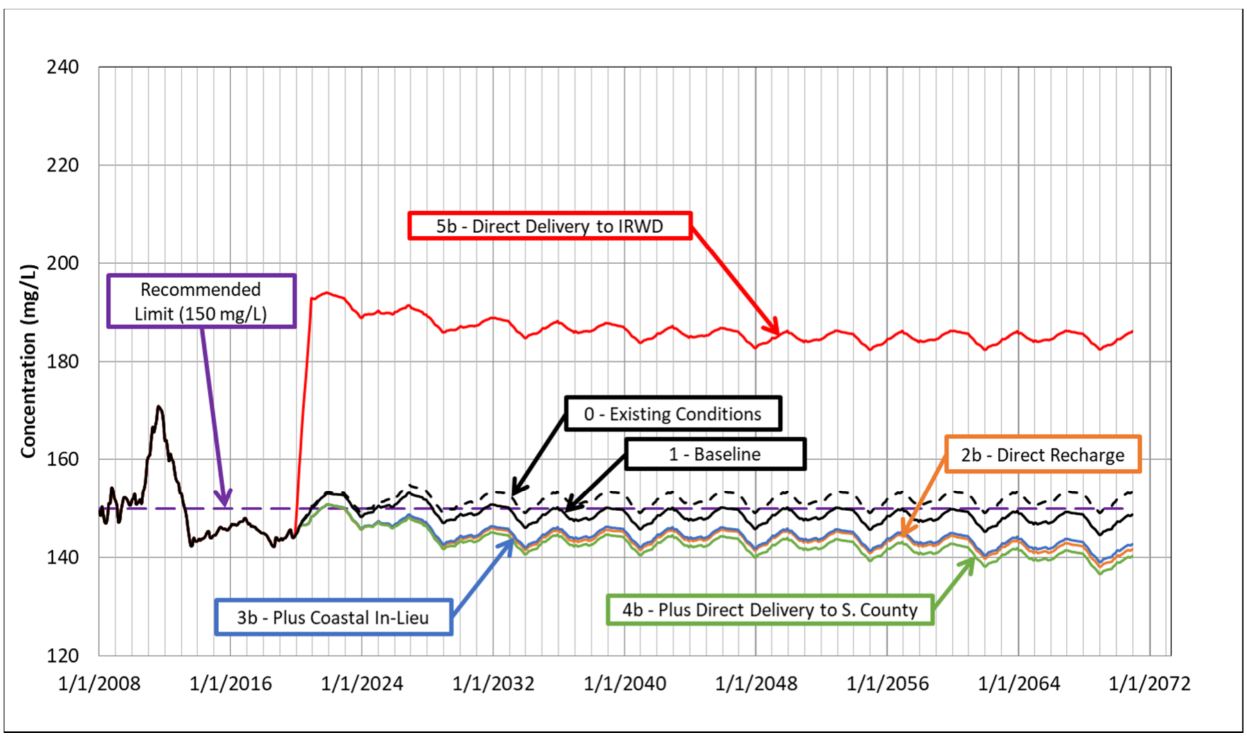


Figure 3-5. MWRP Effluent RAA Boron for Water Quality Group “a” – Baseline A

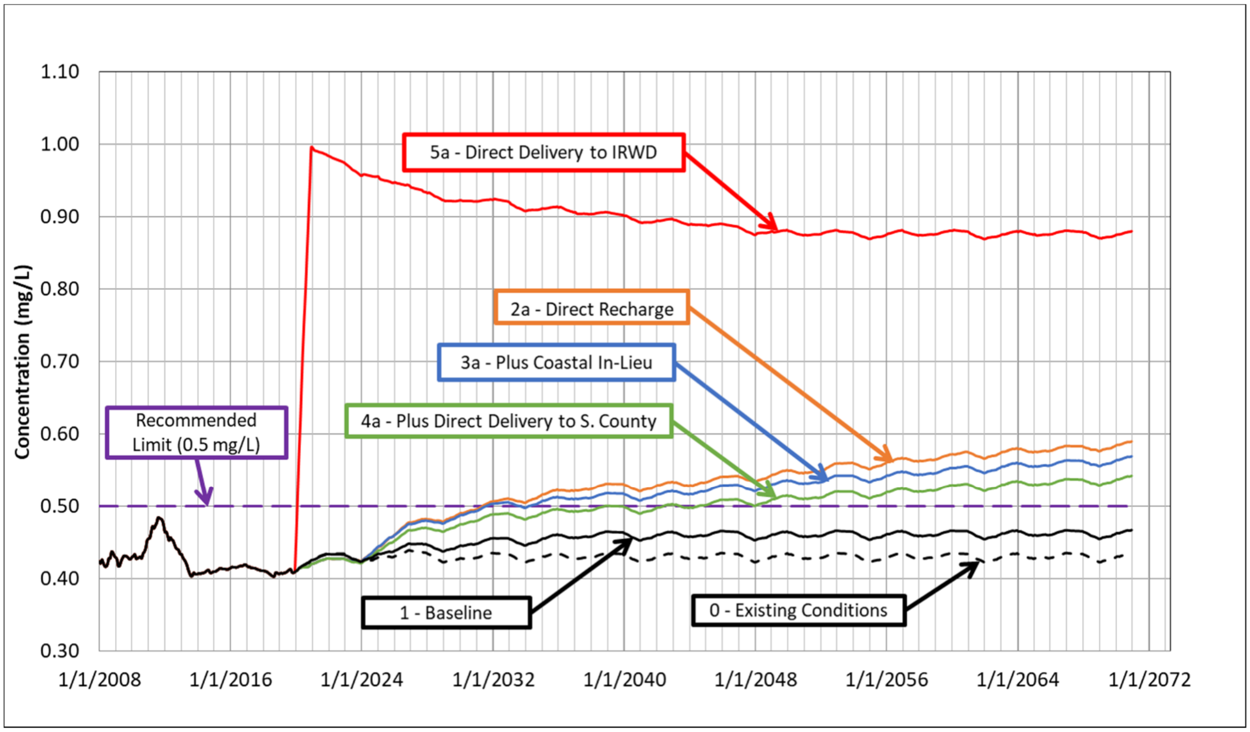


Figure 3-6. MWRP Effluent RAA Boron for Water Quality Group “b” – Baseline A

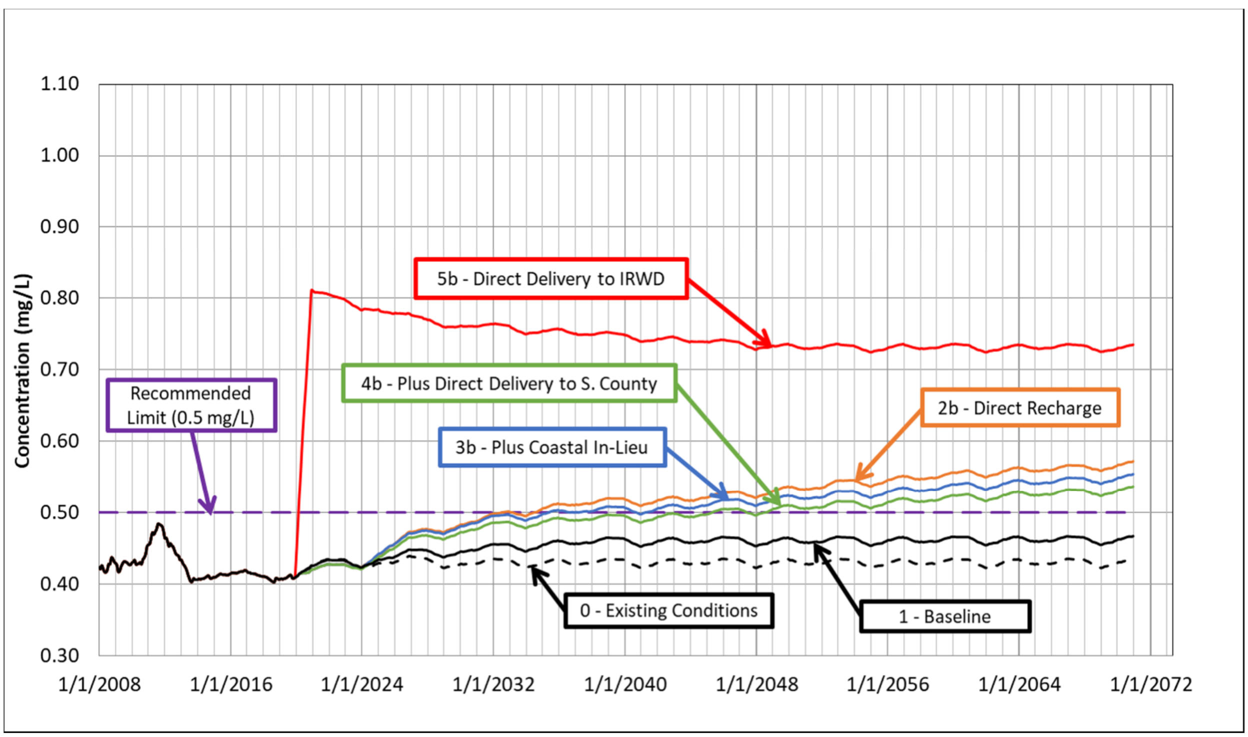


Figure 3-7. MWRP Effluent RAA TDS for Water Quality Group "a" – Baseline B

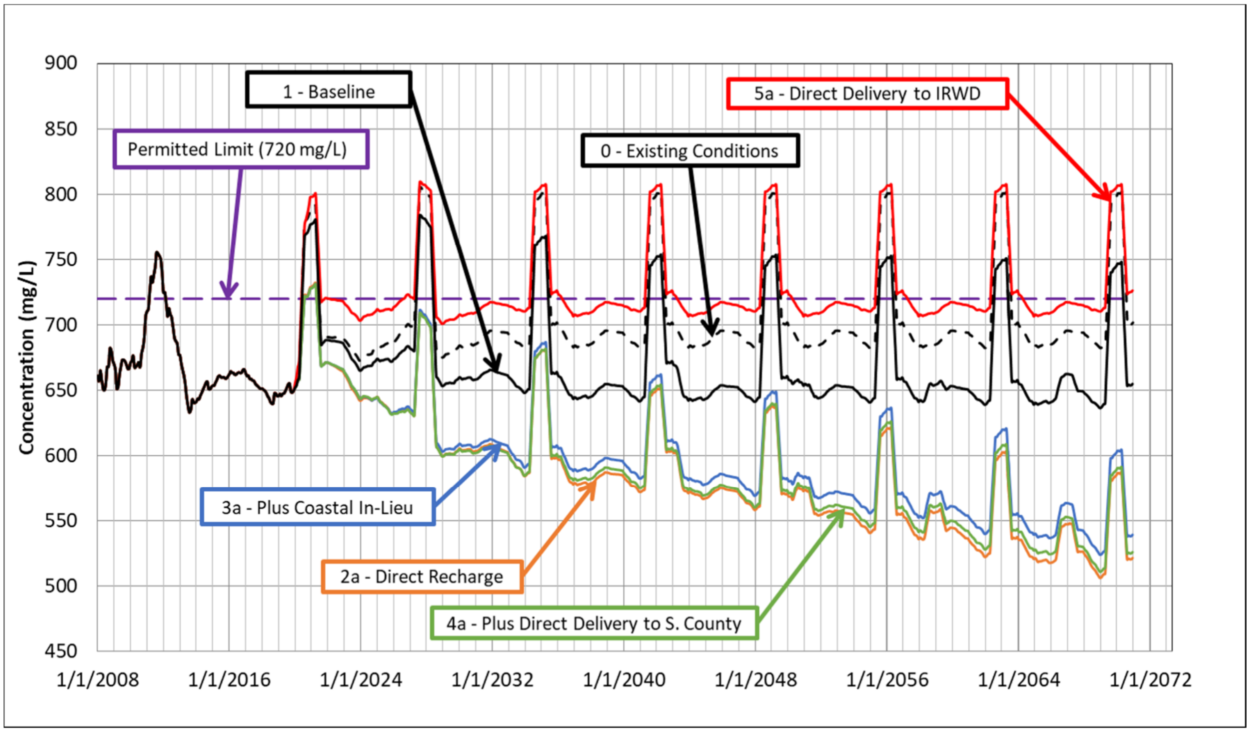


Figure 3-8. MWRP Effluent RAA TDS for Water Quality Group "b" – Baseline B

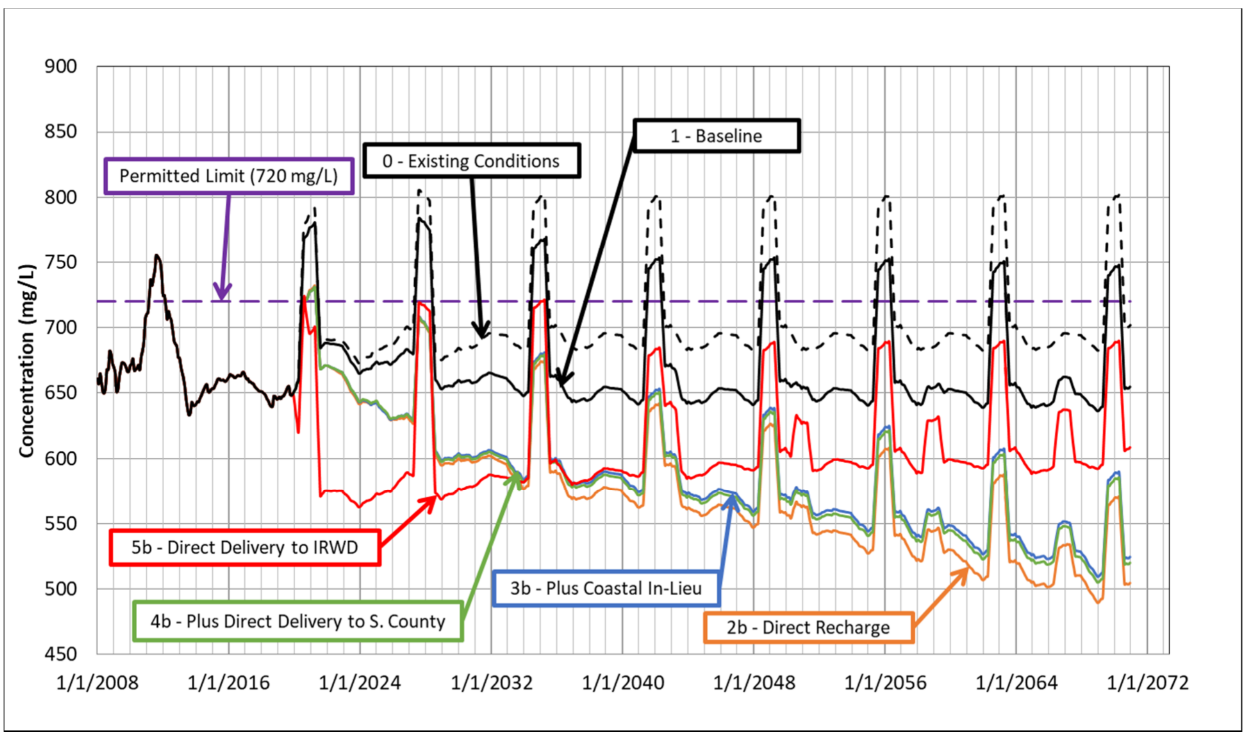


Figure 3-9. MWRP Effluent RAA Chloride for Water Quality Group “a” – Baseline B

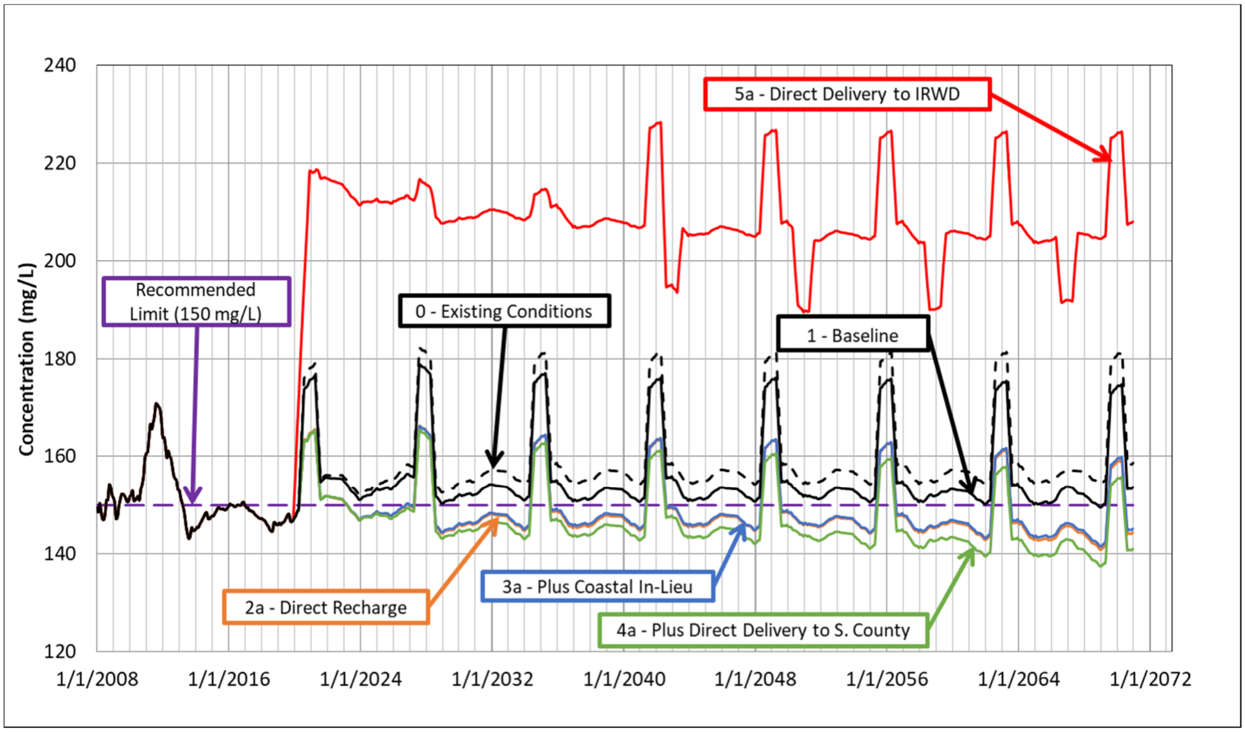


Figure 3-10. MWRP Effluent RAA Chloride for Water Quality Group “b” – Baseline B

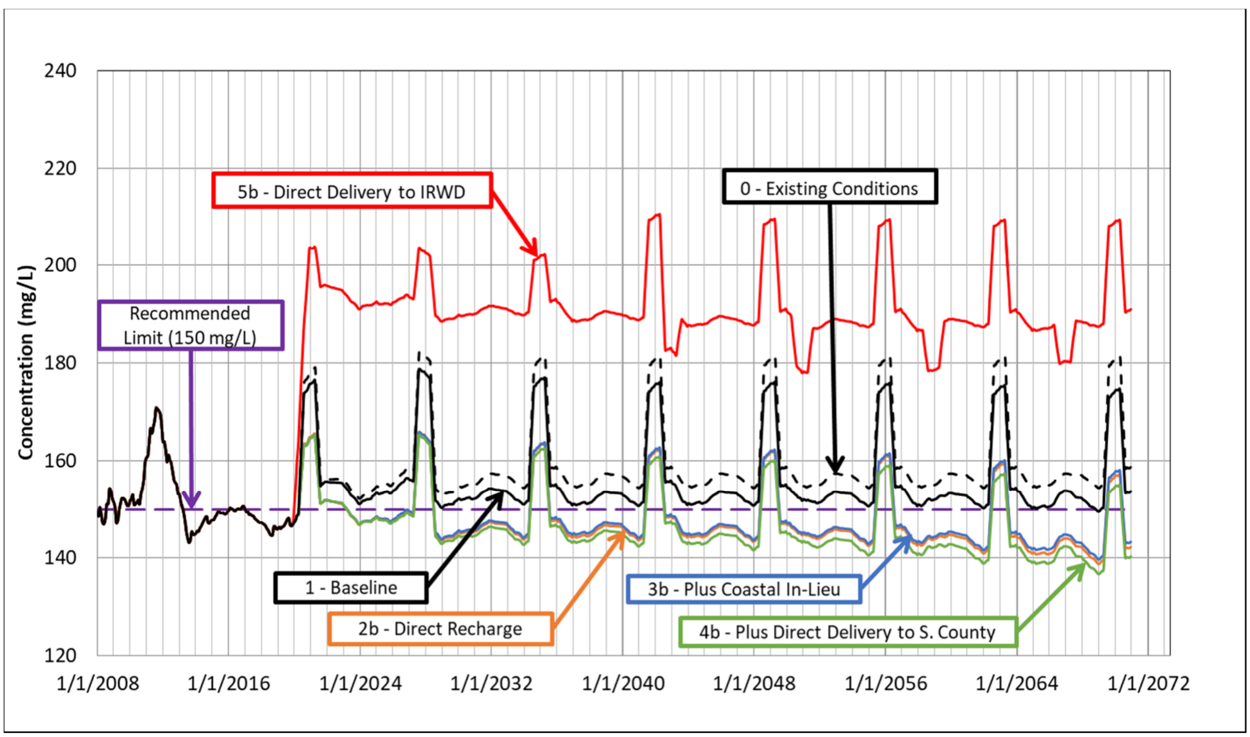


Figure 3-11. MWRP Effluent RAA Boron for Water Quality Group "a" – Baseline B

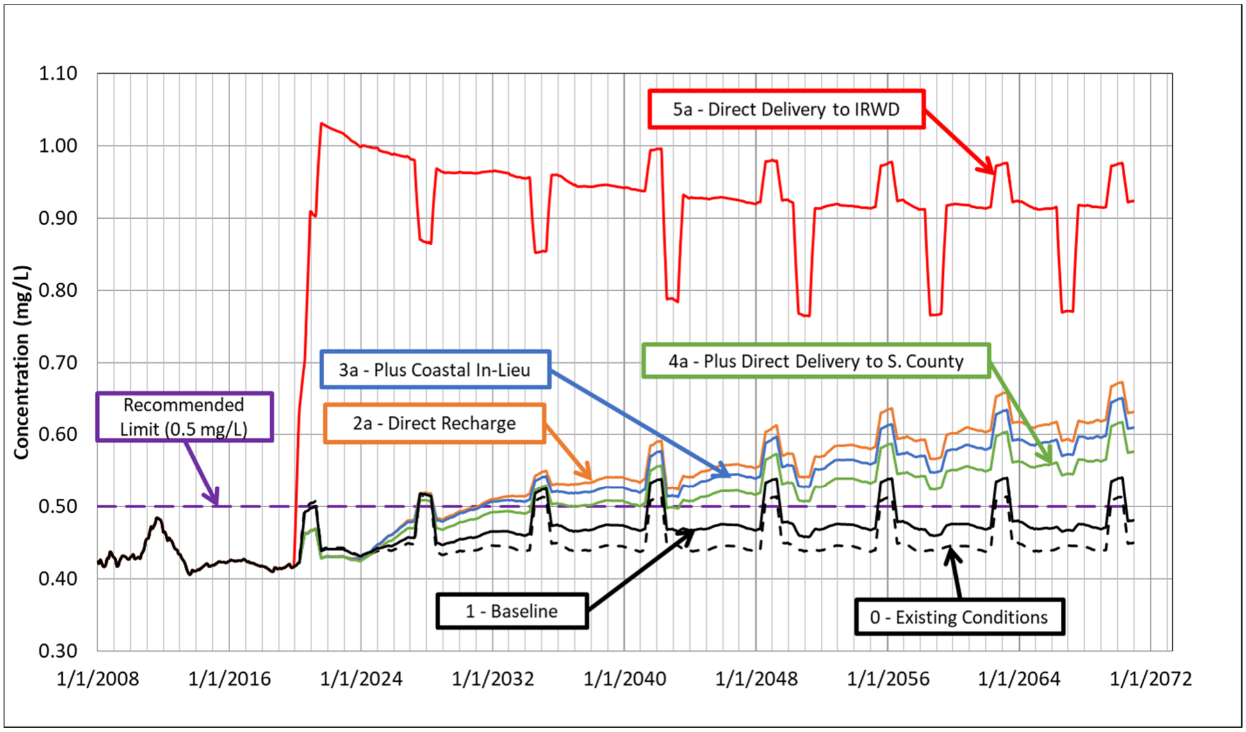
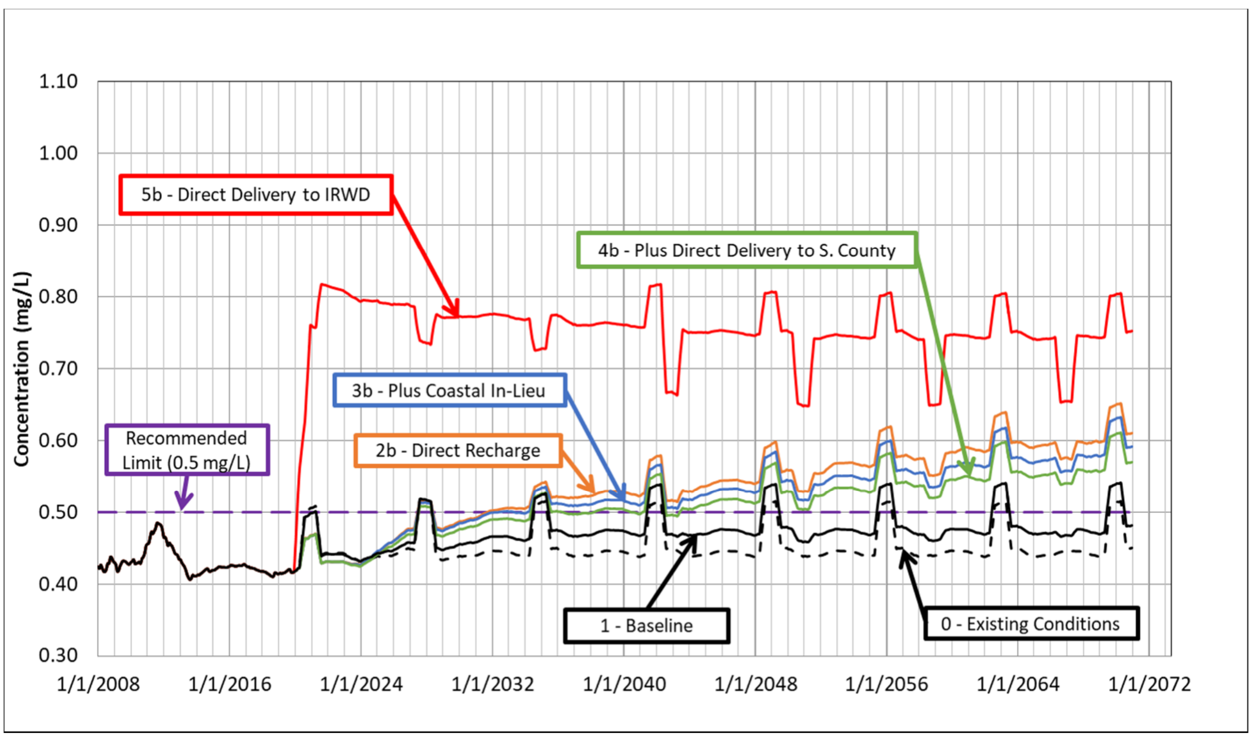


Figure 3-12. MWRP Effluent RAA Boron for Water Quality Group "b" – Baseline B



3.2.1 Model Result Observations

The following observations are in reference to Baseline A for simplicity. Results for all scenarios can be observed through the graphical and tabulated results shown above. All general observations depicted below are in reference to Scenario 1, with exception to Scenario 0 and 1, which is compared to Scenario 0.

Scenario 0 – Existing Condition

The Enhanced Salt Model uses the TH&C (2019) provided DRWF concentrations as model input data from 2020 through 2070. Scenario 0 results in average year 2070 concentrations of 675 mg/L TDS, 153 mg/L chloride, and 0.433 mg/L boron at MWRP effluent once long-term stabilization has occurred. Concentration buffers are maintained at 45 mg/L, -2.7 mg/L, and 0.067 mg/L below the respective limits for TDS, chloride, and boron constituents.

Scenario 1 – Baseline (GWRS Final Expansion Recharge)

Scenario 1 was developed by TH&C and evaluated in this report as a basis for comparison. The following observations are made in comparison to Scenario 0:

- TDS: The TDS concentration decreases by 45 mg/L, which increases the average TDS concentration buffer to 90 mg/L below the 720 mg/L limit.
- Chloride: The chloride concentration decreases by 4.6 mg/L, which increases the average chloride concentration buffer to 2.0 mg/L below the 150 mg/L limit.
- Boron: The boron concentration increases by 0.032 mg/L, which decreases the average boron concentration buffer to 0.035 mg/L below the 0.5 mg/L limit.

Scenario 2a – Direct Recharge (GWRS Final Expansion and Poseidon)

The following observations are made in comparison to Scenario 1:

- TDS: The TDS concentration decreases by 95 mg/L, which increases the average TDS concentration buffer to 185 mg/L below the 720 mg/L limit.
- Chloride: The chloride concentration decreases by 5.3 mg/L, which increases the average chloride concentration buffer to 7.2 mg/L below the 150 mg/L limit.
- Boron: The boron concentration increases by 0.122 mg/L, which exceeds the average boron concentration buffer by 0.088 mg/L above the 0.5 mg/L limit.

Scenario 2b – Direct Recharge (GWRS Final Expansion and Poseidon)

The following observations are made in comparison to Scenario 1:

- TDS: The TDS concentration decreases by 109 mg/L, which increases the average TDS concentration buffer to 199 mg/L below the 720 mg/L limit.

- Chloride: The chloride concentration decreases by 7.0 mg/L, which increases the average chloride concentration buffer to 9.0 mg/L below the 150 mg/L limit.
- Boron: The boron concentration increases by 0.104 mg/L, which exceeds the average boron concentration buffer by 0.070 mg/L above the 0.5 mg/L limit.

Scenario 3a – Plus Coastal In-Lieu (Recharge GWRS Final Expansion and Poseidon plus Coastal In-Lieu)

The following observations are made in comparison to Scenario 1:

- TDS: The TDS concentration decreases by 78 mg/L, which increases the average TDS concentration buffer to 168 mg/L below the 720 mg/L limit.
- Chloride: The chloride concentration decreases by 4.5 mg/L, which increases the average chloride concentration buffer to 6.4 mg/L below the 150 mg/L limit.
- Boron: The boron concentration increases by 0.102 mg/L, which exceeds the average boron concentration buffer by 0.067 mg/L above the 0.5 mg/L limit.

Scenario 3b – Plus Coastal In-Lieu (Recharge GWRS Final Expansion and Poseidon plus Coastal In-Lieu)

The following observations are made in comparison to Scenario 1:

- TDS: The TDS concentration decreases by 90 mg/L, which increases the average TDS concentration buffer to 180 mg/L below the 720 mg/L limit.
- Chloride: The chloride concentration decreases by 6.0 mg/L, which increases the average chloride concentration buffer to 7.9 mg/L below the 150 mg/L limit.
- Boron: The boron concentration increases by 0.087 mg/L, which exceeds the average boron concentration buffer by 0.052 mg/L above the 0.5 mg/L limit.

Scenario 4a – Plus Direct Delivery to South County (Recharge GWRS Final Expansion and Poseidon + Coastal In-Lieu + South County Delivery)

The following observations are made in comparison to Scenario 1:

- TDS: The TDS concentration decreases by 89 mg/L, which increases the average TDS concentration buffer to 179 mg/L below the 720 mg/L limit.
- Chloride: The chloride concentration decreases by 7.8 mg/L, which increases the average chloride concentration buffer to 9.8 mg/L below the 150 mg/L limit.
- Boron: The boron concentration increases by 0.075 mg/L, which exceeds the average boron concentration buffer by 0.040 mg/L above the 0.5 mg/L limit.

Scenario 4b – Plus Direct Delivery to South County (Recharge GWRS Final Expansion and Poseidon + Coastal In-Lieu + South County Delivery)

The following observations are made in comparison to Scenario 1:

- TDS: The TDS concentration decreases by 93 mg/L, which increases the average TDS concentration buffer to 183 mg/L below the 720 mg/L limit.
- Chloride: The chloride concentration decreases by 8.4 mg/L, which increases the average chloride concentration buffer to 10.4 mg/L below the 150 mg/L limit.
- Boron: The boron concentration increases by 0.069 mg/L, which exceeds the average boron concentration buffer by 0.035 mg/L above the 0.5 mg/L limit.

Scenario 5a – Direct Delivery to IRWD (Poseidon Direct Delivery to IRWD + Recharge GWRS Final Expansion + South County Delivery)

The following observations are made in comparison to Scenario 1:

- TDS: The TDS concentration increases by 73 mg/L, which decreases the average TDS concentration buffer to 18 mg/L below the 720 mg/L limit.
- Chloride: The chloride concentration increases by 51.7 mg/L, which exceeds the average chloride concentration buffer by 49.7 mg/L above the 150 mg/L limit.
- Boron: The boron concentration increases by 0.413 mg/L, which exceeds the average boron concentration buffer by 0.378 mg/L above the 0.5 mg/L limit.

