2014 WEST MARIN WATER SYSTEM MASTER PLAN

North Marin Water District

FINAL REPORT

August 2014

ACKNOWLEDGEMENTS

This report was completed under the supervision and guidance of the following District Officers and Department Heads:

Chris DeGabriele	General Manager
Drew McIntyre	Chief Engineer
Robert Clark	Operations \ Maintenance Superintendent
Brad Stompe	Distribution / Treatment Supervisor
Pablo Ramudo	Water Quality Supervisor
Tony Arendell	Construction Superintendent
David Bentley	Auditor-Controller

Many District staff from all departments (too numerous to name) were involved with the preparation of the West Marin Water Master Plan, without whose help the project would not have been successfully completed.

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1. Brelje and Race Consulting Civil Engineers (2001)-"West Marin Long Range Plan" - Prepared in Conjunction with North Marin Water District.

2. Jenipher Hubley, Associate Engineer (2002) - Memorandum - "West Marin Tank Seismic Retrofit Study - Seismic Analysis".

3. Soldati Engineering Services (2000) - "West Marin Storage Capacity Analysis" - Prepared for North Marin Water District.

4. SPH Associates (2005) - "Point Reyes Water Treatment Plant Upgrade Study - North Marin Water District".

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SECTION 1

INTRODUCTION

1.1 PURPOSE OF STUDY

The North Marin Water District (NMWD) has prepared this 2014 update of the West Marin Water System Master Plan to guide immediate and planned future system improvements. The West Marin Water System serves primarily the Point Reyes Station (PRS), Olema, Bear Valley, Inverness Park and Paradise Ranch Estates (PRE) communities and parcels later annexed in to the PRS and PRE-improvement district within NMWD's West Marin service territory in Marin County, encompassing approximately 24 square miles. The West Marin Service Area boundary is shown on Figure 1-1.

The previous West Marin Long Range Plan was prepared in 2001 by Brelje & Race Consulting Civil Engineers. This Master Plan Update identifies necessary system improvements for both current operation and as water demands increase in the future. The Master Plan Update includes a proposed Capital Improvement Plan that identifies the improvement projects and required funding throughout the planning period through FY 2035.

Projects contained in the Capital Improvement Plan are separated by budget category utilized in the District budgeting process. Projects are identified for the following categories.

- Pipeline Replacement/Additions (Category #1)
- System Improvements (Category #2)
- Pt Reyes Treatment Plant Improvements and Other Improvements (Category #3)
- Storage Tanks/Pump Stations (Category #4)

Proposed projects related to water conservation are beyond the scope of the master plan and are not included herein.

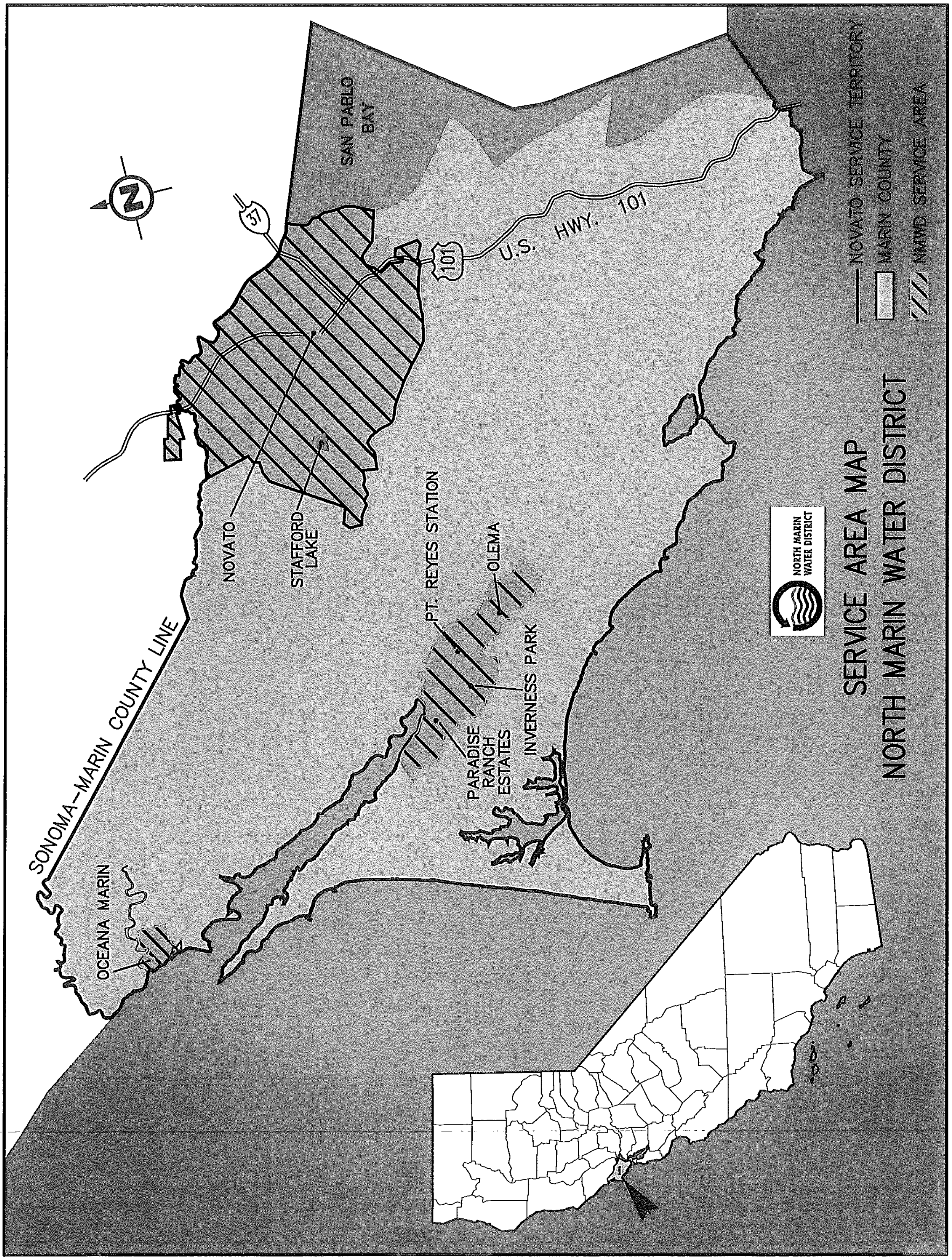
1.2 MAJOR MODIFICATIONS SINCE 2001 LONG RANGE PLAN

The 2001 West Marin Long Range Plan was undertaken by the District in an attempt to develop a long-range strategic plan for identifying and implementing necessary capital improvement projects in the water transmission and distribution system. The effort, including consolidation of various recent planning efforts, a procedure and approach for developing current water consumption by zone, and for monitoring new development within the District boundaries and projecting water demands through buildout. The result of the work was a Capital Improvement Plan that identified a phased plan for implementing recommended improvement projects.

The 2014 Master Plan Update built on the original Long Range Plan with updated historical water production records, updated development forecast and water demand projections. In addition, limited hydraulic analysis was added to evaluate distribution system performance and an asset management section was added to summarize the District's efforts to collect data on existing infrastructure and create a reasonable plan to replace aging facilities.

1.3 SCOPE OF PROJECT

The scope of work consisted of several discrete tasks that covered a particular portion of the study. The following major tasks were performed for this project: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Task 1 – Research Existing Materials
Task 2 – Establish Planning and Evaluation Criteria
Task 3 – Update Water Supply System Planning Discussion
Task 4 – Limited Hydraulic Modeling
Task 5 – Update Water Demand Projections
Task 6 – Perform Storage and Pumping Capacity Evaluation
Task 7 – Perform Hydraulic Evaluation
Task 8 – Evaluate Water Quality
Task 9 – Evaluate Facility Replacements
Task 10 – Develop Capital Improvement Program
Task 11 – Prepare Master Plan Report

1.4 PROJECT TEAM

The project was performed as a collaborative effort between District staff. Associate Engineer Carmela Chandrasekera has served as the overall Project Manager for preparation of the 2014 Master Plan with Pablo Ramudo (Water Quality Supervisor) providing the section on Water Quality Evaluation (Section 6) and Robert Clark (Operations/Maintenance Superintendent) providing the Asset Management (Section 8). Other staff members have participated in the project through interviews and input in revisions of specific chapters. Each discipline and department within the District has been represented as part of the project team and each section has been updated to reflect current data and information.

1.5 LIST OF ABBREVIATIONS

The following abbreviations were utilized in the report and are defined below.

Abbreviation	Definition
AC, ACP	Asbestos Cement Pipe
ADPM	Average Day Peak Month
AF	Acre Feet
AFA	Annual Acre Feet
AM	Asset Management
AOC	Assimilable Organic Carbon
APT	Apartment
AVE, AVG	Average
AWWA	American Water Works Association
CC	City/County Coordination
CI	Cast Iron
CIP	Capital Improvement Plan

Abbreviation	Definition
Cl2	Chlorine
COP	Copper
DBP	Disinfection By-Products
DBPR	Disinfection By-Product Rule
DCMS	Distributed Control and Monitoring System
DPH	California Department of Health Services
DIP	Ductile Iron Pipe
DP	District Planning
DU	Dwelling Unit
EDU	Equivalent Dwelling Unit
fps	feet per second
Ft	Foot, feet
FY	Fiscal Year
GAC	Granular Activated Carbon
Gal	Gallons
GHG	Green House Gas
GIS	Geographic Information System
Gpd	Gallons per day
Gpm	Gallons per minute
HA	Hydraulic Analysis
HAA	Haloacetic acids
HDPE	High-Density Polyethylene
HGL	Hydraulic Grade Line
HP	Horsepower
In	Inch
ISO	Insurance Services Organization
kW	Kilowatt
LIMS	Laboratory Information Management System
LTESWTR	Long-term Enhanced Surface Water Treatment Rule
M/DBP	Microbial/Disinfection By-Product
MCL	Maximum Contaminant Level
mg	Million gallons
mg/l	Milligrams per liter
mgd	Million gallons per day
MH	Mobile Home
MMWD	Marin Municipal Water District
MOU	Memorandum of Understanding
ND	Non-detectable
MCFD	Marin County Fire Department
NMWD	North Marin Water District
PB	Polybutylene (Plastic)
PG&E	Pacific Gas and Electric
POU	Point-Of-Use

Abbreviation	Definition
PR	Pressure Regulator
PS	Pump Station
psi	pounds per square inch
PVC	Poly Vinyl Chloride (Plastic)
RAA	Running Annual Average
RCP	Reinforced Concrete Pressure Pipe
SCADA	Supervisory Control and Data Acquisition
SF	Single Family
SP	Storage and Pumping Capacity Analysis
SS	Stainless Steel, Sanitary Sewer
STL	Steel
SWTR	Surface Water Treatment Rule
TDH	Total Dynamic Head
THC	Townhome / Condominium
THM	Trihalomethane
TOC	Total Organic Carbon
TTHM	Total Trihalomethane
ug/l	Micrograms per liter
USEPA	United States Environmental Protection Agency
WQ	Water Quality
WTP	Water Treatment Plant
WUI	Wildland Urban Interface

SECTION 2
PERFORMANCE AND EVALUATION CRITERIA

SECTION 2

PERFORMANCE AND EVALUATION CRITERIA

2.1 INTRODUCTION

The performance and evaluation criteria used to evaluate the West Marin Water System are presented in Section 2.

In order to perform the required hydraulic evaluation of the existing and buildout water distribution system, conduct storage and pumping capacity evaluations and develop the Capital Improvement Plan, it is necessary to identify the evaluation criteria that will enable identification of deficiencies and to judge the effectiveness of alternative improvements. Performance and evaluation criteria include:

- Water demand peaking factors for average day peak month (ADPM), maximum day (MDD) and peak hour (PHD) demands for use in developing current and buildout water demands
- Water system operating criteria, including minimum and maximum distribution system pressures and minimum and maximum pipeline velocities and head loss under various demand scenarios
- Storage capacity goals
- Pumping capacity goals
- System reliability goals

The performance and evaluation criteria are summarized in Table 2-1 and further described herein.

Table 2-1
Performance and Evaluation Criteria

Item	Criteria
Peaking Factors	• Average day peak month (ADPM) demand = annual average day x 1.45 • Maximum day demand (MDD) = ADPM x 1.43 (or annual average day x 2.11) • Peak hour demand (PHD) = MDD x 1.9 (or annual average day x 4.0)
Minimum pressure	• 40 psi under average day demand • 30 psi under maximum day demand • 20 psi at fire hydrant under fire flow event
Maximum pressure	• 80 psi (services with greater static pressure require a pressure regulator)
Maximum pipeline velocity	• 8 fps under average day demand • 10 fps under maximum day or fire flow demand
Maximum pipeline head loss	• 3 feet per 1000 feet under average day demand • 10 feet per 1000 feet under maximum day demand
Fire flow/storage goals	• 2,000 gpm for 2 hours in Point Reyes Station and 1,000(1) gpm for two hours in all other service zones.
Storage capacity goals	• Storage capacity goal per zone is the sum of operational storage and the greater of the emergency storage or the fire storage volume • Operational storage = 25% of maximum day demand • Fire storage = see above • Emergency storage = 100% of maximum day demand
Pumping capacity goals	• Station firm capacity is equal to maximum day demand pumped over 16 hour duration • Firm capacity = station capacity with largest pump out of service • Pump stations sized for firm capacity equal to maximum day demand

(1) - A minimum goal of 500 gpm for 2 hours will be used in remote locations where the 1,000 gpm goal would be cost prohibitive.

2.2 WATER DEMAND PEAKING FACTORS

Peaking factors represent the increase above the average annual demand experienced during a specified time period. The various peaking conditions are statistical concepts or numerical values obtained from a review of historical data and, at times, tempered by engineering judgment. The following peaking conditions are of particular significance to hydraulic analysis of the water system.

The peaking factors shown in Table 2-1 are averages obtained from the historical water production data as shown in Table 4-1 in Section 4. The development of the peaking factors shown in Table 2-1 is presented in Section 4.

2.3 HYDRAULIC NETWORK MODELING

Hydraulic modeling was not performed during the 2001 West Marin Long Range Plan. Limited flow modeling was performed during the 2014 Master Plan for each individual tank pressure zone to analyze pipeline sizing or storage deficiencies. A description of the model preparation and proposed use of the model is included in Section 7.

2.4 WATER SYSTEM OPERATING CRITERIA

The following operating criteria is used to evaluate system operation and hydraulic analysis.

2.4.1 Distribution System Pressure

In accordance with District Regulation 11, the minimum pressure under normal operation for the West Marin Water System is 40 psi measured at the service meter or building pad. Service connections with less than 40 psi pressure are designated "low-pressure services" and will be furnished only in accordance with Regulation 11.

In accordance with District Regulation 12, the maximum pressure under normal operation for the West Marin Water System is 80 psi measured at the service meter or building pad. Service connections with greater than 80 psi are designated "high-pressure services" and will be furnished only in accordance with Regulation 12. Services with normal static pressure greater than 80 psi are required to install a privately owned pressure regulating device. The maximum design pressure in distribution system pipelines is 150 psi, unless special conditions mandate otherwise.

In evaluating the water system hydraulic operation, the minimum allowable pressure under maximum day demand conditions is 30 psi and the minimum residual pressure at the fire hydrant under fire demand conditions is 20 psi.

2.4.2 Pipeline Flow and Velocity

Distribution system pipelines are generally sized to carry the greater of: 1) peak hour demand; or 2) maximum day demand plus fire flow. The minimum pipeline diameter is 6 inches per District Regulation 21. However, the West Marin Distribution system still has 2-inch and 4-inch mains that were installed prior to NMWD purchasing the water system from Pt Reyes Station Water Company and the Inverness Park Water Company in the 1960's. All pipe segments with a single fire hydrant shall be a minimum of 6 inches diameter (although some existing fire hydrants are on 4-inch laterals).

Other criteria related to the distribution system piping include maximum and minimum velocity and the maximum allowable friction head loss. Pipeline velocity should be limited to approximately 8 feet per second under normal operation. Velocities could increase to approximately 10 fps without damage if not sustained for long periods. There is no minimum velocity requirement in water system design, except that stagnant flow in dead ends is discouraged as water quality suffers.

In most situations, as long as the maximum velocity and pressure criteria are not violated, high head loss by itself is not an important factor. However, a pipe segment with high head loss may serve as a warning that the pipe is nearing the limit of its carrying capacity and may not have excess capacity to perform during peak demand conditions. It is normally good practice to limit head loss to no greater than 10 feet per 1000 feet under maximum day demands or fire flow conditions. Head loss should be limited to approximately 3 feet per 1000 feet under average day demand conditions.

2.5 WATER SUPPLY FACILITIES

Typically, water supply sources must be large enough to meet the various water demand conditions and also be able to meet some demand during emergencies such as power outages and natural disasters. Ideally, water supply sources should meet the maximum day demand. The diurnal fluctuations during the maximum day demand are handled by gravity storage capacity.

2.6 STORAGE FACILITIES

The detailed storage capacity evaluation will be presented in Section 5. The following criteria will serve as a guideline for the analysis.

Storage capacity goals for each zone consist of three components:

- Operational storage volume
- Fire storage volume
- Emergency storage volume

The sum of these three components is the typical total storage capacity used in larger water systems. However, in the 2001 West Marin Long Range Plan, the total storage was calculated as the sum of the operational storage (25% of MDD) and the greater of the emergency storage (100% MDD) or the fire storage volume. The criterion used in the 2001 Long Range Plan will be used for this Master Plan as well (as summarized in Table 2-1). The total storage capacity goal is compared to the existing storage capacity to determine if a surplus or deficit exists within the zone.

2.6.1 Operational Storage Volume

Operational storage volume is the amount of storage capacity in a system to absorb fluctuations of demand versus supply. Ideally, water supply sources are sized to provide the maximum day demand, with gravity storage capacity delivering the remainder during peak demand periods. With adequate operational storage capacity, system pressures are stabilized and adequate storage capacity can be provided for fire and emergency use. In accordance with AWWA guidelines, operational storage capacity is assumed to be 25 percent of the maximum day demand for each pressure zone.

2.6.2 Fire Storage Volume

Fire storage volume is provided for fire-fighting purposes to allow gravity flow in the event the source flow is interrupted. Fire storage volumes vary and are based on the specified fire flow rate for a specified duration as described above.

Fire flow rates are normally based on the requirements of the local Fire Marshal and Insurance Services Office (ISO) requirements. Fire flows are defined as a specified flow rate for a specified duration of time based on the structure size, type of building construction and land use.

The District and the Marin County Fire Department (MCFD) have cooperatively developed fire flow and fire storage capacity goals throughout the West Marin Water System Service Area. The most recent correspondence between the MCFD and the District is provided in Appendix A-1. The MCFD has indicated a minimum fire flow goal of 2,000 gpm for a duration of 2 hours in the Point Reyes Station Area, and 1,000 gpm for a duration of two hours in other service zones.

Based on the representative land use in each of the pressure zones, previous District experience, and in collaboration with the Marin County Fire Department, the District has adopted the following fire flow rates and fire storage volume goals for each pressure zone shown in Table 2-2.

Fire flow goals represent flows over a specific duration for the purpose of determining fire storage capacity. It is desirable to provide the fire flow goal everywhere in the distribution system; however, there are many locations within the system that cannot meet the fire flow goals due to small diameter pipelines or the particular piping configuration in that vicinity. It is not always possible to make improvements for all locations that cannot meet the updated fire flow goals.

Table 2-2
Fire Flow and Fire Storage Volume Goals

Service Area	Pressure Zone	Area Type	Fire Flow Standard	Fire Storage Goal
Pt. Reyes	1	Comm/Res	2000 gpm for 2 hrs	240,000
Inverness Park	1	WUI	1,000 gpm for 2 hrs	120,000
Paradise Ranch Estates	1,2,3,4	WUI	1,000 gpm for 2 hrs	120,000
Bear Valley	1	WUI	1,000 gpm for 2 hrs	120,000
Olema	1	WUI	1,000 gpm for 2 hrs	120,000

2.6.3 Emergency Storage Volume

Emergency storage volume is the storage volume available to meet demand during emergency situations such as pipeline failures, major trunk main failures, pump failures, electrical power outages or other natural disasters. The volume of water allocated for emergency use is determined by historical record of emergencies experienced and by the amount of time which is expected to lapse before the emergency can be corrected. The amount of emergency storage volume included within a particular water system is District-specified, based on an assessment of risk and the desired degree of system reliability. In California, emergency storage volumes range from 25 percent of average day demand to over 100 percent of maximum day demand. The lower criterion would apply to systems with a single pressure zone, adequate and reliable water supply sources (usually with emergency power), and redundant sources. If some, or all, of these criteria do not apply, it is appropriate to use a higher figure.

The District's normal criterion is one maximum day demand for each pressure zone to be reserved as emergency storage capacity.

In West Marin, historically, the District had utilized a total storage capacity criterion equal to two days of maximum day demand. In the 2001 West Marin Long Range Plan, the total storage was calculated as the sum of the operational storage (25% of MDD) and the greater of the emergency storage (100% MDD) or the fire storage volume. The 2001 criterion will be used as the storage capacity goal for this Master Plan as well.

2.7 PUMPING FACILITIES

Providing adequate storage capacity is only one distribution system element that benefits system operation. Adequate pumping capacity must also be provided to enable the storage tank to recover depleted volume in a reasonable time period. Undersized pumps may reduce the effectiveness of storage capacity. An analysis of the pumping capacity is presented in Section 5.

Booster pump stations feeding the higher pressure zones are normally sized to pump the maximum day demand. In order to account for outages and routine maintenance procedures, the District has adopted a criterion that all booster pump stations must have adequate capacity to pump the maximum day demand over a 16-hour interval. Each station should have enough firm capacity to meet the maximum day demand over the 16-hour interval. This results in a reserve duration of eight (8) hours for unplanned contingencies such as power interruptions, pipeline breaks, etc. Firm capacity is defined as the station capacity with one pump out of service. The District's goal is to have at least two pumps at each booster pump station.

2.8 RELIABILITY CRITERIA

Reliability criteria have been established for the major facilities and operation of the water system to provide a level of reliability for the system.

2.8.1 Water Sources

It is preferable to have more than one source of water supply for a water system to provide flexibility should one source be lost. In 2008, CDPH adopted revised Waterworks Standards that require new groundwater based systems to have a minimum of two approved sources. NMWD historically has relied on the two Pt Reyes Wells (aka Coast Guard Wells) located to the south of its Pt Reyes Treatment Plant (PRTP) to supply water for the West Marin service area.

Due to the wells' location in the lower tidal reach of Lagunitas Creek, they are subject to periodic salinity intrusion and occasional flooding. The District is working on having more than one source of water supply to the West Marin Water System. A pipeline connecting the Gallagher Well to the PRTP will be installed in 2014. Once the Gallagher well is connected to the West Marin service area, it will provide the second source of supply.

2.8.2 Booster Pump Stations

District standard design practice is to have at least two pumps at each booster pump station. Additional reliability is designed into the design criteria which limit pumping capacity to a 16-hour window in order to account for outages, mechanical problems and issues of this nature. Although standby power is not required at each station, the District has made provisions for emergency standby power. A portable power generator is available that can be used in the case of a local power failure.

2.8.3 Storage Tanks

Water storage capacity provides for gravity supply of water demand if a pump station is off-line or out of service. The District prefers to have at least two storage tanks for each pressure zone to allow one tank to remain in service while one is taken out of service for maintenance or repairs. All new tanks are designed to meet seismic codes and requirements. Existing tanks not meeting current seismic requirements have been evaluated and the seismic upgrade recommendations are further discussed in Section 9. A Seismic study of West Marin tanks was performed in 2002 (job 2.8713).

2.8.4 Distribution System Pipelines

The distribution system should be adequately looped to minimize dead ends and promote good water circulation. Ideally, there should be at least two paths for water delivery at all locations in the system. Looping is especially important for those areas that do not have storage facilities in the immediate vicinity. However, the system is not looped adequately other than in the Pt Reyes Station zone due to the topography of the area.

Isolation valves should be located to allow shutdown of pipe segments enabling routine maintenance and emergency repairs which impact the fewest customers.

SECTION 3
EXISTING WEST MARIN WATER SYSTEM

SECTION 3

EXISTING WEST MARIN WATER SYSTEM

3.1 INTRODUCTION

Section 3 describes the existing distribution system facilities of the North Marin Water District (NMWD, District) West Marin Water System and presents a general overview of system operation.

3.2 WEST MARIN WATER SYSTEM OVERVIEW

The West Marin Water System serves primarily the Point Reyes Station (PRS), Olema, Bear Valley, Inverness Park and Paradise Ranch Estates (PRE) communities and parcels later annexed in to the PRS and PRE-improvement district within NMWD's West Marin service territory in Marin County, encompassing approximately 24 square miles. The West Marin Service Area boundary is shown on Figure 3-1.

As of June 30, 2013, the West Marin Service area had approximately 776[1] active service connections serving approximately 811[1] dwelling units. The estimated service area population is 1,700[1].

3.3 WATER SUPPLY SOURCES

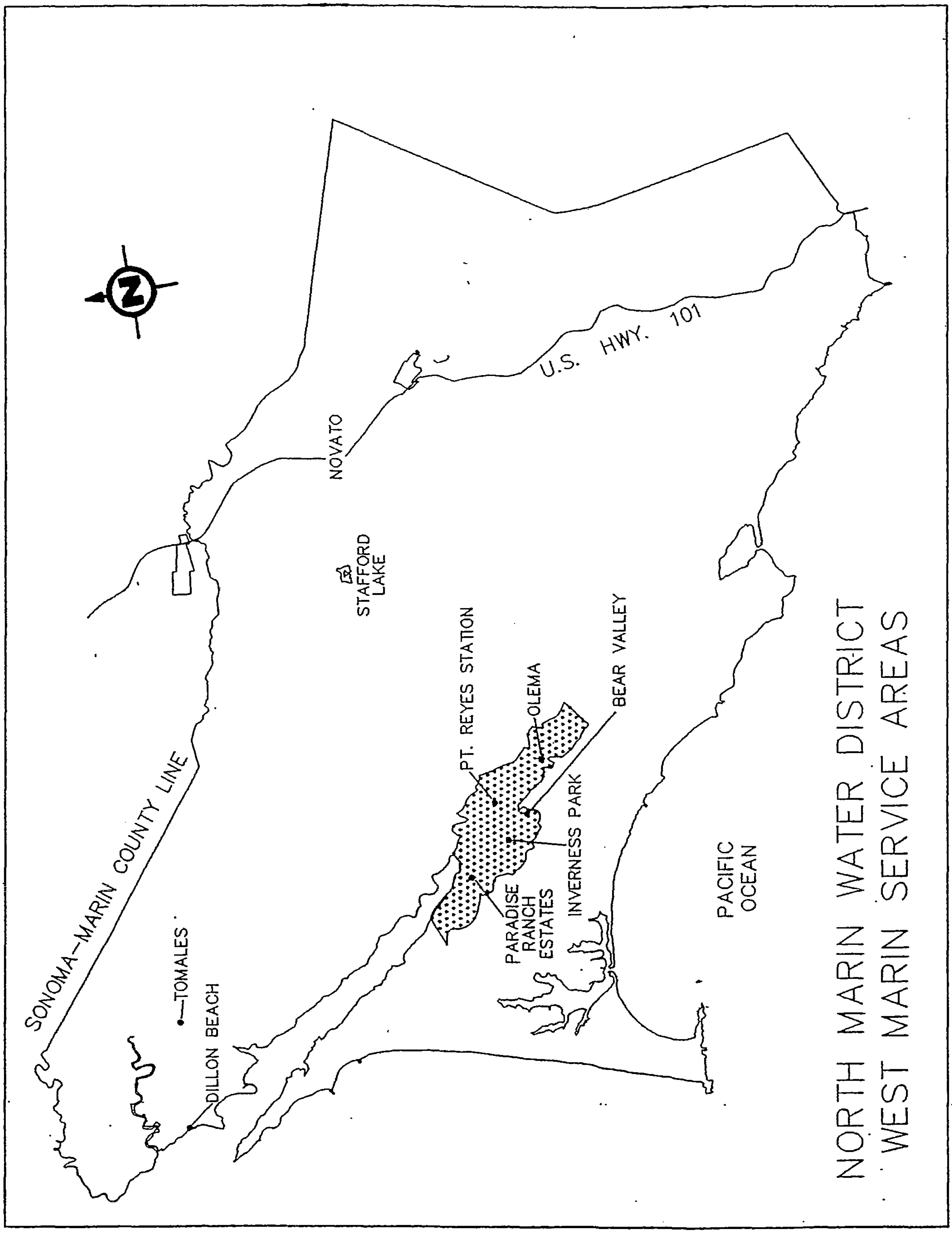
The North Marin Water District water supply for the West Marin Service area is currently derived from a single source, from two wells (Well Nos. 2 and 4) located on the Coast Guard housing facility property in Point Reyes Station and adjacent to Lagunitas Creek. Prior to installation of Well No. 4 in 2013, a total of three supply wells had been in place. Historically, at any one time, only two of these wells had been in service. These wells were identified as Well Nos. 1, 2 and 3. All the wells are installed in close proximity to each other. Well No. 1 was abandoned in 2002 by grouting with concrete. Well No. 4 was installed in 2013 as a replacement well for Well No. 3 due to decrease in the water production capacity from Well No. 3. Well No. 3 is no longer active and is now used as a monitoring well for measuring the depth of groundwater. Due to the Coast Guard Wells' location in the lower tidal reach of Lagunitas Creek, they are subject to periodic salinity intrusion and occasional flooding.

In 1993, Gallagher well was constructed 1.3 miles northeast of Highway 1 within the Gallagher Ranch for use as an emergency source. It is located upstream of any flooding and tidal reach of Lagunitas Creek but not connected to the West Marin Water System. NMWD plans to use Gallagher Well as the source during periods of salinity intrusion and flooding when Coast Guard Wells cannot be operated. A project to connect the Gallagher Well to the Point Reyes Treatment Plant by installing approximately 5,300 ft of pipeline is scheduled to be completed in calendar year 2014 funded by using a California Department of Public Health Prop 50 grant. The Gallagher Well pipeline will connect the well with an existing 6-inch pipeline near the abandoned Downey well site which extends to the PRTP.

NMWD abandoned the use of Downey Well that was located within the Lagunitas Creek stream channel in 2007. The well was originally constructed on the bank of the stream, but the creek has migrated and captured the wellhead. This well produced water with poor water quality.

[1]Source: NMWD Annual Report FY 2013

FIGURE 3-1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NOVATO
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SONOMA–MARIN COUNTY LINE
TOMALES
DILLON BEACH
PT. REYES STATION
OLEMA
BEAR VALLEY
INVERNESS PARK
PARADISE RANCH ESTATES
INVERNESS
PACIFIC OCEAN
NORTH MARIN WATER DISTRICT
WEST MARIN SERVICE AREAS

From 1994 to 2007, this well was used to deliver raw water to the Giacomini Ranch for irrigation. Proposed water supply source locations in West Marin are shown in Figure 3-2.

3.3.1 Coast Guard Wells

The North Marin Water District Point Reyes potable Well Nos. 2 and 4 (Coast Guard Wells) are located on U.S. Coast Guard Property at 101 Commodore Webster Drive, Point Reyes Station, Marin County, California. As shown on the attached Figure 3-2, the Coast Guard well site is located on a grassy flat below residential units on the Coast Guard's Point Reyes Housing Unit. The site is west of Lagunitas Creek. The water from the two existing wells at this well site is pumped by individual 30 HP pumps to the nearby Point Reyes Water Treatment Plant (PRTP) where the water is treated and distributed to the West Marin Service Area. Well Nos. 2 and 4 have respective capacities of 250 gpm and 300 gpm. When both pumps are running at the same time, the combined capacity reduces to a total of 420 gpm.

3.3.2 Gallagher Well Supply

NMWD historically has relied on the two Coast Guard Wells located to the south of its Pt Reyes Treatment Plant (PRTP) to supply water for the West Marin service area. Due to the wells' location in the lower tidal reach of Lagunitas Creek, they are subject to periodic salinity intrusion and occasional flooding. In contrast, the Gallagher well, which was drilled in 1993 as an emergency water source, is upstream of any flooding and tidal reach of Lagunitas Creek. The District is constructing a new 12-inch pipeline so that the existing well is connected to NMWD's PRTP. The capacity of the existing Gallagher well is approximately 120 gpm and construction of additional well(s) is planned in the future.

The Gallagher Well and the new pipeline will provide a second reliable water source that not only addresses salinity intrusion and flooding issues with NMWD's existing Coast Guard Wells but also complies with CDPH Waterworks Standards Section 64554 which states that, community water systems using only ground water shall have a minimum of two approved water sources.

