BEFORE THE WASHINGTON

UTILITIES & TRANSPORTATION COMMISSION

WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION,

Complainant,

v.

CASCADIA WATER, LLC

Respondent.

DOCKET UW-240151

CROSS-EXAMINATION EXHIBIT OF MATTHEW J. ROWELL AND CULLEY J. LEHMAN
ON BEHALF OF THE
WASHINGTON STATE OFFICE OF THE ATTORNEY GENERAL
PUBLIC COUNSEL UNIT

EXHIBIT MJR-CJL-__X

Cascadia Discovery Response to WCAW DR No. 36, Attachment 3
[Excerpt], "*2009-14CALWSP*"

February 6, 2025

CAL WATERWORKS
Lehman Enterprises, Inc.
PO Box 549
Freeland, WA 98249

WA DOH PWS ID #31040

2009 TO 2014
WATER SYSTEM PLAN

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February 2009

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CAL WATERWORKS
2009 – 2014 WATER SYSTEM PLAN

I. PURPOSE

The purposes of this *Water System Plan* are to provide:

1. An inventory of the major water system facilities.
2. A summary of the improvements made to the system since the approval of the 1995 *Water System Plan* prepared by Trepanier Engineering.
3. An evaluation and capacity analysis of the present system.
4. Recommendations for improvements necessary for the system to comply with the Washington Department of Health (WA DOH) guidelines.
5. Budget-level cost estimates for recommended system improvements.
6. A report on the status of various management and operation programs required by the WA DOH.

This Plan includes the following:

(1) Standard specifications and construction details for the extension and replacement of water mains.
(2) Cross Connection Control Program.
(3) Water Conservation Plan and Water Shortage Response Plan.
(4) Wellhead Protection Plan.
(5) Water Quality Monitoring Plan (e.g., Coliform Monitoring Plan).
(6) Emergency Plan.
(7) Six-year and twenty-year capital improvement programs.
(8) Financial Viability Assessment.

The operating programs and plans updated for this *Water System Plan* are also incorporated into the Cal Waterworks *Management and Operations Manual*.

With approval of the Plan, approval is requested to supply 131 ERUs. The limiting factor is the volume of water storage, based on providing the recommended minimum 200 gpd/ERU in standby storage. Approval is also requested for a wholesale intertie to the Goss Lakeridge Acres water system. The approval to supply 131 ERUs will allow the system to supply the 15 current customers in the Goss Lakeridge Acres system plus 17 ERUs for growth until additional storage is provided.

A project report was submitted at the same time as the submittal of this *Water System Plan*. The project report is for the upgrade of the pumping facilities recommended in the six-year capital program. The upgrade of the pumping facilities includes the installation of an emergency generator.

A separate project report will be submitted for the construction of a second storage reservoir. A project report will be submitted by Goss Lakeridge Acres for the improvements need to receive and distribute wholesale water.

II. BACKGROUND

The CAL Waterworks system (WA DOH ID #310406) is owned by Lehman Enterprises, Inc., a for-profit corporation incorporated in the State of Washington. The Group A system is located on the south end of Whidbey Island approximately one mile northeast of the community of Freeland, WA. The service area is shown in the accompanying drawing Water Service Area.

CAL Waterworks, hereinafter referred to as the Purveyor, currently supplies or has commitments to supply 99 equivalent single-family residential connections (ERUs). The system currently has 95 active accounts.

The WA DOH currently approves the system for supply of 99 ERUs.

Because Lehman Enterprises, Inc. owns multiple water systems, with a combined number of customers greater than 100, the CAL Waterworks system is regulated by the WA Utilities and Utilities Commission.

The standard plans and specifications for water main installation are common to all Lehman Enterprises, Inc. owned water systems. The operating programs and plans are provided in two parts. Part I is common to all Lehman Enterprises, Inc. owned water systems; Part 2 provides specific information for each water system.

The Goss Lakeridge Acres Water Association has voted to purchase water (wholesale supply) from the CAL Waterworks system as an alternative to installing a reservoir, booster pump station and water treatment to remove arsenic, iron and manganese. The purchase of wholesale water was included in the Association's Drinking Water State Revolving Fun Loan scope of work

The capacity analysis and system design in this *Water System Plan* includes the 27 ultimate ERUs in the Goss Lakeridge Acres retail service area.

The Purveyor's mailing address is:

P. O. Box 549 Tel. (360) 331-7388
Freeland, WA 98249

The water system day-to-day management and operation, as well as system maintenance are assigned to the following contract certified operator:

Terry Lehman Tel: (360) 331-4016
B & W Pump Company
P. O. Box 55
Freeland, WA 98249

Certif. No. 004920 BTO, CCS, WDM3

III. DESCRIPTION OF SYSTEM

The general configuration of the water system is shown in the drawings in the appendices to this Plan. For the purposes of discussion, the facilities have been grouped into areas of supply; water quality and treatment; storage, pumping and pressure reduction; and distribution.

References to documents denoted with an asterisk [*] were previously submitted in the approved 1995 Water System Plan.

Sources of Supply

The system has two wells located on the Purveyor's owned lot containing a storage reservoir and a booster pump station. The following table summarizes the well information.

Table 1
WELLS

	Casing Diameter	Year Drilled	Depth	Pump Size	Pumping Rate
Well No. 1 (SO 1)	6"	1963	178 feet	3 hp	45 gpm
Well No. 2 (SO 2)	6"	1984	179 feet	3 hp	45 gpm
				Total	90 gpm

A well field was designated in 1994 for the purpose of water quality monitoring (See Appendix E [*]).

The wells have the following water rights:

Table 2
WATER RIGHTS

	Certificate [C] or Permit [P]		Withdrawal Rate (Qi)	Annual Withdrawal (Qa)
Well No. 1	G1-00032C, Dec. 1971		55 gpm	27.5 acre-feet
Well No. 2	G1-27478P, June 1994		35 gpm	26.5 acre-feet
		Total	90 gpm	54.0 acre-feet

Copies of the WA Department of Ecology's (WA DOE) Water Right Certificates and most recent Report of Examination are included in Appendix B. The water rights are additive.

Well No. 1 is located within the building containing the booster pumps for the system. Well No. 2 is located adjacent to the building.

The 100-foot sanitary control radii for both wells extend beyond the well lot.

The Declaration of Covenant and Restrictive Covenants for the sanitary control areas are included in Appendix F. Not all adjacent property owners have signed restrictive Covenants. All adjacent property owners within the sanitary control radii have been requested to sign a Restrictive Covenants.

The well pump curves for the wells are included in Appendix D.

Well pumping test results are included in Appendix G. The WA DOE Report of Examination in Appendix B provides the hydrogeology assessment of the well pumping test.

A Wellhead Protection plan is included in the Appendix P. The WA DOH "Ground Water Susceptibility Assessment Survey" forms for Well Nos. 1 and 2 have been completed and submitted to WA DOH. [*]

A water right self-assessment is included in the Appendix U.

The wells have been assessed as a low risk for seawater intrusion. Confirmation of the risk assessment from the Island County Health Department is included in Appendix A.

Water Quality and Treatment

Appendix Q provides the recent results of tests for Inorganic Chemicals, Volatile Organic Chemicals and Radionuclide.

The following is a summary of the major Inorganic Chemicals (2008 report):

Table 3
SOURCE WATER QUALITY SUMMARY
INORGANIC CHEMICALS

Parameter	Units	MCL	Results (2005)
Arsenic	Mg/L	0.01	0.0025
Iron	Mg/L	0.30	ND
Manganese	Mg/L	0.05	0.011
Total Nitrate/Nitrite	Mg/L	10.0	3.54
Chloride	Mg/L	250	25
Hardness (3)	Mg/L		183
Electrical Conductivity	umhos/cm	700	436
Color (3)	Color Units	15	ND

No treatment is currently provided. The water is not chlorinated to provide a precautionary residual at the ends of the distributions system.

A hypochlorinator is provided (on a stand-by basis) in the pump house for use if a problem is detected from routine coliform monitoring.

Water quality monitoring programs are included in Appendix Q. The monitoring programs include:

- Coliform monitoring plan
- Lead and copper monitoring plan

Storage, Pumping and Pressure Reduction Facilities

Storage is provided in one, 40,000 gallon (nominal volume) Everett Brothers octagon concrete reservoir located on the well lot. The reservoir has a combined inlet and outlet. Electrodes in the reservoir control the two wells.

The booster pump station is located on the well lot adjacent to the reservoir. Water is supplied to the entire service area through booster pumps. Twin 5 hp pumps supply the entire system. Twin 1.5 hp pumps supplied from discharge of the 5 hp pumps supply a high elevation pressure zones. Fire flow is not provided.

The twin 5 hp booster pump motors are protected from frequent on-off cycling by three 315 gallon vertical hydropneumatic tanks. The twin 1.5 hp booster pump motors are protected from frequent on-off cycling by two 220 gallon vertical hydropneumatic tanks. Data on ASME certification of the tanks was not found.

The operating pressure range of the booster pumps for Pressure Zone 1 is 45 psi to 65 psi. The operating pressure range of the booster pumps for Pressure Zone 2 is 75 psi to 95 psi.

The booster pump building is of wood frame construction. Piping within the building is primarily galvanized steel. The amount of equipment in the building leaves little working room.

The drawing System Schematic summarizes the above information on supply, storage and pumping. The drawing Comprehensive Map shows the area covered by the two pressure zones.

The booster pump station is not equipped with an auto-dialer/alarm monitor that has the telephone number of the operator in the computer program.

An emergency generator is not provided for the booster pumps.

A security fence is not provided around the building, reservoir and Well No. 2.

Distribution System

The distribution system is shown in the accompanying drawing Comprehensive Map. The following tables summarizes distribution system inventory:

Table 4
DISTRIBUTION MAINS

	Length (feet)						
	< 2"	2" & 2.5"	3"	4"	6"	8"	Total
Ductile Iron	0	0	0	0	0	0	0
PVC or HDPE	0	931	2,165	321	161	0	3,578
Asbestos Cement	0	0	0	0	0	0	0
Steel	0	0	0	0	0	0	0
Galv. Steel	0	0	0	0	0	0	0
Cast Iron	0	0	0	0	0	0	0
						total	3,578

Table 5
VALVES, HYDRANTS & METER INVENTORY
Excludes Reservoir, Wellheads, & Pump Station

DESCRIPTION	NUMBER
Isolating valves (excluding hydrant valves)	6
Fire hydrants c/w isolating valves	0
Air release valves	0
Blow-off assemblies	4
Services c/w meters	76
Services w/o meters	23
Backflow prevention assemblies	0

The program of installing water meters is scheduled for completion in 2009.

IV. REVIEW OF 1995 PLAN

The status of the planned improvements in the 1995 *Water System Plan* is summarized in the following table:

Table 6
STATUS OF 1995 TWENTY-YEAR PLAN

Category	Project	Status
Supply	Replace existing well pumps	Completed
Treatment	None	
Storage	Add 37,000 gallon storage tanks	Not done
Pumping	Emergency generator	Not done
	Two 5 hp pumps to low pressure zone	Completed
	Upgrade pump suction pipe from reservoir	Not done
	Added one 452 gallon hydropneumatic tank to low pressure zone	Not done
	Add one 436 gallon hydropneumatic tank to high pressure zone	Not done
PRV Stations	None	
Distribution	Upgrade 430 feet of main from pump house to East Harbor Road.	Not done

V. PLANNING

Present and Future Service Area

The present service area is shown in the accompanying drawings Comprehensive Map and Water Service Area. Except for the wholesale supply to Goss Lakeridge Acres as noted previously, expansion of the service area is not planned. The service area is bordered to the south and east by other public water systems and to the west by Holmes Harbor. The area to the north and northeast contains large parcels that could request an expansion of the service area to obtain service.

The water rights of 90 gpm are adequate to supply a service area with 216 ERUs, based on meeting a 600 gpd/ERU water conservation goal. Booster pump and storage facilities would need to be expanded for any major expansion of the service area.

The *Consistency Statement Checklist* signed by the County is included in Appendix S.