Scenario 5b – Direct Delivery to IRWD (Poseidon Direct Delivery to IRWD + Recharge GWRS Final Expansion + South County Delivery)

The following observations are made in comparison to Scenario 1:

- TDS: The TDS concentration decreases by 43 mg/L, which increases the average TDS concentration buffer to 134 mg/L below the 720 mg/L limit.
- Chloride: The chloride concentration increases by 37.2 mg/L, which exceeds the average chloride concentration buffer by 35.2 mg/L above the 150 mg/L limit.
- Boron: The boron concentration increases by 0.268 mg/L, which exceeds the average boron concentration buffer by 0.233 mg/L above the 0.5 mg/L limit.

3.2.2 Boron Sensitivity Analysis

A sensitivity analysis was performed to evaluate the impacts on MWRP effluent due to changing boron concentrations in Poseidon water. TH&C used the GFTSM to reflect a range of water quality impacts at DRWF due to changing Poseidon boron concentrations, which was used as inputs to the Enhanced Salt Model to model the associated impacts in MWRP effluent water quality. The data provided was based on two additional source water quality groups “c” and “d”, which considered the injected Poseidon water quality concentrations for boron as 0.5 mg/L and 0.25 mg/L respectively. Figure 3-13 and

Figure 3-14 display the MWRP boron sensitivity for Scenario 2 (Direct Recharge) and Scenario 5 (Direct Delivery to IRWD) for Baseline A water quality groups "a" through "d". **Appendix E** includes the remaining boron sensitivity graphs for DRWF and MWRP.

Figure 3-13. MWRP Effluent RAA Boron Sensitivity Scenario 2 – Baseline A

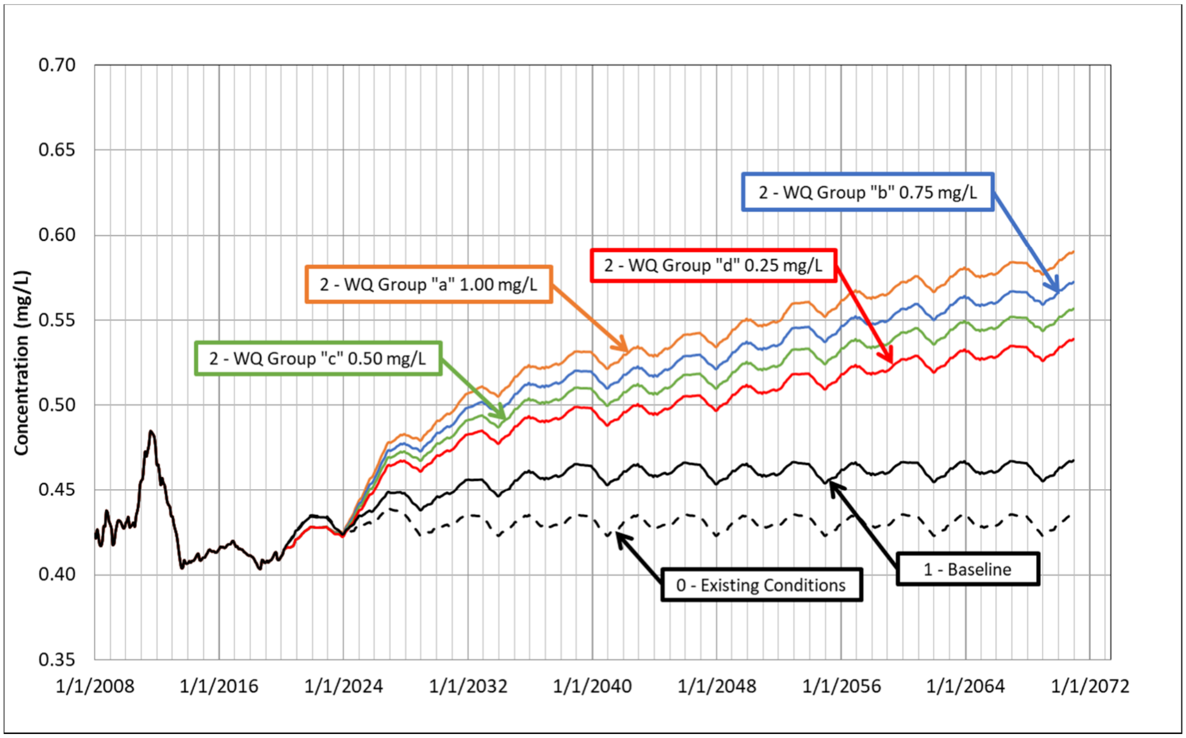
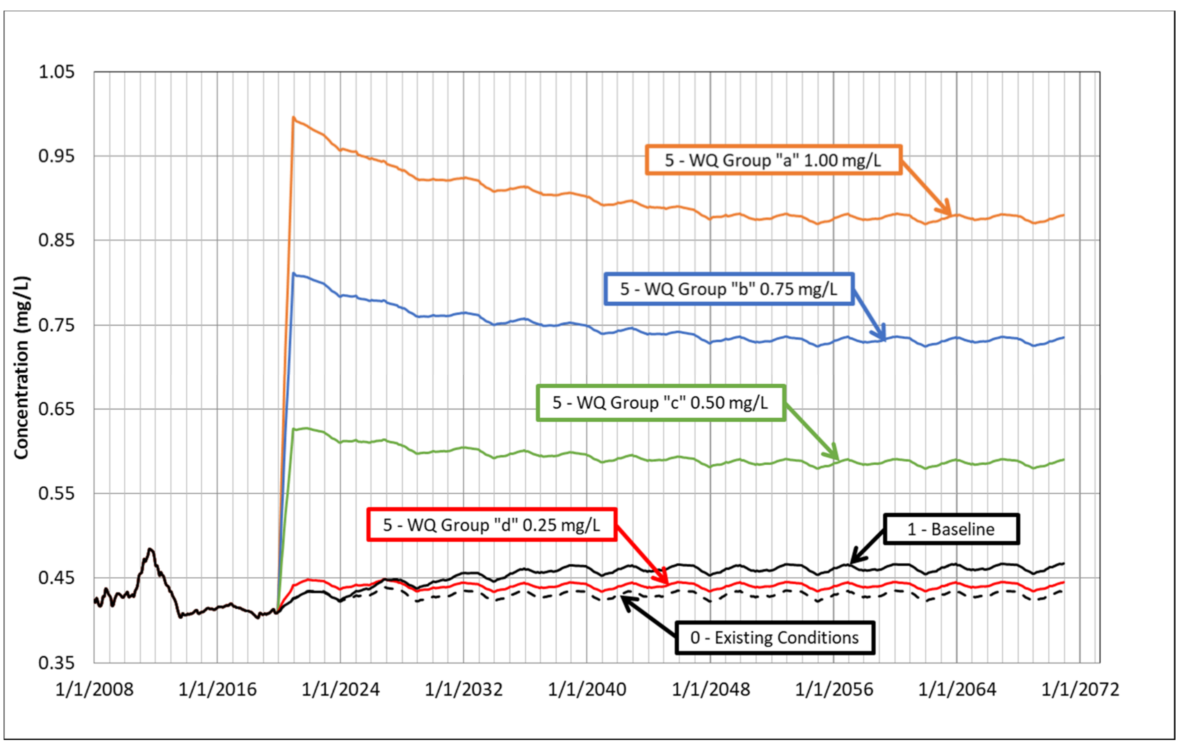


Figure 3-14. MWRP Effluent RAA Boron Sensitivity Scenario 5 – Baseline A



4 Findings and Conclusions

IRWD is responsible for managing recycled water salinity to meet their user requirements and permit conditions. This underscores the need to understand the potential effects of injecting desalinated seawater into an existing groundwater supply source. This evaluation analyzed six potential scenarios for injection of desalinated ocean water into the OCGWB, incorporated adjusted DRWF water quality concentrations based on TH&C's groundwater study (2019), and modeled the associated impact to MWRP recycled water effluent TDS, chloride, and boron. This evaluation also evaluated two potential scenarios for the direct potable use of desalinated water, which was previously evaluated in the 2015 for TDS only. Scenario 0 and 1 were developed as basis for comparisons, in which Scenario 0 represents the existing DRWF conditions and Scenario 1 represents the DRWF conditions after GWRS Final Expansion. The analysis considered the various alternatives identified above for desalinated water distribution and subsequently determined the change in MWRP effluent water quality from Scenario 1.

TH&C's groundwater study (2019) evaluated the effects of desalinated ocean water recharge (which has greater TDS, chloride, and boron concentrations than the current GWRS and ambient groundwater) and the impacts to concentrations at DRWF. Using the Enhanced Salt Model calibrated to IRWD's Salt Balance Model and incorporating the revised TH&C (2019) DRWF data, this study concluded that increases or decreases in DRWF water quality levels due to desalinated ocean water injection causes an increase or decrease in MWRP effluent TDS, chloride, and boron.

Compared to Scenario 1, the RAA concentrations in MWRP effluent generally decrease for Scenarios 2 through 4 for TDS and chloride. Compared to Scenario 1, the RAA boron concentrations in MWRP effluent generally increase for all scenarios. The tables and figures in the previous section summarize the impact of each scenario relative to Scenario 1. In general:

- Modeled TDS and chloride concentrations are larger for Poseidon water quality group "a" than Poseidon water quality group "b" alternatives; boron showed no difference.
- Modeled TDS, chloride, and boron concentrations are larger for Baseline B than Baseline A.
- All groundwater injection scenarios (Scenarios 2 through 4) did not exceed the permit and the recommended limits for TDS and chloride; all scenarios exceed the boron recommended limit identified by IRWD. RAA limits include:
    - RWQCB permitted recycled water quality limit is 720 mg/L for TDS
    - IRWD recommended recycled water quality limit is 150 mg/L for chloride
    - IRWD recommended recycled water quality limit is 0.5 mg/L for boron
- Direct potable use of desalinated water scenarios (Scenario 5) exceeds the IRWD recommended RAA water quality limits for chloride and boron.

IRWD's TDS buffer between the permitted 720 mg/L TDS limit and the measured RAA TDS is maintained under all scenarios within this analysis, with exception to Scenario 5a under Baseline B. In comparison to Scenario 1, this evaluation shows that desalinated ocean water injection increased the average TDS buffer to 199 mg/L for the best-case (Scenario 2b, Baseline A). For the worst-case (Scenario 5a, Baseline B), the average TDS buffer exceeded above the RWQCB permitted limit by 42 mg/L.

The TDS buffer is a beneficial asset, because it provides IRWD some flexibility to operate their system while meeting their RWQCB permit limit. Based on the historic ratios, the Enhanced Salt Model demonstrates that increases or decreases in TDS, chloride, and boron will result in increases or decreases to TDS, chloride, and boron in recycled water quality. This result should be considered in decision making. There appears to be no concerns with the recent scenarios for Baseline A, since the model projects the RAA TDS in MWRP effluent to be lower than the required limit. However, it is recommended that IRWD continue to use IRWD's Salt Balance Model and the Enhanced Salt Model to make informed decisions regarding system operation and policy that protect the TDS buffer.

The chloride and boron buffers were analyzed in comparison to IRWD's recommended chloride and boron limits established in their 2019 Recommended Chlorine Limit and 2019 Recommended Boron Limit technical memorandums (TM). These TM's summarized the impacts to increased concentrations for chloride and boron for MWRP recycled water and the importance to maintain established recommended limits. All scenarios increase their chloride buffer, with exception to scenario 5, and cause no concerns with regard to water quality impacts for chloride. All scenarios exceed the recommended boron limit and can create problems per IRWD's 2019 Recommended Boron Limit. These results along with the boron sensitivity analysis provided in Section 3.2.2 and **Appendix E**, should be considered in decision making.

In **Appendix F**, **Section F.1** discusses the results due to additional groundwater pumping requirements identified by TH&C. This additional pumping is required to maintain the groundwater basin level and is a direct result of additional Poseidon water injection. **Figure F-2** and **Figure F-4** represent the resulting groundwater pumping that exceeds the cap imposed on additional DRWF pumping set to be equal to or below the per-established (existing condition) imported use. The increase in groundwater pumping requirements have major impacts on not only IRWD, but also other agencies. It is recommended that IRWD account for this factor when considering various groundwater injection options.

5 References

California Department of Food and Agriculture

2016 Retrieved from: https://apps1.cdfa.ca.gov/FertilizerResearch/docs/Avocado.html

HDR

2017 IRWD Analysis of Potential Effects of Proposed Seawater Desalination Project on Recycled Water Quality

HDR

2015 IRWD Recycled Water Salt Management Plan

IRWD

2019 Potential Impact of Ocean Desalination – Recommended Chlorine Limit

IRWD

2019 Potential Impact of Ocean Desalination – Recommended Boron Limit

Thomas Harder & Co.

2019 Potential Effects of the Proposed Seawater Desalinated Project (Based on data received on December 4, 2019)

Thomas Harder & Co.

2016 Potential Effects of the Proposed Seawater Desalinated Project

Trussell Technologies, Inc.

2016 Review of Proposed Water Quality Requirements for the Huntington Beach Desalter

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Appendix A. Water Reliability Agreement Term Sheet, May 2015

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Water Reliability Agreement Term Sheet
Attachment A

Quality Parameter	**Analytical Method**[1]	**Sampling**		**Units**	**Mean**[3]	**Maximum**[4]
		Sampling Period[2]	**Sample Frequency**			
Total Dissolved Solids	2540C	One year	Weekly Grab	mg/L	350	500
Chloride	4110B	One year	Weekly Grab	mg/L	75	100
Boron	3120B	One year	Weekly Grab	mg/L	0.75	1.0
Turbidity	2130B	Daily	Continuous[5]	NTU	0.5	1.0
DBP – THM[6]	5710C	One Year	Weekly Grab	µg/L	80% of maximum contaminant level ("MCL")	90% of MCL
DBP – HAA[6]	5710D	One Year	Weekly Grab	µg/L	80% of MCL	90% of MCL
DBP – NDMA[6]	521	One Year	Weekly Grab	µg/L	80% of NL~~MCL~~	Notification Level (0.010 µg/L)
Temperature	2550	One Year	Daily Grab	°F	74	85
pH	4500	Daily	Continuous[5]	pH units	7.0-8.0	>6.5,<8.5
Sodium	200.7	One Year	Weekly Grab	mg/L	60	80
Calcium	200.7	One Year	Weekly Grab	mg/L	20	<20
Magnesium	200.7	One Year	Weekly Grab	mg/L	TBD	TBD
Sodium Adsorption Ratio	Footnote (7) below	One Year	Monthly	none	5	6

1. All methods taken from Standard Methods On-Line, published by APHA, AWWA, and WEF or current EPA methods.

2. Sample period - concentration limits are calculated for this period.

3. Mean – not to exceed (or go below for certain of the Quality Parameter) the average over the Sampling Period.

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Appendix B. Basin Pumping Percentage and Flow Summary

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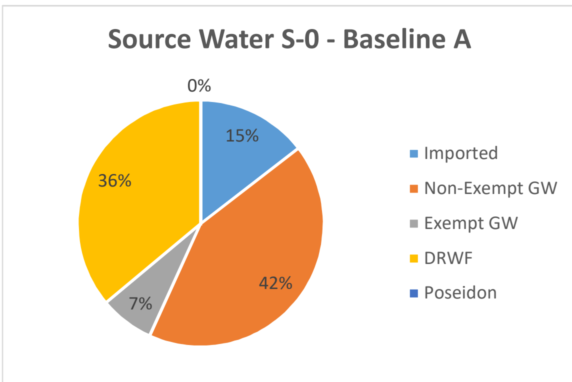
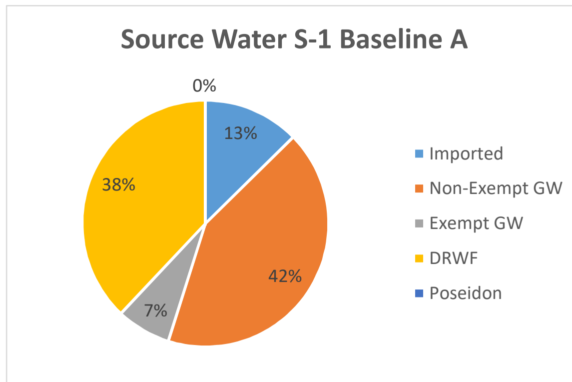
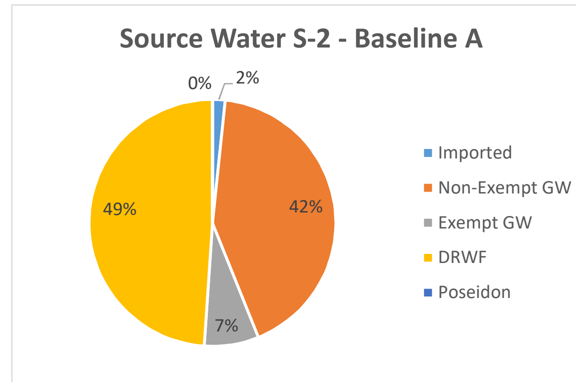
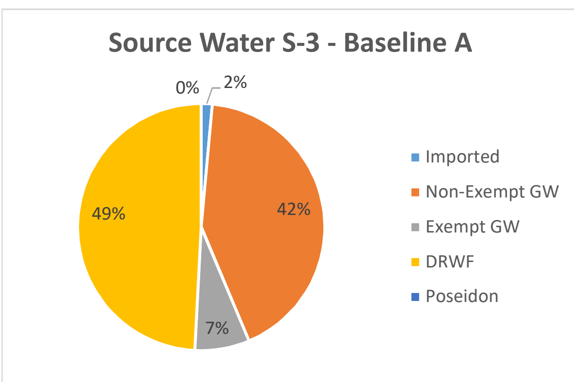
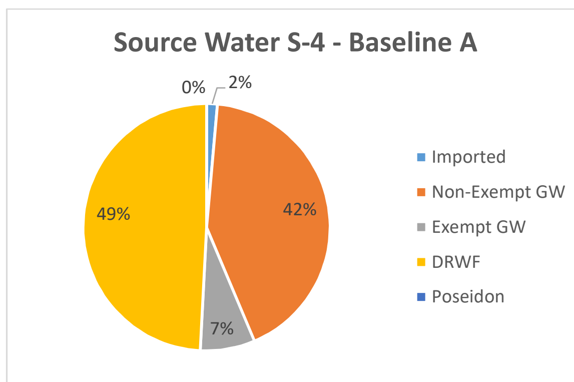
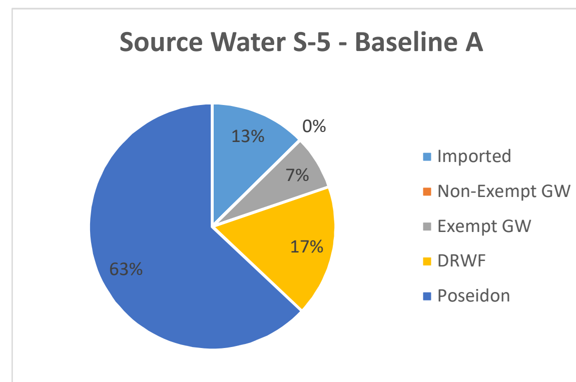

Source Water S-0 - Baseline A
0%
15%
36%
42%
7%
Imported
Non-Exempt GW
Exempt GW
DRWF
Poseidon

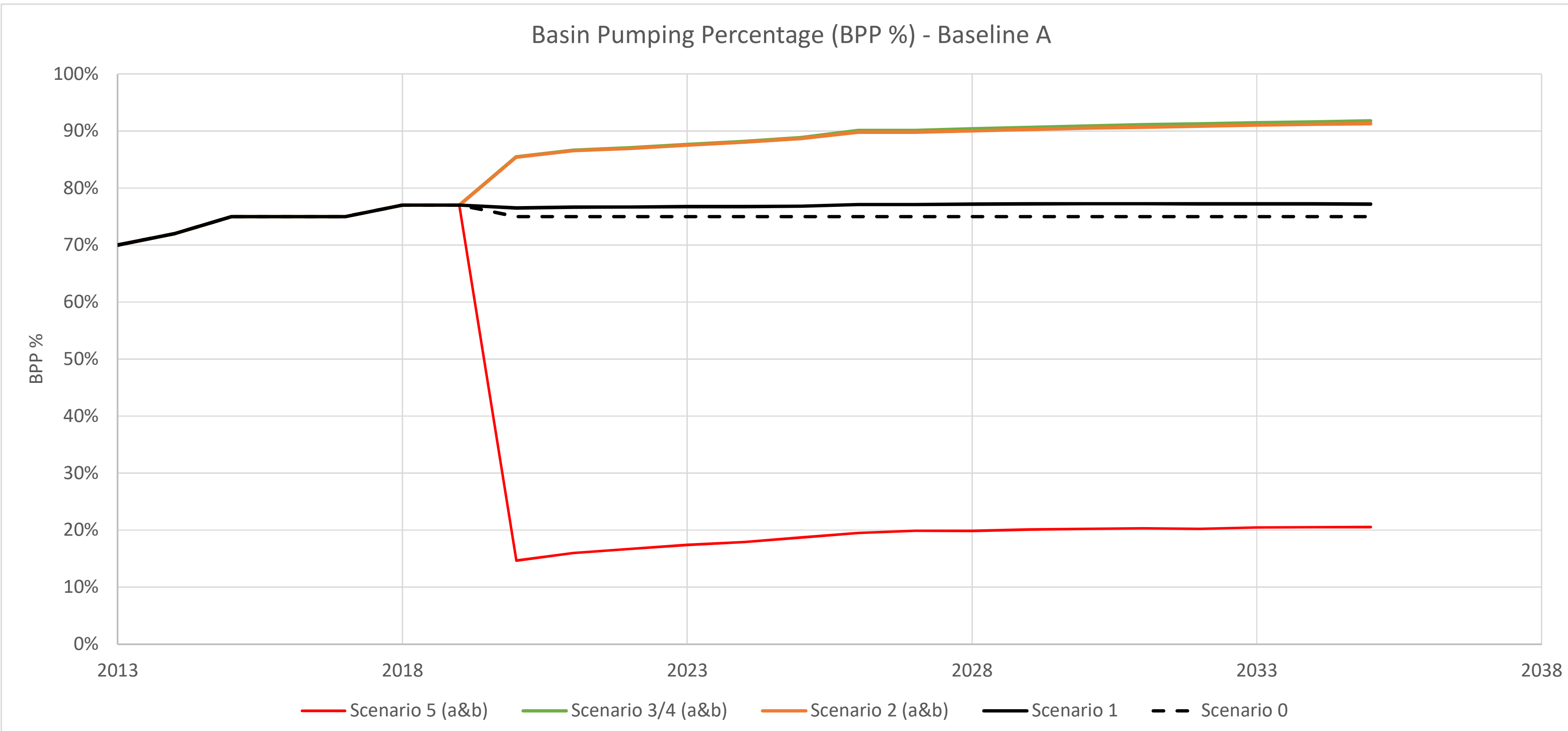

Source Water S-1 Baseline A
0%
13%
38%
42%
7%
Imported
Non-Exempt GW
Exempt GW
DRWF
Poseidon


Source Water S-2 - Baseline A
0%
2%
49%
42%
7%
Imported
Non-Exempt GW
Exempt GW
DRWF
Poseidon

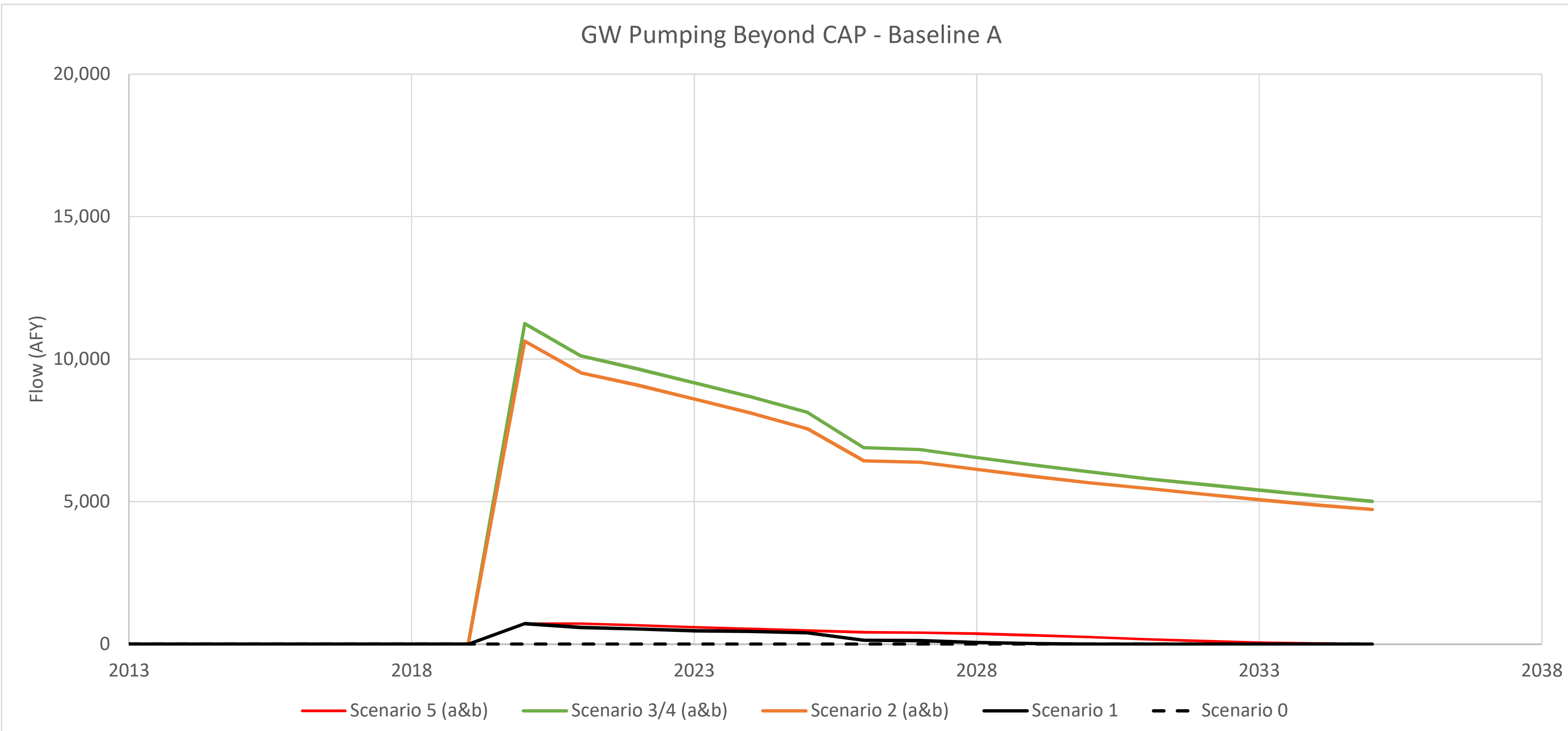

Source Water S-3 - Baseline A
0%
2%
49%
42%
7%
Imported
Non-Exempt GW
Exempt GW
DRWF
Poseidon


Source Water S-4 - Baseline A
0%
2%
49%
42%
7%
Imported
Non-Exempt GW
Exempt GW
DRWF
Poseidon


Source Water S-5 - Baseline A
13%
0%
7%
17%
63%
Imported
Non-Exempt GW
Exempt GW
DRWF
Poseidon



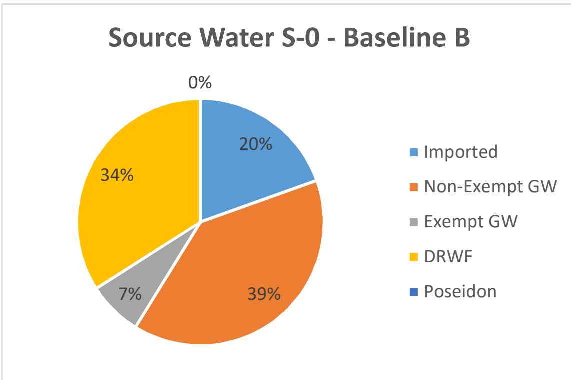
Basin Pumping Percentage (BPP %) - Baseline A
BPP %
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2013
2018
2023
2028
2033
2038
Scenario 5 (a&b)
Scenario 3/4 (a&b)
Scenario 2 (a&b)
Scenario 1
Scenario 0

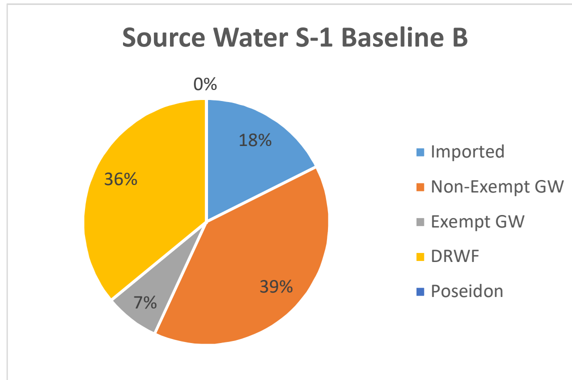

GW Pumping Beyond CAP - Baseline A
Flow (AFY)
20,000
15,000
10,000
5,000
0
2013
2018
2023
2028
2033
2038
Scenario 5 (a&b)
Scenario 3/4 (a&b)
Scenario 2 (a&b)
Scenario 1
Scenario 0

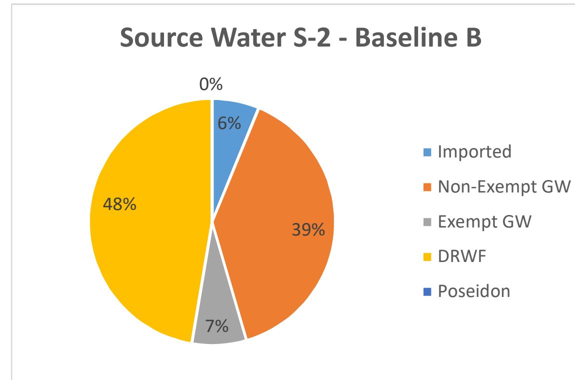
Year	Total Demand	Baseline A GW Exempt	GW Non-Exempt	Additional Flow Identified by TH&C 0	1	2a	2b	3a	3b	4a	4b	5a	5b
2013	61465.43	5,530.29	15,398.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2014	63535.54	5,530.29	16,438.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2015	64181.62	5,530.29	16,648.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2016	65390.34	5,355.59	24,802.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2017	66692.62	5,398.94	27,714.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2018	68042.29	5,475.74	28,111.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2019	69377.52	5,530.29	28,811.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2020	70712.76	5,530.29	29,851.55	0.00	1,772.00	17,859.00	17,859.00	18,535.00	18,535.00	18,535.00	18,535.00	1,772.00	1,772.00
2021	72996.63	5,530.29	30,805.94	0.00	1,772.00	17,859.00	17,859.00	18,535.00	18,535.00	18,535.00	18,535.00	1,772.00	1,772.00
2022	74132.50	5,530.29	31,381.31	0.00	1,772.00	17,859.00	17,859.00	18,535.00	18,535.00	18,535.00	18,535.00	1,772.00	1,772.00
2023	75341.31	5,530.29	31,960.21	0.00	1,772.00	17,859.00	17,859.00	18,535.00	18,535.00	18,535.00	18,535.00	1,772.00	1,772.00
2024	76550.13	5,530.29	32,539.11	0.00	1,772.00	17,859.00	17,859.00	18,535.00	18,535.00	18,535.00	18,535.00	1,772.00	1,772.00
2025	77758.94	5,530.29	33,066.32	0.00	1,772.00	17,859.00	17,859.00	18,535.00	18,535.00	18,535.00	18,535.00	1,772.00	1,772.00
2026	79798.49	5,530.29	33,525.42	0.00	1,772.00	17,859.00	17,859.00	18,535.00	18,535.00	18,535.00	18,535.00	1,772.00	1,772.00
2027	80247.64	5,530.29	33,912.56	0.00	1,772.00	17,859.00	17,859.00	18,535.00	18,535.00	18,535.00	18,535.00	1,772.00	1,772.00
2028	80696.79	5,530.29	33,912.56	0.00	1,772.00	17,859.00	17,859.00	18,535.00	18,535.00	18,535.00	18,535.00	1,772.00	1,772.00
2029	81145.94	5,530.29	33,912.56	0.00	1,772.00	17,859.00	17,859.00	18,535.00	18,535.00	18,535.00	18,535.00	1,772.00	1,772.00
2030	81595.09	5,530.29	33,912.56	0.00	1,772.00	17,859.00	17,859.00	18,535.00	18,535.00	18,535.00	18,535.00	1,772.00	1,772.00
2031	82037.54	5,530.29	33,912.56	0.00	1,772.00	17,859.00	17,859.00	18,535.00	18,535.00	18,535.00	18,535.00	1,772.00	1,772.00
2032	82479.98	5,530.29	33,912.56	0.00	1,772.00	17,859.00	17,859.00	18,535.00	18,535.00	18,535.00	18,535.00	1,772.00	1,772.00
2033	82922.42	5,530.29	33,912.56	0.00	1,772.00	17,859.00	17,859.00	18,535.00	18,535.00	18,535.00	18,535.00	1,772.00	1,772.00
2034	83364.87	5,530.29	33,912.56	0.00	1,772.00	17,859.00	17,859.00	18,535.00	18,535.00	18,535.00	18,535.00	1,772.00	1,772.00
2035	83807.31	5,530.29	33,912.56	0.00	1,772.00	17,859.00	17,859.00	18,535.00	18,535.00	18,535.00	18,535.00	1,772.00	1,772.00
Total	1,724,273.72	126,836.09	686,267.18	0.00	28,352.00	285,744.00	285,744.00	296,560.00	296,560.00	296,560.00	296,560.00	28,352.00	28,352.00

