ATTACHMENT D

State Water Resources Control Board
TMF Assessment Form

ASSESSMENT TYPE: ☐ **Financing Project** ☒ **New System** ☐ **Change of Ownership**

WATER SYSTEM CLASSIFICATION:
☒ **Community Water System**
☐ **Nontransient Noncommunity Water System**
☐ **Transient Noncommunity (TNC) Water System**
You may be eligible to use the TNC EZ Form

A. WATER SYSTEM INFORMATION

Water System Name: Redwood Glen
Water System Number: CA 4100522
Water System Physical Address: 100 Wright Drive, Loma Mar, CA 94021
County: San Mateo
Division of Drinking Water Office or Local Primacy Agency: Santa Clara

B. PERSON COMPLETING THIS TMF ASSESSMENT (*Required fields)

***Name:** Larry Rice	***Signature:** Larry Rice
***Title :** Executive Director	***Date Assessment Completed:** May 16, 2017
***Phone Number:** (650) 879-0320	**Email Address:** exec@rewoodglen.com
***Company Name and Address:** Redwood Glen Camp & Conference Center 100 Wright Drive Loma Mar, CA 94021	

C. MAIN WATER SYSTEM CONTACT PERSON INFORMATION (To be completed only if it's different from B. above)

Name:	**Title:**
Phone Number:	**Email Address:**
Water System Mailing Address:______________________________ ______________________________ **City:**____________________**Zip:**____________________	

TMF Assessment Instructions

In California the technical, managerial, and financial (TMF) assessment must be completed by public water systems that are applicants for State Water Resources Control Board (SWRCB) funding programs, new water systems, and changes of water system ownership.

To complete this assessment refer to the guidance and explanations in the Criteria For TMF Assessment document located on the SWRCB web site at:

http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/TMF.shtml

If requested information has already been submitted directly to the SWRCB division of drinking water office or the LPA, note the location of that information on the assessment form in the comments space. Required documentation may be submitted electronically on a compact disk (if submission is electronic indicate on assessment).

For each TMF element described below place the required information in the appendix and identify it by an attachment number that corresponds to the TMF element number. For example, documentation required for element number seven, Water Rights, should be identified in the appendix as Attachment 7, Water Rights. In addition, in the comments section of each TMF element list the actual documents that are provided in the appendix. For example, under the Water Rights comments section indicate that in the appendix Attachment 7 contains copies of the deeds to Wells 1 and 2 and the State Water Resources Control Board surface water. Check all boxes that are applicable. If the item is not applicable check the NA box to show that these items have been considered.

TMF Elements

1. Consolidation Feasibility

[Funding Projects, New Systems, Change of Ownership - ***Mandatory***]

Each public water system applying for construction funding or a refinancing loan must perform an evaluation, including costs and feasibility, of physically consolidating with another public water system. Guidelines for when a consolidation is most feasible include, but are not limited to:

- When one of the water systems is located within another's established service area,
- When one of the water systems is within an existing General Plan's zone of influence of the other,
- Or when the water system is within five miles of another public water system.

If the water system applying for construction funding or a refinancing loan is a "small community water system" (which is defined as: a community water system that serves no more than 3,300 service connections or a yearlong population of no more than 10,000 persons) and the water system is considered "disadvantaged" (which is defined as: the entire service of area of a community water system, or a community therein, in which the median household income is less than 80 percent of the statewide average), consolidation is *highly* *encouraged* and the water system may be allowed funding for a consolidation feasibility study and/or may be giving priority when seeking construction funding.

☒ List all large water systems and the number of connections that are within five miles of the system.
Record NA if there is no water system in the vicinity. ☐ NA

☒ Submit a consolidation assessment that includes the name of all water systems contacted, and the results of any consolidation discussions conducted with at least one system within the five-mile radius. ☐ NA

Comments: *Redwood Glen has thoroughly investigated the potential of consolidation with nearby water systems, including water systems located within a 3-mile radius, as per the new regulation SB 1263. The detailed evaluation of the physical and managerial consolidation scenarios in included in the Attachment. Attachment 1 includes the following:*

Attachment 1A: *List of all Water Systems Within a 5-Mile and 3- Mile Radius, including Number of Connections*
Attachment 1B: *Physical and Financial Consolidation Assessment (as required by SB 1263)*
Attachment 1C: *Correspondence with Water Systems*

2. System Description

[Funding Projects - ***Necessary****;* New Systems and Change of Ownership - ***Mandatory***]

Provide a system map that illustrates the location of all of the components of the water system including the:

☒ Current service area boundary ☐ NA
☒ Sources ☐ NA
☒ Treatment facilities ☐ NA
☒ Pumping stations ☐ NA
☐ Pressure zones ☒ NA
☒ Storage tanks ☐ NA
☒ Potential contamination hazards ☐ NA
☐ Projected ten-year growth boundaries ☒ NA

Comments: Attachment 2 includes the following:

Attachment 2A*: System Map*

3. Certified Operators

[Funding Projects -***Necessary***; New Systems and Changes of Ownership- ***Mandatory***]

The regulating agency has determined that this water system needs a:
☒ Certified distribution operator, **Grade D2** ☐ NA
☒ Certified treatment operator, **Grade T2** ☐ NA

☒ Provide copies of current certificates with operator names and grades as documentation that the distribution and treatment operators are certified for the appropriate level that is required for the water system.

☒ For a contract certified operator, provide a copy of the contract that describes the: ☐ NA
- Level of certification that the operator will be required to maintain
- Specific duties for which the operator will be responsible
- Time to be spent serving the water system
- Procedures to follow for complaints, compliance discrepancies, and emergencies

Comments: ***Redwood Glen has on-site operations staff as well as a team of contracted certified operators, Bracewell Engineering. Redwood Glen has executed a contract with Bracewell Engineering for the operation of the new surface water system. The following are included in Attachment 3:***

Attachment 3A: *Copies of on-site operator's D2 license*
Attachment 3B: *Executed Contract with Bracewell Engineering, including operator certifications*

4. Source Capacity
[Funding Projects - ***Necessary***; New Systems and Changes of Ownership - ***Mandatory***]

At all times a water system must have the capacity to meet the system's maximum day demand and to ensure that it has suitably adequate sources of water supply to serve the needs of its constituents in the future. Develop and submit the following:

☒ Documentation which demonstrates that the water system has a sufficient water supply as described in California Code of Regulations, Section 64554.

☒ A water conservation plan to address potential drought conditions.

☒ A plan to install water meters on all connections as well as a master meter on each source in order to accurately measure water consumption. [Note that all water systems applying for SWRCB funds must consider the feasibility of installing meters at each service connection that lacks a meter. Additionally, the funding requirements for the project must include conditions that the system will incorporate provisions into its operating procedures and expenses to read the meters and to charge rates based on usage.
☐ N/A – System is metered

☒ A map of the existing service area and surrounding locations that includes the location of all water sources as well as sources of potential contamination such as waste disposal sites, landfills, feedlots, underground storage tanks, out-of-service wells, and other potential contaminants.

☒ Documentation that demonstrates the water sources are protected from vandalism, tampering, contamination, or other threats.

☒ Ten year potential growth plans consistent with local land use plans and projected water demand. Describe how the system will ensure that potential water sources will meet all water quality standards.

☒ A plan to start the process to obtain additional water rights for new water sources if needed. ☐ NA

Comments: ***Redwood Glen's source water portfolio consists of surface water from Hoffman Creek and Piney Creek and raw water storage. A map that includes both sources and any PCAs is included in Attachment 2. Balance Hydrologics established the source capacity for both Hoffman Creek and Piney Creek, as well as a dry year and multi-dry year capacity evaluation to comply with SB1263 (see Attachments 4B and 4C).***

The maximum daily demand (MDD) for the Redwood Glen Water System was established in the Addendum to the Alternative Analysis to be 8.7 gpm (accounting for the State's request for a factor of safety). Analysis was conducted to compare the system demands with the available supply established by Balance Hydrologics. The Technical Report details Redwood Glen's available supply, anticipated demands, and adequacy of supply. Attachment 4F includes the relevant sections of the Technical Report.

Based on the information presented, the State confirmed that the camp has sufficient but marginal supply (Attachment 4A).

The sources are protected from vandalism, tampering, contamination, or other threats. The diversions structures for both Hoffman Creek and Piney Creek are located in non-urban, wooded, hilly and overall very remote areas on Redwood Glen's private property or on County property, at a fair distance from any developed areas. The diversions structures are only accessible on foot, through strenuous hiking trails that are dedicated to the sole purpose of accessing the points of diversion. Additionally, the access to those trails is controlled by Redwood Glen personnel.

As the Redwood Glen Water System serves a camp facility, a 10-year growth plan does not exist for the community or water system – therefore, no growth plan has been included.

The following documents are included as Attachment 4 to support the source capacity section:

> ***Attachment 4A:*** *SWRCB Letter: Adequacy of Supply, Redwood Glen Camp and Conference Center, Water System No. 4100522, 01/07/2017*
> ***Attachment 4B:*** *Streamflow measurements and source capacity estimates at Redwood Glen*
> ***Attachment 4C:*** *Amendment to source capacity estimates at Redwood Glen*
> ***Attachment 4D:*** *Redwood Glen Water Conservation Plan*
> ***Attachment 4E:*** *Water Meter Installation Plan*

5. Operations Plan

[Funding Projects-***Necessary***; New Systems and Changes of Ownership- ***Mandatory***]

An operations plan describes all of the activities needed to maintain the system in compliance with all standards. Operations plans need to be updated whenever changes occur. The date of the latest operations plan review was May 2017.

Provide an operations plan that describes the tasks that would enable another qualified operator to assume the operation of the system in an emergency. Include tasks that will be completed:

☒ Daily
☒ Weekly
☒ Monthly
☒ Yearly

Include non-routine activities relating to:

☒ Positive analytical results
☐ Complaints
☒ Emergency operational practices
☒ Record keeping
☐ Other duties

Templates for a number of sample operations plan can be found on the SWRCB web site at:

http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/TMF.shtml

Comments: *Attachment 5 includes a draft version of the Redwood Glen's Operations Plan.*

6. Training

[Funding Projects, New Systems, and Changes of Ownership - ***Necessary***]

Submit a plan describing the training that will be provided to ensure that everyone associated with the water system has the knowledge to competently comply with existing requirements and to be informed about new compliance requirements, new technologies, and newly identified hazards. The plan needs to describe the training for the following:

☒ Certified operators: Contact hours needed to maintain operator certification at the required grade for the system and other related training.
☒ Governing board and managers: Training that covers board and management roles and responsibilities including ethics and financial management.
☒ Other staff: Pertinent training to enable all staff to competently perform activities necessary to the operation and maintenance of the system.

Comments: *Training will be provided to the certified operators, executive director, and governing board of Redwood Glen. Attachment 6 includes the Redwood Glen Training Plan.*

7. **Ownership**

[Funding Projects; New Systems, and Changes of Ownership - ***Mandatory***]

Ownership must be clearly identified for all components of the water system. Check the type of water system ownership:

☐ Sole proprietorship
☐ Partnership
☒ Corporation
☐ Mutual
☐ Governmental agency
☐ Other formation type

A copy of the deed for any well locations may document both ownership and water rights. Provide the following ownership documentation as hard copies or in electronic format:

☒ Formation papers such as incorporation articles, partnership documentation, by-laws, and governing ordinances. ☐ NA

☒ Deeds and other ownership documentation of all system property including land, buildings, wells, storage tanks, treatment facilities, and other system components. ☐ NA

☐ Easements, leases, or agreements for long term use regarding land or system components that are not owned by the water system. Specify the duration of the authorization. ☒ NA

☐ Encumbrances, trust indentures, bankruptcies, decrees, legal orders, or other items that may affect the owner's control of the water system. ☒ NA

☐ If the water system is under temporary ownership such as a developer, describe the timing for the change in ownership and the contact information for the eventual owner. ☒ NA

☐ If the owner of the water system has owned or managed any other public water system within the last ten years, list these systems by name and number. ☒ NA

☐ For a sole proprietor submit a plan that describes how the system will continue to be operated in the event the owner becomes incapable of carrying out this responsibility. ☒ NA

Comments: *Articles of Incorporation, Bylaws, and other ownership documentation are included in Attachment 7.*

8. **Water Rights**

[Funding Projects; New Systems, and Changes of Ownership - ***Mandatory***]

Provide the following documentation as hard copies or electronic format:

☒ List the current and emergency water sources that will be used to operate the system including groundwater, surface water, purchased water, and any other sources.

<u>The proposed water sources that will be used to operate the system are surface water from Hoffman Creek and Piney Creek and raw water storage. There is an approved emergency connection with Memorial Park, which is permitted to be used for short-term emergencies, if necessary.</u>

☒ Describe the long-term availability of the sources used by the water system to meet a projected 10-year water demand**.**

<u>The 10-year water demand is the same as the current water demand.</u>

<u>Groundwater</u>: ☐ Yes ☒ No

- Unadjudicated Basin: Provide the following: ☒ NA

  ☐ A statement that the groundwater is extracted from a basin that is not adjudicated.

  ☐ Copies of the deeds for the parcels of each unadjudicated groundwater source used by the system.

- Adjudicated Basin: Attach the deed for the parcels of each adjudicated groundwater source that notes the adjudication or provide documentation of the Basin Water Master's terms of the adjudication as they relate to the water system's right to extract water from the adjudicated basin. ☒ NA

<u>Surface Water:</u> ☒ Yes ☐ No

Circle the type of water rights the water system holds for surface water from the list below:

a. Appropriative
   1) Pre-1914
   2) State Water Resources Control Board (SWRCB) Permit or License

b. Riparian

<u>Appropriative</u>

☐ If Pre-1914, provide a statement that water rights were established prior to 1914. ☒ NA

☒ If after 1914, provide a copy of the SWRCB water rights permit or license. Note that an application to the SWRCB does not document water rights. ☐ NA

Riparian

☒ Provide a statement that water is derived from a surface source pursuant to a riparian right. ☐ NA

Purchased Water: ☐ Yes ☒ No

☐ Provide a copy of the water service agreement for purchased water that specifies the duration of the authorization. Note that for funding projects the long-term use agreements must extend for the life of the loan or a minimum of 20 years for grant funded projects. ☒ NA

Comments: ***The water rights documentation for Hoffman Creek and Piney Creek are included as part of Attachment 8. Redwood Glen has claimed Riparian rights to Hoffman Creek. A Notice of Assignment and multiple years of Statements of Water Diversion and Use are included in Attachment 8A. Redwood Glen's appropriative rights to Piney Creek are documented by their SWRCB License for Diversion and Use of Water, included in Attachment 8B.***

Attachment 8A: *Water Rights Documentation for Hoffman Creek*
Attachment 8B: *Water Rights Documentation for Piney Creek*

9. Organization

[Funding Projects – ***Necessary***; New Systems, and Changes of Ownership - ***Mandatory***]

In order to establish the lines of authority and communication between employees and management including the governing board, managers, certified operators, and clerical staff, provide a:

☒ Structural organizational chart for positions associated with the water system that indicates the lines of authority. Specify the frequency of board meetings where appropriate.

☒ Separate chart that lists the names and phone numbers of the specific people who fill those positions. Update this information as needed.

☒ List on the organization charts information on any contract certified operators the system may utilize. Indicate the level of certification and the number of hours for which the services of a certified operator are contracted. ☐ NA

Comments: ***Organizational Charts, as per SWRCB specifications, are included in Attachment 9.***

10. Emergency Response Plan

[Funding Projects – ***Necessary***; New Systems, and Changes of Ownership - ***Mandatory***]

Ensure that the emergency response plan for the water system includes:

☒ A list of all disasters and emergencies that is likely to occur in the water system's service area. Include earthquakes, fires, and disinfection failure at minimum as well as flooding, water outages, water contamination, power outages, and other potential local emergencies.

☒ The names and contact information of water system personnel including the decision makers. Identify responsibilities, and provide a clear chain of command.

☒ An inventory of system resources used for normal operations and available for emergencies including maps and schematic diagrams, lists of emergency equipment and suppliers, emergency contract agreements, and emergency water interconnections or sources.

☒ A communication network that describes a designated location for an emergency operations center, emergency contact information for equipment suppliers, emergency phone and radio communication capabilities, coordination procedures with governmental agencies for health and safety protection, technical and financial assistance, and public notification procedures.

☒ Emergency procedures to quickly assess damage to water system facilities including logistics for emergency source activation and repairs, procedures for monitoring progress of repairs and restoration, and procedures for documenting damage and repairs.

☒ Describe steps that will be taken to resume normal operations and to submit reports to appropriate agencies.

Comments: ***An Emergency Response Plan, as per SWRCB specifications is included in Attachment 10.***

11. Policies

[Funding Projects; New Systems, and Changes of Ownership - ***Necessary***]

☒ A policy manual has been adopted that describes procedures pertinent to the management of the water system. At a minimum the policies described should cover:

a. Nonpayment of water charges
b. Unauthorized use of water
c. Hours worked and overtime
d. Complaint responses
e. Contract operators, if applicable
f. Governing board activities such as regulatory responsibilities, expenditure allowances, meeting notifications, resolution adoptions, and other issues as applicable

Comments: ***A policy manual has been adopted for the Redwood Glen Water System in accordance with the requirements of the State and in alignment with the Redwood Glen Bylaws and Guiding Principles. Nonpayment of water charges is not covered, as***

there are no paying customers for the Redwood Glen Water System. The following items are included as Attachment 11:

> ***Attachment 11A:*** *Redwood Glen Water System Policy Manual and Board Approval*
> ***Attachment 11B:*** *Redwood Glen Bylaws*
> ***Attachment 11C:*** *Redwood Glen Guiding Principles*

12. Budget Projection / Capital Improvement Plan

[Funding Projects; New Systems, and Changes of Ownership - ***Mandatory***]

Use the sample 5-year budget projection/capital improvement plan (CIP) template, or an equivalent alternative, that is located on the CDPH website at

http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/TMF.shtml

This file consists of guidelines for completing this spreadsheet on the first Excel tab, the 5-year budget projection on the second tab, and the CIP on the third tab.

Submit the following:

☒ 5-Year budget projection/CIP template

☒ Documentation that reserve funds have been created for the CIP, operations and maintenance expenses, potential emergency needs, and any other reserve accounts necessary for the management of the system.

☐ Documentation of the current rate structure. ☒ NA

☐ Documentation of the average annual cost of water per connection for the last calendar year. ☒ NA

☒ Documentation that revenues cover expenses including the CIP reserve, or describe the plan to increase revenues to cover these expenditures. ☐ NA

☐ Where appropriate, include the Proposition 218 voter approval process that will be followed if a rate increase is planned. ☒ NA

☐ For investor owned systems documentation from the California Public Utilities Commission of an approved budget, CIP, and rate schedule. ☒ NA

☐ NEW SYSTEMS OR FUNDING PROJECTS ONLY: Proposed rate structure. ☒ NA

☐ NEW SYSTEMS OR FUNDING PROJECTS ONLY: Estimated average annual cost of water per connection based on the proposed new funding amount. ☒ NA

Comments: ***Attachment 12 includes the following:***

Attachment 12A: *Redwood Glen CIP and 5-year Budget Projection*
Attachment 12B: *Letter of Interest from the Christian Community Credit Union*

13. Budget Control

[Funding Projects - ***Necessary****;* New Systems, and Changes of Ownership - ***Mandatory***]

A financial policy that includes:

☒ Budget control procedures in which one person records a transaction and a manager review and approves it. Describe budget controls for:

a. Cash receipts and disbursements
b. Bank accounts
c. Payroll

☒ Financial reports prepared for review by governing board such as:

a. Customer Receivables Report
b. Check Register Review
c. Bank Reconciliation Report
d. Budget Comparison Report
e. Quarterly Comparative Balance Sheet
f. Tax Returns

☒ Criteria and withdrawal guidelines for the maintenance of reserve accounts including:

a. CIP Reserve
b. Operations and Maintenance Reserve
c. Contingency or Emergency Reserve
d. Other Reserves

☐ Reporting procedures to appropriate levels of authority to ensure that there is no commingling of revenue sources. ☒ NA

☐ Periodic reviews of the budget status by a Certified Public Accountant or appropriately qualified financial officer of the water system to ensure continuing financial viability. Three years of the most current audited financial reports must be submitted for all CDPH funding projects. ☒ NA

Comments: ***A policy manual has been adopted for the Redwood Glen Water System in accordance with the requirements of the State and in alignment with the Redwood Glen Bylaws and Guiding Principles. Section 4 of the Policy Manual includes the Financial Policies of the Redwood Glen Water System. The Redwood Glen Water System Policy Manual is included as Attachment 13.***

ATTACHMENT 1

Consolidation Feasibility

ATTACHMENT 1A

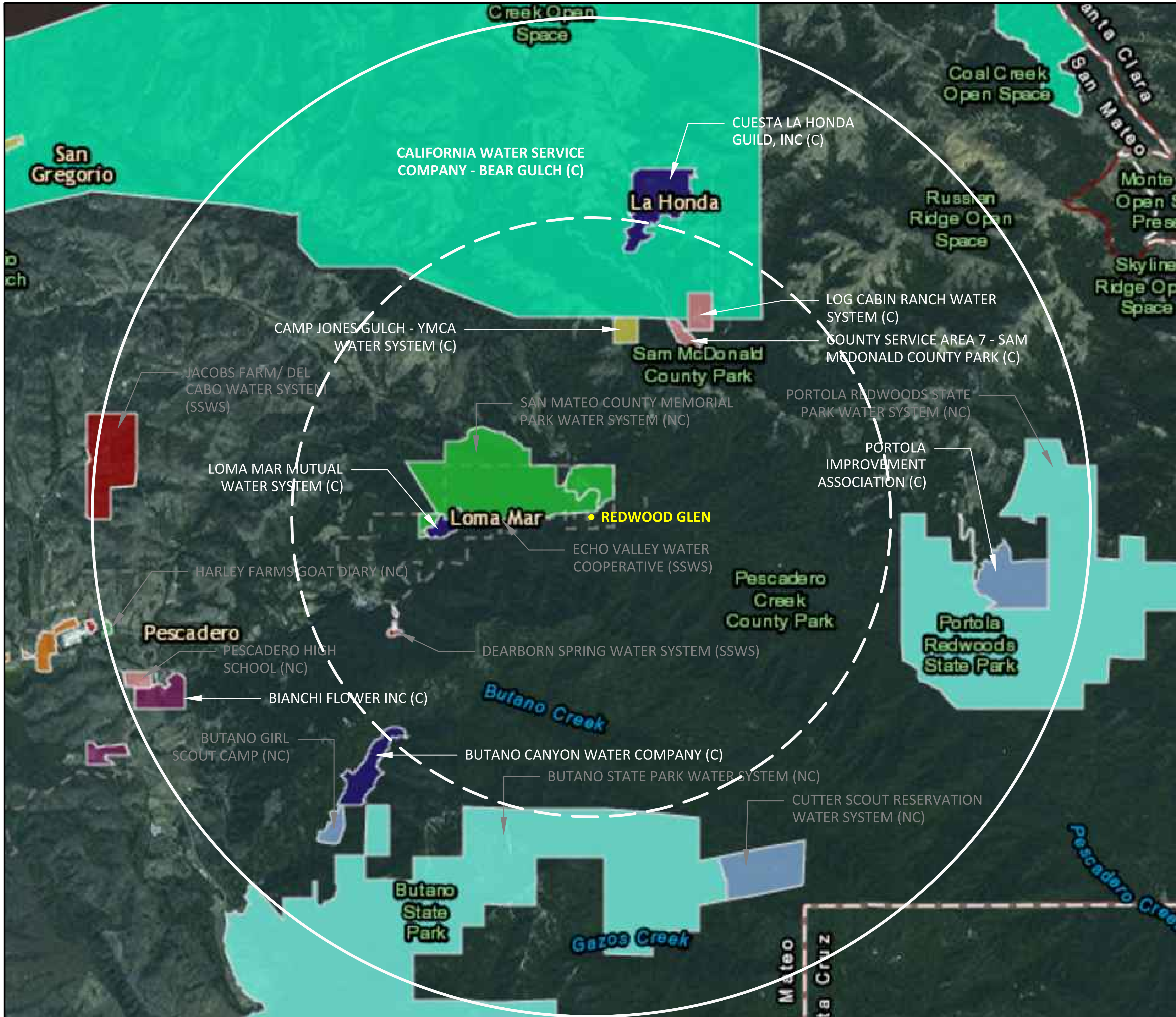
List of Water Systems in a 5-Mile and 3-Mile Radius

List of Community Water Systems in a 5-Mile and 3-Mile Radius of Redwood Glen

Table 1, below includes the community water systems that are within a 5-mile radius of Redwood Glen and the corresponding number of connections. The water systems that are highlighted in blue are also within a 3-mile radius of Redwood Glen. The attached map includes the 3-mile and 5-mile radii and all of the identified water systems.

Table 1 Community Water Systems in 5-Mile Radius

Name of Community Water System	Number of Connections
Bianchi Flowers Inc.	11
Butano Canyon Water Company	94
California Water Service – Bear Gulch	18,836
Cuesta La Honda Guild Inc.	297
Camp Jones Gulch – YMCA	65
Camp Loma Mar – YMCA	21
Log Cabin Ranch	14
County Service Area 7 (Sam McDonald County Park)	68
Loma Mar Mutual	34
Portola Improvement Association	35



ABBREVIATIONS:

(C) - COMMUNITY WATER SYSTEM

(NC) - NON-COMUNITY WATER SYSTEM

(SSWS) - STATE SMALL WATER SYSTEM

LEGENDS:

5-MILE RADIUS

3-MILE RADIUS

N

SCALE: 1 IN = 1 MILE

REVISIONS

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REDWOOD GLEN
100 WRIGHT WAY,
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REDWOOD GLEN TMF

MAP OF CONSOLIDATION FEASIBILITY

SCALE AS SHOWN

SHEET -- OF 01

01

ATTACHMENT 1B

Consolidation Assessment

Redwood Glen has actively pursued consolidation over the last two (2) years with the County of San Mateo (Memorial Park). Additionally, Redwood Glen has recently pursued consolidation with the following local water systems: Loma Mar Mutual Water Company, La Honda Cuesta, YMCA Camp Loma Mar, Cal Water – Bear Gulch, Butano Canyon Water Company, YMCA Camp Jones Gulch, the Log Cabin Ranch and Sam McDonald County Park. The results of Redwood Glen's attempts to consolidate are included in Table 1, below.

Table 1 Summary of Consolidation Investigation

Water System	Summary of Findings
Memorial Park Water System (County of San Mateo)	Redwood Glen was previously served potable water by Memorial Park and would have preferred consolidation with Memorial Park, however this was not possible due to their designation as a transient non-community (TNC) water system and unwillingness to be permitted as a community water system (CWS). Memorial Park has made it very clear that they are not interested in consolidation through meetings and correspondence. Correspondence from County Counsel is included as Attachment 1C.
Loma Mar Mutual Water System	In June of 2014, when Memorial Park originally terminated service to Redwood Glen, staff investigated the possibility of connecting to an existing local CWS that would be willing to consolidate with Redwood Glen. The Loma Mar Mutual Water System seemed to be the best option, however, the water system could not serve Redwood Glen due to the following reasons: the existing sources could not serve the demand at Redwood Glen, the system is designated as strictly residential, and the infrastructure to connect the two (2) systems would be economically infeasible.
La Honda Cuesta Water System	La Honda Cuesta was identified as another local CWS that may be willing to consolidate with Redwood Glen. Connecting to La Honda Cuesta was established as physically and economically infeasible as the water system is over 6 miles away, by County Road, and there is substantial challenging terrain between the two systems.
Camp Loma Mar Water System (YMCA)	Camp Loma Mar was identified as an existing local CWS that may be willing to consolidate with Redwood Glen. Connecting to the Camp Loma Mar Water System was deemed infeasible, as the system does not have the capacity to serve Redwood Glen's demand.

California Water Service – Bear Gulch	Cal Water Bear Gulch is the largest community water system in the vicinity of Redwood Glen camp and is also the closest local water agency. However, the consolidation assessment for this water system showed that it would require at least 12.5 miles of pipe to connect Redwood Glen to Cal Water's closest water main. This consolidation project was deemed economically infeasible due to the high construction costs.
Butano Canyon Water Company	Butano Canyon Water Company is a CWS located within the 3-mile radius of Redwood Glen. However, the water system is12.5 miles away by County Road over challenging terrain and the costs associated with such a long distance of transmission line are prohibitive to a potential consolidation project.
Log Cabin Ranch	The Log Cabin Ranch is within the 3-mile radius of Redwood Glen and operates a CWS. However, it is 6 miles away along County roads over mountainous terrain. Additionally, it is unknown if the water system has sufficient supply to cater to Redwood Glen's water demand.
Camp Jones Gulch (YMCA)	The YMCA Camp Jones Gulch is located 2.7 miles away through County roads and mountainous landscape. It is unknown if the system has sufficient supply to serve Redwood Glen's demands.
County Service Area 7 (Sam McDonald County Park)	The Sam McDonald County Park is located 4 miles away along County roads and it is unknown if its water system has enough water supply to serve Redwood Glen.

Consolidation costs were estimated based on the distance of pipeline required to physically connect Redwood Glen to the neighboring water systems, as well as general allowances for infrastructure improvements and administrative costs. Table 2, below, details the costs associated with connecting Redwood Glen to the neighboring water systems listed above.

Table 2 Consolidation Cost Assessment

	Number of connections	Pipe Distance	Pipe Distance	Pipe Costs[1,2]	Infrastructure Upgrade Costs[3]	Administrative Costs	Enough Water	**TOTAL**
		mi	*ft*	*$*	*$*	*$*	*Y/N*	***$***
Memorial Park	4	0.7	existing	existing	10,000	30,000	Y	40,000
Loma Mar Mutual	34	1.1	5,808	1,028,016	20,000	30,000	N	1,078,016
Cal Water Bear Gulch	18836	12.5	66,000	11,682,000	20,000	30,000	Y	11,732,000
Cuesta La Honda Guild	297	6.3	33,264	5,887,728	15,000	30,000	Y	5,932,728
YMCA Camp Loma Mar	21	0.8	4,224	747,648	15,000	30,000	N	792,648
Butano Canyon Water Company	94	12.5	66,000	11,682,000	20,000	30,000	Y	11,732,000
YMCA Camp Jones Gulch	65	2.7	14,256	2,523,312	20,000	30,000	N	2,573,312
Log Cabin Ranch	14	6	31,680	5,607,360	20,000	30,000	N	5,657,360
Sam McDonald Park	68	4	21,120	3,738,240	20,000	30,000	N	3,788,240

[1]Assumes $177/ft of pipe, including capital costs of pipe and installation underground, assuming 6" diameter PVC pipe and taking into account the rough and hilly terrain. This cost per linear foot estimate is based on the estimates provided by contractors for a similar pipe construction project in San Mateo County over the Summer 2016.
[2]Assumes that miscellaneous appurtenances/valves will be required along the transmission water line and at the tanks.
[3]Assumes upgrades (recirculation systems in tanks, structural integrity reinforcement, increase of pumping capacity, upgrade of intakes, replacement of aging infrastructure).

ATTACHMENT 1C

Correspondence with Neighboring Water Systems

Gmail by Google

Lisa Pezzino <lisa@srtconsultants.com>

Redwood Glen

Nirit S. Eriksson <Neriksson@smcgov.org> Thu, Feb 25, 2016 at 3:59 PM
To: "lisa@srtconsultants.com" <lisa@srtconsultants.com>
Cc: "Eric.Lacy@waterboards.ca.gov" <Eric.Lacy@waterboards.ca.gov>, Gregory Smith <GJSmith@smcgov.org>, Marlene Finley <mfinley@smcgov.org>, Larry Rice <exec@redwoodglen.com>, John Beiers <jbeiers@smcgov.org>

Dear Ms. Pezzino,

I have received the attached email thread pertaining to Memorial Park and Redwood Glen, in which you stated to Eric Lacy and Greg Smith that there has been “no official response from the County regarding their willingness to be designated as a CWS for an interim period of one year.”

I am writing to let you know that the official response from the County is that the County is <u>not</u> willing to be designated as a CWS (whether for an interim period or otherwise). Accordingly, as stated in the One-Year Termination Notice dated February 26, 2015, and again in the January 26, 2016 letter to Redwood Glen, the County will terminate water service to Redwood Glen effective March 1, 2016.

Sincerely,

Nirit Eriksson

Deputy County Counsel

San Mateo County

400 County Center, 6th Floor

Redwood City, CA 94063

Direct Dial: (650) 363-4461

Fax: (650) 363-4034

neriksson@smcgov.org

---------- Forwarded message ----------
From: Marlene Finley <mfinley@smcgov.org>
To: "Nirit S. Eriksson" <Neriksson@smcgov.org>, John Beiers <jbeiers@smcgov.org>

Lara Egbeola-Martial <lara@srtconsultants.com>

Fwd: FW: RE: Draft Plans and Specifications/Technical Report

Lisa Pezzino <lisa@srtconsultants.com> Wed, Jan 25, 2017 at 11:11 AM
To: Lara Egbeola-Martial <lara@srtconsultants.com>

Some consolidation information that will need to be included in the Technical Report (Cal Water Bear Gulch).

---------- Forwarded message ----------
From: **Larry Rice** <exec@redwoodglen.com>
Date: Mon, Aug 22, 2016 at 9:35 AM
Subject: FW: RE: Draft Plans and Specifications/Technical Report
To: Lisa Pezzino <lisa@srtconsultants.com>

Good Morning Lisa,

I'm back to work. Had a nice "vacation" (worked two days and took phone calls on one other day). But got time to spend with my son and his wife, so it was a nice week.

So after reading Karen's and Eric's email, do we need to touch base?

1. How is the issue coming regarding our water rights? Exactly what is it that Eric is looking for? And I guess we need to establish those rights before we can apply for a point of diversion. But should we scope out and decide soon where that POD will be?

2. I talked with Dawn Smithson, District Manager for the Bear Gulch District of Cal Water. Very good conversation, but yes, it was decided that the cost would be prohibitive to connect with them. Their closest connection is 9 miles away as the crow flies (somewhere near the corner of Hwy 84 and Hwy 35) and I measured it this morning driving in that it would be at least 12.5 miles of pipeline. Don't know how you want to word it for the report, but that was the gist of it.

3. Any word as to when the drillers will arrive? I'm planning on emailing Mark at Balance after I send this.

I'm at camp today so call there (650.879.0320) if you need to call. Tomorrow I will be on my cell all day.

Larry Rice
Executive Director
Redwood Glen

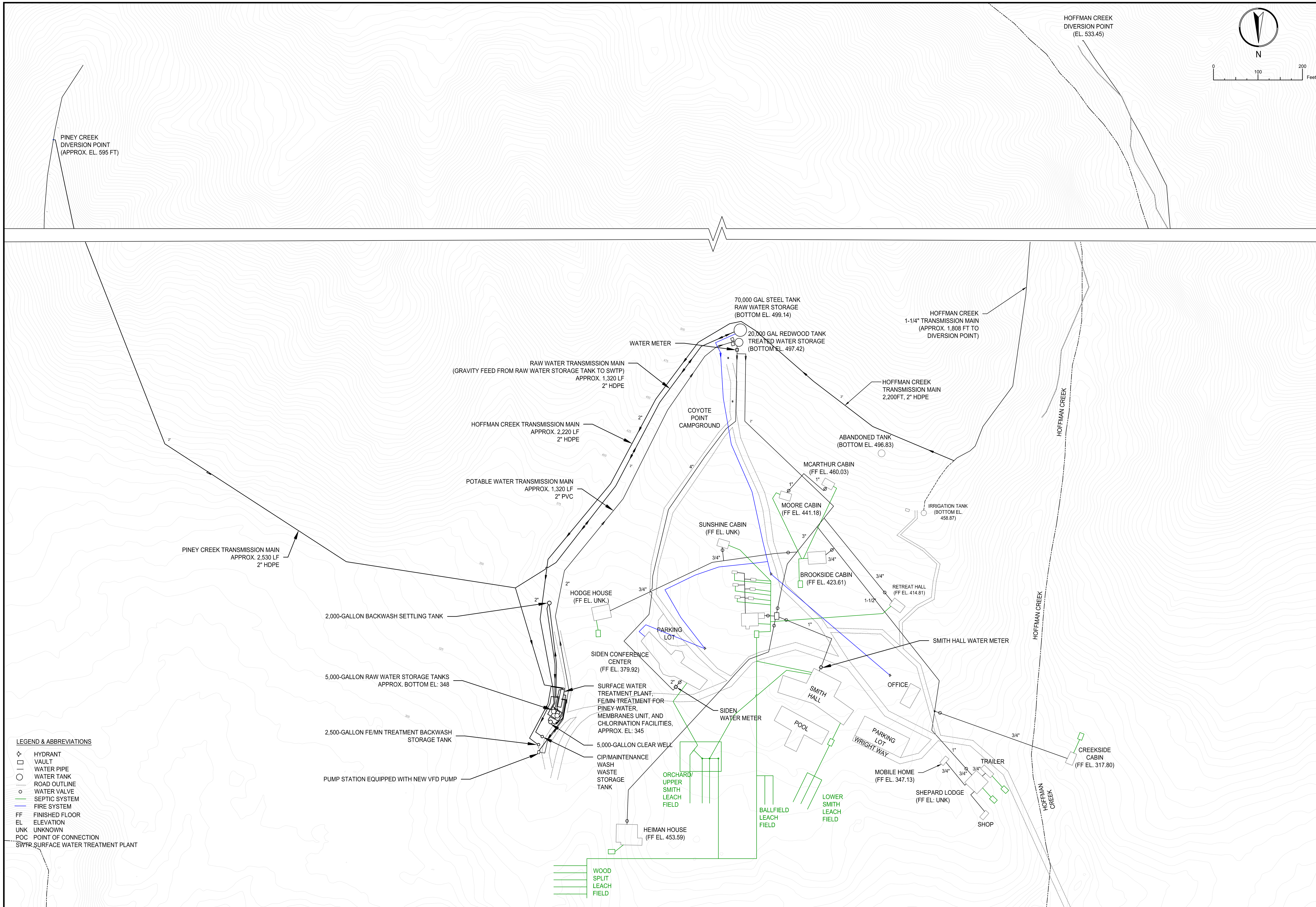
-----Original Message-----
From: "Lacy, Eric@Waterboards" <Eric.Lacy@waterboards.ca.gov>
Sent: Monday, August 22, 2016 8:24am
To: "Lisa Pezzino" <lisa@srtconsultants.com>, "Larry Rice" <exec@redwoodglen.com>
Cc: "Mark Quady" <mark@srtconsultants.com>, "Nishimoto, Karen@Waterboards" <Karen.Nishimoto@waterboards.ca.gov>
Subject: RE: Draft Plans and Specifications/Technical Report

I agree with Karen.

We understand why you are choosing the groundwater op on. And we are hopeful that is will be successful in delivering the quan ty and quality that you need. But we worry what happens if it does not. (It has not panned out in the past.) We are also very concerned that you will run out of me to pursue the surface water op on if too much me is spent on this first op on. (We have not seen formal, wri en documenta on that you can legally divert surface water for domes c use, nor that it will be sufficient to meet your needs.) You can have extra me to complete the

ATTACHMENT 2

System Description



DRAWING NAME: \\Newserver\srt\01_PROJECTS\Redwood Glen\02_TASKS\03 TMF\TMF MAP\TMF MAP.dwg
PLOT DATE: May 19, 2017 – 3:43pm PLOTTED BY: Christine

SYM.	DESCRIPTION	DATE	APPROVED
–	100% DESIGN	03/2017	LP

REVISIONS

NOT FOR CONSTRUCTION

SRT consultants
90 New Montgomery Street, Suite 905
San Francisco, CA 94109
Ph 415.776.5800
Fx 415.776.5200

REDWOOD GLEN CAMP AND CONFERENCE CENTER
100 WRIGHT WAY
LOMAR MAR, CA 94021

REDWOOD GLEN NEW WATER SYSTEM CONSTRUCTION PROJECT

WATER SYSTEM MAP

DATE	MAR 2017
SCALE	AS SHOWN
DESIGN	L. PEZZINO
DRAWN	N.MAO
PROJECT#	------
SHEET	01 OF --

01

ATTACHMENT 3

Certified Operators

ATTACHMENT 3A

On-Site Operator Certification

State of California
State Water Resources Control Board

IN ACCORDANCE WITH DIVISION 104, PART 1, CHAPTER 4, ARTICLE 3
OF THE HEALTH AND SAFETY CODE

Andrew M. Gonsalves

IS AUTHORIZED TO OPERATE OR SUPERVISE THE OPERATION OF A WATER DISTRIBUTION SYSTEM
AND IS HEREBY GRANTED THIS CERTIFICATE FOR

Water Distribution Operator

Grade D2

Operator Number: 46535

Issued
March 2016

Felicia Marcus
Chair

STATE WATER RESOURCES CONTROL BOARD
EUREKA
CALIFORNIA

ATTACHMENT 3B

Bracewell Engineering Contract

Agreement

TITLE: AGREEMENT FOR OPERATION AND MONITORING SERVICES FOR REDWOOD GLEN.

Redwood Glen ("Client") and Bracewell Engineering, Inc. ("Contractor") enter into this agreement on the date stated next to the signature below.

TERMS

1. Duration of Contract. This contract shall commence on June 1, 2017 and end on May 31, 2018, unless sooner terminated as specified herein.

2. Scope of Services. Contractor, for Client's benefit, shall perform the services specified on Attachment A to this contract. Attachment A is made a part of this contract.

3. Payment. In consideration for Contractor's performance, Client shall pay Contractor according to the terms specified in Attachment B. Attachment B is also made a part of this contract.

4. Contract Administrator. Client designates its General Manager as its contract administrator for this contract. All matters concerning this contract which are within the responsibility of Client shall be under the direction of, or shall be submitted to, the Contract Administrator or any employee as the Contract Administrator may appoint. Client may, in its sole discretion, change its designation of the Contract Administrator and shall promptly give written note to Contractor of any such change.

5. Additional Terms. The rights and duties of the parties to this Contract are governed by the terms mutually agreed to and listed in Attachment C. Attachment C is also made a part of this contract.

CLIENT:

By: Larry Rice ______________ 5/18/2017
Date

Title: Executive Director

CONTRACTOR:

By: ______________ President, 5/19/2017
Bracewell Engineering, Inc. Date

ATTACHMENT A

SCOPE OF SERVICES

Contractor shall provide the following services:

Understanding of Services

BEI has over 25 years of experience operating water systems in the greater Bay Area with several systems described in Section E, all of which we have been operating continuously for a minimum of 10 years and up to 20 years. None of these water systems have had any significant compliance issues during this time period and the fact our clients have continued to renew our contracts year after year speaks to their confidence and satisfaction with our operations and maintenance services. The following is an example of our typical scope of services.

1. Review and update Operations & Maintenance (O&M).
2. Perform all standard and emergency laboratory tests in accordance with schedules and requirements of current permits, analyze results, take or recommend necessary action. Maintain laboratory records, equipment and order supplies as required.
3. Perform preventative maintenance on facilities and recommend to Client any necessary plant repairs, including electrical systems, not outlined within contract and all facility related maintenance.
4. Perform plant building and storage tank inspection and cleaning activities (excluding interior of tank).
5. Develop and implement distribution system mainline flushing programs.
6. Perform routine exercising and testing of valves and devices.
7. Monitor all plant and storage tank alarms.
8. Prepare and file daily, weekly, monthly and annual laboratory result reports as required by the State Water Resources Control Board Division of Drinking Water (DDW)
9. Add necessary chemicals to maintain acceptable quality levels necessary for operation of water treatment plants.
10. Review laboratory test results and other data to determine if changes are needed for appropriate treatment plant operations.
11. Perform maintenance, calibration and operation of equipment.
12. Interpret data under unique circumstances or reconcile conflicting data from laboratory tests and other sources of information.
13. Responsible for permit renewals, non-compliance notifications (except already existing notifications for DBPR), O&M manual updates, and Quality Assurance manual updates.
14. Coordinate and communicate with DDW on issuance of any emergency water quality notifications and cancellations.
15. Respond to customer questions and complaints.
16. Document each shift by completing necessary paperwork.
17. Notify Client of noticeable facility repairs or needs. However, building and facility maintenance beyond water operations is the Water District's responsibility.
18. Provide annual operational and capital improvement cost estimates.
19. Provide, at a minimum, the following written reports for the Water System. Reports shall be submitted by email:

- Coliform Reporting Form – Monthly
- Summary of Distribution System Coliform monitoring – Monthly
- Disinfectant Residuals Compliance Report - Quarterly
- DBPR Report - Quarterly
- Water System Monitoring Report – Monthly
- Storage Tank Inspection - Quarterly
- Consumer Confidence Report (CCR) – Annually
- Small Water System Annual Report to the Drinking Water Program – Annually
- Water Quality Emergency Notification Plan – Annually
- Alarm System Testing Report - Quarterly

All services shall be performed in accordance with State, Federal, and Local regulations and in accordance with site permits.

Proposed fee schedule for the Water System shall be considered to include all compensation to adequately provide all operation and maintenance services meeting the needs described above except where specifically indicated or excluded (see Fees, submitted under separate cover).

Specifically excluded from the scope of work are chemical supplies, sludge disposal, power, equipment and repair parts, a repair or improvement that requires more than 2 hours of operator time, services of an electrician, response to significant emergencies such as sewer spills or earthquakes, additional chemical analyses if required by the Water Board, attending Water Board meetings at their offices, and anything not specifically covered in items 1 through 8 above or in the budget as described in Table 1.

Any additional work required or requested by the client will be charged on a time and material basis at the rates shown in Attachement C-1

BEI will provide a licensed grade III operator to supervise the operation of the plant with assistance from grade II and grade I operators as required.

Indemnity and Liability

BEI hereby agrees to and shall hold client harmless, indemnify, and defend client from and against any and all claims, losses, damages, liability, and costs for property damages or bodily injury including death, including but not limited to costs of defense arising out of or in any way connected to BEI's negligent operations under this Scope of Services, to the proportion such negligence contributed to the damages, injury or loss. client agrees to and shall hold BEI harmless, indemnify, and defend BEI from and against any and all claims, losses, damages, liability, and costs for property damages or bodily injury including death, including but not limited to costs of defense, which may arise from client's negligent ownership of the treatment plant or from any negligence performance by client of its responsibilities under this Scope of Services, other than BEI's negligence.

Budget

The estimated annual budget for the 12 months from January 1 through December 31, 2017 is $98,424 with a per month cost of $8,202 for routine and non-routine operations, preventive maintenance, monitoring, and reporting. A summary of the proposed budget is attached as Table 1.

ATTACHMENT B

PAYMENT SCHEDULE

Client shall pay to Contractor the following sums on the following terms.

Budget

The budget proposed for the water system is detailed in the attached Table 1. This budget is subject to revision based on scope of work changes in consultation with Client.

Contractor will invoice Client monthly based on the work conducted. The budget will not be exceeded without prior written authorization by Client.

For out of scope services, Engineering, Operator, and other labor shall be charged at the rates specified in Attachment C-1, "Professional Services Hourly Rate Schedule."

Travel costs and other expenses not specifically included in the Scope of Work will be billed in addition to the above in accordance with the rates specified in Attachment C-1, "Professional Services Hourly Rate Schedule." Travel costs for time and mileage are calculated from Morgan Hill.

Contract and Budget Revisions: The contract and associated budget shall be reviewed three (3) months after the date of contract execution, and every three (3) months thereafter, to evaluate the scope of work and determine if changes should be made to more accurately represent the level of effort provided by the Contractor. It is anticipated that the level of effort will decrease as the Contractor establishes an effective schedule for on-site versus remote monitoring of the water system, and is able to clearly establish tasks and responsibilities for certified Client staff.

ATTACHMENT C-1

PROFESSIONAL SERVICES HOURLY RATE STRUCTURE
(Effective through December 31, 2017)

Principal Engineer	$180.00
Senior Engineer II	$140.00
Operations Manager	$100.00
Chief Plant Operator (Grade III)	$75.00
Operator II	$68.00
Operator I	$62.00
Maintenance Technician	$58.00
Laboratory Technician	$58.00

EXPENSE RATE STRUCTURE

Mileage	$0.58 per mile
Copies	$0.20 each
Blue Prints	$6.00 each
Computer Aided Design & Drafting	$100.00 per hour
Other Expenses (Outside Consultants, Phone, etc. if approved)	plus 10% of cost

ATTACHMENT C

TERMS GOVERNING THE OPERATION OF THE CONTRACT

C-1. **Indemnification**. Contractor shall indemnify, defend and save harmless Client and Client's officers, agents and employees, from and against any and all claims and losses whatsoever arising out of Contractor's performance under this contract, including but not limited to, claims for property damage, personal injury, death and any legal expenses (such as attorney fees, court costs, investigation costs, and experts' fees) incurred by Client in connection with such claims, provided, however, that Contractor's duty to indemnify and hold harmless shall not include any claims or liability arising from the gross negligence or willful misconduct of the Client. Contractor's "performance" includes its action or inaction and the action or inaction of Contractor's officers, employees, agents, and subcontracts.

C-2. **General Insurance Requirements**. Without limiting Contractor's duty to indemnify, Contractor shall comply with the insurance requirements hereinafter set forth in the following paragraph. Insurance shall meet the following requirements.

a. Each policy shall be with a company authorized by law to transact insurance business in the State of California.

b. Each policy shall provide that Client shall be given notice in writing at least thirty (30) days in advance of cancellation thereof.

c. The motor vehicle and comprehensive general liability policies shall each provide an endorsement naming the Client. and its officers, agents and employees as additional insureds.

d. The required coverages shall be maintained in effect throughout the term of this agreement.

C-3. **Insurance Coverage Requirements**. Contractor shall maintain the following insurance policies:

d. Comprehensive General Liability Insurance. Contractor shall maintain comprehensive general liability insurance, covering all of Contractor's operations with a combined limit of two million dollars ($2,000,000.00) and not less than one million dollars ($1,000,000.00) per occurrence.

e. Motor Vehicle Insurance. Contractor shall maintain insurance covering all motor vehicles (including owned and non-owned) used in providing services under this agreement, with a combined single limit of not less than $300,000.00) per occurrence.

f. Workers Compensation Insurance. Contractor shall maintain a workers' compensation plan covering all of its employees as required by Labor Code Section 3700, through workers' compensation insurance issued by an insurance company.

C-4. Certificate of Insurance. Within 45 days of the execution of this agreement by the Client, if requested by the Client, Contractor shall file certificates of insurance with Client, showing that Contractor has in effect the insurance required by this contract. Contractor shall file a new or amended certificate promptly after any change is made in any insurance policy which would alter the information of the certificate then on file.

C-5. Records to be Maintained. The Contractor shall keep and maintain accurate records of all testing, as well as all costs incurred and all time expended for work under this contract, and Contractor will require that all subcontractors performing work called for under this contract also keep and maintain such records. All such records, whether kept by the Contractor or any subcontractor, shall be made available to the Client or its authorized representative for review during normal business hours, upon reasonable advance notice given by the Client.

C-6. Independent Contractor. Contractor and its officers, employees, and agents, in the performance of this agreement, are independent contractors in relation to Client, and not officers or employees of Client. Nothing in this agreement shall create any of the rights, powers, privileges or immunities of any employee of the Client. Contractor shall be solely liable for all applicable taxes, including, but not limited to, Federal and State income taxes and Social Security taxes, arising out of the performance of this agreement.

C-7. Prohibition Against Assignment and Subcontracting. Except as specifically authorized herein, no rights under this agreement may be assigned and no duties may be delegated or subcontracted by Contractor without the written consent of the Client, and any attempted assignment, subcontracting or delegation without such consent shall be void.

C-8. Compliance with Applicable Laws. Contractor at Contractor's sole expense shall comply with all applicable Federal, State and local laws and regulations in performing the work and providing the services specified in this agreement.

C-9. Negotiated Agreement. This agreement has been arrived at through negotiation between the parties. Neither party is to be deemed the party which prepared this agreement within the meaning of Civil Code Section 1654.

C-10. Severability. Should any provision herein be found or deemed to be invalid, this agreement shall be construed as not containing such provision, and all other provisions which are otherwise lawful shall remain in full force and effect, and to this end the provisions of this agreement are declared to severable.

C-11. Entire Agreement. This agreement is the entire agreement of the parties. There are no understandings or agreements pertaining to this contract except as are expressly stated in writing in this agreement or in any document attached hereto or incorporated herein by reference.

C-12. Notice. Notices to the parties in connection with the agreement shall be given personally or by regular mail addressed as follows:

Client:

100 Wright Dr., Loma Mar CA 94021
Redwood Glen

Contractor:

Lloyd W. Bracewell
Bracewell Engineering,
Inc. 16465 Hill Road
Morgan Hill, CA 95037

Notices will be deemed given on the date they are personally delivered to the office of the persons indicated above, with a written notation that the notice is to be given to the person indicated above, or five (5) days after the date they are deposited in the U.S. mail, addressed as indicated above, with first-class postage fully prepaid.

C-13. Time is of the Essence. Time is of the essence in the performance of this agreement.

C-14. Termination of Contract. Either party may terminate agreement, with or without cause at any time upon giving thirty (30) days advance written notice to the other party. Such notice shall set forth the effective date of the termination. Notice shall be as specified in paragraph C-12.

CLIENT CONTACT INFORMATION

Emergency Contact

Name: Larry Rice

Phone: 650.504.2521

E-mail: exec@redwoodglen.com

Secondary Emergency Contact

Name: Andrew Gonsalves

Phone: 650.879.0320

E-mail: andrew@redwoodglen.com

Accounts Receivable

Name: Chad Plantenberg

Phone: 650.879.0320

E-mail: bookkeeper@redwoodglen.com

Address: 100 Wright Dr.

Loma Mar CA 94021

Table 1

Budget Proposal for Operations, Monitoring, and Reporting Services Contract
June 1, 2017 to May 31, 2018
Redwood Glen Water System
Loma Mar, CA

Task	Description	Quantity	Unit	Unit Cost	Cost	Total Cost
	BASIC OPERATIONS & MONITORING SERVICES					
1	**Routine O&M**					
	Operator III	24	Hr	$ 70	$ 1,680	
	Operator II	26	Hr	$ 65	$ 1,690	
	Operator	78	Hr	$ 62	$ 4,836	
	Maintenance I	12	Ea	$ 60	$ 720	
	Subtotal					$ 8,926
2	**Preparation of Monthly DDW Reports**					
	Operator	52	Hr	$ 62	$ 3,224	
	Subtotal					$ 3,224
3	**Preparation of Annual DDW Reports & Post CCR**					
	Annual DDW Small Water System Report	5	Hr	$ 62	$ 310	
	Annual Consumer Confidence Report	6	Hr	$ 62	$ 372	
	Subtotal					$ 682
4	**Management**					
	Principal Engineer	5	Hr	$ 180	$ 900	
	Operations Manager	24	Hr	$ 75	$ 1,800	
	Subtotal					$ 2,700
6	**On-Call Operator for Emergency Response**					
	Operator	12	Hr	$ 62	$ 744	
	Subtotal					$ 744
6	**Expenses**					
	Safety	1	Ls	$ 50	$ 50	
	Automobile	4160	Mi	$ 0.58	$ 2,413	
	Laboratory Certification Fee	1	Ls	$ 234	$ 234	
	Health & Workers Comp Insurance Surcharge	1	Ls	$ 1,259	$ 1,259	
	Subtotal					$ 3,956
7	**Scheduled DDW Source Monitoring - Hoffman & Piney Creeks**					
	Sampling Preparation and Sample Collection	45	Ea	$ 62	$ 2,790	
	Total Coliform (Multiple Tube)	24	Ea	$ 50	$ 1,200	
	Nitrate	8	Ea	$ 25	$ 200	
	Nitrite	2	Ea	$ 25	$ 50	
	Total Organic Carbon (TOC)	24	Ea	$ 43	$ 1,032	
	Manganese	4	Ea	$ 19	$ 76	
	Iron	4	Mo	$ 19	$ 76	
	General Mineral & General Physical	2	Ea	$ 188	$ 376	
	Inorganics - 200.7	2	Ea	$ 82	$ 164	
	Inorganics - 200.8	2	Ea	$ 82	$ 164	
	Cyanide	2	Ea	$ 32	$ 64	
	Perchlorate	4	Ea	$ 48	$ 192	
	Chromium, Hexavalent	2	Ea	$ 44	$ 88	
	Asbestos	2	Ea	$ 192	$ 384	
	1,2,3-Trichloropropane (TCP) - EPA 524.2 M	4	Ea	$ 108	$ 432	
	MTBE	0	Ea	$ 78	$ -	
	Volatile Organic Chemicals (VOC)	8	Ea	$ 108	$ 864	
	Synthetic Organic Chemicals - EPA 504.1	2	Ea	$ 96	$ 192	
	Synthetic Organic Chemicals - EPA 507	2	Ea	$ 132	$ 264	
	Synthetic Organic Chemicals - EPA 508	2	Ea	$ 132	$ 264	
	Synthetic Organic Chemicals - EPA 515.1	2	Ea	$ 132	$ 264	
	Synthetic Organic Chemicals - EPA 525.2	2	Ea	$ 132	$ 264	
	Synthetic Organic Chemicals - EPA 531.1	2	Ea	$ 132	$ 264	
	Synthetic Organic Chemicals - EPA 547	2	Ea	$ 120	$ 240	
	Synthetic Organic Chemicals - EPA 548.1	2	Ea	$ 120	$ 240	
	Synthetic Organic Chemicals - EPA 549.2	2	Ea	$ 120	$ 240	
	Synthetic Organic Chemicals - EPA 1613	2	Ea	$ 360	$ 720	
	Gross Alpha	8	Ea	$ 72	$ 576	
	Uranium	2	Ea	$ 19	$ 38	
	Radium 226	2	Ea	$ 126	$ 252	
	Radium 228	8	Ea	$ 138	$ 1,104	
	Subtotal					$ 13,074

Table 1
Budget Proposal for Operations, Monitoring, and Reporting Services Contract
June 1, 2017 to May 31, 2018
Redwood Glen Water System
Loma Mar, CA

Task	Description	Quantity	Unit	Unit Cost	Cost	Total Cost
	SUBTOTAL OPERATIONS & MONITORING SERVICES:					**$ 33,306**
	TREATMENT SYSTEM OPERATIONS & MAINTENANCE					
1	**Routine Surface Water Treatment System O&M**					
	Operator III	156	Hr	$ 70	$ 10,920	
	Operator II	208	Hr	$ 65	$ 13,520	
	Operator	208	Hr	$ 62	$ 12,896	
	Maintenance I	52	Ea	$ 60	$ 3,120	
	Sampling Preparation and Sample Collection	15	Ea	$ 62	$ 930	
	Sodium Hypochlorite	156	gal	$ 2	$ 314	
	Polymer	144	lbs	$ 2	$ 317	
	Analyzer calibration	4	Ea	$ 124	$ 496	
	Total Organic Carbon (TOC)	24	Ea	$ 43	$ 1,032	
	Alkalinity	24	Ea	$ 31	$ 744	
	Subtotal					$ 44,289
2	**Routine Manganese & Iron Treatment System O&M**					
	Operator III	0	Hr	$ 70	$ -	
	Operator II	65	Hr	$ 65	$ 4,225	
	Operator	44	Hr	$ 62	$ 2,728	
	Maintenance I	52	Ea	$ 60	$ 3,120	
	Sampling Preparation and Sample Collection	9	Hr	$ 62	$ 558	
	Sodium Hypochlorite	13	Gal	$ 2	$ 26	
	Analyzer calibration	4	Ea	$ 124	$ 496	
	Manganese - Field	12	Ea	$ 16	$ 192	
	Manganese	12	Ea	$ 19	$ 228	
	Subtotal					$ 11,573
	SUBTOTAL TREATMENT SYSTEM OPERATIONS & MAINTNENANCE:					**$ 55,863**
	DISTRIBUTION SYSTEM OPERATION, MONITORING & MAINTENANCE					
1	**Routine DDW Distribution Monitoring**					
	Sampling Preparation and Sample Collection	27	Hr	$ 62	$ 1,674	
	Total Coliform (Multiple Tube)	0	Mo	$ 50	$ -	
	Total Coliform (P-A)	52	Mo	$ 40	$ 2,080	
	Manganese	12	Ea	$ 19	$ 228	
	Iron	12	Ea	$ 19	$ 228	
	Trihalomethanes & Haloacetic Acids	4	Ea	$ 141	$ 564	
	Subtotal					$ 4,774
2	**Distribution System Lead & Copper Monitoring**					
	Sampling Preparation and Sample Collection	16	Hr	$ 62	$ 992	
	Lead & Copper	10	Ea	$ 38	$ 380	
	Lead & Copper Evaluation & Reports to DDW	2	Hr	$ 75	$ 150	
	Subtotal					$ 1,522
3	**Distribution System Flushing and Valve Exercising - Annual**					
	Operator	12	Hr	$ 62	$ 744	
	Distribution System Flushing and Valve Exercising	32	Hr	$ 60	$ 1,920	
	Subtotal					$ 2,664
3	**Backflow Valve Certification**					
	Backflow Valve Testing & Certification	4	Valve	$ 55	$ 220	
	Prepare Backflow Report for DDW	1	Hr	$ 75	$ 75	
	Subtotal					$ 295
	SUBTOTAL DISTRIBUTION SYSTEM OPERATIONS, MONITORING & MAINENANCE:					**$ 9,255**
	BASIC OPERATIONS & MONITORING SERVICES					**$ 33,306**
	TREATMENT SYSTEM OPERATIONS & MAINTENANCE					**$ 55,863**
	DISTRIBUTION SYSTEM OPERATION, MONITORING & MAINTENANCE					**$ 9,255**
	TOTAL OPERATIONS & MAINTENANCE ANNUAL FEE:					**$ 98,424**
	MONTHLY SERVICE FEE:					**$ 8,202**

State of California

State Water Resources Control Board

IN ACCORDANCE WITH DIVISION 104, PART 1, CHAPTER 4, ARTICLE 3
OF THE HEALTH AND SAFETY CODE

Christopher T. Hauge

IS AUTHORIZED TO OPERATE OR SUPERVISE THE OPERATION OF A WATER TREATMENT FACILITY
FOR PRODUCTION OF WATER FOR DOMESTIC USE AND IS HEREBY GRANTED THIS CERTIFICATE FOR

Water Treatment Operator

Grade T3

Operator Number: 30792

Issued
December 2014

Felicia Marcus
Chairman

State of California

State Water Resources Control Board

IN ACCORDANCE WITH DIVISION 104, PART 1, CHAPTER 4, ARTICLE 3
OF THE HEALTH AND SAFETY CODE

Christopher T. Hauge

IS AUTHORIZED TO OPERATE OR SUPERVISE THE OPERATION OF A WATER DISTRIBUTION SYSTEM
AND IS HEREBY GRANTED THIS CERTIFICATE FOR

Water Distribution Operator

Grade D3

Operator Number: 36120

Issued
November 2014

Felicia Marcus
Chairman

STATE WATER RESOURCES CONTROL BOARD
EUREKA
CALIFORNIA

State of California
Department of Public Health

IN ACCORDANCE WITH DIVISION 104, PART 1, CHAPTER 4, ARTICLE 3
OF THE HEALTH AND SAFETY CODE

Robert J. Campos

IS AUTHORIZED TO OPERATE OR SUPERVISE THE OPERATION OF A WATER TREATMENT FACILITY
FOR PRODUCTION OF WATER FOR DOMESTIC USE AND IS HEREBY GRANTED THIS CERTIFICATE FOR

Water Treatment Operator
Grade T2

Operator Number: 31723

Issued
October 2013

Leah J Walker
STATE OF CALIFORNIA, DEPARTMENT OF PUBLIC HEALTH

OSP 11 122958

State of California
Department of Public Health

IN ACCORDANCE WITH DIVISION 104, PART 1, CHAPTER 4, ARTICLE 3
OF THE HEALTH AND SAFETY CODE

Robert J. Campos

IS AUTHORIZED TO OPERATE OR SUPERVISE THE OPERATION OF A WATER DISTRIBUTION SYSTEM
AND IS HEREBY GRANTED THIS CERTIFICATE FOR

Water Distribution Operator
Grade D2

Operator Number: 41317

Issued:
June 2012

Leah J Walker

STATE OF CALIFORNIA DEPARTMENT OF PUBLIC HEALTH

THE GREAT SEAL OF THE STATE OF CALIFORNIA

OSP 11 122957

State of California
State Water Resources Control Board

IN ACCORDANCE WITH DIVISION 104, PART 1, CHAPTER 4, ARTICLE 3
OF THE HEALTH AND SAFETY CODE

Kenneth J. Staal

IS AUTHORIZED TO OPERATE OR SUPERVISE THE OPERATION OF A WATER TREATMENT FACILITY
FOR PRODUCTION OF WATER FOR DOMESTIC USE AND IS HEREBY GRANTED THIS CERTIFICATE FOR

Water Treatment Operator

Grade T2

Operator Number: 36901

Issued
January 2015

Felicia Marcus
Chairman

STATE WATER RESOURCES CONTROL BOARD
EUREKA
CALIFORNIA

State of California
Department of Public Health

IN ACCORDANCE WITH DIVISION 104, PART 1, CHAPTER 4, ARTICLE 3
OF THE HEALTH AND SAFETY CODE

Kenneth J. Staal

IS AUTHORIZED TO OPERATE OR SUPERVISE THE OPERATION OF A WATER DISTRIBUTION SYSTEM
AND IS HEREBY GRANTED THIS CERTIFICATE FOR

Water Distribution Operator

Grade D1

Operator Number: 43860

Issued:
May 2014

STATE OF CALIFORNIA DEPARTMENT OF PUBLIC HEALTH

State of California
Department of Public Health

IN ACCORDANCE WITH DIVISION 104, PART 1, CHAPTER 4, ARTICLE 3
OF THE HEALTH AND SAFETY CODE

Joshua P. Ebert

IS AUTHORIZED TO OPERATE OR SUPERVISE THE OPERATION OF A WATER TREATMENT FACILITY
FOR PRODUCTION OF WATER FOR DOMESTIC USE AND IS HEREBY GRANTED THIS CERTIFICATE FOR

Water Treatment Operator
Grade T1

Operator Number: 31825

Issued
April 2010

Gary H Yamamoto

STATE OF CALIFORNIA, DEPARTMENT OF PUBLIC HEALTH

State of California
Department of Public Health

IN ACCORDANCE WITH DIVISION 104, PART 1, CHAPTER 4, ARTICLE 3
OF THE HEALTH AND SAFETY CODE

Joshua P. Ebert

IS AUTHORIZED TO OPERATE OR SUPERVISE THE OPERATION OF A WATER DISTRIBUTION SYSTEM
AND IS HEREBY GRANTED THIS CERTIFICATE FOR

Water Distribution Operator
Grade D2

Operator Number: 44046

Issued:
June 2014

STATE OF CALIFORNIA DEPARTMENT OF PUBLIC HEALTH

ATTACHMENT 4

Source Capacity

ATTACHMENT 4A

SWRCB Letter: Adequacy of Supply
Redwood Glen Camp and Conference Center
Water System No. 4100522, 01/06/2017

CALIFORNIA
Water Boards

EDMUND G. BROWN JR.
GOVERNOR

MATTHEW RODRIQUEZ
SECRETARY FOR
ENVIRONMENTAL PROTECTION

State Water Resources Control Board
Division of Drinking Water

January 6, 2017

Mr. Larry Rice
Redwood Glen Camp and Conference Center
100 Wright Drive
Loma Mar, CA 94021

ADEQUACY OF SUPPLY
Redwood Glen Camp and Conference Center, Water System No. 4100522

Dear Mr. Rice:

This letter is in response to the Water System Supply Alternative Analysis Addendum: Recommended Alternative Design (Report) submitted by SRT Consultants on December 20, 2016 on behalf of Redwood Glen Camp and Conference Center (Center). The Report concluded that developing two existing surface water sources would provide sufficient supply to meet demand for the Center.

While the Division is concerned that solely relying on the two existing surface water sources may only provide a marginal supply that may at times be questionable in the ability to meet demand; the Division finds that the Center has provided sufficient information to justify proceeding with the project provided that the Center continues to collect water supply and demand information and work towards developing additional sources of water.

If you have any questions concerning this letter, please contact Ms. Karen Nishimoto at (510) 620-3461.

Sincerely,

Eric Lacy, P.E.
District Engineer, Santa Clara District
Division of Drinking Water
State Water Resources Control Board

cc: San Mateo County Environmental Health Department (via email to Greg Smith)

ATTACHMENT 4B

Memorandum: Streamflow Measurements and
Source Capacity Estimates, Piney Creek and Hoffman Creek

Memorandum

To: Lisa Pezzino and Mark Quady, SRT Consultants

From: Mark Woyshner and Jonathan Owens

Date: December 17, 2016

Subject: Streamflow measurements and source capacity estimates at Redwood Glen, San Mateo County, CA.

Purpose

Redwood Glen, located at 100 Wright Way, Loma Mar, CA 94021, requires a new water-system permit. Redwood Glen holds riparian water rights to Hoffman Creek and appropriative rights to Piney Creek (also known as Pioneer Creek in some documents) and intends to divert flow from the creeks as source water for the water system.[1] The source capacity of a surface water supply (or a spring) to a public water system shall be the lowest anticipated daily yield based on adequately supported and documented data [Waterworks Standards Section 64554(k)]. This memo presents baseflow measurements during water years 2015 and 2016 and source capacity estimates for the existing point of diversions (PODs) on Hoffman Creek and Piney Creek. Hoffman and Piney Creeks both flow to Pescadero Creek.

Baseflow measurements

On October 12, 2015, Redwood Glen staff measured a flow of 3 gallons per minute (gpm) in Hoffman Creek at Wright Way, and a flow of 4 gpm in Piney Creek at the Old Haul Road (**Figure 1**). Flow was measured with a bucket and stopwatch at the outflow of the road culvert. These late dry-season baseflow measurements were taken during a fourth consecutive dry year, when the annual mean flow at the USGS gage on Pescadero Creek was 41 percent of the mean for the period of record (**Appendix A**). In terms of flow exceedance, the 50-percent exceedance of the annual runoff during water year 2015 (4.90 inches) was 56 percent of the 50-percent exceedance for the

[1] On Piney Creek, two PODs are identified in the License for Diversion and Use of Water, application 24192, permit 16745, license 11116: (a) POD #1 (aka upper POD) is south 2,500 feet and east 200 feet from NW corner of Section 2, T8S, R4W, being within SW1/4 of NW1/4 of said section 2; and (b) POD #2 (aka lower POD) is south 2,000 feet and east 350 feet from NW corner of Section 2, T8S, R4W, being within SW1/4 of NW1/4 of said section 2.

period of record (6.80 inches). The USGS data show that during the 2015 dry-season recession, flow in Pescadero Creek fluctuated within the 10^{th} and 25^{th} percentile of its 65-year record, and on October 12, 2015, flow in Pescadero Creek was less than the 10^{th} percentile (**Figure 2**).[2]

Redwood Glen staff continued to measure flow in Hoffman Creek at Wright Way and in Piney Creek at Old Haul Road during the dry-season recession of 2016. Periodic measurements of flow were also measured by Balance Hydrologics at these two locations and at the upstream PODs, using USGS bucket-wheel current-meter methods (c.f., Rantz and others, 1982) and/or the bucket-and-stopwatch method. The measurement locations are identified in **Figure 1** and **Table 1**, and the flow measurements are shown in **Table 2**. We also measured the specific conductance and temperature of the water in the creeks at these sites (**Table 3**).[3]

The annual mean flow for water year 2016 was 92 percent of the mean for the period of record at the USGS Pescadero Creek station. The 50-percent exceedance of the annual runoff during water year 2016 (6.00 inches) was 88 percent of the 50-percent exceedance for the period of record (6.80 inches), indicating below normal runoff conditions. The baseflow recession ranged from the 50th percentile at the onset of the dry-season to the 25th percentile by the end of the season. Groundwater is the source of baseflow in Hoffman and Piney Creeks, and though water year 2016 was near normal, it did follow four consecutive dry years. In general, normal rainfall provides limited recovery to the depletion of groundwater storage from a multi-year drought.

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[2] U.S. Geological Survey gaging station no. 11162500, Pescadero Creek near Pescadero, CA. LOCATION - Lat 37°15'39", long 122°19'40" referenced to North American Datum of 1927, in SW 1/4 sec.05, T.8 S., R.4 W., San Mateo County, CA, Hydrologic Unit 18050006, on left bank, at downstream side of highway bridge, 3.0 mi east of Pescadero, and 5.3 mi upstream from mouth. DRAINAGE AREA - 45.9 mi^2. PERIOD OF RECORD - April 1951 to current year.

[3] Specific conductance (SC) measures the ability of the water to conduct electricity and is a widely used index for salinity or total dissolved solids (TDS). Rainwater has very low specific conductance (nearly zero), and as water passes over and through the ground, salts are dissolved, thereby increasing the specific conductance. Higher specific conductance indicates transmittal through salt-bearing geologic formations or longer residence times in the ground.

Estimates of mean daily discharge

To estimate the mean daily flow at the existing POD locations, we correlated the baseflow measurements[4] and drainage areas to the daily mean flows at two gaging stations: (a) Pescadero Creek near Pescadero, CA (USGS station no. 11162500; and (b) Gazos Creek above Hwy 1 (a Balance Hydrologics station).[5] The baseflow correlations were based on measurements at the road crossing and then shifted slight to match fewer measurements at the PODs. Higher flows were proportioned to drainage area. Correlations are shown in **Table 4** and **Figures 3, 4, and 5**. Based on these correlations, we developed monthly estimates of mean daily flow for water years 2015 and 2016 (**Table 5 and Figure 6**). We consider these results appropriate estimates of source capacity for surface water supply.

We also estimated the monthly mean daily flows for the period of record at the USGS Pescadero Creek station. We compare the water-year estimates with period-of-record estimates in **Table 5** and **Figure 7**. Given that rainfall and runoff totals during water years 2015 and 2016 were below normal, the estimated dry-season baseflows are shown to be lower than the monthly means for the period of record. Runoff related to the December 11, 2014 storm and the March 6th and 13th, 2016 storms, however, were significantly large, and the related mean daily flow for December 2014 and March 2016 were above normal. The runoff estimate for January 2016 was near normal, while other months were below normal.

Limitations

Balance Hydrologics prepared this memo for the client's exclusive use on this particular project. It was prepared in general accordance with the accepted standard of

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[4] Correlations to daily mean flows were appropriate primarily because no rain occurred during the dry-season baseflow measurement period.

[5] Located approximately one-half mile upstream from Highway 1 and about one-quarter mile upstream of the pump-station diversion, the Gazos Creek station has significantly higher baseflows than streams of generally-similar size in the region (Owens and others, 2002). Much of the drainage basin has developed in flat-lying or gently-dipping fractured mudstones of the Santa Cruz formation (Brabb and others, 2000), which affects not only its infiltration and summer-flow attributes, but also the stability of its bed and banks, water quality, and resilience to wildfires and other watershed-scale disturbances (Hecht and Rusmore, 1973). The period of record for the Gazos Creek station is from water year 2001 through 2016.

practice existing in Northern California at the time the investigation was performed. No other warranties, expressed or implied, are made. It is based in part on information obtained from property plans and well drillers reports, including a level survey of portions of the property and personal communication with the client regarding subsurface conditions below the property. The methods used relied upon flow measurements performed by the client and reference values commonly used in the area or developed by sources generally held to be reliable. Hydrologic results are considered provisional and subject to revision. Findings and recommendations in this memo are based on the assumption that an appropriate and adequate follow-up program will be conducted, and that Balance will be retained at key stages in the project to revise the findings described in this memo as warranted.

References Cited

Hecht, B., and Rusmore, B., eds., 1973, Waddell Creek -- the environment around Big Basin: Sempervirens Fund and the University of California, Santa Cruz, 98 p. + appendix

Brabb, E.E, Graymer, R.W., and Jones, D.L., 2000, Geologic map and map database of the Palo Alto 30′ X 60′ quadrangle, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-2332

Owens, J., Shaw, D., and Hecht, B., 2003, Annual hydrologic record and sediment yield for Gasos Creek above Highway 1, San Mateo County, California: Balance Hydrologics report prepared for the Coastal Watershed Council, funding provided by California Department of Fish and Wildlife, April 2003, 10 p. + tables, figures, and annual summary forms.

Rantz, S.E., and others, 1982, Measurement and computation of streamflow: U. S. Geological Survey Water-Supply Paper 2175, volume 1, p. 1-284, volume 2, p. 285-631.

Attachments

Table 1. Flow measurement sites and nearby gaging stations, Redwood Glen, San Mateo County, CA
Table 2. Streamflow measurements in Hoffman and Piney Creeks, Redwood Glen, San Mateo County, CA
Table 3. Specific conductance and temperature measurements in Hoffman, Piney, and Pescadero Creeks, Redwood Glen, San Mateo County, CA
Table 4. Streamflow correlation equations for Hoffman and Piney Creeks, Redwood Glen, San Mateo County, CA
Table 5. Monthly mean daily discharge estimates for Hoffman and Piney Creeks during water years 2015 and 2016 and for the Pescadero Creek period of record, Redwood Glen, San Mateo County, CA.
Figure 1. Streamflow measurement locations at Redwood Glen, San Mateo County, CA
Figure 2. Baseflow recession in Pescadero Creek, water years 2015 and 2016, San Mateo County, CA
Figure 3. Flow correlations for Piney Creek at lower point of diversion, Redwood Glen, San Mateo County, CA
Figure 4. Flow correlations for Hoffman Creek at upper point of diversion, Redwood Glen, San Mateo County, CA

TABLES

Table 1. Flow measurement sites and nearby gaging stations, Redwood Glen, San Mateo County, CA

Measurement Site	Latitude (WGS84)	Longitude (WGS84)	Drainage area (acres)	(square miles)
Piney Cr at upper POD	37° 15.9460' N	122° 16.6074' W	11.6	0.0182
Piney Cr at lower POD	37° 16.0312' N	122° 16.5767' W	19.7	0.0308
Piney Cr at Haul Rd	37° 16.2378' N	122° 16.5492' W	53.5	0.0835
Hoffman Cr at upper POD "Sink"	37° 15.9452' N	122° 17.0462' W	121	0.189
Hoffman Cr at lower POD	37° 16.0795' N	122° 17.1124' W	154	0.240
Hoffman Cr at Wright Way	37° 16.2378' N	122° 16.5492' W	182	0.285
Gazos Cr above Hwy 1 [1]	37° 10.2833' N	122° 21.3000' W	7,232	11.3
Pescadero Cr near Pescadero, CA [2]	37° 15.6394' N	122° 19.7267' W	29,376	45.9

Notes:

[1] Balance Hydrologics gaging station.

[2] USGS gaging station no. 11162500.

Table 2. Streamflow measurements in Hoffman and Piney Creeks, Redwood Glen, San Mateo County, CA.

Date	Hoffman Cr at "Sink" diversion		Hoffman Cr at shared diversion		Hoffman Cr at Wright Way		Piney Cr upper bowl of lower POD		Piney Cr lower bowl of lower POD		Piney Cr lower POD (composite)		Piney Cr at Haul Rd	
	gpm	cfs	gpm	cfs	gpm	cfs	gpm	cfs	gpm	cfs	gpm	cfs	gpm	cfs
10/12/2015	--	--	--	--	3.0	0.0067	--	--	--	--	--	--	4.0	0.0089
4/14/2016	29	0.065	--	--	36	0.080	--	--	--	--	--	--	22	0.049
5/2/2016	--	--	--	--	41	0.091	--	--	--	--	--	--	12	0.027
5/15/2016	--	--	--	--	26	0.058	--	--	--	--	--	--	14	0.031
5/31/2016	--	--	--	--	25	0.056	--	--	--	--	--	--	10	0.022
6/2/2016	--	--	23	0.051	--	--	--	--	--	--	5.8	0.013	9.6	0.021
6/11/2016	--	--	--	--	14	0.031	--	--	--	--	--	--	8.0	0.018
7/1/2016	6.8	0.015	9.3	0.021	6.8	0.015	--	--	--	--	--	--	7.4	0.016
7/7/2016	--	--	--	--	7.4	0.016	--	--	--	--	--	--	7.2	0.016
7/14/2016	--	--	--	--	6.4	0.014	--	--	--	--	--	--	6.9	0.015
7/21/2016	--	--	--	--	6.7	0.015	--	--	--	--	--	--	7.4	0.016
8/5/2016	--	--	--	--	5.5	0.012	--	--	--	--	--	--	6.9	0.015
8/11/2016	--	--	--	--	3.9	0.0087	--	--	--	--	--	--	6.1	0.013
8/22/2016	--	--	--	--	4.2	0.0093	--	--	--	--	--	--	6.2	0.014
8/29/2016	--	--	--	--	4.4	0.0098	--	--	--	--	--	--	6.2	0.014
9/8/2016	--	--	--	--	2.9	0.0065	--	--	--	--	--	--	5.1	0.011
9/29/2016	--	--	--	--	2.9	0.0065	--	--	--	--	--	--	5.0	0.011
10/11/2016	--	--	--	--	--	--	1.5	0.0033	2.6	0.0058	4.1	0.0091	5.1	0.011
10/13/2016	3.5	0.0078	4.0	0.0089	2.9	0.0065	--	--	--	--	--	--	--	--
10/17/2016	--	--	--	--	22	0.050	--	--	--	--	--	--	13	0.028
11/8/2016	--	--	--	--	8.6	0.019	--	--	--	--	--	--	8.0	0.018
11/19/2016	--	--	--	--	--	--	1.5	0.0033	2.5	0.0055	4.0	0.0088	--	--
12/5/2016	--	--	--	--	15.9	0.035	--	--	--	--	--	--	9.4	0.021

Notes:

1. Flow measurements were more frequently made at the easily accessible culvert outflow sites of Hoffman Cr at Wright Way and of Piney Cr at Haul Rd using a calibrated bucket and stopwatch, mainly by Redwood Glen water-system staff. At the PODs, flows were measured by a Balance Hydrologics hydrologist using either a current meter and open-channel flow method or a bucket and stopwatch where applicable. On these site visits by Balance, flows were also measured at the culvert sites.

Data provisional and subject to revision.

Table 3. Specific conductance and temperature measurements in Hoffman, Piney, and Pescadero Creeks, Redwood Glen, San Mateo County, CA.

Date	Hoffman Cr at "Sink" diversion		Hoffman Cr at shared diversion		Hoffman Cr at Wright Way		Piney Cr upper bowl of lower POD		Piney Cr lower bowl of lower POD		Piney Cr lower POD (composite)		Piney Cr at Haul Rd		Pescadero Creek at park diversion	
	uS/cm @ 25°C	°C	uS/cm @ 25°C	°C	uS/cm @ 25°C	°C	uS/cm @ 25°C	°C	uS/cm @ 25°C	°C	uS/cm @ 25°C	°C	uS/cm @ 25°C	°C	uS/cm @ 25°C	°C
4/14/2016	245	11.6	446	11.7	508	11.5	--	--	--	--	--	--	624	12	599	11.5
6/2/2016	500	14	669	14	785	14.5	--	--	--	--	--	--	809	14.5	778	18
7/1/2016	493	13.6	676	12.3	762	14.2	--	--	--	--	--	--	616	13.5	--	--
10/11/2016	--	--	--	--	--	--	710	12.8	676	13.2	--	--	695	13.2	--	--
10/13/2016	693	12.1	798	11.7	907	12.1	--	--	--	--	--	--	--	--	--	--
11/14/2016	--	--	--	--	--	--	681	12.2	789	12.3	743	12.6	--	--	--	--
11/18/2016	--	--	--	--	--	--	--	--	--	--	--	--	--	--	709	8
11/19/2016	--	--	--	--	--	--	684	10.2	778	12	--	--	--	--	--	--

Notes:

1. Measurements made with a YSI Pro30 specific conductance and temperature field meter.

Data provisional and subject to revision.

Table 4. Streamflow correlation equations for Hoffman and Piney Creeks, Redwood Glen, San Mateo County, CA.

Dependent variable (y)	Independent variable (x)	Polynomial coefficients				Coefficient of determination (r^2)
		ax^3	bx^2	cx	d	
Piney Cr @ lower POD (gpm)	Pescadero Cr near Pescadero, CA (cfs)	-5.60614306215903E-09	2.35285685507246E-05	2.7970205557545E-01	3.47913362880707	0.99999
	Gazos Cr above Hwy 1 (cfs)	-1.5375455711202E-07	1.81482196713601E-04	1.17214688573141	2.93825088578653	0.99999
Hoffman Cr @ upper POD (gpm)	Pescadero Cr near Pescadero, CA (above 2.6 cfs)	0	0	1.85026750816993	0	--
	Pescadero Cr near Pescadero, CA (below 2.6 cfs)	-6.482579967385E-03	1.93766303375248E-01	9.80944085570526E-01	1.35495620814324	0.96798
	Gazos Cr above Hwy 1 above 1.7941 (cfs)	0	0	7.51568837389381	0	--
	Gazos Cr above Hwy 1 below 1.7941 (cfs)	-9.55345646887025E-01	7.22982556216376	-3.88491033748857	2.69959298782699	0.96734
Hoffman Cr @ lower POD (gpm)	Pescadero Cr near Pescadero, CA (above 2.70425 cfs)	0	0	2.347593745915	0	--
	Pescadero Cr near Pescadero, CA (below 2.70425 cfs)	-6.482579967385E-03	1.93766303375248E-01	9.80944085570526E-01	2.40695620814324	0.96798
	Gazos Cr above Hwy 1 (above 2.436151 cfs)	0	0	9.5358011449115	0	--
	Gazos Cr above Hwy 1 (below 2.43615 cfs)	-9.55345646887025E-01	7.22982556216376	-3.88491033748857	3.59959298782699	0.96734

Notes:

1. Correlations of baseflow measurements and of drainage areas were developed using daily mean flows at Gazos Creek above Hwy 1 (a Balance Hydrologics station) and daily mean flows for Pescadero Creek near Pescadero, CA (USGS station no. 11162500). The baseflow correlations were based on more frequent measurements at the easily accessible road-crossing culvert sites and then shifted slight to match fewer measurements at the PODs. Higher flows were proportioned to drainage area. Correlations to daily mean flows were appropriate primarily because no rain occurred during the dry-season baseflow measurement period.

2. Values shown are coefficients "a", "b", "c", and "d" of a polynomial equation $y = ax^3 + bx^2 + cx + d$ where "x" is the flow in Pescadero Creek or Gazos Creek and "y" if the flow in Hoffman or Piney Creeks.

3. The coefficient of determination indicates the proportion of the variance in the dependent variable that is predictable from the independent variable.

Data provisional and subject to revision.

Table 5. Monthly mean daily discharge estimates for Hoffman and Piney Creeks during water years 2015 and 2016 and for the Pescadero Creek period of record, Redwood Glen, San Mateo County, CA.

	Hoffman Cr at lower POD shared diversion *(gpm)*	Hoffman Cr at upper POD "sink" diversion *(gpm)*	Piney Cr at lower POD 2,000 ft south and 350 ft east from NW corner of Section 2, T8S, R4W *(gpm)*
Mean flow ***(Correlation to Pescadero Cr period of record for water years 1951 - 2016)***			
October	11.6	9.23	4.86
November	26.3	20.7	6.62
December	134	106	19.6
January	253	200	33.9
February	289	227	38.2
March	225	178	30.5
April	127	100	18.7
May	42.6	33.5	8.56
June	20.5	16.2	5.92
July	11.7	9.26	4.88
August	7.94	6.26	4.43
September	6.24	5.04	4.21
Annual	95.3	75.1	14.9
Water Year 2015 ***(Average of correlations to Pescadero Cr and Gazos Cr)***			
October	3.24	2.27	3.58
November	7.22	5.75	4.19
December	334	263	44.6
January	39.0	30.7	7.97
February	117	92.1	17.5
March	27.9	22.0	6.61
April	20.2	16.1	5.69
May	13.1	11.2	4.93
June	7.90	6.81	4.38
July	4.86	3.88	3.95
August	3.61	2.63	3.69
September	3.30	2.32	3.55
Annual	48.3	38.2	9.20
Water Year 2016 ***(Average of correlations to Pescadero Cr and Gazos Cr)***			
October	3.26	2.28	3.53
November	8.14	6.79	4.36
December	60.2	47.7	10.6
January	282	222	37.8
February	65.2	51.4	11.1
March	517	407	67.4
April	60.6	47.8	10.6
May	28.4	22.4	6.66
June	13.5	11.4	5.03
July	7.98	6.69	4.40
August	5.42	4.44	4.05
September	4.35	3.37	3.86
Annual	88.8	70.1	14.2

Notes:

1. Water year estimates were based on correlations of baseflow measurements and of drainage areas to Gazos Creek above Hwy 1 (a Balance Hydrologics station) and to Pescadero Creek near Pescadero, CA (USGS station no. 11162500).

FIGURES

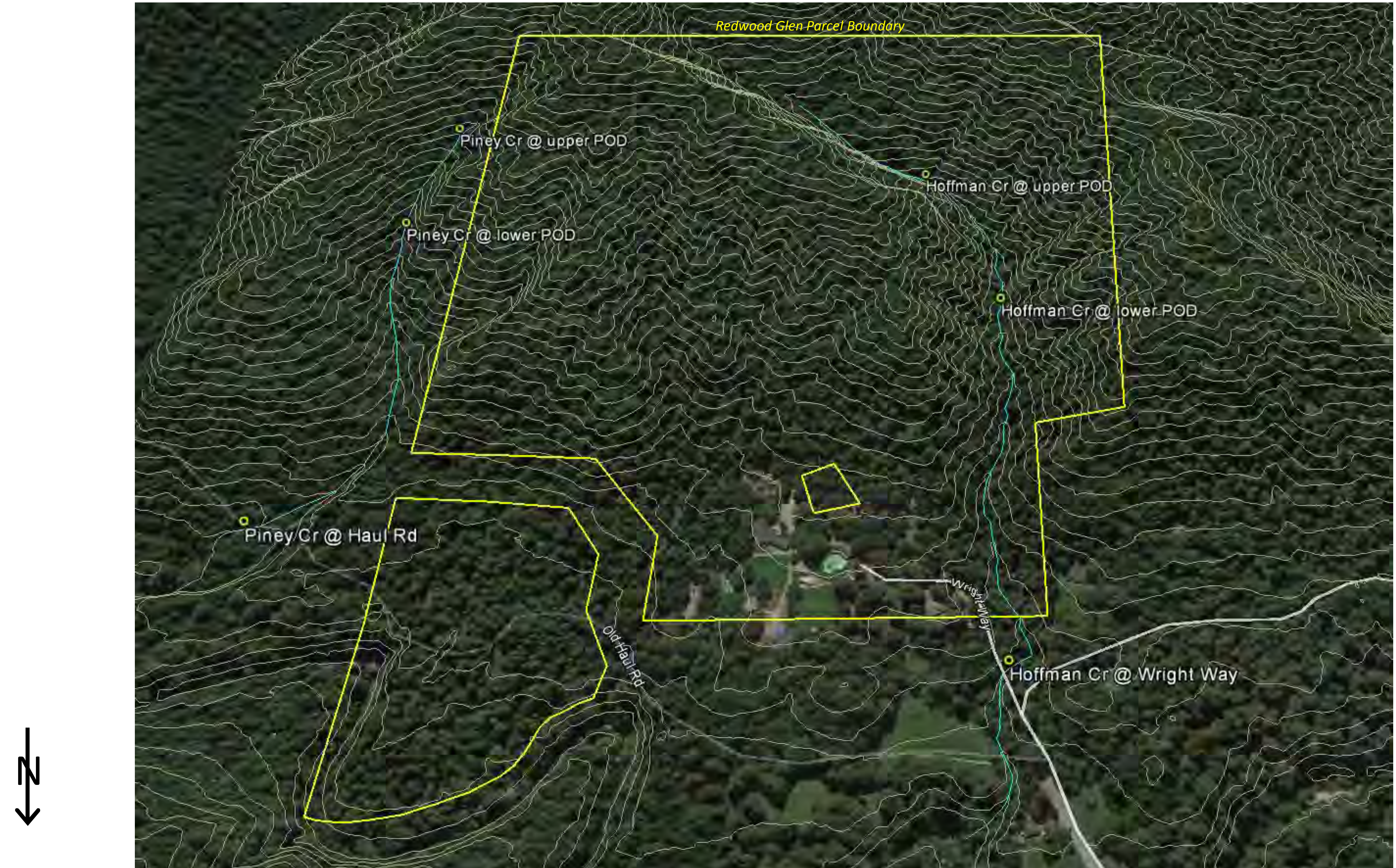

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Figure 1. Streamflow measurement locations at Redwood Glen, San Mateo County, CA.
Oblique photo source: Google Earth. 25-ft contour interval based on LIDAR data.

Data provisional and subject to revision.

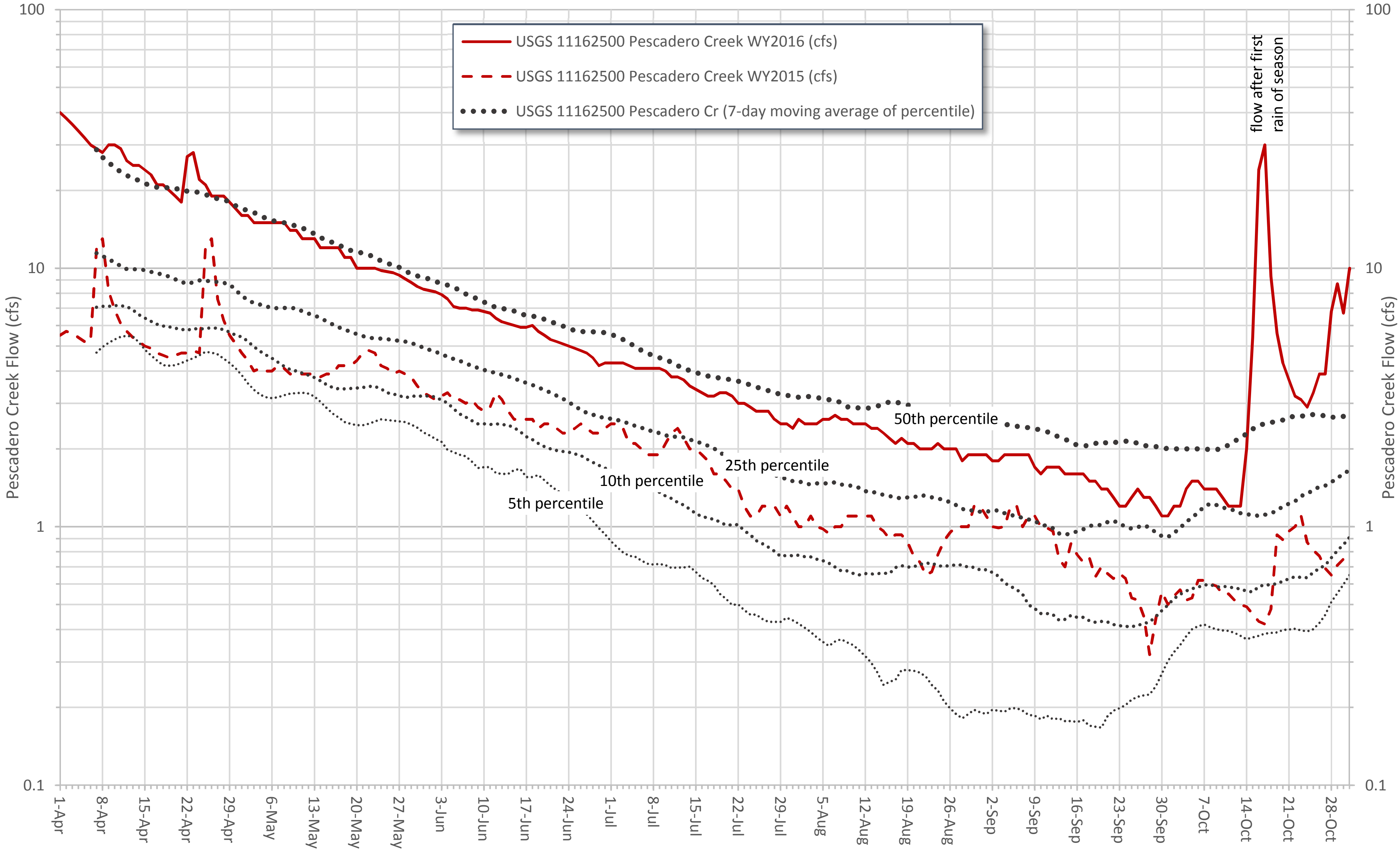

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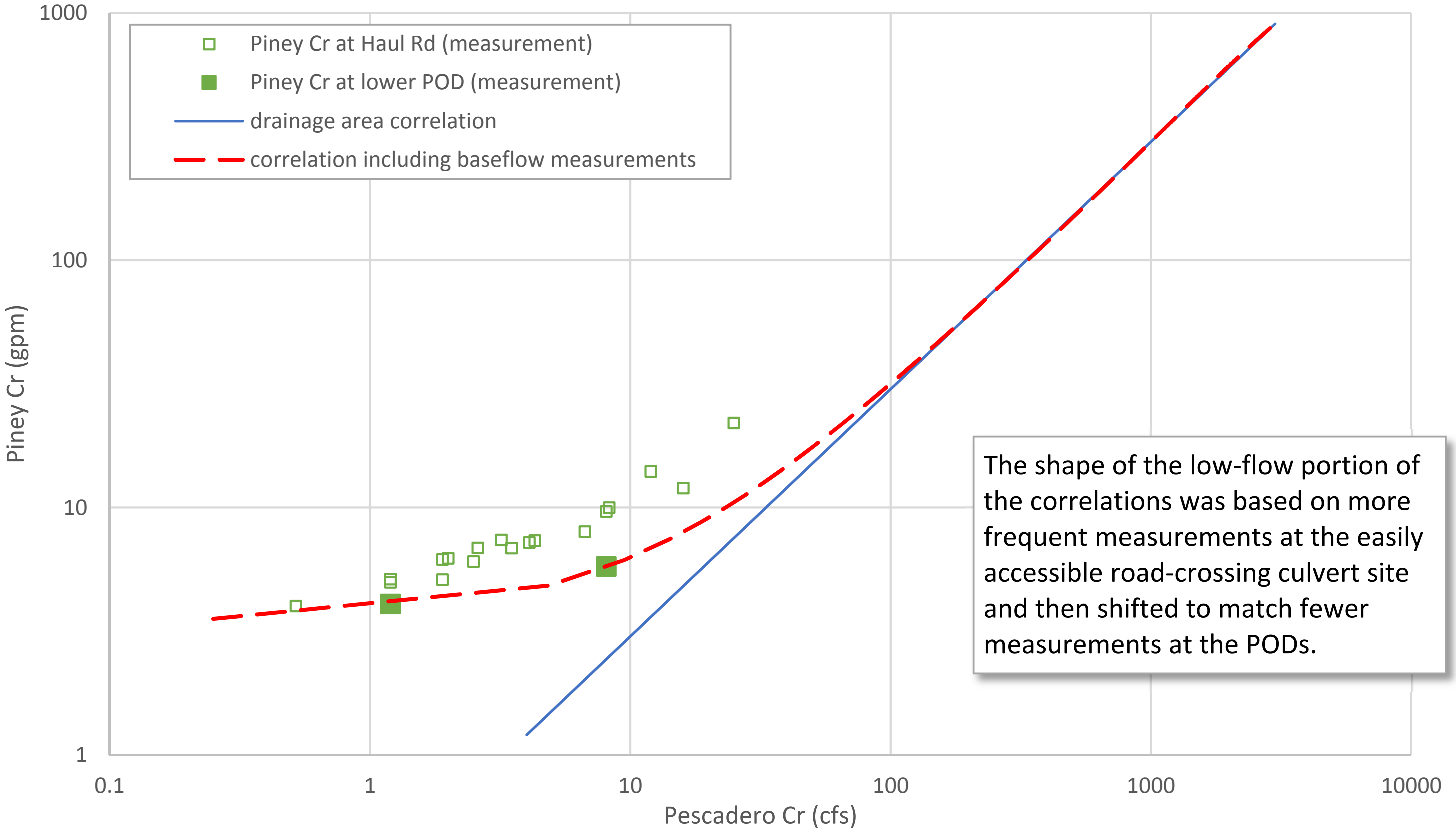
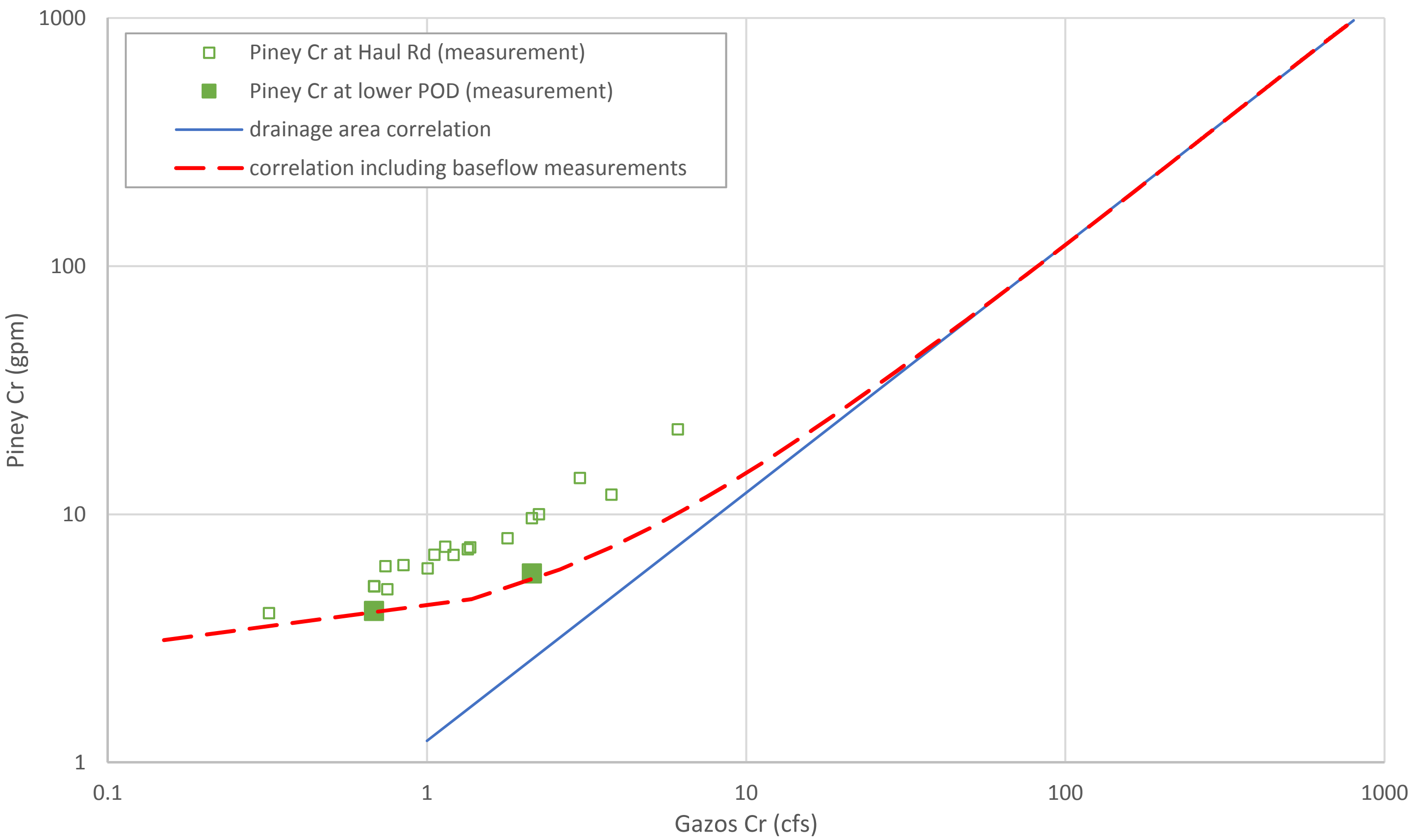
Figure 2. Baseflow recession in Pescadero Creek, water years 2015 and 2016, San Mateo County, CA. Flows in Pescadero Creek during dry-season 2015 fluctuated within the 10th and 25th percentile of the USGS 65-year record; and during water year 2016, flows ranged from the 50th percentile at the onset of the dry-season recession to the 25th percentile by the end of the season. During water year 2015, the 50-percent exceedance of annual runoff (not shown) was 56 percent of that for the period of record, and for water year 2016, it was 88 percent, indicating below normal runoff conditions during both years.

