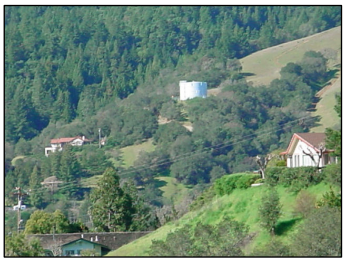
CITY OF
CLOVERDALE

Water System Master Plan Update

August 2010



Coastland
Civil Engineering - Construction Management - Building Dept. Services

1400 Neotomas Ave.
Santa Rosa, CA 95405
(707) 571-8005

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CLOVERDALE

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Prepared Under the Direction of:

Michael J. Nacey, RCE 33373

8/26/10
Date

REGISTERED PROFESSIONAL ENGINEER
MICHAEL JAMES NACEY
6/30/12
No C33373
CIVIL
STATE OF CALIFORNIA

Coastland
Civil Engineering - Construction Management - Building Dept. Services

1400 Neotomas Ave.
Santa Rosa, CA 95405
(707) 571-8005

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TABLE OF ABBREVIATIONS

ADD ..... Average Day Demand
COM ..... Commercial
CON ..... Connection
CY ..... Cubic Yard
EA ..... Each
EDU ..... Equivalent Dwelling Unit
GAL ..... Gallon
GPAPD ..... Gallons per Acre per Day
GPCPD ..... Gallons per Capita per Day
GPM ..... Gallons per Minute
GPD ..... Gallons per Day
IND ..... Industrial
LF ..... Lineal Foot
MDD ..... Maximum Day Demand
MG ..... Million Gallons
MGD ..... Million Gallons per Day
MGPM ..... Million Gallons per Minute
MGPY ..... Million Gallons per Year
PDD ..... Peak Day Demand
PHD ..... Peak Hour Demand
RES ..... Residence
SF ..... Square Foot
SY ..... Square Yard

EXECUTIVE SUMMARY

The last comprehensive update to the City's Water Master Plan was completed in 1998. Since that time, a number of significant changes have taken place in the City including the adoption of a comprehensive update to the City's General Plan in 2009. Recognizing this, the City directed that an update to the Water Master Plan was to be completed taking into account the numerous changes that have taken place and the possible impacts that the 2009 General Plan will have on the system. Therefore, this Water Master Plan Update (Update) evaluates the City's water production, treatment and distribution system (System) with regard to the City's current water needs and further identifies what improvements to the System are required so that the System can serve the City more reliably. The Update also evaluates the future demands of the City as a function of the 2009 General Plan Update and outlines those System improvements that are required to accommodate the General Plan build-out. This Update relied on data provided by the City documenting the water production and water usage for the calendar years 2001 through 2007 and available records (including base mapping and as-built construction documentation) to determine the location, composition and size of the existing pipe network in order to develop a working model of the entire system.

Existing System

The City produced on average 40 million gallons (mg) of water per month over the analysis period to meet the demand of the City. The Russian River watershed provides the source water for the City. Since the late 1800's, water has been pumped from wells adjacent to the Russian River just north of Crocker Road on the west side of the river. Since 1996, pumped water has been drawn from the well field and processed through the City's Water Treatment Plant (Plant) located adjacent to the well field. The water is treated at the Plant, pumped to the City's main reservoirs and then distributed throughout the City System via the existing distribution system. The City operates and maintains approximately 40 miles of water mains ranging in size from 4-inch to 16-inch. The City is divided into three water pressure zones, which use storage elevation to control the water pressure provided within each of the zones. In addition, the City has six (6) water reservoir sites with a total storage of 4.250 million gallons, as well as two (2) pump stations to move water between the primary water zone and the two higher elevation water zones.

In analyzing the water usage for the City, it was determined that the average domestic demand for water over the study period was 110.6 gallons per capita per day (gpcpd). Given the number of domestic connections and the population as of December 2007 (8,577), the average usage per residence was 331.8 gallons per day. Based on this existing water use data for both residential and non-residential uses and detailed information on the existing distribution system, a computer hydraulic model was created to both evaluate the existing System and to be able to evaluate the projected future growth as shown in the 2009 General Plan.

The computer analysis of the System identified/confirmed areas of concern within the existing System that need to be addressed. As confirmed by both the computer model and recent operational experience, a primary concern for the System is that two of the storage sites in the main water zone (Zone 1), the Hot Springs and Clover Springs Reservoirs, are incapable of fully recharging during the off-demand periods of the peak water demands of summer. Another concern identified was that some areas within the current system are unable to maintain the required fire flow and pressure criteria set forth by both the City and the State during the peak demand periods. The other primary area of concern with the existing system is the limited

production capacity of the well field. Although production is currently meeting peak demands, the maximum production capacity does not meet State requirements for peak hour and maximum day rates.

This Update outlines potential solutions, which address the majority of the existing concerns identified by the analysis. The total cost in current dollars required to address these issues is $6.46 million. This includes adding a new 16-inch water main in Asti Rd and various other 12-inch and 8-inch mains to improve water flow through the City and upsizing many of the 4-inch and 6-inch mains to standard 8-inch mains to improve fire flows. The specific locations of the improvements are shown on the exhibits included with this study.

General Plan Build-out

In order to determine the future demands of the City, this Update analyzed the Land Use and Zoning information from the 2009 General Plan Update to determine what the net water demand increase for both residential and non-residential demand will be at build-out. This analysis determined that an approximate 30% increase was anticipated for residential demand for a maximum population of 12,000 citizens and a 55 % increase in non-residential demand occurred when all available non-residential land types were developed to maximum density.

The largest portion of build-out will occur in northern and southern limits of the City primarily on the eastern side of Hwy 101; however some of the build-out will occur as infill within the developed parts of town; the hydraulic model indicated, for the most part, that existing water piping network (Network) was sufficient to handle the new loads due to infill.

To support the non-infill development three (3) new trunk water mains will have to be constructed. The first is in the primary water zone (Zone 1). The Zone 1 water main will extend services along Asti Rd to the south from Santana Drive to south of the Dutcher Creek Exit of Hwy 101. These 16-inch and12-inch water mains will be the backbone service for the Alexander Valley Resort site. A 12-inch water main loop will run south from the existing service on Santana Drive along the railroad corridor to Cloverdale Airport then west along Chrome Iron Road to connect with the 12-inch Asti Rd main. The second new trunk water main will be a 12-inch main, which will extend the Zone 3 water service to the south on the west side of Hwy 101 from Sandholm Ln to Theresa Dr along Dutcher Creek Rd. The last new trunk water main will be located in Zone 2. This 12-inch water main will extended water service north along North Cloverdale Blvd to McCray Rd and cross under Hwy 101. The total cost for these three water mains is $18.32 million.

Additionally, in order to support expanded service the City will have to increase its water storage and production capacity. Increases in water storage will be required for Zones 1 and 2. The Zone 1 increases will require new storage tanks at the Alexander Valley Site (1 million gallons) and increased storage at the main storage reservoir (an additional 200 thousand gallons). The Zone 2 increase occurs by adding an additional 500 thousand gallon tank at the Ritter Reservoir. Further, the City will also need to increase the water production capacity of the system by making replacing older wells and making other improvements to the existing well field and adding up to 3 new wells. One new well may be required to meet current demand and code requirements and up to 3 wells may be required to meet buildout demands. The total cost the additional storage and production capacity will be in excess of $6.10 million.

In conclusion, Cloverdale's Water System is currently meeting demands of the City; however, improvements to the system are required to improve the reliability of the system and expansion will have to be necessary to increase the capacity of the system to meet the requirements of the 2009 General Plan.

1. INTRODUCTION

The goals of the City of Cloverdale's Water Master Plan Update (Update) are to evaluate changes to the System and demands that have occurred since the 1998 Water Master Plan Update, to evaluate the impacts that the 2009 General Plan Update will have on water production, storage, and distribution systems, and determine the infrastructure needed to support build-out of the General Plan. This Update provides an analysis of the current system, identifies areas in the system where improvements are needed, and quantifies the improvements required to the system to support build-out of the 2009 General Plan. This Update is divided into the following four parts:

1. The description, quantification and analysis of the existing water production, storage and distribution system. This section provides a description and analysis of the different parts of the system using water production and usage data provided by the City. The analysis of the production and usage data provided the necessary information to forecast future demand levels, develop a computer hydraulic model of the water system, and identify areas in the system where deficiencies exist.

2. Identification of the demands that will be placed on the system based on built-out in accordance with the 2009 General Plan. This section projects water demands for build-out using the Land Use and Zoning data from the 2009 General Plan. Water demands were calculated for both residential and non-residential uses using a combination of usage data from the existing system, as well as data from industry standards to determine demands, pipe sizes and production and storage requirements. This information ensures that the proposed system is capable of meeting the needs of the City at General Plan build-out.

3. Development of a citywide hydraulic model. The hydraulic model uses data from the previous two parts of the Update to provide an analysis of the system in three different scenarios. These scenarios include a current model of the existing system, a model of the existing system with targeted improvements to alleviate identified problems, and a build-out model of the system that includes improvements to and expansion of the existing system required to support General Plan build-out.

4. Identification and the related cost estimates for changes that are needed in the System. The System changes include both needed improvements to the existing system and improvements needed to support build-out of the General Plan.

2. EXISTING SYSTEM

The City's water production and delivery system (System) provides water for the City's residential and non-residential water users. The System includes the well field, the Water Treatment Plant (Plant), the distribution network (Network), pump stations, and the water storage reservoirs for the City.

The System is operated and maintained by the City. Water is supplied by four (4) wells located adjacent to the Plant, located a ¼ mile north of the East First Street (Crocker Road) Bridge along the Russian River. The water is treated at the Plant, pumped into the storage reservoirs and distributed to the Network.

Map 1 shows the extent of the existing Network. The Network is made up of three (3) distinct Pressure Zones (Zones). Each Zone has its own water storage reservoirs, pumps and Network. The zones are controlled by the maximum storage elevation of the Reservoirs in each respective zone. The elevation of the water in the Reservoirs determines what the pressure is at any particular point in the Network and the maximum elevation of any structure that a particular Zone can support.

- *Zone 1* is the primary water zone in the City. All water flows through Zone 1 to either the individual water users in Zone 1, to any of the three (3) storage reservoir sites, or into one of two pump stations that pump water into the other two Zones. The demand in Zone 1 uses approximately 67% of the water produced by the City. The maximum water surface elevation in the reservoirs in the zone is 468 ft above sea level. The Land Uses within this zone include a mix of residential and non-residential water users.
- *Zone 2* is located in the northern section of the City and generally includes the Jefferson Springs/School Street areas and the Vista View Drive area. Zone 2 contains one storage reservoir. The demand in Zone 2 uses approximately 13% of the water produced by the City. The maximum water surface elevation in the reservoir in this zone is 670 ft above sea level. The Land Uses within Zone 2 include primarily residential water users.
- *Zone 3* is located in the western and southwestern section of the City and primarily serves the areas west of Foothill Drive south of West Second Street. Zone 3 contains three storage reservoirs all on one site. The demand in Zone 3 uses approximately 20% of the water produced by the City. The Land Uses within Zone 3 include primarily residential water users.

2.1 Water Supply

2.1.1. <u>Water Rights</u>

Cloverdale's has one of the oldest water rights on the Russian River. The City's use has been continuous, beneficial and on going since the late 1800's. The following description of Cloverdale's water rights was taken from a letter prepared by Matthew L Emrick, Esq., of the Law Firm Soluri, Emrick, and Meserve and sent to the California State Water Recourse Control Board, dated March 31, 2008. Section V of that letter states:

V. ESTABLISHMENT OF CLOVERDALE'S PRE-1914 WATER RIGHTS

A. Cloverdale Incorporates and Develops Water Supply

The City of Cloverdale is located in Sonoma County at the northern end of the Alexander Valley. (See generally Vol. 3, Cloverdale Histories). The town site was originally part of the Mexican Rancho Rincon de Muscalon. (Id.). In 1858, 759 acres of the rancho were deeded to Richard Markle and W. J. Miller who established a trading post and tavern adjacent to the Russian River from which the town of Cloverdale began. (*Id.*). Early settlers were predominately farmers and ranchers. (*Id.*).

Cloverdale was incorporated as a City in 1872. (*Id.*). A map of the original city is attached. (See Vol. 1, Misc. Documents, Ex. H) Soon after incorporation, the railroad arrived as did commerce, shipping and tourism. (See generally Vol. 3, Cloverdale Histories).

The early residents of Cloverdale originally received their water from individual local wells and from the Cloverdale Water Company. (See generally Vol. 1, Misc. Documents; Vol. 2 Newspaper Articles; and Vol. 3, Cloverdale Histories). Cloverdale Water Company appears to have principally diverted water from several springs (and potentially other sources) near Cloverdale.[1] (*Id.*) However, due largely to the valuable and productive agricultural land surrounding the City, Cloverdale began to grow rapidly and needed water sufficient to meet not only its present needs but its future needs as well. (*Id.*).

Rather than recite the entire early history of Cloverdale, the City has included two major historical treatises on the Town of Cloverdale as well as a section of the City's general plan that give a historic perspective on the City's early years and its development (Vol. 3, Cloverdale Histories). These documents are incorporated by reference. In addition, historical maps of Cloverdale are also included (Vol. 1, Misc. Documents, Ex. H). As discussed in more detail below, the proposed town layout shown in an 1872 map is very similar to the City's boundary in about 1950's and 1960's.

B. Riverside Water Company is Founded to Support a Rapidly Growing City with Sufficient Water

To fulfill the future and expanding water needs of Cloverdale, a private company known as the Riverside Water Company ("Riverside") was formed in about 1884 by William Sink and others with the intent to provide Cloverdale with water from the Russian River (see Vols. 1-4). Construction of Riverside's water diversion facilities from the Russian River began that same year (see Vols. 1-4). Riverside's facilities were completed during the years 1885 to 1886 (see Vols. 1-4). These facilities originally included wells to pump the underflow of the Russian River and a reservoir (see Vols. 1-4). The City's existing wells and diversion facilities are located in nearly the identical area as Riverside's original diversion.

[1] Cloverdale no longer diverts water from these springs.

As noted above, the purpose of Riverside's water diversion facilities was in part to provide municipal water to the City of Cloverdale to meet both its present and future needs (See Vols. 1-4). In order to construct the necessary facilities to serve Cloverdale, Riverside acquired certain pipeline easements to access its reservoir site within Cloverdale (See Vols. 1 and 4). The first water deliveries to Cloverdale from Riverside occurred in 1886 (See Vols. 1-4). Cloverdale granted Riverside a franchise by way of Ordinance for the purpose of constructing its pipelines within the City's streets in the 1880's. (See Vols. 1 and 2)

Water was plentiful even from shallow wells. (See Vols. 1 and 2)

In order to meet an ever faster growing City, Riverside filed and recorded a Notice of Appropriation for Sulfur Creek – just upstream of Riverside's existing facilities on the Russian River. (Vol. 1, Misc. Documents, Ex. C). The Notice set forth the intent to divert 5000 miners' inches of water (125 cfs) for a variety of different purposes, including uses within the City of Cloverdale. This Notice indicates that Riverside provided water for an area larger than just Cloverdale.

Other than the Sanborn Maps, newspaper articles, Cloverdale official minutes, and various recorded documents (e.g. easements and notice of appropriation) provided with this memorandum (Vols. 1 – 4), Cloverdale has not been able to yet locate any other information relating to Riverside. However, research on this issue is on going.

C. <u>Cloverdale Acquires Riverside Water Company</u>

In about 1903, Cloverdale began the process of acquiring Riverside's facilities and water rights. The transfer was completed in 1905 by way of Deed (Vol. 1, Misc Documents, Ex. B; Vol. 6 – 1905 Minutes) The Deed identifies the facilities and point of diversion. The source of water is identified as the Russian River and "adjacent points" – obviously referring to Riverside's rights to Big Sulfur Creek, which were diverted at Riverside's pumping plant. Cloverdale's present diversion facilities are located in nearly the same area as Riverside's original diversion.

At the time of the transfer to Cloverdale, Riverside had two wells and a 250,000-gallon concrete reservoir. Water was pumped from the Russian River via two pumps: a 42,000-gallon per hour steam pump and a 20-21,000 gallon per hour diesel pump (total combined capacity of approximately 1.5 million gallons per day). (See e. g, Vol. 1, Misc. Documents, Ex. A).

Contemporaneously with the purchase of Riverside, and as part of the City's plan for expansion and future use of its water supply, Cloverdale incurred substantial bond indebtedness in order to construct the extension and improvement of the existing water system and also to build an entirely new sewer system (Vol. 4, 1905 Minutes).

D. <u>Summary of Cloverdale's Pre-1914 Water Rights</u>

Based on the discussion above and the supporting evidence, the City of Cloverdale has the following rights:

- A pre-1914 appropriative water right to the Russian River in the

amount of *at least* 2.5 million gallons per day (based on current use) with a priority of 1884 and the right to further expand that use.

- A pre-1914 appropriative right to divert water from Big Sulfur Creek in the amount of 125 cfs (5000 miners' inches) with a priority of 1895.

E. <u>Other Water Related Development Benefiting the City</u>

In 1902, A. E. Sbarboro filed a Notice of Appropriation to divert water from Big Sulfur Creek. (Vol. 1, Misc. Documents, Ex. D; Vol. 2, Newspaper Articles). The diversion was to be by way of a dam that diverted water to powerhouse at the mouth of Big Sulfur Creek (*Id*). The purpose of the diversion was primarily to provide electricity to the City of Cloverdale, Asti and other places in Sonoma County as well as for irrigation and "other useful purposes." (Id.).

This diversion and dam was indeed constructed from about 1903 to 1905. (See Vol. 2, Newspaper Articles). The result was the Cloverdale Light and Power Company. This company provided electric power to Cloverdale until about the early 1920's when it was purchased by PG & E (See Vol. 3, Cloverdale Histories).

2.1.2. <u>Existing Production Wells</u>

For a number of years, the City has relied upon three (3) wells located on the Plant property along the west bank of the Russian River, approximately ¼ mile north of the East First Street (Crocker Road) Bridge. Historically, water produced by these wells had supplied the City and kept up with the needs. In both the 1992 Water Master Plan and the 1998 Water Master Plan Update it was mentioned that additional wells would be needed to support growth and to meet the needs of the General Plan that was adopted in 1992. Beginning in the late 1990's the City experienced a significant increase in growth. The growth required expansion of the City's water treatment plant in 2000. This expansion provided two additional filter bays (for a total of 4 filter bays) for processing water from the wells. Only 3 of the filter bays contain filter media (the fourth was installed but not activated.) During the expansion of the Plant, Wells 6, 7 and 8 were refurbished.

Over the ensuing years after expansion of the plant, the City began to experience a slow degradation of the maximum production volume in the 3 existing wells. In an attempt to improve production, the City refurbished the wells again in 2004. Although production did increase for a few months following the refurbishment, production once again began to drop in 2005. In 2006, the City began to develop plans for the installation of an additional well. Based on results from test wells drilled by consultants, a location for the new well (Well 11) was established just north of Well 8. The well was drilled and tested. During testing, this well was determined to have a constant-yield of approximately 200gpm. Based on this lower yield (in comparison to the other existing wells which produced 800 to 1,000 gpm in the past), it was decided that this well did not have sufficient production to warrant putting into daily production. Therefore, Well No. 11 was capped and was not connected to the yard piping at the Plant. Subsequently, at the direction of a hydrogeologist, further test wells were dug in an effort to find

a higher yielding well. Based on the test data from additional test wells, a new well (Well #3) was installed south of Well 6 and connected to the yard piping at the Plant. Simultaneously with the construction of this well, an older hand dug shallow well (known as old Well #3) that had only been used in emergency situations in the past, was abandoned in accordance with Sonoma County Environmental Health regulations. Subsequently, in 2007, Wells 6, 7 and 8 were refurbished once again.

Based on this scenario, water for the City of Cloverdale is currently provided from four (4) wells adjacent to the City's water treatment plant facility. All four (4) wells are classified by the California Department of Public Health (CDPH) as utilizing groundwater that is under the direct influence of surface water in the Russian River. Under ideal conditions (assuming that the existing wells were producing 800-1,000 gpm each), the City would operate no more than three (3) wells at a time. This allows the wells to be rotated, which extends the operational life of all the wells and provides at least one (1) well to serve as a backup in case of a problem. However, under current conditions, in times of lower ground water elevations, which typically coincide seasonally with the period of high demand, the production capacity of the wells are limited by the entrainment of air. Air entrainment occurs at different pumping rates for each well. As a result of this the current maximum production during seasonally lower ground water is achieved utilizing only two (2) of the four (4) well. In light of this, the City has taken measures to reduce the maximum day demand by instituting water conservation measures during the peak water demand months. In addition to the water conservation measures, in an effort to resolve this, the City has retained a specialty hydrogeology firm to conduct studies on the existing well field as well as explore possible locations for new wells. The following is an excerpt of the findings of the well field hydrogeologic study performed by Luhdorff & Scalmanini:

> A primary purpose of the City's 2008-09 hydrogeologic study was to identify factors that constrain well pumping and limit the City's ability to meet peak water demands. Since about 2001, air entrainment in the pumped well water has been observed during periods of peak water use, a condition that has a deleterious effect on water treatment plant (WTP) operation. When air entrainment occurs, production from the entire well field is reduced by manually restricting of flow through the WTP. While the air entrainment can be alleviated by this action, it comes at the expense of well field capacity and leads to a potential inability to meet peak water demand.
>
> Water level monitoring of the City's wells from winter 2008-09 through summer 2009 was conducted to evaluate the hydraulic relationships between the Russian River, the aquifer system and the wells. This resulted in several findings that are relevant to the air entrainment problem and potential water system improvements. First, there is a favorable hydraulic connection between the Russian River and groundwater levels in the City's wells. When the river stage is highest during the winter months and spring, there are correspondingly high groundwater levels in the City wells. With higher groundwater levels and low water system demand, the wells perform satisfactorily with no air entrainment. However, in summer and fall months when the river stage is lowest, deeper groundwater levels in the wells may constrain pumping on days of highest demand. Interpretation of water level monitoring data indicated that the onset of air entrainment in well water corresponds to the longest run times and the greatest pumping drawdown in the wells. Air entrainment occurs when the pumping water level falls sufficiently below the intake perforations in the well and the water falls or cascades, into the well. Air then

becomes entrained through mixing of the two phases. Because the City wells are shallow, there is limited available pumping drawdown between the perforations and the static water levels during summer months when the demand is highest. This problem may be exacerbated by mutual pumping interference that results in additional lowering of the water table when multiple wells are running.

In 2006, the CDPH noted that problems with air entrainment might affect the City's ability to meet the system MDD. A test of the City's maximum water source capacity was required by CDPH and conducted in September 2009 with Luhdorff & Scalmanini's assistance. The test results indicated that the current maximum capacity of the City's well field is 2.3 to 2.4 MGD. Because of constraints in the well designs (i.e., the elevation of the well perforations), the test could only be conducted with two wells running. Additionally, a lack of well controls prevented optimization of flow from the two wells used in the test. Further limiting the well field capacity were reduced releases from Lake Mendocino in 2009, which led to the lowest river stages in 20 years and even less operating flexibility with respect to the occurrence of air entrainment.

With respect to details of each of the existing wells, the following describes each of the wells:

Well 3 - Well 3 was drilled in 2006, and it is approximately 40 feet from the edge of the bank to the Russian River. The well is equipped with a low head 25 horsepower turbine pump set inside an 8-inch diameter pump casing at 80 feet. The rated well pump capacity is 800 gpm. This well is used infrequently due to air entrainment problems.

