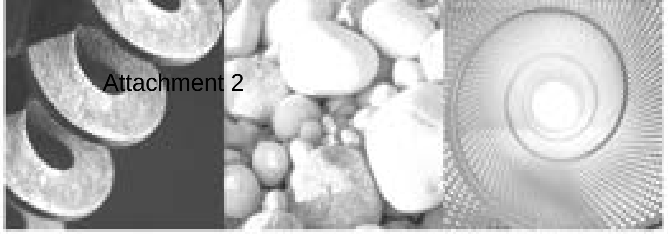

BBWC - SLVWD Integration Assessment

Boulder Creek, California

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Standard Limitations and Disclaimer

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Acronyms and Abbreviations

AACE	Association for the Advancement of Cost Engineering
AC	Asbestos-Cement
ADD	Average Daily Demand
BBWC	Big Basin Water Company
BPS	Booster Pump Station
CDFW	California Department of Fish and Wildlife
CFC	California Fire Code
CM	Construction Management
DIP	Ductile Iron Pipe
EDE	Engineering Desktop Evaluation
FCV	Flow Control Valve
GPM	Gallons per Minute
HDD	Horizontal Directional Drilling
HGL	Hydraulic Grade Line
ISO	Insurance Services Office
LF	Linear Feet
MDD	Maximum Daily Demand
MG	Million Gallons
NRW	Non-Revenue Water
PDPM	Project Development Procedures Manual (Caltrans)
PHD	Peak Hourly Demand
PRV	Pressure Reducing Valve
PSI	Pounds per Square Inch
ROW	Right-of-Way
SCADA	Supervisory Control and Data Acquisition
SLVWD	San Lorenzo Valley Water District
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	State Water Resources Control Board
SWTP	Surface Water Treatment Plant
TCE	Temporary Construction Easement
TM	Technical Memorandum

Executive Summary

This assessment evaluates the technical feasibility of establishing a high-capacity water system intertie between the San Lorenzo Valley Water District (SLVWD) and the Big Basin Water Company (BBWC). Following the 2020 CZU Lightning Complex Fire, this intertie is critical to providing redundancy for BBWC's single remaining source (Well No. 4) and establishing a framework for potential future system consolidation.

Key Findings

- **Mandatory Pumping:** Passive gravity flow from SLVWD to BBWC is impossible due to a ~400-foot elevation gain. A **Booster Pump Station (BPS)** is required for all alternatives.
- **Source Constraints:** The existing 6-inch SLVWD infrastructure ("Condition 1") is insufficient for fire flow. Full 1,000 GPM emergency protection is only achievable once SLVWD completes its **12-inch transmission main upgrades** ("Condition 2").
- **The "Well 4" Limitation:** Alternatives that terminate at the current Well 4 site (Alternatives B & C) fail to address the system's hydraulic core. In these scenarios, the Well 4 Tank becomes a localized supply point, forcing water through aged, undersized distribution lines to reach the rest of the community.

Recommended Alternative: D-1 (Jamison Tank Hub)

Alternative D-1 (Highway 236 Alignment) is recommended as the most resilient technical solution.

- **Strategic Integration:** Direct delivery to **Jamison Tank**—the system's highest hydraulic point—transforms the intertie from a "backup pipe" into a system-wide supply hub. By filling Jamison Tank directly, the intertie enables robust, gravity-fed distribution to all service zones during emergencies.
- **Scope:** Construction of approximately 9,310 linear feet of 10-inch and 12-inch Ductile Iron Pipe (DIP) via the Highway 236 corridor.
- **Primary Benefit:** Maximizes fire suppression by utilizing the full static head of Jamison Tank, bypassing known bottlenecks in the lower distribution network.
- **Estimated Cost: $7.2 Million** (AACE Class 4), inclusive of construction, professional services, and contingency.

Comparison of Alternatives

Table 1-1. Comparison of Alternatives

Alternative	Total Cost (includes 25% Professional Services)	Strategic Value
Alt B (Upsize - Hwy)	$5,740,494	Lower Cost but isolates at the system edge
Alt C (Parallel - Resid)	$7,680,960	Local fire improvement for 82 homes, higher construction risk.
Alt D1 (Jamison - Hwy)	$7,151,137	System-wide gravity resiliency via Jamison Tank
Alt D2 (Jamison - Resid)	$9,091,602	Strategic value if shared with potential SLVWD upgrades

Strategic Recommendations

1. **Proceed with Alternative D-1:** Initiate 30% design focusing on the direct Jamison Tank connection.
2. **Conditional Operation:** Utilize the intertie for domestic supplemental supply in the near term; transition to full fire-flow capacity only after SLVWD Condition 2 upgrades are online.
3. **Bridge and structure Infrastructure:** Conduct a detailed structural assessment of the High Bridge Creek and other retaining wall/large culvert structures to finalize pipe attachment specifications.
4. **Permitting:** Engage early with Caltrans regarding the Highway 236 longitudinal encroachment.

1. Introduction

This Technical Memorandum (TM) documents the feasibility assessment for establishing a physical water system intertie between the San Lorenzo Valley Water District (SLVWD) North System and the Big Basin Water Company (BBWC). Initiated in response to the critical infrastructure damage sustained during the 2020 CZU Lightning Complex Fire, this study evaluates the engineering, operational, and regulatory requirements necessary to connect the two systems. The analysis presented herein is intended to guide decision-making regarding immediate emergency supply redundancy and potential long-term system integration.

1.1. Background

The BBWC drinking water system serves a small, rural community in the Santa Cruz Mountains (see Figure 1-1) and has faced persistent source reliability challenges following the 2020 CZU Lightning Complex Fire. The fire destroyed BBWC's surface water treatment facilities and significantly altered watershed conditions, resulting in a long-term shift toward groundwater reliance and interties with neighboring systems.

BBWC currently relies primarily on Well No. 4 for supply, supplemented by an existing intertie with SLVWD. While this configuration has allowed continued service, it provides limited redundancy and does not meet long-term system reliability or emergency preparedness objectives, particularly under fire-flow and outage scenarios. As a result, BBWC remains vulnerable to single-source failures and constrained operational flexibility.

In parallel, SLVWD is constructing a new 12-inch transmission main that will increase conveyance capacity and improve system resiliency within its service area. This planned infrastructure investment presents a potential opportunity to strengthen near-term reliability for BBWC while also supporting a longer-term strategy for system integration or consolidation, should that pathway be pursued in the future.

1.2. Study Purpose

The purpose of this BBWC–SLVWD Integration Feasibility Assessment is to evaluate conceptual interconnection options between the BBWC system and SLVWD's planned 12-inch transmission main. The assessment focuses on identifying feasible approaches that:

- Improve short-term water supply reliability for BBWC during emergency or outage conditions, and
- Are technically and operationally consistent with a potential future system consolidation between BBWC and SLVWD.

This assessment is intended to inform planning-level decision-making and funding strategy. It does not constitute final design and does not commit any agency to construction or consolidation.

1.3. Study Objectives

The study is guided by the following objectives:

- Identify and screen feasible intertie connection alternatives between BBWC and SLVWD.
- Evaluate hydraulic performance under domestic, peak, and emergency demand scenarios.
- Assess constructability considerations, including terrain, access, and system constraints.
- Develop planning-level cost estimates for each alternative.
- Identify operational dependencies, risks, and limitations that may affect implementation.

1.4. Key Planning Assumptions and Constraints

This assessment is based on a desktop-level review of available system information and incorporates the following key assumptions:

- Hydraulic modeling of the SLVWD system was performed by SLVWD using its existing calibrated model; GEI reviewed and interpreted the results provided.
- BBWC system information is limited and, in some cases, undocumented; therefore, this assessment focuses on high-level feasibility rather than detailed system verification.
- Full emergency fire-flow support through a BBWC–SLVWD intertie is contingent on the completion of SLVWD's planned 12-inch transmission main upgrades (referred to in this report as *Condition 2*).
- Conservative demand assumptions were intentionally used to avoid under-sizing infrastructure intended to support life-safety and emergency response objectives.

Uncertainty related to system documentation and future conditions affects final design and implementation details, but does not preclude planning-level evaluation of intertie feasibility.

1.5. Relationship with Other Planning Efforts

This integration assessment is being conducted in parallel with a separate feasibility study evaluating BBWC surface water supply restoration options. Demand projections and system needs developed under that effort are incorporated here to maintain consistency across planning analyses.

Together, these efforts provide complementary information to support near-term resiliency improvements and longer-term strategic decision-making for BBWC.

1.6. Scope Limitations

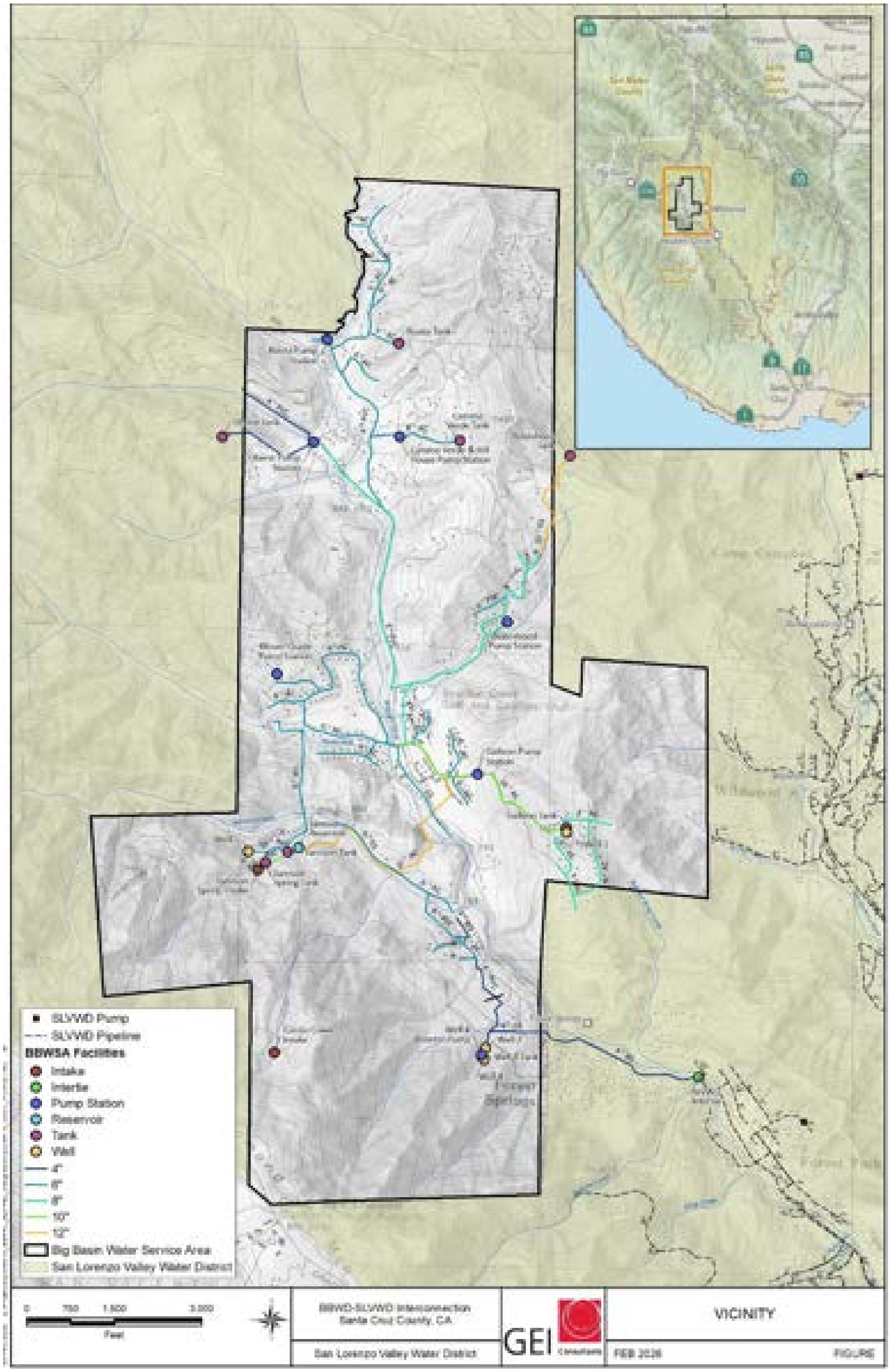
This study is limited to feasibility-level analysis and does not include:

- Detailed engineering design
- Surveying, geotechnical investigations, or potholing
- Environmental review under CEQA or NEPA

- Property or easement acquisition
- Construction management or cost refinement beyond planning-level estimates

Any advancement beyond the feasibility stage would require additional technical studies and coordination.

Figure 1-1. Regional Vicinity Map



2. Existing System Assessment

The existing BBWC infrastructure is currently operating in a vulnerable state, relying on a single groundwater source to serve the entire community. This section summarizes the current operational limitations and physical constraints of the BBWC system, drawing upon recent needs assessments and site evaluations. Identifying these existing deficiencies is critical for defining the hydraulic requirements of the proposed intertie and the downstream improvements necessary to receive imported water.

