

SWRCB Real Loss Target Model Sensitivity Analysis

Regional Water Authority

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1 Background & Summary

The SWRCB developed an excel-based real loss performance target model to establish targets for each of the urban retail water suppliers in California. In May of 2021, the Regional Water Authority (RWA) proposed five revisions to the economic model's assumptions and framework:

- **Annual Price Increase: 1.3%** - Change the average annual rise in price of water to 1.3%.
- **Benefit Cost Ratio: 1.5** - Create a buffer for the benefit to cost ratio (BCR) so that only suppliers with a BCR of 1.5 or higher receive a model-calculated water loss target.
- **Evaluation Timeline: 15 Years** - Change the model's evaluation period to 15 years.
- **Maximum Reduction: 30% of Baseline** - Incorporate a 30% cap on percent reduction for a supplier's 2028 target, reassess in 2029.
- **Additional Baseline Years** - Allow suppliers to use 2017-2021 audit data to establish baseline water loss, with the option to have up to 2 outlier years.

The purpose of this report is to evaluate the impact of four of the five revisions on the initial targets for agencies state-wide. The last requested revision for additional baseline years is not included in the sensitivity analysis because an official dataset of economic model inputs for all affected agencies for the 2017-2021 reporting years is not currently available.

WSO used publicly available draft economic model entries along with default values developed by the SWRCB for each of 409 water systems. The latest version of the SWRCB economic model, released in April of 2021, was run 4,090 times to assess each of the proposed revisions separately, and in selected combinations. WSO did not consider the impact of proposed revisions in combination with other potential custom entries that agencies may derive with their own data. The primary findings from this analysis are:

In the current implementation, the SWRCB model is insensitive to the suggested economic input changes.

Targets are primarily driven by assumptions about potential for loss recovery, like the Infrastructure Condition Factor (ICF), and to a lesser extent, the value of recovered water or the costs of recovery. Therefore, changes to the annual price increase of water, altering the benefit cost ratio, and even reducing the evaluation timeline has very modest impacts for a small number of agencies in our dataset.

2.5% - 3.4% of agencies were impacted by any one of these suggested economic revisions with changes in draft targets between 1.7 and 5.3 gal/conn/day less than their targets would have been without the revisions. See Table 1 for a more detailed summary.

The suggested revision of a maximum reduction of 30% from baseline performance had the biggest impact on draft targets.

50% of agencies are affected by this revision and updated targets change between 0.1 and 341 gallons per connection per day greater than current draft targets.

It is worth noting that this revision generates potentially unrealistic results for agencies that reported high levels of loss during baselining years. For example, if an agency reported baseline loss performance of 300 gal/conn/day their target would be limited to 210 gal/conn/day which does not feel reasonable given median real loss performance statewide of approximately 25 gal/conn/day.

It is certainly possible that agencies reporting such high levels of loss during baselining years had errors in underlying data and therefore reported loss rates do not reflect actual loss rates in the field.

Applying combinations of requested revisions modestly increased the number of impacted agencies and the magnitude of that impact.

The combined impact of all revisions except the 30% reduction threshold would change draft targets for 29 agencies with targets in gallons per connection per day and one additional agency with a target in gallons per mile per day. Considering all four revisions together resulted in updated draft targets for 231 agencies, about 56% of the cohort.

Requested revisions may open the possibility for tipping points when applied in combination with adjustments to high-impact parameters like the Infrastructure Condition Factor (ICF).