Well 6 - Well 6 was drilled in 1968. The well is equipped with a new low-head 20 horsepower turbine pump set inside an 8-inch diameter pump casing at 60 feet. The well's pump capacity is approximately 800 gpm at a total dynamic head of 93 feet. This is a primary source well.

Well 7 - Well 7 was drilled in 1974. The well is equipped with a new low-head 25 horsepower turbine pump set inside an 8-inch diameter pump casing at 60 feet. The well's pump capacity is approximately 1,050 gpm at a total dynamic head of 60 feet. This well is used infrequently due to air entrainment problems and is the first secondary well brought online when wells 6 and 8 cannot meet demand.

Well 8 - Well 8 was drilled in 1976. The well is equipped with a new low head 25 horsepower turbine pump set inside an 8-inch diameter pump casing at 60 feet. The well's pump capacity is approximately 1,050 gpm at a total dynamic head of 80 feet. This is a primary source well.

2.1.3. Treatment Facilities

The City's Water Treatment Plant (Plant) was constructed and placed into service in March 1996. The Plant is located approximately ¼ mile upstream from the East First Street (Crocker Road) Bridge on the west bank of the Russian River. Raw water is drawn from the well field and flows into a single PVC transmission main running parallel to the well field into the treatment plant.

Treatment processes at the Plant includes the following:

- Chemical injection of aluminum sulfate
- Static mixer (baffled) for rapid mixing and coagulation
- Flow through upflow adsorption clarifier for solids removal
- Filtration through mixed media gravity filters
- Post-disinfection by gas chlorination treatment
- Chemical injection of caustic (NaOH) for corrosion control

The treatment plant operates three TR420A Double Stretch CPC Microfloc package treatment units in parallel. Each unit has a design capacity range from 550 to 1,050 gpm. Typical flow rates through the treatment plant are from 550 to 3,150 gpm. Based on this flow rate, and taking into account backwash and filter-to-waste cycles, the approximate maximum production rate of the treatment plant is approximately 4,100,000 gpd. Two 50,000-gallon steel chlorine contact tanks were removed in 2000, and were replaced with a single 750,000-gallon steel combined chlorine contact tank/reservoir.

The Plant's operation is controlled by the water levels in the Main reservoirs. When the Main reservoirs drop past a threshold level, a level transducer in one of the reservoirs sends a signal to activate the well field. This in turn activates the Plant, which begins operating at its lowest capacity of 550 gpm on startup. The Plant can be set to increase production at the rate of 100 gpm for every 0.1-foot drop in the Main reservoirs. However, the filters operate more efficiently with steady flow rates. Consequently, the operators typically use larger increments in plant production rates. When the Main reservoirs are full, a signal is sent to turn off the wells and the Plant.

2.2. Storage and Distribution Facilities

The Storage and Distribution Facilities include the piping network and all of the fire hydrants, pumps, and reservoirs for the separate Zones in the City. Water is distributed to the City through three (3) Pressure Zones.

2.2.1. Pressure Zones and Storage Tanks

Zone 1 - The Main Pressure Zone (Zone 1) serves approximately 2,000 connections and accounts for 67% of the water demand for the entire System. The maximum water surface elevation of Zone 1 tanks is 468 ft above sea level. Zone 1 has three (3) separate gravity controlled storage reservoir sites. The Main Storage Reservoirs are located on top of the hill west of the Plant on King Ridge Road overlooking Hwy 101. The reservoirs on this site consist of two in-ground concrete reservoirs with storage of 354,000 gallons and 196,000 gallons respectively. The second reservoir site is the Southcrest Reservoir. This site is located at the westerly City Limit on Cherry Creek Rd. and consists of a single 200,000-gallon welded steel tank. The third reservoir site is the Hot Springs Reservoirs located at the westerly City Limit on Hot Springs Road. This site consists of two 500,000 gallon welded steel reservoirs.

In addition to the above-mentioned tanks in Zone 1, there also is one 750,000 gallon welded steel tank at the Plant that serves as both a chlorine contact tank and a reservoir. This tank is not

gravity controlled, but is on the inlet side of the pumps that move the water supplied by the treatment plant into the Network.

Zone 1 has approximately 2.5 million gallons (mg) of water storage. Water for Zone 1 is supplied from four (4) pumps located at the Plant. The pumps move the water from the chlorine contact tank at the Plant up to the Main reservoirs and into the Network. There are three (3) 1,150 gallon per minute (gpm), 60 horsepower (hp) pumps and one (1) 2,300 gpm, 150 hp pump.

Zone 2 - Zone 2 serves approximately 350 connections and accounts for approximately 13% of the City's water demand. The Ritter Reservoir is the only storage tank currently in Zone 2 (bolted steel tank) and has a maximum storage capacity of 500,000 gallons. The maximum water surface elevation of the Ritter Reservoir is 670 ft above sea level. The Ritter Reservoir in Zone 2 is supplied by two (2) 600 gpm, 50 hp pumps at the pump station located on School St just north of Hillside Drive. This pump station pumps water from the Zone 1 system up to the Ritter Reservoir. At the current time, only one pump can be operated at a time because of power limitations at the pump station. Zone 2 serves the hillside perimeter connections in the north and northwestern portions of the City including the Jefferson Springs area and the Vista View Drive area (see map). The Ritter Reservoir acts as the control switch for the pump station. When water elevations in the tank fall below a certain level a signal is sent to the pump station to turn on. It should be noted that the Ritter Tank site is ultimately designed to have two 500,000-gallon reservoirs on the site. The current tank is at capacity (based on demand). Any further demand in Zone 2 will require the second tank to be constructed.

Zone 3 - Zone 3 serves approximately 600 connections or 20% of the City's water demand. Zone 3 is comprised of 3 tanks at the Clover Springs Reservoir site. The Clover Springs Reservoir site is located at the westerly end of Skyview Drive. The site consists of two 375,000-gallon welded steel tanks and one 500,000 gallon welded steel tank. The reservoirs have a maximum storage elevation of 710 ft above sea level. All three tanks are fed from a pump station on Foothill Boulevard that pumps water from Zone 1 up to the tanks in Zone 3. The pump station contains three (3) pumps capable of pumping 1,250 gpm if all three (3) pumps are operating at the same time. These 75 hp pumps are controlled from water level transducers in the Clover Springs tanks.

Target storage requirements to meet American Insurance Association guidelines are as follows:

- Domestic Storage – Domestic Storage is the average daily water demand in the year of greatest demand in the past 10 years (this was 2004 for the City of Cloverdale).
- Fire Storage – Fire storage based on the maximum type of land use in a particular Zone and the typical duration to fight a fire.
- Equalization Storage – Equalization storage is one-quarter (¼) of the Peak Daily Demand based on the year of highest demand (2004).

Ideally, reservoir levels should operate on a day-to-day basis using the Domestic Storage water. Water storage in any individual reservoir should contain at least the volume identified as fire storage at all times in case of an emergency. **Table 2.1** below illustrates how the stored water is distributed through the City. Water storage was distributed to each of the water zones in terms of actual demand that each zone has.

Table 2.1
City of Cloverdale
Current Water Storage

Greatest Average Yearly Production (2004)	**528.9**	**Mgpy**

Zone 1 % of total production	***68.16%***	
Demand		
Domestic Demand Storage	987,666	gal
Fire Flow Storage (Industrial) (3000 gpm * 180 min)	540,000	gal
Equalization Storage (ADD-Zone 1 * Peaking Factor * 25%)	484,632	gal
Required Storage	**2,012,299**	**gal**
Storage		
Main Reservoir (2-reservoirs)	550,000	gal
Southcrest (1-tank)	200,000	gal
Hot Springs (2-tanks)	1,000,000	gal
Treatment Plant Storage (1-tank)[1]	750,000	gal
Available Storage	**2,500,000**	**gal**
REMAINING STORAGE	**487,701**	**gal**

Zone 2 % of total production	***14.61%***	
Demand		
Domestic Demand Storage	211,705	gal
Fire Flow Storage (Residential) (1,500 gpm * 120 min)	180,000	gal
Equalization Storage (ADD-Zone 3 * Peaking Factor * 25%)	103,880	gal
Required Storage	**495,585**	**gal**
Storage		
Ritter (1-tank)	500,000	gal
Available Storage	**500,000**	**gal**
REMAINING STORAGE	**4,415**	**gal**

Zone 3 % of total production	***17.23%***	
Demand		
Domestic Demand Storage	249,670	gal
Fire Flow Storage (Commercial) (2,000 gpm * 120 min)	240,000	gal
Equalization Storage (ADD-Zone 3 * Peaking Factor * 25%)	122,509	gal
Required Storage	**612,179**	**gal**
Storage		
Clover Springs (3-tanks)	1,250,000	gal
Available Storage	**1,250,000**	**gal**
REMAINING STORAGE	**637,821**	**gal**

[1] This is the chlorine-contact tank at the Water Treatment Plant. Although it is included here as part of the existing storage, it is technically a treatment facility and consequently it is not included in the future storage calculations shown on Table 3.5.

Peaking Factor (Peak Day Demand/Average Day Demand) = 1.9627, Table 2.6.

In addition to the individual storage for each zone, Zones 1 and 2 and Zones 1 and 3 are interconnected to allow water to move from the higher-pressure zones to the lower pressure zones if pressure in any Zone falls below 20 psi.

2.2.2. Piping Network

The City has approximately 40 miles of water mains ranging from 4-inch diameter to 16-inch diameter. The pipe material includes ductile iron (DI), cast iron, polyvinyl chloride (PVC), and asbestos concrete pipe (ACP). In recent years, the City's adopted Design and Construction Standards require new water mains to be a minimum of 8-inches in diameter. This requirement helps to ensure a system with good fire flow and pressure distribution characteristics. There are some older areas of the City served with 4-inch diameter mains. These pipes should be replaced over time through a capital improvement program. Additionally, there are many 6-inch diameter mains within the system. These mains may or may no need to be replaced, depending on age, pipe condition, fire flow in the area and demand service characteristics.

The **Table 2.2** is a summary showing the pipe material and diameter within the existing distribution system.

Table 2.2
City of Cloverdale
Pipe Material and Diameter Summary (Linear Foot)

	Pipe Size					
Pipe Material	**4-inch**	**6-inch**	**8-inch**	**10-inch**	**12-inch**	**16-inch**
Cast Iron	6,108	1,813	2,876	0	0	0
DI	0	0	0	112	994	0
ACP	10,059	33,644	19,461	9,627	7,887	0
PVC	1,319	4,507	72,539	1,588	45,452	4,241
Subtotal	*17,486*	*39,964*	*94,876*	*11,327*	*54,333*	*4,241*
Total						**222,227**

Table 2.3 shows the approximate relative age of pipes in the City's system by pipe type. Pipe ages are based on best available information compiled from improvement plans.

Table 2.3
City of Cloverdale
Pipe Type and Age (Linear Foot)

Year Installed	Cast Iron	DI	ACP	PVC
1950	10,797	0	0	0
1965	0	0	63,446	64
1970	0	0	2,661	0
1978	0	0	6,944	0
1980	0	0	7,627	6,212
1985	0	0	0	2,944
1989	0	0	0	11,609
1990	0	0	0	1,107
1993	0	1,106	0	7,532
1994	0	0	0	3,898
1996	0	0	0	3,429
1997	0	0	0	3,165
1998	0	0	0	9,172
1999	0	0	0	11,019
2000	0	0	0	17,254
2001	0	0	0	22,087
2002	0	0	0	4,731
2003	0	0	0	4,269
2004	0	0	0	6,711
2006	0	0	0	11,263
2008	0	0	0	3,180
Subtotal	*10,797*	*1,106*	*80,678*	*129,646*
Total				**222,227**

2.2.3. Hydrants

Fire hydrants have a specific flow rating. The flow rating is dependent on land use in the area surrounding the hydrant. Hydrant flows are measured during a Peak Hour Demand (PHD). PHD is measured as the Average Daily Demand (ADD) multiplied by a Peak Day Factor (PDF) then multiplied by a Peak Hour Factor (PHF) of 1.5.

The 2007 California Fire Code, Appendix B, Section B105 sets the fire-flow requirements for all structures and therefore sets the flow requirements for the fire hydrants. The minimum residential fire flow is 500 gpm at a pressure of 20 psi for a structure that has less than 3,600 square feet (sf) that are equipped with automatic fire sprinklers. However, if a structure is not equipped with automatic sprinklers, the minimum fire flow is 1,000 gpm at a pressure of 20 psi for a duration of 2 hours for structures equal to or less than 3,600 sf. For all other structures Table B105.1 of the 2007 California Fire Code applies. Per Table B105.1, the minimum fire flow is 1,500 gpm for a duration of 2 hours based on the square footage of the structure. The City Municipal Code requires all new structures shall be equipped with fire sprinklers.

The required flows for all hydrants are detailed below and are in keeping with the 2007 California Fire Code:

- The minimum acceptable fire flow for existing hydrants in residential areas is 1,000 gpm for 2 hours.
- The required minimum fire flow for new hydrants in residential areas is 1,500 gpm for 2 hours.
- The required minimum fire flow for new or existing hydrants in commercial areas (buildings of 8,200 sf - 12,900 sf) is 2,000 gpm for 2 hours.
- The required minimum fire flow for new or existing hydrants in industrial areas (12,900 sf – 30,100 sf) is 3,000 gpm for 3 hours.

It should be noted that all flows shown above must have a minimum available pressure of 20 psi at the hydrant.

The actual fire flows for a specific new structure served by a fire hydrant shall be based on the requirements of the 2007 California Fire Code Appendix B Section B105 and Table B105.1. In the case that a specific structure's fire flow requirement is greater than the actual fire hydrant's available supply, special conditions for new construction are required.

There are approximately 440 fire hydrants in the City's water distribution system. Hydrant spacing is required by the City Design and Construction standards to be spaced at a maximum of 300 feet on center. There are approximately 2,950 water connections in the City. Of the total connections, 2,650 are residential and 300 are non-residential. Initial assessment of the current system shows that approximately 50 hydrants do not meet the minimum residential fire flow requirements. This is discussed further in Section 4.3.

2.3. Water Supply Analysis

The water supply analysis for the existing system was conducted considering both production and usage. The following subsections outline the analysis procedures used, the production and usage data and data modifications, the production and usage analysis results, and recommendations for modifications, repairs and system improvements.

2.3.1. Data Analysis Procedures

In the analysis of the water system, data from the Water Treatment Plant Operators and City's Utility Billing Department was used. The procedure for analysis required amassing the data into a usable format and conducting an initial quality assessment of the data to develop a level of confidence with regard to its accuracy and dependability. Indicators used in determining the level of confidence in the data were:

- Inconsistent data between independent sources (LOW)
- Multiple manipulations of the recorded data (LOW)
- Small data sets (LOW)
- Wide unanticipated variations in data sets (LOW)
- Consistent, well-monitored data retrieval (HIGH)
- Limited number of manipulations of data (HIGH)

- Large sample sets of data (HIGH)

Data amassed with a level of confidence of "LOW" was analyzed to identify potential problem areas and, if needed, possible solutions to improve the data set. If a process of data repair was possible, repair was undertaken until the level of confidence was "HIGH". If repairs were not possible, the data set was discarded or amended such that the problem areas identified were avoided.

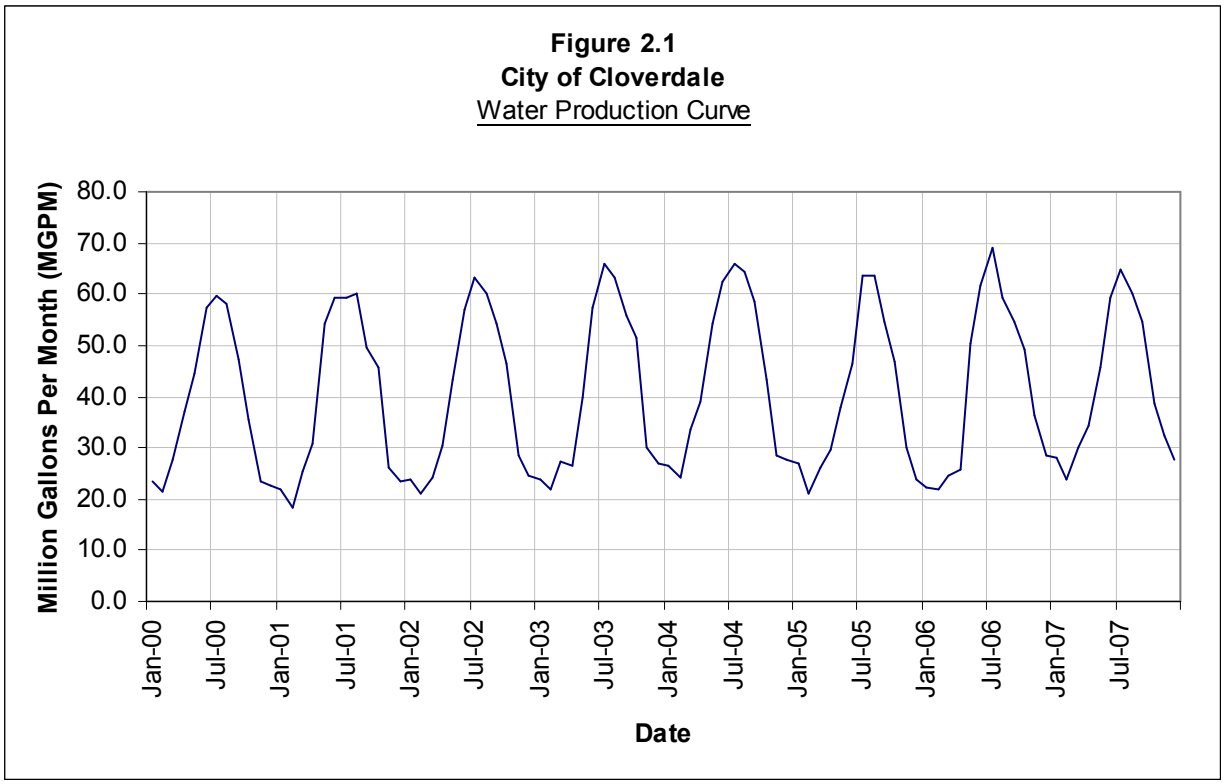
Once the level of confidence for the data was "HIGH" the data was analyzed to determine normal and peak operational parameters for monthly, seasonal, and yearly variations. From these operational parameters, a hydraulic water model (**Section 4.0**) was developed that integrated the usage and production data with the model of the reservoirs, piping network, fire hydrants and pump stations.

2.3.2. Water Production

The water production data was compiled using the production logs from the Cloverdale Water Treatment Plant (Plant). Production data was analyzed for the period from January 2000 through December 2007. The initial assessment of the data resulted in a "HIGH" confidence level because the data included a consistent, well-monitored data retrieval program, there were a limited number of manipulations and the data set was large. Further, the experienced results match the expected out come when a plot of the production by year was created. It was expected that from year to year there would be little variation in the shape of the graph. **Table 2.4** shows the monthly production data and **Figure 2.1** illustrates water production in gallons per month over the study period. The water production graph shows maximums in the summer months and minimums in the winter months corresponding to seasonal variations in water demand. Monthly production varied from approximately 20 million gallons per month (mgpm) in the winter to 70 mgpm during the summer over the study period.

Table 2.4
City of Cloverdale
Monthly Water Production Table (mgpm)

Year	2000	2001	2002	2003	2004	2005	2006	2007	Average
Jan	23.6	21.8	23.9	23.8	26.5	27.0	22.2	28.2	**24.6**
Feb	21.3	18.5	21.1	21.9	24.3	21.1	21.8	23.7	**21.7**
Mar	27.8	25.5	24.1	27.3	33.6	26.1	24.6	30.1	**27.4**
Apr	36.9	31.0	30.6	26.5	39.1	29.8	25.8	34.5	**31.8**
May	44.4	54.3	43.4	39.7	54.3	37.9	50.4	45.8	**46.3**
Jun	57.2	59.2	57.1	57.4	62.5	46.2	61.7	59.3	**57.6**
Jul	59.6	59.2	63.2	65.8	66.0	63.8	69.0	64.7	**63.9**
Aug	58.3	59.9	60.1	63.2	64.3	63.6	59.2	59.9	**61.1**
Sep	47.3	49.4	54.4	55.8	58.4	54.8	54.6	54.7	**53.7**
Oct	35.6	45.6	46.5	51.4	43.2	46.8	49.2	38.8	**44.6**
Nov	23.6	26.0	28.5	30.0	28.6	29.9	36.4	32.5	**29.4**
Dec	22.8	23.3	24.6	27.0	27.8	23.8	28.5	27.8	**25.7**
Totals	**458.4**	**473.7**	**477.6**	**489.7**	**528.6**	**470.9**	**503.5**	**500.0**	**487.8**



2.3.2.1.Analysis

The purpose of the production analysis was to determine the average annual volume needed to meet the current water demand, to determine peak demands, to provide a ratio of comparison of current water production to current water usage for quantifying line losses and to develop the base data used for a hydraulic water model.

The results of the production analysis indicate that the City's water production has been increasing by an average of approximately 6 mg each year over the study period. However, it should be noted that water conservation measures implemented in July 2006 have had a noticeable impact in lessening the demand during the summer months. The peak yearly water production for the study period occurred in 2004 and was 528.6 mg. The average annual production over the study period was 487.8 mg.

The maximum day demand (MDD) was determined from the City's water production records as the largest volume of water produced in a single day within a single year. The maximum daily demand (MDD) in the experience in the last 10 years occurred in July of 2004 and was 2.85 mgd. The maximum day demand experienced in 2009 was 2.07 mgd.

For systems with greater than 1,000 connections (applicable to Cloverdale), Section 64554 of Title 22 of the California Code of Regulations requires the water system to have the capacity to meet the MDD at all times. As discussed in Section 2.1.2 above, the maximum 24-hour production that was achieved in 2009 during the seasonal lower groundwater elevations was 2.45 mgd. This is 400,000 gallons less than the required 2.85 mgd.

In addition, Title 22 of the California Code of Regulations requires the water system be able to meet four hours of peak hourly demand (PHD), with source capacity, storage capacity, and/or

emergency source connections. When daily water usage data is available, Section 64554 of Title 22 requires that PHD be determined as the average hourly demand of the MDD multiplied by a factor of not less than 1.5. The results of this analysis are provided in **Table 2.5**.

Table 2.5
City of Cloverdale
Peak Day and Peak Hour Demand

Year	MDD Production (mg)	Average Maximum Hourly Day Projection (mg)[1]	PHD (gal)
2002	2.833	0.118	177,063
2003	2.517	0.105	157,313
2004	2.850	0.119	178,125
2005	2.379	0.099	148,688
2006	2.552	0.106	159,500
2007	2.395	0.100	149,688
		Maximum PHD	**178,125**
		Required Pump Capacity	**2,969 gpm**

1 The Average Maximum Hourly rate was determined from the Maximum Daily Production divided by 24 hours.

The MDD in the analysis period occurred in 2004, with a total production of 2.85 mgd, equating to an average maximum hourly production of 118,750 gallons. When the required minimum peaking factor of 1.5 is applied to the Average Maximum Hourly Production, the resulting Peak Hourly Demand of 178,125 gallons is obtained.

The maximum 24-hour production of 2.45 mgd from the 2009 24-hour test equates to an average hourly production of only 102, 083. While it is possible that a higher rate could be sustained for a four hours, it would still be far short of the 178,125 PHD requirement.

