FREYER & LAURETA, INC.

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Lynwood Pump Station Replacement

Engineering Assessment

NORTH MARIN WATER DISTRICT

FINAL Technical Report

Prepared By

FL

wra Environmental Consultants

CE&G Pragmatic Expertise™

ADVANCED HYDRO ENGINEERING

Beecher Engineering, Inc.

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ABBREVIATIONS

AAF	Annual Acre-Feet
ADD	Average Day Demand
AHE	Advance Hydro Engineering, Inc.
ARV	Air Relief Valve
ASCE	American Society of Engineers
ASCE7	American Society of Engineers 7 Minimum Design Loads and Associated Criteria for Buildings and Other Structures
BOD	Basis of Design
CBC	California Building Code
City	City of Novato
CE	Categorial Exemption
CE&G	Cal Engineering & Geology, Inc., a division of Haley & Aldrich
CEQA	California Environmental Quality Act
CFGC	California Fish and Game Codes
CGS	California Geological Survey
CMU	concrete masonry unit
District	North Marin Water District
EDU	equivalent residential dwelling units
ERP	Emergency Response Plan
EUSERC	Electrical Utility Service Equipment Requirements
F&L	Freyer & Laureta, Inc.
FEMA	Federal Emergency Management Agency
ft	feet
FY	fiscal year
GPD	gallons per day
GPM	gallons per minute
HGL	hydraulic grade line
HVAC	heating, ventilation and air conditioning
K&J	Kennedy/Jenks Consultants

lf	linear foot
MBTA	Migratory Bird Treaty Act
MCC	motor control center
MCCDA	Marin County Community Development Agency
MDD	maximum day demand
MGD	million gallons per day
NMWD	North Marin Water District
NEC	National Electric Code
NPV	net present value
NRCS	Natural Resources Conservation Service
O&M	Operation & Maintenance
OPC	opinion of probable cost
PG&E	Pacific Gas & Electric
PHD	peak hour deamand
psi	pounds per square inch
PSPS	Public Safety Power Shutoff
SCADA	System Control and Data Acquisition
SCWA	Sonoma County Water Agency
sf	square feet
STP	Stafford Treatment Plant
USGS	United States Geological Survey
VFD	variable frequency drives

ES EXECUTIVE SUMMARY

ES.1 Background and Project Drivers

The North Marin Water District (District) primarily serves the City of Novato (City) and surrounding unincorporated areas in Marin County, encompassing approximately 75 square miles. The District's Novato System potable water system is divided into four main pressure zones. Primary Zone 2 has two main pump stations: (1) Lynwood Pump Station and (2) San Marin Pump Station. Although the two pump stations meet current demands within Primary Zone 2, the pump stations are potentially not equipped to handle future growth.

To complement the Lynwood Pump Station existing capacity evaluation, the District desired to document the existing condition of the critical pump station including review of potential feasibility of in-place rehabilitation or relocation of the pump station to meet the long-term customer needs. The Engineering Assessment project drivers include:

- Identify potential future demands based on current available data from the City of Novato (City) and County of Marin (County) including determining if the future demands will be served by Zone 2, Zone 3, or Zone 4;
- Determine the potential pump station capacity expansion, if required, to meet future projected demands;
- Engage District operations staff to identify potential operation constraints that may affect the final design criteria for an expanded pump station;
- Assess the feasibility of rehabilitating the pump station components within the existing pump station structure to improve the pump station's overall reliability and resiliency; and
- Evaluate up to five potential alternative sites for a replacement to the existing Lynwood Pump Station.

The Engineering Assessment includes estimated future demands that impact the Lynwood Pump Station pump capacity requirements, presents constraints to rehabilitate the existing pump station facility in place, and develops potential pump station replacement alternatives that address both future demands needs and existing operational constraints identified by District operations staff.

ES.2 Existing Conditions

The F&L team assessed the current physical site conditions through visual inspection during an October 27, 2022 site visit. The pump station components were in poor overall condition, and the team observed multiple deficiencies with the existing site. The primary deficiencies identified were grouped into four main categories and summarized below:

- Access:
    - The existing Lynwood Pump Station is below grade creating limited access to all mechanical and electrical equipment and current vertical space does not meet the current California Building Code (CBC) requirement of eight-feet minimum height for ceiling height.
    - Pump and motors can only be accessed by removing concrete covers over each pump, which requires a crane that must be staged adjacent to the existing pump station within a Sunset Parkway travel lane.
- Location and Environment:
    - The constrained site can impact maintenance activities because significant temporary traffic control is required to allow the District to stage equipment and vehicles.
    - Multiple existing utilities within the traffic island, such as stormwater mains, water mains, gas main, and significant Pacific Gas & Electric (PG&E) infrastructure, limit existing pump station upgrades.
    - District staff noted that groundwater is always present and, during storms, can encroach on the floor.
    - The existing site is adjacent to the current Federal Emergency Management Agency (FEMA) 100-year floodplain, putting the existing pump station at risk during significant storm events.
- Mechanical Components:
    - The mechanical components are primarily ductile iron with epoxy coating and range from fair to poor condition.
    - Some components that will require replacement are located below the existing concrete floor requiring that portions of concrete be removed to perform required replacement work.
    - Limited flexibility is provided with the existing layout and components. The lack of seismic fittings increases the components' vulnerability to damage during a significant seismic event where it can be expected that seismic motions would cause differential movement between the existing concrete structure and the existing infrastructure within Sunset Parkway potentially resulting in a catastrophic failure of either the suction or discharge piping rendering the pump station non-functional when water supply for fire fighting could be critical.
- Electrical:
    - Multiple electrical components of the pump station appear to be out of compliance with the NEC.

- Electrical equipment is obsolete and no longer manufactured.

F&L did consider the potential advantages of rehabilitating the existing Lynwood Pump Station components. Although modifying or enhancing the pump station may be considered feasible, the modified facility will not provide similar level of reliability and resiliency due to the overall age, condition, and the significant site constraints that may result in substantial, costly constructability challenges. The alternatives comparison presented in Section ES.7 does include retrofitting the existing pump station as part of the analysis.

ES.3 Current Operating Conditions

ES.3.1 Pump Station Operating Strategy

As a cost-saving measure, District operations staff utilize a partial day operation for both Lynwood Pump Station and San Marin Pump Station during PG&E off-peak hours for electrical use. Currently, PG&E peak pricing occurs five hours each day from 4 pm to 9 pm. The District's operation procedure goal is to operate for a 16-hour period which avoids operating any pumps during the five-hour on-peak usage period plus 1.5 hours before and after the on-peak five-hour period. However during periods of peak water demand, the District currently operates for up to a 19-hour period to meet demands and fill storage tanks.

District pump station operations adapt to PG&E on-peak hour changes during the year to minimize pumping costs since PG&E discounts power usage during off-peak hours. During winter, the discount is minimal due to the low flow pumping rates during this time. In practice, the District does operate its pump stations for up to 16 hours a day but can override automation to ensure that customer demands during high water use periods are always met.

ES.3.2 Emergency Power Strategy

During severe weather events, PG&E turns off power to help prevent wildfires. Times of planned power outages are called Public Safety Power Shutoff (PSPS). During PSPS events, the District utilizes a portable diesel generator to provide emergency power to the District's facilities, including pump stations. The portable diesel generator is not permanently located at the Lynwood Pump Station site and is transported to the District's facilities when needed.

The District staff indicated that a permanent generator is not required at Lynwood Pump Station because it can mobilize the portable emergency generator to the Lynwood Pump Station site in less than two hours, and the system demands can be met for this limited time from the existing storage.

ES.4 Future Demands

ES.4.1 Primary Zone 2 Demands

The Marin County Community Development Agency (MCCDA) provided information on future development anticipated within the City that will result in additional demand throughout the entire

District system. F&L only evaluated the future buildout demands that would be served by Primary Zone 2. All other future build out demands in Zone 1 or hydraulically isolated Zone 2 subpressure zones were not included in the future build out pumping analysis but included in the system distribution model.

There are six future build out demands, including one commercial, office, and government demand, in the northern part of the City within Primary Zone 2 near the existing San Marin Pump Station. There is one future build out demand in the southern part of Primary Zone 2. Based on the information reviewed, the total future MDD is estimated to be 8.95 million gallons per day (MGD) is 1.16 MGD greater than the current MDD of 7.79 MGD.

ES.4.2 Pump Station Capacity

Generally, pump station firm capacity is determined when the largest pump unit is out of service at the station. Because Primary Zone 2 has some redundancy in that it is served by two pump stations (e.g., Lynwood Pump Station and San Marin Pump Station) with identically sized pumps, the District has considered the pump stations firm capacity to be based on a single pump out of service within the entire Primary Zone 2. The F&L team suggested reviewing potential approaches to confirm pump station firm capacity methodology with the District for this Engineering Assessment.

Following collaboration with the District, the pump station firm capacity was defined as adequate pumping equipment to meet MDD when the largest pump unit is out of service at both San Marin Pump Station and Lynwood Pump Station. Currently, both pump stations have three pumps, all rated for 1,800 gallons per minute (GPM); therefore, each pump station's firm capacity is 3,600 GPM.

The F&L team evaluated future pump station capacity requirements using the firm capacity methodology initially based on 16 hours of operation. This approach increased firm capacity rates required for all pump station improvements. However, the F&L team also evaluated pump station operations for periods greater than 16 hours during MDD to determine where there may be potential cost savings or operational benefits to the District including

- The ability to utilize similar pumps to the existing San Marin Pump Station at the new Lynwood Pump Station.
- Capital cost savings by not developing an oversized replacement facility.

Another critical consideration when reviewing pump station capacity is current and future use of variable frequency drives (VFDs) that allow operators to match pump station flows with demands. With VFDs, the operators can choose to operate the pump stations at a range of flows to allow for the pump station to operate at higher flow rates in low demand (and off-peak electrical hours) in anticipation of peak demands.

ES.5 Hydraulic Evaluation Methodology

ES.5.1 Zone 1 Storage Tank Performance

Typically, during the MDD condition in a steady state model run, gravity tanks within a distribution network would be full or filling. The MDD condition was anticipated to occur during the 16-hour pump operation cycle, which changes the typical steady state results. The existing model results that when operating the Lynwood Pump Station and San Marin Pump Station during MDD conditions that the Zone 1 tanks are releasing water to meet both Zone 1 demands and the higher MDD Primary Zone 2 pump station rates. Since the MDD flow rates into Primary Zone 2 are being artificially increased by increased pumping, the North Marin Aqueduct supply alone cannot provide the water volume for the transfer. The Zone 1 tanks release flow to make up the difference. In the Primary Zone 2, the PHD are provided solely from storage after the pumps are turned off, increasing operational storage requirement in this zone.

As discussed previously, District staff have flexibility with selection of the length of daily pump operating periods. District staff reported that when customer demands warrant, the Lynwood Pump Station and San Marin Pump Station pumping period will be extended regardless if the pump stations would be operating during shoulder or peak PG&E electric rate periods. The net pumping capacity evaluation indicated that for existing conditions, the pump cycle time would likely be extended from 16 hours to 17 hours and longer to maintain Zone 2 storage tank levels as necessary.

By extending the pump cycle time to reduce demands on Zone 2 storage tanks, F&L would expect Zone 1 storage tank replenishment demands to be similarly reduced, however, the steady state modeling results did indicate a continued demand on Zone 1 storage tanks during MDD with less than 24-hour pumping. The operations with limited pump cycle time will continue to increase the amount of operational storage requirements for the distribution system. As part of the District's planned update of the 2018 Master Plan, F&L suggests that the District perform an extended period simulation in addition to the steady state analyses to review the Zone 1 and 2 tanks operational storage performance during concurrent limited pump cycle time and MDD conditions discussed above.

ES.5.2 Pacheco Valley Tank Hydraulic Constraint

The District's operations staff noted a hydraulic constraint within the distribution system impacts the Pacheco Valley Tank fill rate from the Lynwood Pump Station. The District expressed interest in investigating potential solutions to improve the District's overall ability to fill Pacheco Valley in addition to evaluating the capacity required for Lynwood Pump Station. Generally, the potential improvement options to improve the District's ability to fill Pacheco Valley Tank include:

- Expand the existing distribution system or introduce a new transmission main;
- Potentially relocate Lynwood Pump Station to a location equidistant between Sunset Tank and Pacheco Valley Tank; or
- Add a third pump station to primary Zone 2 near the Pacheco Valley Tank.

Please refer to Section ES.7 for discussion of each alternative's potential operational improvements.

ES.5.3 Future Conditions Modeling Methodology and Exclusions

To perform pump station alternatives analysis to meet future demands, F&L developed the following methodology:

- Add projected new demands,
- Determine hydraulic conditions with the 16-hour pump cycle with steady state analysis,
- Determine hydraulic conditions with various proposed pump station capacities and pump station locations with steady state analysis.

In the analysis of the Lynwood Pump Station capacity, the following were excluded:

- Fire flow demand for the system was not included since we are not performing a master planning study. Fire flow demands are outside of the scope of this analysis.
- The original 2022 maximum day scenario included the seven hydro-pneumatic stations. Although the hydro-pneumatic stations operate periodically per set pressure points, for simplicity, the hydro-pneumatic stations were modeled as an average of the total daily pumping rate of the hydro-pneumatic system. No additional demands were added to these stations.

ES.6 Alternatives Development

With guidance from District staff and considering the key project goals, F&L developed the following alternative concepts:

- A new pump station that matches the existing Lynwood Pump Station with one additional pump to meet future demands.
- Determine if, by relocating the pump station away from the current Lynwood Pump Station site, the new pump station could continue to provide adequate ability to meet future peak demands throughout Primary Zone 2, and also improve the District's ability to deliver water to Pacheco Valley Tank.
- Include both the replacement of the Lynwood Pump Station and add a pump station at a location within the southern portion of Primary Zone 2 that would improve the District's ability to fill Pacheco Valley Tank without having to isolate Sunset Tank from the system.

One site location was determined based on favorable attributes in the four categories presented above. The detailed siting study can be found in Appendix C. The final locations are:

- Site 1: New pump station to be located within the Sunset Parkway median between Monte Maria Avenue and Cambridge Street.
- Site 2: New pump station to be located on Ignacio Boulevard at Palmer Drive within open space area adjacent to existing pedestrian trails.

- Site 3: New pump station on Bolling Circle at Bolling Drive within a privately maintained open space area.
- Site 4: New pump station on Main Gate Road within open space area adjacent to existing pedestian trials.
- Site 5: New pump station on Main Gate Road and C Street within an existing baseball field privately maintained by the Novato Unified School District.

Alternatives include one or two sites. The alternative site locations are shown in Figure ES-1 and as follows:

- Alternative A is a new pump station that matches the existing Lynwood Pump Station with one additional pump to meet future demands. The new pump station is proposed in close proximity to the existing Lynwood Pump Station and is referred to as Site 1. A key consideration when developing Alternative A was District staff reported the current location provides the ability to meet demands both to the north and south of the existing facility location (Figure ES-2).
- Alternative B was developed to determine if, by relocating the pump station away from the current Lynwood Pump Station site, the new pump station could continue to provide adequate ability to meet future peak demands throughout Primary Zone 2, and also improve the District's ability to deliver water to Pacheco Valley Tank. The new pump station is proposed at a site roughly halfway between the Sunset Tank and Pacheco Valley Tank and referred to as Site 2 (Figure ES-3).
- Alternative C was developed to include both replacement of the Lynwood Pump Station at Site 2 and adding a pump station at a location within the southern portion of Primary Zone 2 that would improve the District's ability to fill Pacheco Valley Tank without having to isolate Sunset Tank from the system. The second pump station is located at Site 3 (Figure ES-4).
- Alternative D was developed to include both replacement of the Lynwood Pump Station at Site 2 and adding a pump station at a location within the southern portion of Primary Zone 2 that would improve the District's ability to fill Pacheco Valley Tank without having to isolate Sunset Tank from the system. The second pump station is located at Site 4 (Figure ES-5).
- Alternative E was developed to include both replacement of the Lynwood Pump Station at Site 2 and adding a pump station at a location within the southern portion of Primary Zone 2 that would improve the District's ability to fill Pacheco Valley Tank without having to isolate Sunset Tank from the system. The second pump station is located at Site 5 (Figure ES-6).

Each of the alternatives were developed to outline key project components provided in the following list that were then used to perform an alternative comparison:

- Pump Station Capacity
- Potential Environmental Permit Requirements and Constraints
- Regional Geologic and Soil Engineering Data
- Conceptual Design (Pumps, Building and Facility Layout)
- Electrical Components
- Capital Cost
- Net Present and Operating Cost

ES.7 Alternative Comparison

The five alternatives were evaluated to identify the preferred alternative. Retrofitting the existing Lynwood Pump Station was also evaluated. To perform the comparative review, F&L developed a series of evaluation criteria, including ranking guidance, and applied the evaluated criteria to each alternative. The evaluation is performed using the following six criteria and summarized in Table ES-1:

- Meet Primary Zone 2 Future Demand,
- Improve Pacheco Valley Tank Flow,
- Improve Primary Zone 2 System Redundancy,
- Site Features,
- Capital Cost, and
- Net Present Value Operation & Maintenance (O&M) Cost.

As further detailed in Section 7 of the Engineering Assessment, the F&L team graded each site on a sliding-point scale. The point scale provides a grade between 1 and 10, with 1 being inadequate/poor and 10 being excellent in meeting the stated evaluation criteria. The final rankings, with the highest total score listed first is;

- Alternative D (38 total points)
- Alternative B (36 total points)
- Alternative E (36 total points)
- Alternative A (35 total points)
- Alternative C (34 total points)
- Retrofit the exisitng Lynwood Pump Station (21 total points)

Based on the evaluation presented above, the preferred alternative is Alternative D, which would provide:

- Two new pump stations with a total firm capacity of 5,400 GPM and all pumps would be 1,800 GPM.
- One pump station with three pumps will be located at Ignacio Boulvard and Palmer Drive (Site 2). The second pump station will have two pumps and will be located at C Street and Main Gate Road (Site 4).
- The new pump stations would be capable, with operation of San Marin Pump Station, to meet future Primary Zone 2 demands.
- The new pump stations would significantly improve flow to Pacheco Valley Tank.

ES.8 Next Steps

ES.8.1 Proposed Pump Station Design

Upon approval of the conceptual design by the District, the selected alternative for the Lynwood Pump Station replacement design can be advanced to the development of construction documents. Upon approval of the conceptual design by the District, a few electrical items should be considered, including electrical equipment lead times and PG&E service coordination. A summary of the electrical items can be found in Appendix H. Further hydraulic modeling of the selected conceptual design should also be performed to verify preliminary identified operational impacts of the new pump station sites and to analyze operational storage needs in the Zone 1 and Primary Zone 2 storage tanks.

ES.8.2 District Master Plan Update Confirmation

The steady state hydraulic modeling results shown that for both existing MDD and future MDD conditions that the Zone 1 Storage Tanks may be draining to meet both the Zone 1 demands and the cumulative supply to both Lynwood Pump Station and San Marin Pump Station. To quantify the potential operational impacts, further steady state analyses and an extended period hydraulic simulation is recommended to be performed as part of the District's planned master plan update. Based on the F&L team's discussions with District staff throughout development of this Engineering Assessment, the District has likely not experienced conditions similar to the MDD scenario used to perform our analysis. The use of a 16-hour pumping period (or other period less than 24 hours) for Primary Zone 2 supply will also increase operational storage volume requirements and create modified storage replenishment conditions during the day. The storage draw from the Zone 1 storage tanks during Primary Zone 2 pumping may be replenished during the daily time period where Primary Zone 2 pumping has halted. These operational conditions should be further reviewed as part of the design of the conceptual pumping alternative chosen.

1 INTRODUCTION

1.1 Background and Project Drivers

The North Marin Water District (District) primarily serves the City of Novato (City) and surrounding unincorporated areas in Marin County, encompassing approximately 75 square miles. The District's potable water system is divided into four main pressure zones. Each pressure zone comprises multiple pump stations and tanks. Primary Zone 2 has two main pump stations: (1) Lynwood Pump Station and (2) San Marin Pump Station. Although the two pump stations meet current demands within Primary Zone 2, the pump stations are potentially not equipped to handle future growth.

To complement the Lynwood Pump Station existing capacity evaluation, the District desired to document the existing condition of the critical pump station including review of potential feasibility of in-place rehabilitation or relocation of the pump station to meet the long-term customer needs. The Engineering Assessment project drivers include:

- Identify potential future demands based on current available data from the City of Novato (City) and County of Marin (County) including determing if the future demands will be served by Zone 2, Zone 3, or Zone 4;
- Determine the potential pump station capacity expansion, if required, to meet future projected demands;
- Engage District operations staff to identify potential operation constraints that may affect the final design criteria for an expanded pump station;
- Assess the feasibility of rehabilitating the pump station components within the existing pump station structure to improve the pump station's overall reliability and resiliency; and
- Evaluate up to five potential alternative sites for a replacement of the existing Lynwood Pump Station.

The Engineering Assessment includes estimated future demands that impact the Lynwood Pump Station capacity requirements, presents constraints to rehabilitate the existing pump station facility in place, and develops potential pump station replacement alternatives that address both future demands needs and existing operational constraints identified by District operations staff.

1.2 Assessment Approach and Report Structure

The District contracted with Freyer & Laureta, Inc. (F&L) to perform an engineering assessment for its Lynwood Pump Station to evaluate the pump station’s condition, review projected future demands that may require the pump station capacity to be increased, determine replacement options, and alternative site locations.

The engineering assessment includes the following components:

- Site visits to perform a visual assessment of the existing systems, including a review of available record drawing information and operational data, are presented in Section 2
- Review of current operating conditions and strategies, presented in Section 3
- Review of Primary Zone 2 existing demands and develop the projected new demands for Primary Zone 2, presented in Section 4
- Develop evaluation method to determine the pump capacity needed for Lynwood Pump Station to meet the project new demands, presented in Section 5
- Develop potential replacement alternatives for Lynwood Pump Station, presented in Section 6
- Evaluate each alternative to identify the preferred replacement option, presented in Section 7

1.3 Project Team

F&L served as the lead engineer for the engineering assessment, supported by the following specialty subconsultants:

- Advanced Hydro Engineer (AHE) – hydraulic modeling support
- Beecher Engineering (Beecher) – electrical, instrumentation, and controls engineer support
- WRA, Inc. (WRA) – environmental permitting support
- Cal Engineering & Geology, Inc, a division of Haley & Aldrich (CE&G) – geotechnical engineering support

2 EXISTING CONDITION ASSESSMENT

The engineering assessment scope of work included a visual inspection of the existing Lynwood Pump Station facility.

The purpose of the condition assessment was to:

- Document existing pump station facility condition based on visual observation.
- Document critical pump station components age and condition to identify those critical components that have likely reached the end of useful service life requiring removal and replacement.
- Perform measurements of all components to determine if the existing pump station layout complies with current codes and regulations or if any rehabilitation project would also require improvements to the structure to facilitate compliance with applicable codes and regulations. For example, a critical compliance and safety item that the F&L team identified during preliminary site visits was that clearances above and in front of the existing motor control center (MCC) likely did not meet the current National Electric Code (NEC) requirements which would require significant modifications to the existing structure or relocation of the MCC to the outside of the existing pump station structure.
- Identify other vulnerabilities, such as risk of damage following a seismic event, that would also be important to address with any rehabilitation or replacement project.
- Document and address, to the extent practicable, access improvements to facilitate long-term operation and maintenance. For example, F&L and District staff discussed that one gate valve on the suction side of Pump No. 2 broke, but because the pipe and valve body was located below the pump station's concrete floor, the District had to sawcut the concrete to remove and replace the valve.

This section summarizes the existing conditions assessment and recommendations with a more detailed discussion of the F&L team's assessment presented in Appendix A.

2.1 Visual Inspection

The existing facility condition review goal was to determine the feasibility of rehabilitating the existing Lynwood Pump Station. The current physical site conditions were assessed through visual inspection during an October 27, 2022 site visit. District staff provided access to the Lynwood Pump Station and accompanied the F&L team throughout the site visit. F&L staff interviewed District staff during the site assessment to document not only the condition of critical and accessible pump station components but also the various operational and maintenance constraints that should be considered when determining the feasibility of rehabilitating the existing pump station.

As summarized below, the F&L team observed the site location, took photographs of the existing conditions, and compared the record drawings to existing site conditions.

2.2 Physical Condition Summary

The pump station components were in poor overall condition, and the team observed multiple deficiencies with the existing site. The primary deficiencies identified were grouped into four main categories:

- Access
- Location and Environment
- Mechanical Components
- Electrical

2.2.1 Access

The existing Lynwood Pump Station is below grade creating limited access to all mechanical and electrical equipment. The below-grade building currently has limited clear space in all dimensions, making maintaining and replacing equipment difficult. The current vertical space does not meet the current California Building Code (CBC) requirement of eight-feet minimum height for ceiling height.

In addition, the pump and motors can only be accessed by removing concrete covers over each pump, which requires a crane that must be staged adjacent to the existing pump station within a Sunset Parkway travel lane. Even if the motor were not removed, the cover would need to be removed to provide the District's operations staff with sufficient access to perform critical maintenance activities.

To improve overall access and facilitate compliance with applicable codes and regulations, the existing pump station structure would require significant modifications, including raising the existing roof, creating larger and more operator-friendly pump access covers, and potentially widening the below-grade structure to provide additional working space for District operations staff.

2.2.2 Location and Environment

The existing site is on Sunset Parkway at the intersection with S. Novato Boulevard, with limited parking. The location is adjacent to the primary entrance to Lynwood Elementary School. The constrained site can impact maintenance activities because significant temporary traffic control is required to allow the District to stage equipment and vehicles. As noted in Section 2.2.1, the pump and motor can only be removed by crane through existing concrete covers that would also need to be removed using the crane. The crane would need to stage on Sunset Parkway, potentially requiring flagging to maintain traffic.

The existing site does not provide an opportunity to improve parking or accessibility, even with removing and replacing the existing pump station facility. The site is within an existing island that likely cannot be expanded or modified due to a reduction in the Sunset Parkway travel widths not being feasible. F&L also identified multiple existing utilties within the traffic island such as stormwater mains, water mains, gas main, and significant Pacific Gas & Electric (PG&E) infrastructure on poles within the easterly end of the traffic island where the pump station is located.

Groundwater and stormwater are also a concern for the existing pump station location. Groundwater was observed to be present under the concrete slab where the District staff had been required to sawcut the slab to remove and replace the Pump No. 2 suction gate valve. In discussions with District staff, F&L understands that groundwater is always present and, during storms, can encroach on the floor.

Furthermore, the existing site is adjacent to the current Federal Emergency Management Agency (FEMA) 100-year floodplain. Based on review of existing topographic data, F&L believes there is a risk that during significant storm events, stormwater within Sunset Parkway may overtop the lowered curb to facilitate District vehicle parking and be conveyed into the below-grade pump structure. Photos of the existing pump station can be found in Appendix A.

2.2.3 Mechanical Components

The mechanical components are primarily ductile iron with epoxy coating and range from fair to poor condition. Several areas of the coating appeared damaged, with visual evidence of corrosion. In addition, several leaks were observed where there was visible evidence of corrosion. District staff indicated that although none of the leaks had free-flowing water, new leaks had been observed within the last one to two years.

Because of the pump station building constrained conditions and the site location within the traffic island, the pumps, pipe, and fittings have been installed with minimal clearances, complicating access to components for maintenance. For example, the limited width of the structure required the original construction to install the pump discharge valves within a limited space (e.g., less than five feet) between the pump discharge flange and the structure wall. Although operators report that, if needed, the valve bolts can be accessed to facilitate maintenance and possible replacement of the valve, the constrained space significantly complicates access and maintenance timelines.

An additional concern is the limited flexibility provided with the existing layout and components. The existing ductile iron pipes directly penetrate the concrete walls without flexible fittings and appear to have no seismic protection. The lack of seismic fittings increases the components' vulnerability to damage during a significant seismic event where it can be expected that seismic motions would cause differential movement between the existing concrete structure and the existing infrastructure within Sunset Parkway potentially resulting in a catastrophic failure of either the suction or discharge piping rendering the pump station non-functional when water supply for fire fighting could be critical.

2.2.4 Electrical

Multiple electrical components of the pump station appear to be out of compliance with current code. Additionally, the electrical equipment is obsolete and no longer manufactured. Nonstandard exposed conduits and pathing for electrical components were observed. Additionally, the conduits routed below the finished floor of the pump station are in a vault used for operation of a valve that is currently not up to code per NEC.

2.3 Existing Conditions Assessment Conclusions

The existing Lynwood Pump Station is in poor condition overall. Multiple upgrades are required to ensure that the pump station is up to date with the latest code and to extend the life as well as improve the overall reliability of the critical District facility, even without considering potential expansion to meet future demands.

Since the pump station is currently below grade, the District's ability to perform any necessary repairs and upgrades is limited. Also, per discussion with the District staff, it is beneficial for the Lynwood Pump Station to be reconstructed above grade to not only improve access but also reduce the risk from groundwater and stormwater intrusion.

F&L did consider the potential advantages of rehabilitating the existing Lynwood Pump Station components. However, modifying or enhancing the pump station is not feasible because of the overall age, condition, and the significant site constraints that may result in substantial, costly constructability challenges. The most critical constraints identified by the assessment were:

- Multiple existing utilities run through the island, including two storm drain mains, two 24-inch water mains, one 4-inch gas main, an existing PG&E transformer, and a PG&E pole. The design of the existing Lynwood Pump Station appeared to be constructed to accommodate the existing utilities within the traffic island, with the exception of the 4-inch gas main, which was shown to be relocated (Figure 1).
- Considering the upgrades needed for Lynwood Pump Station (number of pumps, clearances, electrical upgrades), the site layout would be approximately 27-feet by 43-feet with a proposed height (not including the roof) of approximately 10-feet. The footprint of the proposed pump station would impede traffic sightlines for cars, in all directions of traffic, at the intersection of Sunset Parkway and S. Novato Boulevard.
- To facilitate in-place rehabilitation or replacement, a temporary pump station must be constructed and remain in operation for the duration of the demolition, construction, and testing phases adding increased construction phasing complexities and costs when compared to constructing a new pump station at an alternative location.

F&L did develop a range of magnitude total project cost for rehabilitating or replacing the existing Lynwood Pump Station, which is between $7.0 million and $9.0 million.

Due to the multiple existing utilities and the location of the pump station adjacent to the intersection, the existing location is not feasible. We suggested to District staff that the engineering assessment move forward to consider constructing a new pump station at a different location than the existing Lynwood Pump Station. The construction of a new, modern pump station built to current code and best practices for mechanical equipment layout for operational access, will result in a facility with, at a minimum, a 50-year design life.

3 CURRENT OPERATING CONDITIONS

The review and assessment of the current operating conditions were based on operational information provided by District staff[1], a review of the 2018 Novato Water System Master Plan Update, dated September 2019[2] , System Control and Data Acquisition (SCADA) information, and PG&E billing.

3.1 NMWD Pressure Zones

The District's water system is divided into four main pressure zones, which are generally based on ground elevations. The largest pressure zone, Zone 1, serves elevations up to 60 feet above sea level. Zone 2 serves locations between 60 feet and 200 feet in elevation, Zone 3 serves elevations from 200 feet to 400 feet, and Zone 4 serves elevations 400 feet and above. Figure 2 presents the approximate limits for each of the four pressure zones. In addition, the District's system includes seven smaller zones within Zone 2, Zone 3, and Zone 4 that are served by hydro-pneumatic tanks due to local topographic restrictions requiring additional booster pump stations. These elevations roughly serve as the zone limits, with some water service locations in each zone above or below those limits.

Water supply pumped from the Stafford Treatment Plant and water supply by gravity or pumped from the Sonoma County Water Agency (SCWA) provides the pressure for the Zone 1 system. Pump stations are required to transfer water from the lower elevation zones to the higher elevation zones. Pump station capacity is based on providing water service to the individual zone and all other higher-pressure zones served from the individual zone.

Due to the topographic variation in the District, Zone 2 is comprised of numerous non-contiguous areas, including the largest Zone 2 areas designated as Primary Zone 2 and the smaller Crest/Black Point Zone 2, Captain Nurse Regulated Zone 2, and Airbase Zone 2. The Crest/Black Point Zone 2 is served by the School Road Pump Station and is hydraulically isolated from Primary Zone 2. Both Captain Nurse Regulated Zone 2 and Airbase Zone 2 are connected to the Primary Zone 2, however these two zones are artificially regulated to a lower pressure than the Primary Zone 2. The Primary Zone 2 demands and pumping are the focus of this Engineering Assessment for evaluating the Lynwood Pump Station replacement.

Primary Zone 2 is the largest Zone 2 pressure zone. The northern and southern sections of Primary Zone 2 can be separated by an isolation valve located approximately around the Indian Valley area. When the isolation valve is closed, San Marin Pump Station serves the northern portion of Primary Zone 2, and Lynwood Pump Station serves the southern portion of Primary Zone 2. The isolation

[1] The F&L Team and District staff met on December 16, 2022, and January 26, 2023, to review current and desired operating conditions to better inform the hydraulic modeling effort.

[2] https://nmwd.com/wp-content/uploads/2020/04/2018WMP.pdf

valve is manually closed during the winter when demand is lower and the potential for water quality issues is greater due to water age within the Primary Zone 2 storage tanks, in particular the San Mateo Tank. Isolation of the northern and southern sections of Primary Zone 2 helps the operations staff keep water turn over (mixing) in the San Mateo Tank at acceptable levels to maintain water quality.

The Primary Zone 2 pump stations also convey water from Zone 1 to Zone 3, Zone 4, and the seven hydro-pneumatic zones. All current and potential demands for Zone 3, Zone 4, and hydro-pneumatic zones are considered "pass-through" demands for Primary Zone 2 and must be included in the pump capacity evaluation for both Lynwood Pump Station and San Marin Pump Station.

3.2 Primary Zone 2 Water Supply

The primary water source for the District's water supply comes from SCWA through the North Marin Aqueduct. The District's primary water source is supplemented by through the Stafford Treatment Plant[3] (STP). Currently, San Marin Pump Station is only connected to the District's primary water supply and is not currently connected to STP. Since San Marin Pump Station is only connected to the primary water source, it does not have the capability to effectively pump water to all of Primary Zone 2. Lynwood Pump Station can and has effectively pumped water from Zone 1, regardless of the supply source, to all Primary Zone 2. Therefore, Lynwood Pump Station is a critical pump station for Primary Zone 2.

3.3 Pump Station Operating Strategy

As a cost-saving measure and when feasible based on operational constraints such as demands and storage tank water levels, District operations staff utilize a partial day operation for both Lynwood Pump Station and San Marin Pump Station during PG&E off-peak hours for electrical use. Currently, PG&E peak pricing occurs five hours each day from 4 pm to 9 pm. The District's operation procedure goal is to operate for a 16-hour period which avoids operating any pumps during the five-hour on-peak usage period plus 1.5 hours before and after the on-peak five-hour period. However, the District currently operates for up to 19-hours per day to meet demands and/or fill storage tanks.

District pump station operations adapt to PG&E on-peak hour changes during the year to minimize pumping costs since PG&E discounts power usage during off-peak hours. During winter, the discount is minimal due to the low flow pumping rates during this time. In practice, the District does operate its pump stations for up to 19 hours a day but can override automation to ensure that critical customer demands are always met.

As part of the engineering assessment described in later sections, the F&L team considered the District's desire to only operate pump stations during off-peak hours. As part of the assessment approach, though, we did consider the information provided by District staff during the December

[3] District staff are developing a separate project that would modify a portion of the San Marin Pump Station suction piping to allow for San Marin Pump Station to also draw water supply from the Stafford Treatment Plant.

2022 and January 2023 workshops, where staff provided guidance that pump stations will run during peak hours when needed to continue to fill the storage tanks during periods of high demand. Still, these operating conditions happen infrequently (e.g., less than ten times per year).

3.4 Emergency Power Strategy

During severe weather events, PG&E turns off power to help prevent wildfires. Times of planned power outages are called Public Safety Power Shutoff (PSPS). During PSPS events, the District utilizes a portable diesel generator to provide emergency power to the District's facilities, including pump stations. The portable diesel generator is not permanently located at the Lynwood Pump Station site and is transported to the District's facilities when needed. Because the District maintains a significant amount of storage in Primary Zone 2, Zone 3, and Zone 4, the District has adequate time to mobilize the portable emergency generator to any of the pump stations if the timing of PSPS is unexpected or there is another emergency power disruption. The District's current diesel generator will operate for approximately 13 hours before refueling is required. The District considers that 13 hours of fuel sufficient to operate under emergency conditions for one operational day.

PSPS typically occurs during late summer and fall, when customer demands can be high. Maintaining operations at Lynwood Pump Station is a priority as it can provide water from both District water supply sources (STP and SCWA) to Primary Zone 2 area. However, the District staff indicated that a permanent generator is not required at Lynwood Pump Station because it can mobilize the portable emergency generator to the Lynwood Pump Station site in less than two hours, and the system demands can be met for this limited time from the existing storage.

4 EXISTING AND FUTURE DEMANDS AND PUMPING RATES

This section presents F&L's review of existing demands based on the 2018 Master Plan as well as projected future demands. The existing demand review is critical to support F&L's review of the existing hydraulic model further discussed in Section 5 . The future demands serve as the basis for evaluating whether the Lynwood Pump Station existing pump capacity can meet proposed future development needs. The development of required pumping capacity is also provided in this section.

4.1 Primary Zone 2 Demands

4.1.1 Existing Demands

The forecasted Fiscal Year (FY) 2020 Primary Zone 2 Maximum Day Demands (MDD) from the 2018 Master Plan will be utilized as the baseline demands for existing conditions in this Engineering Assessment for the hydraulic evaluation of Primary Zone 2. FY 2020 MDD, also referred to as "existing demands," from Primary Zone 2, Zone 3, Zone 4, and the hydro-pneumatic zones can be found in Table 1. The total MDD for Primary Zone 2, Zone 3, Zone 4, and hydro-pneumatic zones is 7.79 million gallons per day (MGD).

4.1.2 Projected New Demands

The Marin County Community Development Agency (MCCDA) has provided information on future development anticipated within the City that will result in additional demand throughout the entire District system. F&L only evaluated the future buildout demands that would be served by Primary Zone 2. All other future build out demands were not included in the future build out pumping analysis, but included in the system distribution model.

The information provided by MCCDA identified multiple future developments that will result in future additional demands that are part of Primary Zone 2. As noted in Section 3.1, only Primary Zone 2 is evaluated as part of this engineering assessment. Therefore, any future build out demands served by Crest/Black Point Zone 2 systems were excluded from the future build out demand analysis. Additionally, Zone 3 future build out demands served by the Cherry Hill System were also excluded from the future build out analysis as this portion of Zone 3 is not served by Lynwood Pump Station or San Marin Pump Station. No future build out demands were anticipated for Zone 4.

Future build out locations with Equivalent Residential Dwelling Units (EDU) and commercial square footage (sf) provided by the District are shown in Figure 3. There are six future build out demands, including one commercial, office, and government demand, in the northern part of the City within Primary Zone 2 near the existing San Marin Pump Station and designated as Location 1 through Location 6, shown in Figure 3. One future build out demand in the southern part of the City is within

the Captain Nurse Regulated Zone 2 but is still connected to Primary Zone 2, served by Lynwood Pump Station, and designated as Location 12 in Figure 3.

The EDU and commercial building square footage provided in Figure 3 as was used to calculate the potential additional demand in Annual Acre-Feet (AAF). The demands for Locations 7 through 11 are not part of the Primary Zone 2 system and are not included in the Primary Zone 2 total demands. The AAF for the seven future build out demands is 735 AAF, shown in Table 2. The AAF was then used to calculate the Average Day Demand (ADD). The ADD for the seven future build out demands in Primary Zone 2 is 0.66 MGD, and the resulting MDD is 1.16 MGD. The office, commercial, and government demand was negligible and was captured within the rounding of the total Primary Zone 2 demand, shown in Table 3. Table 1 includes a detailed summary of the existing Primary Zone 2 pressure zones demand and where future demand is allocated to the appropriate subzone. The total future MDD of Primary Zone 2 is 8.95 MGD.

4.2 Pump Station Capacity

4.2.1 Pump Station Firm Capacity Approach

Generally, pump station firm capacity is defined as the pump station capacity when the largest pump unit is out of service. Because Primary Zone 2 is served by two pump stations (e.g., Lynwood Pump Station and San Marin Pump Station), the District has in the past used a firm capacity for the entire zone rather than at an individual station. In the zone approach, the zone firm capacity was defined as the capacity when the largest pump unit in the zone is out of service.

The F&L team suggested reviewing both approaches to confirm impacts of the pump station firm capacity methodology for this Engineering Assessment. The review included a presentation to the District by the F&L team of typical pump station firm capacity methodologies compared with the zone firm capacity methodologies that the District used in prior master planning documents. The firm capacity methodology selected by the District will impact the capacity determination of the required replacement Lynwood Pump Station.

Following collaboration with and further review by the District staff, the individual pump station firm capacity definition was chosen as the preferred approach for this Engineering Assessment. The firm capacity is defined as pumping capacity to meet MDD when the largest pump unit at each pump station is out of service. Both the San Marin Pump Station and Lynwood Pump Station have three pumps, all rated for 1,800 gallons per minute (GPM); therefore, each pump station's firm capacity is 3,600 GPM (5.18 MGD) based on two pumps operating. The individual and total firm capacity for Primary Zone 2 pumping stations is listed in Table 4.

4.2.2 Existing Pump Station Capacity Approach

As noted in the previous section, Lynwood and San Marin pump stations each have a firm capacity of 3,600 GPM. The existing Primary Zone 2 firm pump capacity was calculated to be 10,368,000 gallons per day (GPD) (10.368 MGD) as presented in Table 4. The firm pump capacity is key to calculating the required pump station size to meet current demands. The total firm capacity for

Primary Zone 2 is greater than the Primary Zone 2 existing demand of 7.79 MGD and future demand of 8.95 MGD. However, the District operates the pump stations for only a portion of the day to reduce energy costs. This shortened operating period requires higher capacity pumping rates to deliver the MDD during the shorter period.

The minimum required pump capacity to meet the existing Primary Zone 2 MDD would be based on a 24-hour pumping rate. However, as noted in Section 3.3, the District operational goal is to run the pump stations for only 16 hours per day to minimize power costs associated with pumping. For this case, the minimum pumping rate must be higher than the maximum day demand rate to be able to transfer the total daily demand volume from the Zone 1 system into the Primary Zone 2 system in the shorter time period.

To initially evaluate the system performance under existing demands, the F&L team considered the District's operational goal to operate the pump stations during off-peak hours only. This would result in MDD system demands that occur over a 24-hour basis being required to be met through the pump stations operations over a 16-hour period, requiring the pumping rate be adjusted to reflect the shorter pump station operating duration. The pumping rate adjustment factor is calculated by dividing 24 hours by 16 hours, resulting in an adjustment factor of 1.5. The minimum pumping rate for the 16-hour operation is 1.5 multiplied by the MDD.

The existing Primary Zone 2 demand of 7,785,000 GPD is multiplied by 1.5 to determine the minimum required pump capacity for the combined San Marin Pump Station and Lynwood Pump Station. The required MDD pump capacity based on a 16-hour pumping time is 11,677,500 GPD. Since the total existing Primary Zone 2 firm pump capacity is 10,368,000 GPD, the existing net pumping capacity for the 16-hour pumping time is a deficit of 1,309,500 GPD, as shown in Table 5.

