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Technical Memorandum

Prepared for: Vista Irrigation District

Project Title: Flume Replacement Alignment Study

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Subject: Technical Memorandum No. 8 – Economic Balance Scale Modeling

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To: Vista Irrigation District

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Prepared by: ______________________________
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Note: the documents referenced herein are available in the District's records.

Gillingham Water in partnership with Brown and Caldwell (2024). *Economic Balance Scale Model (V.5)*. Microsoft Excel.

HDR (2017). *Potable Water Supply Master Plan*.

Semper, John P. (2023). *Flume Replacement Alignment Study Workshop No. 3 Fine Screening Phase (aka. FRAS Workshop #3 Board Packet)*.

Sprague, Tess; Sytsma, Anneliese (2024). *Flume Replacement Alignment Study (FRAS): Technical Memorandum #7- Predictive Modeling Long-term Yield (FRAS Climate Study)*.

Stillwater Sciences (2020). *Management and mitigation of Harmful Algal Blooms Laske Henshaw and Lake Wohlford*.

TODD Groundwater (2018). *Warner Valley Basin Groundwater Flow Model Development and Calibration, Vista Irrigation*.

Section 1: Introduction

1.1 Background

In 2019 the District contracted Gillingham Water to conduct the District's Water Supply Planning Study (WSPS), which evaluated options for either replacing or retiring the Flume, known then as the **"To Flume or Not to Flume"** evaluation (see **Figure 1-1**). This analysis weighed the economic advantages of:

a) **The "<u>To Flume</u>" Option** – in which the District would replace its potable water conveyance system (i.e., the Flume), maintaining service from the Escondido-Vista Water Treatment Plant (EVWTP) to the District's Pechstein Reservoir, thereby continuing to operate the local water system (LWS) from the upstream Lake Henshaw and Warner Basin (see **Figure 1-2**) to the benefit of the District and its neighboring agencies,

   versus

b) **The "<u>Not To Flume</u>" Option** – in which the District would retire the existing Flume and rely 100% on purchasing imported treated water from the San Diego County Water Authority (SDCWA) using the existing VID3 connection at Pechstein Reservoir. The District would continue to operate the local water system at a limited capacity, continuing to sell water from Lake Henshaw and Warner Basin to Escondido. In addition, the District would transfer the Boot and Bennett service areas and distribution facilities within those areas to Vallecitos Water District, as well as construct additional storage at Pechstein needed to accommodate SDCWA aqueduct shutdowns.

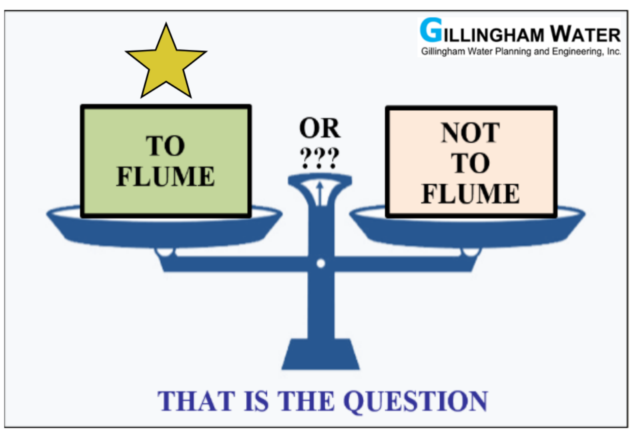

Figure 1-1. To Flume or Not to Flume Balance Scale; WSPS Workshop #3

By March 2020, the WSPS presented to the District's Board that the **"To Flume"** option was the more favorable long-term solution, being the least costly option to the District, providing superior supply reliability and affording the opportunity for continued regional cooperation with neighboring agencies. On April 1, 2020 the Board voted to advance the To Flume option to its planning stage, and on April 2021 the District contracted the Brown and Caldwell (BC) team to conduct the Flume Replacement Alignment Study (Alignment Study) which sought to answer the question, **"How to Flume?"**.

The Alignment Study proceeded to develop and evaluate multiple alignment alternatives for replacing the existing Flume, guide the selection of a preferred alignment, and prepare the conceptual documents describing the approach for implementing the future Flume Replacement Project (Project). The Alignment Study's key objectives focused on addressing:

- feasibility and cost-effective construction
- reliability
- environmental effects
- long-term operations and maintenance (O&M), as well as
- affordability, rate impacts, and funding options.

At the Board's request, staff along with the consultant team was asked to periodically report on the economic viability of the To Flume option, referred to as the Balance Scale Affordability Check-ins, to share their findings and highlight any changes which may influence an off-ramp decision toward the Not To Flume option.

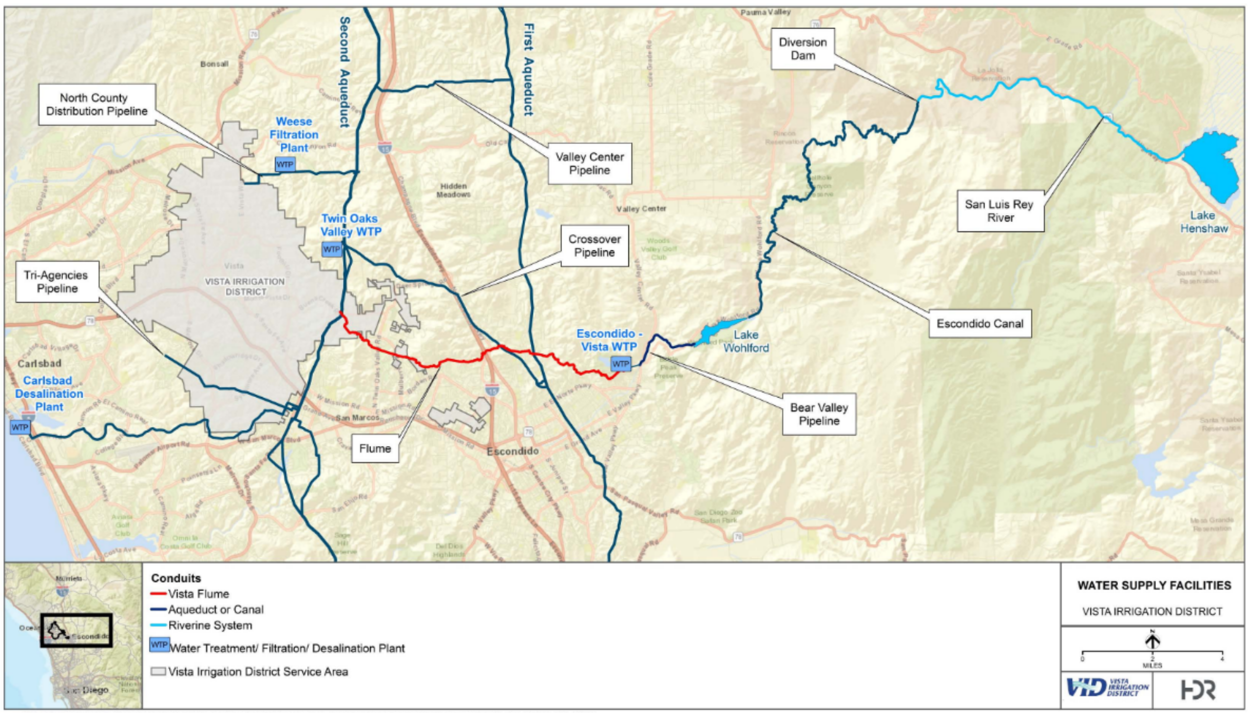

Figure 1-2. Regional water supply facilities; 2016 Vista Irrigation District Master Plan