Gauging Station

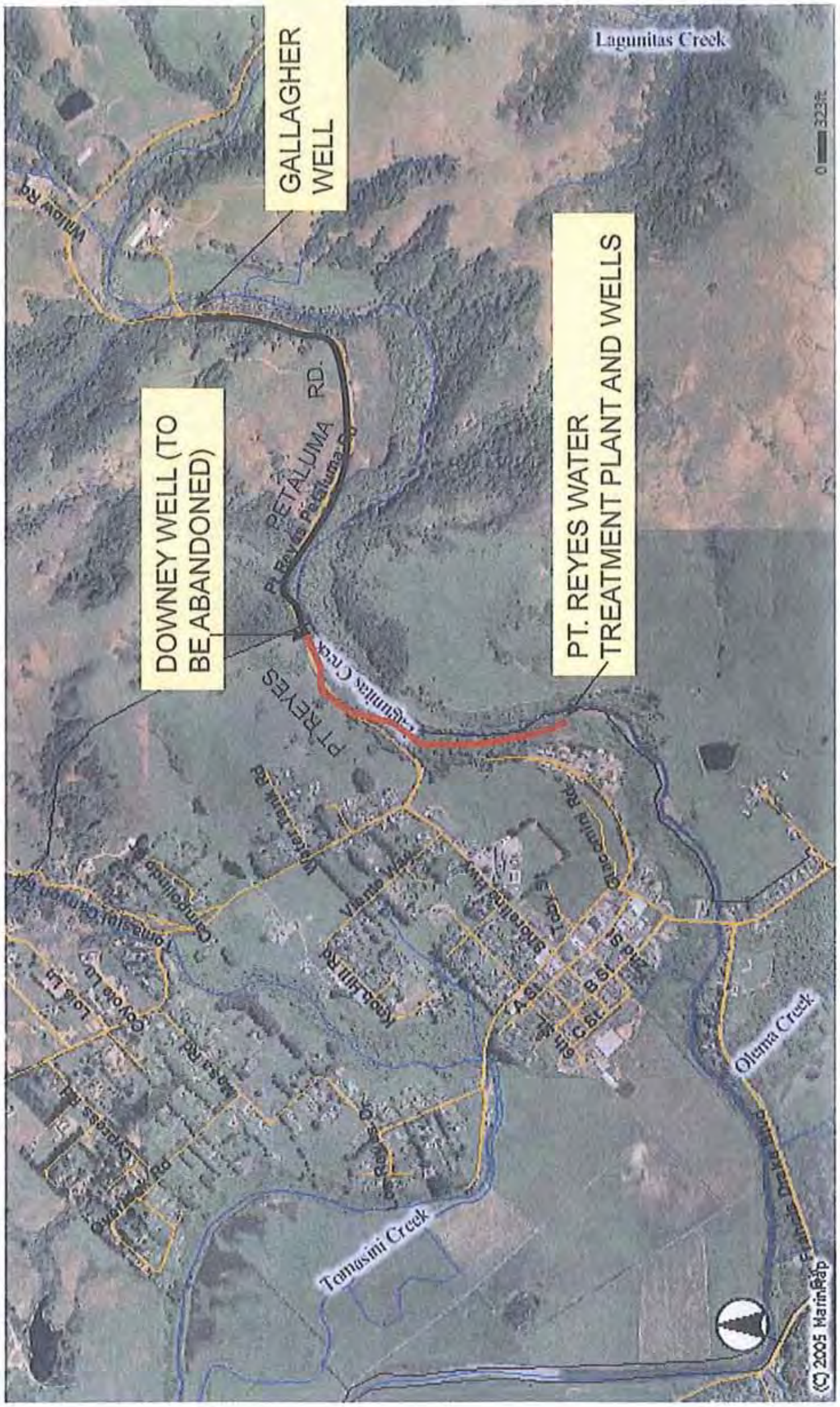
An existing stream gauging station is located between Point Reyes-Petaluma Road and Lagunitas Creek immediately north of the Gallagher Ranch driveway.

In order to gauge the effect of the water drawdown from the well on stream flow downstream of the area where the existing and the new Gallagher Well would be located, an auxiliary (temporary) gauge was installed in 2013 at a location about 1,200 feet south of the existing Gallagher Well. The testing showed that Gallagher Well production was limited to 120 gpm and the drawdown had no significant effect on the downstream flow.

3.4 Existing Water Rights

NMWD diverts water from Lagunitas Creek through a Water License and two Water Right Permits. Water License 4324B allows NMWD to divert water between May 1 and November 1 of each year at a rate not exceeding 0.67 cubic feet per second (cfs) for a maximum diversion of 148.8 acre-feet per year. Approved points of diversion for License 4324B include the Coast Guard Wells, Downey Well, and the Gallagher Well.

Fig 3-2 West Marin Supply Sources



LEGEND:
NEW 12" MAIN -
EX. 6" MAIN -

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FIGURE 3-2

The Water Right Permit 19724 allows diversion of 0.699 cfs (maximum of 212.7 acre-feet diverted) on a year-round basis. Water Right Permit 19725 allows a maximum diversion of 0.961 cfs (292.5 acre-feet maximum) on a year-round basis. The water rights under these two Permits are junior rights that are not available during the summer months (July through October) of dry years. A dry year is defined as a year in which the total precipitation that occurs from October 1 through April 1 is less than 28 inches as measured at the Marin Municipal Water District's Kent precipitation gauge. The Permits authorize diversion from the Coast Guard Wells, Downey Well and Gallagher Well site.

To meet water demand in dry years when water cannot be diverted from Lagunitas Creek due to the restrictions described above, NMWD has an Intertie Connection Agreement with the Marin Municipal Water District (MMWD) to release up to 250 acre-feet of water from Kent Lake.

Dedication of Water for In-Stream Uses

As allowed under California Water Code Section 1707, the purpose of use for Water Right Permit 19724 includes instream use for fish and wildlife preservation and enhancement. The Permit allows diversion of 212.7 acre feet of water per year (at a maximum rate of 0.699 cubic feet per second). NMWD petitioned the State Water Resources Control Board (SWRCB) to change the place of use and purpose of use for 0.699 cubic feet per second (cfs) of water diverted from Lagunitas Creek under Water Right Permit 19724 for municipal uses in the NMWD West Marin Service Area for the purpose of preserving and enhancing wetland habitat, and fish and wildlife resources in Lagunitas Creek pursuant to Water Code Section 1707. The new place of use is defined as instream flows for the protection, preservation, restoration and recovery of aquatic organisms, including but not limited to coho salmon and steelhead trout pursuant to Recovery Planning measures to be developed under the Memorandum of Understanding Among National Marine Fishery Service, California Department of Fish and Game, Army Corps of Engineers, Fish Net4C, counties of Mendocino, Sonoma, Marin, San Mateo, Santa Cruz and Monterey and the County of Humboldt as executed on May 16, 2002. This was approved in February 2013.

3.5 CLIMATE PROTECTION MANAGEMENT PLAN

Climate change is a global phenomenon with local implications. Local and regional actions can affect the overall amount of greenhouse gas emitted, and the District pledges its support to reduce greenhouse gases and improve air quality.

The District has embarked on a program to increase awareness of the affects its operation has on greenhouse gas emissions. Over the past five years, the GHG Emission Reduction Program has included participation in the Marin Clean Energy program with greater than 50% of its power supplied from carbon free emissions, staff training on truck & equipment idling operation, efficient vehicle operation and employee commute options. Operational efficiencies have been implemented at all NMWD pump stations and in new fleet & materials purchases utilizing the most energy-efficient products.

With these improvements, the District has been able to meet the California Assembly Bill 32 (AB32) 2010 targets for emission reduction for both the fleet and electricity uses. The District continues to seek opportunities to reduce greenhouse emissions through programs and philosophies, including the following:

- Utilizing high efficiency pumps and motors at pumping plants.
- Investigate opportunities to reduce energy usage at District facilities.
- Install solar power panels to generate power for District-owned facilities.
- Investigate upsizing transmission mains to reduce overall pumping requirements and reducing energy usage.
- Participate in regional Climate Protection Mitigation Management programs, particularly those with Marin County, Sonoma County and other bay area governments.
- Investigate the possibility of 100 percent energy self-sufficiency.
- Investigate the potential impacts to District facilities from a possible three foot sea level rise by 2050 and a 15 foot sea level rise by 2100.
- Include climate impacts in all CEQA documents for future projects.
- Purchase "Deep Green" power through the Marin Clean Energy Program.

3.6 WATER CONSERVATION

NMWD maintains a comprehensive and innovative Water Conservation Program aimed at improving water use efficiency for residential, commercial, and large landscape customers. Each water conservation program element is analyzed to assure that it will efficiently produce long- lasting water savings, mutually worthwhile to the customer and the District.

Focused residential activities include residential water use surveys (Water Smart Home Survey), high efficiency washing machine rebates, Ultra Low Flush Toilet (ULFT) rebates, High Efficiency Toilet (HET) rebates, a Cash-for-Grass Program (turf removal rebate), Conservation Incentive Rates, flapper rebates, weather based irrigation controller rebates, and a plumbing retrofit on resale program(toilets, showerheads, and bathroom sink aerators). Commercial water conservation programs include High Efficiency Toilet (HET) rebates, high efficiency washing machine rebates, and free water audits/surveys.

The public outreach program includes direct mail newsletters, bill text, newspaper advertisements and articles, and a variety of other customer outreach campaigns. The outreach program is designed to increase customer participation in the various programs offered by the District and fosters customer awareness of water supply issues.

NMWD requires new development to meet some of the most stringent water use standards in the nation, including installation of a high efficiency washing machine, high efficiency toilets, weather based irrigation controllers, a maximum of 400 square feet of turf for residential development and no turf for commercial development, drip or other subsurface irrigation for all irrigated non-turf areas and other landscape requirements consistent with the State model Water Efficient Landscape Ordinance (WELO).

3.7 DISTRIBUTION SYSTEM CHARACTERISTICS

The distribution system facilities for the West Marin Water System are described below. The distribution system piping and major facilities are shown on Figure 3-3. A schematic of the West Marin water system is shown on Figure 3-4.

3.7.1 Service Areas

The District has seven separate service and pressure zones in West Marin based on ground surface elevations and geographic locations. Each zone has one or more water storage tanks

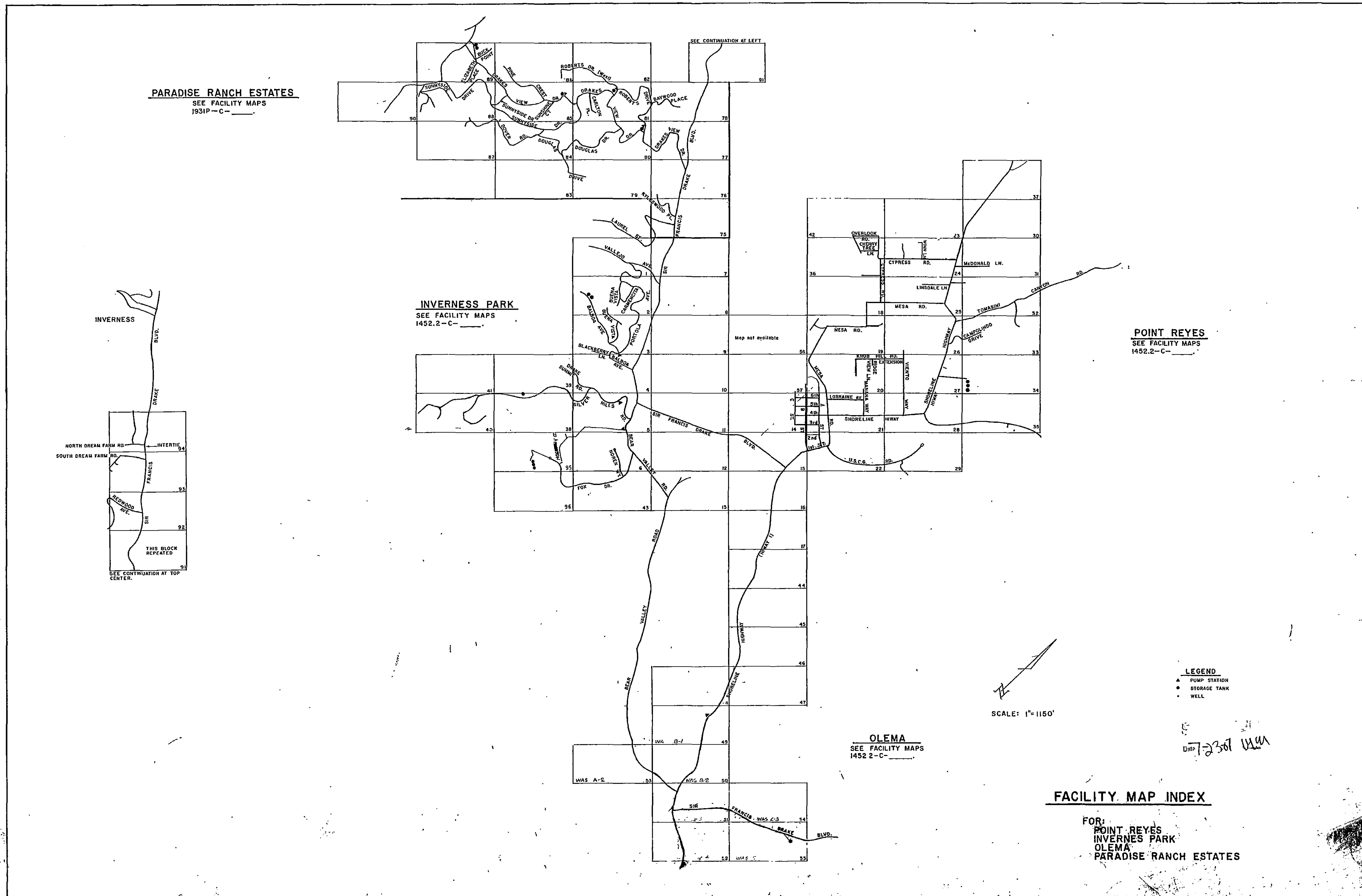
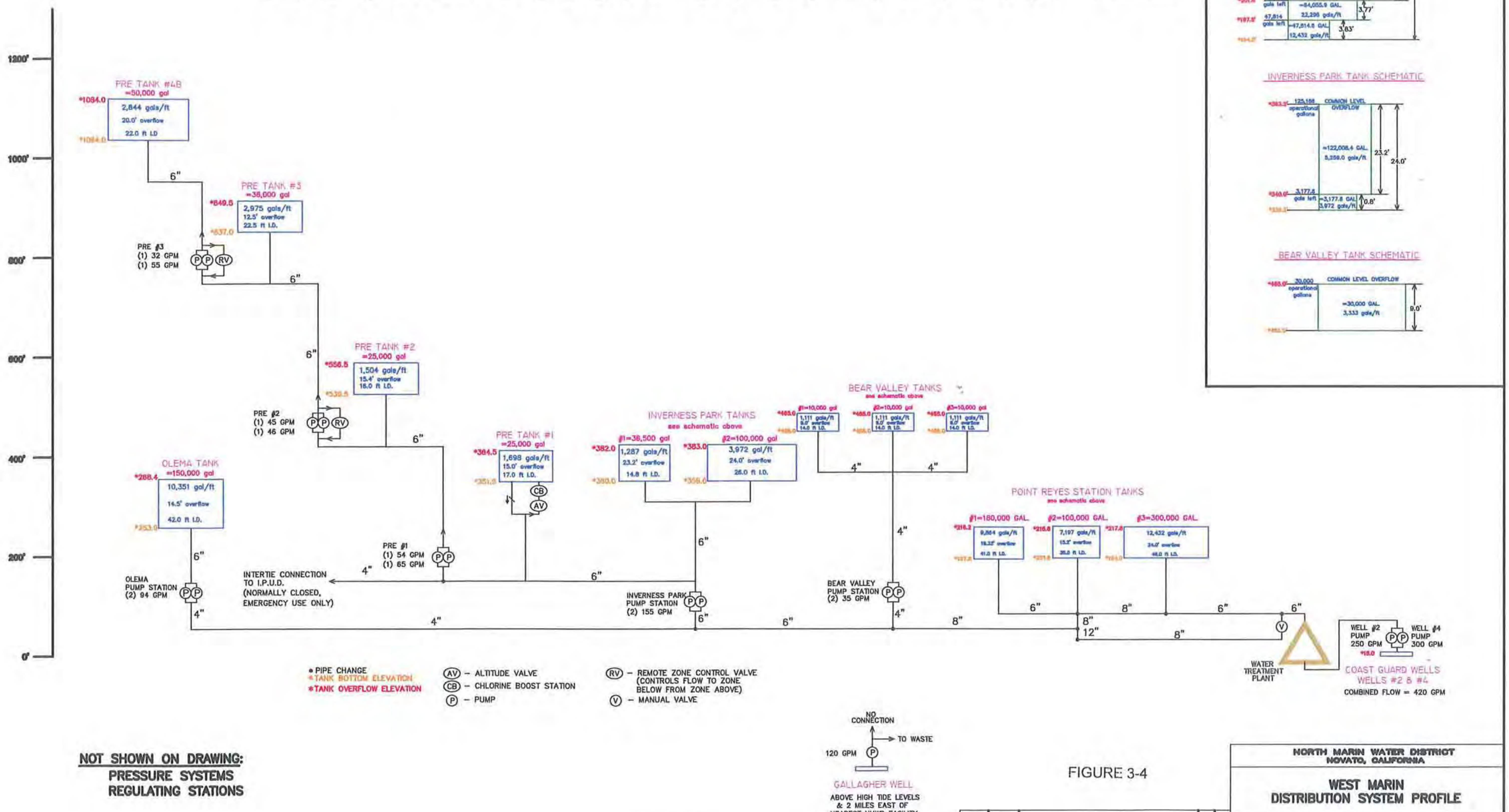

PARADISE RANCH ESTATES
SEE FACILITY MAPS
1931P—C—____.
INVERNESS PARK
SEE FACILITY MAPS
1452.2—C—____.
POINT REYES
SEE FACILITY MAPS
1452.2—C—____.
OLEMA
SEE FACILITY MAPS
1452 2-C-____.
INVERNESS
SEE CONTINUATION AT LEFT
SEE CONTINUATION AT TOP CENTER.
THIS BLOCK REPEATED
Map not available
SIR FRANCIS DRAKE BLVD.
BEAR VALLEY ROAD
SHORELINE HIGHWAY
SCALE: 1"=1150'
LEGEND
PUMP STATION
STORAGE TANK
WELL
FACILITY MAP INDEX
FOR:
POINT REYES
INVERNES PARK
OLEMA
PARADISE RANCH ESTATES

FIGURE 3-3

WEST MARIN DISTRIBUTION SYSTEM PROFILE



NOT SHOWN ON DRAWING:
PRESSURE SYSTEMS
REGULATING STATIONS

FIGURE 3-4

NORTH MARIN WATER DISTRICT
NOVATO, CALIFORNIA

WEST MARIN DISTRIBUTION SYSTEM PROFILE

NO.	DATE	REVISION	BY	APP
3	5/5/14	UPDATED INFORMATION	CC	DM
2	3/3/14	UPDATED INVERNESS PARK TANK ELEVATIONS	CC	DM
1	1/19/07	ADDED SYSTEM DETAILS & TANK SCHEMATICS	LJ	MM

DES	DR	CH
DM	UU	MM

APPROVED: CHIEF ENGINEER
R.E. C40938

SCALE : NONE
DATE : 01/30/01
SHEET NO. : 1 OF 1 SHEETS
SERVICE AREA 2 ACCT.NO. NO. OP13

that establish the maximum water surface elevation for that zone and provide gravity flow during peak demand periods.

The main service zones in West Marin are Point Reyes Station (PRS Zone), Olema, Bear Valley, Inverness Park and the Paradise Ranch Estates (PRE).

Water from the Point Reyes Treatment Plant is first pumped from Coast Guard Wells through the PRTP in to the Point Reyes Station tanks. The Olema, Bear Valley and Inverness Park booster pump stations pump from the Point Reyes zone to Olema, Bear Valley and Inverness Park zones.

Inverness Park pumps and tank supply water to PRE-1 tank. PRE-1 tank uses an Altitude valve because it is lower than the fill elevation of Inverness Park Tank.

Inverness Park Service Zone serves customers along and mostly west of Sir Francis Drake Blvd from approximately Balboa Avenue to Kyleswood Place. PRE-1 serves customers to the north along Sir Francis Drake Blvd and lower areas of the PRE. The Paradise Ranch Estates Service Area consists of four separate pressure zones, each being fed by a booster pump station from the lower PRE-1 pressure zone. PRE-1 Pump Station (PS) pumping to PRE-2 tank, PRE-2 PS pumping to PRE-3 tank and PRE-3 PS pumping to PRE-4 tank. There are two pumps at each of the pump stations.

Storage tanks and pump stations are described in the next sections. The PRE service areas are able to use a cascading system for providing emergency / fire storage using the combined storage of these areas using the available cascading system by pumping from lower zones to the higher zones (or by gravity, bypassing the pumping system in case of an emergency condition in the lower elevation zones).

For FY 2013, Point Reyes Station Service Zone accounted for 64.4 percent of the water demand, the highest demand in the West Marin system. Inverness Park and PRE Service Zones accounted for approximately 19.7 percent of the total system demand. Of this demand, approximately 8.2 percent is for PRE 2, 3, and 4 subzones and 11.5% for Inverness Park Service Zone. Olema Service Zone accounted for approximately 12.5 percent of the total system demand. Bear Valley Service Zone demand accounted for only 3.3 percent of the total system demand.

3.7.2 Storage Tanks

Each pressure zone has gravity storage capacity in one or more storage tanks. There are a total of 13 storage tanks throughout the West Marin Water System, totaling almost 1.035 MG. PRS has a storage capacity of 580,000 gallons. Inverness Park has a total storage capacity of 136,500 gallons. PRE has a combined storage capacity of 138,000 gallons. Bear Valley has 30,000 gallons and Olema has 150,000 gallons of storage capacity. Tank sizes range from 10,000 gallons to 300,000 gallons. Pertinent information for all storage tanks is shown in Table 3-1.

3.7.3 Booster Pump Stations

A total of 6 booster pump stations deliver water from a lower pressure zone to a higher pressure zone. Individual pumps range from 5 hp to 30 hp. Booster pumps are operated based on water surface levels in a storage tank serving the pressure zone. High and low level set points control

Table 3-1
Storage Tanks

				Elevation					
Zone	Storage Tanks	Capacity Gallons	Overflow depth (ft)	Bottom	Overflow	Inside Diameter (Ft)	Gal Per Ft.	Type Of Construction	Year Built
PR	Point Reyes# 1	180,000	18.33	197.83	216.2	41.0	9,864	Concrete	2004
PR	Point Reyes# 2	100,000	15.2	201.6	216.8	35.0	7,197	Welded Steel	1973
PR	Point Reyes# 3	300,000	24.0	194.0	217.8	46.0	12,432	Welded Steel	1982
IP	Inverness Park# 1	36,500	22	360.0	382	16.8	1,658	Concrete	2009
IP	Inverness Park# 2	100,000	24.0	359	383	26.0	3,972	Welded Steel	1982
PRE	PRE# 1	25,000	15.0	351.5	364.5	17.0	1,698	Redwood	1975
PRE	PRE# 2	25,000	15.4	539.5	556.5	16.0	1,504	Redwood	1980
PRE	PRE# 3	38,000	12.5	837.0	849.5	22.5	2,975	Concrete	2002
~~PRE~~	~~PRE# 4A*~~	~~25,000~~						~~Redwood~~	~~1975~~
PRE	PRE# 4B	50,000	20.0	1064.0	1084.0	22.0	2,844	Redwood	1980
BV	Bear Valley# 1	10,000	8.8	456.0	465.0	14.0	1,111	Concrete	1978
BV	Bear Valley# 2	10,000	8.8	456.0	465.0	14.0	1,111	Concrete	1978
BV	Bear Valley# 3	10,000	8.8	456.0	465.0	14.0	1,111	Concrete	1978
Olema	Olema	150,000	14.5	253.9	268.4	42	10,351	Concrete	2005

Total	1,034,500	

* PRE Tank #4A was destroyed in 1995 Mount Vision Fire

R:\Folders by Job No\8000 jobs\8600s\8687 (West Marin)\8687.01 WM Master Plan Update 2013_14\Tables\[Tables Section 3 WM MP.xlsx]Table 3-1

the priority operation of the pumps within each station. Tank level set points vary by season. None of the booster pump stations has permanent standby power facilities. Portable generators are available to power the pump stations in emergency situations. All pumps can be run by emergency generators. All stations have been retrofitted with manual transfer switches to disconnect from the power grid and to accommodate the portable generator hookups.

Water is pumped from the Coast Guard wells directly to PRS system through the PRTP. Olema, Bear Valley, Inverness Park/PRE-1 each have a booster pump station pumping water to these service zones. PRE-1, 2, 3 booster pumps each pump to the next higher level tank (i.e., PRE-2, 3 and 4 respectively). Pertinent information for all pump stations is shown in Table 3-2.

3.7.4 Hydropneumatic Systems

Hydropneumatic systems are installed for small demands that cannot be met from the primary pressure zones. There are no District operated hydropneumatic systems in the West Marin service area.

3.7.5 Pressure Regulator Valves

Normally, services located at elevations that do not match the primary zone elevations are served by intermediate pressure zones. Water is delivered to these intermediate pressure zones from a higher pressure zone through a pressure regulating station, which consists of two or three pressure reducing valves set at an appropriate downstream pressure to serve the zone. There are no pressure regulating valves installed for this purpose in West Marin. All customer services are supplied directly from tanks.

However, there is a system of pressure regulating valves installed at each of the PRE pump stations to create a cascading system to use water from the higher pressure zones during a main failure or high demand (due to fire fighting) in a lower pressure zone. The cascading system is physically set at each regulator.

There are 76 recorded high pressure services (HP) in West Main per the NMWD billing program. These are mainly located all along Sir Francis Drake Blvd, Vallejo Avenue, Laurel Street, and parts of Portola Avenue in Inverness Park Service area, along Fox Drive and Noren Way in Bear Valley Service Area, and along lower areas of Roberts Drive and Baywood Place in Paradise Ranch Estates. These services are required to have private pressure regulator valves installed and maintained by the home owners.

The billing program also shows 13 low pressure (LP) and 49 normal pressure (NP) services. There are 628 undeclared services some of which could be high pressure or low pressure services. No further study was performed to verify if any of these undeclared services are high or low pressure services.

3.7.6 Relief Valves

Pressure relief valves are located at the intermediate zones to open to relieve high pressure that may build up in the distribution system. No pressure relief valves are used in the West Marin System.

Table 3-2
Pump Stations

Pump From	Pump Name	Number Pumps	H.P. Size	Capacity GPM each	Suction Pressure	Discharge Pressure	Pumps to
Well	P.R. Wells	2	30, 30	250, 300	0 psi	100 psi	Point Reyes System
P.R.	I.P. P.S.	2	10, 10	155	50 psi	132 psi	I.P. tanks & PRE #1
P.R.	Olema P.S.	2	7.5, 7.5	94	68 psi	124 psi	Olema System.
P.R.	Bear Valley P.S.	2	5.0	35	72 psi	200 psi	Bear V.& Silver H.
PRE1	PRE 1 P.S.	2	5.0, 5.0	54, 65	8 psi	90 psi	PRE Tank 2 System
PRE2	PRE 2 P.S.	2	5.0, 5.0	45, 46	8 psi	135 psi	PRE Tank 3 System
PRE3	PRE 3 P.S.	2	3.0, 5.0	32, 55	8 psi	105 psi	PRE Tank 4 System
Well	Gallagher Well	1	25	120			Not in Service

3.7.7 Pipelines

The transmission system consists of 8-inch and 4-inch diameter pipelines to convey water supply to the distribution system. The primary transmission mains include 8-inch diameter main connecting the Point Reyes Treatment Plant to Point Reyes Station Tanks and an 8-inch pipeline along Sir Francis Drake Blvd delivering water from the Point Reyes Station zone to Inverness Park and Bear Valley systems. There is also a 4-inch transmission main conveying water to the Olema zone. Transmission system piping is generally constructed of Asbestos Cement (AC) or PVC pressure pipe.

The majority of the distribution system (86%) is comprised of 2-, 4-, or 6-inch diameter pipelines to distribute water from the transmission mains. There are both 8-inch and 12-inch distribution pipes installed (14%) in the more recent developer funded projects such as Point Reyes affordable housing and Heidrun Meadery. Distribution system pipelines are constructed primarily of PVC, AC, and steel pipe. There are older 2-inch galvanized pipe in the PRE zone which had been installed before the District acquired the system from Adams in the 1970s. AC pipe had been used before early 1990s and since 1992 distribution system piping is heavy walled PVC pipe (C-900, dimension ratio 14).

As of June 30, 2013, the distribution system totals approximately 26.5[2] miles of pipeline, based on data initially obtained from a review of the District facility maps in 2001, and continuously updated as projects are completed. The distribution system pipeline characteristics, including the lengths of each pipe material, pipe diameter, and age of pipe, are shown in Table 3-3.

3.8 SYSTEM CONTROL AND OPERATION

The District utilizes a Supervisory Control and Data Acquisition (SCADA) system which allows the system operator to remotely control and monitor pumps, tank levels, pressures and alarm settings for all of the major West Marin facilities which are connected to the SCADA system.

Flow control measurement of the source water is accomplished at the Point Reyes Treatment Plant. Also flow metering is available at each of the pump stations and is connected to the SCADA system.

Table 3-3
West Marin Distribution System Pipeline Characteristics (March 14, 2014)

Pipe Age	Total (ft)	Total (miles)	% of Total
<10 years	4,191	0.79	3.0
10-19 years	7,475	1.42	5.3
20-29 years	3,931	0.74	2.8
30-39 years	89,038	16.86	63.6
40-45 years	25,458	4.82	18.1
over 45 years	9,799	1.86	7.0
Total	**139,892**	**26.5**	**100**

Pipe Material	Total (ft)	Total (miles)	% of Total
Asbestos Cement (ACP)	99,023	18.8	70.8
Ductile Iron (DI)	351	0.1	0.3
Galvanized Steel (GS)	2,152	0.4	1.5
Plastic (PVC)	36,801	7.0	26.3
Steel (STL)	1,565	0.3	1.1
Total	**139,892**	**26.5**	**100.0**

Size (in)	Total (ft)	Total (miles)	% of Total
1	20	0.0	0.0
2	10,468	2.0	7.5
4	25,341	4.8	18.2
6	84,496	16.0	60.4
8	15,678	3.0	11.1
12	3,889	0.7	2.8
Total	**139,892**	**26.5**	**100**

[1]Source: Per West Marin Pipe Count Database

Each tank has a high and low level alarm programmed in the SCADA system. Each pump has a low suction and high discharge pressure alarm in the SCADA system. Pumps can be turned on or off manually from the SCADA system. Other system alarms included are power failure, pump failure, low battery (backup), transducer failure, and communication failure alarms.

3.9 WATER QUALITY

Distribution system water quality is presented in greater detail in Section 6.

3.10 FUTURE DEVELOPMENT

Future development projection and buildout forecast presented in Section 4.

SECTION 4
HISTORICAL WATER DEMANDS AND DEMAND FORECASTS

SECTION 4

HISTORICAL WATER DEMANDS AND DEMAND FORECASTS

The historical, current and forecast buildout water demands for the North Marin Water District's West Marin Water System are presented in Section 4.

4.1 HISTORICAL WATER PRODUCTION

Historical annual water production for the last forty years since FY 1973 for West Marin water supply is shown in Table 4-1.

4.2 CONSUMER ACTIVITY

The District maintains five principal residential customer classifications: single family detached unit (SF); single family attached unit, such as townhouse, condominium or duplex unit (THC); apartment unit (APT); mobile home (MH), and Ranch. The District maintains two other billing classifications that cover non-residential customers: commercial (CM) and government (GVT).

