



MARIN MUNICIPAL WATER DISTRICT

Water Supply Conveyance Improvements Project



TECHNICAL MEMORANDUM

Project Goals, Criteria, and Alternatives

DRAFT FINAL / January 2024





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This document is released for the purpose of information exchange review and planning only under the authority of Timothy F. Taylor, January 25, 2024, California C-44975.

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Abbreviations

AFY	acre-feet per year
BPS	booster pump station
Carollo	Carollo Engineers, Inc.
Cotati	City of Cotati
District	Marin Municipal Water District
ESA	Environmental Science Associates
MG	million gallons
mgd	million gallons per day
NMWD	North Marin Water District
Novato	City of Novato
PETA	North Marin Aqueduct to Reservoirs
Petaluma	City of Petaluma
PG&E	Pacific Gas and Electric
Project	Water Supply Conveyance Improvements Project
STAF	Stafford Lake to Reservoirs
STS	South Transmission System
SWSA	Strategic Water Supply Assessment
TM	technical memorandum
US-101	United States Highway 101

SECTION 1 PURPOSE

The Marin Municipal Water District (District) contracted with Carollo Engineers, Inc., (Carollo) in 2023 to further refine water supply alternatives developed during the Strategic Water Supply Assessment (SWSA) (Jacobs, 2023) as part of the Water Supply Conveyance Improvements Project (Project).

Carollo hosted a workshop (Workshop No. 1) with the District on October 18, 2023, to discuss the project goals, evaluation criteria, and potential alternatives as the first step of the Project. The purpose of this technical memorandum (TM) is to summarize the project goals, evaluation criteria, and alternatives discussed during Workshop No. 1.

As a next step, the project goals and evaluation criteria will be used to screen the list of project alternatives down to approximately three alternatives. Carollo will meet with the District to discuss the project alternatives evaluation method and screening during Workshop No. 2. The three selected alternatives will then be evaluated and compared in further detail during Phase 2 of the Project.

Figure 1 provides an overview of the Project workflow.

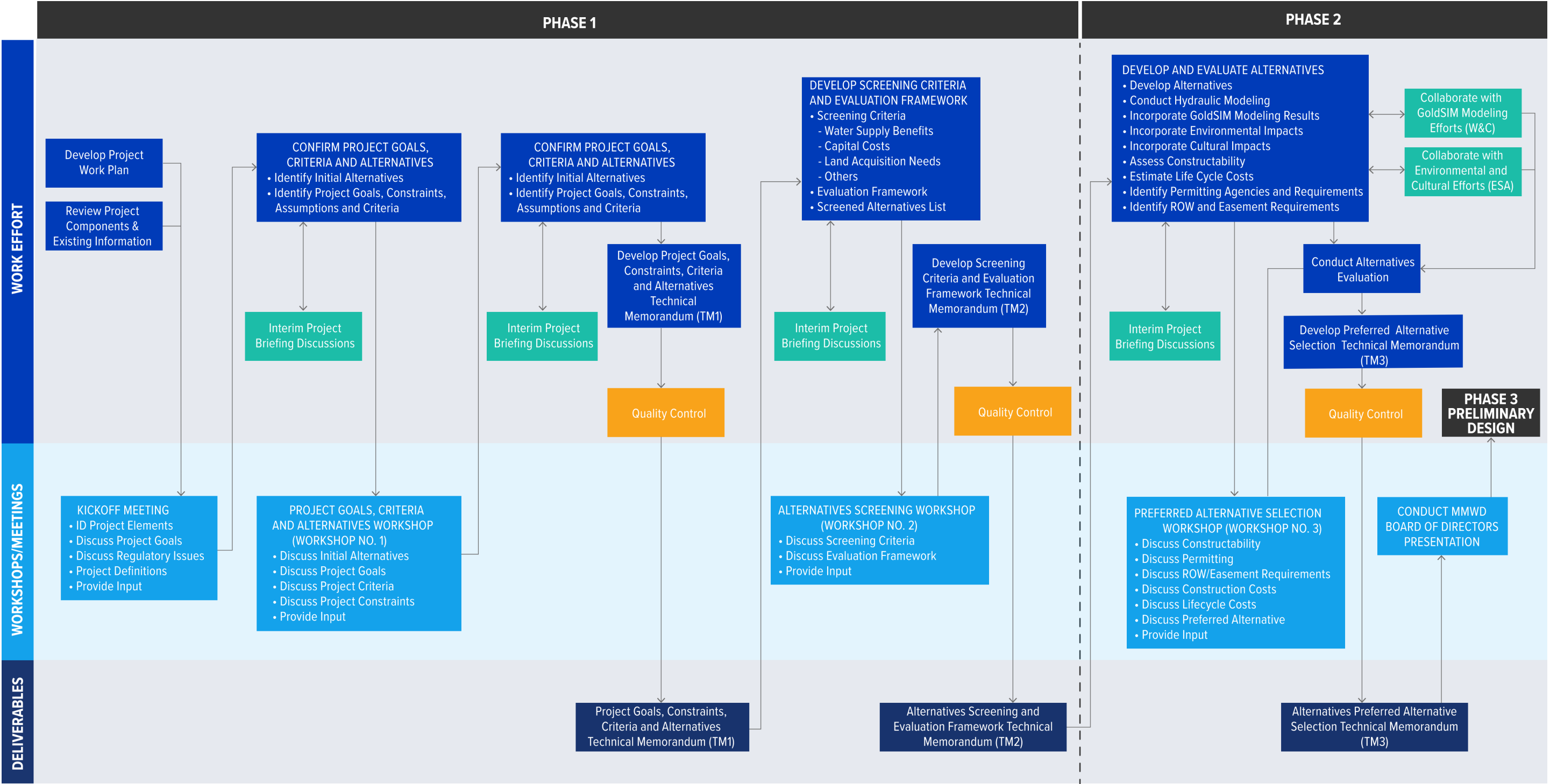


Figure 1 Project Workflow

SECTION 2 BACKGROUND

The District serves more than 191,000 customers in central and southern Marin County. Approximately 75 percent of the District's water supply comes from seven local reservoirs. The District's remaining water supply is imported from Sonoma Water, which delivers water from the Russian River.

In recent years, Marin County and the surrounding area have experienced drought conditions that have threatened the District's water supply reliability. In response, the District commissioned the SWSA, which aimed to provide a road map to a more resilient water supply future. The SWSA, which was completed in early 2023, included an assessment of current and future hydrological conditions, performance of the District's system under these conditions, and consideration of alternatives and strategies to achieve a more resilient water supply future. Ultimately, the SWSA recommended a portfolio of water supply strategies, leading to a target drought water supply benefit of 12,000 to 20,000 acre-feet per year (AFY) by 2035. Strategies included electrifying the District's Soulajule Pump Station; constructing a pipeline to connect the District's Phoenix Lake to the District's Bon Tempe Reservoir; increasing several of the District's local storage reservoirs, including Kent Lake, Nicasio Reservoir, and Soulajule Reservoir; and potentially supplementing the District's water supply via desalination.

Another key strategy identified in the SWSA was to increase the capacity of existing infrastructure to transfer supplemental water from Sonoma Water during the wintertime. The SWSA identified eight project alternatives that would increase the system's capacity to transfer supplemental water from Sonoma Water during the wintertime, including:

- **STS-1:** Install new South Transmission System pipeline along the United States Highway 101 (US-101) corridor to convey additional water from Cotati Tanks to the Kastania Pump Station.
- **STS-2:** Install new South Transmission System pipeline through the downtown area of the City of Petaluma (Petaluma) to convey additional water from Cotati Tanks to the Kastania Pump Station.
- **STAF-1:** Convey water from the North Marin Aqueduct to Nicasio Reservoir using existing North Marin Water District (NMWD) infrastructure to convey water from the North Marin Aqueduct to Stafford Lake and install new facilities to convey water from Stafford Lake to Nicasio Reservoir.
- **STAF-2:** Convey water from the North Marin Aqueduct to Soulajule Reservoir using existing NMWD infrastructure to convey water from the North Marin Aqueduct to Stafford Lake and install new facilities to convey water from Stafford Lake to Soulajule Reservoir.
- **PETA-1:** Install new facilities to convey water from North Marin Aqueduct to Nicasio Reservoir.
- **PETA-2:** Install new facilities to convey water from North Marin Aqueduct to Soulajule Reservoir.
- **COTATI-1:** Install new facilities to convey water from Cotati Tanks to Nicasio Reservoir.
- **COTATI-2:** Install new facilities to convey water from Cotati Tanks to Soulajule Reservoir.