1.2 Objectives of Economic Balance Scale Modeling

The objective of the Economic Balance Scale Model (Gillingham Water, Brown and Caldwell, 2024) was to continue testing the affordability of the "To Flume" project against the "Not To Flume" project. In addition, it was intended for use in periodic check-ins confirming the "To Flume or Not To Flume" balance scale was not tipped during the Alignment Study in a manner that might reverse the decisions made by the District following the WSPS. In doing so, the periodic checks would account for the changing capital and financing costs associated with the project, ongoing work associated with restoring the local water system at Lake Henshaw (being performed by Stillwater Sciences) and the Warner Basin wellfield (being performed by TODD Groundwater), as well as including climate change analysis which may impact the District's share of the long-term average annual local yield.

1.3 Economic Balance Scale Model History

The Economic Balance Scale Model (Gillingham Water, Brown and Caldwell, 2024) was originally developed by Gillingham Water during the WSPS. The original model developed then input local water system costs from an asset management approach that included operation, maintenance, repair, and replacement costs for every component of the local water system between Lake Henshaw, Lake Wohlford, EVWTP, the Flume, and Pechstein Reservoir. During the FRAS, improvements to the Warner Basin wellfield (TODD Groundwater, 2018) and addressing Harmful Algal Blooms (HABs) at Lake Henshaw (Stillwater Sciences, 2020) were new factors not previously accounted for in the WSPS analysis. During the FRAS the local water system costs evolved to include multiple alternatives for addressing HABs and insufficient wellfield capacity, which ultimately had varying effects on anticipated average annual local yield productions. A range of LWS capital projects were defined for use in the model to then account for the short-term and long-term treatment of HABs as well as the optimization of the Warner Basin wellfield to achieve its allowable sustainable yield. Also, WSPS and early FRAS analyses estimated yield forecasts based on historical averages with attempts to account for future conditions. During the FRAS, it was apparent that a more robust analysis was needed and said analysis should consider the possible climate futures which may impact long-term average annual local yield production, which led to predictive climatological modeling of the entire local water system.

Additionally, the WSPS implemented some creative solutions in the Not to Flume option scenario to address routine 10-day SDCWA aqueduct shutdowns, which the District currently depends on for Flume deliveries. Instead of simply building adequate storage for 10 days, the WSPS assumed SDCWA Aqueduct shutdowns could be limited to 3 days by the installation of valves on the 2nd Aqueduct. However, during the FRAS it became apparent to the District that limited shutdowns were unlikely, beyond its control and providing more storage volume to the Not to Flume option would be prudent such that the District can control and maintain system reliability up to a 10-day SDCWA shutdown.

These key factors, plus regular updates capturing evolving capital costs, financial terms, and SDCWA treated water rate escalations were the drivers behind various Balance Scale Model updates. The various revisions to the Balance Scale Model are documented in Table 1-1.

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Table 1-1. Economic Balance Scale Model Version History

Version No.	Version Date	Description*
v.1	10/11/2021	Initial model version developed by Gillingham Water and prepared for use in the WSPS.
v.2	9/14/2022	Gillingham Water prepares the model for use in the FRAS. Updated capital cost and financial assumptions, as well as added Cash Flow worksheet and NPV Annual Cost red/black chart to Dashboard.
v.2.1	9/21/2022	Gillingham Water corrected SDCWA starting rate; switched Flume Replacement default to Alt. 6; reduced Delivery Reliability costs for a smaller Pechstein assuming SDCWA's reliability projects are prioritized.
v.3	10/31/2023	BC assumes responsibility of the model from Gillingham Water. Added Warner Basin wellfield optimization and Lake Henshaw HABs mitigation. Also updated average annuals local yields using results of the climate modeling.
v.4	2/23/2024	BC updates factors relative to LWS improvements using ongoing work on HABs Study and Climate Modeling. Also updated inputs relative to SDCWA rate increases and refined financial terms using more recent information presented by SDCWA's in their public board workshops and input received from VID's financial staff, respectively.
v.5	8/30/2024	BC improved calculations relative to SDCWA rate increases, treated water rate caps, and melded costs of water using more recent information presented by SDCWA's in their public board workshops.

Section 2: Methodology

The following section describes BC's methodology for evaluating the To Flume option versus the Not to Flume option using the Balance Scale Model. This work was presented to the District's Board under the heading of "Balance Scale Affordability Check-ins". This section describes the Balance Scale Model's inputs and assumptions, important sensitive variables, and defines the key run scenarios performed to support the To Flume or Not to Flume decision making process.

2.1 Economic Balance Scale Model

The Economic Balance Scale Model is an excel-based tool originally developed by Gillingham Water satisfying the scope of the 2020 WSPS. The Balance Scale Model was designed to quantify and compare the wholistic costs associated with replacing the Flume for the District's continued use of its share of local water to meeting its customers potable water demands (i.e., "To Flume") versus retiring the Flume and instead supplying its customers with purchased SDCWA treated water from the existing VID3 connection (i.e., "Not To Flume").

Throughout the Alignment Study BC continued to refine the Balance Scale Model as new and additional information was obtained. These included enhancements associated with both operational and cost related factors relative to future Lake Henshaw HABs mitigation (by Stillwater Sciences), Warner Basin wellfield improvements (by TODD Groundwater), forecasting SDCWA rate increases, escalating melded costs for project financing, and long-term climate impacts to average annual local yield.

2.2 Model Setup

2.2.1 Overarching Boundary Conditions

Defining the overarching boundary condition and establishing a set of cost components within said boundary was a fundamental step in developing a model which could wholistically evaluate both the To Flume and Not To Flume options. Using the District's 2016 Master Plan and supporting system schematics the Balance Scale Model's boundary condition was set to encompass the upstream LWS at Lake Henshaw and Warner Basin, the local water treatment capabilities of the EVWTP, as well as the access to SDCWA treated water at the VID3 connection. However, the system is complex and there are many nuanced costs/benefits within this boundary.

2.2.2 Cost Components - Both Sides of the Balance Scale

For enhanced organization, the Balance Scale Model development approach then dissected the Boundary Conditions into assigned "Cost Components" which sought to define all plausible costs and benefits associated with either the To Flume or Not to Flume options. Cost Components considered factors associated with maximizing the beneficial use of local water, infrastructure needs for maintaining level of service and system reliability, as well as long-term operations and maintenance. To facilitate an unbiased side-by-side comparisons of the To Flume and Not to Flume options the cost/benefit for each Cost Component was quantified using one standard metric, US dollars amortized to a 30-year Net Present Value (NPV).