The net pumping capacity deficit is a critical data point because the net deficiency indicates that MDD demands would not be met by the pump stations based on a strict 16-hour operations limit. During existing MDD conditions with a 16-hour operations limit, the existing pumps would not provide sufficient volume into the Primary Zone 2 to meet daily demand. A portion of the storage in the Primary Zone 2 storage tanks would be required to supplement the pumped volume to meet MDD demands.

The typical standard for determining the required pump station capacity during MDD is to provide sufficient pump capacity to meet or exceed the calculated MDD so that storage is not impacted. The storage should be used to meet Peak Hour Demands (PHD), as well as fire flow and emergency storage requirements. Since firm pumping capacity currently exceeds the MDD with a 24-hour pumping period, the time period of pump operations on Max Day can be increased to match the MDD. The F&L team calculated the minimum pumping duration of 18 hours is required during MDD to reduce the potential for some portion of MDD to be met with storage. A summary of the impact of the pumping durations is shown in Table 5.

As noted previously, District staff is not required to operate at a 16-hour limit and will operate one or both pump stations during peak electrical demand periods when customer demand conditions warrant the additional pumping time. Also, the MDD is an estimated value based on historical demands and performance of the District's system and will rarely occur during a year. The actual

demands experienced recently may reflect a reduction in MDD due to water conservation efforts. District staff has reported that the District has not experienced demands that required all four pumps (e.g., two at San Marin Pump Station and two at Lynwood Pump Station) to operate simultaneously.

For this Engineering Assessment, the necessary pump capacity of any new pump station is based initially on the proposed 16-hour pump operating approach and capacity deficiency results as outlined in Table 5. This approach will provide the District with the required pumping capacity to meet the most critical demand experienced by the system at the desired operating conditions.

4.2.3 Future Pump Station Capacity Methodology

For purposes of the engineering assessment, the F&L team evaluated future pump station capacity using the firm capacity approach presented in Section 4.2.1. This capacity was based initially on 16 hours of operation during each day. However, the F&L team also evaluated pump station operations for longer than 16 hours each day if there were potential benefits to the District. These benefits included:

- The ability to utilize similar pumps (model and capacity) to the existing San Marin Pump Station and the existing Lynwood Pump Station for any new pump station.
- Capital cost savings by not developing an oversized replacement facility. For some demand conditions, the pump cycle time can be increased slightly to avoid the added cost of an additional pump that would be needed to meet firm capacity requirements for the shorter pump cycle times.

Another critical consideration when reviewing pump station capacity is current and future use of variable frequency drives (VFDs) that allow operators to match pump station flows with demands. With VFDs, the operators can choose to operate the pump stations at a range of flows to allow for the pump station to operate at higher flow rates in low demand (and off-peak electrical hours) in anticipation of peak demands.

The Lynwood Pump Station replacement alternatives presented in subsequent sections considered the desire to only pump during non-peak electrical demand hours. In addition, the alternatives did not artificially constrain the pump cycle time if there are other potential benefits or cost savings to the District. The analysis was based on recognizing the District can and will operate the pump station as long as necessary to meet demands while maintaining operational, fire and emergency storage volumes.

5 HYDRAULIC EVALUATION METHODOLOGY

To develop potential Lynwood Pump Station alternatives, F&L performed a preliminary hydraulic evaluation of the District's Primary Zone 2 water distribution system both under existing conditions and with the future demands presented in Section 4 **.** In this section, we reviewed and confirmed the existing District hydraulic model demands were consistent with information presented in the 2018 Master Plan, identified critical system operational constraints for pumping, storage and conveyance, and documented the methodology to be used for preliminary modeling of pump station replacement project alternatives.

The use of the model for this Engineering Assessment was primarily for comparison of the different pumping station alternatives and was generally focused on Primary Zone 2 MDD conditions only. The conditions during PHD for tank releases in Primary Zone 2 and tank replenishment in Zone 1 were not considered during the preliminary hydraulic evaluation and should be reviewed as part of final design. A review for confirmation of preliminary results of proposed operations and the impacts for all zones should be performed as part of the next steps in design. The Engineering Assessment results should be revisited with a complete model review prior to final design to confirm the hydraulic conditions for any selected approach and final site location.

5.1 Existing Distribution System Model Review

To develop the potential Lynwood Pump Station replacement alternatives, F&L utilized a water distribution system model previously developed by Kennedy/Jenks Consultants (K&J). The distribution system model used the InfoWater software by Innovyze, an Autodesk company, for the analysis. F&L was provided with a copy of the model and assumed for the purposes of this study, it was calibrated and configured correctly for steady state analysis. The model did not appear to be calibrated to perform extended period simulation. The model included all of the District's water distribution system network, including existing gravity tanks, pumps, pipes, and valves. The model also includes various scenarios, including ADD scenarios, MDD scenarios, and PHD scenarios.

The primary use of the model was the evaluation of the future demand conditions and potential pump capacity requirements. To review model operations, F&L first utilized the existing MDD scenario within the model files and incrementally added modifications to simulate how the District currently operates the water distribution system. This provided a cursory check to compare whether model results were similar to the operating conditions described in the 2018 Master Plan and similar to operations discussed with District staff. Specific modifications to the model can be found in Appendix B. A summary of the steps taken to confirm functionality of the model included:

- Determine if existing demands matched the 2018 Master Plan FY 2020 MDD from Section 4.1.1,
- Determine the hydraulic conditions on a maximum day at the beginning of peak hour, and
- Determine hydraulic conditions with alternative pump cycle durations.

5.2 Existing Conditions Modeling Results

Before proceeding with the pump station replacement alternative development, F&L first reviewed the hydraulic conditions for the existing distribution system. Based on our conversations with District staff, the purpose of the existing conditions hydraulic analysis was to document observed key operational constraints and validate that the hydraulic model generally reflected current system operations. Key findings from the hydraulic model results are summarized below.

5.2.1 Zone 1 Storage Tank Performance

One key finding during the preliminary water distribution system modeling was the shorter 16-hour Primary Zone 2 pump operating periods will change the amounts of operational storage needed for Zone 1 and Primary Zone 2. The operational storage volume needed under the reduced pump operating periods should be further investigated during design for the pump station alternative chosen and also under future master plan updates.

The short higher rate pumping periods draw the Zone 1 tank levels down from a full condition at the MDD condition. Typically, during the MDD condition in a steady state model run, gravity tanks within a distribution network would be full or filling. The MDD condition was anticipated to occur during the 16-hour pump operation cycle, which changes the typical steady state results. The existing model results indicated that when operating the Lynwood Pump Station and San Marin Pump Station for only 16 hours per day during MDD conditions, the Zone 1 tanks are releasing water to meet both Zone 1 demands and the higher 1.5 x MDD Primary Zone 2 pump station rates. Since the MDD flow rates into Primary Zone 2 are being artificially increased by increased pumping, the North Marin Aqueduct supply alone cannot provide the water volume for the transfer. The Zone 1 tanks release flow to make up the difference. In the Primary Zone 2, the PHD are provided solely from storage after the pumps are turned off, increasing operational storage requirement in this zone.

The balancing of the system flows and volumes in Zone 1 occurs when the pumps are turned off. The storage volume drawn out of Zone 1 tanks is replenished during the Primary Zone 2 pump off period at potential peak hour flow. The North Marin Aqueduct supply will meet both Zone 1 PHD and tank replenishment, since there is no water being drawn into the Primary Zone 2.

As discussed previously, District staff have flexibility with selection of the length of daily pump operating periods. District staff reported that when customer demands warrant, the Lynwood Pump Station and San Marin Pump Station pumping period will be extended regardless if the pump stations would be operating during shoulder or peak PG&E electric rate periods. As noted in Section 4.2.2, the net pumping capacity evaluation indicated that for existing conditions, the pump cycle time would likely be extended from 16 hours to 17 hours and higher to maintain Zone 2 storage tank levels as necessary.

By extending the pump cycle time to reduce demands on Zone 2 storage tanks, F&L would expect Zone 1 storage tank replenishment demands to be similarly reduced, however, the steady state modeling results did indicate a continued demand on Zone 1 storage tanks during MDD with less than 24-hour pumping. The operations with limited pump cycle time will continue to increase the amount

of operational storage requirements for the distribution system. As part of the District's planned update of the 2018 Master Plan, F&L suggests that the District perform an extended period simulation in addition to the steady state analyses to review the Zone 1 and 2 tanks operational storage performance during concurrent limited pump cycle time and MDD conditions discussed above.

5.2.2 Pacheco Valley Tank Hydraulic Constraints

The District's operations staff noted hydraulic constraints within the Primary Zone 2 distribution system that impact the fill rate from the Lynwood Pump Station to the Pacheco Valley Tank. These constraints include limited transmission capacity south of the existing Lynwood Pump Station and the proximity of the Sunset Tank to the existing Lynwood Pump Station site. The Pacheco Valley Tank is in the southern part of the District's Primary Zone 2 distribution system and receives water from the Lynwood Pump Station. Due to its location within Primary Zone 2, Pacheco Valley Tank is one of the furthest distance tanks from the existing Lynwood Pump Station location. The head loss along the long transmission route from Lynwood Pump Station limits the fill rate of the Pacheco Valley Tank during peak demands. The District's impacted ability to fill and maintain the Pacheco Valley Tank water level is partially a result of the proximity of the Sunset Tank to the Lynwood Pump Station. See Figure 4 for Pacheco Valley Tank and Sunset Tank locations.

Pacheco Valley's tank overflow elevation is set at 323 feet, similar to the Sunset Tank overflow elevation of 323.5 feet. Sunset Tank resides physically closer to the Lynwood Pump Station and therefore fills faster. To fill Pacheco Valley Tank, District staff must first fill and isolate Sunset Tank. Once Sunset Tank is filled and isolated, the District must turn off one of the pumps at the Lynwood Pump Station to reduce the risk of over-pressurizing portions of the distribution system closest to the pump station. The remaining single pump can convey water to the Pacheco Valley Tank without over-pressurizing portions of Primary Zone 2 adjacent to the Lynwood Pump Station. However, the fill rate is limited and artificially constrained due to only filling at a maximum rate of 1,800 GPM with one pump operating. The District's operations staff has observed that this method can require multiple days to fill Pacheco Valley Tank during periods of high demand.

The 24,500 ft conveyance system between the Lynwood Pump Station and Pacheco Valley Tank is generally comprised of 12-inch and 8-inch diameter piping. Two short pipe sections, a 500-feet length of 12-inch diameter and a 250 feet length of 8-inch diameter, constrict the conveyance system between the Lynwood Pump Station and Pacheco Valley Tank. In a preliminary analysis of head losses, F&L reviewed the MDD flow conditions and determined that the head loss in these two smaller diameter segments is not significant (e.g. about 0.1 ft), when compared to the total head loss of 10 ft within the 24,500 feet of pipe between the Lynwood Pump Station and Pacheco Valley Tank. As a result, the two smaller diameter pipes are not considered to be a significant factor in limiting the flow conveyance capacity. Other distribution system improvements that may resolve the limited conveyance are replacing or paralleling longer pipeline segments or providing water supply to a location closer to the Pacheco Valley Tank. However, the primary hydraulic condition that limits the maximizing of the Pacheco Valley Tank fill rate and to provide similar fill rates with Sunset Tank is the fact that Sunset Tank is significantly closer to the Lynwood Pump Station.

The District expressed interest in investigating potential solutions to improve the District's overall ability to fill Pacheco Valley in addition to evaluating the capacity required for Lynwood Pump Station. Generally, the potential improvement options to improve the District's ability to fill Pacheco Valley Tank include:

- Expand the existing distribution system or introduce a new transmission main;
- Potentially rrelocate Lynwood Pump Station to a location equidistant between Sunset Tank and Pacheco Valley Tank; or
- Add a third pump station to Primary Zone 2 near the Pacheco Valley Tank.

Please refer to Section 6.1 for presentation of the F&L selected alternatives, including discussion of each alternatives potential operational improvement goals.

5.3 Future Conditions Modeling Methodology and Exclusions

To perform preliminary modeling and analysis of pump station alternatives to meet future demands, F&L developed the following methodology:

- Add projected new demands from Section 4.1.2,
- Determine hydraulic conditions with the 16-hour pump cycle with steady state analysis,
- Determine hydraulic conditions with various proposed pump station capacities and pump station locations with steady state analysis.

In the analysis of the Lynwood Pump Station capacity, the following were excluded:

- Fire flow demand for the system was not included since we are not performing a master planning study. Fire flow demands are outside of the scope of this analysis.
- The original 2022 maximum day scenario included the seven hydro-pneumatic stations. Although the hydro-pneumatic stations operate periodically per set pressure points, for simplicity, the hydro-pneumatic stations were modeled as an average of the total daily pumping rate of the hydro-pneumatic system. No additional demands were added to these station service areas.

6 ALTERNATIVES DEVELOPMENT

This section identifies the potential alternatives for replacing the existing Lynwood Pump Station. The F&L team identified five potential alternative solutions. The alternatives were formulated with the primary goal of meeting future Primary Zone 2 MDD and the secondary goal to increase flow to Pacheco Valley Tank. Each alternative concept was developed collaboratively with District staff to provide the F&L team with sufficient guidance to develop specific alternatives for consideration and development.

6.1 Proposed Alternatives

With guidance from District staff and considering the key project goals, F&L developed the following alternative concepts:

- A new pump station near the existing Lynwood Pump Station site with one additional pump to meet future demands.
- A new pump station relocated away from the current Lynwood Pump Station site, ideally with adequate ability to meet future peak demands throughout Primary Zone 2, and also improve the District's ability to deliver water to Pacheco Valley Tank.
- Two new pump stations, with one to replace the Lynwood Pump Station and the second to provide a new pump station at a location within the southern portion of Primary Zone 2 that would improve the District's ability to fill Pacheco Valley Tank without having to isolate Sunset Tank from the system.

Five alternatives were developed using the five selected site locations and are summarized in this section.

6.2 Siting Study

Before performing any hydraulic analysis and detailed development of each of the five alternatives, F&L conducted a desktop siting study to determine the preferred site locations. For each option, three areas were evaluated based on four categories:

- Parcel ownership,
- 100-year floodplain proximity,
- Potential sea level rise, and
- Hydraulic compatibility, including reviewing system changes to the pressure and flow to the gravity storage tanks.

One site location was determined based on favorable attributes in the four categories presented above. The detailed siting study can be found in Appendix C. The final locations are:

- Site 1: Sunset Parkway Pump Station - New pump station within the Sunset Parkway median between Monte Maria Avenue and Cambridge Street.
- Site 2: Ignacio Boulevard Pump Station - New pump station along Ignacio Boulevard at Palmer Drive within open space area adjacent to existing pedestrian trails.
- Site 3: Bolling Drive Pump Station - New pump station near Bolling Circle and Bolling Drive intersection within a privately maintained open space area.
- Site 4: Main Gate Road Pump Station - New pump station along Main Gate Road west of C Street within open space area adjacent to existing pedestrian trails.
- Site 5: C Street Pump Station - New pump station near Main Gate Road and C Street within an existing baseball field privately maintained by the Novato Unified School District.

Five Alternatives A through E were developed for review in this Engineering Assessment. The Alternatives A and B included only one new pump stations. Alternatives C through E included two new pump stations. The five alternatives are summarized below:

- Alternative A is a new pump station that matches the existing Lynwood Pump Station with one additional pump to meet future demands. The new pump station site, referred to as Site 1, is proposed in close proximity to the existing Lynwood Pump Station. A key consideration when developing Alternative A was District staff reported the current location provides the ability to meet demands both to the north and south of the existing facility location.
- Alternative B was developed to determine if, by relocating the pump station away from the current Lynwood Pump Station site, the new pump station could continue to provide adequate ability to meet future peak demands throughout Primary Zone 2, and also improve the District's ability to deliver water to Pacheco Valley Tank. The new pump station is proposed at a site, referred to as Site 2, roughly half way between the Sunset Tank and Pacheco Valley Tank.
- Alternative C was developed to include both replacement of the Lynwood Pump Station at Site 2 and adding a pump station at a location within the southern portion of Primary Zone 2 that would improve the District's ability to fill Pacheco Valley Tank without having to isolate Sunset Tank from the system. The second pump station site is located at Site 3.
- Alternative D was developed based on similar goals as Alternative C but utilized both Site 2 and an alternative pump station site. For Alternative D, the third pump station is located at Site 4.
- Alternative E was developed based on similar goals as Alternative C but utilized both Site 2 and an alternative pump station site. For Alternative E, the third pump station is located at Site 5.

6.3 Alternative A

Alternative A (Figure 5) includes a pump station location within the Sunset Parkway median between Monte Maria Avenue and Cambridge Street (Site 1). This pump station is referred to as the Sunset Parkway Pump Station in this Engineering Assessment. The location is in public right of way and outside the 100-year floodplain.

6.3.1 Pump Station Capacity

F&L performed an initial hydraulic evaluation to determine the required pumping capacity for Alternative A to, at a minimum, meet the future Primary Zone 2 MDD using the District's preferred 16-hour pump cycle time (see Table 6). The hydraulic modeling indicated that the high pumping rates associated with the 16-hour pump cycle time created a risk of over pressurizing the residential service connections near the pump station.

For Alternatives A through E, F&L utilized pumps that matched the current pump models, sizes and pumping rates present in the existing Lynwood Pump Station and San Marin Pump Station. Each pump station used individual pump capacities of 1,800 GPM with the specific number needed to meet the future Primary Zone 2 MDD. This approach was used for consistency to ensure that the District operations staff will not need to be trained to maintain new or different equipment in the new pump station.

Due to Alternative A's pump station location, operationally, the District must utilize the 19-hour pump cycle rather than the 16-hour pump cycle to fill Pacheco Valley Tank or risk over pressurizing the residential services in the pump station vicinity. F&L performed a supplemental simulation of a 19-hour pump cycle time to review the operational constraints observed by the District. The 19-hour pump cycle time simulation was used to determine an appropriate firm pump station capacity that supplies the Primary Zone 2 MDD while keeping the storage tanks full or filling and reduces impacts to the Zone 1 storage tanks. The resulting conditions appeared to provide neutral impacts on Primary Zone 2 tanks with little increase in the impacts on Zone 1 storage tanks compared to existing conditions.

Alternative A operating for 19 hours during MDD results in a minimum firm pump station capacity of 4,250 GPM, which is less than the 5,400 GPM proposed for this alternative. This pumping rate difference results in a net pumping capacity of 1.69 MGD (see Table 6). This pumping rate has minimal impacts on the distribution pressures with a minimal pressure increase between 0 to 5 psi. Alternative A does not improve the ability to fill Pacheco Valley Tank without performing similar operational steps to first fill and isolate Sunset Tank. This approach will continue to require isolating Sunset Tank and reducing the operating flow rate from Lynwood Pump Station to fill Pacheco Valley Tank.

F&L has preliminarily determined that this pump station alternative results in the Primary Zone 2 tanks remaining full or filling and reducing impacts to Zone 1 storage tanks during MDD. However, further analysis of impacts and an analysis of operational storage needs in the Zone 1 and Primary

Zone 2 storage tanks should be verified as part of the design and the District's future update of the 2018 Master Plan.

6.3.2 Potential Environmental Permit Requirements and Constraints

WRA performed an environmental constraints analysis for Alternative A, and the analysis results are summarized in this section with the detailed analysis included in Appendix D.

WRA conducted a field investigation to identify the potential for special-status species within the site. Based on the highly disturbed condition of the proposed site, no further actions are recommended for special-status plant species and special-status wildlife species.

Non-special-status native birds may nest in trees and vegetation within and immediately surrounding the proposed site. The active nests of native birds are protected under the federal Migratory Bird Treaty Act (MBTA) and by California Fish and Game Codes (CFGC). Recommendations to avoid and minimize the potential impacts on nesting birds can be found within WRA's site assessment.

The only potential development-related constraint associated with Alternative A is the trees and shrubs protected under Chapter 17 of the Novato Code of Ordinances ("Tree and Shrub Ordinance"). The District is not required to comply with the City of Novato Ordinances. As such, the project is not required to replace trees to be removed by project activities in accordance with the City's Tree Ordinance. However, the District intends to replace trees removed by the project at the recommended one to one ratio, which is consistent with the City's Tree Ordinances.

Construction of a new pump station at the alternative site would require compliance with the California Environmental Quality Act (CEQA). Based on WRA's review of the site, including biological resources conditions, compliance with Chapter 17 of the Novato Code of Ordinances, and the inclusion of the nesting bird protocol, a new pump station at the Alternative A location would not result in any significant environmental impacts that could not be mitigated pursuant to CEQA.

As part of the CEQA effort, any temporary construction impacts (e.g., noise, dust, stormwater, etc.) would be considered mitigated impacts by maintaining compliance with local and state regulations including but not limited to the Construction Stormwater General Permit, Novato Code of Ordinances, and any additional regulations.

6.3.3 Regional Geologic and Soil Engineering Data

CE&G performed a desktop study for Alternative A, and the analysis results are summarized in this section with the detailed analysis included in Appendix E. The Alternative A location has unconsolidated, fine to medium sand with silt and clay. The Natural Resources Conservation Service (NRCS) soil map shows the site as surficial soils that generally extend to depths of about 80 inches below grade. Groundwater levels in the general area are between 1 and 7 feet below grade. Due to the relatively flat topography at the location, landsliding for the site is unlikely to occur. The site has very low liquefaction susceptibility.

CE&G found that the site is in the seismically active San Francisco Bay Area and will likely experience strong ground shaking from a large earthquake along with one or more of the nearby active faults during the design lifetime of the project.

CE&G evaluated if the Alternative A location was within an Alquist-Priolo Earthquake Fault Zone. According to the California Geological Survey (CGS) (2006), the site is not located within an Alquist-Priolo Earthquake Fault Zone. According to the United States Geological Survey's (USGS) Quaternary Fault and Fold database, no active faults have been mapped across the Alternative A site location.

6.3.4 Conceptual Design

A key component of the alternatives analysis is developing a conceptual design of the proposed pump station. F&L has included a description of key pump station components evaluated for Alternative A below that informed the conceptual design. The proposed Alternative A Conceptual Design drawings are included in Appendix F.

6.3.4.1 Pumps

All pumps will be vertical turbine style and sized at 1,800 GPM. As part of F&L's review of the as-built drawings, the existing pumps at Lynwood Pump Station are Floway Pumps from Trillium Flow Technologies. Trillium Flow Technologies does not have an 1,800 GPM pump but provided the proposed pump model most similar to the San Marin Pumps that, when operated with VFDs, will provide the necessary 1,800 GPM flow. Preliminary information from Trillium Flow Technologies for the recommended pump is included in Appendix G.

6.3.4.2 Building and Facility Layout

The proposed pump station will be a CMU building with access through a double door. The pump station building footprint provides sufficient access to all pumps, valves, and appurtenances within the pump station. Spacing between pumps will be a minimum of five feet of clearance, which will allow the District's staff sufficient room for maintenance and repair work. Most of the piping, valves, and appurtenances will be below the finished floor elevation to maximize clear space within the building but the mechanical components will all be accessible using removable fiberglass grates for the primary floor. The pump station will include a gantry to ease lifting any pump components. A skylight is proposed above each pump to allow access for maintenance and replacement of the pump and motor.

A magnetic flowmeter will be included on the discharge pipe and within the building footprint. A cut sheet of the District's preferred magnetic flow meter by Rosemount is included in Appendix G.

The City is located within an area of elevated seismic activity and any improvements must consider seismic resiliency during design. Utilizing guidance from the American Society of Civil Engineers (ASCE) 7 Minimum Design Loads and Associated Criteria for Buildings and Other Structures (ASCE7), the replacement of Lynwood Pump Station is considered Risk Category IV because it is a critical water facility to maintain water pressure. Based on the elevated risk category, piping into the pump station will include specialized flexible fittings to allow for differential movement between the pumps and

the distribution system. The most commonly used specialized flexible fitting is similar to the EBAA Iron Flex-Tend. A cut sheet of the EBAA Iron Flex-Tend[4] is included in Appendix G.

The 24-inch main on Sunset Parkway that feeds the existing Lynwood Pump Station would continue to feed the new pump station. Approximately 80 ft of 24-inch pipe will be required to connect the existing 24-inch distribution pipe to the new pump station. Approximately 500 ft of 16-inch pipe will be required to join the new pump station to the current Primary Zone 2 distribution pipe.

6.3.4.3 Electrical Components

Alternative A pump station will require:

- A new PG&E service,
- Main service-entrance switchboard,
- Facility standby power provisions,
- Motor Control Center and Variable Frequency Drive Equipment, and
- Non-electrical design considerations.

PG&E Service

The new PG&E service required for this station is relatively large compared to the predominantly residential customer loads in the vicinity. For this reason, obtaining a service of this size at any alternative locations will probably be challenging.

Main Service-Entrance Switchboard

The main service-entrance switchboard equipment and installation must comply with PG&E and Electric Utility Service Equipment Requirements (EUSERC) requirements and standards.

Facility Standby Power Provisions

Based upon discussions with the District, it is preferred that standby power to the station be provided by a portable standby generator rather than installing a permanently mounted standby generator unit. The alternative will show the preferred approach of utilizing a portable standby generator for station backup power. It should be noted that for the option presented, it is not feasible to utilize a portable generator "receptacle." Power receptacles for this type of application are limited to a rating of 400 amperes and, thus, not large enough for this application. A standby generator connection panel will be required for Alternative A, which will require either the connection of portable generator cables to the internal connection panel lugs or connection to the panel via pre-made, color-coded CamLok connectors.

[4] https://ebaa.com/products/flex/flexible-expansion-joint/flex-tend/30

Motor Control Center and Variable Frequency Drive Equipment

The motor control center (MCC) equipment will include a main circuit breaker, pump variable frequency drives, lighting panelboard and transformer, and circuit breakers for anticipated station auxiliary loads such as heating, ventilation, and air conditioning (HVAC), sump pumps, and other miscellaneous electrical equipment. The motor control center will be the industry standard of 90 inches high and 21 inches deep, with each individual section's width determined by what is included in each section.

With respect to variable frequency drive (VFD) equipment selection, it has been assumed that 18-pulse, "Clean Power" VFDs will be specified for the new station. As required by the PG&E "Electric & Gas Service Requirements 2022-2023" document (also known as the PG&E " Greenbook"), customers are not permitted to operate equipment that imposes a "harmful wave form" onto the PG&E distribution system. For each of the presented options, the bulk of the load at each station will be the pump VFDs which, if not specified to be "Clean Power," will impose harmonic distortion onto the PG&E system. The assumed "Clean Power" technology is based upon 18-pulse technology, a proven industry standard for many years. In recent years, however, a newer "Clean Power" VFD technology known as "Active Front End" has been introduced, accomplishing the same level of harmonic distortion mitigation. There are several potential benefits to utilizing the active front-end technology, the most notable being less heat production and a smaller footprint. Experience in recent jobs has indicated, however, that this technology is still evolving to some degree, and the reliability of the equipment has been an issue on recent projects. Until the technology has a proven reliability track record on similar applications in the Bay Area, there is a reluctance to deviate from specifying the proven 18-pulse technology.

Non-Electrical Design Considerations

For this type of water facility, two (2) non-electrical aspects must be considered in the new station's design. The first is HVAC. The electrical equipment that will be housed in the new pump station building will generate heat as significant as 10-20kW. This level of heat generation will almost certainly require some degree of interior building air conditioning. The second non-electrical consideration goes along with the HVAC design. Per NEC requirements, HVAC ducting, process water piping, or any other non-electrical aspect of the facility cannot be routed directly above any electrical equipment. This requirement must be coordinated as part of the final station design to ensure that the mechanical design aspects mesh with the electrical equipment placement within the new building.

6.3.5 Capital Cost

The Conceptual Opinion of Probable Project Cost (OPC) for Alternative A is $4,521,000 and is presented in Table 11. The OPC includes budgets for design, environmental/permitting, construction management including testing and inspection, District administrative allowance, and construction costs. The OPC is presented in 2024 dollars.

The construction cost component of the OPC was developed based on the following:

- Equipment pricing from potential suppliers;
- Recent bid pricing for similar materials;
- Experience with similar projects; and
- Considerations of site constraints.

6.3.6 Net Operating Cost

In order to perform a comprehensive comparison of the five alternatives in Section 7 , F&L developed potential operating costs for a 30-year time frame that, when combined with the capital cost, we could effectively understand the total investment that would be required of the District. The operating cost approach includes:

- Capital cost in Year 0 to capture all costs associated with initial construction and startup;
- Annual electrical costs for the operations based on 17 to 19 hours on average per day with variability in the number of pumps running based on demand variations throught the year;
- Annual District maintenance costs of $5,000;
- Every 10th-year maintenance budget for $50,000 for significant maintenance activities such as rewinding motors or key component replacement; and
- Estimating the net present value of the capital and operating costs based on a 5% discount.

The net present and operating cost based on a 19-hour pump cycle time for Alternative A is $9,868,000, as presented in Table 16.

6.4 Alternative B

The pump station location south of Ignacio Boulevard at Palmer Drive (Site 2) was chosen for the Alternative B (Figure 6) site because it has similar proximity to both Sunset Tank and Pacheco Valley Tank. This pump station is referred to as the Ignacio Boulevard Pump Station in this Engineering Assessment. The site location is in public right of way and is not located within the 100-year floodplain.

6.4.1 Pump Station Capacity

F&L performed the hydraulic evaluation to determine the required pumping capacity for Alternative B to, at a minimum, meet the future Primary Zone 2 MDD with the initial evaluation using the District's preferred 16-hour pump cycle time (see Table 7). The higher firm capacity required for the 16-hour pump cycle time slightly exceeds the proposed pump station firm capacity. Similar to Alternative A, the pump cycle time was increased to reduce the firm pumping capacity rate needed to supply the MDD.

For Alternatives A through E, F&L utilized pumps that matched the current pump models, sizes and pumping rates present in the existing Lynwood Pump Station and San Marin Pump Station. Each pump station used individual pump capacities of 1,800 GPM with the specific number needed to meet the future Primary Zone 2 MDD. This approach was used for consistency to ensure that the District operations staff will not need to be trained to maintain new or different equipment in the new pump station.

F&L performed a supplemental evaluation to extend the pump cycle time. Based on the extended pump cycle time evaluation, a pump cycle time of 17 hours during MDD results in a minimum firm pump station capacity of about 5,200 GPM, which is less than the 5,400 GPM proposed for this alternative. This pumping rate difference results in a net pumping capacity of 0.34 MGD (see Table 7). This pumping rate results in the Primary Zone 2 tanks remaining full or filling while reducing impacts to Zone 1 storage tanks to be similar to existing conditions.

Based on preliminary modeling, Alternative B improves the ability to fill Pacheco Valley Tank without requiring isolation of Sunset Tank prior to filling Pacheco Valley Tank, as well as not increasing the impacts to Zone 1 storage tanks above what is believed to occur under existing conditions. Furthermore, the Alternative B pump station could operate with more than one pump without potentially over-pressurizing portions of the Primary Zone 2 distribution system adjacent to the proposed location. Alternative B, with a firm capacity of 5,400 GPM (see Table 7), has minimal impacts on the distribution pressures with a minimal pressure increase between 0 to 5 psi in preliminary modeling simulations.

F&L has preliminarily determined that this pump station alternative results in the Primary Zone 2 tanks remaining full or filling and reducing impacts to Zone 1 storage tanks during MDD. However, further analysis of impacts and an analysis of operational storage needs in the Zone 1 and Primary Zone 2 storage tanks should be verified as part of the design and the District's future update of the 2018 Master Plan.

6.4.2 Potential Environmental Permit Requirements and Constraints

WRA performed an environmental constraints analysis for Alternative B, and the analysis results are summarized in this section with the detailed analysis included in Appendix D.

WRA conducted a field investigation to identify the potential for special-status species to occur within the sites. Based on the highly disturbed condition of the proposed site, no further actions are recommended for special-status plant species and special-status wildlife species.

The other potential constraint for Alternative B is associated with the existing shrubs and trees. Several trees growing along this creek provide potential nesting habitats for common nesting bird species. Non-special-status native birds may nest in trees and vegetation within and immediately surrounding the proposed site. The active nests of native birds are protected under the federal MBTA and CFGC. Recommendations to avoid and minimize the potential impacts to nesting birds can be found within WRA's site assessment.

The primary potential development-related constraint associated with Alternative B is the proximity of the creek and its associated riparian corridor. Areas within 50 feet of the top of bank or within the limits of existing riparian vegetation are within the Stream Protection Zone, as defined in Section 19.35 of the Novato Code of Ordinances. Any alterations within the Stream Protection Zone would require approval of a Use Permit, Stream Management Plan, and maintenance provisions by the Commission.

Construction of a new pump station would require compliance with the CEQA. Based on WRA's review of the site, including biological resources conditions, compliance with Chapter 17 of the Novato Code of Ordinances, and the inclusion of the nesting bird protocol, a new pump station at the Alternative B location would not result in any significant environmental impacts that could not be mitigated pursuant to CEQA.

As part of the CEQA effort, any temporary construction impacts (e.g., noise, dust, stormwater, etc.) would be considered mitigated impacts by maintaining compliance with local and state regulations including but not limited to the Construction Stormwater General Permit, Novato Code of Ordinances, and any additional regulations.

6.4.3 Regional Geologic and Soil Engineering Data

CE&G performed a desktop study for Alternative B, and the analysis results are summarized in this section, with the detailed analysis included in Appendix E. The Alternative B location has poorly to moderately sorted sand, silt, and gravel. The southwest portion of the proposed location is underlain with loose, unconsolidated, poorly to well-sorted sand, gravel, and cobbles, with minor silt and clay. The site is shown on the NRCS soil map as being surficial soils that generally extends to depths of about 80 inches below grade. Groundwater levels in the general area are between 3 to 10 feet below grade. The site has moderate liquefaction susceptibility, except for the soils along the Arroyo Jan Jose Creek, which are shown to have a very high liquefaction susceptibility. The relatively flat areas of this site are unlikely to experience landsliding; however, shallow landsliding may occur along the Arroyo Jan Jose Creek bank to the southwest.

CE&G found that the site is in the seismically active San Francisco Bay Area and will likely experience strong ground shaking from a large earthquake along with one or more of the nearby active faults during the design lifetime of the project.

CE&G evaluated whether the Alternative B site location was within an Alquist-Priolo Earthquake Fault Zone. According to the California Geological Survey (CGS) (2006), the site is not located within the Alquist-Priolo Earthquake Fault Zone. According to the United States Geological Survey's (USGS) Quaternary Fault and Fold database, no active faults mapped across Alternative B site location.

6.4.4 Conceptual Design

Generally, the Alternative B conceptual design is similar to Alternative A. However, F&L has included a description of key pump station components evaluated for Alternative B and informed the conceptual design. The proposed Alternative B Conceptual Design drawings are included in Appendix F.

6.4.4.1 Pumps

The Alternative B pump station will have the same number and type of pumps as discussed in Alternative A.

6.4.4.2 Building and Facility Layout

The Alternative B pump station will have a similar building and facility layout as discussed in Alternative A.

Approximately 1,300 ft of additional piping would be required to connect the existing 16-inch Zone 1 distribution pipe to the new pump station. Approximately 2,450 ft of additional pipe would be required to connect the new pump station to the existing 16-inch Zone 2 distribution pipe. See conceptual drawings in Appendix F for Alternative B.

6.4.4.3 Electrical Components

The Alternative B pump station will have similar electrical components as discussed in Alternative A.

6.4.5 Capital Cost

The Conceptual OPC for Alternative B was developed similarly to Alternative A. The Alternative B OPC is $6,636,000 and is presented in Table 12. The OPC is presented in 2024 dollars.

6.4.6 Net Operating Cost

The net present and operating cost based on a 17-hour pump cycle time for Alternative B is $11,434,000, as presented in Table 16.

6.5 Alternative C

Alternative C (Figure 7) includes two new pump stations at separate locations. One of the pump stations is located at Site 2. The second pump station is located at the Bolling Circle and Bolling Drive location (Site 3). This pump station is referred to as the Bolling Drive Pump Station in this Engineering Assessment. Site 2 is described in Section 6.4. The Site 3 is within a privately maintained open space and is not within the 100-year floodplain.

6.5.1 Pump Station Capacity

F&L performed the hydraulic evaluation to determine the required pumping capacity for Alternative C to, at a minimum, meet the future Primary Zone 2 MDD with the initial evaluation using the District's preferred 16-hour pump cycle time (see Table 8). Similar to Alternative A, the pump cycle time was increased to reduce the firm pumping capacity rate needed to supply the MDD.

For Alternatives A through E, F&L utilized pumps that matched the current pump models, sizes and pumping rates present in the existing Lynwood Pump Station and San Marin Pump Station. Each pump station used individual pump capacities of 1,800 GPM with the specific number needed to

meet the future Primary Zone 2 MDD. This approach was used for consistency to ensure that the District operations staff will not need to be trained to maintain new or different equipment in the new pump station.

F&L performed a supplemental evaluation to extend the pump cycle time. Based on the extended pump cycle time evaluation, a pump cycle time of 17 hours during MDD results in a minimum firm pump station capacity of about 5,200 GPM, which is less than the 5,400 GPM proposed for this alternative. This pumping rate difference results in a net pumping capacity of 0.34 MGD (see Table 8). This pumping rate results in the Primary Zone 2 tanks remaining full or filling while reducing impacts to Zone 1 storage tanks to be similar to existing conditions.

Based on preliminary modeling, compared to both Alternative A and Alternative B, Alternative C can provide improvements for supply to the Pacheco Valley Tank. Alternative C dramatically improves the ability to fill Pacheco Valley Tank without performing similar operational steps to fill Sunset Tank before filling Pacheco Valley Tank. In addition, this alternative was not increasing the impacts to Zone 1 storage tanks above what is believed to occur under existing conditions.

The resulting pump stations would include a total of three pumps at the Site 2 pump station and two pumps at the Site 3 pump station. Each pump was individually sized for 1,800 GPM matching the current pumps for the existing Lynwood Pump Station and San Marin Pump Station.

Alternative C, with a firm capacity of 1,800 GPM at Site 3 and 3,600 GPM at Site 2 (see Table 8), has minimal impacts on the distribution pressures with a minimal increase of pressure, between 0 to 5 psi in preliminary modeling simulations.

F&L has preliminarily determined that this pump station alternative results in the Primary Zone 2 tanks remaining full or filling and reducing impacts to Zone 1 storage tanks during MDD. However, further analysis of impacts and an analysis of operational storage needs in the Zone 1 and Primary Zone 2 storage tanks should be verified as part of the design and the District's future update of the 2018 Master Plan.

6.5.2 Potential Environmental Permit Requirements and Constraints

WRA performed an environmental constraints analysis for Alternative C. The results are summarized in this section with the detailed analysis in Appendix D. The potential environmental constraints are the same as Alternative B for the new Lynwood Pump Station in Alternative C.

For Site 3, WRA conducted a field investigation to identify the potential for special-status species within the sites. Based on the highly disturbed condition of the proposed site, no further actions are recommended for special-status plant species and special-status wildlife species.

Non-special-status native birds may nest in trees and vegetation within and immediately surrounding the proposed site. The active nests of native birds are protected under the federal MBTA and CFGC. Recommendations to avoid and minimize the potential impacts on nesting birds can be found within WRA's site assessment.

One potential development-related constraint associated with Alternative C is the trees and shrubs protected under Chapter 17 of the Novato Code of Ordinances ("Tree and Shrub Ordinance"). The

District is not required to comply with the City of Novato Ordinances. As such, the project is not required to replace trees to be removed by project activities in accordance with the City's Tree Ordinance. However, the District intends to replace trees removed by the project at the recommended one to one ration, which is consistent with the City's Tree Ordinances.

The primary potential development-related constraints associated with the pump station for Alternative C at Site 3 are the steep slope, exposed bedrock which could affect constructability, and the mature landscaping trees and native trees scattered throughout the project site.

Construction of a new pump station at any of the Alternative C sites would require compliance with the CEQA. Based on WRA's review of the sites, including biological resources conditions, compliance with Chapter 17 of the Novato Code of Ordinances, and the inclusion of the nesting bird protocol, a new pump station at the Alternative C locations would not result in any significant environmental impacts that could not be mitigated pursuant to CEQA.

As part of the CEQA effort, any temporary construction impacts (e.g., noise, dust, stormwater, etc.) would be considered mitigated impacts by maintaining compliance with local and state regulations including but not limited to the Construction Stormwater General Permit, Novato Code of Ordinances, and any additional regulations.

6.5.3 Regional Geologic and Soil Engineering Data

CE&G performed a desktop study for Alternative C, and the analysis results are summarized in this section, with the detailed analysis included in Appendix E. The regional geologic and soil engineering data are the same as Alternative B for Site 2.

The Site 3 location is mapped along a geological contact between Franciscan sedimentary rock and Franciscan Complex Mélange. The site is shown on the NRCS soil map as being surficial soil that generally extend to depths of about 37 inches below grade. The surficial soils unit is classified as well-drained, has a high runoff class, and has low available water storage. Groundwater level data was not found, but typically groundwater within a hillslope area is likely variable, with the water table commonly sloping downhill toward the closest drainage access. The site has a very low liquefaction susceptibility. The site is located on a moderately sloping hillside, likely underlain by shallow bedrock. Although shallow sliding of the surface soils is possible, adverse impacts to the proposed pump station due to landsliding at this site are unlikely.

CE&G found that the site is located in the seismically active San Francisco Bay Area and will likely experience strong ground shaking from a large earthquake along with one or more of the nearby active faults during the design lifetime of the project.

CE&G evaluated if any of the Alternative C site locations were within an Alquist-Priolo Earthquake Fault Zone. According to the California Geological Survey (CGS) (2006), the sites are not within an Alquist-Priolo Earthquake Fault Zone. According to the United States Geological Survey's (USGS) Quaternary fault and fold database, no active faults mapped cross any Alternative C site locations.

6.5.4 Conceptual Design

F&L has included a description of key pump station components evaluated for Alternative C and informed the conceptual design. The proposed Alternative C Conceptual Design drawings are included in Appendix F.

6.5.4.1 Pumps

Alternative C will have the same type of pumps at each of the two new pump stations, as discussed in Alternative A.

6.5.4.2 Building and Facility Layout

The Alternative C pump stations will have a similar building and facility layout as discussed in Alternative A. The size of the building will vary depending on the number of pumps, but all the building components will be similar to Alternative A.

The Site 2 location will have the same additional piping requirements as Alternative B.

For Site 3, approximately 2,200 ft of pipe is needed to connect to the existing 16-inch Zone 1 pipe. Approximately 900 ft of additional piping is needed to connect to the existing 12-inch Zone 2 distribution pipe. See conceptual drawings in Appendix F for Alternative C.

6.5.4.3 Electrical Components

The Alternative C pump stations will have similar electrical components as discussed in Alternative A.

6.5.5 Capital Cost

The Conceptual OPC for Alternative C was developed similarly to Alternative A. The Alternative C OPC is $11,138,000 and is presented in Table 13. The OPC is presented in 2024 dollars.

6.5.6 Net Operating Cost

The net present and operating cost based on a 17-hour pump cycle time Alternative C is $17,267,000, as presented in Table 16.

6.6 Alternative D

Alternative D (Figure 8) includes two new pump stations. One of the pump stations is located at Site 2. The second pump station is located at Main Gate Road just west of C Street at Site 4. This pump station is referred to as the Main Gate Road Pump Station in this Engineering Assessment. Site 2 is described in Section 6.4. The Site 4 is within a publicly maintained open space and is located within the 100-year floodplain of Pacheco Creek. Pacheco Creek crosses under Main Gate Road near the pump station location. The floodplain does not extend across Main Gate Road, so access to the site would remain available in a 100-year flood. The finished floor elevation of the pump station must be above the 100-year floodplain level based on City standards.