2.1. Data Sources and Records Review

The technical analysis and engineering assumptions presented in this memorandum are based on a comprehensive review of the following primary and secondary data sources:

2.1.1. Utility Records and As-Built Drawings

Historic distribution system records were provided by Big Basin Water Company (BBWC). These records, spanning from approximately 1990 to the present, were found to be disorganized, incomplete, and frequently illegible. Specific challenges included:

- **Mapping Drift:** Discrepancies of 10 to 30 feet between historical schematics and recent topographic surveys.
- **Information Gaps:** Lack of verifiable data regarding specific pipe materials (e.g., transition from Galvanized to AC) in the Highway 236 corridor.
- **Selection Criteria:** Only legible sheets verified against surface features or modern topography were utilized for modeling assumptions.

Due to the age and condition of the available as-built documentation, desktop-level engineering interpretation was required to estimate buried infrastructure depths and exact alignments. All modeled pipe locations and structural attachments are considered conceptual and require mandatory field verification (potholing) and site-specific structural analysis prior to final design.

2.1.2. State Infrastructure and Regulatory Data

To reconcile gaps in utility records, official state databases and regulatory records were utilized to establish system constraints:

- **Caltrans State Highway Bridges GIS Dataset (2024):** Utilized to verify the structural capacity and design type of the High Bridge Creek crossing (Structure 36 0008, PM 2.39). Data confirmed a 1925 Concrete Tee Beam construction with an existing H-15 design load and established the bridge's physical dimensions.
- **SWRCB Compliance Records:** Reviewed for historical system performance, chronic outages, and state-mandated redundancy requirements.

2.1.3. Collaborative and Supplemental Data

- **San Lorenzo Valley Water District (SLVWD):** Provided hydraulic boundary conditions and existing model results for the southern integration nodes in addition SLVWD system requirements.
- **Feasibility Studies:** Recent assessments by GEI (2025) and Moonshot Missions (2024) provided the baseline for system-wide needs and fire flow targets.
- **Agency Coordination:** Fire flow requirements were established through direct communication with the local Fire Marshal (Puckett, 2025).

2.2. System Facilities Overview

The BBWC system serves a community serving approximately 541 service connections serving a population of about 1,120 residents in the steep terrain of the Santa Cruz Mountains. The infrastructure utilizes a network of booster pump stations and storage reservoirs to distribute water across multiple pressure zones (Moonshot Missions, Sept 2024). The following is GEI interpretation of the existing facilities.

2.2.1. Water Sources & Supply Reliability

Prior to 2020, the system operated on a conjunctive use strategy. Currently, it relies on a single groundwater source.

- **Well No. 4 (Active):** This is the sole source of potable water for the entire system. Water is pumped from the wellhead directly into the adjacent Well No. 4 Tank (Clearwell) for chlorination before being boosted into the distribution system.

Figure 2-1. Well No. 4 pumps directly to Well No. 4 Tank through bypass line

- **Well No. 2 (Inactive):** Inactive but connected to the system, capable of producing 18 gallons per minute (GPM) when operational.

- **Well No. 5 (Inactive):** Existing groundwater well currently designated as inactive as its condition is unknown and assumed to be abandoned, or destroyed.
- **Surface Water (Destroyed):** The historical surface water intakes, along with the surface water treatment plant (SWTP), were destroyed by the CZU Fire and remain offline.

2.2.2. Finished Water Storage

BBWC utilizes a network of approximately 10 storage tanks to manage pressure zones and provide emergency reserves. The inventory below summarizes the system's storage assets, categorized by capacity.

Major Storage Facilities (>10,000 Gallons) These tanks represent the bulk of the system's theoretical storage capacity and serve as the primary hydraulic anchors for the distribution network.

- **Galleon Tank (325,000 gallons):** Large bolted steel tank serving key pressure zone
  - *Condition*: **Operational**. This tank serves the Galleon pressure zone and remains the largest storage asset in the system. It currently provides the primary operational and fire suppression storage for the upper elevations of the service area
- **Rancho Dia Tank (60,000 Gallons):** Large redwood tank serving a key pressure zone.
  - *Condition*: **Critical/Failing**. Sanitary surveys report active leaks and a foundation compromised by saturation.
- **Jamison Tank (210,000 Gallons):** Welded steel tank located at a high elevation point.
  - *Condition*: **Operational**. This tank is critical for maintaining the Hydraulic Grade Line (HGL) for the upper zones and is a primary discharge target for the intertie.

Figure 2-2: Jamison Tank Bolted Steel (Inlet Pipe Shown)

- **Well No. 4 Tank (84,000 Gallons):** Welded steel tank located at the Well No. 4 site.

- *Condition*: **Operational**. Functions as the chlorine contact vessel and suction source for the main booster pumps.

Figure 2-3: Well No. 4 Tank (Inlet Piping Shown)

- Robin Hood Tank (10,000 Gallons): Welded steel horizontal tank.
  - *Condition*: **Failing**. Cited for removal from service due to severe corrosion.

Additional Distribution Storage (<10,000 Gallons) The system utilizes several smaller tanks to service specific hydraulic pockets or act as intermediate booster reservoirs.

2.2.3. Distribution System and Pumping Infrastructure

Booster Pump Stations (BPS): The system relies on a series of booster stations to lift water from the main distribution system to the upper pressure zones (e.g., Filter Plant BPS, Upper Zone BPS).

Distribution Piping & Water Loss: The network is assumed consists of galvanized steel, Asbestos-Cement (AC), and PVC piping ranging from 2-inch to 12-inch traversing difficult terrain. Based on As-Builts the system is estimated to have approximately 15 miles of pipeline.

System Controls: The system utilizes a functional Supervisory Control and Data Acquisition (SCADA) network to manage key distribution nodes (Moonshot Mission, 2024).

- **General Tank Operations:** Most storage tanks are equipped with telemetry systems that interface directly with associated well pumps or booster stations to maintain operational levels.
- **SCADA Integration:** The chlorine feed system at the Well No. 4 tank site and primary storage nodes are actively monitored through SCADA.
- **Well No. 4 Site:** This critical node is integrated into the SCADA system via a Remote Terminal Unit (RTU). Operators can remotely monitor tank levels and electrical amp readings for all

pumps. The SCADA logic provides active control over the booster pumps, including automatic alternating sequences.

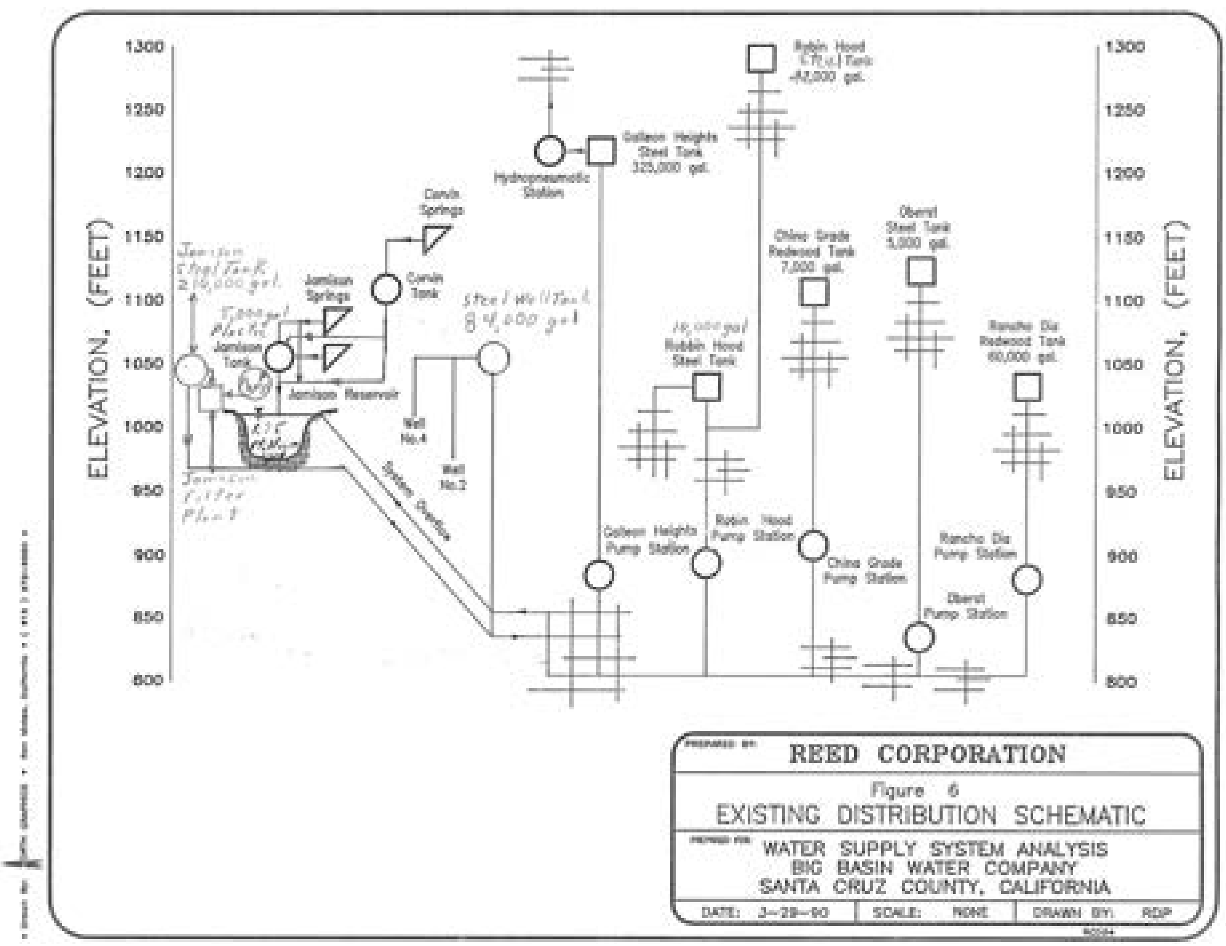
- **Jamison Tank:** Monitored via SCADA primarily for level tracking and telemetry coordination with the supply wells.
- **Galleon Facilities:** Both the Galleon Pump Station and the Galleon PSI System (Galleon Heights) are fully integrated into the SCADA network for pressure and flow monitoring.

SCADA Limitations: Despite SCADA coverage across major nodes, several critical pump stations and storage tanks lack full SCADA integration.

2.2.4. System Connectivity and Hydraulic Profile

To visualize how these assets interact, the historical distribution schematic (Big Basin Water Company, 1990) is provided in Figure 2-4. While the surface water sources (Jamison SWTP) are currently inactive, this schematic illustrates the intended hydraulics of the system, specifically how water must be lifted from the lower elevation sources (main distribution system) to the higher elevation storage nodes such as Galleon Tank.

Figure 2-4. BBWC Distribution Schematic



Notes:
1. Schematic shows items destroyed in the fire (ex. Jamison Filter Plant).

The review of the existing distribution schematic it is apparent that the BBWC system was originally intended to use the Jamison Tank as the central system to be capable of feeding the majority of the system.

Current Primary Source System: Well No. 4 is the system's current primary source.

The Central System (original operation): The Jamison Tank provides the necessary head to serve the core distribution network via gravity. Crucially, it gravity-feeds both the main distribution system and the suction side of secondary booster stations, which feed various tanks that contribute to the other pressurized systems.

The Secondary Systems: Outlying tanks depend on these secondary booster stations. If the primary source systems fail to provide enough volume to satisfy pump suction, the entire outlying network eventually runs dry.

2.3. Existing Infrastructure Operations and Bottlenecks

The required shift from the existing primary gravity down system with primarily use of Jamison Tank surface water supplemented by Well #4 transitioning to Well #4 providing the primary and only reliable source has exposed additional bottlenecks. The following is GEI interpretation of the current operations of the system.

2.3.1. Hydraulic Elevation Challenge: The Gradient Mismatch

There is a significant elevation disconnect between the available supply pressure from SLVWD and the BBWC topography. While it was initially evaluated whether the SLVWD system could provide sufficient head to pressurize the alignment passively, hydraulic modeling of the boundary conditions (**Section 3.2.5**) verified that the available Hydraulic Grade Line (HGL) from SLVWD is insufficient to reach BBWC storage targets since the expected HGL is less than the proposed tank elevations. This modeling confirms that a booster pump station (BPS) is a mandatory requirement for all alignment alternatives to overcome the static head and friction losses.

2.3.2. Mechanical Bottleneck: Well No. 4 Outlet Constraints

The Well No. 4 site is the current primary entry point for supplemental water, yet it is restricted by its historical mechanical evolution:

Historical Evolution: Originally a direct-pumped well site, the addition of a storage tank required the installation of downstream booster pumps to move water into the distribution network.

The Outlet Bottleneck: Although suitable for the existing infrastructure and meeting the supply available from the existing Well #4. The discharge piping from the tank creates a bottleneck discussed in **Section 5.1** that limits increased capacity.

2.3.3. Supply Bottleneck: The "Single Point of Failure" Risk

The system is currently predominantly dependent on Well No. 4 for source production. While the other existing storage tanks can maintain system pressure for a limited duration during a temporary well outage, this hydraulic buffer is finite. Stored water supply would be expected to deplete rapidly during a prolonged mechanical failure of either the existing well, or booster pumps. Once these tanks are empty, there is no secondary source of adequate capacity to refill them.

2.3.4. Distribution Bottleneck: High Non-Revenue Water (NRW)

System-wide water loss is estimated at up to approximately 40% likely due to aged AC and galvanized steel mains estimated based on the amount of water supplied minus the water billed to customers (GEI, Dec 2025).

