County Service Area 16
Shandon, California

Water System Master Plan
2004

County of San Luis Obispo
Public Works Department
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Executive Summary

The County of San Luis Obispo Public Works Department has prepared this Water System Master Plan for CSA 16 in Shandon, California, in order to more effectively plan for capital improvement projects. The existing system analyzed under current and future demands against design criteria reveals deficiencies in the effectiveness of the system. A water distribution system simulator, EPANET was used to run the system model for peak hour demand and maximum day demand plus fire-flow demand.

All of CSA 16 water is supplied by two wells with a total pumping capacity of 800 gallons per minute (gpm). The wells fill a 212,000 gallon bolted steel storage tank that sits at an elevation of 1,190 feet, just east of the service district. This tank regulates pressure to all the services throughout town via 4, 6, 8, and 10-inch polyvinyl chloride (PVC) plastic pipeline.

The existing system serves 284 residential meters with an average use of 370 gpd per meter, 11 public authorities with varying usage, and 1 commercial meter with an average use of 390 gpd. The system is unable to meet fire flow demands in many areas due to undersized lines and lack of available storage. The current groundwater for the Shandon area is the Paso Robles Ground Water Basin, which is sufficient in meeting build-out water demands.

The build-out model includes water lines in the newly annexed Tract 2451 at the east end of Shandon and also assumes that new pipes will be added in the southeast part of town. The build-out system will service 526 residential meters, 12 commercial meters, a larger commercial lot that has the possibility of servicing numerous commercial meters, and 11 public authority meters, as previously mentioned.

One project that has already been initiated is looping the Heights area, from Los Altos Avenue to 1st Street. The estimated construction cost for this project is $248,000 and the preliminary engineering has recently been completed.

The existing 212,000 gallon tank is deficient in storage by 434,400 gallons, if it is to meet Shandon's storage requirements. The estimated construction cost for this new tank is $440,625. The existing 6-inch and 8-inch pipes along Centre Street must be upsized to a 10-inch line and has an estimated cost of $550,000. Furthermore, looping between 2nd and 3rd on Estrella Street is another recommended project with an estimated cost of $60,000. All of the estimated costs are for construction only, and are in current dollars.

The above mentioned projects will enable Shandon to effectively meet daily normal demands but would still be gravely deficient in meeting fire-flow requirements due to the fact that its original design in the 1970's required flows that are half of the current standards. As a result, extensive improvements must be made in order for Shandon's water system to provide adequate fire protection. The existing 10-inch main from the tank must be upsized to a 14-inch, 900 feet of the existing 6-inch pipe on First Street must be upsized to a 10-inch, and all existing 4-inch and most 6-inch pipes must be upsized to an 8-inch. The estimated construction costs for these projects are $380K, $180K and $2.7 million, respectively.

1.0 Introduction

1.1 Overview

County Service Area (CSA) No. 16 - Improvement Area 1 was formed in 1972 under the California Government Code, for the purpose of furnishing potable water. CSA 16-1, herein just referred to as CSA 16, has operated since 1972, and is located in the northeast portion of San Luis Obispo County. Records show that CSA 16 provides water service to 284 residential customers, 11 public authorities, and one business[1], at the time of this report being written. The service area boundary is shown in Figure 1.

All of CSA 16 water supply is groundwater pumped from the Paso Robles Upper Salinas Groundwater Basin, a very large basin underlying the region. Currently, CSA 16 is supplied by two wells with a total pumping capacity of 800 gallons per minute (gpm). These wells are located near Clarke Park. The wells fill the new tank located east of town and the tank regulates pressure to all the services throughout town.

The County is facing some critical decisions involving the upgrade of key water system components. Deciding whether to expend capital improvement funds for system upgrades is difficult without an overall system master plan. Thus, the County has authorized its Public Works Department to create this CSA 16 Water System Master Plan.

As a part of this master plan, a hydraulic computer model of Shandon's water system was developed to aid in identifying existing and future improvements. The existing system and build-out system models are saved on an attached disk.

1.2 Goals and Tasks

The goals of this study are to identify improvements to the water distribution system required to meet existing and projected demands, and to develop a water facilities improvement program to aid the County in conducting long-term planning for CSA 16. Specific tasks that were undertaken to accomplish this include:

a. Data Collection and Review

Data was collected which included water consumption records, water production records, land use and operations plans, and supply, distribution and storage characteristics (see references).

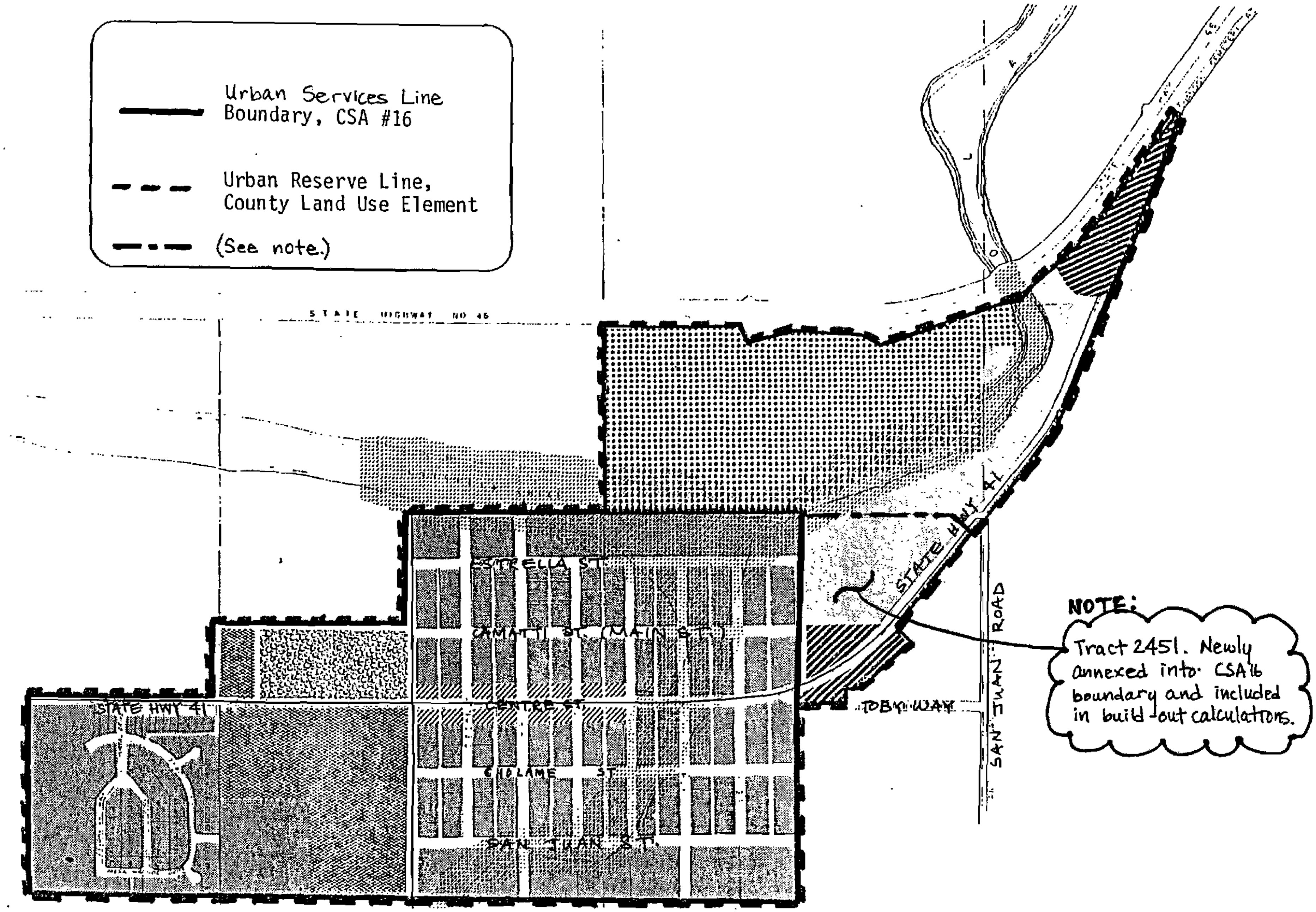

Urban Services Line Boundary, CSA #16
Urban Reserve Line, County Land Use Element
(See note.)
STATE HIGHWAY NO 46
ESTRELLA ST
CAMATTI ST (MAIN ST)
CENTRE ST
CHOLAME ST
SAN JUAN ST
STATE HWY 41
STATE HWY 41
TOBY WAY
SAN JUAN ROAD
NOTE:
Tract 2451. Newly annexed into CSA16 boundary and included in build-out calculations.

FIGURE 1

b. Demand Estimates

Existing land use information available on the County's Property Data Management System[2] was used to determine lot zoning and occupancy status.