The results of this analysis show that the water production capability of the system is clearly not within the requirements of Title 22 with regards to source capacity.

The peaking factor for Maximum Day Demand is an average of peak days for each year in the study period compared with the average day demand for each year. **Table 2.6** below shows this analysis.

Table 2.6
City of Cloverdale
Maximum Day Demand (MDD) Peaking Factor

Year	MDD Production (mg)	ADD Production (mg)	MDD Peaking Factor
2002	2.833	1.253	226.17%
2003	2.517	1.298	193.96%
2004	2.850	1.308	217.83%
2005	2.379	1.342	177.32%
2006	2.552	1.444	176.72%
2007	2.395	1.290	185.65%
Average MDD Peaking Factor			**196.27%**

2.3.3. Water Usage

Water usage differs from water production in that it is measured from the user point of view. In an ideal world the summation of water usage should equate to the total water produced; however, this is generally not the case as water is lost in the system in the form of leaks, un-metered water usage, and other water demands not accounted for in the form of water usage. The data amassed for water usage deals only with metered accounts. The analysis of the water usage will define what the individual water user demands are and provide a geographical breakdown of how the water demand is distributed throughout the City.

2.3.3.1. Source Data

The initial source data used for the analysis of water usage for the City was taken from the Public Water System Statistics for the Calendar Years of 2001 – 2007 provided by the City Utility and Billing Department. However, when the usage values were compared with the production values, some discrepancies were encountered. Therefore, additional analysis was needed and new data was requested from the City. City of Cloverdale's Utility and Billing Department provided data from the Billing Record Database for the period of July 1, 2001 through March 31, 2008.

Each data point represented the total volume of water used in gallons per month per service connection. The initial assessment of the data indicated a "LOW" level of confidence. While the data set was large, there were wide unanticipated variations in the data leading to graphical and statistical abnormalities. Additionally, the data was manipulated by several independent sources with no vertical review between handlers[2]. The usage data was analyzed to identify the root causes of the unanticipated variations in the data and a process of normalization was undertaken. The processes and results of the normalization procedures are discussed in detail in

[2] Vertical data review is required when data is passed up or down a chain of command. Review of the manipulated or recorded data should be reviewed by both the recorder and the data keeper when those tasks are handled by separate people.

Appendix 1. **Table 2.7** below shows the results of the normalization changes to the raw data. Each of the normalization criteria are:

- *Initial reading error.* Initial reading errors occurred with the initial reading of a meter following the transfer of an account to a new account holder
- *Abnormal meter reading.* Abnormal meter readings occurred when a meter recorded an improper value as a result of some sort of a malfunction with the meter
- *Meter reading error.* Meter reading errors occurred when a meter was incorrectly read or recorded
- *Meter correction.* Meter corrections occurred when a meter was misread one month, then corrected the following month

Table 2.7
City of Cloverdale
Water Usage Evaluation Returns

Error Type	Occurrence	Initial Value (Gallons)	Modified Value (Gallons)
1-Initial Meter Adjustment	224	77,644,052	1,913,732
2-Adnormal Meter Reading	103	55,725,382	1,922,453
3-Meter Reading Error	6	248,101,773	3,219,567
4-Meter Correction	6	(97,995)	38,929
Totals	**339**	**381,373,212**	**7,094,682**

After the normalization process, usage data was organized by water user, type of user, location of the connection, and land use type of the location.

2.3.3.2.Modified Water Usage

The resulting graph obtained from the normalization process is shown in **Figure 2.3.** The modified water usage graph also shows the anticipated approximate curve with maximums in the summer months and minimums in the winter months corresponding to seasonal variations in water demand. Daily production varied from approximately 17.0 MGPM in the winter to 60.0 MGPM during the summer over the study period. The comparison with water production curve from **Figure 2.1** is given in **Figure 2.3a**.

Figure 2.3
City of Cloverdale
Modified Water Usage Curve

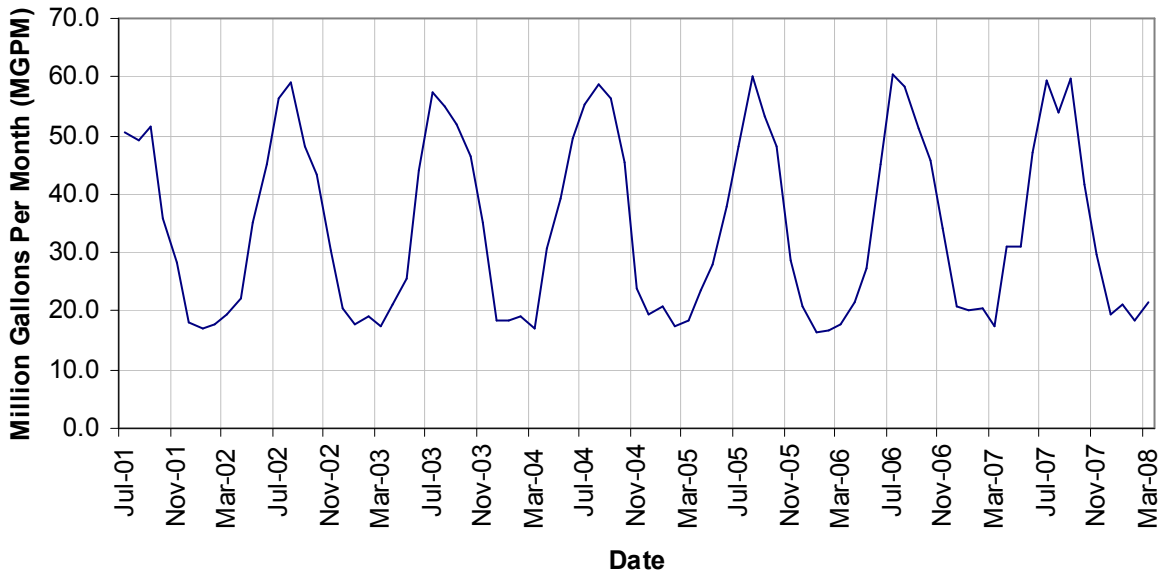
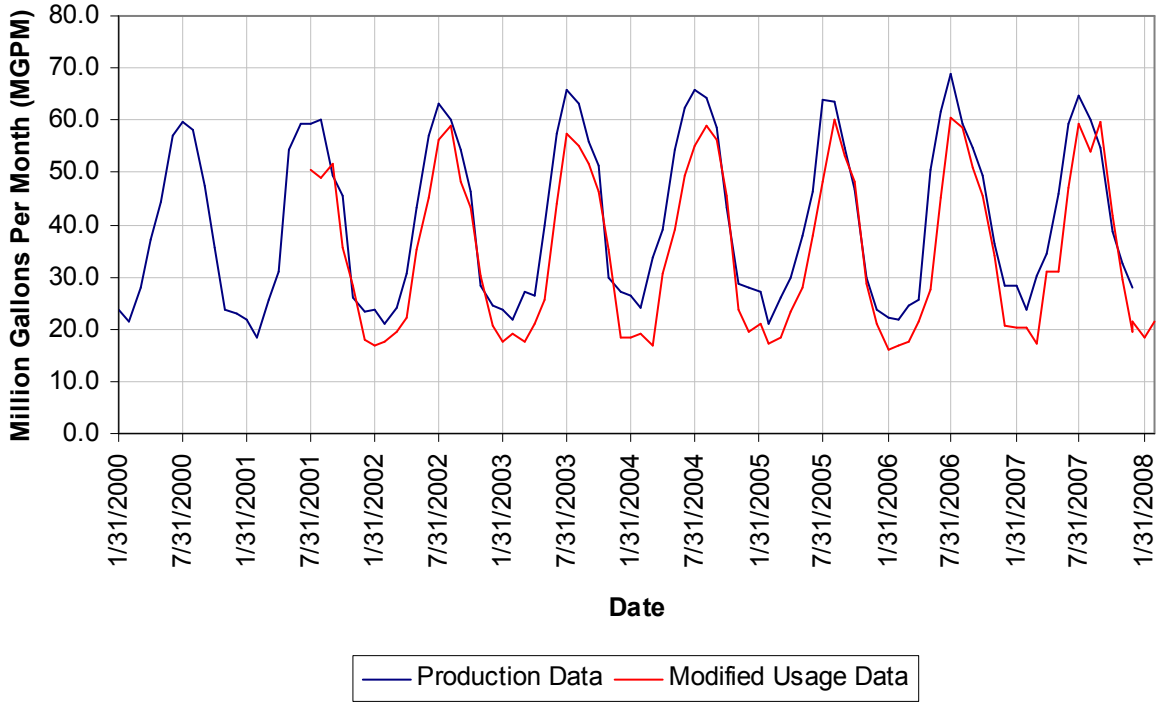


Figure 2.3a
City of Cloverdale
Modified Water Usage v. Water Production Curve



2.3.3.3. Modified Water Usage Analysis

Once normalization of the raw data was complete, analysis of modified usage data was completed. The purpose of this analysis was to quantify the water usage in the City by residential and non-residential demand. As part of the initial assessment of the usage data, each of the water users was identified by land use type and the corresponding location and pressure zone. The data provided was categorized into one of the following 30 water use categories:

Car Wash
Office Space
Professional Office Space
Laundromat
Department/Retail Space
Warehouse
Hospital
Theater
Memberships
Social Services
Motel without Restaurant
Auto Repair/Service
Manufacturing
Shopping Center
Nursery
Supermarket
Restaurant
Schools
Large Volume
Single-Family Dwelling
Multi-Family Dwelling
Residential without Sewer
Commercial without Sewer
Irrigation without Sewer
City Spaces with Sewer
City Domestic without Sewer
City Irrigation
Out of Town Water
Hydrants
Fire Service

Modified water usage in the City was distributed by the following Non-Residential (**Table 2.8a**) and Residential (**Table 2.8b**) values.

Table 2.8a
City of Cloverdale
Non-Residential Water Demand

	Non-Res Con Type	2002		2003		2004		2005		2006		2007	
		Con	Gal / Year	Con	Gal / Year	Con	Gal / Year	Con	Gal / Year	Con	Gal / Year	Con	Gal / Year
2	Car Wash	2	777,226	2	572,260	2	579,740	2	399,460	2	540,094	1	228,904
3	Office Space	22	1,524,151	22	1,904,540	22	1,599,335	22	1,644,218	21	1,680,873	22	2,364,592
4	Professional Office Space	20	2,031,480	21	1,973,361	22	1,825,247	21	1,579,138	21	1,431,771	21	1,425,787
5	Laundromat	1	1,598,587	1	1,544,727	0	372,530	1	1,209,600	1	1,215,584	1	1,324,052
6	Department/Retail Space	16	1,202,868	15	1,030,816	15	1,137,039	16	1,033,060	16	1,154,244	16	1,265,704
7	Warehouse	2	97,247	3	286,504	4	403,948	4	583,481	6	814,629	9	1,857,413
8	Hospital	3	4,372,364	3	3,005,673	3	2,968,270	3	2,832,873	3	2,948,073	2	3,099,179
9	Theater	1	160,831	1	67,325	1	78,545	1	70,317	1	67,325	1	62,836
10	Memberships	12	3,675,179	13	3,283,200	12	3,359,501	13	3,004,177	14	2,934,608	15	3,339,304
11	Social Services	10	1,101,132	10	1,143,023	9	1,467,678	9	1,908,281	9	1,983,834	10	1,751,190
12	Motel without Restaurant	7	2,971,262	8	3,629,548	9	4,105,309	9	3,922,036	9	3,776,914	10	3,726,047
13	Auto Repair/Service	15	2,679,782	14	2,368,332	14	1,931,470	14	1,890,327	13	1,820,010	13	1,839,460
15	Manufacturing	8	4,503,273	8	3,638,525	8	4,136,727	7	3,372,966	8	5,057,579	9	5,186,244
17	Shopping Center	2	38,151	2	31,418	2	29,174	2	35,906	2	41,143	2	87,522
18	Nursery	1	133,901	1	109,964	1	152,603	1	81,538	1	93,506	1	130,909
23	Supermarket	2	1,389,881	2	1,378,660	2	1,609,808	2	2,262,857	2	2,302,504	2	1,832,727
25	Restaurant	21	5,397,966	23	5,329,122	23	5,432,353	21	4,685,797	22	5,337,351	22	5,356,800
26	Schools	11	16,243,948	11	13,214,338	10	15,062,026	11	12,438,608	11	13,807,543	11	18,032,540
27	Large Volume	1	643,325	1	608,914	1	1,380,156	2	1,274,681	1	400,956	1	250,597
31	Commercial without Sewer	0	124,057	0	0	0	0	0	3,740	0	10,473	0	51,616
32	Irrigation without Sewer	23	24,545,829	29	24,919,855	29	23,288,353	32	21,230,462	34	24,944,540	41	27,953,953
33	City Spaces with Sewer	4	1,663,668	4	260,834	3	238,629	3	211,699	3	173,548	3	174,296
34	City Domestic without Sewer	8	4,061,574	8	5,211,220	7	2,148,481	7	1,887,214	8	2,701,781	7	2,352,305
35	City Irrigation	6	7,342,130	7	7,495,481	6	8,846,462	6	7,431,148	5	6,395,844	7	9,198,795
36	Out of Town Water	13	4,015,543	13	3,464,857	13	3,622,816	14	3,796,364	13	3,379,699	13	4,546,660
38	Hydrants	7	10,043,345	8	7,238,151	7	5,185,496	5	1,653,197	6	2,390,026	7	1,778,868
39	Fire Service	0	6,732	1	79,294	1	93,506	1	50,868	1	145,870	1	83,782
	Total	**219**	**102,345,431**	**228**	**93,789,939**	**224**	**91,055,203**	**230**	**80,494,012**	**234**	**87,550,321**	**248**	**99,302,082**
	Avg # Connections											**230**	
	Gal / Con / Yr		467,865		411,811		406,043		350,736		374,680		400,277
	Gal / Con / Day		1,281.8		1,128.2		1,112.4		960.9		1,026.5		1,096.6
	Avg Gal / Con / Day												**1,101**

Table 2.8b
City of Cloverdale
Residential Water Demand

	Residential Connection Type	2002		2003		2004		2005		2006		2007	
		Con	**Gal / Day**	**Con**	**Gal / Day**	**Con**	**Gal / Day**	**Con**	**Gal / Day**	**Con**	**Gal / Day**	**Con**	**Gal / Day**
28	Single-Family Dwelling	2,264	272,672,835	2,433	278,701,218	2,552	304,876,083	2,666	289,752,566	2,674	291,485,683	2,696	294,126,899
29	Multi-Family Dwelling	74	34,073,065	75	31,720,395	75	32,368,956	80	30,509,299	85	31,798,192	87	33,074,369
30	Residential without Sewer	37	5,103,210	36	5,290,971	34	4,929,662	32	4,171,138	31	4,444,925	30	4,373,860
	Total	**2,375**	**311,849,110**	**2,544**	**315,712,584**	**2,660**	**342,174,701**	**2,777**	**324,433,003**	**2,790**	**327,728,800**	**2,813**	**331,575,127**
	# of Residents Mid-Year	7,407		7,720		8,078		8,305		8,446		8,528	
	# of Residents per Con	3.1		3.0		3.0		3.0		3.0		3.0	
	Avg # of Residents per Con											**3.0**	
	Gal / Res / Yr		42,102		40,895		42,359		39,067		38,805		38,881
	Gal / Res / Day		115.3		112.0		116.1		107.0		106.3		106.5
	Avg Gal / Res / Day												**110.6**

Mid-Year population estimates were used as they best describe the median population in any given year.

Tables 2.8a and **2.8b** illustrate the relationship between non-residential and residential demand. The average 110.6 gallons per capita per day (gpcpd) residential usage and the 3.0 average capita per residential connection equate as follows:

*110.6 gpcpd * 3.0 capita / con = 331.8 gal / con / day*

The graphical relationship between residential and non-residential demand is shown in **Figure 2.4**. As seen in the figure below, the residential and non-residential demand, have similar demand curves as anticipated.

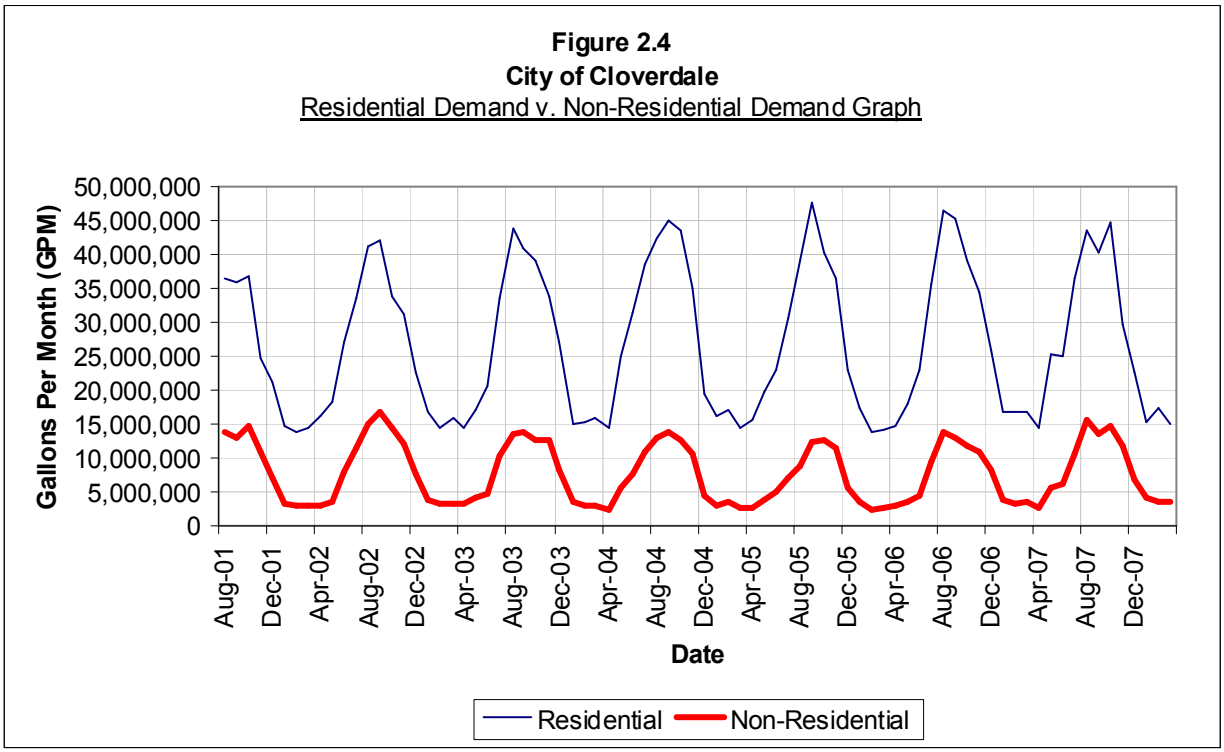
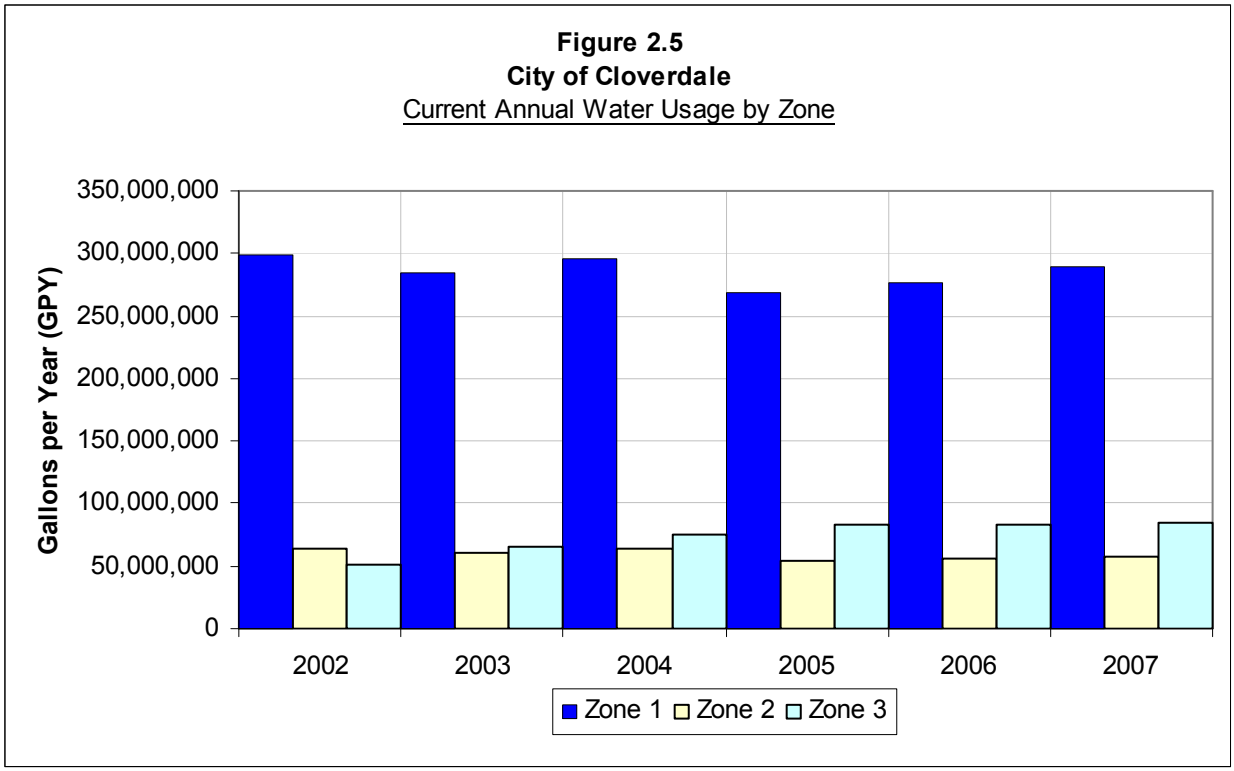
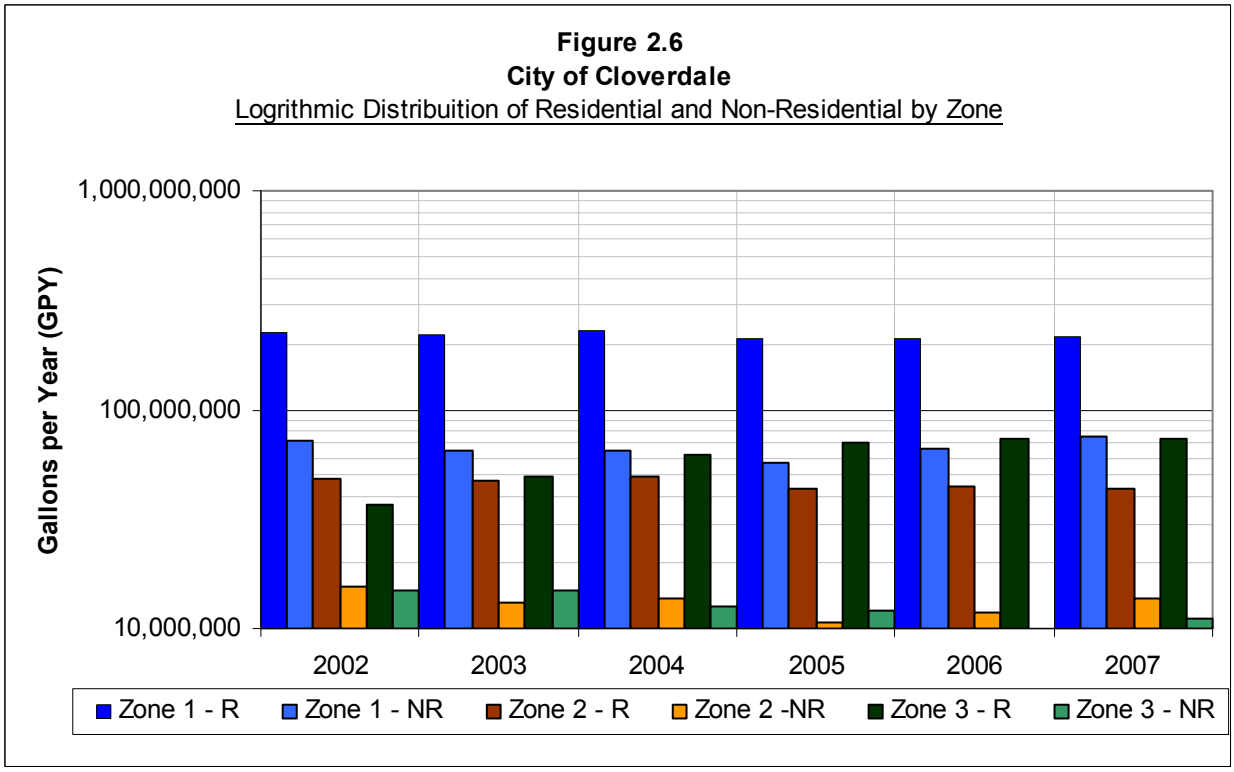


Figure 2.5 below illustrates the demand relationship between pressure zones. Shown in the figure is that Zone 1 carries the largest loading.