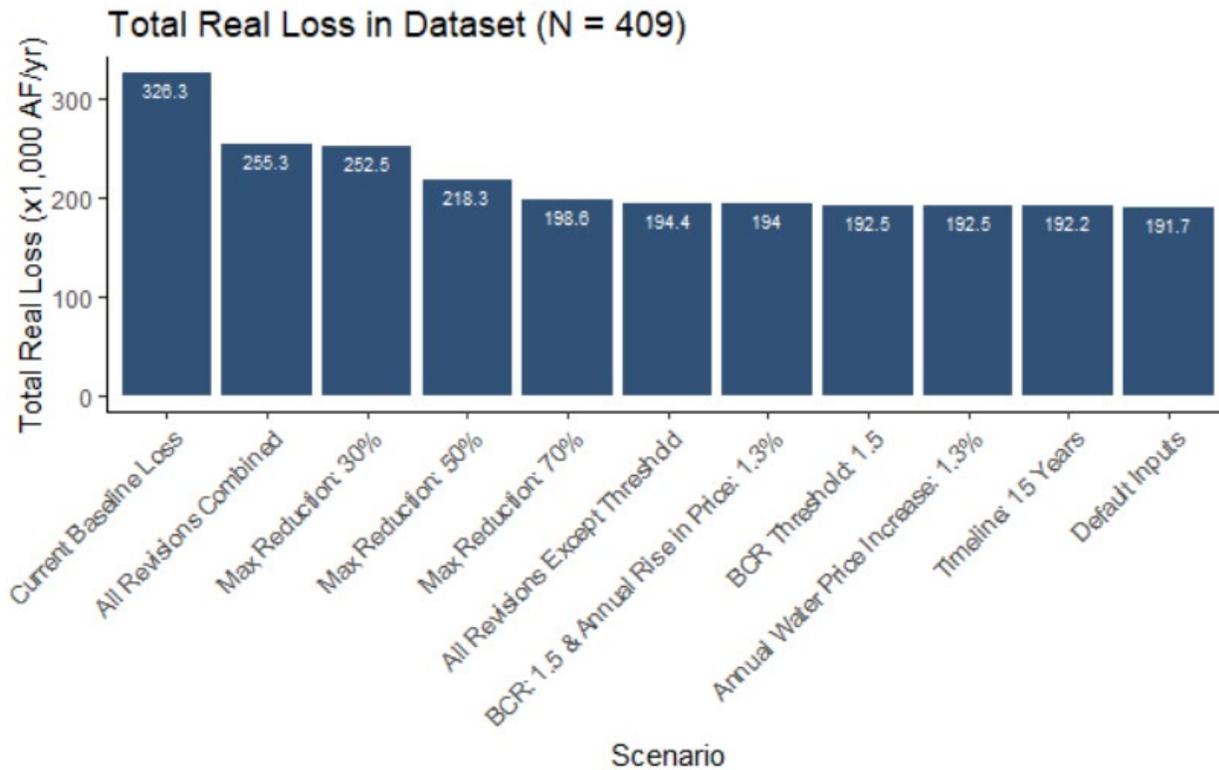
WSO did not analyze the impact of potential agency-specific custom inputs in combination with the requested revisions from RWA for two reasons:

- The level of detail required by the SWRCB to approve custom inputs in the economic model are often unclear.
- It is not possible to foresee which agencies will pursue input customization, what inputs they might seek to customize, and what custom values they will derive for consideration by the SWRCB.

The requested revisions have varied impacts on the total rate of allowable real loss statewide.

The figure below shows the total allowable annual volume of real loss under all scenarios explored, including the current baseline total annual volume of real loss. The maximum percent reduction scenarios had the most significant impact on the total allowable volume. All other revisions had minimal impacts.

Figure 1: Total Allowable Real Loss Under Various Scenarios



* Note that “All Revisions Combined” refers to the Max Reduction: 30%, BCR Threshold: 1.3, Annual Water Price Increase: 1.3%, and Timeline: 15 Years scenarios, not including Max Reduction: 30% or 70%.

The following sections describe the results summarized above in more detail.

2 Results

The results of our analysis are separated into four sections below. First, we show the impact of each requested revision on its own. Then, we detail three scenarios for maximum reduction thresholds of 30%, 50%, and 70%. Next, we show three scenarios of selected combinations of requested revisions. We also show how each revision changes the total allowable rate of real loss to explore the impact of each scenario on the goal of real loss reduction. Finally, we conclude our results for systems with targets expressed in gallons/connection/day with a more thorough exploration of the proportion of agencies impacted by alternative benefit cost ratio thresholds.

Note that for simplicity of presentation, the impacts of all scenarios evaluated on the 14 systems whose targets are expressed in gallons/mile of main/day is limited to the section, “Impacts for Systems with Targets in Gallons per Mile of Main per Day”.

2.1 Discrete Impact of Each Proposed Revision

The impact of each revision alone on the draft performance targets are shown in Table 1 below. The table features a row for each suggested revision and columns that quantify the impact of each revision.

The first column shows the percent of agencies whose targets changed after applying the revision compared to the current implementation of the board’s model with default entries (“the original target”). The second column shows the minimum difference observed by subtracting each agency’s target with the revision applied from the original target. Finally, the maximum and average difference are also provided.