- **Constraint:** Pumping treated water into a leaking system is operationally inefficient. Consequently, the intertie design assumes the replacement of key transmission segments (such as the Jamison Creek AC pipe) to mitigate the risk of failure under new operating pressures.

Future Consideration: While this high rate of water loss does not physically prevent the construction or operation of the proposed intertie, it presents a significant financial challenge regarding the operational costs of purchased water. Comprehensive leak detection and distribution system rehabilitation are beyond the scope of this interconnection project but should be prioritized as a critical **future improvement** to reduce Non-Revenue Water (NRW) and maximize the efficiency of the new supply.

2.3.5. Information Constraint: As-Built Uncertainty

The reliability of existing as built documentation presents a significant information constraint for this study. As detailed in **Section 2.1**, the lack of verifiable, modern record drawings necessitates that all pipeline alignments, connection points, and hydraulic modeling assumptions in this report be considered conceptual. Consequently, the findings of this feasibility study serve as a basis for strategic alternative selection only; a comprehensive detailed design phase, including mandatory field potholing and site-specific structural analysis, is required to reconcile historical mapping discrepancies and confirm existing subsurface conditions prior to construction.

3. Basis of Analysis

3.1. Demand Criteria

The primary objective of the intertie is to provide supplemental supply and redundancy to the BBWC system. To evaluate the impact on the SLVWD source system, critical demand conditions were established based on BBWC's projected needs for the year 2035, as determined in the GEI Feasibility Report. These demands, calculated in **Appendix A** in accordance with California Code of Regulations Title 22 standards for Maximum Daily Demand (MDD) and Peak Hourly Demand (PHD), form the basis for the fixed modeling scenarios analyzed in **Section 3.2**.

3.1.1. Future Average Daily Demand (ADD)

The projected 2035 Future Average Daily Demand (ADD) for the BBWC system is **122 GPM**. This value represents the baseline steady-state delivery required from the SLVWD intertie to support normal daily operations. The demand was determined from the projected average day demand from the Big Basin Feasibility Report (GEI, Dec 2025). The projected 2035 Annual Production was 64 million gallons (MG), translated to an ADD of 122 GPM.

3.1.2. Future Maximum Daily Demand (MDD)

The design requirement for the MDD is established at **275 GPM**. This value was determined by applying a peaking factor to the Future ADD in accordance with CCR Title 22, Section 64554(b)(2), which allows the use of a peaking factor when 10 years of historical daily data is unavailable or unrepresentative of future conditions. A conservative peaking factor of 2.25x was selected to account for the vulnerabilities of the post-fire infrastructure, including the loss of established service patterns and the known high NRW in the system as it is rebuilt. This multiplier aligns with standard engineering practices for small, rural mountain systems that experience significant seasonal peaking and ensures the SLVWD source system can provide a sustained supply during the highest-demand day of the year without compromising local pressure zones.

3.1.3. Peak Hourly Demand (PHD)

The design value for the PHD is established at **413 GPM**. This value was determined by applying a peaking factor of approximately 3.375x to the Future ADD, which represents the 1.5x multiplier applied to the MDD as permitted under CCR Title 22, Section 64554(b)(2). In the absence of metered hourly data for the rehabilitated system, this methodology ensures the intertie and downstream booster station are sized to handle instantaneous diurnal peaks. Applying this factor to the 2035 projected baseline ensures that the SLVWD boundary can support the highest instantaneous domestic stress without dropping below regulatory pressure thresholds.

3.1.4. Fire Flow Requirement

The design target for emergency fire flow is established at **1,000 GPM** for a 2-hour duration. These values were determined based on the California Fire Code (CFC) and local Fire Marshal requirements for residential and light commercial structures in the Big Basin service area. In addition to these fire flow targets, the system was simulated at an extreme stress threshold of **1,275 GPM** to identify the absolute hydraulic ceiling for emergency support and to evaluate the necessity of automated control logic to protect the SLVWD North System during high-flow events.

3.2. System Boundary Conditions (Data Coordination)

The hydraulic analysis was conducted through a coordinated data exchange between the project team and SLVWD. Because the SLVWD North System is a complex, calibrated network, the project team did not independently model the district's infrastructure.

3.2.1. Coordination Overview

SLVWD performed modeling on their side of the connection based on the demands provided in **Section 3.1.** To fully understand the limits of the system a sensitivity of residual pressure outputs for flows ranging from 0 to 2,000 GPM in 250 GPM increments was requested utilizing two conditions (1) Tanks Full; (2) Tanks Empty with SLVWD demand at MDD.

3.2.2. Physical and Regulatory Boundary Conditions

The physical and regulatory boundary conditions were established using a node elevation of **~645 feet** at the proposed intertie. A critical safety constraint for this project is the regulatory pressure floor, which requires a minimum residual pressure of 20 psi to be maintained at the intertie node at all times. This ensures that demands from the Big Basin system do not compromise the integrity of the SLVWD North System or result in vacuum conditions for existing customers.

3.2.3. Infrastructure Scenarios

SLVWD simulated withdrawal at the connection nodes to provide the "Starting HGL" for our analysis under two specific conditions:

Condition 1: Near-Term Construction (February 2026)

- **Description:** Represents the completed construction scheduled for February 2026.
- **Configuration:** Includes extending the San Lorenzo system to Bracken Brae and upsizing the pipe feeding the existing 6-inch pipe (which connects the tie-in location to the 12-inch main).
- **Rationale:** Condition 1 represents the most immediate version of the intertie and how it would potentially operate including any current restrictions, or limitations that are part of SLVWD system.

Condition 2: Future System Integration (Full Buildout)

- **Description:** Represents a future resiliency upgrade.
- **Configuration:** Includes extending a 12-inch line within the main SLVWD system connecting to the pipeline crossing the bridge/connecting to Bracken Brae.
- **Key Feature:** The new tie-in point would connect directly via a 12-inch line, bypassing the existing 6-inch restriction.
- **Rationale:** Condition 2 represents the planned future improvements to the SLVWD system, which would greatly improve the ability to supply water to Big Basin. This configuration provides a more complete understanding of how long-term system upgrades may improve supply reliability and what additional improvements may be required for long term supply.

3.2.4. Description of Modeling Scenarios

To assess system performance, the model utilized specific operational states determined by SLVWD staff. Scenario 1 was simulated under **SLVWD Normal ADD** conditions to establish a baseline. For Scenarios 2 through 6, the model was run using a **SLVWD Normal MDD** baseline to simulate peak-day stress. Furthermore, for Scenarios 4 through 6, storage tanks were set to their minimum operational levels (Tanks 50%) to identify system limitations under stressed resiliency conditions.

Scenario 1: Static / No Flow: Evaluates the system under SLVWD Normal ADD (0 GPM demand at intertie) to establish the maximum possible HGL and static pressure. This represents the baseline energy available when no water is being drawn by BBWC.

Scenario 2: Future ADD: Simulates a steady-state delivery of 122 GPM under SLVWD Normal MDD conditions. This ensures the intertie can support the BBWC 2035 baseline demand even during periods of high demand within the SLVWD system.

Scenario 3: MDD / Resiliency: Tests the connection at 275 GPM under SLVWD Normal MDD conditions. This demand level represents the Maximum Daily Demand for BBWC and serves as a resiliency check for the system's ability to provide sustained peak-day supply.

Scenario 4: Peak Hour (PHD): Models the instantaneous peak of 413 GPM under SLVWD Normal MDD conditions with tanks at their minimum operational levels. This is a critical design point for ensuring that the SLVWD boundary stays above the 20 psi floor during peak diurnal usage even when source storage is depleted.

Scenario 5: Extreme Stress Test: A high-flow simulation at 1,275 GPM under SLVWD Normal MDD conditions with tanks at minimum operational levels. This identifies the threshold at which the SLVWD system fails to maintain positive pressure for emergency fire support.

Scenario 6: Max Capacity Check: Identifies the maximum flow rate the system can support while maintaining the 20 psi residual pressure limit, assuming SLVWD Normal MDD and minimum operational tank levels. This defines the technical "ceiling" of the intertie.

3.2.5. System Simulation and Results

The results of these simulations are summarized in Table 3-1 below:

Table 3-1. Condition 1 and 2 San Lorenzo Residual Pressure and Flow (Source HGL)

Scenario	Demand (GPM)	Condition 1		Condition 2	
		Min Pressure (PSI)	Min Head (HGL, ft)	Min Pressure (PSI)	Min Head (HGL, ft)
1. Static / No Flow	0	102.6	882.0	102.3	881.3
2. Future ADD	122	99.21	874.2	100.4	876.9
3. MDD / Resiliency	275	80.52	831.0	88.6	849.7
4. Peak Hour (PHD)	413	78.79	827.0	96.1	867.0
5. Extreme Stress Test	1275	**-67.57**[1]	**488.9**	62.6	789.7
6. Max Capacity Check	770/2395[2]	20.23	691.7	20.7	692.8

Notes:
1. Negative pressure values (indicated in red) represent state of hydraulic collapse that the system cannot physically deliver the requested flow (1,275 gpm).
2. Max Capacity for Condition 1 was tested at 770 GPM, Condition 2 was tested at 2,395 GPM to identify the absolute system limit.

The modeling results indicate that the existing SLVWD infrastructure associated with Condition 1 is incapable of supporting the "Stress Test" scenario (Max Day Demand plus Fire Flow). As shown in Scenario 5, the 6-inch infrastructure in Condition 1 results in theoretical negative pressures, signaling that the system cannot physically deliver the required 1,000 GPM fire flow.

Furthermore, the maximum delivery capacity for Condition 1 is 770 GPM, which falls short of the minimum 1,000 GPM fire flow requirement. Consequently, Big Basin would be unable to receive full emergency fire flow support from the SLVWD system under this condition.

3.2.6. Sensitivity Analysis of Infrastructure Scenarios

To evaluate the long-term viability and emergency readiness of the intertie, a sensitivity analysis was conducted across a demand spectrum of 0 to 2,000 GPM (see Table 3-2). This analysis compares the hydraulic stability of the existing 6-inch main (Condition 1) against the proposed 12-inch main (Condition 2) under both full storage (Tanks Full) and stressed (Tanks 50%) SLVWD system states.

Table 3-2. Condition 1 and 2 Sensitivity Analysis

Demand (GPM)	Condition 1		Condition 2	
	Min. Pressure (Tanks Full) (PSI)	Min. Pressure (Tanks 50%) (PSI)	Min. Pressure (Tanks Full) (PSI)	Min. Pressure (Tanks 50%) (PSI)
0	101.62	93.63	101.4	93.3
250	91.63	82.01	98.8	89.4
500	69.18	58.15	94.7	84.4
750	35.12	23.85	89.0	77.8
1000	**-7.82**	**-20.2**	82.9	70.2
1250	**-61.26**	**-76.64**	74.8	63.4

Demand (GPM)	Condition 1		Condition 2	
	Min. Pressure (Tanks Full) (PSI)	Min. Pressure (Tanks 50%) (PSI)	Min. Pressure (Tanks Full) (PSI)	Min. Pressure (Tanks 50%) (PSI)
1500	**-126.15**	**-139.01**	63.5	55.7
1750	**-198.96**	**-213.71**	54.6	45.1
2000	**-280.79**	**-291.41**	42.3	36.7

Notes:

1. Negative pressure values (indicated in red) represent state of hydraulic collapse that the system cannot physically deliver the requested flow.

The sensitivity analysis highlights the functional limits of the current infrastructure versus the robust capabilities of the proposed enhancement. For Condition 1 (6-inch main), the data shows a marginal ability to meet the Big Basin demand requirements for Scenario 1 (Static) through Scenario 4 (Peak Hourly Demand). While the system maintains positive pressure at the 413 GPM peak (Scenario 4), the results indicate a rapid degradation of available head beyond this point. Specifically, once demand exceeds 750 GPM, friction losses in the 6-inch main become so significant that residual pressures drop precipitously, eventually collapsing into negative pressure states (-20.20 psi) at 1,000 GPM. This narrow operational window leaves Condition 1 with minimal factor of safety for any demand exceeding the 2035 projected peak.

In contrast, Condition 2 (12-inch main) demonstrates extreme hydraulic resiliency. Given that the maximum expected diurnal demand for the Big Basin system is 413 GPM and the required fire flow is 1,000 GPM, the combined emergency stress on the intertie is expected reach 1,275 GPM. As shown in the sensitivity table, even at a flow of 2,000 GPM under stressed source conditions (Tanks 50%), Condition 2 still maintains a residual pressure of 36.70 psi. This performance ensures that the system can meet the maximum projected domestic demand and full fire flow requirements while maintaining a pressure buffer greater than the 20 psi regulatory floor. This robust stability confirms that the 12-inch main is the only configuration that provides the necessary safety margin and long-term reliability for the intertie.

3.3. Hydraulic Analysis and Performance Criteria

Hydraulic analysis of the proposed intertie alignments (Connection from SLVWD to Big Basin) was performed using spreadsheet modeling based on the Hazen-Williams equation. The following criteria were established to determine pipe sizing, feasibility, and the necessity for active facilities (pump stations or pressure reducing valves). See **Appendix A** for detailed calculation sheets, demand derivations, and pipe sizing logic.

3.3.1. Hydraulic Parameters

Head loss due to friction in all transmission segments was calculated using the Hazen-Williams formula:

$$H_f = k * Q^{1.852}$$

$$k = \frac{(10.44 * LT)}{C^{1.852} * d^{4.87}}$$

Where: H_f = head loss (ft), LT = Adjusted length (ft), C = roughness coefficient, Q = flow (gpm), d = diameter (inches).