This TM is the first step towards identifying a preferred alternative to transfer supplemental water from Sonoma Water during the wintertime to the District's system.

SECTION 3 PROJECT GOALS

The SWSA recommended a portfolio of water supply projects to help the District obtain an additional drought year water supply of 12,000 to 20,000 AFY by 2035, including this Project. Since completing the SWSA, the District and Environmental Science Associates (ESA) have further refined the goal for this Project as part of the California Environmental Quality Act project description. *The goal of the Project is to enhance the reliability, flexibility and resiliency of the water system to improve service to Marin Water customers.*

SECTION 4 EVALUATION CRITERIA

ESA and the District further defined the project goal by developing objectives that will lead to the project goal being met. These objectives will be considered as the evaluation criteria for this Project.

4.1 Water Reliability and Sustainability

This criterion is defined as follows:

- Contribute to a sustainable dry year water supply, consistent with the framework in the SWSA:
 - » In order to constitute contributing to a sustainable dry year water supply, an alternative should be able to increase the system's capacity to take supplemental water from Sonoma Water during the wintertime months by an amount to be determined by the District.
- Provide reliable water supply, treatment, and transmission infrastructure that meets long-term operational needs under average- and maximum-day demand conditions.
- Improve the ability of water storage and delivery to withstand natural hazards.

4.2 Flexibility and Resiliency

This criterion is defined as follows:

- Retain flexibility of District operations.
- Improve the resilience of District operations to adapt to changing conditions, including climate change effects.
- Integrate well with regional water systems.
- Minimize complexities of system operations and hydraulics.

4.3 Schedule and Implementation

This criterion is defined as follows:

- Implement the project in a timely manner, consistent with framework identified in the SWSA.
- Reduce unnecessary regulatory complexity (e.g., minimize number of permits required, number of agencies with involvement, etc.).

- Preserve options for future conveyance systems between Cotati Tanks and the District's facilities.
- Minimize construction complexities (e.g., alignment minimizes trenchless installation of pipe, avoids crowded utility corridors, etc.).

4.4 Water Quality

This criterion is defined as follows:

- Design improvements to meet current and foreseeable future drinking water and environmental regulations with a margin of safety.

4.5 Environmental and Social Stewardship

This criterion is defined as follows:

- Implement the District's commitments to environmental stewardship.
- Minimize environmental impacts during construction and operation relative to other conveyance alternatives.
- Minimize disruption to existing land uses to the extent practical.

4.6 Economic and Financial

This criterion is defined as follows:

- Minimize capital costs for the District's customers relative to yield.
- Minimize life-cycle costs for the District's customers relative to other conveyance alternatives.
- Make efficient use of existing infrastructure.
- Leverage federal and state investments in infrastructure.
- Minimize financial risk.

SECTION 5 EXISTING DISTRICT WATER SYSTEM AND OPERATION

5.1 District Reservoirs

As discussed above, approximately 75 percent of the District's water supply comes from the District's watershed and is stored in seven local reservoirs. Five of the reservoirs—Alpine Lake (8,891 acre-feet storage capacity), Bon Tempe Lake (4,017 acre-feet storage capacity), Kent Lake (32,895 acre-feet storage capacity), Lake Lagunitas (350 acre-feet storage capacity), and Phoenix Lake (411 acre-feet storage capacity)—are located in the Mt. Tamalpais Watershed. The remaining two reservoirs—Nicasio Reservoir (22,340 acre-feet storage capacity) and Soulajule Reservoir (10,572 acre-feet storage capacity)—are located in West Marin. Figure 2 provides an overview of the District's reservoirs.



Figure 2 District Reservoirs

Water from Nicasio Reservoir is sent to the San Geronimo Water Treatment Plant where it is treated before being pumped into the District's potable water distribution system. Water from Soulajule Reservoir does not have a direct connection to the District's potable water distribution system. However, water from Soulajule Reservoir can be pumped to Nicasio Reservoir.

5.2 Water Imported From Sonoma Water

The remaining 25 percent of the District's water is imported from Sonoma Water. In addition to providing approximately 25 percent of the District's water supply, Sonoma Water provides water to a number of other customers, including the City of Santa Rosa, City of Cotati (Cotati), Petaluma, and NMWD. Currently, the District has an agreement with Sonoma Water to provide the District with up to 14,300 AFY of water.

All of the District's water provided by Sonoma Water is conveyed from the Russian River to the Cotati Tanks and to the District through the existing transmission system. Sonoma Water also delivers

water to Cotati, Petaluma, and NMWD from Cotati Tanks. The Cotati Tanks, which are owned and operated by Sonoma Water, include one 6-million-gallon (MG) tank, one 12-MG tank, and one 18-MG tank, providing a total of 36 MG of treated water storage capacity. Water for Petaluma, NMWD, and the District is then conveyed to the Ely Booster Pump Station (BPS) via the Petaluma Aqueduct. The Ely BPS, which is owned and operated by Sonoma Water, has a capacity of 31.6 million gallons per day (mgd). Ely BPS then pumps water to Kastania Pump Station via the Petaluma Aqueduct. Petaluma has several turnouts along this section of pipeline.

Kastania Pump Station, which is owned and operated by the District, has a capacity of 21.5 mgd with one pump running and a capacity of 25 mgd with two pumps running. Recent testing of the pump station indicated that Kastania Pump Station actually has a capacity of 22.5 mgd with one pump running. The pump station pumps water south to Ignacio Pump Station via the North Marin Aqueduct. The North Marin Aqueduct starts out as a 42-inch pipeline, eventually reducing down to a 30-inch pipeline. Along the 30-inch portion of the North Marin Aqueduct, velocity of the pipeline is limited to 8 feet per second, allowing for a maximum capacity of 22.9 mgd in the pipeline. NMWD has several turnouts along this section of pipeline, including a turnout that can convey water to Stafford Lake.

The North Marin Aqueduct conveys water to Ignacio Pump Station, which is owned and operated by the District. The water is treated at the pump station before being discharged into the District's potable water distribution system. Ignacio Pump Station has a sustained capacity of 14.8 mgd or a peak capacity of 16.0 mgd. Figure 3 provides an overview of District facilities and the facilities used to convey water from Cotati Tanks to Ignacio Pump Station.