216050_flow_recession_20161214.xlsx, Pescadero recession chart

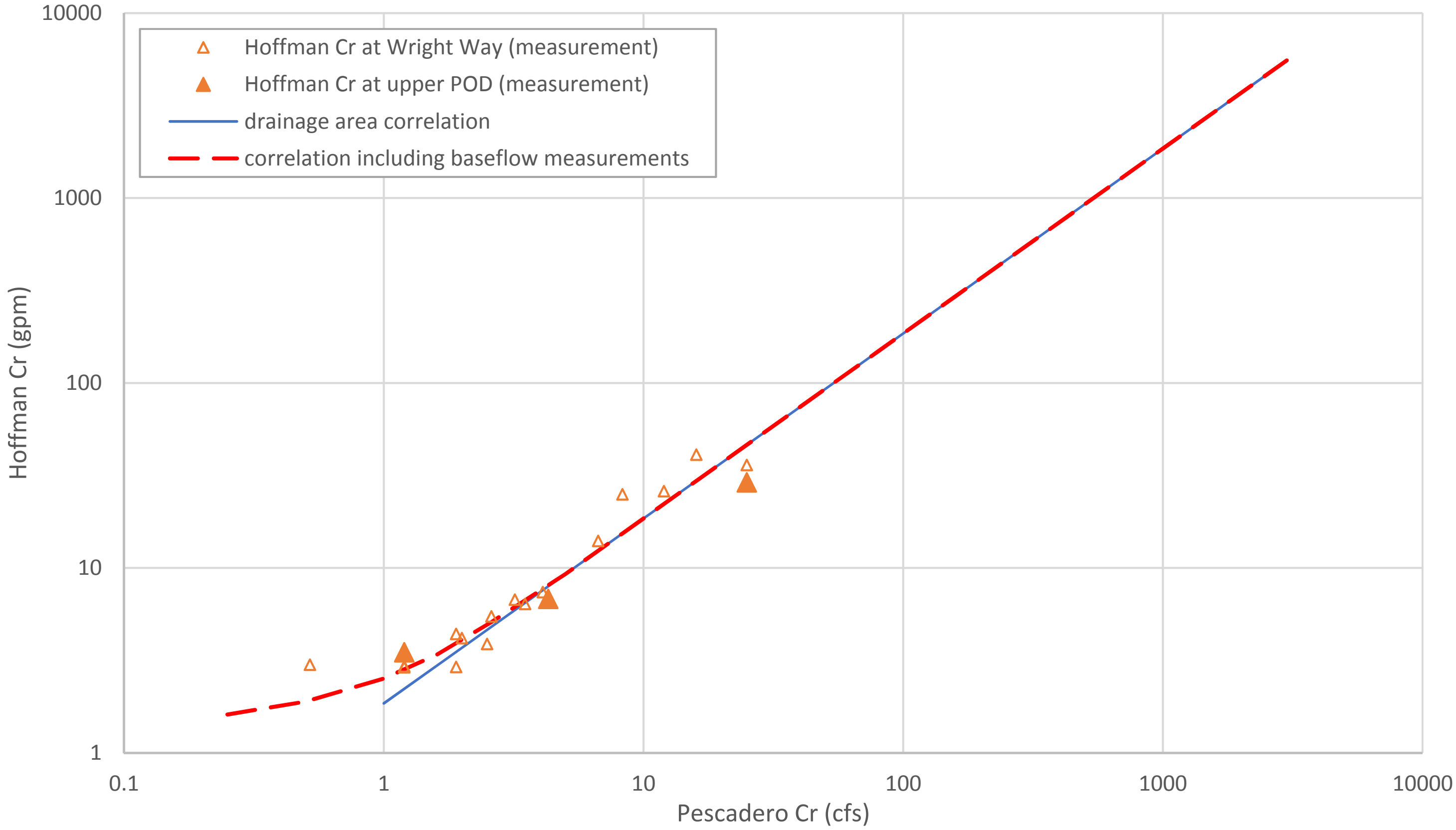


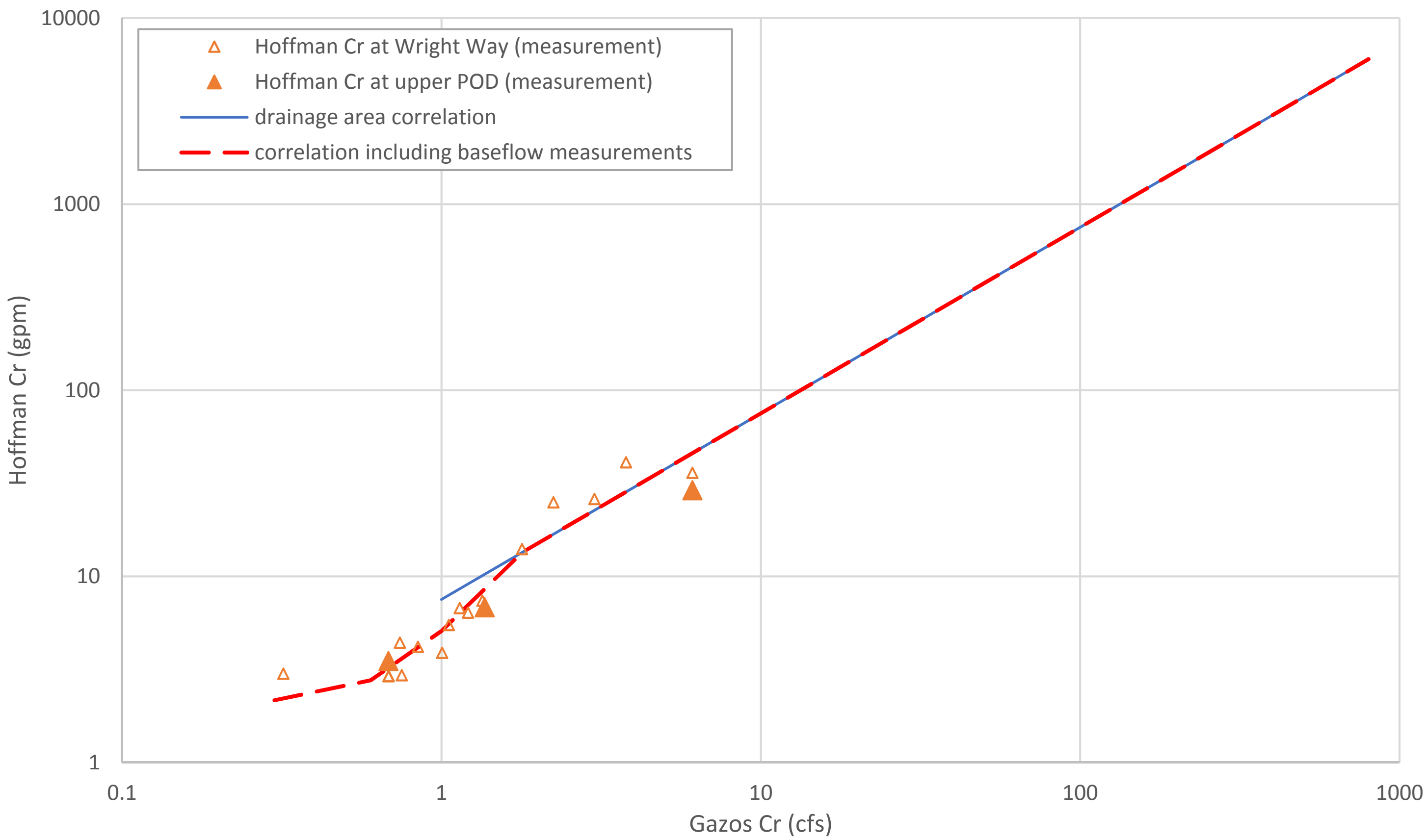


Balance Hydrologics, Inc.®

Figure 3. Flow correlations for Piney Creek at lower point of diversion, Redwood Glen, San Mateo County, CA. Baseflow measurements were correlated to corresponding flows in Gazos Cr above Hwy 1 (a Balance Hydrologics station) and to Pescadero Cr near Pescadero, CA (USGS station no. 11162500). Higher flows were proportioned to drainage area.

Data provisional and subject to revision.

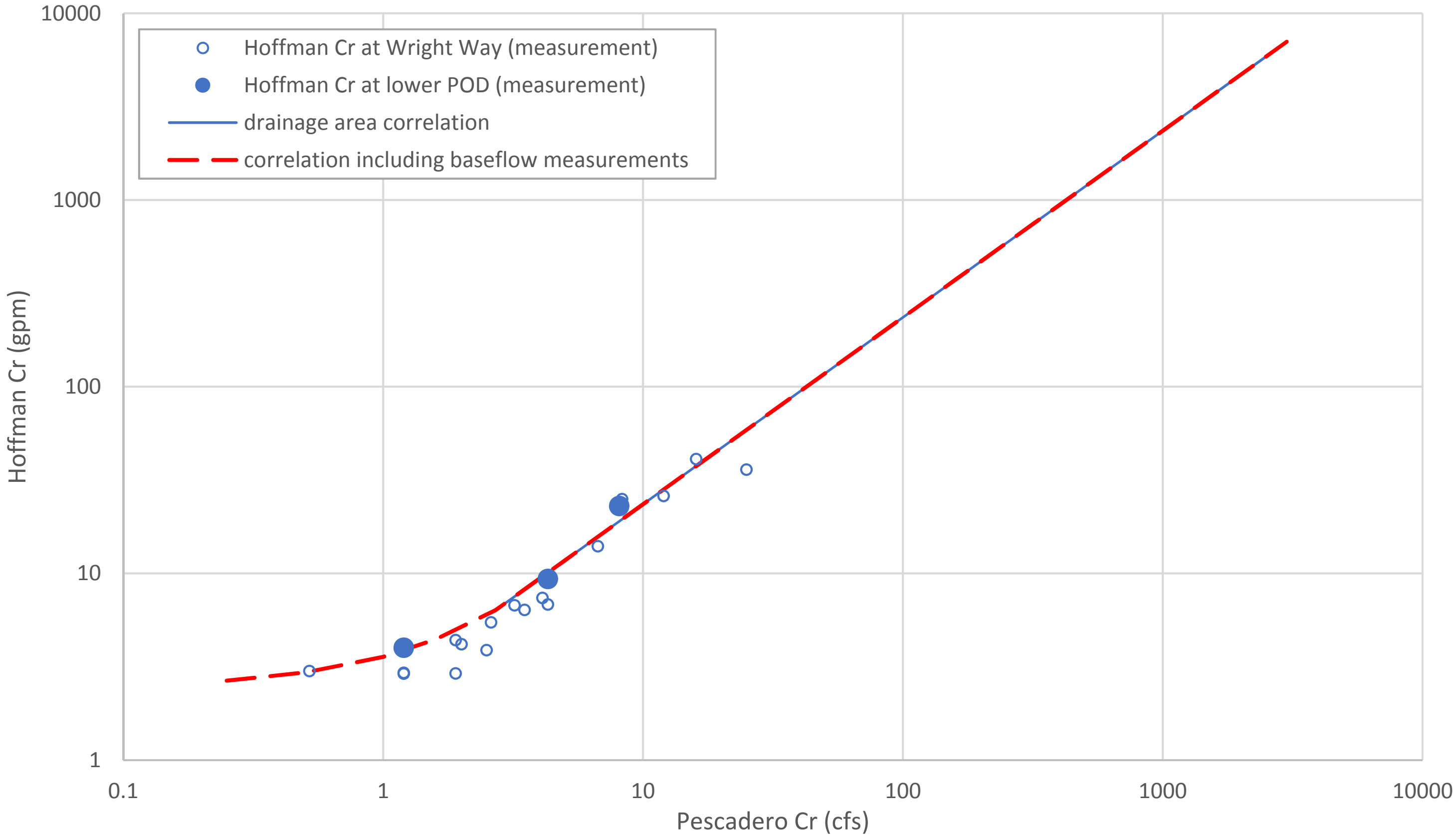


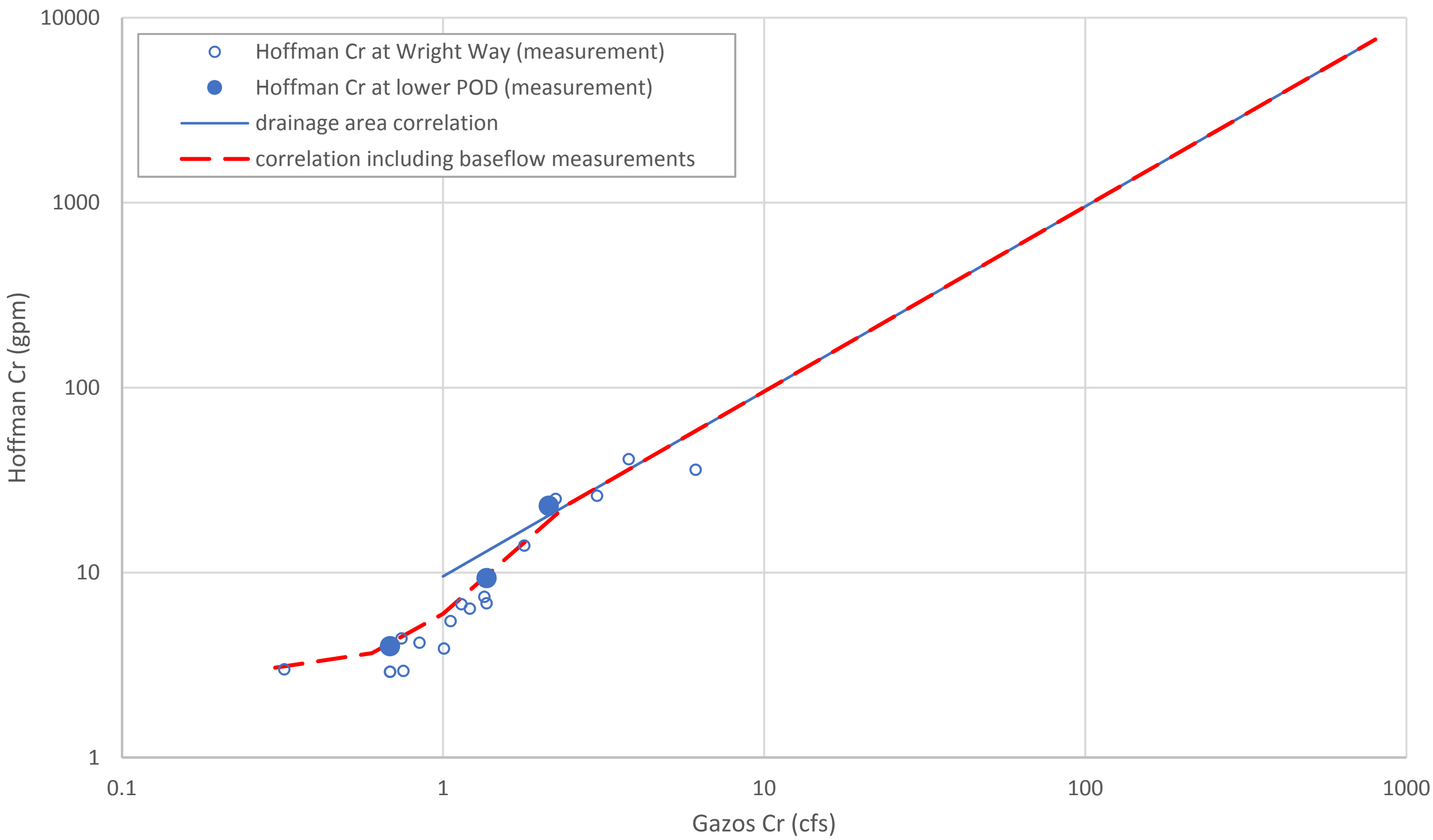


Balance Hydrologics, Inc.®

Figure 4. Flow correlations for Hoffman Creek at upper point of diversion, Redwood Glen, San Mateo County, CA. Baseflow measurements were correlated to corresponding flows in Gazos Cr above Hwy 1 (a Balance Hydrologics station) and to Pescadero Cr near Pescadero, CA (USGS station no. 11162500). Higher flows were proportioned to drainage area.

Data provisional and subject to revision.





Balance Hydrologics, Inc.®

Figure 5. Flow correlations for Hoffman Creek at lower point of diversion, Redwood Glen, San Mateo County, CA. Baseflow measurements were correlated to corresponding flows in Gazos Cr above Hwy 1 (a Balance Hydrologics station) and to Pescadero Cr near Pescadero, CA (USGS station no. 11162500). Higher flows were proportioned to drainage area.

Data provisional and subject to revision.

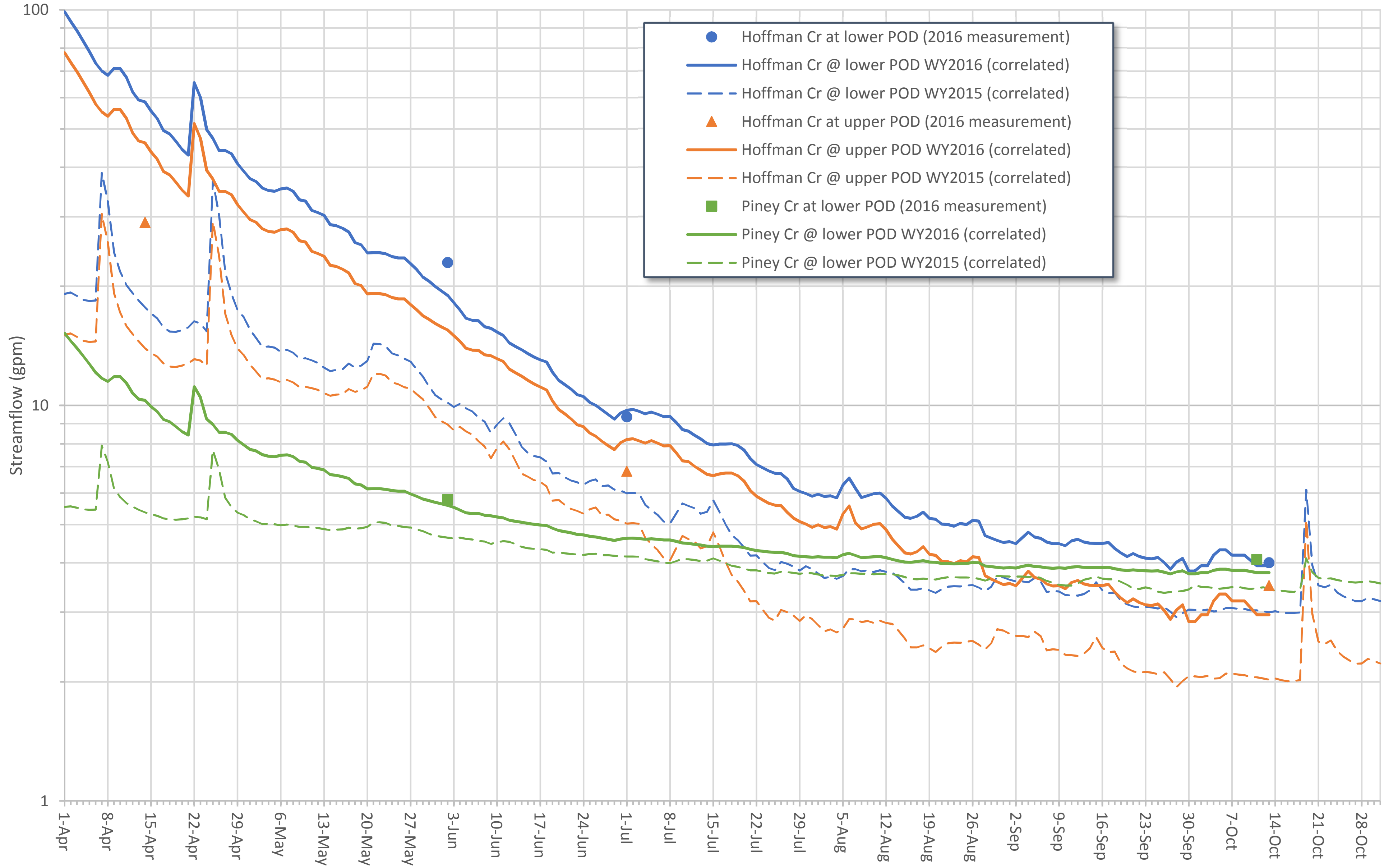


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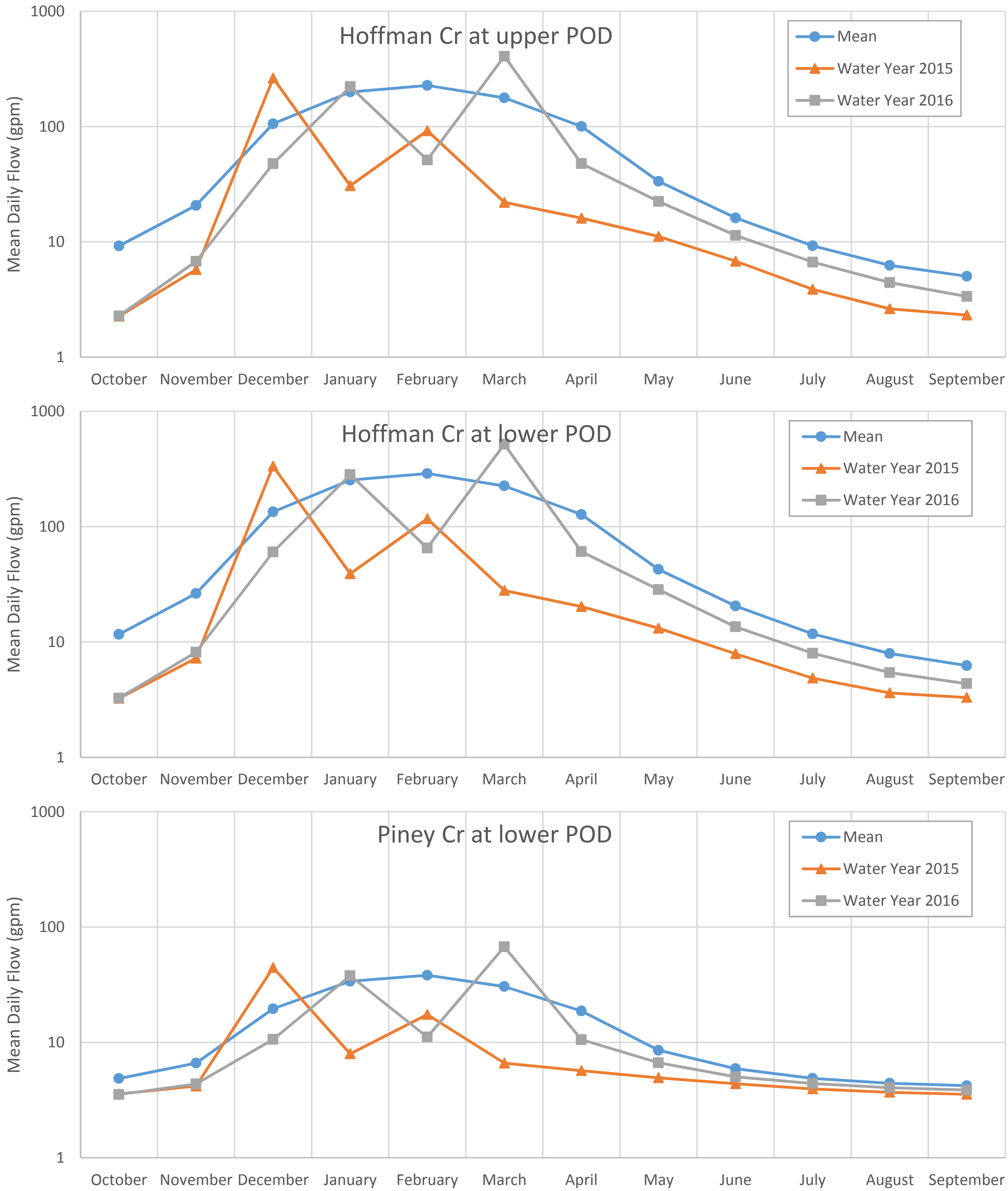
Figure 6. Streamflow recession, Redwood Glen, Loma Mar, San Mateo County, CA. Baseflows in Hoffman and Piney Creeks were measured on October 12, 2015 and during the dry-season recession of 2016, primarily at the easily accessable road culvert sites, but also periodically at the PODs (shown in this figure). Measurements were correlated to corresponding flows in Gazos Cr above Hwy 1 (a Balance Hydrologics station) and to Pescadero Cr near Pescadero, CA (USGS station no. 11162500). Higher flows were proportioned to drainage area.

216050_flow_recession_20161214.xlsx, Hoff and Piney recession chart

Data provisional and subject to revision.



Balance Hydrologics, Inc.®

Figure 7. Monthly mean daily discharge estimatesfor Hoffman and Piney Creeks, Redwood Glen, San Mateo County, CA. Estimates were based on correlations of baseflow measurements and of drainage areas to Gazos Creek above Hwy 1 (a Balance Hydrologics station) and to Pescadero Creek near Pescadero, CA (USGS station no. 11162500).

APPENDIX A

Water-year 2015 and 2016 summaries for USGS station 11162500

USGS Water-Year Summary 2016

11162500 Pescadero Creek near Pescadero, CA

LOCATION - Lat 37°15'39", long 122°19'40" referenced to North American Datum of 1927, in SW 1/4 sec.05, T.8 S., R.4 W., San Mateo County, CA, Hydrologic Unit 18050006, on left bank, at downstream side of highway bridge, 3.0 mi east of Pescadero, and 5.3 mi upstream from mouth.

DRAINAGE AREA - 45.9 mi .

SURFACE-WATER RECORDS

PERIOD OF RECORD - April 1951 to current year. CHEMICAL DATA: Water year 1977. WATER TEMPERATURE: Water years 1965-80. SEDIMENT DATA: Water years 1971, 1973, 1980, 1986, 1990-93.

REVISED RECORDS - WSP 1445: 1952-53 (instantaneous maximum discharge). WSP 1715: Drainage area.

GAGE - Water-stage recorder and crest-stage gage. Datum of gage is 62.30 ft above NGVD of 1929.

REMARKS - Records fair to good. Small diversions upstream from station by pumping.

EXTREMES FOR PERIOD OF RECORD - Maximum discharge, 10,600 ft /s, Feb. 3, 1998, gage height, 22.47 ft, from rating curve extended above 2,700 ft /s, on basis of slope-area measurement of peak flow; no flow at times.

U.S. Department of the Interior
U.S. Geological Survey

Water-Data Report 2016

11162500 Pescadero Creek near Pescadero, CA -- Continued

DISCHARGE, CUBIC FEET PER SECOND
YEAR 2015-10-01 to 2016-09-30
DAILY MEAN VALUES

Day	Oct 2015	Nov 2015	Dec 2015	Jan 2016	Feb 2016	Mar 2016	Apr 2016	May 2016	Jun 2016	Jul 2016	Aug 2016	Sep 2016
1	0.50	0.79	2.4	8.1	44	12	40	16	8.2	4.3	2.6	1.9
2	0.54	2.8	2.3	7.4	40	12	38	16	8.1	4.3	2.5	1.8
3	0.57	4.8	2.9	7.0	36	11	36	15	7.9	4.3	2.5	1.8
4	0.52	3.3	5.7	7.5	32	13	34	15	7.6	4.2	2.5	1.9
5	0.53	2.1	4.4	127	29	327	32	15	7.1	4.1	2.6	1.9
6	0.62	1.6	2.7	209	27	990	30	15	7.0	4.1	2.6	1.9
7	0.62	1.4	2.0	162	25	826	29	15	7.0	4.1	2.7	1.9
8	0.60	1.4	1.7	83	23	342	28	15	6.9	4.1	2.6	1.9
9	0.59	2.7	1.6	52	21	207	30	14	6.9	4.1	2.6	1.7
10	0.55	4.0	3.0	38	19	156	30	14	6.8	4.0	2.5	1.6
11	0.55	3.8	8.7	29	18	287	29	13	6.7	3.8	2.5	1.7
12	0.52	2.6	5.6	24	17	451	26	13	6.4	3.8	2.5	1.7
13	0.50	2.0	7.4	27	16	943	25	13	6.2	3.7	2.4	1.7
14	0.49	1.8	17	26	15	797	25	12	6.1	3.5	2.4	1.6
15	0.46	2.9	6.8	25	15	366	24	12	6.0	3.4	2.3	1.6
16	0.43	4.4	4.1	25	14	241	23	12	5.9	3.3	2.2	1.6
17	0.42	4.4	3.1	30	15	179	21	12	5.9	3.2	2.1	1.6
18	0.48	3.0	2.9	353	44	142	21	11	6.0	3.2	2.2	1.5
19	0.93	2.5	4.7	538	33	118	20	11	5.7	3.3	2.1	1.5
20	0.89	2.3	6.0	326	26	102	19	10	5.5	3.3	2.1	1.4
21	0.96	2.3	26	170	23	97	18	10	5.3	3.2	2.0	1.4
22	1.0	2.3	319	189	20	94	27	10	5.2	3.0	2.0	1.3
23	1.1	2.3	93	288	19	81	28	10	5.1	3.0	2.0	1.2
24	0.87	2.7	37	204	17	72	22	9.8	5.0	2.9	2.1	1.2
25	0.81	3.9	28	138	16	66	21	9.7	4.9	2.8	2.0	1.3
26	0.77	4.5	19	101	15	61	19	9.6	4.8	2.8	2.0	1.4
27	0.69	4.0	15	77	14	56	19	9.4	4.7	2.8	2.0	1.3
28	0.65	3.2	14	61	14	53	19	9.1	4.5	2.6	1.8	1.3
29	0.71	2.8	12	52	13	49	18	8.8	4.2	2.5	1.9	1.2
30	0.75	2.6	9.9	58		46	17	8.5	4.3	2.5	1.9	1.1
31	0.77		8.9	50		43		8.3		2.4	1.9	
Total	20.4	85.2	677	3,492	660	7,240	768	372	182	107	70.1	46.9
Mean	.66	2.84	21.8	113	22.8	234	25.6	12.0	6.06	3.44	2.26	1.56
Max	1.1	4.8	319	538	44	990	40	16	8.2	4.3	2.7	1.9
Min	0.42	0.79	1.6	7.0	13	11	17	8.3	4.2	2.4	1.8	1.1
Ac-ft	40.4	169	1,342	6,926	1,308	14,360	1,523	738	361	211	139	93.0

STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1951 - 2016, BY WATER YEAR (WY)

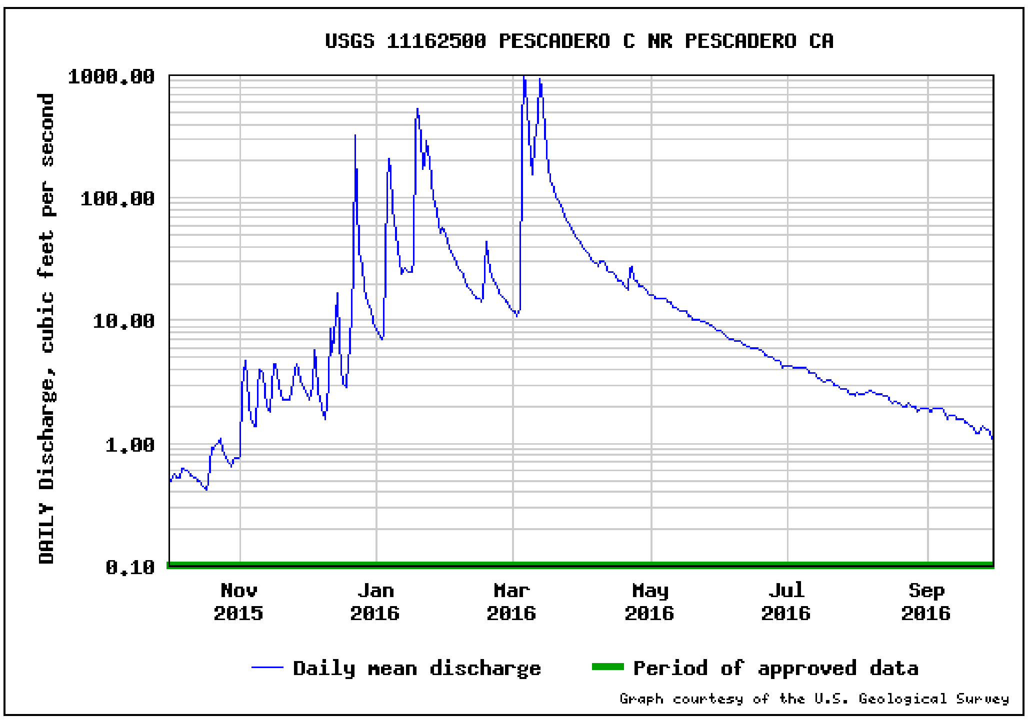
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Mean	4.98	11.3	57.2	108	123	95.9	54.4	18.1	8.76	5.00	3.38	2.62
Max	92.8	85.9	469	435	865	540	398	93.8	32.5	17.5	11.6	8.64
(WY)	(1963)	(1984)	(1956)	(1997)	(1998)	(1983)	(1958)	(1983)	(1998)	(1998)	(1998)	(1998)
Min	.38	1.61	2.03	1.06	2.92	4.25	1.93	1.51	.78	.21	.012	.083
(WY)	(1962)	(1992)	(2014)	(2014)	(1977)	(1988)	(1977)	(2014)	(1977)	(1977)	(1977)	(1977)

Water-Data Report 2016

11162500 Pescadero Creek near Pescadero, CA -- Continued

SUMMARY STATISTICS

	Water Year 2016		Water Years 1951 - 2016	
Annual total	13,720			
Annual mean	37.5		40.6	
Highest annual mean			164.2	1983
Lowest annual mean			1.72	1977
Highest daily mean	990.0	Mar 06	5,560	Dec 23, 1955
Lowest daily mean	0.420	Oct 17	0.0	Sep 09, 1961
Annual 7-day minimum	0.471	Oct 12	0.0	Aug 17, 1977
Maximum peak flow	2,850	Mar 06	10,600	Feb 03, 1998
Maximum peak stage	11.01	Mar 06	22.47	Feb 03, 1998
Annual runoff (cfsm)	0.817		0.880	
Annual runoff (inches)	11.1		12.0	
10 percent exceeds	67.8		84.0	
50 percent exceeds	6.00		6.80	
90 percent exceeds	1.27		1.40	



USGS Water-Year Summary 2015

11162500 Pescadero Creek near Pescadero, CA

LOCATION - Lat 37°15'39", long 122°19'40" referenced to North American Datum of 1927, in SW 1/4 sec.05, T.8 S., R.4 W., San Mateo County, CA, Hydrologic Unit 18050006, on left bank, at downstream side of highway bridge, 3.0 mi east of Pescadero, and 5.3 mi upstream from mouth.

DRAINAGE AREA - 45.9 mi .

SURFACE-WATER RECORDS

PERIOD OF RECORD - April 1951 to current year. CHEMICAL DATA: Water year 1977. WATER TEMPERATURE: Water years 1965-80. SEDIMENT DATA: Water years 1971, 1973, 1980, 1986, 1990-93.

REVISED RECORDS - WSP 1445: 1952-53 (instantaneous maximum discharge). WSP 1715: Drainage area.

GAGE - Water-stage recorder and crest-stage gage. Datum of gage is 62.30 ft above NGVD of 1929.

REMARKS - Records fair to good. Small diversions upstream from station by pumping.

EXTREMES FOR PERIOD OF RECORD - Maximum discharge, 10,600 ft /s, Feb. 3, 1998, gage height, 22.47 ft, from rating curve extended above 2,700 ft /s, on basis of slope-area measurement of peak flow; no flow at times.

U.S. Department of the Interior
U.S. Geological Survey

Suggested citation: U.S. Geological Survey, 2016, National Water Information System data available on the World Wide Web (USGS Water Data for the Nation), accessed [December 12, 2016], at URL http://nwis.waterdata.usgs.gov/nwis/wys_rpt?dv_ts_ids=&8799&adr_begin_date=2014-10-01&adr_end_date=2015-09-30&site_no=11162500&agency_cd=USGS

Water-Data Report 2015

11162500 Pescadero Creek near Pescadero, CA -- Continued

DISCHARGE, CUBIC FEET PER SECOND
YEAR 2014-10-01 to 2015-09-30
DAILY MEAN VALUES

Day	Oct 2014	Nov 2014	Dec 2014	Jan 2015	Feb 2015	Mar 2015	Apr 2015	May 2015	Jun 2015	Jul 2015	Aug 2015	Sep 2015
1	0.46	1.4	11	18	5.6	15	5.5	4.7	3.2	2.5	1.0	1.1
2	0.40	1.8	17	16	5.4	13	5.7	4.4	3.1	2.5	1.0	1.0
3	0.33	1.8	137	15	5.2	13	5.6	4.0	3.2	2.4	1.1	0.99
4	0.30	1.3	70	14	5.1	12	5.4	4.1	3.3	2.1	1.0	1.0
5	0.30	0.82	31	13	4.9	11	5.2	4.0	3.1	2.1	0.98	1.2
6	0.30	0.63	72	13	12	11	5.2	4.0	3.1	2.0	0.94	1.2
7	0.28	0.53	49	12	192	10	12	4.2	3.0	1.9	1.0	1.0
8	0.27	0.49	26	12	343	10	13	4.1	3.1	1.9	1.0	1.1
9	0.25	0.48	16	11	279	9.8	8.2	3.9	2.9	1.9	1.1	1.1
10	0.23	0.52	11	10	129	9.5	6.9	3.9	2.8	2.1	1.1	1.0
11	0.23	0.54	830	10	84	9.6	6.1	3.9	2.9	2.3	1.1	0.99
12	0.22	0.57	609	9.8	62	9.1	5.7	3.9	3.3	2.4	1.1	0.96
13	0.22	0.69	136	9.5	51	8.6	5.4	3.9	3.1	2.2	1.1	0.75
14	0.21	0.83	74	9.0	42	8.6	5.2	3.8	2.8	2.0	1.0	0.70
15	0.22	0.78	123	8.6	36	8.4	5.0	3.9	2.6	2.0	0.96	0.86
16	0.23	1.3	142	8.5	31	7.7	4.9	3.9	2.6	1.9	0.90	0.78
17	0.24	1.3	211	8.3	28	7.4	4.7	4.2	2.6	1.8	0.93	0.73
18	0.24	1.2	113	8.1	25	7.2	4.6	4.2	2.6	1.6	0.93	0.76
19	0.26	1.3	88	8.0	23	7.0	4.5	4.2	2.4	1.6	0.87	0.64
20	0.23	1.6	139	7.7	21	6.9	4.6	4.4	2.5	1.5	0.77	0.70
21	0.29	5.5	109	7.8	19	7.0	4.7	4.7	2.5	1.4	0.73	0.66
22	0.33	4.2	80	7.5	18	6.9	4.7	4.8	2.4	1.4	0.65	0.63
23	0.36	3.7	63	7.2	16	7.8	4.8	4.7	2.3	1.2	0.67	0.66
24	0.38	2.8	52	7.1	15	7.6	4.7	4.2	2.3	1.1	0.78	0.63
25	0.51	1.1	44	6.9	14	6.8	12	4.1	2.4	1.1	0.88	0.53
26	0.77	0.67	36	6.7	14	6.6	13	3.9	2.5	1.2	0.95	0.52
27	0.97	0.53	30	6.5	13	6.6	7.6	4.0	2.4	1.2	1.0	0.45
28	0.94	0.44	27	6.2	14	6.6	6.3	3.9	2.3	1.2	1.0	0.32
29	0.86	1.5	24	5.9		6.3	5.5	3.8	2.3	1.1	1.0	0.44
30	0.66	8.8	22	5.9		6.0	5.1	3.5	2.4	1.2	1.2	0.56
31	0.76		19	5.9		5.8		3.3		1.1	1.2	
Total	12.3	49.1	3,411	295	1,507	269	192	127	82.0	53.9	29.9	24.0
Mean	.40	1.64	110	9.52	53.8	8.67	6.39	4.08	2.73	1.74	.97	.80
Max	0.97	8.8	830	18	343	15	13	4.8	3.3	2.5	1.2	1.2
Min	0.21	0.44	11	5.9	4.9	5.8	4.5	3.3	2.3	1.1	0.65	0.32
Ac-ft	24.3	97.4	6,766	585	2,989	533	380	251	163	107	59.4	47.5

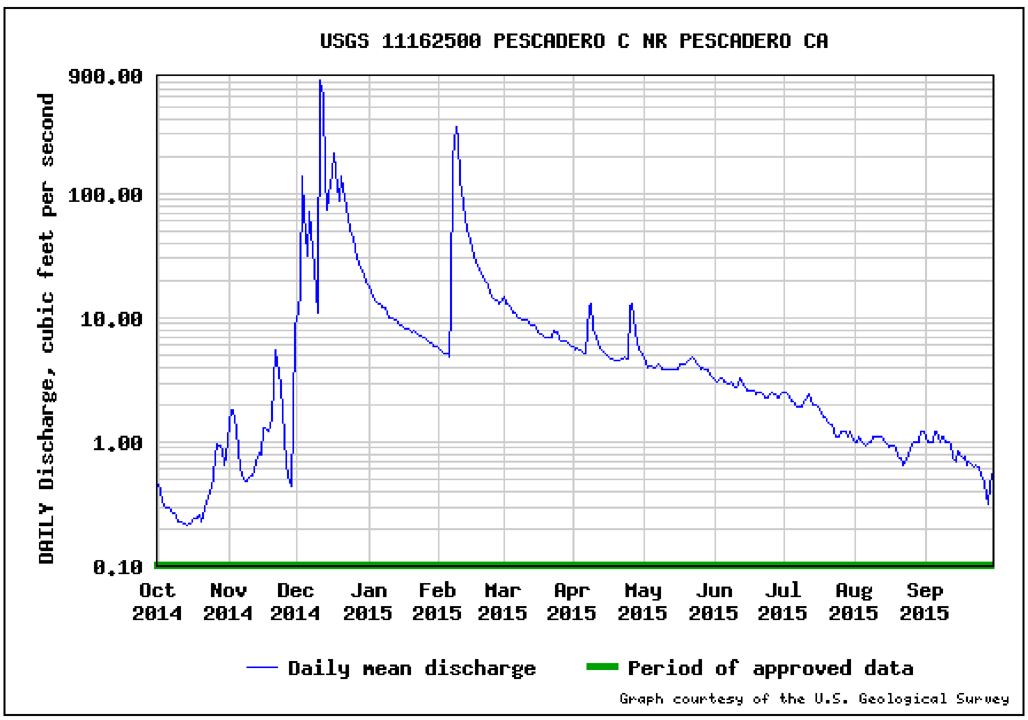
STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1951 - 2015, BY WATER YEAR (WY)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Mean	5.05	11.4	57.8	108	124	93.8	54.8	18.2	8.80	5.03	3.40	2.63
Max	92.8	85.9	469	435	865	540	398	93.8	32.5	17.5	11.6	8.64
(WY)	(1963)	(1984)	(1956)	(1997)	(1998)	(1983)	(1958)	(1983)	(1998)	(1998)	(1998)	(1998)
Min	.38	1.61	2.03	1.06	2.92	4.25	1.93	1.51	.78	.21	.012	.083
(WY)	(1962)	(1992)	(2014)	(2014)	(1977)	(1988)	(1977)	(2014)	(1977)	(1977)	(1977)	(1977)

Water-Data Report 2015
11162500 Pescadero Creek near Pescadero, CA -- Continued

SUMMARY STATISTICS

	Water Year 2015		Water Years 1951 - 2015	
Annual total	6,052			
Annual mean	16.6		40.7	
Highest annual mean			164.2	1983
Lowest annual mean			1.72	1977
Highest daily mean	830.0	Dec 11	5,560	Dec 23, 1955
Lowest daily mean	0.210	Oct 14	0.0	Sep 09, 1961
Annual 7-day minimum	0.223	Oct 10	0.0	Aug 17, 1977
Maximum peak flow	2,500	Dec 11	10,600	Feb 03, 1998
Maximum peak stage	10.41	Dec 11	22.47	Feb 03, 1998
Annual runoff (cfsm)	0.361		0.881	
Annual runoff (inches)	4.90		12.0	
10 percent exceeds	24.4		84.0	
50 percent exceeds	3.80		6.80	
90 percent exceeds	0.536		1.40	



ATTACHMENT 4C

Memorandum: Amendment to Streamflow Measurements and Source Capacity Estimates, Piney Creek and Hoffman Creek

Memorandum

To: Lisa Pezzino and Mark Quady, SRT Consultants

From: Mark Woyshner and Jonathan Owens

Date: February 15, 2017

Subject: Amendment to source capacity estimates at Redwood Glen, San Mateo County, CA.

Purpose

Balance Hydrologics (Woyshner and Owens, 2016) estimated the source capacity of existing point of diversions (PODs) on Hoffman Creek and Piney Creek at Redwood Glen, located at 100 Wright Way, Loma Mar, CA 94021(**Figure 1**). That memo was an attachment to the Alternative Analysis Addendum, allowing Redwood Glen to move forward into the design phase for a new water-system permit. Recently passed Senate Bill No. 1263 Section 116527(c)(8) requires "an analysis of whether a proposed new public water system's total projected water supplies available during normal, single dry, or multiple dry water years during a 20-year projection will meet the projected water demand for the service area." The State Water Resources Control Board requested that Redwood Glen comply with this requirement, given that their application for a new public water system permit has not been deemed complete prior to January 1, 2017 [Section 116527(h)(1)].

The source capacity estimates were based on flow measurements during the dry seasons of 2015 and 2016, which were correlated to the daily mean flows at two gaging stations: (a) Pescadero Creek[1] near Pescadero; and (b) Gazos Creek[2] above Hwy 1. Higher flows were based on drainage area correlations. Rainfall and runoff totals during water years 2015 and 2016 were below normal. The annual runoff at the Pescadero Creek station during water year 2015 was 41 percent of normal (**Table 1**);

[1] U.S. Geological Survey gaging station no. 11162500, Pescadero Creek near Pescadero, CA. Location: Lat 37°15'39", long 122°19'40" referenced to North American Datum of 1927, in SW 1/4 sec.05, T.8 S., R.4 W., San Mateo County, CA, Hydrologic Unit 18050006, on left bank, at downstream side of highway bridge, 3.0 mi east of Pescadero, and 5.3 mi upstream from mouth. DRAINAGE AREA - 45.9 mi^2. Period of record: April 1951 to current year.

[2] Located approximately one-half mile upstream from Highway 1 and about one-quarter mile upstream of the pump-station diversion. The period of record is from water year 2001 through 2016.

during water year 2016, it was 92 percent of normal, or 'near normal'. We developed monthly estimates of mean daily flow for water years 2015 and 2016, as well as for statistically mean ('normal') conditions for the 65-year period of record at the USGS Pescadero Creek station.

To comply with SB 1263, this memo presents additional estimates of monthly mean flow at the PODs on Hoffman Creek and Piney Creek for the recent consecutive dry years 2012, 2013, and 2014, as well as for dry year 2015, below normal year 2016, and mean flow conditions. The annual runoff at the Pescadero Creek station during water years 2012, 2013, and 2014 was 47 percent, 57 percent, and 6 percent of normal, for those respective years. The estimates were based on correlations to the USGS Pescadero Creek gaging station (**Figure 2** and **Table 2**), developed in Woyshner and Owens (2016). The mean annual flow of the four-year dry period 2012 through 2015 ranked fifth for the Pescadero Creek period of record (**Table 1**). For a single dry year, the mean annual flow for water year 2014 ranked second for the Pescadero Creek period of record (**Table 1**). Estimating source capacity for these recent multiple dry years is reasonable, especially given the following conditions: a) the effects of logging during the '50s and '60s have recovered, b) the likely fewer diversions in general than during earlier years, and c) somewhat improved gaging methods.

Results

SB 1263 requires source capacity estimates for a normal, single dry, and multiple dry water years. **Table 3** shows the estimates existing PODs on Hoffman Creek and Piney Creek for water years 2012 through 2016, as well as for normal (mean flow) conditions. Dry-season baseflow estimates for all five years were lower than normal conditions. Baseflow estimates for dry year 2013 were similar to previously estimated baseflows for dry year 2015, and baseflow estimates for dry year 2012 were similar to below normal year 2016 (**Figure 3**). Estimates for water year 2014, the most extreme single dry year, trended lower than estimates for the other years and provide a theoretical base level for the source capacity at each POD.

Limitations

Balance Hydrologics prepared this memo for the client's exclusive use on this particular project. It was prepared in general accordance with the accepted standard of practice existing in Northern California at the time the investigation was performed. No other warranties, expressed or implied, are made. It is based in part on information obtained from property plans and well drillers reports, including a level survey of portions of the property and personal communication with the client regarding subsurface conditions below the property. The methods used relied upon flow measurements performed by the client and reference values commonly used in the area or developed by sources generally held to be reliable. Hydrologic results are considered provisional and subject to revision. Findings and recommendations in this memo are based on the assumption that an appropriate and adequate follow-up program will be conducted, and that Balance will be retained at key stages in the project to revise the findings described in this memo as warranted.

References Cited

Woyshner, M., and Owens, J., 2016, Streamflow measurements and source capacity estimates at Redwood Glen, San Mateo County, CA: A Balance Hydrlogics technical memo to Lisa Pezzino and Mark Quady at SRT Consultants, 5 p. + tables, figures, and appendices.

Attachments

Table 1. Monthly mean flow in Pescadero Creek near Pescadero, San Mateo County, CA.
Table 2. Flow correlation equations for Hoffman and Piney Creeks, Redwood Glen, San Mateo County, CA.
Table 3. Monthly mean flow estimates for Hoffman and Piney Creeks during recent consecutive dry years 2012 through 2015, near normal year 2016, and statistically mean conditions, Redwood Glen, San Mateo County, CA.
Figure 1. Streamflow measurement locations at Redwood Glen, San Mateo County, CA.
Figure 2. Flow correlations for Piney and Hoffman Creeks, Redwood Glen, San Mateo County, CA
Figure 3. Monthly mean flow estimates for Hoffman and Piney Creeks, Redwood Glen, San Mateo County, CA

Table 1. Monthly mean flow in Pescadero Creek near Pescadero, San Mateo County, CA.

By ranking from lowest to highest the annual mean flow and four-year mean annual flow, these data were used to identify which years had flows appropriate for source capacity estimates during a single dry year and a multiple dry year scenario. Highlighted values flag the recent dry-year period 2012 through 2015, which ranked fifth. These recent consecutive dry years were selected for source capacity estimates given the following: a) the effects of logging during the '50s and '60s have recovered, b) the likely fewer diversions in general than during earlier years, and c) somewhat improved gaging methods. Water year 2014 ranked second driest year for the 65-year period of record.

Water	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual Mean			4-yr Mean Annual	
Year	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(% of normal)	(rank)	(cfs)	(rank)
1952	3.84	7.8	158	418.3	134.2	268.3	54.5	23.8	13.8	8.82	5.32	3.14	92.2	227%	59	--	--
1953	2.55	7.01	158.6	184.2	34.7	53	34	23.6	10.7	6.58	5.53	3.2	44.1	109%	40	--	--
1954	4.08	9.25	5.31	35.7	58.9	82.6	46.9	14.9	8.35	3.63	3.56	3.24	22.8	56%	25	--	--
1955	3.99	11.6	64.3	72.5	34.9	23.9	19.3	14.8	6.15	3.56	2.91	1.46	21.6	53%	23	45.2	44
1956	1.97	3.7	469.4	338	134.9	72	32.2	19.6	11.3	7.33	5.17	4.04	92.3	227%	60	45.2	45
1957	5.28	4.59	5.86	13.6	45.2	54.6	18.6	47.8	12.2	4.73	3.71	2.23	18.1	45%	19	38.7	34
1958	8.37	7.26	27	75.3	429.2	255.8	398.4	33.4	16.1	10	6.64	3.97	103.3	254%	63	58.8	54
1959	2.8	3.89	6.83	48.6	98.3	19.5	7.96	5.46	3.3	1.65	1.16	5.53	16.5	41%	16	57.6	53
1960	2.38	2.95	3.67	19.6	67.2	11.1	8.86	4.3	2.33	1.29	0.71	0.807	10.2	25%	9	37.0	29
1961	0.971	5.6	8.3	5.44	12.2	17.3	7.99	5.03	2.25	0.494	0.219	0.223	5.47	13%	4	33.9	22
1962	0.377	2.62	8.6	8.13	153.3	82.9	14.5	7.54	3.74	1.75	1.63	0.33	22.9	56%	26	13.8	3
1963	92.8	9.98	19.8	127.1	259.3	68.7	151.5	41.6	17.8	9.8	5.56	3.99	66.0	162%	54	26.1	14
1964	5.47	21.8	7.64	45.6	13	10.7	6.68	5.09	3.66	2	1.14	0.983	10.3	25%	10	26.2	15
1965	1.34	11.1	158.5	229.5	39.2	21.1	109.1	24.7	13.1	6.9	3.79	2.95	52.1	128%	45	37.8	31
1966	2.55	18.6	35.4	57.6	60.1	20.5	9.69	5.76	3.69	2.37	1.12	1.06	18.0	44%	18	36.6	28
1967	1.12	10.4	54.6	253.7	80.5	147.3	199.2	47.5	21	10.1	5.86	3.34	69.6	171%	55	37.5	30
1968	3.95	4.69	11.5	71.6	60.8	67.5	21.3	8.91	5.09	2.85	3.06	1.7	21.9	54%	24	40.4	37
1969	1.89	4.21	24.4	372	389.9	145.4	55.8	20.5	9.59	9.8	10.5	5.16	85.7	211%	58	48.8	48
1970	5.19	4.8	33.7	256	77.5	80.6	20.9	10.3	6.3	4.03	2.18	1.68	42.0	103%	39	54.8	52
1971	1.76	28.1	124.8	52.8	17.8	36.7	19.9	9.76	5.63	3.55	2.29	1.9	25.6	63%	31	43.8	40
1972	1.76	3.34	23.1	10.8	18	6.52	6.69	3.01	1.79	1.03	0.649	0.799	6.43	16%	6	39.9	36
1973	9.32	71.4	23.2	244.8	301.7	148.2	40.9	16.3	8.53	5.44	3.48	2.79	71.6	176%	56	36.4	27
1974	4.73	49.4	137	130.7	37.4	179.5	172.1	32.9	19	8.58	5.11	4.24	65.3	161%	53	42.2	38
1975	4.65	8.34	28.3	41.3	117.6	138.7	50.3	18.1	10.1	7.13	4.93	3.53	35.6	88%	36	44.7	42
1976	5.64	4.75	4.38	4.29	4.73	9.71	8.48	2.76	1.91	0.921	1.12	0.674	4.11	10%	3	44.2	41
1977	0.921	1.78	2.3	3.22	2.92	4.58	1.93	2	0.78	0.205	0.012	0.083	1.72	4%	1	26.7	17
1978	0.488	3.9	25.8	299.2	166.8	124	86.1	30.4	12.3	6.4	3.25	2.8	63.0	155%	51	26.1	13
1979	2.25	3.43	3.75	34.2	104.9	68.9	36.4	13.8	5.47	3.85	2.75	2.08	22.9	56%	27	22.9	9
1980	4.62	6.14	34.6	150.4	281.9	115.9	51.1	24.9	12.1	6.14	4.17	4.03	57.2	141%	49	36.2	25
1981	2.13	2.4	5.2	31.9	18.9	65.3	19.6	6.49	3.46	1.75	1.78	0.64	13.3	33%	14	39.1	35
1982	3.01	27.6	56.5	292.6	178.6	205.6	351.9	43.5	16.3	9.34	6.95	5.74	99.2	244%	62	48.2	47
1983	7.39	51.2	317.6	311.5	475.7	540.1	129.9	93.8	28.1	14.8	8.71	7.79	164.2	404%	65	83.5	62
1984	10.4	85.9	308.9	72	38	28.2	17.6	12.3	10.7	4.09	3.2	2.34	49.8	123%	43	81.6	60
1985	5.83	35.1	30.5	11.1	55.7	56.5	21.3	9.38	5.2	2.55	2.24	3.32	19.6	48%	21	83.2	61
1986	3.16	8.05	15.1	28	434.3	231.6	35.9	15.5	8	5	3.67	4.57	63.6	157%	52	74.3	58
1987	3.27	3.48	5.41	8.24	27.5	27.6	7.45	3.76	2.14	1.29	0.786	0.787	7.53	19%	7	35.1	24
1988	1.16	2.49	18	27.5	6.93	4.25	5.98	3.61	2.23	0.949	0.391	0.229	6.18	15%	5	24.2	10
1989	0.514	6.21	12.3	13.2	6.87	57.4	11.3	3.47	1.87	1.1	1.27	1.42	9.81	24%	8	21.8	7
1990	11.7	21.2	12.7	17.3	23.4	10.4	7.03	8.72	5.47	3.17	2.48	2.04	10.4	26%	11	8.5	1
1991	1.73	2.12	3.61	2.75	3.64	121.5	13.1	4.56	2.61	1.76	1.35	0.753	13.5	33%	15	10.0	2
1992	1.93	1.61	7.57	10.8	212.9	63.8	14.8	6.46	3.39	2.26	1.09	0.829	26.5	65%	32	15.1	4
1993	1.45	1.9	24.6	288.9	168.8	78.5	36.9	13	9.08	5.02	3.11	2.84	52.3	129%	46	25.7	12
1994	2.93	4.79	16.1	12.1	85	14.1	8.45	7.63	3.02	1.29	0.952	0.645	12.6	31%	13	26.2	16
1995	0.831	8.72	9.62	362.7	54.5	367.5	66.4	62.2	21.9	13.4	7.9	5.28	82.6	203%	57	43.5	39
1996	4.21	4.14	31.9	87.9	310.7	120.7	41.5	25.4	13.8	8.05	5.25	4.08	53.8	132%	47	50.3	49
1997	4.12	14	133.1	435.3	77.9	28.5	16	10.1	6.28	4.27	3.31	2.88	61.7	152%	50	52.7	50
1998	2.91	16.2	28.5	233.5	865.3	132	98.2	51.4	32.5	17.5	11.6	8.64	119.7	295%	64	79.5	59
1999	8.26	9.58	16	79.5	247.1	92.4	81.7	24.5	14.1	9	6.01	5.88	48.1	118%	42	70.8	56
2000	4.98	6.62	5.95	96.7	361.5	133.1	38.3	20.2	11.5	7.91	4.8	4.64	56.8	140%	48	71.6	57
2001	8.19	5.9	6.85	26.5	94.8	66.2	18.3	8.45	4.88	3.56	2.47	1.88	20.2	50%	22	61.2	55
2002	1.69	11.4	118.7	67.1	35.6	39.8	19	10.2	6.57	3.83	2.22	1.77	26.6	65%	33	37.9	32
2003	1.81	5.25	175.1	46	22.6	20.9	72.6	39.7	12	6.89	3.98	2.69	34.4	85%	35	34.5	23
2004	2.33	4.39	66.1	84.3	159.2	49.2	14.9	7.93	4.84	2.86	2.08	1.55	32.9	81%	34	28.5	18
2005	4.74	4.75	69.5	144	96.6	153.2	76.1	32.5	16.8	9.35	5.19	3.88	51.3	126%	44	36.3	26
2006	3.57	5	133.7	154.8	62	329	333.7	43.8	18.4	10.5	7.04	5.09	92.5	228%	61	52.8	51
2007	5.13	7.41	13.8	8.69	64.4	24.1	8.35	5.42	3.66	2.34	1.87	1.48	11.9	29%	12	47.2	46
2008	2.71	2.29	4.27	149	87	22.5	9.59	6.23	3.41	1.98	1.42	0.954	24.2	60%	29	45.0	43
2009	1.3	3.76	6.66	4.55	172.4	100.5	11.5	7.13	4.35	2.47	1.45	1.26	25.5	63%	30	38.5	33
2010	10.9	2.71	6.83	101.2	91	90.4	95	22	9.66	5.26	3.94	2.69	36.5	90%	37	24.5	11
2011	2.97	5.69	62.7	28.7	92.4	255.9	54.4	17.9	15.4	8.38	5.71	3.65	46.1	113%	41	33.1	21
2012	5.54	6.02	4.73	11.3	6.25	105.1	61.3	12.2	6.18	3.65	2.16	1.75	18.9	47%	20	31.8	20
2013	2.21	15.2	186.2	32.8	12.1	9.89	8.15	4	2.72	1.56	0.984	0.935	23.3	57%	28	31.2	19
2014	0.891	2	2.03	1.06	6.02	9.49	6.21	1.51	0.823	0.365	0.102	0.266	2.54	6%	2	22.7	8
2015	0.395	1.64	110	9.52	53.8	8.67	6.39	4.08	2.73	1.74	0.966	0.799	16.6	41%	17	15.3	5
2016	0.658	2.84	21.8	112.6	22.8	233.5	25.6	12	6.06	3.44	2.26	1.56	37.5	92%	38	20.0	6
Mean	4.98	11.3	57.2	108	123	95.9	54.4	18.1	8.74	4.98	3.36	2.61	40.6	--	--	40.4	--

Data source: USGS gaging station 11162500; latitude 37°15'39", longitude 122°19'40" NAD27; drainage area 45.9 square miles; gage datum 62.30 feet above NGVD29.

Table 2. Flow correlation equations for Hoffman and Piney Creeks, Redwood Glen, San Mateo County, CA.

Dependent variable (y)	Independent variable (x)	Polynomial coefficients				Coefficient of determination (r^2)
		ax^3	bx^2	cx	d	
Piney Cr @ lower POD (gpm)	Pescadero Cr near Pescadero, CA (cfs)	-5.60614306215903E-09	2.35285685507246E-05	2.7970205557545E-01	3.47913362880707	0.99999
Hoffman Cr @ upper POD (gpm)	Pescadero Cr near Pescadero, CA (above 2.6868 cfs)	0	0	1.85026750816993	0	--
	Pescadero Cr near Pescadero, CA (below 2.8368 cfs)	0	0	1.07161	2.20888	0.96798
Hoffman Cr @ lower POD (gpm)	Pescadero Cr near Pescadero, CA (above 2.70425 cfs)	0	0	2.347593745915	0	--
	Pescadero Cr near Pescadero, CA (below 2.70425 cfs)	-6.482579967385E-03	1.93766303375248E-01	9.80944085570526E-01	2.40695620814324	0.96798

Notes:

1. Correlations of baseflow measurements and of drainage areas were developed using daily mean flows at Pescadero Creek near Pescadero, CA (USGS station no. 11162500). The baseflow correlations were based on more frequent measurements at the easily accessible road-crossing culvert sites and then shifted slight to match fewer measurements at the PODs. Higher flows were proportioned to drainage area. Correlations to daily mean flows were appropriate primarily because no rain occurred during the dry-season baseflow measurement period.
2. Values shown are coefficients "a", "b", "c", and "d" of a polynomial equation $y = ax^3 + bx^2 + cx + d$ where "x" is the flow in Pescadero Creek or Gazos Creek and "y" if the flow in Hoffman or Piney Creeks.
3. The coefficient of determination indicates the proportion of the variance in the dependent variable that is predictable from the independent variable.

Data provisional and subject to revision.

Table 3. Monthly mean flow estimates for Hoffman and Piney Creeks during recent consecutive dry years 2012 through 2015, near normal year 2016, and statistically mean conditions, Redwood Glen, San Mateo County, CA.

	Hoffman Cr at lower POD shared diversion *(gpm)*	**Hoffman Cr at upper POD** "sink" diversion *(gpm)*	**Piney Cr at lower POD** 2,000 ft south and 350 ft east from NW corner of Section 2, T8S, R4W *(gpm)*
Water Year 2012 *(dry year)*			
October	13	10	5
November	14	11	5
December	11	9	5
January	27	21	7
February	15	12	5
March	247	194	33
April	144	113	21
May	29	23	7
June	15	11	5
July	9	7	5
August	5	5	4
September	5	4	4
Annual	44	35	9
Water Year 2013 *(dry year)*			
October	6	5	4
November	36	28	8
December	437	345	58
January	77	61	13
February	29	22	7
March	23	18	6
April	19	15	6
May	9	7	5
June	6	5	4
July	4	4	4
August	4	3	4
September	4	3	4
Annual	55	44	10
Water Year 2014 *(extreme dry year)*			
October	3	3	4
November	5	5	4
December	5	5	4
January	4	3	4
February	15	12	5
March	22	18	6
April	15	12	5
May	4	4	4
June	3	3	4
July	3	3	4
August	3	2	4
September	3	2	4
Annual	7	6	4

	Hoffman Cr at lower POD shared diversion *(gpm)*	Hoffman Cr at upper POD "sink" diversion *(gpm)*	Piney Cr at lower POD 2,000 ft south and 350 ft east from NW corner of Section 2, T8S, R4W *(gpm)*
Water Year 2015 *(dry year)*			
October	3	3	4
November	5	4	4
December	258	204	35
January	22	18	6
February	126	100	19
March	20	16	6
April	15	12	5
May	10	8	5
June	6	5	4
July	5	4	4
August	4	3	4
September	3	3	4
Annual	39	31	8
Water Year 2016 *(below normal)*			
October	3	3	4
November	7	6	4
December	51	41	10
January	264	208	36
February	53	42	10
March	548	432	71
April	60	47	11
May	28	22	7
June	14	11	5
July	8	6	4
August	6	5	4
September	4	4	4
Annual	88	70	14
Mean Daily Flow *(65-yr period of record)*			
October	12	9	5
November	26	21	7
December	134	106	20
January	253	200	34
February	285	225	38
March	225	178	31
April	127	100	19
May	43	34	9
June	21	16	6
July	12	9	5
August	8	6	4
September	6	5	4
Annual	96	75	15

Notes:

1. Estimates were based on correlations of baseflow measurements (for low flow) and of drainage areas (for high flow) to Pescadero Creek near Pescadero, CA (USGS station no. 11162500), period of record for water years 1951 - 2016.

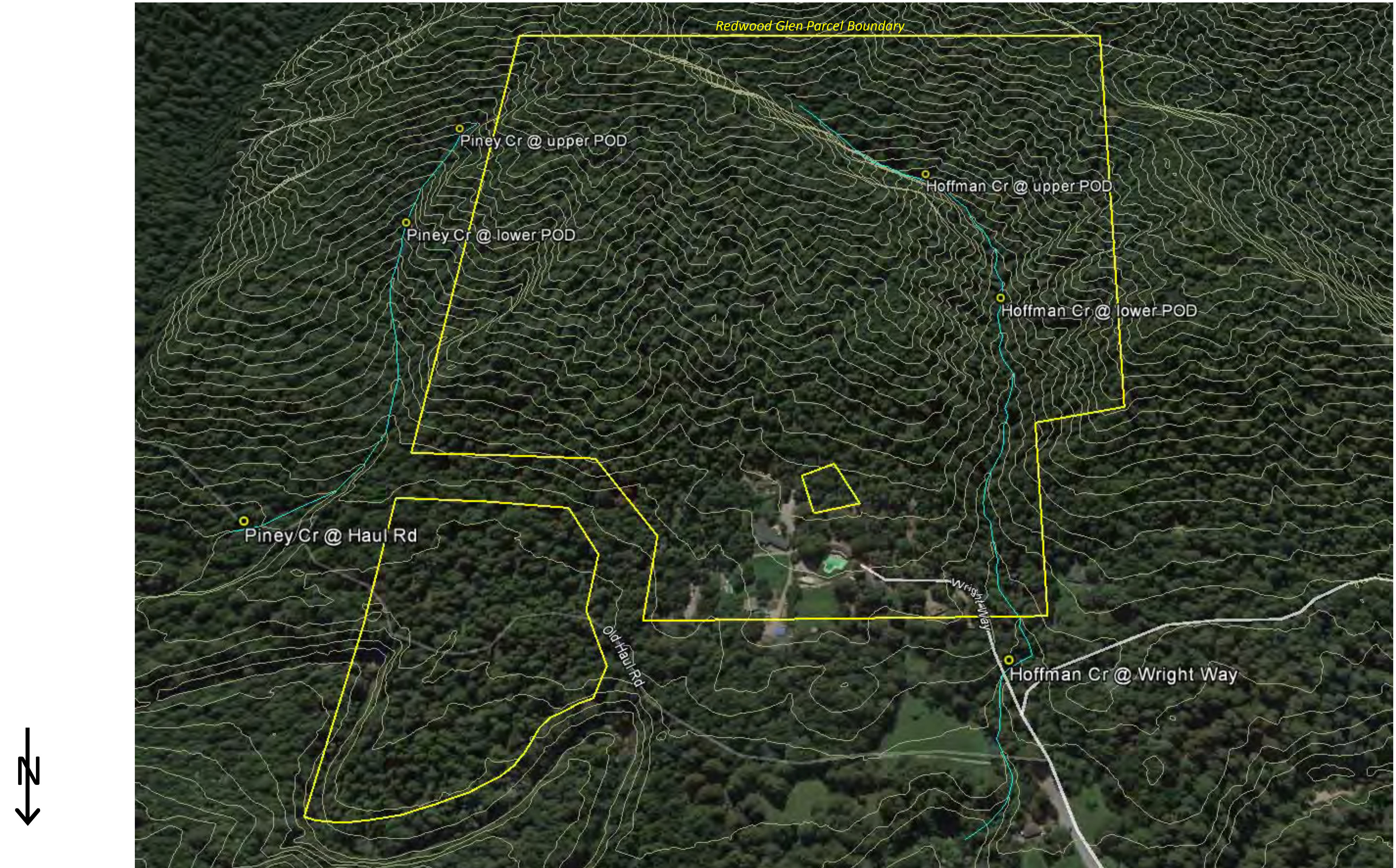


Figure 1. Streamflow measurement locations at Redwood Glen, San Mateo County, CA.
Oblique photo source: Google Earth. 25-ft contour interval based on LIDAR data.

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Data provisional and subject to revision.

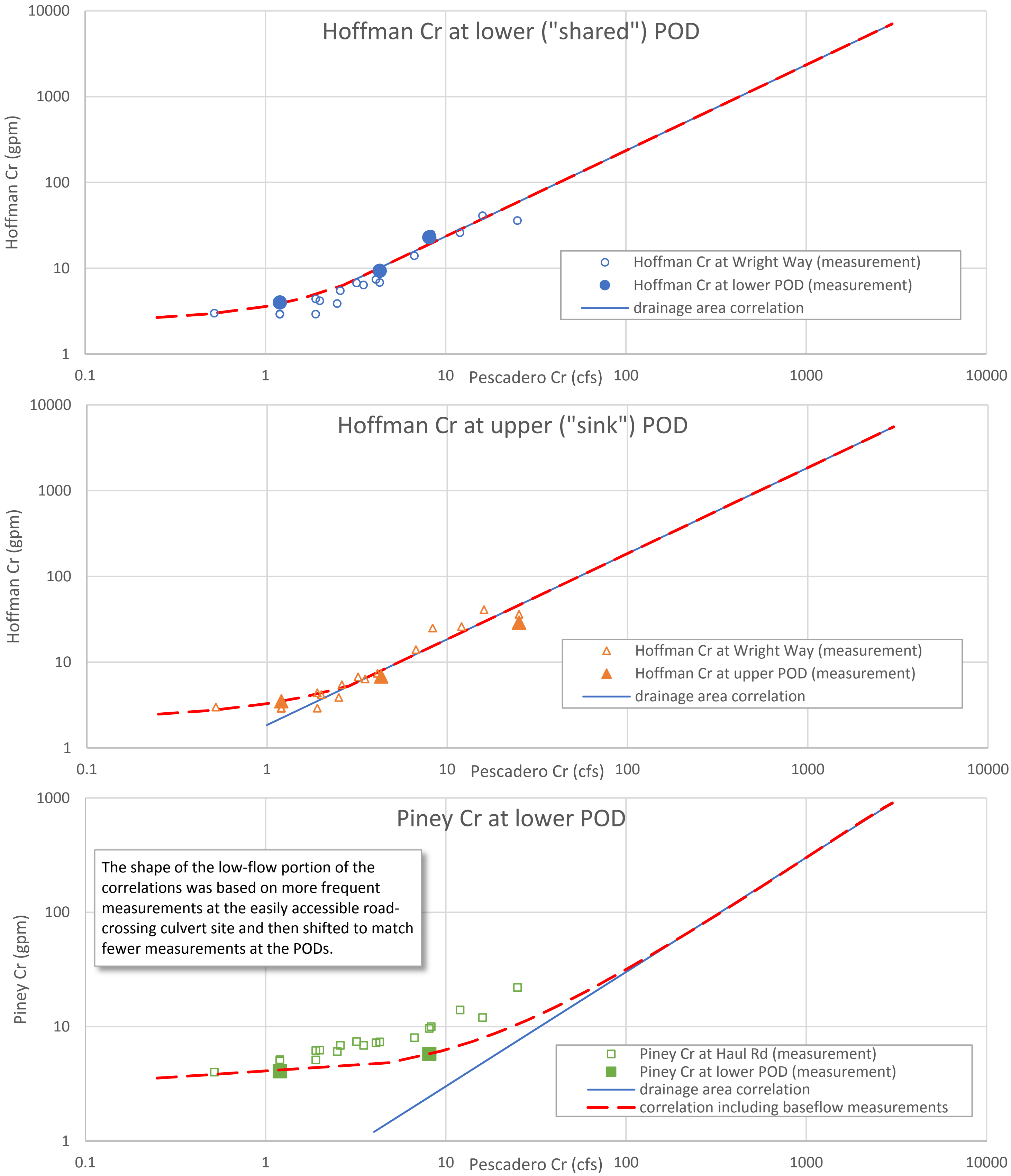

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Figure 2. Flow correlations for Piney and Hoffman Creeks, Redwood Glen, San Mateo County, CA. Baseflow measurements were correlated to corresponding flows in Pescadero Cr near Pescadero, CA (USGS station no. 11162500). Higher flows were proportioned to drainage area.

Data provisional and subject to revision.

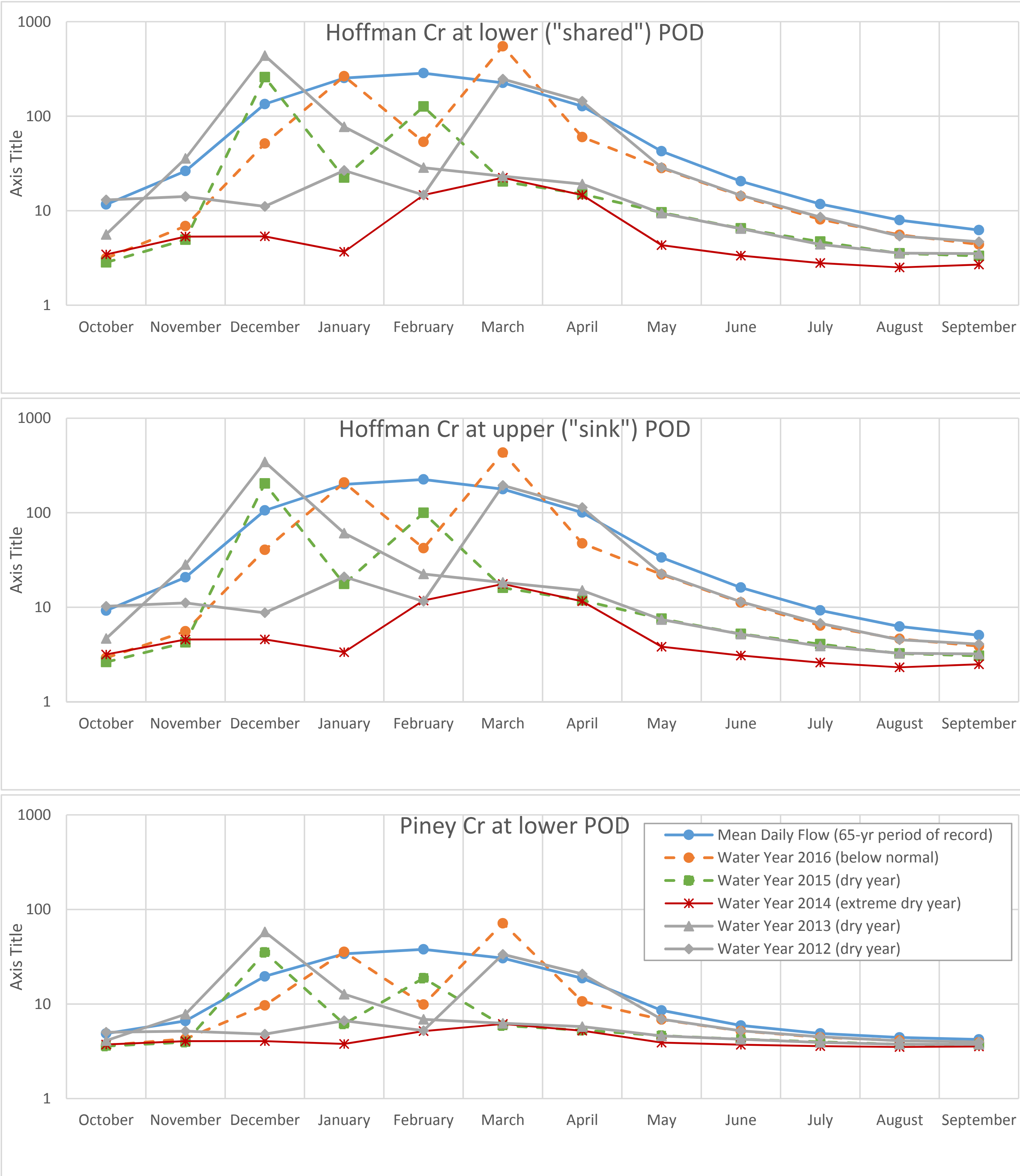

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Figure 3. Monthly mean flow estimates for Hoffman and Piney Creeks, Redwood Glen, San Mateo County, CA. Estimates were based on correlations of baseflow measurements (for low flow) and of drainage area (for high flow) to Pescadero Creek near Pescadero, CA (USGS station no. 11162500).

ATTACHMENT 4D

Redwood Glen Conservation Plan

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REDWOOD GLEN

LOMA MAR, CA

Water Conservation and Drought Contingency Plan

TABLE OF CONTENTS

DEFINITIONS

For the purposes of this plan, the following definitions shall apply:

Aesthetic water use means water use for ornamental or decorative purposes such as fountains, reflecting pools, and water gardens.

Commercial and institutional water use means water that is integral to the operations of commercial and nonprofit establishments and governmental entities such as retail establishments, hotels and motels, restaurants, and office buildings.

Conservation means those practices, techniques, and technologies that reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water or increase the recycling and reuse of water so that a supply is conserved and made available for future or alternative uses.

Customer means any person, company, or organization using water supplied by Redwood Glen.

Domestic water use means water use for personal needs or for household or sanitary purposes such as drinking, bathing, heating, cooking, sanitation, or for cleaning a residence, business, industry, or institution.

Industrial water use means the use of water in processes designed to convert materials of lower value into forms having greater usability and value.

Landscape irrigation use means water used for the irrigation and maintenance of landscaped areas, whether publicly or privately owned, including residential lawns, gardens, rights-of-way and medians.

Nonessential water use means water uses that are not essential or required for the protection of public, health, safety, and welfare, including:

(1) Irrigation of landscape areas, including parks and athletic fields, except otherwise provided under this plan;
(2) Use of water to wash any motor vehicle, motorbike, boat, trailer, or other vehicle;
(3) Use of water to wash down any sidewalks, walkways, driveways, parking lots, tennis courts, or other hard-surfaced areas;
(4) Use of water to wash down buildings or structures for purposes other than immediate fire protection;
(5) Flushing gutters or permitting water to run or accumulate in any gutter or street;
(6) Use of water to fill, refill, or add to any indoor or outdoor swimming pools or Jacuzzi-type pools;
(7) Use of water in a fountain or pond for aesthetic or scenic purposes except where necessary to support aquatic life;
(8) Failure to repair a controllable leak(s) within a reasonable period after having been given notice directing the repair of such leak(s); and
(9) Use of water from hydrants for construction purposes or any other purposes other than firefighting.

1. Introduction

Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or wildfires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts occur slowly, over a multi-year period. In the most general sense, drought is a deficiency of precipitation over an extended period of time, resulting in a water shortage for some activity, group, or environmental sector. However, it is clear that drought cannot be viewed solely as a physical phenomenon. A water shortage occurs when supply is reduced to a level that cannot support existing demands. Natural forces, system component failure or interruption, or regulatory actions may cause these water shortages. Such conditions could last two to three months or extend over many years.

Contingency planning before a shortage allows selection of appropriate responses consistent with the varying severity of shortages. While the actions taken should be adequate to deal with the circumstances and no more, it is essential that water suppliers start demand-reduction programs before a severe shortage. Water suppliers that delay demand-reduction programs may exhaust reserve supplies early in an extended shortage and could cause unnecessary social and economic harm to the communities. A Conservation and Drought Contingency Plan should enable water suppliers to provide water for public health and safety and minimize impacts on economic activity, environmental resources and the region’s lifestyle.

1.1 Purpose

In order to conserve the available water supply and protect the integrity of water supply facilities, with particular regard for domestic water use, sanitation, and fire protection, and to protect and preserve public health, welfare, and safety and minimize the adverse impacts of water supply shortage or other water supply emergency conditions, Redwood Glen has developed this *Conservation and Drought Contingency Plan* to outline the regulations and restrictions on the delivery and consumption of water.

Water uses regulated or prohibited under this *Conservation and Drought Contingency Plan* are considered to be nonessential and continuation of such uses during times of water shortage or other emergency water supply condition are deemed to constitute a waste of water.

1.2 Drought-Related Regulations

The relevant regulations pertaining to drought contingency are summarized in the sections below.

Declaration of Water Shortage Emergencies—California Water Code, Sections 350-359

For California water suppliers, the requirements of these two acts need to be incorporated into any water shortage plans. The key elements of these acts are summarized in Table 1. These provisions provide the authority for water suppliers to declare a water shortage emergency and grant the water supplier broad powers to enforce regulations and restrictions for managing the water shortage. Water needed for domestic purposes is given priority and discrimination within a class of customers is prohibited.

Table 1 Summary of California Water Code Provisions

Section	Summary of Key Points
350	Governing body of water supply distributor has authority to declare water shortage emergency condition. Defines water shortage emergency condition as when there would be "insufficient water for human consumption, sanitation, and fire protection."
351	A public hearing is required prior to a water shortage emergency condition declaration.
352	Advertisement of the public hearing must follow certain notification and distribution procedures.
353	Governing body of water supply distributor must adopt regulations and restrictions to "conserve the water supply for the greatest public benefit." Priority uses are domestic, sanitation, and fire protection.
354	Option given to governing body of water supply distributor to establish additional water allocation, distribution, and delivery priorities. Method of allocation cannot discriminate "between customers using water for the same purpose or purposes."
355	Regulations and restrictions are in effect until the emergency is over and the water supply has been replenished or augmented.
356	Regulations and restrictions allow prohibiting new or additional service connections. Enforcement of regulations and restrictions may include discontinuing service to customers willfully violating them.
357	Regulations and restrictions must prevail over allocation provisions of laws pertaining to water rights of individual customers. Water distributors subject to regulation by the State Public Utilities Commission (PUC) need prior approval by the PUC before adopting regulations and restrictions of this type.
358	Review of an emergency declaration or adopted regulations and restrictions adopted by a court is not prohibited.
359	Requirements for applying for federal drought relief program.

1.3 Existing Water Demand Management Measures

Redwood Glen has made significant efforts to reduce water losses within the existing water system and minimize customer water usage. Redwood Glen has employed strategies to achieve high levels of conservation over the past 10 years. The specific conservation methods employed by Redwood Glen to realize these reductions are included in Table 2.

Table 2 Conservation Efforts and Benefits!

Conservation Effort	Description	Benefits
Installation of low-flow fixtures	Redwood Glen has installed water-efficient fixtures throughout the facilities: all shower fixtures in the service area are low flow and replacement of bathroom faucets with more efficient fixtures has been initiated. In 2011, the urinal in the men's public restroom was converted to a waterless urinal.	Reduces the amount of water used by customers and results in lower water demands.
Leak Detection Program	The Redwood Glen maintenance crew periodically checks for water leaks, toilets stuck in the flow position, and sinks inadvertently left on in public facilities. Any leaks discovered or reported are repaired immediately.	Reduces the amount of water that was lost through leaks in the customers' homes; results in lower water demands.
Public Education	Redwood Glen includes information on conservation to each group that stays at the Camp and Conference Center and posts signs in public areas regarding conservation.	Generates community awareness of conservation and results in water demand reduction.
Reduced On-site Irrigation	Irrigation of the grounds is at the discretion of Redwood Glen based on water supply available. Currently, the fields are not regularly watered and remain brown throughout the summer months. The decorative plants on-site are watered with ice that has been already been used in the kitchen and would otherwise be wasted.	Reduces the amount of water used for irrigation and results in lower water demand from the local creeks (utilized for irrigation).

2. Water Demand Stages and Conservation Requirements

Redwood Glen has developed a tiered program to manage customer water demand in response to availability of water supply. The stages progress from basic public education on water conserving practices to mandatory measures. The specific demand management stage is triggered by the availability of water supply and the ability to maintain fire-fighting and emergency reserves in distribution system water storage tanks. Redwood Glen will continually monitor all available sources for potential deficiencies and the system's ability to keep emergency reserves in storage tanks. The Executive Director and Operations Staff shall monitor water supply and demand conditions and shall determine when conditions warrant initiation of each stage of the plan.

After determining the water shortage stage, the Executive Director shall implement the notification procedures listed below, and alert customers of the water management measures that correspond to the established stage.

1. Notification of the public: The Executive Director shall notify the public by means of one of the following methods:
    a. Direct mail to each resident.
    b. Information included in packets provided to facility guests.
    c. Public service announcements.
    d. Signs posted in public places.

2. Additional notification: The Executive Director shall notify directly, or cause to be notified directly, the following individuals and entities:
    a. Board of Directors
    b. City and/or county emergency management coordinator(s), as necessary
    c. Office of Emergency Health Services (OEHS), as necessary
    d. State Water Resources Control Board, as necessary.

Redwood Glen establishes and recognizes the following stage definitions and the corresponding measures of water conservation and drought contingency:

2.1 STAGE 1 – Normal Water Supply

The Redwood Glen system is considered in Stage 1 when supply and distribution system is able to meet all the water demands of its customers in the immediate future. Redwood Glen staff, residents, and guests are requested to ***voluntarily*** limit their water use by implementing the following water management measures:

- Landscape and recreation fields shall be irrigated early in the day or late in the evening.
- Water shall not be allowed to run off to the roadside ditch or gutter. Care shall be taken not to water past the point of saturation.
- Leaking pipes or faulty sprinklers shall be repaired within five (5) days or less if warranted by the severity of the problem.
- No hosing down of automobiles, boats, sidewalks and/or driveways. Please wash automobiles or equipment on the lawn or at a commercial establishment that uses recycled or reclaimed water.
- Washing of streets, parking lots and buildings except as necessary for health, sanitary or fire protection purposes shall be prohibited.

- Attach automatic shut-off devices on any hose or filling apparatus in use.
- No water from the potable water system shall be used to fill or refill swimming pools, artificial lakes, ponds or streams, except as necessary for public health or fire protection.
- No outdoor water use of any kind during power outages.

2.2 STAGE 2 – Water Alert

The Redwood Glen system is considered in Stage 2 when there is a possibility that the supply and distribution system will not be able to meet the demands of its customers. The following voluntary and mandatory water management measures are associated with water demand management Stage 2.

Voluntary Measures

Redwood Glen staff and residents are requested to ***voluntarily*** limit their water use by implementing the following water management measures, applicable to State 2:

- Automatic sprinkler system timers shall be set to operate during off-peak hours between 10:00 p.m. and 6:00 a.m.
- Water shall not be allowed to run off to the roadside ditch or gutter. Care shall be taken not to water past the point of saturation.
- Leaking consumer pipes or faulty sprinklers shall be repaired within five (5) days or less if warranted by the severity of the problem.
- Attach automatic shut-off devices on any hose or filling apparatus in use.
- The dining hall shall only serve water on specific request.
- No outdoor water use of any kind during power outages.

Mandatory Measures

The following Stage 2 water use restrictions shall apply to all persons:

- No water from the Redwood Glen water system shall be used for landscape and recreation field irrigation on SATURDAYS and SUNDAYS.
- No water from the potable water system shall be used to fill or refill swimming pools, artificial lakes, ponds or streams, except as necessary for public health or fire protection.
- No hosing down of automobiles, boats, sidewalks and/or driveways. Washing of automobiles or equipment shall be done at a commercial establishment that uses recycled or reclaimed water.
- No washing of streets, parking lots and buildings except as necessary for health, sanitary or fire protection purposes.

2.3 STAGE 3 – Water Warning

The Redwood Glen system is considered in Stage 3 when the supply and distribution system probably will not be able to meet all the water demands of its customers. The following voluntary and mandatory water management measures are associated with water demand management Stage 3.

Voluntary Measures

Redwood Glen staff, residents, and guests are requested to ***voluntarily*** limit their water use by implementing the following water management measures, applicable to Stage 3:

- Water shall be allowed to run off to the roadside ditch or gutter. Care shall be taken not to water past the point of saturation.
- Leaking pipes or faulty sprinklers shall be repaired within one (1) day or less if warranted by the severity of the problem.
- Attach automatic shut-off devices on any hose or filling apparatus in use.
- Dining hall shall only serve water on specific request.

Mandatory Measures

Under threat of penalty for violation, the following Stage 3 water use restrictions shall apply to all persons:

- Landscape and recreation field irrigation shall be limited to a maximum of TWO DAYS PER WEEK and will NOT be permitted on SATURDAYS and SUNDAYS.
- Automatic sprinkler system timers shall be set to operate during off-peak hours between 10:00 p.m. and 6:00 a.m.
- No water from the potable water system shall be used to fill or refill swimming pools, artificial lakes, ponds or streams, except as necessary for public health or fire protection.
- No hosing down of automobiles, boats, sidewalks and/or driveways. Washing of automobiles or equipment shall be done at a commercial establishment that uses recycled or reclaimed water.
- No washing of streets, parking lots and buildings except as necessary for health, sanitary or fire protection purposes.
- No outdoor water use of any kind during power outages.

2.4 STAGE 4 – Water Crisis

The Redwood Glen system is considered in Stage 4 when the supply and distribution system is not able to meet all the water demands of its customers under Stage 3 requirements. The following voluntary and mandatory water management measures are associated with water demand management Stage 4.

Voluntary Measures

Water customers are requested to ***voluntarily*** limit their water use by implementing the following water management measures, applicable to Stage 4:

- Water shall not be allowed to run off to the roadside ditch or gutter. Care shall be taken not to water past the point of saturation.
- Leaking consumer pipes or faulty sprinklers shall be repaired within one (1) day.
- Attach automatic shut-off devices on any hose or filling apparatus in use.

Mandatory Measures

Under threat of penalty for violation, the following Stage 4 water use restrictions shall apply to all persons:

- Landscape and recreation field irrigation shall be limited to a maximum of ONE DAY PER WEEK and will NOT be permitted on SATURDAYS and SUNDAYS.
- Automatic sprinkler system timers shall be set to operate during off-peak hours between

10:00 p.m. and 6:00 a.m.

- No water from the potable water system shall be used to fill or refill swimming pools, artificial lakes, ponds or streams, except as necessary for public health or fire protection.
- No hosing down of automobiles, boats, sidewalks and/or driveways. Washing of automobiles or equipment shall be done at a commercial establishment that uses recycled or reclaimed water.
- No washing of streets, parking lots and buildings except as necessary for health, sanitary or fire protection purposes.
- Restaurants shall only serve water on specific request.
- No outdoor water use of any kind during power outages.
- No water from the Redwood Glen system shall be used for construction purposes such as dust control, compaction or trench jetting.

2.5 STAGE 5 – Water Emergency

The Redwood Glen system is considered in Stage 5 when the system is experiencing a major failure of a supply, storage, or distribution facility. Customers shall be required to comply with the requirements and restrictions on certain nonessential water uses, as defined below:

- Landscape and recreation field irrigation will NOT be permitted.
- Leaking consumer pipes or faulty sprinklers shall be repaired immediately or turned off.
- No hosing down of automobiles, boats, sidewalks and/or driveways.
- Washing of streets, parking lots and buildings except as necessary for health, sanitary or fire protection purposes shall be prohibited.
- No water from the potable water system shall be used to fill or refill swimming pools, artificial lakes, ponds or streams, except as necessary for public health or fire protection.
- Dining hall shall only serve water on specific request.
- No potable water from the Redwood Glen water system shall be used for construction purposes of any kind
- No outdoor water use of any kind.

Additionally, the Executive Director may implement mandatory water restrictions in addition to those detailed above to protect public health, safety, welfare, infrastructure, or available resources in the event of an unusual water system operational event, catastrophic occurrence, severe weather event, or other emergency situation or occurrence necessitating additional restrictions.

ATTACHMENT 4E

Water Meter Installation Plan

Redwood Glen Water Meter Installation Plan

The Redwood Glen water system is currently not metered. The following water meter installation plan has been developed based on the assumed usage at all the facilities. The facilities with the highest usage will be metered first (ie. dining hall, conference center), followed by the resident facilities, which are occupied year-round, and then the guest facilities, which are typically occupied in the summer season and occasional weekends throughout the year. Table 1, below, includes the Redwood Glen Water Meter Installation Plan.

Table 1 Redwood Glen Water Meter Installation Plan

Year	Connection	Type of Facility	Meter Size
2017	Groundwater Well(s)/SWTP	Water Source	Unknown
	Siden Conference Center	Guest Facility	2”
	Smith Hall (Dining)	Guest/Resident Dining Facilities	2”
2018	Staff Housing	Permanent and Temporary Staff Housing; Consists of Staff Housing Building and six (6) trailers	¾”
	Heiman House	Resident Facility	1”
	Hodge House	Resident Facility	1”
	Creekside Cabin	Resident Facility	¾”
2019	Shepherd Lodge	Lodge and two (2) trailers	¾”
	Brookside Cabin	Guest Facility	¾”
	Retreat Hall	Guest Facility	¾”
2020	Macarthur Cabin	Guest Facility	1”
	Sunshine Cabin	Guest Facility	¾”
	Moore Cabin	Guest Facility	1”

ATTACHMENT 4F

Relevant Sections of the Redwood Glen Technical Report

SECTION 3 Water System Demand

In accordance with California Code of Regulations (CCR), Title 22, Division 4, Chapter 16 Waterworks Standards §64554, the average daily demand (ADD) and maximum daily demand (MDD) were determined for the Redwood Glen system in order to understand the system demands and establish the source capacity requirements for Redwood Glen.

Redwood Glen provided historical monthly water usage records for the past 10 years (from 2006 to present). Data from 2006 through 2008 was uncharacteristically elevated due to a special school program that ran throughout the year, and which no longer occurs,[4] while data from 2014 was unusually low and incomplete[5]. After discussion with the State, it was determined that these values were not representative of system demands and would not be included in ADD and MDD calculations. The ADD and MDD calculations are included in the section below.

3.1 Average Daily Demand

The ADD was calculated from six (6) years of demand data: 2009 through 2013, and 2015, which are the same values utilized in the initial submission of the SWAA (June 2016) and the submission of the SWAA Addendum (December 2016). Based on these values, the ADD was calculated to be 3,578 gpd, or 2.5 gpm. The distribution of average monthly demand for these six (6) years is included below in Table 5. See Attachment 3 for the raw demand data and demand analysis.

[4] Average annual demands are approximately 1MG (~83%) higher from 2006-2008 in comparison to 2009-2015 (2.2M versus 1.2M), and are not representative of typical demands on the water system.
[5] Incomplete due to water being imported that year and not having complete records.

Table 5 Monthly Distribution of Average Daily Demand (ADD)

Month	Monthly Average Daily Demand (2009-2013 & 2015)	Monthly Average Daily Demand (2009-2013 & 2015)
	gallons	*gpm*
January	96,285	2.2
February	77,296	1.9
March	95,705	2.1
April	122,432	2.8
May	108,817	2.4
June	138,577	3.2
July	168,102	3.8
August	161,224	3.6
September	99,540	2.3
October	106,054	2.4
November	67,202	1.6
December	64,719	1.4
Average	***108,829***	***2.5***

3.2 Maximum Daily Demand

The MDD was calculated based on the CCR Section § 64554(b)(2), utilizing the maximum month calculation. Table 6 presents the maximum month demand for each month of the year based on historical data from 2009-2013 and 2015. Using this calculation, the highest monthly usage that occurred during the period of analysis was reported in July 2011, and equates to 230,010 gallons, or a maximum month average daily demand (MMD) of 7,420 gpd (5.2 gpm).

Table 6 Distribution of Maximum Month Demand (MMD)

Month	Maximum Monthly Demand (2009-2013 & 2015)	Maximum Monthly Demand (2009-2013 & 2015)
	Gallons	*gpm*
January	108,310	2.4
February	147,431	3.6
March	130,077	2.9
April	161,568	3.7
May	129,718	2.9
June	189,244	4.4
July	230,010	5.2
August	191,787	4.3
September	132,300	3.1
October	145,561	3.3
November	98,550	2.3
December	81,300	1.8

A factor of safety was added to the calculated MMD to account for possible growth and/or source failure. The factor of safety was determined through the following methodology:

- **Establish the Adjusted MMD**: An adjusted MMD was calculated by determining the *next highest monthly usage* from the data that was omitted for the "elevated years" of usage at Redwood Glen (2006 through 2008). The *next highest monthly usage* reported was in August 2006: 259,107 gallons for an MMD of 8,358 gpd (5.8 gpm).
- **Calculate the Adjusted MDD**: An adjusted MDD was calculated by multiplying the adjusted MMD (8,358 gpd, or 5.8 gpm) by 1.5, equating to a revised MDD estimate of 12,537 gpd, or 8.7 gpm. This equates to a 1.0 gpm increase over the initial MDD rate of 7.7 gpm.

See Attachment 3 for the raw demand data and the demand analysis.

3.3 Future Demand

There is no anticipated growth over the next 10 years at the Redwood Glen Camp and Conference Center. Furthermore, there is no anticipated increase in water demand on the Redwood Glen water system.

However, the SWRCB indicated a factor of safety should be applied to "account for possible future growth," and per the previous section, this is accounted for in the revised MMD calculation of 5.8 gpm and the revised MDD calculation of 8.7 gpm. These values will be utilized in the supply availability and storage analysis that follows.

3.4 Demand Used for Analysis

As noted above, establishing the demand of Redwood Glen's system is critical in determining the adequacy of supply. The demands used for the supply adequacy analysis (included in Section 4.4) were based on real monthly data for the Redwood Glen system with added factors of safety, as follows:

- The maximum monthly demands over the historical demand data set (2009 - 2013 & 2015, Section 3.2) were used for each month, with 5% losses added to the demands to account for losses in the distribution system and in the operations of the treatment plant[6].
- The adjusted MDD (explained in Section 3.2) was was used for three (3) months of the year (June, July, and August), instead of just the month of August. Losses of 5% were added to these demands as well to account for losses in the distribution system and in the operations of the treatment plant.

Table 7 includes the water demands used for the adequacy of supply calculation included in the following section.

[6] As requested by the State in their response to the SWAA Addendum, December 2016.

Table 7 Redwood Glen Design Water Demands

Month	Water Demands	Water Demand with 5% Losses
	gpm	*gpm*
January	2.4	2.5
February	3.6	3.8
March	2.9	3.1
April	3.7	3.9
May	2.9	3.1
June	5.8	6.1
July	5.8	6.1
August	5.8	6.1
September	2.3	3.2
October	2.4	3.4
November	1.6	2.4
December	1.4	1.9

SECTION 4 Availability of Source Water

Surface water supply is available to Redwood Glen from two (2) creeks to which the camp holds the rights: Hoffman Creek and Piney (or Pioneer) Creek. Updated information regarding the water rights and source water availability is included in the sections below.

4.1 Hoffman Creek

From 1958 to 1995, Redwood Glen (at that time ABCW) utilized Hoffman Creek for domestic purposes to serve a non-transient non-community (NTNC) public water system, providing water for up to 250 persons. Historical documentation notes that the Hoffman Creek water system served the lodges, residences, and campgrounds on site. During this time, records indicate they utilized their full allotment of 8 acre-feet per year (average of 5 gpm or 7,200 gpd, for a total of approximately 2.6 million gallons per year). In 1995, Redwood Glen ceased utilizing Hoffman Creek for their domestic purposes, and began purchasing water from Memorial Park. Since this time, Redwood Glen has utilized the Hoffman Creek water right for irrigation purposes only.

There are two (2) existing diversion structures, and 1,800 feet of raw water transmission line that currently delivers water from the upper diversion structure ("diversion sink") to Redwood Glen facilities for irrigation purposes. Given the existing infrastructure, water rights, recorded flows, and water quality, Hoffman Creek was deemed a viable surface water source for Redwood Glen. The sections below detail the water rights, surface water yield, and water quality results for Hoffman Creek.

4.1.1 Water Rights

Further investigation was conducted as to the Hoffman Creek water rights held by Redwood Glen. It was determined that Redwood Glen holds riparian rights to Hoffman Creek, allowing the camp to utilize water available in Hoffman Creek instantaneously, as well as store up to 10,000 gallons of its water with their existing riparian water right. As noted above, Redwood Glen has historically utilized 8-acre-feet per year (or 2.6 MG) of flow from Hoffman Creek, as per their Statement of Diversion and Use filings with the State (Attachment 4). Given the water rights findings for Hoffman Creek, this source will remain a primary source for the Redwood Glen system, however, the inability to store large amounts of water from the creek will influence the design and operation of the system. The water rights documentation for Hoffman Creek is included as Attachment 4.