Water duty factors for residential and nonresidential land uses were developed using historic water production and consumption data[3]. Peaking factors were determined for maximum day demand and peak hour demand from actual maximum day demand records[3] and applicable literature[4], respectively. Fire flow requirements were established by consulting with California Department of Forestry Fire Prevention Division.

The CSA 16 boundary, also known as the Urban Services Line (USL), defines the limit of water service at build-out. Future average day, maximum day and peak hour demands could be determined after adding the amount of additional water customers at build-out.

c. Existing System Operations

Appropriate County employees were consulted to acquire an understanding of CSA 16 water system operations.

d. Computer Modeling and Hydrant Testing

A computer model was developed to simulate water system performance under both existing and future demands using EPANET. The model was calibrated using results of fire hydrant flow tests performed by County staff.

e. System Deficiencies and Future Needs

A hydraulic analysis was performed to analyze both existing and projected demands. Upgrades were recommended where deficiencies were found. Recommendations for existing and future water supply, storage, back-up power and emergency needs were also made.

f. Recommended Upgrades/Opinion of Probable Cost

The cost and priority of recommended improvements to meet existing and projected water demands were established.

2.0 Existing System

2.1 Overview

A schematic of the CSA 16 water system is shown in Figure 2. Groundwater is pumped and treated with chlorine before delivery to the CSA 16 distribution system. The distribution system consists of 4, 6, 8, and 10-inch polyvinyl chloride (PVC) plastic pipeline. The supply is pumped through town meeting the distribution system demands before continuing on to a 212,000 gallon bolted steel storage tank that sits at an elevation of 1,190 feet just east of the service district.

Shandon is a small rural community, with older homes down near the center of town and newer homes on the outer edges and towards the east side of the service area. When new developments are approved for building, the County has required that water system improvements are made a condition of approval.

2.2 Supply

Water Source:
The current source of supply for the community of Shandon is groundwater. Two wells (#4 and #5) pump water into the distribution system and storage tank. The general characteristics of these two wells are shown in Table 2.1.

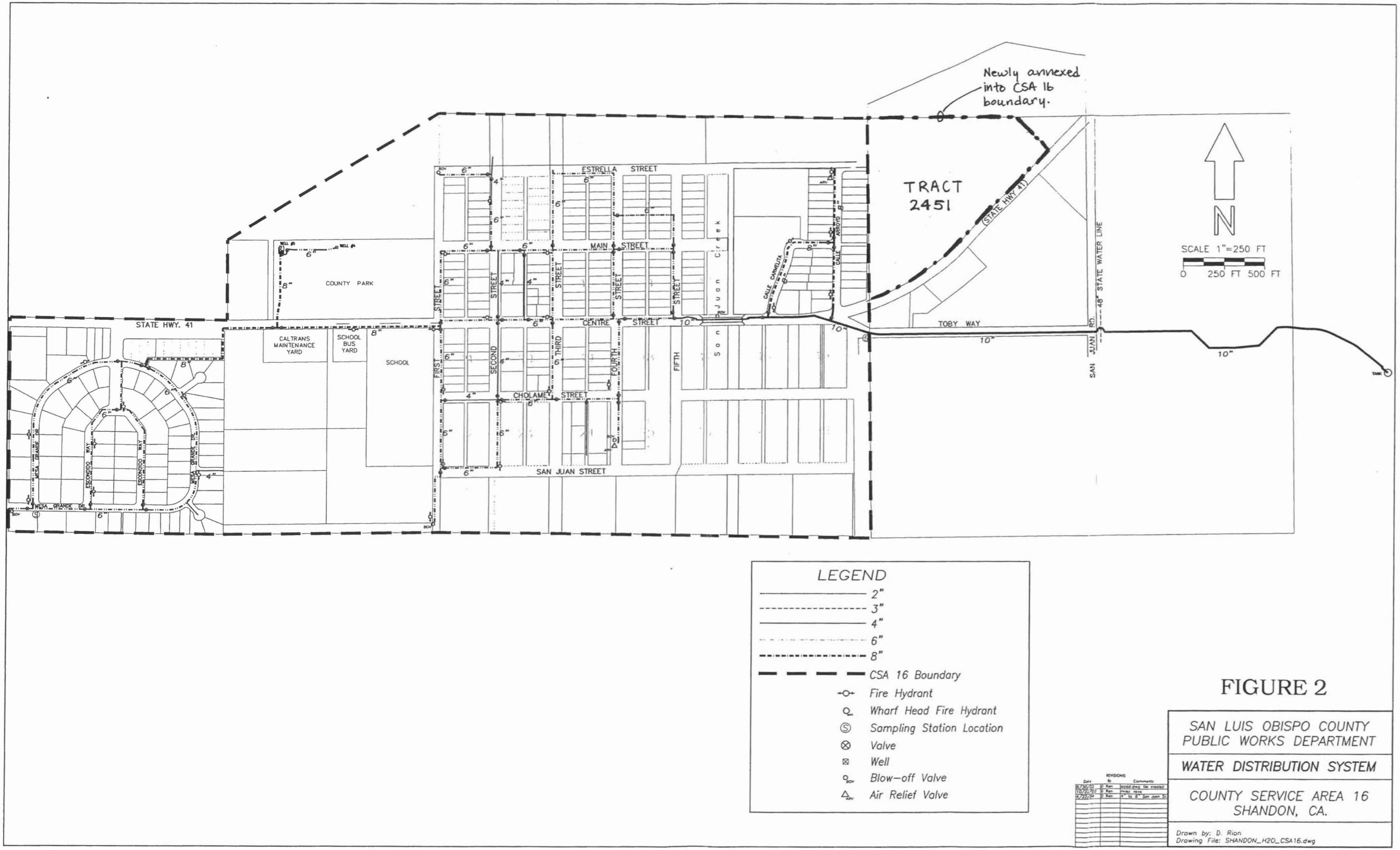
Table 2.1 CSA 16 Groundwater Wells

Well Name	Pumping Capacity (GPM)	Depth of Well (ft. bgs)	Depth of Pump (ft. bgs)	Year of Well Construction
Well #4	500	461	215	1984
Well #5	300	440	250	2002

The well pumps are controlled by the water level in the storage tank. The operating level of the storage tank is between 9 and 14 feet. When the storage tank goes below the low level of 9 feet, one of the wells turns on and will fill the tank until its water level is at 14 feet. The wells alternate cycles and their run times are dependent on the actual demand of the system while they are pumping.

The current groundwater supply is sufficient in meeting the water demands at build-out. According to the "Paso Robles Ground Water Basin Evaluation" dated 2002, groundwater levels in the Shandon area have been steady over the past 40 years.

Supplemental Water Source:
CSA 16 does not have a usable supplemental water source, but does hold 100 AFY of State Water Project supply, which is about two-thirds of Shandon's total annual consumption. In order to use the State Water, the residents of Shandon



Newly annexed into CSA 16 boundary.
TRACT 2451
ESTRELLA STREET
MAIN STREET
CENTRE STREET
CHOLAME STREET
SAN JUAN STREET
FIRST STREET
SECOND STREET
THIRD STREET
FOURTH STREET
FIFTH STREET
San Juan Creek
CALLE CARMELITA
ARROYO
CALLE
STATE HWY. 41
(STATE HWY 41)
TOBY WAY
SAN JUAN RD.
48" STATE WATER LINE
COUNTY PARK
WELL #3
WELL #4
CALTRANS MAINTENANCE YARD
SCHOOL BUS YARD
SCHOOL
MESA GRANDE DR.
ESCONDIDO WAY
N
SCALE 1"=250 FT
0 250 FT 500 FT
LEGEND
2"
3"
4"
6"
8"
CSA 16 Boundary
Fire Hydrant
Wharf Head Fire Hydrant
Sampling Station Location
Valve
Well
Blow-off Valve
Air Relief Valve
SAN LUIS OBISPO COUNTY PUBLIC WORKS DEPARTMENT
WATER DISTRIBUTION SYSTEM
COUNTY SERVICE AREA 16 SHANDON, CA.
Drawn by: D. Rion
Drawing File: SHANDON_H2O_CSA16.dwg

FIGURE 2

would have to approve the construction of a turn-out on the State Water Project pipeline that would cost over $400,000. Construction of a State Water turn-out was never implemented because of the high cost and no immediate need for supplemental water.

Currently, CSA 16's allocation of State Water is up for "sale". The Board of Supervisors periodically considers offers to purchase the water, but no formal agreements have been made to date. There is value in having more than one source of supply for a community, particularly in the event of a water quality emergency, collapse of a well casing, or other emergency. Due to increasing requests for new services and recent inquiries about annexation, the State Water supply may become more and more valuable to the Shandon community.