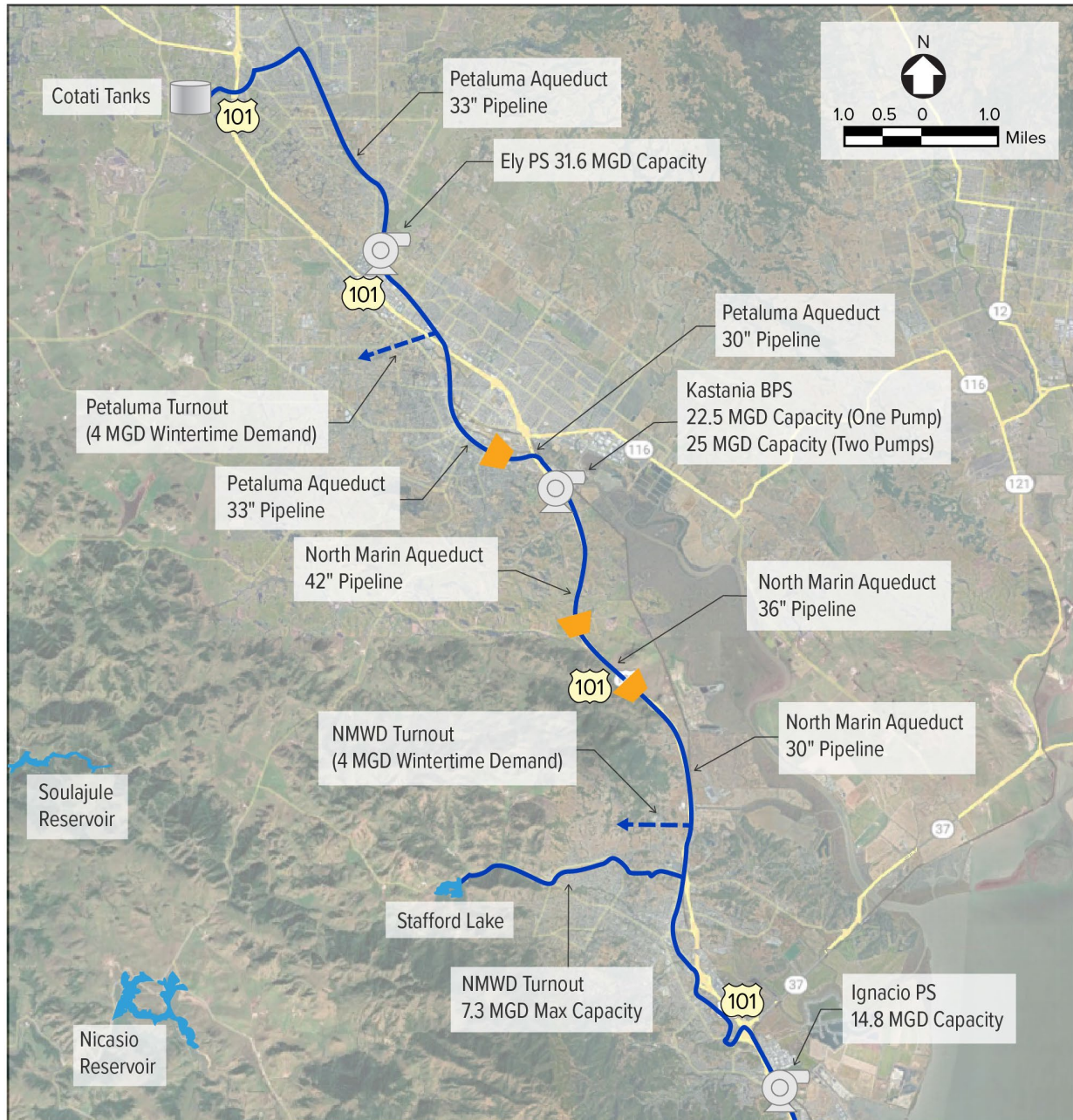


Figure 3 Existing Facilities Between Cotati Tanks and Ignacio Pump Station

5.2.1 Wintertime Demands

As discussed above, several customers receive water from Sonoma Water between Cotati Tanks and Ignacio Pump Station via turnouts, including Petaluma, NMWD, and the District. Demands for these customers vary depending on the time of year. During the wintertime months (October to May) when the District is looking to increase its capacity to transfer supplemental water from Sonoma Water, demands at the turnouts are lower than in higher demand months in the summertime.

Along the Petaluma Aqueduct, Petaluma has several turnouts that divert water from Sonoma Water. During the wintertime months, these Petaluma turnouts have a combined demand of approximately 4.0 mgd. Along the North Marin Aqueduct, NMWD has three turnouts. Two of the turnouts convey water directly to water storage reservoirs. The other turnout conveys water directly into NMWD's distribution system in the City of Novato (Novato). This turnout bifurcates upon turning off of the North Marin Aqueduct. One of the branches ultimately discharges to a pipeline with 7.3 mgd maximum capacity that NMWD uses to convey water to Stafford Lake. During the wintertime months, these NMWD turnouts have a combined demand of approximately 4.0 mgd.

Downstream of these turnouts, the District's water distribution system also sees a reduced demand during the wintertime months. As such, the District limits the amount of water that Ignacio Pump Station pumps to the District's water distribution system to approximately 8.0 mgd during the wintertime months. Although the infrastructure is in place for Ignacio Pump Station to provide more than 8.0 mgd of water to the District's water distribution system, sending additional flow during the wintertime months would significantly impact the District's system operations. One of the major impacts is that water treatment plant(s) would likely need to be taken offline due to low flows, leading to operational complexities and water quality challenges.

5.3 Future System Operation

With the implementation of a project to increase the capacity of existing infrastructure to transfer supplemental water from Sonoma Water during the wintertime, the District's system operation will be required to change slightly. The District will be able to receive more water from Sonoma Water than they currently are receiving. The District and Sonoma Water are engaged in ongoing discussions to determine how much additional water Sonoma Water can provide during wintertime months, while not exceeding the 14,300 AFY that is contractually allowed.

Sonoma Water will send this additional water from the Russian River to Cotati Tanks. The selected project alternative will then convey the water from the Cotati Tanks to the District's distribution system or to District storage reservoirs to augment the District's supply during the wintertime.

SECTION 6 PROJECT ALTERNATIVES

The SWSA identified eight project alternatives that increase the District's capacity to transfer supplemental water from Sonoma Water during the wintertime. Based on discussions with the District, several other alternatives are also feasible and will be included in this TM. A summary of alternatives to be considered is included below.

6.1 South Transmission System (STS) Project Alternatives

In general, the STS alternatives include pipeline and pump station improvements to convey additional water from Cotati Tanks to the Kastania Pump Station. The following alternatives are included under the umbrella of the STS alternatives:

- **STS-1:** Cotati Tanks to Kastania Pump Station along the US-101 corridor.
- **STS-2:** Cotati Tanks to Kastania Pump Station through downtown Petaluma.
- **STS-3:** Cotati Tanks to Kastania Pump Station through rural roads.

For each of these alternatives, the supplemental water from Sonoma Water would be conveyed from Cotati Tanks to Kastania Pump Station, from Kastania Pump Station to Ignacio Pump Station, and from Ignacio Pump Station directly into the District's potable water distribution system. These alternatives all provide a benefit of reducing high velocities and flow constrictions in the existing Petaluma Aqueduct. Figure 4 shows an overview of the STS alternatives.