Service Area Agreement

The signed service area agreement is included Appendix K.

County Franchise

The Island County franchise agreement is included in Appendix I.

System Interties

An emergency intertie to an adjoining system has not been made.

An emergency intertie with the Freeland Water District is feasible. A request to make the intertie has not been made.

Water Supply and Demand Forecast

Appendix U

A copy of the Water Supply and Demand Forecast is included in Appendix S. Also included in this appendix is the Water Right Self-Assessment.

Water Demand

A record of daily source meter readings is maintained by CAL Waterworks. The record of maximum day demand (MDD) and annual demand is provided in the Calculation section of this Plan and in Appendix S. The highest MDD per connection of 388 gpd/ERU occurred in 2004.

For long-term distribution system design, and water storage requirements the WA DOH recommended maximum day demand of 800 gpd/ERU was assumed.

Water Conservation & Water Shortage Response Plan

Consistent with the Island County Coordinated Water System Plan, the Purveyor has adopted a water conservation program and water shortage response plan. Copies of these plans are included in the appendices. The water conservation plan includes the requisite WA DOH "Water Use Data Collection Requirements Checklist" and "Demand Forecast Requirements Checklist".

Although the Municipal Law does not currently apply to CAL Waterworks because it is not a government body, the guidelines are adopted voluntarily. The water use efficiency measures are included in Appendix U.

The short-term water conservation goal for the maximum day demand (MDD) is 600 gpd/ERU. The long-term (20-year) goal is the same (600 gpd/ERU). The current average day demand (ADD) is 258 gpd/ERU. The long-term ADD water conservation goal is 268 gpd/ERU (0.3 acre-feet/year/ERU.

Emergency Plan

An emergency plan is included in the Appendix R.

System Vulnerability

The most vulnerable system component is the failure of a well. The second most vulnerable component of the system that could have a major impact on customer service is a water main break. There are an adequate number of isolating valves to limit the number of customers out of service for repairs.

The wellhead protection plan addresses the potential contamination of a source of supply. There is adequate undeveloped land in the area to secure a replacement well site.

Service Policies

A copy of the adopted service policies are provided in Appendix U. The policies were adopted in the format for WA Utility and Transportation Commission approval.

Community Participation

The record of community participation in the preparation of the Water System Plan is included in Appendix A. As a temporary measure until an additional storage reservoir is constructed, the record of community acceptance of less than the WA DOH recommended standby storage is included in Appendix A.

Review Comments

A copy of the Water System Plan has been submitted to the Island County Health Department and Goss Lakeridge Acres Association for review and comment. The Freeland Water District and Ridgeview Estates, through their water system operator, were notified of the availability of the plan for their review. A copy of the Water System Plan is available for review by customers.

VI. DESIGN CRITERIA

The design criteria utilized for the evaluation and/or design of the Purveyor's system, includes the major design requirements of the Washington Department of Health (WA DOH *Water System Design Manual*, August 2001) and WAC 246-290. The wording of the WA DOH regulations and design criteria may have been abbreviated herein for this summary. An explanation is provided where more stringent design criterion are utilized than the current WA DOH criteria.

Distribution

1. The system shall provide a minimum of 30 psi (preferably higher) operating pressure to all customers during peak hour demand (PHD) conditions, with the equalizing component of storage depleted. [1] {WAC 246-290-230(5), applicable to for new systems or additions to new systems} The calculation of PHD shall be based on WA DOH guidelines. [2]

2. The system shall provide maximum day demand (MDD) plus fire flow at a minimum of 20 psi at all points throughout the distribution system, with the fire suppression and equalizing storage depleted. {WAC 246-290-230(6)} The calculation of MDD shall be based on WA DOH guidelines.

The 2007 *Water Use Efficiency Rule* changes to the WA DOH regulations {WAC 246-290-420(3)} states that 20 psi shall be provided at the operating hydrant and at least positive pressure throughout the system. The maintenance of a minimum of 20 psi at all points in the distribution system during fire flow is the safety factor for prevention of backflow due to backsiphonage in the customer's service line. The Purveyor is responsible (and legally liable) for any contaminant that enters the Purveyor's distributions system due to backflow.

The 2007 *Water Use Efficiency Rule* changes {WAC 246-290-420(2)} states that during normal operating conditions, for both average and peak hour demand periods, water pressure at the service meter shall be maintained at the approved design pressure, but in no case less than 20 psi. Customers usually complain about pressures as low as 30 psi.

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1 The revision to WAC 246-290 effective April 9, 1999 changed the design criterion for calculating minimum system pressure. Previously, the 30 psi requirement was based on the depletion of standby storage; now it is based on the depletion of equalizing storage.

2 The previous WAC 246-290 referred to PHD as maximum instantaneous demand (MID). The June 1999 WA DOH guideline "Water System Design Manual" changed the distribution system criterion for the flow rate (gpm) used in hydraulic analysis.

3. All new or expanding water systems shall provide fire hydrants in residential areas at a maximum spacing of 900 ft., or maximum hose lay of 500 ft., whichever is the lesser, and shall provide a basic fire flow from any one hydrant of 500 gpm. This requirement does not apply to rural lots 2.5 acres or larger, or as otherwise provided through alternate fire protection methods in County Code.

4. For new or expanding systems, the minimum water main size shall be 6-inch, except into cul-de-sacs or other locations where further expansion is very improbable, where lines shall not be less than 2-inch.

5. The system shall be equipped with adequate isolating valves, air release valves, blow-off assemblies, etc., for proper system operation and maintenance.

6. An individual service booster pump is allowed as an interim measure (less than six years) where distribution system pressure is deficient.

Supply

7. The minimum production capacity shall equal the maximum day demand (MDD).

8. The establishment of a water conservation program. The program should follow the latest edition of "Water Conservation Planning Handbook for Public water Systems", and "Guidelines and Requirements for Public Water Systems Regarding Water Use Reporting, Demand Forecasting Methodology, and Conservation Programs".

9. A Step-Drawdown Test and a 24 hour Constant-Rate Test conforming to WA DOH guidelines shall be made to support the source's ability to reliably provide a safe yield. Low water demand sources in high production aquifers may continue the Step-Drawdown Test to stabilization, and forego the subsequent 24 hour Constant-Rate Test.

Storage

10. The minimum standby (i.e., emergency) storage shall be equal to the maximum day demand (MDD). Where multiple sources of supply are available, the standby storage may be reduced by the existing pumping capacity of the wells, assuming the highest capacity well is out of service. A minimum standby storage of 200 gpd/ERU, should be provided regardless of the number of, and/or excess capacity of, the sources available.

11. The minimum equalizing storage shall be provided based on the formula: 150 min. x (PHD-Q), where `Q' is the sum of the capacities of the active sources of supply.

12. The minimum fire protection storage for single-family residences shall be based on a fire flow of 500 gpm for 30 minutes (15,000 gallons). Standby storage may be used for fire protection storage.

Equalizing storage is defined as the volume of storage needed to supplement supply of consumers when the peak hourly demand exceeds the total source pumping capacity. Standby storage is defined as the volume of stored water available for use during a loss of source capacity, power or similar short-term emergency.

A reduction in the requirement for production capacity and standby storage may be requested if adequate water use data is available to demonstrate that the actual average per customer maximum day demand is lower than that specified in the WA DOH Design Guidelines, and that conservation measures can be relied upon to limit new customers to this average water usage. Daily data collected over a two-year period is usually adequate, provided the summer months are typical of warm weather patterns.

The provision of standby storage is a recommendation (not a requirement) of the Design Guidelines. The amount of standby storage may be reduced below the recommended level in the Design Guidelines if "community expectations are amenable to a lesser standby storage capacity".

Pressurization of System

13. The operating cycle of any booster pump shall not exceed 6 cycles per hour.

14. The booster pumps shall have capacity to supply peak hour demand (PHD), preferably with the highest capacity pump out of service for reliability. The average day demand (ADD) shall be met with the largest capacity pump out of service.

15. The booster pumps shall have capacity to supply fire flow plus maximum day demand (MDD).

16. Hydropneumatic tanks shall be ASME approved (labeled) and equipped with a ASME relief valve. Small (up to 120 gallons), non-approved ASME tanks may be used if equipped with an ASME relief valve.

17. Hydropneumatic tanks shall be sized in accordance with WA DOH guidelines.

18. Back-up power shall be provided (i.e., emergency electrical generator) for systems dependent upon booster pumps as the sole source of supply. The electrical generator shall be operated by an automatic transfer switch, except where manual transfer may be completed in a reasonable time.

Treatment for Manganese & Iron

19. All iron and manganese facilities must be pilot plant tested at the site (or full scale tested after installation).

20. The maximum filter unit application rate and minimum backwash application rate shall be 5 gpm/sq.ft. and 12 gpm/sq.ft. unless otherwise approved by the WA Department of Health.

21. Documentation must be provided that the method of waste disposal [backwash] is acceptable to the WA Department of Ecology.

Chlorination

22. A WA DOH Hypochlorination Facilities for Small Systems submittal checklist shall be submitted where chlorination is provided.

Service Meters

23. Meters must be installed on all existing service connections by January 2017.

24. Meters must be installed on all new service connections beginning in January 2007.

VII. SYSTEM EVALUATION

The system evaluation is based on the design criteria given in Section VI. Calculations to support the evaluation are provided in the appendices. The major points in the system evaluation are summarized below:

Sources of Supply

The water right annual withdrawal, water right rate of withdrawal, and well pumping capacity are adequate to supply the maximum day demand (MDD) for ultimate number of customers in the combined retail and wholesale service area.

Water Quality and Treatment

The water quality meets current US EPA guidelines.

The Purveyor has not experienced a history of positive coliform test results.

The Purveyor obtains water samples for routine coliform monitoring from residences. It is desirable to obtain routine samples from curb-side water sample station connected to the distribution system.

With extension of the distribution system to supply Goss Lakeridge Acres, it is desirable to provide a free chlorine residual at the end of the distribution system.

System Hydraulics

The computer analysis of the distribution system in included in the Calculation section of this Plan. The drawing Computer Schematic shows the assigned node numbers, pipes number and flow distribution used with the computer model.

The distribution system design is based on the following:

1. With the extension to Goss Lakeridge Acres, the system will be divided into three pressure zones:
    a. Zone 1 – 123 ERUs Along and west of East Harbor Road, plus 5 ERUs supplied direct to Goss Lakeridge Acres low elevation area.
    b. Zone 2 – 10 ERUs in east of East Harbor Road.
    c. Zone 3 – 22 ERUs supplied by Goss Lakeridge Acres pump station.

2. The Peak Hour Demand (PHD) for 155 ERUs, assuming Maximum Day Demand (MDD) of 800 gpd/ERU is 232 gpm.

3. When a second reservoir is constructed to provide increased standby storage, and the long-range water conservation goal of 600 gpd/ERU is achieved, the system would be able to supply 208 ERUs. The PHD for 208 ERUs assuming a MDD of 600 gpd/ERU is 223 gpm. To be conservative, the system design was based on a PHD of 232 gpm.

4. The fire flow for retail customers is 500 gpm, coincidental with 40% of PHD.

5. Fire flow will only be provided to CAL Waterworks Pressure Zone 1. Fire flow will not be supplied to the Goss Lakeridge Acres wholesale service area or CAL Waterworks Pressure Zone 2.

6. A meter and double check valve assembly will be installed at the intertie to Goss Lakeridge Acres.

The following is a summary of the analysis results:

[a] Existing CAL Distribution System
Existing CAL Booster Pumps
New GLA Booster Pumps
Peak Hour Demand
Existing CAL water mains

Distribution Pressures (psi):

Zone	Minimum
1	41.6
2	31.7
3	33.1

[b] Upgraded CAL Distribution System
New CAL Booster Pumps
New GLA Booster Pumps
Fire Flow of 500 gpm at Node 12 (Ravenridge Dirve)
Upgraded CAL water mains

Distribution Pressures (psi):

Zone	Minimum
1	47.2
2	44.6
3	39.2

Hydrant Residual Pressure: 53.7 psi

[c] Upgraded CAL Distribution System
New CAL Booster Pumps
New GLA Booster Pumps
Peak Hour Demand

Distribution Pressures (psi):

Zone	Minimum
1	51.4
2	44.1
3	41.9

The above “a” scenario shows that the existing booster pumps and distribution system are adequate to supply the 155 ultimate connections in the combined retail and wholesale service areas. This assessment assumes a MDD for calculation of PHD of 800 gpd/ERU.