2.3 Distribution and Transmission Pipelines

The two wells (#4 and #5) are located near Clarke Park and are connected to each other by approximately 300 feet of 6-inch PVC pipe. Water is then transmitted into CSA 16 from the two wells, via 8-inch PVC from Clarke Park both easterly and westerly along Centre Street until it reaches First Street and Mesa Grande Drive. At the intersection of Centre and First Street the distribution system networks into 4, 6 and 8-inch PVC. This portion of the system serves the downtown Shandon area as well as East Shandon. Westerly of wells #4 and #5, the 8-inch PVC networks into 6 and 4-inch PVC to serve the Heights area.

2.4 Storage

The 212,000-gallon storage tank, at an elevation of 1,190 feet and with an overflow at 1,205 feet, is located at the east end of Toby Way and provides gravity flow via a 10-inch PVC to the CSA 16 distribution system. Erected in 2000, the storage tank is bolted steel with a 10-inch overflow, and a 10-inch inlet and outlet. This tank was warranty inspected on January 23, 2002 and the necessary repairs were made in accordance with the warranty provisions of the original contract. Tank inspections are normally conducted every 3 to 5 years, so the next inspection will be scheduled in 2005-2006.

3.0 Existing and Projected Water Demands

3.1 Historic Demand

Historic water usage from 1998 to 2003 for CSA 16 is shown in Table 3.1. The water usage in Shandon has increased steadily since 1998 due to the increased development in the area. The gross meter use, including both residential and non-residential consumption, is about 0.5 AFY.

Table 3.1 Historic Water Use

Type of Meter	98/99*	99/00*	00/01*	01/02	02/03
Residential	228	230	256	272	283
Commercial	1	1	1	1	1
Public Authority	11	11	11	11	11
Total No. of Meters	*240*	*242*	*268*	*284*	*295*
Total Production (AFY)	*120*	*121*	*134*	*143*	*147*

* Estimated number of meters for these years; actual production

3.2 Existing Demand used for Planning

According to 2002-03 meter records, residential usage is approximately 79.5% of the total consumption, commercial usage, less than 0.3%, and public authority usage, approximately 20.3%. These percentages were applied to production data to yield a conservative average usage result.

Table 3.2 Water Use by User Class

	98/99	99/00	00/01	01/02	02/03
Total Production (AFY)	*120*	*121*	*134*	*143*	*147*
Residential Consumption	95.4	96.2	106.5	113.7	116.9
Commercial Consumption	0.4	0.4	0.4	0.4	0.4
Public Authority Consumption	24.2	24.4	27.1	28.9	29.7

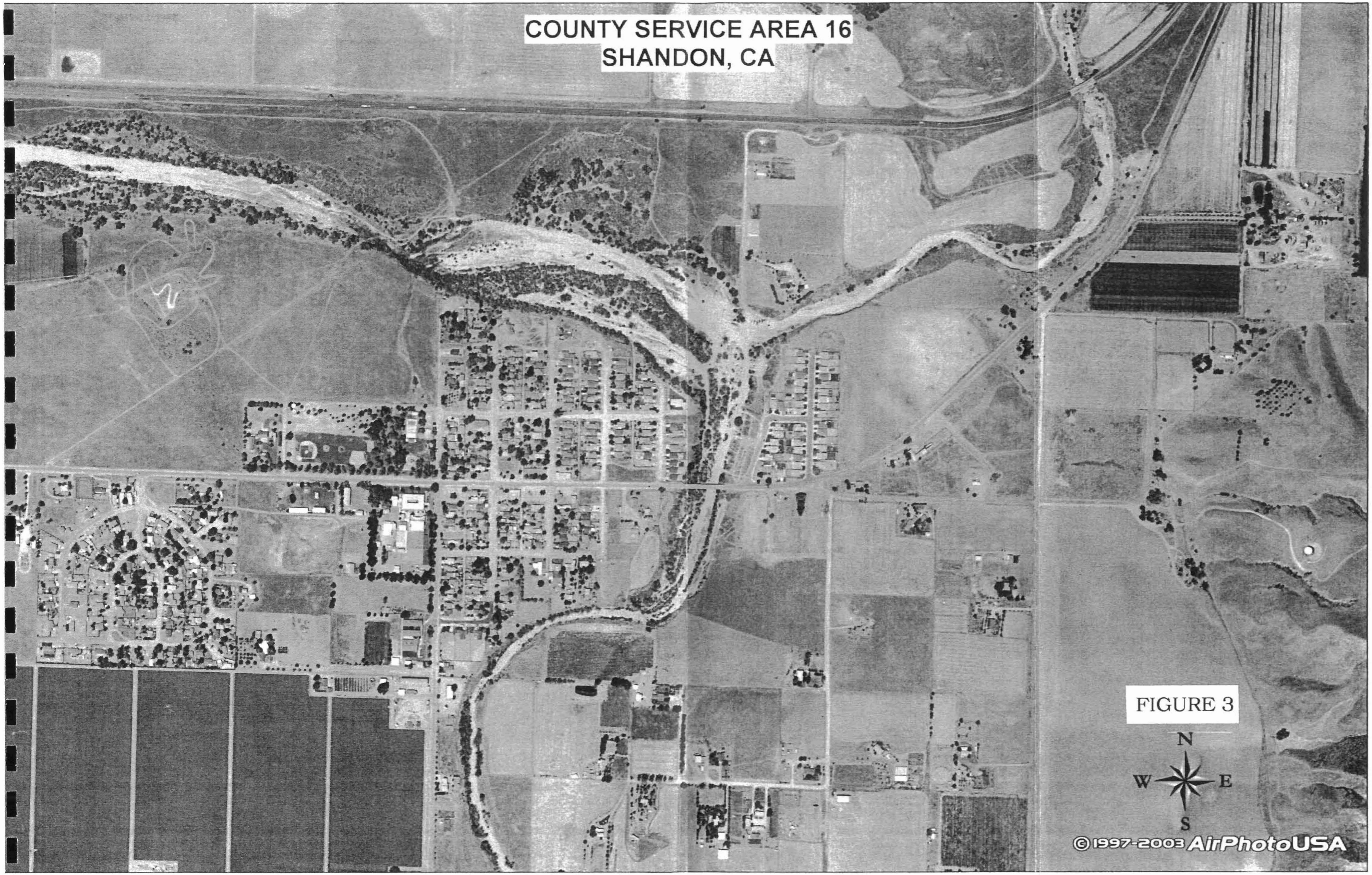
Water Duty Factor Determination:

In order to create a computer model of the existing system, water duty factors for each "node" (the place where multiple pipes meet or the place of central demand) in the system were established. Most of the nodes in the CSA 16 system are for residential water demands. Multi-family and rural residential water duty factors were estimated from the single-family water duty factor.

Table 3.3 Water Duty Factors

Type of Meter	Water Duty Factor	Water Duty Factor
Single-Family Residential	367 gpd/meter	0.25 gpm/meter
Multi-Family Residential	294 gpd/unit	0.20 gpm/unit
Rural Residential	734 gpd/meter	0.50 gpm/meter
Commercial	393 gpd/meter	0.27 gpm/meter
Public Authority	varies	varies

Because public authorities had such varying usage, their individual water duty factors were calculated and applied at the corresponding nodes. These calculations are included in Appendix A of this report.


COUNTY SERVICE AREA 16
SHANDON, CA
FIGURE 3
N
W
E
S
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3.3 Build-Out Demand

Vacant lot information from County records[2] was used to evaluate build-out demand for CSA 16 by locating empty lots and determining their zoning. The USL delineates the County Service Area boundary and was used to define the build-out area for projecting demand in CSA 16. Vacant lots within the USL were identified and assigned water duty factors based on their zoning in order to complete a computer model of the water system for build-out demand. The maximum number of units allowed in a multi-family residential area was used for calculating demand at that lot. The single commercial meter was calculated to have a water duty factor of 0.27 gpm or 0.4 AFY. Since this is relatively low, it was increased to 0.62 gpm or 1 AFY for build-out calculations.

There are currently 217 vacant lots zoned residential, 7 units zoned multi-family residential, 5 rural residential and 12 lots zoned commercial within the USL. In addition, the recently annexed Tract 2451, with 14 residential lots and 1 larger commercial lot, has been included in build-out calculations. Build-out projection suggest about 271 AFY for average day demands.

3.4 Fire Flow Requirements

The Uniform Fire Code establishes minimum fire hydrant flow criteria for particular buildings or zones. After surveying the size and type of construction of the buildings in the critical areas of Shandon, the fire flow requirements were determined to be approximately as shown in Table 3.4.

Table 3.4 Fire Flow Requirements

Type of Development	Fire Flow (gpm)	Duration (hrs)
School	2,750	2
Commercial	2,000	2
Residential Areas	1,000	2

3.5 Peaking Factors

In order for the water system to accommodate maximum demands, peaking factors need to be applied to the average daily demands developed in preceding sections. The maximum daily use was calculated from the maximum production month, June 2001. The CSA 16 distribution should be able to supply the maximum day demand plus fire flow requirements.