- Roughness Coefficient (C-Factor):
  - C = 130 for Ductile Iron Pipe
  - C = 100: Used for existing infrastructure
- Adjusted Length: A standard minor loss allowance of 20% of the calculated friction loss was applied to account for fittings, valves, and bends. This 20% factor is utilized as a conservative engineering contingency for feasibility-level analysis to account for minor losses from valves, fittings, and unanticipated alignment deflections required to avoid utility conflicts.

To determine the required initial hydraulic grade the difference of the starting elevation and the end elevation were added to the total head loss.

$$HGL_{Required} = (E_{End} - E_{Tie\ in}) + Hf$$

3.3.2. Velocity Criteria

The maximum velocity is dictated by requirements of SLVWD which includes: 5.0 feet per second (fps) maximum PHD velocity and 8.0 fps maximum fire flow velocity. The velocity criteria was the primary factor in determining pipe size.

For all alignment alternatives, **10-inch Ductile Iron Pipe (DIP)** is established as the design baseline. While 8-inch diameters were screened and found to meet the 8.0 fps fire flow limit (at 7.33 fps), 10-inch was selected at this feasibility level to ensure a significant safety margin (approximately 40%) below the maximum allowable fire flow velocity. Furthermore, the larger diameter reduces friction-induced head loss, lowering the Total Dynamic Head (TDH) on the booster pumps and decreasing long-term operational energy costs.

3.3.3. Pressure Criteria

Pressure requirements differ based on the segments function of transmission vs distribution.

- Terminal Delivery (Tank Inlet):
  - For segments discharging directly into the Big Basin storage tank, the HGL at the delivery point must exceed the Tank Overflow Elevation by a minimum of 12 ft (approx. 5 psi).
  - Basis: This buffer accounts for head loss through the inlet altitude valve, isolation valves, and tank discharge piping.
  - Due to discrepancy of the various data sources for a desktop feasibility the overflow elevation of the tank was determined to be the greater of the following sources:
    - As-Builts Distribution Schematic (Figure 2-4)
      - Well No. 4 Tank ~ 1,054 feet to the center of the represented tank is the assumed overflow.

- Jamison Tank ~ 1,044 feet to the center of the represented tank is the assumed max capacity since no overflow exists.

- Topographic Data:
  - Well No. 4 Tank ~ 1,044 feet
  - Jamison Tank ~ 1,037 feet
- Moonshot Report (assumed erroneous):
  - Well #4 Tank: 216.5 m (710.3 feet), Tank Elevation
  - Jamison Tank: Not Listed

- Transmission High Points:
  - A minimum residual pressure of 10 psi is required at all topographic high points along the alignment during dynamic flow conditions to prevent air entrapment or column separation.
- Service Connections (Distribution Standard):
  - If a segment is identified to serve active customers, a minimum residual pressure of 40 psi shall be maintained during Normal (MDD) conditions, and 20 psi during Emergency/Fire (PHD) conditions, consistent with California Waterworks Standards.

3.3.4. *Facility Triggers (Pump or Pressure Reducing Valve)*

Active facilities were only included in the alternatives when passive gravity flow could not meet the criteria above.

- Booster Pump Station (BPS) Trigger: A BPS is required if:

$$HGL_{Available} - H_f < HGL_{Required}$$

  - *Interpretation:* A BPS is required if the SLVWD supply pressure, minus friction loss, results in a pressure at the delivery point lower than the Tank Overflow plus the required 12-foot operational buffer.
- Mechanical Sizing Brake Horsepower (BHP): Pumps are sized to deliver the required demand (Q) at the Total Dynamic Head (TDH) necessary to overcome the elevation lift and system friction.
  - BHP is calculated as:

$$BHP = \frac{Q\ x\ TDH}{3{,}960\ x\ e}$$

  - Motor Selection: To ensure reliability and prevent overloading the motor Horsepower is upsized to the next standard size above the calculated BHP.
- **Pressure Reducing Valve (PRV) Trigger:** A PRV is necessary to reduce excess energy at locations where the pressure class of the proposed pipe or existing pipe is exceeded. A PRV is required if:
  - Infrastructure Protection:

   - A PRV is required if the static pressure at any point exceeds the 250 psi operating limit for new Class 350 DIP piping,
   - A PRV is required if the static pressure at any point exceeds the 100 psi operating limit for existing pipe (including branch connections) due to the uncertainty of condition and the NRW in the aged system.
- **Service Pressure** exceeds 80 psi in areas with service connections (requiring regulation).

3.3.5. Gravity Flow Requirements

The capacity of proposed transmission mains and the evaluation of gravity flow potential were calculated using the Hazen-Williams and Manning's equations.

Selection Logic (Jamison Reservoir and Well 4 Tank): Preliminary sizing was conducted by manually evaluating various standard pipe diameters (d) to identify the minimum size capable of delivering the required flow (Q) while maintaining the benchmarked pressure (60 psi)

Hazen-Williams Equation (Volumetric Flow):

$$Q = \frac{S \, * \, C^{1.852} \, * \, d^{4.87}}{10.44}^{0.54}$$

$$S = (E_{Source} - E_{Target} + P_{Target})/L$$

Where:

- Roughness Coefficient C: 130 (DIP).
- Inside Diameter (d): Evaluated at 12-inch (nominal) for primary transmission segments.
- Source Elevation (E_{Source}): Initial hydraulic head (e.g., Tank Bottom Elevation).
- Target Elevation E_{Target}): Topographic elevation at the connection node.
- Target Pressure (P_{Target}): Minimum required delivery pressure (60 psi).
- Effective Length (L): Total pipe length of the analyzed segment. Calculated as physical pipe length plus 20% buffer to account for minor losses (fittings, valves, and bends) for the feasibility alignments.

3.4. Non-Hydraulic Evaluation Criteria

In addition to hydraulic performance, intertie alignments were evaluated based on land use, permitting complexity, constructability, operational value, and long-term cost. These non-hydraulic factors serve as the basis for the comparative evaluation and ranking of alternatives in **Section 4.5**.

3.4.1. Land Use and Right-of-Way Hierarchy

Alignments were scored based on land acquisition complexity, with the following hierarchy of preference (from most to least favorable):

- **Public Right-of-Way (County/City Roads):** Preferred due to established utility corridors, ease of future maintenance access, and avoidance of property negotiations.
- **Existing Public Easements:** Acceptable if current easement language explicitly permits water utility installation and sufficient width exists for construction equipment.
- **Private Easements (Undeveloped Land):** Less favorable due to the schedule and cost implications of acquiring new easements.
- **Private Easements (Developed/Paved Areas):** Least favorable due to disruption of private property, complex restoration requirements, and high homeowner opposition risk.

3.4.2. Caltrans Right-of-Way Impact Classification

Alignments impacting State Highway Right-of-Way (ROW) were categorized into three tiers of complexity based on the Caltrans *Project Development Procedures Manual* (PDPM):

Tier 1: No Impact (Preferred): Alignments that remain entirely within City/County ROW or private easements. No Caltrans Encroachment Permit is required.

Tier 2: Transverse Crossing (Moderate Constraint): Alignments that cross a State Highway perpendicular (or near-perpendicular) to the centerline.

- *Constraint*: Requires a standard Encroachment Permit and trenchless construction (jack-and-bore) with steel casing. This is a feasible but schedule-intensive process (approx. 6–12 month permitting timeline).

Tier 3: Longitudinal Encroachment (Significant Constraint): Alignments that run parallel within the Caltrans ROW.

- *Constraint*: Generally prohibited by Caltrans policy unless no other feasible alternative exists. Requires a rigorous "Exception to Policy" approval process, introducing significant schedule risk (12–24+ months) and potential for rejection. Alternatives falling into this tier are scored lowest.

3.4.3. Constructability and Environmental Constraints

Given the narrow, mountainous terrain, the following constructability factors were used to evaluate each route:

- **Traffic Management & Alignment:** Alignments were evaluated on their ability to maintain one-way traffic. Due to extremely narrow road widths and non-existent shoulders, most routes will require:
    - Off-site hauling of all trench spoils (no side-casting).
    - Temporary closure of both lanes during specific phases (trenching/installation).

- Coordination with residential properties for driveways temporarily severed during installation.

- **Trenching & Backfill:** Methodology: Preference for open-trench in unpaved shoulders. Horizontal Directional Drilling (HDD) is considered for steep or congested areas.
  - **Backfill Materials:** While native materials are preferred, alignments within Caltrans or County ROW are evaluated with the assumption that a slurry backfill, or higher quality aggregate base may be mandated, significantly increasing costs.
- **Staging & Easements:** Due to the lack of available flat land, preference is given to routes near potential material laydown areas. Alignments requiring "Temporary Construction Easements" for staging are penalized.
- **Subsurface Uncertainty:** Routes were evaluated based on the risk of "unforeseen encounters" with existing utilities (as-builts are disorganized/incomplete), which increases the likelihood of accidental breaks and outages. Detailed review of existing utilities and subsurface investigation (811, ground penetrating radar, etc.) should be performed during the detailed design.

3.4.4. Structural Constraints

Alignments requiring physical attachments to existing infrastructure or complex crossings were evaluated for feasibility:

- **Structural Capacity:** Ability of existing structures to support a 10/12-inch waterline (wet weight) without triggering mandatory seismic or safety upgrades.
- **Geotechnical Stability:** Alignments traversing areas with known landslide history or unstable slopes are penalized. Based on County Fault Zone maps, the entire study area appears to reside within a fault zone; consequently, geotechnical risk is assumed to be relatively uniform across all proposed alignments.

3.4.5. Environmental Constraints

In addition to creek-specific permits, alignments were evaluated against broader environmental and biological stressors:

- **Environmental Review (CEQA/NEPA):** While all routes require a baseline environmental determination, the presence of creek crossings or residential impacts may elevate the required documentation from a Categorical Exemption to an Initial Study/Mitigated Negative Declaration (IS/MND).
- **Riparian & Waterway Permitting:** Creek crossings (e.g., High Creek) may require a California Department of Fish and Wildlife (CDFW) Streambed Alteration Agreement and potential Clean Water Act Section 401/404 permits, adding significant lead time.
- **Tree Removal & Habitat Impact:** Construction in narrow, wooded corridors may require the removal of heritage trees or impact protected species habitat. Alignments requiring significant clearing are ranked lower.

- **Erosion Control (Storm Water Pollution Prevention Plan (SWPPP)):** Given the steep topography and proximity to sensitive creeks, rigorous erosion control and stormwater management are mandatory to prevent sediment discharge during trenching.
- **Noise & Vibration:** Routes through dense residential areas (Acorn Drive) are evaluated for their impact on local residents, potentially limiting construction hours.

3.4.6. System Resiliency and Service Expansion Potential

Alignments were evaluated based on their ability to support future infrastructure improvements, specifically the installation of fire hydrants and future service laterals.

- High Benefit (Public ROW / Frontage):
  - Alignments located within accessible public roadways with existing property frontages.
  - *Value*: Allows for the installation of standard fire hydrants to improve local fire suppression capabilities (ISO ratings) and offers the flexibility to add residential service connections in future phases.
  - *Note*: Alternatives selected for this benefit must meet the higher Distribution Pressure Criteria (40 psi residual) defined in **Section 3.3**.
- Limited Benefit (Cross-Country / Transmission Only):
  - Alignments located in remote easements, cross-country terrain, or transmission-only corridors.
  - *Constraint*: Future connections are often restricted by easement language, and lack of fire apparatus access prevents useful hydrant placement.

3.4.7. System Integration and Phasing Dependencies

Alignments were evaluated based on their ability to immediately meet all project capacity goals versus those requiring additional downstream infrastructure upgrades.

- Single-Phase Solution (High Readiness / High Initial Cost):
  - The alternative constructs all required infrastructure immediately.
  - Pro: Immediate full capacity (including Fire Flow).
  - Con: Highest upfront capital requirement, which may exceed current funding availability.
- Phased Solution (Capital Deferment Benefit):
  - The alternative allows for a viable "Phase 1" project that meets critical supply reliability goals (MDD) at a significantly lower initial cost, with "Phase 2" upgrades (e.g., tank outlet improvements) deferred until future funding is secured.
  - Benefit: It allows the intertie to become operational sooner by removing the cost burden of downstream upgrades from the initial project scope.
  - Condition: This scores favorably provided the Total Lifecycle Cost (Phase 1 + Phase 2) is roughly equivalent to the Single-Phase Solution

3.4.8. Operational Flexibility

Alignments were scored based on the operational value they add to the system beyond simple conveyance.

