City of Arroyo Grande
Water System Master Plan
December 2012

The Arroyo Grande Water Master Plan was prepared under the direction of the following registered Civil Engineers:

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RESOLUTION NO. 4506

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF ARROYO GRANDE ADOPTING THE 2012 WATER MASTER PLAN UPDATE AND THE 2012 WASTEWATER MASTER PLAN UPDATE

WHEREAS, the City of Arroyo Grande has updated the 2012 Water Master Plan and the 2012 Wastewater Master Plan; and

WHEREAS, the City Council has reviewed this project in compliance with the California Environmental Quality Act (CEQA), the State CEQA Guidelines, and the Arroyo Grande Rules and Procedures for Implementation of CEQA and has reviewed the Draft Mitigated Negative Declaration prepared for the project.

NOW, THEREFORE, BE IT RESOLVED, that the City Council of the City of Arroyo Grande hereby adopts the 2012 Water Master Plan Update and the 2012 Wastewater Master Plan Update and the Mitigated Negative Declaration prepared for the project and directs the City Clerk to file a Notice of Determination.

On motion by Council Member Brown, seconded by Council Member Guthrie, and by the following roll call vote, to wit:

AYES: Council Members Brown, Guthrie, Costello, and Mayor Ferrara
NOES: None
ABSENT: Council Member Ray

the foregoing Resolution was passed and adopted this 22nd day of January 2013.

TONY FERRARA, MAYOR

ATTEST:

KELLY WETMORE, CITY CLERK

APPROVED AS TO CONTENT:

STEVEN ADAMS, CITY MANAGER

APPROVED AS TO FORM:

TIMOTHY J. CARMEL, CITY ATTORNEY

OFFICIAL CERTIFICATION

I, KELLY WETMORE, City Clerk of the City of Arroyo Grande, County of San Luis Obispo, State of California, do hereby certify under penalty of perjury, that the attached Resolution No. 4506 is a true, full, and correct copy of said Resolution passed and adopted at a Regular meeting of the City Council of the City of Arroyo Grande on the 22nd day of January 2013.

WITNESS my hand and the Seal of the City of Arroyo Grande affixed this 23rd day of January 2013.

Kelly Wetmore

KELLY WETMORE, CITY CLERK

Table of Contents

LIST OF TABLES vii

LIST OF FIGURES ix

EXECUTIVE SUMMARY 1

Introduction 1

Scope of Study 1

Section 1 - Introduction and Overview 3

1.1 Land Use and Population 3

1.2 Water Demand 3

1.3 Water Supply 3

1.4 Water Storage 4

1.5 Water Distribution 4

1.6 Water Quality 4

1.7 Operations and Control 4

1.8 Recommendations and Capital Improvements 5

Section 2 - Land Use and Population 7

2.1 Land Use 7

2.2 Population 9

Section 3 - Water Demand 15

3.1 Historical Demand 15

3.2 Water Demand Factors 17

3.3 Peaking Factors 19

3.4 Future Demand 20

Section 4 - Water Supply 23

4.1 Ground Water 23

4.1.1 The Santa Maria Valley Groundwater Basin 23

4.1.2 The Pismo Foundation 24

4.1.3 Water use of Agriculture inside the City Limit 25

4.2 Surface Water 33

4.3 Recycled Water 33

4.4 Future Water Supplies 34
4.4.1 Supply Redundancy 35
4.4.2 Supplemental Water Supplies, Transfers, and Exchanges 36
4.4.3 Oceano Community Service District (OCSD) 36
4.4.4 Surplus water from Lopez 36
4.4.5 Lopez Reservoir Spillway Raising 36
4.4.6 Supplemental State Project Water via the Coastal Branch and Lopez Pipelines 37
4.4.7 Additional Storm Water Reclamation 37
Section 5 - Water Storage 39
5.1 Existing Facilities 39
5.2 Storage Analysis 41
5.2.1 Emergency storage 41
5.2.2 Fire storage 41
5.2.3 Operational storage 42
Section 6 - Water Distribution 51
6.1 Existing Facilities 51
6.2 Design Requirements 52
6.3 Water System Modeling 53
6.3.1 System Mapping Update 53
6.3.2 Elevation Data 53
6.3.3 Customer Demand Data 53
6.3.4 Analysis of Current and Buildout Acreages 54
6.3.5 Geospatial Allocation of Demands 55
6.3.6 Calculation of Land Use Demand Factors 56
6.3.7 Water Model Calibration 56
6.3.8 Water System Evaluation 57
Section 7 - Water Quality 59
7.1 Groundwater 59
7.2 Disinfection 59
7.2.1 Chloramines 60
7.2.2 Nitrification 60

7.3 Water Quality Summary 61
Section 8 - Operations and Controls 63
8.1 Main City Zone 63
8.2 High Pressure Zones 63
8.3 Supervisory Control and Data Acquisition System (SCADA) 63
Section 9 - Recommendations and Capital Improvements 65
9.1 Data Collection and Field Investigations 65
9.2 Mapping, Population, Land Use and Demand Projections 65
9.3 Water Quality and Supply Evaluation 66
9.4 Water Distribution Hydraulic Analysis 66
9.5 SCADA System Evaluation 66
9.6 Cost Preparation 66
9.7 Water System Program Summary 68
9.8 Water System Project Descriptions 75
Project A-1 - Leanna Drive Creek Crossing Upgrade 77
Project A-2 - SCADA Radio Upgrades 81
Project A-3 - Reservoir 3 and 4 Coating and Seismic Evaluation 83
Project A-4 - Phased Mains Replacement – Fair Oaks 89
Project A-5 - Reservoir 7 93
Project A-6 - Galvanized Service Replacements (25 per year) 97
Project B-1 - Reservoir 5 Coating Project 101
Project B-2 - Coach Road and Garden Street Pipe Bridges Evaluation 105
Project B-3 - SCADA Software/Electronics Upgrade 109
Project B-4 - Highway 101 Crossing Upgrade- El Camino Real to West Branch Street 111
Project B-5 - Highway 101 Crossing Upgrade- West Cherry Ave 115
Project B-6 - Phased Mains Replacements 119
Project B-7 - Le Point Area Main Upgrades 125
Project B-8 - Well Evaluation and Rehabilitation 135
Project B-9 - Galvanized Service Replacements (25 per year) 139
Project B-10 - Lierly Lane to Coach Road Upgrade 143
Project B-11 - Well 4 Minor Rehabilitation 147

Project B-12 - Well 5 and 8 Maintenance 151
Project B-13 - Well Siting Study 155
Project C-1 - New Well 157
Project C-2 - Miller Way Booster Zone Upgrade 161
Project C-3 - Security Upgrades 167
Project C-4 - Coach Road and Greenwood Drive Upgrades 169
Project C-5 - Reservoir 1 Solar PV 175
Project C-6 - Galvanized Service Replacements (25 per year) 177
Project C-7- 4-inch Mains Upgrade 181
Project C-8 - Phased Mains Replacements 207
Project C-9 - Routine Reservoir Maintenance 217
REFERENCES 221
APPENDIX A – Land Use and Zoning Descriptions 223
APPENDIX B – Planning and Evaluation Criteria 227
Water System 227
Sewer System 231
APPENDIX C – Planning and Evaluation Criteria 235
Background 235
Service Area 236
Current Service Area Population 238
Historical Population 239
Projected Population 239
APPENDIX D – Water Supply 241
Executive Summary 241
Supply Sources 242
Groundwater 244
Supply Reliability 250
Supply Redundancy 251
APPENDIX E – Water System Model Development 253
System Mapping Update 254
Elevation Data 254

Customer Demand Data 255
Geospatial Allocation 255
Land Use Demand Factors 256
Water Model Calibration 260
Water System Evaluation 261
Hydrant Testing Datasheets 262
Model Calibration Summary Table 278
APPENDIX F – Well Condition Based Assessment 279
Executive Summary 279
Energy Usage 281
Specific Capacity 287
Remaining Useful Life (RUL) 290
Production Capacity 295
Special Considerations 297
Results 298
Well Inventory Forms (Well 1, 3, 4, 5, 7, 8, 9 and 10) 304
APPENDIX G – Water Quality Assessment 335
Groundwater 335
Disinfection 336
Chloramines 336
Nitrification 337
Water Quality Summary 337
APPENDIX H – Renewable Energy Opportunities 341
Summary of Energy Generation 342
Assumptions and Method 343
Calculating System Size 343
Estimating AC Power 343
Estimating Annual Electricity Generated 343
Financial Considerations 344
Detailed Table of Results 345

LIST OF TABLES

Table 2.1 - Land Use Designations 8
Table 2.2 - Existing and Projected Land Use Distribution 9
Table 3.1 - Historical Water Demand 16
Table 3.2 - Water Demand Factors 18
Table 3.3 - Peaking Factors 20
Table 3.4 - Future Water Demand – By Acreage 21
Table 4.1 - Historical Water Supply 23
Table 4.2 - Existing Well Summary 27
Table 4.3 - Historical and Project Water Use 34
Table 4.4 - Future Water Supply 35
Table 4.5 - Supply Redundancy 36
Table 5.1 - Existing Storage Facilities 40
Table 5.2 - Storage Requirements 43
Table 5.3 - Build-Out Total Storage Requirements 43
Table 6.1 - Existing Pipeline Inventory 51
Table 6.2 – Existing Booster Station Inventory 52
Table 6.3 - Hazen William Friction Factors 57
Table 7.1 - 2010 Water Quality Summary 62
Table 9.1 - Water System Project Summary 68
Table 9.2 - Rancho Grande Zone Buildout Total Storage Requirements 93
Table 9.3 - Rancho Grande Zone Buildout Operational Storage Requirements 94
Table 9.4 - Cast Iron Mains for Phased Replacement 120
Table 9.5 – Le Point Area Main Upgrades 126
Table 9.6 - Well Video Inspection Records 136
Table 9.7 - Installation Date and RUL of Well 4 Components 147
Table 9.8 - Specific Capacity Data 148
Table 9.9 - Supply Redundancy Analysis Results 155
Table 9.10 - Supply Redundancy Analysis Results 157
Table 9.11 - Well Casing Estimated Remaining Useful Life 158
Table 9.12 - 4-inch Mains for Upgrade 182
Table 9.13 - Cast Iron Mains for Phased Replacement 208
Table 9.14 - Reservoir Summary 218
Table 9.15 - Reservoir Maintenance Schedule for 2012-2021 219
Table 9.16 - Reservoir Maintenance Schedule for 2022-2031 220

LIST OF FIGURES

Figure 2-1 – Land Use Map 11
Figure 2-2 – Zoning Map 13
Figure 4-1 Santa Maria Groundwater Basin Adjudication Boundaries 26
Figure 4-2 - Well Locations associated with the Arroyo Grande Groundwater Basin 29
Figure 4-3 Well locations associated with the Pismo Formation 31
Figure 5-1 Existing Water Distribution System 45
Figure 5-2 Pressure Zones and Distribution System Profile 49
Figure 9-1 – Water System Capital Improvements 71
Figure 9-2 - Exposed creek crossing from Leanna Drive 78
Figure 9-3 - Leanna Drive Creek Crossing Upgrade 79
Figure 9-4 - Reservoir 3 Interior Coasting (2003) 84
Figure 9-5 - Reservior 3 Exterior Coasting (2011) 84
Figure 9-6 - Reservoir 4 Interior Coating (2003) 85
Figure 9-7 - Reservoir 4 Exterior Coating (2003) 86
Figure 9-8 - Tuberculation in Removed Old Cast Iron Pipe 90
Figure 9-9 - Reservoir 5 Interior Coating (2003) 102
Figure 9-10 - Reservoir 4 Exterior Coating (2011) 102
Figure 9-11 - Coach Road and Garden Street Pipe Bridge Rehabilitation 106
Figure 9-12 - Highway 101 Crossing Upgrade-El Camino Real to West Branch Street 112
Figure 9-13 - Highway 101 Crossing Upgrade-West Cherry Avenue 116
Figure 9-14 - Tuberculation in Removed Cast Iron Pipe 120
Figure 9-15 - Phased Mains Replacement 121
Figure 9-16 - Tuberculated Cast Iron Pipe 125
Figure 9-17 - Le Point Area Main Upgrades 127
Figure 9-18 - Lierly Lane to Coach Road Main Upgrade 144
Figure 9-19 - Corrosion of Well 4 Discharge Piping 148
Figure 9-20 - Corrosion on Well 5 Piping 152
Figure 9-21 - Gamma ProMinent Chemical Pump at Well 8 152
Figure 9-22 - Miller Way Booster Station Exterior 162
Figure 9-23 - Miller Way Booster Station Roof 162
Figure 9-24 - Miller Way Booster Station Mechanical Equipment 163
Figure 9-25 - Miller Way Bladder Tanks 163
Figure 9-26 - Coach Road and Greenwood Drive Upgrades 170
Figure 9-27 - Reservoir 1 175
Figure 9-28 - 4 Inch Mains Upgrade 183
Figure 9-29 - 4 Inch Mains Upgrade 184

Figure 9-30 - 4 Inch Mains Upgrade 185
Figure 9-31 - 4 Inch Mains Upgrade 186
Figure 9-32 - 4 Inch Mains Upgrade 187
Figure 9-33 - 4 Inch Mains Upgrade 188
Figure 9-34 - 4 Inch Mains Upgrade 189
Figure 9-35 - 4 Inch Mains Upgrade 190
Figure 9-36 - 4 Inch Mains Upgrade 191
Figure 9-37 - 4 Inch Mains Upgrade 192
Figure 9-38 - 4 Inch Mains Upgrade 193
Figure 9-39 - 4 Inch Mains Upgrade 194
Figure 9-40 - Tuberculation in Removed Old Cast Iron Pipe 208
Figure 9-41 - Phased Mains Replacement 209
Figure 9-42 - Phased Main Replacements 210

EXECUTIVE SUMMARY

Introduction

The City of Arroyo Grande (City) provides potable water and fire suppression for residential, commercial, and institutional buildings within the City. According to the State of California, Department of Finance, the 2011 population was approximately 17,291 is expected to increase to 20,000 at build-out within the existing city limit. As older infrastructure is replaced and new development projects are constructed, it is the City's intent to construct water improvements consistent with the ultimate needs of the system and the available water supply. This requires an evaluation of the existing water supply and identifying capital improvements projects (CIP) that are necessary for to meet the future needs of the City. In order to facilitate this goal, the City contracted with Water Systems Consultants (WSC), Inc. to update the hydraulic model of the water distribution system.

The Water Master Plan update was prepared to be consistent with the City General Plan and General Plan Update. Land use and population data were examined in detail along with historical water demand to establish future service requirements. The recommendations contained in this report will be reviewed periodically to ensure they continue to be consistent with current code requirements and population projections.

Scope of Study

The scope of the study included the following:

1. Review the current Land Use Element of the City General Plan for land use zoning and population distribution within the City limits.
2. Identification of the water use characteristics of the developed and undeveloped land areas for both existing and future build-out.
3. Evaluation of the adequacy and reliability of existing water supplies including ground water, Lopez reservoir water, and reclaimed storm water to meet the ultimate water demand, and identify potential future supply sources.
4. Review of historical production and consumption records to estimate existing average day, maximum day, and peak hour demands.
5. Review of Fire Department requirements and other applicable codes to determine the required fire flow and duration according to land use zoning.
6. Estimation of the water supply and distribution requirements at build-out for average day, maximum day, and peak hour demands.

7. Evaluation of the existing water storage system in the City and recommend water storage improvements to meet the ultimate build-out of the system.
8. Development of a computer model of the existing and proposed water systems in order to evaluate the adequacy of the distribution infrastructure.
9. Calibration of the distribution model with fire hydrant field tests conducted throughout the City in coordination with the Fire Department.
10. Utilize existing water atlas information to prepare a comprehensive system map of the existing and ultimate water infrastructure.
11. Identification of existing system deficiencies based on the calibrated computer model and build-out flow requirements. Where deficiencies are found, recommend corrective improvements to the system.
12. Evaluation for future transmission and distribution mains to meet the ultimate system requirements.
13. Preparation of budget level cost estimates for all recommended capital improvements.
14. Prioritization of recommended improvements in coordination with City staff.
15. Review of past and current water conservation programs developed by the City and recommendations for future conservation efforts.
16. Discussion of water quality issues associated with existing groundwater wells as they relate to applicable State Health requirements and system operation.
17. Discussion of the status of the existing Supervisory Control and Data Acquisition (SCADA) system and identify future improvements required to meet the ultimate needs of the system.

Section 1 - Introduction and Overview

Chapter 1 summarizes the study that was performed, and briefly presents recommendations for a program of water system improvements to accommodate the build-out needs of the City.

1.1 Land Use and Population

The land use patterns utilized in this study are based on the 2010 Update of the Land Use Element contained within the Arroyo Grande General Plan and on current or pending changes to this plan associated with the General Plan Amendment process. The 2010 population of the City was 17,252 according to the 2010 U.S. Census Bureau; however, 329 residents inside City limit are served by OCSD Water and 22 residents outside city limits are served by City Water. Therefore, the City currently serves water to a population of 16,945 residents. According to the 2010 Update of the Long Range Planning Report, the population of the City is expected to grow from its current level of approximately 17,252 residents to 20,000 residents at build-out. The infrastructure improvements recommended in this document provide for the ultimate build-out of the City.

1.2 Water Demand

In the water demand analysis, historical water production and consumption records were related with land use zoning to obtain future design factors. These factors were applied to future development to assess the build-out average daily water demand. Historical periods of high water use including the maximum day demand and peak hour demand were also used to assess the future peak usage. Unaccounted for water in the City is generally below 5%, which is considered good performance.

In 2011, the City purchased and produced a total of 2,922 acre-feet of water, with a maximum day demand of 5.45 million gallons. Based on the demand study, the anticipated maximum day demand will be 5.96 million at build-out.

1.3 Water Supply

The water supply analysis compares the existing and future water demand requirements to water supply capabilities. The City receives water from both groundwater and surface water. Groundwater is extracted primarily from the Arroyo Grande Plain of Tri-Cities Mesa sub-basin of the Santa Maria Groundwater Basin. In addition to groundwater, the City receives surface water from the Lopez Reservoir project, which provides a contractual supply of 2,290 acre-feet.

The City has a variety of water sources including groundwater, local surface water, and ponded storm water used for groundwater recharge, irrigation and construction water. The City has completed multiple studies of potential supplemental water supply sources including an extension of the

Nacimiento Pipeline, desalination, recycled water, and State Water Project water from the County. These studies are discussed further in Section 3.0 of the 2010 Urban Water Management Plan.

1.4 Water Storage

The City currently operates six (6) storage reservoirs, which are capable of storing a total of 6.70 million gallons. A storage analysis was prepared to analyze the existing and future storage needs in terms of operational, fire suppression, and emergency storage. In 2004, in order to meet storage needs, the City replaced Reservoir No. 1 (0.75 MG) with a new 2.0 MG reservoir to furnish a total volume of 5.00 MG in the Main Zone. In 2011, the construction of Reservoir No. 6 (.25 MG) was completed, increasing the total storage volume for the Oro Pressure Zone 0.50 MG - Reservoir 6 (0.25 MG) and Reservoir 3 (.25 MG). It is recommended that the City construct Reservoir 7 with a nominal operational volume of 500,000 gallons.

1.5 Water Distribution

The City's water service area population includes residents of nine (9) water service connections outside of City limits and excludes residents of 138 connections served by Oceano Community Service District in an area located in the southwest portion of the City limits. All connections to the City's water system are metered, and there are no agricultural or industrial connections.

A model of the water system was developed and calibrated as part of the update. The model was used to evaluate existing water system performance and examine alternatives for future modifications. The model and field testing indicated that the existing water distribution system meets minimum flow and pressure requirements.

Improvement projects were identified and modeled to address the identified deficiencies where residents within the City do not have adequate water pressure under normal demand conditions. Recommendations are also provided to meet build-out demands and adequate looping to enhance the reliable of the system in the future.

1.6 Water Quality

The City of Arroyo Grande consistently meets applicable water quality standards. The City has not had a primary violation in over 20 years.

1.7 Operations and Control

The City system operates automatically based on tank level and user demand. Operations personnel can control and track critical system parameters at a centralized location through the Supervisory Control and Data Acquisition (SCADA) system. Recommendations are provided to renovate the SCADA system.

1.8 Recommendations and Capital Improvements

The recommendations resulting from this study are summarized in the following chapters. A prioritized capital improvement program was assembled, and project costs were estimated. The capital improvements are summarized below:

Priority A – 5-Year Projects	$2,506,200
Priority B – 15-year Projects	$6,070,750
Priority C – 25-Year Projects	$8,162,450
TOTAL	$16,739,400

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Section 2 - Land Use and Population

2.1 Land Use

The City of Arroyo Grande is located in the Southern portion of San Luis Obispo County along the banks of the Arroyo Grande Creek. The City, a general law entity, currently incorporates 5.45 square miles of land area with primarily residential and agricultural land uses. The City's distinctive character derives from its traditional ties to agriculture, physical diversity, unique village, small town atmosphere, and rural setting. The 2010 population of the City was 17,252 according to the 2010 U.S. Census Bureau; however, 329 residents inside City limit are served by OCSD Water, and 22 residents outside city limits are served by City Water, therefore, the City currently serves water to a population of 16,945 residents. According to the 2010 Update of the Long Range Planning Report, the population of the City is expected to grow from its current level of approximately 17,252 residents to 20,000 residents at build-out. The Land Use zones within the City are established by the Land Use Element (LUE) of the General Plan, which was last updated in 2001. As part of this report, WSC coordinated with City planning staff to identify the following for undeveloped areas:

- Maximum density per current zoning
- Approved development plans with proposed densities
- Approved tentative tract maps with proposed densities

It is anticipated that the LUE will be updated in the near future. In order to reflect proposed changes in zoning and density associated with the General Plan Update process, planning staff indicated areas with proposed density increases or zoning changes. In general, the land use and density creating the highest overall water demand was assumed. As a result, the demand calculations should be valid for both the current and updated General Plan.

It is recommended that the Master Plan be updated approximately every ten (10) years to reflect proposed land use changes. The distribution of Land Use Zones, in accordance with the LUE and approved zoning changes, is categorized in Table 3-1 and shown in Figure 3-1.

In order to facilitate an analysis of the water demand characteristics of the different zoning designations, zones have been combined where two or more zones exhibited similar water demand characteristics. For example, the village residential and single family zones were combined for water use purposes. Table 3-2 summarizes the future land use distribution at build-out. The Five Cities Center commercial development occurs within the PD zone.

However, this project will be considered as a general commercial (GC) development for the purpose of water use estimation. Future demand for the Five Cities Center was based on water use estimates provided by the applicant.

Table 2.1 - Land Use Designations

Classification	DU Density	Consistent Zoning/ Min. Lot Size	Persons/ Household	Approximate Population Density Persons/acre
Single Family Residential (SFR)				
Agriculture (AG)	1 du/10ac.	Gen or Exclusive Agriculture/ 20 ac. (currently 10 ac. In City)	2.4 p/du	0.24 p/ac
	1 du/20ac.			0.12 p/ac
Conservation Open Space(C/OS)	1 du/10ac.	OS & PF	2.4 p/du	0.24 p/ac
	1 du/5ac.	5ac, 10ac, & 20 ac.		0.5 p/ac
Very Low Density (VLD)	1du/2 ½ ac.	RE/2½ ac.	2.4 p/du	1.0 p/ac
Low Density (LD)	1 du/1½ ac.	RH/1½ ac. (cluster)	2.4 p/du	1.6 p/ac
	1 du/1ac.	City RR/1 ac.	2.4 p/du	2.4 p/ac
Low-Medium Density(LMD)	2.5 du/1ac.	City RS	2.4 p/du	6.0 p/ac
Medium Density (MD)	4.5 du/ac	City SF	2.4 p/du	10.8 p/ac
Multi-Family Residential (MFR)				
Medium-High Density (MHD)	9.0 du/ac	City MF	2.0 p/du	18.0 p/ac
High Density (HD)	14 du/ac	City MFA	2.0 p/du	28.0 p/ac
Very High Density(VHD)	25 du/ac	Senior Residential	2.0 p/du	50.0 p/ac
Mixed Use (MU)				
Village Core (VC)	25 du/ac	See Devt. Code	2.0 p/du	50.0 p/ac
Office Professional (O)		See Devt. Code		
Community Facilities (CF)		See Devt. Code		
Regional Commercial (RC)		See Devt. Code		

Source: Adapted from the 2001 City of Arroyo Grande Land Use Land Use Element, Table LU-1

Table 2.2 - Existing and Projected Land Use Distribution

Land Use Code	Land Use Description	Current Status (Acres)	Build-Out (Acres)
AG	Agriculture	345	347
CF	Community Facilities	364	367
HD	Multi-Family High Density	33	43
LD	Single Family Low Density	308	358
LMD	Single Family Low-Medium Density	535	583
MD	Single Family Medium Density	516	535
MHD	Multi-Family Medium-High Density	146	157
MU	Mixed-Use	160	195
O	Office Professional	27	31
C/OS	Conservation/Open Space	320	320
RC	Regional Commercial	60	60
VC	Village Core	52	52
VHD	Multi-Family Very High Density	4	5
VLD	Single Family Very Low Density	48	48
TOTAL		**2,918**	**3,100**

Note: Demand factors do not include areas where the City does not serve water or sewer, or unclassified land uses within City Limits

2.2 Population

According to the State of California, Department of Finance, the 2011 population was approximately 17,291. According to the 2001 City of Arroyo Grande General Plan, the anticipated build-out population of the City is 20,000 residents. For the purposes of this report, infrastructure recommendations will be based on full build-out and will not be phased to account for intermediate populations.

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Figure 2-1 – Land Use Map

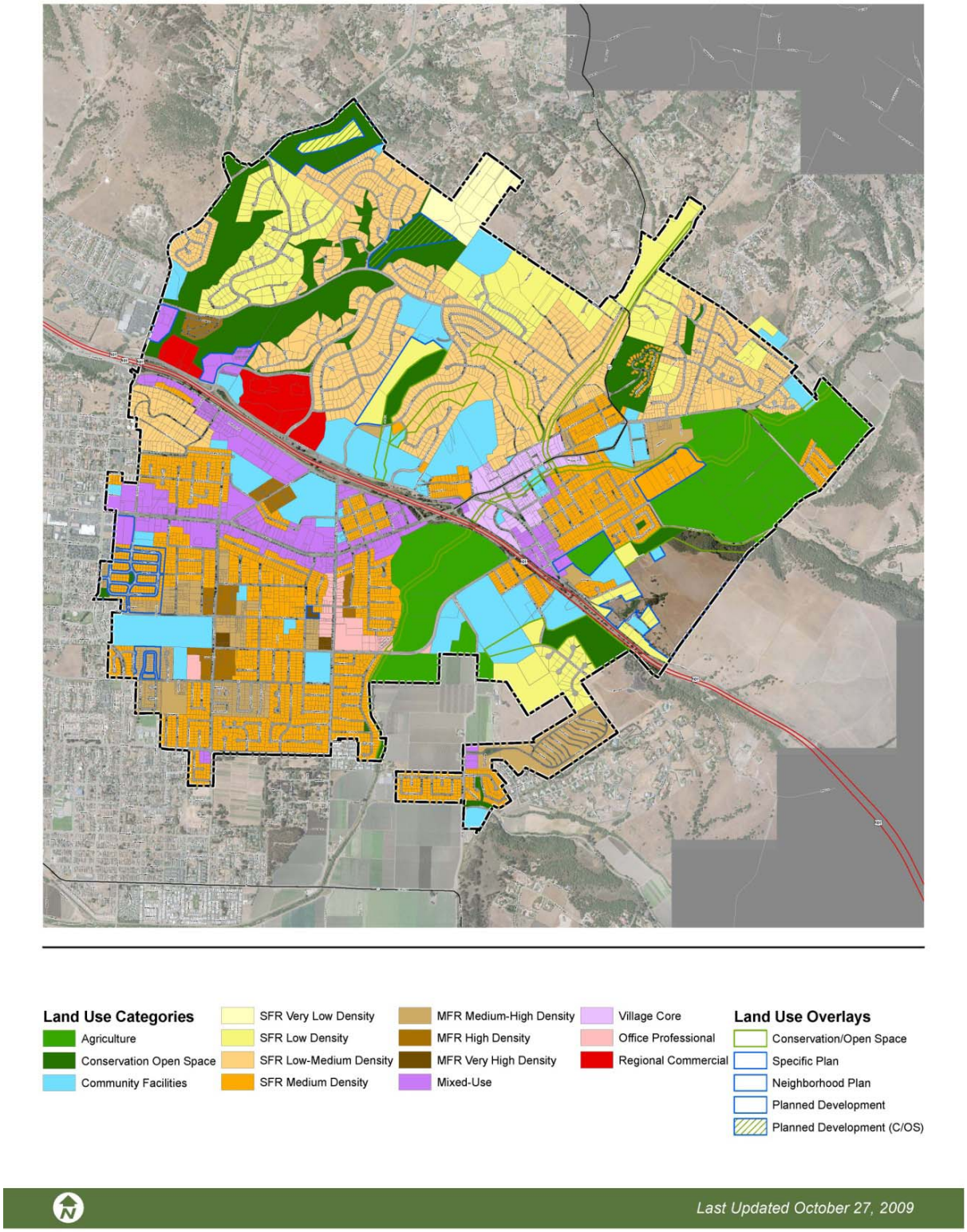

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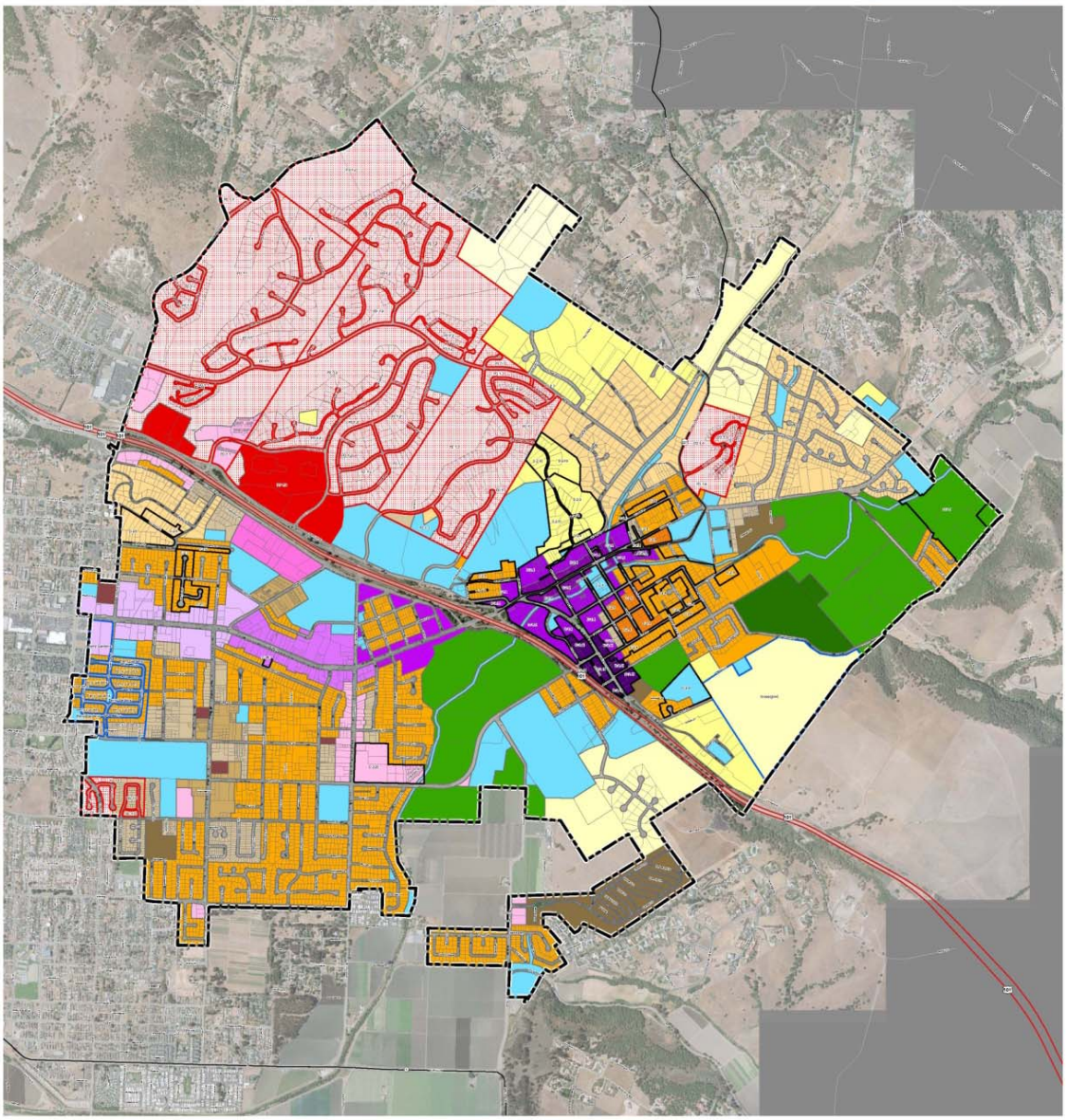
Figure 2-2 – Zoning Map



Zoning Districts
- Agriculture
- Agriculture Preserve
- Residential Estate
- Residential Hillside
- Residential Rural
- Residential Suburban
- Single Family
- Village Residential
- Multi-Family
- Multi-Family Apartment
- Mobile Home Park
- Multi-Family Very High Density
- Planned Development
- Gateway Mixed-Use
- Fair Oaks Mixed-Use
- Highway Mixed-Use
- Village Mixed Use
- Village Core Downtown
- Traffic Way Mixed-Use
- Industrial Mixed-Use
- Office Mixed-Use
- Regional Commercial
- Public Facility

Zoning Overlays
- Design Overlay
- Planned Development
- Specific Plan
- Public Facility
- City Limits

Last Updated December 9, 2010

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Section 3 - Water Demand

Along with the study of population and land use patterns, an analysis of historical water demand is required to establish a basis for projecting future water demand. The City maintains both production and consumption records. Production records indicate the volume of water produced by the water system sources. Consumption records indicate the water delivered to metered water consumers. These records are then summarized in annual reports which the City provides to the State of California Department of Public Health (CDPH).

3.1 Historical Demand

The data presented in the table below indicate that over the past 4 years, less than 5% of the total water production occurs as unmetered use, often called Un-Accounted for Water (UAW). Unmetered water should be minimized where possible since it requires City resources to produce, but does not generate revenue. The current percentage of UAW is lower than average for similar-sized communities. The primary reasons for the efficiency of the City water system are as follows:

Meter calibration	The Public Works Department maintains a comprehensive meter calibration and replacement program. All meters are either replaced or tested on a periodic basis, with the frequency depending on the size of the meter. For example, all standard single family residential meters are replaced every 20 years.
Operational Water Use	Normal operating procedures such as flushing lines or testing hydrants often go unrecorded in water systems, and are therefore included in UAW. The City of Arroyo Grande Maintenance Services Works Department maintains records of such uses where feasible, and the usage is included in the "governmental" use category.

The historical demand for water over the past 10 years is summarized as follows:

Table 3.1 - Historical Water Demand

YEAR	TOTAL PRODUCTION (AFY)	TOTAL METERED CONSUMPTION (AFY)	NRW (AFY)	NRW (%)	ESTIMATED POPULATION[1]	PRODUCTION PER CAPITA (gpcd)	TOTAL RAINFALL (in)[2]
1987	2,891	2,830	61	2.10%	N/A	N/A	9.7
1988	3,027	2,997	30	1.00%	13,750	197	13.5
1989	2,938	2,785	153	5.20%	14,090	186	5.5
1990	2,922	2,755	167	5.70%	15,150	172	5.6
1991	2,665	2,484	181	6.80%	14,600	163	20.4
1992	2,662	2,533	129	4.80%	14,650	162	14.9
1993	2,747	2,600	147	5.40%	15,070	163	16.7
1994	2,702	2,487	215	8.00%	15,146	159	12.5
1995	2,628	2,585	43	1.60%	15,500	151	20.9
1996	2,795	2,739	56	2.00%	15,495	161	28.3
1997	3,087	3,021	66	2.10%	15,495	178	13
1998	2,766	2,567	199	7.20%	15,776	157	27.3
1999	3,173	2,983	190	6.00%	16,007	177	12.6
2000	3,384	3,231	153	4.50%	15,851	191	18.5
2001	3,303	3,210	93	2.80%	16,115	183	19.7
2002	3,503	3,353	150	4.30%	16,294	192	10.5
2003	3,517	3,458	59	1.70%	16,623	189	10.9
2004	3,594	3,490	104	2.90%	16,637	193	13.7
2005	3,415	3,204	210	6.20%	16,682	183	17.7
2006	3,324	3,037	287	8.60%	16,669	178	19.9
2007	3,590	3,272	317	8.80%	16,859	190	8.2
2008	3,513	3,373	140	4.00%	17,136	183	14.6
2009	3,256	3,063	193	5.90%	17,080	170	11.6
2010	2,956	2,782	174	5.90%	16,901	156	32.6
2011	2,922	2,780	142	4.90%	16,901	154	15.1
2012	3,022	2,872	151	5.00%	16,901	160	19.0

Notes: 1. Source: DWR Public Water System Statistics Reports (1994-2010) and the City's 2005 UWMP (1987-1993).
2. Source: City of Arroyo Grande Corp Yard Gauge #177.1 (1987-2010)

3.2 Water Demand Factors

The City classifies its water consumption using the following categories:

- Residential - Single Family
- Residential - Multi-Family
- Commercial
- Industrial
- Government/Institutional
- Landscape Irrigation

No agricultural users are connected to the City system. Agricultural water is provided by private on-site wells. The City classifies its light industrial users as commercial/institutional. For the purposes of estimating future water demand, the above referenced categories were further segregated to reflect the demand by planning zone.

An electronic data base containing bi-monthly water use information for each meter in the City was provided by City staff for the 2008, 2009, and 2010 calendar years. Based on current zoning maps, each meter was assigned a land use zone. The actual annual use was then averaged for each zoning type to determine the existing demand. The demand factors were then proportionally adjusted to reflect total production which includes UAW. The following table summarizes the average daily demand factors for each type of development.

Table 3.2 - Water Demand Factors

Land Use Description	2008-2010 Average Demand Factors (gallons/day/acre)	Future Development Demand Factors assuming 2020 gpcd target (gallons/day/acre)	
		Gallons/day/acre	Gallons/day/du
Agriculture	45	43	70
Community Facilities	433	412	n/a
Multi-Family High Density	3,299	3,141	225
Single Family Low Density	581	553	555
Single Family Low-Medium Density	1,518	1,445	580
Single Family Medium Density	1,756	1,672	373
Multi-Family Medium-High Density	1,630	1,551	173
Mixed-Use	1,788	1,703	n/a
Office Professional	1,305	1,243	n/a
Conservation/Open Space	32	30	n/a
Regional Commercial	1,157	1,102	n/a
Village Core	1,029	980	n/a
Multi-Family Very High Density	4,099	3,902	155
Single Family Very Low Density	363	346	n/a

Notes:

1. Demand factors do not include areas where the City does not serve water or sewer, or unclassified land uses within City Limits

3.3 Peaking Factors

Depending on the water system component under examination, different "maximum use" conditions are examined. For example, supply systems such as wells are often designed for maximum day demand, while distribution lines are sized for peak hour demand. The following list summarizes the domestic flow conditions (not including fire suppression) that will be employed in this report:

- Average Daily Demand (ADD) is derived by averaging total annual water use over an entire year. In this report, other water demand conditions are derived by multiplying ADD by a peaking factor (PF). The demand factors tabulated in Table 4-2 reflect ADD.
- Summer Average Daily Demand is similar to ADD but the water usage is averaged over the three summer months.
- Maximum Day Demand (MDD) is the highest total water use occurring in a single day, averaged over that day.

Peak Hour Demand (PHD) is the maximum amount of domestic water use occurring in a single hour, averaged over that hour (not including fire suppression).

Other conditions such as maximum month demand and winter average demand are periodically employed in water system analysis, but will not be used in this report. Peaking factors for conditions other than ADD were determined based on historical production data or information from similar systems. The following table summarizes the peaking factors that will be used as the basis for design:

Table 3.3 - Peaking Factors

Demand Condition	Flow	Historical Peaking Factor	Design Peaking Factor	Comments
Average Daily Demand	2.89 mgd (2,000 gpm)	n/a	n/a	Flow calculated based on average daily production from 2008-2010.
"Summer" Average Daily Demand	3.96 mgd (2,800 gpm)	1.37	1.37	Historical factor calculated based on three (3) consecutive months with the highest production over 2008-2010.
Maximum Day Demand	5.45 mgd (3,800 gpm)	1.88	1.88	Historical factor calculated based on highest daily demand from 2008-2010, which occurred on 6/21/2008 (5.449 million gallons).
Peak Hour Demand	10.0 mgd (7,600 gpm)	n/a	3.77	Peak hour demand assumed to be 2 x MDD, based on historical data for similar systems.

3.4 Future Demand

The future demand estimated in the table below is based on land use patterns. The total build-out water use that results from this evaluation is 3,020,000 gpd for average daily demand. If this is compared to the estimated future population of 20,000, it equates to a per capita water use of 151 gpd.

Table 3.4 - Future Water Demand – By Acreage

Land Use Description	2008-2010 Existing ADD (gpd)	Development at Build-Out (Acres)	Demand Factor (gpd/Acre)	Build-Out ADD (gpd) with Current Demand Factors	Build-Out ADD (gpd) with SB-7 Target Conservation Demand Factors
Agriculture	15,600	347	45	15,700	14,900
Community Facilities	157,300	367	433	158,600	151,000
Multi-Family High Density	108,000	43	3,299	141,400	134,600
Single Family Low Density	179,100	358	581	208,200	198,300
Single Family Low-Medium Density	811,900	583	1,518	884,400	842,000
Single Family Medium Density	905,800	535	1,756	939,400	894,400
Multi-Family Medium-High Density	238,700	157	1,630	255,400	243,100
Mixed-Use	286,700	195	1,788	349,000	332,200
Office Professional	35,400	31	1,305	40,100	38,200
Conservation/Open Space	10,100	320	32	10,100	9,600
Regional Commercial	69,800	60	1,157	69,800	66,400
Village Core	53,200	52	1,029	53,200	50,600
Multi-Family Very High Density	16,300	5	4,099	22,300	21,200
Single Family Very Low Density	-	48	363	17,300	16,400
Total ADD	**2,890,000**			**3,170,000**	**3,020,000**
Total MDD	**5,450,000**			**5,960,000**	**5,680,000**

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Section 4 - Water Supply

The City currently receives its water supply from both surface and groundwater sources. Ground water extractions are derived from eight (8) wells and two separate basin formations. Surface water is obtained from the Lopez Reservoir Project (Lopez), which was constructed in the late 1960's. Reclaimed storm water collected by the Soto Sports Complex Storm Water Reclamation Project is also used as an irrigation supply source. The following table summarizes the supply sources available to the City over the last 35 years:

Table 4.1 - Historical Water Supply

Sources of Supply	Past Water Supply by Year (acre-feet)							
	1975	**1980**	**1985**	**1990**	**1995**	**2000**	**2005**	**2010**
Groundwater - Arroyo Grande Groundwater Basin	1,202	1,202	1,202	1,202	1,202	1,202	1,202	1,323
Groundwater- Pismo Formation	-	-	-	-	80	80	80	80
County of San Luis Obispo Lopez Reservoir Project	2,290	2,290	2,290	2,290	2,290	2,290	2,290	2,290
Surplus Lopez Project Water	-	-	600	700	910	500	-	-
Oceano Community Services District	-	-	-	-	-	-	100	100
Totals	**3,492**	**3,492**	**4,092**	**4,192**	**4,482**	**4,072**	**3,672**	**3,793**

4.1 Ground Water

Groundwater has been used as a secondary source of supply, with an average yearly groundwater extraction of 775 AFY for the time period of 2008 through 2011. Currently, the City pumps from two different groundwater basins: the Santa Maria Valley Groundwater Basin and the Pismo Formation.

4.1.1 The Santa Maria Valley Groundwater Basin

Prior to 1970, the City's water supply was derived solely from groundwater pumping from the Arroyo Grande Plain - Tri-Cities Mesa (AGP-TCM) groundwater sub-basin of the Santa Maria Ground Water Basin. The Northern Cities (City of Arroyo Grande, the City of Grover Beach, the City of Pismo Beach, and the Oceano Community Services District) as well as local land owners, the County of San Luis Obispo, and the SLOFCWCD have worked together to manage local surface water and groundwater resources since the late 1970s. A yearly basin extraction was established based on a 1979 Groundwater Study performed by the Department of Water Resources. According to the 1979

Groundwater Study, the Safe Yield of the Arroyo Grande Groundwater Basin is 9,500 acre-feet per year. The Northern Cities entered into an informal understanding in 1983 regarding safe well extractions from the basin. This understanding was formally referred to as the "Gentlemen's Agreement" each entity was allocated a yearly basin extraction based on a 1979 Groundwater Study performed by the Department of Water Resources and groundwater use preceding the Lopez Reservoir Project. The 1983 Gentlemen's Agreement City's established an entitlement of 1,202 AFY for the City.

In 2002, an Agreement Regarding Management of the Arroyo Grande Groundwater Basin (known as the Groundwater Management Agreement) was adopted by the Northern Cities and other parties that superseded the 1983 Gentlemen's Agreement. The Groundwater Management Agreement specified division of safe yield of the basin. The City's entitlement from the Arroyo Grande Groundwater Basin was established at 1,202 AFY by the Groundwater Management Agreement. Per the Groundwater Management Agreement, this entitlement has been increased to 1,323 AFY based on the conversion of irrigated agricultural lands to urban use.

The Santa Maria Valley Groundwater Basin is adjudicated. The terms of the adjudication proceedings requires formalized interagency coordination and collaboration, including a framework for monitoring, sharing information, and discussing water usage and impacts of pumping activity.

In 2005, the Groundwater Management Agreement was incorporated in the Santa Maria Valley Groundwater Basin Adjudication. The Superior Court of California, County of Santa Clara then adopted the Judgment in its Judgment after the Trial on January 25, 2008. A copy of the Judgment can be found in the 2010 Urban Water Management Plan. The Judgment requires stipulating parties to comply with each and every term of the Judgment, which includes areas of continuing jurisdiction, groundwater monitoring, reporting, and the technical oversight committee. The management area of the Northern Cities is defined in the Judgment as the Northern Cities Management Area (NCMA).

The Urban Water Management Plan shows the location of the Santa Maria Groundwater Basin Adjudication boundary and management areas. The NCMA Technical Group (NCMA TG) is the technical oversight committee that oversees groundwater monitoring and reporting for the NCMA. The NCMA TG prepares an annual report based on the collection and analysis of data relating to land and water uses within the basin, sources of supply, and groundwater conditions.

4.1.2 The Pismo Foundation

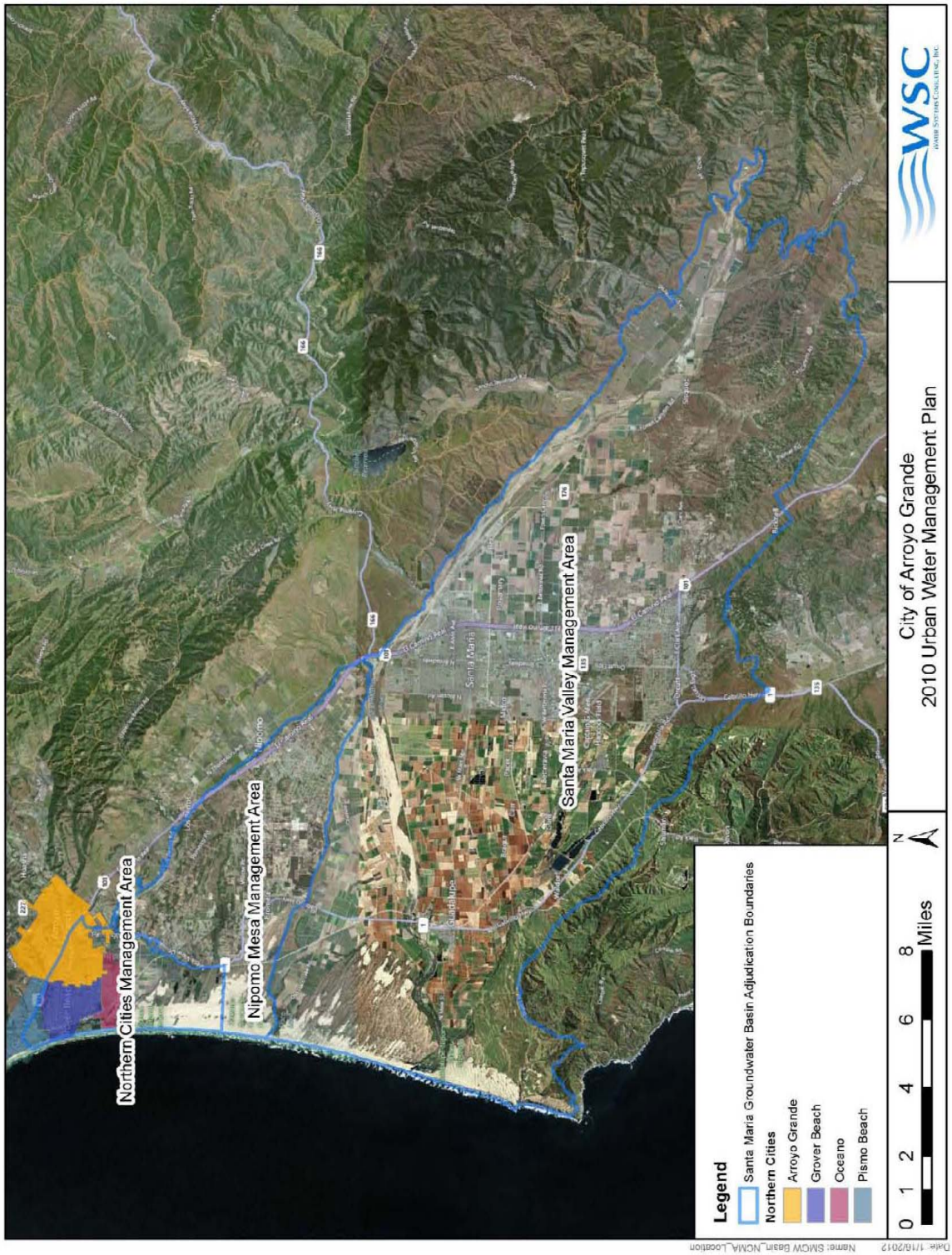
The Pismo Formation is located outside of the Northern Cities Management Area boundary (NCMA) of the Santa Maria Valley Groundwater Basin. The Pismo Formation is a distinct deep aquifer at the northeastern section of the City, identified in water wells along Oak Park Boulevard on the south, at Paseo Ladera Lane to the west, and along James Way to the east. Currently, the City pumps groundwater from Well No. 9 and Well No. 10, which are capable of extracting approximately 90 AFY

each if operated 100% of the time, but are assumed to extract 80 AFY each assuming required operational downtime. Both wells receive treatment for iron, manganese and hydrogen sulfide prior to discharge into the system. Well No. 11 is assumed to be operational by 2015. Well No. 11 is capable of extracting approximately 45 AFY if operated 100% of the time, but is assumed to extract 40 AFY assuming required operational downtime. Water supply from the Pismo Formation is not subject to the Groundwater Management Agreement for the Arroyo Grande Groundwater Basin. The Pismo Formation is not adjudicated and has not been identified as overdrafted or projected to be overdrafted by DWR. In 2003, Cleath & Associates completed a groundwater source assessment for the Oak Park area, which covers the same aquifer as the Pismo Formation. The groundwater yield for the Oak Park area was estimated to be approximately 540 AFY (22). The City exercises an appropriative right to put the water supply from the Pismo Formation to reasonable and beneficial use. The City's appropriative right allows it to pump available groundwater surplus to the needs of all existing overlying rights in the basin.

4.1.3 Water use of Agriculture inside the City Limit

Water used for agriculture within the City limits is produced from privately-owned wells and from riparian diversions. The owners of these private agricultural water wells produce approximately 70% of the water extracted from the AGP-TCM sub-basin. The major diversions of surface water occur during irrigation of lands adjoining Arroyo Grande Creek. The Lopez Project annually discharges up to 4,200 acre-feet of untreated surface water into Arroyo Grande Creek during non-spill periods. The purpose of this release is to maintain groundwater levels in the wells downstream of the dam and to satisfy downstream vested water rights and to meet the environmental needs of the ecosystem downstream. Agricultural groundwater pumping rates are expected to remain relatively constant in the future.

Figure 4-1 Santa Maria Groundwater Basin Adjudication Boundaries



Five of the City's wells (Well Nos. 1, 3, 4, 5, 7, & 8) pump water from the AGP-TCM at a casing depth of 200 to 570 feet. Well Nos. 9 & 10 within the City system are capable of extracting approximately 160 AFY from the Pismo Formation.

Table 4.2 - Existing Well Summary

Well Number	Capacity (gpm)	Year Drilled	Motor Size (HP)	Casing Depth (feet)	Water Quality Constituents
1	327	1940	40	200	Nitrates (under MCL)
3	425	1954	50	219	Nitrates (under MCL)
4	449	1964	60	233	Nitrates (under MCL)
5	1,014	1967	100	202	Nitrates (under MCL)
7	911	1982	150	570	Iron/Manganese (under MCL)
8	480	1990	75	250	Nitrates under MCL
9	65	1990	7.5	389	Iron/Manganese, Sulfide (treatment system added)
10	60	2006	10	850	Iron/Manganese, Sulfide (treatment system added)
11 (not yet equipped)	45 (estimated)	1992	In design	In design	n/a
Total[1]	**3,731**				

Notes: 1. Total capacity does not include Well 11, which is in design.

The locations of the City wells are displayed in Figure 5-1. Water quality issues are discussed in Chapter 7, Water Quality.

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Figure 4-2 - Well Locations associated with the Arroyo Grande Groundwater Basin

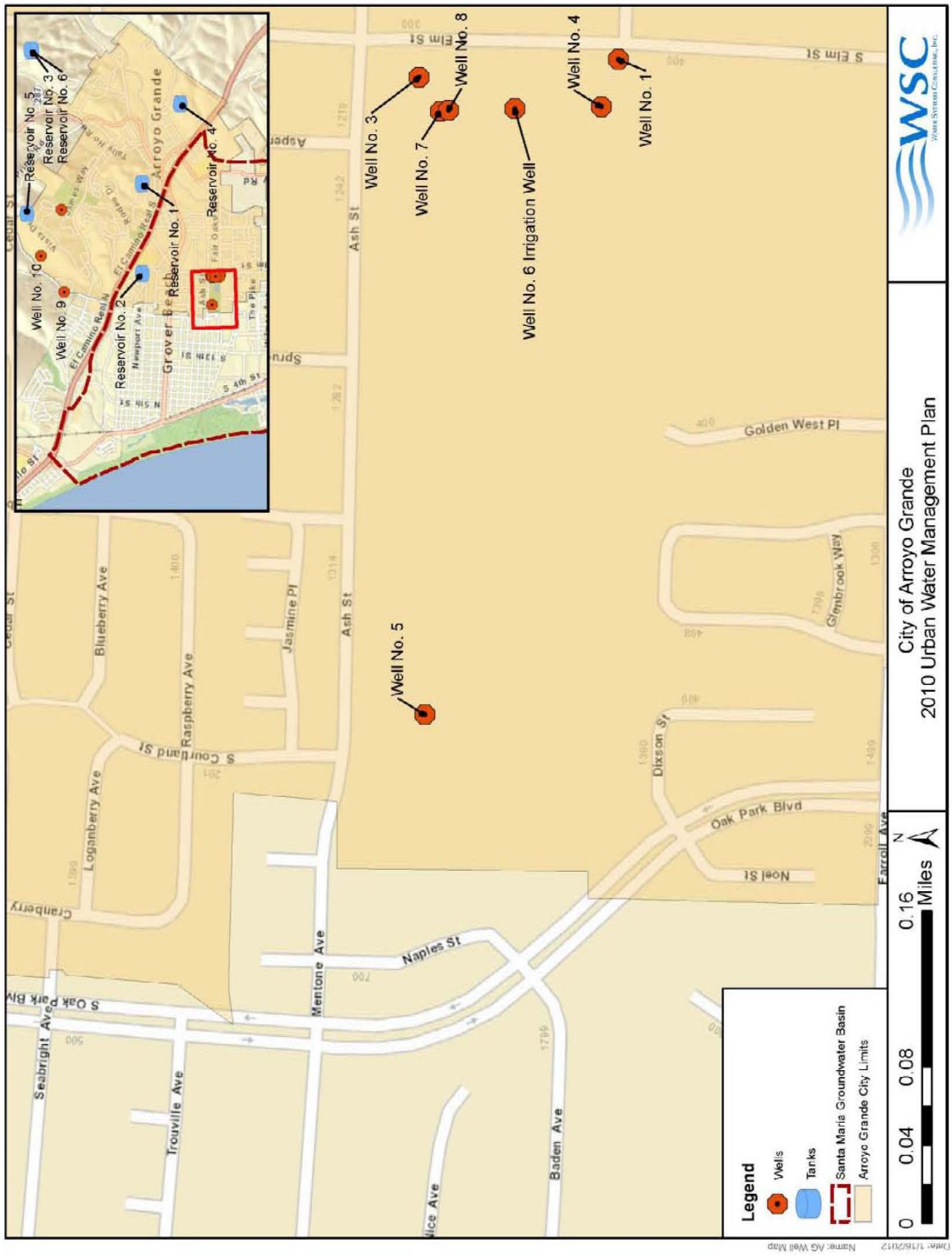

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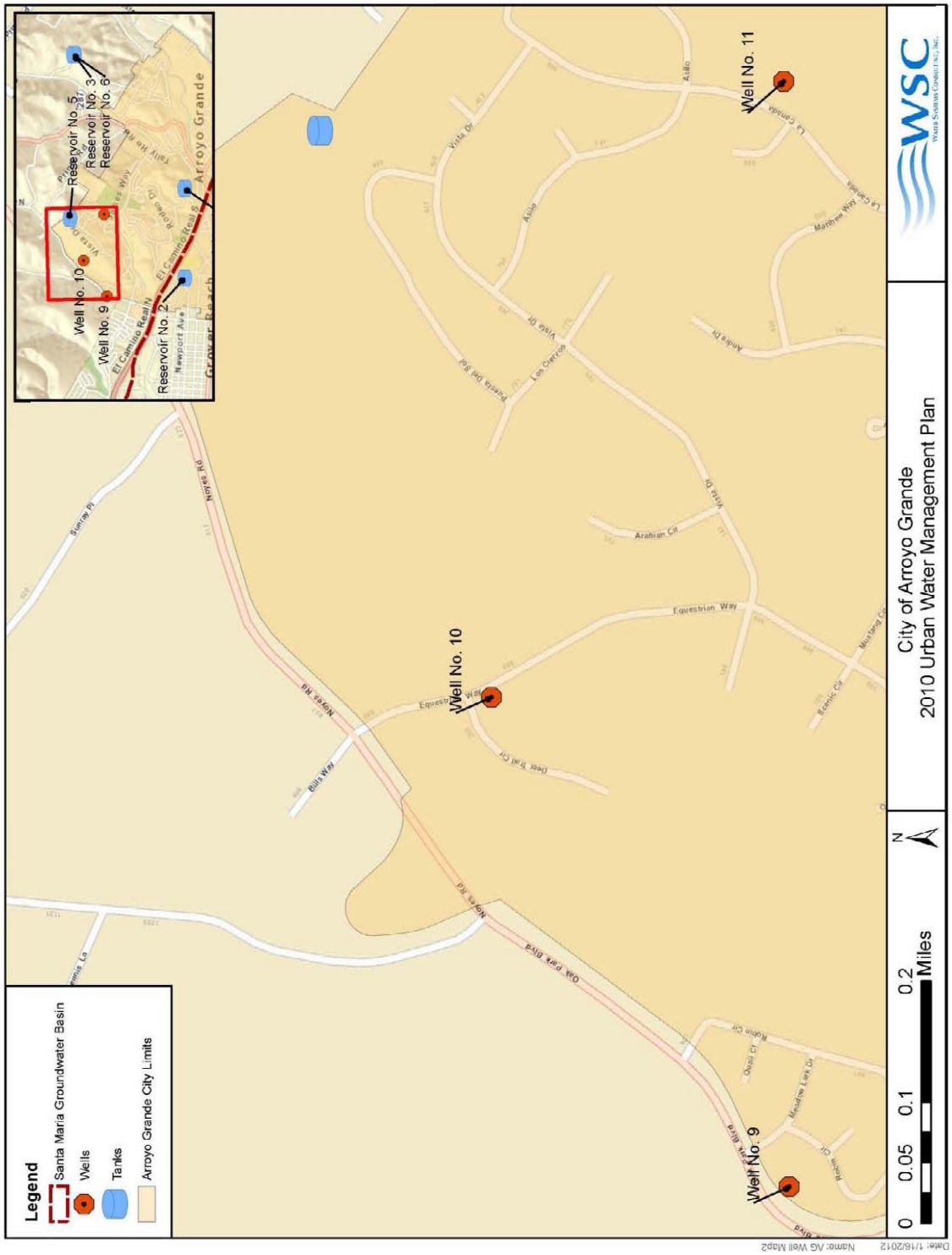
Figure 4-3 Well locations associated with the Pismo Formation



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4.2 Surface Water

In 1966, the City entered into an agreement with the County of San Luis Obispo Flood Control District to receive a yearly allocation of 2,290 acre-feet of water from the Lopez Reservoir Project. The City's allocation accounts for approximately 50.55% of the total purchased water from Lopez Reservoir. Surplus water is available based upon downstream release, unused entitlement, and spill.

The Lopez Reservoir receives runoff from the Arroyo Grande Creek Watershed. The capacity of the reservoir is 49,388 acre-feet, and 4,200 acre-feet of untreated surface water is discharged yearly into Arroyo Grande Creek as described previously. The Lopez Reservoir is considered to be a very reliable source of water supply. The annual safe yield of the reservoir is 8,730 AFY, 4,530 AFY of the reservoir's safe yield is apportioned to contract agencies. The remaining 4,200 AFY of safe yield is reserved for downstream releases to maintain stream flows and groundwater recharge downstream. In years when less water is required to be released downstream in the Arroyo Grande Creek, additional water (known as surplus water) may be available for sale to contracting agencies.

The required minimum pool for the reservoir is 4,000 acre-feet. If this minimum stage of the reservoir is reached and a drought continues, the City of Arroyo Grande will not receive its full 2,290 AFY entitlement, but will continue to receive 50.5% of the safe urban yield. City staff generally minimizes the use of existing well fields in order to maximize the use of available Lopez surplus; however, the capacity of the existing Lopez Water Treatment facility is limited to 6.0 mgd. There are two connections or 'turn-outs" to the Lopez system. Each connection includes a meter and a motorized butterfly valve to adjust flow. Both connections are normally used at once.

4.3 Recycled Water

In addition to the domestic supply sources described above, the City operates the Soto Sports Complex Storm Water Reclamation Project. The project includes a forty-acre joint use facility which serves as a collection point for drainage from a third of the City's area. Storm water is collected for the subsequent irrigation of a park and seven athletic fields. The estimated irrigation capacity of the system is 100 AFY. The system includes the following: drainage basins, one (1) irrigation well, one (1) basin pump with filtration, an irrigation system, and a construction water fill station.

Wastewater from the City of Arroyo Grande is treated by the South San Luis Obispo County Sanitation District (SSLOCSD) Treatment Plant. Wastewater from the City of Arroyo Grande, City of Grover Beach, and the Ocean Community Services District (OCSD) is "treated" by the plant to a secondary disinfected level and discharged to the Pacific Ocean. Several studies have been conducted to examine the feasibility of reclamation.

4.4 Future Water Supplies

According to the General Plan update (October 2001) and as amended by the Housing Element (2003 and 2005), the anticipated build-out population of the City is 20,000 residents. According to the 2010 Urban Water Management Plan, each water use sector is projected to grow at the same annual growth rate as the population with consideration of the reductions in per capita demand through 2020. The following table lists the historical and projected water use.

Table 4.3 - Historical and Project Water Use

Water use	2005	2010	2015	2020	2025	2030
Total Water Deliveries	3,205	2,782	3,123	2,838	2,934	3,017
Non-revenue water (NRW)	210	173	164	149	154	159
Total Water Use	**3,416**	**2,956**	**3,288**	**2,987**	**3,089**	**3,176**

The following table summarizes the future supply available to the City. The available Lopez surplus is projected conservatively based on the minimum available surplus obtained from 1984 through 1996. The minimum surplus of 250 acre-feet was obtained in 1991-1992 at the end of a period of drought. For the purposes of water system planning, it is recommended that the surplus not be considered as a firm supply.

Table 4.4 - Future Water Supply

Water Supply Sources	2015	2020	2025	2030
Groundwater - Arroyo Grande Groundwater Basin	1,323	1,323	1,323	1,323
Groundwater- Pismo Formation[1]	200	200	200	200
County of San Luis Obispo Lopez Reservoir Project	2,290	2,290	2,290	2,290
Total	**3,813**	**3,813**	**3,813**	**3,813**

Notes: 1. Assumes 80 AFY of groundwater from Well No. 9, 80 AFY from Well No. 10, and 40 AFY from Well No. 11 will be available as a reliable source of supply from 2015.

The currently-available drought supply narrowly meets the projected build-out demand. It should be noted that by implementing strict water conservation measures water use could be substantially reduced during drought years if necessary. With this in mind, the supply/demand analysis is somewhat conservative, and therefore the City's supply sources would allow for some unanticipated changes in water use and development patterns.

4.4.1 Supply Redundancy

In the event of a reasonably foreseeable system failure, it is recommended that the City maintain adequate production facilities to accommodate the future maximum day demand. The following criteria are recommended:

1. Meet build-out MDD with the largest well out of service (Lopez in service)
2. Meet future build-out MDD with the Lopez system out of service (Wells in service)

The City system meets Criteria No. 1 and is within 0.2 % meeting Criteria No. 2 as summarized in Table 5.4. In the event of a long-term Lopez outage, the City could readily implement conservation measures to reduce demand below maximum day levels. For instance, in 1995 per capita water use fell to 13% below the estimated future use.

Table 4.5 - Supply Redundancy

Condition	Supply Sources (gpm)			Max Day Demand (gpm)
	Lopez	Wells	Total Supply	
1. Largest well out of service (Lopez in service)[1]	2,096	2,292	4,388	4,139
2. Lopez out of service (Wells in service)[2]		3,306	3,306	4,139

Notes: 1. Assumes maximum capacity at Lopez turnouts, and Well 5 (largest well) and Well 3 (has pumping restrictions) are out of service.