4.1.2 Source Capacity

Balance Hydrologics has been evaluating the source capacity of Hoffman Creek since April 2016. Since April, Balance recorded regular measurements of flow at the Wright Way road culvert, and the two existing points of diversion - the "diversion sink" (upper diversion) and an in-stream diversion structure (lower diversion). The USGS bucket-wheel current-meter methods and/or bucket-and-stopwatch method were utilized to take these measurements.

Balance established monthly reliable yields for the two (2) diversion points in both a dry year (41% of mean flow) and regular year (92% of mean flow). The dry year values, which will be used for the purposes of the supply reliability and storage analysis, are included in Table 8, below. Attachment 5 includes the *Streamflow Measurements and Source Capacity Estimates at Redwood Glen* memorandum prepared by Balance for both Hoffman Creek and Piney Creek. As per the additional requirements of SB 1263, Table 8 presents the Hoffman Creek's monthly reliable yields for the single extreme dry-year and the multi-dry year scenarios. Attachment 6 is the Amendment to the *source capacity estimates at Redwood Glen* prepared by Balance and includes the data related to the single extreme dry-year and multi-dry year scenarios.

Table 8 Hoffman Creek Monthly Reliable Yields at Upper POD
Normal Dry-Year (Water Year 2015), Single Extreme Dry-Year (Water Year 2014) & Multi Dry-Year Scenarios (Water Years 2012-2014)

Month	Water Year 2012 (gpm)	Water Year 2013 (gpm)	Water year 2014 (gpm)	Water Year 2015 (gpm)
January	21	61	3	30.7
February	12	22	12	92.1
March	194	18	18	22.0
April	113	15	12	16.1
May	23	7	4	11.2
June	11	5	3	6.8
July	7	4	3	3.9
August	5	3	2	2.6
September	4	3	2	2.3
October	10	5	3	2.3
November	11	28	5	5.7
December	9	345	5	263

4.1.3 Water Quality

The raw water quality analysis performed in August 2015 for Hoffman Creek (Attachment 7) confirmed that all water quality constituents tested in the source water are below levels of concern or required treatment. The measured concentration of total dissolved solids (TDS) is slightly lower than the recommended maximum concentration level for drinking water of 500 mg/L. Although turbidity was only measured at 0.1 NTU, it is anticipated that turbidity will be a more substantial concern in the winter months.

Although the reported concentrations of total organic carbon (TOC) and dissolved organic carbon (DOC) levels were low, there is a possibility for disinfection by-products (DBPs) formation due to the potential for long contact time between chlorine and water during the low demand season. It is difficult to establish the potential for DBP formation prior to operating the water system with a new source of water, however all water quality concerns are being evaluated for the recommended design.

4.1.4 Source Water Assessment

The watershed for the upper point of diversion includes approximately 117 acres. The point of diversion is located in a non-urban, remote, wooded and mountainous headwaters area and is only accessible through a dedicated hiking trail with semi-controlled access by Redwood Glen staff. No possible contaminating activities (PCAs) that might affect water quality have been identified within the watershed. The source water assessment conducted by Balance Hydrologics is included in Attachment 8 and is based on previous studies, field visits, meetings with system operator and manager, site reconnaissance and flow measurements.

4.2 Piney Creek

Piney Creek was evaluated as a potential surface water source for the new water system in the initial SWAA (June 2016). However, at the time of the initial SWAA, Piney Creek was not considered as a viable source for the camp as it was indicated that there were no existing diversion structures in the creek. Based on this information, it was determined that the permitting process timeline for new diversion structures would not have met the State deadline for Redwood Glen to have a permitted water system[7].

In October 2016, it was brought to the attention of SRT by Redwood Glen staff that two (2) known diversion structures exist and are associated with the approved point(s) of diversion for Piney Creek. The diversion structures, which consist of two concrete basins and pipe outlets, were inspected by SRT and deemed appropriate for use. It was established that both diversion structures are a part of the State-approved “lower POD”, or “Diversion #2”, as shown on the map submitted with the

[7] If new diversion structures needed to be added to the Piney Creek, it was anticipated that the environmental permitting process would have taken at least 12 months.

1980 application to add a point of diversion (see Attachment 9). For the purposes of this report, the diversion structures will be considered the “Lower Piney POD”.

An existing 2-inch raw water pipeline was also identified by Redwood Glen staff and SRT, which at one time connected Piney Creek’s diversion structures to Redwood Glen’s water system. The Piney Creek transmission line is in disrepair, however, it can be rehabilitated and/or replaced for immediate use. Due to the confirmation of the existing diversion structures and the raw water transmission pipe, Piney Creek is now considered a viable surface water source for Redwood Glen.

4.2.1 Water Rights

Redwood Glen holds appropriative rights License No. 11116 to divert water from Piney Creek at a rate not to exceed 0.042 cubic feet per second (19 gpm or 27,000 gpd) from January 1 to December 31, and not to exceed 24 acre-feet per year (Permit No. 16745, Application No. 24192). Appropriative rights also allow Redwood Glen to store an unlimited amount of raw water from Piney Creek, which will likely be important during the summer months given that significant raw water storage from Hoffman Creek is not permitted. The water rights documentation for Piney Creek is included in Attachment 4.

4.2.2 Source Capacity

Balance Hydrologics has been evaluating the source capacity of Piney Creek since April 2016. Since April, regular measurements of flow were recorded by Balance at the Haul Road culvert, and the two (2) existing diversion structures, which are both considered part of the State-approved Lower Piney POD. The USGS bucket-wheel current-meter methods and/or bucket-and-stopwatch method were utilized to take these measurements.

Balance established monthly reliable yields for the two (2) diversion structures located at the approved POD in both a dry year (41% of mean flow) and regular year (92% of mean flow). The dry year values, which will be used for the purposes of the supply reliability and storage analysis, are included in Table 9, below. Attachment 5 includes the *Streamflow Measurements and Source Capacity Estimates at Redwood Glen* memorandum prepared by Balance for both Hoffman Creek and Piney Creek. Attachment 6 is an Amendment to the source capacity estimates and includes the reliable yields of the single extreme dry-year and multi-dry year scenarios for Hoffman and Piney Creek. Table 9 shows Piney Creek’s flow data for the single extreme dry-year (Water Year 2014) and the multi-dry year scenario (Water Years 2012 to 2014).

Table 9 Piney Creek Monthly Reliable Yields at Lower POD
Normal Dry-Year Scenario (Water Year 2015), Single Extreme Dry-Year (Water Year 2014) & Multi Dry-Year Scenarios (Water Years 2012-2014)

Month	Water Year 2012 (gpm)	Water Year 2013 (gpm)	Water Year 2014 (gpm)	Water Year 2015 (gpm)
January	7	13	4	8.0
February	5	7	5	17.5
March	33	6	6	6.6
April	21	6	5	5.7
May	7	5	4	4.9
June	5	4	4	4.4
July	5	4	4	3.9
August	4	4	4	3.7
September	4	4	4	3.5
October	5	4	4	3.6
November	5	8	4	4.2
December	5	58	4	44.6

4.2.3 Water Quality

A water quality sample was taken from the composite flows from both diversion structures in Piney Creek, as this was considered the best representative sample of the Lower Piney POD raw water quality source. Both iron (Fe) and manganese (Mn) concentrations exceed the maximum contaminant level (MCL) for the constituents: Fe is reported at 1058 ppb (MCL of 300 ppb) and Mn is reported at 177 ppb (MCL of 50 ppb). The measured concentration of total dissolved solids (TDS) is slightly lower than the recommended maximum concentration level for drinking water of 500 mg/L and a turbidity level was reported at 6.7 NTU.

Based on the water quality results from Piney Creek, it is expected that specific pre-treatment processes targeting iron and manganese will be required in the system design. Similar to Hoffman Creek, the reported concentrations of total organic carbon (TOC) and dissolved organic carbon (DOC) levels were low, there is a possibility for DBP formation due to the potential for long contact time between chlorine and water during the low demand season. It is difficult to establish the potential for DBP formation prior to operating the water system with a new source of water, however all water quality concerns are being evaluated for the recommended design. The water quality report for the Piney Creek composite sample is included in Attachment 7.

4.2.4 Source Water Assessment

The watershed for the Piney Creek includes approximately 19 acres. The point of diversion is in a non-urban, remote, wooded and mountainous headwaters area on private property and is only accessible through a dedicated hiking trail with controlled access by Redwood Glen staff. No possible contaminating activities (PCAs) that might affect water quality have been identified within the watershed. The source water assessment (SWA) conducted by Balance Hydrologics is included as Attachment 8 and is based on based on previous studies, field visits, meetings with the system operator and manager, site reconnaissance and flow measurements.

4.3 Summary of Source Water Available

Significant surface water is available to Redwood Glen through Hoffman and Piney Creek. Both are important water sources for the Redwood Glen water system:

- Hoffman Creek can provide Redwood Glen with high quality water through infrastructure in need of very minimal repairs, while
- Piney Creek can provide Redwood Glen with raw water that can be stored through the summer months based on the existing appropriative water rights.

The total surface water available to Redwood Glen is presented in Table 10, below. Hoffman Creek water will be utilized before Piney Creek water in order to minimize treatment requirements and to fully utilize Redwood Glen's riparian right to the creek. It is anticipated that Hoffman Creek will be the primary water source of the system through the fall, winter, and spring months. A supply and demand comparison for the water system will be presented in Section 4.4.

Table 10 Monthly Surface Water Flows Available
(Water Year 2015, Normal Dry Year, 41% of mean flow)

Month	Hoffman Creek Flow at Upper POD (gpm)	Piney Creek Flow at Lower POD (gpm)	Total Surface Water Supply Available (gpm)
January	30.74	7.97	38.71
February	92.13	17.47	109.60
March	22.03	6.61	28.64
April	16.07	5.69	21.76
May	11.17	4.93	16.10
June	6.81	4.38	11.19
July	3.88	3.95	7.83
August	2.63	3.69	6.32
September	2.32	3.55	5.87
October	2.27	3.58	5.85
November	5.75	4.19	9.94
December	263.3	44.56	307.86

4.4 Determination of Adequate Supply

A supply and demand comparison was conducted for the Redwood Glen system to determine if raw water storage would be necessary to meet the maximum demands. Monthly surface water yield data (see Sections 4.1 - 4.3) was compared with the historical maximum monthly demand (MMD) values for the low season, and the MMD (5.8 gpm) for the high season (see Section 3 and Table 11 below). This supply versus demand comparison was based only on the combined surface water yields from Hoffman Creek and Piney Creek to determine if the Redwood Glen water system could rely strictly on its surface water sources.

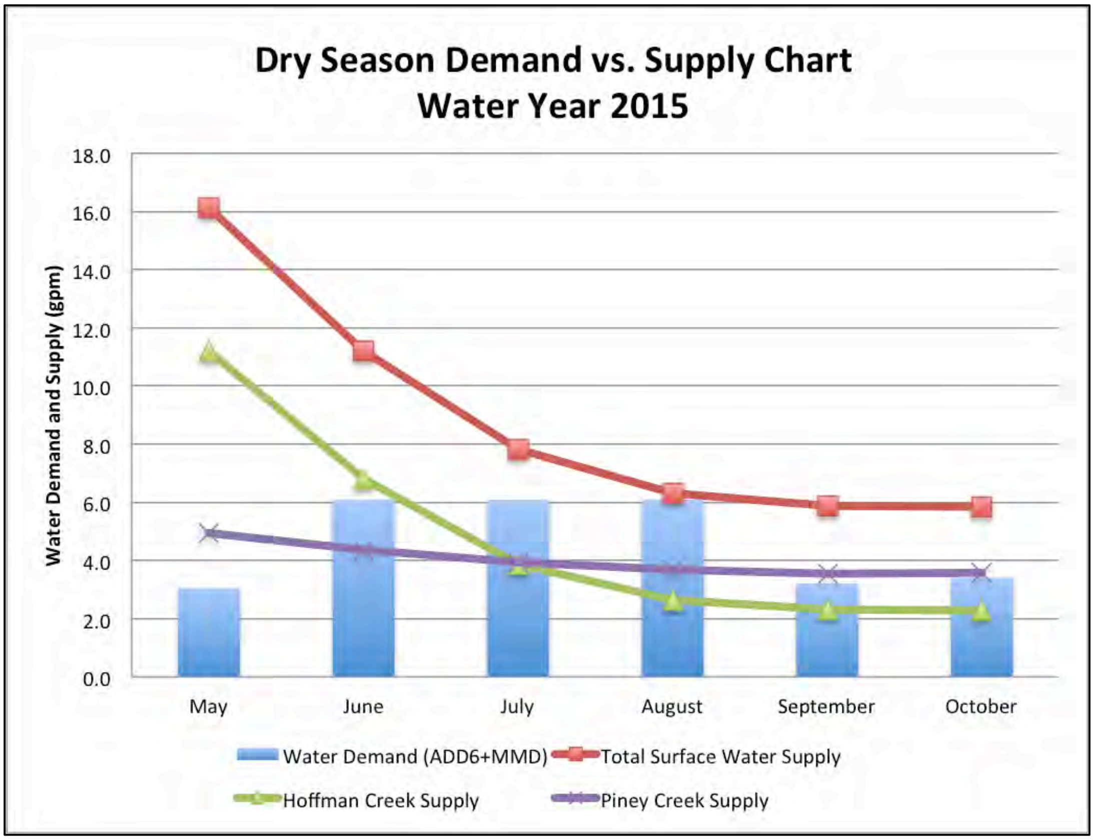
Table 11 Water Demand and Normal Dry-Year Supply Comparison

Month	Water Demand & Losses[1] (gpm)	Hoffman Creek Flow (gpm)	Piney Creek Flow (gpm)	Total Surface Water Supply (gpm)	Rate Deficiency (gpm)
January	2.5	30.7	8.0	38.7	--
February	3.8	92.1	17.5	109.6	--
March	3.1	22.0	6.6	28.6	--
April	3.9	16.1	5.7	21.8	--
May	3.1	11.2	4.9	16.1	--
June	6.1	6.8	4.4	11.2	--
July	6.1	3.9	3.9	7.8	--
August	6.1	2.6	3.7	6.3	--
September	3.2	2.3	3.5	5.9	--
October	3.4	2.3	3.6	5.9	--
November	2.4	5.7	4.2	9.9	--
December	1.9	263	44.6	307.6	--

[1]As mentioned in Section 3, the demands have been calculated based on the historical data over 6 years (2009-2013 & 2015) and the corrected MMD of 5.8 gpm was assumed for 3 months of the year (June, July and August) as a conservative measure, instead of just for the maximum month of August. Additionally, 5% of losses were added to the demand values, as requested by the State and as explained in Section 3.4.

Based on the results presented above (Table 11), it appears that the surface water sources are adequate to cover the demands. Hoffman Creek's flow is sufficient to supply all of Redwood Glen's demand from November to May. As shown in Figure 1, from May to October, Piney Creek can provide the required flow to match the system's demand. Further analysis regarding the available supply and required raw water storage is included in Section 5.4, below.

Figure 1 Demand vs. Supply from May to October



The State issued a letter on January 6, 2017, which recognizes that Redwood Glen's two surface water sources "*would provide sufficient supply to meet demand for the Center*." The State nonetheless expressed concerns that Hoffman Creek and Piney Creek may only provide marginal supply during the dry season. Once the system is up and running, the monitoring and recording of the surface water supply from both sources and of the camp's demands will inform potential future improvements to the system and the development of additional sources of water, if needed.

4.4.1 Single Extreme Dry-Year and Multi-Dry Year Analysis

To comply by SB 1263, the evaluation of Redwood Glen's available supply also included the analysis of single dry-year and multi-dry year scenarios to comply with SB 1263, as described in Attachment 6.

The single extreme dry-year scenario is presented in Table 12, based on data for the water year 2014. A slight shortage of surface water supply occurs over the month of August. In this extreme scenario, approximately 4,500 gallons of water is required from the 70,000-gallon raw water storage tank to bridge the deficit. Based on this conservative analysis, the 70,000-gallon raw water tank provides ample supply in the case of an extreme dry-year scenario.

Table 12 Water Demand and Single Extreme Dry-Year Comparison

Month	Water Demand[1] (gpm)	Hoffman Creek (gpm)	Piney Creek (gpm)	Total Surface Water Supply (gpm)	Deficiency (gallons)
January	2.5	3	4	7	--
February	3.8	12	5	17	--
March	3.1	18	6	24	--
April	3.9	12	5	17	--
May	3.1	4	4	8	--
June	6.1	3	4	7	--
July	6.1	3	4	7	--
August	6.1	2	4	6	4,464
September	3.2	2	4	6	--
October	3.4	3	4	7	--
November	2.4	5	4	9	--
December	1.9	5	4	9	--

[1]As discussed in Section 3, the demands have been calculated based on the historical data over 6 years (2009-2013 & 2015) and the adjusted MMD of 5.8 gpm was assumed for 3 months of the year (June, July and August) as a conservative measure, instead of only for the maximum month of August. Additionally, 5% of losses were added to the demand values, as requested by the State and as explained in Section 3.4.

A similar analysis was performed for the multi-dry year scenario (water years 2012 to 2014) and it revealed that there is no water deficit occurring during the water years 2012 and 2013. Additionally, the supply of water from Hoffman Creek and Piney Creek over the wet months is consistently more than what is needed to refill the 70,000-gallon tank and to supply Redwood Glen's low-season demand from a water year to the next. Therefore, the water deficit for the multi-dry year scenario only occurs during water year 2014, which represents the single extreme dry-year scenario. As such, the deficit of water throughout the dry season never exceeds 4,500 gallons of water, which is easily available in the 70,000-gallon tank.

The analysis confirmed that the surface water sources and the 70,000-gallon tank can provide adequate supply for Redwood Glen's facilities. Attachment 6 includes the multi dry-year analysis from 2012 to 2014, which also shows the single extreme dry-year scenario (Water Year 2014).

ATTACHMENT 4G

Plan to Obtain Additional Water Rights

REDWOOD GLEN
ADDITIONAL WATER RIGHTS PLAN

Due to the regulatory conditions and schedule surrounding the design and construction of Redwood Glen's water system, viable water supply sources have not been pursued given the likelihood that substantial permitting would be required. However, Redwood Glen would potentially pursue these options after an initial water system has been designed and approved by the State Water Resources Control Board.

Specifically, Pescadero Creek is the border of Redwood Glen property at Indian Point, and Redwood Glen has the riparian right to withdraw water from Pescadero Creek at this location. Additionally, Redwood Glen would pursue the option to moving their appropriative right to Piney Creek, a tributary to Pescadero Creek, to this proposed Indian Point point of diversion (POD). The Piney Creek appropriative right would allow Redwood Glen to withdraw enough surface water to meet the MDD of the system. This water source option has not been pursued due to scheduling constraints of this project and the anticipated environmental and legal permitting that would be required to have a new POD on Pescadero Creek. However, should it be necessary to meet system demands, Redwood Glen would further establish water rights at the Indian Point location and connect this source to the existing water system.

ATTACHMENT 5

Operations Plan

WATER SYSTEM OPERATIONS PLAN

Redwood Glen Camp and Conference Center
PWS No. 4100522

Prepared by:

SRT consultants

For submittal to:
State Water Resources Control Board
Division of Drinking Water

May 2017

List of Attachments

A. Water System Map
B. Water System Plans
  - Process Flow Diagram
  - Process & Integration Diagram
C. Membrane Filtration System Manual
D. Iron and Manganese Oxidation/Filtration Unit Specifications & Manual
E. Backwash Recycling Calculations
F. Water Quality Monitoring Plan
G. Bacteriological Site Sampling Plan
H. Emergency Notification Plan

1. PURPOSE AND GOALS

The purpose of this Operations Plan is to provide a clear operational overview of the surface water treatment and distribution system for the Redwood Glen Camp & Conference Center (Redwood Glen). Redwood Glen is seeking classification as a new Community Water System (CWS) through the State of California.

Redwood Glen is a non-profit camp and conference center located in Loma Mar, California, operated by the Redwood Glen Board of Directors. Redwood Glen is located on 165 acres in the Santa Cruz Mountains, ten (10) miles from the Pacific Ocean in San Mateo County (SMC). The camp has lodging, a large kitchen, and bathroom facilities, and can serve a maximum capacity of approximately 300 people.

1.1 Water Quality Goals

The drinking water quality goals are the following:

1. Maintain turbidity in the SWTP effluent below the following:
    - 0.1 NTU on 95% of monthly measurements,
    - 1.0 NTU for two consecutive 15-minute discrete readings.
2. Maintain chlorine residual between 1.0 mg/L and 2.0 mg/L in finished water, and
3. Maintain chlorine residual levels between 0.2 mg/l and 1.5 mg/l throughout the distribution system.
4. Maintain distribution system TTHM and HAA5 concentrations under 0.08 mg/L and 0.06 mg/L, respectively.
5. Maintain compliance with all Title 22 maximum contaminant levels (MCLs) and secondary maximum contaminant levels (SMCLs).

2. WATER SYSTEM DESCRIPTION

The Redwood Glen water system includes the following transmission, treatment, storage, and distribution system components:

- Raw water transmission lines from Hoffman Creek and Piney Creek;
- Two (2) 5,000-gallon raw water storage tanks located at the headworks at SWTP;
- One (1) 70,000-gallon raw water storage tank for the storage of Piney Creek water;
- A surface water treatment plant (SWTP), including a Continuous Microfiltration (CMF) unit and disinfection with sodium hypochlorite;
- An iron (Fe) and manganese (Mn) filtration unit for Piney Creek raw water, located on the Piney Creek raw water transmission line;
- One (1) 5,000-gallon treated water contact tank;
- One (1) treated water pump station;
- One (1) treated water transmission line delivering water from the the pump station to the distribution system storage tank;
- One (1) 20,000-gallon distribution system storage tank; and
- A potable water distribution system consisting of one (1) pressure zone and 13 connections.

Generally, the water system delivers water from the sources to the SWTP as follows:

1. Water from Hoffman Creek gravity feeds to two (2) 5,000-gallon tanks located at the headworks of the SWTP;
2. Water from Piney Creek gravity feeds to the SWTP site, first passing through Fe/Mn treatment[1], and subsequently into the two (2) 5,000-gallon tanks located at the headworks of the SWTP;
3. The backwash water from the unit is sent to a settling tank and delivered back to the two (2) 5,000-gallon tanks located at the headworks of the SWTP; and
4. A transfer pump feeds water from the two (2) 5,000-gallon tanks into the skid-mounted break tank of the CMF unit.

Throughout the wet season, the two (2) 5,000-gallon tanks are gravity fed by Hoffman Creek while the water from Piney Creek fills the 70,000-gallon tank. Whenever Hoffman Creek is not able to supply Redwood Glen's full demand, an automated valve allows Piney Creek to feed into the tanks, which are located downstream of the Fe/Mn treatment unit.

Primary treatment and treated water delivery operations take place at the SWTP site and consist of the following:

1. The pump on the membrane unit draws water from the break tank and pushes water through the membrane unit and into the clearwell;

[1] On the Piney Creek raw water line, the iron and manganese treatment unit will be installed upstream of the 5,000-gallon tanks, as noted above.

2. A flow-paced with residual trim chlorine injection system chlorinates the effluent of the membrane unit before the water flows into the 5,000-gallon chlorine contact tank to achieve contact time (CT)[2]; and
3. A VFD-automated pump transfers water from the 5,000-gallon clearwell to the 20,000-gallon potable water storage tank, while maintaining a constant water level in the clearwell and ensuring continuous CT.

The expected typical operating range of the SWTP is 7 to 15 gallons per minute (gpm), with a peak flow rate of 20 gpm. The operating flow rate of the SWTP can be adjusted based on the number of hours per day that Redwood Glen operations staff deems suitable for the maximum efficiency of the water system. The water level in the 20,000-gallon potable water tank triggers the treatment plant to turn on and off through set electric float levels and ensure that there is enough water in the tank to cater to Redwood Glen's demand at all times. A map of Redwood Glen's water system is included as Attachment A to this Operations Plan.

[2] The contact time will be achieved continuously and the compliance point, where the contact time (CT) will be calculated and confirmed, will be located at the outlet of that clearwell.

3. Water System Operations

The Redwood Glen Water System is controlled through three (3) programmable logic controllers (PLCs). The system's P&ID is included in Attachment B. The PLC provided with the CMF unit controls all aspects of the ultrafiltration unit operations. All external plant devices and instruments are controlled by a separate PLC located at the plant. A third PLC is located at the tanks site and controls the remaining instruments located in the vicinity of the tanks. The PLCs communicate with each other via radio or via ethernet wire, when possible. If a failure is detected by any of the PLCs, the system is automatically shut down until the problem is identified and corrected by the operator.

3.1 Raw Water Operation and Source Selection

There are four (4) available sources of water that can feed the SWTP: Hoffman Creek, Piney Creek direct feed, and Piney Creek raw water storage, and recycled backwash.

3.1.1 Hoffman Creek

For supply by Hoffman Creek, water is delivered from the diversion structure (el. 533) to the raw water storage facilities (5,000-gallon tanks, el. 348) through 1,800 feet of 1.25-inch transmission main and 2,220 feet of 2-inch high-density polyethylene (HDPE) transmission main. See Attachment A for a depiction of the Hoffman Creek water transmission facilities and Attachment B for the P&ID.

3.1.2 Piney Creek Direct Feed

For supply by Piney Creek, water is delivered from the diversion structures (el. 595) to the raw water storage facilities (5,000-gallon tanks, el. 348) through a 2-inch, 3,120-foot HDPE raw water transmission line. Raw water from Piney Creek passes through Fe/Mn treatment at the SWTP site prior to being delivered to the 5,000-gallon raw water feed tanks. See Attachment A for a depiction of the Piney Creek water transmission facilities and Attachment B for the P&ID.

3.1.3 Piney Creek Raw Water Storage

An additional raw water transmission line splits off of the Piney Creek line and connects to the 70,000-gallon raw water storage tank, acting as the common inlet and outlet to the 70,000-gallon raw water tank. The manual ball valves on the transmission lines allow Piney Creek to fill the 70,000-gallon tank during the wet season and to feed into the two (2) 5,000-gallon tanks at the SWTP site during the dry season. Raw water from the 70,000-gallon storage tank passes through Fe/Mn treatment at the SWTP site prior to being delivered to the 5,000-gallon raw water feed tanks. See Attachment A for a depiction of the Piney Creek raw water storage and transmission facilities and Attachment B for the P&ID.

An automated valve at the end of the Piney Creek transmission line regulates the flows from Piney Creek (directly) and the 70,000-gallon raw water storage tank. An automated valve is located on the common inlet/outlet of the 70,000-gallon tank and is controlled based on the pressure measured by two (2) pressure transducers on the line (See Attachment B). The valve opens when the pressure in the Piney Creek line drops lower than the static pressure at the tank. A manual ball valve on the common inlet/outlet of the 70,000-gallon tank allows the tank to be put offline when required, without stopping the flow from Piney Creek to directly feed into the 5,000-gallon tanks.

3.1.4 Backwash Recycling

The backwash water from the CMF is recycled and sent back to the 5,000-gallon tanks after a settling period. During the backwash cycle, the valve on the line between the CMF and the backwash settling tank opens and the backwash water is sent to a 2,000-gallon conical tank. The backwash water is returned to the two (2) 5,000-gallon raw water feed tanks after a settling period, allowing for the necessary drop in turbidity of the backwash water. The particles have the ability to settle, without any inflow disturbances, when the treatment plant is not operating. A flow meter and an automated valve on the return line controls the volume of backwash water sent at once to the two (2) 5,000-gallon tanks. See Attachment B for the P&ID.

3.1.5 Source Selection Operational Strategy

The feed from each of the sources listed above is automated based on the water level in the two (2) 5,000-gallon tanks, which is measured with a submersible pressure transducer. Raw water feed is automated as follows:

- **Hoffman Creek** - Throughout most of the year, the flow from Hoffman Creek is sufficient to meet the camp's demands. The valve on the Hoffman Creek line remains closed as long as the water level in the 5,000-gallon tanks is higher than the high set-point. When the water level in the two (2) feed tanks reaches below this high set-point, the valve on the Hoffman Creek line opens and Hoffman feeds the 5,000-gallon tanks.
- **Piney Creek Direct Feed** - During the dry season, when Hoffman Creek alone cannot supply Redwood Glen's demand, Piney Creek direct feed begins to fill the raw water tanks. When the water level drops below the low set-point, the valve that allows water from Piney to flow into the 5,000-gallon tanks opens and both Hoffman and Piney Creek are directly feeding the raw water storage tanks.
- **Piney Creek Raw Water Storage** - When the pressure from Piney Creek's flow drops lower than the static pressure in the full 70,000-gallon tank, an informational alarm is generated and the valve on the common inlet/outlet to the 70,000-gallon tank opens to allow the water from the tank to flow into the two (2) 5,000-gallon feed tanks. At this point, Hoffman Creek and the Piney Creek raw water storage tank are both feeding the raw water storage tanks.[3]

[3] Raw water is still flowing from the Piney Creek direct feed line, however, it will likely not be filling the raw water storage tanks until the head of the direct feed line is able to overcome the head from the raw water storage tank.

An informational alarm is also generated when the water level in the 70,000-gallon tank reaches a low set-point. The water level in the 70,000-gallon raw water tank is measured using an inline pressure transducer located on the outlet of the tanks.

- **Backwash Recycling** – Flow from he backwash recycling feed is controlled as follows:
  - An automated valve on the downstream end of the feed line between the conical tank and the raw water tanks opens every morning before the plant starts operating and is closed throughout the rest of the day. A flow meter is located on this line and controls the valve in order to limit the volume of backwash water sent at once to the 5,000-gallon tanks to 535 gallons, which represents the maximum daily volume of backwash (MDD conditions). This limit ensures that the recycled flows are never over 10% of the raw water feed tanks.
  - In order to prevent overflow in the 5,000-gallon tanks, the high level set-point in the tanks that triggers the automated valves on the tanks' feed lines (from Hoffman Creek and Piney Creek) to close is set to allow 5.5 inches of headroom, ensuring that the maximum returned amount of backwash allowed (535 gallons) does not overflow the tanks. This control reserves enough headroom for recycled backwash in the raw water feed tanks at the beginning of the day, after the tanks have been filling up all night.
  - A turbidimeter is located on the downstream end of the feed line between the conical backwash tank and the raw water tank. The valve that controls this feed line closes should the turbidity reach the high set-point.

Totalizing flow meters record the flow of the sources described above. Data obtained from the source water flow meters provides insight into Redwood Glen's actual supply and system losses, as well as information critical to the operational philosophy of the SWTP. Totalizing flow meters are installed at the following locations:

- On Piney Creek raw water line, just upstream of the two (2) 5,000-gallon raw water storage tanks;
- On Hoffman Creek raw water line, just upstream of the two (2) 5,000-gallon raw water storage tanks; and
- On the return line from the backwash settling tank, just upstream of the two (2) 5,000-gallon raw water storage tanks.

3.2 Surface Water Treatment Operations

The sources described above feed membrane, disinfection, and Fe/Mn treatment facilities located at the SWTP site, as depicted on Attachment A. The sections below describe the operation of the treatment facilities.

3.2.1 Membrane Filtration

The SWTP includes a microfiltration (MF) membrane unit to remove the turbidity from the raw water. The CMF membrane unit is a packaged, factory-assembled skid that includes four (4) membrane modules, a break tank, a feed pump, piping, valves, instrumentation, a PLC, and a control display. The package is a Memcor CMF unit and the membrane modules are Memcor L10N modules. An actuated valve automatically opens and allows water to fill the feed tank when the water level is running low. The skid-mounted feed pump draws water from the feed tank and pushes it through the hollow fiber membrane cartridges. Turbidity is continuously monitored upstream and downstream of the MF membrane unit. Additional information on the CMF unit and membrane modules is included as Attachment C to this Operations Plan.

The CMF process utilizes hollow fiber membranes to provide a self-cleaning system that can maintain high flow rates by means of the unique low-pressure liquid backwash. The filtration occurs as liquid passes from the outer surface of the fiber (Shell Side) to the hollow inner core (Lumen). Feed liquid passes through the porous wall of the fibers as suspended matter remains on the shell side. This filtration process removes solids larger than approximately 0.1 microns.

Table 1, on the following page, lists the maximum allowable values for the operating and quality control parameters of the CMF membrane unit installed at Redwood Glen. The operating parameters listed in Table 1 are in conformance with the conditions listed in the challenge testing condition and therefore the proposed CMF membrane unit is credited with the following log inactivation credits:

- 4-log inactivation credit for *Giardia lamblia* cysts;
- 1-log inactivation credit for viruses; and
- 4-log inactivation credit for *Cryptosporidium* cysts.

Table 1 System Operating Parameters

Operating Parameter	Maximum Value
Flow (at 20°C)	5.5 - 7 gpm per L10N module
Maximum Housing Pressure	75 psi
Transmembrane Pressure (TMP)	22 psi @ ≤ 30°C 17 psi @ > 30°C
Turbidity	0.1 NTU on 95% of monthly measurements Not to exceed 1.0 NTU for two consecutive 15 minute discrete readings
Membrane Integrity Test (MIT) Ending Pressure to Maintain Resolution of 3 µm	≥ 12.1 psi; Θ = 50° with Θ = liquid-membrane contact wetting angle
MIT Upper Control Limit	1.5 psi/min
Quality Control Release Value (QCRV)	6 sec/mL

Membrane Maintenance

The MF membranes are automatically backwashed with compressed air to keep the Transmembrane Pressure (TMP) within the allowable range. The waste stream generated by the membranes' backwash is directed to a settling tank and its supernatant is directed back into the two (2) 5,000-gallon raw water feed tanks. The solids at the bottom of the tank are periodically hauled off site.

The membranes are periodically Cleaned-In-Place (CIP) using NSF Standard 60 certified chemicals. The CIP function is an operator-initiated task of the CMF unit's programming. The CIP frequency depends on field parameters (including the feed water quality) and is field-adjusted at the time of start-up. CIP procedures for the Redwood Glen SWTP are included in Section 4.1.

The CMF unit includes automatic pressure decay *Membrane Integrity Testing* (MIT). MIT is automatically run every 24 hours of filtration time (run time). The operator can also trigger the test to occur at any time, as necessary. The pressure decay test is based on the expectation that the low-pressure air should not pass through the membrane; instead, the low-pressure air should gradually dissolve in the water if the membranes are operating as designed. During the test, the lumens are drained and the filtrate side of the membrane is pressurized with low-pressure compressed air. Then, the supply of compressed air is shut off and the test measures the rate of pressure drop over two minutes. Procedures for the MIT alarms are included in Section 7.4.

3.2.2 Disinfection and Contact Time

The new SWTP includes disinfection treatment after the CMF unit, which is designed and operated to provide the following:

- A chlorine residual in treated water between 1.0 mg/L and 2.0 mg/L when leaving the disinfection facilities at the treatment plant;
- 0.5 log inactivation for Giardia lamblia cysts; and
- 4.0 log inactivation for viruses.

Disinfection treatment facilities include an injection metering pump, a 35-gallon sodium hypochlorite solution storage tank, NSF-60 certified 12.5% sodium hypochlorite solution and a 5,000-gallon contact tank. The MF membrane unit effluent is chlorinated using a 12.5% sodium hypochlorite solution before it enters the 5,000-gallon storage tank (clearwell), to achieve the required contact time for proper disinfection. The water level in the contact tank is maintain constant and the contact tank is designed to achieve CT by the time the water reaches the outlet of the contact tank and before it is pumped up to the 20,000-gallon potable water distribution system storage tank. The Material Safety Data Sheet (MSDS) of the 12.5% sodium hypochlorite solution is available at the treatment plant.

Chlorine contact time (CT) is critical to ensuring safe drinking water is distributed to customers. Required minimum contact times were calculated for the removal of Giardia and viruses utilizing conservative assumptions. Table 2 presents the minimum CT values corresponding to the bacteriological inactivation performances based on the following assumptions:

- **Water pH, pH** = 7.5, based on pH measurements in both Hoffman and Piney Creek
- **Water temperature, T** = 10°C, based on temperature measurements in both Hoffman and Piney Creek
- **Chlorine residual, C** = 1.0 mg/L
- **Baffling Factor, BF** = 0.1, based on the clearwell configuration

The following formula was used to calculate the contact time requirement for Giardia inactivation:

$$0.2828 * pH^{2.69} * C^{0.15} * 0.933^{(T-5)} * log.removal = 23\ mg.min/L$$ [4]

Table 2 Contact Time Values

Contact Time Value 0.5 log removal for Giardia	Contact Time Value 4.0 log removal for viruses
23 mg*min/L	6 mg*min/L

The calculated contact time was confirmed by the CT log inactivation tables. Since it is required that both of the above inactivation criteria are met, the CT value used to design the contact tanks is Giardia's inactivation contact time, or 23 mg*min/L. To provide for adequate contact time between chlorine and water, the new water treatment plant and treated water pump is run at a constant rate, maintaining a constant level in the contact tank.

A baffling factor of 0.1 is used for the continuous basin disinfection process in the 5,000-gallon clearwell. The continuous volume of water required to achieve CT is calculated considering the following conditions:

- **CT requirement, CT** = 23 mg.min/L
- **Baffling Factor, BF** = 0.1, based on the clearwell configuration
- **Chlorine residual, C** = 1.0 mg/L
- **Max Flow Rate, Q** = 20 gpm, based on the SWTP planned peak flow

The volume of water is calculated according to the equation $CT = BF * C * \frac{V}{Q}$. Based on the most conservative operating conditions of the system (high flow rate, low chlorine residual), the minimum required volume in the clearwell at all times to continuously achieve CT is 4,517 gallons.

The clearwell is kept at the required volume (4,517 gallons) through the automation of the pump that transfers the water from the clearwell to the 20,000-gallon potable water storage tank. The pump is equipped with a variable frequency drive (VFD) that modulates the

[4] Martin, P., "Aqualink - Calculating C x T Compliance", 1993, American Water Works Association Journal, Volume 85, Number 12.

pump's flow rate in order to maintain a constant water level in the tank. The clearwell pump is programmed to turn off when the treatment plant pump turns off.

Treatment Chemicals and Feed Rates

The commercial chemical product utilized for disinfection at the new SWTP is a 12.5% sodium hypochlorite solution. The solution is certified under the NSF Standard 60. Assuming a chlorine dose of 3 mg/L, corresponding to 2 mg/L of chlorine demand and 1 mg/L of chlorine residual, the injection feed rate of 12.5% sodium hypochlorite solution is estimated using the following formulas:

Average Cl_2 required (lb/day) = Average flow rate (MGD) x Dosage (mg/L) x 8.34 (lb/gal)

NaOCl Feed rate (gpd) = Feed rate (lb_{Cl2}/day) ÷ Available chlorine (lb_{Cl2}/gal_{NaOCl})

Where:

Average Flow Rate = 15 gpm

Average Operating Time = 14 hrs/day

Average Daily Flow Rate = 15 gpm x 60 min/hr x 14 hrs/day = 12,600 gpd = 0.0126 MGD

Available Chlorine, 12.5% Solution = 1 lb_{Cl2}/gal_{NaOCl}

Chlorine Dose (mg/L) = *Chlorine Demand (mg/L)* + *Chlorine Residual (mg/L)* = 3 mg/L

Solution:

Required Free Chlorine (lb_{Cl2}/day):

= 0.0126 (MGD) x 3 mg/L x 8.34 (lb/gal) = 0.315 lb_{Cl2}/day

NaOCl Feed rate (gpd):

= Feed rate (lb_{Cl2}/day) ÷ Available chlorine (lb_{Cl2}/gal_{NaOCl}) = 0.315 gpd

For an estimated chlorine demand of 2 mg/L and flow rate of 15 gpm, Table 3 presents the required chlorine dosage and chemical feed rates for chlorine residual concentrations higher than 1.0 mg/L. Chemical feed rates also vary with the flow rate of the SWTP.

Table 3 Chemical Feed Rates at Varied Chlorine Residual Concentrations

Chlorine Residual (mg/L)	*Chlorine Dosage (mg/L)*	*Chemical Feed Rate (gpd)*
1.1	3.1	0.325
1.2	3.2	0.336
1.3	3.3	0.346
1.4	3.4	0.357
1.5	3.5	0.367

Therefore, at minimum (at a chlorine residual of 1 mg/L):

- .5 gallons of 12.5% bleach is needed to treat 20,000 gallons of water;
- .25 gallons of 12.5% bleach is needed to treat 10,000 gallons of water;
- .125 gallons of 12.5% bleach is needed to treat 5,000 gallons of water;
- .0625 gallons of 12.5% bleach is needed to treat 2,500 gallons of water; and
- .025 gallons of 12.5% bleach is needed to treat 1,000 gallons of water.

The expected chlorine demand of 2 mg/L will be verified by trial and error upon startup of the system through dosing and monitoring of the chlorine concentration at key points of the system. Confirmation of the chlorine demand of the potable storage tank and the distribution system will confirm the optimal chlorine dosage concentration specific to Redwood Glen's system.

The chlorine injection point is located inside the SWTP, on the line between the CMF and the clearwell, downstream of the turbidity meter and upstream of the first chlorine analyzer. The metering pump is flow-paced with residual trim to regulate the feed rate of sodium hypochlorite depending on the flow rate of the treatment plant. The rate can be adjusted based on the chlorine concentration downstream of the injection point, in order to maintain a constant chlorine dosage concentration. The chlorinated water is then delivered to the contact tank before passing back through the SWTP for confirmation of adequate post-CT chlorine residual.

3.2.3 Surface Water Pre-Treatment - Iron and Manganese

Given the high Mn and Fe concentrations (1058 ppb and 177 ppb, respectively) in the Piney Creek raw water, a pre-treatment step targeting these constituents is required upstream of the SWTP. The oxidation-filtration unit is NSF-61 certified and includes the following, in series:

1. *A sediment filter:* removes any debris and large particles from the water;
2. *A chlorine injection system which includes a sodium hypochlorite storage tank and a metering pump:* chlorine oxidizes the iron and manganese dissolved in water and causes it to precipitate;
3. *A greensand filter:* the greensand filter removes iron and manganese particulates from the water;
4. *An activated carbon filter:* the activated carbon filter reduces the chlorine concentration of the water exiting the unit to a negligible level before it enters the raw water tanks.

The unit has an automated backwashing cycle, which removes the accumulated Fe and Mn particles from the filter vessels. The frequency of the backwash cycle is programmed in the unit, depending on the predicted water flows and Mn and Fe concentrations, based on the manufacturer's recommendations. The recommended Fe and Mn unit has the specifications to treat Redwood Glen's relatively low flows, contaminant concentrations, and operational needs. It is anticipated that the pre-treatment from Fe and Mn will also result in a reduction in the TDS levels for the Piney Creek raw water.

A bypass of the Fe/Mn unit on the Piney Creek line allows for operational flexibility, since the need for this pre-treatment step is based on a small sample set. The unit can handle significantly higher concentrations of Fe/Mn (up to 10 ppm) and could be bypassed to some extent should the raw water concentrations of Fe and Mn notably decrease. The current design plans for the worst-case scenario with the option for the flow to bypass the Fe/Mn unit as more information is gathered for the Piney Creek raw water quality.

The filtration media and components of the unit will need to be replaced as follows:

- The greensand plus media should be replaced every 12 to 20 years, depending on the usage of the unit and the iron and manganese concentrations of the raw water.
- The activated carbon media should be replaced every 5 years.
- The sediment filter should be replaced every 3 to 6 months, depending of the flow and water quality.

Attachment D includes documentation about the recommended iron and manganese unit, communications with the vendor and the user manual for the system.

3.2.3 SWTP Operations

The following controls and set-points dictate the operation of the SWTP.

- The water level in the 20,000-gallon potable water tank is measured using an inline pressure transducer located on the outlet of the tank. The following set-points are programmed based on the level in the 20,000-gallon tank:
    - Once the water level in the 20,000-gallon potable water tank reaches a low set-point, the water treatment plant turns on, after checking that the water level in the two (2) 5,000-gallon tanks is higher than the low set-point. The VFD-automated treated water pump turns on and fluctuates its speed to maintain a constant water level in the clearwell.
    - When the water level in the 20,000-gallon potable water tank drops below the low-low set-point, an alarm is generated.
    - When the water level in the 20,000-gallon potable water tank reaches a high set-point, the water treatment plant turns off. This action triggers the raw water pump and the treated water pump to turn off as well.
    - If there is a communication failure between the tank site and the treatment plant site (no level data communicated), the treatment plant shuts off.

- The water level in the break tank is measured with instrumentation on the membrane unit. Based on the water level in the break tank:
    - The water level in the break tank on the CMF skid tells the raw water pump and the feed pump to turn on and off, according to three (3) level switches.
    - When the water level in the break tank reaches a low level, the raw water pump turns on (the rate of the raw water pump is at a higher rate than the plant feed pump, to allow the break tank to be refilled while the plant still operates).

    - When the water level in the break tank reaches a low-low level, the feed pump turns off as a protective measure for the feed pump.
    - Once the water level in the break tank reaches a high set-point, the raw water pump turns off.

- The water level in the clearwell is measured with a submersible pressure transducer. Based on the water level in the clearwell:
    - The VFD-automated treated water pump is programmed to fluctuate its speed and maintain a constant water level in the clearwell. This configuration is designed such that the treated water pump matches the rate of the CMF feed pump and the system can consistently meet the required CT.
    - If the water level reaches a high level due to malfunction of the VFD, an alarm is generated and the treatment plant turns off to prevent overflow.
    - If the water level was to reach the low set-point due to a malfunction of the VFD, an alarm is generated and the treated water pump turns off.

- Flow control of the SWTP operating rate is achieved with a dole flow restrictor located downstream of the membrane unit. The dole flow restrictor ensures that the maximum design flow rate to achieve CT is not exceeded by restricting the effluent of the membrane unit.

3.3 Distribution System Operations

The Redwood Glen distribution system demands are met by the 20,000-gallon potable water storage tank.

3.3.1 Distribution System Storage

As noted above, the water level in the 20,000-gallon potable water tank is measured using inline pressure transducers located on the outlet of the tanks. The SWTP turns on and off based on the high, low, and low-low set-points for the 20,000-gallon tank.

3.3.2 Flow Meters

Totalizing flow meters record the flow of water at various points within the distribution system. The analysis of flow data from the flow meters will provide valuable insight into Redwood Glen's actual system demands and losses. Totalizing flow meters are strategically located throughout the system as follows:

- At the outlet of the 20,000-gallon tank;
- At Smith Hall; and
- At Siden Conference Center.

Additional meters will be added to the distribution system in the next five (5) years as per the meter plan included with the TMF.

3.4 SWTP Performance Standards And Regulatory Requirements

The flow rate of the treatment facilities must be designed and regulated to meet the required chlorine contact time in the 5,000-gallon contact tank. Since the required contact time varies with the target chlorine residual and flow rate, the design flow rate varies depending upon the chlorine residual/chlorine dosage. Based on initial calculations, the maximum flow rate at a SWTP is 20 gpm at a chlorine residual of 1.0 mg/L. This can be adjusted depending on the documented operation and monitored chlorine residual of the system.

The flow rate is controlled by a dole flow restrictor located on the CMF effluent flow. The operating flow rate of the treatment plant can be manually adjusted by throttling the feed pump and the flow rate valve on the CMF unit. The MF membrane modules shall comply with the Quality Control Release Valve (QCRV) as required by the SWRCB. The results of the periodic Membrane Integrity Tests shall not exceed the Upper Control Limit of 1.5 psi/min.

3.5 Operational Set-points

Operational set-points for the automated equipment in the Redwood Glen system have been established to optimize the operational efficiency of the water system. Table 4 details the water quality set-points for the system, which Table 5, on the following page, details the operational set-points of the storage facilities and SWTP. These set-points may be altered seasonally or based on operational improvements identified by staff.

Table 4 Redwood Glen Water Quality Set-Points

Parameter	Trigger Point	Action
Filtered Water Turbidity	> 0.1 NTU	Informational Alarm
	> 1 NTU	SWTP Shutdown
Raw Water High Turbidity	> 20 NTU	Informational Alarm
	> 100 NTU	SWTP Shutdown
Backwash Feed High Turbidity	> 100 NTU	Informational Alarm Valve Closes
Post CT Chlorine Residual	< 1.1 mg/L > 2 mg/L	Informational Alarm
	< 1.0 mg/L > 3 mg/L	SWTP Shutdown

Table 5 Redwood Glen Operational Set-Points

		Level Set-points (ft)			
	Description	***Low Low Low***	***Low Low***	***Low***	***High***
5,000-gal feed tanks		3	4.25	6	8
	The set-points are designed to select the water source to feed the system depending on the creek's flow, and also to protect the RWP.	**WTP pump turns off** to prevent the RWP from running dry.	**Informational alarm** that the WL in the feed tanks is getting low (~2,500 gallons in each tank).	When the WL in tank is equal or lower, the **Piney line valve opens.** When the WL is equal or higher, the valve on the Piney line is normally closed.	When the water level is equal or higher, the valve on the Hoffman line closes. Otherwise, the valve is normally open, when the water level is equal or lower than 8 ft.
20,000-gal tank		-	6	8	11
	The set-points determine when the WTP comes on and off.	-	**Informational alarm** that indicates that the WL in the tank causes low pressure levels in the distribution system.	**WTP pump turns on** to fill the tank and cater to the demand.	**WTP pump turns off** to prevent overflow.
5,000-gal clearwell		-	-	8	8.5
	The set-points are established in case of a VFD malfunction. The low set-point prevents non-spec water to ever leave the clearwell, @20 gpm. The high set-point is to avoid overflow.	-	-	In case of malfunction of the VFD (TWP pumping too fast), if the WL is equal or lower than 8 ft, **the WTP pump & TWP turns off.**	In case of malfunction of the VFD (TWP pumping too slowly), if the WL is equal or higher than 8.5 ft, **the WTP pump & TWP turns off.**
70,000-gallon tank		-	9	10.1	-
	The set-point is designed to give an indication of the remaining capacity of the 70k (above the fire storage).	-	**Informational alarm** that indicates that the WL in the tank has reached the fire storage.	**Informational alarm** that gives an indication that the tank can provide 5,000 more gallons before hitting the fire flow storage/outlet.	-
Break tank		-	0.58	1	2.74
	The level switches in the break tank determines when the raw water pump	-	If the WL reaches 0.58 ft, the **WTP pump turns off**, to protect it and prevent it from running dry.	When the WL is equal or higher than 1 ft, the **WTP pump turns on and the RWP turns on.**	When the WL is equal or higher than 2.4 ft, the **RWP turns off and the WTP pump remains on.**
Backwash Tank		-	-	95% of the tank capacity (size TBD)	-
	The high level set-point in the backwash tank is to prevent overflow.	-	-	**A high level float switch** in the tank tells the WTP pump to hold the backwash cycle until the tank is drained to a lower level. The operator manually disengages the switch to lift the backwash inhibit.	-

	Description	***Pressure Set-point (psi)***	
70,000-gallon tank		-	6.5
	Raw water stored in the 70k tank feeds the system when the flows in Piney Creek and Hoffman Creek are not sufficient. Two (2) pressure transducers are located on the 70k common inlet/outlet; one measures the pressure in the line from Piney Creek flow while the other measures the static pressure at the tank.	-	**Informational alarm & the valve opens** when the measured pressure in the common inlet/outlet from Piney Creek flow drops below the static pressure in the tank, which indicates that the water storage is feeding the system. **Informational alarm & the valve closes** when the flow in Piney Creek increases and the pressure from Piney's flow is equal to the static pressure equivalent of the full tank, which shows that Piney Creek is feeding the system and water storage is no longer in use, or that the refill of the tank with Piney Creek's flow is complete.

Abbreviations: RWP: raw water pump
TWP: treated water pump
WL: water level
WTP: water treatment plant

4. ROUTINE OPERATIONAL PROCEDURES

Table 6 outlines the routine daily, weekly, and monthly operational procedures at the SWTP.

Table 6 Routine Operational Procedures

Frequency	Operational Procedures
Daily	● Visually inspect the water treatment plant: o **Micro-filtration Membrane Unit:** Inspect the skid for proper operation. Check for any leaks, openings, damage, or any electrical hazards. Check equipment runtime and integrity test results on HMI screens. Review data from previous day to ensure unit has been functioning properly. o **Iron and Manganese Unit:** When the unit is in operation (summer months), inspect the chlorine injection pump, the valves and electronic control head for proper operation. Check for any leaks, damage, or electrical hazards. Check that the backwash frequency is adequately set for the water demand. Check whether the remaining volume of sodium hypochlorite in the unit's storage tank is adequate. Check that pressure on the line is within allowable range. o **Chlorination Unit**: Inspect the metering pump for proper operation and for any leaks. Check whether the remaining volume of sodium hypochlorite in the storage tank at the chlorine injection point is adequate. o **Appurtenances**: Inspect all gauges, meters, pumps and analyzers for leaks and proper function. Calibrate online analyzers at the frequency recommended by the manufacturer. ● Visually inspect the distribution system and tanks for leaks.
Weekly	● Inspect the storage tanks (20,000-gallon tank, 70,000-gallon tank, 5,000-gallon tanks, clearwell, backwash settling tank) for any leaks or damage; record water levels. ● Inspect the iron and manganese backwash tank. Plan for irrigation use as needed. ● Determine if there is enough sodium hypochlorite solution in the bulk storage tank on site for one or more weeks. ● Inspect raw water in 70,000-gallon tank (color, odor). Start the recirculation pump if deemed necessary. ● Review data from previous week and adjust operation as necessary.

Table 6 Routine Operational Procedures (cont.)

Frequency	Operational Procedures
Monthly	● Exercise valves and inspect for leaks in the distribution system. ● Flush dead end mains. ● Maintenance washes of the membranes occur at a frequency defined by the fouling rate of the membranes. The operator is notified by the PLC that a maintenance wash is required and will be directed to complete the wash (see short CIP procedure included below). It is anticipated that maintenance washes will occur once every 2-4 weeks. ● Inspect both basket strainers and the sediment filter of the iron and manganese unit. Rinse or replace as needed. ● Inspect diversion structures of Hoffman Creek and Piney Creek for damages, leaks, organic matter accumulation or intake obstructions. ● Record values from distribution systems flow meters. ● Review data from previous month and adjust operations as necessary. ● Drain the CIP waste storage tank and dispose of the CIP wastewater (haul off-site).
Quarterly	● Clean-In-Place procedure. See Section 4.1, below, for the CIP procedure. ● Inspect the CIP storage tank and plan for off-site hauling as needed.
Annual	● Clean the three (3) raw water storage tanks (the two (2) 5,000-gallon HDPE raw water feed tanks and the 70,000-gallon raw water steel tank). ● Review media replacement frequency and replace media of the iron and manganese unit accordingly. ● Dispose of the accumulated solids in the conical backwash settling tank.[5]

[5] It is anticipated that the settled solids should be disposed of annually. Corresponding to Redwood Glen's relatively low demands and low TSS concentrations its surface water sources, the accumulated solids are expected to fill less than 10% of the conical part of the settling tank annually. The frequency of solids disposal will be adjusted based on field results.

4.1 Clean-In-Place Procedure

The CMF membrane unit has two (2) CIP cycles, both completed by the Operator under different circumstances. Both CIP cycles have the same procedure, however the length of the cleaning differs. The CIP cycles are as follows:

(1) Long CIP (done quarterly) – The long or “regular” CIP procedure is completed once per quarter regardless of the filtration time or TMP.

(2) Short CIP (as-needed) – The HMI screen on the CMF membrane unit notifies the operator if the filtration time goes over the operator-selected set point, indicating that the membranes may be fouling. This short or “maintenance” CIP is completed at the discretion of the Operator based on the fouling rate of the membrane.

4.1.1 Organics Fouling

The typical CIP procedure addresses membrane fouling from organics and is conducted as follows:

1. Operator turns valve MV5 to feed filtered water into the raw water break tank as opposed to feeding the distribution tanks, as per typical operation.
2. While the machine is in filtration mode, Operator initiates CIP on the HMI screen, selecting either long (regular) CIP or short (maintenance) CIP.
3. The raw water break tank fills to the “high level” switch automatically based on the CIP cycle settings. No Operator involvement required.
4. Water recirculates throughout the membrane unit. No Operator involvement required.
5. The membrane unit backwashes and drains to the “mid level” switch in the break tank. No Operator involvement required.
6. The CIP cycle stops and the Operator is prompted to add a chemical to the break tank. Operator adds NSF-60 certified 12.5% Chlorine solution to the internal raw water break tank in the machine at the following volumes:
    a. 1.5 gallons of NSF-60 certified 12.5% Chlorine solution for a long or “regular” cleaning, or
    b. ½ to ¾ gallons of NSF-60 certified 12.5% Chlorine solution for a short or “maintenance” cleaning
7. Operator prompts the machine to finish CIP cycle. The membrane unit completes CIP cycle. No Operator involvement required.

4.1.2 Inorganics Fouling

If the raw water has a high level of inorganics, additional steps can be added to the typical CIP procedure to address inorganic membrane fouling. Completing the procedure for inorganic fouling involves the use to citric acid and should only be completed during a long or “regular” CIP cycle. The Operator conducts a citric acid CIP procedure as follows:

1. Operator turns valve MV5 to feed filtered water into the raw water break tank as opposed to feeding the distribution tanks, as per typical operation.
2. While the machine is in filtration mode, Operator initiates a long CIP on the HMI screen.
3. The raw water break tank fills to the “high level” switch automatically based on the CIP cycle settings. No Operator involvement required.
4. Water recirculates throughout the membrane unit. No Operator involvement required.
5. The membrane unit backwashes and drains to the “mid level” switch in the break tank. No Operator involvement required.
6. The CIP cycle stops and the Operator is prompted to add a chemical to the break tank. Operator selects “continue CIP cycle” on the HMI screen and adds NSF-60 certified Citric Acid Anhydrous to the break tank while the water is moving (during matriculation). The water is dosed with Citric Acid Anhydrous to a pH level of 2.
7. The membrane unit completes CIP cycle. No Operator involvement required.
8. After the acid wash is completed, the Operator initiates a long CIP on the HMI screen for a 2nd time to complete a chlorine wash*. A chlorine CIP cycle always follows an acid CIP cycle.*
9. The raw water break tank fills to the “high level” switch automatically based on the CIP cycle settings. No Operator involvement required.
10. Water recirculates throughout the membrane unit. No Operator involvement required.
11. The membrane unit backwashes and drains to the “mid level” switch. No Operator involvement required.
12. The CIP cycle stops and the Operator is prompted to add a chemical to the break tank. Operator adds 1.5 gallons of NSF-60 certified 12.5% Chlorine solution to the internal raw water break tank in the machine.
13. Operator prompts the machine to finish CIP cycle. The membrane unit completes CIP cycle. No Operator involvement required.
14. Operator tests the pH at a sample port on the “clean water” side of the membrane unit prior to putting the machine back in service to feed the distribution system. If additional rinsing is required to restore a normal pH, the membrane unit is turned on and treats water to be sent to waste until the pH has returned to normal.

5. MONITORING REQUIREMENTS

Water quality monitoring required by regulation includes turbidity levels (source and treated water), chlorine residual in the SWTP effluent, residuals in the distribution system, and monthly, quarterly, and annual samples of Title 22 constituents. Water quality monitoring will be scheduled according to the water quality monitoring plan attached to this Operations Plan as Attachment F, prepared by Bracewell Engineering, the contract certified operator.

Chlorine residuals are measured weekly at several locations in the distribution system by a certified operator using a LaMotte test kit or Hach test kit. At each location being tested, the certified operator is run for approximately one minute before a sample is taken. The sample locations are included in the Bacteriological Sample Siting Plan (BSSP), which is attached to this Operations Plan as Attachment G.

Instruments used:

- One continuous analyzer measuring raw water turbidity upstream of the MF membrane unit.
- One continuous analyzer measuring filtered water turbidity, downstream of the MF membrane unit.
- One continuous analyzer measured raw water turbidity on the feed line from the membrane backwash recycling tank.
- One continuous chlorine residual analyzer after the chlorine injection point.
- One continuous chlorine residual analyzer after the chlorine contact tank.
- Hach 2100P portable turbidimeter.
- Hach DR/890 portable colorimeter.
- LaMotte 1200 portable colorimeter,
- Extech portable temperature / pH meter.
- Pressure gauges and water usage meters.

Calibration procedures:

- All calibrations are performed following the manufacturer's instructions along with the factory test standards. The turbidimeter calibrations will be completed monthly using the standards provided.

All monthly reports are completed by the on-site water system operator and/or the contract certified operator. The names of the current on-site water system operator and the certified contract operator are included in Section 8 of this Operations Plan and shall be updated as needed. The contract certified operator is responsible for ensuring that all water monitoring is completed as required and submitted on time. The on-site water system operator is the backup person for these responsibilities.

6. Emergency Response Information

In the event of a failure of the surface water treatment system to properly treat or disinfect the drinking water at Redwood Glen Camp and Conference Center, the following regulatory agency personnel require notification:

Ms. Karen Nishimoto
State Water Resources Control Board, Division of Drinking Water
510-620-3461

Mr. Eric Lacy
State Water Resources Control Board, Division of Drinking Water
510-620-3453

Personnel listed in the Water Quality Emergency Notification Plan (WQENP) will implement the emergency disinfection plan and the notification will take place through door-to-door notification and written and posted notice to visitors and staff/non-staff. The WQENP is included as Attachment H.

7. EMERGENCY OPERATIONAL PROCEDURES

The following sections detail the emergency operational procedures to be completed by Redwood Glen staff in the event of a water system failure.

7.1 Procedures For Disinfection Failure

Two (2) chlorine analyzers continuously monitor the chlorine concentration of the treated water (one located after the chlorine injection and one at the outlet of the clearwell) and the alarm settings on both of these chlorine analyzers will help identifying the cause of malfunction. Should a failure to properly disinfect the drinking water for Redwood Glen occur, one of two different procedures shall be implemented. These procedures are detailed in Table 7.

Table 7 Disinfection Failure Procedures

Failure Scenario	Procedure
If inadequately disinfected water has not entered the system:	1. The Redwood Glen water treatment system will be immediately shut down. 2. The automatic chlorine feeder will be inspected to determine if mechanical failure occurred and to repair any malfunctioning parts. 3. Initiate an increased program of bacteriological and chlorine residual monitoring to confirm that treated water quality has not been diminished due to the mechanical failure of the chlorine feeder.
If inadequately disinfected water has entered the system:[6]	1. Immediately notify the SWRCB regulatory personnel listed in Section 6 and the WQENP. 2. Flush the distribution system to remove inadequately disinfected water and to quickly draw in properly disinfected water. 3. Disinfect the system as necessary. 4. Implementation of the WQENP (Attachment H), as necessary.

[6] If inadequately disinfected water has entered the system, there has been a malfunction with the chlorine injection and/or chlorine monitoring equipment, as the SWTP will automatically shutdown if the residual is <1 mg/L. Should a malfunction occur, the operator can determine whether inadequately disinfected water has entered the system by calculating the maximum amount of time that the system could have been pumping inadequately disinfected water to the 20,000-gallon tank. At the average operating rate of 15 gpm, it will take approximately 33 minutes for the water to reach the 20K tank. If the water has not yet reached the tank, then the line can be drained and the SWTP restarted.

7.2 Procedures For High Turbidity

Two (2) turbidity meters continuously monitor the turbidity of the raw and treated water at the treatment plant. Should the treated water effluent turbidity results be higher than 0.1 NTU or 1.0 NTU, one of two different procedures shall be implemented. These procedures are detailed in Table 8.

Table 8 High Turbidity Procedures

Failure Scenario	Procedure
If turbidity readings for the treated water are above 0.1 NTU:	1. Contact the contract certified operator so that they can pinpoint the issue and make adjustments to the system to lower the turbidity. 2. After initial assessment is made, contact the CMF unit provider (Mountainview Services) if a resolution is not established.
If turbidity readings for the treated water are at 1.0 NTU's or higher:	1. Plant will automatically shut off. The operator must acknowledge the alarm before the plant can be started again. 2. Notify the SWRCB personnel included on the WQENP as soon as possible, and within 24 hours at a minimum. SWRCB can provide recommendation for the corrective action to be implemented. 3. Corrective actions may include providing bottled water to visitors and staff, distributing a boil-water notice, trucking in potable water from a certified potable water company, or evacuating all visitors. 4. After an assessment of the issue is made, Redwood Glen staff can contact the CMF unit provider (Mountainview Services) if a resolution is not established.

7.3 Procedures For Positive Bacteriological Results

Should a routine bacteriological sample be taken in Redwood Glen's water system be reported as positive for total coliform by the laboratory, the following actions shall be taken:

1. Notify the SWRCB personnel included on the WQENP as soon as possible, and within 24 hours at a minimum. SWRCB can provide recommendation for the corrective action to be implemented.
2. This may include using the emergency connection to Memorial Park, providing bottled water to visitors and staff, distributing boil-water notices, trucking in potable water from a certified potable water company, or evacuating all visitors.
3. The water treatment operator shall collect at least four repeat samples for each total coliform-positive sample. At least one repeat sample shall be collected from the sampling site where the original total coliform-positive sample was taken. Other repeat samples shall be collected within five service connections upstream or downstream of the original site. At least one sample shall be from upstream and downstream unless there is no upstream and/or downstream service connection.
4. In the month following a total coliform-positive sample, the water system shall collect at least five routine samples.

The BSSP for Redwood Glen's water system, included as Attachment G, contains detailed information regarding bacteriological sampling requirements.

7.4 Procedures For MIT Alarms

The membrane integrity test, or pressure decay test, is an automatic test conducted every 24 hours of run time on the CMF unit. The MIT is testing the entire "clean water" side of the machine, not solely the membrane modules. An alarm indicates that something on the "clean water" side is not functioning properly, and could include the adjustment of valves, replacement of seals, or a compromised membrane fiber.

The MIT is conducted by pressurizing the CMF unit with the goal of reaching approximately 16-17 psi. Once the unit is pressurized, it sits for two (2) minutes holding the pressure. The difference between the starting and ending pressures divided by the time it sits (2 minutes) results in the pressure decay value reported by the HMI system.

The CMF unit has three (3) alarm set-points to alert the Operator that the unit should be inspected based on the MIT results. These set-points are included in the table below along with the procedures to be followed in the event of an alarm.

Table 9 MIT Alarm Procedures

<table>
<tr><th>Failure Scenario</th><th>Investigation and Procedure</th></tr>
<tr><td>"Initial Test Pressure out of Range" Alarm: This alarm is activated if the machine starts the MIT above 18 psi or below 10 psi</td><td>1. The Operator accesses the MIT page on the HMI screen to determine whether the alarm was triggered because the pressure was too high at the start of the test (above 18 psi) or too low at the start of the test (below 10 psi).

2. IF the pressure was too high at the start of the test, Operator should check the following:

a. Air pressure regulator may need to be adjusted;
b. Solenoid valve is allowing air to enter the unit; or
c. The pressure transducer is not operating properly.

Adjust the equipment as necessary and repeat the MIT.

3. IF the pressure was too low at the start of the test, Operator should check if an o-ring, filtrate cup, valve seal, or head block is allowing air to be released from the unit by conducting the following:
a. Check for bubbles through the clear acrylic at each module location.
b. If bubbles are observed, isolate the module and run the pressure test again. If the pressure test still fails, the issue is likely caused by a compromised o-ring, filtrate cup, valve seal, or head block.
c. Inspect glue joints for proper seal, unions for tightness, and o-ring compression in the unions. Check the floor for any leaking water to determine if a valve seal is leaking.
d. If failing part is identified, replace part when the unit is not operating.
e. Manually repeat the MIT to ensure that the problem has been fixed.</td></tr>
</table>

Table 9 MIT Alarm Procedures (cont.)

Failure Scenario	Investigation and Procedure
Warning Alarm: The pressure decay is 1.5 psi/min or greater.	1. The warning alarm indicates that the unit is losing pressure at a rate equal to or greater than 1.5 psi/min. Operator should check if an o-ring, filtrate cup, valve seal, or head block is allowing air to be released from the unit by conducting the following: a. Check for bubbles through the clear acrylic at each module location. b. If bubbles are observed, isolate the module and run the pressure test again. If the pressure test still fails, the issue is likely caused by a compromised o-ring, filtrate cup, valve seal, or head block. c. Inspect glue joints for proper seal, unions for tightness, and o-ring compression in the unions. Check the floor for any leaking water to determine if a valve seal is leaking. d. If failing part is identified, replace part when the unit is not operating. e. Manually repeat the MIT to ensure that the problem has been fixed. 2. **IF** the above does not resolve the pressure decay, it is likely a compromised fiber in the membrane module. The operator shall conduct the following pin repair to restore membrane integrity: a. Either borrow a pin repair kit or contact a local operator who can conduct pin repair on the membrane. b. Remove the module that is failing from the unit and place in pin repair cylinder. c. Identify compromised membrane fiber(s) and seal the fiber off. d. Re-install the membrane module and repeat the MIT to ensure that the problem has been fixed.

Table 9 MIT Alarm Procedures (cont.)

<table>
<tr><th>Failure Scenario</th><th>Investigation and Procedure</th></tr>
<tr><td>Shutdown Alarm: The pressure decay is 2.5 psi/min or greater.</td><td>1. The shutdown alarm indicates that the unit is losing pressure at a rate equal to or greater than 2.5 psi/min. If the shutdown alarm is triggered, the unit must remain off-line until the issue has been resolved and the pressure decay is less than 2.5 psi/min.

2. Operator should check if an o-ring, filtrate cup, valve seal, or head block is allowing air to be released from the unit by conducting the following:

a. Check for bubbles through the clear acrylic at each module location.
b. If bubbles are observed, isolate the module and run the pressure test again. If the pressure test still fails, the issue is likely caused by a compromised o-ring, filtrate cup, valve seal, or head block.
c. Inspect glue joints for proper seal, unions for tightness, and o-ring compression in the unions. Check the floor for any leaking water to determine if a valve seal is leaking.
d. If failing part is identified, replace part when the unit is not operating.
e. Manually repeat the MIT to ensure that the problem has been fixed.

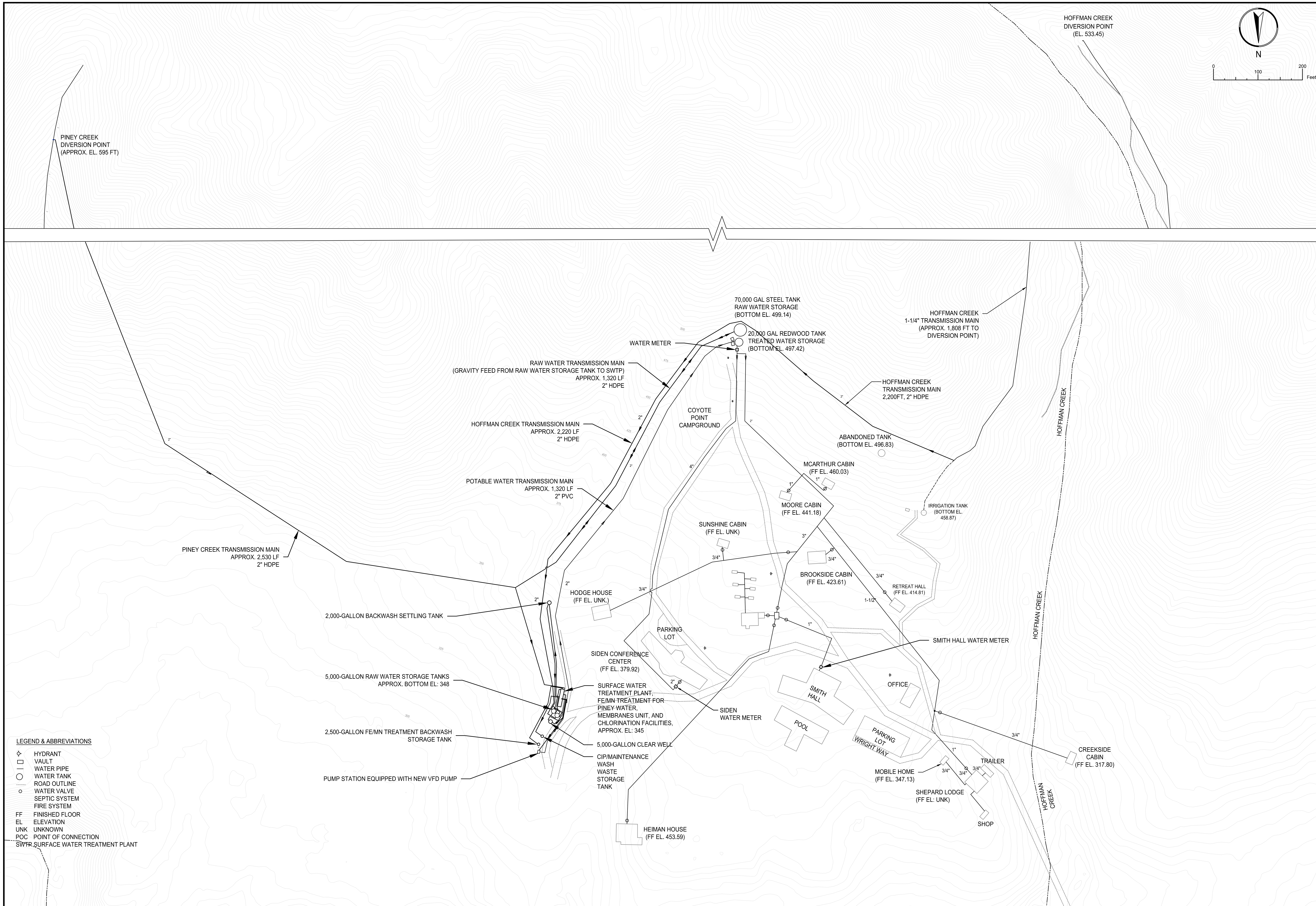
3. IF the above does not resolve the pressure decay, it is likely a compromised fiber in the membrane module. The operator shall conduct the following pin repair to restore membrane integrity:
a. Either borrow a pin repair kit or contact a local operator who can conduct pin repair on the membrane.
b. Remove the module that is failing from the unit and place in pin repair cylinder.
c. Identify compromised membrane fiber(s) and seal the fiber off.
d. Re-install the membrane module and repeat the MIT to ensure that the problem has been fixed.</td></tr>
</table>

8. LIST OF CONTACTS

Certified Water Treatment and Distribution Operator	**Christopher Hauge, Bracewell Engineering** chris@bracewellengineering.com (408) 316-7877 Responsible for the oversight of the water treatment and distribution system. Duties include collecting and submitting water samples, monitoring of the water system, keeping records, working in conjunction with the SWRCB to stay in compliance with all applicable laws. Communicating with Redwood Glen staff on the status of the water system. Monitoring the addition of water treatment chemicals to the water system.
On-Site Water Treatment Operator	**Andrew Gonsalves, Redwood Glen** fixit@redwoodglen.com On-site: (650) 879-0320 x16 Cellphone: (650) 294-9820 Responsible for the operations and maintenance of the distribution system and specfic tasks regarding the SWTP, per direction from the contract certified operator.
Redwood Glen Manager	**Larry Rice, Redwood Glen Executive Director** exec@redwoodglen.com On-site: (650) 879-0320 Cellphone: (650) 504-2521 Responsible for the general oversight of Redwood Glen facilities, including all on-site maintenance staff. Duties include notifying staff, residents, guests, and regulatory entities of any water related emergencies.
Mountainview Services (CMF Unit Provider)	**John Lewis, Moutainview Services** mountainviewservices@mvs2.com 719-494-5293 Available for consultation regarding technology-specific questions about the operation of the CMF unit and associated PLC functionality.
Engineering Support	**Lisa Pezzino, SRT Consultants** lisa@srtconsultants.com (415) 776-5800 x304 Available as technical support for as-needed engineering services related to the operations of the water system and its facilities.

ATTACHMENT A

Water System Map



SYM.	DESCRIPTION	DATE	APPROVED
–	100% DESIGN	03/2017	LP

REVISIONS

NOT FOR CONSTRUCTION

S R T consultants
90 New Montgomery Street,
Suite 905
San Francisco, CA 94109
Ph 415.776.5800
Fx 415.776.5200

REDWOOD GLEN CAMP AND CONFERENCE CENTER
100 WRIGHT WAY
LOMAR MAR, CA 94021

REDWOOD GLEN
NEW WATER SYSTEM
CONSTRUCTION PROJECT

WATER SYSTEM MAP

DATE	MAR 2017
SCALE	AS SHOWN
DESIGN	L. PEZZINO
DRAWN	N.MAO
PROJECT#	------
SHEET	01 OF --

01

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PLOT DATE: May 19, 2017 – 3:41pm PLOTTED BY: Christine

ATTACHMENT B

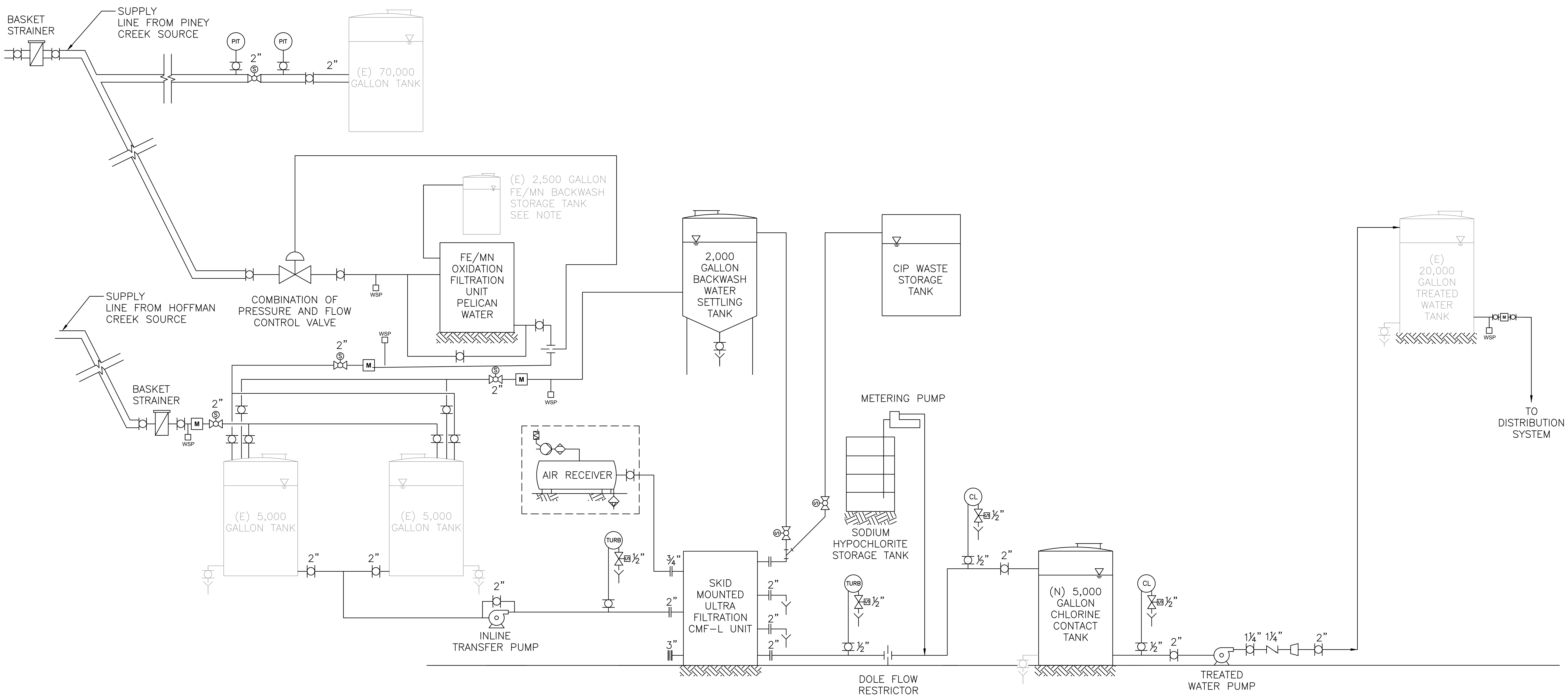
Water System Plans

Process Flow Diagram
Process & Instrumentation Diagram

ATTACHMENT B – PART 1

Process Flow Diagram

NOTE: FE/MN BACKWASH WATER TO BE USED FOR IRRIGATION OR HAULED OFF SITE



LEGEND

- CLASS 150 FLANGE
- COMPRESSOR
- METERING PUMP
- BALL VALVE
- SOLENOID BALL VALVE
- TURBIDITIMETER
- CHLORINE RESIDUAL ANALYZER
- PRESSURE INDICATOR TRANSMITTER
- PRESSURE RELIEF VALVE
- AIR DRYER
- AIR FILTER
- DOUBLE UNION PVC CHECK VALVE
- NPT END
- CENTRIFUGAL PUMP
- EXISTING
- NEW
- DRAIN
- REDUCER
- NORMALLY CLOSED SOLENOID VALVE
- WATER QUALITY SAMPLING POINT

SYM.	DESCRIPTION	DATE	APPROVED
-	100% DESIGN	02/2017	LP

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REDWOOD GELN SURFACE WATER TREATMENT IMPROVEMENT PROJECT
WATER SYSTEM PROCESS FLOW DIAGRAM

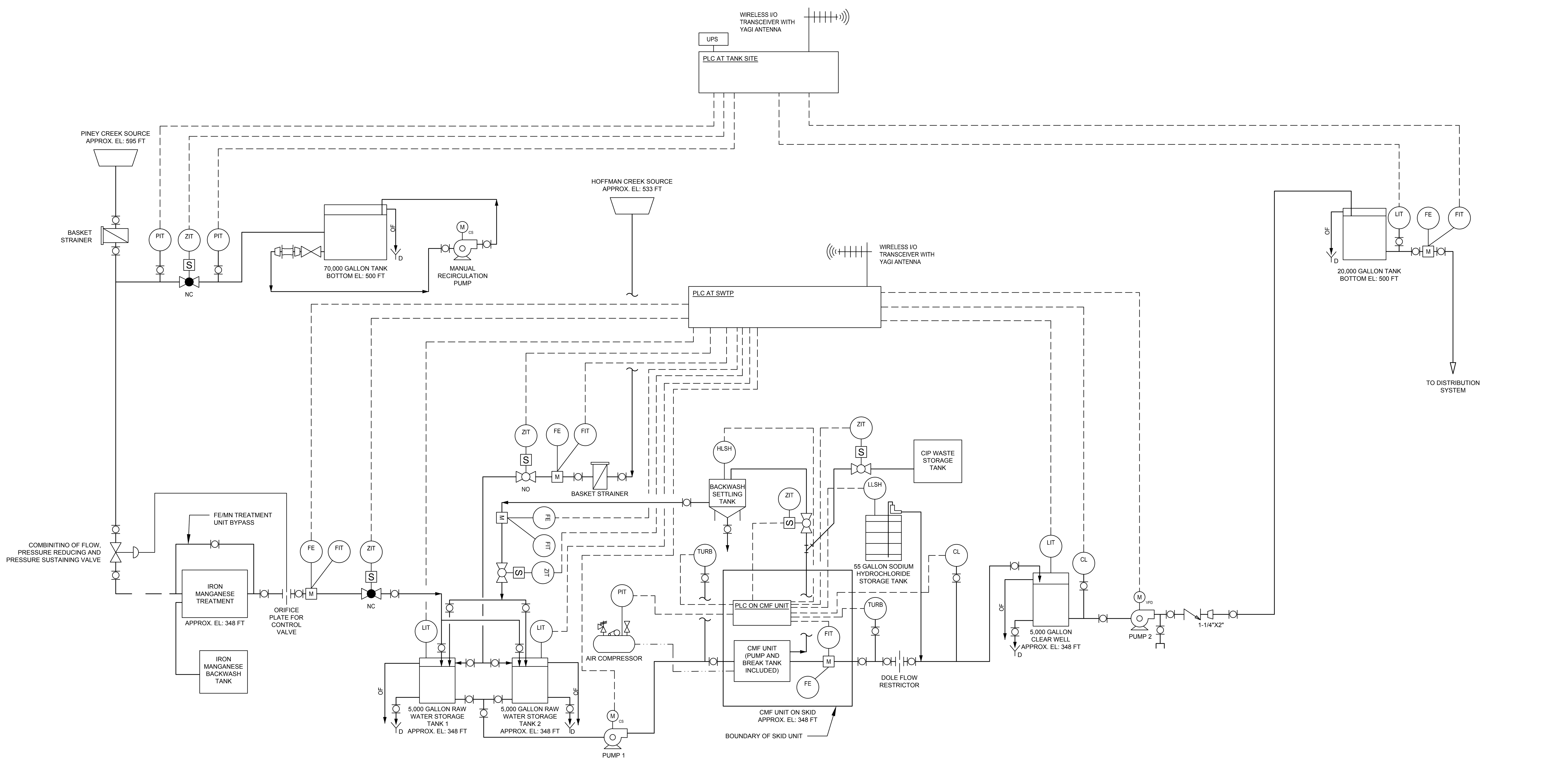
DATE	MAR 2017
SCALE	AS SHOWN
DESIGN	L. PEZZNIO
DRAWN	N.MAO
PROJECT#	------
SHEET	05 OF --

C003

DRAWING NAME: C:\Users\Nino_2\appdata\local\temp\AcPublish_4160\C003.dwg
PLOT DATE: Mar 24, 2017 - 2:13pm PLOTTED BY: Nino_2

ATTACHMENT B – PART 2

Process & Instrumentation Diagram



LEGEND

UNION BALL VALVE	GATE VALVE	HOSE CONNECTION	METERING PUMP	FIELD INSTRUMENT (TYPE NUM)	SOLENOID ACTUATOR
CHECK VALVE	REDUCER	PRESSURE REDUCING VALVE	CENTRIFUGAL PUMP	SIGNAL LINE	MOTOR
GLOBE VALVE	METER		TANK DRAIN	COMPRESSED AIR	

ABBREVIATIONS

FE	FLOW ELEMENT	PLC	PROGRAMMABLE LOGIC CONTROL
FIT	FLOW INDICATOR TRANSMITTER	SWTP	SURFACE WATER TREATMENT PLANT
LIT	LEVEL INDICATOR TRANSMITTER	UPS	UNINTERRUPTIBLE POWER SUPPLY
PE	PRESSURE ELEMENT		
PIT	PRESSURE INDICATOR TRANSMITTER		
ZIT	POSITION INDICATOR TRANSMITTER		

REVISIONS

SYM.	DESCRIPTION	DATE	APPROVED
–	100% DESIGN	03/2017	LP

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REDWOOD GELN SURFACE WATER TREATMENT IMPROVEMENT PROJECT

WATER SYSTEM PROCESS & INSTRUMENTATION DIAGRAM

DATE	MAR 2017
SCALE	AS SHOWN
DESIGN	L. PEZZINO
DRAWN	N.MAO
PROJECT#	------
SHEET	04 OF --

C002

ATTACHMENT C

Membrane Filtration System Manual

ABOUT THIS MANUAL

This manual is intended to provide operating instructions for the 4L10V Continuous Microfiltration System (CMF).

Adherence to specified operating parameters is important to the successful operation of the microfiltration system. Misapplication or improper operation can damage equipment and void warranties. Data logging provides important feedback and is the means of achieving optimum system performance. The success of this system is directly related to the manner in which it is operated.

MANUAL USER'S GUIDE

This manual describes the procedures necessary to install, operate, and maintain your 4L10V Continuous Microfiltration Unit (CMF). Please read this manual carefully before installing and operating your equipment. The equipment warranty may be voided if installation or operation instructions are not followed correctly.

This manual has been formatted for ease of use, combining the instruction for the entire CMF-L Unit into one manual. Literature supplied with some major components being used on this equipment is provided in the back of this manual.

This manual is divided into seven sections. The table of contents for these sections is located at the front of each section. The pages within each section are numbered [section #]-[page #] with the page numbers starting at 1 and incrementing sequentially.

Page numbering will skip over any special documents and continue on the page following the document. Special documents will be noted with an introduction statement that is listed in the table of contents.

Warnings, Cautions, and Notes are used to attract attention to essential or critical information in the manual. Warnings and Cautions will appear before the text associated with them, and notes can appear either before or after associated text.

NOTE: *Notes are used to add information, state exceptions, and point out areas that may be of greater interest or importance.*

WARNING

Warnings indicate condition, practices, or procedures which must be observed to avoid personal injury or fatalities.

CAUTION:

Cautions indicate a situation that may cause damage or destruction of equipment or may pose a long term health hazard.

TABLE OF CONTENTS

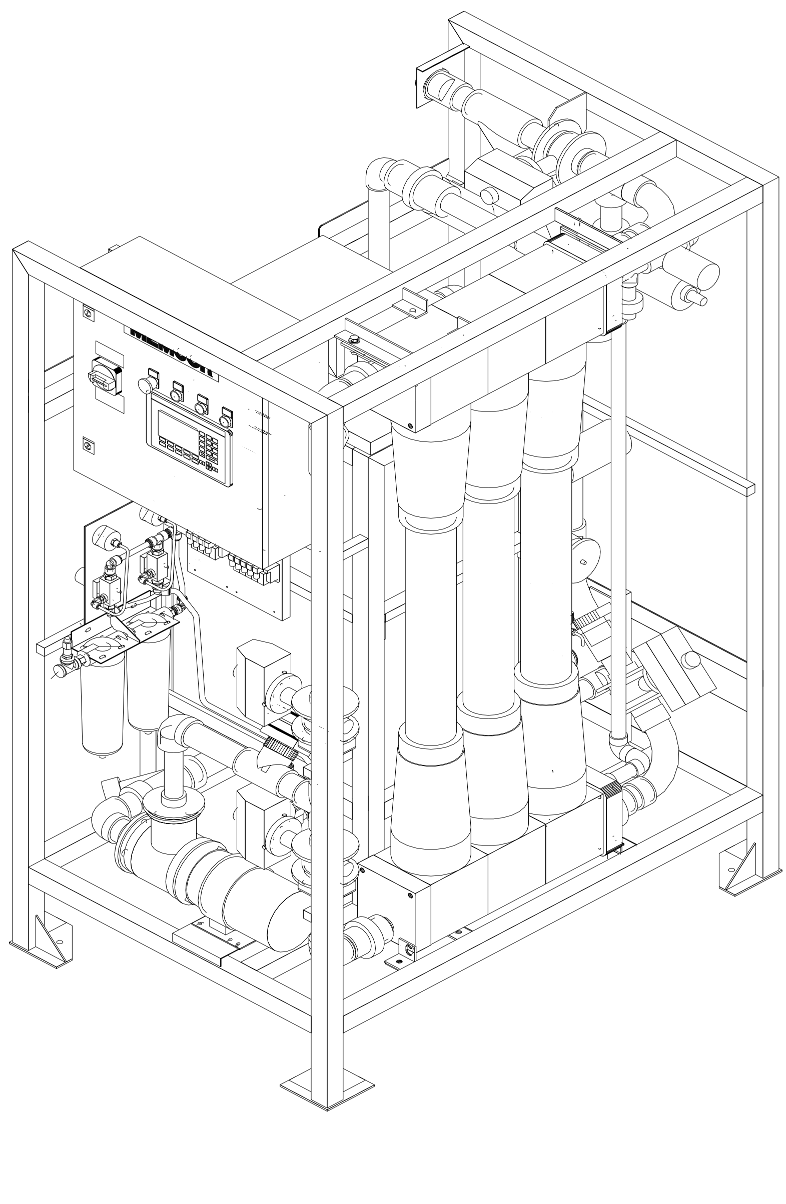
1 PLANT OVERVIEW

This manual provides all the necessary information required to safely operate the CMF-L 6L10V Microfiltration System, Routine test performance, maintenance, troubleshooting and general installation are included.

This manual should be read in conjunction with any additional documentation provided for the specific filtration application. Adherence to specified operating parameters is important to the successful operation of the CMF-L filtration system. Misapplication or improper operation can damage the equipment and void warranties. The success you have with the CMF-L system is directly related to the manner in which it is operated.

Fig 1.1 4L10V series Self-Cleaning Continuous Microfiltration Unit

1.1 GENERAL SYSTEM DESCRIPTION



Central to the functioning of the plant is the Continuous Microfiltration (CMF-L) technology. This membrane-based technology is what provides the filtration of the influent raw water. The membranes, configured into modules and arrayed in the CMF-L units, form the core operational building blocks for this plant. More detailed information about the CMF-L technology is included in section .1.2 Ancillary subsystems support this essential technology.

Feed water is screened through a 500 micron strainer as a pre-filtration measure and is then sent forward to the CMF-L unit for filtration. The filtered water leaving the CMF-L unit, commonly referred to as "filtrate", is collected in a manifold and forwarded to the Potable Water Storage Reservoir where it receives further treatment before distribution.

All of the other equipment and subsystems are used to perform functions that support the operation and automated maintenance of the CMF-L units or are concerned with the disposal of waste by-products from the filtration process.

1.2 CONTINUOUS MIOCROFILTRATION (CMF-L)

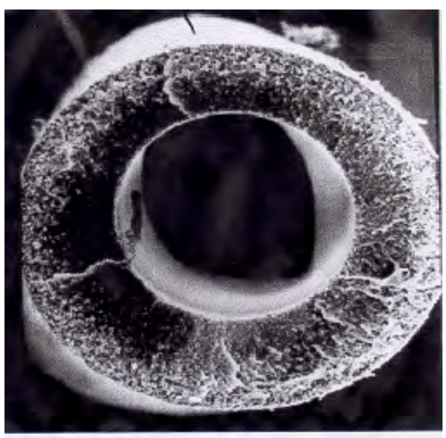
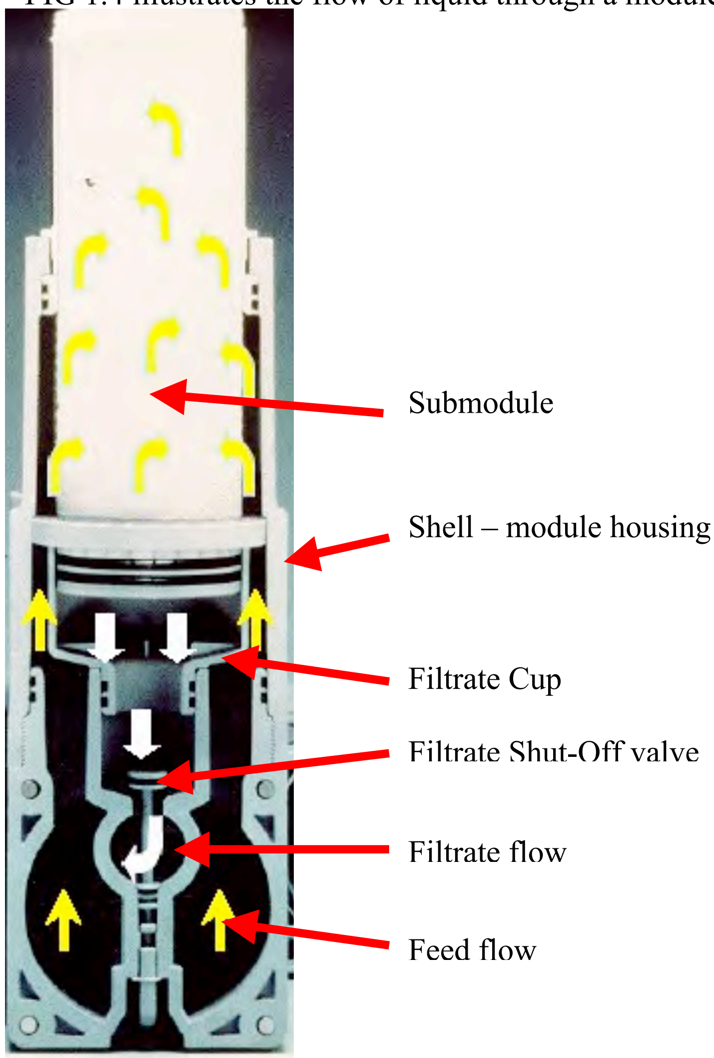


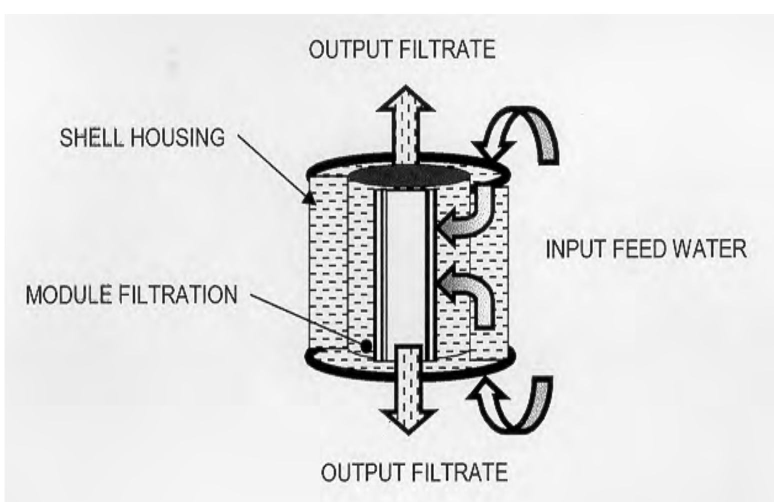
FIG. 1.2 Cross-section (left) and FIG 1.3 surface (right) of a single hollow membrane fiber.

Microfiltration is a fine filtration process that uses a membrane filter to remove suspended particles from a liquid feed stream. The Continuous Microfiltration (CMF) process utilizes hollow fiber membranes to provide a self-cleaning system that can maintain high flow rates by means of the unique low pressure liquid backwash.

The filtration occurs as liquid passes from the outer surface of the fiber (Shell Side) to the hollow inner core (Lumen). Feed liquid passes through the porous wall of the fibers as suspended matter remains on the shell side. This filtration process removes solids larger than approximately 0.1 microns. Bacteria are typically larger than about 1 micron.

FIG 1.4 illustrates the flow of liquid through a module





The nature of the CMF-L system is such that filtrate quality is consistent, meaning that the millionth gallon of filtrate will be as well filtered as the first gallon of filtrate to pass through the CMF-L system. As the CMF-L units continue to operate and remove impurities, these impurities remain trapped on or near the outer wall of the filter media (membrane). If the flow of feed water were to continue uninterrupted, the amount of impurities removed would eventually build up to the extent that no water would flow through the filter media. The filter elements that compose the CMF-L unit would become ineffective. In order to avoid this condition, the patented Low Pressure Liquid Backwash process periodically rejuvenates the filtrate flux. The backwashing process involves stopping the flow of feed water through a CMF-L unit, then introducing low-pressure air in a direction opposite to the normal filtering flow. This pushes trapped debris away from the outer surface of the filter. “Sweep” water is then used to carry away the released debris.

Backwash cycle frequency is determined by one of several methodologies:
- A timer. This may be set to initiate the process at equal predetermined timed intervals.
- A rise in Trans Membrane Pressure (TMP). TMP is the differential pressure as measured between the in-flow and out-flow ports of a CMF-L module block. This indicates that there are increases in the amount of debris removed from the feed water, and thus remaining on the exterior of the filter and impeding the flow of water through it.
- A finished water volume. This may be set to initiate the process at equal predetermined filtered water volumes or batches.
- Manually by Operator

In the case that a Backwash is initiated upon a TMP change, a predetermined set point is selected to trigger the process initiation.
Although highly efficient, the Backwash does not remove all of the impurities from the membrane surface. In time, the deposits increase the filtration resistance to the point that the process becomes inefficient. At this point a chemical cleaning (CIP) of the membranes takes place, removing deposits and restoring the membranes to their near new initial properties.

Both the backwash and CIP processes are automated and performed by the CMF-L equipment with little or no Operator input. The CMF-L units have built-in self-testing and diagnostic capabilities. Once a day or on the operators request the units perform an integrity test on the membranes and clean water associated valves and provide the results to the Operator.

The CMF-L process has many benefits:

- The filtration membrane is a barrier filtration system that provides positive mechanical retention of suspended solids and microorganisms.
- Filtrate quality is consistent despite wide variations in feed stream conditions.
- Filtrate quality is independent of operator interaction.
- The need for chemical cleaning and associated waste streams is minimized due to the recovery of flow via the unique Backwash process.
- Operator input is minimal, making remote, unattended operation possible.
- Coagulant use is not required in normal system operation.
- Primary disinfection is achieved by mechanical retention of fecal bacteria, protozoa, cysts, and other organisms that cause public health problems.
- Secondary disinfection requirements are minimized.
- Each CMF-L unit has a built-in integrity monitoring function that allows operators to verify system integrity at any time.

1.3 CMF-L UNIT CONSTRUCTION

The CMF-L unit contains all of the necessary equipment and instrumentation required for unmanned operation. The operation of the unit is monitored by a PLC based control system which automatically performs the cycles that do not require operator intervention, such as Standby, Filtration, Backwash, Pressure Decay Test (PDT), and Alarm Shut Down. The system prompts the Operator to manually initiate the cleaning cycle or to intervene when a warning or shutdown alarm is detected.

The unit is designed to run in two different feed modes: direct feed or via the Break Tank. The break tank feed is recommended and the most common set up. In this method, the raw water enters the break tank via the actuated valve (AV1). From there it is gravity fed to the unit pump. To prevent the pump from running dry, the break tank has a set of 3 level switches to maintain optimal feed level conditions. The break tank also doubles as a chemical preparation tank during the membrane cleaning cycle. During direct feed mode, the water is provided directly to the suction side of the unit pump.

1.3.1 MATERIALS OF CONSTRUCTION

Filtration Modules:	
Membrane Material	PVDF
Potting Material	Polyurethane
Housing Material	Nylon
Wetted Parts:	
Pipework	PVC
Valves	PVC/PVDF/EPDM & SS/EPDM
Break Tank	HDPE

Gauge Guards	PVC/Viton
B'wash NR Valves	PVC/Buna-N
Switches	316SS
Sample Port	316SS
Pump	304SS

Other:

Frame	Stainless Steel
Control Box	Painted coated steel
Pneumatic Tube	Nylon
Pneumatic Fittings	
Body:	Acetyl Copolymer
Seal:	Nitrile Rubber
Collet:	Acetyl Copolymer/Stainless Steel
B'wash Solenoid	Brass/Buna-N
Pilot Solenoid	Aluminum

1.3.2 FRAME

The CMF-L unit frame is a welded construction of square and rectangular Stainless steel rolled hollow sections. The frame provides mounts for bolted attachments, and the module array, valves, pipework, controls, and instrumentation components are supported by the frame assembly.

The frame has provisions for bolting to ground level mountings. The legs provide clearance for pipework and access to the underside of the module array.