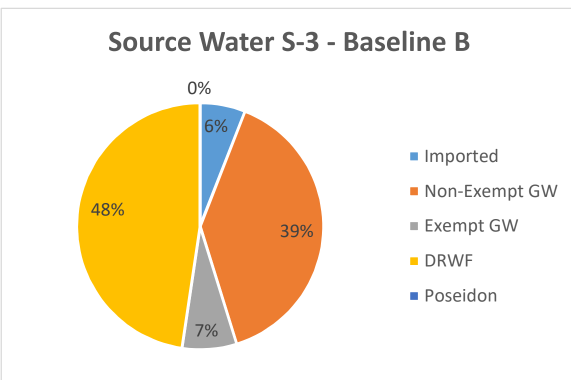
Year	Total Demand	Flow Above Cap Baseline A 0	1	2a	2b	3a	3b	4a	4b	5a	5b
2013	61465.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2014	63535.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2015	64181.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2016	65390.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2017	66692.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2018	68042.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2019	69377.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2020	70712.76	0.00	721.20	10,632.03	10,632.03	11,251.15	11,251.15	11,251.15	11,251.15	721.20	721.20
2021	72996.63	0.00	588.21	9,519.50	9,519.50	10,108.12	10,108.12	10,108.12	10,108.12	721.20	721.20
2022	74132.50	0.00	535.72	9,086.26	9,086.26	9,657.45	9,657.45	9,657.45	9,657.45	664.56	664.56
2023	75341.31	0.00	471.40	8,597.07	8,597.07	9,168.25	9,168.25	9,168.25	9,168.25	597.67	597.67
2024	76550.13	0.00	451.74	8,107.87	8,107.87	8,679.06	8,679.06	8,679.06	8,679.06	538.55	538.55
2025	77758.94	0.00	400.04	7,566.99	7,566.99	8,138.18	8,138.18	8,138.18	8,138.18	474.23	474.23
2026	79798.49	0.00	137.18	6,434.34	6,434.34	6,894.69	6,894.69	6,894.69	6,894.69	422.11	422.11
2027	80247.64	0.00	122.88	6,382.57	6,382.57	6,832.55	6,832.55	6,832.55	6,832.55	402.56	402.56
2028	80696.79	0.00	60.00	6,135.85	6,135.85	6,549.29	6,549.29	6,549.29	6,549.29	372.07	372.07
2029	81145.94	0.00	24.87	5,889.13	5,889.13	6,291.85	6,291.85	6,291.85	6,291.85	313.83	313.83
2030	81595.09	0.00	0.00	5,666.53	5,666.53	6,045.13	6,045.13	6,045.13	6,045.13	245.33	245.33
2031	82037.54	0.00	0.00	5,467.61	5,467.61	5,805.95	5,805.95	5,805.95	5,805.95	175.01	175.01
2032	82479.98	0.00	0.00	5,268.68	5,268.68	5,607.03	5,607.03	5,607.03	5,607.03	113.07	113.07
2033	82922.42	0.00	0.00	5,069.76	5,069.76	5,408.11	5,408.11	5,408.11	5,408.11	51.13	51.13
2034	83364.87	0.00	0.00	4,888.30	4,888.30	5,209.18	5,209.18	5,209.18	5,209.18	21.65	21.65
2035	83807.31	0.00	0.00	4,733.03	4,733.03	5,010.26	5,010.26	5,010.26	5,010.26	0.00	0.00
Total	1,724,273.72	0.00	3,513.23	109,445.53	109,445.53	116,656.26	116,656.26	116,656.26	116,656.26	5,834.17	5,834.17

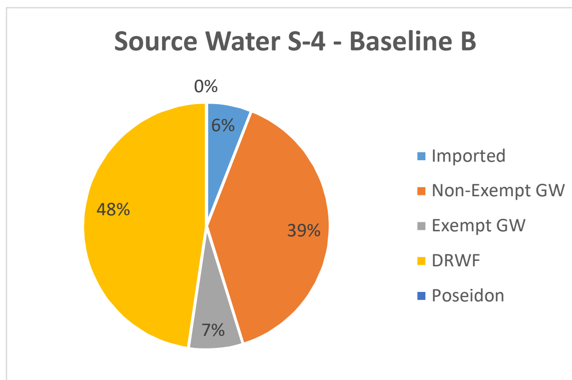
Year	Allowable GW Pumping Existing Condition BPP Baseline A	Basin Pumping Percentage Baseline A 0	1	2a	2b	3a	3b	4a	4b	5a	5b
2013	32,091	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%
2014	38,064	72%	72%	72%	72%	72%	72%	72%	72%	72%	72%
2015	40,071	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
2016	46,672	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
2017	47,974	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
2018	49,323	77%	77%	77%	77%	77%	77%	77%	77%	77%	77%
2019	50,659	77%	77%	77%	77%	77%	77%	77%	77%	77%	77%
2020	51,994	75%	77%	85%	85%	86%	86%	86%	86%	15%	15%
2021	54,278	75%	77%	87%	87%	87%	87%	87%	87%	16%	16%
2022	55,153	75%	77%	87%	87%	87%	87%	87%	87%	17%	17%
2023	55,579	75%	77%	87%	87%	88%	88%	88%	88%	17%	17%
2024	56,006	75%	77%	88%	88%	88%	88%	88%	88%	18%	18%
2025	56,433	75%	77%	89%	89%	89%	89%	89%	89%	19%	19%
2026	57,907	75%	77%	90%	90%	90%	90%	90%	90%	20%	20%
2027	58,188	75%	77%	90%	90%	90%	90%	90%	90%	20%	20%
2028	58,469	75%	77%	90%	90%	90%	90%	90%	90%	20%	20%
2029	58,751	75%	77%	90%	90%	91%	91%	91%	91%	20%	20%
2030	59,032	75%	77%	90%	90%	91%	91%	91%	91%	20%	20%
2031	59,308	75%	77%	91%	91%	91%	91%	91%	91%	20%	20%
2032	59,583	75%	77%	91%	91%	91%	91%	91%	91%	20%	20%
2033	59,859	75%	77%	91%	91%	91%	91%	91%	91%	20%	20%
2034	60,135	75%	77%	91%	91%	92%	92%	92%	92%	21%	21%
2035	60,411	75%	77%	91%	91%	92%	92%	92%	92%	21%	21%

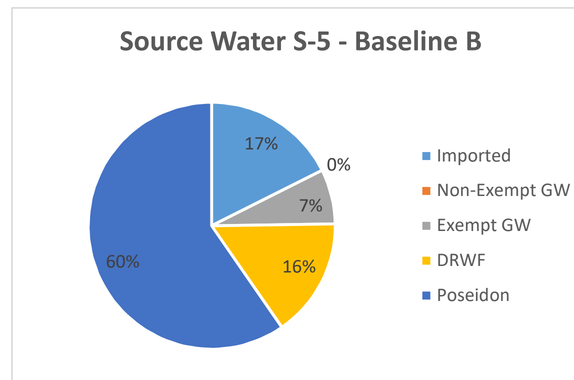

Source Water S-0 - Baseline B
0%
20%
34%
7%
39%
Imported
Non-Exempt GW
Exempt GW
DRWF
Poseidon

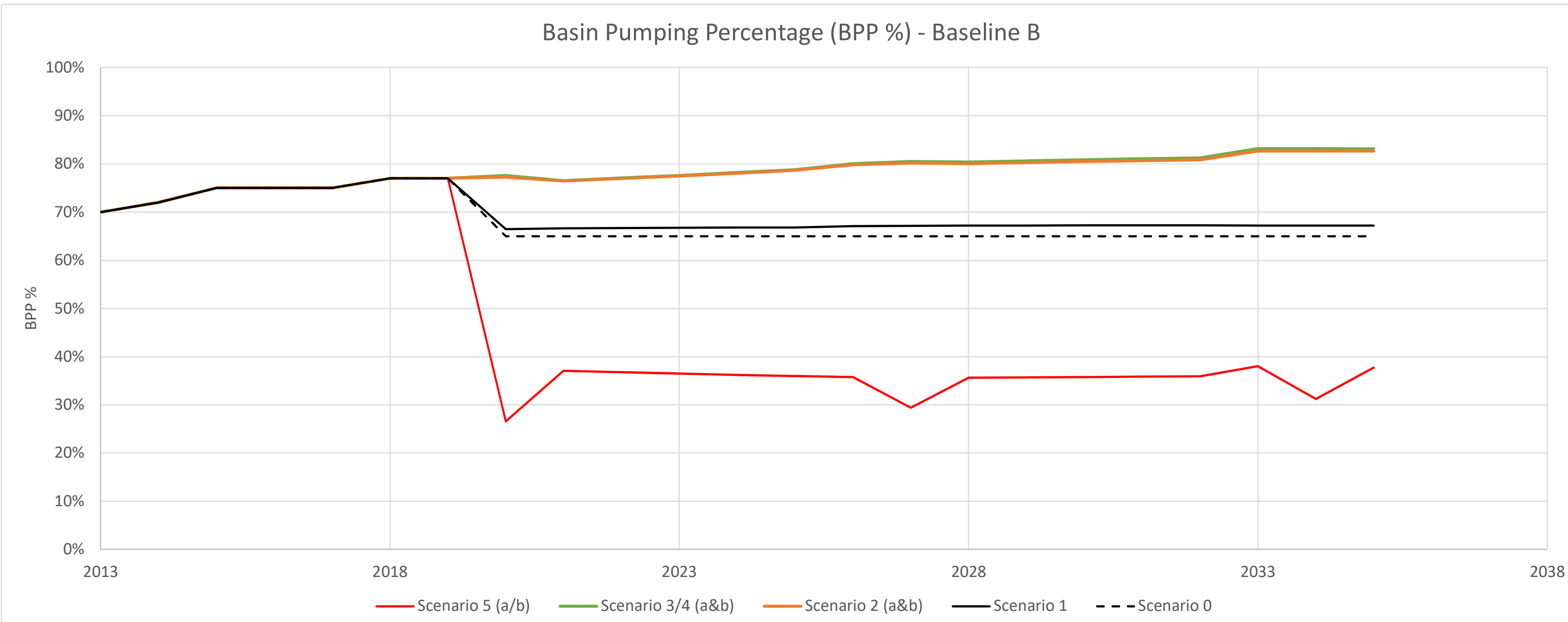

Source Water S-1 Baseline B
0%
18%
36%
7%
39%
Imported
Non-Exempt GW
Exempt GW
DRWF
Poseidon


Source Water S-2 - Baseline B
0%
6%
48%
39%
7%
Imported
Non-Exempt GW
Exempt GW
DRWF
Poseidon

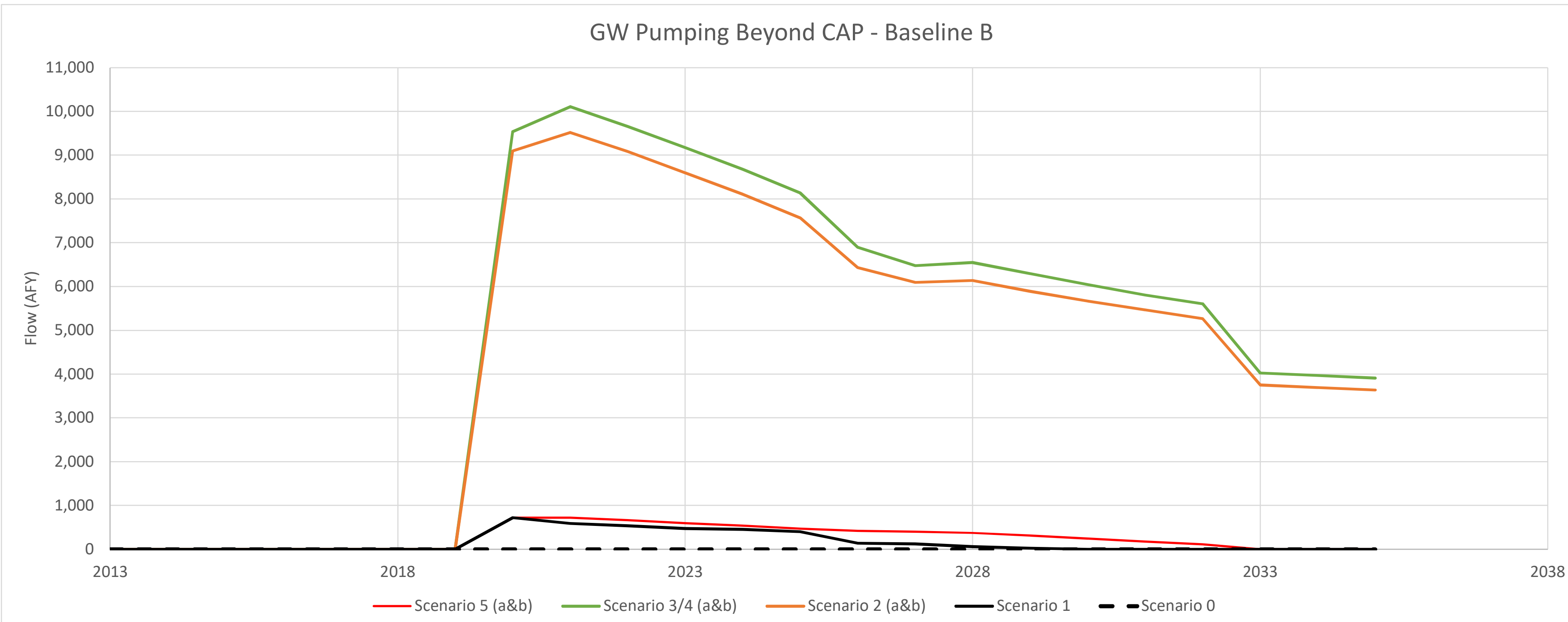

Source Water S-3 - Baseline B
0%
6%
48%
39%
7%
Imported
Non-Exempt GW
Exempt GW
DRWF
Poseidon


Source Water S-4 - Baseline B
0%
6%
48%
39%
7%
Imported
Non-Exempt GW
Exempt GW
DRWF
Poseidon


Source Water S-5 - Baseline B
17%
0%
7%
60%
16%
Imported
Non-Exempt GW
Exempt GW
DRWF
Poseidon



Basin Pumping Percentage (BPP %) - Baseline B
BPP %
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2013
2018
2023
2028
2033
2038
Scenario 5 (a/b)
Scenario 3/4 (a&b)
Scenario 2 (a&b)
Scenario 1
Scenario 0


GW Pumping Beyond CAP - Baseline B
Flow (AFY)
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2013
2018
2023
2028
2033
2038
Scenario 5 (a&b)
Scenario 3/4 (a&b)
Scenario 2 (a&b)
Scenario 1
Scenario 0

Year	Total Demand	Baseline B		Additional Flow Identified by TH&C									
		GW Exempt	GW Non-Exempt	0	1	2a	2b	3a	3b	4a	4b	5a	5b
2013	61465.43	5,530.29	15,398.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2014	63535.54	5,530.29	16,438.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2015	64181.62	5,530.29	16,648.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2016	65390.34	5,355.59	24,802.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2017	66692.62	5,398.94	27,714.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2018	68042.29	5,475.74	28,111.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2019	69377.52	5,530.29	28,811.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2020	70712.76	5,530.29	19,419.18	0.00	1,772.00	17,859.00	17,859.00	18,535.00	18,535.00	18,535.00	18,535.00	1,772.00	1,772.00
2021	72996.63	5,530.29	30,805.94	0.00	1,772.00	17,859.00	17,859.00	18,535.00	18,535.00	18,535.00	18,535.00	1,772.00	1,772.00
2022	74132.50	5,530.29	31,381.31	0.00	1,772.00	17,859.00	17,859.00	18,535.00	18,535.00	18,535.00	18,535.00	1,772.00	1,772.00
2023	75341.31	5,530.29	31,960.21	0.00	1,772.00	17,859.00	17,859.00	18,535.00	18,535.00	18,535.00	18,535.00	1,772.00	1,772.00
2024	76550.13	5,530.29	32,539.11	0.00	1,772.00	17,859.00	17,859.00	18,535.00	18,535.00	18,535.00	18,535.00	1,772.00	1,772.00
2025	77758.94	5,530.29	33,066.32	0.00	1,772.00	17,859.00	17,859.00	18,535.00	18,535.00	18,535.00	18,535.00	1,772.00	1,772.00
2026	79798.49	5,530.29	33,525.42	0.00	1,772.00	17,859.00	17,859.00	18,535.00	18,535.00	18,535.00	18,535.00	1,772.00	1,772.00
2027	80247.64	5,530.29	22,230.50	0.00	1,772.00	17,859.00	17,859.00	18,535.00	18,535.00	18,535.00	18,535.00	1,772.00	1,772.00
2028	80696.79	5,530.29	33,912.56	0.00	1,772.00	17,859.00	17,859.00	18,535.00	18,535.00	18,535.00	18,535.00	1,772.00	1,772.00
2029	81145.94	5,530.29	33,912.56	0.00	1,772.00	17,859.00	17,859.00	18,535.00	18,535.00	18,535.00	18,535.00	1,772.00	1,772.00
2030	81595.09	5,530.29	33,912.56	0.00	1,772.00	17,859.00	17,859.00	18,535.00	18,535.00	18,535.00	18,535.00	1,772.00	1,772.00
2031	82037.54	5,530.29	33,912.56	0.00	1,772.00	17,859.00	17,859.00	18,535.00	18,535.00	18,535.00	18,535.00	1,772.00	1,772.00
2032	82479.98	5,530.29	33,912.56	0.00	1,772.00	17,859.00	17,859.00	18,535.00	18,535.00	18,535.00	18,535.00	1,772.00	1,772.00
2033	82922.42	5,530.29	30,736.48	0.00	1,772.00	17,859.00	17,859.00	18,535.00	18,535.00	18,535.00	18,535.00	1,772.00	1,772.00
2034	83364.87	5,530.29	20,308.51	0.00	1,772.00	17,859.00	17,859.00	18,535.00	18,535.00	18,535.00	18,535.00	1,772.00	1,772.00
2035	83807.31	5,530.29	31,214.53	0.00	1,772.00	17,859.00	17,859.00	18,535.00	18,535.00	18,535.00	18,535.00	1,772.00	1,772.00
Total	1,724,273.72	126,836.09	644,674.61	0.00	28,352.00	285,744.00	285,744.00	296,560.00	296,560.00	296,560.00	296,560.00	28,352.00	28,352.00

Year	Total Demand	Flow Above Cap Baseline B									
		0	1	2a	2b	3a	3b	4a	4b	5a	5b
2013	61465.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2014	63535.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2015	64181.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2016	65390.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2017	66692.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2018	68042.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2019	69377.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2020	70712.76	0.00	721.20	9,095.87	9,095.87	9,538.24	9,538.24	9,538.24	9,538.24	721.20	721.20
2021	72996.63	0.00	588.21	9,519.50	9,519.50	10,108.12	10,108.12	10,108.12	10,108.12	721.20	721.20
2022	74132.50	0.00	535.72	9,086.26	9,086.26	9,657.45	9,657.45	9,657.45	9,657.45	664.56	664.56
2023	75341.31	0.00	471.40	8,597.07	8,597.07	9,168.25	9,168.25	9,168.25	9,168.25	597.67	597.67
2024	76550.13	0.00	451.74	8,107.87	8,107.87	8,679.06	8,679.06	8,679.06	8,679.06	538.55	538.55
2025	77758.94	0.00	400.04	7,566.99	7,566.99	8,138.18	8,138.18	8,138.18	8,138.18	474.23	474.23
2026	79798.49	0.00	137.18	6,434.34	6,434.34	6,894.69	6,894.69	6,894.69	6,894.69	422.11	422.11
2027	80247.64	0.00	122.88	6,092.46	6,092.46	6,479.21	6,479.21	6,479.21	6,479.21	402.56	402.56
2028	80696.79	0.00	60.00	6,135.85	6,135.85	6,549.29	6,549.29	6,549.29	6,549.29	372.07	372.07
2029	81145.94	0.00	24.87	5,889.13	5,889.13	6,291.85	6,291.85	6,291.85	6,291.85	313.83	313.83
2030	81595.09	0.00	0.00	5,666.53	5,666.53	6,045.13	6,045.13	6,045.13	6,045.13	245.33	245.33
2031	82037.54	0.00	0.00	5,467.61	5,467.61	5,805.95	5,805.95	5,805.95	5,805.95	175.01	175.01
2032	82479.98	0.00	0.00	5,268.68	5,268.68	5,607.03	5,607.03	5,607.03	5,607.03	113.07	113.07
2033	82922.42	0.00	0.00	3,750.91	3,750.91	4,026.04	4,026.04	4,026.04	4,026.04	0.00	0.00
2034	83364.87	0.00	0.00	3,692.92	3,692.92	3,968.05	3,968.05	3,968.05	3,968.05	0.00	0.00
2035	83807.31	0.00	0.00	3,634.94	3,634.94	3,910.07	3,910.07	3,910.07	3,910.07	0.00	0.00
Total	1,724,273.72	0.00	3,513.23	104,006.93	104,006.93	110,866.63	110,866.63	110,866.63	110,866.63	5,761.39	5,761.39

Year	Allowable GW Pumping Existing Condition BPP Baseline B	Basin Pumping Percentage Baseline B									
		0	1	2a	2b	3a	3b	4a	4b	5a	5b
2013	32,091	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%
2014	38,064	72%	72%	72%	72%	72%	72%	72%	72%	72%	72%
2015	40,071	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
2016	46,672	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
2017	47,974	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
2018	49,323	77%	77%	77%	77%	77%	77%	77%	77%	77%	77%
2019	50,659	77%	77%	77%	77%	77%	77%	77%	77%	77%	77%
2020	46,408	65%	66%	77%	77%	78%	78%	78%	78%	27%	27%
2021	47,477	65%	67%	76%	76%	77%	77%	77%	77%	37%	32%
2022	47,799	65%	67%	77%	77%	77%	77%	77%	77%	37%	32%
2023	48,169	65%	67%	77%	77%	78%	78%	78%	78%	36%	32%
2024	48,539	65%	67%	78%	78%	78%	78%	78%	78%	36%	31%
2025	48,908	65%	67%	79%	79%	79%	79%	79%	79%	36%	31%
2026	50,186	65%	67%	80%	80%	80%	80%	80%	80%	36%	31%
2027	50,430	65%	67%	80%	80%	81%	81%	81%	81%	29%	25%
2028	50,673	65%	67%	80%	80%	80%	80%	80%	80%	36%	31%
2029	50,917	65%	67%	80%	80%	81%	81%	81%	81%	36%	31%
2030	51,161	65%	67%	80%	80%	81%	81%	81%	81%	36%	31%
2031	51,400	65%	67%	81%	81%	81%	81%	81%	81%	36%	31%
2032	51,639	65%	67%	81%	81%	81%	81%	81%	81%	36%	31%
2033	51,878	65%	67%	83%	83%	83%	83%	83%	83%	38%	33%
2034	52,117	65%	67%	83%	83%	83%	83%	83%	83%	31%	27%
2035	52,356	65%	67%	83%	83%	83%	83%	83%	83%	38%	33%

Appendix C. Dyer Road Well Field Results Tables and Figures

November 18, 2019

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Dyer Road Well Field Average Groundwater Concentrations Year 2070			
Scenario	**TDS (mg/L)**	**Chloride (mg/L)**	**Boron (mg/L)**
0 - Existing Conditions	299	29.3	0.068
1 - Baseline	237	23.3	0.117
WQ Group "a" - Poseidon (350 / 100 / 1.00 mg/L)			
2a - Direct Recharge	155	21.8	0.258
3a - Plus Coastal In-Lieu	175	22.8	0.234
4a - Plus Direct Delivery to S. County	163	19.0	0.203
5a - Direct Delivery to IRWD	350	100.0	1.000
WQ Group "b" - Poseidon (150 / 75 / 0.75 mg/L)			
2b - Direct Recharge	139	19.8	0.237
3b - Plus Coastal In-Lieu	161	21.1	0.217
4b - Plus Direct Delivery to S. County	157	18.3	0.197
5b - Direct Delivery to IRWD	150	75.0	0.750

Footnotes:

1) Concentrations listed in this table represent the average for year 2070.

2) Water quality (WQ) group “a” or “b” identifies the Poseidon water quality used during modeling.

3) Tabulated results reflect the data received from TH&C 2019.

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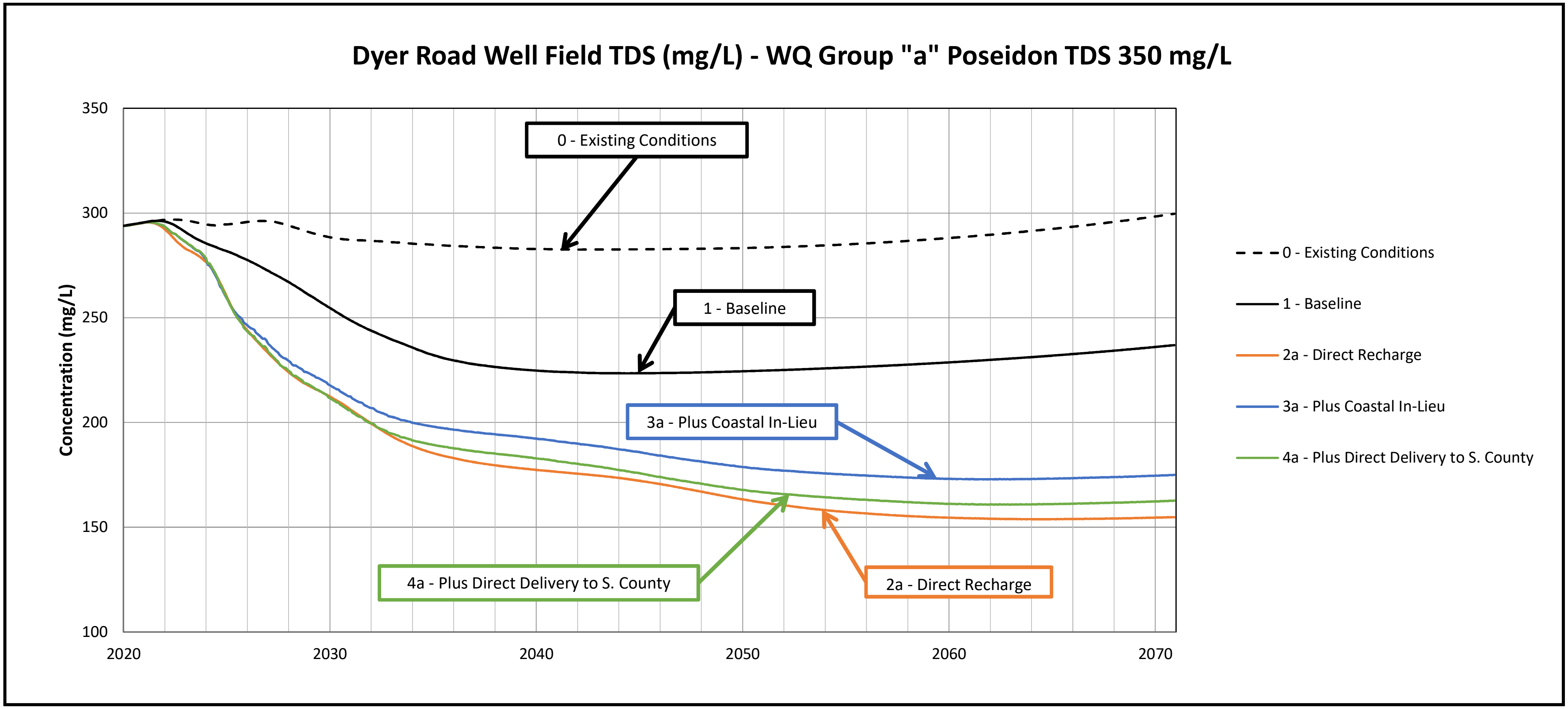
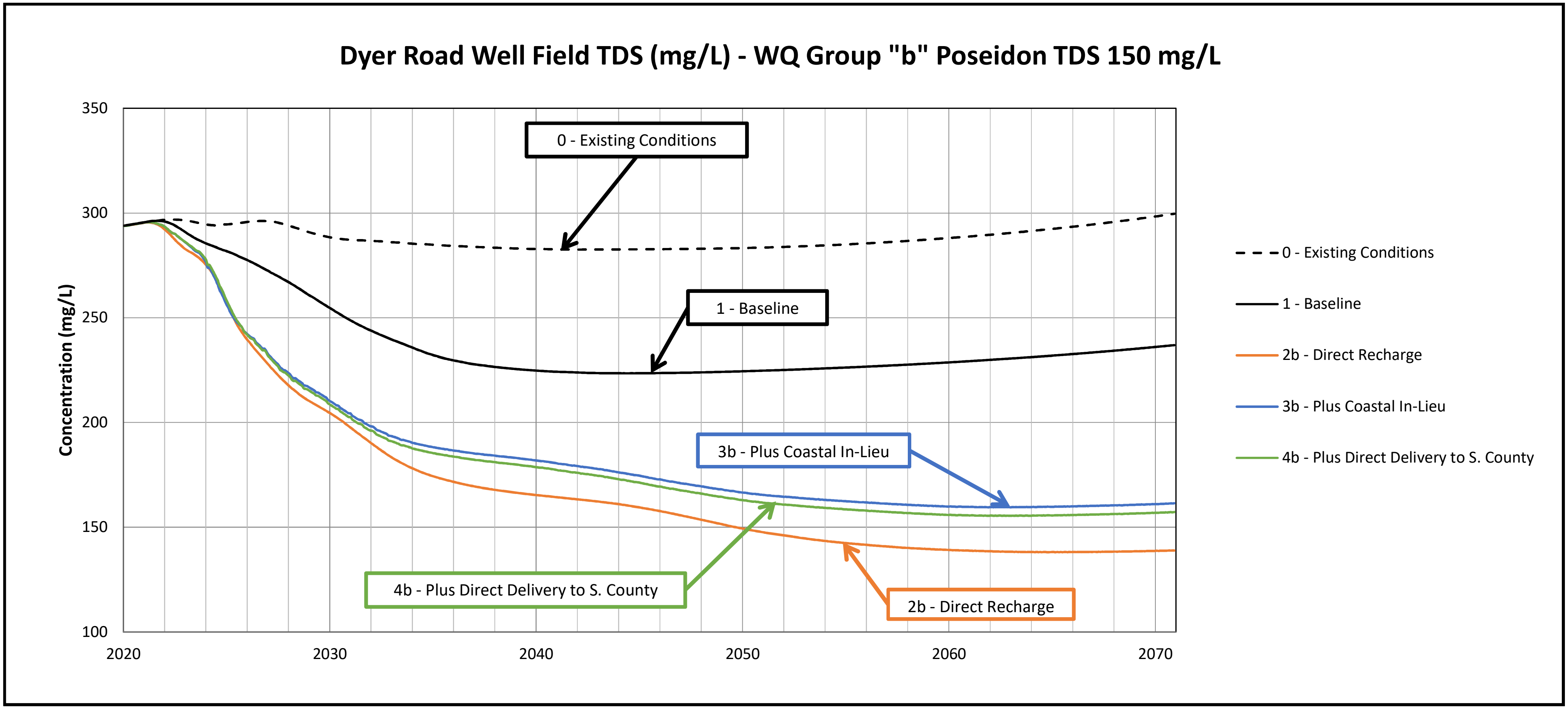
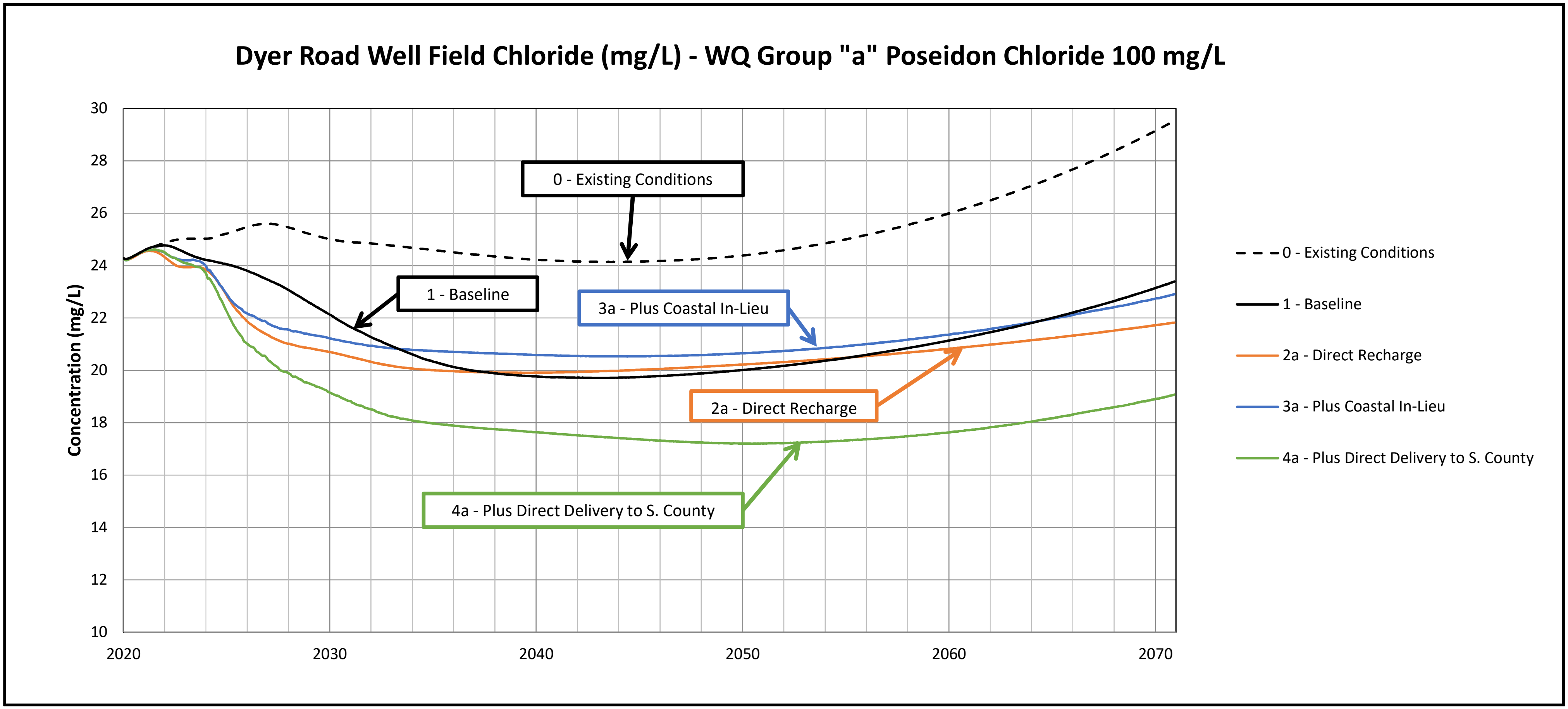