Table 1: Summary of Revision Impacts for Systems with Targets in Gallons / Connection / Day

Scenario	Count & Percent	Minimum Difference (gal/conn./day)	Maximum Difference (gal/conn./day)	Average Difference (gal/conn./day)
	of Targets Changed (N = 395)*			
Annual Price Increase: 1.3%	14, 3.5%	1.7	5.3	3.2
BCR Threshold: 1.5	14, 3.5%	1.7	5.3	3.2
Timeline: 15 Years	10, 2.5%	1.7	4.8	3.0
Max Reduction: 30%	196, 49.6%	0.1	341.1	18.6

**Includes only systems with targets expressed in gallons per connection per day. A later section describes impacts for systems with targets in gallons per mile of main per day.*

Figure 2 shows the impact of each requested revision on the initial targets. The y-axis shows the different requested revisions in addition to the current implementation with default inputs. The x-axis shows the draft target value in gal/conn/day. Points have been plotted for each agency where draft inputs are available (N = 409).

Points colored in blue show targets that have changed compared to the default inputs scenario. Because there is significant overplotting with many overlapping points, boxplots overlay the distribution of points and highlight potential outliers, the 25 percentile, and 75 percentile values in addition to the median value.

It is immediately apparent that the most significant impacts on draft targets are associated with the maximum reduction from baseline of 30%. More points are highlighted in blue and fall well to the right of the targets calculated in the default inputs scenario.

Because the 30% reduction threshold creates several outlying targets, WSO also included Figure 3 that excludes it to show the spread of results under the other scenarios.

Figure 2: Impact of Proposed Revisions for Systems With Targets in Gallons / Connection / Day

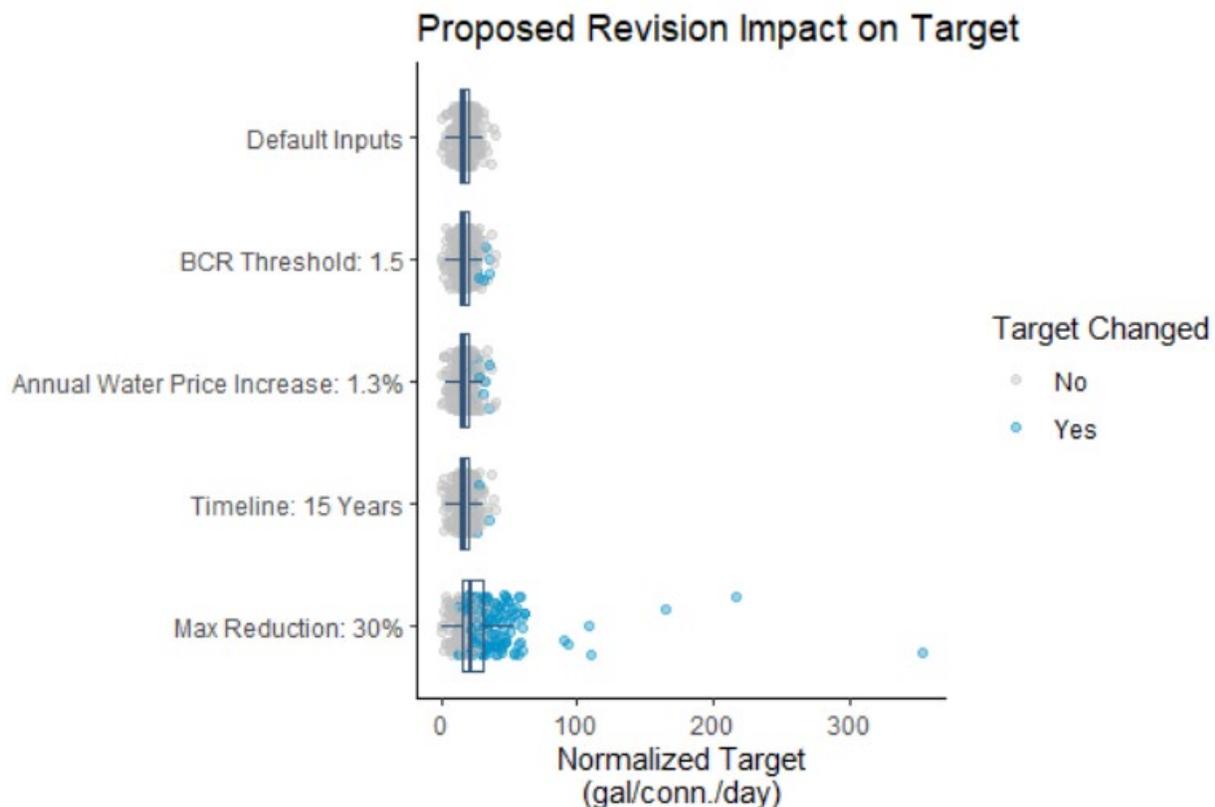
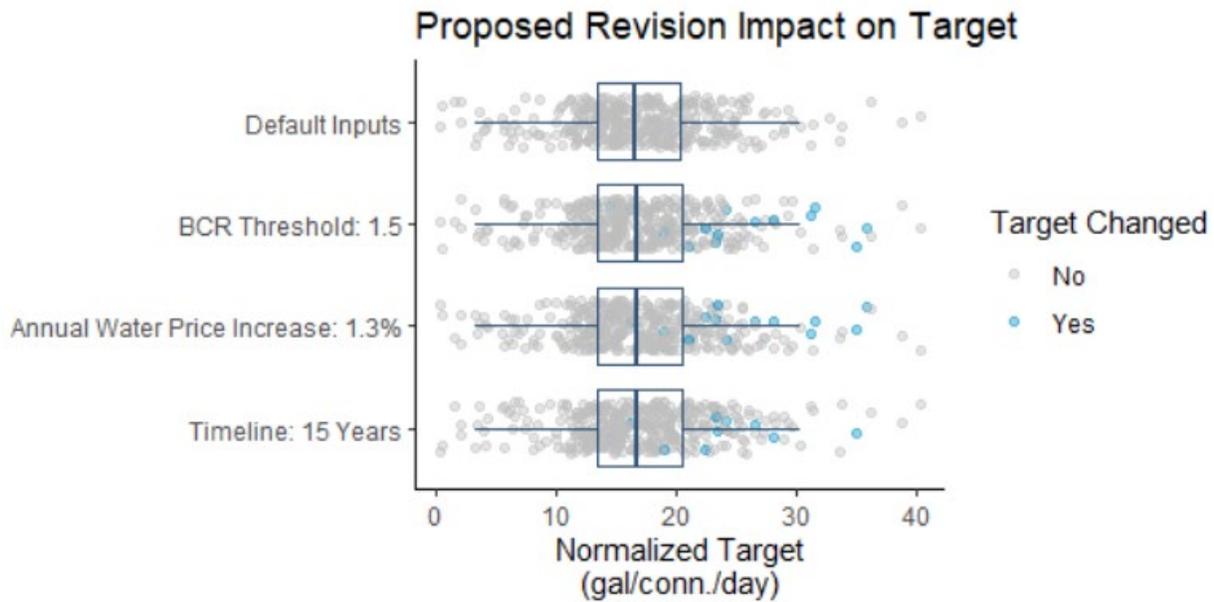