Minimum pressures within the system under normal operating conditions are estimated by using a peak hour demand. Since peak hour demand information was not available, the manual entitled "Distribution Network Analysis for Water Utilities" by the American Water Works Association[4] was consulted. The manual suggests that typical peak hour demands range from 1.3 to 2.0 times the maximum day demand. A peak hour demand of 2.0 was used for the peak hour peaking factor. Calculations of the peak hour demand and maximum day demand for both current and build-out demands are shown in Appendix B and the results summarized in Table 3.5.

Table 3.5 Peaking Considerations

	Average Day Demand (gal/day)	Maximum Day Demand (gal/day)	Daily Peaking Factor	Peak Hour Peaking Factor	Peak Hour Demand (gal/hr)
Current	121,600	302,100	2.5	2.0	25,200
Build-Out	241,600	604,000	2.5	2.0	50,300

4.0 Computer Model

4.1 Model Development

A computer model of the CSA16 water distribution system was created in order to help analyze the water system's capabilities and needs.

The EPA-developed computer software, EPANET, was used to model the water system. EPANET uses the Hazen-Williams formula as the basis for calculating head loss. The model consists of two reservoirs and pumps and one storage tank. Table 4.1 outlines the required information that was input into the model for the system components.

Table 4.1 EPANET System Input

Tanks	Name, Elevation, Initial Level, Minimum Level, Maximum Level, Diameter
Pump	Name, Pump Curve
Pipes	Name, Length, Diameter, Hazen-Williams C-Factor
Nodes	Name, Elevation, Base Demand

A skeletal diagram of the distribution system was created as the model using available maps and operator input while a consolidated, electronic map of the system was created for this report. Operators were asked to provide the operational characteristics for the tanks and pumps. Pipe names were assigned based on the street names, diameters were obtained from maps and operators, and lengths were scaled off of available maps. The C-factors were determined from pipe material and installation date, and are 140 for PVC pipes. Nodal elevations were estimated using available plans. A table of demands at each node can be found in Appendix B of this report. Figure ~~3~~ 4 shows the plot of node numbers and piping used for the EPANET Model. Y

CSA 16 - EXISTING WATER SYSTEM

NODE KEY

Node #	Node Name
1	El Portal1
2	Mesa2
3	Mesa3
4	Escondido1
5	Escondido2
6	Paraiso1
7	Paraiso2
8	Los Altos2
9	Los Altos1
10	El Portal2
11	Mesa1
12	Center1
13	Center2
14	Cholame1
15	San Juan1
16	Elementary
17	San Juan2
18	Cholame2
19	Cholame3
20	Cholame4
21	San Juan3
22	San Juan4
23	Cholame5
24	Center9
25	Camatti7
26	Camatti8
27	Camatti9
28	Camatti6
29	Center8
30	Center7
31	Center6
32	Center5
33	Center4
34	Center3
35	Camatti1
36	Camatti3
37	Camatti4
38	Camatti5
39	Camatti2
40	Estrella1
41	Estrella2
42	Estrella3
43	Center10
44	Center11
45	2
46	3
H	Hydrant
HC	Hydrant Carmelita

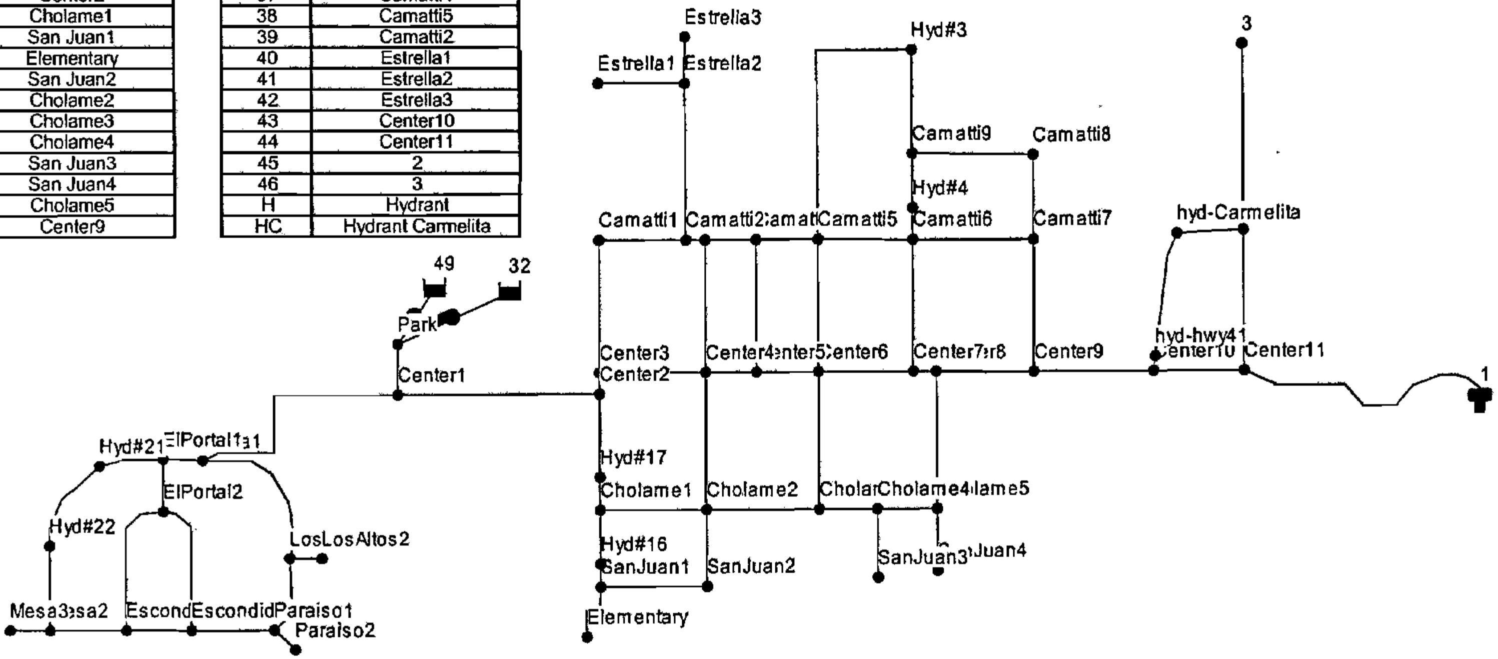

FIGURE 4

4.2 Model Calibration

Fire-flow tests were performed on four hydrants throughout CSA 16 in order to use actual field conditions to calibrate the model. First, static pressure, taken at a residual hydrant, and other conditions, such as weather, tank levels and pump status, are noted on a Fire-Flow Test Form. Pressure is taken at a residual hydrant while a flow hydrant is completely opened. Simultaneously, pressure is measured with a pitot-tube at the midpoint of the discharge at the flow hydrant. The pitot-tube pressure and the hydrant's outlet characteristics are used to calculate the observed flow.

The model analysis was run using average base demand conditions. The resulting model-calculated pressures at the residual hydrant-node locations were compared to field-measured static pressures. The pipe and nodal characteristics of the model, such as the Hazen-Williams C-factor, the elevation or the base demand, were adjusted, as appropriate, until the model-calculated static pressures matched the field-measured static pressures. Next, the observed flow was set as the base demand at the flow hydrant-node, and the model analysis was run, once for each observed flow condition at each flow hydrant-node. The residual pressure calculated by the model at the residual hydrant-node was compared to the field-measured residual pressure. The model is considered calibrated if the model-calculated static pressure is within 5 psi of the field-measured static pressure and if the model-calculated residual pressure is also within 5 psi of the field-measured residual pressure.

4.3 Calibration Results

The four fire hydrants tested were located on Calle Carmelita, Estrella Street, First Street and Mesa Grande Drive. Table 4.2 summarizes the field-measured results and the computer model-calculated results.

Table 4.2 Field-Measured and Model Fire-Flow Results

Location	**Calle Carmelita**	**Estrella Street**	**First Street**	**Mesa Grande**
Observed Static Pressure (psi)	*72*	*70*	*72*	*60*
Model Static Pressure (psi)	76	74	72	61
Observed Residual Pressure (psi)	*65*	*54*	*51*	*35*
Model Residual Pressure (psi)	63	54	46	33
Observed Flow (gpm)	*1210*	*1163*	*1139*	*840*

4.4 Build-Out Model

After calibrating the model, a build-out model was created for running simulations under future demands. Appropriate base demands were assigned to lots according to their zoning.

5.0 Design Criteria

The criteria used to evaluate the ability of the CSA 16 water distribution system to meet both existing and build-out demands are outlined below, and are referenced from Section 4.0.

5.1 Supply System

The source of supply should adequately meet customer needs. The high service pumps should be sized to provide maximum-day demand with the largest source of supply out of service. The system should also be able to replenish fire storage over 72 hours during maximum day demand conditions.