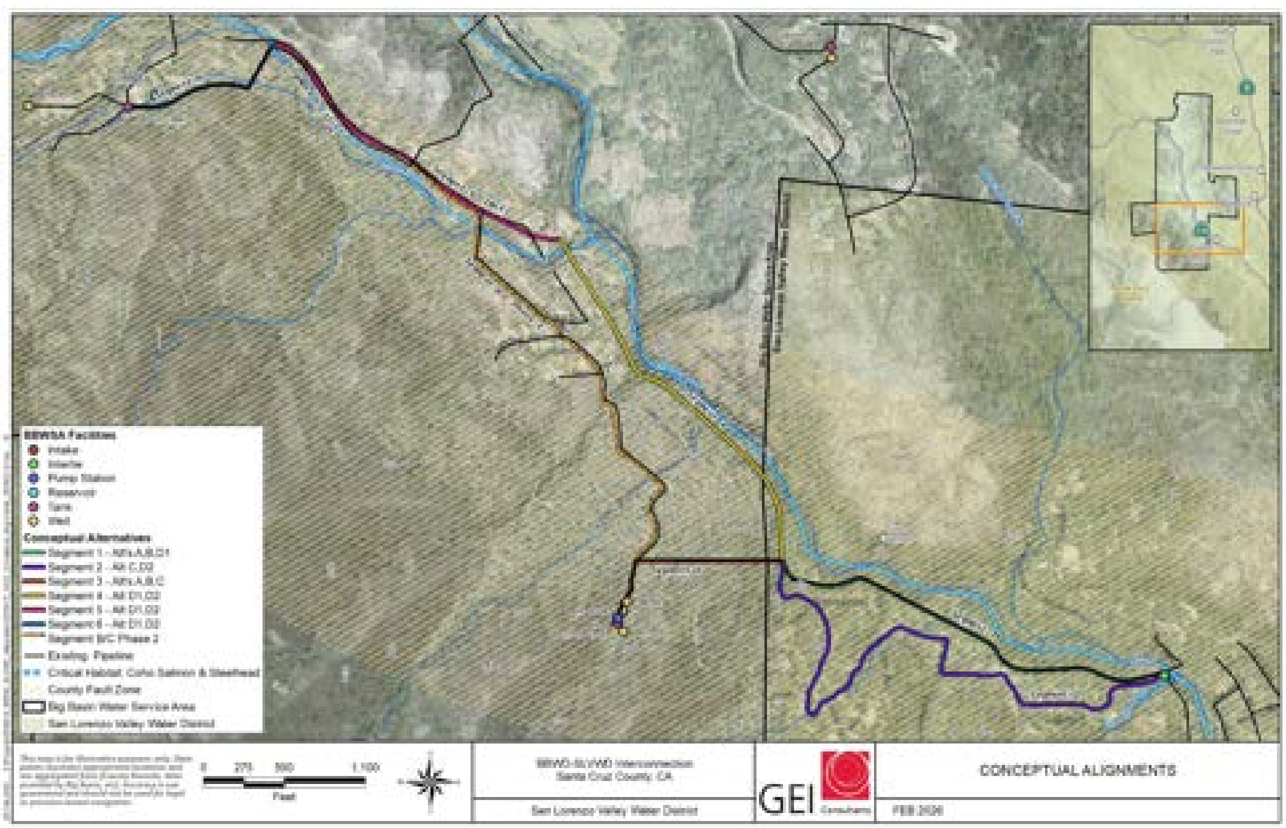
- High Flexibility: Alignments that discharge into a mixing point or key storage node that allows gravity distribution to multiple pressure zones.
- Low Flexibility: Alignments that feed a "dead-end" zone or a single isolated pressure zone, limiting the ability to wheel water to other parts of the service area during emergencies without the use of pumps.

4. Intertie Alignment Alternatives

The identification and development of intertie alignment alternatives were guided by the objective of establishing a resilient, high-capacity connection between the SLVWD North System and the BBWC distribution network. Based on the hydraulic constraints identified in **Section 3** and the strategic injection points discussed in **Section 2**, four primary alignments were developed to evaluate various routing strategies, ranging from utilizing existing infrastructure to establishing new transmission corridors through residential or state-highway rights-of-way.

Each alternative was designed to meet the projected 2035 demands and fire flow requirements, assuming the mandatory integration of a booster pump station to overcome the significant elevation head. Figure 4-1 provides a regional overview of the proposed alignments, and Table 4-1 summarizes the primary physical characteristics of each route.

Figure 4-1. Alternative Alignment Map



The figure above illustrates the geographic relationship between the SLVWD connection point (Bracken Brae area) and the two primary BBWC injection targets: the Well No. 4 Tank and the Jamison Node. The map distinguishes between highway-centric routes (Alternatives A, B, and D-1) and residential-centric corridors (Alternatives C and D-2). Refer to **Appendix C: Conceptual Alignments A through D2** for detailed mapping of each individual alternative.

Corridor Utilization: Alternatives A, B, and D-1 primarily occupy the State Route 236 corridor, while Alternatives C and D-2 divert into the County-maintained residential network of Acorn Drive and Forest Springs.

Injection Targets: Routes terminating at the Well No. 4 site (Alternatives A, B, C) represent a "Perimeter Injection" strategy, whereas routes extending to the Jamison Node (Alternative D) represent a "Central Hub" strategy designed to bypass existing downstream bottlenecks.

Table 4-1. Summary of Alignment Characteristics and Segment Components

Alternative		Total Length (LF)	Target Node	Segment Components	Primary Jurisdictional Impact
Alt A	Baseline (Existing 4")	4,350	Well No. 4 Tank	1 + 3	Caltrans (Tier 3) / Private
Alt B	Replace-in-Place	4,350	Well No. 4 Tank	1 + 3	Caltrans (Tier 3) / Private
Alt C	Residential Route	5,960	Well No. 4 Tank	2 + 3	County / Private
Alt D-1	Central Hub (Hwy)	9,310	Jamison Tank	1 + 4 + 5 + 6	Caltrans (Tier 3) / County / Private
Alt D-2	Central Hub (Acorn)	10,920	Jamison Tank	2 + 4 + 5 + 6	Caltrans (Tier 3) / County / Private

The following segments are used to construct the alignment alternatives presented above. For detailed description of each segment's engineering constraints see the following Sections.

Table 4-2. Segment Reference Catalog

Segment ID	Description	Length (LF)	Primary Jurisdiction
1	Highway 236 Feeder	2,900	Caltrans (Hwy 236)
2	Acorn/Forest Spring Loop	4,510	Santa Cruz County
3	Tank 4 Approach	1,450	Private Easements
4	Highway 236 Extension	2,770	Caltrans (Hwy 236)
5	Jamison Creek Road Injection	2,430	Santa Cruz County
6	Jamison Tank Connection	1,210	Private Easement/Santa Cruz County

The following subsections provide a detailed description of each alignment, highlighting the specific goals, engineering challenges, and unique constraints associated with each route.

4.1. Alternative A: Baseline (Existing 4-inch)

General Description: Utilizes the existing 4-inch asbestos-cement and galvanized steel transmission line connecting SLVWD to the Well No. 4 Tank.

Operational Intent: Serves as the "Do Nothing" baseline for hydraulic comparison. This alignment represents the existing physical connection, which is known to be insufficient based on the available starting pressure determined by SLVWD modeling efforts in **Section 3.2.5.**

4.2. Alternative B: Replace-in-Place (Upsized)

Strategic Goal: To deliver high-capacity flow directly to the Well No. 4 facility while utilizing established utility corridors.

General Features:

- **Total Length:** ~4,350 ft
- **Elevation Profile:** 645 ft (start) → 1,065 ft (Well No. 4 Tank overflow + 5 psi).
- **Primary Material:** 10-inch DIP

Segment 1: Highway 236 Feeder (~2,900 linear feet (LF)): Focuses on the removal and replacement of the existing main to upsize within the paved shoulder of Highway 236. This segment will be governed by Caltrans Tier 3 Longitudinal standards.

Segment 3: Tank Approach (~1,450 LF): Focuses on the removal and replacement of the section of the existing main diverting from the highway to Tank 4. This segment will travel through 2 private parcels (one owned by Big Basin) via existing easements. Upsizing of the pipe diameter here will require renegotiation of easement widths and legal access.

Downstream Dependency: While this alternative successfully fills the Well No. 4 Tank, it remains dependent on the replacement of the undersized 4-inch distribution main exiting the site to achieve system-wide fire protection. Consequently, full emergency functionality for these routes would require the completion of the Phase 2 pipeline segment to bypass this hydraulic bottleneck see Appendix C: Conceptual Alignment B.

Key Constraints: High-traffic corridor requiring extensive traffic control; potential conflict with existing utilities in the narrow shoulder.

4.3. Alternative C: Acorn Drive Route (Residential Alignment)

Strategic Goal: To deliver high-capacity flow to the Well No. 4 facility (as in Alternative B) while providing the secondary benefit of improved local fire suppression and system redundancy by routing infrastructure through dense residential corridors.

General Features:

- **Total Length:** ~5,960 ft
- **Elevation Profile:** 645 ft (start) → 1,065 ft (Well No. 4 Tank overflow + 5 psi).
- **Primary Material:** 10-inch DIP

Segment 2: Acorn/Forest Springs Loop (~4,510 LF): Routes the intertie through County residential streets, avoiding the bulk of the Caltrans highway longitudinal risk. This alignment requires a County Encroachment Permit. Due to narrow road widths and limited shoulder space, up to 82 (44 left, 38 right) Temporary Construction Easements (TCEs) are anticipated on adjacent private properties to facilitate equipment staging and material laydown.

- **Regional Integration Benefit:** This alignment directly supports future SLVWD infrastructure improvements. SLVWD currently plans to construct a new storage tank at the topographic high point of Acorn Drive. Utilizing this route for the intertie completes a significant portion of the transmission infrastructure required for that future facility, offering potential cost-sharing opportunities and long-term regional resiliency. In the event of pursuing this benefit it is likely the size of pipeline may need to be increased to accommodate the additional services and hydrants. For the purposes of the feasibility the costs associated with the upsizing the piping, additional, services, and hydrants have been excluded.

Segment 3: Tank Approach (~1,450 LF): As defined in Alternative B, this segment utilizes private easements to reach the final Tank 4 destination, requiring significant property owner coordination.

Downstream Dependency: Like Alternative B, the effectiveness of this route is throttled by the downstream 4-inch bottleneck at the Well No. 4 site. Full feasibility requires concurrent or subsequent distribution upgrades. Refer to Appendix C: Conceptual Alignment C.

Key Constraints: Significant community impact due to residential road closures; coordination of temporary driveway access; potential structural clear-span required at the Acorn Drive bridge crossing.

4.4. Alternative D: Jamison Tank Intertie Alignment

Strategic Goal: To deliver water directly to the system's primary distribution hub at Jamison Creek Road. This central injection point allows the intertie to supply most customers via gravity, bypassing the mechanical bottlenecks at the Well No. 4 site. While future improvements could allow water to be diverted to other tanks from this hub, the current goal is to establish reliable, high-capacity support at the system's hydraulic center.

General Features:

- **Total Length:** ~9,310 LF (w/ Segment 1), ~ 10,920 LF (w/ Segment 2)
- **Elevation Profile:** 645 ft (start) → 1,056 ft (Jamison Tank Max height + 5 psi)
- **Primary Material:** 10-inch and 12-inch DIP

Initial Feeder (Choice of Route): Alternative D requires a high-capacity feeder to reach the Highway 236 Extension. Two sub-options are evaluated:

- **Segment 1 (Highway 236 Option, ~2,900 feet):** Follows the Highway 236 alignment (matches Alternative B).
- **Segment 2 (Acorn Drive Option, ~4,510 feet):** Follows the residential neighborhood alignment (matches Alternative C footprint).

Segment 4: Highway 236 Extension (~2,770 LF): The connection between the "feeder" terminus and the start of Jamison Creek Road. This involves a Tier 3 Caltrans longitudinal encroachment and the High Bridge Creek crossing.

Segment 5: Jamison Creek Road Injection (~2,430 LF): Follows the narrow County ROW on Jamison Creek Road, utilizing a 10-inch pipe (~1,155 LF) that extends from Big Basin Hwy to the designated injection point that ties into the existing 12-inch AC pipe. At the injection point, the alignment replaces the aged 12-inch AC transmission with new 12-inch DIP (1,275 LF) to the end of Jamison Creek Road. Due to narrow road widths and limited shoulder space, up to 17 (3 left, 14 right) Temporary Construction Easements (TCEs) are anticipated on adjacent private properties to facilitate equipment staging and material laydown.

Segment 6: Jamison Tank Connection (Upgrade of Existing Main) (~1,210 LF): Replaces the aged 12-inch AC transmission main with new 12-inch DIP from Jamison Creek Road to the Tank. This segment will travel through up to 3 private parcels (one owned by Big Basin) via existing easements.

Strategic Advantage: Unlike Alternatives B and C, this route bypasses the Well No. 4 bottleneck entirely, providing immediate gravity-flow benefits to the majority of the service area upon completion. A key strategic benefit is the decommission of the aged dual-pipe (6-inch/12-inch) configuration at Jamison Tank. The replacement of the existing 12-inch AC Jamison Tank outlet with a new 12-inch bidirectional 12-inch DIP manifold, eliminates the dependency on the undersized 6-inch inlet and removes a potential failure risk from the system's hydraulic center.

Key Constraints: Permitting (Caltrans + Structural Bridge Attachment + CDFW Streambed Alteration); structural attachment to High Bridge Creek; extremely narrow road widths requiring off-site spoils hauling.