Figure 3: Impact of Proposed Revisions for Systems with Targets in Gallons / Connection / Day Without 30% Reduction Threshold



2.2 Reduction Threshold at 30%, 50%, and 70%

As described above, the maximum reduction threshold of 30% from baseline performance had the most significant impact on the draft targets of any single requested revision. WSO evaluated three scenarios associated with this revision to assess how many agencies would be impacted if the threshold were instead 50% or 70%.

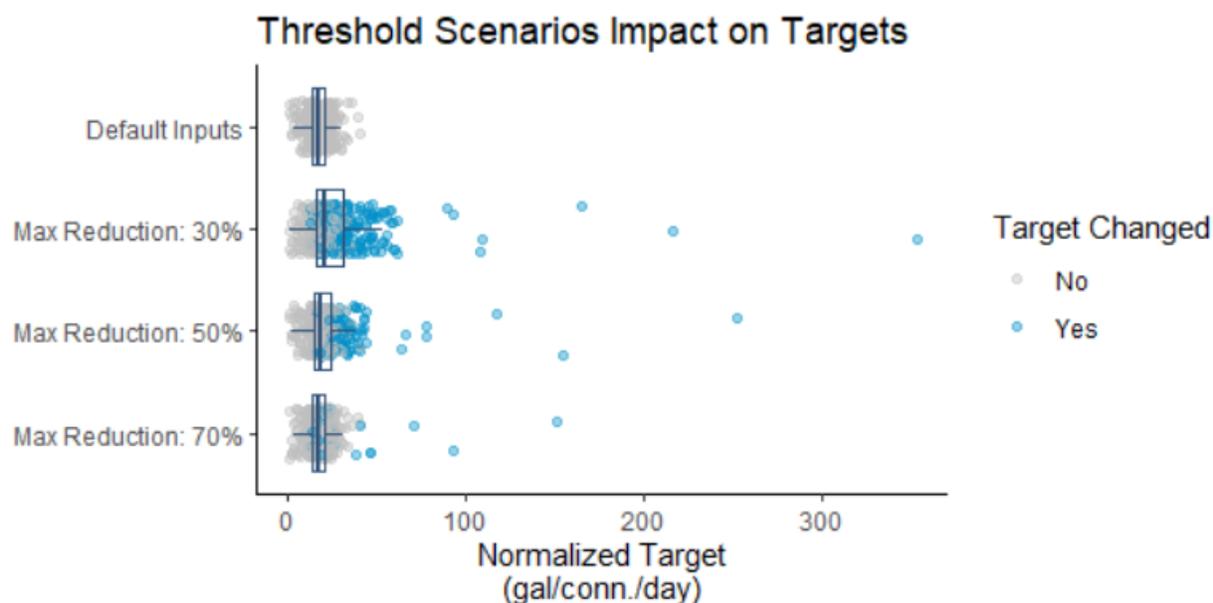
The table and figure below mirror the structure described in the previous section. Changing the maximum reduction threshold to 50% or 70% from baseline performance impacted about 30% and 12% of agencies with targets in gallons per connection per day, respectively.