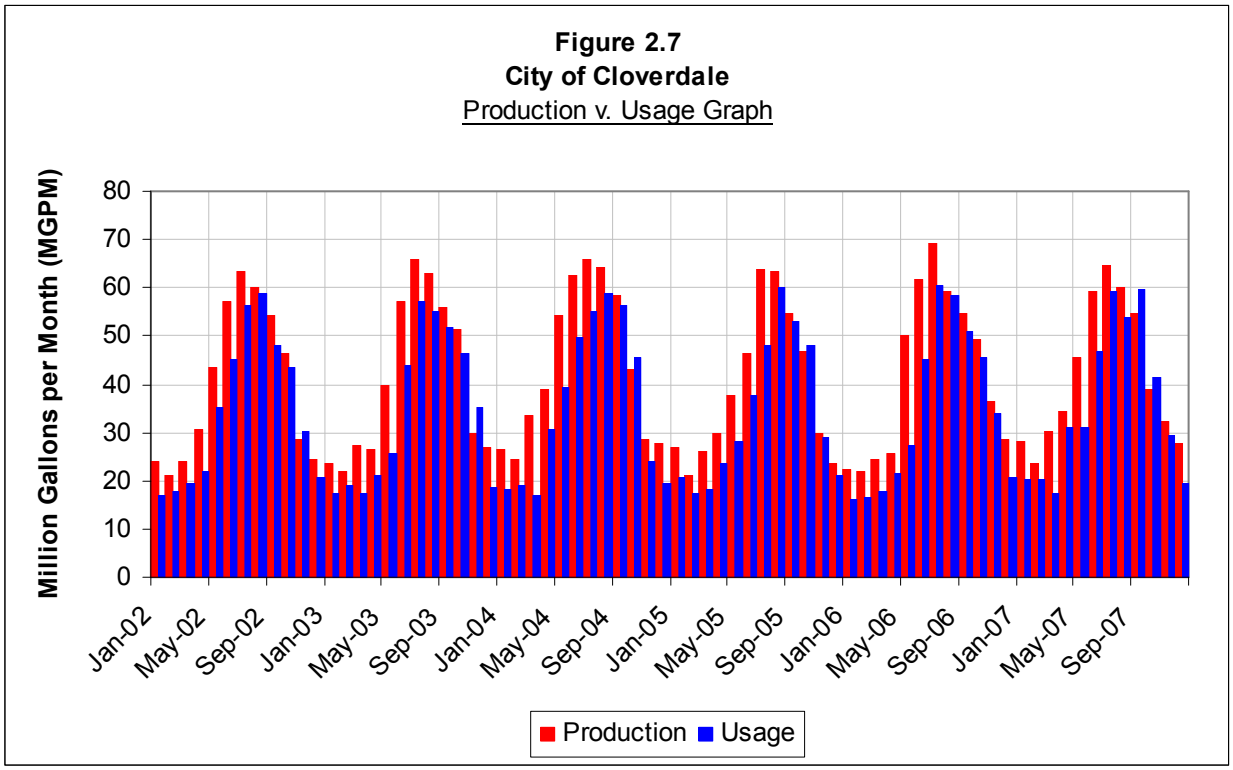
The combination of usage by zone and by residential/non-residential results in the final **Figure 2.6**. **Figure 2.6** is shown in logarithmic format, as the influence of Zone 1 over the other two zones is significant.



2.3.4. Production and Usage Comparison

Once the analysis was performed for production and usage, a comparison was made between the two. The difference between production and usage is referred to as "line loss." Line loss is the water that cannot be accounted for. Generally, line loss can be attributed to water seepage at service saddles, leaking pipe fittings, broken pipes, un-metered usage/stolen water, malfunctioning or worn inaccurate water meters, and water treatment plant filter backwash water (currently, backwash flows are un-metered). In recent years, the City has replaced many leaking water service connections, which has likely been a significant source of line loss.

The average water produced over the 6-year analysis period was 41 million gallons per month (mgpm), while the average water consumed was only 35 mgpm. The net loss was six mgpm or an average of 15% line loss over the study period. The relationship between production and usage is illustrated in **Figure 2.7**. In some regions of the graph, it appears that consumption is outpacing or is on par with production. This is attributed to meter reading intervals. Water production readings at the City's water treatment plant are taken daily and can be considered a "real-time" value (not accounting for variations in water storage volume.) Conversely, customer meters are read on monthly intervals. Monthly meter readings are subject to variations in the number of days of each month of the year, and the even wider variations in the number of days between readings. Further, it generally takes an entire month to read all the customer meters in the City. While production is demand dependent, the effect of the meter reading variables and variations in water consumption over the course of a month can cause the demand to appear to outpace production.



3. BUILD-OUT

This section addresses the requirements for the City of Cloverdale to expand its water system to meet the needs at General Plan build-out. In accordance with Cloverdale's 2009 General Plan, over the next 16 years the City anticipates a build-out scenario of 12,000 residents and complete industrial and commercial build-out in accordance with the Vacant Land Use Map (**Map 2**). For Cloverdale's Water Production and Distribution System (System) to meet those goals, an analysis of the build-out parameters (including a quantification of the new anticipated demands) is required.

The build-out analysis must evaluate the current demand model to quantify the residential, commercial, and industrial water demand components, then extrapolate those demands based on General Plan land uses to predict the water demands in the build-out scenario.

3.1. Residential Build-Out

Per the 2009 General Plan, the City anticipates the base population of the City to grow from 8,577 to 12,000 by December 2035. If current usage demand rates are used (**Table 2.8b**), the total additional average daily residential water demand on the system is:

*(12,000 – 8,577) capita * 110.6 gpcpd = 378,584 gpd*

The total average daily residential production for the City at complete build-out would then be:

*12,000 capita * 110.6 gpcpd = 1,327,200 gpd*

Per the General Plan, the locations of residential land use build-out are generally distributed within the City's Sphere of Influence. A map of the vacant land available is shown in the Vacant Land Use Map (**Map 2**). The analysis assumed that actual land use densities would not exceed the maximum density parameters set in the 2009 General Plan. In a few cases, some areas that are already developed are proposed to be annexed into the City. In order to stay within the 2009 General Plan population cap of 12,000, maximum residential density for each residential land use may or may not be achieved in any given area. Further, the actual location of residential development may vary within the guidelines of both the General Plan and the Vacant Land Use Map. Accordingly, from the point-of-view of the hydraulic model to determine pipe sizes, the maximum density for any particular area was assumed so that pipe sizing could accommodate the maximum possible build-out in any specific location regardless of how many homes would be actually built in a specific location. However, for ultimate production, it was assumed that the overall population for the city would not exceed 12,000.

3.2. Industrial and Commercial Build-Out

The 2009 General Plan Land Use Map and Vacant Land Use Map were used to determine what lands are available for industrial and commercial build-out. The Vacant Land Use Map (**Map 2**) shows the location of each of the specific industrial and commercial components and the specific land use types. Each land use type has a projected water demand rate. **Table 3.1** shows the current acreage breakdown for each non-residential land use in the City.

Table 3.1
City of Cloverdale
Land Use Acreage Table

Land Use Type		Total Acreage	Used Acreage	Vacant Acreage
Business Park	BP	153.7	60.6	93.1
Destination Commercial	DSC	336.2	59.5	276.7
Downtown Commercial	DTC	30.8	29.7	1.1
General Commercial	GC	27.7	19.6	8.1
Highway Frontage Commercial	HF	0.0	0.0	0.0
Mixed Commercial	M	14.1	13.3	0.8
Service Commercial	SC	42.0	30.7	11.3
General Industry	GI	362.9	219.5	143.4
Transit Oriented Development	TOD	13.9	10.2	3.7
Public, Quasi-public, Institutional	P	290.7	290.7	0.0
Conservation Features	CF	1,821.8	1,588.6	233.2
Sub-Total		**3,093.8**	**2,322.5**	**771.3**

In order to quantify the total build-out non-residential water demand, demands for each of the land use types needed to be calculated. Based on existing construction, a relationship was developed from water demand rates using 2007 data. **Table 3.2** shows the distribution per acre of water demand by land use type as of 2007. All water values were tabulated in gallons per acre per year (gpapy) and gallons per acre per day (gpapd).

Table 3.2
City of Cloverdale
Water Demand by Land Use Acreage Table

Land Use Type		Used Acreage	Total Water Used in 2007 by Land Use Type (gpapy)	Per Acre Water Used per Day in 2007 by Land Use Type (gpapd)
Business Park	BP	60.6	6,358,442	287.7
Destination Commercial	DSC	59.5	289,496	13.3
Downtown Commercial	DTC	29.7	13,111,106	1,209.4
General Commercial	GC	19.6	9,463,605	1,323.0
Highway Frontage Commercial	HF	0.0	0	0.0
Mixed Commercial	M	13.3	3,815,065	783.2
Service Commercial	SC	30.7	5,569,247	497.2
General Industry	GI	219.5	5,863,979	73.2
Transit Oriented Development	TOD	10.2	0	0.0
Public, Quasi-public, Institutional	P	290.7	21,708,149	204.6
Conservation Features	CF	1,588.6	0	0.0
Total			**66,179,089**	**4,392**

The total non-residential water use by land use type experienced in 2007 was 66,179,089 gallons; however, the actual water use experience for non-residential demand was 99,302,082. The difference between land use demand and actual non-residential demand results from the fact that

not all non-residential demand occurs in non-residential land uses. For example, water used for car washes is considered non-residential. In Cloverdale, there are two (2) water meters for car washes, one (1) of which located in a land use group for High Density Residential. Therefore, water used at this meter is not counted in a non-residential water use group. Additionally, the water demand rates per acre do not necessarily reflect maximum build-out for that land use type. For example, Destination Commercial (DSC) demand rate of 13.3 gpapd does not reflect the typically experienced demand rate for that land use type. In comparing usage rates experienced in the City with industry standard rates, it was discovered that some demand rates experienced by the City aligned themselves closely with industry standard rates, while others needed to be adjusted for maximum density.

Table 3.3 below assigns average daily water uses in accordance with experienced water demand rates in the City and modified expected demand rates in accordance with typical industry standards, where applicable. Round numbers were used assuming a slightly higher demand rate.

Table 3.3
City of Cloverdale
Water Demand by Land Use Acreage Table

Land Use Type		Per Acre Water Used per Day in 2007 by Land Use Type (gpapd)	Modified Water Usage per Acre per Day (gpapd)
Business Park	BP	287.7	300
Destination Commercial	DSC	13.3	1,200
Downtown Commercial	DTC	1,209.4	1,220
General Commercial	GC	1,323.0	1,350
Highway Frontage Commercial	HF	0.0	400
Mixed Commercial	M	783.2	800
Service Commercial	SC	497.2	500
General Industry	GI	73.2	1,100
Transit Oriented Development*	TOD	0.0	120
Public, Quasi-public, Institutional	P	204.6	250
Conservation Features	CF	0.0	0

* Transit Oriented Development areas in Cloverdale were non-operation because SMART service has not been established in Cloverdale. Once the SMART service is established, the actual water usage will be as shown.

The resulting non-residential water demand expected (including build-out loading) is shown in **Table 3.4**. The Destination Commercial (DSC) land use for the area east of the southerly interchange has a total acreage available of approximately 260 acres. However, a good portion of this land is located on the east side of the railroad right-of-way. Based on a recently approved EIR associated with a development in this location, the land east of the railroad tracks is designated to be part of a golf course. The irrigation water for the golf course is proposed to be supplied by a combination of on-site wells and recycled water and is not proposing to use domestic water from the City. Under the assumption that the proposed development or a similar development moves forward, the net resulting modified acreage available for destination commercial in this area is 87 acres (not including land for 170 new residential units that is proposed to be located within the DSC land use.) Acreages for the Destination Commercial land use in this area have been modified accordingly.

Table 3.4a
Non-Residential Water Demand by Land Use Acreage

Land Use Type		Modified Water Usage per Acre per Day (gpapd)	Vacant Acreage	Total Non-Residential Demand (gpy)
Business Park	BP	300	93.1	10,198,972
Destination Commercial*	DSC	1,200	104.0	45,552,000
Downtown Commercial	DTC	1,220	1.1	489,482
General Commercial	GC	1,350	8.1	3,992,350
Mixed Commercial	M	800	0.8	220,441
Service Commercial	SC	500	11.3	2,064,253
General Industry	GI	1,100	195.3	78,412,950
Transit Oriented Development	TOD	120	3.7	160,673
Totals				**141,091,122**
2007 Non-Residential Water Usage				99,302,082
Total Forecasted Yearly Non-Residential Water Usage (gpy)				**240,393,203**
Total Forecasted Daily Non-Residential Water Usage (gpd)				**658,612**

* Destination Commercial was reduced for areas east of the southern interchange (see above paragraph)

Table 3.4b
Residential Water Demand

Population at Buildout	Residential Water Consumption (gpcpd)	Total Residential Demand (gpd)
12,000	110.6	1,327,200

3.3. Total Required Production at Build-Out

The total required production for the City must be calculated in accordance with the requirements of the California Code of Regulations (CCR) Title 22 Section 64554. The CCR states: "at all times, a public water system's water source(s) shall have the capacity to meet the system's maximum day demand (MDD)." As shown in **Table 2.6**, the peaking factor (PDF) is 196.3% of the average day demand (ADD) and the experienced line loss is 15%.

The total water demand for the City at build-out is:

1,327,200 gpd (Res Demand) + 658,612 gpd (Non-Res Demand) = 1,985,812 gpd (Total)

The ADD is the total water usage plus line losses:

*1,980,612 gpd + (15% * 1,980,612 gpd) = 2,283,684 gpd or 833.6 mgd*

The MDD is the ADD times the PDF:

*2,277,704 gpd * 1.963 = 4,482,872 gpd*

3.4. Total Required Water Storage at Build-Out

The total water storage required at build-out is a function of the existing demand and demand due to build-out. Demand values shown in **Table 2.1** were based on the demand from the year of greatest production (2004); however, for the build-out water storage calculations all existing construction (construction from 2004 through 2007) needed to be accounted for. Therefore, the build-out storage calculations were a function of the following variables:

- Total Residential Loading based on a population of 12,000 (**Table 2.8b**)
- Current (2007) Non-Residential Loading (**Table 2.8a**)
- Future Non-Residential Loading (**Table 3.4**)
- Total Line Loss (Average of the study period – 15%)
- Zone loading Distribution (**Section 2** analysis and Hydraulic Model)
- Peaking Factor (**Table 2.6**)
- Fire Storage

The analysis of the future water storage dictated that the existing storage was not sufficient to handle the future storage demands due to General Plan build-out; therefore, additional storage is needed. The increase in storage is required in Zones 1 and 2 in the form of an additional 200 thousand gallons (kgal) at the main reservoir and a new 1.0 mg reservoir along the Asti Rd corridor build-out and additional 750,000-gal tank at the Ritter Reservoir. The net result increases the remaining citywide storage approximately 345 kgal between the future water storage figures and the current storage figures. However, the additional storage spread the remaining citywide storage more evenly between water zones. It is worthwhile to note that remaining storage is not excess storage, but rather, additional storage which improves the overall safety factor of the water system. In the case of catastrophic emergency, such as an earthquake or significant fire, this additional storage could prove to be extremely advantageous.

Table 3.5 below breaks down the water storage distribution by water zone. It is notable that the fire storage for Zone 2 increased as a result of adding industrial land use to Zone 2.

Table 3.5
City of Cloverdale
Future Water Storage

Total Average Yearly Residential Demand	484.4	Mgpy
Total Average Yearly Non-Residential Demand	240.4	Mgpy
Total Average Yearly Demand	724.8	Mgpy
Total Line Loss (Total Demand * 15%)	108.7	Mgpy
Total Average Yearly Production	**833.6**	**Mgpy**

Zone 1 Estimated % of total production (Hydraulic Model)	***67.57%***	
Demand		
Domestic Demand Storage	1,543,122	gal
Fire Flow Storage (Industrial) (3000 gpm * 180 min)	540,000	gal
Equalization Storage (ADD-Zone 1 * Peaking Factor * 25%)	757,185	gal
Required Storage	**2,840,307**	**gal**
Storage		
Main Tank (Remove Existing Reservoirs and Replace with 2-375 kgal Tanks)	750,000	gal
Southcrest	200,000	gal
Hot Springs	1,000,000	gal
Asti (New 2-500 kgal Tank per Hydraulic Model)	1,000,000	gal
Available Storage	**2,950,000**	**gal**
REMAINING STORAGE	**109,693**	**gal**

Zone 2 Estimated % of total production (Hydraulic Model)	***17.63%***	
Demand		
Domestic Demand Storage	402,623	gal
Fire Flow Storage (Industrial) (3000 gpm * 180 min)	540,000	gal
Equalization Storage (ADD-Zone 3 * Peaking Factor * 25%)	197,561	gal
Required Storage	**1,140,184**	**gal**
Storage		
Ritter (Additional 1- 750 kgal Tank added)	1,250,000	gal
Available Storage	**1,250,000**	**gal**
REMAINING STORAGE	**109,816**	**gal**

Zone 3 Estimated % of total production (Hydraulic Model)	***14.80%***	
Demand		
Domestic Demand Storage	337,993	gal
Fire Flow Storage (Commercial) (2,000 gpm * 120 min)	240,000	gal
Equalization Storage (ADD-Zone 3 * Peaking Factor * 25%)	165,848	gal
Required Storage	**743,841**	**gal**
Storage		
Clover Springs	1,250,000	gal
Available Storage	**1,250,000**	**gal**
REMAINING STORAGE	**506,159**	**gal**

4. HYDRAULIC MODEL

In order to understand how the current system behaves as an integrated system, a hydraulic model was developed. The following section addresses the development of the hydraulic model and the results of the model with regard to the existing system, the existing system plus improvements and the build-out system. The model used current water use demand parameters (as described previously in this report), pipe and storage sizes, hydrant and fire flow components, and pressure zone information (including pump stations and elevation pressure components.)

4.1. Water System Hydraulic Modeling Background

Coastland prepared a hydraulic model for City's 1998 Water Master Plan Update. This model was developed using the KY Pipe software program. Since the 1998 Update, the City's water model has been maintained and modified to account for the growth of the system. For purposes of consistency, the 2009 Update used this same software.

The main purpose of creating a hydraulic model is to be able to run simulations that closely approximate the performance of the existing system. Modeling was compared to existing system performance by testing flows and pressures of fire hydrants throughout the system and making necessary adjustments to the model to ensure it was simulating the existing system as closely as possible.

4.2. Water System Modeling and Analysis Criteria

The criteria used for evaluating the existing water system was based on common industry standards, Cloverdale Water Design Standards, Cloverdale Municipal Code, National Fire Code, California Fire and Plumbing Codes, and California Title 22 requirements.

4.2.1. Fire Flow Protection

The 2007 California Fire Code Appendix B Section B105 sets the standards for fire-flows. Those standards are described in Section 2.3.3 of this report. When evaluating either existing or new fire flows, all water mains were sized to achieve (at a minimum) the following criteria wherever possible.

- The minimum acceptable existing residential fire flows are 1,000 gpm for 2 hours.
- The required minimum residential fire flow for new construction (no more than 8,199 sf) is 1,500 gpm for 2 hours.
- The required minimum commercial fire flow for new or existing construction (no more than 12,899 sf) is 2,000 gpm for 2 hours.
- The required acceptable industrial fire flow for new or existing construction (no more than 30,100 sf) is 3,000 gpm for 3 hours.

In some cases, if the desired criteria could not be met (due to a physical constraint) the goal became to "do not harm", meaning that if an existing main could not be brought into conformance with the criteria, then, at the very least, the existing main shall not be affected negatively.

In each category, fire flows quantities are dependent on the Table B105. The quantities shown above are minimums for the demand uses and are the base demand levels. If the individual

demands of a particular structure exceed the square footage limits, the required fire flow shall default to Table B105.

4.2.2. System Pressure Criteria

In accordance with the City's Design and Construction Standards, the goal for new development is to provide a minimum of 40 pounds per square inch (psi) pressure at the meter when the reservoirs are half-full. In all cases, for all structures, the minimum fire flow residual pressure is 20 psi. Section 64602 if Title 22 of the California Code of Regulations also stipulates that a minimum pressure of 20 psi be maintained at all times.

4.2.3. System Design Criteria

In accordance with the City's Design and Construction Standards, Pressure Class 150 C900 polyvinyl chloride (PVC) or Pressure Class 50 C151ductile iron pipe (DIP) are required for 8-inch and 12-inch water mains where system-working pressures are less than 100 psi. If working pressures are anticipated to exceed 100 psi, then Class 200 PVC or DIP is required. Any pipeline constructed outside of paved areas is required to be DIP, unless otherwise approved by the City. Where system pressures exceed 80 psi, service connections are required to have individual pressure regulating devices.

All new pipelines installed (including pipeline replacement projects) require a minimum pipe diameter of eight (8) inches. If the system is in an industrial area and has a dead-end main, the minimum pipe diameter required is 12 inches.

4.2.4. Hydraulic Model Calibration

In order for the model to simulate actual field conditions as closely as possible, calibration is required. For the hydraulic model, the system required three different calibrations: a demand rate calibration, a flow rate calibration, and pressure zone interconnection calibration. The demand rate calibration addressed the water usage parameters of the City for each zone. The flow rate calibration provided pipe flow constants with regard to how well the water flowed through the pipes. The pressure zone interconnection calibration adjusted the flow between the zones.

There are two different types of flow models that can be used in the hydraulic model - a "snap shot" model (provides a glance at the system at one moment in time), and an Extended Period Simulation (EPS) (looks at the system over a specified time period - usually 24 hours.)

4.2.4.1.Demand Rate Calibration

The hydraulic model's demand rate is based on the actual experienced demand rates in the City based on historical flow data amassed and analyzed in the previous sections. The demand rates for the system are shown in **Table 4.1**.