2. Assumes Lopez system and Well 3 (has pumping restrictions) are out of service.

4.4.2 Supplemental Water Supplies, Transfers, and Exchanges

The City has completed multiple studies of potential supplemental water supply sources including an extension of the Nacimiento Pipeline, desalination, and recycled water. Based on the results of these studies, an extension of the Nacimiento Pipeline and desalination are not considered feasible or cost-effective at this time. However, the City intends to continue regional cooperation and to pursue grant funding in an effort to improve the feasibility of implementing recycled water (refer to the 2010 UWMP). In order to meet total projected water use, as well as offset potential future water shortages due to drought or disaster, the City is considering the following supplemental water supplies:

4.4.3 Oceano Community Service District (OCSD)

In August 2005, the City entered into a two-year agreement with the OCSD to provide 100 AFY. The City never purchased water under this agreement. In January 2009, the City renewed the contract with OCSD for a 5-year period. The supply from OCSD is intended to provide sufficient time to develop other supplemental water supply alternatives. The City has submitted a proposal to OCSD to establish a permanent purchase agreement, but it was rejected.

4.4.4 Surplus water from Lopez

Historically, the City and other contracted agencies have received surplus water from Lopez depending upon yearly requirements for downstream release. The SLOFCWCD - Zone 3 monitors the potential for surplus water availability consistent with the water supply agreement.

4.4.5 Lopez Reservoir Spillway Raising

In 2008/2009, the contract agencies of the Lopez Reservoir conducted a study and evaluation to consider raising the spillway elevation of Lopez Reservoir, as a means of increasing safe yield in the reservoir and thus increasing water supply entitlements to the contract agencies. By raising the

spillway a few feet, the overall capacity of the reservoir increases significantly. The increased capacity will correlate to a greater entitlement of the water supply that can be distributed to the City and the surrounding contract agencies. The project study examines raising the spillway of Lopez Dam by 3 to 5 feet, which would increase gross reservoir storage capacity by a maximum of 2,850-4,750 acre-feet. Annual average yield is estimated to be increased from 671 to 1,371 acre-feet. Refer to Section 3.4 of the City of Arroyo Grande 2010 Urban Water Management Plan.

4.4.6 Supplemental State Project Water via the Coastal Branch and Lopez Pipelines

SLOFCWCD has completed a hydraulic study to determine if additional capacity exists in the Central Coast Water Authority (CCWA) State Water Pipeline for supplemental water deliveries to CCWA subscribers, including Contract Agencies (served via the Lopez Pipeline). The hydraulic study modeled the entire CCWA pipeline delivery system, plus the Lopez pipeline. Refer to Section 3.4 of the City of Arroyo Grande 2010 Urban Water Management Plan for further information.

4.4.7 Additional Storm Water Reclamation

A detention basin currently exists at the Wal-Mart Site near the intersection of West Branch Street and Camino Mercado, which retains water year-round due to storm water inflow. The year-round storage volume is currently unknown; however the approximate volume of the basin is 6.4 acre-feet. If the storm water is deemed a viable source of water, it would potentially offset potable water demand by approximately 43 AFY. Refer to Section 3.4 of the City of Arroyo Grande 2010 Urban Water Management Plan for further information.

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Section 5 - Water Storage

5.1 Existing Facilities

The City currently operates six (6) separate pressure zones for water storage. The pressure zones are summarized as follows:

Main Zone	Approximately 66.25% of City water use occurs within the main pressure zone. In addition, the two connections to the Lopez water system occur within the main zone.
Rancho Grande Zone	Approximately 28.5% of City use occurs in this zone. The hydraulic grade is approximately 135' or 58 psi above the main zone. In 1997, the Hillcrest area on the west side of Highway 101 was added to the Rancho Grande zone through the addition of a 12" transmission line. The Hillcrest area water system had formally operated on a hydro-pneumatic booster system.
Oro Zone	Approximately 5% of City use occurs in this residential zone. The hydraulic grade is the same as the Rancho Grande Zone, but the zones are not connected.
Vista del Mar	Approximately 0.5% of City use occurs in this residential zone. Through the Vista del Mar pump, the pressure is increased to serve thirty-eight (38) residential connections.
Miller Way	Approximately 0.25% of City use occurs in this residential zone. Through the Miller Way pump station, the pressure is increased to serve twenty-six (26) residential connections.
Reservoir 5	Approximately 1.5% of City use occurs in this residential zone. Through the booster pump station, the pressure is increased to serve one-hundred thirty-one (131) residential connections.

The following table summarizes the existing tank storage system:

Table 5.1 - Existing Storage Facilities

Storage Facility (Date Installed)	Usable Volume (Million Gallons)	Material	Pressure Zone
Main Zone			
Reservoir No. 1 (2004)	2.00	Prestressed Concrete, Partially Buried	Main Zone Overflow Elevation = 297'
Reservoir No. 2 (1960)	1.00	Steel, Above Ground	Main Zone Overflow Elevation = 293'
Reservoir No. 4 (1982)	2.00	Steel, Above Ground	Main Zone Overflow Elevation = 291'
Total	**5.00**		
Oro Zone			
Reservoir No. 3 (1978)	0.25	Steel, Above Ground	Oro Zone Overflow Elevation = 432'
Reservoir No. 6 (2011)	0.25	Steel, Above Ground	Oro Zone Overflow Elevation = 432'
Total	**0.50**		
Rancho Grande			
Reservoir No. 5 (1986)	1.20	Steel, Above Ground	Rancho Grande Zone Overflow Elevation = 432'
Total	**1.20**		

5.2 Storage Analysis

The Lopez reservoir functions as a large storage facility for downstream users. However, in the event of a system emergency, it is recommended that adequate storage volume be maintained in City reservoirs for the following reasons:

- The Lopez reservoir would not serve as storage for the higher pressure zones.
- An event which is likely to disable well production facilities (earthquake, etc,) could potentially also disable Lopez production and transmission facilities, therefore Lopez should not be considered for emergency storage.

For the purposes of this study, Lopez storage volume will not be considered in the analysis. There are three types of storage commonly evaluated in a storage analysis - Emergency, Fire, and Operational. The sums of these three are recommended to be the total storage volume available for the system.

5.2.1 Emergency storage

Emergency storage is intended to provide for conditions such as extended power outages, line breaks, pump failures, and similar problems. Most water planners accept that during emergencies supply per capita may be reduced to minimum levels. Emergency storage equals two days of Average Day Demand (ADD) minus the supply from Well 7 and 8, which can be powered by a generator during an emergency. The system emergency storage is apportioned to each zone using the buildout ADD for each zone. The required emergency storage is listed below by pressure zone in Table 6.2 below.

5.2.2 Fire storage

Fire storage is the volume of water needed to control an anticipated fire in a building or group of buildings. The determination for this storage is based upon a recommended flow rate, its duration, and a minimum residual pressure at the established by the agency of interest.

The agencies which establish the relationships between land use and fire requirements include the Uniform Fire Code (UFC) and the Insurance Services Office (ISO). The services of ISO are advisory only, and are used to establish insurance ratings for cities and communities across the nation. Sufficient storage is required to provide the following fire flows:

- Residential areas (1,500 gpm for 2 hours)
- Commercial (3,000 gpm for 3 hours)
- Five Cities Center (4,000 gpm for 4 hours).

This translates to the following storage requirements per zone:

- Main Zone (4,000 gpm for 4 hours)
- Rancho Grande Zone (3,000 gpm for 3 hours)
- Oro Zone (1,500 gpm for 2 hours)

The required fire storage is listed below by pressure zone in Table 6.2 below.

5.2.3 Operational storage

Operational storage is the amount of water needed to equalize the daily supply and demand. Without this storage, water production facilities large enough to meet the instantaneous peak demands of the system would be required. With adequate operating storage, well pumps can operate at the daily average rate, while storage facilities meet the hourly peaks. This operating method also prevents the unnecessary use of additional well pumps at times when electrical rates are the highest.

Operational storage is calculated as a range between the values calculated applying Case A and B for each zone:

(1) Case A: Source capacity for Main Zone is assumed to be that from all wells (except 3, 11) and Lopez. Source capacity for Rancho Grande Zone and Oro Zone are assumed to be that of one booster pump, respectively. Operational storage for each zone is calculated as 4 times zone Peak Hour Demand (PHD) minus assumed source capacity for each zone.

(2) Case B: Source capacity is assumed to be zero (no pumps running during PHD period). Operational storage for each zone is calculated as 4 times zone PHD.

The required operational storage is listed below by pressure zone in the table below.

Table 5.2 - Storage Requirements

Pressure Zone	Operational Storage: Case A[1] (Million Gallons)	Operational Storage: Case B[2]: (Million Gallons)	Fire Flow Storage[3] (Million Gallons)	Emergency Storage[4] (Million Gallons)
Main Zone	0.29	1.46	0.96	1.73
Rancho Grande Zone	0.22	0.46	0.54	0.54
Oro Zone	0.00	0.05	0.18	0.06

Notes:
1. Calculated as 4 hours of PHD, minus assumed source capacity for zone. For main zone, source capacity was assumed to be the total capacity from Well 1, 4, 5, 7, 8, 9, and 10, and Lopez turnouts. For Rancho Grande zone, source capacity was limited to capacity of one (1) booster pump (1,000 gpm). For Oro Zone, source capacity was limited to capacity of one (1) booster pump (400 gpm).
2. Calculated as 4 hours of PHD. Assumes pumps are not operated during PHD period.
3. Assumes the following requirements for each zone: Main Zone- 4,000 gpm for 4 hours; Rancho Grande Zone- 3,000 gpm for 3 hours; Oro Zone- 1,500 gpm for 2
4. Calculated as 2 days of ADD, minus capacity of Well 7 and 8, which can be powered by portable generators in an emergency.

Table 5.3 - Build-Out Total Storage Requirements

Pressure Zone	Existing Storage Available (Million Gallons)	Buildout Required Storage[1] (Million Gallons)
Main Zone	5.0	4.16
Rancho Grande Zone	1.2	1.53
Oro Zone	0.5	0.29

Notes:
1. The required storage uses the operational storage calculated for Case B, which is the the worst case scenario. The Case B operational storage was calculated as 4 hours of PHD.

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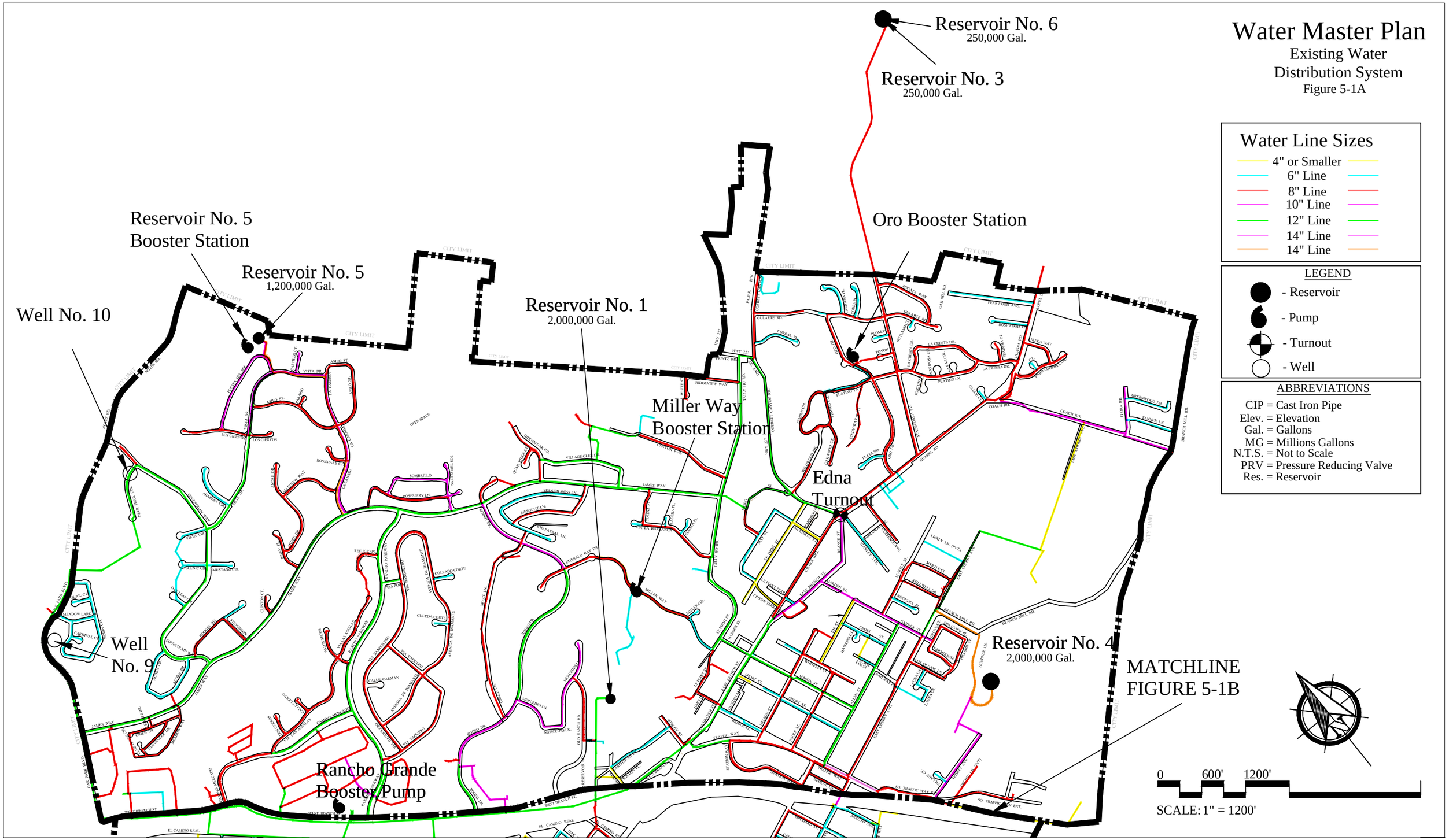
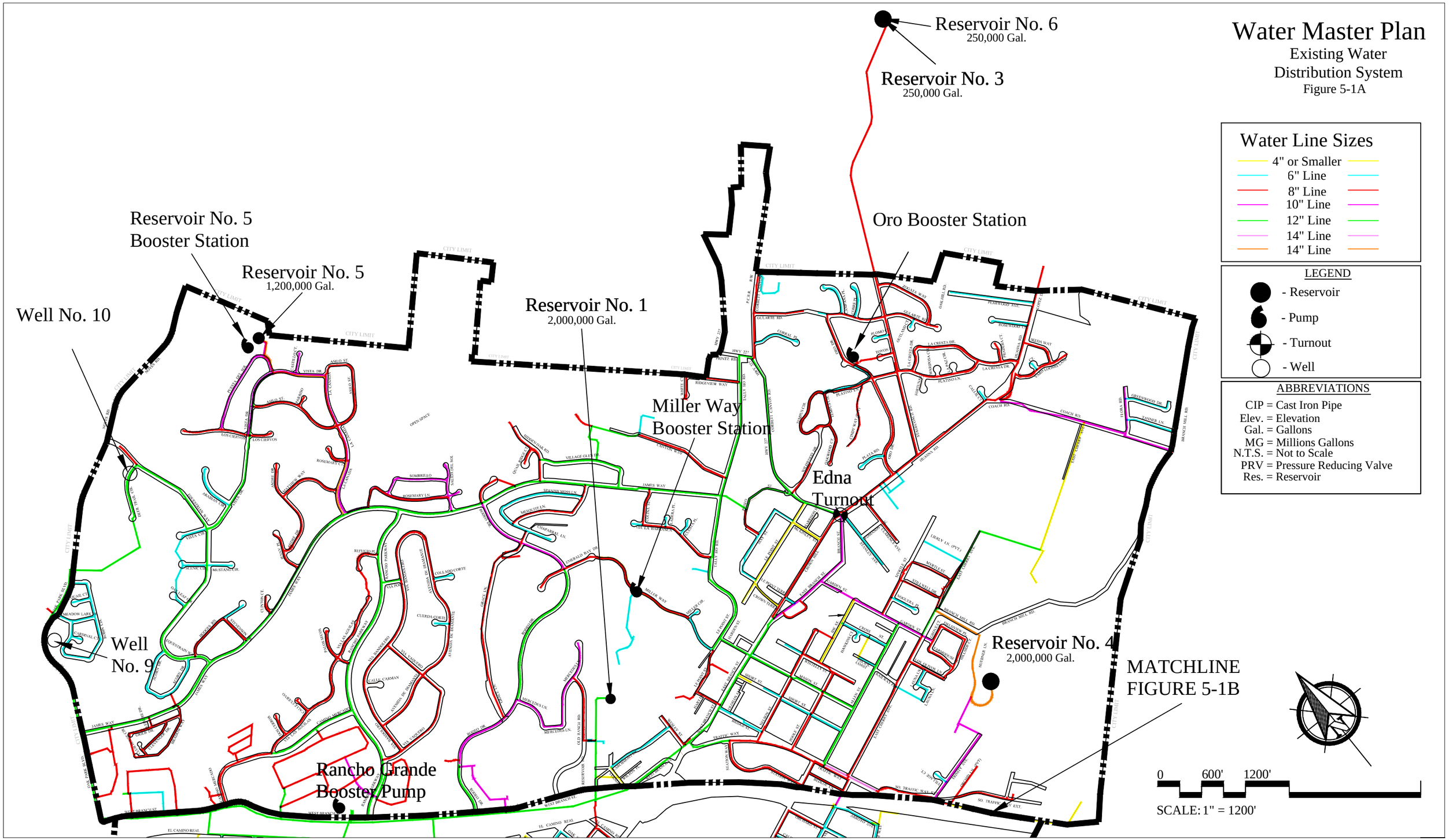
Water Master Plan

Existing Water
Distribution System
Figure 5-1A



Water Master Plan

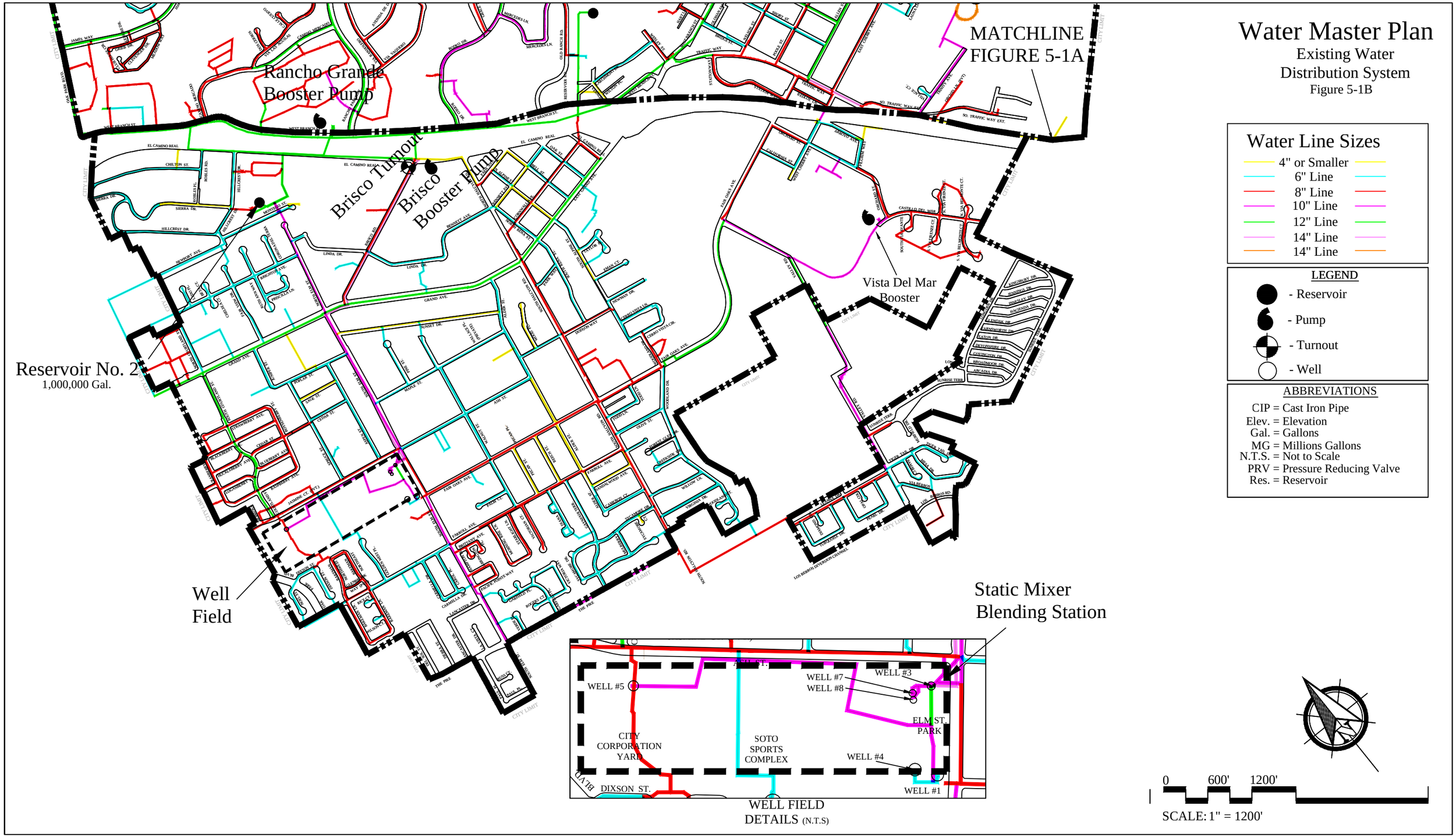
Existing Water
Distribution System
Figure 5-1A



Water Master Plan

Existing Water Distribution System

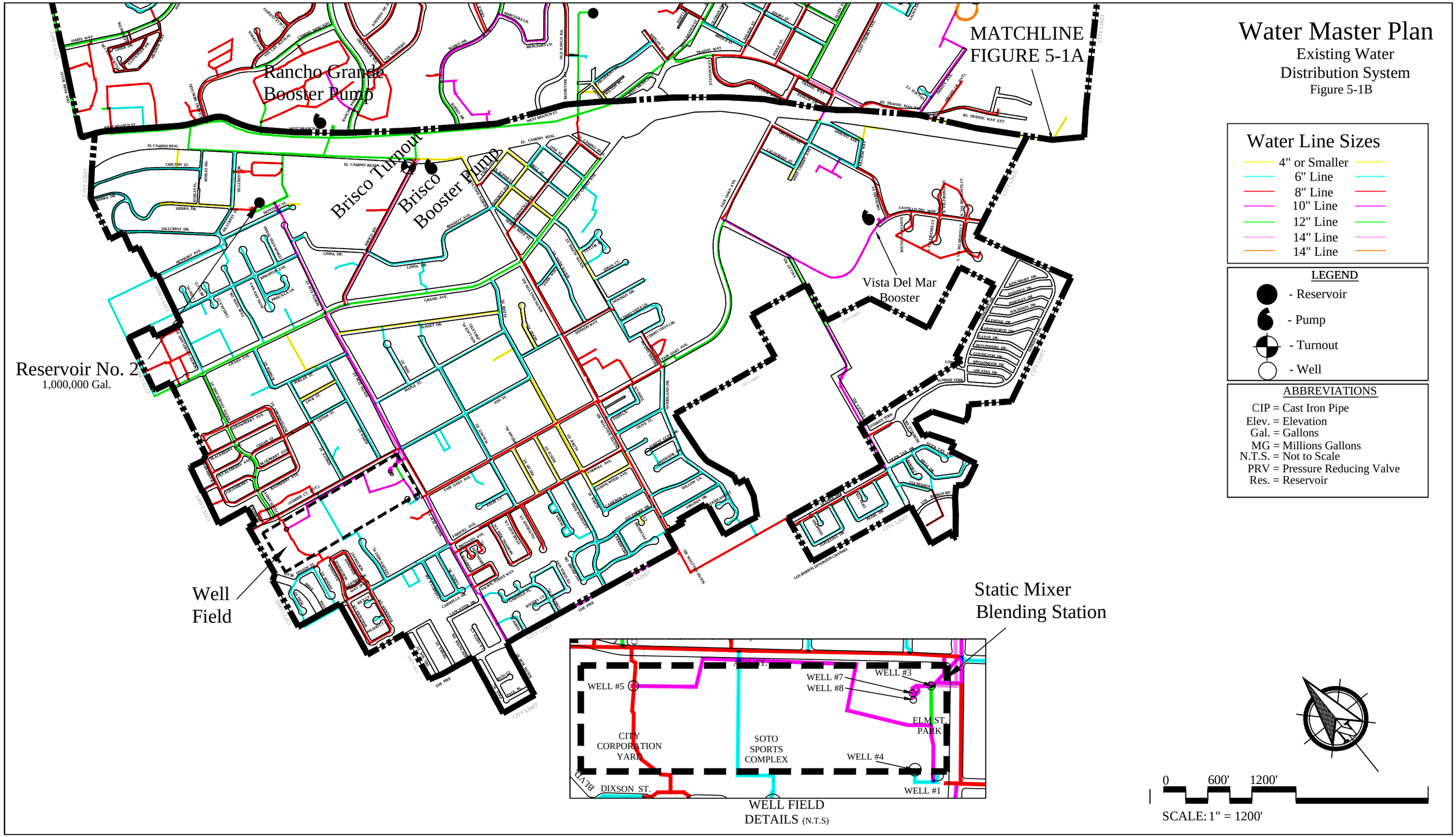
Figure 5-1B



Water Master Plan

Existing Water Distribution System

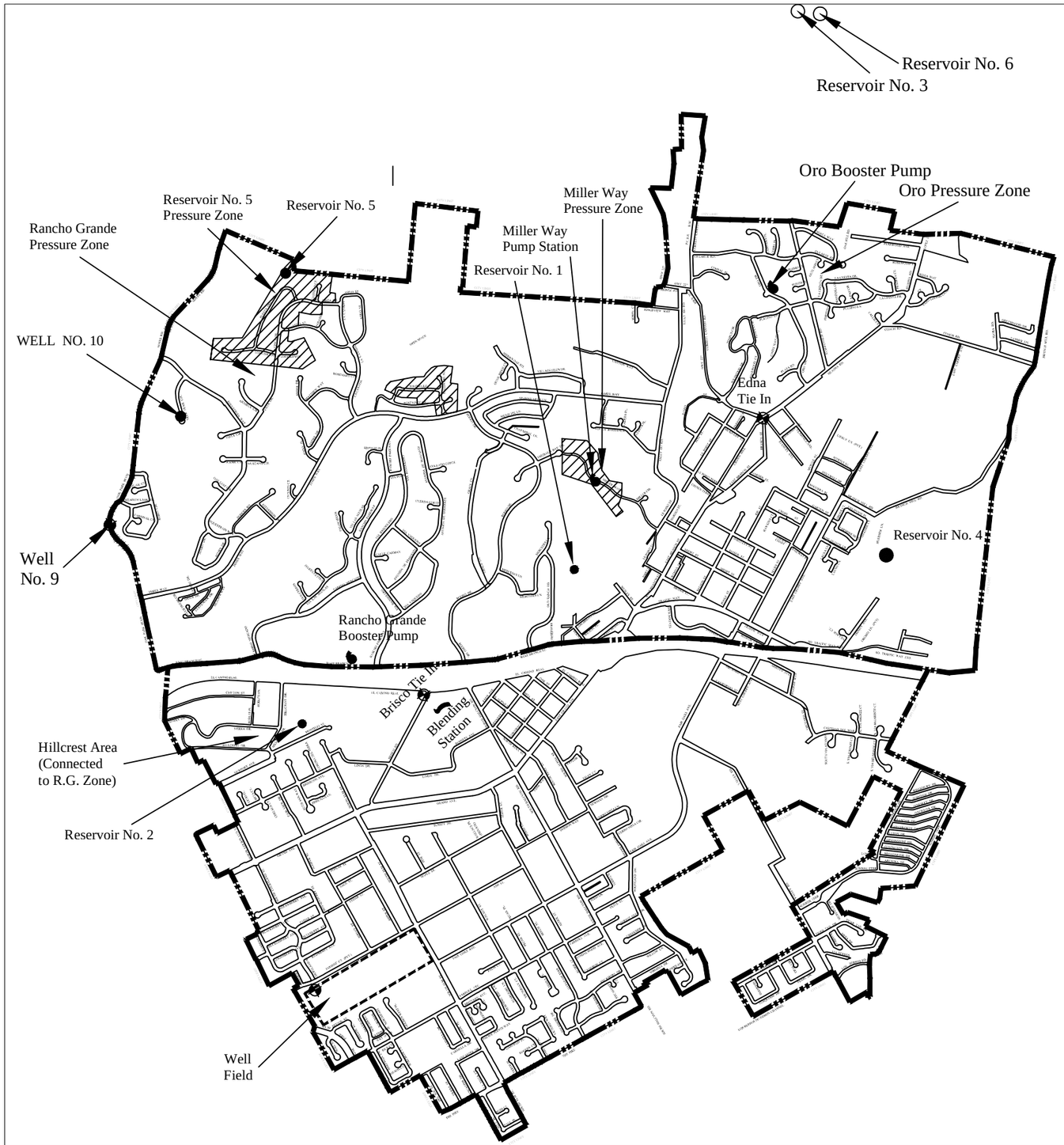
Figure 5-1B



Water Master Plan

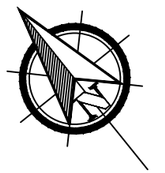
Pressure Zones and Distribution System Profile

Figure 5-2



ABBREVIATIONS

CIP = Cast Iron Pipe
Elev. = Elevation
Gal. = Gallons
MG = Millions Gallons
N.T.S. = Not to Scale
PRV = Pressure Reducing Valve
Res. = Reservoir



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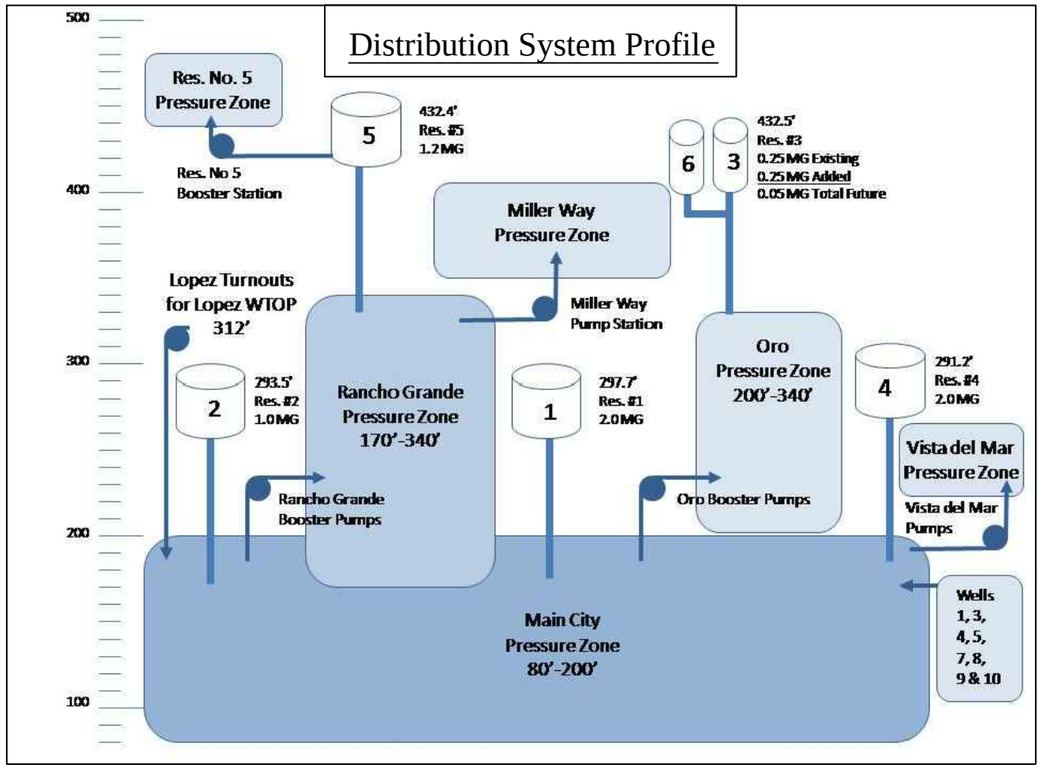
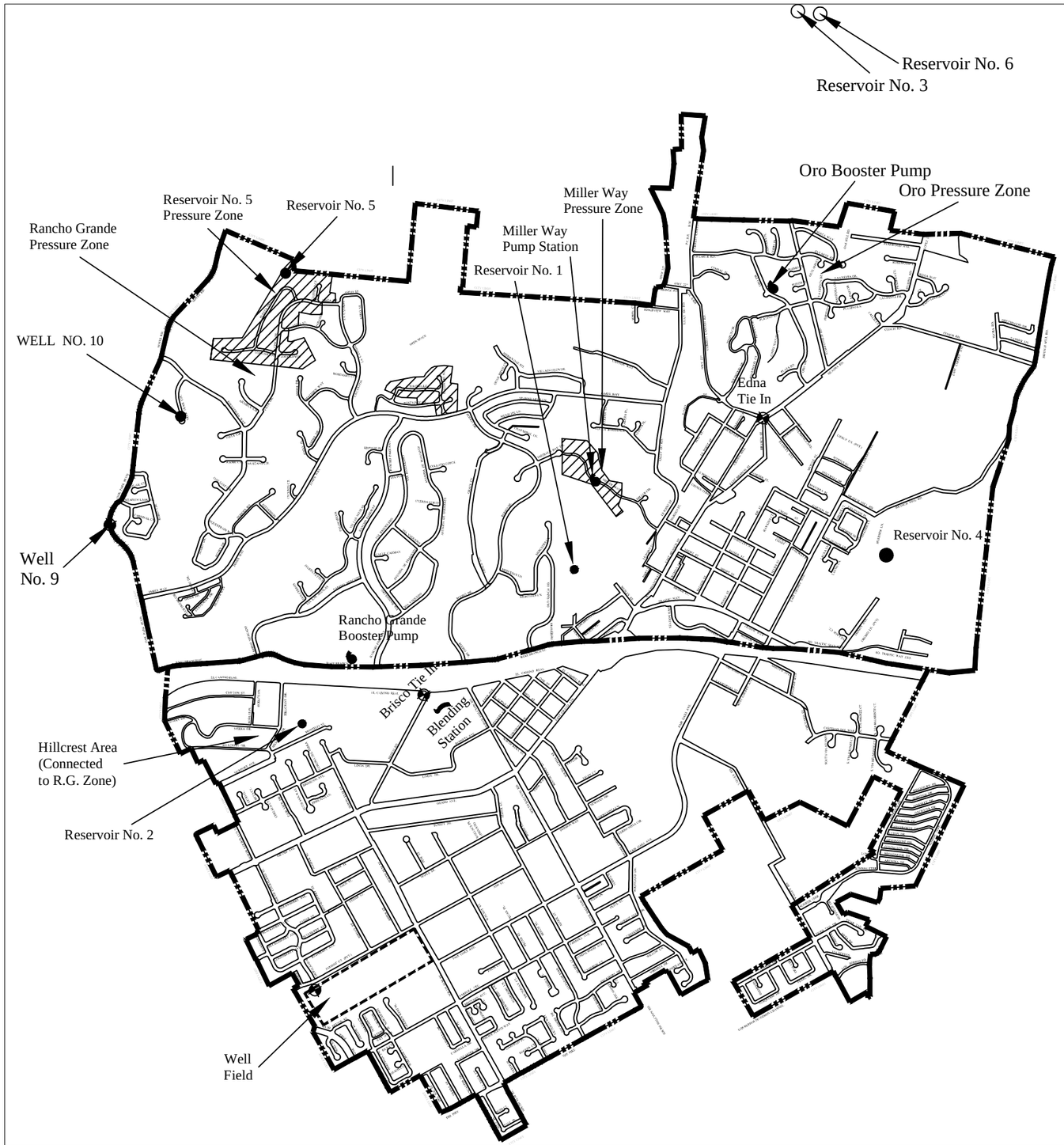


Water Master Plan

Pressure Zones and Distribution System Profile

Figure 5-2



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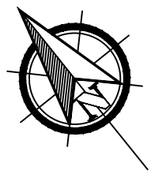

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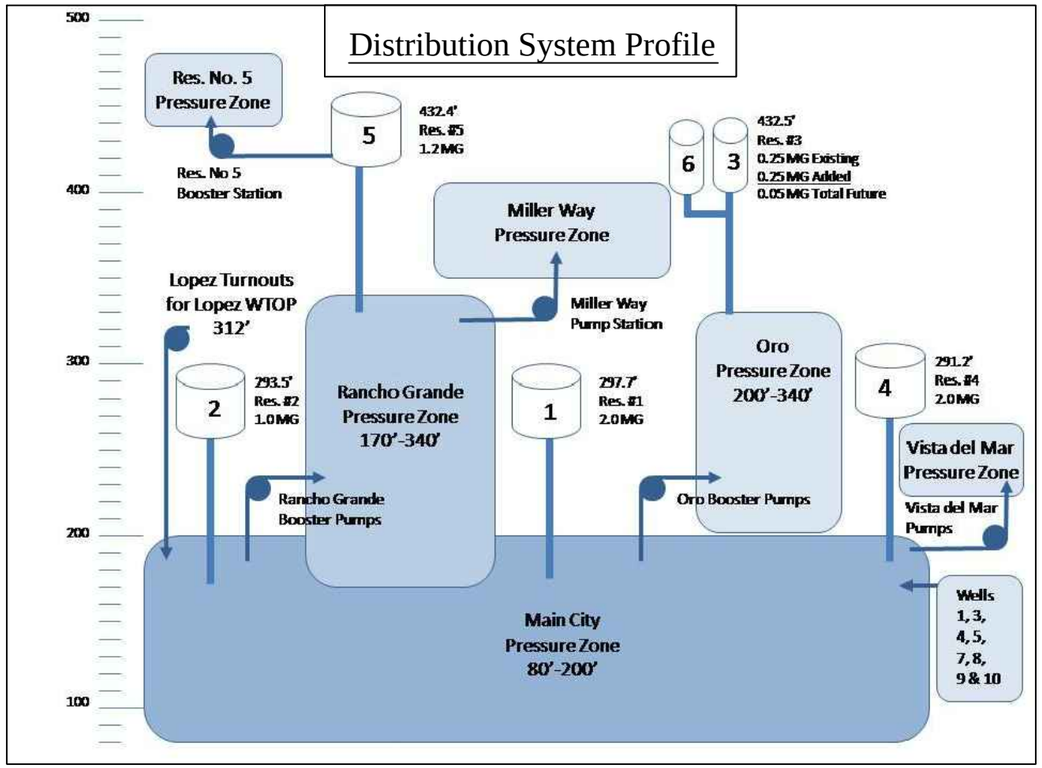

Section 6 - Water Distribution

A hydraulic network evaluation was performed to analyze the City's existing water system. The results of the analysis were used as guidelines for the recommended future improvements.

6.1 Existing Facilities

The existing water distribution system is shown in the table below. An inventory of the existing pipeline network and City booster pump stations is summarized in the table below:

Table 6.1 - Existing Pipeline Inventory

Diameter (inches)	Length	
	(feet)	(miles)
2	5,700	1.08
4	24,500	4.64
6	127,800	24.20
8	166,000	31.44
10	42,800	8.11
12	82,900	15.70
14	5,900	1.12
16	5,500	1.04
TOTAL	461,100	87.33

Table 6.2 – Existing Booster Station Inventory

Station Name	Function	Pump Description	Motor	Backup Power
Rancho Grande Booster Station	Boosts water to Reservoir No. 5	Two Weinman 5L1 pumps (1,000 gpm each)	2 x 60 HP	Manual backup power
Oro Booster Station	Boosts water to Reservoir No. 6	Two Berkeley pumps (300 gpm each)	2 x 25 HP	Manual backup power
Miller Way Booster Station	Boosts pressure to Miller Way boosted zone (small zone)	Two Goulds pump	2 x 5 HP	No Backup power
Brisco Booster Station	Boosts Lopez water to well site for blending	One Weinman Model 8L2 pump (2,200 gpm)	1 x 40 HP	No Backup power
Reservoir 5 Booster Station	Boosts water to the Reservoir 5 boosted zone (small zone)	Three Aurora Model 411 pumps (920 gpm each); One Aurora Model 341A pump (243 gpm); One Aurora Model 340 pump (122 gpm)	3 x 40 HP; 1 x 10 HP; 1 x 5 HP	Automatic generator backup power
Vista Del Mar Booster Station	Boosts water to Vista Del Mar boosted zone (small zone)	Three Ingersol Dressor Model 4LR-10G pumps (700 gpm each); Two Ingersol Dressor Model 2X1X6T pumps (50 gpm each)	3 x 15 HP; 2 x 2 HP	Automatic generator backup power

In the event of a power outage, the City's booster station facilities are equipped with both manual and automatic transfer switch (ATS) mechanisms which allow operations staff to connect City-owned mobile generators to the stations. This method is deemed acceptable by operations staff since the storage available in the various zones provides adequate response time for generator connection. In the case of the Miller Way booster station, if the power is out for an extended period of time, residential pressures will drop but will still stay above the minimum code limitation of 30 psi.

6.2 Design Requirements

The design requirements for the water distribution system relate primarily to the flow and pressure delivered by the system. Pressures below 20 psi are not acceptable in a municipal water system. Ideally, normal operating (static) pressures will be within the range of 40 to 80 psi. This is the range which most people find comfortable and which will serve most fire sprinkler systems. Pressures within the 30 to 35 psi range are acceptable but less than desirable. Pressures higher than 80 psi are

acceptable within the distribution system, but should be reduced to 80 psi by the property owner per the California Pumping Code to prevent water hammer effects or leakage through rapidly-weakening washers and seats.

6.3 Water System Modeling

In order to evaluate the performance of the existing water system, identify deficiencies in the network, and recommend improvements, a computer model was developed using the WaterGEMS water distribution modeling software application.

6.3.1 System Mapping Update

The City's water system GIS information was utilized to develop an updated water model. However, the last major revision to City's GIS mapping was completed in 2003. To update the system mapping, the GIS shapefiles based on information obtained from as-built drawings for development and CIP projects, the City's Water System Atlas, and City Staff. For system components not currently contained within the GIS system mapping, individual shapefiles were developed for the following features:

- Tanks
- Booster Pumps
- Turnouts
- Wells
- PRVs
- Closed Valves

The existing shapefiles were modified to remove the following elements from each of the shapefiles because they are privately maintained or are not necessary to complete the modeling.

6.3.2 Elevation Data

Elevation data was obtained GIS based elevation data from the United States Geological Survey National Elevation Dataset (USGS NED), which provides public domain elevation data for the United States.

The best available resolution for the Arroyo Grande City Limits was 1/3 arc-second. Utilizing ArcMap, WSC overlaid the NED raster dataset and extracted elevation data for each of the point features in the distribution system shapefiles. These elevations were then compared against elevations from record drawings, where available, and modified as needed.

6.3.3 Customer Demand Data

To develop estimates of customer demands for the Arroyo Grande water distribution system, customer water use records were utilized, for 2010, exported from the City of Arroyo Grande's (City) billing database. The City's water system meters are measured on a bi-monthly schedule, with approximately

one half of the meters read on the odd months and the corresponding half on the even months. To determine 2010 annual water demand, WSC summed each customer's bi-monthly water use for the year. The total billed consumption for 2010 was 1,230,613 CCF and the consumption ranged from 0 to 21,943 CCF per customer.

6.3.3.1 Geospatial Allocation

To geospatially allocate consumption data throughout the City's distribution system, the geocoding tool was utilized within ESRI's ArcMap software to plot the geographical location of a point or set of points based on street name or address. The Geocoding tool utilizes a street centerline shapefile, which contains address ranges in the attribute data to determine the approximate location of the each item in the dataset. The ag_roads and all_other_roads street centerline files were utilized for the geocoding process. Discrepancies between the address ranges within the centerline files and the actual address ranges of the residences and businesses within Arroyo Grande limited the accuracy of the geocoding. The address ranges of the ag_roads centerline files were modified, as required, to improve the geocoding results.

The initial geocoding matched 98% of the customer records from Arroyo Grande's billing database. The remaining customer records, with available address data, were located manually using alternative geocoding services, specifically Google maps and Zillow.

6.3.3.2 Land Use Demand Factors

The geospatially allocated demands and the City's Land Use Categories feature dataset were utilized to develop land use demand factors for each land use category. Development of the land use factors involved analysis of current and buildout acreages for each land use category and geospatial allocation of customers to determine each customer's overlying land use. The City's 14 land use categories are shown below:

AG	Agriculture	MU	Mixed-Use
CF	Community Facilities	O	Office Professional
HD	Multi-Family High Density	OS	Conservation/Open Space
LD	Single Family Low Density	RC	Regional Commercial
LMD	Single Family Low-Medium Density	VC	Village Core
MD	Single Family Medium Density	VHD	Multi-Family Very High Density
MHD	Multi-Family Medium-High Density	VLD	Single Family Very Low Density

6.3.4 Analysis of Current and Buildout Acreages

The current and buildout acreage by land use category were estimated using City land use data and a 2009 Preliminary Housing Opportunity Sites Inventory (Inventory) provided by the City. The land use data provided the number of acres of each land use category at buildout. The Inventory provided a list of parcels with development potential including the parcel acreage, existing number of dwelling units,

and estimates of the number of potential dwelling units that could fit within each parcel. Using the data provided in the Inventory, The undeveloped acreage in each parcel was estimated. This analysis assumed the ratio of potential dwelling units to total dwelling units (including current and potential) in each parcel was equal to the ratio of undeveloped acres to total buildout acres of the parcel. This yielded an estimate of undeveloped acreage for each parcel in the Inventory. The current developed acreage for each land use category was estimated by subtracting the estimated undeveloped acreage identified in the Inventory from the buildout acreage for each land use category.

6.3.5 Geospatial Allocation of Demands

There are some areas within City Limits where customers are served water by OCSD and sewer by the City. In these areas the City receives the readings from OCSD to estimate sewer flows and includes the volume in its customer demands database. These areas were included in the analysis of spatially allocated land use demand factors. In some areas within City Limits the City does not serve water or sewer. The City's Land Use Categories layer was modified by deleting areas that are not served by the City's water system and sewer system.

All water system customers receiving water outside of the City limits were excluded from the Land Use Demand Factor Analysis because they are not associated with the City's land use categories. City staff also identified water connections within the City Limits that are not served by the City. For the purposes of the water model, the geospatially allocated water demand points that are not served by the City were excluded. This was executed by editing the land use demand intersection database and creating a new shapefile called WtrSrvPnts.

Geospatially allocated customer demands and land use categories were intersected in GIS to provide a database of demands and associated land uses for each customer. The land use demand intersection database provided a second opportunity to verify the geographic locations of customer demands. To verify that the geographic location of each customer was correct, each customer Account Type was compared with its overlying land use by performing a query of the land use demand intersection database. The query matched customer Account Type with compatible land use categories for each customer. Customer records with incompatible account types and associated land use categories were flagged for review. For example, if a customer Account Type was residential, and its overlying land use was Conservation/ Open Space, then the customer would be flagged to be manually checked in GIS. Each of the customers with incompatible Account Types and overlying land uses were analyzed in the GIS map and compared with available address data from Google maps and Zillow. The points that were located in the wrong place were relocated manually to their correct location. Once all of the geographic locations of the customers were corrected, the geospatially allocated customer demands and land use categories were intersected in GIS again to yield 2010 total deliveries by land use category.

6.3.6 Calculation of Land Use Demand Factors

The total deliveries for each land use category were divided by the total developed acreages for each land use category to yield current deliveries per developed acre for each land use category. To account for an unusually low year for deliveries in 2010, an average of total production from 2008 through 2010 was calculated. To develop the 2008-10 average demand factors, the 2010 deliveries per developed acre were multiplied by the ratio of 2008-2010 total production average to 2010 total deliveries, which is approximately 116%. To develop estimates for build-out demand, the total buildout acreage for each land use was multiplied by the 2008-10 average demand factors. These demand estimates are solely for development of the water model and do not reflect the City's goal of 20% reduction in per capita water use by 2020 as described in the City's 2010 Urban Water Management Plan.

Once the land use demand factors were calculated in tabular format the spatially allocated demands were updated in the water model. The 2010 spatially allocated demands were multiplied by a correlation factor that increased the total demand of the 2010 spatially allocated demands to equal the 2008-10 total average demand. A correlation factor was also applied to the 2008-10 spatially allocated demands to develop the spatially allocated build-out ADD demands for the water model.

6.3.7 Water Model Calibration

To develop a water model that approximates the current performance of the City's distribution system, hydrant testing data was collected, including test hydrant flow rates and residual hydrant pressures, from select locations within the distribution system. To facilitate the data collection, WSC prepared individual data sheets for each hydrant testing location. The hydrant testing locations were selected to: 1) obtain hydraulic data representative of the distribution system; 2) ensure testing was performed in each of the City's pressure zones; 3) match locations from the previous master plan. City Staff performed each hydrant test and recorded all pressure and flow data.

To calibrate the model using the hydrant testing data, modeling scenarios for each hydrant test were developed. Initially the model was loaded with City's average day demand and pipelines were assigned standard or textbook Hazen-Williams friction factors. Individual scenarios for each hydrant test's static condition were created to check for model elevation or pressure gage errors by comparing the static pressures at the residual and test hydrants against the modeled static pressures. Upon approval of the static pressures, individual residual pressure scenarios were developed for each hydrant test. For the residual pressure scenarios, a demand load equal to the test hydrant flow rate was applied to the node representing the test hydrant in the model. The residual hydrant pressure observed during the hydrant test was then compared against the modeled residual pressure at the residual hydrant to check the calibration of the model. The Hazen-Williams friction coefficients for the different pipe materials within the distribution system were then modified to improve the correlation between the

modeled and observed residual pressures at the residual hydrants. The friction coefficients used for the City's water model are shown below.

Table 6.3 - Hazen William Friction Factors

Pipe Material	Hazen Williams C-Factors
ACP	125
CIP	90
COMP	125
DIP	115
GALV	125
PVC	120
STL	125

To compare the differences between the observed pressures and the modeled pressures from the calibrated model, a model correlation plot was developed. Plotting modeled versus observed values should create a 45 degree line to show adequate correlation.

6.3.8 Water System Evaluation

To evaluate the need for improvements to the City's water distribution system, the calibrated model was used to analyze the distribution system's ability to maintain minimum pressures, meet fire flow requirements and operate within the pipeline velocity restrictions. The specific evaluation criteria utilized for the water system evaluation is contained in the Capital Improvement Program and where appropriate the CIP projects were supported with water model runs.

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Section 7 - Water Quality

The Safe Drinking Water Act (SDWA) directs the United States Environmental Protection Agency (EPA) to establish minimum national drinking water standards. These standards set limits on the amounts of various substances sometimes found in drinking water. The City of Arroyo Grande consistently delivers water that meets applicable quality standards. This Chapter contains the following sections:

(1) Groundwater
(2) Disinfection
(3) Water Quality Summary

7.1 Groundwater

Several of the City's wells have historically produced water that is either near or exceeds the maximum contaminant level (MCL) for nitrates or iron/manganese. In past years, the City implemented a blending strategy to ensure that the water delivered to its customers did not exceed any of the primary or secondary MCLs. The blending strategy consisted of the following two blending scenarios to avoid violating nitrate or iron/manganese MCLs.

1. Blend water from Well No. 7 (high iron/manganese) with the other shallow wells (high nitrates)
2. Blend water from the wells with surface water from the Lopez WTP

Recent water quality analysis indicates that the nitrate concentrations in these wells have decreased significantly in recent years; this is attributed to decreased agriculture activities in the area overlying the groundwater basin. Additionally according to City Staff, none of the City's wells in the Arroyo Grande Basin currently exceed any of the EPA's primary or secondary MCLs.

The City continues to blend surface water from the Lopez WTP with the Arroyo Grande Basin groundwater to provide a more consistent water quality to its customers.

Water from Wells 9 & 10, located in the Pismo formation, contains iron, manganese and hydrogen sulfide at levels that exceed MCLs or requires treatments prior to delivery to the City's customers. The City currently operates a Culligan Cullsorb® treatment system at each of these wells. These treatment systems utilize potassium permanganate and proprietary media to remove iron, manganese and hydrogen sulfide through oxidation, ion exchange and particle entrapment.

7.2 Disinfection

The City uses a combination of chlorine and ammonia to produce chloramines to achieve and maintain disinfection within its distribution system.

7.2.1 Chloramines

For the Arroyo Grande Basin wells, the City utilizes two chemical feed pumps to dose Sodium Hypochlorite and ammonium sulfate (25%) to maintain a chlorine to ammonia ratio around 5:1. The flow rates for the two chemical feed pumps are paced on the combined flow rate from all of the Arroyo Grande Basin wells. The chlorine and ammonia are injected into the water on the discharge side Wells 7 and 8, before the connection of the other wells. Therefore, Well 7 and/or 8 must be running to disinfect water pumped from any of the other Arroyo Grande Basin wells (Wells #1, 3, 4, 5, 7, and 8).

Sodium Hypochlorite and Ammonium Sulfate are used to develop the chloramine disinfectant residual at Wells 9 &10. The chemical feed pumps for Wells 9 & 10 are not paced on flow, but are manually set to a constant flow rate due to the consistent flow rates of the these wells.

The Lopez WTP uses chlorine dioxide as its primary disinfectant and chloramines as the secondary disinfectant and to maintain disinfectant residual in the distribution system. Through the consistent use of chloramines as the disinfectant for its wells, the City is able to maintain a stable chloramine residual in its distribution system where groundwater is blended with the purchased surface water supplies from the Lopez WTP.

7.2.2 Nitrification

Nitrification is a biological process that can degrade water quality and deplete the disinfection residual in chloraminated water. Nitrite oxidizing bacteria feed on free ammonia and convert it to nitrite and then nitrate. This process can lead to the breakdown of the chloramine molecules and the loss of disinfectant residual within the distribution system.

To monitor for nitrification within its distribution system, the City performs weekly monitoring of its storage water reservoirs for the following constituents: total chlorine residual; nitrite; and pH. To prevent nitrification the City performs a uni-directional flushing program, maintains a chlorine to ammonia ratio approaching 5:1 and reduces residence time in its distribution system during the summer months. If nitrification or the loss of disinfection residual is detected in its distribution system, the City shock chlorinates its storage water reservoirs with free chlorine to destroy any nitrifying bacteria and to maintain a disinfection residual in its distribution system.

7.3 Water Quality Summary

Table 1 contains a summary of the water quality constituents detected in each of the City's three sources of water in 2010. As shown, in the water quality summary the City delivers water that meets the federal and state standards for drinking water quality. Acronyms used are defined below:

LI – Langelier Index

NA – Not Applicable

ND – Not Detected

NTU – Nephelometric Turbidity Unit

pCi/L – picoCuries per liter (a measure of radiation)

PPB – Parts Per Billion

PPM – Parts Per Million

TON – Threshold Odor Number

TT – Treatment Technique

Table 7.1 - 2010 Water Quality Summary

Detected contaminants with a Primary Drinking Water Standard (Average Value)					
Parameter	**Units**	**MCL**	**Lopez WTP**	**State Water**	**Groundwater**
Aluminum	ppb	1000	ND	70	ND
Arsenic	ppb	10	2.2	ND	ND
Fluoride	ppb	2000	0.35	ND	257
Nitrate	ppm	45	ND	ND	16.5
Selenium	ppb	50	ND	ND	6.4
Haloacetic Acids	ppb	60	ND	14	23.8[1]
Total Chlorine Residual	ppm	4	2.1	2.2	1.67[1]
Chlorite	ppb	1000	0.75	ND	ND
Chlorine Dioxide	ppb	800	67	NA	ND
Total Organic Carbon	ppm	TT	ND	1.8	ND
Nitrate & Nitrite as N	ppm	10000	ND	ND	7056.6
Gross Alpha Particle Activity	pCi/L	15	0.8	ND	4.2
Total Coliform Bacteria	%	5% of Monthly Samples	0.16	ND	0
Total Trihalomethanes	ppb	80		40	34.8
Detected constituents with a Secondary Drinking Water MCL (Average Value)					
Parameter	**Units**	**MCL**	**Lopez WTP**	**State Water**	**Groundwater**
Aluminum	ppb	200	5	90	ND
Chloride	ppm	500	23.9	83	46.6
Iron	ppb	300	ND	ND	ND
Manganese	ppb	50	ND	ND	1.5
Color	CU	15	3	ND	ND
Corrosivity	LI	Noncorrosive		Noncorrosive	Noncorrosive
Odor Threshold	TON	3	2.3	1	1.1
pH	Std. Units	6.5 - 8.5	8.12	8.3	7.5
Specific Conductance	(micromhos)	1600	662	527	832.8
Sulfate	ppm	500	98	93	138.3
Turbidity	NTU	5	0.08	0.06	0.06
Total Dissolved Solids	ppm	1000	390	328	565.7
Detected contaminants without a Drinking Water Standard (Average Value)					
Parameter	**Units**	**MCL**	**Lopez WTP**	**State Water**	**Groundwater**
Alkalinity as Ca CO3	ppm		220	77	220
Calcium	ppm		60	37	86.4
Hardness	ppm		290	68	355.7
Magnesium	ppm		34	6.7	38.4
Potassium	ppm		ND	1.8	2.6
Sodium	ppm		27	32	47.3
Vanadium	ppb		ND	ND	3.5

Notes: These samples results are from the distribution system only.

Section 8 - Operations and Controls

The operation and control of the City water system is based primarily on tank level within the various pressure zones as described below:

8.1 Main City Zone

The Main City Zone, also known as the gravity pressure zone, is fed by a combination of Lopez water from the two turnouts and well water. Reservoirs 1, 2, and 4 are contained within the zone, and wells are generally activated automatically by tank level in Reservoir No. 1. Operations personnel pre-set the wells that will be activated each day, which always include either Well No. 7 or 8 for disinfection purposes as described in Chapter 8. The Brisco Booster Station is also typically activated for blending when wells are being used.

8.2 High Pressure Zones

The two high pressure zones within the City are fed by booster pumps which are activated based on time of use and tank level. In event of a pump station failure, the Rancho Grande Zone can be supplied by a Fire Department pumper truck through an emergency manifold connection installed adjacent to Reservoir No. 2. The high pressure zones are separated from the low pressure zones by check valves or Pressure Reducing Valves (PRV) stations.

8.3 Supervisory Control and Data Acquisition System (SCADA)

The water system controls are accessible at the City corporation yard through a SCADA system. This system allows each tank, pump, well, and Lopez turnout to transfer status information to a central location. In addition, wells, motorized valves, and booster pumps can be activated at the central control panel. SCADA is also useful for collecting and trending data.

The existing SCADA System is functional and currently meets the operational requirements of the City. Due to aging radios, forthcoming Federal Communications Commission (FCC) narrowbanding requirements, and the City's reliance on a single SCADA workstation; it is warranted that the City begin planning for two separate SCADA System upgrade projects. The recommended projects are: a SCADA Software Upgrade Project utilizing Cannon Corp, or other qualified firm, as the integrator; and a Radio Communications Systems Replacement Project utilizing a turnkey approach with a radio communication specialist to furnish new radios and appurtenances. The existing field installed programmable logic controllers (PLCs) are functional and have spare parts available; therefore it is recommended that the City continue using these PLCs.

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Section 9 - Recommendations and Capital Improvements

The results of this study are presented in this chapter as the recommended Master Plan and Capital Improvements Project program for water system facilities in the City of Arroyo Grande. The Master Plan consists of staged improvements to correct existing deficiencies and provide for future system expansion. Cost estimates were prepared and used to develop a capital cost program.

The proposed improvements are needed to correct existing water system deficiencies and provide for the ultimate build out of the system within the existing City boundaries. The water system was evaluated using the WaterGEMS water system modeling program which identified pressures and velocities throughout the system for the specified flow conditions. These flow conditions are those expected to be experienced by the water system. The supply system (Lopez water and wells) and storage tanks were evaluated for their ability to meet the build-out demands of the system under maximum use conditions.

In addition to meeting flow and velocity requirements, the recommended distribution improvements have been selected to provide system reliability. Distribution lines were looped or laid out in a grid pattern where possible to increase the operational ability to work around failures or other emergencies. This chapter outlines the methodologies used to identify the projects recommended in this CIP and to develop project cost opinions.

9.1 Data Collection and Field Investigations

Data collection included City reports, customer water usage and water production data, existing water and sewer models, and a GIS land use database. In addition, City staff members were interviewed to gain insight on current operation of the water and sewer systems and areas known to need improvement. Site visits were performed of all wells, booster stations, reservoirs, and lift stations to review facility condition. As supplemental work, a detailed well condition based assessment (CBA) was performed.

Water distribution performance criteria were gathered through fire hydrant flow testing. A testing protocol was developed and City staff was utilized to perform the testing. The results were used to calibrate the water system hydraulic model.

9.2 Mapping, Population, Land Use and Demand Projections

The water system map was updated to reflect the current systems. This process was an iterative process to create maps that are as accurate as possible based on the available information.

The population served by the City's water distribution system was estimated using 2010 Census data for the City of Arroyo Grande, adjusted to exclude connections within the City limits that are not served by the City and to include connections outside of City limits that are served by the City.

The current and buildout acreage by land use category was estimated using City land use data and a 2009 Preliminary Housing Opportunity Sites Inventory (Inventory) provided by the City. The land use data provided the number of acres of each land use category at buildout. The Inventory provided a list of parcels with development potential including the parcel acreage, existing number of dwelling units, and estimates of the number of potential dwelling units that could fit within each parcel. WSC used the data provided in the Inventory to estimate the undeveloped acreage by land use. The current developed acreage for each land use category was estimated by subtracting the estimated undeveloped acreage identified in the Inventory from the buildout acreage for each land use category.

Water demands throughout the City's distribution system was geospatially allocated based on customer records. The geospatially allocated demands coupled with the land use data allowed for a calculation of land use demand factors (AFY/acre) for each of the City's land use categories. Using the buildout land use data and the calculated demand factors, the water demands were projected at buildout.

9.3 Water Quality and Supply Evaluation

The City's water supply, supply reliability, and supply redundancy, was evaluated and an assessment was performed of the City's water quality based on the 2010 consumer confidence report.

9.4 Water Distribution Hydraulic Analysis

Based on updated mapping, a WaterGEMS® model was created of the City's water distribution system. The water model was calibrated using the fire hydrant flow test results and was compared to the hydraulic model. The model was used to identify existing and future system deficiencies.

9.5 SCADA System Evaluation

An evaluation of the City's SCADA system was performed by interviewing the City's integrator and field visits were conducted to various SCADA sites to understand the City's current SCADA system and identify deficiencies.

9.6 Cost Preparation

The cost opinions (estimates) included in this CIP are based upon the Class 4 Conceptual Report Classification of Opinion of Probable Construction Cost as developed by the Association for the Advancement of Cost Engineering (AACE) Cost Estimate Classification System. The purpose of a Class 4 Estimate is to provide a conceptual level effort that has an expected accuracy range from -30% to +50% and the inclusion of an appropriate contingency for planning and feasibility studies. The conceptual

nature of the design concepts and associated costs presented in this CIP are based upon limited design information available at this stage of the projects. These cost estimates have been developed using a combination of data from RS Means CostWorks®, recent bids, experience with similar projects, current and foreseeable regulatory requirements, specific City requirements, and an understanding of the necessary project components. As the projects progress, the design and associated costs could vary significantly from the project components identified in this CIP.

The recommended projects and these cost opinions are based on the following assumptions:

1. For projects where applicable cost data is available in RS Means CostWorks® (e.g. pipeline replacement), cost data released in Quarter 4 of 2011, adjusted for San Luis Obispo, California, is used. Material prices were adjusted in some cases to provide estimates that align closer with actual local bid results.
2. For projects where RS Means CostWorks® data is not available, cost opinions are generally derived from bid prices from similar projects, vendor quotes, material prices, and labor estimates, with adjustments for inflation, size, complexity, and location.
3. Cost opinions are in 2011 dollars. When budgeting for future years, appropriate escalation factors should be applied (ENR Construction Cost Index of: 9171.73 for December 2011).
4. Cost opinions are "planning-level" and may not fully account for site-specific conditions that will affect the actual costs, such as soils conditions, and utility conflicts.
5. Per the City's standards, design services, which includes an allowance for alternatives analysis, design phase engineering, surveying, and permitting, are included at a rate of 15 percent of the estimated construction cost.
6. Per the City's standards, contract administration services during construction are included at a rate of 10 percent of the estimated construction cost.
7. Per the City's standards, a construction contingency of 10 percent of the estimated construction cost has been included.

9.7 Water System Program Summary

The water system project recommendations address improvements to source of supply, production and distribution facilities. The projects have been divided into three groups, Priority A, B, and C, where Priority A projects have the highest priority. In general, Priority A projects are needed to comply with current or anticipated future regulations, correct recurring failures, address significant safety concerns (including correcting fire flow that is well under the required flow), or ensure that adequate water supplies are available to meet projected demands. Priority B projects address longer-term needs, often related to future growth or improvements that enhance system reliability or other low-level risks. Priority C projects include the recommended long term annual or recurring projects.

The table below provides a summary of the water system CIP projects. Detailed project descriptions, which include scope, purpose, alternatives, and estimated project duration and cost, are described below.