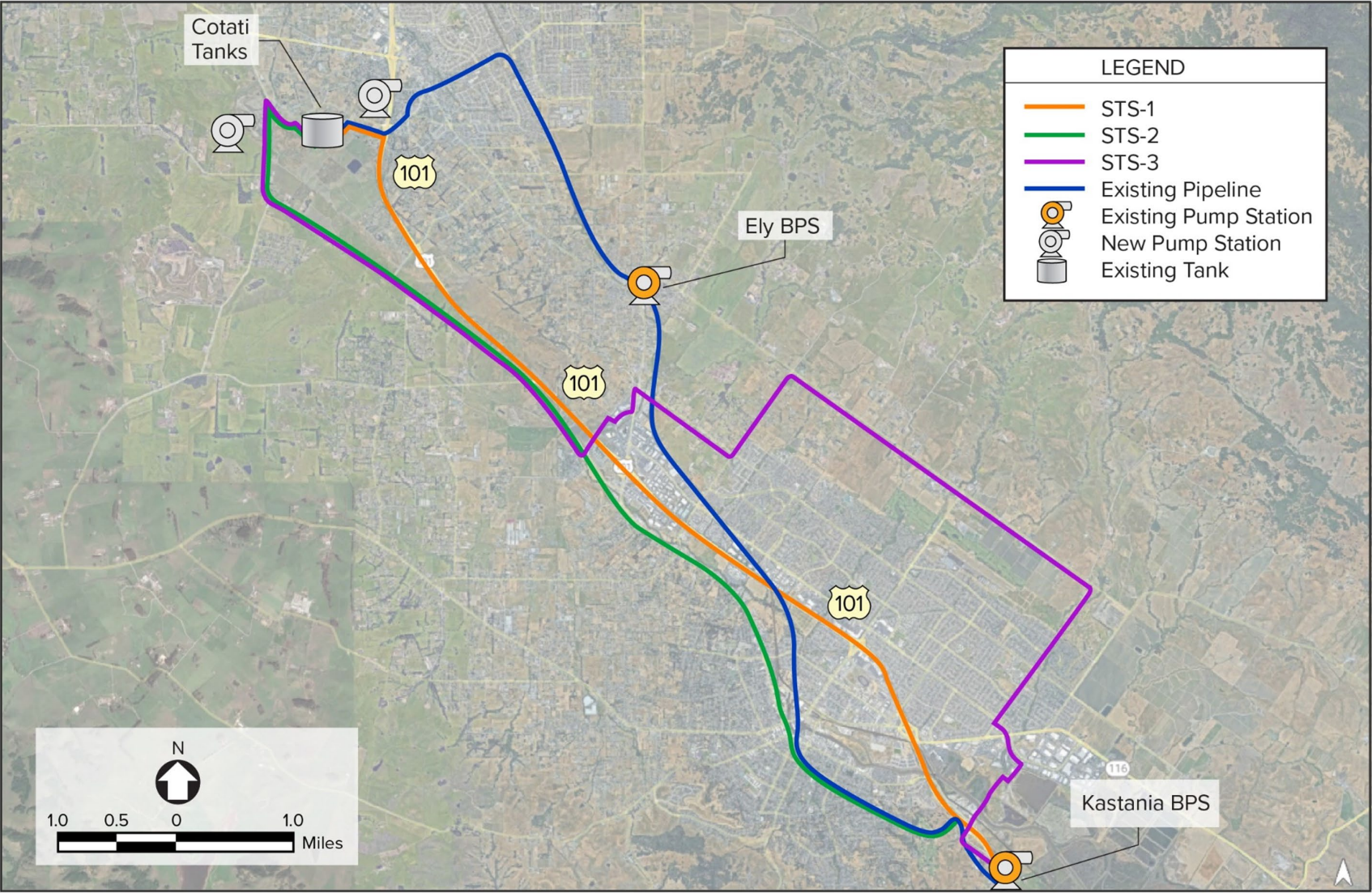


Figure 4 STS Alternatives

6.1.1 STS Alternatives

6.1.1.1 STS-1: Cotati Tanks to Kastania Pump Station Along US-101 Corridor

This alternative includes a new 10.5-mile-long pipeline routed along the US-101 corridor to convey water from the Cotati Tanks to Kastania Pump Station. Most of this proposed pipeline alignment is located within Caltrans right-of-way and a longitudinal easement from Caltrans will be required. It will be very challenging to obtain a 10.5-mile longitudinal easement from Caltrans, especially along US-101.

This proposed alignment will also have significant impacts to the public during construction due to a full lane of traffic along southbound US-101 likely needing to be shut down. This corridor of US-101 already sees heavy traffic during commute hours. Traffic issues will be compounded with the removal of a lane during construction.

Additionally, given the topography of the alignment, a pump station will likely be required for this alternative. The pump station will need to be located near Cotati Tanks.

6.1.1.2 STS-2: Cotati Tanks to Kastania Pump Station Through Downtown Petaluma

This alternative includes a new 12.1-mile-long pipeline routed along Stony Point Road and Petaluma Boulevard to convey water from the Cotati Tanks to Kastania Pump Station. This proposed pipeline alignment runs through Historic Downtown Petaluma, which is a major transit and business corridor. As such, significant coordination with Petaluma will be required to determine feasibility of this pipeline alignment.

Given the high density of businesses within this area, construction of this alternative will be difficult. Construction challenges through Historic Downtown Petaluma include congested utility corridors, limited work areas, and impacts to the public. The public impacts will include traffic impacts, impacts to local restaurants, and impacts to other commercial businesses.

Given the topography of the alignment, a pump station will likely be required for this alternative. The pump station will need to be located near Cotati Tanks.

6.1.1.3 STS-3: Cotati Tanks to Kastania Pump Station Through Rural Roads

This alternative includes a new 15.5-mile-long pipeline routed along rural roads to convey water from the Cotati Tanks to Kastania Pump Station. This alignment was initially developed by Sonoma Water and designed to the 60 percent design level in 2008. Most of the pipeline alignment is located along rural two-lane roadways. There are several areas where the pipeline alignment passes through private property. Further coordination with these private property owners will be required to determine feasibility of this pipeline alignment.

Given the topography of the alignment, a pump station will likely be required for this alternative. The pump station will need to be located near Cotati Tanks.

6.1.2 Water System Supply Benefits of STS

Based on current operations, existing infrastructure can convey up to 31.6 mgd of water from Cotati Tanks to Kastania Pump Station, with Petaluma pulling approximately 4 mgd of that during wintertime months. As such, up to 27.6 mgd of water can be delivered to Kastania Pump Station during wintertime months.

Downstream of Kastania Pump Station, the system demand during wintertime months is approximately 12 mgd. As previously discussed, NMWD would pull approximately 4 mgd during wintertime months and the District would receive, treat, and distribute approximately 8 mgd through Ignacio Pump Station.

Given that the demand downstream of Kastania Pump Station during wintertime months is far less than the available supply of water at Kastania Pump Station, implementing one of the STS alternatives on its own would not provide any tangible water supply benefits to the District. However, the STS alternatives do provide a water supply benefit to the District and other municipalities in the region by adding a redundant transmission pipeline between Cotati Tanks and Kastania Pump Station.

6.2 Stafford Lake to Reservoirs (STAF) Project Alternatives

In general, the STAF alternatives include pipeline and pump station improvements to convey additional water from Stafford Lake to Nicasio Reservoir, Soulajule Reservoir, or both reservoirs. The following alternatives are included under the umbrella of the STAF alternatives:

- **STAF-1:** Stafford Lake to Nicasio Reservoir.
- **STAF-2:** Stafford Lake to Soulajule Reservoir.
- **STAF-3:** Stafford Lake to Nicasio and Soulajule Reservoirs.

For each of these alternatives, water will be conveyed from the North Marin Aqueduct to Stafford Lake using NMWD's existing pipeline. As previously discussed, the NMWD pipeline has a maximum capacity of 7.3 mgd. Use of the NMWD pipeline will be impacted by NMWD's use of the pipeline. Early coordination with NMWD will be required to ensure that use of the NMWD pipeline is allowed, and, if so, what NMWD's anticipated use of the pipeline will be. If deemed acceptable, a formal agreement with NMWD will be required.

Considering the ongoing water quality challenges at Stafford Lake, an alternative including a turnout could be constructed along the existing NMWD pipeline before it discharges to Stafford Lake to take water directly out of the pipeline. The turnout will convey water to a new pump station. The new pump station will pump water via a new pipeline to Nicasio Reservoir, Soulajule Reservoir, or both reservoirs. For each of these alternatives, the supplemental water from Sonoma Water will be sent to existing storage reservoirs to be used by the District at a later time. Figure 5 shows an overview of STAF alternatives.