5.2 Piping System

Pipe segments are considered deficient, or limiting, if the following conditions exist during any demand condition:

- Velocities greater than 5 feet per second (fps)
- Head losses greater than 10 feet per 1000 feet (ft/Kft)

A velocity of 10 feet per second is acceptable only if the head loss criteria are met. Pipelines displaying these conditions usually prevent the system from providing adequate flow and/or pressure, and may be improved by appropriate pipe sizing or routing.

Section 64566 of Title 22 of the California Code of Regulations[5] requires that any changes to the water system should result in an operating pressure of 20 psi under peak hour demand and average day demand plus fire-flow demand conditions. Pressure is considered unacceptable if it falls below 30 psi for peak hour demands, and below 20 psi for maximum day demand plus fire flow demand. Negative pressures indicate that the system is unable to provide the needed flow to meet demand at that location.

5.3 Storage System

The most limiting demand condition for system storage is maximum day demand plus fire flow demand. The tank needs to meet three volume requirements: equalization storage, emergency storage, and fire storage.

Equalization Storage: This storage is required to meet water system demands in excess of what supply can provide during peak demand conditions. The equalization storage volume can be estimated by assuming that demand in excess of rate of supply occurs for 14 hours during the day, and therefore equals:

(Peak Hour Demand – Rate of Supply)*14 hrs

Emergency Storage: This is a volume of water to be available to sustain sanitary needs in the event that an emergency cuts off the normal water supply. The amount of time to restore the normal water supply was estimated at 72 hours, and the basic sanitary demand per capita was estimated to be 50 gallons per day.

Fire Storage: This storage is required to meet the highest fire-flow demand in the CSA 16 water system, which is for school fire protection: 2750 gallons per minute for 2 hours.

6.0 Ability of Existing System to Meet Existing Demands

The model was run under existing conditions at four locations for peak hour demand and maximum day demand plus fire-flow demand. The results from the model runs were compared with the design criteria for the supply, piping, and storage systems. Current system deficiencies were identified in order to help prioritize capital improvement projects.

6.1 Supply System

The high-service pumps are adequate for current maximum day demand since their design flow is 800 gpm and maximum day demand is 210 gpm. If there was a fire near the schools, 330,000 gallons would theoretically be used from the storage tank. The rate needed over 72 hours to replenish 330,000 gallons is 76 gpm. Therefore, the design flow of 800 gpm is adequate to supply 286 gpm.

6.2 Piping System

Under peak hour demand conditions, the model indicated that the system was able to function properly, with head losses below 10 ft/Kft, velocities below 5 fps, and overall system pressures above 30 psi. However, the CSA 16 system could not operate under maximum day demand plus school fire-flow demand. The model showed that negative pressures occurred immediately when the demand at First Street was set to 2750 gpm, the requirement for school fire flow.

The only commercial meter in Shandon is the Shandon Market near Second and Centre Street. When the system was modeled with a fire-flow requirement of 2000 gpm for 2 hours, a majority of the system indicated negative pressures.

Residential fire-flow demands were simulated at three locations: at Carmelita, at Fourth Street between Main and Estrella Street, and on Mesa Grande Drive in the Heights area. The fire-flow requirement of 1000 gpm for 2 hours could be sustained only at the Carmelita location, while maintaining a pressure of 20 psi throughout the system as well as meeting the head loss and velocity requirements.

Furthermore, the locations of the fire flow demand were converted to reservoirs with a hydraulic grade line of the nodal elevation plus 20 psi in order to determine the maximum flow available at 20 psi for 2 hours. The results are shown in Table 6.1. These results show that it is not possible to reach a flow of 1000 gpm at Mesa Grande Drive, nor a flow of 2000 gpm on 2nd and Centre Street, nor a flow of 2750 gpm near the school on First Street.

Table 6.1 Maximum Available Flow at 20 psi

Test	Location	Result (gpm)
School	1st Street (San Juan & Centre St.)	1453 to 1342
Commercial	2nd Street and Centre St.	1713 to 1587 [1hr 43 min]
Residential	Calle Carmelita	2605 to 2431 [1hr 10 min]
Residential	4th Street (Estrella St. & Centre St.)	1726 to 1604 [1hr 43 min]
Residential	Heights Area (Mesa Grande Drive)	960 to 895

It can be concluded that the existing water system is not capable of meeting recommended fire-flows throughout a majority of the service area. This can be attributed to the fact that when the system was built in the 1970's, it was designed with fire flow requirements of 500 gpm for residential and 1000 gpm for commercial and schools.[6] These flow requirements are half the current fire-flow requirements.

6.3 Storage System

Appendix D shows the calculations for the current storage requirements for CSA 16. Table 6.2 below summarizes the results according to storage design criteria. The current storage capacity is deficient by 299,300 gallons.

Table 6.2 Current Storage System Requirements

Required Storage	Volume (gallons)
Equalization	20,000
Emergency	161,300
Fire	330,000
Total Required Storage	511,300
Current Storage	212,000
Additional Storage Needed	299,300

7.0 Ability of Existing System to Meet Build-Out Demands

The model was run under build-out conditions for peak hour demand, maximum day demand plus fire-flow demand. All model fire-flow simulations were run at the same locations as the current demand model-runs, with an additional residential fire flow simulation at a fire hydrant in the newly annexed Tract 2451, east of Calle Arroyo. The results from the model runs were again compared with design criteria for the supply, piping, and storage systems.

Since the fire-flow simulations for the existing system showed negative pressures, the pumps were turned on for build-out so the CSA 16 will not be burdened with paying for an ultra-conservative design. It should be noted that it is highly beneficial for a community to have a generator on-site in the case of an emergency.

7.1 Supply System

The average yearly usage at CSA 16 build-out is estimated to be about 271 acre-feet. Furthermore, the maximum demand is double the present maximum day demand. However, as mentioned in Section 2.0, the groundwater level for the Paso Robles Ground Water Basin has been steady over the past four decades and seems to be adequate in meeting Shandon's water needs at build-out.

The maximum day demand at build-out is 419 gpm, and the required flow to replenish 330,000 gallons over 72 hours for fire protection is 76 gpm. Therefore, the high service pumps would still be able to provide adequate flow for maximum day demand conditions plus fire storage replenishment (495 gpm) since their design flow is 800 gpm.

7.2 Piping System

Under peak hour demand conditions for build-out, the model indicated that the system was able to function properly, with head losses below 10 ft/Kft, velocities below 5 fps, and overall system pressures above 30 psi. However, similar to the model runs for the existing system, it could not operate under maximum day demand plus school fire-flow demand at build-out. The model showed that negative pressures occurred immediately when the demand at First Street was set to 2750 gpm, the requirement for school fire flow.

As expected, negative pressures occurred immediately when the system was modeled with the commercial fire-flow requirement of 2000 gpm near Second and Centre Street, where the Shandon Market is located.

Residential fire-flow demands were simulated at the same three locations as in the existing system and at an additional location in Tract 2451. Again, at the Carmelita location, the requirements for head loss and velocity were met with a