6.6.1 Pump Station Capacity

F&L performed the hydraulic evaluation to determine the required pumping capacity for Alternative D to, at a minimum, meet the future Primary Zone 2 MDD with the initial evaluation using the District's preferred 16-hour pump cycle time (see Table 9). Similar to Alternative A, the pump cycle time was increased to reduce the firm pumping capacity rate needed to supply the MDD.

For Alternatives A through E, F&L utilized pumps that matched the current pump models, sizes and pumping rates present in the existing Lynwood Pump Station and San Marin Pump Station. Each pump station used individual pump capacities of 1,800 GPM with the specific number needed to meet the future Primary Zone 2 MDD. This approach was used for consistency to ensure that the District operations staff will not need to be trained to maintain new or different equipment in the new pump station.

F&L performed a supplemental evaluation to extend the pump cycle time. Based on the extended pump cycle time evaluation, a pump cycle time of 17 hours during MDD results in a minimum firm pump station capacity of about 5,200 GPM, which is less than the 5,400 GPM proposed for this alternative. This pumping rate difference results in a net pumping capacity of 0.34 MGD (see Table 9). This pumping rate results in the Primary Zone 2 tanks remaining full or filling while reducing impacts to Zone 1 storage tanks to be similar to existing conditions.

Based on preliminary modeling, compared to both Alternative A and Alternative B, Alternative D can provide improvements for supply to the Pacheco Valley Tank. Alternative D dramatically improves the ability to fill Pacheco Valley Tank without performing similar operational steps to fill Sunset Tank before filling Pacheco Valley Tank and not increasing the impacts to Zone 1 storage tanks above what is believed to occur under existing conditions. Alternative D results in similar abilities to fill Pacheco Valley Tank as Alternative C.

The resulting pump stations would include a total of three pumps at Site 2 and two pumps at the Site 4 pump station with each pump individually sized for 1,800 GPM matching the current pumps for the existing Lynwood Pump Station and San Marin Pump Station.

Alternative D, with a firm capacity of 1,800 GPM at Site 4 and 3,600 GPM at Site 2 (see Table 9), will have impacts on the distribution pressures located around Site 4 by increasing pressure by approximately 56 psi to a maximum of 134 psi. This is due primarily to the pressure zone change. The portion of Zone 2 adjacent to Site 4 is currently within the Captain Nurse Regulated Zone 2 and is operated at a lower pressure than Primary Zone 2. To effectively implement Alternative D, a portion of Captain Nurse Regulated Zone 2 pipelines will be converted to Primary Zone 2 pipelines. Seven new pressure reducing stations will be installed on branch lines off the converted Primary Zone 2 pipeline to maintain the same pressure for all the existing customers currently being served by the Captain Nurse Regulated Zone 2 (Figure 10).

F&L has preliminarily determined that this pump station alternative results in the Primary Zone 2 tanks remaining full or filling and reducing impacts to Zone 1 storage tanks during MDD. However, further analysis of impacts and an analysis of operational storage needs in the Zone 1 and Primary

Zone 2 storage tanks should be verified as part of the design and the District's future update of the 2018 Master Plan.

6.6.2 Potential Environmental Permit Requirements and Constraints

WRA performed an environmental constraints analysis for Alternative D. The results are summarized in this section with the detailed analysis in Appendix D. The potential environmental constraints are the same as Alternative B for Site 2.

For Site 4, WRA conducted a field investigation to identify the potential for special-status species within the sites. Based on the highly disturbed condition of the proposed site, no further actions are recommended for special-status plant species and special-status wildlife species.

Non-special-status native birds may nest in trees and vegetation within and immediately surrounding the proposed site. The active nests of native birds are protected under the federal MBTA and CFGC. Recommendations to avoid and minimize the potential impacts on nesting birds can be found within WRA's site assessment.

One potential development-related constraint associated with Alternative D is the trees and shrubs protected under Chapter 17 of the Novato Code of Ordinances ("Tree and Shrub Ordinance"). The District is not required to comply with the City of Novato Ordinances. As such, the project is not required to replace trees to be removed by project activities in accordance with the City's Tree Ordinance. However, the District intends to replace trees removed by the project at the recommended one to one ration, which is consistent with the City's Tree Ordinances.

The primary potential development-related constraint associated with Site 4 is the proximity of the creek and its associated riparian corridor. Areas within 50 feet of the top of bank or within the limits of existing riparian vegetation are within the Stream Protection Zone, as defined in Section 19.35 of the Novato Code of Ordinances. Any alterations within the Stream Protection Zone would require approval of a Use Permit, Stream Management Plan, and maintenance provisions by the Commission.

Construction of a new pump station at any of the Alternative D sites would require compliance with the CEQA. Based on WRA's review of the sites, including biological resources conditions, compliance with Chapter 17 of the Novato Code of Ordinances, and the inclusion of the nesting bird protocol, a new pump station at the Alternative D locations would not result in any significant environmental impacts that could not be mitigated pursuant to CEQA.

As part of the CEQA effort, any temporary construction impacts (e.g., noise, dust, stormwater, etc.) would be considered mitigated impacts by maintaining compliance with local and state regulations including but not limited to the Construction Stormwater General Permit, Novato Code of Ordinances, and any additional regulations.

6.6.3 Regional Geologic and Soil Engineering Data

CE&G performed a desktop study for Alternative D, and the analysis results are summarized in this section, with the detailed analysis included in Appendix E. The regional geologic and soil engineering data are the same as Alternative B for Site 2.

Site 4 is mapped as being underlain by Holocene-aged alluvial deposits, which are described as poorly to moderately sorted sand, silt, and gravel. Alluvial deposits in this area is generally underlain with Franciscan Complex sedimentary bedrock. The site is shown on the NRCS soil map as being surficial soil that generally extends to depths of about 37 inches below grade. The surficial soils unit is classified as well-drained, has a high runoff class, and has low available water storage. Groundwater data adjacent to the area showed groundwater levels between 10 and 14 feet below grade. No site specific groundwater level data was found for the site. The site has moderate liquefaction susceptibility. Due to the relatively flat topography, landsliding for this site is unlikely to occur.

CE&G found that the sites are located in the seismically active San Francisco Bay Area and will likely experience strong ground shaking from a large earthquake along with one or more of the nearby active faults during the design lifetime of the project.

CE&G evaluated if any of the Alternative D site locations were within an Alquist-Priolo Earthquake Fault Zone. According to the California Geological Survey (CGS) (2006), the sites are not within an Alquist-Priolo Earthquake Fault Zone. According to the United States Geological Survey's (USGS) Quaternary fault and fold database, no active faults mapped cross any Alternative D site locations.

6.6.4 Conceptual Design

F&L has included a description of key pump station components evaluated for Alternative D and informed the conceptual design. The proposed Alternative D Conceptual Design drawings are included in Appendix F.

6.6.4.1 Pumps

Alternative D will have the same type of pumps at each of the two new pump stations, as discussed in Alternative A.

6.6.4.2 Building and Facility Layout

The Alternative D pump stations will have a similar building and facility layout as discussed in Alternative A. The size of the building will vary depending on the number of pumps, but all the building components will be similar to Alternative A.

Site 2 will have the same additional piping requirements as Alternative B.

Site 4 will have approximately 450 ft of pipe to connect to the existing 16-inch Zone 1 pipe. Approximately 20 ft of additional piping is needed to connect to the existing 16-inch Captain Nurse Regulated Zone distribution pipe. For this alternative, some of the existing pipelines within the Captain Nurse Regulated Zone will be converted to Primary Zone 2 pipelines. The higher pressure that

occurs along these pipes as part of Primary Zone 2 will need to be reduced prior to the current service connections. A pressure reducing valve is proposed for the branch lines to reduce the pressure to the current Captain Nurse Regulated Zone pressure. Specific valve closures have not been identified in this conceptual review. Seven pressure reducing valves will need to be included as part of this alternative. See conceptual drawings in Appendix F for Alternative D.

6.6.4.3 Electrical Components

The Alternative D pump stations will have similar electrical components as discussed in Alternative A, with the exception of the new PG&E service for the new pump station located at Site 4. The existing PG&E infrastructure in this area appears to have been previously connected to commercial customer loads in the area via overhead PG&E distribution. It is suspected that connecting a new PG&E service in this location may be facilitated more so than at the previously discussed sites which are located in predominantly residential areas.

6.6.5 Capital Cost

The Conceptual OPC for Alternative D was developed similarly to Alternative A. The Alternative D OPC is $9,674,000 and is presented in Table 14. The OPC is presented in 2024 dollars.

6.6.6 Net Operating Cost

The net present and operating cost based on a 17-hour pump cycle time Alternative D is $15,803,000, as presented in Table 16.

6.7 Alternative E

Alternative E (Figure 9) includes two new pump stations at separate locations. One of the pump stations is located at Site 2. The second pump station is located near Main Gate Road and C Street (Site 5). This pump station is referred to as the C Street Pump Station in this Engineering Assessment. The site is within a baseball field, privately maintained by Novato Unified School District and is not within the 100-year floodplain.

6.7.1 Pump Station Capacity

F&L performed the hydraulic evaluation to determine the required pumping capacity for Alternative E to, at a minimum, meet the future Primary Zone 2 MDD with the initial evaluation using the District's preferred 16-hour pump cycle time (see Table 10). Similar to Alternative A, the pump cycle time was increased to reduce the firm pumping capacity rate needed to supply the MDD.

For Alternatives A through E, F&L utilized pumps that matched the current pump models, sizes and pumping rates present in the existing Lynwood Pump Station and San Marin Pump Station. Each pump station used individual pump capacities of 1,800 GPM with the specific number needed to meet the future Primary Zone 2 MDD. This approach was used for consistency to ensure that the

District operations staff will not need to be trained to maintain new or different equipment in the new pump station.

F&L performed a supplemental evaluation to extend the pump cycle time Based on the extended pump cycle time evaluation, a pump cycle time of 17 hours during MDD results in a minimum firm pump station capacity of about 5,200 GPM, which is less than the 5,400 GPM proposed for this alternative. This pumping rate difference results in a net pumping capacity of 0.34 MGD (see Table 10). This pumping rate results in the Primary Zone 2 tanks remaining full or filling while reducing impacts to Zone 1 storage tanks to be similar to existing conditions.

Based on preliminary modeling, compared to both Alternative A and Alternative B, Alternative E can provide improvements for supply to the Pacheco Valley Tank. Alternative E dramatically improves the ability to fill Pacheco Valley Tank without performing similar operational steps to fill Sunset Tank before filling Pacheco Valley Tank. In addition, this alternative was not increasing the impacts to Zone 1 storage tanks above what is believed to occur under existing conditions. Alternative E results in similar abilities to fill Pacheco Valley Tank as Alternative C.

The resulting pump stations would include a total of three pumps at Site 2 and two pumps at the Site 5 pump station. Each pump was individually sized for 1,800 GPM matching the current pumps for the existing Lynwood Pump Station and San Marin Pump Station.

Alternative E, with a firm capacity of 1,800 GPM at Site 5 and 3,600 GPM at Site 2 (see Table 10), will have impacts on the distribution pressures located around Site 5 by increasing pressure by approximately 56 psi, similar to Alternative D. This is due primarily to the pressure zone change. The portion of Zone 2 adjacent to Site 5 is currently within the Captain Nurse Regulated Zone 2 and is operated at a lower pressure than Primary Zone 2. To effectively implement Alternative E, a portion of Captain Nurse Regulated Zone 2 pipelines will be converted to Primary Zone 2 pipelines. Seven new pressure reducing stations will be installed on branch lines off the converted Primary Zone 2 pipeline to maintain the same pressure for all the existing customers currently being served by the Captain Nurse Regulated Zone 2 (Figure 10).

F&L has preliminarily determined that this pump station alternative results in the Primary Zone 2 tanks remaining full or filling and reducing impacts to Zone 1 storage tanks during MDD. However, further analysis of impacts and an analysis of operational storage needs in the Zone 1 and Primary Zone 2 storage tanks should be verified as part of the design and the District's future update of the 2018 Master Plan.

6.7.2 Potential Environmental Permit Requirements and Constraints

WRA performed an Environmental Constraints analysis for Site 5. The results are summarized in this section with the detailed analysis in Appendix D. The potential environmental constraints are the same as Alternative B for the Site 2.

For the Site 5, WRA conducted a field investigation to identify the potential for special-status species within the sites. Based on the highly disturbed condition of the proposed site, no further actions are recommended for special-status plant species and special-status wildlife species.

Non-special-status native birds may nest in trees and vegetation within and immediately surrounding the proposed site. The active nests of native birds are protected under the federal MBTA and CFGC. Recommendations to avoid and minimize the potential impacts on nesting birds can be found within WRA's site assessment.

The only potential development-related constraint associated with Alternative E is the trees and shrubs protected under Chapter 17 of the Novato Code of Ordinances ("Tree and Shrub Ordinance"). The District is not required to comply with the City of Novato Ordinances. As such, the project is not required to replace trees to be removed by project activities in accordance with the City's Tree Ordinance. However, the District intends to replace trees removed by the project at the recommended one to one ration, which is consistent with the City's Tree Ordinances.

Construction of a new pump station at any of the Alternative E sites would require compliance with the CEQA. Based on WRA's review of the sites, including biological resources conditions, compliance with Chapter 17 of the Novato Code of Ordinances, and the inclusion of the nesting bird protocol, a new pump station at the Alternative E location would not result in any significant environmental impacts that could not be mitigated pursuant to CEQA.

As part of the CEQA effort, any temporary construction impacts (e.g., noise, dust, stormwater, etc.) would be considered mitigated impacts by maintaining compliance with local and state regulations including but not limited to the Construction Stormwater General Permit, Novato Code of Ordinances, and any additional regulations.

6.7.3 Regional Geologic and Soil Engineering Data

CE&G performed a desktop study for Alternative E, and the analysis results are summarized in this section, with the detailed analysis included in Appendix E. The regional geologic and soil engineering data are the same as Alternative B for Site 2.

The Alternative D, Site 5 location is mapped as being underlain by Holocene-aged alluvial deposits, which are described as poorly to moderately sorted sand, silt, and gravel. Alluvial deposits in this area is generally underlain with Franciscan Complex sedimentary bedrock. The site is shown on the NRCS soil map as being surficial soil that generally extends to depths of about 37 inches below grade. The surficial soils unit is classified as well-drained, has a high runoff class, and has low available water storage. Groundwater data adjacent to the area showed groundwater levels between 10 and 14 feet below grade. No site specific groundwater level data was found for the site. The site has moderate liquefaction susceptibility. Due to the relatively flat topography, landsliding for this site is unlikely to occur.

CE&G found that the site is located in the seismically active San Francisco Bay Area and will likely experience strong ground shaking from a large earthquake along with one or more of the nearby active faults during the design lifetime of the project.

CE&G evaluated if any of the Alternative D site locations were within an Alquist-Priolo Earthquake Fault Zone. According to the California Geological Survey (CGS) (2006), the sites are not within an

Alquist-Priolo Earthquake Fault Zone. According to the United States Geological Survey's (USGS) Quaternary fault and fold database, no active faults mapped cross any Alternative D site locations.

6.7.4 Conceptual Design

F&L has included a description of key pump station components evaluated for Alternative E and informed the conceptual design. The proposed Alternative E Conceptual Design drawings are included in Appendix F.

6.7.4.1 Pumps

Alternative E will have the same type of pumps at each of the two new pump stations, as discussed in Alternative A.

6.7.4.2 Building and Facility Layout

The Alternative E pump stations will have a similar building and facility layout as discussed in Alternative A. The size of the building will vary depending on the number of pumps, but all the building components will be similar to Alternative A.

Site 2 will have the same additional piping requirements as Alternative B.

For Site 5, approximately 40 ft of pipe is needed to connect to the existing 16-inch Zone 1 pipe. Approximately 80 ft of additional piping is needed to connect to the existing 16-inch Captain Nurse Regulated Zone 2 distribution pipe. Similar to Alternative D, some of the existing pipelines within the Captain Nurse Regulated Zone will be converted to Primary Zone 2 pipelines. The higher pressure that occurs along these pipes as part of Primary Zone 2 will need to be reduced prior to the current service connections. A pressure reducing valve is proposed for the branch lines to reduce the pressure to the Captain Nurse Regulated Zone pressure. Specific valve closures have not been identified in this conceptual review. Seven pressure reducing valves will need to be included as part of this alternative. See conceptual drawings in Appendix F for Alternative E.

6.7.4.3 Electrical Components

The Alternative E pump stations will have similar electrical components as discussed in Alternative A, except for the new PG&E service for the new pump station at Site 5. The existing PG&E infrastructure in this area appears to have been previously connected to commercial customer loads in the area via overhead PG&E distribution. It is suspected that connecting a new PG&E service in this location may be facilitated more so than at the previously discussed sites which are located in predominantly residential areas.

6.7.5 Capital Cost

The Conceptual OPC for Alternative E was developed similarly to Alternative A. The Alternative E OPC is $9,823,000 and is presented in Table 15. The OPC is presented in 2024 dollars.

6.7.6 Net Operating Cost

The net present and operating cost based on a 17-hour pump cycle time Alternative E is $15,952,000, as presented in Table 16.

7 ALTERNATIVE COMPARISON

The purpose of this section is to evaluate each alternative described in Section 6 to identify the preferred alternative. To perform the comparative review, F&L first developed a series of evaluation criteria, including ranking guidance, and then applied the evaluated criteria to each option.

7.1 Overview

A set of evaluation criteria was developed to assess each of the alternatives, including retrofitting the existing Lynwood Pump Station. The evaluation criteria were used to establish a total score for each option. The total score ranking is used to select the preferred alternative the District should consider.

The evaluation is performed using the following six criteria:

- Meet Primary Zone 2 Future Demand,
- Improve Pacheco Valley Tank Flow,
- Improve Primary Zone 2 System Redundancy,
- Site Features,
- Capital Cost, and
- Net Present Value Operation & Maintenance (O&M) Cost.

7.2 Pump Station Alternatives Evaluation Criteria

Using the above criteria, the F&L team graded each site on a sliding-point scale. The point scale provides a grade between 1 and 10, with 1 being inadequate/poor and 10 being excellent in meeting the stated evaluation criteria. To develop a score for each component within each of the six evaluation criterion, guidelines for the sliding point scale was developed as follows:

- Meet Primary Zone 2 Future Demand
    - A score of 0 to 4 indicates an alternative with inadequate ability to meet future demand.
    - A score of 5 to 7 indicates an alternative with limited ability to meet future demand.
    - A score of 8 to 10 indicates an alternative with adequate ability to meet future demand.
- Improve Pacheco Valley Tank Flow
    - A score of 0 to 4 indicates an alternative that does not improve or negatively impacts the ability to provide flow to Pacheco Valley Tank.
    - A score of 5 to 7 indicates an alternative continues to meet existing conditions or only minimally provides additional flow to Pacheco Valley Tank.

- A score of 8 to 10 indicates an alternative with adequate ability to provide additional flow to Pacheco Valley Tank.

- Improve Primary Zone 2 System Redundancy
  - A score of 0 to 4 indicates an alternative that continues to provide local redundancy at the pump station itself (i.e. one spare pump).
  - A score of 5 to 7 indicates an alternative that provides enhanced, local redundancy at the pump station itself (i.e., multiple spare pumps) or within the pressure zone potentially allowing multiple pump stations to operate at reduced capacity.
  - A score of 8 to 10 indicates an alternative with adequate ability to provide additional Primary Zone 2 system redundancy within both redundant pump stations and local redundancy.
- Site Features
  - A score of 0 to 4 indicates an alternative with inadequate site features (poor maintenance access, lack of parking, proximity to multiple residential units, requires land acquisition, and some potential environmental constraints).
  - A score of 5 to 7 indicates an alternative with subpar site features (fair maintenance access, potential room for parking, proximity to minimal residential units, and a few potential environmental constraints).
  - A score of 8 to 10 indicates an alternative with adequate site features (good maintenance access, room for parking, proximity to a residential unit, and minimal potential environmental constraints).
- Capital Cost
  - A score of 0 to 4 indicates an alternative with an OPC over $8,000,000.
  - A score of 5 to 7 indicates an alternative with an OPC between $6,000,000 and $8,000,000.
  - A score of 8 to 10 indicates an alternative with an OPC between $4,000,000 and $6,000,000.
- Net Present O&M Cost
  - A score of 0 to 4 indicates an alternative with net present O&M costs over $12,000,000.
  - A score of 5 to 7 indicates an alternative with net present O&M costs between $10,000,000 and $12,000,000.
  - A score of 8 to 10 indicates an alternative with net present O&M costs between $8,000,000 and $10,000,000.

7.3 Alternatives Evaluation Results

The scoring for each component within each evaluation criteria using the guidelines described above is presented in Table 17. For each criteria, a brief summary of the score assigned to each alternative is provided below:

- Meet Primary Zone 2 Future Demand
    - Alternative A is able to meet Primary Zone 2 Future Demand and was therefore assigned a score of 10.
    - Alternative B is able to meet Primary Zone 2 Future Demand and was therefore assigned a score of 10.
    - Alternative C is able to meet Primary Zone 2 Future Demand and was therefore assigned a score of 10.
    - Alternative D is able to meet Primary Zone 2 Future Demand and was therefore assigned a score of 10.
    - Alternative E is able to meet Primary Zone 2 Future Demand and was therefore assigned a score of 10.
    - Retrofit the existing Lynwood Pump Station will meet Primary Zone 2 Future Demand and was therefore assigned a score of 10.
- Improve Pacheco Valley Tank Flow
    - Alternative A does not improve the ability to fill Pacheco Valley Tank but it does not result in worse operational conditions when compared to exsiting operations and is therefore assigned a score of 3.
    - Alternative B significantly improves the District's ability to fill Pacheco Valley Tank without requiring Sunset Tank to be isolated and is therefore assigned a score of 9.
    - Alternative C is the alternative that most improves the District's ability to fill Pacheco Valley Tank and is therefore assigned a score of 10.
    - Alternative D is the alternative that most improves the District's ability to fill Pacheco Valley Tank and is therefore assigned a score of 10.
    - Alternative E is the alternative that most improves the District's ability to fill Pacheco Valley Tank and is therefore assigned a score of 10.
    - Retrofitting the existing Lynwood Pump Station does not improve the ability to fill Pacheco Valley Tank but it does not result in worse operational conditions when compared to exsiting operations and is therefore assigned a score of 3.

- Improves Primary Zone 2 System Redundancy
    - Alternative A continues to meet the exisiting ability to provide Primary Zone 2 system redundancy since it has a spare pump at the pump station and is therefore assigned a score of 1.
    - Alternative B continues to meet the exisiting ability to provide Primary Zone 2 system redundancy since it has a spare pump at the pump station and is therefore assigned a score of 1.
    - Alternative C adequately provides additional Primary Zone 2 system redundancy since it consists of two new pump stations that each include a spare pump and is therefore assigned a score of 10.
    - Alternative D adequately provides additional Primary Zone 2 system redundancy since it consists of two new pump stations that each include a spare pump and is therefore assigned a score of 10.
    - Alternative E adequately provides additional Primary Zone 2 system redundancy since it consists of two new pump stations that each include a spare pump and is therefore assigned a score of 10.
    - Retrofitting the existing Lynwood Pump Station continues to meet the exisiting ability to provide Primary Zone 2 system redundancy since it has a spare pump at the pump station and is therefore assigned a score of 1.
- Site Features
    - Alternative A does improve site access when compared to the existing Lynwood Pump Station site because Sunset Parkway between Cambridge Street and Monte Maria Avenue has both a travel lane and parking lane, which would allow for traffic to pass the site even when the District staff require temporary traffic control. The site is adequately above the FEMA floodplain but the location is constrained by the traffic island width as well as immediately adjacent to several single family homes. Therefore, the alternative is assigned a score of 4.
    - Alternative B improves site access because there are two eastbound travel lanes that would allow for a single lane of traffic to be maintained with temporary traffic control. The site is adequately above the FEMA floodplain but is in close proximity to San Jose Creek. The site would require an easement or other land acquisition from the City. Therefore, the alternative is assigned a score of 5.
    - Alternative C for Site 2 is similar to Alternative B. Site 3 does have adquate site access with temporary traffic control to allow for controlled one way traffic. The second pump station site is adequately above the FEMA floodplain but an easement or other land acquisition from a private land owner would be required to provide the site. Therefore, the alternative is assigned a score of 2 to reflect the overall complexities with securing two pump station sites including potential negotiation with a private land owner.

- Alternative D for Site 2 is similar to Alternative B. Site 4 does have adquate site access with temporary traffic control to allow for controlled one way traffic. Site 4 is within the FEMA floodplain and in close proximity to Pacheco Creek. The site requires an easement or other land acquisition from the City. Therefore, the alternative is assigned a score of 3 to reflect the additional design needed since the second pump station site is within the FEMA floodplain requiring additional floodproofing measures when compared to any of the the other four sites.
- Alternative E for Site 2 is similar to Alternative B. Site 5 does have adquate site access with temporary traffic control to allow for controlled one way traffic. Site 5 is above the FEMA floodplain but an easement or other land acquisition from a private land owner would be required to provide the site. Therefore, the alternative is assigned a score of 1 to reflect the overall complexities with securing two pump station sites including potential negotiation with a private land owner.
- Retrofitting the existing Lynwood Pump Station does not improve site access. The site is above the FEMA floodplain but the location is constrained by the traffic island width as well as immediately adjacent to several single family homes and the Lynwood Elementary School entrance. Therefore, the alternative is assigned a score of 2.

- Capital Cost
  - Alternative A's capital cost is $4.52 million and therefore is assigned a score of 9.
  - Alternative B's capital cost is $6.64 million and therefore is assigned a score of 6.
  - Alternative C's capital cost is $11.14 million and therefore is assigned a score of 1.
  - Alternative D's capital cost is $9.67 million and therefore is assigned a score of 3.
  - Alternative E's capital cost is $9.82 million and therefore is assigned a score of 3.
  - Retrofitting the existing Lynwood Pump Station would be similar to Alternative D and Alternative E and therefore is assigned a score of 3.
- Net Present O&M Cost
  - Alternative A's net present O&M cost is $9.87 million and therefore is assigned a score of 8.
  - Alternative B's net present O&M cost is $11.43 million and therefore is assigned a score of 5.
  - Alternative C's net present O&M cost is $17.27 million and therefore is assigned a score of 1.
  - Alternative D's net present O&M cost is $15.80 million and therefore is assigned a score of 2.
  - Alternative E's net present O&M cost is $15.95 million and therefore is assigned a score of 2.

- Retrofitting the existing Lynwood Pump Station would be similar to Alternative D and Alternative E and therefore is assigned a score of 2.

The final rankings, with the highest total score listed first is;

- Alternative D (38 total points)
- Alternative B (36 total points)
- Alternative E (36 total points)
- Alternative A (35 total points)
- Alternative C (34 total points)
- Retrofit the exisitng Lynwood Pump Station (21 total points)

Based on the evaluation presented above, the preferred alternative is Alternative D, which would provide:

- Two new pump stations with a total firm capacity of 5,400 GPM and all pumps would be 1,800 GPM.
- One pump station with three pumps will be located at Ignacio Boulvard and Palmer Drive (Site 2). The second pump station will have two pumps and will be located at C Street and Main Gate Road (Site 4).
- The new pump stations would be capable, with operation of San Marin Pump Station, to meet future Primary Zone 2 demands.
- The new pump stations would significantly improve flow to Pacheco Valley Tank.

8 NEXT STEPS

8.1 Proposed Pump Station Design

Upon approval of the conceptual design by the District, the selected alternative for the Lynwood Pump Station replacement design can be advanced to the development of construction documents. Upon approval of the conceptual design by the District, a few electrical items should be considered, including electrical equipment lead times and PG&E service coordination. A summary of the electrical items can be found in Appendix H. Further hydraulic modeling of the selected conceptual design should also be performed to verify preliminary identified operational impacts of the new pump station sites and to analyze operational storage needs in the Zone 1 and Primary Zone 2 storage tanks as noted in Section 8.2.

8.2 District Master Plan Update Confirmation

As noted in Section 5.2.1, a key finding during the modeling was that the shorter 16-hour Primary Zone 2 pump operating periods will change the amounts of operational storage needed for Zone 1 and Primary Zone 2. The operational storage needs under the reduced pump operating periods should be further investigated under future master plan updates. The preliminary operational changes that were identified for the selected alternative should be verified by further hydraulic analysis of both Zone 1 and Primary Zone 2 as part of the design of the chosen alternative. This should include review of the PHD conditions including release from Primary Zone 2 tanks and replenishment of Zone 1 tanks.

The preliminary steady state hydraulic modeling results have shown that for both existing MDD and future MDD conditions that the Zone 1 Storage Tanks may be draining to meet both the Zone 1 demands and the cumulative supply to both Lynwood Pump Station and San Marin Pump Station. In order to quantify the potential operational impacts, further steady state analyses and an extended period hydraulic simulation is recommended to be performed. Some of these analyses could be done as part of the District's planned master plan update.

Based on the F&L team's discussions with District staff throughout development of this Engineering Assessment, the District may not have experienced high demand conditions similar to the MDD scenario that was included in the model used to perform the analysis. The use of a 16-hour pumping period (or other period less than 24 hours) for Primary Zone 2 supply will also increase operational storage volume requirements and create modified storage replenishment conditions during the day. The storage draw from the Zone 1 storage tanks during Primary Zone 2 pumping may be replenished during the daily time period where Primary Zone 2 pumping has halted. These operational conditions should be further reviewed as part of the design of the conceptual pumping alternative chosen.

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ABBREVIATIONS

AAF	Annual Acre-Feet
ADD	Average Day Demand
AHE	Advance Hydro Engineering, Inc.
ARV	Air Relief Valve
ASCE	American Society of Engineers
ASCE7	American Society of Engineers 7 Minimum Design Loads and Associated Criteria for Buildings and Other Structures
BOD	Basis of Design
CBC	California Building Code
City	City of Novato
CE	Categorial Exemption
CE&G	Cal Engineering & Geology, Inc., a division of Haley & Aldrich
CEQA	California Environmental Quality Act
CFGC	California Fish and Game Codes
CGS	California Geological Survey
CMU	concrete masonry unit
District	North Marin Water District
EDU	equivalent residential dwelling units
ERP	Emergency Response Plan
EUSERC	Electrical Utility Service Equipment Requirements
F&L	Freyer & Laureta, Inc.
FEMA	Federal Emergency Management Agency
ft	feet
FY	fiscal year
GPD	gallons per day
GPM	gallons per minute
HGL	hydraulic grade line
HVAC	heating, ventilation and air conditioning
K&J	Kennedy/Jenks Consultants

lf	linear foot
MBTA	Migratory Bird Treaty Act
MCC	motor control center
MCCDA	Marin County Community Development Agency
MDD	maximum day demand
MGD	million gallons per day
NMWD	North Marin Water District
NEC	National Electric Code
NPV	net present value
NRCS	Natural Resources Conservation Service
O&M	Operation & Maintenance
OPC	opinion of probable cost
PG&E	Pacific Gas & Electric
PHD	peak hour deamand
psi	pounds per square inch
PSPS	Public Safety Power Shutoff
SCADA	System Control and Data Acquisition
SCWA	Sonoma County Water Agency
sf	square feet
STP	Stafford Treatment Plant
USGS	United States Geological Survey
VFD	variable frequency drives

ES EXECUTIVE SUMMARY

ES.1 Background and Project Drivers

The North Marin Water District (District) primarily serves the City of Novato (City) and surrounding unincorporated areas in Marin County, encompassing approximately 75 square miles. The District's Novato System potable water system is divided into four main pressure zones. Primary Zone 2 has two main pump stations: (1) Lynwood Pump Station and (2) San Marin Pump Station. Although the two pump stations meet current demands within Primary Zone 2, the pump stations are potentially not equipped to handle future growth.

To complement the Lynwood Pump Station existing capacity evaluation, the District desired to document the existing condition of the critical pump station including review of potential feasibility of in-place rehabilitation or relocation of the pump station to meet the long-term customer needs. The Engineering Assessment project drivers include:

- Identify potential future demands based on current available data from the City of Novato (City) and County of Marin (County) including determining if the future demands will be served by Zone 2, Zone 3, or Zone 4;
- Determine the potential pump station capacity expansion, if required, to meet future projected demands;
- Engage District operations staff to identify potential operation constraints that may affect the final design criteria for an expanded pump station;
- Assess the feasibility of rehabilitating the pump station components within the existing pump station structure to improve the pump station's overall reliability and resiliency; and
- Evaluate up to five potential alternative sites for a replacement to the existing Lynwood Pump Station.

The Engineering Assessment includes estimated future demands that impact the Lynwood Pump Station pump capacity requirements, presents constraints to rehabilitate the existing pump station facility in place, and develops potential pump station replacement alternatives that address both future demands needs and existing operational constraints identified by District operations staff.

ES.2 Existing Conditions

The F&L team assessed the current physical site conditions through visual inspection during an October 27, 2022 site visit. The pump station components were in poor overall condition, and the team observed multiple deficiencies with the existing site. The primary deficiencies identified were grouped into four main categories and summarized below:

- Access:
    - The existing Lynwood Pump Station is below grade creating limited access to all mechanical and electrical equipment and current vertical space does not meet the current California Building Code (CBC) requirement of eight-feet minimum height for ceiling height.
    - Pump and motors can only be accessed by removing concrete covers over each pump, which requires a crane that must be staged adjacent to the existing pump station within a Sunset Parkway travel lane.
- Location and Environment:
    - The constrained site can impact maintenance activities because significant temporary traffic control is required to allow the District to stage equipment and vehicles.
    - Multiple existing utilities within the traffic island, such as stormwater mains, water mains, gas main, and significant Pacific Gas & Electric (PG&E) infrastructure, limit existing pump station upgrades.
    - District staff noted that groundwater is always present and, during storms, can encroach on the floor.
    - The existing site is adjacent to the current Federal Emergency Management Agency (FEMA) 100-year floodplain, putting the existing pump station at risk during significant storm events.
- Mechanical Components:
    - The mechanical components are primarily ductile iron with epoxy coating and range from fair to poor condition.
    - Some components that will require replacement are located below the existing concrete floor requiring that portions of concrete be removed to perform required replacement work.
    - Limited flexibility is provided with the existing layout and components. The lack of seismic fittings increases the components' vulnerability to damage during a significant seismic event where it can be expected that seismic motions would cause differential movement between the existing concrete structure and the existing infrastructure within Sunset Parkway potentially resulting in a catastrophic failure of either the suction or discharge piping rendering the pump station non-functional when water supply for fire fighting could be critical.
- Electrical:
    - Multiple electrical components of the pump station appear to be out of compliance with the NEC.

- Electrical equipment is obsolete and no longer manufactured.

F&L did consider the potential advantages of rehabilitating the existing Lynwood Pump Station components. Although modifying or enhancing the pump station may be considered feasible, the modified facility will not provide similar level of reliability and resiliency due to the overall age, condition, and the significant site constraints that may result in substantial, costly constructability challenges. The alternatives comparison presented in Section ES.7 does include retrofitting the existing pump station as part of the analysis.

ES.3 Current Operating Conditions

ES.3.1 Pump Station Operating Strategy

As a cost-saving measure, District operations staff utilize a partial day operation for both Lynwood Pump Station and San Marin Pump Station during PG&E off-peak hours for electrical use. Currently, PG&E peak pricing occurs five hours each day from 4 pm to 9 pm. The District's operation procedure goal is to operate for a 16-hour period which avoids operating any pumps during the five-hour on-peak usage period plus 1.5 hours before and after the on-peak five-hour period. However during periods of peak water demand, the District currently operates for up to a 19-hour period to meet demands and fill storage tanks.

District pump station operations adapt to PG&E on-peak hour changes during the year to minimize pumping costs since PG&E discounts power usage during off-peak hours. During winter, the discount is minimal due to the low flow pumping rates during this time. In practice, the District does operate its pump stations for up to 16 hours a day but can override automation to ensure that customer demands during high water use periods are always met.

ES.3.2 Emergency Power Strategy

During severe weather events, PG&E turns off power to help prevent wildfires. Times of planned power outages are called Public Safety Power Shutoff (PSPS). During PSPS events, the District utilizes a portable diesel generator to provide emergency power to the District's facilities, including pump stations. The portable diesel generator is not permanently located at the Lynwood Pump Station site and is transported to the District's facilities when needed.

The District staff indicated that a permanent generator is not required at Lynwood Pump Station because it can mobilize the portable emergency generator to the Lynwood Pump Station site in less than two hours, and the system demands can be met for this limited time from the existing storage.

ES.4 Future Demands

ES.4.1 Primary Zone 2 Demands

The Marin County Community Development Agency (MCCDA) provided information on future development anticipated within the City that will result in additional demand throughout the entire

District system. F&L only evaluated the future buildout demands that would be served by Primary Zone 2. All other future build out demands in Zone 1 or hydraulically isolated Zone 2 subpressure zones were not included in the future build out pumping analysis but included in the system distribution model.

There are six future build out demands, including one commercial, office, and government demand, in the northern part of the City within Primary Zone 2 near the existing San Marin Pump Station. There is one future build out demand in the southern part of Primary Zone 2. Based on the information reviewed, the total future MDD is estimated to be 8.95 million gallons per day (MGD) is 1.16 MGD greater than the current MDD of 7.79 MGD.

ES.4.2 Pump Station Capacity

Generally, pump station firm capacity is determined when the largest pump unit is out of service at the station. Because Primary Zone 2 has some redundancy in that it is served by two pump stations (e.g., Lynwood Pump Station and San Marin Pump Station) with identically sized pumps, the District has considered the pump stations firm capacity to be based on a single pump out of service within the entire Primary Zone 2. The F&L team suggested reviewing potential approaches to confirm pump station firm capacity methodology with the District for this Engineering Assessment.

Following collaboration with the District, the pump station firm capacity was defined as adequate pumping equipment to meet MDD when the largest pump unit is out of service at both San Marin Pump Station and Lynwood Pump Station. Currently, both pump stations have three pumps, all rated for 1,800 gallons per minute (GPM); therefore, each pump station's firm capacity is 3,600 GPM.

The F&L team evaluated future pump station capacity requirements using the firm capacity methodology initially based on 16 hours of operation. This approach increased firm capacity rates required for all pump station improvements. However, the F&L team also evaluated pump station operations for periods greater than 16 hours during MDD to determine where there may be potential cost savings or operational benefits to the District including

- The ability to utilize similar pumps to the existing San Marin Pump Station at the new Lynwood Pump Station.
- Capital cost savings by not developing an oversized replacement facility.

Another critical consideration when reviewing pump station capacity is current and future use of variable frequency drives (VFDs) that allow operators to match pump station flows with demands. With VFDs, the operators can choose to operate the pump stations at a range of flows to allow for the pump station to operate at higher flow rates in low demand (and off-peak electrical hours) in anticipation of peak demands.

ES.5 Hydraulic Evaluation Methodology

ES.5.1 Zone 1 Storage Tank Performance

Typically, during the MDD condition in a steady state model run, gravity tanks within a distribution network would be full or filling. The MDD condition was anticipated to occur during the 16-hour pump operation cycle, which changes the typical steady state results. The existing model results that when operating the Lynwood Pump Station and San Marin Pump Station during MDD conditions that the Zone 1 tanks are releasing water to meet both Zone 1 demands and the higher MDD Primary Zone 2 pump station rates. Since the MDD flow rates into Primary Zone 2 are being artificially increased by increased pumping, the North Marin Aqueduct supply alone cannot provide the water volume for the transfer. The Zone 1 tanks release flow to make up the difference. In the Primary Zone 2, the PHD are provided solely from storage after the pumps are turned off, increasing operational storage requirement in this zone.

As discussed previously, District staff have flexibility with selection of the length of daily pump operating periods. District staff reported that when customer demands warrant, the Lynwood Pump Station and San Marin Pump Station pumping period will be extended regardless if the pump stations would be operating during shoulder or peak PG&E electric rate periods. The net pumping capacity evaluation indicated that for existing conditions, the pump cycle time would likely be extended from 16 hours to 17 hours and longer to maintain Zone 2 storage tank levels as necessary.

By extending the pump cycle time to reduce demands on Zone 2 storage tanks, F&L would expect Zone 1 storage tank replenishment demands to be similarly reduced, however, the steady state modeling results did indicate a continued demand on Zone 1 storage tanks during MDD with less than 24-hour pumping. The operations with limited pump cycle time will continue to increase the amount of operational storage requirements for the distribution system. As part of the District's planned update of the 2018 Master Plan, F&L suggests that the District perform an extended period simulation in addition to the steady state analyses to review the Zone 1 and 2 tanks operational storage performance during concurrent limited pump cycle time and MDD conditions discussed above.

ES.5.2 Pacheco Valley Tank Hydraulic Constraint

The District's operations staff noted a hydraulic constraint within the distribution system impacts the Pacheco Valley Tank fill rate from the Lynwood Pump Station. The District expressed interest in investigating potential solutions to improve the District's overall ability to fill Pacheco Valley in addition to evaluating the capacity required for Lynwood Pump Station. Generally, the potential improvement options to improve the District's ability to fill Pacheco Valley Tank include:

- Expand the existing distribution system or introduce a new transmission main;
- Potentially relocate Lynwood Pump Station to a location equidistant between Sunset Tank and Pacheco Valley Tank; or
- Add a third pump station to primary Zone 2 near the Pacheco Valley Tank.

Please refer to Section ES.7 for discussion of each alternative's potential operational improvements.

ES.5.3 Future Conditions Modeling Methodology and Exclusions

To perform pump station alternatives analysis to meet future demands, F&L developed the following methodology:

- Add projected new demands,
- Determine hydraulic conditions with the 16-hour pump cycle with steady state analysis,
- Determine hydraulic conditions with various proposed pump station capacities and pump station locations with steady state analysis.

In the analysis of the Lynwood Pump Station capacity, the following were excluded:

- Fire flow demand for the system was not included since we are not performing a master planning study. Fire flow demands are outside of the scope of this analysis.
- The original 2022 maximum day scenario included the seven hydro-pneumatic stations. Although the hydro-pneumatic stations operate periodically per set pressure points, for simplicity, the hydro-pneumatic stations were modeled as an average of the total daily pumping rate of the hydro-pneumatic system. No additional demands were added to these stations.

ES.6 Alternatives Development

With guidance from District staff and considering the key project goals, F&L developed the following alternative concepts:

- A new pump station that matches the existing Lynwood Pump Station with one additional pump to meet future demands.
- Determine if, by relocating the pump station away from the current Lynwood Pump Station site, the new pump station could continue to provide adequate ability to meet future peak demands throughout Primary Zone 2, and also improve the District's ability to deliver water to Pacheco Valley Tank.
- Include both the replacement of the Lynwood Pump Station and add a pump station at a location within the southern portion of Primary Zone 2 that would improve the District's ability to fill Pacheco Valley Tank without having to isolate Sunset Tank from the system.

One site location was determined based on favorable attributes in the four categories presented above. The detailed siting study can be found in Appendix C. The final locations are:

- Site 1: New pump station to be located within the Sunset Parkway median between Monte Maria Avenue and Cambridge Street.
- Site 2: New pump station to be located on Ignacio Boulevard at Palmer Drive within open space area adjacent to existing pedestrian trails.

- Site 3: New pump station on Bolling Circle at Bolling Drive within a privately maintained open space area.
- Site 4: New pump station on Main Gate Road within open space area adjacent to existing pedestian trials.
- Site 5: New pump station on Main Gate Road and C Street within an existing baseball field privately maintained by the Novato Unified School District.