As of June 30, 2013, the approximate water usage, active services and residential dwelling unit mix, per customer classification is as follows:[1]

Structure Type	Consumption (MG)		Number of Accounts		Number of Dwelling Units	
SF	51.2	65%	665	86%	700	86%
THC	0.9	1%	3	0%	34	4%
APT	2.5	3%	16	2%	63	8%
MH	0.2	0%	3	0%	3	0%
Ranch	4.7	6%	8	1%	11	1%
Total	59.5	75%	695	90%	811	100%
CM	13.3	17%	71	9%		
GVT	6.2	8%	10	1%		
Non-Residential Total	19.5	25%	81	10%		
System Total	**79.0**		**776**			

[1] Source: NMWD Auditor Controller, November 2013

Table 4-1 - Historical Potable Water Production and Demands

Fiscal Years	FY Acre Feet	Million Gallons	Annual Daily (mgd)	Peak Month (mgd)	ADPM (mgd)	Factor ADPM/AD	Max Day Demand (mgd)	Factor Max day/ADPM	Factor Max Day/AD	Water Bank Total EDUs	Lost Water %
1973-1974	150.68	49.10	0.13	5.30	0.17	1.27					
1974-1975	184.13	60.00	0.16	6.80	0.22	1.33					
1975-1976	184.75	60.20	0.16	7.00	0.23	1.37					
1976-1977	168.48	54.90	0.15	6.50	0.21	1.39					
1977-1978	160.50	52.30	0.14	5.40	0.17	1.22				21	
1978-1979	208.68	68.00	0.19	8.30	0.27	1.44				18	
1979-1980	190.89	62.20	0.17	8.30	0.27	1.57				16	
1980-1981	225.26	73.40	0.20	8.40	0.27	1.35				104	18%
1981-1982	247.66	80.70	0.22	9.60	0.31	1.40				9	11%
1982-1983	260.24	84.80	0.23	9.70	0.31	1.35				40	17%
1983-1984	253.18	82.50	0.23	11.70	0.38	1.67				25	18%
1984-1985	273.44	89.10	0.24	11.80	0.38	1.56				26	21%
1985-1986	301.67	98.30	0.27	12.30	0.40	1.47				16	25%
1986-1987	342.80	111.70	0.31	13.80	0.45	1.45				10	28%
1987-1988	349.95	114.03	0.31	13.20	0.43	1.36				12	31%
1988-1989	336.30	109.58	0.30	12.92	0.42	1.39				24	29%
1989-1990	297.22	96.85	0.27	11.60	0.37	1.41				13	16%
1990-1991	342.58	111.63	0.31	11.71	0.38	1.24				9	23%
1991-1992	311.87	101.62	0.28	12.49	0.40	1.45				8	20%
1992-1993	294.07	95.82	0.26	12.28	0.40	1.51				6	12%
1993-1994	298.72	97.34	0.27	12.30	0.40	1.49				9	11%
1994-1995	288.01	93.85	0.26	11.63	0.38	1.46				5	10%
1995-1996	320.99	104.59	0.29	12.85	0.41	1.45				7	12%
1996-1997	332.98	108.50	0.30	14.35	0.46	1.56				10	10%
1997-1998	319.89	104.24	0.29	14.13	0.46	1.60				3	10%
1998-1999	381.89	124.44	0.34	16.49	0.53	1.56				4	23%
1999-2000	392.87	128.02	0.35	15.23	0.49	1.40				0	22%
2000-2001	375.95	122.50	0.34	13.82	0.45	1.33	0.66	1.47	1.96	8	10%
2001-2002	365.83	119.21	0.33	14.01	0.45	1.38	0.69	1.52	2.10	5	16%
2002-2003	332.17	108.24	0.30	15.09	0.49	1.64	0.61	1.26	2.07	1	9%
2003-2004	334.70	109.06	0.30	14.47	0.47	1.56	0.57	1.23	1.92	37	18%
2004-2005	336.00	109.49	0.30	16.76	0.54	1.80	0.75	1.40	2.52	2	9%
2005-2006	324.22	105.65	0.29	13.03	0.42	1.45	0.63	1.50	2.18	21	21%
2006-2007	380.36	123.93	0.34	13.94	0.45	1.32	0.62	1.37	1.82	13	19%
2007-2008	303.67	98.95	0.27	11.55	0.37	1.37	0.62	1.67	2.30	4	12%
2008-2009	301.17	98.14	0.27	11.86	0.38	1.42	0.53	1.39	1.97	6	14%
2009-2010	236.38	77.03	0.21	10.59	0.34	1.62	0.44	1.27	2.06	4	2%
2010-2011	243.65	79.39	0.22	9.93	0.32	1.47	0.63	1.98	2.92	3	6%
2011-2012	242.23	78.93	0.22	9.44	0.30	1.41	0.40	1.32	1.86	3	6%
2012-2013	249.71	81.37	0.22	9.81	0.32	1.42	0.40	1.26	1.79	1	4%
Max	1066.11	347.39	0.35	16.76	0.54	1.80		1.98	2.92		21%
Minimum	150.68	49.10	0.13	5.30	0.17	1.22		1.23	1.79		2%
Average	303.29	98.83	0.26	11.51	0.37	1.45		1.43	2.11		11%

R:\Folders by Job No\8000 jobs\8600s\8687 (West Marin)\8687.01 WM Master Plan Update 2013_14\[Tables Section 4 WM MP.xlsx]Table 4-4

4.3 HISTORICAL WATER DEMANDS

As noted in Section 2, water demand peaking factors are utilized to analyze and evaluate the water distribution system. Peaking factors are based on review of historical water demands and production data, operational impacts, and industry standards.

Historical water demand for the West Marin Water System is shown in Table 4-1. The observed annual average day demand, average day peak month (ADPM) demand and maximum day demand (starting from FY2001), along with calculated peaking factors and lost (un-accounted) water percentages for the WM Water System as a whole are also shown in Table 4-1. Daily production data prior to FY2001 were not available.

Historical annual, average day, average day of the peak month and maximum day production records are used to forecast the future demand. Over the past 40 years, the peaking factors have been highly variable and even though the trend is decreasing, the forecast relies on the historical average, which has been relatively constant, continuing to predict average day of the peak month as a function of average daily demand.

4.3.1 Average Day Peak Month Demand

The average day of the peak month (ADPM) demand represents an average daily demand during the month of highest demand for the year, typically July or August. This factor is used by the District to develop unit water demands and plan system improvements. For FY2013, the average day peak month peaking factor is 1.42 times the average day demand. Since FY1974, the ADPM/Average Day peaking factor has varied between 1.22 and 1.8. The 40-year average is 1.45.

4.3.2 Maximum Day Demand

The maximum day demand represents the highest daily demand for the entire year. A water system is usually evaluated under maximum day demand conditions or maximum day demand plus fire flow conditions. This condition allows the system to be stressed at a higher demand rate to ascertain if supply sources and pipeline carrying capacities are adequate. Hydraulic evaluation under maximum day plus fire flow demand conditions represents a reasonable "worst case" scenario of system operation.

For FY2013, the maximum day to ADPM demand peaking factor is 1.26. Thus, the maximum day to average day demand peaking factor is 1.79. Since FY2001, the maximum day to average day demand peaking factor has varied between 1.79 and 2.92. The 13-year average maximum day to ADPM peaking factor is 1.43 and the maximum day to average day peaking factor is 2.11. Maximum day to average day demand peaking factors generally range from 1.2 to 2.5 (per American Waterworks Association guidelines) except for one occurrence which was higher than 2.5 in FY2011 (2.92). In West Marin, the maximum day to average day factor is generally higher than that compared to in the AWWA guidelines.

4.3.3 Peak Hour Demand

The peak hour demand represents the highest hourly demand on the entire system, and simulates the highest flow rate expected on the hottest day of the year. Peak hour demand usually occurs during the morning or evening peak usage periods. Depending on the data, peak hour demand is sometimes considered the "worst case" scenario instead of maximum day demand plus fire flow. It is not appropriate to evaluate a system against a demand rate of peak hour plus fire flow, as the likelihood of a fire event at the hottest hour demand of the year is extremely low.

Actual operational data is not readily available to determine the peak hour to maximum day demand peaking factor for the West Marin Water System. Based on calculations using Harmon Formula and PRP-Gumbel (indoor use only) and comparison with other similar water systems, the peak hour to maximum day demand peaking factor is estimated to be 1.9 (which equates to a peak hour to average day demand peaking factor of 4.0). Peak hour to maximum day demand peaking factors generally range from 1.3 to 2.0 per American Waterworks Association guidelines.

4.3.4 Lost (Un-accounted) Water

Lost water is the water that cannot be credited after accounting for flushing flows, hydrant flow tests, water leaks, and other non-billed usage. The amount of un-accounted for water (or lost water) exhibits a decreasing trend over the past 33 years. The production numbers since FY 2001 are tied to the daily production reports and consumption numbers are from the District's "CORE" utility billing data base. The average lost water percentage for both the last 33 years and the last 13 years (since FY2001) happens to be 11%. Although, the lost water percentages since FY2009 has dropped to an average of 5%, the forecast assumes that there will be no change in the percent or share of un-accounted for water in the future and is projected to continue at an average of approximately 11.0 percent.

4.4 FY 2013 WATER DEMANDS

The FY2013 water demand will be utilized in this Master Plan for several tasks including the hydraulic evaluation of the distribution system and the storage and pumping capacity evaluations. FY2013 demand is also separated by pressure zone.

FY2013 water demand data was obtained from District operations records. In FY2013, the total water produced is 81.37 million gallons.

For FY2013, the average annual water demand in the West Marin System was 0.22 mgd. The average day peak month demand was 0.32 mgd (which occurred in July 2012). The maximum day demand was 0.399 mgd (which occurred on July 8, 2012).

The FY2013 demand, separated by Inverness Park (including PRE), Olema, Bear Valley and Point Reyes, is shown in Table 4-2. Separation of demand by service zones was accomplished by reviewing pump station production records. Point Reyes Station Service Zone is fed directly by the water delivered from the Coast Guard Wells. The Olema, Bear Valley and Inverness Park service zones are all fed by booster pump stations from the Point Reyes Station Service Zone. Each service zone has one or more tanks that provide gravity flow during peak demand periods. Inverness Park pumps and tank supply water to PRE-1 tank. PRE-1 tank uses an Altitude valve

Table 4-2

FY 2013 Water Demands by Service Area

Service Area	Annual Usage Demand (gallons)	Average Day Demand (gpd)	Average Day Demand (gpm)	Max. Day/Ave. Day Peaking Factor	Maximum Day Demand (gpd)	Maximum Day Demand (gpm)	Percentage of Use
Point Reyes Station	55,191,519	151,210	105	2.11	319,052	221.6	64.4
Olema	10,746,267	29,442	20	2.11	62,122	43.1	12.5
Bear Valley	2,857,381	7,828	5	2.11	16,518	11.5	3.3
Inverness Park/PRE-1	10,035,824	27,495	19.1	2.11	58,015	40.3	11.7
PRE-2	1,147,432	3,144	2.2	2.11	6,633	4.6	1.3
PRE-3	2,362,184	6,472	4.5	2.11	13,655	9.5	2.8
PRE-4	3,358,520	9,201	6.4	2.11	19,415	13.5	3.9
Total	85,699,127	234,792	163	2.11	495,411	344.0	100.0

Notes:

Sub area production was obtained by pump records (PRS, Olema, Bear Valley and IP).

PRE breakdown using billing data for individual PRE zones

R:\Folders by Job No\8000 jobs\8600s\8687 (West Marin)\8687.01 WM Master Plan Update 2013_14\Tables\[Tables Section 4 WM MP.xlsx]Table 4-1

because it is lower than the fill elevation of Inverness Park Tank. Paradise Ranch Estates PRE-2, PRE-3 and PRE-4 pressure zones are each being fed by a booster pump station from the lower pressure zone.

4.4.1 Inverness Park and PRE

For FY2013, Inverness Park and PRE service zone accounts for approximately 19.7 percent of the total system demand. Of this demand, approximately 8.2 percent is for PRE-2, 3, and 4 subzones and 11.5% for Inverness Park service zone.

4.4.2 Olema

Olema Service Zone accounts for approximately 12.5 percent of the total system demand.

4.4.3 Bear Valley

Bear Valley Service Zone demand accounts for only 3.3 percent of the total system demand.

4.4.4 Point Reyes Station

Point Reyes Station Service Zone accounted for 64.4 percent, the largest demand in the West Marin system.

4.5 BUILDOUT DEMAND PROJECTIONS

Previous water demand forecasts for North Marin Water District were prepared in 1992 based on the 1991 Countywide Plan. Demands and development projections were updated in the 2001 West Marin Long Range Plan based on a West Marin Storage Capacity Analysis by Soldati Engineering Services (July 2000). July 2000 study demand projections were based on 1991 Countywide Plan and draft County Community Plan. Demands and development projections in this Master Plan are based on 2001 PRS Community Plan and 2007 Countywide Plan update.

4.5.1 Water Demand Projection

The District continually monitors planned development within the distribution system and periodically updates projected buildout water demands. The last update was in November 2013 (Table 4-3).

This demand projection is still applicable since the growth projections in the 2001 Countywide Plan or the PRS Community Plan have not changed since then. The buildout demand projection is shown in Table 4-4. At buildout, there is a projected annual demand of 380 AF per year, or an average daily demand of 338,920 gpd. Utilizing the peaking factor of 2.11, the projected maximum day demand at buildout is 715,122 gpd.

4.5.2 Development Projection

Analysis of projected water demands is based on new development slated to be constructed within the District boundaries. The buildout water demand forecast provided herein is updated

TABLE 4-3

Forecast of Water Demands - Pt Reyes Water System

By:	CD
Orig:	2/26/1992 12:29
Updated:	9/19/2011 0:00
Last:	11/27/2013 0:00

c:\qprofile\pra\WM 2010 Demandnew.xls
References:
I:\files\dlb\excel\wtr use\DWR WM Stat Report 2010 Backup.xls
I:\files\scada\spreadsheet\production\point reyes\Point Reyes Water Production.xls

Basic Breakdown in Water Use in 2010 was (DLB spreadsheet - wtr use\DWR Wm Stat Report 2010 Backup.xls):

	All	AFA	Accounts
Residential	65.37%	155	722
Commercial	16.36%	38.8	68
Agriculture	5.36%	12.7	9
Government	12.91%	30.6	16
All	100%	237.1	815

Household population density of area is 2.48 in Year 2000 according to Marin Countywide Plan Figure 3-57 and is expected to be 2.33 at Theoretical Buildout.
Therefore each person explains 26% of annual residential use per DU.

Pt Reyes Water System Statistics As of June 30, 2011:

	Pt Reyes Station	Olema	PRE	Inv Park/	O'side/O	All	
System Capacity:							
Finished Water Storage, gal.	580,000	150,000	138,000	166,500	-	1,034,500	ref WM Storage Data
Filter Plant, gpm						700	
Well #1 & Pump, operating alone						360	
Well #2 & Pump, operating alone						200	
Well #1 & #2 Operating in Tandem						530	<-limiting
Connections:							
Active						769	ref 12/10 Monthly Rpt
Inactive						46	
Total						815	
DU's:							
Active						802	ref 12/10 Monthly Rpt
Inactive						46	
Correction for Coast Guard(1)						36	
Total						884	
Sales:							
Avg Ann 2002 - 2011 (Acre Feet)						272	
Avg Pk Mo 2002 - 2011 (Acre Feet)						33	
In FY 2010/11:							
afa (w/o unaccounted for)						222	
afa/active acct						0.29	
afa (w unaccounted for)						227	
mgd Pk Mo						0.35	
gpd/active acct						461	
FY 2002-2011 avg:							
1000 Gal/SF DU or EDU						82	
afa/SF DU or EDU						0.19	
Equivalent SF Units(2):						1179	
Storage per EDU:						877	
Production:							
Unaccounted For Water as % of Sales (2002-2011 avg)						18%	
Avg Annual, Acre Feet (2002-2011 avg)						302	
Avg day, cfs (2002-2011 avg)						0.42	
Avg day, gpm (2002-2011 avg)						187	
Avg day of Pk Mo, cfs (2002-2011 avg)						0.54	
Avg day of Pk Mo, gpm (2002-2011 avg)						241	
Avg day of Pk Week, cfs (2002-2011 avg)						0.72	
Avg day of Pk Week, gpm (2002-2011 avg)						323	
Pk Mo to Avg Mo Ratio						1.3	
Pk Week to Pk Mo Ratio						1.3	

County's Estimate of Growth contained in 2001 PRS Community Plan & Countywide Plan Update:

	Pt Reyes Station	Olema	PRE	Inv Park/	O'side/O	All
Existing (3)	445	44	154	158	14	815
Potential (buildout,4)	688	53	214	191	14	1160
Increase DU's	243	9	60	33	0	345
Increase %	55%	21%	39%	21%	0%	42%

Footnotes:

(1) Included in "Gov't" in NMWD records.
Note: There are 36 sf USCG apts and 18 bachelor units currently.
Latter are bedroom w. sink. Share bathrooms. Also mess hall.
(2) Based on annual use of typical SF DU = 0.28 afa.
(3) "Existing" includes 409 Point Reyes Units (from DLB's spreadsheet:wm cust by rate code 063006.xls) and 36 gov't du
Olema, PRE, Inv Park/BV and O'side/Other also from DLB spreadsheet.
(4)"Potential" from 2001 PRS Community Plan and 21% growth in Olema and Inv Park/BV.
For PRE NMWD estimate as already subdivided is used.

Predicted Ultimate Demand:

Assumptions:
(1) Residential will grow per County's perdiction & gorwth will be SF type DU's.
(2) Agriculture will decrease as result of NPS purchase of Giacomini Ranc
(3) Commercial and Gov't will grow and maintain their same relative relationship or share of residential,ie: 45%
(4) Unaccounted For Water will ultimately be: 10%
(5) Pk Mo to Avg Mo ratio remains at: 1.3
(5) Pk Week Mo to Pk Mo ratio remains at: 1.3
(6) Additional Water Conservation achieved between now and buildout is limited to residential fraction and will amount to: 10%
(7) Household Density ultimatly increases from current 2.48 to: 2.3
Associated increase in demand is: 0%

	PR Stat	Olema	PRE	Inv Park	All
Existing Base Demand (Avg 2002-2011):					
afa					272
residential portion, afa					178
New Base Demand:					
New Residential, DU's	243	9	60	33	345
Demand, afa/DU					0.19
Demand, afa					65
New Commercial & Gov't, afa					29
Less Agricultural (Giacomini Ranch, Already reflected in existing ba					0
Existing + New Base Demand, afa:					342
Ultimate Demand**:					
Annual, afa:					376
Peak Mo, cfs:					0.67
Peak Week, cfs:					0.90
Peak Week, gpm:					403

** Includes Unaccounted For Water & adjustments for increased household density and water conservation.

Comparison of Production vs Sales:

	Prod (FYR)	Sales (FYR)	Diff,% (1)	Sales x 1.2
1972	147			
1973	133			
1974	131			
1975	183			
1976	186			
1977	171			
1978	162			
1979	212			
1980	190			
1981	226	184	23%	221
1982	250	200	25%	240
1983	256	205	25%	246
1984	261	213	23%	256
1985	277	216	28%	259
1986	300	226	33%	271
1987	334	243	37%	292
1988	350	245	43%	294
1989	336	242	39%	290
1990	287	247	16%	296
1991	339	263	29%	316
1992	324	251	29%	301
1993	290	260	12%	312
1994	293	270	9%	324
1995	279	262	6%	314
1996	304	283	7%	340
1997	337	303	11%	364
1998	320	289	11%	347
1999	382	294	30%	353
2000	386	305	27%	366
2001	372	325	14%	390
2002	368	308	19%	370
2003	332	301	10%	361
2004	363	294	23%	353
2005	336	304	11%	365
2006	324	255	27%	306
2007	315	276	14%	331
2008	271	267	1%	320
2009	274	258	6%	310
2010	218	233	-6%	280
2011	222	227	-2%	272
@avg	307	260	19%	
@avg 2002-2011	302	272	18%	

Linear Forecast of Demand:

	Hist(1	Forecast
1972	147	
1973	133	
1974	131	
1975	183	
1976	186	
1977	171	
1978	162	
1979	212	
1980	190	
1981	226	
1982	250	
1983	256	
1984	261	
1985	277	
1986	300	
1987	334	
1988	350	
1989	336	
1990	287	
1991	339	
1992	324	
1993	290	
1994	293	
1995	279	
1996	304	
1997	337	
1998	320	
1999	382	
2000	386	
2001	372	
2002	368	
2003	332	
2004	363	
2005	336	
2006	324	
2007	315	
2008	271	
2009	274	
2010	218	
2011	222	
2012		230
2013		238
2014		247
2015		255
2016		263
2017		271
2018		279
2019		288
2020		296
2021		304
2022		312
2023		321
2024		329
2025		337
2026		345
2027		353
2028		362
2029		370
2030		378
annual increment		8.2
DU's/yr		14

1. Up until 1992 unaccounted for water was thought to be 20%.
In 1993 the treatment plant production meter was recalibrated.
Unaccounted for water is now estimated at 18% with ultimate at 10%.

R:\Folders by Job No\8000 jobs\8600s\8687 (West Marin)\8687.01 WM Master Plan Update 2013_14\Tables\[Table 4-3 WM 2010 DEMANDNEW Rev.xls]Forecast

Table 4-4

Point Reyes Water System - Projected Buildout Water Demands by Service Area

Service Area	Current Annual Demand	Current Demand	At Buildout	Buildout Demand	Buildout Ave. day	Buildout Max Day
	gal	afa	afa	mg	gpd	gpd
Point Reyes Station	55,191,519	169	263	85.6	234,391	494,565
Olema	10,746,267	33	40	13.0	35,627	75,173
Bear Valley	2,857,381	9	11	3.5	9,473	19,988
Inverness/ PRE-1	10,035,824	31	37	12.1	33,272	70,203
PRE-2	1,147,432	4	5	1.6	4,370	9,221
PRE-3	2,362,184	7	10	3.3	8,996	18,982
PRE-4	3,358,520	10	14	4.7	12,791	26,989
Total	85,699,127	263	380	123.7	338,920	715,122

Notes:

(1). Current demands are from the pump records for FY 2013 for Pt. Reyes Station, Olema, Bear Valley, Inverness Park/all PRE

(2). The split between PRE zones are based on billing records.

(3). Build out demand was calculated by utilizing percent increase of DUs listed in Table 4-3 (Forecast of Water Demands-Pt Reyes Water System) last updated 11/27/2013 by Chris DeGabriele. The percent increases are- PRS 55%, Olema, Bear Valley, IP/PRE-1, 21%, other PRE zones 39%

(4). Average to max. day factor is 2.11 (See Table 4-1).

R:\Folders by Job No\8000 jobs\8600s\8687 (West Marin)\8687.01 WM Master Plan Update 2013_14\Tables\[Tables Section 4 WM MP.xlsx]Table 4-1

with the county's estimate of growth contained in 2001 PRS Community Plan and Countywide Plan Update. These have not changed since 2001.

The water demand for potential buildout is projected by Point Reyes Station, Olema, PRE and Inverness Park and Bear Valley zones. The projected buildout development demand is shown in Table 4-3. The potential increase in Dwelling Units (DUs) is 243 in Point Reyes Station, 9 in Olema, 60 in PRE and 33 in Inverness Park and Bear Valley. The total increase in residential DUs is 42%. The commercial and governmental sector growth is assumed to be approximately equivalent to residential growth (45%).

The annual demand for the projected residential units is converted to annual acre-feet (AF) with the conversion factor of 0.19 AF per DU equaling 65 AF. The commercial and government component is 29 AF. Agricultural sector is assumed to decrease as a result of National Park Service (NPS) purchase of Giacomini Ranch. Existing base demand is 272 AF. This results in a total buildout demand of 376 AF (Table 4-4 uses 380 AF). The buildout projection used in the 2001 West Marin Long Range Plan was 483 AF. Although the present existing demand has increased slightly due to the persons per household has increased slightly, the decrease in buildout is largely due to the decrease in the buildout projection. The additional buildout demand projection has decreased from 75% of current demand in the 2000 buildout to 42% of current demand in 2013.

4.5.3 Projected Water Demands

Overall, approximately 55% of the new demand will occur in Point Reyes Station, 21% in Olema, 39% in PRE and 21% in Inverness Park/ Bear Valley zones.

Maximum day demands will be utilized for other tasks in this Master Plan, including the storage and pumping capacity evaluation presented in Section 5.

SECTION 5
STORAGE AND PUMPING CAPACITY EVALUATION

SECTION 5

STORAGE AND PUMPING CAPACITY EVALUATION

5.1 INTRODUCTION

The storage and pumping capacity evaluation of the service areas and pump stations in the West Marin System is presented in Section 5. The analysis is based on FY 2013 and projected buildout (FY 2035) water demands presented in Section 4. The existing storage capacity is compared to storage capacity requirements based on District West Marin storage criteria for each service area to determine storage capacity adequacy. Similarly, the existing firm pumping capacity is compared to pumping capacity requirements based on District pumping criteria for the major booster pump stations to determine pumping capacity adequacy.

5.2 BACKGROUND/PREVIOUS STUDIES

In July 2000, Soldati Engineering Services conducted a Storage and Pumping Capacity analysis which was used as the basis of storage and pumping improvements recommended in the 2001 West Marin Long Range Plan. The 2000 storage study included analysis for two conditions; then current (FY1997/98) and the estimated buildout (2035). Service areas found to be deficient in storage and pumping capacity under both then current (FY 1997/98) and buildout demand conditions were identified. These included Olema, Bear Valley and PRE-tanks.

The 2000 study states that historically, the District had used two days of maximum demand (one maximum day for operational needs and one maximum day for fire storage) as the storage capacity goal. Emergency storage was included in the fire protection storage capacity of one maximum day. Typically the storage capacity goal is the summation of operational storage (25% maximum day demand), emergency storage (100% of maximum day demand), and fire storage. Since the West Marin service areas are relatively small and the fire component is such a large component of the total storage capacity required, the 2000 study concluded that it is appropriate that the greater of the fire and emergency component be used instead of both. This will be referred to as the combined storage capacity goal.

Since the 2001 Long Range Plan, all storage deficiencies identified in that plan for the buildout condition (for the modified storage capacity goal) have been addressed with the exception of the Bear Valley / Silver Hills area storage capacity. The PRE service areas are able to use a cascading system for providing emergency / fire storage using the combined storage of these areas using the available cascading system by pumping from lower zones to the higher zones (or by gravity, bypassing the pumping system in case of an emergency condition in the lower elevation zones).

The 2001 Long Range Plan recommended increasing Balboa (Inverness Park) pump capacity from 55 gpm to 150 gpm and installing stand by pumps and controls for all three PRE pump stations. These improvements have been performed since 2001.

With the updated water demand projections now presented in Section 4 of this 2014 Master Plan, it is necessary to update the storage and pumping capacity evaluations for all service areas within the West Marin Water System.

5.3 EVALUATION METHODOLOGY

The pertinent storage capacity evaluation criteria and pumping capacity evaluation criteria are presented in Section 2. The major elements of the approach are summarized herein.

5.3.1 Storage Capacity Evaluation

The storage capacity evaluation is based on determining three storage volume components as presented in Section 2:

- Operational storage
- Fire storage
- Emergency storage

The sum of these three components is the typical total storage capacity for the specific pressure zone. However, in the 2001 West Marin Long Range Plan, the total storage was calculated as the sum of the operational storage (25% of MDD) and the greater of the emergency storage (100% MDD) or the fire storage volume. The calculations for both the typical storage (sum of operational, fire and emergency storage) and the modified criterion are performed. Similar to the 2001 Long Range Plan, the modified criterion (combining fire and emergency storage) is used as the storage capacity goal for the current Master Plan. The storage capacity goal is compared to the existing storage capacity to determine if a surplus or deficit exists within the zone.

5.3.2 Pumping Capacity Evaluation

Providing adequate storage capacity is only one distribution system element that beneficially affects system operation. Adequate pumping capacity must be provided to enable the storage capacity to recover depleted volume in a reasonable time period. Undersized pumps may reduce the effectiveness of storage capacity. Therefore, it is necessary to evaluate the pumping capacity requirements at each booster pump station.

The pumping evaluation in this study consists of comparing the pumping requirement (calculated as maximum day demand pumped over 16 hours) to the firm capacity of the station and determining the surplus or deficit. Firm capacity is defined as the station capacity with the largest pump out of service.

All of the District stations evaluated in this report have at least two pumps, except the Gallagher Well. Note that this analysis uses the rated pump capacity, as individual pump tests have not been performed recently, and actual pump flow information is not available in some instances. The pump capacity of Coast Guard Well No. 2 is 250 gpm when Well No. 4 is off line and Well No. 4 capacity is 300 gpm when Well No. 2 is off line. However, when both pumps are simultaneously in operation, the capacity reduces to 420 gpm. A recent well pump analysis was prepared and concluded that well pump No. 2 needs repair/replacement. Once this deficiency is corrected the combined pumping capacity should increase from 420 gpm to 580 gpm. The total Coast Guard Wells pumping capacity was listed as 550 gpm in the 2001 Long Range Plan.

In general any individual pump or pumps are not operating efficiently, they should be checked and appropriate actions taken. A full evaluation of each pumping station is beyond the scope of this study. It is recommended that the District conduct pump tests and undertake an evaluation of the pumping capacity at each pumping station.

Many pump stations are required to pass water through to a higher zone than the one which the pump station is serving. The total flow that is required to be pumped through the station for both its zone and upper zones is included as appropriate when determining the total pumping capacity requirement.

5.4 PRESSURE ZONE WATER DEMANDS

The storage and pumping evaluation utilizes FY 2013 water demand and projected buildout (FY 2035) water demand. Specifically, operational and emergency storage criteria, as well as the pumping capacity criteria, are based on maximum day demand for each pressure zone, as shown in Table 4-4. Demands were obtained from the pumping records and when pumping records are not available, from billing consumption records (e.g., PRE) which are coded by service area. Billing records and pump records for PRE- 2 and PRE-3 service areas could not be reconciled. It seemed that the billing records were consistent with the use shown in the 2001 Long Range Plan. Therefore, the billing records are used in this Master Plan for the PRE sub zone demands.

In theory, water pumped into the pressure zone should equal the consumption for each zone plus a percentage for lost (un-accounted) water. Comparison of production to consumption could indicate another: (1) lost water; (2) a problem in the method of determining consumption data; (3) the obtaining and recording of production data; or (4) in the actual performance of the pumps.

5.5 STORAGE CAPACITY EVALUATION

The storage capacity requirements for each pressure zone for FY 2013 and buildout (FY 2035) water demands are lower than listed in the 2000 storage capacity study and 2001 Long Range Plan buildout forecast. This is due to the FY 2013 (current) demand being lower than the FY 1999 (then current) demand and the growth and potential buildout forecast is lower than that estimated in the 2001.

All District tanks are designed in cooperation with the MCFD. A breakdown of the Fire Flow and Fire Storage Volume Goals is presented in Section 2, Table 2-2.

5.5.1 FY 2013 Water Demands

Storage capacity requirements by pressure zone for FY 2013 water demand are shown in Table 5-1 for the selected criterion (combined fire/emergency). Pt Reyes Station, Olema and Inverness Park/PRE-1 have surplus storage capacity under current water demand. Note that, although individual PRE service zones show deficits in storage, because all PRE tanks are connected (a cascading system) has a combined storage of 113,000 gallons (excluding PRE-1), therefore the deficit is about 12,000 gallons. Bear Valley service zone has a deficit of 94,000 gallons in storage capacity.

The Point Reyes Station, Olema and Inverness Park/PRE-1 service zones have a surplus of approximately 182,000 gallons, 15,000 gallons and 27,000 gallons respectively.

5.5.2 Buildout Water Demands

Storage capacity requirements by service area at buildout in Year 2035 are shown in Table 5-2 for the combined fire and emergency storage criterion.

Table 5-1
West Marin Storage Capacity Requiremetns - combined fire/emergency storage
FY 2013 Water Demands

Tank/Zone	Tank Capacity (gal)	Estimated Max Day Demand (gal/day) (1)	Operational Storage (gal) (2)	Fire Storage (gal)	Emergency Storage (gal)	> of Fire / Emergency Storage (gal)	Total Storage Required (gal) (3)	Additional Storage Required (gal)
Point Reyes Station	580,000	319,052	79,763	240,000	319,052	319,052	398,815	-181,185
Olema	150,000	62,122	15,531	120,000	62,122	120,000	135,531	-14,469
Bear Valley	30,000	16,518	4,130	120,000	16,518	120,000	124,130	94,130
Inverness Park / PRE-1	161,500	58,015	14,504	120,000	58,015	120,000	134,504	-26,996
PRE-2	25,000	6,633	1,658	120,000	6,633	120,000	121,658	96,658
PRE-3	38,000	13,655	3,414	120,000	13,655	120,000	123,414	85,414
PRE-4	50,000	19,415	4,854	120,000	19,415	120,000	124,854	74,854
Total	1,034,500	495,411	123,853			1,039,052	1,162,905	128,405

Notes:
(1) From Table 4-2
(2) 25% of maximum day demand
(3) Total of operational and greater of fire and emergency storage

R:\Folders by Job No\8000 jobs\8600s\8687 (West Marin)\8687.01 WM Master Plan Update 2013_14\Tables\[Tables Section 5 WM MP.xlsx]Table 5-6

Table 5-2
West Marin Storage Capacity Requirements - combined fire/emergency storage
Projected Buildout Demands

Tank/Zone	Tank Capacity (gal)	Estimated Max Day Demand (gal/day) (1)	Operational Storage (gal) (2)	Fire Storage (gal)	Emergency Storage (gal)	> of Fire / Emergency Storage (gal)	Total Storage Required (gal) (3)	Additional Storage Required (gal)
Point Reyes Station	580,000	494,565	123,641	240,000	494,565	494,565	618,207	38,207
Olema	150,000	75,173	18,793	120,000	75,173	120,000	138,793	-11,207
Bear Valley	30,000	19,988	4,997	120,000	19,988	120,000	124,997	94,997
Inverness Park/PRE-1	161,500	70,203	17,551	120,000	70,203	120,000	137,551	-23,949
PRE-2	25,000	9,221	2,305	120,000	9,221	120,000	122,305	97,305
PRE-3	38,000	18,982	4,746	120,000	18,982	120,000	124,746	86,746
PRE-4	50,000	26,989	6,747	120,000	26,989	120,000	126,747	76,747
Total	1,034,500	715,122	178,780			1,214,565	1,393,346	358,846

Notes:
(1) From Table 4-4
(2) 25% of maximum day demand
(3) Total of operational and greater of fire and emergency storage

R:\Folders by Job No\8000 jobs\8600s\8687 (West Marin)\8687.01 WM Master Plan Update 2013_14\Tables\[Tables Section 5 WM MP.xlsx]Table 5-2

Pt Reyes Station changes from a surplus storage to a minor 38,000 gallon deficit storage at buildout. Pt Reyes Station storage deficit calculated at buildout is primarily due to a higher multiplication factor utilized in this report for converting average day demand to maximum day demand (2.11 in this report vs. 1.76 utilized in 2001 Long Range Plan). Olema and Inverness Park/PRE-1 continue to exhibit surplus storage capacity even at buildout (11,000 gallons and 24,000 gallons, respectively). Although individual PRE service zones show deficits in storage, when connected via the cascading system it has 113,000 gallons of storage, and therefore has a minor 12,000 gallons deficit at buildout. Bear Valley service zone has a slight increase in deficit with 95,000 gallon deficit at buildout.