Table 9.1 - Water System Project Summary

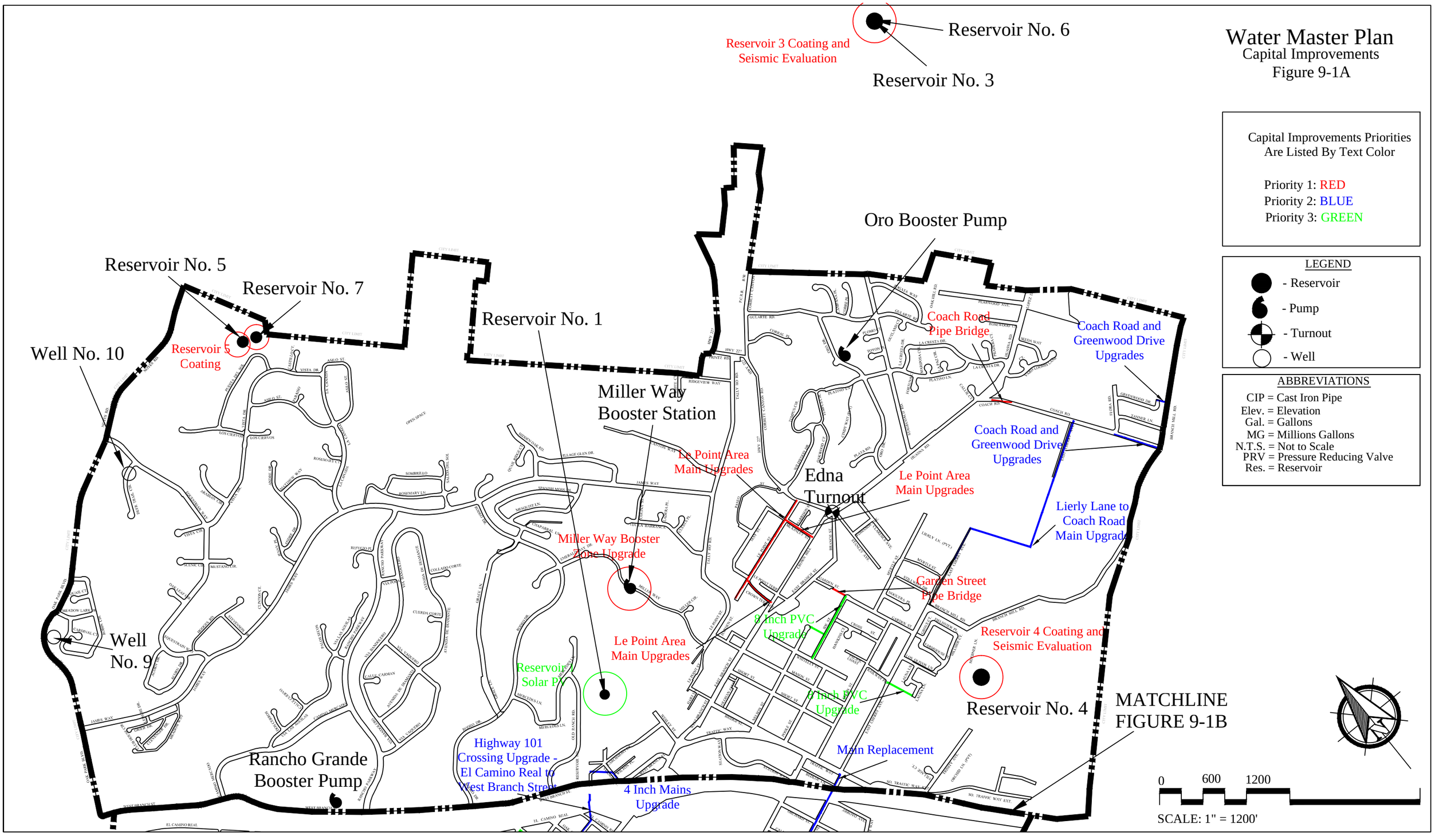
Project	Project Name	Size	Opinion of Total Project Cost
Priority A – Five Year (2013-2017)			
A-1	Leanna Drive Creek Crossing Upgrade	365-LF	$486,000
A-2	SCADA Radio Upgrades	N/A	$40,000
A-3	Reservoir 3 and 4 Coating and Seismic Evaluation	N/A	$695,100
A-4	Phased Mains Replacement – Fairs Oaks	650-LF	$140,000
A-5	Reservoir 7	500,000 gal	$857,600
A-6	Galvanized Service Replacement (25 per year)	125-LF	$287,500
	Priority A Subtotal		**$3,531,100**

Project	Project Name	Size	Opinion of Total Project Cost
Priority B – 15 Year (2018-2027)			
B-1	Reservoir 5 Coating and Seismic Evaluation	N/A	$402,200
B-2	Coach Road and Garden Street Pipe Bridges Evaluation	510-LF	$68,200
B-3	SCADA Software/Electronics Upgrade	N/A	$187,400
B-4	Highway 101 Crossing Upgrade – El Camino Real to West Brach Street	415-LF	$454,600
B-5	Highway 101 Crossing Upgrade – West Cherry Avenue	280-LF	$358,600
B-6	Phased Mains Replacement	3,865-LF	$1,018,050
B-7	Le Point Area Main Upgrades	2,640-LF	$661,600
B-8	Well Evaluation and Rehabilitation	N/A	$173,000
B-9	Galvanized Service Replacement (25 per year)	940 EA	$2,162,000
B-10	Lierly Lane to Coach Road Upgrade	3,245-LF	$288,800
B-11	Well 4 Minor Rehabilitation	N/A	$121,300
B-12	Well 5 and 8 Maintenance	N/A	$120,000
B-13	Well Siting Study	N/A	$55,000
	Priority B Subtotal		**$6,070,750**

Project	Project Name	Size	Opinion of Total Project Cost
Priority C – 25 Year (2028-2037)			
C-1	New Well	800-gpm	$1,134,900
C-2	Miller Way Booster Zone Upgrade	75-gpm	$136,600
C-3	Security Upgrades	N/A	$47,100
C-4	Coach Road and Greenwood Drive Upgrades	1,385-LF	$267,600
C-5	Reservoir 1 Solar PV	81 kW_{DC}	$448,800
C-6	Galvanized Service Replacement (25 per year)	940 EA	$2,162,000
C-7	4-inch Mains Upgrades	11,600-LF	$2,162,000
C-8	Phased Mains Replacement	3,865-LF	$1,018,000
C-9	Routine Reservoir Maintenance	N/A	$9,600
	Priority C Subtotal		**$8,162,450**
			$16,739,400

Summary	Opinion of Total Project Cost
Priority A – Five Year (2013-2017) Subtotal	$3,531,100
Priority B – 15 Year (2018-2027) Subtotal	$6,070,750
Priority C – 25 Year (2028-2037) Subtotal	$8,162,450
Total	**$16,739,400**

Water Master Plan
Capital Improvements
Figure 9-1A



Capital Improvements Priorities Are Listed By Text Color

Priority 1: RED
Priority 2: BLUE
Priority 3: GREEN

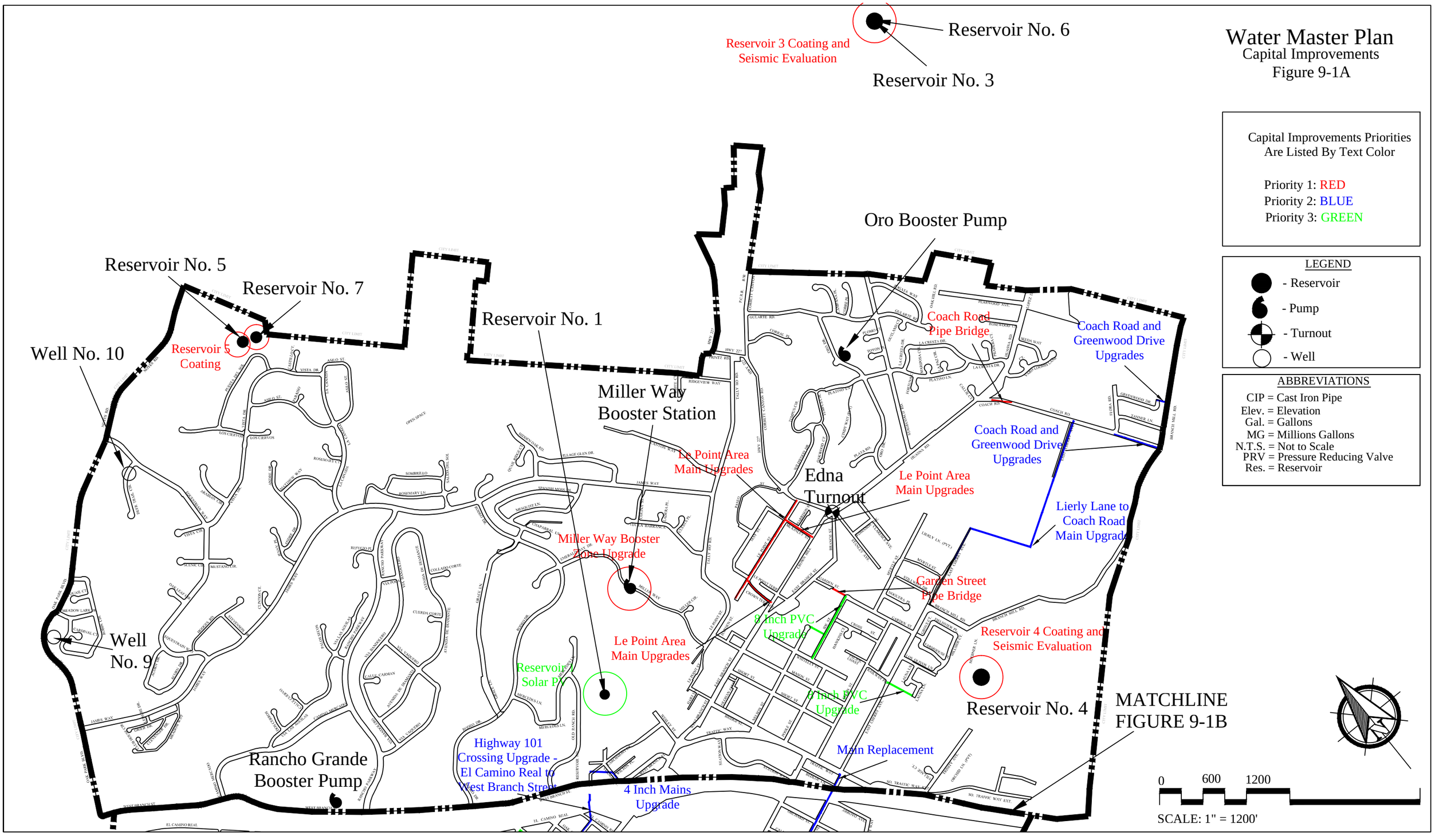
LEGEND

- Reservoir
- Pump
- Turnout
- Well

ABBREVIATIONS

CIP = Cast Iron Pipe
Elev. = Elevation
Gal. = Gallons
MG = Millions Gallons
N.T.S. = Not to Scale
PRV = Pressure Reducing Valve
Res. = Reservoir

Water Master Plan
Capital Improvements
Figure 9-1A



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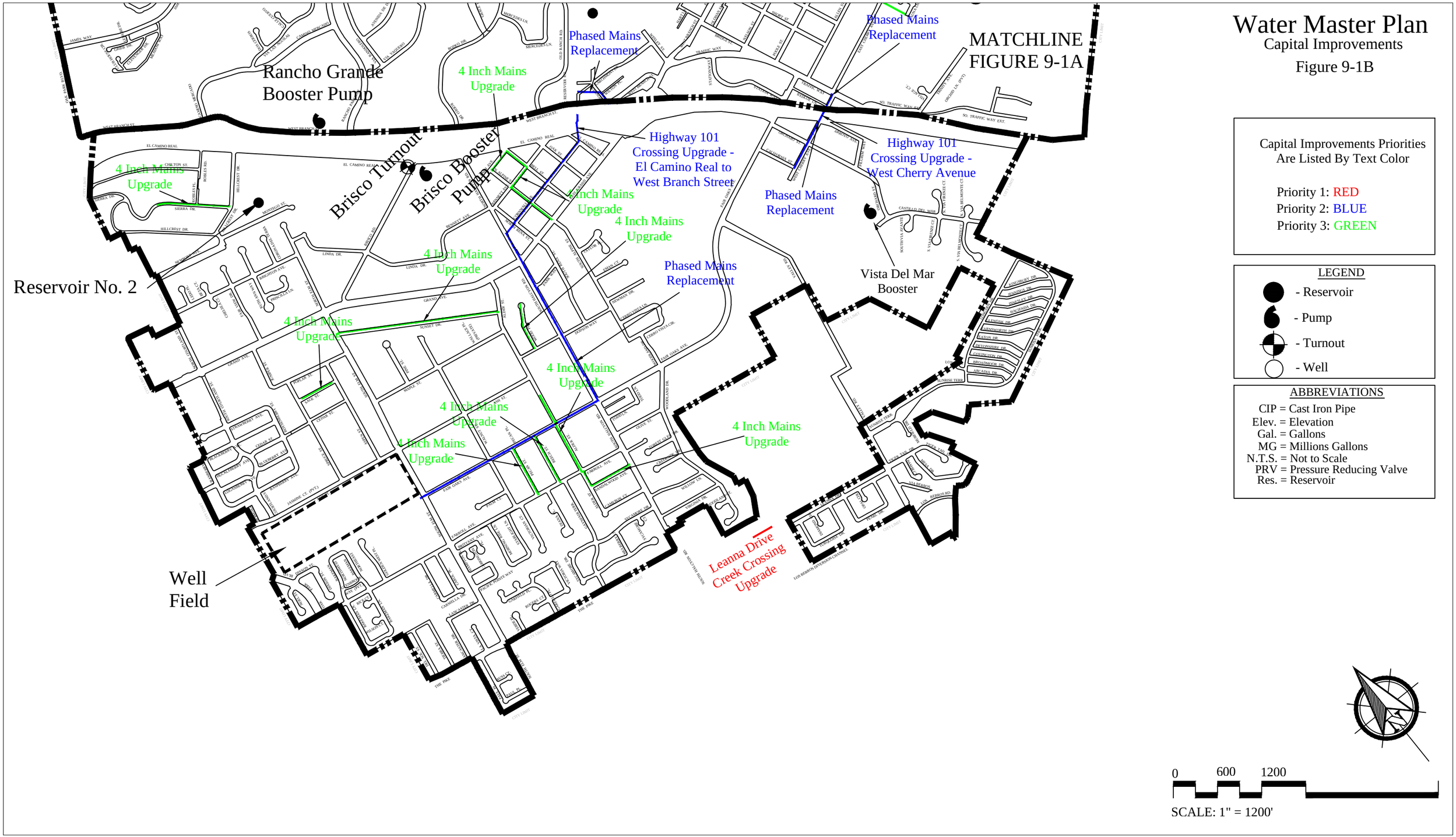
Water Master Plan

Capital Improvements

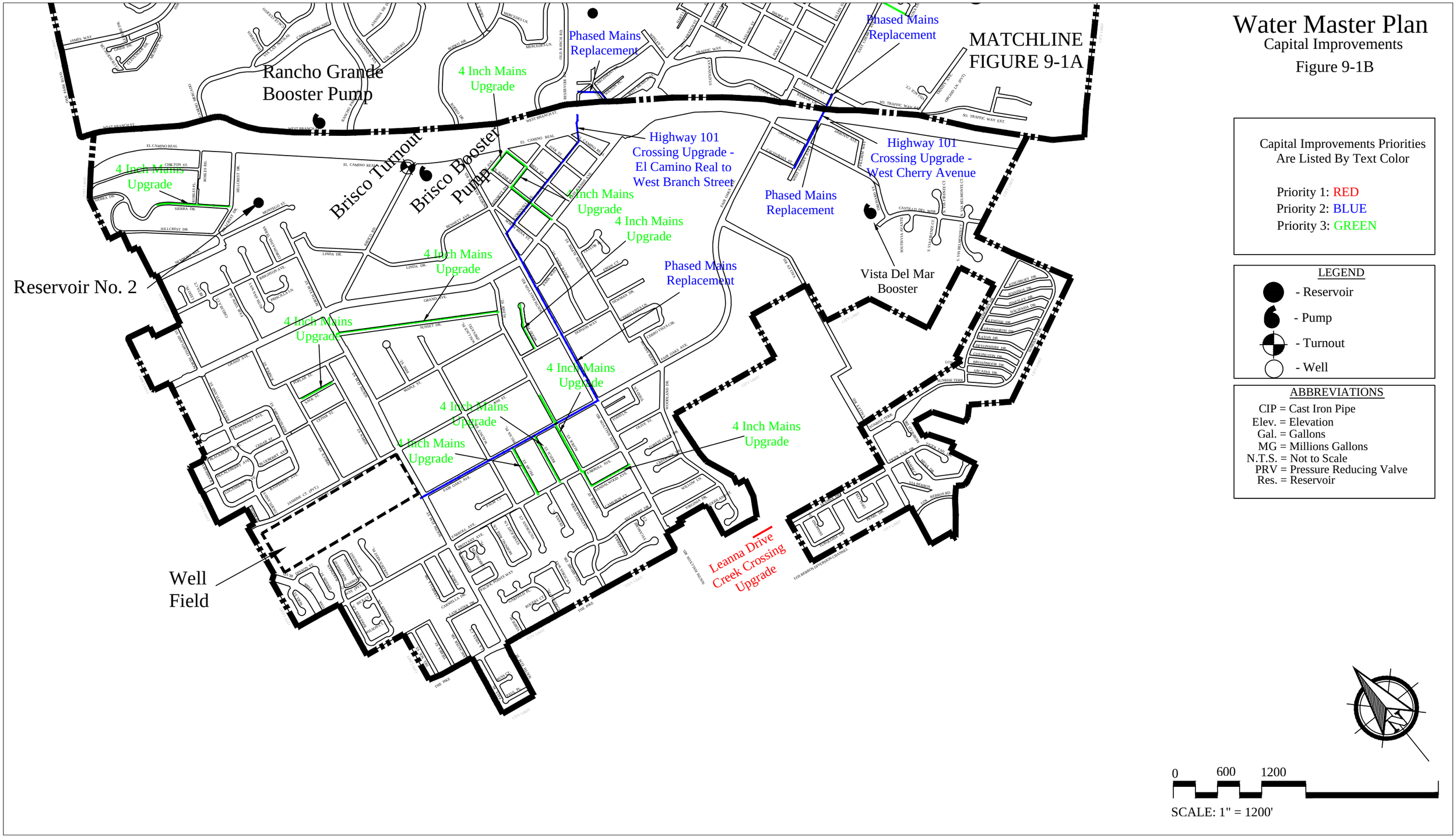
Figure 9-1B



Water Master Plan

Capital Improvements

Figure 9-1B



9.8 Water System Project Descriptions

This section contains detailed project descriptions for the recommended water system projects. The project descriptions include project scope, purpose, alternatives, and estimated project duration and opinion of probable project cost.

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Project A-1 - Leanna Drive Creek Crossing Upgrade

Design and Permitting:	12-14 months		
Construction:	4 months	Opinion of Total Project Cost:	$ 486,000

Need for Project:

The concrete encasement housing the water main crossing the Arroyo Grande Creek from Leanna Drive is exposed. The concrete encasement is being undermined by stream flow and settling. Record drawings show that the concrete encasement is not reinforced with steel and is therefore unlikely to withstand tension loads. Thus, undermining of the concrete encasement may lead to cracking of the concrete encasement and failure of the water main. The adjacent abandoned sewer force main encasement, which was constructed at the same time as the water main, shows strong evidence of cracking and differential settlement indicating failure of the encasement and the encased pipeline. The City will need to evaluate if the exposed concrete encasements for both the force main and the water main need to be removed from the creek (potential fish passage).

Supporting Information:

An 8-inch ductile iron pipe encased in concrete crosses the Arroyo Grande Creek from Leanna Drive. The pipeline is one of the key connections between the east side of the distribution system which contains Reservoir 4 and the west side of the system which contains the wells and most of the residential users. The pipeline is important for system redundancy and reliability. The concrete encasement is exposed, as shown in the figure below, supporting the concrete encasement is likely being washed downstream, leaving the creek crossing at risk for failure.

Figure 9-2 - Exposed creek crossing from Leanna Drive

Recommended Solution:

It is recommended that the City abandon and remove the existing 8-inch ductile iron pipe and concrete encasement from the creek and replace it with a 12-inch high density polyethylene (HDPE) pipe, installed using horizontal directional drilling (HDD) under the creek. The project length is approximately 365-LF. The project location is shown in the figure below.

The Leanna Drive creek crossing is one of two (2) primary links connecting the southeast part of the service area to the system. Upgrading this creek crossing will increase the reliability of supply in this area. Additionally, the increased capacity resulting from upgrading to a 12-inch pipe will improve fire flow.

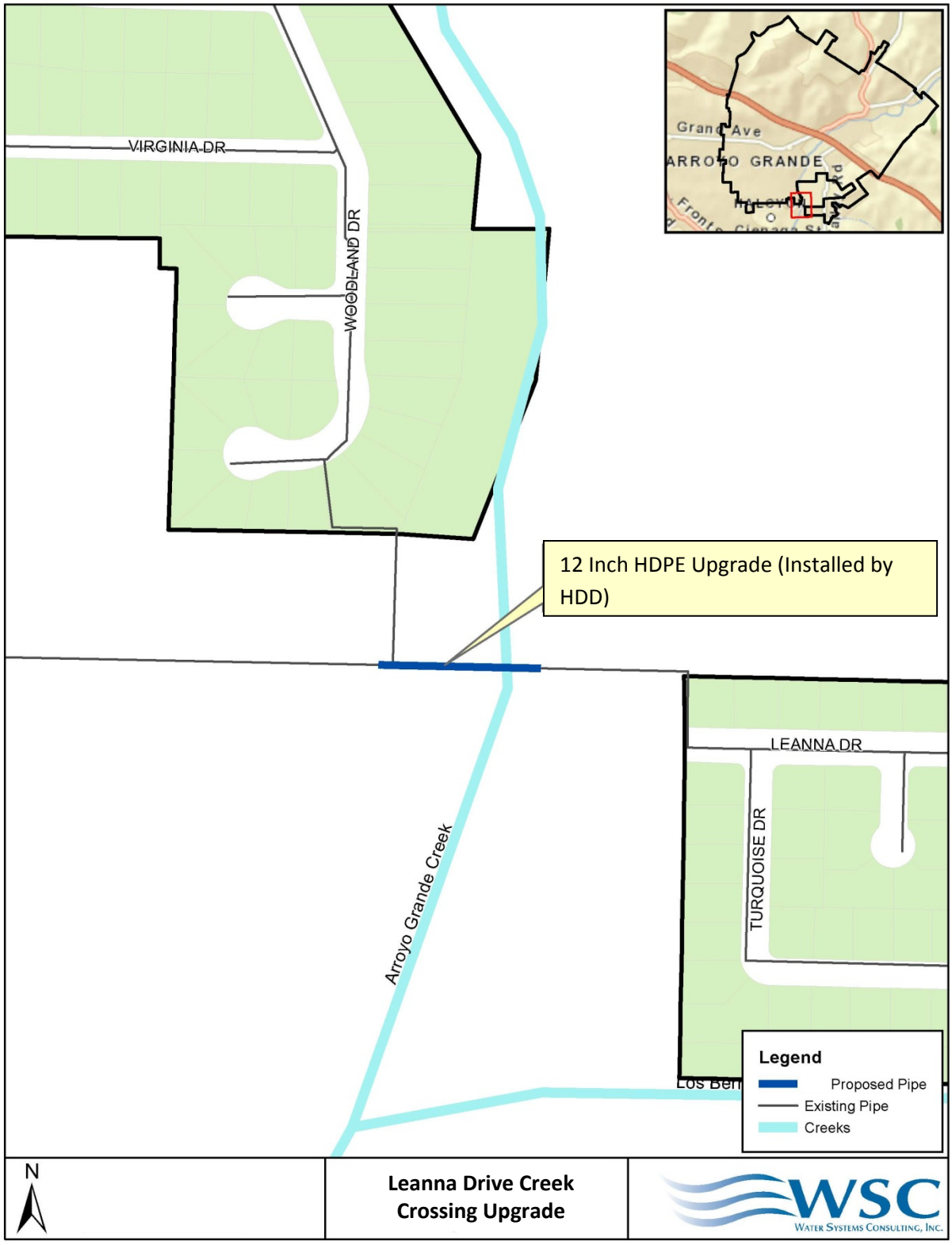

Figure 9-3 - Leanna Drive Creek Crossing Upgrade

Cost Estimate:

Client:	**City of Arroyo Grande**		
Project:	**2011 Water Master Plan Updates**		
Segment:	**A-1**		
Street:	**Leanna Drive Creek Crossing**	**Prepared by:**	JCS
		Reviewed by:	JHR
Opinion of Probable Construction Cost		**Date:**	6/19/2012

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Item Cost
1	Mobilization	1	LS	-	$ 9,800
2	Insurance and Bonds	1	LS	-	$ 9,800
3	Construction Surveying	1	LS	-	$ 4,900
4	Site Clearing and Restoration	1	LS	-	$ 1,600
5	SWPPP Preparation & Implementation	1	LS	-	$ 5,400
6	Traffic Control	2	Day	$ 500	$ 1,000
7	Water Main Construction				
7.1	Pavement Removal & Repair for Trench	3	SY	$ 591	$ 1,800
7.2	Trenching/Compaction/Fill/Hauling	22	CY	$ 45	$ 1,000
7.3	Abandon Existing Water Main	1	LS	$ 2,300	$ 2,300
7.4	Water Main (Furnish and Install)[1]				
7.4.1	8" - HDPE	0	LF		$ -
7.4.2	10" - HDPE	0	LF		$ -
7.4.3	12" - HDPE	365	LF	$ 49	$ 18,000
7.5	Gate Valves (to Furnish and Install)				
7.5.1	8"	0	EA		$ -
7.5.2	10"	0	EA		$ -
7.5.3	12"	2	EA	$ 2,750	$ 5,500
7.6	Fittings (Furnish and Install)	1	LS	$ 8,100	$ 8,100
7.7	Pressure Reducing Valves	0	EA		$ -
7.8	Horizontal Directional Drilling (HDD)	365	LF	$ 700	$ 255,500
7.9	Remove Concrete Encasements from Creek	1	LS	$ 33,000	$ 33,000
8	New Meter and Service				
8.1	1" Water Service from Main to Meter	1	EA	$ 2,300	$ 2,300
9	Fire Hydrants				
9.1	Fire Hydrant Assembly (Furnish and Install)	0	EA		$ -
9.2	Existing Fire Hydrant to be Removed	0	EA	$ 500	$ -

Subtotal 1:	$ 360,000
Construction Contingency (10%):	$ 36,000
Design (15%):	$ 54,000
Contract Administration (10%):	$ 36,000
Total Project Cost:	**$ 486,000**

Note 1: The linear feet of pipe in the opinion of cost may not exactly match the project length described in the CIP because the linear feet of pipe shown in the cost opinion includes a linear footage allowance for making connections to the existing water distribution system based on the preliminary project alignment.

Project A-2 - SCADA Radio Upgrades

Design and Permitting:	2 months		
Construction:	2 months	Opinion of Total Project Cost:	$ 40,000

Need for Project:

The existing radios are near the end of their useful life and are not compliant with new FCC bandwidth requirements that become effective January 1, 2013.

Supporting Information:

The existing radios are near their useful life (15 years) and are no longer supported by the manufacturer for spare parts and/or replacement units. More importantly, there is an FCC deadline to migrate to narrower bandwidths. "Narrowbanding" refers to a requirement by the FCC that on or before January 1, 2013 all existing licensees on the UHF (421-512 MHz) spectrum implement equipment designed to operate on channel bandwidths of 12.5 kHz or less or that meets a specific efficiency standard. Licensees will need to convert or replace their existing UHF wideband 25 kHz systems. The City radios are 25 KHz; hence need to be replaced. Ultimately the FCC may narrow the operational range to bandwidths of 6.25 kHz but no such deadline has been set for this second phase of narrowbanding. Refer to the SCADA System Technical Memorandum.

Recommended Solution:

It is recommended that the City replace the legacy radios with newer units that meet the ultimate 6.25 kHz bandwidth. The City radio system has reliable radio paths utilizing licensed radios. The radio paths, since proven, are not recommended for change. The majority of the existing licensed radios are Teledesign model TSI9600. While the Teledesign TSI9600 radios are functional, they are no longer supported by Teledesign, nor support the ultimate 6.25 kHz narrowbanding FCC requirements. The radio communication equipment should be planned for system wide replacement. The City radio system utilizes licensed frequencies, 453.81250 MHz / 458.81250 MHz. There are numerous advantages with remaining with licensed radios and the current path alignment: as proven radio path performance, reuse of existing infrastructures (poles, antennas), reduction of interference and/or noise associated with spread spectrum unlicensed radios.

New radios offer greater functionality and configurable modes, enhanced security and even multiple communication network technologies. For example, GE Digital's MDS radios can have both serial and Ethernet network connections on the same radio.

While Ethernet based radio network allows for improved security, and is the direction of radio technology, there are drawbacks. Utilizing an Ethernet network for radio communication will add Ethernet "overhead" to the data stream, thereby reducing the available bandwidth for actual data. Typically with Ethernet radios, the network polling time is extended from what was needed with serial based radios. Therefore, it is recommended that the City stay with serial communications for their radio network.

Since the radio communication is the crux of the SCADA system, it is recommended to have a radio communication specialist provide a turnkey project. The communication specialist shall design the radio system, furnish and install the radios and necessary components, test existing repeaters, antenna cables and antennas for total system performance, all with guaranteed and factory trained workmanship. The City would benefit by obtaining desired radio equipment, direct disconnect pricing, elimination of multiple mark ups and single point responsibility for the communication element of their SCADA system. Additional detail on the analysis and recommendations are provided in SCADA System Technical Memorandum.

Alternatives:

Due to new FCC regulations, there are no alternatives to upgrading the system. Specific design alternatives for the radio system will be identified by the radio communication specialist at the time of installation.

Budget Discussion:

Estimated costs for this project are as follows:

Design (15%):	$	2,000
Contract Administration (10%):	$	1,000
Construction Contingency (10%):	$	1,000
Project Construction:	$	36,000
Opinion of Total Project Cost:	$	40,000

A detailed breakdown of the construction costs for this project is shown in the Appendix.

Project A-3 - Reservoir 3 and 4 Coating and Seismic Evaluation

Design and Permitting:	10 months	Opinion of Total Project Cost (Coating and Seismic Evaluation):	$ 695,100
Construction:	8 months	Seismic Retrofit Allowance:	$ 600,000

Need for Project:

The interior and exterior coating on Reservoir 3 and 4 show signs of failure. A new coating system needs to be applied to each reservoir to preserve the steel tanks and protect water quality. In addition, the tanks are not equipped with a seismic restraint system. Although a seismic retrofit is not required statutorily when a new coating system is applied, seismic improvements are recommended to reduce risk of failure and improve public safety.

Supporting Information:

The interior surfaces of Reservoir 3 and 4 are coated with coal tar enamel. The useful life of coal tar enamel when used to coat water storage tanks is relatively long and can exceed 50 years. Inspections provide a more accurate picture of the condition and remaining useful life of the coating systems of each tank. Reservoir 3 and 4 were last inspected in 2003, by Dive/Corr, Inc. A brief discussion of each reservoir and the coating condition follows. For a more detailed description of condition, refer to the tank inspection reports.

- Reservoir 3: Reservoir 3 was built in 1978, and has not been coated since its initial coating was applied when it was built. The existing interior coating is coal tar enamel and the existing exterior coating is enamel paint. In 2003, both the interior and exterior of Reservoir 3 was inspected. The inspection report noted that the exterior coating was in fair condition and the interior coating was in the poor condition. The roof showed increased deterioration since the 1996 inspection. The inspectors listed Reservoir 3 as the highest priority for coating. The figures below show the interior coating in 2003 and the exterior coating in 2011.

Figure 9-4 - Reservoir 3 Interior Coasting (2003)

Figure 9-5 - Reservior 3 Exterior Coasting (2011)

- Reservoir 4: Reservoir 4 was built in 1982, and has not been coated since its initial coating was applied when it was built. The existing interior coating is coal tar enamel and the existing exterior coating is enamel paint. In 2003, both the interior and exterior were inspected. The 2003 inspections found the internal and external coating to be in good condition. In 2007, the City inspected Reservoir 4 again and identified cracks in the coating that resulted from an earthquake. The figures below show the interior and exterior coating, respectively, in 2003.

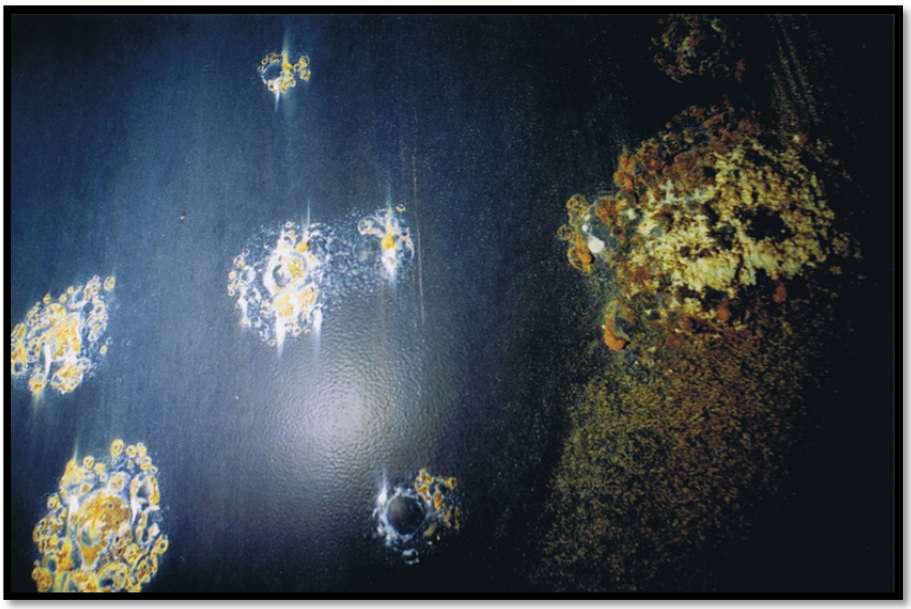

Figure 9-6 - Reservoir 4 Interior Coating (2003)

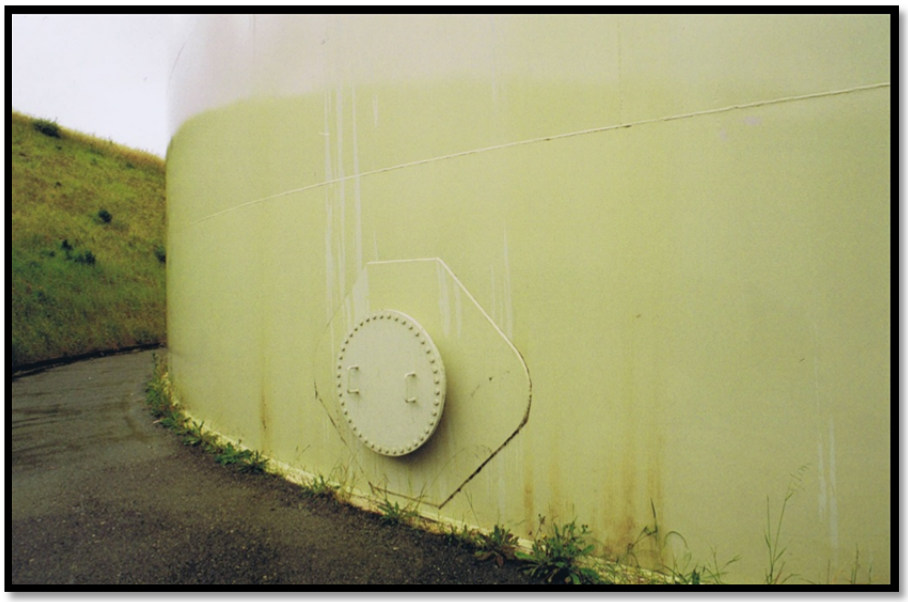

Figure 9-7 - Reservoir 4 Exterior Coating (2003)

Reservoir 3 and 4 are not equipped with a seismic restraint system. According to industry experts, the tanks are not required to be brought up to current seismic requirements unless changes are made that affect the lateral force resisting system by more than 5%. Thus, performing the coating upgrades does not require the City to upgrade the tanks to meet current seismic standards. Although not required, the City may choose to perform seismic retrofits for public safety reasons.

Recommended Solution:

It is recommended that the City apply a new coating system to Reservoir 3 and 4, and perform a seismic evaluation of the tanks, as described here:

(1) Coat the interior and exterior of Reservoir 3 and 4 with an appropriate coating system such as a high-solids epoxy. When the interior of Reservoir 4 is coated, Reservoir 4 should be considered for retrofit with an interior tank mixing system.
(2) Perform a seismic evaluation of Reservoir 3 and Reservoir 4. A seismic evaluation involves inspection and analysis of the tank by a structural engineer and is the first step of a seismic retrofit project. The scope and cost of the seismic retrofits can vary significantly and cannot be determined until a seismic evaluation is performed.

After the seismic evaluation is completed, it is recommended that the City upgrade Reservoir 3 and 4 to meet current seismic requirements as determined by a structural engineer (e.g. through installation of ring wall and anchor bolts).

Budget Discussion:

Estimated costs for the new coating system and seismic evaluation for Reservoirs 3 and 4, and an interior tank mixing system for Reservoir 4 are as follows:

Design (15%):	$	77,200
Contract Administration (10%):	$	51,500
Construction Contingency (10%):	$	51,500
Project Construction:	$	514,900
Opinion of Total Project Cost:	$	695,100

A detailed breakdown of the construction costs for this project is shown below.

The construction costs for the seismic retrofit can vary significantly from approximately $50,000 to over $400,000 per tank depending on the results of the seismic evaluation. Therefore, the project costs for seismic retrofit cannot be estimated until the seismic evaluation is performed. An allowance of $200,000 and $400,000 for the seismic retrofit of Reservoir 3 and Reservoir 4, respectively, is recommended as a budget placeholder. This figure should be modified when the seismic evaluation is complete.

Client:	**City of Arroyo Grande**				
Project:	**2011 Water Master Plan Updates**				
Number:	**A-3**				
Description:	**Reservoir 3 and 4 Coating and Seismic Evaluation**			**Prepared by:**	JCS
				Reviewed by:	JHR
Opinion of Probable Construction Cost				**Date:**	6/19/2012

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Item Cost
1	Mobilization	1	LS	$ 14,400	$ 14,400
2	Insurance and Bonds	1	LS	$ 14,400	$ 14,400
3	Construction Surveying				
4	Site Clearing and Restoration				
5	SWPPP Preparation & Implementation	1	LS	$ 5,000	$ 5,000
6	Traffic Control				
7	New Coating System- Reservoir 3				
7.1	Prepare Interior and Apply New Epoxy Coating	1	LS	$ 69,600	$ 69,600
7.2	Prepare Exterior and Apply New Epoxy Coating	1	LS	$ 16,200	$ 16,200
8	New Coating System- Reservoir 4				
8.1	Prepare Interior and Apply New Epoxy Coating	1	LS	$284,900	$ 284,900
8.2	Prepare Exterior and Apply New Epoxy Coating	1	LS	$ 58,400	$ 58,400
9	Tank Mixing System				
9.1	Reservoir 4 Interior Tank Mixing System	1	LS	$ 25,000	$ 25,000
10	Seismic Evaluations				
10.1	Reservoir 3 Seismic Evaluation	1	LS	$ 12,000	$ 12,000
10.2	Reservoir 4 Seismic Evaluation	1	LS	$ 15,000	$ 15,000
				Subtotal 1:	$ 514,900
				Construction Contingency (10%):	$ 51,500
				Design (15%):	$ 77,200
				Contract Administration (10%):	$ 51,500
				Total Project Cost:	**$ 695,100**

Project A-4 - Phased Mains Replacement – Fair Oaks

Design and Permitting:	See description		
Construction:	See description	Opinion of Total Project Cost:	$ 140,000

Need for Project:

The existing cast iron mains are at or near the end of their useful life. Pipe coupons show evidence of severe tuberculation.

Supporting Information:

Cast iron pipe is estimated to have an expected useful life of 50 to 100 years. The table lists the diameter, length and age of seven (7) pipe segments made of cast iron. Six (6) of these mains were installed 80 or more years ago and one (1) was installed over 50 years ago. They are expected to be at or near the end of their useful life. This is supported by cast iron pipe coupons and pieces of removed cast iron pipe provided by the City, which show signs of severe tuberculation. Tuberculation is the irregular buildup of corrosion scale and associated biofilm inside a cast iron pipe over time leading to decreased pipeline capacity, increased use of chlorine residual, and potential water quality complaints (e.g. red or brown water complaints, taste and odor complaints). The figures below show a piece of tuberculated cast iron pipe recently removed from Arroyo Grande's distribution system.

Figure 9-8 - Tuberculation in Removed Old Cast Iron Pipe

Recommended Solution:

It is recommended that the City replace the 350 LF of cast iron water main on Fair Oaks Avenue from Halcyon Rd west to Alder Street.

Cost Estimate:

Client:	**City of Arroyo Grande**				
Project:	**2011 Water Master Plan Updates**				
Segment:	**A-4**				
Street:	**Phased Main Replacement-Fair Oaks Av**			**Prepared by:**	JCS
				Reviewed by:	JHR
Opinion of Probable Construction Cost				**Date:**	6/19/2012

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Item Cost
1	Mobilization	1	LS	-	$ 12,700
2	Insurance and Bonds	1	LS	-	$ 12,700
3	Construction Surveying	1	LS	-	$ 6,400
4	Site Clearing and Restoration	1	LS	-	$ 2,100
5	SWPPP Preparation & Implementation	1	LS	-	$ 8,000
6	Traffic Control	12	Day	$ 500	$ 6,000
7	Water Main Construction				
7.1	Pavement Removal & Repair for Trench	1311	SY	$ 82	$ 107,100
7.2	Trenching/Compaction/Fill/Hauling	1311	CY	$ 44	$ 57,900
7.3	Abandon Existing Water Main	1	LS	$ 500	$ 500
7.4	Water Main (Furnish and Install)[1]				
7.4.1	8" - C900 PVC	2950	LF	$ 18	$ 53,000
7.4.2	10" - C900 PVC	0	LF		$ -
7.4.3	12" - C900 PVC	0	LF		$ -
7.5	Gate Valves (to Furnish and Install)				
7.5.1	8"	20	EA	$ 2,010	$ 40,200
7.5.2	10"	0	EA		$ -
7.5.3	12"	0	EA		$ -
7.6	Fittings (Furnish and Install)	1	LS	$ 27,100	$ 27,100
7.7	Pressure Reducing Valves	0	EA		$ -
8	New Meter and Service				
8.1	1" Water Service from Main to Meter	43	EA	$ 2,305	$ 99,100
9	Fire Hydrants				
9.1	Fire Hydrant Assembly (Furnish and Install)	5	EA	$ 7,380	$ 36,900
9.2	Existing Fire Hydrant to be Removed	5	EA	$ 500	$ 2,500

Note 1: The linear feet of pipe in the opinion of cost may not exactly match the project length described in the CIP because the linear feet of pipe shown in the cost opinion includes a linear footage allowance for making connections to the existing water distribution system based on the preliminary project alignment.

Subtotal 1:	$ 472,200
Construction Contingency (10%):	$ 47,200
Design (15%):	$ 70,800
Contract Administration (10%):	$ 47,200
Total Project Cost:	**$ 637,400**

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Project A-5 - Reservoir 7

Design and Permitting:	12 months		
Construction:	11 months	Opinion of Total Project Cost:	$ 857,600

Need for Project:

The existing storage in the Rancho Grande zone is not sufficient to meet estimated buildout storage requirements. Also, additional storage is needed in the Rancho Grande Zone to allow Reservoir 5 to be taken out of service in order to recoat the tank interior and perform routine cleaning and maintenance.

Supporting Information:

The Rancho Grande zone currently has a single storage reservoir, Reservoir 5, which has a nominal storage capacity of 1.2 million gallons. At buildout, the Rancho Grande zone is expected to require between 1.29 and 1.53 million gallons of storage, as shown in Table 9.2. Without additional storage, the Rancho Grande zone is estimated to have a storage deficit of 330,000 gallons in the Case B scenario (4 hours of PHD and no pumps operating during PHD period).

Table 9.2 - Rancho Grande Zone Buildout Total Storage Requirements

Pressure Zone	Existing Storage Available (Million Gallons)	Required Storage: Case A[1] (Million Gallons)	Required Storage: Case B[2] (Million Gallons)
Rancho Grande Zone	1.2	1.29	1.53

Notes:
1. [1] Operational storage calculated as 4 hours of PHD, minus assumed source capacity for zone. For Rancho Grande zone, source capacity was limited to capacity of one (1) booster pump (1,000 gpm).
2. [2] Operational storage calculated as 4 hours of PHD. Assumes pumps are not operated during PHD period.

When Reservoir 5 is taken out of service for new interior coatings, Reservoir 7 will be the only storage in the Ranch Grande zone. Therefore, Reservoir 7 should be sized to provide sufficient operational storage for the Rancho Grande zone. As shown in Table 9.3, the Rancho Grande zone is estimated to require between 220,000 gallons and 460,000 gallons of operational storage at buildout. It is

recommended that Reservoir 7 be built with a nominal operational volume of 500,000 gallons to meet Case B (4 hours of PHD and no pumps operating during PHD period).

Table 9.3 - Rancho Grande Zone Buildout Operational Storage Requirements

Pressure Zone	Operational Storage: Case A[1] (Million Gallons)	Operational Storage: Case B[2]: (Million Gallons)
Rancho Grande Zone	0.22	0.46

Notes:
1. **Calculated as 4 hours of PHD, minus assumed source capacity for zone. For Rancho Grande zone, source capacity was limited to capacity of one (1) booster pump (1,000 gpm).**
2. **Calculated as 4 hours of PHD. Assumes pumps are not operated during PHD period.**

Recommended Solution:

It is recommended that the City construct a new steel storage reservoir with a nominal value of 500,000 gallons to serve the Rancho Grande zone. The overflow elevation of the new storage reservoir should be equivalent to Reservoir 5 (overflow elevation 432'), which also serves the Rancho Grande zone. Reservoir 7 should be equipped with an internal mixing system relying on inlet velocity and inlet/outlet configuration to keep the tank mixed.

The City has selected a site for Reservoir 7, which is assumed to require minimal grading.

Alternatives:

There are no viable alternatives to additional storage. There are however, alternatives in the size of the storage reservoir. While a storage reservoir with a nominal volume less than 500,000 may be sufficient, it is not recommended. Sizing the storage reservoir for the operational storage required for Case B (4 hours of PHD and no pumps operating during the PHD period) is conservative and will allow the City flexibility in how they operate their reservoirs and booster pump stations when Reservoir 5 is offline during the Reservoir 5 Rehabilitation Project.

Cost Estimate:

Client:	**City of Arroyo Grande**				
Project:	**2011 Water Master Plan Updates**				
Number:	**A-5**				
Description:	**Reservior 7**			**Prepared by:**	JCS
				Reviewed by:	JHR
Opinion of Probable Construction Cost				**Date:**	6/19/2012
Item No.	**Item Description**	**Quantity**	**Unit**	**Unit Cost**	**Total Item Cost**
1	Mobilization	1	LS	$ 17,500	$ 17,500
2	Insurance and Bonds	1	LS	$ 17,500	$ 17,500
3	Construction Surveying	1	LS	$ 8,700	$ 8,700
4	Site Clearing	1	LS	$ 2,900	$ 2,900
5	SWPPP Preparation & Implementation	1	LS	$ 5,800	$ 5,800
6	Traffic Control	0	Day	$ -	$ -
7	Civil Site Work and Underground				
7.1	Site grading	100	CY	$ 8	$ 800
7.2	Paving and surfacing	900	SF	$ 9	$ 8,100
7.3	Driveway restoration	2760	SF	$ 2	$ 5,520
7.4	Tank Foundation	118	CY	$ 450	$ 53,100
7.5	Site piping & tank appertunance	1	LS	$ 45,000	$ 45,000
7.6	Drainage Improvements & Slope Vegetation	1	LS	$ 15,400	$ 15,400
7.7	Sheeting, shoring and bracing	1	LS	$ 5,000	$ 5,000
8	Storage Tank				
8.1	Steel Water Storage Tank, 500,000 gallons	1	EA	$ 450,000	$ 450,000
				Subtotal 1:	$ 635,300
	Note: Cost does not include property acquisition.			**Construction Contingency (10%):**	$ 63,500
				Design (15%):	$ 95,300
				Contract Administration (10%):	$ 63,500
				Total Project Cost:	**$ 857,600**

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Project A-6 - Galvanized Service Replacements (25 per year)

Design and Permitting:	6 months		
Construction:	Ongoing	Opinion of Total Project Cost:	$ 287,500

Need for Project:

The City reports an increasing number of failures in galvanized services in recent years. The galvanized services have exceeded their useful life.

Supporting Information:

Water services installed prior to 1980 were primarily constructed of galvanized steel. The useful life of galvanized steel ranges from approximately 10 to 50 years depending on soil properties. The City reports that an increasing number of galvanized services are failing; this indicates that the City's galvanized services have exceeded their useful life. The failed services show evidence of significant corrosion. The useful life of the galvanized services installed in the City's system is estimated life to be in the 20 to 30 year range. The City expects that additional failures will occur.

Recommended Solution:

It is recommended that the City plan and implement the replacement of all services installed prior to 1980 with new PVC services within the next 10 years. It is estimated that approximately 2,000 services will need to be replaced. Due to the number of services requiring replacement, it is recommended that the City perform the service replacements in phases, beginning with the highest priority areas. To determine the highest priority areas, it is recommended that the City perform a preliminary study to assess which services pose the highest risk and which areas of the City have been experiencing breaks.

Additionally, the City should couple service replacement projects with other larger projects in the same area when possible. For example, when the City is performing pavement upgrades and/or water main replacements, services in that area can be replaced concurrently. Completing the replacement of all pre-1980 services by a target date of 2027 is recommended (the City should adjust this date pending the outcome of the phasing and prioritization study).

Alternatives:

The do-nothing alternative will result in services being replaced as they fail. To maintain customer service and reliability, this alternative is not recommended. In addition, service replacements as a response to failure may lead to higher overall cost than a planned approach.

Cost Estimate:

Estimated costs for this project are as follows:

Design (3%)	$	5,000
Contract Administration (5%)	$	5,000
Construction Contingency (10%):	$	7,500
Project Construction:	$	270,000
Opinion of Total Project Cost:	$	287,500

A detailed breakdown of the construction costs for this project is shown below and serves an estimate for Projects B-9 andC-6.

Client:	**City of Arroyo Grande**		
Project:	**2011 Water Master Plan Updates**		
Segment:	**A-6, B-9, C-6**		
Street:	**Galvanized Service Replacements**	**Prepared by:**	JCS
		Reviewed by:	JHR
Opinion of Probable Construction Cost		**Date:**	6/19/2012

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Item Cost
1	Mobilization	1	LS	-	$ 138,300
2	Insurance and Bonds	1	LS	-	$ 138,300
3	Construction Surveying	1	LS	-	$ 69,200
4	Site Clearing and Restoration	1	LS	-	$ 23,100
5	SWPPP Preparation & Implementation	1	LS	-	$ 20,000
6	Traffic Control	200	Day	$ 500	$ 100,000
7	Water Main Construction				
7.1	Pavement Removal & Repair for Trench	0	SY		$ -
7.2	Trenching/Compaction/Fill/Hauling	0	CY		$ -
7.3	Abandon Existing Water Main	0	LS		$ -
7.4	Water Main (Furnish and Install)				
7.4.1	8" - C900 PVC	0	LF		$ -
7.4.2	10" - C900 PVC	0	LF		$ -
7.4.3	12" - C900 PVC	0	LF		$ -
7.5	Gate Valves (to Furnish and Install)				
7.5.1	8"	0	EA		$ -
7.5.2	10"	0	EA		$ -
7.5.3	12"	0	EA		$ -
7.6	Fittings (Furnish and Install)	0	LS		$ -
7.7	Pressure Reducing Valves	0	EA		$ -
8	New Meter and Service				
8.1	1" Water Service from Main to Meter	2000	EA	$ 2,305	$ 4,610,100
9	Fire Hydrants				
9.1	Fire Hydrant Assembly (Furnish and Install)	0	EA		$ -
9.2	Existing Fire Hydrant to be Removed	0	EA		$ -

Note: The rates for Design and Contract Administration are reduced for this project since the galvanized services are expected to be installe d on an ongoing basis using City crews or by including the replacement of services with other projects occuring on the street.

Subtotal 1:	$ 5,099,000
Construction Contingency (10%):	$ 509,900
Design (3%)	$ 153,000
Contract Administration (5%)	$ 255,000
Total Project Cost:	**$ 6,016,900**

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Project B-1 - Reservoir 5 Coating Project

Design and Permitting:	9 months		
Construction:	7 months	Opinion of Total Project Cost	$ 402,000

Need for Project:

The interior and exterior coating on Reservoir 5 show signs of failure. A new coating system needs to be applied to each reservoir to preserve the steel tanks and protect water quality. The last coating was applied to Reservoir 5 in 1986, when the tank was constructed. The 2003 tank inspection reports estimated the remaining useful life of the coating to be 5 years from the time of inspection. This time has elapsed.

Supporting Information:

According to the AWWA manual for Steel Water-Storage Tanks, the useful service life of epoxy coating is up to 20 years. Using this assumption, the coating system on Reservoir 5 has exceeded its useful life. Inspections provide a more accurate picture of the condition and remaining useful life of the coating systems of each tank. Reservoir 5 was last inspected in 2003, by Dive/Corr, Inc. A brief discussion of the reservoir and the coating condition follows. For a more detailed description of condition, refer to the tank inspection reports.

Reservoir 5 has not been coated since the initial epoxy coating was applied when it was built in 1986. In 2003, both the interior and exterior of Reservoir 5 was inspected. The inspection report noted that the coating was continuing to deteriorate. The coating was observed to be thin on the roof and there was slight corrosion on the roof underside. The coating was estimated to have a useful life of 5 more years from the date of inspection, that is reach the end of its useful life in 2008. The figures below show the interior coating in 2003, and exterior coating in 2011, respectively.

Figure 9-9 - Reservoir 5 Interior Coating (2003)

Figure 9-10 - Reservoir 4 Exterior Coating (2011)

Recommended Solution:

It is recommended that the City apply a new coating system to Reservoir 5, as described here:

(1) Coat the interior and exterior of Reservoir 5 with an appropriate coating system such as a highsolids epoxy. When the interior of Reservoir 5 is coated, Reservoir 5 should be considered for retrofit with an interior tank mixing system.

Reservoir 5 is currently the only storage reservoir in the Rancho Grande zone; thus, Reservoir 5 cannot be taken out of service to apply the coating at this time. Reservoir 5 must be coated after the completion of Reservoir 7.

When the City prepares the bid package for the coating of Reservoir 5, it is recommended that the engineer determine if backup power and/or backup pumps are required at the Rancho Grande Booster Station when Reservoir 5 is taken out of service. The engineer should then include specifications requiring the contractor to provide the required services (backup power and/or backup pumps at the Rancho Grande Booster Station) when Reservoir 5 is taken out of service for coating.

Cost Estimate:

Client:	**City of Arroyo Grande**				
Project:	**2011 Water Master Plan Updates**				
Number:	**B-1**				
Description:	**Reservoir 5 Coating Project**			**Prepared by:**	JCS
				Reviewed by:	JHR
Opinion of Probable Construction Cost				**Date:**	6/19/2012

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Item Cost
1	Mobilization	1	LS	$ 8,300	$ 8,300
2	Insurance and Bonds	1	LS	$ 8,300	$ 8,300
3	Construction Surveying				
4	Site Clearing and Restoration				
5	SWPPP Preparation & Implementation	1	LS	$ 5,000	$ 5,000
6	Traffic Control				
7	New Coating System- Reservoir 5				
7.1	Prepare Interior and Apply New Epoxy Coating	1	LS	$ 206,600	$ 206,600
7.2	Prepare Exterior and Apply New Epoxy Coating	1	LS	$ 44,700	$ 44,700
8	Tank Mixing System				
8.1	Reservoir 5 Interior Tank Mixing System	1	LS	$ 25,000	$ 25,000
				Subtotal 1:	$ 297,900
				Construction Contingency (10%):	$ 29,800
				Design (15%):	$ 44,700
				Contract Administration (10%):	$ 29,800
				Total Project Cost:	**$ 402,200**

Project B-2 - Coach Road and Garden Street Pipe Bridges Evaluation

Design and Permitting:	8-12 months		
Construction:	N/A	Opinion of Total Project Cost:	$ 68,200

Need for Project:

The existing steel pipe bridges crossing the Arroyo Grande Creek from Coach Road and from Garden Street were constructed in 1964 and shown evidence of corrosion and coatings that require rehabilitation.

Supporting Information:

The existing Coach Road Pipe Bridge is a 10-inch steel pipe supported by galvanized steel bridge rope. The existing Garden Street Pipe Bridge is an 8-inch steel pipe supported by galvanized steel bridge rope. Preliminary field observations indicate that the coatings require rehabilitation on both pipe bridges, and there is evidence of corrosion on the steel pipe.

Recommended Solution:

It is recommended that the City solicit a structural engineer to perform a comprehensive structural analysis of the steel pipe bridges crossing the Arroyo Grande Creek from Coach Road and from Garden Street, which are shown in Figure 9-11 - Coach Road and Garden Street Pipe Bridge Rehabilitation

Using the results of the structural analysis, the City can determine whether rehabilitation or upgrade of one or both of the pipe bridges is required. The structural evaluation should investigate the condition and thickness of the coatings, the condition and thickness of the steel and the condition of the steel rope.

In addition, it is recommended that the City select an environmental permitting consultant to prepare a permitting strategy memorandum, to aid the City with the decision to rehabilitate or replace the pipe bridges. The permitting strategy memorandum will help guide the City through any required environmental permitting procedures such as California Environmental Quality Act (CEQA) compliance, the U.S. Army Corps of Engineers (e.g. 404 Permit), and/or the California Department of Fish and Game (e.g. Streambed Alteration Agreement).

Figure 9-11 - Coach Road and Garden Street Pipe Bridge Rehabilitation

Alternatives:

This structural analysis is required to determine current structural condition. After the structural analysis is performed, there may be several alternatives including replacement or rehabilitation. These alternatives should be should be evaluated at that time.

Doing nothing and/or eventual removal of the pipe bridges is a possible alternative, however removing the bridges will impact movement of water though the City's distribution system. Investigation of the alternative to remove the pipe bridges should be performed after the structural analysis and permitting investigation, especially if the investigations indicate that repair of the pipes bridges is not practical.

In lieu of replacement of the pipe bridges, crossing the creek could be accomplished using horizontal directional drilling (HDD). Installation of a pipeline across the creek using HDD requires room to make the vertical transition down under the creek deep enough to prevent the pipe from being exposed by scour from creek flow. HDD will still require permitting, and depending on the recommendations of the structural analysis, may be more expensive then rehabilitation of the bridges. The current location of the pipe bridges may not suitable for creek crossing by HDD.

Cost Estimate:

Client:	**City of Arroyo Grande**				
Project:	**2011 Water Master Plan Updates**				
Number:	**B-2**				
Description:	**Coach Road and Garden Street Bridge Evaluation**			**Prepared by:**	JCS
				Reviewed by:	JHR
Opinion of Probable Construction Cost				**Date:**	6/19/2012
Item No.	**Item Description**	**Quantity**	**Unit**	**Unit Cost**	**Total Item Cost**
1	Pipe Bridge Structural Evaluation	1	LS	$ 40,000	$ 40,000
2	Preliminary CEQA Compliance and Permitting Strategy	1	LS	$ 22,000	$ 22,000
				Subtotal 1:	$ 62,000
				Construction Contingency (10%):	$ 6,200
				Total Project Cost:	**$ 68,200**

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Project B-3 - SCADA Software/Electronics Upgrade

Design and Permitting:	8 months		
Construction:	6 months	Opinion of Total Project Cost:	$ 187,400

Need for Project:

The City's existing SCADA system relies on a single workstation, leaving the City at risk for failure. Failure of the workstation could lead to the loss of Operator interface and of historical data.

Supporting Information:

The existing SCADA system consists of a single PC workstation that runs the SCADA software, and also acts as the data historian, the development station, and sole client for Operator interface. This leaves the City vulnerable to a complete SCADA System failure, loss of archived historical data, and loss of Operator interface with a single computer failure. The SCADA software, while functional, does not have the features of newer software packages. Newer SCADA software packages offer greater flexibility and services in regards to alarm management, trending, security, report generation, networking, and ease of screen modifications.

Additional details on the SCADA system are documented in the SCADA System Evaluation.

Recommended Solution:

It is recommended that two new redundant workstations, running a new Windows-based SCADA software package (e.g. Wonderware or equivalent), be provided to replace the existing SCADA desktop computer. This will increase the reliability of the City's SCADA system. Additional recommendations include:

- Provide for City Staff remote access to SCADA System via password protected internet access from Operators' off-site computers or smart devices cellular devices;
- Provide for system integrator remote access to SCADA System for development and configuration via internet connection; and
- Provide DSL modem in place of existing system dial-in phone line connection for system integrator.

Specific recommendations detailing how each workstation should be operated and what functionality should be added to the SCADA system can be found in SCADA System Evaluation. Radio upgrades are included in a separate project.

Cost Estimate:

Client:	**City of Arroyo Grande**				
Project:	**2011 Water Master Plan Updates**				
Number:	**B-3**				
Description:	**SCADA Upgrade**			**Prepared by:**	JCS
				Reviewed by:	JHR
Opinion of Probable Construction Cost				**Date:**	6/19/2012
Item No.	**Item Description**	**Quantity**	**Unit**	**Unit Cost**	**Total Item Cost**
1	Mobilization	1	LS	$ 3,900	$ 3,900
2	Insurance and Bonds	1	LS	$ 3,900	$ 3,900
3	Construction Surveying	0	LS	$ -	$ -
4	Site Clearing and Restoration	0	LS	$ -	$ -
5	SWPPP Preparation and Implementation	0	LS	$ -	$ -
6	Traffic Control	0	LS	$ -	$ -
7	SCADA Software Upgrade				
7.1	SCADA Software Package (Wonderware or equal)	1	LS	$ 35,000	$ 35,000
7.2	Control Strategy Workshops	1	LS	$ 10,000	$ 10,000
7.3	Workstations Hardware, Firewall, Router, Misc.	1	LS	$ 18,000	$ 18,000
7.4	Software Configuration, Testing and Start-Up	1	LS	$ 60,000	$ 60,000
8	City Involvement				
8.1	Workshop Participation	1	LS	$ 3,000	$ 3,000
8.2	Contros, Testing and Start-Up Assistance	1	LS	$ 5,000	$ 5,000
				Subtotal 1:	$ 138,800
				Construction Contingency (10%):	$ 13,900
				Design (15%):	$ 20,800
				Contract Administration (10%):	$ 13,900
				Total Project Cost:	**$ 187,400**

Project B-4 - Highway 101 Crossing Upgrade- El Camino Real to West Branch Street

Design and Permitting:	12 months		
Construction:	6 months	Opinion of Total Project Cost:	$ 454,600

Need for Project:

The cast iron main crossing Highway 101 from El Camino Real to West Branch Street has insufficient capacity to satisfy buildout peak hour demands within the established velocity criteria and is expected to be nearing the end of its useful life.

Supporting Information:

At buildout, the flow through the Highway 101 crossing from El Camino Real to West Branch Street is expected to be approximately 915-gpm. The existing 8-inch cast iron pipe allows about 783-gpm of flow at a velocity of 5 fps, resulting in a deficit of 132-gpm.

In addition, the main was installed in 1929, making it 83 years old. Cast iron pipe is estimated to have an expected useful life of 50 to 100 years. The main is expected to be nearing the end of its useful life. This is supported by visual inspection of pieces of cast iron pipe removed from the City's distribution system.

Recommended Solution:

It is recommended that the City upgrade the Highway 101 crossing from El Camino Real to West Branch Street to a 12-inch ductile iron pipe, as shown in Figure 9-12. The project length is approximately 415-LF. This will increase capacity to 1,762-gpm and will improve the condition of the highway crossing.

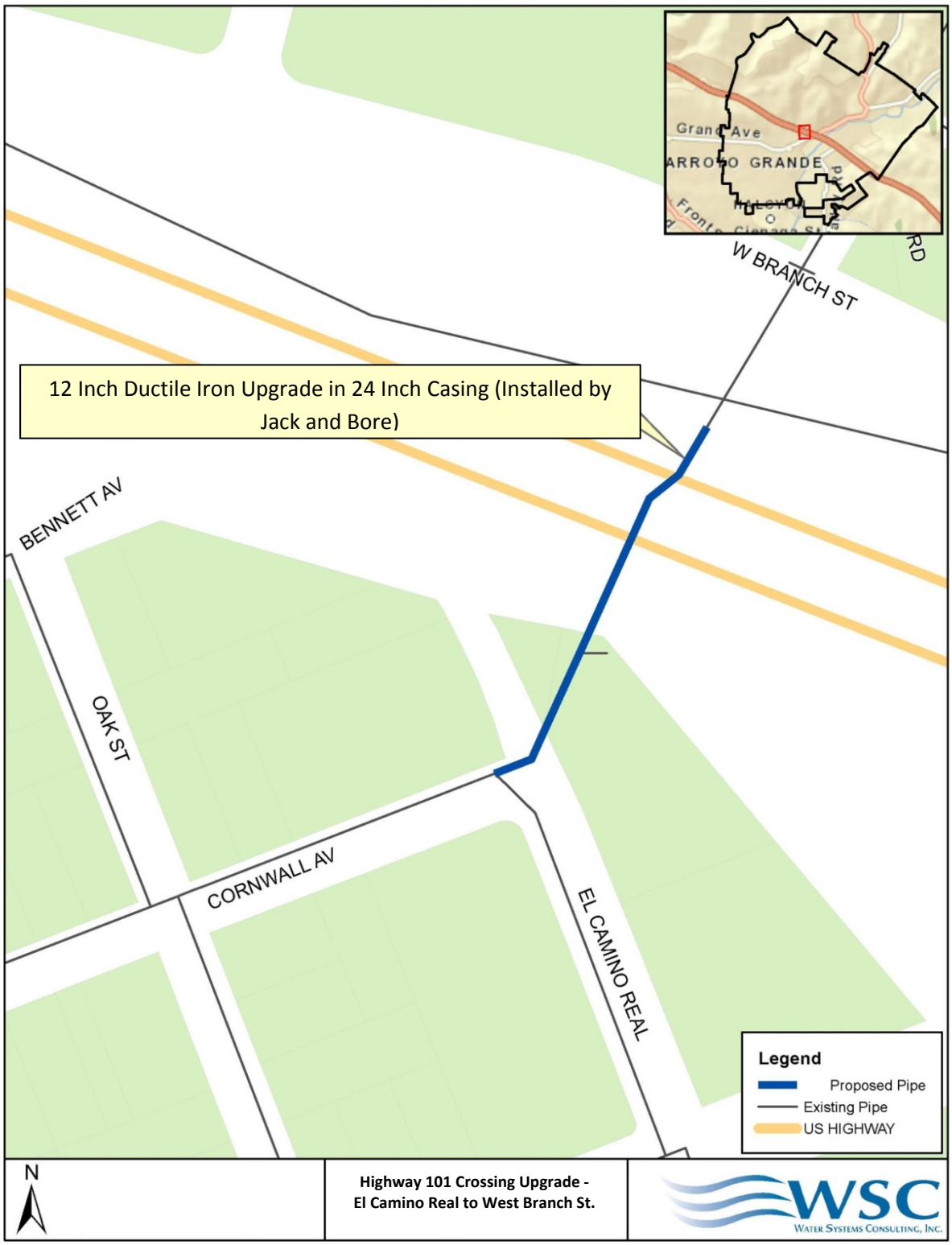

Figure 9-12 - Highway 101 Crossing Upgrade-El Camino Real to West Branch Street

Cost Estimate:

Client:	**City of Arroyo Grande**		
Project:	**2011 Water Master Plan Updates**		
Segment:	**B-4**		
Street:	**Highway 101 Crossing Upgrade- El Camino Real to W Branch**	**Prepared by:**	JCS
		Reviewed by:	JHR
Opinion of Probable Construction Cost		**Date:**	6/19/2012

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Item Cost
1	Mobilization	1	LS	-	$ 9,200
2	Insurance and Bonds	1	LS	-	$ 9,200
3	Construction Surveying	1	LS	-	$ 4,600
4	Site Clearing and Restoration	1	LS	-	$ 1,500
5	SWPPP Preparation & Implementation	1	LS	-	$ 5,400
6	Traffic Control	2	Day	$ 500	$ 1,000
7	Water Main Construction				
7.1	Pavement Removal & Repair for Trench	184	SY	$ 82	$ 15,100
7.2	Trenching/Compaction/Fill/Hauling	184	CY	$ 44	$ 8,100
7.3	Abandon Existing Water Main	1	LS	$ 1,400	$ 1,400
7.4	Water Main (Furnish and Install)[1]				
7.4.1	8" - Ductile Iron	0	LF		$ -
7.4.2	10" - Ductile Iron	0	LF		$ -
7.4.3	12" - Ductile Iron	415	LF	$ 77	$ 31,800
7.5	Gate Valves (to Furnish and Install)				
7.5.1	8"	0	EA		$ -
7.5.2	10"	0	EA		$ -
7.5.3	12"	2	EA	$ 2,750	$ 5,500
7.6	Fittings (Furnish and Install)	1	LS	$ 16,100	$ 16,100
7.7	Pressure Reducing Valves	0	EA		$ -
7.8	Highway Crossing				
7.8.1	24" Casing and Horizontal Boring	415	LF	$ 500	$ 207,500
7.8.2	Heave and Settlement Monitoring	1	LS	$ 20,000	$ 5,700
8	New Meter and Service				
8.1	1" Water Service from Main to Meter	2	EA	$ 3,350	$ 6,700
9	Fire Hydrants				
9.1	Fire Hydrant Assembly (Furnish and Install)	1	EA	$ 7,400	$ 7,400
9.2	Existing Fire Hydrant to be Removed	1	EA	$ 500	$ 500
				Subtotal 1:	$ 336,700
				Construction Contingency (10%):	$ 33,700
				Design (15%):	$ 50,500
				Contract Administration (10%):	$ 33,700
				Total Project Cost:	**$ 454,600**

Note 1: The linear feet of pipe in the opinion of cost may not exactly match the project length described in the CIP because the linear feet of pipe shown in the cost opinion includes a linear footage allowance for making connections to the existing water distribution system based on the preliminary project alignment.