Alternatives include one or two sites. The alternative site locations are shown in Figure ES-1 and as follows:

- Alternative A is a new pump station that matches the existing Lynwood Pump Station with one additional pump to meet future demands. The new pump station is proposed in close proximity to the existing Lynwood Pump Station and is referred to as Site 1. A key consideration when developing Alternative A was District staff reported the current location provides the ability to meet demands both to the north and south of the existing facility location (Figure ES-2).
- Alternative B was developed to determine if, by relocating the pump station away from the current Lynwood Pump Station site, the new pump station could continue to provide adequate ability to meet future peak demands throughout Primary Zone 2, and also improve the District's ability to deliver water to Pacheco Valley Tank. The new pump station is proposed at a site roughly halfway between the Sunset Tank and Pacheco Valley Tank and referred to as Site 2 (Figure ES-3).
- Alternative C was developed to include both replacement of the Lynwood Pump Station at Site 2 and adding a pump station at a location within the southern portion of Primary Zone 2 that would improve the District's ability to fill Pacheco Valley Tank without having to isolate Sunset Tank from the system. The second pump station is located at Site 3 (Figure ES-4).
- Alternative D was developed to include both replacement of the Lynwood Pump Station at Site 2 and adding a pump station at a location within the southern portion of Primary Zone 2 that would improve the District's ability to fill Pacheco Valley Tank without having to isolate Sunset Tank from the system. The second pump station is located at Site 4 (Figure ES-5).
- Alternative E was developed to include both replacement of the Lynwood Pump Station at Site 2 and adding a pump station at a location within the southern portion of Primary Zone 2 that would improve the District's ability to fill Pacheco Valley Tank without having to isolate Sunset Tank from the system. The second pump station is located at Site 5 (Figure ES-6).

Each of the alternatives were developed to outline key project components provided in the following list that were then used to perform an alternative comparison:

- Pump Station Capacity
- Potential Environmental Permit Requirements and Constraints
- Regional Geologic and Soil Engineering Data
- Conceptual Design (Pumps, Building and Facility Layout)
- Electrical Components
- Capital Cost
- Net Present and Operating Cost

ES.7 Alternative Comparison

The five alternatives were evaluated to identify the preferred alternative. Retrofitting the existing Lynwood Pump Station was also evaluated. To perform the comparative review, F&L developed a series of evaluation criteria, including ranking guidance, and applied the evaluated criteria to each alternative. The evaluation is performed using the following six criteria and summarized in Table ES-1:

- Meet Primary Zone 2 Future Demand,
- Improve Pacheco Valley Tank Flow,
- Improve Primary Zone 2 System Redundancy,
- Site Features,
- Capital Cost, and
- Net Present Value Operation & Maintenance (O&M) Cost.

As further detailed in Section 7 of the Engineering Assessment, the F&L team graded each site on a sliding-point scale. The point scale provides a grade between 1 and 10, with 1 being inadequate/poor and 10 being excellent in meeting the stated evaluation criteria. The final rankings, with the highest total score listed first is;

- Alternative D (38 total points)
- Alternative B (36 total points)
- Alternative E (36 total points)
- Alternative A (35 total points)
- Alternative C (34 total points)
- Retrofit the exisitng Lynwood Pump Station (21 total points)

Based on the evaluation presented above, the preferred alternative is Alternative D, which would provide:

- Two new pump stations with a total firm capacity of 5,400 GPM and all pumps would be 1,800 GPM.
- One pump station with three pumps will be located at Ignacio Boulvard and Palmer Drive (Site 2). The second pump station will have two pumps and will be located at C Street and Main Gate Road (Site 4).
- The new pump stations would be capable, with operation of San Marin Pump Station, to meet future Primary Zone 2 demands.
- The new pump stations would significantly improve flow to Pacheco Valley Tank.

ES.8 Next Steps

ES.8.1 Proposed Pump Station Design

Upon approval of the conceptual design by the District, the selected alternative for the Lynwood Pump Station replacement design can be advanced to the development of construction documents. Upon approval of the conceptual design by the District, a few electrical items should be considered, including electrical equipment lead times and PG&E service coordination. A summary of the electrical items can be found in Appendix H. Further hydraulic modeling of the selected conceptual design should also be performed to verify preliminary identified operational impacts of the new pump station sites and to analyze operational storage needs in the Zone 1 and Primary Zone 2 storage tanks.

ES.8.2 District Master Plan Update Confirmation

The steady state hydraulic modeling results shown that for both existing MDD and future MDD conditions that the Zone 1 Storage Tanks may be draining to meet both the Zone 1 demands and the cumulative supply to both Lynwood Pump Station and San Marin Pump Station. To quantify the potential operational impacts, further steady state analyses and an extended period hydraulic simulation is recommended to be performed as part of the District's planned master plan update. Based on the F&L team's discussions with District staff throughout development of this Engineering Assessment, the District has likely not experienced conditions similar to the MDD scenario used to perform our analysis. The use of a 16-hour pumping period (or other period less than 24 hours) for Primary Zone 2 supply will also increase operational storage volume requirements and create modified storage replenishment conditions during the day. The storage draw from the Zone 1 storage tanks during Primary Zone 2 pumping may be replenished during the daily time period where Primary Zone 2 pumping has halted. These operational conditions should be further reviewed as part of the design of the conceptual pumping alternative chosen.

EXECUTIVE SUMMARY
FIGURES

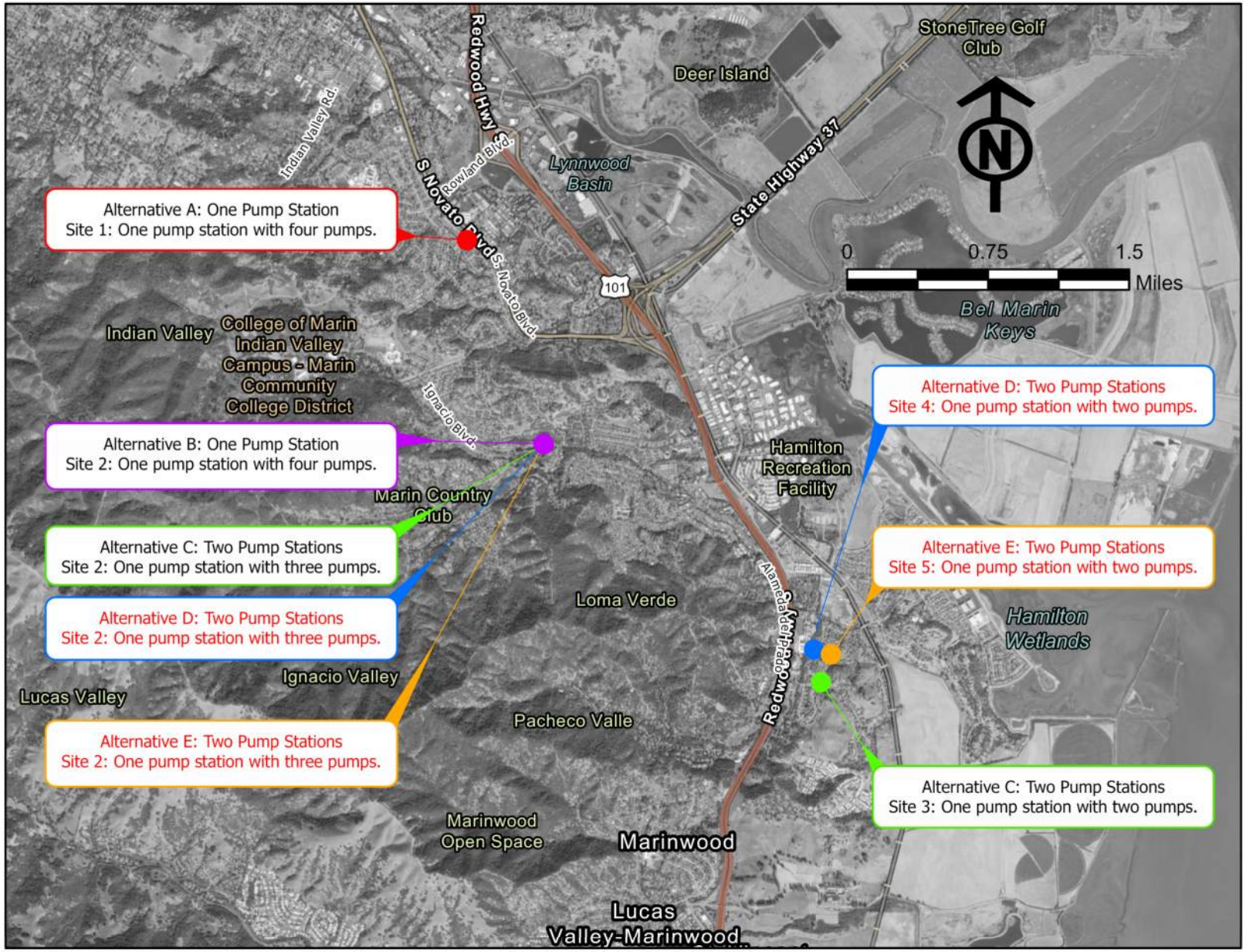

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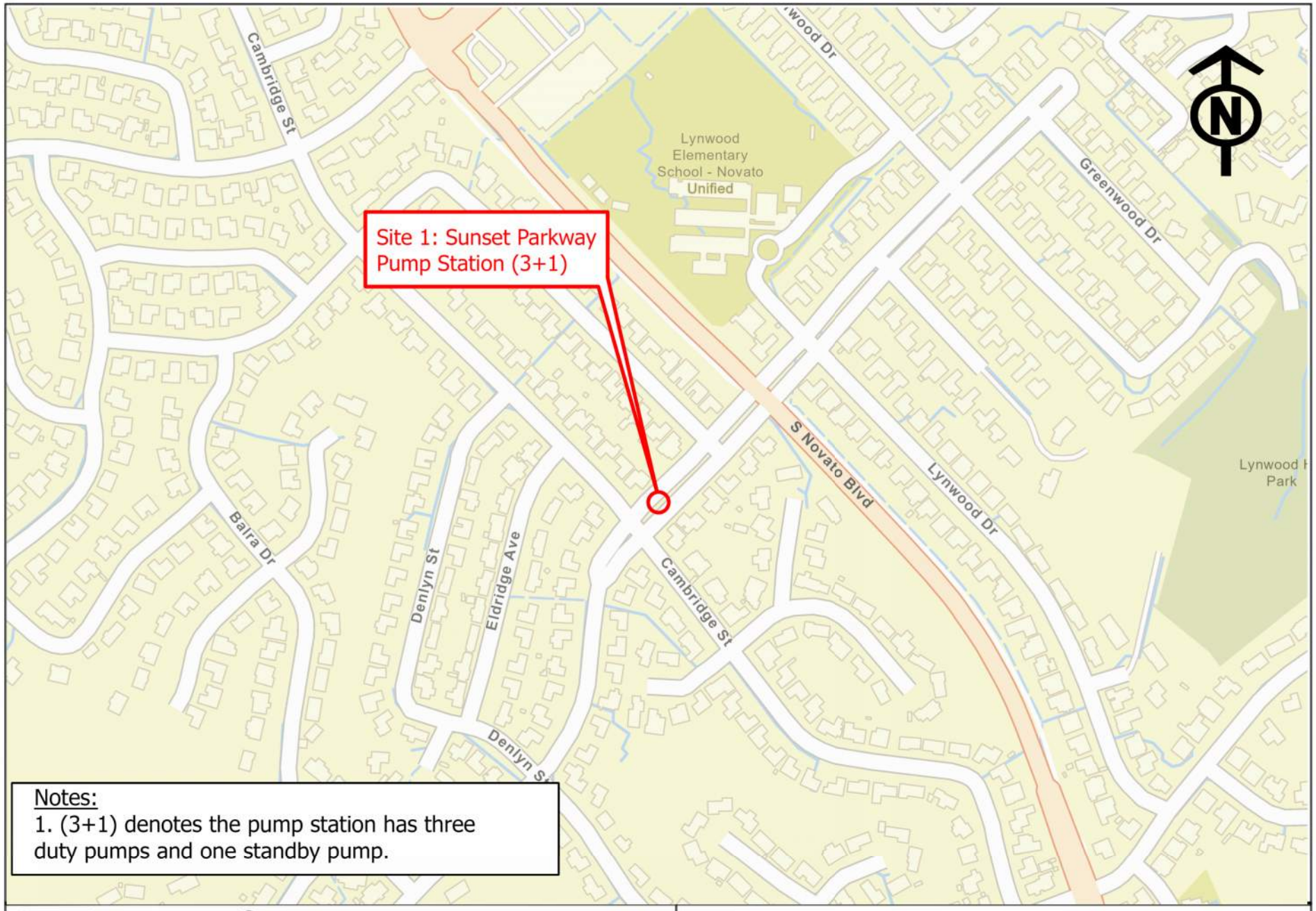
FIGURE ES–1
ALTERNATIVES AND SITE LOCATIONS
NORTH MARIN WATER DISTRICT
NOVATO, CA 94945



Notes:
1. (3+1) denotes the pump station has three duty pumps and one standby pump.

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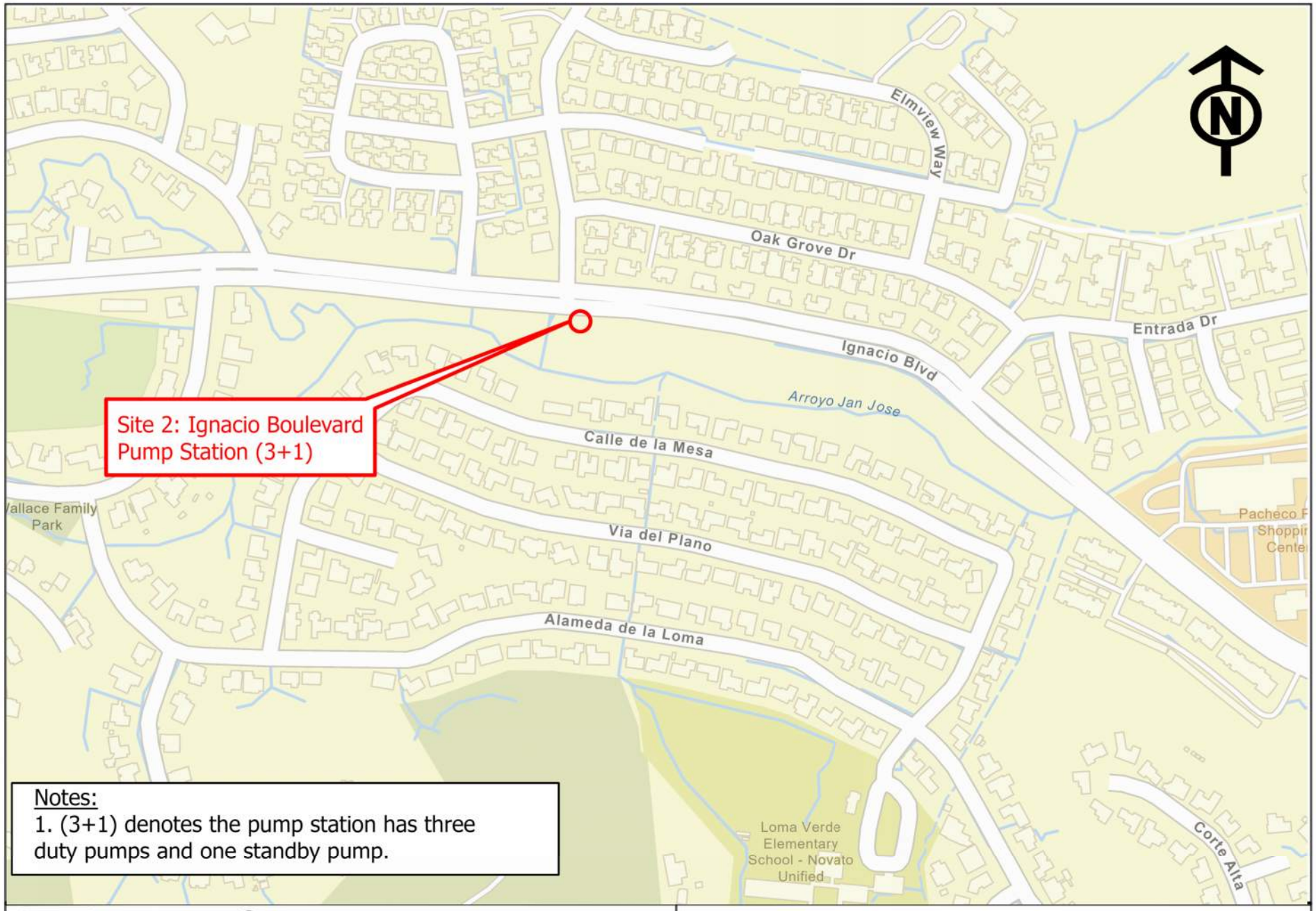
FIGURE ES–2
ALTERNATIVE A LOCATION MAP
NORTH MARIN WATER DISTRICT
NOVATO, CA 94945



Notes:
1. (3+1) denotes the pump station has three duty pumps and one standby pump.

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FIGURE ES–3
ALTERNATIVE B LOCATION MAP
NORTH MARIN WATER DISTRICT
NOVATO, CA 94945

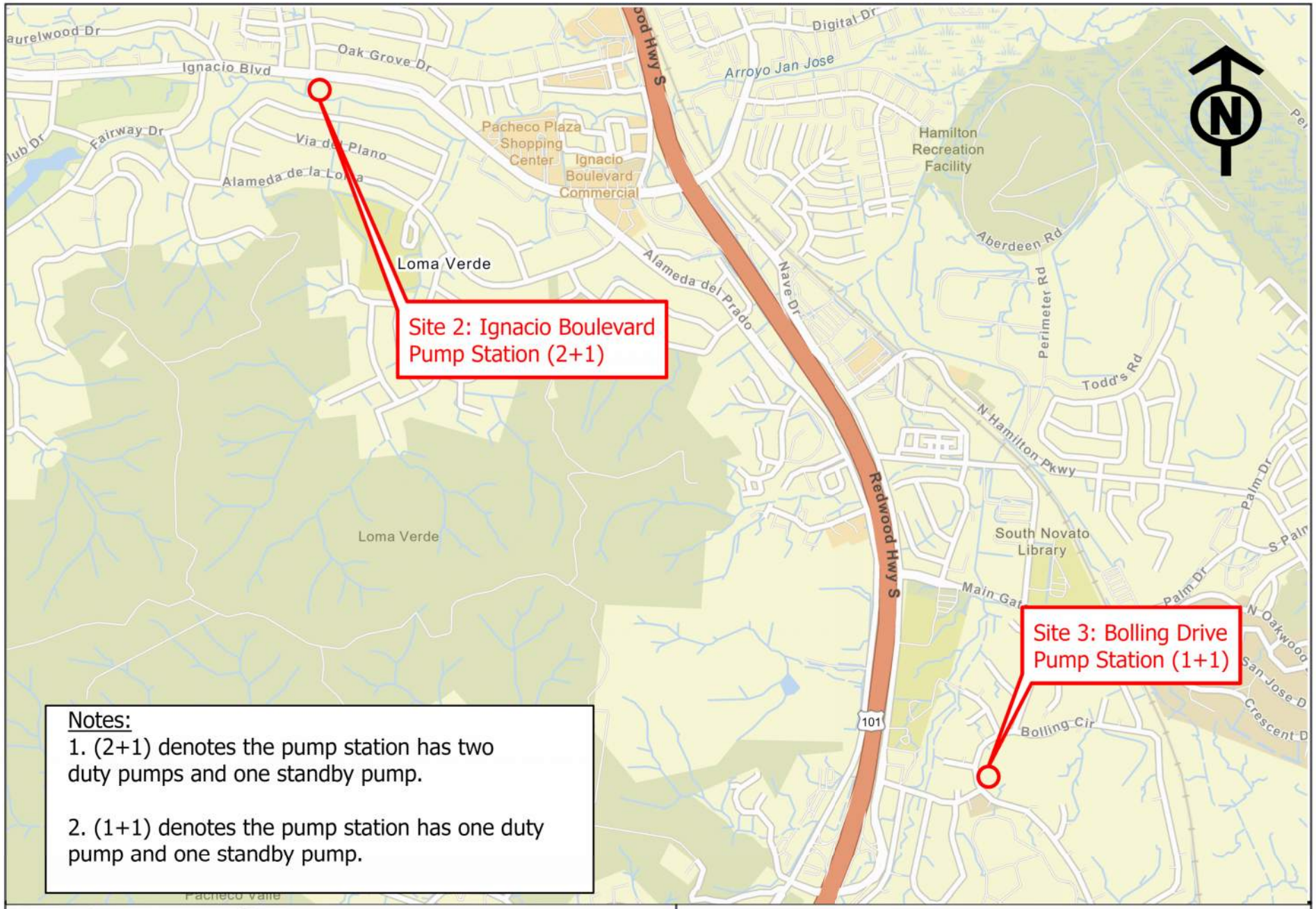

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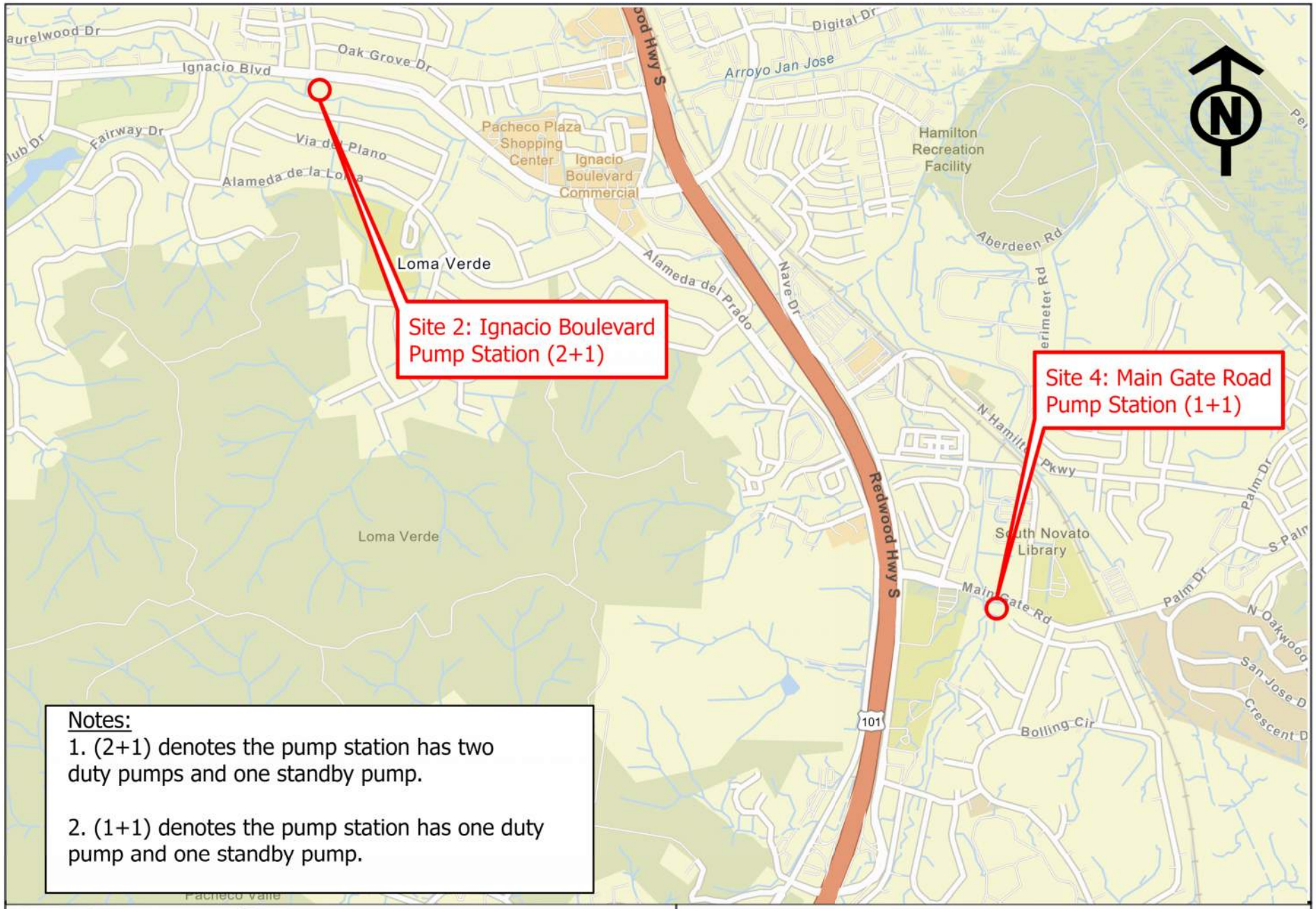
FIGURE ES-4
ALTERNATIVE C LOCATION MAP
NORTH MARIN WATER DISTRICT
NOVATO, CA 94945



Notes:

1. (2+1) denotes the pump station has two duty pumps and one standby pump.

2. (1+1) denotes the pump station has one duty pump and one standby pump.

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FIGURE ES–5
ALTERNATIVE D LOCATION MAP
NORTH MARIN WATER DISTRICT
NOVATO, CA 94945

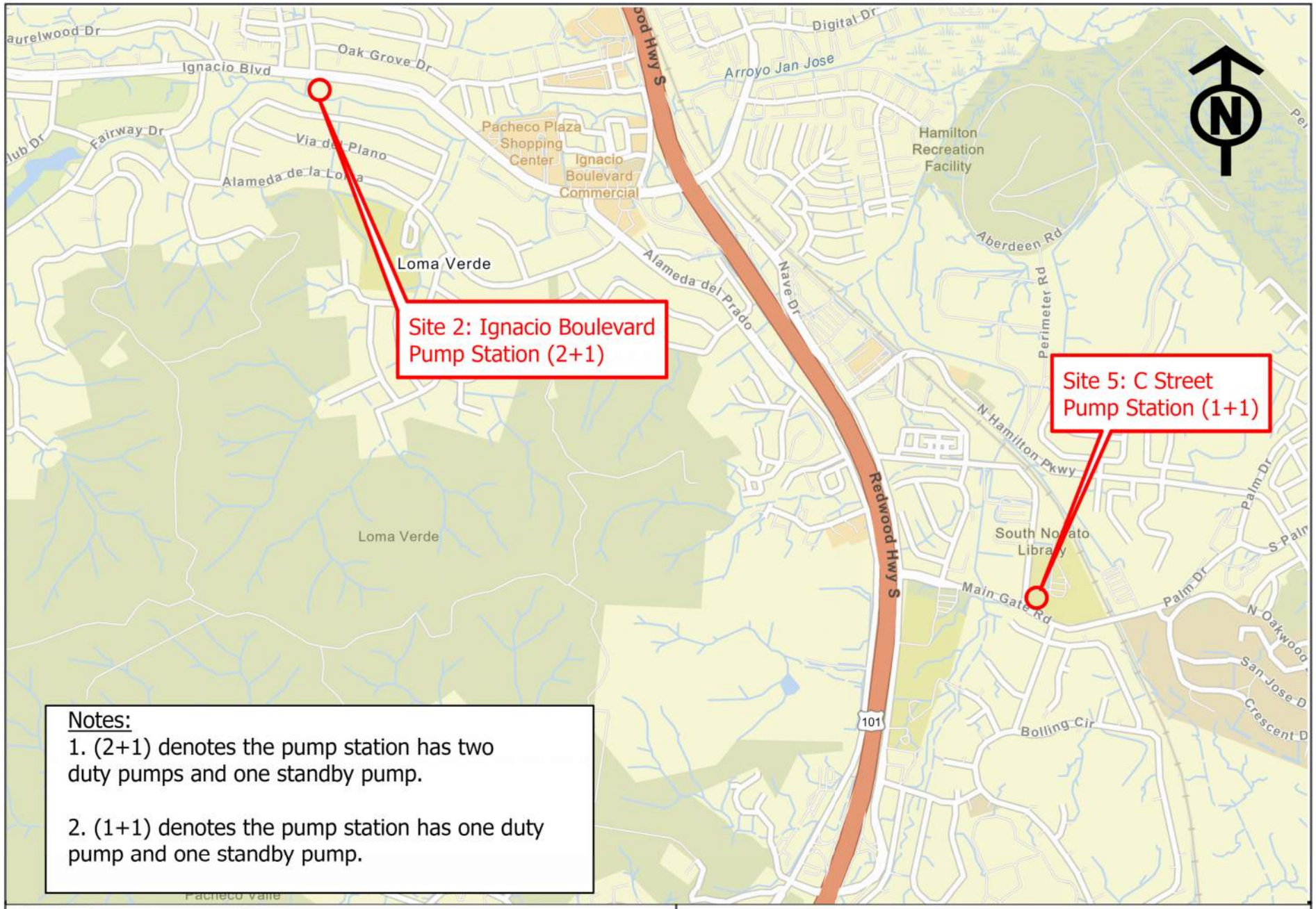

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FIGURE ES–6
ALTERNATIVE E LOCATION MAP
NORTH MARIN WATER DISTRICT
NOVATO, CA 94945

EXECUTIVE SUMMARY
TABLES

Table ES-1
Pump Station Alternatives Evaluation
Lynwood Pump Station Capacity Assessment
North Marin Water District, Novato, California

Evaluation Criteria	Retrofit Existing	Alternative A (Site 1)	Alternative B (Site 2)	Alternative C (Sites 2 & 3)	Alternative D (sites 2 & 4)	Alternative E (Sites 2 & 5)
Replaces Aging Infrastructure	X	X	X	X	X	X
Meets Future Demand	X	X	X	X	X	X
Improvements Safety and Maintenance Access		X	X	X	X	X
Improves Pacheco Valley Tank Fill Operations			X	X	X	X
Provides Opportunity to Improve Zone 1 Storage Tank Operations				X	X	X
Provides System Redundancy				X	X	X
Relative Project Cost	$$$	$	$$	$$$$	$$$	$$$

1 INTRODUCTION

1.1 Background and Project Drivers

The North Marin Water District (District) primarily serves the City of Novato (City) and surrounding unincorporated areas in Marin County, encompassing approximately 75 square miles. The District's potable water system is divided into four main pressure zones. Each pressure zone comprises multiple pump stations and tanks. Primary Zone 2 has two main pump stations: (1) Lynwood Pump Station and (2) San Marin Pump Station. Although the two pump stations meet current demands within Primary Zone 2, the pump stations are potentially not equipped to handle future growth.

To complement the Lynwood Pump Station existing capacity evaluation, the District desired to document the existing condition of the critical pump station including review of potential feasibility of in-place rehabilitation or relocation of the pump station to meet the long-term customer needs. The Engineering Assessment project drivers include:

- Identify potential future demands based on current available data from the City of Novato (City) and County of Marin (County) including determing if the future demands will be served by Zone 2, Zone 3, or Zone 4;
- Determine the potential pump station capacity expansion, if required, to meet future projected demands;
- Engage District operations staff to identify potential operation constraints that may affect the final design criteria for an expanded pump station;
- Assess the feasibility of rehabilitating the pump station components within the existing pump station structure to improve the pump station's overall reliability and resiliency; and
- Evaluate up to five potential alternative sites for a replacement of the existing Lynwood Pump Station.

The Engineering Assessment includes estimated future demands that impact the Lynwood Pump Station capacity requirements, presents constraints to rehabilitate the existing pump station facility in place, and develops potential pump station replacement alternatives that address both future demands needs and existing operational constraints identified by District operations staff.

1.2 Assessment Approach and Report Structure

The District contracted with Freyer & Laureta, Inc. (F&L) to perform an engineering assessment for its Lynwood Pump Station to evaluate the pump station’s condition, review projected future demands that may require the pump station capacity to be increased, determine replacement options, and alternative site locations.

The engineering assessment includes the following components:

- Site visits to perform a visual assessment of the existing systems, including a review of available record drawing information and operational data, are presented in Section 2
- Review of current operating conditions and strategies, presented in Section 3
- Review of Primary Zone 2 existing demands and develop the projected new demands for Primary Zone 2, presented in Section 4
- Develop evaluation method to determine the pump capacity needed for Lynwood Pump Station to meet the project new demands, presented in Section 5
- Develop potential replacement alternatives for Lynwood Pump Station, presented in Section 6
- Evaluate each alternative to identify the preferred replacement option, presented in Section 7

1.3 Project Team

F&L served as the lead engineer for the engineering assessment, supported by the following specialty subconsultants:

- Advanced Hydro Engineer (AHE) – hydraulic modeling support
- Beecher Engineering (Beecher) – electrical, instrumentation, and controls engineer support
- WRA, Inc. (WRA) – environmental permitting support
- Cal Engineering & Geology, Inc, a division of Haley & Aldrich (CE&G) – geotechnical engineering support

2 EXISTING CONDITION ASSESSMENT

The engineering assessment scope of work included a visual inspection of the existing Lynwood Pump Station facility.

The purpose of the condition assessment was to:

- Document existing pump station facility condition based on visual observation.
- Document critical pump station components age and condition to identify those critical components that have likely reached the end of useful service life requiring removal and replacement.
- Perform measurements of all components to determine if the existing pump station layout complies with current codes and regulations or if any rehabilitation project would also require improvements to the structure to facilitate compliance with applicable codes and regulations. For example, a critical compliance and safety item that the F&L team identified during preliminary site visits was that clearances above and in front of the existing motor control center (MCC) likely did not meet the current National Electric Code (NEC) requirements which would require significant modifications to the existing structure or relocation of the MCC to the outside of the existing pump station structure.
- Identify other vulnerabilities, such as risk of damage following a seismic event, that would also be important to address with any rehabilitation or replacement project.
- Document and address, to the extent practicable, access improvements to facilitate long-term operation and maintenance. For example, F&L and District staff discussed that one gate valve on the suction side of Pump No. 2 broke, but because the pipe and valve body was located below the pump station's concrete floor, the District had to sawcut the concrete to remove and replace the valve.

This section summarizes the existing conditions assessment and recommendations with a more detailed discussion of the F&L team's assessment presented in Appendix A.

2.1 Visual Inspection

The existing facility condition review goal was to determine the feasibility of rehabilitating the existing Lynwood Pump Station. The current physical site conditions were assessed through visual inspection during an October 27, 2022 site visit. District staff provided access to the Lynwood Pump Station and accompanied the F&L team throughout the site visit. F&L staff interviewed District staff during the site assessment to document not only the condition of critical and accessible pump station components but also the various operational and maintenance constraints that should be considered when determining the feasibility of rehabilitating the existing pump station.

As summarized below, the F&L team observed the site location, took photographs of the existing conditions, and compared the record drawings to existing site conditions.

2.2 Physical Condition Summary

The pump station components were in poor overall condition, and the team observed multiple deficiencies with the existing site. The primary deficiencies identified were grouped into four main categories:

- Access
- Location and Environment
- Mechanical Components
- Electrical

2.2.1 Access

The existing Lynwood Pump Station is below grade creating limited access to all mechanical and electrical equipment. The below-grade building currently has limited clear space in all dimensions, making maintaining and replacing equipment difficult. The current vertical space does not meet the current California Building Code (CBC) requirement of eight-feet minimum height for ceiling height.

In addition, the pump and motors can only be accessed by removing concrete covers over each pump, which requires a crane that must be staged adjacent to the existing pump station within a Sunset Parkway travel lane. Even if the motor were not removed, the cover would need to be removed to provide the District's operations staff with sufficient access to perform critical maintenance activities.

To improve overall access and facilitate compliance with applicable codes and regulations, the existing pump station structure would require significant modifications, including raising the existing roof, creating larger and more operator-friendly pump access covers, and potentially widening the below-grade structure to provide additional working space for District operations staff.

2.2.2 Location and Environment

The existing site is on Sunset Parkway at the intersection with S. Novato Boulevard, with limited parking. The location is adjacent to the primary entrance to Lynwood Elementary School. The constrained site can impact maintenance activities because significant temporary traffic control is required to allow the District to stage equipment and vehicles. As noted in Section 2.2.1, the pump and motor can only be removed by crane through existing concrete covers that would also need to be removed using the crane. The crane would need to stage on Sunset Parkway, potentially requiring flagging to maintain traffic.

The existing site does not provide an opportunity to improve parking or accessibility, even with removing and replacing the existing pump station facility. The site is within an existing island that likely cannot be expanded or modified due to a reduction in the Sunset Parkway travel widths not being feasible. F&L also identified multiple existing utilties within the traffic island such as stormwater mains, water mains, gas main, and significant Pacific Gas & Electric (PG&E) infrastructure on poles within the easterly end of the traffic island where the pump station is located.

Groundwater and stormwater are also a concern for the existing pump station location. Groundwater was observed to be present under the concrete slab where the District staff had been required to sawcut the slab to remove and replace the Pump No. 2 suction gate valve. In discussions with District staff, F&L understands that groundwater is always present and, during storms, can encroach on the floor.

Furthermore, the existing site is adjacent to the current Federal Emergency Management Agency (FEMA) 100-year floodplain. Based on review of existing topographic data, F&L believes there is a risk that during significant storm events, stormwater within Sunset Parkway may overtop the lowered curb to facilitate District vehicle parking and be conveyed into the below-grade pump structure. Photos of the existing pump station can be found in Appendix A.

2.2.3 Mechanical Components

The mechanical components are primarily ductile iron with epoxy coating and range from fair to poor condition. Several areas of the coating appeared damaged, with visual evidence of corrosion. In addition, several leaks were observed where there was visible evidence of corrosion. District staff indicated that although none of the leaks had free-flowing water, new leaks had been observed within the last one to two years.

Because of the pump station building constrained conditions and the site location within the traffic island, the pumps, pipe, and fittings have been installed with minimal clearances, complicating access to components for maintenance. For example, the limited width of the structure required the original construction to install the pump discharge valves within a limited space (e.g., less than five feet) between the pump discharge flange and the structure wall. Although operators report that, if needed, the valve bolts can be accessed to facilitate maintenance and possible replacement of the valve, the constrained space significantly complicates access and maintenance timelines.

An additional concern is the limited flexibility provided with the existing layout and components. The existing ductile iron pipes directly penetrate the concrete walls without flexible fittings and appear to have no seismic protection. The lack of seismic fittings increases the components' vulnerability to damage during a significant seismic event where it can be expected that seismic motions would cause differential movement between the existing concrete structure and the existing infrastructure within Sunset Parkway potentially resulting in a catastrophic failure of either the suction or discharge piping rendering the pump station non-functional when water supply for fire fighting could be critical.

2.2.4 Electrical

Multiple electrical components of the pump station appear to be out of compliance with current code. Additionally, the electrical equipment is obsolete and no longer manufactured. Nonstandard exposed conduits and pathing for electrical components were observed. Additionally, the conduits routed below the finished floor of the pump station are in a vault used for operation of a valve that is currently not up to code per NEC.

2.3 Existing Conditions Assessment Conclusions

The existing Lynwood Pump Station is in poor condition overall. Multiple upgrades are required to ensure that the pump station is up to date with the latest code and to extend the life as well as improve the overall reliability of the critical District facility, even without considering potential expansion to meet future demands.

Since the pump station is currently below grade, the District's ability to perform any necessary repairs and upgrades is limited. Also, per discussion with the District staff, it is beneficial for the Lynwood Pump Station to be reconstructed above grade to not only improve access but also reduce the risk from groundwater and stormwater intrusion.

F&L did consider the potential advantages of rehabilitating the existing Lynwood Pump Station components. However, modifying or enhancing the pump station is not feasible because of the overall age, condition, and the significant site constraints that may result in substantial, costly constructability challenges. The most critical constraints identified by the assessment were:

- Multiple existing utilities run through the island, including two storm drain mains, two 24-inch water mains, one 4-inch gas main, an existing PG&E transformer, and a PG&E pole. The design of the existing Lynwood Pump Station appeared to be constructed to accommodate the existing utilities within the traffic island, with the exception of the 4-inch gas main, which was shown to be relocated (Figure 1).
- Considering the upgrades needed for Lynwood Pump Station (number of pumps, clearances, electrical upgrades), the site layout would be approximately 27-feet by 43-feet with a proposed height (not including the roof) of approximately 10-feet. The footprint of the proposed pump station would impede traffic sightlines for cars, in all directions of traffic, at the intersection of Sunset Parkway and S. Novato Boulevard.
- To facilitate in-place rehabilitation or replacement, a temporary pump station must be constructed and remain in operation for the duration of the demolition, construction, and testing phases adding increased construction phasing complexities and costs when compared to constructing a new pump station at an alternative location.

F&L did develop a range of magnitude total project cost for rehabilitating or replacing the existing Lynwood Pump Station, which is between $7.0 million and $9.0 million.

Due to the multiple existing utilities and the location of the pump station adjacent to the intersection, the existing location is not feasible. We suggested to District staff that the engineering assessment move forward to consider constructing a new pump station at a different location than the existing Lynwood Pump Station. The construction of a new, modern pump station built to current code and best practices for mechanical equipment layout for operational access, will result in a facility with, at a minimum, a 50-year design life.

3 CURRENT OPERATING CONDITIONS

The review and assessment of the current operating conditions were based on operational information provided by District staff[1], a review of the 2018 Novato Water System Master Plan Update, dated September 2019[2] , System Control and Data Acquisition (SCADA) information, and PG&E billing.

3.1 NMWD Pressure Zones

The District's water system is divided into four main pressure zones, which are generally based on ground elevations. The largest pressure zone, Zone 1, serves elevations up to 60 feet above sea level. Zone 2 serves locations between 60 feet and 200 feet in elevation, Zone 3 serves elevations from 200 feet to 400 feet, and Zone 4 serves elevations 400 feet and above. Figure 2 presents the approximate limits for each of the four pressure zones. In addition, the District's system includes seven smaller zones within Zone 2, Zone 3, and Zone 4 that are served by hydro-pneumatic tanks due to local topographic restrictions requiring additional booster pump stations. These elevations roughly serve as the zone limits, with some water service locations in each zone above or below those limits.

Water supply pumped from the Stafford Treatment Plant and water supply by gravity or pumped from the Sonoma County Water Agency (SCWA) provides the pressure for the Zone 1 system. Pump stations are required to transfer water from the lower elevation zones to the higher elevation zones. Pump station capacity is based on providing water service to the individual zone and all other higher-pressure zones served from the individual zone.

Due to the topographic variation in the District, Zone 2 is comprised of numerous non-contiguous areas, including the largest Zone 2 areas designated as Primary Zone 2 and the smaller Crest/Black Point Zone 2, Captain Nurse Regulated Zone 2, and Airbase Zone 2. The Crest/Black Point Zone 2 is served by the School Road Pump Station and is hydraulically isolated from Primary Zone 2. Both Captain Nurse Regulated Zone 2 and Airbase Zone 2 are connected to the Primary Zone 2, however these two zones are artificially regulated to a lower pressure than the Primary Zone 2. The Primary Zone 2 demands and pumping are the focus of this Engineering Assessment for evaluating the Lynwood Pump Station replacement.

Primary Zone 2 is the largest Zone 2 pressure zone. The northern and southern sections of Primary Zone 2 can be separated by an isolation valve located approximately around the Indian Valley area. When the isolation valve is closed, San Marin Pump Station serves the northern portion of Primary Zone 2, and Lynwood Pump Station serves the southern portion of Primary Zone 2. The isolation

[1] The F&L Team and District staff met on December 16, 2022, and January 26, 2023, to review current and desired operating conditions to better inform the hydraulic modeling effort.

[2] https://nmwd.com/wp-content/uploads/2020/04/2018WMP.pdf

valve is manually closed during the winter when demand is lower and the potential for water quality issues is greater due to water age within the Primary Zone 2 storage tanks, in particular the San Mateo Tank. Isolation of the northern and southern sections of Primary Zone 2 helps the operations staff keep water turn over (mixing) in the San Mateo Tank at acceptable levels to maintain water quality.