CSA-16 PROPOSED FUTURE WATER DISTRIBUTION SYSTEM

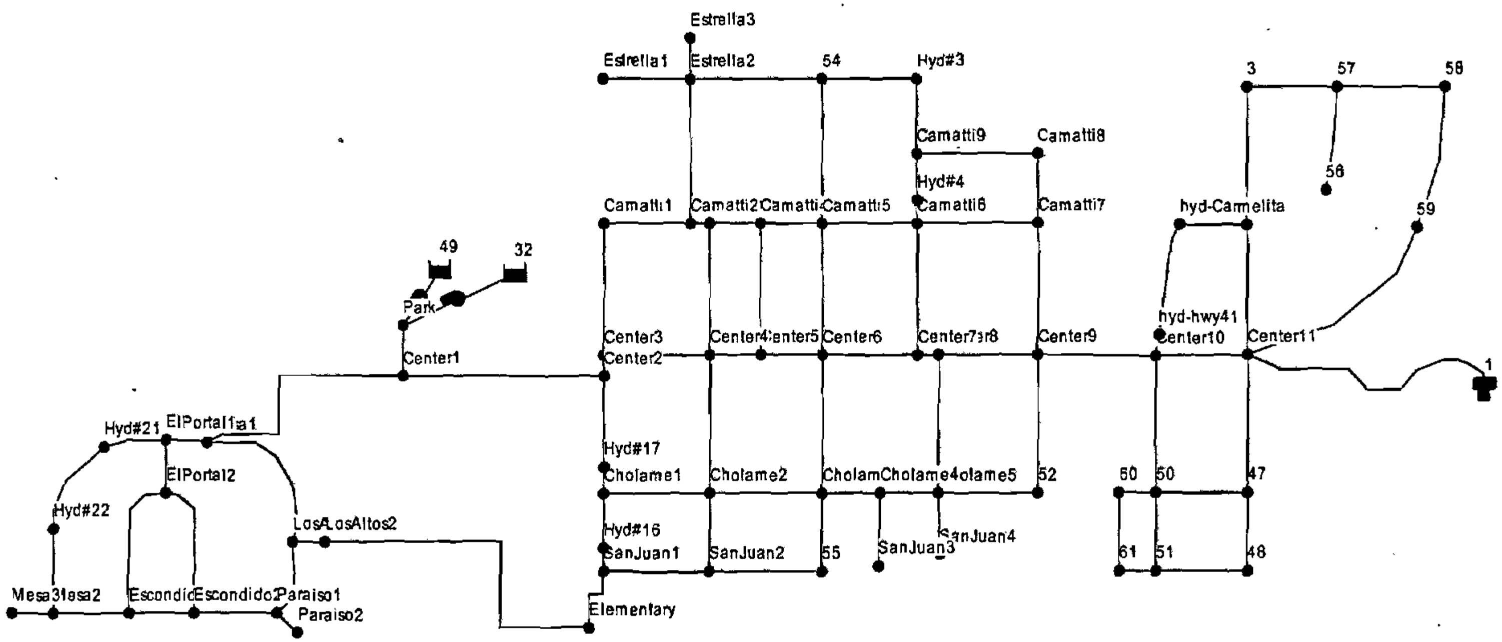

FIGURE 5

flow of 1000 gpm. However, the model showed that the tank ran out of water after one hour and thirty-four minutes and could not be sustained for two hours.

It can be concluded that the existing system is not adequate to meet fire flow requirements at build-out for reasons previously discussed in section 6.2.

7.3 Storage System

Appendix D shows the calculations for the build-out storage requirements for CSA 16. Table 7.1 below summarizes the results according to storage design criteria. The current storage capacity to meet build-out storage requirements is deficient by 434,400 gallons.

Table 7.1 Storage System Requirements at Build-Out

Required Storage	Volume (gallons)
Equalization	20,000
Emergency	296,400
Fire	330,000
Total Required Storage	646,400
Current Storage	212,000
Additional Storage Needed	434,400

8.0 Recommended Capital Improvements

The following projects are those that would provide the greatest improvements to the overall CSA 16 system and/or those projects that have been recommended by the operators. A summary of these projects in order of priority, and construction costs in current dollars, are in Table 8.1. In addition, Appendix E contains the cost estimating data used for evaluating each project.

8.1 Current Projects

Loop Water Mains (Mesa Grande to 1st Street):
The County is currently in the process of initiating this project which involves looping the Heights area by installing approximately 2000 LF of 8-inch PVC pipe from Mesa Grande to 1st Street. This will provide a second source of feed to the Heights area, which makes up 30% of Shandon's water services, as well as increase the pressures during fire flow.

8.2 Recommended Projects

1. New Storage Tank:

According to required storage calculations, Shandon's existing tank is deficient by 434,400 gallons in order to meet build-out needs, as shown in Appendix D of this report. This storage requirement could be reduced if the school buildings were fire-sprinklered; otherwise, the fire-flow requirement for the schools is 2,750 gpm for two hours, per Building Code requirements. The construction cost for a new tank is estimated at $440,625.

Possible locations for the new tank, that would provide a more direct site for looping Shandon's water system, were considered, but upon preliminary review, other sites would prove to be more costly due to easement acquisition. The best location for the new storage tank may be next to the existing tank. Operationally, having the tanks together would be ideal. Since installing the tank would take several years, in all probability, some of the following recommended projects would be completed before the new storage tank was erected.

2. Replace 6-inch Water Line on Centre Street to 10-inch:
The existing water system incurs unnecessary head losses due to the inadequate size of the main water line along Centre Street. Approximately 2750 linear feet of existing 6-inch diameter pipe should be upsized to a 10-inch pipe, from 1st Street to 5th Street, with an estimated construction cost of $550,000.

3. Loop Water Mains (2nd and 3rd Streets):
This project will result in the installation of about 400 linear feet of 6-inch pipe, looping the water mains on Estrella Street from 2nd Street to 3rd Street. Looping will result in higher pressures and reduce head losses during fire flows and has an estimated construction cost of $60,000.

8.3 Other Capital Projects

The projects discussed in the previous section will enable Shandon to effectively meet daily normal demands but would still be gravely deficient in meeting fire-flow requirements due to the fact that its original design in the 1970's required flows that are half of the current standards. As a result, extensive improvements must be made in order for Shandon's water system to provide adequate fire protection, and are as follows:

Replace 10-inch Water Line from Tank
Fire-flow model runs show that this existing 10-inch water main from the tank to 5th Street should be 14-inch in diameter and has an estimated construction cost of $380,000. When this project is initiated, the possibility of a parallel 10-inch pipe should be considered. This new parallel pipe could be connected to the new tank mentioned above, which would enable Shandon to maintain water service in the event of a tank repair or repainting.

Replace Existing 6-inch Pipes to 10-inch:
Replace existing 6-inch pipes to 10-inch pipes along 1st Street between San Juan and Centre Street so that the school fire-flow requirement of 2750gpm can be met. Estimated construction cost is $180,000.

Replace Existing 4 & 6-inch Pipes to 8-inch:

An 8-inch diameter pipe should replace all existing 4-inch diameter pipes and most 6-inch diameter pipes. Also, any new build-out pipes should be 8-inch. This project will enable Shandon to meet the current residential fire-flow requirement of 1000 gpm. Estimated construction cost is $2.7 million.

Table 8.1
Priority of Capital Improvement Projects

	Project Description	Construction Cost	Justification
1	Loop Heights Area	$96,500*	Provides 2nd source of feed, improves fire-flow and water service to customers in Heights area, which encompasses 30% of Shandon.
1	New Storage Tank	$440,625	Improves water service to all customers; better positions community to fight fire
1	Replace Pipe on Centre Street	$550,000	Improves water service to all customers; better positions community to fight fire
2	Loop 2nd and 3rd Street	$60,000	Eliminates dead-end; improves circulation
2	Replace Pipe from Tank	$380,000	Improves water service to all customers; better positions community to fight fire; high head losses with existing pipe.
2	Replace Pipe on 1st Street	$180,000	Enables schools to meet required fire protection; high head losses with current pipes.
3	Replace 4 & 6-inch Pipes	$2,736,000	Enables system to meet required residential fire protection.
	Total =	$4,346,625	

* Per Shandon Loop Heights project P850170 preliminary cost estimate, dated 6/15/04.

M. Lew
7/8/2004

References

1 County of San Luis Obispo. *Quarterly Meter Readings – CSA 16.* 2 years worth kept by Andrea Montes in the Public Works Department; the rest archived.

2 County of San Luis Obispo. *Property Management System.* January 2002.

3 Production and Delivery Data as read from meters for Shandon, March 2000 to November 2003.

4 American Water Works Association. *Distribution Network Analysis for Water Utilities, Manual 32.* First Edition, 1989.

5 California Code of Regulations, Title 22. June 2001.

6 San Luis Obispo County Engineering Department. *Master Water and Sewer Plan, San Luis Obispo County Service Area No. 16 (Shandon).* January 1971.

Appendix A
Water Duty Factor Calculations

Meter Data
June 2002 - July 2003

Type of Meter	Residential	Commercial	Public Authority	Park	Total
No. of Meters (avg.)	**284**	**1**	**10**	**1**	**296**

Consumption

Period	Residential	Commercial	Public Authority	Park	Total
7/10/02	11047	19	866	2978	14910
9/10/02	11394	21	795	3359	15569
11/10/02	8342	18	527	2002	10889
1/10/03	4652	14	209	2	4877
3/10/03	4917	23	239	3	5182
5/13/03	5638	51	249	485	6423
Total (100ft^3)	45990	146	2885	8829	57850
Total (Gallons)	34400520	109208	2157980	6604092	43271800
Percent of Total Use (%)	**79.5**	**0.3**	**5.0**	**15.3**	**100.0**

Water Duty Factors (Based on % of Production)

Total '02-'03 Production = 47804000 gal

Type of Meter & % Usage	*gal/yr*	*AFY*	*gal/day/meter*	*gpm/meter*
Residential (79.5%)	38004180	116.6	367	**0.25**
Commercial (0.3%)	143412	0.4	393	**0.27**
Public Authority (5.0%)	2390200	7.3	655	**0.45**
Park (15.3%)	7314012	22.4	20038	**13.92**

Public Authority Usage (Based on '02-'03 Avg.)