Operational Requirement (Dual-Point Control): To manage flow in this common inlet/outlet main without complex manifolding at every branch, the design assumes a Dual-Point Control Strategy:

- **Tie-In Point:** Installation of a Flow Control Valve (FCV) to regulate inlet pressure and direct flow to the Jamison Tank.
- **Tank Site:** Installation of an Altitude Valve (or automated inlet valve) to prevent overflow and ensure directional filling.
- **SCADA Integration:** Reliable telemetry is required between the SLVWD tie-in point and the Jamison Tank site to coordinate valve positions and monitor real-time flow.
- **Simplified Assumption:** This strategy assumes existing distribution branches can withstand the increased filling pressures. Full hydraulic verification and surge analysis are deferred to the detailed design phase.

4.5. Strategic Intertie Node Identification

The selection of viable intertie locations was driven by the hydraulics of the BBWC system. Based on the facilities overview in **Section 2.2**, the project team evaluated which nodes could most effectively receive and distribute imported water.

4.5.1. Utilization of Major Storage Assets

To maximize immediate fire protection, the project team focused on the system's primary storage vessels. These tanks were selected as target nodes to provide the necessary hydraulic buffer for peak demands:

- **The Well No. 4 Site:** Selected to satisfy the County's requirement for a backup to the primary active source which also is one of the more accessible tanks in route with a reasonable storage capacity.
- **The Jamison Node:** Selected for its strategic elevation and historical role as a distribution hub, allowing for gravity-feed into the main system distribution system.

4.5.2. Injection Strategy

During development, two distinct injection strategies were considered:

1. **Perimeter Injection (Alternatives B & C):** Terminating at the Well No. 4 Tank. This is the most direct route but leaves the system dependent on downstream booster pumps to reach the higher elevations described in the **Section 5.1.4**.
2. **Central Hub Injection (Alternative D):** Terminating at the Jamison Creek Road intersection. This strategy bypasses the Well No. 4 mechanical bottlenecks by injecting water directly into the system's hydraulic center. The proposed injection intends to transition from a dual-pipe (6-inch/12-inch) operation to a unified 12-inch DIP manifold.

5. Comparative Evaluation and Selection

5.1. Hydraulic Performance Comparison

The primary hydraulic goal of the intertie is the reliable delivery of all projected demand scenarios, including Future ADD, MDD, PHD, and Fire Flow, while maintaining a minimum 20-psi residual pressure floor at the SLVWD connection point to protect the integrity of the source system. Summary of the proposed alignments are presented in Table 5-1.

Table 5-1. Summary of Alternatives Required HGL and Residual Pressures

Metric	Alt A: Baseline (Existing 4")	Alt B: Replace in Place (Upsized)	Alt C: Acorn Drive Route	Alt D-1: Jamison (Hwy 236)	Alt D-2: Jamison (Acorn Dr)
Total Alignment Length	4,350 ft	4,350 ft	5,960 ft	9,310 ft	10,920 ft
Material/Pipe Size	Exist Stl, AC, 4"	CL 350 DIP, 10"	CL 350 DIP, 10"	CL 350 DIP, 10"/12"	CL 350 DIP, 10"/12"
Adjusted HGL Slope (ADD)[1]	21.3 Per 1k'	0.1 Per 1k'	0.1 Per 1k'	0.1 Per 1k'	0.1 Per 1k'
				0.1 Per 1k'	0.1 Per 1k'
Adjusted HGL Slope (MDD)[1]	95.7 Per 1k'	0.5 Per 1k'	0.5 Per 1k'	0.5 Per 1k'	0.5 Per 1k'
				0.2 Per 1k'	0.2 Per 1k'
Adjusted HGL Slope (PHD)[1]	202.8 Per 1k'	1.2 Per 1k'	1.2 Per 1k'	1.2 Per 1k'	1.2 Per 1k'
				0.5 Per 1k'	0.5 Per 1k'
Adjusted HGL Slope (FF)[1]	1,635.2 Per 1k'	9.3 Per 1k'	9.3 Per 1k'	9.3 Per 1k'	9.3 Per 1k'
				3.9 Per 1k'	3.9 Per 1k'
Max FF Starting Pressure (Reqd)	3,258 psi	200 psi	206 psi	209 psi	216 psi
Max MDD Starting Pressure (Reqd)	362 psi	183 psi	183 psi	180 psi	180 psi
Max Velocity	32.6 fps	4.8 fps	4.8 fps	4.8 fps	4.8 fps

Notes:
1. Adjusted HGL slope is based on an equivalent length of pipe (Physical length +20%).
2. For Alternatives D-1 and D-2, the 'Adjusted HGL Slope' rows provide two values: the white cells represent the 10-inch pipe segment, while the gray-shaded cells represent the 12-inch pipe segment

Alternative A (Existing 4-inch) is rejected as a non-viable solution due to material overstress and excessive velocity. Hydraulics indicates that the required starting pressure to satisfy the 2035 MDD exceeds **350 psi**, surpassing the safe operating pressure of the existing infrastructure. Furthermore, under fire flow conditions, the 4-inch diameter results in extreme velocities exceeding **30 fps** as shown in the calculations provided in Appendix A which creates a high risk for water hammer and pipe erosion. The "No Action" baseline is discarded as it presents a significant risk to the integrity of the existing system.

5.1.1. Mandatory Booster Pump

As established by the modeling of SLVWD boundary conditions (**Section 3.2.5**) and the subsequent alignment assessment, the available hydraulic grade from the source system is insufficient to passively feed the BBWC service area. While topography suggested a potential mismatch, the **hydraulic modeling verified** that the available HGL from SLVWD cannot overcome the combined static lift and friction losses required to reach Big Basin storage nodes. Consequently, **all alternatives and all demand scenarios require a high-lift Booster Pump Station (BPS)** to ensure terminal delivery. For the purposes of the feasibility the booster pump station is assumed to be at or near the intertie tie in location the actual location and final sizing for the booster pump shall be further evaluated in the detailed design phase. Detailed Total Dynamic Head (TDH) and horsepower calculations are provided in **Appendix A**. For the purposes of the AACE Class 4 planning-level cost estimate, the BPS is assumed to utilize a triplex (three-pump) configuration consisting of three identical, equal-sized pumps.

Table 5-2. Feasibility Level Individual Motor Sizing with an assumed triplex configuration (3 equal pump sizes)

Option	Pump Flow (GPM)	Alt A	Alt B	Alt C	Alt D-1	Alt D-2
Condition 1	638 GPM	N/A	150 HP	150 HP	150 HP	150 HP
Condition 2	638 GPM	N/A	75 HP	75 HP	75 HP	100 HP

Notes:
1. The pump flow is assumed to be half of the required emergency flow demand (1,275 gpm).
2. Alternative A required horsepower exceeds that of standards motor (>3,000 HP) and is determined not suitable at the extreme flow condition.

A design consideration for this station is the potential for Strategic Integration with SLVWD Infrastructure. It is recommended that the project team evaluate the feasibility of incorporating the Big Basin booster requirements into a potential future SLVWD pump station facility. Upsizing a future SLVWD station to provide the necessary flow and pressure for the Big Basin intertie could offer significant benefits, including:

- **Reduced Footprint:** Consolidating mechanical equipment into a single site to minimize land acquisition and community impact.
- **Operational Efficiency:** Streamlining maintenance and SCADA integration under a shared operational framework.
- **Cost Sharing:** Potentially reducing capital expenditures through a joint-use facility agreement.

5.1.2. Pressure Management

The mandatory use of a high-lift BPS to overcome the ~400 feet of static lift generates internal pipe pressures that exceed standard residential and existing pipe unverified design limits. The following mitigations are required to ensure system integrity:

- **Residential Service portion of alignments (Segments 2 and 5):** In residential corridors along Acorn Drive (**Segment 2**) and Jamison Creek Road (**Segment 5**), the residual pressure graphs shown in **Appendix B** indicates that pressures will exceed **80 psi** for most conditions. Per

California Waterworks Standards, individual pressure reducing valves (PRVs) must be installed at all impacted service connections to protect residential plumbing and appliances.

- *Note on Segment 5:* Due to the lack of verifiable as-built documentation, it is currently uncertain whether residents along Jamison Creek Road are connected to the transmission line designated for replacement or the parallel 6-inch waterline.

- **Existing Pipe Structural Protection (Alternative D):** The residual pressure graphs shown in **Appendix B** for Alternative D indicates pressures at the tie-in will remain below 100 psi, this direct transmission injection represents the highest risk for over. For the purposes of this feasibility study, a **Flow Control Valve (FCV)** at the intertie is assumed to maintain a stable HGL. However, additional site-specific design efforts and condition assessments must be completed in future phases to determine the actual suitability and pressure-bearing capacity of the existing pipe and its downstream components.

5.1.3. Sensitivity to Source Infrastructure Scenarios

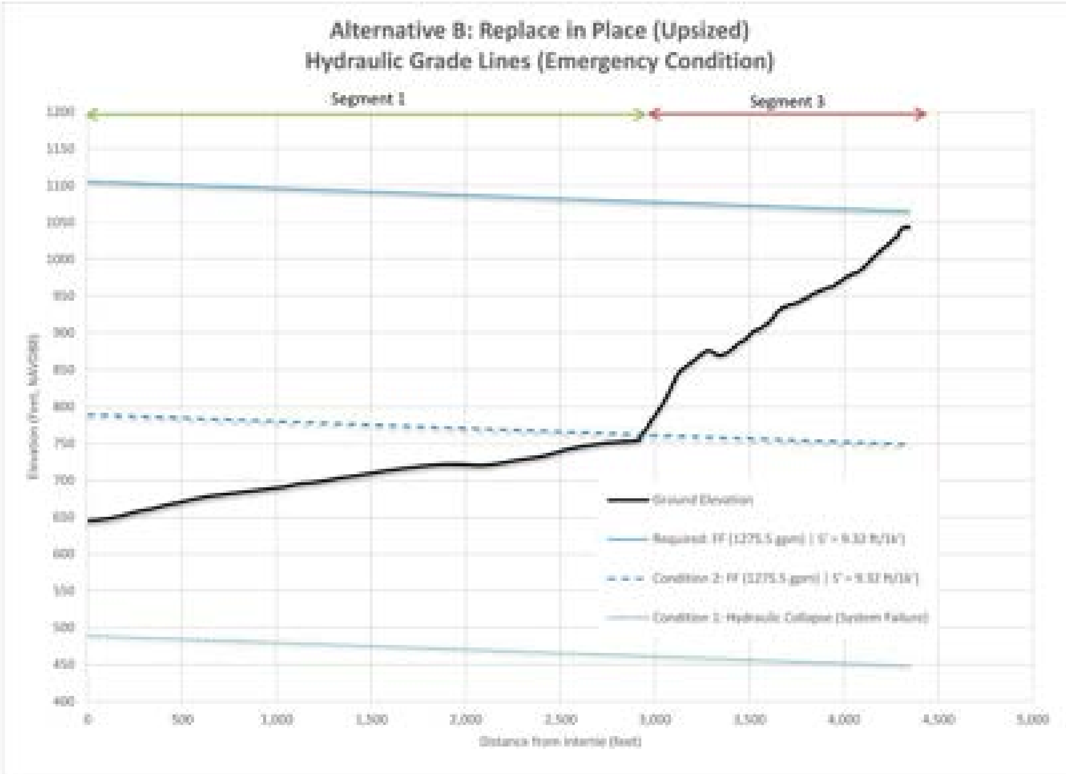
Feasibility is first governed by the SLVWD-side infrastructure established in the **Section 3.2.5**. The source system must be capable of supporting BBWC withdrawals without compromising local service pressures:

Condition 1 (Existing 6-inch Source): While this configuration may support lower domestic flows, modeling confirms it is incapable of meeting the project's primary emergency goals. Under the Extreme Stress Test (Scenario 5: 1,275 GPM), friction losses in the existing 6-inch source main result in theoretical negative pressures, signaling a total hydraulic collapse of the source system. As shown in the "Condition 1" blue dotted line in Figure 5-1, the HGL drops below the ground elevation at the starting node, failing to maintain the 20 psi regulatory residual pressure (additional profiles for Alternative A, C, and D are provided in **Appendix B**).

Condition 2 (Planned 12-inch Source): This planned future upgrade successfully supports the full range of projected demands, including steady-state domestic needs and the **1,000 GPM** fire flow requirement. Even under extreme stress tests of up to **2,000 GPM**, Condition 2 maintains a robust pressure buffer, with residual pressures remaining well above the 20 psi regulatory requirement. This upgrade is a mandatory prerequisite for the feasibility of any Big Basin Water Company (BBWC) alignment intended to provide full emergency fire support.

Required Hydraulic Grade: The following profile illustrates the required HGL to overcome static lift and friction for Alternative B compared against the available grade lines.

Figure 5-1. Alternative B: Hydraulic Grade Lines (Emergency Condition): Required, Condition 1, and Condition 2



5.1.4. Phasing and Downstream Dependency Assessment

A critical distinction between the evaluated alternatives is their relationship with the existing Big Basin distribution bottlenecks, specifically the Well No. 4 Site outlet.

5.1.4.1. <u>The Downstream Bottleneck (Alternative B and C)</u>

Alternatives B and C terminate at the Well No. 4 Tank. While these alignments successfully deliver high-capacity flow to the tank, the current distribution infrastructure exiting the site is limited to a 4-inch diameter pipeline.

The 4-inch Restriction: Finished water must exit the Well No. 4 Tank site existing booster pump site (See **Figure 5-2**) through an existing pipeline of varying diameters (4-to-6-inch pipeline) that extends for approximately 3,800 feet before reaching the 12-inch distribution backbone.