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Project B-5 - Highway 101 Crossing Upgrade- West Cherry Ave

Design and Permitting:	12 months		
Construction:	6 months	Opinion of Total Project Cost:	$ 358,600

Need for Project:

The cast iron main crossing Highway 101 along West Cherry Avenue is expected to be nearing the end of its useful life and is a critical connection for the distribution system across Highway 101.

Supporting Information:

This section of main was installed in 1958, making it 54 years old. Cast iron pipe is estimated to have an expected useful life of 50 to 100 years. The main is expected to be nearing the end of its useful life.

Recommended Solution:

It is recommended that the City upgrade the Highway 101 crossing along West Cherry Avenue to a 12-inch ductile iron pipe, as shown in Figure 9-13. The project length is approximately 280-LF. This will improve the redundancy and reliability of the City's distribution system.

Alternatives:

The do-nothing alternative is not recommended as it will lead to an increased probability that the main will fail.

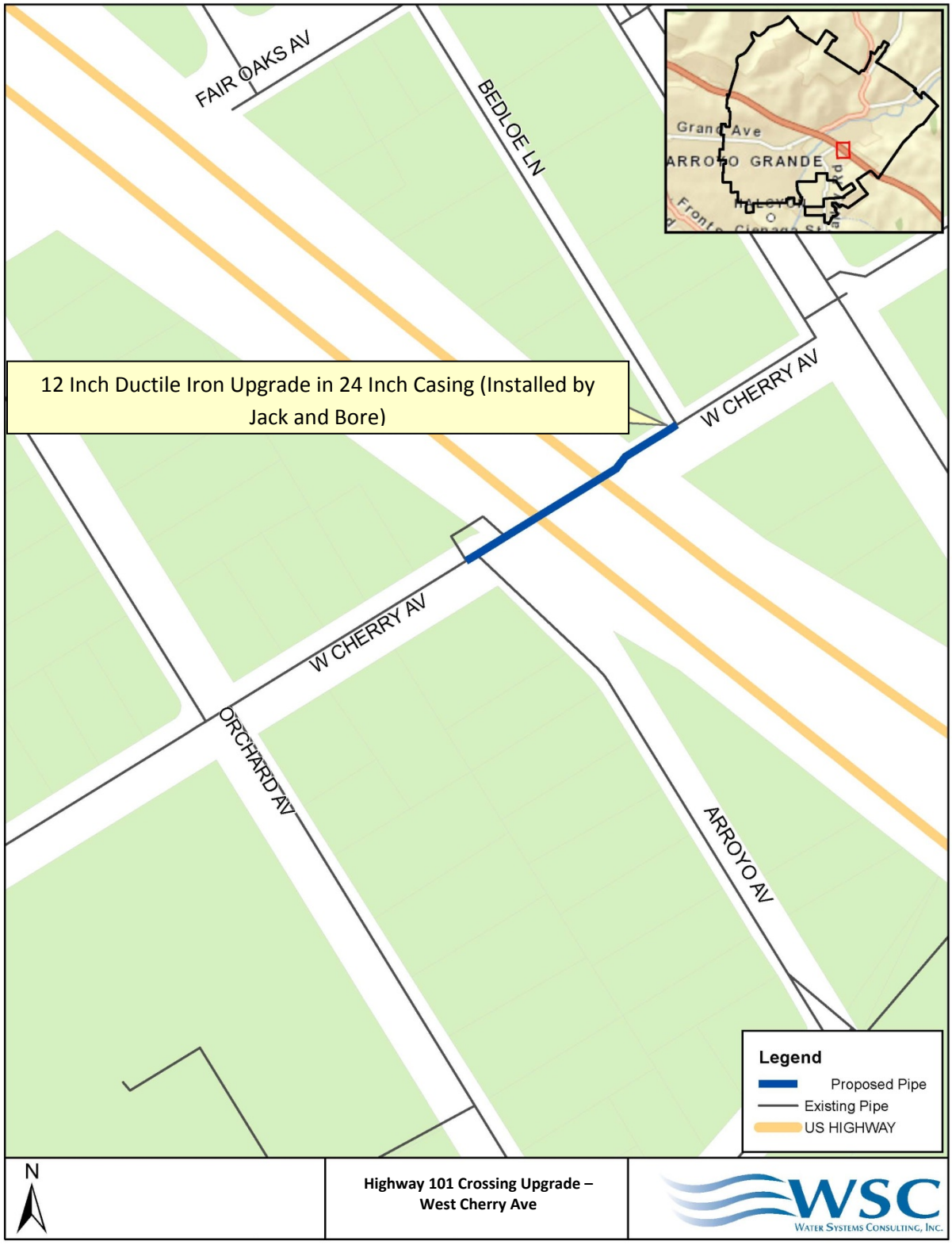

Figure 9-13 - Highway 101 Crossing Upgrade-West Cherry Avenue

Cost Estimate:

Client:	**City of Arroyo Grande**		
Project:	**2011 Water Master Plan Updates**		
Segment:	**B-5**		
Street:	**Highway 101 Crossing Upgrade-West Cherry Av**	**Prepared by:**	JCS
		Reviewed by:	JHR
Opinion of Probable Construction Cost		**Date:**	6/19/2012

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Item Cost
1	Mobilization	1	LS	-	$ 7,200
2	Insurance and Bonds	1	LS	-	$ 7,200
3	Construction Surveying	1	LS	-	$ 3,600
4	Site Clearing and Restoration	1	LS	-	$ 1,200
5	SWPPP Preparation & Implementation	1	LS	-	$ 5,300
6	Traffic Control	2	Day	$ 500	$ 1,000
7	Water Main Construction				
7.1	Pavement Removal & Repair for Trench	124	SY	$ 82	$ 10,200
7.2	Trenching/Compaction/Fill/Hauling	124	CY	$ 44	$ 5,500
7.3	Abandon Existing Water Main	1	LS	$ 500	$ 500
7.4	Water Main (Furnish and Install)[1]				
7.4.1	8" - Ductile Iron	0	LF		$ -
7.4.2	10" - Ductile Iron	0	LF		$ -
7.4.3	12" - Ductile Iron	280	LF	$ 76	$ 21,400
7.5	Gate Valves (to Furnish and Install)				
7.5.1	8"	0	EA		$ -
7.5.2	10"	0	EA		$ -
7.5.3	12"	4	EA	$ 2,750	$ 11,000
7.6	Fittings (Furnish and Install)	1	LS	$ 23,300	$ 23,300
7.7	Pressure Reducing Valves	0	EA		$ -
7.8	Highway Crossing				
7.8.1	24" Casing and Horizontal Boring	280	LF	$ 500	$ 140,000
7.8.2	Heave and Settlement Monitoring	1	LS	$ 20,000	$ 5,700
8	New Meter and Service				
8.1	1" Water Service from Main to Meter	2	EA	$ 3,350	$ 6,700
9	Fire Hydrants				
9.1	Fire Hydrant Assembly (Furnish and Install)	2	EA	$ 7,400	$ 14,800
9.2	Existing Fire Hydrant to be Removed	2	EA	$ 500	$ 1,000
				Subtotal 1:	$ 265,600
				Construction Contingency (10%):	$ 26,600
				Design (15%):	$ 39,800
				Contract Administration (10%):	$ 26,600
				Total Project Cost:	**$ 358,600**

Note 1: The linear feet of pipe in the opinion of cost may not exactly match the project length described in the CIP because the linear feet of pipe shown in the cost opinion includes a linear footage allowance for making connections to the existing water distribution system based on the preliminary project alignment.

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Project B-6 - Phased Mains Replacements

Design and Permitting:	See description		
Construction:	See description	Opinion of Total Project Cost:	$ 1,018,050

Need for Project:

The existing cast iron mains are at or near the end of their useful life. Pipe coupons show evidence of severe tuberculation.

Supporting Information:

Cast iron pipe is estimated to have an expected useful life of 50 to 100 years. The table below lists the diameter, length and age of seven (7) pipe segments made of cast iron. Six (6) of these mains were installed 80 or more years ago and one (1) was installed over 50 years ago. They are expected to be at or near the end of their useful life. This is supported by cast iron pipe coupons and pieces of removed cast iron pipe provided by the City, which show signs of severe tuberculation. Tuberculation is the irregular buildup of corrosion scale and associated biofilm inside a cast iron pipe over time leading to decreased pipeline capacity, increased use of chlorine residual, and potential water quality complaints (e.g. red or brown water complaints, taste and odor complaints). The figures below show a piece of tuberculated cast iron pipe recently removed from Arroyo Grande's distribution system.

Figure 9-14 - Tuberculation in Removed Cast Iron Pipe

Table 9.4 - Cast Iron Mains for Phased Replacement

Pipe Segment	Diameter (in)	Length (ft)	Date Installed	Age (years)
(1) Cornwall St from Barnett St to Halcyon Rd	8	1,600	1929	83
(2) Halcyon Rd from Fair Oaks Ave to Cornwall St	8	2,600	1929	83
(3) Fair Oaks Ave from Alder Street to well field	8	2,050	1929	83
Total	-	**6,250**	-	-

Recommended Solution:

It is recommended that the City replace the cast iron water mains, shown in the figure below, with PVC pipe of equivalent size with an 8-in minimum pipe size. The project locations are shown in the figure below. The replacements are intended to be phased to align with the City's resources. The recommended approach would be to replace the mains in three phases as shown below:

Phase 1
(1) Cornwall St from Barnett St to Halcyon Rd
(2) Halcyon Rd from Fair Oaks Ave to Cornwall St
(3) Fair Oaks Ave from Alder Street to well field

Design and Permitting: 10-12 months
Construction: 10 months

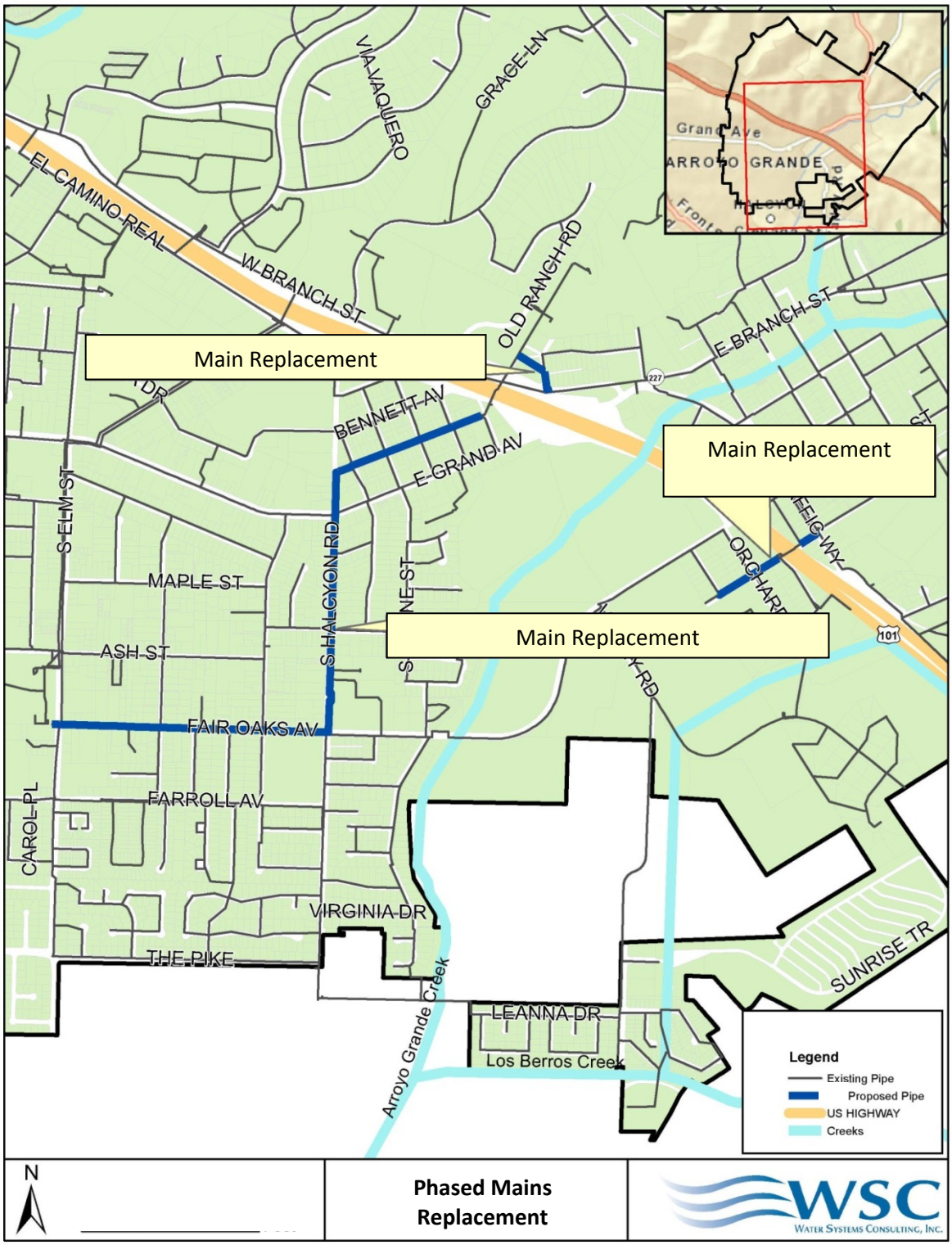

Figure 9-15 - Phased Mains Replacement

Budget Discussion:

Estimated costs for this project are as follows:

Design (15%):	$	150,000
Contract Administration (10%):	$	100,000
Construction Contingency (10%):	$	100,000
Project Construction:	$	668,050
Opinion of Total Project Cost:	$	1,018,050

A detailed breakdown of the construction costs for this project is shown in the Appendix.

Client:	**City of Arroyo Grande**		
Project:	**2011 Water Master Plan Updates**		
Segment:	**B-6**		
Street:	**Phased Main Replacement-Cornwall**	**Prepared by:**	JCS
		Reviewed by:	JHR
Opinion of Probable Construction Cost		**Date:**	6/19/2012

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Item Cost
1	Mobilization	1	LS	-	$ 10,000
2	Insurance and Bonds	1	LS	-	$ 10,000
3	Construction Surveying	1	LS	-	$ 5,000
4	Site Clearing and Restoration	1	LS	-	$ 1,700
5	SWPPP Preparation & Implementation	1	LS	-	$ 6,700
6	Traffic Control	7	Day	$ 500	$ 3,500
7	Water Main Construction				
7.1	Pavement Removal & Repair for Trench	771	SY	$ 82	$ 63,000
7.2	Trenching/Compaction/Fill/Hauling	771	CY	$ 44	$ 34,000
7.3	Abandon Existing Water Main	1	LS	$ 500	$ 500
7.4	Water Main (Furnish and Install)[1]				
7.4.1	8" - C900 PVC	1735	LF	$ 18	$ 31,100
7.4.2	10" - C900 PVC	0	LF		$ -
7.4.3	12" - C900 PVC	0	LF		$ -
7.5	Gate Valves (to Furnish and Install)				
7.5.1	8"	15	EA	$ 2,013	$ 30,200
7.5.2	10"	0	EA		$ -
7.5.3	12"	0	EA		$ -
7.6	Fittings (Furnish and Install)	1	LS	$ 25,000	$ 25,000
7.7	Pressure Reducing Valves	0	EA		$ -
8	New Meter and Service				
8.1	1" Water Service from Main to Meter	45	EA	$ 2,304	$ 103,700
9	Fire Hydrants				
9.1	Fire Hydrant Assembly (Furnish and Install)	6	EA	$ 7,383	$ 44,300
9.2	Existing Fire Hydrant to be Removed	6	EA	$ 500	$ 3,000

Note 1: The linear feet of pipe in the opinion of cost may not exactly match the project length described in the CIP because the linear feet of pipe shown in the cost opinion includes a linear footage allowance for making connections to the existing water distribution system based on the preliminary project alignment.

Subtotal 1:	$ 371,700
Construction Contingency (10%):	$ 37,200
Design (15%):	$ 55,800
Contract Administration (10%):	$ 37,200
Total Project Cost:	**$ 501,900**

Client:	**City of Arroyo Grande**		
Project:	**2011 Water Master Plan Updates**		
Segment:	**B-6**		
Street:	**Phased Main Replacement-Halcyon**	**Prepared by:**	JCS
		Reviewed by:	JHR
Opinion of Probable Construction Cost		**Date:**	6/19/2012

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Item Cost
1	Mobilization	1	LS	-	$ 12,000
2	Insurance and Bonds	1	LS	-	$ 12,000
3	Construction Surveying	1	LS	-	$ 6,000
4	Site Clearing and Restoration	1	LS	-	$ 2,000
5	SWPPP Preparation & Implementation	1	LS	-	$ 7,800
6	Traffic Control	12	Day	$ 500	$ 6,000
7	Water Main Construction				
7.1	Pavement Removal & Repair for Trench	1224	SY	$ 82	$ 100,000
7.2	Trenching/Compaction/Fill/Hauling	1224	CY	$ 44	$ 54,000
7.3	Abandon Existing Water Main	1	LS	$ 500	$ 500
7.4	Water Main (Furnish and Install)[1]				
7.4.1	8" - C900 PVC	2755	LF	$ 18	$ 49,500
7.4.2	10" - C900 PVC	0	LF		$ -
7.4.3	12" - C900 PVC	0	LF		$ -
7.5	Gate Valves (to Furnish and Install)				
7.5.1	8"	14	EA	$ 2,014	$ 28,200
7.5.2	10"	0	EA		$ -
7.5.3	12"	0	EA		$ -
7.6	Fittings (Furnish and Install)	1	LS	$ 17,800	$ 17,800
7.7	Pressure Reducing Valves	0	EA		$ -
8	New Meter and Service				
8.1	1" Water Service from Main to Meter	52	EA	$ 2,306	$ 119,900
9	Fire Hydrants				
9.1	Fire Hydrant Assembly (Furnish and Install)	4	EA	$ 7,375	$ 29,500
9.2	Existing Fire Hydrant to be Removed	4	EA	$ 500	$ 2,000

Note 1: The linear feet of pipe in the opinion of cost may not exactly match the project length described in the CIP because the linear feet of pipe shown in the cost opinion includes a linear footage allowance for making connections to the existing water distribution system based on the preliminary project alignment.

Subtotal 1:	$ 447,200
Construction Contingency (10%):	$ 44,700
Design (15%):	$ 67,100
Contract Administration (10%):	$ 44,700
Total Project Cost:	**$ 603,700**

Project B-7 - Le Point Area Main Upgrades

Design and Permitting:	8 months		
Construction:	5 months	Opinion of Total Project Cost:	$ 661,600

Need for Project:

The City's has experienced numerous recent breaks in the 4-inch cast iron distribution mains in the Le Point area: (1) Crown Terrace from Crown Hill to Le Point, (2) Le Point from Crown Terrace to Hwy 227, and (3) McKinley from Le Point to Crown Hill. Additionally, pipe coupons show that the cast iron pipe in the City's distribution system is in poor condition.

Supporting Information:

City staff report numerous main breaks in the Le Point area over the last few years. The City has performed frequent maintenance to keep the mains in service.

The water mains in the Le Point Area are made of cast iron, and were installed in 1938, making them 74 years old. Cast iron pipe is estimated to have an expected useful life of 50 to 100 years. The recent main breaks signal that the cast iron pipe in the Le Point area has reached the end of its useful life. In addition, coupons from representative cast iron sections show signs of significant tuberculation.

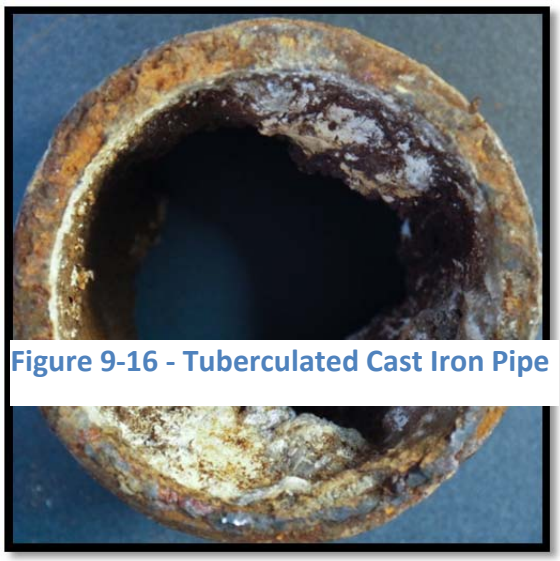

Figure 9-16 - Tuberculated Cast Iron Pipe

Tuberculation is the irregular buildup of corrosion scale and associated biofilm inside a cast iron pipe over time leading to decreased pipeline capacity, increased use of chlorine residual, and potential water quality complaints (e.g. red or brown water complaints, taste and odor complaints). The figure below shows a tuberculated cast iron pipe recently removed from Arroyo Grande's distribution system.

Recommended Solution:

It is recommended that the City replace the following mains with 8-inch PVC pipe: (1) Crown Terrace from Crown Hill to Le Point, (2) Le Point, and (3) McKinley from Le Point to Crown Hill, as shown in the figure below. The length of each pipe segment is shown in the table below.

Table 9.5 – Le Point Area Main Upgrades

Pipe Segment	Length (ft)
(1) Crown Terrace from Crown Hill to Le Point	340
(2) Le Point	1,745
(3) McKinley from Le Point to Crown Hill	555
Total	**2,640**

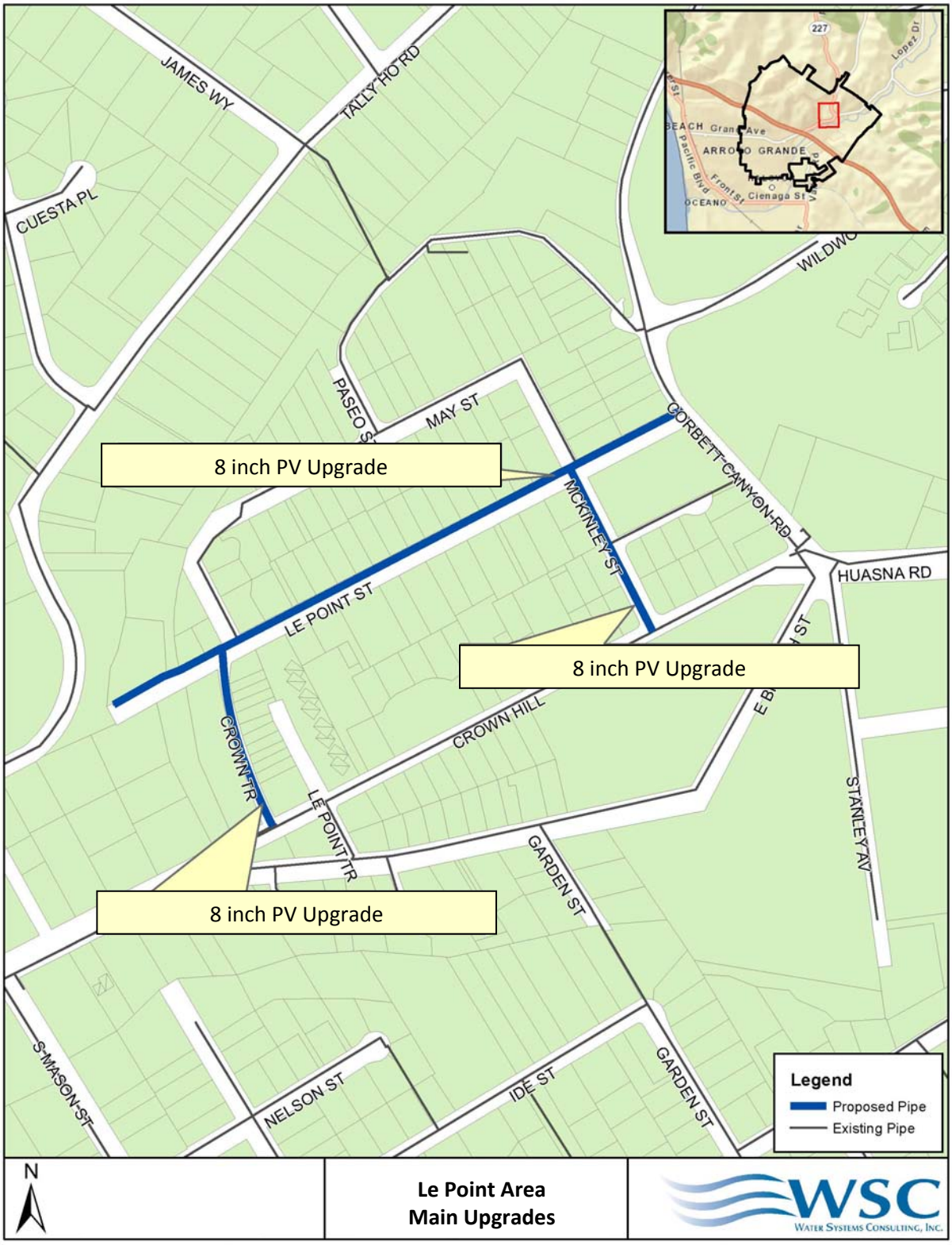

Figure 9-17 - Le Point Area Main Upgrades

Cost Estimate Summary:

Estimated costs for this project are as follows:

Design (15%):	$	73,600
Contract Administration (10%):	$	49,000
Construction Contingency (10%):	$	49,000
Project Construction:	$	490,000
Opinion of Total Project Cost:	$	661,600

A detailed breakdown of the construction costs for this project is shown below.

Client:	**City of Arroyo Grande**		
Project:	**2011 Water Master Plan Updates**		
Segment:	**B-7**		
Street:	**Le Point Area Main Upgrades**	**Prepared by:**	JCS
		Reviewed by:	JHR
Opinion of Probable Construction Cost		**Date:**	6/19/2012

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Item Cost
1	Mobilization	1	LS	-	$ 2,100
2	Insurance and Bonds	1	LS	-	$ 2,100
3	Construction Surveying	1	LS	-	$ 1,000
4	Site Clearing and Restoration	1	LS	-	$ 300
5	SWPPP Preparation & Implementation	1	LS	-	$ 5,300
6	Traffic Control	2	Day	$ 500	$ 1,000
7	Water Main Construction				
7.1	Pavement Removal & Repair for Trench	151	SY	$ 81	$ 12,300
7.2	Trenching/Compaction/Fill/Hauling	151	CY	$ 44	$ 6,700
7.3	Abandon Existing Water Main	1	LS	$ 500	$ 500
7.4	Water Main (Furnish and Install)[1]				
7.4.1	8" - C900 PVC	340	LF	$ 18	$ 6,100
7.4.2	10" - C900 PVC	0	LF		$ -
7.4.3	12" - C900 PVC	0	LF		$ -
7.5	Gate Valves (to Furnish and Install)				
7.5.1	8"	1	EA	$ 2,000	$ 2,000
7.5.2	10"	0	EA		$ -
7.5.3	12"	0	EA		$ -
7.6	Fittings (Furnish and Install)	1	LS	$ 3,100	$ 3,100
7.7	Pressure Reducing Valves	0	EA		$ -
8	New Meter and Service				
8.1	1" Water Service from Main to Meter	13	EA	$ 2,308	$ 30,000
9	Fire Hydrants				
9.1	Fire Hydrant Assembly (Furnish and Install)	1	EA	$ 7,400	$ 7,400
9.2	Existing Fire Hydrant to be Removed	1	EA	$ 500	$ 500

Note 1: The linear feet of pipe in the opinion of cost may not exactly match the project length described in the CIP because the linear feet of pipe shown in the cost opinion includes a linear footage allowance for making connections to the existing water distribution system based on the preliminary project alignment.

Subtotal 1:	$ 80,400
Construction Contingency (10%):	$ 8,000
Design (15%):	$ 12,100
Contract Administration (10%):	$ 8,000
Total Project Cost:	**$ 108,500**

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Client:	**City of Arroyo Grande**		
Project:	**2011 Water Master Plan Updates**		
Segment:	**B-7**		
Street:	**Le Point Area Main Upgrades**	**Prepared by:**	JCS
		Reviewed by:	JHR
Opinion of Probable Construction Cost		**Date:**	6/19/2012

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Item Cost
1	Mobilization	1	LS	-	$ 8,500
2	Insurance and Bonds	1	LS	-	$ 8,500
3	Construction Surveying	1	LS	-	$ 4,200
4	Site Clearing and Restoration	1	LS	-	$ 1,400
5	SWPPP Preparation & Implementation	1	LS	-	$ 6,700
6	Traffic Control	7	Day	$ 500	$ 3,500
7	Water Main Construction				
7.1	Pavement Removal & Repair for Trench	776	SY	$ 82	$ 63,400
7.2	Trenching/Compaction/Fill/Hauling	776	CY	$ 44	$ 34,200
7.3	Abandon Existing Water Main	1	LS	$ 500	$ 500
7.4	Water Main (Furnish and Install)[1]				
7.4.1	8" - C900 PVC	1745	LF	$ 18	$ 31,300
7.4.2	10" - C900 PVC	0	LF		$ -
7.4.3	12" - C900 PVC	0	LF		$ -
7.5	Gate Valves (to Furnish and Install)				
7.5.1	8"	9	EA	$ 2,011	$ 18,100
7.5.2	10"	0	EA		$ -
7.5.3	12"	0	EA		$ -
7.6	Fittings (Furnish and Install)	1	LS	$ 12,900	$ 12,900
7.7	Pressure Reducing Valves	0	EA		$ -
8	New Meter and Service				
8.1	1" Water Service from Main to Meter	39	EA	$ 2,305	$ 89,900
9	Fire Hydrants				
9.1	Fire Hydrant Assembly (Furnish and Install)	4	EA	$ 7,375	$ 29,500
9.2	Existing Fire Hydrant to be Removed	4	EA	$ 500	$ 2,000

Note 1: The linear feet of pipe in the opinion of cost may not exactly match the project length described in the CIP because the linear feet of pipe shown in the cost opinion includes a linear footage allowance for making connections to the existing water distribution system based on the preliminary project alignment.

Subtotal 1:	$ 314,600
Construction Contingency (10%):	$ 31,500
Design (15%):	$ 47,200
Contract Administration (10%):	$ 31,500
Total Project Cost:	**$ 424,800**

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Client:	**City of Arroyo Grande**		
Project:	**2011 Water Master Plan Updates**		
Segment:	**B-7**		
Street:	**Le Point Area Main Upgrades**	**Prepared by:**	JCS
		Reviewed by:	JHR
Opinion of Probable Construction Cost		**Date:**	6/19/2012

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Item Cost
1	Mobilization	1	LS	-	$ 2,400
2	Insurance and Bonds	1	LS	-	$ 2,400
3	Construction Surveying	1	LS	-	$ 1,200
4	Site Clearing and Restoration	1	LS	-	$ 400
5	SWPPP Preparation & Implementation	1	LS	-	$ 5,600
6	Traffic Control	3	Day	$ 500	$ 1,500
7	Water Main Construction				
7.1	Pavement Removal & Repair for Trench	247	SY	$ 82	$ 20,200
7.2	Trenching/Compaction/Fill/Hauling	247	CY	$ 44	$ 10,900
7.3	Abandon Existing Water Main	1	LS	$ 500	$ 500
7.4	Water Main (Furnish and Install)[1]				
7.4.1	8" - C900 PVC	555	LF	$ 18	$ 10,000
7.4.2	10" - C900 PVC	0	LF		$ -
7.4.3	12" - C900 PVC	0	LF		$ -
7.5	Gate Valves (to Furnish and Install)				
7.5.1	8"	2	EA	$ 2,000	$ 4,000
7.5.2	10"	0	EA		$ -
7.5.3	12"	0	EA		$ -
7.6	Fittings (Furnish and Install)	1	LS	$ 6,300	$ 6,300
7.7	Pressure Reducing Valves	0	EA		$ -
8	New Meter and Service				
8.1	1" Water Service from Main to Meter	6	EA	$ 2,300	$ 13,800
9	Fire Hydrants				
9.1	Fire Hydrant Assembly (Furnish and Install)	2	EA	$ 7,400	$ 14,800
9.2	Existing Fire Hydrant to be Removed	2	EA	$ 500	$ 1,000

Note 1: The linear feet of pipe in the opinion of cost may not exactly match the project length described in the CIP because the linear feet of pipe shown in the cost opinion includes a linear footage allowance for making connections to the existing water distribution system based on the preliminary project alignment.

Subtotal 1:	$ 95,000
Construction Contingency (10%):	$ 9,500
Design (15%):	$ 14,300
Contract Administration (10%):	$ 9,500
Total Project Cost:	**$ 128,300**

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Project B-8 - Well Evaluation and Rehabilitation

Design and Permitting:	8 months		
Construction:	2 to 10 months	Opinion of Total Project Cost:	$ 173,000

Need for Project:

Six (6) of the City's eight (8) wells had their most recent cleaning and video inspection performed more than 10 years ago. The current condition of the casing and screens are unknown. Evaluation and inspection are recommended to obtain a current understanding of the well condition.

Supporting Information:

WSC performed a well condition based assessment (CBA) of the City's wells, which yielded a prioritized list of wells for improvement or additional study. The analysis and results are described in the Well CBA Technical Memorandum prepared by WSC. As described in the memo, the wells were prioritized and recommendations were provided on the extent of improvement required for each well. Before carrying out any improvements, however, WSC recommended that the wells are video inspected to obtain an updated understanding of the below ground well condition.

As shown in the Table below, Well 1, 3, 4, and 5 were last video inspected more than 10 years ago. Thus, the current condition of these wells is unknown. In addition, Well 1 and Well 3 are over 50 years old.

Table 9.6 - Well Video Inspection Records

Facility	Install Date	Last Clean & Video Inspection
Well 1	1940	1988
Well 3	1954	1992
Well 4	1964	1993
Well 5	1967	1990
Well 7	1982	2009
Well 8	1990	n/a
Well 9	1990	n/a
Well 10	2006	2009

Recommended Solution:

It is recommended that the City perform video inspections of Well 1, 3, 4, 5, and 8, to understand the current condition of the underground well components, including the casing, screens and pump. The inspection should include pulling the pump to evaluate its condition.

The Well CBA identified Well 1 as having the highest priority for improvement, with a major rehabilitation likely. Based on this analysis, WSC expects that Well 1 will require major rehabilitation but recommends that video inspections are performed on all wells to verify this before improvements are carried out.

WSC recommends that the City prepare for a major rehabilitation of one of the wells. The video inspections will reveal if Well 1 or a different well requires a major rehabilitation. The budget for this project includes cleaning, screen replacement, new piping and valves, an upgraded electrical system and building repairs, for one well.

In addition, the Well CBA identified Well 4 as requiring minor rehabilitation and Well 5 and 8 requiring maintenance. These projects are included in the CIP.

Cost Estimate:

Client:	**City of Arroyo Grande**		
Project:	**2011 Water Master Plan Updates**		
Number:	**B-8**		
Description:	**Well Evaluation and Rehabilitation**	**Prepared by:**	JCS
		Reviewed by:	JHR
Opinion of Probable Construction Cost		**Date:**	6/19/2012

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Item Cost
1	Mobilization	1	LS	$ 3,600	$ 3,600
2	Insurance and Bonds	1	LS	$ 3,600	$ 3,600
3	Construction Surveying	0	LS	$ -	$ -
4	Site Clearing and Restoration	0	LS	$ -	$ -
5	SWPPP Preparation and Implementation	0	LS	$ -	$ -
6	Traffic Control	0	LS	$ -	$ -
7	Evaluation and Inspection				
7.1	Perform video inspection of Well 1, 3, 4, 5, and 8	6	EA	$ 2,500	$ 15,000
8	Major Well Rehabilitation (if needed) [1]				
8.1	Pull Pump and Clean Well	1	LS	$ 3,500	$ 3,500
8.2	Well Screen Repair Allowance	1	LS	$ 8,500	$ 8,500
8.3	Install New Piping and Valves	1	LS	$ 18,000	$ 18,000
8.4	Electrical System Upgrade Allowance	1	LS	$ 32,000	$ 32,000
8.5	Building Repair Allowance	1	LS	$ 12,000	$ 12,000
8.6	Install New Pump and Motor	1	LS	$ 32,000	$ 32,000

Subtotal 1:	$ 128,200
Construction Contingency (10%):	$ 12,800
Design (15%):	$ 19,200
Contract Administration (10%):	$ 12,800
Total Project Cost:	**$ 173,000**

Note 1: Not all of the listed improvements may be required. The City will determine which improvements are necessary after inspecting the wells (line item 7.1). Well 4, 5, and 8 have separate capital improvement projects that address known deficiencies at those wells. The CIP does not recommend major improvements to Well 3. The items listed in 8 above are intended for Well 1 as needed.

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Project B-9 - Galvanized Service Replacements (25 per year)

Design and Permitting:	6 months		
Construction:	Ongoing	Opinion of Total Project Cost:	$ 2,162,000

Need for Project:

The City reports an increasing number of failures in galvanized services in recent years. The galvanized services have exceeded their useful life.

Supporting Information:

Water services installed prior to 1980 were primarily constructed of galvanized steel. The useful life of galvanized steel ranges from approximately 10 to 50 years depending on soil properties. The City reports that an increasing number of galvanized services are failing; this indicates that the City's galvanized services have exceeded their useful life. The failed services show evidence of significant corrosion. The useful life of the galvanized services installed in the City's system is estimated life to be in the 20 to 30 year range. The City expects that additional failures will occur.

Recommended Solution:

It is recommended that the City plan and implement the replacement of all services installed prior to 1980 with new PVC services within the next 10 years. It is estimated that approximately 2,000 services will need to be replaced. Due to the number of services requiring replacement, it is recommended that the City perform the service replacements in phases, beginning with the highest priority areas. To determine the highest priority areas, it is recommended that the City perform a preliminary study to assess which services pose the highest risk and which areas of the City have been experiencing breaks.

Additionally, the City should couple service replacement projects with other larger projects in the same area when possible. For example, when the City is performing pavement upgrades and/or water main replacements, services in that area can be replaced concurrently. Completing the replacement of all pre-1980 services by a target date of 2027 is recommended (the City should adjust this date pending the outcome of the phasing and prioritization study).

Alternatives:

The do-nothing alternative will result in services being replaced as they fail. To maintain customer service and reliability, this alternative is not recommended. In addition, service replacements as a response to failure may lead to higher overall cost than a planned approach.

Cost Estimate:

Estimated costs for this project are as follows:

Design (3%)	$ 75,000
Contract Administration (5%)	$ 100,000
Construction Contingency (10%):	$ 200,000
Project Construction:	$ 1,787,000
Opinion of Total Project Cost:	$ 2,162,000

A detailed breakdown of the construction costs for this project is shown below are serves an estimate for Projects A-6 and C-6 as well.

Client:	**City of Arroyo Grande**		
Project:	**2011 Water Master Plan Updates**		
Segment:	**A-6, B-9, C-6**		
Street:	**Galvanized Service Replacements**	**Prepared by:**	JCS
		Reviewed by:	JHR
Opinion of Probable Construction Cost		**Date:**	6/19/2012

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Item Cost
1	Mobilization	1	LS	-	$ 138,300
2	Insurance and Bonds	1	LS	-	$ 138,300
3	Construction Surveying	1	LS	-	$ 69,200
4	Site Clearing and Restoration	1	LS	-	$ 23,100
5	SWPPP Preparation & Implementation	1	LS	-	$ 20,000
6	Traffic Control	200	Day	$ 500	$ 100,000
7	Water Main Construction				
7.1	Pavement Removal & Repair for Trench	0	SY		$ -
7.2	Trenching/Compaction/Fill/Hauling	0	CY		$ -
7.3	Abandon Existing Water Main	0	LS		$ -
7.4	Water Main (Furnish and Install)				
7.4.1	8" - C900 PVC	0	LF		$ -
7.4.2	10" - C900 PVC	0	LF		$ -
7.4.3	12" - C900 PVC	0	LF		$ -
7.5	Gate Valves (to Furnish and Install)				
7.5.1	8"	0	EA		$ -
7.5.2	10"	0	EA		$ -
7.5.3	12"	0	EA		$ -
7.6	Fittings (Furnish and Install)	0	LS		$ -
7.7	Pressure Reducing Valves	0	EA		$ -
8	New Meter and Service				
8.1	1" Water Service from Main to Meter	2000	EA	$ 2,305	$ 4,610,100
9	Fire Hydrants				
9.1	Fire Hydrant Assembly (Furnish and Install)	0	EA		$ -
9.2	Existing Fire Hydrant to be Removed	0	EA		$ -

Note: The rates for Design and Contract Administration are reduced for this project since the galvanized services are expected to be installe d on an ongoing basis using City crews or by including the replacement of services with other projects occuring on the street.

Subtotal 1:	$ 5,099,000
Construction Contingency (10%):	$ 509,900
Design (3%)	$ 153,000
Contract Administration (5%)	$ 255,000
Total Project Cost:	**$ 6,016,900**

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Project B-10 - Lierly Lane to Coach Road Upgrade

Design and Permitting:	10 months		
Construction:	5 months	Opinion of Total Project Cost:	$ 288,800

Need for Project:

The fire flow in the Coach Road area is inadequate. The recommended upgrades will improve fire flow in the area.

Supporting Information:

The hydraulic model indicates that the fire flow in the Coach Road area is approximately 700-gpm, during the maximum day demand (MDD) scenario. The City requires that residential areas have at least 1,500 gpm of fire flow available for 2 hours. The capacity of the existing pipeline from Lierly Lane to Coach Road needs to be increased to increase the flow capacity to the Coach Road area and help meet fire flow requirements.

Recommended Solution:

It is recommended that the City upgrade the 4-inch main running from Lierly Lane to Coach Road to 8-inch PVC, as shown in Figure 9-18. The length of this main is approximately 3,245-LF. When this project is combined with Project B-12, the available fire flow for the area during MDD will be about 1,290 to 1,440-gpm, which is much closer to meeting the minimum fire flow requirements.

Figure 9-18 - Lierly Lane to Coach Road Main Upgrade

Alternatives:

A potential alignment alternative is to extend an 8-in main down Branch Mill Road to East Cherry Avenue. The fire flow available from this alternative is slightly better than the recommended alternative; however the pipeline is slightly longer and is not aligned with proposed future development. If planned development occurs in this area, the developer(s) would be responsible for placing public infrastructure in the road(s) fronting the development as on-site service. Therefore the proposed alignment will be constructed as development occurs even if the Branch Mill alignment were selected. This would create an overly redundant system, and is not required.

Cost Estimate:

Client:	**City of Arroyo Grande**				
Project:	**2011 Water Master Plan Updates**				
Segment:	**B-10**				
Street:	**Lierly Lane to Coach Road Upgrade**			**Prepared by:**	JCS
				Reviewed by:	JHR
Opinion of Probable Construction Cost				**Date:**	6/19/2012

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Item Cost
1	Mobilization	1	LS	-	$ 5,500
2	Insurance and Bonds	1	LS	-	$ 5,500
3	Construction Surveying	1	LS	-	$ 2,800
4	Site Clearing and Restoration	1	LS	-	$ 900
5	SWPPP Preparation & Implementation	1	LS	-	$ 8,200
6	Traffic Control	13	Day	$ 500	$ 6,500
7	Water Main Construction				
7.1	Pavement Removal & Repair for Trench	67	SY	$ 81	$ 5,400
7.2	Trenching/Compaction/Fill/Hauling	1442	CY	$ 44	$ 63,600
7.3	Abandon Existing Water Main	1	LS	$ 500	$ 500
7.4	Water Main (Furnish and Install)[1]				
7.4.1	8" - C900 PVC	3245	LF	$ 18	$ 58,300
7.4.2	10" - C900 PVC	0	LF		$ -
7.4.3	12" - C900 PVC	0	LF		$ -
7.5	Gate Valves (to Furnish and Install)				
7.5.1	8"	2	EA	$ 2,000	$ 4,000
7.5.2	10"	0	EA		$ -
7.5.3	12"	0	EA		$ -
7.6	Fittings (Furnish and Install)	1	LS	$ 10,200	$ 10,200
7.7	Pressure Reducing Valves	0	EA		$ -
8	New Meter and Service				
8.1	1" Water Service from Main to Meter	15	EA	$ 2,307	$ 34,600
9	Fire Hydrants				
9.1	Fire Hydrant Assembly (Furnish and Install)	1	EA	$ 7,400	$ 7,400
9.2	Existing Fire Hydrant to be Removed	1	EA	$ 500	$ 500

Note 1: The linear feet of pipe in the opinion of cost may not exactly match the project length described in the CIP because the linear feet of pipe shown in the cost opinion includes a linear footage allowance for making connections to the existing water distribution system based on the preliminary project alignment.

Subtotal 1:	$ 213,900
Construction Contingency (10%):	$ 21,400
Design (15%):	$ 32,100
Contract Administration (10%):	$ 21,400
Total Project Cost:	**$ 288,800**

Project B-11 - Well 4 Minor Rehabilitation

Design and Permitting:	6 months		
Construction:	9 months	Opinion of Total Project Cost:	$ 121,300

Need for Project:

The Well CBA identified Well 4 as requiring minor rehabilitation because the well screening is expected to be in good condition, but the mechanical and electrical equipment is at or near the end of its useful life.

Supporting Information:

Table 9.7 shows the date of installation of the major components of Well 4, as well as the date of the most recent casing cleaning and motor rewind. The estimated remaining useful life (RUL), which was used to assist in prioritizing well improvements in the well CBA analysis, is also shown. As shown in Table 9.7, the well casing, motor, pump and electrical system have exceeded or will soon exceed their useful life.

Table 9.7 - Installation Date and RUL of Well 4 Components

Component	Install Date	Most Recent Improvement	RUL (years)
Well Casing	1964	1993 (cleaned)	3
Motor	1964	1993 (rewound)	-8
Pump	1993	n/a	2
Electrical System	1964	n/a	-17

The casing was installed in 1964 and last inspected with video in 1993. Although the casing is almost 50 years old, which is the assumed expected useful life, the specific capacity has increased between 2007 and 2011, signifying that casing or screen rehabilitation is likely not necessary. Table 9.8 shows the specific capacity calculated for 2007 and 2011 based on pumping water level, static water level and flow rate measurements made in 2007 and 2011, respectively. As Table 9.8 shows, the specific capacity has increased by about 150% from 2007 to 2011. A video inspection is required to confirm the condition of the casing and screens and to verify that there are not large holes in the screens.

Table 9.8 - Specific Capacity Data

Facility	Pump Test Date	Pumping Water Level (ft)	Static Water Level (ft)	Drawdown (ft)	Flow Rate (GPM)	Specific Capacity (GPM/ ft drawdown)
Well 4	5/1/2007	85	75	10	442	44
	12/9/2011	75	71	4	455	114

The piping at Well 4 is in poor condition. Figure 9-19 shows failed coatings and corrosion on the discharge piping at Well 4.

Figure 9-19 - Corrosion of Well 4 Discharge Piping

Recommended Solution:

Before improvements are carried out, it is recommended that the City perform a video inspection of Well 4. If the results of the video inspection show that screen rehabilitation is not necessary, it is recommended that the City replace the motor, pump, piping, valves and electrical system at Well 4.

If the video inspection shows failure in the screening, a major rehabilitation, which includes screen rehabilitation, will likely be necessary. Because only a minor rehabilitation of Well 4 is expected, the budget for this project includes the following items: new motor, new pump, new piping, new valves, and a new electrical system.

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Alternatives:

The mechanical and electrical equipment is at or near the end of its useful life; thus, the do-nothing alternative is not recommended even if the video inspection shows the casing is in good condition.

Cost Estimate:

Client:	**City of Arroyo Grande**				
Project:	**2011 Water Master Plan Updates**				
Number:	**B-11**				
Description:	**Well 4 Minor Rehabilitation**			**Prepared by:**	JCS
				Reviewed by:	JHR
Opinion of Probable Construction Cost				**Date:**	6/19/2012
Item No.	**Item Description**	**Quantity**	**Unit**	**Unit Cost**	**Total Item Cost**
1	Mobilization	1	LS	-	$ 1,900
2	Insurance and Bonds	1	LS	-	$ 1,900
3	Construction Surveying	0	LS	$ -	$ -
4	Site Clearing and Restoration				
5	SWPPP Preparation & Implementation	0	LS	$ -	$ -
6	Traffic Control	0	Days	$ -	$ -
7	Investigate and Upgrade Well 4				
7.1	Replace Pump, Motor and column pipe	1	LS	$ 24,000	$ 24,000
7.2	Replacement of Valves and Piping	1	LS	$ 18,000	$ 18,000
7.3	Building Improvement Allowance	1	LS	$ 8,000	$ 8,000
7.4	Electrical Upgrades	1	LS	$ 36,000	$ 36,000
				Subtotal 1:	$ 89,800
				Construction Contingency (10%):	$ 9,000
				Design (15%):	$ 13,500
				Contract Administration (10%):	$ 9,000
				Total Project Cost:	**$ 121,300**

Project B-12 - Well 5 and 8 Maintenance

Design and Permitting:	4 months		
Construction:	5 months	Opinion of Total Project Cost:	$ 120,000

Need for Project:

The piping and valves Well 5 are near the end of their useful life and need to be repaired/replaced.

The electrical system at Well 8 requires investigation to determine the cause of repeated blown motors. In addition, the ProMinent Gamma style chemical pump is should be updated when due.

Supporting Information:

Well 5:

- Field observations revealed that the piping and valves at Well 5 are in poor condition and are nearing the end of their useful life. Figure 9-20 shows failed coatings and corrosion on the pipes at Well 5.

Well 8:

- City staff report that motor failure has occurred several times at Well 8, which has resulted in repeated blown motors. Note that the existing motor at Well 8 was installed in 2010.
- One of the ProMinent chemical pumps is the Gamma style, as shown in Figure 9-21, and should be updated when it is due for replacement.

Figure 9-20 - Corrosion on Well 5 Piping

Figure 9-21 - Gamma ProMinent Chemical Pump at Well 8

Recommended Solution:

It is recommended the City replace the valves and piping at Well 5.

It is recommended that the City hire an electrical engineer to perform an investigation of the electrical equipment at Well 8 to diagnose the cause of repeated motor failures. In addition, it is recommended that the City upgrade the ProMinent Gamma chemical pump to a ProMinent Delta pump when it's due for replacement.

Alternatives:

A do-nothing alternative is not recommended. Well maintenance is necessary to ensure supply reliability.

Cost Estimate:

Client:	**City of Arroyo Grande**				
Project:	**2011 Water Master Plan Updates**				
Number:	**B-12**				
Description:	**Wells 5 and 8 Maintenance**			**Prepared by:**	JCS
				Reviewed by:	JHR
Opinion of Probable Construction Cost				**Date:**	6/19/2012
Item No.	**Item Description**	**Quantity**	**Unit**	**Unit Cost**	**Total Item Cost**
1	Mobilization	1	LS	$ 2,500	$ 2,500
2	Insurance and Bonds	1	LS	$ 2,500	$ 2,500
3	Construction Surveying	0	LS	$ -	$ -
4	Site Clearing and Restoration	0	LS	$ -	$ -
5	SWPPP Preparation & Implementation	0	LS	$ -	$ -
6	Traffic Control	0	LS	$ -	$ -
7	Well 8 Upgrades				
7.1	Perform Electrical Study	1	LS	$ 7,500	$ 7,500
7.2	Allowance to Upgrade Electrical System	1	LS	$ 22,000	$ 22,000
7.3	Allowance to Install New Motor	1	LS	$ 12,000	$ 12,000
8	Well 5 Upgrades				
8.1	Replacement of Valves and Piping	1	LS	$ 18,400	$ 18,400
8.2	Building Improvement Allowance	1	LS	$ 24,000	$ 24,000
				Subtotal 1:	$ 88,900
				Construction Contingency (10%):	$ 8,900
				Design (15%):	$ 13,300
				Contract Administration (10%):	$ 8,900
				Total Project Cost:	**$ 120,000**

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Project B-13 - Well Siting Study

Design and Permitting:	8 months		
Construction:	N/A	Opinion of Total Project Cost:	$ 55,000

Need for Project:

The supply redundancy analysis identified insufficient supply redundancy. In addition, the results of the well condition-based assessment support the need for a new well with at least 800-gpm reliable yield. A well siting study is necessary to determine an optimal location for the new well to avoid excessive drawdown in the current main well field (location of Well 1, 3, 4, 7, 8), and in consideration of regional hydrogeology and pumping patterns.

Supporting Information:

The supply redundancy analysis identifies a shortage of 800-gpm when the Lopez WTP and Well 3 are out of service. (Well 3 was taken out of service for the supply redundancy analysis because Well 3 has pumping restrictions and cannot be used when surface water is within 150 feet of the well).

Table 9.9 - Supply Redundancy Analysis Results

Condition	Supply Sources (gpm)			Buildout MDD (gpm)
	Lopez	Wells	Total Supply	
1. Largest well out of service (Lopez in service)[1]	2,096	2,325	4,421	4,139
2. Lopez out of service (Wells in service)[2]	-	3,339	3,339	4,139

Notes:
1. **Assumes maximum capacity at Lopez turnouts, and Well 5 (largest well) and Well 3 (has pumping restrictions) are out of service.**
2. **Assumes Lopez system and Well 3 (has pumping restrictions) are out of service.**

Approximately 70% of the City's groundwater production capacity is located in the main well field in Elm Street Park. This is the location of Well 1, 3, 4, 7 and 8. Well 5 is located in the nearby City maintenance yard, approximately 1,600 feet from the main well field. When the capacity of Well 5 is included, these six wells account for over 95% of the City's groundwater production capacity. Although the main well field is very productive, excessive drawdown is a concern and placing an additional well

in the vicinity may not yield a sustainable solution. A well siting study is needed to determine an optimal location for a new well that can provide a minimum of 800-gpm of reliable yield.

Recommended Solution:

It is recommended that the City hire a hydrogeologist to perform a well siting study to determine the optimal location that will yield the desired production. A well siting study could help to avoid excessive drawdown at the current main well field and help protect long term production at those wells. The well siting study should include consideration of regional hydrogeology, pumping patterns, location and capacity of the City's existing water distribution system infrastructure, availability of property, etc. The result of the study should be identification of at least three potential sites for the City to purchase (if needed) and utilize for the proposed well.

Alternatives:

The alternative is to not perform a well siting study, but rather choose a location based on preference or past production records. This alternative is not recommended. The production capacity from the main well field is adequate for the City's needs, but adding an additional well in the vicinity could lead to adverse effects on the groundwater basin and excessive drawdown.

Cost Estimate:

Client:	**City of Arroyo Grande**				
Project:	**2011 Water Master Plan Updates**				
Number:	**B-13**				
Description:	**Well Siting Study**			**Prepared by:**	JCS
				Reviewed by:	JHR
Opinion of Probable Construction Cost				**Date:**	6/19/2012
Item No.	**Item Description**	**Quantity**	**Unit**	**Unit Cost**	**Total Item Cost**
1	Well Siting Study	1	LS	$ 50,000	$ 50,000
				Subtotal 1:	$ 50,000
				Construction Contingency (10%):	$ 5,000
				Total Project Cost:	**$ 55,000**

Project C-1 - New Well

Design and Permitting:	12 months		
Construction:	16 months	Opinion of Total Project Cost:	$ 1,134,900

Need for Project:

The supply redundancy analysis identified a supply shortage when Lopez and Well 3 are out of service. In addition, the well condition-based assessment supports the need for a new well, as several of the existing wells are expected to be nearing the end of their useful life.

Supporting Information:

The supply redundancy analysis identified a shortage of 800-gpm when Lopez and Well 3 are out of service. (Well 3 was taken out of service for the supply redundancy analysis because Well 3 has pumping restrictions and cannot be used when surface water is within 150 feet of the well).

Table 9.10 - Supply Redundancy Analysis Results

Condition	Supply Sources (gpm)			Buildout MDD (gpm)
	Lopez	Wells	Total Supply	
1. Largest well out of service (Lopez in service)[1]	2,096	2,325	4,421	4,139
2. Lopez out of service (Wells in service)[2]	-	3,339	3,339	4,139

[1] Assumes maximum capacity at Lopez turnouts, and Well 5 (largest well) and Well 3 (has pumping restrictions) are out of service.

[2] Assumes Lopez system and Well 3 (has pumping restrictions) are out of service.

In the well condition based assessment, an analysis of the remaining useful life (RUL) of the major well components, including the casing, was carried out. The expected useful life (EUL) of a well depends on many factors, including casing material, construction methodology, screening design, maintenance, groundwater quality, and pumping characteristics. EUL estimates given in literature range from 30 to

50 years[2]. Some of the wells in the City have been operating for more than 50 years, with Well 1 being the oldest (over 70 years old). Based on historical performance, WSC selected a nominal EUL value of 50 years, which is at the upper limit of the EUL range, to use for prioritizing well improvements. As shown in Table 9.11, Well 1 and Well 3 have a negative RUL. Although these wells are still operating, the wells with a negative RUL deserve attention and signify that extensive rehabilitation or well replacement may be necessary to avoid failure. Well 3 is not recommended for Major Rehabilitation because it is not considered reliable since it is under the influence of surface water and has restrictions on when the well can be used.

Table 9.11 - Well Casing Estimated Remaining Useful Life

Facility	Install Date	RUL	Last Clean & Video Inspection
Well 1	1940	-21	1988
Well 3	1954	-7	1992
Well 4	1964	3	1993
Well 5	1967	6	1990
Well 7	1982	21	2009
Well 8	1990	29	n/a
Well 9	1990	29	n/a
Well 10	2006	45	2009

Recommended Solution:

It is recommended that the City drill and equip a new well at the site identified in the Well Siting Study (Project B-8). This project includes cost for a vertical turbine pump with a design flow of 800-gpm at approximately 375 to 425-ft TDH with a 125 to 150 HP premium efficiency motor, associated valves, piping and telemetry equipment, and a secure enclosure (actual well pump performance would depend on location of the well, depth to groundwater, and pump efficiency).

[2] Fulton, A. et al. *Water Well Design, Construction, and Development: Important Considerations Before Making the Investment*. University of California.

Alternatives:

There are currently no other alternative supply options besides groundwater.

Cost Estimate:

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Item Cost
1	Mobilization	1	LS	$ 13,200	$ 13,200
2	Insurance and Bonds	1	LS	$ 13,200	$ 13,200
3	Construction Surveying	1	LS	$ 1,500	$ 1,500
4	Site Clearing and Restoration	1	LS	$ 8,000	$ 8,000
5	SWPPP Preparation and Implementation	1	LS	$ 10,000	$ 10,000
6	Traffic Control	0	LS	$ -	$ -
7	Well Drilling and Construction				
7.1	Noise control	1	LS	$ 10,000	$ 10,000
7.2	Testing and disposal of borehole cuttings	1	LS	$ 8,000	$ 8,000
7.3	NPDES compliance	1	LS	$ 15,000	$ 15,000
7.4	Drill 38-inch conductor borehole, install 26-inch conductor casing	50	ft	$ 400	$ 20,000
7.5	Drill pilot borehole	680	ft	$ 60	$ 40,800
7.6	Geophysical borehole log	1	LS	$ 5,000	$ 5,000
7.7	Isolated zone aquifer testing	2	Zones	$ 5,000	$ 10,000
7.8	Ream pilot hole to 22-inches	680	ft	$ 55	$ 37,400
7.9	Caliper survey of reamed borehole	1	LS	$ 1,500	$ 1,500
7.10	Furnish and install 12 3/4 inch OD blank casing	320	ft	$ 100	$ 32,000
7.11	Furnish and install louvered screen	400	ft	$ 150	$ 60,000
7.12	Furnish and install 2-inch sounding tube	298	ft	$ 10	$ 2,980
7.13	Furnish and install 3-inch gravel feed pipe	210	ft	$ 18	$ 3,780
7.14	Furnish and install filter pack	530	ft	$ 50	$ 26,500
7.15	Install surface seal	200	ft	$ 50	$ 10,000
7.16	Well development & pumping tests	1	LS	$ 60,000	$ 60,000
7.17	Well completion	1	LS	$ 5,000	$ 5,000
7.18	As-built documentation	1	LS	$ 6,500	$ 6,500
8	Civil Site Work and Underground				
8.1	Site grading and landscaping	1	LS	$ 12,000	$ 12,000
8.2	Paving and surfacing	3000	SF	$ 5	$ 15,000
8.3	Driveway	1	LS	$ 5,000	$ 5,000
8.4	Site piping	1	LS	$ 35,000	$ 35,000
8.5	Bollards	4	EA	$ 500	$ 2,000
8.6	Sheeting, shoring and bracing	1	LS	$ 5,000	$ 5,000
9	Pump Station				
9.1	Submersible pump and motor	1	EA	$ 24,000	$ 24,000
9.2	Piping, valving and appurtenances	1	LS	$ 25,000	$ 25,000
9.3	Pump column	450	LF	$ 10	$ 4,500
10	Building				
10.1	Building foundation	45	CY	$ 750	$ 33,750
10.2	Building walls	1000	SF	$ 20	$ 20,000
10.3	Pre-engineered truss and roof	750	SF	$ 30	$ 22,500
10.4	Interior framing, wall board, insulation and finishes	1	LS	$ 15,000	$ 15,000
10.5	Louvers	1	LS	$ 10,000	$ 10,000
10.6	Doors, frames and finish hardware	3	EA	$ 15,000	$ 45,000
10.7	Exterior finish and coatings	1	LS	$ 20,000	$ 20,000

11	Electrical				
11.1	Utility fee estimate	1	LS	$ 15,000	$ 15,000
11.2	Utility primary conduit and transformer pad	1	LS	$ 10,000	$ 10,000
11.3	Switchboard and MCC	1	LS	$ 55,000	$ 55,000
11.4	Conduit and cable	500	LF	$ 45	$ 22,500
11.5	Panels	1	LS	$ 8,500	$ 8,500
11.6	Instrumentation	1	LS	$ 5,000	$ 5,000
11.7	Lighting and receptacles	1	LS	$ 9,000	$ 9,000
11.8	Grounding	1	LS	$ 8,000	$ 8,000
11.9	Terminations, splices, labels and nameplates	1	LS	$ 5,000	$ 5,000
11.10	Stanchions, anchors, supports	1	LS	$ 5,000	$ 5,000
11.11	Testing and start-up	1	LS	$ 2,500	$ 2,500
11.12	Training	1	LS	$ 1,000	$ 1,000
				Subtotal 1:	$ 840,600
				Construction Contingency (10%):	$ 84,100
				Design (15%):	$ 126,100
				Contract Administration (10%):	$ 84,100
				Total Project Cost:	**$ 1,134,900**

Note: Cost does not include property acquisition.

Project C-2 - Miller Way Booster Zone Upgrade

Design and Permitting:	8 months		
Construction:	6 months	Opinion of Total Project Cost:	$ 136,600

Need for Project:

The Miller Way zone is underserved. The Miller Way Booster Station is unable to provide reliable service to the Miller Way zone. City staff report that the water service pressure is inadequate during peak periods.

Supporting Information:

The Miller Way Booster Station, which has two (2) 5-HP pumps, requires frequent maintenance and suffers from occasional pump and tank failures. When failures occur at the Miller Way Booster Station, the Miller Way zone receives water from the Rancho Grande zone since the services are also plumbed to the Rancho Grande main that runs along Miller Way. (The Rancho Grande main is the Miller Way zone's fire flow source). The Rancho Grande main running along Miller Way is at a lower hydraulic gradient than the Miller Way zone resulting in a considerably lower service pressure (approximately 40-psi).

City staff perform frequent maintenance on the booster station to keep it operational, which has resulted in high maintenance costs. The booster station building and roof are showing signs of deterioration and rot, as shown in Figure 9-22 and Figure 9-23. The pumps and building were constructed in 1978. The bladder style hydropneumatic tanks are newer because they are replaced on a more frequent basis as they wear out. The building storing the bladder tanks requires extensive cosmetic repair including painting, re-roofing and replacement of dry rotted boards and/or siding and

is recommended for replacement. Figure 9-25 shows that there are seven (7) bladder tanks installed at the booster station.

Figure 9-22 - Miller Way Booster Station Exterior

Figure 9-23 - Miller Way Booster Station Roof

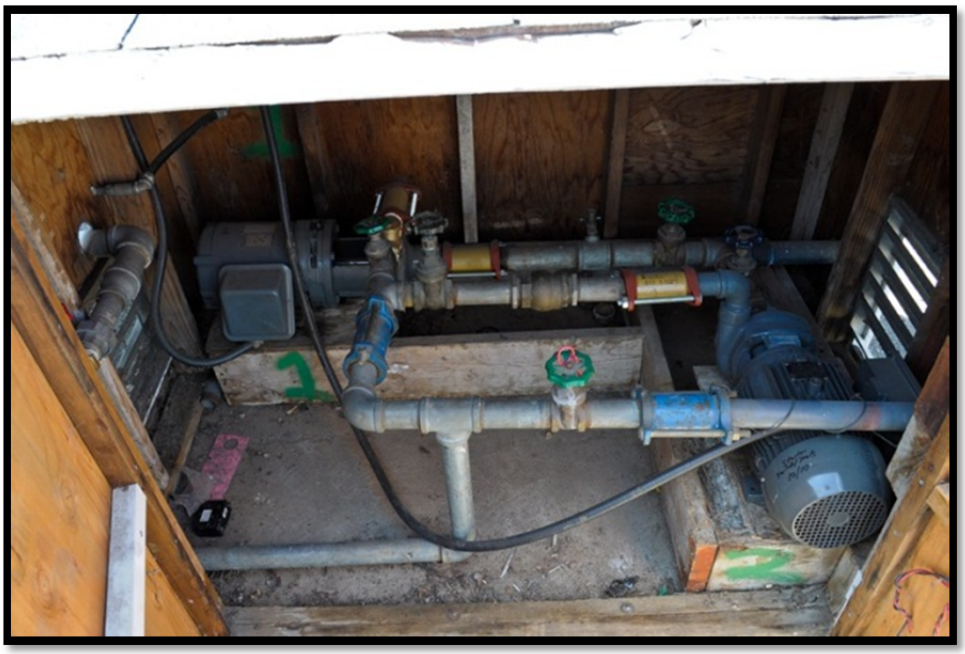

Figure 9-24 - Miller Way Booster Station Mechanical Equipment

Figure 9-25 - Miller Way Bladder Tanks

Recommended Solution:

It is recommended that the City perform a complete upgrade on the Miller Way Booster Station, including a new pump building (or enclosed package pump station), new pumps and motors (2 x 5-HP), and new bladder tanks. The upgraded booster station will have a design capacity of 75-gpm. This will increase the reliability of the water supply to the Miller Way zone and will improve water service pressure. In addition, this is expected to decrease maintenance costs.