Name	*Node Number*	*ft^3/day*	*gal/day*	*gpm*	*sum*
Park (calc'd. above)	12			13.92	
Fire Station	12	51.23	383.22	0.27	
Caltrans	12	146.30	1094.33	0.76	14.95
Unified School District	13	63.01	471.34	0.33	
Unified School District	13	144.66	1082.04	0.75	
Unified School District	13	23.56	176.24	0.12	1.20
Elementary School	16	9.86	73.78	0.05	
Elementary School	16	63.01	471.34	0.33	0.38
Postmaster	32	2.74	20.49	0.01	0.01
Church	33	30.41	227.47	0.16	0.16
Community Bldg.	35	94.25	704.96	0.49	0.49

Appendix B
Demand at Node Calculations

WATER DUTY FACTOR CALCULATIONS (Existing Water System)

abbrev.	**desc.**	**gpm/meter**
SFR	Single Family Residential	0.25
MFR	Multi-Family Residential	0.20
RR	Rural Residential	0.50
Comm.	Commercial	0.27
PA	Public Authority	varies

Node #	Type	Units	Factor	Demand (gpm)	**Sum**
1	SFR	10.0	0.25	2.50	**2.50**
2	SFR	10.0	0.25	2.50	**2.50**
3	SFR	2.0	0.25	0.50	**0.50**
4	SFR	9.0	0.25	2.25	**2.25**
5	SFR	12.0	0.25	3.00	**3.00**
6	SFR	4.0	0.25	1.00	**1.00**
7	SFR	3.0	0.25	0.75	**0.75**
8	SFR	2.0	0.25	0.50	
	RR	1.0	0.50	0.50	**1.00**
9	SFR	8.0	0.25	2.00	**2.00**
10	SFR	14.0	0.25	3.50	**3.50**
11	SFR	12.0	0.25	3.00	**3.00**
12	PA			14.95	**14.95**
13	PA			1.20	
	SFR	2.0	0.25	0.50	**1.70**
14	SFR	7.0	0.25	1.75	**1.75**
15	SFR	4.0	0.25	1.00	**1.00**
16	PA			0.38	**0.38**
17	SFR	8.0	0.25	2.00	
	RR	1.0	0.50	0.50	**2.50**
18	SFR	15.0	0.25	3.75	
	MFR	2.0	0.20	0.40	**4.15**
19	SFR	4.0	0.25	1.00	
	MFR	2.0	0.20	0.40	**1.40**
20	SFR	2.0	0.25	0.50	**0.50**
21	SFR	2.0	0.25	0.50	**0.50**
22	RR	0.5	0.50	0.25	**0.25**
23	RR	0.5	0.50	0.25	
	SFR	3.0	0.25	0.75	**1.00**
24	SFR	4.0	0.25	1.00	**1.00**
25	SFR	7.0	0.25	1.75	**1.75**
26	SFR	12.0	0.25	3.00	**3.00**
27	SFR	15.0	0.25	3.75	**3.75**
28	SFR	10.0	0.25	2.50	**2.50**
29	SFR	3.0	0.25	0.75	**0.75**
30	SFR	3.0	0.25	0.75	**0.75**
31	SFR	4.0	0.25	1.00	
	MFR	10.0	0.20	2.00	
	Comm.	1.0	0.27	0.27	**3.27**
32	PA			0.01	
	SFR	3.0	0.25	0.75	
	MFR	2.0	0.20	0.40	**1.16**

33	SFR	6.0	0.25	1.50	
	PA			0.16	**1.66**
34	SFR	4.5	0.25	1.13	**1.13**
35	SFR	6.5	0.25	1.63	
	PA			0.49	**2.12**
36	SFR	3.0	0.25	0.75	
	MFR	4.0	0.20	0.80	**1.55**
37	SFR	2.0	0.25	0.50	
	MFR	2.0	0.20	0.40	**0.90**
38	SFR	16.0	0.25	4.00	**4.00**
39	SFR	4.0	0.25	1.00	**1.00**
40	SFR	2.0	0.25	0.50	**0.50**
41	SFR	2.0	0.25	0.50	**0.50**
42	RR	1.0	0.50	0.50	
	SFR	2.0	0.25	0.50	**1.00**
43	SFR	7.0	0.25	1.75	**1.75**
44	SFR	8.0	0.25	2.00	**2.00**
45	SFR	12.0	0.25	3.00	**3.00**
46	SFR	10.0	0.25	2.50	**2.50**

NODE KEY

Node #	Node Name
1	El Portal1
2	Mesa2
3	Mesa3
4	Escondido1
5	Escondido2
6	Paraiso1
7	Paraiso2
8	Los Altos2
9	Los Altos1
10	El Portal2
11	Mesa1
12	Center1
13	Center2
14	Cholame1
15	San Juan1
16	Elementary
17	San Juan2
18	Center2
19	Center3
20	Center4
21	San Juan3
22	San Juan4
23	Center5
24	Center9
25	Camatti7
26	Camatti8
27	Camatti9
28	Camatti6
29	Center8
30	Center7
31	Center6
32	Center5
33	Center4
34	Center3
35	Camatti1
36	Camatti3
37	Camatti4
38	Camatti5
39	Camatti2
40	Estrella1
41	Estrella2
42	Estrella3
43	Center10
44	Center11
45	2
46	3
H	Hydrant
HC	Hydrant Carmelita

WATER DUTY FACTOR CALCULATIONS (Build-Out Water System)

abbrev.	desc.	gpm/meter
SFR	Single Family Residential	0.25
MFR	Multi-Family Residential	0.20
RR	Rural Residential	0.50
Comm.	Commercial	0.62
PA	Public Authority	varies

Node #	Type	Units	Factor	Demand (gpm)	Sum
1	SFR	12.0	0.25	3.00	
	RR	1.0	0.50	0.50	**3.50**
2	SFR	12.0	0.25	3.00	**3.00**
3	SFR	2.0	0.25	0.50	**0.50**
4	SFR	10.0	0.25	2.50	**2.50**
5	SFR	14.0	0.25	3.50	**3.50**
6	SFR	4.0	0.25	1.00	**1.00**
7	SFR	3.0	0.25	0.75	**0.75**
8	SFR	29.0	0.25	7.25	
	RR	1.0	0.50	0.50	**7.75**
9	SFR	8.0	0.25	2.00	**2.00**
10	SFR	15.0	0.25	3.75	**3.75**
11	SFR	13.0	0.25	3.25	
	RR	1.0	0.50	0.50	**3.75**
12	PA			14.95	**14.95**
13	PA			1.20	
	SFR	4.0	0.25	1.00	**2.20**
14	SFR	8.0	0.25	2.00	**2.00**
15	SFR	4.0	0.25	1.00	**1.00**
16	PA			0.38	
	RR	1.0	0.50	0.50	**0.88**
17	SFR	8.0	0.25	2.00	
	RR	1.0	0.50	0.50	**2.50**
18	SFR	15.0	0.25	3.75	
	MFR	4.0	0.20	0.80	**4.55**
19	SFR	4.0	0.25	1.00	
	MFR	2.0	0.20	0.40	**1.40**
20	SFR	2.0	0.25	0.50	**0.50**
21	SFR	3.0	0.25	0.75	
	RR	1.0	0.50	0.50	**1.25**
22	RR	1.5	0.50	0.75	
	SFR	2.0	0.25	0.50	**1.25**
23	RR	0.5	0.50	0.25	
	SFR	4.0	0.25	1.00	**1.25**
24	SFR	6.0	0.25	1.50	
	Comm.	1.0	0.62	0.62	**2.12**
25	SFR	8.0	0.25	2.00	**2.00**
26	SFR	25.0	0.25	6.25	**6.25**
27	SFR	16.0	0.25	4.00	**4.00**
28	SFR	10.0	0.25	2.50	**2.50**
29	SFR	4.0	0.25	1.00	
	Comm.	3.0	0.62	1.86	**2.86**