Existing storage volumes and current (2013) and buildout storage volumes are compared in Table 5-3.

5.5.3 Historical Comparison

At Pt. Reyes Station and Olema service zones, the 2001 Long Range Plan identified storage deficits at buildout have been rectified since that time. The current (2014 Master Plan) update shows 38,000 gallon deficit at Pt. Reyes Station and 11,000 gallon surplus at Olema. Bear Valley service area continues to have a storage deficit of 95,000 gallons and combined PRE (excluding PRE-1) has a deficit of approximately 12,000 gallons. Pt Reyes Station

5.6 PUMPING CAPACITY EVALUATION

The pumping capacity requirements for each pressure zone for FY2013 and buildout (FY2035) water demands are shown below. Specific recommendations to address pumping capacity needs are presented later in this section.

5.6.1 FY 2013 Water Demands

Pumping capacity requirements for each pump station under current water demands are shown in Table 5-4. The annual pump demand is the actual volume of water pumped by each pump station in FY2013. Utilizing the average day/maximum day peaking factor specific to each pressure zone (presented in Table 4-2), a maximum day demand in gallons per day for each pump station was determined. The maximum day pumping requirement represents the gallons per minute pumping capacity needed by each pump station to pump the maximum day demand over 16 hours, per District criterion.

5.6.2 Buildout Water Demands

Pumping capacity requirement by pump station at buildout in FY2035 is shown in Table 5-5. Coast Guard well pumps have a firm capacity deficit of 495 gpm. Other pump stations have small surplus capacities except PRE-1 and PRE-2 pump stations. The deficit at these two pump stations are not very significant at 3 gpm each and can be neglected due to the uncertainty in build out demand.

5.6.3 Historical Comparison

A comparison of the pumping capacity deficit from the last study (in 2000) and present (2013) at buildout (FY2035) is show in Table 5-6. It should be noted that water use demands in FY2013

Table 5-3
West Marin Storage Capacity
Existing Volumes and Capacity Goals

Tank/Zone	Existing Tank Capacity (gal)	Current Requirement (gal) (1)	Buildout Requirement (gal) (2)
Point Reyes Station			
Point Reyes -1	180,000		
Point Reyes -2	100,000		
Point Reyes -3	300,000		
Totals	580,000	398,815	618,207
Olema	150,000		
Olema -1			
Totals	150,000	135,531	138,793
Bear Valley			
Bear Valley -1	10,000		
Bear Valley -2	10,000		
Bear Valley -3	10,000		
Totals	30,000	124,130	124,997
Inverness Park/Paradise Ranch Estates 1			
Inverness Park -1	36,500		
Inverness Park -2	100,000		
PRE -1	25,000		
Totals	161,500	134,504	137,551
Paradise Ranch Estates -2			
PRE-2	25,000		
Totals	25,000	121,658	122,305
Paradise Ranch Estates -3			
PRE-3	38,000		
Totals	38,000	123,414	124,746
Paradise Ranch Estates -4			
PRE-4	50,000		
Totals	50,000	124,854	126,747

Notes:
(1) From Table 5-1
(2) From Table 5-2

R:\Folders by Job No\8000 jobs\8600s\8687 (West Marin)\8687.01 WM Master Plan Update 2013_14\Tables\[Tables Section 5 WM MP.xlsx]Table 5-6

Table 5-4
West Marin Pumping Capacity Requiremetns
FY 2013 Water Demands

Pump Station	Tank(s)	Zone Max Day Demand (gal/day) (1)	Transfer to other Zones (gal) (2)	Total Pumping Flow (gal/day)	Pumping Requirement (3) gpm	Pump Firm Capacity (gpm) (4)	Additional Capacity Required (gpm) (5)
Coast Guard Wells	Point Reyes Station	319,052	176,359	495,411	516	420	96
Olema	Olema	62,122	0	62,122	65	94	-29
Bear Valley	Bear Valley	16,518	0	16,518	17	35	-18
Inverness Park	Inverness Park / PRE-1	58,015	39,703	97,719	102	155	-53
PRE-1	PRE-2	6,633	33,070	39,703	41	54	-13
PRE-2	PRE-3	13,655	19,415	33,070	34	45	-11
PRE-3	PRE-4	19,415	0	19,415	20	32	-12

Notes:
(1) From Table 4-2
(2) Includes demands for upper zones that are pumped through station
(3) Total Pumping Flow pumped over 16 hours per day per District criterion
(4) Pump Station capacity with largest pump out of service (Added 120 gpm expected from alternate source at Gallagher well to Coast Guard capacity)
(5) Additional capacity needed to meet maximum day demand criteria.

R:\Folders by Job No\8000 jobs\8600s\8687 (West Marin)\8687.01 WM Master Plan Update 2013_14\Tables\[Tables Section 5 WM MP.xlsx]Table 5-4

Table 5-5
West Marin Pumping Capacity Requiremetns
Projected Buildout Demands

Pump Station	Tank(s)	Zone Max Day Demand (gal/day) (1)	Transfer to other Zones (gal) (2)	Total Pumping Flow (gal/day)	Pumping Requirement (3) gpm	Pump Firm Capacity (gpm) (4)	Additional Capacity Required (gpm) (5)
Coast Guard Wells	Point Reyes Station	494,565	220,556	715,121	745	420	325
Olema	Olema	75,173	0	75,173	78	94	-16
Bear Valley	Bear Valley	19,988	0	19,988	21	35	-14
Inverness Park	Inverness Park / PRE-1	70,203	55,192	125,395	131	155	-24
PRE-1	PRE-2	9,221	45,971	55,192	57	54	3
PRE-2	PRE-3	18,982	26,989	45,971	48	45	3
PRE-3	PRE-4	26,989	0	26,989	28	32	-4

Notes:
(1) From Table 4-3
(2) Includes demands for upper zones that are pumped through station
(3) Total Pumping Flow pumped over 16 hours per day per District criterion
(4) Pump Station capacity with largest pump out of service (Added 120 gpm expected from alternate source at Gallagher well to Coast Guard capacity)
(5) Additional capacity needed to meet maximum day demand criteria.

R:\Folders by Job No\8000 jobs\8600s\8687 (West Marin)\8687.01 WM Master Plan Update 2013_14\Tables\[Tables Section 5 WM MP.xlsx]Table 5-6

Table 5-6
West Marin Pumping Capacity Goals 2000 and 2014
Projected Buildout Demands

Pump Station	Tank(s)	2000 Goal gpm (1)	Additional Capacity Required in 2000 report (gpm) (2)	2013 Goal gpm (3)	Additional Capacity Required (present study) (gpm) (4)
Coast Guard Wells	Pt Reyes Station	850	550	745	325**
Olema	Olema	130	36	78	0
Bear Valley	Bear Valley	33	33	21	0
Inverness Park	Inverness Park / PRE-1	204	149	131	0
PRE-1	PRE-2	75	75	57	3
PRE-2	PRE-3	68	68	48	3
PRE-3	PRE-4	48	48	28	0

Notes:
(1) From Table 7 - West Marin Storage Capacity Analysis - Soldati Engineering Services (July 7, 2000)
(2) From Table 7 - West Marin Storage Capacity Analysis - Soldati Engineering Services (July 7, 2000)
(3) From Table 5-5 (this report)
(4) From Table 5-5 using 0 for additional capacity required when there is surplus capacity
At Coast Guard Wells, 120 gpm from Gallagher well (alternate source) was added to reduce the deficit.
** More wells are proposd at Gallagher Ranch

R:\Folders by Job No\8000 jobs\8600s\8687 (West Marin)\8687.01 WM Master Plan Update 2013_14\Tables\[Tables Section 5 WM MP.xlsx]Table 5-6

were approximately 12% lower system-wide than in FY 1997-98. A reduction in annual demand results in lower max day pumping demands at any given pump station.

5.7 CONCLUSIONS AND RECOMMENDATIONS

The recommended improvements to address current and future storage and pumping capacity deficiencies are summarized below. Specific projects are listed in Sections 9 and 10.

5.7.1 Storage Capacity Improvements

Specific improvements to address pressure zones with inadequate storage capacity are presented below. Other pressure zones not specifically listed require no improvements.

5.7.1.1 Point Reyes Tanks

There is a deficit of 38,200 gallons at buildout. This can be addressed in the future when time comes for replacing one of the tanks.

5.7.1.2 Bear Valley Tanks

There is a storage deficit of 95,000 gallons at buildout. Adding a new 65,000 gallon tank at the present tank location and a 30,000 gallon tank at Silver Hills Road is appropriate.

5.7.1.3 PRE Tanks

There is a storage deficit of 12,000 gallons at buildout. Adding a new 80,000 gallon PRE-4 tank will rectify the storage deficit and will provide fire storage capacity for lower PRE zones via the cascading system.

5.7.2 Pumping Capacity Improvements

Specific improvements to address pump station capacity deficits are presented below. Other pump stations not specifically listed require no improvements.

5.7.2.1 Coast Guard Wells

Point Reyes Station has a pumping deficit of 445 gpm at buildout. Since Gallagher well will be adding 120 gpm flow, the deficit is reduced to 325 gpm. Since there is a future project to add well(s) at Gallagher Ranch site in the future, no changes other than repair/replacement of the pump at Coast Guard well #2 is proposed.

In 2001, the District initiated time-of-use pumping at both Coast Guard wells. The program has resulted in over 5% energy savings annually. The district will continue to work with PG&E and Marin Clean Energy to further optimize the program to reduce energy consumption and pumping cost.

SECTION 6
WATER QUALITY EVALUATION

SECTION 6

WATER QUALITY EVALUATION

6.1 INTRODUCTION

Ensuring water quality is one of the primary goals of the District. Policy supports this goal with Board and management commitment to meeting or exceeding all US Environmental Protection Agency (EPA) and California Department of Public Health (CDPH) regulatory requirements. Water quality is monitored by the Water Quality Division whose responsibility is to provide oversight to all District activities as they relate to water quality.

Section 6 presents information on the current water quality, and provides recommendations for operational modifications and capital improvements related to water quality in the West Marin Water System.

6.2 CURRENT WATER QUALITY

6.2.1 Source Water Quality

Source water for the West Marin system is supplied by two wells adjacent to Lagunitas Creek(Coast Guard wells). The wells have a maximum depth of around 60 feet. This water is low in naturally occurring organic compounds and requires minimal disinfection to maintain a disinfectant residual. The total DBP (disinfection by products) formation potential is normally moderate with aconcentrations of around 40 ug/L at the location with the highest water age or maximum residence time. During times of salinity intrusion the brominated constituents of DBPs can rise significantly resulting in a total THM concentration of up to 89 ug/L at maximum residence.

The primary contaminants in water from the Coast Guard Wells are iron and manganese. These are removed through oxidation and green sand filtration. The green sand must be chemically activated in order to remove iron and manganese filters, this chemically active state is maintained with potassium permanganate that is injected along with sodium hypochlorite (for disinfection) at the front of the chemical contact tank.

6.2.2 Existing Distribution System Water Quality

Water quality in the distribution system is generally excellent. Although iron and manganese are not generally detectable in finished water, sediment composed of these metals has accumulated from time to time in certain parts of the distribution system. These sediments can be stirred up by atypical water demand and cause dirty water complaints. Salinity intrusion can cause changes in taste, increased corrosion from copper pipes and metal fixtures, as well as an increase in the concentration of certain disinfection byproducts.

6.3 DRINKING WATER REGULATIONS AND NMWD MONITORING PROGRAMS

The District operates the West Marin Water System under an operating permit issued by the California Department of Public Health (CDPH). CDPH is responsible for enforcing both State and Federal (United States Environmental Protection Agency, USEPA) drinking water regulations as a “primacy” State. NMWD’s operating permit requires compliance with all State and Federal drinking water regulations and imposes several additional operating and monitoring conditions.

Discussion follows on the drinking water regulations and permit conditions that are most significant in regards to distribution system water quality. The purpose of the regulation, NMWD's response and review of issues for the West Marin customers is addressed for each.

- Coliform Rule
- Stage II Disinfection By-Product Rule (DBP II)
- Groundwater Rule
- Lead and Copper Rule
- Fluoridation Mandate
- Other regulations and permit conditions
- Other NMWD programs and emerging issues

6.3.1 Coliform Rule

- *Purpose of rule:*
  Assure pathogenic microbial growth is not present in water supply.

- *Monitoring requirement:*
  CDPH requires every separate hydraulic zone of water, as represented by a tank or pressure system, must be monitored monthly. A minimum number of samples are required per month based on population served.

- *NMWD response:*
  Currently, 7 samples sites are identified in the NMWD Coliform Sampling Plan. CDPH regulations require 3 samples be collected each month. NMWD has structured a sampling program that provides for sampling 1 to 2 sites on four separate routes, each sampled every four weeks.

- *Issues:*
  Historically the District relied on customer taps for sample sites. Finding representative sample sites among residential and business taps has been difficult at times. A standard sampling station design has been developed and 4 have been installed. Sample stations should be installed to replace tap sampling for the 3 remaining locations.

6.3.3 Disinfection By-Product Rules Stage II

- *Purpose of rule*:
  Minimize health effects related to chemicals formed during the disinfection process.

- *Monitoring requirement:*
  Distribution sampling is required in the two warmest quarters at two locations for total trihalomethanes (THMs) and haloacetic acids. Compliance is based on location running annual average. Locations are determined by conducting an Initial Distribution System Evaluation (IDSE) using a number of factors including results from increased system wide monitoring for one year, residence time, and population distribution.

- *NMWD response*:
  DBP formation potential in water from the Coast Guard wells is relatively low. Samples taken at the distribution system location with the highest residence time (furthest from the source) rarely exceed 55 ug/L. Re-chlorination at PRE tank 1 raises the concentrations of DBPs along with boosting chlorine concentration. During periods when salinity intrusion at the Coast Guard well site raises the concentration of bromide in source water, the THMs concentration has risen to just below 90 ug/L.

  Sprayer systems have been installed in Inverness Park Tanks and PRE tank 2 to volatilize and ventilate DBPs from the water in the tank to the atmosphere. They have been effective in reducing DBPs by up to half.

- *Issues*:
  There is a conflict in simultaneous compliance with maintaining an adequate chlorine residual and keeping DBPs as low as possible. Other water utilities have converted to chloramines as the disinfectant to lower DBPs while maintaining an adequate residual in the distribution system. Conversion to chloramines by NMWD would require the addition of ammonia into the water supply and is not necessary under current standards.

  The sprayer systems in Inverness Park Tanks and PRE tank 2 can also have the effect of lowering chlorine residuals. Monitoring the chlorine concentration and dose at the PRE Tank 1 booster station is necessary to ensure adequate residual.

6.3.4 Groundwater Rule

- *Purpose of rule*:
  The purpose of the rule is to provide for increased protection against microbial pathogens in public water systems that use ground water sources. EPA is particularly concerned about ground water systems that are susceptible to fecal contamination since disease-causing pathogens may be found in fecal contamination

- *Monitoring requirement:*
  The groundwater rule requires triggered source water monitoring for fecal coliforms and/or E coli if a routine sample for compliance with the Total Coliform Rule is positive for coliforms. An E coli positive in source water would require a system-wide Boil Water Order (BWO) and follow up monitoring. There is a waiver of the triggered source water monitoring and BWO requirement if the system maintains 4-log inactivation of viruses through treatment.

- *NMWD response:*
  NMWD has applied for and received the 4-log waiver from requirements of the Groundwater Rule. 4-log inactivation is achieved by qualifying disinfection in the contact tank at the Point Reyes Treatment Plant (PRTP). The 4-log waiver is maintained by monthly reporting of the lowest daily contact time (CT) value.

- *Issues:*
  4-log inactivation of viruses has not been difficult to maintain. Data collected in the Supervisory Control and Data Acquisition (SCADA) system is used to generate the monthly report. Failure to document 4-log at the time of a coliform positive in the distributions system would trigger the source water monitoring and reporting.

6.3.5 Lead & Copper Rule

- *Purpose of rule:*
  Reduce corrosion of lead and copper in consumer plumbing.
- *Monitoring requirement:*
  20 residences have been identified to test for lead and copper. Currently, NMWD is under a reduced monitoring program of 10 residences every three years.

- *NMWD Response:*
  Samples tested as part of the lead and copper monitoring do not commonly contain lead at concentrations nearing the action level. Copper has been detected at levels above the action level in some samples

- *Issues:*
  Salinity intrusion can make water more aggressive and could increase lead and copper values above the action level.
  Some of the older valves in the distribution system, such as those associated with older fire service assemblies, may have lead weights. These valves are being removed from the system as repairs are identified. The Point Reyes distribution system has no lead service lines.

6.3.7 Other Regulations and Permit Conditions

In addition to the regulations discussed above, the California CDPH has regulations that focus on assuring that water systems are designed, constructed and operated in a manner compatible with public health goals. Cross connection control, State Waterworks Standards and Operator Certification stand out as regulations focused on maintaining water quality.

- Cross Connection Control
- State Waterworks Standards
- Operator Certification
- West Marin Permit Provisions

6.3.8 Cross-Connection Control

- *Relationship to Water Quality:*
  Contamination of a treated water supply within the distribution system due to cross-connection/backflow conditions is a primary concern. California regulations require that all water suppliers maintain a cross-connection control program with specific required elements including annual testing of devices and certification of personnel.

  North Marin has experienced cross-connection events in the distribution system. There have been instances where soda-dispensing systems (soft drinks) have allowed carbonation to backflow, causing copper leaching.

  Other cross-connection events may not have been recognized and reported. Close compliance with the District program remains the strongest protection.

- *The North Marin Water District Program:*
  The current NMWD cross-connection program is the responsibility of the Maintenance Division. The responsibility includes identification of hazards within the system, and assuring compliance with NMWD regulation 6 and Title 17, California Code of Regulations.

  The NMWD program differs from other local water agencies in that District staff test backflow prevention devices. This has the advantage of assuring that tests have been properly performed and costs are reduced for the rate payers because employees trained and supervised by the District's certified cross-connection control technician are used. Management provides the staff resources and oversight to assure that the program is carried out and minimal delays occur between a test failure and repairs.

- *Issues:*
  There have been several revisions to the California Code of Regulations, Title 17 governing selection and location of backflow preventers. A survey of the West Marin cross-connection control program has revealed under-utilization of backflow devices in some areas of the system. The District has planned for the capital and maintenance costs for upgrading services and updated District regulations and fee schedules to cover these required costs.

6.3.9 State Waterworks Standards

- *Relationship to Water Quality*:
  California Department of Public Health sets regulations including design and construction standards to be used by water suppliers. These standards were recently revised. Specific design and construction criteria are identified to provide protection of public health.
- *Highlights of the Waterworks Standards as related to West Marin:*
  - Requires an amendment to the water permit if volume of water delivered increases by more than 10 percent.
  - A source capacity report is required of all systems.
  - All coatings, linings, gaskets or sealing materials, joint compounds or tank materials must be certified to meet ANSI/NSF Standard 61.
  - Details on standards for flushing valves and blow-offs, air release valves and isolation valves are identified.
  - Reservoirs are required to have separate inlet and outlet and sampling taps.
  - A Distribution System Operation Plan is required with updates every five years.
  - Mapping Standards are identified.
- *Issues:*
  The most significant issue is the requirement for NSF Standard 61 certification for materials. Standard 61 addresses water quality contamination issues but does not address longevity or strength. Care must be taken in selecting appropriate materials.

  Both District and contract work will be required to be in compliance with the new standards.

6.3.10 Operator Certification

- *Relationship to Water Quality*:
  All states are required to develop operator certification programs to comply with regulations. California water treatment operators have been certified for many years. As more focus has recently arisen related to distribution system operation, a California program has been underway since 2004 to certify distribution operators. Certification is also required for cross-connection control device testers.
- *The North Marin Water District Program*:
  The District is required to have distribution operator certification for all employees with duties that involve decisions in operation, maintenance or repair of distribution system facilities. All District treatment operators are certified. The District's cross connection control technician is certified by AWWA as a tester and assumes the role of certifying other District personnel hired to test NMWD devices.
- *Issues:*
  The most significant impact of the new California certification rules is the requirement for continuing education units and the successful testing of all employees to receive certification.

6.4 OTHER NMWD PROGRAMS AND EMERGING ISSUES

Distribution water quality is maintained if policies and procedures are in place to assure that good planning, construction and maintenance practices are followed. Some of the programs developed by NMWD staff can be considered quasi-regulated because they are cited in the Point Reyes Operations Plan that is reviewed and approved by the Department of Health Services. Following is a review of:

- Tank inspections, operations and maintenance
- Valve Turning
- Flushing
- New construction approval process
- Water Quality Laboratory
- Source Controls and Treatment
- Emerging Issues

6.4.1 Tank Inspections, Operations and Maintenance

- *Relationship to Water Quality*:
  Storage tanks are a location of high vulnerability. Storage of water, while providing fire protection and emergency supply, can cause the water to age and lose chlorine residual. Screens on vents and overflows must be properly maintained to prevent intrusion by birds, and animals.
- *The North Marin Water District program:*
  The current NMWD tank inspection program is carried out by the Operations division with occasional assistance from the Maintenance division. The Maintenance division conducts annual inspections, typically performed by the Electrical/Mechanical staff. The Operations division inspects four tanks weekly for chlorine residuals and tank security issues. These are Olema Tank, Bear Valley Tanks, PRE Tank 1, and PRE Tank 4. A water quality-focused inspection of all tanks typically occurs once a year during the winter. Samples are collected by the distribution system operator for lab analysis,

including coliform growth and heterotrophic bacteria. Tank inspection observations are recorded in the database "Tank Cleaning Sch.xls" which is maintained by the Operations staff. Tank Inspection forms, typically filled out during tank cleanings, are included in the individual tank binders located in the Engineering department.

Reduced chlorine residuals have caused a tank chlorine augmentation program to be developed. Chlorine dispersion tubes have been installed in Olema Tank and PRE Tank 4. A regular program is conducted by the distribution operator to monitor all of the tanks and add chlorine tablets as necessary. Records are maintained on this activity and correlation with lab sampling within the zone is reviewed by the Water Quality division. Significant improvement in maintaining a chlorine residual and a marked decrease in the number of coliform positive samples in the distribution system has been observed as a result of these actions

The pump operational set points at the storage tanks and system dynamics have a great influence on water age.

- *Issues:*
  Tank inspections must be scheduled and maintenance prioritized so water quality problems are quickly remedied.

  Overflow drains may not be located on facility drawings.

  Augmentation of tanks with chlorine tablets is time-consuming. If it is determined that ongoing chlorine augmentation is advantageous, alternatives to the program will be investigated.

  A system to chlorinate the larger tanks under emergency conditions is needed.

  Separate tank inlet and outlet pipelines have been designed for some NMWD tanks. Their performance has been positive in de-stratifying tank water and maintaining adequate chlorine residuals throughout the water column. Proposed Water Works Standards will require separate inlet and outlet pipelines.

6.4.2 Valve Turning Program

- *Relation to Water Quality:*
  Turning all valves provides assurance that valves are functioning and can be used to valve off main breaks or contamination events in a timely manner. It also provides an opportunity for staff to gain knowledge of valve locations and assure they haven't been buried by new paving and are fully operational.

- *The North Marin Water District program*:
  NMWD has a good program that provides for turning all distribution and transmission system valves each year by the Maintenance Division.

- *Issues*:
  A valve replacement program with identified goals should be considered. Fewer available staff has allowed for this program to fall behind.

6.4.3 Flushing

- *Relation to Water Quality:*
  Flushing has long been identified as one of the most effective maintenance practices for improving water quality by removing sediments, corrosion by-product biofilms and introducing higher chlorine residual to stagnant dead ends.
- *The North Marin Water District program:*
  North Marin initiated an annual, system-wide flushing program over 30 years ago. Budget constraints caused the program to be abbreviated in the ‘90s. Currently, flushing is carried out by Maintenance, Construction, and Operations personnel, coordinated by the Treatment and Distribution Supervisor with flushing routes assigned to several flushing teams. Flushing is generally conducted annually.
- *Issues:*
  Flushing of dead ends and between pressure zones is complicated by the lack of flushing blow-offs at zone valves. A program to install zone valve blow-offs has been initiated. Flushing zone-valve dead-ends without blow-offs requires that stagnant water from the higher zone be flushed to the lower zone which can jeopardize customer water quality, as well as the risks associated with introducing a higher pressure to an area.

  Although the flushing program has been normally performed annually, cutting the program back due to water supply concerns has not resulted in an increase of colored water complaints.

  Stormwater protection rules require dechlorination of all water discharged during flushing. The District has adopted a policy of dechlorinating at all flushing points; previously dechlorination took place only adjacent to locations that were perceived as being environmentally sensitive.

6.4.4 New Construction Approval Process

- *Relationship to Water Quality:*
  New facilities are approved for service by procedures that allow for their disinfection and subsequent testing to show no contamination. The final approval depends on more than the disinfection process but starts with good design and construction practices.

- *The North Marin Water District Program*:
  Design review procedures include review for water quality concerns. District procedures document the post-construction disinfection and approval process. The Operations division has procedures for liquid chlorine disinfection of mains. Protection of the sanitary condition of pipe in storage has been identified as a goal and is now practiced.

- *Issues:*
  The electrical/mechanical crew has developed a procedure for the disinfection of pressure reducing stations and their bypass valves. This procedure should be documented.

  Engineering should include a representative from the Water Quality division at pre-construction meetings on larger projects to review the approval process and discuss BMPs as relating to assuring water quality. Distribution of the appropriate standards related to disinfection and main approval to the project construction superintendent could be included on the job check list.

Flushing velocities have been less than sufficient in many cases to clear lines. Tie-in to existing mains has been required in several cases prior to main approval in order to achieve flushing velocities. NMWD should consider providing temporary connection with backflow protection to mains.

Covered storage has been suggested to provide contamination protection for pipe and appurtenances in yard. In lieu of covered storage, end caps are used on stored pipe. End cap effectiveness requires prompt capping and contractor attention at job sites.

District experience with pipeline disinfection using liquid hypochlorite is positive. Training District personnel on main disinfection procedures has been done to enhance the ability to respond to emergencies. However, the District utilizes outside contractors for pipeline disinfection on large, planned projects.

6.4.5 Water Quality Laboratory

- *Relationship to Water Quality*:
  The ability to consistently control and improve water quality is determined by the ability to quickly obtain data and detect trends. The ability to provide quantitative data that can be used to guide process control decisions allows for a higher quality product. It is the role of the laboratory to provide this data. An on-site laboratory equipped to perform tests on demand provides the timely detection that is crucial to good water quality control.

- *The North Marin Water District Program:*
  The NMWD Water Quality laboratory is staffed and equipped to perform common regulatory tests and those tests that are routinely requested by staff or customers. The laboratory is certified under the California Environmental Laboratory Accreditation Program and staff are certified as Water Quality Analysts by the California-Nevada Section of the American Water Works Association. It has been the policy to equip the lab with the ability to perform those tests essential to monitoring constituents of concern, i.e., those that can be controlled by adjustment to either plant operations or distribution practices. Use of commercial laboratory services is limited to those tests of constituents that are required for regulatory purposes, primarily to show their absence, or to those tests which are not cost effective for the District to perform.

- *Issues:*
  There is no commercial laboratory in Marin County that is certified to perform bacteriological tests on water. The NMWD laboratory has been asked by County Environmental Health if NMWD would be capable of accepting private well bacteriological tests of Non-District County residents. The NMWD laboratory has started to accept samples from Novato Sanitary District and Marin Municipal Water District. The lab should continue to market lab services to neighboring water and wastewater utilities to add revenue and reduce operational costs.

A Laboratory Information Management System (LIMS) was implemented in June 2007 and has been put into daily operation. This system allows for automated reporting from instruments and a streamlined, multistep process for validating results. All bench sheets and reports (including electronic reports to the state database) are generated from the LIMS.

Results of all testing are compiled and summarized in an Annual Water Quality Report. This report (identified as a Consumer Confidence Report as required by the US Safe Drinking Water Act) lists any detected contaminant or constituent with a primary standard as well as several constituents with secondary standards that may be of interest to consumers. The Annual Water Quality Report is sent to each customer in a special mailer and is posted on the District's website.

6.4.6 Source Controls and Treatment

- *Relationship to Water Quality*:
  Good source water quality is typically directly related to treated water quality. Improving source water quality can improve treated water quality.
- *The North Marin Water District Program:*
  A Sanitary Survey showed no major threats to source water.

6.5 WATER QUALITY GOALS

Based on the issues discussed and experienced the following goals are identified as appropriate to assure water quality in the West Marin Water System:

1. A minimum 0.20 chlorine residual maintained at all points in the distribution system.
2. Heterotrophic plate counts not exceeding 500/ml bacteria at all points in the distribution system.
3. No taste and odor complaints or detection.
4. Total Trihalomethanes reduced below 60 ug/L at all DBP sample sites; total haloacetic acids reduced below 40 ug/L at all sample sites.
5. Maintain Sodium concentration below 50 mg/L at all times.
6. Annual inspection and testing of all reservoirs for bacterial quality and sediments that would warrant disinfection and/or cleaning.
7. All reservoirs cleaned (or bypassed for cleaning based on data) every five years.
8. Annually, flush all mains and turn all valves.
9. Test backflow prevention devices annually and repair within 45 days of failure identification date.
10. Maintain lead and copper below action level at all consumer taps.
11. Respond to customer complaints within the workday.

6.6 RECOMMENDATIONS

The following are recommended actions towards achieving water quality goals.

6.6.1 Source Quality

1. When Gallagher well and pipeline is completed, develop a salinity avoidance strategy that takes advantage of this separate source of supply either wholly or by blending with the coast guard well supply.

6.6.2 Treatment

1. Continue permitting, design, and construction work to eliminate backwash discharge to land.

6.6.3 Distribution

1. Install additional DBP reduction sprayers at tank sites where they are found to be effective and as they are needed related to salinity intrusion.
2. Improve flushing by including Engineering in annual update of flushing routes adding new mains.
3. Continue to install flushing blow-offs at dead-end valves.
4. A valve replacement program with identified goals should be considered.
5. Review security issues and address vulnerabilities as appropriate. Consider SCADA-based security alarms and general SCADA security.
6. Consider electronic collection of cross connection control test results in the field that can be downloaded upon return to the office.
7. Continue to replace the older NMWD-design fire service double check detector assembly and rely on fire systems with approved single detector checks and rely on the alarm check in the fire system to provide redundancy. The older checks should be removed to eliminate head loss, lead components and liability.

6.6.4 Other Issues

1. Maintain laboratory service ability to meet customer priorities and provide feedback to operational issues. Utilize contract laboratory services to monitor regulated contaminants that are not a concern and testing and/or maintaining laboratory certification is not cost effective.
2. Integrate all District Information management systems including the development of a Laboratory Information Management System (LIMS). Information is critical to effective application of resources.
3. Provide laboratory services to County and other agencies.

SECTION 7
HYDRAULIC EVALUATION

SECTION 7

HYDRAULIC EVALUATION

7.1 INTRODUCTION

The hydraulic evaluation of the West Marin Water System is presented in Section 7. The 2001 West Marin Long Range plan did not include a hydraulic evaluation to identify hydraulic adequacy under several demand conditions, including a fire flow evaluation. Only limited hydraulic evaluation is performed under the present Master Plan however, some recommendations are discussed as appropriate to address distribution system hydraulic improvements. A future study is suggested to address an improved and calibrated hydraulic model.

7.2 HYDRAULIC MODELS

EPANET 2, public domain software developed by the US Environmental Protection Agency, is used for hydraulic flow modeling by NMWD staff. Over the years, simple hydraulic models have been developed to evaluate fire flow capacity for local developer projects in certain service zones using EPANET 2. These models are for Pt. Reyes, Bear Valley, Inverness Park and PRE service zones.

7.2.1 Modeling Criteria

Establishing hydraulic modeling criteria is important for development, calibration and use of the hydraulic network model, as well as interpreting the results. Key criteria utilized in development and use of the District's hydraulic models is as follows:

- All pipes 4 -inch diameter and larger are included in the model, with some key 2- inch diameter pipes that complete loops or are essential to water flow also included. Demands at the end of these pipelines are placed at the nearest node.
- Pipe lengths and nominal diameters were obtained from the District's facility maps maintained by the Engineering Department.
- The pipe roughness coefficient, Hazen-Williams "C" value, was assigned to each pipe segment based on pipe material and age.
- Water entering a modeled zone is represented by pumps utilizing pump curves provided by the District. Water leaving a modeled zone (such as at upper zone pump stations) is represented as a node with a demand indicating the number pumps operating as necessary.
- Tank dimensions and elevations were input for all storage facilities.
- Ground surface elevations were obtained from the District's facility maps, or Marin County orthophoto mapping in some cases.
- Water demands and flow rates are expressed in gallons per minute (gpm).