Alternatives:

There are two alternatives to consider:

(1) One alternative is to reconfigure the service laterals in the Miller Way zone to connect solely to the Rancho Grande zone and abandon the customer services connected to the main supplied by the Miller Way Booster Station. To implement this alternative, approximately 25 service laterals would need to be constructed and connected to the existing Rancho Grande main in Miller Way. This alternative results in low service pressure in the Miller Way zone (about 40 psi). For these reasons, this alternative is not recommended.

(2) A second alternative is to connect the Miller Way zone main to the Rancho Grande main at two points, one on either side of the Miller Way zone, and abandon the existing individual services to the Rancho Grande zone. This alternative also results in low service pressure (about 40 psi) and is not recommended.

The above alternatives are not recommended because the customers in the Miller Way zone would receive supply at about 40 psi. Although 40 psi meets CPDH requirements, this service pressure will likely lead to unsatisfied customers.

Cost Estimate:

Client:	**City of Arroyo Grande**				
Project:	**2011 Water Master Plan Updates**				
Number:	**C-2**				
Description:	**Miller Way Booster Zone Upgrade**			**Prepared by:**	JCS
				Reviewed by:	JHR
Opinion of Probable Construction Cost				**Date:**	6/19/2012

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Item Cost
1	Mobilization	1	LS	-	$ 2,800
2	Insurance and Bonds	1	LS	-	$ 2,800
3	Construction Surveying	1	LS	-	$ 1,400
4	Site Clearing and Restoration	1	LS	-	$ 1,200
5	SWPPP Preparation & Implementation	1	LS	-	$ 500
6	Traffic Control	1	LS	-	$ 500
7	Pump Station				
7.1	Site grading and landscaping	1	LS	$ 2,000	$ 2,000
7.2	Driveway Restoration	1	LS	$ 1,500	$ 1,500
7.3	Site piping	1	LS	$ 7,500	$ 7,500
7.4	Pump and motor (5-hp)	2	EA	$ 3,500	$ 7,000
7.5	Bladder Tank (200 gallon)	1	EA	$ 13,000	$ 13,000
7.6	Prefabricated Utility Building	1	LS	$ 30,000	$ 30,000
8	Electrical				
8.1	Switchboard, MCC, and Instrumentation	1	LS	$ 18,000	$ 18,000
8.2	Panelboard and utility connection	1	LS	$ 4,000	$ 4,000
8.3	Conduit, cable, terminations, grounding	1	LS	$ 6,000	$ 6,000
9	Start-up and Testing				
9.1	Start-up and Testing	1	LS	$ 2,000	$ 2,000
9.2	Training	1	LS	$ 1,000	$ 1,000
				Subtotal 1:	$ 101,200
				Construction Contingency (10%):	$ 10,100
				Design (15%):	$ 15,200
				Contract Administration (10%):	$ 10,100
				Total Project Cost:	**$ 136,600**

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Project C-3 - Security Upgrades

Design and Permitting:	4 months		
Construction:	5 months	Opinion of Total Project Cost:	$ 47,100

Need for Project:

The City's previously prepared Vulnerability Assessment identified project required to improve the security of the City's water distribution system. Many of the recommendations of the Vulnerability Assessment have been implemented by the City. However, there are a couple of projects that still require completion. To protect the distribution system security, the details of the projects are not listed in this report.

Supporting Information:

Refer to the Vulnerability Assessment for additional information.

Recommended Solution:

It is recommended that the City implement the remaining recommendations from the Vulnerability Assessment.

Cost Estimate:

Client:	**City of Arroyo Grande**				
Project:	**2011 Water Master Plan Updates**				
Number:	**C-3**				
Description:	**Security Upgrades**			**Prepared by:**	JCS
				Reviewed by:	JHR
Opinion of Probable Construction Cost				**Date:**	6/19/2012
Item No.	**Item Description**	**Quantity**	**Unit**	**Unit Cost**	**Total Item Cost**
1	Mobilization	1	LS	$ -	$ 1,000
2	Insurance and Bonds	0	LS	$ -	$ 1,000
3	Misc. Security Upgrades				$ 32,900
				Subtotal 1:	$ 34,900
				Construction Contingency (10%):	$ 3,500
				Design (15%):	$ 5,200
				Contract Administration (10%):	$ 3,500
				Total Project Cost:	**$ 47,100**

Project C-4 - Coach Road and Greenwood Drive Upgrades

Design and Permitting:	8 months		
Construction:	7 months	Opinion of Total Project Cost:	$ 267,600

Need for Project:

The fire flow in the Coach Road and Greenwood Road area is inadequate. The recommended upgrades will improve fire flow in the area.

Supporting Information:

The hydraulic model indicates that the fire flow in the Coach Road and Greenwood Drive area is approximately 700-gpm, during the maximum day demand (MDD) scenario. The City requires that residential areas have at least 1,500-gpm of fire flow available for 2 hours. The capacity of the existing pipeline needs to be increased to help decrease this deficit in fire flow.

Recommended Solution:

It is recommended that the City upgrade the 4-inch ACP main along Coach Road, between Flora Road and Branch Mill Road, to 8-inch PVC. The length of this main is approximately 710-LF. In addition, it is recommended that the City extend the existing main from Greenwood Road to Branch Mill Road, as shown in Figure 9-26. This new main will be approximately 675-LF. Thus, the total project length is 1,385-LF. These upgrades will result in a fire flow of approximately 840-gpm in the area. When this project is combined with Project B-5, the available fire flow for the area during MDD will be about 1,290 to 1,440-gpm, which is much closer to meeting the minimum fire flow requirements.

Figure 9-26 - Coach Road and Greenwood Drive Upgrades

Cost Estimate:

Client:	**City of Arroyo Grande**		
Project:	**2011 Water Master Plan Updates**		
Segment:	**C-4**		
Street:	**Coach Road and Greenwood Road Upgrades**	**Prepared by:**	JCS
		Reviewed by:	JHR
Opinion of Probable Construction Cost		**Date:**	6/19/2012

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Item Cost
1	Mobilization	1	LS	-	$ 3,500
2	Insurance and Bonds	1	LS	-	$ 3,500
3	Construction Surveying	1	LS	-	$ 1,700
4	Site Clearing and Restoration	1	LS	-	$ 600
5	SWPPP Preparation & Implementation	1	LS	-	$ 5,700
6	Traffic Control	3	Day	$ 500	$ 1,500
7	Water Main Construction				
7.1	Pavement Removal & Repair for Trench	316	SY	$ 82	$ 25,800
7.2	Trenching/Compaction/Fill/Hauling	316	CY	$ 44	$ 13,900
7.3	Abandon Existing Water Main	1	LS	$ 500	$ 500
7.4	Water Main (Furnish and Install)[1]				
7.4.1	8" - C900 PVC	710	LF	$ 18	$ 12,700
7.4.2	10" - C900 PVC	0	LF		$ -
7.4.3	12" - C900 PVC	0	LF		$ -
7.5	Gate Valves (to Furnish and Install)				
7.5.1	8"	2	EA	$ 2,000	$ 4,000
7.5.2	10"	0	EA		$ -
7.5.3	12"	0	EA		$ -
7.6	Fittings (Furnish and Install)	1	LS	$ 6,300	$ 6,300
7.7	Pressure Reducing Valves	0	EA		$ -
8	New Meter and Service				
8.1	1" Water Service from Main to Meter	16	EA	$ 2,306	$ 36,900
9	Fire Hydrants				
9.1	Fire Hydrant Assembly (Furnish and Install)	2	EA	$ 7,400	$ 14,800
9.2	Existing Fire Hydrant to be Removed	2	EA	$ 500	$ 1,000
				Subtotal 1:	$ 132,400
				Construction Contingency (10%):	$ 13,200
				Design (15%):	$ 19,900
				Contract Administration (10%):	$ 13,200
				Total Project Cost:	**$ 178,700**

Note 1: The linear feet of pipe in the opinion of cost may not exactly match the project length described in the CIP because the linear feet of pipe shown in the cost opinion includes a linear footage allowance for making connections to the existing water distribution system based on the preliminary project alignment.

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Client:	**City of Arroyo Grande**		
Project:	**2011 Water Master Plan Updates**		
Segment:	**C-4**		
Street:	**Easement off Greenwood**	**Prepared by:**	JCS
		Reviewed by:	JHR
Opinion of Probable Construction Cost		**Date:**	6/19/2012

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Item Cost
1	Mobilization	1	LS	-	$ 1,600
2	Insurance and Bonds	1	LS	-	$ 1,600
3	Construction Surveying	1	LS	-	$ 800
4	Site Clearing and Restoration	1	LS	-	$ 300
5	SWPPP Preparation & Implementation	1	LS	-	$ 5,700
6	Traffic Control	3	Day	$ 500	$ 1,500
7	Water Main Construction				
7.1	Pavement Removal & Repair for Trench	211	SY	$ 81	$ 17,200
7.2	Trenching/Compaction/Fill/Hauling	300	CY	$ 44	$ 13,200
7.3	Abandon Existing Water Main	0	LS		$ -
7.4	Water Main (Furnish and Install)[1]				
7.4.1	8" - C900 PVC	675	LF	$ 18	$ 12,100
7.4.2	10" - C900 PVC	0	LF		$ -
7.4.3	12" - C900 PVC	0	LF		$ -
7.5	Gate Valves (to Furnish and Install)				
7.5.1	8"	0	EA		$ -
7.5.2	10"	0	EA		$ -
7.5.3	12"	0	EA		$ -
7.6	Fittings (Furnish and Install)	1	LS	$ 3,900	$ 3,900
7.7	Pressure Reducing Valves	0	EA		$ -
8	New Meter and Service				
8.1	1" Water Service from Main to Meter	0	EA		$ -
9	Fire Hydrants				
9.1	Fire Hydrant Assembly (Furnish and Install)	1	EA	$ 7,400	$ 7,400
9.2	Existing Fire Hydrant to be Removed	1	EA	$ 500	$ 500

Note 1: The linear feet of pipe in the opinion of cost may not exactly match the project length described in the CIP because the linear feet of pipe shown in the cost opinion includes a linear footage allowance for making connections to the existing water distribution system based on the preliminary project alignment.

Subtotal 1:	$ 65,800
Construction Contingency (10%):	$ 6,600
Design (15%):	$ 9,900
Contract Administration (10%):	$ 6,600
Total Project Cost:	**$ 88,900**

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Project C-5 - Reservoir 1 Solar PV

Design and Permitting:	8 months		
Construction:	4 months	Opinion of Total Project Cost:	$ 448,800

Need for Project:

Reservoir 1 is a reinforced concrete reservoir with a reinforced concrete roof making it a suitable site for a solar photovoltaic (PV) system. A solar PV system would allow the City to generate renewable energy and reduce the City's electricity bills.

Supporting Information:

Reservoir 1 was constructed in 2004 and has a flat, reinforced concrete roof, which is assumed to be capable of bearing the solar PV system load. The reservoir is 105-ft in diameter. An approximately 81 kW_{DC} PV system could be installed on the roof of the reservoir. A system of this size in Arroyo Grande is estimated to generate approximately 118,000 kWh annually.

Figure 9-27 - Reservoir 1

Recommended Solution:

It is recommended that the City investigate installation of a solar PV system on Reservoir 1. It is estimated that an 81 kW_{DC} system could be installed on Reservoir 1, which could generate approximately 118,000 kWh/year.

Because there is only a minor electrical demand at the site, it is recommended that the City deliver the power to PG&E through the Renewable Energy Self-Generation Bill Credit Transfer (RES-BCT) rate schedule, which was developed specifically for local governments. Thorough the RES-BCT rate schedule, the value of the monthly kWh exported at Reservoir 1 can be credited to the City's other PG&E electric accounts.

Cost Estimate:

Client:	**City of Arroyo Grande**				
Project:	**2011 Water Master Plan Updates**				
Number:	**C-5**				
Description:	**Reservior 1 Solar**			**Prepared by:**	JCS
				Reviewed by:	JHR
Opinion of Probable Construction Cost				**Date:**	6/19/2012
Item No.	**Item Description**	**Quantity**	**Unit**	**Unit Cost**	**Total Item Cost**
1	Mobilization	1	LS	$ 60,000	$ 11,000
2	Insurance and Bonds	1	LS	$ 25,000	$ 11,000
3	Structural Evaluation of Roof Load	1	LS	$ 8,000	$ 8,000
4	Install Solar System				
4.1	PG&E coordination	1	LS	$ 13,000	$ 13,000
4.2	Install 81 kW Solar System on Reservoir 1	81	kW	$ 4,500	$ 365,000
				Subtotal 1:	$ 408,000
				Construction Contingency (10%):	$ 40,800
				Total Project Cost:	**$ 448,800**

See Project Description for detailed description of financing and pay back options for solar installations.

Project C-6 - Galvanized Service Replacements (25 per year)

Design and Permitting:	6 months		
Construction:	Ongoing	Opinion of Total Project Cost:	$ 2,162,000

Need for Project:

The City reports an increasing number of failures in galvanized services in recent years. The galvanized services have exceeded their useful life.

Supporting Information:

Water services installed prior to 1980 were primarily constructed of galvanized steel. The useful life of galvanized steel ranges from approximately 10 to 50 years depending on soil properties. The City reports that an increasing number of galvanized services are failing; this indicates that the City's galvanized services have exceeded their useful life. The failed services show evidence of significant corrosion. The useful life of the galvanized services installed in the City's system is estimated life to be in the 20 to 30 year range. The City expects that additional failures will occur.

Recommended Solution:

It is recommended that the City plan and implement the replacement of all services installed prior to 1980 with new PVC services within the next 10 years. It is estimated that approximately 2,000 services will need to be replaced. Due to the number of services requiring replacement, it is recommended that the City perform the service replacements in phases, beginning with the highest priority areas. To determine the highest priority areas, it is recommended that the City perform a preliminary study to assess which services pose the highest risk and which areas of the City have been experiencing breaks.

Additionally, the City should couple service replacement projects with other larger projects in the same area when possible. For example, when the City is performing pavement upgrades and/or water main replacements, services in that area can be replaced concurrently. Completing the replacement of all pre-1980 services by a target date of 2027 is recommended (the City should adjust this date pending the outcome of the phasing and prioritization study).

Alternatives:

The do-nothing alternative will result in services being replaced as they fail. To maintain customer service and reliability, this alternative is not recommended. In addition, service replacements as a response to failure may lead to higher overall cost than a planned approach.

Cost Estimate:

Estimated costs for this project are as follows:

Design (3%)	$ 75,000
Contract Administration (5%)	$ 100,000
Construction Contingency (10%):	$ 200,000
Project Construction:	$ 1,787,000
Opinion of Total Project Cost:	$ 2,162,000

A detailed breakdown of the construction costs for this project is shown below.

Client:	**City of Arroyo Grande**		
Project:	**2011 Water Master Plan Updates**		
Segment:	**A-6, B-9, C-6**		
Street:	**Galvanized Service Replacements**	**Prepared by:**	JCS
		Reviewed by:	JHR
Opinion of Probable Construction Cost		**Date:**	6/19/2012

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Item Cost
1	Mobilization	1	LS	-	$ 138,300
2	Insurance and Bonds	1	LS	-	$ 138,300
3	Construction Surveying	1	LS	-	$ 69,200
4	Site Clearing and Restoration	1	LS	-	$ 23,100
5	SWPPP Preparation & Implementation	1	LS	-	$ 20,000
6	Traffic Control	200	Day	$ 500	$ 100,000
7	Water Main Construction				
7.1	Pavement Removal & Repair for Trench	0	SY		$ -
7.2	Trenching/Compaction/Fill/Hauling	0	CY		$ -
7.3	Abandon Existing Water Main	0	LS		$ -
7.4	Water Main (Furnish and Install)				
7.4.1	8" - C900 PVC	0	LF		$ -
7.4.2	10" - C900 PVC	0	LF		$ -
7.4.3	12" - C900 PVC	0	LF		$ -
7.5	Gate Valves (to Furnish and Install)				
7.5.1	8"	0	EA		$ -
7.5.2	10"	0	EA		$ -
7.5.3	12"	0	EA		$ -
7.6	Fittings (Furnish and Install)	0	LS		$ -
7.7	Pressure Reducing Valves	0	EA		$ -
8	New Meter and Service				
8.1	1" Water Service from Main to Meter	2000	EA	$ 2,305	$ 4,610,100
9	Fire Hydrants				
9.1	Fire Hydrant Assembly (Furnish and Install)	0	EA		$ -
9.2	Existing Fire Hydrant to be Removed	0	EA		$ -

Note: The rates for Design and Contract Administration are reduced for this project since the galvanized services are expected to be installe d on an ongoing basis using City crews or by including the replacement of services with other projects occuring on the street.

Subtotal 1:	$ 5,099,000
Construction Contingency (10%):	$ 509,900
Design (3%)	$ 153,000
Contract Administration (5%)	$ 255,000
Total Project Cost:	**$ 6,016,900**

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Project C-7- 4-inch Mains Upgrade

Design and Permitting:	14 months		
Construction:	12 months	Opinion of Total Project Cost:	$ 2,937,800

Need for Project:

Twelve (12) segments of 4-inch water main have insufficient capacity to meet fire flow requirements.

Supporting Information:

A 4-inch main allows about 200-gpm of flow at a 5-fps velocity as specified in the Evaluation Criteria. This is less than generally needed for the distribution system to meet fire flow demands. For comparison an 8-in main carries 780-gpm at 5-fps velocity which is usually enough to meet 1,500-gpm fire flow since the flow arrives at the fire hydrant from two directions. The 4-inch mains requiring upgrade are listed in the Table below.

Recommended Solution:

It is recommended that the City upgrade the twelve (12) main segments to 8-inch PVC. The total length of 4-inch mains to be replaced is 11,600-LF, as shown in the table above. The lengths of the individual pipe segments are also shown in the table below. The project locations are shown in Figure 9-28 through Figure 9-39. Note that Project C-2(11) also includes abandoning the 4-inch main along South Halcyon Road as it is a redundant main that is not needed due to the 8-inch parallel main on South Halcyon Road (see Figure 9-38). The need and location of C-2(12) from Luana Lane to East Cherry Avenue should be triggered by development in the vicinity of the main. The final alignment of the main should conform to developer plans.

The capacity of 8-inch PVC is 780-gpm, which yields approximately 1,500-gpm at a hydrant as discussed above; thus, when these mains are upgraded to 8-inch PVC, they will be able to provide build-out demands and will improve available fire flow in these areas.

Table 9.12 - 4-inch Mains for Upgrade

Pipe Segment	Length (ft)	Estimated Total Project Cost[1]
(1) Sierra Dr	1,000	$ 236,400
(2) North Alpine St	1,165	$ 320,800
(3) Sunset Dr	2,310	$ 546,800
(4) Ide St	1,325	$ 324,100
(5) Wood Pl	675	$ 190,000
(6) Bell St/Faeh Ave	705	$ 174,000
(7) Sage St	530	$ 164,500
(8) Alder St (Sandalwood Ave to north of Fair Oaks Ave)	1,400	$ 372,800
(9) Beech St	720	$ 186,000
(10) Pecan St	720	$ 186,000
(11) Sandalwood Ave	630	$ 161,100
(12) Launa Ln to E Cherry Ave	415	$ 75,300
Total	**11,600**	**$ 2,937,800**

[1] See Appendix A for detailed cost breakdown.

Alternatives:

There are alternatives in alignment, which will be analyzed by the design engineer.

Figure 9-28 - 4 Inch Mains Upgrade

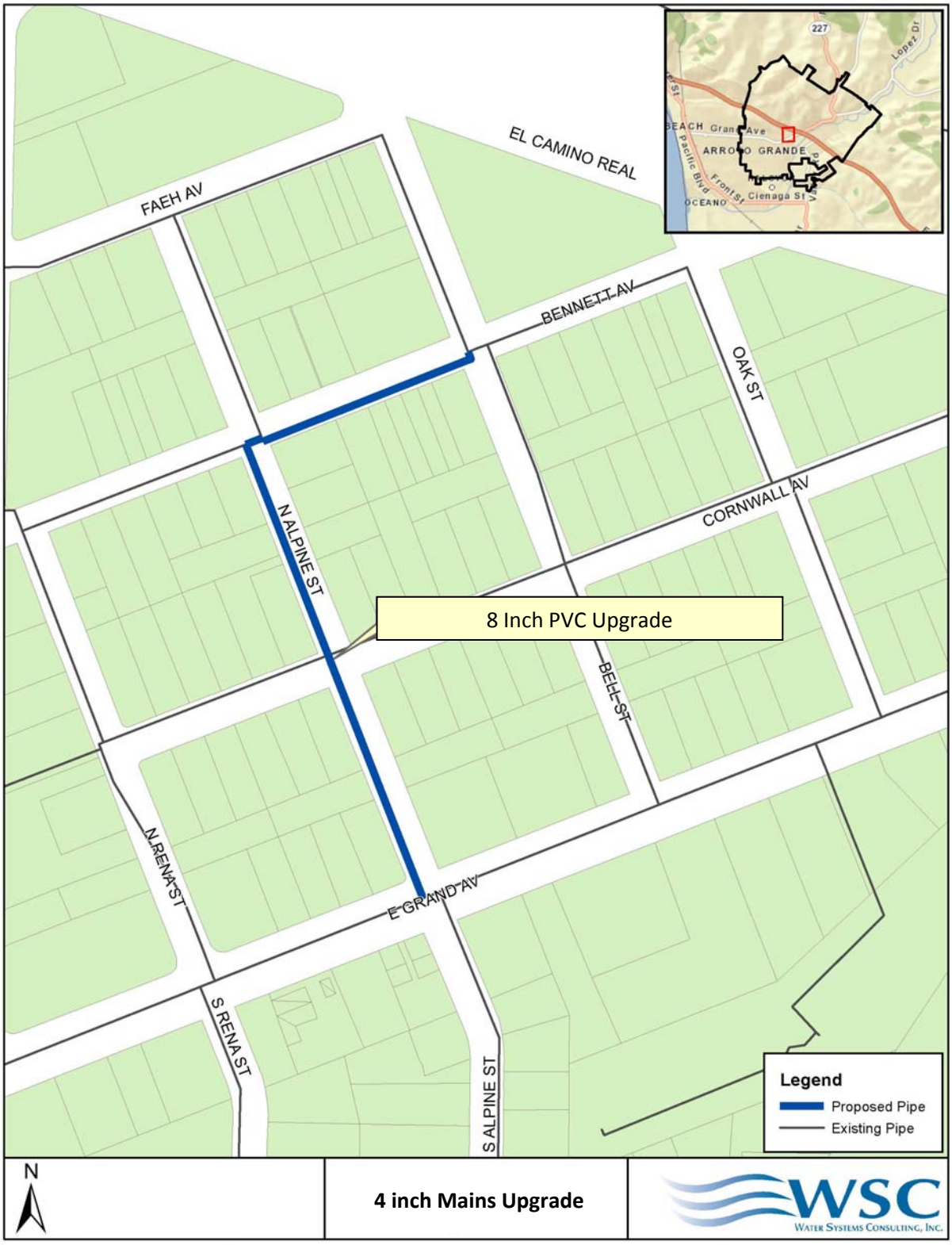

Figure 9-29 - 4 Inch Mains Upgrade

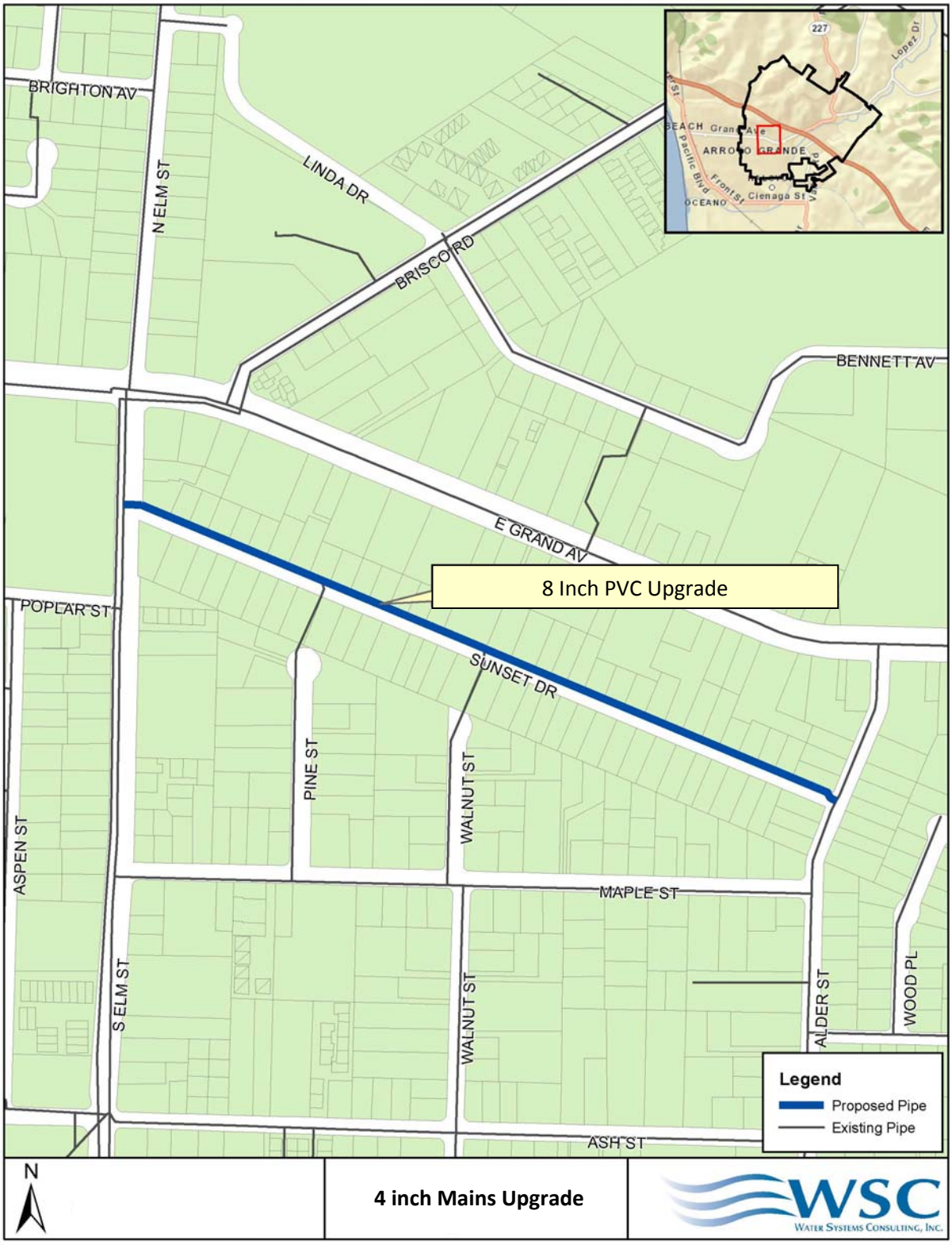

Figure 9-30 - 4 Inch Mains Upgrade

Figure 9-31 - 4 Inch Mains Upgrade

Figure 9-32 - 4 Inch Mains Upgrade

Figure 9-33 - 4 Inch Mains Upgrade

Figure 9-34 - 4 Inch Mains Upgrade

Figure 9-35 - 4 Inch Mains Upgrade

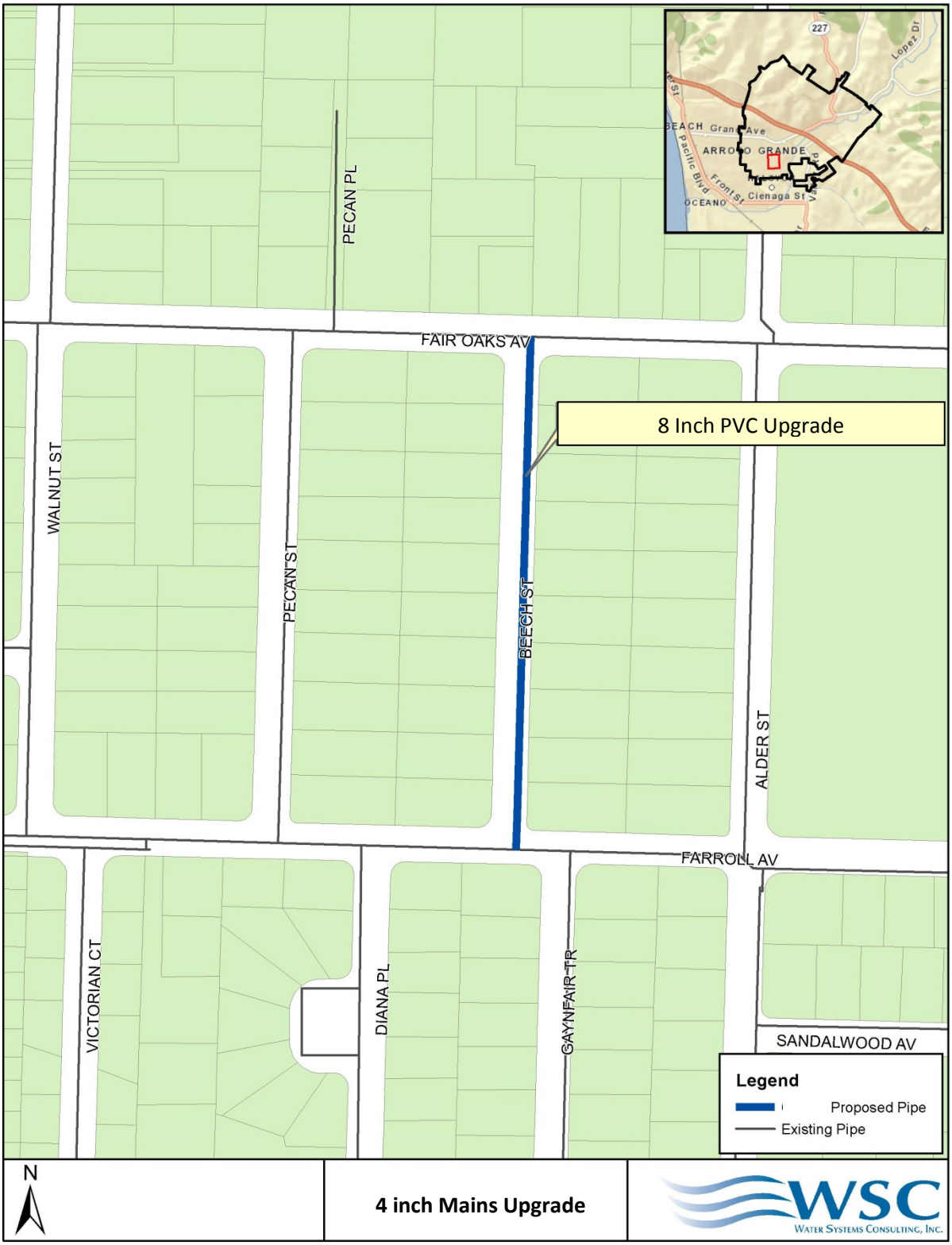

Figure 9-36 - 4 Inch Mains Upgrade

Figure 9-37 - 4 Inch Mains Upgrade

Figure 9-38 - 4 Inch Mains Upgrade

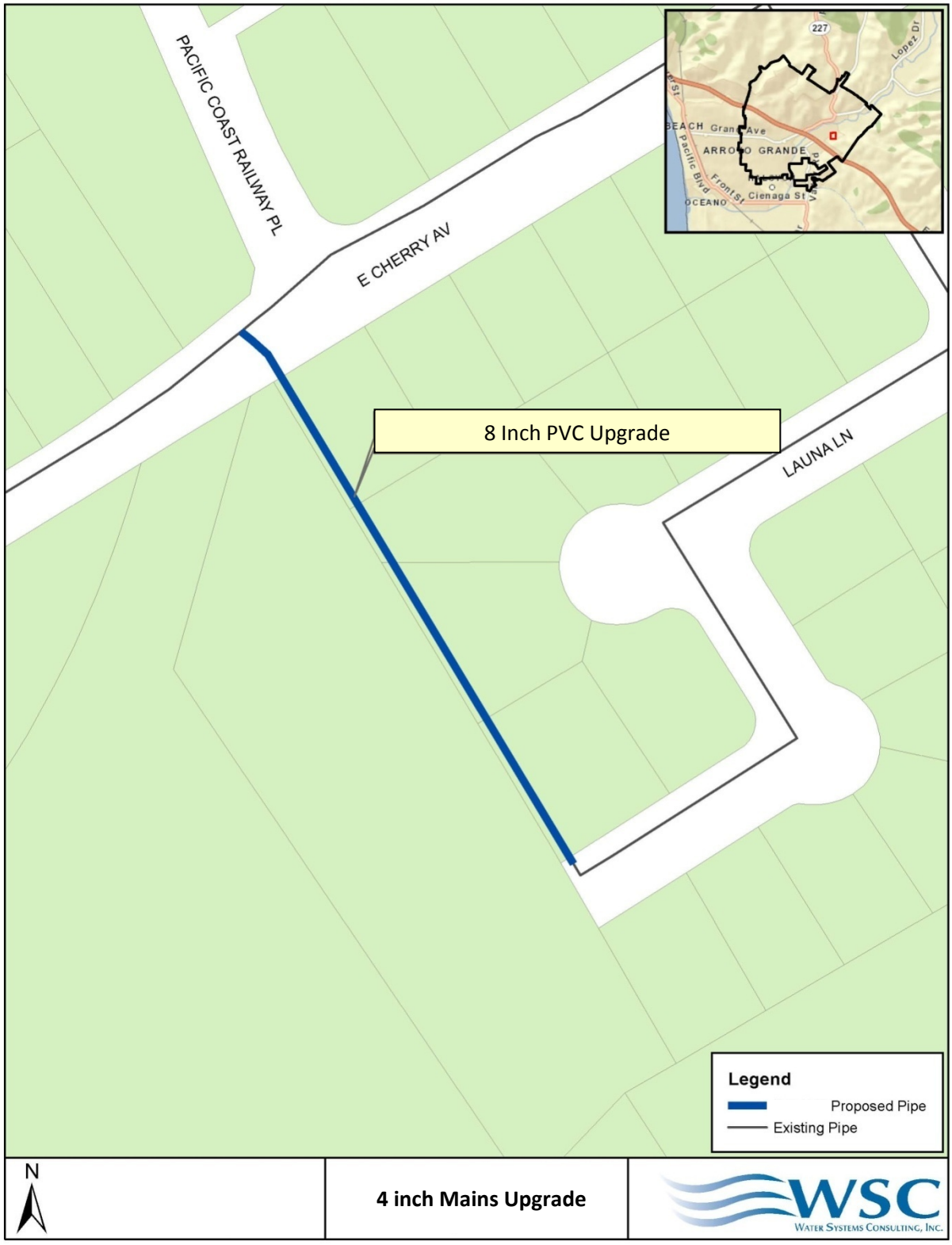

Figure 9-39 - 4 Inch Mains Upgrade

Cost Estimate:

Client:	**City of Arroyo Grande**				
Project:	**2011 Water Master Plan Updates**				
Segment:	**C-7**				
Street:	**4 Inch Main Upgrade- Sierra**			**Prepared by:**	JCS
				Reviewed by:	JHR
Opinion of Probable Construction Cost				**Date:**	6/19/2012

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Item Cost
1	Mobilization	1	LS	-	$ 4,600
2	Insurance and Bonds	1	LS	-	$ 4,600
3	Construction Surveying	1	LS	-	$ 2,300
4	Site Clearing and Restoration	1	LS	-	$ 800
5	SWPPP Preparation & Implementation	1	LS	-	$ 6,000
6	Traffic Control	4	Day	$ 500	$ 2,000
7	Water Main Construction				
7.1	Pavement Removal & Repair for Trench	444	SY	$ 82	$ 36,300
7.2	Trenching/Compaction/Fill/Hauling	444	CY	$ 44	$ 19,600
7.3	Abandon Existing Water Main	1	LS	$ 500	$ 500
7.4	Water Main (Furnish and Install)[1]				
7.4.1	8" - C900 PVC	1000	LF	$ 18	$ 18,000
7.4.2	10" - C900 PVC	0	LF		$ -
7.4.3	12" - C900 PVC	0	LF		$ -
7.5	Gate Valves (to Furnish and Install)				
7.5.1	8"	1	EA	$ 2,000	$ 2,000
7.5.2	10"	0	EA		$ -
7.5.3	12"	0	EA		$ -
7.6	Fittings (Furnish and Install)	1	LS	$ 3,200	$ 3,200
7.7	Pressure Reducing Valves	0	EA		$ -
8	New Meter and Service				
8.1	1" Water Service from Main to Meter	26	EA	$ 2,304	$ 59,900
9	Fire Hydrants				
9.1	Fire Hydrant Assembly (Furnish and Install)	2	EA	$ 7,400	$ 14,800
9.2	Existing Fire Hydrant to be Removed	1	EA	$ 500	$ 500

Subtotal 1:	$ 175,100
Construction Contingency (10%):	$ 17,500
Design (15%):	$ 26,300
Contract Administration (10%):	$ 17,500
Total Project Cost:	**$ 236,400**

Note 1: The linear feet of pipe in the opinion of cost may not exactly match the project length described in the CIP because the linear feet of pipe shown in the cost opinion includes a linear footage allowance for making connections to the existing water distribution system based on the preliminary project alignment.

Client:	**City of Arroyo Grande**		
Project:	**2011 Water Master Plan Updates**		
Segment:	**C-7**		
Street:	**4 Inch Main Upgrade-North Alpine**	**Prepared by:**	JCS
		Reviewed by:	JHR
Opinion of Probable Construction Cost		**Date:**	6/19/2012

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Item Cost
1	Mobilization	1	LS	-	$ 6,400
2	Insurance and Bonds	1	LS	-	$ 6,400
3	Construction Surveying	1	LS	-	$ 3,200
4	Site Clearing and Restoration	1	LS	-	$ 1,100
5	SWPPP Preparation & Implementation	1	LS	-	$ 6,200
6	Traffic Control	5	Day	$ 500	$ 2,500
7	Water Main Construction				
7.1	Pavement Removal & Repair for Trench	518	SY	$ 82	$ 42,300
7.2	Trenching/Compaction/Fill/Hauling	518	CY	$ 44	$ 22,800
7.3	Abandon Existing Water Main	1	LS	$ 500	$ 500
7.4	Water Main (Furnish and Install)[1]				
7.4.1	8" - C900 PVC	1165	LF	$ 18	$ 20,900
7.4.2	10" - C900 PVC	0	LF		$ -
7.4.3	12" - C900 PVC	0	LF		$ -
7.5	Gate Valves (to Furnish and Install)				
7.5.1	8"	10	EA	$ 2,010	$ 20,100
7.5.2	10"	0	EA		$ -
7.5.3	12"	0	EA		$ -
7.6	Fittings (Furnish and Install)	1	LS	$ 16,100	$ 16,100
7.7	Pressure Reducing Valves	0	EA		$ -
8	New Meter and Service				
8.1	1" Water Service from Main to Meter	25	EA	$ 2,304	$ 57,600
9	Fire Hydrants				
9.1	Fire Hydrant Assembly (Furnish and Install)	4	EA	$ 7,375	$ 29,500
9.2	Existing Fire Hydrant to be Removed	4	EA	$ 500	$ 2,000

Note 1: The linear feet of pipe in the opinion of cost may not exactly match the project length described in the CIP because the linear feet of pipe shown in the cost opinion includes a linear footage allowance for making connections to the existing water distribution system based on the preliminary project alignment.

Subtotal 1:	$ 237,600
Construction Contingency (10%):	$ 23,800
Design (15%):	$ 35,600
Contract Administration (10%):	$ 23,800
Total Project Cost:	**$ 320,800**

Client:	**City of Arroyo Grande**		
Project:	**2011 Water Master Plan Updates**		
Segment:	**C-7**		
Street:	**4 Inch Main Upgrade-Sunset Av**	**Prepared by:**	JCS
		Reviewed by:	JHR
Opinion of Probable Construction Cost		**Date:**	6/19/2012

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Item Cost
1	Mobilization	1	LS	-	$ 10,900
2	Insurance and Bonds	1	LS	-	$ 10,900
3	Construction Surveying	1	LS	-	$ 5,500
4	Site Clearing and Restoration	1	LS	-	$ 1,800
5	SWPPP Preparation & Implementation	1	LS	-	$ 7,300
6	Traffic Control	10	Day	$ 500	$ 5,000
7	Water Main Construction				
7.1	Pavement Removal & Repair for Trench	1027	SY	$ 82	$ 83,900
7.2	Trenching/Compaction/Fill/Hauling	1027	CY	$ 44	$ 45,300
7.3	Abandon Existing Water Main	1	LS	$ 500	$ 500
7.4	Water Main (Furnish and Install)[1]				
7.4.1	8" - C900 PVC	2310	LF	$ 18	$ 41,500
7.4.2	10" - C900 PVC	0	LF		$ -
7.4.3	12" - C900 PVC	0	LF		$ -
7.5	Gate Valves (to Furnish and Install)				
7.5.1	8"	6	EA	$ 2,017	$ 12,100
7.5.2	10"	0	EA		$ -
7.5.3	12"	0	EA		$ -
7.6	Fittings (Furnish and Install)	1	LS	$ 12,400	$ 12,400
7.7	Pressure Reducing Valves	0	EA		$ -
8	New Meter and Service				
8.1	1" Water Service from Main to Meter	66	EA	$ 2,305	$ 152,100
9	Fire Hydrants				
9.1	Fire Hydrant Assembly (Furnish and Install)	2	EA	$ 7,400	$ 14,800
9.2	Existing Fire Hydrant to be Removed	2	EA	$ 500	$ 1,000

Note 1: The linear feet of pipe in the opinion of cost may not exactly match the project length described in the CIP because the linear feet of pipe shown in the cost opinion includes a linear footage allowance for making connections to the existing water distribution system based on the preliminary project alignment.

Subtotal 1:	$ 405,000
Construction Contingency (10%):	$ 40,500
Design (15%):	$ 60,800
Contract Administration (10%):	$ 40,500
Total Project Cost:	**$ 546,800**

Client:	**City of Arroyo Grande**		
Project:	**2011 Water Master Plan Updates**		
Segment:	**C-7**		
Street:	**4 Inch Main Upgrade-Ide St**	**Prepared by:**	JCS
		Reviewed by:	JHR
Opinion of Probable Construction Cost		**Date:**	6/19/2012

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Item Cost
1	Mobilization	1	LS	-	$ 6,400
2	Insurance and Bonds	1	LS	-	$ 6,400
3	Construction Surveying	1	LS	-	$ 3,200
4	Site Clearing and Restoration	1	LS	-	$ 1,100
5	SWPPP Preparation & Implementation	1	LS	-	$ 6,300
6	Traffic Control	6	Day	$ 500	$ 3,000
7	Water Main Construction				
7.1	Pavement Removal & Repair for Trench	589	SY	$ 82	$ 48,100
7.2	Trenching/Compaction/Fill/Hauling	589	CY	$ 44	$ 26,000
7.3	Abandon Existing Water Main	1	LS	$ 1,400	$ 1,400
7.4	Water Main (Furnish and Install)[1]				
7.4.1	8" - C900 PVC	1325	LF	$ 18	$ 23,800
7.4.2	10" - C900 PVC	0	LF		$ -
7.4.3	12" - C900 PVC	0	LF		$ -
7.5	Gate Valves (to Furnish and Install)				
7.5.1	8"	7	EA	$ 2,014	$ 14,100
7.5.2	10"	0	EA		$ -
7.5.3	12"	0	EA		$ -
7.6	Fittings (Furnish and Install)	1	LS	$ 11,200	$ 11,200
7.7	Pressure Reducing Valves	0	EA		$ -
8	New Meter and Service				
8.1	1" Water Service from Main to Meter	25	EA	$ 2,304	$ 57,600
9	Fire Hydrants				
9.1	Fire Hydrant Assembly (Furnish and Install)	4	EA	$ 7,375	$ 29,500
9.2	Existing Fire Hydrant to be Removed	4	EA	$ 500	$ 2,000

Note 1: The linear feet of pipe in the opinion of cost may not exactly match the project length described in the CIP because the linear feet of pipe shown in the cost opinion includes a linear footage allowance for making connections to the existing water distribution system based on the preliminary project alignment.

Subtotal 1:	$ 240,100
Construction Contingency (10%):	$ 24,000
Design (15%):	$ 36,000
Contract Administration (10%):	$ 24,000
Total Project Cost:	**$ 324,100**

Client:	**City of Arroyo Grande**		
Project:	**2011 Water Master Plan Updates**		
Segment:	**C-7**		
Street:	**4 Inch Main Upgrade-Wood Pl**	**Prepared by:**	JCS
		Reviewed by:	JHR
Opinion of Probable Construction Cost		**Date:**	6/19/2012

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Item Cost
1	Mobilization	1	LS	-	$ 3,700
2	Insurance and Bonds	1	LS	-	$ 3,700
3	Construction Surveying	1	LS	-	$ 1,900
4	Site Clearing and Restoration	1	LS	-	$ 600
5	SWPPP Preparation & Implementation	1	LS	-	$ 5,700
6	Traffic Control	3	Day	$ 500	$ 1,500
7	Water Main Construction				
7.1	Pavement Removal & Repair for Trench	300	SY	$ 82	$ 24,500
7.2	Trenching/Compaction/Fill/Hauling	300	CY	$ 44	$ 13,200
7.3	Abandon Existing Water Main	1	LS	$ 500	$ 500
7.4	Water Main (Furnish and Install)[1]				
7.4.1	8" - C900 PVC	675	LF	$ 18	$ 12,100
7.4.2	10" - C900 PVC	0	LF		$ -
7.4.3	12" - C900 PVC	0	LF		$ -
7.5	Gate Valves (to Furnish and Install)				
7.5.1	8"	1	EA	$ 2,000	$ 2,000
7.5.2	10"	0	EA		$ -
7.5.3	12"	0	EA		$ -
7.6	Fittings (Furnish and Install)	1	LS	$ 2,500	$ 2,500
7.7	Pressure Reducing Valves	0	EA		$ -
8	New Meter and Service				
8.1	1" Water Service from Main to Meter	23	EA	$ 2,304	$ 53,000
9	Fire Hydrants				
9.1	Fire Hydrant Assembly (Furnish and Install)	2	EA	$ 7,400	$ 14,800
9.2	Existing Fire Hydrant to be Removed	2	EA	$ 500	$ 1,000

Note 1: The linear feet of pipe in the opinion of cost may not exactly match the project length described in the CIP because the linear feet of pipe shown in the cost opinion includes a linear footage allowance for making connections to the existing water distribution system based on the preliminary project alignment.

Subtotal 1:	$ 140,700
Construction Contingency (10%):	$ 14,100
Design (15%):	$ 21,100
Contract Administration (10%):	$ 14,100
Total Project Cost:	**$ 190,000**

Client:	**City of Arroyo Grande**		
Project:	**2011 Water Master Plan Updates**		
Segment:	**C-7**		
Street:	**4 Inch Main Upgrade-Bell/Faeh**	**Prepared by:**	JCS
		Reviewed by:	JHR
Opinion of Probable Construction Cost		**Date:**	6/19/2012

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Item Cost
1	Mobilization	1	LS	-	$ 3,400
2	Insurance and Bonds	1	LS	-	$ 3,400
3	Construction Surveying	1	LS	-	$ 1,700
4	Site Clearing and Restoration	1	LS	-	$ 600
5	SWPPP Preparation & Implementation	1	LS	-	$ 5,700
6	Traffic Control	3	Day	$ 500	$ 1,500
7	Water Main Construction				
7.1	Pavement Removal & Repair for Trench	313	SY	$ 82	$ 25,600
7.2	Trenching/Compaction/Fill/Hauling	313	CY	$ 44	$ 13,800
7.3	Abandon Existing Water Main	1	LS	$ 500	$ 500
7.4	Water Main (Furnish and Install)[1]				
7.4.1	8" - C900 PVC	705	LF	$ 18	$ 12,700
7.4.2	10" - C900 PVC	0	LF		$ -
7.4.3	12" - C900 PVC	0	LF		$ -
7.5	Gate Valves (to Furnish and Install)				
7.5.1	8"	3	EA	$ 2,000	$ 6,000
7.5.2	10"	0	EA		$ -
7.5.3	12"	0	EA		$ -
7.6	Fittings (Furnish and Install)	1	LS	$ 7,200	$ 7,200
7.7	Pressure Reducing Valves	0	EA		$ -
8	New Meter and Service				
8.1	1" Water Service from Main to Meter	10	EA	$ 2,310	$ 23,100
9	Fire Hydrants				
9.1	Fire Hydrant Assembly (Furnish and Install)	3	EA	$ 7,400	$ 22,200
9.2	Existing Fire Hydrant to be Removed	3	EA	$ 500	$ 1,500

Note 1: The linear feet of pipe in the opinion of cost may not exactly match the project length described in the CIP because the linear feet of pipe shown in the cost opinion includes a linear footage allowance for making connections to the existing water distribution system based on the preliminary project alignment.

Subtotal 1:	$ 128,900
Construction Contingency (10%):	$ 12,900
Design (15%):	$ 19,300
Contract Administration (10%):	$ 12,900
Total Project Cost:	**$ 174,000**

Client:	**City of Arroyo Grande**		
Project:	**2011 Water Master Plan Updates**		
Segment:	**C-7**		
Street:	**4 Inch Main Upgrade-Sage St**	**Prepared by:**	JCS
		Reviewed by:	JHR
Opinion of Probable Construction Cost		**Date:**	6/19/2012

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Item Cost
1	Mobilization	1	LS	-	$ 3,200
2	Insurance and Bonds	1	LS	-	$ 3,200
3	Construction Surveying	1	LS	-	$ 1,600
4	Site Clearing and Restoration	1	LS	-	$ 500
5	SWPPP Preparation & Implementation	1	LS	-	$ 5,500
6	Traffic Control	3	Day	$ 500	$ 1,500
7	Water Main Construction				
7.1	Pavement Removal & Repair for Trench	236	SY	$ 82	$ 19,200
7.2	Trenching/Compaction/Fill/Hauling	236	CY	$ 44	$ 10,400
7.3	Abandon Existing Water Main	1	LS	$ 2,300	$ 2,300
7.4	Water Main (Furnish and Install)[1]				
7.4.1	8" - C900 PVC	530	LF	$ 18	$ 9,500
7.4.2	10" - C900 PVC	0	LF		$ -
7.4.3	12" - C900 PVC	0	LF		$ -
7.5	Gate Valves (to Furnish and Install)				
7.5.1	8"	2	EA	$ 2,000	$ 4,000
7.5.2	10"	0	EA		$ -
7.5.3	12"	0	EA		$ -
7.6	Fittings (Furnish and Install)	1	LS	$ 3,600	$ 3,600
7.7	Pressure Reducing Valves	0	EA		$ -
8	New Meter and Service				
8.1	1" Water Service from Main to Meter	18	EA	$ 2,306	$ 41,500
9	Fire Hydrants				
9.1	Fire Hydrant Assembly (Furnish and Install)	2	EA	$ 7,400	$ 14,800
9.2	Existing Fire Hydrant to be Removed	2	EA	$ 500	$ 1,000

Note 1: The linear feet of pipe in the opinion of cost may not exactly match the project length described in the CIP because the linear feet of pipe shown in the cost opinion includes a linear footage allowance for making connections to the existing water distribution system based on the preliminary project alignment.

Subtotal 1:	$ 121,800
Construction Contingency (10%):	$ 12,200
Design (15%):	$ 18,300
Contract Administration (10%):	$ 12,200
Total Project Cost:	**$ 164,500**

Client:	**City of Arroyo Grande**		
Project:	**2011 Water Master Plan Updates**		
Segment:	**C-7**		
Street:	**4 Inch Main Upgrade- Alder St**	**Prepared by:**	JCS
		Reviewed by:	JHR
Opinion of Probable Construction Cost		**Date:**	6/19/2012

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Item Cost
1	Mobilization	1	LS	-	$ 7,400
2	Insurance and Bonds	1	LS	-	$ 7,400
3	Construction Surveying	1	LS	-	$ 3,700
4	Site Clearing and Restoration	1	LS	-	$ 1,200
5	SWPPP Preparation & Implementation	1	LS	-	$ 6,400
6	Traffic Control	6	Day	$ 500	$ 3,000
7	Water Main Construction				
7.1	Pavement Removal & Repair for Trench	622	SY	$ 82	$ 50,800
7.2	Trenching/Compaction/Fill/Hauling	622	CY	$ 44	$ 27,500
7.3	Abandon Existing Water Main	1	LS	$ 4,600	$ 4,600
7.4	Water Main (Furnish and Install)[1]				
7.4.1	8" - C900 PVC	1400	LF	$ 18	$ 25,100
7.4.2	10" - C900 PVC	0	LF		$ -
7.4.3	12" - C900 PVC	0	LF		$ -
7.5	Gate Valves (to Furnish and Install)				
7.5.1	8"	9	EA	$ 2,011	$ 18,100
7.5.2	10"	0	EA		$ -
7.5.3	12"	0	EA		$ -
7.6	Fittings (Furnish and Install)	1	LS	$ 13,400	$ 13,400
7.7	Pressure Reducing Valves	0	EA		$ -
8	New Meter and Service				
8.1	1" Water Service from Main to Meter	33	EA	$ 2,306	$ 76,100
9	Fire Hydrants				
9.1	Fire Hydrant Assembly (Furnish and Install)	4	EA	$ 7,375	$ 29,500
9.2	Existing Fire Hydrant to be Removed	4	EA	$ 500	$ 2,000

Note 1: The linear feet of pipe in the opinion of cost may not exactly match the project length described in the CIP because the linear feet of pipe shown in the cost opinion includes a linear footage allowance for making connections to the existing water distribution system based on the preliminary project alignment.

Subtotal 1:	$ 276,200
Construction Contingency (10%):	$ 27,600
Design (15%):	$ 41,400
Contract Administration (10%):	$ 27,600
Total Project Cost:	**$ 372,800**

Client:	**City of Arroyo Grande**		
Project:	**2011 Water Master Plan Updates**		
Segment:	**C-7**		
Street:	**4 Inch Main Upgrade- Beech St**	**Prepared by:**	JCS
		Reviewed by:	JHR
Opinion of Probable Construction Cost		**Date:**	6/19/2012

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Item Cost
1	Mobilization	1	LS	-	$ 3,600
2	Insurance and Bonds	1	LS	-	$ 3,600
3	Construction Surveying	1	LS	-	$ 1,800
4	Site Clearing and Restoration	1	LS	-	$ 600
5	SWPPP Preparation & Implementation	1	LS	-	$ 5,700
6	Traffic Control	3	Day	$ 500	$ 1,500
7	Water Main Construction				
7.1	Pavement Removal & Repair for Trench	320	SY	$ 82	$ 26,100
7.2	Trenching/Compaction/Fill/Hauling	320	CY	$ 44	$ 14,100
7.3	Abandon Existing Water Main	1	LS	$ 2,300	$ 2,300
7.4	Water Main (Furnish and Install)[1]				
7.4.1	8" - C900 PVC	720	LF	$ 18	$ 12,900
7.4.2	10" - C900 PVC	0	LF		$ -
7.4.3	12" - C900 PVC	0	LF		$ -
7.5	Gate Valves (to Furnish and Install)				
7.5.1	8"	0	EA		$ -
7.5.2	10"	0	EA		$ -
7.5.3	12"	0	EA		$ -
7.6	Fittings (Furnish and Install)	1	LS	$ 3,600	$ 3,600
7.7	Pressure Reducing Valves	0	EA		$ -
8	New Meter and Service				
8.1	1" Water Service from Main to Meter	20	EA	$ 2,305	$ 46,100
9	Fire Hydrants				
9.1	Fire Hydrant Assembly (Furnish and Install)	2	EA	$ 7,400	$ 14,800
9.2	Existing Fire Hydrant to be Removed	2	EA	$ 500	$ 1,000

Note 1: The linear feet of pipe in the opinion of cost may not exactly match the project length described in the CIP because the linear feet of pipe shown in the cost opinion includes a linear footage allowance for making connections to the existing water distribution system based on the preliminary project alignment.

Subtotal 1:	$ 137,700
Construction Contingency (10%):	$ 13,800
Design (15%):	$ 20,700
Contract Administration (10%):	$ 13,800
Total Project Cost:	**$ 186,000**

Client:	**City of Arroyo Grande**		
Project:	**2011 Water Master Plan Updates**		
Segment:	**C-7**		
Street:	**4 Inch Main Upgrade- Pecan St**	**Prepared by:**	JCS
		Reviewed by:	JHR
Opinion of Probable Construction Cost		**Date:**	6/19/2012

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Item Cost
1	Mobilization	1	LS	-	$ 3,600
2	Insurance and Bonds	1	LS	-	$ 3,600
3	Construction Surveying	1	LS	-	$ 1,800
4	Site Clearing and Restoration	1	LS	-	$ 600
5	SWPPP Preparation & Implementation	1	LS	-	$ 5,700
6	Traffic Control	3	Day	$ 500	$ 1,500
7	Water Main Construction				
7.1	Pavement Removal & Repair for Trench	320	SY	$ 82	$ 26,100
7.2	Trenching/Compaction/Fill/Hauling	320	CY	$ 44	$ 14,100
7.3	Abandon Existing Water Main	1	LS	$ 2,300	$ 2,300
7.4	Water Main (Furnish and Install)[1]				
7.4.1	8" - C900 PVC	720	LF	$ 18	$ 12,900
7.4.2	10" - C900 PVC	0	LF		$ -
7.4.3	12" - C900 PVC	0	LF		$ -
7.5	Gate Valves (to Furnish and Install)				
7.5.1	8"	0	EA		$ -
7.5.2	10"	0	EA		$ -
7.5.3	12"	0	EA		$ -
7.6	Fittings (Furnish and Install)	1	LS	$ 3,600	$ 3,600
7.7	Pressure Reducing Valves	0	EA		$ -
8	New Meter and Service				
8.1	1" Water Service from Main to Meter	20	EA	$ 2,305	$ 46,100
9	Fire Hydrants				
9.1	Fire Hydrant Assembly (Furnish and Install)	2	EA	$ 7,400	$ 14,800
9.2	Existing Fire Hydrant to be Removed	2	EA	$ 500	$ 1,000

Note 1: The linear feet of pipe in the opinion of cost may not exactly match the project length described in the CIP because the linear feet of pipe shown in the cost opinion includes a linear footage allowance for making connections to the existing water distribution system based on the preliminary project alignment.

Subtotal 1:	$ 137,700
Construction Contingency (10%):	$ 13,800
Design (15%):	$ 20,700
Contract Administration (10%):	$ 13,800
Total Project Cost:	**$ 186,000**

Client:	**City of Arroyo Grande**		
Project:	**2011 Water Master Plan Updates**		
Segment:	**C-7**		
Street:	**4 Inch Main Upgrade- Sandalwood Ave**	**Prepared by:**	JCS
		Reviewed by:	JHR
Opinion of Probable Construction Cost		**Date:**	6/19/2012

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Item Cost
1	Mobilization	1	LS	-	$ 3,100
2	Insurance and Bonds	1	LS	-	$ 3,100
3	Construction Surveying	1	LS	-	$ 1,600
4	Site Clearing and Restoration	1	LS	-	$ 500
5	SWPPP Preparation & Implementation	1	LS	-	$ 5,600
6	Traffic Control	3	Day	$ 500	$ 1,500
7	Water Main Construction				
7.1	Pavement Removal & Repair for Trench	280	SY	$ 82	$ 22,900
7.2	Trenching/Compaction/Fill/Hauling	280	CY	$ 44	$ 12,400
7.3	Abandon Existing Water Main	1	LS	$ 2,800	$ 2,800
7.4	Water Main (Furnish and Install)[1]				
7.4.1	8" - C900 PVC	630	LF	$ 18	$ 11,300
7.4.2	10" - C900 PVC	0	LF		$ -
7.4.3	12" - C900 PVC	0	LF		$ -
7.5	Gate Valves (to Furnish and Install)				
7.5.1	8"	2	EA	$ 2,000	$ 4,000
7.5.2	10"	0	EA		$ -
7.5.3	12"	0	EA		$ -
7.6	Fittings (Furnish and Install)	1	LS	$ 3,500	$ 3,500
7.7	Pressure Reducing Valves	0	EA		$ -
8	New Meter and Service				
8.1	1" Water Service from Main to Meter	17	EA	$ 2,306	$ 39,200
9	Fire Hydrants				
9.1	Fire Hydrant Assembly (Furnish and Install)	1	EA	$ 7,400	$ 7,400
9.2	Existing Fire Hydrant to be Removed	1	EA	$ 500	$ 500

Note 1: The linear feet of pipe in the opinion of cost may not exactly match the project length described in the CIP because the linear feet of pipe shown in the cost opinion includes a linear footage allowance for making connections to the existing water distribution system based on the preliminary project alignment.

Subtotal 1:	$ 119,400
Construction Contingency (10%):	$ 11,900
Design (15%):	$ 17,900
Contract Administration (10%):	$ 11,900
Total Project Cost:	**$ 161,100**

Client:	**City of Arroyo Grande**		
Project:	**2011 Water Master Plan Updates**		
Segment:	**C-7**		
Street:	**4 Inch Main Upgrade- Launa Ln to E Cherry Ave**	**Prepared by:**	JCS
		Reviewed by:	JHR
Opinion of Probable Construction Cost		**Date:**	6/19/2012

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Item Cost
1	Mobilization	1	LS	-	$ 1,400
2	Insurance and Bonds	1	LS	-	$ 1,400
3	Construction Surveying	1	LS	-	$ 700
4	Site Clearing and Restoration	1	LS	-	$ 200
5	SWPPP Preparation & Implementation	1	LS	-	$ 5,400
6	Traffic Control	2	Day	$ 500	$ 1,000
7	Water Main Construction				
7.1	Pavement Removal & Repair for Trench	184	SY	$ 82	$ 15,100
7.2	Trenching/Compaction/Fill/Hauling	184	CY	$ 44	$ 8,100
7.3	Abandon Existing Water Main	0	LS		$ -
7.4	Water Main (Furnish and Install)[1]				
7.4.1	8" - C900 PVC	415	LF	$ 18	$ 7,500
7.4.2	10" - C900 PVC	0	LF		$ -
7.4.3	12" - C900 PVC	0	LF		$ -
7.5	Gate Valves (to Furnish and Install)				
7.5.1	8"	2	EA	$ 2,000	$ 4,000
7.5.2	10"	0	EA		$ -
7.5.3	12"	0	EA		$ -
7.6	Fittings (Furnish and Install)	1	LS	$ 3,500	$ 3,500
7.7	Pressure Reducing Valves	0	EA		$ -
8	New Meter and Service				
8.1	1" Water Service from Main to Meter	0	EA		$ -
9	Fire Hydrants				
9.1	Fire Hydrant Assembly (Furnish and Install)	1	EA	$ 7,400	$ 7,400
9.2	Existing Fire Hydrant to be Removed	0	EA	$ 500	$ -

Note 1: The linear feet of pipe in the opinion of cost may not exactly match the project length described in the CIP because the linear feet of pipe shown in the cost opinion includes a linear footage allowance for making connections to the existing water distribution system based on the preliminary project alignment.

Subtotal 1:	$ 55,700
Construction Contingency (10%):	$ 5,600
Design (15%):	$ 8,400
Contract Administration (10%):	$ 5,600
Total Project Cost:	**$ 75,300**

Project C-8 - Phased Mains Replacements

Design and Permitting:	See description		
Construction:	See description	Opinion of Total Project Cost:	$ 1,018,050

Need for Project:

The existing cast iron mains are at or near the end of their useful life. Pipe coupons show evidence of severe tuberculation.

Supporting Information:

Cast iron pipe is estimated to have an expected useful life of 50 to 100 years. The table below lists the diameter, length and age of seven (7) pipe segments made of cast iron. Six (6) of these mains were installed 80 or more years ago and one (1) was installed over 50 years ago. They are expected to be at or near the end of their useful life. This is supported by cast iron pipe coupons and pieces of removed cast iron pipe provided by the City, which show signs of severe tuberculation. Tuberculation is the irregular buildup of corrosion scale and associated biofilm inside a cast iron pipe over time leading to decreased pipeline capacity, increased use of chlorine residual, and potential water quality complaints (e.g. red or brown water complaints, taste and odor complaints). The figures below show a piece of tuberculated cast iron pipe recently removed from Arroyo Grande's distribution system.