Importantly, the maximum change in targets was still very large across all scenarios. One agency that reported very high levels of loss in the baselining years would have a target over 100 gallons per connection per day even in the maximum 70% reduction scenario.

Table 2: Impact of Alternative Reduction Thresholds on Targets Gallons / Connection / Day

Scenario	Count & Percent			
	of Targets Changed (N = 395)	Minimum Difference (gal/conn./day)	Maximum Difference (gal/conn./day)	Average Difference (gal/conn./day)
Max Reduction: 30%	196, 49.6%	0.1	341.1	18.6
Max Reduction: 50%	118, 29.9%	0.3	240.1	15.4
Max Reduction: 70%	48, 12.2%	0.3	139.0	12.1

Figure 4: Impact of Threshold Scenarios on Systems with Targets in Gallons / Connection / Day



2.3 Combined Impact of More Than One Revision

WSO assessed three scenarios of combined revisions simultaneously. Since each of the requested revisions impact separate model mechanics or inputs, their combined impact would be greater than any single revision alone.

- A. **All four revisions** were evaluated to assess what the combined impact of all the revisions would be on the draft targets for agencies.
- B. **All four revisions except the 30% reduction threshold** were evaluated to assess the combined impact of the less individually influential revisions (the reduction threshold had the most significant impact on draft targets by itself).
- C. **A benefit cost ratio threshold and annual price increase** were evaluated to highlight revisions for financial inputs that would not change the model's structure by altering the evaluation timeline or introducing a new maximum reduction threshold.

The results of these scenarios are summarized in Table 3 and Figure 5 below. After altering the BCR threshold and the annual rise in water price (Scenario C), 25 agencies had updated draft targets, though the magnitude of the change was still relatively modest falling between 1.7 and 5.5 gallons per connection per day.

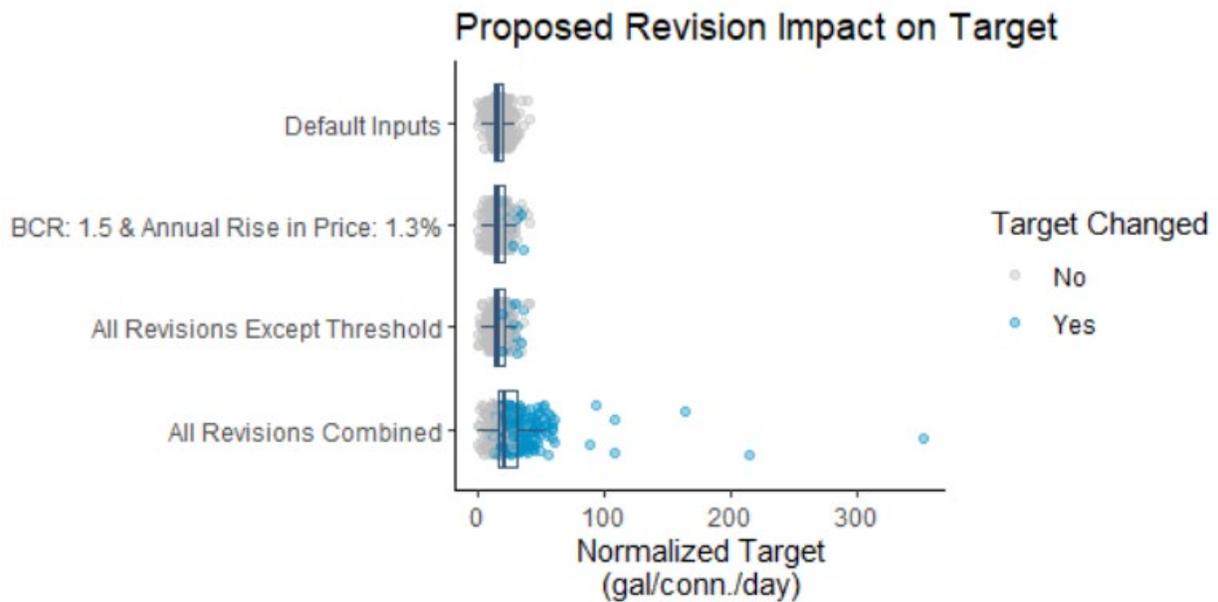
After introducing the reduction in evaluation timeline from 30 years to 15 (Scenario B), an additional 4 agencies were impacted with the same range of target changes (1.7 – 5.5 gal/conn./day).

