DRAFT FINAL Technical Memorandum

North Marin Water District/Novato Sanitary District - Recycled Water Project

Subject: Recycled Water Facility Expansion - Basis of Design

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The purpose of this Technical Memorandum (TM) is to evaluate and develop the basis of design for recycled water production capacity expansion to serve the Central Service Area in Novato. Design criteria, facility descriptions, siting and implementation steps for the project are presented in the TM, which is organized as follows:

1. Introduction and Background
2. Recycled Water Demands and Production Facilities
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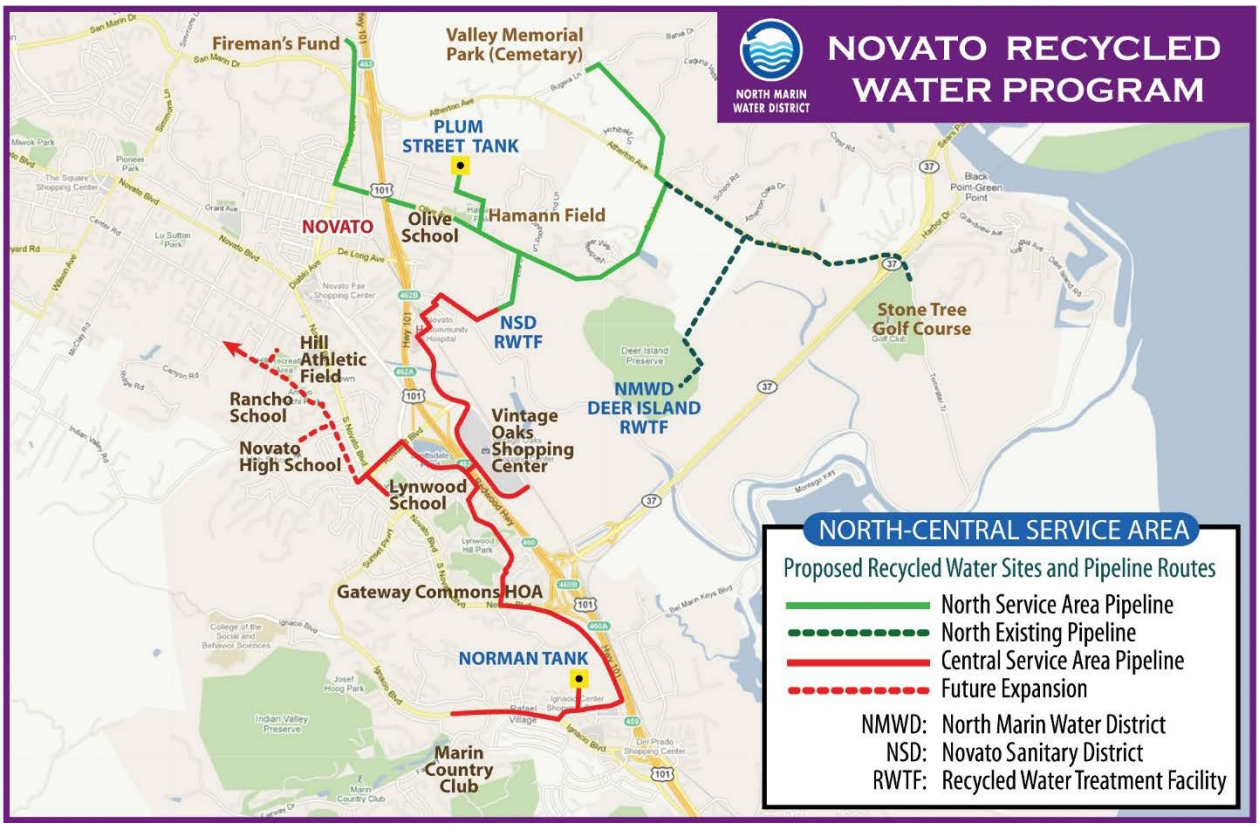
1 Introduction and Background

Novato Sanitary District (NSD) and North Marin Water District (NMWD) have partnered to produce tertiary-treated recycled water for irrigation at the Stone Tree Golf Course (STGC) since 2006 and the North Service Area since 2011. NSD provides secondary effluent to NMWD for tertiary treatment at the Deer Island Recycled Water Facility, which can treat up to 0.5 million gallons per day (mgd) of recycled water. In addition, the existing Novato Recycled Water Facility (RWF) tertiary treatment facility at the Novato Wastewater Treatment Plant (Novato WWTP) located on Davidson Street, has a total design production capacity of 0.85 mgd (firm), to serve recycled water users in the Novato North Service area.

2 Recycled Water Demands and Production Facilities

North Marin Water District is looking to expand their recycled water distribution system to serve the Central Service Area as shown in Figure 2-1. Under the existing configuration, the Central Service Area would be served from the Novato RWF. Projected recycled water demands were reviewed to confirm recycled water production requirements and corresponding improvements at the Novato RWF and/or Deer Island RWF.

Figure 2-1: Existing North Service Area and Planned Central Service Area Expansion



2.1 Recycled Water Demand Confirmation

The Novato RWF facility was originally designed in 2010 for expansion from the existing 0.85 mgd to 1.7 mgd firm capacity to provide future service to the Central Service Area. The purpose of this section is to confirm the total estimated recycled water demand from the North and Central Service Area as they relate to the sizing of new treatment facilities at the Novato RWF and to the previously planned capacity increase to 1.7 mgd.

The development of the current recycled water demand estimates, distribution system and distributed storage analysis was performed and provided by NMWD. The 2010 demand projections, as well as revised 2015 demand figures based on data provided by NMWD are summarized in Table 2-1. The original design for the existing Novato RWF included provisions for capacity expansion. The revised recycled water demand estimate for the average day of the peak month of 1.5 mgd is close to the originally planned 1.7 mgd service capacity expansion. This estimate includes 43 new irrigation connections in the central service area.

The existing North Service Area has 0.5 mg of storage at the Plum Street tank. The new Central Service Area will have an additional 0.5 mg of storage at the Norman tank. NMWD has performed a hydraulic analysis to confirm peak hour demands and that the demands can be met. Storage will be used to meet peak day and peak hour demands. In addition, NMWD will coordinate with recycled water users to stagger the larger demands to minimize the amount of peak hour capacity required. There is an existing 0.37 mg recycled water clearwell at the NSD site, which can be used as a buffer to normalize recycled water production to meet diurnal demand.

Table 2-1: Original and Revised Recycled Water Demands

Demand Category	Average Annual (acre-ft/year)		Average Day of the Peak Month Demand (mgd)		Peak Day Demand (mgd)		Peak Hour (gpm)	
	2010 Projection	Revised Estimated	2010 Projection	Revised Estimate	2010 Projection	Revised Estimated	2010 Projection	Revised Estimate
North Service Area								
Existing	181	300	0.43	0.58	0.60	0.84	415	703
Future	186	30	0.40	0.06	0.68	0.08	1,402	174
North Area Subtotal	**367**	**330**	**0.83**	**0.64**	**1.28**	**0.92**	**1,817**	**877**
Central Service Area								
Existing	-	322	-	0.72	-	1.00	-	2,094
Future	356	73	0.79	0.16	1.29	0.23	2,756	474
Central Area Subtotal	**356**	**394**	**0.79**	**0.88**	**1.29**	**1.23**	**2,756**	**2,568**
Total Demand	**723**	**724**	**1.63**	**1.52**	**2.57**	**2.15**	**4,573**	**3,445**

Notes:
- North Service Area demands are based on actual recycled water production in 2014 plus 10% for future expansion.
- Average annual recycled water demands for the Central Service Area are based on estimates and hydraulic modeling provided by NMWD.
- For the Central Service Area, the following peaking factors were used:
    - Average Annual to Average Day of the Peak Month = 2.5
    - Average Day of the Peak Month to Peak Day = 1.4
    - Peak Day to Peak Hour = 3.0, which represents recycled water use spread evenly over an 8 hour irrigation period

2.2 Existing Recycled Water Production Facilities

The Novato RWF and the Deer Island RWF were evaluated to develop alternatives for increasing recycled water production to meet additional recycled water demand from the Central Service Area.

Novato RWF

The existing facilities evaluated for potential upgrades for recycled water production capacity expansion at the Novato RWF consists of the following process components:

- Filter feed pump station: 2 vertical turbine pumps (1 duty, 1 standby), each with a design capacity of 1.7 mgd (50.8 ft design head at 1780 rpm maximum speed).
- Tertiary filtration: 2 upflow continuous backwashing sand filters (1 duty, 1 standby), each including 2 filter cells with 3 modules. Designed loading rate is 4.5 gpm/sq-ft (0.94 mgd per filter), including 10% for backwash flow.
- Chemical feed system: 2 chemical feed pumps (1 duty, 1 standby) that can pump either coagulant or polymer with a capacity of 0.4 gph each before dilution.
- Disinfection: 4 sodium hypochlorite feed pumps with a capacity of 0.2 gpm each.
- Chlorine contact tank (CCT): 514,000 gallons capacity (covered) and a theoretical contact time of 253 min at peak design flow of 2.92 mgd after capacity expansion.
- Clearwell storage: 369,000 gallons working volume (uncovered).
- Distribution pump station: 2 vertical turbine pumps (1 duty, 1 standby), each with a design capacity of 1.7 mgd (180 ft deign head at 1785 rpm maximum speed)

These facilities provide a design production capacity of 0.85 mgd (firm), to serve recycled water users in the Novato North Service area.

Deer Island RWF

The existing Deer Island RWF consists of the following:

- Influent pump station: 2 submersible non-clog pumps with a 382 gpm design flow (44 ft design head at 1745 rpm maximum speed).
- Chemical storage and feed facilities: 2 coagulant metering pumps, each with a feed range of 0-5 gph.
- Filter units: 3 upflow continuous backwashing sand filters, each with 2 filter cells. The filter units have a design filter bed loading rate of up to 2.8 gpm/ft^2 at a maximum influent flow of 382 gpm with all units operating.
- Chlorine contact tank: 1 sodium hypochlorite pumps, each with a feed range of 0-20 gph. Chlorine contact tank capacity: 42,000 gallons (uncovered).
- Distribution pump station: 2 horizontal end suction pumps with a 350 gpm design flow capacity (51 ft design head and 1770 rpm maximum speed).

These facilities provide a capacity of 0.5 million gallons per day of recycled water, predominantly serving the Stone Tree Golf Course. There is no space at the existing site to expand this facility.

3 Expanded Recycled Water Production Alternatives

The NSD RWF and Deer Island RWF both produce Title 22 disinfected tertiary recycled water, which complies with the requirements listed in Table 3-1.

Table 3-1: Title 22 Facility Requirements

Parameter	Maximum Title 22 Requirements for Disinfected Tertiary RW (Not to Exceed or Minimum values as noted)
Filter Loading Rate	5 gallons/ minute / ft^2 (not to exceed)
Tertiary Treated Effluent Turbidity	2 NTU average in a 24 hr period (not to exceed)
	5 NTU more than 5% of the time in a 24 hr period (not to exceed)
	10 NTU during all times (not to exceed)
Chlorine Residual times Modal Contact Time	450 mg-minutes/L (minimum)
Chlorination Modal Contact Time	90 minutes (minimum)
Tertiary Treated Effluent Total Coliform Bacteria	2.2 MPN / 100 mL per 7 day period (not to exceed)
	23 MPN / 100 mL per 30 day period (not to exceed)
	240 MPN / 100 mL during all periods (not to exceed)

Upgrades to the existing Deer Island RWF were examined as part of the alternative development process. There is insufficient space at the Deer Island RWF site to expand the production capacity beyond 0.5 mgd. Therefore, upgrades were focused on using the Deer Island RWF as a complementary supply for the Central Service Area expansion. The Deer Island RWF distribution pumps primarily serves the Stone Tree Golf Course and has 51 ft of design head, whereas the remainder of the Central Service Area system needs up to 170 ft of head. The potable water backup connection at the Novato RWF would need to meet the remainder of the expanded design recycled water production for the North and Central Service Areas.

For example, if one of the two existing filters is out of service, the Novato RWF can produce up to 0.97 mgd of recycled water, therefore a minimum of 0.23 mgd of potable water is required in addition to the 0.5 mgd from the Deer Island RWF to meet the 1.7 mgd design recycled water production. The Deer Island RWF does not have sufficient capacity to provide full redundancy, if one of the filter units at the Novato RWF is out of service.

The Deer Island RWF distribution pump station could be upgraded to provide sufficient head to serve other users besides Stone Tree Golf Course. The currently installed HDPE distribution pipeline (SDR 17), from Deer Island RWF, is rated for 100 psi of pressure. A pressure relief valve would be installed for the golf course service. A preliminary cost estimate for installing new pumps, modifying the pump station and piping, adding two pressure relief valves, and upgrading electrical and instrumentation equipment is $145,000.

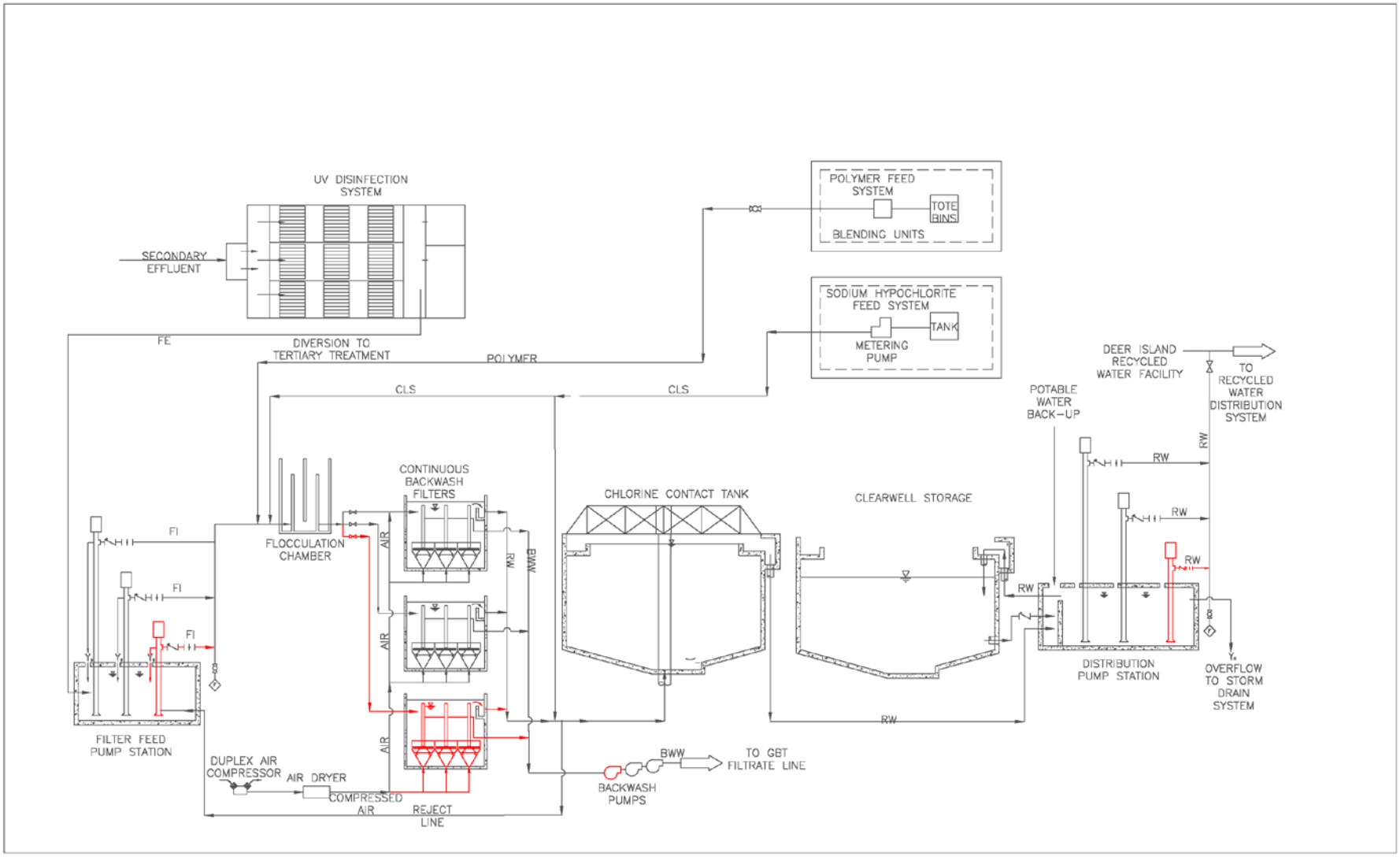
Upgrading the pump station was not investigated further as an alternative, because it would not increase production capacity and would provide limited benefit over the current configuration.

Two alternatives were developed to provide a firm (i.e. with one unit out of service as backup) recycled water production capacity of 1.7 mgd. Alternative A would involve additional process equipment to increase the firm capacity of the Novato RWF to 1.7 mgd. Alternative B includes the same improvements as Alternative A plus additional operational improvements to the Novato RWF that are not strictly capacity related.