Table 4.1
City of Cloverdale
Hydraulic Model Residential Demand Loading Criteria

ADD @ 331.8 gpd (110.6 gpcpd w/3 capita per connection)	(331.8 gal / con / day = **0.23 gal / con / min)**
PDD = ADD * 2.1783 = 722.8 gpd (Peaking Factor is derived from the highest demand day in the analysis, not the average)	(722.8 gal / con / day = **0.50 gal / con / min**)
PHD = PDD / 24 * 1.5 = 45.2 gph (Per Title 22 California Code of Regulations)	(45.2 gal / con / day = **0.75 gal / con / min**)

The hydraulic model distributes water usage demand in the form of Residential Demand Units (RDU). Each RDU represents the water demand from one standard residential unit in the system (the standard average occupancy is three residents per structure). For all residential loading, each pipe was assigned with the number of RDU that were connected to it by evaluating the utility billing records for the location of each residence. Based on our review of utility records, the average usage from one residential water user to the next was not significantly different. Therefore, a uniform average gallons per day demand rate was used for the loading throughout the City.

For the non-residential demand, each water user was evaluated by their specific water demand rate. For instance, if the typical demand from a non-residential user was 1,000 gpd, the connection was assigned with 1,000 gpd / 331.8 gal per con per day or 3 RDU. This analysis was done for each non-residential user.

4.2.4.2.Flow Rate Calibration

The most effective approach to calibrating a digital hydraulic model is by physically measuring flows and pressures relative to storage reservoir elevation levels. Field conditions are then compared to the water model outputs. If there is a significant difference between the model output and the physical field-test calibration data, then certain parameters within the model are adjusted to bring the model performance in line with field measurements.

Due to concerns related to water shortage during the high-use season of 2008, only static pressures could be obtained from the water system for calibration purposes. However, it should be noted that the model had been calibrated in the past during previous model scenarios. Consequently, the model was initially calibrated using pipe roughness factors (C-factors) based on pipe age and type.

The elevations assigned to the different elements within the model were obtained from orthogonal photographic data, topographical mapping, and elevations obtained with Google Earth. Pipe attributes included diameter, length, year constructed, material type, pressure rating (PVC only), and Hazen-Williams roughness (C) factor.

The water supply was modeled as being fed from an infinite source. The rational for this was that the Main Reservoir level acts as the control for the operation of the wells and Water Treatment Plant (Plant). Ultimately, there needs to be enough water to meet demand and performance of the Network is reservoir and tank water levels but is not related to water

production unless a tank is emptied. The assumption that there is an infinite supply in the model only assumes that the water production will be sufficient to meet the demand.

4.2.4.3.Pressure Zone Interconnection Calibration

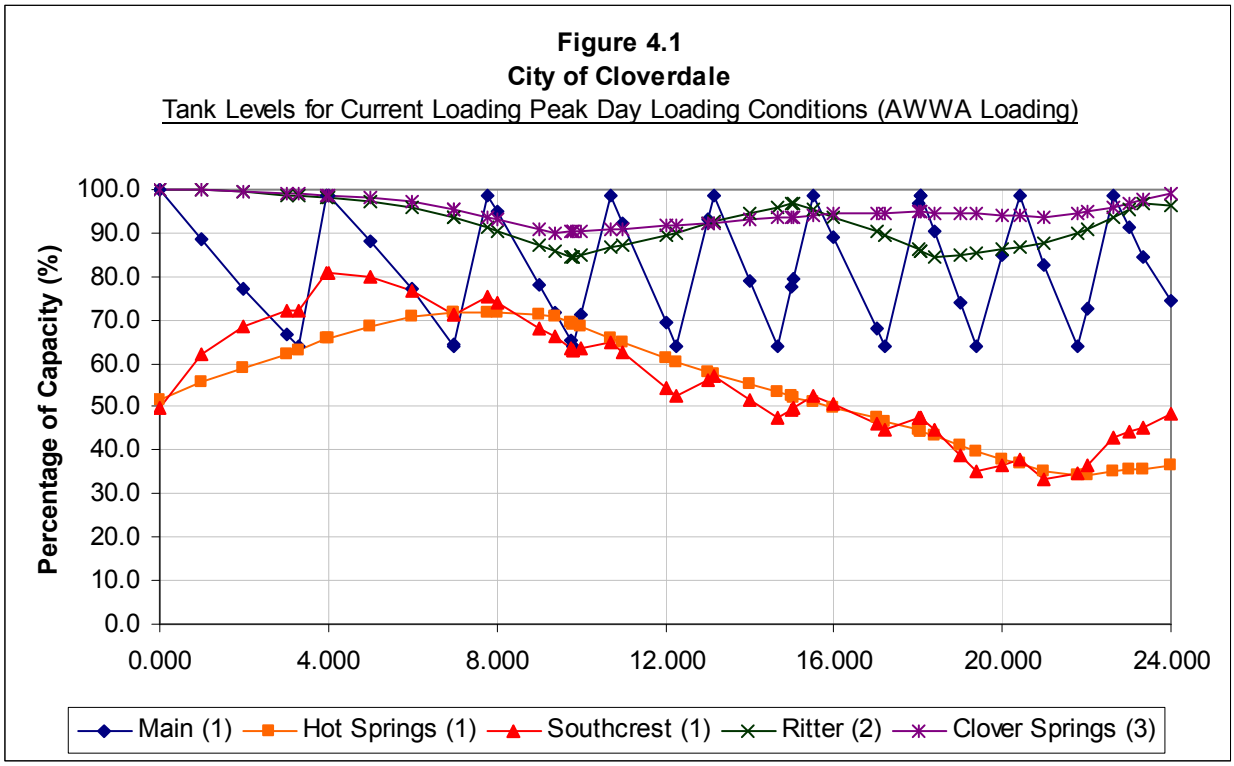
The pressure zone model required that water be moved from the Plant to Zone 1, and then into either Zone 2 or Zone 3. At each of the pressure zone interconnections, a pump station was designed such that the interconnection behaved as experienced in the field. The pumps in the model were set to match the manufactures' system parameters for the pumps in the field. The model was run assuming that the Main Reservoir, the Ritter Reservoir, and Clover Springs Reservoir were all full, as each of these reservoirs has a pump associated with them that is turned on and off depending on the level of water in each reservoir. The Hot Springs and Southcrest Reservoirs were set to half full because these two reservoirs are dependant on the flows from the Main Reservoir and are affected by the flows out of Zone 1 into both Zones 2 and 3. Unfortunately, there was no quantitative reservoir level data available; however, the Plant Operation Staff had observed that consistently in times of peak day demand (PDD) that the Hot Springs and Southcrest tanks were not fully recharging overnight.

For the pressure zone interconnection calibration, a record of the tank levels was required to determine what the flow rates into and out of Hot Springs and Southcrest reservoirs were in a PDD scenario. The AWWA standard flow model was used to distribute the demand rate throughout the day assuming periods of high demand during the day and periods of low demand during the night. By using a 24-hour EPS with the AWWA standard flow model, a measure of each of the reservoir's performance was cataloged.

The results from the EPS 24-hour simulation were analyzed to compare performance of the Southcrest and Hot Springs Reservoirs with the given set of pumping parameters. Once an analysis was completed, the results of the analysis were integrated with the model for another EPS and the process was restarted. This iterative process required taking the results of changes derived from the analysis and making those changes in the model until the performance of the two reservoirs performed as reported by the Plant Operators.

The final Reservoir Calibration Simulation Graph is shown in **Figure 4.1** (the number after the tank represents the water zone that tank resides in). As shown in the figure neither of the reservoirs in question were recharging in the PDD scenario. At 0.50 gal / con / min and a total of 3,786 connections, (the number of connections takes into account multiple connections per account for non-residential demand as well as the number of residential connections) the total daily demand would be:

*0.50 gal / con / min * 3786 connections * 60 min * 24 hours = 2.85 mgpd*



At this loading level the Hot Springs and Southcrest Reservoirs do not recharge and in fact drop to lower levels by the time the 24-hour simulation has passed. It should be noted that 2.85 mgpd represents the highest water demand rate experienced in the City in the study period and is a worst-case scenario.

4.3.Water System Evaluation

The hydraulic model was evaluated for the existing condition, the existing condition with system improvements, and in a build-out condition. The system was evaluated for fire flow and water storage. From this, a new piping and storage model could be simulated to meet the needs of the City. In order to determine fire flow a "snap shot" was taken of the system in the PHD loading scenario. This loading scenario assumed the worst possible loading case where the fire flow and line pressures would be at there lowest throughout the City. The second loading scenario was a PDD loading during a 24-hour EPS (similar to the one that was done for the pressure zone calibration.) This simulation would show how the reservoirs performed during a time of peak demand.

4.3.1. Existing Condition Model

The specifications for the existing condition model are shown in **Table 4.2**. PDD production is based on ADD production times a peaking factor in accordance with Title 22 of the California Code of Regulations (CCR). The peaking factor used for the model was based on the highest peaking factor experienced in order to achieve the worst-case scenario.

Table 4.2
City of Cloverdale
Existing Condition Criteria

KY Pipe Output Data	
NUMBER OF PIPES	774
NUMBER OF END NODES	658
NUMBER OF PRIMARY LOOPS	111
NUMBER OF SUPPLY NODES	6
NUMBER OF SUPPLY ZONES	1
NUMBER OF RDU	3,876
Water User Demand Loading	
ADD Loading per EDU	0.23 gpm
PDD Loading per EDU	0.52 gpm
PHD Loading per EDU	0.78 gpm
Water Production	
ADD Loading (including Line Loss)	1.48 mgpd
PDD Loading	2.90 mgpd
PHD Loading	3,018 gpm

The current conditions model scenario indicates that several areas are in need of improvement in the areas of both water supply to the tanks and fire flow capability. As shown in **Figure 4.1**, the existing system does not have adequate flow to recharge either the Southcrest or Hot Springs Reservoirs during PDD loading. The computer simulation showed that water levels in those two reservoirs began to use water reserved for fire protection in the tanks. As a rule, each reservoir should maintain, at a minimum, a water elevation in the demand/equalization storage elevation. The demand/equalization storage volume is the water used to supply the system during normal operation. If storage falls below this volume then the water set aside for fire flow is being used to supply regular City water demand and this affects the City's water volume to fight fires.

This problem appears to be caused by the inability for water to get from the Main Reservoirs to the Southcrest and Hot Springs tanks in a direct manor. As water flows from the Main Reservoir out into the Zone 1 Network, there is a significant demand on the pipes within the system. This demand is such that the volume of water that reaches the Southcrest and Hot Springs reservoirs is not sufficient to recharge the tanks (too much water is being siphoned off of the mains by other users.) The inability of these tanks to recharge impacts the supply pressure to those areas served by these tanks. This problem can be resolved by providing a more direct pipe route to get the water to these tanks without a number of users drawing water out of the mains as it is in route to the tanks.

The fire flow model also brought to light issues relating to flow as shown in **Table 4.3**. A number of hydrants do not meet the minimum fire flow criteria set by the City. It should be noted that the hydrants that do not meet current City standards are older hydrants there were installed several years before current standards were adopted. As can be seen in **Table 4.3**, approximately one quarter of the hydrants either do not meet or just meet the minimum residential flows. The specific areas of concern seem to be mostly concentrated in the higher elevation hillsides served by Zone 2. In most cases, the pipe sizes in the Network in specific locations restrict the flow such that the fire flows are deficient. By upsizing pipes to meet

current standards fire flows to those areas improves and, in most cases, alleviates the problem entirely.

Table 4.3
City of Cloverdale
Existing Condition – Hydrant Fire Flows (PHD Loading)

Fire Flow < 1,000 gpm [1]	50
Fire Flow between 1,000 gpm and 1,500 gpm [2]	54
Fire Flow between 1,500 gpm and 2,000 gpm	58
Fire Flow between 2,000 gpm and 3,000 gpm	92
Fire Flow > 3,000 gpm	189
Total Hydrants	**443**

[1] Hydrants do not meet flow requirements.
[2] Hydrants just meet flow requirements.

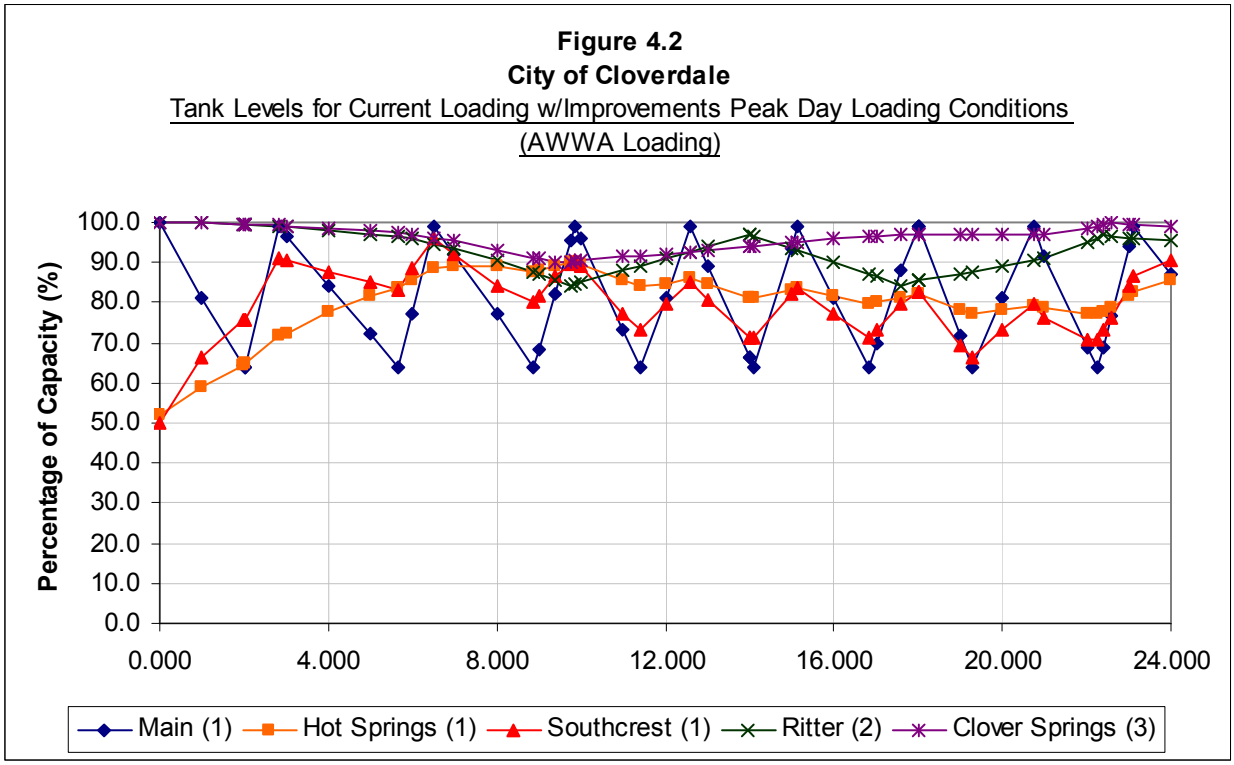
4.3.2. Existing Condition with Improvements Model

The Existing Condition with Improvements Model did not change any of the loading parameters shown in **Table 4.2**. **Map 3** shows the proposed improvements made to the Network and **Table 4.4** summarizes the pipe changes to the system. These values include all pipes in problem areas being replaced/upsized and new mains being installed in some locations to allow more efficient transmission of water to the reservoirs.

Table 4.4
City of Cloverdale
Pipe Improvements

Pipe Diameter (in)	Removed (lf)	Installed (lf)
4	12,690	0
6	6,883	0
8	3,950	28,882
10	1,338	3,209
12	0	12,192
16	0	5,461
Total	**24,861**	**49,744**
Total New Reach of Pipe		**24,883**

Based on results from the model analyses, if the proposed improvements (removing and replacing undersized mains) were made, it would have significant impacts on both the storage reservoir recovery and fire flows throughout the system. **Figure 4.2** shows the resultant reservoir levels experience in the PDD 24-hour EPS. Both the Hot Springs and Southcrest Reservoirs recharge and water levels in all tanks remained within the domestic demand component.



The proposed improvement that made the biggest difference in keeping the tanks recharged in the southern part of the City is the inclusion of a new 16-inch water main in Asti Rd. This main connects to the existing 16-inch main in East First Street at the intersection with Asti Rd. Two stretches of this 16-inch main in Asti Road were needed (from E First Street to the existing 16-inch main just north of Citrus Fair Dr and from just south of the Wastewater Treatment Facility to Santana Drive.) Additionally, a new 12-inch main is proposed to connect to the proposed 16-inch main in Asti Rd (just south of Porterfield Creek) and extend under Hwy 101 to connect to an existing 12-inch main in the Briarwood Mobile Home Park. These improvements made a significant difference in delivering the water in a more direct fashion to the tanks in the southerly portion of the City, which allows tanks to recharge quicker.

Fire flows were also addressed by replacing existing smaller mains with upsized 8-inch and 12-inch mains in specific locations throughout the City. The resulting fire flow improvements are shown in **Table 4.5**. Of the 50 hydrants with a fire flows less than 1,000 gpm shown in **Table 4.3**, all but one increased to above the 1,000-gpm level. The hydrant that did not meet the 1,000 gpm flow requirement is on Kings Ridge Rd. The analysis showed this hydrant flowed at 580 gpm. Unfortunately, increasing this main to a minimum loading of 1,000 gpm is not achievable due to the elevation of the hydrant relative to the Ritter Reservoir in Zone 2. Accordingly, it does not appear that improvements can be made to bring this hydrant into conformance with minimum flow requirements.

Table 4.5
City of Cloverdale
Existing Condition w/Improvements - Fire Flows (PHD Loading)

Fire Flow < 1,000 gpm	1
Fire Flow between 1,000 gpm and 1,500 gpm	24
Fire Flow between 1,500 gpm and 2,000 gpm	30
Fire Flow between 2,000 gpm and 3,000 gpm	69
Fire Flow > 3,000 gpm	319
Total Hydrants	**443**

4.3.3. Build-Out Condition Model

The build-out condition model expanded the demand level for the City to include a maximum density build-out of all vacant lands. This analysis scenario was included to determine pipe sizing only and was not meant to analyze ultimate total demand. This scenario does not restrict the maximum population; but rather, the scenario identifies the maximum possible development on an individual parcel to determine the sizes of pipe needed to serve undeveloped parcels under the most intense development levels.[3]

For build-out production demands, demands were scaled from maximum density demand to the 12,000-max population demand in accordance with the General Plan to show actual water production demands. The build-out condition model incorporated all improvements addressed in the previous section (needed upgrades for increased flows to tank and fire hydrants) and included new water mains to service areas identified for build-out in the Vacant Land Use shown on **Map 2**. **Map 3** shows all proposed modifications to the existing Network as mentioned in **Section 4.3.2** of this Update, as well as, improvements to the Network to meet General Plan build-out. It should be noted that the improvements include new tanks for the Main Reservoir, the Ritter Reservoir, and a new Reservoir east of Asti Road south of the southerly interchange. **Tables 4.6a and 4.6b** show the demand associated with build-out.

[3] The general approach to pipe sizing is that the pipe design shall be sized to accommodate the largest feasible demand based on the highest and best use (maximum density) at the time of build-out. The actual location of each development and the respective demand loading associated with that development are unknown at the time of planning. This pipe-sizing concept allows development to occur at vacant or obvious underdeveloped locations up to the General Plan maximum density.

Table 4.6a
City of Cloverdale
Build-Out Loading - Non Residential

Zone	Build-Out Connection Point	EDU	Vacant Acreage							
			SC	GI	BP	GC	DTC	DSC	MC	TOD
1	BP1	33.7			37.3					
3	BP2	46.7			51.6					
3	BP3	2.6			2.9					
3	BP4	1.4			1.5					
1	DSC1*	314.6						87		
1	DSC2	61.5						17		
1	DTC1	0.7					0.2			
1	DTC2	3.3					0.9			
1	G1	185.0		55.8						
1	G2	131.1		39.5333						
1	G3	66.0		19.9						
1	G4	10.9		3.3						
1	G5	16.9		5.1						
2	G6	171.4		51.7						
1	GC1	29.1				7.15				
1	GC2	3.8				0.94				
1	Lumber Yard	66.3		20						
1	MX1	1.5							0.61	
1	MX2	0.5							0.19	
2	SC1	1.0	0.66							
2	SC2	1.4	0.96							
1	SC3	1.5	0.97							
1	SC4	1.9	1.26							
3	SC5	11.3	7.47							
1	TOD	1.3								3.7
	Total EDU	1,165.4								
	Gallons per EDU	331.8	gpd							
	Total Added	**386,664.2**	**gpd**							

** DSC1 – Alexander Valley Resort Site has a reduced vacant acreage due to the location of the General Pacific Railway line and the residential element to the development.*

Table 4.6b
City of Cloverdale
Build-Out Loading - Residential

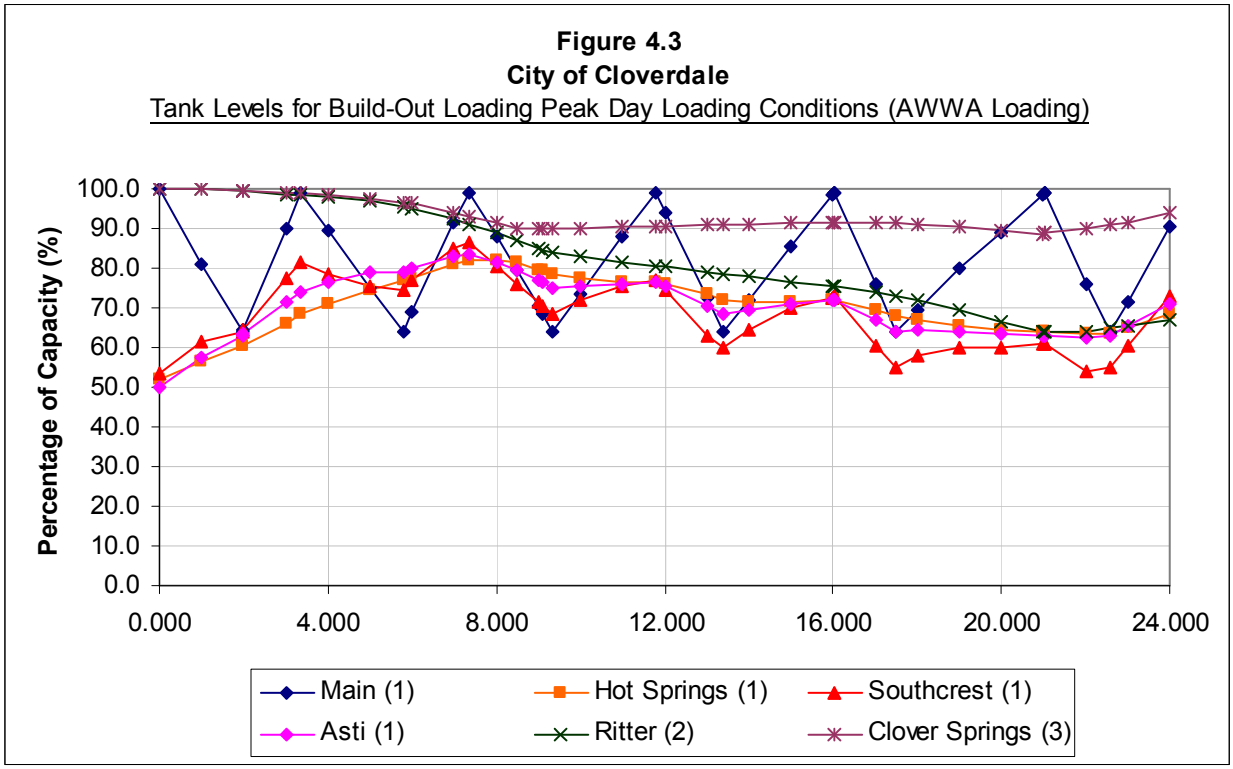
Zone	Build-Out Connection Point	EDU Max Density	EDU Adjusted for Max 12,000 Pop	Vacant Acreage			
				RR	LDR	MDR	HDR
3	R1	38.0	24.3		19.0		
3	R2	28.0	17.9		14.0		
1	R4	141.0	90.2			23.5	
3	R5	4.0	2.6		1.8		
3	R6	11.0	7.0		5.4		
1	R7	32.0	20.5				2.7
1	R8	3.0	1.9		1.4		
3	R9	9.0	5.8		4.3		
1	R10	12.0	7.7		6.1		
3	R11	5.0	3.2		2.6		
2	R12	69.0	44.1		34.6		
1	R13	12.0	7.7				1.0
1	R14	3.0	1.9		1.3		
1	R15	3.0	1.9	3.0			
1	R16	20.0	12.8			3.4	
1	R17	45.0	28.8			7.5	
1	R18	6.0	3.8			1.0	
1	R19	6.0	3.8			1.0	
2	R20	13.0	8.3	13.0			
2	R21	307.0	196.3			51.2	
1	R22	35.0	22.4				2.9
1	R23	24.0	15.3				2.0
2	Riverdale Ranch	229.0	146.5				
3	Dutcher Creek Rd	24.0	15.3				
3	Theresa Dr	35.0	22.4				
1	Downtown	500.0	319.8				
1	Alexander Valley	170.0	108.7				
	Total EDU		1,141.0				
	Gallons per EDU		331.8	gpd			
	Total Added		**378,583.8**	**gpd**			

Based on the General Plan Build-out scenario, additional storage was required for the Main and Ritter Reservoirs. Additionally, a new storage reservoir was needed in the southeastern portion of the City (southeast of the southerly interchange.) The total increase in storage volume needed to support build-out is 1,950,000 gallons. The required changes at each particular reservoir site are as follows:

- The Main Reservoir was increased from 550,000 gal to 750,000 gal with the replacement of the existing tanks with two 375,000-gallon tanks.