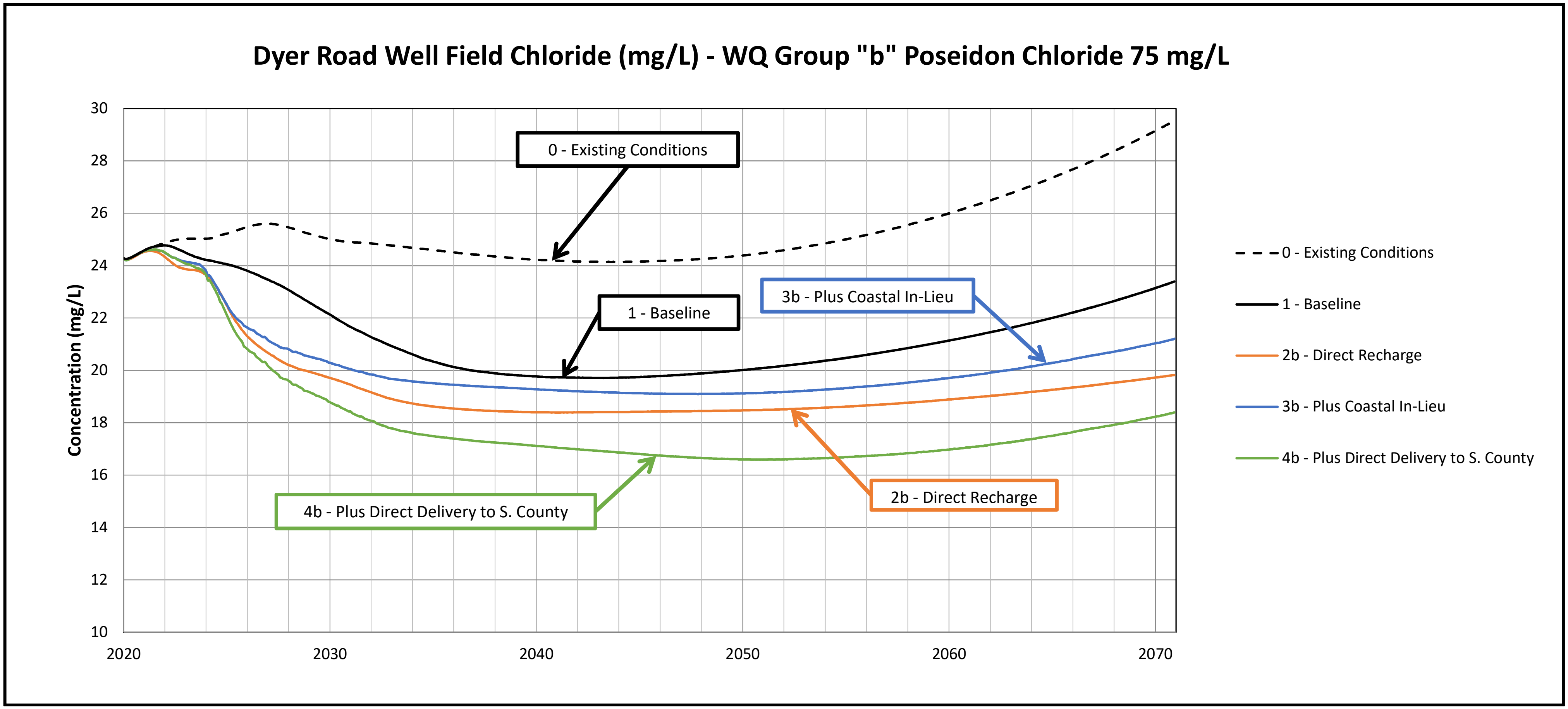
* Graphed results reflect data received from TH&C 2019



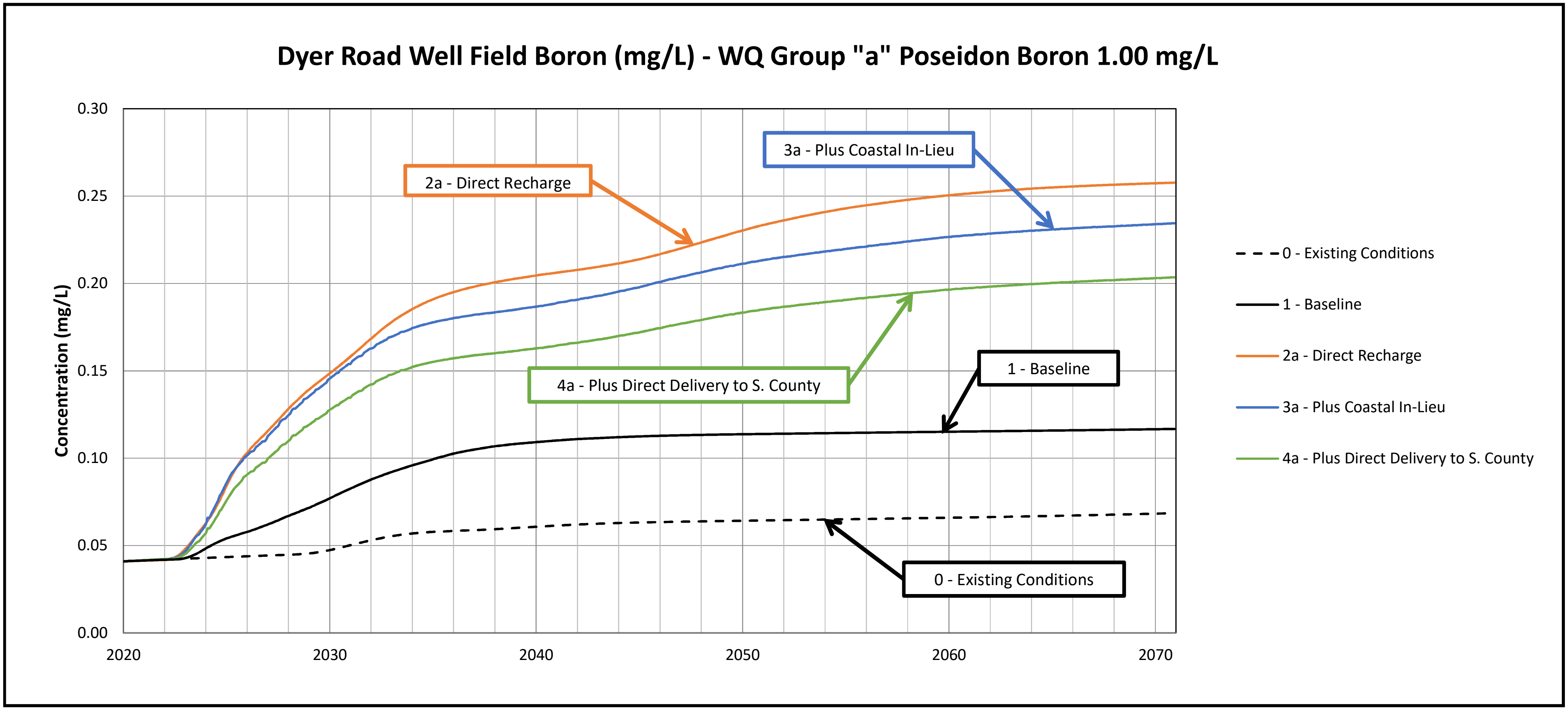
* Graphed results reflect data received from TH&C 2019



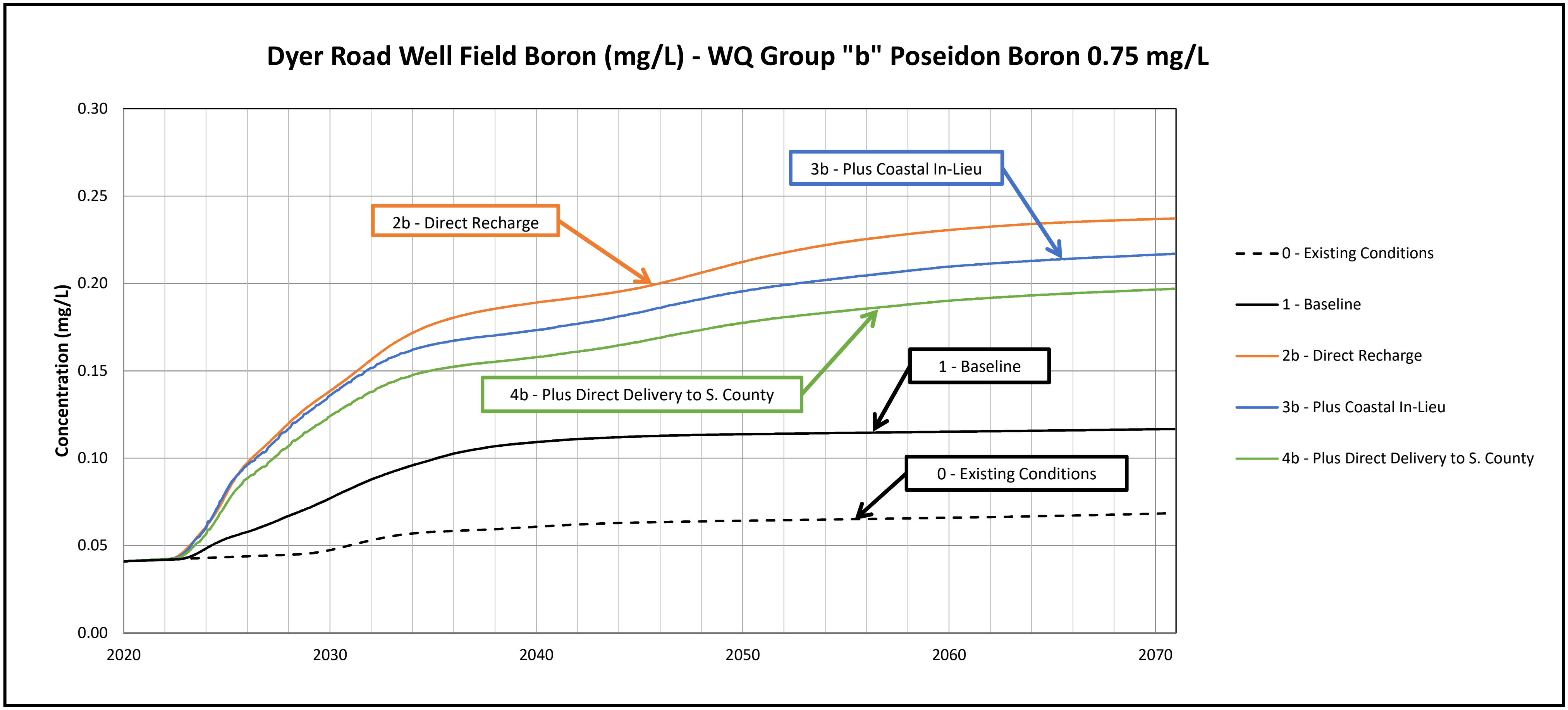
* Graphed results reflect data received from TH&C 2019



* Graphed results reflect data received from TH&C 2019



* Graphed results reflect data received from TH&C 2019



* Graphed results reflect data received from TH&C 2019

Appendix D. MWRP Effluent Results Tables and Figures

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MWRP EFFLUENT TDS CONCENTRATIONS: Average RAA 2070

Scenario	IRWD Salt Model - Baseline A			IRWD Salt Model - Baseline B		
	mg/L	lbs/M	% Increase	mg/L	lbs/M	% Increase
0 - Existing Conditions	675	4,916,000	NA	747	5,437,000	NA
1 - Baseline	630	4,586,000	0.00%	696	5,072,000	0.00%
WQ Group "a" - Poseidon TDS 350 mg/L						
2a - Direct Recharge	535	3,964,000	-15.05%	551	4,082,000	-20.90%
3a - Plus Coastal In-Lieu	552	4,089,000	-12.37%	568	4,211,000	-18.40%
4a - Plus Direct Delivery to S. County	541	4,010,000	-14.06%	555	4,113,000	-20.29%
5a - Direct Delivery to IRWD	702	5,115,000	11.53%	762	5,552,000	9.47%
WQ Group "b" - Poseidon TDS 150 mg/L						
2b - Direct Recharge	521	3,862,000	-17.24%	534	3,958,000	-23.30%
3b - Plus Coastal In-Lieu	540	4,002,000	-14.24%	554	4,103,000	-20.49%
4b - Plus Direct Delivery to S. County	537	3,975,000	-14.81%	549	4,070,000	-21.13%
5b - Direct Delivery to IRWD	586	4,270,000	-6.89%	645	4,695,000	-7.42%

Footnotes:
1) Percent increase is with regards to Scenario 1 - GWRS Expansion Baseline.
2) Concentrations listed in this table represent the average RAA for year 2070.
3) Water quality (WQ) group "a" or "b" identifies the Poseidon water quality used during modeling.

MWRP EFFLUENT TDS BUFFER: Compared to 720 mg/L Limit

Scenario	IRWD Salt Model - Baseline A		IRWD Salt Model - Baseline B	
	Average TDS Buffer (mg/L)	Percent Buffer Increase (mg/L)	Average TDS Buffer (mg/L)	Percent Buffer Increase (mg/L)
0 - Existing Conditions	45	NA	-27	NA
1 - Baseline	90	0% (0 mg/L)	24	0% (0 mg/L)
WQ Group "a" - Poseidon TDS 350 mg/L				
2a - Direct Recharge	185	105% (95 mg/L)	169	619% (146 mg/L)
3a - Plus Coastal In-Lieu	168	86% (78 mg/L)	152	544% (128 mg/L)
4a - Plus Direct Delivery to S. County	179	98% (89 mg/L)	165	600% (141 mg/L)
5a - Direct Delivery to IRWD	18	-80% (-73 mg/L)	-42	-280% (-66 mg/L)
WQ Group "b" - Poseidon TDS 150 mg/L				
2b - Direct Recharge	199	120% (109 mg/L)	186	690% (162 mg/L)
3b - Plus Coastal In-Lieu	180	99% (90 mg/L)	166	606% (143 mg/L)
4b - Plus Direct Delivery to S. County	183	103% (93 mg/L)	171	625% (147 mg/L)
5b - Direct Delivery to IRWD	134	48% (43 mg/L)	75	220% (52 mg/L)

Footnotes:
1) Percent increase is with regards to Scenario 1 - Baseline.
2) Permitted RAA TDS Limit is 720 mg/L.
3) Water quality (WQ) group "a" or "b" identifies the Poseidon water quality used during modeling.

MWRP EFFLUENT CHLORIDE CONCENTRATIONS: Average RAA 2070

Scenario	IRWD Salt Model - Baseline A			IRWD Salt Model - Baseline B		
	mg/L	lbs/M	% Increase	mg/L	lbs/M	% Increase
0 - Existing Conditions	153	1,112,000	NA	169	1,230,000	NA
1 - Baseline	148	1,078,000	0.00%	163	1,188,000	0.00%
WQ Group "a" - Poseidon Chloride 100 mg/L						
2a - Direct Recharge	143	1,058,000	-3.55%	151	1,119,000	-7.42%
3a - Plus Coastal In-Lieu	144	1,064,000	-3.02%	152	1,124,000	-6.99%
4a - Plus Direct Delivery to S. County	140	1,039,000	-5.27%	148	1,094,000	-9.51%
5a - Direct Delivery to IRWD	200	1,455,000	34.92%	216	1,575,000	32.60%
WQ Group "b" - Poseidon Chloride 75 mg/L						
2b - Direct Recharge	141	1,045,000	-4.72%	149	1,103,000	-8.71%
3b - Plus Coastal In-Lieu	142	1,053,000	-4.02%	150	1,110,000	-8.11%
4b - Plus Direct Delivery to S. County	140	1,035,000	-5.67%	147	1,088,000	-9.96%
5b - Direct Delivery to IRWD	185	1,349,000	25.13%	199	1,450,000	22.12%

Footnotes:
1) Percent increase is with regards to Scenario 1 - Baseline.
2) Concentrations listed in this table represent the average RAA for year 2070.
3) Water quality (WQ) group "a" or "b" identifies the Poseidon water quality used during modeling.

MWRP EFFLUENT CHLORIDE BUFFER: Compared to 150 mg/L Limit

Scenario	IRWD Salt Model - Baseline A		IRWD Salt Model - Baseline B	
	Average Chloride Buffer (mg/L)	Percent Buffer Increase (mg/L)	Average Chloride Buffer (mg/L)	Percent Buffer Increase (mg/L)
0 - Existing Conditions	-2.7	NA	-18.8	NA
1 - Baseline	2.0	0% (0 mg/L)	-13.1	0% (0 mg/L)
WQ Group "a" - Poseidon Chloride 100 mg/L				
2a - Direct Recharge	7.2	268% (5 mg/L)	-1.0	92% (12 mg/L)
3a - Plus Coastal In-Lieu	6.4	228% (4 mg/L)	-1.7	87% (11 mg/L)
4a - Plus Direct Delivery to S. County	9.8	398% (8 mg/L)	2.4	118% (16 mg/L)
5a - Direct Delivery to IRWD	-49.7	-2633% (-52 mg/L)	-66.3	-406% (-53 mg/L)
WQ Group "b" - Poseidon Chloride 75 mg/L				
2b - Direct Recharge	9.0	356% (7 mg/L)	1.1	108% (14 mg/L)
3b - Plus Coastal In-Lieu	7.9	303% (6 mg/L)	0.1	101% (13 mg/L)
4b - Plus Direct Delivery to S. County	10.4	427% (8 mg/L)	3.1	124% (16 mg/L)
5b - Direct Delivery to IRWD	-35.2	-1895% (-37 mg/L)	-49.2	-275% (-36 mg/L)

Footnotes:
1) Percent increase is with regards to Scenario 1 - Baseline.
2) IRWD recommended RAA Chloride Limit is 150 mg/L; see IRWD TM - Potential Impact of Ocean Desalination - Recommended Chlorine Limit (8/7/19).
3) Water quality (WQ) group "a" or "b" identifies the Poseidon water quality used during modeling.

MWRP EFFLUENT BORON CONCENTRATIONS: Average RAA 2070

Scenario	IRWD Salt Model - Baseline A			IRWD Salt Model - Baseline B		
	mg/L	lbs/M	% Increase	mg/L	lbs/M	% Increase
0 - Existing Conditions	0.433	3,150	NA	0.479	3,490	NA
1 - Baseline	0.465	3,390	0.00%	0.508	3,700	0.00%
WQ Group "a" - Poseidon Boron 1.0 mg/L						
2a - Direct Recharge	0.588	4,350	26.28%	0.650	4,810	27.91%
3a - Plus Coastal In-Lieu	0.567	4,200	21.86%	0.628	4,650	23.61%
4a - Plus Direct Delivery to S. County	0.540	4,000	16.09%	0.595	4,410	17.07%
5a - Direct Delivery to IRWD	0.878	6,390	88.65%	0.947	6,900	86.49%
WQ Group "b" - Poseidon Boron 0.75 mg/L						
2b - Direct Recharge	0.570	4,220	22.45%	0.628	4,650	23.65%
3b - Plus Coastal In-Lieu	0.552	4,090	18.60%	0.609	4,510	19.91%
4b - Plus Direct Delivery to S. County	0.535	3,960	14.87%	0.588	4,350	15.68%
5b - Direct Delivery to IRWD	0.733	5,340	57.49%	0.775	5,650	52.61%

Footnotes:
1) Percent increase is with regards to Scenario 1 - Baseline.
2) Concentrations listed in this table represent the average RAA for year 2070.
3) Water quality (WQ) group "a" or "b" identifies the Poseidon water quality used during modeling.

MWRP EFFLUENT BORON BUFFER: Compared to 0.5 mg/L Limit

Scenario	IRWD Salt Model - Baseline A		IRWD Salt Model - Baseline B	
	Average Boron Buffer (mg/L)	Percent Buffer Increase (mg/L)	Average Boron Buffer (mg/L)	Percent Buffer Increase (mg/L)
0 - Existing Conditions	0.067	NA	0.021	NA
1 - Baseline	0.035	0% (0 mg/L)	-0.008	0% (0 mg/L)
WQ Group "a" - Poseidon Boron 1.0 mg/L				
2a - Direct Recharge	-0.088	-353% (-0.12 mg/L)	-0.150	-1767% (-0.14 mg/L)
3a - Plus Coastal In-Lieu	-0.067	-293% (-0.1 mg/L)	-0.128	-1494% (-0.12 mg/L)
4a - Plus Direct Delivery to S. County	-0.040	-216% (-0.07 mg/L)	-0.095	-1080% (-0.09 mg/L)
5a - Direct Delivery to IRWD	-0.378	-1190% (-0.41 mg/L)	-0.447	-5475% (-0.44 mg/L)
WQ Group "b" - Poseidon Boron 0.75 mg/L				
2b - Direct Recharge	-0.070	-301% (-0.1 mg/L)	-0.128	-1497% (-0.12 mg/L)
3b - Plus Coastal In-Lieu	-0.052	-250% (-0.09 mg/L)	-0.109	-1260% (-0.1 mg/L)
4b - Plus Direct Delivery to S. County	-0.035	-200% (-0.07 mg/L)	-0.088	-993% (-0.08 mg/L)
5b - Direct Delivery to IRWD	-0.233	-772% (-0.27 mg/L)	-0.275	-3331% (-0.27 mg/L)

Footnotes:
1) Percent increase is with regards to Scenario 1 - Baseline.
2) IRWD recommended RAA Boron Limit is 0.5 mg/L; see IRWD TM - Potential Impact of Ocean Desalination - Recommended Boron Limit (8/7/19).
3) Water quality (WQ) group "a" or "b" identifies the Poseidon water quality used during modeling.

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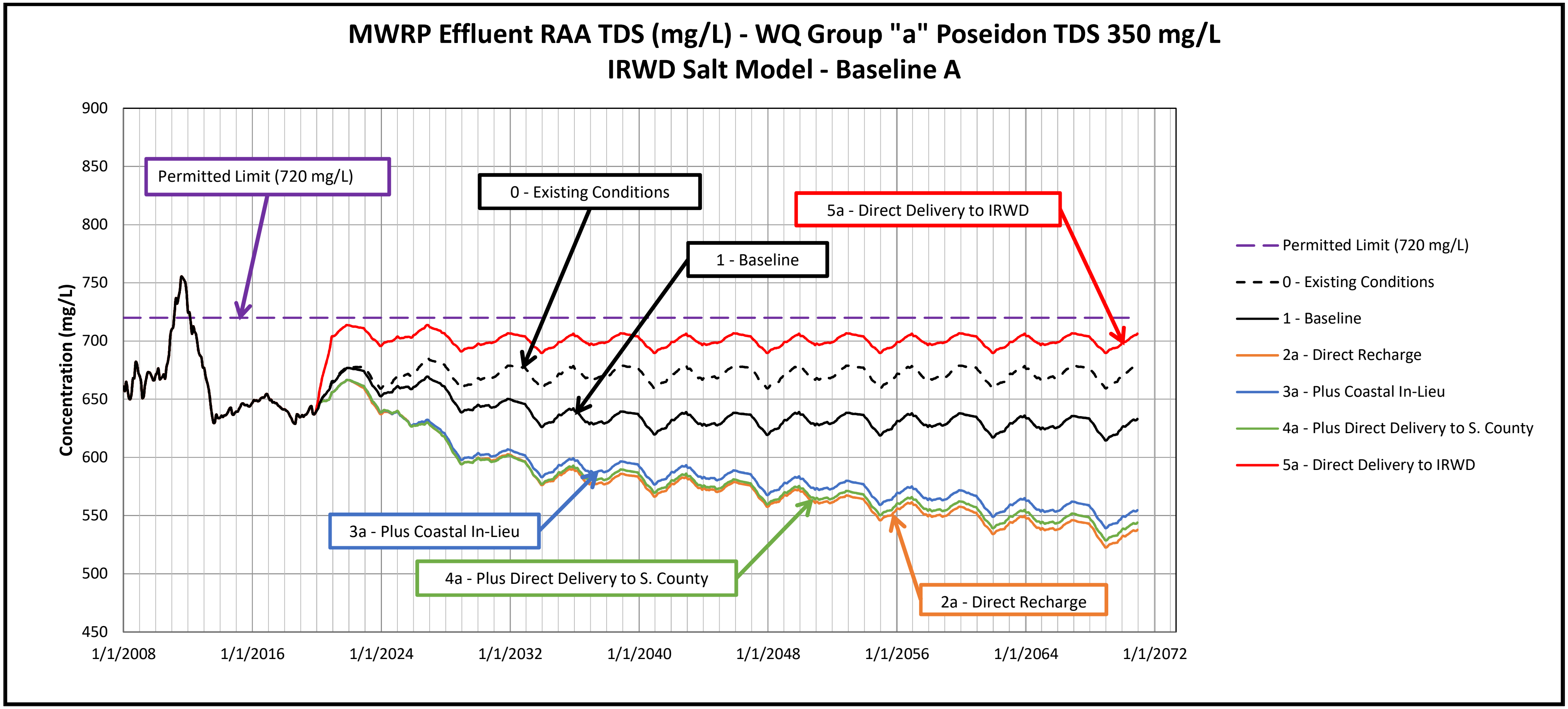
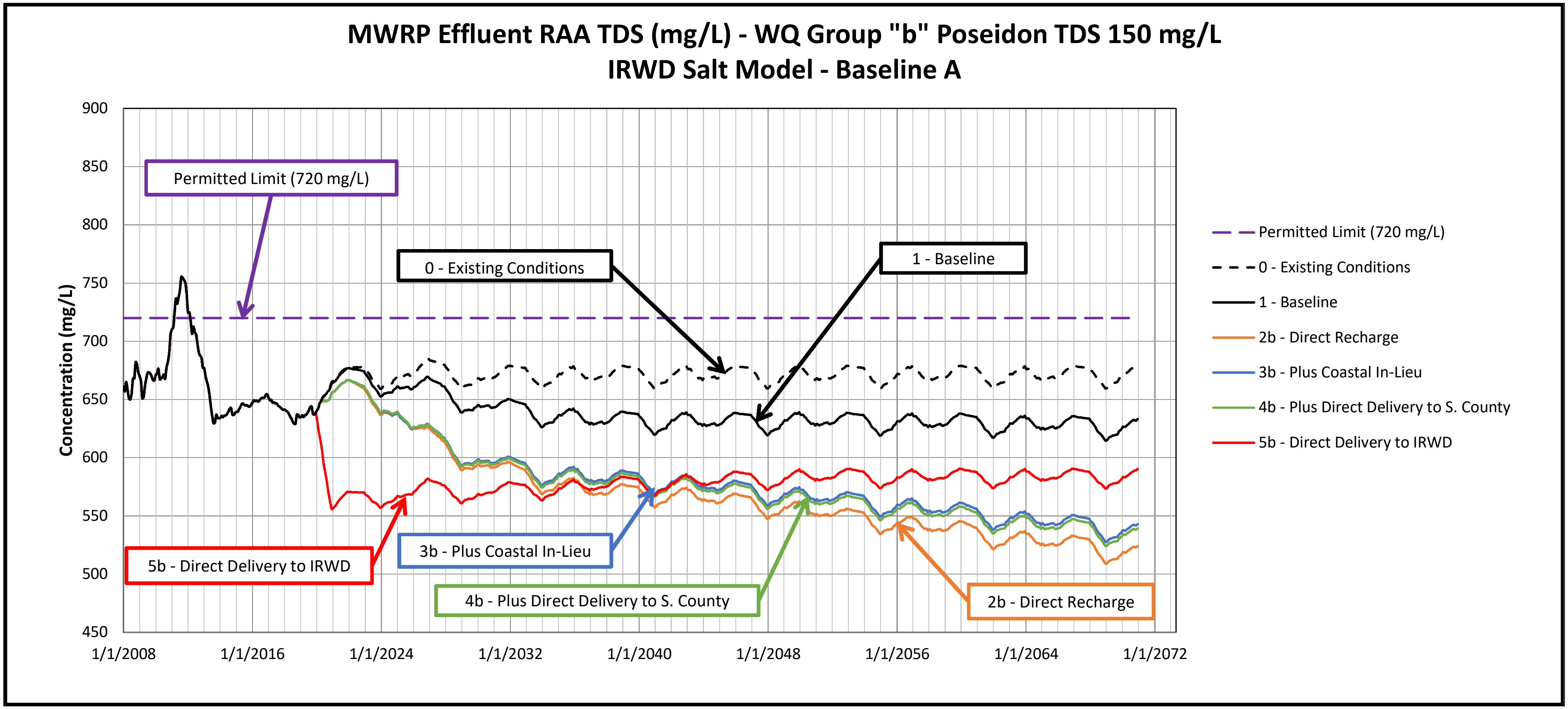
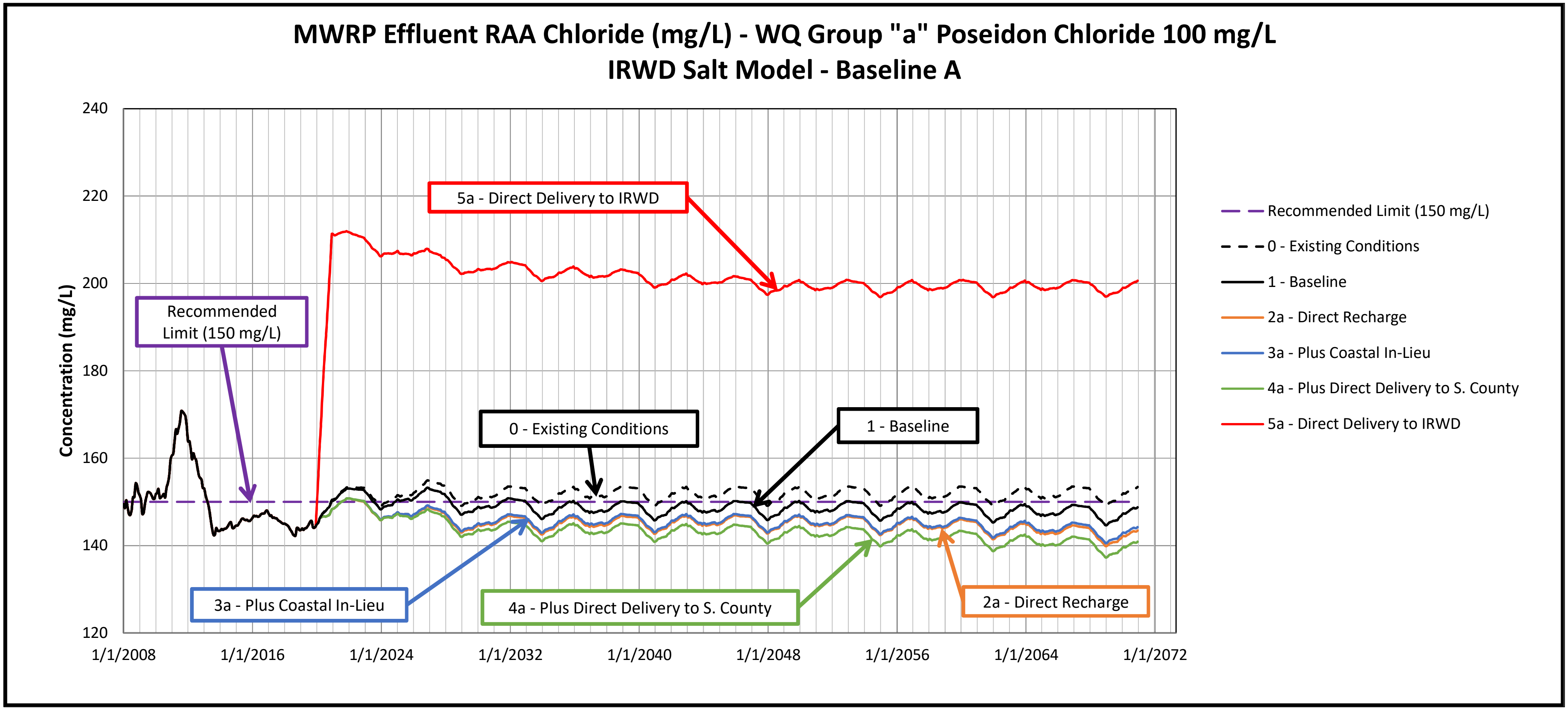
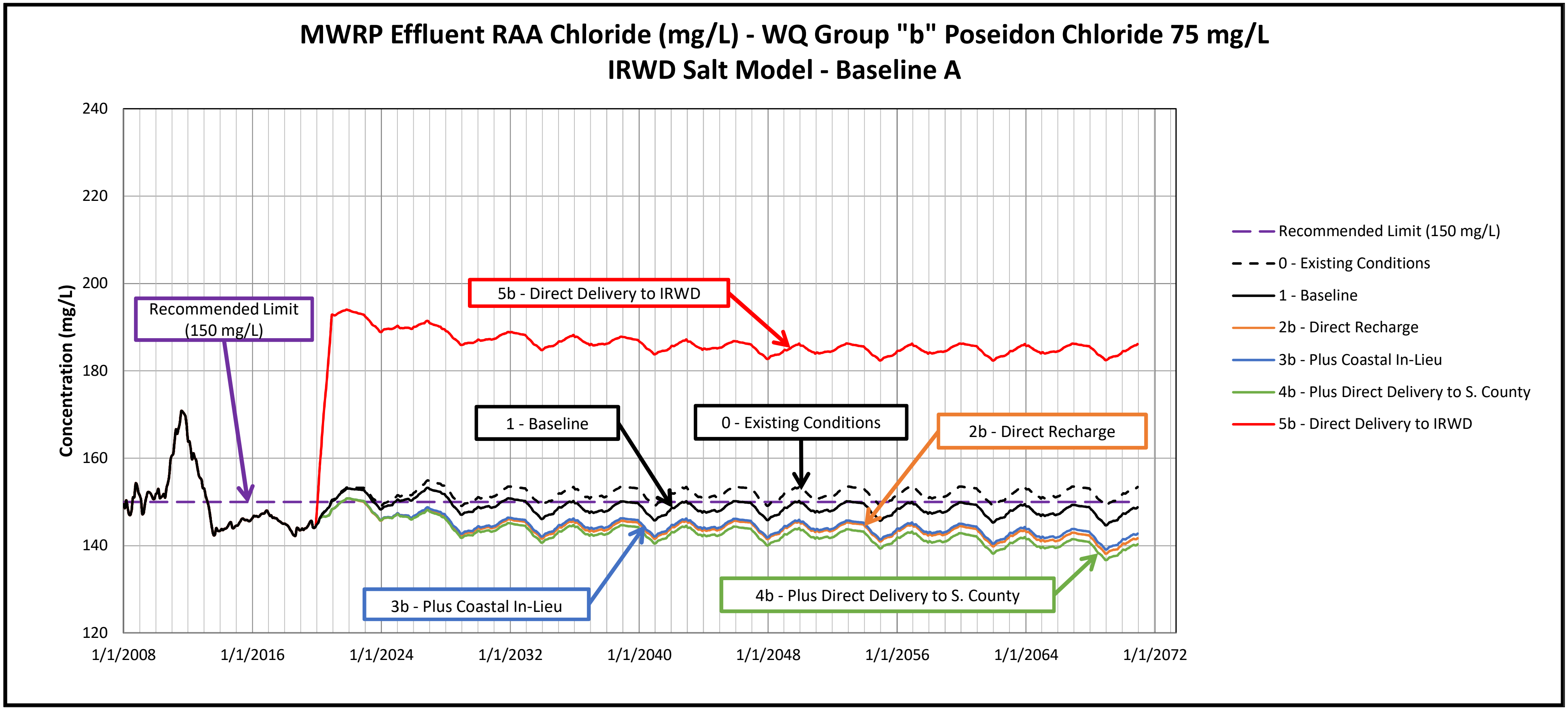