3.1 Alternative A – Expand Novato RWF

Alternative A involves upgrading the Novato RWF to meet the recycled water average day peak month demands (1.5 mgd) from the North and Central service areas. Although the total installed capacity at the Novato RWF is 1.7 mgd, additional standby units are needed to provide a firm capacity of 1.5 mgd, in the event a unit is out of service. The additional components required to increase the firm capacity include a filter feed pump, a continuous backwashing sand filter, a backwash pump and a recycled water distribution system pump. Peak hour demands will be managed with the two tanks located in the distribution system (Norman tank and Plum St. tank). An updated process flow diagram is shown in Figure 3-1 with new equipment shown in red. A summary description of each of the new components is provided below.

Figure 3-1 – Process Flow Diagram: New Equipment Highlighted in Red



3.1.1 Sand Filter

Currently there are two continuous backwashing sand filters installed at the WWTP, both of which will be required to meet expanded water demands. An additional filter will need to be installed to act as a standby filter. The original design of the recycled water facility included space for a third filter.

Adding an additional filter will increase the filtration process to 3 cells, consisting of three 50 square foot modules each, providing a total duty filtration area of 300 square feet with an additional 150 square feet as back up. At a maximum loading rate of 5 gpm/ft^2, the firm production capacity of the filtration process is 1.90 mgd with both active cells in service. A third filter cell will allow the plant to meet the increased average day peak month demand, with one filter as back-up. An updated quote for a third filter has been provided by Westech at $154,000.

Intermittent Backwash

The advantage of intermittent backwash is a reduction in the amount of time the compressor runs thus reducing the energy consumption. For example, a typical operation for intermittent backwash is to run the filters 15 minutes out of every hour at the same airflow rate as continuous backwash, approximately 2-3 scfm. For improved operational flexibility, Westech offers an intermittent backwash system, which could reduce total wash water volume by up to 5% and avoid the need for the compressors to run continuously. The maximum backwash flow with intermittent backwash is 7% of the influent flow.

The filter manufacturer recommends that 5 scfm be provided to each filter module during "Burst Mode", which is required for 30 seconds when first starting up a filter cell. Burst mode can be staggered amongst the filters to reduce peak air requirements. With the new, third, filter cell there would be a total of nine filter modules. The current compressors (rated at 35 scfm) can provide 3.8 scfm to each of the nine filter modules, sufficient for continuous and intermittent backwashing operation. If additional redundancy or the ability to run more than one filter at a time in Burst Mode is desired an additional compressor could be provided at an equipment cost of $10,000.

The quote for the intermittent backwash retrofit kit, is $34,000, which includes all three filters. A comparison of air compressors for continuous and intermittent backwash and their respective annual energy cost is outlined in Table 3-2. Switching to intermittent backwash could reduce annual energy costs by $10,800.

Table 3-2: Compressor Comparison for Continuous versus Intermittent Backwash

Parameter	Continuous Backwash	Intermittent Backwash
Average air flow requirements (scfm)		
Start-up	5	5
Normal Operation	2-3	2-3
Power (hp)	10	10
Percentage of Time in Operation	100%	25%
Estimated Annual Energy Cost*	$14,300	$3,500

*Assuming $0.18/kWh energy cost and 80% energy efficiency for compressors.

3.1.2 Filter Feed Pump

Adding an additional filter will require an extra vertical turbine filter feed pump, which will increase the firm capacity of the filter feed pump station to 2,360 gpm (3.4 mgd). The additional pump is needed to meet the 1.7 mgd (1180 gpm) demand and provide sufficient flow to meet an average 10% backwash flow, resulting in a design filter feed flow of 1320 gpm. The duty and standby pumps will have VFDs to allow adjustment of recycled water production to match demand. The original design of the recycled water treatment facility included space for a third filter feed pump. Should all three filters (2 duty and 1 standby) need to be operating at maximum capacity, only two filter feed pumps will be required to meet filter

capacity with one left on standby. An updated quote has been provided by Floway at $39,000 for an additional filter feed pump.

3.1.3 Backwash Pump

The current capacity of the two existing backwash pumps is 100 gpm each (1 duty, 1 standby). The increased capacity of the filters will result in a combined backwash flow rate of 150 gpm, so an additional duty backwash pump will need to be installed. The two duty backwash pumps will be configured to operate in a lead-lag arrangement. An updated quote for an additional backwash pump has been provided by Goulds at $3,000.

3.1.4 Distribution System Pump

An additional vertical turbine distribution pump is needed as standby, because two pumps will be required to meet peak day demands for the North and Central Service Areas. The two system are hydraulically connected together. The pump station will discharge into a common header with individual pipes to the North and Central Service Area distribution systems. See the NMWD *Flow Modeling for Recycled Water Central Service Area* Memorandum in the appendix for more information. With two duty pumps, the firm capacity of the recycled water distribution pump station will be 2,360 gpm (3.4 mgd) at a maximum speed of 1800 rpm and a design head 180 ft. The hydraulics of the distributions systems are primarily controlled by water levels in the Plum Street and Norman storage tanks. A summary of the tank elevations is presented in Table 3-3.

Table 3-3: Storage Tank Elevations

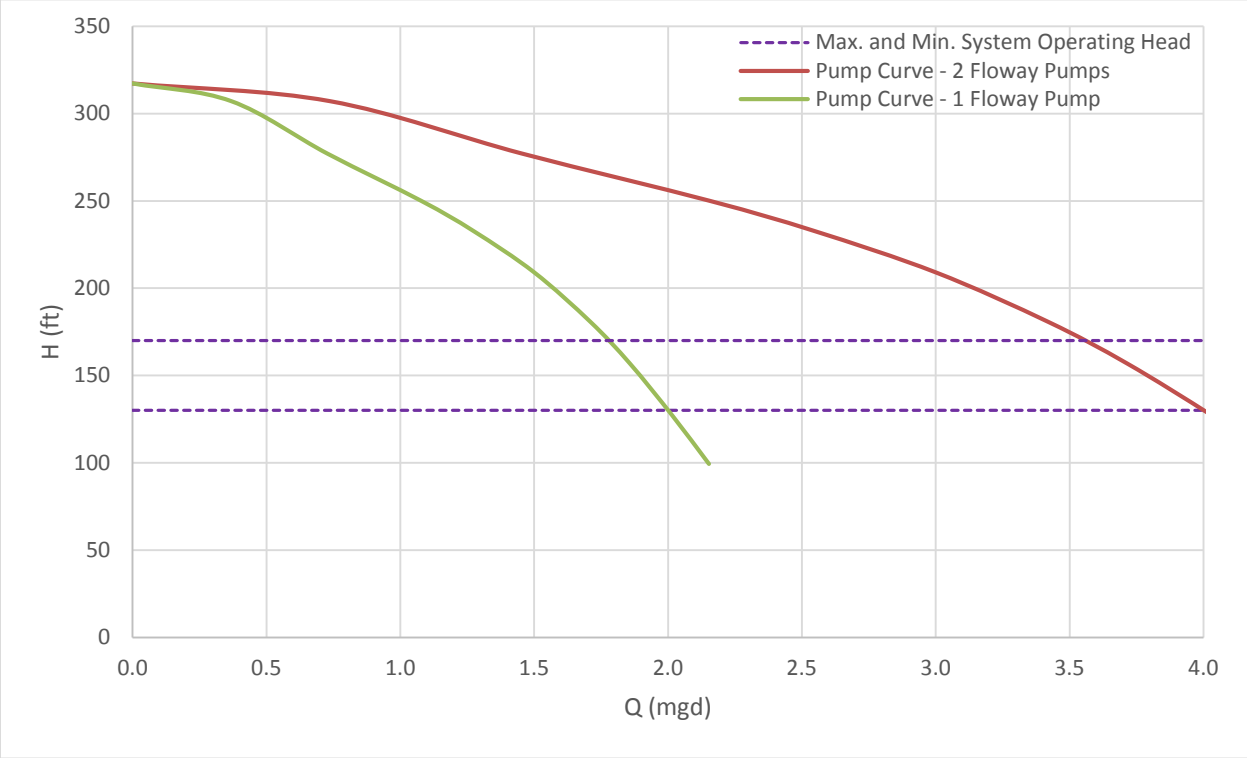
Tank	Service Area	Bottom Elevation	Maximum Water Depth	Maximum Water Surface Elevation
Plum Street	North	134 feet	23.7 feet	154.7 feet
Norman	Central	123 feet	33 feet	156 feet

Pump curves for a single duty pump and two duty pumps running in parallel are shown in Figure 3-2. In addition, this figure shows the minimum and maximum system operating head, generated using demands for both the North and Central Service Areas. The system operating head is a result of necessary pump discharge pressures to pump water to Norman and Plum Street tanks. Two Floway pumps running in parallel can provide the necessary head to pump the maximum design recycled water production of the expanded Novato RWF, which lies at 2.92 mgd, as outlined in section 4.

Because the North and Central Service Areas will be hydraulically connected, the water levels in both storage tanks will trend towards the same elevation. It is assumed that after the Central Service Area is brought in to service, the Novato RWF will continue to be operated based on maintaining a target water level in the Plum Street Tank.

The additional pumping capacity will allow recycled water stored in the clearwell to be used to help Norman and Plum Street tanks meet peak hour demands. An updated quote has been provided by Floway for an additional distribution pump at $46,000.

Figure 3-2: Distribution Pump Curves[1] at maximum speed (1785 rpm) with System Operating Head



*Note that the system head is typically between 130 feet and 170 feet and is controlled by the water elevation in the distributed storage tanks.

3.2 Alternative B – Expand Novato RWF Plus Operational Improvements

Alternative B would involve the same improvements to the Novato RWF as Alternative A plus additional operational improvements. As part of the recycled water capacity evaluation, NSD and Veolia (contract operator) staff were interviewed to obtain input on the current Novato RWF operation. The majority of items noted by NSD staff were operational improvements, which would not explicitly be required in order to expand the capacity of the existing facility. However, NSD may want to include some of these operational improvements as part of capacity expansion project.

3.2.1 Filter Effluent Line Hydraulic Restriction

Currently, there is an unidentified hydraulic restriction in the filter effluent line that is creating more headloss in the filter effluent line than expected. The additional headloss results in treated water spilling over the bypass line to the filter feed pump station, which should only occur when the filtered effluent does not meet Title 22 requirements. Although this issue can be addressed by raising the invert elevation of the line that spills back to the filter feed pump station, it is estimated that at higher flow rates (~2.2 mgd) the hydraulic restriction may cause the tertiary filters to overflow. Based on hydraulic testing performed by NSD in Fall 2015, it is currently believed that the hydraulic restriction is located somewhere down stream of the 18" diameter slip-lined section of the filter effluent line. Additional investigation is required to identify and address the hydraulic restriction. A preliminary construction cost estimate to fix the restriction lies at $59,000 and will be refined upon further investigation.

[1] Pump Curves shown are for 4 stage 1780 rpm vertical turbine Floway pumps.

3.2.2 Clearwell Improvements

The clearwell is an abandoned clarifier that was connected to the recycled water system for storage, however it is not required for operation of the existing RWF. To accommodate the increased peak month demand from expanding recycled water supply to the Central Service Area, the use of the clearwell will be important for managing daily recycled water production as well as meeting peak day and peak hour demands. The clearwell storage tank is not covered. Currently the clearwell is not being used due to occasional high coliform counts that have been measured in the clearwell. The cause of the high coliform counts has not been identified, but they may be due to recontamination from birds that land in and around the clearwell and/or due to loss of residual chlorine in the clearwell. Two alternatives, covering the clearwell or adding an additional chlorine dosing point at the clearwell were considered to prevent high coliform counts in the clearwell.

Cover

Adding a cover to the clearwell would protect the treated water from recontamination from birds. Three clearwell cover material options have been identified, further described below and shown in Figure 3-3.

- Aluminum truss: An aluminum truss cover similar to the cover on the chlorine contact tank could be installed on the clearwell. The lowest quote received for raw construction cost is at $247,000. For maintenance and inspection purposes, aluminum panels can be walked upon but would be too heavy to lift, so an access hatches are needed.
- Fiber-reinforced plastic (FRP) cover: FRP is a more cost effective option than aluminum and, with the lowest estimated raw construction cost at $186,600. For maintenance and inspection purposes, FRP panels can be walked upon but would also be too heavy to lift, so access hatches are needed.
- Geomembrane cover: Another cost effective option would be a geomembrane cover. A geomembrane cover would need to be supported by the existing walkway and center column in the clearwell. A more detailed investigation would be needed as part of design if this type of cover is selected. The geomembrane cover would also need to be structurally supported due to the size of the tank and has an estimated raw construction cost of $211,000. For maintenance and inspection, a geomembrane cover cannot be walked upon but panels can be lifted up by individuals. Geomembrane covers more vulnerable to external damage compared to FRP and aluminum covers.

Figure 3-3: From Left to Right – Example Aluminum, FRP and Geomembrane Covers

Chlorine Injection

An alternative to covering the clearwell would be to monitor residual chlorine in the clearwell and inject chlorine as needed to maintain a residual. This option would involve installing approximately 450 ft of ½-inch diameter chlorine line that would convey liquid hypochlorite from the hypochlorite storage area to the clearwell, as shown in Figure 3-4. There is not enough capacity in the current hypochlorite feed system to inject more chlorine in to the chlorine contact tank upstream of the clearwell. A new chlorine residual analyzer would also be installed at the clearwell along with a mixing system. The estimated installation cost of this alternative is $85,000, including the chlorine analyzer and SCADA integration, which is significantly lower than the installation costs of the different cover options. However, the operational cost of this alternative is higher than that of the covers. While the cover would only require routine inspection and maintenance, the chlorine injection system would require on-going chemical and pumping energy costs.

Annual combined chlorine and energy costs would be an estimated $6,000, based on the addition of 1 mg/L of chlorine at the clearwell, on top of the chlorine already added to the chlorine contact tank upstream of the clearwell. The 20 year life cost of the chlorine injection system is thus estimated at $205,000, whereas the cheapest cover option is estimated to cost $186,600.

Figure 3-4: Chlorine Injection at Clearwell

3.2.3 Intermittent Filter Backwash

NSD occasionally has trouble meeting a 2.0 NTU turbidity limit in the filter effluent. An intermittent backwashing system has been suggested by the filter manufacturer as an option to help improve filter performance. The filter manufacturer, Westech, offers a retrofit kit that will allow for automated control for intermittent backwashing. Retrofitting the existing air lift backwash system with the intermittent backwash control system has been estimated to cost $34,000. Intermittent backwashing would also reduce the air compressor run time, thereby lowering energy costs. The use of intermittent backwash would also avoid the need for a second air compressor package unit, if a third filter cell is installed. If continuous backwashing is used, a second compressor unit would be required.

3.2.4 Additional SCADA Programming

Improved SCADA programming would help process monitoring and compliance reporting. Plant staff would like programming improvements that will allow them to easily generate operating data for monthly self-monitoring reports. In addition, the SCADA programming should be modified to automatically freeze filter effluent turbidity data when the filter effluent is being diverted to the filter feed pump station wet (i.e. upon closure of valve BFV-1410-06.01). When not producing recycled water, freezing the last value will prevent data from counting against the filter effluent turbidity rolling average required for Title 22 compliance. The preliminary cost estimate for improved SCADA programming is $23,000.

3.2.5 Filter Piping Modifications

As currently configured, the existing filters cannot be isolated from each other on the discharge side. Isolation valves could be added to the discharge of each filter along with an overflow or waste line, which would allow staff to troubleshoot or start-up filters individually, while allowing the other filters to produce Title 22 compliant water. The effluent from the offline filter would be sent to the plant drainage system.

Another piping modification would be to remove or lower the gooseneck on the recycled water line just downstream of the filters. The gooseneck was installed to minimize air binding in the recycled water, however at higher flow rates the elevation of the gooseneck causes the recycled water weirs in the filters to become submerged. Although submergence of the weirs does impact filter performance, the gooseneck elevations should be lowered to prevent submergence from occurring. The height of the fall after the gooseneck also results in air entrainment in the recycled water flow, which may be a contributor to the unknown hydraulic issue in the recycled water line.

A preliminary raw construction cost estimate for isolating the filters and adding an overflow line lies at $37,000 and will be refined during design. A preliminary raw construction cost estimate for lowering the gooseneck lies at $24,000.

3.2.6 Mixing System for Chlorine Contact Tank

Veolia staff noted difficulties in maintaining consistent chlorine residual in the chlorine contact tank effluent. Veolia staff noted that they believe chlorine is sinking to the bottom of the tank, which leads to the inconsistent residual concentrations and that mixing the chlorine contact tank during start-up only (i.e. not when recycled water is being produced) would help minimize this impact. The State Water Resources Control Board Division of Drinking Water (DDW) may not allow a mixing system to be installed due to the potential for the mixing system to be turned on during recycled water production, which could prevent NSD from meeting the required minimum CT value required by Title 22. The preliminary construction cost estimate for the mixing system lies at $41,000. An alternative solution could be to add additional curtain baffles to the chlorine contact tank to help reduce some of the dead volume in the tank, thereby reducing the ability of the chlorine to stay on the bottom of the tank. A preliminary cost estimate for this solution lies at $85,000.