Figure 5-2. Tank #4 Booster Pump Piping

Operational Impact: Even with a high-lift booster pump station at the SLVWD intertie, the 4-inch outlet prevents the delivery of 1,000 GPM fire flows to the rest of the community due to extreme velocities as represented by the Alternative A scenario.

Phasing Requirement: These alternatives require a Two-Phase Approach:

- **Phase 1 (Intertie):** Provides immediate domestic supply redundancy (MDD/PHD) and refills the Well No. 4 tank.

Phase 2 (Downstream): Requires the replacement of approximately 1,600 LF of 4-inch pipe and approximately 2,200 LF 6-inch pipe shown on Figure 4-1 with a larger diameter pipe to unlock system-wide fire protection. For Alternatives B and C, the total project cost must include a "Phase 2" budget for the downstream upgrades. Without these secondary improvements the intertie serves as a domestic resiliency project only and is limited by the existing pump capacity. Preliminary sizing completed in **Appendix A** indicates that for gravity flow out of the Well #4 Tank it is expected that a minimum pipe size of 10-inch or 12-inch diameter would be required to maintain 60 psi residual pressure at the selected node where the new piping would tie in with the existing system. Although 10-inch is determined to be capable of providing the extreme scenario for the purposes of the cost estimate a 12-inch diameter is assumed as a conservative approach which would also be in line with the gravity pipeline coming out of the Jamison Tank.

Recommendation: It is recommended that a detailed hydraulic model be performed during the design phase to verify the required pipe diameter for this downstream Tank 4 segment is sufficient of providing minimum pressures in the rest of the Big Basin existing system. If during the design phase the hydraulics indicates that 12-inch is insufficient to maintain the 20-psi residual pressure at the system extremities during fire flow, the design must be upsized, or an additional booster pump shall be sized to provide minimum system pressures.

5.1.4.2. The Central Hub Strategy (Alternative D)

Alternative D is designed to bypass the mechanical and bottlenecks at the Well No. 4 site by injecting water directly into the system's primary distribution hub at the Jamison Creek Road intersection.

Operational Benefit: By connecting directly to the existing 12-inch transmission infrastructure, this route allows the intertie to support the majority of the service area via gravity from a central location, serving as a Single-Phase Solution for fire protection.

Integrated Infrastructure Upgrade (Segment 6): To ensure long-term reliability and compliance with modern fire flow standards, this alternative assumes the full replacement of the existing 12-inch Asbestos-Cement (AC) transmission main. Replacing this segment with new Ductile Iron Pipe (DIP) eliminates the risk of pipeline failure under the increased directional filling pressures and high-velocity fire flows required by the new SLVWD-supplied operating regime.

Sizing Verification Risk: Calculations indicated that a 10-inch nominal diameter would theoretically satisfy the hydraulic requirements for gravity flow. However, a **12-inch diameter** was selected for the recommended alternative to match the existing 12-inch infrastructure, minimize frictional head loss over the long alignment, and provide additional capacity for future emergency demands.

Recommendation: It is recommended that a detailed hydraulic model be performed during the design phase to verify the required pipe diameter for Segment 6. If during the design phase the hydraulics indicates that 12-inch is insufficient to maintain the 20-psi residual pressure at the system extremities during fire flow, the design must be upsized, or an additional booster pump shall be sized to provide minimum system pressures.

5.1.5. Hydraulic Feasibility Matrix (Pass/Fail)

The "Pass/Fail" status of each alternative, as shown in Table 5-3, is determined by its ability to meet the following four criteria simultaneously. A failure in any single category results in an overall "Fail" for that scenario.

A "Pass" indicates the alternative meets all the following:

- **Hydraulic Grade Delivery:** The alignment, **supported by a booster pump station**, successfully delivers the required flow to the target tank max elevation plus a 12-foot (5 psi) operational buffer.
- **Pressure Compliance:** Steady-state operating pressures remain below the **250 psi** limit for new pipe and below **100 psi** if any existing pipeline segments are utilized. The existing pipe is assumed with a conservative pressure limit due to the uncertainty of the pipe used and the known high NRW ~ 40% (GEI, Dec 2025).
- **Velocity Limits:** Flow velocities do not exceed SLVWD standards: **5.0 fps** for PHD and **8.0 fps** for Emergency Fire Flow.

- **Source Integrity:** The withdrawal does not drop the SLVWD source system residual pressure below the **20 psi** regulatory floor.

Table 5-3. Hydraulic Feasibility Matrix

Scenario	Alt A	Alt B	Alt C	Alt D (1/2)
2. Future ADD	C1: Fail[1]	C1: Pass	C1: Pass	C1: Pass
	C2: Fail[1]	C1: Pass	C1: Pass	C2: Pass
3. MDD / Resiliency	C1: Fail[2]	C1: Pass[6]	C1: Pass[6]	C1: Pass
	C2: Fail[2]	C1: Pass[6]	C1: Pass[6]	C2: Pass
4. Peak Hour (PHD)	C1: Fail[2]	C1: Pass[6]	C1: Pass[6]	C1: Pass
	C2: Fail[2]	C1: Pass[6]	C1: Pass[6]	C2: Pass
5. Extreme Stress Test	C1: Fail[3]	C1: Fail[4]	C1: Fail[4]	C1: Fail[4]
	C2: Fail[3]	C1: Pass[6]	C1: Pass[6]	C2: Pass

Notes:

1. **Alt A (ADD) - Material Overstress:** The required pressure of 217.9 psi exceeds the 100 psi safety threshold established for aged asbestos-cement (AC) and galvanized steel infrastructure.
2. **Alt A (MDD/PHD) - Excessive Friction:** Friction losses in the 4-inch pipe at these flow rates result in required pressures that exceed the 250 psi design ceiling for all municipal infrastructure analyzed in this study.
3. **Alt A (Fire Flow) - Hydraulic Collapse:** The theoretical friction loss for 1,275 GPM in a 4-inch pipe results in negative residual pressures, indicating total hydraulic failure and an inability to deliver the required flow.
4. **All Alternatives (Condition 1 Fire Flow) - Source Bottleneck:** The existing SLVWD 6-inch source main cannot deliver 1,275 GPM without dropping below the 20 psi regulatory residual pressure floor.
5. **All Alternatives (Condition 2 Fire Flow) - Future Pass:** These alignments only "Pass" the Fire Flow scenario assuming the planned SLVWD Condition 2 upgrades (12-inch main) are completed.
6. **Alternative B and Alternative C – Downstream Bottleneck:** The current distribution infrastructure exiting the site is limited to a 4-inch diameter pipeline and is unlikely to meet scenario demands as is. Alt. B and Alt. C pass only with multi-phase infrastructure.

5.2. Non-Hydraulic Feasibility

This section provides a comprehensive assessment of each alternative against the criteria defined in **Section 3.4**, incorporating findings from internal engineering desktop evaluations (EDE) and regulatory data.

5.2.1. Alternative B: Highway 236 (Replace-in-Place)

Land Use & ROW: While primarily within Caltrans ROW for Segment 1, this alignment includes a critical transition segment to the feeder pipe that is located outside of public jurisdiction. Segment 3 requires the renegotiation of 2 private permanent easements to accommodate the wider trench and maintenance offset.

Permitting & Caltrans Policy: Segment 1 is classified as Tier 3 Longitudinal Encroachment. Caltrans policy generally prohibits longitudinal occupancy when local road alternatives (like Acorn Drive) are available. This represents a "Critical Risk" for permit rejection or extended approval timelines.

Constructability & Logistics:

- Traffic Management (Segment 1): Maintaining one lane of traffic is mandatory on this high-speed corridor. Because road shoulders are essentially non-existent, all trench spoils must be hauled off-site as trenching progresses.
- Backfill (Segment 1): Encroachment permits are anticipated to mandate a slurry backfill of the trench, significantly increasing materials and labor costs compared to standard native backfill.
- Community Impact (Segment 1): Construction would force through-traffic onto Acorn Drive, increasing vehicle counts and accelerating the wear on residential road surfaces.
- Missing as-built locations for existing lines increase the risk of pipeline breaks and facility outages during excavation.

Structural Constraints: An existing large diameter culvert and retaining wall were identified along Segment 1. The existing retaining wall and culvert currently has a number of small diameter pipelines connected to it. It appears to be feasible to connect a larger diameter waterline with a similar design as the existing small diameter pipelines. See Photos E8 and E9 in Appendix E.

Environmental Constraints: Alternative B represents the lowest environmental level of effort (LOE). Because the alignment is limited to a previously disturbed highway shoulder and follows a "replace-in-place" strategy, it has case for a Categorical Exemption under CEQA subject to the Lead Agency verification. This minimizes the need for specialized biological or noise studies, though standard SWPPP and erosion control for highway runoff remain mandator

System Resiliency/Expansion: Limited benefit. The highway corridor lacks residential property frontages for new service connections and provides poor access for fire apparatus to utilize new hydrants.

Phasing & Integration: Phased solution. This route terminates at the Well No. 4 Tank. As detailed in **Section 5.1.4**, this leaves the system dependent on the 4-inch site bottleneck.

Operational Flexibility: Limited. Relies on "Perimeter" injection; water must be boosted multiple times to reach majority of system.

5.2.2. Alternative C: Acorn Drive (Residential Route)

Land Use & ROW: Segment 2 is the most easement intensive portion of the project. Due to the narrow road widths, this segments requires up to 82 total temporary construction easements (44 left, 38 right) to facilitate equipment maneuvering and staging. While detailed design may allow for optimization to reduce impacts on one or both sides of the roadway, this study assumes a maximum-impact scenario for budgetary and permitting planning purposes. The approach to the Tank Segment 3 requires the same 2 private permanent easement renegotiations identified in Alternative B.

Permitting & Caltrans Policy: Favorable Tier 1 status for the majority of the route. A short Tier 3 Longitudinal segment to connect Segment 2 and Segment 3 is required for the system tie-in, assumed to be in the Caltrans shoulder.

Constructability & Logistics:

- Traffic Management (Segment 2): Road widths are extremely narrow, making one-lane traffic maintenance challenging. Local traffic would need to be detoured in incremental stages.
- Property Access (Segment 2): Coordination with residents is mandatory for temporarily severed driveway access during pipe installation.
- Missing as-built, non complete sub surface investigation for locations for existing utilities increase the risk of pipeline breaks and facility outages during excavation. It is expected a significant number of utilities to exist within Segment 2.

Structural Constraints: While the desktop level feasibility identifies (Segment 2), has multiple larger culvert crossings (>12" diameter). The existing culvert crossings appear likely to be able to be installed via standard deep-trenching. Additionally due to the higher density housing it is expected to have a higher density of smaller utilities within the road.

Environmental Constraints: Alternative C carries a moderate environmental LOE. Due to the proximity to 82 residential homes and the use of extensive temporary construction easements, this route likely will require an Initial Study/Mitigated Negative Declaration (IS/MND). The CEQA process for this alternative would focus heavily on Noise and Vibration mitigation and traffic circulation impacts to ensure the residential community is not significantly impacted during the trenching phase.

System Resiliency/Expansion: High benefit. If the project is upsized beyond the requirements of providing Big Basin water supply it has the ability to support the installation of fire hydrants and water services in a dense residential loop, significantly improving water availability and protection for over 82 homes.

Phasing & Integration: Phased solution. Similar to Alternative B, this route is dependent on Phase 2 downstream upgrades at the Well No. 4 Tank site (See **Section 5.1.4**).

Operational Flexibility : Identified as a high-value redundancy loop, allowing for fire hydrant placement in a dense residential zone to improve local fire suppression.

5.2.3. Alternative D: Jamison Tank Extension

Land Use & ROW: This alignment involves complex property coordination across two distinct segments. Segment 5 (Jamison Creek Rd) requires 16 TCEs, while Segment 6 (Tank Approach travels through 2 private parcels (one BBWC-owned) where existing easements must be updated. Where Segment 2 instead of Segment 1 is used would have the same requirements of Alternative C.

Permitting & Caltrans Policy: Segment 4 has high complexity due to Tier 3 Longitudinal Encroachment and a concurrent structural attachment review. Segment 1 if selected would have similar constraints as Segment 4.

Constructability & Logistics:

- Logistics: Steep terrain requires off-site spoils hauling and specialized off-site staging.
- Traffic Management (Segment 1, 4): Maintaining one lane of traffic is mandatory on this high-speed corridor. Because road shoulders are essentially non-existent, all trench spoils must be hauled off-site as trenching progresses.
- Backfill (Segment 1, 4): Encroachment permits are anticipated to mandate a slurry backfill of the trench, significantly increasing materials and labor costs compared to standard native backfill.
- Community Impact (Segment 1): Construction would force through-traffic onto Acorn Drive, increasing vehicle counts and accelerating the wear on residential road surfaces.
- Missing as-built locations for existing lines increase the risk of pipeline breaks and facility outages during excavation.
- Property Access (Segment 2, 5, 6): Coordination with residents is mandatory for temporarily severed driveway access during pipe installation.
- Missing as-built, non complete sub surface investigation for locations for existing utilities increase the risk of pipeline breaks and facility outages during excavation. It is expected a significant number of utilities to exist within Segment 2, 5, and 6.

Structural Constraints: Alternative D is a composite route that inherits the structural constraints of its feeder segment in addition to a mandatory terminal crossing.