Table 2-1 lists all the Cost Components identified within the overarching boundary conditions. Moreover, these Cost Components had tangible costs/benefits that were adequately quantifiable for use in side-by-side economic evaluations of the To Flume and Not to Flume options.

Table 2-1. Cost Components as Defined on Both Sides of the Balance Scale			
TO FLUME -- Replace the Flume and continue using local water --		**NOT TO FLUME** -- Retire the Flume and rely on purchasing SDCWA treated water --	
Flume Replacement COST (-)	Design, permit, construct, a new (36-inch) pipeline that replaces the existing Flume. Includes demolishing the existing Flume.	Additional SDCWA Purchases COST (-)	Purchase treated water at Pechstein using the VID3 connection equal to the amount of annual local yield produced.
Local Water System (LWS) COST (-)	Design, permit, construct, operate and maintain improvements that will OPTIMIZE local yield from Lake Henshaw and Warner Basin, including: - Replace and expand wellfield, - HABs Management, - All Other LWS Items, such as improving the conveyance system between the wellfield and Lake Henshaw, maintaining Henshaw Dam and Escondido Canal.	Local Water System (LWS) COST (-)	Design, permit, construct, operate and maintain improvements that will MAINTAIN HISTORICAL local yield from Lake Henshaw and Warner Basin, including: - Limited new wells to maintain production, - HABs Management (same as left), - All Other LWS Items (same as left).
Water Treatment COST (-)	Design, permit, construct, operate and maintain any EVWTP improvements needed to facilitate the connection of the new pipeline and maximize the use of local water from the "optimized" Warner Basin wellfield, such as chemical system improvements.	Exchange Benefit BENEFIT (+)	Revenue earned by the District from the sale of its unused local water from Lake Henshaw and Warner Basin to the City of Escondido.
Flume O&M COST (-)	Long-term operation and maintenance of the Flume new replacement pipeline (36-inch).	Delivery Reliability COST (-)	Additional infrastructure needed at Pechstein so the District may reliably store and continue delivering water to its customers during the SDCWA's annual treated water system 10-day maintenance shutdowns.
Self-Treatment Benefits BENEFIT (+)	Savings to the District arising from its treatment of SDCWA raw water at the EVWTP when demands cannot solely be met by local water supplies. The District realizes a cost savings in comparison to solely purchasing SDCWA's treated water.	Boot & Bennett Transfer COST (-)	Retiring the Flume means the District can no longer serve the Boot and Bennett service areas. This includes the capital and administrative costs associated with transferring the assets to Vallecitos Water District (asset depreciation reimbursement, annexation fees, existing water meter capacity fees).
		Flume Demolition COST (-)	Demolition of the Flume still required to mitigate risk and hazard associate with slope failures and bench section collapse. This will remove the District's liability thereby eliminating the need to monitor and maintain this retired asset.
		Reduced Pumping Costs BENEFIT (+)	Savings to the District when taking deliveries at VID3 and the resulting reduction in pumping costs out of Pechstein to the 976/984 zones.

COST (-) = Capital or operational expenditures incurred by the District amortized to a 30-year NPV.
BENEFIT (+) = Capital or operational cost savings or revenues earned by the District amortized to a 30-year NPV.

2.3 Model Inputs

2.3.1 General Approach to Entering Input Values

As stated above, the system is complex and capturing all plausible system costs/benefits through a comprehensive set of Cost Components was essential for facilitating wholistic alternatives evaluations. The general approach developed a series of inputs using available data to calculate quantifiable costs/benefits for each Cost Component in terms of 30-year NPV. All inputs were entered as a range of Low, Mid, and High values. This facilitated the use of the Balance Scale Model as a scenario evaluation tool and allowed BC and the District to better test various combinations of inputs and scenarios.

2.3.2 Special Considerations & Sensitivities

Throughout the course of this study the Balance Scale Model was refined, and results iterated many times over. This process highlighted two key variables (i.e., inputs) which impacted the To Flume or Not to Flume decision, the Balance Scale results, greater than the others. They were the ***Average Annual Local Yield*** and the ***SDCWA Rate Escalations***. Therefore, the following subsections are dedicated to the special considerations and steps taken to increase the level of confidence in these most sensitive inputs.

2.3.2.1 Average Annual Local Yield and Climate Change

The District's share of average annual local yield produced from the LWS, which includes the watersheds and infrastructure upstream of EVWTP (see Figure 1-2), is a critical factor in the economic viability of the future Flume replacement project. During Board Workshops No. 1 and 2 the team presented sensitivity analyses which underscored the point of how much the economics are impacted by incremental changes in average annual local yield. On average, for every 100 acre-feet per year (AFY) the average annual local yield changed a net impact of $8M (30-year NPV) is realized on the balance scale. This cost impact translates to a ~3-5% tipping of the balance scale for every 100 AFY of incremental change to the average annual local yield entered into the Balance Scale Model. This has a very direct impact on the To Flume or Not to Flume decision when historical averages have ranged from 800 AFY to well over 5,000 AFY.

Climate change analysis and the predictive modeling work simulated future climatological effects on the LWS and increased our confidence in the Balance Scale economic analysis by:

- Establishing a baseline system performance using a soil-water-balance model for current hydrologic conditions and a GoldSIM model for future LWS operational conditions.
- Amending the baseline modeling results to consider possible future climatological conditions (Dry, Baseline, and Wet conditions) and study their impacts on the LWS.
- Calculating the predictive local yields generated for each conceptual LWS investment scenario by applying the above referenced climatological conditions.
- Augmenting the "To Flume or Not to Flume" economic analysis to consider a range of climatological futures and their plausible effects on local yield.

Prior to the predictive modeling effort, the balance scale analysis did not have the benefit or confidence to capture long-term trends in the availability or costs of the local water. The predictive model gave the consultant team a tool which could better quantify subtle differences between the LWS enhancements being evaluated by the District's staff. In coordination with District staff, the prior project scenarios were expanded to five possible "investment scenarios". The investment scenarios were developed using input from the work performed by Stillwater Sciences on the Lake

Henshaw HABs mitigation study, TODD Groundwater Warner Basin wellfield optimization, and Brown and Caldwell's climatological modeling of predictive yield. The body of how this work was used to develop these investment scenarios was presented to the District's board at Workshop #3, refer to FRAS Workshop #3 Board Packet (dated, December 11, 2023).

The investment scenarios ranged from maintaining the existing system as-is (Scenario #1: Low-range) to implementing a host of LWS enhancements including, in-lake HABs mitigations, an expanded wellfield, and a lake bypass pipeline (Scenario #5: High-range). The five investment scenarios are listed below and defined in the first column of Table 2-2.

- Scenario #1: Low-range
- Scenario #2: HABs Control Only
- Scenario #3: Baseline or "Mid-Range"
- Scenario #4: Max. Allowable Sustainable Yield
- Scenario #5: High-range

Each investment scenario was modeled against three different climate change scenarios, which applied delta factors for "Dry" (CMCC_CMS RCP8.5), "Baseline" (Historical), and "Wet" (CanESM2 RCP8.5) climate conditions. The results of this work, which quantifies the District's share of the average annual local yield predicted for each of the five LWS investment scenarios, are presented below in Table 2-2.