7.2.2 Water Demands

The model demands are based on average annual daily demands in the past 13 years as presented in Section 4. For model runs under conditions other than average day demands, a multiplier was used to determine those demands. Multipliers for maximum day and peak hour demands vary with service (or pressure) zones, however, the billing data was not analyzed to determine individual service (or pressure) zone multipliers. Therefore, multipliers for the whole West Marin Distribution system were used for the individual zones.

7.3 DISTRIBUTION SYSTEM ANALYSIS

The hydraulic network models were utilized to evaluate the performance of the PRS and Bear Valley water distribution systems under current (FY 2013) and future buildout (FY 2035) water demands. The hydraulic model output results include flow, velocity and head loss for all pipe segments, and pressure and hydraulic gradient for all network nodes in the system. This information is compared to specific evaluation criteria to determine hydraulic adequacy. Solutions to correct identified deficiencies are then run with the model to determine their effectiveness. Limited modeling was performed in the Inverness Park-Paradise Ranch Estates zone and no modeling was performed in the Olema zone.

Model runs are steady-state runs, which represent a specific snapshot in time. The status of zone pumps, outflows from the zone, peaking factors, and pipelines and tanks that are in service or out of service is all input into the model as boundary conditions. The model output results indicate system operation at that particular point in time.

Extended-period or dynamic model runs were not performed during this analysis.

7.3.1 Evaluation Criteria

In order to effectively evaluate the model runs, the model output results were compared against established evaluation criteria. These criteria include: minimum and maximum pressure, maximum velocity, maximum head loss, residual pressure at fire nodes, and fire flow requirements. In addition, other system reliability criteria also govern the analysis. A detailed discussion of the development of these criteria is presented in Section 2, and the pertinent criteria are summarized below:

- Minimum normal pressure = 40 psi
- Minimum pressure under max day demand = 35 psi
- Minimum pressure under peak hour demand = 30 psi
- Maximum normal pressure = 80 psi
- Maximum pipeline velocity = 8 fps; 10 fps under fire demand conditions
- Maximum pipeline head loss = 10 feet per 1000 feet
- Minimum fire flow requirement = 2,000 gpm for Point Reyes Station and 1,000 gpm elsewhere (for 2 hours). Note this is the recommended fire flow by Marin County Fire Department and has increased over time (initially 500 gpm to 1,000 gpm for 15 minutes in rural areas) [(1).]
- Residual pressure under fire flow = 20 psi

7.4 MODEL SIMULATION APPROACH

The service zone models were run separately under three basic steady-state demand conditions that stress the distribution system: 1) maximum day demand; 2) peak hour demand;

[1] Paradise Ranch Estates Water System Improvements EIR (NMWD, 1979)

and 3) maximum day demand plus fire flow. The modeled pressure, pipe head loss and velocity were compared with the evaluation criteria noted above. Deficiencies were noted and improvements recommended as necessary. These modeled demand scenarios were intended to stress the system with the highest expected flow rates throughout the system, with the intent that if the system functioned adequately under these stressed conditions, then it is anticipated that lower demands can be accommodated.

A review of all fire hydrant flow tests to determine low fire flow areas and hydraulic modeling to identify potential pipeline improvement and replacement projects to increase fire flows to these hydrants is beyond the scope of this master plan. The District can conduct a review of the fire hydrant flow tests and target specific areas for more detailed evaluation of fire protection capabilities.

7.5 PT REYES STATION (PRS) ZONE HYDRAULIC ANALYSIS

7.5.1 Assumptions

PRS model simulations are run under the following assumptions:

- The storage tanks are operated at a water level less than full that represents a typical level during maximum day demand.
- The maximum day to average day demand multiplier is 2.11 and the peak hour to average day demand multiplier is 4.0.
- Maximum fire flow rate is 2,000 gpm in Pt Reyes Station and 1,000 gpm in other areas.
- For FY 2013, the average day demand is 163 gpm; maximum day demand is 344 gpm; and peak hour demand is 652 gpm.
- For FY 2035, the average day demand is 235 gpm; maximum day demand is 496 gpm; and peak hour demand is 940 gpm.

Table 7-1
PRS Zone Model Parameters

Model Run Scenario **Model Input Parameter**	**Maximum Day**	**Peak Hour**	**Maximum Day + Fire Flow**
Multiplier – Existing (Buildout)	2.11	4.0	14.3
PRS Tank 1 Water Elevation (ft)	212.8	212.8	212.8
PRS Tank2 Water Elevation (ft)	212.8	212.8	212.8
PRS Tank 3 Water Elevation (ft)	212.8	212.8	212.8
Flow out to other zones (gpm)	120	228	2,120

7.5.2 General Modeling Information - PRS

The Coast Guard Wells pump water through the PRSTP to PRS Tanks and also to the distribution system simultaneously. In the present modeling, the Coast Guard Wells were not included. Instead, gravity flow from the PRS Tanks was used. The flow out of the system to other service zones was applied to the model node at the B Street and 1st Street intersection. The demands were randomly applied at different nodes of the model (not based on billing data).

7.5.3 Maximum Day Demand Scenario

The PRS model was run under current maximum day demand to ascertain potential existing system hydraulic adequacy. In this scenario, 344 gpm flows out of the PRS Tanks and into the distribution system and 120 gpm leaves to the other pressure zones. Under these conditions, except at 2 nodes on a 2-inch private line on Hwy 1 in the north east corner of the PRS service zone, there were no pressures less than 35 psi or pipelines with high head loss or velocity. These results indicate that there is ample pipe capacity to meet existing maximum day demand.

7.5.4 Peak Hour Demand Scenario

Similar results occur during peak hour demand scenarios. The primary impact is that more water must be delivered from the tanks to meet demands. There are no additional low pressure locations or pipelines with high head loss or velocity.

7.5.5 Maximum Day Demand + Fire Flow Scenario

The fire flow analysis was conducted utilizing one location to place the fire flow in the model. The fire flow of 2,000 gpm was applied at the western end of the PRS service zone at the intersection of 1st and B Street. Maximum day demand was also randomly distributed as mentioned earlier.

Although in the model simulations only tank storage is utilized, there is direct pumping from the Coast Guard wells that can supplement flow and pressure. This conservative approach will identify any hydraulic deficiencies to meet fire flows in the PRS zone.

The fire flow analysis consisted of applying fire flow and maximum day demand and determining if the 20 psi residual pressure criterion is met. A few areas showed less than 20 psi pressure (between and 10 and 20 psi). However, the velocity in these segments remains below the criteria for deficiency, and these pipeline segments are not candidates for replacement strictly for hydraulic benefit alone. It is not uncommon for many locations that are deficient at the higher fire flows to meet the requirements at the lower fire flows. These are the upper elevation areas on the 12-inch main on Shoreline Highway.

7.5.9 Buildout Demand Scenarios

Buildout demands were applied at the same locations as the present day simulations but used the 2035 multiplier to reach 940 gpm for peak hour demand. There were no additional deficiencies other than that previously described in the peak hour demand scenario.

7.6 BEAR VALLEY ZONE HYDRAULIC ANALYSIS

Limited modeling was performed. Fire flow criteria of 1,000 gpm in Bear Valley is approximately 50 times the pumping rate due to low residential demand in this pressure zone. Therefore, sizing pipes for fire flow goal of 1,000 gpm rate seems extreme and modeling was performed with 500 gpm flow. Marin County Fire Department has allowed minimum fire flow of 500 gpm for residential projects in this area. The modeling shows that 500 gpm flow rate creates negative pressure at a node 900 ft downstream of the tank where the 4-inch main branches into a 4-inch and a 6-inch loop at 370 ft elevation. If this 900 ft of pipe downstream from Bear Valley tanks is upsized to a 6-inch, the 500 gpm flow can be achieved with 36 psi residual pressure at that node meeting the minimum 20 psi pressure criteria and 1,000 gpm flow is achievable with 17 psi residual pressure at that node. If the 4-inch pipe is replaced with an 8-inch pipe, the 1,000 gpm flow could be achieved with a minimum residual pressure of 38 psi.

7.7 INVERNESS PARK - PARADISE RANCH ESTATES ZONE HYDRAULIC ANALYSIS

Limited model simulations were performed to check if 500 gpm fire flow can be obtained with the existing system. No pressure or velocity deficiencies were noted.

7.8 OLEMA ZONE HYDRAULIC ANALYSIS

Modeling was not performed for this zone. However, it is noted that the only supply line to Olema Tank is along Highway 1. Installing bypass connections along the existing 4-inch main or installing a second supply main from Bear Valley system along Bear Valley Road will improve reliability of service to the Olema service zone. Since current Bear Valley storage is limited, this proposed improvement would also require increasing Bear Valley Tank storage.

SECTION 8
ASSET MANAGEMENT

SECTION 8

ASSET MANAGEMENT

8.1 INTRODUCTION

The North Marin Water District (NMWD) West Marin Asset Management (WMAM) Program is a staff-driven program that has been developed following the Novato program. From this effort, staff recommended defining WMAM for NMWD as a long-range planning document that can be used to understand the following:

- The assets that NMWD owns, their current physical condition, and the services that they provide;
- The present and future demands on the NMWD assets that are critical for delivering the level of service to customers and the community;
- The current estimate of the short-term and long-term financial requirements (both capital and operational) necessary to maintain the assets and the services that they provide;
- The current and proposed policies, strategies, and programs that are necessary to meet the long-term provision of services;
- The business risk exposure associated with the potential failure of the assets to meet the expected levels of service;
- The linkages necessary between strategic business objectives and the service that the assets are delivering; and
- The organizational continuity that will span staffing changes and the transfer of asset management knowledge between successive generations of utility managers and staff.

[NOTE: This is NMWD's 1st draft of the WMAM Plan and as such, does not meet all of the long-range goals for a fully-developed WMAM Program.]

It is intended that the production of a 5-year WMAM Plan will be updated as part of the NMWD ongoing Master Plan process.

The District's WMAM Plan has a short-term focus (five years) within the WMAM Program of the longer-term period (100 years) covering the full life cycle of the assets. It is based on a set of systematic planning activities to assess asset performance and demands, improve reliability of asset performance, improve forecasts for both capital and operational budgets based on asset performance and reliability needs, identify and quantify business risks and trends, formulate and evaluate both capital and operational options for meeting service levels, and plan continuous improvements related to delivering the lowest life cycle cost service solutions.

WMAM Program Development & Planning is related to the assets that are currently owned and will be owned in the future, and how the business decisions related to these assets will affect its ability to sustain asset performance and consequently sustain provision of economical services to its customers. NMWD has traditionally performed many of these tasks across the organization; however, the results of this work have not been collated into a single, concise document to allow the organization to clearly understand the overall business planning ramifications.

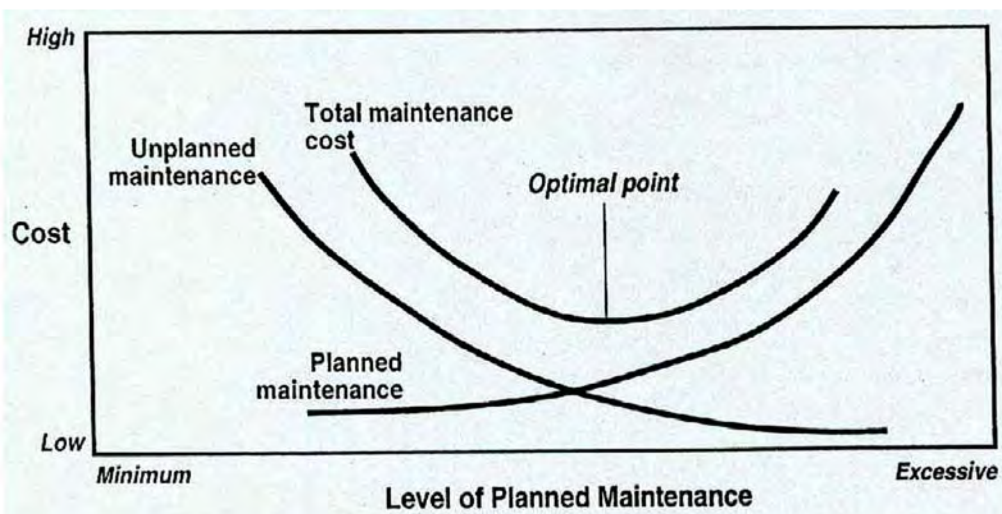
8.2 WMAM PROGRAM OBJECTIVES AND GOALS

The District's mission is to provide "… *an adequate supply of safe, **reliable** and high quality water … to our customers at **reasonable cost*** …". Accordingly, it is appropriate that the goals of the District's WMAM Plan are to: (1) improve water system reliability by reducing system failure rates; (2) minimize the time and money spent reacting to problems through proactive implementation of necessary WMAM projects; (3) forecast exhausted asset replacement costs; and (4) develop a practical replacement plan.

Without an effective WMAM Program, infrastructure reliability cannot be achieved in a cost-effective manner. As an example, consider the graphical illustration contrasting total repair and replacement (R&R) costs versus planned and unplanned R&R activities as shown in Figure 8-1. From this graph, it is it apparent that there is an optimal point at which total R&R costs are lowest.

With the District approaching community build-out, more of the daily construction and maintenance activities have switched from new construction to R&R of aging infrastructure. In addition, a greater percentage of funds for these R&R projects will come from District operating revenues and not connection fees associated with new development.

Figure 8-1
Level of Planned Maintenance



Managing water facility infrastructure R&R projects has always been a part of the District's annual Capital Improvement Projects (CIP) budgeting process. However, in the past, many of the R&R projects have been developed based primarily on an intuitive process utilizing the knowledge of senior construction and maintenance staff. Since the District will be losing much of this historical and institutional knowledge due to retirements, it is important that the program moves toward a fact-based WMAM plan rather than one that is intuitive-driven.

Over the next five years, District staff will focus on Asset Data Management, development of asset evaluation matrices and methods to be considered for asset condition and performance assessment.

8.3 CURRENT ASSETS

8.3.1 Asset Categories

The West Marin water system includes the following major components:

- 13 storage tanks
- 9 pump stations
- 27 miles of pipeline
- 168 fire hydrants
- 281 valves
- 776 active (820 total) service connections

8.3.2 8.3.2 Asset Value

Asset values for District infrastructures installed over time are shown in Fig. 8-2. The asset values were derived from original installation costs and are adjusted for inflation. Current infrastructure asset values are in excess of $6.25 million. Most of the District's assets are associated with buried facilities (i.e., transmission and distribution pipelines and appurtenances). Accordingly, the following discussion will focus on NMWD's buried assets (so-called "horizontal" assets) so that the WMAM Plan is focused on the greatest need within the District. Expansion of the Plan to include above-ground ("vertical" assets) infrastructure such as storage tanks, treatment plants and pump stations will occur at a later date after more experience is gained with this step.

8.3.3 Recent Improvements

As part of ongoing WMAM and business planning processes with NMWD, the following efforts continue:

- Best appropriate practices for WMAM, as well as development of case studies that can be used to learn how to implement strategic WMAM tools; and
- Development of tools for decision analysis and implementation of asset management practices. This includes a cost tool and a refined gap tool that helps to compare NMWD WMAM practices to those of other utilities. These tools will allow NMWD to benchmark against other utilities.

8.3.4 Levels of Service

NMWD will develop a summary of its present and future Levels of Service requirements and incorporate into asset matrices for the next Plan period.

8.3.5 Focus Area

Whether planned or unplanned, maintenance costs associated with District facilities have been trending higher as the District's assets have expanded and aged over time as shown in Figure 8-3, annual and 10-year running average expenditures (adjusted for inflation). For both FY12 and FY13, maintenance expenditures have exceeded $70,000. When compared against the total FY 2013 Operating Expenses of $545,482, maintenance costs account for about 13% of the total budget. A tabulation of total maintenance costs for the District's nine categories (from FY83/84 to FY12/13) is provided in Table 8-1. This tabulation, ranked from lowest to highest expenditures shows that maintenance of storage facilities, main lines and copper and PB (polybutylene) services consumed over 50% of the annual maintenance costs during this period. Note that the identified costs do not include major replacement projects that are typically budgeted as Capital Improvement Projects. Furthermore, some large repair projects are not included in the aforementioned costs since they too are budgeted as a Capital Improvement Project. Recent examples of this are a 2012 Point Reyes Well #3 Replacement at the Coast Guard site ($263K), PB Service replacements ($58K), PRE2 Tank Retaining Wall Repair ($56K), and Viento Way main line costs ($21K). These four projects alone are nearly 50% more than the expenditures shown for replacement of aging facilities. In FYs 14 & 15, NMWD has planned respective costs of $235K and $220K over this two-year period for more of this same type of aging facility replacement. These costs account for 25% of the total CIP budget and will continue to get higher, as a majority of the CIP budget for FY15 is the pipeline project from Gallagher Well site to the Pt. Reyes TP.

Figure 8-2
Asset Value History

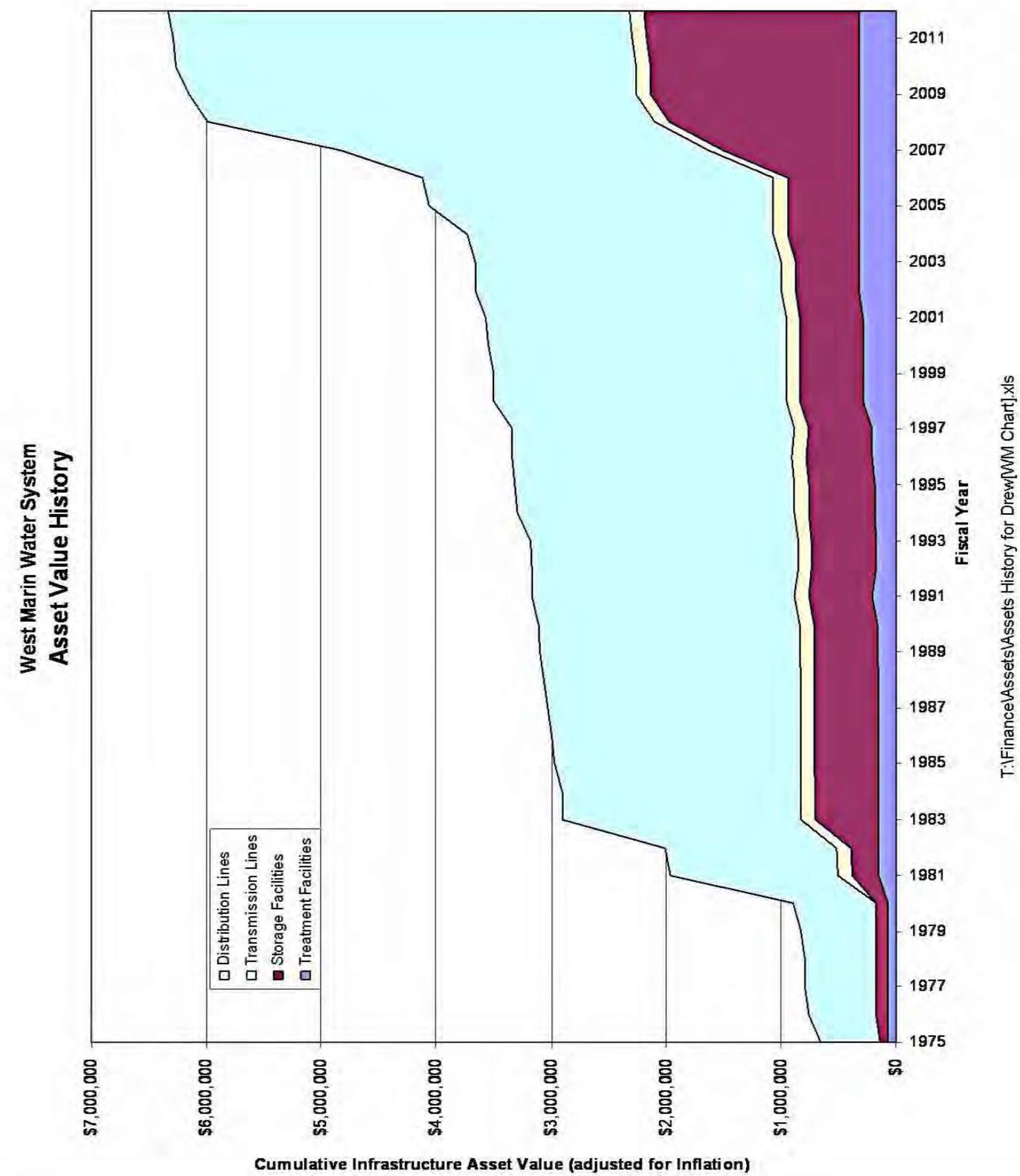


Figure 8-3
Maintenance Expense History

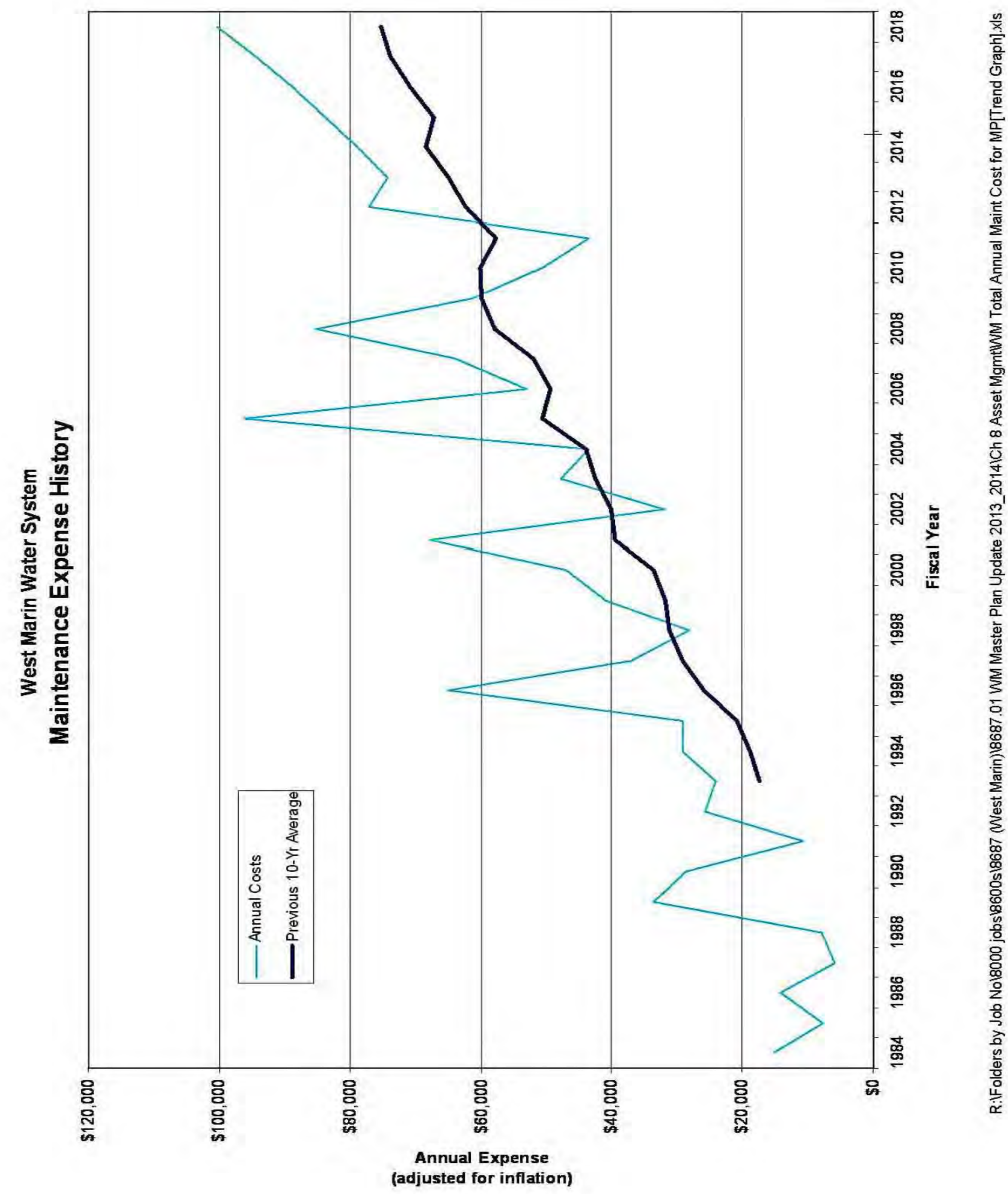


Table 8-1
Total Annual Maintenance Costs (adjusted for inflation)
West Marin Service Area

	Detector Check Assembly Maint	Maintenance of Copper Services	Maintenance of Hydrants	Backflow Prevention Program	Maintenance of Valves & Reliefs	Maintenance of Meters	Maintenance of PB Service Lines	Maintenance of Mains	Maintenance of Storage Facilities	Annual Costs
FY 2013	$0	$7,205	$0	$1,698	$6,642	$3,398	$34,996	$0	$20,310	$74,249
FY 2012	$1,877	$7,590	$3,468	$6,004	$5,070	$1,847	$22,156	$427	$28,586	$77,025
FY 2011	$233	$4,518	$4,080	$4,288	$8,326	$2,073	$8,304	$2,304	$9,404	$43,531
FY 2010	$404	$3,593	$2,281	$1,237	$6,259	$3,335	$19,235	$752	$13,520	$50,616
FY 2009	$0	$255	$4,389	$1,191	$6,226	$4,813	$16,917	$16,353	$11,147	$61,292
FY 2008	$670	$6,327	$2,705	$6,744	$6,886	$10,500	$21,663	$12,764	$16,969	$85,228
FY 2007	$240	$115	$1,082	$4,927	$1,966	$9,906	$17,265	$18,561	$9,933	$63,995
FY 2006	$0	$770	$3,258	$7,718	$3,792	$3,638	$23,295	$5,989	$4,593	$53,051
FY 2005	$0	$3,654	$2,523	$0	$4,590	$5,618	$7,347	$22,696	$49,836	$96,265
FY 2004	$0	$5,810	$7,062	$2,098	$4,470	$1,986	$1,872	$11,129	$9,143	$43,571
FY 2003	$0	$2,688	$1,490	$1,889	$866	$4,295	$11,928	$7,278	$17,401	$47,835
FY 2002	$0	$0	$3,211	$5,260	$3,490	$2,018	$5,304	$6,151	$6,584	$32,018
FY 2001	$0	$4,138	$2,311	$6,213	$5,633	$1,703	$12,961	$2,492	$32,402	$67,853
FY 2000	$0	$5,051	$5,031	$1,490	$4,355	$4,719	$6,084	$4,191	$16,088	$47,008
FY 1999	$0	$1,101	$5,725	$5,151	$8,222	$6,195	$0	$4,321	$10,223	$40,939
FY 1998	$0	$2,535	$3,640	$2,017	$3,814	$2,136	$0	$7,847	$6,182	$28,172
FY 1997	$0	$224	$6,788	$1,757	$2,694	$14,019	$0	$4,990	$6,524	$36,996
FY 1996	$0	$185	$2,954	$3,636	$7,032	$21,975	$7,432	$9,362	$12,388	$64,965
FY 1995	$0	$0	$1,032	$1,378	$4,196	$6,206	$0	$6,523	$9,716	$29,050
FY 1994	$0	$0	$3,563	$5,541	$3,657	$2,509	$0	$4,728	$9,153	$29,151
FY 1993	$0	$0	$0	$4,475	$3,967	$1,928	$0	$6,030	$7,684	$24,084
FY 1992	$0	$0	$0	$3,844	$476	$1,506	$0	$15,610	$4,308	$25,743
FY 1991	$0	$0	$1,464	$1,244	$1,450	$2,211	$0	$2,957	$1,323	$10,648
FY 1990	$0	$0	$1,354	$2,484	$938	$1,890	$0	$5,794	$16,355	$28,814
FY 1989	$0	$0	$1,444	$2,831	$1,301	$2,817	$0	$21,489	$3,697	$33,578
FY 1988	$0	$0	$973	$1,189	$1,993	$273	$0	$2,438	$1,041	$7,907
FY 1987	$0	$0	$1,493	$34	$1,453	$231	$0	$1,448	$1,269	$5,928
FY 1986	$0	$0	$3,098	$0	$1,375	$360	$0	$4,672	$4,658	$14,162
FY 1985	$0	$0	$0	$2,421	$1,583	$713	$0	$1,721	$1,313	$7,752
FY 1984	$0	$0	$3,967	$9	$1,708	$473	$0	$5,998	$3,053	$15,207
Category Total	$3,423	$48,555	$80,388	$87,070	$107,790	$121,892	$181,762	$217,015	$324,490	$1,246,633

(1) Does not include related project costs budgeted as a CIP.

R:\Folders by Job No\8000 jobs\8600s\8687 (West Marin)\8687.01 WM Master Plan Update 2013_14\Ch 8 Asset Mgmt\WM Total Annual Maint Cost for MP[Table 8-1].xlsx

8.4 ASSET CONDITION AND PERFORMANCE ASSESSMENT

The focus of this Plan is the development of a standardized Plan and assembly of current information. Assessment of overall condition, performance and remaining useful life for water facilities installed will be part of continuing AM efforts. The District collects a significant amount of information regarding maintenance costs and line breaks. The planning of repair and replacement projects has primarily been based on the intuitive knowledge base of senior staff. While this approach has its merits, it should not serve as the sole source of asset management planning. Historically, the District has been “data rich” but “knowledge poor” when it comes to reporting and analyzing much of this data. Efforts have been made and/or are in progress to help move the District from an intuitive based R&R decision process to a data-based R&R decision process. These improvements include:

- Expanded use of the District’s computerized maintenance management system (CMMS) – “MaintScape;”
- Improved tagging, filing, and diagnosis of worn facilities taken out of the ground when performing repairs;
- Improved proactive subsurface investigation program (i.e., soil sampling) to better quantify areas of poor infrastructure condition;
- Development of a GIS system that will allow expansion of the existing facility map database to serve as a key database repository for infrastructure information (in progress);
- Development of asset condition & evaluation matrices, based on the database connected to the GIS system (in progress);
- Better characterization of existing asset inventory (as contained herein); and
- Better exchange of information between NMWD departments as it relates to condition assessment/repair (as contained herein).

8.4.1 Condition/Performance

Historically, service lines have been the highest cost for maintenance activities, most of which have been unplanned due to the randomness of both PB & CU (copper) service line failures. Over the past 10 years, however, staff has focused more efforts to better understand the modes of service failures and have identified a few key aspects to help plan replacements and extend service life. For all new CU service installations, we are installing CP anodes as well as adding CP anodes to recent installations. Moving forward, specific testing methods will need to be developed to aid in condition assessments. Storage facilities’ costs have surpassed those for maintenance of pipeline mains.

8.4.2 Inventory of Assets

The average age and value of the assets which NMWD owns is increasing steadily over time, and the asset replacement obligation is rising. As a consequence, NMWD needs to plan for decreased capital expenditures for capacity expansion and increased renewal expenditures in the future relative to past expenditure levels. More focus is necessary to ensure that appropriate operation and maintenance strategies are being applied in consideration to the varying ages of assets being maintained.

As previously mentioned under the “Current Assets” section, NMWD’s assets can generally be categorized into two simple groups: those assets which are buried, or below ground (“horizontal” assets) and those which are above ground (“vertical” assets). Below-ground assets include transmission and distribution (T&D) pipelines and appurtenances (valves and regulators). Above-ground assets include storage tanks, pump stations, regulating stations, fire hydrants, treatment facilities, service connections (meters), and backflow prevention assemblies (BFPAs).

Figures 8-4 to 8-6 (based on currently-available data) represent the history and age profiles of the assets within these two groups (vertical and horizontal), with the exception of meters (see “Maintenance of Meters”) and BFPAs. The monitoring (testing) of BFPAs is done on an annual basis, and depending on the type of device, maintenance and/or repairs are the responsibility of both NMWD and the customer being served.

8.4.3 Asset Evaluation

The table below presents the current replacement and depreciated values of NMWD’s assets. The replacement value represents the cost in June 2014 dollars to completely rebuild all the assets to a new condition. The depreciated value is the replacement value (depreciated) of the assets based on their age, and limited Operations & Maintenance data, which is a prediction of their current condition. A formal current condition assessment has not been performed and will be part of the continued development of a full WMAM program.

Valuation	Transmission & Distribution	Storage Tanks	Treatment Plants	Total
Replacement Value ($M)	$9.5	$3.1	$0.8	$13.4
Depreciated Value ($M)	$5.3	$2.3	$0.2	$7.7

In time, the District WMAM Program will develop a schedule when these assets are due to be replaced.