4 Recommended Project

Expanding the recycled water production capacity at the Novato RWF is recommended to provide reliable recycled water production to meet North and Central Service Area demands. In addition to providing reliability, expanding the capacity at the Novato RWF will maintain centralized recycled water production at the Novato treatment plant site. This alternative will not change the operation of the Deer Island RWF, which will continue to be operated on as-needed basis. The Novato RWF and Deer Island RWF combined can meet the peak day demand for the north and central service areas. Design criteria for an expanded, 1.7 mgd (firm capacity) Novato RWF is described in Section 4.1.

NSD, at its discretion, may choose to include some or all of the operational improvements described as part of Alternative B; however, these improvements are not required to increase the capacity of the Novato RWF.

4.1 Design Criteria

The existing and revised design criteria of all existing and recommended project components for the tertiary treatment facility at the Novato WWTP are listed in Table 4-1.

Table 4-1: Design Criteria for Tertiary Treatment Facilities at Novato RWF

Description	Existing Facilities	Proposed Upgraded Facility
Design Flow		
Max Recycled Water Production (All units running[2])	1.94 mgd	2.92 mgd

[2] "All units running" represents 1.94 mgd and 2.92 mgd of capacity, for the existing and revised facilities respectively, for the remainder of this table. The filters are the limiting process.

Description	Existing Facilities	Proposed Upgraded Facility
Design Recycled Water Production (Duty units running)	0.85 mgd	1.70 mgd
Average Day Peak Month Demand (Combined North and Central Service Area)	0.64 mgd	1.52 mgd
Peak Day Demand (Combined North and Central Service Area)	0.92 mgd	2.15 mgd
Influent Quality		
Maximum Total Suspended Solids (TSS)	30 mg/L	30 mg/L
Average Turbidity	5 NTU	5 NTU
Filter Feed Pump Station		
Design Capacity (Duty pumps)	1.7 mgd	3.4 mgd
Pump Type	Vertical column	Vertical column
Pump Quantity	2	3
Duty	1	2
Standby	1	1
Maximum Speed, each	1800 rpm	1800 rpm
Maximum Capacity, each	1180 gpm	1180 gpm
Maximum Speed Design Head	50.8 feet	50.8 feet
Horsepower, each	20 hp	20 hp
Meter Type	Electromagnetic Flow Meter	Electromagnetic Flow Meter
Coagulant Chemical Feed System		
Polymer		
Type	Specialty Coagulant	Specialty Coagulant
Concentration	30% percent (Specific gravity of 1.025)	30% percent (Specific gravity of 1.025)
Minimum Dose	0.1 mg/L	0.1 mg/L
Average Dose	1 mg/L	1 mg/L
Maximum Dose	5 mg/L	5 mg/L
Polymer Storage		
Type	Totes	Totes
Number	1	1
Capacity, each	350 gallons	350 gallons
Storage at Average Day Demand (each)	126 days	63 days
Polymer Feed Units		
Type	Diaphragm	Diaphragm
Number	2	2
Duty	1	1
Standby	1	1
Capacity, each (before dilution)	0.1 gpm	0.1 gpm
Capacity required (Max Dose, Peak Day Demand – All units running)	0.02 gpm	0.03 gpm
Filters		
Type	Continuous backwashing sand filters	Continuous backwashing sand filters
Number of filter units	2	3
Duty	1	2

Description	Existing Facilities	Proposed Upgraded Facility
Standby	1	1
Filter area per unit	150 sq ft	150 sq ft
Total filter area, all units(duty)	150 sq ft	300 sq ft
Media type	Sand	Sand
Media depth	80 inches	80 inches
Maximum filter loading rate	5.0 gpm/sq ft	5.0 gpm/sq ft
Design filter loading rate	4.4 gpm/sq ft	4.4 gpm/sq ft
Design flowrate (Duty Filters)	660 gpm	1320 gpm
Maximum backwash flow	15%	15%
Average backwash flow	10%	10%
Design filter output (Duty Filters)	0.85 mgd	1.7 mgd
Air Compressor Type	Duplex	Duplex
Air Dryer Type	Desiccant	Desiccant
Backwash pumps		
Type	Horizontal End Suction	Horizontal End Suction
Number	2	3
Duty	1	2
Standby	1	1
Capacity, each	100 gpm	100 gpm
Hypochlorite Feed System		
Disinfectant type	Liquid sodium hypochlorite	Liquid sodium hypochlorite
Solution	12.5%	12.5%
Design Dose Range		
Max	20 mg/L	20 mg/L
Average	3 mg/L	3mg/L
Min. Desired Residual	2 mg/L	2 mg/L
Hypochlorite storage tank	Existing	Existing
Type	Cross Linked HDPE	Cross Linked HDPE
Number	2	2
Capacity	6,000 gallons	6,000 gallons
Storage at average day demand[3]	58 days	29 days
Hypochlorite feed pump		
Type	Diaphragm	Diaphragm
Number	4	4
Duty	1	1
Standby	1	1
Capacity, each (minimum)	12 gph	12 gph
Capacity required (Max dose, Peak day demand – All units running)	13 gph	20 gph
Motor size	2 hp	2 hp
Chlorine Contact Tank		
Type	Circular, Concrete Clarifier-style Tank	Circular, Concrete Clarifier-style Tank
Number of basins	1	1

[3] This calculation assumes the Hypochlorite in storage is used for this process only, whereas it is currently being used for other treatment processes.

Description	Existing Facilities	Proposed Upgraded Facility
Tank Diameter	75 ft	75 ft
Tank Depth (average)	15.5 ft	15.5 ft
Center Baffle diameter	12 ft	12 ft
Diameter of ports in baffle	12 in	12 in
Number of ports	6	6
Tank Volume	514,000 gallons	514,000 gallons
Theoretical contact time at max recycled water production (All units running)	382 min	253 min
Baffling efficiency (Dye Tracer Test Results)[4]	40%	40%
Minimum contact time requirement at peak design flow	90 min	90 min
Contact time at design recycled water production	348 min	174 min
Contact time at max recycled water production (All units running)	153 min	101 min
Tank Drainage Pump		
Type	Submersible centrifugal	Submersible centrifugal
Number (duty/standby)	1/0	1/0
Flow capacity	200 gpm	200 gpm
TDH	23 ft	23 ft
Horsepower	1.5 hp	1.5 hp
Clearwell Storage Tank		
Total Volume	514,000 gallons	514,000 gallons
Working Volume	369,000 gallons	369,000 gallons
Max water level elevation	10 ft	10 ft
Min water level (min submergence of distribution pump station)	-1.167 ft	-1.167 ft
Tank Drainage Pump		
Type	Submersible centrifugal	Submersible centrifugal
Number (duty/standby)	1/0	1/0
Flow capacity	500 gpm	500 gpm
Time to drain “dead” volume	4.8 hours	4.8 hours
TDH	23 ft	23 ft
Horsepower	5 hp	5 hp
Distribution Pump Station		
Type	Vertical Turbine Pumps	Vertical Turbine Pumps
Speed	1770 rpm	1770 rpm
Number of Pumps	2	3
Duty	1	2
Standby	1	1
Maximum Speed	1800 rpm	1800 rpm
Maximum capacity, each	1,250 gpm	1,250 gpm
Design head	180 ft	180 ft
Horsepower, each	75 hp	75 hp

[4] From April 2014 dye tracer test results.

4.2 Cost Estimate

Table 4-2 summarizes the preliminary construction cost and project implementation cost estimate for the recommended alternative**.** The estimated project cost for the capacity improvement is $1,227,000.

Table 4-3 summarizes the preliminary construction cost and project implementation cost estimate for the operational improvements. The estimated project cost for the operational improvements is $652,000, which is based on the assumption that a clearwell cover is the preferred option to mitigate clearwell contamination problem. The alternative, chlorine injection in the clearwell, is estimated to have a $183,000 total project cost. In addition, it is assumed that isolating the filters is the preferred alternative over lowering the gooseneck and that installing a mixing system in the chlorine contact tank is the preferred option over adding curtain baffles.

Detailed cost estimates are provided in Appendix A. Combined, the estimated total project cost of the capacity and operational improvements is $1,879,000.

Table 4-2: Recommended Project Preliminary Cost Estimate

	Filter Feed Pump Station	Tertiary Filtration	RW Distribution Pump Station	Totals
Raw Construction Cost	$145,900	$321,900	$149,500	$618,000
Mobilization/Demobilization[5]	$14,600	$32,190	$14,950	$62,000
Tax on Materials[6]	$6,600	$14,500	$6,800	$28,000
Contractor Overhead and Profit[7]	$21,900	$48,300	$22,500	$93,000
25% Planning Level Estimating Contingency	$36,500	$80,500	$37,400	$155,000
Estimated Construction Cost August 2015 Dollars	**$225,490**	**$497,390**	**$231,150**	**$955,000**
Escalation to Mid. Construction (July 2017)[8]	$13,300	$29,400	$13,700	$56,400
Construction Cost Estimate	**$238,790**	**$526,790**	**$244,850**	**$1,020,000**
Project Implementation (Design/CM/Admin/Permits)[9]	$51,100	$112,700	$52,400	$217,000
TOTAL RECOMMENDED PROJECT COST	**$289,890**	**$639,490**	**$297,250**	**$1,227,000**

[5] Assuming 10% of raw construction cost
[6] Assuming 9% sales tax on materials and 50% of raw construction cost is for materials.
[7] 15% of total raw construction cost
[8] Assuming construction begins mid-February 2017 and lasts 9 months
[9] 35% of total raw construction cost

Table 4-3: Operational Improvement Preliminary Cost Estimate

	Filter Effluent Line Restriction	Clearwell Cover	SCADA Programming	Filter Piping Modifications	CCT Mixing System	Totals
Raw Construction Cost	$39,200	$185,900	$15,000	$36,700	$27,500	**$305,000**
Mobilization/Demobilization	$3,920	$18,590	-	$3,670	$2,750	**$29,000**
Tax on Materials	$1,800	$8,400	$700	$1,700	$1,300	**$14,000**
Contractor Overhead and Profit	$5,900	$27,900	$2,300	$5,600	$4,200	**$46,000**
25% Planning Level Estimating Contingency	$9,800	$46,500	$3,800	$9,200	$6,900	**$77,000**
Estimated Construction Cost August 2015 Dollars	**$60,620**	**$287,290**	**$21,800**	**$56,870**	**$42,650**	**$470,000**
Escalation to Mid. Construction (July 2017)	$3,600	$10,200	$800	$2,000	$1,500	**$19,000**
Construction Cost Estimate	**$64,220**	**$297,490**	**$22,600**	**$58,870**	**$44,150**	**$490,000**
Project Implementation (Design/CM/Admin/Permits)	$21,300	$100,600	$7,700	$20,000	$15,000	**$165,000**
TOTAL OPERATIONAL IMPROVEMENT COST	**$85,520**	**$398,090**	**$30,300**	**$78,870**	**$59,150**	**$652,000**

4.3 Regulations and Permitting

The existing recycled water production facilities at the Novato treatment plant site and Deer Island are permitted under the Regional Water Quality Control Board (RWQCB) General Water Recycling Order.

Expansion of the Novato RWF will require the development and approval of a revised Title 22 Engineer's Report for the production of recycled water. The revised production Engineer's Report will need to be reviewed by the State Water Resources Control Board Division of Drinking Water (DDW) and approved by the RWQCB.

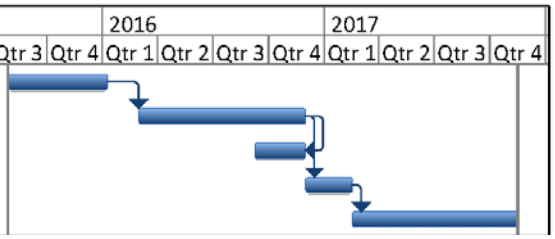
Recycled water distribution and use is currently covered by separate approval from the RWQCB as well as a separate Engineer's Report for recycled water distribution. The Central Service Area was previously identified as a future area of expansion in the existing distribution Engineer's Report, therefore the development and approval of a modified distribution Engineer's Report is not required. NMWD will need to identify the Central Service Area users in accordance with the NMWD's existing Recycled Water Program Manual.

4.4 Project Schedule and Implementation

A preliminary project schedule is shown in Figure 4-1. This schedule assumes both design and construction will take approximately 9 months each.

Figure 4-1: Project Schedule

ID	Task Name	Start	Finish
1	Technical Memorandum	Wed 7/29/15	Fri 1/8/16
2	Design	Tue 3/1/16	Wed 11/30/16
3	Title 22 Report Update	Thu 9/8/16	Wed 11/30/16
4	Bid/Award	Thu 12/1/16	Wed 2/15/17
5	Construction	Thu 2/16/17	Wed 11/15/17



Appendix A – Preliminary Cost Estimates

Project: Novato Sanitary District/NMWD - Recycled Water Expansion

Aspect: Overall Construction Cost Estimate

August 2015 SF CCI 11155.07

Estimate Type: Preliminary

Divisions	Filter Feed Pump Station	Tertiary Filtration	RW Distribution Pump Station	Totals	Percent of Raw Const. Cost
9 - Finishes	$ 2,786	$ 3,137	$ 2,793	**$ 9,000**	1%
11 - Equipment	$ 78,611	$ 253,295	$ 89,516	**$ 422,000**	68%
15 - Mechanical	$ 14,461	$ 35,413	$ 7,151	**$ 58,000**	9%
16 - Electrical	$ 35,000	$ 15,000	$ 35,000	**$ 85,000**	14%
17 - Instrumentation	$ 15,000	$ 15,000	$ 15,000	**$ 45,000**	7%
Raw Const. Cost	$ 145,900	$ 321,900	$ 149,500	**$ 618,000**	61%
Mobilization/Demobilization	$ 14,590	$ 32,190	$ 14,950	**$ 62,000**	6%
Tax on Materials	$ 6,600	$ 14,500	$ 6,800	**$ 28,000**	3%
Contractor Overhead and Profit	$ 21,900	$ 48,300	$ 22,500	**$ 93,000**	9%
25% Design Level Estimating Contingency	$ 36,500	$ 80,500	$ 37,400	**$ 155,000**	15%
Estimated Cost August 2015 Dollars	**$ 225,490**	**$ 497,390**	**$ 231,150**	**$ 955,000**	94%
Escalation to Mid. Const. (July 2017)	$ 13,300	$ 29,400	$ 13,700	$ 56,400	6%
Construction Cost Estimate	**$ 238,790**	**$ 526,790**	**$ 244,850**	**$ 1,020,000**	

Project: Novato Sanitary District/NMWD - Recycled Water Expansion

Aspect: Filter Feed Pump Station

Estimate Type: Preliminary

Date: December, 2015
Project Number: 0036-005

Prepared by: F. Goddard
Checked by: M. Nakamoto
Check Date: November, 2015

Spec. Division	Item	Size	Units	Quantity	Unit	Unit Cost	Total Cost	Notes
9 - Finishes							**$ 2,786**	
	Coating			1	LS	$2,500	$ 2,500	
	Allowance for Painting and Coating, 0.2% of the raw construction cost					0.2%	$ 286	Typical allowance
11 - Equipment							**$ 78,611**	
	Filter feed vertical turbine pumps	20	hp	1	EA	$ 38,673	$ 38,673	Updated quote from G3 Engineering.received on September 17th 2015 for contractor price.
	Installation and Start-up/Testing Allowance				ALLOW	50%	$ 19,337	
	VFD			1	EA	$ 16,858	$ 16,858	Interpolated between 10hp and 50hp for a 20hp VFD
	Allowance for Misc Attachment Materials & Items Etc.					5%	$ 3,743	Typical allowance
15 - Mechanical							**$ 14,461**	
	Butterfly Valves	8	in	1	EA	$ 966	$ 966	
	Check Valves	8	in	1	EA	$ 2,781	$ 2,781	
	Piping	10	in	14	LF	$ 50	$ 700	
	Fittings	10	in	1	EA	$ 1,200	$ 1,200	
	Allowance for miscellaneous valves/fittings			1	LS	$ 7,500	$ 7,500	
	Allowance for Hangers, Supports, Etc.			1	LS	10%	$ 1,315	Typical allowance
16 - Electrical							**$ 35,000**	
	Allowance electrical installation including sub markup				LS	$ 35,000	$ 35,000	
17 - Instrumentation & Control							**$ 15,000**	
	Allowance for instrumentation including sub markup				LS	$ 15,000	$ 15,000	

FACILITY RAW CONSTRUCTION COST		**$**	**145,858**	
Sales Tax	9.00%	$	7,000	Assuming 50% of raw construction cost for materials
Mobilization/Demobilization	10.00%	$	15,000	
Contractor Overhead and Profit	15.0%	$	22,000	of total raw construction cost
25% Design Level Estimating Contingency	25.0%	$	36,000	of total raw construction cost
ESTIMATED FACILITY CONSTRUCTION COST (SUBTOTAL)		**$**	**226,000**	