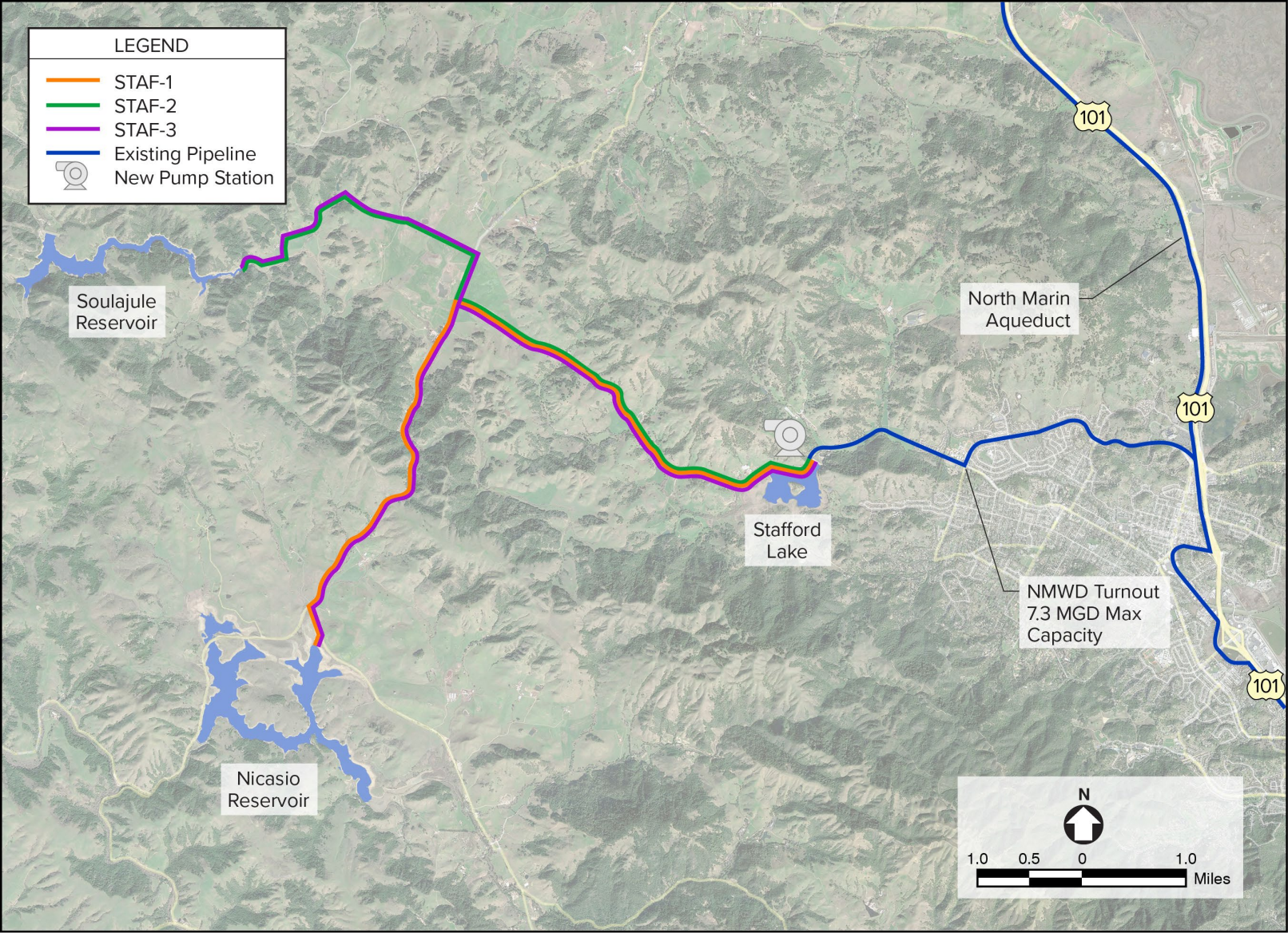


Figure 5 STAF Alternatives

6.2.1 STAF Alternatives

6.2.1.1 STAF-1: Stafford Lake to Nicasio Reservoir

This alternative includes a new pump station and pipeline to convey water from Stafford Lake to Nicasio Reservoir. This alternative will require approximately 8.0 miles of new pipeline routed along Novato Boulevard and Pt. Reyes – Petaluma Road, all of which is through rural two-lane roadways. For this alternative, the supplemental water will be conveyed to Nicasio Reservoir for storage.

6.2.1.2 STAF-2: Stafford Lake to Soulajule Reservoir

This alternative includes a new pump station and pipeline to convey water from Stafford Lake to Soulajule Reservoir. This alternative would require approximately 6.8 miles of new pipeline routed along Novato Boulevard, Pt. Reyes – Petaluma Road, Hicks Valley Road, and a fire road. The fire road is routed through private property. Discussions with the private property owner will be required to determine feasibility of this pipeline alignment. For this alternative, the supplemental water will be conveyed to Soulajule Reservoir for storage.

6.2.1.3 STAF-3: Stafford Lake to Nicasio and Soulajule Reservoirs

This alternative includes a new pump station and approximately 11.0 miles of pipeline to convey water from Stafford Lake to Nicasio and Soulajule Reservoirs. This alternative will require approximately 4.0 miles of new pipeline routed along Novato Boulevard. At the intersection of Novato Boulevard and Pt. Reyes – Petaluma Road, the pipeline will bifurcate, with one branch of the pipeline heading south approximately 4.0 miles along Pt. Reyes – Petaluma Road to Nicasio Reservoir and the other branch heading northwest approximately 3.0 miles along Pt. Reyes – Petaluma Road, Hicks Valley Road, and a fire road to Soulajule Reservoir. The fire road is routed through private property. Discussions with the private property owner will be required to determine feasibility of this pipeline alignment. For this alternative, the supplemental water will be conveyed to Nicasio and Soulajule Reservoirs for storage. Under this alternative the District will have the ability to select which reservoir to fill based on reservoir levels, demands within the system, and operational considerations. The District would be able to utilize the storage capacity of both reservoirs, increasing the amount of water that can be taken from Sonoma Water and stored in the reservoirs.

6.2.2 Water System Supply Benefits of STAF

As previously discussed, the existing NMWD pipeline has a maximum capacity of approximately 7.3 mgd from the North Marin Aqueduct to Stafford Lake. As such, the new facilities from Stafford Lake to the reservoirs will be sized to convey 7.3 mgd, maximizing the amount of water that can be conveyed through NMWD's pipeline. No other improvements or upgrades to the existing system are anticipated to be needed to convey 7.3 mgd from Stafford Lake to the reservoirs.

6.3 North Marin Aqueduct to Reservoirs (PETA) Project Alternatives

In general, the PETA alternatives include pipeline and pump station improvements to convey additional water from the North Marin Aqueduct to Nicasio Reservoir, Soulajule Reservoir, or both reservoirs. These alternatives are similar to the STAF alternatives, but do not utilize the existing NMWD pipeline that conveys water from the North Marin Aqueduct to Stafford Lake. The following alternatives are included under the umbrella of the PETA alternatives:

- **PETA-1:** North Marin Aqueduct to Nicasio Reservoir.
- **PETA-2:** North Marin Aqueduct to Soulajule Reservoir.
- **PETA-3:** North Marin Aqueduct to Nicasio and Soulajule Reservoirs.
- **PETA-4:** North Marin Aqueduct to Nicasio and Soulajule Reservoirs via San Antonio Road.

For each of these four alternatives, water will be conveyed from the North Marin Aqueduct to Nicasio Reservoir, Soulajule Reservoir, or both reservoirs via a new pump station and pipeline. For each of these alternatives, the supplemental water from Sonoma Water will be sent to existing storage reservoirs to be used by the District at a later time. Figure 6 shows an overview of PETA alternatives.