The Primary Zone 2 pump stations also convey water from Zone 1 to Zone 3, Zone 4, and the seven hydro-pneumatic zones. All current and potential demands for Zone 3, Zone 4, and hydro-pneumatic zones are considered "pass-through" demands for Primary Zone 2 and must be included in the pump capacity evaluation for both Lynwood Pump Station and San Marin Pump Station.

3.2 Primary Zone 2 Water Supply

The primary water source for the District's water supply comes from SCWA through the North Marin Aqueduct. The District's primary water source is supplemented by through the Stafford Treatment Plant[3] (STP). Currently, San Marin Pump Station is only connected to the District's primary water supply and is not currently connected to STP. Since San Marin Pump Station is only connected to the primary water source, it does not have the capability to effectively pump water to all of Primary Zone 2. Lynwood Pump Station can and has effectively pumped water from Zone 1, regardless of the supply source, to all Primary Zone 2. Therefore, Lynwood Pump Station is a critical pump station for Primary Zone 2.

3.3 Pump Station Operating Strategy

As a cost-saving measure and when feasible based on operational constraints such as demands and storage tank water levels, District operations staff utilize a partial day operation for both Lynwood Pump Station and San Marin Pump Station during PG&E off-peak hours for electrical use. Currently, PG&E peak pricing occurs five hours each day from 4 pm to 9 pm. The District's operation procedure goal is to operate for a 16-hour period which avoids operating any pumps during the five-hour on-peak usage period plus 1.5 hours before and after the on-peak five-hour period. However, the District currently operates for up to 19-hours per day to meet demands and/or fill storage tanks.

District pump station operations adapt to PG&E on-peak hour changes during the year to minimize pumping costs since PG&E discounts power usage during off-peak hours. During winter, the discount is minimal due to the low flow pumping rates during this time. In practice, the District does operate its pump stations for up to 19 hours a day but can override automation to ensure that critical customer demands are always met.

As part of the engineering assessment described in later sections, the F&L team considered the District's desire to only operate pump stations during off-peak hours. As part of the assessment approach, though, we did consider the information provided by District staff during the December

[3] District staff are developing a separate project that would modify a portion of the San Marin Pump Station suction piping to allow for San Marin Pump Station to also draw water supply from the Stafford Treatment Plant.

2022 and January 2023 workshops, where staff provided guidance that pump stations will run during peak hours when needed to continue to fill the storage tanks during periods of high demand. Still, these operating conditions happen infrequently (e.g., less than ten times per year).

3.4 Emergency Power Strategy

During severe weather events, PG&E turns off power to help prevent wildfires. Times of planned power outages are called Public Safety Power Shutoff (PSPS). During PSPS events, the District utilizes a portable diesel generator to provide emergency power to the District's facilities, including pump stations. The portable diesel generator is not permanently located at the Lynwood Pump Station site and is transported to the District's facilities when needed. Because the District maintains a significant amount of storage in Primary Zone 2, Zone 3, and Zone 4, the District has adequate time to mobilize the portable emergency generator to any of the pump stations if the timing of PSPS is unexpected or there is another emergency power disruption. The District's current diesel generator will operate for approximately 13 hours before refueling is required. The District considers that 13 hours of fuel sufficient to operate under emergency conditions for one operational day.

PSPS typically occurs during late summer and fall, when customer demands can be high. Maintaining operations at Lynwood Pump Station is a priority as it can provide water from both District water supply sources (STP and SCWA) to Primary Zone 2 area. However, the District staff indicated that a permanent generator is not required at Lynwood Pump Station because it can mobilize the portable emergency generator to the Lynwood Pump Station site in less than two hours, and the system demands can be met for this limited time from the existing storage.

4 EXISTING AND FUTURE DEMANDS AND PUMPING RATES

This section presents F&L's review of existing demands based on the 2018 Master Plan as well as projected future demands. The existing demand review is critical to support F&L's review of the existing hydraulic model further discussed in Section 5 . The future demands serve as the basis for evaluating whether the Lynwood Pump Station existing pump capacity can meet proposed future development needs. The development of required pumping capacity is also provided in this section.

4.1 Primary Zone 2 Demands

4.1.1 Existing Demands

The forecasted Fiscal Year (FY) 2020 Primary Zone 2 Maximum Day Demands (MDD) from the 2018 Master Plan will be utilized as the baseline demands for existing conditions in this Engineering Assessment for the hydraulic evaluation of Primary Zone 2. FY 2020 MDD, also referred to as "existing demands," from Primary Zone 2, Zone 3, Zone 4, and the hydro-pneumatic zones can be found in Table 1. The total MDD for Primary Zone 2, Zone 3, Zone 4, and hydro-pneumatic zones is 7.79 million gallons per day (MGD).

4.1.2 Projected New Demands

The Marin County Community Development Agency (MCCDA) has provided information on future development anticipated within the City that will result in additional demand throughout the entire District system. F&L only evaluated the future buildout demands that would be served by Primary Zone 2. All other future build out demands were not included in the future build out pumping analysis, but included in the system distribution model.

The information provided by MCCDA identified multiple future developments that will result in future additional demands that are part of Primary Zone 2. As noted in Section 3.1, only Primary Zone 2 is evaluated as part of this engineering assessment. Therefore, any future build out demands served by Crest/Black Point Zone 2 systems were excluded from the future build out demand analysis. Additionally, Zone 3 future build out demands served by the Cherry Hill System were also excluded from the future build out analysis as this portion of Zone 3 is not served by Lynwood Pump Station or San Marin Pump Station. No future build out demands were anticipated for Zone 4.

Future build out locations with Equivalent Residential Dwelling Units (EDU) and commercial square footage (sf) provided by the District are shown in Figure 3. There are six future build out demands, including one commercial, office, and government demand, in the northern part of the City within Primary Zone 2 near the existing San Marin Pump Station and designated as Location 1 through Location 6, shown in Figure 3. One future build out demand in the southern part of the City is within

the Captain Nurse Regulated Zone 2 but is still connected to Primary Zone 2, served by Lynwood Pump Station, and designated as Location 12 in Figure 3.

The EDU and commercial building square footage provided in Figure 3 as was used to calculate the potential additional demand in Annual Acre-Feet (AAF). The demands for Locations 7 through 11 are not part of the Primary Zone 2 system and are not included in the Primary Zone 2 total demands. The AAF for the seven future build out demands is 735 AAF, shown in Table 2. The AAF was then used to calculate the Average Day Demand (ADD). The ADD for the seven future build out demands in Primary Zone 2 is 0.66 MGD, and the resulting MDD is 1.16 MGD. The office, commercial, and government demand was negligible and was captured within the rounding of the total Primary Zone 2 demand, shown in Table 3. Table 1 includes a detailed summary of the existing Primary Zone 2 pressure zones demand and where future demand is allocated to the appropriate subzone. The total future MDD of Primary Zone 2 is 8.95 MGD.

4.2 Pump Station Capacity

4.2.1 Pump Station Firm Capacity Approach

Generally, pump station firm capacity is defined as the pump station capacity when the largest pump unit is out of service. Because Primary Zone 2 is served by two pump stations (e.g., Lynwood Pump Station and San Marin Pump Station), the District has in the past used a firm capacity for the entire zone rather than at an individual station. In the zone approach, the zone firm capacity was defined as the capacity when the largest pump unit in the zone is out of service.

The F&L team suggested reviewing both approaches to confirm impacts of the pump station firm capacity methodology for this Engineering Assessment. The review included a presentation to the District by the F&L team of typical pump station firm capacity methodologies compared with the zone firm capacity methodologies that the District used in prior master planning documents. The firm capacity methodology selected by the District will impact the capacity determination of the required replacement Lynwood Pump Station.

Following collaboration with and further review by the District staff, the individual pump station firm capacity definition was chosen as the preferred approach for this Engineering Assessment. The firm capacity is defined as pumping capacity to meet MDD when the largest pump unit at each pump station is out of service. Both the San Marin Pump Station and Lynwood Pump Station have three pumps, all rated for 1,800 gallons per minute (GPM); therefore, each pump station's firm capacity is 3,600 GPM (5.18 MGD) based on two pumps operating. The individual and total firm capacity for Primary Zone 2 pumping stations is listed in Table 4.

4.2.2 Existing Pump Station Capacity Approach

As noted in the previous section, Lynwood and San Marin pump stations each have a firm capacity of 3,600 GPM. The existing Primary Zone 2 firm pump capacity was calculated to be 10,368,000 gallons per day (GPD) (10.368 MGD) as presented in Table 4. The firm pump capacity is key to calculating the required pump station size to meet current demands. The total firm capacity for

Primary Zone 2 is greater than the Primary Zone 2 existing demand of 7.79 MGD and future demand of 8.95 MGD. However, the District operates the pump stations for only a portion of the day to reduce energy costs. This shortened operating period requires higher capacity pumping rates to deliver the MDD during the shorter period.

The minimum required pump capacity to meet the existing Primary Zone 2 MDD would be based on a 24-hour pumping rate. However, as noted in Section 3.3, the District operational goal is to run the pump stations for only 16 hours per day to minimize power costs associated with pumping. For this case, the minimum pumping rate must be higher than the maximum day demand rate to be able to transfer the total daily demand volume from the Zone 1 system into the Primary Zone 2 system in the shorter time period.

To initially evaluate the system performance under existing demands, the F&L team considered the District's operational goal to operate the pump stations during off-peak hours only. This would result in MDD system demands that occur over a 24-hour basis being required to be met through the pump stations operations over a 16-hour period, requiring the pumping rate be adjusted to reflect the shorter pump station operating duration. The pumping rate adjustment factor is calculated by dividing 24 hours by 16 hours, resulting in an adjustment factor of 1.5. The minimum pumping rate for the 16-hour operation is 1.5 multiplied by the MDD.

The existing Primary Zone 2 demand of 7,785,000 GPD is multiplied by 1.5 to determine the minimum required pump capacity for the combined San Marin Pump Station and Lynwood Pump Station. The required MDD pump capacity based on a 16-hour pumping time is 11,677,500 GPD. Since the total existing Primary Zone 2 firm pump capacity is 10,368,000 GPD, the existing net pumping capacity for the 16-hour pumping time is a deficit of 1,309,500 GPD, as shown in Table 5.

The net pumping capacity deficit is a critical data point because the net deficiency indicates that MDD demands would not be met by the pump stations based on a strict 16-hour operations limit. During existing MDD conditions with a 16-hour operations limit, the existing pumps would not provide sufficient volume into the Primary Zone 2 to meet daily demand. A portion of the storage in the Primary Zone 2 storage tanks would be required to supplement the pumped volume to meet MDD demands.

The typical standard for determining the required pump station capacity during MDD is to provide sufficient pump capacity to meet or exceed the calculated MDD so that storage is not impacted. The storage should be used to meet Peak Hour Demands (PHD), as well as fire flow and emergency storage requirements. Since firm pumping capacity currently exceeds the MDD with a 24-hour pumping period, the time period of pump operations on Max Day can be increased to match the MDD. The F&L team calculated the minimum pumping duration of 18 hours is required during MDD to reduce the potential for some portion of MDD to be met with storage. A summary of the impact of the pumping durations is shown in Table 5.

As noted previously, District staff is not required to operate at a 16-hour limit and will operate one or both pump stations during peak electrical demand periods when customer demand conditions warrant the additional pumping time. Also, the MDD is an estimated value based on historical demands and performance of the District's system and will rarely occur during a year. The actual

demands experienced recently may reflect a reduction in MDD due to water conservation efforts. District staff has reported that the District has not experienced demands that required all four pumps (e.g., two at San Marin Pump Station and two at Lynwood Pump Station) to operate simultaneously.

For this Engineering Assessment, the necessary pump capacity of any new pump station is based initially on the proposed 16-hour pump operating approach and capacity deficiency results as outlined in Table 5. This approach will provide the District with the required pumping capacity to meet the most critical demand experienced by the system at the desired operating conditions.

4.2.3 Future Pump Station Capacity Methodology

For purposes of the engineering assessment, the F&L team evaluated future pump station capacity using the firm capacity approach presented in Section 4.2.1. This capacity was based initially on 16 hours of operation during each day. However, the F&L team also evaluated pump station operations for longer than 16 hours each day if there were potential benefits to the District. These benefits included:

- The ability to utilize similar pumps (model and capacity) to the existing San Marin Pump Station and the existing Lynwood Pump Station for any new pump station.
- Capital cost savings by not developing an oversized replacement facility. For some demand conditions, the pump cycle time can be increased slightly to avoid the added cost of an additional pump that would be needed to meet firm capacity requirements for the shorter pump cycle times.

Another critical consideration when reviewing pump station capacity is current and future use of variable frequency drives (VFDs) that allow operators to match pump station flows with demands. With VFDs, the operators can choose to operate the pump stations at a range of flows to allow for the pump station to operate at higher flow rates in low demand (and off-peak electrical hours) in anticipation of peak demands.

The Lynwood Pump Station replacement alternatives presented in subsequent sections considered the desire to only pump during non-peak electrical demand hours. In addition, the alternatives did not artificially constrain the pump cycle time if there are other potential benefits or cost savings to the District. The analysis was based on recognizing the District can and will operate the pump station as long as necessary to meet demands while maintaining operational, fire and emergency storage volumes.

5 HYDRAULIC EVALUATION METHODOLOGY

To develop potential Lynwood Pump Station alternatives, F&L performed a preliminary hydraulic evaluation of the District's Primary Zone 2 water distribution system both under existing conditions and with the future demands presented in Section 4 **.** In this section, we reviewed and confirmed the existing District hydraulic model demands were consistent with information presented in the 2018 Master Plan, identified critical system operational constraints for pumping, storage and conveyance, and documented the methodology to be used for preliminary modeling of pump station replacement project alternatives.

The use of the model for this Engineering Assessment was primarily for comparison of the different pumping station alternatives and was generally focused on Primary Zone 2 MDD conditions only. The conditions during PHD for tank releases in Primary Zone 2 and tank replenishment in Zone 1 were not considered during the preliminary hydraulic evaluation and should be reviewed as part of final design. A review for confirmation of preliminary results of proposed operations and the impacts for all zones should be performed as part of the next steps in design. The Engineering Assessment results should be revisited with a complete model review prior to final design to confirm the hydraulic conditions for any selected approach and final site location.

5.1 Existing Distribution System Model Review

To develop the potential Lynwood Pump Station replacement alternatives, F&L utilized a water distribution system model previously developed by Kennedy/Jenks Consultants (K&J). The distribution system model used the InfoWater software by Innovyze, an Autodesk company, for the analysis. F&L was provided with a copy of the model and assumed for the purposes of this study, it was calibrated and configured correctly for steady state analysis. The model did not appear to be calibrated to perform extended period simulation. The model included all of the District's water distribution system network, including existing gravity tanks, pumps, pipes, and valves. The model also includes various scenarios, including ADD scenarios, MDD scenarios, and PHD scenarios.

The primary use of the model was the evaluation of the future demand conditions and potential pump capacity requirements. To review model operations, F&L first utilized the existing MDD scenario within the model files and incrementally added modifications to simulate how the District currently operates the water distribution system. This provided a cursory check to compare whether model results were similar to the operating conditions described in the 2018 Master Plan and similar to operations discussed with District staff. Specific modifications to the model can be found in Appendix B. A summary of the steps taken to confirm functionality of the model included:

- Determine if existing demands matched the 2018 Master Plan FY 2020 MDD from Section 4.1.1,
- Determine the hydraulic conditions on a maximum day at the beginning of peak hour, and
- Determine hydraulic conditions with alternative pump cycle durations.

5.2 Existing Conditions Modeling Results

Before proceeding with the pump station replacement alternative development, F&L first reviewed the hydraulic conditions for the existing distribution system. Based on our conversations with District staff, the purpose of the existing conditions hydraulic analysis was to document observed key operational constraints and validate that the hydraulic model generally reflected current system operations. Key findings from the hydraulic model results are summarized below.

5.2.1 Zone 1 Storage Tank Performance

One key finding during the preliminary water distribution system modeling was the shorter 16-hour Primary Zone 2 pump operating periods will change the amounts of operational storage needed for Zone 1 and Primary Zone 2. The operational storage volume needed under the reduced pump operating periods should be further investigated during design for the pump station alternative chosen and also under future master plan updates.

The short higher rate pumping periods draw the Zone 1 tank levels down from a full condition at the MDD condition. Typically, during the MDD condition in a steady state model run, gravity tanks within a distribution network would be full or filling. The MDD condition was anticipated to occur during the 16-hour pump operation cycle, which changes the typical steady state results. The existing model results indicated that when operating the Lynwood Pump Station and San Marin Pump Station for only 16 hours per day during MDD conditions, the Zone 1 tanks are releasing water to meet both Zone 1 demands and the higher 1.5 x MDD Primary Zone 2 pump station rates. Since the MDD flow rates into Primary Zone 2 are being artificially increased by increased pumping, the North Marin Aqueduct supply alone cannot provide the water volume for the transfer. The Zone 1 tanks release flow to make up the difference. In the Primary Zone 2, the PHD are provided solely from storage after the pumps are turned off, increasing operational storage requirement in this zone.

The balancing of the system flows and volumes in Zone 1 occurs when the pumps are turned off. The storage volume drawn out of Zone 1 tanks is replenished during the Primary Zone 2 pump off period at potential peak hour flow. The North Marin Aqueduct supply will meet both Zone 1 PHD and tank replenishment, since there is no water being drawn into the Primary Zone 2.

As discussed previously, District staff have flexibility with selection of the length of daily pump operating periods. District staff reported that when customer demands warrant, the Lynwood Pump Station and San Marin Pump Station pumping period will be extended regardless if the pump stations would be operating during shoulder or peak PG&E electric rate periods. As noted in Section 4.2.2, the net pumping capacity evaluation indicated that for existing conditions, the pump cycle time would likely be extended from 16 hours to 17 hours and higher to maintain Zone 2 storage tank levels as necessary.

By extending the pump cycle time to reduce demands on Zone 2 storage tanks, F&L would expect Zone 1 storage tank replenishment demands to be similarly reduced, however, the steady state modeling results did indicate a continued demand on Zone 1 storage tanks during MDD with less than 24-hour pumping. The operations with limited pump cycle time will continue to increase the amount

of operational storage requirements for the distribution system. As part of the District's planned update of the 2018 Master Plan, F&L suggests that the District perform an extended period simulation in addition to the steady state analyses to review the Zone 1 and 2 tanks operational storage performance during concurrent limited pump cycle time and MDD conditions discussed above.

5.2.2 Pacheco Valley Tank Hydraulic Constraints

The District's operations staff noted hydraulic constraints within the Primary Zone 2 distribution system that impact the fill rate from the Lynwood Pump Station to the Pacheco Valley Tank. These constraints include limited transmission capacity south of the existing Lynwood Pump Station and the proximity of the Sunset Tank to the existing Lynwood Pump Station site. The Pacheco Valley Tank is in the southern part of the District's Primary Zone 2 distribution system and receives water from the Lynwood Pump Station. Due to its location within Primary Zone 2, Pacheco Valley Tank is one of the furthest distance tanks from the existing Lynwood Pump Station location. The head loss along the long transmission route from Lynwood Pump Station limits the fill rate of the Pacheco Valley Tank during peak demands. The District's impacted ability to fill and maintain the Pacheco Valley Tank water level is partially a result of the proximity of the Sunset Tank to the Lynwood Pump Station. See Figure 4 for Pacheco Valley Tank and Sunset Tank locations.

Pacheco Valley's tank overflow elevation is set at 323 feet, similar to the Sunset Tank overflow elevation of 323.5 feet. Sunset Tank resides physically closer to the Lynwood Pump Station and therefore fills faster. To fill Pacheco Valley Tank, District staff must first fill and isolate Sunset Tank. Once Sunset Tank is filled and isolated, the District must turn off one of the pumps at the Lynwood Pump Station to reduce the risk of over-pressurizing portions of the distribution system closest to the pump station. The remaining single pump can convey water to the Pacheco Valley Tank without over-pressurizing portions of Primary Zone 2 adjacent to the Lynwood Pump Station. However, the fill rate is limited and artificially constrained due to only filling at a maximum rate of 1,800 GPM with one pump operating. The District's operations staff has observed that this method can require multiple days to fill Pacheco Valley Tank during periods of high demand.

The 24,500 ft conveyance system between the Lynwood Pump Station and Pacheco Valley Tank is generally comprised of 12-inch and 8-inch diameter piping. Two short pipe sections, a 500-feet length of 12-inch diameter and a 250 feet length of 8-inch diameter, constrict the conveyance system between the Lynwood Pump Station and Pacheco Valley Tank. In a preliminary analysis of head losses, F&L reviewed the MDD flow conditions and determined that the head loss in these two smaller diameter segments is not significant (e.g. about 0.1 ft), when compared to the total head loss of 10 ft within the 24,500 feet of pipe between the Lynwood Pump Station and Pacheco Valley Tank. As a result, the two smaller diameter pipes are not considered to be a significant factor in limiting the flow conveyance capacity. Other distribution system improvements that may resolve the limited conveyance are replacing or paralleling longer pipeline segments or providing water supply to a location closer to the Pacheco Valley Tank. However, the primary hydraulic condition that limits the maximizing of the Pacheco Valley Tank fill rate and to provide similar fill rates with Sunset Tank is the fact that Sunset Tank is significantly closer to the Lynwood Pump Station.

The District expressed interest in investigating potential solutions to improve the District's overall ability to fill Pacheco Valley in addition to evaluating the capacity required for Lynwood Pump Station. Generally, the potential improvement options to improve the District's ability to fill Pacheco Valley Tank include:

- Expand the existing distribution system or introduce a new transmission main;
- Potentially rrelocate Lynwood Pump Station to a location equidistant between Sunset Tank and Pacheco Valley Tank; or
- Add a third pump station to Primary Zone 2 near the Pacheco Valley Tank.

Please refer to Section 6.1 for presentation of the F&L selected alternatives, including discussion of each alternatives potential operational improvement goals.

5.3 Future Conditions Modeling Methodology and Exclusions

To perform preliminary modeling and analysis of pump station alternatives to meet future demands, F&L developed the following methodology:

- Add projected new demands from Section 4.1.2,
- Determine hydraulic conditions with the 16-hour pump cycle with steady state analysis,
- Determine hydraulic conditions with various proposed pump station capacities and pump station locations with steady state analysis.

In the analysis of the Lynwood Pump Station capacity, the following were excluded:

- Fire flow demand for the system was not included since we are not performing a master planning study. Fire flow demands are outside of the scope of this analysis.
- The original 2022 maximum day scenario included the seven hydro-pneumatic stations. Although the hydro-pneumatic stations operate periodically per set pressure points, for simplicity, the hydro-pneumatic stations were modeled as an average of the total daily pumping rate of the hydro-pneumatic system. No additional demands were added to these station service areas.

6 ALTERNATIVES DEVELOPMENT

This section identifies the potential alternatives for replacing the existing Lynwood Pump Station. The F&L team identified five potential alternative solutions. The alternatives were formulated with the primary goal of meeting future Primary Zone 2 MDD and the secondary goal to increase flow to Pacheco Valley Tank. Each alternative concept was developed collaboratively with District staff to provide the F&L team with sufficient guidance to develop specific alternatives for consideration and development.

6.1 Proposed Alternatives

With guidance from District staff and considering the key project goals, F&L developed the following alternative concepts:

- A new pump station near the existing Lynwood Pump Station site with one additional pump to meet future demands.
- A new pump station relocated away from the current Lynwood Pump Station site, ideally with adequate ability to meet future peak demands throughout Primary Zone 2, and also improve the District's ability to deliver water to Pacheco Valley Tank.
- Two new pump stations, with one to replace the Lynwood Pump Station and the second to provide a new pump station at a location within the southern portion of Primary Zone 2 that would improve the District's ability to fill Pacheco Valley Tank without having to isolate Sunset Tank from the system.

Five alternatives were developed using the five selected site locations and are summarized in this section.

6.2 Siting Study

Before performing any hydraulic analysis and detailed development of each of the five alternatives, F&L conducted a desktop siting study to determine the preferred site locations. For each option, three areas were evaluated based on four categories:

- Parcel ownership,
- 100-year floodplain proximity,
- Potential sea level rise, and
- Hydraulic compatibility, including reviewing system changes to the pressure and flow to the gravity storage tanks.

One site location was determined based on favorable attributes in the four categories presented above. The detailed siting study can be found in Appendix C. The final locations are:

- Site 1: Sunset Parkway Pump Station - New pump station within the Sunset Parkway median between Monte Maria Avenue and Cambridge Street.
- Site 2: Ignacio Boulevard Pump Station - New pump station along Ignacio Boulevard at Palmer Drive within open space area adjacent to existing pedestrian trails.
- Site 3: Bolling Drive Pump Station - New pump station near Bolling Circle and Bolling Drive intersection within a privately maintained open space area.
- Site 4: Main Gate Road Pump Station - New pump station along Main Gate Road west of C Street within open space area adjacent to existing pedestrian trails.
- Site 5: C Street Pump Station - New pump station near Main Gate Road and C Street within an existing baseball field privately maintained by the Novato Unified School District.

Five Alternatives A through E were developed for review in this Engineering Assessment. The Alternatives A and B included only one new pump stations. Alternatives C through E included two new pump stations. The five alternatives are summarized below:

- Alternative A is a new pump station that matches the existing Lynwood Pump Station with one additional pump to meet future demands. The new pump station site, referred to as Site 1, is proposed in close proximity to the existing Lynwood Pump Station. A key consideration when developing Alternative A was District staff reported the current location provides the ability to meet demands both to the north and south of the existing facility location.
- Alternative B was developed to determine if, by relocating the pump station away from the current Lynwood Pump Station site, the new pump station could continue to provide adequate ability to meet future peak demands throughout Primary Zone 2, and also improve the District's ability to deliver water to Pacheco Valley Tank. The new pump station is proposed at a site, referred to as Site 2, roughly half way between the Sunset Tank and Pacheco Valley Tank.
- Alternative C was developed to include both replacement of the Lynwood Pump Station at Site 2 and adding a pump station at a location within the southern portion of Primary Zone 2 that would improve the District's ability to fill Pacheco Valley Tank without having to isolate Sunset Tank from the system. The second pump station site is located at Site 3.
- Alternative D was developed based on similar goals as Alternative C but utilized both Site 2 and an alternative pump station site. For Alternative D, the third pump station is located at Site 4.
- Alternative E was developed based on similar goals as Alternative C but utilized both Site 2 and an alternative pump station site. For Alternative E, the third pump station is located at Site 5.

6.3 Alternative A

Alternative A (Figure 5) includes a pump station location within the Sunset Parkway median between Monte Maria Avenue and Cambridge Street (Site 1). This pump station is referred to as the Sunset Parkway Pump Station in this Engineering Assessment. The location is in public right of way and outside the 100-year floodplain.

6.3.1 Pump Station Capacity

F&L performed an initial hydraulic evaluation to determine the required pumping capacity for Alternative A to, at a minimum, meet the future Primary Zone 2 MDD using the District's preferred 16-hour pump cycle time (see Table 6). The hydraulic modeling indicated that the high pumping rates associated with the 16-hour pump cycle time created a risk of over pressurizing the residential service connections near the pump station.

For Alternatives A through E, F&L utilized pumps that matched the current pump models, sizes and pumping rates present in the existing Lynwood Pump Station and San Marin Pump Station. Each pump station used individual pump capacities of 1,800 GPM with the specific number needed to meet the future Primary Zone 2 MDD. This approach was used for consistency to ensure that the District operations staff will not need to be trained to maintain new or different equipment in the new pump station.

Due to Alternative A's pump station location, operationally, the District must utilize the 19-hour pump cycle rather than the 16-hour pump cycle to fill Pacheco Valley Tank or risk over pressurizing the residential services in the pump station vicinity. F&L performed a supplemental simulation of a 19-hour pump cycle time to review the operational constraints observed by the District. The 19-hour pump cycle time simulation was used to determine an appropriate firm pump station capacity that supplies the Primary Zone 2 MDD while keeping the storage tanks full or filling and reduces impacts to the Zone 1 storage tanks. The resulting conditions appeared to provide neutral impacts on Primary Zone 2 tanks with little increase in the impacts on Zone 1 storage tanks compared to existing conditions.

Alternative A operating for 19 hours during MDD results in a minimum firm pump station capacity of 4,250 GPM, which is less than the 5,400 GPM proposed for this alternative. This pumping rate difference results in a net pumping capacity of 1.69 MGD (see Table 6). This pumping rate has minimal impacts on the distribution pressures with a minimal pressure increase between 0 to 5 psi. Alternative A does not improve the ability to fill Pacheco Valley Tank without performing similar operational steps to first fill and isolate Sunset Tank. This approach will continue to require isolating Sunset Tank and reducing the operating flow rate from Lynwood Pump Station to fill Pacheco Valley Tank.

F&L has preliminarily determined that this pump station alternative results in the Primary Zone 2 tanks remaining full or filling and reducing impacts to Zone 1 storage tanks during MDD. However, further analysis of impacts and an analysis of operational storage needs in the Zone 1 and Primary

Zone 2 storage tanks should be verified as part of the design and the District's future update of the 2018 Master Plan.

6.3.2 Potential Environmental Permit Requirements and Constraints

WRA performed an environmental constraints analysis for Alternative A, and the analysis results are summarized in this section with the detailed analysis included in Appendix D.

WRA conducted a field investigation to identify the potential for special-status species within the site. Based on the highly disturbed condition of the proposed site, no further actions are recommended for special-status plant species and special-status wildlife species.

Non-special-status native birds may nest in trees and vegetation within and immediately surrounding the proposed site. The active nests of native birds are protected under the federal Migratory Bird Treaty Act (MBTA) and by California Fish and Game Codes (CFGC). Recommendations to avoid and minimize the potential impacts on nesting birds can be found within WRA's site assessment.

The only potential development-related constraint associated with Alternative A is the trees and shrubs protected under Chapter 17 of the Novato Code of Ordinances ("Tree and Shrub Ordinance"). The District is not required to comply with the City of Novato Ordinances. As such, the project is not required to replace trees to be removed by project activities in accordance with the City's Tree Ordinance. However, the District intends to replace trees removed by the project at the recommended one to one ratio, which is consistent with the City's Tree Ordinances.

Construction of a new pump station at the alternative site would require compliance with the California Environmental Quality Act (CEQA). Based on WRA's review of the site, including biological resources conditions, compliance with Chapter 17 of the Novato Code of Ordinances, and the inclusion of the nesting bird protocol, a new pump station at the Alternative A location would not result in any significant environmental impacts that could not be mitigated pursuant to CEQA.

As part of the CEQA effort, any temporary construction impacts (e.g., noise, dust, stormwater, etc.) would be considered mitigated impacts by maintaining compliance with local and state regulations including but not limited to the Construction Stormwater General Permit, Novato Code of Ordinances, and any additional regulations.

6.3.3 Regional Geologic and Soil Engineering Data

CE&G performed a desktop study for Alternative A, and the analysis results are summarized in this section with the detailed analysis included in Appendix E. The Alternative A location has unconsolidated, fine to medium sand with silt and clay. The Natural Resources Conservation Service (NRCS) soil map shows the site as surficial soils that generally extend to depths of about 80 inches below grade. Groundwater levels in the general area are between 1 and 7 feet below grade. Due to the relatively flat topography at the location, landsliding for the site is unlikely to occur. The site has very low liquefaction susceptibility.

CE&G found that the site is in the seismically active San Francisco Bay Area and will likely experience strong ground shaking from a large earthquake along with one or more of the nearby active faults during the design lifetime of the project.

CE&G evaluated if the Alternative A location was within an Alquist-Priolo Earthquake Fault Zone. According to the California Geological Survey (CGS) (2006), the site is not located within an Alquist-Priolo Earthquake Fault Zone. According to the United States Geological Survey's (USGS) Quaternary Fault and Fold database, no active faults have been mapped across the Alternative A site location.

6.3.4 Conceptual Design

A key component of the alternatives analysis is developing a conceptual design of the proposed pump station. F&L has included a description of key pump station components evaluated for Alternative A below that informed the conceptual design. The proposed Alternative A Conceptual Design drawings are included in Appendix F.

6.3.4.1 Pumps

All pumps will be vertical turbine style and sized at 1,800 GPM. As part of F&L's review of the as-built drawings, the existing pumps at Lynwood Pump Station are Floway Pumps from Trillium Flow Technologies. Trillium Flow Technologies does not have an 1,800 GPM pump but provided the proposed pump model most similar to the San Marin Pumps that, when operated with VFDs, will provide the necessary 1,800 GPM flow. Preliminary information from Trillium Flow Technologies for the recommended pump is included in Appendix G.

6.3.4.2 Building and Facility Layout

The proposed pump station will be a CMU building with access through a double door. The pump station building footprint provides sufficient access to all pumps, valves, and appurtenances within the pump station. Spacing between pumps will be a minimum of five feet of clearance, which will allow the District's staff sufficient room for maintenance and repair work. Most of the piping, valves, and appurtenances will be below the finished floor elevation to maximize clear space within the building but the mechanical components will all be accessible using removable fiberglass grates for the primary floor. The pump station will include a gantry to ease lifting any pump components. A skylight is proposed above each pump to allow access for maintenance and replacement of the pump and motor.

A magnetic flowmeter will be included on the discharge pipe and within the building footprint. A cut sheet of the District's preferred magnetic flow meter by Rosemount is included in Appendix G.

The City is located within an area of elevated seismic activity and any improvements must consider seismic resiliency during design. Utilizing guidance from the American Society of Civil Engineers (ASCE) 7 Minimum Design Loads and Associated Criteria for Buildings and Other Structures (ASCE7), the replacement of Lynwood Pump Station is considered Risk Category IV because it is a critical water facility to maintain water pressure. Based on the elevated risk category, piping into the pump station will include specialized flexible fittings to allow for differential movement between the pumps and

the distribution system. The most commonly used specialized flexible fitting is similar to the EBAA Iron Flex-Tend. A cut sheet of the EBAA Iron Flex-Tend[4] is included in Appendix G.

The 24-inch main on Sunset Parkway that feeds the existing Lynwood Pump Station would continue to feed the new pump station. Approximately 80 ft of 24-inch pipe will be required to connect the existing 24-inch distribution pipe to the new pump station. Approximately 500 ft of 16-inch pipe will be required to join the new pump station to the current Primary Zone 2 distribution pipe.

6.3.4.3 Electrical Components

Alternative A pump station will require:

- A new PG&E service,
- Main service-entrance switchboard,
- Facility standby power provisions,
- Motor Control Center and Variable Frequency Drive Equipment, and
- Non-electrical design considerations.

PG&E Service

The new PG&E service required for this station is relatively large compared to the predominantly residential customer loads in the vicinity. For this reason, obtaining a service of this size at any alternative locations will probably be challenging.

Main Service-Entrance Switchboard

The main service-entrance switchboard equipment and installation must comply with PG&E and Electric Utility Service Equipment Requirements (EUSERC) requirements and standards.

Facility Standby Power Provisions

Based upon discussions with the District, it is preferred that standby power to the station be provided by a portable standby generator rather than installing a permanently mounted standby generator unit. The alternative will show the preferred approach of utilizing a portable standby generator for station backup power. It should be noted that for the option presented, it is not feasible to utilize a portable generator "receptacle." Power receptacles for this type of application are limited to a rating of 400 amperes and, thus, not large enough for this application. A standby generator connection panel will be required for Alternative A, which will require either the connection of portable generator cables to the internal connection panel lugs or connection to the panel via pre-made, color-coded CamLok connectors.

[4] https://ebaa.com/products/flex/flexible-expansion-joint/flex-tend/30

Motor Control Center and Variable Frequency Drive Equipment

The motor control center (MCC) equipment will include a main circuit breaker, pump variable frequency drives, lighting panelboard and transformer, and circuit breakers for anticipated station auxiliary loads such as heating, ventilation, and air conditioning (HVAC), sump pumps, and other miscellaneous electrical equipment. The motor control center will be the industry standard of 90 inches high and 21 inches deep, with each individual section's width determined by what is included in each section.

With respect to variable frequency drive (VFD) equipment selection, it has been assumed that 18-pulse, "Clean Power" VFDs will be specified for the new station. As required by the PG&E "Electric & Gas Service Requirements 2022-2023" document (also known as the PG&E " Greenbook"), customers are not permitted to operate equipment that imposes a "harmful wave form" onto the PG&E distribution system. For each of the presented options, the bulk of the load at each station will be the pump VFDs which, if not specified to be "Clean Power," will impose harmonic distortion onto the PG&E system. The assumed "Clean Power" technology is based upon 18-pulse technology, a proven industry standard for many years. In recent years, however, a newer "Clean Power" VFD technology known as "Active Front End" has been introduced, accomplishing the same level of harmonic distortion mitigation. There are several potential benefits to utilizing the active front-end technology, the most notable being less heat production and a smaller footprint. Experience in recent jobs has indicated, however, that this technology is still evolving to some degree, and the reliability of the equipment has been an issue on recent projects. Until the technology has a proven reliability track record on similar applications in the Bay Area, there is a reluctance to deviate from specifying the proven 18-pulse technology.

Non-Electrical Design Considerations

For this type of water facility, two (2) non-electrical aspects must be considered in the new station's design. The first is HVAC. The electrical equipment that will be housed in the new pump station building will generate heat as significant as 10-20kW. This level of heat generation will almost certainly require some degree of interior building air conditioning. The second non-electrical consideration goes along with the HVAC design. Per NEC requirements, HVAC ducting, process water piping, or any other non-electrical aspect of the facility cannot be routed directly above any electrical equipment. This requirement must be coordinated as part of the final station design to ensure that the mechanical design aspects mesh with the electrical equipment placement within the new building.

6.3.5 Capital Cost

The Conceptual Opinion of Probable Project Cost (OPC) for Alternative A is $4,521,000 and is presented in Table 11. The OPC includes budgets for design, environmental/permitting, construction management including testing and inspection, District administrative allowance, and construction costs. The OPC is presented in 2024 dollars.

The construction cost component of the OPC was developed based on the following:

- Equipment pricing from potential suppliers;
- Recent bid pricing for similar materials;
- Experience with similar projects; and
- Considerations of site constraints.

6.3.6 Net Operating Cost

In order to perform a comprehensive comparison of the five alternatives in Section 7 , F&L developed potential operating costs for a 30-year time frame that, when combined with the capital cost, we could effectively understand the total investment that would be required of the District. The operating cost approach includes:

- Capital cost in Year 0 to capture all costs associated with initial construction and startup;
- Annual electrical costs for the operations based on 17 to 19 hours on average per day with variability in the number of pumps running based on demand variations throught the year;
- Annual District maintenance costs of $5,000;
- Every 10th-year maintenance budget for $50,000 for significant maintenance activities such as rewinding motors or key component replacement; and
- Estimating the net present value of the capital and operating costs based on a 5% discount.

The net present and operating cost based on a 19-hour pump cycle time for Alternative A is $9,868,000, as presented in Table 16.

6.4 Alternative B

The pump station location south of Ignacio Boulevard at Palmer Drive (Site 2) was chosen for the Alternative B (Figure 6) site because it has similar proximity to both Sunset Tank and Pacheco Valley Tank. This pump station is referred to as the Ignacio Boulevard Pump Station in this Engineering Assessment. The site location is in public right of way and is not located within the 100-year floodplain.

6.4.1 Pump Station Capacity

F&L performed the hydraulic evaluation to determine the required pumping capacity for Alternative B to, at a minimum, meet the future Primary Zone 2 MDD with the initial evaluation using the District's preferred 16-hour pump cycle time (see Table 7). The higher firm capacity required for the 16-hour pump cycle time slightly exceeds the proposed pump station firm capacity. Similar to Alternative A, the pump cycle time was increased to reduce the firm pumping capacity rate needed to supply the MDD.

For Alternatives A through E, F&L utilized pumps that matched the current pump models, sizes and pumping rates present in the existing Lynwood Pump Station and San Marin Pump Station. Each pump station used individual pump capacities of 1,800 GPM with the specific number needed to meet the future Primary Zone 2 MDD. This approach was used for consistency to ensure that the District operations staff will not need to be trained to maintain new or different equipment in the new pump station.

F&L performed a supplemental evaluation to extend the pump cycle time. Based on the extended pump cycle time evaluation, a pump cycle time of 17 hours during MDD results in a minimum firm pump station capacity of about 5,200 GPM, which is less than the 5,400 GPM proposed for this alternative. This pumping rate difference results in a net pumping capacity of 0.34 MGD (see Table 7). This pumping rate results in the Primary Zone 2 tanks remaining full or filling while reducing impacts to Zone 1 storage tanks to be similar to existing conditions.

Based on preliminary modeling, Alternative B improves the ability to fill Pacheco Valley Tank without requiring isolation of Sunset Tank prior to filling Pacheco Valley Tank, as well as not increasing the impacts to Zone 1 storage tanks above what is believed to occur under existing conditions. Furthermore, the Alternative B pump station could operate with more than one pump without potentially over-pressurizing portions of the Primary Zone 2 distribution system adjacent to the proposed location. Alternative B, with a firm capacity of 5,400 GPM (see Table 7), has minimal impacts on the distribution pressures with a minimal pressure increase between 0 to 5 psi in preliminary modeling simulations.

F&L has preliminarily determined that this pump station alternative results in the Primary Zone 2 tanks remaining full or filling and reducing impacts to Zone 1 storage tanks during MDD. However, further analysis of impacts and an analysis of operational storage needs in the Zone 1 and Primary Zone 2 storage tanks should be verified as part of the design and the District's future update of the 2018 Master Plan.

6.4.2 Potential Environmental Permit Requirements and Constraints

WRA performed an environmental constraints analysis for Alternative B, and the analysis results are summarized in this section with the detailed analysis included in Appendix D.

WRA conducted a field investigation to identify the potential for special-status species to occur within the sites. Based on the highly disturbed condition of the proposed site, no further actions are recommended for special-status plant species and special-status wildlife species.

The other potential constraint for Alternative B is associated with the existing shrubs and trees. Several trees growing along this creek provide potential nesting habitats for common nesting bird species. Non-special-status native birds may nest in trees and vegetation within and immediately surrounding the proposed site. The active nests of native birds are protected under the federal MBTA and CFGC. Recommendations to avoid and minimize the potential impacts to nesting birds can be found within WRA's site assessment.

The primary potential development-related constraint associated with Alternative B is the proximity of the creek and its associated riparian corridor. Areas within 50 feet of the top of bank or within the limits of existing riparian vegetation are within the Stream Protection Zone, as defined in Section 19.35 of the Novato Code of Ordinances. Any alterations within the Stream Protection Zone would require approval of a Use Permit, Stream Management Plan, and maintenance provisions by the Commission.

Construction of a new pump station would require compliance with the CEQA. Based on WRA's review of the site, including biological resources conditions, compliance with Chapter 17 of the Novato Code of Ordinances, and the inclusion of the nesting bird protocol, a new pump station at the Alternative B location would not result in any significant environmental impacts that could not be mitigated pursuant to CEQA.

As part of the CEQA effort, any temporary construction impacts (e.g., noise, dust, stormwater, etc.) would be considered mitigated impacts by maintaining compliance with local and state regulations including but not limited to the Construction Stormwater General Permit, Novato Code of Ordinances, and any additional regulations.