- Feeder Crossing:
    - If utilizing the Hwy 236 feeder (Segment 1), this alignment faces the same Boulder Creek retaining wall/culvert capacity concerns as Alternative B.
    - If utilizing the Acorn Drive feeder (Segment 2), it will have similar culvert crossing and likely higher density of small utilities described in **Section 5.2.2**.
- Segment 4 Constraints: Further structural design is required, however the below are the currently assumed methods for cost purposes.
    - High Bridge Creek - Structure 36 0008: This 1925 Concrete Tee Beam structure at Postmile 2.39 was designed for a legacy H-15 load (California Department of Transportation (Caltrans), 2024). The Tee Beam configuration presents significant utility attachment challenges, as the monolithic deck and beam construction limits the availability of mounting points without compromising the primary structural members. Consequently, a separate self-supporting span is assumed for this crossing.
    - Retaining Wall with Large Box Culvert (See E13 in Appendix E) is a large structure directly past High Bridge Creek. The structure appears feasible to hang piping on the side or possibly installing a shallow trench outside of the limits of the tie backs. Retaining Wall with Large Box Culvert (See E14 in Appendix E) is a large structure at the intersection of the highway and Jamison Creek Road it appears unlikely to be able to attach to the structure and would require a clear span, or potentially shallow bury trench outside of any tie back limits.

- Segment 5: Near the end of Jamison Creek Road exists a small bridge that has attached the existing 12-inch and 6-inch diameter pipe see E14 in Appendix E. It is assumed the bridge is capable of supporting the proposed pipeline with the replacement of the existing.

Environmental Constraints: Alternative D represents the most intensive environmental and permitting LOE. The requirement for a separate pipe span at High Bridge Creek triggers will likely trigger IS/MND under CEQA, a CDFW Streambed Alteration Agreement (Section 1602), and potentially Clean Water Act Section 401/404 permits. This alignment may require detailed biological assessments and riparian habitat surveys, significantly extending the pre-construction schedule compared to the baseline alternatives.

System Resiliency/Expansion:

- With Segment 1: Moderate. Provides transmission-level resiliency but potentially improves service for individual residential services along the creek corridor Segment 5 and 6.
- With Segment 2: High benefit. Directly supports the installation of fire hydrants in a dense residential loop, significantly improving fire protection for over 82 homes in addition to the benefits of Segment 5 and 6.

Phasing & Integration: Potential Single-Phase solution. As detailed in **Section 5.1.4**, this is the only route that injects water into the system's hydraulic center.

Operational Flexibility: Superior operational value. Bypasses the Well No. 4 mechanical bottleneck and allows gravity feeding of multiple pressure zones by injecting at the system's "Central Hub".

5.3. Planning Level Cost Estimates (AACE Class 4)

The following parameters and assumptions form the foundation of the planning-level costs for all analyzed intertie alternatives:

- **Estimate Class:** AACE International Class 4 (-30% to +50% accuracy).
- **Pipeline Materials and appurtenances:** Assumes 10-inch and 12-inch Class 350 Ductile Iron Pipe (DIP) and appurtenances for new transmission segments to accommodate the high-lift booster pressures and minimize frictional head loss. At the feasibility level ductile iron pipe is selected because it is a standard material used by SLVWD for transmission mains and offers superior structural resilience for infrastructure located within geological fault zone. The design phase should include a value-engineering evaluation for alternative materials such as HDPE, or C900 PVC, which may offer a significant cost savings for specific segments of the alignments.
- **Booster Pump Facilities:** Includes a high-lift Booster Pump Station (BPS) at the SLVWD intertie, mandatory for all alternatives to overcome the static head and friction losses required to reach Big Basin storage nodes. Assumes requirement of new transformer.
- **Pressure & Flow Controls (FCV):** Costs include a Flow Control Valve (FCV) assembly and pre-cast concrete vault at the intertie connection to regulate inlet pressure and protect legacy downstream pipelines from over-pressurization.
- **Storage Tank Retrofits:**

- **Altitude Valves:** Automated inlet valves are included at the target tanks (Well No. 4 or Jamison) to prevent catastrophic overflows during high-head pumping cycles.
- **Nozzle Modifications:** Segment 3 and 6 includes costs for a tank nozzle retrofit to upsize the inlet to handle the full design flow replenishment rate.

- **SCADA & Telemetry:** Includes Remote Terminal Units (RTUs) and communication hardware to synchronize valve positions between the SLVWD tie-in point and the target BBWC storage tanks.
- **Jurisdictional & Structural Constraints:**
  - **Caltrans (Tier 3):** Costs include mandatory 2-sack slurry backfill, full-lane width cold plane/overlay, and professional traffic control for State Route 236.
  - **Temporary Construction Easements and Private Easements**: Include a cost per assumed temporary construction easement, or private easement.
  - **Bridge Crossings/Structures:**
    - Includes separate self-supporting pipe spans for the High Bridge Creek to avoid compromising the structural integrity of the aged existing bridges.
    - Includes heavy-duty hangers attachments for other existing concrete bridge structures (retaining wall with culverts) and for small bridge crossing.
- **Excluded Costs**
  - Implementation of the additional services along Segment 2 are excluded. However it is expected that if services and hydrants are to be included the pipe along Segment 2 would require upsizing. It is assumed this would be a potential cost share item.
  - Segment 5: The costs of new services are excluded and are assumed to be able to remain in service with the placement of the new 12-inch pipe.
- **Soft Costs & Contingency:**
  - **Professional Services:** Design, Construction Management (CM), and Administration estimated at 25% of the construction subtotal.
  - **Planning Contingency:** 30% to account for subsurface uncertainty, design required realignment, and unknown field conditions

Table 5-4. Construction Segment Costs

Segment ID	Description	Primary Drivers	Subtotal
1	Highway 236 Feeder	Caltrans Slurry, Pipe Bridge, Traffic Control	$1,316,000
2	Acorn/Forest Loop	82 TCEs, Utility Potholing, Residential Coordination	$2,794,450
3	Tank 4 Approach	Private Easements, Clearing and Grubbing, Access Road Improvement	$580,500
4	Jamison Gateway	Pipe Bridge (80'), Hwy 236 Extension	$1,669,700
5	Jamison Connector	FCV Vault, 10" DIP, Off-site Spoils	$1,205,175
6	Jamison Hub	Yard Piping, Tank Retrofit to support bidirectional manifold, SCADA Integration	$441,450

Segment ID	Description	Primary Drivers	Subtotal
Phase 2	Downstream Alt B/C	14 TCEs, Utility potholing, Flow Control Valve	$1,661,050
Common Items	Common Items similar for all Alternatives	Booster Pump, Electrical, Tank Improvements	$816,160

Table 5-5 Comparative Cost Summary

Alternative	Part A: Intertie Project	Part B: Downstream Upgrades	Construction Cost	Total Cost (includes 25% Professional Services)
Alt B (Upsize - Hwy)	$2,848,293	$1,744,103	$4,592,396	$5,740,494
Alt C (Parallel - Resid)	$4,400,666	$1,744,103	$6,144,768	$7,680,960
Alt D1 (Jamison - Hwy)	$5,720,909		$5,720,909	$7,151,137
Alt D2 (Jamison - Resid)	$7,273,282		$7,273,282	$9,091,602

Consideration of AACE International Class 4 (-30% to +50% accuracy). The estimated cost for each alternative is expected to fall into the following range.

Alternative	AACE Class 4 Range
Alt B (Upsize - Hwy)	$4,010,000 - $8,620,000
Alt C (Parallel - Resid)	$5,370,000 - $11,530,000
Alt D1 (Jamison - Hwy)	$5,000,000 - $10,730,000
Alt D2 (Jamison - Resid)	$6,360,000 - $13,640,000

6. Recommendations

Based on the hydraulic modeling results, non-hydraulic feasibility ranking, and the strategic objectives of both SLVWD and BBWC, the following actions are recommended.

6.1. Primary Recommendation: Alternative D-1 (Central Hub Strategy)

Alternative D-1 (Highway 236 Alignment) is recommended as the primary technical solution for establishing the intertie. This route provides the most direct path to the system's hydraulic center at Jamison Tank and avoids the significant administrative and community impacts associated with residential construction.

- Efficiency: At approximately 9,310 linear feet, D-1 is the most efficient "transmission-only" route to bypass the Well No. 4 bottlenecks.
- Reduced Coordination: This alignment avoids the requirement for 82 Temporary Construction Easements (TCEs) needed for the Acorn Drive residential route (D-2).
- Permitting Path: While this route requires a Caltrans Tier 3 Longitudinal Encroachment permit, it is justifiable as the most direct path for an emergency intertie that provides system-wide fire protection.

6.2. Strategic Alternative D-2 (Partnership-Driven Alignment)

Alternative D-2 (Acorn Drive Alignment) remains a highly favorable strategic option, but only if implemented as a **Joint-Use Project** with SLVWD.

- Regional Benefit: If SLVWD proceeds with its planned infrastructure improvements in the Acorn Drive corridor, D-2 offers superior regional value by providing local fire suppression to 82 residential homes and supporting future SLVWD storage assets.
- Required Scope Adjustments (Cost-Share): It should be noted that the cost estimate provided in **Section 5.3** for D-2 is based on a 10-inch transmission-only baseline. A viable partnership would require the following scope additions, which are currently excluded from the feasibility budget:
  - Upsized Diameter: Transitioning from the assumed 10-inch main to potentially larger diameter (e.g. 12-inch main) to accommodate combined flows.
  - Distribution Infrastructure: Installation of new service laterals, meters, and fire hydrants to serve the 82 residences along the corridor.
- Cost-Share Dependency: Because D-2 is longer, additional services will likely require a larger diameter for distribution, and involves complex residential coordination, it is only recommended if a Cost-Share Agreement is reached to cover the additional costs.

6.3. Phased Source Integration and Storage Management

To ensure immediate resiliency while SLVWD completes its planned system upgrades, the intertie should be managed using a phased approach:

- Interim Phase (Domestic Resiliency): Utilize existing SLVWD Condition 1 infrastructure to meet BBWC's daily demands. Focus operations on maintaining a "Full Tank" status across the system to maximize fire-flow reserves stored in the Jamison and Galleon tanks.
- Future Phase (Full Fire Support): Transition to full 1,000 GPM replenishment capacity once SLVWD completes the Condition 2 (12-inch main) extension.

6.4. Strategic Facility Integration

It is recommended that the project team evaluate a **Joint-Use Booster Pump Station** with SLVWD. Consolidating the BBWC intertie pumps into a future SLVWD facility would reduce the mechanical footprint, simplify SCADA integration, and streamline maintenance under a shared operational framework.

6.5. Project Implementation Requirements

To move the Primary Recommendation (D-1) into the design phase, the following high-priority tasks are required:

- Structural Bridge Analysis: Perform a site-specific structural review of the High Bridge Creek (Structure 36 0008) to finalize the design of the separate clear-span pipe bridge.
- Transient (Surge) Analysis: Conduct a water hammer study to design appropriate slow-closing valves or surge protection, ensuring the high-lift booster pumping cycles do not damage the aged AC components of the BBWC network.
- Caltrans Coordination: Initiate early-stage "Pre-Application" meetings with Caltrans to confirm the acceptability of the longitudinal encroachment based on the emergency nature of the project.

6.6. Pre-Design Investigation Requirements and Disclaimers

A high-level site investigation was conducted on February 23, 2026, to ground-truth the conceptual alignments (detailed in Appendix E). To mitigate risk during the 30% design phase, the following site and structural verifications are mandatory.

- Topographic Survey and Alignment Optimization: A professional land survey is required to correct "mapping drift" observed in historical records. During the 30% design phase, alternative paths (such as utilizing existing access roads or mid-slope benches) should be evaluated to optimize constructibility and avoid high-cost obstructions like retaining walls, or bridge crossings where feasible.
- Utility Potholing: Physical verification of existing pipeline locations is required to resolve subsurface conflicts, particularly in the Segment 2 (Acorn Drive) corridor if pursued.
- Material and Cost Analysis: The design phase must include a value-engineering evaluation of alternative pipe materials. While Ductile Iron (DIP) is the feasibility baseline for high-pressure segments, the use of High-Density Polyethylene (HDPE) or C900 PVC should be analyzed for specific segments to reduce material and installation costs where hydraulic conditions allow.

- Infrastructure Condition Assessment: Perform diagnostic pressure testing or thickness gauging on existing transmission segments (such as the Jamison 12-inch AC main) to verify their pressure-bearing capacity under the new high-lift booster pump operating regime.
- Advanced Modeling: Evaluate the conversion of the Jamison Tank from a dual-pipe system to a single 12-inch inlet/outlet manifold and define the "Inlet/Outlet" logic for the Jamison main.

6.6.1. Study Disclaimers

- Data Reliability: Findings are subject to the accuracy of historical as-built drawings; final alignments and costs may shift based on actual field conditions.
- Source Dependency: The ability to meet fire flow targets is entirely dependent on the timing of SLVWD system upgrades.
- Operational Constraints: Final design must include a transient (surge) analysis to ensure that high-lift pumping cycles do not damage the aged components of the BBWC distribution network.

7. References

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Appendix A Engineering Calculations and Technical Basis

Appendix B Hydraulic Grade Line (HGL) Profiles and Residual Pressures

Appendix C Conceptual Alignment Exhibits and Mapping

Appendix D Modeling Coordination and Source Documentation

Appendix E Site Assessment Field Notes – Big Basin