Figure 9-40 - Tuberculation in Removed Old Cast Iron Pipe

Table 9.13 - Cast Iron Mains for Phased Replacement

Pipe Segment	Diameter (in)	Length (ft)	Date Installed	Age (years)
(1) West Cherry Ave from California Ave to Arroyo Ave	4	730	1932	80
(2) West Cherry Ave from Bedloe Ln to Traffic Way	4	220	1932	80
(3) Easement from Vernon Rd to Reservoir Rd	4	310	1954	58
(4) Vernon Rd from Wilton Pl to West Branch St	4	220	1929	83
Total	-	**1,480**	-	-

Recommended Solution:

It is recommended that the City replace the cast iron water mains, shown in the figure below, with PVC pipe of equivalent size with an 8-in minimum pipe size. The project locations are shown in the figures below. The replacements are intended to be phased to align with the City's resources. The recommended approach would be to replace the mains in three phases as shown below:

Phase A	(1) West Cherry Ave from California Ave to Arroyo Ave (2) West Cherry Ave from Bedloe Lane to Traffic Way	Design and Permitting: 8 months Construction: 5 months
Phase B	(1) Easement from Vernon Rd to Reservoir Rd (2) Vernon Rd from Wilton Pl to West Branch St	Design and Permitting: 8 months Construction: 5 months

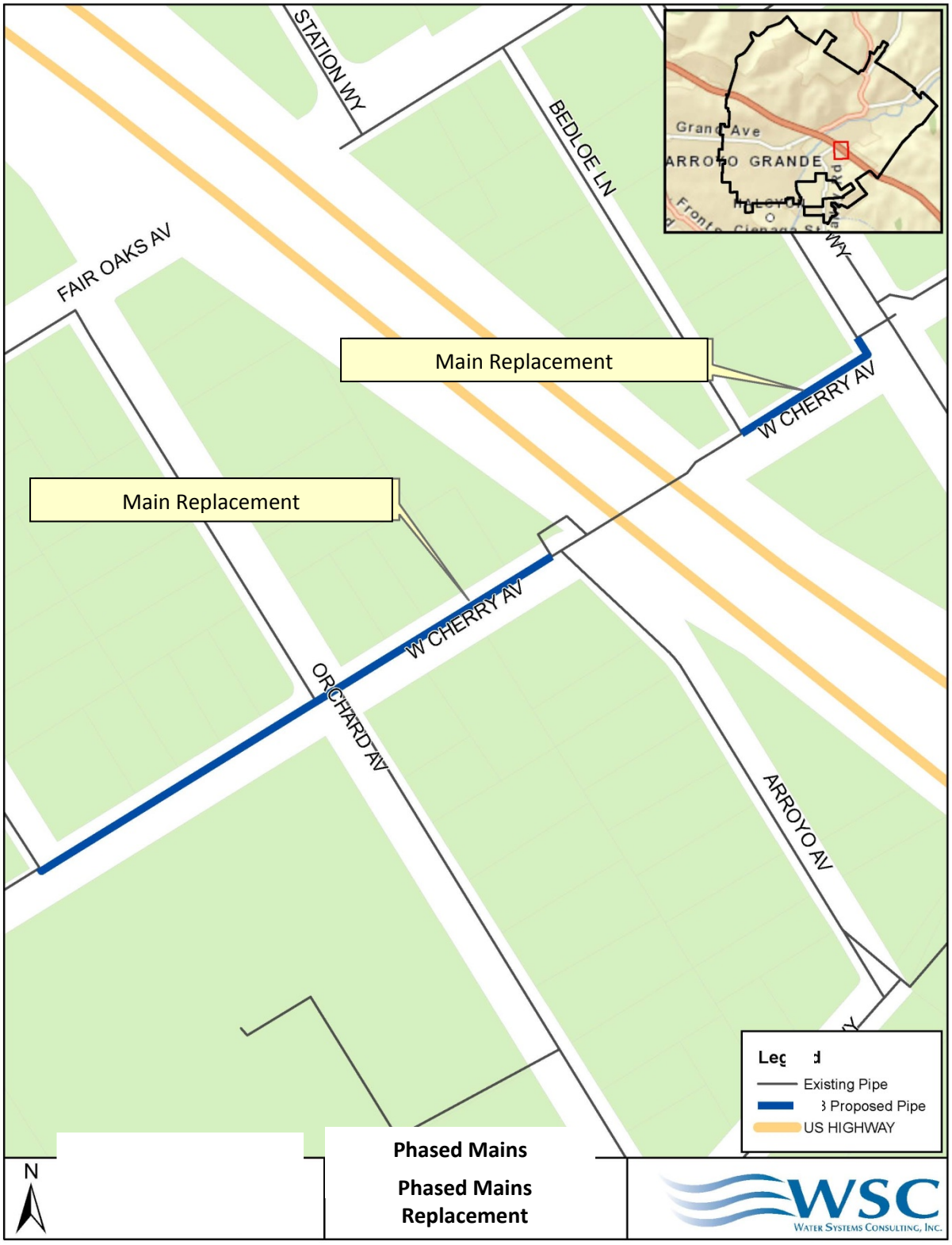

Figure 9-41 - Phased Mains Replacement

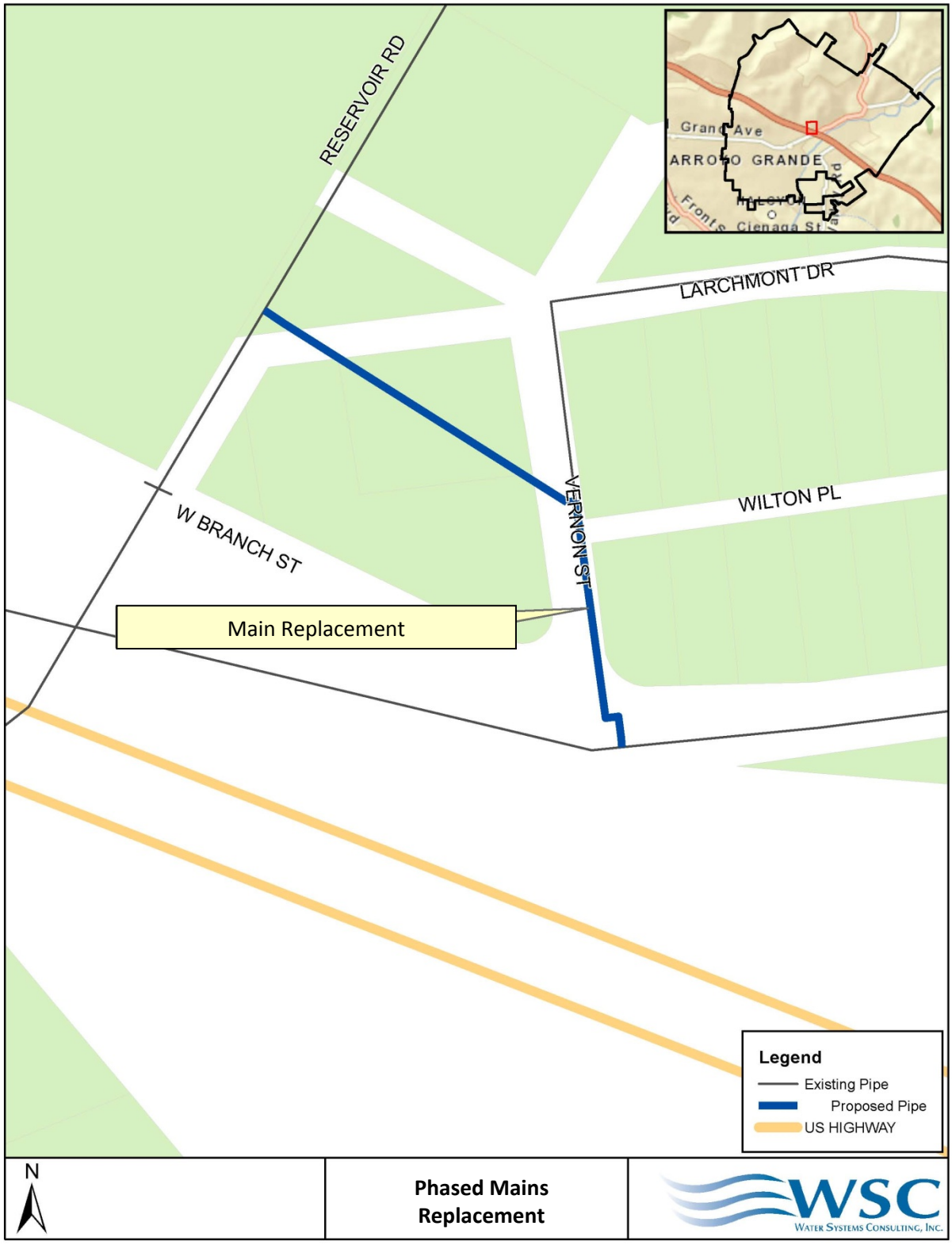

Figure 9-42 - Phased Main Replacements

Budget Discussion:

Estimated costs for this project are as follows:

Phase A:

Design (15%):	$	31,700
Contract Administration (10%):	$	21,200
Construction Contingency (10%):	$	21,200
Project Construction:	$	211,200
Opinion of Total Project Cost:	$	285,300

Phase B:

Design (15%):	$	16,400
Contract Administration (10%):	$	11,000
Construction Contingency (10%):	$	11,000
Project Construction:	$	109,400
Opinion of Total Project Cost:	$	147,800

A detailed breakdown of the construction costs for this project is shown in the Appendix.

Client:	**City of Arroyo Grande**		
Project:	**2011 Water Master Plan Updates**		
Segment:	**C-8**		
Street:	**Phased Main Replacement-W Cherry**	**Prepared by:**	JCS
		Reviewed by:	JHR
Opinion of Probable Construction Cost		**Date:**	6/19/2012

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Item Cost
1	Mobilization	1	LS	-	$ 4,100
2	Insurance and Bonds	1	LS	-	$ 4,100
3	Construction Surveying	1	LS	-	$ 2,000
4	Site Clearing and Restoration	1	LS	-	$ 700
5	SWPPP Preparation & Implementation	1	LS	-	$ 5,800
6	Traffic Control	4	Day	$ 500	$ 2,000
7	Water Main Construction				
7.1	Pavement Removal & Repair for Trench	338	SY	$ 82	$ 27,600
7.2	Trenching/Compaction/Fill/Hauling	338	CY	$ 44	$ 14,900
7.3	Abandon Existing Water Main	1	LS	$ 500	$ 500
7.4	Water Main (Furnish and Install)[1]				
7.4.1	8" - C900 PVC	760	LF	$ 18	$ 13,600
7.4.2	10" - C900 PVC	0	LF		$ -
7.4.3	12" - C900 PVC	0	LF		$ -
7.5	Gate Valves (to Furnish and Install)				
7.5.1	8"	6	EA	$ 2,017	$ 12,100
7.5.2	10"	0	EA		$ -
7.5.3	12"	0	EA		$ -
7.6	Fittings (Furnish and Install)	1	LS	$ 11,200	$ 11,200
7.7	Pressure Reducing Valves	0	EA		$ -
8	New Meter and Service				
8.1	1" Water Service from Main to Meter	14	EA	$ 2,307	$ 32,300
9	Fire Hydrants				
9.1	Fire Hydrant Assembly (Furnish and Install)	3	EA	$ 7,400	$ 22,200
9.2	Existing Fire Hydrant to be Removed	3	EA	$ 500	$ 1,500

Note 1: The linear feet of pipe in the opinion of cost may not exactly match the project length described in the CIP because the linear feet of pipe shown in the cost opinion includes a linear footage allowance for making connections to the existing water distribution system based on the preliminary project alignment.

Subtotal 1:	$ 154,600
Construction Contingency (10%):	$ 15,500
Design (15%):	$ 23,200
Contract Administration (10%):	$ 15,500
Total Project Cost:	**$ 208,800**

Client:	**City of Arroyo Grande**		
Project:	**2011 Water Master Plan Updates**		
Segment:	**C-8**		
Street:	**Phased Main Replacement- W Cherry**	**Prepared by:**	JCS
		Reviewed by:	JHR
Opinion of Probable Construction Cost		**Date:**	6/19/2012

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Item Cost
1	Mobilization	1	LS	-	$ 1,400
2	Insurance and Bonds	1	LS	-	$ 1,400
3	Construction Surveying	1	LS	-	$ 700
4	Site Clearing and Restoration	1	LS	-	$ 200
5	SWPPP Preparation & Implementation	1	LS	-	$ 5,200
6	Traffic Control	1	Day	$ 500	$ 500
7	Water Main Construction				
7.1	Pavement Removal & Repair for Trench	91	SY	$ 81	$ 7,400
7.2	Trenching/Compaction/Fill/Hauling	91	CY	$ 44	$ 4,000
7.3	Abandon Existing Water Main	1	LS	$ 500	$ 500
7.4	Water Main (Furnish and Install)[1]				
7.4.1	8" - C900 PVC	205	LF	$ 18	$ 3,700
7.4.2	10" - C900 PVC	0	LF		$ -
7.4.3	12" - C900 PVC	0	LF		$ -
7.5	Gate Valves (to Furnish and Install)				
7.5.1	8"	2	EA	$ 2,000	$ 4,000
7.5.2	10"	0	EA		$ -
7.5.3	12"	0	EA		$ -
7.6	Fittings (Furnish and Install)	1	LS	$ 7,200	$ 7,200
7.7	Pressure Reducing Valves	0	EA		$ -
8	New Meter and Service				
8.1	1" Water Service from Main to Meter	2	EA	$ 2,300	$ 4,600
9	Fire Hydrants				
9.1	Fire Hydrant Assembly (Furnish and Install)	2	EA	$ 7,400	$ 14,800
9.2	Existing Fire Hydrant to be Removed	2	EA	$ 500	$ 1,000

Note 1: The linear feet of pipe in the opinion of cost may not exactly match the project length described in the CIP because the linear feet of pipe shown in the cost opinion includes a linear footage allowance for making connections to the existing water distribution system based on the preliminary project alignment.

Subtotal 1:	$ 56,600
Construction Contingency (10%):	$ 5,700
Design (15%):	$ 8,500
Contract Administration (10%):	$ 5,700
Total Project Cost:	**$ 76,500**

Client:	**City of Arroyo Grande**		
Project:	**2011 Water Master Plan Updates**		
Segment:	**C-8**		
Street:	**Phased Main Replacement-Easement**	**Prepared by:**	JCS
		Reviewed by:	JHR
Opinion of Probable Construction Cost		**Date:**	6/19/2012

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Item Cost
1	Mobilization	1	LS	-	$ 1,600
2	Insurance and Bonds	1	LS	-	$ 1,600
3	Construction Surveying	1	LS	-	$ 800
4	Site Clearing and Restoration	1	LS	-	$ 300
5	SWPPP Preparation & Implementation	1	LS	-	$ 5,400
6	Traffic Control	2	Day	$ 500	$ 1,000
7	Water Main Construction				
7.1	Pavement Removal & Repair for Trench	156	SY	$ 82	$ 12,700
7.2	Trenching/Compaction/Fill/Hauling	156	CY	$ 44	$ 6,900
7.3	Abandon Existing Water Main	1	LS	$ 500	$ 500
7.4	Water Main (Furnish and Install)[1]				
7.4.1	8" - C900 PVC	350	LF	$ 18	$ 6,300
7.4.2	10" - C900 PVC	0	LF		$ -
7.4.3	12" - C900 PVC	0	LF		$ -
7.5	Gate Valves (to Furnish and Install)				
7.5.1	8"	3	EA	$ 2,000	$ 6,000
7.5.2	10"	0	EA		$ -
7.5.3	12"	0	EA		$ -
7.6	Fittings (Furnish and Install)	1	LS	$ 4,900	$ 4,900
7.7	Pressure Reducing Valves	0	EA		$ -
8	New Meter and Service				
8.1	1" Water Service from Main to Meter	3	EA	$ 2,300	$ 6,900
9	Fire Hydrants				
9.1	Fire Hydrant Assembly (Furnish and Install)	1	EA	$ 7,400	$ 7,400
9.2	Existing Fire Hydrant to be Removed	1	EA	$ 500	$ 500

Note 1: The linear feet of pipe in the opinion of cost may not exactly match the project length described in the CIP because the linear feet of pipe shown in the cost opinion includes a linear footage allowance for making connections to the existing water distribution system based on the preliminary project alignment.

Subtotal 1:	$ 62,800
Construction Contingency (10%):	$ 6,300
Design (15%):	$ 9,400
Contract Administration (10%):	$ 6,300
Total Project Cost:	**$ 84,800**

Client:	**City of Arroyo Grande**		
Project:	**2011 Water Master Plan Updates**		
Segment:	**C-8**		
Street:	**Phased Main Replacement-Vernon Rd**	**Prepared by:**	JCS
		Reviewed by:	JHR
Opinion of Probable Construction Cost		**Date:**	6/19/2012

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Item Cost
1	Mobilization	1	LS	-	$ 1,100
2	Insurance and Bonds	1	LS	-	$ 1,100
3	Construction Surveying	1	LS	-	$ 600
4	Site Clearing and Restoration	1	LS	-	$ 200
5	SWPPP Preparation & Implementation	1	LS	-	$ 5,300
6	Traffic Control	2	Day	$ 500	$ 1,000
7	Water Main Construction				
7.1	Pavement Removal & Repair for Trench	116	SY	$ 81	$ 9,400
7.2	Trenching/Compaction/Fill/Hauling	116	CY	$ 44	$ 5,100
7.3	Abandon Existing Water Main	1	LS	$ 500	$ 500
7.4	Water Main (Furnish and Install)[1]				
7.4.1	8" - C900 PVC	260	LF	$ 18	$ 4,700
7.4.2	10" - C900 PVC	0	LF		$ -
7.4.3	12" - C900 PVC	0	LF		$ -
7.5	Gate Valves (to Furnish and Install)				
7.5.1	8"	1	EA	$ 2,000	$ 2,000
7.5.2	10"	0	EA		$ -
7.5.3	12"	0	EA		$ -
7.6	Fittings (Furnish and Install)	1	LS	$ 3,100	$ 3,100
7.7	Pressure Reducing Valves	0	EA		$ -
8	New Meter and Service				
8.1	1" Water Service from Main to Meter	2	EA	$ 2,300	$ 4,600
9	Fire Hydrants				
9.1	Fire Hydrant Assembly (Furnish and Install)	1	EA	$ 7,400	$ 7,400
9.2	Existing Fire Hydrant to be Removed	1	EA	$ 500	$ 500

Note 1: The linear feet of pipe in the opinion of cost may not exactly match the project length described in the CIP because the linear feet of pipe shown in the cost opinion includes a linear footage allowance for making connections to the existing water distribution system based on the preliminary project alignment.

Subtotal 1:	$ 46,600
Construction Contingency (10%):	$ 4,700
Design (15%):	$ 7,000
Contract Administration (10%):	$ 4,700
Total Project Cost:	**$ 63,000**

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Project C-9 - Routine Reservoir Maintenance

Design and Permitting:	N/A		
Construction:	Ongoing	Opinion of Total Project Cost:	$ 9,600 Average Per Reservoir Per Year

Need for Project:

Tank inspection reports show that several of the City's reservoirs are in need of significant maintenance.

Supporting Information:

The following table shows a summary of the City's reservoirs, including dates of inspections. Historically, the time interval between structural and internal inspections has varied from 2 years to over 10 or more years (see the Table below). As the existing tanks continue to age, the City will benefit from a routine maintenance program to extend the useful life of this infrastructure. In 2003, the City hired professional divers to conduct an inspection of Reservoir 3, 4, and 5. While the condition of these tanks varied, the results of the inspections showed that the City's reservoirs have coatings in need of repair and require regular routine maintenance.

Table 9.14 - Reservoir Summary

Reservoir	Usable Volume (MG)	Material	Year Built	Last Coating	Recorded Inspections	Most Recent Inspection Notes
1	2.00	Reinforced Concrete	2004	n/a	n/a	n/a
2	1.00	Steel	1961	1998	1998, 2000	Exterior coating good but evidence of rust; Rust tubercles on interior
3	0.25	Steel	1978	1978	1998, 2003	Exterior coating in fair condition; Internal coating in poor condition
4	2.00	Steel	1982	1982	1996, 2003, 2007	Earthquake damage to coating (crack in coating)
5	1.20	Steel	1986	1986	1996, 2003	Tank in stable condition, but coating continuing to deteriorate; Useful life of coating estimated at 5 more years
6	0.25	Steel	2011	2011	n/a	n/a

Recommended Solution:

It is recommended that the City implement a Routine Reservoir Maintenance Program to address current deficiencies and ensure regular maintenance is carried out in the future. Some of these inspections are already routinely performed by the City. This Program will also allow the City to prioritize improvements and phase major maintenance projects over a 20-year time frame.

The Program should include the following:

1. Periodic Inspections—Performed approximately monthly
    a. Site Evaluation (Security, Lighting, Drainage)
    b. Leak Detection (Piping, Connections)
    c. Vents and Pressure Relief System Inspection
    d. Overflow and Drains Inspection (Cross-Connection)
2. Annual Inspections—Performed every year
    a. Coating Visual Assessment
    b. Vents and Pressure Relief System Cleaning
    c. Cathodic Protection System Verification
    d. Grout, Foundation, Grade and Drainage Visual Assessment
    e. Safety Equipment Verification

3. Major Inspection and Cleaning—Performed every 5 years
    a. Silt Removal / Detailed Interior Inspection
    b. Complete Coating System Evaluation
    c. Analysis of Coating Needs
    d. Cathodic System Evaluation
    e. Safety Equipment and Access Portals Update
    f. Structural Evaluation
    g. Expansion Joint/Piping Evaluation

A preliminary maintenance schedule that includes the application of new coatings (Project A-4), Annual Inspections and Major Inspections and Cleaning (every 5 years) is provided in the tables below. The periodic inspections should also be performed approximately every month as described above.

Table 9.15 - Reservoir Maintenance Schedule for 2012-2021

Facility	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Reservoir 1	Annual Inspect.	Major I&C	Annual Inspections				Major I&C	Annual Inspect.		
Reservoir 2	Annual Inspections		Major I&C	Annual Inspections				Major I&C	Annual Inspections	
Reservoir 3	Annual Inspect.	Coat Tank	Annual Inspections				Major I&C	Annual Inspections		
Reservoir 4	Annual Inspections		Coat Tank	Annual Inspections				Major I&C	Annual Inspections	
Reservoir 5	Annual Inspections			Coat Tank	Annual Inspections				Major I&C	Annual Inspect.
Reservoir 6	Annual Inspections				Major I&C	Annual Inspections				Major I&C
Reservoir 7	n/a	n/a	Build Tank	Annual Inspections				Major I&C	Annual Inspections	

Major I&C - Major Inspection and Cleaning

Table 9.16 - Reservoir Maintenance Schedule for 2022-2031

Facility	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Reservoir 1	Annual Inspect.	Major I&C	Annual Inspections				Major I&C	Annual Inspections		
Reservoir 2	Annual Inspections		Major I&C	Annual Inspections				Major I&C	Annual Inspections	
Reservoir 3	Annual Inspect.	Major I&C	Annual Inspections				Major I&C	Annual Inspections		
Reservoir 4	Annual Inspections		Major I&C	Annual Inspections				Major I&C	Annual Inspections	
Reservoir 5	Annual Inspecttions			Major I&C	Annual Inspections				Major I&C	Annual Inspect.
Reservoir 6	Annual Inspections				Major I&C	Annual Inspections				Major I&C
Reservoir 7	Annual Inspections		Major I&C	Annual Inspections				Major I&C	Annual Inspections	
Major I&C - Major Inspection and Cleaning										

Alternatives:

A do-nothing alternative is not recommended as it will lead to premature failure of the tanks.

Budget Discussion:

Estimated average costs for per reservoir per year are as follows:

Construction Contingency (10%):	$	900
Project Construction:	$	8,700
Opinion of Total Project Cost:	$	9,600

A detailed breakdown of the construction costs for this project is shown in the Appendix.

REFERENCES

"California Safe Drinking Water Act and Related Laws," California Department of Health Services, 1996.

City of Arroyo Grande Final Long Range Planning Report," Arroyo Grande Long Range Planning Committee, 1996

"City of Arroyo Grande General Plan - Land Use Element," Planning Network, 1990.

"City of Arroyo Grande Urban Water Management Plan Update," Arroyo Grande Public Works Department, 1990.

"Distribution Network Analysis for Water Utilities," American Water Works Association, 1989.

"Distribution System Requirements for Fire Protection," American Water Works Association, 1992.

"Oceano Community Services District Water Master Plan," John L. Wallace & Associates, 1991 .

"Safe Yield Study - Lopez Reservoir," James M. Montgomery Consulting Engineers, Inc., 1984.

"Templeton Community Services District Water Master Plan," John L. Wallace & Associates, 1994.

'Uniform Fire Code," International Fire Code Institute, 1994.

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APPENDIX A – Land Use and Zoning Descriptions

Single-Family Residential (SFR) District - The primary purpose of the SF district is to provide for residential development on common sized suburban lots. This district is intended as an area for development of single-family detached residential, small lot single-family detached residential at a maximum allowable density of 4.5 dwelling units per gross acre.

Agriculture (AG) - General Agricultural District. The primary purpose of the AG district is to provide for and protect lands for agricultural crop production, grazing, limited sales of agricultural products, and limited agricultural support industries and services. This district is intended primarily as an area for the production of food and fiber, but also permits single-family detached residential dwellings at a maximum density of 1.0 dwelling unit per 10.0 gross acres, as well as temporary housing for farm workers.

Residential Estate (RE) - The RE district is intended to permit single-family residential development on estate size lots commensurate with the rural character and lifestyle of adjoining county developments. This district is intended as an area for development of low density, large lot, single-family detached residential dwelling units at a maximum density of one dwelling unit per 2.5 gross acres.

Residential Hillside (RH) - The primary purpose of the RH district is to provide for and protect rural atmosphere and lifestyles, as well as to provide for protection of existing hillside areas in accordance with general plan policies. This district is intended as an area for development of low density, large lot, single-family detached and small lot single-family detached residential dwelling units at a maximum density of one dwelling unit per 1.5 gross acres. Cluster development is encouraged in order to protect the environment. Other uses may be considered through a planned unit development or similar mechanism.

Rural Residential (RR) - The primary purpose of the RR district is to provide for and protect rural atmosphere and lifestyles. This district is intended as an area for development of low density, large lot residential dwelling units at a maximum density of one dwelling unit per one gross acre.

Residential Suburban (RS) - The primary purpose of the RS district is to provide a transition between rural and urban density development areas, and to provide for a suburban lifestyle on residential lots larger than those commonly found in suburban subdivisions. This district is intended as an area for development of moderate sized lot, single-family detached residential dwelling units at a maximum allowable density of 2.5 dwelling units per gross acre.

Condominium/Townhouse (MF) - The primary purpose of the MF district is to provide for a variety of residential uses, encourage diversity in housing types with enhanced amenities (common open space and recreation areas), or provide transitions between higher intensity and lower intensity uses. This district is intended as an area for development of small lot single-family detached, single-family attached, and multifamily attached residential dwelling units, planned unit developments, condominiums, and certain senior housing types, at a maximum allowable density of nine dwelling units per gross acre.

Multifamily Very High Density (MFVH) - The purpose of the MFVH district is to provide suitable locations for the provision of very high density multifamily housing including housing for senior and handicapped citizens, independent living, congregate care, assisted living, and convalescent living arrangements. Senior housing developments within the MFVH district may be age-restricted to senior citizens (for non-handicapped households) to the extent permitted by state law. The maximum allowable density, shall be twenty-five (25) dwelling units per gross acre

Industrial Mixed Use (IMU) - The primary purpose of the IMU district is to provide a sound and diversified economic base and employment opportunities for the citizens of Arroyo Grande. It is the further intent of this chapter to accomplish this via the establishment of a specific, well-defined pattern of industrial activities which is compatible with residential, commercial, institutional, and other uses within the community; has good access to the regional transportation system; accommodates the personal needs of workers and business visitors; and which meets the service needs of local businesses.

Village Core Downtown (VCD) District. The primary purpose of the VCD district is to provide for a combination of commercial, office, upper-story residential uses and compatible related development to promote pedestrian use and enjoyment of the downtown village area. Regulations for the VCD district combined with the historic character overlay district, promote and preserve older architectural styles compatible with the historical, small-town nature of Arroyo Grande. Typical uses may include, but are not limited to, second-story residential and office, specialty retail and studios such as art galleries, book-stores, antique stores, flower shops, personal services, small markets and restaurants (without drive-through windows). The VCD district implements and is consistent with the village core land use designation of the general plan

Office Mixed Use (OMU) - The primary purpose of the office mixed use (OMU) district is to provide areas for the establishment of corporate, administrative, and medical offices and facilities, commercial services that are required to support major business medical development, and multi-family housing. Retail facilities and support business are encouraged to serve nearby office and residential uses. Typical uses include, but are not limited to, professional and medical offices, business-related retail and service functions, restaurants, health clubs, financial institutions, medical and health care facilities and multi-family housing. The OMU district implements and is consistent with the office professional/medical-hospital and mixed land use designation of the general plan.

Regional Commercial (RC) - The primary purpose of the RC is to provide for a diversity of commercial uses that serve community and regional needs for retail and personal services within distinctive and internally pedestrian-oriented shopping centers. The RC district implements and is consistent with the Regional Commercial land use designation of the General Plan

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Technical Memorandum

APPENDIX B – Planning and Evaluation Criteria

Date: 4/24/2012

To: Mr. Mike Linn, P.E.
City of Arroyo Grande
208 E. Branch Street
Arroyo Grande, CA 93421

Phone: (805) 473-5444

CC: Shane Taylor, Mike Linn, P.E.; Teresa McClish

Prepared by: Joshua Reynolds, P.E.; Lianne Williams, P.E.

Reviewed by: Jeffery Szytel, P.E.

Project: City of Arroyo Grande Water and Sewer Master Plan Updates

SUBJECT: **PLANNING AND EVALUATION CRITERIA**

The 2011 Water and Sewer Master Plan Update recommends capital improvements that are necessary for the City of Arroyo Grande to continue to provide safe, adequate and reliable water and sewer service to its customers. The proposed improvements will also allow the City to continue to supply domestic, commercial, institutional and industrial customer demand; provide sewer collection service to customers; meet federal, state and local regulatory requirements; and provide fire protection capability. This Technical Memorandum (TM) summarizes the criteria used for evaluating the various system components and is organized into two (2) main sections:

(1) Water System
(2) Sewer System

Water System

In planning the needed water facilities, state regulations and accepted engineering standards and practices are utilized to evaluate facilities. The evaluation criteria for the water system have been organized into five categories:

- Customer and Demand Projections
- Supply Reliability
- Distribution

- Storage, and
- Booster Pumps.

The specific criteria included in each of the categories are shown in the following tables.

Table B.1. Water System Planning and Evaluation Criteria: Customer and Demand Projections

Purpose	Regulation or Reference	Engineering and Planning Criteria
Future System Demand	City's General Plan Housing Element; California Senate Bill x7-7 (SB x7-7)	Calculate buildout demand from: (1) Buildout population projections from City's General Plan Housing Element; and (2) Gallons per capita per day (GPCD) based on 2020 target required by SBx7-7

Table B.2. Water System Planning and Evaluation Criteria: Supply Reliability

Purpose	Regulation or Reference	Engineering and Planning Criteria
Reliable Supply	California Waterworks Standards	Calculate reliable supply by determining system capacity with the City's largest source out of service
Source Capacity	California Waterworks Standards	System must be able to meet Maximum Day Demand (MDD) with source capacity only, considering the reliability requirements identified above. System must be able to meet four hours of Peak Hour Demand (PHD) with source capacity and storage capacity.
Water Quality	Current and pending drinking water regulations	Analyze existing water quality and compare against current and pending MCLs
Water Disinfection	California Waterworks Standards	Disinfection systems must meet regulations for chloramine residuals and disinfection by-products (DBP); Chemical storage must be sufficient for at least two weeks

Table B.3. Water System Planning and Evaluation Criteria: Distribution

Purpose	Regulation or Reference	Engineering and Planning Criteria
System Pressure	California Waterworks Standards	Maintain a minimum pressure of 30 psi (40 psi for new systems) at all locations under normal conditions and maintain 20 psi under fire flow conditions.
Fire Flows	California Fire Code (Appendix B)	Residential areas (1,500 gpm for 2 hours) Commercial (3,000 gpm for 3 hours) Five Cities Center (4,000 gpm for 4 hours)
Pipeline Velocities	Hazen-Williams Formula; City of Arroyo Grande system characteristics	Maintain headloss gradient of less than 12 ft of headloss per 1000 ft of pipeline during peak hour; For an 8" pipe, this equates to a maximum velocity of approximately 5 fps
New Distribution Mains	Engineer's Judgment and City preference	New mains will be 8-in diameter or larger
New Transmission Mains	Engineer's Judgment and City preference	Major transmission mains or mains that potentially can serve as major transmission mains should be 12-inches in diameter or larger

Table B.4. Water System Planning and Evaluation Criteria: Storage

Purpose	Regulation or Reference	Engineering and Planning Criteria
Operational Storage	CDPH Waterworks Standards	Operational storage is calculated as a range between the values calculated applying Case A and B for each zone: (1) Case A: Source capacity for Main Zone is assumed to be that from all wells (except 3, 11) and Lopez. Source capacity for Rancho Grande Zone and Oro Zone are assumed to be that of one booster pump, respectively. Operational storage for each zone is calculated as 4 times zone PHD minus assumed source capacity for each zone. (2) Case B: Source capacity is assumed to be zero (no pumps running during PHD period). Operational storage for each zone is calculated as 4 times zone PHD.
Fire Flow Storage	California Fire Code (Appendix B)	Sufficient storage is required to provide the following fire flows: Residential areas (1,500 gpm for 2 hours) Commercial (3,000 gpm for 3 hours) Five Cities Center (4,000 gpm for 4 hours). This translates to the following storage requirements per zone: Main Zone (4,000 gpm for 4 hours) Rancho Grande Zone (3,000 gpm for 3 hours) Oro Zone (1,500 gpm for 2 hours)
Emergency Storage	*Handbook of Public Water Systems*[3]	Emergency storage equals two days of Average Day Demand (ADD) minus the supply from Well 7 and 8, which can be powered by a generator during an emergency. The system emergency storage is apportioned to each zone using the buildout ADD for each zone.

[3] HDR. *Handbook of Public Water Systems 2nd ed*. New York : John Wiley & Sons, Inc., 2001. ISBN 0-471-29211-7.

Table B.5. Water System Planning and Evaluation Criteria: Booster Pumps

Purpose	Regulation or Reference	Engineering and Planning Criteria
Zone Reliability	CDPH Waterworks Standards; Accepted Engineering Practice	Must be capable of meeting MDD within zone, with largest pump out of service
Fire Flow Pumping	California Fire Code (Appendix B)	Must be sized to meet maximum fire flow within zone, if no elevated storage exists: Residential areas (1,500 gpm for 2 hours) Commercial (3,000 gpm for 3 hours) Five Cities Center (4,000 gpm for 4 hours)
Emergency Power	*Recommended Standards for Water Works*[4]	Emergency power must be sufficient to meet system average day demands and preparedness for other emergencies

Sewer System

In planning the needed sewer facilities, accepted engineering standards and practices are utilized to evaluate facilities. The evaluation criteria for the sewer system have been organized into four categories: Customer and Flow Projections (Table B.6), Gravity Pipelines (Table B.7), Force Mains (Table B.8), and Lift Stations (Table B.9). The specific criteria included in each of the categories are shown in the following tables.

Table B.6. Sewer System Planning and Evaluation Criteria: Customer and Flow Projections

Purpose	Regulation or Reference	Engineering and Planning Criteria
Future System Flows	City's General Plan Housing Element	Calculate wastewater flows at buildout from: (1) Buildout land use from City's General Plan Housing Element; and (2) Wastewater duty factors by land use type

[4] *Recommended Standards for Water Works (Ten State Standards).* Water Supply Committee of the Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers. Albany : Health Research, Inc., 2007.

Table B.7. Sewer System Planning and Evaluation Criteria: Gravity Pipelines

Purpose	Regulation or Reference	Engineering and Planning Criteria
Pipe Velocities	*Recommended Standards for Wastewater Facilities*[5]; *Civil Engineering Reference Manual*[6]	Maintain minimum velocity of 2 fps at Average Annual (Daily) Flow (AAF) and a maximum velocity of 10 fps at Peak Hour Wet Weather Flow (PHWWF)
d/D	Survey of utility sewer design standards; Engineer's Judgment	Maximum d/D: 0.60 for pipes with diameter 12-in or less 0.75 for pipes with diameter greater than 12-in
Minimum Slope	Engineering Calculations (using Manning's Equation to meet 2 fps pipe velocity at half full flow)	The sewer must be designed with a slope to be able to serve its entire tributary area. The preferred minimum slope for gravity sewers is 0.005. When conditions require, flatter slopes may be approved in accordance with following: The minimum slope for an 8" sewer is 0.004; The minimum slope for a 10" sewer is 0.0028; The minimum slope for a 12" sewer is 0.0022; The minimum slope for a 15" sewer is 0.0017.

Table B.8. Sewer System Planning and Evaluation Criteria: Force Mains

Purpose	Regulation or Reference	Engineering and Planning Criteria
Pipe Velocities	*Pumping Station Design*[7]	Design new mains to operate at velocity of 3 to 4 fps; Maintain velocity as close to 3 fps as possible for existing mains

[5] *Recommended Standards for Wastewater Facilities (Ten State Standards).* Wastewater Committee of the Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers. Albany : Health Research, Inc., 2004.

[6] Lindeburg, Michael R. *Civil Engineering Reference Manual for the PE Exam 8th ed.* Belmont : Professional Publications, Inc., 2001. ISBN 1-888577-66-5.

[7] Jones, Garr M. Editor-in-Chief. *Pumping Station Design Revised 3rd ed.* Burlington : Elsevier, Inc., 2008. ISBN 978-1-85617-513-5.

Table B.9. Sewer System Planning and Evaluation Criteria: Lift Stations

Purpose	Regulation or Reference	Engineering and Planning Criteria
Pump Capacity	Accepted Engineering Practice	Capacity should be sufficient to meet PHWWF, with one pump available as a back up
Wet Well Size	*Unified Facilities Criteria*[8]	Keep retention times less than 30 minutes unless odor control chemicals are added; Keep the number of pump starts per hour below manufacturer specifications

[8] Department of Defense. *Unified Facilities Criteria (UFC), Wastewater Collection and Pumping*, 2004. UFC 3-240-06A.

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Technical Memorandum

APPENDIX C – Planning and Evaluation Criteria

Date: 4/24/2012

To: Mr. Mike Lilnn, P.E.
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Reviewed by: Jeffery Szytel, P.E., Jeffery Szytel, P.E.

Project: City of Arroyo Grande Water and Sewer Master Plan Updates

SUBJECT: **SERVICE AREA POPULATION PROJECTION METHODOLGY**

This Technical Memorandum (TM) describes the methodology used by Water Systems Consulting, Inc. (WSC) to establish historical, current, and projected service area populations for the City of Arroyo Grande's (City) 2011 Water and Sewer Master Plan Update and the 2010 Urban Water Management Plan (UWMP). This TM is organized into the following sections:

Background
Service Area
Current Service Area Population
Historical Population
Projected Population

Background

The Urban Water Management Planning Act in conjunction with Senate Bill x 7-7(SB7) requires water suppliers to estimate population based on California Department of Finance data or U.S. Census Bureau data. SB7 contains very specific population estimate requirements for water suppliers whose service areas do not match their jurisdictional boundaries. To meet the requirements of SB7, WSC utilized the California Department of Water Resources (DWR) *Methodologies for Calculating Baseline and Compliance Urban Per Capita Water Use* (1) as a guide to develop its service area population estimates.

Service Area

The first step in determining the service area population involves establishing the service area boundary and the customers served within that boundary. WSC worked with City Staff to establish the location of customer connections outside of City limits served by the City and connections within the City limits not served by the City. WSC then plotted these connections as points in a map using Geographical Information Systems (GIS) software. The points contain spatial data tied to a geodatabase with information about each connection. Figure C-1 shows the connections located within City limits served by Oceano Community Services District (OCSD), connections located outside of City limits served by the City, and connections located outside of City limits that could be served by the City in the future.

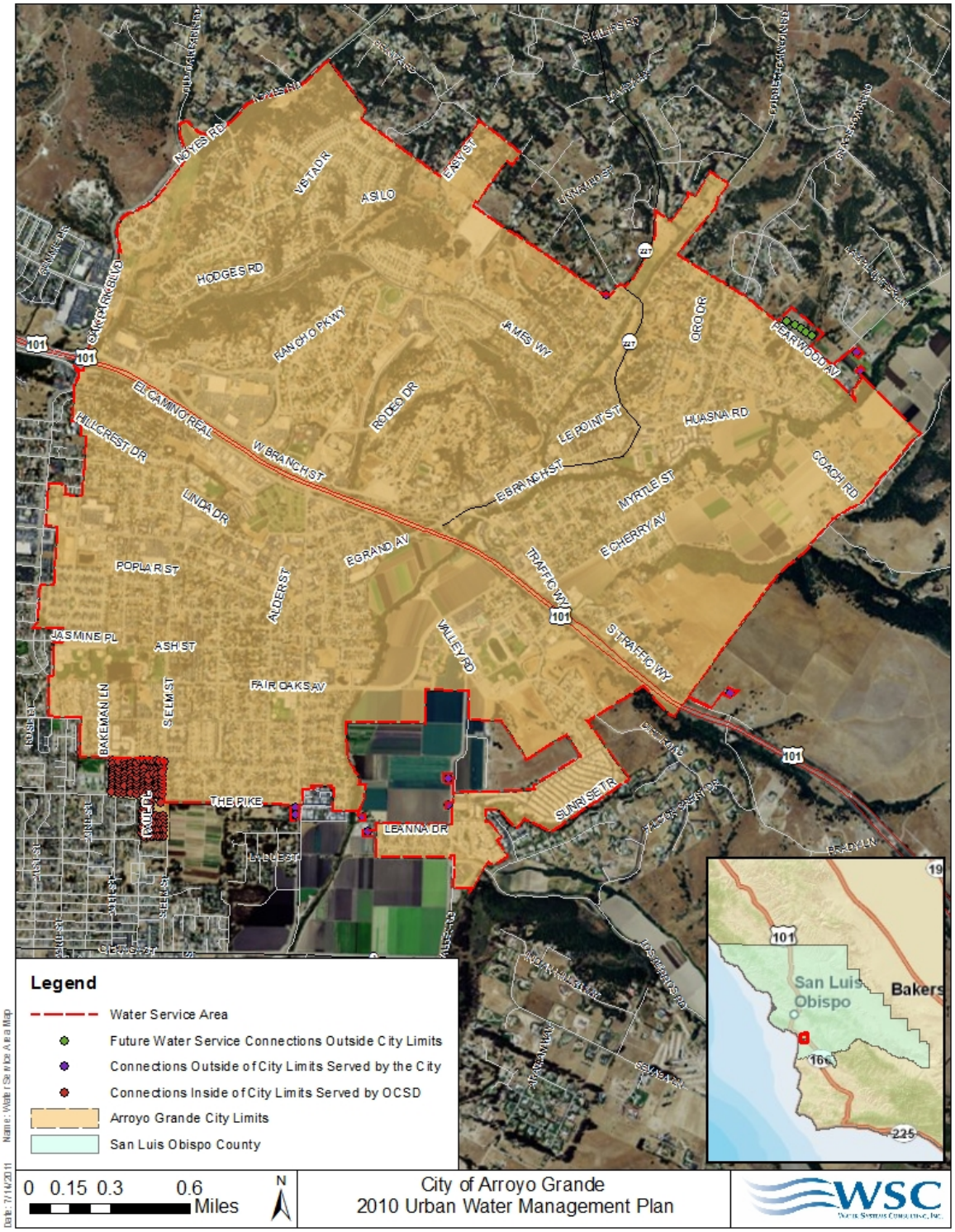

Figure C-1. City of Arroyo Grande Water Service Area

Current Service Area Population

To estimate the total population served by the City in 2010, WSC subtracted the population within City limits served by OCSD and added the population outside of City limits served by the City to the City's population from the 2010 Census.

To establish the populations for areas inside City limits served by OCSD and outside City limits served by the City, WSC applied a person per connection factor of 2.4 based on the persons per household factor used in the City's General Plan Land Use Element Table LU-1 for residential land uses. The 2010 Census population per occupied household is 2.4 as well. Table C.1 shows the breakdown of separate population areas by source, number of connections, and population.

Table C.1. Water Service Area Population

Population Area	Source	2010 Connections	2010 Population
City Limits	Census	n/a	17,252
Inside City Limits Served by OCSD Water	City Staff & Land Use Element	137 [1]	329 [2]
Inside City Limits Served by City Water	Calculation (City Limits Census Pop. minus Pop. Served by OCSD)	n/a	16,923
Outside City Limits Served by City Water	City Staff & Land Use Element	9 [1]	22 [2]
Total Water Service Area	**Calculation (Inside City Limits Pop. plus Outside City Limits Pop.)**	**n/a**	**16,945**

[1] The connections were identified and provided by City Staff.

[2] **Assumes a persons per residential connection factor of 2.4.**

City Staff estimate the service area population each year for the Department of Water Resources Public Water System Statistics report (DWR reports). The methodology used by City staff to calculate service area population is very similar to the methodology WSC used to develop its 2010 population estimate. City Staff calculate the service area population by applying 2.4 persons per household to the number of residential connections served by OCSD in each year and subtracting that population from the City limits population. The population estimated in the 2010 DWR report is 16,901, a difference of 0.3% from WSC's estimate of 16,945.

Historical Population

Since census data is not available for interim years between 2000 and 2010, historical population is assumed to be the same as the estimated service area population presented in the DWR reports for 1994-2010. Using the DWR report population estimates allows for consistency between documents and eliminates conflicting historical records of connection conditions for each year from 1994 through 2010. Figure C-2 shows the historical population as reported in the DWR reports.

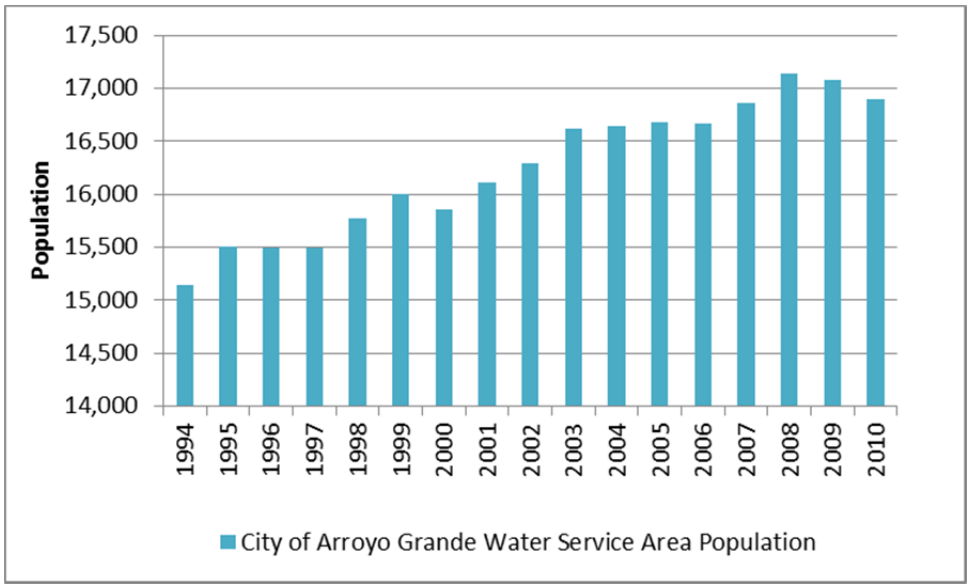

Figure C-2. Historical Population

Projected Population

The San Luis Obispo Council of Governments (SLOCOG) develops population projections for San Luis Obispo County and the cities and communities within the County. SLOCOG projects the population for the City through 2035 in its *Update to Long Range Socio-Economic Projections* report (2). The projections are based on a comprehensive study of historical population trends for California and the County, short-term and long-term population reports, economic conditions, and consultation with planners from the County. The report presents three growth scenarios: low, medium, and high. For the purposes of projecting population, WSC used the medium growth scenario population projections from SLOCOG's report to develop annual growth rates through 2030. The annual growth rates are applied to the 2010 population to yield the projected populations shown in Table C.2. The buildout population, defined as the maximum population that can occur considering the zoning and land use designations of the current General Plan, is established at 20,000 persons based on the City's General Plan Housing Element.

Table C.2. Service Area Population Projections

	2010	2015	2020	2025	2030
Population	16,901	17,553	17,943	18,552	19,077
Annual Growth Rate %	n/a	0.76%	0.44%	0.67%	0.56%

Technical Memorandum

APPENDIX D – Water Supply

Date: 4/24/2012

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Project: City of Arroyo Grande Water and Sewer Master Plan Updates

SUBJECT: **WATER SUPPLY**

This technical memorandum (TM) provides a summary of the City of Arroyo Grande's historical and future water supply and is intended to replace Chapter 5 in the 1999 Water Master Plan. This TM is organized into the following sections:

(1) Executive Summary
(2) Supply Sources
(3) Supply Reliability
(4) Supply Redundancy

Executive Summary

The City has a variety of water sources including groundwater, local surface water, and ponded storm water used for groundwater recharge, irrigation and construction. The City has completed multiple studies of potential supplemental supply sources. The supplemental sources considered the most viable are discussed in this memo. Other potential sources and associated studies are discussed in detail in the City's 2010 Urban Water Management Plan (2010 UWMP).

Table D.1 and Table D.2 outline the City's historical, current and projected potable water supplies through 2030.

Table D.1. Historical Water Supply – AFY

Water Supply Sources	1980	1985	1990	1995	2000	2005	2010
Groundwater – Santa Maria Groundwater Basin	1,202	1,202	1,202	1,202	1,202	1,202	1,323
Groundwater – Pismo Formation	0	0	0	80	80	80	80
County of San Luis Obispo Lopez Reservoir Project	2,290	2,290	2,290	2,290	2,290	2,290	2,290
Surplus Lopez Project Water	-	600	700	910	500	0	0
Oceano Community Services District	-	-	-	-	-	100	100
TOTAL	**3,490**	**4,090**	**4,192**	**4,472**	**4,062**	**3,758**	**3,793**

Table D.2. Projected Water Supply – AFY

Water Supply Sources	2015	2020	2025	2030
Groundwater – Santa Maria Groundwater Basin	1,323	1,323	1,323	1,323
Groundwater – Pismo Formation[1]	200	200	200	200
County of San Luis Obispo Lopez Reservoir Project	2,290	2,290	2,290	2,290
Oceano Community Services District [2]	100	-	-	-
TOTAL	**3,913**	**3,813**	**3,813**	**3,813**

[1] Assumes 80 AFY of groundwater from Well No. 9, 80 AFY from Well No. 10, and 40 AFY from Well No. 11 will be available as a reliable source of supply from 2015 through 2030.

[2] Assumes that the remaining three years of the five year contract of 100 AFY with OCSD will be utilized in 2014, 2015, and 2016.

Supply Sources

The City's current sources of potable supply are surface water from the Lopez Reservoir and groundwater pumped from the Santa Maria Valley Groundwater Basin and the Pismo Formation. The City also utilizes ponded storm water for non-potable uses. Future supply is expected to be comprised

of supplemental sources in addition to the current supply sources. These supplemental sources may include water purchased from the Oceano Community Services District (OCSD), additional water from Lopez Reservoir, supplemental water from the State Water Project, recycled water, and/or additional reclaimed storm water.

Surface Water- Lopez Reservoir

Lopez Dam and Reservoir were planned, designed, and constructed under the auspices of the San Luis Obispo County Flood Control and Water Conservation District (SLOFCWCD), Zone 3. The Dam and Reservoir were completed in 1970; the primary purpose of the reservoir is to provide water supply for contracting communities within the County Flood Control Zone No. 3, however there are many other important benefits of the project including recreation, flood control, and regulated release for Arroyo Grande Basin groundwater recharge. The Lopez Reservoir has a capacity of approximately 49,388 acre-feet. The Lopez Dam is 1,120 feet in length and has a vertical height of 166 feet. A steel transmission main, ranging in diameter from 20-inch to 30-inch, carries untreated water from the dam to the 844 acre-foot Lopez terminal reservoir at the 6 MGD[9] Lopez Water Treatment Plant (WTP). Treated water is conveyed from the Lopez WTP to water contractors in the Five Cities area (including Arroyo Grande, Grover Beach, Oceano, Pismo Beach, and Avila Beach) via the Lopez Pipeline (1).

Safe Yield

The current safe yield of Lopez Reservoir is 8,730 AFY, which reflects the sustainable water supply during a drought. The safe yield is derived from two historical studies: Lopez Project Hydrology Review, conducted in June 1962, and the Hydrologic Balance of Arroyo Grande Groundwater Basin, conducted in November 1962. The reservoir is operated to stay within the safe yield. As previously noted, over half of the project's safe yield (4,530 AFY) has been apportioned by agreements to contract agencies. The remaining 4,200 AFY is reserved for downstream releases. The safe yield is currently being re-evaluated as part of an ongoing study to determine the feasibility of raising the dam spillway with an inflatable weir. If the Safe Yield is increased, the City will increase its entitlement.

Lopez WTP

Because of the bodily-contact recreation use, public health officials required the installation of a terminal reservoir between Lopez Dam and the Lopez WTP. This reservoir provides a theoretical detention time of over 30 days for 844 acre-feet of storage. Untreated water is drawn from the intake tower of the terminal dam and passed through an influent pipeline to the 6 MGD[9] treatment plant.

[9] The Zone 3 2010 UWMP states that the capacity of the Lopez WTP is 6 MGD (12). According to Lopez WTP operators the maximum design capacity of the WTP is 6.7 MGD (38).

The Lopez WTP includes chemical pretreatment, dissolved air floatation, membrane microfiltration, chlorine dioxide disinfection, and chloramination for distribution system residual. The current average daily flow is approximately 4.0 MGD. Major infrastructure is designed with a maximum capacity of 6.7 MGD[1].

Lopez Distribution System

Water is distributed to the various agencies through the Lopez Distribution System, which extends from the treatment facility to Port San Luis. The distribution system conveys a blend of treated water from the Lopez Reservoir and the State Water Project to the communities of Arroyo Grande, Grover Beach, Pismo Beach, Oceano, and County Service Area (CSA) 12. The pipeline is approximately 17.6 miles long with various turnouts to the contracting agencies. The turnouts are sized to meet corresponding contract requirements. The distribution line consists of concrete mortar lined and coated steel pipe which is 33 inches in diameter from the Lopez Treatment Plant to Edna Road, 30 inches to Brisco Road, 18 inches from Grover Beach to Vista Del Mar, and 14 inches to El Portal.

The operation and maintenance of the dam, treatment plant, and water conveyance system are the responsibility of SLOFCWCD Zone 3.

Arroyo Grande Lopez Entitlement

The City is contracted to receive 2,290 acre-feet of water per year from the Lopez Reservoir, which accounts for approximately 50.55 percent of the available water from Lopez. Entitlements are based on the current estimated safe yield; thus, entitlements may change if the safe yield changes.

Surplus Entitlement

During years when less than 4,200 AFY is released for downstream flows, or a spill occurs, surplus supply is available. The surplus is offered to Contract Agencies including the City.

Groundwater

Prior to 1970, the City's water supply was derived solely from groundwater pumping from the Arroyo Grande Plain of the Tri-Cities Mesa (AGP-TCM) groundwater sub-basin of the Santa Maria Valley Groundwater Basin. Currently, the City pumps from two different groundwater basins: the Santa Maria Valley Groundwater Basin and the Pismo Formation. Table D.3 and Table D.4 show the historical and projected groundwater pumping for each groundwater source. Table D.5 shows current groundwater supplies.

Table D.3. Historical Groundwater Pumping – AFY

Basin Names	2006	2007	2008	2009	2010
Groundwater – Santa Maria Valley Groundwater Basin	1,025	1,256	1,096	799	539
Groundwater – Pismo Formation	0	16	67	80	70
Total Groundwater	**1,025**	**1,272**	**1,164**	**879**	**610**
Percent of total water supply	31%	35%	33%	27%	21%

Table D.4. Projected Groundwater Pumping – AFY

Basin Names	2015	2020	2025	2030
Groundwater – Santa Maria Groundwater Basin	798	497	599	686
Groundwater – Pismo Formation	200	200	200	200
Total Groundwater	**998**	**697**	**799**	**886**
Percent of total water supply	30%	23%	26%	28%

Table D.5. Current (2010) Groundwater Supply

Basin Name	AFY
Santa Maria Groundwater Basin	1,323
Pismo Formation	160
Total	**1,483**

The following two subsections provide an overview of the two groundwater basins utilized by the City. More detailed information is contained in the 2010 UWMP.

Santa Maria Valley Groundwater Basin

Four urban agencies known as the Northern Cities (the City, the City of Grover Beach, the City of Pismo Beach, and the Oceano Community Services District) currently extract water from the Santa Maria Valley Groundwater Basin. Additional basin uses include other urban water suppliers, agriculture, and local landowners.

Six of the City's wells currently pump from the Santa Maria Valley Groundwater Basin (Well No. 1, 3, 4, 5, 7, and 8). The City's entitlement from the Arroyo Grande Groundwater Basin was established at 1,202 AFY by the 2002 Groundwater Management Agreement. Per the Groundwater Management Agreement, this entitlement has been increased to 1,323 AFY based on the conversion of irrigated agricultural lands to urban use (2). In 2005, the Groundwater Management Agreement was incorporated into the Santa Maria Valley Groundwater Basin Adjudication. Refer to the 2010 UWMP for a detailed description of the management of this basin, and related agreements.

Pismo Formation

The Pismo Formation is a distinct deep aquifer at the northeastern section of the City, identified in water wells along Oak Park Boulevard on the south, at Paseo Ladera Lane to the west, and along James Way to the east. Currently, the City pumps groundwater from Well No. 9 and Well No. 10, which are capable of extracting approximately 90 AFY each if operated 100% of the time, but are assumed to extract a maximum of 80 AFY each assuming required operational downtime. Both wells receive treatment for iron, manganese and hydrogen sulfide prior to discharge into the system. Well No. 11 is assumed to be operational by 2015. Well No. 11 is capable of extracting approximately 45 AFY if operated 100% of the time, but is assumed to extract 40 AFY assuming required operational downtime. Water supply from the Pismo Formation is not subject to the adjudication for the Santa Maria Valley Groundwater Basin. The Pismo Formation is not adjudicated and has not been identified as overdrafted or projected to be overdrafted by DWR. In 2003, Cleath & Associates completed a groundwater source assessment for the Oak Park area, which covers the same aquifer as the Pismo Formation. The groundwater yield for the Oak Park area was estimated to be approximately 540 AFY (3). The City exercises an appropriative right to put the water supply from the Pismo Formation to reasonable and beneficial use. The City's appropriative right allows it to pump available groundwater surplus to the needs of all existing overlying rights in the basin.

Table D.6 provides a summary of the City's existing wells (including Well 11, which is drilled but not yet equipped).

Table D.6. Existing Well Summary

Well Number	Capacity (gpm)	Year Drilled	Motor Size (HP)	Casing Depth (feet)	Water Quality Constituents
1	330	1940	40	200	Nitrates high but under MCL
3	432	1954	50	219	Nitrates high but under MCL
4	455	1964	60	233	Nitrates over MCL
5	992	1967	100	202	Nitrates over MCL
7	940	1982	150	570	Iron/Manganese over MCL
8	500	1990	75	250	Nitrates high but under MCL
9	65	1990	15	389	Iron/Manganese, Sulfide-treatment system added
10	65	2006	10	850	Iron/Manganese, Sulfide-treatment system added
11[1]	28	2006	TBD	TBD	TBD

[1] Well 11 is in the well equipping design stage.

Water used for agriculture within the City limits is produced from privately-owned wells and from riparian diversions. The City does not have any agricultural connections. According to the 2002 DWR report on *Water Resources of the Arroyo Grande – Nipomo Mesa Area*, the owners of these private agricultural water wells produce approximately 40 percent of the water extracted from the AGP-TCM sub-basin. The major diversions of surface water occur during irrigation of lands adjacent to the Arroyo Grande Creek. The Lopez Project is obligated to discharge up to 4,200 acre-feet of untreated surface water into Arroyo Grande Creek during non-spill periods. The purpose of this release is to maintain groundwater levels in the wells downstream of the dam and to satisfy downstream vested water rights. Agricultural groundwater pumping rates are expected to remain relatively constant or decrease slightly with the use of advanced watering technology in the future.

Reclaimed Storm Water

Since 1990, the City has operated the Soto Sports Complex Storm Water Reclamation Project. This project includes a forty-acre joint use facility, which serves as a collection point for drainage from a third of the City's area. Storm water is collected for the subsequent irrigation of a park and seven athletic fields. The estimated offset of potable water demand is approximately 100 AFY. The system includes drainage water sumps, an irrigation well, two booster pump stations, an irrigation system, and a construction water fill station.

Supplemental Water Supply Sources

The City has completed multiple studies of potential supplemental water supply sources including an extension of the Nacimiento Pipeline, desalination, and recycled water. Based on the results of these studies, an extension of the Nacimiento Pipeline and desalination are not considered feasible or cost-effective at this time. Based on several recycled water studies prepared by the City as well as the South San Luis County Sanitation District and the City of Pismo Beach, the City determined recycled water is not currently cost-effective. However, the City intends to continue regional cooperation and to pursue grant funding in an effort to to improve the feasibility of implementing recycled water (refer to the 2010 UWMP). In order to meet total projected water use, as well as offset potential future water shortages due to drought or disaster, the City is considering the following supplemental water supplies:

- Oceano Community Service District (OCSD): In August 2005, the City entered into a two-year agreement with the OCSD to provide 100 AFY. The City never purchased water under this agreement. In January 2009, the City renewed the contract with OCSD for a 5-year period. The supply from OCSD is intended to provide sufficient time to develop other supplemental water supply alternatives. The City has submitted a proposal to OCSD to establish a permanent purchase agreement.

- Surplus water from Lopez: Historically, the City and other contracted agencies have received surplus water from Lopez depending upon yearly downstream releases. The SLOFCWCD - Zone 3 monitors the potential for surplus water availability consistent with the water supply agreement.
- Lopez Reservoir Spillway Raising: In 2008/2009, SLOFCWCD Zone 3 conducted a study to consider raising the spillway elevation of Lopez Reservoir, as a means of increasing safe yield in the reservoir and thus increasing water supply entitlements to the contract agencies. The project study examines raising the spillway of Lopez Dam by 3 to 5 feet, which would increase gross reservoir storage capacity by a maximum of 2,850-4,750 acre-feet. Based on evaluation of historic drought years (1986-1996), the average yield disbursed over 11 years would provide an estimated safe yield from 259-432 AFY (1). The next phase of this study is currently under way and is expected to be completed later this year. The 2010 UWMP provides additional detail on this study.

- Supplemental State Project Water via the Coastal Branch and Lopez Pipelines: SLOFCWCD recently completed a hydraulic study to evaluate the hydraulic capacity of the Coastal Branch of the State Water Project. The study will be used as a starting point for the SLOFCWCD and CCWA to enter into negotiations to consider utilization of the County's excess State Water Project entitlement, and could provide an opportunity for the City to purchase a temporary, permanent and/or drought buffer allocation from the project.
- Additional Storm Water Reclamation: A detention basin currently exists at the Wal-Mart Site near the intersection of West Branch Street and Camino Mercado, which according to staff, holds water year-round due to storm water inflow. The year-round storage volume is currently unknown; however the approximate volume of the basin is 6.4 acre-feet (4). The *Recycled Water Distribution System Conceptual Plan Technical Memorandum* recommends conducting a feasibility study for the storm water reclamation project. If the storm water is deemed a viable source of water, it would potentially offset potable water demand by approximately 43 AFY (4).

Supply Reliability

The 2010 UWMP provides a detailed reliability analysis of each supply source, and discusses the average, single dry, and multiple dry years supply availability based on historical hydrologic conditions.

Conjunctive use of the groundwater basins and surface water supplies provides an effective management strategy, which increases the overall reliability of all the resources to meet current and future water demands. Additional detail can be found in the 2010 UWMP. A 20-year projected supply estimate is shown in Table D.7.

Table D.7. Arroyo Grande Historical and Projected Supply– AFY

Source	2010	2015	2020	2025	2030
Lopez Reservoir	2,290	2,290	2,290	2,290	2,290
Groundwater: Arroyo Grande Basin	1,323	1,323	1,323	1,323	1,323
Groundwater: Pismo Formation	80	200	200	200	200
OCSD Agreement[1]	100	100	0	0	0
Total[2]	**3,793**	**3,913**	**3,813**	**3,813**	**3,813**

[1] It is assumed the City will amend its five-year contract with OCSD to use its remaining 3 years of annual purchases of 100 AFY in 2014, 2015, and 2016.

[2] The basis of water supply for an average year is 1957. A single dry weather year occurred in 1989, where the total precipitation measured 5.5 inches. A multiple dry year period occurred from 1988 through 1990 **(5)**.

Supply Redundancy

The supply reliability analysis described above considers legal and climatic changes over time, and provides annual supply estimates to ensure annual demand can be met. Supply redundancy analysis is focused on a smaller time scale, in this case a maximum demand day, to ensure that the City can supply maximum day demand (MDD) in the event of a reasonable system failure. The reliable supply is determined by the system capacity with the largest source out of service (see Appendix C). For the City, the following criteria are recommended to assess if the City has adequate redundancy of supply:

(1) Meet build-out MDD with the largest well out of service and the Lopez system in service.
(2) Meet build-out MDD with the Lopez system out of service and the wells in service.

The City meets Criteria 1, as shown in

Table D.8 below. When assessing Criteria 1, Well 3 was also assumed to be out of service. This is because Well 3 is not always available for use (Well 3 is under pumping restrictions and cannot be used when surface water is within 150 feet of the well).

The City does not currently meet Criteria 2. In the event of a Lopez system failure, the City must implement water conservation to ensure that demand does not exceed approximately 80% of MDD (equivalent to about 150% of ADD). To meet Criteria 2 without conservation, additional water supply sources are necessary. While supplemental water sources (described in Section 2) may help the City meet Criteria 2, siting and developing a new well is considered the most reliable way to increase the

system's redundancy. The Capital Improvement Plan (CIP) recommends siting a new well to help the City meet Criteria 2.

Table D.8. Supply Redundancy

Condition	Supply Sources (gpm)			Build-out MDD (gpm)
	Lopez	Wells	Total Supply	
1. Largest well out of service (Lopez in service)[1]	2,096	2,325	4,421	4,139
2. Lopez out of service (Wells in service)[2]	-	3,339	3,339	4,139

[1] Assumes maximum capacity at Lopez turnouts, and Well 5 (largest well) and Well 3 (has pumping restrictions) are out of service.

[2] Assumes Lopez system and Well 3 (has pumping restrictions) are out of service.

Technical Memorandum

APPENDIX E – Water System Model Development

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Project: City of Arroyo Grande Water and Sewer Master Plan Updates

Subject: **WATER SYSTEM MODEL DEVELOPMENT**

The purpose of Water System Model Development Technical Memorandum (TM) is to describe the development of the water system model for the purposes of evaluating system capacity. This TM contains the following sections:

(1) System Mapping Update
(2) Elevation Data
(3) Customer Demand Data
(4) Geospatial Allocation
(5) Land Use Demand Factors
(6) Water Model Calibration
(7) Water System Evaluation

System Mapping Update

WSC utilized the City's water system GIS information to develop an updated water model. However, the last major revision to City's GIS mapping was completed in 2003. To update the system mapping, WSC modified the GIS shapefiles based on information obtained from as-built drawings for development and CIP projects, the City's Water System Atlas and City Staff. For system components not currently contained within the GIS system mapping, WSC developed individual shapefiles for the following features:

- Tanks
- Booster Pumps
- Turnouts
- Wells
- PRVs
- Closed Valves

WSC also modified the existing shapefiles provided by the City to remove the following elements from each of the shapefiles because they are privately maintained or are not necessary to complete the modeling.

Table E.1. Modifications to City's shapefiles

Shapefile	Description
w_mains_WSC Edits	Mains with the pipe type F.S. (fire service) – privately maintained
w_nodes_WSC Edits	Nodes that did not intersect the water mains shapefile – not necessary for modeling
w_valves_WSC Edits	Valves that did not intersect the water mains shapefile – not necessary for modeling

Elevation Data

Elevation data is a critical component of the development of a water system model. The City's existing GIS system does not contain any attribute elevation data. To correlate elevation data with the distribution system point features, WSC obtained GIS based elevation data from the United States Geological Survey National Elevation Dataset (USGS NED). The USGS NED provides public domain raster elevation data for the conterminous United States, Alaska, Hawaii and territorial islands. The NED provides elevation data in the following resolutions:

- 1 arc-second (approx. 30 meter grids)
- 1/3 arc-second (approx. 10 meter grids)
- 1/9 arc-second (approx. 3 meter grids)

The best available resolution for the Arroyo Grande City Limits was 1/3 arc-second. Utilizing ArcMap, WSC overlaid the NED raster dataset and extracted elevation data for each of the point features in the distribution system shapefiles. These elevations were then compared against elevations from record drawings, where available, and modified as needed.