Project: Novato Sanitary District/NMWD - Recycled Water Expansion

Aspect: Tertiary Filtration

Estimate Type: Preliminary

Date: December, 2015
Project Number: 0036-005

Prepared by: F. Goddard
Checked by: M. Nakamoto
Check Date: November, 2015

Spec. Division	Item	Size	Units	Quantity	Unit	Unit Cost	Total Cost	Notes
9 - Finishes							**$ 3,137**	
							$ 2,500	
	Allowance for Painting and Coating, 0.2% of the raw construction cost					0.2%	$ 637	Typical allowance
11 - Equipment							**$ 253,295**	
	Upflow Continous Backwash Filter	150	SF	1	EA	$ 153,854	$ 153,854	Updated quote received from Misco Water on October 14th
	Backwash Pumps	5	hp	1	EA	$ 2,900	$ 2,900	Updated quote received from Gierlich-Mitchell on October 28th
	Intermittent Backwash			1	EA	$ 34,000	$ 34,000	Quote received from Misco Water on October 14th
	Equipment Installation, startup and testing			1	LS	$ 50,000	$ 50,000	Engineers estimate
	52 SCFM Quincy Compressor			1	LS	$ 10,073	$ 10,073	Optional upgrade for added redudancy - not included in total cost
	Allowance for Misc Attachment Materials & Items Etc.					5%	$ 12,541	Typical allowance
15 - Mechanical							**$ 35,413**	
	Check valves	4	in	1	EA	$ 2,126	$ 2,126	From Backwash Sump Pump to Filtrate Line
	Butterfly valves	4	in	1	EA	$ 837	$ 837	From Filter to Backwash Sump Pump
	Butterfly valves	10	in	1	EA	$ 1,391	$ 1,391	From Filter Feed Channel into each Filter
	Plug Valve	10	in	2	EA	$ 3,712	$ 7,425	For backwash pump
	Piping	18	in	10	LF	$ 81	$ 810	
	Piping	14	in	10	LF	$ 67	$ 665	
	Piping	10	in	50	LF	$ 50	$ 2,500	
	Piping	4	in	15	LF	$ 20	$ 300	
	Fittings	18	in	1	EA	$ 1,920	$ 1,920	
	Fittings	14	in	1	EA	$ 1,440	$ 1,440	
	Fittings	10	in	5	EA	$ 960	$ 4,800	
	Fittings	4	in	2	EA	$ 240	$ 480	
	Allowance for miscellaneous valves/fittings			1	LS	$ 7,500	$ 7,500	
	Allowance for Hangers, Supports, Etc.			1	LS	10%	$ 3,219	Typical allowance
16 - Electrical							**$ 15,000**	
	Allowance electrical installation including sub markup				LS	$ 15,000	$ 15,000	
17 - Instrumentation & Control							**$ 15,000**	
	Allowance for instrumentation including sub markup				LS	$ 15,000	$ 15,000	

FACILITY RAW CONSTRUCTION COST		**$**	**331,919**
Sales Tax	9.00%	$ 15,000	Assuming 50% of raw construction cost for materials
Mobilization/Demobilization	10.00%	$ 33,000	
Contractor Overhead and Profit	15.0%	$ 50,000	of total raw construction cost
25% Design Level Estimating Contingency	25.0%	$ 83,000	of total raw construction cost
ESTIMATED FACILITY CONSTRUCTION COST (SUBTOTAL)		**$**	**513,000**

Project: Novato Sanitary District/NMWD - Recycled Water Expansion

Aspect: RW Distribution Pump Station

Estimate Type: Preliminary

Date: December, 2015
Project Number: 0036-005

Prepared by: F. Goddard
Checked by: M. Nakamoto
Check Date: November, 2015

Spec. Division	Item	Size	Units	Quantity	Unit	Unit Cost	Total Cost	Notes
9 - Finishes							**$ 2,793**	
							$ 2,500	
	Allowance for Painting and Coating, 0.2% of the raw construction cost					0.2%	$ 293	Typical allowance
11 - Equipment							**$ 89,516**	
	Vertical Turbine Pumps			1	EA	$ 45,545	$ 45,545	Updated quote from G3 Engineering.received on September 17th 2015 for contractor price.
	Installation and Start-up/Testing Allowance				ALLOW	50%	$ 11,386	
	VFD (75 hp pump)			1	EA	$ 28,322	$ 28,322	Unit cost is average between 50 and 100 hp pump.
	Allowance for Misc Attachment Materials & Items Etc.					5%	$ 4,263	Typical allowance
15 - Mechanical							**$ 7,151**	
	10" pipe	10	IN	5	LF	$ 50	$ 250	
	Air Valve	2	IN	1	EA	$ 274.95	$ 275	
	Check valves	10	IN	1	EA	$ 3,712.32	$ 3,712	
	Butterfly Valve	10	IN	1	EA	$ 1,390.94	$ 1,391	
	Fittings	10	IN	1	EA	$ 960.00	$ 960	
	Allowance for Hangers, Supports, Etc.			1	LS	10%	$ 563	Typical allowance
16 - Electrical							**$ 35,000**	
	Allowance electrical installation including sub markup				LS	$ 35,000	$ 35,000	
17 - Instrumentation & Control							**$ 15,000**	
	Allowance for instrumentation including sub markup				LS	$ 15,000	$ 15,000	

FACILITY RAW CONSTRUCTION COST		**$**	**149,460**
Sales Tax	9.00%	$ 7,000	Assuming 50% of raw construction cost for materials
Mobilization/Demobilization	10.00%	$ 15,000	
Contractor Overhead and Profit	15.0%	$ 22,000	of total raw construction cost
25% Design Level Estimating Contingency	25.0%	$ 37,000	of total raw construction cost
ESTIMATED FACILITY CONSTRUCTION COST (SUBTOTAL)		**$**	**230,000**

Project: Novato Sanitary District - Contract D

Aspect: Overall Construction Cost Estimate Summary - Operational Improvements

August 2015 SF CCI 11155
Estimate Type: Preliminary

Divisions	Filter Effluent Line Restriction	Clearwell Cover	Clearwell Chlorine Injection	Additional SCADA Programming	Filter Piping Modifications	CCT Mixing System	Totals (excluding chlorine injection)	Percent of Raw Const. Cost
2 - Site Work	$ 31,500	$ -	$ 11,841	$ -	$ 900	$ -	**$ 33,000**	11%
5 - Metals	$ -	$ 185,430	$ -	$ -	$ -	$ -	**$ 186,000**	61%
9 - Finishes	$ -	$ 371	$ -	$ -	$ -	$ -	**$ 1,000**	0%
11 - Equipment	$ -	$ -	$ 62,296	$ -	$ -	$ -	**$ -**	0%
15 - Mechanical	$ 7,684	$ -	$ 11,093	$ -	$ 35,774	$ 27,500	**$ 71,000**	23%
17 - Instrumentation	$ -	$ -	$ -	$ 15,000	$ -	$ -	**$ 15,000**	5%
Raw Const. Cost	$ 39,200	$ 185,900	$ 85,300	$ 15,000	$ 36,700	$ 27,500	**$ 305,000**	49%
Mobilization/Demobilization (10%)	$ 3,920	$ 18,590	$ 8,530	-	$ 3,670	$ 2,750	**$ 38,000**	6%
Tax on Materials	$ 1,800	$ 8,400	$ 3,900	$ 700	$ 1,700	$ 1,300	**$ 18,000**	3%
Contractor Overhead and Profit	$ 5,900	$ 27,900	$ 12,800	$ 2,300	$ 5,600	$ 4,200	**$ 59,000**	10%
25% Design Level Estimating Contingency	$ 9,800	$ 46,500	$ 21,400	$ 3,800	$ 9,200	$ 6,900	**$ 98,000**	16%
Estimated Cost August 2015 Dollars	**$ 60,620**	**$ 287,290**	**$ 131,930**	**$ 21,800**	**$ 56,870**	**$ 42,650**	**$ 602,000**	97%
Escalation to Mid. Const.(October 2016)	$ 2,200	$ 10,200	$ 4,700	$ 800	$ 2,000	$ 1,500	**$ 17,000**	3%
Construction Cost Estimate	**$ 62,820**	**$ 297,490**	**$ 136,630**	**$ 22,600**	**$ 58,870**	**$ 44,150**	**$ 620,000**	
Project Implementation (Design/CM/Admin/Perm	**$ 21,300**	**$ 100,600**	**$ 46,200**	**$ 7,700**	**$ 20,000**	**$ 15,000**	**$ 165,000**	
TOTAL PROJECT COST	**$ 84,120**	**$ 398,090**	**$ 182,830**	**$ 30,300**	**$ 78,870**	**$ 59,150**	**$ 651,000**	

Project: Novato Sanitary District - Contract D

Aspect: Filter Effluent Line Restriction

Estimate Type: Preliminary

Date: December, 2015
Project Number: 0036-005

Prepared by: F. Goddard
Checked by: M. Takemoto
Check Date: November, 2015

Spec. Division	Item	Size	Units	Quantity	Unit	Unit Cost	Total Cost	Notes
2 - Sitework							**$ 31,500**	
	Piping and Misc.						$ 30,000	
	Allowance for Shoring/Dewatering/Thrust Protection/Misc					5%	$ 1,500	Typical allowance
15 - Mechanical							**$ 7,684**	
	Fittings			3	EA	$ 1,440	$ 4,320	
	14" HDPE Pipe	14	IN	10	LF	$ 67	$ 665	
	Pipe Supports				LS	$ 2,000	$ 2,000	
	Allowance for Hangers, Supports, Etc.			1	LS	10%	$ 699	Typical allowance
						FACILITY RAW CONSTRUCTION COST	**$ 39,184**	
						Sales Tax 9.00%	$ 2,000	Assuming 50% of raw construction cost for materials
						Mobilization/Demobilization 10.00%	$ 4,000	
						Contractor Overhead and Profit 15.0%	$ 6,000	of total raw construction cost
						25% Design Level Estimating Contingency 25.0%	$ 10,000	of total raw construction cost
						ESTIMATED FACILITY CONSTRUCTION COST (SUBTOTAL)	**$ 61,000**	

Project: Novato Sanitary District - Contract D

Aspect: Clearwell Cover

Estimate Type: Preliminary

Date: December, 2015
Project Number: 0036-005

Prepared by: F. Goddard
Checked by: M. Takemoto
Check Date: November, 2015

Spec. Division	Item	Size	Units	Quantity	Unit	Unit Cost	Total Cost	Notes
5 - Metals							**$ 185,430**	
	Aluminum Cover				EA	$ 235,000		Quote received from Misco Water on October 21 2015
	FRP Cover			1	EA	$ 176,600	$ 176,600	Quote received from Envirotrol on September 27 2015
	Geomembrane cover				EA			Awaiting Quote
	Allowance for Nuts/Bolts/Connections/Etc					5%	$ 8,830	Typical allowance

FACILITY RAW CONSTRUCTION COST		**$**	**185,801**	
Sales Tax	9.00%	$	8,000	Assuming 50% of raw construction cost for materials
Mobilization/Demobilization	10.00%	$	19,000	
Contractor Overhead and Profit	15.0%	$	28,000	of total raw construction cost
25% Design Level Estimating Contingency	25.0%	$	46,000	of total raw construction cost
ESTIMATED FACILITY CONSTRUCTION COST (SUBTOTAL)		**$**	**287,000**	

Project: Novato Sanitary District - Contract D

Aspect: Additional SCADA Programming

Estimate Type: Preliminary

Date: December, 2015
Project Number: 0036-005

Prepared by: F. Goddard
Checked by: M. Takemoto
Check Date: November, 2015

Spec. Division	Item	Size	Units	Quantity	Unit	Unit Cost	Total Cost	Notes
17 - Instrumentation & Control							**$ 15,000**	
	Instrumentation and Misc						$ 15,000	

FACILITY RAW CONSTRUCTION COST		**$**	**15,030**	
Sales Tax	9.00%	$	1,000	Assuming 50% of raw construction cost for materials
Contractor Overhead and Profit	15.0%	$	2,000	of total raw construction cost
25% Design Level Estimating Contingency	25.0%	$	4,000	of total raw construction cost
ESTIMATED FACILITY CONSTRUCTION COST (SUBTOTAL)		**$**	**22,000**	

Project: Novato Sanitary District - Contract D

Aspect: Filter Piping Modifications - Isolating Filters

Estimate Type: Preliminary

Date: December, 2015
Project Number: 0036-005

Prepared by: F. Goddard
Checked by: M. Takemoto
Check Date: November, 2015

Spec. Division	Item	Size	Units	Quantity	Unit	Unit Cost	Total Cost	Notes
2 - Sitework							**$ 900**	
	Core Drill			3	EA	$ 286	$ 857.15	
	Allowance for Shoring/Dewatering/Thrust Protection/Misc					5%	$ 43	Typical allowance
15 - Mechanical							**$ 35,774**	
	12" Pipe	12	IN	60	LF	$ 60	$ 3,600	
	Fittings	12	IN	12	EA	$ 1,200	$ 14,400	
	BFV	12	IN	3	EA	$ 2,471	$ 7,414	
	Pipe Supports				LS		$ 10,000	
	Allowance for Hangers, Supports, Etc.			1	LS	10%	$ 360	Typical allowance

FACILITY RAW CONSTRUCTION COST		**$**	**36,674**
Sales Tax	9.00%	$ 2,000	Assuming 50% of raw construction cost for materials
Mobilization/Demobilization	10.00%	$ 4,000	
Contractor Overhead and Profit	15.0%	$ 6,000	of total raw construction cost
25% Design Level Estimating Contingency	25.0%	$ 9,000	of total raw construction cost
ESTIMATED FACILITY CONSTRUCTION COST (SUBTOTAL)		**$**	**58,000**

Project: Novato Sanitary District - Contract D

Aspect: CCT Mixing System

Estimate Type: Preliminary

Date: December, 2015
Project Number: 0036-005

Prepared by: F. Goddard
Checked by: M. Takemoto
Check Date: November, 2015

Spec. Division	Item	Size	Units	Quantity	Unit	Unit Cost	Total Cost	Notes
15 - Mechanical							**$ 27,500**	
	Mixing System			1	EA	$ 25,000	$ 25,000	Cost for Flygt submersible mixer (#4650) received Nov 12 2015 from Shape
	Allowance for Hangers, Supports, Etc.			1	LS	10%	$ 2,500	Typical allowance

FACILITY RAW CONSTRUCTION COST		**$**	**27,500**	
Sales Tax	9.00%	$	1,000	Assuming 50% of raw construction cost for materials
Mobilization/Demobilization	10.00%	$	3,000	
Contractor Overhead and Profit	15.0%	$	4,000	of total raw construction cost
25% Design Level Estimating Contingency	25.0%	$	7,000	of total raw construction cost
ESTIMATED FACILITY CONSTRUCTION COST (SUBTOTAL)		**$**	**43,000**	

Project: Novato Sanitary District - Contract D

Aspect: Intermittent Backwash

Estimate Type: Preliminary

Date: December, 2015
Project Number: 0036-005

Prepared by: F. Goddard
Checked by: M. Takemoto
Check Date: November, 2015

Spec. Division	Item	Size	Units	Quantity	Unit	Unit Cost	Total Cost	Notes
11 - Equipment							**$ 35,700**	
	Intermittent Backwash System			1	EA	$ 34,000	$ 34,000	Quote received from Misco Water on October 14 2015
	Allowance for Misc Attachment Materials & Items Etc.					5%	$ 1,700	Typical allowance
						FACILITY RAW CONSTRUCTION COST	**$ 35,700**	
						Sales Tax 9.00%	$ 2,000	Assuming 50% of raw construction cost for materials
						Mobilization/Demobilization 10.00%	$ 4,000	
						Contractor Overhead and Profit 15.0%	$ 5,000	of total raw construction cost
						25% Design Level Estimating Contingency 25.0%	$ 9,000	of total raw construction cost
						ESTIMATED FACILITY CONSTRUCTION COST (SUBTOTAL)	**$ 56,000**	

Appendix B – NWMD Flow Modeling for Recycled Water Central Service Area Memorandum

MEMORANDUM

To: Project File (J-5.6058.00) April 13, 2015

By: Carmela Chandrasekera, Associate Engineer Initials: CC Date: 5/4/15

Reviewed By: Dave Jackson, Associate Engineer Initials: DJ Date: 5/4/15

Approved By: Drew McIntyre, Chief Engineer Initials: DM Date: 5/4/15

Subject: Flow Modeling for Recycled Water Central Service Area

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Introduction:

This memo is prepared to document flow modeling parameters, boundary conditions and results for the recycled water pipeline expansion to the Central Service Area project. A map showing the pipeline alignment is provided in Attachment 1. This alignment mostly represents alignment included in the Recycled Water Implementation Plan (Nute, 2006) except for some minor changes. Extension of the pipeline to serve the Marin Country Club (MCC) Golf Course has been added and extensions north of Rowland Blvd on S. Novato Blvd have been eliminated in this phase of the project.

Background:

In Phase 1, NMWD constructed recycled water facilities to supply recycled water to the Stone Tree Golf Course (STGC) by a Title 22 – compliant tertiary filtration and disinfection system (Recycled Water Facility, RWF) installed off Highway 37 near Deer Island in Novato with an average capacity of 0.5 mgd and a 8-inch transmission pipeline installed along Atherton Avenue (see attachment 1). The 8-inch main was also extended up to Novato Fire Protection District, Station No. 2 (FS #2) on Atherton Avenue for provision of recycled water for FS #2 landscape irrigation.