1.3.3 THE MODULE ARRAY

The main component of the CMF-L unit is the L10V module. Each module contains thousands of hollow fiber filtration membranes surrounded by a protective plastic screen and sealed at both ends. The membranes have a 0.1 μm Nominal Pore Size and each module has an active membrane area of 252 ft^2. This membrane sub-module forms a replaceable filter element which can be removed from the module housing for repair or replacement.

The 3L10 series CMF-L unit is fitted with one row of three modules. The end plates are fitted to the upper and lower ends of the row and provide feed or filtrate connections.

The module assembly design provides for isolation of filtrate flow from any individual module in the unit. This is done using the two filtrate isolation valves in the upper and lower heads of each module.

1.3.4 CMF-L UNIT CONTROLS

This CMF-L unit is controlled by the Allen Bradley SLC504 Programmable Logic Controller located inside the Control Panel.
The PLC receives the data regarding filtrate flow, feed, filtrate and compressed air pressures and any signal from external instrumentation if used.
Based on the information provided, the PLC governs all the functions and operations of the unit until Operator intervention is required. Dialog with the unit is accomplished by using a Panelview display terminal located at the front of the Control Cabinet.

The control system is equipped with an Air Pressure Switch located inside the Control Cabinet protecting the unit from operation if the air pressure drops below 60psi.

The electrical rating of the unit is as follows:

Power Supply:	1 Ph, 230 V, 60 Hz
Feed Pump Motor Rating:	11/2 Hp
Thermal Overload Setting:	4.2 amps / 230 VAC
Control System:	
Programmable Logic Controller:	Allen Bradley SLC504

Control Settings:

Air Pressure Switch:	60psi (400kPa)
Level Switch 1:	14 gal (53 L)
Level Switch 2:	22 gal (83 L)
Level Switch 3:	58 gal(220 L)

1.4 SYSTEMS

1.4.1 COMPRESSED AIR SYSTEM

Compressed air is required for CMF-L control functions and process cycles. Control functions include the supply of air to open and close pneumatically actuated valves on the CMF-L unit and the backwash and CIP systems. Process functions include the use of low-pressure air in the performance of the backwash as well as in such diagnostic unit operations as the Pressure Decay Test and Sonic Test. By far the largest consumption of air takes place during the backwash cycle. The volume of compressed air that is required to backwash a single unit is significant. The instantaneous air supply required for each unit is 12CFM @ 90 psi.

NOTE: *The CMF-L unit backwashes an average of three times per hour. The air usage is intermittent.*

The air receiver stores the required air for use by the CMF-L system for both control and process functions. Air supply from the receiver is fed to the CMF-L systems, various piping, and regulators, sized according to the specific system need. A 25 micron coalescing filter, (located on the CMF-L unit), and an automatic drain valve fitted to the air receiver tank ensure that the air is clean and dry.

There are four air regulators: one for control air pressure, one for backwash air pressure, one for air scour air pressure, and one for testing. The settings on the regulators are as follows:

- Control Air - 90 psi (620 kPa).
- Backwash Air - 30 psi (200 kPa)
- Air Scour Air – 7 psi (45 kpa)
- Membrane Test - 17 psi (100 kPa)

Nylon air tubing and Acetyl Copolymer air fittings are used to distribute the air within the skid through aluminum pilot solenoids to valve actuators.

The process air required for Backwash is delivered through Brass/Buna-N solenoid valves. For detailed information and interconnection of the air system components, consult the drawing section of this manual.

1.4.2 BACKWASH SYSTEM

At the beginning of the Backwash cycle, the flow of feed water to the CMF-L unit is stopped and water is filtered to backwash level. During this step, the compressed air (regulated to 200 kPa or 30 psi) is injected into the shell side to drive the filtration and lower the shell side liquid level. Next low pressure air enters the shell side providing air scouring while compressed air (regulated to 200 kPa or 30 psi) pushes the filtrate in the lumen to backpulse through the membrane. Air scouring continues after the liquid backwash ends. The lumen side is continued to be pressurized. Air is then injected into the top feed manifold while the lower backwash discharge valve is opened. Air pushes the backwash waste out of the shell. Feed water then enters the shell side via lower feed manifold and exit the unit via top backwash discharge valves. The filtrate side is isolated. Feed water continues to enter the shell side via lower feed manifold, however, top backwash discharge valve is closed and filtrate exhaust valve is opened.

1.4.3 CIP (CLEAN-IN-PLACE) SYSTEM

When the filtrate flow-rate declines and cannot be restored by backwashing, chemical cleaning of the CMF-L is necessary. The CMF-L unit incorporates an internal Clean-In-Place (CIP) system, allowing the cleaning process to take place without dismantling the components. A CIP is needed when there is a rise in the filtration Trans-Membrane Pressure (TMP) above a pre-determined set-point, typically 15 -18 psi.
The CIP cycle will be automatically requested by each CMF-L unit as required. A CIP cycle must be initiated from the operator interface screen. Once initiated by the operator, the cleaning cycle proceeds until operator intervention is required. The operator must ensure that an adequate supply and concentration of cleaning solution is maintained. The concentrations of chemical solutions used for the CIP process are as follows:

CIP SOLUTION CONCENTRATION

Citric Acid	2ph
Maintenance Wash Sodium Hypochlorite	300 - 400 ppm
Normal Wash Sodium Hypochlorite	800 - 1000 ppm
CIP solution volume:	22 gal

1.5 INSTRUMENTATION AND CONTROLS

The instrumentation and control systems work together to enable the automated operation of the water treatment plant within the desired performance parameters.

Plant-wide instrumentation is used to monitor the coordinated efforts of the overall plant as they relate to the CMF-L unit. This instrumentation provides feedback to the CMF-L Unit PLC which then performs an analysis of the data provided. The results of that analysis tell the PLC what operations to request from the CMF-L unit.

Instrumentation specific to the CMF-L unit, which also provides feedback to the CMF-L unit's PLC, monitors the conditions that exist within the unit.

1.5.1 INSTRUMENTATION

As previously mentioned, the instrumentation utilized falls into one of two categories, plant-wide or local CMF-L.

1.5.1.1 LOCAL CMF-L INSTRUMENTATION

In order to control CMF-L operation, the CMF-L unit's PLC monitors the pressure, flow, and liquid level conditions occurring within the unit. The following instrumentation is contained in each CMF-L unit:

- Pressure transducers located on the lower manifolds of the module array that monitor feed and filtrate pressures. This information is especially useful when conducting several of the unit operations as well as conducting tests such as the Pressure Decay Test. These transducers also provide feedback for the continuous monitoring of the trans-membrane pressure (TMP).
- A filtrate flow meter, measures the filtrate out-flow prior to the filtrate outlet.
- An air pressure switch located inside the control panel cabinet. This instrument sends a signal to the PLC when the control air pressure is above a predetermined minimum, usually 75 psi.

CMF-L unit instrumentation typically provides analog 4-20 mA current loop outputs. Current loops for pressure and flow transmitters and for filtrate flow control valve position pass through a set of terminals connected by jumpers in the electrical control panel, and through a load resistor on the data collection port. The jumpered terminals provide customer access, if required, to the current loop signals. The data collection port provides a means of high-speed data collection direct from the unit. This is used for pressure and flow profile monitoring and analysis during commissioning and service.

1.5.2 PNEUMATIC SUPPLY AND CONTROLS

Compressed air is required to operate the CMF-L system. Air is supplied by a 15 SCFM air compressor. Air from the receiver is fed through a liquid coalescing compressed air filter integral to the CMF-L unit and is then passed to the air regulators. There are 4 air regulators mounted on the unit. One serves to feed the solenoid valves which operate the butterfly valves. A second regulator provides the proper pressure for the backwash cycle. A third supplies air for the low pressure air scour. A fourth regulates the air pressure for operating the membrane test function.

1.5.2.1 PNEUMATIC VALVES

Process valves on the CMF-L system are single and double-acting pneumatically operated butterfly valves controlled by means of pilot solenoid valves. The pilot solenoids receive a 24 VAC signal from the PLC and supply control air to each actuator. The process valves are opened or closed when air pressure is applied to either side of the actuator.

Most of the process valves are installed as normally closed valves. Two valves, (AV7 and AV9), on each of the CMF-L units, however, are installed in the normally open position; i.e. they are open while the pilot solenoid valve is de-energized, and closed when the pilot solenoid is energized. Stroke limiters are fitted to some valve actuators, (In Some Cases AV1) (In All Cases AV2, AV6, and AV9), to control the extent of opening, thereby providing a method of limiting flow rate within the pipework.

A manual override button is located on each solenoid and pushing this button down places the valve in it’s actuated or energized position.

Warning: Operation of automated cycles with valves manually actuated may damage equipment or cause erratic operation.

1.5.3 ELECTRICAL CONTROLS

1.5.3.1 PROGRAMMABLE LOGIC CONTROLLERS (PLCS)

The PLC operates in accordance with the program stored within its memory. Programming of the PLC is by ladder logic, which utilizes internal relays, shift registers, timers and counters to coordinate the necessary procedures in the CMF-L unit's automatic cycles.

All pushbuttons and switches (other than main switches and disconnects) are connected to the low voltage 24 VAC inputs of the PLC. Pump contactors, indicator lamps, and solenoid valves are connected to relay output modules of the PLC. The relay contacts on the output modules enable switching of power to the respective output components.

2 SAFETY GUIDELINES

2.1 GENERAL

Warning: This equipment operates at high voltage and high pressure, and has moving parts and hazardous chemicals that may cause serious injury or fatality if not operated and maintained according to the procedures outlined in this manual.

- No one should use or service this equipment without proper training and supervision. **It is the responsibility of the owner** to ensure that this equipment is used properly and safely, strictly following the instructions contained herein.

- Remain alert at all times during the operation of this equipment. Do not get near this equipment if you are drowsy or impaired in any way.

- Always wear safety equipment (safety glasses and gloves) for protection while working on the equipment.

- Prior to handling hazardous chemicals, Refer to their associated Material Safety Data Sheets.

- Always operate the equipment within the parameters specified.

- Never connect the system to piping that has not approved for the rated pressures and uses.

- Never remove any components from the unit while it is under pressure.

- Warning labels have been placed on the equipment to remind the operator of certain hazards. Never remove these labels.

- Proper maintenance assures the equipment will run properly and can lower the risk of injury. Be sure to follow the instructions on maintenance carefully.

- Be sure to maintain all equipment, tools and sub-systems used with the equipment.

- Continuously inspect the system for leaks and damage. Correcting problems as they occur will help prolong the life of the system.

- Use Lock-Out and Tag-Out procedures when servicing the unit.

This manual should be used as a guidance tool and should not replace common sense. If you are unsure about a procedure please contact a qualified service person for assistance.

2.2 SAFETY PRECAUTIONS

The purpose of this manual is to provide the user with the necessary information to operate this equipment without undue risk. Failure to follow the instructions laid forth in this manual may place the operator(s) at risk of injury and possible fatality. Please read this entire manual before beginning any procedure. This Operations and Maintenance Manual should remain with the equipment at all times to act as a ready reference guide for anyone who operates this equipment.

2.3 SAFETY EQUIPMENT

Below is a list of equipment and materials that should be kept near the equipment. This equipment is the bare minimum required to maintain a safe working environment.

- Lock-out and Tag-out devices for servicing and shutdowns.

- Eyewash/safety shower for chemical accidents.

- Safety glasses are to be worn at all times.

- Earplugs should be worn when encountering high levels of noise.

- Gloves that offer protection from the chemicals used herein. (See Materials Safety Data Sheets (MSDS) for detailed precautions regarding specific chemicals)

- Steel toe work boots for protection against heavy equipment and components

2.4 MATERIAL SAFETY DATA SHEETS

The following pages contain the Material Safety Data Sheets (MSDS) for the chemicals used with this CMF-L system. Throughout the operational life of this system, additional chemicals may come into use. Material Safety Data Sheets for these items should be added to this section. In the event that the end user sees fit to make changes to the chemistry in use, it is incumbent upon the end user to update this section with the proper MSDS information.

MSDS LIST

Citric Acid
Sodium Hypochlorite
Lithium Battery
O-ring Grease

3 STARTUP AND OPERATION

3.1 CONTROLS OVERVIEW

The control system consists of two parts: the electrical system and the pneumatic system. Interconnections of these systems enable automatic control of the CMF-L Filtration System.

The central control component is the programmable logic controller (PLC). It is located inside the electrical enclosure. All automatic cycles are controlled through the PLC in accordance with the program stored within the PLC memory. Programming of the PLC is by ladder logic.

3.2 CMF-L CONTROL PANEL

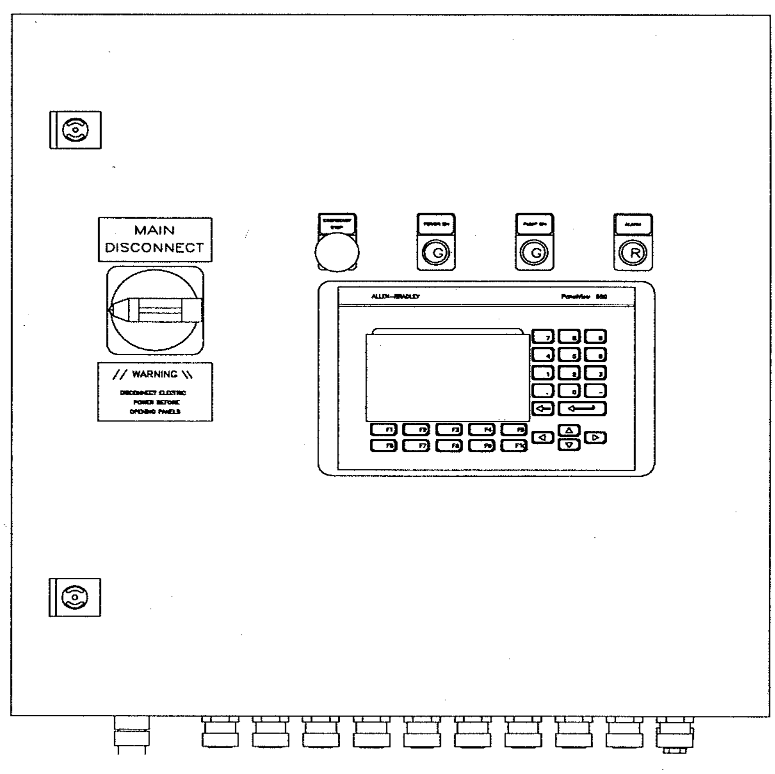


Figure 3-1 –CMF-L Control Panel

The chart entitled "CMF-L Control Panel – Indicators and Controls", describes the function and meaning of the pushbuttons and indicator lamps found on this panel.

CMF-L CONTROL PANEL – INDICATORS AND CONTROLS

LABEL	DESCRIPTION	FUNCTION
MAIN DISCONNECT	2 position switch	Main power isolation for CMF-L unit
POWER ON	White lamp	Illuminated when power is available to the control system
PUMP ON	Green lamp	Illuminated when pump is on
ALARM	Red lamp	Illuminated when a General Alarm condition is present
EMERGENCY STOP	Push Button	Stops operation of the system
PANELVIEW INTERFACE	Digital Display	Shows status of the unit

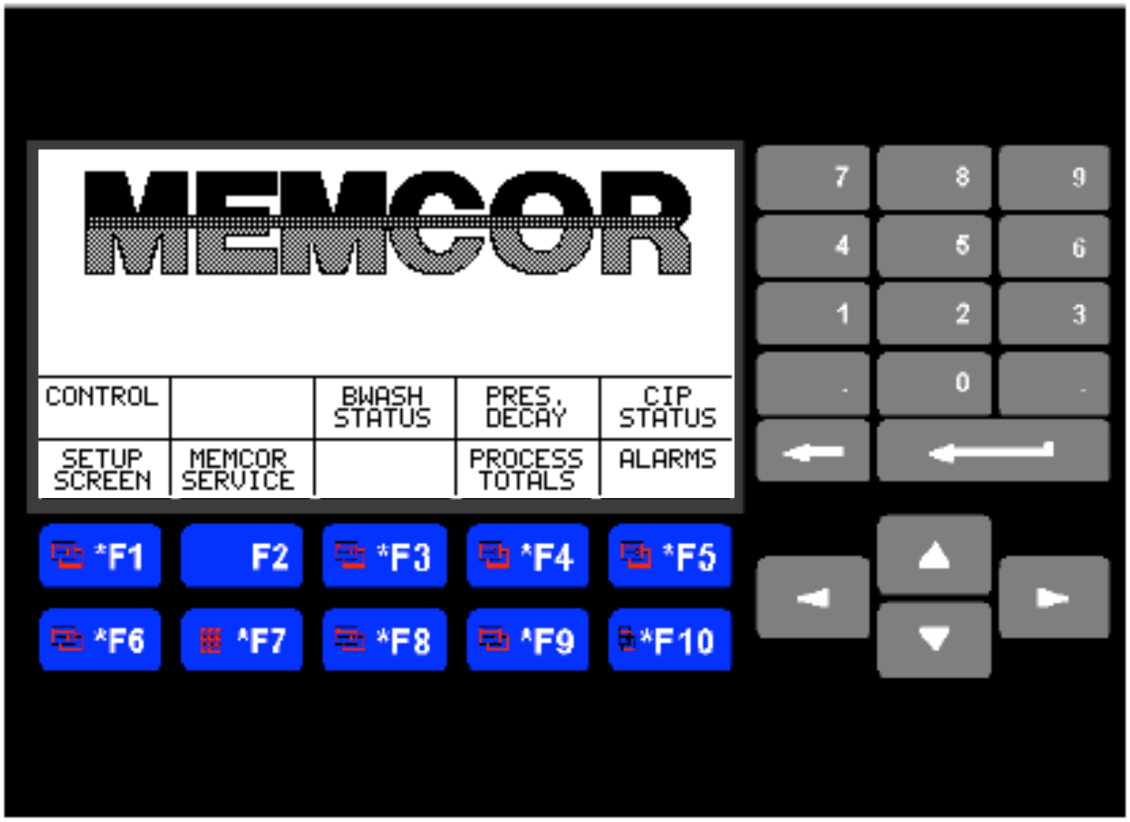
3.3 PANELVIEW TERMINAL

The following pages contain examples and descriptions of the Panelview terminal screens used to control the CMF-L unit.

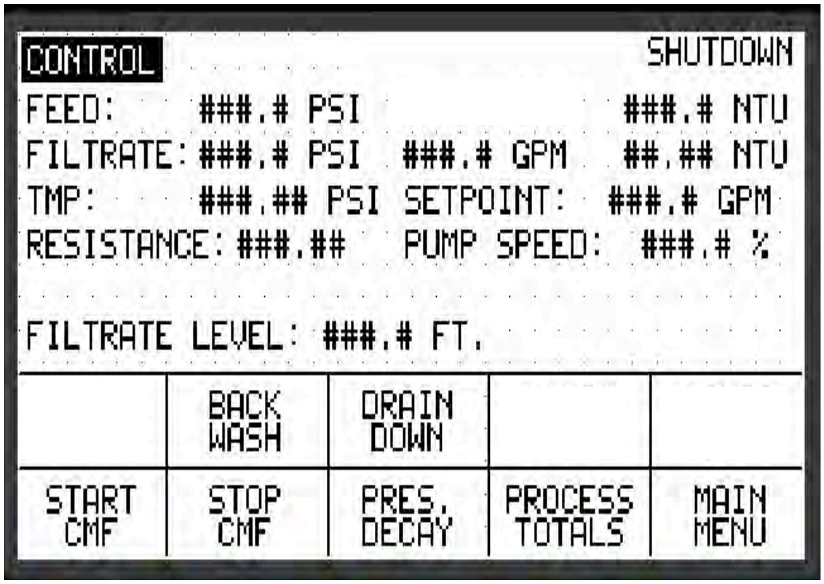
The Panelview terminal displays the CMF-L unit parameters and allows the operator to set the values required to operate the plant. The values are entered into the numerical keypad located on the right side of the Panelview terminal. The short arrow button is a “Backspace” and the long arrow button is “Enter”. The four cursor keys located below the numeric keypad are used to select the desired field.

There are ten programmable function buttons (F1 – F10) located below the display. The functions of those keys are displayed above on the table. The function keys are used for navigation between Panelview screens and to interact with the CMF-L unit.

3.3.1 MAIN MENU SCREEN



3.3.1.1 CONTROL SCREEN



To access: Main Menu – F10.
This control screen provides access to the following cycles:

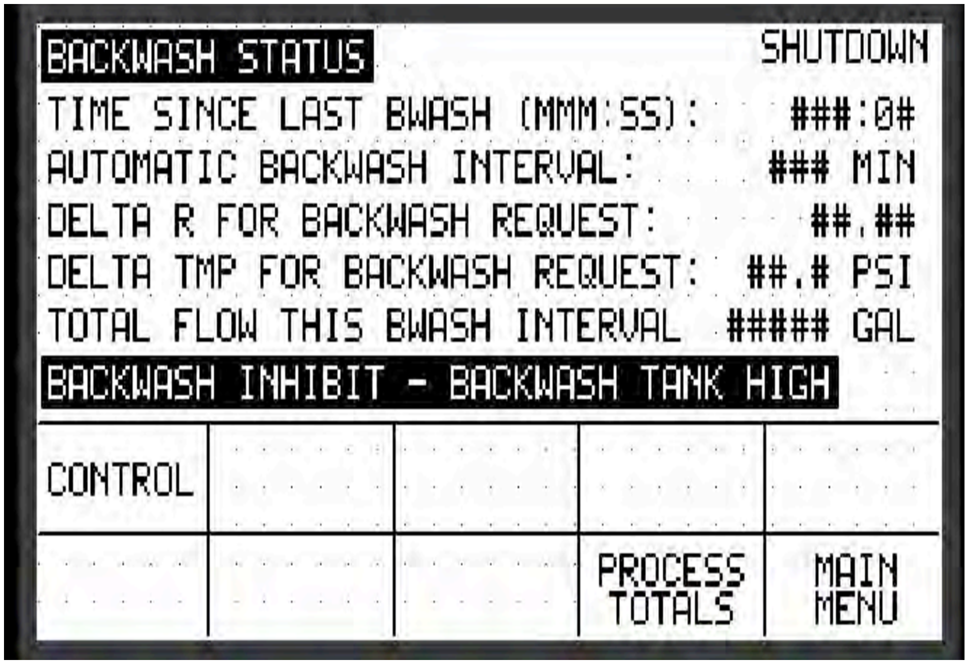
- START CMF-L (F6) to start the unit.

NOTE: *Pressing F6 does not automatically start the unit. If there is no demand for filtrate the unit will go into stand-by mode.*

- STOP CMF-L (F7) to stop the unit.
- BACKWASH (F2) to activate a backwash cycle.
- DRAIN DOWN (F3) to perform a drain down.
- PRES. DECAY (F8) to initiate a pressure decay test.

These cycles are described in detail later in this chapter.
The operator can also go to the PROCESS TOTALS screen (F9), or return to the MAIN MENU (F10).

3.3.1.2 BACKWASH STATUS SCREEN

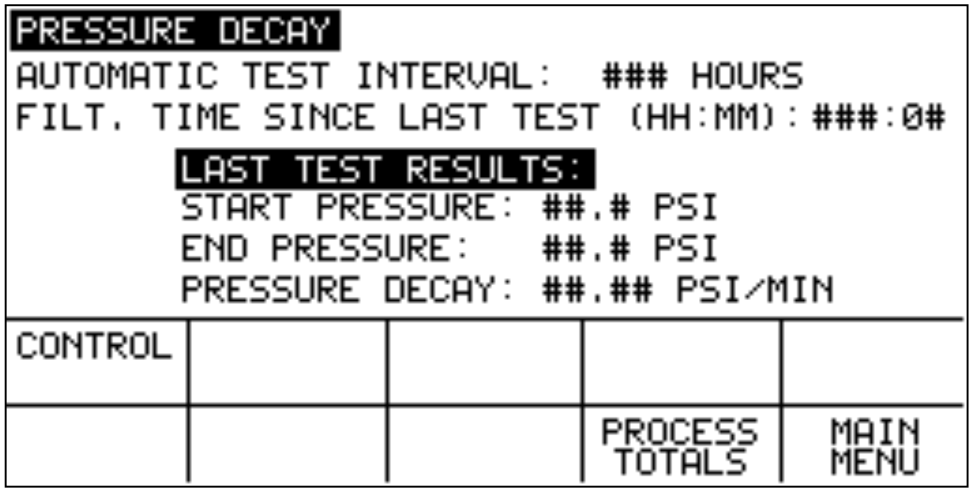


To access: Main Menu – F10

The backwash status screen displays the following information:

- Filtration time since last backwash
- Automatic backwash interval which can be set in the Setup screen.
- Delta R for backwash request
- Delta TMP for backwash request

3.3.1.3 <u>PRESSURE DECAY SCREEN</u>

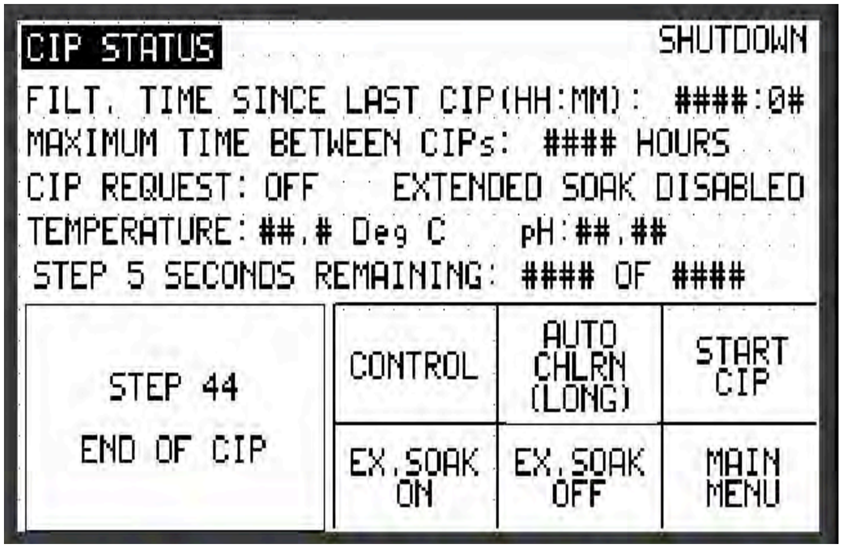


To access: Main Menu – F10

The pressure decay screen displays the following information:

- Automatic test interval
- Filtration time since last test
- Last test results

3.3.1.4 CIP STATUS SCREEN



To access: Main Menu – F10

The CIP status screen displays the following information:

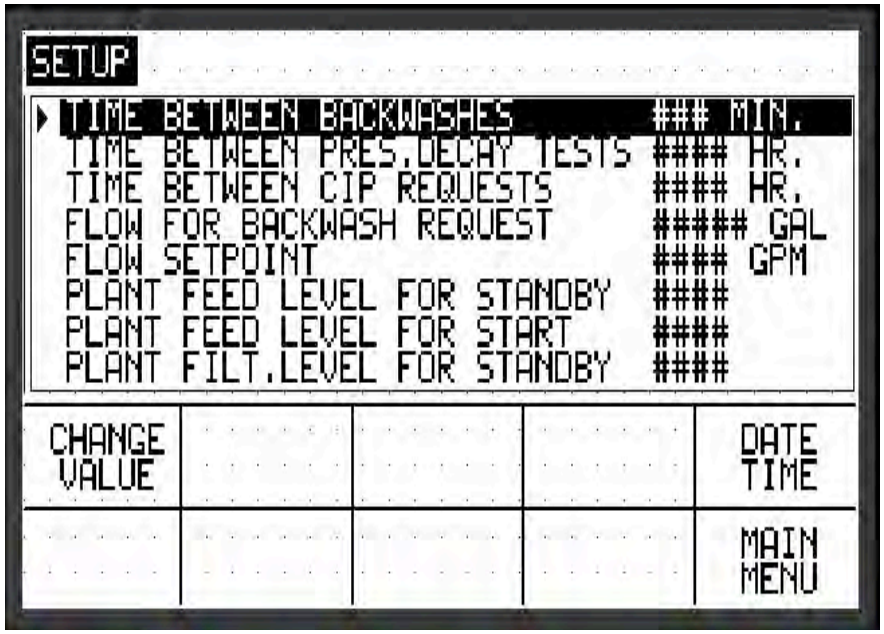
- Filtration time since last CIP
- Maximum time between CIP(s)
- CIP request ON or OFF
- CIP extended soak ENABLED or DISABLED
- Extended soak time

The CIP status screen provides access to the following cycles:

- START CIP (F5) to start the CIP cycle.
- EX.(TENDED) SOAK ON (F8) to temporarily stop the CIP Cycle and soak the membranes
- EX. (TENDED) SOAK OFF (F9) to return to CIP Cycle.

The CIP cycle is described later in this chapter.
The operator can start a CIP cycle and enable an extended soak from this screen.

3.3.1.5 SETUP SCREEN



To access: Main Menu – F10

The setup screen allows the operator to control the following:

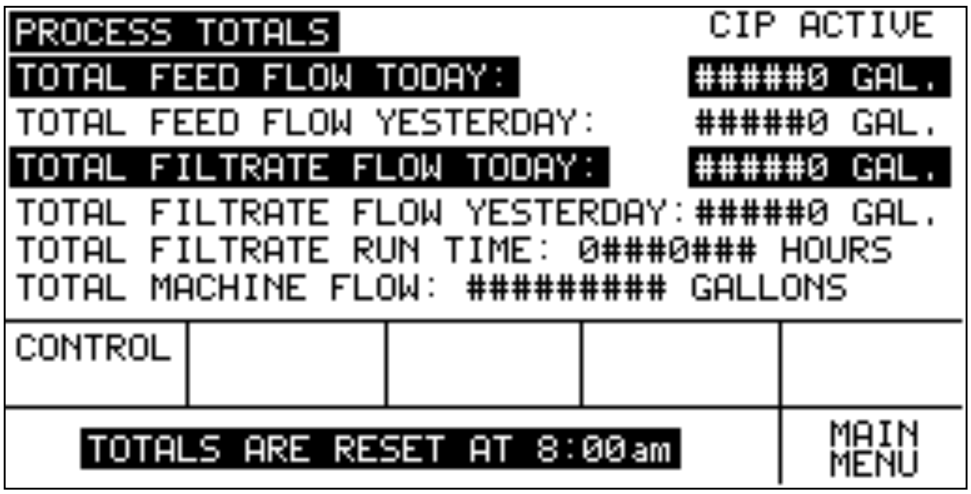
- Set the maximum time between backwashes
  Press *F1* and enter the desired time in minutes using the keypad. Press the enter arrow key when done.
- To move between set points to be changed use the up or down arrows on the keypad.
- Set the maximum time between pressure decay tests
  Press *F1* and enter the desired time in hours using the keypad. Press the enter arrow key when done.
- Set the maximum time between CIP(s)
  Press *F1* and enter the desired time in hours using the keypad. Press the enter arrow key when done.

The setup screen allows the operator to set maximum time intervals between consecutive Backwashes, Pressure Decay Tests and CIP Cycles.
The option of “auto re-start” of the unit can also be set from this screen in the case of power failure.

3.3.1.6 <u>SERVICE SCREEN</u>

The Service screen is password protected and only for use by Qualified Service personnel to set up parameters.

3.3.1.7 <u>PROCESS TOTALS SCREEN</u>



To access: Main Menu – F10

3.3.1.8 ALARM SCREEN

To access: Main Menu – F10.

The Panelview terminal provides automatic notification of abnormal operation of the CMF-L unit.
There are two types of alarms:

- Warning alarms. This type of alarm warns the Operator that a parameter is out of range but is not serious enough to create any danger to the operation or quality of the product. The plant will operate with an active alarm.
- Shutdown alarms. This type of alarm will shut the plant down as further operation of the plant with such a condition may lead to damage of the equipment or may impact the product quality. The plant will not restart until the cause of the alarm is rectified and the alarm is reset.

The alarm screen displays a shutdown alarm (if one exists), and any warning alarm(s) that exist. Press NEXT ALARM (F4) to scroll through the warning alarms. After the alarms are remedied, press RESET ALARMS (F2).
The red alarm indicator on the CMF-L control panel will show any current alarm.

3.4 VALVE SCHEDULE

Tag ID	TYPE AND SIZE	PURPOSE	OPERATION
AV1	Pneumatic, butterfly 2" D.A.	Break Tank Fill	Automatic
AV2	Pneumatic w/limiter, butterfly 2" D.A.	Lower Feed	Automatic
AV3	Pneumatic w/limiter, butterfly 2" D.A.	Upper Feed	Automatic
AV4	Pneumatic, butterfly 3" D.A	Upper Backwash	Automatic
AV5	Pneumatic, butterfly 3" D.A	Lower Backwash	Automatic
AV6	Pneumatic w/limiter, butterfly 2" D.A.	Cross-flow Recirculation	Automatic
AV7	Pneumatic, butterfly 1 ¼ " N.O.	Filtrate Header Isolate	Automatic
AV8	Pneumatic, butterfly 2" D.A.	Filtrate	Automatic
AV9	Pneumatic w/limiter, 2" D.A. N.O.	Filtrate Exhaust	Automatic
MV1	Manual Butterfly, 3"	Break Tank Feed	Isolating
MV2	Manual Butterfly, 3"	External Feed	Isolating
MV3	Manual Butterfly, 2"	Break Tank Drain	Isolating
MV4	Manual Diaphragm, 1 ½"	Filtrate	Isolating
MV5	Manual L- port, 3-way Valve 2"	Recirc/Filtrate Out	Selector
MV6	Manual needle ¼"	Sample Port	Isolating
NRV1	Check Valve 3/4"	Low Pressure Air Scour	
NRV2	Check Valve ½"	PDT and Pulse Backwash Air	
NRV3	Check Valve ½"	Shell Drain Air	

3.5 CMF-L INSTRUMENTATION

The following instruments and controls are located on the CMF-L skid:

DESIGNATION	TYPE AND SIZE	PURPOSE
LS1	Level switch	Break tank low level
LS2	Level switch	Break tank level control
LS3	Level switch	Break tank high level
FM1	Flowmeter, 2"	Feed flow (optional)
FM2	Flowmeter, 1 1/2"	Filtrate flow
PT1	Pressure transducer	Feed pressure
PT3	Pressure transducer	Filtrate pressure

3.6 CONTROL INTERLOCKS

The unit will automatically go into standby and terminate operation of any automatic cycles (except the CIP cycle) if:

- There is a low fluid level in the break tank when the unit is in break tank feed mode.
- There is low air pressure.

At any time, only one automatic cycle can be initiated. If a second cycle is initiated, there will be no response from the unit. This includes the backwash cycle. If any shutdown alarm is triggered, the unit will go into shutdown mode. The alarm must be cleared and the unit restarted. Any general alarm will display and the alarm indicator will light, but the unit will continue to run.

The CIP cycle cannot be reset by removing the system from filtration mode or turning off the main disconnect switch. The cycle can only be reset at its completion.

CAUTION: Do not operate manual cycles with the actuated valves manually activated. This may cause damage to the equipment or erratic operation.

3.7 OPERATION OF THE PLANT

The CMF-L plant is designed to run unattended. Once the plant is started there is very little operator input required to operate the plant. The plant/unit PLC constantly monitors the process parameters and reacts accordingly, going through normal operation steps like backwash, standby or self-diagnostic tests without operator input.

The plant will alarm if special attention is required and shut down if any dangerous conditions occur. The typical Operator input during operation of the plant includes, but is not limited to, the following:

- visual check for leaks and loose connections
- maintaining a supply of chemicals
- data logging
- initiation and support of the CIP cycle when prompted.

3.7.1 STARTING THE CMF-L PLANT

3.7.1.1 CONNECTIONS

For Break Tank feed, make the following connections for the unit:

- Break tank fill port (TP3) to water source .
- Backwash port (TP4) to backwash tank.
- Filtrate port (TP2) to filtrate tank.
- Break tank drain port (TP5) to drain.
- Ensure External Feed Inlet (TP1) is blocked off.

NOTE: *The CMF-L feed mode is set during start up of the plant by the Commissioning Engineer. The information regarding the direct feed mode is provided for reference only.*

For Direct feed, make the following connections for the unit:

- Backwash port (TP4) to backwash tank.
- Filtrate port (TP2) to filtrate tank.
- Break tank drain port (TP5) to drain.
- External Feed Inlet (TP1) to water source.

3.7.1.2 CMF-L UNIT SETTINGS

Set the manual valves for the unit as follows:

VALVE	TYPE	SETTING	LOCATION
MV1	Manual Butterfly	Open - Break Tank feed Closed – Direct feed	Under break tank
MV2	Manual Butterfly	Open - Direct feed Closed – Break Tank feed	Under break tank
MV3	Manual Butterfly	Closed	Under break tank
MV4	Manual Diaphragm	Partially open	Filtrate line under flow meter
MV5	Manual 3-way Ball	Filtrate to external port	Adjacent to break tank
MV6	Needle (Sample Port)	Closed	Filtrate line

Ensure that no pilot solenoid valve is manually actuated (overridden).

3.7.1.3 START UP

- Check that the valves are set correctly
- Turn on the compressor and ensure that sufficient air pressure (90 PSI) is available.
- Check that the pressure regulators are set to:
  90 psi (620 kPa) - control air pressure
  30 psi (620 kPa) – high pressure process air
  17 psi (100kPa) – low pressure process air
  7 psi (45kPa) – low pressure backwash air
- Check that the drain from the backwash tank is available. Ensure that the drain valve is opened.
- Turn on the power to the unit by rotating the main disconnect switch. The green POWER ON indicator will illuminate.
- If the unit has been shut down for more than 7 days, operate the pneumatically actuated valves by activating the corresponding pilot solenoid valves. This is to exercise the valves to avoid sticking due to inactivity.
- Turn on the feed supply.
- Release the red EMERGENCY STOP button on the Control Panel.
- Press START CMF-L F6 on the control screen of the Panelview terminal. AV1 will open to allow water to enter the break tank until it reaches the high level switch. The unit will shell fill and begin normal filtration.

CAUTION: The unit feed pump may start at this point

3.7.2 OPERATION

STEP	DESCRIPTION
ST1	WAIT (delay for break tank fill)
ST2	FILL SHELL #1
ST3	FILL SHELL #2
ST4	FILL LUMENS
ST5	END OF STARTUP

3.7.3 STOPPING THE CMF-L UNIT

3.7.3.1 EMERGENCY SHUTDOWN

To stop the unit in case of emergency, press the red EMERGENCY STOP button on the CMF-L unit control panel. This action will safely shut down the unit, causing all valves to shut down and the feed pump to stop. The EMERGENCY STOP button will latch and must be released before the unit can be restarted.

3.7.3.2 NORMAL SHUTDOWN

Press STOP CMF-L F7 on the control screen of the Panelview terminal. The unit will shut down in a controlled manner with all the valves in shutdown position and the feed pump halted.

3.7.3.3 SHUTDOWN AND DRAINDOWN FOR MAINTENANCE

Press DRAIN DOWN F3 on the control screen of the Panelview terminal while the unit is in filtration or shutdown mode. This cycle is used to drain the liquid from the unit so that the pipework can be dismantled. During the process, the filtrate line is closed. During the operation of this cycle, the lumens are drained to the break tank. Then the fluid in the recirculation line is pumped to the backwash outlet of the unit. The unit will stop upon reaching a low level in the break tank when in the Break Tank Feed Mode. The unit will shut down at the end of the cycle.

NOTE: *Before commencing maintenance, switch off the power to the unit, isolate and vent the compressed air system and open the sample valve.*

3.7.4 CIP (CLEANING IN PLACE) CYCLE

Chemical cleaning of the CMF-L unit should be performed when:

- The TMP (Trans-membrane pressure) exceeds the set design parameter. (Usually 15 -18 PSI of the operating flow rate).
- Time between CIP's timer reaches set point.
- An extended shutdown is going to occur.
- Starting up from an extended shutdown.
- Maintenance of modules, pumps or hydraulic components is required and there is danger of contact with contaminated feed.

3.7.4.1 CONNECTIONS AND SETUP

- Connect the CIP chemical inlet to the CIP hand pump
- Connect the Backwash tank drain to the external collection tank for disposal of cleaning chemicals. pH balancing is required.
- Secure all hoses and shield from splashing of cleaning chemicals.
- Set the manual valves on the unit to the following settings:

VALVE	TYPE	SETTING	LOCATION
MV1	Manual Diaphragm	Partially open	Filtrate line under flow meter
MV2	Manual 3-way T-port	Open - Break Tank feed Closed – Direct feed	Under break tank
MV3	Manual Butterfly	Closed	Underneath break tank
MV4	3-way Ball	Filtrate to break tank	Adjacent to break tank
MV6	Needle	Closed	Filtrate Line

NOTE : *Warm water (90^{0}F) will improve cleaning effectiveness.*

3.7.4.2 PROCEDURE

CAUTION:	Do not allow the water temperature to exceed 104^{o}F as damage to the membranes may occur.

The CMF-L unit can be programmed to use either external or feed water for the cleaning cycle. The selection is set in the SERVICE screen. Contact your Service representative to change the cleaning water source operation.

When using an external cleaning water source, such as a hose or hot water heater, the break tank is drained and the unit pauses, waiting for the break tank to be filled. When using the break tank water source, the unit will filter the break tank water and return it to the break tank for approximately 10 minutes. Following the filtration period, the unit will backwash and then halt when the break tank reaches mid-level.

The operator will be prompted when it is time to add the chemicals and begin the CIP cycle (press F5).

The CMF-L unit may require 2 separate CIP cycles:

Acid Clean: The chemical used in this cycle is Citric Acid. Mixing depends on the concentration of the chemical as purchased. The pH must be kept higher than 2. The recommended pH is 2.2.

Chlorine clean: The chemical used in this cycle is Sodium Hypochlorite. Mixing depends on the concentration of the chemical as purchased:

1.5 gal of Sodium Hypochlorite solution (standard bleach)
or
1 gal of Sodium Hypochlorite solution

Perform the following steps:

- Ensure that the filtrate valve MV4 is opened toward the break tank, closed to filtrate.
- Start the CIP cycle by pressing START CIP F5 on the CIP STATUS screen. Perform the appropriate steps corresponding to the selected water source as follows:
  For External Water Source:
  - The CMF-L unit will drain down the break tank and prompt the operator for an addition of water and chemicals.
  - Fill the break tank to the middle level switch from the external water source and then add the required chemicals.

  For Break Tank Water Source:
  - After 10 minutes of filtration the unit will backwash and drain to the middle level switch. It will then prompt the operator to add chemicals.
- Add the required chemicals.
- Press START CIP F5 on the CIP STATUS screen.
- Now the CMF-L unit is in the automatic cleaning cycle.

Once the CIP cycle has completed chemical recirculation, the CMF-L unit will stop. If an extended soak is desired, press EXTENDED SOAK F8 as soon as the cycle resumes. In CIP step 9 the unit will remain in the soak step until F8 is pressed again to end the desired extended period. The extended soak elapsed time is found on the CIP STATUS screen.
In CIP step 11, the unit will pause and the operator will be prompted to press START CIP F5 prior to the "Drain down", "Backwash", and "Rinse to Waste" cycles. This pause allows the backwash drain to be redirected to a neutralization area.
The CMF-L unit will rinse down automatically and perform backwashes automatically.

When the CMF-L unit has completed the backwashes it will go into shutdown.
Start the CMF-L unit by pressing START CMF-L F6 on the control screen.

3.7.4.3 OPERATION

STEP	DESCRIPTION
CIP1	FILTRATE RECIRCULATION (This step is skipped if external CIP feed source is set.)
CIP2	SPARE - not used
CIP3	SPARE - not used
CIP4	CIP BACKWASH (If internal CIP feed source is set, backwash cycle will continue until level in break tank drops to mid level switch.)
CIP5	ADD CHEMICALS (If external CIP feed source is set, the operator will also fill break tank with cleaning water to the mid level switch.)
CIP6	SPARE - not used
CIP7	CIP RECIRCULATE FILTRATE OPEN (30 min)
CIP8	CIP SOAK (30 min)
CIP9	CIP EXTENDED SOAK (Only if extended soak is set)
CIP10	CIP RECIRCULATE SHELL SIDE ONLY (60 min)
CIP11	CIP PAUSE (Unit will pause to allow operator to redirect backwash drain.)
CIP12	CIP SOLUTION DRAIN
CIP13	RINSE FILL
CIP14	RINSE TO WASTE
CIP15	SPARE - not used
CIP16	RINSE - WAIT (Unit will wait until break tank reaches high level.)

3.7.5 MANUAL INITIATION OF AUTOMATED CYCLES

Ancillary cycles on the system are automated through the PLC. The switching sequence for each of the automatic cycles is programmed into the PLC. Manual initiation of the following cycles should be performed only when necessary.

3.7.5.1 BACKWASH

The CMF system incorporates a backwash cycle which is automatically initiated. The period between each backwash cycle is set in accordance with the value entered in the setup screen. A backwash cycle can be manually initiated by pressing BACKWASH F2 on the control screen of the Panelview terminal.

3.7.5.2 OPERATION:

Step Number		Time in Seconds
Step 1	Log Data	2
Step 2	Close Feed	2
Step 3	Filter Down #1	2
Step 4	Filter Down #2	35
Step 5	Vent	2
Step 6	Pre-Aeration	10
Step 7	Liquid Backwash with Air Scour	12
Step 8	Post Aeration	38
Step 9	Vent	3
Step 10	Shell Drain #1	8
Step 11	Shell Drain #2	3
Step 12	Shell Fill #1	10
Step 13	Shell Fill #2	10
Step 14	Lumen Fill #1	5
Step 15	Lumen Fill #2	10
Step 17	End of Backwash	2

These times may be adjusted at the time of installation and very slightly.

4 SHUTDOWN AND STORAGE

4.1 SHUT DOWN

4.1.1 EMERGENCY SHUTDOWN

To stop the unit in case of an emergency, press the red EMERGENCY STOP button on the CMF-L unit control panel. This action will safely shut down the unit, leaving all valves in shutdown mode and halting the feed pump. The EMERGENCY STOP button latches and has to be released before the unit can be restarted.

4.1.2 NORMAL SHUTDOWN

Press STOP CMF-L F7 on the control screen of the Panelview terminal. The unit will shut down in a controlled manner, leaving all valves in shutdown position and halting the feed pump.

4.1.3 SHUTDOWN AND DRAINDOWN FOR MAINTENANCE

While the unit is in filtration or shutdown mode, press DRAIN DOWN F3 on the control screen of the Panelview. This cycle is used to drain the liquid from the unit so that the pipework can be dismantled. During the process, the filtrate line is closed. During the operation of this cycle, the lumens are drained to the break tank. Then the fluid in the recirculation line is pumped to the backwash outlet of the unit. The unit will stop upon reaching a low level in the break tank when in Break Tank Feed mode. The unit will shut down at the end of the cycle.

NOTE: *Before commencing maintenance, switch off the power to the unit, isolate and vent the compressed air system and open the sample valve.*

4.2 STORAGE

4.2.1 SHORT TERM (UNDER 7 DAYS)

- Press STOP CMF-L F7 on the control screen.
- If the unit is in external feed mode, turn off the feed source.
- Turn off the main disconnect.

4.2.2 LONG TERM

A 0.5 – 2.0 ppm solution of sodium hypochlorite should be used to store the unit. The liquid level should remain visible in the upper clear endplate of the unit during storage to ensure complete fiber protection. The break tank cover should be secured to reduce evaporation. The solution should be changed monthly. Be sure to affix appropriate warning labels indicating the presence of chemicals in the unit.

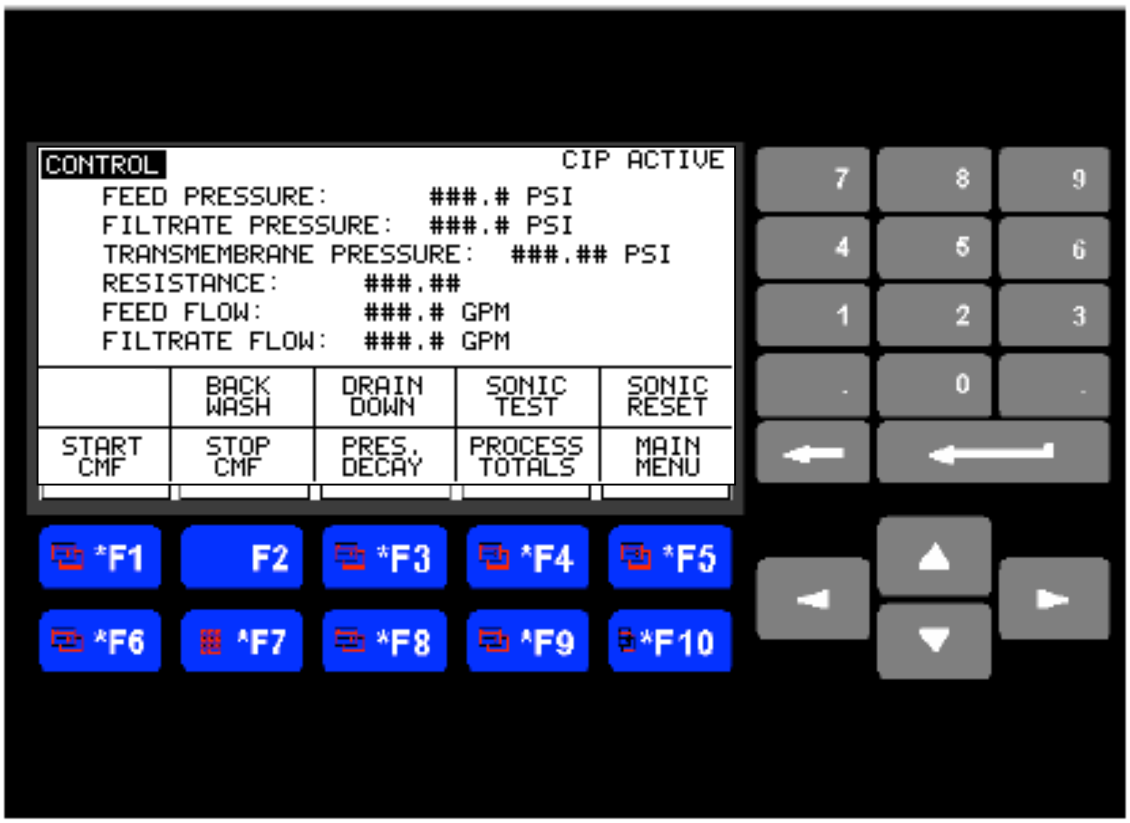
Before commencing the storage cycle, any feed in the unit should be rinsed out with clean water. This is done by first draining the break tank and then connecting the feed water to the break tank inlet and running the unit in filtration mode until all feed liquid has been displaced from the system.

Use the procedures as outlined for cleaning to circulate and mix the storage solution, with the following exception: during the soak period, isolate the tank feed to prevent the break tank from refilling. This will allow the correct concentration and amount of solution to remain in the CMF-L unit following the drain down cycle.

5 TESTING AND SAMPLING

The CMF-L unit has a preprogrammed cycle to assist with testing and evaluating the module integrity: Then Pressure Decay Test cycle uses low pressure air to measure the ability of the integral wet membrane to resist passing air through its wall. The resistance is caused by surface tension, and the pressure at which the air will overcome this resistance is called the Bubble Point.

The cycle is initiated from the CMF-L Panelview control screen.



PRESSURE DECAY TESTING

The pressure decay test checks the physical integrity of the modules and related finished water valves and orings. It is based on the expectation that the low pressure air will not pass through the membrane, but will gradually dissolve in the water. During this test the lumens are drained to the break tank and pressurized, and then the supply of low pressure compressed air is shut off. The test measures the rate of pressure drop over time.

NOTE *The modules must be tested at least once per week. The unit will automatically perform the pressure decay test at the interval entered in the setup screen of the CMF-L unit. Refer to Ch.3 for details.*

> **WARNING: Be careful not to over-pressurize during lumen drain because doing so will dry out the membranes.**

The test can be started manually. To operate the cycle, the following should be done:

- Check that the Low Pressure Process Air regulator is set to 15-17 psi (100 kPa).
- Press the PRESSURE DECAY (F8) push button on the Panelview control screen. The filter lumens will drain and the filtrate side will be pressurized to approximately 15-17 psi (100 kPa) for about 15 seconds.
- The unit will stabilize for two minutes and begin testing. The test period is two minutes long. If the initial test pressure is above 17 psi or below 10 psi, the unit will trigger an "Initial Test Pressure out of Range" alarm.

At the end of testing, the unit will automatically return to the normal filtration mode. If the pressure decay is greater than 1.5 psi per minute, a "general pressure decay" warning alarm will occur. If the pressure decay is greater than 2 psi per minute, a shutdown alarm will occur.

5.1.1 PRESSURE DECAY TEST RESULTS:

As the test is carried out over a fixed time interval (2 minutes) and the Filtrate pressure is measured at the beginning and end of the test period a defined result may be recorded.

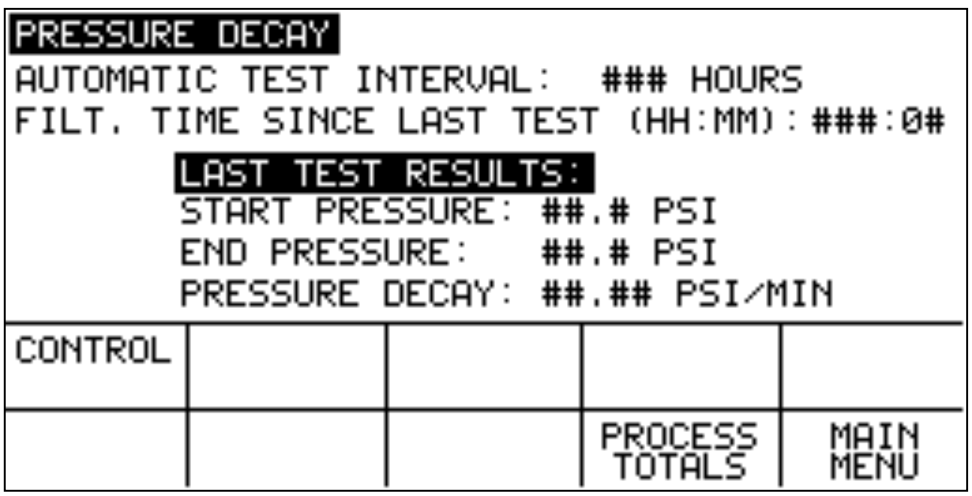
Calculation:

$$\frac{\text{Start Pressure} - \text{End Pressure}}{\text{Time}}$$

Sample calculation: $\frac{14.50 \text{ PSI} - 14.30 \text{ PSI}}{2 \text{ Minutes}} = 0.10 \text{ PSI/Min}$

To achieve a Log 4 removal, the PDT result should be less than 1 PSI/Min. Therefore, a warning alarm should be set to go off at 1 PSI/Min. and a shut down alarm should be set to go off at 2 PSI/Min. If a CMF-L unit carries out a PDT and a Warning or Shutdown alarm is registered, wait until the unit has been in Filtration for 10 minutes and then manually initiate and repeat the test. During the test period look for bubbles in the clear top head block end plate. If there are no bubbles inspect the valves associated with the finished water side of the machine. If bubbles are observed remove module for repair or contact a qualified service engineer for assistance.

The Pressure Decay Test data and results may be viewed from the Pressure Decay Screen (F8 from Panelview MAIN MENU screen).



The upper portion of the screen shows the “Automatic Test Interval” and the “Filtration Time Since Last Test”. (Both of these parameters are in terms of unit operational time, not total elapsed time). The lower portion of the screen shows the results of the last Pressure Decay Test performed.

5.2 TAKING SAMPLES FOR ANALYSIS

5.2.1 NON-STERILE WATER SAMPLING

Prior to taking water samples, be sure to have on hand an adequate supply of clean plastic bottles. Glass bottles should not be used for sampling de-ionized water because silica contamination of the sample can occur.

1. Prior to taking a sample, open the sample cock to the highest practical flow for three minutes. Tubing or some other material may be used to direct the water to a container or drain to avoid unnecessary spillage.
2. After the sample valve has been left wide open for three and one half minutes, reduce the flow to a reasonable stream of water. Allow the water to flow to drain for an additional three minutes.
3. Open the sample bottle and rinse the bottle 3 times with the sample flow.
4. After rinsing the bottle, fill it to nearly overflowing to avoid trapping air when the cap is replaced.
5. After the sample has been taken, immediately place the cap on the sample bottle and tighten it securely.
6. Duplicate samples should be taken at each sample point to avoid loss of a sample through laboratory error and to insure reasonable validity through comparison.

5.2.2 <u>STERILE WATER SAMPLING (OPTIONAL)</u>

The following is a general procedure to be followed when taking samples for bacteria testing. Prior to taking the water sample, be sure to have on hand an adequate supply of sterile bottles. These sterile bottles should be obtained from a reputable laboratory and should have been autoclaved and contained within a plastic outer wrapping.

1. Prior to taking the sample, open the sample valve to full force for a complete three and one half minutes. The inside diameter of a sample valve must not exceed 1/8" to insure proper velocity. Tubing or some other material may be used to direct the water to a container or drain to avoid unnecessary spillage.
2. After the valve has been left wide open for three and one half minutes, reduce the flow to a reasonable stream of water. Flow to drain for an additional three minutes.
3. Open the sterile bottle and hold the cap down. Fill the sample bottle all the way to the top of the neck, then immediately cap the bottle tightly.
4. The sample container should be placed in a plastic wrapping and should be taken to the laboratory for testing as soon as possible following the above procedure.
5. Duplicate samples should be taken at each test station during each specific test to avoid loss of a sample through laboratory error and to insure reasonable validity through comparison.

6 MAINTENANCE

Caution: Before performing maintenance on the CMF-L unit, be sure that the electrical power is disconnected at the source, and the main disconnect switch on the front of the control panel is switched off.

When working with air lines, be sure that the compressor is switched off and air is bled from the lines prior to performing maintenance. Do not operate the membrane test function immediately after backwashing. Faulty readings can result.

Do not use any chemical cleaning or sanitization solution other than what's specified. Damage to the system components may result.

Prefilter (100 mesh) large material from the process fluid before it enters the system.

Do not use chemicals which may damage the unit components in close proximity to the unit.

6.1 GENERAL MAINTENANCE GUIDELINES

PREVENTIVE MAINTENANCE							
DESCRIPTION OF WORK	FREQUENCY						
	D	W	M	Q	S	A	OTHER
Check the pipework and valves for leaks.	✓						
Check the coalescing air filter for condensation. Drain as necessary.	✓						
Check the pneumatic air lines for leaks.	✓						
Check the operation of pressure gauges and controls.		✓					
Check the settings of the air pressure regulators.		✓					
Ensure that all fasteners on pipework and supports are tight.		✓					
Manually initiate the Membrane Pressure Decay Test and observe for air bubbles. Record results on the log sheet.		✓					
Inspect and clean the suction strainer.		✓					
Inspect and clean, if necessary, the three level switches in the tank.			✓				
Lubricate the pump and pump motor.			✓				

Check the air filter element and replace as necessary, or after six months of operation.			✓				
Perform a Sonic Test and record the results on the log sheet.			✓				
Perform a thorough inspection of pipework for damage, wear, or corrosion. Remedy as needed.					✓		
Check calibration of flowmeters					✓		
Check calibration of pressure transducers and pressure gauges					✓		
Check calibration of all instrumentation plant wide					✓		
Clean the plant thoroughly.						✓	
D - Daily W - Weekly M - Monthly		Q - Quarterly S - Semi-Annually A - Annually					

6.1.1 DATA LOGGING

Records should be kept on operation, cleaning and adjustments to the system to protect warranties and aid in optimizing operation for your process. Charts for data logging and module replacement are included.

6.2 TROUBLE SHOOTING GUIDE

PROBLEM	POSSIBLE CAUSE	REMEDY	REFERENCE
Unit will not start and "Power On" indicator is off	Control fuse is blown.	Check fuse on the fused disconnect switch. Replace blown fuse.	See drawings for fuse locations
Unit will not start and "Power On" indicator is on	Thermal overload is tripped.	Reset the thermal overload located inside the electrical control panel.	See drawings for thermal overload location
Low filtrate flow	Modules are contaminated.	Initiate a manual backwash cycle.	See Section 3.7.5.3 for performing a backwash cycle.
	Modules are dry.	Initiate a manual rewet cycle.	See Section 3.7.5.1 for performing a rewet cycle.
	Valves or pipework is leaking.	Check all valves and pipework for leaks or defects.	
	Manual valves are not set correctly.	Check manual valves for proper position.	See Section 3.7.4.1 for valve set-up
	Pump rotation is incorrect.	Interchange any 2 power supply leads to pump.	
Poor filtrate quality	Air in filtrate.	Examine a filtrate sample after de-aeration. Improve feed pretreatment.	
	Module(s) are defective.	Perform a pressure decay test and pin-repair or replace as needed.	
Pump cavitations	Pump seal is worn.	Replace the pump seal.	See for pump manual.
	Feed line is restricted.	Check the strainer/feed line for dirt or damage. Increase external feed line size or shorten run length.	.
Incorrect pressure readings	Pressure gauges or transducers not operating correctly.	Verify that all pressure readings are within 1 psi of each other Repair or replace any gauge(s) not reading correctly	

		Repair or replace defective pressure transducer (s).	
Filtrate does not start when tank is at least half full.	Middle level switch is defective.	Check the middle level switch for proper operation and position.	
Tank overflows during filtration.	High level switch is defective.	Check the high level for proper operation and position.	
Pump running when tank is empty.	Low level switch is defective.	Check the low level for proper operation and position.	
System air pressure low.	Compressor is not switched on. Receiver drain valve is open.	Ensure that compressor is on and operating correctly. Close receiver drain valve. Check all pressure regulators, feed valves and pipework for settings, leaks or defects.	See compressor manual.

6.3 SHUTDOWN ALARMS

SHUT DOWN ALARM	POSSIBLE CAUSE	REMEDY	REFERENCE
E-STOP	E-stop pressed	Release E-stop	
CONTROL AIR PRESSURE LOW	Compressor faulted Filter / coalesce blocked	Check compressor overloads. Check filter / coalesce for blockage.	See compressor manual See Section 6.5.2.
FEED PUMP FAULT	Pump overload Low voltage	Reset motor starter overload. Check for proper line voltage.	See pump manual
FEED TANK LEVEL LOW	AV1 not operating No feed water source Present LS1 not working properly	Check AV1 for proper operation. Check feed water source. Test break tank level switch	See valve manual for valve repair & replacement
MASTER COMMS FAILED	Communication cable loose	Check communication cable connection, or replace communication cable.	

FILTRATE FLOW RATE LOW-LOW	Modules blocked Feed Strainer is blocked Flow meter fault	Perform a CIP. Remove and Clean Strainer Check Flow meter	See Section 3.7.4 for instructions.
PRESSURE DECAY EXCEEDED SHUTDOWN SETPOINT	Damaged fibers Damaged o-rings Damaged valve seals	Perform analysis to isolate problem component. Contact Service	See Section 5.2 for instructions.
CIP RECIRC FEED FLOW LOW DURING CIP7 OR CIP10	AV2 and AV6 stroke limiters not adjusted properly	Contact Service.	

6.4 WARNING ALARMS

WARNING ALARM	POSSIBLE CAUSE	REMEDY	REFERENCE
LOW FEED PRESSURE FAILURE DURING BW	Pressure transducer PT1 malfunctioning	Check PT1 operation during normal filtration to validate readings.	
LOW FILTRATE PRESSURE FAILURE DURING BW	Pressure transducer PT3 malfunctioning	Check PT3 operating during normal filtration to validate readings.	
CONTROL AIR PRESSURE LOW	Compressor faulted Filter/coalesce blocked	Check compressor overloads. Check filter/coalesce for blockage.	See compressor manual See Section 6.5.2
INITIAL TEST PRESSURE IS OUT OF RANGE	PDT pressure set out of range Membranes not properly wetted	Adjust PDT pressure to 15 - 17 psi.	See Section 3.5.1 for instructions.
PRESSURE DECAY EXCEEDED	Damaged fibers Damaged o-rings Damaged valve seals	Perform analysis to isolate problem component.	See Section 5.2 for instructions.
TANK NOT DRAINED DURING DD4	LS1 malfunctioning	Check operation of LS1.	
CIP RECIRC FEED FLOW LOW DURING CIP7 OR CIP10	AV2 AND AV3 stroke limiters not adjusted properly	Contact Service.	
FILTRATE FLOW RATE LOW	Modules blocked Flowmeters malfunctioning Pump malfunctioning	Perform a CIP. Check flow meter function Check pump function	See Section 3.7.4 for instructions. Consult manufacturer's literature

FILTRATE FLOW RATE HIGH	Flowmeters malfunctioning Pump malfunctioning	Check flow meter function Check pump function	Consult manufacturer's literature
STANDBY CAUSED BY TMP EXCEEDING MAXIMUM ALLOWED	Excessive fouling of modules Excessive Filtrate Flow	Perform CIP Check for Proper Valve operation (PV8 or 9)	See Section 3.7.4 for instructions.

6.5 COMPONENT MAINTENANCE

6.5.1 ISOLATING A MODULE

If a module is identified as defective through sonic analysis (see Section 5.2) and it is necessary to later remove it from the CMF-L unit for repair, the flow through the module can be interrupted without shutting down the entire unit. The following procedure describes how to close the valves at the top and bottom of a module in order to isolate it.

SPECIAL TOOLS (optional, Available from Siemens)

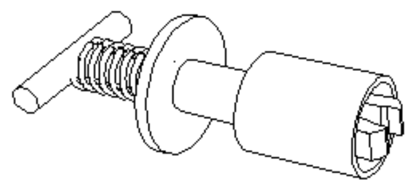


Fig 6-1 Filtrate valve shutoff tool (part # 6205-005)

6.5.2 PROCEDURE

To ensure that a flow rate of 0.5 gpm/m^2 is not exceeded, the flow rate must be adjusted to compensate for any modules that will be isolated. The following table shows the correct flow rate for the number of modules operating.

NUMBER OF MODULES IN SERVICE	FLOW RATE NOT TO EXCEED
3	22.5 GPM
2	15 GPM
1	7.5 GPM

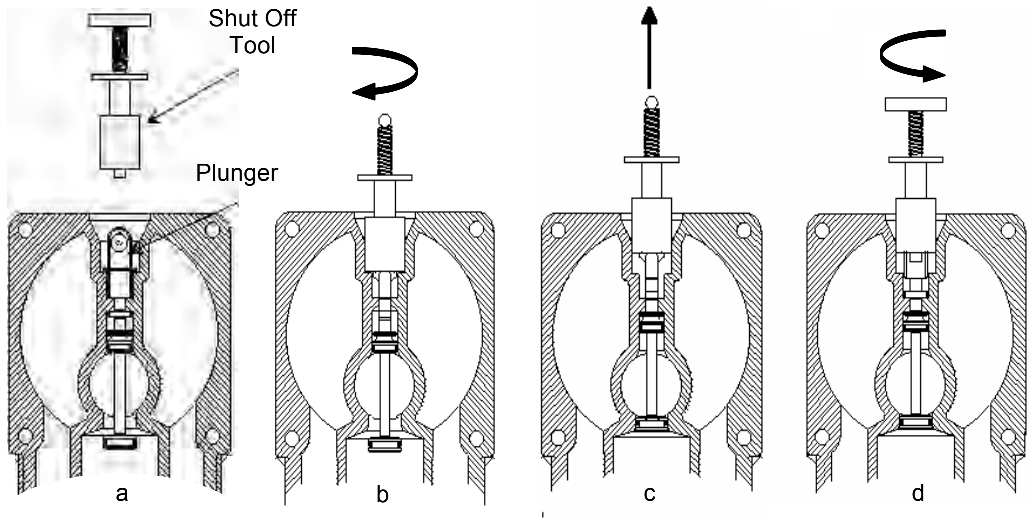


Fig 6.2 Module isolation

Place the filtrate valve shutoff tool (6205005) in the hole in the top of the module to be isolated as shown in Figure 6-3a. The pliers end should grip the top of the gray plunger. The plunger is shown in the normal filtration position.

Turn the shutoff tool one quarter turn clockwise to unlock the valve as shown in Figure 6-3b

Pull up on the valve and turn the tool one quarter turn counter-clockwise to lock the valve in the upper position. (See Figure 6-3c and d). The top end of the module is now isolated.

Repeat the procedure for the bottom end of the module. The unit can now be restarted with the adjusted flow rate as noted above.

NOTE: *Do not isolate the module when performing a Pressure Decay Test. Wait until the unit is back in filtration mode before isolating the module. If during isolating there is a resistance of the valve to move, contact Service Department and DO NOT FORCE the valve.*

6.5.3 MODULE REMOVAL, REPAIR, AND REPLACEMENT

6.5.3.1 SPECIAL TOOLS:

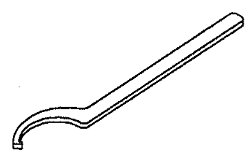


Fig.6-3 C-spanner (part # 6205012)

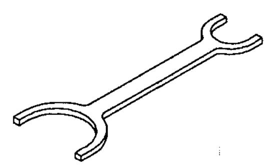


Fig 6-4 Filtrate cup tool (part # 6205011)

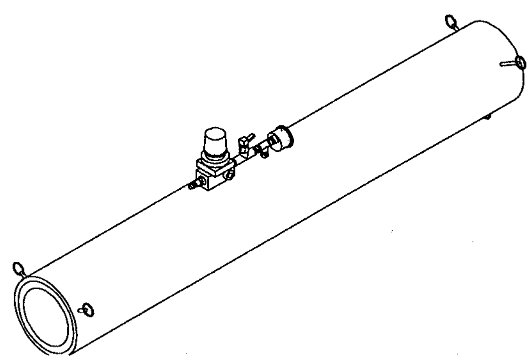


Fig. 6-5 M10 module test fixture (part # 6205025)

The module test fixture includes a small hammer, stainless steel pins, pin insertion tool, water basin, and wash bottle.

6.5.3.2 DISASSEMBLY PROCEDURE

- Ensure that all liquid is released from the system. This is done by opening the unions at the bottom of the end plates and opening AV4 on the top of the backwash line. To open AV4, locate PS4 in the solenoid valve block in the Pneumatic Panel and move the slider to the override position.

- Insert the hook end of the c-spanner into one of the grooves in the outer sleeve at the top of the module. (See Figure 6-7) Rotate the sleeve counter-clockwise until it is loose enough to be moved by hand.

- Disengage the outer sleeve from the head and lower it. The top filtrate cup and part of the submodule should now be visible. Remove the clips from the submodule (See Figure 6-8). Wind the top outer sleeve back onto the head a few turns to support the center tube while working on the lower end of the module.

- Disengage the outer sleeve from the lower end of the module. Lift and support the bottom outer sleeve. The bottom filtrate cup and part of the submodule should now be accessible.

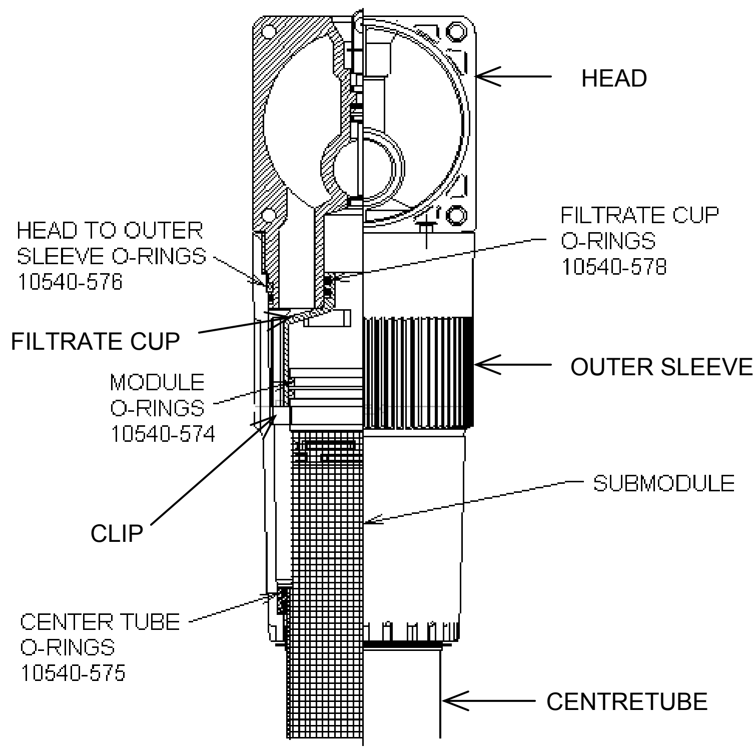


Fig.6-6 Module assembly

- Remove the clips and firmly push the submodule down into the bottom filtrate cup (see Figure 6-7). Avoid squeezing the submodule screen against the fibers. The submodule / filtrate cup length must be shortened so that it and the center tube assembly can be removed from between the fixed heads. As a guide, the top of the filtrate cup should be within 1/4 to 1/2 inch from the exposed screen area of the submodule.

- Unwind and lower the top outer sleeve to expose the submodule and filtrate cup. Firmly squeeze the top filtrate cup downward. Avoid squeezing the submodule screen against the fibers. Do not use a metal lever between the filtrate cup and the head piece. The top filtrate cup should now be disengaged from the head piece with a gap of approximately 1 1/4 inches.

Fig 6-7. Removal of module clips

- Remove the submodule, filtrate cups, and center tube assembly by lifting the bottom filtrate cup until it just clears the bottom head. There should be sufficient clearance to remove the whole assembly from between the heads. If the top filtrate cup re-engages in the top head while lifting, the filtrate cups have not been pushed far enough onto the submodule.

- Sliding the filtrate cups over the submodule may be extremely difficult. If the submodule / filtrate cup length cannot be reduced sufficiently to remove the assembly directly, then perform the first four steps and disengage the top outer sleeve to reveal the filtrate cup, which should just clear the head. Tilt the whole assembly away from the head at the top, and lift the whole assembly via the bottom filtrate cup, once the top end can clear the head. This method is easier, but risks the possibility of buckling the submodule. Buckling the submodule must be avoided to prevent fiber damage.

- Ensure that there is a clean area to place the membrane. If not, lay down a cloth and use this as your work area. Place one end of the assembly on the ground and stand it up.

- Remove the filtrate cups from each end of the submodule by placing the filtrate cup tool under two of the cup ridges and hammering upwards.
- Remove the inner and outer o-rings from one end of the submodule and slide the submodule out of the center tube.

- Remove all sixteen o-rings from the filtrate cups, submodule, center tube and heads. Dispose of all used o-rings. If spares are available, the filtrate cups and clips should also be discarded.

This completes the disassembly procedure.

6.5.3.3 <u>ASSEMBLY PROCEDURE</u>

Inspect all components. O-rings and sealing surfaces must be free of defects. Fibers should not be kinked, broken, or indented. All components must be clean.
New o-rings required for assembly are: (Refer to Fig 6-7)
4 for the submodule (part # 10540-574)
4 for the filtrate cups (part # 10540-578)
4 for the center tube (part # 10540-575)
4 for the head pieces (part # 10540-576)
Before installing o-rings lubricate them with Bel-Ray No-Tox silicone valve seal lubricant (part # 6020-041)

- Install the two o-rings on the bottom head, two on the top head, and two at each end of the center tube. Ensure that none of the o-rings are twisted.
- Install two o-rings on each filtrate cup. Ensure that the o-rings are not twisted.
- Install two o-rings on one end of the submodule. Ensure that the o-rings are not twisted. Press a filtrate cup fully onto this end. The submodule can be tapped lightly on the end to assist in assembly. This end will be the lower end when replacing the module in the unit.
- Slide the submodule through the center tube assembly.
- Place the second filtrate cup fully over the top end of the submodule. The filtrate cup will loosely slide onto the submodule, allowing for easier manipulation during the following steps.
- Install the center tube / submodule assembly into the unit, pushing the lower filtrate cup into the lower head.
- Push the top filtrate cup into the upper head. The o-ring grooves at the upper end of the submodule should now be exposed. Slide the two remaining o-rings into their grooves. Ensure that they are not twisted.
- Install a pair of clips on the upper end of the submodule, and use them to lift the submodule into the upper filtrate cup until the clips contact the filtrate cup.
- Lift the top outer sleeve and wind it onto the upper head until the o-rings engage. Use the c-spanner to wind the outer sleeve to within 0.5 mm of the head at the closest point. If the sleeve is not wound to within 0.5 mm, the submodule may not be in the proper position to execute the next step.
- Lift and support the lower outer sleeve to gain access to the lower filtrate cup and submodule. Slide the lower filtrate cup downward. The submodule should remain in place, supported by the outer sleeve and clips at the top of the module. The filtrate cup must be low enough and the submodule must be high enough to allow correct fitting of both clips. If the submodule stretches slightly while sliding the filtrate cup, it must be lifted to fit the clips. Avoid squeezing the exposed screen against the fibers.
- Install the clips on the lower end of the submodule.
- Wind the outer sleeve onto the lower head. To engage the threads, it may be necessary to grip the center tube and push downward to fully engage its top o-rings with the top outer sleeve. Tighten the bottom outer sleeve with the c-spanner to within 0.5 mm of the head at the closest point. Ensure that the top outer sleeve does not unwind.
- Close the drain plug on the lower feed line, and close MV10.
- Use the log sheets in Section 8 to record any repairs or replacements.

This completes the assembly procedure.

6.5.4 PIN REPAIR

Before repairing a submodule, ensure that it is fully wetted. This is best achieved by performing a CIP cycle.
Place one end of the pin repair test fixture in the basin and stand upright.
After removing a submodule (see Section 6.5.3), with the o-rings installed on both ends of the submodule, immediately insert it into the test vessel or soak it in a container of chlorinated water. Do not allow the submodule to dry out.
Once the submodule is placed in the test fixture, Attach an air hose to the regulator. Slowly pressurize to 7 psi (50 kPa). Pour water on top of the submodule with the bottle and observe bubbles. Broken or damaged fibers will create big bubbles before a pressure of 7 psi (50 kPa) is reached.

Repair a bubbling fiber by pushing a nylon pin into the end of the fiber by hand. Cut off excess pin length as close to the pot as possible. Drive the pin in so it is flush with the urethane top of the submodule.

WARNING:	**The end of the pin can fly off with considerable velocity. Eye protection must be worn**.

Fig 6-8 Testing the module for leaks

When all damaged fibers are pinned at one end of the submodule, the other end of the submodule must be checked. If a fiber is broken in the center of the bundle, it will bubble at both ends. If a fiber is damaged, (as opposed to broken), air will leak to the end of the submodule nearest the damage. Once that end is pinned, air will take the higher resistance path to the other end. Also, if a fiber has missed being potted in the urethane it will bubble on one end. Remove the repaired submodule from the test fixture and reassemble it according to Section 6.5.3.

6.5.5 VALVE REPAIR AND REPLACEMENT

6.5.5.1 BUTERFLY VALVE

The butterfly valves installed on the unit are serviceable. In the case of a malfunction or water leak the valve seat can be replaced.
Ensure that all liquid is released from the line containing the valve.
Remove the valve from the pipe work by loosening and removing the bolts from the flanges or unions on each side of the valve.
To remove a pneumatically actuated valve, first disconnect the pneumatic tubing from the actuator.
Unbolt the actuator from the valve body.
For Bray actuator repair, consult the Bray Actuators and accessories manual.

Do not attempt to repair any of the Gemu valve actuators. This actuator requires specialized tooling to make proper repairs. For safety reasons it best to replace the Gemu actuator than repair it.

6.5.5.2 CHECK VALVES

Check valve CV1 is located on the air inlet to the upper filtrate manifold and has no serviceable parts.
Check valve CV2 is located on the upper feed manifold.
Remove the check valve from the pipeline by unscrewing the union nut. (See Figures 6-9 and 6-10).
Examine the internal stop and the diaphragm to see if they are defective. If so, replace them.
If the inlet housing or outlet housing is damaged, remove the check valve from the pipeline and re-plumb with a new check valve. Make certain that the arrow is pointing in the direction of the flow. The assembly should only be tightened one eighth (1/8) of a turn with a strap wrench after hand tightening. Do not over-tighten; Damage or fracturing of the valve housing could result. **Avoid using Metal tools to grip or install plastic components metal tools could damage the component and also cause injuries**.

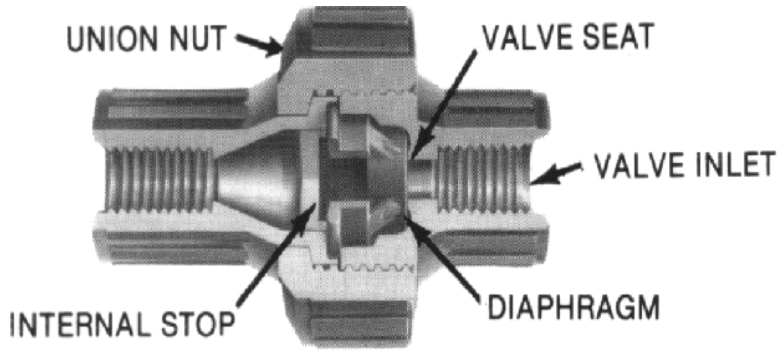


Fig 6-9 Check valve assembly

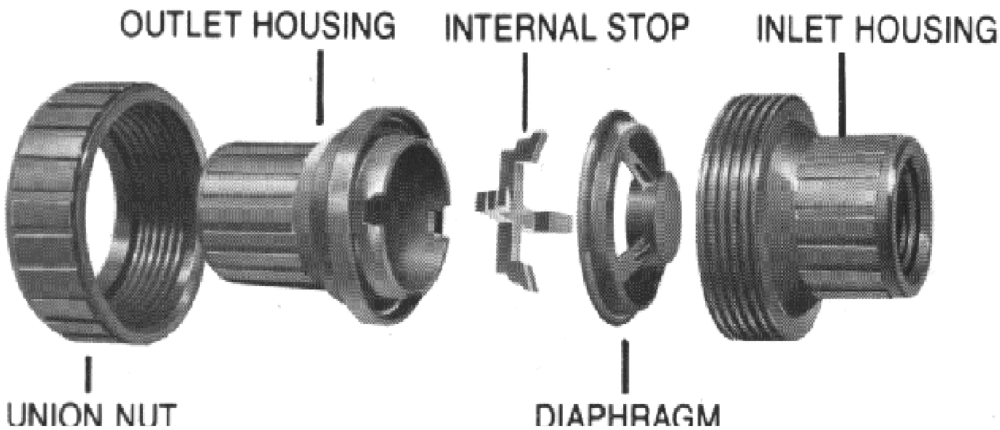


Fig 6-10 Check valve exploded view

6.6 PNEUMATIC EQUIPMENT

6.6.1 PRESSURE REGULATORS

The pressure regulators should be set as follows:

Backwash pressure	30 psi
Membrane Test pressure	15-20 psi
Control air pressure	90 psi
Scour air pressure	7 psi

The pressure regulators may be removed if necessary if they are leaking air or not maintaining the proper pressure.

When servicing the solenoid valves, ensure that both the electricity and air supplies to the unit are isolated. Make certain that all pressurized air which could present a hazard is bled from the system.

6.6.2 COALESCER MEMBRANE

The coalescing filter is located on the air line.
The filter element should be inspected monthly and replaced as needed. To inspect or replace a filter element, unscrew the nut on top of the filter housing. The bowl will separate from the head piece.
The filter element can be removed from the bowl. If it is wet or dirty, it should be discarded and replaced with a new one. If the filter element is clean and dry, place it back in the bowl and reassemble the housing.

6.7 CONTROL PANEL

Ensure that power to the unit is disconnected at the source, and the Main Disconnect on the front of the panel is off before performing any maintenance on the electrical panel.
Disconnect the main air line at the source when working with the pressure switch.

6.8 PUMP

For any pump maintenance, please refer to the Installation, Operation and Maintenance Instructions.

7 APPENDIX

7.1 GLOSSARY OF TERMINOLOGY

A	
Acidity	The quantitative capacity of aqueous solutions to react with alkalis. See also pH.
Activated Carbon	Specially treated carbon that can be used to absorb chlorine, organic compounds, and odors.
Alkalinity	The quantitative capacity of aqueous solutions to react with acids. See also pH.
B	
Backwash	Reversed flow through a filter medium to remove filtered solids.
BOD	Biochemical Oxygen Demand. Measures biodegradable organic matter. Expressed as O_2.
Break Tank	Storage tank at atmospheric (a break in head pressure) pressure from which feed is drawn prior to filtration.
Bubble Point	The pressure at which air first passes through a wet membrane; the path being the channel of greatest pore size.
C	
Cartridge	An assembly of filtration media in a housing. See also Module.
Caustic Soda	A Sodium Hydroxide (NaOH) solution.
Center Tube	The nylon tube with two (outer) sleeves that forms the main shell of an L10 class CMF-L module.

CIP	Clean-in-place. A method whereby a filter medium can be chemically cleaned to restore performance without requiring removal from the system.
Cleaning Agent	An agent used to soften, disintegrate, or dissolve contaminants lodged in a filter.
CMF-L	Continuous Microfiltration. Microfiltration product, which uses a gas backwash to allow continuous operation on feed streams of varying quality, is a CMF-L system.
Coliforms	A group of bacteria which are used as indicator organisms in various standards of hygiene for drinking water and wastewater treatment.
Concentrate	The non-filtered stream leaving a cross flow filter system. Also called Return, Recycle, Recirculation, or Reject.
Compaction	The reduction in thickness of a filter medium as a result of applied filtration pressure (TMP). See Dynamic Membrane.
Cross Flow Filtration	Method of filtration where the feed stream flows parallel to the surface of the filter medium to minimize fouling. Only a percentage of the feed passes through the filter medium.
D	
DAF Test	Diffusive Air Flow Test. A high resolution test for detecting membrane integrity to one part in 107. It measures the amount of air that is diffused through a wetted membrane.
Deadleg	An area of the pipework in which process fluid may stagnate.
D.I.	De-ionize. The removal of ions from a liquid, usually by a vessel containing ion exchange resin.
Direct Filtration	A method of filtration whereby the feed stream is fed directly to the filtration media. All the feed passes through the membrane. No cross flow is used; therefore, feed flow and filtrate flow are balanced during filtration.

Dynamic Membrane	A transient membrane formed on the surface of an established membrane by solids filtered from the feed stream. Sometimes called a filter cake.
E	
End Manifold	A molded plastic component which provides a simplified means of connecting module banks together to form a module array, while maintaining separation of feed and filtrate.
EDTA	Ethylene Diamine Tetraacetic Acid – the chemical used in restoring the membrane surface during CIP process.
F-G	
Feed	The raw supply liquid to the filtration unit.
Fiber	More correctly called the Hollow Fiber Membrane. A bundle of thousands of fibers is used in each module.
Filtrate	The product of the filtration process; i.e. liquid exiting the filtrate outlet.
Filtrate Flow Rate	The instantaneous volume per unit time of filtrate produced by a system, typically measured on a filtrate flowmeter.
Filtrate Flux	The rate of filtrate flow as expressed per unit of filtration area (liters/meter sq. hour).
Filtrate Shut-off Valve	The device used to isolate filtrate flow from a single module. It is a built-in feature of the L10 class module.
Filtrate Side	That part of a system which carries filtrate flow, including fiber lumens and all filtrate-carrying manifolds and pipework. Same as Lumen Side.
FTU	A measure of turbidity equal to NTU.
H-I-J	
Hardness	The concentration of polyvalent actions in water.

Head	The manifold headpiece of the CMF-L module.
HMI	Human Machine Interface. A device that allows a human to receive information from, or give instruction to a machine.
Hydrophilic	Water-loving. Easily wetted with water.
Hydrophobic	Water-aversive. Not easily wetted with water.
K	
kg	Kilogram - unit of mass. Consists of 1000 grams or 2.2 lbs.
kPa	Kilopascal - a unit of pressure. 100kPa = 14.75 psi or 1 atmosphere.
L	
L10	Nomenclature for the filter modules used in CMF-L systems. Membranes housed in an L10 module have an equivalent surface area of approximately 252ft^2 (square feet) or more.
Lumen	The axial hole through the center of a hollow fiber membrane.
Lumen Side	Same as Filtrate Side for outside to inside filtration, as used by the CMF-L process.
M	
Membrane	A porous barrier filtration medium. It may be flat (e.g. RO), or a hollow fiber.

Membrane Test	A process, based on membrane bubble point characteristics, for testing the integrity of the membranes used by the CMF-L system.
Memclean C	Proprietary chemical solution used to clean microfiltration membranes and systems. It is used in conjunction with caustic soda, when a caustic CIP is called for by a CMF-L unit. When used only with water (no caustic mixed), it serves as an excellent wetting agent for the CMF-L modules while in short or long term storage.
Memclean EXA2	A mixture of Memclean C and caustic soda used as the basis for the CIP cleaning solution. Used when a caustic CIP is called for by a CMF-L unit.
Microfiltration	Membrane filtration of a liquid which removes particles in the range of 0.1 to 1.5 microns. The membranes have a nominal pore size of 0.2 microns.
Module	An assembly of hollow fiber membranes in a single pressure vessel or housing with a head manifold at each end containing separate feed and filtrate connections. See also Cartridge and Center Tube.
Module Array	Multiple module banks connected by end manifolds to form a block of filtration modules. A ninety-module array consists of fifteen banks of six modules each.
Module Bank	Multiple single modules connected together in a row with end manifolds.
N	
Nephelometer	An instrument which uses scattering light to measure turbidity in a liquid. Commonly known as a turbidimeter.
NTU	Nephelometric Turbidity Unit. Unit of turbidity (lack of clarity) obtained by measuring the scattering of light in a liquid.
O	
Osmosis	The natural transport of water through a semi-permeable membrane which separates two solutions of different solute concentration.

Outer Sleeve	The threaded retainer which holds the head to the center tube of an L10 CMF-L module.
P-Q	
Permeate	The product, or filtrate, of Reverse Osmosis or ultrafiltration.
pH	Measurement of acidity (<7) or alkalinity (>7). The logarithm of the concentration of the hydrogen ion (ordinarily ranges between about 1 and 10-14 gram-equivalents per liter.)
PLC	Programmable Logic Controller. Used to control the functions of a CMF-L system.
Pore	Small interconnecting passage through the membrane. The size and irregular path of a pore determines the removal rating of a membrane.
Pore Size	The equivalent diameter of the smallest part of any channel through a membrane.
Potting	The securing material or adhesive that seals the filter material in a cartridge.
Prefilter	A device installed upstream of the main filtration process to remove large solids.
PSI	Pounds per square inch. A unit of pressure. 1 PSI = 6.78 kPa.
R	
Return Flow	The concentrate which is returned to the head of the process for further processing.
Reverse Osmosis	A pressure-driven solution/diffusion process, which transports a liquid through a semi-permeable membrane with the exclusion of nearly all solutes as small as approximately 0.005 microns. Also called hyperfiltration.
S	
Sanitizing Agent	An agent introduced into a system to kill organisms and prevent the growth of organisms.
SCADA	Supervisory Control And Data Acquisition system. A PC based computer interface that allows the operator to interface with the

	plant master PLC in order to monitor and control plant operation. (Also see HMI).
Scale	The deposits, usually salts, created as a solution increases and exceeds their solubility limits, which build up on the filter media.
Shell	The outer tube encasing the hollow fibers in a module.
Shell Side	The part of a CMF-L system which carries feed flow, including module casings, feed manifolds, and feed and recirculation pipework.
Sub Module	The replaceable bundle of hollow fiber membranes contained in an L10 class module
T	
TDS	Total Dissolved Solids. May be used as an indication of the level of contamination of water.
TMP	Transmembrane Pressure. The average pressure across the membrane.
TOC	Total Organic Carbon. May be used as an indication of the level of contamination of water. Measures the CO_2 produced from organics when a water sample is atomized into a combustion chamber.
Train	A row of CMF-L units of the same configuration, sharing common manifolds and a Backwash Tank.
Turbidity	Non-clarity caused by fine suspended particles. Defined by measurement of scattering light through a sample. See NTU.

U-V	
Ultrafiltration	A pressure-driven membrane process which rejects large molecules in the range of approximately 0.005 to 0.1 microns.
W-X-Y-Z	
Wetting	The process of filling pores of a hydrophobic membrane with water. Typical methods include use of alcohol as a wetting solution, or high pressure to drive air out. See also Rewetting.

ATTACHMENT D

Iron and Manganese Oxidation/Filtration Unit
Specifications & Manual

Details about treatment unit – Pelican Water website

Benefits of the Pelican Iron System back to top

- 90-Day Satisfaction Guarantee
- Iron removal up to 10 PPM
- Non-Electric Self-Priming Chemical Pump
- No more stains on sidewalks, driveways or houses
- System comes complete and ready to install
- Safe for use with septic systems
- Limited lifetime warranty on tank and parts
- 5 Year Warranty on the solid state microprocessor (head unit)

How It Works back to top

The WF4/WF8 Iron Series utilizes a 4 stage system to oxidize and remove the iron from the water, clean up taste and odor, and filter your water to make it the best water you could have.

Stage 1 - Pelican Sediment Filter

All Pelican Carbon Series Premium Whole House Water Filters come with a 5 micron pre-filter system that helps protect your new filter system and your home appliances from the damaging effects of sediment (dirt & debris) build up. The sediment in city or well water can clog faucets, damage appliances and even change the taste of your drinking water. The pre-filter system filters down to 20 times smaller than the diameter of a human hair or 5 microns in size. Learn More.

Stage 2 - Pelican Chlorination System - Performance beyond the competition!

Installed directly in the water supply line, the injector operates without electricity, using water pressure as the power source. The water drives the injector, which pulls the required percentage of concentrate directly from the chemical solution tank. Inside the patented mixing chamber, the concentrate is mixed with the water, and the water pressure forces the mixed solution downstream. The amount of concentrate will be directly proportional to the volume of fluid entering the injector, regardless of variations in flow or pressure.

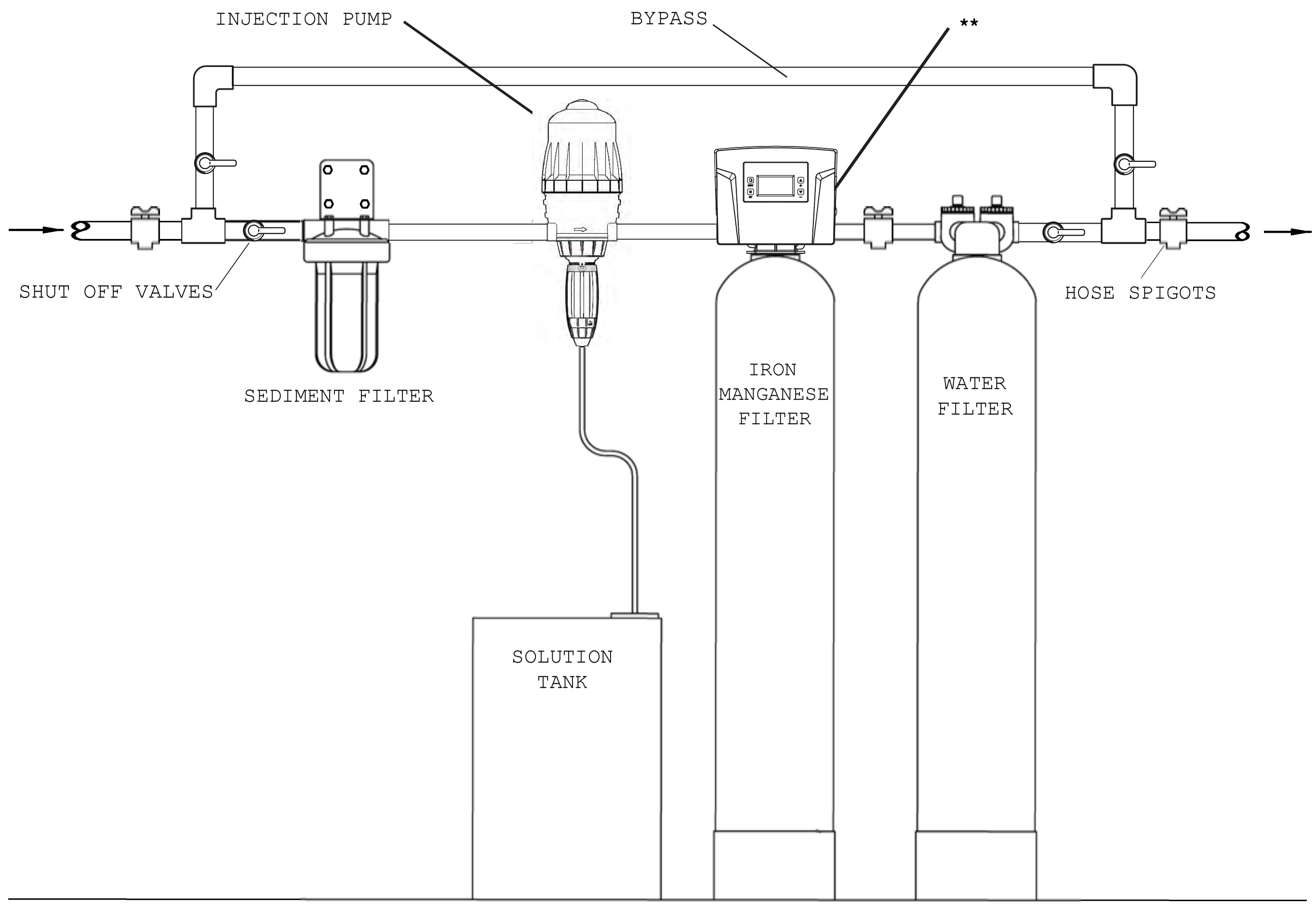
Stage 3 - Greensand Plus Iron Removal

Stage 3 traps the iron with a filter media and gravel under bed then flushes it out with the backwash system. This Improved version of greensand improves its reduction of iron and manganese. The Greensand-Plus filter provides an excellent long-term, relatively low-maintenance solution. GreensandPlus has received the WQA Gold Seal Certification for compliance with NSF/ANSI 61.

Stage 4 - Carbon Filtration

The premium carbon filtration system is designed/developed to significantly reduce chlorine, chloramines, sediment and/or particulate matter, tastes, and odors that may be present in your water. This deluxe, high-capacity, virtually maintenance-free system is easily installed in any home and has a 600,000.1,000,000 gal/5-year Performance Guarantee, the best value on any whole house water filtration system in America!

Tired of stained toilets and unsightly house stains?
We have the answer to your problem!



**BACKWASH LINE TO BE PLUMBED TO A DRAIN

Pelican Water Systems
3060 PERFORMANCE CR
SUITE 2
DELAND, FL 32724
1-877-842-1635
www.pelicanwater.com

DO NOT SCALE DRAWING

CONNECTION SIZE: 1"
MAX PRESSURE OPERATING: 80
PSI MAX TEMPERATURE: 100°

INSTALLATION OVERVIEW
WF 4/8

Gmail by Google

Lara Egbeola-Martial <lara@srtconsultants.com>

Is there anything else I can help you with?

matt@pelicanwater.com <matt@pelicanwater.com> Mon, Jan 9, 2017 at 2:53 PM
To: Lara Egbeola-Martial <lara@srtconsultants.com>

Hi Lara,

The WF8 needs to backwash every 3 days for 20 minutes and uses approx. 75 gallons per cycle.

The water is going to have a high iron/manganese content so it is fine for irriga. on, but not recommended to cycle back through your system.

The system includes 50ft of drain line that you can run to septic, floor drain, drain field, etc.

The sediment filter should be replaced every 3-6 months ($15 each), the greensand usually lasts 12-20 years or longer, and the carbon should be replaced every 5 years ($298).

We sell all of the media and filters on our website, and you can also find them from filtration supply companies as well.

Please feel free to call/email me for further assistance any time.

Thanks again!

MATT BAURIES
Water Treatment Specialist

Phone: 386-469-0138 x212 | Email: matt@pelicanwater.com
www.pelicanwater.com

Gmail by Google

Lara Egbeola-Martial <lara@srtconsultants.com>

Is there anything else I can help you with?

matt@pelicanwater.com <matt@pelicanwater.com> Thu, Jan 12, 2017 at 3:15 PM
To: Lara Egbeola-Martial <lara@srtconsultants.com>

Hi Lara,

The purpose of the carbon filter is to remove the chlorine and by-products completely a. er iron and manganese removal.

There will be very small or no trace amounts of residual chlorine after the carbon stage of the system, it is designed to remove about 6 mg/L of chlorine from the water.

The concentration in your holding tank will be extremely low to none, so you should have no issues with chlorinated water or water with THMS and HAAC present.

MATT BAURIES
Water Treatment Specialist

Phone: 386-469-0138 x212 | Email: matt@pelicanwater.com
www.pelicanwater.com

From: Lara Egbeola-Martial [mailto:lara@srtconsultants.com]
Sent: Thursday, January 12, 2017 6:11 PM

[Quoted text hidden]

[Quoted text hidden]

Phone conversation with Matt Bauries from Pelican Water – 1/12/2017

Electrical Requirements: normal 110 V outlet, 100 mA during idling and up to 200-300 mA during the backwash.

Pressure drop through the unit: 5 to 6 psi

Max flow rate: 15 gpm

Backwash flow rate requirement: 5-8 gpm

Backwash frequency of every 3 days is appropriate to a combined Mn and Fe concentration of 5 ppm. The frequency of backwash can be adjusted and could be set to every 4 or 5 days in our case, due to our lower Mn and Fe concentrations.

Concentration of chlorine can be adjusted but the default setting aims for a chlorine concentration of 2.6 – 3 mg/L prior to the carbon filter. The **carbon filter** however is there to remove chlorine from the water and is designed to remove up to 6 mg/L of chlorine,

Once ordered, the unit would be sent by freight and can be expected in 6-7 days. **Delivery** is then arranged over the phone from the freight port.

Mn/Fe Pelican Water unit - Backwash Info

Backwash Frequency

- The system with a backwash cycle every 3 days is rated for about 1,200 gallons of water (estimating 400 gallons/day) with a combined Mn/Fe concentration of up to 5 ppm.
- If the usage or concentration is lower, the frequency of backwash cycles can be changed to up to every 7 days.
- At a combined Mn/Fe concentration of ~1ppm, the backwash frequency can be set every 5 days, as long as it is not extreme high consumption.
- For our high summer consumptions, the unit will most likely need to backwash at least once a day.

Backwash Volume

- The backwash volume is 75 gallons
- Raw water is used for the backwash cycle of the filters of the unit. A bypass valve on the unit ensures that when the backwash cycle is triggered, the raw water is sent in the opposite flow direction (from outlet to inlet) to backwash the filters.

Pelican

877-842-1635

Menu

Menu

Read Reviews

Pelican Iron & Manganese Water Filter

1-3 Bathrooms

Pelican Model	WF4
Warranty	Limited Lifetime
Suggested Retail Price	~~$6,298.00~~
SALE PRICE	**$3,149.00***

* 50% FACTORY-DIRECT SAVINGS

FREE SHIPPING
Ships freight within 24-48 hours!

Quantity: 1

ADD TO CART

Item in-stock.