- The Ritter Reservoir was increased from one 500,000-gallon to one 500,000-gallon tank and one (1) 750,000-gallon tank.
- The Asti Rd Reservoir was added at southeast of the southern interchange. This reservoir consisted of two 500,000-gal tanks.

Figure 4.3 details the tank-recharging rate at PDD loading levels for the build-out model. From the analysis it appears that the problems with the Southcrest and Hot Springs tanks are still an issue; however, during extended 72-hour simulations the Hot Springs, Southcrest, and Asti Rd Reservoirs do recharge to levels within the average day demand level of storage and, over time would recharge to a near full capacity. The Ritter and Clover Springs Reservoirs do experience a remaining storage volume drop over the same 72-hour simulation.



The demand loading for the Ritter and Clover Springs Reservoirs during peak day demand appears to be greater than the current pumping parameters can offset. In the case of the Ritter reservoir at the time the new tank is brought online the School St Pumping Station will also have to be upgraded to allow for both pumps to work simultaneously. In the case of the Clover Springs Reservoir, the pumping cycles at the Zone 1-Zone 3 pumping station will have to be upgraded to accommodate the larger demand. Upgrades may include upsizing the pumps and retooling and reconfiguring the pump station mechanical facilities. This work would be done after other improvements have been completed that eliminate system constrictions and allow more water to flow to the Zone 1 Hot Springs and Southcrest reservoirs.

The fire flow analysis for the build-out model showed that the improvements achieved in the existing condition with improvement model were sustainable through build-out. **Table 4.7** shows the fire flow loading experienced.

Table 4.7
City of Cloverdale
Build-Out Condition - Fire Flows (PHD Loading)

	Existing Hydrants	Build-Out Hydrants
Fire Flow < 1,000 gpm	1	0
Fire Flow between 1,000 gpm and 1,500 gpm	7	0
Fire Flow between 1,500 gpm and 2,000 gpm	23	15
Fire Flow between 2,000 gpm and 3,000 gpm	100	26
Fire Flow > 3,000 gpm	312	44
Total Hydrants	**443**	**85**

For the build-out model, additional fire hydrants were added to measure the fire flows in the new reaches of piping network. These hydrants were not added in accordance with the 300 lf spacing criteria as set forth by the City Standards. The actual number and location of all new fire hydrants would be in keeping with the City Standard spacing. The fire flows experienced in the model for build-out land areas were all greater than 1,500-gpm minimum requirement as shown in **Table 4.7** above.

5. CAPACITY ANALYSIS

The hydraulic model identified the specific areas that experience problems meeting storage and water flow requirements. Improvements to the existing system were added to the model from the existing system to solve these problems. Once a model was built that remedied the existing deficiencies, an additional model was designed (using this modified existing system model) to accommodate 2009 General Plan build-out demand. The following subsections identify the specific areas that require improvements to the existing system needed to resolve deficiencies, as well as system improvements needed to meet build-out demands.

5.1. Existing System Improvements

The following outlines the improvements needed for the existing system to bring it into conformance with acceptable flow criteria as identified by the hydraulic model and existing condition analysis.

5.1.1. Hot Springs and Southcrest Reservoir Flow Improvements

The recharging of the Hot Springs and Southcrest Reservoirs is a priority for the City. The problem identified in the hydraulic model was that direct flow for these two reservoirs was significantly restricted during peak demand. In order to direct a greater flow to these reservoirs, additional piping in Asti Road is needed.

Currently, water flowing to these reservoirs comes either from the Main Reservoir or directly from the Plant via the 16-inch main in East First St. Water then travels through the Network to each of the reservoirs. As water flows through the Network, the demand by the specific water users along the route reduces the operating pressure of the mains. Additionally, the pipe sizing of the Network forces the water through smaller water mains, which greatly reduces the water flow.

In order to remedy this situation it is necessary to increase the movement of water to these reservoirs with as little demand as possible. To accomplish this, the construction of a new 16-inch main from the existing 16-inch main in East First St to the existing 16-inch main at Citrus Fair Dr. is required. This improvement will alleviate most of the recharge problems the tanks experience. Additional Asti Road 16” main improvements are required before additional buildout in the southerly portion of the City.

5.1.1.1.Cost Estimate for Asti Rd Improvements

The cost estimates for the Asti Rd 16” main improvements are shown in **Table 5.1**.

Table 5.1
City of Cloverdale
Cost Estimate for Hot Springs and Southcrest Reservoir Flow Improvements
Asti Road -North of Citrus Fair Drive

Item No.	Item Description	Estimated Quantity	Unit of Measure	Unit Cost	Item Total Cost
1	Clearing and Grubbing	1	Lump	$5,000	$5,000
2	Construction Area Signs	1	Lump	$2,500	$2,500
3	Erosion Control	1	Lump	$2,500	$2,500
4	Traffic Control	1	Lump	$5,000	$5,000
5	Allowance for Hazardous Material	1	Lump	$15,000	$15,000
6	Mobilization	1	Lump	$15,000	$15,000
7	Remove Concrete Sidewalk	32	SF	$3.00	$96
8	Remove Asphalt Concrete	4,524	SF	$4.00	$18,096
9	Minor Concrete, Sidewalk	32	SF	$10	$320
10	Striping	1	Lump	$5,000	$5,000
11	Place Asphalt Concrete (Miscellaneous Areas)	13	SY	$50	$667
12	Pavement Reinforcing Fabric	2,115	SY	$2.50	$5,288
13	Asphalt Concrete Surface	102	Tons	$90	$9,161
14	Aggregate Base, Class 2	705	CY	$55	$38,779
15	16" Gate Valve	7	EA	$4,500	$31,500
16	12" Gate Valve	1	EA	$2,500	$2,500
17	8" Gate Valve	2	EA	$1,100	$2,200
18	Remove 6" Gate Valve	1	EA	$650	$650
19	Fire Hydrant Assembly	4	EA	$4,400	$17,600
20	Water Main Tie In	4	EA	$3,000	$12,000
21	Abandon Fire Hydrant	1	EA	$850	$850
22	Remove Existing 6" Water Main	1	Lump	$3,500	$3,500
23	8" PVC Water Main	190	LF	$65	$12,350
24	16" PVC Water Main- PVC C905	2,072	LF	$95	$196,840
25	Trench Shoring and Bracing-Water	1	Lump	$2,500	$2,500
				Construction Subtotal	**$404,897**

Contingency (20%)	$80,979
Construction Total	**$485,876**

Administration & Legal (10%)	$40,490
Design PS&E (15%)	$60,735
Environmental (5%)	$20,245
Construction Management (15%)	$60,735
Total Project Cost	**$668,080**

5.1.2. North Zone 2 - Vista View Dr Improvements

In the existing condition model, the northern side of Zone 2, specifically Vista View Dr, experiences restricted fire flows at the hydrants during peak hour demand. The diminished flows are a result of two problems. One, the elevation of the hydrants on Vista View is such that main pressures are reduced due to relatively small hydraulic head (the difference between the storage site and the hydrant). Second, the 6-inch main is undersized, a dead end main (no loop) and aged.

In order to remedy this problem new sections of 12-inch main are required to replace the 8-inch main from North Cloverdale Blvd up the hill to Vista View Dr from Shahan Drive. Additionally, the 6-inch main in Vista View Dr. needs to be upsized to a 12-inch main. This improvement will also include the demolition of the pump station adjacent to Stameroff Court and reconfiguration the piping to connect to the main in Stameroff Court.

This project is low priority and should not be undertaken until the existing facilities have reached usable lifespan.

5.1.2.1.Cost Summary for North Zone 2 Improvements

The cost summary for the north Zone 2 and vista View Dr. Improvements are shown in **Table 5.2.**

Table 5.2
City of Cloverdale
Cost Estimate for North Zone 2 -- Vista View Dr Improvements

Item No.	Item Description	Estimated Quantity	Unit of Measure	Unit Cost	Item Total Cost
1	Clearing and Grubbing	1	Lump	$7,500.00	$7,500
2	Construction Area Signs	1	Lump	$2,500.00	$2,500
3	Erosion Control	1	Lump	$5,000.00	$5,000
4	Traffic Control	1	Lump	$2,500.00	$2,500
5	Mobilization	1	Lump	$35,000.00	$35,000
6	Remove Concrete Sidewalk	36	SF	$3.00	$108
7	Remove Asphalt Concrete	1,700	SF	$4.00	$6,800
8	Minor Concrete, Sidewalk	36	SF	$10.00	$360
9	Remove Curb and Gutter	15	LF	$7.00	$105
10	Minor Concrete, Curb and Gutter	15	LF	$35.00	$525
11	Striping	1	Lump	$2,000.00	$2,000
12	Pavement Reinforcing Fabric	250	SY	$2.50	$625
13	Asphalt Concrete Surface	60	Tons	$90.00	$5,400
14	Aggregate Base, Class 2	100	CY	$55.00	$5,500
15	Air Release Valve	1	Each	$2,000.00	$2,000
16	12" Gate Valve	4	Each	$2,500.00	$10,000
17	8" Gate Valve	4	Each	$1,100.00	$4,400
18	Water Service	40	Each	$1,500.00	$60,000
19	Blow Off Valve	1	Each	$850.00	$850
20	Fire Hydrant Assembly	3	Each	$4,400.00	$13,200
21	Water Main Tie In	4	Each	$3,500.00	$14,000
22	Abandon Fire Hydrant	3	Each	$850.00	$2,550
23	8" Water Main - Ductile Iron	400	LF	$70.00	$28,000
24	12" PVC Water Main	1,000	LF	$90.00	$90,000
25	12" Water Main - Ductile Iron	2,150	LF	$115.00	$247,250
26	12" DIP Water Main Rest. Joint	100	LF	$175.00	$17,500
27	Demolish Pump Station	1	Lump	$10,000.00	$10,000
28	Abandon Water Main	1	Lump	$10,000.00	$10,000
29	Trench Shoring and Bracing-Water	1	Lump	$3,000.00	$3,000
				Construction Subtotal	**$586,673**

Contingency (20%)	$117,335
Construction Total	**$704,008**

Administration & Legal (10%)	$58,667
Design PS&E (15%)	$88,001
Environmental (5%)	$29,334
Construction Management (15%)	$88,001
Total Project Cost	**$968,010**

5.1.3. Northwest Zone 1 Improvements

In several locations, Northwest Zone 1 experiences restricted fire flows due to aged and undersize water mains. To increase flows to the northern part of Zone 1, the following water mains need to be upsized to 8-inch diameter and new fire hydrants and services installed:

- W. Fourth St from Josephine Dr to Hardister Dr (4-inch main currently)
- Champlain from N. Jefferson to N. Cloverdale (6-inch main currently)
- North St (6-inch main currently)
- Josephine Dr from W Fourth to Antonio St (4-inch main currently)
- Antonio St (4-inch main currently)
- Hardister St (4-inch main currently)
- Franklin St from W Second to W First St (4-inch main currently)
- Connect Butler Ct to the water main adjacent to the City Park (6-inch mains currently)
- W. First St from Franklin to Las Colinas (4-inch main currently)
- W. First St from Franklin to Commercial Street(remove 4-inch main and tie over services and hydrants)
- Los Colinas (4-inch main currently)

5.1.3.1.Cost Estimate for Northwest Zone 1 Improvements

The cost estimate for the northwest Zone 1 Improvements are shown in **Table 5.3**

Table 5.3
City of Cloverdale
Cost Estimate for Northwest Zone 1 Improvements

Item No.	Item Description	Estimated Quantity	Unit of Measure	Unit Cost	Item Total Cost
1	Clearing and Grubbing	1	Lump	$7,500.00	$7,500
2	Construction Area Signs	1	Lump	$3,000.00	$3,000
3	Erosion Control	1	Lump	$1,000.00	$1,000
4	Traffic Control	1	Lump	$7,500.00	$7,500
5	Mobilization	1	Lump	$40,000.00	$40,000
6	Remove Concrete Sidewalk	184	SF	$3.00	$552
7	Remove Asphalt Concrete	11,400	SF	$4.00	$45,600
8	Minor Concrete, Sidewalk	184	SF	$10.00	$1,840
9	Remove Curb and Gutter	46	LF	$7.00	$322
10	Minor Concrete, Curb and Gutter	46	LF	$35.00	$1,610
11	Striping	1	Lump	$4,000.00	$4,000
12	Asphalt Concrete Surface	428	Tons	$90.00	$38,520
13	Aggregate Base, Class 2	422	CY	$55.00	$23,210
14	Air Release Valve	2	Each	$2,000.00	$4,000
15	8" Gate Valve	54	Each	$1,100.00	$59,400
16	Water Service	64	Each	$1,500.00	$96,000
17	Fire Hydrant Assembly	28	Each	$4,400.00	$123,200
18	Water Main Tie In	6	Each	$3,500.00	$21,000
19	Abandon Fire Hydrant	13	Each	$850.00	$11,050
20	8" Water Main - PVC	5,926	LF	$65.00	$385,190
21	8" Water Main - Ductile Iron	541	LF	$70.00	$37,870
22	Abandon Water Main	1	Lump	$25,000.00	$25,000
23	Trench Shoring and Bracing-Water	1	Lump	$4,500.00	$4,500
		Construction Subtotal			**$942,804**

Contingency (20%)	$188,561
Construction Total	**$1,131,365**
Administration & Legal (10%)	$94,280
Design PS&E (15%)	$141,421
Right of Way	$0
Environmental (5%)	$47,140
Construction Management (15%)	$141,421
Total Project Cost	**$1,555,627**

5.1.4. Tarman Tract Improvements

The Tarman Tract development between South Cloverdale Blvd and Highway 101 has aged and undersized mains. Needed improvements include: upsizing 4-inch mains in, Clark Ave., Caldwell St, Dina St., Tarman Dr, Hillview Dr., Mayor Way., Brookside Dr., Rosewood Dr., and Debmar Lane and upsizing the 6-inch main in a section of Clark Ave to 8-inch mains.

5.1.4.1.Cost Estimate for Tarman Tract Improvements

The cost estimate for the Tarman Tract Zone 1 Improvements are shown in **Table 5.4**

Table 5.4
City of Cloverdale
Cost Estimate for Tarman Track Improvements

Item No.	Item Description	Estimated Quantity	Unit of Measure	Unit Cost	Item Total Cost
1	Clearing and Grubbing	1	Lump	$10,000	$10,000
2	Construction Area Signs	1	Lump	$5,000	$5,000
3	Erosion Control	1	Lump	$2,500	$2,500
4	Traffic Control	1	Lump	$10,000	$10,000
5	Mobilization	1	Lump	$75,000	$75,000
6	Remove Concrete Sidewalk	136	SF	$3.00	$408
7	Remove Concrete Pavement	245	SF	$3.00	$735
8	Remove Asphalt Concrete	17,274	SF	$4.00	$69,096
9	Remove Curb and Gutter	34	LF	$7.00	$238
10	Remove & Replace Chain Link Fence	24	LF	$15	$360
11	Remove & Replace Wood Fence	24	LF	$12	$288
12	Minor Concrete, Sidewalk	136	SF	$10	$1,360
13	Minor Concrete, P.C.C. Cross Gutter	245	SF	$20	$4,900
14	Striping	1	Lump	$5,000	$5,000
15	Place Asphalt Concrete (Miscellaneous Areas)	19	SY	$50	$960
16	Pavement Reinforcing Fabric	1,919	SY	$2.50	$4,798
17	Asphalt Concrete Surface	389	Tons	$90	$34,980
18	Aggregate Base, Class 2	640	CY	$55	$35,188
19	Air Release Valve	2	EA	$2,000	$4,000
20	12" Gate Valve	1	EA	$1,500	$1,500
21	8" Gate Valve	47	EA	$1,100	$51,700
22	4" Gate Valve	1	EA	$750	$750
23	Water Service	137	EA	$1,500	$205,500
24	Fire Hydrant Assembly	17	EA	$4,400	$74,800
25	Water Main Tie In	12	EA	$3,500	$42,000
26	Abandon Fire Hydrant	10	EA	$850	$8,500
27	8" PVC Water Main	8,637	LF	$65	$561,405
28	Abandon Water Main	1	Lump	$25,000	$25,000
29	Trench Shoring and Bracing-Water	1	Lump	$10,000	$10,000
				Construction Subtotal	**$1,245,966**

Contingency (20%)	$249,193
Construction Total	**$1,495,159**

Administration & Legal (10%)	$124,597
Design PS&E (15%)	$186,895
Environmental (5%)	$62,298
Construction Management (15%)	$186,895
Total Project Cost	**$2,055,843**

5.1.5. Various Zone 1 Improvements

Several smaller projects in Zone 1 are also needed. These include:

- Upsize the 4-inch main in Railroad Ave between Cloverdale Blvd and South East St.
- Move the hydrants and services along North Cloverdale Blvd from the 2 and 4-inch main to the existing 10-inch main between Cloverdale Creek and East Third St.
- Add new 8-inch main from South Cloverdale Blvd to Douglas Fir Circle in Shady Lane.
- Add new 8-inch main from East First St to Oakbrook Ln to complete loop.
- Add new meter manifold, install 4 new services and replace supply lines to existing homes in one location; Cherry Creek Drive at the entrance to Cherry Creek Estates

5.1.5.1. Cost Estimate for Various Zone 1 Improvements

The cost estimate for the various Zone 1 Improvements are shown in **Table 5.5**

Table 5.5
City of Cloverdale
Cost Estimate for Various Zone 1 Improvements

Item No.	Item Description	Estimated Quantity	Unit of Measure	Unit Cost	Item Total Cost
1	Clearing and Grubbing	1	Lump	$5,000.00	$5,000
2	Construction Area Signs	1	Lump	$5,000.00	$5,000
3	Erosion Control	1	Lump	$2,500.00	$2,500
4	Traffic Control	1	Lump	$5,000.00	$5,000
5	Mobilization	1	Lump	$5,000.00	$5,000
6	Remove Concrete Sidewalk	10	SF	$3.00	$30
7	Remove Asphalt Concrete	3,600	SF	$4.00	$14,400
8	Remove Curb and Gutter	16	LF	$7.00	$112
9	Remove & Replace Cyclone Fence	25	LF	$50.00	$1,250
10	Remove & Replace Wood Fence	25	LF	$75.00	$1,875
11	Minor Concrete, Sidewalk	64	LF	$10.00	$640
12	Minor Concrete, Curb and Gutter	16	LF	$35.00	$560
13	Striping	1	Lump	$5,000.00	$5,000
14	Pavement Reinforcing Fabric	400	sy	$2.50	$1,000
15	Asphalt Concrete Surface	81	Tons	$90.00	$7,290
16	Aggregate Base, Class 2	356	CY	$55.00	$19,580
17	Gravel Driveway Conform	7	CY	$100.00	$741
18	Blow Off Valve	1	Each	$850.00	$850
19	Air Release Valve	2	Each	$2,000.00	$4,000
20	8" Gate Valve	7	Each	$1,100.00	$7,700
21	Water Service	31	Each	$1,500.00	$46,500
22	Fire Hydrant Assembly	8	Each	$4,400.00	$35,200
23	Water Main Tie In	6	Each	$3,500.00	$21,000
24	Abandon Fire Hydrant	9	Each	$850.00	$7,650
25	8" PVC Water Main	1,500	LF	$65.00	$97,500
26	8" Ductile Iron Water Main Rest. Joint Pipe	300	LF	$150.00	$45,000
27	Meter Manifold & 4 Meters	1	Lump	$10,000.00	$10,000
28	Abandon Water Main	1	Lump	$2,000.00	$2,000
29	Trench Shoring and Bracing-Water	1	Lump	$2,500.00	$2,500
				Construction Subtotal	**$354,878**

Contingency (20%)	$70,976
Construction Total	**$425,853**

Administration & Legal (10%)	$35,488
Design PS&E (15%)	$53,232
Environmental (5%)	$17,744
Construction Management (15%)	$53,232
Total Project Cost	**$585,548**

5.1.6. Zone 3 Improvements

Zone 3 has some of the newest water mains in the City. There are only two required improvement in Zone 3, to connect the 12-inch main in Clover Springs Dr with a 12-inch stub in Chablis Way and to connect the 8-inch main in Pepperwood Drive to the 8-inch main in Elbridge Avenue.