In Phase 2, NMWD expanded facilities to supply recycled water to the rest of the Novato North Service Area (Starting at Novato Sanitary District, then along Lea Drive to Olive Avenue, all of Olive Avenue; to Redwood Blvd and Atherton Avenue, and Redwood Blvd; north of Olive Avenue intersection). The project consisted of rehabilitation of Plum Street water storage tank and distribution facilities. Novato Sanitary District (NSD) added recycled water facilities to Davidson Waste Water Treatment Plant (WWTP) to deliver tertiary treated recycled water. The Deer Island Recycled Water facilities operate intermittently, providing potable water backstop capability and peak season recycled water production capacity in concert with the treatment facilities at the NSD Davidson WWTP.

The Central Service Area pipeline alignment is proposed to serve existing and future customers who use potable water for landscaping irrigation as discussed below. Norman Tank (0.5 MG) will be rehabilitated to store recycled water.

Pipeline Alignment:

On East side of Highway 101

1. Starting from Novato Sanitary District Recycled Water Facility along Davidson Street to Louis Drive intersection
2. Continuing from there along Louis Drive to Slade Park
3. From Slade Park, pipeline will cross underneath the SMART railroad to Franklin paper street.

4. Continue south along Franklin paper street and then to Novato Community Hospital property
5. From hospital site to Rowland Way
6. Cross the bridge over Novato Creek on Rowland Way
7. Continue on Rowland Way to Rowland Blvd to turn in to Vintage Way
8. Vintage Way.

On West Side of Highway 101

1. South Novato Blvd. from Lynwood School to Rowland Blvd.
2. Rowland Blvd. from South Novato Blvd. intersection to Redwood Blvd. intersection.
3. Redwood Blvd. south to Briarwood Ct. and along the path within NMWD easement
4. Continue south on Redwood Blvd. to South Novato Blvd.
5. Continue on S. Novato Blvd to the beginning of Highway 101 south on-ramp
6. Pipe to be installed on bike path west of Highway 101 and continue south to Entrada Drive through Inn Marin property.
7. Continue on Entrada Drive to Ignacio Blvd.
8. Continue on Ignacio Blvd until 300 ft east of Country Club Drive.
9. Entrada Drive to Norman Tank.

EPANET Modeling:

EPANET 2, public domain software developed by the US Environmental Protection Agency, is used for hydraulic flow modeling. The model consists of nodes (junctions) that link pipe segments. Each node is assigned an elevation (in feet) and a water demand (in gallons per minute) if applicable. The links (pipe segments) are assigned a length (in feet), a pipe diameter (in inches) and a roughness coefficient (Hazen Williams "C", unitless). The links can also be assigned an "open" or "close" status.

Modeling Approach:

The model assumes two parallel pumps at the Davidson WWTP to feed the system. The model includes one tank (Norman Tank) and RW pipelines. The bottom of Norman Tank is at 123 ft elevation. The initial water level is set to 20 ft and maximum water level is set to 33 ft. The flow modeling was performed independent of the Novato North Service Area. However, Novato Service Area demands will be accounted for in the conclusion discussion of this memo.

Model Runs:

The modeling was performed in static mode (snap shot in time-Model 1) and with a time extended mode for 48 hours (Model 2).

Demands:

Peak Hour Demands were applied at the following locations and are also shown in Table 1 in detail.

a) NSD to Rowland Way (181 gpm)
b) Vintage Oaks (138 gpm)
c) HOAs between Highway 101 and S. Novato Blvd (398 gpm)
d) Scottsdale Lake HOA and Lynwood School (279 gpm)
e) Villa Entrada (48 gpm)
f) Marin Country Club and Ignacio Blvd (933 gpm)
g) Future demand to schools to the north (118 gpm)
h) Future demand west of MCC (261gpm)
i) Future Hanna Ranch /McPhails (200 gpm)

The peak hour demand was calculated at 70% of peak hour demand shown in the RW Implementation Plan (2006) and MCC demand of ~800 gpm over a 7 hour period was taken from the Marin Country Club-NMWD MOU (November 2014). For all demands other than MCC ,the demand reduction factor is based on actual demand in comparison to the estimated demands in the 2006 report. The attached Table 1 shows the hourly demands. The total peak hourly demand is 2,555 gpm (including 379 gpm for future extensions to Central C-3 and S-4 areas).

Modeling Parameters and Boundary Conditions:

- For all new pipes a roughness coefficient of 140 was used.
- The node elevations and pipe lengths are shown in Attachment 2A and 2B.
- Elevations at junctions (nodes) were approximated from NMWD topographic maps.
- Pipe Diameters: See Attachment 3. The proposed main extension on S. Novato Blvd is 8-inch and all other pipe on the west side of Highway 101 is 12-inch. The rest of the proposed pipe on east side of highway 101 is 18-inch except for the pipe on Vintage Way south (12-inch), south of where the 18-inch pipe crosses Highway 101.
- Flow velocities for all options to be less than or equal to 7 ft/s per NMWD standards.
- Target residual pressure at all nodes in the system is 40 psi except 25 psi at the delivery point to Marin Country Club on Ignacio Blvd is acceptable.
- In snap shot in time model (Model 1, Attachment 4A and 4B), all demands apply simultaneously.
- In the time extended model runs (Model 2, Attachments 5 thru 7), the demands were spread out over two different times (irrigation patterns). Marin Country Club and Ignacio customer irrigation was assumed to start at 9:00 pm and end at 4:00 am and the rest of the demands start at 4:00 am and end at 9:00 am. Time patterns of irrigation demand are shown in Table 2.
- The two parallel pumps (Floway 12DOH) were used with flow curves as shown in Table 3.

Model Results:

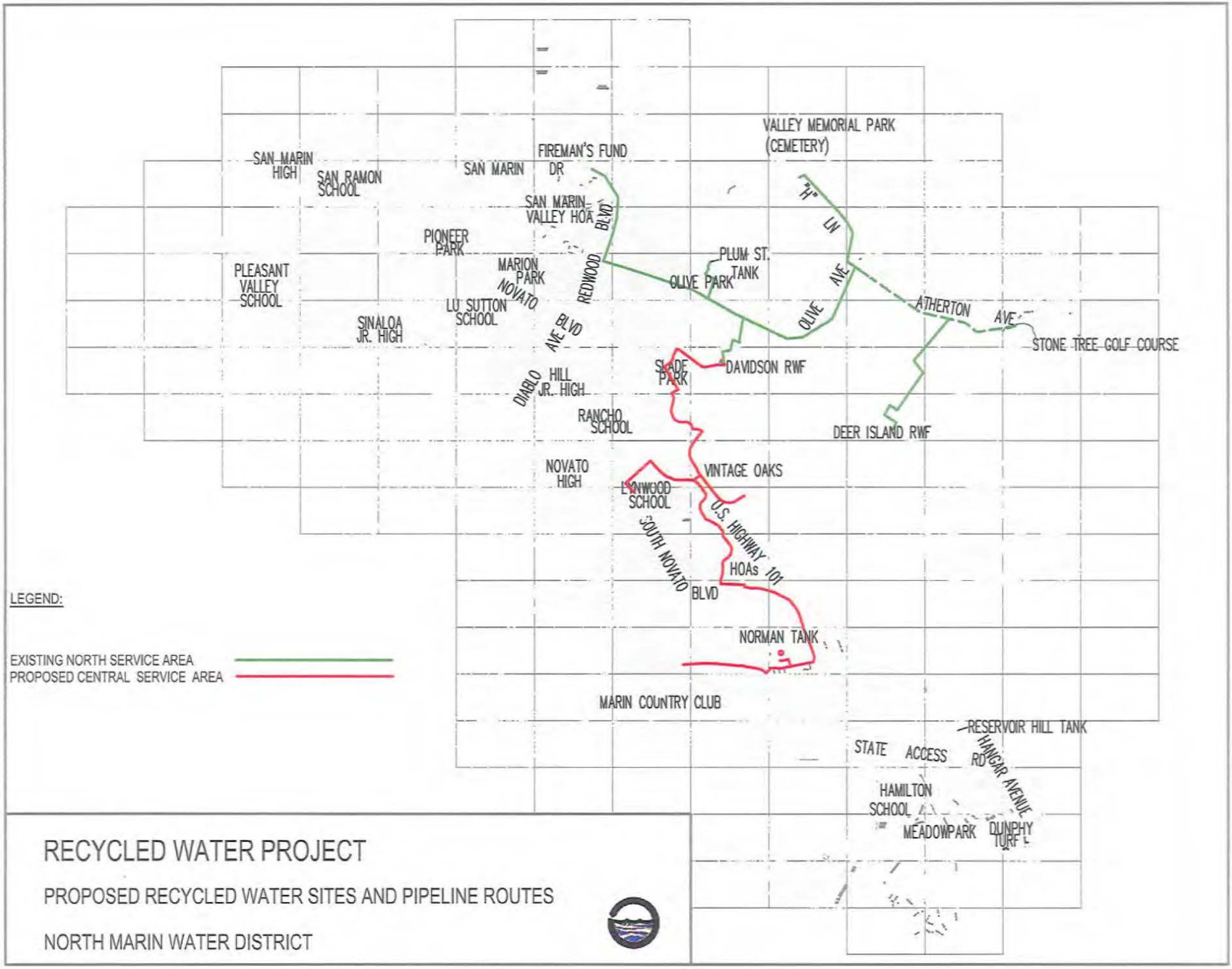
The Model 1 (snap shot in time) results are shown in Attachments 4A (Pressure and Flow) and 4B (flow velocity) and the Model 2 (time extended) pressure and flow results are shown in Attachments 5 (a) to 5(e) at various times of the day (12:00 am, 6:00 am, 10:00 am, 2:00 pm and 8:00 pm). Attachment 6 shows flows leaving Davidson WWTP and Norman Tank flows for 48 hours. Attachment 7 shows residual pressure at Marin Country Club recycled water delivery point on Ignacio Blvd. The residual pressure needs to be minimum of 25 psi per the agreement with MCC. If Norman Tank is out of Service, pressure of 25 psi cannot be maintained at MCC delivery point.

Conclusion:

All pipe sizes selected are adequate to provide necessary flow without exceeding the flow velocity of 7 ft/s. The maximum flow velocity is 3.4 ft/s in the 12-inch pipes in Ignacio Blvd. The residual pressure of minimum 25 psi can be maintained at MCC delivery point by using alternate irrigation patterns as was modeled. The maximum flow required from each of the pumps is ~838 gpm for a total flow of 1,676 gpm from Davidson WWTP since Norman Tank supplies the rest of the demand (879 gpm). If the total demand (2,555 gpm) must be solely supplied from Davidson WWTP pumping (not including Norman Tank storage), each pump must deliver ~1,278 gpm during peak demand.

Per NSD WWTP project Manager, John Bailey, existing Novato Service Area peak instantaneous demand is ~1,200 gpm and the maximum production rate is ~0.85 MGD (August 2014). The current treatment capacity is 1.7 MGD with 2 filters of 0.85 MGD capacity (0.85 MGD firm capacity). The Central Service Area peak pumping rate is 1500 gpm (not including future near term extensions to C-3, S-4 and Hanna Ranch areas) with one storage tank (Norman Tank) supplying demand

during peak use and assuming two different (non-overlapping) irrigation patterns. The peak day demand including future near term extensions is 0.85 MGD. Treatment capacity will need expansion with another filter with 0.85 MGD capacity to meet the Central Area demand. One difference between the North and the Central Areas is that the Central Area does not have a reservoir as at Stone Tree Golf Course ponds to even out the demands on production and pumping.

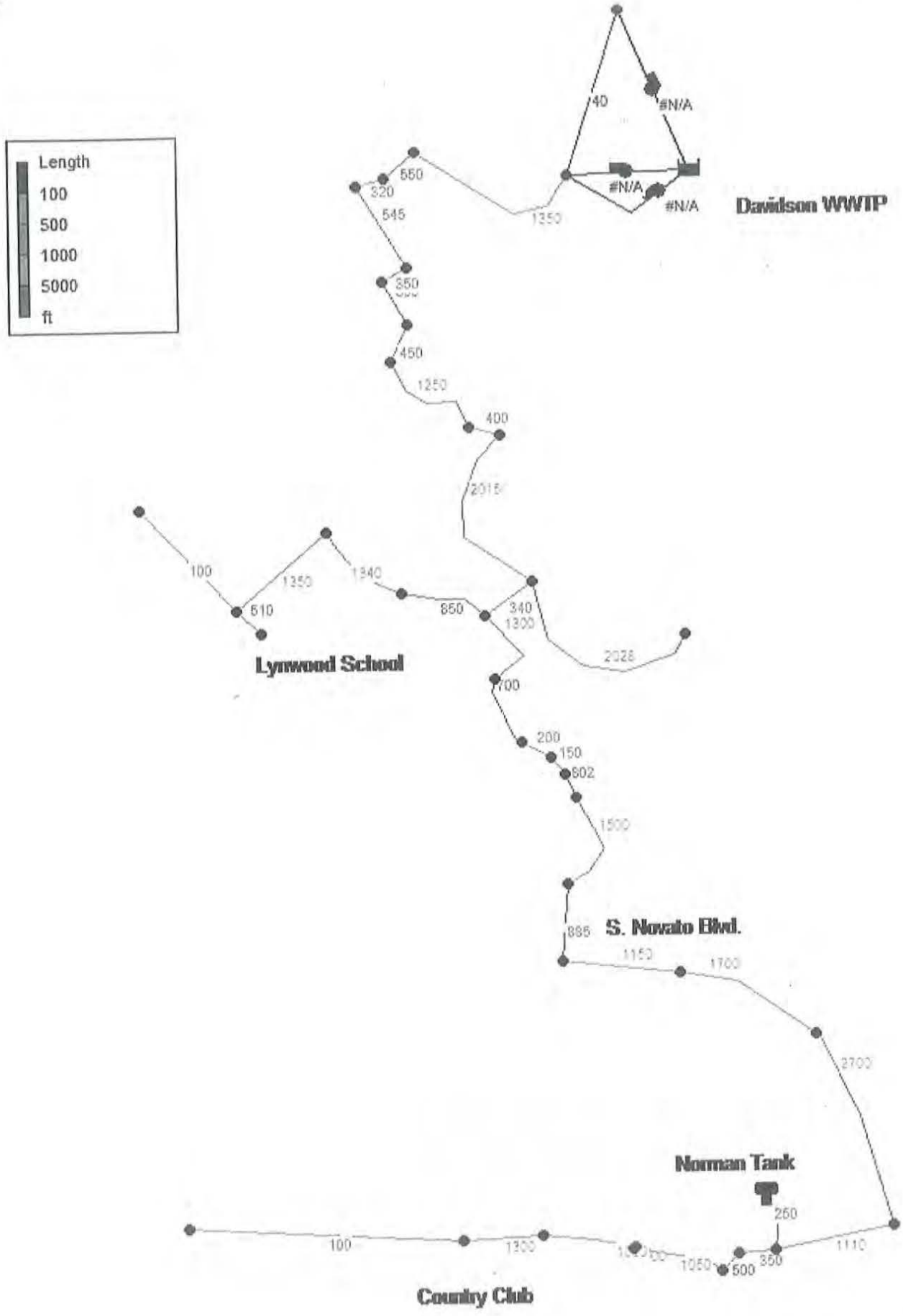


RECYCLED WATER PROJECT

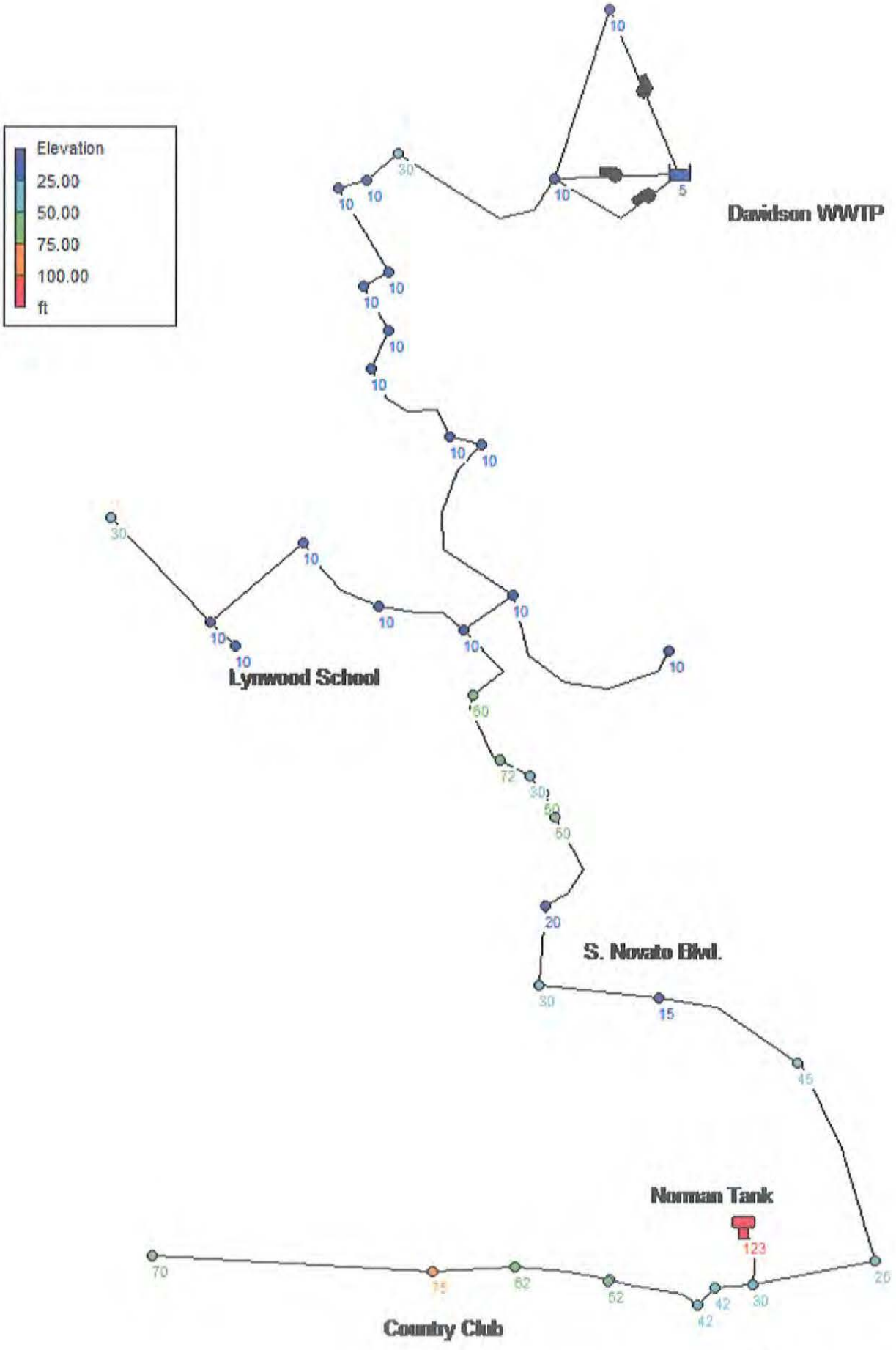
PROPOSED RECYCLED WATER SITES AND PIPELINE ROUTES