The existing pumps are not adequate to supply fire flow. The “b” and “c” scenarios show the adequacy of the proposed booster pumps for fire flow.

Although the existing booster pumps are adequate to supply the ultimate PHD, the hydropneumatic tank storage volume is slightly inadequate (1,023 gallons required versus 945 gallons available). Since new pumping facilities are scheduled for construction in 2009, this slight difference in hydropneumatic storage volume should not result in excessive wear on the pump motors. The CAL Waterworks recorded maximum day demand is significantly less than 800 gpd/ERU.

VIII. RECOMMENDED IMPROVEMENTS

The following major system improvements are recommended.

Short-term (six-years)

1. Replace the booster pump station. The station will provide pumps for fire flow in Pressure Zone 1. The pumps for Pressure Zone 2 will be supplied from the reservoir and not from Pressure Zone 1. The pump station work includes:

    a. Installing an emergency generator for the pump station.

    b. Installing a hypochlorinator to provide a precautionary residual to the ends of the distribution system.

    c. Installing a security fence around the storage tank, pump station, wells and emergency generator.

    d. Replacing the yard piping to/from the existing storage reservoir to provide dedicated inlet and outlet pipes.

2. For fire flow, replace the 4-inch water mains with 8-inch mains from the pump station to and 6-inch mains along East Harbor Road.

3. Install curb-side water sample stations.

4. Install air-release valves at high points.

5. For fire flow, replace the 3-inch water mains on Beachwood Drive and Ravenridge Drive.

6. Construct second storage reservoir.

Long-range (20 years)

7. Replace glued-joint 2-inch and 3-inch PVC water mains.

The cost for the extension of the system to supply wholesale water to Goss Lakeridge Acres will be borne by the applicant. No improvements to the CAL Waterworks system are scheduled for this extension.

Administrative Tasks

Once Goss Lakeridge Acres is supplied with water, make application to the WA Department of Ecology for increased water rights in the amount required to supply the ultimate number of customers (27 ERUs) in Goss Lakeridge Acres.

IX. CAPITAL FACILITIES PLAN

The following table summarizes the capital improvements for this *Water System Plan*. All costs are in current-year dollars.

Table 7
SIX-YEAR CAPITAL FACILITIES PLAN

Project	Year	Budget Estimate (2008 dollars)
1) Booster pump station	2009	$ 252,700
2) Water main replacement – E. Harbor Dr.	2009	$ 175,500
3) Curb-side water sample stations (4)	2010	$ 6,000
4) Air release valve assemblies (2)	2010	$ 4,000
5) Water main replacement – Brentwood Dr. Water main replacement – Ravenridge Dr.	2010	$ 158,500
6) Second storage reservoir	2012	$ 91,800

The total six-year capital program is $ 688,500. The Calculation section of this Plan includes the details of the cost estimate for each project.

The replacement cost of the existing distribution system (11,305 feet) is $ 1,017,500 (in 2008 dollars), assuming average cost of $90 per foot with service replacement.

X. FINANCES

A financial viability assessment, developed in accordance with the Washington Department of Health Financial Viability Manual, March 1995, is provided in the Appendix T. This assessment is provided as a guide for application to the WA Utilities and Transportation Commission for the setting of water rates and charges.

Funding is obtained for the operation of the water system from the WA UTC approved water rates and charges (copy in Appendix T). The connection to the Goss Lakeridge Acres water system to provide a wholesale supply is funded solely by wholesale customers.

The current financial plan assumes that all future major water system improvements will be financed by borrowing.

Any surplus funds from water rates and connection fees are allocated to a capital reserve fund. These funds will be used for capital improvements whenever possible.

XI. OPERATION AND MAINTENANCE

Details on the following operation programs and plans are included in appendices and in the M. & O. Manual.

- Cross Connection Control Program
- Water Conservation Plan
- Water Shortage Response Plan
- Wellhead Protection Program
- Water Quality Monitoring Plan (including lead and copper monitoring)
- Corrosion Control Plan
- Emergency Plan

A safety program has not been developed. The Purveyor relies upon contract certified operator (B & W Pump Company) for system maintenance and operation. The contract operator is responsible for the preparation of a safety program, training of personnel, etc.

The following status reports on the implementation and operation of the above noted programs and plans are provided. In addition a summary of the routine distribution system preventative maintenance programs is provided.

Cross Connection Control Program

All elements for initiation of the program have been competed with the exception of the periodic distribution of the residential survey questionnaire for risk assessment.

Water Conservation Plan

The unaccounted-for water cannot be calculated until the last of the residential meters are installed.

Water Shortage Response Plan

The water shortage response plan has not been needed. No modifications to the plan were necessary. With the current low recorded maximum day demand, and multiple sources of supply, the likelihood of needing to implement the plan is low.

Wellhead Protection Program

The task has not been scheduled to refine the delineation of the wellhead protection areas from the fixed radius method assumed initially. With the land up-gradient (inland) being mostly undeveloped, this task is not needed for the foreseeable future.

Emergency Plan

It has not been necessary to implement the emergency plan.

Water Quality Monitoring Plan

The Purveyor is on schedule for sampling for inorganic chemicals, volatile organic compounds and applying for monitoring waivers.

Routine Distribution System Maintenance Program

The routine preventative maintenance task schedule for the distribution system is summarized in the following table.

Table 8
ROUTINE DISTRIBUTION SYSTEM MAINTENANCE AND INSPECTION SCHEDULE

Description	Schedule	Status
a) Hydrant inspection and exercising	Annual	None installed at present
b) Line valve inspection and exercising	Annual	Scheduled annually
c) Blow-off inspection and exercising	Annual	Periodic, limited number currently in system
d) Air release valve inspection	Annual	None installed at present
e) Source meters testing and maintenance /calibration	Every 2 years	Approximately every two years
f) Small customer meter testing and replacement		Not currently scheduled. Meters on 15-year replacement schedule
g) Water main flushing	Annually	Each fall
h) Pump Station	Twice weekly	General inspection
i) Reservoir	Monthly	General sanitation, e.g., hatch, oveflow
j) PRV Stations	Monthly	None installed at present
k) Wells	Monthly	Static and pumping levels

Reservoir cleaning is scheduled when needed. Iron and manganese in the source water is well below the MCL.

XII. STANDARD SPECIFICATIONS - WATER MAIN

For any future extension or replacement of water mains, the appendices include standard specifications and construction plans for water mains 2 to 12-inch in diameter.

CALCULATIONS

CAL WATERWORKS CALCULATIONS

SUMMARY OF SYSTEM INFORMATION

WA DOH approved connections:	99	ERUs		
Current number of customers:	99	ERUs	With 4 committed water availability	
Previous assumed ultimate number of lot	147	ERUs	From previous Water System Plan	
Counted number of lots:	128	ERUs	With current combined lots	
Counted lots with wholesale customers:	155	ERUs	15 active / 27 ultimate customers in Goss Lakeridge Acres	
Number of lots assumed for design:	208	ERUs	Based on adding 2nd storage tank	
Recorded Maximum Day Demand:				
2008	305	gpd/ERU	Saturday August 23rd	
2007	318	gpd/ERU	Monday Sept 3rd	
2006	276	gpd/ERU	Friday, July 7th	
2005	289	gpd/ERU	Saturday, August 20th	
2004	388	gpd/ERU	Thursday, July 29th	
MDD without conservation:	800	gpd/ERU	assumed without recorded MDD	
MDD long-term goal (20-years):	600	gpd/ERU		
Recorded annual production:				
2008	4800,950	gallons		
2007	5,226,817	gallons		
2006	6,894,240	gallons	21.2	acre-feet
2005	7,082,510	gallons		
2004	8,286,960	gallons		Started meter installation
2003	9,645,300	gallons	←	on services
2002	10,293,400	gallons		
ADD based on WA DOE allowance:	268	gpd/ERU	(0.3 acre-ft/year/ERU)	
ADD long-term goal (20-years):	268	gpd/ERU		
ADD based on record use, 2004 to 2006	240	gpd/ERU	0.27	acre-ft/year/ERU

Water rights:

Well No. 1	G1-00032C	55	gpm	27.5	acre-feet	Dec. 1971
Well No. 2	G1-27478P	35	gpm	26.5	acre-feet *	Jun. 1994
		90	gpm	54.0	acre-feet *	

(* WR are additive)

Well production:	Well No. 1	45	gpm	Flow rates from WA DOE
	Well No. 2	45	gpm	Report of Examination for 4-hour test
		90	gpm	

Well construction:	Well No. 1	178	ft of 6"Ø	3	hp pump	1963
	Well No. 2	179	ft of 6"Ø	3	hp pump	1985

Well pumps:	Well No. 1	3 hp	Flint & Wallings, 7 stage, 55 gpm @ 165 ft TDH
	Well No. 2	3 hp	Flint & Wallings, 7 stage, 55 gpm @ 165 ft TDH

Summary of System Information (continued)

Water quality:	Iron	0.10	mg/L	Manganese	0.013	mg/L
(combined sources)	Arsenic	0.002	mg/L	Chloride	24	mg/L
	Hardness	171	mg/L	Nitrates	3.03	mg/L

Treatment plant capacity: 0 gpm No treatment necessary
Treatment plant backwash: 0 gpd

Hypochlorinators: Well No. 1 gpd Chlorination not provided
Well No. 2 gpd

Storage:
Existing tank 40,000 gallons (nominal) Everett Brothers octagon

Booster pumps:
Low elevation service area

#1	Sta-Rite DJH	5	hp	140	gpm at	104	feet TDH
#2	Sta-Rite DJH	5	hp	140	gpm at	104	feet TDH

High elevation service area

#3	Sta-Rite HMSF	1.5	hp	30	gpm at	132	feet TDH
#4	Sta-Rite HMSF	1.5	hp	30	gpm at	132	feet TDH

Note: High elevating service area supplied from low elevation service area, not from reservoir.

Hydropneumatic tank:
Low elevation service area

3 Galv steel tanks	315	gallon, 36"Ø x 60" (80"± o.a.) vertical			945	total gallons
	45	psi to	65	psi operating range		

High elevation service area

2 Steel tanks	220	gallon, 30"Ø x 72" vertical			440	total gallons
	75	psi to	95	psi operating range		

Note: Make and pressure rating of tanks are unknown

Pressure reducing valve stations: None in system

Distribution system inventory:

8"Ø	0	feet		Service meters (Nov. 07):	76
6"Ø	1,760	feet		Gate valves:	6
4"Ø	540	feet	11,305 feet	Fire hydrants:	0
3"Ø	5,935	feet	all mains are PVC	Air release valves:	0
2.5"Ø	0			Blow-off assemblies:	4
2"Ø	3,070	feet		Backflow assemblies:	0
<2"Ø	0	feet		Curbside sample sta.:	0

Summary of System Information (continued)

Static Water Level Elevation for Island County
Seawater Intrusion Risk Category Assessment

	Well No. 1 ID# AGA928 (feet)	Well No. 2 ID# AGA927 (feet)		
Top of Casing Elevation				
NAVD 88 Datum *	161.85	163.45		
MSL Datum	158.18	159.78	-3.67	correction
Static Water Depth **	147.79	148.66		used for
Static Water Elevation (MSL Datum)	10.39	11.12		MSL datum

* Survey by Thatcher & Morrison
** From WA DOE Report of Examination

ALLOWABLE NUMBER OF CONNECTIONS (ERUs)

The following is a summary of the calculated number of equivalent single-family residential connections (ERUs) that the system may supply, based on various design criteria.