5.1.6.1.Cost Estimate for Zone 3 Improvements

The cost estimate for the various Zone 3 Improvements are shown in **Table 5.6**

Table 5.6
City of Cloverdale
Cost Estimate for Zone 3 Improvements

Item No.	Item Description	Estimated Quantity	Unit of Measure	Unit Cost	Item Total Cost
1	Clearing and Grubbing	1	Lump	$10,000.00	$10,000
2	Construction Area Signs	1	Lump	$2,500.00	$2,500
3	Erosion Control	1	Lump	$1,500.00	$1,500
4	Traffic Control	1	Lump	$5,000.00	$5,000
5	Mobilization	1	Lump	$10,000.00	$10,000
6	Asphalt Concrete Surface	2	Tons	$90.00	$203
7	Roadway Excavation	19	CY	$30.00	$556
8	Aggregate Base, Class 2	4	CY	$55.00	$220
9	Blow Off Valve	1	Each	$850.00	$850
10	Air Release Valve	2	Each	$2,000.00	$4,000
11	12" Gate Valve	6	Each	$250.00	$1,500
12	Water Service	11	Each	$1,500.00	$16,500
13	Fire Hydrant Assembly	3	Each	$4,400.00	$13,200
14	Water Main Tie In	2	Each	$3,000.00	$6,000
15	12" Water Main- Ductile Iron	582	LF	$90.00	$52,380
16	12" Ductile Iron Water Main Rest. Joint Pipe	137	LF	$175.00	$23,975
17	8" Water Main	900	LF	$65.00	$58,500
18	8" Gate Valve	4	Each	$1,100.00	$4,400
19	8" Ductile Iron Water Main Rest. Joint Pipe	100	LF	$150.00	$15,000
20	Trench Shoring and Bracing-Water	1	Lump	$2,500.00	$2,500
21	Bore & Jack 20" Steel Casing- DI Pipe	180	lf	$750.00	$135,000
				Construction Subtotal	**$363,783**
				Contingency (20%)	$72,757
				Construction Total	**$436,540**

Administration & Legal (10%)	$36,378
Design PS&E (15%)	$54,567
Right of Way	$25,000
Environmental (5%)	$18,189
Construction Management (15%)	$54,567
Total Project Cost	**$625,242**

5.2. Build-Out Improvements

The following sections outline the Network and Storage improvement requirements are for the City for General Plan build-out. Each area associated with build-out development of vacant lands is identified on **Map 2.**

5.2.1. Reservoir Storage Improvements

As identified previously, storage quantities for the City will have to be increased to support build-out. The total existing storage must be increased by 1,950,000 gal. The Main Reservoir has two existing aging concrete storage tanks with a combined capacity of 550,000 gal. These tanks are located on King Ridge Road overlooking Highway 101 and the Plant. The hillside to the east of the tanks has ongoing stability issues due to problems associated with the construction of the Highway 101 bypass. Because the tanks are sub-surface, the maximum elevation of Zone 1 could be maintained by placing two (2) 375,000 gal above ground tanks west of their current location assuming the slopes on the west side of the hill are stable. No investigation has been done thus far. Investigations should be concluded and cost estimates refined before considering this the solution to the problem. Loss of the Main Reservoirs due to a landslide would be catastrophic for the City, as this reservoir is the primary distribution point for all water storage in Zones 1, 2 and 3. An alternative route for distribution to the system would be through the 16-inch water main from the Plant to E First Street, however pumping configurations and telemetry for Plant and well controls would have to be modified until new main reservoirs could be constructed.

The Ritter Reservoir has only one (1) 500,000 gal tank. The water demand requirements for Zone 2 are currently at capacity given the existing tank size. Furthermore, because there is only one tank and Zone 2 is not interconnected with any of the other zones, this reservoir cannot be taken out of service for maintenance, repair or upkeep. Having two tanks at any particular reservoir site will allow the City to perform maintenance by taking one tank off line and leaving the other operating during periods of low demand. Therefore, prior to any additional development in Zone 2 and before any maintenance on the existing tank can be done, an additional 750,000-gallon tank should be installed at the Ritter site. It should be noted that the current site is plumbed and graded to allow for construction of another tank.

The last storage issue is with regards to the lands to the south of the current City limits. Based on the General Plan, this area is targeted for development during build-out. Additional storage will be required to meet the fire flow capacity and the additional water demand in this area. The Asti Rd Reservoir site is proposed to be added in the area southeast of the southerly interchange and be included in Zone 1. The Asti Rd Reservoir site would include two (2) 500,000 gal tanks.

5.2.1.1.Cost Estimate for Reservoir Storage Improvements

The cost estimates for the Reservoir Storage Improvements are shown in **Table 5.7a** through **5.7c.**

Table 5.7a
City of Cloverdale
Cost Estimate for Reservoir Storage Improvements
Cost for Two New 375,000 Gallon Tanks At Main Reservoir Site

Item No.	Item Description	Estimated Quantity	Unit of Measure	Unit Cost	Item Total Cost
1	Clearing and Grubbing	1	Lump	$2,000	$2,000
2	Construction Area Signs	1	Lump	$1,000	$1,000
3	Erosion Control	1	Lump	$4,000	$4,000
4	Traffic Control	1	Lump	$1,000	$1,000
5	Mobilization	1	Lump	$25,000	$25,000
6	Site Drainage Control	1	Lump	$25,000	$25,000
7	Fencing	300	LF	$30	$9,000
8	Lighting	5	EA	$150	$750
9	Site Grading and Preparation	2	Lump	$98,142	$196,285
10	Tank Valves, Controls and Piping	2	Lump	$26,235	$52,470
11	Welded Steel Tank and Foundation	2	Lump	$250,622	$501,245
12	Disinfection and Operational Preparation	2	Lump	$1,500	$3,000
13	10" Water Main - Ductile Iron	500	LF	$105	$52,500
14	12" Water Main - Ductile Iron	500	LF	$115	$57,500
15	18" Water Main - Ductile Iron	150	LF	$150	$22,500
16	Roadway Preparation	111	CY	$50	$5,550
17	Asphalt Concrete Surface	112	Tons	$90	$10,080
18	Aggregate Base, Class 2	55	CY	$55	$3,025
19	Demolition of Existing Tanks	1	Lump	$40,000	$40,000
20	Trench Shoring and Bracing-Water	1	Lump	$5,000	$5,000
				Construction Subtotal	**$1,016,905**

Contingency (20%)	$203,381
Construction Total	**$1,220,286**

Administration & Legal (10%)	$101,691
Design PS&E (15%)	$152,536
Right of Way	$15,000
Environmental (5%)	$50,845
Construction Management (15%)	$152,536
Total Project Cost	**$1,692,893**

Table 5.7b
City of Cloverdale
Cost Estimate for Reservoir Storage Improvements
Cost for Two New 500,000 Gallon Tanks At Asti Rd Reservoir Site

Item No.	Item Description	Estimated Quantity	Unit of Measure	Unit Cost	Item Total Cost
1	Clearing and Grubbing	1	Lump	$2,000	$2,000
2	Construction Area Signs	1	Lump	$1,000	$1,000
3	Erosion Control	1	Lump	$4,000	$4,000
4	Traffic Control	1	Lump	$1,000	$1,000
5	Mobilization	1	Lump	$25,000	$25,000
6	Site Drainage Control	1	Lump	$25,000	$25,000
7	Fencing	300	LF	$30	$9,000
8	Lighting	5	EA	$150	$750
9	Site Grading and Preparation	2	Lump	$130,857	$261,713
10	Tank Valves, Controls and Piping	2	Lump	$34,980	$69,960
11	Welded Steel Tank and Foundation	2	Lump	$334,163	$668,326
12	Disinfection and Operational Preparation	2	Lump	$1,500	$3,000
13	12" Water Main - Ductile Iron	500	LF	$115	$57,500
14	18" Water Main - Ductile Iron	150	LF	$150	$22,500
15	Roadway Preparation	111	CY	$50	$5,550
16	Asphalt Concrete Surface	112	Tons	$90	$10,080
17	Aggregate Base, Class 2	55	CY	$55	$3,025
18	Trench Shoring and Bracing-Water	1	Lump	$5,000	$5,000
				Construction Subtotal	**$1,174,405**

Contingency (20%)	$234,881
Construction Total	**$1,409,286**

Administration & Legal (10%)	$117,441
Design PS&E (15%)	$176,161
Right of Way	$15,000
Environmental (5%)	$58,720
Construction Management (15%)	$176,161
Total Project Cost	**$1,952,768**

Table 5.7c
City of Cloverdale
Cost Estimate for Reservoir Storage Improvements
Cost for One New 750,000 Gallon Tanks At Ritter Reservoir Site

Item No.	Item Description	Estimated Quantity	Unit of Measure	Unit Cost	Item Total Cost
1	Clearing and Grubbing	1	Lump	$500	$500
2	Construction Area Signs	1	Lump	$1,000	$1,000
3	Erosion Control	1	Lump	$4,000	$4,000
4	Traffic Control	1	Lump	$1,000	$1,000
5	Mobilization	1	Lump	$5,000	$5,000
6	Site Drainage Control	1	Lump	$2,500	$2,500
7	Fencing	150	LF	$50	$7,500
8	Lighting	2	EA	$150	$300
9	Site Grading and Preparation	1	Lump	$147,214	$147,214
10	Tank Valves, Controls and Piping	1	Lump	$39,353	$39,353
11	Welded Steel Tank and Foundation	1	Lump	$375,934	$375,934
12	Disinfection and Operational Preparation	1	Lump	$1,500	$1,500
13	12" Water Main - Ductile Iron	150	LF	$115	$17,250
14	18" Water Main - Ductile Iron	150	LF	$150	$22,500
15	Increase Pump Station Capacity - Electrical Upgrade	1	Lump	$25,000	$25,000
16	Trench Shoring and Bracing-Water	1	Lump	$5,000	$5,000
				Construction Subtotal	**$655,550**

Contingency (20%)	$131,110
Construction Total	**$786,660**

Administration & Legal (10%)	$65,555
Design PS&E (15%)	$98,333
Right of Way	$15,000
Environmental (5%)	$32,778
Construction Management (15%)	$98,333
Total Project Cost	**$1,096,658**

5.2.2. Hot Springs and Southcrest Reservoir Flow Improvements

In section 5.1.1, it was noted that additional 16" water main improvements will be required to be constructed in Asti Road before there can be additional buildout expansion in the southerly portion of the City. Those improvements include the construction of a new 16-inch main from the existing 16-inch main at the entrance to the Wastewater Treatment Plant to Santana Drive. As well, a new 12-inch main is also needed to connected from the new 16-inch main (at approximately Porterfield Creek) to an existing 12-inch main in Briarwood Mobile Home Park.

5.2.2.1.Cost Estimate for Asti Rd Improvements

The cost estimates for the Asti Rd Improvements are shown in **Table 5.8a – 5.8b.** The project is divided into two phases. Phase I extends the 16-inch main in Asti Rd from adjacent to the Wastewater Treatment Plant to the existing 12 inch main at Santana Drive. Phase II connects the new 16-inch main in Asti Rd to the existing 12-inch main in Briarwood Mobile Home Park via a 12-inch main under Highway 101.

Table 5.8a
City of Cloverdale
Cost Estimate for Hot Springs and Southcrest Reservoir Flow Improvements Phase I
Asti Road -South of Citrus Fair Drive

Item No.	Item Description	Estimated Quantity	Unit of Measure	Unit Cost	Item Total Cost
1	Clearing and Grubbing	1	Lump	$5,000	$5,000
2	Construction Area Signs	1	Lump	$5,000	$5,000
3	Erosion Control	1	Lump	$5,000	$5,000
4	Traffic Control	1	Lump	$2,500	$2,500
5	Allowance for Hazardous Material	1	Lump	$25,000	$25,000
6	Mobilization	1	Lump	$40,000	$40,000
7	Remove Asphalt Concrete	7,404	SF	$4.00	$29,616
8	Thermoplastic Pavement Markings	1	Lump	$7,500	$7,500
9	Place Asphalt Concrete (Miscellaneous Areas)	27	SY	$50	$1,333
10	Pavement Reinforcing Fabric	823	SY	$2.50	$2,057
11	Asphalt Concrete Surface	167	Tons	$90	$14,993
12	Aggregate Base, Class 2	274	CY	$55	$15,082
13	Air Release Valve	4	EA	$2,000	$8,000
14	Blow Off Valve	2	EA	$850	$1,700
15	16" Gate Valve	13	EA	$4,500	$58,500
16	12" Gate Valve	3	EA	$2,500	$7,500
17	Fire Hydrant Assembly	8	EA	$4,400	$35,200
18	Water Main Tie In	2	EA	$3,500	$7,000
19	16" PVC Water Main	3,322	LF	$95	$315,590
20	16" Restrained Joint Pipe	380	LF	$175	$66,500
21	Trench Shoring and Bracing-Water	1	Lump	$15,000	$15,000
22	Bore & Jack 30" Steel Casing- Under Rail Road	150	LF	$700	$105,000
23	Bore & Jack 30" Steel Casing- Porterfield Creek	150	LF	$750	$112,500
				Construction Subtotal	**$885,571**

Contingency (20%)	$177,114
Construction Total	**$1,062,686**

Administration & Legal (10%)	$88,557
Design PS&E (15%)	$132,836
Environmental (5%)	$44,279
Construction Management (15%)	$132,836
Total Project Cost	**$1,461,193**

Table 5.8b
City of Cloverdale
Cost Estimate for Hot Springs and Southcrest Reservoir Flow Improvements Phase II
Asti Rd to Briarwood Mobile Park Connection

Item No.	Item Description	Estimated Quantity	Unit of Measure	Unit Cost	Item Total Cost
1	Clearing and Grubbing	1	Lump	$7,500	$7,500
2	Construction Area Signs	1	Lump	$5,000	$5,000
3	Erosion Control	1	Lump	$2,500	$2,500
4	Traffic Control	1	Lump	$10,000	$10,000
5	Mobilization	1	Lump	$25,000	$25,000
6	Remove Concrete Pavement	704	SF	$3.00	$2,112
7	Remove Asphalt Concrete	30	SF	$4.00	$120
8	Pavement Reinforcing Fabric	20	SY	$2.50	$50
9	Asphalt Concrete Surface	1	Tons	$90	$90
10	Roadway Excavation	6	CY	$30	$167
11	Excavation (Out of Right of Way)	1,782	CY	$15	$26,736
12	Aggregate Base, Class 2	1	CY	$55	$61
13	Air Release Valve	4	EA	$2,000	$8,000
14	Blow Off Valve	2	EA	$850	$1,700
15	12" Gate Valve	5	EA	$2,500	$12,500
16	8" Gate Valve	1	EA	$1,100	$1,100
17	Fire Hydrant Assembly	3	EA	$4,400	$13,200
18	Water Main Tie In	2	EA	$3,500	$7,000
19	12" x 8" x 12" Tee	1	EA	$4,750	$4,750
20	12" x 12" x 6" Tee	3	EA	$4,500	$13,500
21	Remove and Replace Wood Fence	350	LF	$75	$26,250
22	12" Ductile Iron Water Main Rest. Joint Pipe	1,386	LF	$115	$159,390
23	Trench Shoring and Bracing-Water	1	Lump	$5,000	$5,000
25	Bore & Jack 20" Steel Casing- DI Pipe	275	LF	$750	$206,250
				Construction Subtotal	**$537,976**

Contingency (20%)	$107,595
Construction Total	**$645,571**

Administration & Legal (10%)	$53,798
Design PS&E (15%)	$80,696
Right of Way	$5,000
Environmental (5%)	$26,899
Construction Management (15%)	$80,696
Total Project Cost	**$892,660**

5.2.3. North Zone 2 Improvements

As development occurs in this area, new main will need to be installed and some undersized main replaced. New 12-inch water mains would replace the 8 and 10-inch mains from the Ritter Reservoir to Hillside Dr, the 8-inch main from Hillside Dr. to North Cloverdale Blvd, and the portion of 10" main between Shahan Drive and North Street.

5.2.3.1.Cost Summary for North Zone 2 Improvements

The cost summary for the North Zone 2 Improvements are shown in **Table 5.9.**

Table 5.9
City of Cloverdale
Cost Estimate for North Zone 2

Item No.	Item Description	Estimated Quantity	Unit of Measure	Unit Cost	Item Total Cost
1	Clearing and Grubbing	1	Lump	$7,500.00	$7,500
2	Construction Area Signs	1	Lump	$2,500.00	$2,500
3	Erosion Control	1	Lump	$5,000.00	$5,000
4	Mobilization	1	Lump	$40,000.00	$40,000
5	Remove Concrete Sidewalk	100	SF	$3.00	$300
6	Remove Asphalt Concrete	3,616	SF	$4.00	$14,464
7	Minor Concrete, Sidewalk	100	SF	$10.00	$1,000
8	Remove Curb and Gutter	19	LF	$7.00	$133
9	Minor Concrete, Curb and Gutter	19	LF	$35.00	$665
10	Striping	1	Lump	$5,000.00	$5,000
11	Pavement Reinforcing Fabric	291	SY	$2.50	$728
12	Asphalt Concrete Surface	60	Tons	$90.00	$5,400
13	Aggregate Base, Class 2	100	CY	$55.00	$5,500
14	Air Release Valve	2	Each	$2,000.00	$4,000
15	12" Gate Valve	38	Each	$2,500.00	$95,000
16	Water Service	40	Each	$1,500.00	$60,000
17	Blow Off Valve	1	Each	$850.00	$850
18	Fire Hydrant Assembly	14	Each	$4,400.00	$61,600
19	Water Main Tie In	6	Each	$3,500.00	$21,000
20	Abandon Fire Hydrant	10	Each	$850.00	$8,500
21	12" PVC Water Main	1,658	LF	$90.00	$149,220
22	12" Water Main - Ductile Iron	1,771	LF	$115.00	$203,665
23	Abandon Water Main	1	Lump	$10,000.00	$10,000
24	Trench Shoring and Bracing-Water	1	Lump	$4,500.00	$4,500
				Construction Subtotal	**$706,525**

Contingency (20%)	$141,305
Construction Total	**$847,829**

Administration & Legal (10%)	$70,652
Design PS&E (15%)	$105,979
Environmental (5%)	$35,326
Construction Management (15%)	$105,979
Total Project Cost	**$1,165,765**

5.2.4. Northwest Zone 1 Improvements

To accommodate additional Northwest Zone 1 development, the 12-inch main at the northerly end of Foothill Blvd adjacent to the Vintage Meadows subdivision needs to be extended to North Foothill Blvd. Additionally, the 8-inch water main in North Foothill Blvd needs to be upsized to a 12-inch main. From the end of North Foothill Blvd, the main needs to extend northerly to West Fourth St, then in West Forth St to North Jefferson.

5.2.4.1.Cost Estimate for Northwest Zone 1 Improvements

The cost estimate for the Northwest Zone 1 Improvements are shown in **Table 5.10.**

Table 5.10
City of Cloverdale
Cost Estimate for Northwest Zone 1 Improvements

Item No.	Item Description	Estimated Quantity	Unit of Measure	Unit Cost	Item Total Cost
1	Clearing and Grubbing	1	Lump	$7,500.00	$7,500
2	Construction Area Signs	1	Lump	$2,000.00	$2,000
3	Erosion Control	1	Lump	$1,500.00	$1,500
4	Traffic Control	1	Lump	$2,500.00	$2,500
5	Mobilization	1	Lump	$30,000.00	$30,000
6	Remove Asphalt Concrete	1,500	SF	$4.00	$6,000
7	Remove & Replace Chainlink Fence	40	LF	$55.00	$2,200
8	Remove & Replace Wood Fence	40	LF	$75.00	$3,000
9	Striping	1	Lump	$1,000.00	$1,000
10	Asphalt Concrete Surface	56	Tons	$90.00	$5,040
11	Aggregate Base, Class 2	56	CY	$55.00	$3,080
12	Air Release Valve	2	Each	$2,000.00	$4,000
13	12" Gate Valve	10	Each	$2,500.00	$25,000
14	Water Service	10	Each	$1,500.00	$15,000
15	Blow Off Valve	1	Each	$850.00	$850
16	Fire Hydrant Assembly	2	Each	$4,400.00	$8,800
17	Water Main Tie In	2	Each	$3,500.00	$7,000
18	Abandon Fire Hydrant	1	Each	$850.00	$850
19	12" PVC Water Main	536	LF	$90.00	$48,240
20	12" Water Main - Ductile Iron	1,804	LF	$115.00	$207,460
21	12" Ductile Iron Rest. Joint Pipe	100	LF	$175.00	$17,500
22	Abandon Water Main	1	Lump	$10,000.00	$10,000
23	Trench Shoring and Bracing-Water	1	Lump	$3,000.00	$3,000
24	Bore & Jack 20" Steel Casing- DI Pipe	60	LF	$750.00	$45,000
		Construction Subtotal			$456,520

Contingency (20%)	$91,304
Construction Total	**$547,824**
Administration & Legal (10%)	$45,652
Design PS&E (15%)	$68,478
Right of Way	$0
Environmental (5%)	$22,826
Construction Management (15%)	$68,478
Total Project Cost	**$753,258**

5.2.5. North Cloverdale Expansion

The build-out identified in the 2009 General Plan addresses three primary areas of development in the City where the bulk of new water demand will occur. One of these areas encompasses the land in the northeast area of the General Plan, east of Highway 101 at McCray Rd. This area will add a maximum of 550 homes to the water system. The proposed new 12-inch water main alignment to serve this area will extend from the new 12-inch main crossing North Cloverdale Blvd at Shahan Dr. north along North Cloverdale Blvd to McCray Rd. The 12-inch main will then proceed along McCray Road, go under Hwy 101, and create a loop along Hwy 101, McCray Rd and North Cloverdale Blvd. The conceptual alignment of the main can be seen on **Map 3**. This area will be served with water from Zone 2.

5.2.5.1.Cost Estimate for North Cloverdale Expansion

The cost estimate for the North Cloverdale Improvements are shown in **Table 5.11.**

Table 5.11
Cost Estimate for North Cloverdale Expansion

Item No.	Item Description	Estimated Quantity	Unit of Measure	Unit Cost	Item Total Cost
1	Clearing and Grubbing	1	Lump	$10,000	$10,000
2	Construction Area Signs	1	Lump	$5,000	$5,000
3	Erosion Control	1	Lump	$5,000	$5,000
4	Traffic Control	1	Lump	$10,000	$10,000
5	Allowance for Hazardous Material	1	Lump	$25,000	$25,000
6	Mobilization	1	Lump	$125,000	$125,000
7	Remove Asphalt Concrete	29,315	SF	$4.00	$117,260
8	Striping	1	Lump	$3,000	$3,000
9	Pavement Reinforcing Fabric	2,194	SY	$2.50	$5,484
10	Asphalt Concrete Surface	1,481	Tons	$90	$133,259
11	Aggregate Base, Class 2	1,272	CY	$55	$69,948
12	12" Gate Valve	21	EA	$2,500	$52,500
13	Fire Hydrant Assembly	33	EA	$4,400	$143,308
14	Water Main Tie In	1	EA	$3,500	$3,500
15	Air Release Valve	3	EA	$2,000	$6,000
16	Blow Off Valve	3	EA	$850	$2,550
17	12" Water Main-PVC	9,771	LF	$90	$879,390
18	12" Water Main - Ductile Iron	2,700	LF	$115	$310,500
19	Trench Shoring and Bracing-Water	1	Lump	$10,000	$10,000
20	Bore & Jack 20" Steel Casing- 12" Pipe	465	LF	$750	$348,750
				Construction Subtotal	**$2,265,448**

Contingency (20%)	$453,090
Construction Total	**$2,718,538**
Administration & Legal (10%)	$226,545
Design PS&E (15%)	$339,817
Right of Way	$15,000
Environmental (5%)	$113,272
Construction Management (15%)	$339,817
Total Project Cost	**$3,752,989**

5.2.6. Downtown Cloverdale

The second primary area identified in the General Plan for growth is the downtown section of Cloverdale. Per the General Plan, this area could be used to support an additional maximum of 500 new units to the downtown area in the form of mixed used residential/commercial facilities. Although no new Network improvements are identified, new construction including pavement replacement, new structures, and frontage improvements along North Cloverdale Blvd will be needed; however, the in ground water facilities are sufficient to handle the new loads per the hydraulic model. There is no direct cost estimate for these projects as they are not specifically identified or defined.