6.4.3 Regional Geologic and Soil Engineering Data

CE&G performed a desktop study for Alternative B, and the analysis results are summarized in this section, with the detailed analysis included in Appendix E. The Alternative B location has poorly to moderately sorted sand, silt, and gravel. The southwest portion of the proposed location is underlain with loose, unconsolidated, poorly to well-sorted sand, gravel, and cobbles, with minor silt and clay. The site is shown on the NRCS soil map as being surficial soils that generally extends to depths of about 80 inches below grade. Groundwater levels in the general area are between 3 to 10 feet below grade. The site has moderate liquefaction susceptibility, except for the soils along the Arroyo Jan Jose Creek, which are shown to have a very high liquefaction susceptibility. The relatively flat areas of this site are unlikely to experience landsliding; however, shallow landsliding may occur along the Arroyo Jan Jose Creek bank to the southwest.

CE&G found that the site is in the seismically active San Francisco Bay Area and will likely experience strong ground shaking from a large earthquake along with one or more of the nearby active faults during the design lifetime of the project.

CE&G evaluated whether the Alternative B site location was within an Alquist-Priolo Earthquake Fault Zone. According to the California Geological Survey (CGS) (2006), the site is not located within the Alquist-Priolo Earthquake Fault Zone. According to the United States Geological Survey's (USGS) Quaternary Fault and Fold database, no active faults mapped across Alternative B site location.

6.4.4 Conceptual Design

Generally, the Alternative B conceptual design is similar to Alternative A. However, F&L has included a description of key pump station components evaluated for Alternative B and informed the conceptual design. The proposed Alternative B Conceptual Design drawings are included in Appendix F.

6.4.4.1 Pumps

The Alternative B pump station will have the same number and type of pumps as discussed in Alternative A.

6.4.4.2 Building and Facility Layout

The Alternative B pump station will have a similar building and facility layout as discussed in Alternative A.

Approximately 1,300 ft of additional piping would be required to connect the existing 16-inch Zone 1 distribution pipe to the new pump station. Approximately 2,450 ft of additional pipe would be required to connect the new pump station to the existing 16-inch Zone 2 distribution pipe. See conceptual drawings in Appendix F for Alternative B.

6.4.4.3 Electrical Components

The Alternative B pump station will have similar electrical components as discussed in Alternative A.

6.4.5 Capital Cost

The Conceptual OPC for Alternative B was developed similarly to Alternative A. The Alternative B OPC is $6,636,000 and is presented in Table 12. The OPC is presented in 2024 dollars.

6.4.6 Net Operating Cost

The net present and operating cost based on a 17-hour pump cycle time for Alternative B is $11,434,000, as presented in Table 16.

6.5 Alternative C

Alternative C (Figure 7) includes two new pump stations at separate locations. One of the pump stations is located at Site 2. The second pump station is located at the Bolling Circle and Bolling Drive location (Site 3). This pump station is referred to as the Bolling Drive Pump Station in this Engineering Assessment. Site 2 is described in Section 6.4. The Site 3 is within a privately maintained open space and is not within the 100-year floodplain.

6.5.1 Pump Station Capacity

F&L performed the hydraulic evaluation to determine the required pumping capacity for Alternative C to, at a minimum, meet the future Primary Zone 2 MDD with the initial evaluation using the District's preferred 16-hour pump cycle time (see Table 8). Similar to Alternative A, the pump cycle time was increased to reduce the firm pumping capacity rate needed to supply the MDD.

For Alternatives A through E, F&L utilized pumps that matched the current pump models, sizes and pumping rates present in the existing Lynwood Pump Station and San Marin Pump Station. Each pump station used individual pump capacities of 1,800 GPM with the specific number needed to

meet the future Primary Zone 2 MDD. This approach was used for consistency to ensure that the District operations staff will not need to be trained to maintain new or different equipment in the new pump station.

F&L performed a supplemental evaluation to extend the pump cycle time. Based on the extended pump cycle time evaluation, a pump cycle time of 17 hours during MDD results in a minimum firm pump station capacity of about 5,200 GPM, which is less than the 5,400 GPM proposed for this alternative. This pumping rate difference results in a net pumping capacity of 0.34 MGD (see Table 8). This pumping rate results in the Primary Zone 2 tanks remaining full or filling while reducing impacts to Zone 1 storage tanks to be similar to existing conditions.

Based on preliminary modeling, compared to both Alternative A and Alternative B, Alternative C can provide improvements for supply to the Pacheco Valley Tank. Alternative C dramatically improves the ability to fill Pacheco Valley Tank without performing similar operational steps to fill Sunset Tank before filling Pacheco Valley Tank. In addition, this alternative was not increasing the impacts to Zone 1 storage tanks above what is believed to occur under existing conditions.

The resulting pump stations would include a total of three pumps at the Site 2 pump station and two pumps at the Site 3 pump station. Each pump was individually sized for 1,800 GPM matching the current pumps for the existing Lynwood Pump Station and San Marin Pump Station.

Alternative C, with a firm capacity of 1,800 GPM at Site 3 and 3,600 GPM at Site 2 (see Table 8), has minimal impacts on the distribution pressures with a minimal increase of pressure, between 0 to 5 psi in preliminary modeling simulations.

F&L has preliminarily determined that this pump station alternative results in the Primary Zone 2 tanks remaining full or filling and reducing impacts to Zone 1 storage tanks during MDD. However, further analysis of impacts and an analysis of operational storage needs in the Zone 1 and Primary Zone 2 storage tanks should be verified as part of the design and the District's future update of the 2018 Master Plan.

6.5.2 Potential Environmental Permit Requirements and Constraints

WRA performed an environmental constraints analysis for Alternative C. The results are summarized in this section with the detailed analysis in Appendix D. The potential environmental constraints are the same as Alternative B for the new Lynwood Pump Station in Alternative C.

For Site 3, WRA conducted a field investigation to identify the potential for special-status species within the sites. Based on the highly disturbed condition of the proposed site, no further actions are recommended for special-status plant species and special-status wildlife species.

Non-special-status native birds may nest in trees and vegetation within and immediately surrounding the proposed site. The active nests of native birds are protected under the federal MBTA and CFGC. Recommendations to avoid and minimize the potential impacts on nesting birds can be found within WRA's site assessment.

One potential development-related constraint associated with Alternative C is the trees and shrubs protected under Chapter 17 of the Novato Code of Ordinances ("Tree and Shrub Ordinance"). The

District is not required to comply with the City of Novato Ordinances. As such, the project is not required to replace trees to be removed by project activities in accordance with the City's Tree Ordinance. However, the District intends to replace trees removed by the project at the recommended one to one ration, which is consistent with the City's Tree Ordinances.

The primary potential development-related constraints associated with the pump station for Alternative C at Site 3 are the steep slope, exposed bedrock which could affect constructability, and the mature landscaping trees and native trees scattered throughout the project site.

Construction of a new pump station at any of the Alternative C sites would require compliance with the CEQA. Based on WRA's review of the sites, including biological resources conditions, compliance with Chapter 17 of the Novato Code of Ordinances, and the inclusion of the nesting bird protocol, a new pump station at the Alternative C locations would not result in any significant environmental impacts that could not be mitigated pursuant to CEQA.

As part of the CEQA effort, any temporary construction impacts (e.g., noise, dust, stormwater, etc.) would be considered mitigated impacts by maintaining compliance with local and state regulations including but not limited to the Construction Stormwater General Permit, Novato Code of Ordinances, and any additional regulations.

6.5.3 Regional Geologic and Soil Engineering Data

CE&G performed a desktop study for Alternative C, and the analysis results are summarized in this section, with the detailed analysis included in Appendix E. The regional geologic and soil engineering data are the same as Alternative B for Site 2.

The Site 3 location is mapped along a geological contact between Franciscan sedimentary rock and Franciscan Complex Mélange. The site is shown on the NRCS soil map as being surficial soil that generally extend to depths of about 37 inches below grade. The surficial soils unit is classified as well-drained, has a high runoff class, and has low available water storage. Groundwater level data was not found, but typically groundwater within a hillslope area is likely variable, with the water table commonly sloping downhill toward the closest drainage access. The site has a very low liquefaction susceptibility. The site is located on a moderately sloping hillside, likely underlain by shallow bedrock. Although shallow sliding of the surface soils is possible, adverse impacts to the proposed pump station due to landsliding at this site are unlikely.

CE&G found that the site is located in the seismically active San Francisco Bay Area and will likely experience strong ground shaking from a large earthquake along with one or more of the nearby active faults during the design lifetime of the project.

CE&G evaluated if any of the Alternative C site locations were within an Alquist-Priolo Earthquake Fault Zone. According to the California Geological Survey (CGS) (2006), the sites are not within an Alquist-Priolo Earthquake Fault Zone. According to the United States Geological Survey's (USGS) Quaternary fault and fold database, no active faults mapped cross any Alternative C site locations.

6.5.4 Conceptual Design

F&L has included a description of key pump station components evaluated for Alternative C and informed the conceptual design. The proposed Alternative C Conceptual Design drawings are included in Appendix F.

6.5.4.1 Pumps

Alternative C will have the same type of pumps at each of the two new pump stations, as discussed in Alternative A.

6.5.4.2 Building and Facility Layout

The Alternative C pump stations will have a similar building and facility layout as discussed in Alternative A. The size of the building will vary depending on the number of pumps, but all the building components will be similar to Alternative A.

The Site 2 location will have the same additional piping requirements as Alternative B.

For Site 3, approximately 2,200 ft of pipe is needed to connect to the existing 16-inch Zone 1 pipe. Approximately 900 ft of additional piping is needed to connect to the existing 12-inch Zone 2 distribution pipe. See conceptual drawings in Appendix F for Alternative C.

6.5.4.3 Electrical Components

The Alternative C pump stations will have similar electrical components as discussed in Alternative A.

6.5.5 Capital Cost

The Conceptual OPC for Alternative C was developed similarly to Alternative A. The Alternative C OPC is $11,138,000 and is presented in Table 13. The OPC is presented in 2024 dollars.

6.5.6 Net Operating Cost

The net present and operating cost based on a 17-hour pump cycle time Alternative C is $17,267,000, as presented in Table 16.

6.6 Alternative D

Alternative D (Figure 8) includes two new pump stations. One of the pump stations is located at Site 2. The second pump station is located at Main Gate Road just west of C Street at Site 4. This pump station is referred to as the Main Gate Road Pump Station in this Engineering Assessment. Site 2 is described in Section 6.4. The Site 4 is within a publicly maintained open space and is located within the 100-year floodplain of Pacheco Creek. Pacheco Creek crosses under Main Gate Road near the pump station location. The floodplain does not extend across Main Gate Road, so access to the site would remain available in a 100-year flood. The finished floor elevation of the pump station must be above the 100-year floodplain level based on City standards.

6.6.1 Pump Station Capacity

F&L performed the hydraulic evaluation to determine the required pumping capacity for Alternative D to, at a minimum, meet the future Primary Zone 2 MDD with the initial evaluation using the District's preferred 16-hour pump cycle time (see Table 9). Similar to Alternative A, the pump cycle time was increased to reduce the firm pumping capacity rate needed to supply the MDD.

For Alternatives A through E, F&L utilized pumps that matched the current pump models, sizes and pumping rates present in the existing Lynwood Pump Station and San Marin Pump Station. Each pump station used individual pump capacities of 1,800 GPM with the specific number needed to meet the future Primary Zone 2 MDD. This approach was used for consistency to ensure that the District operations staff will not need to be trained to maintain new or different equipment in the new pump station.

F&L performed a supplemental evaluation to extend the pump cycle time. Based on the extended pump cycle time evaluation, a pump cycle time of 17 hours during MDD results in a minimum firm pump station capacity of about 5,200 GPM, which is less than the 5,400 GPM proposed for this alternative. This pumping rate difference results in a net pumping capacity of 0.34 MGD (see Table 9). This pumping rate results in the Primary Zone 2 tanks remaining full or filling while reducing impacts to Zone 1 storage tanks to be similar to existing conditions.

Based on preliminary modeling, compared to both Alternative A and Alternative B, Alternative D can provide improvements for supply to the Pacheco Valley Tank. Alternative D dramatically improves the ability to fill Pacheco Valley Tank without performing similar operational steps to fill Sunset Tank before filling Pacheco Valley Tank and not increasing the impacts to Zone 1 storage tanks above what is believed to occur under existing conditions. Alternative D results in similar abilities to fill Pacheco Valley Tank as Alternative C.

The resulting pump stations would include a total of three pumps at Site 2 and two pumps at the Site 4 pump station with each pump individually sized for 1,800 GPM matching the current pumps for the existing Lynwood Pump Station and San Marin Pump Station.

Alternative D, with a firm capacity of 1,800 GPM at Site 4 and 3,600 GPM at Site 2 (see Table 9), will have impacts on the distribution pressures located around Site 4 by increasing pressure by approximately 56 psi to a maximum of 134 psi. This is due primarily to the pressure zone change. The portion of Zone 2 adjacent to Site 4 is currently within the Captain Nurse Regulated Zone 2 and is operated at a lower pressure than Primary Zone 2. To effectively implement Alternative D, a portion of Captain Nurse Regulated Zone 2 pipelines will be converted to Primary Zone 2 pipelines. Seven new pressure reducing stations will be installed on branch lines off the converted Primary Zone 2 pipeline to maintain the same pressure for all the existing customers currently being served by the Captain Nurse Regulated Zone 2 (Figure 10).

F&L has preliminarily determined that this pump station alternative results in the Primary Zone 2 tanks remaining full or filling and reducing impacts to Zone 1 storage tanks during MDD. However, further analysis of impacts and an analysis of operational storage needs in the Zone 1 and Primary

Zone 2 storage tanks should be verified as part of the design and the District's future update of the 2018 Master Plan.

6.6.2 Potential Environmental Permit Requirements and Constraints

WRA performed an environmental constraints analysis for Alternative D. The results are summarized in this section with the detailed analysis in Appendix D. The potential environmental constraints are the same as Alternative B for Site 2.

For Site 4, WRA conducted a field investigation to identify the potential for special-status species within the sites. Based on the highly disturbed condition of the proposed site, no further actions are recommended for special-status plant species and special-status wildlife species.

Non-special-status native birds may nest in trees and vegetation within and immediately surrounding the proposed site. The active nests of native birds are protected under the federal MBTA and CFGC. Recommendations to avoid and minimize the potential impacts on nesting birds can be found within WRA's site assessment.

One potential development-related constraint associated with Alternative D is the trees and shrubs protected under Chapter 17 of the Novato Code of Ordinances ("Tree and Shrub Ordinance"). The District is not required to comply with the City of Novato Ordinances. As such, the project is not required to replace trees to be removed by project activities in accordance with the City's Tree Ordinance. However, the District intends to replace trees removed by the project at the recommended one to one ration, which is consistent with the City's Tree Ordinances.

The primary potential development-related constraint associated with Site 4 is the proximity of the creek and its associated riparian corridor. Areas within 50 feet of the top of bank or within the limits of existing riparian vegetation are within the Stream Protection Zone, as defined in Section 19.35 of the Novato Code of Ordinances. Any alterations within the Stream Protection Zone would require approval of a Use Permit, Stream Management Plan, and maintenance provisions by the Commission.

Construction of a new pump station at any of the Alternative D sites would require compliance with the CEQA. Based on WRA's review of the sites, including biological resources conditions, compliance with Chapter 17 of the Novato Code of Ordinances, and the inclusion of the nesting bird protocol, a new pump station at the Alternative D locations would not result in any significant environmental impacts that could not be mitigated pursuant to CEQA.

As part of the CEQA effort, any temporary construction impacts (e.g., noise, dust, stormwater, etc.) would be considered mitigated impacts by maintaining compliance with local and state regulations including but not limited to the Construction Stormwater General Permit, Novato Code of Ordinances, and any additional regulations.

6.6.3 Regional Geologic and Soil Engineering Data

CE&G performed a desktop study for Alternative D, and the analysis results are summarized in this section, with the detailed analysis included in Appendix E. The regional geologic and soil engineering data are the same as Alternative B for Site 2.

Site 4 is mapped as being underlain by Holocene-aged alluvial deposits, which are described as poorly to moderately sorted sand, silt, and gravel. Alluvial deposits in this area is generally underlain with Franciscan Complex sedimentary bedrock. The site is shown on the NRCS soil map as being surficial soil that generally extends to depths of about 37 inches below grade. The surficial soils unit is classified as well-drained, has a high runoff class, and has low available water storage. Groundwater data adjacent to the area showed groundwater levels between 10 and 14 feet below grade. No site specific groundwater level data was found for the site. The site has moderate liquefaction susceptibility. Due to the relatively flat topography, landsliding for this site is unlikely to occur.

CE&G found that the sites are located in the seismically active San Francisco Bay Area and will likely experience strong ground shaking from a large earthquake along with one or more of the nearby active faults during the design lifetime of the project.

CE&G evaluated if any of the Alternative D site locations were within an Alquist-Priolo Earthquake Fault Zone. According to the California Geological Survey (CGS) (2006), the sites are not within an Alquist-Priolo Earthquake Fault Zone. According to the United States Geological Survey's (USGS) Quaternary fault and fold database, no active faults mapped cross any Alternative D site locations.

6.6.4 Conceptual Design

F&L has included a description of key pump station components evaluated for Alternative D and informed the conceptual design. The proposed Alternative D Conceptual Design drawings are included in Appendix F.

6.6.4.1 Pumps

Alternative D will have the same type of pumps at each of the two new pump stations, as discussed in Alternative A.

6.6.4.2 Building and Facility Layout

The Alternative D pump stations will have a similar building and facility layout as discussed in Alternative A. The size of the building will vary depending on the number of pumps, but all the building components will be similar to Alternative A.

Site 2 will have the same additional piping requirements as Alternative B.

Site 4 will have approximately 450 ft of pipe to connect to the existing 16-inch Zone 1 pipe. Approximately 20 ft of additional piping is needed to connect to the existing 16-inch Captain Nurse Regulated Zone distribution pipe. For this alternative, some of the existing pipelines within the Captain Nurse Regulated Zone will be converted to Primary Zone 2 pipelines. The higher pressure that

occurs along these pipes as part of Primary Zone 2 will need to be reduced prior to the current service connections. A pressure reducing valve is proposed for the branch lines to reduce the pressure to the current Captain Nurse Regulated Zone pressure. Specific valve closures have not been identified in this conceptual review. Seven pressure reducing valves will need to be included as part of this alternative. See conceptual drawings in Appendix F for Alternative D.

6.6.4.3 Electrical Components

The Alternative D pump stations will have similar electrical components as discussed in Alternative A, with the exception of the new PG&E service for the new pump station located at Site 4. The existing PG&E infrastructure in this area appears to have been previously connected to commercial customer loads in the area via overhead PG&E distribution. It is suspected that connecting a new PG&E service in this location may be facilitated more so than at the previously discussed sites which are located in predominantly residential areas.

6.6.5 Capital Cost

The Conceptual OPC for Alternative D was developed similarly to Alternative A. The Alternative D OPC is $9,674,000 and is presented in Table 14. The OPC is presented in 2024 dollars.

6.6.6 Net Operating Cost

The net present and operating cost based on a 17-hour pump cycle time Alternative D is $15,803,000, as presented in Table 16.

6.7 Alternative E

Alternative E (Figure 9) includes two new pump stations at separate locations. One of the pump stations is located at Site 2. The second pump station is located near Main Gate Road and C Street (Site 5). This pump station is referred to as the C Street Pump Station in this Engineering Assessment. The site is within a baseball field, privately maintained by Novato Unified School District and is not within the 100-year floodplain.

6.7.1 Pump Station Capacity

F&L performed the hydraulic evaluation to determine the required pumping capacity for Alternative E to, at a minimum, meet the future Primary Zone 2 MDD with the initial evaluation using the District's preferred 16-hour pump cycle time (see Table 10). Similar to Alternative A, the pump cycle time was increased to reduce the firm pumping capacity rate needed to supply the MDD.

For Alternatives A through E, F&L utilized pumps that matched the current pump models, sizes and pumping rates present in the existing Lynwood Pump Station and San Marin Pump Station. Each pump station used individual pump capacities of 1,800 GPM with the specific number needed to meet the future Primary Zone 2 MDD. This approach was used for consistency to ensure that the

District operations staff will not need to be trained to maintain new or different equipment in the new pump station.

F&L performed a supplemental evaluation to extend the pump cycle time Based on the extended pump cycle time evaluation, a pump cycle time of 17 hours during MDD results in a minimum firm pump station capacity of about 5,200 GPM, which is less than the 5,400 GPM proposed for this alternative. This pumping rate difference results in a net pumping capacity of 0.34 MGD (see Table 10). This pumping rate results in the Primary Zone 2 tanks remaining full or filling while reducing impacts to Zone 1 storage tanks to be similar to existing conditions.

Based on preliminary modeling, compared to both Alternative A and Alternative B, Alternative E can provide improvements for supply to the Pacheco Valley Tank. Alternative E dramatically improves the ability to fill Pacheco Valley Tank without performing similar operational steps to fill Sunset Tank before filling Pacheco Valley Tank. In addition, this alternative was not increasing the impacts to Zone 1 storage tanks above what is believed to occur under existing conditions. Alternative E results in similar abilities to fill Pacheco Valley Tank as Alternative C.

The resulting pump stations would include a total of three pumps at Site 2 and two pumps at the Site 5 pump station. Each pump was individually sized for 1,800 GPM matching the current pumps for the existing Lynwood Pump Station and San Marin Pump Station.

Alternative E, with a firm capacity of 1,800 GPM at Site 5 and 3,600 GPM at Site 2 (see Table 10), will have impacts on the distribution pressures located around Site 5 by increasing pressure by approximately 56 psi, similar to Alternative D. This is due primarily to the pressure zone change. The portion of Zone 2 adjacent to Site 5 is currently within the Captain Nurse Regulated Zone 2 and is operated at a lower pressure than Primary Zone 2. To effectively implement Alternative E, a portion of Captain Nurse Regulated Zone 2 pipelines will be converted to Primary Zone 2 pipelines. Seven new pressure reducing stations will be installed on branch lines off the converted Primary Zone 2 pipeline to maintain the same pressure for all the existing customers currently being served by the Captain Nurse Regulated Zone 2 (Figure 10).

F&L has preliminarily determined that this pump station alternative results in the Primary Zone 2 tanks remaining full or filling and reducing impacts to Zone 1 storage tanks during MDD. However, further analysis of impacts and an analysis of operational storage needs in the Zone 1 and Primary Zone 2 storage tanks should be verified as part of the design and the District's future update of the 2018 Master Plan.

6.7.2 Potential Environmental Permit Requirements and Constraints

WRA performed an Environmental Constraints analysis for Site 5. The results are summarized in this section with the detailed analysis in Appendix D. The potential environmental constraints are the same as Alternative B for the Site 2.

For the Site 5, WRA conducted a field investigation to identify the potential for special-status species within the sites. Based on the highly disturbed condition of the proposed site, no further actions are recommended for special-status plant species and special-status wildlife species.

Non-special-status native birds may nest in trees and vegetation within and immediately surrounding the proposed site. The active nests of native birds are protected under the federal MBTA and CFGC. Recommendations to avoid and minimize the potential impacts on nesting birds can be found within WRA's site assessment.

The only potential development-related constraint associated with Alternative E is the trees and shrubs protected under Chapter 17 of the Novato Code of Ordinances ("Tree and Shrub Ordinance"). The District is not required to comply with the City of Novato Ordinances. As such, the project is not required to replace trees to be removed by project activities in accordance with the City's Tree Ordinance. However, the District intends to replace trees removed by the project at the recommended one to one ration, which is consistent with the City's Tree Ordinances.

Construction of a new pump station at any of the Alternative E sites would require compliance with the CEQA. Based on WRA's review of the sites, including biological resources conditions, compliance with Chapter 17 of the Novato Code of Ordinances, and the inclusion of the nesting bird protocol, a new pump station at the Alternative E location would not result in any significant environmental impacts that could not be mitigated pursuant to CEQA.

As part of the CEQA effort, any temporary construction impacts (e.g., noise, dust, stormwater, etc.) would be considered mitigated impacts by maintaining compliance with local and state regulations including but not limited to the Construction Stormwater General Permit, Novato Code of Ordinances, and any additional regulations.

6.7.3 Regional Geologic and Soil Engineering Data

CE&G performed a desktop study for Alternative E, and the analysis results are summarized in this section, with the detailed analysis included in Appendix E. The regional geologic and soil engineering data are the same as Alternative B for Site 2.

The Alternative D, Site 5 location is mapped as being underlain by Holocene-aged alluvial deposits, which are described as poorly to moderately sorted sand, silt, and gravel. Alluvial deposits in this area is generally underlain with Franciscan Complex sedimentary bedrock. The site is shown on the NRCS soil map as being surficial soil that generally extends to depths of about 37 inches below grade. The surficial soils unit is classified as well-drained, has a high runoff class, and has low available water storage. Groundwater data adjacent to the area showed groundwater levels between 10 and 14 feet below grade. No site specific groundwater level data was found for the site. The site has moderate liquefaction susceptibility. Due to the relatively flat topography, landsliding for this site is unlikely to occur.

CE&G found that the site is located in the seismically active San Francisco Bay Area and will likely experience strong ground shaking from a large earthquake along with one or more of the nearby active faults during the design lifetime of the project.

CE&G evaluated if any of the Alternative D site locations were within an Alquist-Priolo Earthquake Fault Zone. According to the California Geological Survey (CGS) (2006), the sites are not within an

Alquist-Priolo Earthquake Fault Zone. According to the United States Geological Survey's (USGS) Quaternary fault and fold database, no active faults mapped cross any Alternative D site locations.

6.7.4 Conceptual Design

F&L has included a description of key pump station components evaluated for Alternative E and informed the conceptual design. The proposed Alternative E Conceptual Design drawings are included in Appendix F.

6.7.4.1 Pumps

Alternative E will have the same type of pumps at each of the two new pump stations, as discussed in Alternative A.

6.7.4.2 Building and Facility Layout

The Alternative E pump stations will have a similar building and facility layout as discussed in Alternative A. The size of the building will vary depending on the number of pumps, but all the building components will be similar to Alternative A.

Site 2 will have the same additional piping requirements as Alternative B.

For Site 5, approximately 40 ft of pipe is needed to connect to the existing 16-inch Zone 1 pipe. Approximately 80 ft of additional piping is needed to connect to the existing 16-inch Captain Nurse Regulated Zone 2 distribution pipe. Similar to Alternative D, some of the existing pipelines within the Captain Nurse Regulated Zone will be converted to Primary Zone 2 pipelines. The higher pressure that occurs along these pipes as part of Primary Zone 2 will need to be reduced prior to the current service connections. A pressure reducing valve is proposed for the branch lines to reduce the pressure to the Captain Nurse Regulated Zone pressure. Specific valve closures have not been identified in this conceptual review. Seven pressure reducing valves will need to be included as part of this alternative. See conceptual drawings in Appendix F for Alternative E.

6.7.4.3 Electrical Components

The Alternative E pump stations will have similar electrical components as discussed in Alternative A, except for the new PG&E service for the new pump station at Site 5. The existing PG&E infrastructure in this area appears to have been previously connected to commercial customer loads in the area via overhead PG&E distribution. It is suspected that connecting a new PG&E service in this location may be facilitated more so than at the previously discussed sites which are located in predominantly residential areas.

6.7.5 Capital Cost

The Conceptual OPC for Alternative E was developed similarly to Alternative A. The Alternative E OPC is $9,823,000 and is presented in Table 15. The OPC is presented in 2024 dollars.

6.7.6 Net Operating Cost

The net present and operating cost based on a 17-hour pump cycle time Alternative E is $15,952,000, as presented in Table 16.

7 ALTERNATIVE COMPARISON

The purpose of this section is to evaluate each alternative described in Section 6 to identify the preferred alternative. To perform the comparative review, F&L first developed a series of evaluation criteria, including ranking guidance, and then applied the evaluated criteria to each option.

7.1 Overview

A set of evaluation criteria was developed to assess each of the alternatives, including retrofitting the existing Lynwood Pump Station. The evaluation criteria were used to establish a total score for each option. The total score ranking is used to select the preferred alternative the District should consider.

The evaluation is performed using the following six criteria:

- Meet Primary Zone 2 Future Demand,
- Improve Pacheco Valley Tank Flow,
- Improve Primary Zone 2 System Redundancy,
- Site Features,
- Capital Cost, and
- Net Present Value Operation & Maintenance (O&M) Cost.

7.2 Pump Station Alternatives Evaluation Criteria

Using the above criteria, the F&L team graded each site on a sliding-point scale. The point scale provides a grade between 1 and 10, with 1 being inadequate/poor and 10 being excellent in meeting the stated evaluation criteria. To develop a score for each component within each of the six evaluation criterion, guidelines for the sliding point scale was developed as follows:

- Meet Primary Zone 2 Future Demand
    - A score of 0 to 4 indicates an alternative with inadequate ability to meet future demand.
    - A score of 5 to 7 indicates an alternative with limited ability to meet future demand.
    - A score of 8 to 10 indicates an alternative with adequate ability to meet future demand.
- Improve Pacheco Valley Tank Flow
    - A score of 0 to 4 indicates an alternative that does not improve or negatively impacts the ability to provide flow to Pacheco Valley Tank.
    - A score of 5 to 7 indicates an alternative continues to meet existing conditions or only minimally provides additional flow to Pacheco Valley Tank.

- A score of 8 to 10 indicates an alternative with adequate ability to provide additional flow to Pacheco Valley Tank.

- Improve Primary Zone 2 System Redundancy
  - A score of 0 to 4 indicates an alternative that continues to provide local redundancy at the pump station itself (i.e. one spare pump).
  - A score of 5 to 7 indicates an alternative that provides enhanced, local redundancy at the pump station itself (i.e., multiple spare pumps) or within the pressure zone potentially allowing multiple pump stations to operate at reduced capacity.
  - A score of 8 to 10 indicates an alternative with adequate ability to provide additional Primary Zone 2 system redundancy within both redundant pump stations and local redundancy.
- Site Features
  - A score of 0 to 4 indicates an alternative with inadequate site features (poor maintenance access, lack of parking, proximity to multiple residential units, requires land acquisition, and some potential environmental constraints).
  - A score of 5 to 7 indicates an alternative with subpar site features (fair maintenance access, potential room for parking, proximity to minimal residential units, and a few potential environmental constraints).
  - A score of 8 to 10 indicates an alternative with adequate site features (good maintenance access, room for parking, proximity to a residential unit, and minimal potential environmental constraints).
- Capital Cost
  - A score of 0 to 4 indicates an alternative with an OPC over $8,000,000.
  - A score of 5 to 7 indicates an alternative with an OPC between $6,000,000 and $8,000,000.
  - A score of 8 to 10 indicates an alternative with an OPC between $4,000,000 and $6,000,000.
- Net Present O&M Cost
  - A score of 0 to 4 indicates an alternative with net present O&M costs over $12,000,000.
  - A score of 5 to 7 indicates an alternative with net present O&M costs between $10,000,000 and $12,000,000.
  - A score of 8 to 10 indicates an alternative with net present O&M costs between $8,000,000 and $10,000,000.

7.3 Alternatives Evaluation Results

The scoring for each component within each evaluation criteria using the guidelines described above is presented in Table 17. For each criteria, a brief summary of the score assigned to each alternative is provided below:

- Meet Primary Zone 2 Future Demand
    - Alternative A is able to meet Primary Zone 2 Future Demand and was therefore assigned a score of 10.
    - Alternative B is able to meet Primary Zone 2 Future Demand and was therefore assigned a score of 10.
    - Alternative C is able to meet Primary Zone 2 Future Demand and was therefore assigned a score of 10.
    - Alternative D is able to meet Primary Zone 2 Future Demand and was therefore assigned a score of 10.
    - Alternative E is able to meet Primary Zone 2 Future Demand and was therefore assigned a score of 10.
    - Retrofit the existing Lynwood Pump Station will meet Primary Zone 2 Future Demand and was therefore assigned a score of 10.
- Improve Pacheco Valley Tank Flow
    - Alternative A does not improve the ability to fill Pacheco Valley Tank but it does not result in worse operational conditions when compared to exsiting operations and is therefore assigned a score of 3.
    - Alternative B significantly improves the District's ability to fill Pacheco Valley Tank without requiring Sunset Tank to be isolated and is therefore assigned a score of 9.
    - Alternative C is the alternative that most improves the District's ability to fill Pacheco Valley Tank and is therefore assigned a score of 10.
    - Alternative D is the alternative that most improves the District's ability to fill Pacheco Valley Tank and is therefore assigned a score of 10.
    - Alternative E is the alternative that most improves the District's ability to fill Pacheco Valley Tank and is therefore assigned a score of 10.
    - Retrofitting the existing Lynwood Pump Station does not improve the ability to fill Pacheco Valley Tank but it does not result in worse operational conditions when compared to exsiting operations and is therefore assigned a score of 3.

- Improves Primary Zone 2 System Redundancy
    - Alternative A continues to meet the exisiting ability to provide Primary Zone 2 system redundancy since it has a spare pump at the pump station and is therefore assigned a score of 1.
    - Alternative B continues to meet the exisiting ability to provide Primary Zone 2 system redundancy since it has a spare pump at the pump station and is therefore assigned a score of 1.
    - Alternative C adequately provides additional Primary Zone 2 system redundancy since it consists of two new pump stations that each include a spare pump and is therefore assigned a score of 10.
    - Alternative D adequately provides additional Primary Zone 2 system redundancy since it consists of two new pump stations that each include a spare pump and is therefore assigned a score of 10.
    - Alternative E adequately provides additional Primary Zone 2 system redundancy since it consists of two new pump stations that each include a spare pump and is therefore assigned a score of 10.
    - Retrofitting the existing Lynwood Pump Station continues to meet the exisiting ability to provide Primary Zone 2 system redundancy since it has a spare pump at the pump station and is therefore assigned a score of 1.
- Site Features
    - Alternative A does improve site access when compared to the existing Lynwood Pump Station site because Sunset Parkway between Cambridge Street and Monte Maria Avenue has both a travel lane and parking lane, which would allow for traffic to pass the site even when the District staff require temporary traffic control. The site is adequately above the FEMA floodplain but the location is constrained by the traffic island width as well as immediately adjacent to several single family homes. Therefore, the alternative is assigned a score of 4.
    - Alternative B improves site access because there are two eastbound travel lanes that would allow for a single lane of traffic to be maintained with temporary traffic control. The site is adequately above the FEMA floodplain but is in close proximity to San Jose Creek. The site would require an easement or other land acquisition from the City. Therefore, the alternative is assigned a score of 5.
    - Alternative C for Site 2 is similar to Alternative B. Site 3 does have adquate site access with temporary traffic control to allow for controlled one way traffic. The second pump station site is adequately above the FEMA floodplain but an easement or other land acquisition from a private land owner would be required to provide the site. Therefore, the alternative is assigned a score of 2 to reflect the overall complexities with securing two pump station sites including potential negotiation with a private land owner.

- Alternative D for Site 2 is similar to Alternative B. Site 4 does have adquate site access with temporary traffic control to allow for controlled one way traffic. Site 4 is within the FEMA floodplain and in close proximity to Pacheco Creek. The site requires an easement or other land acquisition from the City. Therefore, the alternative is assigned a score of 3 to reflect the additional design needed since the second pump station site is within the FEMA floodplain requiring additional floodproofing measures when compared to any of the the other four sites.
- Alternative E for Site 2 is similar to Alternative B. Site 5 does have adquate site access with temporary traffic control to allow for controlled one way traffic. Site 5 is above the FEMA floodplain but an easement or other land acquisition from a private land owner would be required to provide the site. Therefore, the alternative is assigned a score of 1 to reflect the overall complexities with securing two pump station sites including potential negotiation with a private land owner.
- Retrofitting the existing Lynwood Pump Station does not improve site access. The site is above the FEMA floodplain but the location is constrained by the traffic island width as well as immediately adjacent to several single family homes and the Lynwood Elementary School entrance. Therefore, the alternative is assigned a score of 2.

- Capital Cost
  - Alternative A's capital cost is $4.52 million and therefore is assigned a score of 9.
  - Alternative B's capital cost is $6.64 million and therefore is assigned a score of 6.
  - Alternative C's capital cost is $11.14 million and therefore is assigned a score of 1.
  - Alternative D's capital cost is $9.67 million and therefore is assigned a score of 3.
  - Alternative E's capital cost is $9.82 million and therefore is assigned a score of 3.
  - Retrofitting the existing Lynwood Pump Station would be similar to Alternative D and Alternative E and therefore is assigned a score of 3.
- Net Present O&M Cost
  - Alternative A's net present O&M cost is $9.87 million and therefore is assigned a score of 8.
  - Alternative B's net present O&M cost is $11.43 million and therefore is assigned a score of 5.
  - Alternative C's net present O&M cost is $17.27 million and therefore is assigned a score of 1.
  - Alternative D's net present O&M cost is $15.80 million and therefore is assigned a score of 2.
  - Alternative E's net present O&M cost is $15.95 million and therefore is assigned a score of 2.

- Retrofitting the existing Lynwood Pump Station would be similar to Alternative D and Alternative E and therefore is assigned a score of 2.

The final rankings, with the highest total score listed first is;

- Alternative D (38 total points)
- Alternative B (36 total points)
- Alternative E (36 total points)
- Alternative A (35 total points)
- Alternative C (34 total points)
- Retrofit the exisitng Lynwood Pump Station (21 total points)

Based on the evaluation presented above, the preferred alternative is Alternative D, which would provide:

- Two new pump stations with a total firm capacity of 5,400 GPM and all pumps would be 1,800 GPM.
- One pump station with three pumps will be located at Ignacio Boulvard and Palmer Drive (Site 2). The second pump station will have two pumps and will be located at C Street and Main Gate Road (Site 4).
- The new pump stations would be capable, with operation of San Marin Pump Station, to meet future Primary Zone 2 demands.
- The new pump stations would significantly improve flow to Pacheco Valley Tank.

8 NEXT STEPS

8.1 Proposed Pump Station Design

Upon approval of the conceptual design by the District, the selected alternative for the Lynwood Pump Station replacement design can be advanced to the development of construction documents. Upon approval of the conceptual design by the District, a few electrical items should be considered, including electrical equipment lead times and PG&E service coordination. A summary of the electrical items can be found in Appendix H. Further hydraulic modeling of the selected conceptual design should also be performed to verify preliminary identified operational impacts of the new pump station sites and to analyze operational storage needs in the Zone 1 and Primary Zone 2 storage tanks as noted in Section 8.2.

8.2 District Master Plan Update Confirmation

As noted in Section 5.2.1, a key finding during the modeling was that the shorter 16-hour Primary Zone 2 pump operating periods will change the amounts of operational storage needed for Zone 1 and Primary Zone 2. The operational storage needs under the reduced pump operating periods should be further investigated under future master plan updates. The preliminary operational changes that were identified for the selected alternative should be verified by further hydraulic analysis of both Zone 1 and Primary Zone 2 as part of the design of the chosen alternative. This should include review of the PHD conditions including release from Primary Zone 2 tanks and replenishment of Zone 1 tanks.

The preliminary steady state hydraulic modeling results have shown that for both existing MDD and future MDD conditions that the Zone 1 Storage Tanks may be draining to meet both the Zone 1 demands and the cumulative supply to both Lynwood Pump Station and San Marin Pump Station. In order to quantify the potential operational impacts, further steady state analyses and an extended period hydraulic simulation is recommended to be performed. Some of these analyses could be done as part of the District's planned master plan update.

Based on the F&L team's discussions with District staff throughout development of this Engineering Assessment, the District may not have experienced high demand conditions similar to the MDD scenario that was included in the model used to perform the analysis. The use of a 16-hour pumping period (or other period less than 24 hours) for Primary Zone 2 supply will also increase operational storage volume requirements and create modified storage replenishment conditions during the day. The storage draw from the Zone 1 storage tanks during Primary Zone 2 pumping may be replenished during the daily time period where Primary Zone 2 pumping has halted. These operational conditions should be further reviewed as part of the design of the conceptual pumping alternative chosen.