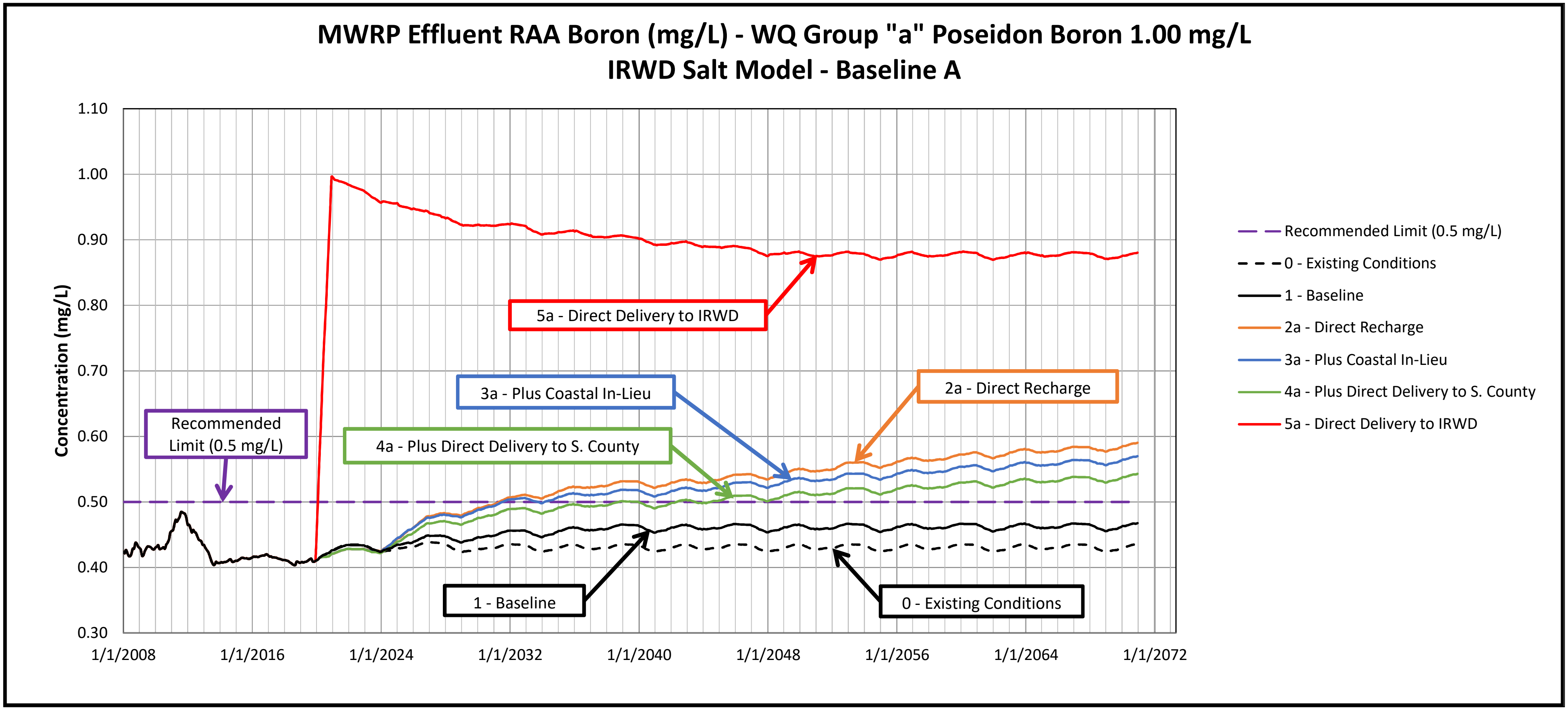
MWRP Effluent RAA TDS (mg/L) - WQ Group "a" Poseidon TDS 350 mg/L
IRWD Salt Model - Baseline A
Concentration (mg/L)
900
850
800
750
700
650
600
550
500
450
1/1/2008
1/1/2016
1/1/2024
1/1/2032
1/1/2040
1/1/2048
1/1/2056
1/1/2064
1/1/2072
Permitted Limit (720 mg/L)
0 - Existing Conditions
5a - Direct Delivery to IRWD
1 - Baseline
3a - Plus Coastal In-Lieu
4a - Plus Direct Delivery to S. County
2a - Direct Recharge
Permitted Limit (720 mg/L)
0 - Existing Conditions
1 - Baseline
2a - Direct Recharge
3a - Plus Coastal In-Lieu
4a - Plus Direct Delivery to S. County
5a - Direct Delivery to IRWD

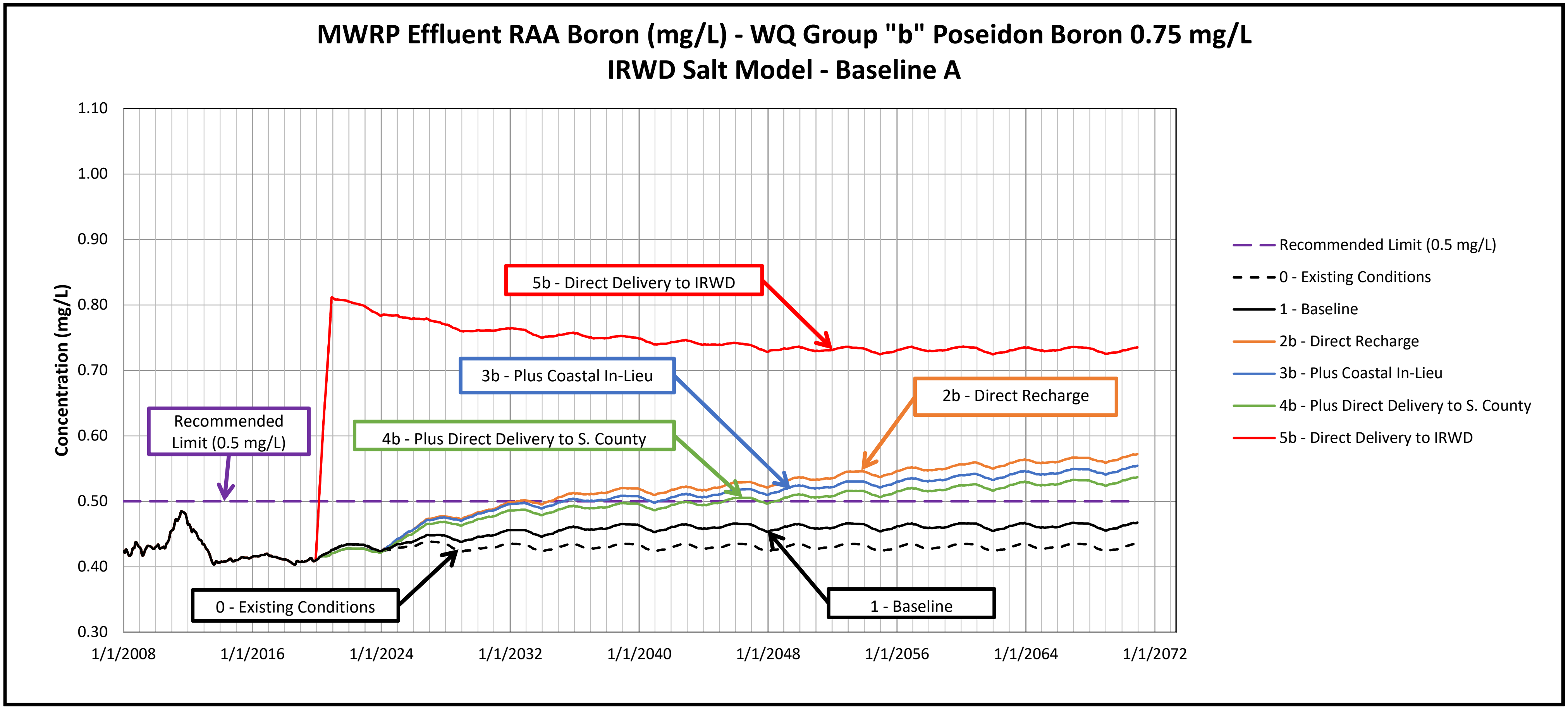

MWRP Effluent RAA TDS (mg/L) - WQ Group "b" Poseidon TDS 150 mg/L
IRWD Salt Model - Baseline A
Concentration (mg/L)
900
850
800
750
700
650
600
550
500
450
1/1/2008
1/1/2016
1/1/2024
1/1/2032
1/1/2040
1/1/2048
1/1/2056
1/1/2064
1/1/2072
Permitted Limit (720 mg/L)
0 - Existing Conditions
1 - Baseline
5b - Direct Delivery to IRWD
3b - Plus Coastal In-Lieu
4b - Plus Direct Delivery to S. County
2b - Direct Recharge
Permitted Limit (720 mg/L)
0 - Existing Conditions
1 - Baseline
2b - Direct Recharge
3b - Plus Coastal In-Lieu
4b - Plus Direct Delivery to S. County
5b - Direct Delivery to IRWD



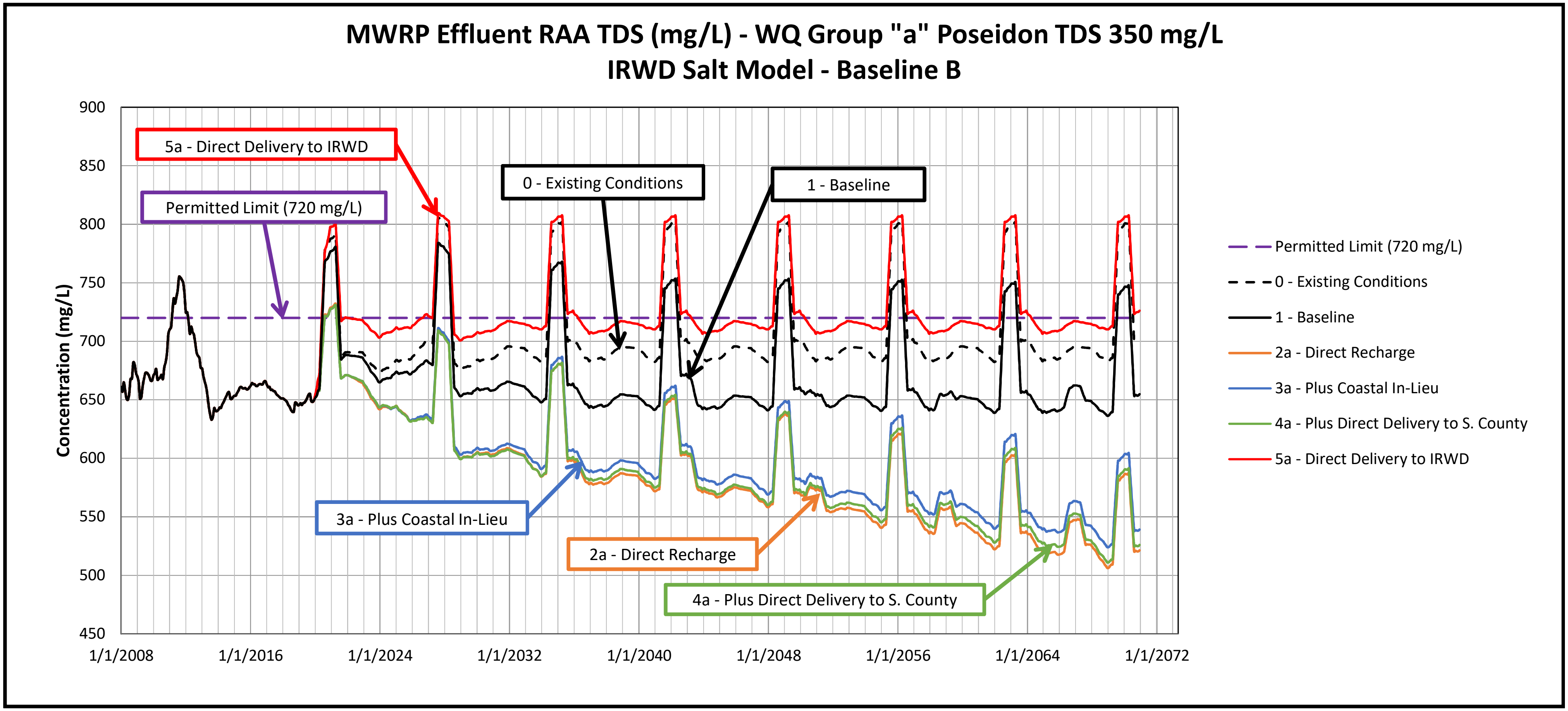
MWRP Effluent RAA Chloride (mg/L) - WQ Group "a" Poseidon Chloride 100 mg/L
IRWD Salt Model - Baseline A
Concentration (mg/L)
240
220
200
180
160
140
120
1/1/2008
1/1/2016
1/1/2024
1/1/2032
1/1/2040
1/1/2048
1/1/2056
1/1/2064
1/1/2072
5a - Direct Delivery to IRWD
Recommended Limit (150 mg/L)
0 - Existing Conditions
1 - Baseline
3a - Plus Coastal In-Lieu
4a - Plus Direct Delivery to S. County
2a - Direct Recharge
Recommended Limit (150 mg/L)
0 - Existing Conditions
1 - Baseline
2a - Direct Recharge
3a - Plus Coastal In-Lieu
4a - Plus Direct Delivery to S. County
5a - Direct Delivery to IRWD


MWRP Effluent RAA Chloride (mg/L) - WQ Group "b" Poseidon Chloride 75 mg/L
IRWD Salt Model - Baseline A
Concentration (mg/L)
240
220
200
180
160
140
120
1/1/2008
1/1/2016
1/1/2024
1/1/2032
1/1/2040
1/1/2048
1/1/2056
1/1/2064
1/1/2072
Recommended Limit (150 mg/L)
5b - Direct Delivery to IRWD
1 - Baseline
0 - Existing Conditions
2b - Direct Recharge
3b - Plus Coastal In-Lieu
4b - Plus Direct Delivery to S. County
Recommended Limit (150 mg/L)
0 - Existing Conditions
1 - Baseline
2b - Direct Recharge
3b - Plus Coastal In-Lieu
4b - Plus Direct Delivery to S. County
5b - Direct Delivery to IRWD

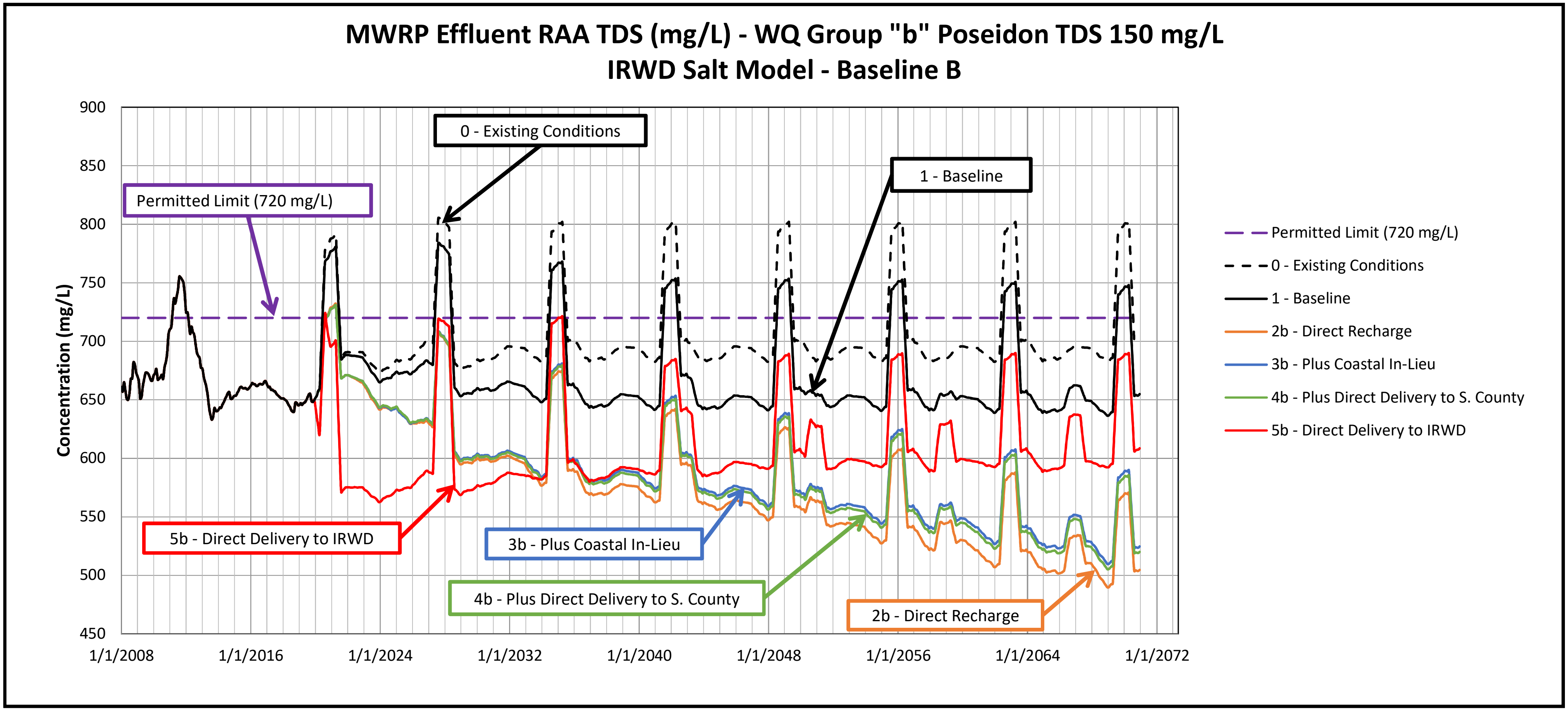

MWRP Effluent RAA Boron (mg/L) - WQ Group "a" Poseidon Boron 1.00 mg/L
IRWD Salt Model - Baseline A
Concentration (mg/L)
1.10
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
1/1/2008
1/1/2016
1/1/2024
1/1/2032
1/1/2040
1/1/2048
1/1/2056
1/1/2064
1/1/2072
5a - Direct Delivery to IRWD
3a - Plus Coastal In-Lieu
2a - Direct Recharge
Recommended Limit (0.5 mg/L)
4a - Plus Direct Delivery to S. County
1 - Baseline
0 - Existing Conditions
Recommended Limit (0.5 mg/L)
0 - Existing Conditions
1 - Baseline
2a - Direct Recharge
3a - Plus Coastal In-Lieu
4a - Plus Direct Delivery to S. County
5a - Direct Delivery to IRWD



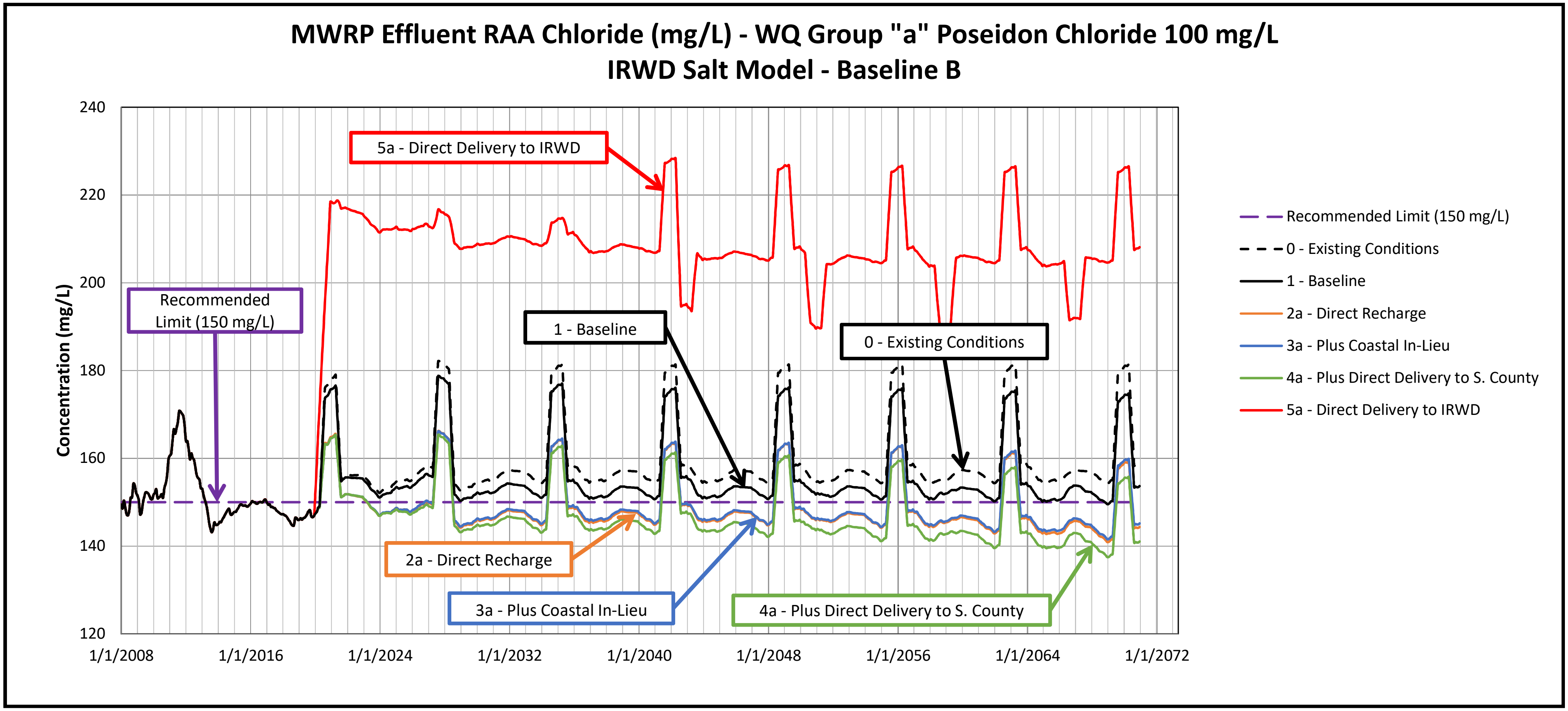
MWRP Effluent RAA Boron (mg/L) - WQ Group "b" Poseidon Boron 0.75 mg/L
IRWD Salt Model - Baseline A
Concentration (mg/L)
1.10
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
1/1/2008
1/1/2016
1/1/2024
1/1/2032
1/1/2040
1/1/2048
1/1/2056
1/1/2064
1/1/2072
5b - Direct Delivery to IRWD
3b - Plus Coastal In-Lieu
2b - Direct Recharge
Recommended Limit (0.5 mg/L)
4b - Plus Direct Delivery to S. County
0 - Existing Conditions
1 - Baseline
Recommended Limit (0.5 mg/L)
0 - Existing Conditions
1 - Baseline
2b - Direct Recharge
3b - Plus Coastal In-Lieu
4b - Plus Direct Delivery to S. County
5b - Direct Delivery to IRWD

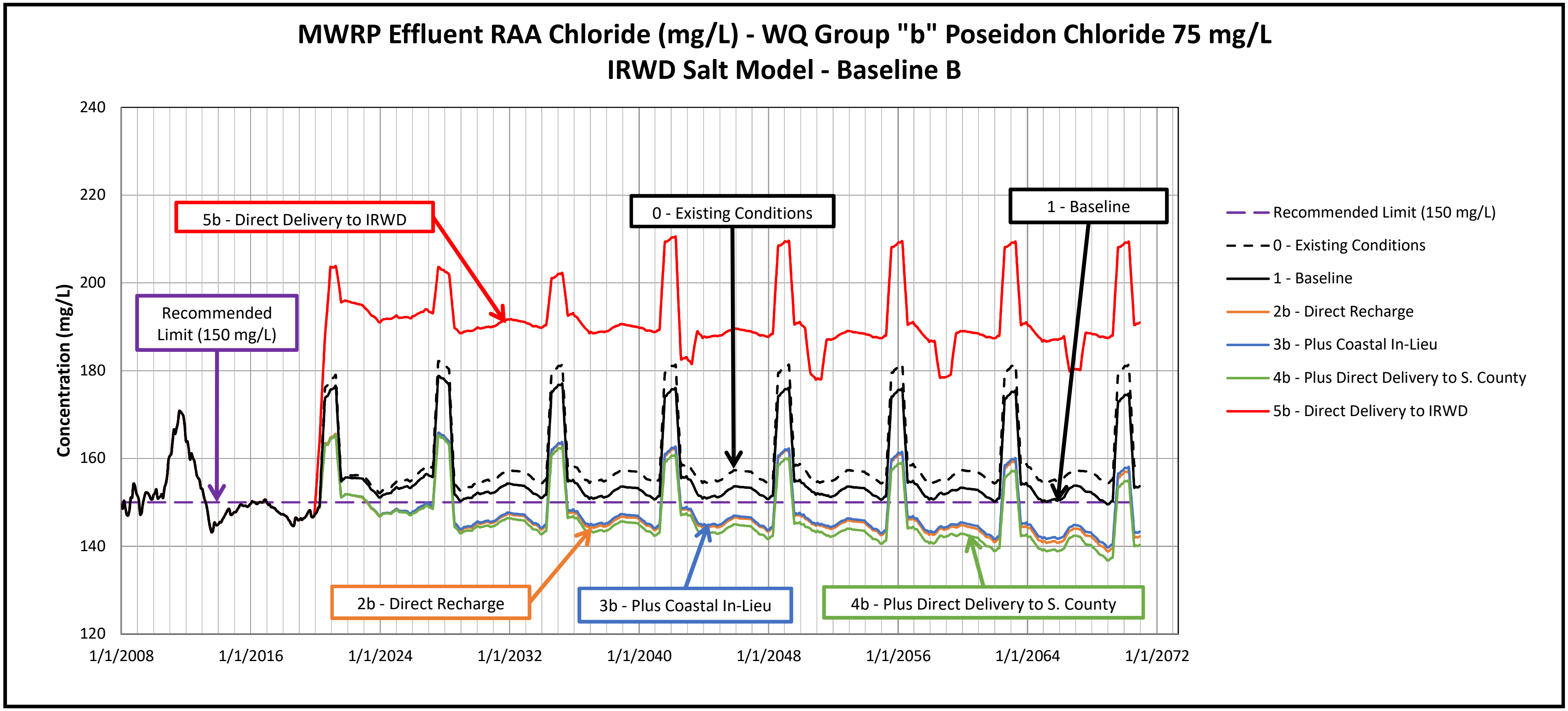


MWRP Effluent RAA TDS (mg/L) - WQ Group "a" Poseidon TDS 350 mg/L
IRWD Salt Model - Baseline B
Concentration (mg/L)
900
850
800
750
700
650
600
550
500
450
1/1/2008
1/1/2016
1/1/2024
1/1/2032
1/1/2040
1/1/2048
1/1/2056
1/1/2064
1/1/2072
5a - Direct Delivery to IRWD
Permitted Limit (720 mg/L)
0 - Existing Conditions
1 - Baseline
3a - Plus Coastal In-Lieu
2a - Direct Recharge
4a - Plus Direct Delivery to S. County
Permitted Limit (720 mg/L)
0 - Existing Conditions
1 - Baseline
2a - Direct Recharge
3a - Plus Coastal In-Lieu
4a - Plus Direct Delivery to S. County
5a - Direct Delivery to IRWD