Customer Demand Data

To develop estimates of customer demands for the Arroyo Grande water distribution system, WSC utilized customer water use records, for 2010, exported from the City of Arroyo Grande's (City) billing database. The pertinent fields contained within the City's database are listed in Table E.2 below. The City's water system meters are measured on a bi-monthly schedule, with approximately one half of the meters read on the odd months and the corresponding half on the even months.

Table E.2. Fields in City's Billing Database

Field Name	Description
Acct #	9 digit unique identifier for each for each customer in the City's database
Acct_Type	City designated account type
Service Location	Address of service connection including City, State and Zip Code
Month (Jan-Dec)	Bi-monthly consumption data (CCF)

To determine 2010 annual water demand, WSC summed each customer's bi-monthly water use for the year. The total billed consumption for 2010 was 1,230,613 CCF and the consumption ranged from 0 to 21,943 CCF per customer.

Geospatial Allocation

To geospatially allocate consumption data throughout the City's distribution system; WSC utilized the geocoding tool within ESRI's ArcMap software. Geocoding is a process that plots the geographical location of a point or set of points based on street name or address. The Geocoding tool utilizes a street centerline shapefile, which contains address ranges in the attribute data to determine the approximate location of the each item in the dataset. WSC used the ag_roads and all_other_roads street centerline files provided by the City of Arroyo Grande for the geocoding process. Discrepancies

between the address ranges within the centerline files and the actual address ranges of the residences and businesses within Arroyo Grande limited the accuracy of the geocoding. WSC modified the address ranges of the ag_roads centerline files to improve the geocoding results, as required.

The initial geocoding matched 98% of the customer records from Arroyo Grande's billing database. The remaining customer records, with available address data, were located manually using alternative geocoding services, specifically Google maps and Zillow.

Land Use Demand Factors

WSC utilized the geospatially allocated demands and the City's Land Use Categories feature dataset to develop land use demand factors for each land use category. Development of the land use factors involved analysis of current and buildout acreages for each land use category and geospatial allocation of customers to determine each customer's overlying land use. The City's 14 land use categories are shown below:

Table E.3. City of Arroyo Grande Land Use Categories

Code	Code Description
AG	Agriculture
CF	Community Facilities
HD	Multi-Family High Density
LD	Single Family Low Density
LMD	Single Family Low-Medium Density
MD	Single Family Medium Density
MHD	Multi-Family Medium-High Density
MU	Mixed-Use
O	Office Professional
OS	Conservation/Open Space
RC	Regional Commercial
VC	Village Core
VHD	Multi-Family Very High Density
VLD	Single Family Very Low Density

Analysis of Current and Buildout Acreages

WSC estimated current and buildout acreage by land use category using City land use data and a 2009 Preliminary Housing Opportunity Sites Inventory (Inventory) provided by the City. The land use data provided the number of acres of each land use category at buildout. The Inventory provided a list of parcels with development potential including the parcel acreage, existing number of dwelling units, and estimates of the number of potential dwelling units that could fit within each parcel. Using the data provided in the Inventory, WSC estimated the undeveloped acreage in each parcel. This analysis assumed the ratio of potential dwelling units to total dwelling units (including current and potential) in each parcel was equal to the ratio of undeveloped acres to total buildout acres of the parcel. This yielded an estimate of undeveloped acreage for each parcel in the Inventory. WSC estimated current developed acreage for each land use category by subtracting the estimated undeveloped acreage identified in the Inventory from the buildout acreage for each land use category.

Geospatial Allocation of Demands

There are some areas within City Limits where customers are served water by OCSD and sewer by the City. In these areas the City reads the water meters to estimate sewer flows and includes the volume in its customer demands database. These areas were included in the analysis of spatially allocated land use demand factors. In some areas within City Limits the City does not serve water or sewer. The City's Land Use Categories layer was modified by deleting areas that are not served by the City's water system and sewer system. The areas shown in Table 4 were removed from the City's Land Use Categories layer to improve the accuracy of the land use demand factors, which are based on water usage per acre for each land use category.

Table E.4. Land Use Categories Layer Modifications

OBJECTID	Land Use Category
110	Mixed-Use
265	Single Family Medium Density
266	Single Family Medium Density

All water system customers receiving water outside of the City limits were excluded from the Land Use Demand Factor Analysis because they are not associated with the City's land use categories. City staff also identified water connections within the City Limits that are not served by the City. For the purposes of the water model, the geospatially allocated water demand points that are not served by the City were excluded. This was executed by editing the land use demand intersection database and creating a new shapefile called WtrSrvPnts.

Geospatially allocated customer demands and land use categories were intersected in GIS to provide a database of demands and associated land uses for each customer. The land use demand intersection database provided a second opportunity to verify the geographic locations of customer demands. To verify that the geographic location of each customer was correct, each customer Account Type was compared with its overlying land use by performing a query of the land use demand intersection database. The query matched customer Account Type with compatible land use categories for each customer. Customer records with incompatible account types and associated land use categories were flagged for review. For example, if a customer Account Type was residential, and its overlying land use was Conservation/ Open Space, then the customer would be flagged to be manually checked in GIS. Each of the customers with incompatible Account Types and overlying land uses were analyzed in the GIS map and compared with available address data from Google maps and Zillow. The points that were located in the wrong place were relocated manually to their correct location. Once all of the geographic locations of the customers were corrected, the geospatially allocated customer demands and land use categories were intersected in GIS again to yield 2010 total deliveries by land use category.

Calculation of Land Use Demand Factors

The total deliveries for each land use category were divided by the total developed acreages for each land use category to yield current deliveries per developed acre for each land use category. To account for an unusually low year for deliveries in 2010, an average of total production from 2008 through 2010 was calculated. To develop the 2008-10 average demand factors, the 2010 deliveries per developed acre were multiplied by the ratio of 2008-2010 total production average to 2010 total deliveries, which is approximately 116%. To develop estimates for build-out demand, the total buildout acreage for each land use was multiplied by the 2008-10 average demand factors. The 2008-10 average and build-out demand estimates are shown in Table E.5. These demand estimates are solely for development of the water model and do not reflect the City's goal of 20% reduction in per capita water use by 2020 as described in the City's 2010 Urban Water Management Plan.

Table E.5. Spatially Allocated Land Use Demand Factors

Land Use Code Description	2008-2010 Existing ADD (gpd)	Current Status (Acres)	2008-2010 Average Demand Factors (gallons/day/acre)	Development at Build-Out (Acres)	Build-Out ADD (gpd) with Current Demand Factors[1]
Agriculture	15,600	345	45	347	15,700
Community Facilities	157,300	364	433	367	158,600
Multi-Family High Density	108,000	33	3,299	43	141,400
Single Family Low Density	179,100	308	581	358	208,200
Single Family Low-Medium Density	811,900	535	1,518	583	884,400
Single Family Medium Density	905,800	516	1,756	535	939,400
Multi-Family Medium-High Density	238,700	146	1,630	157	255,400
Mixed-Use	286,700	160	1,788	195	349,000
Office Professional	35,400	27	1,305	31	40,100
Conservation/Open Space	10,100	320	32	320	10,100
Regional Commercial	69,800	60	1,157	60	69,800
Village Core	53,200	52	1,029	52	53,200
Multi-Family Very High Density	16,300	4	4,099	5	22,300
Single Family Very Low Density	-	48	363	48	17,300
TOTAL	2,890,000	2,918		3,100	3,170,000

[1] These demand estimates are solely for development of the water model and do not reflect the City's goal of 20% reduction in per capita water use by 2020 as described in the City's 2010 Urban Water Management Plan.

Once the land use demand factors were calculated in tabular format the spatially allocated demands were updated in the water model. The 2010 spatially allocated demands were multiplied by a correlation factor that increased the total demand of the 2010 spatially allocated demands to equal the 2008-10 total average demand. A correlation factor was also applied to the 2008-10 spatially allocated demands to develop the spatially allocated build-out ADD demands for the water model.

Water Model Calibration

To develop a water model that approximates the current performance of the City's distribution system, WSC coordinated with City Staff to collect hydrant testing data, including test hydrant flow rates and residual hydrant pressures, from select locations within the distribution system. To facilitate the data collection, WSC prepared individual data sheets for each hydrant testing location. The hydrant testing locations were selected to: 1) obtain hydraulic data representative of the distribution system; 2) ensure testing was performed in each of the City's pressure zones; 3) match locations from the previous master plan. City Staff performed each hydrant test and recorded all pressure and flow data. The completed hydrant testing datasheets are located in 0.

To calibrate the model using the hydrant testing data, WSC developed modeling scenarios for each hydrant test. Initially the model was loaded with City's average day demand and pipelines were assigned standard or textbook Hazen-Williams friction factors. WSC then created individual scenarios for each hydrant test's static condition to check for model elevation or pressure gage errors by comparing the static pressures at the residual and test hydrants against the modeled static pressures. Upon approval of the static pressures, individual residual pressure scenarios were developed for each hydrant test. For the residual pressure scenarios, a demand load equal to the test hydrant flow rate was applied to the node representing the test hydrant in the model. The residual hydrant pressure observed during the hydrant test was then compared against the modeled residual pressure at the residual hydrant to check the calibration of the model. The Hazen-Williams friction coefficients for the different pipe materials within the distribution system were then modified to improve the correlation between the modeled and observed residual pressures at the residual hydrants. The friction coefficients used for the City's water model are shown in the table below and a summary table of the hydrant test results and the model calibration the figure below.

Table E.6. Hazen Williams Friction Factors

Pipe Material	Hazen Williams C-Factors
ACP	125
CIP	90
COMP	125
DIP	115
GALV	125
PVC	120
STL	125

To compare the differences between the observed pressures and the modeled pressures from the calibrated model, WSC developed a model correlation plot. Plotting modeled versus observed values should create a 45 degree line to show adequate correlation. The correlation plot for the water system mode is shown in Figure E-1 below.

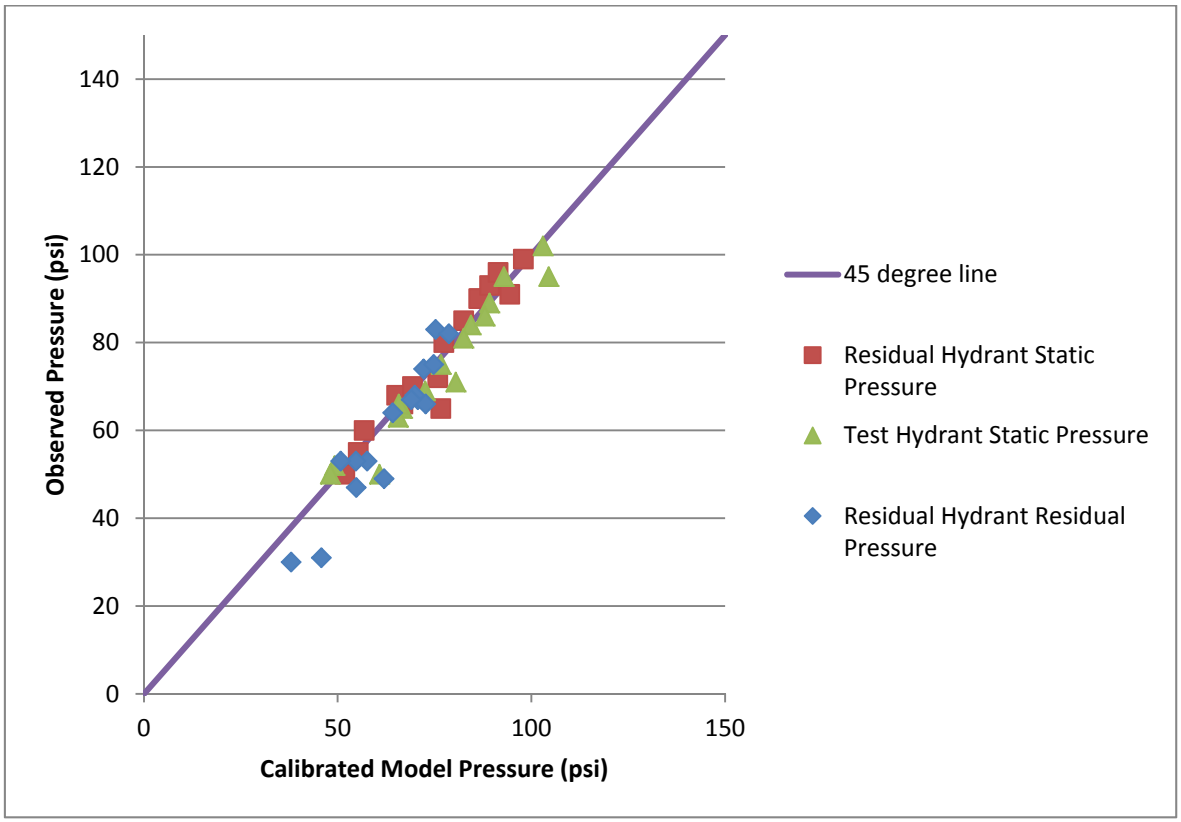


Figure E-1. Water system model calibration correlation plot

Water System Evaluation

To evaluate the need for improvements to the City's water distribution system, WSC used the calibrated model to analyze the distribution system's ability to maintain minimum pressures, meet fire flow requirements and operate within the pipeline velocity restrictions. The specific evaluation criteria utilized for the water system evaluation is contained in the Capital Improvement Program and where appropriate the CIP projects were supported with water model runs.

Hydrant Testing Datasheets

City of Arroyo Grande
Hydrant Testing - 2011 Master Plan Update

Zone:	Main City
Location:	Oro Drive
Date:	11/16/2011
Time:	8:55
Tester:	Paul M
Fire Hydrant ID:	
Fire Hydrant Model:	
Water Main Size (in):	
Test Hydrant Static Reading (psi):	52
Residual Hydrant Static Reading (psi):	55
Test Hydrant Residual Reading (psi):	40
Residual Hydrant Residual Reading (psi):	31
Pitot Gauge Reading (psi):	27 (Record pitot tube size and/or coefficent if necessary)
Fire Hydrant Flow Rate (gpm):	790
Total Flow Rate (gpm):	790

Notes:

Location Map

Boundary Conditions

Tank Levels: #1	24.5
#2	25.1
#3	
#4	26
#5	
Booster Pumps:	off
Turnouts: Edna	491
Brisco	1033
Wells (#1 - #8):	off
#9	60
#10	60

City of Arroyo Grande
Hydrant Testing - 2011 Master Plan Update

Zone:	Oro			
Location:	Platino Drive			
Date:	11/16/2011	Test Hydrant Static Reading (psi):	95	
Time:	9:10	Residual Hydrant Static Reading (psi):	99	
Tester:	Paul M.	Test Hydrant Residual Reading (psi):	43	
Fire Hydrant ID:		Residual Hydrant Residual Reading (psi):	53	
Fire Hydrant Model:		Pitot Gauge Reading (psi):	35	(Record pitot tube size and/or coefficent if necessary)
Water Main Size (in):		Fire Hydrant Flow Rate (gpm):	914	
		Total Flow Rate (gpm)	914	

Notes:

Location Map

Boundary Conditions

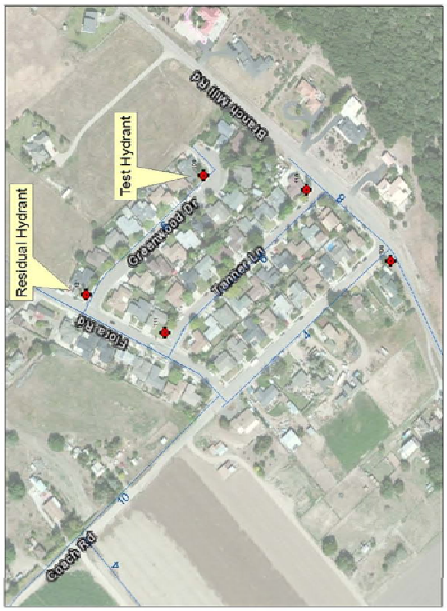
Tank Levels: #1	
#2	
#3	17.2
#4	
#5	
Booster Pumps:	off
Turnouts: Edna	n/a
Brisco	n/a
Wells (#1 - #8):	n/a
#9	n/a
#10	n/a

City of Arroyo Grande
Hydrant Testing - 2011 Master Plan Update

Zone:	Main City
Location:	Greenwood Drive
Date:	12/13/2011
Time:	13:20
Tester:	Paul M.
Fire Hydrant ID:	
Fire Hydrant Model:	
Water Main Size (in):	
Notes:	

Test Hydrant Static Reading (psi):	50
Residual Hydrant Static Reading (psi):	50
Test Hydrant Residual Reading (psi):	20
Residual Hydrant Residual Reading (psi):	30
Pitot Gauge Reading (psi):	17 (Record pitot tube size and/or coefficent if necessary)
Fire Hydrant Flow Rate (gpm):	640
Total Flow Rate (gpm):	640

Location Map



Boundary Conditions

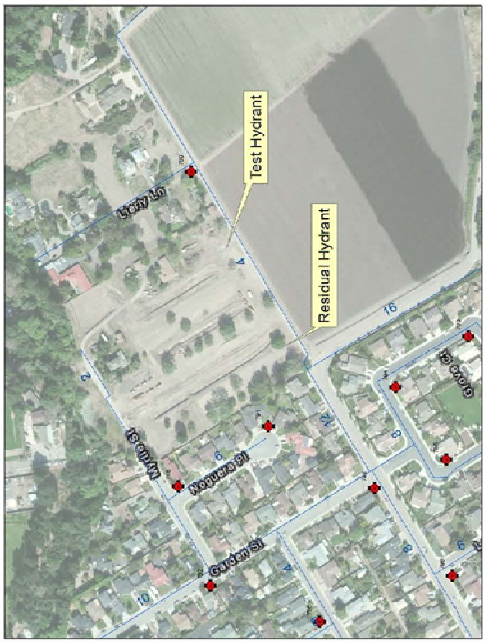
Tank Levels: #1	20.5
#2	20.4
#3	24.3
#4	
#5	
Booster Pumps:	off
Turnouts: Edna	750
Brisco	500
Wells (#1 - #8):	off
#9	on
#10	on

City of Arroyo Grande
Hydrant Testing - 2011 Master Plan Update

Zone:	Main City
Location:	East Cherry
Date:	11/16/2011
Time:	10:30
Tester:	Paul M.
Fire Hydrant ID:	
Fire Hydrant Model:	
Water Main Size (in):	
Test Hydrant Static Reading (psi):	65
Residual Hydrant Static Reading (psi):	66
Test Hydrant Residual Reading (psi):	
Residual Hydrant Residual Reading (psi):	64
Pitot Gauge Reading (psi):	33/32 (Record pitot tube size and/or coefficent if necessary)
Fire Hydrant Flow Rate (gpm):	852/870
Total Flow Rate (gpm)	1722

Notes:

Location Map



Boundary Conditions

Tank Levels: #1	24.5
#2	24.8
#3	
#4	26.8
#5	
Booster Pumps:	off
Turnouts: Edna	1027
Brisco	498
Wells (#1 - #8):	off
#9	60
#10	60

City of Arroyo Grande
Hydrant Testing - 2011 Master Plan Update

Zone:	Main City			
Location:	Whiteley Street-A			
Date:	11/16/2011	Test Hydrant Static Reading (psi):	71	
Time:	10:40	Residual Hydrant Static Reading (psi):	72	
Tester:	Paul M.	Test Hydrant Residual Reading (psi):		
Fire Hydrant ID:		Residual Hydrant Residual Reading (psi):	67	
Fire Hydrant Model:		Pitot Gauge Reading (psi):	23/27	(Record pitot tube size and/or coefficent if necessary)
Water Main Size (in):		Fire Hydrant Flow Rate (gpm):	750/830	
		Total Flow Rate (gpm)	1580	

Notes:

Location Map

Boundary Conditions

Tank Levels: #1	24.5
#2	24.8
#3	
#4	27
#5	
Booster Pumps:	off
Turnouts: Edna	1028
Brisco	500
Wells (#1 - #8):	off
#9	on
#10	on

City of Arroyo Grande
Hydrant Testing - 2011 Master Plan Update

Zone:	Rancho Grande
Location:	Equestrian Way
Date:	12/13/2011
Time:	
Tester:	Paul M
Fire Hydrant ID:	
Fire Hydrant Model:	
Water Main Size (in):	
Test Hydrant Static Reading (psi):	102
Residual Hydrant Static Reading (psi):	90
Test Hydrant Residual Reading (psi):	
Residual Hydrant Residual Reading (psi):	68
Pitot Gauge Reading (psi):	45/53 (Record pitot tube size and/or coefficent if necessary)
Fire Hydrant Flow Rate (gpm):	1026/1100
Total Flow Rate (gpm)	2126

Notes:

Location Map

Boundary Conditions

Tank Levels: #1	
#2	
#3	
#4	
#5	26.8
Booster Pumps:	off
Turnouts: Edna	n/a
Brisco	n/a
Wells (#1 - #8):	n/a
#9	n/a
#10	n/a

City of Arroyo Grande
Hydrant Testing - 2011 Master Plan Update

Zone:	Rancho Grande			
Location:	Los Ciervos			
Date:	11/16/2011	Test Hydrant Static Reading (psi):	95	
Time:	11:30	Residual Hydrant Static Reading (psi):	91	
Tester:	Paul M	Test Hydrant Residual Reading (psi):		
Fire Hydrant ID:		Residual Hydrant Residual Reading (psi):	66	
Fire Hydrant Model:		Pitot Gauge Reading (psi):	40/35	(Record pitot tube size and/or coefficent if necessary)
Water Main Size (in):		Fire Hydrant Flow Rate (gpm):	974/914	
		Total Flow Rate (gpm)	1888	

Notes:

Location Map

Boundary Conditions

Tank Levels: #1	
#2	
#3	
#4	
#5	27.6
Booster Pumps:	Reservoir 5 Fire Pumps On
Turnouts: Edna	n/a
Brisco	n/a
Wells (#1 - #8):	n/a
#9	n/a
#10	n/a

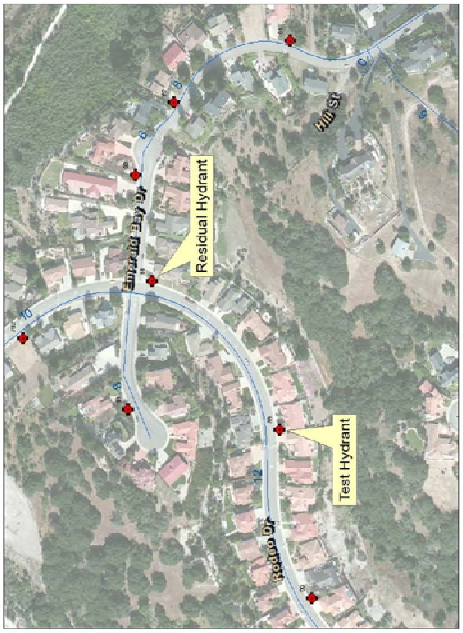
City of Arroyo Grande
Hydrant Testing - 2011 Master Plan Update

Zone:	Rancho Grande
Location:	Rodeo Drive
Date:	12/13/2011
Time:	
Tester:	Paul M.
Fire Hydrant ID:	
Fire Hydrant Model:	
Water Main Size (in):	
Notes:	

Test Hydrant Static Reading (psi):	69
Residual Hydrant Static Reading (psi):	70
Test Hydrant Residual Reading (psi):	
Residual Hydrant Residual Reading (psi):	53
Pitot Gauge Reading (psi):	26/20
Fire Hydrant Flow Rate (gpm):	840/698
Total Flow Rate (gpm)	1538

(Record pitot tube size and/or coefficent if necessary)

Location Map



Boundary Conditions

Tank Levels: #1	
#2	
#3	
#4	
#5	27.3
Booster Pumps:	off
Turnouts: Edna	n/a
Brisco	n/a
Wells (#1 - #8):	n/a
#9	n/a
#10	n/a

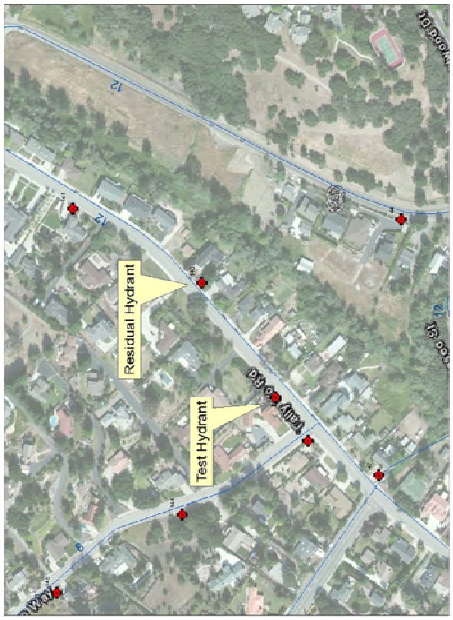
City of Arroyo Grande
Hydrant Testing - 2011 Master Plan Update

Zone:	Main City
Location:	Tally Ho
Date:	11/16/2011
Time:	11:00
Tester:	Paul M.
Fire Hydrant ID:	
Fire Hydrant Model:	
Water Main Size (in):	
Test Hydrant Static Reading (psi):	66
Residual Hydrant Static Reading (psi):	68
Test Hydrant Residual Reading (psi):	
Residual Hydrant Residual Reading (psi):	49
Pitot Gauge Reading (psi):	27/27
Fire Hydrant Flow Rate (gpm):	814/814
Total Flow Rate (gpm)	1628

(Record pitot tube size and/or coefficent if necessary)

Notes:

Location Map



Boundary Conditions

Tank Levels: #1	24.5
#2	24.8
#3	
#4	27.1
#5	
Booster Pumps:	off
Turnouts: Edna	1032
Brisco	498
Wells (#1 - #8):	off
#9	on
#10	on

City of Arroyo Grande
Hydrant Testing - 2011 Master Plan Update

Zone:	Rancho Grande			
Location:	Montego Street			
Date:	11/16/2011	Test Hydrant Static Reading (psi):	84	
Time:	13:50	Residual Hydrant Static Reading (psi):	90	
Tester:	Paul M	Test Hydrant Residual Reading (psi):	55	
Fire Hydrant ID:		Residual Hydrant Residual Reading (psi):	83	
Fire Hydrant Model:		Pitot Gauge Reading (psi):	50	(Record pitot tube size and/or coefficent if necessary)
Water Main Size (in):		Fire Hydrant Flow Rate (gpm):	1077	
		Total Flow Rate (gpm)	1077	

Notes:

Location Map

Boundary Conditions

Tank Levels: #1	
#2	
#3	
#4	
#5	26.2
Booster Pumps:	off
Turnouts: Edna	n/a
Brisco	n/a
Wells (#1 - #8):	n/a
#9	n/a
#10	n/a

City of Arroyo Grande
Hydrant Testing - 2011 Master Plan Update

Zone:	Main City			
Location:	Halcyon			
Date:	11/16/2011	Test Hydrant Static Reading (psi):	75	
Time:	14:10	Residual Hydrant Static Reading (psi):	80	
Tester:	Paul M	Test Hydrant Residual Reading (psi):		
Fire Hydrant ID:		Residual Hydrant Residual Reading (psi):	67	
Fire Hydrant Model:		Pitot Gauge Reading (psi):	33/30	(Record pitot tube size and/or coefficent if necessary)
Water Main Size (in):		Fire Hydrant Flow Rate (gpm):	870/852	
		Total Flow Rate (gpm)	1722	

Notes:

Location Map

Boundary Conditions	
Tank Levels: #1	24.9
#2	25.1
#3	
#4	28.3
#5	
Booster Pumps:	off
Turnouts: Edna	1042
Brisco	468
Wells (#1 - #8):	off
#9	60
#10	60

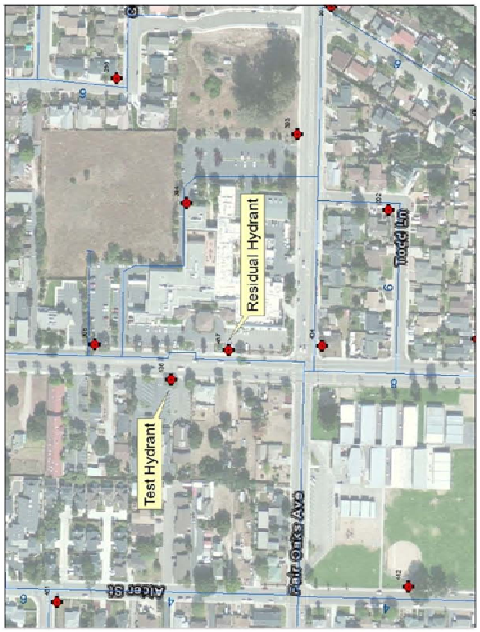
City of Arroyo Grande
Hydrant Testing - 2011 Master Plan Update

Zone: Main City
Location: Halcyon
Date: 11/16/2011
Time: 14:10
Tester: Paul M
Fire Hydrant ID:
Fire Hydrant Model:
Water Main Size (in):

Test Hydrant Static Reading (psi): 75
Residual Hydrant Static Reading (psi): 80
Test Hydrant Residual Reading (psi):
Residual Hydrant Residual Reading (psi): 67
Pitot Gauge Reading (psi): 33/30 (Record pitot tube size and/or coefficent if necessary)
Fire Hydrant Flow Rate (gpm): 870/852
Total Flow Rate (gpm) 1722

Notes:

Location Map



Boundary Conditions

Tank Levels: #1 24.9
#2 25.1
#3
#4 28.3
#5
Booster Pumps: off
Turnouts: Edna 1042
Brisco 468
Wells (#1 - #8): off
#9 60
#10 60

City of Arroyo Grande
Hydrant Testing - 2011 Master Plan Update

Zone:	Main City	Test Hydrant Static Reading (psi):	81
Location:	Faroll Ave	Residual Hydrant Static Reading (psi):	85
Date:	11/16/2011	Test Hydrant Residual Reading (psi):	
Time:	14:15	Residual Hydrant Residual Reading (psi):	74
Tester:	Paul M	Pitot Gauge Reading (psi):	40/40 (Record pitot tube size and/or coefficent if necessary)
Fire Hydrant ID:		Fire Hydrant Flow Rate (gpm):	974/974
Fire Hydrant Model:		Total Flow Rate (gpm)	1948
Water Main Size (in):			
Notes:			

Location Map

Boundary Conditions

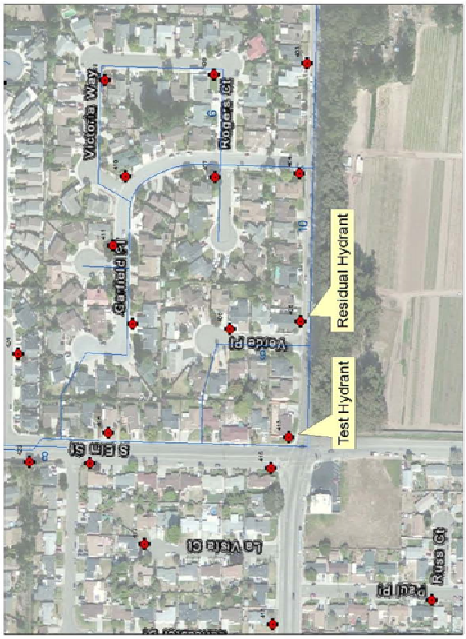
Tank Levels: #1	24.9
#2	25.1
#3	
#4	28.3
#5	
Booster Pumps:	off
Turnouts: Edna	1042
Brisco	468
Wells (#1 - #8):	off
#9	60
#10	60

City of Arroyo Grande
Hydrant Testing - 2011 Master Plan Update

Zone:	Main City
Location:	South Elm
Date:	11/16/2011
Time:	14:20
Tester:	Paul M
Fire Hydrant ID:	
Fire Hydrant Model:	
Water Main Size (in):	
Notes:	

Test Hydrant Static Reading (psi):	89
Residual Hydrant Static Reading (psi):	93
Test Hydrant Residual Reading (psi):	
Residual Hydrant Residual Reading (psi):	82
Pitot Gauge Reading (psi):	32/35 (Record pitot tube size and/or coefficent if necessary)
Fire Hydrant Flow Rate (gpm):	865/914
Total Flow Rate (gpm)	1779

Location Map



Boundary Conditions

Tank Levels: #1	24.9
#2	25.1
#3	
#4	28.3
#5	
Booster Pumps:	off
Turnouts: Edna	1042
Brisco	468
Wells (#1 - #8):	off
#9	60
#10	60

City of Arroyo Grande
Hydrant Testing - 2011 Master Plan Update

Zone:	Main City			
Location:	Bakeman Lane			
Date:	11/16/2011	Test Hydrant Static Reading (psi):	86	
Time:	14:55	Residual Hydrant Static Reading (psi):	96	
Tester:	Paul M	Test Hydrant Residual Reading (psi):		
Fire Hydrant ID:		Residual Hydrant Residual Reading (psi):	75	
Fire Hydrant Model:		Pitot Gauge Reading (psi):	27/30	(Record pitot tube size and/or coefficent if necessary)
Water Main Size (in):		Fire Hydrant Flow Rate (gpm):	805/852	
		Total Flow Rate (gpm)	1657	

Notes:

Location Map

Boundary Conditions

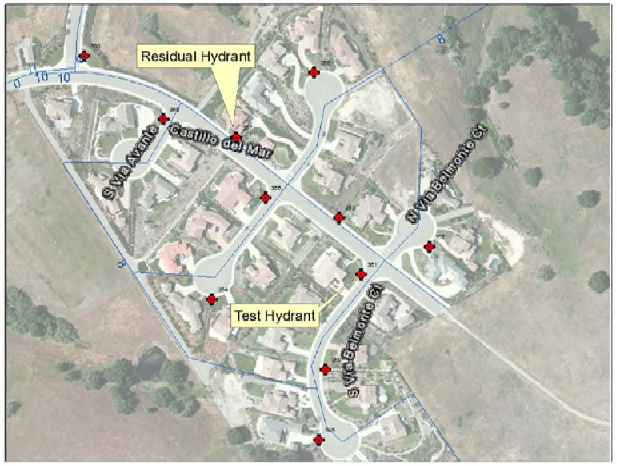
Tank Levels: #1	25
#2	25.2
#3	
#4	28.4
#5	
Booster Pumps:	off
Turnouts: Edna	1032
Brisco	503
Wells (#1 - #8):	off
#9	60
#10	60

City of Arroyo Grande
Hydrant Testing - 2011 Master Plan Update

Zone:	Vista Del Mar			
Location:	Castillo Del Mar			
Date:	11/16/2011	Test Hydrant Static Reading (psi):	50	
Time:	15:25	Residual Hydrant Static Reading (psi):	65	
Tester:	Paul M	Test Hydrant Residual Reading (psi):		
Fire Hydrant ID:		Residual Hydrant Residual Reading (psi):	47	
Fire Hydrant Model:		Pitot Gauge Reading (psi):	18/16	(Record pitot tube size and/or coefficent if necessary)
Water Main Size (in):		Fire Hydrant Flow Rate (gpm):	680/620	
		Total Flow Rate (gpm)	1300	

Notes:

Location Map



Boundary Conditions

Tank Levels: #1	
#2	
#3	
#4	
#5	
Booster Pumps:	VDM Fire Pumps on
Turnouts: Edna	n/a
Brisco	n/a
Wells (#1 - #8):	n/a
#9	n/a
#10	n/a

WSC
Water Systems Consulting, Inc.

Model Calibration Summary Table

Hydrant Testing Location	Zone	Test Hydrant Static Pressure (psi)	Residual Hydrant Static Pressure (psi)	Residual Hydrant Residual Pressure (psi)	Test Hydrant Flow Rate (gpm)	Model Test Hydrant Static Pressure (psi)	Model Residual Hydrant Static Pressure (psi)	Model Residual Hydrant Residual Pressure (psi)	Flowed Hydrant Static Pressure Delta (psi)	Residual Hydrant Static Pressure Delta (psi)	Residual Hydrant Residual Pressure Delta (psi)	Pressure Drop Delta (psi)
Oro Drive	Main City	52	55	31	790	49.2	55.3	45.8	2.8	-0.3	-14.8	14.5
Platino Drive	Oro	95	99	53	914	92.9	97.9	57.6	2.1	1.1	-4.6	5.7
Greenwood Drive	Main City	50	50	30	640	48.1	51.8	38	1.9	-1.8	-8	6.2
East Cherry	Main City	65	66	64	1722	66.7	66.8	64.2	-1.7	-0.8	-0.2	-0.6
Whiteley Street-A	Main City	71	72	67	1580	80.5	75.8	70.7	-9.5	-3.8	-3.7	-0.1
Tally Ho	Main City	66	68	49	1628	65.8	65.2	62	0.2	2.8	-13	15.8
Rodeo Drive	Rancho Grande	69	70	53	1538	72.6	69.3	54.7	-3.6	0.7	-1.7	2.4
Los Ciervos	Rancho Grande	95	91	66	1888	104.5	94.4	72.7	-9.5	-3.4	-6.7	3.3
Equestrian Way	Rancho Grande	102	90	68	2126	103	86.6	69.9	-1	3.4	-1.9	5.3
Via Vaquero	Rancho Grande	63	60	53	1026	65.6	56.8	50.8	-2.6	3.2	2.2	1
Montego Street	Rancho Grande	84	90	83	1077	84.4	86.4	75.3	-0.4	3.6	7.7	-4.1
Halcyon	Main City	75	80	67	1722	76.7	77.4	69	-1.7	2.6	-2	4.6
Faroll Ave	Main City	81	85	74	1948	82.5	82.5	72.2	-1.5	2.5	1.8	0.7
South Elm	Main City	89	93	82	1779	89.2	89.2	78.7	-0.2	3.8	3.3	0.5
Bakeman Lane	Main City	86	96	75	1657	88	91.4	74.8	-2	4.6	0.2	4.4
Castillo Del Mar	Vista Del Mar	50	65	47	1300	60.8	76.6	54.8	-10.8	-11.6	-7.8	-3.8

Technical Memorandum

APPENDIX F – Well Condition Based Assessment

Date: 4/24/2012

To: Mr. Mike Linn, P.E.
City of Arroyo Grande
208 E. Branch Street
Arroyo Grande, CA 93421

Phone: (805) 473-5444

CC: Shane Taylor; Michael Linn, P.E.; Teresa McClish

Prepared by: Joshua Reynolds, P.E.; Lianne Williams, P.E.

Reviewed by: Jeffery Szytel, P.E.

Project: City of Arroyo Grande Water and Sewer Master Plan Updates

SUBJECT: **WELL CONDITION BASED ASSESSMENT**

The purpose of this assessment was to estimate the condition of the City's groundwater production wells and associated mechanical equipment in order to identify wells requiring immediate maintenance and to prioritize well rehabilitation and equipment replacement to support the development of the Water System Master Plan Update. This technical memorandum (TM) is organized into the following seven (7) sections:

Executive Summary
Energy Usage
Specific Capacity
Remaining Useful Life
Production Capacity
Special Considerations
Results

Executive Summary

The assessment was based on data provided by the City of Arroyo Grande and Pacific Gas and Electric Company (PG&E), as well as field inspections conducted by Water Systems Consulting, Inc. (WSC). To

provide a relative measure of priority for upgrade or replacement of each well, WSC assigned each well a rank for the following five categories: (1) Energy Usage, (2) Specific Capacity, (3) Remaining Useful Life (RUL), and (4) Production Capacity. The five ranks were weighted to give an overall rank for each well. In addition, WSC asked City staff to provide insight into the current well condition, water quality, and recurrent or known problems with the well appurtenances. The City staff input, combined with field observations, is summarized under Special Considerations (Section 6).

The analysis yielded a prioritized list of wells for improvement or additional study. An overview of the results, in the order of well priority, is shown in Table F.1. Based on the results of this analysis, WSC recommends conducting video inspections of all wells, in the order of priority shown in Table F.1, before improvements are carried out.

Table F.1. Well Priority and Summary of Results

Facility	Energy Ranking	Specific Capacity Ranking	RUL Ranking	Production Ranking	Weighted Overall Ranking	Recommended Improvement
Well 1	2	2	1	2	1.6	Major Rehab
Well 3	1	3	1	2	1.7	Replacement
Well 7	1	1	3	1	1.8	Frequent Inspection
Well 4	1	3	2	2	2.1	Minor Rehab
Well 8	3	2	2	2	2.2	Maintenance
Well 5	3	3	2	1	2.4	Maintenance
Well 9	Inconclusive	Inconclusive	3	3	3.0[1]	Maintenance
Well 10	Inconclusive	Inconclusive	3	3	3.0[1]	Maintenance

[1] The overall ranks for Well 9 and 10 were calculated based on the ranking categories containing data only.

Recommended Improvements

The Condition-Based Assessment makes general recommendations for capital improvement projects based on the ranking and condition of each well. The recommendations from the Condition-Based Assessment fall into five categories: (1) Replacement; (2) Major Rehabilitation; (3) Minor Rehabilitation; (4) Maintenance; and (5) Frequent Inspection. The items of work for each category are described in detail in the Results Section.

Energy Usage

Energy usage of the wells is assessed using overall pumping efficiency (OPE) as measured during pump testing, 2008 – 2010 electricity billing information, and average annual well production records. The energy usage assessment consists of: (1) an evaluation of OPE; and (2) an analysis of energy consumption over the years 2008-2010.

Overall Pumping Efficiency (OPE)

The OPE is calculated by dividing the water power (HP) by the measured power input to the motor (HP). The water power is calculated using the measured pumping water level, discharge pressure and flow. Note that the OPE is an instantaneous measurement and reflects the measured flow and pressure conditions during the test.

This analysis incorporates data from both the 2007 and 2011 pump efficiency tests, which were performed through PG&E's Advanced Pumping Efficiency Program (APEP). The 2011 pump tests were performed in December 2011, and the results represent the most current OPE data available. The calculated OPEs for each well based on the 2007 pump tests and 2011 pump tests are shown in Table F.3. The OPEs are also shown graphically in Figure F-1 where they are overlaid on average annual production.

The average OPE of the City's wells based on the 2007 pump tests is 58%. The average OPE based on the 2011 pump tests is 60%. The average OPE does not include Well 9 and 10, which are not eligible for testing through APEP due to their small size (well pumps powered by motors less than 25 HP are not eligible). Acceptable ranges for OPE typically vary with motor size, as larger motors and pumps are generally able to achieve higher efficiencies. This is evident in the OPE classifications shown in Figure F-1, which were taken from past PG&E literature for APEP (1). Based on the calculated OPE for each well, the classification system in Table F.2 was used to classify the well as having a poor, fair, good or excellent OPE. The motor size, OPE, and classification are shown in Table F.3.

Table F.2. Typical OPE Classifications (1)

Motor HP	Poor	Fair	Good	Excellent
3-7.5	<44.0	44-49.9	50-54.9	>54.9
10	<46.0	46-52.9	53-57.9	>57.9
15	<47.1	48-53.9	54-59.9	>59.9
20-25	<48.0	50-56.9	57-60.9	>60.9
30-50	<52.1	52.1-58.9	59-61.9	>61.9
60-75	<56.0	56-60.9	61-65.9	>65.9
100	<57.3	57.3-62.9	63-66.9	>66.9
150	<58.1	58.1-63.4	63.5-68.9	>68.9
200	<59.1	59.1-63.8	63.9-69.4	>69.4
250	<59.1	59.1-63.8	63.9-69.4	>69.4
300	<60.0	60-64.0	64.1-69.9	>69.9

Table F.3. Overall Pumping Efficiency for Wells based on 2007 and 2011 Pump Efficiency Tests

Facility	Motor HP	OPE, 2007 Pump Test	OPE Classification, 2007 Pump Test	OPE, 2011 Pump Test	OPE Classification, 2011 Pump Test	OPE Change from 2007 to 2011
Well 1	40 HP	53%	Fair	57%	Fair	Increase
Well 3	50 HP	61%	Good	55%	Fair	Decrease
Well 4	60 HP	58%	Fair	58%	Fair	Constant
Well 5	100 HP	70%	Excellent	65%	Good	Decrease
Well 7	150 HP	54%	Poor	62%	Fair	Increase
Well 8	75 HP	53%	Poor	63%	Good	Increase
Well 9	15 HP	n/a	n/a	n/a	n/a	n/a
Well 10	10 HP	n/a	n/a	n/a	n/a	n/a
Average	-	58%	-	60%	-	Increase

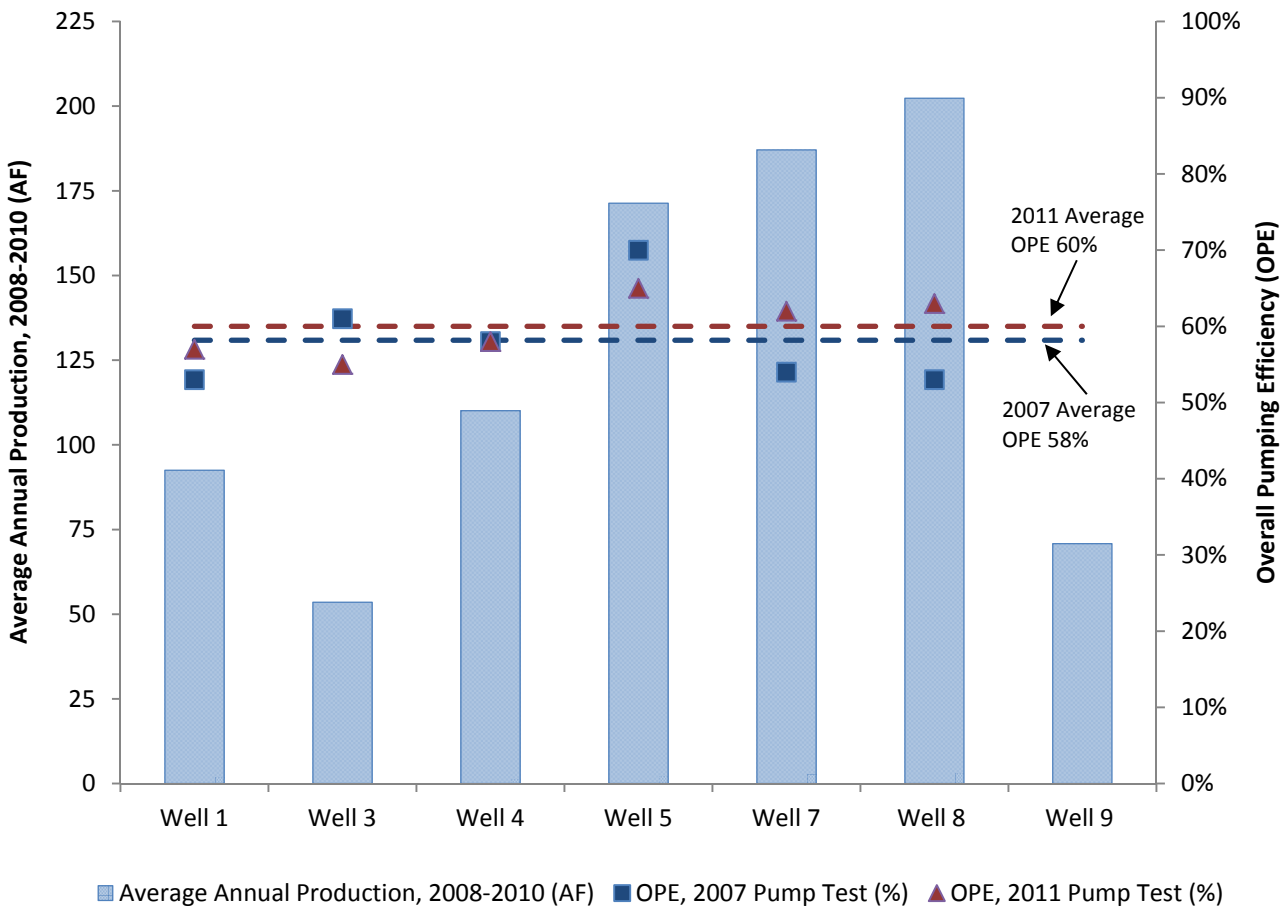


Figure F-1. OPE and Well Production[10]

Energy Consumption

Calculated OPE from pump efficiency tests give an instantaneous measure of energy consumption for the test conditions. Analyzing energy usage over several years can provide additional information about the well's operating efficiency and help to quantify the potential for energy savings.

Using 2008-2010 production records and electricity billing data, WSC calculated the average energy consumption per volume of water produced (kWh/AF) for each well. The calculated energy intensity (kWh/AF) for each well is shown in Table F.4. This data is also shown graphically in Figure F-2 where it is overlaid on average annual production. Note that Well 1 and 4 share the same electricity meter and Well 7 and 8 share the same electricity meter. To estimate the individual energy usage for Well 1 and 4, the total electricity usage was split between the wells based on the comparison of well capacity,

[10] OPE data not available for Well 9 and 10. Production data not available for Well 10.

horsepower, and 2011 OPE and then multiplying the total production from these wells by that ratio to obtain an estimate of kWh/AF. The same method was used for Well 7 and 8.

The average annual production across all wells was calculated to be 127 AF/year. The average energy intensity across all wells, excluding Well 9 and 10, was calculated to be 615 kWh/AF. Well 9 and 10 were excluded from this analysis due to limited data[11].

Wells with high energy intensity (high kWh/AF) and high annual production (AF) generally use the most energy and should therefore be prioritized for efficiency improvement. Wells with a high energy intensity but low production or those with low energy intensity but high production should be the next priority; wells with low energy intensity and high production are considered second priority because making small efficiency improvements on high producing wells can yield significant energy savings. Wells with low energy intensity and low production are assumed to have the lowest priority for maintenance.

However, only evaluating energy intensity and annual production does not account for potential improvements to the efficiency of the well pump and motor. Table F.4 shows the energy available to the City if the well efficiency is improved to a ranking of "good" for each well. The target OPE was chosen as the midpoint OPE of the "good" range for the respective motor size for each well from Table F.2 above. The OPE measured during the 2011 pump tests was used as the baseline OPE for each well. The average energy intensity and target energy intensity are shown graphically in Figure F-2.

[11] Pump efficiency tests have not been performed on Well 9 and 10, and energy usage data was not available for Well 10 since it did not begin production until 2011. Note that Well 9 and 10 have wellhead treatment, which requires additional energy (the other wells do not have wellhead treatment).

Table F.4. Well Energy Intensity and Ranking

Facility	Average Energy Intensity, 2008-2010 (kWh/AF)	OPE, 2011 Pump Test (%)	Target OPE (%)	Target Energy Intensity (kWh/AF)	Potential Energy Savings (kWh/AF)	Energy Ranking
Well 1	561	57%	61%	538	22	2
Well 3	585	55%	61%	549	35	1
Well 4	581	58%	64%	546	35	1
Well 5	489	65%	65%	489	0	3
Well 7	778	62%	66%	747	31	1
Well 8	623	63%	64%	617	6	3
Well 9	n/a	n/a	n/a	n/a	n/a	Inconclusive
Well 10	n/a	n/a	n/a	n/a	n/a	Inconclusive
Average	615	60%	-	-	-	-

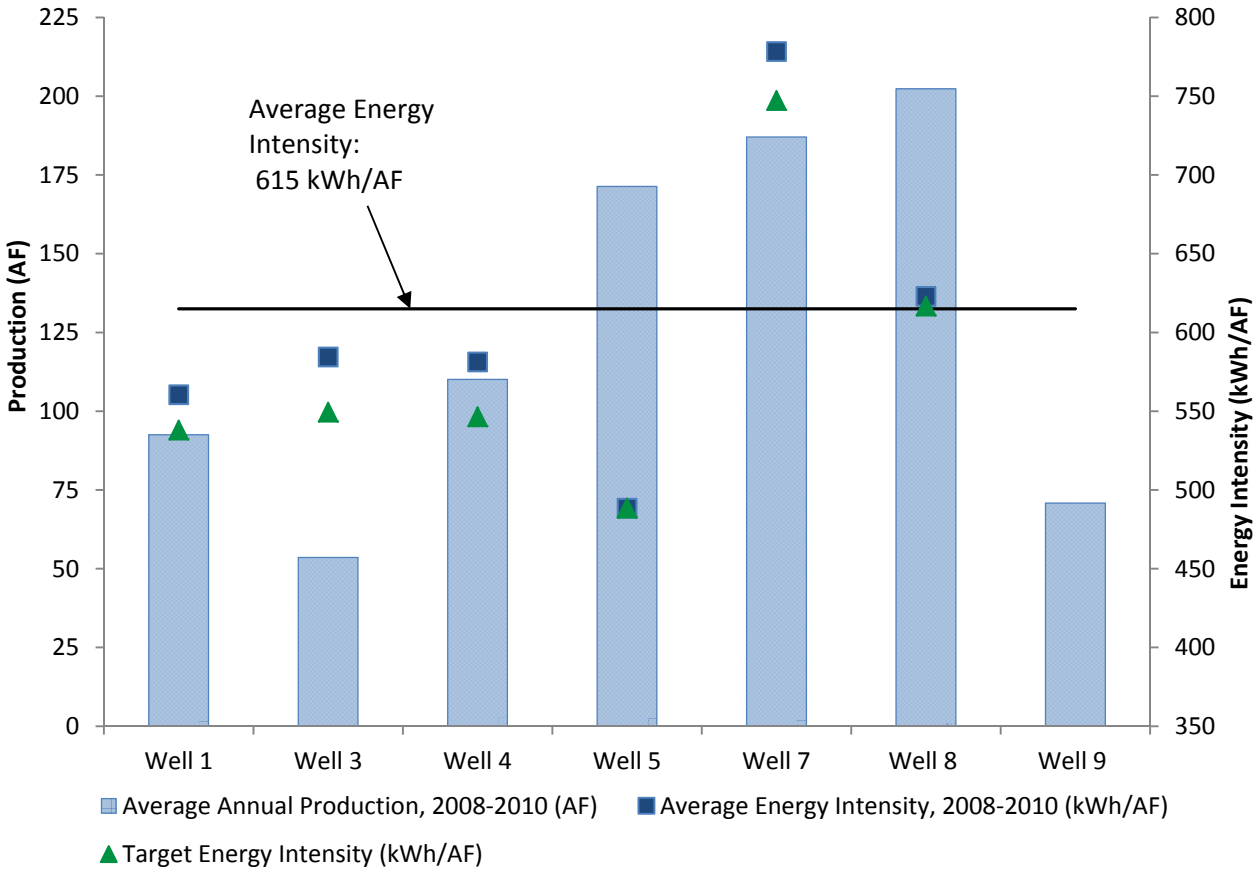


Figure F-2. Energy Intensity and Well Production[12]

Using the potential energy savings (column 6 of Table F.4), an energy usage ranking was assigned as follows:

Rank of 1: Potential energy savings greater than 30 kWh/AF. Well 3, 4, and 7 were given a ranking of 1 because:

- Well 3: Potential energy savings of 35 kWh/AF are available with an improvement in OPE from 55% to 61%.
- Well 4: Potential energy savings of 35 kWh/AF are available with an improvement in OPE from 58% to 64%.
- Well 7: Potential energy savings of 31 kWh/AF are available with an improvement in OPE from 62% to 66%.

[12] Energy data not available for Well 9 and 10. Production data not available for Well 10.

Although Well 7 has a sand/sediment trap, this analysis includes the head losses through the sediment trap (via measured OPE).

Rank of 2: Potential energy savings greater than 10 kWh/AF but less than 30 kWh/AF. Well 1 was given a ranking of 2 because:

- Well 1: Potential energy savings of 22 kWh/AF are available with an improvement in OPE from 57% to 61%.

Rank of 3: Potential energy savings of less than 10 kWh/AF. Well 5 and 8 were given a ranking of 3 because:

- Well 5: OPE meets good ranking criteria
- Well 8: OPE meets good ranking criteria.

Although Well 8 has a sand/sediment trap, this analysis includes the head losses through the sediment trap (via measured OPE).

Inconclusive: Measured OPE was not available for Well 9 and 10. Energy and production data for Well 10 is not available because the City did not begin producing water from Well 10 until 2011. Well 9 and 10 should be included in future analyses.

Specific Capacity

Besides energy consumption and OPE, static and pumping water level and flow rate characteristics can yield additional detail on the performance and condition of the well. This data is measured during pump tests and is most useful when tracked over time. Pump tests were performed on most of the City's wells in 1986, 2007, and 2011, through PG&E's APEP. Well 4 and 8 were not tested in 1986. Additionally, pump test data is not available for Well 9 and 10 because they are not eligible for testing through APEP due to their small size (well pumps powered by motors less than 25 HP are not eligible). The important production parameters from available pump test results are summarized in Table F.5. From this data, a specific capacity rank was assigned as shown in Table F.5 and described below.

Table F.5. Production Characteristics from Pump Tests and Associated Ranking

Facility	Pump Test Date	Pumping Water Level (ft)	Static Water Level (ft)	Drawdown (ft)	Flow Rate (GPM)	Specific Capacity (GPM/ ft drawdown)	Specific Capacity Ranking
Well 1	7/2/1984	74	71	3	293	89	2
	5/1/2007	79	72	7	283	40	
	12/9/2011	72	68	4	330	83	
Well 3	7/2/1984	93	76	17	381	22	3
	5/1/2007	92	79	13	412	32	
	12/9/2011	83	74	9	432	48	
Well 4	5/1/2007	85	75	10	442	44	3
	12/9/2011	75	71	4	455	114	
Well 5	7/2/1984	70	62	9	921	106	3
	5/1/2007	73	65	8	985	123	
	12/9/2011	65	60	5	992	198	
Well 7	9/3/1986	204	90	114	1112	10	1
	5/1/2007	126	81	45	987	22	
	12/9/2011	200	75	125	940	8	
Well 8	5/1/2007	122	75	47	417	9	2
	12/9/2011	122	74	48	500	10	
Well 9	See note[1]	137	67	70	65	0.9	Inconclusive
Well 10	See note[1]	274	17	257	65	0.3	Inconclusive

[1] Pump efficiency tests have not been performed on Well 9 and 10. Data shown here is taken from the 2010 CDPH report and represents measurements taken at various times, where the water level and flow rate measurements were not taken at the same time.

From the production characteristic data, a specific capacity ranking was assigned as follows:

Rank of 1: Well rehabilitation may be necessary; video inspection of wells should be prioritized. Well 7 was given a ranking of 1 because:

- Well 7: There is large difference in pumping water level measurements among pump test reports, which results in significant differences in specific capacity. The 2011 pump test showed a decrease in specific capacity of more than 50% compared to the 2007 pump test. The City believes there were pumping water level measurement errors in the 2007 pump test for Well 7, due to the very large distance below ground to the pumping water level. The City's 2008 CDPH report lists the pumping water level at 210 feet, but does not provide a date of measurement. A pumping water level of 210 feet is consistent with the 1986 and 2011 pump tests and would result in a similar specific capacity. The discrepancies in reported measurements warrant investigation. In addition, the flow rate has decreased over time.

Rank of 2: Well rehabilitation does not appear to be necessary at this time; specific capacity should be monitored over time. Well 1 and 8 were given a ranking of 2 because:

- Well 1: Specific capacity decreased by more than 50% between the 1986 pump test and the 2007 pump test. The 2011 pump test showed an increase in specific capacity from the 2007 pump test, returning almost to that reported in the 1986 pump test. The low specific capacity in 2007 may indicate that the well was plugged. However, the well casing has not been cleaned since 1988; thus, the cause of the increased capacity from 2007 to 2011 is not obvious. Specific capacity and operational changes should continue to be monitored over time.
- Well 8: Measured draw down is high and specific capacity is relatively low. Pumping water level and static water level were very similar in 2007 and 2011; thus the calculated draw down in both years was also about the same. The flow rate, however, increased by about 20% from 2007 to 2011, which led to a 10% increase in specific capacity. The small increase in specific capacity indicates an improvement in well performance. However, specific capacity should continue to be monitored over time due to the high draw down.

Rank of 3: Well appears to be performing well; rehabilitation is not a high priority. Well 3, 4, and 5 were given a ranking of 3 for the following reasons:

- Well 3: No apparent issues. Specific capacity has improved in each subsequent pump test. The 2011 pump test showed an increase in specific capacity of 50% compared to the 2007 pump test.
- Well 4: No apparent issues. Specific capacity has improved in each subsequent pump test. The 2011 pump test showed an increase in specific capacity of more than 100% compared to the 2007 pump test.
- Well 5: No apparent issues. Specific capacity has improved in each subsequent pump test. The 2011 pump test showed an increase in specific capacity of more than 50% compared to the 2007 pump test.

Inconclusive: Pump test reports for Well 9 and 10 were not available. Although these wells are the newest wells, data compiled from well data sheets indicates that the specific capacities of these wells are poor. Pump tests are recommended to understand current operating characteristics.

Remaining Useful Life (RUL)

To evaluate the RUL of each well facility, the RUL of the casing, motor, pump, and electrical system were evaluated. While there are other components in the well system, including valves and piping, the age of the well casing, motor, pump, and electrical systems were assumed to be the most important for this assessment. A qualitative assessment of the condition of the valves and piping is included in Section 6. Treatment systems are not addressed because treatment systems are only installed at Well 9 and 10, which are the newest wells.

The installation dates of the existing casing, motor and pump were obtained from City records and/or directly from City staff. In addition, the date of the last well casing cleaning, which is also the date of the last video inspection, and the date of the last motor repair were obtained for applicable wells. Some of the pumps have been replaced since the wells were first brought into service; the installation date of the currently operating pump is shown. Since none of the pumps currently in use have had a major repair since their installation, pump repair date is omitted from the analysis. The electrical systems were assumed to be installed when the wells were constructed.

The well casing, motor, pump, and electrical systems were analyzed separately and a priority was assigned to each well for each of these components. An overall RUL ranking was calculated based on the prioritization assigned for the casing, motor, pump, and electrical system. The analysis of each component is described below.

Well Casing:

The expected useful life (EUL) of a well depends on many factors, including casing material, construction methodology, screening design, maintenance, groundwater quality, and pumping characteristics. EUL estimates given in literature range from 30 to 50 years (2). Some of the wells in the City have been operating for more than 50 years, with Well 1 being the oldest (over 70 years old). Based on historical performance, WSC selected a nominal EUL value of 50 years, which is at the upper limit of the EUL range, to use for prioritizing well improvements. Because the actual EUL depends on many factors, the assumed EUL is not used to predict when failure will occur, but only to help with prioritization.

Table F.6. Assumed EUL for Analysis - Well Casing

Well Component	Assumed EUL (years)
Well Casing	50

The RUL was calculated based on the casing installation date and the EUL of 50 years, according to the following equation:

RUL = (Installation Date + EUL) – Current Date, which translates to
RUL = (Installation Date + 50 years) – Current Date

The estimated RULs are shown in Table F.11. These RULs are not intended to predict when the casing will fail, but are for making relative comparisons and prioritizing improvements. Note that wells with negative RULs are still operating; a negative RUL, however, deserves attention and may signify extensive rehabilitation or well replacement is necessary to avoid failure. Video inspections must be conducted to determine actual RUL. The date of the last video inspections, which coincides with the date of the last well cleaning, is shown in Table F.11 for reference.

Motor:

The EUL of a motor depends on many factors, including motor type, brand and build quality, loading conditions, and operating environment. For this analysis, WSC assumed a nominal EUL value of 20 years to use for prioritizing motor improvements, as shown in Table F.7. Repairing a motor by rewinding it yields additional life and needs to be accounted for when estimating RUL. Rewinding was assumed to add an additional 10 years to the life of the motor from the date of repair. As explained earlier, the actual EUL will vary; these assumed values are for the purposes of prioritization only.

Table F.7. Assumed EUL for Analysis - Motor

Well Component	Assumed EUL (years)	Additional Life due to Repair (years)
Motor	20	10

For each well, Table F.11 shows the date of installation of the motor and the date of the most recent rewind, as applicable. Note that some of the motors have been rewound many times, but only the most recent date is shown.

For motors that have been rewound, the RUL was calculated according to the following equation:

RUL = (Repair Date + Additional Life due to Repair) – Current Date, which translates to
RUL = (Repair Date + 10 years) – Current Date

For motors that have not been rewound, the RUL was calculated according to the following equation:

RUL = (Installation Date + EUL) – Current Date, which translates to
RUL = (Installation Date + 20 years) – Current Date

For each well, the estimated RUL for the motor is shown in Table F.11. As noted before, the estimated RULs are not intended to predict when the motor will fail, but are for making relative comparisons and prioritizing improvements. Note that motors with negative RULs are still operating; a negative RUL, however, deserves attention and may signify that a motor is due for repair or replacement. When choosing replacement versus repair, the life cycle costs should be a driving factor.

Pump:

The EUL of a pump depends on many factors, including pump design (manufacturer, materials, type, installation), water quality, operating frequency and characteristics, and maintenance. For this analysis, WSC assumed a nominal EUL value of 20 years to use for prioritizing pump improvements, as shown in Table F.8. According to City staff, the pumps have not had a major repair since their installation. Because the actual EUL will vary, this assumed EUL value is for prioritization purposes only.

Table F.8. Assumed EUL for Analysis - Pump

Well Component	Assumed EUL (years)
Pump	20

For each well, the RUL of the pump was calculated according to the following equation:

RUL = (Installation Date + EUL) – Current Date, which translates to
RUL = (Installation Date + 20 years) – Current Date

For each well, the estimated RUL for the pump is shown in Table F.11. As noted before, the estimated RULs are not intended to predict when the pump will fail, but are for making relative comparisons and prioritizing improvements. Note that pumps with negative RULs are still operating; a negative RUL, however, deserves attention and may signify replacement is necessary to avoid failure.

Electrical Systems:

The EUL of the electrical system depends on several factors, including design, manufacturer, loading and use, and operating environment. For this analysis, WSC assumed a nominal EUL value of 30 years to use for prioritizing electrical system improvements, as shown in Table F.9. This assumed EUL is to help with prioritization, not to predict failure.

Table F.9. Assumed EUL for Analysis- Electrical System

Well Component	Assumed EUL (years)
Electrical System	30

For each well, the RUL of the electrical system was calculated according to the following equation:

RUL = (Installation Date + EUL) – Current Date, which translates to
RUL = (Installation Date + 30 years) – Current Date

As noted earlier, WSC assumed the original electrical systems installed when the wells were constructed are still in use. Therefore, the electrical system installation date is the same as the well casing. For each well, the estimated RUL for the electrical system is shown in Table F.11. As described earlier, the estimated RULs are not intended to predict when the electrical system will fail, but are for making relative comparisons and prioritizing improvements.

RUL Rank:

For each well, a priority of 1, 2, or 3 was assigned to each component (the well casing, motor, pump and electrical system), based on the following:

- Priority of 1: RUL ≤ 0
- Priority of 2: 0 < RUL ≤ 10
- Priority of 3: RUL > 10

The overall RUL rank was calculated by weighting the priorities assigned for the well casing, the motor, the pump, and the electrical system, using the weighting factors shown in Table F.10.

Table F.10. Weighting Factors Used to Determine RUL Rank

Well Component	Weight Given to RUL Rank	Reason
Well Casing	50%	The well casing is assumed to be the most difficult and costly to repair if failure were to occur. Failure could lead to significant structural damage to the well, including collapse. Failure would lead to the longest disruption in production.
Motor	5%	The motor is considered a consumable that will have to be repaired or replaced one or more times. It assumed to be the quickest and easiest to repair, leading to the shortest disruption in well production.
Pump	10%	The pump is also considered a consumable that will need to be replaced one or more times. Repairing the pump requires downhole work and typically results in more downtime than a motor repair.
Electrical System	35%	Repairing the electrical system is an engineered project, which requires design. The electrical system also has safety considerations, as its failure could lead to fire and/or other significant damage.