FIGURES

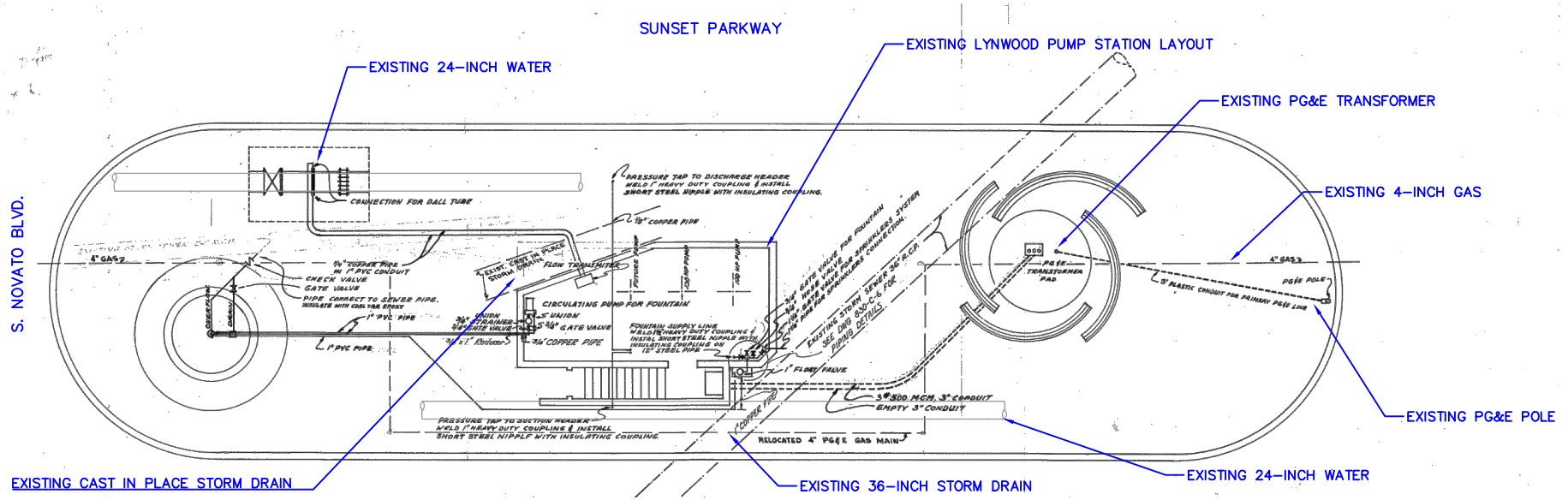

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FIGURE 1
EXISTING LYNWOOD PUMP STATION SITE CONSTRAINTS
NORTH MARIN WATER DISTRICT
NOVATO, CA, 94945

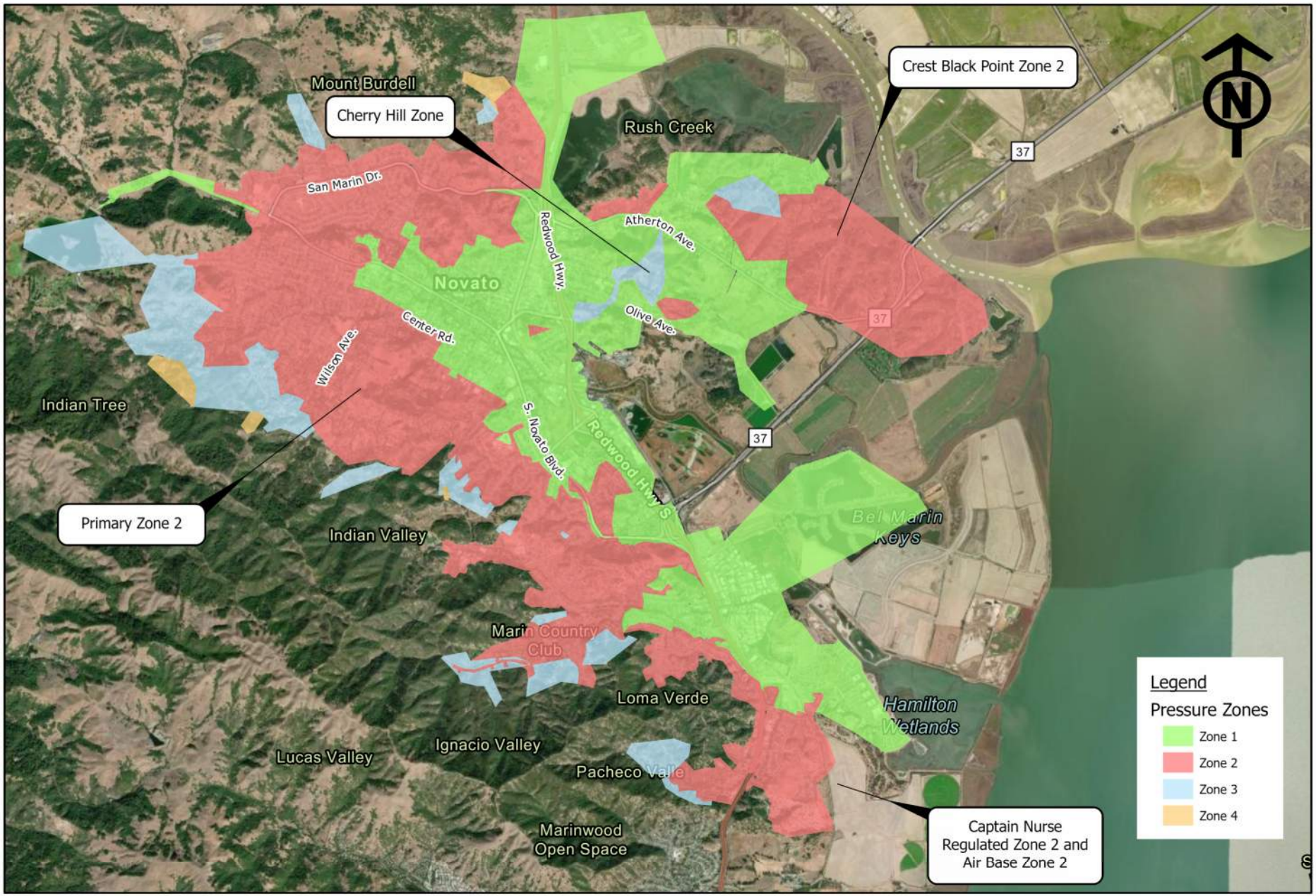

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FIGURE 2
ZONE MAP
NORTH MARIN WATER DISTRICT
NOVATO, CA 94945

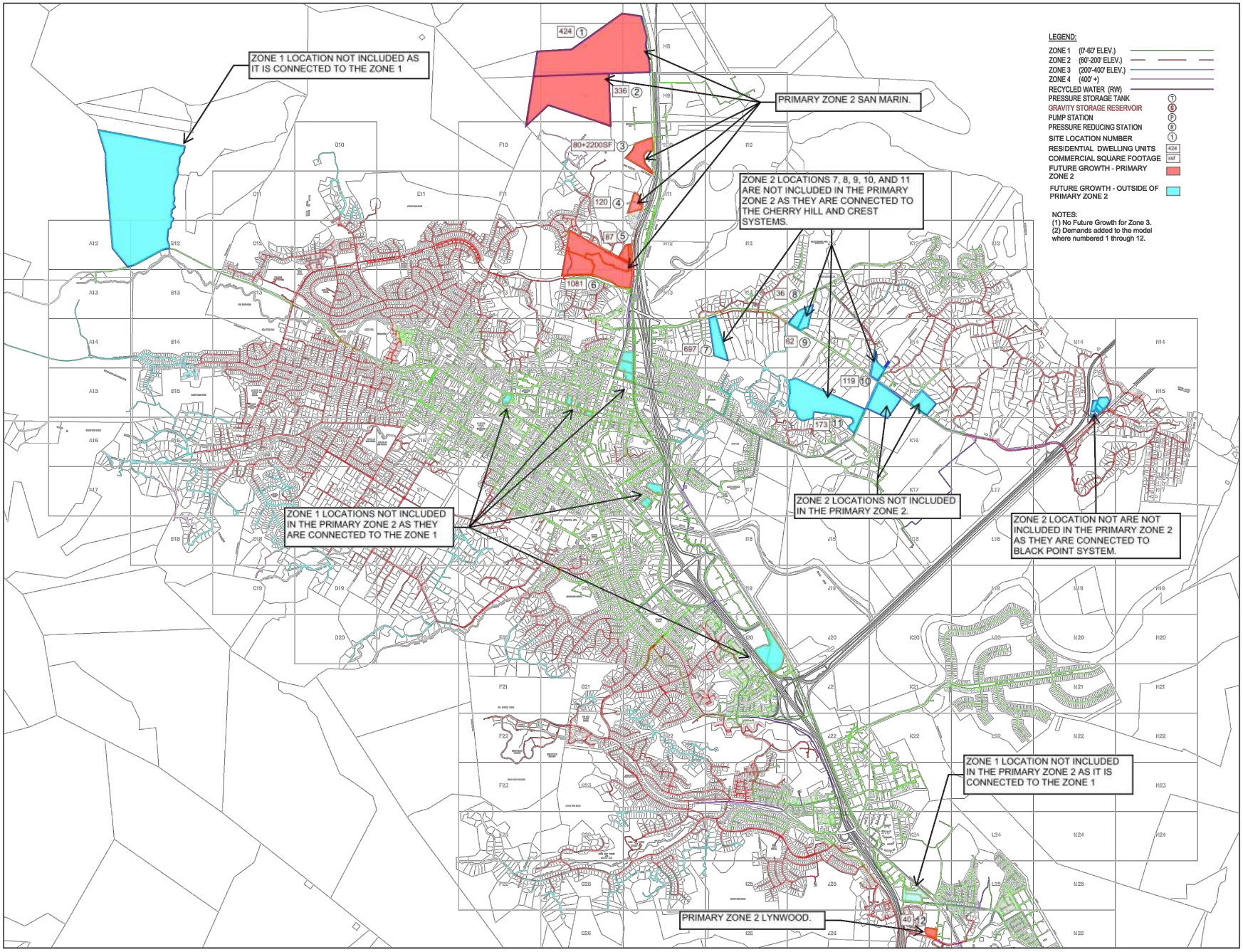

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FIGURE 3
FUTURE DEMAND LOCATIONS
NORTH MARIN WATER DISTRICT
NOVATO, CA, 94945

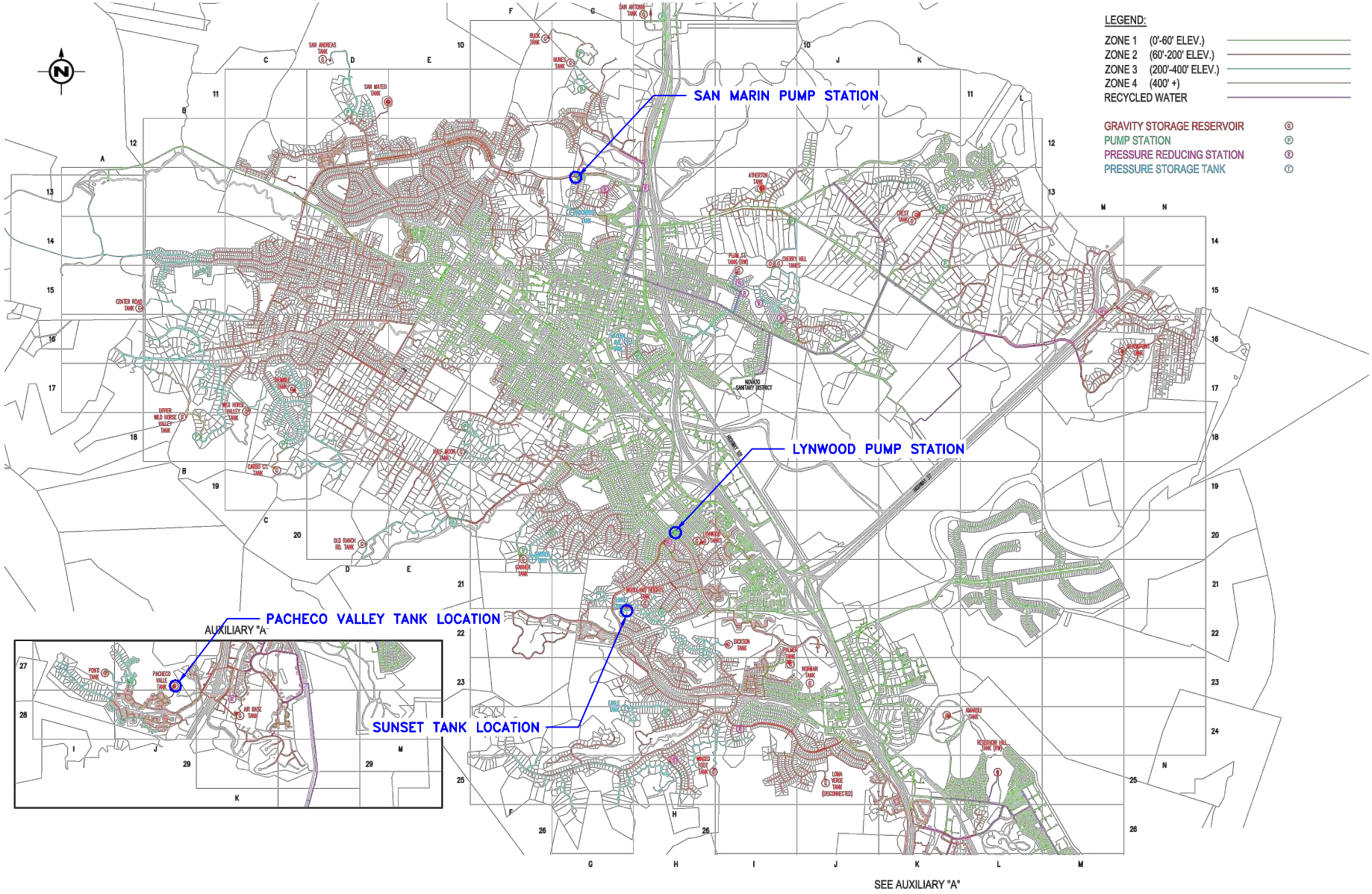

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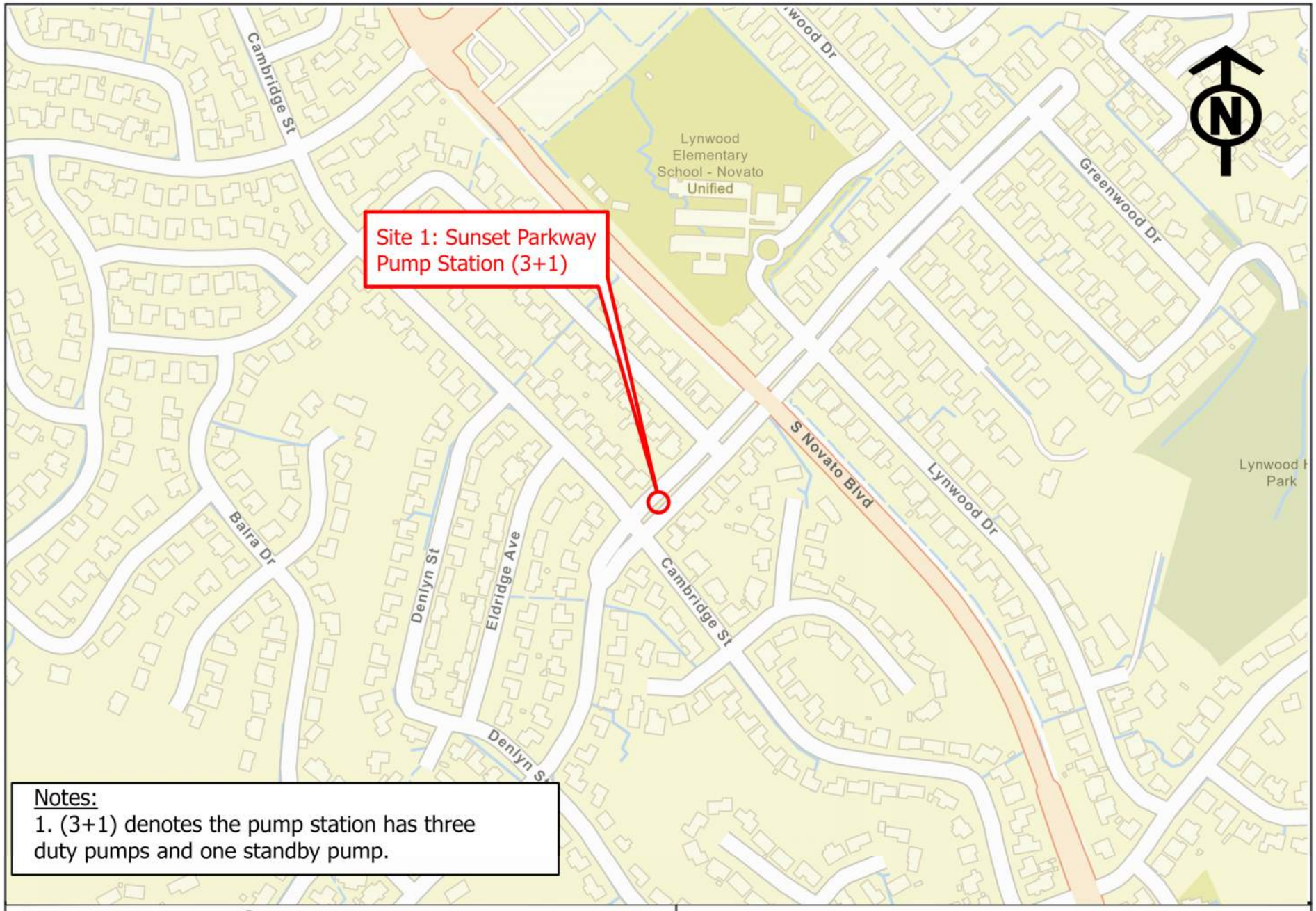
FIGURE 4
LOCATION MAP
NORTH MARIN WATER DISTRICT
NOVATO, CA, 94945



Notes:
1. (3+1) denotes the pump station has three duty pumps and one standby pump.

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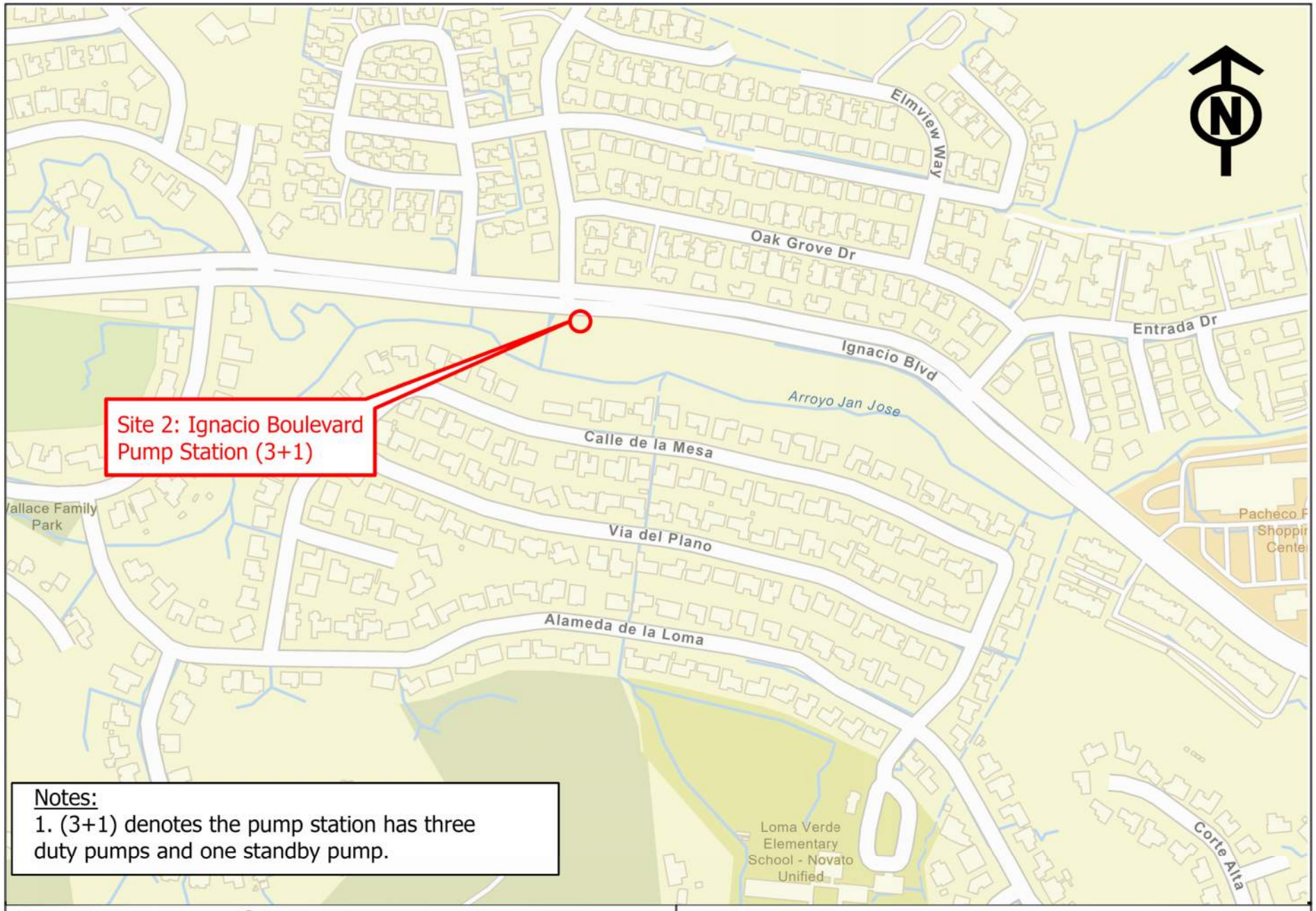
FIGURE 5
ALTERNATIVE A LOCATION MAP
NORTH MARIN WATER DISTRICT
NOVATO, CA 94945



Notes:
1. (3+1) denotes the pump station has three duty pumps and one standby pump.

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FIGURE 6
ALTERNATIVE B LOCATION MAP
NORTH MARIN WATER DISTRICT
NOVATO, CA 94945

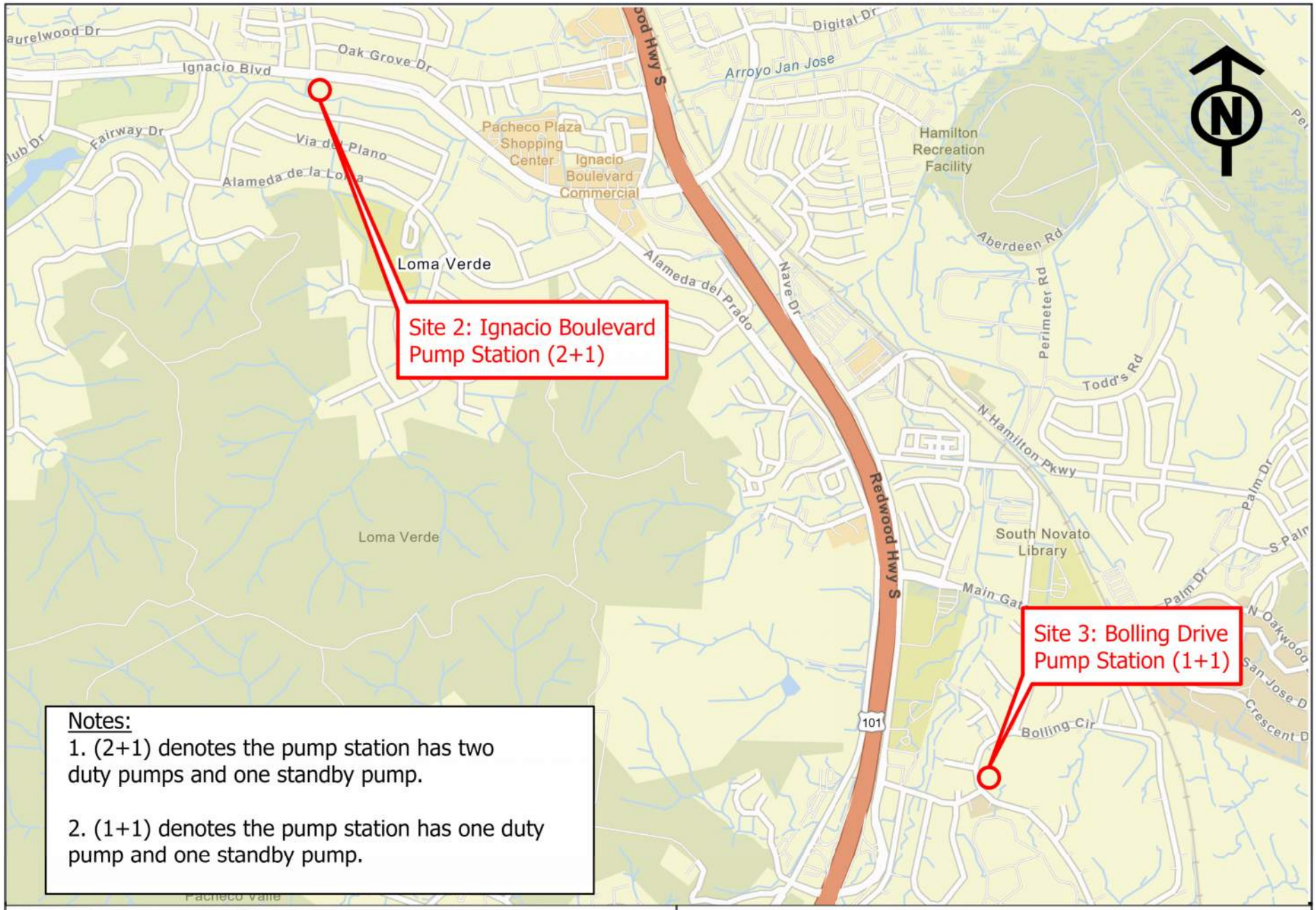

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FIGURE 7
ALTERNATIVE C LOCATION MAP
NORTH MARIN WATER DISTRICT
NOVATO, CA 94945

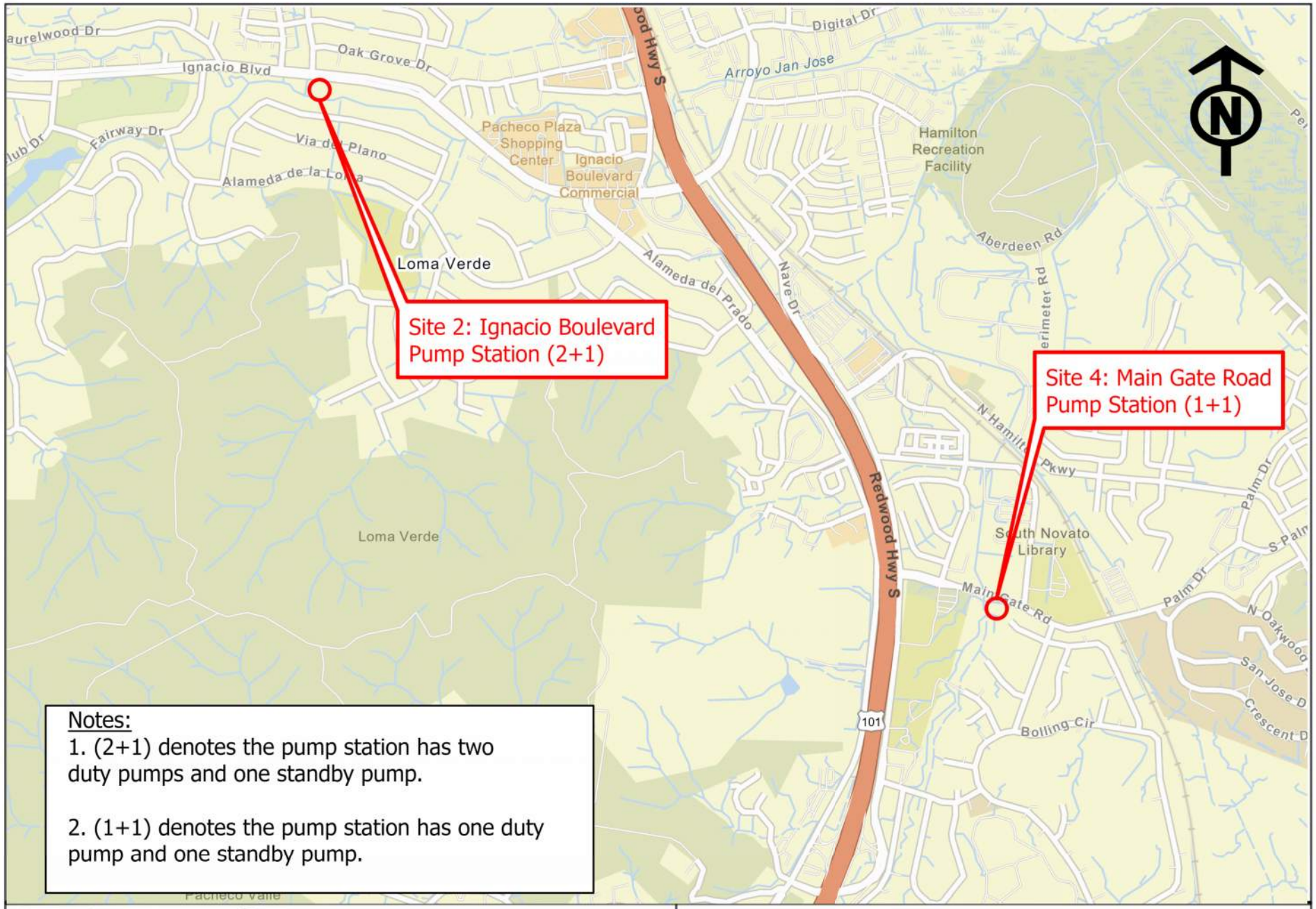

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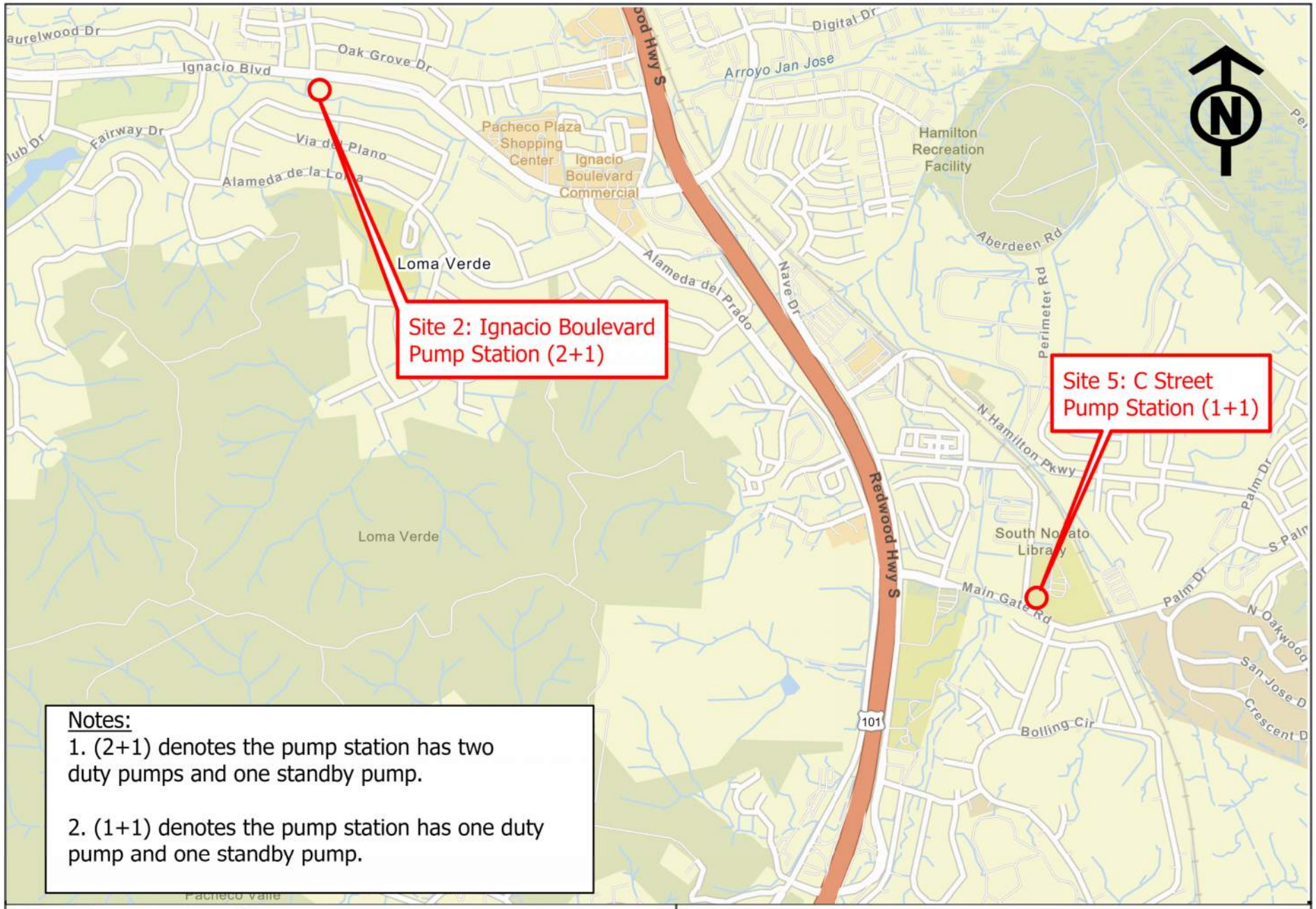
FIGURE 8
ALTERNATIVE D LOCATION MAP
NORTH MARIN WATER DISTRICT
NOVATO, CA 94945



Notes:

1. (2+1) denotes the pump station has two duty pumps and one standby pump.

2. (1+1) denotes the pump station has one duty pump and one standby pump.

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FIGURE 9
ALTERNATIVE E LOCATION MAP
NORTH MARIN WATER DISTRICT
NOVATO, CA 94945

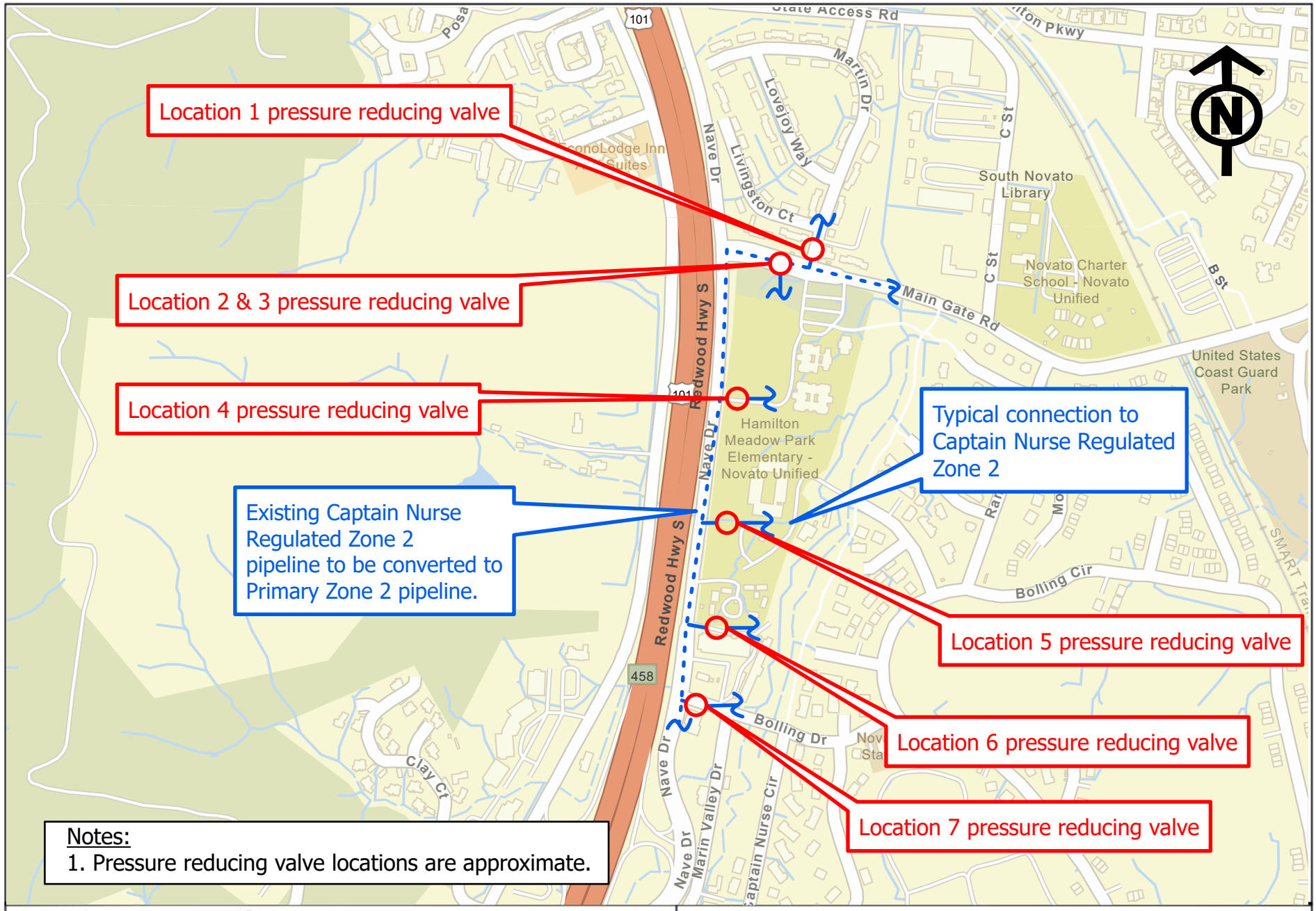

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FIGURE 10
PRESSURE REDUCING VALVE LOCATION MAP
NORTH MARIN WATER DISTRICT
NOVATO, CA 94945

TABLES

Table 1
Future Zone Demands on Primary Zone 2, Zone 3, Zone 4, and Hydro-Pneumatic Zones
Lynwood Pump Station Capacity Assessment
North Marin Water District, Novato, California

Pressure Zone	Existing Primary Zone 2 FY 2020 Max Day Demand (GPD) (1)	Added Future Primary Zone 2 Max Day Demand (GPD)	Future Primary Zone 2 Max Day Demand (GPD)
Zone 2			
Crest (2)	0	-	0
Black Point (2)	0	-	0
San Mateo/Trumbull Subzone	3,693,000	1,140,000	4,833,000
Sunset/Pacheco Subzone	2,634,000	0	2,634,000
Air Base	468,000	22,000	490,000
Zone 2 Total	6,795,000	1,162,000	7,957,000
Zone 3			
Cherry Hill (2)	0	-	0
Halfmoon	35,000	-	35,000
Wild Horse Valley/Center Road	421,000	-	421,000
Garner	30,000	-	30,000
Old Ranch Road	16,000	-	16,000
Dickson	93,000	-	93,000
Winged Foot	107,000	-	107,000
Ponti	122,000	-	122,000
San Andreas	30,000	-	30,000
Nunes	19,000	-	19,000
Zone 3 Total	873,000	0	873,000
Zone 4			
Buck	29,000	-	29,000
Upper Wild Horse Valley	17,000	-	17,000
Cabro Court	5,000	-	5,000
Zone 4 Total	51,000	0	51,000
Hydro-Pneumatic Zones			
Bahia (2)	0	-	0
Hayden (2)	0	-	0
Diablo Hills (2)	0	-	0
Garner	10,000	-	10,000
Indian Hills	11,000	-	11,000
Rockrose	14,000	-	14,000
Eagle Drive	31,000	-	31,000
Hydro-Pneumatic Total	66,000	0	66,000
Total	**7,785,000**	**1,162,000**	**8,947,000**

Notes
(1) Values taken from NMWD, 2019. 2018 Novato Water System Master Plan Update, September 2019. North Marin Water District.
(2) Pressure Zones demands not included. Pressure Zones not directly influenced by the Lynwood or San Marin pump stations (Primary Zone 2).

Abbreviations
FY: Financial Year
GPD: Gallons Per Day

References
NMWD, 2019. 2018 Novato Water System Master Plan Update, September 2019. North Marin Water District. https://nmwd.com/wp-content/uploads/2020/04/2018WMP.pdf

Table 2
Future Primary Zone 2 Demands Annual Acre-Feet
Lynwood Pump Station Capacity Assessment
North Marin Water District, Novato, California

	Residential Demand		Commercial, Office and Government Demand	
Location	**Equivalent Residential Dwelling Units (EDU)(1)**	**Annual Acre-Feet (AAF)(2)**	**Square Footage (SF) (1)**	**Annual Acre-Feet (AAF) (3)**
1	424	144	-	-
2	336	114	-	-
3	80	27	2,200	0.3
4	120	41	-	-
5	87	29	-	-
6	1,081	366	-	-
7 (4)	697 (4)	236 (4)	-	-
8 (4)	36 (4)	12 (4)	-	-
9 (4)	62 (4)	21 (4)	-	-
10 (4)	119 (4)	40 (4)	-	-
11 (4)	173 (4)	59 (4)	-	-
12	40	14	-	-
Total Primary Zone 2	**2,168**	**735**	**2,200**	**0.3**

Notes
(1) Information provided by District.
(2) Residential Demand (AAF) = 0.339 AAF per EDU. NMWD, 2019.
(3) Office, Commercial and Government Demand was calculated to be 0.3 AAF which was captured within the rounding of the Residential Demand.
(4) Location is not within Primary Zone 2 and is therefore not served by Lynwood or San Marin Pump Station. Values not included in Total Primary Zone 2.

Abbreviations
AAF: Annual Acre-Feet
EDU: Equivalent Residential dwelling Units
SF: Square Feet

References
NMWD, 2019. 2018 Novato Water System Master Plan Update, September 2019. North Marin Water District. https://nmwd.com/wp-content/uploads/2020/04/2018WMP.pdf

Table 3
Future Primary Zone 2 Demands
Lynwood Pump Station Capacity Assessment
North Marin Water District, Novato, California

	Annual Demand (AAF) (1) (2)	Average Day Demand (MGD) (3)	Maximum Day Demand (MGD) (4)
Future Primary Zone 2 Demand	735	0.66	1.16

Notes
(1) Values from Table 2 - Future Primary Zone 2 Demands Annual Acre-Feet
(2) Office, Commercial and Government Demand was calculated to be 0.3 AF which was captured within the rounding of the Residential Demand.
(3) Average Day Demand = (Annual Acre-Feet /365 Days) * (1 AF/ 0.325850 MG)
(4) Maximum Day Demand (MDD) = (Average Day Demand)*1.77

Abbreviations
AAF: Annual Acre-Feet
MGD: Million Gallons per Day
MG: Million Gallons

References
NMWD, 2019. 2018 Novato Water System Master Plan Update, September 2019. North Marin Water District.
https://nmwd.com/wp-content/uploads/2020/04/2018WMP.pdf

Table 4
Existing Primary Zone 2 Firm Capacities
Lynwood Pump Station Capacity Assessment
North Marin Water District, Novato, California

Description and Location	Firm Capacity (GPM) (1)	Capacity (GPD)
San Marin Pump Station	3,600	5,184,000
Lynwood Pump Station	3,600	5,184,000
Total	**7,200**	**10,368,000**

Notes
(1) Firm capacity based on two of three pumps operating at each pump station.