Cells highlighted in red represent annual average local yield values that would not economically support the Flume replacement project, and therefore do not represent a viable To Flume project. Green highlighted cells represent annual average local yield values which do economically support the Flume replacement project and its long-term operations. Also, these values do not require any modifications to the EVWTP's current blend limitations of 40:60 local-to-imported raw water ratio. Cells highlighted in yellow represent an upside in local yield generally not seen by the existing LWS. However, to beneficially use this amount of local water, modest investments in improving the water quality at Lake Wohlford and the treatability at EVWTP would be required to accept blend ratios above the existing 40:60 local-to-imported water blend limit at EVWTP.

In summary, this work concluded that addressing HABs at Lake Henshaw and optimizing the Warner Basin wellfield remain a priority for positive Balance Scale economics. Only three of the 15 model runs (20%) produced local yields which would not support the future Flume Replacement project; none of these scenarios included HABs mitigation or wellfield improvement measures. Six of the 15 model runs (40%) predicted local yields greater than the EVWTP's current 40:60 local-to-imported water blend ratio, which would require additional investments in treatment system modifications to fully realize the full benefit of this additional yield. The remaining six of the 15 model runs (40%) predicted local yields acceptable to the existing EVWTP with little to no treatability modifications to the EVWTP. Therefore, most climate futures, 80% of the modeled scenarios, predict the District can confidently rely on local water being available over a wide variety of climate conditions, and the economics weigh in favor of a To Flume project if modest investments are made to the LWS.

Note, the three average annual local yield values circled in blue on Table 2-2 were used as direct inputs to the Balance Scale Model.

Table 2-2. Possible Range of Local Water System Investment Scenarios				
Local Water System Investment Scenario	Capital Costs[a]	Anticipated Range of Average Annual Local Yield (AFY) [b,c]		
		Dry [b,c] (CMCC_CMS RCP8.5)	Baseline [b,c] (Historical)	Wet [b,c] (CanESM2 RCP8.5)
Scenario #1: Low-range • Maintain wellfield as-is; no new wellheads • No long-term in-lake HABs solution • Respond to HABs using algaecide when needed • No lake bypass pipeline or additional operational flexibility	$8M	1,700	2,500	3,000
Scenario #2: HABs Control Only • Replace wellheads as-needed to preserve historical yield • Implement long-term in-lake HABs solution • Preventative HABs control using chemical treatment • No lake bypass pipeline or additional operational flexibility	$13M	1,900	2,700	3,300
Scenario #3: Baseline or "Mid-Range" • Optimize wellfield to achieve the historical, and can achieve sustainable yield over 12-months [d] • Implement long-term in-lake HABs solution • Preventative HABs control using chemical treatment • No lake bypass pipeline or additional operational flexibility	$23M	4,700	5,600	7,500
Scenario #4: Max. Allowable Sustainable Yield • Maximize wellfield to achieve allowable sustainable yield [e] • Implement long-term in-lake HABs solution • Preventative HABs control using chemical treatment • No lake bypass pipeline or additional operational flexibility	$37M	5,400	6,200	7,800
Scenario #5: High-range • Maximize wellfield to achieve allowable sustainable yield [e] • Implement long-term in-lake HABs solution. • Preventative HABs control using chemical treatments • Install a lake bypass pipeline for additional operational flexibility	$57M	6,900	7,200	7,900

a. *Capital costs presented are in 2023 dollars, and only include District's share of costs (e.g., 70% for wellfield projects and 50% for Henshaw projects).*

b. *District's share of the anticipated average annual local yield in AFY estimated for the corresponding modelled scenario.*

c. *The District's share of local yield presented herein are results from the predictive climatological model described above.*

d. *Warner Basin's historical yield is ~7,140 AFY which equates to a District share of ~1,750 AFY.*

e. *Warner Basin's maximum allowable sustainable yield is 9,125 AFY, which equates to a District share of ~2,400 AFY.*

f. *Legend:*
   a. Red = Future Flume replacement project is not economically viable (the District's LW yield is less than 2,700 AFY).
   b. Green = No modifications needed to Lake Wohlford or EVWTP keeping to 40:60 Local-to-Imported water blend ratio.
   c. *Yellow = Requires improvements to Lake Wohlford or EVWTP to local yields which are more than the current 40:60 Local-to-Imported water blend ratio limitation.*

2.3.2.2 SDCWA Treated Water Rates and Future Rate Adjustments

The Balance Scale Model's input parameters pertaining to the SDCWA's treated water rates, and their anticipated future escalations, began with referencing the SDCWA's Long-Range Financing Plan (LRFP) published in September 2021. The rate adjustments originally presented in the 2021 LRFP, as shown in Figure 2-1 below, forecasted 10-year average annual rate adjustments ranging between 3.91% to 7.32%. However, recent trends of declining water sales and aging infrastructure needs, compounded with escalating capital and financing costs, plus passthrough imported water rate increases from the Metropolitan Water District of Southern California (MWD) have imparted significant financial pressures on the SDCWA.

"All-In" Rate Adjustments

	CY '23	CY '24	CY '25	CY '26	CY '27	CY '28	CY '29	CY '30	CY '31	10 Yr CAGR
1D - High	8.5%	9.5%	10.9%	9.9%	8.9%	5.7%	5.3%	3.4%	3.4%	7.25%
2D - High	11.3%	9.7%	10.3%	7.5%	6.4%	5.2%	4.8%	4.4%	4.4%	7.07%
3D - High	8.2%	9.2%	11.2%	9.7%	7.3%	6.6%	6.6%	3.7%	3.7%	7.32%
1D - Low	5.9%	4.7%	4.8%	5.2%	3.7%	3.3%	3.3%	3.4%	3.4%	4.18%
2D - Low	5.9%	3.7%	5.3%	4.5%	3.0%	3.5%	2.6%	2.7%	4.1%	3.91%
3D - Low	6.2%	4.4%	6.0%	5.9%	3.5%	2.8%	2.8%	3.0%	3.0%	4.16%

Figure 2-1. SDCWA Rate Adjustments per the September 2021 LRFP

Since 2021, the SDCWA's financial staff has been studying these recently observed trends and their financial impacts on the 2021 LRFP's forecasted rate adjustments. The SDCWA's staff most recently reported on this topic during their July 2024 public board hearing summarizing the results of their iterative forecasts performed since December 2023. As shown in Figure 2-2 below, the SDCWA's financial staff presented future rate adjustments ranging between 14% and 30%, with the most resent iteration settling between 14.0% and 16.9%.