Figure 8-4
Main Installations

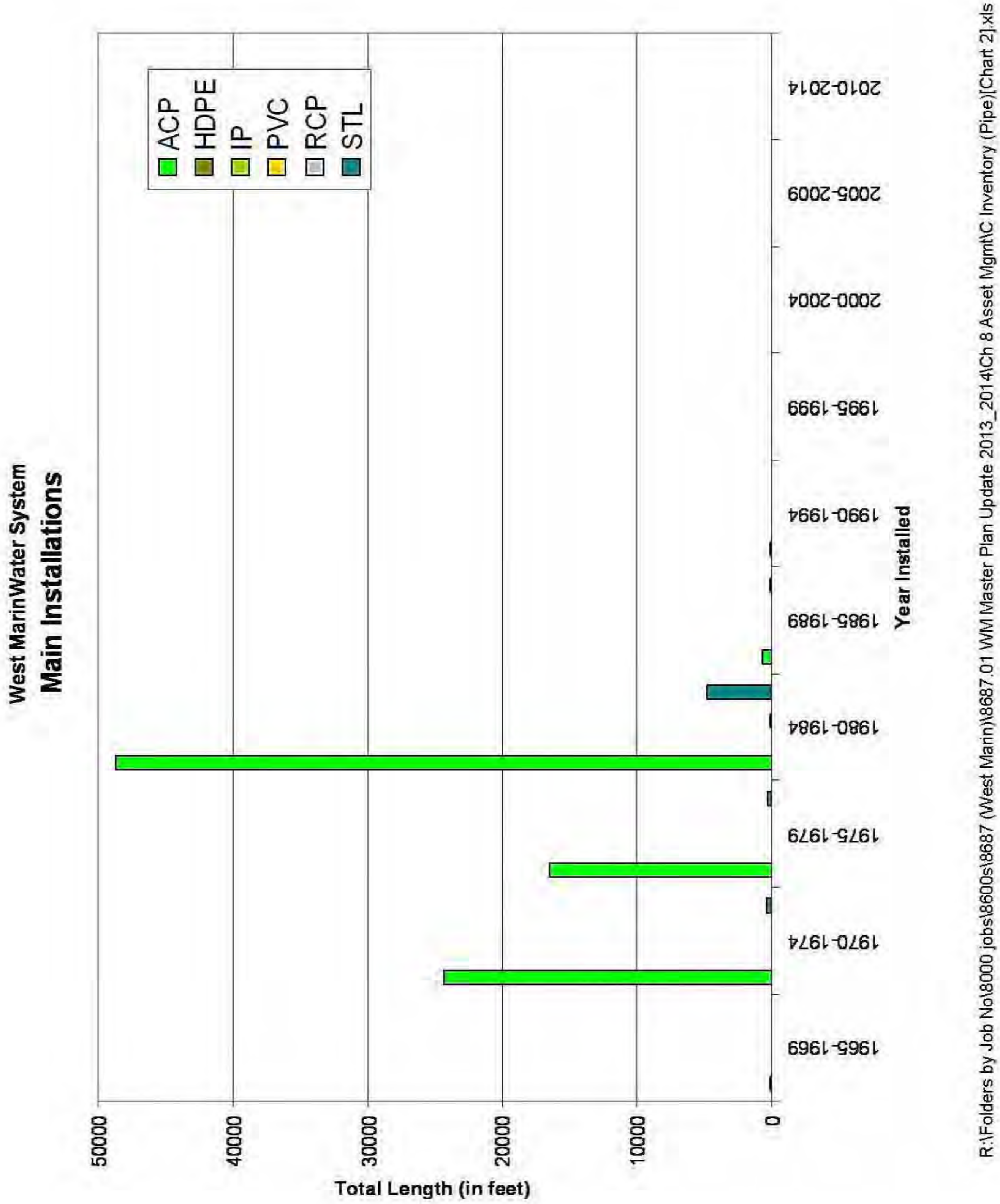


Figure 8-5
West Marin Storage Facilities

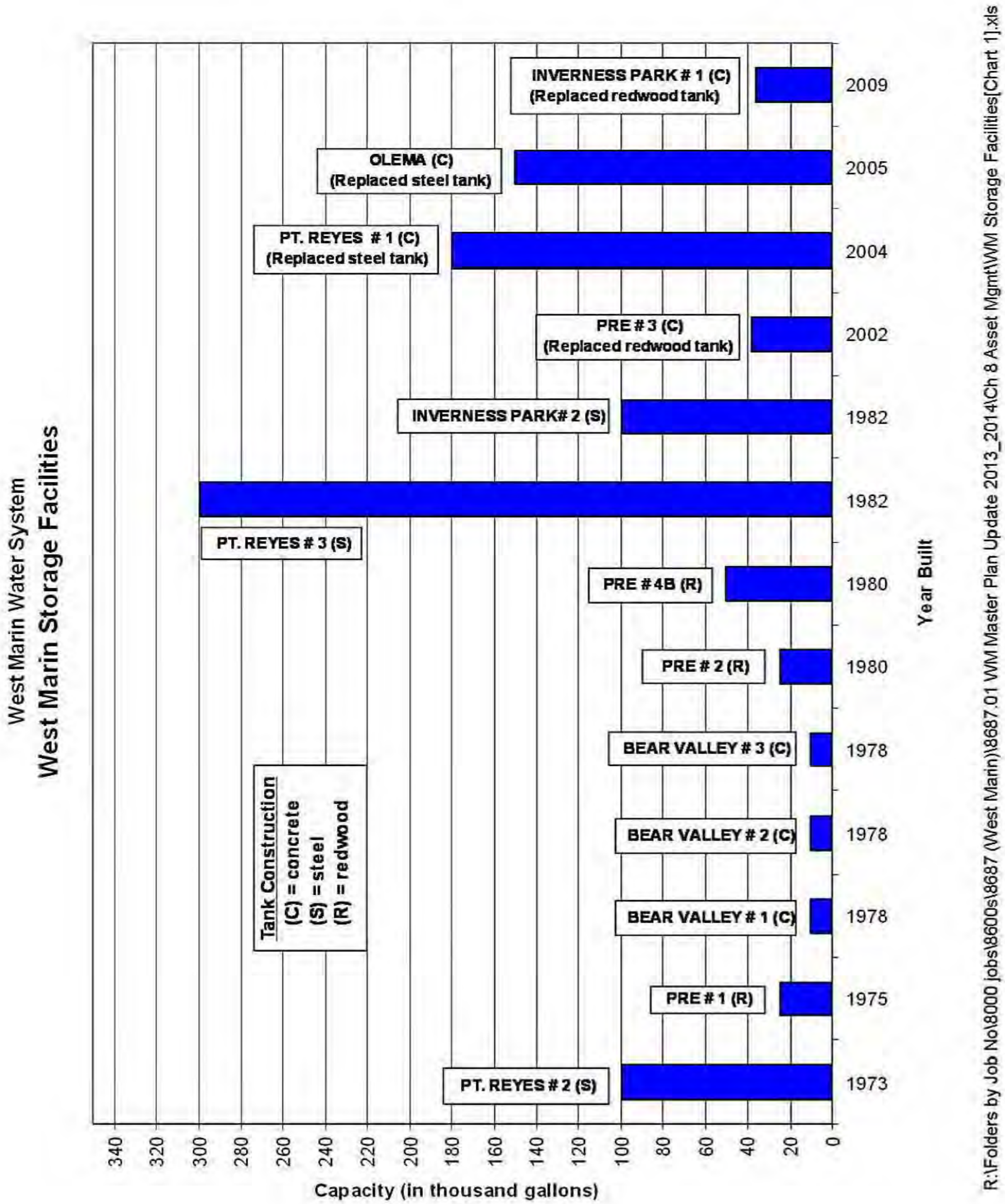
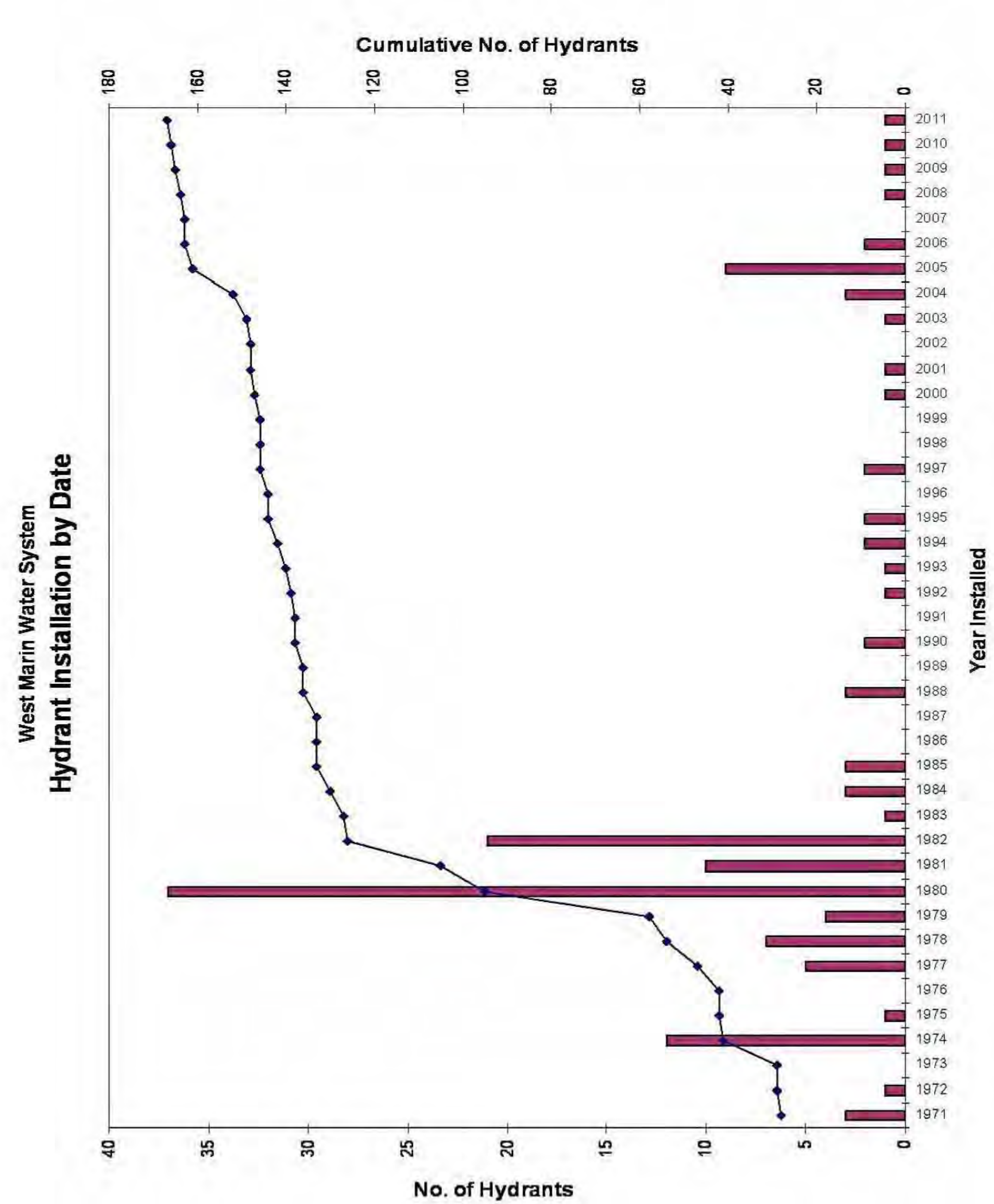


Figure 8-6
Hydrant Installation by Date



R:\Folders by Job No\8000 jobs\8600s\8687 (West Marin)\8687.01 WM Master Plan Update 2013_2014\Ch 8 Asset Mgmt\WM Hydrant Installation by Date[Chart 2].xls

8.5 WMAM PROGRAM SUMMARY

The District's WMAM program consists of four components: monitoring, managing, evaluating infrastructure condition, and replacement planning. A computerized maintenance management system (CMMS) is used to systematically gather (monitor) information about the current condition of facilities, most of which are below ground. Once collected, the software manages how the information is stored, organized and accessed. District staff then can utilize the CMMS program to evaluate the data to identify items in need of rehabilitation or replacement. In addition to the existing CMMS program, other miscellaneous databases are used as part of the infrastructure monitoring and evaluation process.

With the outline used in the Novato Master Plan, staff attempted to create an evaluation summary for the buried assets in West Marin. This data, shown in Figures 8.7 – 8.13, has been found to be inconsistent and lacking information needed to make reliable assessments. For instance, the Service Leak / Replacement History costs do not match the number of services identified as being replaced for both PB (polybutylene) and CU (copper) services. While this information is important to have in the graphical format, incomplete information can lead to inaccurate conclusions.

To improve the District's capabilities for identifying the most appropriate method for AM, we will work on these five focus areas:

- Improve Operational Cost Accounting
- Improve Repair and Replacement Tracking
- Storage, Main Line and Service Asset Matrices
- Facility Map and Data Coordination
- GIS of West Marin Service Area

Figure 8-7
Service Lateral Leak and Replacement History

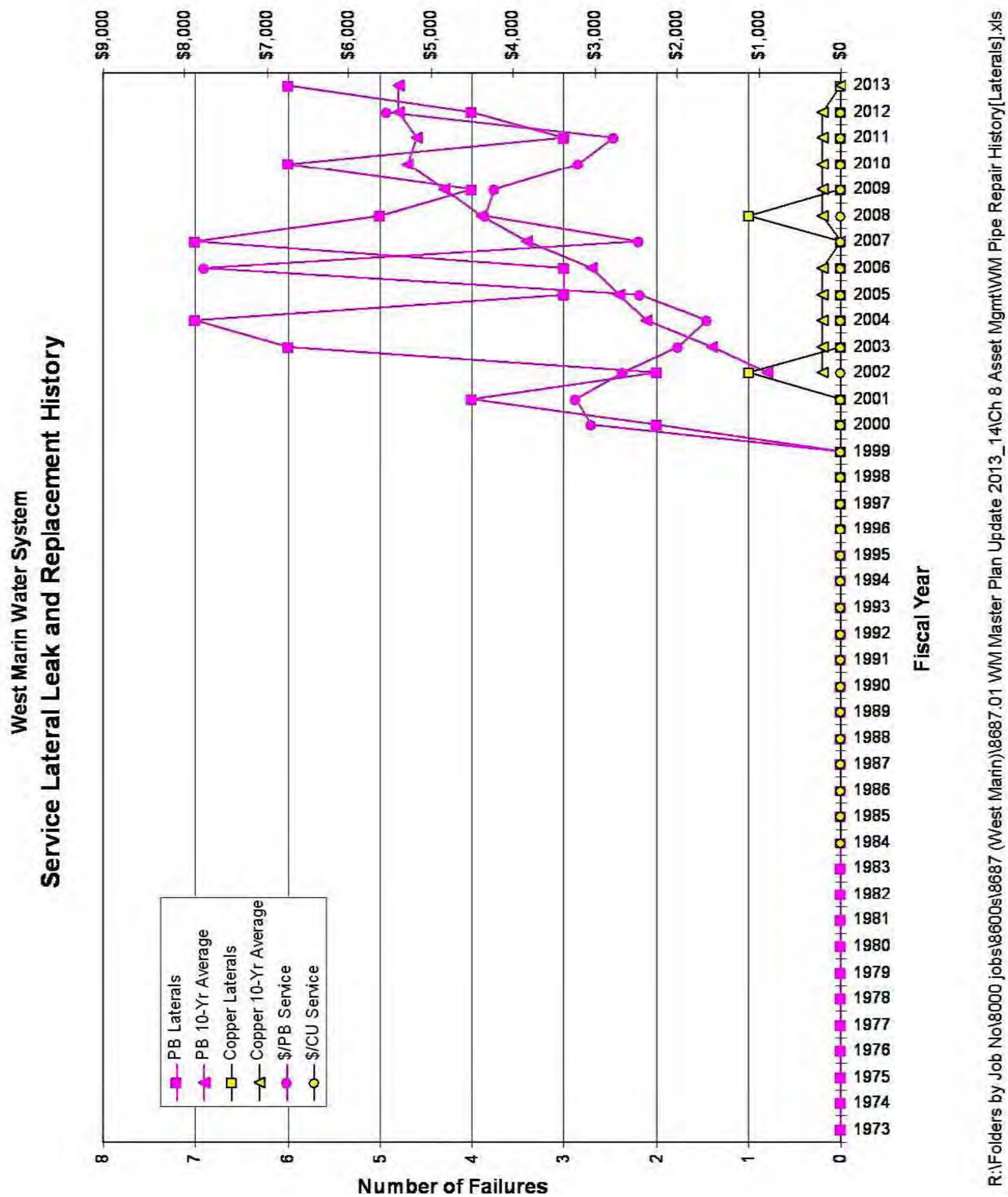


Figure 8-8
Annual Maintenance of Polybutylene Service Lines Cost History

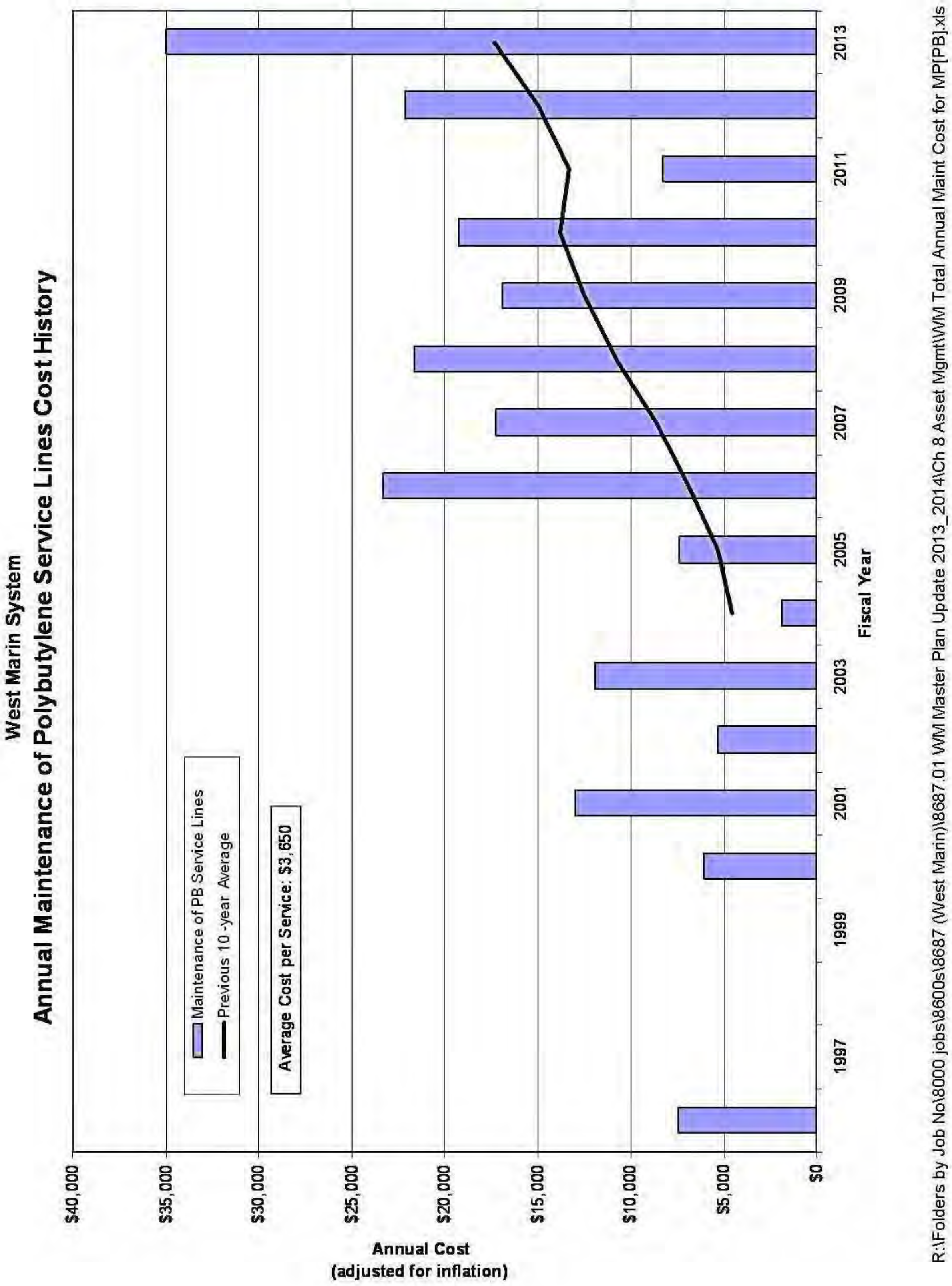


Figure 8-9
Annual Maintenance of Copper Service Lines Cost History

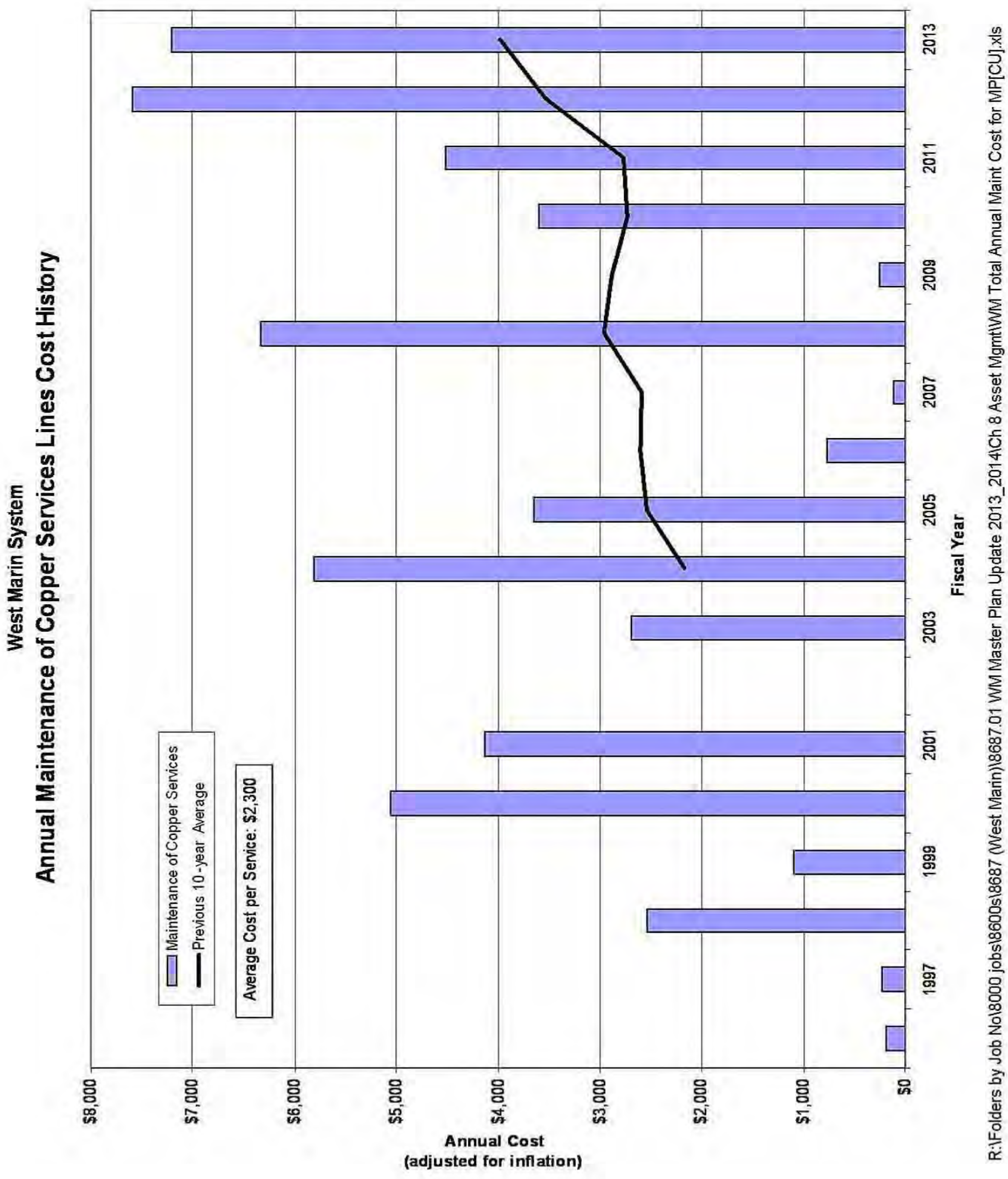


Figure 8-10
Annual Maintenance of Meters Cost History

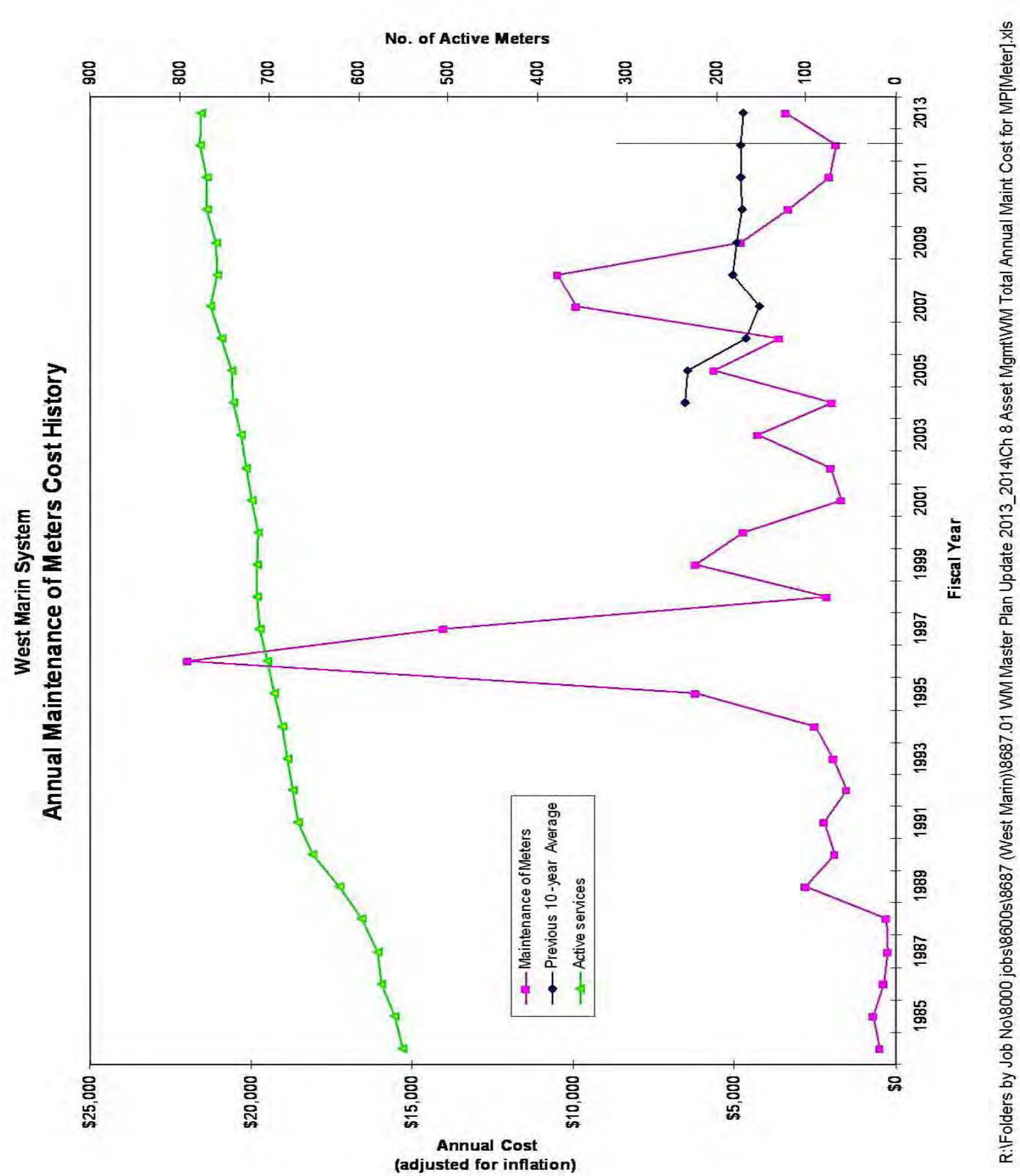


Figure 8-11
Maintenance of Valves Cost History

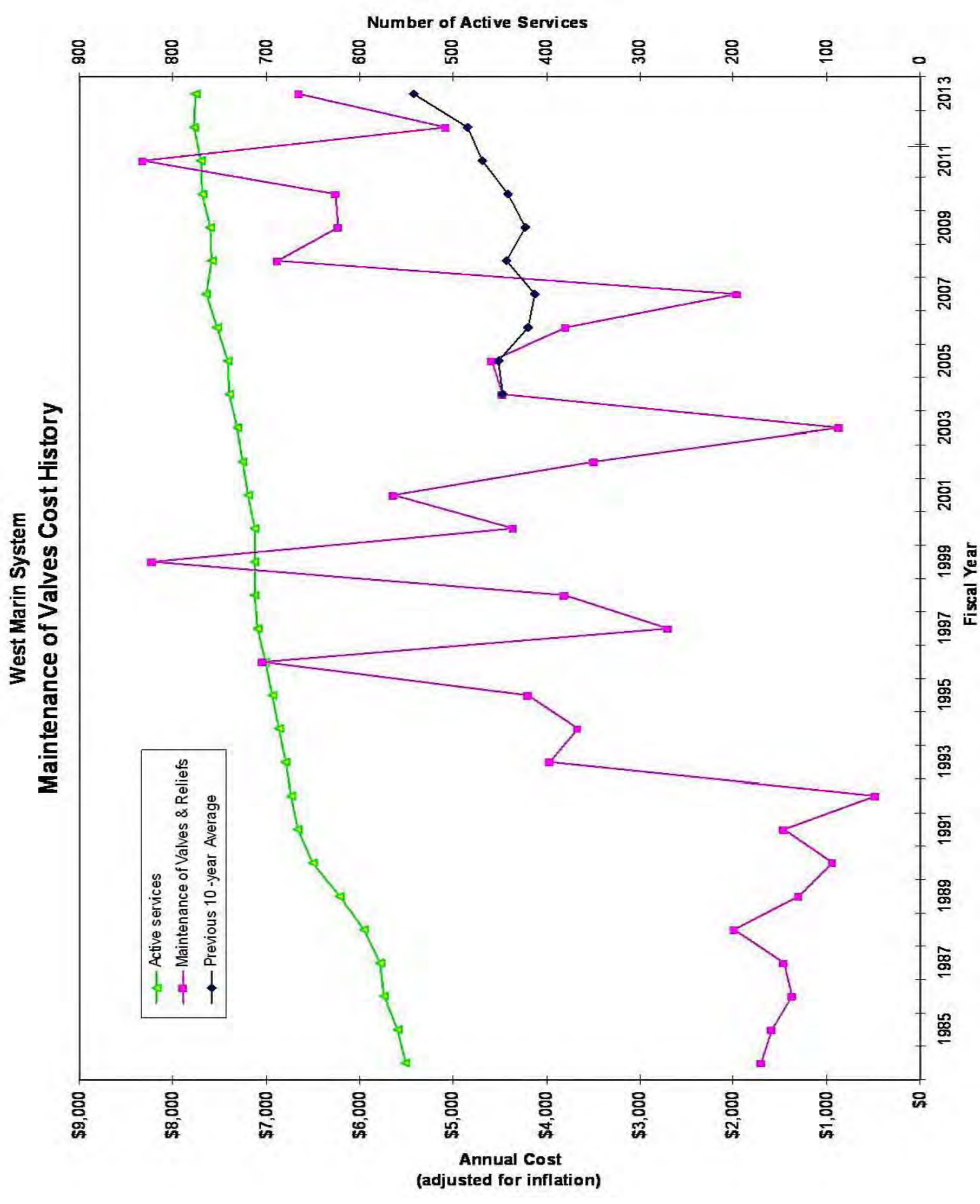


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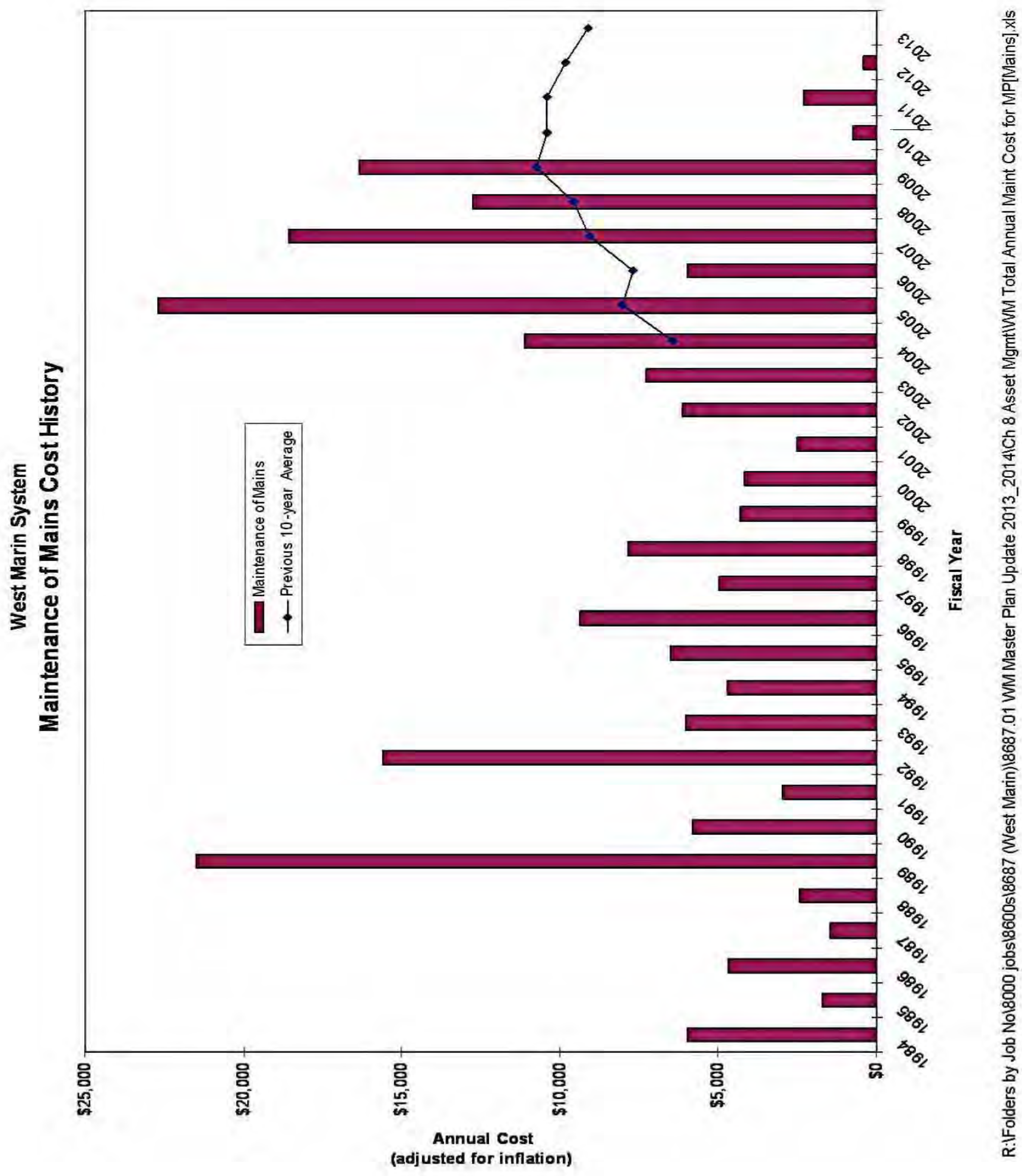
Figure 8-12
Maintenance of Mains Cost History



SECTION 9
EVALUATION OF IMPROVEMENT PROJECTS

SECTION 9

EVALUATION OF IMPROVEMENT PROJECTS

9.1 INTRODUCTION

The capital improvement projects and other studies and investigations that have been identified through this study are summarized in Section 9. All of these projects discussed in this section are included in the Capital Improvement Program presented in Section 10. Cost estimates and project phasing are presented in Section 10.