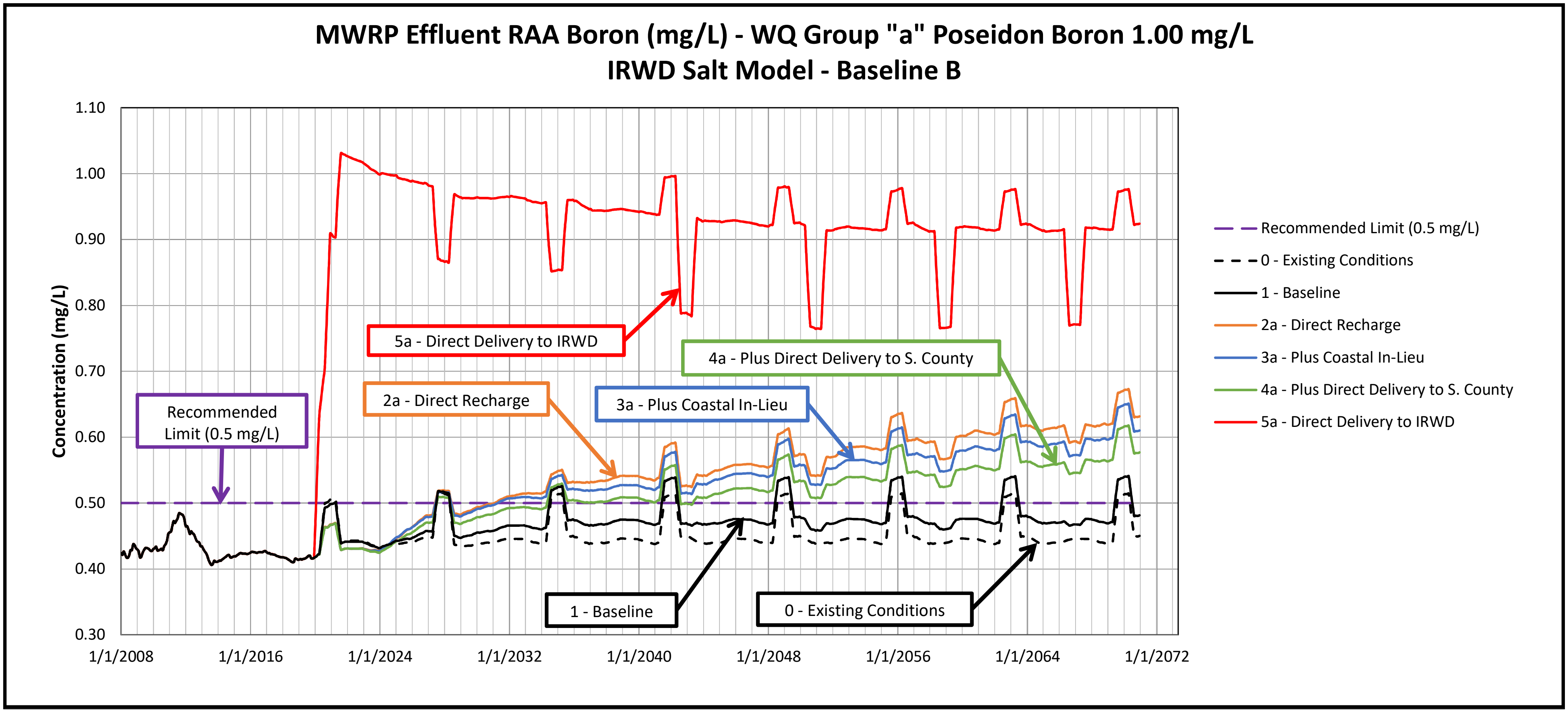


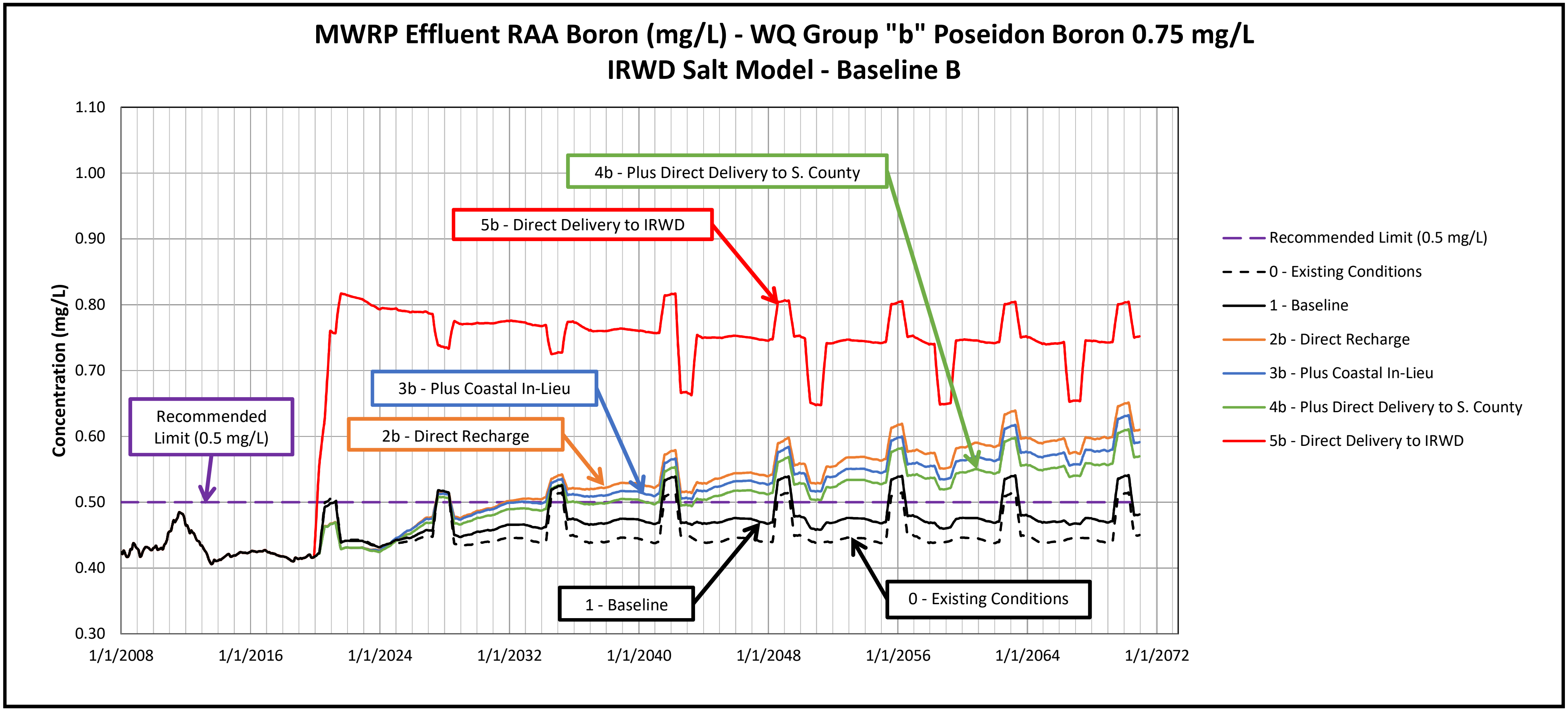
MWRP Effluent RAA TDS (mg/L) - WQ Group "b" Poseidon TDS 150 mg/L
IRWD Salt Model - Baseline B
Concentration (mg/L)
900
850
800
750
700
650
600
550
500
450
1/1/2008
1/1/2016
1/1/2024
1/1/2032
1/1/2040
1/1/2048
1/1/2056
1/1/2064
1/1/2072
0 - Existing Conditions
1 - Baseline
Permitted Limit (720 mg/L)
5b - Direct Delivery to IRWD
3b - Plus Coastal In-Lieu
4b - Plus Direct Delivery to S. County
2b - Direct Recharge
Permitted Limit (720 mg/L)
0 - Existing Conditions
1 - Baseline
2b - Direct Recharge
3b - Plus Coastal In-Lieu
4b - Plus Direct Delivery to S. County
5b - Direct Delivery to IRWD


MWRP Effluent RAA Chloride (mg/L) - WQ Group "a" Poseidon Chloride 100 mg/L
IRWD Salt Model - Baseline B
Concentration (mg/L)
240
220
200
180
160
140
120
1/1/2008
1/1/2016
1/1/2024
1/1/2032
1/1/2040
1/1/2048
1/1/2056
1/1/2064
1/1/2072
5a - Direct Delivery to IRWD
Recommended Limit (150 mg/L)
1 - Baseline
0 - Existing Conditions
2a - Direct Recharge
3a - Plus Coastal In-Lieu
4a - Plus Direct Delivery to S. County
Recommended Limit (150 mg/L)
0 - Existing Conditions
1 - Baseline
2a - Direct Recharge
3a - Plus Coastal In-Lieu
4a - Plus Direct Delivery to S. County
5a - Direct Delivery to IRWD



MWRP Effluent RAA Chloride (mg/L) - WQ Group "b" Poseidon Chloride 75 mg/L
IRWD Salt Model - Baseline B
Concentration (mg/L)
240
220
200
180
160
140
120
1/1/2008
1/1/2016
1/1/2024
1/1/2032
1/1/2040
1/1/2048
1/1/2056
1/1/2064
1/1/2072
5b - Direct Delivery to IRWD
0 - Existing Conditions
1 - Baseline
Recommended Limit (150 mg/L)
2b - Direct Recharge
3b - Plus Coastal In-Lieu
4b - Plus Direct Delivery to S. County
Recommended Limit (150 mg/L)
0 - Existing Conditions
1 - Baseline
2b - Direct Recharge
3b - Plus Coastal In-Lieu
4b - Plus Direct Delivery to S. County
5b - Direct Delivery to IRWD


MWRP Effluent RAA Boron (mg/L) - WQ Group "a" Poseidon Boron 1.00 mg/L
IRWD Salt Model - Baseline B
Concentration (mg/L)
1.10
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
1/1/2008
1/1/2016
1/1/2024
1/1/2032
1/1/2040
1/1/2048
1/1/2056
1/1/2064
1/1/2072
5a - Direct Delivery to IRWD
4a - Plus Direct Delivery to S. County
2a - Direct Recharge
3a - Plus Coastal In-Lieu
Recommended Limit (0.5 mg/L)
1 - Baseline
0 - Existing Conditions
Recommended Limit (0.5 mg/L)
0 - Existing Conditions
1 - Baseline
2a - Direct Recharge
3a - Plus Coastal In-Lieu
4a - Plus Direct Delivery to S. County
5a - Direct Delivery to IRWD


MWRP Effluent RAA Boron (mg/L) - WQ Group "b" Poseidon Boron 0.75 mg/L
IRWD Salt Model - Baseline B
Concentration (mg/L)
1.10
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
1/1/2008
1/1/2016
1/1/2024
1/1/2032
1/1/2040
1/1/2048
1/1/2056
1/1/2064
1/1/2072
4b - Plus Direct Delivery to S. County
5b - Direct Delivery to IRWD
3b - Plus Coastal In-Lieu
2b - Direct Recharge
Recommended Limit (0.5 mg/L)
1 - Baseline
0 - Existing Conditions
Recommended Limit (0.5 mg/L)
0 - Existing Conditions
1 - Baseline
2b - Direct Recharge
3b - Plus Coastal In-Lieu
4b - Plus Direct Delivery to S. County
5b - Direct Delivery to IRWD

Appendix E. Boron Sensitivity Analysis

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Dyer Road Well Field
Boron Sensitivity

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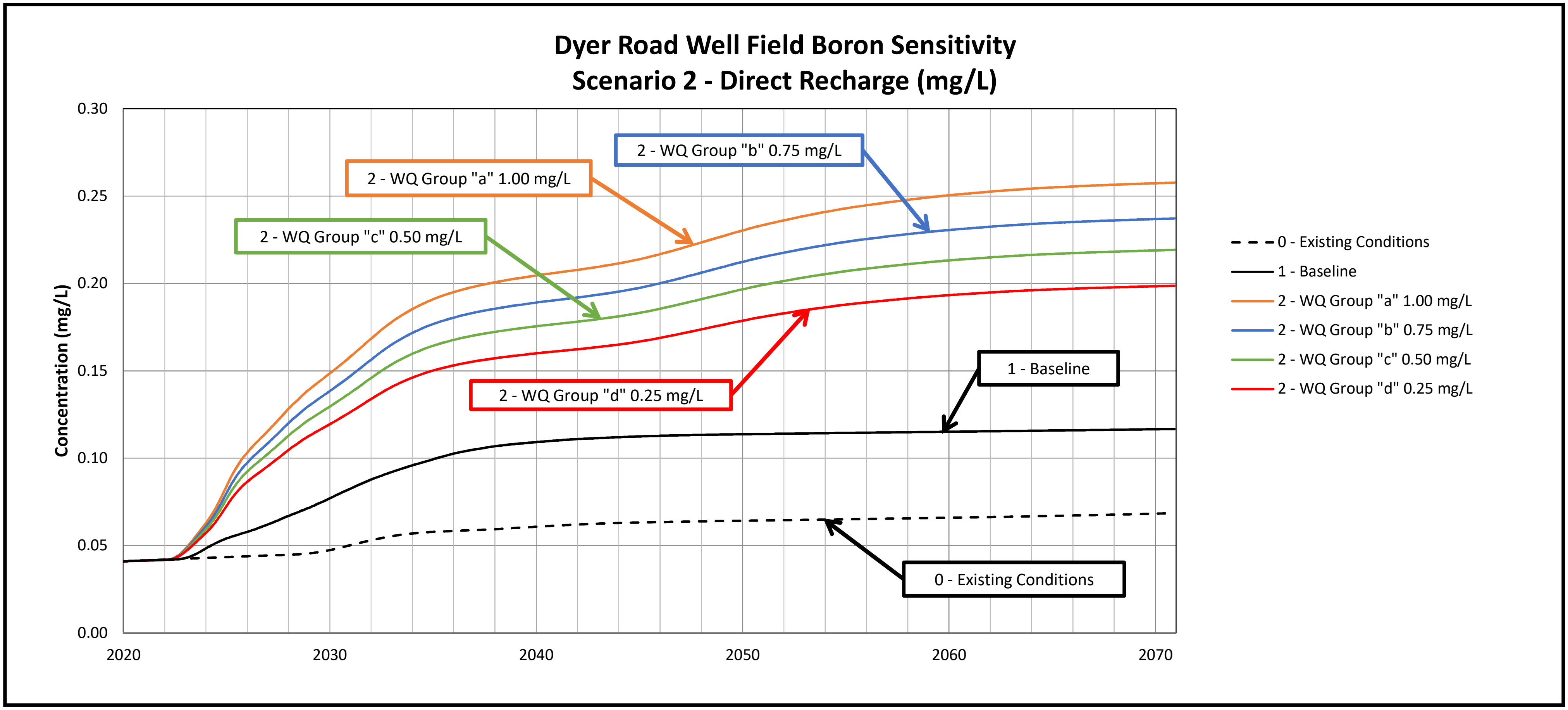
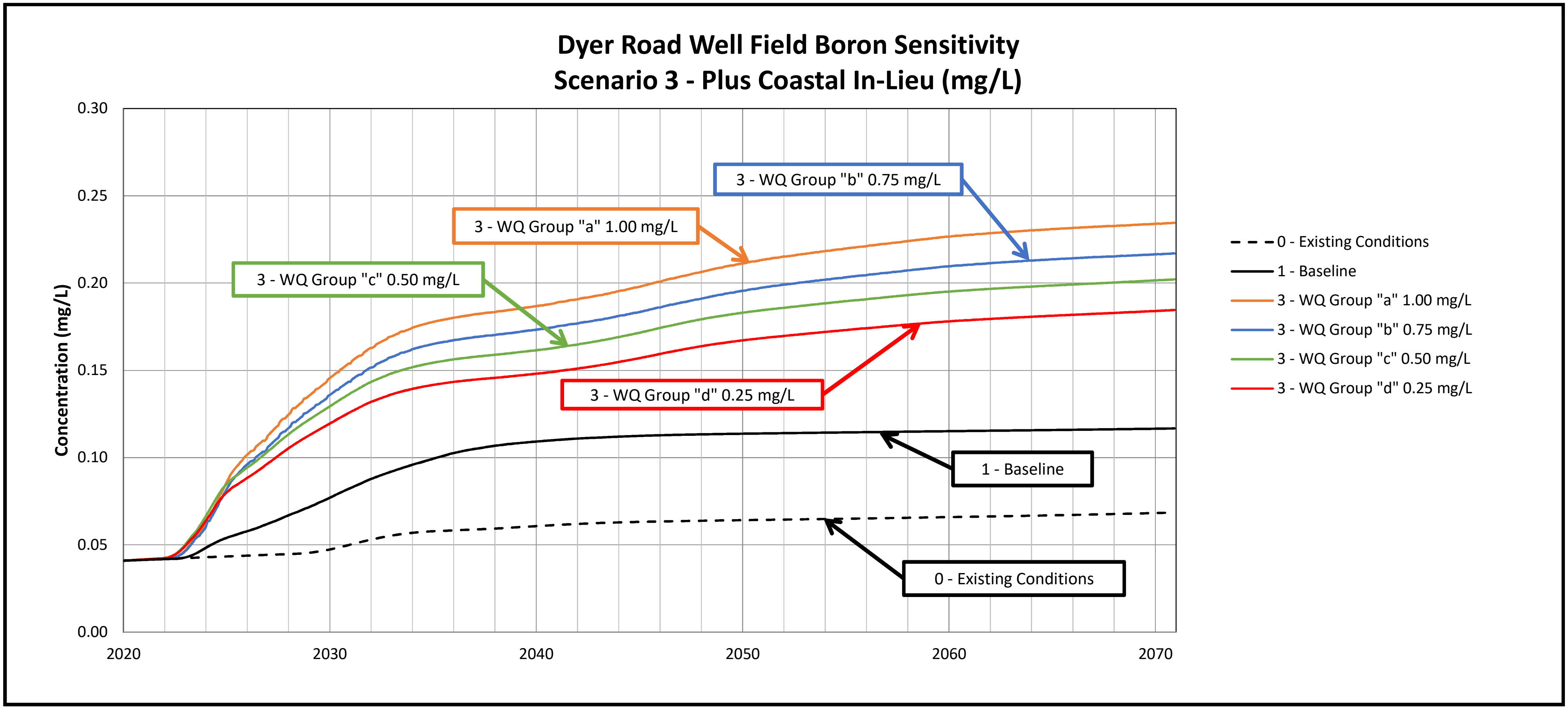
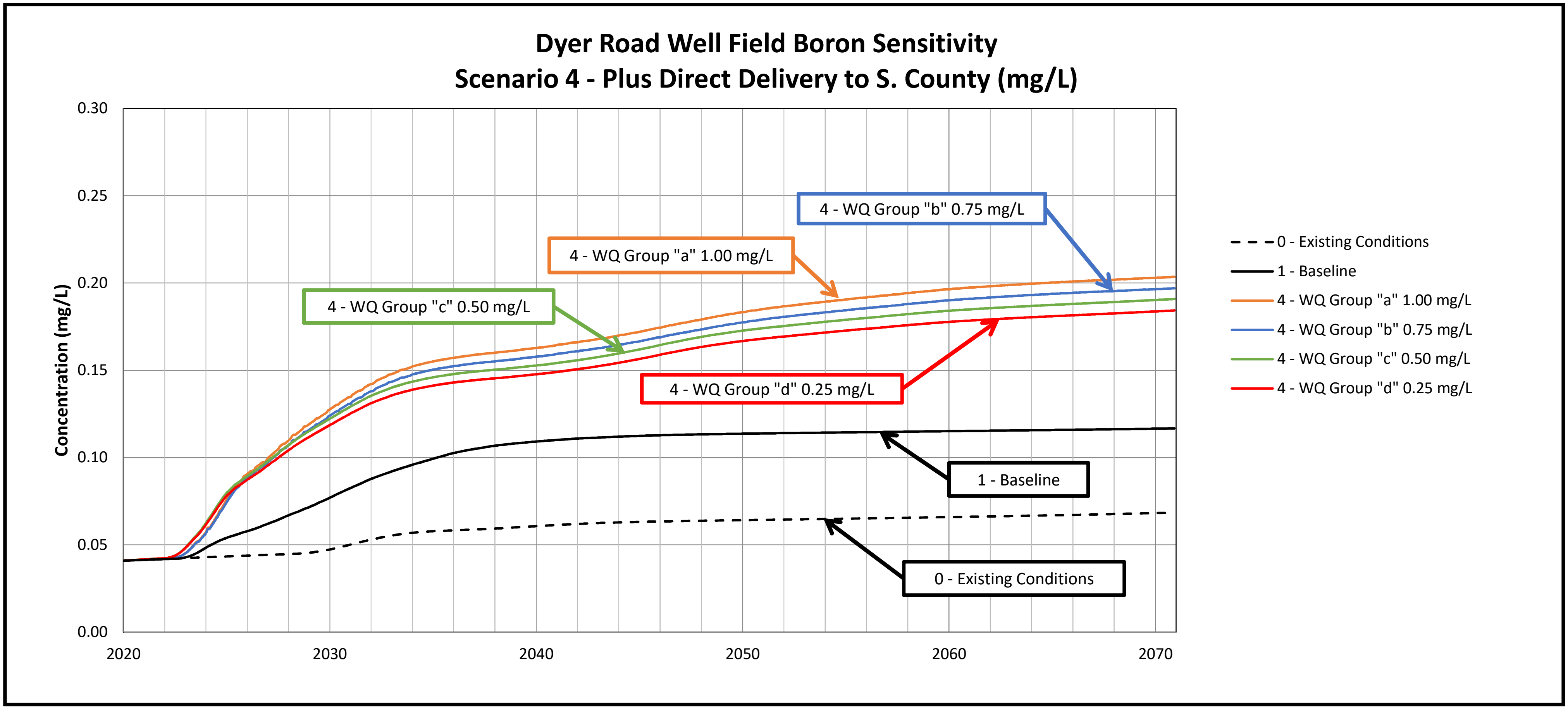


* Graphed results reflect data received from TH&C 2019



* Graphed results reflect data received from TH&C 2019



* Graphed results reflect data received from TH&C 2019

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MWRP Effluent
Boron Sensitivity

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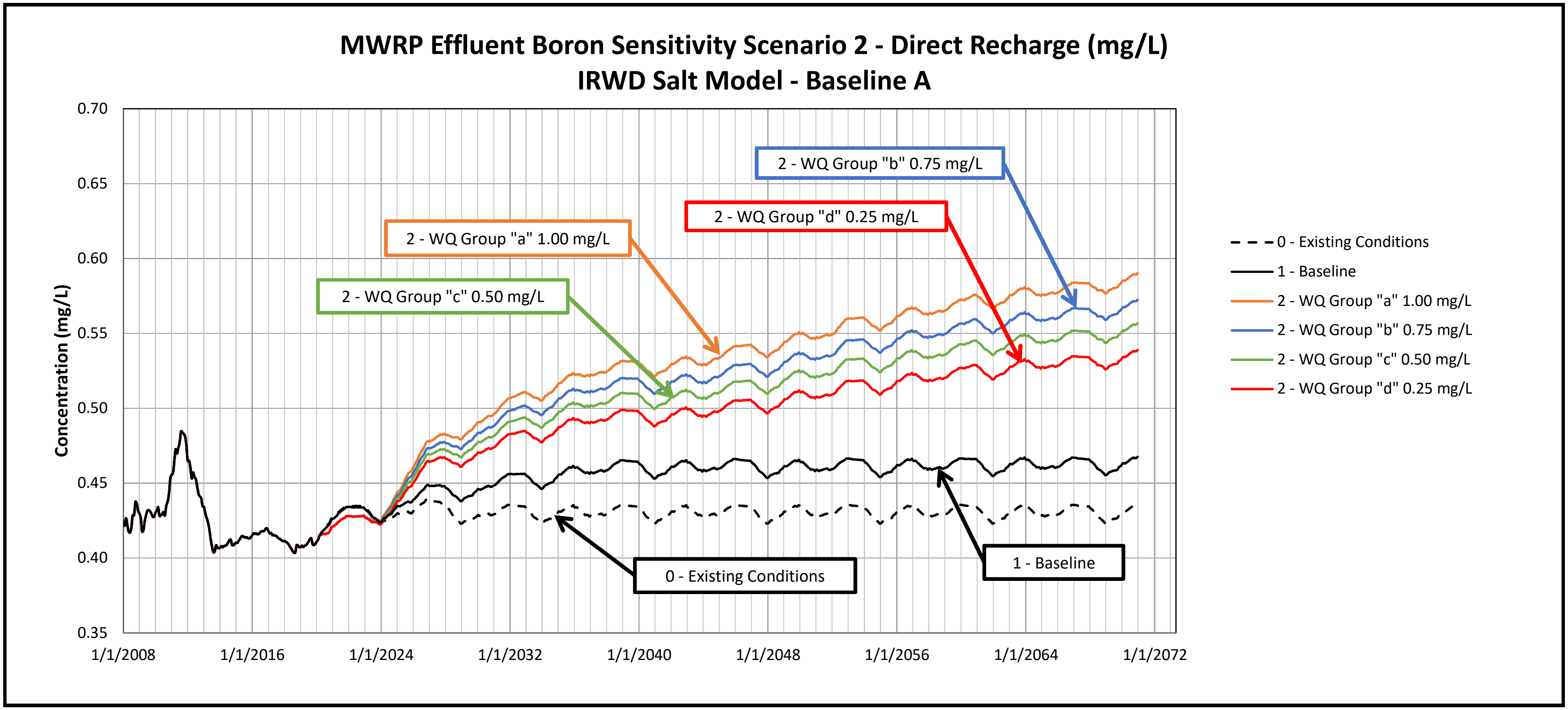
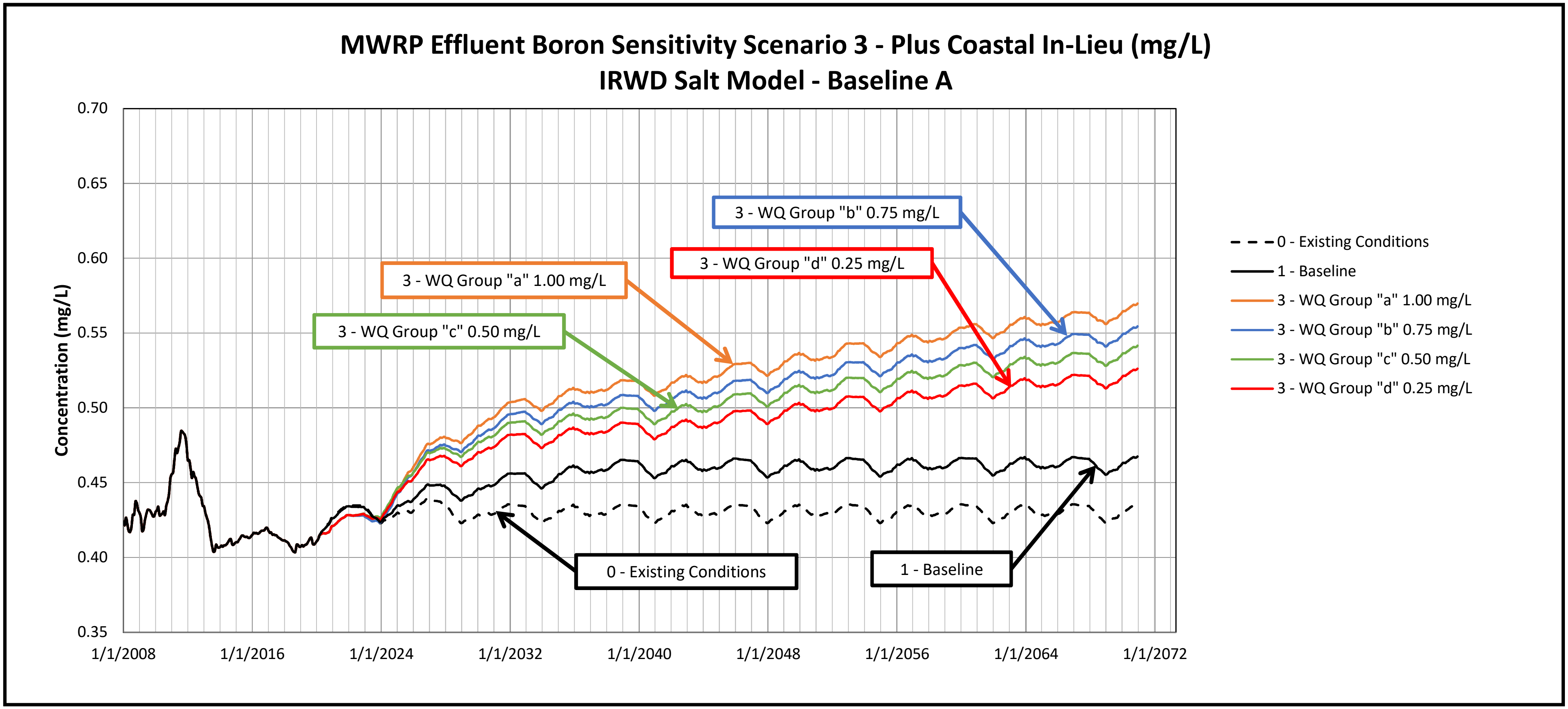
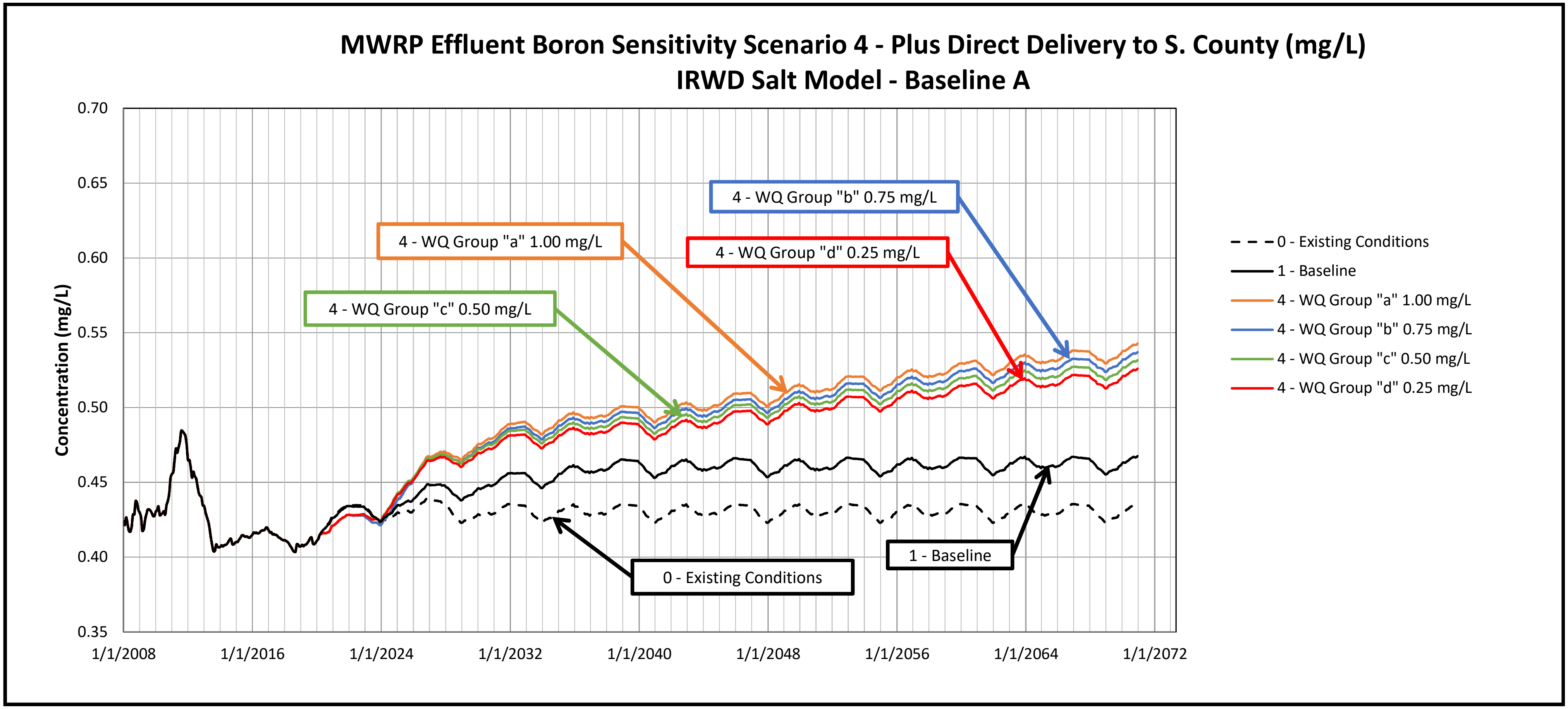
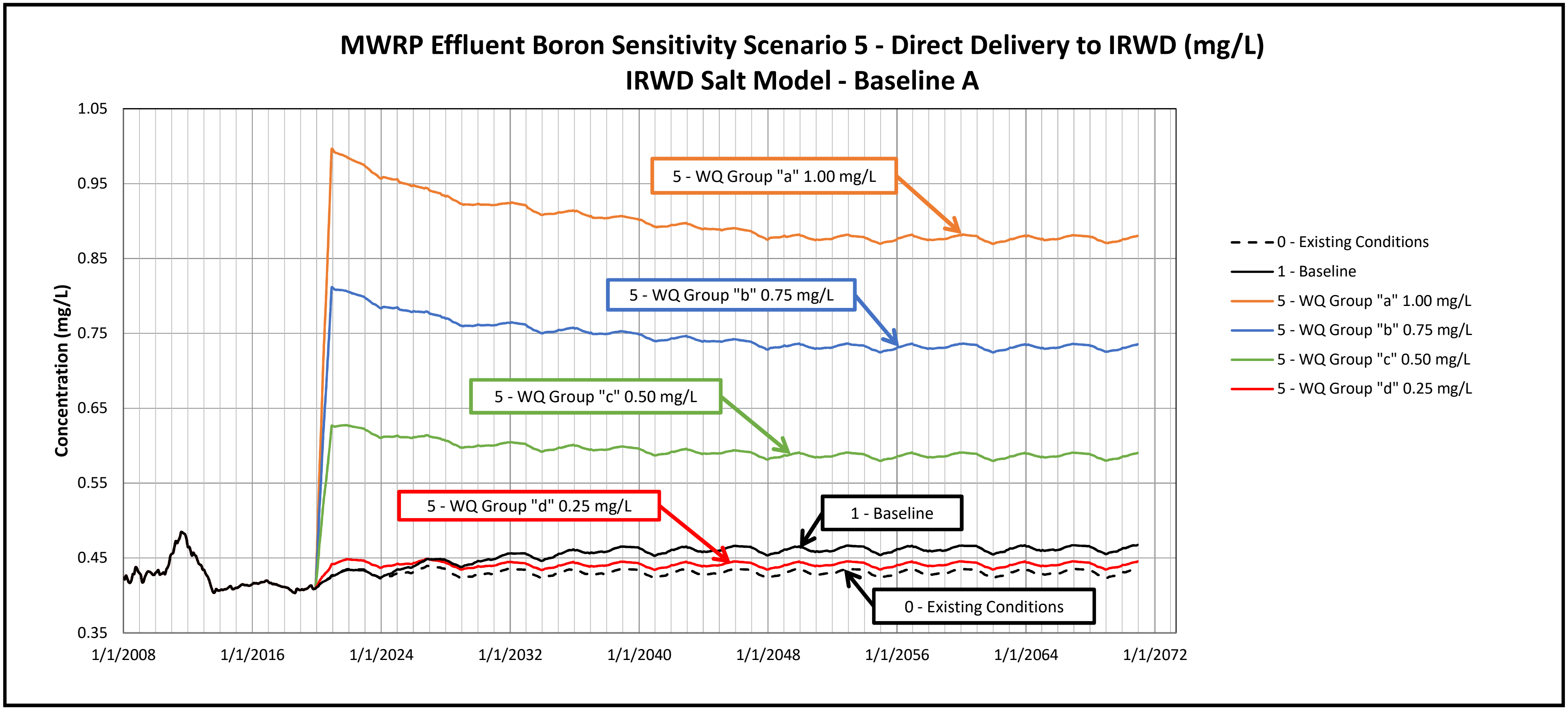
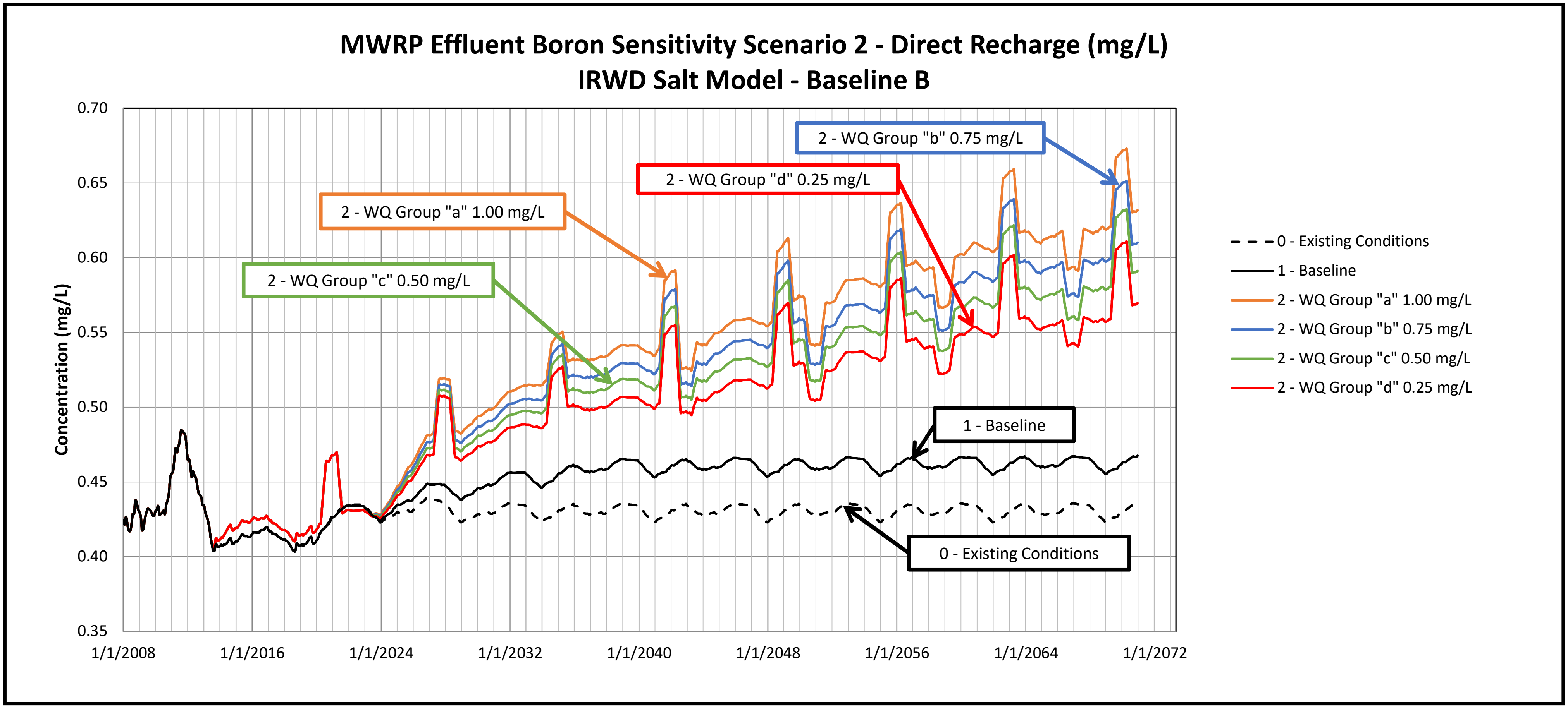