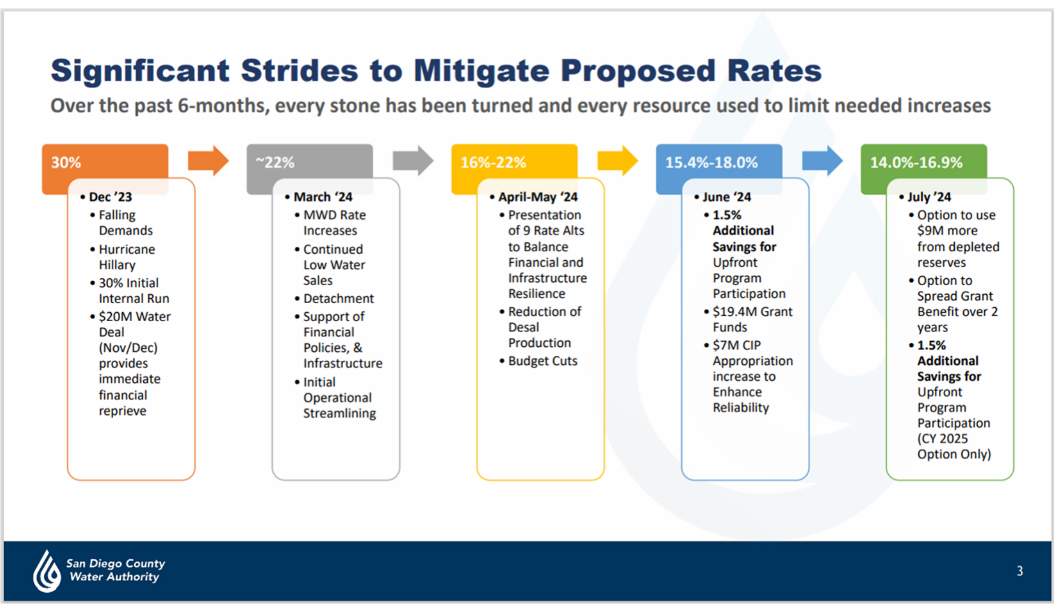

Figure 2-2. Integrations on Forecasted Rate Adjustments; SDCWA's July 2024 Board Meeting

Considering this Study is benchmarked on a 30-year planning horizon, and all costs are thereby normalized to a 30-year NPV, the study team has elected to define a range of longer-term averages for future SDCWA rate adjustments than what the SDCWA has been presented to-date. This range reflects a “Low cost” (i.e., optimistic) outcome, “Mid-range cost” outcome, and “High cost” (i.e., pessimistic) outcome. They are defined as follows:

- Low (optimistic) = Assumes the SDCWA’s rate adjustments follow the originally planned 2021 LRFP forecasts with initial adjustments averaging 11.3% per year (i.e., over the next 9-years). Thereafter the rate adjustments would settle down to a long-term average of 7.3% per year (i.e., 10+ years).
- Mid-range = Assumes initial adjustments averaging near the mid-point of the most recent SDCWA’s forecasts at 15.5% per year (see green box in Figure 2-2 above), followed by long-term average adjustments consistent with the high end of the 2021 LRFP adjustments at 11.5% per year.
- High (pessimistic) = Assumes the current rate forecasts will become policy and continue for the foreseeable future. In this case, the initial average adjustments is near the midpoint of all the iterations shown in Figure 2-2 above at 19.5% per year and will settle down to 15.5% per year on average over the long-term.

2.3.3 Summary of Inputs, Sensitivities, and Assumptions

As the Balance Scale Model was developed, inputs entered, and iterative scenarios were run, opportunities to further refine the Balance Scale Model for improved accuracy were identified. Through the course of this study the inputs were periodically refined using newly available data and calculation methods for quantifying all plausible costs/benefits were enhanced through additional studies or modeling. In total, five unique versions of the Balance Scale Model were developed, each building off the previous, see Table 1-1.

Table 2-3 below lists the key inputs used in this most recent version of the Balance Scale Model and documents the important sensitivities and assumptions associated with each input.

Table 2-3. Model Inputs, Sensitivities, and Assumptions

Criteria	Input Range			Sensitivity (Delta on Balance Scale)	Assumptions	Additional Considerations
	Low	Mid	High			
Local Yield [1]	1,700AF/yr	4,700AF/yr	6,900AF/yr	$6M-$308M (~$8M/100AF)	For conservatism, used the predictive model's "DRY" results for the low, mid, and high ranges LWS investment scenarios, respectively.	Based on results of the Predictive Climatological Modeling efforts reported in Technical Memo #7 of the Study.
SDCWA Escalation Rate [1,2] *- Avg. increases over first 9-years* *- Avg. increases thereafter* *- Rate limit (i.e. market cap)*	5.0% *11.3%* *7.3%* $3,250/AF	9.0% *15.5%* *11.5%* $4,250/AF	12.0% *19.5%* *15.5%* $5,000/AF	$140M-$280M	Low: long-term average rate increases return to 2021 LRFP rate model. Mid: recent rate policies limited to near-term and continue to improve. High: recent rate policies are accurate and continue into future. Rate limit assumes a breakpoint where imported treated water costs are no longer competitive with building and operating additional local treatment.	Based on CWA's 2021 LRFP and adjusted using information presented in SDCWA's July and August 2024 Board Meetings.
Water Treatment	$200/AF	$250/AF	$300/AF	$7M-$14M	Low: modest improvements at Lake Wohlford addressing water quality. Mid: above plus modest chemical system improvements at EVWTP. High: increase blend ratio at EVWTP with more investment at Wohlford and EVWTP.	This input accounts for the District's portion of the cost shared with Escondido on LWS improvements. Treatment costs have minimal impact relative to the benefit of being able to additional local water. See "Local Yield" row above for true benefit of using additional local water.
Local Water System	$81M	$103M	$159M	$18M-$64M	Low: replace wellheads to preserve historical yield plus algaecide treatments. Mid: optimize wellfield to sustainable yield plus long-term HABs mitigation. High: same as above plus lake bypass pipeline.	This input accounts for the District's portion of the cost shared with Escondido on LWS improvements.
Exchange Benefit [2]	1,500AF/yr	2,000AF/yr	2,500AF/yr	$31M-$62M	Plausible range of City of Escondido's utilization based on feedback received from City's staff.	Escondido's utilization offsets District's cost with increase in revenue. Uncertainty is in Escondido's actual commitment to utilize.
Delivery Reliability	$34M	$52M	$180M	$18M-$149M	Low: Desal to P3 or modest Pechstein II. Mid: Desal to P3 confirmed plus 25MG at Pechstein II High: Desal to P3 confirmed plus 90MG at Pechstein II	With Desal to P3 option confirmed, 25MG of additional storage at Pechstein II should provide ~3 days of emergency reserve. Providing 90MG of additional storage at Pechstein II should provide ~11 days of emergency reserve for full supply during a 10-day SDCWA shutdown.
Boot & Bennett Transfer	$18M	$28M	$34M	$7M-$18M	Estimated cost of transfer applying different %-splits between the District and Vallecitos ranging from optimistic to pessimistic.	The Balance Scale Model treats this as a direct cost in the NPV calculation; similar to design and construction. A small portion of the cost ~5% is realized during planning/design. The remaining is financed at the beginning of construction.
Capital Costs (Flume)	$169M	$179M	$197M	$15M-$64M	Based on BC's Oct. 2023 estimate presented to District's Board at Workshops #3 and #4.	The Balance Scale Model treats this as a direct cost in the NPV calculation; similar to design and construction. A small portion of the cost ~5% is realized during planning/design. The remaining is financed at the beginning of construction.
NPV Term – Operations		30yrs		$6M per 1yr	Set to the loan terms being considered by the District's Finance Dept.	Reasonable term for long-range planning guided by the typical term of loans for financing projects.
District Discount Rate		5.50%		$21M per 1%	Reflects the finance sector and interest rate trends between 2023 & 2024.	Confirmed with the District's Finance Dept.
Melded Cost of Funds		5.00%		$11M per 1%	Reflects the finance sector and interest rate trends between 2023 & 2024.	Confirmed with the District's Finance Dept.
Water System Base Inflation		4.50%		$39M per 1%	Reflects the finance sector and interest rate trends between 2023 & 2024.	Confirmed with the District's Finance Dept. and considers CWA increases/passthroughs