5.2.7. Southern Asti Rd Expansion

For the lands to the south and east of Cloverdale along Asti Rd, a significant water main extension is required to support growth at the Alexander Valley Site and to the South along Asti Rd. The primary backbone of the system is a 16-inch main from Santana Dr in Asti Rd to the new Asti Rd Reservoir Site. A 12-inch water main will continue new water service in Asti Rd to approximately ½ mile south of the Dutcher Creek Exit of Hwy 101. A 12-inch loop running from Asti Rd in Chrome Iron Rd to Cloverdale Airport then North along the western boundary of the Airport along the railroad tracks will connect to an existing 12-inch stub main in Santana Dr. These improvements are shown on **Map 3**. The southern Asti Rd Expansion is designed to support as much as 700 EDUs or an additional 230,000 gpd of average day demand.

5.2.7.1. Cost Estimates for the Asti Road Improvements

The cost estimate for the improvements southeast of the southerly interchange are shown in **Table 5.12**

Table 5.12
City of Cloverdale
Cost Estimate for Southern Asti Build Out Expansion

Item No.	Item Description	Estimated Quantity	Unit of Measure	Unit Cost	Item Total Cost
1	Clearing and Grubbing	1	Lump	$10,000	$10,000
2	Construction Area Signs	1	Lump	$5,000	$5,000
3	Erosion Control	1	Lump	$5,000	$5,000
4	Traffic Control	1	Lump	$10,000	$10,000
5	Allowance for Hazardous Material	1	Lump	$25,000	$25,000
6	Mobilization	1	Lump	$125,000	$125,000
7	Remove Asphalt Concrete	28,342	SF	$4.00	$113,368
8	Striping	1	Lump	$3,000	$3,000
9	Pavement Reinforcing Fabric	3,149	SY	$2.50	$7,873
10	Asphalt Concrete Surface	2,126	Tons	$90	$191,309
11	Aggregate Base, Class 2	1,050	CY	$55	$57,734
12	16" Gate Valve	5	EA	$4,500	$22,500
13	12" Gate Valve	40	EA	$2,500	$100,000
14	Fire Hydrant Assembly	42	EA	$4,400	$183,333
15	Water Main Tie In	2	EA	$3,500	$7,000
16	Air Release Valve	9	EA	$2,000	$18,000
17	Blow Off Valve	4	EA	$850	$3,400
18	12" Water Main-PVC	12,500	LF	$90	$1,125,000
19	12" Water Main - Ductile Iron	5,012	LF	$115	$576,380
20	12" Ductile Iron Water Main Rest. Joint Pipe	100	LF	$150	$15,000
21	16" Water Main-PVC	1,845	LF	$95	$175,275
22	Trench Shoring and Bracing-Water	1	Lump	$8,500	$8,500
23	Bore & Jack 20" Steel Casing- 12" Pipe	470	LF	$750	$352,500
				Construction Subtotal	**$3,140,171**

Contingency (20%)	$628,034
Construction Total	**$3,768,206**

Administration & Legal (10%)	$314,017
Design PS&E (15%)	$471,026
Right of Way	$15,000
Environmental (5%)	$157,009
Construction Management (15%)	$471,026
Total Project Cost	**$5,196,283**

5.2.8. Southwestern Cloverdale Expansion

The General Plan Build-Out for Cloverdale identified the western side of Hwy 101, south of Sandholm Ln, as a location for expansion. This development area extends south to the Rains Creek Water District at Theresa Dr along Dutcher Creek Rd. In order to provide water service to this area Zone 3 would be expanded to include all of this new development. This project is broken into three (3) separate phase. The first phase is a 12-inch water main loop extending from the 12-inch water main at Sandholm and Foothill Blvd south to just north of Dutcher Creek then looping east to Dutcher Creek Rd and north along Dutcher Creek Rd to Sandholm Ln and finally west to complete the loop at Foothill Blvd. The second phase extends the new 12-inch water main in Dutcher Creek Rd south to Theresa Dr. The final phase provides water service through a 12-inch water main west in Theresa Dr. This water main extension project is shown on **Map 3**.

5.2.5.1 Cost Estimate for Southwestern Cloverdale Expansion

The cost estimates for the three phases of the Southwestern Cloverdale Expansion are shown in **Tables 5.13a** through **Table 5.13c.**

Table 5.13a
City of Cloverdale
Cost Estimate for Southern Cloverdale Expansion Phase 1
Western Zone 3 Improvements

Item No.	Item Description	Estimated Quantity	Unit of Measure	Unit Cost	Item Total Cost
1	Clearing and Grubbing	1	Lump	$15,000	$15,000
2	Construction Area Signs	1	Lump	$5,000	$5,000
3	Erosion Control	1	Lump	$2,500	$2,500
4	Traffic Control	1	Lump	$10,000	$10,000
5	Allowance for Hazardous Material	1	Lump	$6,000	$6,000
6	Mobilization	1	Lump	$60,000	$60,000
7	Asphalt Concrete, Type "A"	139	Tons	$90	$12,486
8	Aggregate Base, Class 2	228	CY	$55	$12,560
9	12" Gate Valve	29	EA	$2,500	$72,500
10	Water Service	104	EA	$1,500	$156,000
11	Fire Hydrant Assembly	10	EA	$4,400	$45,217
12	Water Main Tie In	2	EA	$3,500	$7,000
13	12" Water Main - PVC	3083	LF	$90	$277,470
14	12" Water Main - Ductile Iron	4600	LF	$115	$529,000
15	Trench Shoring and Bracing-Water	1	Lump	$7,500	$7,500
				Construction Subtotal	**$1,218,234**

Contingency (20%)	$243,647
Construction Total	**$1,461,881**

Administration & Legal (10%)	$121,823
Design PS&E (15%)	$182,735
Right of Way	$15,000
Environmental (5%)	$60,912
Construction Management (15%)	$182,735
Total Project Cost	**$2,025,086**

Table 5.13b
City of Cloverdale
Cost Estimate for Southern Cloverdale Expansion Phase 2
Dutcher Creek Build Out Expansion

Item No.	Item Description	Estimated Quantity	Unit of Measure	Unit Cost	Item Total Cost
1	Clearing and Grubbing	1	Lump	$10,000	$10,000
2	Construction Area Signs	1	Lump	$5,000	$5,000
3	Erosion Control	1	Lump	$2,500	$2,500
4	Traffic Control	1	Lump	$10,000	$10,000
5	Allowance for Hazardous Material	1	Lump	$4,000	$4,000
6	Mobilization	1	Lump	$50,000	$50,000
7	Remove Asphalt Concrete	6,960	SF	$4.00	$27,840
8	Striping	1	Lump	$3,000	$3,000
9	Pavement Reinforcing Fabric	773	SY	$2.50	$1,933
10	Asphalt Concrete Surface	157	Tons	$90	$14,094
11	Aggregate Base, Class 2	258	CY	$55	$14,178
12	12" Gate Valve	23	EA	$2,500	$57,500
13	Fire Hydrant Assembly	12	EA	$4,400	$51,040
14	Water Main Tie In	2	EA	$3,500	$7,000
15	Air Release Valve	2	EA	$2,000	$4,000
16	Blow Off Valve	2	EA	$850	$1,700
17	12" Water Main -PVC	3,480	LF	$90	$313,200
18	Trench Shoring and Bracing-Water	1	Lump	$8,500	$8,500
19	Bore & Jack 20" Steel Casing- DI Pipe	30	LF	$750	$22,500
				Construction Subtotal	**$607,985**

Contingency (20%)	$121,597
Construction Total	**$729,582**

Administration & Legal (10%)	$60,799
Design PS&E (15%)	$91,198
Right of Way	$15,000
Environmental (5%)	$30,399
Construction Management (15%)	$91,198
Total Project Cost	**$1,018,175**

Table 5.13c
City of Cloverdale
Cost Estimate for Zone 3 Build Out Improvements
Theresa Drive Build Out Improvements

Item No.	Item Description	Estimated Quantity	Unit of Measure	Unit Cost	Item Total Cost
1	Clearing and Grubbing	1	Lump	$15,000	$15,000
2	Construction Area Signs	1	Lump	$5,000	$5,000
3	Erosion Control	1	Lump	$2,500	$2,500
4	Traffic Control	1	Lump	$10,000	$10,000
5	Mobilization	1	Lump	$25,000	$25,000
6	Remove Asphalt Concrete	5,840	SF	$4.00	$23,360
7	Striping	1	Lump	$2,500	$2,500
8	Pavement Reinforcing Fabric	649	SY	$2.50	$1,622
9	Asphalt Concrete Surface	131	Tons	$90	$11,826
10	Aggregate Base, Class 2	216	CY	$55	$11,896
11	12" Gate Valve	10	EA	$2,500	$25,000
12	Fire Hydrant Assembly	10	EA	$4,400	$42,827
13	Water Main Tie In	1	EA	$3,500	$3,500
14	Air Release Valve	2	EA	$2,000	$4,000
15	Blow Off Valve	1	EA	$850	$850
16	12" Water Main-PVC	2,920	LF	$90	$262,800
17	Trench Shoring and Bracing-Water	1	Lump	$5,500	$5,500
				Construction Subtotal	**$453,181**

Contingency (20%)	$90,636
Construction Total	**$543,817**

Administration & Legal (10%)	$45,318
Design PS&E (15%)	$67,977
Right of Way	$15,000
Environmental (5%)	$22,659
Construction Management (15%)	$67,977
Total Project Cost	**$762,749**

5.2.9. Zone 2 - Vista View Expansion

The Vista View Expansion ties the new 12-inch water main in North Cloverdale Blvd to the upsized 12-inch water main in Vista View Dr near the top of the hill. This main will be used to support the new development along Vista View north of the existing Vista View Dr.

5.2.9.1.Cost Estimate for Zone 2 – Vista View Expansion

The cost estimate for the Zone 2 – Vista View Expansion are shown in **Table 5.14**

Table 5.14
City of Cloverdale
Cost Estimate for Zone 2 - Vista View Expansion

Item No.	Item Description	Estimated Quantity	Unit of Measure	Unit Cost	Item Total Cost
1	Clearing and Grubbing	1	Lump	$5,000	$5,000
2	Construction Area Signs	1	Lump	$1,000	$1,000
3	Erosion Control	1	Lump	$2,500	$2,500
4	Traffic Control	1	Lump	$1,000	$1,000
5	Mobilization	1	Lump	$2,500	$2,500
6	Minor Concrete, Curb and Gutter	17	LF	$35	$583
7	Striping	1	Lump	$5,000	$5,000
8	Place Asphalt Concrete (Miscellaneous Areas)	556	SY	$50	$27,800
9	Pavement Reinforcing Fabric	556	SY	$2.50	$1,389
10	Asphalt Concrete Surface	375	Tons	$90	$33,750
11	Aggregate Base, Class 2	185	CY	$55	$10,185
12	8" Gate Valve	54	EA	$1,100	$59,400
13	Blow Off Valve	1	EA	$850	$850
14	Fire Hydrant Assembly	8	EA	$4,400	$36,667
15	Water Main Tie In	2	EA	$3,500	$7,000
16	8" Water Main - PVC	2,500	LF	$65	$162,500
17	Trench Shoring and Bracing-Water	1	Lump	$7,500	$7,500
				Construction Subtotal	**$364,624**

Contingency (20%)	$72,925
Construction Total	**$437,549**

Administration & Legal (10%)	$36,462
Design PS&E (15%)	$54,694
Environmental (5%)	$18,231
Construction Management (15%)	$54,694
Total Project Cost	**$601,630**

5.2.10. Church Lane Expansion

The build-out of Church Lane incorporates a new 8-inch main connected to the 12-inch main at Sherwood Dr and at South Cloverdale Blvd at El Rancho Dr and Church Lane.

5.2.10.1. Cost Estimate for Church Lane Improvements

The cost estimate for the Church Lane Improvements are shown in **Table 5.15.**

Table 5.15
City of Cloverdale
Cost Estimate for Church Lane Build Out Improvements

Item No.	Item Description	Estimated Quantity	Unit of Measure	Unit Cost	Item Total Cost
1	Clearing and Grubbing	1	Lump	$5,000	$5,000
2	Construction Area Signs	1	Lump	$5,000	$5,000
3	Erosion Control	1	Lump	$2,500	$2,500
4	Traffic Control	1	Lump	$1,000	$1,000
5	Mobilization	1	Lump	$15,000	$15,000
6	Asphalt Concrete, Type "A"	109	Tons	$90	$9,810
7	Aggregate Base, Class 2	179	CY	$55	$9,851
8	12" Gate Valve	20	EA	$1,250	$25,000
9	Fire Hydrant Assembly	8	EA	$4,400	$35,464
10	Water Main Tie In	3	EA	$3,500	$10,500
11	8" Water Main - PVC	2,418	LF	$65	$157,170
12	8" Water Main - Ductile Iron	1,107	LF	$110	$121,770
13	Trench Shoring and Bracing-Water	1	Lump	$3,500	$3,500
				Construction Subtotal	**$401,565**

Contingency (20%)	$80,313
Construction Total	**$481,878**

Administration & Legal (10%)	$40,157
Design PS&E (15%)	$60,235
Right of Way	$25,000
Environmental (5%)	$20,078
Construction Management (15%)	$60,235
Total Project Cost	**$687,582**

5.3. Production Analysis

The production capacity analysis evaluates both the current and future capacities of the Water Treatment Plant and wells (Plant) to meet the needs of the City. It should be noted that all future development will have an associated operation and maintenance cost above what is currently experienced.

5.3.1. Existing System Production

As addressed in the analysis portion of this report the Maximum Daily Demand (MDD) experienced over the study period occurred in 2004 at 2.85 million gallons per day (mgpd). **Table 5.16** outlines the plant production values.

Table 5.16
City of Cloverdale
Historic Water Treatment Plant Loading

	2000	2001	2002	2003	2004	2005	2006	2007
Total Year (mgpy)	458.4	473.7	477.6	489.7	528.5	470.9	503.5	500.0
Average Day (mgpd)	1.25	1.30	1.31	1.34	1.44	1.29	1.38	1.37
Period Oct-Mar (mg / Period)	154.7	160.7	168.7	181.4	183.9	174.8	182.8	181.0
Period Apr-Sep (mg / Period)	303.8	313.0	308.8	308.3	344.6	296.1	320.8	318.9
Average Apr-Sep (mgpd)	1.66	1.71	1.69	1.68	1.88	1.62	1.75	1.74
MDD (mg)	2.71	2.57	2.83	2.52	2.85	2.38	2.55	2.40
# of Days > 2 mg Production	34	40	38	59	82	42	66	54

As can be seen in the production analysis the City experiences approximately two-thirds of its water demand in the summer months. Additionally, the Plant experiences approximately 50 to 70 days of demand greater than 2.0 mgd. Assuming well pump production of approximately 660 gpm per well, it requires two pumps running 23 hours per day, with a third well pump running for 2 hours. Accordingly, approximately 60 days of the year the pumps are operating more than 50% of the time.

At these levels, the Plant capacity is well within its ability to keep up with demand. However, in recent years the pumping capability of some of the four wells has had trouble consistently producing 660 gpm for extended periods particularly during the summer when demands are highest. Based on recent ongoing studies, it appears that Well 6 and Well 8 combined can reliably produce 1,700 gpm. Both of these wells are typically the lead well pumps for the system. Both Wells 3 and 7 have experienced air in the wells over the last 7 or 8 years due to well water levels falling below the tops of the screens in these wells. Because air cannot be tolerated for long periods of time in the filter units, the pumps for both wells 3 and 7 have had to be either cutback so that drawdown is lessened, or these wells are not used. Currently, a study is underway to identify possible solutions to resolve this problem. Possible solutions to these problems include:

- Well replacement and/or modification to change perforation elevations and mitigate air entrainment. This may include the replacement of Well 7 and the installation of a liner over part of the screen in Well 3.

- Add individual well controls such as motor control valves to control well flow rates.
- Modify the WTP SCADA system for well pumping optimization.

Definitive solutions will be identified in a report from the contract hydrogeologist. Cost estimates for the work will be provided with the report.

Based on the current production capabilities, it is clear that the City will need to develop additional water sources (wells) in order to meet the demands identified in the General Plan

5.3.2. Future Water Production

As addressed above in the quantitative build-out water production analysis above, the City has identified a maximum build-out population of 12,000 and a maximum commercial and industrial build-out in accordance with the Vacant Area Map (**Map 2**). The demands from this level of growth equates to:

From Section 3.3 MDD = 4.48 Mgpd

4.48 Mgpd / 1,440 min/day = 3,113 gpm

*3,113 gpm * 1.5 PHD Peaking Factor = 4,669 gpm*

4,669 gpm / 660 gpm/pump = 7 pumps

In order to meet the peak hourly demand (PHD) seven (7) total pumps will be required with an average sustainable pumping capacity of 660 gpm. The higher the average capacity of the pumps the fewer the number of pumps required. For instance, if the pump capacity were increased to 800 gpm, 6 pumps would be required. Accordingly, additional wells will need to be constructed. Depending on well production, it is anticipated that an additional two to three wells will be needed.

5.3.2.1.Cost Estimate for New Wells

The cost estimate for the new wells are shown in **Table 5.17**

Table 5.17
City of Cloverdale
Cost Estimate for Construction of New Wells

Item No.	Item Description	Estimated Quantity	Unit of Measure	Unit Cost	Item Total Cost
1	New Well	3	Each	$250,000	$750,000
2	Additional Filter Bay Media & Piping	1	Lump	$50,000	$50,000
				Construction Subtotal	**$800,000**

Contingency (20%)	$160,000
Construction Total	**$960,000**

Administration & Legal (10%)	$80,000
Design PS&E (15%)	$120,000
Right of Way	$5,000
Environmental (5%)	$40,000
Construction Management (15%)	$120,000
Total Project Cost	**$1,325,000**

5.4. Water Conservation

5.4.1. Water Conservation

In 2007 and 2008, the City enacted voluntary water conservation measures in the form of alternating landscape irrigation schedules. This action was largely successful in helping the City avoid severe water shortages during the peak dry season of drought-like conditions. Based on the success of this voluntary program and the need to conserve water in the Russian River Watershed, it is recommended that the City develop an aggressive water conservation program.

As identified in **Section 2** of this report, the City averages a 15% loss of water between water production and usage each year. The City is unable to account for this level of water loss.

Although it is clear that the City is not the only water user that contributes to the water loss, this report identifies two primary areas that the City can focus on to help reduce unaccounted for water loss. The primary areas include the City's water distribution system and its water customer base.

In the United States today, an average of 42% of annual water consumption is for indoor uses, with the remaining 58% of annual water consumption being used for exterior purposes, such as landscape irrigation, car washing, etc. According to information obtained through the analysis of Cloverdale's water production and consumption, and a comparison to the wastewater treatment plant influent from the Sewer Master Plan process, it is apparent that Cloverdale's indoor use is 50%, suggesting that the balance of 50% is being used for outdoor purposes.

In the evaluation of water production versus consumption presented in **Section 2.3.4**, there is an approximate loss of 15% between water produced and consumed. The reasons given for this were primary distribution system leakage, and unmetered flows (malfunctioning meters, water theft, fire flows, etc.). While it is impossible to predict the source of the biggest losses, it is likely on the City's side of the water meters. Fortunately, the City does have the ability to implement projects to identify and reduce such losses. In addition to the projects identified in this report, the City should consider implementing a program of replacing older water meters.

5.4.2. Current Water Usage

The City's water usage patterns were determined from the differences in production and consumption between the wet season (fall, winter and early spring) and the dry season (late spring and summer.) This is further confirmed by analysis of the dry weather wastewater treatment plant influent flow patterns from the Sewer Master Plan update. This wet-weather/dry-weather difference is very pronounced, showing that uses historically increase dramatically during the dry season.

5.4.3. Suggested Steps to Promote Water Conservation

5.4.3.1.Water Distribution System

In recent years, the City has been routinely replacing service saddles and corporation stop valves in concentrated areas within the City due to failing hardware. Based the historical record of a limited practice of replacing older mains, the City may want to consider a more aggressive system of replacing old and undersized water mains and more aggressively replacing water

services in known problem areas. In addition, the City should continue to monitor aggressively unauthorized fire hydrant usage. Finally, it is recommended that the City evaluate the irrigation systems in the city-owned parks to see if systems can be installed to minimize water use (e.g. controllers linked to soil moisture sensors, underground irrigation systems, etc.)

5.4.3.2.Consumer Usage

With the current environmental awareness, consumer-based efforts have been largely effective at conserving water. Some concepts that the City may want to consider include:

- Provide free trade-ins of older indoor water fixtures for low-volume fixtures, such as shower heads
- Promote the purchase of water conserving appliances, such as dish and clothes washing machines
- Continued, consistent community outreach and education concerning water conservation and water-efficient landscape and irrigation practices
- Promote water-efficient landscaping and irrigation practices, including xeriscape, or near-xeriscape landscaping and use of low-water demanding native vegetation conditions on proposed developments
- Encourage customers with usages higher than expected to have a leak detection audit performed on their service line and plumbing
- Encourage residents to report potential unauthorized usage from fire hydrants

5.5. CONCLUSION

The Cloverdale Water Master Plan Update has described, analyzed and modeled the Water Production, Storage and Distribution for the City of Cloverdale. The Update, identified areas that were in need of improvement and determined how the 2009 General Plan build-out will affect the current system.

The findings of this Update indicate that the current system has some deficiencies that will require action to fix. Three of the more significantly identified items include: (1) Hot Springs and Southcrest Reservoirs are having trouble recharging during peak demand periods; (2) in several locations pipe sizes and the subsequent water flow was not adequate to serve the minimum fire flow requirements for those locations during peak hour demand periods; and (3) maximum water production capacity from the existing well field improvements does not meet State regulation during dry weather periods. To resolve these issues, the following improvements are needed:

- Provide well field improvements to alleviate water production shortages during dry weather periods (refer to Technical Memorandum from Luhdorff and Scalmanini dated March 15, 2010, for recommended improvements).
- Add a new 16-inch main in Asti Rd between W First & Citrus Fair to improve water flow to the Hot Springs and Southcrest Reservoirs.
- Upsize existing water mains to 8-inch, 10-inch and 12-inch water mains to improve water flow and add looping during peak demand periods.
- Extending existing 12-inch mains to connect specific regions of the City, which have inadequate water flows.

The Update addressed the impact that the 2009 General Plan build-out would have on the existing system. Build-out require the City to add additional 53,000 linear feet of water mains, the addition of 4 reservoirs tanks totaling 1,950,000 gallons of additional storage, and an additional 305 million gallons of water per year. The facilities needed to support build-out include:

- Providing up to an additional three wells
- Replace the Main Reservoirs with two 375,000-gallon tanks
- Increase water storage at the Ritter Reservoir with an additional 750,000-gallon tank
- Add two new 500,000-gallon reservoirs in the southerly portion of the city southeast of the southerly interchange
- Increase the capacity of the water treatment plant by adding filter media into the fourth filter bay and connecting the filter to the system to accommodate increased water demand and provide redundancy.
- Add new 16-inch main in Asti Rd between the WWTP and Santana to increase flows to the Hot Springs and Southcrest Reservoirs and facilitate southerly expansion.
- Provide new 12-inch water main in Zone 2 north along North Cloverdale Blvd to the potential build-out location at McCray Rd.
- Extend a new 16-inch / 12-inch water main south of Santana Blvd on Asti Rd to support the growth in the southern Asti Rd area.
- Provide a 12-inch Zone 3 loop south of Sandholm Lane and north of Dutcher Creek Rd. and connect Dutcher Creek Rd and Theresa Dr areas to City water service.