9.2 PROJECT SUMMARIES

9.2.1 Project Categories

In order to coordinate with the District annual budgeting process, the projects listed herein will be separated by category as shown below:

- *Pipeline Replacements/Additions (CIP budget):*
  Pipeline replacement projects and additional pipelines needed.
- *System Improvements (CIP budget):*
  Improvement projects not specifically related to tanks, pump stations or pipelines.
- *Treatment Plant (CIP Budget)*
  Projects that are related to the Point Reyes Water Treatment Plant.
- *Storage Tanks/Pump Stations (CIP budget):*
  Projects that are related to the storage tanks and pump station facilities.
- *Preliminary Project Engineering and Studies (OPS budget):*
  Engineering studies and investigations that are identified in the Master Plan and may lead to capital improvements at a later date.

Other categories also exist for which specific projects have been identified elsewhere and are not included in this Master Plan. These categories include:

- Water Conservation
- Liability/Safety Modifications

Projects have been identified through several processes, many of which are presented in this Master Plan. Each listed project references the process by which it was found and the Master Plan section where is discussed, using the following codes:

SP - Storage and Pumping Capacity Analysis (section 5)
WQ - Water Quality Evaluation (section 6)
HA - Hydraulic Analysis (section 7)
AM - Asset Management (section 8)
DP - District Planning
CC - County Coordination

9.2.2 Project Timing

Within the CIP list it is necessary to prioritize the projects over the 22-year period until buildout in year 2035. Projects are given a completion goal to identify the urgency with which each project is needed. Each 5-year incremental period (FY 2015, FY 2020, FY 2025, FY 2030, FY 2035) signifies that the project should be included in one or more of the annual budgets for that five year interval. It is expected that the projects within each interval be evaluated at each annual budgeting cycle to determine which year's budget to assign it. The District regularly updates its 2-year and 5-year CIP budget, and this regular review enables the projects to be developed as funds are more available and priorities change. Approval of this Master Plan does not constitute adoption or approval of individual projects. Each project will be considered for inclusion in specific annual budgets. Note that the FY 2015 interval includes only one year (FY 2015).

9.3 PIPELINE REPLACEMENTS/ADDITIONS

Projects within this category fall into two main areas: 1) replacement of existing pipelines; or 2) installation of new pipelines required to improve system operation. Pipeline replacement and pipeline addition improvement projects are shown in Table 9-1.

9.4 SYSTEM IMPROVEMENTS

System improvements include valving projects, installation, repair or replacement of appurtenances, and other non-pipeline, tank or pump station facilities, or those projects related to improving water quality. System improvement projects are shown in Table 9-2.

9.5 PRTP IMPROVEMENTS AND OTHER IMPROVEMENTS

The improvements to existing wells or installing new wells and improvements to the treatment plant are addressed in this section. System improvement projects are shown in Table 9-3.

9.6 STORAGE TANKS AND PUMP STATIONS

Storage tank and pump station projects include storage or pumping capacity additions, tank modifications and pump station modifications, based on the results of the storage and pumping capacity analysis summarized in Section 5, and asset management projects related to tanks and pump stations discussed in Section 8. Capital improvement projects at storage tanks and pump stations are shown in Table 9-4.

9.7 PRELIMINARY PROJECT ENGINEERING AND STUDIES

As a result of initial investigations and evaluations conducted in this Master Plan, several additional engineering studies are recommended to be included in the Studies budget (which were historically CIP projects, but are now funded by the West Marin Operations). These studies are beyond the scope of the master plan or cannot be completed within the time frame of the master plan. These studies may identify additional capital improvement projects that will need to be included in subsequent CIPs. These studies are identified in Table 9-5.

Table 9-1
Pipeline Replacement and Addition Projects

ID #	Project Name & Description	When	Category
Pipeline Replacement Projects			
1a-01	**Replace Aging Galvanized Steel Pipe**	*2025*	*AM*
	Replace 2,152 feet of galvanized steel (GS) pipe, with priority given to the oldest pipe. Replace 500 feet annually from 2020 until the program is completed in FY 2025. Locations tracked in the database " WMPipeCount.xls" which is maintained by the Engr Dept and shown in Appendix C-1.		
1a-02	**Replace 4" main on Bear Valley Road**	*2015*	*HA*
	Replace and upsize 900 feet of 4" main on Bear Valley Road starting from the tank. In order to provide a minimum of 500 gpm fire flow, the main needs to be upsized to 6-inch or 8-inch to avoid negative pressure at the high point at the end of 900 ft.		
1a-03	**Replace All TW Plastic Pipe**	*ongoing*	*AM*
	Replace and upsize 6,100 feet of Thin Wall (TW) 2-inch plastic pipe with priority given to the oldest pipe. Replace 1,000 ft biennially until the program is completed in FY 2027. Locations tracked in the database " WMPipeCount.xls" which is maintained by the Engr Dept and shown in Appendix C-1.		
Pipeline Addition Projects			
ID #	**Project Name & Description**	**When**	**Category**
1c-01	**Replace Polybutylene Service Lines**	*ongoing*	*AM*
	Replace 48 PB services on Sir Francis Drake Blvd and Highway 1. Develop a data base that would eventually replace all PB services with copper in the other areas.		
1d-01	**Relocations to Synchronize with County Projects**	*ongoing*	*CC*
	Relocation of existing District water facilities of County of Marin street improvement projects. Specific projects to be included in each annual CIP as appropriate.		
1d-02	**Install Gallagher Well Pipeline**	*2015*	
	Install approximately 1 mile of 12-inch PVC pipe from Gallagher well to connect to the 6-inch main leading to PRTP near Downey well site		

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Table 9-2
System Improvement Projects

ID #	Project Name & Description	When	Category
2-01	**Replace Untestable Detector Checks**	*ongoing*	*WQ/AM*
	Replace 2 assemblies per year with District-standard assemblies. 6 untestable assemblies are listed in the database "DCVA_WM DB.exl" which is maintained by Maintenance Dept and is shown in Appendix C-5.		
2-02	**Install Flushing Taps at Dead-End Valves**	*ongoing*	*WQ*
	Review dead end valves that need flushing and develop a database. Install 4 taps at dead-end valves bienially		
2-03	**Install Permanent Water Quality Sampling Stations**	*2020*	*WQ*
	Install sample stations at Red Barn (PRS, 510 Mesa Rd), 22 Portola (Inverness Park, PRE-1) and 95 Drakes View (PRE-2).		

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Table 9-3
Pt Reyes Treatment Plant Improvements and Other Improvements

ID #	Project Name & Description	When	Category
3-01	**Replace Well #2 at Coast Guard Site**	*2020*	*WQ/AM*
	Well #2 is nearing the end of its useful life and has decreased in production capacity over the years.		
3-02	**Install Gallagher Well #2**	*2025*	*DP*
	Existing Gallagher well #1 has only 120 gpm capacity. A second well is needed to meet the 300 gpm combined capacity at Gallagher wells to meet the buildout demand.		
3-03	**Pt Reyes Treatment Plant Solids Handling Tank**	*2020*	*SP*
	Constructing a 100,000 gallon solids handling dual concrete tank.		
3-04	**Major PRTP Upgrade**	*2030*	*DP*
	Construct a new Treatment Plant to replace the existing facility that has reached the end of its useful life		
3-05	**Abandon Downey Well**	*2020*	*DP*
	The Downey well is no longer functional and needs to be properly sealed and abandoned per Marin County and State Standards.		

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Table 9-4
Storage Tank & Pump Station Projects

ID #	Project Name & Description	When	Category
4-01	**Add Storage Capacity at Bear Valley Tanks**	*2030*	*SP*
	Construct 65,000 gallon tank and piping modifications (to address zone deficiency of 94,000 gal now and 95,000 gal at buildout).		
4-02	**Add Storage Capacity at Silver Hills (Bear Valley Area)**	*2025*	*SP*
	Construct 30,000 gallon tank and piping modifications (to address zone deficiency of 94,000 gal now and 95,000 gal at buildout).		
4-03	**Inspect and assessment of Pt Reyes Tank #2**	*2020*	*SP*
	Pt. Reyes tank #2 was constructed in 1973 and need assessment of the condition of the tank		
4-04	**Replace 25,000 gallon PRE-1 Tank**	*2025*	*SP*
	Replace PRE-1 Redwood Tank		
4-05	**Replace 25,000 gallon PRE-2 Tank**	*2025*	*SP*
	Replace PRE-2 Redwood Tank		
4-06	**Replace PRE-4A Tank**	*2020*	*AM*
	Replace 25,000 gallon PRE-4A with 80,000 gallon tank		
4-07	**Olema Pump Station Flood Protection and RTU Upgrade**	*2015*	*AM*
	Modify existing structure to prevent flooding of facilities by Olema Creek and RTU upgrade		
4-08	**Recoat Pt Reyes Tank #3**	*2020*	*AM*
	Recoat Pt Reyes Tank #3 .		
4-09	**Emergency Generator Connections**	*2015*	*AM*
	For PRE and Olema Pump Stations		
4-10	**Add Aeration at PRE-2 and Inverness Park Tanks**	*2020*	*WQ*
	Install aeration systems to help reduce THMs in PRE		
4-11	**Install an RTU at PRE-4**	*2020*	*WQ*
	Include with PRE Tank 4-B construction		

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Table 9-5
Preliminary Project Engineering and Study Projects

ID #	Project Name & Description	When	Category
S-01	**Master Plan Update**	*2025*	*DP*
	Update of 2014 Master Plan (every ten years)		
S-02	**Hydraulic Model Development**	*2020*	*DP*
	Study of actual data to calibrate hydraulic model, then use model to predict low fire flow areas.		
S-03	**Prepare Electronic Facility Maps**	*2020*	*DP*
	Convert West Marin Facility Maps to digital format .		

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9.8 PT REYES WATER TREATMENT PLANT IMPROVEMENTS

In 2005, SPH Associates prepared the Point Reyes Water Treatment Plant Upgrade Study to identify feasible capital improvement project alternatives to meet both present and future requirements. The SPH study recommended construction of the following near term improvement projects: (1) Pressure Contact Tank, (2) Third Pressure Filter and (3) Backwash pumps. A pressurized contact tank was constructed in 2007 at a cost of approximately $120,000. In addition, modifications made by NMWD operations staff to improve current backwash operations have negated the need for installation of backwash pumps at this time. Finally, due to reductions in overall peak system demands, the need for a third pressure filter can be delayed into the future. As a case in point, respective average day peak month demands in FY 2004 and FY 2005 were approximately 0.47 MGD and 0.54 MGD. Since the 2009 drought, West Marin Customers have reduced overall consumption by approximately 30 percent resulting in current average day peak month water demands less than 0.35 MGD.

The study does identify significant future long term plant upgrades to improve performance, address salinity intrusion and enhance reliability. The minimum cost for a major plant upgrade (in 2005 dollars) was projected by the SPH report to be $2.8 M. This cost is significant and will need to be paid financed through a combination of grants and loans. This future project is projected to be required on or before 2030 at which time the original Treatment Plant (installed in 1975) will be over 50 years old.

Other necessary near term projects related to the PR Treatment Plant include: (1) a new Solids Handling Tank and (2) rehabilitation of Coast Guard Well No. 2. A new Solids Handling Tank is recommended to eliminate the off-site discharge of filter backwash water. Once constructed, this project would allow for storage of backwash water for re-treatment at the plant and settled solids would be off hauled to a remote location for treatment and disposal. The rehabilitation of Coast Guard Well No. 2 is a similar project to the recently completed Well No.4 installation to replace the old and failing Well No. 3. Although the condition of Well No. 2 (installed in 1973) is not as dire as was the case with Well No. 3, it is acknowledged that the well is over 40 years old and near the end of its useful life.

9.9 LIABILITY/SAFETY MODIFICATIONS

All of the District facilities (pumps, tanks, regulating stations, etc.) are designed to provide security against unlawful entry and/or operation. In recent years, District staff has increased security awareness and made improvements as necessary at its facilities. At the present time, security at tanks has been identified as a risk and a project to alarm access hatches to the SCADA System is planned.

Since the terrorist attacks in September 2001, water utilities have increased awareness of possible threats to the water systems. A vulnerability assessment is recommended for West Marin Water System to define projects for protecting water quality and tank overflow monitoring. Emergency disinfection plans are to be developed to address emergency situations.

9.10 FUTURE DEVELOPMENT

As discussed in Section 4, the average annual demand in the West Marin Water System is projected to increase by up to 43% at buildout in Year 2035. All of the projected new development known at this time will occur within the current existing pressure zones and service areas. Therefore, it is not expected that new pressure zones will be required or that facilities will require extension beyond the current boundaries.

Each of the development projects that come up for review and approval in the future will be evaluated on a case-by-case basis for impacts to the existing water system. The District requires specific projects or system upgrades for domestic water service and fire protection to serve any new development and to bolster the distribution system in the vicinity of the new development. All new construction of water facilities will be governed by District Regulations.

SECTION 10
CAPITAL IMPROVEMENT PLAN

SECTION 10

CAPITAL IMPROVEMENT PLAN

10.1 INTRODUCTION

Section 10 presents the Capital Improvement Plan for water system projects that were identified through this master plan and described in Section 9. Total project costs are developed for each project. The projects are then scheduled for implementation within each five-year incremental period through buildout in year 2035.

10.2 CAPITAL IMPROVEMENT PROJECTS

The capital improvement projects developed through this master plan are presented in Section 9 and separated by classifications which are consistent with the District budget:

- Pipeline Replacement/Additions
- System Improvement Projects
- Point Reyes Treatment Plant Improvements and Other Improvements
- Storage Tank/Pump Station Projects
- Preliminary Project Engineering and Study

Those projects presented in Section 9 were identified by District staff as projects that would provide benefit to the West Marin Water System and should be included in the long-range Capital Improvement Plan for the District.

10.3 PROJECT COST ESTIMATES

Project cost estimates were developed for each capital improvement project described in Section 9. In addition, annual budgets are established for general projects that are not well-defined at the present time.

The following cost estimating criteria serves as the guideline for developing the cost estimates that will be used in the Capital Improvement Plan and as assistance in evaluating developer proposals. Total project cost estimates include the following:

- Baseline construction cost – a conceptual-level estimate of probable construction cost;
- Contingency – added to the construction cost to cover unknowns;
- Design/Construction Management/Administration – non-construction related costs;
- CEQA cost – to cover environmental review (if necessary); and
- Property acquisition – costs to cover easements and property purchases for facilities (if necessary).

Project cost estimates for all capital improvement projects identified in Section 9 are provided in Appendix D-1.

10.3.1 Baseline Construction Costs

Construction costs for new facilities are based on cost curves, engineering judgment, recent bid prices, historical trends and recent District experience, and are not based on detailed engineering design and analysis. Therefore, conceptual-level construction cost estimates are considered to range from approximately –10% to +35% of the expected bid price.

The unit construction costs reflect an Engineering News Record (ENR) construction cost index for the San Francisco Bay Area of 10,894, which represents costs for the 1st quarter 2014. Costs are based on normal construction. Unusual construction must be addressed individually on a project-by-project basis. Contractor overhead and profit costs are included in the baseline construction costs.

10.3.2 Pipelines.

A majority of the projects are pipeline installation and replacement projects. Therefore, it is appropriate to develop unit prices for various pipe diameters constructed in pavement and in non-paved areas. The estimated unit cost of pipelines includes pipe material, trenching (at minimum cover), installation of the pipe, fittings, appurtenances, service connections, backfill, pavement restoration (as applicable), traffic control and testing. Pipeline costs are for PVC C-900 (Class DR14) pipe up to 12 inches in diameter. Pipeline unit prices are shown in Table 10-1.

Table 10-1
Pipeline Unit Prices

Pipe Diameter	PVC Pipe Unit Cost ($/lf)		Steel Pipe Unit Cost ($/lf)	
	In Paved [(1)] Road	In Unpaved Road	Paved Road	Unpaved Road
6	110	95	-	-
8	130	105	-	-
12	170	140	-	-

[(1)] Note: Unit cost for paved roads can increase by $10 to $15 per foot due to increased paving requirements. Application is on a case-by-case basis.

It should be noted that the unit pipeline costs in the 2014 Master Plan include all ancillary items, including line valves, air relief valves, and tie-ins. Previous Mater Plans utilized pipeline unit costs that represented solely pipeline installation costs.

10.3.3 Storage Tanks.

Based on the District's experience with water storage tank construction, tank construction costs cannot be easily developed with cost curves and unit prices. It is possible to determine the tank structure cost with unit prices. However, site limitations, excavation cost, access road cost and other site-specific conditions vary greatly between sites. Therefore, storage tank construction cost estimates will be determined on a project-by-project basis utilizing recent bid prices and conceptual level site-specific estimates of non-structure costs.

10.3.4 Pump Stations.

Pump stations and pumping capacity modifications are unique in nature and conceptual-level cost estimates will be provided on a project-by-project basis.

10.3.5 Construction Contingency

Since site-specific conditions are unknown for projects in the early planning stages in a master plan, a 30 percent construction contingency will be added to each project baseline construction cost to account for unforeseen events and unknown conditions.

10.3.6 Non-Construction Costs

At this preliminary stage of development, the final costs for administration, engineering, construction management are not known. Therefore, a cost equal to 25% of the sum of the baseline construction cost and the construction contingency is applied to the cost estimate to cover these items.

Some projects will require environmental review to comply with the California Environmental Quality Act (CEQA). For those projects that will likely require environmental review, a cost to cover this work is included. Some projects may require purchase of easements or right-of-way. If known during development of the master plan, additional costs are included for those projects.

10.4 CAPITAL IMPROVEMENT PLAN

Placement of projects within the CIP is based on a number of factors, including relative cost in relation to other required projects, timing of new demand, physical need for the project, and equitable distribution of funds for each interval.

In addition, the projects identified in this Master Plan are those associated with the distribution and transmission system. Other projects in the categories listed herein and in other categories as well may be identified by other means and included in the annual budgets as they are developed.

The Capital Improvement Plan is presented in Tables 10-2 through 10-6 in accordance with the appropriate budget categories. The Capital Improvement Plan summary separated by 5-year increments is shown in Table 10-7

Table 10-2
Pipeline Replacements/Additions Projects
Capital Improvement Plan

ID #	Project	Improvement Project Cost ($)				
		FY 2014 to FY 2015	**FY 2016 to FY 2020**	**FY 2021 to FY 2025**	**FY 2026 to FY 2030**	**FY 2031 to FY 2035**
1a-01	Replace Aging Galvanized Steel Pipe			$385,000		
1a-02	Replace 4" main on Bear Valley Road	$191,000				
1a-03	Replace All TW Plastic Pipe		$273,000	$273,000	$273,000	
1a-04	Ongoing Replacement Projects					$250,000
1b-01	Gallagher Well Pipeline	$1,486,000				
1c-01	Replace Polybutylene Service Lines		$48,750	$48,750	$48,750	$48,750
1d-01	Relocations to Synchronize with County Projects	$25,000	$25,000	$25,000	$25,000	$25,000
	Totals	**$1,702,000**	**$346,750**	**$731,750**	**$346,750**	**$323,750**

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Table 10-3
System Improvement Projects
Capital Improvement Plan

ID #	Project	Improvement Project Cost ($)				
		FY 2014 to FY 2015	FY 2016 to FY 2020	FY 2021 to FY 2025	FY 2026 to FY 2030	FY 2031 to FY 2035
2-01	Replace Untestable Detector Checks		$32,500	$32,500	$32,500	
2-02	Install Flushing Taps at Dead-End Valves		$32,500	$32,500		
2-03	Install Permanent Water Quality Sampling Stations		$27,000			
2-04	To be determined (TBD)					$100,000
		$0	**$92,000**	**$65,000**	**$32,500**	**$100,000**

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Table 10-4
Pt Reyes Treatment Plant and Supply Improvements
Capital Improvement Plan

ID #	Project	Improvement Project Cost ($)				
		FY 2014 to FY 2015	FY 2016 to FY 2020	FY 2021 to FY 2025	FY 2026 to FY 2030	FY 2031 to FY 2035
3-01	Replace Well #2 at Coast Guard Site		$300,000			
3-02	Install Gallagher Well #2			$300,000		
3-03	Pt Reyes Treatment Plant Solids Handling Tank		$910,000			
3-04	Major PRTP Upgrade			$2,800,000		
3-05	To Be Determined (TBD)				$200,000	$200,000
	Totals	**$0**	**$1,210,000**	**$3,100,000**	**$200,000**	**$200,000**

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Table 10-5
Storage Tank/Pump Station Projects
Capital Improvement Plan

ID #	Project	Improvement Project Cost ($)				
		FY 2014 to FY 2015	FY 2016 to FY 2020	FY 2021 to FY 2025	FY 2026 to FY 2030	FY 2031 to FY 2035
4-01	Add Storage Capacity at Bear Valley Tanks				$530,000	
4-02	Add Storage Capacity at Silver Hills			$245,000		
4-03	Inspect and assessment of Pt Reyes Tank #2				$10,000	
4-04	Replace 25,000 gallon PRE-1 Tank				$250,000	
4-05	Replace 25,000 gallon PRE-2 Tank				$250,000	
4-06	Replace PRE-4A Tank		$650,000			
4-07	Olema Pump Station Flood Protection and RTU Upgrade	$100,000				
4-08	Recoat Pt Reyes Tank #3		$255,000			
4-09	Emergency Generator Connections	$15,000				
4-10	Add Aeration at PRE-2 and Inverness Park Tanks		$10,000			
4-11	Install an RTU at PRE-4			$20,000		
4-12	To be determined (TBD)					$300,000
	Totals	**$115,000**	**$915,000**	**$265,000**	**$1,040,000**	**$300,000**

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Table 10-6
Preliminary Project Engineering and Study Projects
Capital Improvement Plan

ID #	Project	Improvement Project Cost ($)				
		FY 2014 to FY 2015	FY 2016 to FY 2020	FY 2021 to FY 2025	FY 2026 to FY 2030	FY 2031 to FY 2035
S-01	Master Plan Update			$30,000		$40,000
S-02	Hydraulic Model Development		$25,000			
S-03	Prepare Electronic Facility Maps		$30,000			
	Totals	**$0**	**$55,000**	**$30,000**	**$0**	**$40,000**

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Table 10-7
Capital Improvement Plan Summary[1]

	Category	Improvement Project Cost ($)					
		FY 2014 to FY 2015	**FY 2016 to FY 2020**	**FY 2021 to FY 2025**	**FY 2026 to FY 2030**	**FY 2031 to FY 2035**	**Totals**
1a	Main/Pipeline Replacements	$191,000	$273,000	$658,000	$273,000	$250,000	$1,645,000
1b	Pipeline Additions	$1,486,000					$1,486,000
1c	PB Service Line Replacements	$0	$48,750	$48,750	$48,750	$48,750	$195,000
1d	Relocations to Sync w/ County CIP & New Pipe	$25,000	$25,000	$25,000	$25,000	$25,000	$125,000
2	System Improvements	$0	$92,000	$65,000	$32,500	$100,000	$289,500
3	PRTP Improvements and Other Improvements	$0	$1,210,000	$3,100,000	$200,000	$200,000	$4,710,000
4	Storage Tanks/Pump Stations	$115,000	$915,000	$265,000	$1,040,000	$300,000	$2,635,000
Study	Preliminary Project Engineering and Studies	$0	$55,000	$30,000	$0	$40,000	$125,000
	Totals	**$1,817,000**	**$2,618,750**	**$4,191,750**	**$1,619,250**	**$963,750**	**$11,210,500**

(1) - Target is $25,000/year or $1.25 million/5 years

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APPENDICES

APPENDIX A-1

NORTH MARIN
WATER DISTRICT

999 Rush Creek Place
P.O. Box 146
Novato, CA 94948

PHONE
415.897.4133

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info@nmwd.com

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April 1, 2014

Scott Alber,
Marin County Fire Marshal
P.O. Box 518
Woodacre, CA 94973

Re: West Marin Water System Fire Flow Goals
NMWD File 2 8687.01

Dear Mr. Alber:

This letter is regarding the 2014 West Marin Water System Master Plan Fire Flow Goals. Thank you in advance for your review and comment.

Attached is an expanded Fire Flow and Fire Storage Goals tabulation for your review. Storage capacity goals are the sum of operational and the greater of fire and emergency storage volumes. Operational storage equals 25% of maximum day demand and emergency storage equals 100% of maximum day demand. Fire flow goals are as shown in the tabulation for each pressure zone, and operational and emergency storage needs anticipated at present (2013) and at buildout (year 2035). The buildout storage goals have been derived from regional population and development projections (2001 PRS Community Plan and County wide Plan Update).

The outcome of this analysis is that each pressure zone falls into one of the following categories:

- Current storage capacity exceeds buildout storage needs.
  (Olema and Inverness Park/PRE-1)
- Additional storage needed at buildout is minimal and the deficit is acceptable, no further action recommended.
  (Pt. Reyes Station)
- Additional storage needed at buildout is in a small pressure zone where the existing system is limited and improvement costs are prohibitive. (these are PRE-2, -3 and -4). In this scenario, more storage will be added to the highest pressure zone (PRE-4) and by a cascading system, this storage will be available to the lower PRE zones (PRE-2 and 3).
- Additional storage needed at buildout is substantial and a project has been or will be added to the NMWD Capital Improvement Plan to address this deficiency.
  (Bear Valley and PRE-4 tanks).

Please note that although the tank storage capacities are increased, the pipes are sized for a minimum 500 gpm flow in most areas. A pipe upsizing project is proposed for the Bear Valley Service area to accommodate the aforementioned minimum flow rate.

Please sign the acknowledgment below to confirm this approach is understood and is acceptable.

Sincerely,

Drew McIntyre
Chief Engineer

Attachment

DM:edb
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The above is hereby acknowledged by

This the 15 day of APRIL 2014

By SCOTT D. ALBER Title FIRE MARSHAL

Print or type name

Fire Flow and Fire Storage Volume Goals - West Marin (Current - 2013)

						current (2013)				
Tank/Zone	Tank Capacity (gal)	Estimated Max Day Demand (gal/day)	Area Type	Fire Flow Standard 2001 and 2014	Fire Storage (gal)	Emergency Storage (gal)	Operational Storage (gal) (1)	> of Fire / Emergency Storage (gal) (2)	Total Storage Required (gal) (3)	Additional Storage Required (gal)
Point Reyes Station	580,000	319,052	comm / residential	2000 gpm for 2 hrs	240,000	319,052	79,763	319,052	398,815	-181,185
Olema	150,000	62,122	WUI	1000 gpm for 2 hrs	120,000	62,122	15,531	120,000	135,531	-14,469
Bear Valley	30,000	16,518	WUI	1000 gpm for 2 hrs	120,000	16,518	4,130	120,000	124,130	94,130
Inverness Park/PRE-1	161,500	58,015	WUI	1000 gpm for 2 hrs	120,000	58,015	14,504	120,000	134,504	-26,996
PRE-2	25,000	6,633	WUI	1000 gpm for 2 hrs	120,000	6,633	1,658	120,000	121,658	96,658
PRE-3	38,000	13,655	WUI	1000 gpm for 2 hrs	120,000	13,655	3,414	120,000	123,414	85,414
PRE-4	50,000	19,415	WUI	1000 gpm for 2 hrs	120,000	19,415	4,854	120,000	124,854	74,854
Total	1,034,500	495,411					123,853	1,039,052	1,162,905	128,405

Fire Flow and Fire Storage Volume Goals - West Marin (At Buildout)

						At Buildout FY 2035				
Tank/Zone	Tank Capacity (gal)	Estimated Max Day Demand (gal/day)	Area Type	Fire Flow Standard 2001 and 2014	Fire Storage (gal)	Emergency Storage (gal)	Operational Storage (gal) (1)	> of Fire / Emergency Storage (gal) (2)	Total Storage Required (gal) (3)	Additional Storage Required (gal)
Point Reyes Station	580,000	494,565	comm / residential	2000 gpm for 2 hrs	240,000	494,565	123,641	494,565	618,207	38,207
Olema	150,000	75,173	WUI	1000 gpm for 2 hrs	120,000	75,173	18,793	120,000	138,793	-11,207
Bear Valley	30,000	19,988	WUI	1000 gpm for 2 hrs	120,000	19,988	4,997	120,000	124,997	94,997
Inverness Park/PRE-1	161,500	70,203	WUI	1000 gpm for 2 hrs	120,000	70,203	17,551	120,000	137,551	-23,949
PRE-2	25,000	9,221	WUI	1000 gpm for 2 hrs	120,000	9,221	2,305	120,000	122,305	97,305
PRE-3	38,000	18,982	WUI	1000 gpm for 2 hrs	120,000	18,982	4,746	120,000	124,746	86,746
PRE-4	50,000	26,989	WUI	1000 gpm for 2 hrs	120,000	26,989	6,747	120,000	126,747	76,747
Total	1,034,500	715,122					178,780	1,214,565	1,393,346	358,846

Notes:

(1) 25% of maximum day demand

(2) Due to small systems greater of fire and emergency storage is used

(3) Sum of Operational Storage and greater of Fire/Emergency Storage

Project needed to add storage defficiency

with PRE-4 addtion of 80K gallon tank and the cascading system from higher PRE zone(s), no increase in storage required