The RUL rank was calculated according the following equation:

RUL Rank = ((Well Casing Priority x 0.50) + (Motor Priority x 0.05) + (Pump Priority x 0.10) + (Electrical System Priority x 0.35)

The resulting value from this calculation was rounded to the nearest whole number, giving weighted RUL rankings from 1 to 3, where 1 is the highest priority. The RUL ranks are shown in Table F.11.

Table F.11. RUL of Well Casing, Motor, and Pump and Associated Ranking

Facility	Well Casing				Motor				Pump			Electrical System			RUL Ranking
	Install Date	RUL	Last Clean & Video Inspection	Priority	Install Date	Last Repair	RUL	Priority	Install Date	RUL	Priority	Install Date	RUL	Priority	
Well 1	1940	-21	1988	1	2007	n/a	16	3	1988	-3	1	1940	-41	1	1
Well 3	1954	-7	1992	1	1954	1992	-9	1	1992	1	2	1954	-27	1	1
Well 4	1964	3	1993	2	1964	1993	-8	1	1993	2	2	1964	-17	1	2
Well 5	1967	6	1990	2	1967	2010	9	2	1995	4	2	1967	-14	1	2
Well 7	1982	21	2009	3	1982	2009	8	2	2009	18	3	1982	1	2	3
Well 8	1990	29	n/a	3	2010	n/a	19	3	1991	0	1	1990	9	2	2
Well 9	1990	29	n/a	3	2008	n/a	17	3	2011	20	3	1990	9	2	3
Well 10	2006	45	2009	3	2010	n/a	19	3	2010	19	3	2006	25	3	3

Production Capacity

Well capacity is an important factor for the reliability of the City's water supply. Wells with a high capacity have a high consequence of failure, and should be prioritized when making well improvements. WSC assigned a rank for production capacity to each well based on the measured pump capacity from the pump test reports, or from CDPH data when pump tests are not available (Wells 9 and 10). The well capacity ranking is based on the measured capacity of the well during the 2011 pump tests, in gallons per minute (gpm). The well capacities are shown in the table below.

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Table F.12. Production Capacity

Facility	Pump Capacity (GPM)	Production Ranking
Well 1	330	2
Well 3	432	2
Well 4	455	2
Well 5	992	1
Well 7	940	1
Well 8	500	2
Well 9	65	3
Well 10	65	3
Average	472	-

From the pump capacity, a production ranking was assigned as follows:

Rank of 1: Pump capacity is greater than 130% of the average pump capacity across all wells, i.e. greater than 600-gpm. Well 5 and 7 were given a ranking of 1 because:

- Well 5: Pump capacity is 992-gpm.
- Well 7: Pump capacity is 940-gpm.

Rank of 2: Pump capacity is between 70% and 130% of the average production across all wells, i.e. between 320-gpm and 600-gpm. Well 1, 3, 4, and 8 were given a ranking of 2 because:

- Well 1: Pump capacity is 330-gpm.
- Well 3: Pump capacity is 432-gpm.
- Well 4: Pump capacity is 455-gpm.
- Well 8: Pump capacity is 500-gpm.

Rank of 3: Pump capacity is less than 70% of the average production across all wells, i.e. less than 320-gpm. Well 9 and 10 were given a ranking of 3 because:

- Well 9: Pump capacity is 65-gpm.
- Well 10: Pump capacity is 65-gpm

Special Considerations

To expand the analysis, City staff provided qualitative information on the current condition of the well, current condition of the valves and piping, recurrent or known problems, and water quality. In addition, WSC performed field visits of the well facilities. A summary of the information gathered from the City and the field visits is shown in Table F.13. These considerations are not used in the quantitative ranking but are summarized here to assist with capital improvement plan (CIP) development and prioritization and with determining whether deficient wells should be improved or replaced (discussed in Section 7).

Table F.13. Summary of Special Considerations

Facility	Current Condition of Well	Current Condition of Piping and Valves	Known or Recurrent Problems	Water Quality
Well 1	Fair	Poor	None	None
Well 3	Fair	Poor	None	Restrictions due to surface water influence[1]
Well 4	Fair	Poor	None	None
Well 5	Fair	Poor	None	High NO3 but less than MCL; Steadily declining
Well 7	Good	Good	None	Mn & Fe at MCL
Well 8	Fair	Good	Recurring problem with blown motors	None
Well 9	Fair	Fair	None	High H2S & Mn
Well 10	Good	Good	None	High H2S & Temperature

[1] Both the City and the Department of Public Health are aware of this issue. The City does not pump from this well when it is under surface water influence; thus wellhead treatment is not required.

In Table F.13 above, the measures of condition for the wells are defined as follows:

Good: Estimated that more than 70% of life is remaining; well does not need more than routine maintenance; video inspections show a screen without tuberculation or bio growth, and no physical damage.

Fair: Estimated that more than 30% of life is remaining; some aspects of the well require additional routine maintenance; video inspections show some tuberculation and/or bio growth; no physical damage to screen.

Poor: Estimated that less than 30% of life is remaining; several components of well require additional maintenance and some components may not function correctly; projects for repair/replacement are planned but have not been implemented; video inspection indicates well needs to be cleaned and screen may show signs of damage (but not imminent failure).

In Table F.13 above, the measures of condition for the piping are defined as follows:

Good: Estimated that more than 70% of life is remaining; coatings are in clean with no chipping or chalking; no visible leaks; bolts and nuts show no corrosion.

Fair: Estimated that more than 30% of life is remaining; some evidence of coating deterioration such as excessive chalking or minor shipping; no visible leaks; some corrosion in evidence at damaged coating locations; bolts and nuts may show minor corrosion.

Poor: Estimated that less than 30% of life is remaining; coatings are worn away at more than 10% of surface area; minor leaks may be present; evidence of rust at flanges, bolts and fittings; bolts and nuts may be seized; pipe supports may be damaged or missing; valves and taps are difficult to turn and may not shut leak tight.

Results

The rankings for the four categories were weighted and an overall rank was assigned. Table F.14 explains how the five ranking categories were weighted to achieve a single overall rank for each well. The rankings for each of the five categories are summarized in Table F.15.

Table F.14. Explanation of Weighting Used to Calculate Overall Rank

Ranking Categories	Weight Given to Overall Rank	Reason
Energy Usage	20%	Energy usage ranking is a measure of performance, specifically related to efficiency. While a low energy usage (high efficiency) is desirable, it is not critical to well production.
Specific Capacity Ranking	30%	Changes in specific capacity and other production characteristics may signal problems with the well and the need for rehabilitation. Decreasing specific capacity may affect production in the future.
RUL Ranking	40%	RUL ranking prioritizes wells based on how long the well is expected to last. RUL ranking is weighted the highest, as a failure due to the well reaching its end of life can be catastrophic and lead to significant disruption in production.
Production Ranking	10%	The highest producing wells are the most critical to the City's water supply. This factor does not assess condition but assists with prioritizing wells.

For each well, the overall rank was calculated according the following equation:

Overall Rank = (Energy Usage Rank x 0.20) + (Specific Capacity Rank x 0.30) + (RUL Rank x 0.40) + (Production Rank x 0.10)

The overall weighted ranks for each well, shown in order of priority, are shown in Table F.15. The wells were prioritized based on the overall weighted ranking. These ranks range from 1 to 3, where 1 is the highest priority. Two significant figures are shown to help with prioritization.

Table F.15. Overall Well Ranking Results (wells listed in order of priority)

Facility	Energy Ranking	Specific Capacity Ranking	RUL Ranking	Production Ranking	Weighted Overall Ranking	Recommended Improvement
Well 1	2	2	1	2	1.6	Major Rehab
Well 3	1	3	1	2	1.7	Replacement
Well 7	1	1	3	1	1.8	Frequent Inspection
Well 4	1	3	2	2	2.1	Minor Rehab
Well 8	3	2	2	2	2.2	Maintenance
Well 5	3	3	2	1	2.4	Maintenance
Well 9	Inconclusive	Inconclusive	3	3	3.0[1]	Maintenance
Well 10	Inconclusive	Inconclusive	3	3	3.0[1]	Maintenance

[1] The overall ranks for Well 9 and 10 were calculated based on the ranking categories containing data only.

Recommended Improvements

Replacement: In the event an existing well has special considerations that makes a major rehabilitation infeasible (e.g. surface water influence, water quality problems, a damaged screen or casing) a well replacement is recommended. Well replacement involves siting, drilling, developing and equipping a new well at either the existing site, or at a new location as identified in a well siting study conducted at that time. The well siting study should include a comprehensive evaluation of the location and yield of the City's wells, as well as surrounding wells within the groundwater basin in order to locate the well in a sustainable location.

Major Rehabilitation: A well that has exceeded its rated useful life can either be replaced or rehabilitated. Inspection and evaluation of the well casing and screen will determine if the well should undergo rehabilitation or replacement. If the well components, including the screen, have exceeded their useful life but the screen is in a condition suitable for rehabilitation and the well has steady specific capacity, consistent production, and/or good water quality, the well is a candidate for a major rehabilitation in lieu of replacement. Major rehabilitation would

include replacement of the pipes, valves, pump, motor, electrical systems, building, chemical treatment, and/or screen rehabilitation (relining, patching, or repacking as appropriate). Major rehabilitation is like building a new well using the rehabilitated casing and screen.

Minor Rehabilitation: A well with components that have exceeded their useful life, but a well screen that has substantial life remaining, is recommended for a minor rehabilitation. A minor rehabilitation includes: replacement of equipment such as pipes, pump, and motor; electrical upgrades; well cleaning; and addition of chemical treatment as applicable. A well receiving a minor rehabilitation will probably not require all of the listed items. Minor rehabilitation does not include casing or screen rehabilitation.

Maintenance: Wells with remaining useful life and generally in acceptable condition will still have some components that require maintenance or replacement. The work included in the maintenance category is limited to replacement of pipes, valves or motors, or building maintenance such as painting, trim replacement and roofing repair/replacement.

Frequent Inspection: As indicated in Table F.5, Well 7 has had varying specific capacity showing a dramatic drop in specific capacity between the 2007 and 2011 measurements. Even ignoring the 2007 measurement because it may be incorrect, the well's specific capacity has declined by 20% compared to the 1986 measurements, and that time period includes a cleaning performed in 2009. Considering that Well 7 received recent cleaning and improvements and the importance of the well to the City's water supply portfolio, the well warrants frequent testing and inspection. WSC recommends the City video inspect the well every 2-4 years and test the well annually until such time that the City is confident the well is operating in a stable manner.

Based on the results of this analysis, WSC recommends conducting video inspections of the wells, in the order of priority shown in Table F.15, before improvements are carried out. The video inspection includes pulling the pump. The wells should also be tested on a routine schedule. APEP will cover the cost of the inspection every 4 years. Therefore WSC recommends that the wells be tested at least that frequently. The cost of the testing is about $250 per well; considering that the information obtained from the testing is the primary indicator of the health of the well and well pump, it is cheap insurance to perform the testing more frequently. Annual testing of the wells is highly recommended.

As illustrated by the decision tree in Figure F-3, the results from the video inspections will help the City determine if improvements are required, and which category of improvement is most appropriate. For wells needing improvement, the City should first consider the "Special Considerations" listed in Table F.13. These factors will aid the City in determining the preferred alternative, i.e. to improve the existing well or to construct a replacement well. Before a replacement well is constructed, a comprehensive well siting study should be carried out. (Note that a new well would replace the production capacity of the failing well but may not be constructed adjacent to the failing well).

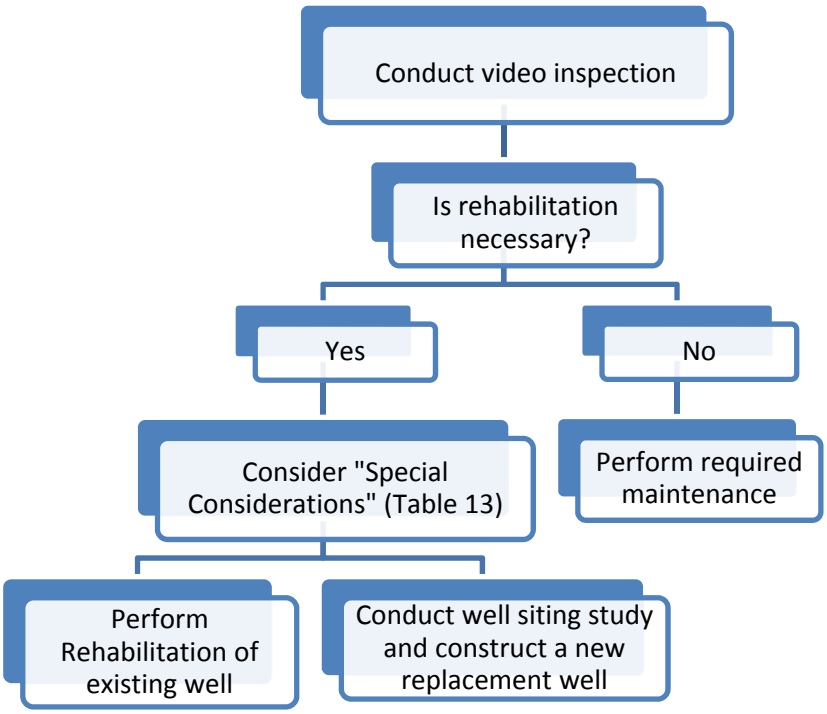


Figure F-3. Decision Tree for Making Well Improvements

A summary of observed deficiencies, listed in the order of well priority, is shown in Table F.16. If the City decides to replace a well, as described above, some of these improvements may become irrelevant. Specific recommended projects and corresponding budget will be included in the CIP, which is part the Master Plan. A summary of field observations, photos, and collected data, for each well are included as attachments to this memorandum.

Table F.16. Observed Deficiencies (wells listed in order of priority)

Facility	Observed Deficiencies
Well 1	Replace valves and piping. Building and building roof needs maintenance (see attachment for Well 1).

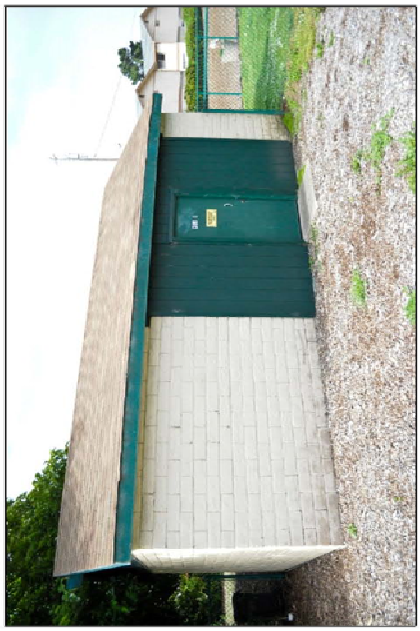
Well 3	Replace valves and piping. Building and building roof needs maintenance (see attachment for Well 3).
Well 7	Building and building roof needs maintenance (see attachment for Well 7). Ventilation fans may need replacement.
Well 4	Replace valves and piping. Building and building roof needs maintenance (see attachment for Well 4). Move flow meter vault.
Well 8	Investigate blown motor issue.
Well 5	Replace valves and piping. Repair/Replace exterior door (see attachment for Well 5).
Well 9	Install more secure enclosure around the well head (see attachment for Well 9). Improve access (see attachment for Well 9).
Well 10	Fix radio communication.

Well Inventory Forms (Well 1, 3, 4, 5, 7, 8, 9 and 10)

Well 1

Address: 1221 S. Elm St.
Arroyo Grande

Date Assessed: 13-Jun-11
Atlas Sheet No.: 9



No.	Noted Deficiencies
1	Piping is 71 years old and shows evidence of corrosion and failed coatings.
2	The building needs maintenance - roof needs minor repair, fascia shows signs of dry rot and needs to be repainted.
3	The electrical components are old. They look to be in okay condition, but should be monitored.
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Page 1 of 4

Site Details

Site: Well 1
Address: 1221 S. Elm St.

Date Assessed: 6/13/2011
Atlas Sheet No.: 9

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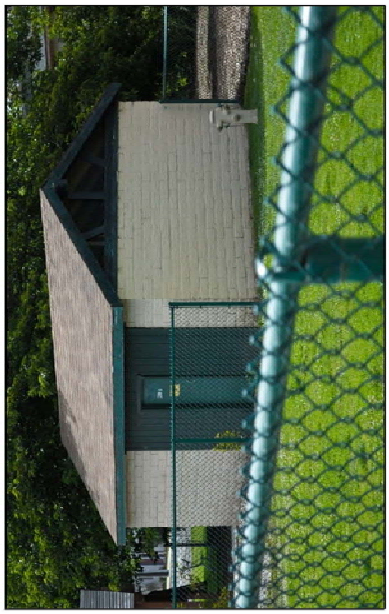
Pump and Motor	Pump Make:	Peerless	Date Installed:	1988	
	Pump Model:	8MA	Number of Stages:	14	
	Pump Capacity:	300 gpm			
	Pump Design Head:	350 ft			
	Motor Manufacturer:	GE Motor	Date Installed:	2007	
	Nameplate HP:	40			
	Measured HP:	42	Date Measured:	2007	
	Overall Pumping Efficiency:	53%	Date Measured:	2007	
	Column Pipe Diameter:				
	Column Pipe Material:				
	Pump to Waste Valve:	Yes			
	Flow Meter?				
Well	Date Drilled:	1940			
	Date Rehabilitated:	1988			
	Frequency of Use:	Seasonal			
	Casing End Depth (BGS):	200 ft	Date Installed:	1940	Casing was cleaned in 1988 (zipcord blast and bailed).
	Casing Diameter:	14 in			
	Casing Material:	Steel			
	Screen Depth (BGS):	90 ft			Other sources state screen starts at 103 ft
	Screened Interval (BGS):	103 ft - 223 ft			
	Sanitary Seal Depth:	50 ft			
	Static Water Level:	72 ft	Date Measured:	2007	
	Pumping Water Level:	79 ft	Date Measured:	2007	
	Well Yield	283 gpm	Date Measured:	2007	
	Specific Capacity:	40.4 gpm/ft draw	Date Measured:	2007	
	Surface Water Influence?	No			
	Down Well Level Sensor?				
Treatment	Pump Type:	Chloramination performed at central location near Well 7 & 8. Refer to Well 7.			
	Backup:	n/a			
	Volume of Chlorine Storage:	n/a			
	Volume of Ammonia Storage:	n/a			
Electrical Systems	Control System:	HOA with SCADA control on Tank Level from Reservoir 4?			
	Utility Service:	PG&E, 3-phase			
	Backup Power:	No			
Building and Grounds	Enclosure/Housing:	Concrete & Wooden Building			
	Floor Material:	Concrete			
	Site Security:	Fencing, Locked Building			
Notes	Well has shown no loss of production. Well was video inspected in 1988. Piping out of well is very old, evidence of corrosion and failed coating. Building needs maintenance, roof needs minor repair, fascia shows signs of dry rot, needs to be repainted. The electrical components are old. They look to be in okay condition, but should be monitored.				

Photos

Site: Well 1
Address: 1221 S. Elm St.

Date Assessed: 6/13/2011
Atlas Sheet No.: 9



AG Condition Assessment Form_Well 1 revised2.xlsx, Photos

Page 3 of 4

4/27/2012

Photos (Continued)

Site: Well 1
Address: 1221 S. Elm St.

Date Assessed: 6/13/2011
Atlas Sheet No.: 9

AG Condition Assessment Form_Well 1 revised2.xlsx, Photos (Continued)

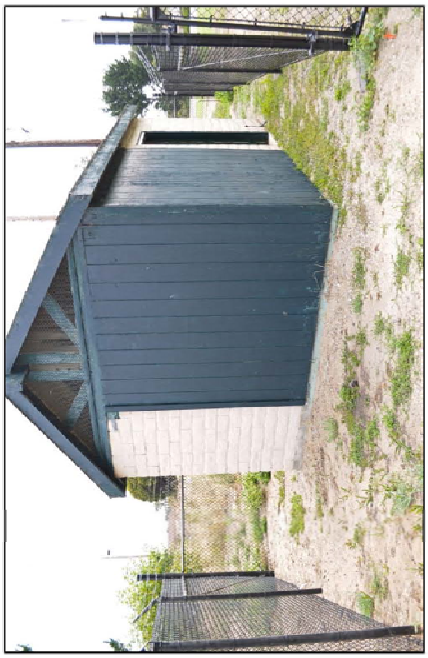
Page 4 of 4

4/27/2012

Well 3

Address: 1221 S. Elm St.
Arroyo Grande

Date Assessed: 13-Jun-11
Atlas Sheet No.: 9



No.	Noted Deficiencies
1	Valves and piping are 57 years old and show evidence of corrosion and failed coatings.
2	The electrical components are old and should be monitored.
3	Building trim need painting, fascia may have some dry rot, roof needs repair.
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Page 1 of 4

Site Details

Site: Well 3
Address: 1221 S. Elm St.

Date Assessed: 6/13/2011
Atlas Sheet No.: 9

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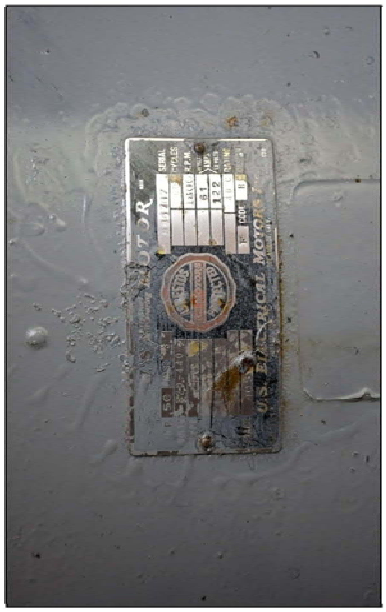
Pump and Motor	Pump Make:	Berkeley	Date Installed:	1992	
	Pump Model:	10LB	Number of Stages:	8	
	Pump Capacity:	400 gpm			
	Pump Design Head:	320 ft			
	Motor Manufacturer:	U.S. Electrical Motor	Date Installed:	1954	Motor was repaired in 1992 (bake and dip windings).
	Nameplate HP:	50			
	Measured HP:	54	Date Measured:	2007	
	Overall Pumping Efficiency:	61%	Date Measured:	2007	
	Column Pipe Diameter:				
	Column Pipe Material:				
	Pump to Waste Valve:	Yes			
	Flow Meter?				
Well	Date Drilled:	1954			
	Date Rehabilitated:	1992			
	Frequency of Use:	Seasonal			
	Casing Beginning/End Depth (BGS)	219 ft	Date Installed:	1954	Casing was cleaned in 1992 (zipcord blast and bailed).
	Casing Diameter:	14 in			
	Casing Material:	Steel			
	Screen Depth (BGS):	100 ft			
	Screened Interval (BGS):	100 ft - 219 ft			
	Sanitary Seal Depth:	29 ft			
	Static Water Level:	79 ft	Date Measured:	2007	
	Pumping Water Level:	92 ft	Date Measured:	2007	
	Well Yield:	412 gpm	Date Measured:	2007	
	Specific Capacity:	31.7 gpm/ ft draw	Date Measured:	2007	
	Surface Water Influence?	Well not used when surface water is within 150' of well			
	Down Well Level Sensor?				
Chemicals	Pump Type:	Chloramination performed at central location near Well 7 & 8. Refer to Well 7.			
	Backup:	n/a			
	Volume of Chlorine Storage:	n/a			
	Volume of Ammonia Storage:	n/a			
Electrical Systems	Control System:	HOA with SCADA control on Tank Level from Reservoir 4?			
	Utility Service:	PG&E, 3-phase			
	Backup Power:	No			
Building and Grounds	Enclosure/Housing:	Concrete & Wooden Building			
	Floor Material:	Concrete			
	Site Security:	Fencing with 3-strand barbed wire; Locked Building			
Notes	Well condition is ok. Well was video inspected in 1992. Valves and piping are old. Old electrical components. Building trim need painting, fascia may have some dry rot, roof needs repair.				

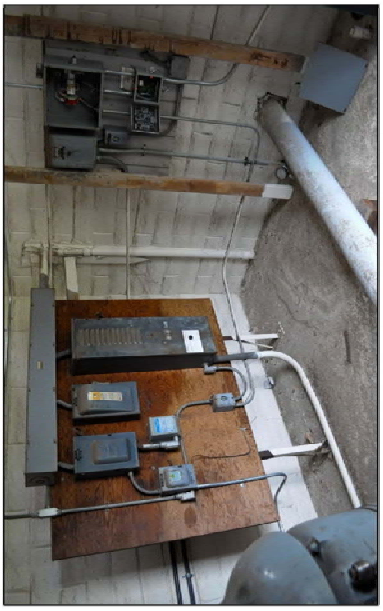
WSC
Water Systems Consulting, Inc.

Photos

Site: Well 3
Address: 1221 S. Elm St.

Date Assessed: 6/13/2011
Atlas Sheet No.: 9

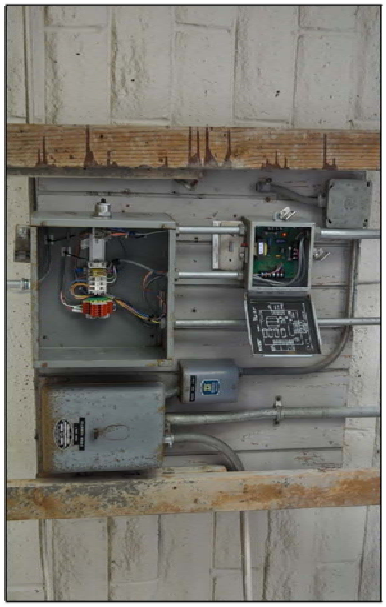




Photos (Continued)

Site: Well 3
Address: 1221 S. Elm St.

Date Assessed: 6/13/2011
Atlas Sheet No.: 9



Well 4

Address: 1221 S. Elm St.
Arroyo Grande

Date Assessed: 13-Jun-11
Atlas Sheet No.: 9

No.	Noted Deficiencies
1	Valves and piping are 47 years old and show evidence of corrosion and failed coatings.
2	Building needs maintenance, roof needs minor repair, fascia shows signs of dry rot, needs to be repainted.
3	Flow meter vault is buried inside the dog park - should be moved.
4	The electrical components are old. They look to be in okay condition, but should be monitored.
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Page 1 of 4

Site Details

Site: Well 4
Address: 1221 S. Elm St.

Date Assessed: 6/13/2011
Atlas Sheet No.: 9

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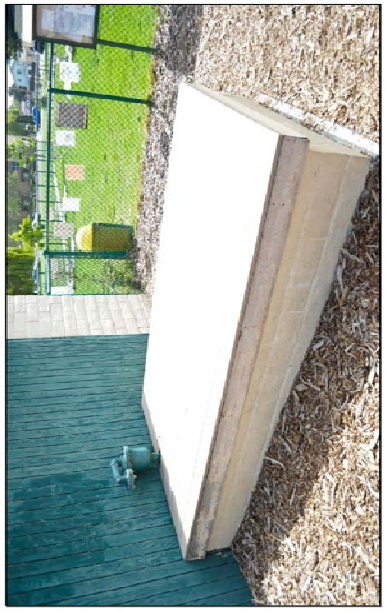
Pump and Motor	Pump Make:	Peerless	Date Installed:	1993	
	Pump Model:	10MA	Number of Stages:	9	
	Pump Capacity:	550 gpm			
	Pump Design Head:	320 ft			
	Motor Manufacturer:	U.S. Motors	Date Installed:	1964	Motor was repaired in 1993 (bake and dip windings).
	Nameplate HP:	60			
	Measured HP:	62	Date Measured:	2007	
	Overall Pumping Efficiency:	58%	Date Measured:	2007	
	Column Pipe Diameter:				
	Column Pipe Material:				
	Pump to Waste Valve:	No?			
	Flow Meter?				
Well	Date Drilled:	1964			
	Date Rehabilitated:	1993			
	Frequency of Use:	Seasonal			
	Casing Beginning/End Depth (BGS)	233 ft	Date Installed:	1964	Casing was cleaned in 1993 (zipcord blast and bailed).
	Casing Diameter:	14 in			
	Casing Material:	Steel			
	Screen Depth (BGS):	92 ft			
	Screened Interval (BGS):	92 ft - 233 ft			
	Sanitary Seal Depth:	49.5 ft			
	Static Water Level:	75 ft	Date Measured:	2007	
	Pumping Water Level:	85 ft	Date Measured:	2007	
	Well Yield:	442 gpm	Date Measured:	2007	
	Specific Capacity:	44.2 gpm/ft draw	Date Measured:	2007	
	Surface Water Influence?	No			
	Down Well Level Sensor?				
Chemicals	Pump Type:	Chloramination performed at central location near Well 7 & 8. Refer to Well 7.			
	Backup:	n/a			
	Volume of Chlorine Storage:	n/a			
	Volume of Ammonia Storage:	n/a			
Electrical Systems	Control System:	HOA with SCADA control based on system pressure			
	Utility Service:	PG&E, 3-phase			
	Backup Power:	No			
Building and Grounds	Enclosure/Housing:	Concrete & Wooden Building			
	Floor Material:	Concrete			
	Site Security:	Fencing; Locked Building			
Notes	Well condition is ok. Well was video inspected in 1993. Valves and piping are old. Building needs maintenance, roof needs minor repair, fascia shows signs of dry rot, needs to be repainted. Flow meter vault is buried inside the dog park - should be moved. The electrical components are old. They look to be in okay condition, but should be monitored.				

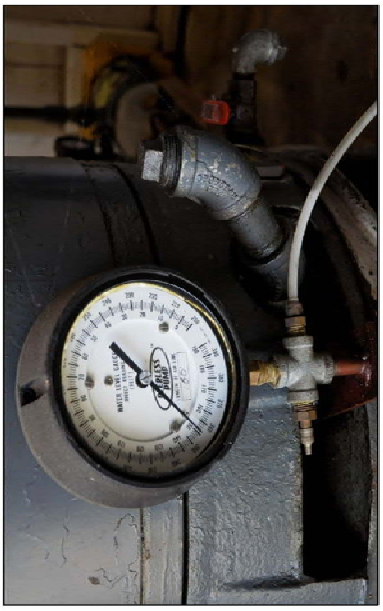
WSC
Water Systems Consulting, Inc.

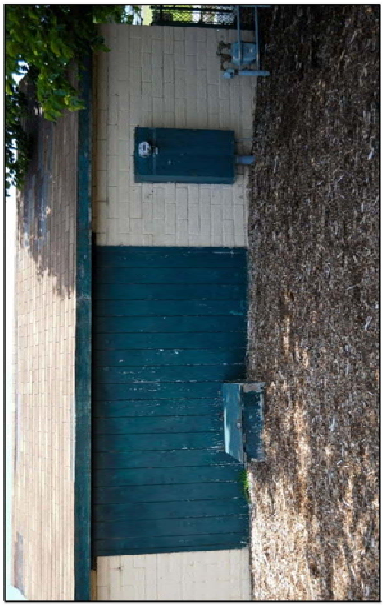
Photos

Site: Well 4
Address: 1221 S. Elm St.

Date Assessed: 6/13/2011
Atlas Sheet No.: 9







AG Condition Assessment Form_Well 4 revised.xlsx Photos

Page 3 of 4

4/27/2012

Photos (Continued)

Site: Well 4
Address: 1221 S. Elm St.

Date Assessed: 6/13/2011
Atlas Sheet No.: 9

Well 5

Address: 1375 Ash Street
Arroyo Grande

Date Assessed: 13-Jun-11
Atlas Sheet No.: 9

No.	Noted Deficiencies
1	Valves and piping are 44 years old and show evidence of corrosion and failed coatings.
2	Well has high NO3, but has steadily declined over the past 5 years to the current level of 30 mg/l.
3	The exterior door needs repair/replacement (low priority). Building looks like it may need to be painted in the next couple years.
4	Electrical components are servicalbe, but old. Need to monitor condition.
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Site Details

Site:	Well 5	**Date Assessed:**	6/13/2011
Address:	1375 Ash Street	**Atlas Sheet No.:**	9

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Pump and Motor	Pump Make:	Peerless	Date Installed:	1995	
	Pump Model:	12LB	Number of Stages:	7	
	Pump Capacity:	750 gpm			
	Pump Design Head:	438 ft head			
	Motor Manufacturer:	U.S. Electrical Motors	Date Installed:	1967	Motor was repaired in 2010.
	Nameplate HP:	100			
	Measured HP:	114	Date Measured:	2007	
	Overall Pumping Efficiency:	70%	Date Measured:	2007	
	Column Pipe Diameter:				
	Column Pipe Material:				
	Pump to Waste Valve:	Yes			
	Flow Meter?				
Well	Date Drilled:	1967			
	Date Rehabilitated:	1990			
	Frequency of Use:	Active			Operates primarily in the summer (May to October).
	Casing Beginning/End Depth (BGS)	202 ft	Date Installed:	1967	Casing was cleaned in 1990 (zipcord blast and bailed).
	Casing Diameter:	14 in			
	Casing Material:	Steel			
	Screen Depth (BGS):	75 ft			
	Screened Interval (BGS):	192 ft			
	Sanitary Seal Depth:	55 ft			
	Static Water Level:	65 ft	Date Measured:	2007	
	Pumping Water Level:	73 ft	Date Measured:	2007	
	Well Yield:	985 gpm	Date Measured:	2007	
	Specific Capacity:	123.1 gpm/ ft draw	Date Measured:	2007	
	Surface Water Influence?	No			
	Down Well Level Sensor?				
Chemicals	Pump Type:	Chloramination performed at central location near Well 7 & 8. Refer to Well 7.			
	Backup:	n/a			
	Volume of Chlorine Storage:	n/a			
	Volume of Ammonia Storage:	n/a			
Electrical Systems	Control System:	HOA with SCADA control based on system pressure			
	Utility Service:	PG&E, 3-phase			
	Backup Power:	No			
Building and Grounds	Enclosure/Housing:	Corrugated Metal Building			
	Floor Material:	Concrete			
	Site Security:	Fencing; Locked Building			
Notes	Well condition is ok. Well was video inspected in 1990. Valves and piping are old. Well has high NO3, but has steadily declined over the past 5 years to the current level of 30 mg/l. Metal well building looks to be in decent condition. The exterior door needs repair/replacement (low priority). Building looks like it may need to be painted in the next couple years. Electrical components are servicalbe, but old. Need to monitor condition.				

Photos

Site: Well 5
Address: 1375 Ash Street

Date Assessed: 6/13/2011
Atlas Sheet No.: 9

AG Condition Assessment Form_Well 5 revised.xlsx, Photos

Page 3 of 4

AG7/2012

Photos (Continued)

Site: Well 5
Address: 1375 Ash Street

Date Assessed: 6/13/2011
Atlas Sheet No.: 9

Well 7

Address: 1221 S. Elm Street
Arroyo Grande

Date Assessed: 13-Jun-11
Atlas Sheet No.: 9

No.	Noted Deficiencies
1	Iron and Mangense levels are at MCL.
2	Some of the fascia boards show dry rot signs. Trim needs to be painted. Stucco looks due for a painting. Roof looks ok.
3	One of the Prominent Chemical pumps is the old pulse style and should be updated when due.
4	Chemical handling is functional. Ventilation fans show signs of corrosion, may need replacement.
5	The shared Well 7 & 8 pump to waste line, if clogged or blocked could lead to pumping water into the other well.
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Page 1 of 4

Site Details

Site: Well 7
Address: 1221 S. Elm Street

Date Assessed: 6/13/2011
Atlas Sheet No.: 9

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Pump and Motor	Pump Make:	Peerless	Date Installed:	2009	
	Pump Model:		Number of Stages:	7	
	Pump Capacity:				
	Pump Design Head:				
	Motor Manufacturer:	GE	Date Installed:	1982	Standard clean up and refurbish done on motor in 2009.
	Nameplate HP:	150			
	Measured HP:	169	Date Measured:	2007	
	Overall Pumping Efficiency:	54%	Date Measured:	2007	
	Column Pipe Diameter:				
	Column Pipe Material:				
	Pump to Waste Valve:	Yes			
	Flow Meter?				
Well	Date Drilled:	1982			
	Date Rehabilitated:	2009			Acid wash was performed in 2009. Well bore report done in 2009.
	Frequency of Use:	Seasonal			
	Casing Beginning/End Depth (BGS)	570 ft	Date Installed:	1982	
	Casing Diameter:	16 in			
	Casing Material:	Steel			
	Screen Depth (BGS):	290 ft			
	Screened Interval (BGS):	290 ft - 570 ft			
	Sanitary Seal Depth:	260 ft			
	Static Water Level:	81 ft	Date Measured:	2007	
	Pumping Water Level:	126 ft	Date Measured:	2007	
	Well Yield:	987 gpm	Date Measured:	2007	
	Specific Capacity:	21.9 gpm/ft draw	Date Measured:	2007	
	Surface Water Influence?	No			
	Down Well Level Sensor?				
Chemicals	Pump Type:	ProMinent Pump (2.5 gph). Central chloramination facility. Chloramination performed here for water produced at Wells 1, 3, 4, 5, 7, 8.			
	Backup:				
	Volume of Chlorine Storage:				
	Volume of Ammonia Storage:				
Electrical Systems	Control System:	HOA with SCADA control based on system pressure			
	Utility Service:	PG&E, 3-phase			
	Backup Power:	No			
Building and Grounds	Enclosure/Housing:	None for pump. Wooden, stucco building for chloramination facility.			
	Floor Material:	Concrete			
	Site Security:	Fencing; Locked Chloramination Building			
Notes	Well condition is good. Well was video inspected in 2009. Valves and piping are in good condition. Manganese and Iron levels are at MCL. Some of the fascia boards show dry rot signs. Trim needs to be painted. Stucco looks due for a painting. Roof looks ok. One of the Prominent Chemical pumps is the old pulse style and should be updated when due. Chemical handling is functional. Ventilation fans show signs of corrosion, may need replacement. The shared Well 7 & 8 pump to waste line, if clogged or blocked could lead to pumping water into the other well.				

Photos

Site: Well 7
Address: 1221 S. Elm Street

Date Assessed: 6/13/2011
Atlas Sheet No.: 9

AG Condition Assessment Form_Well 7 revised.xlsx, Photos

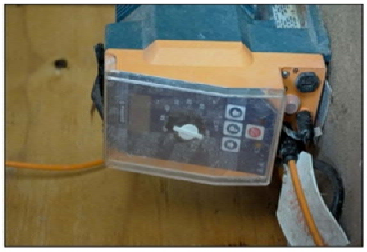
Page 3 of 4

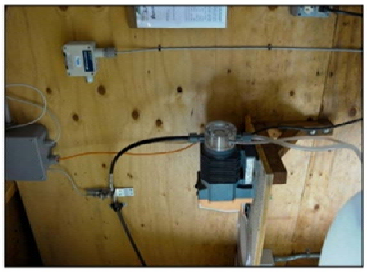
4/27/2012

Photos (Continued)

Site: Well 7
Address: 1221 S. Elm Street

Date Assessed: 6/13/2011
Atlas Sheet No.: 9





Well 8

Address: 1221 S. Elm Street
Arroyo Grande

Date Assessed: 13-Jun-11
Atlas Sheet No.: 9

No.	Noted Deficiencies
1	Well has experienced recurring problem of blown motors (5-6 times).
2	Some of the fascia boards show dry rot signs. Trim needs to be painted. Stucco looks due for a painting. Roof looks ok.
3	One of the Prominent Chemical pumps is the old pulse style and should be updated when due.
4	Chemical handling is functional. Ventilation fans show signs of corrosion, may need replacement.
5	The shared Well 7 & 8 pump to waste line, if clogged or blocked could lead to pumping water into the other well.
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Page 1 of 4

Site Details

Site: Well 8
Address: 1221 S. Elm Street

Date Assessed: 6/13/2011
Atlas Sheet No.: 9

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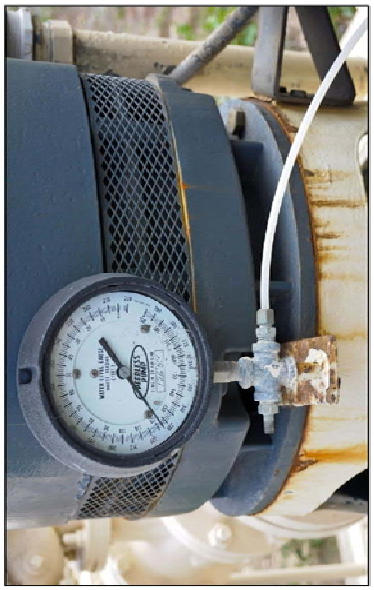
Pump and Motor	Pump Make:	Peerless	Date Installed:	1991	
	Pump Model:	8 x 8 x 16.5	Number of Stages:	7	
	Pump Capacity:	490 gpm			
	Pump Design Head:				
	Motor Manufacturer:	U.S. Electrical Motors	Date Installed:	2010	NEMA nominal eff. 91.7%.
	Nameplate HP:	75			
	Measured HP:	73	Date Measured:	2007	
	Overall Pumping Efficiency:	53%	Date Measured:	2007	
	Column Pipe Diameter:				
	Column Pipe Material:				
	Pump to Waste Valve:	Yes			
	Flow Meter?				
Well	Date Drilled:	1990			
	Date Rehabilitated:	n/a			
	Frequency of Use:	Seasonal			
	Casing Beginning/End Depth (BGS)	250 ft	Date Installed:	1990	No work on well or casing since installation.
	Casing Diameter:	12 in			
	Casing Material:	Steel; PVC			
	Screen Depth (BGS):	136 ft			
	Screened Interval (BGS):	136 ft - 250 ft			
	Sanitary Seal Depth:	136 ft			
	Static Water Level:	75 ft	Date Measured:	2007	
	Pumping Water Level:	122 ft	Date Measured:	2007	
	Well Yield:	417 gpm	Date Measured:	2007	
	Specific Capacity:	8.9 gpm/ft	Date Measured:	2007	
	Surface Water Influence?	No			
	Down Well Level Sensor?				
Chemicals	Pump Type:	Chloramination at central facility near Well 7. Refer to Well 7..			
	Backup:	n/a			
	Volume of Chlorine Storage:	n/a			
	Volume of Ammonia Storage:	n/a			
Electrical Systems	Control System:	HOA with SCADA control based on system pressure			
	Utility Service:	PG&E, 3-phase			
	Backup Power:	No			
Building and Grounds	Enclosure/Housing:	None			
	Floor Material:	Concrete			
	Site Security:	Fencing with 3-strand barbed wire			
Notes	Condition of well is ok. Valves and piping are in good condition. Well has experienced recurring problem of blown motors (5-6 times). Some of the fascia boards show dry rot signs. Trim needs to be painted. Stucco looks due for a painting. Roof looks ok. One of the Prominent Chemical pumps is the old pulse style and should be updated when due. Chemical handling is functional. Ventilation fans show signs of corrosion, may need replacement. The shared Well 7 & 8 pump to waste line, if clogged or blocked could lead to pumping water into the other well.				

WSC
Water Systems Consulting, Inc.

Photos

Site: Well 8
Address: 1221 S. Elm Street

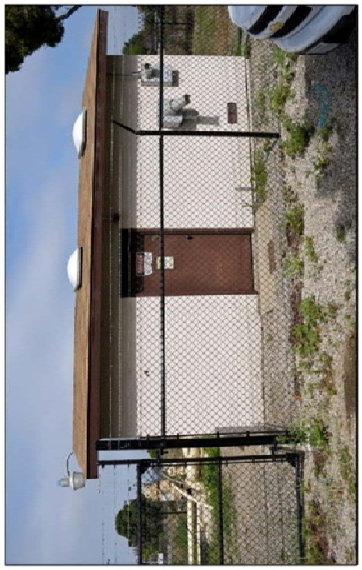
Date Assessed: 6/13/2011
Atlas Sheet No.: 9

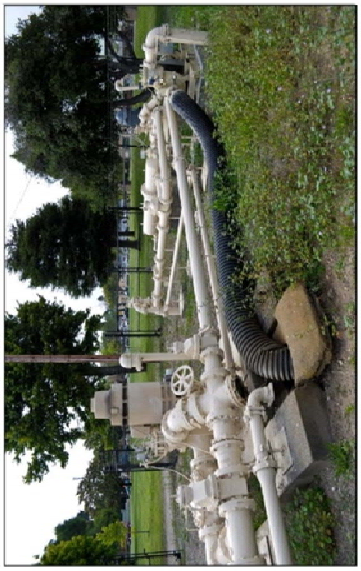


Photos (Continued)

Site: Well 8
Address: 1221 S. Elm Street

Date Assessed: 6/13/2011
Atlas Sheet No.: 9





AG Condition Assessment Form_Well 8 revised.xlsx, Photos (Continued)

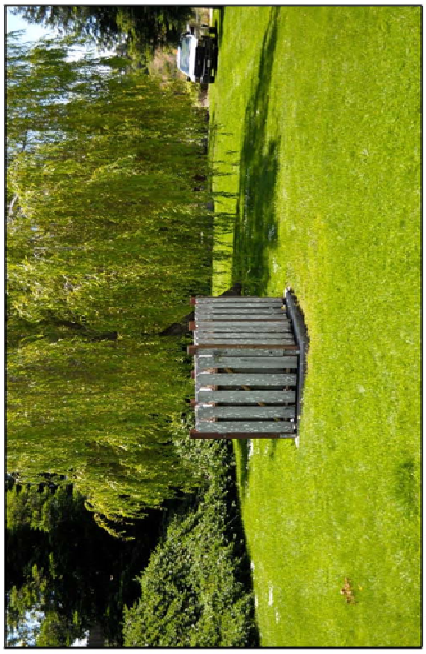
Page 4 of 4

4/27/2012

Well 9

Address: Oak Park Street
Arroyo Grande

Date Assessed: 13-Jun-11
Atlas Sheet No.: 38



No.	Noted Deficiencies
1	The wooden enclosure around the well head should be made more secure. People walking their dogs in the area appear to mistake it for a trash can.
2	Need a driveway and access to the well areas for service trucks.
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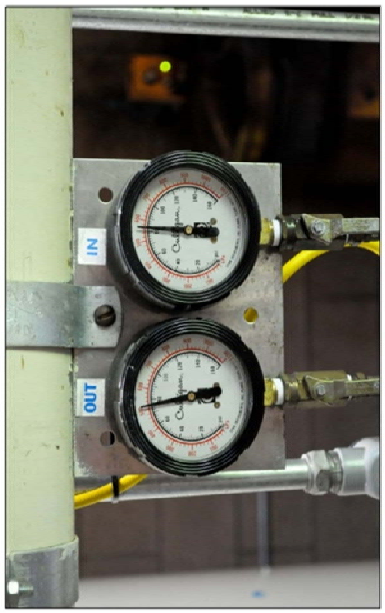
Page 1 of 4

Photos (Continued)

Site: Well 9
Address: Oak Park Street

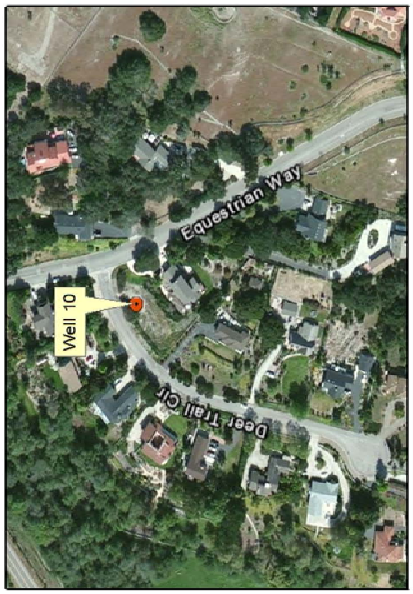
Date Assessed: 6/13/2011
Atlas Sheet No.: 38



Well 10

Address: 190 Deer Trail Circle
Arroyo Grande

Date Assessed: 13-Jun-11
Atlas Sheet No.: 45



No.	Noted Deficiencies
1	Radio communication at the well is not working properly.
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Page 1 of 4

Site Details

Site: Well 10
Address: 190 Deer Trail Circle

Date Assessed: 6/13/2011
Atlas Sheet No.: 45

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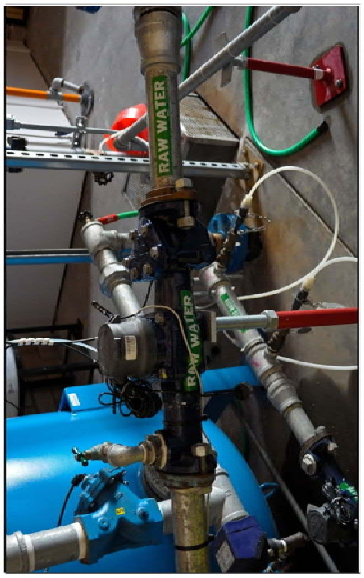
Pump and Motor	Pump Make:	Gould Submersible	Date Installed:	2010	
	Pump Model:	65L10	Number of Stages:	10	
	Pump Capacity:	65 gpm (range 20 - 90 gpm)			
	Pump Design Head:	~450 ft (rane 557 - 179 ft)			
	Motor Manufacturer:		Date Installed:	2010	Equipped with ABS VFD.
	Nameplate HP:	10			
	Measured HP:	n/a	Date Measured:	n/a	
	Overall Pumping Efficiency:	n/a	Date Measured:	n/a	
	Column Pipe Diameter:				
	Column Pipe Material:				
	Pump to Waste Valve:	Yes			
	Flow Meter?				
Well	Date Drilled:	2006			
	Date Rehabilitated:	Numerous times			
	Frequency of Use:	Continuous			
	Casing Ending Depth (BGS):	850 ft	Date Installed:	2006	Well has been repaired/rehabilitated numerous times, incl. 2008 and 2009.
	Casing Diameter:	8 in, 6 in, 4 in			
	Casing Material:	Steel; PVC			
	Screen Depth (BGS):	620 ft			
	Screened Interval (BGS):	620 ft - 830 ft; 620 ft - 760 ft			
	Sanitary Seal Depth:	60 ft			
	Static Water Level:	17.4 ft	Date Measured:	2007	
	Pumping Water Level:	274 ft	Date Measured:	2008	
	Well Yield:	65 gpm	Date Measured:	2007	
	Specific Capacity:	0.3 gpm/ft draw	Date Measured:	calculated	Calculated based on above measurements.
	Surface Water Influence?	No			
	Down Well Level Sensor?				
Treatment/ Chemicals	Disinfection:	Chloramination	Pump Type:	ProMinent	
	Volume of Chlorine Storage:				
	Volume of Ammonia Storage:				
	Wellhead Treatment:	Culligan System			
Electrical Systems	Control System:	HOA with SCADA control based on system pressure			
	Utility Service:	PG&E, 3-phase			
	Backup Power:	No			
Building and Grounds	Enclosure/Housing:	Concrete building			
	Floor Material:	Concrete			
	Site Security:	Locked building; Locked wooden gate			
Notes	Well , valves, and piping are in new condition. Currently, radio communication at the well is not working properly. Well has issues with high H2S and high temperature; wellhead treatment is installed.				

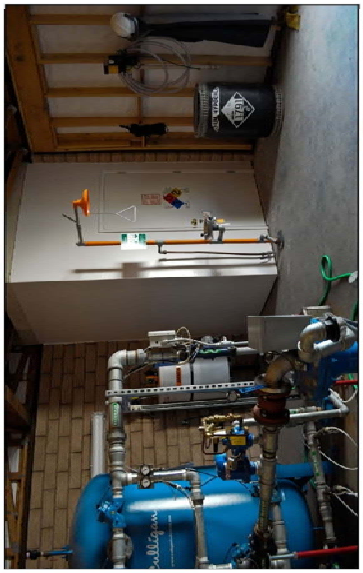
WSC
WATER SYSTEMS CONSULTING, INC.

Photos

Site: Well 10
Address: 190 Deer Trail Circle

Date Assessed: 6/13/2011
Atlas Sheet No.: 45

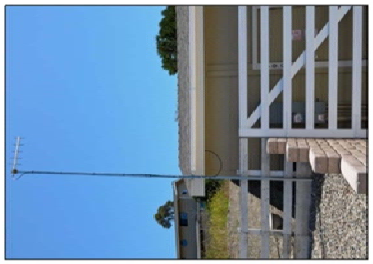


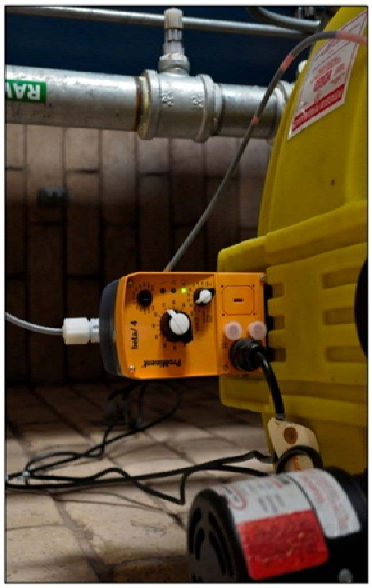


Photos (Continued)

Site: Well 10
Address: 190 Deer Trail Circle

Date Assessed: 6/13/2011
Atlas Sheet No.: 45





Technical Memorandum

APPENDIX G – Water Quality Assessment

Date: 4/24/2012

To: Mr. Mike Linn, P.E.
City of Arroyo Grande
208 E. Branch Street
Arroyo Grande, CA 93421

Phone: (805) 473-5444

CC: Shane Taylor; Teresa McClish

Prepared by: Joshua Reynolds, P.E.; Lianne Williams, P.E.

Reviewed by: Jeffery Szytel, P.E.

Project: City of Arroyo Grande Water and Sewer Master Plan Updates

SUBJECT: **WATER QUALITY ASSESSMENT**

The purpose of the Water Quality Assessment Technical Memorandum (TM) was to review available water quality data and update the water quality section of the Water Master Plan to represent the current water quality composition of the City's water sources and distribution system. This TM contains the following sections:

(1) Groundwater
(2) Disinfection
(3) Water Quality Summary

Groundwater

A shown in Table 6 of Chapter 5 - Water Supply, several of the City's wells have historically produced water that is either near or exceeds the maximum contaminant level (MCL) for nitrates or iron/manganese. In past years, the City implemented a blending strategy to ensure that the water delivered to its customers did not exceed any of the primary or secondary MCLs. The blending strategy consisted of the following two blending scenarios to avoid violating nitrate or iron/manganese MCLs.

1. Blend water from Well No. 7 (high iron/manganese) with the other shallow wells (high nitrates)
2. Blend water from the wells with surface water from the Lopez WTP

Recent water quality analysis indicates that the nitrate concentrations in these wells have decreased significantly in recent years; this is attributed to decreased agriculture activities in the area overlying

the groundwater basin. Additionally according to City Staff, none of the City's wells in the Arroyo Grande Basin currently exceed any of the EPA's primary or secondary MCLs.

The City continues to blend surface water from the Lopez WTP with the Arroyo Grande Basin groundwater to reduce hardness and to provide a more consistent water quality to its customers.

Water from Wells 9 & 10, located in the Pismo formation, contains iron, manganese or hydrogen sulfide at levels that exceed MCLs or requires treatments prior to delivery to the City's customers. The City currently operates a Culligan Cullsorb® treatment system at each of these wells. These treatment systems utilize potassium permanganate and manganese greensand media to remove iron, manganese and hydrogen sulfide through oxidation, ion exchange and particle entrapment.

Disinfection

The City uses a combination of chlorine and ammonia to produce chloramines to achieve and maintain disinfection within its distribution system.

Chloramines

For the Arroyo Grande Basin wells, the City utilizes two chemical feed pumps to dose Sodium Hypochlorite (12.5%) and ammonia sulfate (25%) and maintain a chlorine to ammonia ratio around 4:1. The flow rates for the two chemical feed pumps are paced on the combined flow rate from all of the Arroyo Grande Basin wells. However, the chlorine and ammonia are injected into the water on the discharge side Wells 7 and 8, before the connection of the other wells. Therefore, Well 7 and/or 8 must be running to disinfect water pumped from any of the other Arroyo Grande Basin wells (Wells #1, 3, 4, 5, 7, and 8).

Sodium Hypochlorite and Ammonia Sulfate are used to develop the chloramine disinfectant at Wells 9 &10. The chemical feed pumps for Wells 9 & 10 are not paced on flow, but are manually set to a constant flow rate due to the consistent flow rates of the these wells.

The Lopez WTP uses chlorine dioxide as its primary disinfectant and chloramines as the secondary disinfectant and to maintain disinfectant residual in the distribution system. Through the consistent use of chloramines as the disinfectant for its wells, the City is able to maintain a stable chloramine residual in its distribution system where groundwater is blended with the purchased surface water supplies from the Lopez WTP.

Nitrification

Nitrification is a biological process that can degrade water quality and deplete the disinfection residual in chloraminated water. Ammonia and nitrite oxidizing bacteria feed on free ammonia and convert it to nitrite and then nitrate. This process can lead to the breakdown of the chloramine molecules and the loss of disinfectant residual within the distribution system.

To monitor for nitrification within its distribution system, the City performs weekly monitoring of its storage water reservoirs for the following constituents: total chlorine residual; nitrite; and pH. To prevent nitrification the City performs a uni-directional flushing program, maintains a chlorine to ammonia ratio approaching 4:1 and reduces residence time in its distribution system during the summer months. If nitrification or the loss of disinfection residual is detected in its distribution system, the City super or shock chlorinates its storage water reservoirs with free chlorine to disinfect any nitrifying bacteria and to maintain a disinfection residual in its distribution system.

Water Quality Summary

Table G.1 contains a summary of the water quality constituents[13] detected in each of the City's three sources of water in 2010. As shown, in the water quality summary the City delivers water that meets the federal and state standards for drinking water quality. Acronyms used in the table below are defined as follows:

LI – Langelier Index
NA – Not Applicable
ND – Not Detected
NTU – Nephelometric Turbidity Unit
pCi/L – picoCuries per liter (a measure of radiation)
PPB – Parts Per Billion
PPM – Parts Per Million
TON – Threshold Odor Number
TT – Treatment Technique

[13] Water Quality constituent information obtained from the City of Arroyo Grande 2010 Water Quality Report

Table G.1. 2010 Water Quality Summary

Parameter	Units	MCL	Lopez WTP	State Water	Groundwater
Detected contaminants with a Primary Drinking Water Standard (Average Value)					
Aluminum	ppb	1000	36	90	ND
Arsenic	ppb	10	2.9	ND	ND
Fluoride	ppb	2000	0.33	ND	257
Nitrate	ppm	45	ND	2.5	18.1
Selenium	ppb	50	ND	ND	6.4
Haloacetic Acids	ppb	60	24	13	18.7[14]
Total Chlorine Residual	ppm	4	2.1	2	1.57[1]
Chlorite	ppb	1000	0.56	ND	ND
Chlorine Dioxide	ppb	800	130	NA	ND
Total Organic Carbon	ppm	TT	ND	2.1	ND
Nitrate & Nitrite as N	ppm	10	ND	ND	7
Gross Alpha Particle Activity	pCi/L	15	ND	ND	4.2
Total Coliform Bacteria	%	5% of Monthly Samples	0.16	0.2	0
Total Trihalomethanes	ppb	80	42	51	33.8
Detected constituents with a Secondary Drinking Water MCL (Average Value)					
Aluminum	ppb	200	36	90	ND
Chloride	ppm	500	37.1	83	46.6
Iron	ppb	300	ND	ND	ND
Manganese	ppb	50	ND	ND	3.5
Color	CU	15	2	ND	ND
Corrosivity	LI	Noncorrosive		Noncorrosive	Noncorrosive
Odor Threshold	TON	3	1.7	1	1.1
pH	Std. Units	6.5 - 8.5	8.25	8.2	7.5

[14] These samples results are from the distribution system only.

Specific Conductance	(micromhos)	1600	700	527	832.8
Sulfate	ppm	500	116	93	138.3
Turbidity	NTU	5	0.07	0.06	0.06
Total Dissolved Solids	ppm	1000	440	328	565.7
Detected contaminants without a Drinking Water Standard (Average Value)					
Alkalinity as Ca CO3	ppm		220	77	220
Calcium	ppm		61	52	86.4
Hardness	ppm		230	107	355.7
Magnesium	ppm		31	17	38.4
Potassium	ppm		ND	3.2	2.6
Sodium	ppm		40	82	47.3
Vanadium	ppb		ND	ND	3.5

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Technical Memorandum

APPENDIX H – Renewable Energy Opportunities

Date: 4/24/2012

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Project: City of Arroyo Grande Water and Sewer Master Plan Updates

SUBJECT: **RENEWABLE ENERGY OPPORTUNITIES**

As part of the City of Arroyo Grande's water and wastewater master planning efforts, WSC investigated opportunities for renewable energy generation at the City's water and wastewater facilities. WSC considered solar photovoltaic (PV) and in-conduit hydropower technologies. WSC identified Reservoir 1 as the most promising site for solar photovoltaic (PV) generation. Reservoir 1 was constructed in 2004 and has a flat, reinforced concrete roof, which is assumed to be capable of bearing the solar PV system load. The steel storage tanks in the City's system are also potential sites for solar PVs; the steel tanks, however, are not included in this analysis because the roofs of the steel tanks would likely require significant structural retrofits to accommodate the solar PV systems, which may make the projects infeasible.

WSC estimated that the City could generate approximately 118 MWh per year of renewable energy if solar PV is installed on the roof of Reservoir 1. This amount of energy would offset the average annual energy usage of Well 1 and Well 4 based on 2008-2010 electricity records. Section 3 describes the power delivery mechanisms the City could utilize to apply this generation credit to electricity bills at other facilities, like Well 1 and 4.

WSC did not identify any sites suitable for in-conduit hydropower generation in the City's water system. In-conduit hydropower is best suited for sites where a significant amount of excess head is being dissipated through a pressure reducing valve (PRV) or a flow control valve (FCV). Locations with significant excess head are not present in the City's system.

Summary of Energy Generation

Based on the available reservoir roof area, WSC sized a PV system for Reservoir 1. Using the estimated solar radiation for the location, WSC calculated the expected annual energy production. The key parameters of the system are summarized in Table H.1 below. Section 2 provides detail on the assumptions and methods used to generate these results.

Table H.1. Summary of Reservoir 1 Solar PV System

9.8.1.1.1 Facility	9.8.1.1.1.1 Solar Energy Estimates
Reservoir 1 *City of Arroyo Grande* 	➢ System Size: 81 kW_{DC} ➢ Number of PV Modules: 353 ➢ Annual Energy Produced: 118,429 kWh/year ➢ Trees may require trimming to eliminate shading ➢ Reinforced concrete roof should not require structural modifications

Assumptions and Method

In developing the annual solar electricity estimates showing in Section 1, WSC made the following assumptions:

1. The peak watts per square foot factor for the solar PV array is 10.4 W/sf, which is equivalent to 230 W/module (based on SunPower T10 Solar Roof Tile with SunPower 72-cell SPR-230).
2. The roof area required by one PV module, including panel, mounting apparatus and space between rows, is 22.1 sf (based on SunPower T10 Solar Roof Tile with SunPower 72-cell SPR-230).
3. Ninety percent (90%) of the rooftop or available land will be occupied by the solar arrays. This accounts for unusable area and access for maintenance.
4. The DC-to-AC derate factor is 0.77 (based on recommendations by the National Renewable Energy Laboratory (NREL)).
5. The roof mounted PV arrays have a fixed tilt of 10°.
6. The PV arrays have an azimuth of 180°.

Calculating System Size

The size of the PV system is its nameplate DC power rating (kW_{DC}). The PV system size is determined by the number of PV modules and the DC power rating for the modules. The number of modules in the solar array was estimated based on available area. The PV system size was then calculated based on product specifications for a typical module; in this case, each module was assumed to be rated at 230 watts DC (see Attachment A for product specifications).

Estimating AC Power

Modules are given a nameplate DC power rating at standard test conditions (STC). When the DC power is converted to AC power for use on the grid, losses occur; thus, the AC power to the grid is always less than the nameplate DC power. These losses are due to a variety of factors, including the losses in the inverter and transformer, mismatch, diodes and connections, and AC and DC wiring. The overall DC-to-AC derate factor is used to account for all these losses. An AC-to-DC derate factor of 0.77 is applied to the DC system size (kW_{DC}) to estimate the AC power output.

Estimating Annual Electricity Generated

The annual electricity generated by the solar PV system depends on the solar radiation or insolation ($kWh/m^2/day$) at the location of the facility. The annual electricity generated was estimated for the site using NREL's PVWatts tool (NREL PVWatts version 2). This tool was developed by NREL for public

use and yields a more accurate estimate of solar electricity generation than simpler methods like those based only on the average annual solar radiation for the location.

PVWatts calculates the solar radiation for the location (based on zip code) and array tilt angle. PVWatts performs an hour-by-hour calculation with corrections for factors including the impact of the PV module's temperature on PV efficiency, reflection losses, and inverter efficiency as a function of load. The PVWatts result was checked using an estimated annual average radiation of 5.78 $kWh/m^2/day$ for the region. For Reservoir 1, the simple annual average method resulted in an electricity estimate of about 11% higher than that estimated by PVWatts. Since PVWatts provides a more accurate and detailed analysis, the electricity estimate from PVWatts was used. A detailed table of results is provided in Attachment B.

Financial Considerations

Through the California Solar Initiative (CSI), the City may be eligible for a performance-based incentive (PBI) of up to $0.15 per kWh produced for the first 5 years. This incentive level corresponds to CSI Step 8, which is the level PG&E is currently at for the non-residential customer class. Due to budgetary constraints, however, PG&E is not guaranteeing CSI incentives for non-residential customers at this time. If the City chooses to pursue a solar PV project, WSC recommends that the City file an application to get on the CSI incentive waiting list as soon as possible. More information can be obtained from the CSI website: http://www.gosolarcalifornia.org.

In addition to incentives, the City should consider the power delivery mechanisms available to deliver power to the electrical grid. The City does not have regular electrical demand at Reservoir 1 (only a sump pump); thus, WSC recommends utilizing PG&E's Renewable Energy Self-Generation Bill Credit Transfer (RES-BCT) rate schedule, which was developed specifically for local governments. Thorough the RES-BCT rate schedule, the value of the monthly kWh exported at Reservoir 1 can be credited to the City's other PG&E electric accounts. Reservoir 1 would be termed the generating account. The City can specify up to 50 benefiting accounts, with a percentage allocation for each. The benefits of the RES-BCT rate structure are that the energy is credited at its actual value (including time-of-use factors) and the City is not locked into a long-term contract at a fixed rate, like a feed-in-tariff. More information on PG&E's RES-BCT rate schedule can found here: http://www.pge.com/tariffs/tm2/pdf/ELEC_SCHEDS_RES-BCT.pdf.

Detailed Table of Results

Parameter	Reservoir 1
Location	City of Arroyo Grande
Zip Code	93420
Diameter (ft)	105
Roof area (sf)	8659
Solar array area (sf)	7793
Number of PV modules	353
Rated DC power (kW)	81
AC power (kW)	62
Estimated annual electricity[1] (kWh/year)	118,429
Notes	Reinforced concrete roof is assumed to be capable of bearing the solar PV system load; Tree trimming may be required

[1] Estimated annual electricity calculated using NREL PVWatts tool version 2 for location (zip code) and array tilt.