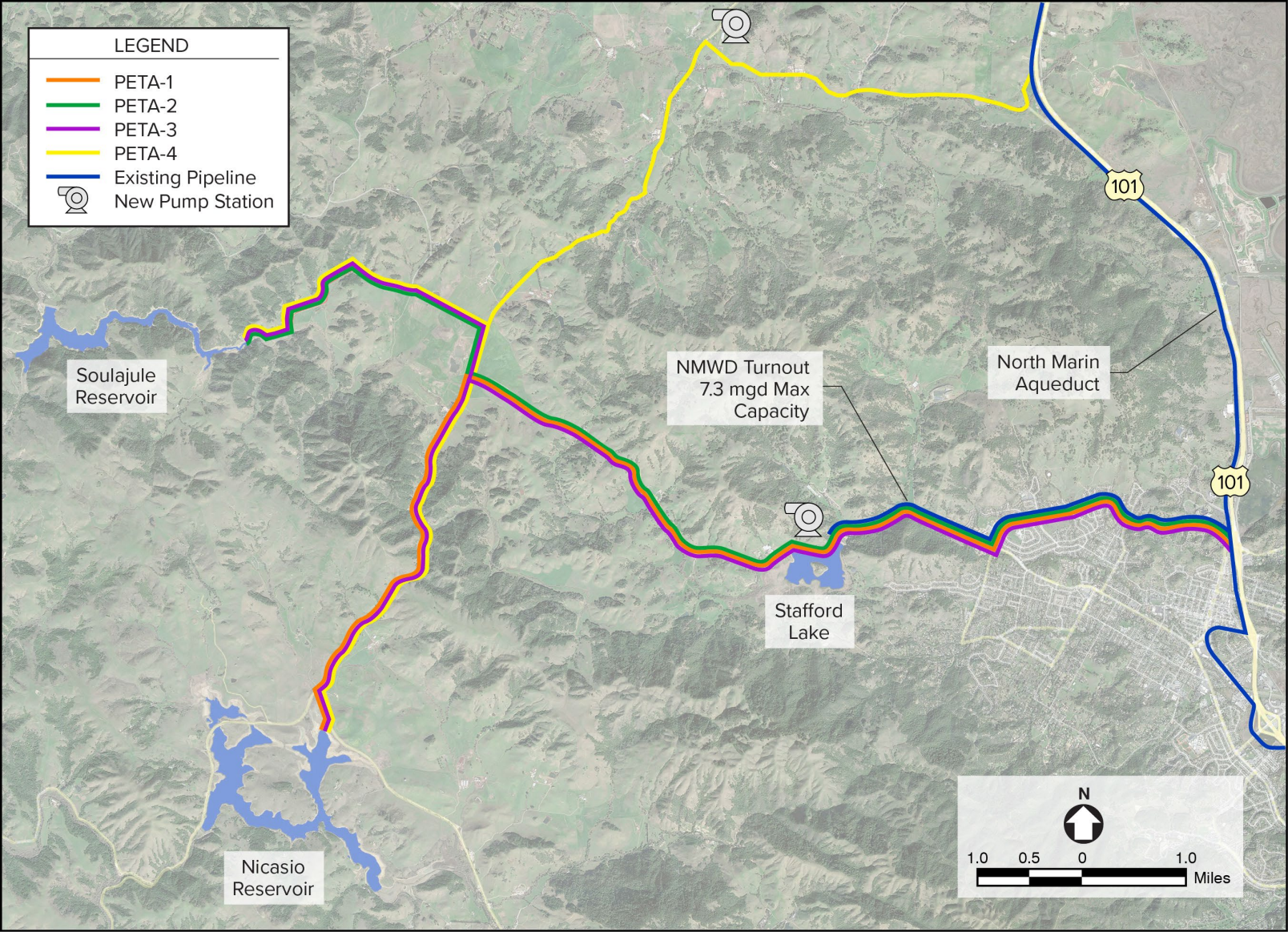


Figure 6 PETA Alternatives

6.3.1 PETA Alternatives

6.3.1.1 PETA-1: North Marin Aqueduct to Nicasio Reservoir

This alternative includes a new pump station and pipeline to convey water from the North Marin Aqueduct to Nicasio Reservoir. This alternative will require approximately 13.2 miles of new pipeline routed along San Marin Drive, Novato Boulevard, and Pt. Reyes – Petaluma Road. A portion of this pipeline will parallel the existing NMWD pipeline that conveys water from the North Marin Aqueduct to Stafford Lake through residential areas. The remaining portion of pipeline is through rural two-lane roadways. For this alternative, the supplemental water will be conveyed to Nicasio Reservoir for storage.

6.3.1.2 PETA-2: North Marin Aqueduct to Soulajule Reservoir

This alternative includes a new pump station and pipeline to convey water from the North Marin Aqueduct to Soulajule Reservoir. This alternative will require approximately 12.0 miles of new pipeline routed along San Marin Drive, Novato Boulevard, Pt. Reyes – Petaluma Road, Hicks Valley Road, and a fire road. A portion of this pipeline will parallel the existing NMWD pipeline that conveys water from the North Marin Aqueduct to Stafford Lake through residential areas. The remaining portion of pipeline is through rural two-lane roadways and the fire road. The fire road is routed through private property. Discussions with the private property owner will be needed to determine feasibility of this pipeline alignment. For this alternative, the supplemental water will be conveyed to Soulajule Reservoir for storage.

6.3.1.3 PETA-3: North Marin Aqueduct to Nicasio and Soulajule Reservoirs

This alternative includes a new pump station and approximately 16.2 miles of pipeline to convey water from the North Marin Aqueduct to Nicasio and Soulajule Reservoirs. This alternative will require approximately 9.2 miles of new pipeline routed along San Marin Drive and Novato Boulevard. A portion of this pipeline will parallel the existing NMWD pipeline that conveys water from the North Marin Aqueduct to Stafford Lake through residential areas. At the intersection of Novato Boulevard and Pt. Reyes – Petaluma Road, the pipe will bifurcate, with one branch of the pipeline heading south approximately 4.0 miles along Pt. Reyes – Petaluma Road to Nicasio Reservoir and the other branch heading northwest approximately 3.0 miles along Pt. Reyes – Petaluma Road, Hicks Valley Road, and a fire road to Soulajule Reservoir. The fire road is routed through private property. Discussions with the private property owner will be needed to determine feasibility of this pipeline alignment. For this alternative, the supplemental water will be conveyed to Nicasio and Soulajule Reservoirs for storage. The District will have the ability to select which reservoir to fill based on reservoir levels, demands within the system, and operational considerations. The District will be able to utilize the storage capacities of both reservoirs, increasing the amount of water that can be taken from Sonoma Water.

6.3.1.4 PETA-4: North Marin Aqueduct to Nicasio and Soulajule Reservoirs via San Antonio Road

This alternative includes a new pump station and approximately 14.8 miles of pipeline to convey water from the North Marin Aqueduct to Nicasio and Soulajule Reservoirs. This alternative will branch off of the North Marin Aqueduct farther upstream than PETA-1, PETA-2, and PETA-3. This alternative requires approximately 7.8 miles of new pipeline routed along San Antonio Road and Pt. Reyes – Petaluma Road.

At the intersection of Pt. Reyes – Petaluma Road and Hicks Valley Road, the pipe will bifurcate, with one branch of the pipeline heading south approximately 4.5 miles along Pt. Reyes – Petaluma Road to Nicasio Reservoir and the other branch heading west approximately 2.5 miles along Hicks Valley Road and a fire road to Soulajule Reservoir. The fire road is routed through private property.

Discussions with the private property owner will be needed to determine feasibility of this pipeline alignment. For this alternative, the supplemental water will be conveyed to Nicasio and Soulajule Reservoirs for storage. The District will have the ability to select which reservoir to fill based on reservoir levels, demands within the system, and operational considerations. The District will be able to utilize the storage capacities of both reservoirs, increasing the amount of water that can be taken from Sonoma Water.

6.3.2 Water System Supply Benefits of PETA

6.3.2.1 PETA-1, PETA-2, and PETA-3

The sizing of the facilities for each of these alternatives is highly dependent upon the capacity of existing infrastructure upstream of the proposed turnout location along the North Marin Aqueduct. Based on current operations, the existing infrastructure can convey up to 31.6 mgd of water from Cotati Tanks to Kastania Pump Station, with Petaluma pulling approximately 4 mgd of that during wintertime months. As such, up to 27.6 mgd of water can be delivered to Kastania Pump Station during wintertime months. Kastania Pump Station has a maximum capacity of 25 mgd. Downstream of Kastania Pump Station, for PETA-1, PETA-2, and PETA-3, the proposed turnout location is in Novato, adjacent the existing NMWD pipeline that conveys water from the North Marin Aqueduct to Stafford Lake. At this proposed turnout location, the existing North Marin Aqueduct is 30 inches and has a maximum capacity of 22.9 mgd, assuming a maximum allowable velocity in the pipeline of 8 feet per second. Additionally, downstream of Kastania Pump Station, the system demand during wintertime months is approximately 12 mgd. As previously discussed, NMWD would pull approximately 4 mgd during wintertime months and the District would receive, treat, and distribute approximately 8 mgd through Ignacio Pump Station.

Given these capacities and demands, the largest bottleneck in the system upstream of the proposed turnout location is the segment of 30-inch pipe in the North Marin Aqueduct. Assuming a maximum capacity of 22.9 mgd of water can be conveyed through this segment of the North Marin Aqueduct, and assuming there is a demand of 12 mgd during wintertime operations downstream of this segment of pipe, approximately 10.9 mgd of water is available to be conveyed from the North Marin Aqueduct to the reservoirs. No other improvements or upgrades to the existing system are anticipated to be needed to convey 10.9 mgd from the North Marin Aqueduct to the reservoirs.

It's possible to increase the water supply benefit of the PETA-1, PETA-2, and PETA-3 alternatives further by implementing improvements to bottlenecks upstream of the proposed turnout location. Although a wide range of improvements can be implemented to increase the capacity of the system by varying amounts, improvements were selected that maximize the use of existing infrastructure. Required improvements to

the existing system that will allow up to 15.6 mgd of water to be conveyed from the North Marin Aqueduct to the reservoirs include:

- No upgrades needed between Cotati Tanks to Kastania Pump Station:
 - » As stated above, existing infrastructure can convey up to 31.6 mgd of water from Cotati Tanks to Kastania Pump Station, with Petaluma pulling approximately 4 mgd of that during wintertime operations.
 - » As such, up to 27.6 mgd of water could be delivered to Kastania Pump Station during wintertime months.
- Increasing the capacity of Kastania Pump Station from 25 mgd to 27.6 mgd.
- Increasing the maximum allowable velocity of the North Marin Aqueduct pipeline to 10 feet per second, providing a maximum capacity of 28.6 mgd:
 - » Further evaluation of the existing 30-inch North Marin Aqueduct would be needed prior to making this change:
 - Need to determine if increasing the velocity in the existing pipeline would damage the pipeline.