30	SFR	5.0	0.25	1.25	
	Comm.	3.0	0.62	1.86	**3.11**
31	SFR	5.0	0.25	1.25	
	MFR	15.0	0.20	3.00	
	Comm.	2.0	0.62	1.24	**5.49**
32	PA			0.01	
	SFR	4.0	0.25	1.00	
	MFR	2.0	0.20	0.40	
	Comm.	2.0	0.62	1.24	**2.65**
33	SFR	6.0	0.25	1.50	
	PA			0.16	
	Comm.	1.0	0.62	0.62	**2.28**
34	SFR	4.5	0.25	1.13	
	Comm.	1.0	0.62	0.62	**1.75**
35	SFR	6.5	0.25	1.63	
	PA			0.49	**2.12**
36	SFR	3.0	0.25	0.75	
	MFR	4.0	0.20	0.80	**1.55**
37	SFR	2.0	0.25	0.50	
	MFR	2.0	0.20	0.40	**0.90**
38	SFR	17.0	0.25	4.25	**4.25**
39	SFR	4.0	0.25	1.00	**1.00**
40	SFR	3.0	0.25	0.75	**0.75**
41	SFR	3.0	0.25	0.75	**0.75**
42	RR	1.0	0.50	0.50	
	SFR	10.0	0.25	2.50	**3.00**
43	SFR	8.0	0.25	2.00	**2.00**
44	SFR	9.0	0.25	2.25	
	Comm.*	1.0		12.00	**14.25**
45	SFR	12.0	0.25	3.00	**3.00**
46	SFR	11.0	0.25	2.75	**2.75**
47	SFR	24.0	0.25	6.00	**6.00**
48	SFR	24.0	0.25	6.00	**6.00**
50	SFR	24.0	0.25	6.00	**6.00**
51	SFR	23.0	0.25	5.75	**5.75**
52	SFR	8.0	0.25	2.00	
	RR	1.0	0.50	0.50	**2.50**
54	SFR	10.0	0.25	2.50	**2.50**
55	SFR	3.0	0.25	0.75	
	RR	1.0	0.50	0.50	**1.25**
56	SFR*	5.0	0.42	2.10	**2.10**
57	SFR*	4.0	0.42	1.68	**1.68**
58	SFR*	5.0	0.42	2.10	**2.10**
60	SFR	11.0	0.25	2.75	**2.75**
61	SFR	11.0	0.25	2.75	**2.75**

* For SFR, denotes higher water duty factors due to larger lot sizes; for Comm., denotes average daily demand based on future lot usage and landscape demand.

Appendix C
Peaking Factor Calculations

Peaking Factors Calculations

Current:
Maximum Day Demand found to be in June 2001 = 302,100 gpd

Daily Peaking Factor	= Maximum Day Demand / Average Day Demand
Average Day Demand	= Total 2001 Production / 365 = 44,396,152 gallons / 365 = 121,633 gpd
Daily Peaking Factor	= 302,100 gpd / 121,633 gpd = 2.5
Peak Hour Peaking Factor	= 2.0
Peak Hour Demand	= Peak Hour Peaking Factor x Maximum Day Demand = 2.0 x 302,100 gpd x (1 d / 24 hr) = 25,175 gph

Build-Out:

217 Residential Meters * 360 gpd/meter	= 78,120
7 Multi-Family Residential Units * 288 gpd/unit	= 2,016
5 Rural Residential Meters * 720 gpd/meter	= 3,600
12 Commercial Meters * 893 gpd/meter	= 10,716
14 Residential Meters * 600 gpd/meter[1]	= 8,400
Commercial Lot[1]	= 17,107
Total	= 119,959 gpd

Average Day Demand	= 121,633 gpd + 119,959 gpd = 241,592 gpd or 271 AFY
Maximum Day Demand	= 241,592 gpd * 2.5 = 603,980 gpd or 419 gpm
Peak Hour Demand	= 603,980 gpd * 2.0 * (1 d / 24 hr) = 50,332 gph

[1] Per report entitled "CSA 16 Water System Model Prepared for Tract 2451, Shandon, CA" by North Coast Engineering, Inc., dated May 16, 2003.

Appendix D
Required Storage Calculations

Current Required Storage Volumes Calculations

Equalization Storage:

Assume that demand in excess of average maximum day demand occurs for 14 hours during the day.

Equalization Storage = (Peak Hour Demand – Rate of Supply)*14 hrs

Peak Hour Demand = 25,200 gph

Rate of Supply = 800 gpm * 0.8 = 640 gpm = 38,400 gph

Since the rate of supply is greater than the peak hour demand, a volume of storage to minimize pump cycling to approximately 30 minutes should be required.

640 gpm * 30 min = 20,000 gallons

Emergency Storage:

Minimum sanitary supply = 50 gallons per capita for 3 days

Currently:
- 279 Residential meters
- 6 Multi-family Residential Meters (22 Units)
- 5 Rural Residential Meters
- 3.6 capita per household (from 2001 U.S. Census data and number of residential meters)

(279 + 22 + 5) households * 3.6 capita/household = 1,102 capita
1,102 capita * 50 gallons/capita * 3 days = 165,300 gallons

Fire Storage:

Highest fire-flow demand: 2,750 gpm for 2 hours
2,750 gpm * 60 min/hr *2 hr = 330,000 gallons

Total Current Required Storage = 20,000 + 165,300 + 330,000 = 515,300 gallons
Existing = 212,000 gallon tank Need = 303,300 gallon tank

Build-Out Required Storage Volume Calculations

Equalization Storage:

Assume that demand in excess of average maximum day demand occurs for 14 hours during the day.

Equalization Storage = (Peak Hour Demand – Rate of Supply)*14 hrs

Peak Hour Demand = 32,100 gph

Rate of Supply = 800 gpm * 0.8 = 640 gpm = 38,400 gph

Since the rate of supply is greater than the peak hour demand, a volume of storage to minimize pump cycling to approximately 30 minutes should be required.

640 gpm * 30 min = 20,000 gallons

Emergency Storage:

Minimum sanitary supply = 50 gallons per capita for 3 days

At Build-Out:	510 Residential meters
	6 Multi-family Residential Meters (29 Units)
	10 Rural Residential
	3.6 capita per household (see note on previous page)

(510 + 29 + 10) households * 3.6 capita/household = 1,976 capita
1,976 capita * 50 gallons/capita * 3 days = 296,400 gallons

Fire Storage:

Highest fire-flow demand: 2,750 gpm for 2 hours
2,750 gpm * 60 min/hr *2 hr = 330,000 gallons

Total Current Required Storage = 20,000 + 296,400 + 330,000 = 646,400 gallons
Existing = 212,000 gallon tank Need = 434,400 gallon tank

Appendix E
Construction Cost Estimates of Recommended Capital Improvement Projects

CONSTRUCTION COST ESTIMATES OF RECOMMENDED CAPITAL IMPROVEMENT PROJECTS

Project	Lineal Feet of Waterline Replaced	Bid or Engineer's Estimate	$/LF
Loop Mesa Grande to 1st Street	2000	$96,500 [1]	NA
New Tank	NA	$440,625 [2]	NA
Centre Street	2750	$550,000	$200
Loop 2nd and 3rd Street	400	$60,000	$150
Pipe from Tank	4220	$380,000 [3]	NA
1st Street	900	$180,000	$200
Rest of Shandon	15200	$2,736,000	$180

1 Per Shandon Loop Heights project P850170 preliminary cost estimate, dated 6/15/04.

2 New Tank		
Property	$20,000	4 Parcels (Assessor's Values approx. $6K for 2 parcels)
Foundation Work	$82,500	1/3 of the tank cost
Tank	$250,000	Superior Tank Quote, welded steel tank
Subtotal	$352,500	
Total with 25% Contingency	$440,625	

3 Using actual 2000 construction cost for existing tank as a guide, with a 5% annual inflation rate and an adjustment factor of 1.5.

M. Lew
06/29/04

Appendix F
Project Cost Estimates of Recommended Capital Improvement Projects

PROJECT COST ESTIMATES
OF RECOMMENDED CAPITAL IMPROVEMENT PROJECTS

	% of CC*	Loop Heights Area**	New Storage Tank	Replace Pipe on Centre Street	Loop 2nd & 3rd	Pipe from Tank	1st Street	4 & 6-inch Pipes	TOTAL
Construction Cost (CC)		*$136,500*	*$440,625*	*$550,000*	*$60,000*	*$380,000*	*$180,000*	*$2,736,000*	***$4,483,125***
Preliminary Engineering	*1*	*$9,400*	$4,406	$5,500	$600	$3,800	$1,800	$27,360	***$52,866***
Project Management	*5*	*$9,400*	$22,031	$27,500	$3,000	$19,000	$9,000	$136,800	***$226,731***
Environmental	*10*	*$1,100*	$44,063	$55,000	$6,000	$38,000	$18,000	$273,600	***$435,763***
Design	*20*	*$13,900*	$88,125	$110,000	$12,000	$76,000	$36,000	$547,200	***$883,225***
Right-of-Way	*5*	*$30,000*	$22,031	$27,500	$3,000	$19,000	$9,000	$136,800	***$247,331***
Storm Water Prevention Plan	*5*		$22,031	$27,500	$3,000	$19,000	$9,000	$136,800	***$217,331***
Contract Administration	*20*		$88,125	$110,000	$12,000	$76,000	$36,000	$547,200	***$869,325***
Overhead	*17*		$74,906	$93,500	$10,200	$64,600	$30,600	$465,120	***$738,926***
Contingency	*50*		$220,313	$275,000	$30,000	$190,000	$90,000	$1,368,000	***$2,173,313***
PROJECT COST		$200,300	$1,026,656	$1,281,500	$139,800	$885,400	$419,400	$6,374,880	***$10,327,936***

* % of construction cost per Project Management Manual
** project is already initiated; expected construction completion in FY 05-06

M. Lew
07/06/04