MWRP Effluent Boron Sensitivity Scenario 2 - Direct Recharge (mg/L)
IRWD Salt Model - Baseline A
Concentration (mg/L)
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
1/1/2008
1/1/2016
1/1/2024
1/1/2032
1/1/2040
1/1/2048
1/1/2056
1/1/2064
1/1/2072
2 - WQ Group "b" 0.75 mg/L
2 - WQ Group "d" 0.25 mg/L
2 - WQ Group "a" 1.00 mg/L
2 - WQ Group "c" 0.50 mg/L
0 - Existing Conditions
1 - Baseline
0 - Existing Conditions
1 - Baseline
2 - WQ Group "a" 1.00 mg/L
2 - WQ Group "b" 0.75 mg/L
2 - WQ Group "c" 0.50 mg/L
2 - WQ Group "d" 0.25 mg/L


MWRP Effluent Boron Sensitivity Scenario 3 - Plus Coastal In-Lieu (mg/L)
IRWD Salt Model - Baseline A
Concentration (mg/L)
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
1/1/2008
1/1/2016
1/1/2024
1/1/2032
1/1/2040
1/1/2048
1/1/2056
1/1/2064
1/1/2072
3 - WQ Group "b" 0.75 mg/L
3 - WQ Group "d" 0.25 mg/L
3 - WQ Group "a" 1.00 mg/L
3 - WQ Group "c" 0.50 mg/L
0 - Existing Conditions
1 - Baseline
0 - Existing Conditions
1 - Baseline
3 - WQ Group "a" 1.00 mg/L
3 - WQ Group "b" 0.75 mg/L
3 - WQ Group "c" 0.50 mg/L
3 - WQ Group "d" 0.25 mg/L

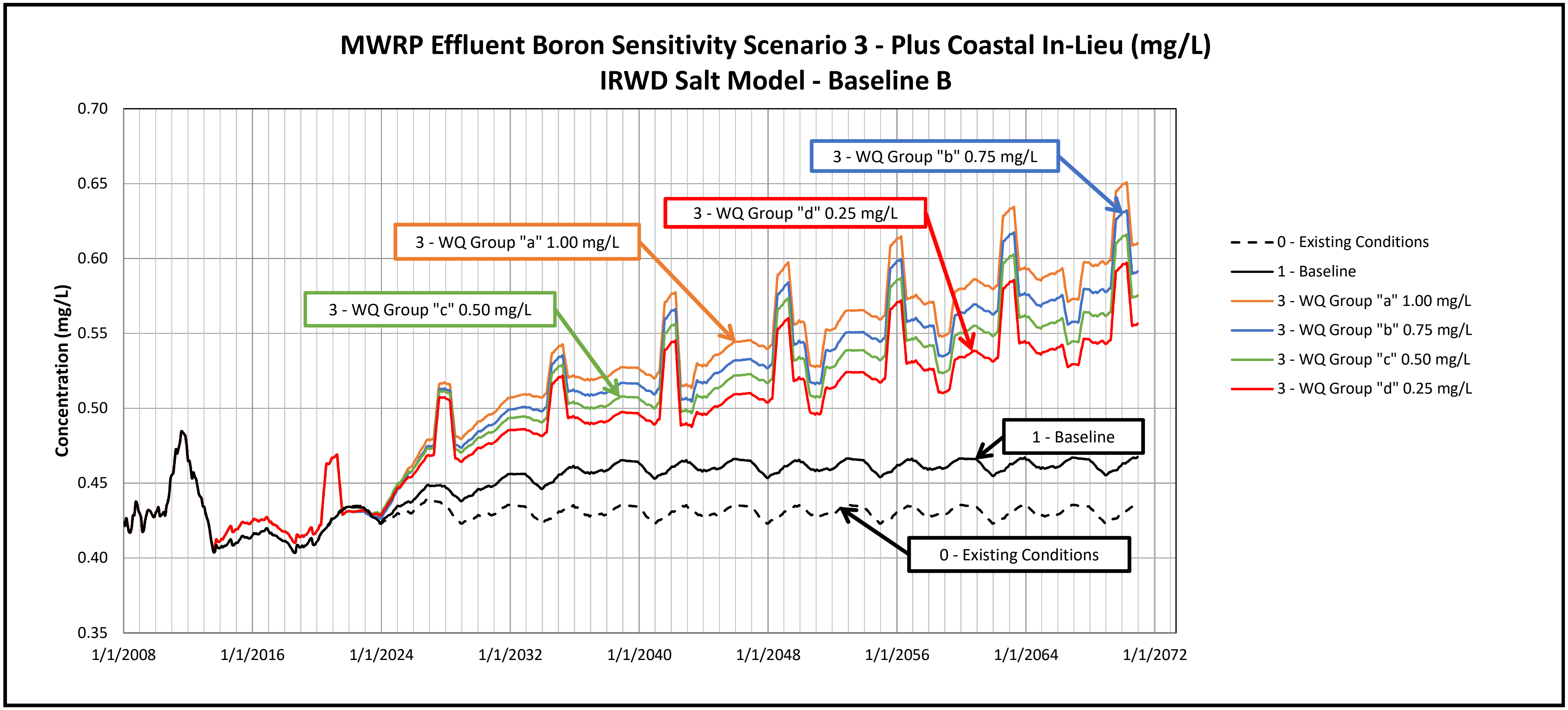


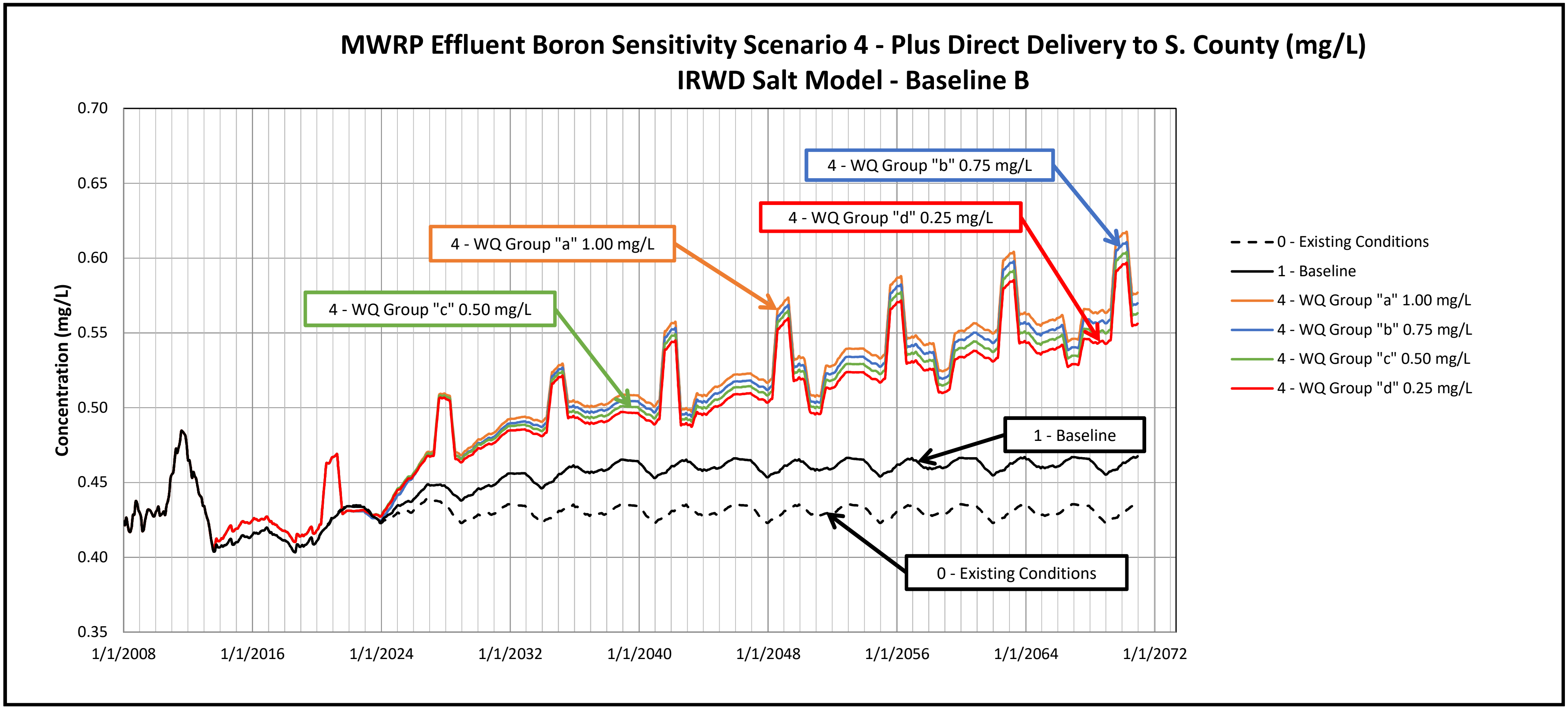
MWRP Effluent Boron Sensitivity Scenario 4 - Plus Direct Delivery to S. County (mg/L)
IRWD Salt Model - Baseline A
Concentration (mg/L)
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
1/1/2008
1/1/2016
1/1/2024
1/1/2032
1/1/2040
1/1/2048
1/1/2056
1/1/2064
1/1/2072
4 - WQ Group "b" 0.75 mg/L
4 - WQ Group "a" 1.00 mg/L
4 - WQ Group "d" 0.25 mg/L
4 - WQ Group "c" 0.50 mg/L
0 - Existing Conditions
1 - Baseline
0 - Existing Conditions
1 - Baseline
4 - WQ Group "a" 1.00 mg/L
4 - WQ Group "b" 0.75 mg/L
4 - WQ Group "c" 0.50 mg/L
4 - WQ Group "d" 0.25 mg/L

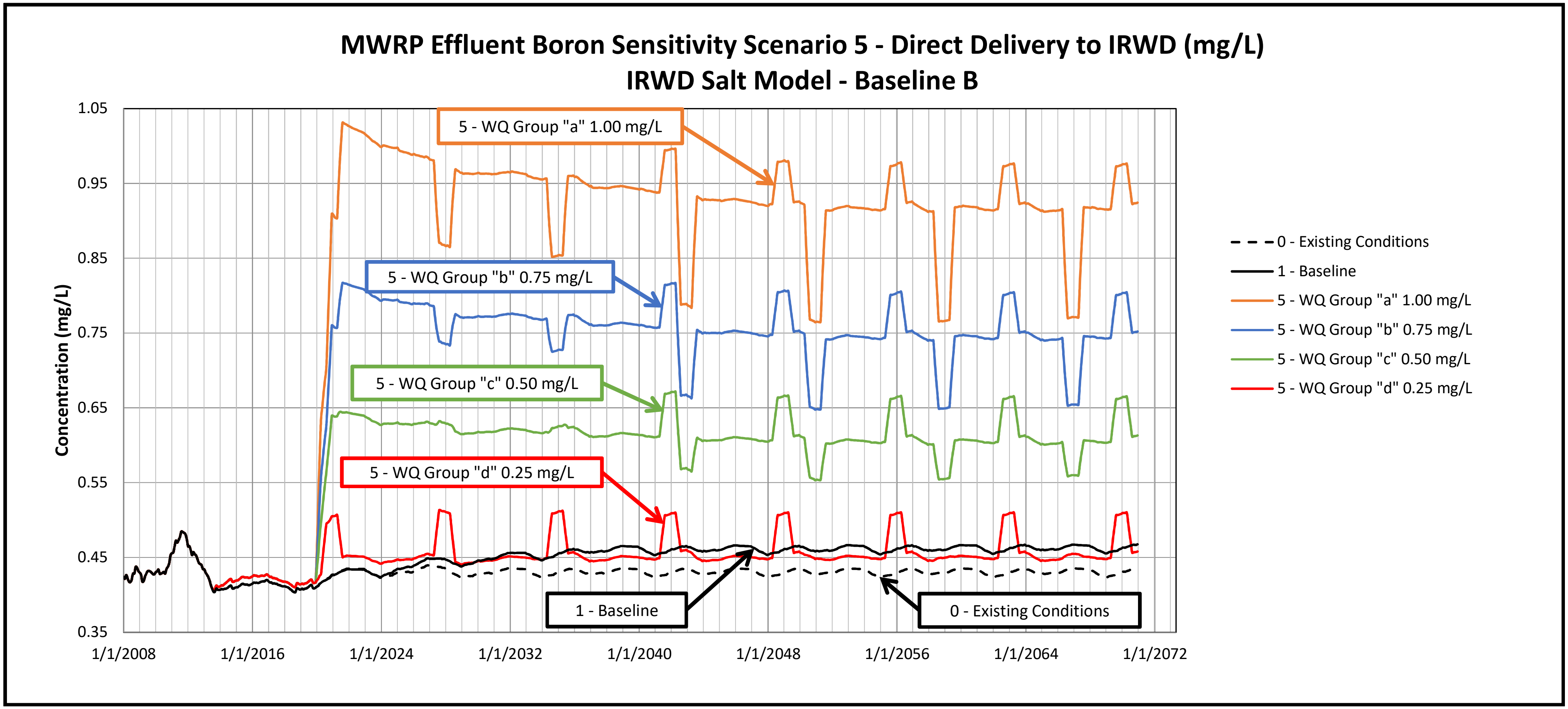

MWRP Effluent Boron Sensitivity Scenario 5 - Direct Delivery to IRWD (mg/L)
IRWD Salt Model - Baseline A
Concentration (mg/L)
1.05
0.95
0.85
0.75
0.65
0.55
0.45
0.35
1/1/2008
1/1/2016
1/1/2024
1/1/2032
1/1/2040
1/1/2048
1/1/2056
1/1/2064
1/1/2072
5 - WQ Group "a" 1.00 mg/L
5 - WQ Group "b" 0.75 mg/L
5 - WQ Group "c" 0.50 mg/L
5 - WQ Group "d" 0.25 mg/L
1 - Baseline
0 - Existing Conditions
0 - Existing Conditions
1 - Baseline
5 - WQ Group "a" 1.00 mg/L
5 - WQ Group "b" 0.75 mg/L
5 - WQ Group "c" 0.50 mg/L
5 - WQ Group "d" 0.25 mg/L



MWRP Effluent Boron Sensitivity Scenario 2 - Direct Recharge (mg/L)
IRWD Salt Model - Baseline B
Concentration (mg/L)
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
1/1/2008
1/1/2016
1/1/2024
1/1/2032
1/1/2040
1/1/2048
1/1/2056
1/1/2064
1/1/2072
2 - WQ Group "b" 0.75 mg/L
2 - WQ Group "d" 0.25 mg/L
2 - WQ Group "a" 1.00 mg/L
2 - WQ Group "c" 0.50 mg/L
1 - Baseline
0 - Existing Conditions
0 - Existing Conditions
1 - Baseline
2 - WQ Group "a" 1.00 mg/L
2 - WQ Group "b" 0.75 mg/L
2 - WQ Group "c" 0.50 mg/L
2 - WQ Group "d" 0.25 mg/L


MWRP Effluent Boron Sensitivity Scenario 3 - Plus Coastal In-Lieu (mg/L)
IRWD Salt Model - Baseline B
Concentration (mg/L)
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
1/1/2008
1/1/2016
1/1/2024
1/1/2032
1/1/2040
1/1/2048
1/1/2056
1/1/2064
1/1/2072
3 - WQ Group "b" 0.75 mg/L
3 - WQ Group "d" 0.25 mg/L
3 - WQ Group "a" 1.00 mg/L
3 - WQ Group "c" 0.50 mg/L
1 - Baseline
0 - Existing Conditions
0 - Existing Conditions
1 - Baseline
3 - WQ Group "a" 1.00 mg/L
3 - WQ Group "b" 0.75 mg/L
3 - WQ Group "c" 0.50 mg/L
3 - WQ Group "d" 0.25 mg/L


MWRP Effluent Boron Sensitivity Scenario 4 - Plus Direct Delivery to S. County (mg/L)
IRWD Salt Model - Baseline B
Concentration (mg/L)
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
1/1/2008
1/1/2016
1/1/2024
1/1/2032
1/1/2040
1/1/2048
1/1/2056
1/1/2064
1/1/2072
4 - WQ Group "b" 0.75 mg/L
4 - WQ Group "d" 0.25 mg/L
4 - WQ Group "a" 1.00 mg/L
4 - WQ Group "c" 0.50 mg/L
1 - Baseline
0 - Existing Conditions
0 - Existing Conditions
1 - Baseline
4 - WQ Group "a" 1.00 mg/L
4 - WQ Group "b" 0.75 mg/L
4 - WQ Group "c" 0.50 mg/L
4 - WQ Group "d" 0.25 mg/L



MWRP Effluent Boron Sensitivity Scenario 5 - Direct Delivery to IRWD (mg/L)
IRWD Salt Model - Baseline B
Concentration (mg/L)
1.05
0.95
0.85
0.75
0.65
0.55
0.45
0.35
1/1/2008
1/1/2016
1/1/2024
1/1/2032
1/1/2040
1/1/2048
1/1/2056
1/1/2064
1/1/2072
5 - WQ Group "a" 1.00 mg/L
5 - WQ Group "b" 0.75 mg/L
5 - WQ Group "c" 0.50 mg/L
5 - WQ Group "d" 0.25 mg/L
1 - Baseline
0 - Existing Conditions
0 - Existing Conditions
1 - Baseline
5 - WQ Group "a" 1.00 mg/L
5 - WQ Group "b" 0.75 mg/L
5 - WQ Group "c" 0.50 mg/L
5 - WQ Group "d" 0.25 mg/L

Appendix F. Enhanced Salt Model Methodology

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F Enhanced Salt Model Methodology

This section provides a description of how the Enhanced Salt Model was developed from IRWD's Salt Balance Model and used to estimate the impact of desalinated ocean water on the District's recycled water quality.

IRWD's Salt Balance Model's ability to forecast TDS concentrations ends at year 2035. However, the TH&C's study (2016) indicates the TDS, chloride, and boron impacts from desalinated water injection stabilize after this timeframe. In addition, the model simulates TDS but does not have the ability to model chloride and boron. Finally, many of the model's complexities require significant data and are not expected to change in response to the injection of desalinated ocean water.

Therefore, the Enhanced Salt Model was developed and calibrated to IRWD's Salt Balance Model through 2035. It was extended to December 2070 using TH&C (2019) estimates for the DRWF and repeating other data from 2028 to 2035 when future developments are expected to be operational. It includes chloride and boron using the average historic ratios for Chloride/TDS and Boron/TDS. A simplified relationship was used between source flows, treatment plant inflows, and treatment plant outflows to model the impact of desalinated ocean water on MWRP's recycled water quality. The Enhanced Salt Model builds on the original model and uses historical data to forecast TDS, chloride, and boron concentrations through December 2070. The Enhanced Salt Model input data and development are described in greater detail below and in **Appendix D**.

F.1 IRWD's Updated Salt Balance Model

In order to facilitate the Enhanced Salt Model's operation, IRWD's original Salt Balance Model was modified to run eight additional scenarios for Baseline A and B separately while maintaining its original modeling capabilities. The modifications include the additional ability to accept DRWF TDS concentrations as input for each scenario and run/record separate mass balances. Using these modifications and input from the TH&C, IRWD's Salt Balance Model was used to obtain MWRP effluent TDS concentrations through 2035. These TDS concentrations were then used to calibrate the Enhanced Salt Model to IRWD's Salt Balance Model and account for DRWF lost salt load (DRWF Loss Factor).

For each scenario, TH&C identified an additional amount of groundwater pumping required to maintain the groundwater basin levels. IRWD's Salt Balance Model was updated to incorporate this additional groundwater pumping. Additional BPP and flow information can be found in **Appendix B**. **Figure F-1** and **Figure F-2** represent the resulting change in Basin Pumping Percentage (BPP, calculated as groundwater production divided by total demand) when compared to the existing conditions. The BPP percentage defines the allowable groundwater pumping for IRWD and establishes the distribution of source water. **Figure F-2** and **Figure F-4** represents the resulting groundwater pumping that exceeds the cap imposed on DRWF pumping, which is set to be equal to or below the pre-established (existing condition) imported water use.

Figure F-1. IRWD - Effective Basin Pumping Percentage (BPP %) – Baseline A

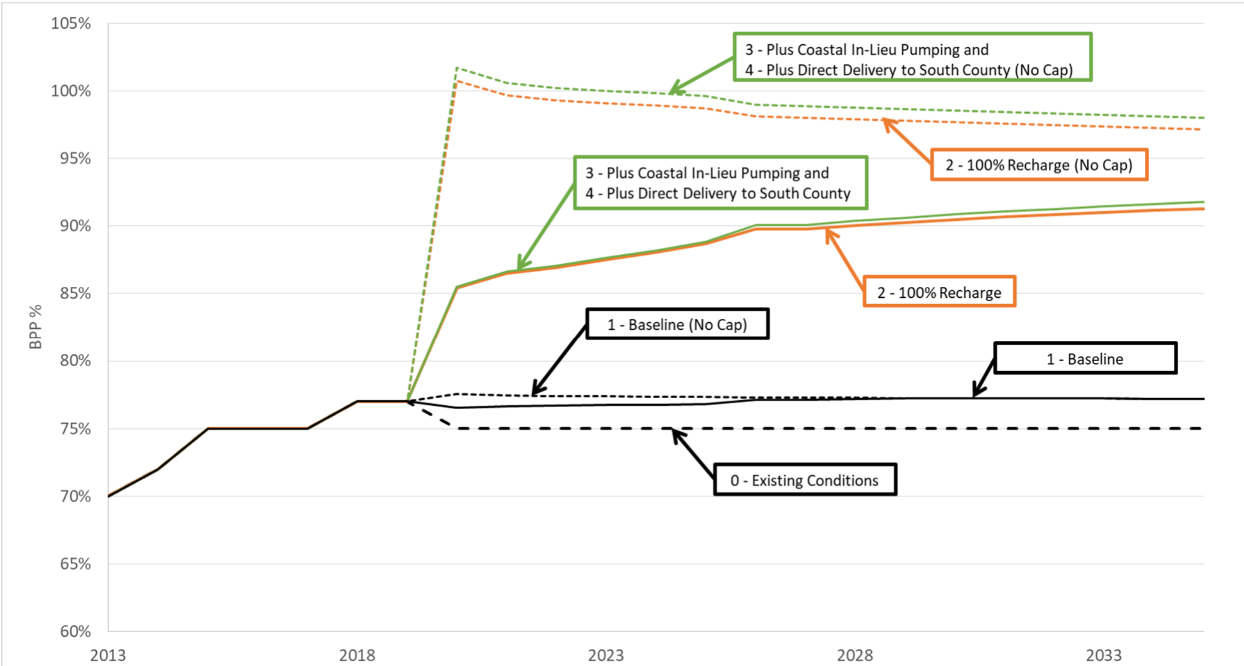


Figure F-2. Groundwater Pumping Beyond Cap – Baseline A

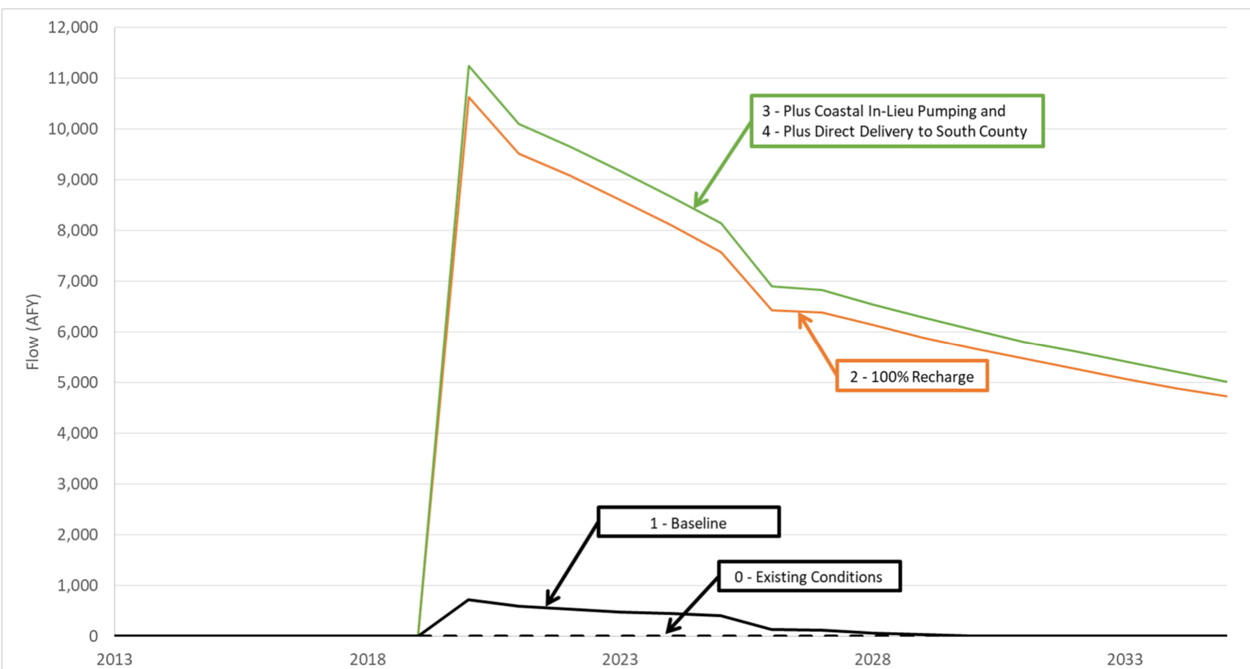


Figure F-3. IRWD - Effective Basin Pumping Percentage (BPP %) – Baseline B

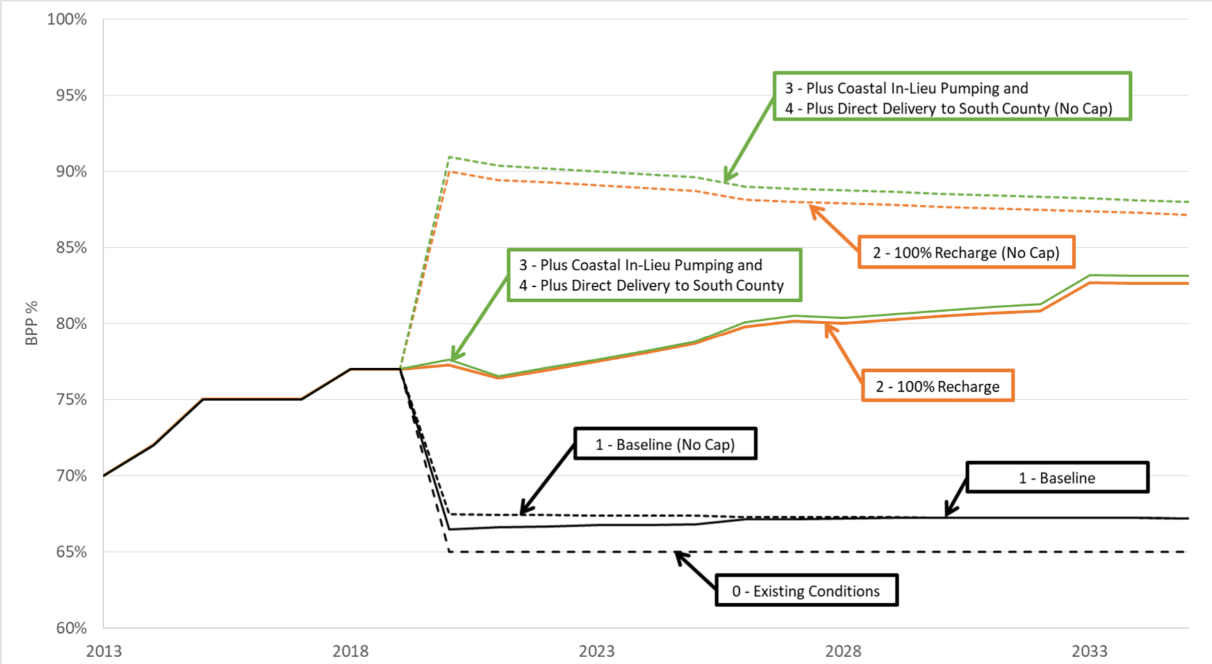
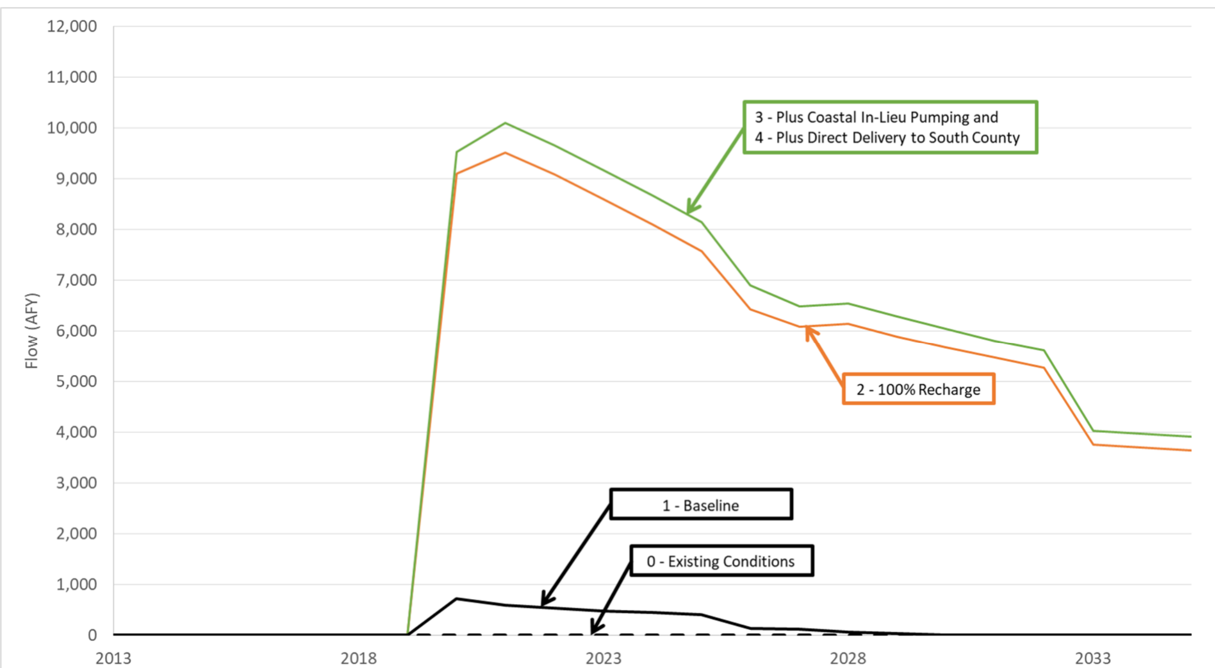


Figure F-4. Groundwater Pumping Beyond Cap– Baseline B



The model accounted for additional groundwater pumping from TH&C by incorporating the flows and redistributing the pre-established source water demands for each scenario on a monthly basis. Depending on the scenario selected, the model reads the concentration input provided for DRWF and the additional groundwater pumping required. For each month, additional flow is then distributed amongst the source water by adding the capped flow to DRWF and subtracting from the imported water use. The cap on additional pumping is set to match the total imported water use previously established for that month. Flow that exceeds this cap will require other groundwater pumping outside of IRWD's system to maintain the groundwater basin level; these values for each scenario are represented in **Figure F-2** and **Figure F-4** above. These modifications provide consistency with TH&C assumptions for groundwater pumping and provide the ability for the model to simulate multiple scenarios with varying flow and concentrations.