Abbreviations
GPM: Gallons Per Minute
GPD: Gallons Per Day

Table 5
Existing Primary Zone 2 Net Pumping Capacities
Lynwood Pump Station Capacity Assessment
North Marin Water District, Novato, California

Description and Location	Capacity (GPD)
Total Existing Primary Zone 2 Firm Capacity (1)	10,368,000
Existing Primary Zone 2 Max Day Demand (2)	7,785,000
Adjusted 16 Hour Pumping Rate Required (3)	11,677,500
Adjusted 18 Hour Pumping Rate Required (4)	10,354,050
Net Pumping Capacity For 16 Hour Pumping (5)	**-1,309,500**
Net Pumping Capacity For 18 Hour Pumping (6)	**13,950**

Notes
(1) Value taken Table 4
(2) Value taken from Table 1
(3) Adjusted 16 Hour Pumping Rate Required = (Existing Primary Zone 2 Max Day Demand)*1.50
(4) Adjusted 18 Hour Pumping Rate Required = (Existing Primary Zone 2 Max Day Demand)*1.33
(5) Net Pumping Capacity For 16 Hour Pumping = Total Existing Primary Zone 2 Firm Capacity - Adjusted 16 Hour Pumping Rate Required
(6) Net Pumping Capacity For 18 Hour Pumping = Total Existing Primary Zone 2 Firm Capacity - Adjusted 18 Hour Pumping Rate Required

Abbreviations
GPM: Gallons Per Minute
GPD: Gallons Per Day

References
NMWD, 2019. 2018 Novato Water System Master Plan Update, September 2019. North Marin Water District.
https://nmwd.com/wp-content/uploads/2020/04/2018WMP.pdf

Table 6
Lynwood Pump Station Capacity Alternative A
Lynwood Pump Station Capacity Assessment
North Marin Water District, Novato, California

Pump Station	Number of Operating Pumps (2)	Capacity per Pump (GPM)	Firm Capacity (GPM)	Capacity (GPD)
San Marin Pump Station (1)	2	1,800	3,600	5,184,000
New Site 1: Sunset Parkway Pump Station	3	1,800	5,400	7,776,000
Total	5	-	9,000	12,960,000
			Future Primary Zone 2 Max Day Demand	8,947,000
			Adjusted 16 Hour Pumping Rate (3)	13,420,500
			Adjusted 19 Hour Pumping Rate (4)	11,273,220
			Net Pumping Capacity For 16 Hour Pumping (5)	-460,500
			Net Pumping Capacity For 19 Hour Pumping (6)	1,686,780

Notes
(1) Values taken from NMWD, 2019. 2018 Novato Water System Master Plan Update, September 2019. North Marin Water District.
(2) Each pump station includes one additional standby pump as a back up.
(3) Adjusted 16 Hour Pumping Rate = (Future Primary Zone 2 Max Day Demand)*1.50
(4) Adjusted 19 Hour Pumping Rate = (Future Primary Zone 2 Max Day Demand)*1.26
(5) Net Pumping Capacity For 16 Hour Pumping = Total Existing Primary Zone 2 Firm Capacity - Adjusted 16 Hour Pumping Rate Required
(6) Net Pumping Capacity For 19 Hour Pumping = Total Existing Primary Zone 2 Firm Capacity - Adjusted 19 Hour Pumping Rate Required

GPM: gallons per minute
GPD: gallons per day

References
NMWD, 2019. 2018 Novato Water System Master Plan Update, September 2019. North Marin Water District. https://nmwd.com/wp-content/uploads/2020/04/2018WMP.pdf

Table 7
Lynwood Pump Station Capacity Alternative B
Lynwood Pump Station Capacity Assessment
North Marin Water District, Novato, California

Pump Station	Number of Operating Pumps (2)	Capacity per Pump (GPM)	Firm Capacity (GPM)	Capacity (GPD)
San Marin Pump Station (1)	2	1,800	3,600	5,184,000
New Site 2: Ignacio Boulevard Pump Station	3	1,800	5,400	7,776,000
Total	5	-	9,000	12,960,000
			Future Primary Zone 2 Max Day Demand	8,947,000
			Adjusted 16 Hour Pumping Rate (3)	13,420,500
			Adjusted 17 Hour Pumping Rate (4)	12,615,270
	Net Pumping Capacity For 16 Hour Pumping (5)			-460,500
	Net Pumping Capacity For 17 Hour Pumping (6)			344,730

Notes
(1) Values taken from NMWD, 2019. 2018 Novato Water System Master Plan Update, September 2019. North Marin Water District.
(2) Each pump station includes one additional standby pump as a back up.
(3) Adjusted 16 Hour Pumping Rate = (Future Primary Zone 2 Max Day Demand)*1.50
(4) Adjusted 17 Hour Pumping Rate = (Future Primary Zone 2 Max Day Demand)*1.41
(5) Net Pumping Capacity For 16 Hour Pumping = Total Existing Primary Zone 2 Firm Capacity - Adjusted 16 Hour Pumping Rate Required
(6) Net Pumping Capacity For 17 Hour Pumping = Total Existing Primary Zone 2 Firm Capacity - Adjusted 17 Hour Pumping Rate Required

Abbreviations
GPM: gallons per minute
GPD: gallons per day

References
NMWD, 2019. 2018 Novato Water System Master Plan Update, September 2019. North Marin Water District. https://nmwd.com/wp-content/uploads/2020/04/2018WMP.pdf

Table 8
Lynwood Pump Station Capacity Alternative C
Lynwood Pump Station Capacity Assessment
North Marin Water District, Novato, California

Pump Station	Number of Operating Pumps (2)	Capacity per pump (GPM)	Firm Capacity (GPM)	Capacity (GPD)
San Marin Pump Station (1)	2	1,800	3,600	5,184,000
New Site 2: Ignacio Boulevard Pump Station	2	1,800	3,600	5,184,000
New Site 3: Bolling Drive Pump Station	1	1,800	1,800	2,592,000
Total	5	-	9,000	12,960,000
			Future Primary Zone 2 Max Day Demand	8,947,000
			Adjusted 16 Hour Pumping Rate (3)	13,420,500
			Adjusted 17 Hour Pumping Rate (4)	12,615,270
	Net Pumping Capacity For 16 Hour Pumping (5)			-460,500
	Net Pumping Capacity For 17 Hour Pumping (6)			344,730

Notes
(1) Values taken from NMWD, 2019. 2018 Novato Water System Master Plan Update, September 2019. North Marin Water District.
(2) Each pump station includes one additional standby pump as a back up.
(3) Adjusted 16 Hour Pumping Rate = (Future Primary Zone 2 Max Day Demand)*1.50
(4) Adjusted 17 Hour Pumping Rate = (Future Primary Zone 2 Max Day Demand)*1.41
(5) Net Pumping Capacity For 16 Hour Pumping = Total Existing Primary Zone 2 Firm Capacity - Adjusted 16 Hour Pumping Rate Required
(6) Net Pumping Capacity For 17 Hour Pumping = Total Existing Primary Zone 2 Firm Capacity - Adjusted 17 Hour Pumping Rate Required

Abbreviations
GPM: gallons per minute
GPD: gallons per day

References
NMWD, 2019. 2018 Novato Water System Master Plan Update, September 2019. North Marin Water District https://nmwd.com/wp-content/uploads/2020/04/2018WMP.pdf

Table 9
Lynwood Pump Station Capacity Alternative D
Lynwood Pump Station Capacity Assessment
North Marin Water District, Novato, California

Pump Station	Number of Operating Pumps (2)	Capacity per pump (GPM)	Firm Capacity (GPM)	Capacity (GPD)
San Marin Pump Station (1)	2	1,800	3,600	5,184,000
New Site 2: Ignacio Boulevard Pump Station	2	1,800	3,600	5,184,000
New Site 4: Main Gate Road Pump Station	1	1,800	1,800	2,592,000
Total	5	-	9,000	12,960,000
			Future Primary Zone 2 Max Day Demand	8,947,000
			Adjusted 16 Hour Pumping Rate (3)	13,420,500
			Adjusted 17 Hour Pumping Rate (4)	12,615,270
	Net Pumping Capacity For 16 Hour Pumping (5)			-460,500
	Net Pumping Capacity For 17 Hour Pumping (6)			344,730

Notes
(1) Values taken from NMWD, 2019. 2018 Novato Water System Master Plan Update, September 2019. North Marin Water District.
(2) Each pump station includes one additional standby pump as a back up.
(3) Adjusted 16 Hour Pumping Rate = (Future Primary Zone 2 Max Day Demand)*1.50
(4) Adjusted 17 Hour Pumping Rate = (Future Primary Zone 2 Max Day Demand)*1.41
(5) Net Pumping Capacity For 16 Hour Pumping = Total Existing Primary Zone 2 Firm Capacity - Adjusted 16 Hour Pumping Rate Required
(6) Net Pumping Capacity For 17 Hour Pumping = Total Existing Primary Zone 2 Firm Capacity - Adjusted 17 Hour Pumping Rate Required

Abbreviations
GPM: gallons per minute
GPD: gallons per day

References
NMWD, 2019. 2018 Novato Water System Master Plan Update, September 2019. North Marin Water District
https://nmwd.com/wp-content/uploads/2020/04/2018WMP.pdf

Table 10
Lynwood Pump Station Capacity Alternative E
Lynwood Pump Station Capacity Assessment
North Marin Water District, Novato, California

Pump Station	Number of Operating Pumps (2)	Capacity per pump (GPM)	Firm Capacity (GPM)	Capacity (GPD)
San Marin Pump Station (1)	2	1,800	3,600	5,184,000
New Site 2: Ignacio Boulevard Pump Station	2	1,800	3,600	5,184,000
New Site 5: C Street Pump Station	1	1,800	1,800	2,592,000
Total	5	-	9,000	12,960,000
			Future Primary Zone 2 Max Day Demand	8,947,000
			Adjusted 16 Hour Pumping Rate (3)	13,420,500
			Adjusted 17 Hour Pumping Rate (4)	12,615,270
	Net Pumping Capacity For 16 Hour Pumping (5)			-460,500
	Net Pumping Capacity For 17 Hour Pumping (6)			344,730

Notes
(1) Values taken from NMWD, 2019. 2018 Novato Water System Master Plan Update, September 2019. North Marin Water District.
(2) Each pump station includes one additional standby pump as a back up.
(3) Adjusted 16 Hour Pumping Rate = (Future Primary Zone 2 Max Day Demand)*1.50
(4) Adjusted 17 Hour Pumping Rate = (Future Primary Zone 2 Max Day Demand)*1.41
(5) Net Pumping Capacity For 16 Hour Pumping = Total Existing Primary Zone 2 Firm Capacity - Adjusted 16 Hour Pumping Rate Required
(6) Net Pumping Capacity For 17 Hour Pumping = Total Existing Primary Zone 2 Firm Capacity - Adjusted 17 Hour Pumping Rate Required

Abbreviations
GPM: gallons per minute
GPD: gallons per day

References
NMWD, 2019. 2018 Novato Water System Master Plan Update, September 2019. North Marin Water District
https://nmwd.com/wp-content/uploads/2020/04/2018WMP.pdf

Table 11
Conceptual Opinion of Probable Project Cost for Lynwood Pump Station Alternative A
Lynwood Pump Station Capacity Assessment
North Marin Water District, Novato, California

Item No.	Description	Units	Quantity (2)	Unit Price	Budget
Site 1: Sunset Parkway - Conceptual Opinion of Probable Construction Cost					
1	Mobilization/Demobilization (3)	%	5.00%	-	$ 120,000
2	Traffic Control	ls	1	$ 25,000	$ 25,000
3	Demolition of Existing Pump Station	ls	1	$ 75,000	$ 75,000
4	Stormwater Pollution Prevention & Control	ls	1	$ 25,000	$ 25,000
5	Sheeting, Shoring, and Bracing	ls	1	$ 25,000	$ 25,000
6	New Pumps 1800 GPM	ea	4	$ 85,000	$ 340,000
7	Suction Pipe Extension 24" Ductile Iron	lf	60	$ 500	$ 30,000
8	Discharge Pipe Extension 24" Ductile Iron	lf	20	$ 500	$ 10,000
9	Mainline Extension Sunset to S. Novato 16" Ductile Iron	lf	500	$ 400	$ 200,000
10	36" HDPE DR 17 Storm Drain Replacement Pipe	lf	320	$ 300	$ 96,000
11	New Storm Drain Manholes	ls	4	$ 12,000	$ 48,000
12	Pump House CMU Including Concrete	ls	1	$ 125,000	$ 125,000
13	Pump Station Mechanical Piping and Valves	ls	1	$ 200,000	$ 200,000
14	PG&E Service Conduit Installation	ls	1	$ 100,000	$ 100,000
15	1200A Service Entrance Switchboard	ls	1	$ 170,000	$ 170,000
16	1200A Manual Transfer Switch	ls	1	$ 20,000	$ 20,000
17	Portable Generator Connection Panel	ls	1	$ 30,000	$ 30,000
18	1200A Motor Control Center	ls	1	$ 600,000	$ 600,000
19	PLC Panel	ls	1	$ 100,000	$ 100,000
20	Wire and Conduit	ls	1	$ 100,000	$ 100,000
21	Electrical Testing, VFD Configuration and Documentation	ls	1	$ 30,000	$ 30,000
22	Field Instrumentation	ls	1	$ 15,000	$ 15,000
23	Electrical Supports, Lighting and Other Misc. Electrical	ls	1	$ 25,000	$ 25,000
24	Contingency (3)(4)	%	30%	$ 2,389,000	$ 720,000
Subtotal - Site 1: Sunset Parkway - Conceptual Opinion of Probable Construction Cost					**$ 3,229,000**
Engineering and Administration Cost					
25	Design	%	10%	$ 3,229,000	$ 322,900
26	Environmental/Permitting	%	10%	$ 3,229,000	$ 322,900
27	Construction Management/ Inspection/ Testing	%	15%	$ 3,229,000	$ 484,350
28	District Administration	%	5%	$ 3,229,000	$ 161,450
				Subtotal - Engineering and Administration Cost	**$ 1,292,000**
				Total Conceptual Opinion of Probable Project Cost	**$ 4,521,000**

Notes
(1) Opinion of Probable Project Cost is based on the Conceptual Design dated January 17, 2024.
(2) Quantities rounded to nearest 10 feet.
(3) Prices rounded to nearest $10,000.
(4) Contingency does not include Mobilization/Demobilization.

Abbreviations

A	amp
ea	each
GPM	gallons per minute
HDPE	high density polyethylene
lf	linear feet
ls	lump sum
PLC	programmable logic controller
VFD	variable frequency drive

Table 12
Conceptual Opinion of Probable Project Cost for Lynwood Pump Station Alternative B
Lynwood Pump Station Capacity Assessment
North Marin Water District, Novato, California

Item No.	Description	Units	Quantity (2)	Unit Price	Budget
Site 2: Ignacio Boulevard - Conceptual Opinion of Probable Construction Cost					
1	Mobilization/Demobilization (3)	%	5.00%	-	$ 180,000
2	Traffic Control	ls	1	$ 25,000	$ 25,000
3	Demolition of Existing Pump Station	ls	1	$ 75,000	$ 75,000
4	Stormwater Pollution Prevention & Control	ls	1	$ 30,000	$ 30,000
5	Sheeting, Shoring, and Bracing	ls	1	$ 25,000	$ 25,000
6	New Pumps 1800 GPM	ea	4	$ 85,000	$ 340,000
7	Suction Pipe Extension 16" Ductile Iron	lf	1,300	$ 400	$ 520,000
8	Discharge Pipe Extension 16" Ductile Iron	lf	2,450	$ 400	$ 980,000
9	Pump House CMU Including Concrete	ls	1	$ 125,000	$ 125,000
10	Pump Station Mechanical Piping and Valves	ls	1	$ 200,000	$ 200,000
11	PG&E Service Conduit Installation	ls	1	$ 100,000	$ 100,000
12	1200A Service Entrance Switchboard	ls	1	$ 170,000	$ 170,000
13	1200A Manual Transfer Switch	ls	1	$ 20,000	$ 20,000
14	Portable Generator Connection Panel	ls	1	$ 30,000	$ 30,000
15	1200A Motor Control Center	ls	1	$ 600,000	$ 600,000
16	PLC Panel	ls	1	$ 100,000	$ 100,000
17	Wire and Conduit	ls	1	$ 100,000	$ 100,000
18	Electrical Testing, VFD Configuration and Documentation	ls	1	$ 30,000	$ 30,000
19	Field Instrumentation	ls	1	$ 15,000	$ 15,000
20	Electrical Supports, Lighting and Other Misc. Electrical	ls	1	$ 25,000	$ 25,000
21	30% Contingency (3)(4)	%	30%	$ 3,510,000	$ 1,050,000
Subtotal - Site 2: Ignacio Boulevard - Conceptual Opinion of Probable Construction Cost					**$ 4,740,000**
Engineering and Administration Cost					
22	Design	%	10%	$ 4,740,000	$ 474,000
23	Environmental/Permitting	%	10%	$ 4,740,000	$ 474,000
24	Construction Management/ Inspection/ Testing	%	15%	$ 4,740,000	$ 711,000
25	District Administration	%	5%	$ 4,740,000	$ 237,000
				Subtotal - Engineering and Administration Cost	**$ 1,896,000**
				Total Conceptual Opinion of Probable Project Cost	**$ 6,636,000**

Notes
(1) Opinion of Probable Project Cost is based on the Conceptual Design dated January 17, 2024.
(2) Quantities rounded to nearest 10 feet.
(3) Prices rounded to nearest $10,000.
(4) Contingency does not include Mobilization/Demobilization.

Abbreviations

A	amp
ea	each
GPM	gallons per minute
lf	linear feet
ls	lump sum
PLC	programmable logic controller
VFD	variable frequency drive

Table 13
Conceptual Opinion of Probable Project Cost for Lynwood Pump Station Alternative C
Lynwood Pump Station Capacity Assessment
North Marin Water District, Novato, California

Item No.	Description	Units	Quantity (2)	Unit Price	Budget
Site 2: Ignacio Boulevard - Conceptual Opinion of Probable Construction Cost					
1	Mobilization/Demobilization (3)	%	5.00%	-	$ 170,000
2	Traffic Control	ls	1	$ 25,000	$ 25,000
3	Demolition of Existing Pump Station	ls	1	$ 75,000	$ 75,000
4	Stormwater Pollution Prevention & Control	ls	1	$ 30,000	$ 30,000
5	Sheeting, Shoring, and Bracing	ls	1	$ 25,000	$ 25,000
6	New Pumps 1800 GPM	ea	3	$ 85,000	$ 255,000
7	Suction Pipe Extension 16" Ductile Iron	lf	1,300	$ 400	$ 520,000
8	Discharge Pipe Extension 16" Ductile Iron	lf	2,450	$ 400	$ 980,000
9	Pump House CMU Including Concrete	ls	1	$ 125,000	$ 125,000
10	Pump Station Mechanical Piping and Valves	ls	1	$ 200,000	$ 200,000
11	PG&E Service Conduit Installation	ls	1	$ 100,000	$ 100,000
12	1200A Service Entrance Switchboard	ls	1	$ 170,000	$ 170,000
13	1200A Manual Transfer Switch	ls	1	$ 20,000	$ 20,000
14	Portable Generator Connection Panel	ls	1	$ 30,000	$ 30,000
15	1200A Motor Control Center	ls	1	$ 600,000	$ 600,000
16	PLC Panel	ls	1	$ 100,000	$ 100,000
17	Wire and Conduit	ls	1	$ 100,000	$ 100,000
18	Electrical Testing, VFD Configuration and Documentation	ls	1	$ 30,000	$ 30,000
19	Field Instrumentation	ls	1	$ 15,000	$ 15,000
20	Electrical Supports, Lighting and Other Misc. Electrical	ls	1	$ 25,000	$ 25,000
21	30% Contingency (3)(4)	%	30%	$ 3,425,000	$ 1,030,000
Subtotal - Site 2: Ignacio Boulevard - Conceptual Opinion of Probable Construction Cost					**$ 4,625,000**

Table 13
Conceptual Opinion of Probable Project Cost for Lynwood Pump Station Alternative C
Lynwood Pump Station Capacity Assessment
North Marin Water District, Novato, California

Item No.	Description	Units	Quantity (2)	Unit Price	Budget
Site 3: Bolling Drive - Conceptual Opinion of Probable Construction Cost					
22	Mobilization/Demobilization (3)	%	5.00%	-	$ 120,000
23	Traffic Control	ls	1	$ 25,000	$ 25,000
24	Stormwater Pollution Prevention & Control	ls	1	$ 25,000	$ 25,000
25	Sheeting, Shoring, and Bracing	ls	1	$ 25,000	$ 25,000
26	New Pumps 1800 GPM	ls	2	$ 85,000	$ 170,000
27	Suction Pipe Extension 16" Ductile Iron	lf	2,200	$ 400	$ 880,000
28	Discharge Pipe Extension 12" Ductile Iron	lf	900	$ 250	$ 225,000
29	Pump House CMU Including Concrete	ls	1	$ 125,000	$ 125,000
30	Pump Station Mechanical Piping and Valves	ls	1	$ 200,000	$ 200,000
31	PG&E Service Conduit Installation	ls	1	$ 100,000	$ 100,000
32	600A Service Entrance Switchboard	ls	1	$ 120,000	$ 120,000
33	600A Manual Transfer Switch	ls	1	$ 10,000	$ 10,000
34	Portable Generator Connection Panel	ls	1	$ 20,000	$ 20,000
35	600A Motor Control Center	ls	1	$ 300,000	$ 300,000
36	PLC Panel	ls	1	$ 100,000	$ 100,000
37	Wire and Conduit	ls	1	$ 60,000	$ 60,000
38	Electrical Testing, VFD Configuration and Documentation	ls	1	$ 20,000	$ 20,000
39	Field Instrumentation	ls	1	$ 15,000	$ 15,000
40	Electrical Supports, Lighting and Other Misc. Electrical	ls	1	$ 25,000	$ 25,000
41	30% Contingency (3)(4)	%	30%	$ 2,445,000	$ 730,000
Subtotal - Site 3: Bolling Drive - Conceptual Opinion of Probable Construction Cost					**$ 3,295,000**
Engineering and Administration Cost					
42	Design	%	10%	$ 7,920,000	$ 792,000
43	Land Rights Acquisition	ls	1	$ 50,000	$ 50,000
44	Environmental/Permitting	%	10%	$ 7,920,000	$ 792,000
45	Construction Management/ Inspection/ Testing	%	15%	$ 7,920,000	$ 1,188,000
46	District Administration	%	5%	$ 7,920,000	$ 396,000
				Subtotal - Engineering and Administration Cost	**$ 3,218,000**
				Total Conceptual Opinion of Probable Project Cost	**$ 11,138,000**

Notes
(1) Opinion of Probable Project Cost is based on the Conceptual Design dated January 17, 2024.
(2) Quantities rounded to nearest 10 feet.
(3) Prices rounded to nearest $10,000.
(4) Contingency does not include Mobilization/Demobilization.

Abbreviations

A	amp
ea	each
GPM	gallons per minute
lf	linear feet
ls	lump sum
PLC	programmable logic controller
VFD	variable frequency drive

Table 14
Conceptual Opinion of Probable Project Cost for Lynwood Pump Station Alternative D
Lynwood Pump Station Capacity Assessment
North Marin Water District, Novato, California

Item No.	Description	Units	Quantity (2)	Unit Price	Budget
Site 2: Ignacio Boulevard - Conceptual Opinion of Probable Construction Cost					
1	Mobilization/Demobilization (3)	%	5.00%	-	$ 170,000
2	Traffic Control	ls	1	$ 25,000	$ 25,000
3	Demolition of Existing Pump Station	ls	1	$ 75,000	$ 75,000
4	Stormwater Pollution Prevention & Control	ls	1	$ 30,000	$ 30,000
5	Sheeting, Shoring, and Bracing	ls	1	$ 25,000	$ 25,000
6	New Pumps 1800 GPM	ea	3	$ 85,000	$ 255,000
7	Suction Pipe Extension 16" Ductile Iron	lf	1,300	$ 400	$ 520,000
8	Discharge Pipe Extension 16" Ductile Iron	lf	2,450	$ 400	$ 980,000
9	Pump House CMU Including Concrete	ls	1	$ 125,000	$ 125,000
10	Pump Station Mechanical Piping and Valves	ls	1	$ 200,000	$ 200,000
11	PG&E Service Conduit Installation	ls	1	$ 100,000	$ 100,000
12	1200A Service Entrance Switchboard	ls	1	$ 170,000	$ 170,000
13	1200A Manual Transfer Switch	ls	1	$ 20,000	$ 20,000
14	Portable Generator Connection Panel	ls	1	$ 30,000	$ 30,000
15	1200A Motor Control Center	ls	1	$ 600,000	$ 600,000
16	PLC Panel	ls	1	$ 100,000	$ 100,000
17	Wire and Conduit	ls	1	$ 100,000	$ 100,000
18	Electrical Testing, VFD Configuration and Documentation	ls	1	$ 30,000	$ 30,000
19	Field Instrumentation	ls	1	$ 15,000	$ 15,000
20	Electrical Supports, Lighting and Other Misc. Electrical	ls	1	$ 25,000	$ 25,000
21	30% Contingency (3)(4)	%	30%	$ 3,425,000	$ 1,030,000
Subtotal - Site 2: Ignacio Boulevard - Conceptual Opinion of Probable Construction Cost					**$ 4,625,000**

Table 14
Conceptual Opinion of Probable Project Cost for Lynwood Pump Station Alternative D
Lynwood Pump Station Capacity Assessment
North Marin Water District, Novato, California

Item No.	Description	Units	Quantity (2)	Unit Price	Budget
Site 4: Main Gate Road - Conceptual Opinion of Probable Construction Cost					
22	Mobilization/Demobilization (3)	%	5.00%	-	$ 80,000
23	Traffic Control	ls	1	$ 25,000	$ 25,000
24	Stormwater Pollution Prevention & Control	ls	1	$ 25,000	$ 25,000
25	Sheeting, Shoring, and Bracing	ls	1	$ 25,000	$ 25,000
26	New Pumps 1800 GPM	ea	2	$ 85,000	$ 170,000
27	Suction Pipe Extension 16" Ductile Iron	lf	450	$ 400	$ 180,000
28	Discharge Pipe Extension 12" Ductile Iron	lf	20	$ 250	$ 5,000
29	Pump House CMU Including Concrete	ls	1	$ 125,000	$ 125,000
30	Pump Station Mechanical Piping and Valves	ls	1	$ 200,000	$ 200,000
31	Flood Proofing Allowance	ls	1	$ 100,000	$ 100,000
32	Pressure Reducing Valves	ea	7	$ 10,000	$ 70,000
33	PG&E Service Conduit Installation	ls	1	$ 100,000	$ 100,000
34	600A Service Entrance Switchboard	ls	1	$ 120,000	$ 120,000
35	600A Manual Transfer Switch	ls	1	$ 10,000	$ 10,000
36	Portable Generator Connection Panel	ls	1	$ 20,000	$ 20,000
37	600A Motor Control Center	ls	1	$ 300,000	$ 300,000
38	PLC Panel	ls	1	$ 100,000	$ 100,000
39	Wire and Conduit	ls	1	$ 60,000	$ 60,000
40	Electrical Testing, VFD Configuration and Documentation	ls	1	$ 20,000	$ 20,000
41	Field Instrumentation	ls	1	$ 15,000	$ 15,000
42	Electrical Supports, Lighting and Other Misc. Electrical	ls	1	$ 25,000	$ 25,000
43	30% Contingency (3)(4)	%	30%	$ 1,695,000	$ 510,000
Subtotal - Site 4: Main Gate Road - Conceptual Opinion of Probable Construction Cost					**$ 2,285,000**
Engineering and Administration Cost					
44	Design	%	10%	$ 6,910,000	$ 691,000
45	Environmental/Permitting	%	10%	$ 6,910,000	$ 691,000
46	Construction Management/ Inspection/ Testing	%	15%	$ 6,910,000	$ 1,036,500
47	District Administration	%	5%	$ 6,910,000	$ 345,500
				Subtotal - Engineering and Administration Cost	**$ 2,764,000**
				Total Conceptual Opinion of Probable Project Cost	**$ 9,674,000**

Notes
(1) Opinion of Probable Project Cost is based on the Conceptual Design dated January 17, 2024.
(2) Quantities rounded to nearest 10 feet.
(3) Prices rounded to nearest $10,000.
(4) Contingency does not include Mobilization/Demobilization.

Abbreviations

A	amp
ea	each
GPM	gallons per minute
lf	linear feet
ls	lump sum
PLC	programmable logic controller
VFD	variable frequency drive

Table 15
Conceptual Opinion of Probable Project Cost for Lynwood Pump Station Alternative E
Lynwood Pump Station Capacity Assessment
North Marin Water District, Novato, California

Item No.	Description	Units	Quantity (2)	Unit Price	Budget
Site 2: Ignacio Boulevard - Conceptual Opinion of Probable Construction Cost					
1	Mobilization/Demobilization (3)	%	5.00%	-	$ 170,000
2	Traffic Control	ls	1	$ 25,000	$ 25,000
3	Demolition of Existing Pump Station	ls	1	$ 75,000	$ 75,000
4	Stormwater Pollution Prevention & Control	ls	1	$ 30,000	$ 30,000
5	Sheeting, Shoring, and Bracing	ls	1	$ 25,000	$ 25,000
6	New Pumps 1800 GPM	ea	3	$ 85,000	$ 255,000
7	Suction Pipe Extension 16" Ductile Iron	lf	1,300	$ 400	$ 520,000
8	Discharge Pipe Extension 16" Ductile Iron	lf	2,450	$ 400	$ 980,000
9	Pump House CMU Including Concrete	ls	1	$ 125,000	$ 125,000
10	Pump Station Mechanical Piping and Valves	ls	1	$ 200,000	$ 200,000
11	PG&E Service Conduit Installation	ls	1	$ 100,000	$ 100,000
12	1200A Service Entrance Switchboard	ls	1	$ 170,000	$ 170,000
13	1200A Manual Transfer Switch	ls	1	$ 20,000	$ 20,000
14	Portable Generator Connection Panel	ls	1	$ 30,000	$ 30,000
15	1200A Motor Control Center	ls	1	$ 600,000	$ 600,000
16	PLC Panel	ls	1	$ 100,000	$ 100,000
17	Wire and Conduit	ls	1	$ 100,000	$ 100,000
18	Electrical Testing, VFD Configuration and Documentation	ls	1	$ 30,000	$ 30,000
19	Field Instrumentation	ls	1	$ 15,000	$ 15,000
20	Electrical Supports, Lighting and Other Misc. Electrical	ls	1	$ 25,000	$ 25,000
21	30% Contingency (3)(4)	%	30%	$ 3,425,000	$ 1,030,000
Subtotal - Site 2: Ignacio Boulevard - Conceptual Opinion of Probable Construction Cost					**$ 4,625,000**

Table 15
Conceptual Opinion of Probable Project Cost for Lynwood Pump Station Alternative E
Lynwood Pump Station Capacity Assessment
North Marin Water District, Novato, California

Item No.	Description	Units	Quantity (2)	Unit Price	Budget
Site 5: C Street - Conceptual Opinion of Probable Construction Cost					
22	Mobilization/Demobilization (3)	%	5.00%	-	$ 90,000
23	Traffic Control	ls	1	$ 25,000	$ 25,000
24	Stormwater Pollution Prevention & Control	ls	1	$ 25,000	$ 25,000
25	Sheeting, Shoring, and Bracing	ls	1	$ 25,000	$ 25,000
26	New Pumps 1800 GPM	ea	2	$ 85,000	$ 170,000
27	Suction Pipe Extension 16" Ductile Iron	lf	40	$ 400	$ 16,000
28	Discharge Pipe Extension 12" Ductile Iron	lf	80	$ 250	$ 20,000
29	Pump House CMU Including Concrete	ls	1	$ 125,000	$ 125,000
30	Pump Station Mechanical Piping and Valves	ls	1	$ 200,000	$ 200,000
31	Site Restoration Allowance	ls	1	$ 300,000	$ 300,000
32	Pressure Reducing Valves	ea	7	$ 10,000	$ 70,000
33	PG&E Service Conduit Installation	ls	1	$ 100,000	$ 100,000
34	600A Service Entrance Switchboard	ls	1	$ 120,000	$ 120,000
35	600A Manual Transfer Switch	ls	1	$ 10,000	$ 10,000
36	Portable Generator Connection Panel	ls	1	$ 20,000	$ 20,000
37	600A Motor Control Center	ls	1	$ 300,000	$ 300,000
38	PLC Panel	ls	1	$ 100,000	$ 100,000
39	Wire and Conduit	ls	1	$ 60,000	$ 60,000
40	Electrical Testing, VFD Configuration and Documentation	ls	1	$ 20,000	$ 20,000
41	Field Instrumentation	ls	1	$ 15,000	$ 15,000
42	Electrical Supports, Lighting and Other Misc. Electrical	ls	1	$ 25,000	$ 25,000
43	30% Contingency (3)(4)	%	30%	$ 1,746,000	$ 520,000
Subtotal - Site 5: C Street - Conceptual Opinion of Probable Construction Cost					**$ 2,356,000**
Engineering and Administration Cost					
44	Design	%	10%	$ 6,981,000	$ 698,100
45	Land Rights Acquisition	ls	1	$ 50,000	$ 50,000
46	Environmental/Permitting	%	10%	$ 6,981,000	$ 698,100
47	Construction Management/ Inspection/ Testing	%	15%	$ 6,981,000	$ 1,047,150
48	District Administration	%	5%	$ 6,981,000	$ 349,050
				Subtotal - Engineering and Administration Cost	**$ 2,842,000**
				Total Conceptual Opinion of Probable Project Cost	**$ 9,823,000**

Notes
(1) Opinion of Probable Project Cost is based on the Conceptual Design dated January 17, 2024.
(2) Quantities rounded to nearest 10 feet.
(3) Prices rounded to nearest $10,000.
(4) Contingency does not include Mobilization/Demobilization.

Abbreviations

A	amp
ea	each
GPM	gallons per minute
lf	linear feet
ls	lump sum
PLC	programmable logic controller
VFD	variable frequency drive

Table 16
Net Present Capital and Operating Cost Comparison for Lynwood Pump Station Alternatives
Lynwood Pump Station Capacity Assessment
North Marin Water District, Novato, California

Year	Alternative A (1)		Alternative B (2)		Alternative C (3)		Alternative D (3)		Alternative E (3)	
	Cost (4) (5)	Net Present Value (6)	Cost (4) (5)	Net Present Value (6)	Cost (4) (5)	Net Present Value (6)	Cost (4) (5)	Net Present Value (6)	Cost (4) (5)	Net Present Value (6)
0	$ 4,521,000	$ 4,521,000	$ 6,636,000	$ 6,636,000	$ 11,138,000	$ 11,138,000	$ 9,674,000	$ 9,674,000	$ 9,823,000	$ 9,823,000
1	$ 344,235	$ 327,840	$ 308,526	$ 293,834	$ 395,112	$ 376,297	$ 395,112	$ 376,297	$ 395,112	$ 376,297
2	$ 344,235	$ 312,230	$ 308,526	$ 279,842	$ 395,112	$ 358,378	$ 395,112	$ 358,378	$ 395,112	$ 358,378
3	$ 344,235	$ 297,360	$ 308,526	$ 266,516	$ 395,112	$ 341,313	$ 395,112	$ 341,313	$ 395,112	$ 341,313
4	$ 344,235	$ 283,200	$ 308,526	$ 253,825	$ 395,112	$ 325,060	$ 395,112	$ 325,060	$ 395,112	$ 325,060
5	$ 344,235	$ 269,720	$ 308,526	$ 241,738	$ 395,112	$ 309,581	$ 395,112	$ 309,581	$ 395,112	$ 309,581
6	$ 344,235	$ 256,870	$ 308,526	$ 230,227	$ 395,112	$ 294,839	$ 395,112	$ 294,839	$ 395,112	$ 294,839
7	$ 344,235	$ 244,640	$ 308,526	$ 219,264	$ 395,112	$ 280,799	$ 395,112	$ 280,799	$ 395,112	$ 280,799
8	$ 344,235	$ 232,990	$ 308,526	$ 208,823	$ 395,112	$ 267,427	$ 395,112	$ 267,427	$ 395,112	$ 267,427
9	$ 344,235	$ 221,900	$ 308,526	$ 198,879	$ 395,112	$ 254,693	$ 395,112	$ 254,693	$ 395,112	$ 254,693
10	$ 389,235	$ 238,960	$ 353,526	$ 217,034	$ 440,112	$ 270,191	$ 440,112	$ 270,191	$ 440,112	$ 270,191
11	$ 344,235	$ 201,270	$ 308,526	$ 180,389	$ 395,112	$ 231,014	$ 395,112	$ 231,014	$ 395,112	$ 231,014
12	$ 344,235	$ 191,680	$ 308,526	$ 171,799	$ 395,112	$ 220,013	$ 395,112	$ 220,013	$ 395,112	$ 220,013
13	$ 344,235	$ 182,560	$ 308,526	$ 163,618	$ 395,112	$ 209,536	$ 395,112	$ 209,536	$ 395,112	$ 209,536
14	$ 344,235	$ 173,860	$ 308,526	$ 155,827	$ 395,112	$ 199,558	$ 395,112	$ 199,558	$ 395,112	$ 199,558
15	$ 344,235	$ 165,580	$ 308,526	$ 148,406	$ 395,112	$ 190,056	$ 395,112	$ 190,056	$ 395,112	$ 190,056
16	$ 344,235	$ 157,700	$ 308,526	$ 141,339	$ 395,112	$ 181,005	$ 395,112	$ 181,005	$ 395,112	$ 181,005
17	$ 344,235	$ 150,190	$ 308,526	$ 134,609	$ 395,112	$ 172,386	$ 395,112	$ 172,386	$ 395,112	$ 172,386
18	$ 344,235	$ 143,040	$ 308,526	$ 128,199	$ 395,112	$ 164,177	$ 395,112	$ 164,177	$ 395,112	$ 164,177
19	$ 344,235	$ 136,230	$ 308,526	$ 122,094	$ 395,112	$ 156,359	$ 395,112	$ 156,359	$ 395,112	$ 156,359
20	$ 389,235	$ 146,700	$ 353,526	$ 133,240	$ 440,112	$ 165,874	$ 440,112	$ 165,874	$ 440,112	$ 165,874
21	$ 344,235	$ 123,560	$ 308,526	$ 110,743	$ 395,112	$ 141,822	$ 395,112	$ 141,822	$ 395,112	$ 141,822
22	$ 344,235	$ 117,680	$ 308,526	$ 105,470	$ 395,112	$ 135,069	$ 395,112	$ 135,069	$ 395,112	$ 135,069
23	$ 344,235	$ 112,070	$ 308,526	$ 100,447	$ 395,112	$ 128,637	$ 395,112	$ 128,637	$ 395,112	$ 128,637
24	$ 344,235	$ 106,740	$ 308,526	$ 95,664	$ 395,112	$ 122,512	$ 395,112	$ 122,512	$ 395,112	$ 122,512
25	$ 344,235	$ 101,650	$ 308,526	$ 91,109	$ 395,112	$ 116,678	$ 395,112	$ 116,678	$ 395,112	$ 116,678
26	$ 344,235	$ 96,810	$ 308,526	$ 86,770	$ 395,112	$ 111,122	$ 395,112	$ 111,122	$ 395,112	$ 111,122
27	$ 344,235	$ 92,200	$ 308,526	$ 82,638	$ 395,112	$ 105,830	$ 395,112	$ 105,830	$ 395,112	$ 105,830
28	$ 344,235	$ 87,810	$ 308,526	$ 78,703	$ 395,112	$ 100,791	$ 395,112	$ 100,791	$ 395,112	$ 100,791
29	$ 344,235	$ 83,630	$ 308,526	$ 74,955	$ 395,112	$ 95,991	$ 395,112	$ 95,991	$ 395,112	$ 95,991
30	$ 389,235	$ 90,060	$ 353,526	$ 81,798	$ 440,112	$ 101,832	$ 440,112	$ 101,832	$ 440,112	$ 101,832
		$ 9,868,000		**$ 11,434,000**		**$ 17,267,000**		**$ 15,803,000**		**$ 15,952,000**

Notes

(1) Assumes one pump running for 19 hours for 365 days, a second pump running for 19 hours for 183 days, and a third pump running for 19 hours for 90 days.

(2) Assumes one pump running for 17 hours for 365 days, a second pump running for 17 hours for 183 days, and a third pump running for 17 hours for 90 days.

(3) Assumes two pumps running for 17 hours for 365 days and a third pump running for 17 hours for 90 days.

(4) Year 0 is the total capital cost with an annual allowance for general maintenance with allowance every 10 years to repair a leak.

(5) Year 0 is the construction cost, daily electrical costs based on electrical cost of $0.30 per kwH, $5,000 annual labor cost, and $50,000 maintenance cost every 10 years to rewind motor and other maintenance.

(6) Net present value is calculated assuming an average annual discount rate of 5%.

Table 17
Pump Station Alternatives Evaluation Scoring
Lynwood Pump Station Capacity Assessment
North Marin Water District, Novato, California

	Alternative A		Alternative B		Alternative C		Alternative D		Alternative E		Retrofit Existing	
Criteria (1)	**Criteria Evaluation (2)**	**Score (3)**	**Criteria Evaluation (2)**	**Score (3)**	**Criteria Evaluation (2)**	**Score (3)**	**Criteria Evaluation (2)**	**Score (3)**	**Criteria Evaluation (2)**	**Score (3)**	**Criteria Evaluation (2)**	**Score (3)**
Meet Primary Zone 2 Future Demand	Meets Future Demand	10	Meets Future Demand	10	Meets Future Demand	10	Meets Future Demand	10	Meets Future Demand	10	Meets Future Demand	10
Improve Pacheco Valley Tank Flow	Does Not Improve Flow	3	Improves Flow	9	Significantly Improves Flow	10	Significantly Improves Flow	10	Significantly Improves Flow	10	Does not Improve Flow	3
Improve Primary Zone 2 System Redundancy	Includes standby pump for redundancy.	1	Includes standby pump for redundancy.	1	Includes standby pump for redundancy at each pump station. Includes redundancy with two pump station sites.	10	Includes standby pump for redundancy at each pump station. Includes redundancy with two pump station sites.	10	Includes standby pump for redundancy at each pump station. Includes redundancy with two pump station sites.	10	Includes standby pump for redundancy.	1
Site Features	- Above FEMA Floodplain - Improved site access compared to existing pump station - Project site constrained by traffic island width - Potential impacts to residential neighbors - Easement from City is needed	4	- Above FEMA Floodplain'- Adjacent to San Jose Creek - Improved Site Access compared to existing pump station - Project site has some constraints due to pedestrian path and adjacent waterway - Minimal potential impacts to residential neighbors - Easement from City is needed	5	Pump Station 1 Site (Site 2) - Above FEMA Floodplain - Improved Site Access compared to existing pump station - Project site has some constraints due to pedestrian path - Minimal potential impacts to residential neighbors - Easement from City is needed Pump Station 2 Site (Site 3) - Above FEMA Floodplain - Improved site access compared to existing pump station - Project site has some constraints due to pedestrian path - Minimal potential impacts to residential neighbors - Easement from private land owner is needed	2	Pump Station 1 Site (Site 2) - Above FEMA Floodplain - Improved Site Access compared to existing pump station - Project site has some constraints due to pedestrian path - Minimal potential impacts to residential neighbors - Easement from City is needed Pump Station 2 Site (Site 4) - Within FEMA Floodplain - Improved site access compared to existing pump station - Project site has some constraints due to pedestrian path and adjacent water way. - Minimal potential impacts to residential neighbors - Easement from City is needed	3	Pump Station 1 Site (Site 2) - Above FEMA Floodplain - Improved Site Access compared to existing pump station - Project site has some constraints due to pedestrian path - Minimal potential impacts to residential neighbors - Easement from City is needed Pump Station 2 Site (Site 5) - Above FEMA Floodplain - Improved site access compared to existing pump station - Project site has some constraints due to adjacent Novato Charter School. - Minimal potential impacts to residential neighbors - Easement or land purchase from Novato Unified School District is needed	1	- Above FEMA Floodplain - Similar site access compared to existing pump station - Project site constrained by traffic island width - Potential impacts to residential and school neighbors - Easement from City is not needed.	2
Capital Cost	$ 4,521,000	9	$ 6,636,000	6	$ 11,138,000	1	$ 9,674,000	3	$ 9,823,000	3	(4)	3
Net Present O&M Cost	$ 9,868,000	8	$ 11,434,000	5	$ 17,267,000	1	$ 15,803,000	2	$ 15,952,000	2	(4)	2
Total		**35**		**36**		**34**		**38**		**36**		**21**

Notes

(1) The criteria evaluation was completed based on a sliding point scale as follows:

Meet Primary Zone 2 Future Demand
- o A score of 0 to 4 indicates an alternative with inadequate ability to meet future demand.
- o A score of 5 to 7 indicates an alternative with limited ability to meet future demand.
- o A score of 8 to 10 indicates an alternative with adequate ability to meet future demand.

Improve Pacheco Valley Tank Flow
- o A score of 0 to 4 indicates an alternative that does not improve or negatively impacts the ability to provide flow to Pacheco Valley Tank.
- o A score of 5 to 7 indicates an alternative continues to meet existing conditions or only minimally provides additional flow to Pacheco Valley Tank.
- o A score of 8 to 10 indicates an alternative with adequate ability to provide additional flow to Pacheco Valley Tank.

Improve Primary Zone 2 System Redundancy
- o A score of 0 to 4 indicates an alternative that continues to provide local redundancy at the pump station itself (i.e. one spare pump).
- o A score of 5 to 7 indicates an alternative that provides enhanced, local redundancy at the pump station itself (i.e., multiple spare pumps) or within the pressure zone potentially allowing multiple stations to operate at reduced capacity.
- o A score of 8 to 10 indicates an alternative with adequate ability to provide additional Primary Zone 2 system redundancy within both redundant pump stations and local redundancy.

Site Features
- o A score of 0 to 4 indicates an alternative with inadequate site features (poor maintenance access, lack of parking, proximity to multiple residential units, requires land acquisition, and some potential environmental constraints).
- o A score of 5 to 7 indicates an alternative with subpar site features (fair maintenance access, potential room for parking, proximity to minimal residential units, and a few potential environmental constraints).
- o A score of 8 to 10 indicates an alternative with adequate site features (good maintenance access, room for parking, proximity to a residential unit, and minimal potential environmental constraints).

Capital Cost
- o A score of 0 to 4 indicates an alternative with an OPC over $8,000,000.
- o A score of 5 to 7 indicates an alternative with an OPC between $6,000,000 and $8,000,000.
- o A score of 8 to 10 indicates an alternative with an OPC between $4,000,000 and $6,000,000.

Net Present O&M Cost
- o A score of 0 to 4 indicates an alternative with net present O&M costs over $12,000,000.
- o A score of 5 to 7 indicates an alternative with net present O&M costs between $10,000,000 and $12,000,000.
- o A score of 8 to 10 indicates an alternative with net present O&M costs between $8,000,000 and $10,000,000.

(2) Brief description of each alternatives ability to meet each criterion.

(3) Score assigned based on each alternative's ability to meet the list criterion on the sliding scale described in Note 1.

(4) Capital Cost and Net Present O&M Cost for retrofitting the existing pump station is similar to Alternative D & E.

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