Finally, considering all four revisions (Scenario A) impacted 57% of agencies and changed targets between 0.1 gallons per connection per day to about 341 gallons per connection per day. Again, the most significant impacts were introduced by including the maximum reduction threshold of 30%.

Table 3: Impact of Selected Revision Combinations on Targets in Gallons / Connection / Day

Scenario	Count & Percent of Targets Changed (N = 395)	Minimum Difference (gal/conn./day)	Maximum Difference (gal/conn./day)	Average Difference (gal/conn./day)
A All Revisions Combined	225, 57.0%	0.1	341.1	16.7
B All Revisions Except Threshold	29, 7.3%	1.7	5.5	3.9
C BCR: 1.5 & Annual Price Rise: 1.3%	25, 6.3%	1.7	5.5	3.7

Figure 5: Impact of Selected Revision Combinations on Systems with Targets in Gallons / Connection / Day



2.4 Exploring Alternative Benefit Cost Ratio Thresholds

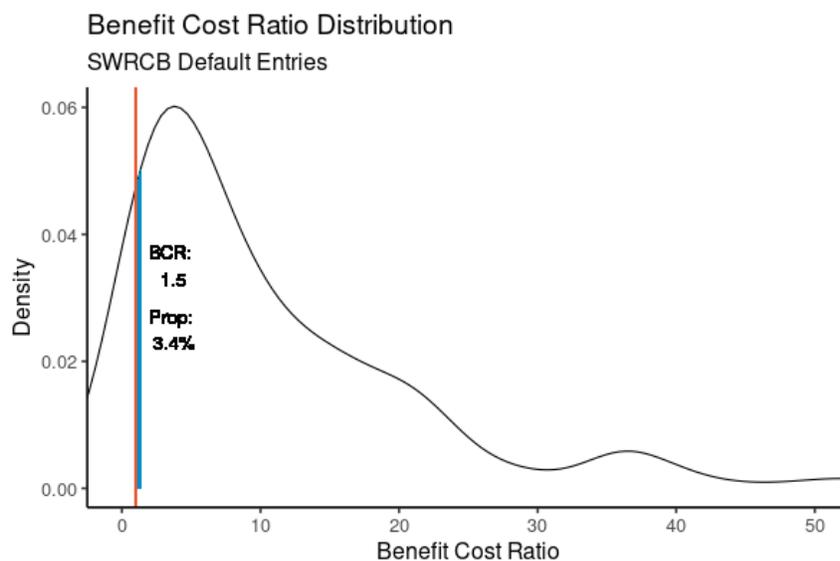
WSO explored the alternative benefit cost ratio (BCR) of 1.5 scenario further to evaluate the proportion of agencies impacted by changing the threshold to various values. The figures shown below are images downloaded from an [interactive data visualization that WSO developed](#) that can be accessed at the link to help evaluate changes to the threshold.