NORTH MARIN WATER DISTRICT

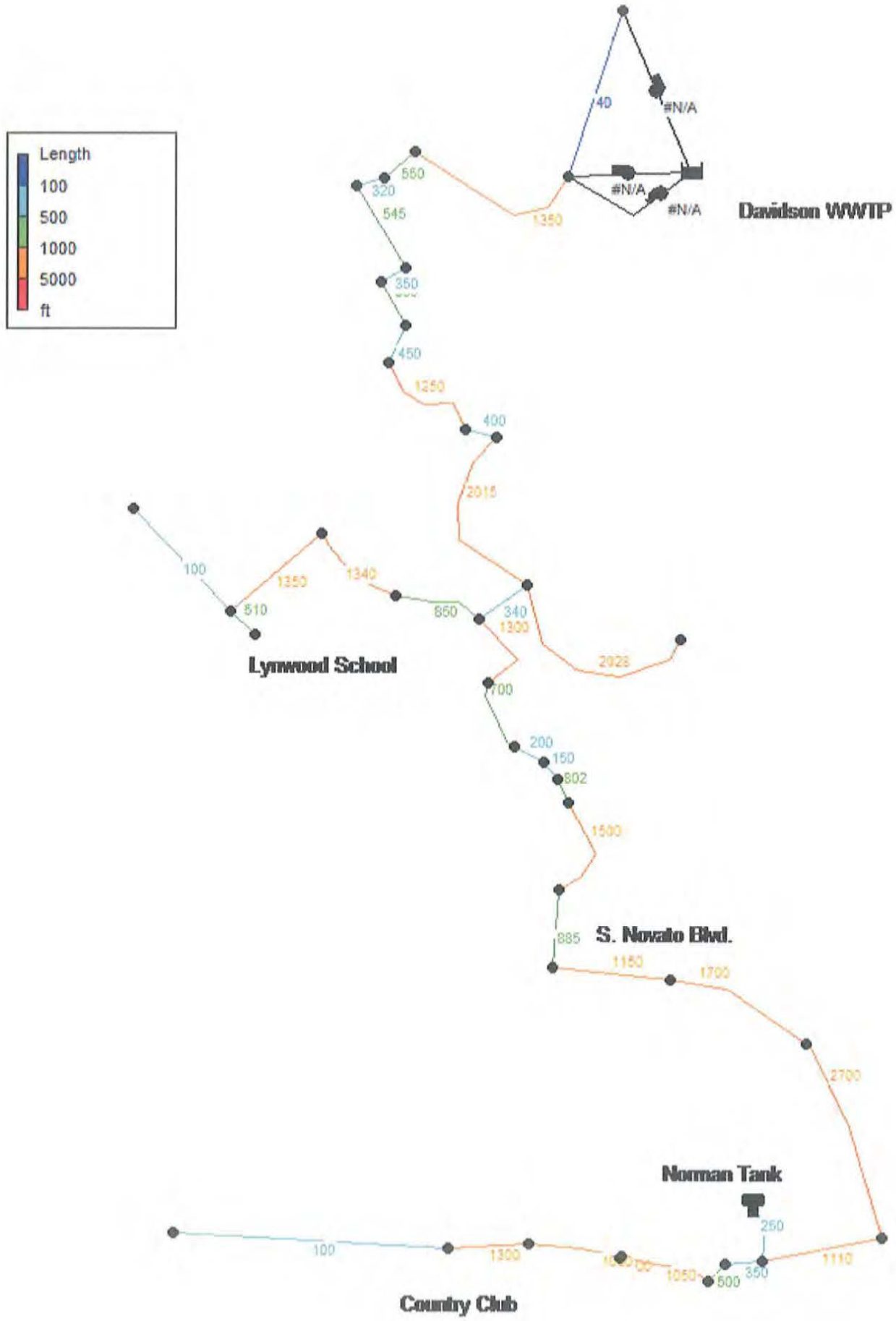
Attachment 1



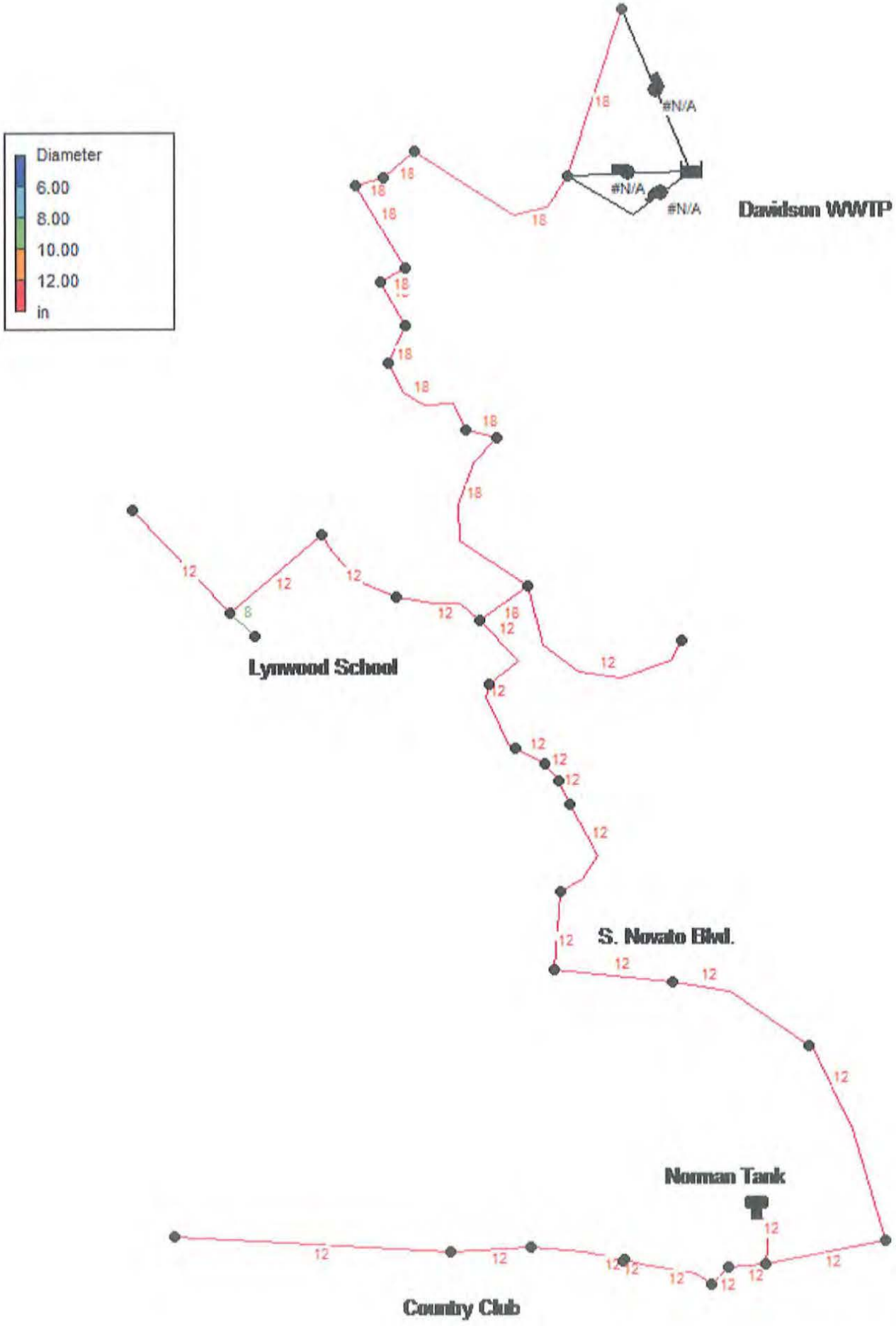
Attachment 2



Attachment 2A

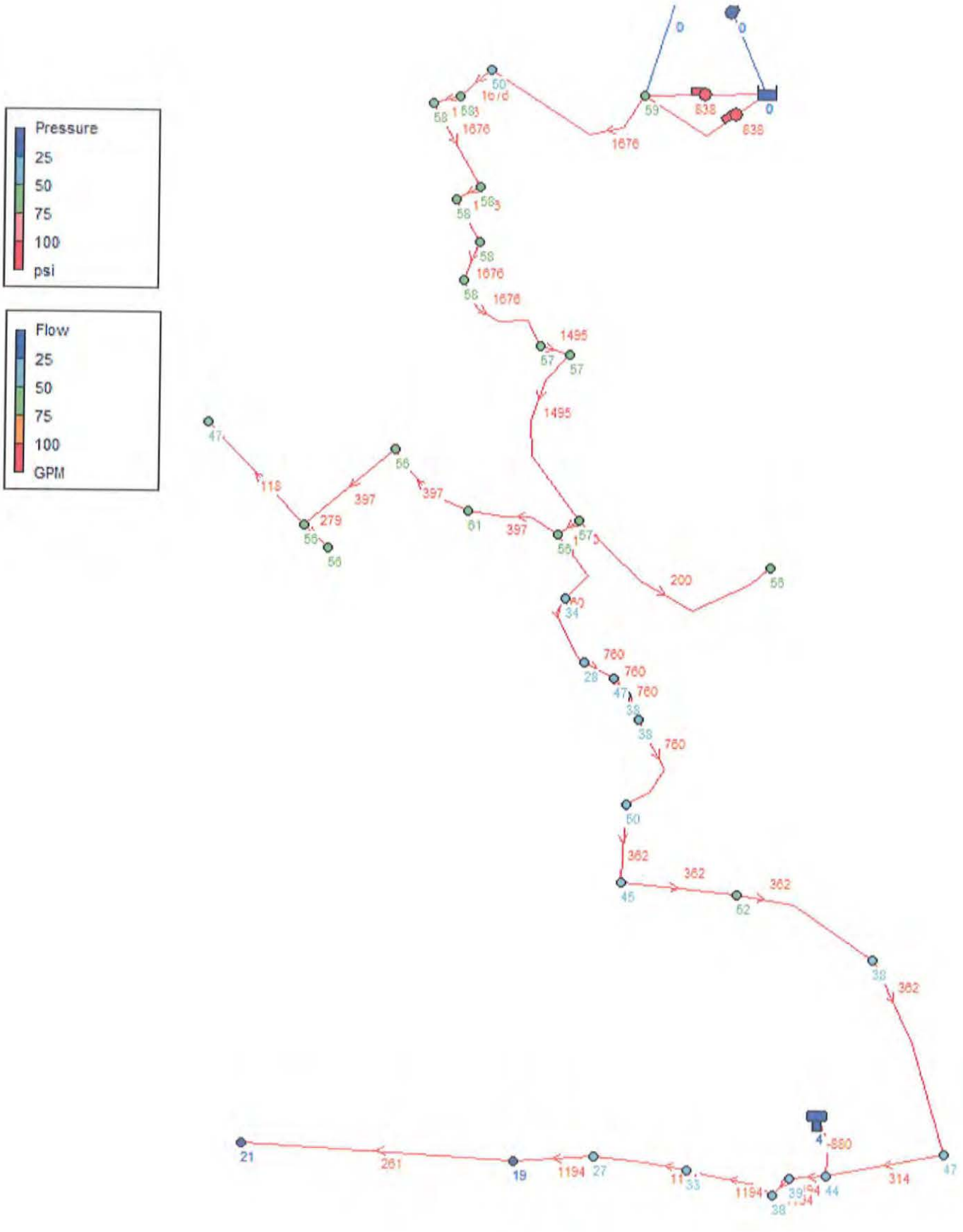


Attachment 2B



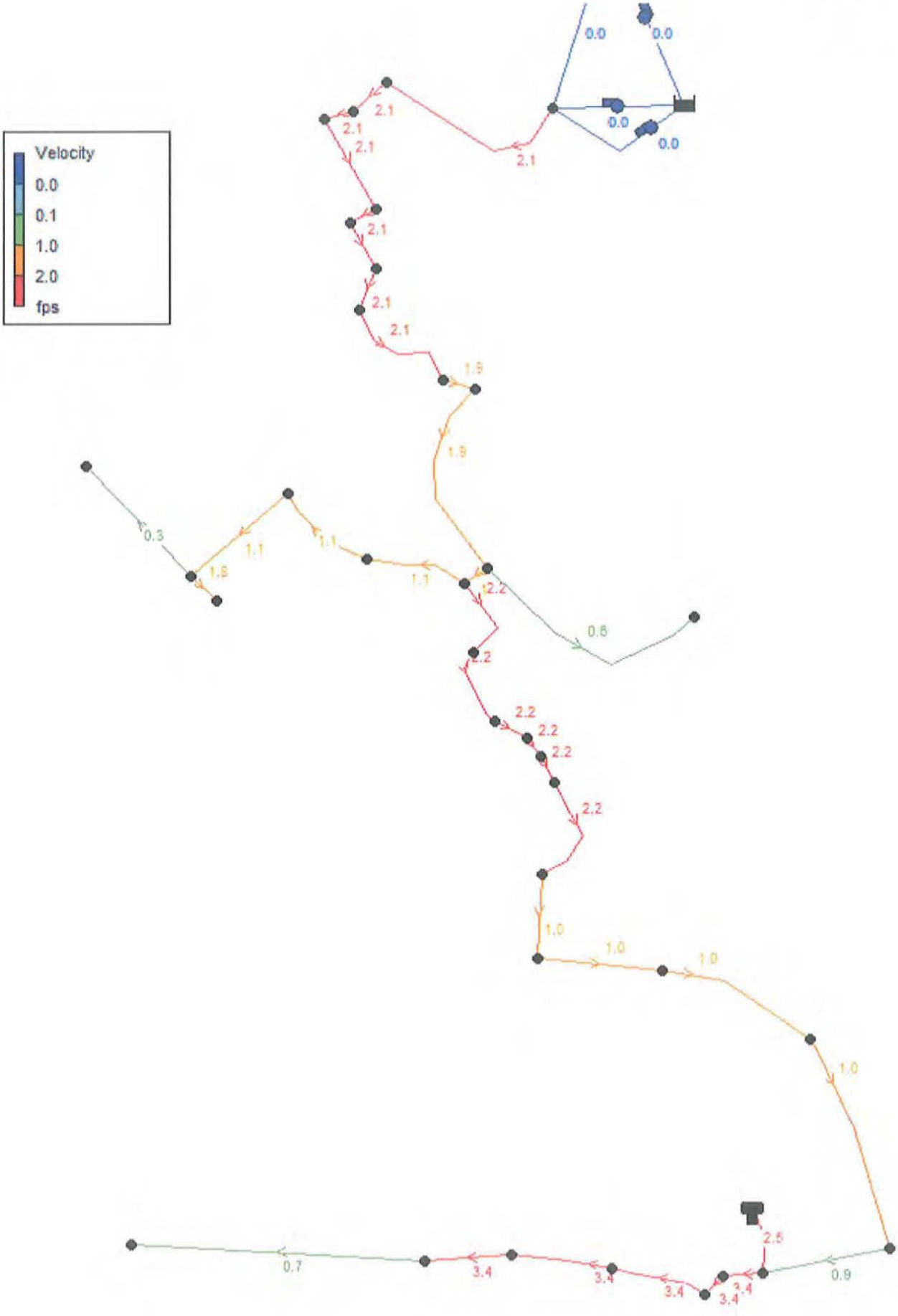
Attachment 3

Model 1 - Snapshot in Time



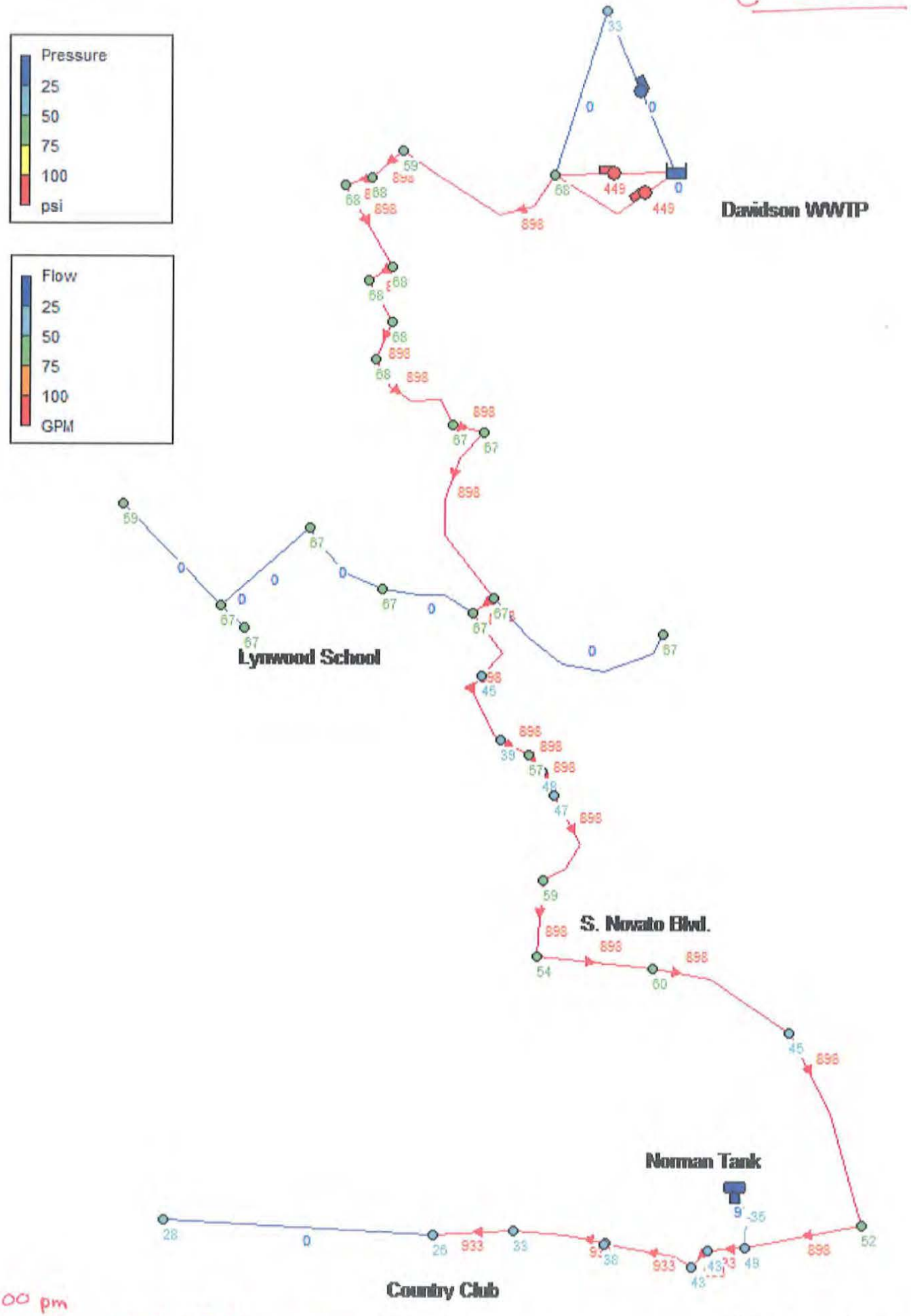