APPENDIX D-1

Expanded CIP Table													
By:	Carmela Chandrasekera												
Date:	2/20/2014												
Category	ID#	Project Name	Description	Project Summary	Recommended by	Unit	Qty	Unit Price	Baseline Construction Cost	Contingency	Admin/Design/ CMS	Total Project Cost	Notes
	1a-01	**Replace Aging Galvanized Steel Pipe**	Replace 2,152 feet of galvanized steel (GS) pipe, with priority given to the oldest pipe. Replace 500 feet annually from 2020 until the program is completed in FY 2025. Locations tracked in the database " WMPipeCount.xls" which is maintained by the Engr Dept and shown in Appendix C-1.			ft	2,152	110	$236,720	$71,016	$76,934	$384,670	cost based on unit price for 6" T-10.1
	1a-02	**Replace 4" main on Bear Valley Road**	Replace and upsize 900 feet of 4" main on Bear Valley Road starting from the tank. In order to provide a minimumof 500 gpm fire flow, the main needs to be upsized to 6-inch or 8-inch to avoid negative pressure at the high point at the end of 900 ft.			ft	900	130	$117,000	$35,100	$38,025	$190,125	cost based on unit price for 8" T-10.1
	1a-03	**Replace All TW Plastic Pipe**	Replace and upsize 6,100 feet of Thin Wall (TW) 2-inch plastic pipe with priority given to the oldest pipe. Replace 1,000 ft biennially until the program is completed in FY 2027. Locations tracked in the database " WMPipeCount.xls" which is maintained by the Engr Dept and shown in Appendix C-1.			ft	6,100	110	$671,000	$201,300	$218,075	$1,090,375	baseline cost based on unit price for 6" T-10.1
	1c-01	**Replace Polybutylene Service Lines**	Replace 48 PB services on Sir Francis Drake Blvd and Highway 1. Develop a data base that would eventually replace all PB services with copper in the other areas.			ea	48	2500	$120,000	$36,000	$39,000	$195,000	estimated repl. 2 services/crew day
	1d-01	**Relocations to Synchronize with County Projects**	Relocation of existing District water facilities of County of Marin street improvement projects. Specific projects to be included in each annual CIP as appropriate.									$25,000	
	1d-02	**Gallagher Well Pipeline Project**	Install approximately 1 mile of 12" pipeline from Gallagher well to connect to the 6" main leading to PRTP near Downey well site									$1,400,000	Project Summary
	2-01	**Replace Untestable Detector Checks**	Replace 2 assemblies per year with District-standard assemblies. 6 untestable assemblies and are listed in the database "DCVA_WM DB.exl" which is maintained by Maintenance Dept and is shown in Appendix C-5.			ea	2	10000	$20,000	$6,000	$6,500	$32,500	~$14,000/replacement Novato project (J-1.7007.07)
	2-02	**Install Flushing Taps at Dead-End Valves**	Review dead end valves that need flushing and develop a database. Install 4 taps at dead-end valves bienially			ea	4	5000	$20,000	$6,000	$6,500	$32,500	Novato project J-1.8677.18 ~ total $5,700/location
	2-03	**Install Permanent Water Quality Sampling Stations**	Install sample stations at Red Barn (PRS, 510 Mesa Rd), 22 Portola (Inverness Park, PRE-1) and 95 Drakes View (PRE-2).			ea	3	5500	$16,500	$4,950	$5,363	$26,813	total $5,065/location in Novato project 1.8650.19
	2-04	**TBD**										$100,000	
	3-01	**Replace Well #2 at Coast Guard Site**	Well #2 is nearing the end of its useful life and has decreased in production capacity over the years.			ea	1	185000	$185,000	$55,500	$60,125	$300,625	Well No. 2 repl. Cost was $270k in 2013

Category	ID#	Project Name	Description	Project Summary	Recommended by	Unit	Qty	Unit Price	Baseline Construction Cost	Contingency	Admin/Design/CMS	Total Project Cost	Notes
	3-02	**Install Gallagher Well #2**	second well is needed to meet the 300 gpm combined capacity at Gallagher wells to meet the buildout demand.			ea	1	185000	$185,000	$55,500	$60,125	$300,625	Well No. 2 repl. Cost was $270k in 2013
	3-03	**Pt Reyes Treatment Plant Solids Handling Tank**	Construction of a backwash waste water treatment system to eliminate discharge of untreated backwash water and reclamation of clarified backwash water for recycling.	yes	DJ	ea	1	560000	$560,000	$168,000	$182,000	$910,000	from Project summary
	3-04	**Major PRTP Upgrade**	Construct a new Treatment Plant to replace the existing facility that has reached the end of its useful life			ea	1	2500000	$2,500,000	$750,000	$812,500	$4,062,500	July 2005 $1.9M const cost adjusted to 2014 (31.8% increase)
	3-05	**Abandon Downey Well**	The Downey well is no longer functional and needs to be properly sealed and abandoned per Marin County and State Standards.									$100,000	Estimate from Nor-Cal wells
	4-01	**Add Storage Capacity at Bear Valley Tanks**	Construct 65,000 gallon tank and piping modifications (to address zone deficiency of 94,000 gal now and 95,000 gal at buildout).			ea	1	325000	$325,000	$97,500	$105,625	$528,125	unit price $5/gal (see App D-2)
	4-02	**Add Storage Capacity at Silver Hills (Bear Valley Area)**	Construct 30,000 gallon tank and piping modifications (to address zone deficiency of 94,000 gal now and 95,000 gal at buildout).			ea	1	150000	$150,000	$45,000	$48,750	$243,750	unit price $5/gal (see App D-2)
	4-03	**Inspect and assessment of Pt Reyes Tank #2**	Pt. Reyes tank #2 was constructed in 1973 and need assessment of the condition of the tank									$10,000	assessment by consultant
	4-04	**Replace 25,000 gallon PRE-1 Tank**	Replace PRE-1 Redwood Tank			ea	1	125000	$125,000	$37,500	$40,625	$203,125	unit price $5/gal (see App D-2)
	4-05	**Replace 25,000 gallon PRE-2 Tank**	Replace PRE-2 Redwood Tank			ea	1	125000	$125,000	$37,500	$40,625	$203,125	unit price $5/gal
	4-06	**Replace PRE-4A Tank**	Replace 25,000 gallon PRE-4A with 80,000 gallon tank			ea	1	400000	$400,000	$120,000	$130,000	$650,000	unit price $5/gal (see App D-2)
	4-07	**Olema Pump Station Flood Protection and RTU Upgrade**	Modify existing structure to prevent flooding of facilities by Olema Creek and RTU upgrade	yes	DJ							$100,000	from Project summary
	4-08	**Recoat Pt Reyes Tank #3**	Recoat Pt Reyes Tank #3.			sq ft	13,000	12	$156,000	$46,800	$50,700	$253,500	unit price $12/sq ft-estimates from tank coating contractor (Blastco) & MMWD
	4-09	**Emergency Generator Connections**	For PRE and Olema Pump Stations									$15,000	
3-02	4-10	**Add Aeration at PRE-2 and Inverness Park Tanks**	Install aeration systems to help reduce THMs in PRE									$10,000	
3-03	4-11	**Install an RTU at PRE-4**	Include with PRE Tank 4-B construction									$20,000	
	S-01	**Master Plan Update**	Update of 2014 Master Plan (every ten years)									$30,000	
	S-02	**Hydraulic Model Development**	Study of actual data to calibrate hydraulic model, then use model to predict low fire flow areas.									$25,000	
3-04	S-03	**Prepare Electronic Facility Maps**	Convert West Marin Facility Maps to digital format .			days	23	1000	$23,000	$6,900		$30,000	time estimate by AutoCAD Draftsman (AC)

APPENDIX D-2

Tank Construction and re-coating costs
Prepared By: Carmela Chandrasekera
Date: Jun-14

Construction Projects (total project cost)
NMWD

Year	Job No.	Tank	Description	Tank Material	Size (gal)	Cost*	cost/gallon
2002-2003	2.6259	PRS Tank 1	Replace	Concrete	100,000	$399,707	$4.00
2002-2003	2.6262	PRE #3	Replace	Concrete	38,000	$91,821	$2.42
2007-2008	1.6233.00	Palmer Tank	Replace	welded steel	3,000,000	$2,934,745	$0.98
2007-2008	2.6253.21	IP Tank	Replace	Concrete	30,000	$164,300	$5.48
2008-2009	1.6235.00	Crest Tank	New+ re-coat exteror of ex.	welded steel	500,000	$969,875	$1.94
2011-2012	5.6055.14	Plum Tank	Re-hab	Steel	500,000	612866	$1.23
AVERAGE							$2.67

MMWD (Tank Construction cost only)

Year		Tank		Tank Material	Size (gal)	Cost	Total const. $	Tank $/gal	
2005		Fairfax Manor First		Bolted Steel	20,000	$327,000	$16.35	$2.15	
2007		Sequoia 2		Bolted Steel	51,000	$299,718	$5.88	$2.13	
2005		Monte Mar Vista		Bolted Steel	60,000	$249,202	$4.15	$0.98	
2006		Fair Hills Tank		Bolted Steel	60,000	277,888	$4.63	$1.42	
2007		Tam woods Top		Bolted Steel	80,000	$369,581	$4.62	$1.63	
2006		Kent		Bolted Steel	100,000	$452,500	$4.53	$1.40	
1998		Wilson Way Tank		welded steel	100,000	$493,147	$4.93	$1.80	
2008		Summit Lower Tank		welded steel	100,000	$676,347	$6.76	$3.38	
2008		Oak Manor First Lift		welded steel	100,000	$578,322	$5.78	$2.80	
2008		Beacon Hill		welded steel	100,000	$677,060	$6.77	$2.86	
2009		Slide Gulch		welded steel	100,000	$670,000	$6.70	$3.70	Eng. Est
2007		Sequoia 1		Bolted Steel	114,000	$340,908	$2.99	$1.05	
2005		Scott Tanks		Bolted Steel	120,000	$444,955	$3.71	$1.12	
2009		Cascade		Bolted Steel	120,000	$349,044	$2.91	$1.37	
2008		Friar Tuck Lane Tank		welded steel	125,000	$642,075	$5.14	$2.87	
2002		Corte Madera Top		Bolted Steel	132,000	$235,200	$1.78	$0.59	
2005		Bay Rd		Bolted Steel	132,000	$388,000	$2.94	$0.72	
2006		Marin City Tank		welded steel	200,000	$813,860	$4.07	$1.59	
2004		Oak Woodland		welded teel	230,000	$840,440	$3.65	$1.50	
2009		Sugar Loaf Tank		welded steel	254000	$1,155,000	$4.55	$2.76	Eng. Est
2006		Santa Venetia		welded steel	310,000	$844,450	$2.72	$1.73	
2007		Mt Tiburon Tank		welded teel	590,000	$830,000	$1.41	$0.78	
2002		Spring Lane		welded steel	1,500,000	$1,011,725	$0.67	$0.31	
AVERAGE							$4.68	$1.77	

MMWD Average Costs Based on Tank Type and Size

Total cost WELDED	Total cost BOLTED		tank only WELDED	tank only BOLTED	total cost size <100k gal	size >=100k gal	tank only size <100k gal	size >=100k gal
$4.43	$4.95		$2.17	$1.32	$6.46	$3.05	$2.20	$1.37

NMWD Re-coat Projects

Year	Job No.	Tank	Description	Material	Size (gal)	Cost*	cost/gallon
2003-2004	1.6200.20	Air Base Tank	Re-coat	welded steel	1,000,000	$242,689	$0.24
2008-2009	1.6219.20	Ponti Tank	Re-coat	welded steel	500,000	$314,587	$0.63
2011-2012	1.6206.22	Crest Tank 1 -interior	Re-coat	welded steel	500,000	$176,487	$0.35
AVERAGE							$0.41

Notes:
* Cost from NMWD Job transaction detail records - includes all project costs including design and management
MMWD costs do not include design and other costs (construction costs only)

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APPENDIX D-3

Reference Project	Wilson Way Tank	Corte Madera Top	Spring Lane	Oak Woodland	Monte Mar Vista	Fairfax Manor First	Scott Tanks
Job #	F9903	D9931	D99061	D04028	D03035	D03025	D03034
	WeldedSteel	Bolted Steel	Welded Steel	Welded Steel	Bolted Steel	Bolted Steel	Bolted Steel
	W/ Anchors	W/O Anchors	W/O Anchors	W/Anchors	W/Anchors	W/Anchors	W/Anchors
ign Report Estimate ineer's Estimate rapolated Bid							
Contractor Cost Breakdown	Contractor Cost Breakdown	Contractor Cost Breakdown	Contractor Cost Breakdown	Contractor Cost Breakdown	Contractor Cost Breakdown	Contractor Cost Breakdown	Contractor Cost Breakdown
Capacity (gal)	100,000	132,000	1,500,000	230,000	60,000	20,000	120,000
Bid Date/ Date of the Estimate	11/10/1998	9/27/2000	6/27/2002	9/28/2004	1/24/2005	2/8/2005	3/21/2005
Construction Costs							
Mobilization	$ 7,000	$ 6,500	$ 22,700	$ 29,300	$ 2,500	$ 10,500	$ 8,500
Survey						$ 6,850	
Submittals	$ 6,500						
Clear and Grub Site	$ 13,500		$ 10,500		$ 13,487		$ 10,500
Temp. Tanks		$ 14,163					
Demo Existing TKS	$ 10,250	$ 21,240		$ 47,025	$ 11,102	$ 15,000	$ 21,500
Site Excavation/Grading	$ 55,817	$ 37,116	$ 211,800	$ 45,375	$ 18,095	$ 47,000	$ 56,500
Recompact Site		$ 8,025					
Storm Drainage System	$ 12,500		$ 24,450	$ 52,530		$ 1,500	
Cathodic Protection							
Concrete V-Ditches	$ 3,500						
Water Pipe System	$ 23,250		$ 75,125	$ 75,000	$ 45,494	$ 38,000	$ 58,350
Tank Piping		$ 16,650					
Install Fire Hydrant Offsite		$ 5,525					
Wood Retaining Wall		$ 7,930				$ 35,200	
Pile Wall	$ 36,500		$ 55,515		$ 35,831		
Elect. Controls	$ 47,250	$ 5,736		$ 17,300	$ 18,250	$ 18,000	$ 40,950
Tank Foundation	$ 18,750	$ 18,360	$ 68,750	$ 122,400	$ 16,729	$ 44,611	$ 46,250
Under Tank Fill &Paving	$ 4,100	$ 5,520			$ 3,239		$ 9,575
Site Paving	$ 9,250		$ 23,000	$ 53,900	$ 10,070	$ 22,601	
Sub Grade Roadway	$ 3,400						$ 46,580
Landscaping	$ 32,600	$ 1,830			$ 3,158	$ 16,500	
Site Fencing	$ 21,000	$ 7,320	$ 2,000	$ 16,000	$ 3,750	$ 27,500	$ 11,750
Site Stairs					$ 8,657	$ 750	
Construct Road							
Tank		$ 73,935			$ 58,840	$ 42,988	$ 134,500
Submittals & Engineerin	$ 8,500						
Shop Fabricated Materia	$ 52,000		$ 153,400	$ 98,000			
Tank Construction	$ 84,499		$ 104,850	$ 127,000			
Shop Coating	$ 10,150		$ 45,100				
Field Coating	$ 21,506		$ 155,915	$ 120,000			
Delivery of Tanks	$ 3,300	$ 3,525					
Tank subtotal	$ 179,955	$ 77,460	$ 459,265	$ 345,000	$ 58,840	$ 42,988	$ 134,500
Testing				$ 20,310			
Concrete slope protection			$ 20,500				
Shore, OverExcavation, I	$ 8,025	$ 1,825	$ 38,120	$ 16,300			
Pump Station (break down elswhere)							
5% Contingency for Estimates Only							
Contract Total	$ 493,147	$ 235,200	$ 1,011,725	$ 840,440	$ 249,202	$ 327,000	$ 444,955
COST PER GALLON TA	$ 1.80	$ 0.59	$ 0.31	$ 1.50	$ 0.98	$ 2.15	$ 1.12
OST PER GALLON - T	$ 4.93	$ 1.78	$ 0.67	$ 3.65	$ 4.15	$ 16.35	$ 3.71

Reference Project	Bay Rd	Fairhills	Santa Venetia Bids	Marin City Tank	Kent Woodlands	Mt Tiburon Tank	Sequoia	
Job #	D04023	D04033	D04026	D06024	D05053	D06002	D05052	
	Bolted Steel	Bolted Steel	Welded Steel	Welded Steel	Bolted Steel	Welded Steel	TK-215 Bolted Steel	TK-216 Bolted Steel
	W/O Anchors	W/ Anchors	W/Anchors	W/Anchors	W/ Anchors	w/ anchor	W/ Anchors	W/ Anchors
ign Report Estimate ineer's Estimate rapolated Bid								
Contractor Cost Breakdown	Contractor Cost Breakdown	Contractor Cost Breakdown	Contractor Cost Breakdown	Contractor Cost Breakdown	Contractor Cost Breakdown	Contractor Cost Breakdown	Contractor Cost Breakdown	Contractor Cost Breakdown
Capacity (gal)	132,000	60,000	310,000	200,000	100,000	590,000	114,000	51,000
Bid Date/ Date of the Estimate	4/11/2005	11/8/2005	6/6/2006	7/20/2006	9/21/2006	5/3/2007	9/18/2007	
Construction Costs								
Mobilization	$ 10,000	$ 10,000	$ 35,000	$ 18,000	$ 25,000	$ 8,000	$ 7,000	$ 3,000
Survey					$ 3,000			
Submittals				$ 7,200				
Clear and Grub Site	$ 26,410	$ 4,228		$ 6,000	$ 8,000		$ 13,250	$ 9,250
Temp. Tanks				$ 68,000	$ 20,000			
Demo Existing TKS	$ 16,680	$ 20,100		$ 37,500	$ 20,500		$ 30,600	$ 27,600
Site Excavation/Grading	$ 22,780	$ 5,095	$ 175,800	$ 39,000	$ 10,000	$ 52,000	$ 20,100	$ 13,097
Recompact Site								
Storm Drainage System	$ 30,370			$ 24,360			$ 14,593	$ 5,500
Cathodic Protection	$ 7,850		$ 9,000	$ 5,000				
Concrete V-Ditches								
Water Pipe System		$ 35,700	$ 25,000	$ 72,120	$ 62,500	$ 65,000	$ 25,800	$ 38,500
Tank Piping	$ 18,660	$ 23,500	$ 10,000	$ 6,500			$ 15,482	$ 14,700
Install Fire Hydrant Offsite			$ 5,000					
Wood Retaining Wall					$ 14,000	$ 60,000		$ 16,600
Pile Wall		$ 18,800					$ 20,628	
Elect. Controls	$ 29,930	$ 8,250	$ 31,200	$ 49,800	$ 5,000	$ 75,000	$ 24,100	$ 20,100
Tank Foundation	$ 38,470	$ 26,200		$ 115,000	$ 74,000	$ 65,000	$ 29,800	$ 24,800
Under Tank Fill &Paving	$ 14,350	$ 6,200		$ 11,000			$ 4,721	$ 4,721
Site Paving	$ 21,300			$ 15,000	$ 30,000	$ 47,000	$ 9,200	$ 8,200
Sub Grade Roadway	$ 42,790							
Landscaping		$ 3,158			$ 2,000			
Site Fencing	$ 13,910	$ 23,000	$ 17,000	$ 22,000	$ 35,000		$ 5,850	$ 4,850
Site Stairs		$ 8,657			$ 3,500			
Construct Road								
Tank	$ 94,500	$ 85,000	$ 405,450	$ 187,780	$ 140,000	$ 125,000		
Submittals & Engineerin						$ 33,500		
Shop Fabricated Materia						$ 65,000		
Tank Construction						$ 96,000	$ 119,784	$ 108,800
Shop Coating			$ 31,000	$ 21,600		$ 63,500		
Field Coating			$ 100,000	$ 108,000		$ 75,000		
Delivery of Tanks								
Tank subtotal	$ 94,500	$ 85,000	$ 536,450	$ 317,380	$ 140,000	$ 458,000	$ 119,784	$ 108,800
Testing								
Concrete slope protection								
Shore, OverExcavation, I								
Pump Station (break down elswhere)								
5% Contingency for Estimates Only								
Contract Total	$ 388,000	$ 277,888	$ 844,450	$ 813,860	$ 452,500	$ 830,000	$ 340,908	$ 299,718
COST PER GALLON TA	$ 0.72	$ 1.42	$ 1.73	$ 1.59	$ 1.40	$ 0.78	$ 1.05	$ 2.13
OST PER GALLON - T	$ 2.94	$ 4.63	$ 2.72	$ 4.07	$ 4.53	$ 1.41	$ 2.99	$ 5.88

Reference Project	Tam Woods Top Tank	Summit Lower Tank	Friar Tuck Lane Tank	Oak Manor First Lift	Beacon Hill	Cascade	Sugar Loaf Tank	Slide Gulch
Job #	D07031	D07016	D08004	D06025	D05049	D08045	D08006	D06023
	Bolted Steel	Welded Steel	Welded Steel	Welded Steel	Welded Steel	2-Bolted Steel	Welded Steel	Welded Steel
	W/ Anchors	W/ Anchors	W/ Anchors	W/ Anchors	W/ Anchors	w/o temp tanks	w/o temp tanks	w/ temp tanks
ign Report Estimate ineer's Estimate rapolated Bid						Extrapolated Bid	Engineer's Estimate	
Contractor Cost Breakdown	Contractor Cost Breakdown	Contractor Cost Breakdown	Contractor Cost Breakdown	Contractor Cost Breakdown	Contractor Cost Breakdown	2 at 60,000 gallons	2 at 127,000 gallons	Engineer's Estimate
Capacity (gal)	80,000	100,000	125,000	100,000	100,000	120,000	254,000	100,000
Bid Date/ Date of the Estimate	9/20/2007	7/1/2008	7/22/2008	9/5/2008	10/6/2008	4/28/2009	4/20/2009	10/1/2009
Construction Costs								
Mobilization	$ 26,831	$ 22,000	$ 32,103	$ 32,072	$ 25,000	$ 5,000	$ 55,000	$ 25,000
Survey				$ 3,500				
Submittals								
Clear and Grub Site		$ 10,000		$ 7,000		$ 10,000	$ 20,000	$ 10,000
Temp. Tanks	$ 9,000	$ 5,082	$ 59,662	$ 24,000	$ 10,560			$ 15,000
Demo Existing TKS	$ 7,500	$ 27,810	$ 31,890	$ 15,000	$ 20,000	$ 25,000	$ 25,000	$ 30,000
Site Excavation/Grading	$ 15,500	$ 25,327	$ 65,900	$ 20,000	$ 35,000		$ 20,000	$ 25,000
Recompact Site								
Storm Drainage System	$ 4,000	$ 12,410		$ 7,200	$ 8,200	$ 15,000	$ 15,000	$ 10,000
Cathodic Protection	$ 4,000			$ 4,000	$ 2,500		$ 5,000	
Concrete V-Ditches								
Water Pipe System	$ 20,000	$ 55,134		$ 36,000	$ 26,000		$ 25,000	$ 50,000
Tank Piping		$ 9,803				$ 20,000	$ 20,000	$ 10,000
Install Fire Hydrant Offsite								
Wood Retaining Wall							$ 5,000	
Pile Wall	$ 49,750	$ 56,293		$ 38,000	$ 87,000		$ 80,000	
Elect. Controls	$ 14,500	$ 35,000	$ 25,000	$ 9,500	$ 8,500	$ 25,000	$ 30,000	$ 25,000
Tank Foundation	$ 63,500	$ 32,781	$ 27,900	$ 32,800	$ 145,800	$ 60,000	$ 80,000	$ 35,000
Under Tank Fill &Paving	$ 3,000	$ 20,674		$ 12,000			$ 25,000	$ 20,000
Site Paving	$ 7,000	$ 18,191	$ 35,000	$ 16,000	$ 22,500		$ 25,000	$ 25,000
Sub Grade Roadway								
Landscaping								
Site Fencing	$ 12,500	$ 11,353	$ 6,000	$ 26,500		$ 25,000	$ 25,000	$ 20,000
Site Stairs				$ 13,750				
Construct Road								
Tank	$ 130,000		$ 265,304	$ 200,000	$ 116,000	$ 164,044	$ 700,000	$ 370,000
Submittals & Engineerin		$ 13,580						
Shop Fabricated Materia		$ 175,125						
Tank Construction		$ 62,889			$ 85,000			
Shop Coating								
Field Coating		$ 82,406	$ 93,316	$ 80,000	$ 85,000			
Delivery of Tanks								
Tank subtotal	$ 130,000	$ 334,000	$ 358,620	$ 280,000	$ 286,000	$ 164,044	$ 700,000	$ 370,000
Testing	$ 2,500	$ 2,000		$ 1,000				
Concrete slope protection								
Shore, OverExcavation, I		$ 10,000						
Pump Station (break down elswhere)								
5% Contingency for Estimates Only								
Contract Total	$ 369,581	$ 676,347	$ 642,075	$ 578,322	$ 677,060	$ 349,044	$ 1,155,000	$ 670,000
COST PER GALLON TA	$ 1.63	$3.38	$ 2.87	$ 2.80	$ 2.86	$ 1.37	$ 2.76	$ 3.70
OST PER GALLON - T	$ 4.62	$6.76	$ 5.14	$ 5.78	$ 6.77	$ 2.91	$ 4.55	$ 6.70

APPENDIX D-3

APPENDIX E-1

NORTH MARIN WATER DISTRICT
WATER SYSTEM IMPROVEMENTS/SPECIAL PROJECTS
PROJECT SUMMARY
AS OF March 2013

Job No.	Title:
2.6601.32	PRTP Solids Handling Tank
Facility No. 6601	Facility Type (Pipelines, Pump Stations, etc.) Treatment Plant

Description
Purchasing land, constructing a 100,000 gallon solids handling concrete tank and pipe line extension from PRTP to Four G's property where the tank will be located.
Change 3/11: Railroad Property Purchased, Dual tank design planned.

Project Justification
Point Reyes Water Treatment Plant Upgrade Study by SPH Associates (July 2005) recommended construction of a backwash waste water treatment system to eliminate discharge of untreated backwash water and reclamation of clarified backwash water for recycling.

	Baseline Cost Estimate	Design/ Permit	Constr. Ph. (Original)	Expended to Date	Total Est (3/11)	Total Est (5/12)	Total Est (3/13)		Start	Finish (Est.)	Finish (Actual)
1	Project Development (1)	$20,000		$12,000	$12,000	$12,000	$12,000	Project Dev.	Mar-09	Jun-09	
2	Prelim. Design(2)	$10,000		$10,800	$10,800	$10,800	$10,800	Prelim.	Jul-09	Sep-09	
3	Land Purchase (3)	$250,000		$40,000	$40,000	$40,000	$40,000				
4	Surveying/Mapping	$5,000		$8,000	$8,000	$8,000	$8,000		Jul-09	Aug-09	
5	Geotech. Invest	$5,000		$5,000	$5,000	$5,000	$5,000		Jul-09	Aug-09	
6	CEQA / Permitting	$20,000		$35,600	$20,000	$20,000	**$52,000**	Permitting	Jul-09	Sep-09	Jul-12
7	Final Design	$10,000		$40,000	$30,000	$40,000	**$45,000**	Final Design	Aug-12	Jul-13	
8	Design Phase Staff Costs	$5,000		$17,800	$10,000	$10,000	**$25,000**				
9	Bidding Services	$5,000			$5,000	$5,000	$5,000				
10	Construction(4)&(7)		$327,000		$313,000	$530,000	$530,000				
11	Fence & retaining wall (5)		$75,000		above						
12	Pipe extension (6)		$137,500		Included below	Included above	Included above				
13	Pump		$10,000								
14	Elec. / Mech.		$5,000		$260,000						
15	Const. Admin		$10,000		$20,000	$20,000	$20,000	Construction	Jan-13	Jun-13	
16	Project Closeout		$3,000		$5,200	$5,200	$5,200	Project Closeout	Jun-13	Aug-13	
	Project Subtotal		$567,500		$739,000	$706,000	**$758,000**				
	Project Contingency		$56,750		$100,000	$140,000	**$150,000**				
	Sub-Total	$330,000	$624,250	$169,200	$839,000	$846,000	**$908,000**				
	Grand Total		$954,250								

Notes: **Note revisions in BOLD**

(1) Conceptual Design Report (Job #2.7102.00)
(2) Preliminary Design ($5,000 staff costs, $5,000 consultant)
(3) Purchase of 1.5 acres from Four G's property. (RR Right-a-Way purchased, 1.3 A)
(4) based on estimate for PRE tank #4 100,000 gallon tank (Prelim Est for Concrete Dual tanks)
(5) Fence and Retaining wall estimate from SPH report
(6) Pipe extension from Four G's property to existing PRTP (approx. 1,100 ft x$125) (NOT REQUIRED)
(7) Inserted Construction Cost estimate from Pre-Design Report, HydroScience Engineers.
(8) Added costs due to Coastal Permit - Fees $11,000; LCA $13,000; HSE $8,200

NORTH MARIN WATER DISTRICT
WATER SYSTEM IMPROVEMENTS/SPECIAL PROJECTS
PROJECT SUMMARY

COMPLETED BY: **Robert Clark** Updated by: David Jackson
DATE: 3/5/2012 Date: 3/18/2014

SERVICE AREA: ☐ **NOVATO** **X WEST MARIN** ☐ **OCEANA MARIN**

Job No. | Title: Olema PS Flood Protection & RTU upgrade
2.6130 | Facility Type: Pump Station

Description: Raise the building above flood level and replace RTU.

Project Justification: The Olema Pump station has flooded every year during heave winter rains. The flood level is 18"-24" AFF prohibiting staff from entering site for service. The intent is to use reinforced concrete blocks to raise the foundation and build a retaining wall around the building and back fill adjcent area for safe vehicle access. The RTU has failed twice over the past three years and TESCO recomends a full replacement. The cost is 5x the Automation Direct unit to replace. Over the years we have not had communications failures during the winter rains and have had to trouble shoot to make repairs we need to locate the damagend section of cable and make repairs to save time and money and annual down time..

Baseline Cost Estimate	Initial (03/12)	Updated (3/13)	Updated (3/14)	Expended to Date	Baseline Schedule	Start	Finish (Est.)	Finish (Actual)
Project Dev.			$ 5,000	$5,000.00	Project Dev.	07/01/13		02/01/14
Design	$ 1,000	$ 5,000	$ 13,000	$ 300.00	Design	03/15/14	05/30/14	
Permitting					Permitting			
Land					Procurement			
Procurement	$ 9,000	$ 15,000	$ 10,000		Construction	06/01/14	09/30/14	
Construction	$ 15,000	$ 65,000	$ 55,000					
Const. Admin.		$ 5,000	$ 2,000		Project Closeout			
Project Closeout		$ 2,000	$ 2,000					
Project Contingency		$ 8,000	$ 13,000					
Total	$ 25,000	$ 100,000	$ 100,000					

NORTH MARIN WATER DISTRICT
WATER SYSTEM IMPROVEMENTS/SPECIAL PROJECTS
PROJECT SUMMARY
AS OF 4/23/2014 - Invoice 1 Prop 50

Job No. 2.7087		Title: **Gallagher Well Pipeline**– West Marin
Facility No.		Facility Type (Pipelines, Pump Stations, etc.): Pipeline & other

Description
Project involves Gallagher pipeline final design (~~7,200~~ **5,200** ft of 12" pipeline), Environmental and Geotechnical review, Permitting, Construction and contract administration costs and ~~installing 3 new wells at Gallagher~~. rehabilitation of existing Gallagher well.

Project Justification:
Lagunitas Creek Salinity Intrusion Study (1998) prepared by Soldati Engineering Services recommended that the District construct a pipeline to the existing Gallagher well for additional supply or for blending with the Coast Guard supply. One is currently at the site with a reliable capacity of approx. 120 GPM. It is assumed that additional wells at Gallagher are required to provide a fully redundant 700 GPM well field. **(which will be a future project(s)**

Baseline Cost Estimate	**2007 (Est.) $**	**2014 (Est.) $**	**Expended To Date $**	**Baseline Schedule**	**Start**	**Finish (Est.)**	**Finish (Actual)**
Project Dev.		13,000	12,627	Project Dev.	2007		Feb-13
Design (1)	115,000	100,000	80,397	Design	Mar-13	Oct-13	Feb-14
Geotechnical Review & Testing(2)*	30,000	40,000	9,900	Geotechnical Review			
Environmental Review(3)	15,000	25,000	17,161	Environmental Review		2009	
Encroachment Permit(4)	65,832	5,000		Permitting			
Grant funding and Pre-Const.project admin(5)	30,800	18,000	10,500	Bid Phase			
Construction(6)	856,000	1,040,000		Construction		Oct-14	
Material(6a)		[redacted]					
CM/Inspection.(7)	60,000	60,000		Project Closeout			
Wells (8)	241,200	70,000	70,316				
Admin/Design Support(9)	27,000	20,000					
Project Closeout(10)	12,000	13,000				Dec-14	
Project Contingency(11)	219,440	57,000					
Total	1,672,272	1,486,000	$200,901				

Comments:
(Note: for the 2007 Cost Estimate, the original 1999 costs were inflated to represent current (2007) costs based on San Francisco Construction Cost Index published in Engineering News Record. CCI (Dec. 1998) = 6845.6, CCI (Dec, 2007) = 9131.8. Increase in costs= 9131.8 / 6845.6 =1.3339.). The following represents 2013

(1) 10% of construction cost - CSW bridge crossing design and NMWD eng.
(2) Material testing and geotech services estimate including geotech report. expended ($9,900 from.01)
(3) Consultant for CEQA + SWPPP. expended are all AP costs in 2.7087.00.
(4) Estimate County Encroachment Permit
(5) 2% of construction cost for Staff costs for funding application preparation, plan check, includes topo survey, bid evaluation and general pre-design project administration. expended cost is topo survey ($10,500 from .01).
(6) Current construction cost updated after bid opening ($1,039,858)
(7) NMWD Inspection cost.
(8) 2007 estimate for two additional wells. 2014 estimate is only for rehabilitation of existing well and permitting (Auxiliary gage).
(9) Engineering svcs during construction plus overall admin.
(10) 1.5% of construction. Includes As-built drawings and close out
(11) 12.5% Contingency based on Construction cost only

Prop 50 Grant Funding Categories: Invoice 1 - Prop 50
yellow -preliminary costs ($120,504); blue-engineering costs ($80,397); green-equipment costs