General Notes:

1. *Yellow highlighted rows indicate the top two input parameters that are most sensitive to change, where incremental changes have a higher net impact on cost relative to other input parameters.*
2. *Calculation for this input is depended on the SDCWA treated water rates and is interconnected to more than one input.*
3. *Cost: Costs are based on 2022 values; includes an adjustment factor (%) to escalate values. Keep costs as-is, except for new estimated capital. Use 6% escalation for rest.*
4. *Schedule: Construction start was set for 2029; allows 5-years from 2024 to complete planning (CEQA), design, permitting, and secure financing. 30-year financing begins end of 2028.*

Section 3: Findings

The following sections summarize the Balance Scale Model's key findings, and sensitivity analyzes performed, which ultimately supported the District's To Flume or Not To Flume decision making process.

3.1 Balance Scale Model Runs

Once all climate futures were modeled for each of the LWS investment scenarios, a range of predictive average annual local yields were available for input into the Balance Scale Model. Entering these amongst all other inputs listed in Table 2-3 above helped make the Balance Scale Model a useful tool for simulating endless combinations of plausible economic possibilities. However, to streamline the analysis and organize the outcomes to best facilitate a To Flume or Not to Flume decision, model runs were defined in a manner isolating the most impactful variables for "Test" runs (i.e. Average Annual Local Yield and SDCWA Rate Escalations) and for the intentionally biased Not to Flume "Sensitivity" Runs (i.e., Delivery Reliability and Fiscal Terms). The focus run scenarios uses in this study are defined in Table 3-1 below:

Table 3-1. Balance Scale Model Run Scenarios

Run	Scenario	Description*
1	Test: Variable Long-term Average Annual Local Yield	Climate: vary Average Annual Local Yield to match LWS investment scenarios below using the Baseline Condition from the predictive model (i.e., Dry). LWS Investment Scenarios: vary Low, Mid-Range, and High for To Flume; set to Low for Not to Flume. Water Treatment: vary to match the To Flume level of LWS Investment above. SDCWA Rate Escalation: set to Mid-Range. Exchange Benefit: set to Mid-Range. Delivery Reliability Benefit: set to Mid-Range. Boot and Bennett Transfer: set to Mid-Range.
2	Test: Variable SDCWA Treated Water Rate Escalations	Climate: set to Mid-Range LWS investment for the Baseline Condition (i.e., Dry) = 4,700 AFY. LWS Investment Scenarios: set to Mid-Range of both sides of Balance Scale to generate local water maximizing Exchange Benefit with Escondido. Water Treatment: set to Mid-Range. SDCWA Rate Escalation: vary between Low, Mid-Range, and High. Exchange Benefit: vary to match SDCWA Rate Escalation above; higher SDCWA rates will incentivize Escondido to purchase more of District's share of local water. Delivery Reliability Benefit: set to Mid-Range. Boot and Bennett Transfer: set to Mid-Range.
3	Sensitivity: Not To Flume Biased using Variable System Reliabilities	Climate: set to Mid-Range LWS investment for the Baseline Condition (i.e., Dry) = 4,700 AFY. LWS Investment Scenarios: set to Mid-Range for To Flume and Low-Range for Not to Flume to avoid over investments relative to the Balance Scale Option being tested. Water Treatment: set to Mid-Range. SDCWA Rate Escalation: set to Low-Range (optimistic). Exchange Benefit: set to High-Range (optimistic). Delivery Reliability Benefit: vary between Low, Mid-Range, and High to unscored the cost associate with limiting risk and increasing reliability during SDCWA scheduled shutdowns. Boot and Bennett Transfer: set to Low-Range (optimistic).
4	Sensitivity: Not To Flume Biased using Variable Financial and NPV Terms	Same as Run #3 above but setting Delivery Reliability to the Mid-Range. District Discount Rate: increase this input until Balance Scale breaks-even; normally 5.5% Melded Cost of Funds: increase this input until Balance Scale breaks-even; normally set to 5.0% Water Syst. Base Inflation: increase this input until Balance Scale breaks-even; normally set to 4.5%

* Blue text indicates the variable inputs relative to each model run.

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3.2 Model Results

The Balance Scale Model generates output dashboards as shown in Figure 3-1 below, which have been copy and pasted side by side herein for presentation. These model outputs were then summarized in a table for convenience, as shown in Table 3-2 below. This approach helps with post-processing calculations to estimate the equivalent cost per acre-foot ($/AF), as well as provides an easy to follow comparison of the results most important in the To Flume or Not to Flume decision process. This section prominently presents the Balance Scale Model's results in tabular form and discusses the findings derived from each model run.