Water Rights:

162 ERUs Based on the current water right rate of production, assuming 800 gpd/ERU Maximum Day Demand (no water conservation).

180 ERUs Based on the current water right annual withdrawal, assuming WA DOE standard allocation of 0.3 acre-feet/year/ERU (268 gpd/ERU).

216 ERUs Based on the current water right rate of production, assuming 600 gpd/ERU Maximum Day Demand (moderate water conservation).

Well Production: See above calculations for water rights; well production equals water right rate of production

Water Treatment: Not Required

Water Storage:

112 ERUs Based on current storage, assuming 800 gpd/ERU for standby storage and calculation of Peak Hour Demand, reduction for operating and dead storage, current well production, credit for multiple sources.

131 ERUs Based on current storage, assuming 600 gpd/ERU for standby storage and calculation of Peak Hour Demand, reduction for operating and dead storage, current well production, credit for multiple sources.

Standby storage is a recommendation of the WA DOH Design Guidelines. The community may vote to accept less than the recommended standby storage. Fire storage is a requirement (where hydrants are installed).

SUMMARY OF SYSTEM INFORMATION, - WHOLESALE SUPPLY TO GOSS LAKERIDGE ACRES

WA DOH approved connections:		19	ERUs			
Current number of customers:		15	ERUs			
Ultimate number of customers:		27	ERUs			
Water rights:						
Well Nos. 1 & 2	8811 P	50	gpm	25	acre-feet	Mar. 1966
Well production:	Well No. 1	50	gpm	Second well is for redundancy		
	Well No. 2	50	gpm	in lieu of storage		
Well construction:	Well No. 1	210	ft of 6"Ø	1963		
	Well No. 2	210	ft of 6"Ø	1997		
Well pumps:	Well No. 1	5 hp	Flint & Wallings, 16 stage, 40 gpm @ 325 ft TDH			
	Well No. 2	5 hp	Flint & Wallings, 16 stage, 40 gpm @ 325 ft TDH			
Water quality:	Iron	0.68	mg/L	Manganese	0.47	mg/L
(combined sources)	Arsenic	0.028	mg/L	Chloride	< 20	mg/L
	Hardness	148	mg/L	Nitrates	< 0.5	mg/L
Hydropneumatic tank:	4	119 gallon bladder tanks				

CAL WATERWORKS CALCULATIONS

[a] RESERVOIR SIZING

Allowable number of connections based on existing reservoirs, no water conservation, (MDD of 800 gpd/ERU), current well production (at water right), no water treatment, credit towards storage requirement for multiple sources of supply, and criteria in the WA DOH August 2001 "Water System Design Guidelines".

Allowable number of service connections:			**112**	
Number of wells:			**2**	
Well production capacities (current, throttled to match water rights):			**90**	gpm
Peak Hour Demand (PHD):			184	gpm
Maximum Day Demand (MDD) based on	**800**	gpd/ERU	89,600	gal/day
Required minimum continuous well production			62	gpm (avg)
Minimum standby storage based on MDD **800** gal/connection [D.O.H.]			89,600	gal
Credit for multiple well source **55** gpm (each well produces 55 gpm)		less	79,200	gal
Equalizing storage: whenever source pumping capacity cannot meet peak demands [D.O.H.] E.S. = (PHD-Q)(150) Q = source production in gpm			14,117	gal
Added for fire storage (500 gpm for 30 minutes) for single-family residential homes			4,600	gal
Add min. standby storage based on	200	gpd/ERU	7,400	gal
Total required storage		[1+2+3]	36,517	gal
Allowance for filter backwash		add	0	gal
Allowance for operating and dead storage (1 ft)		add	3,333	gal
	TOTAL		39,850	gal
Existing storage 1 Everett Brothers octagon, 12 ft height			40,000	gal

[b] RESERVOIR SIZING

Allowable number of connections based on existing reservoirs, water conservation goal (MDD of 600 gpd/ERU), current well production (at water right), no water treatment, credit towards storage requirement for multiple sources of supply, and criteria in the WA DOH August 2001 "Water System Design Guidelines".

Allowable number of service connections:			**131**	
Number of wells:			**2**	
Well production capacities (current, throttled to match water rights):			**90**	gpm
Peak Hour Demand (PHD):			158	gpm
Maximum Day Demand (MDD) based on	**600**	gpd/ERU	78,600	gal/day
Required minimum continuous well production			55	gpm (avg)
Minimum standby storage based on MDD **600** gal/connection [D.O.H.]			78,600	gal
Credit for multiple well source **55** gpm (each well produces 55 gpm)		less	78,600	gal
Equalizing storage: whenever source pumping capacity cannot meet peak demands [D.O.H.]			10,263	gal
E.S. = (PHD-Q)(150) Q = source production in gpm				
Added for fire storage (500 gpm for 30 minutes) for single-family residential homes			15,000	gal
Add min. standby storage based on	200	gpd/ERU	11,200	gal
Total required storage		[1+2+3]	36,463	gal
Allowance for filter backwash		add	0	gal
Allowance for operating and dead storage (1 ft)		add	3,333	gal
	TOTAL		39,796	gal
Existing storage 1 Everett Brothers octagon, 12 ft height			40,000	gal

[c] RESERVOIR SIZING

Required storage for ultimate number of customers in retail and wholesale service area, assumed 800 gpd/ERU MDD (no water conservation), credit from multiple sources of supply and criteria in the WA DOH August 2001 "Water System Design Guidelines".

Ultimate number of service connections:			**155**	
Number of wells:			**2**	
Well production capacities (current, throttled to match water rights):			**90**	gpm
Peak Hour Demand (PHD):			232	gpm
Maximum Day Demand (MDD) based on	**800**	gpd/ERU	124,000	gal/day
Required minimum continuous well production			86	gpm (avg)
Minimum standby storage based on MDD **800** gal/connection [D.O.H.]			124,000	gal
Credit for multiple well source **55** gpm (each well produces 55 gpm)		less	79,200	gal
Equalizing storage: whenever source pumping capacity cannot meet peak demands [D.O.H.]			21,283	gal
E.S. = (PHD-Q)(150) Q = source production in gpm				
Added for fire storage (500 gpm for 30 minutes) for single-family residential homes			0	gal
Add min. standby storage based on	200	gpd/ERU	0	gal
Total required storage		[1+2+3]	66,083	gal
Allowance for filter backwash		add	0	gal
Allowance for operating and dead storage (1 ft)		add	3,333	gal
	TOTAL		69,417	gal
Existing storage 1 Everett Brothers octagon, 12 ft height			40,000	gal
Required added storage:			29,417	gal

[d] RESERVOIR SIZING

Required storage for ultimate number of customers in retail and wholesale service area, assumed 800 gpd/ERU MDD (no water conservation), credit towards standby storage from multiple sources of supply and emergency intertie with Freeland Water District, and criteria in the WA DOH August 2001 "Water System Design Guidelines".

Allowable number of service connections:			**155**	
Number of wells:			**2**	
Well production capacities (current, throttled to match water rights):			**90**	gpm
Peak Hour Demand (PHD):			232	gpm
Maximum Day Demand (MDD) based on	**800**	gpd/ERU	124,000	gal/day
Required minimum continuous well production			86	gpm (avg)
Minimum standby storage based on MDD **800** gal/connection [D.O.H.]			124,000	gal
Credit for multiple well source **90** gpm (with emergency intertie)		less	124,000	gal
Equalizing storage: whenever source pumping capacity cannot meet peak demands [D.O.H.]			21,283	gal
E.S. = (PHD-Q)(150) Q = source production in gpm				
Added for fire storage (500 gpm for 30 minutes) for single-family residential homes			15,000	gal
Add min. standby storage based on	200	gpd/ERU	16,000	gal
Total required storage		[1+2+3]	52,283	gal
Allowance for filter backwash		add	0	gal
Allowance for operating and dead storage (1 ft)		add	3,333	gal
	TOTAL		55,617	gal
Existing storage 1 Everett Brothers octagon, 12 ft height			40,000	gal
Required added storage:			15,617	gal

CAL WATERWORKS CALCULATIONS

[a] BOOSTER PUMP SIZING - PROPOSED SYSTEM, CAL + GLA ZONE 1, 145 ERUs

Number of ERUs:	145		Number of pumps to meet PHD:	2	
Recorded MDD:	800	gpd/ERU	PHD based on MDD:	221	gpm
			[PHD = (MDD/1440)*(C*N+F)+18]		

1) Required capacity				**110**	gpm
2) Required pressue at pump house (from network analysis)					
Pump "on" pressure	62	psi		143	ft
Minus water level in reservoir (pump `on'):				-11	ft
Plus equalizing storage allowance:				9	ft
4) Contingency allowance				5	ft
Head required at		**110**	gpm :	**146**	ft
				63	psi @ pump
6) Pressure range of hydropneumatic tank					
Pump "off" minus pump "on" pressu	20	psi		46	ft
7) Allowance for positive pump shut off				10	ft
Shutoff head		**0**	gpm :	**202**	ft

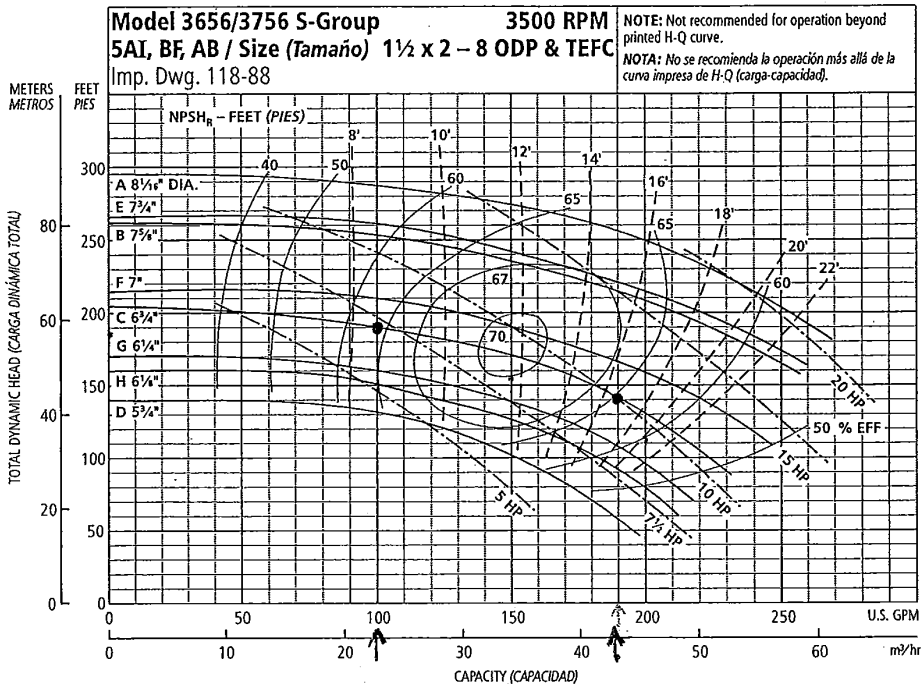
Approx. motor size
[hp = (Q x H)/(3960 x eff.)] **6.8** hp @ 60% efficiency

Existing pump:

	Head		Flow	
GOULDS 3656, 10 HP, 6.5" Impelle Pump on	175	ft	110	gpm
	185	ft	0	gpm

Notes: See attached pump curve and computer analysis results
Pump specifications are included in the Project Report accompanying this WSP