4-6 Bathrooms

Pelican Model	WF8
Warranty	Limited Lifetime
Suggested Retail Price	~~$7,138.00~~
SALE PRICE	**$3,569.00***

* 50% FACTORY-DIRECT SAVINGS

FREE SHIPPING
Ships freight within 24-48 hours!

Quantity: 1

ADD TO CART

Item in-stock.

Details

The Pelican WF4/WF8 Iron Series utilizes the latest technology designed to give you quality iron free water with the least amount of maintenance. Using the most advanced non-electric dosing system available, the Pelican Iron Series delivers performance beyond the competition. The Pelican

Menu

Specs

Diagrams / Owners Manual

Owner's Manual for WF4/WF8 (link opens in new window)

Product Information

	WF4	
Max. Flow Rate:		10 GPM
Connection Size:		1"
Operating Pressure:		25-80 PSI
Operating Temperatures:		36-120 F
pH Range:		7-11
Iron Range:		Up to 10 PPM
Drain Size:		3/4" (50ft Supplied)
	WF8	
Max. Flow Rate:		15 GPM
Connection Size:		1"
Operating Pressure:		25-80 PSI
Operating Temperatures:		36-120 F
pH Range:		7-11
Iron Range:		Up to 10 PPM
Drain Size:		3/4" (50ft Supplied)

There is no such thing as a silly question!
Our friendly water treatment specialists are here to help!

877-842-1635Call Monday-Friday: 8:00AM - 9:00PM EST
Saturday 8:00AM - 8:00PM EST

Pelican Water, 3060 Performance Cir, Suite 2 Deland, FL 32724

OUR PRODUCTS

Water Filters
Water Softeners
Well Water
UV
Drinking Filters
Shower Filters

PAYMENT OPTIONS

CERTIFICATION

Pelican
Water Systems

Owner's Manual

Pelican WF4/WF8 Premium Whole House Iron and Manganese Filtration System

Table of Contents

Product Operation and Specifications

Specification Description	WF4	WF8
Max Flow Rate	10 GPM	15 GPM
Minimum Working Pressure	25 PSI	
Maximum Working Pressure	80 PSI	
Maximum Vacuum	5 inch/127 mm Hg	
Operating Temperatures	36°F – 100°F	
pH Range	7 - 11	

Important Information

- Read these instructions carefully and determine the location of all system components before beginning installation.
- Check all applicable plumbing, building, and electrical codes for installation compliance.
- Install the system on the main water supply.
- The use of Teflon Tape and/or Pipe Thread Seal Paste will be needed on all threaded connections.
- Systems that contain electronic components cannot be installed outside in uncovered areas.

⚠ WARNING:

If this or any other system is installed in a metal (conductive) plumbing system, i.e. copper or galvanized metal, the plastic components of the system will interrupt the continuity of the plumbing system. As a result any errant electricity from improperly grounded appliances downstream or potential galvanic activity in the plumbing system can no longer ground through contiguous metal plumbing. Some homes may have been built in accordance with building codes, which actually encouraged the grounding of electrical appliances through the plumbing system. Consequently, the installation of a bypass consisting of the same material as the existing plumbing, or a grounded "jumper wire" bridging the equipment and re-establishing the contiguous conductive nature of the plumbing system must be installed prior to your systems use.

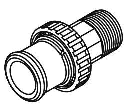
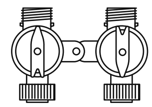
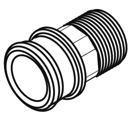
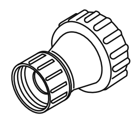
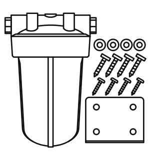
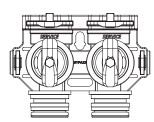
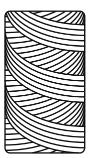
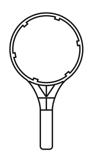
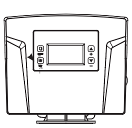
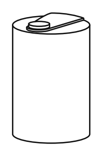
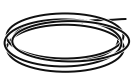
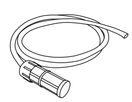
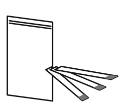
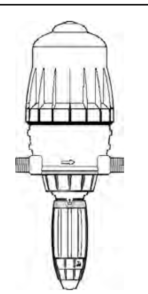
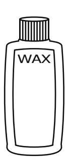
⚠ CAUTION:

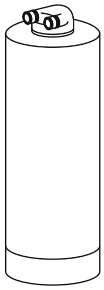
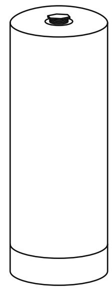
When adding a filtration/softening system to homes/buildings supplied by well water, the system should be installed following the pressure tank. **DO NOT USE this system for pneumatic or hydro pneumatic applications. If you are using a booster pump, then install this system following the booster pump.** If you have questions, please call customer service.

Complete Parts List

Note: Pelican supplies the parts below to accommodate a variety of water supply lines.

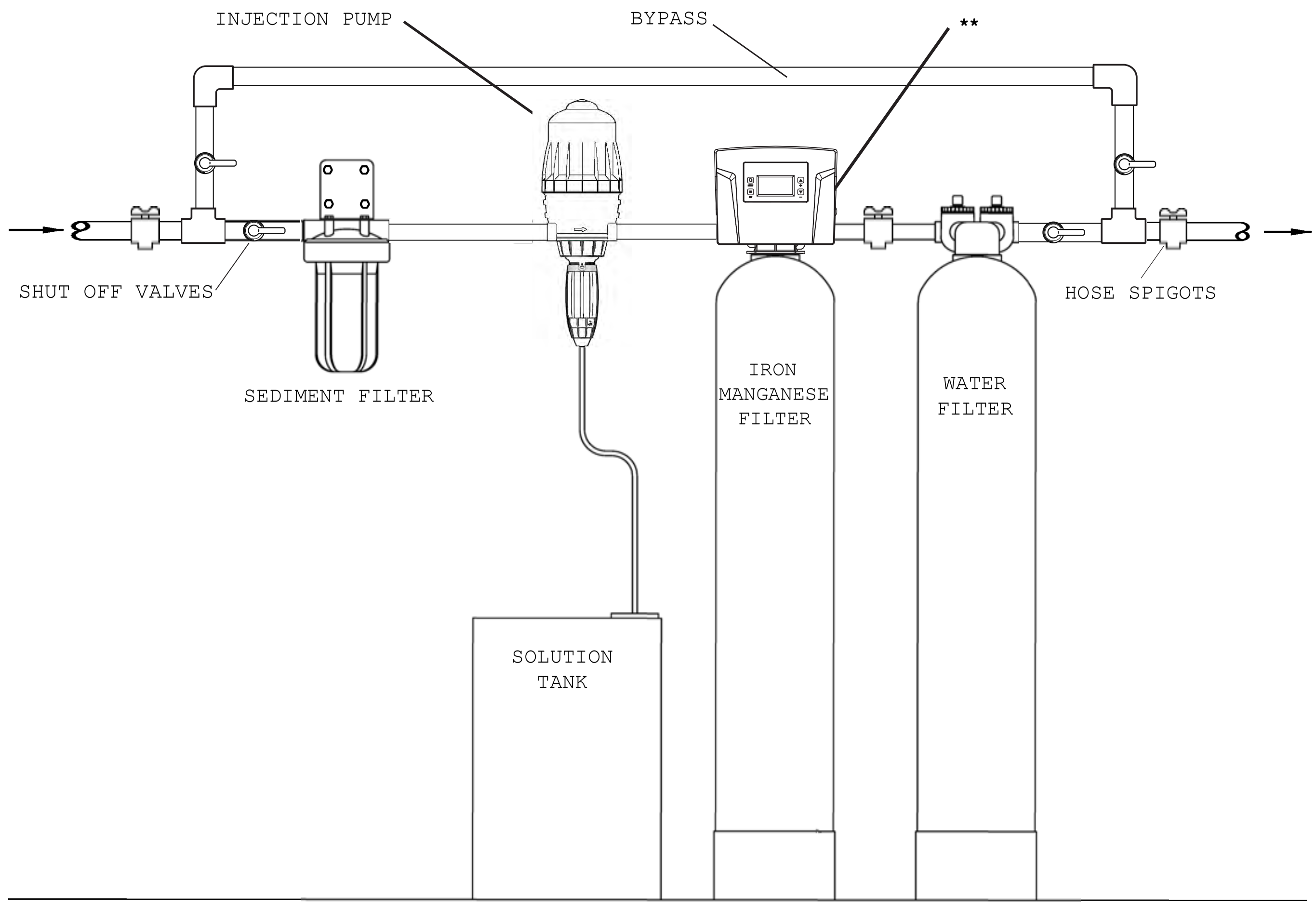
Table 1: Parts List

Part	Description	Qty.	Part	Description	Qty.
	**1" Plastic Male NPT Assembly:** V3007-04 1" Plastic Male NPT Assembly (2): O-Rings (2), Split Rings (2), and Connectors (2)	1		**Bypass Valve:** In/Out Bypass Valve with Red Arrow Handles	1
	**1" PVC Tail Adaptor for Electronic Head Bypass** 90 Degree 1" PVC Tail Adaptors also included	2		**Hose Bib Assembly**	1
	**Sediment Filter System:** Big Blue Filter Housing, Mounting Bracket, Phillips Head Screws (4), Bolt Head Screws (4), and Washers (4)	1		**Bypass Valve for Electronic Head**	1
	**Sediment Filter:** 5 Micron Poly-Spun Sediment Filter	1		**Sediment Filter Wrench**	1
	**Electronic Head**	1		**Solution Tank**	1
	**PVC Tubing Drain Line (50 ft.)**	1		**Chemical Injector Pump Tubing**	1
	**Chlorine Test Strips**	1		**Chemical Injector Pump** (2) 1" Bushings Included	1
	**Non-Abrasive Auto Wax** 4 oz. Bottle	1			

Part	Description	Qty.	Part	Description	Qty.
	**Pelican Whole House Carbon Filter**	1		**Pelican Whole House Iron & Manganese Filter**	1

Note: Drawings are not to scale.

Additional fittings will be needed to adapt to your plumbing.



**BACKWASH LINE TO BE PLUMBED TO A DRAIN

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3060 PERFORMANCE CR
SUITE 2
DELAND, FL 32724
1-877-842-1635
www.pelicanwater.com

DO NOT SCALE DRAWING

CONNECTION SIZE: 1"
MAX PRESSURE OPERATING: 80
PSI MAX TEMPERATURE: 100°

INSTALLATION OVERVIEW
WF 4/8

Installation Overview

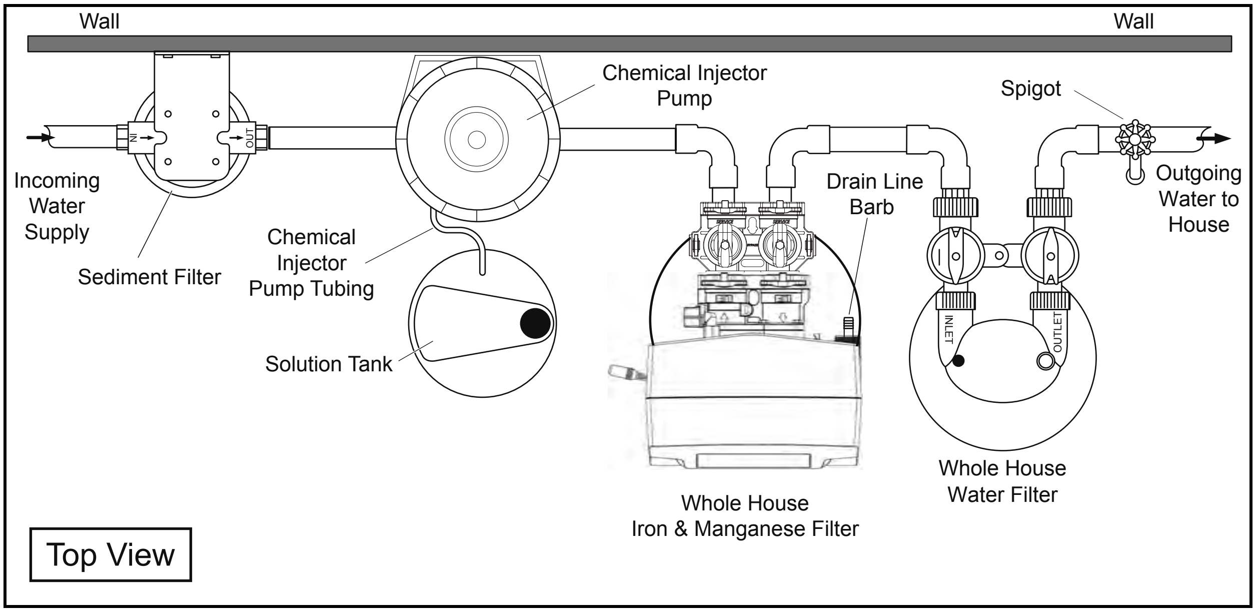


Figure 1

Pre-Installation

Bypass Valve Installation

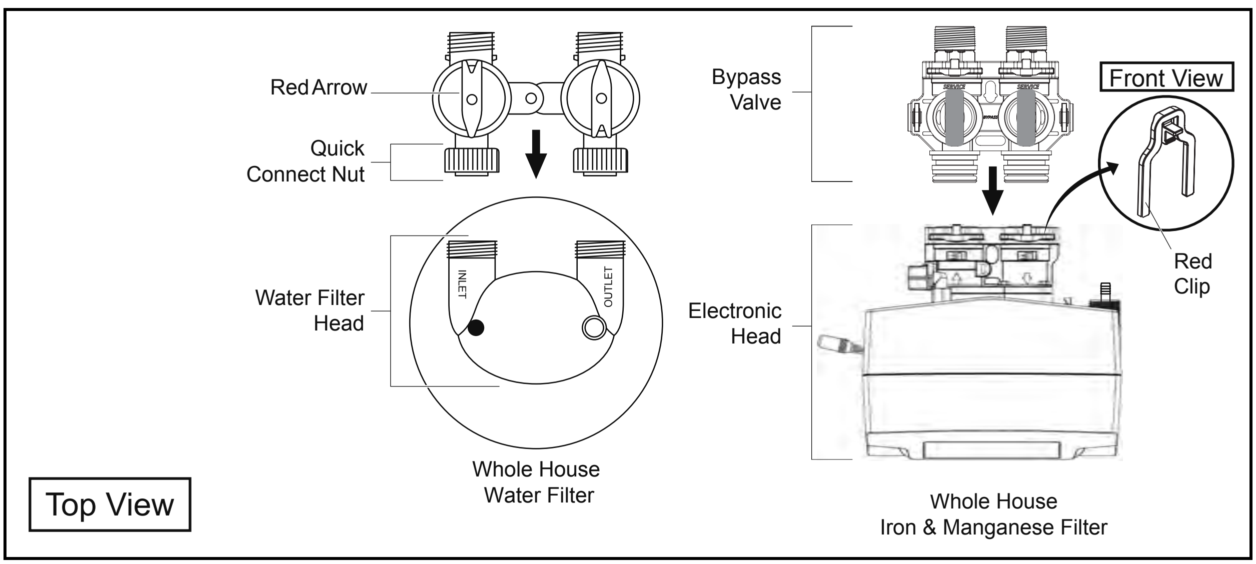
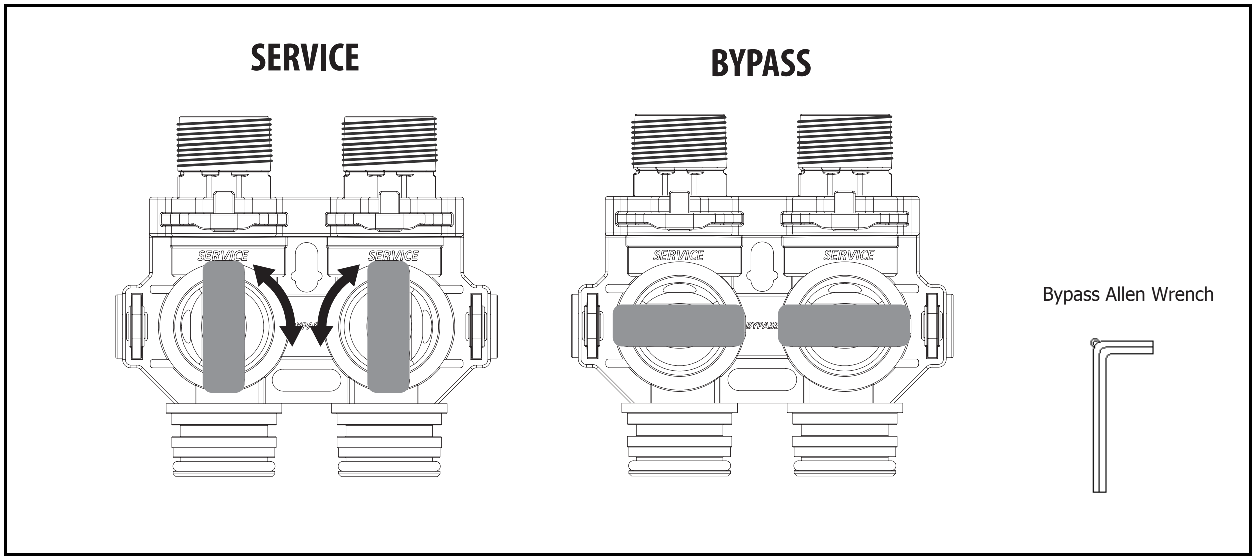


Figure 2

Whole House Water Filter - The Bypass Valve comes pre-assembled and ready to install with the O-Rings, Split Rings, and Quick Connect Nuts. Push the Bypass Valve into the head of the Whole House Water Filter with the unthreaded ends orientated towards the tank and hand-tighten the Quick Connect Nuts.

Whole House Iron & Manganese Filter - If the Red Clips are in the slots (female opening of Electronic Head) remove them. Push the male O-Ring side of the Bypass Valve into the female opening of the Electronic Head. Push the Red Clips back into the slots to tighten.

Bypass Operation

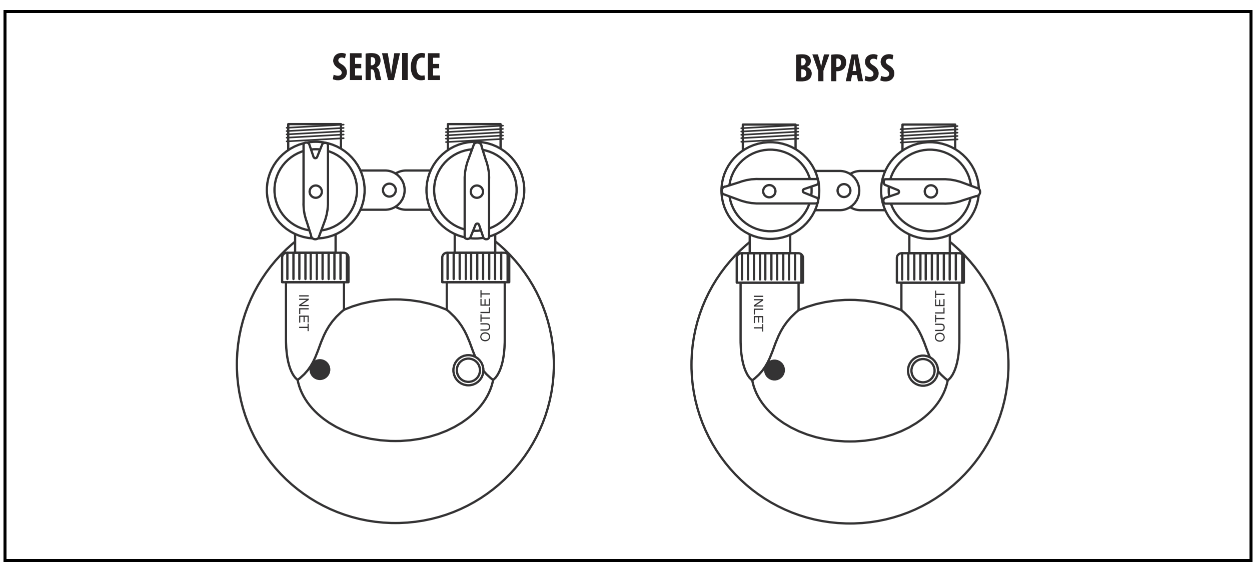


Notice:

The Bypass Valve on the Electronic Head can be set to Bypass or Service by turning the knobs on the top of the valve. The valves can be difficult to turn by hand until the seals become saturated. Use the supplied Bypass Allen Wrench to turn the knobs if necessary.

Note: The Red Arrows on the Whole House Carbon Filter Bypass may be pointing in a different direction then shown. If this is the case, remove the Red Arrows by pulling them straight up. Turn them around and reposition correctly onto the Bypass Valve so they are positioned as shown in the service posistion below.

The Bypass Valve on the Whole House Water Filter can be set to Bypass or Service by turning the Red Arrows on the top of the valve.



Water Filter - Carbon Soak

!IMPORTANT!
Your system will not be ready for use for a minimum of 48 hours while the Carbon Soak process takes place. Please plan your installation accordingly.

Notice:
Water will flow out of the outlet side of the Bypass Valve during this process. Be sure you perform this series of steps in a location suitable for water flow.

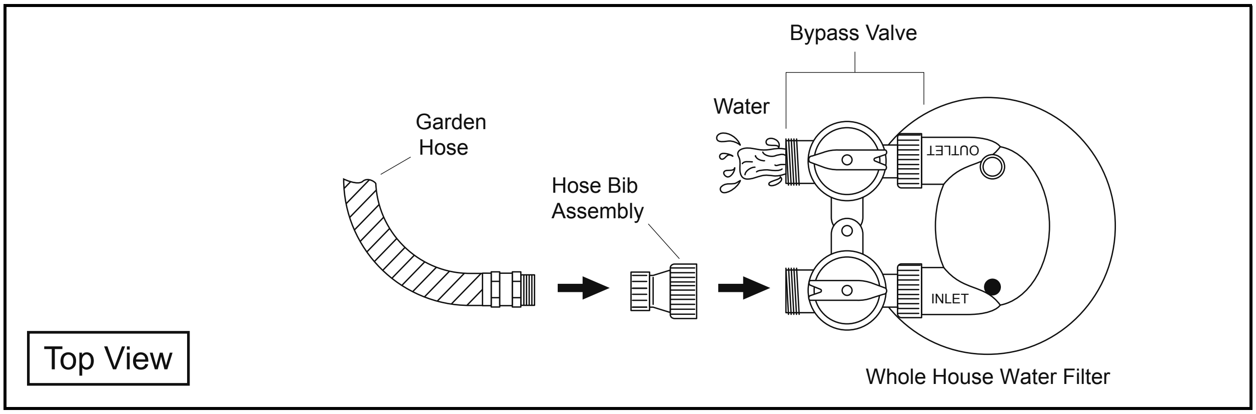


Figure 3

1. Attach a garden hose to the Hose Bib Assembly
2. Connect the Hose Bib Assembly to the inlet side of the Bypass Valve and hand tighten
3. Fill the Whole House Water Filter until water comes out of outlet side of the Bypass Valve.
4. Turn the water off.
5. Remove the garden hose from the Hose Bib Assembly. Do not remove the fitting.
6. Allow the carbon in the Water Filter to soak for a minimum of 48 hours prior to installation.

   NOTE: Allowing the Whole House Water Filter to soak longer than 48 hours is completely fine as it will help with further saturation and minimize the break in period.

Water Filter - Carbon Flush

!IMPORTANT!
Do not perform the Carbon Flush until the Carbon Soak process is complete.

Notice:

Water will flow out of the outlet side of the Bypass Valve during this process. Be sure you perform this series of steps in a location suitable for water flow.

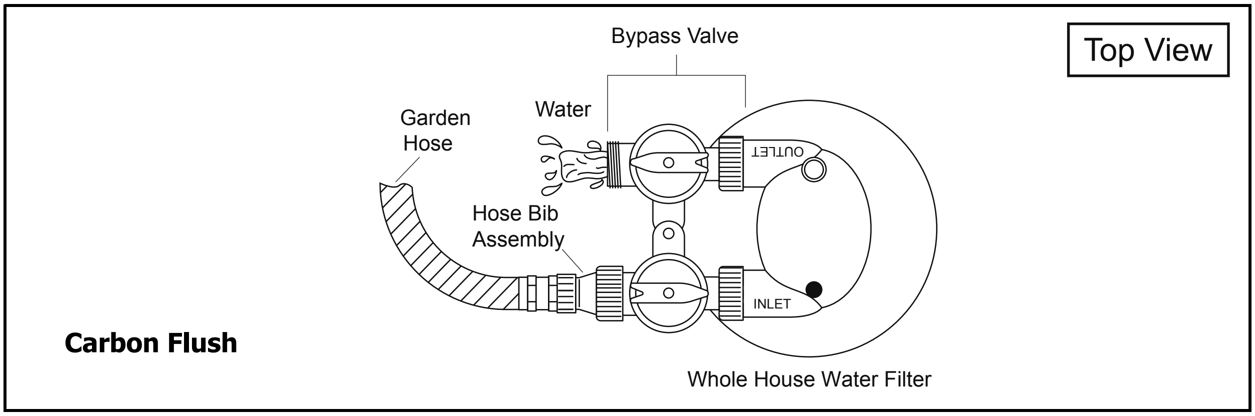


Figure 4

1. Reattach the garden hose to the Hose Bib Assembly.
2. Slowly turn on the water less than a 1/4 turn on the hose spigot.
3. Run water through the inlet side of the Bypass Valve for 30 minutes to expel any carbon fines.
4. Turn off the water.
5. Remove the Hose Bib Assembly from the inlet side and attach it to the outlet side of the Bypass Valve.
6. Slowly, fully open the hose spigot.
7. Run the water through the outlet side for 3 minutes to reset the carbon.
8. Turn off the water.
9. Remove the Hose Bib Assembly from the Bypass Valve and disconnect the garden hose.

   Note: Please save the Hose Bib Assembly as this will be used in the future for the carbon replacement.

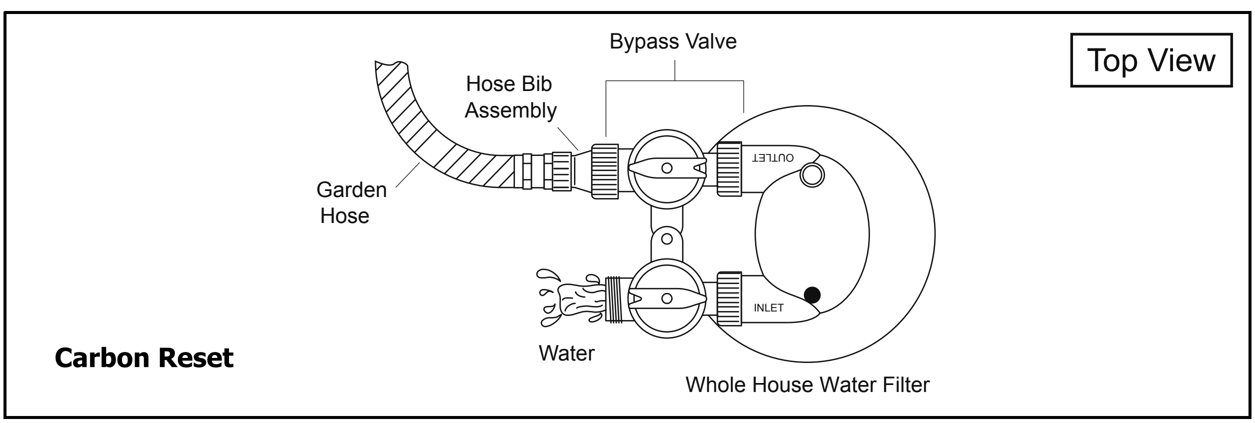


Figure 4-2

Installation

Sediment Filter Assembly

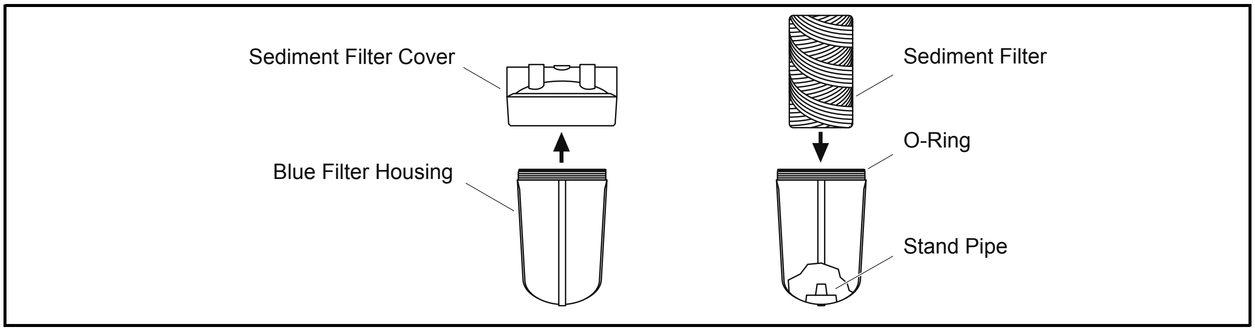


Figure 5

1. Unscrew the cover from the Blue Filter Housing.
2. Remove the plastic covering from the Sediment Filter.
3. Place the Sediment Filter onto the Stand Pipe in the Blue Filter Housing and set aside.

Sediment Filter Installation

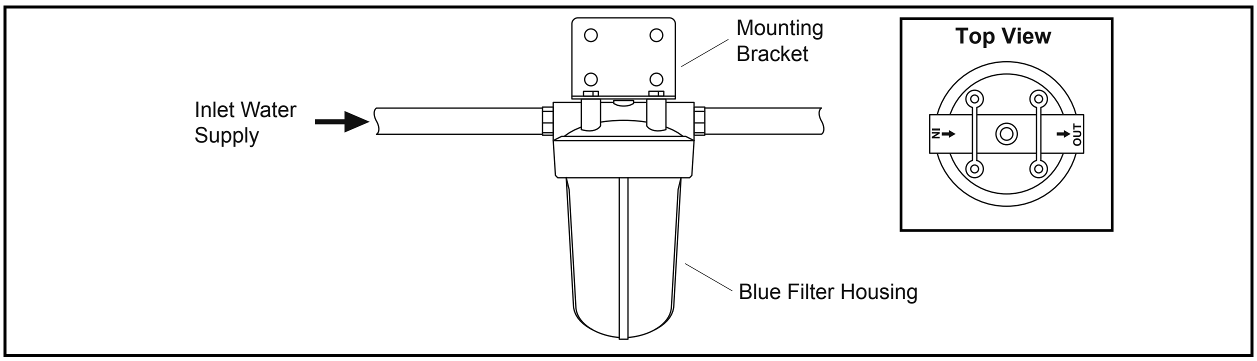


Figure 6

1. Shut off the water.
2. Attach the Filter Cover to the Mounting Bracket using the supplied Bolt Head Screws and Washers. Make sure to properly orientate the IN and OUT to match your flow pattern.
3. Attach the Mounting Bracket to the wall using the supplied Phillips Head Screws.
4. Hand tighten the Blue Filter Housing and then using the supplied Filter Wrench lightly snug the housing making sure not to over-tighten. (counter clockwise).
5. Determine the size of your inlet water supply line.

Notice:
The Sediment Filter Housing comes with a 1″ threaded female inlet/outlet and will require additional fittings to adapt to your plumbing. A shut-off valve is recommended prior to the Sediment Filter System.

Chemical Injector Pump Overview

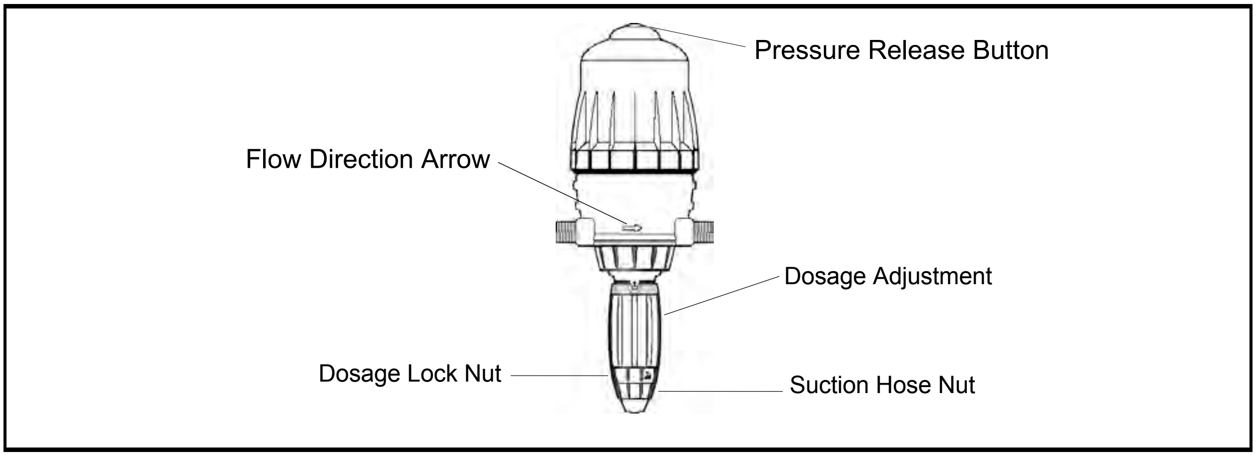


Figure 7

Pressure Release Button - Allows you to relieve the air pressure after install and maintenance.

Flow Direction Arrow - Indicates the proper flow pattern depending on how the unit is installed.

Dosage Adjustment - Allows you to increase or decrease the amount of solution injected per gallon of flow.

Dosage Lock Nut - Locks and unlocks the Dosage Adjustment for increasing and decreasing solution.

Suction Hose Nut - Compression nut the secures the injector tubing to the injector.

Chemical Injector Pump and Solution Tank Installation

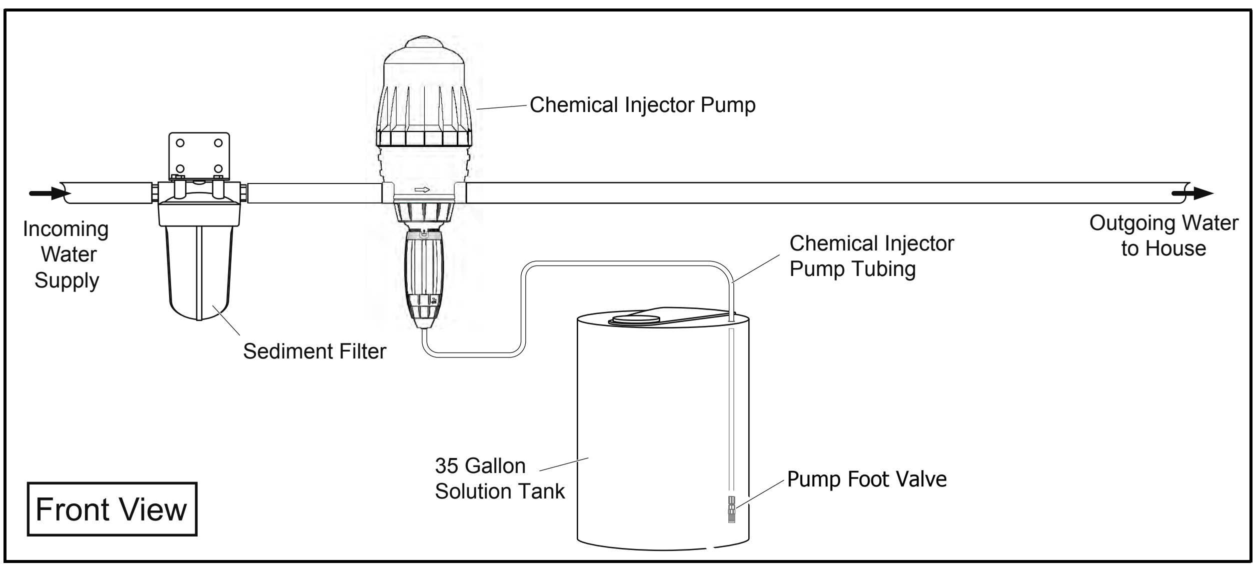


Figure 8

Chemical Injector Pump Installation

!IMPORTANT!
Install the Chemical Injector Pump onto the water supply after the Sediment Filter and before any other filtration or softening system.

1. Determine the size and material of your incoming water supply line from the Sediment Filter System.
2. Mount the Chemical Injector Pump to the wall using the provided bracket. Line up the inflow and outflow connections with the current water line.
3. Remove the two red thread protectors from inlets and discard. Injector Pump has 3/4" connections, two 1" bushings are included.
4. Plumb the Injector Pump into your water line. The arrow on the body of the Injector Pump shows the correct water flow direction. The Injector Pump can be rotated to match your flow direction. The water should enter and exit the pump following the direction of the arrow.

Solution Tank Installation

1. Remove the black cap from the opening on the Solution Tank.
2. Drill one 1/2” hole into the top of the Solution Tank. (Hole should be larger than tubing to allow air in)
3. Insert the end of the Chemical Injector Pump Tubing with the pump foot valve connected, into the hole which was covered by the black cap on the top of the Solution Tank.
4. Feed and pull the other end of the tubing through the drilled opening on the top of the Solution Tank.
5. Determine the length of Chemical Injector Pump Tubing required for the foot valve to reach 4" from the bottom of the Solution Tank and cut tubing.
6. Connect the Chemical Injector Pump Tubing to the suction valve on the Chemical Injector Pump by removing the suction hose nut, place nut over tubing, push tubing onto suction valve and tighten nut.
7. Fill the Solution Tank with 17 gallons of bottled water and proper number cups of bleach based on the % concentration of Sodium Hypochlorite noted on the bottle. (see chart below)

Concentration of Bleach (% Sodium Hypochlorite)	Number of Cups	Gallons of Water
3.00%	12	17
5.25%	7	17
6.00%	6	17
8.25%	4.5	17

!IMPORTANT! Ensure the Chemical Injector Pump Tubing is free of kinks and the Solution Tank is not sitting directly on concrete. The cold temperatures held by concrete floors can separate your solution.

Iron and Manganese Tank Installation

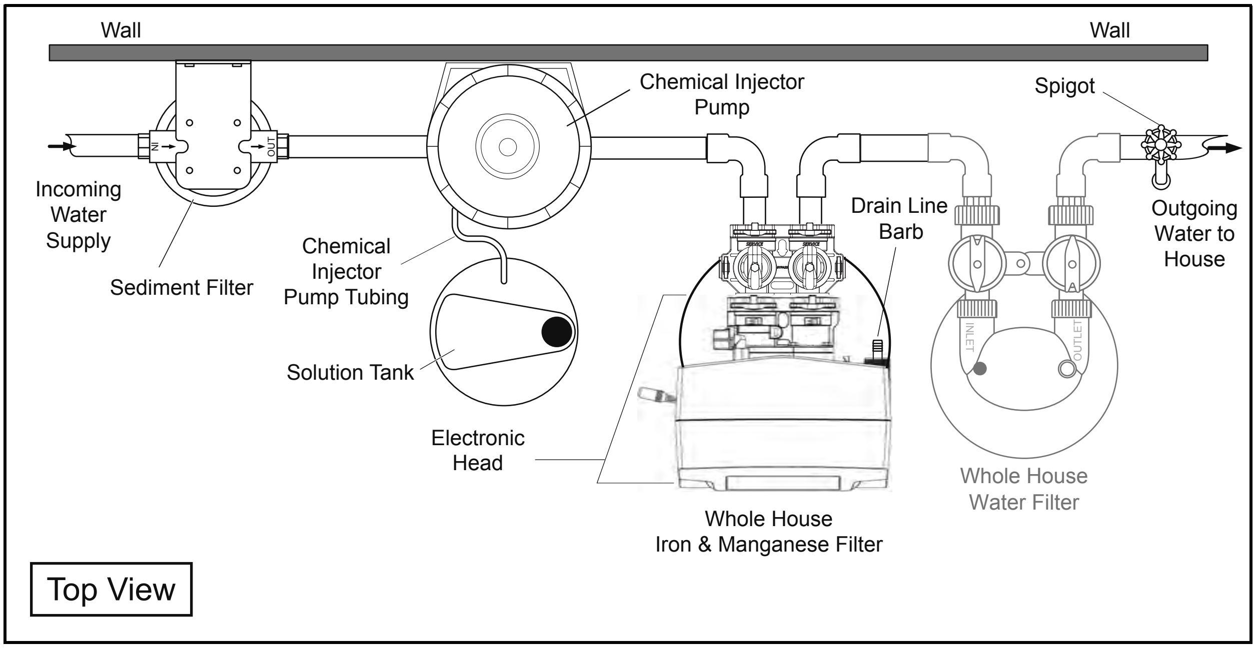


Figure 8

1. Level the Whole House Iron & Manganese Filter.

Notice:

If the tank is not level, lift the tank straight up 6 inches and tap it on the ground until the tank stands vertical. The bottom of the tank is round and the boot allows the tank to stand upright.

2. Determine the size and material of your incoming water supply line from the Injection Pump and choose the appropriate fittings required to connect it to the Bypass Valve.

⚠ CAUTION:

Do not over-tighten any of the fittings during installation.

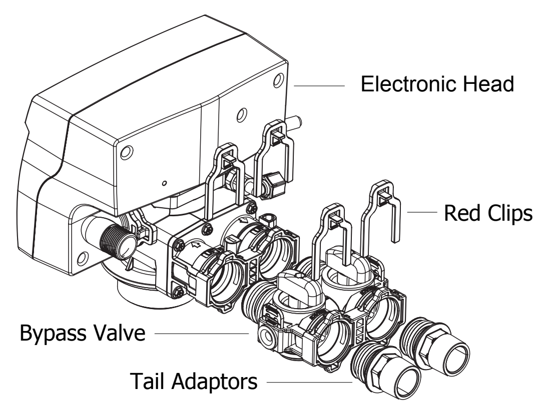
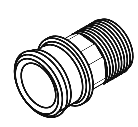


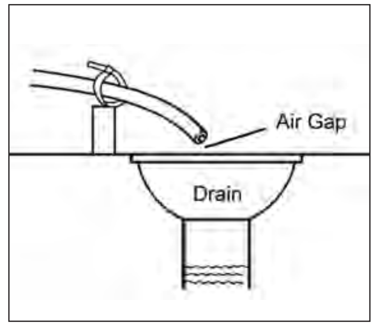
Table 2: Bypass Valve Fittings

Part	Description	Qty.
	**1" PVC Tail Adaptor for Electronic Head Bypass**	2

3. Remove the gray cap from the top of the Whole House Iron & Manganese tank.
4. Screw the Electronic Head onto the tank hand-tight.
5. Install the fittings onto the inlet and outlet, following the labels on the Head.
6. Connect the incoming water supply to the fitting on the inlet side of the Bypass Valve.
7. Connect the outgoing water supply to the outlet side of the Bypass Valve.
8. Firmly press one end of the PVC Tubing Drain Line onto the Drain Line Barb, and secure the other end of the line to a drain.

IMPORTANT!

- Ensure the PVC Tubing Backwash Drain Line is not submerged and is free of kinks.
- Maximum vertical rise of the backwash line is 6 feet.
- If incorporating two or more backwashing systems make sure to keep the drain lines separate.



Whole House Water Filter Installation

1. Level the Whole House Water Filter.

Notice:

If the tank is not level, lift the tank straight up 6 inches and tap it on the ground until the tank stands vertical. The bottom of the tank is round and the boot allows the tank to stand upright.

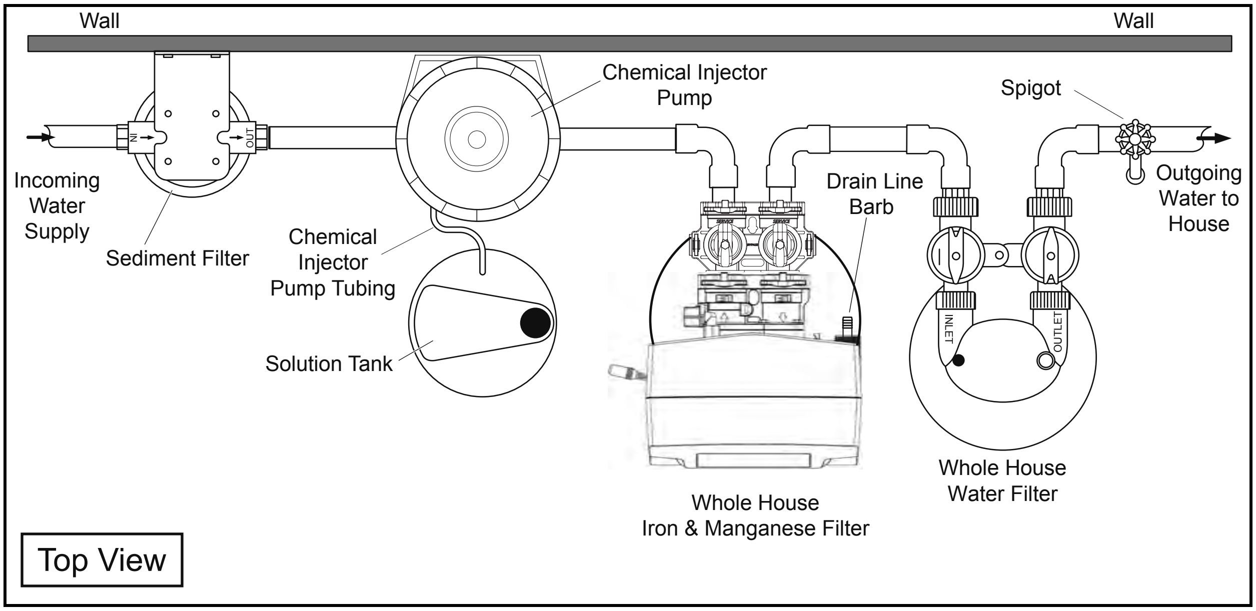


Figure 9

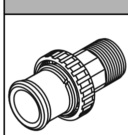
2. Determine the size and material of your incoming water supply line from the Whole House Iron & Manganese Filter and choose the appropriate plumbing required to adapt to the 1” Male NPT Assembly.

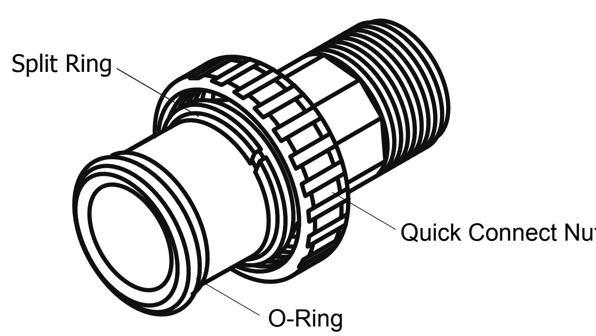
CAUTION:

Do not over-tighten any of the fittings during installation.

Table 3: Bypass Valve Fittings

Note: The fitting below is designed with a ¼" give to allow for proper pipe alignment. It will not leak and is intended to have some flexibility.

Part	Description	Qty.
	**1" Plastic Male NPT Assembly:** V3007-04 WS1 Fitting 1" Plastic Male NPT Assembly (2): O-Rings (2), Split Rings (2), and Connectors (2)	1 bag



3. Install the fitting onto the inlet and outlet sides of the Bypass Valve. Follow the diagram supplied with the fitting.
4. Connect the incoming water supply from the Whole House Iron & Manganese Filter to the fitting on the inlet side of the Bypass Valve.
5. Connect the outgoing water supply back into the home to the outlet side of the Bypass Valve.

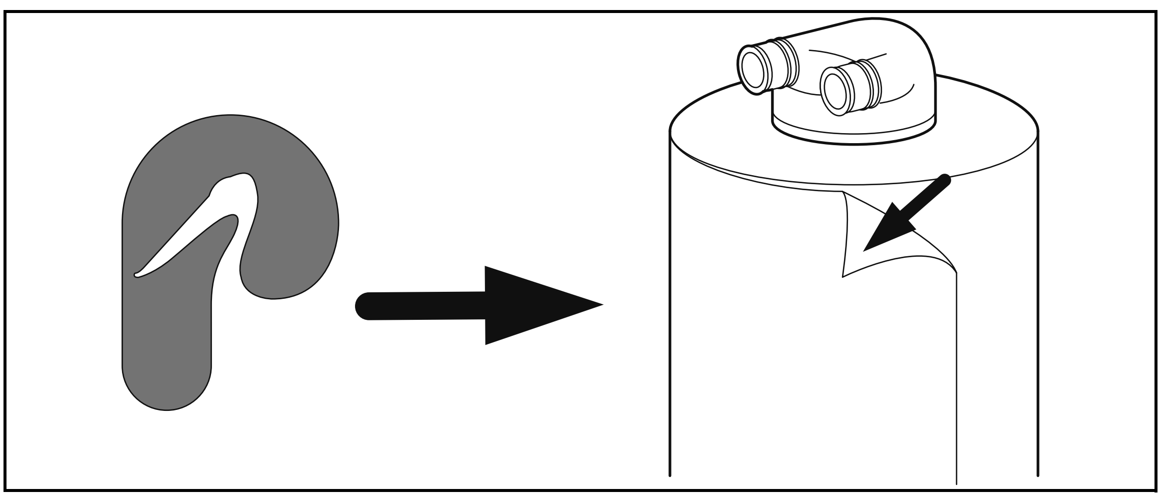
⚠ CAUTION:

Avoid high flow rates such as bathtub, utility sinks, hose bibs, multi-headed showers, body sprayers, or anything that is considered high flow for the first 72 hours to avoid flow restrictions caused by carbon blockage of the top basket inside the carbon tank.

Carbon dust may be released into the water lines of the house/building during the first few days of water use after Whole House Water Filter installation. The carbon dust is harmless, but may give the water a gray appearance that should diminish within a week or 10 days depending on water use.

Complete the Installation

1. Turn on the main water supply.
2. Press Pressure Release Button on top of Injector Pump.
3. Check for leaks.
4. Peel off the protective plastic wrap from the stainless steel tank jackets.
5. Add the Pelican logo sticker in the desired location on the tank.

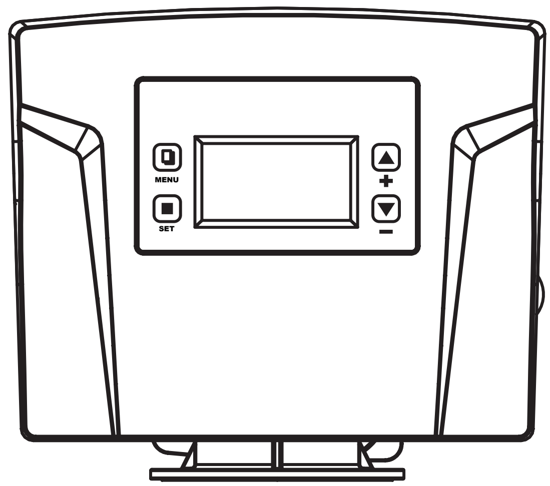


6. Wax stainless steel tank jacket(s) with wax provided or any other non-abrasive auto wax a minimum of 1-2 times per year or as needed based on the installed environment.

Programming the Electronic Head

Note: Power Source - For safety reasons the outlet must be protected by a Ground Fault Circuit Interrupter (GFCI).

Your system is pre-set to regenerate every 3 days at 2:00 am, the complete process takes 20 minutes



Step 1: Setting the Date & Time

1. Press and hold the MENU button until you hear the beep to unlock.
2. Press MENU button for menu.
3. Press SET once **Date & Time Setting** is highlighted.
4. Using the UP and DOWN buttons input the correct Date and Time pressing SET after each input.
5. Once set press the MENU button to return to the main menu.

IMPORTANT!
You will need to manually regenerate (**Regen Now**) your system prior to use. To do so follow the programming below. You will not be able to use water for 20 minutes during this process.

Notice:
In the event of spikes in Iron and Manganese levels you may choose to manually regenerate your system if you experience colored water from your system.

Step 2: Performing a Manual Regeneration

1. Using the DOWN button select **Manual Regen** and press SET.
2. Using the UP or DOWN button select either **Regen Now** or **Regen Tonight**.
   -**Regen Now** will start a regeneration process immediately.
   -**Regen Tonight** will regenerate the system at the default regeneration time of 2:00am.
3. Once selected press the SET button to confirm. Gears will make noise and water will start to flow. Allow the system to regenerate for approximately 20 minutes.
4. Once complete press the MENU button to return to the main menu.
5. Your programming is now complete.

Testing Chlorine Levels in Water - Dialing In

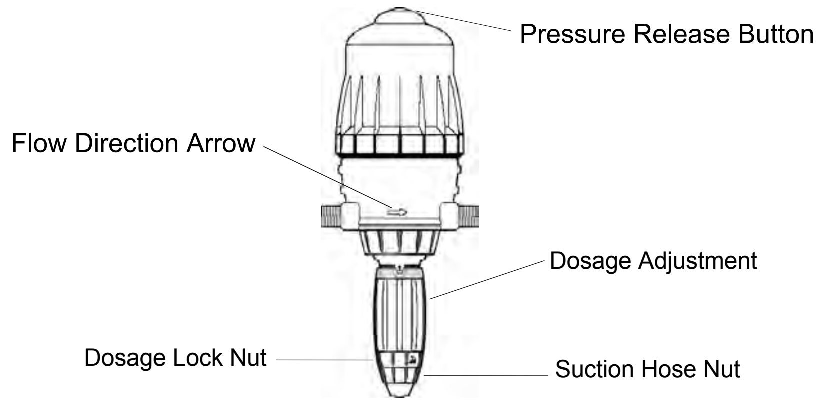


Figure 13

1. Put the Whole House Water Filter into bypass. (See page 9 for bypass position)
2. Turn on the nearest cold water faucet to the system.
3. Listen and watch the pump to make sure it is pumping. The pump should pulse and not run continuously. If the water is off, the pump will stop.
4. Let the water run for 15 minutes.
5. After 15 minutes, use a chlorine test strip to test a sample of water from the cold water faucet.
    a. The optimum chlorine level reading is 2.6ppm on the test strip.
    b. If you do not have a reading of chlorine you will need to add 3 more cups of bleach to the solution tank and mix. Note the new total or bleach to 17 gallons water. Repeat steps 4 & 5 to achieve a new sample for testing. Double check to make sure the Water Filter is in bypass. Page 9 shows the bypass position.
    c. If your reading is close to 2.6ppm then you will unlock the dosage adjustment on the injector pump and rotate up two full turns. Re-lock the dosage adjustment and repeat steps 4 & 5 to achieve a new sample for testing.

6. If you needed to test another sample and you still do not have a reading of chlorine add another 3 cups of bleach and mix. Note the new total of bleach to 17 gallons of water. Repeat steps 4 & 5 to achieve a new sample for testing.
7. If your reading is close to 2.6ppm then you will unlock the dosage adjustment on the injector pump and rotate up two full turns. Re-lock the dosage adjustment and repeat steps 4 & 5 to achieve a new sample for testing.

!IMPORTANT!
If after testing again there is still no reading of chlorine we recommend calling in to speak with a Technical Support representative. 877-842-1635

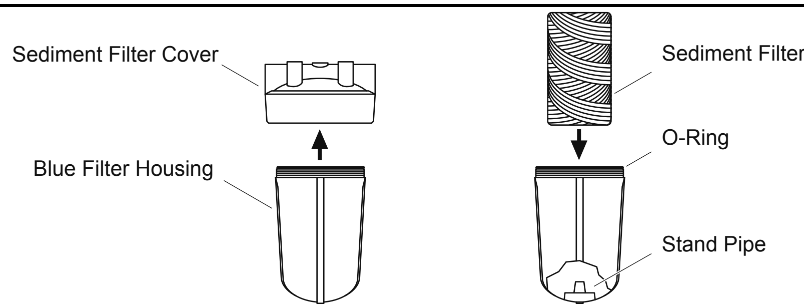
Concentration of Bleach (% Sodium Hypochlorite)	Number of Cups	Gallons of Bottled Water
3.00%	12	17
5.25%	7	17
6.00%	6	17
8.25%	4.5	17

Maintenance

Sediment Filter

It is recommended that the Sediment Filter be replaced every 6-9 months depending on the amount of sediment present in the water supply. If the system has been working properly and the pressure is slowing, it may be time to change the Sediment Filter. Check the Sediment Filter and replace if necessary.

Replacing the Sediment Filter



1. Turn off the main water supply to the Sediment Filter System and bypass all tanks.
2. Run a faucet (cold water) inside the house to relieve the pressure. (Leave faucet open)
3. Unscrew the Blue Filter Housing clockwise using the supplied Filter Wrench.
4. Remove the existing Sediment Filter and discard.
5. Remove the O-Ring and wipe the groove clean. Lubricate a new O-Ring with a coating of clean silicone grease. Replace O-Ring and press the O-Ring down into the groove with two fingers.

   Note: This step is important to ensure the proper filter seal. Make sure the O-Ring is seated level in the groove. If the O-Ring appears damaged, stretched, or crimped it should be replaced.
6. Place a new Sediment Filter onto the Stand Pipe in the Blue Filter Housing.
7. Screw the Blue Filter Housing onto the Filter Cover hand tight. Lightly snug the housing with the spanner wrench making sure not to over-tighten.
8. Turn on main water supply slowly to allow the Sediment Filter System to fill with water and expel air from lines. Put tanks back in service, out of bypass.
9. Check for leaks.

Chemical Injector Pump:

1. Change once a year (Injector Pump Seal Kit - 3 O-Rings & Check Valve)

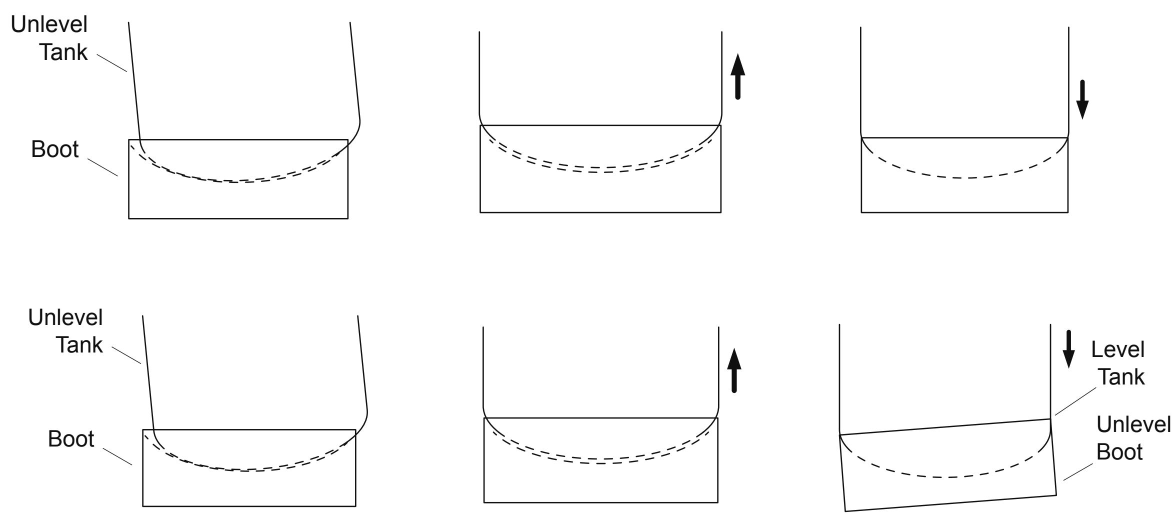
Note: Spare kits for replacement purposes can be obtained by calling your customer service representative at Pelican Water.

Solution Tank Refill — Bleach & Water

1. Check the level of the Solution Tank twice per month. Do not let the liquid in the tank fall below ¼ full.
2. Fill the Solution Tank with bleach and treated water as needed. (Water that has gone through your filtration system).

Troubleshooting

Problem	Solution
Water leaking at the top of the tank around the head.	You may need to turn the head to tighten it. The tank head is pre-installed hand-tight, do not overtighten the head (just turn it snug).
The tank leans to one side or is not level.	If the tank is not level, lift the tank straight up 6 inches and tap it on the ground until the tank stands vertical. The bottom of the tank is round and the boot allows the tank to stand upright.



Water pressure is slowing.	It is recommended that the Sediment Filter be replaced every 6-9 months depending on the amount of sediment present in the water supply. If the system has been working properly and the pressure is slowing, it may be time to change the Sediment Filter. Check the Sediment Filter and replace if necessary.
Water appears grey or cloudy.	Water may appear grey or cloudy for the first seven to ten days after installation due to extra carbon dust.
Water pressure is slowing immediately after installation.	High flow rates such as bathtubs, utility sinks, hose bibs, multi-headed showers, body sprayers, or anything that is considered high flow for the first 72 hours should be avoided. If you suspect a carbon blockage of the top basket due to a high-flow situation within the first 72 hours of installation, turn off any running water for at least 30 minutes. This will clear the blockage and you can resume using water at low or normal flow rates.
Water is backfilling into the solution tank	The check valve on the lower end of the pump is stuck in the open position. Turn water off, relieve pressure, remove the suction hose nut as well as the retaining nut underneath. Remove the check valve by pulling down. Rotate the white retainer cap to expose the check valve. Clean o-ring, inner housing and Replace.

Warranty

Pelicans Limited Lifetime Warranty

Pelican Water ("Pelican") warrants to the end user ("customer") that its tanks (13" & smaller), in/out heads, bypass's, fittings, NaturSoft media and housings ("Covered Items") will be free from defects in material and workmanship under normal use and service for the life of the system. No warranty is made with respect to defects or damaged due to neglect, misuse, alterations, accident, misapplication, physical damage, installation on water quality outside guidelines for system or damaged caused by fire, acts of God, or freezing.**

Pelican Dosatron Professional Chemical Injector Pump Warranty

Pelican Water ("Pelican") warrants to the end user ("customer") that its Dosatron Professional Chemical Injector Pump Motor (upper half of unit) will be free from defects in material and workmanship under normal use and service for a period of 1 year. The Dosatron Professional Chemical Injector Pump Adjustment Ratio Side (lower half of unit) will be free from defects in material and workmanship under normal use and service for a period of 90 days. The Chemical Injector Pump tubing is not covered as part of this warranty.

Limitations and Responsibilities

Pelican's obligation to the customer under these warranties shall be limited, at its option, to replacement or repair of Covered Items by these warranties, labor is not covered. Prior to return or repair of Covered Items, the customer must obtain a return goods authorization number from Pelican and at Pelicans option, return the Covered Items freight prepaid. Any Covered Item repaired or replaced under these warranties will be returned prepaid standard freight to the original point of shipment. Expedited freight options are available at customer expense.

No warranty is made with respect to defects or damaged due to neglect, misuse, alterations, accident, misapplication, physical damage, or damaged caused by fire, acts of God, or freezing. These warranties apply only to the original registered owner so long as the owner owns the home in which the unit was originally installed. Customer must register their system with Pelican within 90 days of purchase* in order to obtain a warranty. Warranty will discontinue after the unit is removed from the location where it was originally installed. Warranty begins on the date of delivery of product to the customer. Improper maintenance of system (i.e. not replacing filters or media) on time will be considered "neglect". Installation of any system on water conditions outside of or beyond the recommended specs of any system voids any warranty.

Pelican gives this warranty to the customer in lieu of all other warranties, express or implied, including without limitation any implied warranties of merchantability or fitness for a particular purpose or treatment of certain water and hereby expressly disclaims all other such warranties. Pelican's liability hereunder shall not exceed the cost of the product. Under no circumstances will Pelican be liable for any incidental or consequential damages or for any other loss, damage or expense of any kind, including loss of use, arising in connection with the installation or use or inability to use the Covered Items or any water treatment system the Covered Items are incorporated into. These warranties are governed by the laws of the state of Florida and may change at any time without notice.

*Failure by California and Quebec residents to complete the product registration form does not diminish their warranty rights.

**For all orders placed on or after June 3rd, 2011.

Manufacturer’s Performance Guarantee

The Pelican PC600 Premium Whole House Water Filter is guaranteed to perform removing Chlorine and Chloramines to an undetectable level for 600,000 gallons or (5) years whichever comes first. The Pelican PC1000 Premium Whole House Water Filter is guaranteed to perform removing Chlorine and Chloramines to an undetectable level for 1,000,000 gallons or (5) years whichever comes first. The authorized dealers shall be responsible for the repair or replacement of defective media only, labor to replace the media is the responsibility of the purchaser.

Pelican 7 Year Limited Warranty

Pelican Water ("Pelican") warrants to the end user ("customer") that its solid-state electronic heads ("Covered Items") will be free from defects in material and workmanship under normal use and service for a period of 7 years.

Warranty Registration Form

Send in this Warranty Registration Form to validate your warranty or visit www.PelicanWater.com to complete warranty registration form online.

Pelican Warranty Registration Form

Date Item(s) were Received: ____________ **Order ID#:** ____________ **Model:** ____________

Dealer Purchased From: ____________

Model/Serial Number: ____________

Name: ____________

Address: ____________

City: ____________ **State:** ____________ **Zip:** ____________

Send To:

Pelican Water Systems
3060 Performance Circle, Suite 2
DeLand, FL 32724
Phone: 1-(877) 842-1635

Plumber's Information (optional)

We like to recommend good plumbers throughout the USA and if you were happy with your installer please give us their information so we can pass it on as a courtesy. Thank you for your time.

Name of Plumbing Company used to install system: ____________

Phone #: (______)-____________ of the Plumbing installer

!IMPORTANT!
Do not use where water is microbiologically unsafe or with water of unknown quality without proper disinfection before or after the filter/softener system.

Product Certifications

	Pelican NaturSoft-NS3/NS6 – WQA Gold Seal tested and certified under NSF/ ANSI61 for material safety and tested according to NSF/ANSI 42 for structural integrity only
	Clack V3007-xx Bypass Fittings – WWQA Gold Seal Certified to NSF/ANSI Standard 44 for material safety and structural integrity only
	U.S. Green Building Council

ATTACHMENT E

Backwash Recycling Calculations

MDD (gpm)	8.7	Water req. from Piney to satisfy demand in Aug. (gpm)	3.5
MDD (gallons)	12528	Water req. from Piney to satisfy demand in Aug. (gallons)	5040

At MDD conditions, water from Hoffman and Piney Creek will supply the system and be treated by the CMF unit.
Only the water from Piney will undergo Mn/Fe treatment.
This scenario considers the water required from Piney for the month of August (highest Piney flow required in August).

Backwash from SWTP

Raw water concentration		
TDS - Piney Creek (mg/L)	489	Based on water quality reports
TDS - Hoffman Creek (mg/L)	437	
Average TDS (mg/L)	463	*Actual average will be lower than this, since some of Piney's TDS will be captured by the Mn/Fe treatment unit
TSS - Piney Creek (mg/L)	2	Based on water quality reports - Hoffman Creek conc. will be used as a conservative measure
TSS - Hoffman Creek (mg/L)	10	
Operating Characteristics		
SWTP flow rate (gpm)	15	operational characteristics to satisfy's MDD's demand
Hours of operation/day (hrs)	14	
Volume of treated water/day (gallons)	12600	
Number of backwash cycle/hr	1	
Volume of water per backwash (gallons)	38	Info given by supplier
Duration of backwash cycle (min)	1.5	
Results		
# of backwash cycle/day	14	
Daily total backwash duration (hrs)	0.350	
Volume of backwash/day (gallons)	**532.0**	
TSS concentration of backwash (mg/L)	250	Based on manufacturer's estimation (backwash conc.= 25* raw water conc.)
Estimated settled solids (g)	503.4	
Estimated settled solids (lbs)	1.11	
Density of settled particles (g/cm3)	2.66	
Volume of settled particles (cm3)	189.25	
Volume of conical section of tank (cm3)	900141	
Volume of conical section of tank (gallons)	237.792048	
	0	

Backwash from Mn and Fe Treatment

Raw water concentration		
Mn - Piney Creek (mg/L)	0.177	Based on water quality reports
Fe- Piney Creek (mg/L)	1.058	
Operating Characteristics		
Unit flow rate (gpm)	15	operational characteristics to satisfy's MDD's demand
Hours of operation/day (hrs)	5.6	
Volume of treated water/day (gallons)	5040	
# of backwash cycle/day	1	
Volume of water per backwash (gallons)	75	Info given by supplier
Duration of backwash cycle (min)	20	
Results		
# of backwash cycle/day	1.0	
Daily total backwash duration (hrs)	0.3	
Volume of backwash/day (gallons)	**75**	
Mn conc. In backwash (mg/L)	13.3	
Fe conc. In backwash (mg/L)	79.4	

MDD (gpm)	8.7		Water req. from Piney to satisfy demand in Aug. (gpm)	3.5	
MDD (gallons)	12528		Water req. from Piney to satisfy demand in Aug. (gallons)	5040	

At MDD conditions, water from Hoffman and Piney Creek will supply the system and be treated by the CMF unit.
Only the water from Piney will undergo Mn/Fe treatment.
This scenario considers the water required from Piney for the month of August (highest Piney flow required in August).

Backwash from SWTP

Raw water concentration		
TDS - Piney Creek (mg/L)	489	Based on water quality reports
TDS - Hoffman Creek (mg/L)	437	
Average TDS (mg/L)	463	*Actual average will be lower than this, since some of Piney's TDS will be captured by the Mn/Fe treatment unit
TSS - Piney Creek (mg/L)	2	Based on water quality reports - Hoffman Creek conc. will be used as a conservative measure
TSS - Hoffman Creek (mg/L)	10	
Operating Characteristics		
SWTP flow rate (gpm)	15	operational characteristics to satisfy's MDD's demand
Hours of operation/day (hrs)	14	
Volume of treated water/day (gallons)	12600	
Number of backwash cycle/hr	1	
Volume of water per backwash (gallons)	38	Info given by supplier
Duration of backwash cycle (min)	1.5	
Results		
# of backwash cycle/day	14	
Daily total backwash duration (hrs)	0.350	
Volume of backwash/day (gallons)	**532.0**	
TSS concentration of backwash (mg/L)	250	Based on manufacturer's estimation (backwash conc.= 25* raw water conc.)
Estimated settled solids (g)	503.4	
Estimated settled solids (lbs)	1.11	
Density of settled particles (g/cm3)	2.66	
Volume of settled particles (cm3)	189.25	
Volume of conical section of tank (cm3)	900141	
Volume of conical section of tank (gallons)	237.792048	
	0	

Backwash from Mn and Fe Treatment

Raw water concentration		
Mn - Piney Creek (mg/L)	0.177	Based on water quality reports
Fe- Piney Creek (mg/L)	1.058	
Operating Characteristics		
Unit flow rate (gpm)	15	operational characteristics to satisfy's MDD's demand
Hours of operation/day (hrs)	5.6	
Volume of treated water/day (gallons)	5040	
# of backwash cycle/day	1	
Volume of water per backwash (gallons)	75	Info given by supplier
Duration of backwash cycle (min)	20	
Results		
# of backwash cycle/day	1.0	
Daily total backwash duration (hrs)	0.3	
Volume of backwash/day (gallons)	**75**	
Mn conc. In backwash (mg/L)	13.3	
Fe conc. In backwash (mg/L)	79.4	

ATTACHMENT F

Water Quality Monitoring Plan

Redwood Glen
Water Quality Monitoring Plan
Sources

Signature
5/15/2017

Redwood Glen Community System # 4100522	EPA Method	Chemical Group	Sampling Frequency	# in set	Last Done Date	Due	2017				2018				2019			
						2017	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
		Nitrate	quarterly		7/31/2015	4	1	1	1	1	1	1	1	1	1	1	1	1
		Nitrite	every 12 months		7/31/2015	1			1				1				1	
		Total Organic Carbon (TOC)	monthly			12	M	M	M	M	M	M	M	M	M	M	M	M
		Total Coliform (P-A)	NA			0												
		Total Coliform (Multiple Tube)	quarterly	1		12	M	M	M	M	M	M	M	M	M	M	M	M
		General Mineral & General Physical	every 12 months		7/31/2015	1			1				1				1	
	200.7	Inorganics - 200.7	every 12 months		7/31/2015	1			1				1				1	
	200.8	Inorganics - 200.8	every 12 months		7/31/2015	1			1				1				1	
		Manganese	NA			0												
		Iron	NA			0												
Hoffman Creek		Perchlorate	initial			2		3		3			1				1	
Surface Water		Chromium, Hexavalent	every 12 months			1			1				1				1	
		Asbestos	intital			1		3										
	524.2	Volatile Organic Chemicals (VOC)	initial			3		3	3	3	3						1	
	524.2	MTBE	in VOC			0												
PS Code	524.2 M	1,2,3-Trichloropropane (TCP) - EPA 524.2 M	Initial - early			1			1		1							
007	504.1	Synthetic Organic Chemicals - EPA 504.1	NA			1		3										
	507	Synthetic Organic Chemicals - EPA 507	NA			1		3										
	508	Synthetic Organic Chemicals - EPA 508	NA			1		3										
	515.1	Synthetic Organic Chemicals - EPA 515.1	every 3 years			1		3										
	525.2	Synthetic Organic Chemicals - EPA 525.2	every 3 years			1		3										
	531.1	Synthetic Organic Chemicals - EPA 531.1	every 3 years			1		3										
	547	Synthetic Organic Chemicals - EPA 547	every 3 years			1		3										
	548.1	Synthetic Organic Chemicals - EPA 548.1	every 3 years			1		3										
	549.2	Synthetic Organic Chemicals - EPA 549.2	every 3 years			1		3										
	1613	Synthetic Organic Chemicals - EPA 1613	NA			1		3										
		Gross Alpha	initial			3		3	3	3	3							
		Uranium	initial			1		3										
		Radium 226	initial			1		3										
		Radium 228	initial			3		3	3	3	3							
		Cyanide	intital			1		3										
		Yeast & Mold	NA			0												
		Aerobic Plate Count	NA			0												
		Nitrate	quarterly		11/14/2016	4	1	1	1	1	1	1	1	1	1	1	1	1
		Nitrite	every 12 months		11/14/2016	1			1				1				1	
		Total Organic Carbon (TOC)	monthly			12	M	M	M	M	M	M	M	M	M	M	M	M
		Total Coliform (P-A)	NA			0												
		Total Coliform (Multiple Tube)	quarterly	1		12	M	M	M	M	M	M	M	M	M	M	M	M
		General Mineral & General Physical	every 12 months		11/14/2016	1			1				1				1	
	200.7	Inorganics - 200.7	every 12 months		11/14/2016	1			1				1				1	
	200.8	Inorganics - 200.8	every 12 months		11/14/2016	1			1				1				1	
		Manganese	quarterly		11/14/2016	4	1	1	1	1	1	1	1	1	1	1	1	1
		Iron	quarterly		11/14/2016	4	1	1	1	1	1	1	1	1	1	1	1	1
Piney Creek		Perchlorate	initial			2		3		3			1				1	
(Pioneer Creek)		Chromium, Hexavalent	every 12 months			1			1				1				1	
Surface Water		Asbestos	intital			1		3										
	524.2	Volatile Organic Chemicals (VOC)	intitial			3		3	3	3	3						1	
	524.2	MTBE	in VOC			0												
PS Code	524.2 M	1,2,3-Trichloropropane (TCP) - EPA 524.2 M	Initial - early			1			1		1							
008	504.1	Synthetic Organic Chemicals - EPA 504.1	NA			1		3										
	507	Synthetic Organic Chemicals - EPA 507	NA			1		3										
	508	Synthetic Organic Chemicals - EPA 508	NA			1		3										
	515.1	Synthetic Organic Chemicals - EPA 515.1	every 3 years			1		3										
	525.2	Synthetic Organic Chemicals - EPA 525.2	every 3 years			1		3										
	531.1	Synthetic Organic Chemicals - EPA 531.1	every 3 years			1		3										
	547	Synthetic Organic Chemicals - EPA 547	every 3 years			1		3										
	548.1	Synthetic Organic Chemicals - EPA 548.1	every 3 years			1		3										
	549.2	Synthetic Organic Chemicals - EPA 549.2	every 3 years			1		3										
	1613	Synthetic Organic Chemicals - EPA 1613	NA			1		3										

Redwood Glen
Water Quality Monitoring Plan
Treatment - Distribution

Signature
5/15/2017

Redwood Glen Community System # 4100522	EPA Method	Chemical Group	Sampling Frequency	# in set	Last Done Date	Due	2017				2018				2019			
						2017	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Treated Water						0												
Manganese & Iron						0												
PS Code		Manganese	monthly			12	M	M	M	M	M	M	M	M	M	M	M	M
-		Manganese - Field	weekly			12	M	M	W	M	M	M	W	M	M	M	W	M
		Iron	monthly			12	M	M	M	M	M	M	M	M	M	M	M	M
						0												
						0												
						0												
Treated Water		Total Organic Carbon (TOC)	monthly	2		24	M	M	M	M	M	M	M	M	M	M	M	M
Surface Water		Alkalinity	montly	2		24	M	M	M	M	M	M	M	M	M	M	M	M
PS Code		analyzer calibration	quarterly	1		4	1	1	1	1	1	1	1	1	1	1	1	1
-						0												
						0												
						0												
						0												
Distribution System																		
PS Codes																		
		Total Coliform (P-A)	weekly	1		52	W	W	W	W	W	W	W	W	W	W	W	W
		Total Coliform (Multiple Tube)	monthly			0												
		Chlorine Resdual - field	weekly			52	W	W	W	W	W	W	W	W	W	W	W	W
						0												
						0												
		asbestos	not required			0												
						0												
900		Trihalomethanes & Haloacetic Acids	quarterly			4	1	1	1	1	1	1	1	1	1	1	1	1
						0												
		lead & copper	Initial	5		10	2		2				2				2	
Notes:						0												
		Water Quality Parameter Tests	not required unless Pb			0												
			and Cu exceeds action			0												
			level			0												
						0												
						0												
						0												

ATTACHMENT G

Bacteriological Site Sampling Plan (BSSP)

Small Water System Bacteriological Sampling Plan

I. System Information:

System or Facility Name: Redwood Glen Camp and Conference Center

Population: 22-250 people

Source(s): Hauled Potable Water – Skylonda Equipment

II. Routine Sampling Frequency

The water system must collect 1 routine sample at a frequency of once every week.

III. Routine and Repeat Sampling Sites

***Routine sample site No. 1: Smith Hall**

*This site must be representative of the distribution system and shall not be designated as a water source (i.e. well, etc.).

If this routine sample contains coliform bacteria, the water system must collect a set of repeat samples within 24 hours of being notified of the result. (If your routine sampling frequency is equal to or less than one sample per month, the repeat sample set must consist of **4** samples. If your routine sampling frequency is greater than one sample per month, the repeat sample set need only consist of **3** samples.)

Repeat Sample Set (No. 1)

Repeat sample site No. 1: **Smith Hall**
(Collect one sample at the original routine sample site)

Repeat sample site No. 2: **Hodge House**
(Collect one sample within five connections upstream)

Repeat sample site No. 3: **Heiman House**
(Collect one sample within five connections downstream)

Repeat sample site No. 4: **Siden Conference Center**
(Collect one additional sample in the distribution system)

If you purchase water from another water system, you must contact the water system from which you purchase water within 24 hours of being notified of a routine total coliform positive sample result.
Name of wholesaler contact: Jeanie Johns, Skylonda Equipment

Phone number of wholesaler contact: (415) 868-0037

* A routine sample site must be designated for each pressure zone or separate area served by the water system. The routine sample sites must be rotated such that they are all sampled on a regular basis. If this water system must designate more than one routine sample site, please do so on the following page.

Check one of the following:

☒ Only one routine sample site is necessary to adequately represent the system. Additional routine and repeat sample sites *are not* attached.

☐ This water system contains more than one pressure zone or separate area. Additional routine and repeat sample sites *are* attached.

Routine Sample Site No. 2: Siden Conference Center

This site must be representative of the distribution system and shall not be designated as a water source (i.e. well, etc.).

If this routine sample contains coliform bacteria, the water system must collect a set of repeat samples within 24 hours of being notified of the result. (If your routine sampling frequency is equal to or less than one sample per month, the repeat sample set must consist of **4** samples. If your routine sampling frequency is greater than one sample per month, the repeat sample set need only consist of **3** samples.)

Repeat Sample Set No. 2:

Repeat sample site No. 1: Siden Conference Center
(Collect one sample at the original routine sample site)

Repeat sample site No. 2: Hodge House (not upstream)
(Collect one sample within five connections upstream)

Repeat sample site No. 3: Creekside Cabin (not downstream)
(Collect one sample within five connections downstream)

Repeat sample site No. 4: Smith Hall
(Collect one additional sample in the distribution system)

Groundwater Triggered Source Sample(s): NA (Identify Sources)
(Collect one sample for *E. coli* from each ground water source on line at the time of the routine total coliform-positive sample result)

If you purchase water from another water system, you must contact the water system from which you purchase water within 24 hours of being notified of a routine total coliform positive.

Routine Sample Site No. 3: Creekside Cabin
This site must be representative of the distribution system and shall not be designated as a water source (i.e. well, etc.).

If this routine sample contains coliform bacteria, the water system must collect a set of repeat samples within 24 hours of being notified of the result. (If your routine sampling frequency is equal to or less than one sample per month, the repeat sample set must consist of **4** samples. If your routine sampling frequency is greater than one sample per month, the repeat sample set need only consist of **3** samples.)

Repeat Sample Set No. 3:

Repeat sample site No. 1: Creekside Cabin
(Collect one sample at the original routine sample site)

Repeat sample site No. 2: Hodge House
(Collect one sample within five connections upstream)

Repeat sample site No. 3: Smith Hall
(Collect one sample within five connections downstream)

Repeat sample site No. 4: Siden Conference Center
(Collect one additional sample in the distribution system)

Groundwater Triggered Source Sample(s): NA (Identify Sources)
(Collect one sample for *E. coli* from each ground water source on line at the time of the routine total coliform-positive sample result)

If you purchase water from another water system, you must contact the water system from which you purchase water within 24 hours.

IV. Sampling During The Month Following A Positive Sample

If one or more samples are positive for total coliform in a month, the water system is required to collect five routine samples during the following month. These five samples can be collected over the course of the month or all on the same day. Please list the locations from which these extra samples would be collected:

1. Smith Hall 2. Siden Conference Center 3. Creekside Cabin

4. Heiman House 5. Hodge House

V. Map or Diagram

A map showing the locations of routine and repeat sample sites is included as Attachment A.

VI. Personnel and Laboratory Notification

Sampler: Andrew Gonsalves
(Sample collection must be performed by a person trained in sample collection. Provide name of sampler.)

Laboratory: San Mateo County Public Health Laboratory
(Provide the name and phone number of the certified lab doing your water analysis. Arrangement must be made for weekend and holiday analysis if needed.)

Notification: Laboratory to notify persons designated below within 24 hours whenever a sample is found to contain coliform bacteria:

	(Name)	(Daytime Phone #)	(Evening Phone #)
1.	Andrew Gonsalves, Redwood Glen	(650) 879-0320 x16	(650) 294-9820
2.	Chris Hauge, Bracewell Engineering	(408) 316-7877	(408) 316-7877

VII. Notification of the Department

The water system will notify the State Water Resources Control Board, Division of Drinking Water Sonoma District Office, within 24 hours whenever a sample contains fecal coliform or *E. coli* bacteria or whenever a follow-up sample is positive.

Santa Clara District Office:	510-620-3474 (day or night, leave message)
Eric Lacy, P.E. District Engineer:	510-620-3453
Karen Nishimoto, Staff District Engineer	510-620-3461

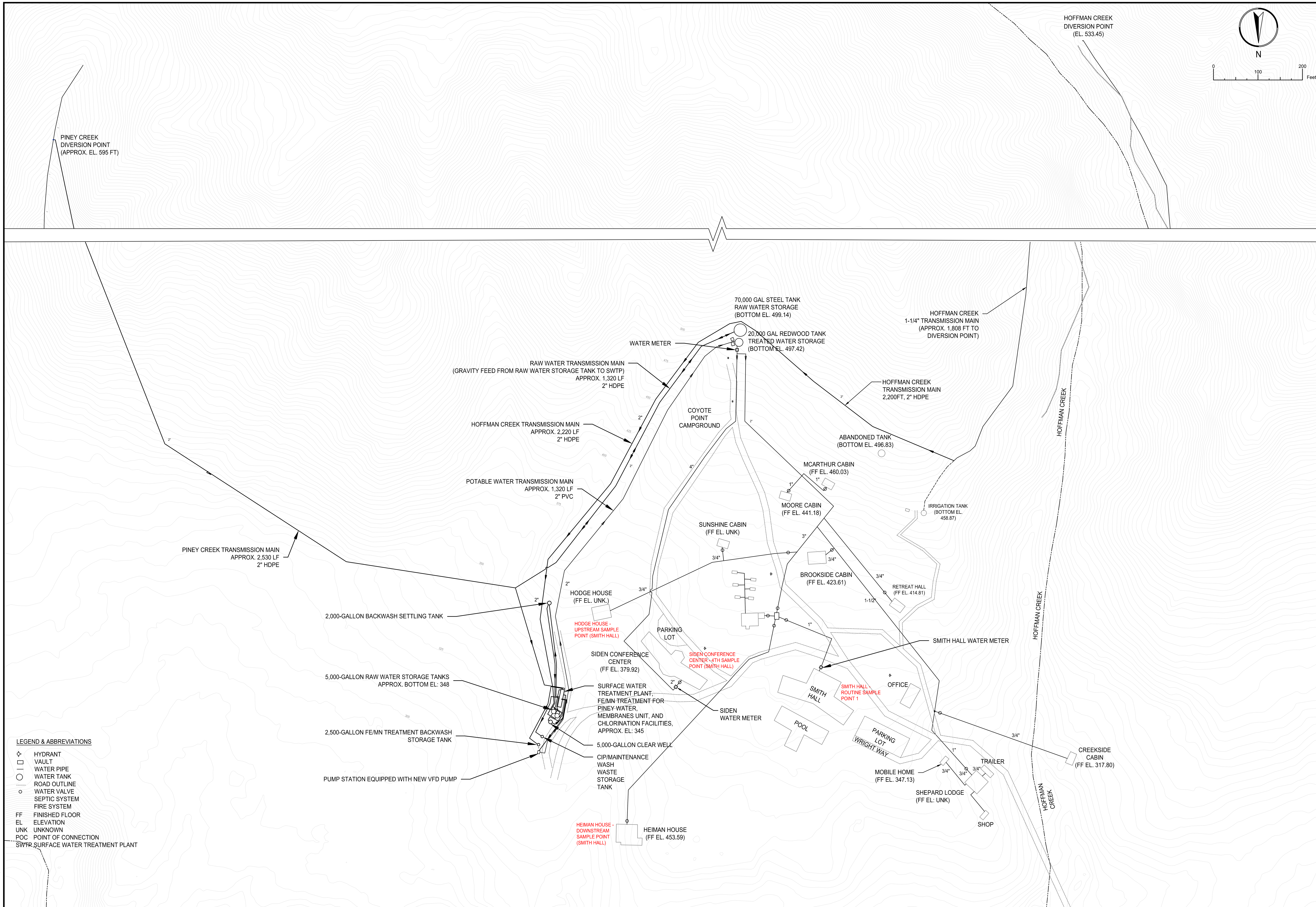
Submitted by: Andrew Gonsalves Date 3/21/2016

KEEP A COPY OF THIS FORM FOR YOUR REFERENCE AND USE

ADDITIONAL INFORMATION

When responding to a laboratory report of bacterial contamination, keep in mind the following:

1. Coliform bacteria should not be present in drinking water and the presence of coliform indicates a potentially serious problem. Appropriate investigation should be performed immediately.
2. Check water system components such as water sources, filtration and/or chlorination equipment and storage tanks for indications of unusual conditions or problems.
3. Correct problems immediately. Do not wait for results of follow-up samples to take action.
4. **If a triggered source sample result is E. coli-positive, the system must conduct Tier 1 notification and collect five (5) additional source samples within 24 hours of being notified of the *E. coli*-positive sample result.**



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PLOT DATE: May 19, 2017 – 3:46pm PLOTTED BY: Christine

SYM.	DESCRIPTION	DATE	APPROVED
–	100% DESIGN	03/2017	LP

REVISIONS

NOT FOR CONSTRUCTION

SRT consultants
90 New Montgomery Street, Suite 905
San Francisco, CA 94109
Ph 415.776.5800
Fx 415.776.5200

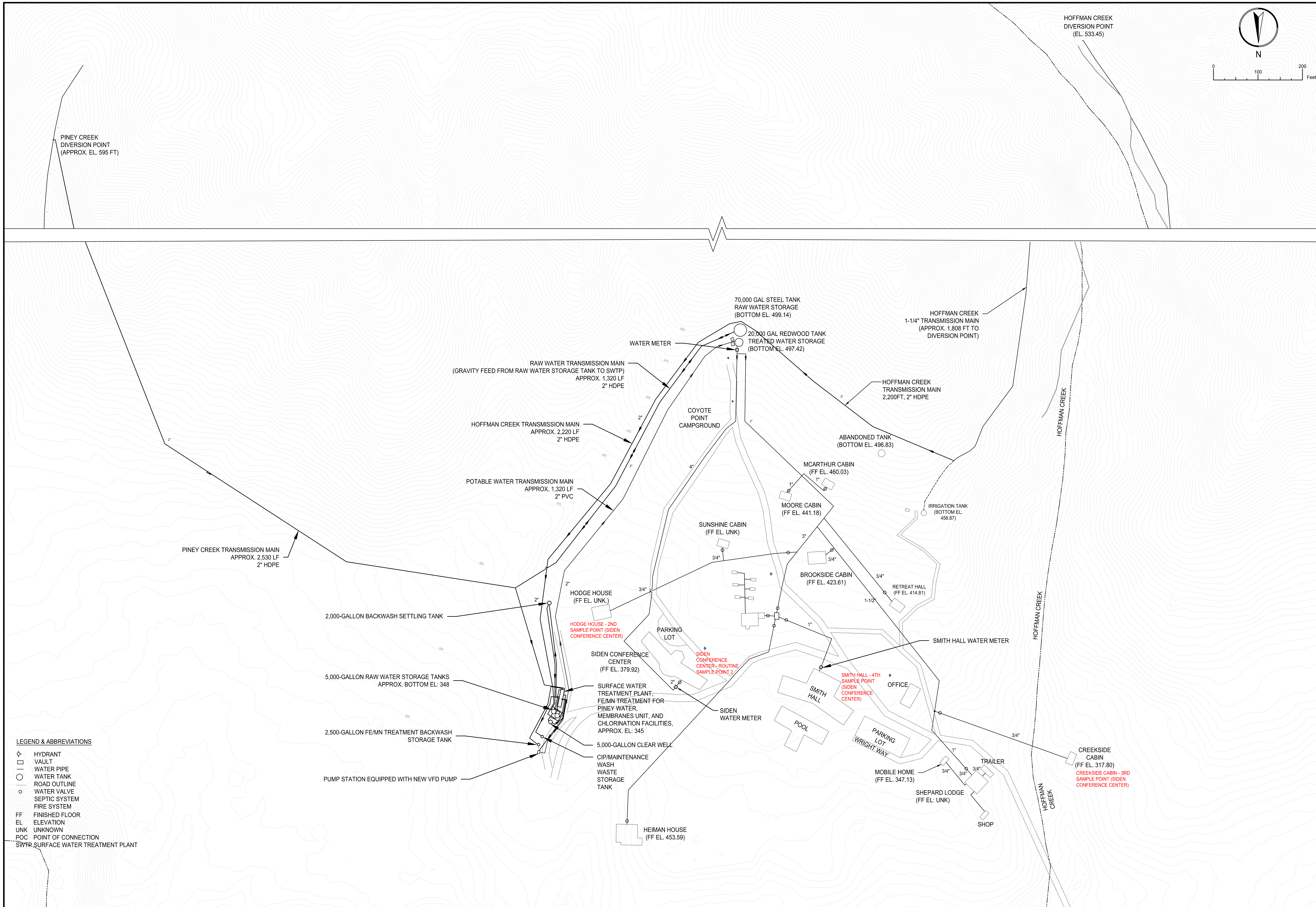
REDWOOD GLEN CAMP AND CONFERENCE CENTER
100 WRIGHT WAY
LOMAR MAR, CA 94021

REDWOOD GLEN NEW WATER SYSTEM CONSTRUCTION PROJECT

WATER SYSTEM MAP

DATE	MAR 2017
SCALE	AS SHOWN
DESIGN	L. PEZZINO
DRAWN	N.MAO
PROJECT#	------
SHEET	01 OF --

01



DRAWING NAME: \\Newserver\srt\01_PROJECTS\Redwood Glen\02_TASKS\03 TMF\TMF MAP\TMF MAP.dwg
PLOT DATE: May 19, 2017 – 3:49pm PLOTTED BY: Christine

REVISIONS

SYM.	DESCRIPTION	DATE	APPROVED
–	100% DESIGN	03/2017	LP

NOT FOR CONSTRUCTION

S R T consultants
90 New Montgomery Street,
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San Francisco, CA 94109
Ph 415.776.5800
Fx 415.776.5200

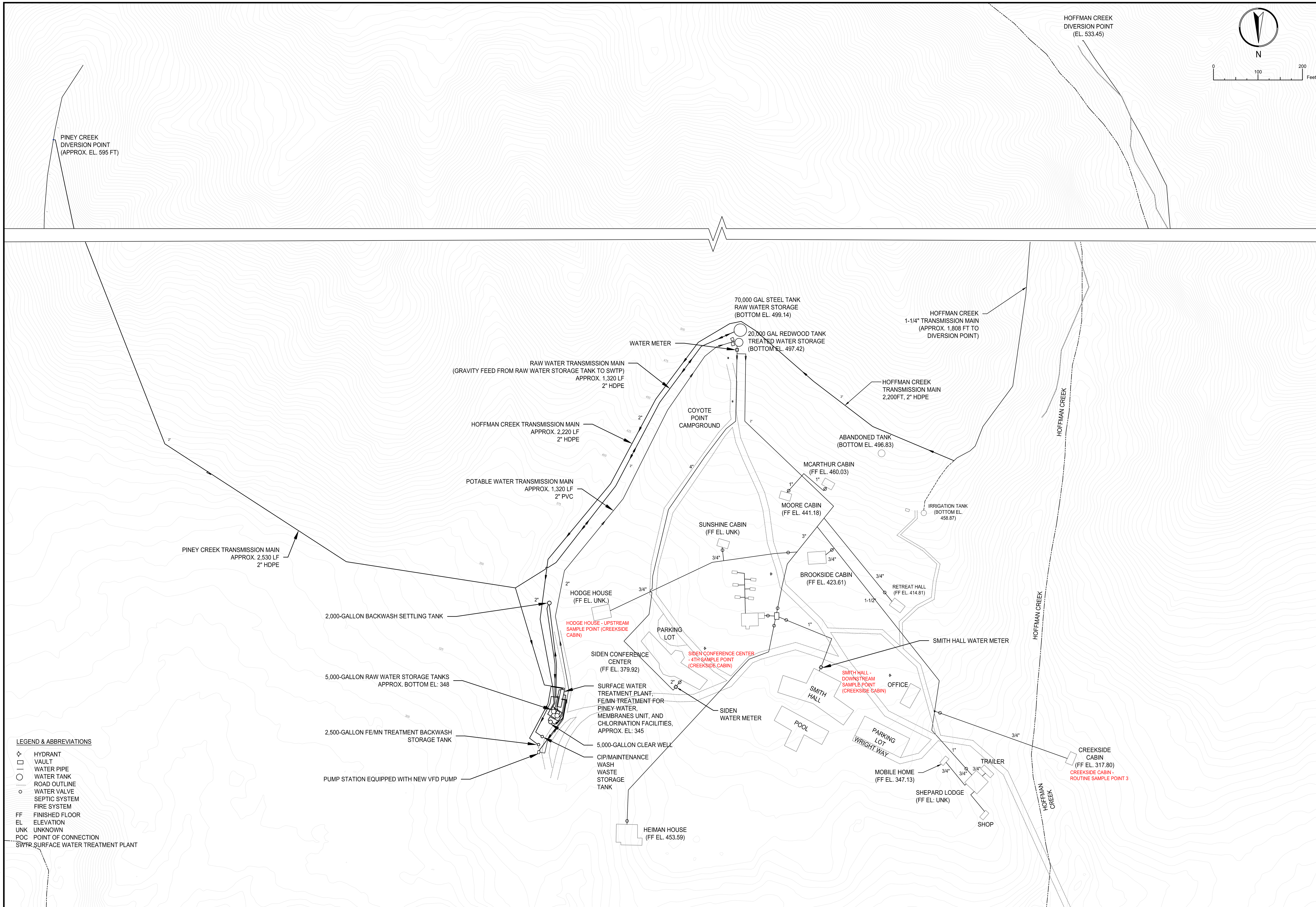
REDWOOD GLEN CAMP AND CONFERENCE CENTER
100 WRIGHT WAY
LOMAR MAR, CA 94021

REDWOOD GLEN NEW WATER SYSTEM CONSTRUCTION PROJECT

WATER SYSTEM MAP

DATE	MAR 2017
SCALE	AS SHOWN
DESIGN	L. PEZZINO
DRAWN	N.MAO
PROJECT#	------
SHEET	01 OF --

01



SYM.	DESCRIPTION	DATE	APPROVED
–	100% DESIGN	03/2017	LP

REVISIONS

NOT FOR CONSTRUCTION

SRT consultants
90 New Montgomery Street,
Suite 905
San Francisco, CA 94109
Ph 415.776.5800
Fx 415.776.5200

REDWOOD GLEN CAMP AND CONFERENCE CENTER
100 WRIGHT WAY
LOMAR MAR, CA 94021

REDWOOD GLEN
NEW WATER SYSTEM
CONSTRUCTION PROJECT

WATER SYSTEM MAP

DATE	MAR 2017
SCALE	AS SHOWN
DESIGN	L. PEZZINO
DRAWN	N.MAO
PROJECT#	------
SHEET	01 OF --

01

DRAWING NAME: \\Newserver\srt\01_PROJECTS\Redwood Glen\02_TASKS\03_TMF\TMF MAP\TMF MAP.dwg
PLOT DATE: May 19, 2017 – 3:50pm PLOTTED BY: Christine

ATTACHMENT H

Water Quality Emergency Notification Plan (WQENP)

CALIFORNIA
Water Boards

EDMUND G. BROWN JR.
GOVERNOR

MATTHEW RODRIQUEZ
SECRETARY FOR
ENVIRONMENTAL PROTECTION

State Water Resources Control Board
Division of Drinking Water

WATER QUALITY EMERGENCY NOTIFICATION PLAN

Name of System: Redwood Glen Camp and Conference Center System No.: 4100522

System Location: 100 Wright Drive, Loma Mar, CA 94021 County: San Mateo

The following persons have been designated to implement the plan upon notification by the State Department of Public Health that an imminent danger to the health of the water users exists:

	Name	Title	Day Phone	Evening Phone
1.	Andrew Gonsalves	Water System Operator	(650) 879-0320 Ext. 16	(650) 294-9820
2.	Chris Hauge	Contract Water System Operator	(408) 316-7877	(408) 316-7877
3.	Larry Rice	Executive Director	(650) 879-0320	(650) 504-2521

The implementation of the plan will be carried out with the following State and County Health Department personnel:

	Name	Title	Day Phone	Evening Phone
1.	Eric Lacy	District Engineer	(510) 620-3453	(925) 299-6936
2.	Karen Nishimoto	Associate Sanitary Engineer	(510) 620-3461	(209) 598-8484
3.	Greg Smith	San Mateo County Environmental Health Specialist	(650) 372-6279	(650) 867-9434

After reaching the Santa Clara County Emergency Communications Center, ask for the on-call Environmental Health personnel.

4. If the above personnel cannot be reached, contact:

The State Office of Emergency Services Warning Center (24 hours) **(916) 845-8911 or (800) 852-7550**. When reporting a water quality emergency to the Warning Center, please ask for the California Department of Public Health – Drinking Water Program Duty Officer.

NOTIFICATION PLAN

The water operator and staff will verbally notify persons using the site. Appropriate signage will be posted in public common areas. It is estimated that the entire service area can be covered in less than two hours.

Report Prepared by:

Larry Rice

3/21/2016

Signature and Title **Date**

ATTACHMENT 6

Training Plan

Redwood Glen Water System Training Plan

Introduction

Competent, trained personnel are crucial to a reliable operation of the water system. Continuous training will provide the water system personnel with essential knowledge of the latest technology and regulations. In order to keep abreast with the increasingly complex and technical drinking water regulations, Redwood Glen is committed to provide continuous training to its certified operators, management members and other staff.

Training Requirements for Certified Operators

Redwood Glen requires certified operators (including contract operators) to obtain continuing education contact hours for certification renewal. Contact hour requirements are listed in Table 1.

Table 1 Contact Hours Requirement for Certified Operators

Water Treatment Operators	Contact Hours Required
Grade T1	12
Grade T2	16
Grade T3	24
Grade T4	36
Grade T5	36
Distribution Operators	**Contact Hours Required**
Grade D1	12
Grade D2	16
Grade D3	24
Grade D4	36
Grade D5	36

Training obtained by operators shall be documented using the form provided in Attachment A. If a certificate of completion is offered, Redwood Glen will keep it on file. Redwood Glen will organize operators to attend courses from continuing education providers and specialized courses listed in Attachment B.

Training Requirements for Management and Board Members

Redwood Glen management members are required to obtain training on ethics, financial management and regulation updates.

Ethics Training Requirements

The Redwood Glen management will receive two (2) hours of ethic training every five (5) years. Recommended training resources are as follows: State Water Resources Control Board (SWRCB), Rural Community Association Corporation, and/or other courses provided by a local agency. Table 2 shows a list of recommended topics. Redwood Glen will provide management team with information required to meet these requirements.

Training obtained by management team members will be documented in the using the form provided in Attachment A. If a certificate of completion is offered, Redwood Glen will keep it on file.

Table 2 Recommended Topics for Ethics Training

Recommended Training Topics	Presented By
Ethics, Conflict of Interest & Policies	RCAC
Ethics Training for Board Members	RCAC
Board Basics: Board Roles & Responsibilities	RCAC

Financial Management Training Requirements

The Redwood Glen management team will receive two (2) hours of financial management training every two (2) years. Recommended training topics include budget projection, Capital Improvement Projects (CIP) planning, financial stability and other financial management topics. Recommended training resources are as follows: State Water Resources Control Board (SWRCB), Rural Community Association Corporation, and/or other courses provided by a local agency. Redwood Glen will provide management team with information required to meet these requirements.

Training obtained by management team members will be documented in the using the form provided in Attachment A. If a certificate of completion is offered, Redwood Glen will keep it on file.

Regulation Updates

Redwood Glen Business Manager will sign up for newsletter from SWRCB and Environmental Protection Agency (EPA) to keep abreast with the latest changes in regulations, and send updates to Redwood Glen management team members and operations staff. The Executive Director will authorize members to attend applicable trainings.