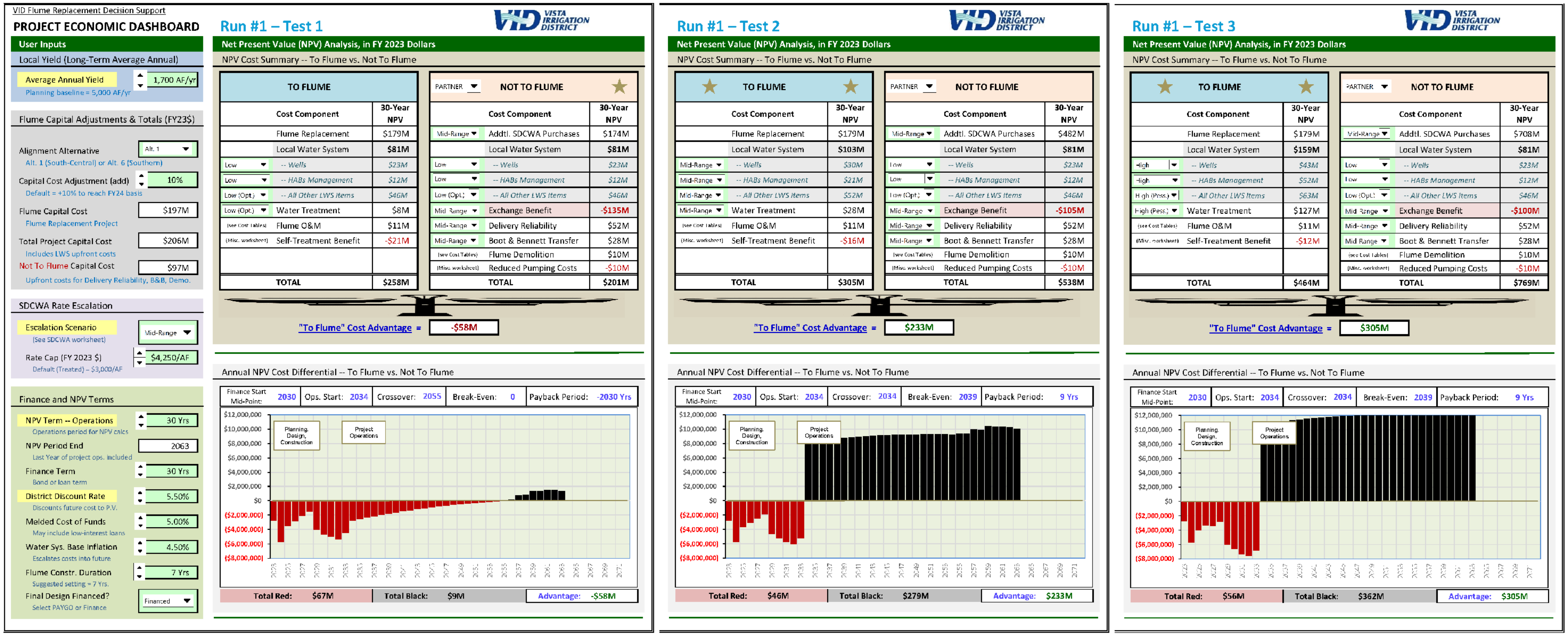

Figure 3-1. Balance Scale Model Run #1 Outputs; Side-by-Side Comparison

3.2.1 Run #1: Variable Long-term Average Annual Local Yield (Test)

Model Run #1 results, as presented in Table 3-2 below, shows that under all scenarios where long-term HABs mitigation and wellfield improvements are implemented, the cost advantage will favor the To Flume option. However, when long-term HABs mitigations are not implemented, the resulting reduction in average annual local yield can tip the balance scale toward the Not to Flume option.

Table 3-2. Balance Scale Model - Run #1 Test Results

Possible Investment Strategies	To Flume ($M)[a,b]	Not to Flume ($M)[a,b]	Cost Advantage ($M)[c,d]	Dry Climate Predicted Yield (afy)[e]	Break-even Yield (afy)[f]
Dry Condition without HABs mitigation (Low-range)[e]	$258M $5,100/AF	$201M $3,900/AF	Not To Flume $58M	1,700 afy	2,200 afy
Dry Condition with HABs mitigation plus optimized wellfield (Mid-range)[e]	$305M $2,200/AF	$538M $3,800/AF	To Flume $233M	4,700 afy	2,400 afy
Dry Condition with HABs mitigation plus optimized wellfield and bypass pipeline (High-range)[e]	$464M $2,200/AF	$769M $3,700/AF	To Flume $305M[h]	6,900 afy[g]	3,600 afy

a. *The top value represents the 30-year net present value results from the Balance Scale Model rounded to the nearest $1 million.*
b. *The bottom value represents the cost per acre-foot ($/AF) equivalent of the Balance Scale Model's results.*
c. *Cost Advantage is the difference between 30-year NPVs for Not to Flume minus To Flume District; advantage goes to the lower NPV.*
d. *Costs are a function of average annual local yield; note, as anticipated local yield increases so does the cost advantage tipping the Balance Scale toward To Flume.*
e. *District's share of anticipated average annual yield produced by the corresponding scenarios shown on* Table 2-2*; for conservatism, the above used local yields from the "Dry" climate model scenarios.*
f. *District's share of average annual local yield needed for there to be no cost advantage between To Flume and Not to Flume.*
g. *Utilizing this amount of local yield would require a higher local-to-imported water blend ratio at EVWTP then the current 40:60 limit. This would require additional capital investments at Lake Wohlford and EVWTP to improve local water treatability.*

The above analysis continues to quantify the value the ecologic health of Lake Henshaw has on the economic viability of the future Flume replacement project. It also found that the anticipated local water system expenditures are relatively small compared to the economic advantages gained by the increased average annual local yield.

For example, from Table 3-2 above, the "Low-range" expenditure estimated to produce an average annual local yield of 1,700 AFY, which results in a To Flume project NPV cost of $258 million and a Not To Flume project cost of $201 million on a 30-year NPV basis. At this specific yield-to-cost relationship, the Not To Flume option has a 30-year NPV cost advantage over To Flume by approximately $58 million. Now, if the District continues to fully operate and maintain its LWS, the "Mid-range" option's 30-year NPV cost To Flume would increase to $305 million while Not to Flume would increase more greatly to $538 million. The corresponding increase in average annual local yield, and resulting avoided cost of purchasing treated water achieved by these investments, effectively tips the scales toward the To Flume option. At this specific yield-to-cost relationship, To Flume is estimated to have a 30-year NPV cost advantage of $233 million over Not to Flume, which is a $291 million increase in cost advantage over the investment scenario that does not include HABs mitigation.

3.2.2 Run #2: Variable SDCWA Treated Water Rate Escalation (Test)

Model Run #2 results, as presented in Table 3-3 below, shows that under all scenarios the cost advantage continues to favor the To Flume option despite plausible futures in SDCWA rate adjustments, whether optimistic or pessimistic.

Table 3-3. Balance Scale Model - Run #2 Test Results

Possible Investment Strategies	To Flume ($M)[a,b]	Not to Flume ($M)[a,b]	Cost Advantage ($M)[c,d]	Dry Climate Predicted Yield (afy)[e]	Break-even Yield (afy)[f]
Low-range SDCWA Rate Escalations (Optimistic)	$305M $2,200/AF	$436M $3,100/AF	To Flume $131M	4,700 afy	3,000 afy
Mid-range SDCWA Rate Escalations	$305M $2,200/AF	$556M $3,900/AF	To Flume $251M	4,700 afy	2,300 afy
High-range SDCWA Rate Escalations (Pessimistic)	$305M $2,200/AF	$639M $4,500/AF	To Flume $334M[h]	4,700 afy	1,700 afy

a. The top value represents the 30-year net present value results from the Balance Scale Model rounded to the nearest $1 million.
b. The bottom value represents the cost per acre-foot ($/AF) equivalent of the Balance Scale Model's results.
c. Cost Advantage is the difference between 30-year NPVs for Not to Flume minus To Flume District; advantage goes to the lower NPV.
d. Costs are a function of average annual local yield; note, as anticipated local yield increases so does the cost advantage tipping the Balance Scale toward To Flume.
e. District's share of anticipated average annual yield produced by the corresponding scenarios shown on Table 2-2; for conservatism, the above used local yields from the "Dry" climate model scenarios.
f. District's share of average annual local yield needed for there to be no cost advantage between To Flume and Not to Flume.

This run scenario quantifies the impact of purchasing SDCWA treated water at a range of various treated water rates inclusive of plausible future rate escalations. In this run the To Flume investments costs are held constant to establish a control for comparison. Since the To Flume option uses local water in lieu of purchasing SDCWA treated water, it's 30-year NPV does not change as it is immune to SDCWA's rate increases. In comparison, the Not to Flume option costs do change across the scenarios because it replaces the District's share of annual local water with purchased SDCWA treated water in the same amount. Therefore, Not to Flume option costs increase across the scenarios as the applied SDCWA's rates are increased to simulate different plausible outcomes of the SDCWA's current rate escalation evaluations.