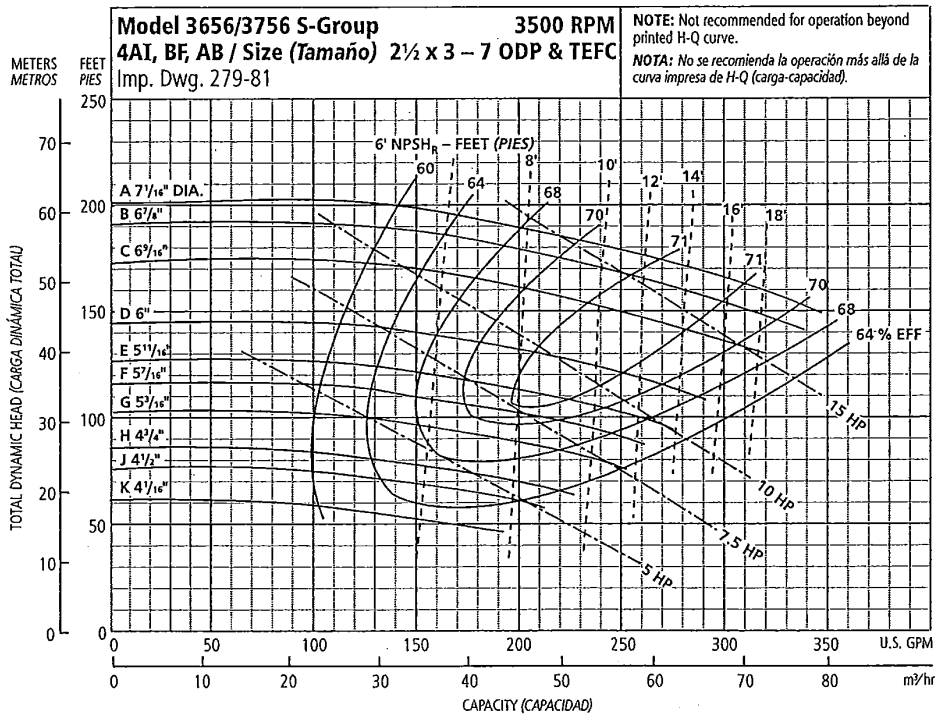
Performance Curves – 60 Hz, 3500 RPM
Curvas de desempeño – 60 Hz, 3500 RPM



Optional Impeller *Impulsor optativo*	
Ordering Code *Código de pedido*	**Dia.** *Diá.*
A	8 1/16"
E	7 3/4"
B	7 5/8"
F	7
C	6 3/4
G	6 1/4
H	6 1/8
D	5 3/4

NOTE: Pump will pass a sphere to 5/16" diameter.

NOTA: La bomba dejará pasar una esfera de hasta 5/16 de pulgada de diámetro.



Optional Impeller *Impulsor optativo*	
Ordering Code *Código de pedido*	**Dia.** *Diá.*
A	7 1/16"
B	6 7/8
C	6 9/16
D	6
E	5 11/16
F	5 7/16
G	5 3/16
H	4 3/4
J	4 1/2
K	4 1/16

NOTE: Pump will pass a sphere to 7/16" diameter.

NOTA: La bomba dejará pasar una esfera de hasta 7/16 de pulgada de diámetro.

[b] BOOSTER PUMP SIZING - PROPOSED SYSTEM, CAL ZONE 2, 10 ERUs

Number of ERUs:	10		Number of pumps to meet PHD:	1	
Design MDD:	800	gpd/ERU	PHD based on MDD:	35	gpm
			[PHD = (MDD/1440)*(C*N+F)+18]		

1) Required capacity				**35**	gpm
2) Required pressue at pump house (from network analysis)					
Pump "on" pressure	94	psi		217	ft
Minus water level in reservoir (pump `on'):				-11	ft
Plus equalizing storage allowance:				3	ft
4) Contingency allowance				5	ft
Head required at		**35**	gpm :	**214**	ft
				93	psi @ pump
6) Pressure range of hydropneumatic tank					
Pump "off" minus pump "on" pressu	20	psi		46	ft
7) Allowance for positive pump shut off				10	ft
Shutoff head		**0**	gpm :	**270**	ft

Approx. motor size
[hp = (Q x H)/(3960 x eff.)] **3.1** hp @ 60% efficiency

Recommended pump:

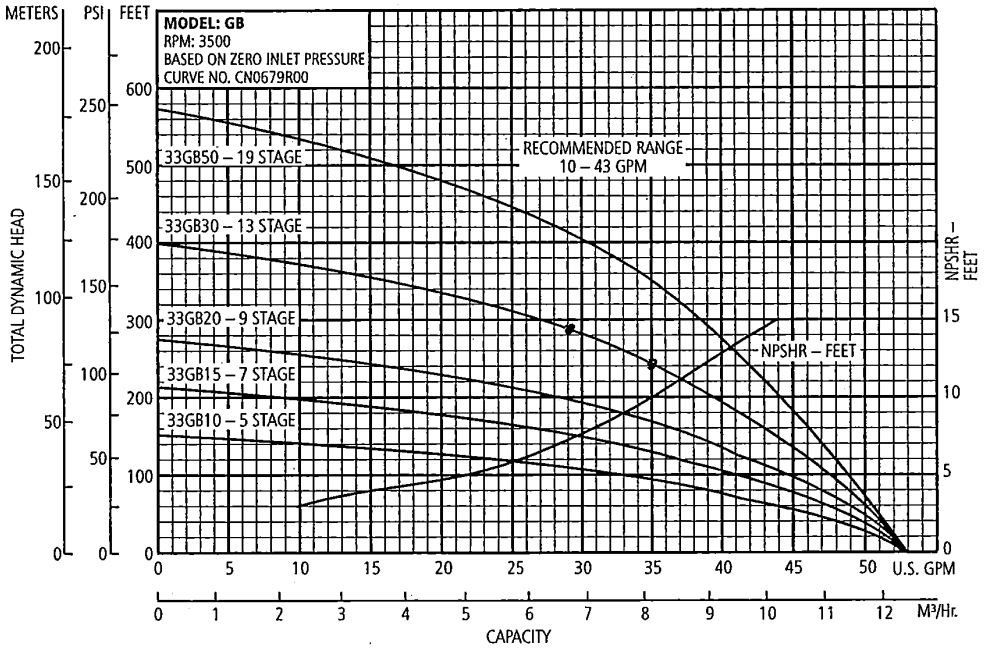
		Head		Flow	
GOULDS 33 GB, 13 stage, 3 hp	Pump on	220	ft	35	gpm
		400	ft	0	gpm

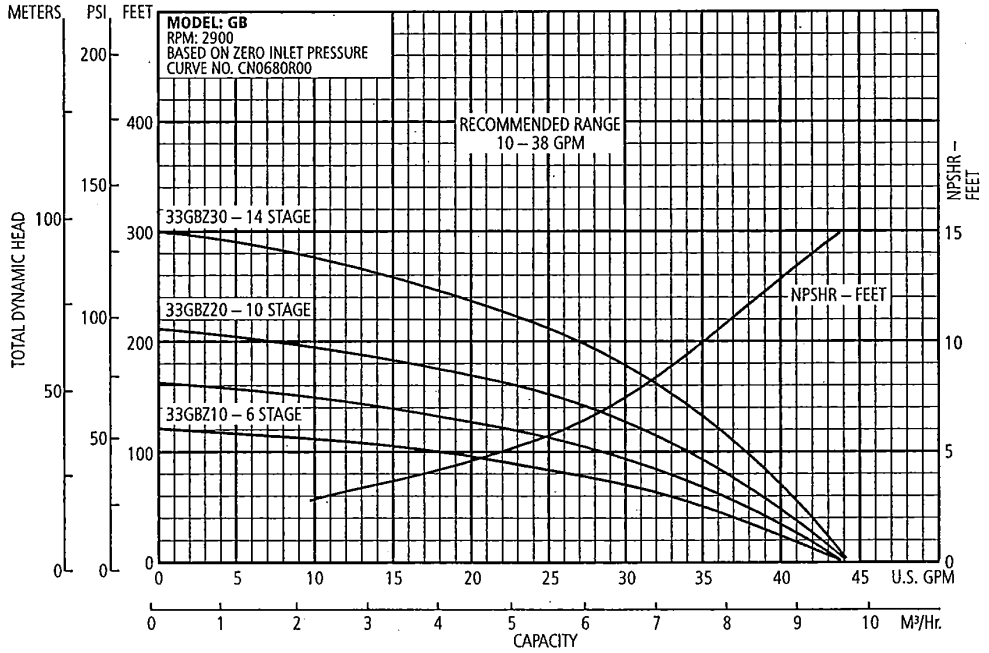
Notes: See attached pump curve.
Pump specifications are included in the Project Report accompanying this WSP

ITT

GOULDS PUMPS
Residential Water Systems

33GB PERFORMANCE CURVES





PEAK HOUR DEMAND AND AVERAGE MAXIMUM DAY DEMAND FOR SYSTEM DESIGN

(a) **ERUs 128** CAL Waterworks current number of counted lots, considering combined lots.
MDD 800 Assumed MDD

PHD = (MDD/1440)*(C*N+F)+18 = **201.9** gpm

Range of ERUs (N)	C	F	C	F
15 to 50	3.0	0	0.0	0
51 to 100	2.5	25	0.0	0
101 to 250	2.0	75	2.0	75
251 to 500	1.8	125	1.8	0
> 500	1.6	225	0.0	0
	for calc. -->		2.0	75

Average MDD = MDD*ERUs/1440 = **71** gpm **35%** of PHD Say 40%

(b) **ERUs 128** CAL Waterworks current number of counted lots, considering combined lots.
MDD 388 Recorded MDD

PHD = (MDD/1440)*(C*N+F)+18 = **107.2** gpm

Average MDD = MDD*ERUs/1440 = **34** gpm **32%** of PHD

(c) **ERUs 155** Ultimate number of lots in CAL Waterworks (128) plus GLA (27)
MDD 800 Assumed MDD

PHD = (MDD/1440)*(C*N+F)+18 = **231.9** gpm

Average MDD = MDD*ERUs/1440 = **86** gpm **37%** of PHD

(d) **ERUs 155** Ultimate number of lots in CAL Waterworks (128) plus GLA (27)
MDD 600 Assumed MDD

PHD = (MDD/1440)*(C*N+F)+18 = **178.4** gpm

Average MDD = MDD*ERUs/1440 = **65** gpm **36%** of PHD

(e) **ERUs 208** Number of connections for design with CAL Water Rights of 90 gpm and
MDD 600 conservation reducing MDD to long-range conservation goal

PHD = (MDD/1440)*(C*N+F)+18 = **222.6** gpm

Average MDD = MDD*ERUs/1440 = **87** gpm **39%** of PHD

DISTRIBUTION OF DEMAND

CAL Waterworks with wholesale supply to Goss Lakeridge Acres

Platted lots	128	CAL Waterworks Current count with combined lots
	27	Goss Lakeridge Acres

Peak Hour Demand for 155 ERUs

{i}	231.9	gpm for an assumed Maximum Day Demand of	800	gpm/ERU	100% of {i}
{ii}	178.4	gpm for an assumed Maximum Day Demand of	600	gpm/ERU	77%

Peak Hour Demand for 208 ERUs (for possible future expansion of service area)

{III}	222.6	gpm for an assumed Maximum Day Demand of	600	gpm/ERU	96%

DEMAND DISTRIBUTION
155 ERUs, 232 gpm PHD

Node	ERUs	Demand (gpm)	
1	0	0	
2	0	0	
3	0	0	
4	0	0	
5	0	0	
6	9	14	
7	0	0	
8	0	0	
9	12	19	
10	23	36	
11	6	9	
12	39	62	
13	0	0	
14	0	0	
15	20	31	
16	5	8	
17	4	6	
51	0	0	
52	0	0	
53	3	5	
54	6	9	
55	1	3	
72	5	5	GLA 27 lots
75	7	7	
76	5	5	
77	10	13	
Total	155	232	

Pressure Zone 1	123	ERUs
Pressure Zone 2	10	ERUs
Pressure Zone 3	22	ERUs

NETWORK ANALYSIS - COMPUTER PROGRAM DATA
Initial Input - November 2007 System

Program Input Codes:

0	1	0.001	1	1	1	1
2	1	5	1			
24	22					

Pipe Data:

Pipe No.	Between Nodes		Length (feet)	Diameter (inches)	H-W Coefficient	
1	1	2	20	4	140	8"Ø replacement size
2	2	3	20	4	140	8"Ø replacement size
3	3	4	10	3	140	Booster pump (Zone 1)
4	4	5	20	4	140	8"Ø replacement size
5	5	6	600	2	140	
6	5	7	360	4	140	8"Ø replacement size
7	7	8	1760	6	140	
8	8	9	160	4	140	6"Ø replacement size
9	9	13	1550	3	140	6"Ø replacement size
10	9	10	570	3	140	6"Ø replacement size
11	10	11	125	3	140	
12	10	12	180	3	140	6"Ø replacement size
13	13	12	1500	3	140	
14	13	14	200	3	140	6"Ø replacement size
15	14	15	1450	3	140	
16	12	15	200	3	140	
17	15	16	160	3	140	
18	14	17	420	2	140	
51	4	51	10	2	140	
52	51	52	10	2	140	Booster pump (Zone 2;
53	52	53	840	2	140	now supplied from Zone 1)
54	53	54	820	2	140	
55	53	55	390	2	140	
70	14	70	3050	6	140.1	} Proposed extension for intertie
71	70	71	10	2	99.1	} Meter & DCVA
72	71	72	565	4	140.1	} Proposed supply to pump station
73	72	73	685	4	140.1	}
74	73	74	10	2	140.1	Proposed pump station (Zone 3)
75	74	75	980	4	140	}
76	75	76	635	4	140	} Existing water mains
77	75	77	970	3	140	}
99	52	54	9999	0.5	99	Pseudo pipe

CAL WATERWORKS CALCULATIONS

Input Data (continued)

Node No.	Demand (gpm)	Elevation (feet)	Notes:		
1	0	150	Reservoir		
2	0	150			
3	0	150			
4	0	150			
5	0	150			
6	14	145			
7	0	135			
8	0	140			
9	19	140			
10	36	120			
11	9	120			
12	62	120			
13	0	145			
14	0	145			
15	31	120			
16	8	120			
17	6	130			
51	0	150	Pressure zone 2		
52	0	150			
53	5	155			
54	9	250			
55	3	170			
70	0	145			
71	0	145			
72	0	165		5	Goss Lakeridge Acres
73	0	205		0	
74	0	205	Pressure zone 3	0	
75	0	215		7	
76	0	165		5	
77	0	320		13	
Total	202			Total 30	

Note:
H-W Coefficient ending in 0.1 indicates new water main

Assumed H-W Coefficients

140	PVC & Lined DI pipe
120	Asbestos cement pipe
100	Unlined CI, Galv Stl or unknown
99	Pseudo pipe
140.1	New water mains
140.2	Replacement water mains

CAL WATERWORKS CALCULATIONS

Input Data (continued)

Program Input Codes:

1	2	0	0	0
3				

Source Pump Data:

1	1	Reservoir		Node No.; No. of Pump (Operating as reservoir)
	0	100	1000	Flow (gpm)
	11	11	11	Head (feet), height of water in 12 ft high reservoir
3	1	Ex. Booster pump to Zone 1		Pipe No.; No. of Pumps operating
	0	100	140	Flow (gpm) Ex. STA-RITE DHJ 5 HP
	162	135	105	Head (feet)
52	1	Ex. Booster pump to Zone 2		Pipe No.; No. of Pumps operating
	0	20	40	Flow (gpm) STA-RITE HMS 1.5 HP
	170	150	110	Head (feet)
74	1	Proposed GLA pump station		Pipe No.; No. of Pumps operating
	0	50	100	Flow (gpm)
	160	160	160	Head (feet), assumed pump "on" pressure

Note: Ex. Pump to Zone 2 is supplied from discharge of pump to Zone 1.

CAL Waterworks, Existing Distribution System Inventory:

	Length of Mains (feet)						
	< 2"	2" & 2.5"	3"	4"	6"	8"	total
Ductile Iron	0	0	0	0	0	0	0
PVC or HDPE	0	3,070	5,935	540	1,760	0	11,305
Asbestos Cement	0	0	0	0	0	0	0
Steel	0	0	0	0	0	0	0
Galv. Steel	0	0	0	0	0	0	0
Cast Iron	0	0	0	0	0	0	0
Sub-total	0	3,070	5,935	540	1,760	0	
						total	11,305

NETWORK ANALYSIS
7/29/2008

[a] PHD for 155 ERUs, EX. CAL BOOSTER PUMPS, NEW GLA BOOSTER PUMPS
EX. CAL DISTRIBUTION SYSTEM, NEW WHOLESALE INTERTIE TO GLA
EX. GLA DISTRIBUTION SYSTEM DOWNSTREAM OF BOOSTER PUMPS

File: J601ay

Source Reservoir:

Node No.	No. of Pumps	Elev. of Pumps	Pumps Flows and Related Heads (height of water in reservoir)			
			0	100	1000	Reservoir
1	1	150	11	11	11	Height of water (full)

Booster Pumps:

Pipe No.	No. of Pumps	Pumps Flows and Related Heads (pump curve)			
		0	100	140	Booster Pump, Pressure Zone 1
3	2	162	135	105	STA-RITE DHJ 5 HP
		0	20	40	Booster Pump, Pressure Zone 2
52	1	170	150	110	STA-RITE HMS 1.5 HP
		0	50	100	Booster Pump, Pressure Zone 3 GLA
74	1	175	175	175	Required "pump on" TDH

Pressure Reducing Valves:

PRV No.	Pipe No.	Ref. Node	Downstream HGL	K-value	CV feature
none					

Pipe Flows:

Pipe Dia. (inches)	Upstrm. Node	Dnstrm. Node	Pipe No.	Flow (gpm)	Head loss (feet)	Velocity (fps)	Upstrm. HGL (feet)	
4	1	2	1	232.0	0.6	5.9	161.0	
4	2	3	2	232.0	0.6	5.9	160.4	
3	3	4	3	232.0	-121.7	10.5	159.8	Pump
4	4	5	4	215.0	0.5	5.5	281.5	(Zone 1)
2	5	6	5	14.0	3.0	1.4	280.9	
4	5	7	6	201.0	8.6	5.1	280.9	
6	7	8	7	201.0	5.9	2.3	272.3	
4	8	9	8	201.0	3.8	5.1	266.4	
3	9	13	9	67.7	20.1	3.1	262.6	
3	9	10	10	114.3	19.5	5.2	262.6	
3	10	11	11	9.0	0.0	0.4	243.1	
3	10	12	12	69.3	2.4	3.2	243.1	
3	13	12	13	18.9	1.8	0.9	242.5	

CAL WATERWORKS CALCULATIONS

[a] PHD for 155 ERUs, EX. CAL BOOSTER PUMPS, NEW GLA BOOSTER PUMPS

Pipe Flows:

Pipe Dia. (inches)	Upstrm. Node	Dnstrm. Node	Pipe No.	Flow (gpm)	Head loss (feet)	Velocity (fps)	Upstrm. HGL (feet)	
3	13	14	14	48.8	1.4	2.2	242.5	
3	14	15	15	12.8	0.9	0.6	241.1	
3	12	15	16	26.2	0.5	1.2	240.7	
3	15	16	17	8.0	0.0	0.4	240.2	
2	14	17	18	6.0	0.4	0.6	241.1	
2	4	51	51	17.0	0.1	1.7	281.5	
2	51	52	52	17.0	-152.9	1.7	281.4	Pump
2	52	53	53	16.9	6.0	1.7	434.3	(Zone 2)
2	53	54	54	8.9	1.8	0.9	428.3	
2	53	55	55	3.0	0.1	0.3	428.3	
6	14	70	70	30.0	0.3	0.3	241.1	
2	70	71	71	30.0	19.6	3.1	240.8	Meter/DCVA
4	71	72	72	30.0	0.4	0.8	221.1	
4	72	73	73	25.0	0.4	0.6	220.7	
2	73	74	74	25.0	-174.9	2.6	220.4	Pump
4	74	75	75	25.0	0.5	0.6	395.2	(Zone 3)
4	75	76	76	5.0	0.0	0.1	394.8	
3	75	77	77	13.0	0.6	0.6	394.8	
0.5	52	54	99	0.1	8.0	0.2	434.3	

Node Pressures:

Node No.	Elevation (feet)	Demand (gpm)	HGL (feet)	Pressure (psi)		Static Pressure Pump on (psi)	Static Pressure Pump off (psi)
1	150	-232.0	161.0	4.8	Reservoir	NA	NA
2	150	0.0	160.4	4.5		NA	NA
3	150	0.0	159.8	4.2		NA	NA
4	150	0.0	281.5	56.9	Booster Pump	45.0	65.0
5	150	0.0	280.9	56.7		45.0	65.0
6	145	14.0	277.9	57.5		47.2	67.2
7	135	0.0	272.3	59.4		51.5	71.5
8	140	0.0	266.4	54.7		49.3	69.3
9	140	19.0	262.6	53.1		49.3	69.3
10	120	36.0	243.1	53.3		58.0	78.0
11	120	9.0	243.1	53.3		58.0	78.0
12	120	62.0	240.7	52.2		58.0	78.0
13	145	0.0	242.5	42.2		47.2	67.2
14	145	0.0	241.1	41.6		47.2	67.2
15	120	31.0	240.2	52.0		58.0	78.0
16	120	8.0	240.2	52.0		58.0	78.0
17	130	6.0	240.6	47.9		53.7	73.7

CAL WATERWORKS CALCULATIONS

[a] PHD for 155 ERUs, EX. CAL BOOSTER PUMPS, NEW GLA BOOSTER PUMPS

Node Pressures:

Node No.	Elevation (feet)	Demand (gpm)	HGL (feet)	Pressure (psi)		Static Pressure Pump on (psi)	Static Pressure Pump off (psi)
51	150	0.0	281.4	56.9		45.0	65.0
52	150	0.0	434.3	123.1	Booster Pump	75.0	95.0
53	155	5.0	428.3	118.3	see pump "on" &	72.8	92.8
54	250	9.0	426.4	76.3	"off" pressure	31.7	51.7
55	170	3.0	428.2	111.8	settings	66.3	86.3
70	145	0.0	240.8	41.5		47.2	67.2
71	145	0.0	221.1	33.0	Meter & DCVA	47.2	67.2
72	165	5.0	220.7	24.1		38.5	58.5
73	205	0.0	220.4	6.7	GLA pump suction	21.2	41.2
74	205	0.0	395.2	82.4	Required discharge	83.0	103.0
75	215	7.0	394.8	77.8		78.7	98.7
76	165	5.0	394.7	99.5		100.3	120.3
77	320	13.0	394.2	32.1		33.2	53.2

Maximum unbalanced head in any loop 0.1762 In loop # 1

NETWORK ANALYSIS
7/31/2008

[b] 500 GPM FIRE FLOW AT NODE 12, UPGRADED CAL BOOSTER PUMPS, NEW GLA BOOSTER PUMPS, UPGRADED CAL DISTRIBUTION SYSTEM, NEW WHOLESALE INTERTIE TO GLA, EX. GLA DISTRIBUTION SYSTEM DOWNSTREAM OF BOOSTER PUMPS File: J601bx

Source Reservoir:

Node No.	No. of Pumps	Elev. of Pumps	Pumps Flows and Related Heads (height of water in reservoir)			
			0	100	1000	Reservoir
1	1	150	5	5	5	Height of water (1/2 full)

Booster Pumps:

Pipe No.	No. of Pumps	Pumps Flows and Related Heads (pump curve)			
		0	150	200	Booster Pump, Pressure Zone 1
3	4	185	155	112	Goulds 3656 10 HP, 6.5" Impeller
		0	20	40	Booster Pump, Pressure Zone 2
52	1	200	200	200	Assumed pump on pressure (90 psi)
		0	50	100	Booster Pump, Pressure Zone 3 GLA
74	1	175	175	175	Required "pump on" TDH

Pressure Reducing Valves:

PRV No.	Pipe No.	Ref. Node	Downstream HGL	K-value	CV feature
none					

Pipe Flows:

Pipe Dia. (inches)	Upstrm. Node	Dnstrm. Node	Pipe No.	Flow (gpm)	Head loss (feet)	Velocity (fps)	Upstrm. HGL (feet)	
8	1	2	1	592.8	0.1	3.8	155.0	
8	2	3	2	586.0	0.1	3.7	154.9	
3	3	4	3	586.0	-148.6	26.6	154.8	Pump
8	4	5	4	586.0	0.1	3.7	303.4	(Zone 1)
2	5	6	5	5.6	0.6	0.6	303.3	
8	5	7	6	580.4	2.1	3.7	303.3	
6	7	8	7	580.4	41.7	6.6	301.2	
6	8	9	8	580.4	3.8	6.6	259.4	
6	9	13	9	107.7	1.6	1.2	255.7	
6	9	10	10	465.1	9.0	5.3	255.7	
3	10	11	11	3.6	0.0	0.2	246.7	
6	10	12	12	447.1	2.6	5.1	246.7	
3	13	12	13	47.1	10.0	2.1	254.0	

[b] 500 GPM FIRE FLOW AT NODE 12, UPGRADED CAL BOOSTER PUMPS, NEW GLA

Pipe Flows:

Pipe Dia. (inches)	Upstrm. Node	Dnstrm. Node	Pipe No.	Flow (gpm)	Head loss (feet)	Velocity (fps)	Upstrm. HGL (feet)	
6	13	14	14	60.6	0.1	0.7	254.0	
3	14	15	15	46.2	9.3	2.1	254.0	
3	12	15	16	-30.6	-0.6	-1.4	244.1	
3	15	16	17	3.2	0.0	0.2	244.7	
2	14	17	18	2.4	0.1	0.3	254.0	
2	2	51	51	6.8	0.0	0.7	154.9	
2	51	52	52	6.8	-200.0	0.7	154.9	Pump
2	52	53	53	6.8	1.1	0.7	354.9	(Zone 2)
2	53	54	54	3.6	0.3	0.4	353.8	
2	53	55	55	1.2	0.0	0.1	353.8	
6	14	70	70	12.0	0.1	0.1	254.0	
2	70	71	71	12.0	18.0	1.2	253.9	Meter/DCVA
4	71	72	72	12.0	0.1	0.3	235.9	
4	72	73	73	10.0	0.1	0.3	235.8	
2	73	74	74	10.0	-175.0	1.0	235.8	Pump
4	74	75	75	10.0	0.1	0.3	410.8	(Zone 3)
4	75	76	76	2.0	0.0	0.1	410.7	
3	75	77	77	5.2	0.1	0.2	410.7	
0.5	52	54	99	0.0	2.0	0.1	354.9	

Node Pressures:

Node No.	Elevation (feet)	Demand (gpm)	HGL (feet)	Pressure (psi)		
1	150	-592.8	155.0	2.2	Reservoir	
2	150	0.0	154.9	2.1		
3	150	0.0	154.8	2.1		
4	150	0.0	303.4	66.4	Booster Pump	
5	150	0.0	303.3	66.4		
6	145	5.6	302.7	68.3		
7	135	0.0	301.2	71.9		
8	140	0.0	259.4	51.7		
9	140	7.6	255.7	50.1		
10	120	14.4	246.7	54.9		
11	120	3.6	246.7	54.9		
12	120	524.8	244.1	53.7	⇦	Fire Flow
13	145	0.0	254.0	47.2		
14	145	0.0	254.0	47.2		
15	120	12.4	244.7	54.0		
16	120	3.2	244.7	54.0		
17	130	2.4	253.9	53.6		

[b] 500 GPM FIRE FLOW AT NODE 12, UPGRADED CAL BOOSTER PUMPS, NEW GLA

Node Pressures:

Node No.	Elevation (feet)	Demand (gpm)	HGL (feet)	Pressure (psi)	
51	150	0.0	154.9	2.1	
52	150	0.0	354.9	88.7	Booster Pump
53	155	2.0	353.8	86.0	
54	250	3.6	352.9	44.6	
55	170	1.2	353.7	79.5	
70	145	0.0	253.9	47.1	
71	145	0.0	235.9	39.4	Meter & DCVA
72	165	2.0	235.8	30.7	
73	205	0.0	235.8	13.3	GLA pump suction
74	205	0.0	410.8	89.1	Required discharge
75	215	2.8	410.7	84.7	
76	165	2.0	410.7	106.3	
77	320	5.2	410.6	39.2	

Maximum unbalanced head in any loop 0.5246 In loop # 1

NETWORK ANALYSIS
7/31/2008

[c] PHD FOR 155 ERUs, UPGRADED CAL BOOSTER PUMPS (1 of 4 pumping), NEW GLA File: J601cz
BOOSTER PUMPS, UPGRADED CAL DISTRIBUTION SYSTEM, NEW WHOLESALE INTERTIE TO GLA, EX. GLA DISTRIBUTION SYSTEM DOWNSTREAM OF BOOSTER PUMPS

Source Reservoir:

Node No.	No. of Pumps	Elev. of Pumps	Pumps Flows and Related Heads (height of water in reservoir)			
			0	100	1000	Reservoir
1	1	150	10	10	10	Height of water (full)

Booster Pumps:

Pipe No.	No. of Pumps	Pumps Flows and Related Heads (pump curve)			
		0	150	200	Booster Pump, Pressure Zone 1
3	1	185	155	112	Goulds 3656 10 HP, 6.5" Impeller
		0	20	40	Booster Pump, Pressure Zone 2
52	1	200	200	200	Assumed pump on pressure (90 psi)
		0	50	100	Booster Pump, Pressure Zone 3 GLA
74	1	175	175	175	Required "pump on" TDH

Pressure Reducing Valves:

PRV No.	Pipe No.	Ref. Node	Downstream HGL	K-value	CV feature
none					

Pipe Flows:

Pipe Dia. (inches)	Upstrm. Node	Dnstrm. Node	Pipe No.	Flow (gpm)	Head loss (feet)	Velocity (fps)	Upstrm. HGL (feet)	
8	1	2	1	232.0	0.0	1.5	160.0	
8	2	3	2	215.0	0.0	1.4	160.0	
3	3	4	3	215.0	-110.9	9.8	160.0	Pump
8	4	5	4	215.0	0.0	1.4	270.9	(Zone 1)
2	5	6	5	14.0	3.0	1.4	270.8	
8	5	7	6	201.0	0.3	1.3	270.8	
6	7	8	7	201.0	5.9	2.3	270.5	
6	8	9	8	201.0	0.5	2.3	264.7	
6	9	13	9	56.8	0.5	0.6	264.2	
6	9	10	10	125.2	0.8	1.4	264.2	
3	10	11	11	9.0	0.0	0.4	263.4	
6	10	12	12	80.2	0.1	0.9	263.4	
3	13	12	13	8.3	0.4	0.4	263.7	

CAL WATERWORKS CALCULATIONS

[c] PHD FOR 155 ERUs, UPGRADED CAL BOOSTER PUMPS (1 of 4 pumping), NEW GLA

Pipe Flows:

Pipe Dia. (inches)	Upstrm. Node	Dnstrm. Node	Pipe No.	Flow (gpm)	Head loss (feet)	Velocity (fps)	Upstrm. HGL (feet)	
6	13	14	14	48.4	0.1	0.6	263.7	
3	14	15	15	12.4	0.8	0.6	263.6	
3	12	15	16	26.6	0.5	1.2	263.3	
3	15	16	17	8.0	0.0	0.4	262.8	
2	14	17	18	6.0	0.4	0.6	263.6	
2	2	51	51	17.0	0.1	1.7	160.0	
2	51	52	52	17.0	-199.9	1.7	159.9	Pump
2	52	53	53	16.9	6.0	1.7	359.8	(Zone 2)
2	53	54	54	8.9	1.8	0.9	353.8	
2	53	55	55	3.0	0.1	0.3	353.8	
6	14	70	70	30.0	0.3	0.3	263.6	
2	70	71	71	30.0	19.6	3.1	263.3	Meter/DCVA
4	71	72	72	30.0	0.4	0.8	243.7	
4	72	73	73	25.0	0.4	0.6	243.3	
2	73	74	74	25.0	-174.9	2.6	242.9	Pump
4	74	75	75	25.0	0.5	0.6	417.8	(Zone 3)
4	75	76	76	5.0	0.0	0.1	417.3	
3	75	77	77	13.0	0.6	0.6	417.3	
0.5	52	54	99	0.1	8.0	0.2	359.8	

Node Pressures:

Node No.	Elevation (feet)	Demand (gpm)	HGL (feet)	Pressure (psi)	
1	150	-232.0	160.0	4.3	Reservoir
2	150	0.0	160.0	4.3	
3	150	0.0	160.0	4.3	
4	150	0.0	270.9	52.3	Booster Pump
5	150	0.0	270.8	52.3	
6	145	14.0	267.8	53.2	
7	135	0.0	270.5	58.7	
8	140	0.0	264.7	54.0	
9	140	19.0	264.2	53.8	
10	120	36.0	263.4	62.1	
11	120	9.0	263.3	62.1	
12	120	62.0	263.3	62.0	
13	145	0.0	263.7	51.4	
14	145	0.0	263.6	51.4	
15	120	31.0	262.8	61.8	
16	120	8.0	262.8	61.8	
17	130	6.0	263.2	57.7	

[c] PHD FOR 155 ERUs, UPGRADED CAL BOOSTER PUMPS (1 of 4 pumping), NEW GLA

Node Pressures:

Node No.	Elevation (feet)	Demand (gpm)	HGL (feet)	Pressure (psi)	
51	150	0.0	159.9	4.3	
52	150	0.0	359.8	90.8	Booster Pump
53	155	5.0	353.8	86.1	
54	250	9.0	351.9	44.1	
55	170	3.0	353.7	79.5	
70	145	0.0	263.3	51.2	
71	145	0.0	243.7	42.7	
72	165	5.0	243.3	33.9	Meter & DCVA
73	205	0.0	242.9	16.4	GLA pump suction
74	205	0.0	417.8	92.1	
75	215	7.0	417.3	87.6	
76	165	5.0	417.3	109.2	
77	320	13.0	416.7	41.9	

Maximum unbalanced head in any loop 0.1762 In loop # 1

CAL WATERWORKS CALCULATIONS

[c] BOOSTER PUMP SIZING CHECK - EXISTING SYSTEM, CAL 99 ERUs

Number of ERUs:	99		Number of pumps to meet PHD:	1	
Recorded MDD:	388	gpd/ERU	PHD based on MDD:	91	gpm
			[PHD = (MDD/1440)*(C*N+F)+18]		

1) Required capacity				**91**	gpm
2) Required pressue at pump house (from network analysis)					
Pump "on" pressure	45	psi		104	ft
Minus water level in reservoir (pump `on'):				-11	ft
Plus equalizing storage allowance:				3	ft
4) Contingency allowance				5	ft
Head required at		**91**	gpm :	**101**	ft
				44	psi @ pump
6) Pressure range of hydropneumatic tank					
Pump "off" minus pump "on" pressu	20	psi		46	ft
7) Allowance for positive pump shut off				10	ft
Shutoff head		**0**	gpm :	**157**	ft

Approx. motor size
[hp = (Q x H)/(3960 x eff.)] **3.9** hp @ 60% efficiency

Existing pump:

		Head		Flow	
STA-RITE Model DJH 5 hp	Pump on	101	ft	145	gpm
		162	ft	0	gpm

Notes: See pump curve in Appendix H

CAL WATERWORKS CALCULATIONS

[d] BOOSTER PUMP SIZING CHECK - EXISTING SYSTEM, CAL + GLA 114 ERUs

Number of ERUs:	114		Number of pumps to meet PHD:	1	
Design MDD:	600	gpd/ERU	PHD based on MDD:	144	gpm
			[PHD = (MDD/1440)*(C*N+F)+18]		

1) Required capacity				**144**	gpm
2) Required pressue at pump house (from network analysis)					
Pump "on" pressure	45	psi		104	ft
Minus water level in reservoir (pump `on'):				-11	ft
Plus equalizing storage allowance:				3	ft
4) Contingency allowance				5	ft
Head required at		**144**	gpm :	**101**	ft
				44	psi @ pump
6) Pressure range of hydropneumatic tank					
Pump "off" minus pump "on" pressu	20	psi		46	ft
7) Allowance for positive pump shut off				10	ft
Shutoff head		**0**	gpm :	**157**	ft

Approx. motor size
[hp = (Q x H)/(3960 x eff.)] **6.1** hp @ 60% efficiency

Existing pump:

		Head		Flow	
STA-RITE Model DJH 5 hp	Pump on	101	ft	145	gpm
		162	ft	0	gpm

Notes: The Goss Lakeridge Acres 2001 record of daily summer source meter meter readings showed a MDD of 756 gpd/ERU (See submittal of December 10, 2001 to WA DOH). The weighted average of the CAL Waterworks MDD (388 gpd/ERU for 96 ERUs) and Goss Lakeridge Acres MDD, would be 426 gpd/ERU. To be conservative, a MDD of 600 gpd/ERU was assumed.