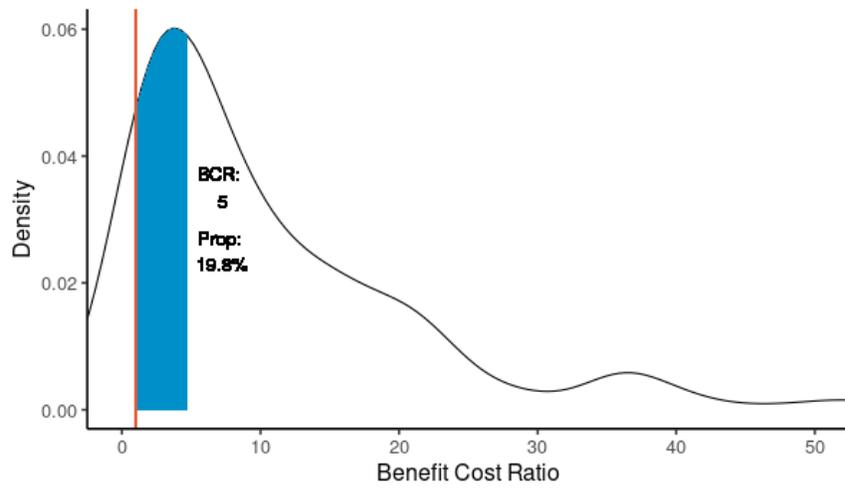
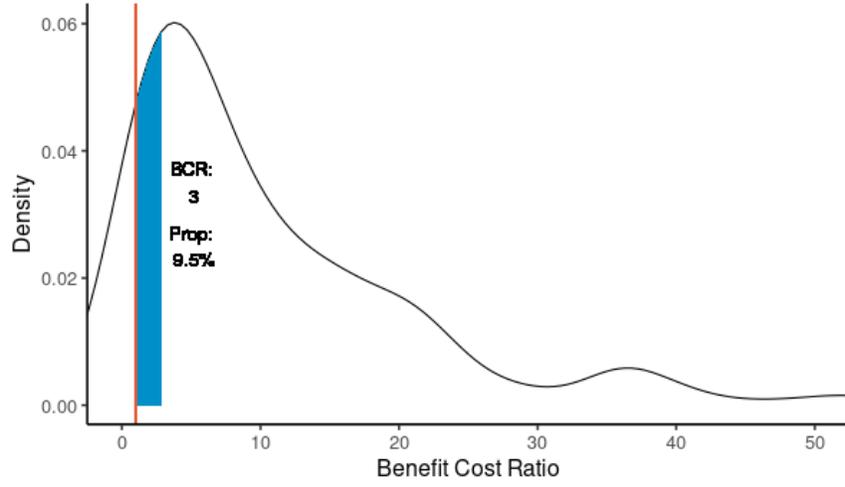
The figure shows the benefit cost ratio on the x-axis with some outliers removed. The height of the black line shows the proportion of agencies that fall within a given range on the x-axis, like a histogram except smoothed. The peaks of the density plot show where most values are concentrated. The higher the density value on the y-axis, the more datapoints fall close to the corresponding value on the x-axis. The vertical orange line shows the current benefit cost ratio threshold proposed by the SWRCB of 1.0 and the blue slice shows the proportion of agencies that fall within a given range.

For example, the first plot shows that changing the benefit cost ratio threshold to 1.5 would result in 3.4% additional agencies required to maintain current performance instead of having a reduction requirement. The subsequent plots show that at a BCR of 3, 9.5% of agencies would be affected and at a BCR of 5, 19.8% of agencies would be affected.

Note that for these figures, WSO considered all agencies irrespective of the target units (N = 409) so there are fractional differences in the percentage of agencies impacted compared to Table 1 which only considers agencies with targets in gallons / connection / day (N = 395).