If the improvements detailed above are included with the Project, the maximum capacity of the system upstream of the turnout location would be increased to 27.6 mgd. Assuming 12 mgd of demand during wintertime months downstream of this turnout location, approximately 15.6 mgd of water is available to be conveyed from the North Marin Aqueduct to the reservoirs.

Regardless of whether PETA-1, PETA-2, and PETA-3 alternatives include upgrades to existing upstream infrastructure or not, these alternatives also provide a water supply benefit to NMWD. By adding a pipeline parallel the existing NMWD pipeline from the North Marin Aqueduct to Stafford Lake, these alternatives add a redundant transmission system between North Marin Aqueduct and Stafford Lake.

6.3.2.2 PETA-4

For PETA-4, the proposed turnout location from the North Marin Aqueduct is north of Novato, at San Antonio Road. Based on current operations, the existing infrastructure can convey up to 31.6 mgd of water from Cotati Tanks to Kastania Pump Station, with Petaluma pulling approximately 4 mgd of that during wintertime months. As such, up to 27.6 mgd of water can be delivered to Kastania Pump Station during wintertime months. Kastania Pump Station has a maximum capacity of 25 mgd. Downstream of Kastania Pump Station, for PETA-4, at the proposed turnout location the existing North Marin Aqueduct is 42 inches and can convey approximately 45 mgd, assuming a maximum allowable velocity in the pipeline of 8 feet per second. Additionally, downstream of Kastania Pump Station, the system demand during wintertime months is approximately 12 mgd. As previously discussed, NMWD would pull approximately 4 mgd during wintertime months and the District will receive, treat, and distribute approximately 8 mgd through Ignacio Pump Station.

Given these capacities and demands, the largest bottleneck in the system upstream of the proposed turnout location is Kastania Pump Station. Assuming that Kastania Pump Station has a maximum capacity of 25 mgd, and assuming there is a demand of 12 mgd during wintertime operations downstream of the proposed turnout location, approximately 13 mgd of water is available to be conveyed from North Marin

Aqueduct to the reservoirs. No other improvements or upgrades to the existing system are anticipated to be needed to convey 13 mgd from the North Marin Aqueduct to the reservoirs.

It's possible to increase the water supply benefit of the PETA-4 alternative further by implementing improvements to bottlenecks upstream of the proposed turnout location. Although a whole range of upstream improvement projects can be implemented to increase the capacity of the system by varying amounts, improvements were selected that maximized the use of existing infrastructure. Required improvements to the existing system that will allow up to 25.6 mgd of water to be conveyed from the North Marin Aqueduct to the reservoirs include:

- Constructing an STS alternative that can convey an additional 10 mgd from Cotati Tanks to Kastania Pump Station:
 - » As stated above, existing infrastructure can convey up to 31.6 mgd of water from Cotati Tanks to Kastania Pump Station:
 - Petaluma pulls approximately 4 mgd of that during wintertime operations. As such, approximately 27.6 mgd of water can currently be delivered to Kastania Pump Station during wintertime months.
 - With the addition of facilities conveying 10 mgd from Cotati Tanks to Kastania Pump Station, up to 37.6 mgd of water could be delivered to Kastania Pump Station during wintertime operations:
 - No improvements would need to be made to the existing Petaluma Aqueduct or Ely BPS.
- Increasing the capacity of Kastania Pump Station from 25 mgd to 37.6 mgd.

If the improvements detailed above are included with the Project, the maximum capacity of the system upstream of the turnout location will be increased to 37.6 mgd. Assuming 12 mgd of demand during wintertime operations downstream of this turnout location, the District should be able to convey up to 25.6 mgd of water from North Marin Aqueduct to the reservoirs.

If PETA-4 includes the upgrades to existing upstream infrastructure detailed above, the alternative does provide a water supply benefit to other municipalities in the region by adding a redundant transmission system between Cotati Tanks and Kastania Pump Station.

6.4 Cotati Tanks to Reservoirs (COTATI) Project Alternatives

In general, the COTATI alternatives include pipeline and pump station improvements to convey additional water from Cotati Tanks to Nicasio Reservoir, Soulajule Reservoir, or both reservoirs. The following alternatives are included under the umbrella of the COTATI alternatives:

- **COTATI-1:** Cotati Tanks to Nicasio Reservoir.
- **COTATI-2:** Cotati Tanks to Soulajule Reservoir.
- **COTATI-3:** Cotati Tanks to Nicasio and Soulajule Reservoirs.

For each of these alternatives, water will be conveyed from the Cotati Tanks to Nicasio Reservoir, Soulajule Reservoir, or both reservoirs via a new pump station(s) and pipeline. For each of these alternatives, the supplemental water from Sonoma Water will be sent to existing storage reservoirs to be used by the District at a later time. Figure 7 shows an overview of COTATI alternatives.

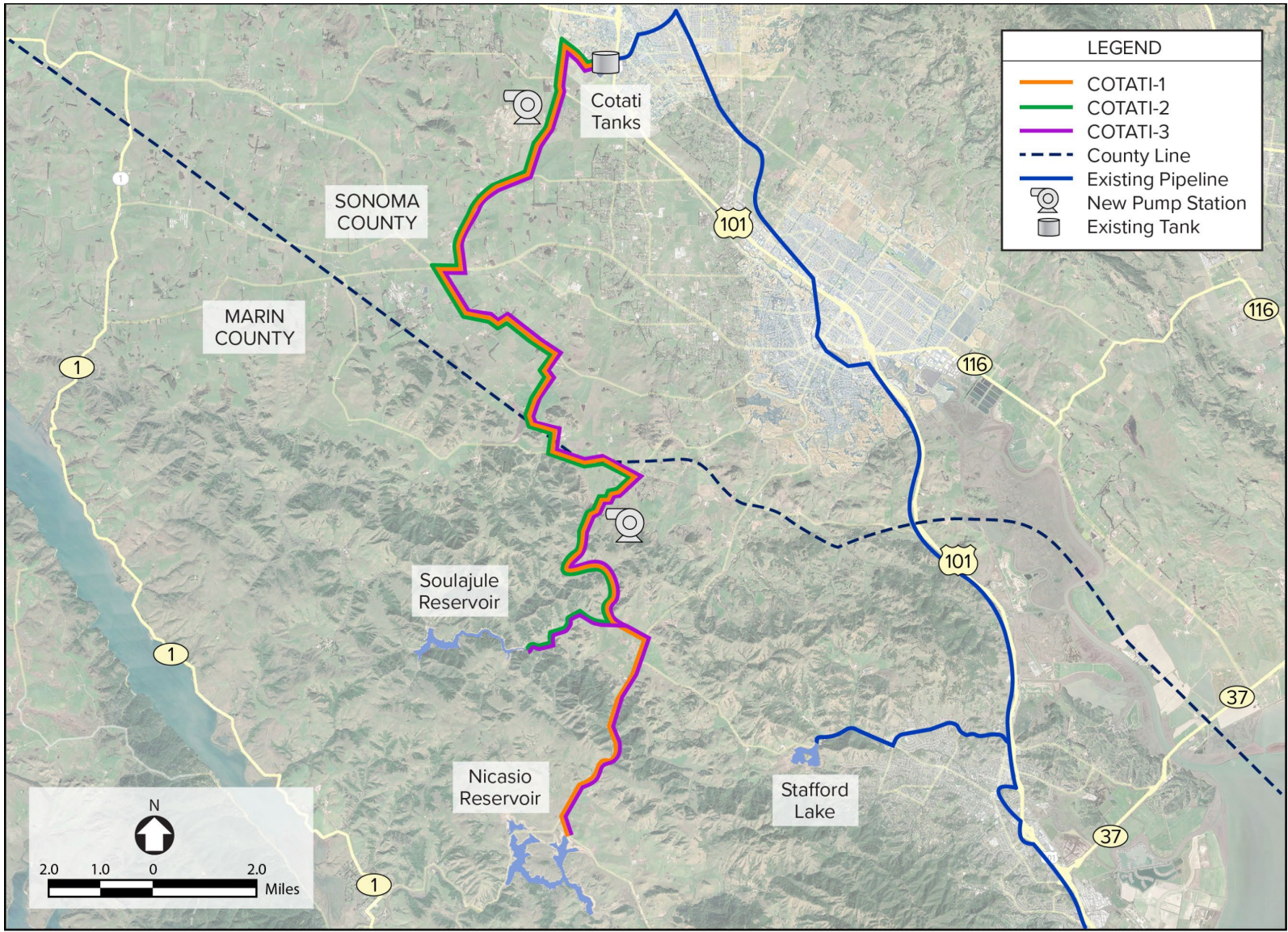


Figure 7 COTATI Alternatives

6.4.1 COTATI Alternatives

6.4.1.1 COTATI-1: Cotati Tanks to Nicasio Reservoir

This alternative includes a new pump station(s) and pipeline to convey water from Cotati Tanks to Nicasio Reservoir. This alternative will require approximately 24.2 miles of new pipeline routed along mostly rural two-lane roadways. An approximately 2.0-mile segment of the proposed pipeline alignment crosses a private property. Further coordination with the private property owners will be needed to determine feasibility of this pipeline alignment. Additionally, the pipeline alignment proposed for this alternative is routed near several land trusts. Further evaluation of the extent of the land trusts is needed to determine impacts, if any. For this alternative, the supplemental water will be conveyed to Nicasio Reservoir for storage.