ATTACHMENT A

Training Log

Redwood Glen Water System Training Record Form

Water System No. 4100522

Training Date	Training Description	Training Type	Provided By	Participants	Contact Hours

ATTACHMENT B

List of Continuing Education Courses and Providers

Continuing Education Providers

In order to renew your certification, you must submit proof of completion for the number of continuing education contact hours as listed below. Acceptable drinking water courses must have been completed **within the past 3 years** of the Due Date listed on your renewal and not used on a prior renewal. You may use your contact hours for both distribution and treatment renewals.

	Grade 1	**Grade 2**	**Grade 3**	**Grade 4**	**Grade 5**
Number of Required Contact Hours	12 Hours	16 Hours	24 Hours	36 Hours	36 Hours

The following is a list of providers that offer Continuing Education contact hours. This is not a complete list. Other continuing education providers and courses are available. Click on a provider's name for contact information. You may then contact the training provider for class availability, locations, costs, and contact hours awarded. ***Be aware that some providers offer a variety of courses and not all courses are acceptable for continuing education contact hours for Drinking Water Treatment or Distribution!*** Only subject matter related to drinking water treatment, distribution, or safety is acceptable.

Online Courses		**Correspondence Courses**	
American Water College	RCAC	CSUS	
AWWA	Red Vector	**Classroom and Seminar Courses**	
CA-NV AWWA	TargetSolutions	Advanced Electric	H2O Professor
CEUPlan.com	Technical Learning College	AWWA	IAPMO Backflow
CRWA	Technology Transfer Services	CA-NV AWWA	OCT Water Quality Academy
CSUS	TPC Training Systems	CRWA	Pump Training by Volk
David H Paul Training	Water Grades	David H Paul Training	Quality Assurance Solutions
ehs Inc.	Zarathom	ehs Inc.	RCAC
Grepa Trainers	@Home Prep	Grepa Trainers	TPC Training Systems
MOST	@ 1st Attempt	Golden State Water Co.	Water Opcert School
OCT Water Quality Academy	360water	Hach Company	WQI
		Harry Brown Training	

Continuing Education Providers

Online courses/Computer based training	
Training Provider	**Contact Information**
American Water College	American Water College Web: www.americanwatercollege.org Email: info@americanwatercollege.org Phone: (661) 874-1655
AWWA	American Water Works Association Web: www.awwa.org/conferences-education.aspx Email: service@awwa.org Phone: (800) 926-7337
CA-NV AWWA	California-Nevada Section of American Water Works Association Web: http://www.ca-nv-awwa.org/ Email: info@ca-nv-awwa.org Phone: (909) 481-7200
CEUPlan.com	CEUPlan.com Web: www.ceuplan.com Email: support@ceuplan.com Phone: N/A
CRWA	California Rural Water Association Web: www.calruralwater.org/pages/schedule Email: ccolson@calwater.org Phone: (916) 283-8502
CSUS	Office of Water Programs, California State University Web: www.owp.csus.edu Email: wateroffice@owp.csus.edu Phone: (916) 278-6142
David H Paul Training	David H Paul Training Web: www.dhptraining.com Email: dhp@dhptraining.com Phone: (877) 711-4347
ehs Inc.	ehs Inc. Web: www.ehsinc.org Email: info@ehsinc.org Phone: (855) 234-7462
Grepa Trainers	Grepa Health and Environmental Web: www.grepatrainers.org Email: grepatrainers@gmail.com Phone: (760) 402-6788
MOST	McLean's Operational Services Training Web: www.mostwatertraining.com Email: N/A Phone: (661) 312-5463

OCT Water Quality Academy	OCT Water Quality Academy Web: www.octinc.com Email: info@octinc.com Phone: (866) 266-0028
RCAC	Rural Community Assistance Corporation Web: www.events.rcac.org/rcac/Calendar.asp Email: registration@rcac.org Phone: (916) 447-9832 ext. 1429
Red Vector	Red Vector Web: www.redvector.com Email: accreditations@redvector.com Phone: (866) 546-1212
TargetSolutions	TargetSolutions Web: www.targetsolutions.com Email: support@targetsolutions.com Phone: (800) 840-8048
Technical Learning College	Technical Learning College Web: www.abctlc.com Email: info@tlch2o.com Phone: (866)557-1746
Technology Transfer Services, Inc.	Technology Transfer Services, Inc. Web: waterprograms.myodesie.com Email: waterprograms@myodesie.com Phone: (813) 908-1100
TPC	TPC Training Systems Web: www.tpctraining.com Email: info@tpctraining.com Phone: (800) 837-8872
Water Grades	Water Grades Virtual Classroom Web: www.watergrades.com Email: admin@watergrades.com Phone: N/A
Zarathom	Zarathom Web: www.zarathom.com Email: info@zarathom.com Phone: (844) 927-2846
@ Home Prep	@ Home Prep – A Division of Stautzenberger College Web: www.athomeprep.com Email: info@athomeprep.com Phone: (800) 952-0910
@ 1st Attempt	At 1st Attempt (Formerly AYPO) Web: www.aypotech.com Email: contact@atyourpaceonline.com Phone: (877) 724-6150

360water	360water Web: www.360water.com Email: serviceteam@360water.com Phone: (866) 923-3600
Correspondence Courses	
CSUS	Office of Water Programs, California State University, Sacramento Web: www.owp.csus.edu Email: wateroffice@owp.csus.edu Phone: (916) 278-6142
Classroom and Seminar Courses	
Advanced Electric	Advanced Electric Web: www.advancedelectric-co.com Email: advelect@yahoo.com Phone: (831) 818-5122
AWWA	American Water Works Association Web: www.awwa.org/conferences-education.aspx Email: service@awwa.org Phone: (800) 926-7337
CA-NV AWWA	California-Nevada Section of American Water Works Association Web: www.ca-nv-awwa.org Email: info@ca-nv-awwa.org Phone: (909) 481-7200
CRWA	California Rural Water Association Web: www.calruralwater.org/pages/schedule Email: ccolson@calwater.org Phone: (916) 283-8502
David H Paul Training	David H Paul Training Web: www.dhptraining.com Email: dhp@dhptraining.com Phone: (877) 711-4347
ehs Inc.	ehs Inc. Web: www.ehsinc.org Email: info@ehsinc.org Phone: (855) 234-7462
Grepa Trainers	Grepa Health and Environmental Web: www.grepatrainers.org Email: grepatrainers@gmail.com Phone: (760) 402-6788
GSWC	Golden State Water Company Web: www.gswater.com Email: registration@gswater.com Phone: (714) 535-7711
Hach Company	Hach Company Web: www.hach.com/training Email: httc@hach.com Phone: (800) 227-4224 ext. 2344

Harry Brown Training	Harry Brown Training Web: www.harrybrowntraining.com Email: info@harrybrowntraining.com Phone: (805) 460-0148
H2O Professor	H2O Professor Web: N/A Email: h2oprofess@aol.com Phone: (619) 851-4457
IAPMO	IAPMO Backflow Prevention Institute Web: www.iapmodwbp.org/Pages/TrainingandCertification.aspx Email: bpiseminars@iapmo.org Phone: (855) 536-2800
OCT Water Quality Academy	OCT Water Quality Academy Web: www.octwqa.org Email: info@octinc.com Phone: (800) 266-0028 or 916-640-2114
Pump Training by Volk	Volk & Associates, Inc. Web: www.volkassociates.com Email: info@volkassociates.com Phone: (510) 482-8655
Quality Assurance Solutions LLC	Quality Assurance Solutions LLC Web: www.qasolutions-llc.com Email: dlawver@qasolutions-llc.com Phone: (408) 772-0077
RCAC	Rural Community Assistance Corporation Web: www.events.rcac.org/rcac/Calendar.asp Email: registration@rcac.org Phone: (916) 447-9832 ext. 1429
TPC	TPC Training Systems Web: www.tpctraining.com Email: info@tpctraining.com Phone: (800) 837-8872
Water Opcert School	Water Opcert School Web: www.opcertschool.com Email: postmaster@opcertschool.com Phone: (866) 795-5798
WQI	WQI Web: www.waterqualityinc.com Email: jpburnsh@hotmail.com Phone: (281) 866-9414

The following list represents courses the Department (CDPH) has reviewed and accepted as specialized training courses for our exams. An "X" in the DWT column means the course can be used as a Drinking Water Treatment course. An "X" in the WSP column means the course can be used as a Water Supply Principles course. An "X" in the Supplemental column means the course can be used only as a supplemental specialized training course required for Grade 3-5 exams. Courses that are crossed out are no longer available but are still acceptable for exam qualification.

SPECIALIZED TRAINING COURSE	**Updated - May 2016**		
Class Title	**DW Treatment**	**Water Supply Principles**	**Supplemental Course**
ON-LINE COURSES			
AMERICAN WATER COLLEGE	**DWT**	**WSP**	**Suppl.**
info@americanwatercollege.org Phone 661-874-1655 **Website: www.americanwatercollege.org** **American Water College P.O. Box 903185 Palmdale, CA 93590**			
Water Treatment Basics	X	X	X
Distribution System Basics		X	X
WATER OPERATOR ASSOCIATION	**DWT**	**WSP**	**Suppl.**
Website: http://www.wateroperatorsassociation.com/ **Email: info@wateroperatorsassociation.com**			
Water Distribution Introduction		X	X
Water Distribution Advanced		X	X
Water Treatment Introduction	X	X	X
Water Treatment Advanced	X	X	X
SANTA ROSA JUNIOR COLLEGE	**DWT**	**WSP**	**Suppl.**
Website: http://online.santarosa.edu/section/?15533 **email: cjudson@santarosa.edu**			
WTR110 Water Treatment Plant Operation	X	X	X
CORRESPONDENCE COURSES			
CALIFORNIA STATE UNIVERSITY (SACRAMENTO)	**DWT**	**WSP**	**Suppl.**
Office of Water Programs, 600 J Street, Sacramento, CA 95819-6025 **(916) 278-6142 Fax (916) 278-5959 Website: http://owp.csus.edu**			
Advanced Waste Treatment			X
Distribution System O&M		X	X
O&M of WW Collection Systems, Vol. 1			X
O&M of WW Collection Systems, Vol. 2			X
Small WW System O&M, Vol. 1			X
Small Water System O&M		X	X
Water Treatment Plant Op., Vol. 1	X	X	X
Water Treatment Plant Op., Vol. 2	X	X	X
Wastewater Treatment Plant Op., Vol. 1			X
Wastewater Treatment Plant Op., Vol. 1			X
Industrial Waste Treatment, Vol. 1			X
Industrial Waste Treatment, Vol. 2			X
Pretreatment Facility Inspection			X
Treatment of Metal Wastestream			X
Utility Management *(acceptable for supplemental if 4.5 CEU's awarded)			X*
Manage For Success			X

IACET Providers			
CA-NV-AWWA Water College	**DWT**	**WSP**	**Suppl.**
CA-NV-AWWA, 10435 Ashford St., 2nd Floor, Rancho Cucamonga, CA 91730 (909) 481-7200 Fax: (909) 481-4688 Website: http://www.ca-nv-awwa.org			
Beginning Water Distribution		X	X
Intermediate Water Distribution		X	X
Advanced Water Distribution		X	X
Beginning Water Treatment	X	X	X
Intermediate Water Treatment	X	X	X
Advanced Water Treatment	X	X	X
Introduction to Water Conservation			X
Backflow Tester Course			X
Cross-Connection Specialist Course			X
OCT Academy	**DWT**	**WSP**	**Suppl.**
5840 Price Avenue McClellan, California (916) 649-8166, (866) 266-0028 Website: http://www.octinc.com			
Fundamentals of Drinking Water Treatment, Basic Level	X	X	X
Fundamentals of Drinking Water Treatment, Intermediate Level	X	X	X
Fundamentals of Drinking Water Treatment, Advanced Level	X	X	X
Water Distribution Systems, Basic Level		X	X
Water Distribution Systems, Intermediate		X	X
Water Distribution Systems, Advanced		X	X
Water Distribution Opereations Management			X
CRWA ACADEMY OF WATER EDUCATION	**DWT**	**WSP**	**Suppl.**
4125 Northgate Blvd., Sacramento, CA 95838, Phone (800)-833-0322, Website: www.calruralwater.org			
Water Distribution O & M		X	X
Water Treatment O & M	X	X	X
GOLDEN STATE WATER COMPANY	**DWT**	**WSP**	**Suppl.**
www.gswater.com			
(WQ 100) Introduction to Water Treatment Principles	X	X	X
(WQ 200) Intermediate Water Treatment Principles	X	X	X
(WQ 300) Advanced Water Treatment	X	X	X
(WD 100) Introduction to Water Distribution Principles		X	X
(WD 200) Intermediate Water Distribution Principles		X	X
(WD300) Advanced Water Distribution Principles		X	X
Basic Water Distribution, (So. Cal. Water Company)		X	X
Intermediate Water Distribution (So. Cal Water Company)		X	X
Cross-Connection and Backflow, (So. Cal Water Company)			X
COLLEGE COURSES			
ANTELOPE VALLEY COLLEGE (LANCASTER)	**DWT**	**WSP**	**Suppl.**
Antelope Valley College, 3041 West Avenue K, Lancaster 93536-5426 661-722-6300 Fax:661-943-5573 Website: http://www.avc.edu			
Tech 110 Water Supply & Treatment	X	X	X
Tech 111 Water System Operation			X
Tech 113 Wastewater Treatment & Disposal I			X
Tech 114 Wastewater Treatment & Disposal II			X
Tech 115 Wastewater Treatment & Disposal III			X
WDTO 901 Applied Water Treatment and Distribution Math I & II			X

WDTO 915 Water Distribution I		X	X
WDTO 916 Water Distribution II		X	X
WDTO 920 Water Treatment I	X	X	X
BAKERSFIELD COLLEGE (BAKERSFIELD)	**DWT**	**WSP**	**Suppl.**
Bakersfield College, 1801 Panorama Dr., Bakersfield, CA 93305-1299 **(661) 395-4011 Fax: (661) 395-4241 Website: http://www.bc.cc.ca.us**			
WTRT B51: Basic Water Treatment	X	X	X
WTRT B52: Basic Water Distribution		X	X
WTRT B53: Water and Wastewater Analysis			X
WTRT B61: Advanced Water Treatment	X	X	X
WTRT B62: Advanced Water Distribution		X	X
BASSETT USD - BASSETT ADULT SCHOOL	**DWT**	**WSP**	**Suppl.**
Water Tech/Dist. I	X	X	X
CITRUS COLLEGE (GLENDORA)	**DWT**	**WSP**	**Suppl.**
Citrus College, 1000 W. Foothill Blvd., Glendora, CA 91741-1899 **(626) 963-0323 Fax: (626) 914-8823 Website: http://www.citruscollege.edu**			
WATR 150 - Intro to Water Systems	X	X	X
WATR 151 - Water Resources & Distribution I		X	X
WATR 152 - Cross-Connection Control			X
WATR 153 - Water Resources & Distribution II		X	X
WATR 156 - Water Treatment I	X	X	X
WATR 157 - Water Treatment II	X	X	X
WATR 162 - Water Conservation			X
COLLEGE OF THE CANYONS (SANTA CLARITA)	**DWT**	**WSP**	**Suppl.**
College of the Canyons, 26455 Rockwell Canyon Road, Santa Clarita, CA 91355-1899 **(661) 259-7800 , (661) 362-5096 Fax: (661) 259-8302** **Website: http://www.canyons.edu**			
Water - 20 Intro to Water Systems Technology			X
Water - 030 Waterworks Mathematics			X
Water - 031 Advanced Waterworks Mathematics			X
Water - 032 Water Supply			X
Water - 035 Water Quality			X
Water - 040 Water Distribution Operator I		X	X
Water - 041 Water Distribution Operator II		X	X
Water - 050 Water Treatment Plant Operation Processes I	X	X	X
Water - 052 Water Treatment Plant Operation Processes II	X	X	X
100: Waterworks Mathematics			X
101: Water Treatment Processes I	X	X	X
102: Water Treatment Processes II	X	X	X
105: Water Distribution Operator I		X	X
106: Water Distribution Operator II		X	X
108: Water Treatment Chemistry			X
110: Wastewater Treatment & Disposal I			X
110: Wastewater Treatment & Disposal II			X
110: Wastewater Treatment & Disposal III			X
COLLEGE OF THE REDWOODS (EUREKA)	**DWT**	**WSP**	**Suppl.**
7351 Tompkins Hill Rd. Eureka, CA 1-800-641-0400 or 707-476-4100 **Website: www.redwoods.edu**			
WAT-10 Introduction to Water and Wastewater Technology			X
WAT-12 Water and Wastewater Science			X
WAT-20 Mechanical and Electrical Systems in the Water and Wastewater Industry			X
WAT-25 Applied Fluid Dynamics for the Municipal Industry			X
WAT-30 Operations of Drinking Water Treatment Systems	X	X	X
WAT-31 Operations of Drinking Water Distribution Systems		X	X
WAT-50 Operations of Wastewater Treatment Systems			X
WAT-51 Operations of Wastewater Collection Systems			X

COLLEGE OF THE SEQUOIAS (VISALIA)	DWT	WSP	Suppl.
College of the Sequoias, 915 S. Mooney Blvd., Visalia, CA 93277 (559) 730-3700 Fax: (559) 730-3894 Website: http://www.cos.edu			
I & T 220: Water Treatment Fundamentals	X	X	X
I & T 221: Wastewater Treatment Fundamentals			X
COLUMBIA COLLEGE (SONORA)	**DWT**	**WSP**	**Suppl.**
Columbia College, 11600 Columbia College Drive, Sonora, CA 95370 (209) 588-5100 Website: http://columbia.yosemite.cc.ca.us			
NARTC 163 Water For Consumption	X	X	X
CUESTA COLLEGE (SAN LUIS OBISPO)	**DWT**	**WSP**	**Suppl.**
Cuesta College San Luis Obispo CA 93403-8106 (805) 546-3100 Website: http://www.cuesta.edu			
CTCH 176 Basic Water Treatment (formerly CTECH 76)	X	X	X
CTCH 177 Water Distribution Systems (formerly CTECH 77)		X	X
CUYAMACA (SAN DIEGO)	**DWT**	**WSP**	**Suppl.**
Cuyamaca, 900 Rancho San Diego Parkway, El Cajon, CA 92019 (619) 660-4000 Website: http://www.cuyamaca.edu			
WWTR 101 Fundamentals of Water/Wastewater Technology			X
WWTR 102 Calculations in Water/Wastewater Technology			X
WWTR 103 Intro. To Water Resources Management			X
WWTR 104 Basic Hydraulics			X
WWTR 105 Principles and Practices of Water Conservation			X
WWTR 106 Intro. to Electrical & Instr. Process			X
WWTR 110 Laboratory Analysis for Water/Wastewater			X
WWTR 112 Basic Plant Operations: Water Treatment	X	X	X
WWTR 114 Basic Plant Operations: Wastewater Treatment			X
WWTR 115 Wastewater Reclamation and Reuse			X
WWTR 117 Advanced Plant Operations: Water Treatment	X	X	X
WWTR 120 Advanced Plant Operations: Wastewater Treatment			X
WWTR 130 Water Distribution Systems		X	X
WWTR 132 Wastewater Collection Systems			X
WWTR 134 Mechanical Maintenance			X
WWTR 265 Water Distribution Systems II		X	X
WWTR 270 Public Works Supervision			X
WWTR 280 Backflow Tester Training			X
WWTR 282 Cross Connection Control Specialist			X
WWTR 284 Cross Connection Control Specialist - Recycled Water			X
FOLSOM LAKE COLLEGE (FOLSOM)	**DWT**	**WSP**	**Suppl.**
10 College Parkway, Folsom CA 95630 (916)-608-6500 Website: http:// www.flc.losrios.edu			
ENVT 351: Math for Water and Wastewater Operators			X
ENVT 353: Science for Water and Wastewater Operators			X
ENVT 354: Waste Water Management: Basic Instrumentation and Electrical			X
ENVT 355: Introduction to Water, Wastewater and Recycled Water Management			X
ENVT 358: Water Treatment Operation and Maintenance I	X	X	X
ENVT 359: Water Treatment Operation and Maintenance II	X	X	X
ENVT 360: Water Distribution Operation and Maintenance		X	X
FRESNO CITY COLLEGE (FRESNO)	**DWT**	**WSP**	**Suppl.**
Fresno City College, 1101 E. University Ave., Fresno, CA 93741 (559) 442-4600 Fax: (559) 485-3367 Website: http://www.fresnocitycollege.com			
WUS 51: Water Treatment Fundamentals	X	X	X

GAVILAN COLLEGE (GILROY)	DWT	WSP	Suppl.
Gavilan College, 5055 Santa Teresa Blvd, Gilroy, CA 95020 **(408)-852-2804 Website: http://www.gavilan.edu/**			
WTRM 101 Introduction to Water / Wastewater Technology			X
WTRM 102 Beginning Water / Wastewater / Distribution Math			X
WTRM 103 Introduction to Electrical and Instrumentation Processes			X
WTRM 104 Motors and Pumps / Operation and Maintenance			X
WTRM 105 Water Distribution 1		X	X
WTRM 106 Beginning Water Treatment Plant Operation	X	X	X
WTRM 107 Beginning Wastewater Treatment Operations			X
WTRM 108 Water Distribution 2		X	X
WTRM 109 Advanced Water Treatment Plant Operation	X	X	X
WTRM 110 Advanced Water / Wastewater / Distribution Math			X
WTRM 111 Advanced Wastewater Treatment Plant Operation			X
WTRM 112 Applied Hydraulics			X
WTRM 113 Beginning Wastewater Collection			X
WTRM 114 Laboratory Analysis for Water / Wastewater			X
WTRM 116 Advanced Wastewater Collections			X
WTRM 117 Water Use Efficiency Practitioner			X
WTRM 118 Introduction to Occupational Health and Safety			X
WTRM 119 Industrial Wastewater Management & Treatment			X
WTRM 120 Pollution Prevention and Storm Water			X
WTRM 121 Mechanical Maintenance			X
Water Treatment Plant Operations 2	X	X	X
Basic Water Distribution Systems		X	X
Advanced Water Distribution		X	X
Introduction to Water/Wastewater math			X
Introduction to Water/Wastewater Operations			X
Wastewater Treatment Plant Operations 1			X
Wastewater Treatment Plant Operations Advanced			X
Backflow Course			X
GLENDALE COMMUNITY COLLEGE (GLENDALE)	**DWT**	**WSP**	**Suppl.**
Glendale Community College Community Services Education, **1122 East Garfield Avenue, Glendale CA 91205** **(818) 548-0864 Ext. 5015 or 5016 Fax: (818) 548-6216** **Website: http://www.glendale.edu/cse/**			
Fundamentals of Drinking Water Treatment	X	X	X
Drinking Water Treatment & Facility Operation	X	X	X
Introduction to Water Supply Principles		X	X
Drinking Water Distribution		X	X
100 Math for Water and Wastewater Operators			X
105 Science for Water and Wastewater Operators			X
115 Intro to Water, Wastewater & Recycled Water Management			X
120 Water Treatment Operations and Maintenance I	X	X	X
125 Water Treatment Operations and Maintenance II	X	X	X
130 Water Distribution Operation and Maintenance		X	X
HARTNELL COLLEGE (SALINAS)	**DWT**	**WSP**	**Suppl.**
Hartnell College, 156 Homestead Ave., Salinas, CA 93901 **(831) 755-6700 Fax: (831) 753-7941 Website: http://www.hartnell.cc.ca.us**			
WAT 150: Water Chemistry			X
WAT 161: Introduction to Water Treatment	X	X	X
WAT 162: Advanced Water Treatment	X	X	X
WAT 163: Intro. To Wastewater Treatment			X
WAT 164: Advanced Wastewater Treatment			X
WAT 165: W/WW Math			X
WAT 167: Water Distribution Systems		X	X

IMPERIAL VALLEY COLLEGE (IMPERIAL)	DWT	WSP	Suppl.
Imperial Valley College, 380 East Aten Road, Imperial, CA 92251-0158 (760) 352-8320 Fax: (760) 355-2663 Website: http://www.imperial.cc.ca.us			
WT 1: Water Treatment Plant Operator I	X	X	X
WT 2: Water Treatment Plant Operator II	X	X	X
WT 4: Water Distribution Systems		X	X
WT 6: Computational Procedures for WTPO I			X
WT 7: Computational Procedures for WTPO II			X
WT 8: Computational Procedures for WTPO III			X
WT 9: Wastewater Treatment I			X
WT 10: Wastewater Treatment II			X
WT 105: Computational Procedures Operator I			X
WT 110: Water Treatment Plant Operator I	X	X	X
WT 120: Computational Procedures Operator I			X
WT 130: Wastewater Treatment Operator I			X
WT 140: Water Distribution Systems		X	X
WT 150 Wastewater Collection Systems			X
WT 205: Computational Procedures Operator II			X
WT 210: Water Treatment Plant Operator II	X	X	X
WT 220: Computational Procedures Operator II			X
WT 230: Wastewater Treatment Operator II			X
LOS ANGELES TRADE TECHNICAL COLLEGE (LOS ANGELES)	**DWT**	**WSP**	**Suppl.**
Los Angeles Trade-Tech College, 400 W. Washington Blvd., Los Angeles, CA 90015 (213) 744-9058 Fax: (213) 748-7334 Website: http://www.lattc.edu			
Water 1: Modern Waterworks I		X	X
Water 2: Modern Waterworks II		X	X
Water 3: Water Systems Control			X
Water 4: Water Purification I (Potable)	X	X	X
Water 5: Water Purification II (Potable)	X	X	X
Water 8: Adv. Water Systems Control			X
Water 12: Wastewater Operations I			X
Water 13: Wastewater Operations II			X
Water 14: Wastewater Operations III			X
Water 15: Wastewater Operations IV			X
Water 16: Wastewater Operations V			X
Water 17: Wastewater Operations VI			X
Water 18: Water & Wastewater Math			X
Water 101: Intro. To Water Supply Technology		X	X
Water 102: Calculations and Measurements for Water			X
MENDOCINO COLLEGE (MENDOCINO)	**DWT**	**WSP**	**Suppl.**
Mendocino College, 1000 Hensley Creek Road, Ukiah, CA 95482 (707) 468-3102 Fax: (707) 468-3430 Website: http://www.mendocino.cc.ca.us			
40 Water Treatment Technology	X	X	X
MERCED COLLEGE (MERCED)	**DWT**	**WSP**	**Suppl.**
Merced College, 3600 M Street, Merced, CA 95348-2898 (209) 384-6000 Fax: (209) 384-6043 Website: http://www.merced.cc.ca.us			
WWT 60: Water Treatment Plant Operation	X	X	X
WWT 61: Introduction to Wastewater			X
WWT 62: WWT Calculations			X
WWT 63: Adv. Water Treatment Plant Operation	X	X	X
WWT 64: Advanced Wastewater Treatment			X
MESA COLLEGE (SAN DIEGO)	**DWT**	**WSP**	**Suppl.**
Mesa College, 7250 Mesa College Drive, San Diego, CA 92111-4998 (619) 388-2600 Fax: (619) 388-2929 Website: http://www.sandiegomesacollege.net			
W/WW Tech. 101: W/WW Fundamentals			X

W/WW Tech. 102: Calculations in Water Tech.			**X**

W/WW Tech. 104: Basic Hydraulics			X
W/WW Tech. 106: Intro. to Electrical & Instr. Process			X
W/WW Tech. 110: W/WW Lab Analysis			X
W/WW Tech. 112: Basic Plant Ops/Treatment	X	X	X
W/WW Tech. 114: Basic Plant Ops/Wastewater			X
W/WW Tech. 117: Advanced Plant Ops/Treatment	X	X	X
W/WW Tech. 120: Advanced Plant Ops/Wastewater			X
W/WW Tech. 130: Water Distribution Systems		X	X
W/WW Tech. 132: Wastewater Collection Systems			X
W/WW Tech. 134: Mechanical Maintenance			X
MT. SAN ANTONIO COLLEGE (WALNUT)	**DWT**	**WSP**	**Suppl.**
Mt. San Antonio College, 1100 N. Grand Avenue, Walnut, CA 91789 **(909) 594-5611 Fax: (909) 598-2303 Website: http://www.mtsac.edu**			
WATR 60: Intro. to Water Systems	X	X	X
WATR 61: Water Treatment	X	X	X
WATR 62: Water Distribution		X	X
WATR 63: Cross-Connection Control Tester			X
WATR 64: Cross-Connection Control Specialist			X
WATR 65: Wtr. Supply Hydraulics & Instrumentation			X
MT. SAN JACINTO COLLEGE (SAN JACINTO)	**DWT**	**WSP**	**Suppl.**
Mt. San Jacinto College, 1499 N. State Street, San Jacinto, CA 92583 **(909) 487-6752 Fax: (909) 654-6236 Website: http://www.msjc.cc.ca.us/**			
WATR 103 - Water Treatment Plant Operations I & II	X	X	X
WATR 105 - Water Treatment Plant Operations III, IV & V	X	X	X
WATR 107 - Water Distribution I & II		X	X
WATR 109 - Water Distribution III, IV & V		X	X
WATR 120 - Wastewater Treatment Plant Operations I & II			X
WATR 102 - Wastewater Treatment Plant Operations III, IV & V			X
WATR 125 - Laboratory Procedures for Water and Wastewater			X
MICHIGAN STATE UNIVERSITY			
Supervisory Management in the Water/Wastewater Field			X
CSU, NORTHRIDGE	**DWT**	**WSP**	**Suppl.**
HSCI 457: Water Supply & Sewage Disposal			X
OHLONE COLLEGE (FREMONT)	**DWT**	**WSP**	**Suppl.**
Ohlone College, 43600 Mission Blvd., Fremont, CA 94539-5884 **(510) 659-6000 Fax: (510) 659-6058 Website: http://www.ohlone.edu**			
ENGI-213 Water Distribution		X	X
PALOMAR COLLEGE (SAN MARCOS)	**DWT**	**WSP**	**Suppl.**
Palomar College, 1140 W. Mission Road, San Marcos, CA 92069-1487 **(760) 744-1150 Fax: (760) 744-8123 Website: http://www.palomar.edu/**			
WTE 100: WaterWorks Distribution		X	X
WTE 105: Water Treatment Plant Operation I	X	X	X
WTE 110: Waterworks Math			X
WTE 115: Water Analysis			X
WTE 120 or WTE56: Instrumentation and Control			X
WTE 125: WaterWorks Supervision			X
WTE 135: Backflow Prevention			X
WTE 140: Basic Hydraulics			X
WTE 150 or WTE64: Water Quality Monitoring			X
WTE 205: Water Distribution II		X	X
WTE 210: Water Treatment Plant Operation II	X	X	X
WTE 215: Motors and Pumps, Operation and Maintenance			X
WWT 100: Wastewater/Treatment Plant			X
WWT 110: Wastewater Math			X
WWT 150: Collection Systems Operator			X
WWT 155: WasteWater Treatment Process Control			X

WWT 220: Wastewater Monitoring			X
WWT 160: Biological Nutrient Removal AWT			X

SACRAMENTO CITY COLLEGE	DWT	WSP	Suppl.
Sacramento City College, 3835 Freeport Blvd, Sacramento CA 95822 (916) 558-2111 Website: http://www.scc.losrios.edu/			
CHEM 326 Water and Wastewater Treatment Chemistry			X
MET 353 Water Treatment Plant Calculations			X
MET 354 Wastewater Treatment Plant Calculations			X
MET 355 Water Treatment Plant O & M I	X	X	X
MET 356 Wastewater Treatment Plant O & M I			X
MET 365 Water Treatment Plant O & M II	X	X	X
MET 366 Wastewater Treatment Plant O & M II			X
MET 375 Water Treatment Plant O & M III	X	X	X
MET 376 Wastewater Treatment Plant O & M I			X
BIOL 444 Water and Wastewter Microbiology			X
SAN BERNARDINO VALLEY COLLEGE (SAN BERNARDINO)	**DWT**	**WSP**	**Suppl.**
San Bernardino Valley College, 701 S. Mt. Vernon Ave., San Bernardino, CA 92410 (909) 384-4400 Fax: (909) 381-4175 Website: http://www.valleycollege.net			
WST 031 Water Use Efficiency Practitioner I			X
WST 045 or WST 145 Backflow Prevention Devices			X
WST 048 Cross-Connection Control			X
WST 052 or WST 050 Water Technology Math			X
WST 061 Water Distribution I		X	X
WST 062 Water Distribution II		X	X
WST 063 Water Distribution III		X	X
WST 071 Water Treatment I	X	X	X
WST 072 Water Treatment II	X	X	X
WST 073 Water Treatment III	X	X	X
WST 074 Water / Wastewater Analysis			X
WST 081 Wastewater Collection I			X
WST 082 Wastewater Collection II			X
WST 091 or WST 146 Wastewater Treatment I			X
WST 092 or WST 147 Wastewater Treatment II			X
WST 093 Wastewater Treatment III			X
WST 140 or WSE 140: Water Utilities Distribution I		X	X
WST 141 or WSE 141: Water Utilities Distribution II		X	X
WST 142 or WSE 142: Water Qual. & Basic WT	X	X	X
WST 143 or WSE 143: Adv. Dom. Wtr.& Ind. Treat.	X	X	X
WST 144 or WSE 144: Cross Connection Control and Water Safety			X
SAN JOSE / EVERGREEN COMMUNITY COLLEGE	**DWT**	**WSP**	**Suppl.**
Workforce Institute, 600 S. Bascom Avenue, Suite T-101, San Jose, CA 95128 (408) 918-5100 Website: www.wi-sjeccd.edu			
Basic Water Distribution		X	X
Water Treatment and Supply	X	X	X
SAN JOSE STATE UNIVERSITY (SAN JOSE)	**DWT**	**WSP**	**Suppl.**
Website: http://www.sjsu.edu/			
CE 170 Environmental Engineering			X
CE 270 Water Quality Lab			X
CE 271 Water Treatment and Plant Design	X	X	X
WSE 146: Wastewater Treatment Operations I			X
~~SANTA ANA COLLEGE (SANTA ANA)~~	**DWT**	**WSP**	**Suppl.**
Santa Ana College no longer offers these courses			
WUS 50: Water Math and Hydraulics			X
WUS 60: Applied Hydraulics			X
WUS 90: Water Math and Hydraulics Review			X
WUS 101: Water Treatment Fundamentals	X	X	X
WUS 102: Adv. Water Treatment	X	X	X

WUS 103: Water Chemistry and Bacteriology			X
WUS 105: Telemetering & Instr. Principles			X
WUS 107: California Water Resources			X
WUS 108: Cross Connection Control Specialist			X
WUS 109: Distribution Systems		X	X
WUS 111: Intro. To Operation of Wastewater Treatment Plants			X
WUS 112: Adv. Operation of Wastewater Treatment Plants			X
WUS 117: Wastewater Management			X
WUS 204: Water Reclamation and Reuse			X
WUS 206: Water Quality and Cross Connection Control			X
WUS 208: Pumps and Pumping			X
WUS 210: Advanced Water Distribution		X	X
SANTA BARBARA CITY COLLEGE (SANTA BARBARA)	**DWT**	**WSP**	**Suppl.**
Santa Barbara City College, 721 Cliff Dr., Santa Barbara, CA 93109-2394 **(805) 965-0581 Fax: (805) 963-7222 Website: http://www.sbcc.net**			
WTRSC 22: Groundwater Production & Protection			X
WTRSC 100: Basic Wastewater Treatment			X
WTRSC 101: Water Distribution Systems		X	X
WTRSC 102: Water Systems Instru.			X
WTRSC 103: Pumps and Motors: Operation & Maintanance			X
WTRSC 104: Adv. Water Treatment	X	X	X
WTRSC 105: Water Chem. & Bact.			X
WTRSC 106: Groundwater Production & Protection			X
WTRSC 110: Basic Water Treatment	X	X	X
WTRSC 111: Wastewater Collection			X
WTRSC 112: Wtr. Quality Prot. & Cross-Connection			X
WTRSC 113: W/WW Hydraulics			X
WTRSC 114: Advanced Wastewater Treatment			X
WTRSC 116: W/WW Management			X
SANTA ROSA JUNIOR COLLEGE (SANTA ROSA)	**DWT**	**WSP**	**Suppl.**
Santa Rosa Junior College, 1501 Mendocino Avenue, Santa Rosa, CA 95401 **(707) 524-1535 Fax: (707) 527-4816 Website: http://www.santarosa.edu**			
WTR (ENVT) 110: Water Treatment Plant Operation	X	X	X
WTR (ENVT) 111: Water Distribution Operation		X	X
WTR 104: Chem Lab for Drinking Water Treatment Operators			X
WWTR 112: Wastewater Treatment Math			X
WWTR 120: Wastewater Treatment 1			X
WWTR 121: Wastewater Treatment 2			X
WWTR 122: Wastewater Chemistry			X
WWTR 123: Instrumentation and Controls			X
WWTR 124: Pumps			X
WWTR 125: Prereatment Facility Inspection			X
ENVT 220: Wastewater Operation			X
ENVT 300: Intro. to Environmental Tech.			X
ENVT 310: Water Treatment Plant Operation	X	X	X
ENVT 320: Wastewater Treatment Plant Operation			X
SANTIAGO CANYON COLLEGE (ORANGE)	**DWT**	**WSP**	**Suppl.**
Santiago Canyon College, 8045 E. Chapman Avenue, Orange, CA 92869-4512 **(714) 564-4000 Fax: (714) 564-4379 Website: http://www.sccollege.edu**			
WATR 50: Water Math and Hydraulics			X
WATR 60: Applied Hydraulics			X
WATR 90: Water Math and Hydraulics Review			X
WATR 101: Water Treatment Fundamentals	X	X	X
WATR 102: Adv. Water Treatment	X	X	X
WATR 103: Water Chemistry and Bacteriology			X
WATR 104: Elec/Circ			X
WATR 105: Telemetering & Instr. Principles			X

WATR 107: California Water Resources			X
WATR 108: Cross Connection Control Specialist			X
WATR 109: Distribution Systems		X	X
WATR 111: Intro. To Operation of Wastewater Treatment Plants			X
WATR 112: Adv. Operation of Wastewater Treatment Plants			X
WATR 117: Wastewater Management			X
WATR 204: Water Reclamation & Reuse			X
WATR 206: Water Quality and Cross Connection Control			X
WATR 208: Pumps and Pumping			X
WATR 210: Advanced Water Distribution		X	X
AMM-047 Maint. Mech App I Level 7	X	X	X
AMM-047 Maint. Mech App II Level 7	X	X	X
SHASTA COLLEGE (REDDING)	**DWT**	**WSP**	**Suppl.**
Shasta College, P O Box 496006, Redding, CA 96049-6006 (530) 225-4600 **Fax: (530) 225-4990 Website: http://www.shastacollege.edu**			
180: Intro. to Water Treatment	X	X	X
181: Intermediate Water Treatment	X	X	X
184: Small Water Systems and Distribution	X	X	X
177: Intro. to Wastewater Treatment			X
183: Interm. Wastewater Treatment			X
186: Advanced Wastewater Treatment			X
SOLANO COMMUNITY COLLEGE (SUISUN)	**DWT**	**WSP**	**Suppl.**
Solano Community College, 4000 Suisun Valley Road, Fairfield, CA 94534-4017 **(707) 864-7000 Fax: (707) 864-7213 Website: http://www.solano.edu**			
Water 100: Intro. to Wastewater Treatment			X
Water 102: Sanitary Chemistry			X
Water 104: Intro. to Water Supply & Treatment	X	X	X
Water 105: Wastewater Treatment			X
Water 106: Instruments and Control			X
Water 107: Math for W/WW Treatment			X
UC DAVIS (DAVIS)	**DWT**	**WSP**	**Suppl.**
Evaluation and Design of Small Water Systems	X	X	X
VENTURA COLLEGE (VENTURA)	**DWT**	**WSP**	**Suppl.**
Ventura College, 4667 Telegraph Road, Ventura, CA 93003 **(805) 654-6400 Fax: (805) 654-6466 Website: http://www.venturacollege.edu/**			
WS 10: Basic Water/Wastewater Systems			X
WS 11: Water Treatment	X	X	X
WS 12: Wastewater Treatment			X
WS 13: Wastewater Collection			X
WS 14: Water Distribution		X	X
WS 15: Water Sys. Instrumental & Control			X
WS 16: Water Quality Protection/Cross-Connection Cntrl			X
WS 17: Water/Wastewater Protection			X
WS 18: Motors/Pumps O&M			X
WS V 19: Water Treatment Advanced	X	X	X
WS 21: Water Chemistry & Bacteriology			X
WS 25: W/WW Management			X
WATER OPERATOR'S ASSOCIATION	**DWT**	**WSP**	**Suppl.**
WDI - Source to Tap			X
YUBA COLLEGE	**DWT**	**WSP**	**Suppl.**
Yuba Community College District, 2088 North Beale Road, Marysville, CA 95901 **(530)-741-6700 Website: http://yc.yccd.edu/**			
ENVTC-20: Water Distribution System O & M		X	X
ENVTC-21: Water Treatment Plant Operation	X	X	X
ENVTC-23: Water Treatment Plant Operation Level II	X	X	X
ENVTC-25: WasteWater Treatment Plant Operation Level II			X

ATTACHMENT 7

Ownership

2628580

State of California

SECRETARY OF STATE

I, *Kevin Shelley*, Secretary of State of the State of California, hereby certify:

That the attached transcript of 7 page(s) has been compared with the record on file in this office, of which it purports to be a copy, and that it is full, true and correct.

IN WITNESS WHEREOF, I execute this certificate and affix the Great Seal of the State of California this day of

OCT 1 2 2004

Kevin Shelley

Secretary of State

THE GREAT SEAL OF THE STATE OF CALIFORNIA

EUREKA

OFFICE OF THE SECRETARY OF STATE

Sec/State Form CE-107 (rev. 1/03)

OSP 03 80510

2628580

ARTICLES OF INCORPORATION
OF
REDWOOD GLEN

ONE: The name of this corporation is REDWOOD GLEN.

TWO: This corporation is a religious corporation and is not organized for the private gain of any person. It is organized under the Nonprofit Religious Corporation Law exclusively for religious purposes. The specific purpose for which this corporation is organized is:

> To transform individuals and communities, locally and globally, by providing varied opportunities to study, experience, and know creation and Creator.

THREE: The name and address in the State of California of this corporation's initial agent for service of process is:

> Jay Nordgaard, 100 Wright Drive, Loma Mar CA 94021.

FOUR: (a) This corporation is organized and operated exclusively for religious purposes within the meaning of Section 501(c)(3) of the Internal Revenue Code of 1986 or the corresponding provision of any future federal tax code.

(b) Notwithstanding any other provision of these Articles, the corporation shall not carry on any other activities not permitted to be carried on (1) by a corporation exempt from federal income tax under Section 501(c)(3) of the Internal Revenue Code of 1986 or the corresponding provision of any future federal tax code, or (2) by a corporation contributions to which are deductible under Section 170(c)(2) of the Internal Revenue Code of 1986 or the corresponding provision of any future federal tax code.

(c) No substantial part of the activities of this corporation shall consist of carrying on propaganda, or otherwise attempting to influence legislation, and the corporation shall not participate or intervene in any political campaign (including the publishing or distribution of statements) on behalf of, or in opposition to, any candidate for public office.

FIVE: The name and address of the person appointed to act as the initial Director of this corporation is:

Melissa Bowman, 100 Wright Drive, Loma Mar CA 94021.

SIX: (a) The property of this corporation is irrevocably dedicated to religious purposes meeting the requirements for exemption provided by Section 207 of the California Revenue and Taxation Code, and no part of the net income or assets of the organization shall ever inure to the benefit of any Director, officer or member thereof, or to the benefit of any private person.

(b) Upon the dissolution or winding up of the corporation, its assets remaining after payment of, or provision for payment of, all debts and liabilities of this corporation, shall be distributed to a nonprofit fund, foundation or corporation which is organized and operated exclusively for religious purposes meeting the requirements for exemption provided by Section 207 of the California Revenue and Taxation Code and which has established its tax-exempt status under Section 501(c)(3) of the Internal Revenue Code of 1986 or the corresponding provision of any future federal tax code.

Date: October 5, 2004

Melissa Bowman

Melissa Bowman, Director

We, the above-mentioned initial Directors of this corporation, hereby declare that we are the persons who executed the foregoing Articles of Incorporation, which execution is our act and deed.

Melissa Bowman

Melissa Bowman, Director

OFFICE OF THE SECRETARY OF STATE

BYLAWS

OF

REDWOOD GLEN

A California Religious Corporation

ARTICLE 1
OFFICES

SECTION 1.1 PRINCIPAL OFFICE

The principal office of the corporation for the transaction of its business is located in San Mateo County, California.

SECTION 1.2 CHANGE OF ADDRESS

The county of the corporation's principal office can be changed only by amendment of these Bylaws and not otherwise.

SECTION 1.3 OTHER OFFICES

The corporation may also have offices at such other places, within or without the State of California, where it is qualified to do business, as its business may require and as the Board of Directors may, from time to time, designate.

ARTICLE 2
PURPOSES

SECTION 2.1 OBJECTIVES AND PURPOSES

The primary objectives and purposes of this corporation shall be:

To transform individuals and communities, locally and globally, by providing varied opportunities to study, experience, and know creation and Creator.

ARTICLE 3
DIRECTORS

SECTION 3.1 NUMBER

The corporation shall have no fewer than seven (7) and no more than twelve (12) directors, with the exact number to be fixed within these limits by approval of the Board of Directors in the manner provided in these Bylaws, and collectively they shall be known as the Board of Directors. The above numbers may be changed by amendment of this Bylaw, or by repeal of this Bylaw and adoption of a new Bylaw, as provided in these Bylaws.

No less than seven (7) directors must be active members in American Baptist Churches. The Executive Director of the corporation shall also serve as President of the Board of Directors. The President, Chair, Vice Chair, Secretary and Treasurer of the Board shall all be voting members of the Board of Directors.

SECTION 3.2 POWERS

Subject to the provisions of the California Nonprofit Religious Corporation Law, the activities and affairs of this corporation shall be conducted and all corporate powers shall be exercised by or under the direction of the Board of Directors.

SECTION 3.3 DUTIES

It shall be the duty of the directors to:

(a) Perform any and all duties imposed on them collectively or individually by law, by the Articles of Incorporation of this corporation, or by these Bylaws;

(b) Appoint and remove, employ and discharge, and, except as otherwise provided in these Bylaws, prescribe the duties and fix the compensation, of all officers of the corporation;

(c) Supervise all officers of the corporation to assure that their duties are performed properly;

(d) Meet at such times and places as required by these Bylaws;

(e) Register their addresses with the Secretary of the corporation and notices of meetings mailed or e-mailed to them at such addresses shall be valid notices thereof.

SECTION 3.4 TERMS OF OFFICE/TERM LIMITS

Each director shall hold office for a period of three (3) years, until the next annual meeting for election of the Board of Directors corresponding to the completion of each director's term, as specified in these Bylaws, and until his or her successor is elected and qualifies.

Furthermore, each director may hold office for no more than two (2) consecutive 3-year terms (6 years total), after which they must remain off the Board of Directors for at least one (1) year.

Because the Executive Director shall also serve as President of the corporation (See Section 3.1), there shall be no limits imposed on his/her term other than the length of his/her employment as Executive Director. In other words, as long as he/she is employed as Executive Director of the corporation, he/she shall also serve as President of the Board.

SECTION 3.5 COMPENSATION

Directors shall serve without compensation except that they shall be allowed and paid their actual and necessary expenses incurred in attending directors' meetings. In addition, they shall be allowed reasonable advancement or reimbursement of expenses incurred in the performance of their regular duties as specified in Section 3.3 of this Article.

SECTION 3.6 PLACE OF MEETINGS

Meetings shall be held at the principal office of the corporation unless otherwise provided by the Board or at such place within or without the State of California which has been designated from time to time by resolution of the Board of Directors. In the absence of such designation, any meeting not held at the principal office of the corporation shall be valid only if held on the written consent of all directors given either before or after the meeting and filed with the Secretary of the corporation or after all Board members have been given written notice of the meeting as hereinafter provided for special meetings of the Board. Any meeting, regular or special, may be held by conference telephone or similar communications equipment, so long as all directors participating in such meeting can hear one another.

SECTION 3.7 REGULAR AND ANNUAL MEETINGS/ELECTION OF DIRECTORS

Meetings of directors shall be held at least three (3) times per year, as follows: during the first quarter; during the second or third quarters; and during the third or fourth quarters of each fiscal year. Sufficient and proper notice as to the exact date, time and location of each meeting shall be given to all directors (as mentioned in Section 3.9, below).

At the annual meeting of directors held during the first quarter of each fiscal year, directors shall be elected by the Board of Directors in accordance with this Section. Cumulative voting by directors for the election of directors (which allocates to each voting director as many votes as there are candidates and permits the director to cast these votes for one person) shall not be permitted. The candidates receiving the highest number of votes shall be elected. Each director shall cast one vote, with voting being by ballot only.

SECTION 3.8 SPECIAL MEETINGS

Special meetings of the Board of Directors may be called by the Chair-person of the Board, the President, the Vice President, the Secretary, or by any two directors, and such meetings shall be held at the place, within or without the State of California, designated by the person or persons calling the meeting, and in the absence of such designation, at the principal office of the corporation.

SECTION 3.9 NOTICE OF MEETINGS

Meetings of the Board shall be held upon four (4) days' notice by first-class mail or forty-eight (48) hours' notice delivered personally or by telephone, telecopier (fax) or other electronic means such as e-mail. Such notices shall be addressed to each director at his or her address as shown on the books of the corporation. Notice of the time and place of holding an adjourned meeting need not be given to absent directors if the time and place of the adjourned meeting are fixed at the meeting adjourned and if such adjourned meeting is held no more than twenty four (24) hours from the time of the original meeting. Notice shall be given of any adjourned regular or special meeting to directors absent from the original meeting if the adjourned meeting is held more than twenty-four (24) hours from the time of the original meeting.

SECTION 3.10 CONTENTS OF NOTICE

Notice of meetings not herein dispensed with shall specify the place, day and hour of the meeting. The purpose of any Board meeting need not be specified in the notice.

SECTION 3.11 WAIVER OF NOTICE AND CONSENT TO HOLDING MEETINGS

The transactions of any meeting of the Board, however called and noticed or wherever held, are as valid as though the meeting had been duly held after proper call and notice, provided a quorum, as hereinafter defined, is present and provided that either before or after the meeting each director not present signs a waiver of notice, a consent to holding the meeting, or an approval of the minutes thereof. All such waivers, consents, or approvals shall be filed with the corporate records or made a part of the minutes of the meeting.

SECTION 3.12 QUORUM FOR MEETINGS

A quorum shall consist of a majority of the Board of Directors.

Except as otherwise provided in these Bylaws or in the Articles of Incorporation of this corporation, or by law, no business shall be considered by the Board at any meeting at which a quorum, as hereinbefore defined, is not present, and the only motion which the Chair shall entertain at such meeting is a motion to adjourn. However, a majority of the directors present at such meeting may adjourn from time to time until the time fixed for the next regular meeting of the Board.

When a meeting is adjourned for lack of a quorum, it shall not be necessary to give any notice of the time and place of the adjourned meeting or of the business to be transacted at such meeting, other than by announcement at the meeting at which the adjournment is taken, except as provided in Section 3.9 of this Article.

The directors present at a duly called and held meeting at which a quorum is initially present may continue to do business notwithstanding the loss of a quorum at the meeting due to a withdrawal of directors from the meeting, provided that any action thereafter taken must be approved by at least a majority of the required quorum for such meeting or such greater percentage as may be required by law, or the Articles of Incorporation or Bylaws of this corporation.

SECTION 3.13 MAJORITY ACTION AS BOARD ACTION

Every act or decision done or made by a majority of the directors present at a meeting duly held at which a quorum is present is the act of the Board of Directors, unless the Articles of Incorporation or Bylaws of this corporation, or provisions of the California Nonprofit Religious Corporation Law, particularly those provisions relating to appointment of committees (Section 9212), approval of contracts or transactions in which a director has a material financial interest (Section 9243) and indemnification of directors (Section 9246e), require a greater percentage or different voting rules for approval of a matter by the Board.

SECTION 3.14 CONDUCT OF MEETINGS

Meetings of the Board of Directors shall be presided over by the Chair-person of the Board, or, if no such person has been so designated or, in his or her absence, by the Vice Chair of the corporation or, in his or her absence, by the President of the corporation or, in the absence of each of these persons, by a Chair-person chosen by a majority of the directors present at the meeting. The Secretary of the corporation shall act as secretary of all meetings of the Board, provided that, in his or her absence, the presiding officer shall appoint another person to act as secretary of the meeting.

Meetings shall be governed by such rules as the Board of Directors may from time to time establish or adopt, insofar as such rules are not inconsistent with or in conflict with these Bylaws, with the Articles of Incorporation of this corporation, or with provisions of law.

SECTION 3.15 ACTION BY UNANIMOUS WRITTEN CONSENT WITHOUT MEETING

Any action required or permitted to be taken by the Board of Directors under any provision of law may be taken without a meeting, if all members of the Board shall individually or collectively consent in writing to such action. Such written consent or consents shall be filed with the minutes of the proceedings of the Board. Such action by written consent shall have the same force and effect as the unanimous vote of the directors. Any certificate or other document filed under any provision of law which relates to action so taken shall state that the action was taken by unanimous written consent of the Board of Directors without a meeting and that the Bylaws of this corporation authorize the directors to so act, and such statement shall be prima facie evidence of such authority.

SECTION 3.16 VACANCIES

Vacancies on the Board of Directors shall exist (1) on the death, resignation or removal of any director, and (2) whenever the number of authorized directors is increased.

The Board of Directors may declare vacant the office of a director who has been declared of unsound mind by a final order of court, or convicted of a felony, or has been removed from office by order of the Superior Court for engaging in fraudulent acts pursuant to Section 9233 of the California Nonprofit Religious Corporation Law.

Any director may resign effective upon giving written notice to the Chair-person of the Board, the President, the Secretary, or the Board of Directors, unless the notice specifies a later time for the effectiveness of such resignation. No director may resign if the corporation would then be left without a duly elected director or directors in charge of its affairs.

Vacancies on the Board may be filled by approval of the Board or, if the number of directors then in office is less than a quorum, by (1) the unanimous written consent of the directors then in office, (2) the affirmative vote of a majority of the directors then in office at a meeting held pursuant to notice or waiver of notice complying with this Article of these Bylaws, or (3) a sole remaining director.

A person elected to fill a vacancy as provided by this Section shall hold office until the next annual election of the Board of Directors or until his or her death, resignation or removal from office.

SECTION 3.17 NON-LIABILITY OF DIRECTORS

The directors shall not be personally liable for the debts, liabilities, or other obligations of the corporation.

SECTION 3.18 INDEMNIFICATION BY CORPORATION OF DIRECTORS, OFFICERS, EMPLOYEES AND OTHER AGENTS

To the extent that a person who is, or was, a director, officer, employee or other agent of this corporation has been successful on the merits in defense of any civil, criminal, administrative or investigative proceeding brought to procure a judgment against such person by reason of the fact that he or she is, or was, an agent of the corporation, or has been successful in defense of any claim, issue or matter, therein, such person shall be indemnified against expenses actually and reasonably incurred by the person in connection with such proceeding.

If such person either settles any such claim or sustains a judgment against him or her, then indemnification against expenses, judgments, fines, settlements and other amounts reasonably incurred in connection with such proceedings shall be provided by this corporation but only to the extent allowed by, and in accordance with the requirements of, Section 9246 of the California Nonprofit Religious Corporation Law.

SECTION 3.19 INSURANCE FOR CORPORATE AGENTS

The Board of Directors may adopt a resolution authorizing the purchase and maintenance of insurance on behalf of any agent of the corporation (including a director, officer, employee or other agent of the corporation) against any liability other than for violating provisions of law relating to self-dealing (Section 9243 of the California Nonprofit Religious Corporation Law) asserted against or incurred by the agent in such capacity or arising out of the agent's status as such, whether or not the corporation would have the power to indemnify the agent against such liability under the provisions of Section 9246 of the California Nonprofit Religious Corporation Law.

ARTICLE 4
OFFICERS

SECTION 4.1 NUMBER OF OFFICERS

The officers of the corporation shall be a President, a Secretary, a Chief Financial Officer, who shall be designated the Treasurer, and a Chair and Vice Chair. The corporation may also have, as determined by the Board of Directors, one or more Vice Presidents, Assistant Secretaries, Assistant Treasurers, or other officers. Any number of offices may be held by the same person except that neither the Secretary nor the Treasurer may serve as the President or Chair-person of the Board.

SECTION 4.2 QUALIFICATION, ELECTION, AND TERM OF OFFICE

Any person may serve as officer of this corporation. Officers shall be elected by the Board of Directors, at any time, and each officer shall hold office until he or she resigns or is removed or is otherwise disqualified to serve, or until his or her successor shall be elected and qualified, whichever occurs first.

SECTION 4.3 SUBORDINATE OFFICERS

The Board of Directors may appoint such other officers or agents as it may deem desirable, and such officers shall serve such terms, have such authority, and perform such duties as may be prescribed from time to time by the Board of Directors.

SECTION 4.4 REMOVAL AND RESIGNATION

Any officer may be removed, either with or without cause, by the Board of Directors, at any time. Any officer may resign at any time by giving written notice to the Board of Directors or to the President or Secretary of the corporation. Any such resignation shall take effect at the date of receipt of such notice or at any later date specified therein, and, unless otherwise specified therein, the acceptance of such resignation shall not be necessary to make it effective. The above provisions of this Section shall be superseded by any conflicting terms of a contract which has been approved or ratified by the Board of Directors relating to the employment of any officer of the corporation.

SECTION 4.5 VACANCIES

Any vacancy caused by the death, resignation, removal, disqualification, or otherwise, of any officer shall be filled by the Board of Directors. In the event of a vacancy in any office other than that of President, such vacancy may be filled temporarily by appointment by the President until such time as the Board shall fill the vacancy. Vacancies occurring in offices of officers appointed at the discretion of the Board may or may not be filled as the Board shall determine.

SECTION 4.6 DUTIES OF PRESIDENT

The President shall be the chief executive officer of the corporation and shall, subject to the control of the Board of Directors, supervise and control the affairs of the corporation and the activities of the officers. He or she shall perform all duties incident to his or her office and such other duties as may be required by law, by the Articles of Incorporation of this corporation, or by these Bylaws, or which may be prescribed from time to time by the Board of Directors. Unless another person is specifically appointed as Chair-person of the Board of Directors, he or she shall preside at all meetings of the Board of Directors. Except as otherwise expressly provided by law, by the Articles of Incorporation, by these Bylaws, or by resolution of the Board of Directors, he or she shall, in the name of the corporation, execute such deeds, mortgages, bonds, contracts, checks, or other instruments which may from time to time be authorized by the Board of Directors.

Additionally, as described in Section 3.1 of these Bylaws, the President of the Board of Directors shall also serve as Executive Director of the corporation. As Executive Director, he/she shall appoint and remove, employ and discharge, and, except as otherwise provided in these Bylaws, prescribe the duties and fix the compensation, if any, of all agents and employees of the corporation, and supervise all agents and employees of the corporation to assure that their duties are performed properly;

SECTION 4.7 DUTIES OF CHAIR

In the absence of the President, or in the event of his or her inability or refusal to act, the Chair shall perform all the duties of the President, and when so acting shall have all the powers of, and be subject to all the restrictions on, the President. The Chair shall have other powers and perform such other duties as may be prescribed by law, by the Articles of Incorporation, or by these Bylaws, or as may be prescribed by the Board of Directors.

SECTION 4.8 DUTIES OF SECRETARY

The Secretary shall:

Certify and keep at the principal office of the corporation the original, or a copy, of these Bylaws as amended or otherwise altered to date.

Keep at the principal office of the corporation or at such other place as the Board may determine, a book of minutes of all meetings of the directors, and, if applicable, meetings of committees of directors, recording therein the time and place of holding, whether regular or special, how called, how notice thereof was given, the names of those present or represented at the meeting, and the proceedings thereof.

See that all notices are duly given in accordance with the provisions of these Bylaws or as required by law.

Be custodian of the records and of the seal of the corporation and see that the seal is affixed to all duly executed documents, the execution of which on behalf of the corporation under its seal is authorized by law or these Bylaws.

Exhibit at all reasonable times to any director of the corporation, or to his or her agent or attorney, on request therefor, the Bylaws and the minutes of the proceedings of the directors of the corporation.

In general, perform all duties incident to the office of Secretary and such other duties as may be required by law, by the Articles of Incorporation of this corporation, or by these Bylaws, or which may be assigned to him or her from time to time by the Board of Directors.

SECTION 4.9 DUTIES OF TREASURER

Subject to the provisions of these Bylaws relating to the “Execution of Instruments, Deposits and Funds,” the Treasurer shall:

Have charge and custody of, and be responsible for, all funds and securities of the corporation, and deposit all such funds in the name of the corporation in such banks, trust companies, or other depositories as shall be selected by the Board of Directors.

Receive, and give receipt for, monies due and payable to the corporation from any source whatsoever.

Disburse, or cause to be disbursed, the funds of the corporation as may be directed by the Board of Directors, taking proper vouchers for such disbursements.

Keep and maintain adequate and correct accounts of the corporation's properties and business transactions, including accounts of its assets, liabilities, receipts, disbursements, gains and losses.

Exhibit at all reasonable times the books of account and financial records to any director of the corporation, or to his or her agent or attorney, on request therefor.

Render to the President and directors, whenever requested, an account of any or all of his or her transactions as Treasurer and of the financial condition of the corporation.

Prepare, or cause to be prepared, and certify, or cause to be certified, the financial statements to be included in any required reports.

In general, perform all duties incident to the office of Treasurer and such other duties as may be required by law, by the Articles of Incorporation of this corporation, or by these Bylaws, or which may be assigned to him or her from time to time by the Board of Directors.

SECTION 4.10 COMPENSATION

The salaries of the officers, if any, shall be fixed from time to time by resolution of the Board of Directors, and no officer shall be prevented from receiving such salary by reason of the fact that he or she is also a director of the corporation. In all cases, any salaries received by officers of this corporation shall be reasonable and given in return for services actually rendered the corporation which relate to the performance of the religious purposes of this corporation.

ARTICLE 5
COMMITTEES

SECTION 5.1 EXECUTIVE COMMITTEE

The Board of Directors may, by a majority vote of directors, designate two (2) or more of its members (who may also be serving as officers of this corporation) to constitute an Executive Committee and delegate to such Committee any of the powers and authority of the Board in the management of the business and affairs of the corporation, except with respect to:

(a) The filling of vacancies on the Board or on any committee which has the authority of the Board.

(b) The fixing of compensation of the directors for serving on the Board or on any committee.

(c) The amendment or repeal of Bylaws or the adoption of new Bylaws.

(d) The amendment or repeal of any resolution of the Board which by its express terms is not so amendable or repealable.

(e) The appointment of committees of the Board or the members thereof.

By a majority vote of its members then in office, the Board may at any time revoke or modify any or all of the authority so delegated, increase or decrease but not below two (2) the number of its members, and fill vacancies therein from the members of the Board. The Committee shall keep regular minutes of its proceedings, cause them to be filed with the corporate records, and report the same to the Board from time to time as the Board may require.

SECTION 5.2 OTHER COMMITTEES

The corporation shall have such other committees as may from time to time be designated by resolution of the Board of Directors. Such other committees may consist of persons who are not also members of the Board. These additional committees shall act in an advisory capacity only to the Board and shall be clearly titled as "advisory" committees.

SECTION 5.3 MEETINGS AND ACTION OF COMMITTEES

Meetings and action of committees shall be governed by, noticed, held and taken in accordance with the provisions of these Bylaws concerning meetings of the Board of Directors, with such changes in the context of such Bylaw provisions as are necessary to substitute the committee and its members for the Board of Directors and its members, except that the time for regular meetings of committees may be fixed by resolution of the Board of Directors or by the committee. The time for special meetings of committees may also be fixed by the Board of Directors. The Board of Directors may also adopt rules and regulations pertaining to the conduct of meetings of committees to the extent that such rules and regulations are not inconsistent with the provisions of these Bylaws.

ARTICLE 6
EXECUTION OF INSTRUMENTS, DEPOSITS AND FUNDS

SECTION 6.1 EXECUTION OF INSTRUMENTS

The Board of Directors, except as otherwise provided in these Bylaws, may by resolution authorize any officer or agent of the corporation to enter into any contract or execute and deliver any instrument in the name of and on behalf of the corporation, and such authority may be general or confined to specific instances. Unless so authorized, no officer, agent, or employee shall have any power or authority to bind the corporation by any contract or engagement or to pledge its credit or to render it liable monetarily for any purpose or in any amount.

SECTION 6.2 CHECKS AND NOTES

Except as otherwise specifically determined by resolution of the Board of Directors, or as otherwise required by law, checks, drafts, promissory notes, orders for the payment of money, and other evidence of indebtedness of the corporation shall be signed by any two (2) of the following officers or staff members: President, Secretary, Treasurer, Chair, Vice Chair, Director of Guest Services, Director of Maintenance, Director of Food Service, Director of Camp Programming, or bookkeeper.

SECTION 6.3 DEPOSITS

All funds of the corporation shall be deposited from time to time to the credit of the corporation in such banks, trust companies, or other depositories as the Board of Directors may select.

SECTION 6.4 GIFTS

The Board of Directors may accept on behalf of the corporation any contribution, gift, bequest, or devise for the religious purposes of this corporation.

ARTICLE 7
CORPORATE RECORDS, REPORTS AND SEAL

SECTION 7.1 MAINTENANCE OF CORPORATE RECORDS

The corporation shall keep at its principal office in the State of California:

(a) Minutes of all meetings of directors and committees of the Board, indicating the time and place of holding such meetings, whether regular or special, how called, the notice given, and the names of those present and the proceedings thereof;

(b) Adequate and correct books and records of account, including accounts of its properties and business transactions and accounts of its assets, liabilities, receipts, disbursements, gains and losses;

(c) A copy of the corporation's Articles of Incorporation and Bylaws as amended to date.

SECTION 7.2 CORPORATE SEAL

The Board of Directors may adopt, use, and at will alter, a corporate seal. Such seal shall be kept at the principal office of the corporation. Failure to affix the seal to corporate instruments, however, shall not affect the validity of any such instrument.

SECTION 7.3 DIRECTORS' INSPECTION RIGHTS

Every director shall have the absolute right at any reasonable time to inspect and copy all books, records and documents of every kind and to inspect the physical properties of the corporation.

SECTION 7.4 RIGHT TO COPY AND MAKE EXTRACTS

Any inspection under the provisions of this Article may be made in person or by agent or attorney and the right to inspection includes the right to copy and make extracts.

ARTICLE 8
FISCAL YEAR

SECTION 8.1 FISCAL YEAR OF THE CORPORATION

The fiscal year of the corporation shall begin on the first day of January and end on the last day of December in each year.

ARTICLE 9
AMENDMENT OF BYLAWS

SECTION 9.1 AMENDMENT

Subject to any provision of law applicable to the amendment of Bylaws of religious nonprofit corporations, these Bylaws, or any of them, may be altered, amended, or repealed and new Bylaws adopted by approval of the Board of Directors of this corporation.

ARTICLE 10
AMENDMENT OF ARTICLES

SECTION 10.1 AMENDMENT OF ARTICLES

Any amendment of the Articles of Incorporation may be adopted by approval of the Board of Directors.

ARTICLE 11
PROHIBITION AGAINST SHARING CORPORATE PROFITS AND ASSETS

SECTION 11.1 PROHIBITION AGAINST SHARING CORPORATE PROFITS AND ASSETS

No director, officer, employee, or other person connected with this corporation, or any private individual, shall receive at any time any of the net earnings or pecuniary profit from the operations of the corporation, provided, however, that this provision shall not prevent payment to any such person of reasonable compensation for services performed for the corporation in effecting any of its religious purposes, provided that such compensation is otherwise permitted by these Bylaws and is fixed by resolution of the Board of Directors; and no such person or persons shall be entitled to share in the distribution of, and shall not receive, any of the corporate assets on dissolution of the corporation. On such dissolution or winding up of the affairs of the corporation, whether voluntarily or involuntarily, the assets of the corporation, after all debts have been satisfied, shall be distributed as required by the Articles of Incorporation of this corporation and not otherwise.

ARTICLE 12
MEMBERS

SECTION 12.1 DETERMINATION OF MEMBERS

This corporation shall make no provision for members, however, pursuant to Section 9310(b)(1) of the Nonprofit Religious Corporation Law of the State of California, any action which would otherwise, under law or the provisions of the Articles of Incorporation or Bylaws of this corporation, require approval by a majority of all members or approval by the members, shall only require the approval of the Board of Directors.

WRITTEN CONSENT OF DIRECTORS ADOPTING BYLAWS

We, the undersigned, are all of the persons named as the initial directors in the Articles of Incorporation of REDWOOD GLEN, a California nonprofit corporation, and, pursuant to the authority granted to the directors by these Bylaws to take action by unanimous written consent without a meeting, consent to, and hereby do, adopt the foregoing Bylaws, consisting of 14 pages, as the Bylaws of this corporation.

Dated: December 8, 2004

____

Melissa Bowman, Director

CERTIFICATE

This is to certify that the foregoing is a true and correct copy of the Bylaws of the corporation named in the title thereto and that such Bylaws were duly adopted by the Board of Directors of said corporation on the date set forth above.

Dated:

____

Melissa Bowman, Secretary

RECORDING REQUESTED BY
First American Title Insurance Company
National Commercial Services

AND WHEN RECORDED MAIL TO:
Redwood Glen
100 Wright Drive
Loma Mar, CA 94021

WE HEREBY CERTIFY THIS TO BE A TRUE AND CORRECT COPY OF THE ORIGINAL RECORDED
ON: 1/7/05 INSTRUMENT # 2005-002710
COUNTY OF: San Mateo
FIRST AMERICAN TITLE COMPANY
BY: L Ingade

Space Above This Line for Recorder's Use Only

A.P.N.:

File No.: NCS-134352-SC (LT)

The Undersigned Grantor(s) Declare(s): DOCUMENTARY TRANSFER TAX **$1,980.00**; CITY TRANSFER TAX **$0.00**; SURVEY MONUMENT FEE $

[x] computed on the consideration or full value of property conveyed, OR
[ ] computed on the consideration or full value less value of liens and/or encumbrances remaining at time of sale,
[x] unincorporated area; [ ] City of , and

CORPORATION GRANT DEED

FOR A VALUABLE CONSIDERATION, receipt of which is hereby acknowledged, **American Baptist Churches of the West, a California corporation, formerly known as American Baptist Union of the San Francisco Bay Cities, a corporation, which acquired title as San Francisco Bay Cities Baptist Union, a corporation, as their interests appear of record, a California Corporation**

organized under the laws of the State of **California**

hereby GRANTS to **Redwood Glen, a California Non-Profit Corporation**

the following described property in the unincorporated area of , County of **San Mateo**, State of **California**:

PARCEL 1:

The Northeast Quarter (1/4) of Section 3, Township 8, South of Range 4 West, Mount Diablo Base and Meridian.

EXCEPTING THEREFROM all those certain parcels of land described as follows:

(1) Part of the Northwest Quarter (1/4) of the Northeast Quarter (1/4) of Section 3, Township 8 South, Range 4 West, Mount Diablo Base and Meridian, to-wit:

Beginning at the 1/2 section corner between Sections 3 and 34 and running East 5.00 chains; thence South 12.00 Chains; thence West 5.00 chains; thence North 12.00 chains to the place of beginning.

(2) All that certain real property as described in the grant deed executed by American Baptist churches of the West, a California corporation, to the County of San Mateo, a political subdivision of the State of California, dated November 15, 1974, which recorded March 7, 1975 in Book 6795 at page 658, Official Records, more particularly described as follows:

Mail Tax Statements To: **SAME AS ABOVE**

A portion of the Southeast 1/4 of Section 34-Township 7 South, Range 4 West and a portion of the Northeast 1/4 of Section 3, Township 8 South, Range 4 West, M.D.B. & M., more particularly described as follows:

Beginning at a point on the line dividing Section 3, Township 8 South, Range 4 West from Section 34 Township 7 South, Range 4 West, M.D.B. & M., at the Northeast corner of that certain 10-acre parcel described in deed from Gladys E. Helmann to American Baptist Church of the San Francisco Bay Cities, a corporation, recorded January 6, 1964 in Book 4620 of Official Records at page 682 (File No. 76192-W), Records of San Mateo County, California; thence from said point of beginning along the Northwesterly line of Parcel II as described in Deed from Mariana Blomquist to San Francisco Bay Cities Baptist Union, a corporation, recorded June 10, 1958 in Book 3406 of Official Records at page 388 (File No. 48346-Q), Records of San Mateo County, California, North 19 deg. 09' 08" East (called North 20 deg. 08' East in said last mentioned deed) 200 feet; thence leaving said line South 25 deg. 37' 42" East 206.60 feet to a point on said dividing line between Sections 3 and 34; thence South 0 deg. 58 52" East 252.63 feet; South 34 deg. 11' 08" East 247.84 feet; South 82 deg. 19' 22" East 298.91 feet and North 89 deg. 01' 08" East 314.20 feet to the Easterly line of said Section 3; thence along said Easterly line South 0 deg. 58' 52" East 200 feet; thence leaving said Easterly line South 89 deg. 01' 08" West 314.20 feet; North 84 deg. 37' 11" West 406.13 feet, North 34 deg. 11' 08" West 415.60 feet and North 0 deg. 58' 52" West 312.26 feet to the line dividing said Sections 3 and 34; thence along said dividing line North 89 deg. 01' 08" East 45 feet to the point of beginning.

APN: 084-071-26; 084-071-27 ptn; 084-071-100; 084-120-010 and 084-120-060

PARCEL TWO:

That portion of the Southeast quarter of the Southeast quarter of Section 34, Township 7 South, Range 4 West, M.D. B & M, bounded as follows:

On the North by the center line of Pescadero Creek as it meanders to the dividing line between Sections 34 and the Northeast quarter of Section 3;

On the Northwest by the Northeasterly prolongation of the line commencing at the point of beginning of the lands described in Parcel One of the Deed to Blomquist May 21, 1945 in Book 1175 of Official Records at page 340, and running from the last said point of beginning, North 20 degrees, 08 minutes, 20 seconds East a distance of 200 feet; to its intersection with the center line of Pescadero Creek as it presently exists;

On the Southwest by the second call of the lands conveyed to The County of San Mateo, a political subdivision of the State of California in the Deed recorded March 7, 1975 in Book 6795 at page 658, Official Records described as follows: "Thence leaving said line, South 25 degrees, 37 minutes, 42 seconds East a distance of 206.60 feet to a point on said dividing line between Sections 3 and 34.

APN: 084-071-027 ptn
JPN: 084-071-017 ptn

Should the Real Property conveyed hereby be sold within fifteen (15) years of the date of this Deed for purposes other than continuation or expansion of a Christian ministry, Grantee shall first recover from sale proceeds its cost of sale, the purchase price paid hereby as well as any other costs of the purchase, and the value of any capital improvements made to the Property during Grantee's ownership; after such recovery, remaining funds received from the sale shall go to Grantor, up to a maximum of $1,750,000. Funds in excess of this amount shall go to Grantee. If sold for the purpose fo continuation or expansion of a Christian ministry, then all funds shall go to Grantee.

Dated: 1/5/05

American Baptist Churches of the West, a California Corporation

Paul D. Borden

By: Paul D. Borden, Executive Minister

By: Pamela Breen, Regional Administrator

Should the Real Property conveyed hereby be sold within fifteen (15) years of the date of this Deed for purposes other than continuation or expansion of a Christian ministry, Grantee shall first recover from sale proceeds its cost of sale, the purchase price paid hereby as well as any other costs of the purchase, and the value of any capital improvements made to the Property during Grantee's ownership; after such recovery, remaining funds received from the sale shall go to Grantor, up to a maximum of $1,750,000. Funds in excess of this amount shall go to Grantee. If sold for the purpose fo continuation or expansion of a Christian ministry, then all funds shall go to Grantee.

Dated: ______________

American Baptist Churches of the West, a
California Corporation

____

By: Paul D. Borden, Executive Minister

Pamela Breen

By: Pamela Breen, Regional
Administrator

STATE OF California)SS
COUNTY OF Sacramento)

On January 5, 2005, before me, Robert A. Williams personally appeared Paul D. Borden, ~~personally known to me~~ (or proved to me on the basis of satisfactory evidence) to be the person(s) whose name(s) is/~~are~~ subscribed to the within instrument and acknowledged to me that he/s~~he/they~~ executed the same in his/~~her/their~~ authorized capacity(ies), and that by his/~~her/their~~ signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

WITNESS my hand and official seal.

This area for official notarial seal

ROBERT A. WILLIAMS
COMM. # 1381924
NOTARY PUBLIC-CALIFORNIA
SACRAMENTO COUNTY
COMM. EXP. OCT. 28, 2006

Signature [signature]

My Commission Expires: 10/28/06

Notary Name: Robert A. Williams Notary Phone: (916) 852-6390
Notary Registration Number: 1381924 County of Principal Place of Business: Sacramento

STATE OF California)SS
COUNTY OF Contra Costa)

On January 5, 2005, before me, Chris Loach, Notary Public personally appeared Pamela Breen, ~~personally known to~~ me (or proved to me on the basis of satisfactory evidence) to be the person~~(s)~~ whose name(s) is/~~are~~ subscribed to the within instrument and acknowledged to me that ~~he~~/she/~~they~~ executed the same in ~~his~~/her/~~their~~ authorized capacity(~~ies~~), and that by ~~his~~/her/~~their~~ signature~~(s)~~ on the instrument the person~~(s)~~, or the entity upon behalf of which the person~~(s)~~ acted, executed the instrument.

WITNESS my hand and official seal.

Signature Chris Loach

My Commission Expires: May 30, 2007

This area for official notarial seal

CHRIS LOACH
Commission # 1421012
Notary Public - California
Contra Costa County
My Comm. Expires May 30, 2007

Notary Name: Chris Loach Notary Phone: 925 855-4700
Notary Registration Number: 1421012 County of Principal Place of Business: Contra Costa

INTERNAL REVENUE SERVICE
P. O. BOX 2508
CINCINNATI, OH 45201

DEPARTMENT OF THE TREASURY

Date: FEB 17 2005

REDWOOD GLEN
100 WRIGHT DR
LOMA MAR, CA 94021-9718

Employer Identification Number:
20-1750321
DLN:
17053024002045
Contact Person:
DIANE M GENTRY ID# 31361
Contact Telephone Number:
(877) 829-5500
Accounting Period Ending:
DECEMBER 31
Public Charity Status:
170(b)(1)(A)(vi)
Form 990 Required:
YES
Effective Date of Exemption:
OCTOBER 12, 2004
Contribution Deductibility:
YES
Advance Ruling Ending Date:
DECEMBER 31, 2008

Dear Applicant:

We are pleased to inform you that upon review of your application for tax exempt status we have determined that you are exempt from Federal income tax under section 501(c)(3) of the Internal Revenue Code. Contributions to you are deductible under section 170 of the Code. You are also qualified to receive tax deductible bequests, devises, transfers or gifts under section 2055, 2106 or 2522 of the Code. Because this letter could help resolve any questions regarding your exempt status, you should keep it in your permanent records.

Organizations exempt under section 501(c)(3) of the Code are further classified as either public charities or private foundations. During your advance ruling period, you will be treated as a public charity. Your advance ruling period begins with the effective date of your exemption and ends with advance ruling ending date shown in the heading of the letter.

Shortly before the end of your advance ruling period, we will send you Form 8734, Support Schedule for Advance Ruling Period. You will have 90 days after the end of your advance ruling period to return the completed form. We will then notify you, in writing, about your public charity status.

Please see enclosed Information for Exempt Organizations Under Section 501(c)(3) for some helpful information about your responsibilities as an exempt organization.

REDWOOD GLEN

Sincerely,

Lois G. Lerner

Lois G. Lerner
Director, Exempt Organizations
Rulings and Agreements

Enclosures: Information for Organizations Exempt Under Section 501(c)(3)
Form 872-C

ATTACHMENT 8

Water Rights

ATTACHMENT 8A

Water Rights Documentation: Hoffman Creek

S010156

State of California
State Water Resources Control Board
DIVISION OF WATER RIGHTS
P.O. Box 2000, Sacramento, CA 95812-2000
Info: (916) 341-5300, FAX: (916) 341-5400, Web: http://www.waterrights.ca.gov

STATE WATER RESOURCES CONTROL BOARD
10 AUG 24 PM 1:49
DIV. OF WATER RIGHTS
SACRAMENTO

NOTICE OF ASSIGNMENT

State Water Resources Control Board
Division of Water Rights
P.O. Box 2000
Sacramento, CA 95812-2000

Gentlemen:

I have assigned all my right, title, and interest in

Statement Number **s010156** on file with the State Water Resources

Control Board to:

Redwood Glen

whose address is:

100 Wright Drive
(Street Address)
Loma Mar
(City)
CA **94021**
(State) (Zip code)

Telephone No. ( ) **650-879-0320**

Pamela Breen
(Printed Name)
Pamela Breen
(Signature)

Telephone No. (925) 277-3980

Dated: **August 19, 2010**

CM 10/27/10

STATEMENT-ASGN (4-10)

STATE WATER RESOURCES CONTROL BOARD
DIVISION OF WATER RIGHTS
P.O. Box 2000
Sacramento, CA 95812-2000

STATEMENT OF WATER DIVERSION AND USE INFORMATION SHEET

STATEMENT NO. S010156

DIVERSION SITE:

OWNER'S NAME AMERICAN BAPTIST CHURCHES OF THE WEST
(FIRST) (MIDDLE) (LAST)

PARCEL NO. 084-071-100; 260; 270
084-120-010; 060

PLACE OF USE:

OWNER'S NAME REDWOOD GLEN BAPTIST CAMP, ABCW
(FIRST) (MIDDLE) (LAST)

1. **PARCEL NO.** 084-071-100; 260; 270
2. **PARCEL NO.** 084-120-010; 060
3. **PARCEL NO.** ____________

PERSON OR FIRM TO RECEIVE ALL CORRESPONDENCE AND SUPPLEMENTAL STATEMENTS:

OWNER/LESSEE/AGENT/OTHER Agent

NAME Ray Miller
(FIRST) (MIDDLE) (LAST)

MAILING ADDRESS 1430 Wurr Road
Loma Mar CA 94021
(CITY) (STATE) (ZIP)

TELEPHONE NO. (415) 879 - 0320

OTHERS USING ABOVE DIVERSION LOCATION:

1. **NAME** ____________
(FIRST) (MIDDLE) (LAST)

MAILING ADDRESS ____________

(CITY) (STATE) (ZIP)

TELEPHONE NO. (____) ______ - ______

2. **NAME** ____________
(FIRST) (MIDDLE) (LAST)

MAILING ADDRESS ____________

(CITY) (STATE) (ZIP)

TELEPHONE NO. (____) ______ - ______

☐ ADDITIONAL INFORMATION CONTINUED ON BACK OF PAGE OR ATTACHED

PLEASE USE THE OTHER SIDE TO PROVIDE THE ABOVE INFORMATION FOR ADDITIONAL OWNERS OR PLACES OF USE AND CHECK THE ADDITIONAL INFORMATION BOX.

(1/95)

S-10156

** PLEASE COMPLETE, SUBMIT THE ORIGINAL AND MAKE A COPY FOR YOUR RECORDS ***

STATE WATER RESOURCES CONTROL BOARD
DIVISION OF WATER RIGHTS

P.O. BOX 2000 SACRAMENTO, CA 95812-2000

SUPPLEMENTAL STATEMENT OF WATER DIVERSION AND USE

STATEMENT NO: S010156
OWNER OF RECORD: AMERICAN BAPTIST CHURCHES OF THE WEST

1o RAY MILLER
1430 WURR ROAD
LOMA MAR, CA 94021

STATE WATER RESOURCES CONTROL BOARD
1995 APR 12 PM 1:18
DIV. OF WATER RIGHTS
SACRAMENTO

SOURCE: HOFFMAN CREEK
TRIBUTARY TO: PESCADERO CREEK
COUNTY: SAN MATEO
DIVERSION WITHIN: NW¼ OF NE¼ SECTION 3, T8S, R4W, MDB&M.

TELEPHONE NUMBER: (415) 879-0320
YEAR OF FIRST USE: 1964
PARCEL NO:

(If any of the above information is inaccurate or missing, please correct. Notify this office if ownership or address changes occur during the coming year.)

COMPLETE AND RETURN THIS FORM BY JULY 1, 1995.

A. Water is used under: Riparian claim X; Pre 1914 right ____; Other (explain) ____

B. Year of first use (Please provide if missing above) 1964.

C. Amount of Use - Enter the amount of water used each month. If monthly and annual use are not known, check the months in which water was used.

Amounts below are: ☐ Gallons ☒ Acre-feet ☐ (other) ____

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC	TOTAL ANNUAL
1992	X	X	X	X	X	X	X	X	X	X	X	X	
1993	X	X	X	X	X	X	X	X	X	X	X	X	
1994	X	X	X	X	X	X	X	X	X	X	X	X	

D. Purpose of Use - Specify number of acres irrigated, stock watered, persons served, etc.
Irrigation ____ acres; Stockwatering ____; Domestic 250 persons
Other (specify) served in lodges, residences and campgrounds.

*** CONTINUE ON BACK PAGE ***

***** PLEASE COMPLETE, SUBMIT THE ORIGINAL AND MAKE A COPY FOR YOUR RECORDS *****

E. Changes in Method of Diversion - Describe any changes in your project since your previous statement was filed. (New pump, enlarged diversion dam, location of diversion, etc.)

No changes

F. If part of the water listed in Part C consists of reclaimed or polluted water, please indicate the annual amounts of reclaimed or polluted water in the space below.

N/A

I declare under penalty of perjury that the information in this report is true to the best of my knowledge and belief.

DATED: April 10, 19 95, at Loma Mar, California

SIGNATURE: Ray Miller

PRINTED NAME: Ray (FIRST NAME) (M. NAME) Miller (LAST NAME)

COMPANY NAME: REDWOOD GLEN BAPTIST CAMP & CONFERENCE

GENERAL INFORMATION PERTAINING TO WATER RIGHTS IN CALIFORNIA

There are two principal types of surface water rights in California. They are riparian and appropriative rights.

A riparian right enables an owner of land bordering a natural lake or stream to take and use water on his riparian land. Riparian land must be in the same watershed as the water source and must never have been severed from the sources of supply by an intervening parcel without reservation of the riparian right to the severed parcel. Generally, a riparian water user must share the water supply with other riparian users. Riparian rights may be used to divert the natural flow of a stream but may not be used to store water for later use or to divert water which originates in a different watershed, or return flows from use of groundwater.

An appropriate right is required for use of water on nonriparian land and for storage of water. Generally, appropriative rights may be exercised only when there is a surplus not needed by riparian water users. Since 1914 new appropriators have been required to obtain a permit and license from the State.

Statements of Water Diversion and Use must be filed by riparian and pre-1914 appropriative water users. The filing of a statement (1) provides a record of water use, (2) enables the State to notify such users if someone proposes a new appropriation upstream from their diversion, and (3) assists the State to determine if additional water is available for future appropriators.

The above discussion is provided for general information. For more specific information concerning water rights, please contact an attorney or write to this office. We have several pamphlets available. They include:

"Statements of Water Diversion and Use"
"Information Pertaining to Water Rights in California"
"Water Rights for Stockponds Constructed Prior to 1969"
"Appropriation of Water in California"

STATE OF CALIFORNIA
STATE WATER RESOURCES CONTROL BOARD
Division of Water Rights

P.O. BOX 2000 SACRAMENTO, CA 95810
901 P ST. SACRAMENTO, CA
(916) 322-4503

(916) 324-5676
SUPPLEMENTAL STATEMENT OF WATER DIVERSION AND USE

1992 FEB -3 PM 3: 26
DIV. OF WATER RIGHTS
SACRAMENTO

DIVERTER OF RECORD: STATEMENT NO: 010156

AMERICAN BAPTIST CHURCHES OF THE WEST
C/O RAY MILLER
1430 WURR ROAD
LOMA MAR, CA 94021

TELEPHONE NUMBER:
(415) 879-0320

IF NAME/ADDRESS/PHONE NO. IS WRONG OR MISSING, PLEASE CORRECT.

SOURCE: HOFFMAN CREEK

TRIBUTARY TO: PESCADERO CREEK

COUNTY: SAN MATEO

DIVERSION
WITHIN: NW1/4 OF NE1/4 SECTION 03, T08S, R04W, MDB&M.

INSTRUCTIONS: Please complete Items A. B and C. Item D should be completed if you replaced all or part of your regular water supply with reclaimed or polluted water. RETURN THIS FORM BY JULY 1, 1992. (Additional information on reverse side of this form.)

A. Amount of Use - Fill in the amount of water used each month. If monthly and annual use are not known, check the months in which water was used.

Amounts below are: ☐ Gallons ☒ Acre-feet ☐ ________ (other)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total Annual
1989	X	X	X	X	X	X	X	X	X	X	X	X	8
1990	X	X	X	X	X	X	X	X	X	X	X	X	8
1991	X	X	X	X	X	X	X	X	X	X	X	X	8

B. Purpose of Use - Specify number of acres irrigated, stock watered, persons served, etc.

Irrigation ________

Stockwatering ________

Domestic 250 persons served in lodge, residences and campgrounds

Other (specify) ________

C. Changes in Method of Diversion - Describe any changes in your project since your previous statement was filed. (New pump, enlarged diversion dam, location of diversion, etc.)

No changes

D. If part of the water listed in Part A consists of reclaimed or polluted water, please indicate the annual amounts of reclaimed or polluted water in the space below.

I declare under penalty of perjury that the information in this report is true to the best of my knowledge and belief.

DATED: January 30, 19 92, at Loma Mar, California

Signature: Ray Miller

WR 40-1 (11/85)
0034

1991

STATE OF CALIFORNIA
STATE WATER RESOURCES CONTROL BOARD
Division of Water Rights

P.O. BOX 2000 SACRAMENTO, CA 95810
901 P ST. SACRAMENTO, CA
(916) 322-4503

OCT 21 '87 K.R.B.

(916) 324-5741

SUPPLEMENTAL STATEMENT OF WATER DIVERSION AND USE

DIVERTER OF RECORD: STATEMENT NO: 010156

AMERICAN BAPTIST CHURCHES OF THE WEST
C/O ~~XXXX XXXXXX~~ RAY MILLER
1430 WURR ROAD
LOMA MAR, CA ~~94020~~ 94021

TELEPHONE NUMBER:
(415) 879-0320

IF NAME/ADDRESS/PHONE NO. IS WRONG OR MISSING, PLEASE CORRECT.

SOURCE: HOFFMAN CREEK

TRIBUTARY TO: PESCADERO CREEK

COUNTY: SAN MATEO

DIVERSION
WITHIN: NW1/4 OF NE1/4 SECTION 03, T08S, R04W, MDB&M.

SACRAMENTO '87 OCT -5 PM 2:37

INSTRUCTIONS: Please complete Items A. B and C. Item D should be completed if you replaced all or part of your regular water supply with reclaimed or polluted water. RETURN THIS FORM BY JULY 1, 1986. (Additional information on reverse side of this form.)

A. Amount of Use - Fill in the amount of water used each month. If monthly and annual use are not known, check the months in which water was used.

Amounts below are: ☐ Gallons ☒ Acre-feet ☐ ________ (other)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total Annual
1983	X	X	X	X	X	X	X	X	X	X	X	X	8
1984	X	X	X	X	X	X	X	X	X	X	X	X	8
1985	X	X	X	X	X	X	X	X	X	X	X	X	8

B. Purpose of Use - Specify number of acres irrigated, stock watered, persons served, etc.

Irrigation ________

Stockwatering ________

Domestic 250 persons served in lodge, residences and campgrounds

Other (specify) ________

C. Changes in Method of Diversion - Describe any changes in your project since your previous statement was filed. (New pump, enlarged diversion dam, location of diversion, etc.)

no changes

D. If part of the water listed in Part A consists of reclaimed or polluted water, please indicate the annual amounts of reclaimed or polluted water in the space below.

I declare under penalty of perjury that the information in this report is true to the best of my knowledge and belief.

DATED: October 1, 19 87, at Loma Mar, California

Signature: Ray Miller

OCT 2 0 1987 SN 10.6.87

WR 40-I (11/85) 0034

1985

STATE OF CALIFORNIA

S10156

STATE WATER RESOURCES CONTROL BOARD
DIVISION OF WATER RIGHTS

STATE WATER RESOURCES CONTROL BOARD
DEC 12 4 15 PM '80
DIV. OF WATER RIGHTS SACRAMENTO

STATEMENT OF WATER DIVERSION AND USE

(This is not a Water Right)

This statement should be typewritten or legibly written in ink.

A. Name of person diverting water American Baptist Churches of the West
Address c/o Stanley S. Skeehan, 210-16th Ave. Santa Cruz CA 95060 Telephone: (415) 879-0320

B. Name of body of water at point of diversion Hoffman Creek
Tributary to Pescadero Creek

C. Place of diversion SW (N) 1/4 NE 1/4 Section 3, Township 8S, Range 4W, MD B&M,
San Mateo County, or locate it on sketch of section grid on reverse side with regard to section lines or prominent local landmarks.

D. Name of works none

E. Capacity of diversion works Estimated to be 4 (6) gpm — cubic feet per second / gallons per minute
Capacity of storage reservoir None — gallons / acre-feet
State quantity of water used each month in gallons or acre-feet

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total Annual
1980	X	X	X	X	X	X	X	X	X	X	X	X	4 ac-ft

If monthly and annual use are not known, check months in which water was used. State extent of use in units, such as acres of each crop irrigated, average number of persons served, number of stock watered, etc.
250 people served in lodges, residences and campgrounds

Maximum annual water use in recent years Estimated at 4 (8) ac-ft. — gallons / acre-feet
Minimum annual water use in recent years Estimated at 2 (4) ac-ft. — gallons / acre-feet
Type of diversion facility: gravity X, pump ___

Method of measurement: weir ___, flume ___, electric power meter ___, water meter ___, estimate X

F. Purpose of use (what water is being used for) Domestic use

G. General description or location of place of use (use sketch of section grid on reverse side if you desire)
Redwood Glen Camp

H. Year of first use as nearly as known 1964

I. Name of person filing statement Stanley S. Skeehan
Position Water Rights Consultant Organization Same
Address 210 16th Ave, S.C. Ca 95062 Telephone: 408 425-9318

I declare under penalty of perjury that the above is true and correct to the best of my knowledge and belief.
DATED: Dec. 10th, 1980, at Santa Cruz, California.

Signature: Stanley S. Skeehan, agent

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SWRCB 40 (7/77)

See Instructions on Reverse Side

3-703-01-00-0

ATTACHMENT 8B

Water Rights Documentation: Piney Creek

STATE OF CALIFORNIA
THE RESOURCES AGENCY
STATE WATER RESOURCES CONTROL BOARD
DIVISION OF WATER RIGHTS

License for Diversion and Use of Water

APPLICATION 24192 PERMIT 16745 LICENSE 11116

THIS IS TO CERTIFY, That AMERICAN BAPTIST CHURCHES OF THE WEST
268 GRAND AVENUE, OAKLAND, CALIF 94610

HAVE made proof as of OCTOBER 29, 1979 (the date of inspection)
to the satisfaction of the State Water Resources Control Board of a right to the use of the water of AN UNNAMED STREAM (AKA PIONEER CREEK) IN SAN MATEO COUNTY

tributary to PESCADERO CREEK

for the purpose of DOMESTIC USE
under Permit 16745 of the Board and that the right to the use of this water has been perfected in accordance with the laws of California, the Regulations of the Board and the permit terms; that the priority of this right dates from SEPTEMBER 27, 1972 and that the amount of water to which this right is entitled and hereby confirmed is limited to the amount actually beneficially used for the stated purposes and shall not exceed FORTY-TWO THOUSANDTHS (0.042) CUBIC FOOT PER SECOND, TO BE DIVERTED FROM JANUARY 1 TO DECEMBER 31 OF EACH YEAR. THE MAXIMUM AMOUNT DIVERTED UNDER THIS LICENSE SHALL NOT EXCEED 24 ACRE-FEET PER YEAR.

THE POINTS OF DIVERSION OF SUCH WATER ARE LOCATED:

(1) SOUTH 2,500 FEET AND EAST 200 FEET FROM NW CORNER OF SECTION 2, T8S, R4W, MDB&M, BEING WITHIN SW1/4 OF NW1/4 OF SAID SECTION 2 AND
(2) SOUTH 2,000 FEET AND EAST 350 FEET FROM NW CORNER OF SECTION 2, T8S, R4W, MDB&M, BEING WITHIN SW1/4 OF NW1/4 OF SAID SECTION 2.

A DESCRIPTION OF LANDS OR THE PLACE WHERE
SUCH WATER IS PUT TO BENEFICIAL USE IS AS FOLLOWS:

AT REDWOOD GLEN CAMP WITHIN N1/2 OF NE1/4 OF SECTION 3, T8S, R4W, MDB&M AND SE1/4 OF SE1/4 OF SECTION 34, T7S, R4W, MDB&M.

THE QUANTITY OF WATER DIVERTED UNDER THIS LICENSE IS SUBJECT TO MODIFICATION BY THE STATE WATER RESOURCES CONTROL BOARD, IF, AFTER NOTICE TO THE LICENSEE AND AN OPPORTUNITY FOR HEARING, THE BOARD FINDS THAT SUCH MODIFICATION IS NECESSARY TO MEET WATER QUALITY OBJECTIVES IN WATER QUALITY CONTROL PLANS WHICH HAVE BEEN OR HEREAFTER MAY BE ESTABLISHED OR MODIFIED PURSUANT TO DIVISION 7 OF THE WATER CODE. NO ACTION WILL BE TAKEN PURSUANT TO THIS PARAGRAPH UNLESS THE BOARD FINDS THAT (1) ADEQUATE WASTE DISCHARGE REQUIREMENTS HAVE BEEN PRESCRIBED AND ARE IN EFFECT WITH RESPECT TO ALL WASTE DISCHARGES WHICH HAVE ANY SUBSTANTIAL EFFECT UPON WATER QUALITY IN THE AREA INVOLVED, AND (2) THE WATER QUALITY OBJECTIVES CANNOT BE ACHIEVED SOLELY THROUGH THE CONTROL OF WASTE DISCHARGES.

Licensee shall allow representatives of the Board and other parties, as may be authorized from time to time by the Board, reasonable access to project works to determine compliance with the terms of this license.

Pursuant to California Water Code Section 100 all rights and privileges under this license, including method of diversion, method of use and quantity of water diverted are subject to the continuing authority of the Board in accordance with law and in the interest of the public welfare to prevent waste, unreasonable use, unreasonable method of use or unreasonable method of diversion of said water.

This continuing authority of the Board may be exercised by imposing specific requirements over and above those contained in this license with a view to minimizing waste of water and to meeting the reasonable water requirements of licensee without unreasonable draft on the source. Licensee may be required to implement such programs as (1) reusing or reclaiming the water allocated; (2) restricting diversions so as to eliminate agricultural tailwater or to reduce return flow; (3) suppressing evaporation losses from water surfaces; (4) controlling phreatophytic growth; and (5) installing, maintaining, and operating efficient water measuring devices to assure compliance with the quantity limitations of this license and to determine accurately water use as against reasonable water requirements for the authorized project. No action will be taken pursuant to this paragraph unless the Board determines, after notice to affected parties and opportunity for hearing, that such specific requirements are physically and financially feasible and are appropriate to the particular situation.

Reports shall be filed promptly by licensee on appropriate forms which will be provided for the purpose from time to time by the Board.

The right hereby confirmed to the diversion and use of water is restricted to the point or points of diversion herein specified and to the lands or place of use herein described.

This license is granted and licensee accepts all rights herein confirmed subject to the following provisions of the Water Code:

Section 1625. Each license shall be in such form and contain such terms as may be prescribed by the Board.

Section 1626. All licenses shall be under the terms and conditions of this division (of the Water Code).

Section 1627. A license shall be effective for such time as the water actually appropriated under it is used for a useful and beneficial purpose in conformity with this division (of the Water Code) but no longer.

Section 1628. Every license shall include the enumeration of conditions therein which in substance shall include all of the provisions of this article and the statement that any appropriator of water to whom a license is issued takes the license subject to the conditions therein expressed.

Section 1629. Every licensee, if he accepts a license does so under the conditions precedent that no value whatsoever in excess of the actual amount paid to the State therefor shall at any time be assigned to or claimed for any license granted or issued under the provisions of this division (of the Water Code), or for any rights granted or acquired under the provisions of this division (of the Water Code), in respect to the regulation by any competent public authority of the services or the price of the services to be rendered by any licensee or by the holder of any rights granted or acquired under the provisions of this division (of the Water Code) or in respect to any valuation for purposes of sale to or purchase, whether through condemnation proceedings or otherwise, by the State or any city, city and county, municipal water district, irrigation district, lighting district, or any political subdivision of the State, of the rights and property of any licensee, or the possessor of any rights granted, issued, or acquired under the provisions of this division (of the Water Code).

Section 1630. At any time after the expiration of twenty years after the granting of a license, the State or any city, city and county, municipal water district, irrigation district, lighting district, or any political subdivision of the State shall have the right to purchase the works and property occupied and used under the license and the works built or constructed for the enjoyment of the rights granted under the license.

Section 1631. In the event that the State, or any city, city and county, municipal water district, irrigation district, lighting district, or political subdivision of the State so desiring to purchase and the owner of the works and property cannot agree upon the purchase price, the price shall be determined in such manner as is now or may hereafter be provided by law for determining the value of property taken in eminent domain proceedings.