F.2 Data Collection

The Enhanced Salt Model uses the available data from IRWD's Salt Balance Model except for the DRWF concentrations; these were replaced with the results from TH&C's analysis (2019) for TDS, chloride, and boron for years 2020 to 2070. Data used in the Enhanced Salt Model was obtained from IRWD historical measurements, IRWD's Salt Balance Model projections/estimates, and TH&C's groundwater study (2019). The historical data measurements included TDS, chloride, and boron concentrations from January 2004 to May 2016 for the following sources: MWRP influent, MWRP effluent, and DRWF effluent. The time period of the historical data used, ranged from January 2004 to May 2016. Collected data used by the model includes:

- Flow from IRWD's Salt Balance Model (2008 to 2035)
- TDS from IRWD's Salt Balance Model (2008 to 2035)
- Historical TDS, chloride, and boron measurements from MWRP influent and effluent (2008 to 2016)
- Historical TDS, chloride, and boron measurements from DRWF (2004 to 2015)
- Historical TDS, chloride, and boron measurements from Imported (2007 to 2016)
- Projected TDS, chloride, and boron concentrations for DRWF provided by TH&C (2020 to 2070)

F.3 Determining Unknown Data

The Enhanced Salt Model includes a simplified approach to estimate future TDS, chloride, and boron concentrations. Several different methods were used to obtain flow and concentration data that was not readily available in IRWD's Salt Balance Model. These methods include historically determined ratios, cycling known concentrations, and maintaining flow trends, which are described in this section, **Section F.4** and **Section F.5** of this report.

F.3.1 Historic Ratios

Since IRWD's Salt Balance Model was created to predict TDS concentrations, the available TDS data required identifying average ratios based on historic data to estimate the corresponding chloride and boron concentrations. Average Chloride/TDS and Boron/TDS ratios were determined from historical TDS, chloride, and boron concentrations at MWRP influent, MWRP effluent, DRWF, and Imported Sources at Diemer. The Chloride/TDS and Boron/TDS ratios were then used to define unknown terms in Scenario 0 such that a simplified mass balance could be achieved to reflect

IRWD's Salt Balance Model results. Once the mass balance was created to match IRWD's Salt Balance Model, the ratios were not used.

In addition, a TDS concentration ratio for MWRP influent to MWRP effluent was required to define MWRP influent TDS concentrations as this data was not readily available in IRWD's Salt Balance Model.

F.3.2 Concentrations beyond Year 2035

The use of historical data and projected data estimates in IRWD's Salt Balance Model made it possible to define unknown terms for years 2008 to 2035, but TH&C results (2016) indicate that the TDS, chloride, and boron concentrations stabilize after year 2035. Therefore, concentrations beyond year 2035 used concentration data cycled every 7 years from years 2028 to 2035 after all anticipated future system developments were expected to be operational.

F.3.3 Flow Rates beyond Year 2035

Flow data for years beyond 2035 were not simply cycled every 7 years but were calculated to maintain the same flow trend that was observed prior to year 2035. The flow rates were set to increase at the same rate as they did from years 2008 to 2035. Additionally, the MWRP influent and MWRP effluent flow rates were capped at MWRP's 33 MGD capacity for Phase 3 expansion, which has not yet occurred.

F.4 2019 Enhanced Salt Model Development

IRWD's Salt Balance Model estimates TDS concentrations out to year 2035. The Enhanced Salt Model estimates MWRP effluent TDS, chloride, and boron concentrations based on the change in DRWF water quality to year 2070 and uses the TDS from years 2008 to 2035 from IRWD's Salt Balance Model as a check for accuracy and calibration.

Enhanced Salt Model modifications were incorporated to provide modeling consistency between the IRWD Salt Model and TH&C scenario development. The DRWF flow and concentration data provided by TH&C change for each scenario, which required modifications to the original salt modeling methodology.

F.4.1 Enhanced Salt Model Calibration (DRWF Loss Factor)

For this analysis, the only input concentration that changes for each scenario is DRWF TDS, chloride, and boron. The Enhanced Salt Model is a simplified version of IRWD's Salt Balance Model and does not have a method for independently determining the salt load lost from DRWF once it is changed from Scenario 0. Essentially, Scenario 0 in the Enhanced Salt Model is a snapshot of the IRWD's Salt Balance Model calculation. Therefore, the Enhanced Salt Model was calibrated to IRWD's Salt Balance Model in order to determine the loss factor for DRWF salt load. This loss factor is nearly 0.5, which means that 50% of the salt load added to the system by DRWF will reach MWRP effluent. This loss factor allows the simplified model to account for the loss in DRWF salt load as it moves through the sewershed stage (Stage 2). After applying this loss factor, the TDS results between both models were sufficiently close with a maximum single month percent difference in TDS (from 2008 to 2035) of 7.71% for the worst case scenario; this occurs for Scenario 5b in Baseline A. For Baseline B, the percent difference was greater during in-lieu periods due to the higher effluent concentrations that appear in these months. **Table F-1** below is a summary of the maximum single month percent differences between the TDS estimated by the Enhanced Salt Model and IRWD's Salt Balance Model for each scenario. The average percent difference for all scenarios was minimize to zero percent.

Table F-1. Enhanced Salt Model & IRWD's Salt Balance Model Comparison

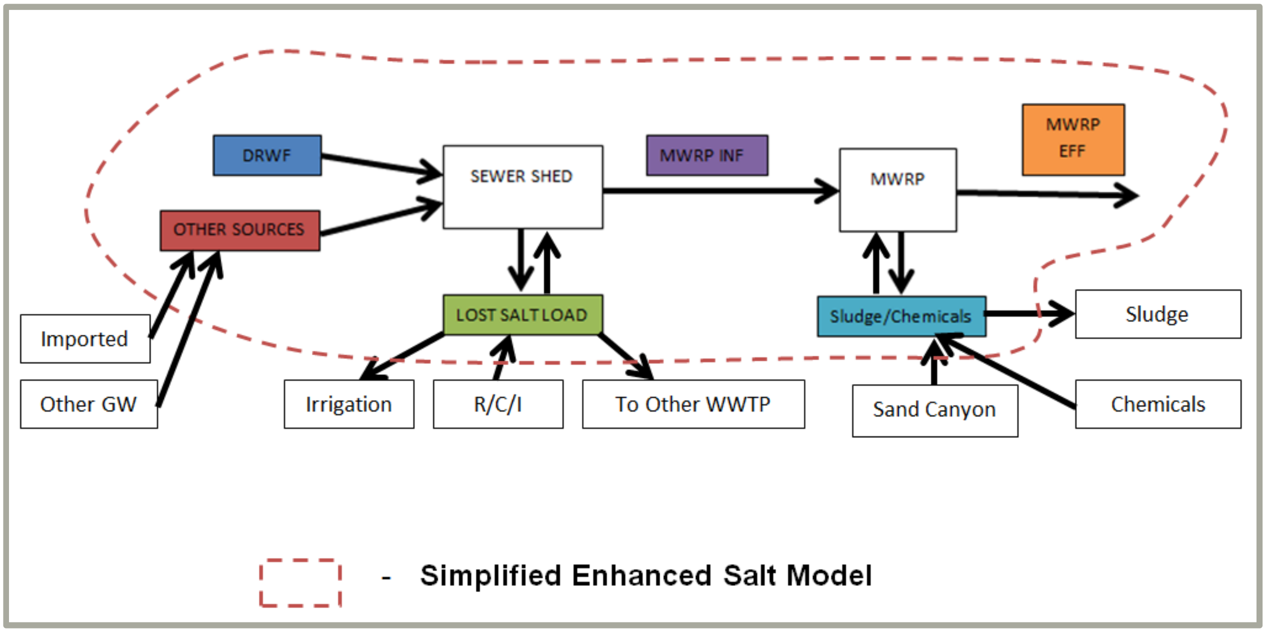
Description	Max % Single Month Difference	
	IRWD Salt Model Baseline A	IRWD Salt Model Baseline B
0 - Existing Conditions	0.00% (0.00 mg/L)	0.00% (0.00 mg/L)
1 - Baseline	1.48% (9.69 mg/L)	1.55% (10.48 mg/L)
WQ Group "a" - Poseidon TDS 350 mg/L		
2a - Direct Recharge	4.81% (30.48 mg/L)	4.91% (31.88 mg/L)
3a - Plus Coastal In-Lieu	4.16% (26.47 mg/L)	4.44% (28.90 mg/L)
4a - Plus Direct Delivery to S. County	4.63% (29.39 mg/L)	4.92% (31.93 mg/L)
5a - Direct Delivery to IRWD	0.00% (0.00 mg/L)	0.00% (0.00 mg/L)
WQ Group "b" - Poseidon TDS 150 mg/L		
2b - Direct Recharge	5.41% (34.20 mg/L)	5.52% (35.67 mg/L)
3b - Plus Coastal In-Lieu	4.69% (29.74 mg/L)	5.00% (32.38 mg/L)
4b - Plus Direct Delivery to S. County	4.85% (30.71 mg/L)	5.15% (33.34 mg/L)
5b - Direct Delivery to IRWD	7.71% (46.79 mg/L)	7.30% (13.55 mg/L)

NOTES:
1) mg/L = milligrams per liter

F.4.2 Methodology

This section provides a brief description for each component of the Enhanced Salt Model, which simplifies its more complex and data intensive parent model—IRWD's Salt Balance Model. The mass balances included in the Enhanced Salt Model are diagrammed in **Figure F-5** below. The colored boxes (e.g. DWRF, Other Sources, etc.) represent the elements that are included in the Enhanced Salt Model. The uncolored boxes (Imported, other groundwater (GW), etc.) represent key inputs that are combined and represented by the colored boxes. **Section F.4.3** provides a more detailed discussion of the Enhanced Salt Model methodology.

Figure F-5. Enhanced Salt Model Process Diagram



The Enhanced Salt Model employs a two-part calculation. Part 1 estimates the dependent salinity sources (DRWF, Other Sources, Lost Salt Load, MWRP Influent (INF), and Sludge/Chemicals) based on Scenario 0, which are then held constant for the remaining analysis. Once these terms are defined, Part 2 uses the new input data for DRWF to determine the MWRP effluent TDS, chloride, and boron concentrations. Following is a description of each Enhanced Salt Model component presented in **Figure F-5**.

Dyer Road Well Field

DRWF water quality is expected to change in response to the injection of desalinated ocean water. It was estimated for each part of the calculations as follows:

Part 1: From DRWF TDS, chloride, and boron historical data, the average Chloride/TDS and Boron/TDS ratios were calculated to be approximately 8% and 0.08% respectively. This data was used with TDS data from IRWD's Salt Balance Model to calculate chloride and boron concentrations for the years not projected from TH&C's study (2008 to 2016). From January 2020 to December 2070, TH&C (2019) provided TDS, chloride, and boron concentrations for all scenarios in this analysis. For Part 1, the TDS, chloride, and boron values for DRWF were only used for Scenario 0.

Part 2: For the second part of the Enhanced Salt Model, the values for DRWF TDS, chloride, and boron from TH&C (2019) were adjusted with the DRWF loss factor to account for a loss of salt load through the sewershed. The adjusted values were then used to calculate MWRP influent (INF) and effluent (EFF) TDS, chloride, and boron for each scenario.

Other Sources

The water quality from “Other Sources” includes imported supplies and groundwater supplies other than DRWF. This was expected to remain unchanged in response to the injection of desalinated ocean water and estimated as follows:

For Parts 1 and 2 of the calculation, the flow rates, TDS, chloride, and boron for the “Other Sources” were combined into one term to simplify calculations. Since each source had a unique salt concentration and flow associated with it, a calculation was performed to find a mass balanced concentration for the combined flow. The TDS concentration and flow for each source was copied from IRWD’s Salt Balance Model. The associated chloride and boron concentrations were calculated from the historic Chloride/TDS and Boron/TDS ratios, respectively, and the predicted TDS concentrations. IRWD’s Salt Balance Model imported sources at MWD’s Diemer WTP have an average Chloride/TDS ratio of 16% and an average Boron/TDS ratio of 0.04% for imported sources. As previously stated, the average DRWF Chloride/TDS and Boron/TDS ratios are 8% and 0.08% based on historic data. This ratio was estimated to be consistent for the groundwater flows in “Other Sources.”

Lost Salt Load

Lost salt load includes all flow and salt that does not go to MWRP Influent. This includes flows and salts that go to other treatment facilities, flows and salts lost by irrigation and other means, and a proportional amount of additional salts that are added into the system by residential, commercial and industrial users. IRWD’s Salt Balance Model analyzes this salt load in greater detail, but the calibration between the Enhanced Salt Model and IRWD’s Salt Balance Model accounts for any loss in accuracy.

Part 1: TDS, chloride, and flow are calculated from a mass balance equation for Scenario 0.

Part 2: The values that are calculated in Part 1 are held constant to allow for the calculation of MWRP INF with the new concentrations for DRWF.

MWRP INF (Influent)

The MWRP inflow water quality is expected to change in response to the injection of desalinated ocean water. It was estimated for each part of the calculations as follows:

Part 1: MWRP INF flows were taken from IRWD’s Salt Balance Model for the Baselines. MWRP INF TDS for Scenario 0 was calculated from the MWRP INF to EFF TDS ratio based on historical data; the INF/EFF ratio was calculated to be roughly 97%. The historical Chloride/TDS ratio of 20% was used to calculate the chloride concentration for MWRP INF. The historical Boron/TDS ratio of 0.06% was used to calculate the boron concentration for MWRP INF.

Part 2: MWRP INF TDS, chloride, and boron calculations were based on the flows from IRWD’s Salt Balance Model baselines with the changed DRWF salt concentrations.

Sludge/Chemicals (Within MWRP)

The sludge/chemical load includes all flow and salt that is either added or removed before the MWRP EFF is measured. This can include flows and concentrations that leave as sludge, enter as chemicals, or enter from Sand Canyon reservoir before the MWRP EFF is measured. The load was estimated for each part of the calculations as follows:

Part 1: Sludge/Chemicals are calculated from the mass balance across MWRP using the values calculated for INF and EFF from historical ratios and data.

Part 2: The flow and concentrations found in Part 1 are set as constants in order to use a mass balance with the new values for MWRP INF based on changes in DRWF concentrations to calculate MWRP EFF.

MWRP EFF (Effluent)

The MWRP effluent water quality is expected to change in response to the injection of desalinated ocean water. It was estimated for each part of the calculations as follows:

Part 1: MWRP EFF flow and TDS values taken from IRWD's Salt Balance Model modeling Scenario 0 DRWF TDS data. Historical Chloride/TDS ratios were used to calculate MWRP EFF chloride concentrations. Historical Boron/TDS ratios were used to calculate MWRP EFF boron concentrations.

Part 2: The MWRP EFF TDS, chloride, and boron were calculated in the final step of the model using the updated DRWF TDS, chloride, and boron values.

F.4.3 Methodology for Enhanced Salt Model Modifications

TH&C developed a total of eight scenarios for their groundwater modeling effort to determine the impacts to DRWF concentrations for TDS, chloride, and boron; **Section 2.3** and **Section F.5** provide detailed descriptions of this scenario development. The Enhanced Salt Model required modifications to incorporate TH&C's groundwater modeling results and provide consistency with their methodology. The Enhanced Salt Model was originally developed to extend the results of the original IRWD Salt Model beyond year 2035 and to include additional constituents (chloride & boron). The model was designed to maintain consistent flow for each scenario, and modify results based on changing DRWF concentrations only. Now that each scenario has varying flow and concentration for DRWF and source water (flow only), each scenario has its own Microsoft Excel workbook for the Enhance Salt Model portion. Separating the modeling components in this manner is necessary since the Enhanced Salt Model requires a basis of comparison for each scenario with unique system flows. Using Scenario 0 concentrations as a basis of comparison allows the Enhanced Salt Model to operate as originally designed and provides a basis for comparison between scenarios with independent flow and concentration data.

The methodology for Scenario 5 was based on a previously evaluated scenario from the 2015 RWSMP to maximize the direct use (via pipeline) of available desalinated Poseidon water in IRWD's service area to meet demand by replacing non-exempt groundwater supplies (Poseidon Max). Modifications to the Enhanced Salt Model were required to include this scenario within this evaluation. Scenario 5 evaluated direct potable use of desalinated Poseidon water while using the TH&C identified concentrations and flow for DRWF to match Scenario 1 and included additional recharge from GWRS Final Expansion. The Enhanced Salt Model was modified to include DRWF as a constant source water while evaluating the change in Poseidon water as a direct source.

F.5 Scenario Description

IRWD selected all eight TH&C (2019) scenarios for analysis and two Direct Delivery to IRWD scenarios to estimate the TDS, chloride, and boron impact to MWRP recycled water effluent using the Enhanced Salt Model. IRWD selected these scenarios based on the different options being investigated by OCWD for the use and recharge of desalinated ocean water and their likeliness to occur. All scenarios were modeled for both Baseline A and B.

F.5.1 Scenario Parameters

The main differences between the scenarios are the location, flows, and concentrations at which desalinated ocean water will be injected, as previously described in **Section 2.3**. Water injected at the TIB can be either desalinated ocean water or GWRS water. Water injected at the MBIP must exclusively be GWRS or a blend of GWRS with desalinated ocean water, because these waters are conveyed to the MBIP and Forebay through a common pipeline.

For these scenarios, water quality parameters were consistent with those in TH&C's evaluation (2019):

- Poseidon desalinated ocean water: 350 or 150 mg/L TDS, 100 or 75 mg/L chloride, and 1.00 or 0.75 mg/L boron
- GWRS product water: 48 mg/L TDS, 6 mg/L chloride, and 0.25 mg/L boron
- Ambient DRWF groundwater: 257 mg/L TDS, 21 mg/L chloride, and 0.17 mg/L boron

Amy & Curtis, consider including the Baseline A & B discussion and pumping cap issues from the Executive Summary here..

F.5.2 Modeled Scenarios

The following are detailed descriptions of each scenario that are summarized in **Table F-2**.

Scenario 0 – Existing Condition

Scenario 0 represents the existing condition of GWRS at its current production capacity prior to GWRS Final Expansion and the Poseidon Project. A total of 28 MGD is injected into 26 TIB wells, and 1.6 MGD is injected into the existing MBIP well. These wells are located within the GFSTM study area. The remaining flows are delivered to recharge basins in the Forebay. A total of 100 MGD is delivered.

Scenario 1 – Baseline (GWRS Final Expansion Recharge)

Injected water is 130 MGD of GWRS Final Expansion only; no Poseidon water is injected. A total of 28 MGD is injected using the 36 TIB wells, and 8 MGD is injected using the 5 MBIP wells. These wells are located within the GFSTM domain. To maintain the water balance, the pumping rates for extraction wells within the GFSTM domain are proportionally increased 6.4 MGD to account for the GWRS Final Expansion within the model area and the four additional MBIP wells in Centennial Park. The injection rates are uniform. The remaining GWRS is assumed to be delivered to recharge basins in the OCWD Forebay. A total of 130 MGD is delivered.

Scenario 2 – Direct Recharge (GWRS Final Expansion and Poseidon)

Injected water is 34 MGD of Poseidon water at the TIB and SETIB. A blend of 16 MGD Poseidon water and 130 MGD GWRS Final Expansion water are delivered to the GWRS pipeline for injection and delivery to the Forebay. To maintain the water balance, the extraction wells within the GFSTM domain are proportionally increased 34.9 MGD to account for the GWRS expansion and Poseidon water delivered into the model area. A total of 180 MGD is delivered.

Scenario 3 – Plus Coastal In-Lieu (Recharge GWRS Final Expansion and Poseidon plus Coastal In-Lieu)

A total of 11 MGD of Poseidon water is delivered as surface water in-lieu of pumping to coastal districts. Similar to Scenario 2, injected water at the TIB and SETIB is Poseidon water but at a lower rate of 23 MGD to account for the 11 MGD provided in-lieu of pumping. A blend of Poseidon water at 16 MGD and GWRS Final Expansion at 130 MGD are delivered to the GWRS pipeline for injection and delivery to the forebay. To maintain a water balance, the extraction wells within the GFSTM domain are proportionally increased by 34.9 MGD to account for the GWRS expansion and Poseidon water delivered to the model area. A total of 180 MGD is delivered.

Scenario 4 – Plus Direct Delivery to South County (Recharge GWRS Final Expansion and Poseidon + Coastal In-Lieu + South County Delivery)

Similar to Scenario 3, 11 MGD of Poseidon water is delivered as surface water in-lieu of pumping to coastal district, and injected water at the TIB and SETIB is Poseidon water at 23 MGD. In addition, a total of 10 MGD of Poseidon water is delivered to South County. The remaining 6 MGD of Poseidon water and 130 MGD of GWRS Final Expansion water is delivered to the GWRS pipeline for injection and delivery to the Forebay. To maintain a water balance, the extraction wells within the GFSTM domain are proportionally increased by 34.9 MGD to account for the GWRS expansion and Poseidon water delivered into the model area. A total of 180 MGD is delivered.

Scenario 5 – Direct Delivery to IRWD (Poseidon Direct Delivery to IRWD + Recharge GWRS Final Expansion + South County Delivery)

This scenario incorporates the groundwater injection flows and increased pumping from Scenario 1. In addition, 43.2 MGD of Poseidon water is involuntarily delivered as direct potable water to IRWD in-lieu of imported water and non-exempt groundwater. As previously mentioned, Scenario 5 was based on a previously evaluated scenario from the 2015 RWSMP.

Table F-2. Enhanced Salt Model Flow Summary

Scenario	System	Delivery Water (MGD)						
		GWRS	GWRS Subtotal	Poseidon	Poseidon Subtotal	GWRS/ Poseidon Blend	GWRS/ Poseidon Blend Total	Total
0	TIB	28	100	0	0	0	0	100
	MBIP	1.6		0		0		
	Proposed IWs (model area)	0		0		0		
	to the Forebay and northern IWs	70.4		0		0		
	Coastal Pumpers	0		0		0		
	South County	0		0		0		
1	TIB	28	130	0	0	0	0	130
	MBIP	8		0		0		
	Proposed IWs (model area)	0		0		0		
	to the Forebay and northern IWs	94		0		0		
	Coastal Pumpers	0		0		0		
	South County	0		0		0		
2a and 2b	TIB + SETIB	0	0	34	34	0	146	180
	MBIP	0		0		8		
	Proposed IWs (model area)	0		0		22.5		
	to the Forebay and northern IWs	0		0		115.5		
	Coastal Pumpers	0		0		0		
	South County	0		0		0		
3a and 3b	TIB + SETIB	0	0	23	34	0	146	180
	MBIP	0		0		8		
	Proposed IWs (model area)	0		0		22.5		
	to the Forebay and northern IWs	0		0		115.5		
	Coastal Pumpers	0		11		0		
	South County	0		0		0		

Scenario	System	Delivery Water (MGD)						
		GWRS	GWRS Subtotal	Poseidon	Poseidon Subtotal	GWRS/ Poseidon Blend	GWRS/ Poseidon Blend Total	Total
4a and 4b	TIB + SETIB	0	0	23	44	0	136	180
	MBIP	0		0		8		
	Proposed IWs (model area)	0		0		22.5		
	to the Forebay and northern IWs	0		0		105.5		
	Coastal Pumpers	0		11		0		
	South County	0		10		0		
5a and 5b	TIB	28	130	0	50	0	0	180
	MBIP	8		0		0		
	Proposed IWs (model area)	0		0		0		
	to the Forebay and northern IWs	94		0		0		
	Coastal Pumpers	0		0		0		
	IRWD	0		43				
	South County	0		7		0		

NOTES: [1] The maximum available Poseidon supply is 43.2 MGD (RWSMP, 2015).
Source: Evaluation of Potential Effects of Proposed Seawater Desalination Project (TH&C, 2019).

The following are descriptions regarding the determined concentrations for Poseidon, GWRS, and ambient groundwater in the TH&C model.

- **TDS Concentration:**
  - **Poseidon: 350 mg/L or 150 mg/L.** The proposed Term Sheet states that desalinated water quality will meet an average TDS limit of 350 mg/L; however, Poseidon has indicated that the plant will likely produce effluent with 150 mg/L TDS, similar to the existing Poseidon Carlsbad Desalination Plant. The anticipated 150 mg/L TDS was further supported in the “Review of Proposed Water Quality Requirements for the Huntington Beach Desalter” Technical Memorandum (Trussell Technologies, 2016) prepared for OCWD, where a commercial model of desalination systems (ToraySD™) was used to characterize the water quality likely to be produced by Poseidon. The maximum TDS limit of 500 mg/L significantly exceeds this typical concentration. Therefore, the upper TDS level was estimated to be 350 mg/L and the lower value was set to 150 mg/L.
  - **GWRS**: **48 mg/L.** This is based on the 2013 average.

- **Ambient Groundwater: 257 mg/L.** This is based on the 2008-2012 average composite flow from the DRWF.
- **GWRS: 0.25 mg/L.** This is based on the 2013 average.
- **Ambient Groundwater: 0.17 mg/L.** This is based on the 2008-2012 average composite flow from the DRWF.

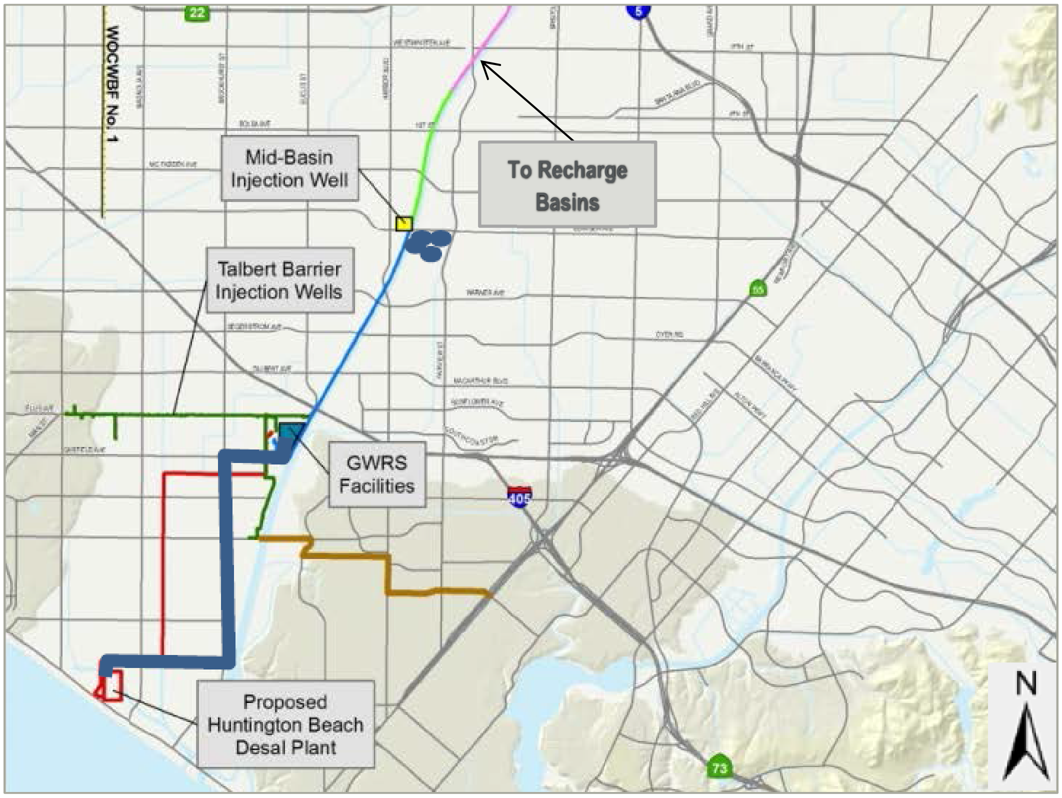
- **Chloride Concentration:**
  - **Poseidon: 75 or 100 mg/L.** The proposed Term Sheet states that desalinated ocean water quality will meet an average chloride limit of 75 mg/L, which is consistent with Poseidon and OCWD's anticipated effluent quality. The proposed Term Sheet also states that the desalinated ocean water quality will meet a maximum chloride limit of 100 mg/L.
  - **GWRS: 6 mg/L.** This is based on the 2013 average.
  - **Ambient Groundwater: 21 mg/L.** This is based on the 2008-2012 average composite flow from the DRWF.
- **Boron Concentration:**
  - **Poseidon: 0.75 or 1.00 mg/L.** The proposed Term Sheet states that desalinated ocean water quality will meet an average boron limit of 0.75 mg/L, which is consistent with Poseidon and OCWD's anticipated effluent quality. The Term Sheet also states that the desalinated ocean water quality will meet a maximum boron limit of 1.00 mg/L.

Table F-3 summarizes the concentrations to be modeled in the Enhanced Salt Model per each scenario.

Table F-3. Enhanced Salt Model Scenario Concentration Summary

Source Water	TDS (mg/L)	Chloride (mg/L)	Boron (mg/L)
GWRS	48	6	0.25
Poseidon Water Quality Group "a"	350	100	1.00
Poseidon Water Quality Group "b"	150	75	0.75

Figure F-6. Desalinated Seawater Injection Conveyance System



Source: OCWD Board of Directors Meeting (June 1, 2016), "Water Quality Study for proposed Poseidon Desalination Project"

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