Attachment 4A

Model 1 -
Snapshot in Time



Attachment 4B

@ 12:00 am.

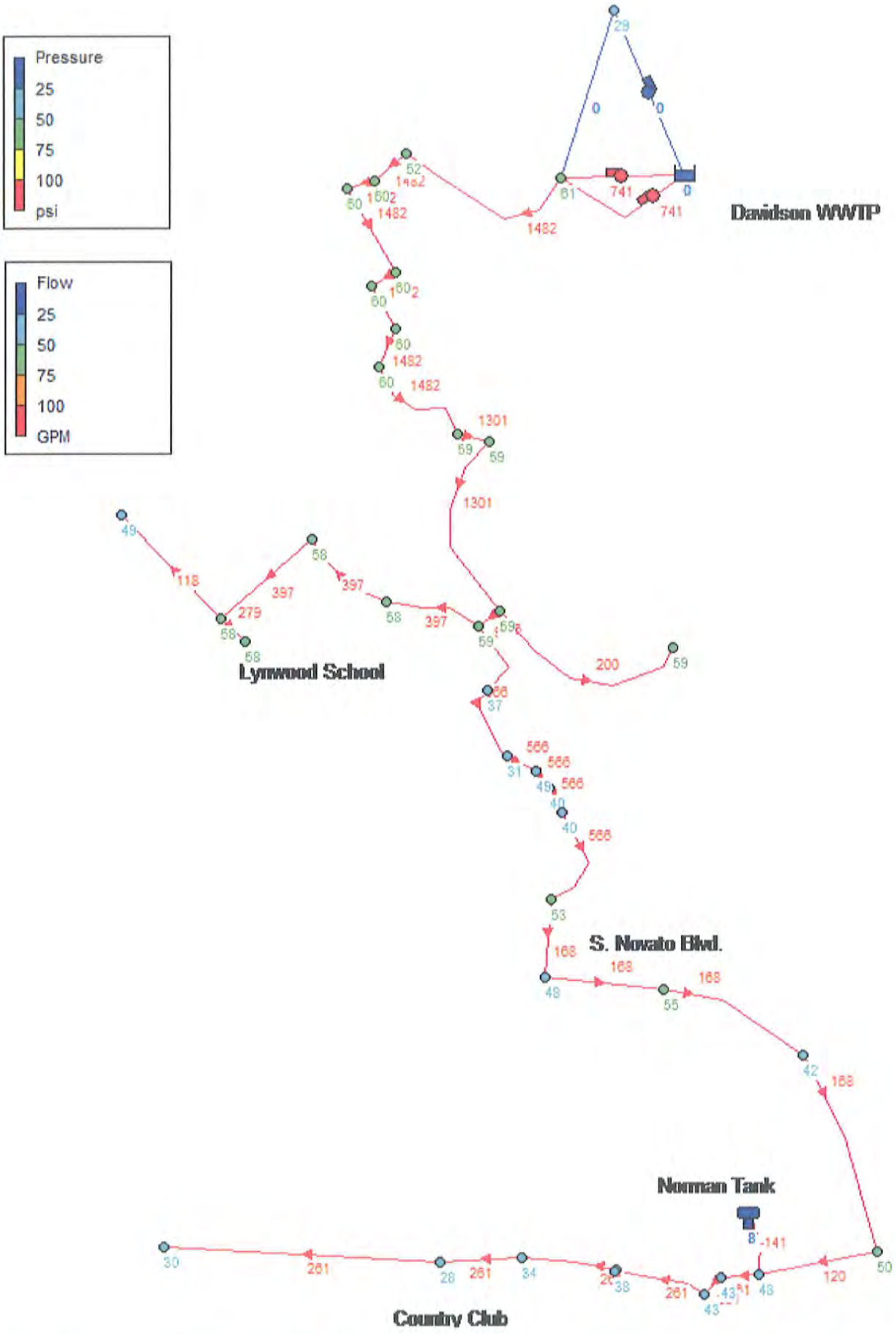


9:00 pm

to 4:00 am. - MCC Irrig.

Attachment 5(a)

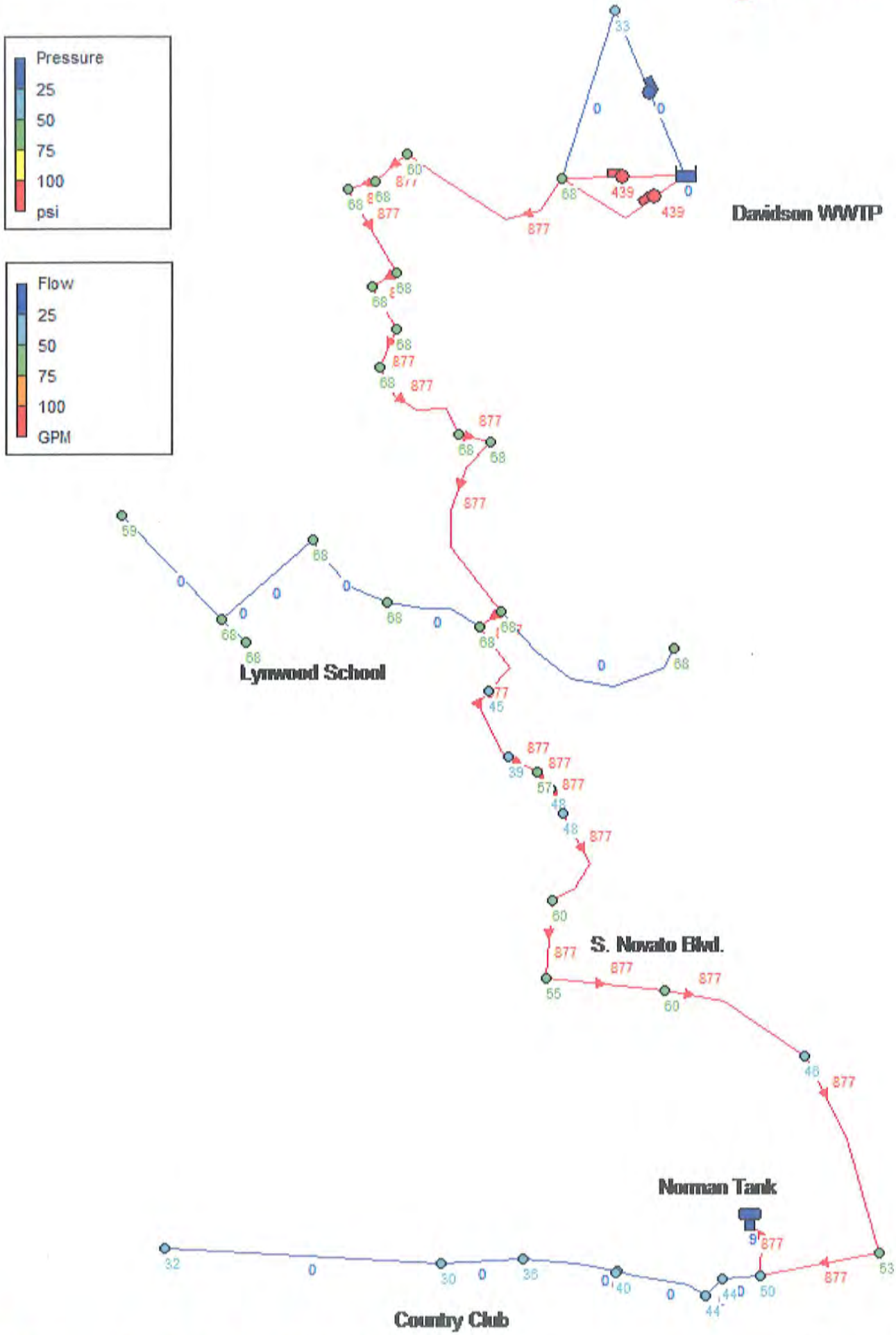
@ 6:00 am.



4:00 am to 8:45 am all except MCC irrig.

Att. 5(b)

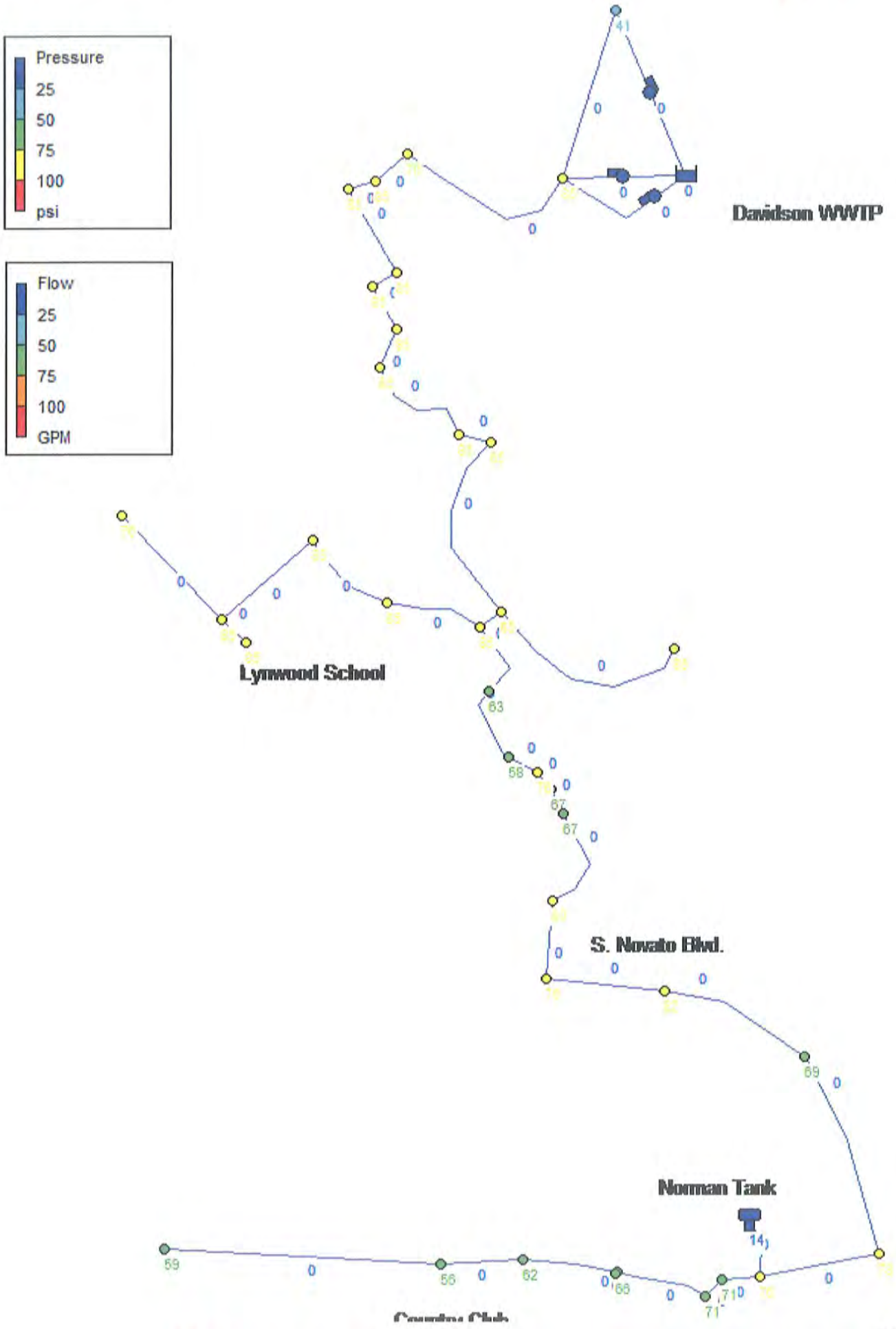
@ 10:00 am.