Given the topography of the alignment, two pump stations will likely be required. One of the pump stations will need to be located near Cotati Tanks and the other will need to be located approximately halfway between Cotati Tanks and the reservoirs. Early consideration must be given to the power requirements for the pump stations because the pump stations will have high electrical demands. Pacific Gas and Electric (PG&E) also has limited power transmission facilities near the proposed pump station locations. Further coordination with PG&E to determine if new power transmission facilities are required for the pump stations is needed. Alternatively, a single pump station located near Cotati Tanks may be capable of pumping water to the reservoirs. With a single pump station, the system will have to operate at high pressure to convey water to the reservoirs.

6.4.1.2 COTATI-2: Cotati Tanks to Soulajule Reservoir

This alternative includes a new pump station(s) and pipeline to convey water from Cotati Tanks to Soulajule Reservoir. This alternative will require approximately 20.5 miles of new pipeline routed along mostly rural two-lane roadways. An approximately 2.0-mile segment of the proposed pipeline alignment crosses a private property. Additionally, a portion of the pipeline is proposed to be routed along a fire road that is located through private property. Further coordination with the private property owners will be needed to determine feasibility of this pipeline alignment. Additionally, the pipeline alignment proposed for this alternative is routed near several land trusts. Further evaluation of the extent of the land trusts is needed to determine impacts, if any. For this alternative, the supplemental water will be conveyed to Soulajule Reservoir for storage.

Given the topography of the alignment, two pump stations would likely be required. One of the pump stations will need to be located near Cotati Tanks and the other will need to be located approximately halfway between Cotati Tanks and the reservoirs. Early consideration must be given to the power requirements for the pump stations because the pump station will have high electrical demands. PG&E also has limited power transmission facilities near the proposed pump station locations. Further coordination with PG&E to determine if new power transmission facilities are required for the pump stations is needed. Alternatively, a single pump station located near Cotati Tanks may be capable of pumping water to the reservoirs. With a single pump station, the system will have to operate at high pressure to convey water to the reservoirs.

6.4.1.3 COTATI-3: Cotati Tanks to Nicasio and Soulajule Reservoir

This alternative includes a new pump station(s) and pipeline to convey water from Cotati Tanks to Nicasio and Soulajule Reservoirs. This alternative will require approximately 25.9 miles of new pipeline routed along mostly rural two-lane roadways to convey water from Cotati Tanks to Nicasio Reservoir. At the intersection of Hicks Valley Road and 3 Peaks Fire Road, the pipeline will bifurcate with one branch routed west approximately 2.0 miles along the fire road to convey water to Soulajule Reservoir. The other branch will continue along Hicks Valley Road and Pt. Reyes – Petaluma Road to Nicasio Reservoir. A couple of portions of this proposed pipeline alignment cross private property. Further coordination with the private property owners will be needed to determine feasibility of this pipeline alignment.

The pipeline alignment is also routed through several land trusts. Further evaluation of the extent of the land trusts is needed to determine impacts, if any. For this alternative, the supplemental water will be conveyed to Nicasio and Soulajule Reservoirs for storage. The District will have the ability to select which reservoir to fill based on reservoir levels, demands within the system, and operational considerations. The District will be able to utilize the storage capacities of both reservoirs, increasing the amount of water that can be taken from Sonoma Water.

Given the topography of the alignment, two pump stations will likely be required. One of the pump stations will need to be located near Cotati Tanks and the other will need to be located approximately halfway between Cotati Tanks and the reservoirs. Early consideration must be given to the power requirements for the pump stations because the pump station will have high electrical demands. PG&E also has limited power transmission facilities near the proposed pump station locations. Further coordination with PG&E to determine if new power transmission facilities are required for the pump stations is needed. Alternatively, a single pump station located near Cotati Tanks may be capable of pumping water to the reservoirs. With a single pump station, the system will have to operate at high pressure to convey water to the reservoirs.

6.4.2 Water System Supply Benefits of COTATI

Considering the COTATI alternatives include new infrastructure that is independent of the existing system, the sizing of the facilities and associated water supply benefits can be defined by the District. Based on discussions with the District, these alternatives would likely be sized to convey a maximum flow of approximately 30 to 35 mgd.

6.5 Summary of Alternatives

A summary of the alternatives discussed above is included in Table 1. Once finalized, the recommended project goals and evaluation criteria will be used to screen this list of project alternatives down to approximately three alternatives.

Table 1 Summary of Alternatives

Alternative	Description	Added Capacity ⁽¹⁾ (mgd)	Required Pipeline Length (miles)
STS-1	Cotati Tanks to Kastania Pump Station Along US-101 Corridor	0.0 ⁽²⁾	10.5
STS-2	Cotati Tanks to Kastania Pump Station Through Downtown Petaluma	0.0 ⁽²⁾	12.1
STS-3	Cotati Tanks to Kastania Pump Station Through Rural Roads	0.0 ⁽²⁾	15.5
STAF-1	Stafford Lake to Nicasio Reservoir	7.3	8.0
STAF-2	Stafford Lake to Soulajule Reservoir	7.3	6.8
STAF-3	Stafford Lake to Nicasio and Soulajule Reservoirs	7.3	11.0
PETA-1	North Marin Aqueduct to Nicasio Reservoir	10.9 ⁽³⁾ 15.6 ⁽⁴⁾	13.2
PETA-2	North Marin Aqueduct to Soulajule Reservoir	10.9 ⁽³⁾ 15.6 ⁽⁴⁾	12.0
PETA-3	North Marin Aqueduct to Nicasio and Soulajule Reservoirs	10.9 ⁽³⁾ 15.6 ⁽⁴⁾	16.2
PETA-4	North Marin Aqueduct to Nicasio and Soulajule Reservoirs via San Antonio Road	13.0 ⁽³⁾ 25.6 ⁽⁴⁾	14.8 ⁽⁶⁾
COTATI-1	Cotati Tanks to Nicasio Reservoir	30.0 ⁽⁵⁾	24.2
COTATI-2	Cotati Tanks to Soulajule Reservoir	30.0 ⁽⁵⁾	20.5
COTATI-3	Cotati Tanks to Nicasio and Soulajule Reservoirs	30.0 ⁽⁵⁾	25.9

Notes:

- (1) The added capacity listed is in excess of the 8.0 mgd conveyed through the existing system from Cotati Tanks to Ignacio Pump Station during wintertime operations.
- (2) This alternative improves existing system reliability. However, the alternative does not deliver water to storage, so the additional capacity is estimated as 0 mgd.
- (3) This capacity assumes improvements to the existing system are not made.
- (4) This capacity assumes additional improvements are made to increase the capacity of the existing system to deliver higher flows.
- (5) Since this alternative does not impact existing hydraulic system, the capacity can be designed to meet District preference based on the available water supply.
- (6) Required pipeline length does not include STS. STS is also required if 25.6 mgd is desired.

SECTION 7 NEXT STEPS

This TM summarizes the project goals, evaluation criteria, and alternatives for the Project. Once finalized, the recommended project goals and evaluation criteria will be used to screen a list of project alternatives down to approximately three alternatives. The screened alternatives will then be evaluated in detail during Phase 2 of the Project.