APRIL 29 1981

Dated:

STATE WATER RESOURCES CONTROL BOARD

Raymond Walsh

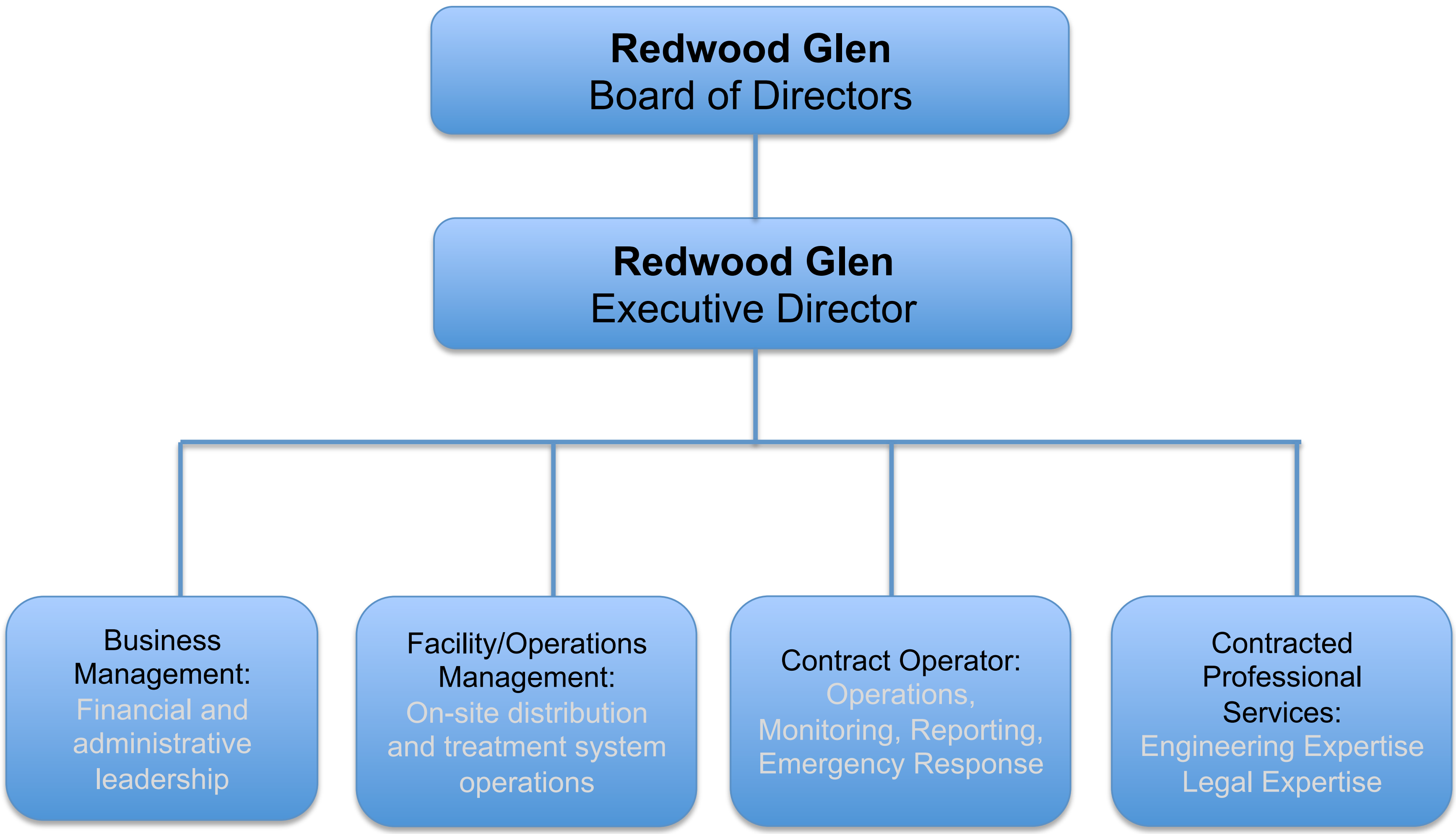
Chief, Division of Water Rights

2

ATTACHMENT 9

Organization

Water System Organizational Chart - General



Water System Organizational Chart – Names and Contact

Redwood Glen
Board of Directors

Gerald Mann, Chair
Carole Moore, Secretary
Carolyn Neitzke, CFO, Treasurer
Alondra Trevino
Jeanette Calixto
Wyman Chin
Mike Greene
Anita Falltrick

Redwood Glen
Executive Director
Larry Rice
(650) 879-0320 x13

Business Management
Carolyn Neitzke, CFO
Chad Plantenberg, Bookkeeper
(650) 879-0320 x18

Facility/Operations Management:
Andrew Gonsalves
(650) 879-0320 x16
Jeff Tessier
(650) 879-0320 x10

Contract Operator:
Chris Hauge,T3, D3
Bracewell Engineering
25 hr/week
(408) 316-7877

Contracted Professional Services:
Lisa Pezzino, P.E.
SRT Consultants
(415) 776-5800 x304

ATTACHMENT 10

Redwood Glen Emergency Response Plan

Redwood Glen Water System

Emergency/Disaster Response Plan

Water System Name: Redwood Glen Camp and Conference Center

Water System ID No: 4100522

Number of Service Connections: 13

Population Served: 23 permanent residents; as many as 250 temporary residents

To continue minimum service levels and mitigate the public health risks from drinking water contamination that may occur during a disaster or other emergency events and in order to provide reliable water service and minimize public health risks from unsafe drinking water during those events, the Redwood Glen Water System proposes the following plan that defines how it will respond to emergencies and/or disasters that are likely to affect its operation.

Disasters/emergencies that are likely to occur in the water system's service area that are addressed are: earthquake, major fire emergencies, water outages due to loss of power, localized flooding, water contamination, and acts of sabotage.

1) **DESIGNATED RESPONSIBLE PERSONNEL:** For designated responsible personnel and chain of command and identified responsibilities, see the attached table "Water System Emergency/Disaster Personnel and Responsibilities".
2) **INVENTORY OF RESOURCES:** An inventory of system resources used for normal operations and available for emergencies are included in this plan. The inventory includes maps of the water system, lists of emergency equipment, equipment suppliers, and emergency contract agreements that are kept at the water system office.
3) **EMERGENCY OPERATIONS CENTER:** The Redwood Glen water system office has been designated as the communication network emergency operations center. Emergency contact information for equipment suppliers is attached. The telephone and fax will be the primary mode of communication in an emergency.

Agency	Address, City	Phone #	FAX #
Water System (Primary Site)	100 Wright Drive, Loma Mar, CA 94021	(650) 879-0320	(650) 879-2081
Cal Fire Loma Mar Fire Station	8879 Pescadero Creek Rd., Loma Mar, CA 94021	(650) 879-9716	NA
San Mateo County Sheriff	537 Kelly Ave. Half Moon Bay, CA 94019	(650) 726-8288	NA

4) **OTHER AGENCY COORDINATION:** Coordination procedures with governmental agencies for health and safety protection; technical, legal, and financial assistance, and public notification procedures are continually being developed and updated through regulation and experience and will be added as necessary to this plan. (See External Emergency Contact sheet.)

5) **<u>RESPONSE PROCEDURES</u>:** Personnel will, as quickly as possible, determine the status of other employees, assess damage to water system facilities, provide logistics for emergency repairs, monitor progress of repairs and restoration efforts, communicate with health officials and water users according to the "Water Quality Emergency Notification Plan" (WQENP) on file with the regulatory agency (i.e., State Water Resources Control Board (SWRCB) Division of Drinking Water (DDW)) and document damage and repairs. Copies of the approved WQENP and user notification templates are attached.

6) **PUBLIC NOTIFICATION PROCEDURES:** Public notification procedures have been established as part of the attached Redwood Glen WQENP. The following public notifications are attached to this ERP for use by Redwood Glen staff during an emergency:

- **Consumer Alert During Water Outages or Periods of Low Pressure** – If a water system is experiencing power outages, water outages or low-pressure problems, a consumer alert may be issued to the public. The notice provides consumers information on conserving water and how to treat the water with household bleach if the water quality is questionable.

- **Boil Water Notice (BWN)** – A BWN shall be issued when minimum bacteriological water quality standards cannot be reasonably assured. To assure public health protection, Redwood Glen shall issue a BWN as soon as it is concluded by the designated personnel that the water supply is or may be biologically unsafe. Examples of these situations include:

    a) Biological contamination of water supply system, including but not limited to:
       - Positive total or fecal coliform bacteriological samples;
       - Prolonged water outages in areas of ruptured sewer and/or water mains;
       - Failed septic tank systems in close proximity to ruptured water mains;
       - Ruptured water treatment, storage, and/or distribution facilities in areas of known sewage spills
       - Known biological contamination;
       - Cross-connection contamination problems;
       - Illness attributed to water supply.

    b) Unusual system characteristics, including but not limited to:
       - Prolonged loss of pressure;
       - Sudden loss of chlorine residual;
       - Severe discoloration and odor;
       - Inability to implement emergency chlorination.

    c) Implemented due to treatment inadequacies.

    A BWN is not appropriate in response to most types of chemical contamination. A BWN may also be inappropriate in cases where boiling the water may tend to concentrate regulated contaminants that are known to be in the water and that are just below an MCL (e.g. Nitrates or Nitrites that are over 50 percent of the MCL).

- **Unsafe Water Alert (UWA)/"Do Not Drink"** – In the event a water quality emergency due to known or suspected chemical (non-bacteriological) contamination to a water system a UWA or "Do Not Drink" shall be issued. Water should not be used for drinking and cooking, but may be used for sanitation purposes (e.g. toilet flushing, clothes washing, etc.). Examples of these situations include:

  a) Known or suspected widespread chemical or hazardous contamination in water supply distribution, including but not limited to:
     - Ruptured water distribution system (storage tanks, mains) in area of known chemical spill coupled with loss of pressure;
     - Severe odor and discoloration;
     - Loss of chlorine residual;
     - Inability of existing water treatment process to neutralize chemical contaminants prior to entering the distribution system.

  b) Threatened or suspected acts of sabotage confirmed by analytical results, including but not limited to:
     - Suspected contamination triggered by acts of sabotage or vandalism.

  c) Emergency use of an unapproved source to provide a supplemental water supply.

- **Unsafe Water Alert (UWA)/"Do Not Use"** – In the event a known or suspected contamination event to a water system, where the contaminant may be chemical, biological or radiological a UWA or "Do Not Use" should be issued. Water should not be used for drinking, cooking, or sanitation purposes. Examples of these situations include:

  a) Known or suspected widespread chemical or hazardous contamination in water supply distribution, including but not limited to
     - Terrorist contamination event.

One, or a combination of, the following agencies can issue a BWN, UWA-DND or UWA-DNU Notices:

- **SWRCB DDW:** Designated personnel- District Engineer, Regional Engineer or Branch Chief.
- **San Mateo County Environmental Health:** Designated personnel – Representative from San Mateo County Environmental Services and/or the County Health Officer.
- **Affected Water System:** Designated personnel- Executive Director, Contract Operator, Consulting Engineer, or on-site Operator.

All public notifications (BWN, UWA-DND or UWA-DNU Notices) shall be coordinated with the SWRCB DDW District Engineer, County Environmental Health Services and the County Health Officer prior to issuing a public notice. However, any one of the three agencies can act in an emergency to immediately issue a BWN or UWA, if delays would jeopardize public health and safety. The SWRCB DDW District Engineer or the water system must notify the County Environmental Health Services and the County Health Officer prior to or immediately after issuing a public notice. Notice must be given directly to a person, and a message left on voicemail or answering machine is not sufficient to

meet this requirement. Details of the person responsible for completing this notification and the method that will be utilized are included in the WQENP.

Cancellation of Public Notification

Once a BWN/UWA is issued, the only agency that can rescind the public notice is the drinking water primacy agency. SWRCB DDW will not lift the BWN for a microbial contaminant until two rounds of samples, collected one day apart, for coliform bacteria samples have been analyzed and the results are negative. The two sets of sample results should be faxed to the SWRCB DDW District Office for final approval before rescinding the BWN. Special chemical sampling may be required to get approval to rescind an UWA; Redwood Glen staff must contact the SWRCB DDW District Office to determine what sampling will be required.

7) RESUME NORMAL OPERATIONS: The steps that will be taken to resume normal operations and to prepare and submit reports to appropriate agencies will include identifying the nature of the emergency (e.g., earthquake-causing water outage/leaks, fire or power outage causing water shortage/outage, sabotage resulting in facility destruction or water contamination).

a. **Leaks (Result of earthquake, etc.)**

    i. Immediately increase system disinfectant residual as a precaution, until normal service is resumed. Determine the locations of leaks and make temporary repairs using clamps and other pipe repair devices that will allow for repairs to be made while system pressure is maintained. If this is not possible, isolate leaks by turning off power or flow, to repair or replace the pipe. Repair or isolate major breaks to allow service to the maximum system population possible.

    ii. Disinfect all repairs as per attached AWWA Standards[1];

    iii. Reestablish normal service.

b. **Low pressure or service interruption (Result of earthquake, fire, storm, water source outage, power outage, etc.) – See also section on Leaks, above.**

    i. Increase production, if possible, to provide maximum system output.

    ii. Increase disinfectant residual as a precaution against potential contamination.

If any customers have experienced low pressure or a water outage as a result of an earthquake, fire, storm, water source outage, power outage or any other event or failure, immediately contact your SWRCB DDW to determine if a Boil Water Notice (BWN) must be issued to users. ***Note: Whether issued by the water system or a regulatory agency, the BWN can only be rescinded or lifted by SWRCB. Normally the regulatory agency will consider rescinding a BWN after total coliform sampling on two consecutive days show an absence of total and fecal coliform organisms.***

c. **Power outage**

[1] AWWA C651: Standard for Disinfecting Water Mains and AWWA C652: Standard for Disinfection of Water-storage Facilities

i. Place emergency generator on line to provide minimum water pressure to system.
ii. Increase disinfectant residual as precaution to potential contamination.
iii. See also water outages, above.

d. Contamination

i. Immediately, contact SWRCB DDW in accordance with the WQENP. Follow the directions of SWRCB DDW regarding steps to be taken, emergency notification of users, and public notification.
ii. Identify location and source of contamination.
iii. If contamination is from system source, isolate or treat source.
iv. If contamination is an act of sabotage, take appropriate action based on nature of contamination. Immediately contact local law enforcement and your regulatory agency (SWRCB DDW). Actions should be taken in consultation with the regulatory agency and could include shutting off water until all contaminants are identified.

e. Physical destruction of facility or evidence of tampering (sabotage)

i. Immediately contact local law enforcement and regulatory agency for consultation.
ii. Consider the steps necessary to isolate the facilities or portions of the system that may be affected (close valves, turn off pumps, etc.).

All emergencies will be documented along with action taken, and kept in the files of the water system office. Acts of sabotage will be reported to the local law enforcement agency.

Water System Emergency/Disaster Personnel and Responsibilities

Name / Title	Telephone No. (Work) / Telephone No. (Home)	Role
Jeff Tessier Director of Operations	(650) 879-0320 (Work) (650) 879-9344 (Home)	Initial contact at office, in charge for all emergencies until replaced by Executive Director.
Larry Rice Executive Director/Owner	(650) 879-0320 (Work) (650) 504-2521 (Home)	In charge for all emergencies, issues notices to residents and/or guests.
Chris Hauge, Bracewell Engineering Contract Operator	(408) 316-7877 (Work) (408) 316-7877 (Home)	Oversees all emergency repairs to the water system and disinfection procedures, as necessary.
Jeanette Calixto Board Member	(510) 701-8927 (Home)	Assists Executive Director in notifying residents/guests and other necessary tasks.
Andrew Gonsalves Operator	(650) 879-0320 (Work) (650) 879-0320 (Home)	Emergency assistance and support.

External Emergency Contact List

Agency/Department	Telephone No. (Day) Telephone No. (After Hours)
Loma Mar Mutual La Honda Water (Peter Lyon)	(650) 879-9638 (650) 208-5924
Local Fire Department Cal Fire Loma Mar Fire Station	(650) 879-9716 (650) 879-9716
Local Law Enforcement San Mateo County Sheriff	(650) 726-8288
County Office of Emergency Services San Mateo County Office of Emergency Services	(650) 363-4790 (650) 363-4790
FBI Office (terrorism or sabotage) (Also notify local law enforcement.)	
California Office of Emergency Services — Warning Center (24-hr. number)—*Note: Ask for referral to SWRCB DDW Duty Officer-Drinking Water Program*	**(800) 852-7550 or** **(916) 845-8911**
SWRCB DDW District Office District 17 – Santa Clara	(510) 620-3474
Local Environmental Health Agency San Mateo County Environmental Health Services	(650) 372-6200 so we have a backup

Water system contact information:

Name: Redwood Glen Camp & Conference Center
Address: 100 Wright Drive, Loma Mar, CA 94021
Phone: (650) 879-0320
FAX: (650) 879-2081

Emergency Supplier Contact Numbers and Supply List

A. List of equipment on hand for emergency repairs

1. Backup generators: 1 mobile; 3 stationary
2. Entire bay of plumbing supplies including pipes and fittings - 1”, 2”, 4”
3. Backhoe, trencher, auger

B. List of sources of needed equipment, not on hand

1. SkyLonda Equipment
   (Sources for backhoe, jackhammer, technical support. Sources under contract.)
2. Periot Plumbing; Palo Alto Electric
   (Sources for electrical and pump repair.)
3. AAA Rentals
   (Sources for emergency generators in case of prolonged power outages.)

C. List of distributors or suppliers of replacement parts for the system

1. Ferguson Supply; Ace Hardware; Home Depot
   (Sources for PVC pipe, valves, and fittings.)
2. Periot Plumbing; Ferguson Supply
   (Sources for pumps, pressure tank, and gauges.)

D. List of emergency supplier/equipment phone numbers:

	Name	Phone (Day)
Plumber	Periot Plumbing	(650) 879-1526
Electrician	Full Spectrum Lighting	(415) 378-7695
Laboratory	SMC Public Health Laboratory	(650) 573-2500
Electric & Pump (repair service)	Palo Alto Electric	(650) 493-5585
Chemical Disinfectant Supplier	Esbro	(650) 365-0441
Other Water Agency (equip. support)	Loma Mar Mutual La Honda Water (Peter Lyon)	(650) 879-9638 (650) 208-5924
Equipment Suppliers	SkyLonda Equipment	(415) 990-8078
	AAA Rentals	(650) 365-6743
	Ferguson Supply	(650) 368-1291

ATTACHMENTS

ATTACHMENT A: Water Quality Emergency Notification Plan (WQENP)

ATTACHMENT B: System Map of Sources and Distribution Area

ATTACHMENT C: Public Notifications

Consumer Alert During Water Outages or Periods of Low Pressure
Boil Water Notice (Emergency Situation)
Unsafe Water Alert – Do Not Drink
Unsafe Water Alert – Do Not Use

ATTACHMENT D: AWWA Disinfection Standards

ATTACHMENT A

Water Quality Emergency Notification Plan

State Water Resources Control Board
Division of Drinking Water

WATER QUALITY EMERGENCY NOTIFICATION PLAN

Name of System: Redwood Glen Camp and Conference Center System No.: 4100522

System Location: 100 Wright Drive, Loma Mar, CA 94021 County: San Mateo

The following persons have been designated to implement the plan upon notification by the State Department of Public Health that an imminent danger to the health of the water users exists:

	Name	Title	Day Phone	Evening Phone
1.	Andrew Gonsalves	Water System Operator	(650) 879-0320 Ext. 16	(650) 294-9820
2.	Chris Hauge	Contract Water System Operator	(408) 316-7877	(408) 316-7877
3.	Larry Rice	Executive Director	(650) 879-0320	(650) 504-2521

The implementation of the plan will be carried out with the following State and County Health Department personnel:

	Name	Title	Day Phone	Evening Phone
1.	Eric Lacy	District Engineer	(510) 620-3453	(925) 299-6936
2.	Karen Nishimoto	Associate Sanitary Engineer	(510) 620-3461	(209) 598-8484
3.	Greg Smith	San Mateo County Environmental Health Specialist	(650) 372-6279	(650) 867-9434

After reaching the Santa Clara County Emergency Communications Center, ask for the on-call Environmental Health personnel.

4. If the above personnel cannot be reached, contact:

The State Office of Emergency Services Warning Center (24 hours) **(916) 845-8911 or (800) 852-7550**. When reporting a water quality emergency to the Warning Center, please ask for the California Department of Public Health – Drinking Water Program Duty Officer.

NOTIFICATION PLAN

The water operator and staff will verbally notify persons using the site. Appropriate signage will be posted in public common areas. It is estimated that the entire service area can be covered in less than two hours.

Report Prepared by:

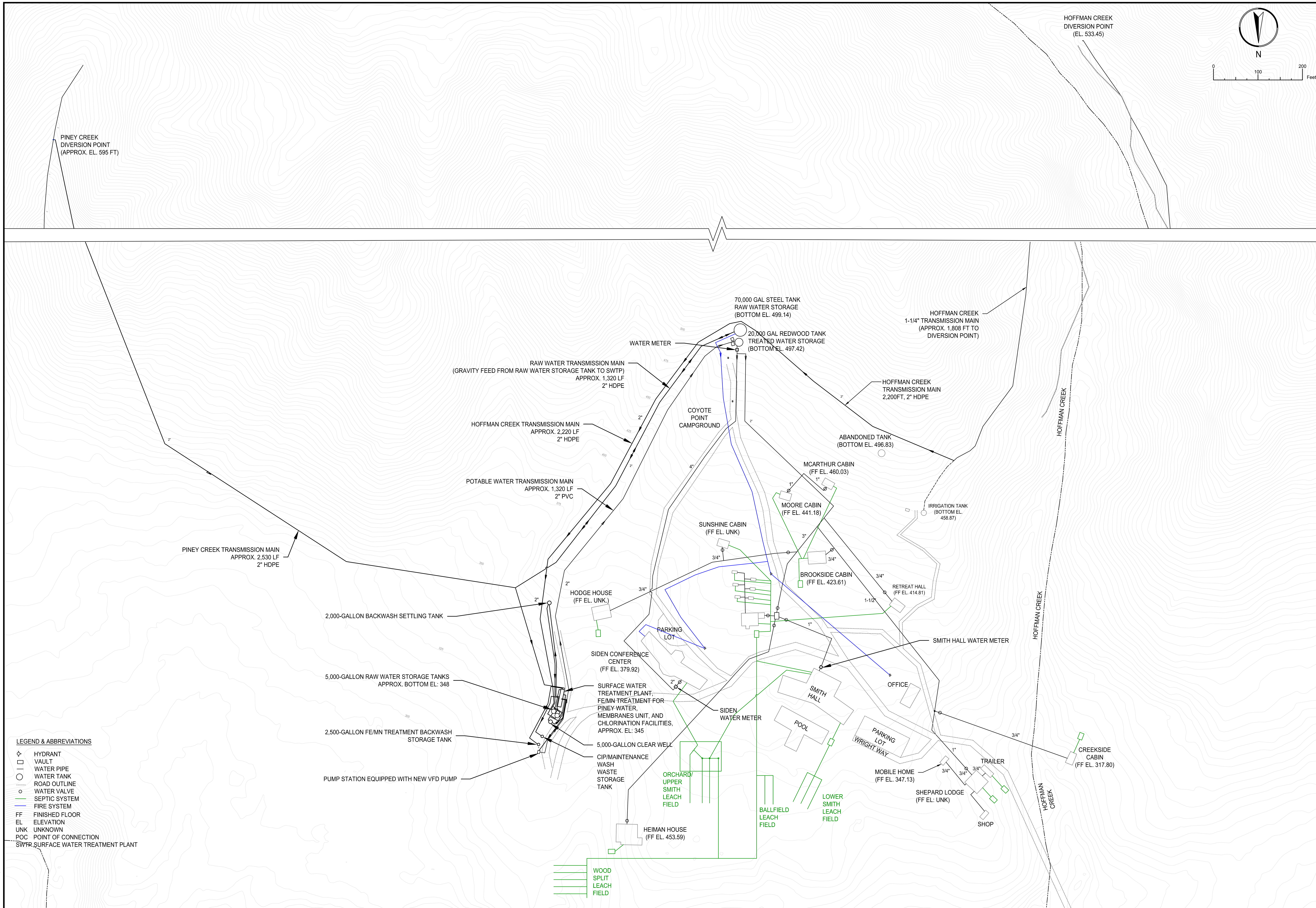
Larry Rice

3/21/2016

Signature and Title **Date**

ATTACHMENT B

System Map



SYM.	DESCRIPTION	DATE	APPROVED
–	100% DESIGN	03/2017	LP

REVISIONS

NOT FOR CONSTRUCTION

SRT consultants
90 New Montgomery Street,
Suite 905
San Francisco, CA 94109
Ph 415.776.5800
Fx 415.776.5200

REDWOOD GLEN CAMP AND CONFERENCE CENTER
100 WRIGHT WAY
LOMAR MAR, CA 94021

REDWOOD GLEN
NEW WATER SYSTEM
CONSTRUCTION PROJECT

WATER SYSTEM MAP

DATE	MAR 2017
SCALE	AS SHOWN
DESIGN	L. PEZZINO
DRAWN	N.MAO
PROJECT#	------
SHEET	01 OF --

01

ATTACHMENT C

Public Notifications

PUBLIC NOTICE

Este informe contiene información muy importante sobre su agua potable.
Tradúzcalo o hable con alguien que lo entienda bien.

CONSUMER ALERT DURING WATER OUTAGES OR PERIODS OF LOW PRESSURE

1. If you are experiencing water outages or low water pressure, immediately discontinue any non-essential water usage. This includes all outdoor irrigation and car washing. Minimizing usage will reduce the potential for the water system to lose pressure or completely run out of water. Please notify your water system of the outage or low pressure.

2. If the water looks cloudy or dirty, you should not drink it. Upon return of normal water service, you should flush the hot and cold water lines until the water appears clear and the water quality returns to normal.

3. If you are concerned about the water quality or are uncertain of its safety, you may add eight drops of household bleach to one gallon of water and let it sit for 30 minutes or alternatively, if you are able, water can be boiled for one minute at a rolling boil to ensure its safety.

4. Use of home treatment devices does not guarantee the water supply is safe after low-pressure situations.

5. Do not be alarmed if you experience higher than normal chlorine concentrations in your water supply since the SWRCB is advising public water utilities to increase chlorine residuals in areas subject to low pressure or outages.

6. The SWRCB has also advised public water systems to increase the bacteriological water quality monitoring of the distribution system in areas subject to low pressure. They may be collecting samples in your area to confirm that the water remains safe. You will be advised if the sampling reveals a water quality problem.

7. Your water system is committed to make certain that an adequate quantity of clean, wholesome, and potable water is delivered to you. We recommend that you discuss the information in this notice with members of your family to ensure that all family members are prepared should water outages or low water pressure occur.

BOIL WATER NOTICE

Este informe contiene información muy importante sobre su agua potable.
Tradúzcalo o hable con alguien que lo entienda bien.

BOIL YOUR WATER BEFORE USING

Failure to follow this advisory could result in stomach or intestinal illness.

Due to the recent event [e.g., water outage, power outage, flood, fire, earthquake or other emergency situation], the State Water Resources Control Board (SWRCB) Division of Drinking Water (DDW) in conjunction with the San Mateo County Environmental Health Services, and Redwood Glen Camp and Conference Center Water System are advising residents of Redwood Glen to use boiled tap water or bottled water for drinking and cooking purposes as a safety precaution.

DO NOT DRINK THE WATER WITHOUT BOILING IT FIRST. Bring all water to a boil, **let it boil for one (1) minute,** and let it cool before using, or use bottled water. Boiled or bottled water should be used for drinking and food preparation **until further notice**. Boiling kills bacteria and other organisms in the water.

Optional Alternative to Boiling Water, as necessary:

- An alternative method of disinfection for residents that are not able to boil their water is to use fresh, unscented, liquid household bleach. To do so, **add 8 drops (or 1/8 teaspoon) of bleach per gallon of clear water** or **16 drops (or 1/4 teaspoon) per gallon of cloudy water**, mix thoroughly, and allow it to stand for 30 minutes before using. A chlorine-like taste and odor will result from this disinfection procedure and is an indication that adequate disinfection has taken place.
- Water disinfection tablets may also be used by following the manufacturer's instructions.
- Potable water is available at the following locations: **Redwood Glen Offices**

We will inform you when tests show that water is safe to drink and you no longer need to boil your water. We anticipate resolving the problem within [INSERT ESTIMATED TIME FRAME].

For more information call:
Redwood Glen: Larry Rice, Executive Director (650) 879-0320
SWRCB DDW: Eric Lacy or Karen Nishimoto (510) 620-3474
San Mateo County Environmental Health: Greg Smith (650) 372-6279

Please share this information with all the other people who drink this water, especially those who may not have received this notice directly.

UNSAFE WATER ALERT

Redwood Glen water is possibly contaminated with an unknown substance.

DO NOT DRINK YOUR WATER

Failure to follow this advisory could result in illness.

An unknown substance has been added to the drinking water supplied by the Redwood Glen Water System due to a recent [INSERT CAUSATION: ie. intrusion; break-in] at [INSERT LOCATION: one of the wells; our treatment plant; storage tank; specific facility]. The State Water Resources Control Board (SWRCB) Division of Drinking Water (DDW), San Mateo County Environmental Health Services, and Redwood Glen Water System are advising residents of Redwood Glen Camp and Conference Center to **NOT USE THE TAP WATER FOR DRINKING AND COOKING UNTIL FURTHER NOTICE.**

What should I do?

- **DO NOT DRINK YOUR TAP WATER---USE ONLY BOTTLED WATER.** Bottled water should be used for all drinking (including baby formula and juice), brushing teeth, washing dishes, making ice and food preparation **until further notice**.

- **DO NOT TRY AND TREAT THE WATER YOURSELF.** Boiling, freezing, filtering, adding chlorine or other disinfectants, or letting water stand will not make the water safe.

- Optional: Potable water is available at the following locations: Redwood Glen Offices

We will inform you when tests show that the water is safe again. We expect to resolve the problem within [INSERT ESTIMATED TIMEFRAME].

For more information call:
Redwood Glen: Larry Rice, Executive Director (650) 879-0320
SWRCB DDW: Eric Lacy or Karen Nishimoto (510) 620-3474
San Mateo County Environmental Health: Greg Smith (650) 372-6279

This notice is being sent to you by Redwood Glen Camp and Conference Center.
California Public Water System ID # 4100522. **Date Distributed:** [INSERT DATE].

Please share this information with all the other people who drink this water, especially those who may not have received this notice directly.

UNSAFE WATER ALERT

Redwood Glen water is possibly contaminated with [an unknown substance]

DO NOT USE YOUR WATER

Failure to follow this advisory could result in illness.

An unknown substance has been added to the drinking water supplied by the Redwood Glen Water System due to a recent [INSERT CAUSATION: ie. intrusion; break-in] at [INSERT LOCATION: one of the wells; our treatment plant; storage tank; specific facility]. The State Water Resources Control Board (SWRCB) Division of Drinking Water (DDW), San Mateo County Environmental Health Services, and Redwood Glen Camp and Conference Center Water System are advising residents of Redwood Glen to NOT USE THE TAP WATER FOR DRINKING, COOKING, HAND WASHING, OR BATHING UNTIL FURTHER NOTICE.

What should I do?

- **DO NOT USE YOUR TAP WATER---USE ONLY BOTTLED WATER.** Bottled water should be used for all drinking (including baby formula and juice), brushing teeth, washing dishes, making ice, food preparation and bathing **until further notice**.
- **DO NOT TRY AND TREAT THE WATER YOURSELF.** Boiling, freezing, filtering, adding chlorine or other disinfectants, or letting water stand will not make the water safe.
- Optional: Potable water is available at the following locations: Redwood Glen Offices

We will inform you when tests show that the water is safe again. We expect to resolve the problem within [INSERT ESTIMATED TIMEFRAME].

For more information call:
Redwood Glen: Larry Rice, Executive Director (650) 879-0320
SWRCB DDW: Eric Lacy or Karen Nishimoto (510) 620-3474
San Mateo County Environmental Health: Greg Smith (650) 372-6279

This notice is being sent to you by Redwood Glen Camp and Conference Center.
California Public Water System ID # 4100522. **Date Distributed:** [INSERT DATE].

Please share this information with all the other people who drink this water, especially those who may not have received this notice directly.

ATTACHMENT D

AWWA Disinfection Specifications

AWWA C651 – Disinfection of Water Mains
AWWA C652 – Disinfection of Water Storage Facilities

ANSI/AWWA C651-14
(Revision of ANSI/AWWA C651-05)

American Water Works Association

Dedicated to the World's Most Important Resource™

AWWA Standard

Disinfecting Water Mains

Effective date: Feb. 1, 2015.
First edition approved by AWWA Board of Directors Sept. 30, 1947.
This edition approved June 8, 2014.
Approved by American National Standards Institute Nov. 18, 2014.

STANDARD
Since 1881

AWWA Standard

This document is an American Water Works Association (AWWA) standard. It is not a specification. AWWA standards describe minimum requirements and do not contain all of the engineering and administrative information normally contained in specifications. The AWWA standards usually contain options that must be evaluated by the user of the standard. Until each optional feature is specified by the user, the product or service is not fully defined. AWWA publication of a standard does not constitute endorsement of any product or product type, nor does AWWA test, certify, or approve any product. The use of AWWA standards is entirely voluntary. This standard does not supersede or take precedence over or displace any applicable law, regulation, or codes of any governmental authority. AWWA standards are intended to represent a consensus of the water supply industry that the product described will provide satisfactory service. When AWWA revises or withdraws this standard, an official notice of action will be placed in the Official Notice section of *Journal - American Water Works Association*. The action becomes effective on the first day of the month following the month of *Journal - American Water Works Association* publication of the official notice.

American National Standard

An American National Standard implies a consensus of those substantially concerned with its scope and provisions. An American National Standard is intended as a guide to aid the manufacturer, the consumer, and the general public. The existence of an American National Standard does not in any respect preclude anyone, whether that person has approved the standard or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standard. American National Standards are subject to periodic review, and users are cautioned to obtain the latest editions. Producers of goods made in conformity with an American National Standard are encouraged to state on their own responsibility in advertising and promotional materials or on tags or labels that the goods are produced in conformity with particular American National Standards.

CAUTION NOTICE: The American National Standards Institute (ANSI) approval date on the front cover of this standard indicates completion of the ANSI approval process. This American National Standard may be revised or withdrawn at any time. ANSI procedures require that action be taken to reaffirm, revise, or withdraw this standard no later than five years from the date of ANSI approval. Purchasers of American National Standards may receive current information on all standards by calling or writing the American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036; 212.642.4900, or emailing info@ansi.org.

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DOI: http://dx.doi.org/10.12999/AWWA.C651.14

Committee Personnel

The AWWA Standards Committee on Disinfection of Facilities, which reviewed and approved this standard, had the following personnel at the time of approval:

Betsy Reilley, *Chair*

General Interest Members

G. Boyd,* Standards Council Liaison, Cadmus Group, Seattle, Wash.	(AWWA)
K.C. Choquette, Consultant, Des Moines, Iowa	(AWWA)
C.B. Hagar, Carollo Engineers, Phoenix, Ariz.	(AWWA)
J.M. Henderson, Consultant, Concord, Mass.	(AWWA)
P.J. Olson,* Standards Staff Liaison, AWWA, Denver, Colo.	(AWWA)
S. Vidika, Dixon Engineering Inc., Medina, Ohio	(AWWA)
J.S. Wailes, Consultant, Black Hawk, Colo.	(AWWA)
T.W. Walker, New York State Department of Health, Victor, N.Y.	(AWWA)
M.L. Wentink, Nebraska DHHS Division of Public Health, North Platte, Neb.	(AWWA)

Producer Members

R.J. Gordhamer, Measurement Technologies Inc., Redmond, Wash.	(AWWA)
D.T. Hanson, Design Water Technologies, Shorewood, Minn.	(AWWA)
P.L. Smith, Smith LaSalle Inc., Western Springs, Ill.	(AWWA)

User Members

G.A. Burlingame, Philadelphia Water Department, Philadelphia, Penn.	(AWWA)
R.C. Lorenz, Westerville Water Plant, Westerville, Ohio	(AWWA)
P.M. Marchand, Bristol County Water Authority, Warren, R.I.	(AWWA)
B. Reilley, MWRA, Southborough, Mass.	(AWWA)
E.D. Schwartz, New Jersey American Water Company, Plainsboro, N.J.	(AWWA)
B.L. Whitteberry, Greater Cincinnati Water Works, Cincinnati, Ohio	(AWWA)

* Liaison, nonvoting

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Contents

All AWWA standards follow the general format indicated subsequently. Some variations from this format may be found in a particular standard.

Foreword

This foreword is for information only and is not a part of ANSI/AWWA C651.*

I. Introduction.

I.A. *Background.* This standard describes methods of disinfecting newly constructed potable water mains; mains that have been removed from service for planned repairs or for maintenance that exposes them to contamination; mains that have undergone emergency repairs because of physical failure; and mains that, under normal operation, continue to show the presence of coliform organisms. The disinfecting agents discussed in this standard are chlorine solutions that may be derived from liquid chlorine (Cl_2), calcium hypochlorite ($Ca(OCl)_2$), or sodium hypochlorite (NaOCl). Combinations of free chlorine residual and contact time are provided. Chlorine dosage reference tables are provided as appendix B of this standard.

I.B. *History.* This standard was first approved on Sept. 30, 1947, by the AWWA Board of Directors and published as 7D.2-1948, A Procedure for Disinfecting Water Mains. Revisions were approved on Sept. 14, 1948; Mar. 6, 1953; May 27, 1954; June 2, 1968; and June 7, 1981. All were done under the designation ANSI/AWWA C601, Standard for Disinfecting Water Mains. In 1986, the designation of the standard was changed to ANSI/AWWA C651, and the subsequent editions were approved on Jan. 26, 1986; June 18, 1992; June 20, 1999; and Jan. 16, 2005. This edition was approved on June 8, 2014.

I.C. *Acceptance.* In May 1985, the US Environmental Protection Agency (USEPA) entered into a cooperative agreement with a consortium led by NSF International (NSF) to develop voluntary third-party consensus standards and a certification program for direct and indirect drinking water additives. Other members of the original consortium included the Water Research Foundation (formerly AwwaRF) and the Conference of State Health and Environmental Managers (COSHEM). The American Water Works Association (AWWA) and the Association of State Drinking Water Administrators (ASDWA) joined later.

In the United States, authority to regulate products for use in, or in contact with, drinking water rests with individual states.† Local agencies may choose to impose requirements more stringent than those required by the state. To evaluate the health

* American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036.
† Persons outside the United States should contact the appropriate authority having jurisdiction.

effects of products and drinking water additives from such products, state and local agencies may use various references, including

1. An advisory program formerly administered by USEPA, Office of Drinking Water, discontinued on Apr. 7, 1990.

2. Specific policies of the state or local agency.

3. Two standards developed under the direction of NSF*: NSF/ANSI 60, Drinking Water Treatment Chemicals—Health Effects, and NSF/ANSI 61, Drinking Water System Components—Health Effects.

4. Other references, including AWWA standards, *Food Chemicals Codex*, *Water Chemicals Codex*,† and other standards considered appropriate by the state or local agency.

Various certification organizations may be involved in certifying products in accordance with NSF/ANSI 60. Individual states or local agencies have authority to accept or accredit certification organizations within their jurisdictions. Accreditation of certification organizations may vary from jurisdiction to jurisdiction.

Annex A, "Toxicology Review and Evaluation Procedures," to NSF/ANSI 60 does not stipulate a maximum allowable level (MAL) of a contaminant for substances not regulated by a USEPA final maximum contaminant level (MCL). The MALs of an unspecified list of "unregulated contaminants" are based on toxicity testing guidelines (noncarcinogens) and risk characterization methodology (carcinogens). Use of Annex A procedures may not always be identical, depending on the certifier.

ANSI/AWWA C651 does not address additives requirements. Thus, users of this standard should consult the appropriate state or local agency having jurisdiction in order to

1. Determine additives requirements including applicable standards.

2. Determine the status of certifications by parties offering to certify products for contact with, or treatment of, drinking water.

3. Determine current information on product certification.

II. Special Issues.

II.A. *Information on Application of This Standard.* Generally, it is easier to disinfect a new main than one that has had emergency repairs in terms of access, sanitary control, and the time available for disinfection, sampling, and testing.

* NSF International, 789 North Dixboro Road, Ann Arbor, MI 48105.

† Both publications available from National Academy of Sciences, 500 Fifth Street, NW, Washington, DC 20001.

For a new main, there is typically more time available for disinfection and testing since there is no immediate demand from customers. Given the often significant amount of time and materials involved in a new water main project, careful disinfection and testing of the main are reasonable and necessary to ensure public health protection.

Conditions for pipe repair projects vary tremendously in terms of the size of the repair, the sanitary conditions, and the time constraints resulting from immediate customer demands. It should be noted if the line is depressurized or opened to the environment prior to or during repair, the sanitary integrity of the pipe is compromised and it is critical to follow sanitary procedures throughout the repair—not just as it is being returned to service. Crews responsible for the repair of mains should be aware of the potential health hazards and be trained to carefully observe prescribed construction practices and disinfection procedures.

Because of the differences between initial installation and repair, the disinfection requirements for each situation are also different. The installation of new mains requires that two sets of samples for coliform analysis are collected at least 16 hr apart, or two sets collected 15 min apart after at least a 16-hr rest period. For repaired mains that are depressurized and/or wholly or partially dewatered, one set of samples may be required, and depending on the sanitary conditions, the line may be returned to service prior to the completion of bacteriological testing. For repaired mains that are maintained under pressurized conditions at all times, bacteriological testing is not required

When required, samples are now specified to be collected at least 16 hr apart, or 15 min apart after a 16-hr rest period. The purpose of this change is to consider the balance between public health, improved test methods, and timely work completion. This timing is sufficient to allow bacterial regrowth within the line if there was a contamination problem and provides more flexibility in the scheduling of various work activities.

Bacteriological testing in accordance with Sec. 5.1 is used to verify the absence of coliform organisms and is generally accepted as verification that disinfection of the pipeline has been accomplished; and following sanitary practices for handling and installation of pipe, valves, fittings, and accessories, coupled with adequate flushing of the line before disinfection, is necessary to ensure the disinfected pipeline will be ready for connection to the water system. Failure to pass the bacteriological test requires that the flushing or disinfection process be repeated. It must be remembered that the final water quality test is not the primary means for certifying the sanitary condition of a main. The sanitary handling of materials, the practices during construction, and the continual inspection of the work are the primary means for ensuring the sanitary condition of the water main.

Four methods of disinfecting newly constructed water mains are described in this standard: the tablet method, the continuous-feed method, the slug method, and the spray method. The utility should decide which of these methods is most suitable for a given situation. Factors to consider when choosing a method should include the length and diameter of the main, type of joints present, availability of materials, equipment required for disinfection, training of the personnel who will perform the disinfection, and safety concerns. For example, if gas chlorination is the chosen chemical when either continuous-feed or slug methods are being used, use only properly designed and constructed equipment; makeshift equipment is not acceptable when liquid chlorine (gas) cylinders are used.

Thorough consideration should be given to the impact of highly chlorinated water flushed into the environment. If there is any question that damage may be caused by chlorinated-waste discharge (to fish life, plant life, physical installations, or other downstream water uses of any type), then an adequate amount of reducing agent should be applied to water being disposed of in order to thoroughly neutralize the chlorine residual remaining in the water.

The tablet method cannot be used unless the main can be kept clean and dry. It cannot be used in large-diameter mains if it is necessary for a worker to enter the main to grout joints or perform inspection because the tablets may release toxic fumes after exposure to moist air. When using the tablet method, the chlorine concentration is not uniform throughout the main because the hypochlorite solution is dense and tends to concentrate at the bottom of the pipe. The use of the tablet method precludes preliminary flushing. The tablet method is convenient to use in mains having diameters up to 24 in. (600 mm), and it requires no special equipment.

The continuous-feed method is suitable for general application. Preliminary flushing removes light particulates from the main but not from the pipe-joint spaces. The chlorine concentration is uniform throughout the main.

The slug method is suitable for use in large-diameter mains where the volume of water makes the continuous-feed method impractical and difficult to achieve for short attachments. The slug method results in appreciable savings of chemicals used to disinfect long large-diameter mains. Also, this method reduces the volume of heavily chlorinated water to be flushed to waste.

The spray method is suitable for use in large-diameter transmission lines where spray equipment can be used to disinfect all surfaces of the pipe. This method reduces the volume of heavily chlorinated water to be flushed to waste.

The purpose of all four chlorination methods is to disinfect water lines, resulting in an absence of coliforms as confirmed by laboratory analysis. As noted above, the four methods attempt to provide flexibility in responding to specific situations. The tablet and continuous-feed methods both have initial chlorine concentrations of 25 mg/L and a minimum contact time of 24 hr. Because the tablet method cannot be flushed and cleaned prior to disinfection, the required free chlorine residual must be detectable (≥0.2 mg/L) after 24 hr. Because the continuous-feed method can be used to flush particles, a higher free chlorine residual of 10 mg/L is required after 24 hr. To meet the needs of situations requiring reduced contact times, the slug method allows only a 3-hr contact time but requires a 100-mg/L initial chlorine dosage. For larger transmission lines, spray disinfection using 200 mg/L free chlorine may be a suitable option, minimizing discharges of highly chlorinated water. While the contact times of the methods may not be identical, the end result, absence of coliforms, is the same for all four methods.

Disinfectants other than chlorine may be appropriate to use. Although this standard describes only the use of liquid chlorine (gas), sodium hypochlorite solutions, and calcium hypochlorite, the applicability of other disinfectants should be evaluated. Ozone and chemical cleaners have been used, and these warrant further investigation. Whichever disinfectant or method is selected, approval from the local regulatory agency may be required.

III. Use of This Standard. It is the responsibility of the user of an AWWA standard to determine that the products described in that standard are suitable for use in the particular application being considered.

III.A. *Purchaser Options and Alternatives.* This standard is written as though the disinfection work will be performed by the purchaser's personnel. Where the work is to be performed using a separate contract or as part of a contract for installing mains,* appropriate provisions should be included in the purchase documents to ensure that the constructor is specifically instructed as to its responsibilities. The following information should be provided by the purchaser.

---

* Refer to other AWWA standards and manuals for design criteria and installation procedures for various pipe materials.

1. Standard used— that is, ANSI/AWWA C651, Standard for Disinfection of Water Mains, of latest revision.

2. Approval requirements before use.

3. Those procedures included in the standard that are designated as optional, that are to be included in the purchase documents.

4. Whether compliance with NSF/ANSI 60, Drinking Water Chemicals—Health Effects, is required.

5. Whether compliance with NSF/ANSI 61, Drinking Water System Components—Health Effects, is required.

6. Details of other federal, state or provincial, and local requirements (Section 4).

7. Form of chlorine to be used (Sec. 4.1.1, 4.1.2, and 4.1.3).

8. Method of chlorination (Sec. 4.3, 4.4, 4.5, and 4.6).

9. Flushing locations, rates of flushing, and locations of drainage facilities (Sec. 4.4.2, 4.9.1, and 4.9.2).

10. Responsibility for tapping existing mains and connections to new mains (Sec. 4.4.3[1], 4.4.3[2], and 4.10).

11. The number and frequency of samples for bacteriological tests (Sec. 5.1.1, 5.1.2, and 5.2).

12. Method of taking samples (Sec. 5.1.3).

III.B. *Modification to Standard.* Any modification of the provisions, definitions, or terminology in this standard must be provided by the purchaser.

IV. Major Revisions. Major revisions made to the standard in this edition include the following:

1. Clarified differences in the requirements between new and repaired mains (foreword II.A, Sec. 1.1, and 4.11).

2. Changed the requirement for bacteriological sampling in new mains from two sets of samples 24 hr apart to add two options for two sets of samples: Option A samples are 16 hr apart, and Option B samples are 15 min apart after a 16-hr rest period (foreword II.A and Sec. 5.1).

3. The flushing rate of 2.5 ft/sec has been increased to 3.0 ft/sec for a scour flush based on testing performed under Water Research Foundation Project No. 4307, which indicates the threshold velocity of 2.5 to 3.0 ft/sec for successful flushing (2.5- to 3.0-log removal) of sand particles. Since this is a threshold velocity, 3.0 ft/sec was chosen for the standard (Sec. 4.4.2 and Table 3).

4. Added spray disinfection method for large transmission mains (Sec. 4.6).

5. Appendix C has been deleted, and instead, a reference to ANSI/AWWA C655 is made for dechlorination (Sec. 4.7 and 4.9.2).

6. Developed a rationale for evaluating risk during pipe repairs and the level of disinfection and sampling needed under those conditions (Sec. 4.11).

V. Comments. If you have any comments or questions about this standard, please call the AWWA Engineering and Technical Services at 303.794.7711, FAX at 303.795.7603; write to the group at 6666 West Quincy Avenue, Denver, CO 80235-3098; or email the group at standards@awwa.org.

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ANSI/AWWA C651-14
(Revision of ANSI/AWWA C651-05)

American Water Works Association
Dedicated to the World's Most Important Resource™

AWWA Standard

Disinfecting Water Mains

SECTION 1: GENERAL

Sec. 1.1 Scope

This standard describes essential procedures for the disinfection of new and repaired potable water mains. New water mains shall be disinfected before they are placed in service. Water mains taken out of service for inspection, repair, or other activities may or may not require disinfection and sampling, depending on the risk of contamination. This standard describes the process for evaluating the risk under different conditions.

Sec. 1.2 Purpose

The purpose of this standard is to define the minimum requirements for the disinfection of water mains, including the preparation of water mains, application of chlorine, and sampling and testing for the presence of coliform bacteria.

Sec. 1.3 Application

This standard can be referenced in the purchase documents for the disinfection of water mains and can be used as a guide for the preparation of water mains, application of chlorine, and sampling and testing for the presence of coliform bacteria. The stipulations of this standard apply when this document has been referenced and only to the disinfection of water mains.

SECTION 2: REFERENCES

This standard references the following documents. In their latest editions, they form a part of this standard to the extent specified within the standard. In any case of conflict, the requirements of this standard shall prevail.

ANSI*/AWWA B300—Hypochlorites.

ANSI/AWWA B301—Liquid Chlorine.

ANSI/AWWA C652—Disinfection of Water Storage Facilities.

ANSI/AWWA C655—Field Dechlorination.

APHA,† AWWA, and WEF.‡ *Standard Methods for the Examination of Water and Wastewater*.

AWWA Manual M12, *Simplified Procedures for Water Examination*.

NSF/ANSI 61—Drinking Water System Components–Health Effects.

SECTION 3: DEFINITIONS

The following definitions shall apply in this standard:

1. *Available chlorine:* A measure of the amount of chlorine in chlorinated lime, hypochlorite compounds, chloramines, and other materials that are used for disinfection compared with the amount in elemental (liquid or gaseous) chlorine.

2. *Chlorine, combined:* The amount of chlorine combined with ammonia (NH_3) or other compounds in water.

3. *Chlorine, free:* Also called *free available chlorine*, the amount of chlorine available as dissolved gas (Cl_2), hypochlorous acid (HOCl), and hypochlorite (OCl^-) that is not combined with ammonia (NH_3) or other compounds in water that is available for disinfection.

4. *Chlorine residual:* Concentration of chlorine species present in water after the oxidant demand has been satisfied.

5. *Chlorine, total:* A combination of free chlorine, combined chlorine, and organochlorine species.

6. *Constructor:* The party that provides the work and materials for placement or installation.

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* American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036.
† American Public Health Association, 800 I Street NW, Washington, DC 20001.
‡ Water Environment Federation, 601 Wythe Street, Alexandria, VA 22314.

7. *Liquid chlorine (gas):* the commercially available form of liquefied elemental chlorine gas. (The term *liquid chlorine* is sometimes used to describe a hypochlorite solution. This use of the term is discouraged. See ANSI/AWWA B300, Hypochlorites.)

8. *Manufacturer:* The party that manufactures, fabricates, or produces materials or products.

9. *Purchaser:* The person, company, or organization that purchases any materials or work to be performed.

10. *Supplier:* The party that supplies material or services. A supplier may or may not be the manufacturer.

11. *Organochlorine:* Any organic compound containing chlorine as a constituent. Organochlorine compounds can form when chlorine reacts with organic substances.

SECTION 4: REQUIREMENTS

Materials shall comply with the requirements of the Safe Drinking Water Act and other federal regulations for potable water, wastewater, and reclaimed water systems as applicable.

Sec. 4.1 Forms of Chlorine for Disinfection

The forms of chlorine that may be used in the water main disinfection operations are liquid chlorine (gas), sodium hypochlorite solution, and calcium hypochlorite granules or tablets.

4.1.1 *Liquid chlorine (gas).* Liquid chlorine (gas) conforming to ANSI/AWWA B301 contains 100 percent available chlorine and is packaged in steel containers usually of 100-lb, 150-lb, or 1-ton (45.4-kg, 68.0-kg, or 907.2-kg) net chlorine weight. Liquid chlorine (gas) shall be used only (1) in combination with appropriate gas-flow chlorinators and ejectors to provide a controlled high-concentration solution feed to the water to be chlorinated; (2) under the direct supervision of someone familiar with the biological, chemical, and physical properties of liquid chlorine (gas) and who is trained and equipped to handle any emergency that may arise; and (3) when appropriate safety practices are observed to protect working personnel and the public. Makeshift equipment is not acceptable when liquid chlorine (gas) cylinders are used.

4.1.2 *Sodium hypochlorite.* Sodium hypochlorite conforming to ANSI/AWWA B300 is available in liquid form in glass, rubber-lined, or plastic containers typically ranging in size from 1 qt (0.95 L) to 5 gal (18.92 L). Containers of 30 gal (113.6 L) or larger may be available in some areas. Sodium hypochlorite contains approximately 5 percent to 15 percent available chlorine, and the storage conditions and time must be controlled to minimize its deterioration. (Available chlorine is expressed as a percent of weight when the concentration is 5 percent or less, and usually as a percent of volume for higher concentrations. Percent × 10 = grams of available chlorine per liter of hypochlorite.)

4.1.3 *Calcium hypochlorite.* Calcium hypochlorite conforming to ANSI/AWWA B300 is available in granular form or in 5-g tablets and must contain approximately 65 percent available chlorine by weight. The material should be stored in a cool, dry, and dark environment to minimize its deterioration.

Caution: Tablets dissolve in approximately 7 hr and must be given adequate contact time. Do not use calcium hypochlorite intended for swimming pool disinfection, as this material has been sequestered and is extremely difficult to eliminate from the pipe after the desired contact time has been achieved.

Sec. 4.2 General Considerations for All Methods of Chlorination

4.2.1 *General.* Four methods of chlorination are explained in this section: tablet, continuous feed, slug, and spray. The tablet method gives an initial chlorine dose of 25 mg/L; the continuous-feed method gives a 24-hr chlorine residual of not less than 10 mg/L; the slug method gives a 3-hr exposure of not less than 50 mg/L free chlorine; and the spray method gives a 30-min exposure of not less than 200 mg/L free chlorine. Caution should be used with highly chlorinated water when conducting hydrostatic pressure testing and with high-volume flushing of water.

4.2.2 *Flushing.* Potable water shall be used for disinfection, hydrostatic pressure testing, and flushing. Drainage should take place away from the construction or work area. Adequate drainage must be provided during flushing. If applicable, the valve(s) isolating the main from existing system should be locked out and tagged out to prevent unintentional release of the elevated chlorine residual water used for disinfection.

4.2.3 *Dechlorination.* When dechlorination is required, it is recommended that any high-velocity flushing be completed prior to disinfection. Dechlorination equipment may not be capable of handling high flows with high levels of chlorine.

Table 1 Weight of calcium hypochlorite granules to be placed at beginning of main and at each 500-ft (150-m) interval

Pipe Diameter (*d*)		Calcium Hypochlorite Granules	
in.	*(mm)*	*oz*	*(g)*
4	(100)	1.7	(48)
6	(150)	3.8	(108)
8	(200)	6.7	(190)
10	(250)	10.5	(298)
12	(300)	15.1	(428)
14 and larger	(350 and larger)	$D^2 \times 15.1$	$D^2 \times 428$

Where D is the inside pipe diameter, in feet $D = d/12$

Sec. 4.3 Tablet/Granule Method of Chlorination

4.3.1 *Tablet method.* The tablet method consists of placing calcium hypochlorite granules or tablets in the water main during installation and then filling the main with potable water to create a chlorine solution. This method may be used only if the pipes and appurtenances are kept clean and dry during construction.

Warning: This procedure must not be used on solvent-welded plastic or on screwed-joint steel pipe because of the danger of fire or explosion from the reaction of the joint compounds with the calcium hypochlorite.

4.3.2 *Placement of calcium hypochlorite granules during construction.* Calcium hypochlorite granules shall be placed at the upstream end of the first section of pipe, at the upstream end of each branch main, and at 500-ft (150-m) intervals. The quantity of granules at each location shall be as shown in Table 1.

4.3.3 *Placement of calcium hypochlorite tablets during construction.* Calcium hypochlorite tablets (5-grams) shall be placed in the upstream end of each section of pipe to be disinfected, including branch lines. Also, at least one tablet shall be placed in each hydrant branch and in other appurtenances. The number of 5-g tablets required for each pipe section shall be $0.0012\ d^2L$ rounded to the next higher integer, where d is the inside pipe diameter, in inches, and L is the length of the pipe section, in feet. Table 2 shows the number of tablets required for commonly used sizes of pipe. Calcium hypochlorite tablets shall be attached by an adhesive meeting the requirements of NSF/ANSI 61. There shall be adhesive only on the broadside of the tablet attached to the surface of the pipe. Attach tablets inside and at the top of the main. If the tablets are attached before the pipe section is placed in

Table 2 Number of 5-g calcium hypochlorite tablets required for dose of 25 mg/L*

Pipe Diameter		Length of Pipe Section, *ft (m)*				
		13 (4.0) or less	18 (5.5)	20 (6.1)	30 (9.1)	40 (12.2)
in.	*(mm)*	Number of 5-g Calcium Hypochlorite Tablets				
4	(100)	1	1	1	1	1
6	(150)	1	1	1	2	2
8	(200)	1	2	2	3	4
10	(250)	2	3	3	4	5
12	(300)	3	4	4	6	7
16	(400)	4	6	7	10	13

*Based on 3.25-g available chlorine per tablet

the trench, their positions shall be marked on the pipe exterior to indicate that the pipe has been installed with the tablets at the top.

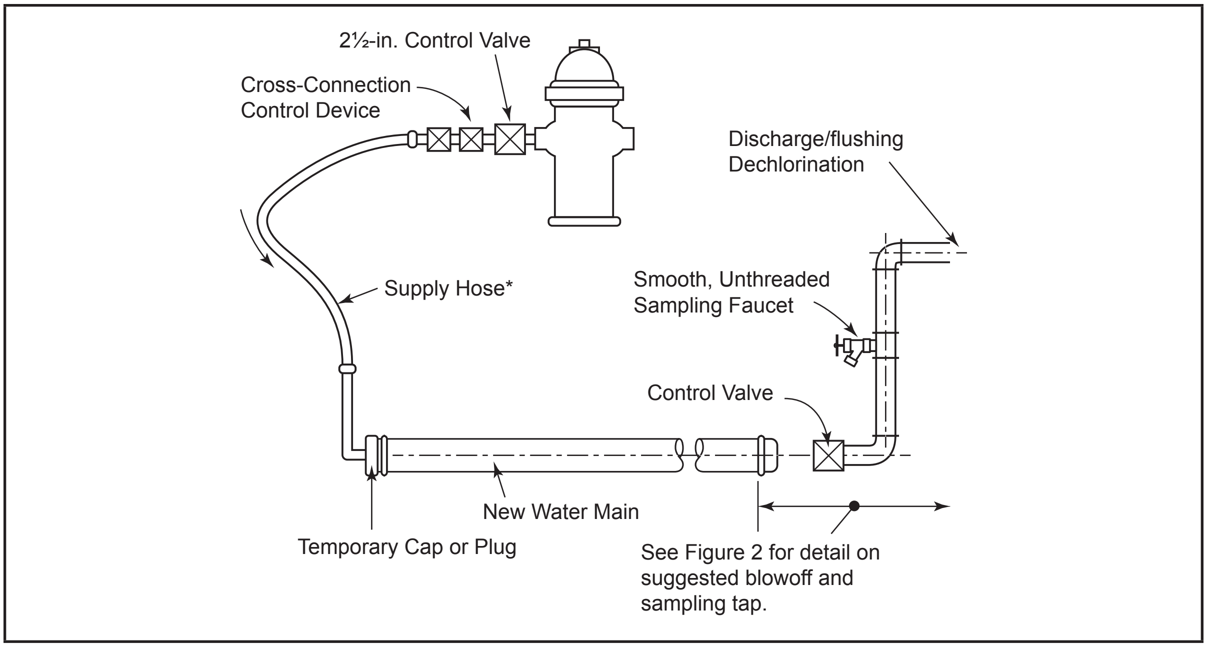
4.3.4 *Filling and contact time.* When installation has been completed, the main shall be filled with water such that the full pipe velocity is no greater than 1 ft/sec (0.3 m/sec). Fill rate must be carefully controlled to ensure tablets do not come loose from pipe. Precautions shall be taken to ensure that air pockets are eliminated. As an optional procedure, if required by the purchaser, water used to fill the new main shall be supplied through a temporary connection that shall include an appropriate cross-connection control device, consistent with the degree of hazard, for backflow protection of the active distribution system (see Figure 1).

The chlorinated water shall remain in the pipe for at least 24 hr. If the water temperature is less than 41°F (5°C), the water shall remain in the pipe for at least 48 hr. A detectable free chlorine residual (≥0.2 mg/L) shall be found at each sampling point after the 24- or 48-hr period.

Sec. 4.4 Continuous-Feed Method of Chlorination

4.4.1 *Continuous-feed method.* The continuous-feed method consists of completely filling the main with potable water, removing air pockets, then flushing the completed main to remove particulates, and refilling the main with potable water that has been chlorinated to 25 mg/L. After a 24-hr holding period in the main there shall be a free chlorine residual of not less than 10 mg/L.

4.4.2 *Preliminary flushing.* Before the main is chlorinated, it shall be filled with potable water to eliminate air pockets and flushed to remove particulates. The flushing velocity in the main shall not be less than 3.0 ft/sec (0.91 m/sec) unless



NOTE: Figure 1 applies to pipes with diameters 4 in. (100 mm) through 12 in. (300 mm). Larger sizes must be handled on a case-by-case basis.

*Clean potable-water hose only. Size and number of taps per Table 3. This hose must be removed during the hydrostatic pressure test.

Figure 1 Suggested temporary flushing/testing connection

Table 3 Required flow and openings (either taps or hydrants) to flush pipelines at 3.0 ft/sec (0.91 m/sec) (40 psi [276 kPa] residual pressure in water main)*

Pipe Diameter		Flow Required to Produce 3.0 ft/sec (approx.) Velocity in Main		Size of Tap Used, *in. (mm)* 1 (25)	1½ (38)	2 (51)	Number of Hydrant Outlets	
in.	*(mm)*	*gpm*	*(L/sec)*	Number of Taps Required on Pipe†			2½-in. (64-mm)	4½-in. (114 mm)
4	(100)	120	(7.4)	1	—	—	1	1
6	(150)	260	(16.7)	—	1	—	1	1
8	(200)	470	(29.7)	—	2	—	1	1
10	(250)	730	(46.3)	—	3	2	1	1
12	(300)	1,060	(66.7)	—	—	3	2	1
16	(400)	1,880	(118.6)	—	—	5	2	1

*With a 40-psi (276-kPa) pressure in the main with the hydrant flowing to atmosphere, a 2½-in. (64-mm) hydrant outlet will discharge approximately 1,000 gpm (63.1 L/sec); and a 4½-in. (114-mm) hydrant outlet will discharge approximately 2,500 gpm (160 L/sec).

†Number of taps on pipe based on 3.0-ft/sec discharge through 5 ft (1.5 m) of galvanized iron (GI) pipe with one 90° elbow.

the purchaser determines that conditions do not permit the required flow to be discharged to waste. Table 3 shows the rates of flow required to produce a velocity of 3.0 ft/sec (0.91 m/sec) in commonly used sizes of pipe. (Note: flushing is no substitute for preventive measures during construction. Certain contaminants, such as caked deposits, resist flushing at any feasible velocity, and pigging of the main, or other suitable method acceptable to the purchaser, may be required.) Where such flow rates are not possible, flushing at the maximum expected flow rate for the line for 2–3 volumes may be acceptable. For larger mains, pigging (or other suitable method acceptable to the purchaser) is an option in place of high velocity flushing.

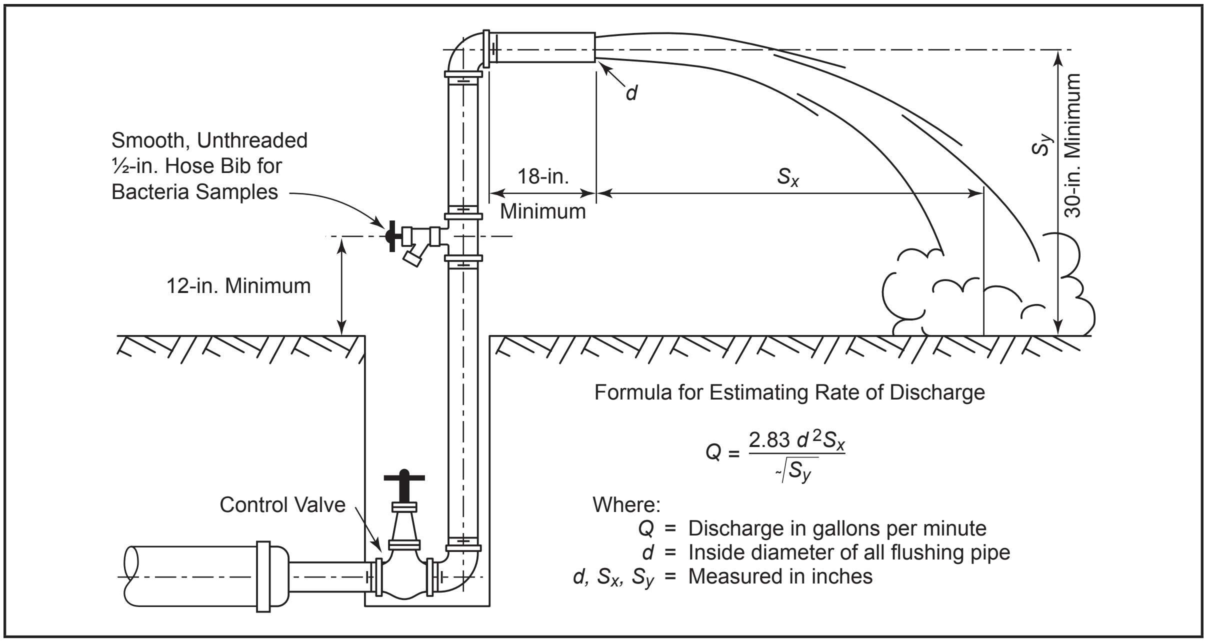
For 24-in. (600-mm) or larger diameter mains, an acceptable alternative to flushing is to broom-sweep the main, carefully removing sweepings prior to filling and chlorinating the main. Warning: OSHA requirements for confined space need to be addressed before entering a pipeline.

4.4.3 *Procedure for chlorinating the main.*

1. Potable water may be supplied from a temporary backflow-protected connection to the existing distribution system or other supply source approved by the purchaser. The cross-connection control device shall be consistent with the degree of hazard for backflow protection of the active distribution system (see Figure 1). The flow shall be at a constant, measured rate into the newly installed water main. In the absence of a meter, the rate may be approximated using a Pitot gauge in the discharge, measuring the time to fill a container of known volume, or measuring the trajectory of the discharge and using the formula shown in Figure 2. The main should undergo hydrostatic testing prior to disinfection.

2. At a point not more than 10 ft (3 m) downstream from the beginning of the new main, water entering the new main shall receive a dose of chlorine fed at a constant rate such that the water will have not less than 25 mg/L free chlorine. To ensure that an appropriate concentration is achieved, the free chlorine concentration shall be measured at regular time intervals in accordance with the procedures described in *Standard Methods for the Examination of Water and Wastewater* or AWWA Manual M12, or using appropriate chlorine test kit (see appendix A).

Table 4 gives the amount of chlorine required for each 100 ft (30.5 m) of pipe for various pipe diameters. Solutions with a minimum 1 percent chlorine concentration may be prepared with sodium hypochlorite or calcium hypochlorite. The latter solution requires 1 lb (454 g) of calcium hypochlorite in 8 gal (30.3 L) of water.



NOTE: This figure applies to pipes up to and including 8-in. (200-mm) diameter.

Figure 2 Suggested combination blowoff and sampling tap

Table 4 Chlorine required to produce an initial 25-mg/L concentration in 100 ft (30.5 m) of pipe by diameter

Pipe Diameter		100% Chlorine		1% Chlorine Solution	
in.	*(mm)*	*lb*	*(g)*	*gal*	*(L)*
4	(100)	0.013	(5.9)	0.16	(0.6)
6	(150)	0.030	(13.6)	0.36	(1.4)
8	(200)	0.054	(24.5)	0.65	(2.5)
10	(250)	0.085	(38.6)	1.02	(3.9)
12	(300)	0.120	(54.4)	1.44	(5.4)
16	(400)	0.217	(98.4)	2.60	(9.8)

3. Chlorine application shall not cease until the entire main is filled with chlorinated water. The chlorinated water shall be retained in the main for at least 24 hr, during which time valves and hydrants in the treated section shall be operated to ensure disinfection of the appurtenances. At the end of this 24-hr period, the treated water in all portions of the main shall have a residual of not less than 10 mg/L of free chlorine.

4. Direct-feed chlorinators, which operate solely from gas pressure in a chlorine cylinder, shall not be used for the application of liquid chlorine (gas). (The

danger of using direct-feed chlorinators is that water pressure in the main can exceed gas pressure in the chlorine cylinder. This allows backflow of water into the cylinder, resulting in severe cylinder corrosion and the escape of chlorine gas.)

The preferred equipment for applying liquid chlorine (gas) is a solution-feed, vacuum-operated chlorinator and a booster pump. The vacuum-operated chlorinator mixes the chlorine gas in solution water; the booster pump then injects the chlorine solution into the main to be disinfected. Hypochlorite solutions may be applied to the water main with a chemical-feed pump designed for feeding chlorine solutions. Feed lines shall be made of material capable of withstanding the corrosion caused by the concentrated chlorine solutions and the maximum pressures that may be created by the pumps. All connections shall be checked for tightness before the solution is applied to the main.

Sec. 4.5 Slug Method of Chlorination

4.5.1 *Slug method.* The slug method consists of completely filling the main to eliminate air pockets; flushing the main to remove particulates; then slowly flowing through the main a slug of water dosed with chlorine to a concentration of 100 mg/L. The slow rate of flow ensures that all parts of the main and its appurtenances will be exposed to the highly chlorinated water for a period of not less than 3 hr.

4.5.2 *Preliminary flushing.* Same as Sec. 4.4.2.

4.5.3 *Procedure for chlorinating the main.*

1. Potable water may be supplied from a temporary backflow-protected connection to the existing distribution system or other supply source approved by the purchaser. The cross-connection control device shall be consistent with the degree of hazard for backflow protection of the active distribution system (see Figure 1). The flow shall be at a constant, measured rate into the newly installed water main. In the absence of a meter, the rate may be approximated using a Pitot gauge in the discharge, measuring the time to fill a container of known volume, or measuring the trajectory of the discharge and using the formula shown in Figure 2. The main should undergo hydrostatic testing prior to disinfection.

2. At a point not more than 10 ft (3 m) downstream from the beginning of the new main, water entering the new main shall receive a dose of chlorine fed at a constant rate such that the water will have not less than 100 mg/L free chlorine. To ensure that this concentration is achieved, the free chlorine concentration shall be measured at regular time intervals sufficient to guide the completion of the successful loading of the target chlorine concentration. The chlorine shall be applied

continuously and for a sufficient period to develop a solid column, or slug, of chlorinated water that will, as it moves through the main, expose all interior surfaces to a concentration of approximately 100 mg/L for at least 3 hr.

3. The free chlorine residual shall be measured in the slug as it moves through the main. If at any time it drops below 50 mg/L, the flow shall be stopped; chlorination equipment shall be relocated at the head of the slug; and, as flow resumes, chlorine shall be applied to restore the free chlorine in the slug to not less than 100 mg/L.

4. As chlorinated water flows past fittings and valves, related valves and hydrants shall be operated so as to disinfect appurtenances and pipe branches.

Sec. 4.6 Spray Disinfection for Large Transmission Lines

For very large transmission mains (where personnel or equipment may safely enter the pipe), spray disinfection may be an appropriate and efficient means of achieving disinfection. For this method, refer to ANSI/AWWA C652, Sec. 4.3.2 (Disinfection of Water Storage Facilities; Chlorination Method 2). In general, once pipe is cleaned, spray a 200-mg/L free chlorine solution on all surfaces. After 30 min, fill line and sample as described in Sec. 5.1.

Sec. 4.7 Basic Disinfection Procedure for New Mains

The basic disinfection procedure consists of

1. Inspecting materials to be used to ensure their integrity.

2. Preventing contaminating materials from entering the water main during storage, construction, or repair and noting potential contamination at the construction site.

3. Removing, by flushing or other means, those materials that may have entered the water main or appurtenances.

4. Preventing contamination of existing mains from cross-connection during flushing, pressure testing, and disinfection.

5. Pressure testing the water main to ensure the main meets the purchaser's allowable leakage rate. Hydrostatic pressure tests should be conducted with potable water.

6. Chlorinating and adequately documenting the process used for disinfection.

7. Flushing the chlorinated water from the main. Refer to ANSI/AWWA C655 Field Dechlorination for dechlorination procedures, if dechlorination is required.

8. Determining the bacteriological quality of water samples collected from the pipe by laboratory test after disinfection.

9. Final connecting of the newly disinfected water main to the active distribution system without sacrificing sanitary practices and conditions.

Sec. 4.8 Preventive and Corrective Measures During New Construction

4.8.1 *General.* Heavy particulates generally contain bacteria and prevent even very high chlorine concentrations from contacting and killing these organisms. Therefore, the procedures of this section must be observed to ensure that a water main and its appurtenances have been thoroughly cleaned for the final disinfection by chlorination. Also, any connection of a new water main to the active distribution system before the receipt of satisfactory bacteriological samples may constitute a cross-connection. Therefore, the new main must be isolated until bacteriological tests described in Section 5 of this standard are satisfactorily completed.

4.8.2 *Keeping pipe clean and dry.* The interiors of pipes, fittings, and valves shall be protected from contamination.

4.8.2.1 Openings. Openings in the pipeline shall be closed with watertight plugs when pipe laying is stopped at the close of the day's work or for other reasons, such as rest breaks or meal periods. Rodent-proof plugs may be used when watertight plugs are not practicable and when thorough cleaning will be performed by flushing or other means.

4.8.2.2 Stringing pipe. Pipe delivered for construction shall be strung to minimize the entrance of foreign material.

4.8.2.3 Delays. Delay in placement of delivered pipe invites contamination. The more closely the rate of delivery is correlated to the rate of pipe laying, the lower the risk of contamination.

4.8.3 *Joints.* Joints of pipe in the trench shall be completed before work is stopped. If water accumulates in the trench, the plugs shall remain in place until the trench is free of standing water and mud that may enter the pipe.

4.8.4 *Packing materials.* Yarning or packing material shall consist of molded or tubular rubber rings, rope of treated paper, or other approved materials. Materials such as jute or hemp shall not be used. Packing material shall be handled in a manner that avoids contamination.

4.8.5 *Sealing materials.* No contaminated material or any material capable of supporting growth of microorganisms shall be used for sealing joints. Sealing material or gaskets shall be handled in a manner that avoids contamination. The lubricant used in the installation of sealing gaskets shall be suitable for use in potable water meeting the requirements of NSF/ANSI 61 and shall not contribute odors. It shall be delivered to the job in closed containers and shall be kept clean and applied with dedicated clean applicators.

4.8.6 *Cleaning and swabbing.* If dirt enters the pipe, it shall be removed and the interior pipe surface swabbed with a minimum 1 percent free chlorine disinfecting solution. If, in the opinion of the purchaser, the dirt remaining in the pipe will not be removed using the flushing operation, the interior of the pipe shall be cleaned using mechanical means, such as a hydraulically propelled foam pig (or other suitable device acceptable to the purchaser) in conjunction with the application of a minimum 1 percent free chlorine disinfecting solution. The cleaning method used shall not force mud or debris into the interior pipe-joint spaces and shall be acceptable to the purchaser.

4.8.7 *Wet-trench construction.* If it is not possible to keep the pipe and fittings dry during installation, a scour flush at 3.0 ft/sec (0.91 m/sec) or greater for a minimum of three pipe volumes (see Table 3) followed by slug or continuous-feed chlorination and bacteria testing before release is required. For larger mains, pigging or other suitable method acceptable to the purchaser is an option in place of high-velocity flushing.

4.8.8 *Flooding by storm or accident during construction.* If the main is flooded during construction, it shall be cleared of the floodwater by draining and flushing with potable water until the main is clean. The section exposed to the floodwater shall then be filled with a chlorinated potable water that, at the end of a 24-hr holding period, will have a free chlorine residual of not less than 25 mg/L. The chlorinated water may then be drained or flushed from the main. If chemical contamination occurs, such as a hydraulic oil leak or petroleum product spill, the pipe sections exposed to the contamination should be replaced and not reused for potable water applications. After construction is completed, the main shall be disinfected using the continuous-feed, slug, or spray methods.

4.8.9 *Backflow protection (optional).** As an optional procedure (if required by the purchaser), the new water main shall be kept isolated from the active distribution system using a physical separation (see Figure 1) until satisfactory bacteriological testing has been completed and the disinfection water flushed out.

Water required to fill the new main for hydrostatic pressure testing, disinfection, and flushing shall be supplied through a temporary connection between the

* Optional Sec. 4.8.9 is not included as part of the standard unless required by the purchaser.

distribution system and the new main or other supply source approved by the purchaser. The temporary connection shall include an appropriate cross-connection control device consistent with the degree of hazard (a double check valve assembly or a reduced pressure zone assembly) and shall be disconnected (physically separated) from the new main during the hydrostatic pressure test. It will be necessary to reestablish the temporary connection after completion of the hydrostatic pressure test to flush out the disinfectant water prior to final connection of the new main to the distribution system. NOTE: Exposure to high levels of chlorine or high pH can cause severe irritation to customers. Also, the chlorinated water can be high in disinfection by-products.

Sec. 4.9 Final Flushing for New Mains

4.9.1 *Clearing the main of heavily chlorinated water.* After the applicable retention period, heavily chlorinated water should not remain in prolonged contact with pipe. In order to prevent damage to the pipe lining or to prevent corrosion damage to the pipe itself, the heavily chlorinated water shall be flushed from the main fittings, valves, and branches until chlorine measurements show that the concentration in the water leaving the main is no higher than that generally prevailing in the distribution system or that is acceptable for domestic use.

4.9.2 *Disposing of heavily chlorinated water.* The environment to which the chlorinated water is to be discharged shall be inspected. If there is any possibility that the chlorinated discharge will cause damage to the environment, a neutralizing chemical shall be applied to the water to be wasted to thoroughly neutralize the residual chlorine (see ANSI/AWWA C655 for neutralizing chemicals). Where necessary, federal, state, local, or provincial regulatory agencies should be contacted to determine special provisions for the disposal of heavily chlorinated water.

Sec. 4.10 Final Connections to Existing Mains

Water mains and appurtenances must be completely installed, flushed, disinfected, and satisfactory bacteriological sample results received prior to permanent connections being made to the active distribution system. Sanitary construction practices must be followed during installation of the final connection so that there is no contamination of the new or existing water main with foreign material or groundwater.

4.10.1 *Connections equal to or less than one pipe length (generally ≤20 ft [6 m]).* The new pipe, fittings, and valve(s) required for the connection may be spray disinfected or swabbed with a minimum 1 percent solution of chlorine just before being installed, if the total length of the connection from the end of a new main to the existing main is equal to or less than 20 ft (6 m).

4.10.2 *Connections greater than one pipe length (generally >20 ft [6 m]).* The pipe required for the connection must be set up aboveground, disinfected, and bacteriological samples taken, as described in Section 5, if the total length of the connection from the end of a new main to the existing main is greater than 20 ft (6 m). After satisfactory bacteriological sample results have been received for the predisinfected pipe, the pipe can be used in connecting the new main to the active distribution system. Between the time the satisfactory bacteriological sample results are received and the time that the connection piping is installed, the ends of the piping must be sealed with plastic wraps, watertight plugs, or caps.

Sec. 4.11 Disinfection Procedures When Cutting Into or Repairing Existing Pipe

4.11.1 *General.* The planned, unplanned, or emergency repair of a water main or appurtenance (e.g., valve) is time sensitive—an important goal is to minimize the disruption of water service to customers. Nonetheless, the repair work needs to be accomplished using sanitary and safe procedures by well-trained crews with proper supervision and guidance. Refer to preventive and corrective measures described previously in Sec. 4.8.2, 4.8.3, 4.8.4, and 4.8.5. Follow all personal protection precautions when working with chlorine solutions.

4.11.2 *Basic disinfection.* Work should follow basic disinfection and contamination prevention procedures:

1. Preventing contaminants from entering the existing pipe during the repair such as by maintaining positive pressure in the leaking pipe until the repair site on the pipe is fully exposed, by maintaining a dewatered trench, and by keeping all pipe materials being used in the repair in a clean and sanitary condition.
2. Inspecting and cleaning, followed by disinfection of spraying or swabbing with a minimum 1 percent chlorine solution:
   - Exposed portions of existing pipe interior surfaces
   - Pipe materials used in the repair
   - Handheld materials and tools used to make the repair
3. As appropriate, advising affected customers to adequately flush their service lines upon return to service.

4.11.3 *Selection of disinfection procedure.* The disinfection procedure selected should be determined by the conditions and severity of the main break. Many leaks or breaks can be repaired under controlled conditions without depressurizing the water main, such as when applying a clamp to a small crack or hole, thus preventing contaminants from entering the water system. In most other situations, the water main can be maintained pressurized until the break site is secured and the pipe is fully exposed. Some circumstances (e.g., severe erosion of the local environment or icing of the roadway) that impact public safety may require that water pressure be substantially reduced prior to exposing the pipe in the area of the leak. In some cases, situations become catastrophic where there is a pipe blowout and a loss of water pressure prior to shutdown, requiring disinfection procedures equivalent to those of a new main installation. The procedures described in Sec. 4.11.3.1 through 4.11.3.3 describe the contamination risks and the associated disinfection and sampling requirements for different scenarios of pipeline repair. Specific situations not captured below need to be evaluated and the appropriate disinfection and sampling methods followed.

Note that the procedures explained in Sec. 4.11.3.1, 4.11.3.2, and 4.11.3.3 for distribution mains may need to be modified for large transmission mains. Large mains may need additional work (such as having a valve replaced or requiring a special order on a connection), may be out of service for more than a day, or may not be able to accommodate a scour flush. These modifications need to be made on a case-by-case basis but should still take into account the procedures outlined in ANSI/AWWA C651.

4.11.3.1 Controlled pipe repair without depressurization. In this situation, activities are well controlled and a full shutdown is not needed, thus maintaining positive pressure to the area of shutdown and around the break site at all times. The repair site is exposed and the trench is adequately dewatered so that the repair site can be cleaned and disinfected by spraying or swabbing with a minimum 1 percent chlorine solution. The water main is then returned to service with flushing to obtain three volumes of water turnover, making sure that the flushed water is visually clear. No bacteriological testing is necessary. It is advisable to check for a typical system chlorine residual, and if not found, to continue flushing until residuals are restored to levels maintained in the distribution system by the water utility—if the system operates with a disinfectant residual.

4.11.3.2 Controlled pipe repair with depressurization after shutdown. In this situation, after the repair site has been exposed and secured from trench soil/water contamination, the water main is depressurized by a shutdown to complete the repair. The repair site should be cleaned and disinfected by spraying or swabbing with a minimum 1 percent chlorine solution. The water main is then returned to service with flushing to scour the pipe and obtain three volumes of water turnover, making sure that the flushed water is visually clear. It is advisable to check for a typical system chlorine residual, and if not found, to continue flushing until residuals are restored to levels maintained in the distribution system by the water utility—if the system operates with a disinfectant residual.

When the existing pipe has to be opened and the interior surfaces of the water system exposed to the environment, additional procedures need to be followed. The existing pipe should be inspected and cleaned with the help of flushing water into the trench, where possible, until the flush water runs visually clear. The repair site should be accessible and the trench adequately dewatered so that the repair site can be cleaned and disinfected by spraying or swabbing with a minimum 1 percent chlorine solution. Additionally, any accessible upstream and downstream interior of the existing pipe should be disinfected by swabbing or spraying with a minimum 1 percent chlorine solution. If the repair requires a full pipe section replacement, the new pipe should be inspected, cleaned, and disinfected from both ends by swabbing with a minimum 1 percent chlorine solution. The water main may then be returned to service after flushing to scour the pipe and obtain three volumes of water turnover. The flushed water should run visually clear, have a measurable chlorine residual if the system operates with a residual, and be checked with bacteriological testing. The pipeline may be returned to service prior to obtaining bacteriological results.

4.11.3.3 Uncontrolled pipe break with a likelihood of water contamination or loss of sanitary conditions during repair. In situations in which the existing main to be repaired could not be protected and kept free of contamination and there are obvious signs of contamination (e.g., muddy trench water flowing into the broken pipe and a leaking sewer pipe in the trench, or catastrophic pipe failure where pipe is open and there is a likelihood that contamination was drawn into the active system) or when a controlled repair situation turns into a situation in which the internal pipe and water have become contaminated, the procedures outlined in Sec. 4.3, 4.4, 4.5, or 4.6 should be followed where practical. These methods specify chlorine doses of 25–300 mg/L; however, such levels may present greater harm if the line or services cannot be reliably isolated or shut down and exposure of customers to high concentrations of chlorine cannot be controlled. Free chlorine residuals up to 4 mg/L (based on annual averages) are allowed by federal drinking water regulations; therefore this level is suggested as a minimum to be maintained for at least 16 hr in conjunction with flushing, coliform sampling, and associated customer education. Such situations require careful review and need to balance the public health risks of the pipeline failure as well as the repair process.

Where practical and appropriate considering the risks of public exposure to high concentrations of chlorine, in addition to the procedures previously described in this standard, the section of pipe in which the break is located shall be isolated, all service connections shut off, and the section flushed and disinfected. If the slug chlorination method is employed, the dose may be increased to as much as 300 mg/L and the contact time reduced to as little as 15 min. After chlorination and repair, perform scour flushing at 3.0 ft/sec (0.91 m/sec) or greater for a minimum of three pipe volumes and continue until discolored water is not observed and the chlorine residual is restored to the levels maintained in the distribution system by the water utility.

For larger-diameter pipe (12 in. and greater), if a water velocity of 3.0 ft/sec (0.91 m/sec) cannot be achieved, it is desirable to flush at the maximum flow for the main until three pipe volumes have been displaced before returning the main to service. The flushed water should run visually clear, and have typical system chlorine residual (if the system operates with a disinfectant residual).

For very-large-diameter pipe (where personnel may safely enter the pipe), in lieu of flushing following disinfection, the interior of the pipe at the repair site may be cleaned by sweeping or high pressure wash using potable water before disinfection. Standing water and debris from the cleaning must be removed from the pipe prior to disinfection. The affected pipe shall be disinfected by swabbing or spraying with a minimum 1 percent chlorine solution.

After following the appropriate methods above, prior to returning the pipe to service, the efficacy of the disinfection procedure shall be verified by testing for the absence of coliform bacteria. If allowed by local regulations, the pipeline may be returned to limited service prior to obtaining bacteriological results with proper notification of the affected customers.

4.11.4 *Temporary service lines.* Temporary water service lines to customers during main repair activities shall be disinfected prior to use. Materials shall meet the NSF/ANSI 61 certification for potable water use. Disinfection should be accomplished by the procedures in Sec. 4.4 or 4.5 followed by scour flushing at 3.0 ft/sec (0.91 m/sec) or greater for a minimum of three pipe volumes (see Table 3), or until the water runs visually clear and preferably a measurable chlorine residual is restored.

SECTION 5: VERIFICATION

Sec. 5.1 Bacteriological Tests

5.1.1 *Standard conditions for new mains.* It should be recognized that the primary means of ensuring the sanitary integrity of a main are the sanitary handling of materials, the practices during construction, and continual inspection of work. After disinfection and final flushing such that typical system chlorine residuals are present, if the system operates with a residual, samples shall be collected as follows:

5.1.1.1 For new mains, the purchaser has two options for the bacteriological testing for total coliform analysis.

Option A: Before approving a main for release, take an initial set of samples and then resample again after a minimum of 16 hr using the sampling site procedures outlined. Both sets of samples must pass for the main to be approved for release.

Option B: Before approving a main for release, let it sit for a minimum of 16 hr without any water use. Then collect, using the sampling site procedures outlined and without flushing the main, two sets of samples a minimum of 15 min apart while the sampling taps are left running. Both sets of samples must pass for the main to be approved for release.

A set of samples includes all samples collected along the length of the pipeline, as described in Sec. 5.1.1.2.

5.1.1.2 For new mains, sets of samples shall be collected every 1,200 ft (370 m) of the new water main, plus one set from the end of the line and at least one from each branch greater than one pipe length.

5.1.1.3 If trench water has entered the new main during construction or if, in the opinion of the purchaser, excessive quantities of dirt or debris have entered the new main, bacteriological samples shall be taken at intervals of approximately 200 ft (61 m), and the sampling location shall be identified (see Sec. 5.1.3 for sampling location details). Samples shall be taken of water that has stood in the new main for at least 16 hr after final flushing has been completed.

5.1.1.4 A standard heterotrophic plate count (HPC) test may be required at the option of the purchaser because new mains do not typically contain coliform bacteria but often contain HPC bacteria. If sample results show HPC greater than 500 CFU/mL, flushing should resume and another set of HPC and coliform samples collected until no coliform are present and the HPC is less than 500 CFU/mL.

5.1.2 *Standard conditions for repaired mains.* It should be recognized that the primary means of ensuring the sanitary integrity of a main are the sanitary handling of materials, the practices during repair work, and continual inspection of work. After disinfection and final flushing, samples shall be collected as follows:

5.1.2.1 For repaired mains that were depressurized and/or wholly or partially dewatered, one set of samples may be required, and depending upon the sanitary conditions, the line may be reactivated prior to the completion of bacteriological testing. Samples shall be collected downstream of the repair site and at intervals of approximately 200 ft (61 m) within the length of pipe that was shut down. If direction of flow is not known, samples shall be collected on either side of the repair site. Refer to Sec. 4.11.

5.1.2.2 For repaired mains that were maintained under pressurized conditions at all times, disinfection and/or testing may not be required. Refer to Sec. 4.11.3.

5.1.2.3 However, under either main repair scenario, it is advisable where possible to provide a scour flush to clear before the release of the repaired section.

5.1.3 *Sampling procedure.* Samples for bacteriological analysis shall be collected in sterile bottles treated with sodium thiosulfate, in accordance with Section 9060—Samples of *Standard Methods for the Examination of Water and Wastewater*. Hoses and fire hydrants are not recommended for the collection of samples that will be used to make decisions on the bacteriological quality of drinking water. However, if no sampling port is available, cleaned fire hydrants that have been cleared of standing water and/or other sanitized sampling apparatus (i.e., sanitized tubing, hose, gooseneck, spigot) may be used with the understanding that they do not represent optimum access to the water main for bacteriological sampling. A suggested combination blowoff and sampling tap used for mains up to and including 8-in. (200-mm) diameter is shown in Figure 2. There should be no water in the trench up to the connection for sampling. The sampling pipe must be dedicated and clean and disinfected and flushed prior to sampling. A corporation cock may be installed in the main with a copper-tube gooseneck assembly. After samples have been collected, the gooseneck assembly may be removed and retained for future use and the corporation cock should be capped or taped for future reuse. If corporation cocks are placed at the 12 o'clock position, they may be struck more easily during future excavations.

5.1.4 *Sample results.* Samples shall be tested for bacteriological quality in accordance with *Standard Methods for the Examination of Water and Wastewater* and shall show the absence of coliform bacteria.

In addition, it is recommended that samples be tested for acceptable aesthetic quality (e.g., chlorine residual, pH, alkalinity, specific conductance, turbidity). Levels should be as expected or typical for the water system. For new mains, a standard heterotrophic plate count test may be required at the option of the purchaser because new mains do not typically contain coliform bacteria but often contain HPC bacteria. If sample results show HPC greater than 500 CFU/mL, flushing should resume and another set of HPC and coliform samples collected until no coliform are present and the HPC is less than 500 CFU/mL.

5.1.5 *Record of compliance.* The record of compliance shall be the bacteriological test results certifying that the water sampled is free of coliform bacteria contamination.

5.1.6 *Redisinfection.* If the initial disinfection fails to produce satisfactory bacteriological results, or if other results indicate unacceptable water quality, the main may be reflushed and shall be resampled. If check samples fail to produce acceptable results, the main shall be rechlorinated by the continuous-feed or slug method until satisfactory results are obtained—that being acceptable samples taken as described in Sec. 5.1.1.1.

Note: In the case of new mains, high velocities in the adjacent existing system, resulting from flushing the new main, may disturb sediment that has accumulated in the existing mains. When check samples are taken, it is advisable to sample water entering the new main to determine if excessive turbidity is present that could be interfering with results.

Sec. 5.2 Optional Sampling and Testing

If a pipeline is not promptly returned to service, the situation should be evaluated to determine if the water quality may have been impacted and if additional testing is warranted. Test results should confirm that the water quality is appropriate for distribution. Although this assessment is unique for each system, parameters considered for testing include disinfectant residual, total coliform bacteria, HPC, turbidity, pH, alkalinity, total chlorine, odor, and specific conductance.

SECTION 6: DELIVERY

This standard has no applicable information for this section.

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APPENDIX A

Chlorine Residual Testing

This appendix is for information only and is not a part of ANSI/AWWA C651.

SECTION A.1: DPD DROP DILUTION METHOD (FOR FIELD TEST)

The N, N-diethyl-p-phenylenediamine (DPD) drop dilution method of approximating total residual chlorine is suitable for concentrations above 10 mg/L, such as those applied in the disinfection of water mains or tanks.

Sec. A.1.1 Apparatus

1. A graduated cylinder for measuring distilled water.
2. An automatic or safety pipette.
3. Two dropping pipettes that deliver a 1-mL sample in 20 drops. One pipette is for dispensing the water sample, and the other is for dispensing the DPD and buffer solutions. The pipettes should not be interchanged.
4. A comparator kit containing a suitable range of standards.

Sec. A.1.2 Reagents

1. DPD indicator solution. Prepare as prescribed in *Standard Methods for the Examination of Water and Wastewater*.

Sec. A.1.3 Procedure

1. Add 10 drops of DPD solution and 10 drops of buffer solution (or 20 drops of combined DPD-buffer solution) to a comparator cell.
2. Fill the comparator cell to the 10-mL mark with distilled water.
3. With a dropping pipette, add the water sample one drop at a time; mix until a red color is formed that matches one of the color standards.
4. Record the total number of drops used and the final chlorine reading obtained (that is, the chlorine reading of the matched standard).
5. Calculate the milligrams per liter of free residual chlorine as follows:

$$\text{mg/L chlorine} = \frac{\text{reading} \times 200}{\text{drops of sample}}$$

SECTION A.2: HIGH-RANGE CHLORINE TEST KITS

Several manufacturers produce high-range chlorine test kits that are inexpensive, easy to use, and satisfactory for the precision required.

APPENDIX B

Chlorine Dosages

This appendix is for information only and is not a part of ANSI/AWWA C651.

Table B.1 Amounts of chemicals required to produce various chlorine concentrations in 100,000 gal (378.5 m^3) of water*

Desired Chlorine Concentration in Water	Liquid Chlorine Required		Sodium Hypochlorite Required						Calcium Hypochlorite Required	
			5% Available Chlorine		10% Available Chlorine		15% Available Chlorine		65% Available Chlorine	
mg/L	*lb*	*(kg)*	*gal*	*(L)*	*gal*	*(L)*	*gal*	*(L)*	*lb*	*(kg)*
2	1.7	(0.77)	3.9	(14.7)	2.0	(7.6)	1.3	(4.9)	2.6	(1.18)
10	8.3	(3.76)	19.4	(73.4)	9.9	(37.5)	6.7	(25.4)	12.8	(5.81)
50	42.0	(19.05)	97.0	(367.2)	49.6	(187.8)	33.4	(126.4)	64.0	(29.03)

*Amounts of sodium hypochlorite are based on concentrations of available chlorine by volume. For either sodium hypochlorite or calcium hypochlorite, extended or improper storage of chemicals may have caused a loss of available chlorine.

Table B.2 Amounts of chemicals required to produce chlorine concentration of 200 mg/L in various volumes of water*

Volume of Water		Liquid Chlorine Required		Sodium Hypochlorite Required						Calcium Hypochlorite Required	
				5% Available Chlorine		10% Available Chlorine		15% Available Chlorine		65% Available Chlorine	
gal	*L*	*lb*	*(g)*	*gal*	*(L)*	*gal*	*(L)*	*gal*	*(L)*	*lb*	*(g)*
10	(37.9)	0.02	(9.1)	0.04	(0.15)	0.02	(0.08)	0.02	(0.08)	0.03	(13.6)
50	(189.3)	0.10	(45.4)	0.20	(0.76)	0.10	(0.38)	0.07	(0.26)	0.15	(68.0)
100	(378.5)	0.20	(90.7)	0.40	(1.51)	0.20	(0.76)	0.15	(0.57)	0.30	(136.1)
200	(757.1)	0.40	(181.4)	0.80	(3.03)	0.40	(1.51)	0.30	(1.14)	0.60	(272.2)

*Amounts of sodium hypochlorite are based on concentrations of available chlorine by volume. For either sodium hypochlorite or calcium hypochlorite, extended or improper storage of chemicals may have caused a loss of available chlorine.

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ANSI/AWWA C652-02

(Revision of ANSI/AWWA C652-92)

AWWA STANDARD

FOR

DISINFECTION OF WATER-STORAGE FACILITIES

American National Standards Institute

Effective date: Aug. 1, 2002.

First edition approved by AWWA Board of Directors June 15, 1980.

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Approved by American National Standards Institute Inc., May 21, 2002.

AMERICAN WATER WORKS ASSOCIATION

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AWWA Standard

This document is an American Water Works Association (AWWA) standard. It is not a specification. AWWA standards describe minimum requirements and do not contain all of the engineering and administrative information normally contained in specifications. The AWWA standards usually contain options that must be evaluated by the user of the standard. Until each optional feature is specified by the user, the product or service is not fully defined. AWWA publication of a standard does not constitute endorsement of any product or product type, nor does AWWA test, certify, or approve any product. The use of AWWA standards is entirely voluntary. AWWA standards are intended to represent a consensus of the water supply industry that the product described will provide satisfactory service. When AWWA revises or withdraws this standard, an official notice of action will be placed on the first page of the classified advertising section of *Journal AWWA*. The action becomes effective on the first day of the month following the month of *Journal AWWA* publication of the official notice.

American National Standard

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Committee Personnel

The AWWA Standards Committee on Disinfection of Facilities which reviewed and approved this standard, had the following personnel at the time of approval:

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Contents

All AWWA standards follow the general format indicated subsequently. Some variations from this format may be found in a particular standard.

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Foreword

This foreword is for information only and is not a part of AWWA C652.

I. Introduction.

I.A. *Background.* This standard describes methods of disinfecting water storage tanks. The disinfecting agents discussed in this standard are chlorine solutions, and several combinations of free chlorine residual and contact time *(CT)* are provided. The chlorine solutions may be derived from liquid chlorine (Cl_2), calcium hypochlorite ($Ca(OCl)_2$), or sodium hypochlorite (NaOCl).

I.B. *History.* This standard was first approved on June 15, 1980, under the designation AWWA D105, Standard for Disinfection of Water Storage Facilities. The 1980 edition was developed from information originally contained in AWWA D102-64, modified to include disinfection of water-storage facilities constructed of steel or other materials. The standard was redesignated AWWA C652 with the 1986 edition. It was revised in 1992. This edition was approved on Jan. 20, 2002.

I.C. *Acceptance.* In May 1985, the US Environmental Protection Agency (USEPA) entered into a cooperative agreement with a consortium led by NSF International (NSF) to develop voluntary third-party consensus standards and a certification program for all direct and indirect drinking water additives. Other members of the consortium included the American Water Works Association Research Foundation (AWWARF) and the Conference of State Health and Environmental Managers (COSHEM). The American Water Works Association (AWWA) and the Association of State Drinking Water Administrators (ASDWA) joined later.

In the United States, authority to regulate products for use in, or in contact with, drinking water rests with individual states.* Local agencies may choose to impose requirements more stringent than those required by the state. To evaluate the health effects of products and drinking water additives from such products, state and local agencies may use various references, including

1. An advisory program formerly administered by USEPA, Office of Drinking Water, discontinued on Apr. 7, 1990.
2. Specific policies of the state or local agency.

*Persons in Canada, Mexico, and non-North American countries should contact the appropriate authority having jurisdiction.

3. Two standards developed under the direction of NSF, ANSI[*]/NSF[†] 60, Drinking Water Treatment Chemicals—Health Effects, and ANSI/NSF 61, Drinking Water System Components—Health Effects.

4. Other references, including AWWA standards, *Food Chemicals Codex, Water Chemicals Codex*,[‡] and other standards considered appropriate by the state or local agency.

Various certification organizations may be involved in certifying products in accordance with ANSI/NSF 60. Individual states or local agencies have authority to accept or accredit certification organizations within their jurisdiction. Accreditation of certification organizations may vary from jurisdiction to jurisdiction.

Annex A, "Toxicology Review and Evaluation Procedures," to ANSI/NSF 60 does not stipulate a maximum allowable level (MAL) of a contaminant for substances not regulated by a USEPA final maximum contaminant level (MCL). The MALs of an unspecified list of "unregulated contaminants" are based on toxicity testing guidelines (noncarcinogens) and risk characterization methodology (carcinogens). Use of Annex A procedures may not always be identical, depending on the certifier.

AWWA C652 does not address additives requirements. Thus, users of this standard should consult the appropriate state or local agency having jurisdiction in order to

1. Determine additives requirements, including applicable standards.

2. Determine the status of certifications by all parties offering to certify products for contact with, or treatment of, drinking water.

3. Determine current information on product certification.

II. Special Issues.

II.A. *Information on Application of This Standard.* Utilities are increasingly focusing on water storage reservoir management and maintenance as part of preserving distribution system water quality. As more frequent inspections and cleaning of reservoirs are required, utilities are turning to methods, which minimize downtime and wasted water. Utilities are utilizing inspection methods such as divers,

*American National Standards Institute, 25 W. 43rd St., Fourth Floor, New York, NY 10036.

†NSF International, 789 N. Dixboro Rd., Ann Arbor, MI 48105.

‡Both publications available from National Academy of Sciences, 2102 Constitution Ave. N.W., Washington, DC 20418.

float down, remotely operated vehicles for both inspection and sediment removal. Sec. 4.4 of this standard describes the disinfection procedures and operational considerations for conducting in-service inspection and cleaning in potable-water-storage facilities. Originally this standard addressed inspection of storage tanks by diving but has been expanded to address all forms of inspection and cleaning that are performed while the tanks are full of water.

It should be noted that any underwater retrieval of remotely operated vehicles with divers must be performed in accordance with all aspects of this standard.

Although, Sec. 4.4 specifically addresses water quality protection, the diving subcommittee felt it was very important to communicate the critical aspects of contractor safety, which should be incorporated into any project of this type. Utilities must be aware that it is their responsibility to determine if contractors working on their property are following proper OSHA procedures. When selecting a contractor to perform this type of work, it is essential to evaluate their experience, safety procedures, and methods. Each bidder should be willing to meet the minimums set by this standard for safe performance of the work.