9:00 am to 2:00 pm Tank filling

AH 5(c)

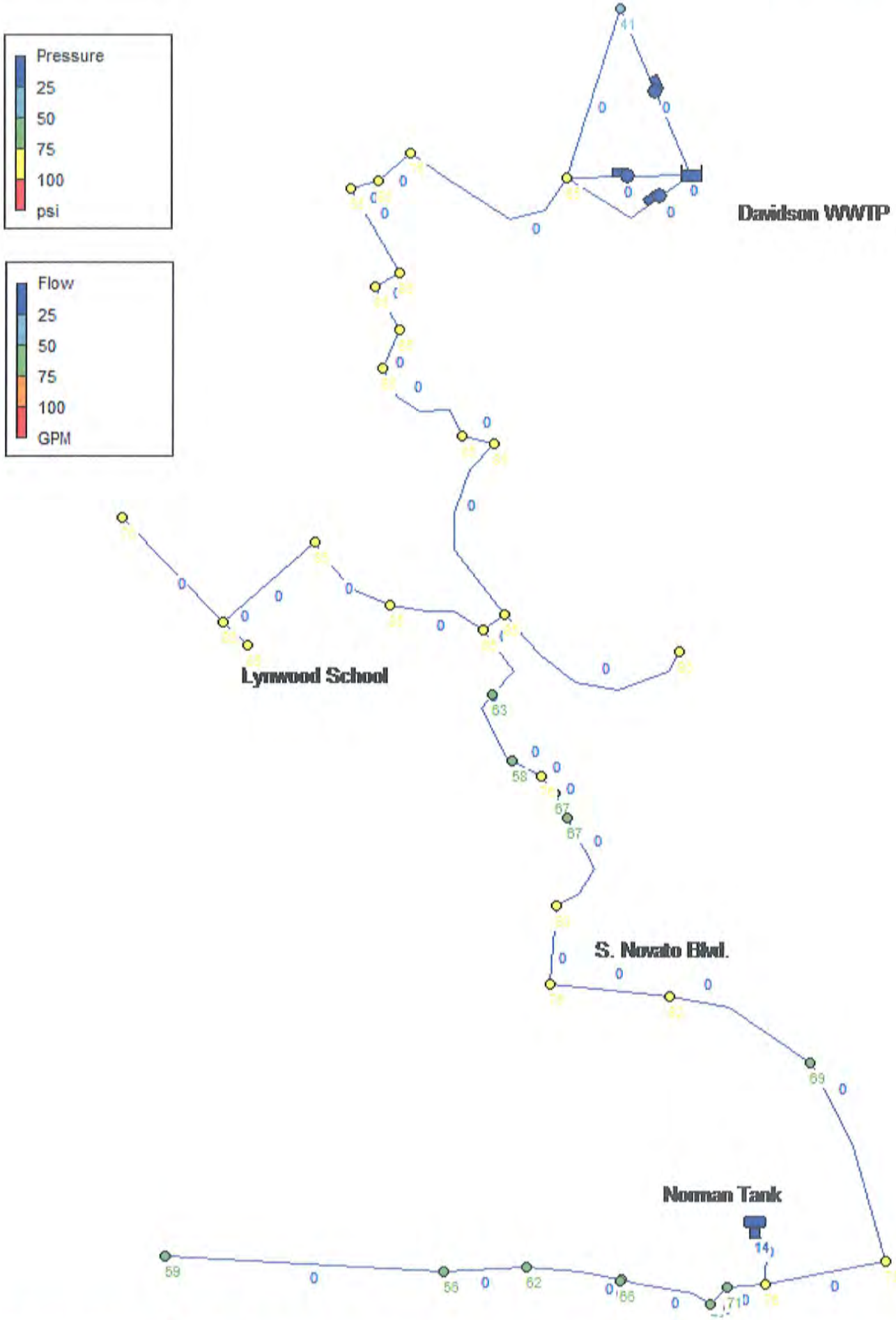
@ 2:00 pm



Tank filling stops - no flows (2:00 pm to 8:00 pm)

Att. 5(d)

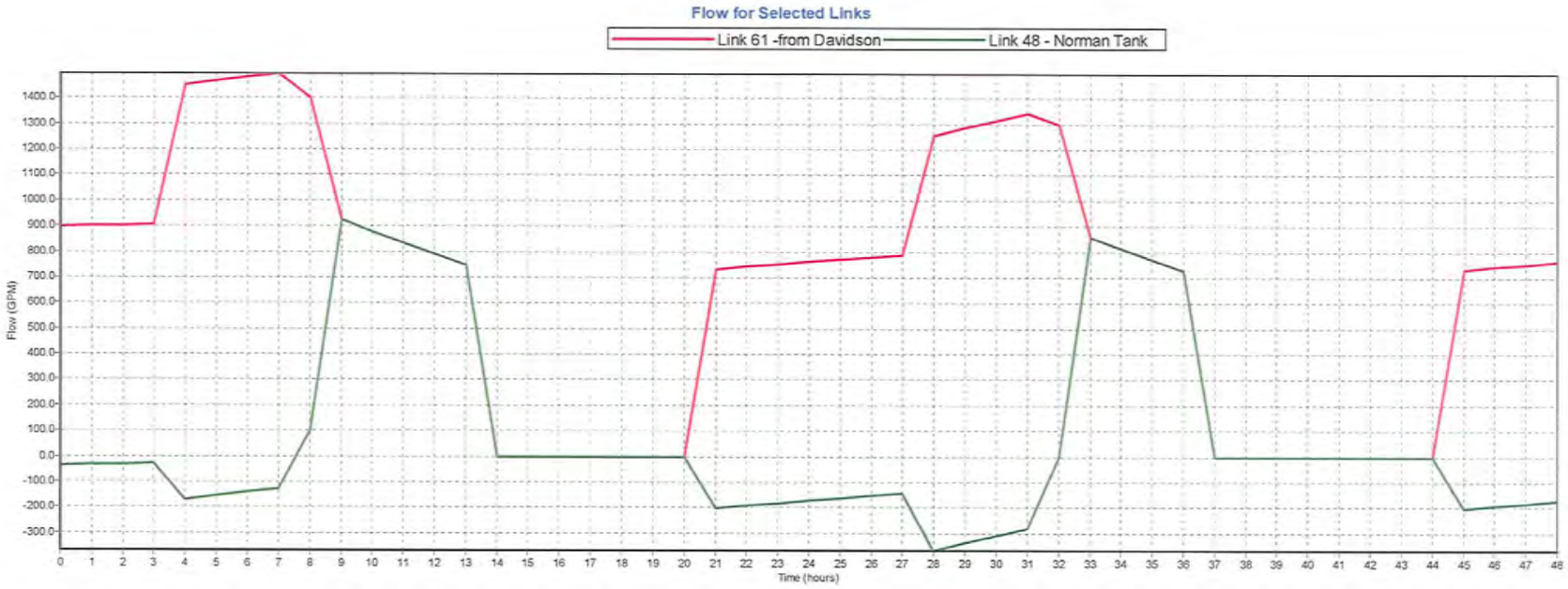
@ 8:00 pm.



@ 8:00 pm. (just before MCC irrig. starts @ 9:00 pm)

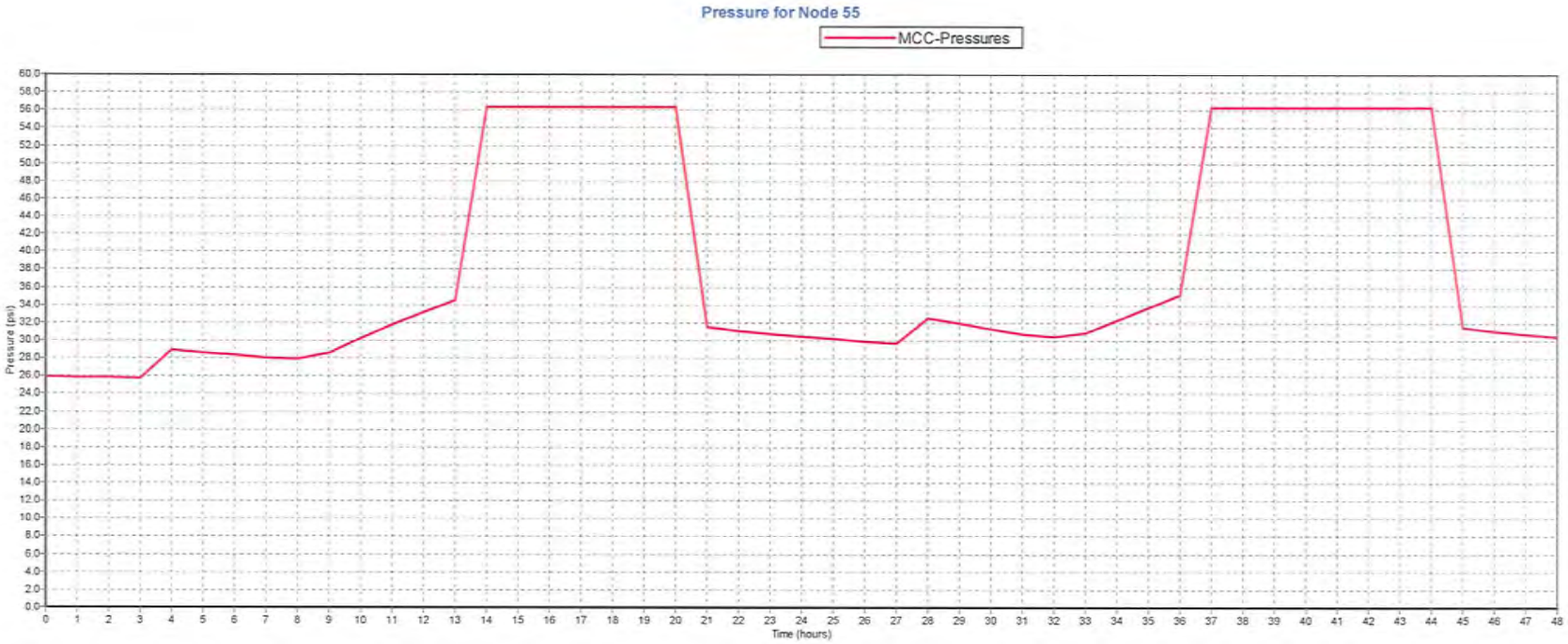
Att. 5(e)

Recycled Water - Central Service Area



AH 6

Recycled Water - Central Service Area



AH. 7

Job No.: 5.6058.00
Flow demands for EPANET Modeling
By: Carmela Chandrasekera
Date: 14-Oct-14 Revised February 20, 2015

Recycled Water Review Table For Central Service Area						EPANET - Demand assignment								
User Number	Name	Existing Potable Water Offsets from 2006 Report (AFY)	Existing Potable Water Offsets from 2006 Report (MG/Yr)	Adjusted Potable Water Offsets Using 2013 Use(AFY)	Adjusted Potable Water Offsets Using 2013 Use(MG/Yr)	Average Day Peak Month (GPD)	Average Day Peak Year Peak Month (GPD)	Ratio (peak/average) day	Peak Hour Average Day	Peak Hour Peak Day (6)	gpm based on peak hour(average day)	gpm based on peak hour(peak day)	EPANet ID and Flow	Flow Pattern
Area C2	(From Nute 2006)													
C-2-2	Vintage Oaks 210 Vintage	8.28	2.698	5.9	1.9	8998	12597	1.4		2624		44		
C-2-3	Vintage Oaks 142 Vintage	3.57	1.163	2.5	0.8	3879	5431	1.4		1132		19		
C-2-4	Vintage Oaks 111 Vintage	3.98	1.297	2.8	0.9	4325	6055	1.4		1261		21		
C-2-5	Vintage Oaks 214 Vintage	2.92	0.951	2.1	0.7	3173	4442	1.4		925		15		
C-2-6	Vintage Oaks 122 Vintage	4.65	1.515	3.3	1.1	5053	7074	1.4		1474		25		
C-2-16	Cal Trans 139 Vintage	2.76	0.899	2.0	0.6	2999	4199	1.4		875		15	138	1
C-2-7	Four Star Investment 500 Redwood	12.76	4.158	9.1	3.0	13866	19412	1.4		4044		67		
C-2-8	84 Rowland	2.61	0.850	1.9	0.6	2836	3971	1.4		827		14		
C-2-9	Fire Department 7025 Redwood	3.74	1.219	2.7	0.9	4064	5690	1.4		1185		20		
C-2-11	City 585 Louis Dr.	6.4	2.085	4.5	1.5	6955	9737	1.4		2028		34		
C-2-12	Novato San 500 Davidson	4.42	1.440	3.1	1.0	4803	6724	1.4		1401		23		
C-2-13	City 800 S Novato Blvd	3.26	1.062	2.3	0.8	3543	4960	1.4		1033		17		
C-2-14	Golden Gate LLC 101 Rowland	2.57	0.837	1.8	0.6	2793	3910	1.4		815		14		
C-2-15	Golden Gate LLC 741 Franklin	2.9	0.945	2.1	0.7	3151	4412	1.4		919		15		
C-2-1	Novato Community Hospital	5.98	1.949	4.2	1.4	6498	9098	1.4		1895		32		
C-2-17	Rowland Plaza 5 Rowland	2.3	0.749	1.6	0.5	2499	3499	1.4		729		12	181	1
C-2-18	Cal Trans 65 Los Padres	0	0.000	0.0	0.0									
C-2-19	Cal Trans 6169 Redwood	0	0.000	0.0	0.0									
C-2-20	Cal Trans 1300 Redwood	0	0.000	0.0	0.0									
C-2-10	City 2 Larch	0.19	0.062	0.1	0.0	206	289	1.4		60		1		
C-2-21	Crossroads Towhomes HOA	25.21	8.215	17.9	5.8	27395	38353	1.4		7990		133		
C-2-22	Crossroads Village	8.82	2.874	6.3	2.0	9585	13418	1.4		2795		47		
C-2-23	Cheda Acres 299 Silvio	4.42	1.440	3.1	1.0	4803	6724	1.4		1401		23		
C-2-24	Sequoia Glen HOA	2.22	0.723	1.6	0.5	2412	3377	1.4		704		12		
C-2-25	Cheda Knolls	9.9	3.226	7.0	2.3	10758	15061	1.4		3138		52		
C-2-26	Western Oaks Village	24.49	7.980	17.4	5.7	26613	37258	1.4		7762		129	398	1
C-2-27	Scottsdale Lake HOA	7.15	2.330	5.1	1.7	7770	10878	1.4		2266		38		
C-2-28	Hillside Park HOA #1	20.23	6.592	14.4	4.7	21984	30777	1.4		6412		107		
Area C3														
C-3-4	NUSD Lynwood 1307 Lynwood(1)	62.19	20.3	18.00	14.4	27550	38569	1.4		8035		134	279	1
Area S2	(From Nute 2014)													
S-2-10	Villa Entrada- 520 Entrada			6.39	2.1	9780	13692	1.4		2853		48	48	1
Area S3	(From Nute 2014)													
S-3-1	Marin Glen HOA-192 Ignacio			3.93	1.3	6015	8421	1.4		1754		29		
S-3-2	Marin Glen HOA - 325 Ignacio			2.94	1.0	4500	6300	1.4		1312		22		
S-3-4	Marin Country Club (4)			155	50.5	237233	332126	1.4		69193		790		
S-3-6	Fairway Apts. 1000 Fairway Drive			1	0.3	1531	2143	1.4		446		7		
S-3-7	City Median - 119 Ignacio Blvd			6.37	2.1	9750	13649	1.4		2844		47		
S-3-8	City Median - 123 Ignacio Blvd			3.25	1.1	4974	6964	1.4		1451		24	920	4
Future(3) Area C-3	(From Nute 2006)													
C-3-3	1430 Johnson (NUSD	12.76	4.2	9.1	3.0	13866	19412	1.4		4044		67		
C-3-5	625 Arthur (NUSD)	0.95	0.3	0.7	0.2	1032	1445	1.4		301		5		
C-3-8	1560 Hill Road (City)	2.01	0.7	1.4	0.5	2184	3058	1.4		637		11	83	1
Future Area S4														
S-4-4	City of Novato -571 Marin Oaks-Hoog Park			9.4	3.1	14387	20142	1.4		4196		70		
S-4-5	Novato Unified - 1000 Sunset Pkwy			12.92	4.2	19775	27684	1.4		5768		96		
S-4-6	City of Novato-1800 Ignacio Blvd-ball field			12.3	4.0	18826	26356	1.4		5491		92	258	1
Future (5)	Future Hanna Ranch/McPhails (Est.)			27.00	8.8	41324	57854	1.4		12053		201	200	
Total	**(Current + Future)(7)**			**394.4**	**137.0**	**603688**	**845164**			**63733**		**2571**	**2503**	
Total	**(Current Maximum)(8)**			**321.6**								**2030**		
Total	**(Current Minimum)(9)**			**182.1**								**1319**		

(1) The recent use has dropped. Used 2013 use (12 AF) multiplied by 1.5
(2) Used 29% reduction factor
(3) Future extension peak hour gpm from 2006 report
(4) Demand taken from Feasibility study to provide recycled water to the Marin Country Club Golf Couse by Nute Engineering 2014
(5) Future Hanna Ranch/McPhails
(6) Peak Hourly Flow is ~5 times the average day gpm flow rate (assumes irrigation only 8 hours in a day with a peaking factor of 1.67 = 3x1.67)
(7) Does not include any future West Novato RW Extension demands (~145 AFY)
(8) Assumes Maximum MCC demands and no future demands (i.e. C-3, S-4 & Hanna Ranch)
(9) Same as (8) but MCC demand is capped at 10% of maximum demand

Pattern 1 - Morning watering at Max GPM 4 to 8 am = 1.0 8 to 9 am = 0.8 **Pattern 2 - Constant flow 24 hours per day at Max flow rate.**
Pattern 4 - Watering from 9:00 pm to 4:00 am (7 hours) **Pattern 3 - All the other times except times of pattern 1**

Table 1

Irrigation Patterns for the Time Extended Model

Time	EPANET Pattern Data Marin Country Club Pattern 4	EPANET Pattern Data All Except MCC Pattern 1
12:00 AM	1	0
1:00 AM	1	0
2:00 AM	1	0
3:00 AM	1	0
4:00 AM	0	1
5:00 AM	0	1
6:00 AM	0	1
7:00 AM	0	1
8:00 AM	0	0.8
9:00 AM	0	0
10:00 AM	0	0
11:00 AM	0	0
12:00 PM	0	0
1:00 PM	0	0
2:00 PM	0	0
3:00 PM	0	0
4:00 PM	0	0
5:00 PM	0	0
6:00 PM	0	0
7:00 PM	0	0
8:00 PM	0	0
9:00 PM	1	0
10:00 PM	1	0
11:00 PM	1	0

Table 2

EPANET Curve Data
PUMP
Floway 12DOH - A 3 STAGE

Flow (gpm)	Head (ft)
0	240 ~~277~~
400	234
800	204
1000	195
1100	189
1200	177
1300	162
1600	117

why at 85% speed in model?

Table 3