The above analysis underscores the value of having access to local water. Regardless of future SDCWA treated water rate escalations, even if they are minimized to more optimistic 2021 LRFP values, the cost per acre-foot associated with replacing the existing Flume plus improving the LWS (i.e., To Flume) remains more competitive than purchasing SDCWA treated water (i.e., Not to Flume).

For example, from Table 3-3 above, the "Low-range" SDCWA Rate Escalations results in a To Flume project NPV cost of $305 million and a Not To Flume project cost of $436 million on a 30-year NPV basis. At this specific yield-to-cost relationship, the To Flume option has a 30-year NPV cost advantage over Not to Flume by approximately $131 million. Now, if the SDCWA Rate Escalations continue as recently reported to their board, the "High-range" option's 30-year NPV cost would increase the Not To Flume option to $639 million while the To Flume option would remain. At this specific SDCWA Rate-to-cost relationship, To Flume is estimated to have a 30-year NPV cost advantage of $334 million over Not to Flume; a $203 million increase in cost advantage over the optimistic SDCWA Rate Escalation future.

3.2.3 Run #3: Not To Flume Biased using Variable System Reliabilities (Sensitivity)

Model Run #3 results, as presented in Table 3-4 below, highlight the sensitivities associated with paying for additional system reliability, primarily by adding additional storage at Pechstein II. Under all scenarios the cost advantage continues to favor the To Flume option even if delivery reliability costs are reduced to a minimum and additional risk is absorbed by the District and its customers,

Table 3-4. Balance Scale Model - Run #3 Sensitivity Results

Possible Investment Strategies	To Flume ($M)[a,b]	Not to Flume ($M)[a,b]	Cost Advantage ($M)[c,d]	Dry Climate Predicted Yield (afy)[e]	Break-even Yield (afy)[f]
Low cost System Reliability (highest risk to the District)	$305M $2,200/AF	$391M $2,800/AF	To Flume $86M	4,700 afy	3,600 afy
Mid-Range cost System Reliability (moderate risk to the District)	$305M $2,200/AF	$409M $2,900/AF	To Flume $104M	4,700 afy	3,300 afy
High cost System Reliability (lowest risk to the District)	$305M $2,200/AF	$537M $3,800/AF	To Flume $232M[h]	4,700 afy	1,800 afy

a. The top value represents the 30-year net present value results from the Balance Scale Model rounded to the nearest $1 million.
b. The bottom value represents the cost per acre-foot ($/AF) equivalent of the Balance Scale Model's results.
c. Cost Advantage is the difference between 30-year NPVs for Not to Flume minus To Flume District; advantage goes to the lower NPV.
d. Costs are a function of average annual local yield; note, as anticipated local yield increases so does the cost advantage tipping the Balance Scale toward To Flume.
e. District's share of anticipated average annual yield produced by the corresponding scenarios shown on Table 2-2; for conservatism, the above used local yields from the "Dry" climate model scenarios.
f. District's share of average annual local yield needed for there to be no cost advantage between To Flume and Not to Flume.

3.2.4 Run #4: Not To Flume Biased using Variable Financial and NPV Terms (Sensitivity)

Model Run #4 results, as presented in Table 3-5 below, highlight the sensitivities associated with the fiscal terms used for estimating project financing as well as 30-year NPV calculations. The results suggest that the terms required to tip the balance scale away from the To Flume option must use rates which significantly exceed industry norms beyond values that are truly plausible.

Table 3-5. Balance Scale Model - Run #4 Sensitivity Results

Possible Investment Strategies	To Flume ($M)[a,b]	Not to Flume ($M)[a,b]	Cost Advantage ($M)[c,d]	Dry Climate Predicted Yield (afy)[e]	Break-even Rates (afy)[f]
District Discount Rate; normally 5.5%	$109M $800/AF	$109M $800/AF	Break-even $0M	4,700 afy	12.5% (not plausible)
Melded Cost of Funds; normally 5.0%	$502M $3,600/AF	$502M $3,600/AF	Break-even $0M	4,700 afy	14.2% (not plausible)
Water System Base Inflation; normally 4.5%	$208M $1,500/AF	$208M $1,500/AF	Break-even $0M	4,700 afy	0.9% (not plausible)

a. The top value represents the 30-year net present value results from the Balance Scale Model rounded to the nearest $1 million.
b. The bottom value represents the cost per acre-foot ($/AF) equivalent of the Balance Scale Model's results.
c. Cost Advantage is the difference between 30-year NPVs for Not to Flume minus To Flume District; advantage goes to the lower NPV.
d. Costs are a function of average annual local yield; note, as anticipated local yield increases so does the cost advantage tipping the Balance Scale toward To Flume.
e. District's share of anticipated average annual yield produced by the corresponding scenarios shown on Table 2-2; for conservatism, the above used local yields from the "Dry" climate model scenarios.
f. Financial terms needed for there to be no cost advantage between To Flume and Not to Flume.

Section 4: Conclusions

This technical memorandum documents the Economic Balance Scale Modeling efforts performed to date. The objective of the Balance Scale Model was to facilitate informed To Flume or Not to Flume decision making by the District's staff and Board. The following are key take-aways learned from these efforts, which have in turn supported the District's decision to proceed with replacing its existing Flume (i.e., advancing the To Flume option).

1. Most climate futures, 80% of the modeled scenarios, predict the District can confidently rely on local water being available over a wide variety of climate conditions, and the economics weigh in favor of a To Flume project if modest investments are made to the LWS. See Section 2.3.2.1 for details.

2. Model Run #1 suggests the District may move forward with confidence that investments in mitigating HABs and optimizing the Warner Basin wellfield will provide significant economic advantage to the District and its ratepayers. However, building additional infrastructure, such as a bypass pipeline around Lake Henshaw, may have diminishing returns. See Section 3.2.1 for details.

3. Model Run #2 suggests that although the SDCWA Rate Escalations impart substantial costs to the Balance Scale, there is no plausible outcome of future SDCWA rate adjustments which would tip the Balance Scale away from the To Flume option. In summary, if the SDCWA's rate adjustments follow the originally planned lower rate increases then, on a relative basis, this would favor the "To Flume" option, albeit a little less. If SDCWA's rate increases are in the "mid-range," then this input would favor "To Flume" even more. If the SDCWA's rate adjustments follow the "High" rate increases, then this favors "To Flume" the most. See Section 3.2.2 for details.

4. Sensitivity analyzes performed under Model Runs #3 and #4 suggests that the District may move forward with additional confidence. Despite imparting undue bias in favor of the Not to Flume option and unjustifiably adjusting inputs beyond reasonable norms, the To Flume option retained the Balance Scale cost advantage. See Sections 3.2.3 and 3.2.4 for details.

5. Considering all model runs, and supporting modeling efforts, the To Flume option retains significant cost advantage in comparison to the Not To Flume option, and still supports LWS improvements at Lake Henshaw and Warner Basin wellfield; so long as the District's share of average annual local yield is above 2,400 AFY (Run #1 with Mid-range LWS Investments).