This standard includes references to pertinent OSHA regulations.

It should be recognized that there are specific technical skills a utility should look for when considering a firm for this type of work:

- Qualifications for conducting in-service operations in compliance with OSHA
- Qualifications for inspecting and evaluating steel/concrete/wood or membrane-covered reservoirs
- Resumes for those specific personnel who will perform underwater inspection

Sec. 4.4 does not address the following items, each of which must be specified by the purchaser:

1. The type of inspection to be performed (structural, coating, bottom sediment, cathodic protection, bacteriological, and so forth).
2. The technical requirements of the inspection.

For additional guidance:

Refer to AWWA M42 Manual of Water Supply Practices *Steel Water-Storage Tanks*.

Sec. 4.4 does not attempt to rewrite existing safety standards and relies on the existing applicable OSHA Standards, including but not limited to

OSHA, 29 CFR, Subpart T Commercial Diving Operations 1910.401 through 1910.441

OSHA, 29 CFR, Permit Required Confined Spaces, 1910.146

III. Use of This Standard. This standard describes methods of disinfecting water-storage facilities that are newly constructed, have been entered for construction or inspection purposes, or that continue to show the presence of coliform bacteria during normal operation. In addition, the standard defines disinfection procedures for underwater inspections because water utilities increasingly are employing divers to conduct underwater inspections of on-line potable-water-storage facilities to minimize water loss and downtime normally associated with necessary maintenance inspections. The standard does not describe the type and technical requirements of underwater inspection or the required skill level of the diving inspector.

A storage facility is defined as a reservoir from which water, without further treatment other than booster disinfection, is supplied directly to the distribution piping system for domestic use. From a practical standpoint, this standard applies to the disinfection of covered storage facilities constructed of steel, concrete, or materials that would provide a similar structure from a water quality standpoint. Because wood may support the growth of coliform bacteria, it is recommended that any submerged wood surface (columns, baffles, and so forth) be coated with epoxy or other durable, effectively impermeable paint or coating approved for domestic water use.

Parts of this standard may be applicable to the disinfection of large, finished-water, open storage reservoirs, such as reservoirs formed by concrete or earth dams, but these applications are incidental, and this standard is not intended to cover those kinds of storage facilities.

Three methods of chlorinating storage facilities are described in this standard. Each utility should decide which method is most suitable for a given situation. In selecting the method to be used, the utility should consider the availability of materials and equipment for disinfection, the training of personnel who will perform the disinfection, and safety. For example, gas chlorination should be used only when properly designed and constructed equipment is available; makeshift equipment is not acceptable when liquid-chlorine cylinders are used. Spray equipment should be used inside the storage facility only when thorough ventilation is assured or when appropriate protection is provided using canister-type gas masks or self-contained breathing units. If a chlorination method is selected that requires the draining of a storage facility in order to dispose of highly chlorinated water, then thorough consideration should be given to the effect on the receiving environment. If there is any question as to whether a chlorinated-waste discharge may cause damage to fish life, plant life, physical installations, or other downstream water uses of any type, then an adequate amount of a reducing agent should be applied to the discharged water in order to thoroughly neutralize the chlorine residual.

III.A. *Purchaser Options and Alternatives.* This standard is written as though the work will be done by the purchaser's personnel. If the purchaser is contracting for the work to be done, appropriate provisions should be included in the contract agreement to ensure that the constructor is specifically instructed as to his responsibilities. At the least, the purchaser should specify the following:

1. Standard used—that is, AWWA C652, Standard for Disinfection of Water-Storage Facilities, of latest edition.
2. Method of disinfection to be used.
3. Any required disposal and precautions to be taken in disposing of chlorinated water in the storage facility.
4. Bacteriological testing and method to be used.
5. Redisinfection procedure if required.

III.B. *Modification to Standard.* Any modification of the provisions, definitions, or terminology in this standard must be provided in the purchaser's specifications.

IV. Major Revisions. Major changes made in this revision of AWWA C652 are as follows:

1. Sec. 4.4, Disinfection Procedures When Conducting Underwater Inspection of Potable-Water-Storage Facilities, was modified.

V. Comments. If you have any comments or questions about this standard, please call the AWWA Volunteer & Technical Support group, (303) 794-7711 ext. 6283, FAX (303) 795-7603, or write to the group at 6666 W. Quincy Ave., Denver, CO 80235.

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American Water Works Association

ANSI/AWWA C652-02
(Revision of ANSI/AWWA C652-92)

AWWA STANDARD FOR

DISINFECTION OF WATER-STORAGE FACILITIES

SECTION 1: GENERAL

Sec. 1.1 Scope

This standard for disinfection of water-storage facilities describes materials, facility preparation, application of disinfectant to interior surfaces of facilities, and sampling and testing for the presence of coliform bacteria. The standard also includes disinfection procedures for underwater inspection of on-line, potable-water-storage facilities but does not describe the technical aspects of underwater inspection. All new storage facilities shall be disinfected before they are placed in service. All storage facilities taken out of service for inspecting, repairing, painting, cleaning, or other activity that might lead to contamination of water shall be disinfected before they are returned to service.

Sec. 1.2 Purpose

The purpose of this standard is to define the minimum requirements for the disinfection of water storage facilities, including the preparation of water storage facilities, application of chlorine, procedures for disinfecting underwater inspection equipment, and sampling and testing for the presence of coliform bacteria.

Sec. 1.3 Application

This standard can be referenced in specifications for the disinfection of water storage facilities and can be used as a guide for the preparation of water storage facilities, application of chlorine, disinfection procedures to be used during underwater inspections, and testing for the presence of coliform bacteria. The stipulations of this standard apply when this document has been referenced and then only to the disinfection of water storage facilities.

SECTION 2: REFERENCES

This standard references the following documents. In their latest edition, they form a part of this standard to the extent specified within the standard. In case of any conflict, the requirements of this standard shall prevail.

ANSI*/AWWA B300—Hypochlorites.

ANSI/AWWA B301—Liquid Chlorine.

Standard Methods for the Examination of Water and Wastewater. APHA,† AWWA, and WEF.‡ Washington, D.C. (20th ed., 1998).

Additional materials relating to activity according to this standard include the following:

Chlorine Manual—Chlorine Institute Inc.§

Introduction to Water Treatment. WSO Series, Vol. 2. AWWA, Denver (1994).

Material safety data sheets for forms of chlorine used (provided by suppliers).

Safety Practice for Water Utilities. AWWA Manual M3. AWWA, Denver (2002).

Water Chlorination Principles and Practices. AWWA Manual M20. AWWA, Denver (1973).

Water Quality and Treatment. AWWA, Denver (5th ed.).

SECTION 3: DEFINITIONS

1. *Constructor:* The party that provides the work and materials for placement and installation.

*American National Standards Institute, 25 W. 43rd St., Fourth Floor, New York, NY 10036.

†American Public Health Association, 800 I St., N.W., Washington, DC 20001-3710.

‡Water Environment Federation, 601 Wythe St., Alexandria, VA 22314.

§Chlorine Institute Inc., 2001 L St. N.W., Suite 506, Washington, DC 20036-4919.

SECTION 4: REQUIREMENTS

Sec. 4.1 Materials and Cleaning

4.1.1 *Materials entering tank.* All scaffolding, planks, tools, rags, and other materials not part of the structural or operating facilities of the tank shall be removed. Then the surfaces of the walls, floor, and operating facilities of the storage facility shall be cleaned thoroughly using a high-pressure water jet, sweeping, scrubbing, or equally effective means. All water, dirt, and foreign material accumulated in this cleaning operation shall be discharged from the storage facility or otherwise removed.

4.1.2 *Other materials.* Following the cleaning operation, the vent screen, overflow screen, and any other screened openings shall be checked and put in satisfactory condition to prevent birds, insects, and other possible contaminants from entering the facility. Any material required to be in the operating storage facility after the cleaning procedure has been completed shall be clean and sanitary when placed in the facility. In these instances, care shall be taken to minimize the introduction of dirt or other foreign material. (For example, placing a layer of limestone granules on the unpainted bottom of the storage facility to prevent corrosion.)

Sec. 4.2 Forms of Chlorine for Disinfection

The forms of chlorine that may be used in the disinfecting operations are liquid chlorine, sodium hypochlorite solution, and calcium hypochlorite granules or tablets.

4.2.1 *Liquid chlorine.* Liquid chlorine conforming to ANSI/AWWA B301 contains 100 percent available chlorine and is packaged in steel containers usually of 100-lb, 150-lb, or 1-ton (45.4-kg, 68.0-kg, or 907.2-kg) net chlorine weight. Liquid chlorine shall be used only (1) in combination with appropriate gas-flow chlorinators and ejectors to provide a controlled high-concentration solution feed to the water to be chlorinated; (2) under the direct supervision of a person who is familiar with chlorine's physiological, chemical, and physical properties, and who is trained and equipped to handle any emergency that may arise; and (3) when appropriate safety practices are observed to protect working personnel and the public.

4.2.2 *Sodium hypochlorite.* Sodium hypochlorite conforming to ANSI/AWWA B300 is available in liquid form in glass, rubber-lined, or plastic containers typically ranging in size from 1 qt (0.95 L) to 5 gal (18.92 L). Containers of 30 gal (113.6 L) or larger may be available in some areas. Sodium hypochlorite contains approximately 5 percent to 15 percent available chlorine by volume, and care must be taken to control storage conditions and length of storage to minimize its deterioration.

4.2.3 *Calcium hypochlorite.* Calcium hypochlorite conforming to ANSI/AWWA B300 is available in granular form or in small tablets and contains approximately 65 percent available chlorine by weight. The material should be stored in a cool, dry, dark environment to minimize its deterioration.

Sec. 4.3 Methods of Chlorination

Three methods of chlorination are explained in this standard. Typically, only one method will be used for a given storage-facility disinfection, but combinations of the methods may be used. The three methods are (1) chlorination of the full storage facility such that, at the end of the appropriate retention period, the water will have a free chlorine residual of not less than 10 mg/L; (2) spraying or painting of all storage facility water-contact surfaces with a solution of 200-mg/L available chlorine; and (3) a two-step process of chlorinating the bottom portion of the storage facility with 50-mg/L available chlorine followed by filling to overflow and maintaining a free chlorine residual of at least 2 mg/L for 24 hr.

4.3.1 *Chlorination method 1.* The water-storage facility shall be filled to the overflow level with potable water to which enough chlorine is added to provide a free chlorine residual in the full facility of not less than 10 mg/L at the end of the appropriate 6-hr or 24-hr period, as described in Sec. 4.3.1.4. The chlorine, either as calcium hypochlorite, sodium hypochlorite, or liquid chlorine, shall be introduced into the water as described hereafter.

4.3.1.1 Liquid-chlorine use. Liquid chlorine shall be introduced into the water filling the storage facility in such a way as to give a uniform chlorine concentration during the entire filling operation. Portable chlorination equipment shall be carefully operated and shall include a liquid-chlorine cylinder, gas-flow chlorinator, chlorine ejector, safety equipment, and an appropriate solution tube to inject the high-concentration chlorine solution into the filling water. The solution tube shall be inserted through an appropriate valve located on the inlet pipe and near the storage facility such that the chlorine solution will mix readily with the inflowing water.

4.3.1.2 Sodium hypochlorite use. Sodium hypochlorite shall be added to the water entering the storage facility by means of a chemical-feed pump or shall be applied by hand-pouring into the storage facility and allowing the inflowing water to provide the desired mixing.

4.3.1.2.1 When a chemical-feed pump is used, the concentrated chlorine solution shall be pumped through an appropriate solution tube so as to inject the high-concentration chlorine solution at a rate that will give a uniform chlorine concentration in the filling water. The solution tube shall be inserted through an appropriate valve located on the inlet pipe and near the storage facility, or through an appropriate valve located on the storage facility such that the chlorine solution will mix readily with the filling water.

4.3.1.2.2 When the sodium hypochlorite is poured into the storage facility, the filling of the storage facility shall begin immediately thereafter or as soon as any removed manhole covers can be closed. The sodium hypochlorite may be poured through the cleanout or inspection manhole in the lower course or level of the storage facility, in the riser pipe of an elevated tank, or through the roof manhole. The sodium hypochlorite shall be poured into the water in the storage facility when the water is not more than 3 ft (0.9 m) in depth, nor less than 1 ft (0.3 m) in depth or as close thereto as manhole locations permit.

4.3.1.3 Calcium hypochlorite use. Calcium hypochlorite granules or tablets broken or crushed to sizes not larger than ¼-in. (6.4-mm) maximum dimension may be poured or carried into the storage facility through the cleanout or inspection manhole in the lower course or level of the storage facility, into the riser pipe of an elevated tank, or through the roof manhole. The granules or tablet particles shall be placed in the storage facility before flowing water into it. The granules or tablets shall be located so that the inflowing water will ensure a current of water circulating through the calcium hypochlorite, dissolving it during the filling operation. The calcium hypochlorite shall be placed only on dry surfaces unless adequate precautions are taken to provide ventilation or protective breathing equipment.

4.3.1.4 Retention period. After the storage facility has been filled with the disinfecting water, it shall stand full as follows: (1) for a period of not less than 6 hr when the water entering the storage facility has been chlorinated uniformly by gas-feed equipment or chemical pump, or (2) for a period of not less than 24 hr when the storage facility has been filled with water that has been mixed with sodium hypochlorite or calcium hypochlorite within the storage facility as described in Sec. 4.3.1.2 and 4.3.1.3.

4.3.1.5 Handling of disinfection water. After the retention period stated in Sec. 4.3.1.4, the free chlorine residual in the storage facility shall be reduced to a concentration appropriate for distribution by completely draining the storage facility and refilling with potable water, or by a combination of additional holding time and blending with potable water having a low chlorine concentration. When an appropriate chlorine concentration is reached and subjected to satisfactory bacteriological testing and acceptable aesthetic quality, the water may be delivered to the distribution system.

4.3.1.5.1 The environment into which the chlorinated water is to be discharged shall be inspected, and if there is any likelihood that the chlorinated discharge will cause damage, then a reducing agent shall be applied to the water to be wasted to thoroughly neutralize the chlorine residual in the water. Federal, state, or local environmental regulations may require special provisions or permits prior to disposal of highly chlorinated water. The proper authorities should be contacted prior to disposal of highly chlorinated water.

4.3.2 *Chlorination method 2.* A solution of 200-mg/L available chlorine shall be applied directly to the surfaces of all parts of the storage facility that would be in contact with water when the storage facility is full to the overflow elevation.

4.3.2.1 Method of application. The chlorine solution may be applied with suitable brushes or spray equipment. The solution shall thoroughly coat all surfaces to be treated, including the inlet and outlet piping, and shall be applied to any separate drain piping such that it will have available chlorine of not less than 10 mg/L when filled with water. Overflow piping need not be disinfected.

4.3.2.2 Retention. The disinfected surfaces shall remain in contact with the strong chlorine solution for at least 30 min, after which potable water shall be admitted, the drain piping purged of the 10-mg/L chlorinated water, and the storage facility then filled to its overflow level. Following this procedure and subject to satisfactory bacteriological testing and acceptable aesthetic quality, the water may be delivered to the distribution system.

4.3.3 *Chlorination method 3.* Water and chlorine shall be added to the storage facility in amounts such that the solution will initially contain 50 mg/L available chlorine and will fill approximately 5 percent of the total storage volume. This solution shall be held in the storage facility for a period of not less than 6 hr. The storage facility shall then be filled to the overflow level by flowing potable water into the highly chlorinated water. It shall be held full for a period of not less than 24 hr. All highly chlorinated water shall then be purged from the drain piping. Following this procedure and subject to satisfactory bacteriological testing and acceptable aesthetic quality, the remaining water may be delivered to the distribution system.

4.3.3.1 Adding chlorine. Chlorine shall be added to the storage facility by the method described in Sec. 4.3.1.1, 4.3.1.2, or 4.3.1.3. The actual volume of the 50-mg/L chlorine solution shall be such that, after the solution is mixed with filling water and the storage facility is held full for 24 hr, there will be a free-chlorine residual of not less than 2 mg/L.

Sec. 4.4 Disinfection Procedures When Conducting Underwater Inspection of Potable-Water-Storage Facilities

4.4.1 *Pre-job meeting.* A pre-job meeting involving the constructor and water utility representatives shall be held to ensure the following; that the personnel understand the configuration of the reservoir, the disinfection procedures, that underwater appurtenances are identified, that time restrictions are discussed, that the diving conditions are considered, that safety procedures are in place, and that inspection requirements are understood. Any problems associated with logistics should be resolved at this time. Clear communications between utility operations personnel and the constructor are essential.

4.4.2 *Storage-facility isolation.* In certain instances, safe diving operations may require the water-storage facility to be removed from service and isolated from the system prior to inspection by closing all inlet and outlet valves. Flowmeters and the tank level should be monitored to verify that the facility has been isolated. The underwater inspection should be made with the reservoir as full as possible, while still leaving room for access to the roof area. If the reservoir must be inspected with the inlet/outlet valves in the open position, then system valves further upstream or downstream should be closed. Off-line inspection/cleaning of storage facilities may not be possible or convenient for certain tanks or clearwells. On-line diving work may be completed safely, but strict attention to safety is required. If special operational conditions necessitate underwater inspection or cleaning without isolation, then diving work should be done during periods when positive flow into the reservoir is maintained and rates into or out of the water-storage facility are minimal. For underwater inspection of nonisolated facilities having a common inlet/outlet pipe, it is strongly recommended that a positive flow into the storage facility be maintained during the dive.

4.4.3 *Storage-facility access.* Before the facility access hatch is opened, the hatch and immediate area shall be cleaned of all loose dirt and debris. Special care should be taken to keep the equipment and personnel clean prior to entering the tank. Dirt and contaminants on the reservoir roof, adjacent to the hatch can re-contaminate the equipment. If any equipment that will enter the tank makes contact with the roof, it shall be re-disinfected prior to entering the tank.

4.4.4 *Initial water quality.* The first step of any in-service inspection project shall be for the utility to establish the chlorine residual and turbidity in the reservoir contents before entering the reservoir for any other purpose. The utility should take representative water samples from several depth locations, if possible, and analyze for chlorine residual and turbidity. Turbidity testing is especially important if the reservoir is being cleaned or inspected while on line. The results shall be recorded for future reference.

4.4.5 *Equipment and personnel requirements.*

4.4.5.1 Equipment and clothing. All equipment to be used for inspection/cleaning of potable-water-storage facilities shall be dedicated for that purpose only. All equipment shall be constructed and maintained in such a fashion so that water quality will not be affected. All equipment shall be available for inspection.

4.4.5.1.1 According to this standard, both SCUBA (self-contained underwater breathing apparatus) and externally supplied air methods are acceptable air sources.

4.4.5.1.2 All equipment exposed to the water shall be suitable for disinfection. Divers shall be completely encapsulated with no bare skin exposed. Diving clothing shall be of the dry-suit type and shall be in good condition, free from tears, scrapes, unrepaired areas, or other imperfections that may impair the integrity of the suit. The diver and the clothing shall be disinfected after the diver is suited up and on top of the tank as per Sec. 4.3.2. All equipment and dry suits dedicated for potable-water underwater inspection work shall be stored in a manner that prevents both chemical and bacteriological contamination. Personnel entering a tank for the purposes of a float-down inspection must wear a dry suit that can be disinfected properly.

4.4.5.1.3 There shall be no contact of the mouth or head with the water during any underwater operations. The head shall be fully encapsulated by one or a combination of the following: helmet or dry suit hood with full-face mask.

4.4.5.1.4 Divers shall have communication in accordance with federal, state, provincial, and local regulations.

4.4.5.1.5 Underwater operations may be videotaped or documented with still photographs at the utility's request.

4.4.5.1.6 Disturbing tank bottom sediment may impair water quality. Sediment may contain bacteria, which if resuspended can cause contamination. Disturbed sediment will create localized turbidity. In some cases, it may be desirable to disturb a small area of thin sediment in order to inspect the underlying coating or floor condition. Divers or ROVs shall not disturb the sediment in any way unless explicitly approved by the utility to do so; this includes "walking on the floor."

4.4.5.2 Personnel requirements. Because of the hazardous nature of this work, combining confined-space entry and diving, the constructor performing the work shall comply with all federal, state, provincial, and local regulations.

4.4.5.2.1 Certain diving constructors who have been providing these services for many years may not have the formal certifications listed below. Utilities should carefully review the documentation of training and experience for these firms and require a detailed personal diver's log for the personnel who will conduct the on-site work. Simply, the presentation of a sport diver certification card for SCUBA by itself is not acceptable proof of proper training.

The following is a limited list of examples of diver qualifications that are acceptable—but not without detailed documentation of training and direct tank inspection—cleaning work experience:

2nd Class US Navy Diver Training

ANSI/ACDE 01 (latest version) Commercial Diver Certification

ADC Commercial Certification

4.4.5.2.2 All personnel on the dive or float-down team must be OSHA Confined Space Certified. These certificates should be provided on the job site for all personnel.

4.4.5.2.3 All personnel on the dive or float-down team shall be free of communicable disease and shall not have been under a physician's care within the seven-day period prior to the entering of the facility. No person who knowingly has an abnormal temperature or symptoms of illness shall work in a water-storage facility.

4.4.5.2.4 The American Red Cross or an equivalent agency shall certify all dive team members in the use of CPR and First Aid.

4.4.5.3 Safety. The dive team shall comply with all applicable local, state, and federal safety requirements and shall provide all necessary safety equipment suitable for the specific access opening, depth to water, and other aspects of the water-storage facility to be inspected.

4.4.5.3.1 The constructor shall have a comprehensive safety manual on site, which addresses all of the potential hazards encompassed by the in-service operations. The safety manual shall include certifications for all on site employees for diving, confined space, first aid, and CPR. The constructor shall have a method and the equipment readily available for the extraction of an injured diver and a method for lowering a person to the ground who is incapacitated. This may include the use of a properly trained and equipped local fire department or rescue squad. The use of an outside response team must be covered in the pre-job meeting, and they must be able to respond quickly or be on site during the work.

4.4.6 *Equipment disinfection.* All equipment that will enter the water-storage facility must be disinfected immediately prior to entry into the potable-water reservoir. Any equipment making contact with the tank roof must be disinfected again prior to entry into the water. The method of equipment disinfection can be submersion in, spraying with, or sponging with disinfectant solution as defined in Sec. 4.3.2. Care must be taken when applying disinfectant solution to the diver and equipment so that any excess, runoff, or spillage is controlled so it does not enter the reservoir.

4.4.7 *Post-inspection chlorine residual and bacteriological testing.* If proper disinfection procedures are followed, there should be no need to increase the chlorine residual in the storage facility after completion of the inspection. However, after all personnel and equipment are removed from the water-storage facility, the chlorine residual in the facility should be re-tested. If the chlorine residual has dropped from that indicated by the initial test made prior to entry, sufficient chlorine solution or granules shall be added to the storage facility to return the chlorine residual to pre-entry levels, but not to exceed a chlorine concentration of 2 mg/L.

Disinfectant shall be added in a manner to achieve maximum distribution over the surface and achieve all possible mixing. Adequate mixing can be promoted by circulation, if available, or with portable mixers or portable pumps suitably disinfected. (NOTE: The pre- and post-dive residuals may not match exactly because of sampling and analytical variability).

When chlorine residual is at pre-entry levels, samples for coliform organisms should be taken by the owner and analyzed in accordance with Sec. 5.1.

If the chlorine residual in the storage facility did not drop during the inspection, the facility can be returned to service (if it was isolated) as soon as the bacteriological samples have been confirmed as acceptable. However, if it was necessary to rebuild the chlorine residual in the storage facility, the facility should not be placed in service until after completion of a satisfactory bacteriological analysis.

4.4.9 *Affidavit of compliance.* The purchasing utility may require that the constructor performing the inspection or cleaning services provide an affidavit of compliance with the requirements of this standard.

SECTION 5: VERIFICATION

Sec. 5.1 Bacteriological Sampling and Testing

5.1.1 *Standard conditions.* After the chlorination procedure is completed and before the storage facility is placed in service, water from the full facility shall be sampled and tested for coliform organisms in accordance with the latest edition of *Standard Methods for the Examination of Water and Wastewater.* The testing method used shall be either the multiple-tube fermentation technique or the membrane-filter technique, or the enzyme substrate coliform test.

5.1.1.1 Test for odor. The water in the full facility should also be tested to ensure that no offensive odor exists because of chlorine reactions or excess chlorine residual.

5.1.1.2 Results of testing. If the test for coliform organisms is negative, then the storage facility may be placed in service. If the test shows the presence of coliform bacteria, then the situation shall be evaluated by qualified personnel. In any event, repeat samples shall be taken until two consecutive samples are negative, or the storage facility shall again be subjected to disinfection.

5.1.1.3 Care in sampling. The samples shall be taken from a sample tap on the outlet piping from the storage facility or from a sample tap connected directly to the storage facility. In either case, the operation shall be such as to ensure that the sample collected is actually from water that has been in the storage facility.

5.1.1.4 Recommended additional samples. During the disinfection operation and the required sampling of water from the storage facility, it is recommended that samples be taken from water flowing into the storage facility to determine if coliforms are present in the typical potable water source.

SECTION 6: DELIVERY

This standard has no applicable information for this section.

APPENDIX A

Chlorine Residual Testing

This appendix is for information only and is not part of AWWA C652.

SECTION A.1: DPD DROP DILUTION METHOD (FOR FIELD TEST)

The N, N-diethyl-p-phenediamine (DPD) drop dilution method of approximating total residual chlorine is suitable for concentrations above 10 mg/L, such as those applied in the disinfection of water mains or tanks.

Sec. A.1.1 Apparatus

1. A graduated cylinder for measuring distilled water.
2. An automatic or safety pipette.
3. Two dropping pipettes that deliver a 1-mL sample in 20 drops. One pipette is for dispensing the water sample, and the other is for dispensing the DPD and buffer solutions. The pipettes should not be interchanged.
4. A comparator kit containing a suitable range of standards.

Sec. A.1.2 Reagents

1. DPD indicator solution. Prepare as prescribed in *Standard Methods for the Examination of Water and Wastewater* (20 ed.), Section 4500-Cl, p. F.2*b*.

Sec. A.1.3 Procedure

1. Add 10 drops of DPD solution and 10 drops of buffer solution (or 20 drops of combined DPD-buffer solution) to a comparator cell.
2. Fill the comparator cell to the 10-mL mark with distilled water.
3. With a dropping pipette, add the water sample one drop at a time, mix until a red color is formed that matches one of the color standards.
4. Record the total number of drops used and the final chlorine reading obtained (that is, the chlorine reading of the matched standard).
5. Calculate the milligrams per liter of free residual chlorine as follows:

$$\text{mg/L chlorine} = \frac{\text{reading} \times 200}{\text{drops of sample}}$$

SECTION A.2: HIGH-RANGE CHLORINE TEST KITS

Several manufacturers produce high-range chlorine test kits that are inexpensive, easy to use, and satisfactory for the precision required.

APPENDIX B

Chlorine Dosages

This appendix is for information only and is not a part of AWWA C652.

Table B.1 Amounts of chemicals required to give various chlorine concentrations in 100,000 gal (378.5 m^3) of water*

Desired Chlorine Concentration in Water	Chlorine Required		Sodium Hypochlorite Required: 5 Percent Available Chlorine		Sodium Hypochlorite Required: 10 Percent Available Chlorine		Sodium Hypochlorite Required: 15 Percent Available Chlorine		Calcium Hydrochlorite Required: 65 Percent Available Chlorine	
mg/L	*lb*	*(kg)*	*gal*	*(L)*	*gal*	*(L)*	*gal*	*(L)*	*lb*	*(kg)*
2	1.7	(0.8)	3.9	(14.7)	2.0	(7.6)	1.3	(4.9)	2.6	(1.1)
10	8.3	(3.8)	19.4	(73.4)	9.9	(37.5)	6.7	(25.4)	12.8	(5.8)
50	42.0	(19.1)	97.0	(367.2)	49.6	(187.8)	33.4	(126.4)	64.0	(29.0)

*Amounts of sodium hypochlorite are based on concentrations of available chlorine by volume. For either sodium hypochlorite or calcium hypochlorite, extended or improper storage of chemicals may cause a loss of available chlorine.

Table B.2 Amounts of chemicals required to give various chlorine concentrations in 200 mg/L in various volumes of water*

Volume of Water		Chlorine Required		Sodium Hypochlorite Required: 5 Percent Available Chlorine		Sodium Hypochlorite Required: 10 Percent Available Chlorine		Sodium Hypochlorite Required: 15 Percent Available Chlorine		Calcium Hydrochlorite Required: 65 Percent Available Chlorine	
gal	*(L)*	*lb*	*(kg)*	*gal*	*(L)*	*gal*	*(L)*	*gal*	*(L)*	*lb*	*(kg)*
10	(37.9)	0.02	(9.1)	0.04	(0.15)	0.02	(0.08)	0.02	(0.08)	0.03	(13.6)
50	(189.3)	0.1	(45.4)	0.2	(0.76)	0.1	(0.38)	0.07	(0.26)	0.15	(68.0)
100	(378.5)	0.2	(90.7)	0.4	(1.51)	0.2	(0.76)	0.15	(0.57)	0.3	(136.1)
200	(757.1)	0.4	(181.4)	0.8	(3.03)	0.4	(1.51)	0.3	(1.14)	0.6	(272.2)

*Amounts of sodium hypochlorite are based on concentrations of available chlorine by volume. For either sodium hypochlorite or calcium hypochlorite, extended or improper storage of chemicals may cause a loss of available chlorine.

APPENDIX C

Disposal of Heavily Chlorinated Water

This appendix is for information only and is not a part of AWWA C652.

1. Check with the local sewer department for the conditions of disposal to the sanitary sewer.

2. Chlorine residual of water being disposed will be neutralized by treatment with one of the chemicals listed in Table C.1.

Table C.1 Amounts of chemicals required to neutralize various residual chlorine concentrations in 100,000 gal (378.5 m^3) of water

Residual Chlorine Concentration	Chemical Required							
	Sulfur Dioxide (SO_2)		Sodium Bisulfite ($NaHSO_3$)		Sodium Sulfite (Na_2SO_3)		Sodium Thiosulfate ($Na_2S_2O_3 \cdot 5H_2O$	
mg/L	*lb*	*(kg)*	*lb*	*(kg)*	*lb*	*(kg)*	*lb*	*(kg)*
1	0.8	(0.36)	1.2	(0.54)	1.4	(0.64)	1.2	(0.54)
2	1.7	(0.77)	2.5	(1.13)	2.9	(1.32)	2.4	(1.09)
10	8.3	(3.76)	12.5	(5.67)	14.6	(6.62)	12.0	(5.44)
50	41.7	(18.91)	62.6	(28.39)	73.0	(33.11)	60.0	(27.22)

ATTACHMENT 11

Policies

ATTACHMENT 11A

Redwood Glen Water System Policy Manual and Board Approval

REDWOOD GLEN

LOMA MAR, CA

REDWOOD GLEN WATER SYSTEM MANAGERIAL POLICY MANUAL

The Redwood Glen Camp & Conference Center Board of Directors manages the Redwood Glen Water System, which operate based on the Redwood Glen By-laws and Guiding Principles. For all matters regarding general Board policies and approval processes, reference the By-laws and/or Guiding Principles.

This policy manual covers the management and operation of the Redwood Glen Water System, and is in addition to and aligned with the Redwood Glen By-laws and Guiding Principles. The policies are subject to change as required and voted upon by the Board of Directors.

1.0 General

The purpose of the Redwood Glen Water System is to provide a safe supply of water to customers within its service area. Water supply and use shall be in conformance with these rules and regulations.

2.0 Customer Policies

The following sections cover the non-paying customer policies regarding the Redwood Glen Water System, in accordance with the Redwood Glen By-laws and Guiding Principles.

2.1 Applicability

The Redwood Glen Water System serves the residents and guests of Redwood Glen Camp and Conference Center, however Redwood Glen does not have paying customers, and therefore does not collect water service or usage charges from the customers served. Additionally, there is no “new development” within the Redwood Glen service area that is initiated by an outside party. As such, Redwood Glen Water System management and operations staff does not interface with the customers that they serve in the capacity typical of a water utility (ie. paying of bills, requesting water service to new homes, etc.). The following section includes water user policies as applicable to the Redwood Glen Water System.

2.2 Purpose

The purpose of the customer policies is to provide a framework for the way in which the Redwood Glen Water System interfaces with water users, or non-paying customers, of the water system. These policies shall be reviewed periodically by the Board of Directors and may be amended as necessary by a majority vote of members.

2.3 Resident or Guest Grievances

An informal complaint generated by a water user and directed to the Redwood Glen management or operations staff will be reviewed by the Executive Director and Board of Directors. The water user must inform management or operations staff as to the concerns they have regarding the water served. The Executive Director and Board of Directors will investigate the customer grievance and issue a response based on the investigation. If specialized assistance is required, Redwood Glen will seek the counsel of the appropriate water resources professionals.

2.4 Water Facility Inspections at Residential/Guest Housing

Representatives of the Redwood Glen Water System shall have the right at any reasonable hour to enter residential or guest housing in order to read water meters, inspect piping, and perform other duties for the proper maintenance and operation of service.

2.5 Interruption of Service

Redwood Glen Water System will make reasonable efforts to supply continuous, uninterrupted service. However, Redwood Glen shall have the right to interrupt service for the purpose of making repairs or for other necessary work. Efforts will be made to notify residents or guests who may be affected by such interruptions, however Redwood Glen will not accept responsibility for losses that might occur due to such necessary interruptions. Additionally, Redwood Glen does not accept responsibility for losses due to interruptions of service caused by storms, floods, or other events beyond the utility's control.

2.6 Unauthorized Use of Water

Should it come to the attention of the management and operations staff at Redwood Glen Water System that a resident or guest is using water in a capacity that exceeds typical residential uses, or is being used for unauthorized industrial, commercial, or agricultural uses, Redwood Glen will exercise their authority to restrict this usage of water. This includes unauthorized irrigation on the premises and utilizing water for industrial washing and/or commercial gain.

2.7 Conservation

Water users shall adhere to the daily conservation efforts at the Redwood Glen facilities as well as any necessary conservation actions mandated by Redwood Glen management as drought contingency measures.

3.0 Employee Policies

The following sections cover the employee policies regarding the Redwood Glen Water System, in accordance with the Redwood Glen By-laws and Guiding Principles.

3.1 Applicability

All employees of the Redwood Glen Water System are employees of the Redwood Glen Camp & Conference Center, including management and operations staff. Detailed employee guidelines are included in the Redwood Glen Employee Handbook; however, policies relevant to the Redwood Glen Water System are included below. Additionally, Redwood Glen Water System retains a contract certified operator to assist with operation and maintenance (O&M) of the water system, a contract position with separate requirements from Redwood Glen employees.

3.2 Purpose

The purpose of the employee policies is to provide a framework for effective management and operation of the Redwood Glen water system. These policies shall be reviewed periodically by the Board of Directors and may be amended as necessary by a majority vote of members.

3.3 Employee Classifications

The following employee classifications are applicable to the Redwood Glen Water System Staff:

- ***Full-time employees*** are those working a regular, non-seasonal schedule of at least 32 hours per week, for a total of at least 1,664 hours per calendar year.
- ***Part-time employees*** are those working a regular, non-seasonal schedule of less than 32 hours per week.
- ***Seasonal employees*** are those working specified seasons of the year, such as summer and/or winter camping seasons.
- ***Non-Exempt employees*** are all those who are eligible to be paid for overtime work in accordance with the provisions of applicable wage and hours laws.
- ***Exempt employees*** are all those who are not eligible for overtime pay.

3.4 Working Hours

Since Redwood Glen is a continuous 7-day-a-week, 365-day-per-year facility, the individual employee's specific workdays will vary. The normal, standard workweek is a 4- or 5-day workweek consisting of 32-40 hours with two (2) days off. Especially in the summer, workweek schedules may be six (6) or seven (7) days. The two (2) days off are not necessarily consecutive. Each workday shall be approximately eight (8) hours, with a paid 10-minute mid-morning break, a paid 10-minute mid-afternoon break, and an unpaid 30-minute meal period. Employees may be required to stay longer than eight (8) hours by their supervisor to finish a job. Off duty and meal periods are excluded from hours of work.

3.5 Time Cards

The employee is to indicate on his/her time card, next to the appropriate date, the time (to the nearest quarter hour) that he/she arrived and left; and indicate the total hours worked in the appropriate column in ink, as required by the State of California. At the end of the month, you are to sign your card at the bottom. Time cards must be neat and legible. Each employee is responsible for marking days as Holiday/Vacation Days, Sick Days or Regular Days Off so that he/she may receive the appropriate credit.

3.6 Overtime

Overtime at the rate of 1½ times the employee's regular rate of pay will be paid for all hours worked in excess of 40 in one workweek, for the first four (4) hours in excess of eight (8) in any one workday, but not both, and for the first eight (8) hours on the seventh day of work in one workweek, but not both.

Overtime at the rate of two (2) times the employee's regular rate of pay will be paid for all hours worked in excess of twelve (12) in one workday and for all hours worked in excess of eight (8) on the seventh day of work in one workweek.

The workweek, on which overtime calculations will be based, begins each Monday at 12:01a.m. Each workday, on which daily overtime calculations will be based, begins at midnight.

3.7 Contract Operators

Redwood Glen retains a team of certified contract operators to assist in the O&M of the Redwood Glen Water System. The certified operator shall maintain distribution and treatment certifications that meet or exceed the requirement of the Redwood Glen Water System at all times. All details regarding the contract operator's responsibilities are included in the specifications of their executed contract.

3.8 Management Training

The Redwood Glen Executive Director and Board of Directors shall continue to receive training in utility management, ethics, drinking water regulations and resource management in order to effectively manage public water systems. The Redwood Glen Water System Training Plan details the regular training for management staff.

3.9 Operator Training

Any person operating the Redwood Glen Water System must continue to receive training appropriate to the size, type and complexity of the system. Additionally, water treatment and distribution system operators require continuing education to maintain their certifications. The Redwood Glen Water System Training Plan details the regular training and continuing education for operations staff.

4.0 Financial Management Policies

The following sections cover the financial management policies regarding the Redwood Glen Water System, in accordance with the Redwood Glen By-laws and Guiding Principles. The Redwood Glen Water System serves the residents and guests of Redwood Glen Camp and Conference Center, however Redwood Glen does not collect water service or usage charges from the customers served.

4.1 Applicability

Financial policies of the Board of Directors shall conform to applicable state statutes, local ordinances, and other legal obligations of the system. Any section or sections of these policies determined to be in conflict shall be null and void, without affecting the applicability of other sections and provisions.

4.2 Purpose

The purpose of these policies is to provide a framework for the effective management and conduct of the financial affairs of the Redwood Glen Water System. These policies shall be reviewed periodically by the Board of Directors and may be amended as necessary by a majority vote of members.

4.3 Enterprise Accounting

The system shall be operated as an enterprise. It is the policy of the Board of Directors that the system shall operate on a financially self-sustaining basis. The full cost of providing water services to guests and staff on a continual basis shall be recovered through guest group user fees and charges established by the Board of Directors.

4.4 Generally Accepted Accounting Principles

It is the policy of the Board of Directors that financial affairs of the system are conducted according to generally accepted accounting principles (GAAP). The utility's financial accounting and reporting system will be conducted on an accrual basis.

4.5 Insurance

Redwood Glen shall maintain insurance coverage that is adequate and necessary to protect the system against potential financial losses.

4.6 Revenues

It is the policy of the Board of Directors that 20% of the funds generated from guest group user fees and charges may be used only for expenses directly associated with the system's operation and maintenance, debt service, debt-service reserve, and other financial-reserve funds authorized by the board. If more funds are needed, the Board of Directors shall, by majority vote, authorize such expenditures.

4.7 Fiscal Year

The fiscal year of the Redwood Glen Water System shall be for a 12-month period, beginning on the 1st day of January, and ending on the 31st day of December annually. Tax returns for will be prepared and approved by the Board of Directors.

4.8 Audit Reports

Audit reports shall be prepared annually covering financial operations for the previous fiscal year. Audit reports shall be completed by an independent public accountant with experience in auditing similar organizations, and will be reviewed by the Board of Directors.

4.9 Long- and Short-term Planning

The Board of Directors shall develop long- and short-term financial plans that forecast future capital and operational needs of the system and that provide a strategy for financing those future needs. Operational, financial, and administrative staff of the system shall assist the board in developing these financial plans.

4.10 Budget Development

At least 30 days prior to the beginning of each fiscal year, the Board of Directors shall develop and adopt an annual revenue and expense budget for the operation of the system. The annual budget must show that anticipated revenues shall be sufficient to cover all operating expenses.

4.11 Budget Format

The budget format and expense and revenue line items shall conform to state and/or federal requirements, if applicable. Each source of revenue and each category of expense shall be separately identified in detail sufficient to present an accurate picture of the system's financial condition.

4.12 Rate and User-charge Review

Guest group user fees and charges shall be reviewed annually as part of the budgeting process and adjusted as necessary to remain financial secure.

4.13 Financial Reserves

It is the policy of the Board of Directors that in order to maintain financial stability and self-sufficiency, and to achieve both long- and short-term capital and operational needs into the future, the system shall maintain financial reserve funds. The financial reserve funds shall be used for:

- **Debt-service reserve funds (DSRF) as may be required by lenders:** Debt-service reserve funds for the water system shall be established and maintained in a separate account in an amount consistent with requirements of the system's lenders.
- **CIP Reserve:** Planned system improvements consistent with long-range capital needs.
- **O&M Reserve:** Equipment replacement of short-lived assets.
- **Emergency Reserve:** Emergency funds for unforeseen breakdowns and system repairs.

4.14 Financial Reserve Accounts and Withdrawal Guidelines

The financial reserves shall be maintained in separate accounts. All financial reserve funds shall be deposited in federally insured depositories. Expenditures or transfers from financial reserves shall be only with approval of the Board of Directors.

4.15 Monitoring Budgeted Revenues and Expenditures

Each quarter during the fiscal year, the Board of Directors shall receive and review a financial report from Redwood Glen's accounting personnel, which includes the water system budget. Quarterly financial reports shall contain:

- Current quarter's revenues and expenditures
- Actual year-to-date revenues and expenditures
- Net income or loss
- Beginning and ending balances for all operating and reserve accounts of the system
- Summary of past-due accounts receivable (number and total amount)

4.16 Accounting Policies

The Redwood Glen Water System financial accounting will become a part of the entire Redwood Glen Camp accounting and will follow the policies and procedures as such. It will be maintained as a separate class so monthly reports and accountability can be maintained.

4.17 Budget Control

The following budget control policies are applicable to the Redwood Glen Water System:

- **Checks and Notes:** Except as otherwise specifically determined by resolution of the Board of Directors, or as otherwise required by law, checks, drafts, promissory notes, orders for the payment of money, and other evidence of indebtedness of the corporation shall be signed by any two (2) of the following officers or staff members: President, Secretary, Treasurer, Chair, Vice Chair, Director of Maintenance, Director of Camp Programming, or bookkeeper.

- **Deposits:** All funds of the corporation shall be deposited to the credit of the corporation in such banks, trust companies, or other depositories as the Board of Directors may select. Deposits shall be prepared by the bookkeeper and approved by the Executive Director.
- **Cash Receipts and Disbursements:** Cash receipts and disbursement shall be prepared by the bookkeeper and approved by the Executive Director.
- **Execution of Instruments:** The Board of Directors, except as otherwise provided in the Bylaws, may by resolution authorize any officer or agent of the corporation to enter into any contract or execute and deliver any instrument in the name of and on behalf of the corporation, and such authority may be general or confined to specific instances. Unless so authorized, no officer, agent, or employee shall have any power or authority to bind the corporation by any contract or engagement or to pledge its credit or to render it liable monetarily for any purpose or in any amount.
- **Payroll:** Payroll is prepared by the bookkeeper and approved by the Executive Director. When the paycheck is received, the employee will sign for it on the appropriate form provided by Human Resources.

4.18 Budget Adjustments

Based on reviews of quarterly financial reports, the Board of Directors shall make budget adjustments or amendments as necessary. Adjustments to an approved budget must be voted on by the Board of Directors.

Redwood Glen Board of Directors
July 27, 2016
Water System Update and Action Items

Redwood Glen received permits to drill three wells.

Compliance for water system update:

Complete Technical Managerial Financial (TMF) form by July 31,2016

Submit current policy manual

Redwood Glen Policy Manual emailed to all board members for preview and approval. Larry Rice, Executive Director requested call vote board approval.

July 7, 016

Policy Manual approval (7 0)

Voting members:

Wyman Chan, Jeanette Calixto, Mike Greene, Carole Moore
Carolyn Nietzke, Alondra Trevino Ortiz, Anita Falltrick

ATTACHMENT 11B

Redwood Glen By-laws

BYLAWS

OF

REDWOOD GLEN

A California Religious Corporation

ARTICLE 1
OFFICES

SECTION 1.1 PRINCIPAL OFFICE

The principal office of the corporation for the transaction of its business is located in San Mateo County, California.

SECTION 1.2 CHANGE OF ADDRESS

The county of the corporation's principal office can be changed only by amendment of these Bylaws and not otherwise.

SECTION 1.3 OTHER OFFICES

The corporation may also have offices at such other places, within or without the State of California, where it is qualified to do business, as its business may require and as the Board of Directors may, from time to time, designate.

ARTICLE 2
PURPOSES

SECTION 2.1 OBJECTIVES AND PURPOSES

The primary objectives and purposes of this corporation shall be:

To transform individuals and communities, locally and globally, by providing varied opportunities to study, experience, and know creation and Creator.

ARTICLE 3
DIRECTORS

SECTION 3.1 NUMBER

The corporation shall have no fewer than seven (7) and no more than twelve (12) directors, with the exact number to be fixed within these limits by approval of the Board of Directors in the manner provided in these Bylaws, and collectively they shall be known as the Board of Directors. The above numbers may be changed by amendment of this Bylaw, or by repeal of this Bylaw and adoption of a new Bylaw, as provided in these Bylaws.

No less than seven (7) directors must be active members in American Baptist Churches. The Executive Director of the corporation shall also serve as President of the Board of Directors. The President, Chair, Vice Chair, Secretary and Treasurer of the Board shall all be voting members of the Board of Directors.

SECTION 3.2 POWERS

Subject to the provisions of the California Nonprofit Religious Corporation Law, the activities and affairs of this corporation shall be conducted and all corporate powers shall be exercised by or under the direction of the Board of Directors.

SECTION 3.3 DUTIES

It shall be the duty of the directors to:

(a) Perform any and all duties imposed on them collectively or individually by law, by the Articles of Incorporation of this corporation, or by these Bylaws;

(b) Appoint and remove, employ and discharge, and, except as otherwise provided in these Bylaws, prescribe the duties and fix the compensation, of all officers of the corporation;

(c) Supervise all officers of the corporation to assure that their duties are performed properly;

(d) Meet at such times and places as required by these Bylaws;

(e) Register their addresses with the Secretary of the corporation and notices of meetings mailed or e-mailed to them at such addresses shall be valid notices thereof.

SECTION 3.4 TERMS OF OFFICE/TERM LIMITS

Each director shall hold office for a period of three (3) years, until the next annual meeting for election of the Board of Directors corresponding to the completion of each director’s term, as specified in these Bylaws, and until his or her successor is elected and qualifies.

Furthermore, each director may hold office for no more than two (2) consecutive 3-year terms (6 years total), after which they must remain off the Board of Directors for at least one (1) year.

Because the Executive Director shall also serve as President of the corporation (See Section 3.1), there shall be no limits imposed on his/her term other than the length of his/her employment as Executive Director. In other words, as long as he/she is employed as Executive Director of the corporation, he/she shall also serve as President of the Board.

SECTION 3.5 COMPENSATION

Directors shall serve without compensation except that they shall be allowed and paid their actual and necessary expenses incurred in attending directors' meetings. In addition, they shall be allowed reasonable advancement or reimbursement of expenses incurred in the performance of their regular duties as specified in Section 3.3 of this Article.

SECTION 3.6 PLACE OF MEETINGS

Meetings shall be held at the principal office of the corporation unless otherwise provided by the Board or at such place within or without the State of California which has been designated from time to time by resolution of the Board of Directors. In the absence of such designation, any meeting not held at the principal office of the corporation shall be valid only if held on the written consent of all directors given either before or after the meeting and filed with the Secretary of the corporation or after all Board members have been given written notice of the meeting as hereinafter provided for special meetings of the Board. Any meeting, regular or special, may be held by conference telephone or similar communications equipment, so long as all directors participating in such meeting can hear one another.

SECTION 3.7 REGULAR AND ANNUAL MEETINGS/ELECTION OF DIRECTORS

Meetings of directors shall be held at least three (3) times per year, as follows: during the first quarter; during the second or third quarters; and during the third or fourth quarters of each fiscal year. Sufficient and proper notice as to the exact date, time and location of each meeting shall be given to all directors (as mentioned in Section 3.9, below).

At the annual meeting of directors held during the first quarter of each fiscal year, directors shall be elected by the Board of Directors in accordance with this Section. Cumulative voting by directors for the election of directors (which allocates to each voting director as many votes as there are candidates and permits the director to cast these votes for one person) shall not be permitted. The candidates receiving the highest number of votes shall be elected. Each director shall cast one vote, with voting being by ballot only.

SECTION 3.8 SPECIAL MEETINGS

Special meetings of the Board of Directors may be called by the Chair-person of the Board, the President, the Vice President, the Secretary, or by any two directors, and such meetings shall be held at the place, within or without the State of California, designated by the person or persons calling the meeting, and in the absence of such designation, at the principal office of the corporation.

SECTION 3.9 NOTICE OF MEETINGS

Meetings of the Board shall be held upon four (4) days' notice by first-class mail or forty-eight (48) hours' notice delivered personally or by telephone, telecopier (fax) or other electronic means such as e-mail. Such notices shall be addressed to each director at his or her address as shown on the books of the corporation. Notice of the time and place of holding an adjourned meeting need not be given to absent directors if the time and place of the adjourned meeting are fixed at the meeting adjourned and if such adjourned meeting is held no more than twenty four (24) hours from the time of the original meeting. Notice shall be given of any adjourned regular or special meeting to directors absent from the original meeting if the adjourned meeting is held more than twenty-four (24) hours from the time of the original meeting.

SECTION 3.10 CONTENTS OF NOTICE

Notice of meetings not herein dispensed with shall specify the place, day and hour of the meeting. The purpose of any Board meeting need not be specified in the notice.

SECTION 3.11 WAIVER OF NOTICE AND CONSENT TO HOLDING MEETINGS

The transactions of any meeting of the Board, however called and noticed or wherever held, are as valid as though the meeting had been duly held after proper call and notice, provided a quorum, as hereinafter defined, is present and provided that either before or after the meeting each director not present signs a waiver of notice, a consent to holding the meeting, or an approval of the minutes thereof. All such waivers, consents, or approvals shall be filed with the corporate records or made a part of the minutes of the meeting.

SECTION 3.12 QUORUM FOR MEETINGS

A quorum shall consist of a majority of the Board of Directors.

Except as otherwise provided in these Bylaws or in the Articles of Incorporation of this corporation, or by law, no business shall be considered by the Board at any meeting at which a quorum, as hereinbefore defined, is not present, and the only motion which the Chair shall entertain at such meeting is a motion to adjourn. However, a majority of the directors present at such meeting may adjourn from time to time until the time fixed for the next regular meeting of the Board.

When a meeting is adjourned for lack of a quorum, it shall not be necessary to give any notice of the time and place of the adjourned meeting or of the business to be transacted at such meeting, other than by announcement at the meeting at which the adjournment is taken, except as provided in Section 3.9 of this Article.

The directors present at a duly called and held meeting at which a quorum is initially present may continue to do business notwithstanding the loss of a quorum at the meeting due to a withdrawal of directors from the meeting, provided that any action thereafter taken must be approved by at least a majority of the required quorum for such meeting or such greater percentage as may be required by law, or the Articles of Incorporation or Bylaws of this corporation.

SECTION 3.13 MAJORITY ACTION AS BOARD ACTION

Every act or decision done or made by a majority of the directors present at a meeting duly held at which a quorum is present is the act of the Board of Directors, unless the Articles of Incorporation or Bylaws of this corporation, or provisions of the California Nonprofit Religious Corporation Law, particularly those provisions relating to appointment of committees (Section 9212), approval of contracts or transactions in which a director has a material financial interest (Section 9243) and indemnification of directors (Section 9246e), require a greater percentage or different voting rules for approval of a matter by the Board.

SECTION 3.14 CONDUCT OF MEETINGS

Meetings of the Board of Directors shall be presided over by the Chair-person of the Board, or, if no such person has been so designated or, in his or her absence, by the Vice Chair of the corporation or, in his or her absence, by the President of the corporation or, in the absence of each of these persons, by a Chair-person chosen by a majority of the directors present at the meeting. The Secretary of the corporation shall act as secretary of all meetings of the Board, provided that, in his or her absence, the presiding officer shall appoint another person to act as secretary of the meeting.

Meetings shall be governed by such rules as the Board of Directors may from time to time establish or adopt, insofar as such rules are not inconsistent with or in conflict with these Bylaws, with the Articles of Incorporation of this corporation, or with provisions of law.

SECTION 3.15 ACTION BY UNANIMOUS WRITTEN CONSENT WITHOUT MEETING

Any action required or permitted to be taken by the Board of Directors under any provision of law may be taken without a meeting, if all members of the Board shall individually or collectively consent in writing to such action. Such written consent or consents shall be filed with the minutes of the proceedings of the Board. Such action by written consent shall have the same force and effect as the unanimous vote of the directors. Any certificate or other document filed under any provision of law which relates to action so taken shall state that the action was taken by unanimous written consent of the Board of Directors without a meeting and that the Bylaws of this corporation authorize the directors to so act, and such statement shall be prima facie evidence of such authority.

SECTION 3.16 VACANCIES

Vacancies on the Board of Directors shall exist (1) on the death, resignation or removal of any director, and (2) whenever the number of authorized directors is increased.

The Board of Directors may declare vacant the office of a director who has been declared of unsound mind by a final order of court, or convicted of a felony, or has been removed from office by order of the Superior Court for engaging in fraudulent acts pursuant to Section 9233 of the California Nonprofit Religious Corporation Law.

Any director may resign effective upon giving written notice to the Chair-person of the Board, the President, the Secretary, or the Board of Directors, unless the notice specifies a later time for the effectiveness of such resignation. No director may resign if the corporation would then be left without a duly elected director or directors in charge of its affairs.

Vacancies on the Board may be filled by approval of the Board or, if the number of directors then in office is less than a quorum, by (1) the unanimous written consent of the directors then in office, (2) the affirmative vote of a majority of the directors then in office at a meeting held pursuant to notice or waiver of notice complying with this Article of these Bylaws, or (3) a sole remaining director.

A person elected to fill a vacancy as provided by this Section shall hold office until the next annual election of the Board of Directors or until his or her death, resignation or removal from office.

SECTION 3.17 NON-LIABILITY OF DIRECTORS

The directors shall not be personally liable for the debts, liabilities, or other obligations of the corporation.

SECTION 3.18 INDEMNIFICATION BY CORPORATION OF DIRECTORS, OFFICERS, EMPLOYEES AND OTHER AGENTS

To the extent that a person who is, or was, a director, officer, employee or other agent of this corporation has been successful on the merits in defense of any civil, criminal, administrative or investigative proceeding brought to procure a judgment against such person by reason of the fact that he or she is, or was, an agent of the corporation, or has been successful in defense of any claim, issue or matter, therein, such person shall be indemnified against expenses actually and reasonably incurred by the person in connection with such proceeding.

If such person either settles any such claim or sustains a judgment against him or her, then indemnification against expenses, judgments, fines, settlements and other amounts reasonably incurred in connection with such proceedings shall be provided by this corporation but only to the extent allowed by, and in accordance with the requirements of, Section 9246 of the California Nonprofit Religious Corporation Law.

SECTION 3.19 INSURANCE FOR CORPORATE AGENTS

The Board of Directors may adopt a resolution authorizing the purchase and maintenance of insurance on behalf of any agent of the corporation (including a director, officer, employee or other agent of the corporation) against any liability other than for violating provisions of law relating to self-dealing (Section 9243 of the California Nonprofit Religious Corporation Law) asserted against or incurred by the agent in such capacity or arising out of the agent's status as such, whether or not the corporation would have the power to indemnify the agent against such liability under the provisions of Section 9246 of the California Nonprofit Religious Corporation Law.

ARTICLE 4
OFFICERS

SECTION 4.1 NUMBER OF OFFICERS

The officers of the corporation shall be a President, a Secretary, a Chief Financial Officer, who shall be designated the Treasurer, and a Chair and Vice Chair. The corporation may also have, as determined by the Board of Directors, one or more Vice Presidents, Assistant Secretaries, Assistant Treasurers, or other officers. Any number of offices may be held by the same person except that neither the Secretary nor the Treasurer may serve as the President or Chair-person of the Board.

SECTION 4.2 QUALIFICATION, ELECTION, AND TERM OF OFFICE

Any person may serve as officer of this corporation. Officers shall be elected by the Board of Directors, at any time, and each officer shall hold office until he or she resigns or is removed or is otherwise disqualified to serve, or until his or her successor shall be elected and qualified, whichever occurs first.

SECTION 4.3 SUBORDINATE OFFICERS

The Board of Directors may appoint such other officers or agents as it may deem desirable, and such officers shall serve such terms, have such authority, and perform such duties as may be prescribed from time to time by the Board of Directors.

SECTION 4.4 REMOVAL AND RESIGNATION

Any officer may be removed, either with or without cause, by the Board of Directors, at any time. Any officer may resign at any time by giving written notice to the Board of Directors or to the President or Secretary of the corporation. Any such resignation shall take effect at the date of receipt of such notice or at any later date specified therein, and, unless otherwise specified therein, the acceptance of such resignation shall not be necessary to make it effective. The above provisions of this Section shall be superseded by any conflicting terms of a contract which has been approved or ratified by the Board of Directors relating to the employment of any officer of the corporation.

SECTION 4.5 VACANCIES

Any vacancy caused by the death, resignation, removal, disqualification, or otherwise, of any officer shall be filled by the Board of Directors. In the event of a vacancy in any office other than that of President, such vacancy may be filled temporarily by appointment by the President until such time as the Board shall fill the vacancy. Vacancies occurring in offices of officers appointed at the discretion of the Board may or may not be filled as the Board shall determine.

SECTION 4.6 DUTIES OF PRESIDENT

The President shall be the chief executive officer of the corporation and shall, subject to the control of the Board of Directors, supervise and control the affairs of the corporation and the activities of the officers. He or she shall perform all duties incident to his or her office and such other duties as may be required by law, by the Articles of Incorporation of this corporation, or by these Bylaws, or which may be prescribed from time to time by the Board of Directors. Unless another person is specifically appointed as Chair-person of the Board of Directors, he or she shall preside at all meetings of the Board of Directors. Except as otherwise expressly provided by law, by the Articles of Incorporation, by these Bylaws, or by resolution of the Board of Directors, he or she shall, in the name of the corporation, execute such deeds, mortgages, bonds, contracts, checks, or other instruments which may from time to time be authorized by the Board of Directors.

Additionally, as described in Section 3.1 of these Bylaws, the President of the Board of Directors shall also serve as Executive Director of the corporation. As Executive Director, he/she shall appoint and remove, employ and discharge, and, except as otherwise provided in these Bylaws, prescribe the duties and fix the compensation, if any, of all agents and employees of the corporation, and supervise all agents and employees of the corporation to assure that their duties are performed properly;

SECTION 4.7 DUTIES OF CHAIR

In the absence of the President, or in the event of his or her inability or refusal to act, the Chair shall perform all the duties of the President, and when so acting shall have all the powers of, and be subject to all the restrictions on, the President. The Chair shall have other powers and perform such other duties as may be prescribed by law, by the Articles of Incorporation, or by these Bylaws, or as may be prescribed by the Board of Directors.

SECTION 4.8 DUTIES OF SECRETARY

The Secretary shall:

Certify and keep at the principal office of the corporation the original, or a copy, of these Bylaws as amended or otherwise altered to date.

Keep at the principal office of the corporation or at such other place as the Board may determine, a book of minutes of all meetings of the directors, and, if applicable, meetings of committees of directors, recording therein the time and place of holding, whether regular or special, how called, how notice thereof was given, the names of those present or represented at the meeting, and the proceedings thereof.

See that all notices are duly given in accordance with the provisions of these Bylaws or as required by law.

Be custodian of the records and of the seal of the corporation and see that the seal is affixed to all duly executed documents, the execution of which on behalf of the corporation under its seal is authorized by law or these Bylaws.

Exhibit at all reasonable times to any director of the corporation, or to his or her agent or attorney, on request therefor, the Bylaws and the minutes of the proceedings of the directors of the corporation.

In general, perform all duties incident to the office of Secretary and such other duties as may be required by law, by the Articles of Incorporation of this corporation, or by these Bylaws, or which may be assigned to him or her from time to time by the Board of Directors.

SECTION 4.9 DUTIES OF TREASURER

Subject to the provisions of these Bylaws relating to the “Execution of Instruments, Deposits and Funds,” the Treasurer shall:

Have charge and custody of, and be responsible for, all funds and securities of the corporation, and deposit all such funds in the name of the corporation in such banks, trust companies, or other depositories as shall be selected by the Board of Directors.

Receive, and give receipt for, monies due and payable to the corporation from any source whatsoever.

Disburse, or cause to be disbursed, the funds of the corporation as may be directed by the Board of Directors, taking proper vouchers for such disbursements.

Keep and maintain adequate and correct accounts of the corporation's properties and business transactions, including accounts of its assets, liabilities, receipts, disbursements, gains and losses.

Exhibit at all reasonable times the books of account and financial records to any director of the corporation, or to his or her agent or attorney, on request therefor.

Render to the President and directors, whenever requested, an account of any or all of his or her transactions as Treasurer and of the financial condition of the corporation.

Prepare, or cause to be prepared, and certify, or cause to be certified, the financial statements to be included in any required reports.

In general, perform all duties incident to the office of Treasurer and such other duties as may be required by law, by the Articles of Incorporation of this corporation, or by these Bylaws, or which may be assigned to him or her from time to time by the Board of Directors.

SECTION 4.10 COMPENSATION

The salaries of the officers, if any, shall be fixed from time to time by resolution of the Board of Directors, and no officer shall be prevented from receiving such salary by reason of the fact that he or she is also a director of the corporation. In all cases, any salaries received by officers of this corporation shall be reasonable and given in return for services actually rendered the corporation which relate to the performance of the religious purposes of this corporation.

ARTICLE 5
COMMITTEES

SECTION 5.1 EXECUTIVE COMMITTEE

The Board of Directors may, by a majority vote of directors, designate two (2) or more of its members (who may also be serving as officers of this corporation) to constitute an Executive Committee and delegate to such Committee any of the powers and authority of the Board in the management of the business and affairs of the corporation, except with respect to:

(a) The filling of vacancies on the Board or on any committee which has the authority of the Board.

(b) The fixing of compensation of the directors for serving on the Board or on any committee.

(c) The amendment or repeal of Bylaws or the adoption of new Bylaws.

(d) The amendment or repeal of any resolution of the Board which by its express terms is not so amendable or repealable.

(e) The appointment of committees of the Board or the members thereof.

By a majority vote of its members then in office, the Board may at any time revoke or modify any or all of the authority so delegated, increase or decrease but not below two (2) the number of its members, and fill vacancies therein from the members of the Board. The Committee shall keep regular minutes of its proceedings, cause them to be filed with the corporate records, and report the same to the Board from time to time as the Board may require.

SECTION 5.2 OTHER COMMITTEES

The corporation shall have such other committees as may from time to time be designated by resolution of the Board of Directors. Such other committees may consist of persons who are not also members of the Board. These additional committees shall act in an advisory capacity only to the Board and shall be clearly titled as “advisory” committees.

SECTION 5.3 MEETINGS AND ACTION OF COMMITTEES

Meetings and action of committees shall be governed by, noticed, held and taken in accordance with the provisions of these Bylaws concerning meetings of the Board of Directors, with such changes in the context of such Bylaw provisions as are necessary to substitute the committee and its members for the Board of Directors and its members, except that the time for regular meetings of committees may be fixed by resolution of the Board of Directors or by the committee. The time for special meetings of committees may also be fixed by the Board of Directors. The Board of Directors may also adopt rules and regulations pertaining to the conduct of meetings of committees to the extent that such rules and regulations are not inconsistent with the provisions of these Bylaws.

ARTICLE 6
EXECUTION OF INSTRUMENTS, DEPOSITS AND FUNDS

SECTION 6.1 EXECUTION OF INSTRUMENTS

The Board of Directors, except as otherwise provided in these Bylaws, may by resolution authorize any officer or agent of the corporation to enter into any contract or execute and deliver any instrument in the name of and on behalf of the corporation, and such authority may be general or confined to specific instances. Unless so authorized, no officer, agent, or employee shall have any power or authority to bind the corporation by any contract or engagement or to pledge its credit or to render it liable monetarily for any purpose or in any amount.

SECTION 6.2 CHECKS AND NOTES

Except as otherwise specifically determined by resolution of the Board of Directors, or as otherwise required by law, checks, drafts, promissory notes, orders for the payment of money, and other evidence of indebtedness of the corporation shall be signed by any two (2) of the following officers or staff members: President, Secretary, Treasurer, Chair, Vice Chair, Director of Guest Services, Director of Maintenance, Director of Food Service, Director of Camp Programming, or bookkeeper.

SECTION 6.3 DEPOSITS

All funds of the corporation shall be deposited from time to time to the credit of the corporation in such banks, trust companies, or other depositories as the Board of Directors may select.

SECTION 6.4 GIFTS

The Board of Directors may accept on behalf of the corporation any contribution, gift, bequest, or devise for the religious purposes of this corporation.

ARTICLE 7
CORPORATE RECORDS, REPORTS AND SEAL

SECTION 7.1 MAINTENANCE OF CORPORATE RECORDS

The corporation shall keep at its principal office in the State of California:

(a) Minutes of all meetings of directors and committees of the Board, indicating the time and place of holding such meetings, whether regular or special, how called, the notice given, and the names of those present and the proceedings thereof;

(b) Adequate and correct books and records of account, including accounts of its properties and business transactions and accounts of its assets, liabilities, receipts, disbursements, gains and losses;

(c) A copy of the corporation’s Articles of Incorporation and Bylaws as amended to date.

SECTION 7.2 CORPORATE SEAL

The Board of Directors may adopt, use, and at will alter, a corporate seal. Such seal shall be kept at the principal office of the corporation. Failure to affix the seal to corporate instruments, however, shall not affect the validity of any such instrument.

SECTION 7.3 DIRECTORS' INSPECTION RIGHTS

Every director shall have the absolute right at any reasonable time to inspect and copy all books, records and documents of every kind and to inspect the physical properties of the corporation.

SECTION 7.4 RIGHT TO COPY AND MAKE EXTRACTS

Any inspection under the provisions of this Article may be made in person or by agent or attorney and the right to inspection includes the right to copy and make extracts.

ARTICLE 8
FISCAL YEAR

SECTION 8.1 FISCAL YEAR OF THE CORPORATION

The fiscal year of the corporation shall begin on the first day of January and end on the last day of December in each year.

ARTICLE 9
AMENDMENT OF BYLAWS

SECTION 9.1 AMENDMENT

Subject to any provision of law applicable to the amendment of Bylaws of religious nonprofit corporations, these Bylaws, or any of them, may be altered, amended, or repealed and new Bylaws adopted by approval of the Board of Directors of this corporation.

ARTICLE 10
AMENDMENT OF ARTICLES

SECTION 10.1 AMENDMENT OF ARTICLES

Any amendment of the Articles of Incorporation may be adopted by approval of the Board of Directors.

ARTICLE 11
PROHIBITION AGAINST SHARING CORPORATE PROFITS AND ASSETS

SECTION 11.1 PROHIBITION AGAINST SHARING CORPORATE PROFITS AND ASSETS

No director, officer, employee, or other person connected with this corporation, or any private individual, shall receive at any time any of the net earnings or pecuniary profit from the operations of the corporation, provided, however, that this provision shall not prevent payment to any such person of reasonable compensation for services performed for the corporation in effecting any of its religious purposes, provided that such compensation is otherwise permitted by these Bylaws and is fixed by resolution of the Board of Directors; and no such person or persons shall be entitled to share in the distribution of, and shall not receive, any of the corporate assets on dissolution of the corporation. On such dissolution or winding up of the affairs of the corporation, whether voluntarily or involuntarily, the assets of the corporation, after all debts have been satisfied, shall be distributed as required by the Articles of Incorporation of this corporation and not otherwise.

ARTICLE 12
MEMBERS

SECTION 12.1 DETERMINATION OF MEMBERS

This corporation shall make no provision for members, however, pursuant to Section 9310(b)(1) of the Nonprofit Religious Corporation Law of the State of California, any action which would otherwise, under law or the provisions of the Articles of Incorporation or Bylaws of this corporation, require approval by a majority of all members or approval by the members, shall only require the approval of the Board of Directors.

WRITTEN CONSENT OF DIRECTORS ADOPTING BYLAWS

We, the undersigned, are all of the persons named as the initial directors in the Articles of Incorporation of REDWOOD GLEN, a California nonprofit corporation, and, pursuant to the authority granted to the directors by these Bylaws to take action by unanimous written consent without a meeting, consent to, and hereby do, adopt the foregoing Bylaws, consisting of 14 pages, as the Bylaws of this corporation.

Dated: December 8, 2004

____

Melissa Bowman, Director

CERTIFICATE

This is to certify that the foregoing is a true and correct copy of the Bylaws of the corporation named in the title thereto and that such Bylaws were duly adopted by the Board of Directors of said corporation on the date set forth above.

Dated:

____
Melissa Bowman, Secretary

ATTACHMENT 11C

Redwood Glen Guiding Principles

Redwood Glen Guiding Principles

Adopted September 26, 2009

PREAMBLE

The following document is intended by the Redwood Glen Board of Directors ("the Board") to implement an accountable leadership model for the specific needs of Redwood Glen. The Guiding Principles fall into three categories: Mission Principles, Boundary Principles and Accountability Principles, and are subject to continual revision by the Board. The Guiding Principles are not subject to revision or approval by any authority other than the Board.

Through its Mission Principles, the Board prescribes for the Executive Director the major ends to be achieved by Redwood Glen. These ends are in harmony with the following purpose language from the original incorporation papers: *To transform individuals and communities, locally and globally, by providing opportunities to study, experience, and know creation and Creator.*

Through its Boundary Principles, the Board sets limits on the means that may be used in pursuit of those ends prescribed through the Mission Principles. However, the Board is careful not to prescribe any particular means to be used, in order to leave the leadership and management of Redwood Glen to its Executive Director and staff.

Through its Accountability Principles, the Board instructs its chairperson how to maintain the connection of the Board with its constituents, the monitoring of the Executive Director's performance, and the integrity of the Board's own process. In any case, where these Guiding Principles delegate to the Executive Director and staff a decision required by the Bylaws or other legal authority to be made by the Board, such requirement will be fulfilled through the use of a routine, consent agenda by the Board.

MISSION PRINCIPLES

[Whereby the Board prescribes for the Executive Director
***what difference** Redwood Glen is to make **for whom** and **to what extent**]*

MP 1.0 Comprehensive Mission Principle

To provide a special and unique Christian environment of service, affordability, transformation, renewal and networking that partners with Bay Area churches and faith-based organizations to produce more and stronger disciples and churches in the wider Christian family, while recognizing our historical connections with American Baptist Churches.

MP1.1 Component: Service *"Reflecting Christ through Serving Others"*

Provide for all who come excellent housing, dining, meeting and recreation facilities, excellent food service, and excellent service that is reflective of Jesus Christ. We serve with excellence to encourage openness in all our guests to follow Jesus Christ. Reflecting Christ through serving others is our first priority.

MP1.2 Component: Affordability *"No Child Left Inside"*

Provide for all families an affordable opportunity to send their child to summer camp, regardless of the family's income. Encouraging gifts to the camp scholarship fund and good management practices will enable us to offer reasonable camp fees. Using excellent Christian stewardship and sound business practices; affordable summer camps to all families, regardless of their income, is our second priority.

MP1.3 Component: Transformation and Renewal

Transform and renew all who come in a Christian spiritual environment of natural and architectural beauty, for their faith journey of life and service. An environment of transformation and renewal is our third priority.

MP1.4 Component: Networking

Network, collaborate and partner with Bay Area churches, Christian leaders and other faith-based organizations in order to multiply and strengthen disciples and churches. An environment of networking is our fourth priority.

BOUNDARY PRINCIPLES

*[Whereby the Board **limits the acceptable means** that the Executive Director may use to achieve the Mission Principles]*

BP1.0 Comprehensive Boundary Statement

The Redwood Glen Executive Director shall not cause or allow any practice, activity, decision or organizational circumstance that is imprudent, unethical or unbiblical.

BP1.1 Component: Staff & Conference Leadership

The Executive Director shall not fail to uphold high standards of Biblical teaching and morality for her/him, the Redwood Glen staff and Redwood Glen-sponsored guest speakers and volunteer camp directors.

BP1.2 Component: Financial Planning

With respect to financial planning, the Executive Director shall not deviate materially from the Board's Mission Principles, shall not risk financial jeopardy and shall not be limited to a short-range perspective.

BP1.3 Component: Financial Condition and Activities

With respect to the actual, ongoing financial conditions and activities, the Executive Director shall not allow the development of fiscal jeopardy, material deviation from generally accepted accounting principles as normally applied to similar organizations or a material deviation of actual expenditures from Board priorities established in the Mission Principles.

BP1.4 Component: Endowments

The Executive Director shall not deviate from the endowment policies as determined by the Board, as appended to the Guiding Principles.

BP1.5 Component: Treatment of Staff

With respect to the treatment of paid and volunteer staff, the Executive Director shall not cause or allow conditions that are unbiblical, unfair, undignified or unlawful.

BP1.6 Component: Treatment of Guests

With respect to the treatment of campers, guests and conferees, the Executive Director shall not cause or allow: 1) dishonesty in relationship to guests or potential guests; 2) guests to be treated unfairly or with disrespect; 3) unhealthy, unclean or degraded facilities; or 4) exploitation of any guest for personal and/or financial gain.

BP1.7 Component: Communication and Support to the Board

The Executive Director shall not permit the Board to be uninformed or unsupported in its work.

BP1.8 Component: Prohibited Use

The Executive Director shall not permit, wherever legally possible, the use of Redwood Glen grounds or resources by groups that are actively opposed to Christianity or the Redwood Glen Guiding Principles.

BP1.9 Component: Certification of Budget

The Executive Director shall not fail to bring the annual budget to the Board for certification as being in compliance with the Guiding Principles, particularly BP1.2.

BP1.10 Detail: Use of Line of Credit

In order to protect the use of the Line of Credit, the Executive Director may draw up to $5,000, as necessary, to meet cash-flow needs. The Executive Committee may authorize a draw up to $20,000. Any draw over $20,000 must be authorized by the full board. All draws from the Line of Credit must be communicated in writing to the full board by the Executive Director or Board Chair.

ACCOUNTABILITY PRINCIPLES

[Whereby the Board defines for the chairperson the ***standards to enforce the three accountabilities*** *of the Board]*

AP1.0 Comprehensive Accountability Statement

The responsibility of the Board, on behalf of Jesus Christ and those served by Redwood Glen in His name, is to ensure Redwood Glen, through the leadership of its Executive Director, (1) achieves the fulfillment of its Mission Principles, and (2) avoids violation of its Boundary Principles.

AP1.1 Component: Stewardship to Christ for Those He Calls Us to Serve

The Board shall maintain an active connection to Christ, as the ultimate Owner of Redwood Glen, as well as to supporters and participants, including American Baptists and the wider Christian community.

AP1.1.1 Detail: Continuing Education

The Board will annually research emerging trends in order to enhance its understanding of the training and equipping needed by professional and lay leaders for effective ministry.

AP1.1.2 Detail: Feedback and Assessment

The Board will intentionally gather input and feedback from conferees and stakeholders to better understand their needs and their perceived effectiveness of Redwood Glen in accomplishing our mission principles.

AP1.1.3 Detail: Prayer and Scripture

The Board will continually seek the wisdom and leading of Christ, as the Lord of Redwood Glen. To this end, significant attention will be given to prayer and Scripture, both as individual Board members and as a corporate Board.

AP1.2 Component: Board Process

The Board shall conduct itself with discipline and integrity, with regard to its own process of governance.

AP1.2.1 Detail: Board Style

The Board will govern with an emphasis on (1) advancement of the Kingdom rather than internal preoccupation; (2) encouragement of a variety of viewpoints; (3) strategic direction more than administrative detail; (4) clear distinction of board and staff roles; (5) collective rather than individual decisions; and (6) proactivity rather than reactivity.

AP1.2.2 Detail: Board Job Description

The essential tasks of the Board are to: (1) function as a steward representing the Owner; (2) define the guiding principles; and (3) employ the Executive Director and evaluate his/her performance. In addition to these three essentials, the Board shall exercise authority granted to it in the Bylaws but withheld from the Executive Director by virtue of the Boundary Principles.

AP1.2.3 Detail: Board Member Code of Conduct

The Board commits itself and its members to the following code of conduct:

a. Board members agree to honor the principles and decisions of the Board acting as a whole. They agree not to foster divisiveness or attempt to exercise individual authority over the staff or the organization, except as explicitly stated in the Guiding Principles.
b. Board members agree to respect the confidentiality of sensitive Board issues and to avoid facilitating gossip or other "triangulation."
c. Board members agree to represent the mission of Redwood Glen in its totality and not the special interests of any group within the organization or outside of it. Each member also agrees to disclose any personal or organizational conflict of interest and withdraw from any decision-making process materially affected. (See Redwood Glen Conflict of Interest Policy)
d. Board members agree to bring to the Board Chair's immediate attention any condition or action which they believe to be in violation of board policies.
e. Board members agree to attend every board meeting, unless an emergency or an important previous commitment prohibit. Each member also agrees to give advance explanation of an absence to the Chairperson whenever possible and to withdraw from membership on

the Board if two consecutive absences from regularly scheduled board meetings occur or if three absences within a three-year term occur.

f. Board members agree to be significant annual givers of record to Redwood Glen in order to provide ongoing financial support for its Mission Principles and, therefore, have 100% integrity behind the fundraising efforts of the Executive Director.

AP1.2.4 Detail: Responsibility of the Chairperson for Integrity of Process

The Board Chair enforces the integrity and fulfillment of the Board's process including the monitoring of the Executive Director's performance. The Chair is authorized to use any reasonable interpretation of the Accountability Principles as he or she acts to ensure the integrity of the Board's process.

AP1.2.5 Detail: Responsibility of the Redwood Glen Executive Director for Visionary Leadership

The Executive Director has the responsibility, authority and accountability to serve as the primary visionary leader of Redwood Glen at every level, including conferees, board, and staff. If a question of process arises with regard to the Bylaws or the Redwood Glen Guiding Principles, the Executive Director will defer to the judgment of the Board Chair.

AP1.2.6 Detail: Use of Board Committees

Board committees, such as the Executive Committee, will be assigned to reinforce the wholeness of the Board's job and not to interfere with: (a) the delegation from the Board to the Executive Director; or (b) with the work of the staff.

AP1.2.7 Detail: Cost of Governance

The Board will continue to invest in its own governance capacity through training, outside expertise, research mechanisms and meeting costs.

AP1.3 Component: Monitoring the Performance of the Executive Director

The Board's sole official connection to the operations of Redwood Glen, its achievement and conduct shall be through the Executive Director.

AP1.3.1 Detail: Unity of Control

Only decisions of the Board, acting as a whole, or its Executive Committee, acting on its behalf, are binding on the Executive Director.

AP1.3.2 Detail: Accountability of the Executive Director

The Executive Director is the Board's only link to operational achievement and conduct, so that all authority and accountability of staff, as far as the Board is concerned, is considered the authority and accountability of the Executive Director.

AP1.3.3 Detail: Delegation to the Executive Director

The Board will instruct the Executive Director through the Guiding Principles that define the mission to be achieved and boundaries to be enforced, allowing the Executive Director to use any reasonable interpretation of these principles.

AP1.3.4 Detail: Performance of the Executive Director

The Board will conduct systematic and objective monitoring of the Executive Director's performance solely against accomplishment of the Mission Principles and compliance with the Boundary Principles.

a. The Executive Director will be required to write measurable goals each year that correspond to each of the Mission Principles.
b. Each year the Board shall review the results achieved by the Executive Director on each of the Mission Principles as the basis of compensation increase or corrective action. These results include both those achieved with reference to annual goals and those achieved in addition to annual goals.
c. The Executive Director will be required to report to the Board on compliance with Boundary Principles at each annual performance review and to affirm or give evidence of compliance upon request by the Board at any time.

ATTACHMENT 12

Budget Projection / Capital Improvement Plan

ATTACHMENT 12A

Budget Projection and Capital Improvement Plan Worksheets

SIMPLIFIED CAPITAL IMPROVEMENT PLAN (CIP)

Date: 5/17/17
System ID No.: 4100522
System Name: Redwood Glen Water System
Service Connections: 1

QTY	COMPONENT	UNIT COST	INSTALLED COST	AVG LIFE, YEARS	ANNUAL RESERVE	MONTHLY RESERVE	MONTHLY RESERVE PER CUSTOMER
	Existing CIP Costs (NONE)						
	NEW Project CIP Costs						
1	Preferred Alternative - SWTP and system improvements	300,000	300000	30	10000.00	833.33	833.33
			0	0	0.00	0.00	0.00
			0	0	0.00	0.00	0.00
			0	0	0.00	0.00	0.00
	SUBTOTAL New Project CIP Costs		$300,000.00		$10,000.00	$833.33	$833.33
	TOTAL Existing and New Project CIP:		$300,000.00		$10,000.00	$833.33	$833.33

Report Prepared by (Title): _ Lisa Pezzino, PE

Date: May 17, 2017

NOTE: Installed costs are averages and include all materials and contracted labor and equipment.

NOTES:

FIVE YEAR BUDGET PROJECTION (Small Community Water System)

INSTRUCTIONS: Yellow-shaded cells are for data entry; all other cells are locked except line item descriptions which can be changed if needed.
Years 2 through 5 will be compounded automatically by the inflation factor in Cell G6.

System Name: Redwood Glen Water System

Inflation Factor (%): 3.0

System ID Number: 4100522

LINE		EXPENSES AND SOURCE OF FUNDS	2016	2017	2018	2019	2020
1	OPERATIONS AND MAINTENANCE (O&M) EXPENSES						
2		Salaries and Benefits	19,000.00	19,570.00	20,157.10	20,761.81	21,384.67
3		Contract Operation and Maintenance	1,091.77	1,124.53	1,158.26	1,193.01	1,228.80
4		Power and Other Utilities	7,107.41	7,320.63	7,540.25	7,766.46	7,999.45
5		Fees Regulatory	800.00	824.00	848.72	874.18	900.41
6		Treatment Chemicals	960.00	0.00	0.00	0.00	0.00
7		Coliform Monitoring	1,144.00	1,178.32	1,213.67	1,250.08	1,287.58
8		Chemical Monitoring	0.00	0.00	0.00	0.00	0.00
9		Transportation	1,336.20	1,376.29	1,417.58	1,460.11	1,503.91
10		Materials, Supplies, and Parts	2,463.20	2,537.10	2,613.21	2,691.61	2,772.36
11		Office Supplies	651.40	670.94	691.07	711.80	733.16
12		Miscellaneous	0.00	0.00	0.00	0.00	0.00
13		Additional O&M for New Project - Bracewell Engineering. 2016 includes the current Bracewell budget. 2017 - 2020 references the new contract which includes: all water quality monitoring and laboratory fees, treatment chemicals, and operation of the SWTP. See executed contract and budget with Bracewell Engineering. Total initial annual operating budget of $98,424, to be revisited every 3 months. It is assumed that the annual fee to Bracewell will decrease over time as Redwood Glen takes on more responsibility for the water system.	3,090.00	57,085.92	78,424.00	68,424.00	58,424.00
14		**Total O&M Expenses:**	37,643.99	91,687.73	114,063.86	105,133.06	96,234.33
16	GENERAL AND ADMINISTRATIVE EXPENSES						
17		Engineering and Professional Services	5,000.00	200,000.00	5,000.00	5,150.00	5,304.50
18		Depreciation and Amortization	5,836.82	6,011.93	6,192.29	6,378.05	6,569.40
19		Insurance	3,296.90	3,395.81	3,497.68	3,602.61	3,710.69
20		Existing Contribution to CIP (From CIP J48)	0.00	0.00	0.00	0.00	0.00
21		O&M Reserve	0.00	0.00	0.00	0.00	0.00
22		Other Reserves	0.00	0.00	0.00	0.00	0.00
23		Miscellaneous	1,253.53	1,291.13	1,329.87	1,369.76	1,410.86
24	**	New Funding Project Costs	0.00	300,000.00	0.00	0.00	0.00
25		Additional New Project Contribution to CIP (From CIP J59)	0.00	0.00	10,000.00	10,000.00	10,000.00
26	**	Debt Service	0.00	0.00	31,353.00	31,353.00	31,353.00
27		**Total General and Administrative Expenses:**	15,387.25	510,698.87	57,372.83	57,853.43	58,348.44
28		**TOTAL EXPENSES (Line 14+ Line 27):**	53,031.24	602,386.59	171,436.69	162,986.48	154,582.77
30	REVENUES RECEIVED						
31		Cash Revenues (Camp Fees)	94,705.98	189,411.95	189,411.95	189,411.95	189,411.95
32	**	Depreciation Reserves	0.00	0.00	0.00	0.00	0.00
33	**	Fees and Services	0.00	0.00	0.00	0.00	0.00
34	**	Hookup Charges	0.00	0.00	0.00	0.00	0.00
35	**	Withdrawal from CIP or Other Reserves	0.00	0.00	0.00	0.00	0.00
36	**	Other Fund Sources: Interest, Etc.	0.00	0.00	0.00	0.00	0.00
37	**	Grants	0.00	0.00	0.00	0.00	0.00
38	**	SRF Loan	0.00	0.00	0.00	0.00	0.00
39	**	Business Loans	0.00	500,000.00	0.00	0.00	0.00
40		**TOTAL REVENUE (Lines 31 through 39):**	94,705.98	689,411.95	189,411.95	189,411.95	189,411.95
41		**NET LOSS OR GAIN:**	41,674.74	87,025.36	17,975.26	26,425.47	34,829.18

Report Prepared by (Name and Title): ______________________________ Date: ________________

(** Inflation factor not applied to future year projections)

	2016	2017	2018	2019	2020
Number of Customers:	1	1	1	1	1
Average Monthly Revenue Needed Per Customer:	4419.27	25198.88	14286.39	13582.21	12881.90

(total expenses ÷ # of customers ÷ 12)

Rev 11/9/09

ATTACHMENT 12B

Letter of Interest – Christian Community Credit Union

Christian Community CREDIT UNION

255 N. Lone Hill Ave. San Dimas, CA 91773 800.347.CCCU • F:909.971.9643 • ministrylending@myCCCU.com • myCCCU.com

September 26, 2016

Redwood Glen
Attn: Larry Rice
100 Wright Drive
Loma Mar, CA 94021

Re: Letter of Interest

Dear Larry Rice,

Thank you for giving Christian Community Credit Union an opportunity to present this loan proposal to Redwood Glen. As we have discussed, these funds will be used for the development of a water system at your Loma Mar camp site, ultimately allowing Redwood Glen to become water independent. Christian Community Credit Union's mission is to "help our members become better stewards and achieve their financial goals", so please let me know how we might be able to help your ministry in this way.

This letter is for informational purposes only and is not a loan approval or formal commitment. The formal loan approval can only be considered after receipt of a complete loan application package. Furthermore, formal loan approval will remain subject to the continuing accuracy, throughout loan settlement, of the information which you or your representatives make in the formal loan application and other supporting documents.

The following includes the terms of the loan we discussed:

Proposed loan terms/conditions:

Loan Amount: Approximately up to **$500,000**

Interest Rate: **5 Year balloon term with a fixed rate of 3.40% to 4.15%**
7 Year balloon term with a fixed rate of 3.65% to 4.40%
Based on current market conditions as of September 1st 2016

Payment: The monthly payment will be based on a **25 year amortization**.
5 Year at approximately **$2,476 to $2,681** per month
7 Year at approximately **$2,543 to $2,751** per month

Term: **5 or 7 year balloon term.** At the time of the balloon date, Christian Community Credit Union will review the ministry's borrowing capacity under the then current credit underwriting standards and may extend and/or modify the loan for another 5 or 7 years at the prevailing interest rate. Please be aware that interest rates in effect at the time of extension/modification may be substantially higher or lower than the initial rate.

Loan Fee: **¼ to ½ Point**

Pre-Payment Penalties: None. CCCU does not charge pre-payment penalties on any loans. It is the Credit Union's mission to help its members be good stewards. If you can payoff the loan early and save money on interest, more money will become available for ministry to further the Kingdom.

Formal loan approval will be further conditioned upon receipt and review of the following:

- Completed CCCU Ministry Loan Package
- Financials to qualify and meet CCCU Guidelines
- Other conditions may arise during loan process as documentation is reviewed by CCCU

It would be a privilege to partner with Redwood Glen with this ministry loan request. Should you have any questions regarding the information in this letter, please call me directly at 800-347-2228 ext. 6196.

Sincerely,

Jeremy Brown
Ministry Development Officer
Ministry Development Group – Sales

ATTACHMENT 13

Budget Control

Redwood Glen Water System Policy Manual

REDWOOD GLEN WATER SYSTEM
MANAGERIAL POLICY MANUAL

The Redwood Glen Camp & Conference Center Board of Directors manages the Redwood Glen Water System, which operate based on the Redwood Glen By-laws and Guiding Principles. For all matters regarding general Board policies and approval processes, reference the By-laws and/or Guiding Principles.

This policy manual covers the management and operation of the Redwood Glen Water System, and is in addition to and aligned with the Redwood Glen By-laws and Guiding Principles. The policies are subject to change as required and voted upon by the Board of Directors.

1.0 General

The purpose of the Redwood Glen Water System is to provide a safe supply of water to customers within its service area. Water supply and use shall be in conformance with these rules and regulations.

2.0 Customer Policies

The following sections cover the non-paying customer policies regarding the Redwood Glen Water System, in accordance with the Redwood Glen By-laws and Guiding Principles.

2.1 Applicability

The Redwood Glen Water System serves the residents and guests of Redwood Glen Camp and Conference Center, however Redwood Glen does not have paying customers, and therefore does not collect water service or usage charges from the customers served. Additionally, there is no “new development” within the Redwood Glen service area that is initiated by an outside party. As such, Redwood Glen Water System management and operations staff does not interface with the customers that they serve in the capacity typical of a water utility (ie. paying of bills, requesting water service to new homes, etc.). The following section includes water user policies as applicable to the Redwood Glen Water System.

2.2 Purpose

The purpose of the customer policies is to provide a framework for the way in which the Redwood Glen Water System interfaces with water users, or non-paying customers, of the water system. These policies shall be reviewed periodically by the Board of Directors and may be amended as necessary by a majority vote of members.

2.3 Resident or Guest Grievances

An informal complaint generated by a water user and directed to the Redwood Glen management or operations staff will be reviewed by the Executive Director and Board of Directors. The water user must inform management or operations staff as to the concerns they have regarding the water served. The Executive Director and Board of Directors will investigate the customer grievance and issue a response based on the investigation. If specialized assistance is required, Redwood Glen will seek the counsel of the appropriate water resources professionals.

2.4 Water Facility Inspections at Residential/Guest Housing

Representatives of the Redwood Glen Water System shall have the right at any reasonable hour to enter residential or guest housing in order to read water meters, inspect piping, and perform other duties for the proper maintenance and operation of service.

2.5 Interruption of Service

Redwood Glen Water System will make reasonable efforts to supply continuous, uninterrupted service. However, Redwood Glen shall have the right to interrupt service for the purpose of making repairs or for other necessary work. Efforts will be made to notify residents or guests who may be affected by such interruptions, however Redwood Glen will not accept responsibility for losses that might occur due to such necessary interruptions. Additionally, Redwood Glen does not accept responsibility for losses due to interruptions of service caused by storms, floods, or other events beyond the utility's control.

2.6 Unauthorized Use of Water

Should it come to the attention of the management and operations staff at Redwood Glen Water System that a resident or guest is using water in a capacity that exceeds typical residential uses, or is being used for unauthorized industrial, commercial, or agricultural uses, Redwood Glen will exercise their authority to restrict this usage of water. This includes unauthorized irrigation on the premises and utilizing water for industrial washing and/or commercial gain.

2.7 Conservation

Water users shall adhere to the daily conservation efforts at the Redwood Glen facilities as well as any necessary conservation actions mandated by Redwood Glen management as drought contingency measures.

3.0 Employee Policies

The following sections cover the employee policies regarding the Redwood Glen Water System, in accordance with the Redwood Glen By-laws and Guiding Principles.

3.1 Applicability

All employees of the Redwood Glen Water System are employees of the Redwood Glen Camp & Conference Center, including management and operations staff. Detailed employee guidelines are included in the Redwood Glen Employee Handbook; however, policies relevant to the Redwood Glen Water System are included below. Additionally, Redwood Glen Water System retains a contract certified operator to assist with operation and maintenance (O&M) of the water system, a contract position with separate requirements from Redwood Glen employees.

3.2 Purpose

The purpose of the employee policies is to provide a framework for effective management and operation of the Redwood Glen water system. These policies shall be reviewed periodically by the Board of Directors and may be amended as necessary by a majority vote of members.

3.3 Employee Classifications

The following employee classifications are applicable to the Redwood Glen Water System Staff:

- ***Full-time employees*** are those working a regular, non-seasonal schedule of at least 32 hours per week, for a total of at least 1,664 hours per calendar year.
- ***Part-time employees*** are those working a regular, non-seasonal schedule of less than 32 hours per week.
- ***Seasonal employees*** are those working specified seasons of the year, such as summer and/or winter camping seasons.
- ***Non-Exempt employees*** are all those who are eligible to be paid for overtime work in accordance with the provisions of applicable wage and hours laws.
- ***Exempt employees*** are all those who are not eligible for overtime pay.

3.4 Working Hours

Since Redwood Glen is a continuous 7-day-a-week, 365-day-per-year facility, the individual employee's specific workdays will vary. The normal, standard workweek is a 4- or 5-day workweek consisting of 32-40 hours with two (2) days off. Especially in the summer, workweek schedules may be six (6) or seven (7) days. The two (2) days off are not necessarily consecutive. Each workday shall be approximately eight (8) hours, with a paid 10-minute mid-morning break, a paid 10-minute mid-afternoon break, and an unpaid 30-minute meal period. Employees may be required to stay longer than eight (8) hours by their supervisor to finish a job. Off duty and meal periods are excluded from hours of work.

3.5 Time Cards

The employee is to indicate on his/her time card, next to the appropriate date, the time (to the nearest quarter hour) that he/she arrived and left; and indicate the total hours worked in the appropriate column in ink, as required by the State of California. At the end of the month, you are to sign your card at the bottom. Time cards must be neat and legible. Each employee is responsible for marking days as Holiday/Vacation Days, Sick Days or Regular Days Off so that he/she may receive the appropriate credit.

3.6 Overtime

Overtime at the rate of 1½ times the employee's regular rate of pay will be paid for all hours worked in excess of 40 in one workweek, for the first four (4) hours in excess of eight (8) in any one workday, but not both, and for the first eight (8) hours on the seventh day of work in one workweek, but not both.

Overtime at the rate of two (2) times the employee's regular rate of pay will be paid for all hours worked in excess of twelve (12) in one workday and for all hours worked in excess of eight (8) on the seventh day of work in one workweek.

The workweek, on which overtime calculations will be based, begins each Monday at 12:01a.m. Each workday, on which daily overtime calculations will be based, begins at midnight.

3.7 Contract Operators

Redwood Glen retains a team of certified contract operators to assist in the O&M of the Redwood Glen Water System. The certified operator shall maintain distribution and treatment certifications that meet or exceed the requirement of the Redwood Glen Water System at all times. All details regarding the contract operator’s responsibilities are included in the specifications of their executed contract.

3.8 Management Training

The Redwood Glen Executive Director and Board of Directors shall continue to receive training in utility management, ethics, drinking water regulations and resource management in order to effectively manage public water systems. The Redwood Glen Water System Training Plan details the regular training for management staff.

3.9 Operator Training

Any person operating the Redwood Glen Water System must continue to receive training appropriate to the size, type and complexity of the system. Additionally, water treatment and distribution system operators require continuing education to maintain their certifications. The Redwood Glen Water System Training Plan details the regular training and continuing education for operations staff.

4.0 Financial Management Policies

The following sections cover the financial management policies regarding the Redwood Glen Water System, in accordance with the Redwood Glen By-laws and Guiding Principles. The Redwood Glen Water System serves the residents and guests of Redwood Glen Camp and Conference Center, however Redwood Glen does not collect water service or usage charges from the customers served.

4.1 Applicability

Financial policies of the Board of Directors shall conform to applicable state statutes, local ordinances, and other legal obligations of the system. Any section or sections of these policies determined to be in conflict shall be null and void, without affecting the applicability of other sections and provisions.

4.2 Purpose

The purpose of these policies is to provide a framework for the effective management and conduct of the financial affairs of the Redwood Glen Water System. These policies shall be reviewed periodically by the Board of Directors and may be amended as necessary by a majority vote of members.

4.3 Enterprise Accounting

The system shall be operated as an enterprise. It is the policy of the Board of Directors that the system shall operate on a financially self-sustaining basis. The full cost of providing water services to guests and staff on a continual basis shall be recovered through guest group user fees and charges established by the Board of Directors.

4.4 Generally Accepted Accounting Principles

It is the policy of the Board of Directors that financial affairs of the system are conducted according to generally accepted accounting principles (GAAP). The utility's financial accounting and reporting system will be conducted on an accrual basis.

4.5 Insurance

Redwood Glen shall maintain insurance coverage that is adequate and necessary to protect the system against potential financial losses.

4.6 Revenues

It is the policy of the Board of Directors that 20% of the funds generated from guest group user fees and charges may be used only for expenses directly associated with the system's operation and maintenance, debt service, debt-service reserve, and other financial-reserve funds authorized by the board. If more funds are needed, the Board of Directors shall, by majority vote, authorize such expenditures.

4.7 Fiscal Year

The fiscal year of the Redwood Glen Water System shall be for a 12-month period, beginning on the 1st day of January, and ending on the 31st day of December annually. Tax returns for will be prepared and approved by the Board of Directors.

4.8 Audit Reports

Audit reports shall be prepared annually covering financial operations for the previous fiscal year. Audit reports shall be completed by an independent public accountant with experience in auditing similar organizations, and will be reviewed by the Board of Directors.

4.9 Long- and Short-term Planning

The Board of Directors shall develop long- and short-term financial plans that forecast future capital and operational needs of the system and that provide a strategy for financing those future needs. Operational, financial, and administrative staff of the system shall assist the board in developing these financial plans.

4.10 Budget Development

At least 30 days prior to the beginning of each fiscal year, the Board of Directors shall develop and adopt an annual revenue and expense budget for the operation of the system. The annual budget must show that anticipated revenues shall be sufficient to cover all operating expenses.

4.11 Budget Format

The budget format and expense and revenue line items shall conform to state and/or federal requirements, if applicable. Each source of revenue and each category of expense shall be separately identified in detail sufficient to present an accurate picture of the system's financial condition.

4.12 Rate and User-charge Review

Guest group user fees and charges shall be reviewed annually as part of the budgeting process and adjusted as necessary to remain financial secure.

4.13 Financial Reserves

It is the policy of the Board of Directors that in order to maintain financial stability and self-sufficiency, and to achieve both long- and short-term capital and operational needs into the future, the system shall maintain financial reserve funds. The financial reserve funds shall be used for:

- **Debt-service reserve funds (DSRF) as may be required by lenders:** Debt-service reserve funds for the water system shall be established and maintained in a separate account in an amount consistent with requirements of the system's lenders.
- **CIP Reserve:** Planned system improvements consistent with long-range capital needs.
- **O&M Reserve:** Equipment replacement of short-lived assets.
- **Emergency Reserve:** Emergency funds for unforeseen breakdowns and system repairs.

4.14 Financial Reserve Accounts and Withdrawal Guidelines

The financial reserves shall be maintained in separate accounts. All financial reserve funds shall be deposited in federally insured depositories. Expenditures or transfers from financial reserves shall be only with approval of the Board of Directors.

4.15 Monitoring Budgeted Revenues and Expenditures

Each quarter during the fiscal year, the Board of Directors shall receive and review a financial report from Redwood Glen's accounting personnel, which includes the water system budget. Quarterly financial reports shall contain:

- Current quarter's revenues and expenditures
- Actual year-to-date revenues and expenditures
- Net income or loss
- Beginning and ending balances for all operating and reserve accounts of the system
- Summary of past-due accounts receivable (number and total amount)

4.16 Accounting Policies

The Redwood Glen Water System financial accounting will become a part of the entire Redwood Glen Camp accounting and will follow the policies and procedures as such. It will be maintained as a separate class so monthly reports and accountability can be maintained.

4.17 Budget Control

The following budget control policies are applicable to the Redwood Glen Water System:

- **Checks and Notes:** Except as otherwise specifically determined by resolution of the Board of Directors, or as otherwise required by law, checks, drafts, promissory notes, orders for the payment of money, and other evidence of indebtedness of the corporation shall be signed by any two (2) of the following officers or staff members: President, Secretary, Treasurer, Chair, Vice Chair, Director of Maintenance, Director of Camp Programming, or bookkeeper.

- **Deposits:** All funds of the corporation shall be deposited to the credit of the corporation in such banks, trust companies, or other depositories as the Board of Directors may select. Deposits shall be prepared by the bookkeeper and approved by the Executive Director.
- **Cash Receipts and Disbursements:** Cash receipts and disbursement shall be prepared by the bookkeeper and approved by the Executive Director.
- **Execution of Instruments:** The Board of Directors, except as otherwise provided in the Bylaws, may by resolution authorize any officer or agent of the corporation to enter into any contract or execute and deliver any instrument in the name of and on behalf of the corporation, and such authority may be general or confined to specific instances. Unless so authorized, no officer, agent, or employee shall have any power or authority to bind the corporation by any contract or engagement or to pledge its credit or to render it liable monetarily for any purpose or in any amount.
- **Payroll:** Payroll is prepared by the bookkeeper and approved by the Executive Director. When the paycheck is received, the employee will sign for it on the appropriate form provided by Human Resources.

4.18 Budget Adjustments

Based on reviews of quarterly financial reports, the Board of Directors shall make budget adjustments or amendments as necessary. Adjustments to an approved budget must be voted on by the Board of Directors.