See pump curve in Appendix H

CAL WATERWORKS CALCULATIONS

[a] HYDROPNEUMATIC TANK SIZING, CHECK FOR EXISTING PUMP
Twin STA-RITE DHJ 5 hp

Horizontal Tank Formula:

$$Vt = \frac{[P1 + 14.7]}{[P1 - P2]} * \frac{15}{N} * Qp * Mf$$

Vertical Tank (non-bladder) Formula:

$$Vt = \frac{[P1 + 14.7]}{[P1 - P2]} * \frac{15}{N} * Qp * Mf + 0.024D^2$$

Bladder Tank Formula:

$$Ts*Vb = \frac{15*(P1+14.7)*(P2+14.7)}{(P1-P2)*(P2+9.7)} * \frac{Qp}{N}$$

Vt	total volume of tank (gallons)
P1	pump off setting (psi)
P2	pump on setting (psi)
N	pump operating cycle of 6 per hour per pump
Qp	pump delivery capacity at midpoint of pressure range (gpm)
Mf	multiplying factor related to tank size
D	tank diameter (inches)
Vb	volume of individual bladder tank (gallons)
Ts	number of bladder tanks of size Vb

Design Parameters:

P1 =	**65**	psi	P2 =	**45**	psi	Qp =	**200**	gpm
	150	ft		**104**	ft		**100**	gpm each pump
N =	**12** (alternating)		Mf =	1.13		for tank diameter	**36**	inches

Required Capacity:

Horizontal Vt :	**1,126**	gallons	Vertical Vt :	1,023	gallons
Bladder Ts*Vb :	1,087	gallons	Individual bladder tank volume not to exceed 120 gallons		

Existng tanks:	three	315 gallon 36"Ø x 60" (80" o.a.)	945	gallons

[b] HYDROPNEUMATIC TANK SIZING, PRESSURE ZONE 1, REPLACEMENT PUMPS

For four Goulds, 3656 10 hp, twin pumps alternating with twin pumps

Horizontal Tank Formula:

$$Vt = \frac{[P1 + 14.7]}{[P1 - P2]} * \frac{15}{N} * Qp * Mf$$

Vertical Tank (non-bladder) Formula:

$$Vt = \frac{[P1 + 14.7]}{[P1 - P2]} * \frac{15}{N} * Qp * Mf + 0.024D^2$$

Bladder Tank Formula:

$$Ts*Vb = \frac{15*(P1+14.7)*(P2+14.7)}{(P1-P2)*(P2+9.7)} * \frac{Qp}{N}$$

Vt	total volume of tank (gallons)
P1	pump off setting (psi)
P2	pump on setting (psi)
N	pump operating cycle of 6 per hour per pump
Qp	pump delivery capacity at midpoint of pressure range (gpm)
Mf	multiplying factor related to tank size
D	tank diameter (inches)
Vb	volume of individual bladder tank (gallons)
Ts	number of bladder tanks of size Vb

Design Parameters:

P1 =	**82**	psi	P2 =	**62**	psi Qp =	**300**	gpm
N =	**12** (alternating)		Mf =	1.07	for tank diameter	**54**	inches

Required Capacity:

Horizontal Vt :	**1,940**	gallons		Vertical Vt :	1,873	gallons
Bladder Ts*Vb :	1,940	gallons	Individual bladder tank volume not to exceed 120 gallons			

Recommended tanks:	1	Roy E. Hanson, 125 ps Horizontal	54"Ø	181" o.a.	2,050	gallon

[c] HYDROPNEUMATIC TANK SIZING, PRESSURE ZONE 2

For twin Goulds 33 GB 3 hp, alternating

Horizontal Tank Formula:

$$Vt = \frac{[P1 + 14.7]}{[P1 - P2]} * \frac{15}{N} * Qp * Mf$$

Vertical Tank (non-bladder) Formula:

$$Vt = \frac{[P1 + 14.7]}{[P1 - P2]} * \frac{15}{N} * Qp * Mf + 0.024D^2$$

Bladder Tank Formula:

$$Ts*Vb = \frac{15*(P1+14.7)*(P2+14.7)}{(P1-P2)*(P2+9.7)} * \frac{Qp}{N}$$

Vt	total volume of tank (gallons)
P1	pump off setting (psi)
P2	pump on setting (psi)
N	pump operating cycle of 6 per hour per pump
Qp	pump delivery capacity at midpoint of pressure range (gpm)
Mf	multiplying factor related to tank size
D	tank diameter (inches)
Vb	volume of individual bladder tank (gallons)
Ts	number of bladder tanks of size Vb

Design Parameters:

P1 =	**113**	psi	P2 =	**93**	psi Qp =	**35**	gpm
N =	**12** (alternating)		Mf =	1.24	for tank diameter	**24**	inches

Required Capacity:

Horizontal Vt :	346	gallons	Vertical Vt :	291	gallons
Bladder Ts*Vb :	**293**	gallons	Individual bladder tank volume not to exceed 120 gallons		

Recommended tanks: 3 Well-X-Trol WX 350, 119 gallon 125 psi vertical **357** gallons

CAMANO HILLS WATER COMPANY BUDGET COST ESTIMATE

REPLACEMENT BOOSTER PUMP STATION
Two pumped zones, 500 gpm fire flow in zone 1

	ITEM		QUANTITY		UNIT COST	COST
1	Mobilization, demolization		1	ea	$ 55,000	$ 55,000
2	Wood frame buildings, 22 ft x 20 ft		440	sf	$ 80	$ 35,200
3	Piping within building	[a]	1	job	$ 2,600	$ 2,600
4	5 hp Pumps for Zone 1	[b]	4	ea	$ 2,850	$ 11,400
5	3 hp Pumps for Zone 2	[b]	2	ea	$ 2,500	$ 5,000
6	2,050 gallon hydropneumatic tank (Zone 1)		1	ea	$ 12,000	$ 12,000
7	119 gallon bladder tanks (Zone 2)		3	ea	$ 960	$ 2,880
8	Miscellaneous valves & gauges	[a]	1	job	$ 3,100	$ 3,100
9	Installation 3 to 8		1	job	$ 10,000	$ 10,000
10	Electrical within building		1	job	$ 7,000	$ 7,000
11	Electrical generator with propane tank		1	job	$ 31,000	$ 31,000
12	New PSE power supply from E. Harbor Rd		1	job	$ 5,000	$ 5,000
13	Yard piping materials & installation		1	job	$ 8,000	$ 8,000
14	New Utility Vault well enclosure, Well # 1		1	ea	$ 2,400	$ 2,400
15	New source meters in pump house	[b]	2	ea	$ 650	$ 1,300
16	New hypochlorinator	[b]	1	ea	$ 900	$ 900
17	Yard security fence		370	ft	$ 18	$ 6,660
18	County, WA DOH & WA L&I fees		allowance			$ 2,000
					Sub-total	$ 201,440
					Tax 8.3%	$ 16,720
					Contingency 15%	$ 30,216
					Inspection	$ 1,000
					Project Report	$ 3,500
						$ 252,876

Notes:
[a] From 2007 Skagit Co. W.D. No. 1 project
[b] From Camano Hills Water Co 2008 project
[c] H. D. Fowler, August 2008

CAMANO HILLS WATER COMPANY BUDGET COST ESTIMATE

WATER MAIN REPLACEMENT, TO & ALONG E. HARBOR ROAD

	ITEM	QUANTITY		UNIT COST	COST
1	Mobilization, demolization	1	job	$ 6,000	$ 6,000
2	Traffic control and trench safety	1	job	$ 3,200	$ 3,200
3	8" PVC pipe c/w sand bedding, native backfill	360	ft	$ 54	$ 19,440
4	6" PVC pipe c/w sand bedding, native backfill	1,980	ft	$ 45	$ 89,100
5	Granular backfill (allow 10% of length in fog line)	43.3	cy	$ 9	$ 390
6	8" gate valve c/w valve box	1	ea	$ 1,500	
7	6" gate valve c/w valve box	2	ea	$ 1,200	$ 2,400
8	6 & 8" DI fittings	383	lbs	$ 3	$ 1,149
9	Air release valve assemblies	1	ea	$ 1,250	$ 1,250
10	Blow-off assemblies	0	ea	$ 1,250	$ -
11	Fire hydrant	2	ea	$ 3,500	$ 7,000
12	Pavement cut & replacement (road X-ings)	72	sf	$ 15	$ 1,080
13	Road X-ing casing pipe c/w spacers	24	ft	$ 80	$ 1,920
14	CDF for casing pipe road crossings	4.4	cy	$ 85	$ 378
15	Service replacement to existing meter	0	ea	$ 550	$ -
16	Pressure test and disinfection	1	job	$ 2,500	$ 2,500

Notes:

Unit costs from low bid to Del Mar, 2007 with adjustment for 8" PVC pipe at $11.19/ft vs 8" DI at $24.22/ft: prices from H.D. Fowler Aug-08

Sub-total		$ 135,807
Tax	8.3%	$ 11,272
Contingency	15%	$ 20,371
Surveyor (for base plan)		$ 4,000
Construction plans		$ 2,000
Inspection		$ 2,000
		$ 175,450
	cost per foot	$ 74.98

CAMANO HILLS WATER COMPANY BUDGET COST ESTIMATE

WATER MAIN REPLACEMENT, BEACHWOOD DRIVE & RAVENRIDGE DRIVE

ITEM		QUANTITY		UNIT COST	COST
1	Mobilization, demolization	1	job	$ 6,000	$ 6,000
2	Traffic control and trench safety	1	job	$ 3,200	$ 3,200
3	8" PVC pipe c/w sand bedding, native backfill	0	ft	$ 54	$ -
4	6" PVC pipe c/w sand bedding, native backfill	1,730	ft	$ 45	$ 77,850
5	Granular backfill (allow 10% of length in fog line)	32.0	cy	$ 9	$ 288
6	8" gate valve c/w valve box	0	ea	$ 1,500	
7	6" gate valve c/w valve box	3	ea	$ 1,200	$ 3,600
8	6 & 8" DI fittings	218	lbs	$ 3	$ 654
9	Air release valve assemblies	1	ea	$ 1,250	$ 1,250
10	Blow-off assemblies	0	ea	$ 1,250	$ -
11	Fire hydrant	1	ea	$ 3,500	$ 3,500
12	Pavement cut & replacement (road X-ings)	72	sf	$ 15	$ 1,080
13	Road X-ing casing pipe c/w spacers	24	ft	$ 80	$ 1,920
14	CDF for casing pipe road crossings	4.4	cy	$ 85	$ 378
15	Service replacement to existing meter	39	ea	$ 550	$ 21,450
16	Pressure test and disinfection	1	job	$ 2,500	$ 2,500

Notes:

Unit costs from low bid to Del Mar, 2007 with adjustment for 8" PVC pipe at $11.19/ft vs 8" DI at $24.22/ft: prices from H.D. Fowler Aug-08

Sub-total		$ 123,670
Tax	8.3%	$ 10,265
Contingency	15%	$ 18,551
Surveyor (for base plan)		$ 2,000
Construction plans		$ 2,000
Inspection		$ 2,000
		$ 158,485
cost per foot		$ 91.61

Bratton {8/10/2008}