Figure 6: Exploring Alternative Benefit Cost Ratio Thresholds



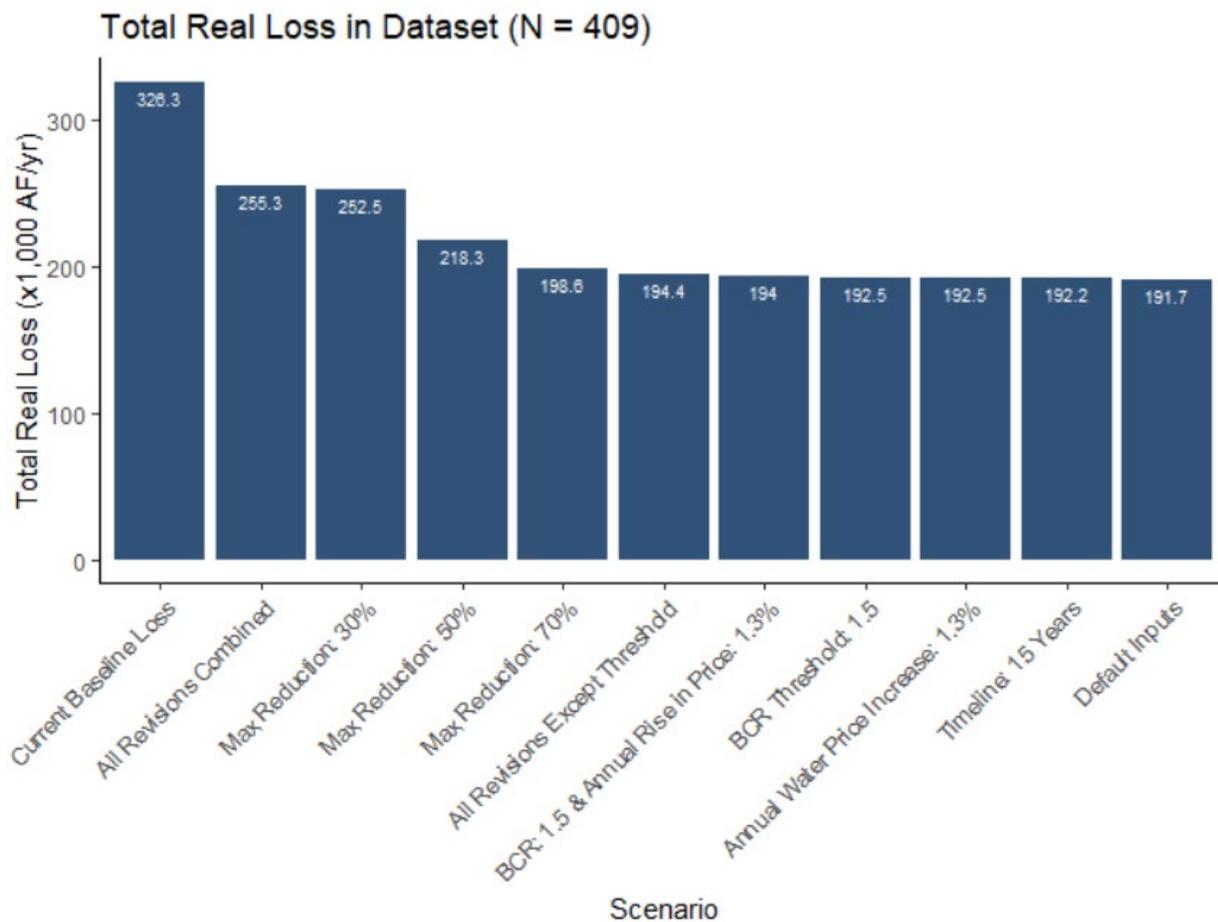


2.5 Proposed Revisions Impact on Total Real Loss Statewide

The primary objective of the performance targets set by the SWRCB is to reduce the total rate of real loss statewide. Therefore, WSO evaluated how the proposed revisions from RWA would impact the total volume of allowable real loss across all agencies in our dataset. Figure 7 below shows the total allowable rate of real loss (1,000 AF/yr) under each scenario explored above.

The bar to the far left shows the total rate of real loss for all agencies in our dataset, the average real loss rate for the three baselining years. The bar on the far right shows the total rate of allowable real loss using the SWRCB’s currently proposed default inputs. Therefore, the difference between these two bars is the proposed total real loss reduction based on the April 2021 draft economic model developed by the board.

Figure 7: Total Allowable Real Loss Under Various Scenarios



* Note that “All Revisions Combined” refers to the Max Reduction: 30%, BCR Threshold: 1.3, Annual Water Price Increase: 1.3%, and Timeline: 15 Years scenarios, not including Max Reduction: 30% or 70%.

2.6 Impacts for Systems with Targets in Gallons per Mile of Main per Day

For simplicity of presentation, WSO presents the impact on systems with targets in gallons/mile of main/day in this separate section. Agencies with a service connection density below 32 connections per mile of main receive water audit key performance indicators in this unique unit because normalizing their loss rates by the count of service connections may not provide a reliable comparison to other systems with higher service connection densities. Since a relatively small number of agencies have targets in these units, visualizations of the data have been foregone in favor of a simple table.

Table 4: Impacts on Systems with Targets in Gallons / Mile of Main / Day

Scenario	Count & Percent of Targets Changed (N = 14)	Minimum Difference (gal/conn./day)	Maximum Difference (gal/conn./day)	Average Difference (gal/conn./day)
All Revisions Combined	6, 42.9%	306.7	3055.0	1472.7
All Revisions Except Threshold	1, 7.1%	306.7	306.7	306.7
Max Reduction: 30%	5, 35.7%	530.8	3055.0	1705.9
Max Reduction: 50%	5, 35.7%	188.7	2032.9	1061.4
Max Reduction: 70%	4, 28.6%	23.6	1010.9	559.4

** Note that scenarios where no differences were observed have been excluded from this table.*